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Classification of interactive tasks

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Each task is analyzed and discussed by several experts from partner institutions: Javier Bilbao and Eugenio Bravo from the University of the Basque Country (Spain); Zsuzsa Pluhar and András Margitay-Becht from Eötvös Loránd University (Hungary); Marika Parviainen from the University of Turku (Finland); Heikki Hyyrö from the University of Tampere (Finland); Yasemin Gulbahar from the University of California (USA); Filiz Kalelioğlu from Başkent University (Turkey); and Daumilas Ardickas, Marytė Skakauskienė and Vaiva Žukauskaitė from Vilnius University; Andrew Csizmadia from the University of Oxford (UK), teachers Indra Sudeikienė and Daiva Gaučytė from Klaipėda Gedminai progymnasium (Lithuania), teachers Ieva Savulionienė, Alina Bikulč, and Jurgita Šumskienė from Druskininkai "Saulės" progymnasium (Lithuania).

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General overview

The goal of Work Package 4 (WP 4) is to develop a set of interactive tasks and design/program a tool for creating interactive tasks for the Computational Thinking (CT) integrated with Algebraic Thinking (AT) skills development. The created interactive tasks and tools are going to be integrated into the ecosystem with learning analytics.

One of the Specific Objectives is:

SO 4.1. Classify interactive tasks based on the existing Bebras tasks repository (all Bebras tasks were created using Creative Common licence)

To achieve the estimated objective SO 4.1, the following quantitative indicator is taken into account:

- To review the Bebras task repository and select 200 interactive tasks as examples for future investigation and a basis for creating new Bebras-like tasks.

The classification of interactive tasks based on the concepts of Computer Science / Informatics and Computational Thinking is presented in the tables below, covering the years 2017-2022.

The texts of all 200 selected Bebras tasks are also provided, with solutions and detailed explanations.

2022 year

	Task ID	Name	Author	8–10	10–12	12–14	Interactivity	Concepts of Computer Science (CS) / Computation Thinking (CT)
1.	2022-AR-03	**Golden Ticket**	Mónica Ferro Raciti (Argentina), Andrea Rocca (Argentina)	**M**	**E**		Open text	Communication & Networking (Security (Cryptography))
2.	2022-AT-01a	**Coloring Page**	Florentina Voboril (Austria)	**E**			Click on picture parts	Data structures & representation (Graphs)
3.	2022-AU-02	**Remembering Faces**	Allira Crowe (Australia), Graeme Buckie (Australia), Susannah Quidilla (Australia)	**M**			Drag & Drop	Data structures & representation (Decision tree)
4.	2022-AU-03	**Lights On**	Adam Grodeck (Australia)		**H**	**M**	Click on picture parts	Computer Architecture (Boolean Logic)
5.	2022-BE-02	**Four Tiles**	Kris Coolsaet (Belgium)			**H**	Click on object and rotate	Data structures & representation (Graphs)
6.	2022-BR-01	**Pick up sticks**	Leonardo Cavalcante (Brazil)	**M**			Drag & Drop	Data structures & representation (Stack)
7.	2022-CH-03a	**Super Security System**	Sebastian Knüsli (Switzerland)		**H**	**M**	Drag & Drop	Algorithmic Thinking (Backtracking algorithm)
8.	2022-CH-04	**Greedy Trolls**	Roman Duveen (Switzerland), Masiar Babazadeh (Switzerland)			**H**	Drag & Drop	Automaton (Pushdown automaton)
9.	2022-CH-08	**Pantry Map**	Waël Almoman (Switzerland), Jean-Philippe Pellet (Switzerland)		**H**	**M**	Click on picture parts	Data structures & representation (Coding)
10.	2022-CH-14	**Lila's Guessing Game**	Bernadette Spieler (Switzerland), Tobias Berner (Switzerland), Susanne Datzko (Switzerland)	**M**	**E**		Drag & Drop	Sequencing (Permutation)
11.	2022-CY-01	**Mary's Neighbours**	Thomas Ioannou (Cyprus), Marielle Léonard (France), Marta J. Burzanska (Poland)	**H**	**H**	**M**	Drag & Drop	Data structures & representation (Graphs), Computation
12.	2022-DE-03	**Listen and Walk**	Michael Weigend (Germany)			**H**	Drag & Drop	AI (Algorithm execution, (weak AI))
13.	2022-DE-05	**Hangar Carousel**	Kirsten Schlüter (Germany)			**H**	Open Integer	Efficiency (Searching and sorting)
14.	2022-DE-06	**Kids and Books**	Wolfgang Pohl (Germany)	**E**			Click on icon	Data Analysis (Databases, Searching and sorting)
15.	2022-DE-07	**Favorite Movie**	Wolfgang Pohl (Germany)			**H**	Click on icon	Efficiency (Pre-computation)
16.	2022-FR-02a	**Bee hive**	Marielle Léonard (France)	**M**			Drag & Drop	Logics & Logical Thinking (constraint satisfaction)
17.	2022-IE-02	**Forest party**	Taina Lehtimäki (Ireland), Tom Naughton (Ireland)	**M**	**E**		Drag & Drop	Logics & Logical Thinking (constraint satisfaction)
18.	2022-IN-01	**Learn Traditional Art**	Anupama Sivakumar (India), Aabha Utkalika Meher (India)	**M**	**E**		Drag & Drop	Patterns & Pattern Recognition (Logical reasoning)
19.	2022-JP-02	**Where is beaver?**	Maiko Shimabuku (Japan)	**M**	**E**		Drag & Drop	Sequencing (Algorithm execution)
20.	2022-LT-01	**Connection of islands**	Valentina Dagienė (Lithuania)			**H**	Open Integer	Data structures & representation (Grahp)

21.	2022-LT-05	**Overlapping villages**	Tomas Šiaulys (Lithuania)			**H**	Open Integer	Algorithmic Thinking (Algorithm)
22.	2022-ME-05b-eng	**Ski Trail Map**	Jelena Milojkovic (Montenegro), Goran Šuković (Montenegro)	**H**	**M**	**E**	Open text	Data structures & representation (Directed graph)
23.	2022-ME-09-eng	**The Bay of Beavers Programmers**	Jelena Milojkovic (Montenegro), Goran Šuković (Montenegro)	**M**	**E**		Open Integer	Data structures & representation (Coding)
24.	2022-MK-01-eng	**Treasure box**	Veronika Stefanovska (Macedonia), Monika Maneva (Macedonia), Veronika Ognjanovska (Macedonia), Mile Jovanov (Macedonia), Emil Stankov (Macedonia)	**H**	**M**	**E**	Drag & Drop	Logics & Logical Thinking (constraint satisfaction)
25.	2022-NL-03-eng	**A gift for the president**	Willem van der Vegt (Netherlands)			**H**	Open Integer	Algorithmic Thinking (Optimization)
26.	2022-PH-03	**Tortoise and Hare**	Mark Edward M. Gonzales (Philippines)	**M**			Click on icon	Data structures & representation (Linked list)
27.	2022-SA-05-eng	**Robot Colors**	Laila Alharthi (Saudi Arabia)	**E**			Drag & Drop	Patterns & Pattern Recognition (Logical reasoning, spatial thinking)
28.	2022-TR-02-eng	**Rug Weaving**	Yasemin Gulbahar (Turkey)	**H**	**M**	**E**	Click on picture parts	Patterns & Pattern Recognition (Algorithm execution), Conditionals
29.	2022-TW-03	**Strawberry**	Ling-Chian Chang (Taiwan)			**M**	Open Integer	Algorithmic Thinking (Algorithm)
30.	2022-TW-05-eng	**Tug of war**	Fang-lan Huang (Taiwan)	**E**			Drag & Drop	Algorithmic Thinking (Knapsack problem, optimization)
31.	2022-UA-01a-eng	**Filling green**	Nadiya Manko (Ukraine)	**M**	**E**		Drag & Drop	Algorithmic Thinking (Optimisation)
32.	2022-VN-05-eng	**Colorful tower**	Le Quang Quan (Vietnam)	**H**	**M**	**E**	Click on shapes	Patterns & Pattern Recognition (Logical reasoning, Executing algorithm)

2021 year

	Task ID	**Name**	**Author**	**8–10**	**10–12**	**12–14**	**Interactivity**	**Concepts of Computer Science (CS) / Computation Thinking (CT)**
33.	2021-AT-01-eng	**Forest Observation**	Florentina Voboril (Austria)		**H**	**M**	Click on object	Data structures & representation (Graphs (Vertex cover))
34.	2021-AT-02-eng	**Downtown**	Florentina Voboril (Austria)		**H**	**M**	Open Integer	Data structures & representation (Graph, Traveling Salesman Problem)
35.	2021-AT-04b-eng	**#Book**	Wilfried Baumann (Austria)			**H**	Click on object	Data structures & representation (Hash function, hash table)
36.	2021-AU-04b-eng	**Ada's Marble Machine**	Ruwan Devasurendra (Australia)			**H**	Click on object	Data structures & representation (Sorting, Constraints, Logical reasoning)

37.	2021-AU-05-eng	**Wrestling Holds**	Graeme Buckie (Australia)		**M**	**E**	Open Integer	Data structures & representation (Set cover problem, Greedy algorithm)
38.	2021-AU-06-eng	**Party Foul**	Graeme Buckie (Australia)		**H**	**M**	Open Integer	Modelling (Exponential Growth)
39.	2021-CA-01	**Cuckoo Birds**	Sarah Chan (Canada)		**H**	**M**	Drag & Drop	Data structures & representation (Binary search tree)
40.	2021-CH-04c1-eng	**Strawberry Thief**	Juraj Hromkovic (Switzerland)	**H**	**M**	**E**	Click on object	Data structures & representation (Graph, Graph coloring)
41.	2021-CH-13-eng	**Fruit Stack**	Angélica Herrera Loyo (Switzerland), Michael Barot (Switzerland), Fabian Frei (Switzerland)			**H**	Drag & Drop	Data structures & representation (Stack, Constraint problem, Boolean algebra)
42.	2021-CH-15-eng	**April Fool**	Fabian Frei (Switzerland)	**M**	**E**		Dropdown-Select	Data structures & representation (Sorting algorithms, ordering)
43.	2021-CH-26a-eng	**Chez Connie**	Nalo Reiter (with Team Reite.rs, Switzerland+Romania)		**H**	**M**	Drag & Drop	Modelling (Scheduling)
44.	2021-CY-02-eng	**New residents to Beaverland**	Pavlos Pavlikas (Cyprus)	**H**	**M**	**M**	Click on object	Algorithmic Thinking (Backtracking)
45.	2021-CY-03-eng	**Best Route**	Nikolaos Stratis (Cyprus)	**H**	**M**	**E**	Open Integer	Communication & Networking (Routing algorithm)
46.	2021-CZ-01-eng	**Secret Of The Diary**	Pavel Kohutovič (Czechia), Jiří Vaníček (Czechia)		**H**	**H**	Open text	Communication & Networking (Security (Cryptography))
47.	2021-CZ-06-eng	**Pyramid of coins**	Jiří Vaníček (Czechia)	**E**			Click on object	Sequencing (Stack)
48.	2021-DE-01-eng	**Treasure Hunt**	Karsten Schulz (Germany)	**M**	**E**		Click To Choose	Algorithmic Thinking (Algorithm execution)
49.	2021-DE-03-eng	**Robot Arm**	Kirsten Schlüter (Germany)	**H**	**M**	**E**	Multiple-Select	Algorithmic Thinking (Permutation)
50.	2021-DE-04-eng	**Detective Lawn Mower**	Michael Weigend (Germany)		**H**	**M**	Click on object	Automation (execution) (Algorithm execution)
51.	2021-DE-08	**Preferences A**	Wolfgang Pohl (Germany)	**M**			Draw lines	Algorithmic Thinking (Divide-and-conquer algorithm)
52.	2021-DE-08	**Preferences B**	Wolfgang Pohl (Germany)		**M**		Draw lines	Algorithmic Thinking (Divide-and-conquer algorithm)
53.	2021-DE-09	**Preferences C**	Wolfgang Pohl (Germany)		**H**	**M**	Drag & Drop	Algorithmic Thinking (Bipartite graph)
54.	2021-EE-03	**Logs**	Anastassia Fomin (Estonia), Lidia Feklistova (Estonia), Ahto Truu (Estonia)			**H**	Open Integer	Concurrency (Parallel processing)
55.	2021-HR-03-eng	**Letters**	Darija Dasović (Hrvatska)	**E**			Drag & Drop	Communication & Networking (Security (Cryptography))

56.	2021-HU-01-eng	**Repair the network**	Zsuzsa Pluhár, (Hungary)		**M**	**E**	Open Integer	Communication & Networking (Graph, Error detection)
57.	2021-HU-02-eng	**Fault Detection**	Zsuzsa Pluhár, (Hungary)			**H**	Click on object	Communication & Networking (Graph, Redundancy)
58.	2021-HU-04-eng	**Roborally**	Zsuzsa Pluhár, (Hungary)			**H**	Drag & Drop	Concurrency (Parallel processing)
59.	2021-ID-08-eng	**Self Health B**	Adriana Halim (Indonesia)	**H**	**M**	**E**	Open Integer	Algorithmic Thinking (Conditional statements)
60.	2021-ID-09-eng	**Go To The Market**	Kurniawan (Indonesia)	**E**	**E**		Drag & Drop	Algorithmic Thinking (Constraint satisfaction)
61.	2021-IE-06-eng	**Elephants in the refrigerator**	Rosemary Monahan (Ireland)		**H**	**M**	Multiple-Select with Images	Logics & Logical Thinking (Boolean algebra)
62.	2021-IS-03-eng	**The gift**	Linda Björk Bergsveinsdóttir (Iceland)		**H**	**M**	Click on object	Data structures & representation (Graph, Directed graph, Backtracking)
63.	2021-IS-04c	**Between dots**	Linda Björk Bergsveinsdóttir (Iceland)	**M**	**E**		Click on object	Automation (execution) (Program execution)
64.	2021-IT-01a	**Stacks of tokens**	Lorenzo Repetto (Italy)		**M**	**M**	Drag & Drop	Algorithmic Thinking (Partition problem, exhaustive search)
65.	2021-IT-03a	**An abstract picture**	Lorenzo Repetto (Italy)	**H**	**M**	**E**	Click on object	Data structures & representation (Graph, Graph coloring)
66.	2021-IT-05	**Snow White**	Mauro Torelli (Italy)		**H**	**H**	Open Integer	Data structures & representation (Graphs)
67.	2021-LT-01	**Meeting race**	Tomas Šiaulys (Lithuania)			**H**	Open Integer	Algorithmic Thinking (Branch and bound algorithm)
68.	2021-LT-03	**Three beavers**	Valentina Dagienė (Lithuania)	**H**	**M**		Open Integer	Algorithmic Thinking (Computational complexity, Scheduling)
69.	2021-LT-06	**Do they meet?**	Valentina Dagienė (Lithuania)	**M**			Open text	Automation (execution) (Backtracking)
70.	2021-LV-01-eng	**Comfort temperature**	Mārtiņš Opmanis (Latvia)		**H**	**H**	Click to Choose	Data Analysis (Data visualization)
71.	2021-LV-04-eng	**Curd snack**	Mārtiņš Opmanis (Latvia)		**H**	**M**	Open Integer	Algorithmic Thinking (Constraint satisfaction, Backtracking)
72.	2021-NL-03-eng	**Garden of Eden, Hotel California**	Willem van der Vegt (Netherlands)	**H**	**M**	**E**	Click on object	Data structures & representation (Graph, Maximum flow problem)
73.	2021-PL-01a-eng	**Bebras runs**	Maciej M. Sysło (Poland)		**H**	**M**	Click to Choose	Algorithmic Thinking (Sorting)
74.	2021-PL-03a-eng	**WhatDoesItDo**	Maciej M. Sysło (Poland)			**H**	Click to Choose	Algorithmic Thinking (recursion)

75.	2021-PL-05-eng	**Diamenty**	Maciej M. Sysło (Poland)		**H**	**M**	Click to Choose	Testing & Debugging (Program execution)
76.	2021-RO-01	**Boxes**	Laura Ungureanu (Romania), Corina-Elena Vint (Romania), Alina Gabriela Boca(Romania)		**M**	**E**	Drag & Drop	Computational Modelling, Conditionals (IF conditions)
77.	2021-RU-03	**Genome decoding**	Sergei Pozdniakpv (Russia)	**H**	**M**	**E**	Open text	Data Analysis, Abtraction
78.	2021-SI-02-eng	**Jumping Jack**	Janez Demšar (Slovenia)	**H**	**M**		Click on object	Data structures & representation (Graph, Search)
79.	2021-TW-03a	**Napping Together**	Ya-Chun Hsu (Taiwan)	**H**	**M**	**E**	Open Integer	Data structures & representation (Graph, Disjoint-set)
80.	2021-UK-01-eng	**Robot Drawing**	Chris Roffey (United Kingdom)		**H**	**E**	Connect the pictures	Automation (execution) (Program execution, Logical reasoning)
81.	2021-UK-04a-eng	**Upcycling A**	Chris Roffey (United Kingdom)	**H**	**M**	**E**	Open Integer	Algorithmic Thinking (Optimisation, Greedy algorithm)
82.	2021-UK-04b-eng	**Upcycling B**	Chris Roffey (United Kingdom)		**H**	**H**	Open Integer	Algorithmic Thinking (Optimisation, Greedy algorithm)
83.	2021-US-02	**Animal sorting**	Eljakim Schrijvers (USA)	**H**	**M**	**E**	Click on object	Algorithmic Thinking (Decision tree, IF statement)
84.	2021-UY-09	**Mastermind**	Graciela Oyhenard (Uruguay), Rosario Schunk (Uruguay), Víctor Koleszar (Uruguay		**H**	**H**	Open Integer	Logics & Logical Thinking (Logical reasoning)
85.	2021-UZ-01b-eng	**Kangaroo A**	Alisher Ikramov (Uzbekistan), Timur Sitdikov, (Uzbekistan)	**E**	**E**		Click on object	Algorithmic Thinking (Graph, Breadth First Search)
86.	2021-UZ-01c-eng	**Kangaroo B**	Alisher Ikramov (Uzbekistan), Timur Sitdikov, (Uzbekistan)	**H**	**M**	**E**	Click on object	Algorithmic Thinking (Graph, Breadth First Search)
87.	2021-UZ-01d-eng	**Kangaroo C**	Alisher Ikramov (Uzbekistan), Timur Sitdikov, (Uzbekistan)		**H**	**H**	Click on object	Algorithmic Thinking (Graph, Breadth First Search)
88.	2021-UZ-04-eng	**Fence**	Alisher Ikramov (Uzbekistan), Timur Sitdikov, (Uzbekistan)		**M**	**E**	Click on object	Algorithmic Thinking (Optimisation, Greedy algorithm)

2020 year

	Task ID	Name	Author	8–10	10–12	12–14	Interactivity	Concepts of Computer Science (CS) / Computation Thinking (CT)
89.	2020-AT-02-eng	**Treasure Island**	Florentina Voboril (Austria)	**H**	**M**	**E**	Click on object	Abstract Machine (Automaton)
90.	2020-AU-02-eng	**Stamp Collecting**	Tom Grubb (Australia)	**E**			Drag & drop	Patterns & Pattern Recognition

91.	2020-BE-02	**Processing objects**	Guillaume de Moffarts (Belgium)	**H**	**M**	**E**	Open Integer	Testing & Debugging (Scheduling)
92.	2020-CH-04c-eng	**Tree Sudoku**	Juraj Hromkovič (Switzerland), Regula Lacher (Switzerland), Xavier Muñoz (Spain), Susanne Datzko (Switzerland), Tom Grubb (Australia)			**H**	Click on object	Data structures & representation (Verification)
93.	2020-CH-07-eng	**A Beaver at the Castle**	Jonas Winckler, Serge Adam, Jean-Philippe Pellet (Switzerland)	**H**	**M**	**E**	Click on object	Loops (Cycle)
94.	2020-CH-09b-eng	**Secret Digits**	Juraj Hromkovič, Regula Lacher, Susanne Datzko (Switzerland), Sarah Chan (Canada), Linda Björk Bergsveinsdóttir (Iceland), Tom Naughton (Ireland)	**M**	**E**		Open Integer	Data structures & representation (Encoding)
95.	2020-CY-02-eng	**Jacques The Porter**	Thomas Ioannou, Cyprus		**H**	**M**	Open Integer	Data structures & representation (Encryption)
96.	2020-CZ-03-eng	**Don't crash**	Jiří Vaníček, Czechia		**M**	**M**	Each square in a table is interactive	Testing & Debugging (Testing)
97.	2020-CZ-04	**Rabbit paddock**	Jiří Vaníček, Czechia			**H**	1-drag and drop version, 2-clickable version	Concurrency (Parallel processing)
98.	2020-DE-03	**Moving Plates**	Michael Weigend (Germany)	**H**	**M**		Open text	Algorithmic thinking (Conditional statement)
99.	2020-DE-04a	**Wood Processing**	Michael Weigend (Germany), Emil Stankov (Macedonia), Mile Jovanov (Macedonia)			**H**	Drag & Drop	Concurrency (Parallel processing)
100.	2020-DE-07	**Flowerbox**	Wolfgang Pohl (Germany), Peter Tomcsányi (Slovakia)			**M**	Drag & drop	Algorithmic Thinking (Optimization)
101.	2020-HR-02-eng	**Needlework**	Ela Veža (Croatia)		**H**	**M**	Click to Choose	Data structures & representation (Encoding), Patterns & Pattern Recognition
102.	2020-HU-02-eng	**Sierpinski triangle**	Christian Datzko (Hungary), Ungyeol Jung (Korea), Kwangsik Moon (Korea)			**H**	Click on object	Algorithmic Thinking (Recursion)
103.	2020-IE-01b-eng	**Party message**	Taina Lehtimäki (Ireland), Tom Naughton (Ireland)	**H**	**E**		Drag & Drop	Data structures & representation (Encoding)

104.	2020-IE-08	**Creatures zoo**	Carla Martet-Doleu (Ireland), Tom Naughton (Ireland)	**M**	**E**		click to choose multiple objects	Logics & Logical Thinking, Boolean Logic
105.	2020-KR-05-eng	**Train Ticket Reservation**	Seungsoo Kim (South Korea), Kwangsik Moon (South Korea), Ungyeol Jung (South Korea), J.P. Pretti (Canada), Eslam Wageed (Egypt)	**M**			Click on object	Logics & Logical Thinking
106.	2020-KR-06-eng	**Handing out Candy**	Hwang, Soobin and Kim, Dong Yoon (South Korea), Kwangsik Moon (South Korea), Ungyeol Jung (South Korea), Darija Dasović (Croatia), Vernon Gutierrez (Philippines)	**E**			Connect objects	Logics & Logical Thinking
107.	2020-LT-01-eng	**Jumping kangaroo**	Valentina Dagienė (Lithuania), Tolmantas Dagys (Lithuania)	**H**	**M**	**E**	Open Integer	Algorithmic Thinking (Searching)
108.	2020-LT-04-eng	**Sorting the pencils**	Valentina Dagienė (Lithuania), Tolmantas Dagys (Lithuania)		**H**	**M**	Open text	Algorithmic Thinking (Sorting)
109.	2020-LT-08-eng	**A tree structure**	Valentina Dagienė (Lithuania), Tolmantas Dagys (Lithuania)	**H**	**M**		Open text	Data structures & representation (tree; binary tree)
110.	2020-LT-16-eng	**Remembering a Password**	Juraj Hromkovič (Switzerland), Regula Lacher (Switzerland), Valentina Dagienė (Lithuania)		**M**	**E**	Click to Choose	Data structures & representation (Data security)
111.	2020-MK-03-eng	**Spreading the news**	Mile Jovanov (Macedonia), Emil Stankov (Macedonia)		**H**	**H**	Open Integer	Data structures & representation (Graph, Graph center)
112.	2020-NL-04-engV2	**Pigs cot code**	Willem van der Vegt (Netherlands)	**H**	**M**	**E**	Open text	Communication and networking (Cryptography)
113.	2020-NL-06-eng	**Vulnerable**	Willem van der Vegt (Netherlands)			**H**	Click on object	Data structures & representation (Directed graph)
114.	2020-PH-02a-eng	**Robot Maze Game**	Vernon Gutierrez (Philippines)			**H**	Open Integer	AI
115.	2020-PT-03-eng	**Creating Numbers**	Pedro Ribeiro (Portugal)		**H**	**M**	Open Integer	Algorithmic Thinking (Optimization; Greedy Algorithm; Divide and Conquer)
116.	2020-RO-01	**Robots**	Laura Ungureanu (Romania)		**M**		Open Integer	Data structures & representation (non-oriented graphs)
117.	2020-RS-03-eng	**Data visualization**	Milan Rajković (Serbia)	**M**	**E**		Click to Choose	Data structures & representation (Data visualization)

118.	2020-SK-03b-eng	**Sprinkler**	Monika Tomcsanyiová (Slovakia)	**M**	**E**		Click on object	Algorithmic Thinking (Optimization)
119.	A2020-TH-05-eng	**Water Bottles**	Bundit Thanasopon (Thailand)		**M**	**E**	Open Integer	Algorithmic Thinking (Greedy Algorithm)
120.	2020-UK-01-eng	**Gift**		**E**			Drag & Drop	Data structures & representation (Graph, Bipartite graph)
121.	2020-US-03	**Zoo Animals**	Eljakim Schrijvers (USA)	**H**	**M**	**M**	Click on object	Logics & Logical Thinking, Boolean Logic
122.	2020-US-04	**Favourite Animals**	Eljakim Schrijvers (USA)	**M**	**E**		Drag & Drop	Logics & Logical Thinking, Boolean Logic

2019 year

	Task ID	**Name**	**Author**	**8–10**	**10–12**	**12–14**	**Interactivity**	**Concepts of Computer Science (CS) / Computation Thinking (CT)**
123.	2019-AT-03	**Counter**	Wilfried Baumann (Austria)			**H**	Open Integer	Data structures & representation (Binary)
124.	2019-AT-07	**Wizard Bibraxus**	Florentina Voboril (Austria)	**H**	**M**	**E**	Click to choose	Data structures & representation (Coding, parity bit), Logics & Logical Thinking
125.	2019-BE-02	**In Danger**	Kris Coolsaet (Belgium)			**E**	Open Integer	Algorithmic Thinking (Recursion)
126.	2019-CA-01	**Special Towers**	J.P. Pretti (Canada)	**H**	**M**	**E**	Open Integer	Algorithmic Thinking (Sorting)
127.	2019-CA-05b	**Seating Plan**	Troy Vasiga (Canada)			**M**	Drag & Drop	Logics & Logical Thinking (Boolean algebra)
128.	2019-CH-03b-eng	**Beavercoins**	Juraj Hromkovič (Switzerland), Regula Lacher (Switzerland), Christian Datzko (Switzerland)	**E**			Drag & Drop	Data structures & representation (Binary representations)
129.	2019-CH-04e-eng	**Colorful Flags**	Juraj Hromkovič (Switzerland), Regula Lacher (Switzerland), Dennis Komm (Switzerland)	**H**	**M**	**E**	Interactive picture	Data structures & representation (Tree)
130.	2019-CY-01-eng	**Olive farm**	Dimitris Mavrovouniotis (Cyprus)		**M**		Open Integer	Patterns & Pattern Recognition (Logical reasoning)
131.	2019-DE-02-eng	**Push-Away Parking**	Kirsten Schlüter (Germany)	**H**	**M**		Drag & Drop	Algorithmic Thinking (brute-force algorithm, autonomous (automatic) parking algorithm)
132.	2019-DE-03-eng	**Watched**	Michael Weigend (Germany)			**M**	Drag & Drop	AI (Weak), Data Analysis (Automatic image processing and analysis)
133.	2019-HU-02-eng	**A bag of candies**	Mária Kiss (Hungary)		**H**	**M**	Open Integer	Algorithmic Thinking (Conditionals)
134.	2019-IN-03	**Aircraft Scheduling**	Vipul Shah (India), Yogananda Jeppu (India)			**H**	Open Integer	Data structures & representation (Graph, Graph coloring)

135.	2019-KR-04	**Buying Shoes**	Jihye Kim (South Korea)			**H**	Open Integer	Data Analysis (Binary search algorithm)
136.	2019-KR-06_b	**Filling_Boxes**	Hyun-seok Jeon (South Korea), Heejin Park (South Korea)	**M**	**E**		Open Integer	Algorithmic Thinking (Optimization)
137.	2019-LT-02	**Many Beavers**	Valentina Dagienė (Lithuania), Gabrielė Stupurienė (Lithuania)		**H**	**H**	Open Integer	Data structures & representation (Graph, (Directed graph))
138.	2019-LT-05	**Word Coding**	Valentina Dagienė (Lithuania),		**H**	**M**	Open text	Algorithmic Thinking (Algorithm (Flowcharts))
139.	2019-LT-06	**Ants in Swamp**	Valentina Dagienė (Lithuania),		**H**	**M**	Open Integer	Algorithmic Thinking (Optimization, Maximum flow problem)
140.	2019-LT-07-eng	**Snowmen's hats**	Valentina Dagienė (Lithuania), Gabrielė Stupurienė (Lithuania)	**H**	**M**		Connect the dots	Data Analysis (Mapping, Stack)
141.	2019-MY-02	**Digital Number**	Muhammad Faiz Bin Ahmad Ismail (Malaysia)		**M**	**M**	Interactive picture	Algorithmic Thinking (Coding)
142.	2019-NL-03-eng-version-2	**By car or by train?**	Victor Schmidt (the Netherlands)		**H**	**H**	Open Integer	Data structures & representation (Graph), Algorithmic Thinking (Constraint satisfaction problem)
143.	2019-RO-01	**Visits**	Laura Ungureanu (Romania), Corina Vint (Romania)		**H**	**M**	Open Integer	Data structures & representation (Graph, Shortest path problem), Algorithmic Thinking (Optimization)
144.	2018-RU-01	**Video Compression**	Sergey Pozdnyakov (Russia)		**H**	**M**	Open Integer	Data structures & representation (Compression)
145.	2019-TH-07	**Bus Schedule**	Jonatan Pipping (Sweden)			**E**	Open text	Algorithmic Thinking (Optimization, (Constraints, Shortest path problem))
146.	2019-TH-08	**Beaver Network**	Nol Premasathian (Thailand)			**H**	Open text	Communication & Networking (IP routing)
147.	2019-US-04	**Boxes**	Eljakim Schrijvers (USA)		**H**		Drag & Drop	Logics & Logical Thinking (Logical reasoning)

2018 year

	Task ID	Name	Author	8–10	10–12	12–14	Interactivity	Concepts of Computer Science (CS) / Computation Thinking (CT)
148.	2018-AU-02-eng	**Honey Pot**	Allira Storey (Australia), Katie Rowe (Australia)	**E**			Drag & Drop	Logics & Logical Thinking
149.	2018-AU-03-eng	**Bird Colours**	Allira Storey (Australia), Katie Rowe (Australia)	**M**			Drag & Drop	Patterns & Pattern Recognition
150.	2018-CH-04-eng	**Find the Fountain**	Olivier Ens (Switzerland), Susanne Datzko (Switzerland), Christian Datzko (Switzerland)	**H**	**M**	**E**	Interactive picture	Data Representation (Hamiltonian paths)

151.	2018-CH-05-eng	**Visit friends**	Urs Hauser (Switzerland), Juraj Hromkovic (Switzerland), Regula lacher (Switzerland), Jacqueline Staub (Switzerland)	**H**	**M**	**E**	Drag & Drop	Algorithmic Thinking (Optimization, Graph)
152.	2018-CH-07-eng	**Elevator**	Urs Hauser (Switzerland), Juraj Hromkovic (Switzerland), Regula lacher (Switzerland), Jacqueline Staub (Switzerland)		**M**		Drag & Drop	Algorithmic Thinking (Optimization)
153.	2018-CH-11-eng	**Beaver-Modulo**	Urs Hauser (Switzerland), Juraj Hromkovic (Switzerland), Regula lacher (Switzerland), Jacqueline Staub (Switzerland)			**M**	Open Integer	Computation (Euclidean division)
154.	2018-CZ-02	**Family tree**	V?lav Stan? (Czechia), Jiří Vaníček (Czechia)		**M**		Drag & Drop	Data structures & representation (Graph, Tree)
155.	2018-CZ-05	**Arrow maze**	Jiří Vaníček (Czechia)		**M**		Drag & Drop	Algorithmic Thinking (Backtracking)
156.	2018-DE-07	**Room Sharing**	Wolfgang Pohl (Germany)		**M**		Drag & Drop	Logics & Logical Thinking (constraint satisfaction problem)
157.	2018-HR-06-eng-pillows	**Pillow fight**	Aleksandra Žufić (Croatia)	**M**			Open Integer	Algorithmic Thinking (Grouping)
158.	2018-HR-07-eng	**Rafting**	Mihaela Kelava (Croatia)		**H**	**M**	Drag & Drop	Algorithmic Thinking (Optimization)
159.	2018-HR-08	**Desert**	Mihaela Kelava (Croatia)			**H**	Interactive picture	Algorithmic Thinking (Graph, Depth first search)
160.	2018-HU-01-eng	**Ada and crayons A**	Zsuzsa Pluhár (Hungary)	**M**	**E**		Open Integer	Algorithmic Thinking (sequences, modify sequence)
161.	2018-HU-01-eng	**Ada and crayons B**	Zsuzsa Pluhár (Hungary)	**H**	**E**		Open Integer	Algorithmic Thinking (sequences, modify sequence)
162.	2018-ID-02aa-eng	**One Hour One Task**	Suryana Setiawan (Indonesia)		**H**	**M**	Open Integer	Communication & networking (Network scheduler, Round-robin scheduling)
163.	2018-IL-02	**Sin Nombre**	Averbuch Haim (Israel)			**H**	Open Integer	Logics & Logical Thinking (constraint satisfaction problem)
164.	2018-IR-05-eng	**Bank Queue**	Saeed Shabani (Iran)		**H**	**M**	Open Integer	Algorithmic Thinking (Optimization, Job-shop scheduling)
165.	2018-IT-01a-eng	**Atomic shelters**	Lorenzo Repetto (Italy)			**H**	Interactive picture	Algorithmic Thinking (Optimization, Optimization of plant location problem)
166.	2018-IT-02a-eng	**Islands and bridges**	Mauro Torelli (Italy)	**M**	**E**		Open Integer	Data structures & representation (Graph)
167.	2018-KR-05	**Stone Bridge Making**	Seul-ki Kim (South Korea), Tae-hyun Lee (South Korea)	**H**	**M**	**E**	Interactive picture	Data structures & representation (Breadth-first search (BFS))
168.	2018-LT-02-eng	**Beaver lake**	Valentina Dagienė (Lithuania),			**H**	Open Integer	Algorithmic Thinking (Wavefront algorithm, BFS)

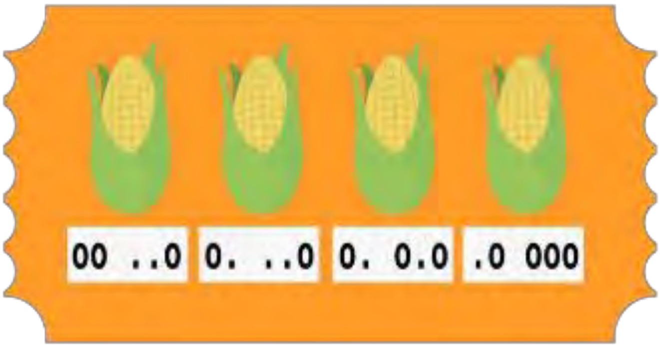
169.	2018-LT-04-eng	**Two beavers are working**	Valentina Dagienė (Lithuania),	**H**	**M**		Open Integer	Algorithmic Thinking (Decreasing Time Algorithm, Scheduling)
170.	2018-LT-05-eng	**Beaver land**	Bronius Skūpas (Lithuania)		**M**	**E**	Drag & Drop	Logics & Logical Thinking (constraint satisfaction problem)
171.	2018-LT-07-eng	**Beavers' puzzle**	Valentina Dagienė (Lithuania)	**M**	**E**		Drag & Drop	Data structures & representation (Grid Graphs, Domino problem)
172.	2018-LT-08-eng	**Beaver tables**	Lina Vinikiene (Lithuania), Valentina Dagienė (Lithuania)		**M**		Open Integer	Patterns & Pattern Recognition (Modeling iterative or repeating patterns)
173.	2018-MY-07-eng	**Passcode**	Muhammad Faiz Bin Ahmad Ismail (Malaysia)			**H**	Drag & Drop	Logics & Logical Thinking (constraint satisfaction problem)
174.	2018-MY-08	**Ring Toss**	Muhammad Aidel Bin Sallehl (Malaysia)	**E**			Open Integer	Data Analysis (Stack)
175.	2018-NL-02	**Medal Ranking**	Victor Schmidt (the Netherlands)		**M**	**E**	Open Integer	Algorithmic Thinking (Sorting)
176.	2018-RO-05	**Dominant shape**	Laura Ungureanu (Romania), Raluca Constantinescu (Romania)		**M**		Drag & Drop	Data Analysis (Frequent element)
177.	2018-RO-06	**Beaver's birthday party**	Laura Ungureanu (Romania), Corina Vint(Romania), Raluca Constantinescu (Romania)		**H**	**M**	Drag & Drop	Algorithmic Thinking (Bipartite graph)
178.	2018-SK-03-eng	**Towers**	Monika Tomcsányiová (Slovakia), Peter Tomcsányi (Slovakia)			**M**	Drag & Drop	Algorithmic Thinking (Graph)
179.	2018-SK-04-eng	**Haloween walk**	Andrej Blaho (Slovakia), Peter Tomcsányi (Slovakia)		**H**	**H**	Drag & Drop	Logics & Logical Thinking (constraint satisfaction problem)
180.	2018-SK-07	**Hotel Binary**	Lucia Budinská (Slovakia)		**M**	**E**	Interactive picture	Algorithmic Thinking (Binary search tree)
181.	2018-TW-03a	**Beaver nesting doll(I)**	Ya-Chun Hsu (Taiwan), Ya-Chun Hsu (Taiwan)	**H**	**M**		Open Integer	Algorithmic Thinking (Sorting, Longest Decreasing Subsequence)
182.	2018-TW-03b	**Beaver nesting doll(II)**	Ya-Chun Hsu (Taiwan)			**M**	Open Integer	Algorithmic Thinking (Sorting, Longest Decreasing Subsequence)
183.	2018-UK-03	**Smallest Program**	Chris Roffey (United Kingdom),		**M**		This task uses a Blockly playground but only uses loops and move blocks so does not require the interface to be learnt.	Algorithmic Thinking (Loops, Spotting patterns)
184.	2018-US-01	**Lemonade Party**	Eljakim Schrijvers (USA)		**E**		Click on objects	Data structures & representation (Binary counting system)
185.	2018-US-04	**Happy Binary Cake**	Eljakim Schrijvers (USA)			**M**	Open Integer	Data structures & representation (Computation, Combinatorics rules)

2017 year

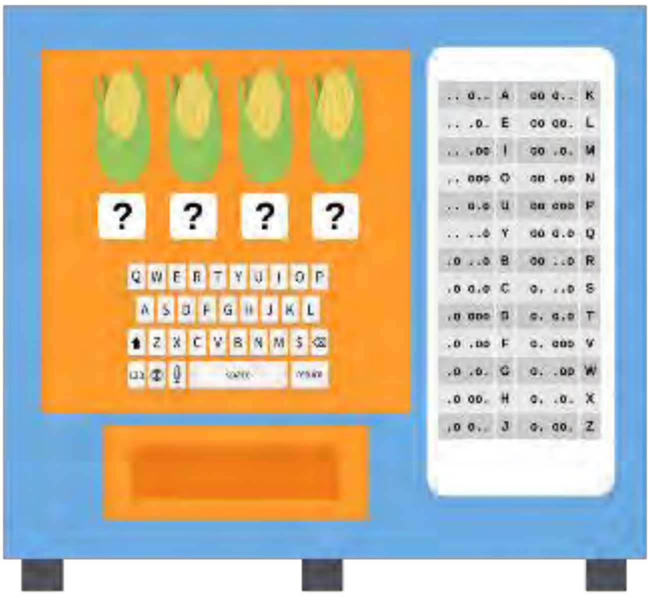
	Task ID	Name	Author	8–10	10–12	12–14	Interactivity	Concepts of Computer Science (CS) / Computation Thinking (CT)
186.	2017-AZ-02-eng-new	**Binary Gate**	Adil Aliyev (Azerbaijan)	**H**	**M**	**E**	Open Integer	Data structures & representation (Binary system, combinatorics)
187.	2017-BE-01	**Farewell party**	Veerle Fack (Belgium)			**H**	Open text	Algorithmic Thinking (Greedy algorithm for scheduling)
188.	2017-BE-02	**Celebrity**	Veerle Fack (Belgium)		**H**	**H**	Open text	Data structures & representation (Directed Graph)
189.	2017-BE-03a	**LeftRight**	Kris Coolsaet (Belgium)	**H**	**M**	**E**	Open Integer	Data structures & representation (Coding)
190.	2017-CA-07	**Soda Shoppe**	Carmen Bruni (Canada)			**H**	Open Integer	Algorithmic Thinking (Optimization, Matching)
191.	2017-CH-01a-eng	**Exit the maze A**	Juraj Hromkovic (Switzerland), Urs Hauser (Switzerland), Ivana Kosirova (Switzerland), Regula Lacher (Switzerland)	**M**	**E**		Drag & Drop	Algorithmic Thinking (Modelling, constraints)
192.	2017-CH-01b-eng	**Exit the maze B**	Juraj Hromkovic (Switzerland), Urs Hauser (Switzerland), Ivana Kosirova (Switzerland), Regula Lacher (Switzerland)		**H**	**M**	Drag & Drop	Algorithmic Thinking (Modelling, constraints)
193.	2017-CH-03-eng	**Pizzeria Biberia**	Juraj Hromkovic (Switzerland), Urs Hauser (Switzerland), Ivana Kosirova (Switzerland), Regula Lacher (Switzerland)			**M**	Open Integer	Algorithmic Thinking (Scheduling, Round Robin algorithm)
194.	2017-CH-04-eng	**What's for lunch?**	Juraj Hromkovic (Switzerland), Urs Hauser (Switzerland), Ivana Kosirova (Switzerland), Regula Lacher (Switzerland)	**H**	**M**	**E**	Open text	Communication & networking (Cryptography, Polyalphabetic Cipher)
195.	2017-CH-07b-eng	**Tunnels of the Homestead Dam**	Juraj Hromkovic (Switzerland), Valentina Dagienė (Lithuania)			**H**	Open Integer	Data structures & representation (Graph (flow network), Scheduling)
196.	2017-CH-08b-eng	**One Armed Beaver**	Christian Datzko (Switzerland), Susanne Datzko (Switzerland)	**M**	**E**		Drag & Drop	Algorithmic Thinking (Sorting algorithm)
197.	2017-CZ-02	**Card code**	Jiří Vaníček (Czechia)	**M**	**E**	**E**	Open Integer	Data structures & representation (Coding, Binary system)
198.	2017-CZ-03b	**Crossbreeds A**	Jiří Vaníček (Czechia)		**M**	**E**	Drag & Drop	Data structures & representation (structure, Constraints)
199.	2017-CZ-03	**Crossbreeds B**	Jiří Vaníček (Czechia)	**M**	**E**		Drag & Drop	Data structures & representation (structure, Constraints)
200.	2017-EE-01	**Sports**	Lidia Feklistova (Estonia)		**H**	**M**	Interactive list	Logics & Logical Thinking (Boolean Logic)

1. Golden Ticket

María, the armadillo, has a golden ticket that is worth four corn. Together with Juan, the capybara, they go to the vending machine to redeem it.
On the way, they look at the ticket, but do not understand the code on it.



When they see the code table on the vending machine, everything becomes clear: They will have to figure out what four letters are encoded on their ticket.



Question / Challenge
What four letters should they enter to get their corn?

Answer Options / Interactivity Description

String of four capital letters.

Answer Explanation

The code corresponds to letters R S T D.

Replacing each code on the ticket with a letter:

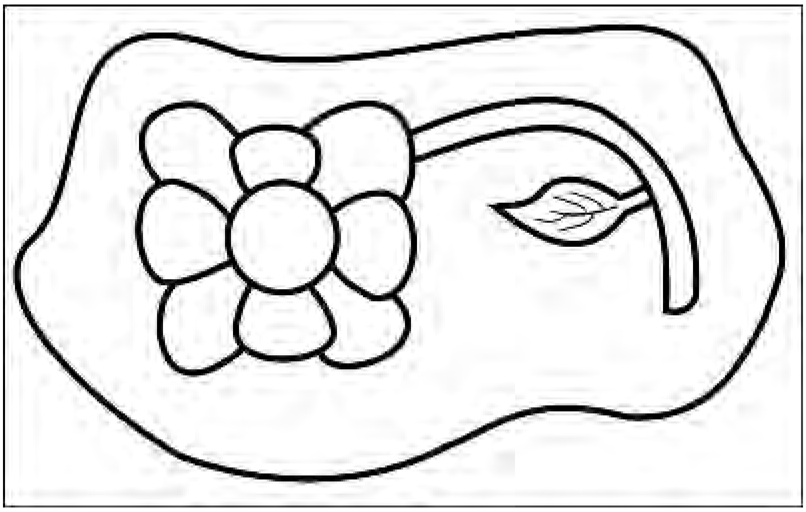
oo ..o   R

o. ..o   S

o. o.o   T

.o ooo   D

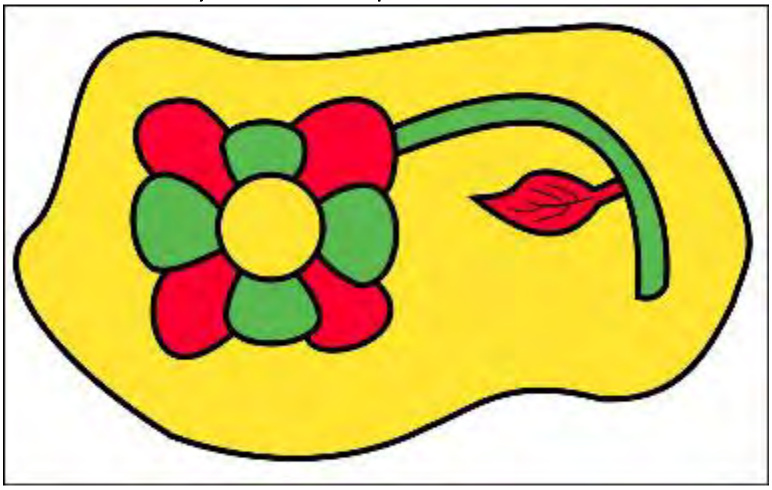
2. Coloring Page



Question / Challenge
Color the picture in green, yellow and red so that no two parts of the same color ever touch.

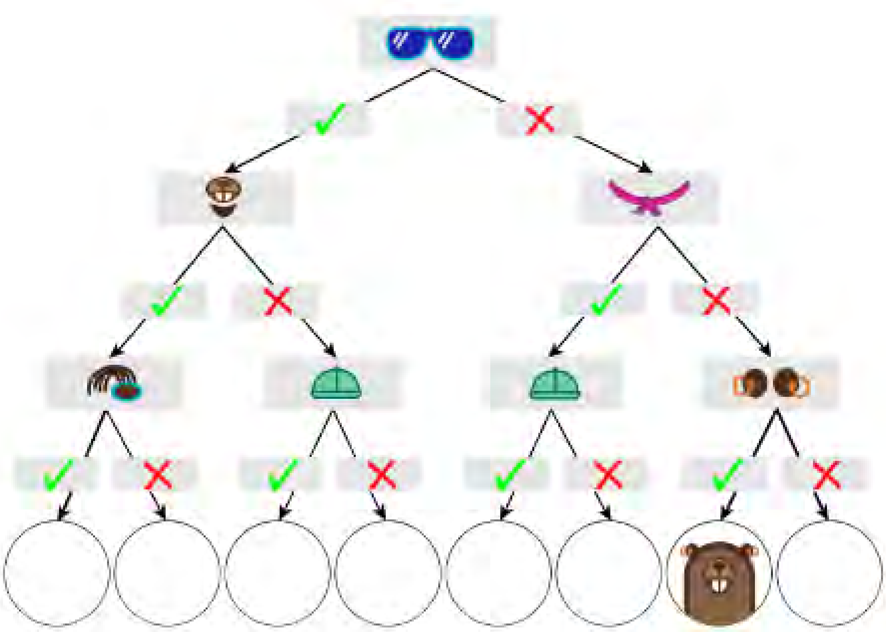
Answer Options / Interactivity Description
The pupils can click on an area to color it. It is possible to choose between Green, Yellow and Red. (Alternatively, dragging variously colored paint buckets to areas might be more appealing.)

Answer Explanation
Here is one way to color the picture.



First choose a color for the outermost part, say yellow. Every other part except the center of the flower touches this part, so these must be colored red and green. Start with any of the parts and keep alternating colors.

3. Remembering Faces



New classmates will arrive in the classroom. The children have eight pictures to identify them.

Question / Challenge

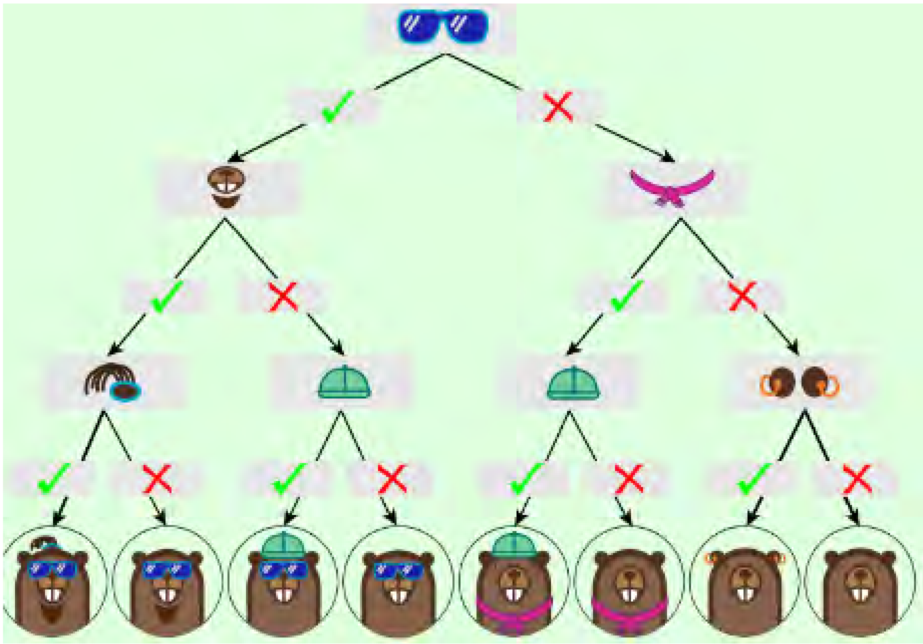
Please, put the remaining pictures in the right place!

Answer Options / Interactivity Description

Drag and drop images of beavers to where they go on the decision tree.

Answer Explanation

The answer is:



There are multiple ways to come to this solution. One of the most straightforward is to pick an image of a beaver, and follow the arrows from top to bottom, answering each question in turn to identify where that beaver should be placed.

4. Lights On

Beaver Sofia and her group of friends are playing games in an arcade. They decide to play a game called 'Lights On'. The game has 8 buttons for Sofia and her friends to stand on. Standing on a button will send a signal down a wire. These wires pass through some triangle or square boxes and eventually lead to a light bulb.

A triangle will send on a signal if BOTH incoming wires send it a signal.
A square will send on a signal if only ONE of the incoming wires send it a signal.
The beavers win the game if they can turn the light on.

Question / Challenge

Which buttons should Sofia and her friends stand on to turn on the light at the end and win the game?

Answer Options / Interactivity Description

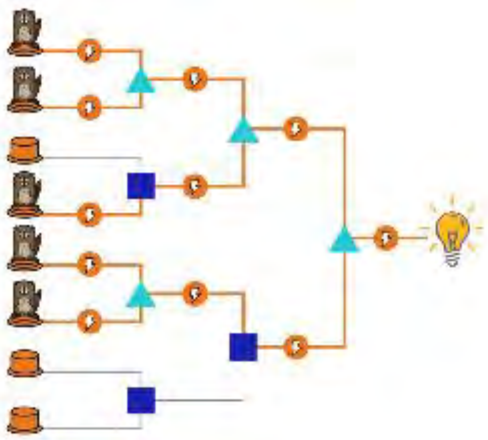
Interactive: an image of the 8 buttons and the wires coming out, leading into 4 squares/triangles, that lead into 2 squares/triangles, and into the final triangle and then the light bulb.
The 8 buttons start in their default off state, which looks like an unpressed button that is unlit (dull red).

When clicking on a button it becomes 'pressed', which puts a beaver on the button and the button depresses down which means it is ON.

Clicking again turns the button OFF, returning it to the first state.

Answer Explanation

There are 16 possible combinations of the 8 buttons that will turn the light-bulb on at the end. One of these solutions is shown below.



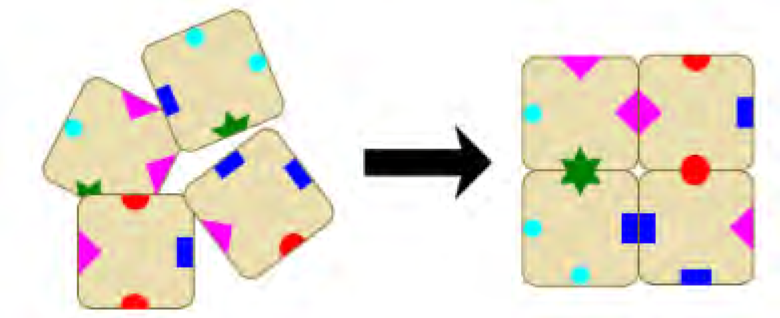
Screenshot of button presses that turns on light, with the wires highlighted in orange if they are on.

Explanation:

A good approach to this question is to work backwards. The light-bulb at the end is connected to wire in column 4 that comes from a triangle. For this wire to be ON, we know that the two wires leading into the triangle must also be ON.
These wires are connected to a triangle and a square
We know the triangle must be ON, therefore the wires connecting to it must both be ON.
We know the square must be ON, therefore one of the wires connecting to it must be ON, and the other must be OFF.
For columns 1 and 2, we will look at the wires in the top half and bottom half separately For the top half:
Both wires in column 2 must be ON. Therefore, the top 2 buttons in column 1 must be pressed, and exactly one of the buttons of the bottom 2 buttons must be pressed.
For the bottom half:
Given the square is in the ON position, exactly one of the wires leading into it must be ON, and the other is OFF. Therefore, either the triangle leading into it must be ON and the square OFF, or vice versa. There are multiple ways of doing this – the solution shown above demonstrates one possible approach. Here, the triangle is ON and therefore the top two buttons must be pressed, meaning the square must be OFF and the bottom two buttons are either both pressed or not pressed (in this case, both are not pressed).

5. Four Tiles

You are asked to arrange four tiles into a 2 x 2 square, according to the following rule:
Tiles may only touch each other at sides that carry exactly the same symbol!
The picture below shows an example:



You are now given the following 5 tiles.

You must arrange four of these five tiles into a 2 x 2 square that follows the rule above. (In this case there is only one possible choice of four tiles that allows this.)

Question / Challenge

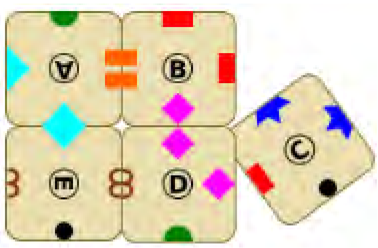
Which tile will you NOT use?

Answer Options /Interactivity Description

A.
B.
C.
D.
E.

Answer Explanation

The correct answer is C. It is possible to create a 2 x 2 square that follows the rule using tiles A, B, D and E, as shown below:



Trying the many possibilities until one happens to fit is an option, but there is a way to reduce the number of possibilities that have to be checked.
We do this in two separate steps.
1) We make a diagram of the five tiles and connect them with a line if they share at least one symbol.
Diagram Explanation: C and E are connected by a line because both tiles have a little black circle on one of their sides.

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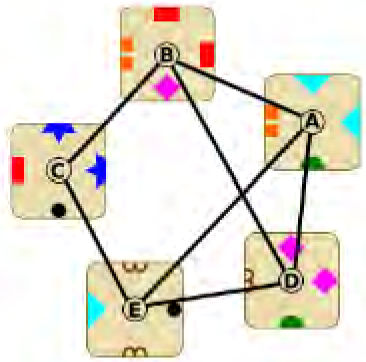
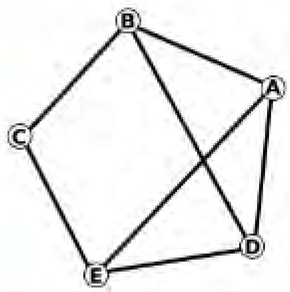
A and C are not connected because none of the symbols on A occurs on C. (The simplified diagram on the right is called
a graph.)





Explanation of the term 4-cycle: a path from tile to tile that follows the lines and ends up at the start after 4 steps from one tile to the next. It is important to realise that the four tiles in a 2 x 2 square that follows the rule, correspond to a 4-cycle.

2) With the help diagram, we find out all the possible 4-cycles. In our diagram there are three 4-cycles:

a) The first goes from A to B to D to E and then back to A (That 4-cycle corresponds to our solution).

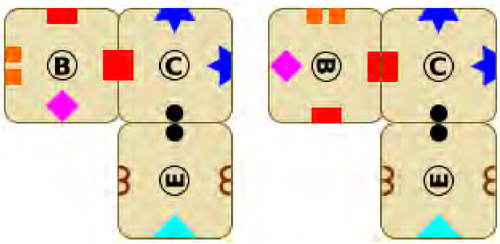
b) The second is the A-B-C-E-A.

c) The third is the B-C-E-D-B.

Of course all cyclic permutations of the five letters (i.e. starting from any letter, but keeping the order) are equivalent, as well as their reverse. For example A-B-C-E-A, B-C-E-A-B and E-C-B-A-E are equivalent.

Is it possible the second or the third 4-cycle may lead to another solution of our puzzle?

Both cycles contain B-C-E, and there are only two possibilities to join these tiles in that order:

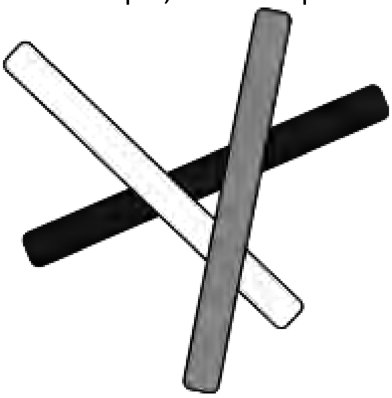


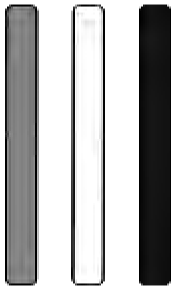
Neither tile A nor D can be used to complete these to a 2 x 2 square (and still conform to the rule).

6. Pick up sticks

Ana is playing the pick-up sticks game. She drops some sticks on a table, and then picks them all up according to the following rules:
- pick up one stick at a time
- only pick up a stick if no other stick is covering it

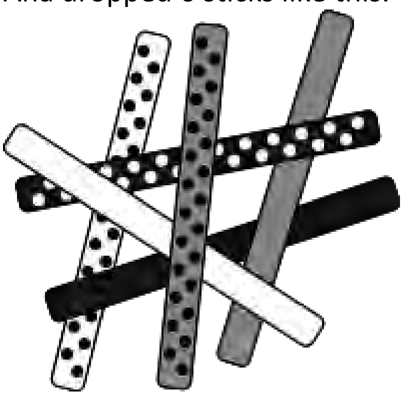
For example, if she drops 3 sticks like this: She has to pick them up in this order:





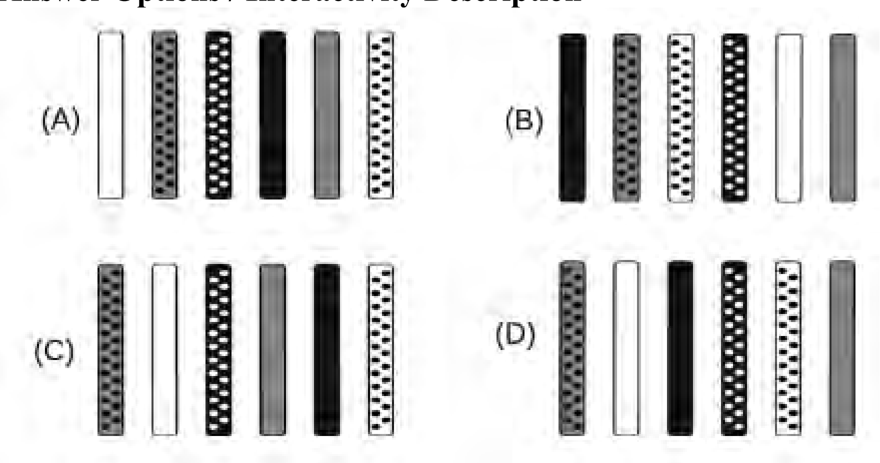
Question / Challenge

Ana dropped 6 sticks like this:



In which order should she pick them up?

Answer Options / Interactivity Description



Interactive version:

Have an area that lets the user change the order of the sticks using drag and drop.

For a full interactive version with feedback, add a “play” button, that executes this “program”, removing sticks one by one until all sticks are removed, or until the stick that Ana attempts to remove breaks the rules, in which case we highlight the stick with a red border, and display a message “Ana is trying to remove a stick that is covered with another stick”.
After every attempt, we would throw the sticks again, so that students can’t just change the order until it works, but have to plan everything carefully.

Answer Explanation

The answer is option (C).
Since Ana needs to pick up one stick at a time and without moving the others, she must pick up the stick above the others each time.
Firstly, the stick above the others is the dotted gray one. Once the dotted gray stick has been picked up, the stick above the others is the white one. Once the white stick has been picked up, the stick above the others is the dotted black one. The whole sequence of sticks picked up by Ana is dotted gray – white - dotted black - dotted white – black - gray.
The option (A) is wrong, because Ana picks up the black stick after the white, dotted black, and dotted white sticks.
The option (B) is wrong, because Ana picks up the dotted white stick before the black stick, and the gray stick after the dotted white and black sticks.
The option (D) is wrong, because Ana picks up the white stick before the dotted black stick, and the dotted white stick before the black stick.

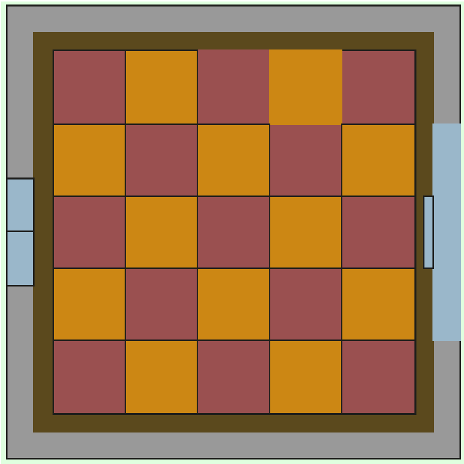
7. Super Security System

Beaver Business Banking needs a new security system to secure the room in front of their safe from intruders. They bought five detectors. Each detector sends out laser beams in eight directions until they hit an object or a wall.

If an intruder crosses the laser beam of any detector, the alarm is activated. But if one of the detectors stands in the way of a laser beam of another one, the alarm goes off as well.

Question / Challenge

Position the five detectors on the squared floor tiles such that they cover the whole remaining tiles in the room, but do not activate each other.



Answer Options / Interactivity Description

Interactivity Description: The detectors can be dragged and dropped onto the small squares making up the floor of the room. Ideally, on release, they snap to the center of the square where they are dropped. Additionally, one could add a red alarm lamp somewhere which turns on as soon as a laser beam is obstructed. In the most elegant execution (although this would make the task easier), the laser beams would also be drawn as soon as the detector is released, going from the detector to the first obstruction, i.e. the wall or another detector.

Answer Explanation

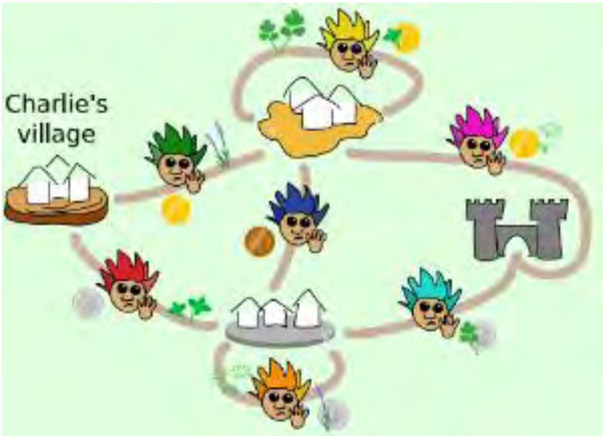
There are multiple solutions. Here are three:

To build a solution, one can first notice that at most one detector will be placed in each row and in each column, since they send out horizontal and vertical beams and must not detect

each other. That would be enough to detect any intruder. But since the detectors also send out beams diagonally, care must be taken that no two detectors will be placed on the same diagonal.
More generally, in a correct solution, the following conditions must hold for any pair of two different detectors. Call x is the number of the column in which the first detector stands and y the number of the row of that detector, and a is the number of the column in which the second detector stands and b is the number of the row of that detector. Then:
• x and a cannot be the same due to the vertical beams;
• y and b cannot be the same due to the horizontal beams:
• when subtracting the smaller one of x and a from the larger one and doing the same for y and b, the results of those two subtractions cannot be the same, due to the diagonal beams.

8. Greedy Trolls

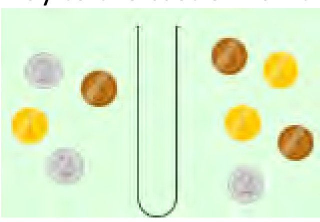
Charlie wants to go from his home village to the castle, but in the woods between the villages are greedy trolls waiting on the paths. All of them request one specific coin () from anybody who passes. Some of them also want one specific herb () as an extra to ken. Luckily those herbs can be found in the woods on the paths between some of the villages. In the picture you can see which coin each troll wants and if they also require a herb. It's not possible to gather a herb without first paying the troll on that path.



Charlie has a tube to store his coins. He fills it before leaving. Because he can only access one coin after the other, he must fill his tube in the exact order in which he needs the coins. Charlie also travels with a small backpack to store the herbs he finds in the woods. The backpack is very narrow, therefore he can only ccess the top-most herb in his backpack. Charlie leaves with an empty backpack.

Question / Challenge

Fill Charlies tube with five coins in the right order, so that he can pay the greedy trolls on his way to the castle. Don't forget about the herbs he must collect.

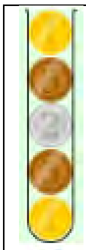
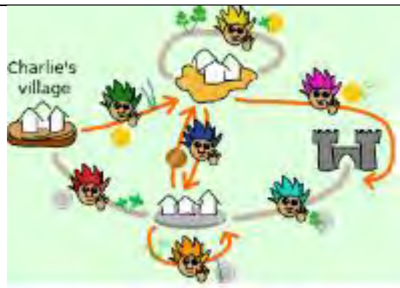
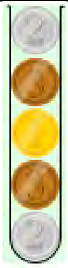
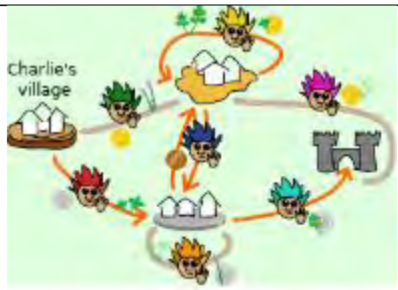


Answer Options / Interactivity Description

There should be a tube the width of a coin and the height of five coins. As well as one symbol each for a gold, silver and copper coin. From the symbols it should be possible to drag the corresponding coin to the tube.

Answer Explanation

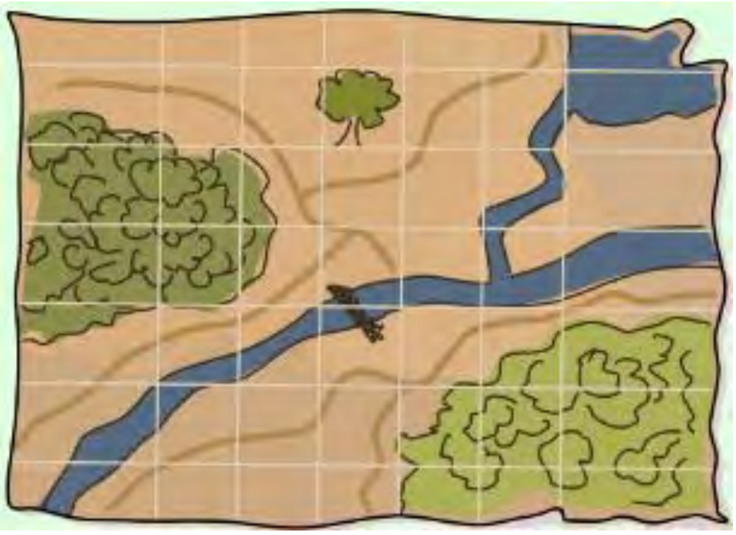
There are two possible solutions:

	Charlie first goes to Gold Village. On the way he pays one gold and gathers lavender. Then he goes to Silver Village and pays one copper on the way. Then he takes a tour through the woods where he has to pay one silver and the lavender but he can gather dill. After that he goes to Gold Village again at the cost of one copper. From there he can go to the castle because he has one gold and dill.	
	Charlie first goes to Silver Village. On the way he pays one silver and gathers basil. Then he goes to Gold Village and pays one copper on the way. Then he takes a tour through the woods where he has to pay one gold and the basil but where he can gather coriander. After that he goes to Silver Village again at the cost of one copper. From there he can go to the castle because he has one silver and coriander.	

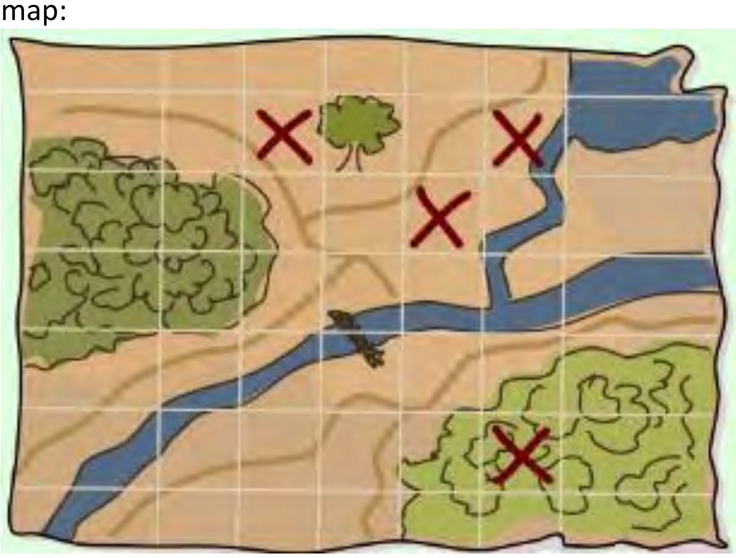
These are the only solutions, because he either needs dill or coriander to get to the castle. To get the dill he needs to gather lavender first. With the restriction of five coins this leaves only solution 1. To get the coriander he needs to gather basil first. And that leaves only solution 2. Every other way would cost him more than five coins.

9. Pantry Map

Castorus found two good hiding places for his food. To remember them, he wants to mark the spots on this map with an “X”. But if his rival Biberina finds the map, she would know where to look!



To confuse Biberina, Castorus randomly adds some “X”s in other squares of the map, making sure that the total number of “X”s in each row and each column is even (Note: 0 is also an even number). Then he erases the two “X”s showing his hiding places. This is the resulting map:



Question / Challenge

Where are Castorus’s two hiding places?

Interactive: On this map, click on the two squares where Castorus’s hiding places are.

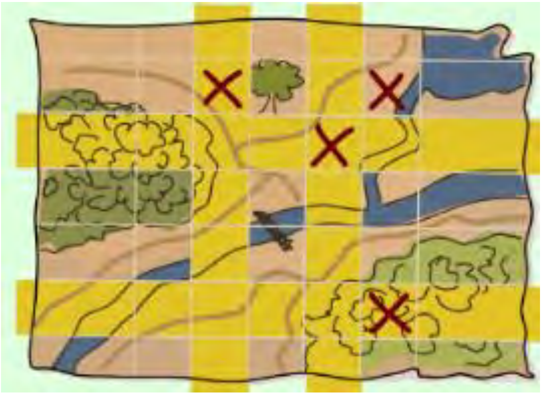
Answer Options / Interactivity Description

Each square can be toggled, which has the effect of showing or hiding a “hand-drawn” X or circle on top of that square showing it as “marked”.

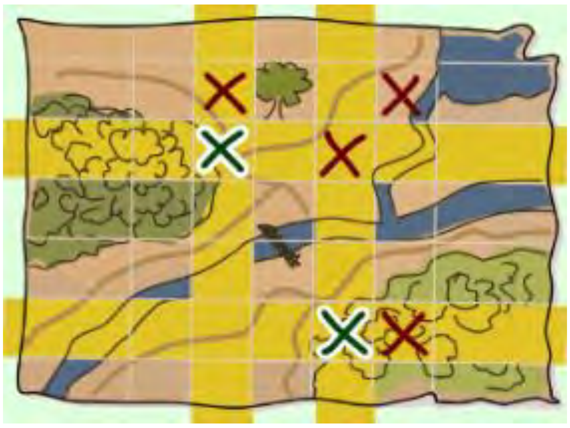
Answer Explanation

Here is the location of the two hiding places:

To find them, we look at the final map and find that there are two rows and two columns where the number of “X”s is not even: Rows 2 and 5 row (from the bottom), and columns 3 and 5 (from the left).
This shows the rows and columns involved in yellow:



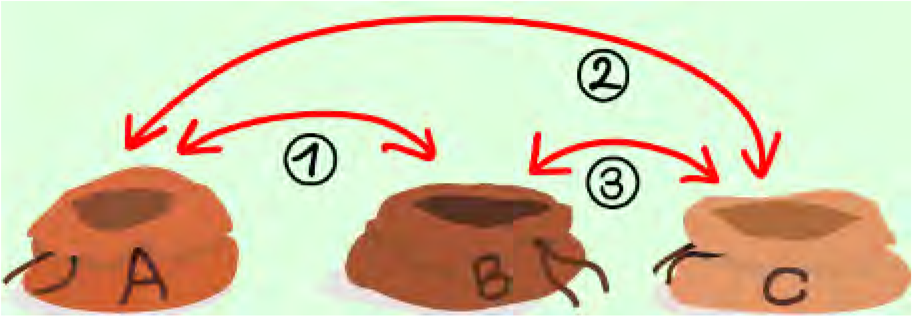
The two erased “X”s showing the real hiding places must have been in them! So we must find a way to add them back into these rows and columns to restore the even constraint.
There are 4 squares at the intersection of the yellow rows and columns. The upper red intersection square is marked with an “X” already: it cannot be a hiding place, since we know Castorus has erased the “X”s from the true hiding places. So in order to recover an even number of “X”s on that second row, we have to add it in the upper left yellow intersection square: we now know one hiding place.
The second hiding place can be determined as follows: once we’ve found the first one, we cannot place the second one in the bottom left red intersection square, as this would result in 3 “X”s in the second column, and 3 is not even. The only choice left is the lower right intersection square, which gives the answer shown above.
This shows the map before Castorus erased “X”s, with an even number of “X”s in each row and column:



10. Lila's Guessing Game

Lila and her friends are playing a guessing game. To start the game, Lila puts a marble in Bag A, a gem in Bag B, and a crumpled piece of paper in Bag C.

She then asks her friends to close their eyes. While their eyes are closed she mixes up the contents of the bags. First, she switches the items in bags A and B. Then, she switches the items in bags A and C. Lastly, she switches the items in bags B and C.

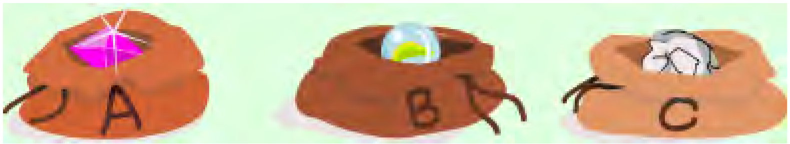


Question / Challenge
Where are Lila's items now?

Answer Options / Interactivity Description

The marble, gem, and paper can be dragged and dropped into the bags.

Answer Explanation
Lila switches the items three times. After the first switch the bags look like this:



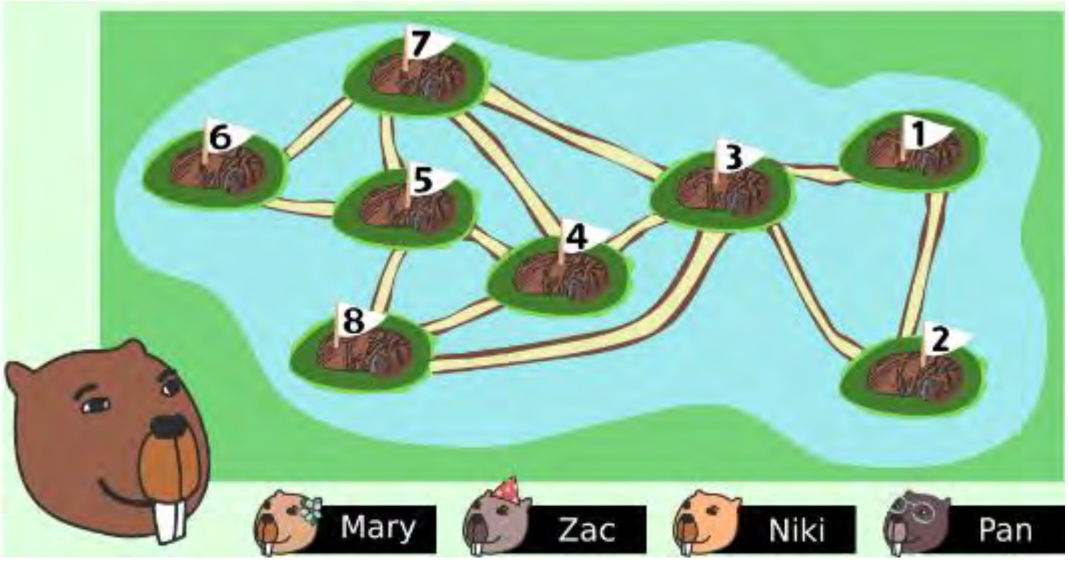
After the second switch the bags look like this:

After the third and final switch the bags look like this:

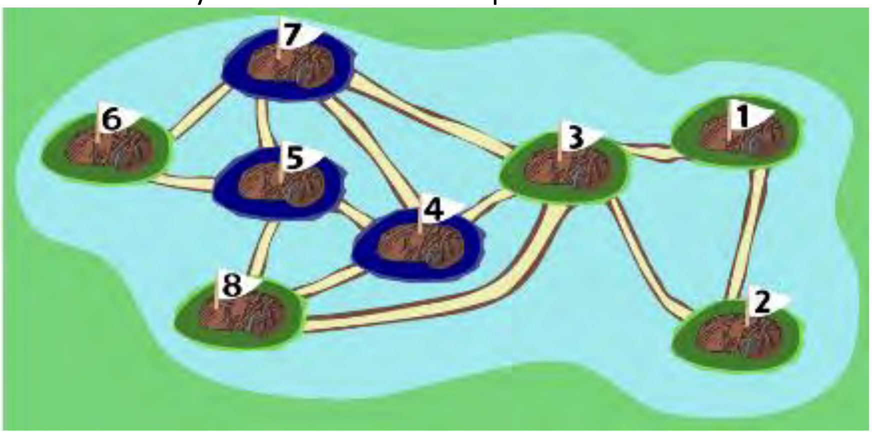
Therefore, the paper is in Bag A, the gem is in Bag B, and the marble is in Bag C.

11. Mary's Neighbours

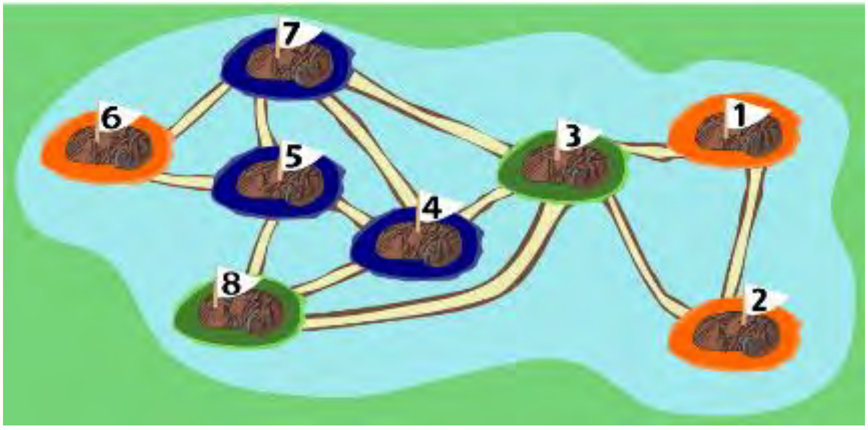
Bebras wants to visit his friend Mary. But he doesn't know where she lives. Fortunately, he has a map and some information. Two beavers are neighbours if a path connects their house.
• Each of the following three beavers: Mary, Zac, and Pan, has four neighbours.
• Zac and Pan are neighbours with Niki.
• Niki has no other neighbour.



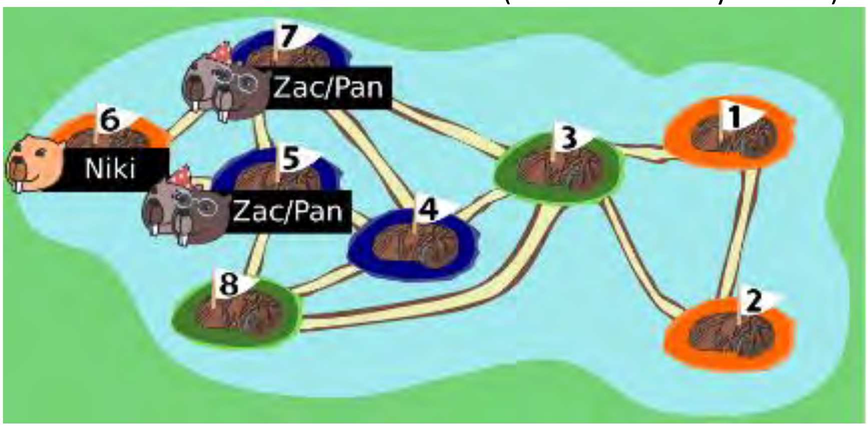
Question / Challenge
What is Mary's house number? (Enter the number)
Answer Options / Interactivity Description
As helper it is possible to use drag & drop to make it easier to solve. You can move and place Mary, Zac, Niki, and Pan anywhere on the map to help you.
Answer Explanation
The answer is the number 4.
To solve the problem, it is necessary to focus on the paths, that go from each house. We first need to identify the houses with four paths. There are three such houses: 4, 5 and 7.



So, Mary, Zac and Pan live in one of these three houses, but we need to find out where exactly Mary does live.
The other two pieces of information describe Nikis house. We can deduce that there are only two paths from it. So, Niki lives in one of the houses with numbers 1, 2 or 6.



As Niki is neighbour with Pan and Zac, we can further deduce that:
• Niki lives in house number 6
• Zac and Pan live at numbers 5 and 7 (or the other way around)

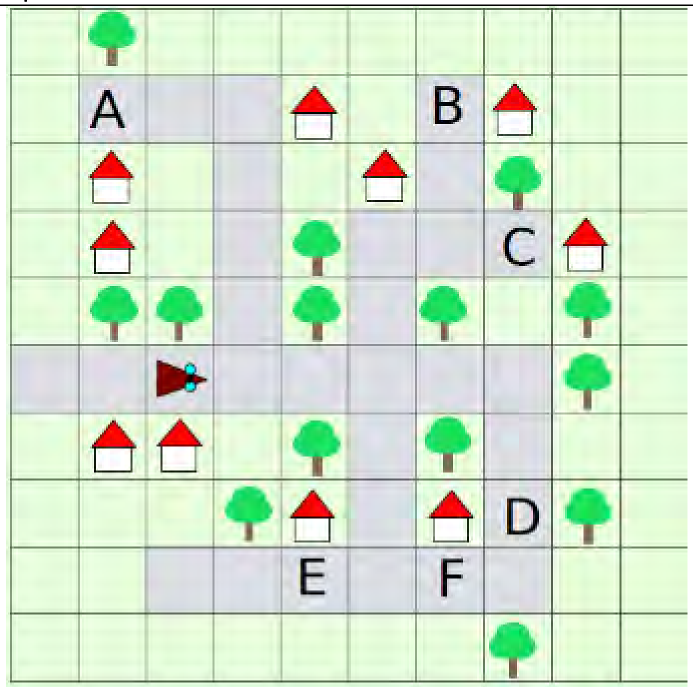


Thus, there is only one house with four paths that can be Marys house. And it is the one with the number 4!

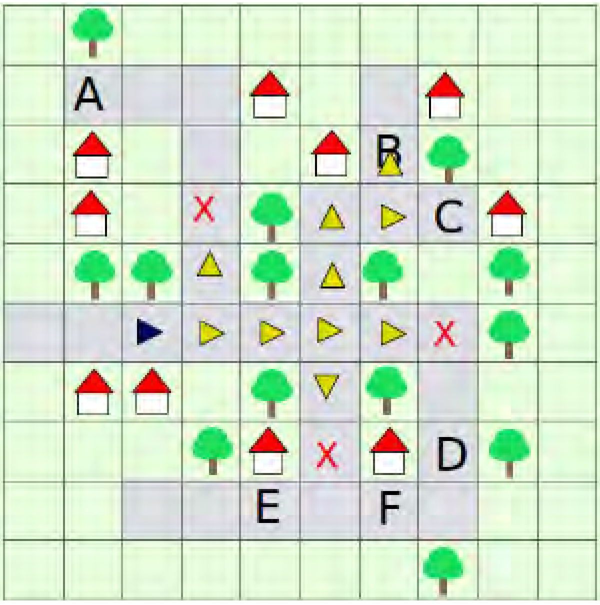
12. Listen and Walk

Tina, who is blind walks through the city along the roads, using her talking glasses. The talking glasses have cameras and an intelligent object recognition system. They can recognize the four types of squares of the map below: a house, a tree, a road and lawn. When Tina enters a new road square, the talking glasses tell her – in this order – what is on her left, what is in front of her and what is on her right; for example: “tree road house”.

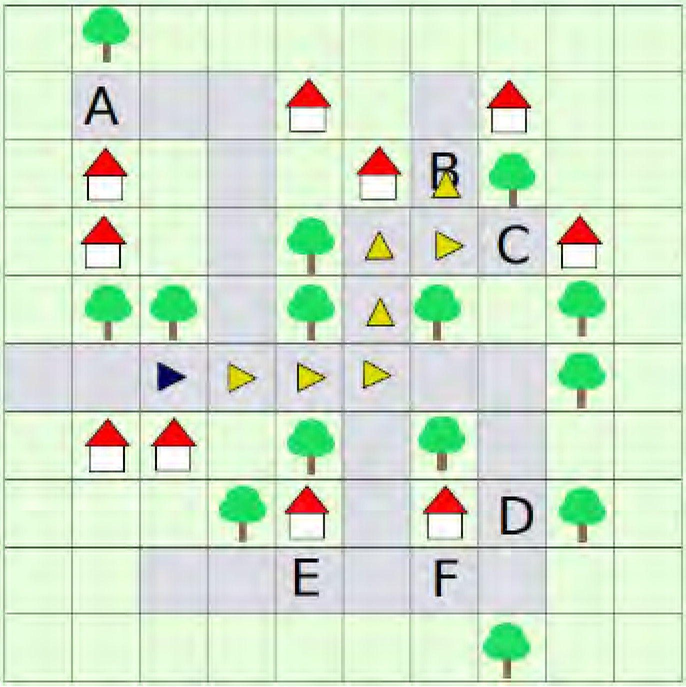
Tina starts (facing the right side of the map) at the triangle and listens to her talking glasses. This is what they tell her (beginning with the starting square):
tree road house,
road road lawn,
tree road tree,
road road road,
tree road tree,
tree house road,
road road tree,
house road tree
At the end, Tina has arrived at one of the squares labeled with a letter.



Question / Challenge
At which one?
Open answer: Enter the letter of that square.
Interactive**:** Click on that square.
Answer Options / Interactivity Description
Open answer: One letter A-F
Interactive: Squares with labels can be clicked to be selected (and clicked again to get deselected). At most one square can be selected at a time.
Answer Explanation
The correct answer is B.
There are different strategies to find the solution. You can just follow the way from the start and walk along the path that matches the information given by the talking glasses.
The objects do not tell us when Tina makes a turn on the road. So if at any location the next set of objects match objects on more than one roads, we try each road at a time. For example, if we take the road to destination A, to continue along the road, we would realize that after “tree road tree” the next (4th) set of objects should have been “lawn road tree”.
However the objects are “road road road” which do not match the objects on road to destination A. So we trace back to the intersection where we chose the road to destination A and take another road. We do this till we have either tried all the possible roads or until we reach one of the targets. The figure below shows possible paths Tina can take. X indicates that she could not have continued on the path.

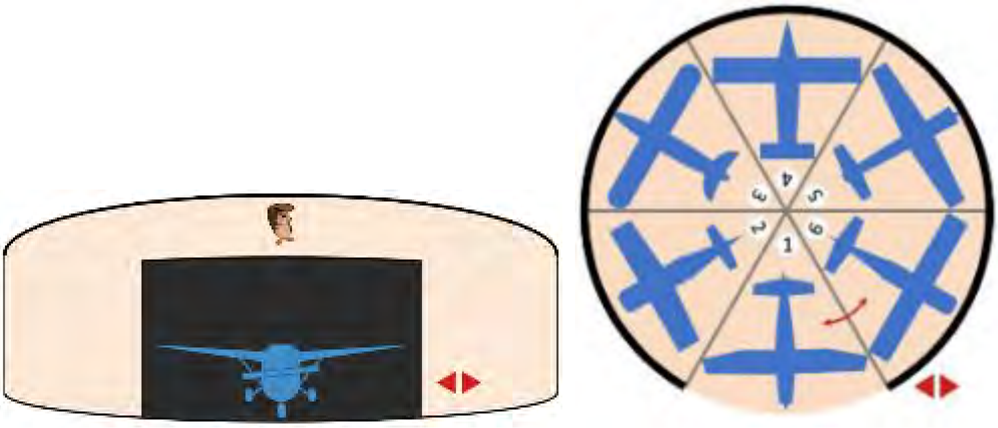


Alternatively, you can check the six target squares. Only B and D match the description “house road tree”. But both squares adjacent to D do not match “road road tree”, which is the second last description. Therefore, B must be Tina’s goal square.



13. Hangar Carousel

At Beavertown airfield, six planes are parked on a rotating turntable in the round hangar. The turntable can be rotated to the left or to the right by using a control panel with two arrows ◄►. One button press rotates the turntable exactly one parking position either left or right. The gate of the hangar is wide enough for one plane to roll out. The turntable is very slow to rotate so having fewer button presses will avoid delays.



In the mornings, when pilots come to pick up their planes, the parking position 1 is always at the gate. In the best case, arrow keys need to be pressed five times to get all planes to roll out. In these cases pilots want to access the parking positions in order: 1, 2, 3, 4, 5, 6 by pressing ► five times, or in order: 1, 6, 5, 4, 3, 2 by pressing ◄ five times.
But what is the worst case? That is, what order accessing the parking positions will require the maximum number of button presses for all planes to be rolled out?

Question / Challenge
Provide one of such worst-case order for pilots to access the parking positions 1 - 6.

Answer Options / Interactivity Description
Six fields for entering numbers from 1 to 6. A validity check would be useful (e. g. no number twice).

Answer Explanation
There are two worst-case orders of parking positions: 4 1 3 6 2 5 and 4 1 5 2 6 3.
The worst case and hence the correct answer can be found by selecting the next parking position that is always farthest away from the gate. The challenge here is to imagine the result of the turn and visualize how space for space is freed up. Because you can move the turntable in both directions, there is more than one correct solution; with six planes there are two correct solutions.
4 1 3 6 2 5 :
First accessing the position 4 requires three presses (either left or right)
Next accessing position 1 requires three presses (either left or right)
Next accessing position 3 requires two presses right.
Next accessing position 6 requires three presses (either left or right)
Next accessing position 2 requires two presses right
Finally accessing position 5 requires three presses (either left or right)
4 1 5 2 6 3:
First accessing the position 4 requires three presses (either left or right)

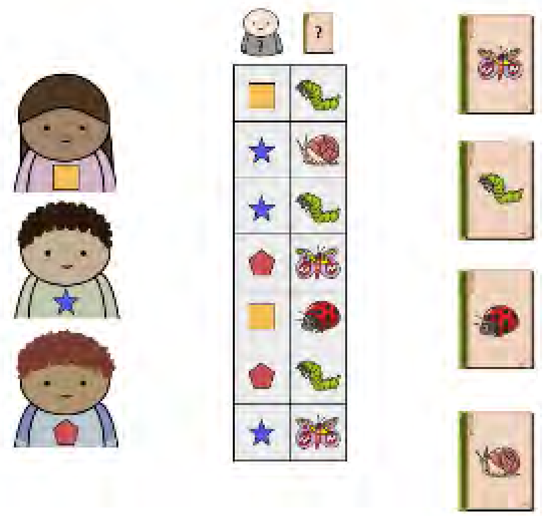
Next accessing position 1 requires three presses (either left or right)
Next accessing position 5 requires two presses left
Next accessing position 2 requires three presses (either left or right)
Next accessing position 6 requires two presses left
Finally accessing position 3 requires three presses (either left or right)

14. Kids and Books

Kids borrow books from the library. The library made a borrowing table to find out which book was most popular.

Question / Challenge

Which book are the kids borrowing most often based on the borrowing table below?
Click on that book.



Answer Options / Interactivity Description

Books can be clicked to select up to one of them. In detail: In the beginning, all books are unselected. A click on a not selected book makes it selected - and a previously selected book, if any, unselected. Thus, no more than one book can be selected at any time. A click on a selected book (the only one) makes the book unselected. A selected book should be highlighted graphically.

Answer Explanation

This is correct:
Two kids ask for the book with the butterfly.
Three kids aks for the book with the caterpillar.
One kid asks for the book with the ladybug.
Also, one kid asks for the book with the snail.
That is, the book with the caterpillar is asked for most often.

15. Favorite Movie

A group of friends need to choose which of seven movie to watch. Each friend rates each movie as shown.

	1	2	3	4	5	6	7
Ada	✓	✓	✓	✓	✓	✓	✓
Nancy	●	✓	✓	●	●	✓	✓
Niklaus	✗	✗	✗	●	✗	✗	✗
Grace	✗	●	●	●	✗	●	✗
Edsger	✓	●	✗	✗	●	✓	✓
Rosza	●	✗	●	✗	✓	●	●

The ratings from the best to worst are: ✓, ●, ✗.
A movie is called a "favourite movie", if all friends give it their best rating. For example Movie 1 is not a favourite movie because Nikolaus gave his best rating to the Movie 4.

Question / Challenge
What is the smallest possible number of ratings that need to be changed such that there will be a favourite
movie?

Answer Options / Interactivity Description
Any integer number from [0,...,7]
Please note that the author would prefer an interactive version, where contestants can actively change ratings as needed.

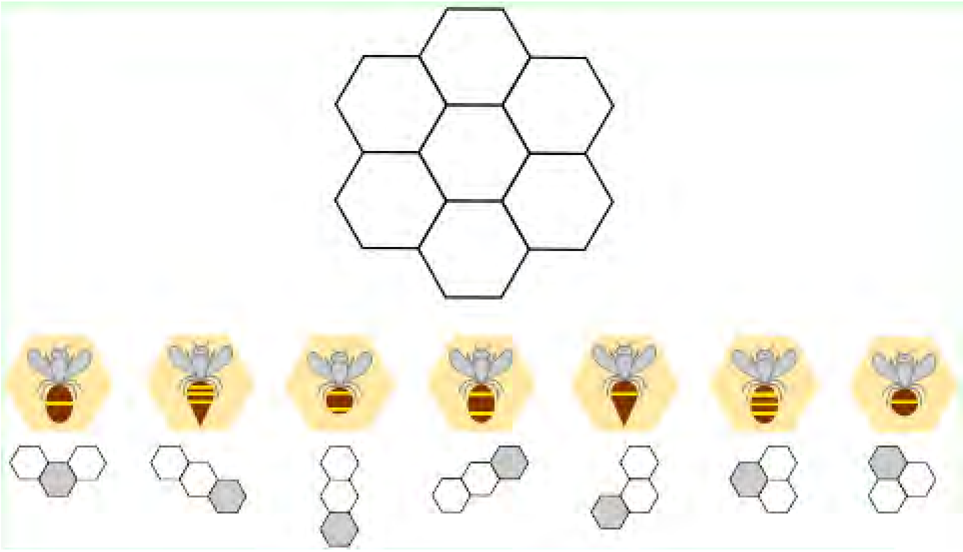
Answer Explanation
2 is the correct answer.
There is no way to change only 1 entry such there will be a favourite movie. In the survey, for each movie another movie is rated better by at least two friends:

Movie	That many friends rated other movies better
1.	4: Nancy, Niklaus, Grace, and Rozsa
2.	3: Niklaus, Edsger, and Rozsa
3.	3: Niklaus, Edsger, and Rozsa
4.	3: Nancy, Edsger, and Rozsa
5.	3: Nancy, Grace, and Edsger
6.	2: Niklaus and Rozsa
7.	3: Niklaus, Grace, and Rozsa

Now Ada needs to convince Niklaus and Rozsa to change one rating each such that movie 6 will be a favourite movie.
Niklaus and Rosza need to improve their ratings for movie 6. Alternatively, they could downgrade their ratings for those movies they rated better than 6: that is movies 4 (Niklaus) and 5 (Rosza). It is easy to see, however, that Ada needs to consider rating improvements only in similar future situations.

16. Bee hive

Beaver needs some help to place the bees in the hive.



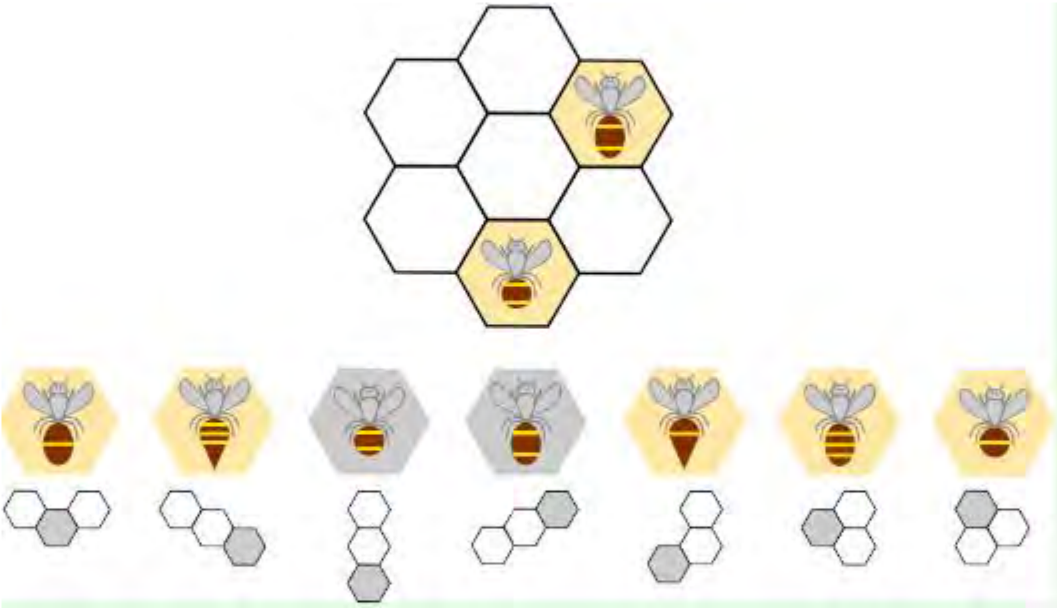
Below each bee a rule is shown: The bee must be put in the gray cell.

Question / Challenge

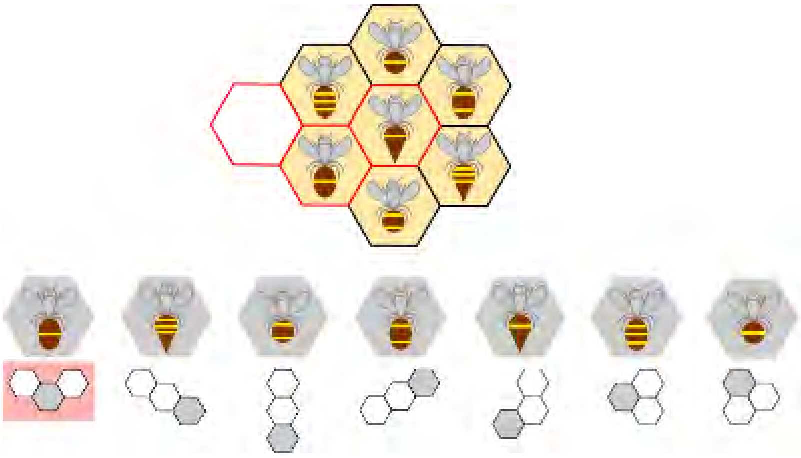
Drag and drop the bees into the hive obeying their rules.

Answer Options / Interactivity Description

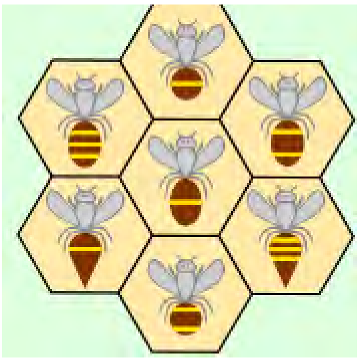
Interface during the resolution: so that users can check the rules they have already used, the backgrounds of the bees already placed are changed to gray. A bee can be removed from the hive. In this case, the rule for this bee is automatically returned to its initial state.



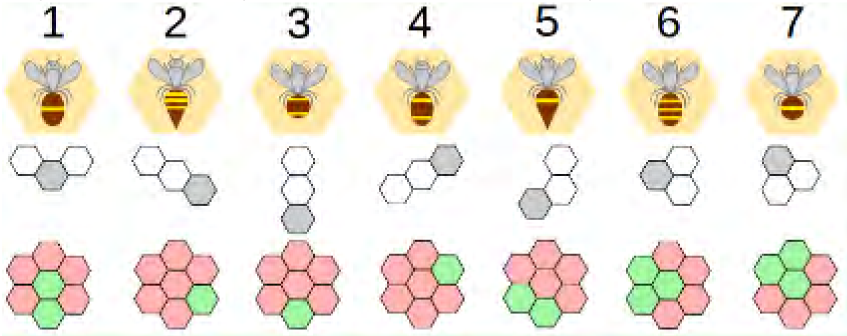
For full feedback, after all the bees have been placed, the background of one of the rules that is broken is changed to red. The corresponding cells in the grid are outlined in red.



Answer Explanation
Here is the solution:



You can solve the task just by trying it out. But this can take a lot of time. To find a quicker way, take a closer look at the bees' rules. In the following image you see each bee and its rule. The cells, in which the bee can be placed according to it's rule are colored green.
You see that some bees can be placed in only one cell of the hive and others can be placed in different cells. For example bee 2 can only be placed in one cell, because there is only one way to place the bee's part of the hive in the complete hive.



To solve the task you proceed like this: First place the bees for which only one placement is possible, that is to say bees 2, 3 and 4.
There is then only one possible place left for the bees 1 and 5. In the same way you place in order the bee 6 and finally the bee 7.

17. Forest party

Betty Beaver, Fiona Fox, and Bobby Bear are having a party. The table shows which foods each friend can eat.

	Leaves	Fish	Mushrooms	Berries
Betty Beaver	Yes	No	No	Yes
Fiona Fox	No	Yes	No	Yes
Bobby Bear	No	Yes	Yes	Yes

They have nine food portions at the party. Each friend should get three portions of food.

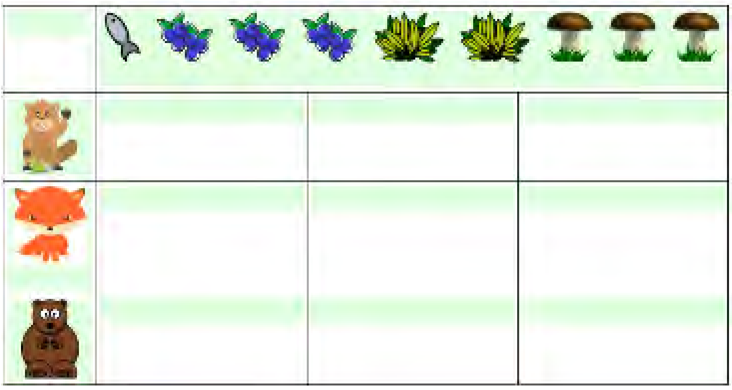
Question / Challenge

Divide the foods so that each friend gets three portions of food.

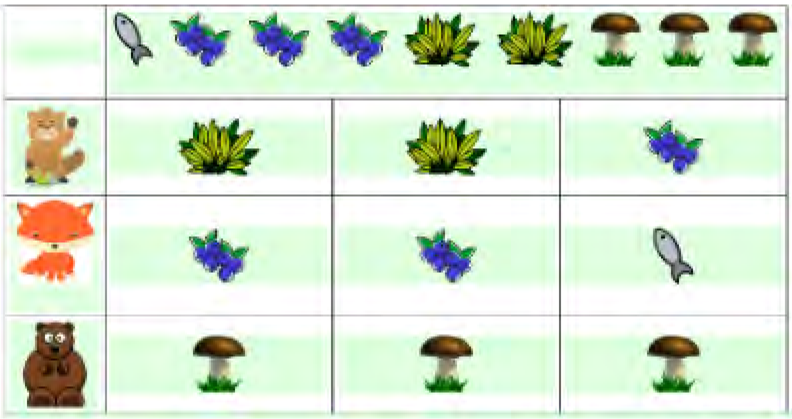
Instruction: Drag suitable food portions to each friend.

Answer Options / Interactivity Description

Each food portion is to be dragged to a friend that eats that type of food. Each friend should get three portions.



Answer Explanation



To solve this task, one could start with Betty Beaver since Betty is the only friend that eats leaves. This means that all leaves should go to her. The only other food she eats is berries so her third food has to be berries. Next, Bobby Bear is the only friend that eats mushrooms, so all three mushrooms should go to him. Fiona Fox will get what is left over: two berries and the fish.

There are the other way of solving this problem, for example one could start with Fiona Fox and observe that since Fiona only eats fish and berries, then she must get at least two portions of berries and her third portion will be either fish or berries. Betty Beaver is the only friend that eats leaves. This means that all leaves should go to her. The only other food she eats is berries so her third food has to be berries. Because there are no berries left, now we know that Fiona Fox's third food has to be fish. Bobby Bear will get what is left over: the three mushrooms.

18. Learn Traditional Art

Deepa is learning Warli painting. With the help of some cards, she wants to create the following picture:

She has to follow the step-by-step instructions shown on the cards, but she dropped them and now they are all mixed up!

Question / Challenge

Put these cards back in the proper order.

Answer Options / Interactivity Description

There are 6 empty card slots. Students can drag a card into a card slot.

Answer Explanation

The correct order of the cards is:

Each card adds one more feature of the final picture.

19. Where is beaver?

Bibako wants to move from the START room to Be-taro's room.
Bibako uses a map of rooms.
On the map, each room is marked by a picture.

Bibako moves by the following arrow sequence:

↑	→	↓	↓	↑	←	←	↓	→	→

Each arrow tells Bibako in which direction to move from one room to the next.

Question / Challenge

Which picture is Be-taro’s room marked by?

Answer Options / Interactivity Description

A) 

B) 

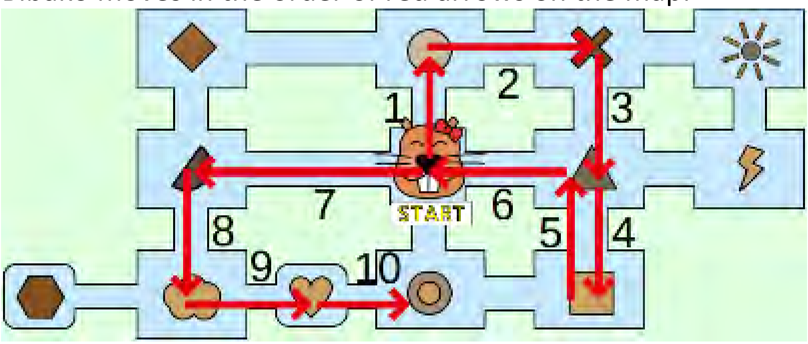
C) 

D) 

Answer Explanation

B) 

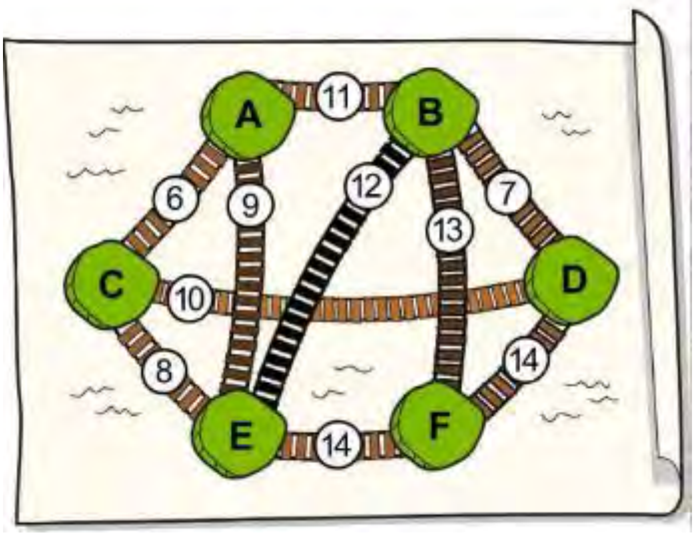
Bibako moves in the order of red arrows on the map.



20. Connection of islands

A jungle community, living in six islands, wants to connect these islands by building a network of canopy bridges. A plan of the possible connection of bridges was made. Bridges do not intersect each other. The numbers show costs of building of bridges for possible connection of islands.

The community wants to link all the islands so that it is possible to travel from any island to any other island either directly or by going indirectly through one or more islands. At the same time, the community wants to build bridges as cheap as possible.



Question / Challenge

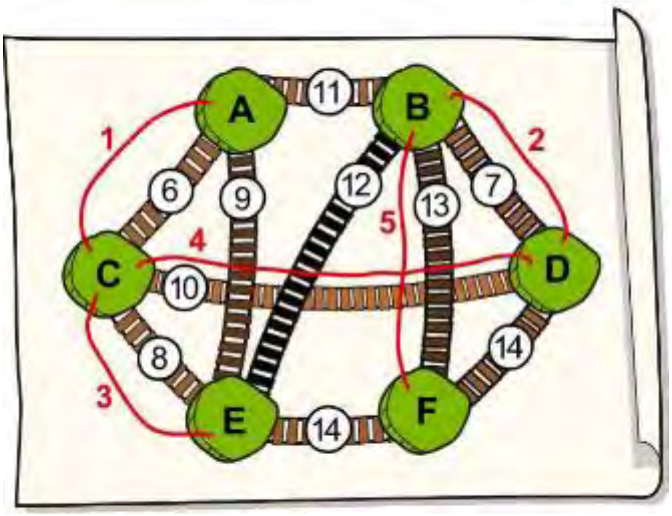
What is the cheapest way to link up all six islands?

Answer Options / Interactivity Description

44

Answer Explanation

Counting: 6 + 7 + 8 + 10 + 13 = 44



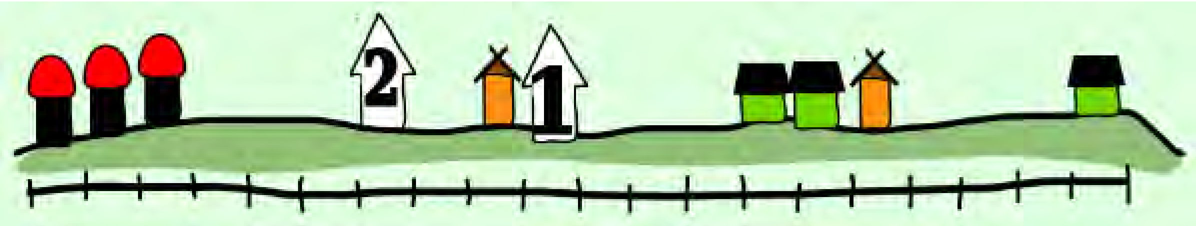
Algorithm is simple and intuitive (it is known as Kruskal's algorithm):
1. Start from the cheapest bridge AC – cost 6.
2. Then we choose the second cheapest bridge – BD (7).
3. The third cheapest bridge is CE (8).

4. Next cheapest bridge cost 9. However if we build it, we get a circuit AECA. It means that we do not need this bridge at all – we can reach islands A, C, and E without building thebridge AE.
5. The fourth bridge to build is CD (10).
6. Next bridge which cost AB (11) is a circuit again: ABDCA
7. In similar way the bridge BE (12) makes circuit: ACDBEA
8. The fifth bridge that we need to build is BF (13).

Now we have all six islands connected, and it is a cheapest way to build the five connection bridges: in each step we have chose the cheapest possible bridge.

21. Overlapping villages

As years went by, the villages of Cabbageville, Strawberrton and Carrotford grew and started to overlap. Whenever a new house is built, the villagers use the following rule to decide which village the house is assigned to:
The new house belongs to the village assigned most often among the X nearest houses. Ties are broken by assigning the new house to the same village as its nearest neighbor.
Now, two new houses are built and assigned to villages using the same value of X. House 1 is built and assigned before House 2.



Question / Challenge

What is the smallest value of X so that House 2 is assigned to Strawberrton?

Answer Options / Interactivity Description

Integer numbers from 1 to 8.

Answer Explanation

The correct answer is 5.

If X=1, both House 1 and House 2 are assigned to Carrotford.

If X=2, House 1 is still assigned to Carrotford, since the nearest of its two neighbors is from Carrotford. House 2 is also assigned to Carrotford, since its nearest neighbors are both from Carrotford.

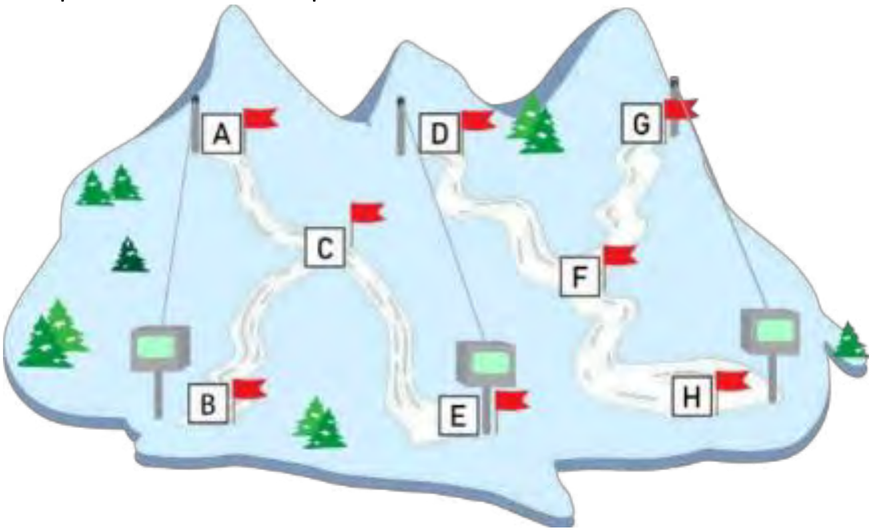
If X=3, House 1 is assigned to Cabbageville, since two of its neighbors are from Cabbageville. House 2 is assigned to Carrotford, since its neighbors are all different, but the nearest one is from Carrotford.

If X=4, House 1 is assigned to Carrotford, since it has two neighbors from Cabbageville and two from Carrotford, and the nearest one is from Carrotford. Hence House 2 also is assigned to Carrotford, since it has two Carrotford neighbors and two Strawberrton neighbors, but the nearest one is from Carrotford.

If X=5, House 1 is assigned to Carrotford, similar to when X=4, and House 2 is assigned to Strawberrton, since three out of its five neighbors are from Strawberrton.
When X=6 or X=7, House 2 is also assigned to Strawberrton, but these are not the smallest values of X for which this happens.

22. Ski Trail Map

The picture shows a map of ski trails and ski lifts in a ski resort:



Skiers use only ski lifts to go uphill and they ski downhill only on the official ski trails. There are 6 ski trails at the ski resort: A-C, C-B, C-E, D-F, F-H, and G-F.
A skier made a bet with his friend that he can find a way to use all the ski lifts and ski downhill on all the ski trails exactly once.

Question / Challenge

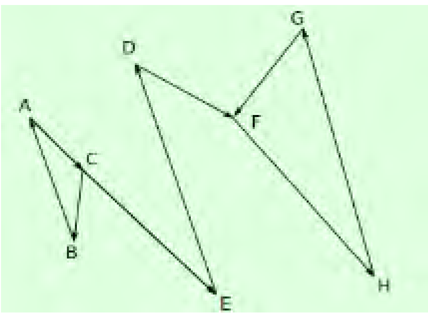
From which location must the skier start to do so?

Answer Options / Interactivity Description

Open-answer tasks: character (A, B, C, D, E, F, G, or H)
Alternative: use multiple-choice question with options A, B, C, D, E, F, G, H
Alternative 2: there is also an interactive version of the task (2022-ME-05a)

Answer Explanation

The correct answer is C.
In order to go down all the ski trails exactly once and use each ski lift exactly once, the skier should pass the locations in this order: C, B, A, C, E, D, F, H, G, F.
The following picture represents the ski lifts and ski trails and the direction the skier can travel on them:

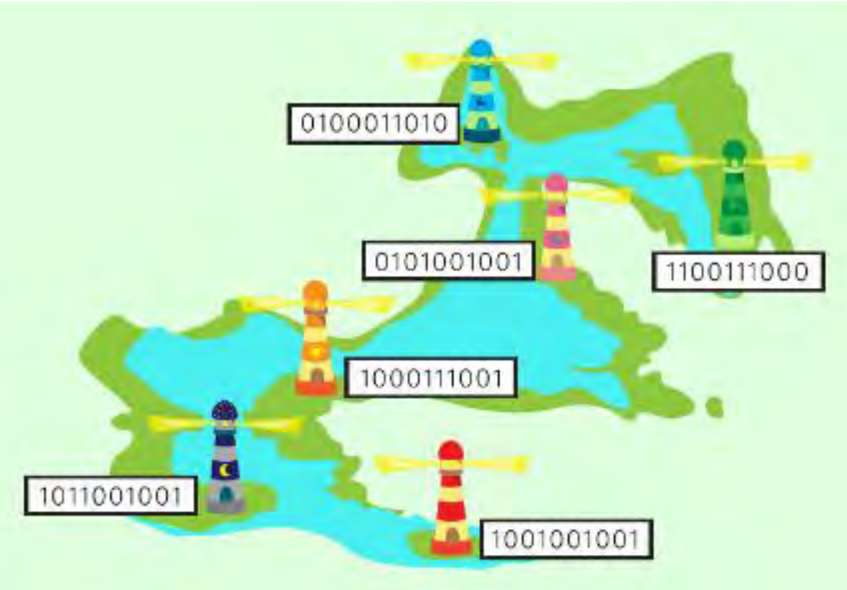


There is only one path to and from each location on the picture, except for C and F. At location C there are two paths out (to B and E), while at location F there are two paths in (from D and G).
As a skier cannot ski from location F to location D and from location F to location G (because he would have to go uphill by the ski trails), location F is not the right solution.

Location C remains the only possible solution. Following the arrows from C, you can trace the path through all the arrows in the picture, which means C is a correct answer.

23. The Bay of Beavers Programmers

In the Bay of Beavers Programmers, the lights on each lighthouse are turned on and off in a unique way. Each lighthouse has it‘s own unike code describing the way in which it turns on and off the light, so that sailors can easily determine which lighthouse they are observing.



For example, if a lighthouse has code "1011001001" it describes that during the first 10 seconds of working, each second the light turns on and off as follows:
on, off, on, on, off, off, on, off, off, on.
Every 10 seconds, the light on the lighthouse turns on and off in the same way.

Question / Challenge

If all lighthouses start working at the same time, in which second will all the lighthouses light up together for the first time?
Input one number.

Answer Options / Interactivity Description

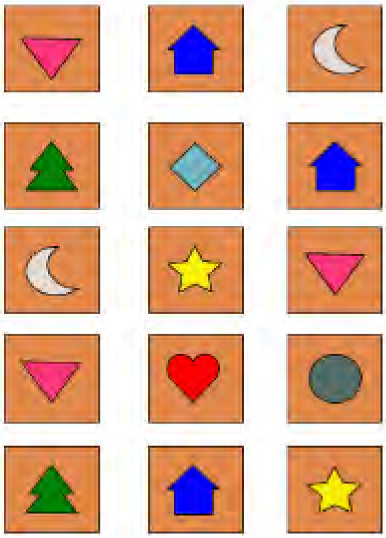
Open-answer task: one Integer number

Answer Explanation

The answer is 7.
If we write the lighthouse‘s codes one below the other, it will be easy to notice that in all the codes there will be a "1" ("1" determines that the light will be on) in the seventh second (read digits from left to right):
010001**1**010
010100**1**001
110011**1**000
100011**1**001
101100**1**001
100100**1**001

24. Treasure box

Maria found a box containing hidden treasure, but the box was locked. To unlock the box, she needs to use the correct combination of three shapes. Help Maria unlock the box by following the given hints on the right of the combinations shown below.

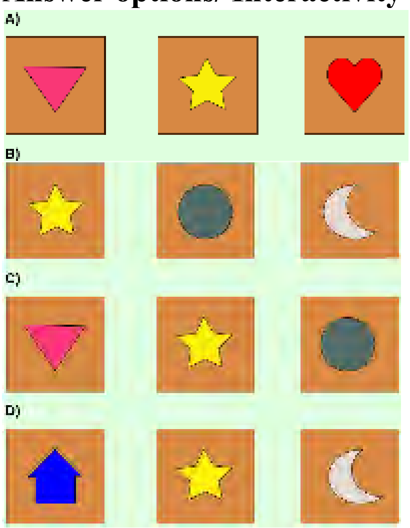


1. One shape is correct and well-placed.
2. Nothing is correct.
3. Two shapes are correct but in the wrong place.
4 . One shape is correct but in the wrong place.
5. One shape is correct but in the wrong place.

Question / Challenge

Which of the following combinations will unlock the treasure box?

Answer options/ Interactivity Description

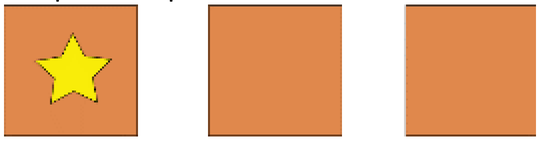


Answer Explanation

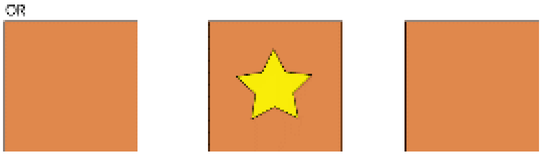
The correct answer is B).

We will start by eliminating the shapes that do not fit into the combination that unlocks the box. In
the second row of the manual of hints we see that nothing belongs in our combination, which means
that the Christmas tree , diamond and arrow do not lead to unlocking of the box.

In the last row of the manual of hints we see that one shape is correct but placed incorrectly. We have previously concluded that the Christmas tree and the arrow are not used, so the shape we need
is a star , but it is placed incorrectly.
The possible positions of the star are as follows.



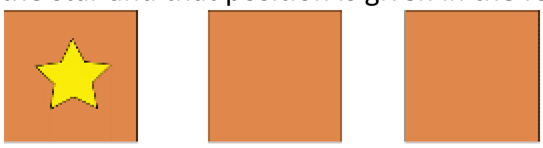
OR



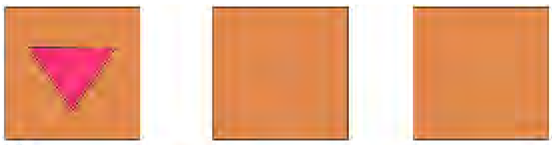
We can continue to find the other two shapes. From the first row we see that one form is correct and in the right place, we reject the arrow because it does not belong to the final combination, so it follows that one of these combinations is correct.

OR

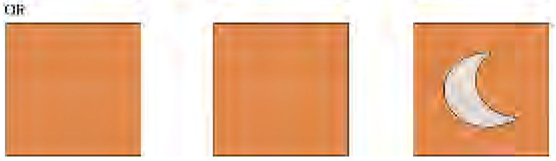
From the third row we see that two shapes are correct, but wrong placed. We definitely need the star but its position is not in the middle, so now we have definitely found the position of the star and that position is given in the following picture:



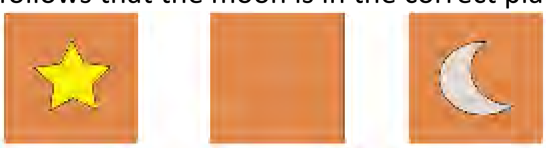
We found one shape and its appropriate place. We continue to find the remaining two shapes.
From the first row we had



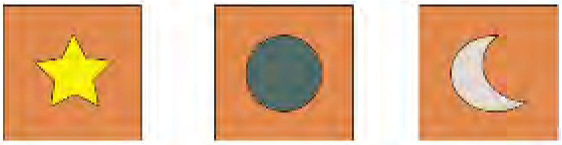
OR



Since we found the star to be in the first position, the triangle can't be in the first position so it follows that the moon is in the correct place. So far we have



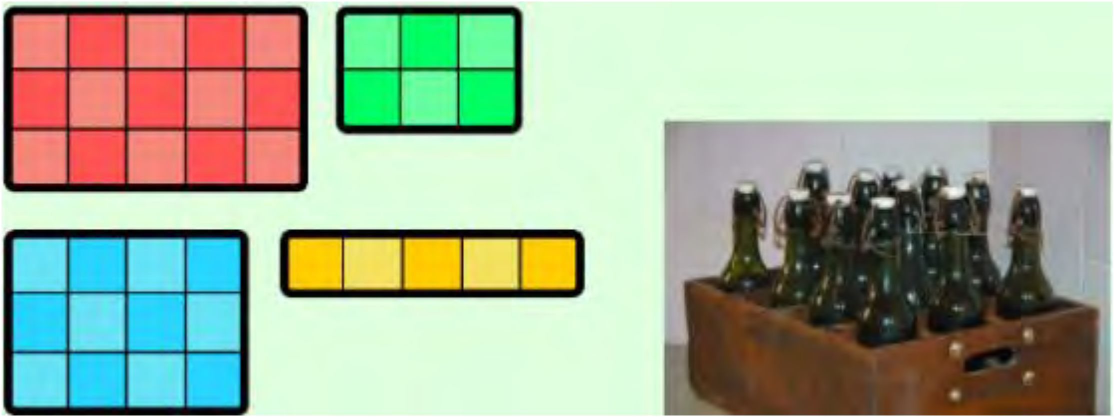
From the fourth row we see that one shape is correct, but incorrectly placed, the triangle is out and the only place left is the middle place. The heart can’t be correct because it is in the middle place, it follows that the circle should stand in the middle.



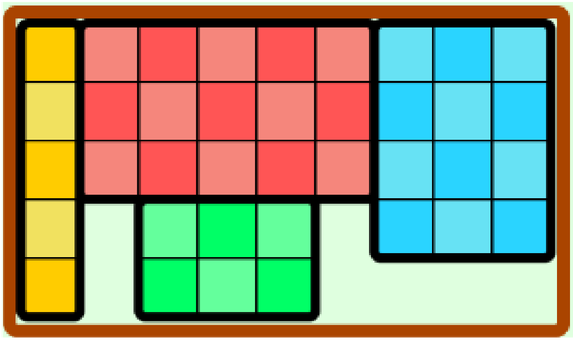
There are other possible ways to determine the answer other than the explanation above. All these
different ways will still lead to the correct answer, B.

25. A gift for the president

A factory produces 4 types of beer. For each type they use a special crate of a different size. We see these crates from above in the picture. Observe that the biggest crate contains 15 bottles.



(The photo on the right shows what a crate for 12 bottles would look like from the side.) You have to prepare a special gift for the president containing one crate of each flavor. These four crates have to be placed in a rectangular container. Crates cannot be stacked on top of each other and we want to leave as few gaps as possible (which we then will fill with single bottles). For example, if we use the container below, we have to add 7 single bottles for the container to be full.



Question / Challenge

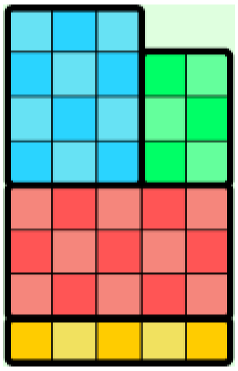
In a rectangular container that holds the four gift crates with as few gaps as possible, how many single bottles need to be added for this container to be full?

Answer Options / Interactivity Description

Integer number

Answer Explanation

The correct answer is 2. Here is a possible arrangement of crates that achieves this.



The number of bottles in all 4 crates put together is 12 + 15 + 6 + 5 = 38. A container that holds 38 bottles with 0 gaps must have dimensions 1 x 38 or 2 x 19. You will never be able to fit the 3 x 5 crate (or the 3 x 4 crate) in this container.

A container with 1 gap would hold 39 bottles. There are two possibilities, 1 x 39 (not possible) or 3 x 13. The two largest crates would take up 9 rows within such a container. The remaining 4 rows are not enough to place the smallest crate of size 1 x 5.

Hence 2 gaps is the minimum we can have in any container, and we can achieve this as shown above.

26. Tortoise and Hare

A tortoise and a hare are trying to race against each other in the track shown below:
They both start at the same time in the field with a heart in it and they follow the direction of the arrows on the track. The tortoise moves one field every minute. The hare moves two fields every minute.

Question / Challenge

What is in the field where the tortoise and the hare meet for the first time after the start?

Answer Options / Interactivity Description

A. 

B. 

C. 

D. 

E. 

F. 

G. The tortoise and the hare will never meet

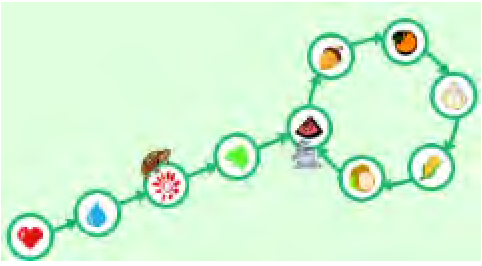
Answer Explanation

The correct answer is (C) .

The figures below show the locations of the tortoise and the hare after every minute:

After 1 minute

After 2 minutes



After 3 minutes

After 4 minutes

After 5 minutes

After 6 minutes

27. Robot Colors

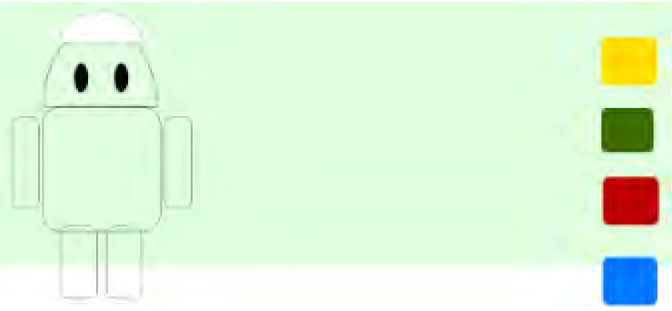
Taweeq has four robot friends. Each robot is painted using four colors: red, blue, green and yellow. Each robot has a unique color pattern. This means that there are never two robots with the same part painted in the same color.

Question / Challenge

Based on the first three robots, what will the fourth robot look like? Drag & drop each color on the body part you want to fill.

Answer Options / Interactivity Description

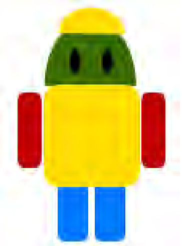
Students must drag & drop each color on the body part they want to fill.



First, the student chooses the box of color and then drags&drops it on the body part to fill.

Answer Explanation

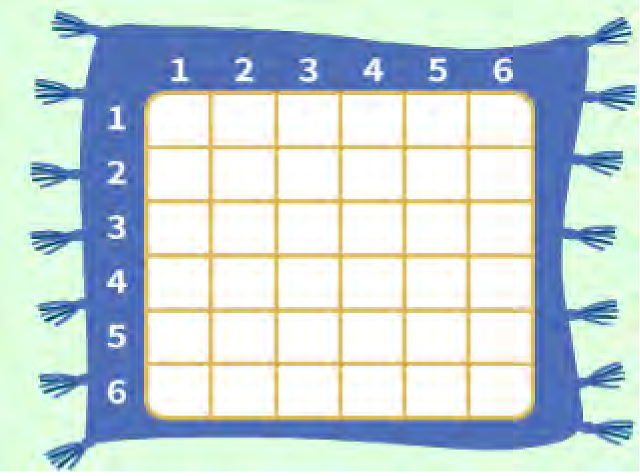
The correct answer is:



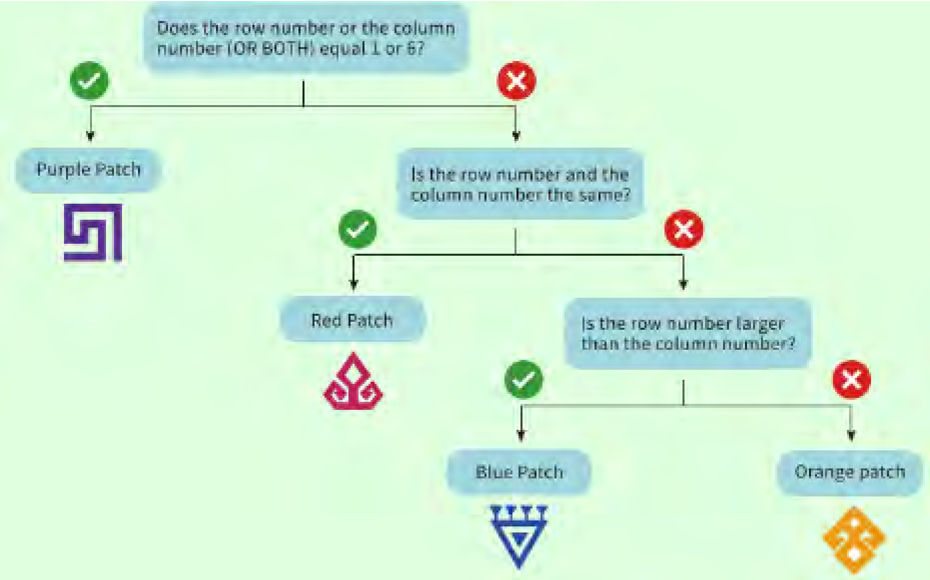
Let's start from the hat. The first three robots have green, red and blue hats respectively. The only remaining color that can be used to paint a hat is yellow. Similarly, to be different to all the others, the arms must be red, the face green, the body yellow and the legs blue.

28. Rug Weaving

Hale is a Turkish weaving artist. She is making a square rug with 6 rows and 6 columns.



Hale puts a symbol in each square on the grid of the rug using the following questions:



Question / Challenge

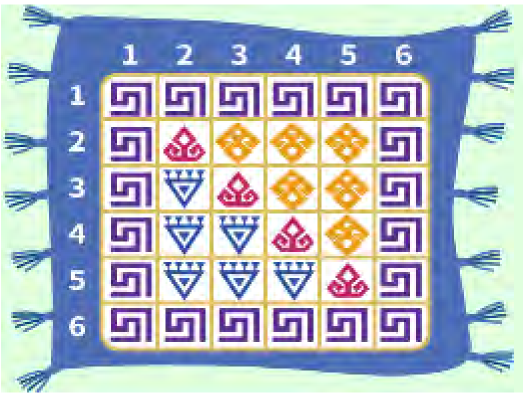
Using this method, what would the resulting rug look like?

Answer Options / Interactivity Description

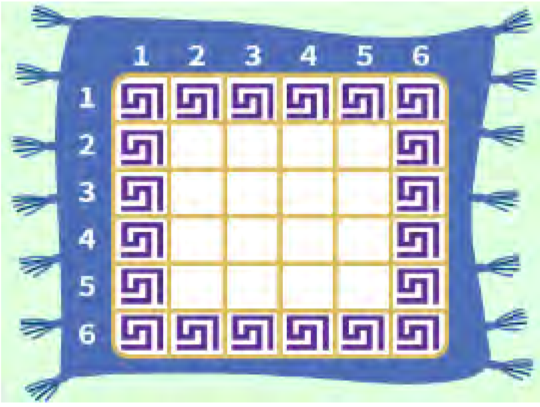
Interactive question where clicking on a square on the grid brings up the purple symbol, clicking again brings up the red symbol, clicking again brings up the blue symbol, clicking again brings up the yellow symbol, and clicking again changes the square to blank again.

Answer Explanation

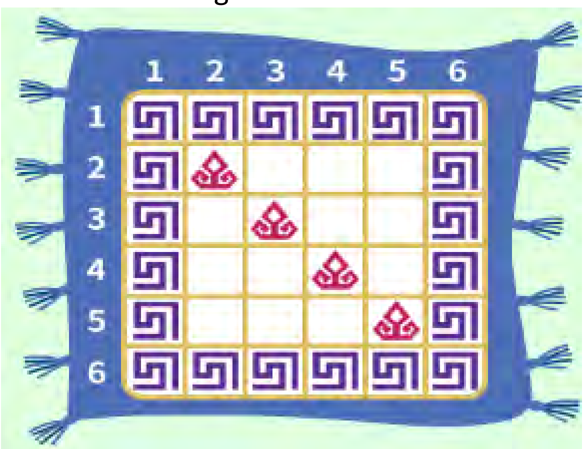
Correct answer



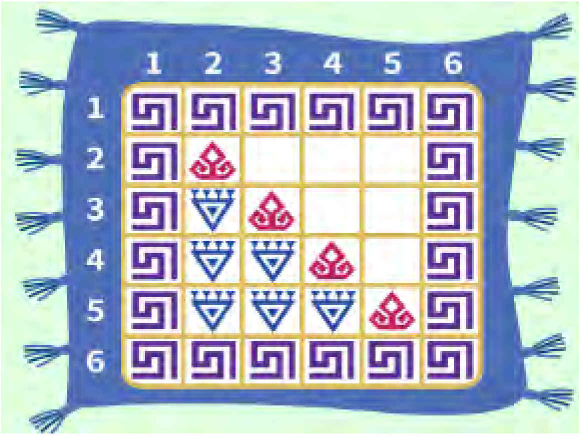
The first question that Hale asks indicates that the 1st and 6th rows as well as the 1st and 6th columns should have purple shapes. This gives the following symbol arrangement:



The second question leads to all squares on the diagonal of the rug having a red symbol, because on the diagonal the row and column numbers are the same:



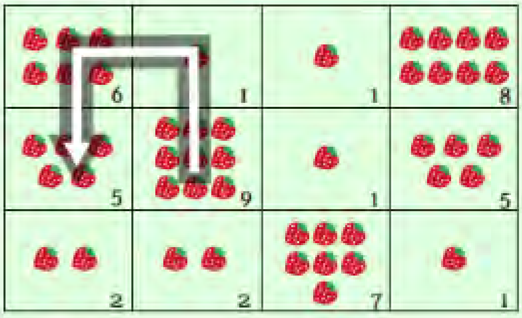
On the next layer of questions, we find that the row number is larger than the column number in all the squares to the left of the diagonal. In these places a blue symbol is placed:

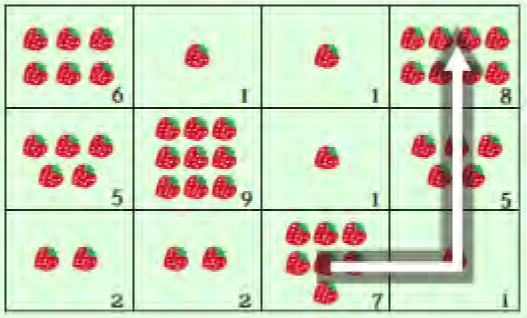


Finally, the remaining squares to the right of the diagonal all have row numbers that are NOT larger than the column numbers, hence they are filled in with yellow symbol.

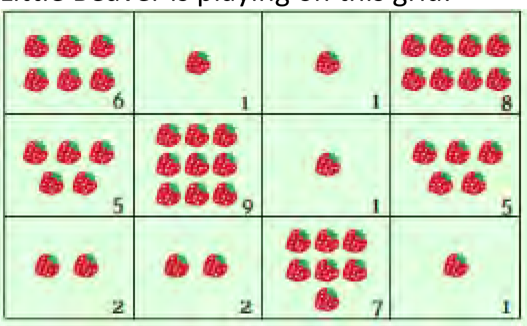
29. Strawberry

Beavers love to play "strawberry hunt"!
In this game, a different number of strawberries is put on each field of a grid.
A beaver can then start from any field and take 3 steps.
At each step, they can choose to go up, down, right, or left, to a neighboring field.
On the chosen path a beaver visits four fields and will eat all strawberries on these fields.
Here are two examples for the same grid:
Choosing the path on the left, a beaver will eat 9 + 1 + 6 + 5 = 21 strawberries.
Choosing the path on the right, the beaver will eat 7 + 1 + 5 + 8 = 21 strawberries as well.





Little Beaver is playing on this grid:



Question / Challenge
How many strawberries can Little Beaver eat at most?
Answer Options / Interactivity Description
Integer numbers from [1,48]; 48 is the overall number of strawberries on the grid.
Answer Explanation
The correct answer is 23.
Though there are 51 possible ways to finish the game (see table below), we don't have to check all 51 total sums of strawberries. Here is how.
We know that each player can reach 4 consecutive, adjacent fields. These 4 fields can only make the following shapes:

	uare	line	L shape	horizontal L shape	Z shape	vertical Z shape
possibilities	6	3	12	16	8	6

Now, we check these shapes including any of the fields with 9 or 8 strawberries (including all shapes with both of these fields). Since checking field combinations with 9 or 8 strawberries will also cover those fields with 5, 6 or 7 strawberries, all grids with larger numbers of strawberries will be covered. Then, we can find the largest total number of strawberries:

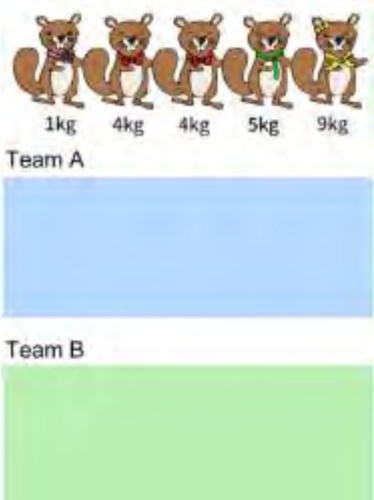
	Number of strawberries Little Beaver can eat on a path		
	including the field '9'	including the field '8'	largest of the two
square	9+5+6+1=21	8+5+1+1=15	21
line	5+9+1+5=20	6+1+1+8=16	20
L shape	7+2+9+1=19	8+5+1+7=21	21
Horizontal L shape	9+1+5+8=23	9+1+5+8=23	23
Z shape	5+9+2+7=23	8+1+1+9=19	23
Horizontal Z shape	6+5+9+2=22	8+5+1+7=21	22

Now, note that without the fields with 8 and 9, the maximum sum of strawberries on any other combination of four fields is 7 + 6 + 5 + 5 = 23. That is, also without fields 8 and 9, 23 cannot be exceeded. Therefore, Little Beaver can eat at most 23 strawberries.

30. Tug of war

Beaver School is having a tug-of-war competition. In order to have a fair competition, the school will divide all participating beavers into teams based on their weight. The goal is to have weight difference between these two teams to be as close as possible.
Take the following figure as an example: the weight difference between these two teams is only 1 kg.

Question / Challenge
Today five beavers sign up for the competition. Drag the beavers into the rectangles and divide them so that the weight difference between the two teams is as close as possible.



Answer Options / Interactivity Description
Interactivity Description: Each picture of a beaver (with its weight) can be dragged with the mouse. When we drop a beaver image over one of the rectangles, it is stays in that rectangle.
Answer Explanation
The correct answers are 4:

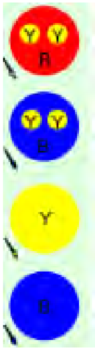
Team A: 1, 4, 5 (10 kg), Team B: 4, 9 (13 kg)
or swap teams
Team A: 4, 9 (13 kg), Team B: 1, 4, 5 (10 kg)

or
Team A: 4, 4, 5 (13 kg), Team B: 1, 9 (10 kg)
or swap teams
Team A: 1, 9 (10 kg), Team B: 4, 4, 5 (13 kg)
The total weight of all five beavers is 1+4+9+4+5=23. Ideally, the total weight of each team is exactly the same, which is half of A (11.5). However, each beaver's weight is an integer, the total weight of each team should also be an integer.
Under this constraint, the ideal total weight of one team is 11 and the other is 12.
Unfortunately, no combination of any of the five beavers are weighted 11 or 12 in total. We had to try making the weight of two teams to be 10 (11-1) and 13 (12+1).
In this case, the team of 10 kg can be (1, 4, 5) or (1, 9), and the other team can be (4, 9) or (4, 4, 5).

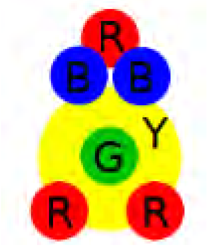
31. Filling green

Beavers use a palette with colors red (R), blue (B), yellow (Y) and green (G).

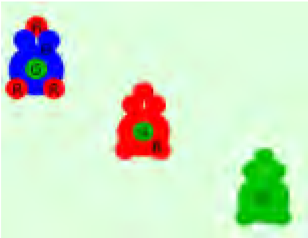
They can color any shape by selecting a color and then clicking inside the shape.
For example, beavers could color the „face" to the right in blue with these instructions:
1) Select blue color and fill the red part to get
2) Select yellow and fill the blue part to get
3) Select blue and fill the yellow part to get



Question / Challenge
Help the beavers fill the whole figure below in green by clicking on palette colors and then on parts of the figure you want to color. (palette and figure are interactive)

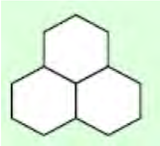


Can you do it by 3 fillings? (Beavers can!)
Answer Options / Interactivity Description
Interactivity description: click on palette colors to select one, and then – on parts of the figure to color it.
Answer Explanation
The initial drawing contains four colors. Only one color can be redrawn by a single filling. So the minimum number of steps is three.
1) Yellow to blue:
We got rid of the yellow color and got a single blue part.
2) Blue to red:
We got one a single red part.
3) Red to green:
We are done!



32. Colorful tower

Sam has hexagon puzzle pieces in three colors. When he places three pieces as shown, the three pieces must all be the same color or all different colors.



Question / Challenge

Sam places pieces in a tower shape as shown below. What must the top piece be?

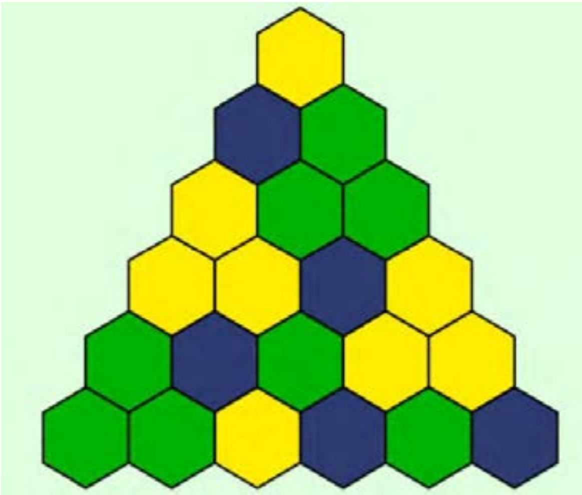
Answer Options / Interactivity Description

Answer Explanation

The correct answer is

When we know the colors of two pieces beside each other, we know what the color of the piece above them must be. For example, consider the bottom left unknown piece. Since the two pieces below it are green, it must also be green. On the other hand, the piece to its right must be blue because the two pieces below it are green and yellow.

We can use this idea to work from the bottom to the top of the tower. The result must be this:



Note that we can work in any order on each row of the tower.

33. Forest Observation

The forest rangers need to observe the types of animals that wander onto the paths. They watch the paths from tall observation towers. There is only room for one ranger in each observation
tower.

Question / Challenge

How many observation towers need to have a forest ranger in order to see all the paths

Answer Options / Interactivity Description

Interactive tasks: It is possible to click at an observation tower to put a ranger in it. Then all ways next to the tower are marked. If you click again on an observation tower, the ranger and the marked ways are removed.

Answer Explanation

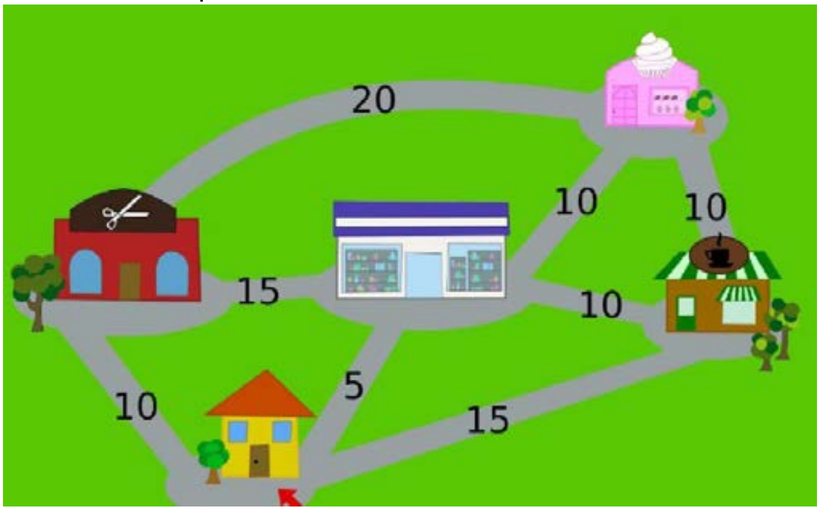
The correct answer is 3.

The three occupied observation towers and the respective overseen paths are shown in the image.

There are 8 ways. If there were just two observation towers occupied, one would have to observe at least 4 ways. This is not possible, because no observation tower is next to 4 ways.

34. Downtown

Beaver Ben has to do some shopping. The numbers on the roads show how long Ben needs to walk from one place to another. He starts and ends at his home, marked with the red arrow.



Question / Challenge

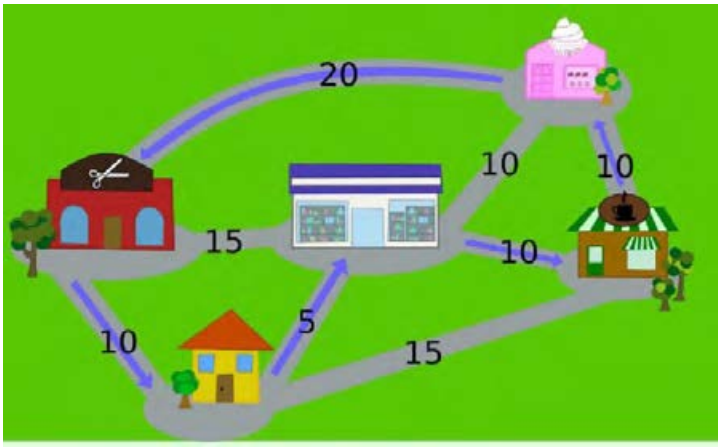
What is the shortest amount of time Ben needs to visit all four shops and come back home?

Answer Options / Interactivity Description

Integer numbers from [0, 100]

Answer Explanation

The correct answer is 55. There are two shortest ways for Ben. One shortest way is as follows: home to grocery to cafe to cake shop to barbershop to home. This is shown in the picture below.



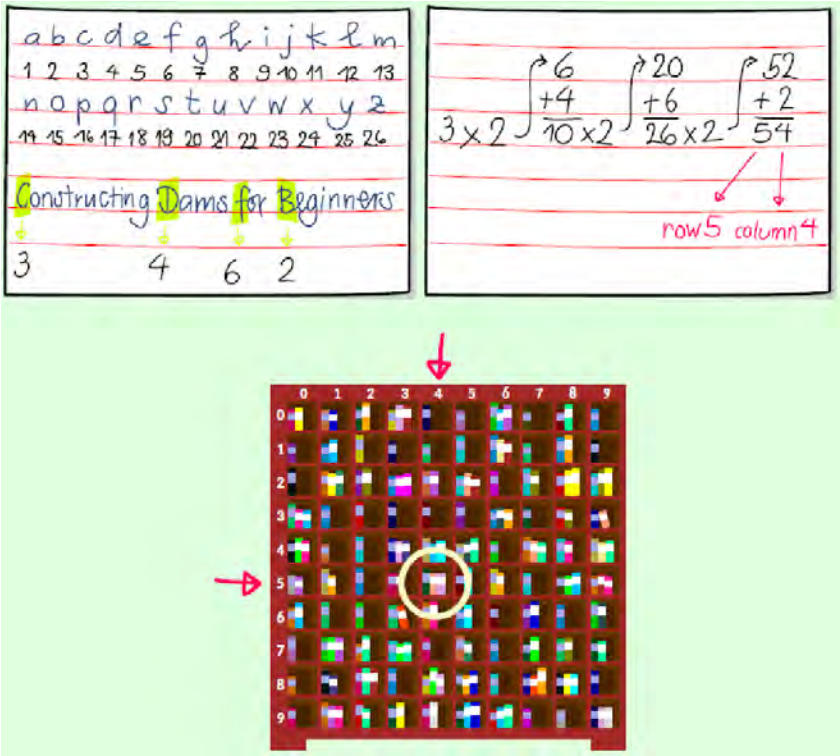
We get another way by following all the arrows along the opposite direction: home to barbershop to cake shop to cafe to grocery to home.

To answer the question quickly, we can simplify the map. Ben can ignore the road between the barbershop and the grocery, because it is just as fast to go from barbershop to home to grocery, or the other way around. Ben can also ignore the road between home and the cafe, because it is just as fast to go from home to grocery to cafe, or the other way around.

After the map is simplified, it is easy to see what the shortest way must be.

35. #Book

Tim accompanies his older sister Sue to the Bebras Public Library. The library only has one huge shelf. They want to borrow the book "Constructing Dams for Beginners".
When they arrived Sue goes straight to the bookshelf and pulls out the correct book. "How did you know where the book was", Tim asked surprised. Sue smiled and showed him two pieces of paper:



"I took the first letters of each word in the title and converted them into a number using the table. Then I multiplied the number of the first letter by 2 and added the number of the second letter. I then multiplied the result by 2 and added the number of the third letter. Finally I multiplied that result by 2 once more and added the number of the last letter. I looked in the row of the second-to-last digit and in the column of the last digit for the book. It was very easy to find the correct book from the three books that are there," explained Sue.
"But what about numbers greater than 99," asked Tim. Sue replied: "I just ignore all digits except for the last two."

Question / Challenge

Construct an expression that will calculate the bay in which you can find the book "How to Avoid Falling Trees".

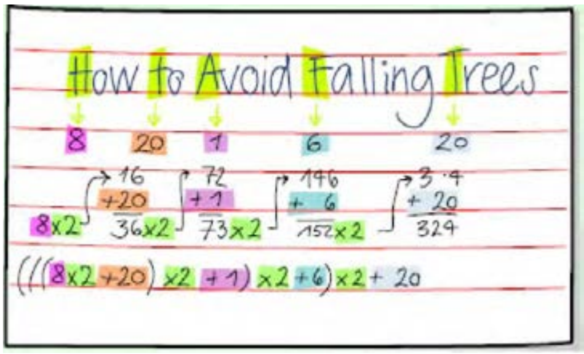
Answer Options / Interactivity Description

Present the student with a calculator-like interface with the controls "0", …, "9", "+", "(…)×2", and " " that will automatically construct an expression; "(…)×2" will automatically ☒ add a set of parenthesis around the already calculated expression (to avoid any issues with parenthesis).
The result of the expression should automatically be calculated and the corresponding row and column will automatically be read out of the expression. It would even be possible to avoid the "+" sign if for the first number the "0" to "9" are just "0" to "9" and once the

"(…)×2" has been hit it changes to "+0" to "+9" and after the first digit back to "0" to "9". That way every expression is syntactically correct and only multiplications by 2 can happen.

Answer Explanation

The correct answer is "(((8×2+20)×2+1)×2+6)×2+20" resulting in the number 324 which shows that the book must be in row 2 and column 4. The following piece of paper shows the translation of the term to be calculated:



36. Ada's Marble Machine

Ada the engineer has been asked to create a sorting machine to sort marbles. She is given a table of possible marble designs:

Size	Colour	Material	Design
Small	Red	Stone	Glitter
Small	Red	Stone	Mosaic
Small	Red	Metal	Glitter
Small	Red	Metal	Mosaic
Small	Yellow	Stone	Glitter
Small	Yellow	Stone	Mosaic
Small	Yellow	Metal	Glitter
Small	Yellow	Metal	Mosaic
Large	Red	Stone	Glitter
Large	Red	Stone	Mosaic
Large	Red	Metal	Glitter
Large	Red	Metal	Mosaic
Large	Yellow	Stone	Glitter
Large	Yellow	Stone	Mosaic
Large	Yellow	Metal	Glitter
Large	Yellow	Metal	Mosaic

Ada knows the following restrictions on the marble designs:
1. marbles made of metal cannot be large-sized
2. marbles made of stone cannot be red
3. the glitter decoration cannot be applied to large marbles
4. the mosaic decoration cannot be applied to red marbles

Question / Challenge
Which marble designs in the table are allowed by the restrictions?

Answer Options / Interactivity Description
Click on table lines with allowed designs to mark them.

Answer Explanation
Applying the restrictions one by one, we can eliminate forbidden combinations, leaving us with only six possible outcomes:

Size	Colour	Material	Design	Possible?	Restriction from list
Small	Red	Stone	Glitter	No	2
Small	Red	Stone	Mosaic	No	2, 4
Small	Red	Metal	Glitter	Yes	
Small	Red	Metal	Mosaic	No	4
Small	Yellow	Stone	Glitter	Yes	
Small	Yellow	Stone	Mosaic	Yes	
Small	Yellow	Metal	Glitter	Yes	
Small	Yellow	Metal	Mosaic	Yes	
Large	Red	Stone	Glitter	No	2, 3
Large	Red	Stone	Mosaic	No	2, 4
Large	Red	Metal	Glitter	No	1, 3
Large	Red	Metal	Mosaic	No	1, 4
Large	Yellow	Stone	Glitter	No	3
Large	Yellow	Stone	Mosaic	Yes	
Large	Yellow	Metal	Glitter	No	1, 3
Large	Yellow	Metal	Mosaic	No	1

37. Wrestling Holds

John Beava is training to become a professional wrestler. He knows that during a match, he can be in the ring in any of the six different positions listed below:

- Lying (P1)
- Standing (P2)
- Running (P3)
- Against the ropes (P4)
- In the corner (P5)
- Top Rope (P6)

His wrestling trainer can teach him a set of moves, and each move has a list of positions that it can be performed from. John wants to make sure that he learns a move for every position, but wants to learn the fewest number of moves possible, to make sure that he has more time to practice each one. The moves that his trainer can teach him and the positions they can be used from are as follows:

M1. Crossbody – Running, Top Rope (P3, P6)
M2. Suplex – Standing, Top Rope (P2, P6)
M3. Clothesline – Standing, Running, Top Rope, Against the ropes (P2, P3, P4, P6)
M4. Back Elbow – Standing, In the corner, Against the ropes (P2, P4, P5)
M5. Armbar – Standing, Lying (P1, P2)
M6. Running Splash – Running (P3)

Question / Challenge
What is the minimum number of moves John needs to learn to make sure that he can perform a move from any position?
Answer Options / Interactivity Description
There are several ways to achieve this with only 3 moves.
One possible way to attempt this question is to find the move that covers the largest number of remaining positions possible. In this case, Clothesline (M3) will cover 4 positions – Standing, Running, Top Rope and Against the ropes (P2, P3, P4, P6). This leaves us with 2 positions left to be covered – Lying (P1) and In the Corner (P5). There are no moves that will cover more than one of the remaining positions, so we need to select Armbar (M5) and Back Elbow (M4). Thus, 3 moves (M3, M4, and M5) covers all positions (P1, P2, P3, P4, P5, and P6) We found an answer with 3 moves. Because the minimum number of moves is sought, we must argue that

it is not possible to have an answer with two moves. This is because if we take any pairs of moves, that pair will not cover all 6 position. For a pair containing in total less than 6 positions (e.g. for pair of M1 and M2) this is obvious. And for other pairs, this is easy to check.

38. Party Foul

Corey Beaverton is having a party this weekend. He would like to meet new people. The party invitation includes an instruction to make four identical copies of the invitation and send them to four more people. Corey sends out the first round of invitations to four of his friends. (Each new group of invitations that goes out is considered a round). Each beaver sends out exactly 4 invitations as instructed.
Corey forgets to put a limit on how many people can be invited in total.

Question / Challenge

Assuming that no beaver is invited more than once, how many rounds of invitations have to be sent out at most for 500 beavers in total to be invited to Corey's party? Give your answer as an integer.

Answer Options / Interactivity Description

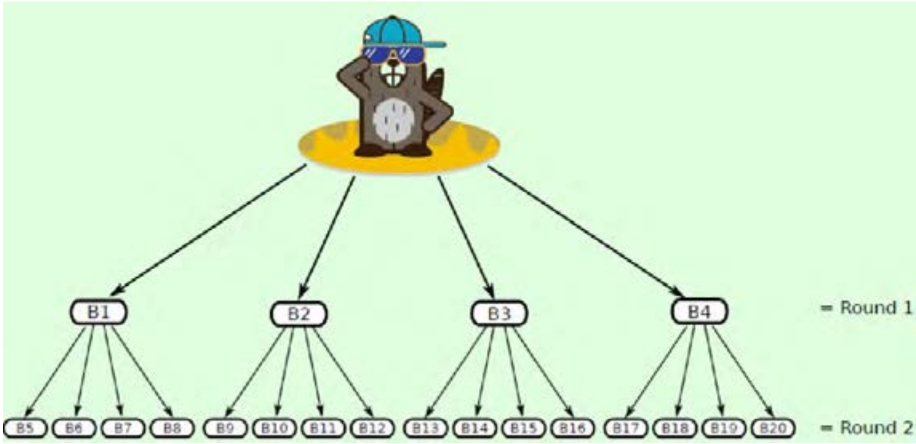
Open Integer

Answer Explanation

The correct answer is 5.
In the table below, the number of new beavers invited to the party is shown for each round, along with the total number of beavers invited.

Invitation Round	New Beavers Invited	Total Beavers Invited
1	4	4
2	16	20
3	64	84
4	256	340
5	1024	1364
6	4096	5460

In the first round (R1), Corey sends out 4 invitations inviting beaver 1, 2, 3 and 4 (B1 to B4). See the illustration below. After the first round, 4 beavers (not including Corey) are invited to the party.
1 x 4 = 4
[Corey x 4 invitations = newly invited beavers]
During the second round (R2) each of the four beavers sent out four more invitations, inviting 16 new beavers (B5 to B20), making a total of 20 beavers invited. See calculation below.
4 x 4 = 16
[Invited beavers from R1 x 4 invitations = newly invited beavers]
16 + 4 = 20
[newly invited beavers + Invited beavers from R1 = total beavers invited in R2]

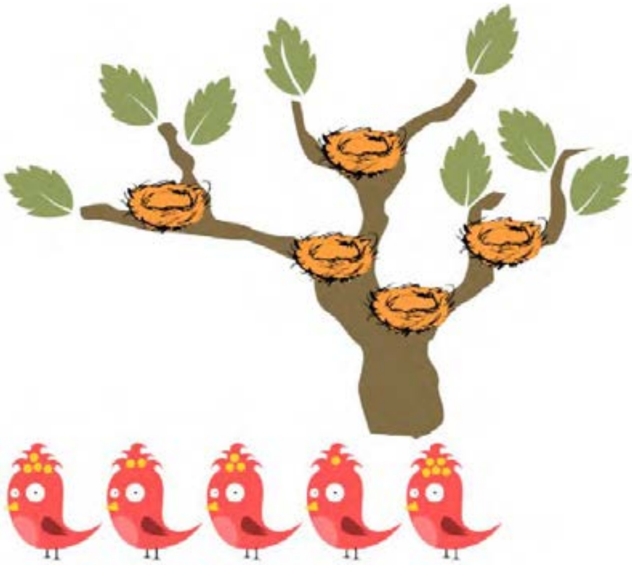


In the third round (R3), the 16 beavers invited in the second round invited another 64 beavers, making the total invited beavers 84. The third round includes beavers 21 to 84.
16 x 4 = 64
[Invited beavers from R2 x 4 invitations = newly invited beavers]
64 + 20 = 84
[newly invited beavers + Invited beavers from R2 = total beavers invited in R3]
In the fourth round (R4), those 64 beavers invite a further 256 beavers, making the total beavers invited, 340. The 265 beavers sent out invitations to beaver 85 to 340.
64 x 4 = 256
[Invited beavers from R3 x 4 invitations = newly invited beavers]
256 + 84 = 340
newly invited beavers + Invited beavers from R3 = total beavers invited in R4]
The fifth round (R5) sees the 256 beavers invited in R4 send out invitations to a further 1024 beavers. This round includes beaver number 341 to 1364. Therefore 500 beavers would have been reached after sending out the fifth round of invitations.
256 x 4 = 1024
[Invited beavers from R4 x 4 invitations = newly invited beavers]
1024 + 340 = 1364
[newly invited beavers + Invited beavers from R4 = total beavers invited in R5]

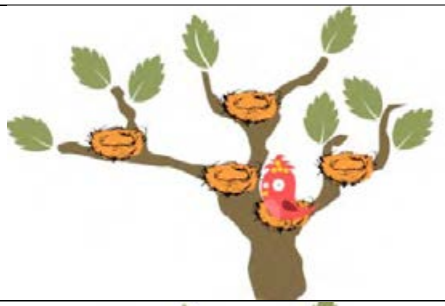
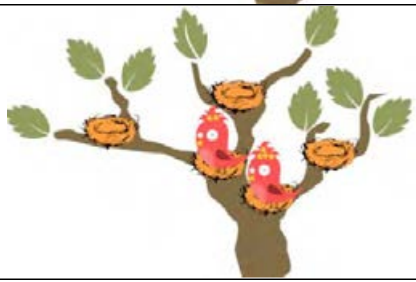
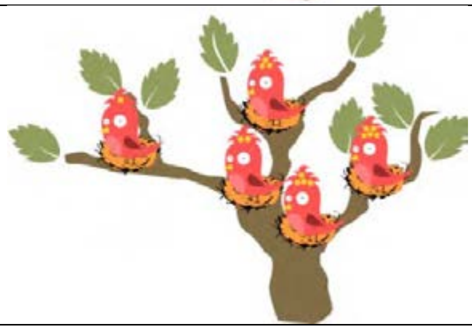
39. Cuckoo Birds

Spotted cuckoo birds don't build nests. Instead, they move into empty nests.
When a spotted cuckoo bird finds a tree with empty nests, it moves into a nest as follows:
It starts at the bottom of the tree. It repeats the following steps until it finds an empty nest:
1. It goes up until it finds a nest.
2. If the nest is empty, it moves into the nest. Done.
3. If the nest is occupied, the bird looks at the other cuckoo bird in the nest: if the other bird
   has more spots, the bird continues to the left.
   has the same number or fewer spots, the bird continues to the right.

There is a tree with five empty nests, and there are five cuckoo birds.
The birds move into the empty nests in the order from left to right; the bird with four spots is the first.

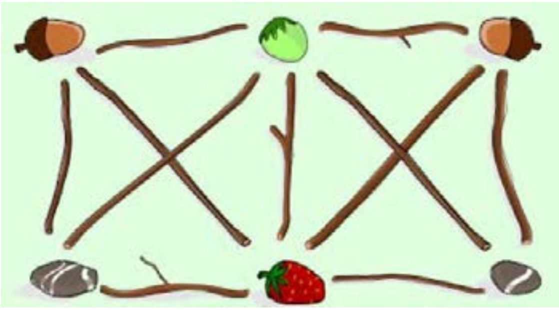


Question / Challenge
Drag each bird into the right nest.
Answer Options / Interactivity Description
A bird can be dragged from its initial position in the "bird row" into an empty nest.
From a nest, a bird can be dragged back either (a) to its initial position in the bird row only (not to any other (empty) position in the row, as the order in the row is crucial) or (b) into another empty nest.
Nice to have: Dragging a bird to an occupied nest makes the bird occupying the nest before going back to its initial position in the row. Throwing other birds out of their nests – that would be quite cuckoo-ish!
All situations with each bird in a nest can be submitted as solutions.
Answer Explanation
This way you get it right:

The first bird, with four spots, moves into the lowest nest.	
The second bird has two spots. The lowest nest is occupied by the first bird, with four spots. Since four is more than two, the second bird continues to the left and moves into the next empty nest.	
The third bird has three spots. Since four is more than three, at the lowest nest the bird continues to the left. The next nest is occupied by the second bird, with two spots. Since two is less than three, the bird continues to the right, and moves into the next empty nest – which is the highest nest.	
The fourth bird has one spot. Like the birds before, at the lowest nest, the bird continues to the left. At the next nest it must continue to the left, and moves into the next empty nest, at the very left.	
The last bird has five spots. It has to go right at the lowest nest and finds the next nest (at the very right) empty, where it moves in.	

40. Strawberry Thief

Anja is playing outdoors and makes a design on the ground using four types of objects: acorns, hazelnuts, pebbles, and strawberries. She then adds sticks to her design according to her Very Important Rule:
A stick can go between two objects only if the two objects are different types.
Here is Anja's completed design:



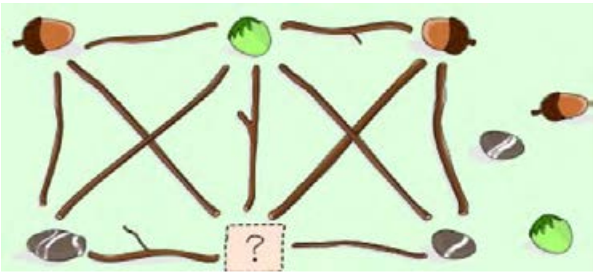
Anja's sister Zoë sees the design and eats the strawberry! To hide what she has done she replaces the strawberry with a different type of object. She also removes exactly one stick so that the Very Important Rule will not be broken.

Question / Challenge

Which object did Zoë replace the strawberry with and which stick did Zoë remove?

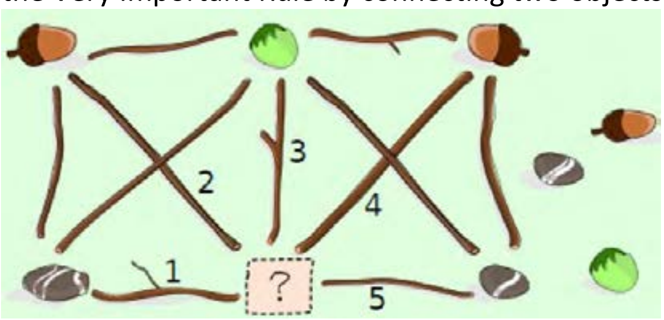
Answer Options / Interactivity Description

Interactivity description: There are two tasks for the student to complete. First, drag and drop an object onto the question mark to show which object Zoë replaces the strawberry with. Second, click on the stick that Zoë removes.



Answer Explanation

Zoë replaced the strawberry with a hazelnut and removed the stick labelled 3 since it violates the Very Important Rule by connecting two objects of the same type.



All other strawberry replacements would require Zoë to remove more than one stick.
If Zoë replaced the strawberry with an acorn she would have had to remove sticks 2 and 4.

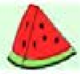
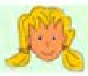
If Zoë replaced the strawberry with a stone she would have had to remove sticks 1 and 5.

41. Fruit Stack

A family of father, mother, daughter, and son prepares breakfast for the next day. They pile up four boxes in the fridge, each filled with a different fruit: Apple, banana, orange, water melon.

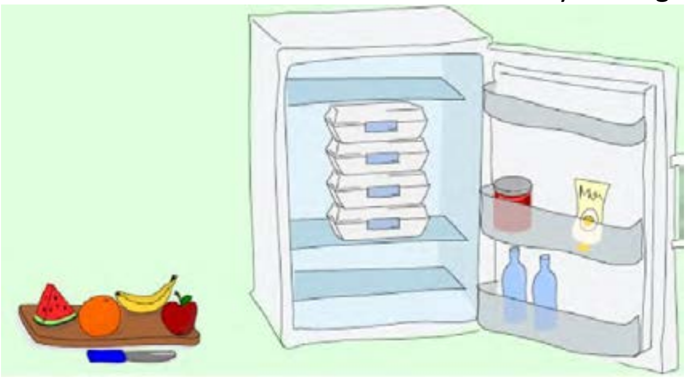
Being half asleep in the morning, everyone just grabs the topmost box right after getting up. They do not know in which exact order they will get up, but the mother always does so before the daughter, and the father is always last.

Nobody likes all fruits; here is the list of preferences:

				
	X	X	✓	X
	✓	X	✓	✓
	✓	✓	✓	X
	✓	✓	X	✓

Question / Challenge results can this machine produce?

Put the fruits into the boxes such that everyone is guaranteed to get a fruit they like.



Answer Options / Interactivity Description

Interactive implementation. Illustration with an open fridge and a pile of four empty boxes inside; the four different fruits on the side. You can either drag and drop the fruits into the boxes or first click a fruit and then a box to put it fruit into the box.

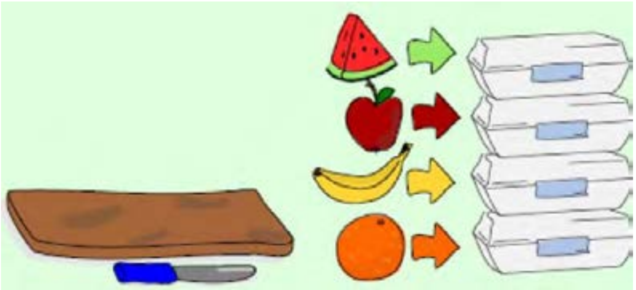
(The fruit can appear cut up when in the box.)

It is also possible to implement fruits being swapped out.

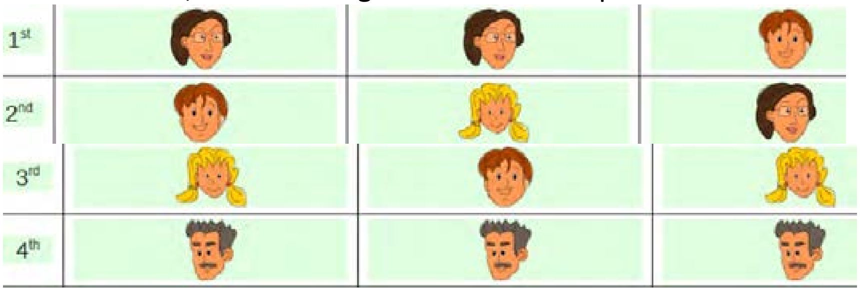
You can reset. You can submit your answer.

Answer Explanation

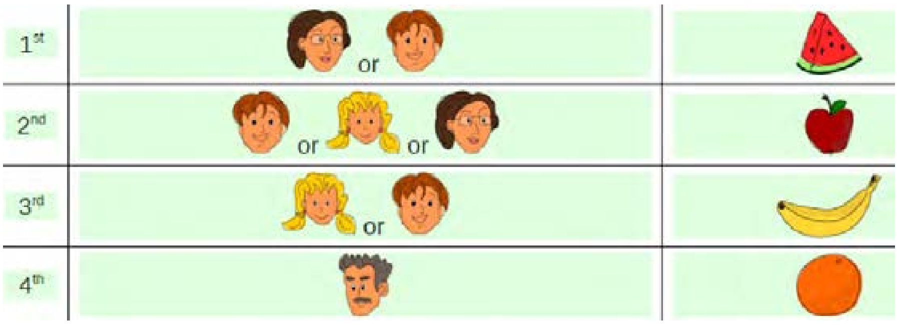
There is only one correct solution



We can see this as follows: We first look at what the father wants. He only likes oranges and is getting up last. Therefore, we need to put oranges into the box at the bottom.
Because the mother has eaten when the daughter gets up, the mother is either the first or the second one to take a box.
For same reason, the daughter is the second or third one to take a box. The son can be first, second, or third.
To summarize, the following three orders are possible:



We see that the second one to get up can be either the son, daughter, or mother. This means that we need to put into the second box from top something they all like.
The only option is apple, as we can see from the table of preferences. (Second row in the table below.) So we are left with two choices for the topmost box, banana and water melon - The mother does not like banana, therefore we have to put water melon into the first box, which the son also likes. (First row in the table below.)
We can now put banana into the third box, which son and daughter both like. (Third row in the table below.)
In summary, we had the following options for the order of the persons and the order of the fruits.



Co-funded by the European Union

42. April Fool

Beaver Tsuki has a pile of photos taken in 2020, each with the exact date on it. She asks her friend Luna to sort the pictures by month into 12 albums. Tsuki is of course expecting the usual order:

But it is April Fools’ Day, so Luna plays a prank and sorts the months alphabetically instead:

Question / Challenge

In which album will Tsuki find the pictures from January?

Answer Options / Interactivity Description

Dropdown with the number 1, 2, .., 12. (Or clickable albums, allowing to highlight exactly one.)

Answer Explanation

The complete arrangement of Luna looks as follows:

Thus the photos from January are found in album 5.

43. Chez Connie

Beavertown's favorite takeaway, Chez Connie, is about to open and lots of beavers are already waiting in line, impatient to order one of the three treats on the menu:

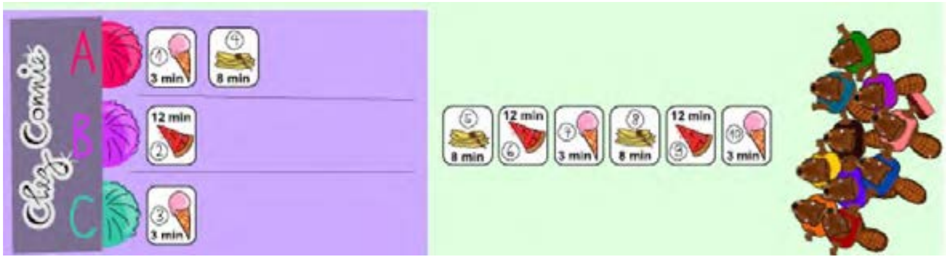
- ice cream, prepared 3 minutes;
- crêpe, prepared in 8 minutes;
- pizza, prepared in 12 minutes.

At the windows A, B, and C, every employee can prepare any of the treats. Connie wants to organize the orders, so that the clients get served quickly. She notes the incoming orders on numbered papers. This is her first order today:

Then Connie distributes the orders to the windows A, B, C. She always assigns the next order to the first available window in alphabetical order.

Question / Challenge

Connie has already distributed the first four orders. Can you distribute the next six orders?



Answer Options / Interactivity Description

The orders 5 to 10 are movable and can be dragged into the 3 rows in front of the windows. There is a reset-button to go back. Orders 1 to 4 stay fix.

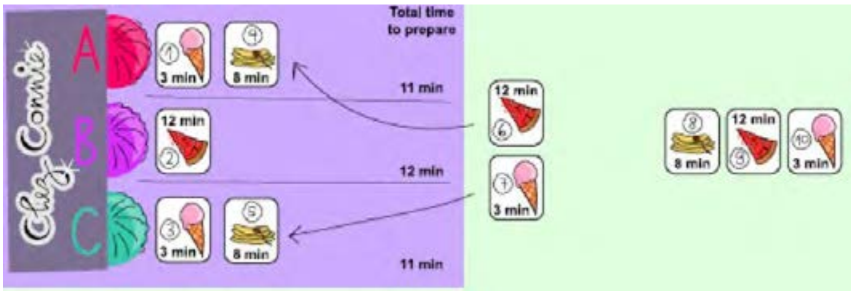
Answer Explanation

The correct solution is:

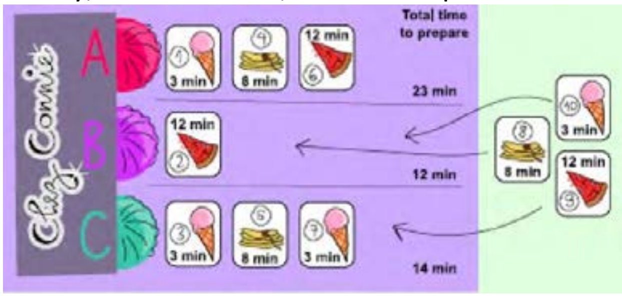
4

To distribute the orders to the different windows, Connie has to compare the total time to prepare the treats that are already ordered. At 3 minutes, windows A and C is free. Since she assigns the next order to the first available window in alphabetical order, she chooses for order 4 window A and for order 5 window C.

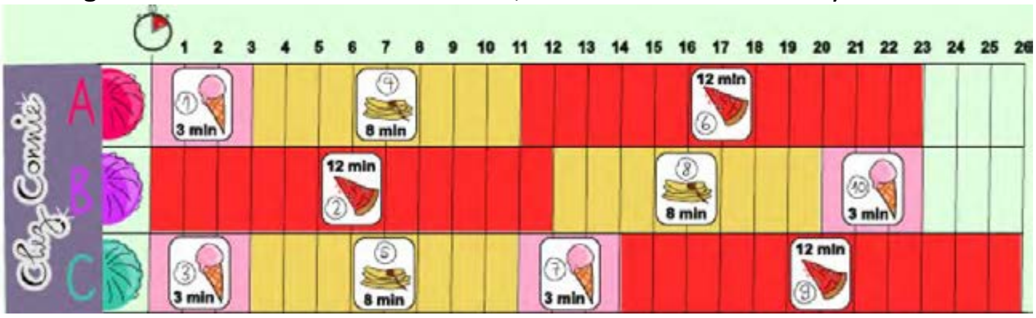
At 11 minutes, order 6 and 7 are distributed alphabetically to window A and C.



At 12 minutes, order 8 is placed at window B. At 14 minutes, order 9 is placed at window C. Finally, at 20 minutes, order 10 is placed at window B.



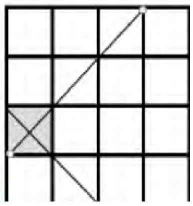
To have a better overview, Connie could use a table like this. It shows minute by minute, starting with the first minute on the left, which window was busy with which order.



44. New residents to Beaverland

Four new bebras families had applied for a construction license to the Bebrasland City Hall. The mayor allocated a square area to be given to the families. The area is divided into 16 equal numbered areas as is shown to the picture below.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16



The families can build their lodge inside an area but they must follow three rules.
Rule 1: There can be at most one lodge in each row of the area
Rule 2: There can be at most one lodge in each column of the area
Rule 3: There can be at most one lodge in each diagonal of the area – see the picture above for the definition of a diagonal.

Question / Challenge

Write the numbers of the areas, in an ascending order separated with space, where the largest number of bebras families can build their nests following Rules 1-3?

Answer Options / Interactivity Description

It is a nice task for interactive use of a backtracking method.
Question/Challenge (all 16 areas should be active for clicking): Click on a largest number of areas where bebras families can build their nests following Rules 1-3.

Answer Explanation

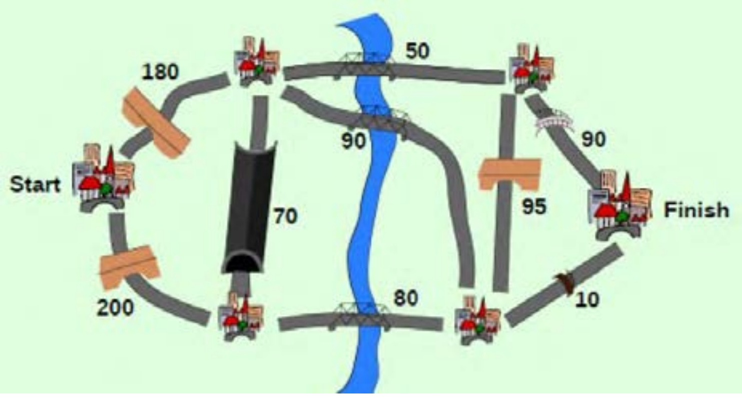
There are two solutions: 3 5 12 14 and 2 8 9 15, both with 4 places for bebras nests, as shown below:

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

45. Best Route

Trucks travel between cities on the highways shown below.



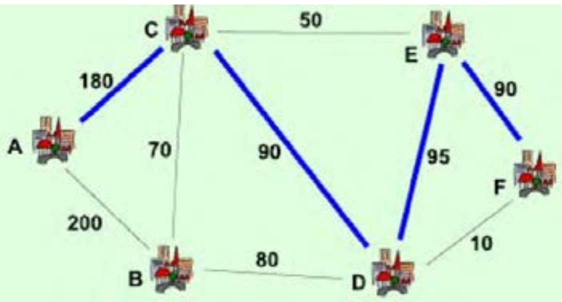
Bridges and tunnels limit how high trucks can be. Specifically, the label on each highway is the maximum height of a truck that can use the highway.
Question / Challenge
What is the maximum height of a truck that can be sent from Start to Finish?

Answer Options / Interactivity Description

Answer: 90

Answer Explanation

To get from Start to Finish, a truck must pass from the three leftmost cities to the three rightmost cities. Only three highways can be used to do this and the limits on these three highways are 50, 90 and 80. This tells us that a truck with a height greater than 90 cannot be sent from Start to Finish.



Is it possible for a truck with a height of 90 to be sent from Start to Finish. Yes! If a truck travels using the route shown below, then the height limits it will encounter will be 180, 90, 95 and 90. The smallest of these is 90. This means it is possible for a truck of height 90 to be sent from Start to Finish.
Another (longer) way to solve this problem is to carefully check all the possibilities either Starting from Start or working backwards from Finish.

Co-funded by the European Union

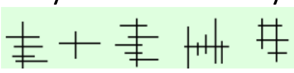
46. Secret Of The Diary

Petra and Jana have found the secret diary of their classmate Lucie. Unfortunately for them, Lucie has encrypted the text in her diary using horizontal and vertical lines with the help of the following table of letters:

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	R	S	T	U
V	W	X	Y	Z

The two girls notice that in the encrypted text there are many more than 25 different symbols.

They also successfully decrypt the symbols below to be the name of Lucie's brother, PAVEL:



Question / Challenge

Decrypt the name of Lucie's boyfriend, which is written in the diary using the following symbols:

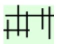
Answer Options / Interactivity Description

Write a word

Answer Explanation

The name of Lucie's boyfriend is JOSEF.

The horizontal and vertical lines found in the encrypted symbols have meaning. The number of horizontal lines corresponds with a row number in the table of letters. Similarly, the number of vertical lines corresponds with a column number. The letter found where the row and column meet is the letter encrypted by the symbol.

For example, the first symbol  has 2 horizontal lines and 5 vertical lines. The letter found where row 2 and column 5 meet is J.

Using this process for each remaining symbol, the name JOSEF can be decrypted.

47. Pyramid of coins

Emil has 6 coins.

He laid them on top of each other on the table and made a shape looking like pyramid out of them.

Question / Challenge

Which coin was the fourth one which Emil laid on the table? Click on the coin!

Answer Options / Interactivity Description

Interactive version:

The coins can be seen on the picture (pyramid) and they can be clicked, but can not be drug. The clicked object (coin) will be the answer.

Answer Explanation

Coins were laid in the order (pictures...)

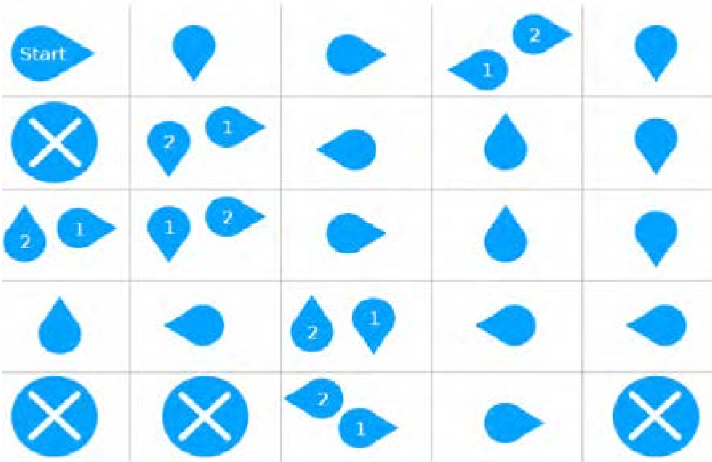
Each coins overlap at least one other, so you can start to find the solution from the last top laid coin. The last coin which is not overlapped by the others is .The coin not overlapped by any other than  is coin . And 4th laid coin must not be overlapped by any other than  and coins . This coin is .

48. Treasure Hunt

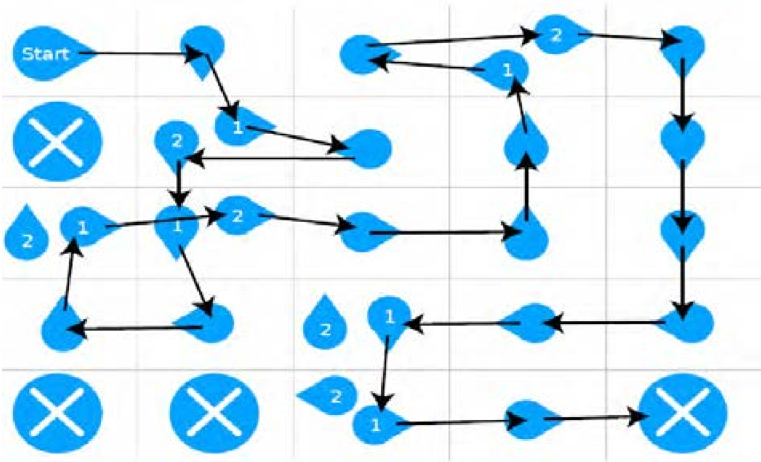
Your fellow pirates have found a map but can't quite figure out what it means. All they see are strange shapes. You are the smartest pirate on the ship, so they come to you for help. Can you solve the puzzle and show them the way to the treasure?
Analyzing the map very carefully, you found these instructions on the back of the map.

Symbol	Start		1	2
Meaning	Start here and follow the arrow to the next field	Continue to the next field in the direction of the arrow	When you reach this field for the first time, follow the direction of this arrow	When you reach this field for the second time, follow the direction of this arrow

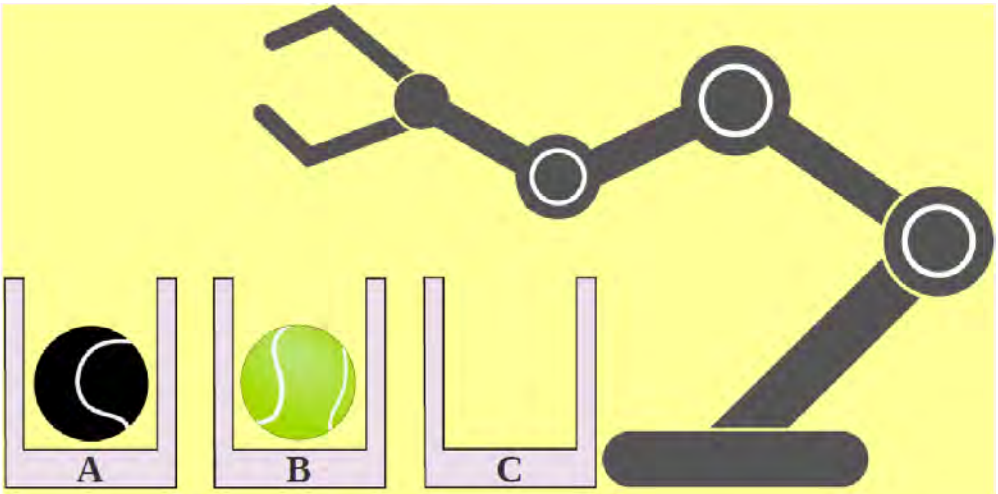
Question / Challenge
Solve the maze and click on the cirlce marked X where the treasure is hidden.



Answer Options / Interactivity Description
The circles marked "X" can be clicked-to-select. Clicking a selected circle de-selects it. Only one circle can be selected at a time: Clicking a circle when another one is selected, switches selection to the new circle.
Answer Explanation
The correct answer is the circle in the bottom-right corner.
The solution path is depicted below. Notice how the droplets with numbers influence the path you must take. Where there are fields with two droplets, you connect to ‘1’ when you enter a field the first time. You follow ‘2’ when you enter the field a second time. For this, you need to remember if you have already visited that field.


Start
1
2
1
2
1
1
2
2
2
1
2
1

49. Robot Arm



There are two balls: one in tray A, and another in tray B. Tray C is empty.
The robot arm follows these steps in order:
1. Pick up the ball in A and put it in C.
2. Pick up the ball in B and put it in A.
3. Pick up the ball in C and put it in B.

Question / Challenge

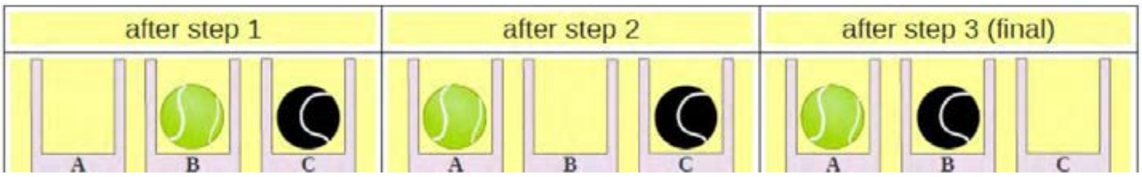
When the robot arm is finished, which of the following statements are true? You can check more than one.

Answer Options / Interactivity Description

A) The balls have swapped places.
B) There are two balls in tray A.
C) There are two balls in tray B.
D) Tray A is empty.
E) Tray C is empty.
F) Nothing has changed. Each ball is back in its place.

Answer Explanation

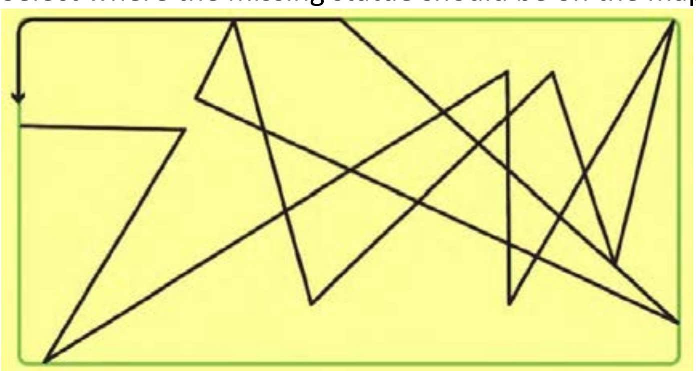
Answers A) and E) are correct. See the states after each execution step:



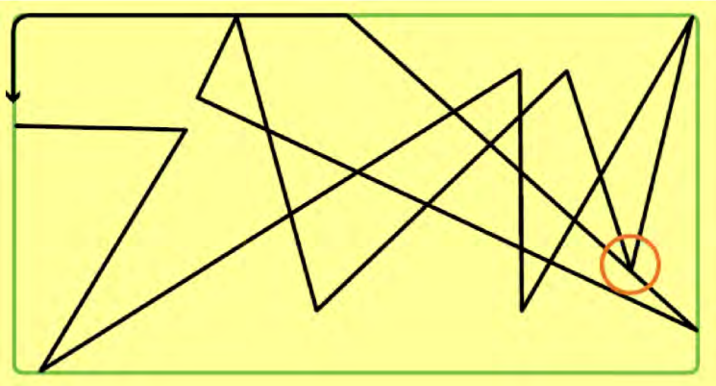
50. Detective Lawn Mower

Angela arrived at the park this morning to discover a statue is missing! A robotic lawn mower cuts the grass in the park each night, by looking at a map of the mower's movements, we can determine where items are located in the park. This park has a tree, a park bench, a long flowerbed and — normally — a statue.
The robotic lawn mower moves according to these rules:
1. When the mower starts it selects a random direction and then proceeds straight forward.
2. When the mower hits an obstacle or reaches the park boundary, it turns in a new, randomly selected direction and goes straight.
3. When the robot's battery is low its behaviour changes: once it reaches the park boundary, it follows the boundary back to the charging station and stops.
Angela notices from the map of the mower's movements that the statue went missing while the mower was running last night.

Question / Challenge
Select where the missing statue should be on the map of the park.



Answer Options / Interactivity Description
Students click on the map to select the previous location of the statue.

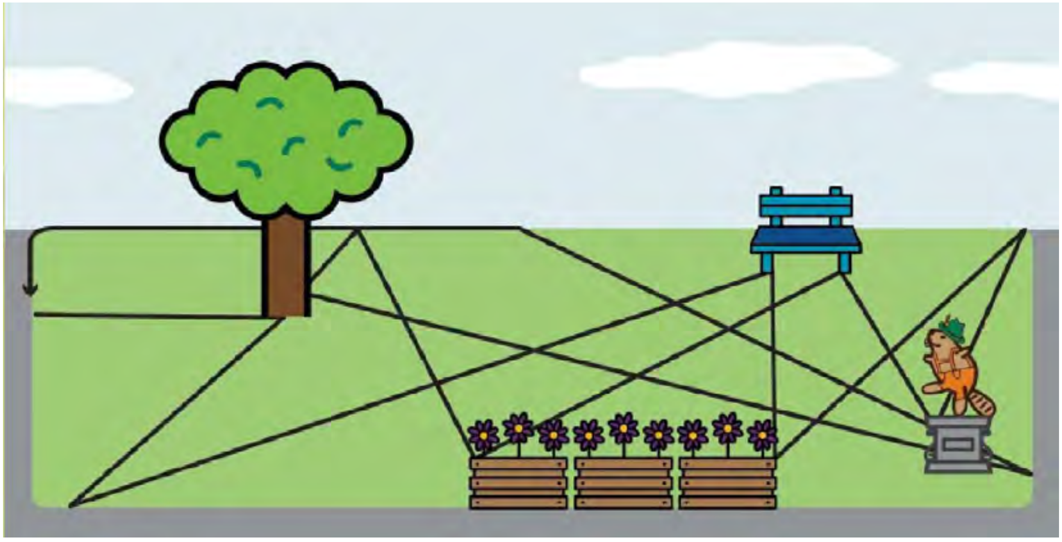


Answer Explanation

The missing statue was located in the right-hand corner of the park as shown below. This is where the robot mower's behaviour changed over the course of the night. Shortly after the robot started mowing it changed its direction in the middle of the lawn. This shows that it had hit an obstacle, the tree. The robot continued in a new direction until it reached the boundary of the park where it changed direction and continued until it hit the park bench.

The robot went on to collide with the flower bed, park boundary, the statue, park bench (again), flower bed (again), park boundary, the tree (again), and then continued through the same area the statue had previously been to the boundary.

The robot changed direction and again moved through the area where there had previously been an obstacle (the statue) to the top boundary and then back to its charging station. The map shows us that the robot passed through the bottom, right area of the park without changing direction whereas earlier in the night it had hit something there and changed direction. This indicates that the statue was now missing and did not block the robot's path anymore.

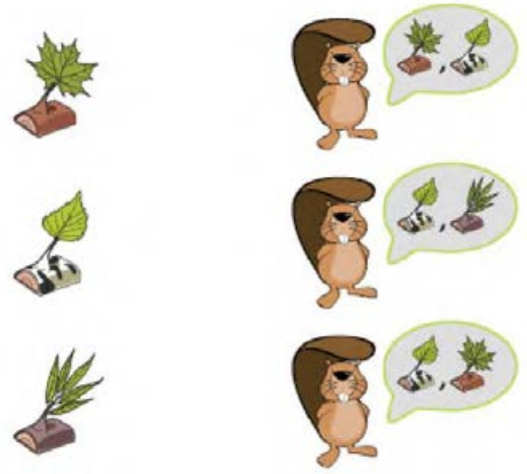


51. Preferences A

The beaver family has three gifts for their young beavers, one gift for each.
Each young beaver tells, which gift it prefers first-place, and which one it prefers second-place.
The family wants to assign the gifts in the best way:
They want to satisfy as many first-place preferences as possible, and then as many second-place preferences as possible.

Question / Challenge

See the gifts on the left, and the young beavers and their preferences on the right.
Assign the gifts in the best way, by drawing lines from gifts to beavers.

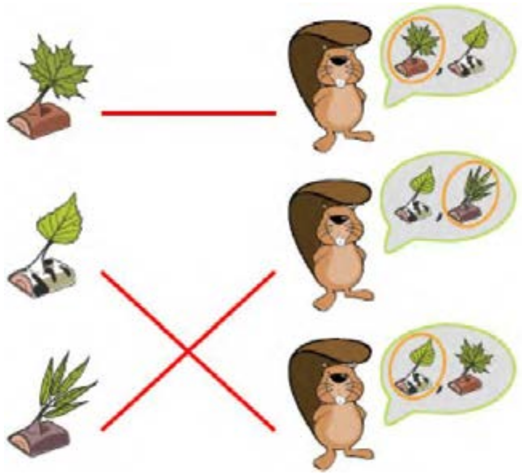


Answer Options / Interactivity Description

Draw lines connecting one object on the left to one object on the right. From each object on the left, only one line may go to the right. Similarly, for each object on the right, only one line may lead to this object. (The lines illustrate a matching.)

Answer Explanation

See below for an assignment of gifts in the best way.



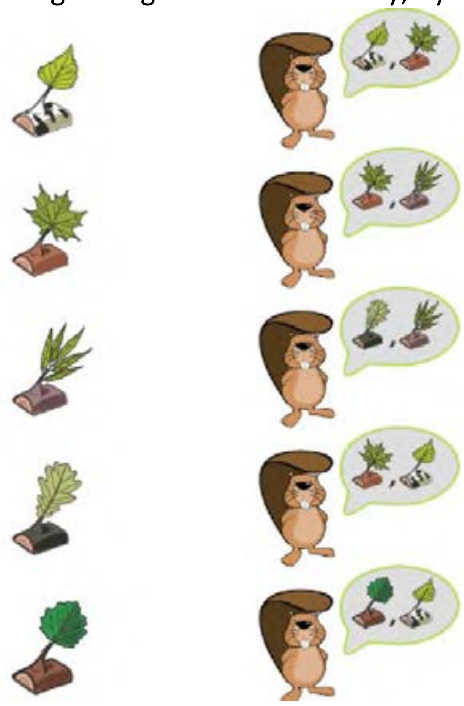
We cannot satisfy all first-place preferences, because two young beavers have the same first-place preference. The assignment shown above satisfies two first-place preferences, and one second-place preference. For this case, a better assignment is impossible. Note that if, going from top to bottom, you assigned the second gift to the second beaver (just like the first gift to the first beaver), you could not assign a preferred gift to the third beaver any more. That is, in this problem it is not sufficient to be "greedy" and take the next best thing one by one.

52. Preferences B

The beaver family has five gifts for their young beavers, one gift for each.
Each young beaver tells, which gift it prefers first-place, and which one it prefers second-place.
The family wants to assign the gifts in the best way:
They want to satisfy as many first-place preferences as possible, and then as many second-place preferences as possible.

Question / Challenge

See the gifts on the left, and the young beavers and their preferences on the right.
Assign the gifts in the best way, by drawing lines from gifts to beavers.

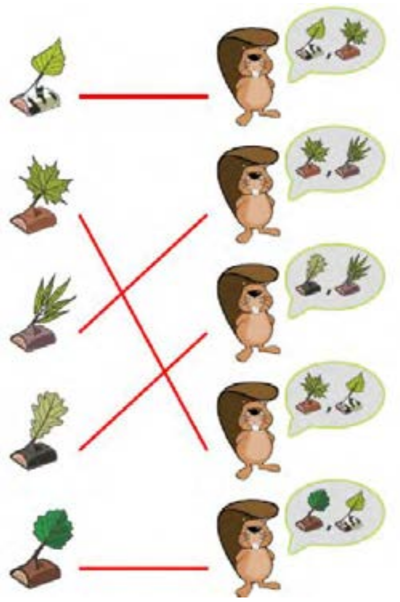


Answer Options / Interactivity Description

Draw lines connecting one object on the left to one object on the right. From each object on the left, only one line may go to the right. Similarly, for each object on the right, only one line may lead to this object. (The lines illustrate a matching.)

Answer Explanation

See below for an assignment of gifts in the best way.



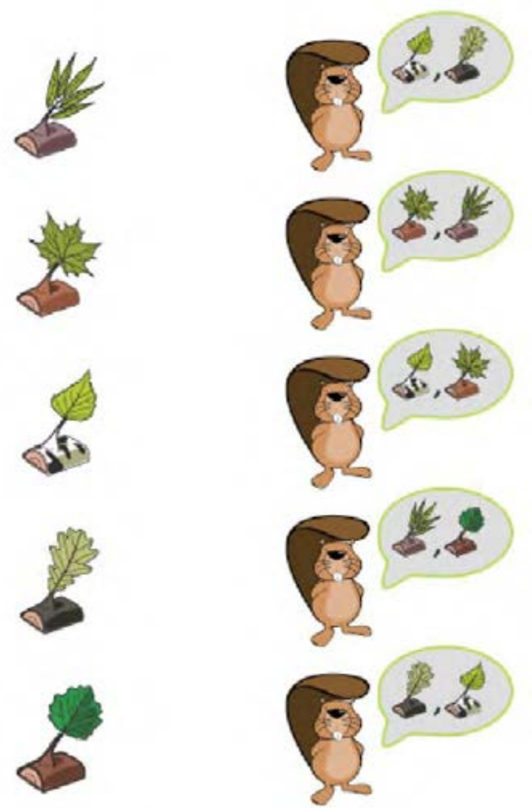
We cannot satisfy all first-place preferences, because two young beavers have the same first-place preference. The assignment shown above satisfies four first-place preferences, and one second-place preference. For this case, a better assignment is impossible. Note that if, going from top to bottom, you would assign the second gift to the second beaver (just like the first gift to the first beaver, thus satisfying the second beaver's first preference), you could not assign a preferred gift to the fourth beaver any more. This is why there is no other best assignment than the one shown above.
That is, in this problem it is not sufficient to be "greedy" and take the next best thing one by one.

53. Preferences C

The beaver family has five gifts for their young beavers, one gift for each.
Each young beaver tells, which gift it prefers first-place, and which one it prefers second-place.
The family wants to assign the gifts in the best way:
Each young beaver must give a preferred gift.
They want to satisfy as many first-place preferences as possible.

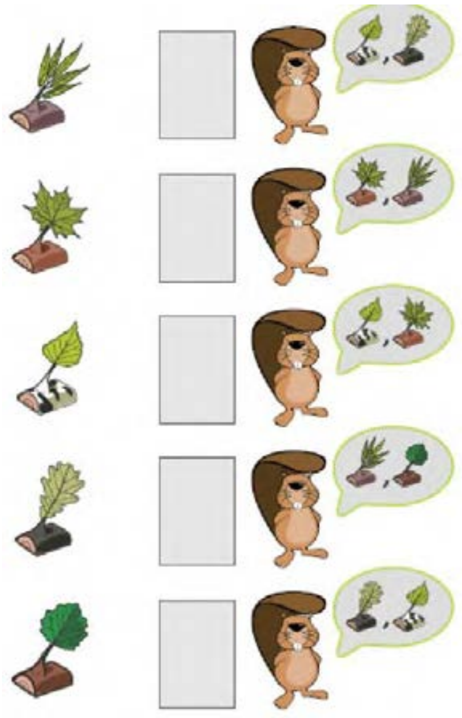
Question / Challenge

See the gifts on the left, and the young beavers and their preferences on the right.
Assign the gifts in the best way, by drawing lines from gifts to beavers.



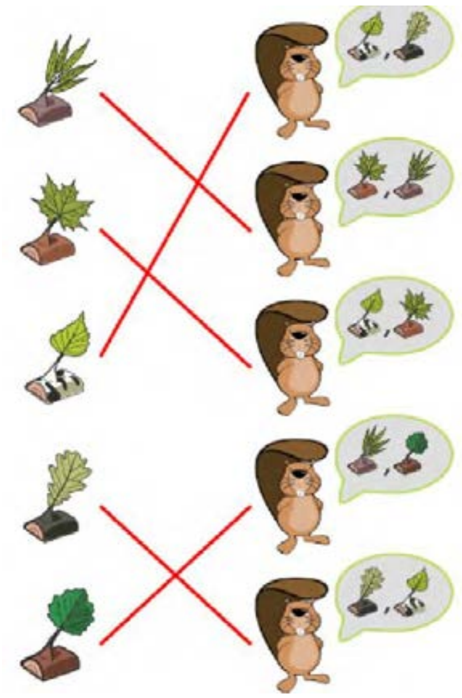
Answer Options / Interactivity Description

Draw lines connecting one object on the left to one object on the right. From each object on the left, only one line may go to the right. Similarly, for each object on the right, only one line may lead to this object. (The lines illustrate a matching.)
Drag and drop version: Move gifts to the shadow rectangles.



Answer Explanation

See below for an assignment of gifts in the best way.



Why this solution is only the correct one:

Only one young beaver prefers the poplar log, so we must assing it to him (5-th log from above to 4-th beaver).

After this, only one beaver prefers the willow log, the 1-st log must be assigned to 2-nd beaver.

Then, only one maple log remain among wishes the others beavers. It is a preference of 3-rd beaver, we have to assign him to 2-nd log.
Two beavers (1-st and 5-th) remain, both have the same set of preferences. We have two ways how to assign them to the remaining logs and we choose the way following their first preferences.
So we assign 1-st beaver to the birch log (3-rd) and 5-th beaver to the oak log (5-th).

54. Logs

Jack and Sam are building a log house. Jack is bringing logs from the forest to the storage area. He can move from the forest to the storage area in 5 minutes and drag two logs at the same time. Sam is taking the logs from the storage area to the construction site. He can move from the storage area to the construction site in just 2 minutes, but only carry one log. Both beavers move at the same speed to and from the storage area with or without logs. They are working as follows:

When Jack arrives at the storage area with new logs, he will drop the logs and call out to Sam before returning to the forest; Sam will then stop working at the construction site and take the logs from the storage area.

When Sam takes the last log from the storage area and returns to the house, he will resume doing his work at the construction site; but if there are logs left at the storage area, Sam will drop the log at the house and immediately return for more logs to the storage area.

Question / Challenge

How many logs will be at most at the construction site 30 minutes after the friends start working?

Answer Options / Interactivity Description

Integers [0, 20]

Answer Explanation

The correct answer is 5 .

In 30 minutes, Jack will have enough time for three runs from the forest to the storage area and back. More concretely, he will arrive with two new logs 5, 15, and 25 minutes after the start.

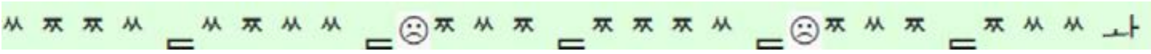
When Jack arrives with the first two logs 5 minutes into the workday, the storage area is empty and he will call Sam. It will take Sam 2 minutes to get to the storage area, so he will get the first of the two logs to the construction site at 9 minutes and the second one at 13 minutes. He will then resume other work.

The process repeats itself when Jack arrives with the next two logs at 15 minutes. Sam gets those to the construction site at 19 and 23 minutes, respectively.

Out of the third pair of logs that Jack brings to the storage area at 25 minutes, only the first will be at the construction site by the half-hour mark, bringing the total number of logs at the construction site to 5.

55. Letters

Lena and Ana use a secret system to write messages to each other. Ana asks Lena by text where she is going for her next holiday.
Ana answers “SWEDEN” but she writes it as:



Later Lena asks Ana about the homework their teacher set. She asked whether it was to read a book or to watch the news.

Question / Challenge

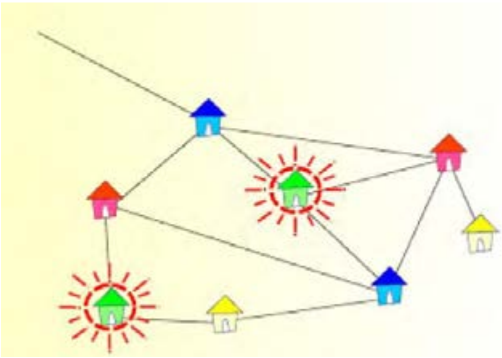
How would Ana reply in code if it was “NEWS”
(Drag and drop the emojis to:
. . . .

Answer Options / Interactivity Description

Answer Explanation

The last 4 emoticons of Sweden form the letter N so the first 4 of NEWS are those.
The 2nd 4 emoticons of Sweden form the letter E so the second 4 of NEWS are those etc.

56. Repair the network



The Beaver Communication Corporation has a communication network in BeaverCity.
They notice communication error signals from two houses meaning that there is no active connection to the marked houses.
They know some network sections between houses are broken. They don't have any other error signal, so they have at least one connection to each other house in the city.

Question / Challenge

Connectivity to all houses must be restored immediately. All other lines that are broken can be fixed next week. How many lines can be fixed next week?

Answer Options / Interactivity Description

Integer numbers from [1,5]

Answer Explanation

Correct answer: 3

There are 5 network-sections broken (2+3). Because they have connection to all other houses, it is enough to immediately repair one section to each marked house. The other 3 non - essential lines can be fixed next week.

57. Fault Detection

In BeaverCity, electricity is produced by windmills on the hills and it gets carried to the houses through this network:

Some links are faulty, though: the two houses with the lights off don't have electricity any more! All others do. Electricity can be carried from house to house in any direction.

Question / Challenge

According to the current state of houses, indicate for each link in this electricity-distribution network if (1) it is known to be faulty ( ), (2) it is known to be working ( ), or (3) we cannot tell without more information if it is faulty or working ( ).

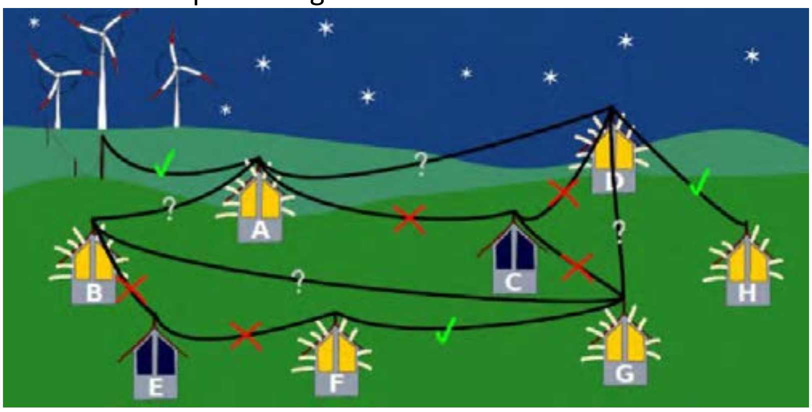
Click on each link (several times if needed) to determine its state.

Answer Options / Interactivity Description

Display a picture with the map above in a version that has a changeable and clickable picture label attached to each of its links. Initially, all are shown in some undetermined state. Clicking them then makes them loop through the three states that can be chosen for the answer: (1) showing as faulty, (2) showing as working, (3) showing as "we don't know".

Answer Explanation

Here is the map showing what we know about the links in the electricity-distribution network:



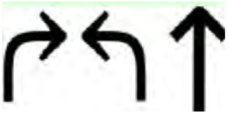
The first thing we know is that the 2 direct links to house E and the 3 direct links to house C are all faulty. As all neighboring houses have electricity, a working link would have brought electricity to houses C and E as well.

Next, links that are alone in providing electricity to houses where the lights are on cannot be faulty, otherwise no electricity could arrive there. This is the case for the link leading to house H and the link from house G to F. The link from the windmills to house A must also be working, otherwise no one would have electricity at all.

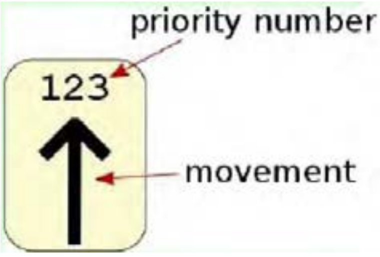
The remaining houses, B, G, and D, are multiply connected to house A. For instance, B can get its electricity directly from A, but it could also get it from G if the link to A was faulty. The same can be said about D. Finally, G can get its electricity either from B or from D. One of the links in the A – B – G – D – A cycle could thus be faulty and these 4 houses would still get electricity.

58. Roborally

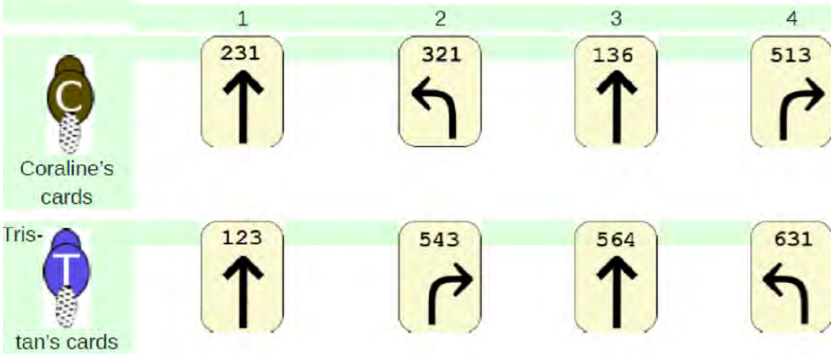
Coraline and Tristan are playing a board game (Beaver-rally).
Each player has a beaver on the board and they direct its movement by playing cards. The cards specify movements, such as move one space forward, turn left or right (in the current space).



The players choose 4 cards and arrange them in the order they want their beaver to move. All beavers can move simultaneously in each round. The problem of beavers attempting to move into the same space at the same time is resolved by the priority numbers printed on the cards.

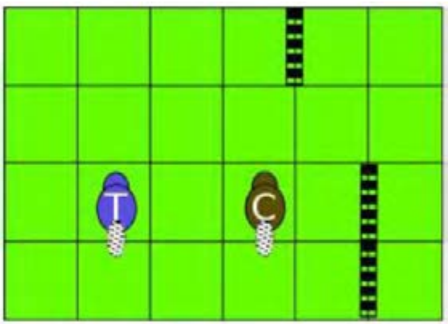


The movement on the card with the higher priority number will be executed first. If a beaver is moving to an occupied space he shifts the other beaver and pushes it to the next space.



Question / Challenge

Move the beavers to the new position on the board!

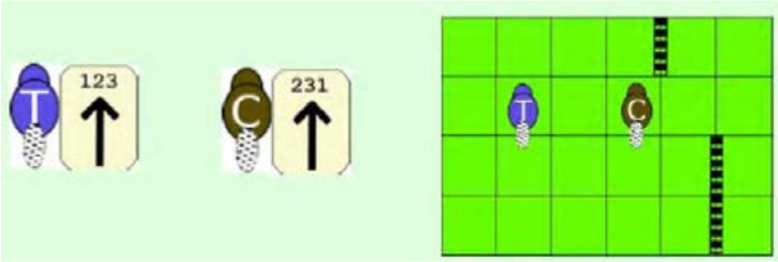


Answer Options / Interactivity Description

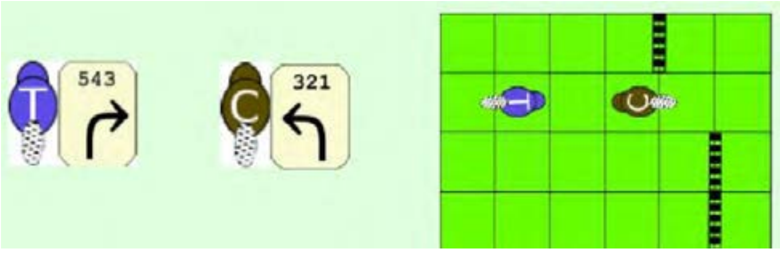
Interactivity: the 2 beavers can be moved to the new spaces. The beavers can be dropped only on spaces on the board.

Answer Explanation

1) The first move can be executed simultaneously.
The beavers will be moved one space forward.

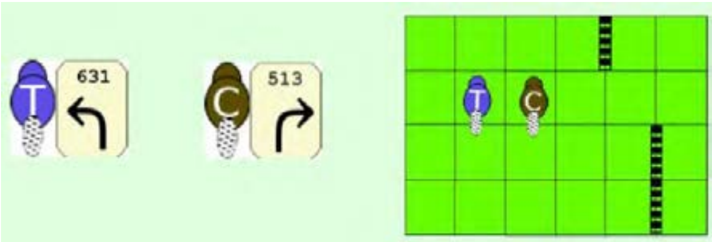


2) The second move can be executed simultaneously, too, and the beavers will turn.



3) By the 3rd move both beavers would be moved to the same space.
Tristan can move first, because his card has the higher value (564).
Then Coraline’s beaver will be moved one forward – it shifts Tristan’s beaver.

4) Last the beavers can turn simultaneously:



59. Self Health B

Beaver Dean visits a self-help health website because he is not feeling well. He gets a list of questions that everyone needs to answer. Depending on his answer to each question, he will be directed to some advice or another question. He starts at question 1.

1. Have you had a fever for the past three days?
If your answer is YES, then go to Question 2.
If your answer is NO, then go to Question 4.
2. Are you feeling pain in any part of your body?
If your answer is YES, then go to advice 3.
If your answer is NO, then go to Question 5.
3. Go to see a medical doctor immediately!
4. Can you count down from 20 to 1?
If your answer is YES, then go to advice 7.
If your answer is NO, then go to advice 8.
5. Are you feeling dizzy?
If your answer is YES, then go to advice 6.
If your answer is NO, then go to Question 4.
6. There is something wrong and you should give your body a rest immediately!
7. Your concentration is intact, but you should give your body a rest.
8. Your concentration seems to be failing, please ask a friend to sit beside you.

Question / Challenge

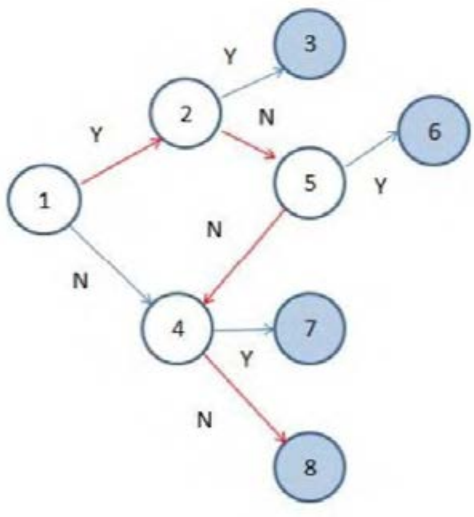
Dean's answers in order are: YES, NO, NO, NO. What advice does he get? Submit your answer by entering the number of the advice that he gets.

Answer Options / Interactivity Description

Answer should be integer number from 1 to 8

Answer Explanation

The correct answer is 8. You need to follow Dean's answers to each question in the picture below. The red arrows show the result of Dean's answers. They start from question 1 and ends at advice number 8.


1
2
3
4
5
6
7
8
Y
N
Y
N
Y
N
Y
N

60. Go To The Market

With the holidays approaching, Ana, Barnie, Chloe and Derrick are planning a party for their family. They need to go to the market to buy food for their guests.
They need to buy the following items:

- 4 kg assorted fruit
- 1 kg spinach
- 2 kg sugar
- 3 kg chicken
- 2 kg beef
- 3 kg fish
- 5 kg rice
- 1 kg eggs

Each type of food is placed in a different basket. Each beaver can only carry two baskets at a time — one in each hand. Barnie is the strongest beaver and can carry 8kg of food items. Ana and Derrick can both carry 5kg of food while Chloe can only carry 3kg of food.

Question / Challenge

All the food must be carried home in a single trip. Which items from the shopping list should each beaver carry?

Answer Options / Interactivity Description

Move the food items to the baskets of the beaver who is carrying it.

Answer Explanation

The answer is

Barnie (8kg): 5kg rice **+**
3kg chicken **or** 3kg fish
Chloe (3kg): 1kg spinach **or** 1kg eggs **+**
2kg sugar **or** 2kg beef
Ana and
Derrick: 4kg fruit **+**
(5kg each) 1kg spinach **or** 1kg eggs
2kg beef or 2kg sugar +
3kg chicken or 3kg fish

Barnie can carry 8kg so he should carry 5kg of rice and either 3kg of chicken or 3kg of fish.
Chloe can carry 3kg so she should carry 1kg of spinach or 1kg of eggs and 2kg of sugar or 2kg of beef.
Ana and Derrick can each carry 5kg so one should carry 4kg of fruit and either 1kg of spinach or 1kg of eggs while the other carries 2kg of beef or 2kg of sugar and 3kg of chicken or 3kg of fish.
We know that:

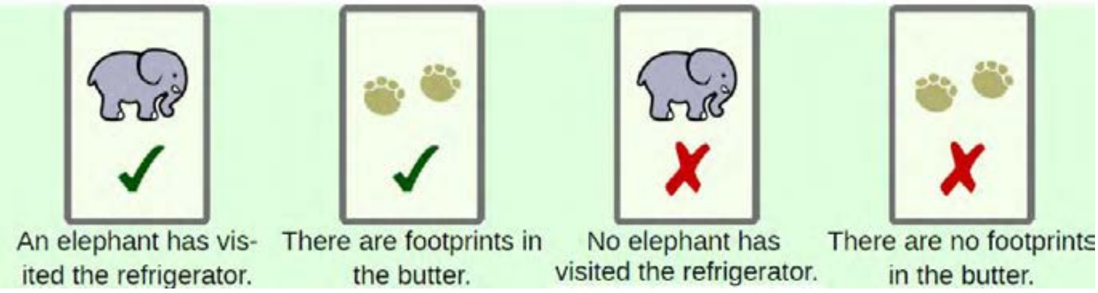
a) one beaver can only carry two baskets
b) each food item is in its own individual basket
c) we have eight different food items

So all four beavers will need to carry two different food items home.
This means the 5kg of rice can only be carried by Barnie. Even though both Ana and Derrick can carry 5kg, this would mean they are unable to carry any other food. To make sure Barnie is carrying the maximum possible, he needs to carry one of the 3kg items (chicken or fish) in his other hand.
Chloe can only carry 3kg of food. Her maximum weight can only be achieved by carrying one of the 1kg items (spinach or egg) and one of the 2kg items (sugar or beef).

This leaves the two beavers that can carry 5kg. The 4kg of fruit pairs with the remaining 1kg item to make 5kg, and the remaining 3kg and 2kg items make up the other 5kg.

61. Elephants in the refrigerator

Joanna has been given four playing cards by her dad about what happened in the refrigerator. Each card has two sides, one side says whether an elephant has visited the refrigerator, the other side says whether there are footprints in the butter. These are the four cards:

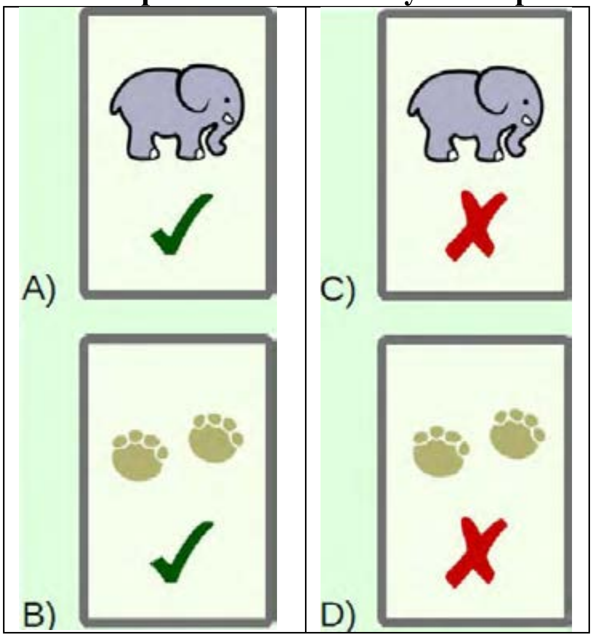


Joanna's father says: "If an elephant has visited the refrigerator, then there are footprints in the butter." Joanna doubts that this is true.

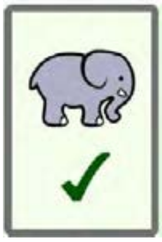
Question / Challenge

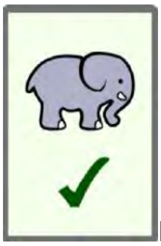
Select all cards with which Joanna could prove her dad wrong.

Answer Options / Interactivity Description

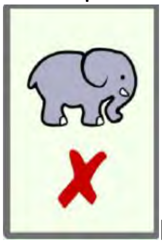


Answer Explanation

The correct answer is  and 

If Joanna flips , and the other side says there are no footprints in the butter, then she has successfully proven her dad wrong. Of course, the other side might say there are footprints in the butter, but at least turning this card gives Joanna a chance to disprove her dad’s claim.

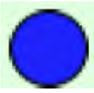
If Joanna flips , it doesn’t matter what the other side says. If the other side says an elephant has visited, it reaffirms her dad’s claim. If the other side says no elephant has visited, then it doesn’t contradict her dad’s claim since he said nothing about what would happen if no elephant has visited the refrigerator.

If Joanna flips , it doesn’t matter what the other side says, since Joanna’s dad said nothing about what would happen if no elephant has visited the refrigerator.

If Joanna flips , and the other side says an elephant has visited the refrigerator, then she has successfully proven her dad wrong. Of course, the other side might say no elephant has visited, but at least turning this card gives Joanna a chance to disprove her dad’s claim.

62. The gift

Bella's mom bought a present and locked it in the safe.

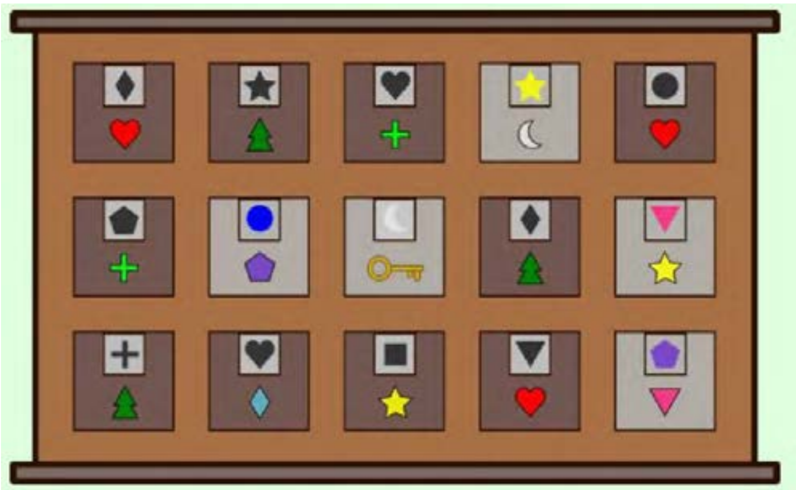
She gave Bella a blue ball  and said: “You can have the gift if you can solve the puzzle and get the key that is in the middlemost drawer. “
To open a drawer Bella must put an object of the correct shape in the key hole on the drawer. Then the drawer pops open and she can get the object which is shown on the front of the drawer and lies in the drawer.

Question / Challenge

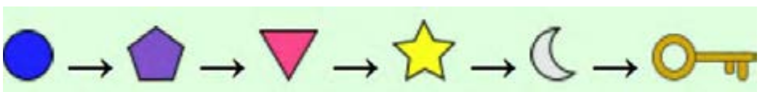
Help Bella to get the key.

Answer Options / Interactivity Description

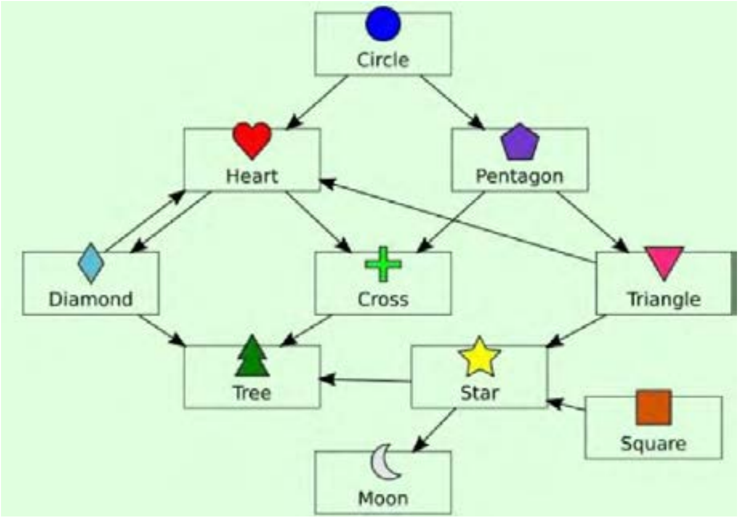
Click on the drawers that Bella can open to get key in the right order.



The task is to find a path between the circle(ball) to the moon as the keyhole on the drawer that contains the key is in the shape of a moon.



To find the solution it helps to draw the objects and arrows (directed graph) to represent what object is needed to get the object from a drawer.



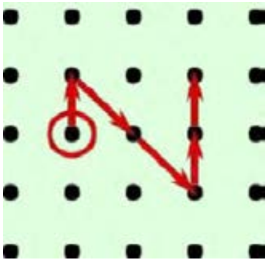
You can use backtracking from the moon to the circle to help you to find the correct path.

63. Between dots

Emma is playing with a robot that draws lines between dots.
She pushes arrow buttons to send the robot to the next dot.

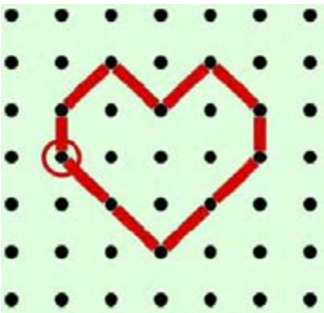
The robot starts on the dot with the circle around it.

This arrow sequence  tells the robot to draw:



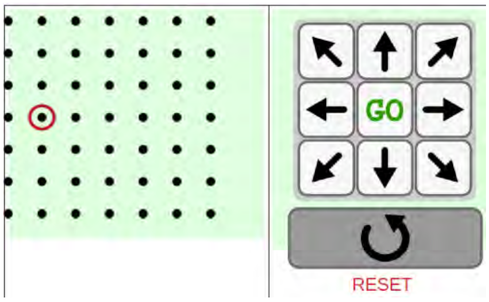
Question / Challenge

Help Emma to draw this image:

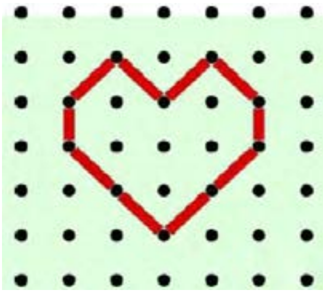


Answer Options / Interactivity Description

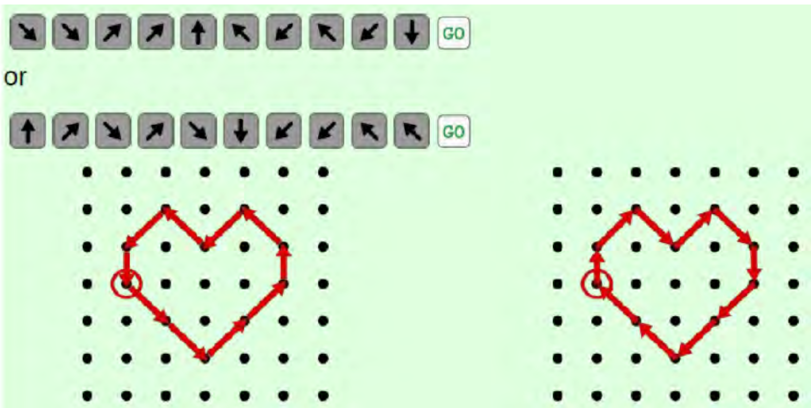
Interactive grid with button controls on the side. The starting point is the dot with the circle around it. The circle is the robot and moves between the dots and draws line between the dots according to the buttons pushed. The reset button under the arrow controls resets; clears the lines from the grid and sends the robot to the starting point.



Answer Explanation

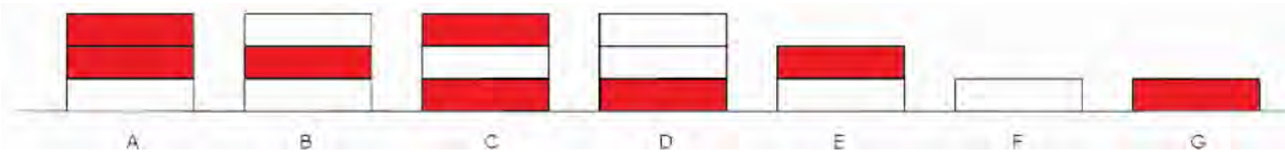


The buttons can be pushed in two type of sequence to draw this image:



64. Stacks of tokens

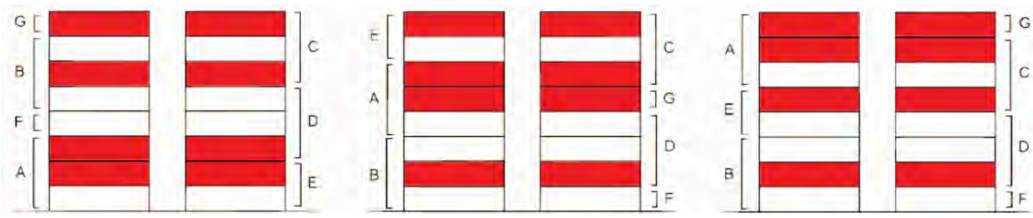
Stephan placed seven stacks of tokens (8 white and 8 red) on the table as shown in the figure below:



Question / Challenge
Can you put these stacks on top of each other (without splitting them) so as to form two identical
stacks?
The resulting two stacks must have the same height (eight tokens) and the same sequence of colors (from the bottom up).

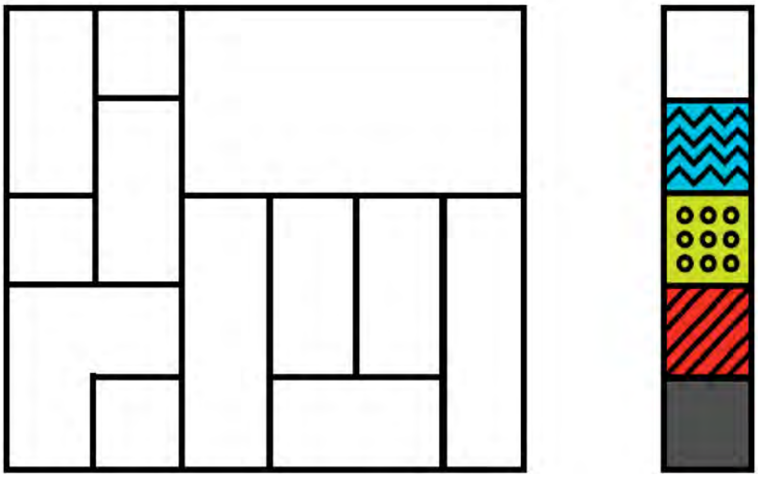
Answer Options / Interactivity Description
Drag-and-drop the stacks onto each other, forming two equal stacks.

Answer Explanation
Representing with (x, y, z, …) the stack obtained by placing y onto x, z onto y, and so on, there are three different solutions (see also the figure below):
- (A, F, B, G) and (E, D, C);
- (B, A, E) and (F, D, G, C);
- (B, E, A) and (F, D, C, G).



Since there are 16 tokens, of which 8 are white and 8 red, each of the two resulting stacks must be made up of 4 white and 4 red tokens. Of the four stacks A, B, C, and D (3 tokens high), two must be in one stack and the other two in the other stack. But A and C (as well as B and D) cannot be in the same stack, otherwise it would be impossible to balance the colors (two white tokens should be added to the pair A-C, and two red tokens to the pair B-D). Also, but a little more laboriously, it can be shown that putting A and D in the same stack (and B and C in the other stack) does not lead to any result.

65. An abstract picture



Piet the painter divided a rectangular canvas into several regions. Now, Piet wants to colour his picture using as few colors as possible while ensuring that no two regions beside each other have the same colour.

Question / Challenge

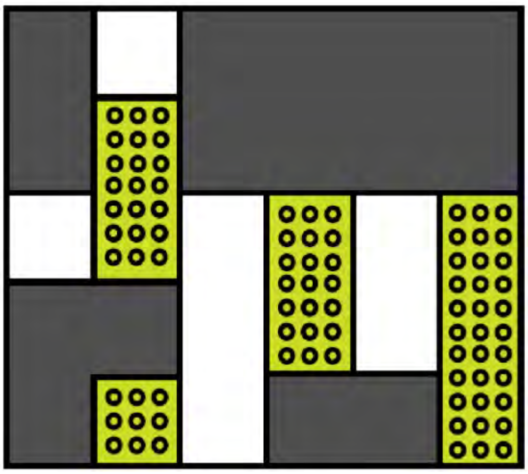
Do you want to try it too? Click on a region and choose its colour from the palette on the right. Try to paint the entire canvas with with as few colours as possible. The fewer colours you use, the more points you will get!

Answer Options / Interactivity Description

Click on each region and choose one of the five colours each time. To remove a colour, click on the white colour in the palette

Answer Explanation

One way to paint this is by starting with the 3 regions in the lower right hand corner. Paint each one with a separate colour and continue the pattern. We don't need more than three colours, as can be seen in the picture below.



To prove that we cannot do it with fewer than three colours, consider anywhere that three regions meet at a point, such as where the three lower right regions meet. At such a point, we have to give each of the three regions a different colour because they are all touching each other. Therefore, we need at least three different colours to solve this task. Note, this picture has been carefully drawn so that no more than three regions meet at one point.

66. Snow White

Snow White and the seven dwarfs live in a house together. For easy reference, we address the dwarfs by numbers as shown in the picture below.

The seven dwarfs just had a quarrel. After that, 12 is friend with 1 and 2, 13 with 1 and 3, 23 with 2 and 3, and 123 is friend with all.
Trying to entertain the dwarfs, Snow white has proposed a game where she will call a number command and the dwarfs have to go in or out of the house based on the following rules:

- Calling “2” makes 2 and his friends (namely 12, 23, and 123) go into the house.
- Calling “3” makes 3 and his friends (namely 13, 23, and 123) go into the house.
- Calling “4” makes 1 and his friends change their individual positions.
- Calling “5” makes 2 and his friends change their individual positions.
- Calling “6” makes 3 and his friends change their individual positions.

For example, suppose 1, 2 and 12 are in the house while 3, 13, 23 and 123 are outside. If Snow White calls “5”, then 2 and 12 go outside, while 23 and 123 go into the house, and rest of the dwarfs stays where they are.

Question / Challenge

All the seven dwarfs are now in the house, but Snow White would like to stay alone with the Prince. What is the shortest sequence of number commands where she can send all the dwarfs outside? Example: 6512 for the sequence 6, 5, 1, 2.

Answer Options / Interactivity Description

42536, OR 43625

Answer Explanation

Since there is no direct commands to send any dwarf out of the house, the idea is of course to dismiss the dwarfs through commands “4”, “5” or “6”. The problem is that some of them will be called back, so Snow White needs to call back those dwarfs who are outside in order to dismiss them altogether.
Because there is no direct way to call 1 and his friends back in the house, Snow White can start by calling “4” and sending 1 and his friends out. This will leave 2, 3 and 23 in the house. At this point, some friends of 2 or 3 are out of the house; Snow White can call the combinations of “25” and “36” in either order, having a group of friends back in the house and send them out together. The following tables shows the position changes after every commands:

- When Snow White calls 42536:

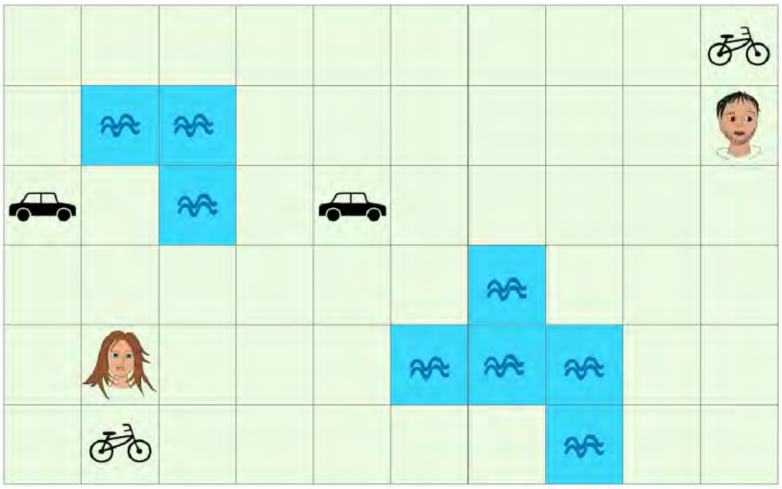
Command	4	2	5	3	6
Dwarfs inside the house	2, 3, and 23	2, 3, 12, 23, and 123	3	3, 13, 23, and 123	--
Dwarfs out-side the house	1, 12, 13, and 123	1 and 13	1, 2, 12, 13, 23, and 123	1, 2, and 12	1, 2, 3, 12, 13, 23, and 123

• When Snow White calls 43625:

Command	4	3	6	2	5
Dwarfs inside the house	2, 3, and 23	2, 3, 13, 23, and 123	2	2, 12, 23, and 123	--
Dwarfs out-side the house	1, 12, 13, and 123	1 and 12	1, 3, 12, 13, 23, and 123	1, 3, and 13	1, 2, 3, 12, 13, 23, and 123

67. Meeting race

Two friends need to meet urgently - see the map below. They can walk from a square to a horizontally or vertically adjacent square in exactly one minute. If they reach a bike or car they can use it to travel faster – 2 squares in one minute with a bike, 5 squares with a car.
They cannot travel over water.



Question / Challenge

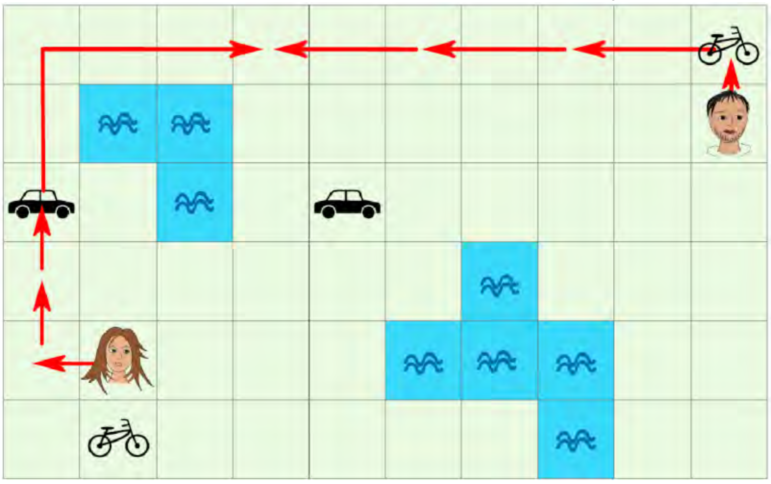
What is the minimum number of minutes they need to end up on the same square?

Answer Options / Interactivity Description

Open Integer (minutes).
Optionally some interactivity could be added (e.g., allowing the two characters to be moved around the map with the mouse) to help students to think systematically without using pen and paper or needing to touch the screen.

Answer Explanation

The correct answer is 4. This can be achieved by the route shown below:



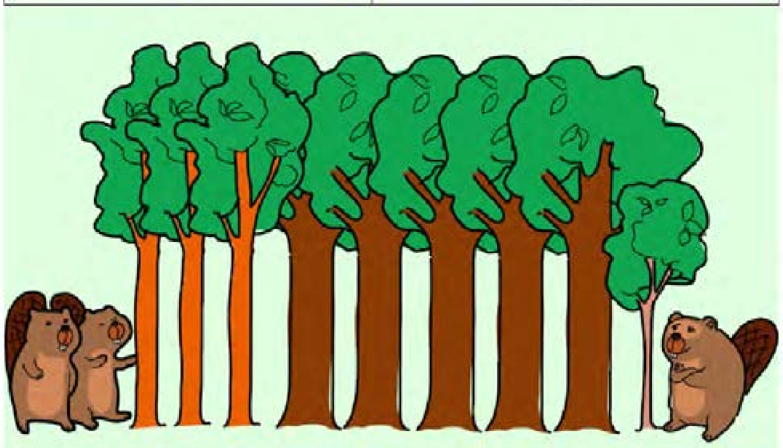
(Another option is to take the leftmost bike and cycle to the leftmost car and then continue as above.)
To see why 3 minutes are not sufficient, you can reason as follows.
• Although in 3 minutes you can reach the car on the left, there is no time left to drive it anywhere. And that position cannot be reached in three minutes by the other person.
So the cars are of no use and we may as well remove them from the map.

• The two friends are more than 5 minutes away from each other on foot, so they need a bike. In fact, both need a bike because they are separated by more than 9 positions.
But finding that bike costs one minute and with only two minutes left they cannot reach each other, even by bike.

68. Three beavers

Three beavers cut down the trees. Each beaver works on its own. Trees are different thickness and they require different cutting time.

Number of trees of the same thickness	How many hours is needed for cutting one tree
5	4
3	3
1	1



The beavers can cut down the trees in any order they want. But they have to finish the current tree they work on, before they start cutting down the next one.

Question / Challenge

What is the least number of hours for the beavers to cut down all trees?

Answer Options / Interactivity Description

Write an integer number

Answer Explanation

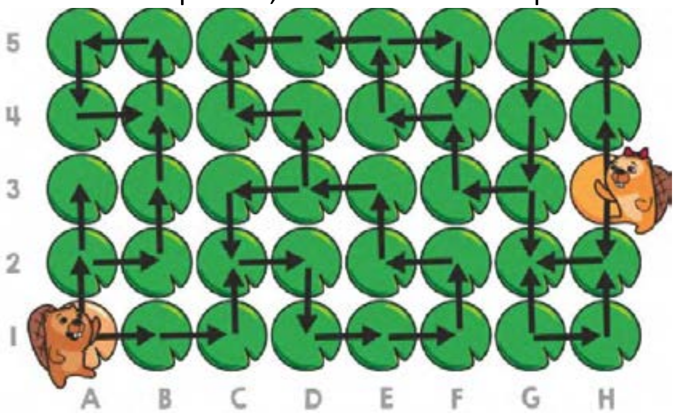
Correct answer is 11 hours.
It might appear that the result would be 10 hours.
$(5\times4+3\times3+1\times1)/3 = 10$
However, you cannot group the trees into three equal groups that allow each beaver to spend ten hours cutting the logs.
As seen in the diagram, the three beavers cannot spend the same time. Two beavers are cutting trees for 11 hours while the third only uses eight hours cutting trees.
We can see it in the next scheme

In this scheme, when a beaver finishes cutting a tree, it proceeds to cut the largest tree available.
The three beavers start cutting large trees (4 hours of work) when they finish, simultaneously, the first two start with the last two large trees and the third beaver goes on to cut a medium tree. Since the third beaver finishes earlier, he proceeds to cut a second medium tree. The

first two beavers finish later, simultaneously and choose, one the last medium tree and the other the only small tree. The first beaver spends 11 hours at work, the second nine and the third ten.
In this case, the strategy followed has been to choose the largest tree available to continue the work.

69. Do they meet?

On the lake, beavers can go from one lily pad to another only in the way the arrows show. Bob starts on pad A1, and Nora starts on pad H3.



Question / Challenge

Is it possible that the beavers meet each other? If yes, where may they meet?

Answer Options / Interactivity Description

Interactive task: select the pad/pads where they can meet.

Answer Explanation

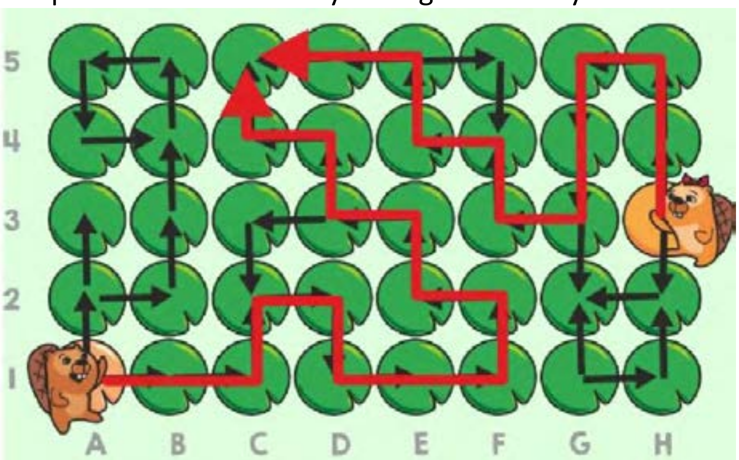
The correct answer is D: The beavers may meet on pad C5.

At his starting position, Bob has two options: If he goes “up”, then he may either run into the dead end at A3 or get stuck in the loop that begins at B4. If he goes “right” (to B1), he can continues to D3. At D3 he may either go “left” into a loop that will take him back to D3 eventually or go “up”, which makes him end up at C5, another dead end.

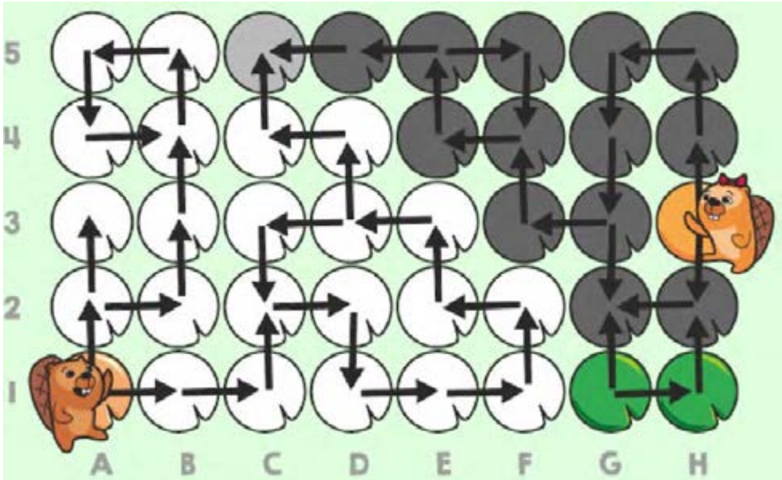
Nora also has two options at the start. If she goes “down”, she will run into the dead end at G2. If she goes “up”, she will reach G3. From there she may either run into the G2 dead end again, or go “left” and reach E5 eventually. There she may either go into a loop that will take her back to E5 again or reach another dead end at C5.

As we already know, Bob may reach C5 as well, so we can see that they may meet at C5.

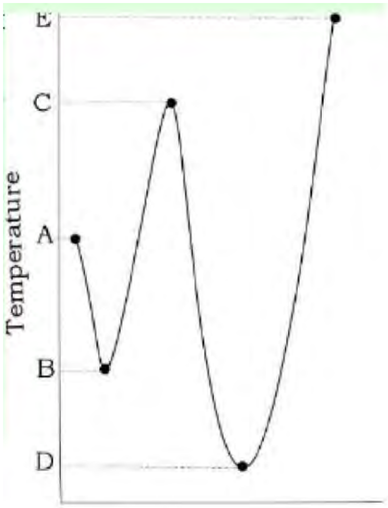
The picture shows the ways along which they both can reach C5.



But this does not yet fully guarantee that they cannot meet at F4 or C5 either. The next picture shows the set of pads that Bob (white) and Nora (dark gray) may reach by following the arrows in any possible way. We can see that C5 is the only pad common to both sets.


5
4
3
2
1
A
B
C
D
E
F
G
H

70. Comfort temperature



Every day beaver Theophilus measures the water temperature and records measurements in a table. He records the first measurement immediately after waking up, and the last one shortly before bedtime. Theophilus knows that the temperature changes constantly, so during the day he records only the extreme temperatures - those before which the temperature increased and then began to decrease, or vice versa – decreased and then began to increase. For example, if the temperature changed as in the drawing, Theophilus would have written the numbers A, B, C, D, E in the table. There is exactly one temperature value, the comfort temperature, at which Theophilus feels best.

Question / Challenge

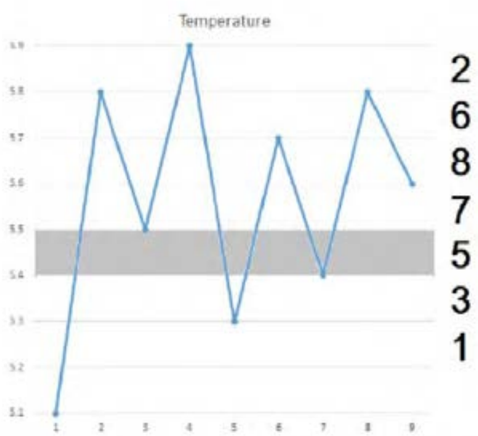
What are the limits of the comfort temperature if the comfort temperature was met exactly five times yesterday and yesterday's observations are the following:
5.1, 5.8, 5.5, 5.9, 5.3, 5.7, 5.4, 5.8, 5.6?

Answer Options / Interactivity Description

Two numbers A and B denoting that comfort temperature is between A and B. Any temperature between 5.4 and 5.5.

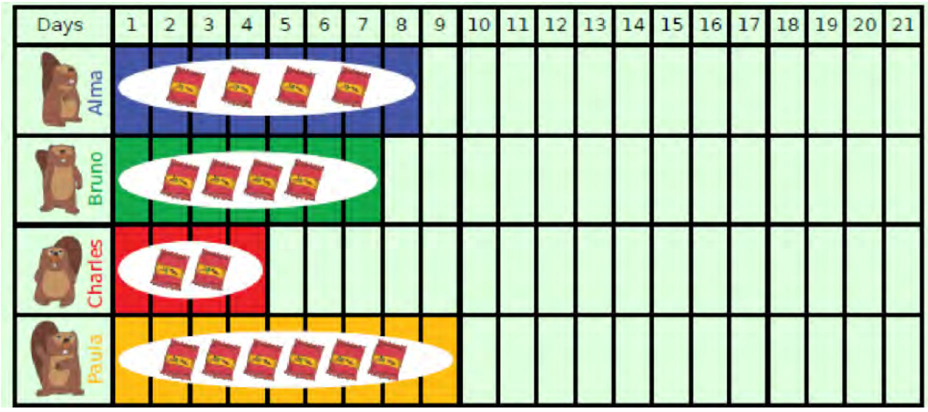
Answer Explanation

Using the given data, we can build a graph similar to the given as example in the task description:



Then we can count number of times when lines crosses particular intervals. The same temperature exactly five times corresponds to the interval (5.4;5.5) (excluding endpoint values).

71. Curd snack



Four beavers, Alma, Bruno, Charles, and Paula are going on a 3 week hike. Each beaver carries their favorite curd snack and eats a specific amount over consecutive days. On each day, a beaver will either eat no snack or one snack. As the chart shows, Alma eats 4 snacks every 8 days, Bruno eats 4 snacks every 7 days, Charles eats 2 snacks every 4 days, and Paula eats 6 snacks every 9 days.

Question / Challenge

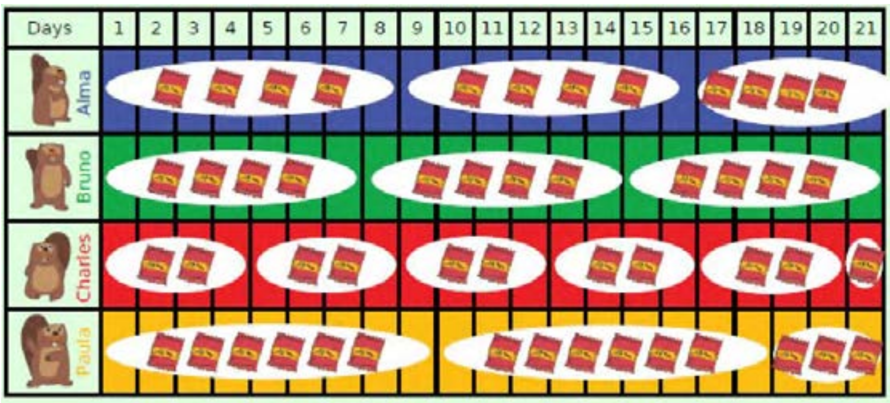
If we don’t know on which days the beavers will eat their snacks, what will be the maximum number of snacks eaten during hike?

Answer Options / Interactivity Description

Integer number. Answer: 50 snacks should be brought on the hike.

Answer Explanation

The table shows the maximum number of snacks eaten by each beaver. The key to this task is to understand that the beavers may wish to eat their snacks at the beginning of their consecutive days, rather than spreading them out. So, for Alma, for example, she will eat 4 snacks during the first 8 days, 4 snacks during the next 8 days, and then there are only 5 days left before the end of the hike. Alma may wish to eat as many of her snacks as she can on during those 5 days, in which case she would eat all 4 of her snacks during the hike. So, in 21 days Alma will eat at most 12 snacks.

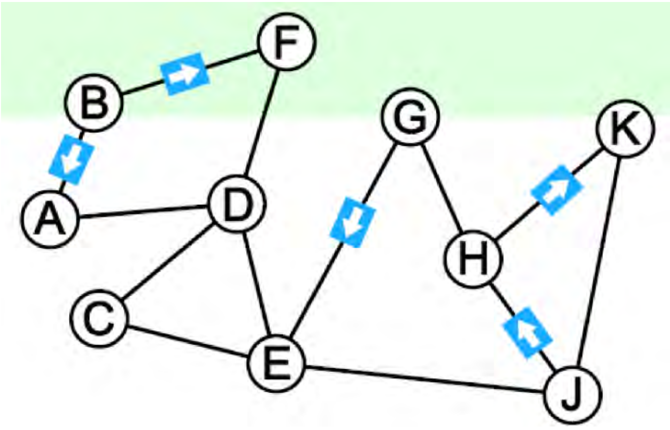


Similarly, Bruno will eat at most 12 snacks in 21 days.

Charles will eat at most 11 snacks in 21 days. There is one day left over after as you can see from the picture, and he can eat a snack on that day.
Paula will eat at most 15 snacks in 21 days. Paula can eat one snack during each of her last three days.
This totals 50 snacks in 21 days as a maximum.

72. Garden of Eden, Hotel California

In Beaver County 10 towns are connected by roads. The county council decides to make some of the roads one way roads. This is the first design.
If a town cannot be entered due to the one way roads, it is called a "Garden of Eden".
If a town cannot be left due to the one way roads, it is called a "Hotel California".
Both situations are to be avoided. Help the county council to find them.



Question / Challenge
Click on all towns that are a “Garden of Eden” or a “Hotel California” (if they are).
Answer Options / Interactivity Description
Click on problematic points in the graph
Answer Explanation
B is a “Garden of Eden”. It has two roads and both are going outside.
There is no “Hotel California”. Only towns which are ends of the arrows may satisfy this condition, but from A, F and E we can go to D, from H to K and from K to J.

73. Bebras runs

Bebras Bob has a great idea that he can use to sort a list of numbers.
He runs through the list of numbers from left to right and performs the following steps:
- He compares the current number with the next number in the list.
- If the next number is smaller, than the current number he swaps them.
- He moves to the next position in the list and repeats the steps above
- When he reaches the end of the list, this is called one pass.

Bob performs one pass on the following list of numbers:

5 3 5 6 7 4 3 6 8 4

The steps that Bob performs in the first pass are highlighted below.
(1)3556743684 (2)3556743684 (3)3556743684 (4)3556743684 (5)3556743684
(6)3556473684 (7)3556437684 (8)3556436784 (9)3556436784 (10)3556436748
After he has finished the first pass, the list of numbers looks like this:
3 5 5 6 4 3 6 7 4 8

Question / Challenge

Place the set after 3 passes:

Modification. I suggest to generate random data for this task whenever a student opens it.

Answer Options / Interactivity Description

Interactive task, see above.

Answer Explanation

The Correct answer for the list

5	3	5	6	7	4	3	6	8	4

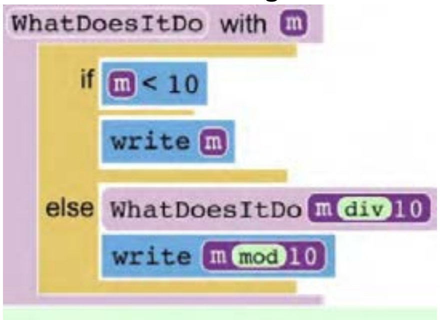
Is the following sequence:

3	5	4	3	5	6	4	6	7	8

This is the sequence after 3 iterations of the Bubble sort

74. WhatDoesItDo

Little Beaver has just learn that **div** takes the result of a division and round it down to a whole number and **mod** that takes the remainder.
For example, 90 **div** 7 is 12 and 90 **mod** 7 is 6.
Little Beaver is now given the following function which takes an integer m as input.

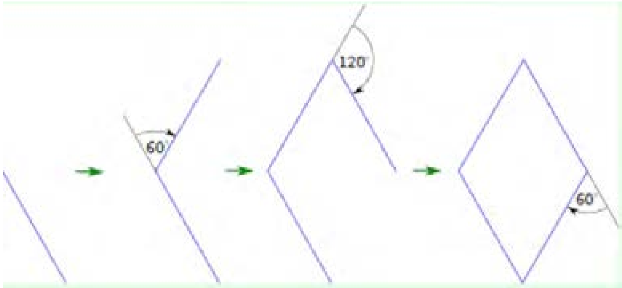


Question / Challenge
When m is 30241, what number will the function write?
In the window below write the result of the above function for m = 30241
Modification. I suggest to generate m whenever a student opens this task.
Answer Options / Interactivity Description
Interactive task – open window
Answer Explanation
The correct answer is 30241.
Since the function includes itself as part of it, the integer m is processed through the function over and over again. Each time updating the input and write down the output as shown in the following table:

	Input	p(m<10)	m div 10	m mod 10	Output
1	30241	False	3024	-	-
2	3024	False	302	-	-
3	302	False	30	-	-
4	30	False	3	-	-
5	3	True	-	-	3
4	30	-	-	0	0
3	302	-	-	2	2
2	3024	-	-	4	4
1	30241	-	-	1	1

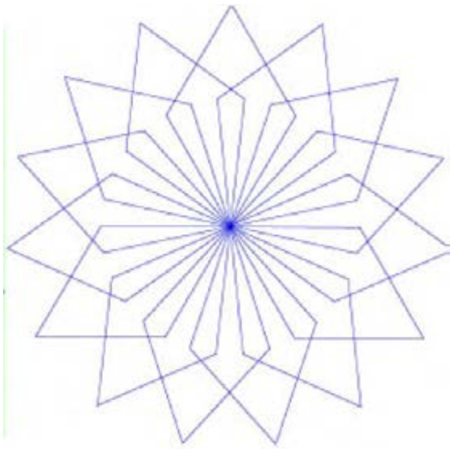
75. Diamenty

The execution of the following instructions generates a diamond. The process is shown in the picture



Diamond
repeat 2 times
move 50 steps
turn right 60 degree
move 50 steps
turn right 120 degree

Question / Challenge



In the following program:
Rosette
repeat …X… times
diamond
turn right …Y…degree
replace numbers X and Y by such numbers that the program will draw the rosette shown in the figure.

Answer Options / Interactivity Description

Interactive task – open windows

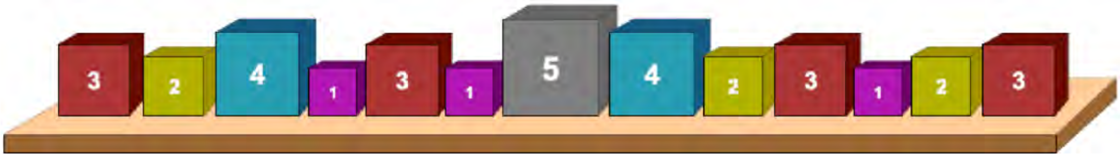
Answer Explanation

Correct answer 15 and 24.
The rosette in the picture consists of 15 diamonds. When finishing one diamond our drawing machine (or whatever it is) has the same direction as at the beginning of drawing this diamond because we turned totally 60+120+60+120 degrees.

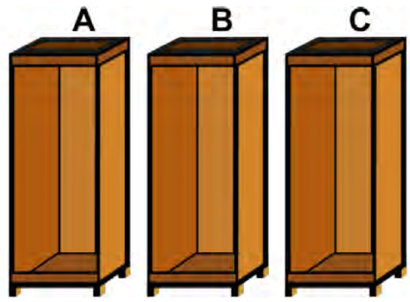
Before drawing each new diamond we should rotate the same angle and totally we rotate 15 times returning back to the initial direction. So our rotation angle should be 360:15=24 degrees.

76. Boxes

Mr. Beaver has cubes of 5 different weights: 1 kg, 2 kg, 3 kg, 4kg, and 5 kg. The weight is written on each cube.
He is tidying up the room so he wants to put all the cubes into three tall cabinets: Cabinet A, Cabinet B, and Cabinet C. Each cabinet can only hold a maximum weight of 15 kg.
Another rule is that a heavier cube cannot be placed on top of a lighter cube.
Mr. Beaver puts the cubes in the cabinets in the order that they are lined up starting from the cube on the left. For each cube, he puts it in the first cabinet (always starting with cabinet A), where it can fit, according to the weight rules.

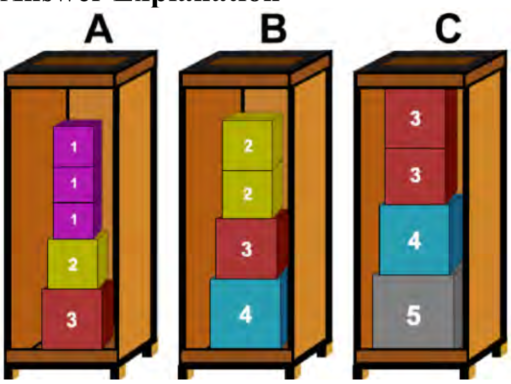


Question / Challenge
Help Mr. Beaver to put all the cubes into the cabinets. Drag the cubes into the cabinets, following the rules.



Answer Options / Interactivity Description
There should be 3 cabinets and 13 cubes. The cubes must be pulled into the cabinets, in the right order, one on top of the other.
At any time, only the first available cube on the shelf can be moved. There is an undo button that puts the last placed cube back on the shelf.

Answer Explanation



The correct answer is:
Place a cube on top of another cube with the nearest weight.
The first cube of weight 3 goes into Cabinet A

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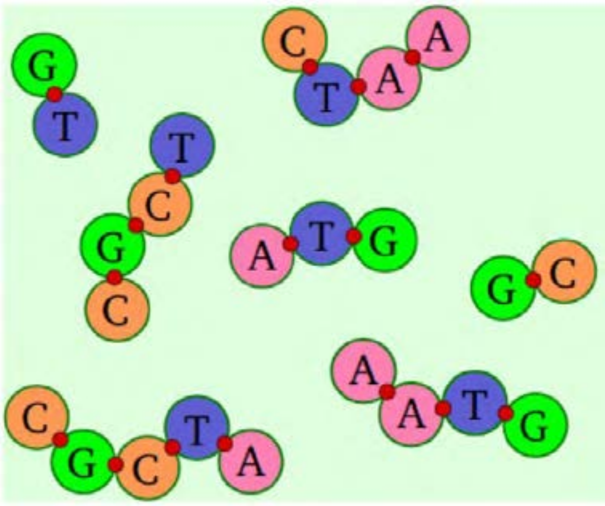
The second cube of weight 2 will be placed over the cube of weight 3, in Cabinet A, in order to let the Cabinet B have a heavier cube at the bottom.
The cube of weight 4 will be placed in Cabinet B,
The cube of weight 1 will be placed in Cabinet A, over the cube of weight 2 (instead of putting it into Cabinet B over the cube of weight 4, thus leaving room for a cube with a higher weight).
Follow the same principle until all the cubes are arranged in cabinets.

77. Genome decoding

DNA molecules are a chain made of four nucleobases: Cytosine(C), Guanine(G), Adenine(A), and Thymine(T). A Scientist
is trying to recreate a DNA molecule from the pieces below.



The molecule letters can be read from both sides (left to right and right to left).

For example, 

can be read as "ATG" or "GTA".

Question / Challenge

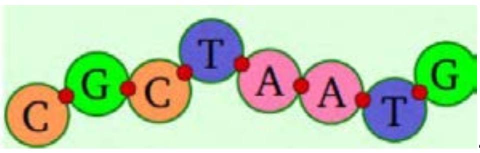
What is the shortest possible chain that contains all these pieces?

Answer Options / Interactivity Description

Enter the word, consisting of letters A, C, G, T.

Answer Explanation

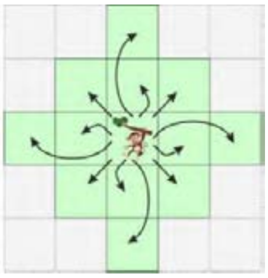
The answer is CGCTAATG or GTAATCGC (see the chain below)



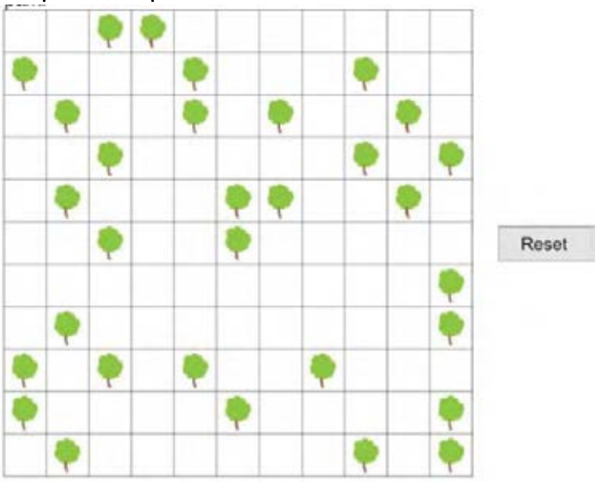
.

We can see that this chain contains all requires pieces. CGCTA and AATG can intersect only by one letter, so it is the
shortest one

78. Jumping Jack



Jack is not a beaver. He is a monkey living in a park. From one tree, he can jump to another tree if it's either up to two cells away horizontally or vertically, or one cell away diagonally, as shown in the diagram.
Jack plays a game in which he jumps to as many different trees as possible without touching the ground. He can start from any tree in the park.
Map of the park:



Question / Challenge

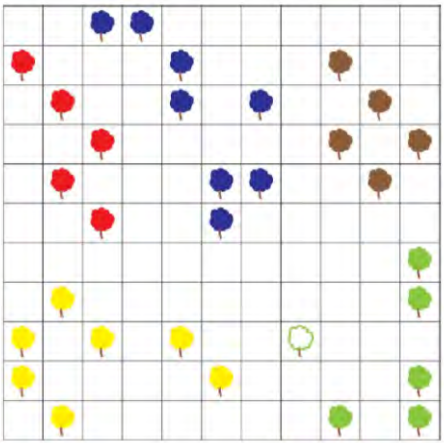
Color in blue, the biggest number of different trees Jack can visit in one go without touching the ground.
Click on a tree to change its color. It will flip between green, blue and gray. You can use green or gray to help you solve the task, but only blue trees are part of the answer.

Answer Options / Interactivity Description

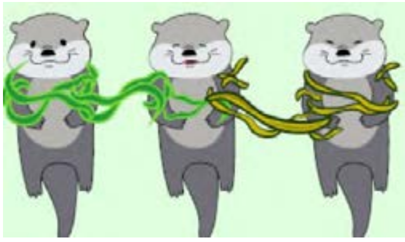
Clicking on a tree flips its color from green to dark blue to gray, then to green again.
Clicking on the reset button colors all trees back to green.

Answer Explanation

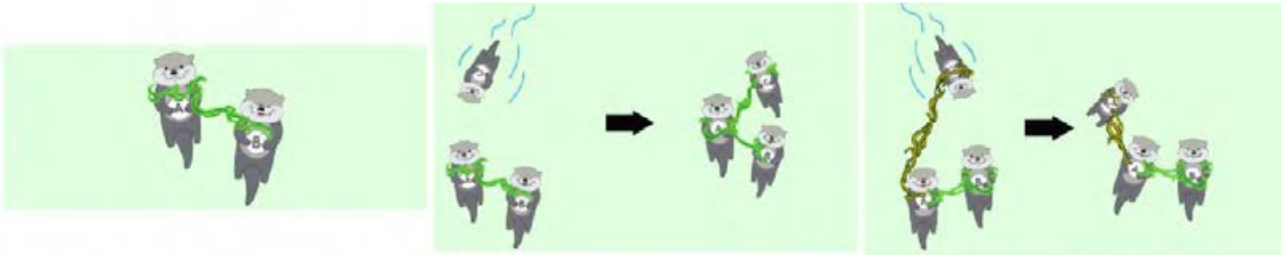
In this diagram, Jack can visit the 8 trees that are colored in dark blue. We colored other trees with multiple colors, to show the different groups of trees.
There are essentially six groups of trees in the park. If Jack starts on a tree we painted yellow, he can reach all yellow trees, and no trees of other colors.
How do we find such groups?
Pick a random tree and color it as you wish. Then use the same color for all trees that are reachable from it. And all trees that are reachable from those trees, too. And so on, until you cannot reach any other trees. If there are any trees you haven't colored yet, take another color and start again from a random uncolored tree. Your coloring simulates Jack's exploring.



79. Napping Together



When two otters in OtterKingdom meet each other, they will wrap a seaweed around themselves so that they can stay together during nap time. However, to avoid knots, if two otters are already connected, they won't wrap another seaweed.
For instance: If otters meet each other in following order: A - B, A - C, B - C



OtterB meets otterA. They wrap a seaweed around themselves. | OtterC meets otterA. They wrap a seaweed around themselves. | OtterC meets otterB. Since they are already conncted through otterA, they won't wrap a seaweed around themselves.

Otters meet each other in following order:
A - B, A - C, B - C, D - E, A - E, D - F, A - F

Question / Challenge

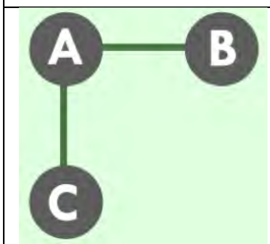
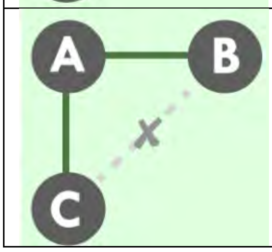
How many seaweeds are wrapped around otterA?

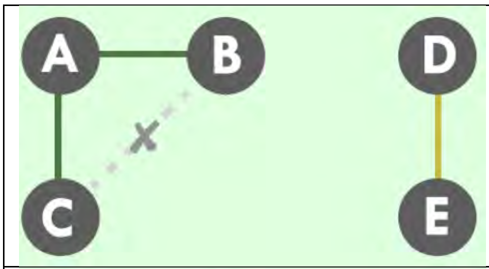
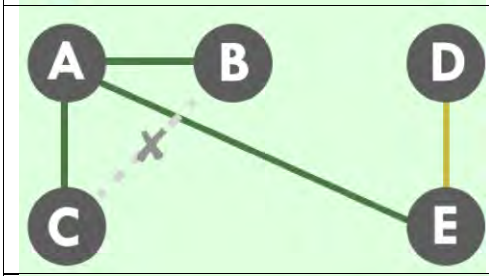
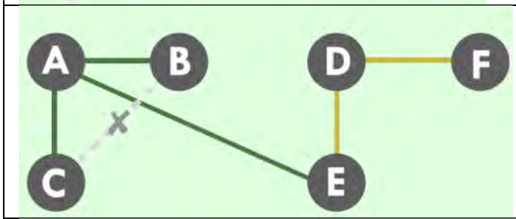
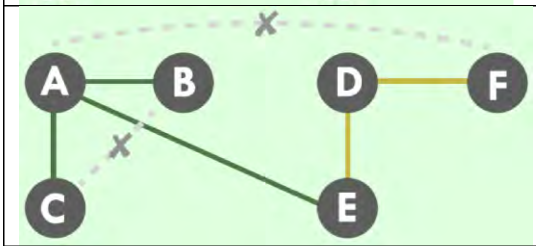
Answer Options / Interactivity Description

Integer numbers [0,10]

Answer Explanation

The correct answer is 3.

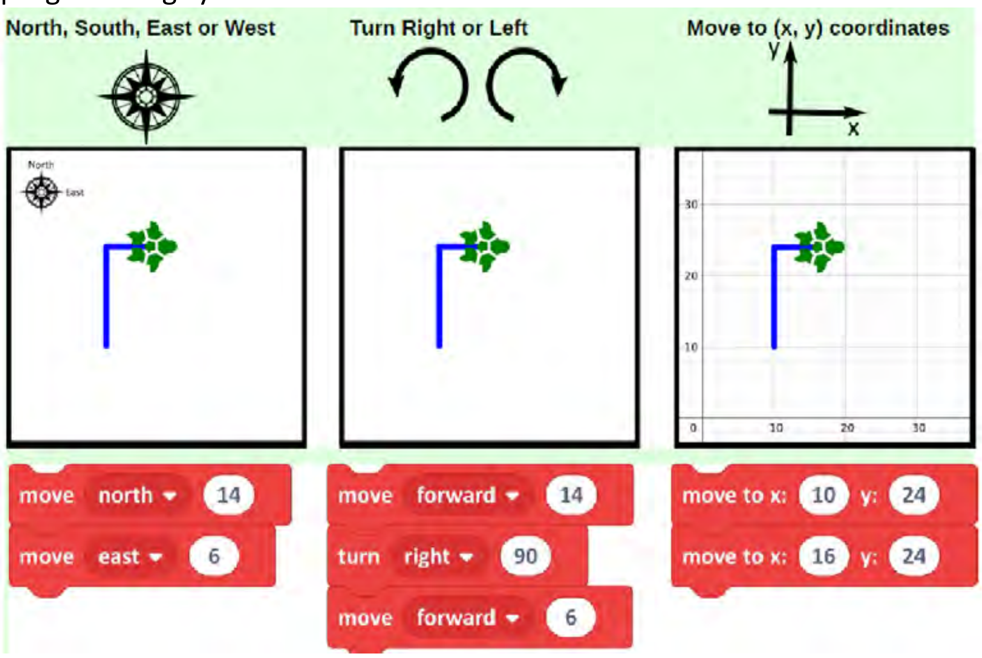
	A meets B. They wrap a seaweed around themselves. One seaweed is wrapped around otter A at this point.
	A meets C. They wrap a seaweed around themselves. Two seaweed is wrapped around otter A at this point.
	B meets C. Since they are already conneted, they won't wrap any seaweed around themselves.

	D meets E. They wrap a seaweed around themselves.
	A meets E. They wrap a seaweed around themselves. Three seaweed is wrapped around otter A at this point.
	D meets F. They wrap a seaweed around themselves.
	A meets F. Since they are already conneted, they won't wrap any seaweed around themselves.

Thus, only three seaweeds are wrapped around otter A.

80. Robot Drawing

A school has a turtle robot that has a pen which draws lines when the robot moves. The robot's movement can be programmed in different ways using three different programming systems:

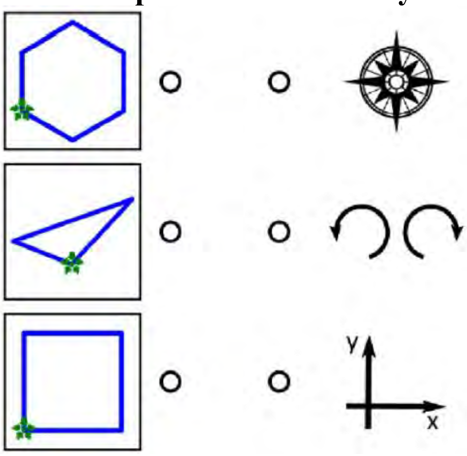


The three sets of programming commands above make the robot draw the same picture. The robot can only be programmed using whole numbers without decimals.

Question / Challenge

Connect the pictures below to the correct programming system so that the robot can be programmed to draw the three pictures using as few move to (x, y) coordinates programming commands as possible. Each programming system can only be used to draw one picture.

Answer Options / Interactivity Description



Connect points using 3 lines.

Drag and drop version: move the drawings to the symbol of the appropriate drawing system

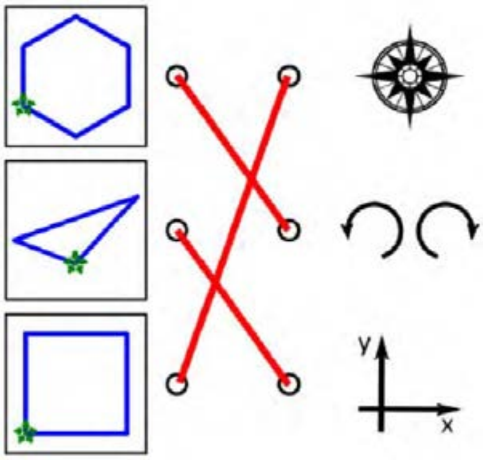
Answer Explanation

Correct answer – on the right:

Sally has two constraints:

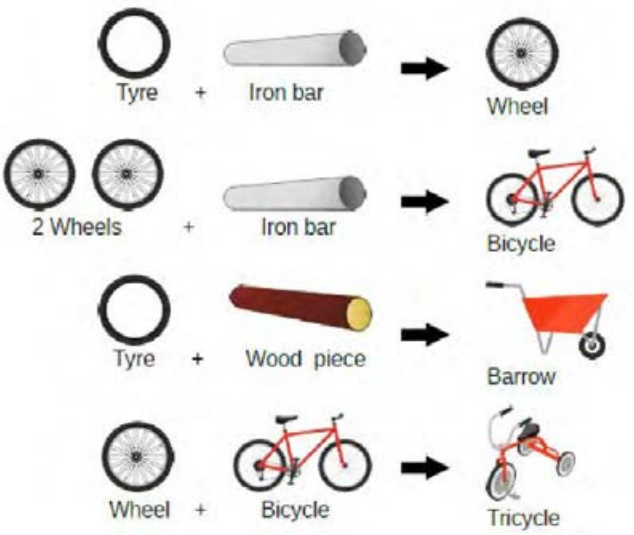
1. She must use each of the three programming systems
2. She wants to avoid using as many move to (x, y) coordinates programming commands as possible.

The North South West East programming system can only move the robot horizontally or vertically. That means that the hexagon and triangle can’t be drawn with this system, only the square can be drawn with this system.
Sally can use the Coordinates programming system for both of the remaining drawings. The triangle has three points and thus needs three coordinate commands, the hexagon has six. This means the triangle should be drawn with the coordinates programming system to satisfy the second constraint. But this is only possible if the robot can draw a hexagon using the Turn Left and Right system.
The hexagon can be programmed using the Turn Left and Right programming system because the turn block allows the programmer to choose how far to turn. Because a hexagon has six of the same angles, the robot repeats going straight and turning 60o a total of 6 times.

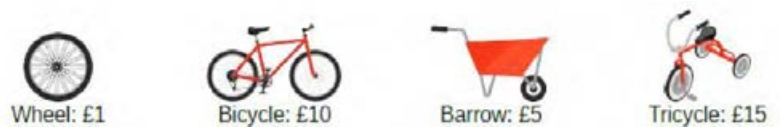


81. Upcycling A

Beavers hate waste. They like to use old worn out things as materials to make new usefulitems. This is called upcycling. It is shown below what materials are required to make a wheel, a bicycle, a barrow, and a tricycle.



Doreen loves upcycling and likes to sell the items she is making. They can be sold at the market for these prices:



Question / Challenge

Doreen has these materials: 4 tyres, 4 iron bars and 1 wood piece. What is the most money she can make by upcycling when she sells the items she makes?

(Give your answer in the form of an integer)

Answer Options / Interactivity Description

Answer: 20

The most that Doreen can make is £20.

Answer Explanation

The value of a tricycle is more than a bicycle and a wheel so Doreen should aim to make a tricycle.

A tricycle uses: 2 wheels and 1 iron bar (to make a bicycle), and another wheel.

3 wheels use: 3 tyres and 3 iron bars.

This leaves 1 tyre and 1 wood piece.

The highest value item Doreen can now make is a barrow.

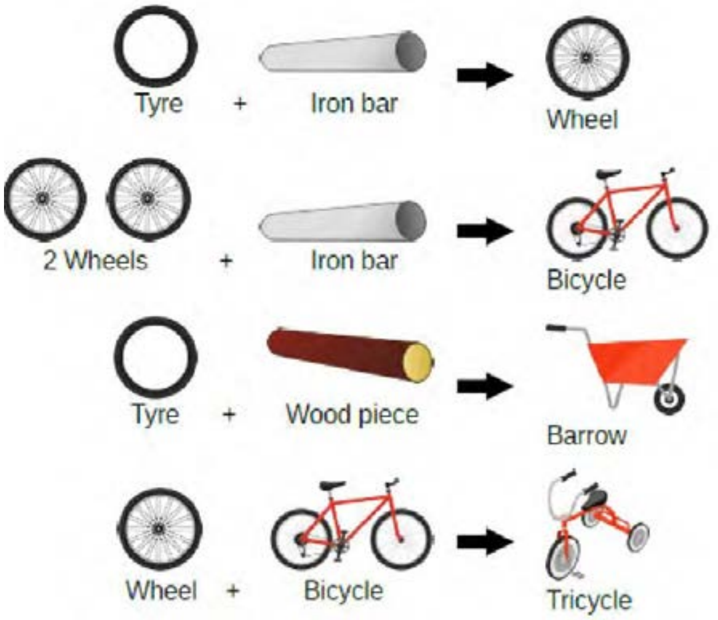
Total value of 1 tricycle + 1 barrow = 15 + 5 = £20.

This amount of £20 is the most money that Doreen can make. This occurs when she always tries to build an item of the highest possible value, given what materials she has available.

This works for the values in this task but will not always work. Can you convince yourself of this?

82. Upcycling B

Beavers hate waste. They like to use old worn out things as materials to make new useful items. This is called upcycling. It is shown below what materials are required to make a wheel, a bicycle, a barrow, and a tricycle.



Beavers hate waste. They like to use old worn out things as materials to make new useful items. This is called upcycling. It is shown below what materials are required to make a wheel, a bicycle, a barrow, and a tricycle.

Question / Challenge

Doreen has these materials: 6 tyres, 6 iron bars and 2 wood pieces. What is the most money she can make by upcycling when she sells the items she makes?
(Give your answer in the form of an integer)

Answer Options / Interactivity Description

Answer: 30
The most that Doreen can make is £30.

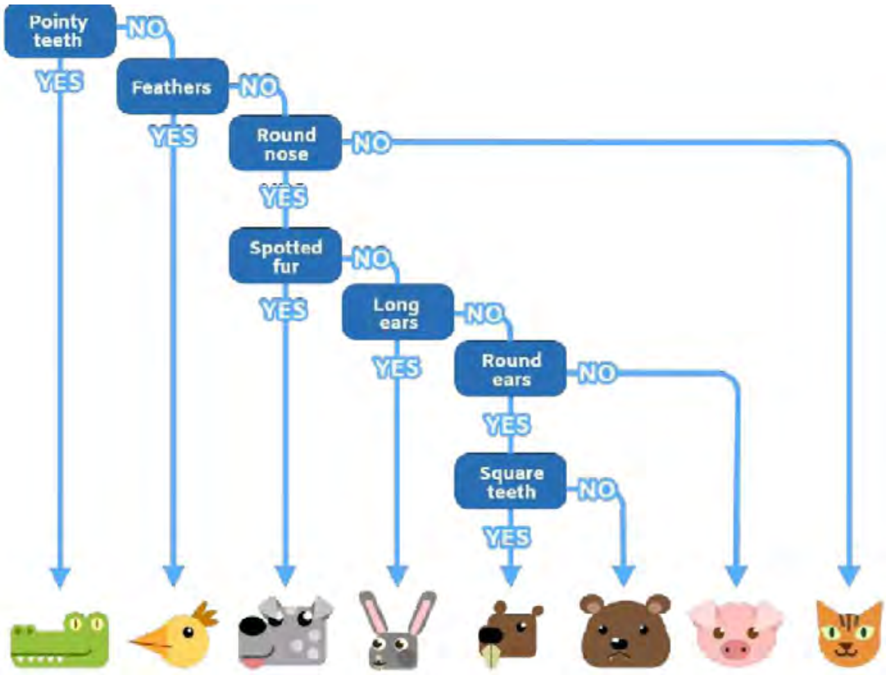
Answer Explanation

It might be tempting to think that Doreen should build a tricycle because this is the item that can be sold for the most total money. If she does, it requires 2 wheels and one iron bar (to

make a bicycle) and another wheel. The 3 wheels need 3 tyres and 3 iron bars. So this leaves Doreen with 3 tyres, 2 iron bars, 2 wood pieces.
Now, Doreen no longer has the three iron bars needed to make another bicycle so she can only make wheels and barrows. Since she has the same number of iron bars as wood pieces, and barrows can be sold for more than wheels, she should then make two barrows.
This uses 2 tyres and 2 iron bars, leaving 1 tyre and 2 iron bars.
It would now be possible to make a wheel, leaving 1 iron bar which cannot be used for anything else.
The total value of items made is 1 tricycle + 2 barrows + 1 wheel = 15 + 10 + 1 = £26. So £26 is the most money Doreen can make if she builds a tricycle.
But what if Doreen does not build a tricycle?
Doreen could make two bicycles using 2 tyres and 4 iron bars, leaving 4 tyres, 2 iron bars and 2 wood pieces. Then, she could also make 2 barrows, leaving just 2 iron bars unused.
The total value of this second strategy is 2 bicycles + 2 barrows = 20 +10 = £30. This is the maximum that can be earned given the resources available.
Can you convince yourself that no other scenarios can produce items with a greater total value?

83. Animal sorting

The animal species in Beavertown can be distinguished by their features. To identify an animal, we use a decision tree. When the answer to a question is yes you go down and when the answer to a question is no you go right.
The decision tree below distinguishes between eight different animal species. Some animals can be identified with just one question, others need seven questions before they are identified.



Question / Challenge
Click on all the animals that need more than three questions before we can identify them with this decision tree.
Answer Options / Interactivity Description
Clickable SVG.
Answer Explanation
Animal species 3,4,5,6 and 7 need more than 3 questions before we can identify them.
Animal species 1, 2 and 8 will be identified with the first three questions.

84. Mastermind

George is playing Mastermind on his computer: The computer makes up a password from 4 distinct digits. The player can submit several guesses of this password. Each time the computer responds with the number of correct digits, which appear both in the guess and in the password. Also it tells whether George placed these digits in the right positions.
George made some guesses (?). From the responses, he was able to discover the password.

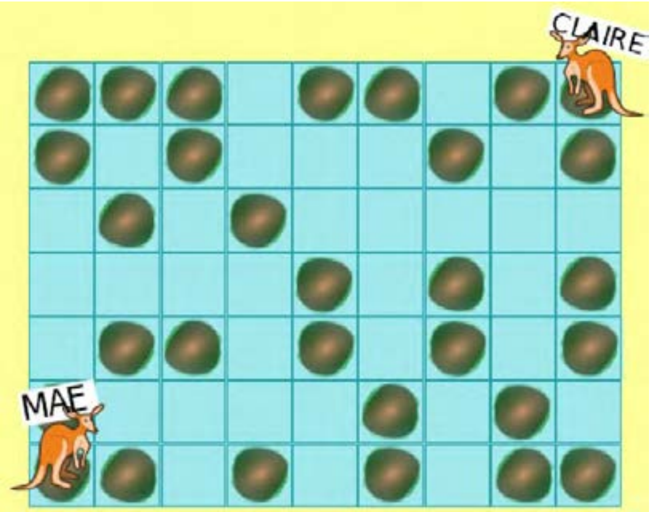
?	?	?	?	Response
5	7	2	0	One of the digits is correct and in the proper position.
6	0	3	1	One of the digits is correct but not in the proper position.
1	4	8	5	Two digits are correct but they are not in the proper positions.
1	5	9	6	None of the digits is correct.
8	1	2	5	One of the digits is correct but not in the proper position

Question / Challenge
What is the password?
Answer Options / Interactivity Description
The implementation should accept a 4-digit integer as a solution. It may also check whether all four digits are distinct, but that's a matter of taste.
It is recommendable, though, to strive for a more specific implementation. For instance, there could be four separate input fields, each accepting exactly one digit.
Answer Explanation
The correct answer is 3748. To arrive at this number we must systematically follow a procedure according to the information available. This process must be iterative. One of the ways to solve it is to subdivide the problem and first try to discover the digits and then the correct order.
From the first row (guess plus response) we know that only one of the given digits is part of the password. The second and third rows provide similar information. The fourth row then helps to extract more information from rows 1 to 3: We can discard 5 from the first guess, 6 from the second guess, and 1 and 5 from the third guess. From this last step we know that 4 and 8 are parts of the password. Then the correct digit in the fifth guess is 8; from that we can conclude from row 5 that 1, 2 and 5 are not parts of the password. If we go back to rows 1 and 2, the possibly correct numbers are 7 or 0 in row 1, and 3 or 0 in row 2. Thus, we have 5 possible numbers 0,3,4,7 and 8. Since no digit can be repeated, we can discard the 0. Therefore, the other digits that complete the code are 3 and 7.
Now we consider the information of the position or order. From rows 3 and 5, we know that 8 can be in positions 2 or 4:
?-8-?-8
and that 4 can be in all positions but 2:

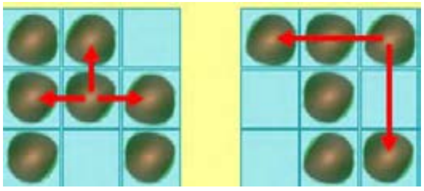
4-?-4-4
From row 1 we know that 7 must be in position 2; then, 8 must be in position 2. From row 2 we know that 3 cannot be in position 3, so that it must be in position 1. Hence, 4 is in position 3.
3-7-4-8

85. Kangaroo A

Kangaroo Mae needs to reach kangaroo Claire. To achieve this, she needs to jump on bumps in a swamp. The swamp is represented as a grid as shown below.



Mae can only perform two kinds of jumps: short and long. Short jumps are to move from a cell to any of four neighboring cells. Long jumps are to jump straight over any of four neighboring cells. The images below show short jumps on the left and long jump on the right.



Mae cannot make any other jumps (diagonal moves, jumps over two or more cells, etc.).
Long jumps are more tiring and dangerous, so she cannot make two consecutive long jumps.

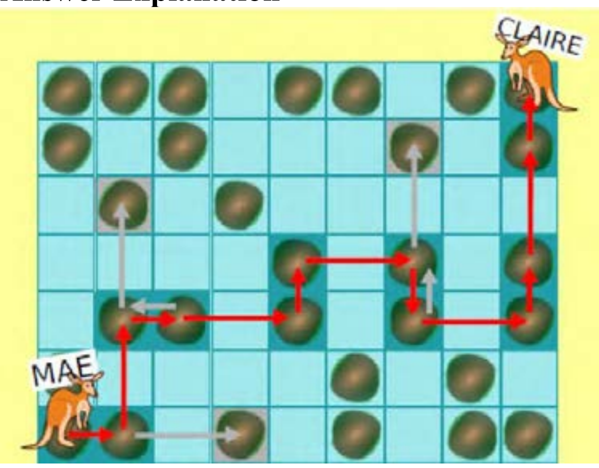
Question / Challenge

Find the way for Mae to reach Claire.

Answer Options / Interactivity Description

Construct the path from Mae to Claire by clicking on the cells in their exact order of Mae's jumps. The last clicked cell must be Claire's cell.

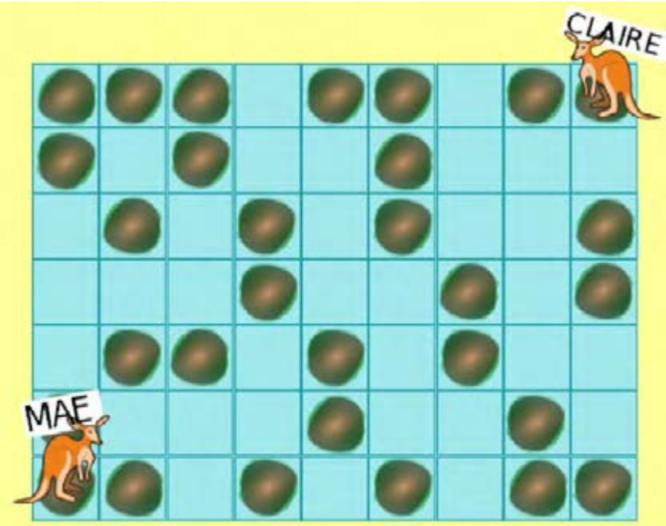
Answer Explanation



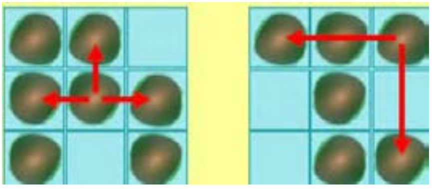
The picture above shows the solution to the problem. Other solutions may include Mae revisiting previously visited bumps several times.
There are only three bumps that Maé can reach (in gray) that are not part of her path. Otherwise, she will have to make two consecutive long jumps. After excluding these bumps from consideration, the only bumps Mae can reach are used as parts of her path in the solution.

86. Kangaroo B

Kangaroo Mae needs to reach kangaroo Claire. To achieve this, she needs t



Mae can only perform two kinds of jumps: short and long. Short jumps are to move from a cell to any of four neighboring cells. Long jumps are to jump straight over any of four neighboring cells. The images below show short jumps on the left and long jumps on the right.



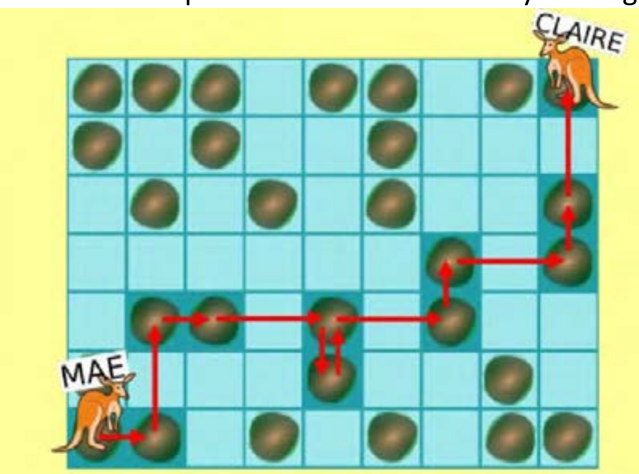
Mae cannot make any other jumps (diagonal moves, jumps over two or more cells, etc). Long jumps are more tiring and dangerous, so she cannot make two consecutive long jumps. But she can revisit previously visited bumps.

Question / Challenge

Find the way for Mae to reach Claire.

Answer Options / Interactivity Description

Construct the path from Mae to Claire by clicking on the cells of Mae's jumps

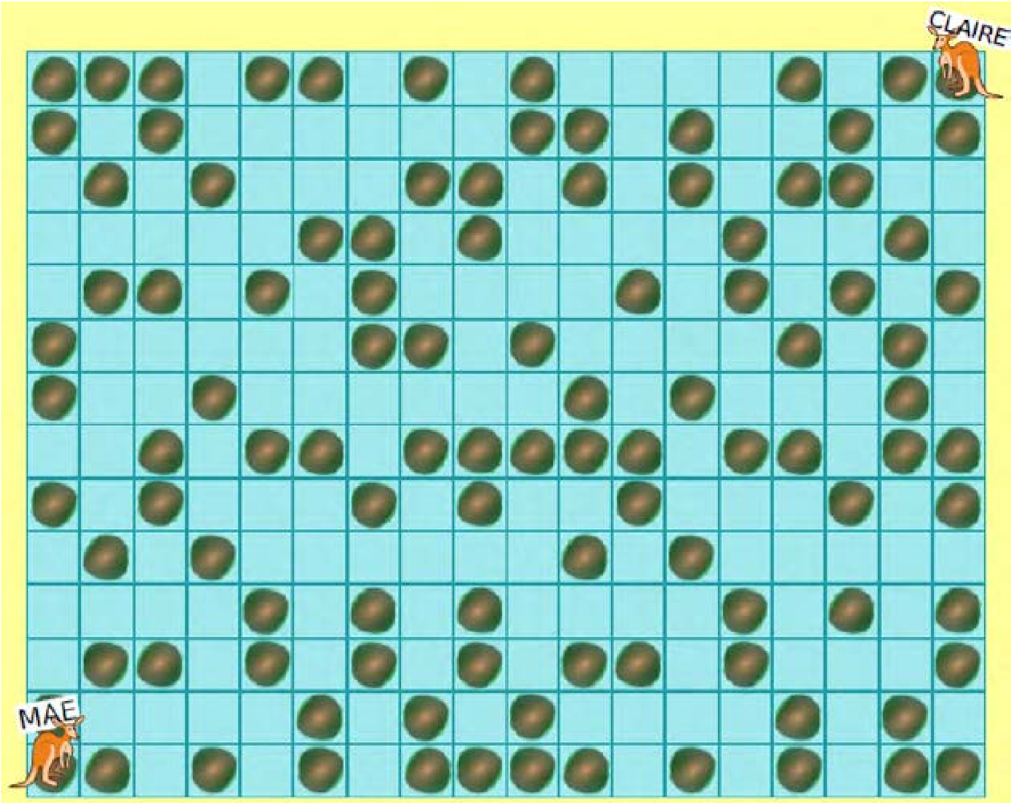


The picture above shows the solution to the problem. Other solutions may include Mae revisiting previously visited bumps several times.

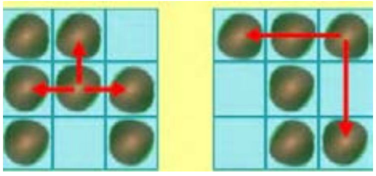
There are few one-cell sized bumps that Mae cannot visit, otherwise, she will have to make two consecutive long jumps. After excluding these bumps from consideration, the only bumps Mae can reach are used as parts of her path in the solution.
Mae can visit other bumps after reaching Claire but we excluded these possibilities.

87. Kangaroo C

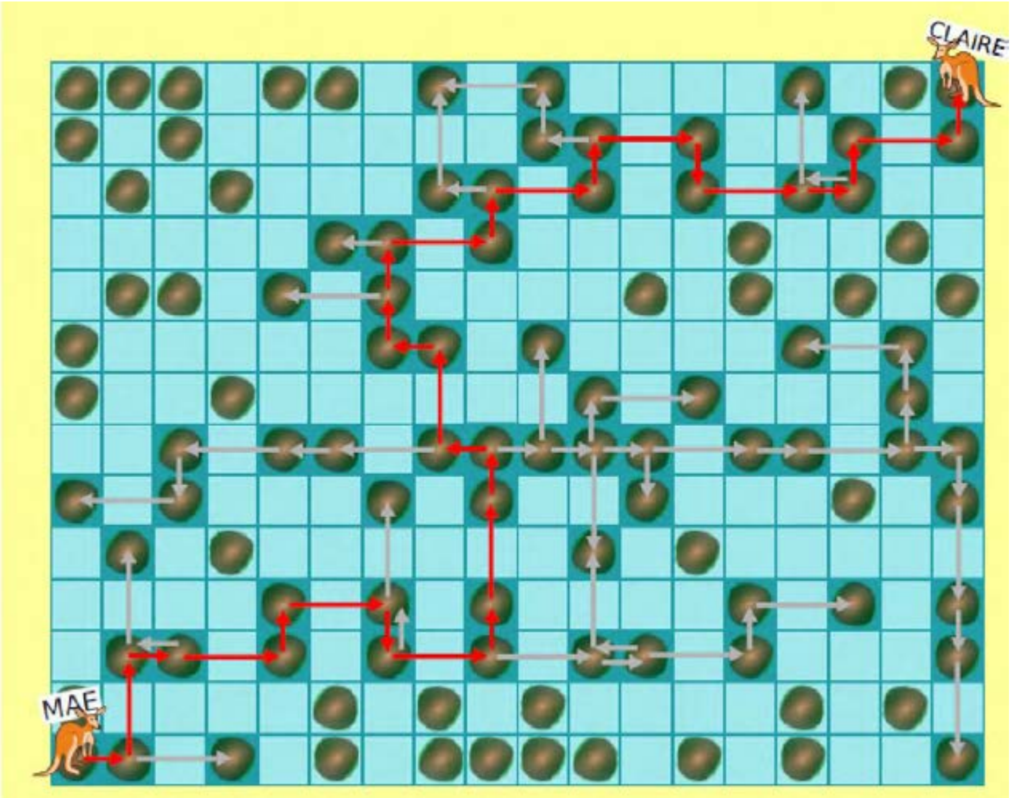
Kangaroo Mae needs to reach kangaroo Claire. To achieve this, she needs to jump on bumps in a swamp. The swamp is represented as a grid as shown below



Mae can only perform two kinds of jumps: short and long. Short jumps are to move from a cell to any of four neighboring cells. Long jumps are to jump straight over any of four neighboring cells. The images below show short jumps on the left and long jumps on the right.
Mae cannot make any other jumps (diagonal moves, jumps over two or more cells, etc). Long jumps are more tiring and dangerous, so she cannot make two consecutive long jumps.



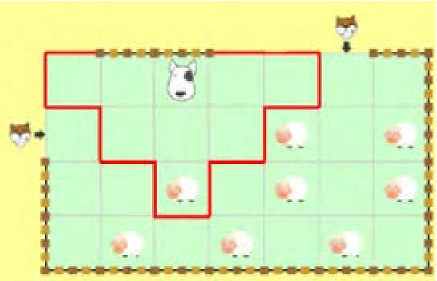
Question / Challenge
Find the way for Mae to reach Claire by clicking on the cells in the exact order of Mae's jumps. The last clicked cell must be Claire's cell.
Answer Options / Interactivity Description
Notes for interactivity (aimed :
- clicking on a cell draws an arrow from the last visited cell - clicking on a cell draws an arrow from the last visited cell and changes the background color of the cell to dark blue - a second click resets the initial background color of the cell, and so on - only the background color of the current cell can be changed - clicking on a button "undo" removes the last jump made (but leave the background color in the current state)
Answer Explanation
The picture above shows the solution to the problem.



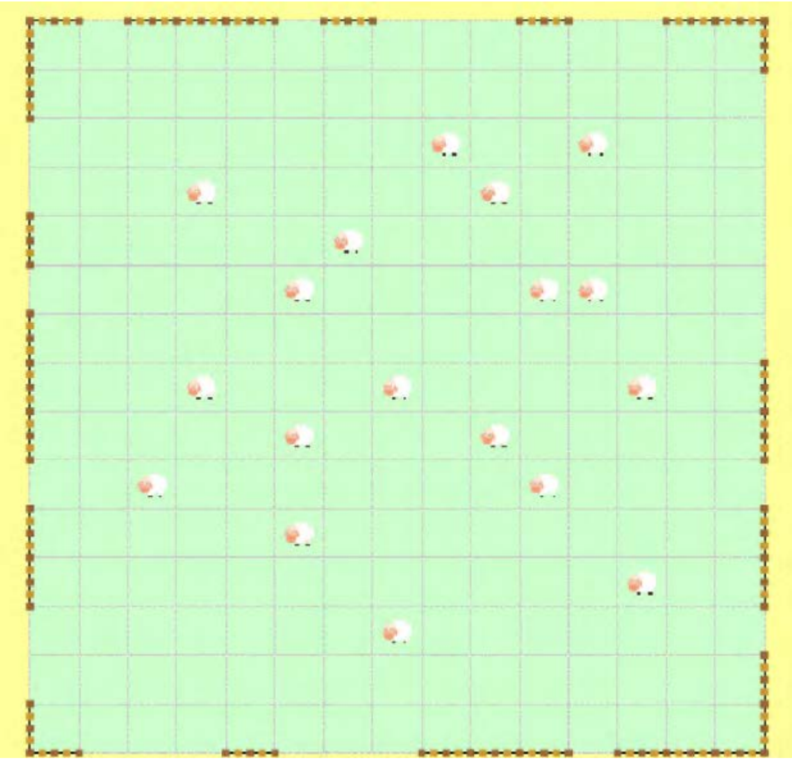
The cells with dark blue background are the cells that could be visited. A correct path is in red. The gray arrows show the paths to other accessible cells that do not lead to a correct path.

88. Fence

A pasture is surrounded by an old fence. Unfortunately, the fence has holes at several places. To protect the sheep, the farmer is going to have dogs guarding the pasture where needed, so that the foxes cannot enter into the pasture. A dog placed in a cell can protect neighboring cells at distance of two cells horizontally, two cells vertically, and one cell diagonally, as shown in the image.



The image below shows the farmer’s pasture and the holes in the fence.



Question / Challenge

Help the farmer to protect the pasture. Place a minimum number of dogs so that the foxes can not enter inside the pasture through the holes in the fence. Dogs should be placed right next to the fence.

Answer Options / Interactivity Description

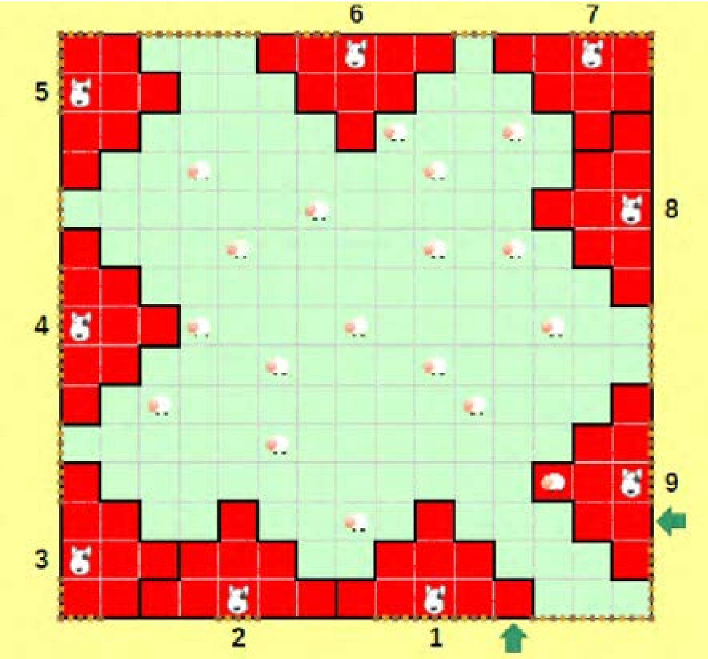
Student is to click on the image to place dogs onto the pasture. When a cell is clicked, an image of a dog appears into that cell.

After submitting the answer, if more than 9 dogs have been added, a message appears: “You can protect the pasture with fewer dogs.” If a section without a fence has been missed, the unprotected cells are highlighted and a message appears: “The pasture is not protected.”

Answer Explanation

The minimum number of dogs needed is 9.

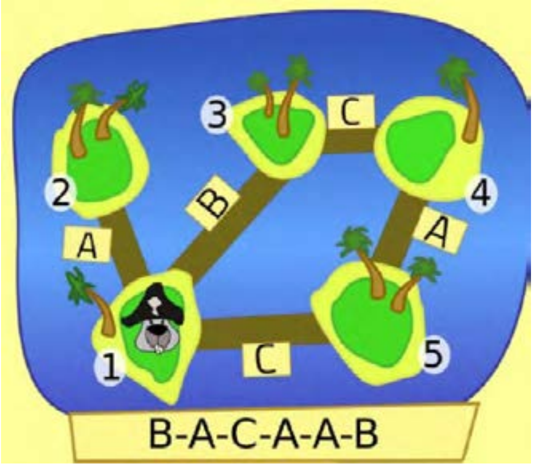
The image below shows how to achieve one optimal result.



One can see that the two holes marked with green arrows in the image, cannot be protected by one dog. Thus one of the possible approaches of solving this problem is to start from one of the cells and place dogs using a “greedy” strategy. If starting from the left hole marked with the arrow, we’ll achieve the placement shown in the image. Note that the solution is not unique, there are other good placements of 9 dogs.

89. Treasure Island


Pirate Pierre lives on Island 1, as shown on the map. He has been given a secret code: B-A-C-A-A-B. This code tells him which bridges to cross to get to a hidden treasure.



Sometimes, the code has a letter for a bridge that is not directly reachable from the island Pierre will be on. In this case, he must ignore that letter and move to the next letter in the code.

For example, if the code was A-B-A, Pierre would cross Bridge A, from Island 1 to Island 2. Then he would stay on Island 2 because there is no Bridge B. Finally, he would go back to Island 1, taking Bridge A again.

Question / Challenge

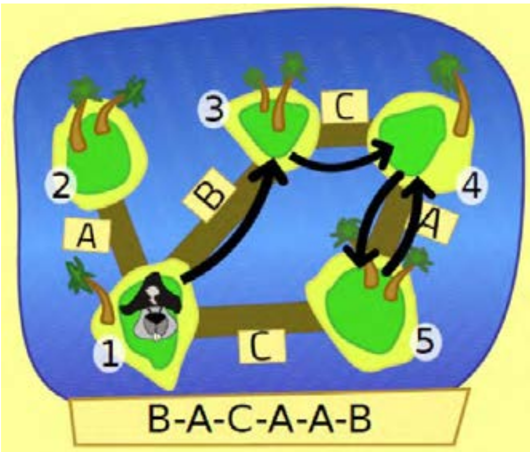
*T*he code is B-A-C-A-A-B. Click on the island where the treasure is hidden.

Answer Options / Interactivity Description

You can click on one of the five islands.

Answer Explanation

Island 4 is correct.



Starting at Island 1:

B … Pierre crosses Bridge B to come from Island 1 to Island 3

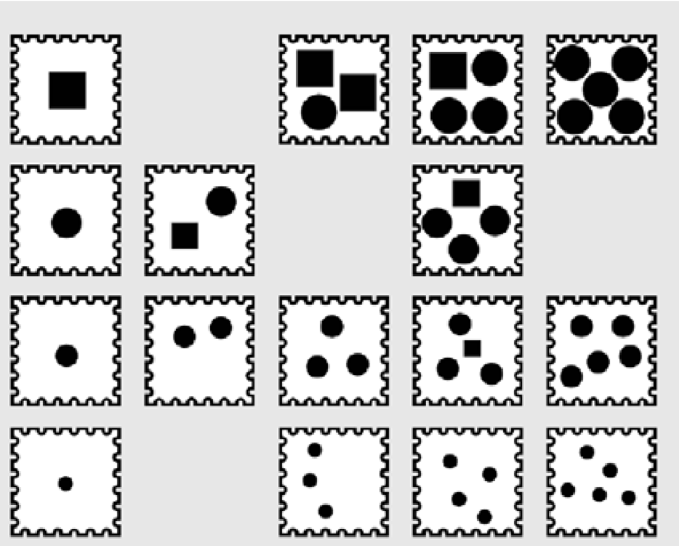
A … He stays on Island 3 because there is no Bridge A

C … He crosses Bridge C to come from Island 3 to Island 4

A … He crosses Bridge A to come from Island 4 to Island 5
A … He crosses Bridge A to come from Island 5 to Island 4
B … He stays on Island 4 because there is no Bridge B

90. Stamp Collecting

Beavers love collecting and organising stamps by their designs. Beaver Jo has accidentally dropped some stamps!

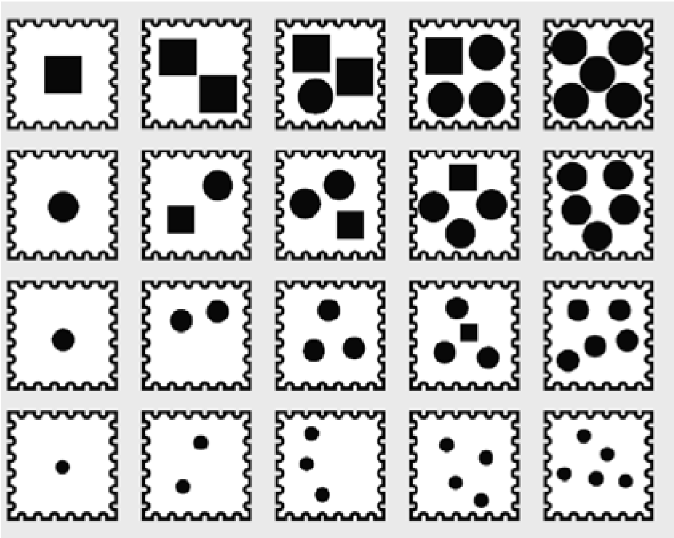


Question / Challenge

Help Jo organize them by dragging and dropping the stamps into the correct positions.

Answer Options / Interactivity Description

Drag the correct stamps into positions



Answer Explanation

The correct answer follows the application of two rules:

- The number of objects increases left to right
- The size of the shapes on the stamp decreases from top to bottom down the collection

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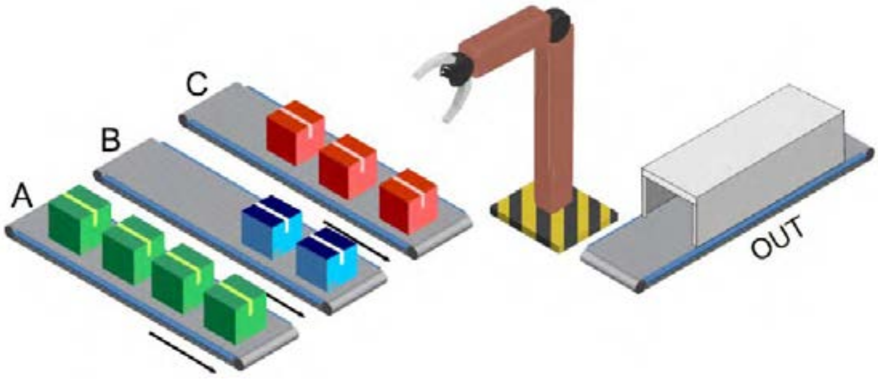
91. Processing objects

A robot arm takes objects from three conveyor belts (A, B and C) to move them to the processing conveyor belt (OUT).
Here is how the robot arm works:
it first takes an object from A and moves it to OUT,
it then moves to B, takes an object from B and moves it to OUT,
finally, it does the same steps with C, before starting again from A (step 1).
When there is no object to pick on a conveyor belt, the robot arm waits until one becomes available, because the processing unit needs one object from each to proceed.



Question / Challenge

Given the situation shown on the picture, and knowing that no new objects will arrive on the conveyor belts (A, B and C), how many objects will be moved by the arm?
Answer Options
An integer between 0 and 9.

Answer Explanation

The correct answer is 7. Indeed, the arm will first move an object from conveyor belt A, then one from B and finally one from C (which is already 3 objects). It then goes back to A, followed by B and C (which makes now a total of 6 objects).
Finally, the arm starts again with A (which makes now a total of 7 objects) and then moves to B where there is no more object. Since no new objects are coming, the arm will be stuck on B after the two complete iterations.

92. Tree Sudoku

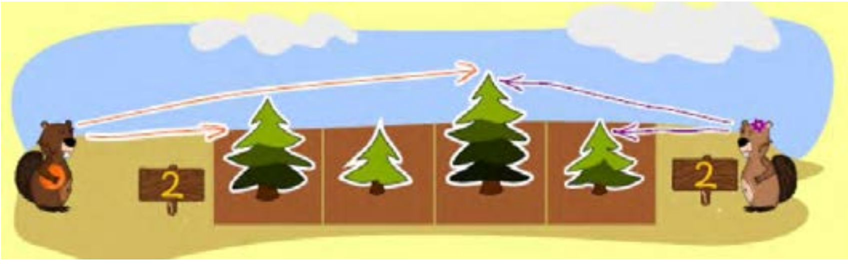
A beaver's field is divided into 16 plots arranged in a 4 x 4 grid where they can place one tree in each plot.

They plant 16 trees of heights 

in each field by following the rule:

• each row (a horizontal line) contains exactly one tree of each height
• each column (a vertical line) contains exactly one tree of each height

If beavers observe the trees in one line (see figure) they can not see trees that are hidden behind a taller tree. At the end of each row and column of the 4 x 4 field the beavers placed a sign and wrote on it the numbers of trees visible from that position.



Kubko has written down the numbers on the signs correctly but he placed some trees in wrong plots.

Question / Challenge

Can you find the mistakes Kubko made and correct the heights of the trees?
Click on a tree to change it's height.

Answer Options / Interactivity Description

Interactivity set-up:

• When clicking on a tree it should increase the size of the tree by one. When the largest tree is clicked on 4 ( ) it will begin with tree size 1 ( ) again.
• There should be a reset button to undo all the changes.

Answer Explanation

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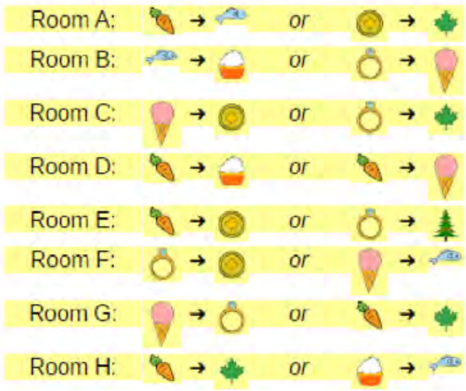
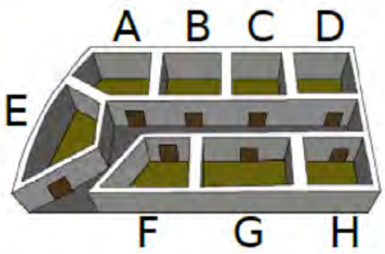
When looking at Kubko's original field description, the placement of the trees follows the rules (Each row and each column contains four trees of all four heights) but the numbers on the signs do not correspond to the numbers of trees visible from each position.
To solve, identify any rows or columns that are correct: the numbers on the signs match the visible trees. Rows 2 and 3; and columns 2 and 4 should not be changed as they are correct. Any rows or columns that have the incorrect number of trees visible from the signs will need to have some tree sizes changed. Rows 1 and 4 and columns 1 and 3 have signs showing the incorrect number of trees seen, and thus must have incorrectly placed trees.
Using this logic, we can identify the plots which are at the intersection of these rows and columns that need to be changed (shaded red in the figure below). Changing only the height of these trees with mistakes means that the correct rows and columns remain unchanged. In the first column, swap the trees in red. This will ensure the signs read correctly. Similarly in the 3r column.
By changing the trees in these four positions until all rows and columns obey the rules (Each row and each column contains four trees of all four heights) and are the correct height for the signs, you can solve this problem.

93. A Beaver at the Castle

A smart beaver needs a fir tree to build a dam on a river. But he only has one carrot. At Grandson Castle there is a trade today and exchange is possible. The beaver goes there with his carrot and hopes to exchange it for a fir tree.

In each room two exchanges are allowed according to the following table





Question / Challenge

What is the sequence of rooms the beaver has to go in, to ensure that he will eventually get a fir tree ?

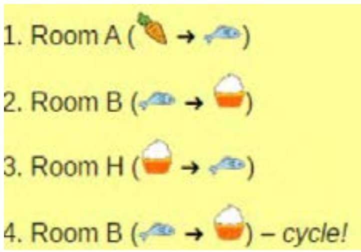
Answer Options / Interactivity Description

DGE / GGE / AGE / DBC

Answer Explanation

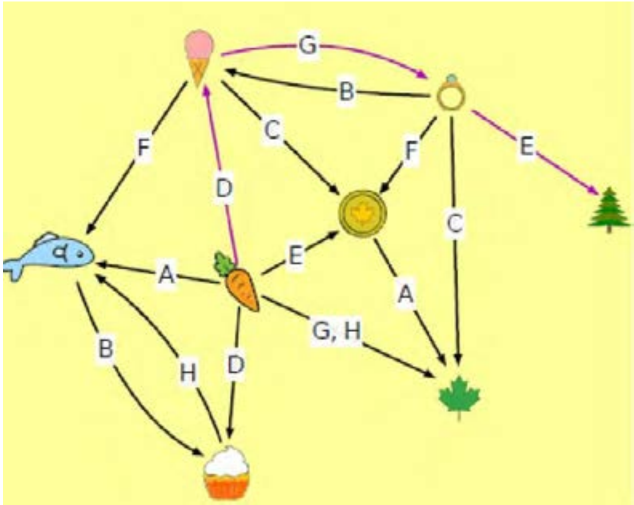
The correct answer is: DGE. In the Room D, the beaver exchanges his carrot for an ice cream cone . After that he moves to the room G to exchanged the ice cream cone for a ring . Finally, the beaver goes to the room E to exchange the ring for the fir tree .

While looking for a feasible room order, mainly two distinct strategies can be followed. The first one is a longer way and is based on the idea that the beaver can initially exchange the carrot in five rooms (A, D, E, G and H) for 6 objects. After that all following possibilities should be considered. This can even generate endless cycles if no exit conditions is provided. One of that situations is illustrated below:



The second strategy is a shorter way and is based on "upside down" principle. The starting point is in the Room E as it is the only room where the beaver can get the fir tree . This fir tree was exchanged for a ring . We can see that the ring can be obtained only in the room G by exchanging for an ice cream cone . With the last step we have to control how can we get an ice cream cone. This exchange is only possible in the room B for a ring or in the room D for a

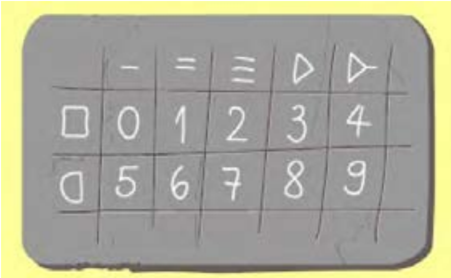
carrot . As the beaver has only a carrot the room D is the correct one. So, this is what we were looking for — namely, to connect the path that leads from the carrot to the fir tree .
The structure of of the table with the possible paths can be represented as a graph. Each node of it represents an object to exchange and each outgoing edge represents a visiting room for the exchange:



The visual representation of a sequence of rooms allows in an easier manner trace the connection between the carrot and the fir tree . We can easily verify that DGE is the correct answer.

94. Secret Digits

Beaver homes are numbered using symbols instead of digits according to the table shown:



For example, the digit 5 is written by locating the digit in the table and then combining its row symbol with its column symbol to create the new symbol .

Here is a picture of one beaver's home:

Question / Challenge

What digits are on this beaver's home?

Answer Options / Interactivity Description

Open-integer task should ideally accept for correction all four-digit numbers, i.e., matching the regexp [0-9]{4}.

Answer Explanation

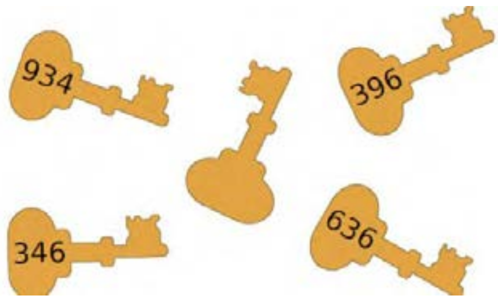
The digits on the beaver's home can be figured out by using each symbol on the home to find the correct row and column and then finding where the row and column meet.

Therefore, the digits on the beaver's home are 1973.

95. Jacques The Porter

Jacques is a porter in an apartment building. There are five apartments. Each apartment is occupied by one beaver. Leaving for work, the beavers give their keys to Jacques.
To not mix up the keys Jacques uses a locker for each apartment. On each locker stands the first three letters of the owner's name.

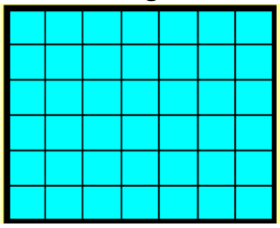
For security reasons, no names are written on the keys. Instead Jacques labelled three digits to the keys to indicate the owner. For all the keys the same letter always corresponds to the same single digit.
Once all lockers fell down and the keys crumbled. One of the labels got lost.



Question / Challenge
What label is lost?
Answer Options / Interactivity Description
496
Answer Explanation
The locker BEB is the only one where the first and the third letter is B. So, this locker matches with the key 636. Now we know that the letter B corresponds to 6 and the letter E to 3. The locker AER is the only one that ends with R. Thus, the letter R corresponds to 4 and the only suitable key is 934. Based on that the letter A corresponds to 9. Now we can match EAB with 396 and ERB with 346. So, the locker RAB is the only one left and the label is 496.

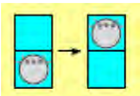
96. Don't crash

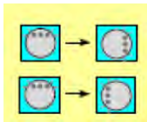
A robotic vacuum cleaner  moves in a room of 6×7 squareshaped tiles with walls surrounding it.



The robot is always in the middle of a square and is oriented towards one of the four walls. It can be moved according to a program built of these commands:

• STEP: move to the next tile in front of the robot (always according to its current orientation)





• LEFT: turn 90 degrees anticlockwise while staying on the same tile
• RIGHT: turn 90 degrees clockwise while staying on the same tile

Now assume the robot is to execute the following program:
STEP LEFT STEP RIGHT STEP

Question / Challenge

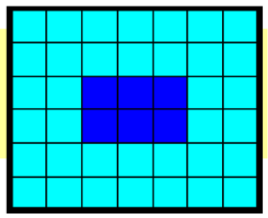
Interactive: On which tiles can the robot can start and execute this program without crashing into a wall, no matter what its initial orientation is? Click on the tiles to mark them.
Open-answer variant: On how many tiles can the robot can start and execute this program without crashing into a wall, no matter what its initial orientation is?

Answer Options / Interactivity Description

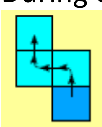
Interactive task. Each square in a table is interactive, after clicking on it a fill color is changed, second click causes return to the original fill color.
For open-answer variant: Integer numbers from [0,42].

Answer Explanation

The correct answer is shown in a picture on the right.
Open-answer variant: The correct answer is 6.



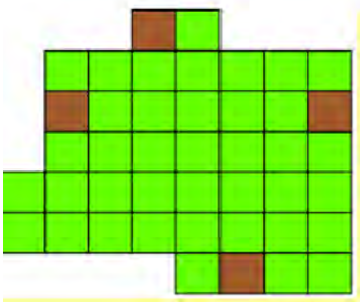
During execution the program, the robot went two tile forward and one tile left:



One must take care that this movement must be able to happen in all four possible orientations for a starting tile to qualify.

If the robot started on any tile directly touching the walls (call it border tile) or on any tile touching any border tile, there is (at least) one orientation (pointing at the nearest wall) where the robot would crash while executing the program.
The marked "central" tiles are safe because they are far away enough from the walls.

97. Rabbit paddock



Jirka is playing with 4 robots on the grid shown that consists of regular tiles (green) and charging station tiles (brown). The robots move according to a program built using these commands:

STEP – move forward to the next tile in front of you 

LEFT – turn 90 degrees anticlockwise, don't move forward 

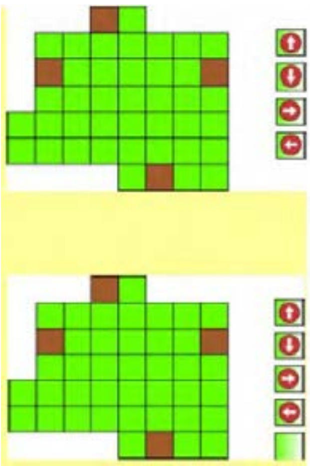
RIGHT – turn 90 degrees clockwise, don't move forward 

Question / Challenge

Jirka wrote a program STEP LEFT STEP STEP and downloaded it to all 4 robots. Place 4 robots on green tiles and set their directions so that after executing the program, each of them ends up at a different charging station without crashing into each other. Notice that all robots execute the program the same time.

Answer Options / Interactivity Description

Interactivity - drag and drop version:

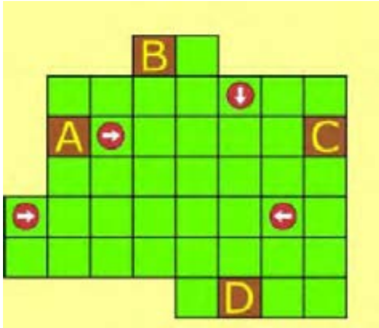


There are 4 decks of draggable cards (on the right to the grid). The player should drag those cards to the grid. Each deck must contain at least 4 cards of the same arrow so that user could set the same direction for all 4 robots.

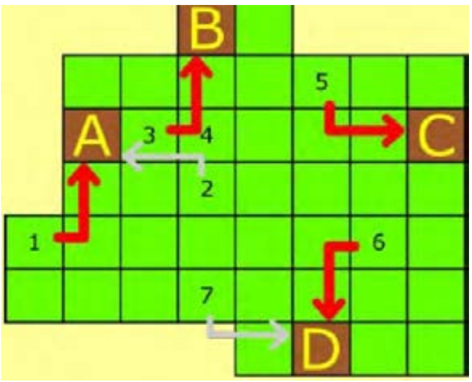
Interactivity – clickable version:

After clicking on any green cell, the next icon from the list of 5 icons is shown on this cell. The player should click on the chosen cell until the correct icon appears. These 5 icons are 4 arrows and an empty cell, which is initially shown on each cell. This set of 5 icons is shown on the right of the picture.

Answer Explanation
The correct answer, graphically showing the correct positions and orientations, is:

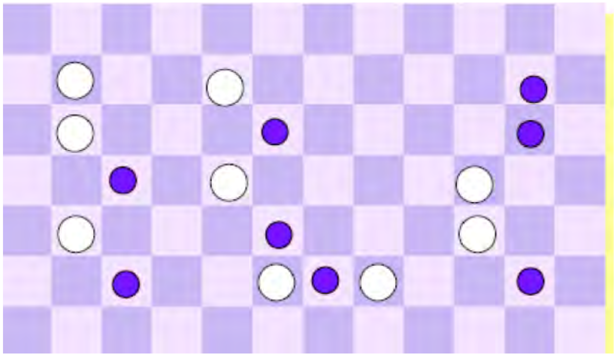


The correct solution is found as follows.
Note, during the execution of the program, each robot travels along a path that is the shape of a rotated reflected character L, starting from its shorter "leg".
We will use the table on the right with numbered cells in our explanation.
The charging station B is reachable only from the cell 3 because starting from cell 5 a robot crashes into a wall.
Cell 6 could be a starting point for a walk to charging stations C or D. However, while charging station C is reachable from cells 5 and 6, charging station D is reachable only from cell 6 (because starting from cell 7, the robot crashes into a wall). So cell 6 must be used as the starting point for the walk to charging station D. As a result then, cell 5 must be the starting point for the walk to charging station C.
There are two cells where a robot could start walking to reach charging station A: 1 and 2. If a robot starts from cell 2 and at the same time another robot starts from cell 3, they crash each other in cell 4 after execution of first step of the program. So charging station A is reachable only from cell 1.



98. Moving Plates

Who is on duty to clean the kitchen today?



The nickname of the person is hidden in the white plates and blue cups on the table. Find the nickname by following this instruction:

Do this once with each plate:

If the plate is not next to a cup (on the left or on the right), move the plate to the next square on the right.

Question / Challenge

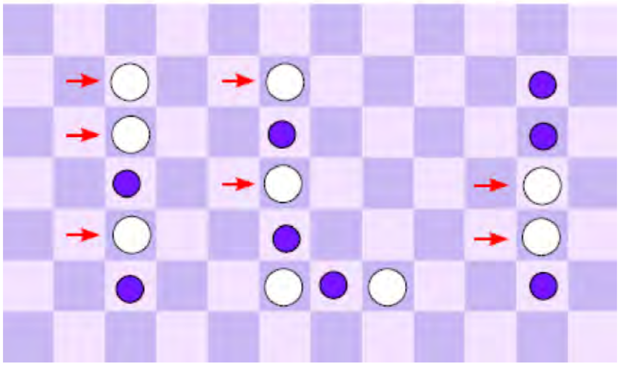
Enter the three letters of the nickname.

Answer Options / Interactivity Description

Strings of 3 capital letters.

Answer Explanation

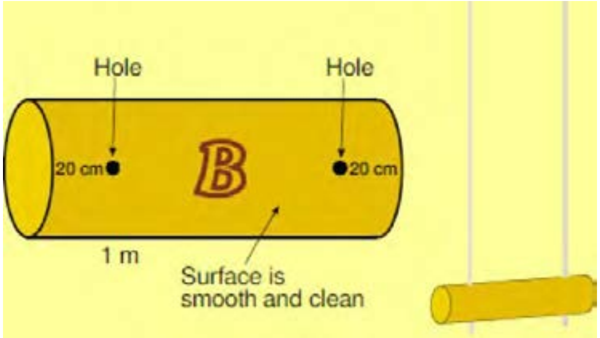
The nickname of the person in charge is ILI.



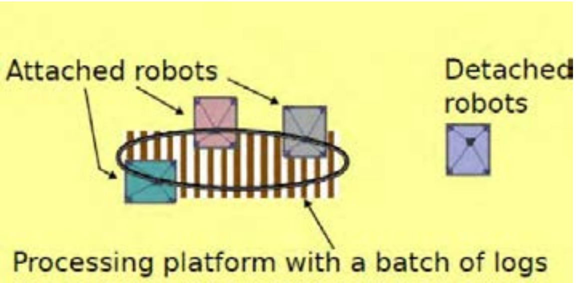
The image shows which plates will be moved to the right, and which will stay in the initial position after executing the instruction.

99. Wood Processing

In a factory, a team of robots work on the wooden logs to produce swing seats, like in the images. To produce swing seats following four robots are needed.



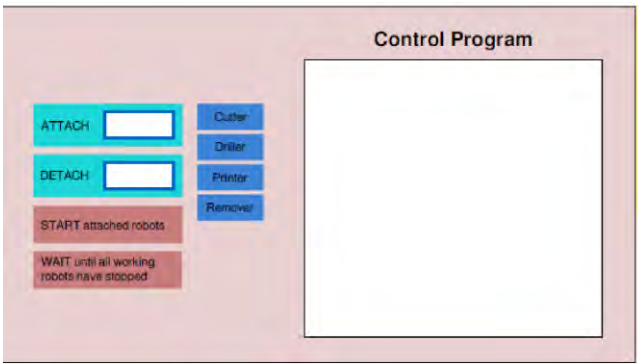
Cutter: Cuts a log on one side to make it 1 m long.
Driller: Drills holes through the log in a distance of exactly 20 cm from the left and right.
Printer: Prints the company's logo in the middle of a smooth and clean log surface.
Remover: Removes the bark and makes the surface smooth and clean.



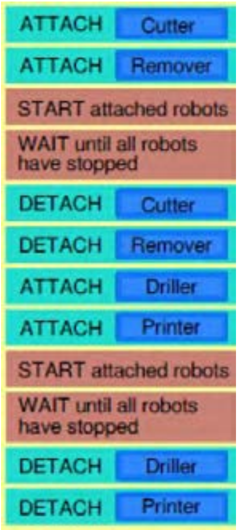
In order to work a robot has to be attached to the processing platform. Multiple robots may be attached at the same time to work in parallel.
A robot starts working when it gets a START command from the Control Program. A robot stops working after it has processed all logs in the batch. The commands in the Control Program are executed one after the other. At the end of the Control Program all robots have to be detached from the production line.
A new delivery of wooden logs will be used to make swing seats. Logs are longer than 1 m. You will need to write a time efficient Control Program to process the new batch of logs.

Question / Challenge

Compose a Control Program to process the logs to make swing seats. Arrange the commands such a way that each robot completes its task in suitable order and as efficiently as possible.

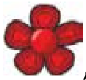
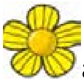
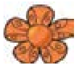


Answer Options / Interactivity Description
The command blocks can be moved with drag&drop.
Answer Explanation
The image shows a possible solution.
Most efficient way is to run multiple robots at the same time in parallel if it is possible. It is possible first to pair up the Cutter and the Remover and later the Driller and the Printer. The order of commands for the Cutter and the Remover can be interchanged and similarly the commands for the Driller and the Printer may be interchanged without changing the effect of the program.
The Cutter and the Remover work first in parallel starting at the same time.
The Driller and the Printer start working in parallel after the other two have stopped working. This is because they both need logs, which are exactly 1 m long. The Printer additionally needs logs with a smooth and clean surface.



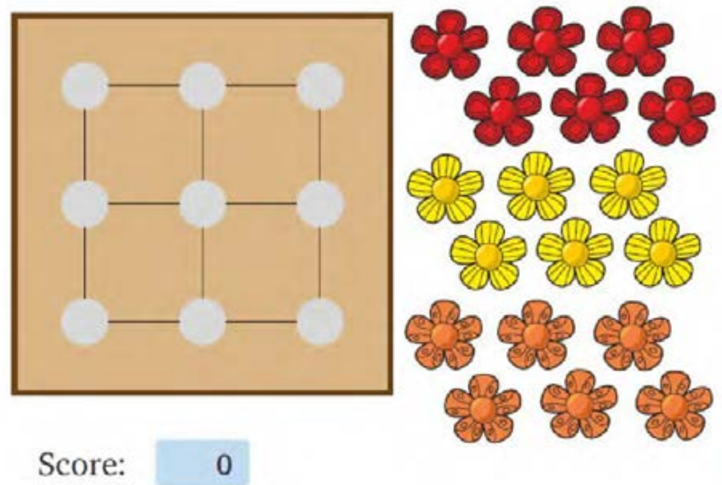
100. Flowerbox

Ben loves flowers. He has a new indoor flowerbox,
which can hold an arrangement of 3x3 flowers.

He has three kinds of flowers: red , yellow  and orange .
Now Ben is looking for the perfect arrangement of these flowers in the flowerbox.
Ben gives a score for a flower arrangement.
He looks at flowers that are next to each other: on the left, on the right, above, or below.
If a red flower is next to a yellow flower, Ben adds 3 points to the score.
If a yellow flower is next to an orange flower, Ben adds 1 point to the score.
For all other cases, Ben does not add points to the score.
All colors must appear in the arrangement.

Question / Challenge

Create a flowerbox arrangement with the highest possible score.
Drag flowers from the right onto the spaces in the flowerbox.
The score of your arrangement is shown below the flowerbox.



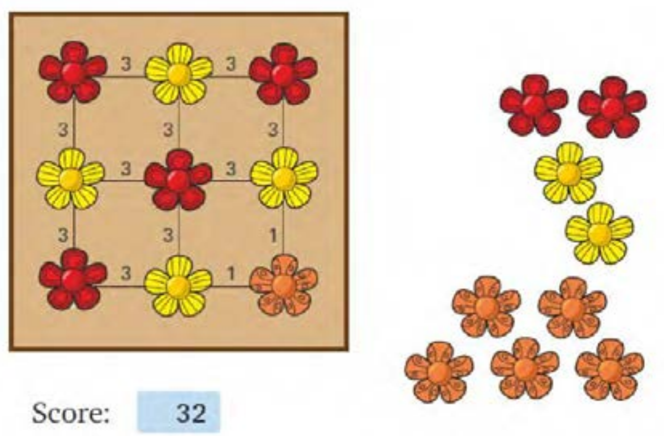
Answer Options / Interactivity Description

Interactivity is like described above: Flowers can be dragged from the "repository" on the right and dropped onto the gray spaces in the flowerbox. A dropped flower is "consumed" and no longer visible in the repository. Dropping a flower on an occupied space replaces the flower on that space; the replaced flower goes back to the repository.
Acceptance of answers and the level of feedback can be implemented in various ways, depending on the practice of the particular country.
Things that you may consider:

- Whether to accept or not (give a warning and not allow to submit) answers where not all flower spaces are occupied.
- Whether to accept or not (give a warning and not allow to submit) answers where not all the three kinds of flowers are used.
- Whether the current number of points is shown at all, if it is shown after placing each flower or only when all gray places are filled.

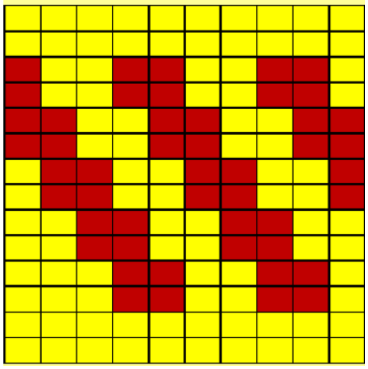
Answer Explanation

Note that Ben assigns points to pairs of flowers that are next to each other in the flowerbox arrangement. In the image, these points are shown at the lines connecting the "next-to-pairs". Obviously, the flowerbox arrangement with the highest possible score should have as many next-to-pairs of red and yellow flowers as possible. At least one orange flower must appear, though. In order to help with the score, this orange flower must be part of next-to-pairs with yellow flowers – but as few as possible.
Therefore, the only orange flower must be put into a corner, where it can become part of only two next-to-pairs.
(Note that it does not matter which corner to begin with; so there are four correct solutions.)
At all other positions, the orange flower would be next to more than two other flowers. In order to achieve at least a few points, yellow flowers must be put next to the orange flower. From then on, put red and yellow flowers next to each other in order to achieve the highest score. See the result of this process with the orange flower in the lower right corner:



101. Konavoskivez

Lina loves Konavle embroidery in yellow and red. She wishes to learn how to make some of the patterns, and her friend Tereza gave her only one instruction and “code”:
Instruction: “Look from the bottom up and from left to right”



And read this “Code”:

8.4.2
6.4.4
4.4.6
2.4.4.2.2
2.2.4.4.2
6.4.4
4.4.6
2.4.4.2.2
2.2.4.4.2
6.4.4

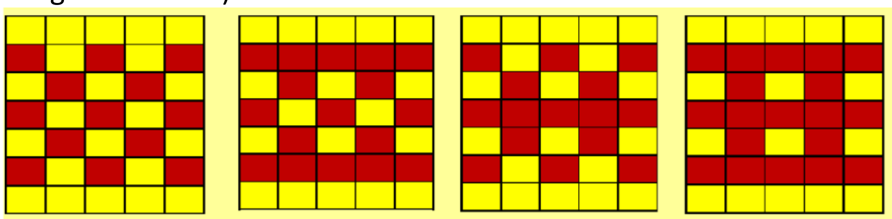
Question / Challenge

Teresa gave each family member a “code” for new samples. As real computer scientists, they shortened the “code” and wrote down only the repeating part.
Drag each code to the matching pattern.

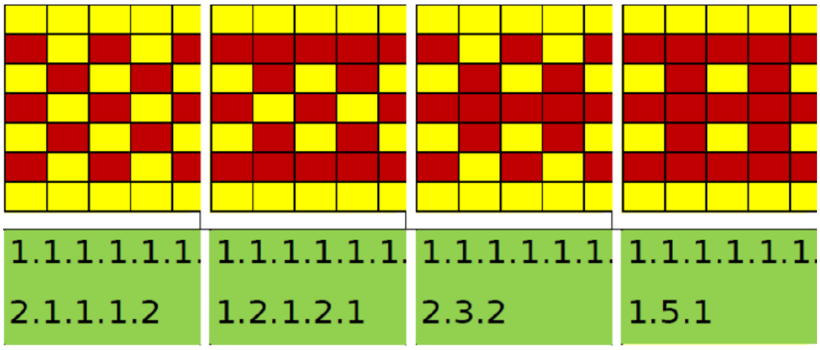
1.1.1.1.1.1.	1.1.1.1.1.1.	1.1.1.1.1.1.	1.1.1.1.1.1.
2.1.1.1.2	1.2.1.2.1	2.3.2	1.5.1

Answer Options / Interactivity Description

(patterns and codes are to be presented in random order; the contest system is able to check the given answer)



Answer Explanation



From the example, we notice that each row in the code represents one column on picture. It is important to follow Tereza's instructions and start looking from the bottom left corner upwards.

Continuing this process for each row in code and each column on picture we get the algorithm.

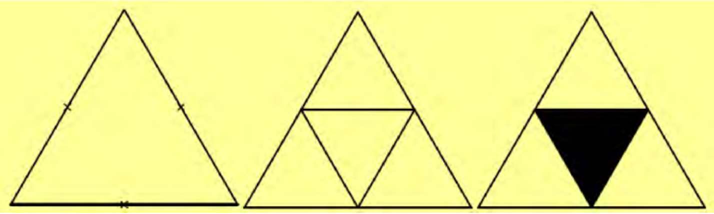
The first rows in all the patterns in question are all the same. The differences appear in the second rows and you need to check which pattern matches each code.

102. Sierpiński triangle

To form a Sierpiński triangle, an initial equilateral triangle is drawn. For each iteration the following set of steps are repeated for each triangle that is not black:

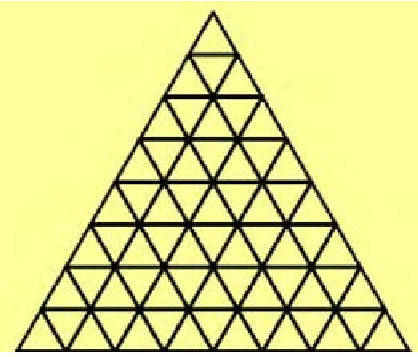
• Mark the centers of the sides of the triangle.
• Connect these three centers to each other to form a four new triangles.
• Color the newly formed center triangle black.

The following graphic shows the first set of steps:



Question / Challenge

For this question the set of steps are only iterated three times.
Color those triangles that will end up being black.
[For the contest system only:] Click on each triangle to change its color. Possible outlines of the triangles are presented to help you, they are not part of the solution.

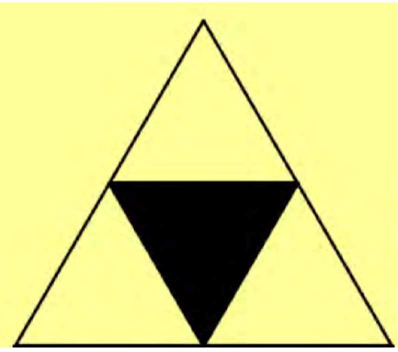


Answer Options / Interactivity Description

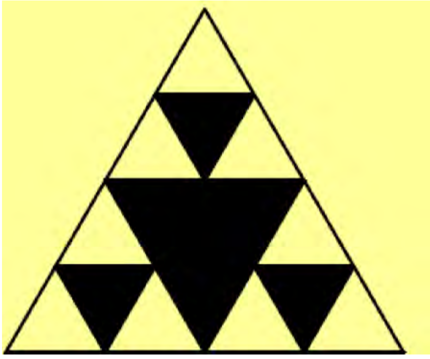
The student should be able to click on any of the 64 small triangles and the color should change from white to black and then back from black to white.

Answer Explanation

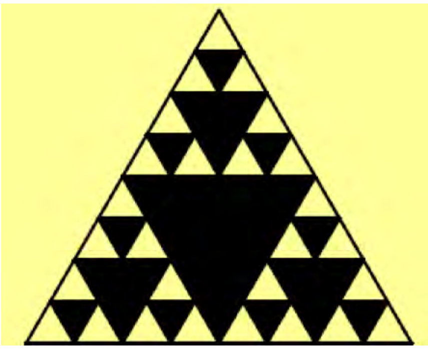
For the first time that the set of steps are repeated, the single center triangle gets colored black:



For the second time that the set of steps are repeated, every one of the four triangles gets divided into four sub-triangles each. The center triangle of each of these four triangles gets colored black. For the original center triangle this coloring does not make a difference, because it's already painted black, but three other newly colored black triangles appear:



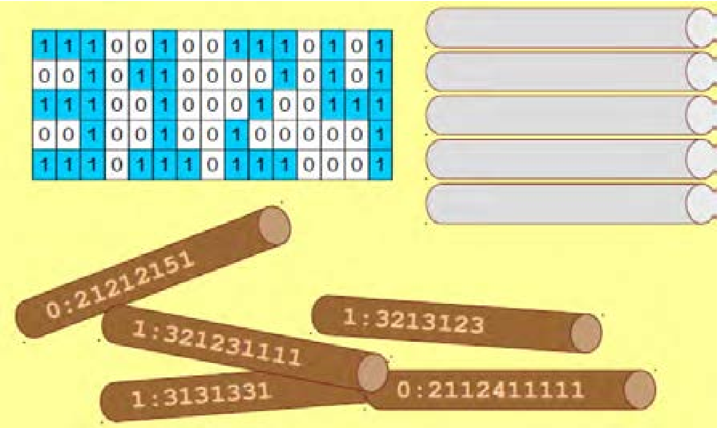
For the third and last time that the set of steps are repeated, the same thing happens to every one of the 16 sub-triangles (or simply of the 9 white sub-triangles, because all others are already colored black). That creates 9×4=36 new sub-sub-triangles of which 9 are colored black:



Therefore this is the (only) correct solution.

103. Party message

Beaver Ann is using a secret coding to send messages to her friends. She is preparing a party and she wants her friend to give the entrance password. She has engraved a secret party message for her friend on five sticks, but she got the sticks order mixed up. What order should the sticks be?



Question / Challenge

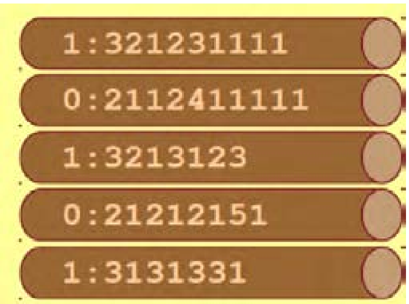
What order from top to bottom should sticks be? Drag the sticks to their appropriate places.

Answer Options / Interactivity Description

Drag the sticks in the correct order.

Answer Explanation

The correct answer is:



Each stick compactly describes a row of the binary string encoding the message. The first digit on each stick tells if the line of the image starts with white or blue square (0 for white and 1 for blue). Numbers after the ":" tell how many squares of each alternating colour will follow.

By observation we may deduce that the stick starts with the first binary digit, then, after the ":", it lists the number of zeros or ones that follow. For instance, 1:321231111 means that we have 3 ones, 2 zeros, 1 one, 2 zeros, 3 ones, and so on, corresponding to the first row of the message 1 1 1 0 0 1 0 0 1 1 1 0 1 0 1 .

Example: The fist line of the image begins with blue square (1). The ":" is to be followed by a digit showing the number of squares in that colour (3 for three blue squares). This is followed by 2 whites followed by 1 blue followed by 2 whites and so on.

The top stick should have following code:

1	1	1	0	0	1	0	0	1	1	1	0	1	0	1

first square blue : 3b 2w 1b 2w 3b 1w 1b 1w 1b 1w

1 : 3 2 1 2 3 1 1 1 1 1

The second line of the image begins with white square so the first digit on the stick will be 0. There is 2 whites followed by 1 blue, followed by 1 white, followed by 2 blues and so on:

0	0	1	0	1	1	0	0	0	0	1	0	1	0	1

first square white : 2w 1b 1w 2b 4w 1b 1w 1b 1w 1b

0 : 2 1 1 2 4 1 1 1 1 1
Following three sticks are matched to the corresponding lines of the image in the same way.

104. Creatures zoo

A zookeeper wants to allocate creatures to different enclosures in groups of three different creatures. Some creatures eat only fish, others eat only plants:

Because there is too much vegetation, there has to be at least one plant-eating creature in each enclosure.

Question / Challenge

The zookeeper has arranged the creatures as follows. Click on the enclosures where they forgot to put a plant-eating creature:

Answer Options / Interactivity Description

For an interactive task, the player would select the enclosures representing their answer by selectively clicking them. The selected encosures should appear highlighted or have a checkbox to give visual feedback. The selection should toggle naturally (clicking twice unselects the option).

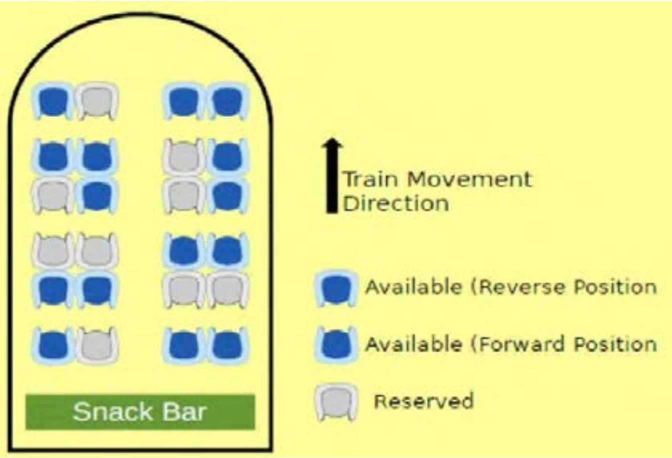
For a PDF or printed version of the task (i.e. non-interactive), the question could be how many enclosures do not have a plant eater, or, alternatively, which is the only enclosure that does or does not satisfy the constraint.

Answer Explanation

The correct answer is that the zookeeper forgot to put a plant eater in the first and third enclosures. The two other enclosures have at least one plant-eating creature each:
the second enclosure has a pink plant eater (and also a white plant eater), and the fourth enclosure has a purple plant eater.

105. Train Ticket Reservation

Alex and Bob decided to go on a train trip this weekend. When they accessed the train reservation software to book train tickets, the following screen appeared.

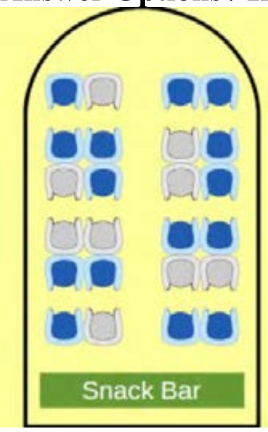


Here is what Alex and Bob should consider to book the tickets:
- Reserved seats cannot be selected.
- Alex and Bob want to sit next to each other.
- Alex wants to sit in the forward position because of motion sickness.
- Bob wants to sit as close as possible to the snack corner.

Question / Challenge

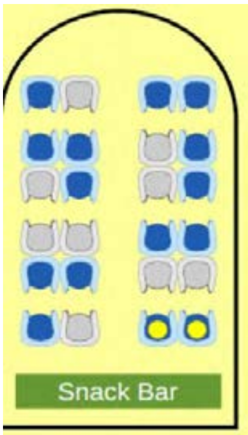
Let's click on two seats that can satisfy both Alex and Bob's considerations.

Answer Options / Interactivity Description



Answer Explanation

The correct answer is:



Two of the available seats must be consecutive. The places that satisfies this are the yellow circles in Fig. 1.

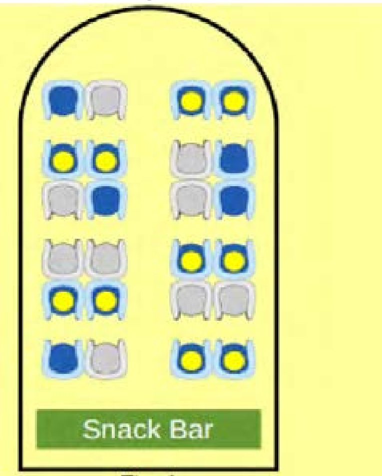


Fig. 1

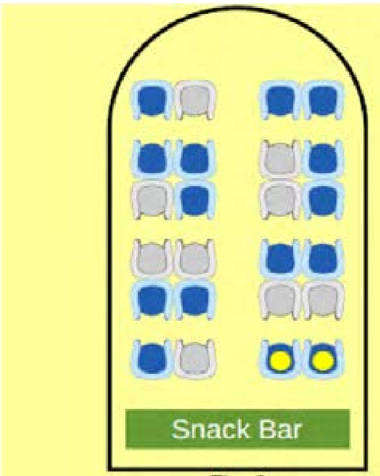


Fig. 2

On the other hand, Alex wants the forward position, and Bob wants to be close to the snack corner. The place that satisfies all of this is the two forward seats in the last row. Therefore, the correct answer is shown in Fig. 2.

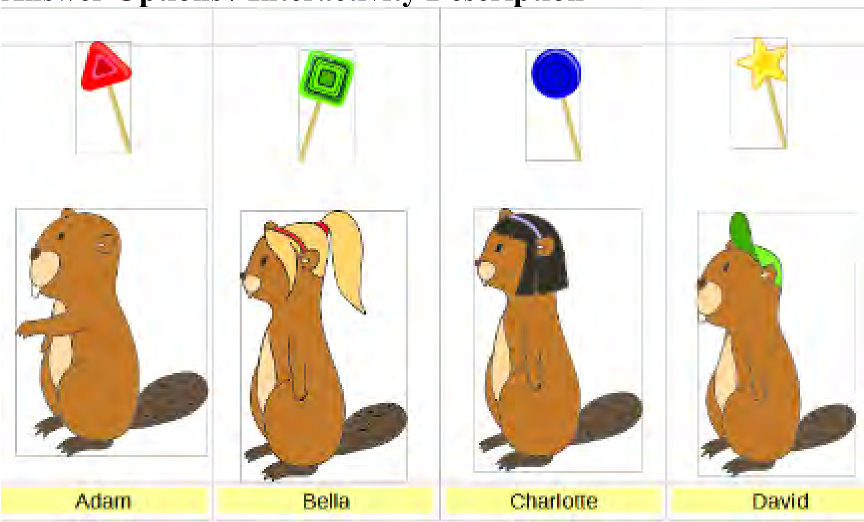
106. Handing out Candy

A dad beaver wants to give his four children candy of different shapes and colors.
Adam says, “I don’t want a red candy.”
David says, “I want a star candy.”
Bella says, “I want my candy to be a square or a triangle.”
Charlotte: “I want a red candy.”

Question / Challenge

How can dad hand out the candy, so that each child gets the candy he or she wishes?
Connect candies and children using straight lines.

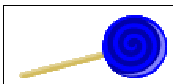
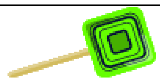
Answer Options / Interactivity Description



Adam Bella Charlotte David

Answer Explanation

The correct answer is:

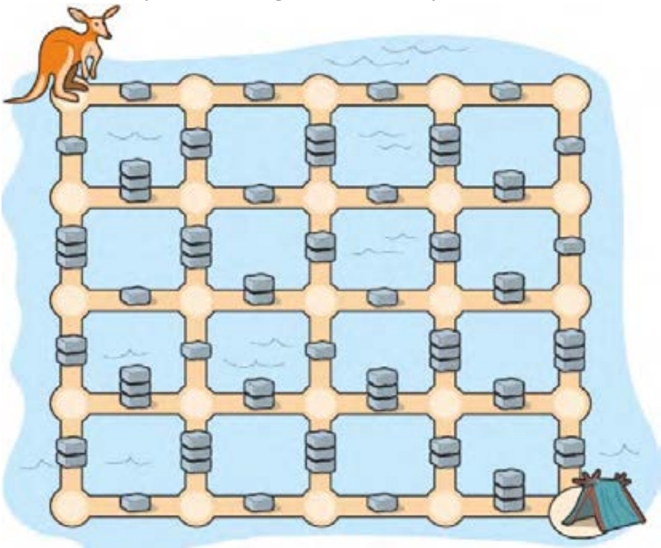
			
Adam	Bella	Charlotte	David

Since Charlotte wants a red candy, dad should give her the triangle one. Bella wants a square or a triangle candy. But the triangle candy already goes to Charlotte, so Bella should get the square candy.

The blue circle and yellow star candies are left. Adam said that any candy is fine except for red, but David wants the star. Dad should give the star candy to David and finally the circle candy to Adam.

107. Jumping kangaroo

A kangaroo jumps home. She can jump only along the path, only vertically (up – down) or horizontally (left – Right) and only if there are not more than two bricks in the way.



The kangaroo wants to be home as quickly as possible.

Question / Challenge

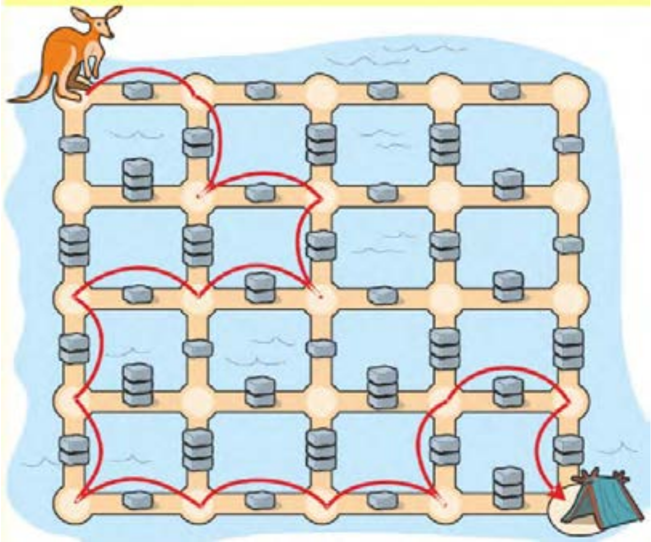
How many jumps does the kangaroo need to make?

Answers

Open integer

The correct answer is:

14 jumps. Solution is shown in picture below.

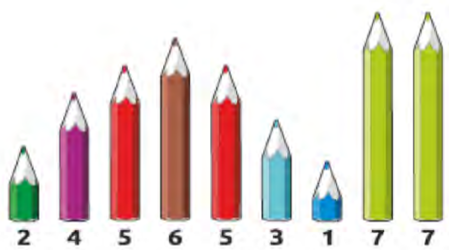


108. Sorting the pencils

There are nine pencils in a line on Theresa's desk.
She plays with them comparing the lengths of two neighboring pencils. She changes the order of neighboring pencils, applying the rule:
If the left pencil of two neighboring pencils is longer, swap the two neighboring pencils, otherwise leave them in the original order.

Going from left to right, she applies the rule to each pair of neighboring pencils in the line, until she reaches the end of the line. Note that she applies the rule eight times. This we call the procedure.
The image shows the initial line of pencils. Each number indicates the length of the pencil above.

The left picture shows the pencils on the table, after she has performed the procedure once. The picture on the right shows the pencils after she has performed the procedure second time.



Question / Challenges

Write down the lengths of the pencils in the correct order, after she has performed the procedure four
times.

Answers

Answer Explanation

The correct answer is:

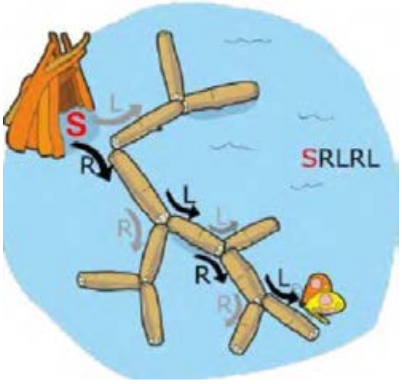
2	4	5	3	1	5	6	7	7

The picture on the left shows the pencils after the third execution of the procedure, after she went from left to right again applying the rule until she reached the end of the line.
The picture on the right shows the pencils after the fourth execution of the procedure.

As you see, pencils are going to be sorted in ascending order.
In every turn the actual longest pencil moves to the right until it reaches the same or longer one.
When it reaches the end of the strictly increasing line it remains there till the next execution of the procedure. When it reaches its final position at the right end, it does not move again.
If no swapping is performed during the execution of the procedure, the pencils are in ascending order and Theresa stops.

109. A tree structure

Beavers built an incredible structure from logs, starting at their lodge S.

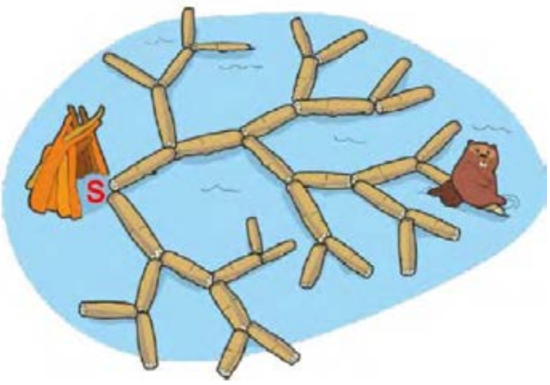


A path to each log can be described by using the two commands L (for left) and R (for right). For example, the path to the butterfly is:

S R L R L

Question / Challenge

Describe the path from the lodge S to the relaxing beaver.



Answers

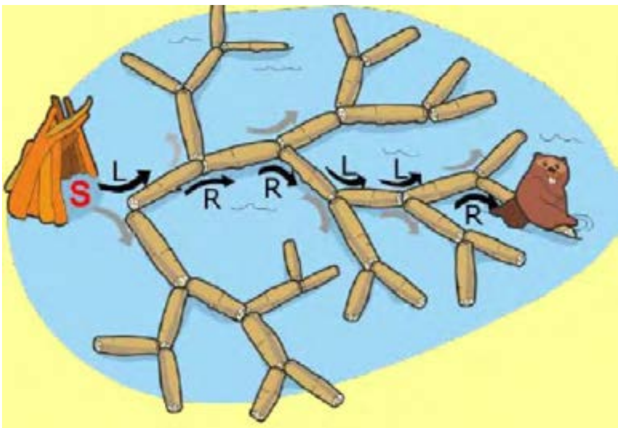
S									

The correct answer is:

Correct answer is: **S L R R L L R**

Just by looking to the picture, you can see that first move to the right won't lead to relaxing beaver.

So it has to be left. Then you go until you reach next fork and choose direction by looking on which side is the beaver.



110. Remembering a Password

Beaver Pfifikus wants to create a password that he can remember, but cannot be guessed easily by anybody else. So he uses a special method to create his password.
Beaver Pfifikus likes to say this sentence:

I like goulash made by Chef Wilhelm

So he uses this sentence to create his password:

I1l4g7m4b2C4W7

Question / Challenge

Using the same method, what password will you get from this sentence:

I learn informatics from Miss Hannah

Answer Options / Interactivity Description

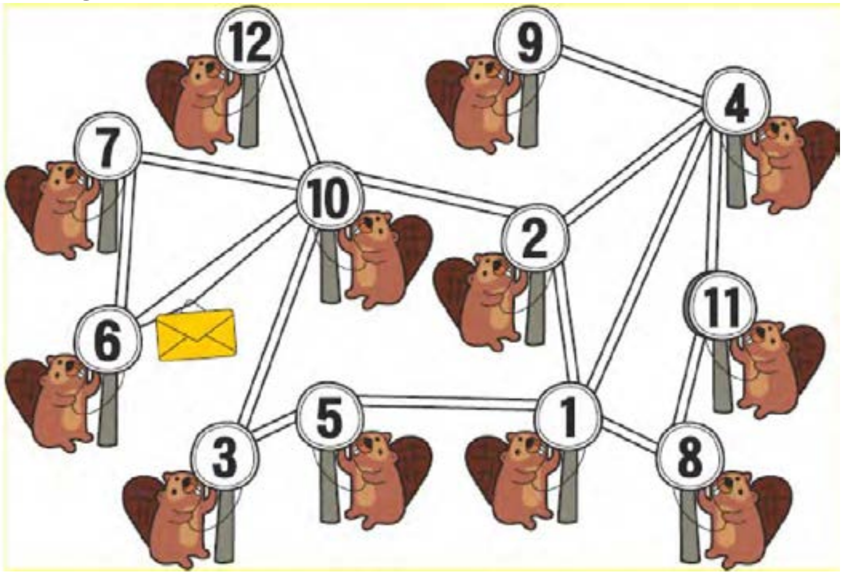
Strings of 12 alphanumerical characters.

Answer Explanation

Correct answer is: I1l5i11f4M4H6
The beaver used a special method to create his password. The method takes the first letter of each word, followed by the length of the word (the number of letters in the word):
I → I1
like → l4
goulash → g7
made → m4
by → b2
Chef → C4
Wilhelm → W7
Using the same method, we can also create the password for the new sentence:
I → I1
learn → l4
informatics → i11
from → f4
Miss → M4
Hannah → H6
So the password for the new sentence is: I1l4i11f4M4H6
Take note that in the example given, the letters C and W are both capitalised in the password.
This means that if a letter is capitalised in the sentence, it is also capitalised in the password. Therefore the letters M and H must also be capitalised in the answer.

111. Spreading the news

There is a large colony of beavers, where 12 Beavers live. Each one has his own hole but as we can see on the picture the holes are connected with ropes the beavers use to transfer the messages.



The beavers really like to be informed about the events as quickly as possible. Whenever one hears a good story he immediately uses all the ropes in his hole to inform the other beavers. For example, if the beaver in the hole 8 hears a story, he informs beavers in holes 1 and 11. The next ones who will hear the story, are the beavers in holes 2, 4 and 5 and so on, till all the beavers know the latest story.

Question / Challenge

Which beaver you should inform if you wanted the story will be known to all beavers as soon as possible?

Answer Options / Interactivity Description

Integer number from [1,12].

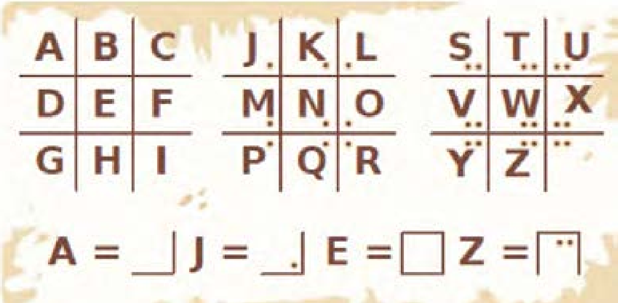
Answer Explanation

The correct answer is 2.

If the story is told to beaver #2, it will be distributed to all the other beavers in 2 steps. In the first step beavers 4, 1, and 10 are informed. They inform all other beavers. So all the holes are on a distance at most 2 from hole 2. There is no other hole for which this is possible, or even a hole with distance 1 to all other holes.

112. Pigs cot code

Beaver found the explanation of an old secret code system named pigs code.
It makes use of three diagrams with nine cells each. The very last cell contains a blank (or space). The rest of the cells contain a letter each.
The first diagram uses no dots, the second one has one dot in every cell and the third one has two dots in every cell.
You can now notice that the borders of a cell, along with the dots in it uniquely determine a letter.



In the picture you can see the codes for A, J, E and Z.
A has no dots, and two borders (one to the right, another to the bottom).
J has one dot, and two borders (one to the right, another to the bottom).
E has no dots and all four borders (top, bottom, right, and left).
Z has two dots, and three borders (left, top, and right).

Question / Challenge

Which word is written down here?

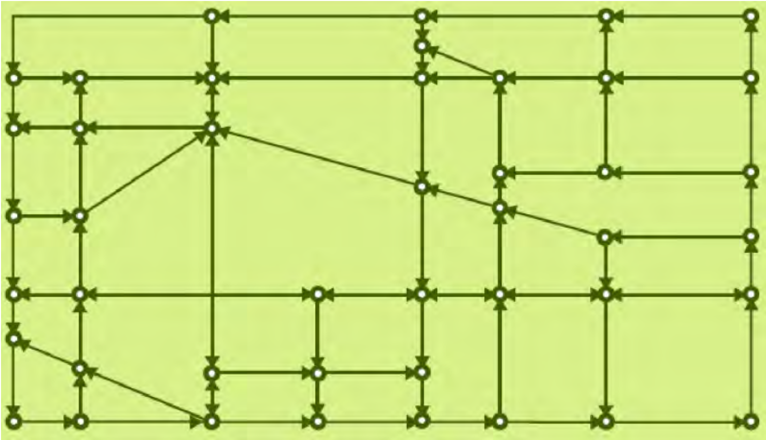
Answer Options / Interactivity Description

Enter a string:

Answer Explanation

The correct answer is INTERNET.
There are five kinds of letters in the word. You can first count the number of dots in a cell to identify the diagram, then you look at the borders around the cell.
The first letter, with no dots and two borders (left and top), is I.
The second letter, with one dot and all four borders, is N.
The third letter, with two dots and three borders (left, bottom, and right), is T.
The fourth letter, with no dots and all four borders, is E.
The fifth letter, with one dot and two borders (left and top), is R.
The remaining three are repetitions of letters N,E, and T.

113. Vulnerable



In this city map you can see that many streets have one-way traffic, indicated by a single arrow-head.
Some of the streets have two-way traffic, indicated by two arrow-heads.
A crossroad is called vulnerable if it can only be reached from one other crossroad.

Question / Challenge

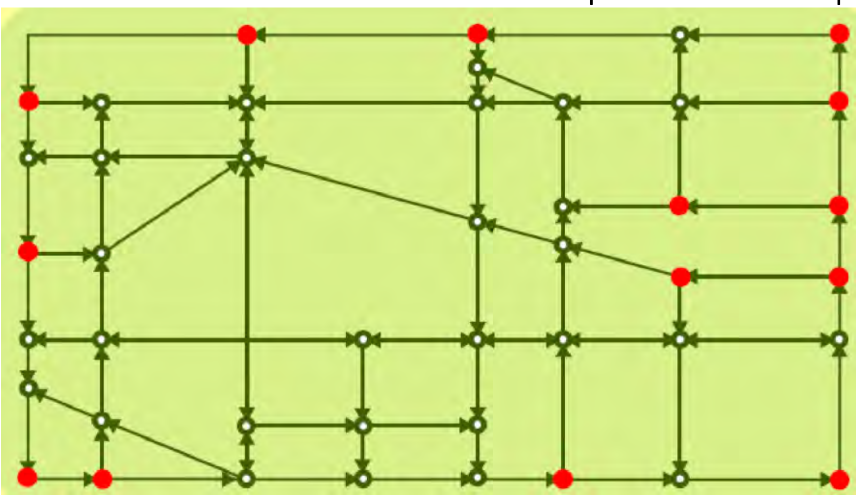
Interactive task:
Mark all vulnerable crossroads in the city map by clicking on them
This task could also be questioned as a non-interactive task:
How many vulnerable crossroads are there in the city map?

Answer Options / Interactivity Description

For interactive tasks: All crossroads are clickable and a color indicates if they are marked.
There are a Save and a Reset button.
For open-answer tasks: Integer numbers from [0,44]

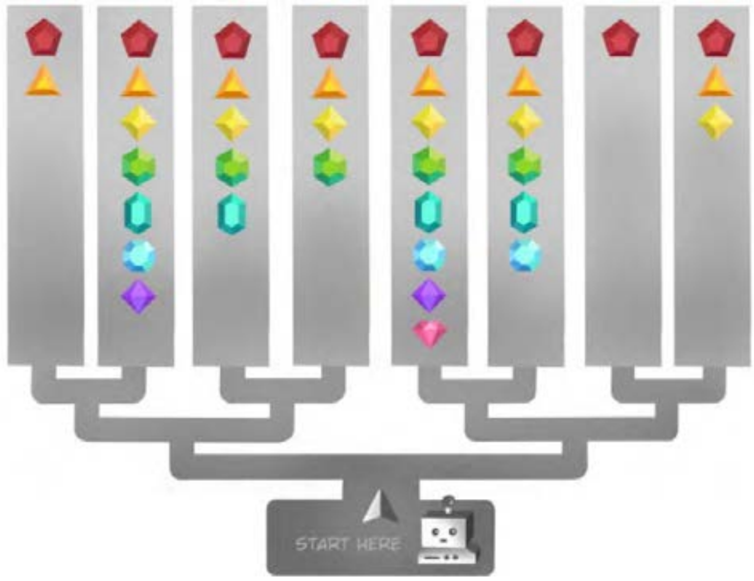
Answer Explanation

There are 14 vulnerable crossroads in the map as marked in the picture.



114. Robot Maze Game

Alice and Bob are controlling a robot in a maze with gems. The robot starts at the location in the maze shown below. The robot will keep following the path until a fork in the maze is reached. One of the players decides which path (left or right) the robot should take. The robot will then follow the path again until a fork is reached, and so on.



Alice and Bob take turns deciding, with Alice going first.
The game ends when the robot reaches a dead end. It then takes all the gems there. Alice wants to make the robot end up with highest number of gems possible, while Bob wants to make the robot end up with the least.
Alice and Bob both know that each one will try to outsmart the other. So if for example Bob will direct the robot towards the fork where 3 or 7 gems are reachable, he knows that Alice will command the robot to chose the path towards 7 gems.

Question / Challenge

How many gems will the robot end up with?

Answer Options / Interactivity Description

Integer numbers from [1, 8]

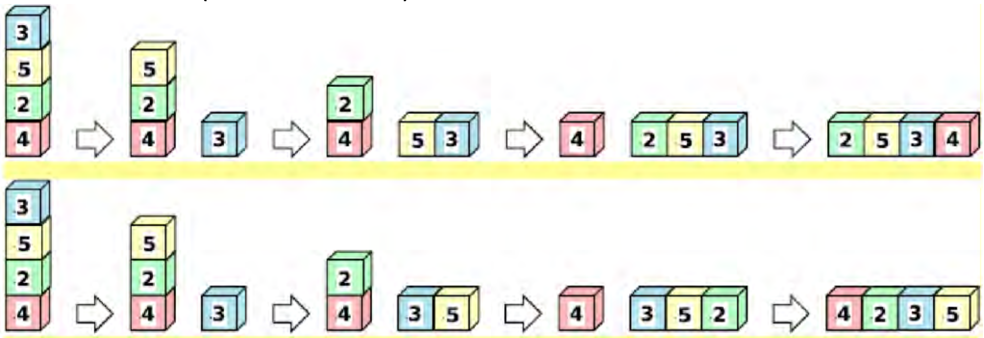
Answer Explanation

The correct answer is 5.
Alice knows that if she makes the robot go right on the first turn, Bob will not make the robot go left. Thus, the robot can never get 6 or 8 gems. If Alice makes the robot go right, the robot can only get 3. It is possible for the robot to get more if it goes left. (You'll see later that it's not possible for the robot to get 2 gems if it goes left, so it can only get either 4, 5, or 7 gems which are all strictly bigger than 3.) Thus, on the first turn, Alice makes the robot go left.
Bob knows that if he makes the robot go left on the second turn, Alice will not make the robot go left. Thus, the robot can never get 2 gems. If Bob makes the robot go left, the robot can only get 7. It is possible for the robot to get less if it goes right. Thus, on the second turn, Bob makes the robot go right.
Finally, on the third turn, Alice will obviously make the robot go left.
There is an easy and "mindless" way to get the answer: mark the forks layer by layer, starting from the bottom. At the bottom-most layer, it's Alice's turn. Look at the numbers directly below each fork, and write the bigger number on the fork. At the middle layer, it's Bob's turn.

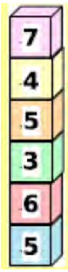
Again, look at the numbers directly below each fork, and write the smaller number on the fork.
Finally, at the top layer, it's Alice's turn. Again, look at the numbers directly below the top fork, and write the bigger number at the starting point. This number is the answer.

115. Creating Numbers

Olivia, the beaver, is playing with blocks. Each block has a single digit on it. She loves to make a big tower and then use the blocks one by one, from the top, to form a number. Each time she removes one block, she can place it to the right or to the left of the number she is forming. The following figures show a tower of 4 blocks and two possible numbers that can be formed from it (2534 and 4235):



Olivia just built a new tower of 6 blocks and she wants to create the smallest possible number from it. Can you help her?



Question / Challenge

What is the smallest number that can be formed from the tower of 6 blocks shown above, following the rules?

Answer Options / Interactivity Description

An integer number with 6 digits

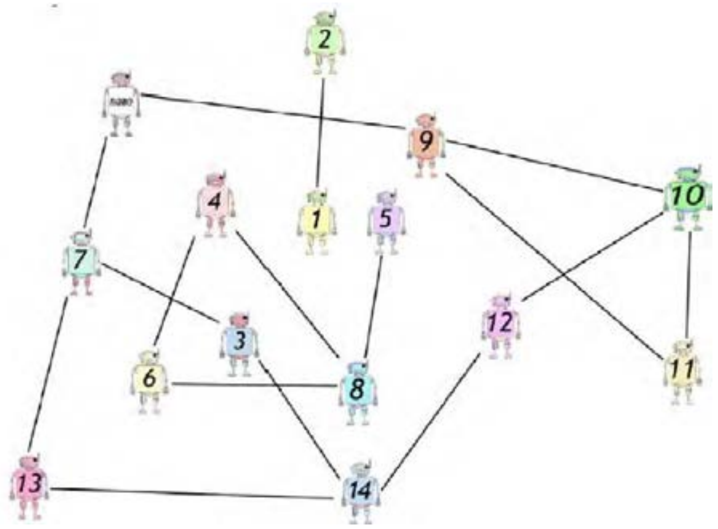
Answer Explanation

The correct answer is 347565.

The smallest possible number should start with the smallest digit in the tower, which is 3. All the numbers that are below 3 in the tower should be added to the right of the number being formed, so the final number ends with 65. Above 3 we have a smaller tower 547, from which we want to form the smallest possible number to come between 3 and 65. We apply the same reasoning: the number should start with the smallest digit, 4, and 5 should be added to the right, so we get the number 475. This gives us final answer, 475, preceded by 3, followed by 65.

116. Robots

Robo caught a virus, who knows from where. He called all of his friends he met last week and found out that they also met with other robots and there is a high probability of all getting sick. He created a map with him and his friends in order to see better how the virus would have spread.



Question / Challenge

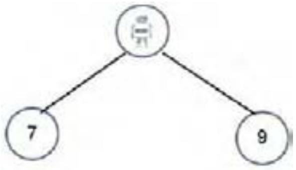
If it takes 3 days for a healthy robot to get sick, what is the total number of days in which all the robots connected to Robo will get sick? (Enter your answer as an integer and press Save.)

Answer Options / Interactivity Description

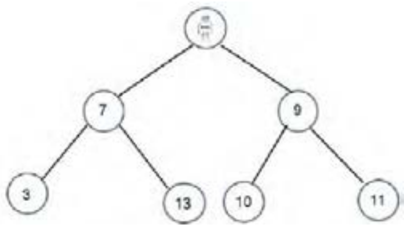
Open integer.

Answer Explanation

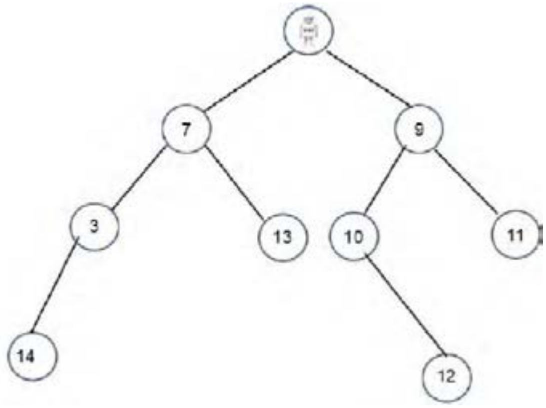
The correct answer is 9. To determine the maximum number of days, we connect the nodes starting from the first: After 3 days, robots 7 and 9 will get sick.



After 6 days, robots 3, 13,10 and 11 will also get sick.

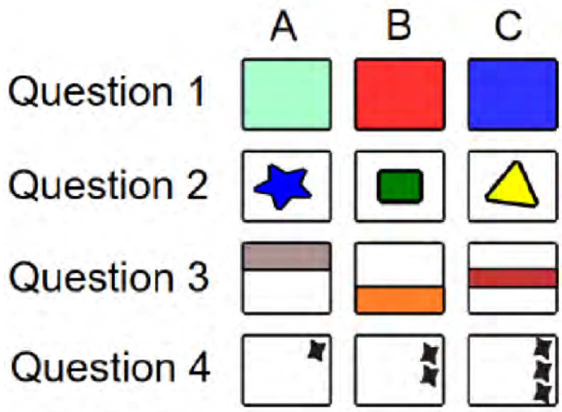


Finally, after 9 days, robots 12 and 14 get sick.

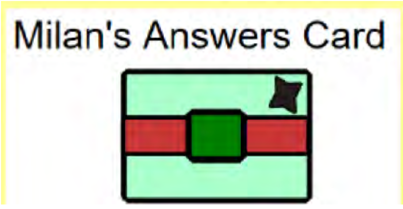

7
9
3
13
10
11
14
12

117. Data visualization

Milan and Maya completed a questionnaire with 4 questions.
Milan’s answers were:
Question 1. Answer A.
Question 2. Answer B.
Question 3. Answer C.
Question 4. Answer A.
Following the rules pictured below,



Milan received a card representing his answers.



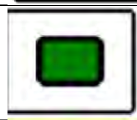
Question / Challenge

Maya answers were:
Question 1. Answer B.
Question 2. Answer B.
Question 3. Answer A
Question 4. Answer B.
Which card represents Maya's answers?

Answer Options / Interactivity Description

Answer Explanation

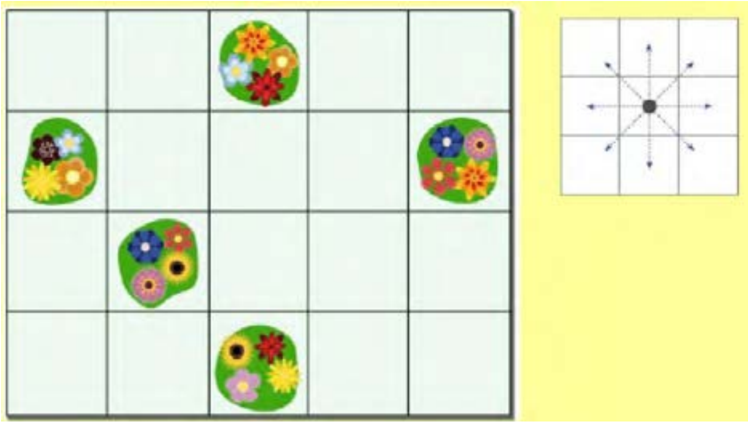
Is correct. Following these rules for creating cards, we can see that:

Question 1. Answer B. Presented as:	
Question 2. Answer B. Presented as:	
Question 3. Answer A. Presented as:	
Question 4. Answer B. Presented as	

Answer A) is incorrect, The card represents visually the following answers:
A. Question 1. Answer A.
B. Question 2. Answer A.
C. Question 3. Answer B
D. Question 4. Answer A.
Answer C) is incorrect, The card represents visually the following answers:
A. Question 1. Answer A.
B. Question 2. Answer C.
C. Question 3. Answer B.
D. Question 4. Answer C.
Answer D) is incorrect, The card represents visually the following answers:
A. Question 1. Answer C.
B. Question 2. Answer B.
C. Question 3. Answer C.
D. Question 4. Answer A.

118. Sprinkler

Beaver Bob planted some flower-beds in his square-grid garden (see the figure on the left). To make sure each flower-bed gets enough water, Bob decides to place some sprinklers at the empty squares of his garden. Each sprinkler can water all flower-beds in the eight squares next to it, as you can see in the picture on the right.



Question / Challenge

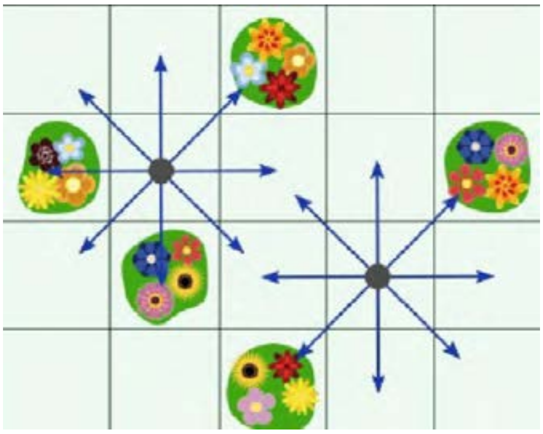
Use the minimum number of sprinklers needed to water all the flower-beds. Click on the empty squares of the garden where you want to place sprinklers.

Answer Options / Interactivity Description

The interactive application will allow click on squares with no flowers. Each such click will show or hide a sprinkler on that square.

Answer Explanation

The correct answer is shown if the following picture:



In fact it is impossible to reach all the flower-beds with just one sprinkler: for example the flower-beds in the second row cannot be watered by a single sprinkler because they are too distant. Thus using two sprinklers is the best we can do.

119. Water Bottles

Beaver Jack works in a water bottling factory. Daily he has to fill as many bottles as possible out of a water tank of 50 liters using the bottles available. Today, he has these 10 bottles to fill. On each bottle there is a label showing how many liters it can hold:

Question / Challenge

What is the maximum number of bottles that beaver Jack can fill entirely?

Answer Options / Interactivity Description

Open Integer: Integer numbers from [1,10]

Answer Explanation

The answer is 7 bottles

At any point, if you have two empty bottles that can hold different amounts of water, there is no advantage to filling the larger bottle. So we can approach this task by first arranging the bottles from smallest to largest (in terms of how many liters they can hold).

Now, we can fill the bottles one by one until we run out of water. Doing this, we will be able to entirely fill a total of 7 bottles using 3 + 4 + 5 + 6 + 7 + 8 + 9 = 42 liters. Now you only have 8 liters left and all the remaining bottles can hold more than 9 liters, so no more bottles can be filled.

120. Gift

Georgina received 5 presents from her friends but the labels telling her who sent the presents have come off!

She remembers the following clues about each of the presents:

Clues:

- Alison sent a present with stars.
- Brenda sent a present with a bow.
- Charlie sent a present with wavy stripes.
- David sent a long thin present.
- Elaine's present did not have a bow.

Help her match the sender to the correct present by using the clues

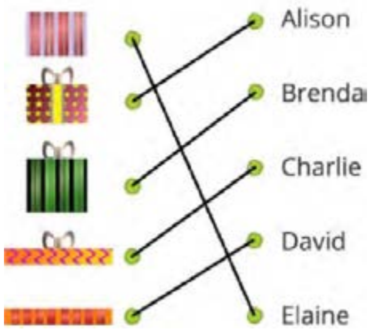
Question / Challenge

Match the present givers' names with the correct presents.

Answer Options / Interactivity Description

Click on a dot and drag line to the proper dot in the opposite column.

Answer Explanation



It helps with these sort of tasks to set up a table to summarise what we know:

	1	2	3	4	5
A		Y			
B		?	?	?	
C				Y	
D				?	?
E	?				?

So A can only be present 2 and C can only be present 4.

We can then amend our table as we now know D and B:

	1	2	3	4	5
A		Y			
B			Y		
C				Y	
D					Y
E	?				?

So E (Elaine) must have sent present 1

121. Zoo Animals

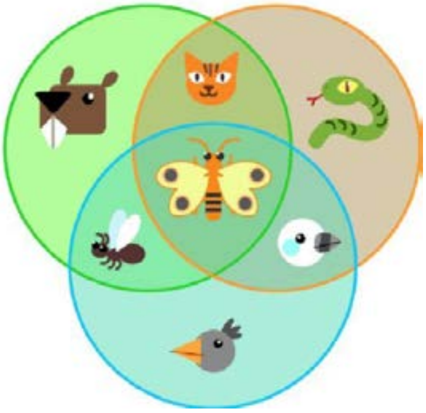
The following diagram shows three circles. Each circle shows different animals. One circle shows animals with stripes, one circle shows animals with more than two legs, and one circle shows animals with wings.
If an animal has wings and stripes then it will be placed in the overlap of both circles.
Your friend has selected two types of animals that she likes. She tells you:

I like winged animals that don't have stripes or many legs.

I also like animals without wings and that have stripes and many legs.

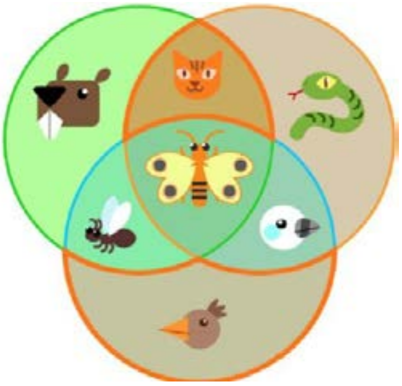
Question / Challenge

Click on the animals that your friend likes.



Answer Options / Interactivity Description

Preview the interactivity here:
https://challenge.bebraschallenge.org/?action=question_preview&que_id=1810&t=371178ebfff52630,
This shows the correct solution:



Answer Explanation

The correct answer is the cat and the bottom bird.
Winged animals that don't have stripes or many legs: the bottom bird, as shown

Animals without wings that have stripes and many legs: cat, as shown

Each of the other animals is not possible because it is not allowed in each sentence:
The dog has many legs (1st sentence) and no stripes (2nd sentence).

The snake has many legs (1st sentence) and not many legs (2nd sentence).
The butterfly has many legs (1st sentence) and has wings (2nd sentence).
The fly has many legs (1st sentence) and has wings (2nd sentence).
The white bird has stripes (1st sentence) and has wings (2nd sentence).

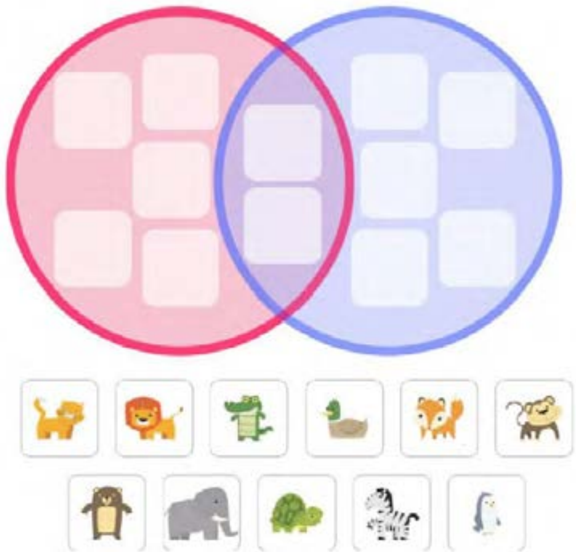
122. Favourite Animals

Kim and Mary are talking about which animals they love. They find out that there are some animals that they both love.

They decide to put in the animals in the following two circles.

Question / Challenge

Drag the animals that Mary loves to her (pink) circle. Drag the animals that Kim loves to his (blue) circle. Make sure that animals that they both love are in both circles.



Answer Options / Interactivity Description

Allow the kids to drag and drop the animals to the proper circle.
Check out the interactivity here:
https://challenge.bebraschallenge.org/?action=question_preview&que_id=1811&t=ba63efda405379eb

Answer Explanation

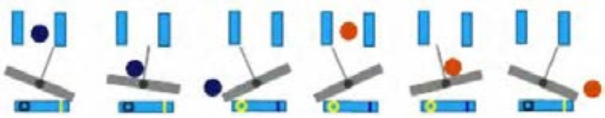
It does not matter in which order the animals are dropped.
Kim only: beaver, snake, earthworm, mouse, lion
Mary only: dog, fish, bird, elephant
Both: cat, bear

123. Counter

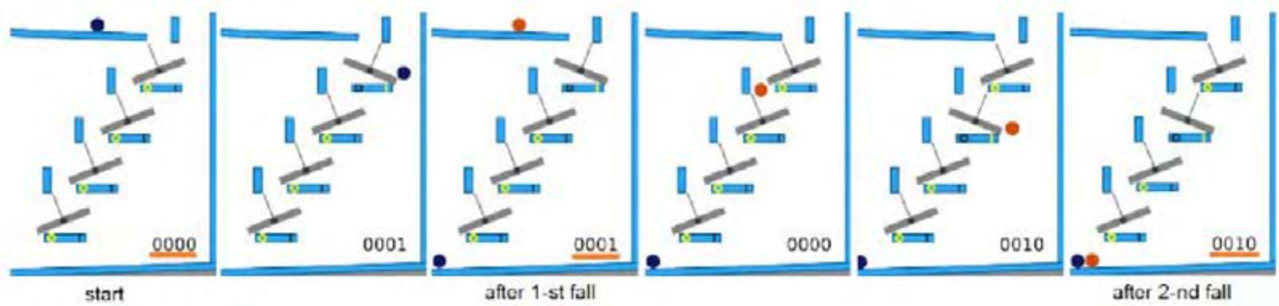
In this machine, there are four bars that can tilt.

- A bar tilted to the left = 0
- A bar tilted to the right = 1

When a ball drops and lands on a bar, the bar tilts and the ball rolls off.



Here is the machine when the first 2 balls are dropped
In the first picture, all the bars are 0 and the counter shows 0000



Question / Challenge
What will the counter be after 5 balls have been dropped?
Answers
Please give a 4-digit answer (only 0 and 1)
The correct answer is:
0101
The complete sequence is: 0001, 0010, 0011, 0100, 0101
This is a mechanical binary counter.
The starting position is 0000.
The first ball tilts Bar 1 to the right. The counter is 0001.
The second ball tilts Bar 1 to left and tilts Bar 2 to the right. The counter is 0010.
The third ball tilts Bar 1 to the right and rolls off. Bar 2 remains tilted to the right. The counter is 0011.
The fourth ball tilts Bar 1 to the left, Bar 2 to the left and Bar 3 to the right. The counter is 0100
The last ball tilts Bar 1 to the right and rolls off. Bar 2 remains tilted to the left and Bar 3 remains tilted to the right. The counter is 0101
We can also look at it from this point of view:
The ball falls onto each bar until it hits the first bar that is in a 0 position. Then the bar tilts toward the right and rolls out of the machine.

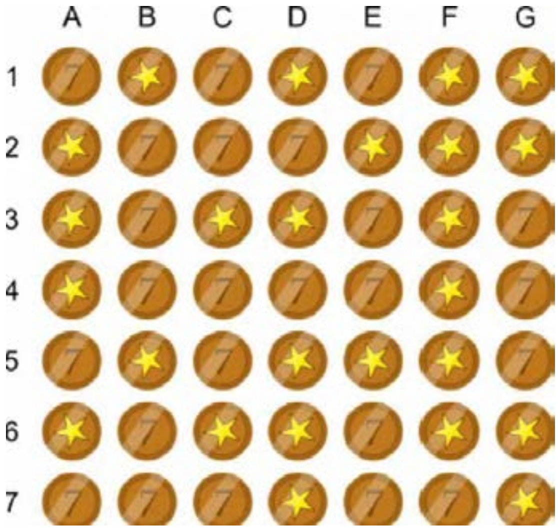
124. Wizard Bibraxus

In front of Wizard Bibrax is a table with 49 coins. While his eyes are covered, you are allowed to turn a coin over. Once his eyes are uncovered, Bibrax quickly knows which coin has been turned over. He tells you his secret: "In every row and in every column there is an even number of coins with a star on top. After turning a coin over, there is exactly one row and one column with an odd number of coins showing the star on top.
Where this row and this column meet is the changed coin."

Question / Challenge

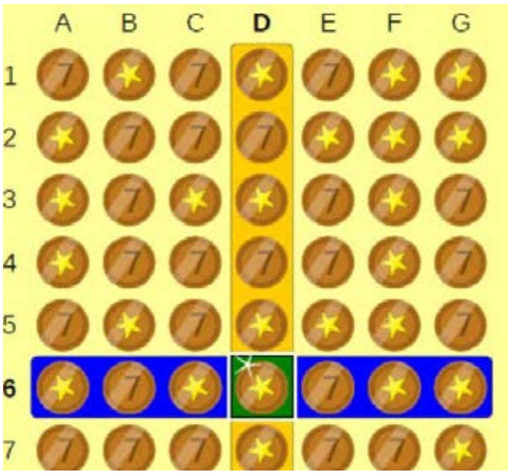
At the next show you may support him

Which coin was turned over? Click on it!



The correct answer is:

D6.

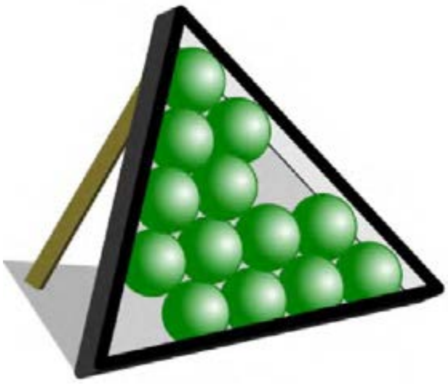


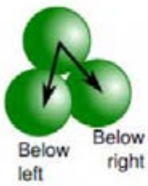
Column D contains five coins with a star symbol. Row 6 also contains five coins with a star symbol.

D6 is the coin, where row 6 and column D meet. All other columns and rows have an even number of coins where the star is visible.

125. In Danger

We have put 13 balls in a triangular box - as shown in the picture. If we lift up the top corner of the box then, because of the gaps, some of the balls are in danger of rolling down.





We say that a ball is 'in danger' if either of the following is true:
There is at least one gap to the left or right immediately below that ball.
There is at least one ball that is 'in danger' to the left or right immediately below that ball.

How many balls in the box shown are NOT 'in danger'?

Answers

Integer in range [0,13]

The correct answer is:

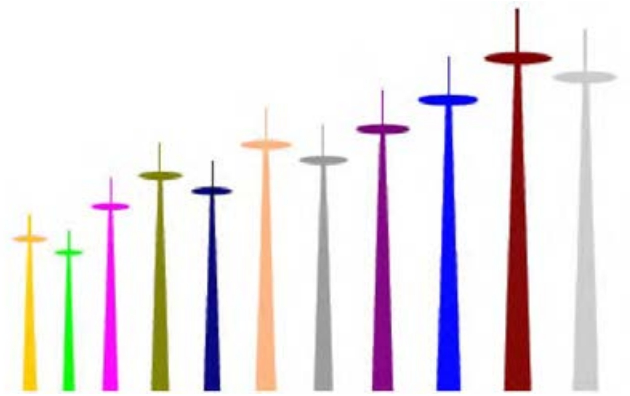
8

One way to find the answer is as follows
1. Start at the bottom row of the triangle and mark all balls on that row.
2. Proceed to the row above.
3. Mark all balls on that row that have two marked balls immediately below them.
4. Repeat step 2 and 3 until no more rows are left over.
5. At this point, the balls that marked are those that are not in danger.

This is illustrated in the picture below. (From the fourth row onwards, no balls can be marked anymore.)

126. Special Towers

Look at the towers shown below.



A tower is **special** if all towers to the left of it are shorter, and all towers to the right of it are taller.

How many special towers are there?

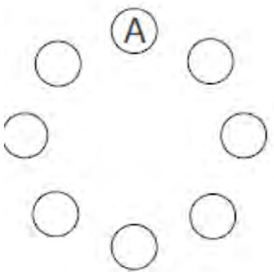
Answer

3

The correct answer is: 3

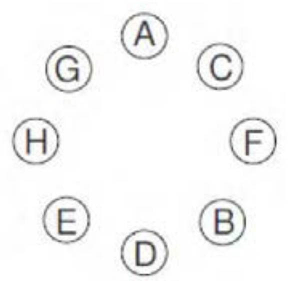
127. Seating Plan

Eight friends sit around a circle, as shown below. They are all facing inwards.



We know the following facts about where the friends sit:
1. Alice sits directly opposite to David.
2. Henry sits between Greta and Eugene
3. Franny is not beside Alice or David.
4. There is one person between Greta and Clare.
5. Eugene is beside David, on David's left.

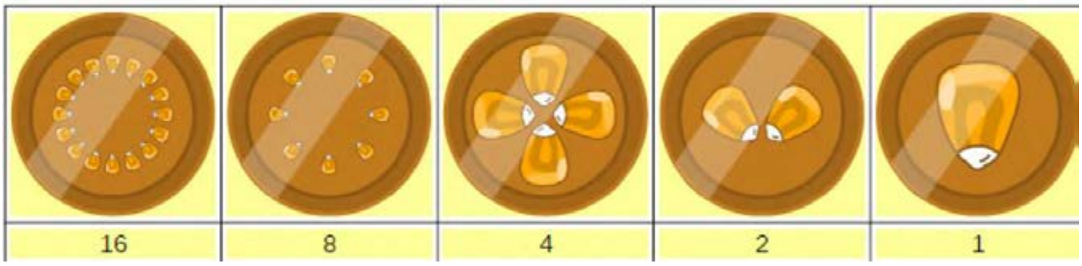
Place the friends in the correct places at the table.
NOTE on interactivity: To make this easier for students, dropping in letters B,C,D,E,F,G,H is better than names or
images of friends. (A clever developer could have a list of names in alphabetical order and when the user selects a
name only the first letter drags across.)
Answers
The correct answer is:
Alice, Clare, Franny, Bruce, David, Eugene, Henry, Greta



Explanation:
Fact 1, Alice sits directly opposite to David, enables us to seat David.
Now, Fact 5, Eugene is beside David, on David's left, enables us to seat Eugene.
At this stage, Fact 2, Henry sits between Greta and Eugene, tells us where Henry sits. Knowing where Henry sits we now can place Greta.
With five friends placed, Fact 3, Franny is not beside Alice or David, leaves only one space for Franny.
Fact 4, There is one person between Greta and Clare, now tells us where Clare sits.
Finally there is only one seat and one friend to place so we can place Bruce.

128. Beavercoins

The money used in Beaverland is called 'Beavercoins'. The coins have the following values:



Question / Challenge

The beavers do not like to carry many coins so they have a rule to always pay with as few coins aspossible. Under this rule, which coins would be used to pay 13 Beavercoins?

Answer Options / Interactivity Description

The student should be able to drag as many 1, 2, 4, 8 or 16 coins from a repository onto a place where there is sufficient space to use more coins than necessary. As an optional feature the current sum of the coins selected could be displayed to ease the math in this task.

Answer Explanation

The optimal and therefore correct solution is 

(1×8-Beavercoins, 1×4-Beavercoins and 1×1-Beavercoins), because 8 + 4 + 1 = 13. Less coins are not possible, because a coin larger than 1×8-Beavercoins cannot be taken (1×16-Beavercoins would already be too much) and there is no Beavercoins with the value 5. The next smaller coin is of value 4. One could also start with different set of coins, for instance 2×4-Beavercoins, 1×2-Beavercoins, and 3×1-Beavercoins. Then one could minimize the number of coins by exchanging the Beavercoins of the same value for the Beavercoins of the double value.

129. Colorful Flags

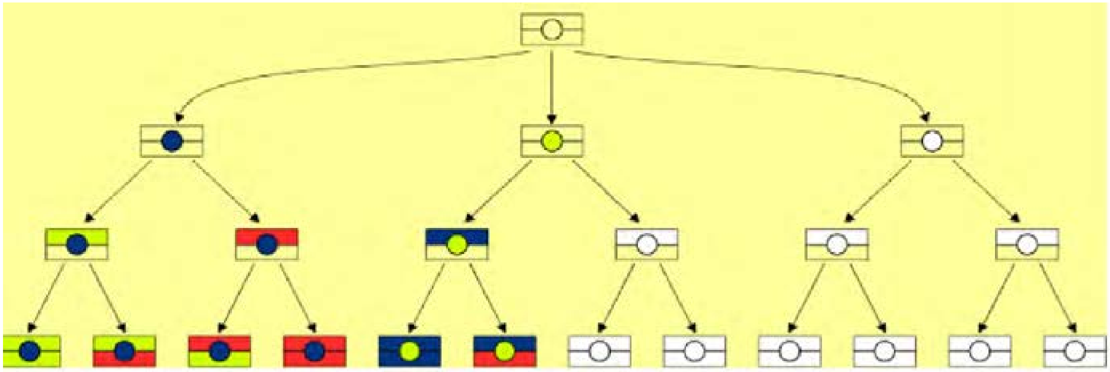
The BEBRAS shipyard builds excellent boats. Every beaver wants to own a boat from them. But there is a problem: How to recognize your boat if they all look alike!
Because of that, the beavers decided to put flags on all boats. The flags have the following pattern:

The beavers agree on three different possible colors for the three areas on each flag: red, green, and blue. While the two stripes may be of the same color, the area of the circle in the center must have a different color than each of the two stripes.

The beavers started to create a diagram which they use to construct all possible color combinations for the flags. Unfortunately, because of a storm, they did not finish their work and some of the flags are not completely colored.

Question / Challenge

Help the beavers complete the diagram by clicking on the missing fields (in white) to color them.
Note that there are multiple solutions, you only need to find any one solution



Answer Options / Interactivity Description

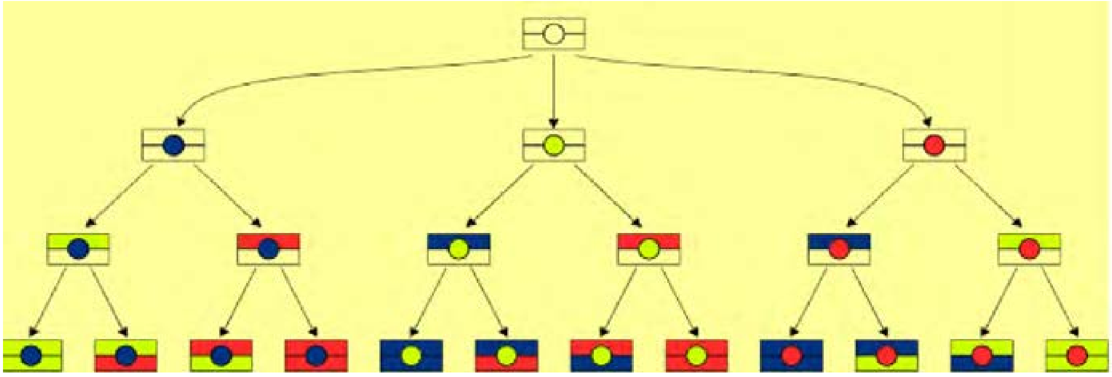
The interactivity should be set up so that

- In the second row only the circle in the rightmost branch should be clickable and change its color to red, green, blue and starting from red again; if the color of the circle gets changed, all circles in the flags below (that is third row rightmost and second rightmost as well as the four rightmost flags in the fourth row) change the color alike.
- In the third row the top stripes in the three rightmost flags may change its color to red, green, blue and starting from red again; if the color of the top stripe gets changed all top stripes in the flags below change the color alike.
- In the third row the circles of the three rightmost flags may also be clickable like described above, but only the color of this flag and all flags below (but not above or next to it) may change; this behavior is essential for the learning process of “inheritance” in the tree.

• In the fourth row all three areas of the six rightmost flags may be change its color to red, green, blue and starting from red again; no change of other areas happen if a color change happens here.

Answer Explanation

One of the possible solutions is:



In general any combination of colors is correct as long as:

• In the second row the rightmost circle must be red.

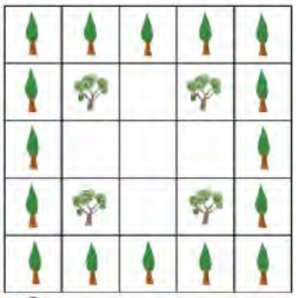
• In the third row for each of the three circle colors both other colors are chosen for the top stripe. The order does not matter.

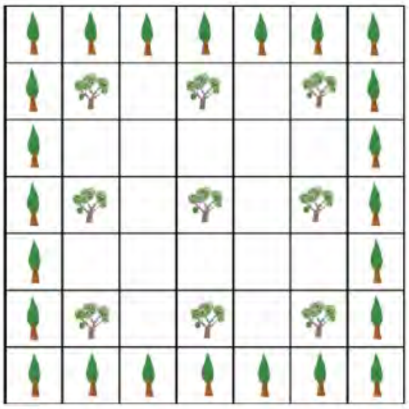
• In the fourth row for each of the circle colors and for every top stripe color the two colors other than the circle color are chosen. The order does not matter.

130. Olive farm

Kalia the beaver farmer wants to plant some olive trees in a square field. To protect the olive trees from excessive wind, she decides that she also needs to plant cypresses around the field. In the charts below you can see two examples of tree arrangements based on the following rules which Kalia makes for planting olive trees:

- Each square plan contains the same number of rows and columns of olive trees.
- Plant the first olive tree at the top left corner within the border of cypresses.
- Leave one blank row between rows of olive trees, and leave one blank column between columns of olive trees.


n=2


n=3

n: rows of olive trees


cypress

olive tree

Question / Challenge

How many olive trees and cypresses does Kalia have to plant, if she wants 5 rows of olive trees ?

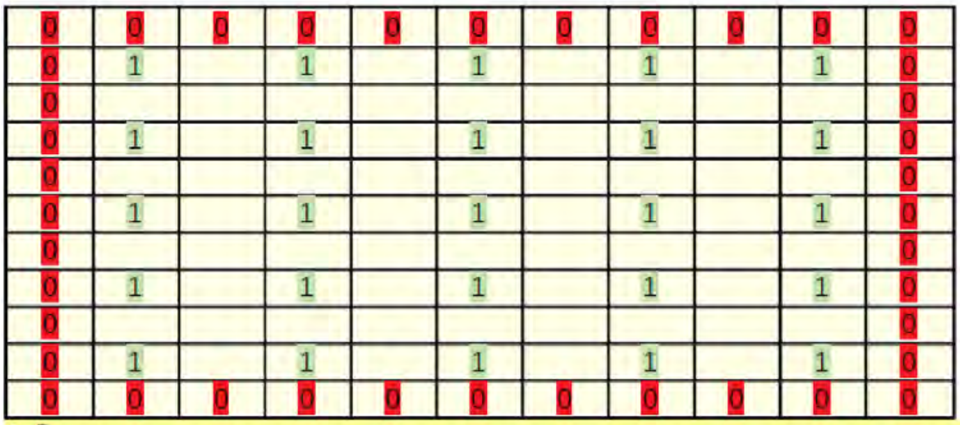
Answers

Olive trees: integer [0..99], Cypresses: integer [0..99]

The correct answer is:

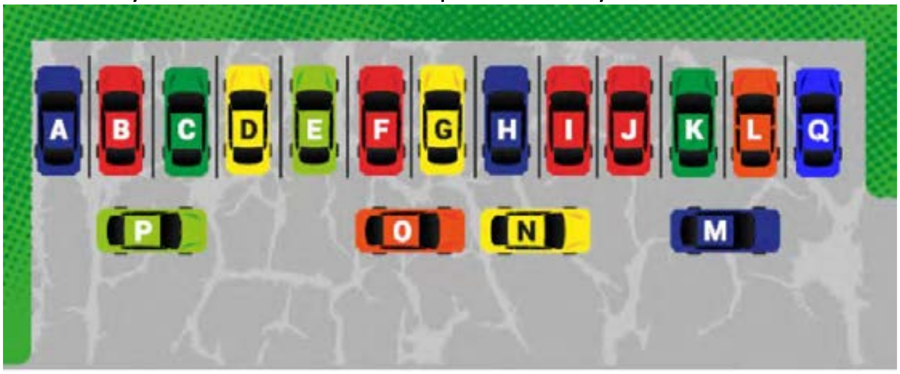
Olive trees(1):25

Cypresses(0):40


n=5

131. Push-Away Parking

In a parking lot, cars can be parked in parking spaces or in front of these parking spaces as shown in the image below. Cars that are parked in front of the parking spaces can be pushed forward or backward carefully if they block a car that wants to leave its parking space.
For example, in the image below, car A is not blocked and can leave its parking space. Car L is blocked by car M. Car M must be pushed away before car L can leave its parking space.



Question / Challenge

Which car needs two other cars to be pushed away before it can leave its parking space?

Answers

There are several ways to implement the answering part:

- *constructive*: Click on that car to select it.
- *Open answer*: Enter the letter of that car here:
- *multiple-choice*: car B, car C, car F, car G, car H, car I, car K, car L

The correct answer is:

Car I.

Car I is blocked by car N. There is not enough space to push car N away so that car I can leave its parking space. Therefore, car O must be pushed to the left or car M must be pushed to the right.
Then, there is space to push car N away for car I to leave its parking space.
There is no other car for which two cars must be pushed away for: cars A, D, E, J and Q can leave their parking spaces immediately. Cars B, C, F, G, H, K and L can leave their parking spaces if one of cars P, O, N, or M is pushed away.

132. Watched

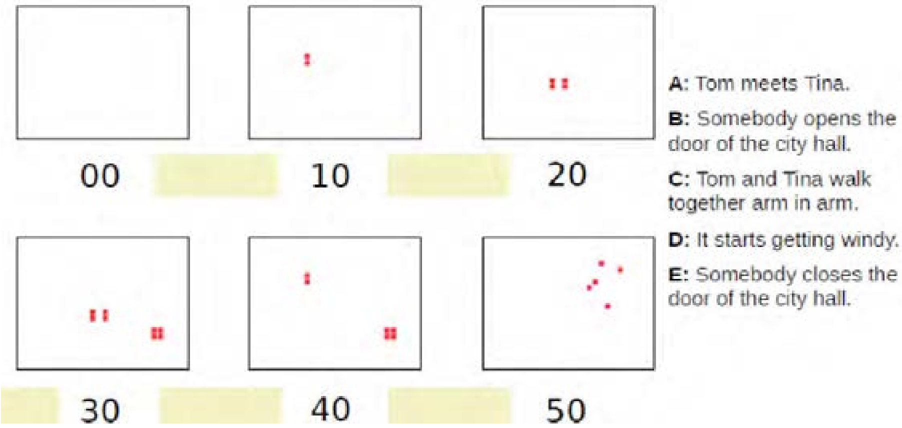
Every 10 seconds a digital camera takes a photo of the market place as shown on the right. A computer program compares each new photo with the previous photo and creates a *difference image*. On a difference image there is a little red square at each position where the new photo looks different from the previous photo.

If the difference image is white, there is no difference between the two photos.
For example for the two photos below, the different image (on the right) shows the difference between the first and the second photo.

Below you see a sequence of difference images covering 50 seconds. Five events happened during
that time.

Question / Challenge

Move each event to an appropriate position.



Answers

Interactive: Drag&Drop. There are images of five text blocks that can be dragged on screen and dropped on the areas between the difference images. The letters A..E can be removed. Any constellation with each text block dropped at one event position (between two difference images) is accepted as answer.

The correct answer is:

There are two correct answers: **BACED** and **EACBD**
Between seconds 0 and 10: Somebody opens the door of the city hall.

On the difference image at second 10 there are red squares at the position of the door indicating a change, which could be caused by opening the door (or closing the door).
Between seconds 10 and 20: Tom meets Tina.
The red squares in the middle of the difference image at second 20 indicate the position where Tom and Tina met. They were approaching one from left and one from right so they were not visible on the photo 10 seconds before.
Between seconds 20 and 30: Tom and Tina walk together arm in arm.
The difference image at second 30 shows red squares indicating the present position and the previous position of Tom and Tina. While walking together they are so close together that the camera image depicts them as one spot.
Between seconds 30 and 40: Somebody closes (or opens) the door of the city hall, while Tom and Tina keep walking, moving out of the of the market place.
In the difference image at second 40 there are red squares at the position of the door indicating a change, which could be caused by closing the door (or opening the door), and at the previous position of Tom and Tina, who are not there anymore.
Between seconds 40 and 50: It starts getting windy.
On the final difference image at second 50 there are red squares in the area of the tree crown. This indicates changes (like moving leafs) that might be caused by wind.
Please note: Events B and E can be switched, as they make no difference with respect to difference images.

133. A bag of candies

Peti has a bag of candies. There are 4 green, 4 yellow and 4 red candies in the bag.
Peti plays with his friend and they have some rules: the friend has three turns to take out a candy from the bag and he has to collect them in a bowl.

• Each time he takes out a green candy, he has to put it in the bowl and he takes out one more candy from the bag (though it is still considered as the same turn)
• If he takes out a yellow candy, he eats it right away without putting it in the bowl.
• If he takes out a red one, he has to put it in the bowl immediately.

Question / Challenge

What is the maximum number of candies that can be in the bowl after the third turn?

Answer Options / Interactivity Description

Answer Explanation

The correct answer is: 7
The best possible outcome is the following:
1st turn: green + green + green + green + red = 5
2nd turn: red = 1
3rd turn: red = 1
Total: 5+1+1=7

If the first, the second and the third candies would be yellow, no candies would taken in the bowl.
If in one turn we would have a yellow candy, the friend would eat it and we would have one candy less in the bowl.
With just one turn we get the most candies out of the bag if we pull out all of the green candies followed by a red candy. For the remaining turns we should choose the red candies.

134. Aircraft Scheduling

When an aircraft lands at an airport, it is assigned a corridor to avoid accidents. This is a designated airspace, which separates planes from each other.
At the Bebrasland airport, two aircraft cannot have the same corridor if they are landing within 15 minutes of each other.
For example, if we have Flight #1 landing at 6:10 AM, Flight #2 landing at 6:25 AM and Flight #3 landing at 6:26 AM, then Flight #1 and Flight #2 cannot be assigned the same corridor whereas Flight #3 can be assigned the same corridor as Flight #1, but not the same corridor as Flight #2.
You are the Air Traffic Controller at the airport today and your job is to assign corridors for the scheduled flights shown in the table below.

Flight	Time
9W2400	7:00
9W1321	7:21
AI561	7:20
AI620	7:18
EK427	7:03
SG147	7:12

Question / Challenge

What is the minimum number of corridors needed to ensure that all the above flights land according to the rules?

Answers

Integer numbers from [0,8]

The correct answer is:

4

Let us list flights and flight times in ascending order of landing time.

1. 9W2400 7:00
2. EK427 7:03
3. SG147 7:12
4. AI620 7:18
5. AI561 7:20
6. 9W1321 7:21

The first flight 9W2400 is at 7:00 so we assign it to corridor 1. The next two flights EK427 and SG147 are within 15 minutes of the first flight and the 3rd flight is within 15 minutes of 2nd flight as well, so clearly, all three need to be assigned separate corridors. So we need 3 corridors so far.

For each of the following flights, we try to assign it to already used corridors if possible. The 4th flight AI620 at 7:18 is more than 15 minutes away from the first flight 9W2400 and can be assigned the same corridor as flight 9W2400. Similarly, the 5th flight AI561 cannot be assigned corridor 1 as it is within 15 minutes of AI620 but can be assigned corridor 2 as it is more than 15 minutes away from EK427.

The 6th flight 9W1321 at 7:21 is less than 15 minutes from flights SG147 (7:12), AI620 (7:18), and AI561 (7:20) that are assigned to the 3 corridors so far. So we must assign another corridor for this flight.

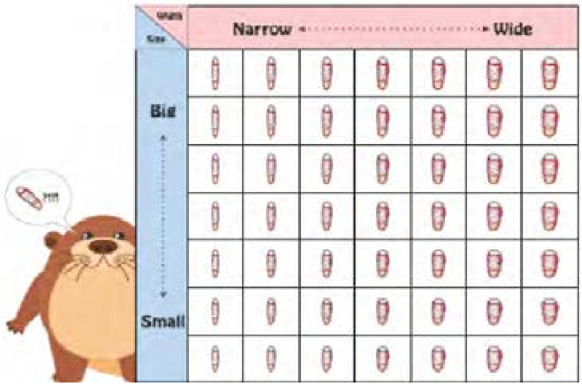
Thus giving us the following flight assignments to corridors:

Corridor 1: 9W2400 (7:00), AI620 (7:18)
Corridor 2: EK427 (7:03), AI561 (7:20)
Corridor 3: SG147 (7:12)
Corridor 4: 9W1321 (7:21)

While we can assign more than 4 corridors, it is clear that less than 4 may result in accidents

135. Buying Shoes

Beaver went to the shoe store to buy a pair of shoes. He saw several shoes on display arranged as shown in the picture. The shoes were arranged in increasing order of size as well as width. The shoes varied in size and width, with the smallest and the narrowest shoes kept in left bottom and the biggest and the widest shoe at the top right. All shoes have different size and width.



Being a forgetful beaver, he did not remember his shoe size and will have to try on shoes till he finds the right fit. A right fit is one that is the right size and the right width.

Beaver uses a method that guarantees that he can find the shoe that fits him in 'n' tries.

Question / Challenge

What is the least possible value of 'n'?

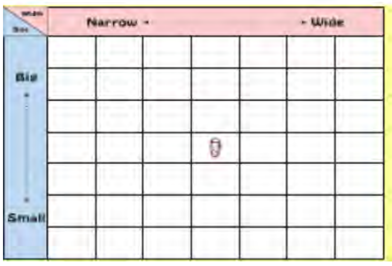
Answers

2

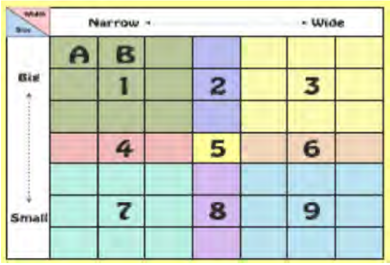
The correct answer is:

The beaver can get lucky and find the shoe in the first attempt. However, he can find the right fit after trying on 2 shoes.

- He can start with the shoes in the center as shown below.



- The shoe will either be the right size, smaller, bigger and right width, narrow or wide for the beaver. According to the fit, the beaver will know that the shoe that will fit him will be in one of the following nine colored zones.
- If the shoe fits him, he has found the right pair of shoes
- If the shoe is smaller and wider, he would try shoes in zone 1
- If the shoe is smaller but the right width, he would try shoes in zone 2
- If the shoe is bigger and narrow, he would try shoes in zone 9 and so on



Let us suppose the pair of shoes the beaver tried is smaller and wider for him. So he has to try for bigger and narrower shoes, which will be in zone 1.

He now tries the shoe in the center of zone 1 (box marked as #1).

. If the shoe fits him, he has found the right pair of shoes

. If the shoe is still smaller and wider for him, the shoe in position A will be the right fit.

. If the shoe is smaller but the right width, the shoe in position B will be the right fit.

As we can see, the beaver will have to try at the most 2 shoes to find the right fit.

If he starts in any other position, he will have to try our more shoes.

136. Filling_Boxes

You have to pack 5 large, 2 medium and 5 small balls into boxes. You have 3 large, 5 medium and 3 small boxes. A ball can only fit in the box of the same or larger size. A box can have only one ball inside. Even in a large box you can fit only a single small ball.

Question / Challenge

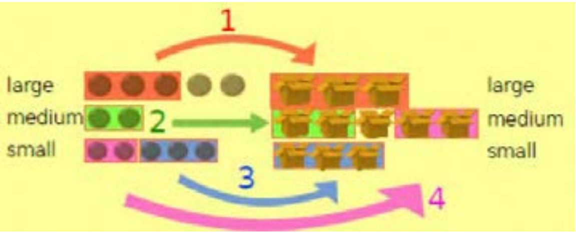
How many balls will be packed?

Answers

A) 8 B) 9 C) 10 D) 11

The correct answer is:

C) 10

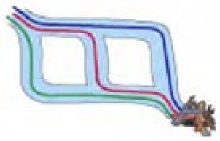


Possible solution:
1. 3 large balls are put in 3 large boxes.
2. 2 medium balls are put in 2 medium boxes.
3. 3 small balls are put in 3 small boxes.
4. The 2 remaining small balls are put in the 2 remaining medium boxes.

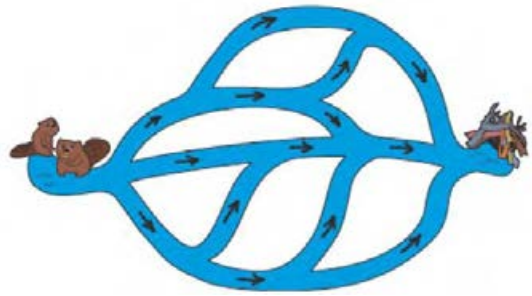
It is not possible to pack more balls because there are no large boxes for the remaining 2 large balls.

137. Many Beavers

Beavers are very ambitious: each beaver must have its own path to their home, but they are too lazy to swim upstream. For example, if we have the river structure in the picture below, we have at most 3 different paths from start to finish. So, we can have at most 3 beavers living on this river.



There is a couple of beavers living on a different river shown in the picture below.



Question / Challenge

The beaver couple decided to expand their family. What is the maximum number of kids they can have, if each family member must have its own path to their home?

The correct answer is:

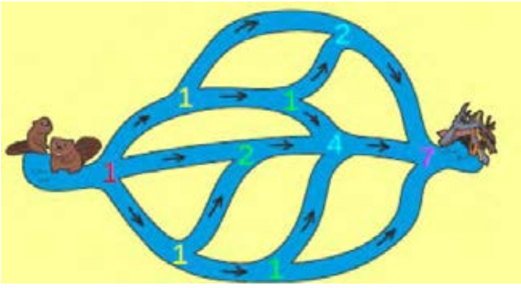
5

There are 7 different paths that leads to their home, 2 of which are reserved for the parents. We can count these paths in two different ways.

One way is to look for all the paths in the picture and draw them in different colors:

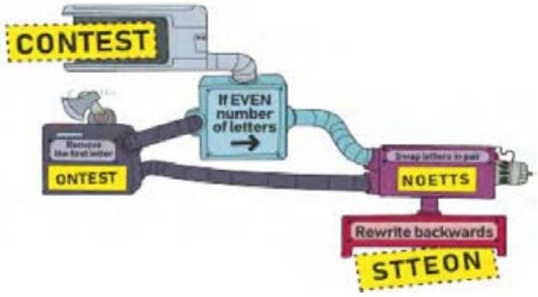
A second way is to use a *dynamic programming method*. We look for all the junctions in the picture. We count how many paths lead to each junction and write the appropriate number on it. To do it, we go from left to right and sum up the numbers on the junctions that are directly connected to the current junction by incoming arrows.

In this instance, we start by putting 1 into the starting junction (red), because there's only one path from the initial beavers' position. Then we calculate the numbers for the yellow junctions – they also equal 1, because the only possible preceding junction is the red one. After that we calculate the green junctions: for example, to get the green 2 we sum up red 1 and yellow 1. Next we calculate the blue junctions, and then the final junction: we get 7 by summing up 2, 4 and 1 from the previous junctions.


1
1
2
1
2
4
7
1
1
1

138. Word Coding

Beavers have built a machine that transforms words in the following way. If the number of letters is even, it is passed along unchanged. Otherwise, the first letter of the word is removed. Next, each pair of neighboring letters is swapped: the first and the second letters, then the third and the fourth, and so on. In the final step, the resulting word is reversed.
For example, the word CONTEST is converted to STTEON:



Question / Challenge

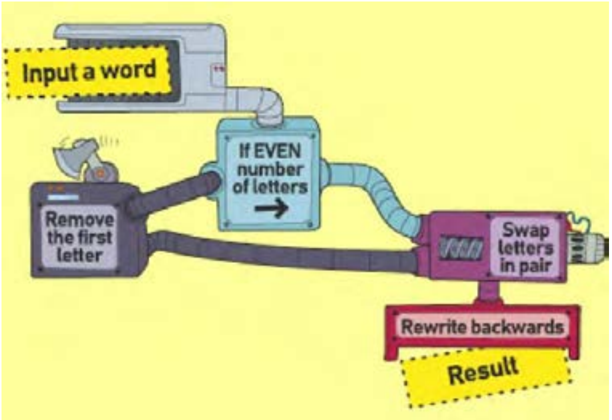
If we send a word STORAGE, we get ….

Answers

<String of capital letters>.

The correct answer is:

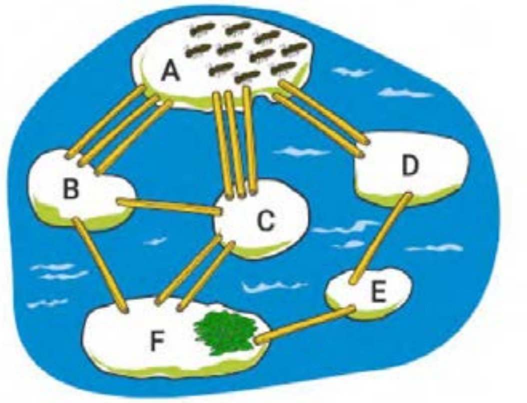
Correct answer is GERATO.
Word STORAGE is odd, so remove first letter and get TORAGE. The next step is swap letters in pair and get OTAREG. And final steps is rewrite backwards: GERATO.



The picture (schema) in this task is part of a simple flowchart, that explains how to change a word step by step. Flowcharts are a way to describe algorithms: notice that flowcharts can capture the idea of decisions (as in the "IF EVEN" part of the machine), or perform actions (like the REMOVE or SWAP parts of the machine). Notice that flowcharts can also allowing looping/repetition, which would be represented by moving "back" to an earlier part of the machine.
In this task the algorithm changes words

139. Ants in Swamp

Ten ants are located on Stone A and seek to reach the food on Stone F. Only one ant at a time can walk on a single straw, and it takes 1 minute for an ant to walk from one stone to another.



Question / Challenge

What is the maximum number of ants that can reach the food on Stone F after 3 minutes?

Answers

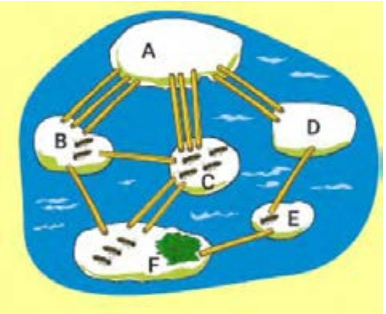
Integer numbers from [0,10];

The correct answer is:

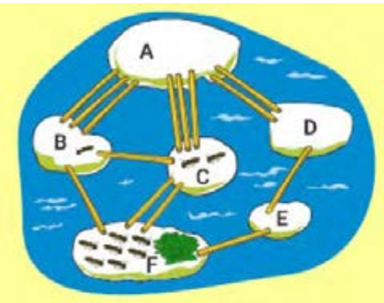
Correct answer is 7.

A possible situation after each minute is presented in the images below.

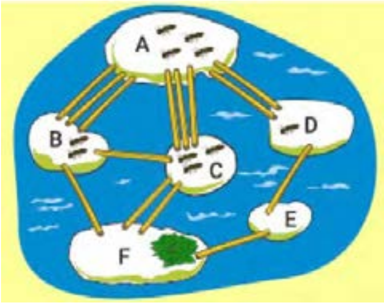
After **one** minute:



After **two** minutes:



After **three** minutes:


A
B
C
D
E
F

140. Snowmen's hats

Five snowmen are standing in line. From left to right each gets its hat according to its size. The snowmen get the hats from the top, one by one.

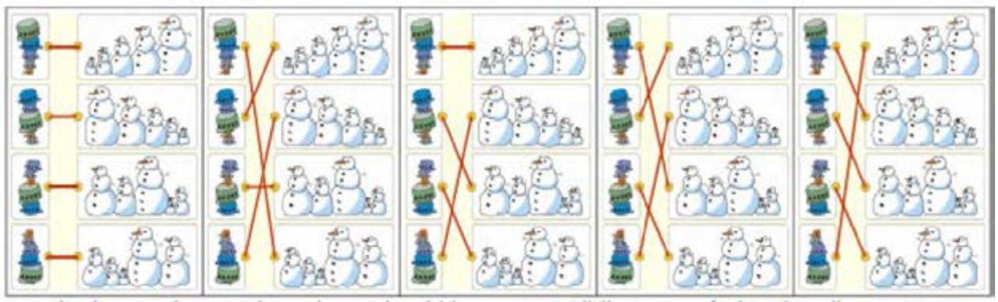
Question / Challenge

Which pile of hats belongs to which row of snowmen?

For the interactive version only: Use your mouse to connect the yellow dots.

Answers

A)	B)	C)	D)	E)



For the interactive version: There should be two possibile ways of „drawing“ lines:

• Click on a yellow button on the left or on the right and click on a yellow button on the other side and those two buttons get connected. Whenever one clicks on a yellow button which has already a connection, this connection is deleted.

• Click on a yellow button on the left or on the right and drag onto a yellow button on the other side and those two buttons get connected. A line from the clicked yellow button to the current mouse position is shown while dragging. If outside of the yellow buttons on the opposite side is dragged or even on a yellow button on the same side, the line is discarded.

The correct answer is:

The correct answer is answer E) 

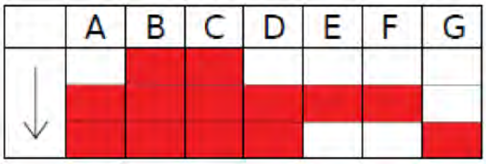
The first pile of hats belongs to the second row of snowmen. The first snowman is the largest snowman with 5 buttons and the first hat is the largest hat. The second snowman gets the next hat, and so on.
The second pile of hats belongs to the third row of snowmen. The first snowman is the second largest snowman with 4 buttons and the first hat belongs to the second largest snowman with 4 buttons. Each of the remaining snowmen gets the correct hat as before.
The third pile of hats belongs to the fourth row of snowmen. Here, the first snowman is the third largest with 3 buttons and the first hat is the third largest hat. Each of the remaining snowmen gets the correct hat as before.
The fourth pile of hats belongs to the first row of snowmen. We can see that as follows. The first snowman is the smallest snowman with 1 button and the top hat is the smallest hat. The second snowman is the next smallest snowman with 2 buttons and the next hat is the next smallest hat. This continues for the rest of the snowmen and hats.
Answer A is incorrect, because in the first row, the smallest snowman with 1 button gets the largest hat.
Answer B is incorrect, because in the first row, the smallest snowman with 1 button gets the second largest hat.
Answer C is incorrect, because in the first row, the smallest snowman with 1 button gets the largest hat.
Answer D is incorrect, because in the first row, the smallest snowman with 1 button gets the second largest hat.

141. Digital Number

Alyna wants to display numbers using her light emitting diodes (LEDs). She wants to use 7 LED segments to represent each number. Segments are labeled A, B, C, D, E, F, and G, as shown below.

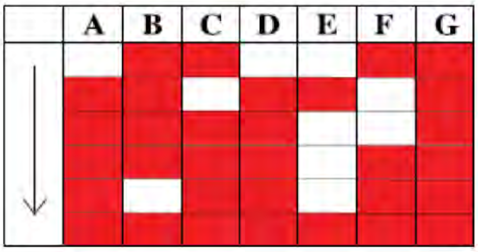
In order to turn on a certain LED segment, she needs to indicate it in the corresponding cell of the table.

For example, the following table will show the three-digit number 103:



Question / Challenge

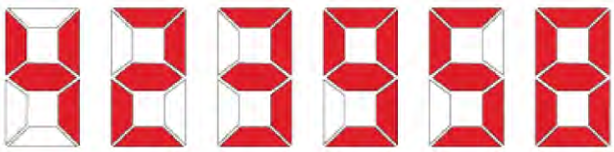
What will be shown on the display, if we use the following table?



Answer

(Click the segment to change the color)

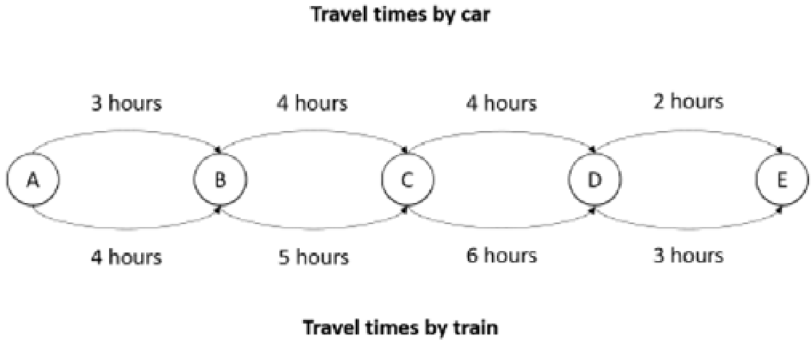
The correct answer is:



From the example, we notice that each row in the table represents one digital number. For the first row in the question's table, only segment **B**, **C**, **F** and **G** are selected, which represents the number **4**. For the second row, segments **A**, **B**, **D**, **E**, **G** are selected, representing the number **2**. Continuing this process for each row, we get the number **423958**.

142. By car or by train?

Beaver John has to travel from A to E via B, C and D. Traveling from a city to the next he can take the train. Train times are depicted in the picture below. Alternatively, in each city he can hire a car and drive to the next city. Driving times are also depicted in the picture below.



John cares a lot about environmental issues and about preventing climate change. So he wants to travel by car as less as possible. Unfortunately, he has to show up in E within 15 hours time.
Therefore he is forced to travel at least a part of the journey by car.

Question / Challenge

What is the minimum time John has to travel by car?

Answers

Enter your answer as an integer between 0 and 100.

The correct answer is:

6 hours.

John prefers traveling by train. The whole journey by train would take him 18 hours. So he has to exchange at least three hours of train traveling by driving by car. We can sum up all possibilities to do so.

	Time saving due to traveling by car instead of traveling by train	Driving times
From A to B	1 hour	3 hours
From B to C	1 hour	4 hours
From C to D	2 hours	4 hours
From D to E	1 hour	2 hours

Our problem can be rephrased as follows: Minimize the total driving time under the condition that time saving adds up for at least 3 hours. The tables show four exchange possibilities.

	saved time	driving time
A to B	1	3
B to C	1	4
D to E	1	2
Total	3	9

	saved time	driving time
B to C	1	4
C to D	2	4
Total	3	8

	saved time	driving time
A to B	1	3
C to D	2	4
Total	3	7

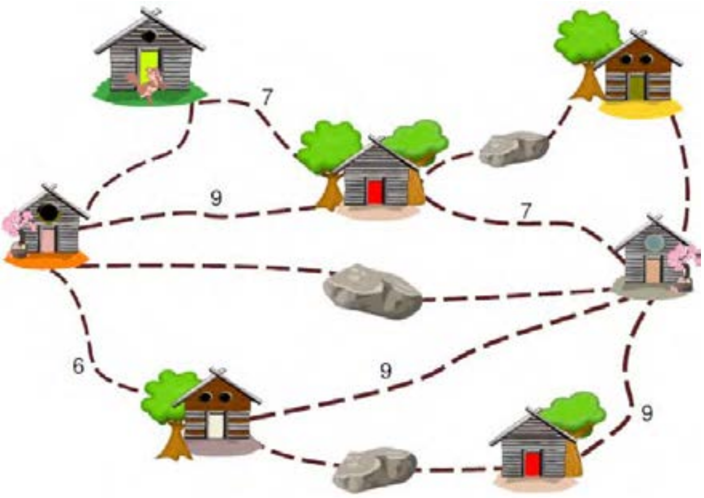
	saved time	driving time
C to D	2	4
D to E	1	2
Total	3	6

The best way to save three hours time is driving from C to D and from D to E (last table). This saves three hours and requires only 6 hours of driving. All alternative exchange options require a
longer driving time.

143. Visits

Little Tom is at home and wants to visit all his relatives. To use some of the roads he has to pay a fee (they are shown in the picture below). If he uses a road more than once, he doesn't have to pay again. Some of the roads are blocked by rocks, so they cannot be used.

Tom's house



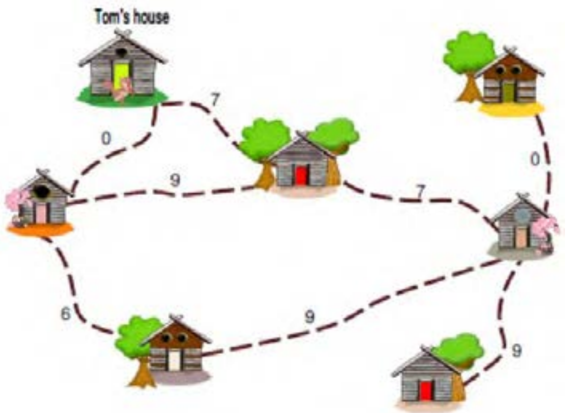
What is the minimum amount of money Little Tom must have in order to be able to visit all his relatives?

Answers

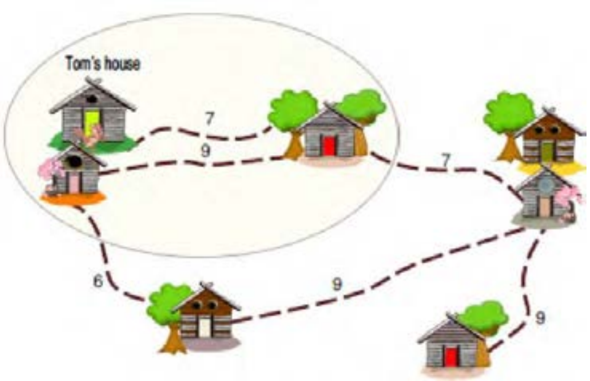
Open integer: 0 - ...

The correct answer is: 29

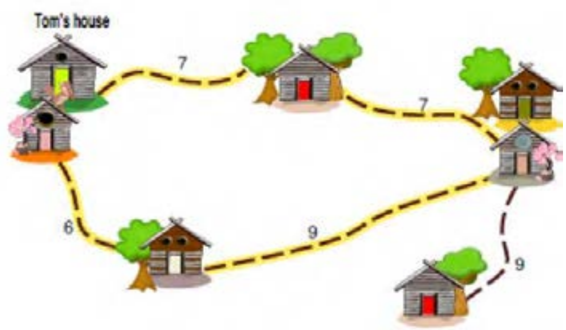
We can consider that the cost of the roads that have no fee is 0, and the roads with rocks are nonexistent. Thus, the map will look like this:



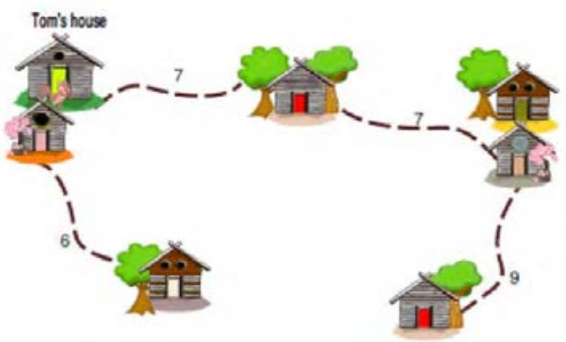
The places at the two ends of the roads with the fee of 0 can be considered as one place as we can move freely between them. After moving them together the map will look like this:



Now we see that the circled places have two roads between them, so we can remove the one with the higher fee.

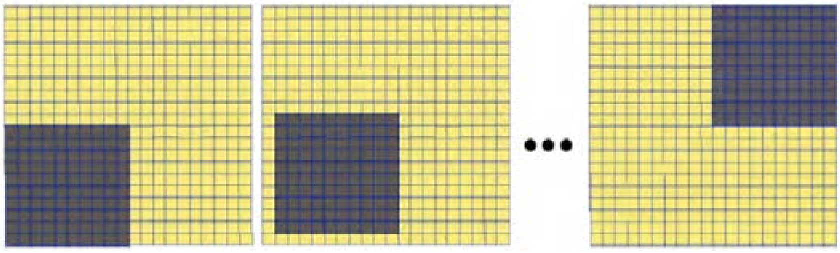


The only thing we have left to resolve is the circuit that is highlighted on the map. In the circuit we can remove any single road and still reach all the other houses the other way if necessary. So we remove the road with the highest fee in the circuit.



Now we just have to sum the fees of the roads that remain on the map, that is 6 + 7 + 7 + 9 = 29

144. Video Compression



A computer image is a rectangular grid of coloured squares, called pixels. A video is a sequence of images, called frames, each slightly different from the previous one. The simplest way to store a video is to store all the pixels in each frame. A more efficient way is to store the entire first frame and then only store those pixels that change from the current frame to the next one. In the picture above, the 10×10 dark coloured square moves from the lower left corner to the upper right corner of the light coloured 20×20 field, moving one pixel horizontally and vertically in each frame. This takes 11 frames. If we store this video in the simple format, this will require (20×20)×11 = 4400 pixels.

Question / Challenge

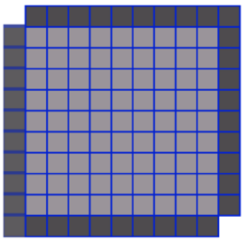
If we store this video in our more efficient format, how many pixels do we require?

Answers

Open integer

The correct answer is: 780

We need remember 20×20 = 400 pixels for the first frame.
From each frame to the next, 38 pixels change, as shown below.



There are 10 new frames after the first frame, so overall we need to store 400+(38×10) = 780 pixels.

145. Bus Schedule

The following tables show when buses will stop at each bus stop.

Bus stop	Route 1	Route 1	Route 1
Stop A	10:00	11:00	12:00
Stop B	10:20	11:20	12:20
Stop C	10:40	11:40	12:40
Stop D	11:00	12:00	13:00
Stop E	11:20	12:20	13:20

Bus stop	Route 2	Route 2
Stop A	10:10	11:10
Stop F	10:20	11:20
Stop C	10:30	11:30

Question / Challenge

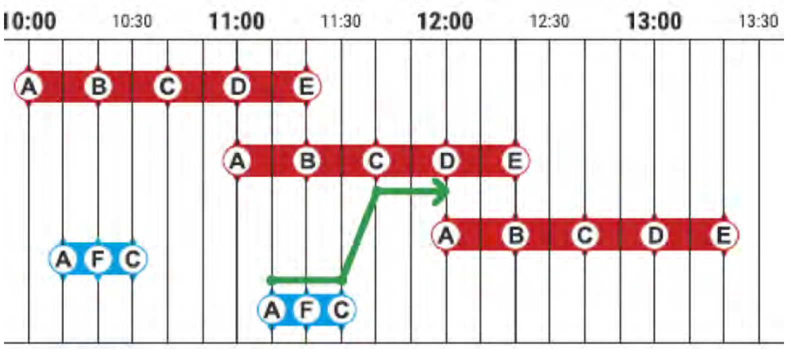
If beaver James is at stop A at 11:05, what is the earliest time that he can reach stop D?

Answer Explanation

Take the Route 2 bus from stop A at 11:05 to stop C at 11:30

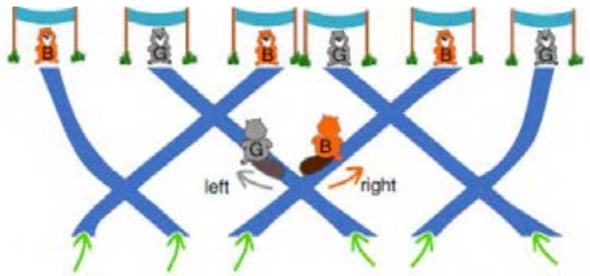
Take the Route 1 bus from stop C at 11:40 to stop D at 12:00

If James had taken the Route 1 bus from stop A, he would not have arrived until 13:00.



146. Beaver Network

There is network of passages that beavers enter and exit. There are six entrances and six exits. Exactly one beaver enters at each entrance. There are two types of beavers, grey and brown. If two beavers meet at a junction and they are of two different colors, the brown beaver will go to the right while the grey one will go to the left. Six beavers enter the network of passages at the same time.



Question / Challenge

For the following order of beavers exiting the network: BGBGBG write in the space provided the order
they entered the network.

Answer Options / Interactivity Description

A string of characters indicating the order of entry.

Answer Explanation

The correct answer is: BBGBGG or BBBGGG. Any other answer would not provide the exit order needed.
In order to have a B at the most left exit, it is necessary for the two most left entries to be BB. Any other combination would produce G at the most left exit.
In order to have a G at the most right exit, it is necessary for the two most right entries to be GG. Any other combination would produce B at the most right exit.
For the two middle positions in the entrance we are left with only two combinations: BG or GB. Its easy to check that both are correct.

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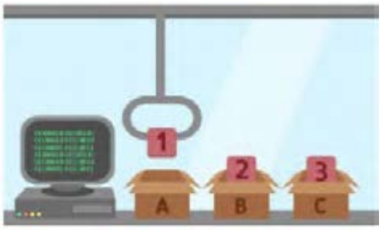
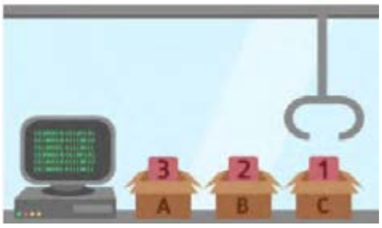
147. Boxes

There are three boxes, A, B, C. Each box holds a single number.
Three steps happen in the following order:
If the number in Box A is less than the number in Box B, switch the numbers;
If the number in Box B is less than the number in Box C, switch the numbers;
If the number in Box A is less than the number in Box B, switch the numbers;
For instance, if the numbers in the boxes are: [A: 1] [B: 2] [C: 3]

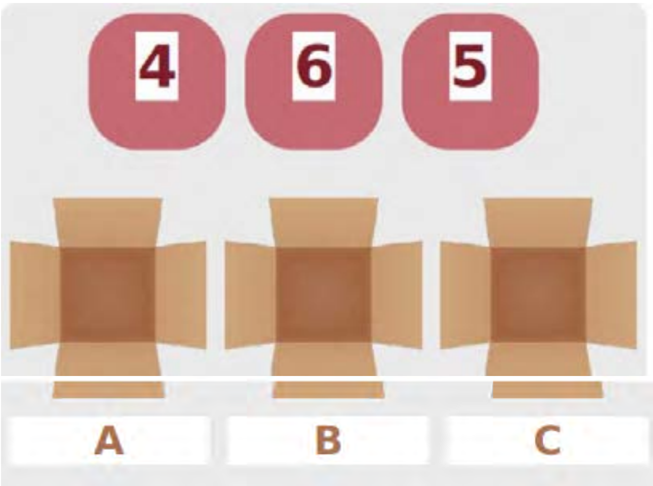


The result after all three steps will be: [A: 3] [B: 2] [C: 1]



Question / Challenge

If the numbers in the boxes are [A: 4] [B: 6] [C:5], what will the result be after all three steps?



Answers

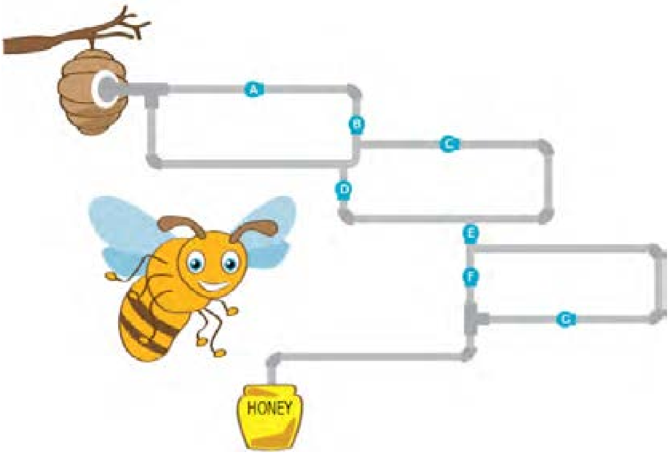
Drag and drop the numbers to the correct boxes.

The correct answer is: 654

The instructions describe a three step process that always sorts the input from largest to smallest.
The numbers start out as 4 6 5
After step 1, the order will be 6 4 5
After step 2, the order will be 6 5 4
After step 3, the order will still be 6 5 4
(There are only six possible answers: 456,465,546,564,645,654)

148. Honey Pot

Bertie the bee has to work fast and fill honey pot to take to the market.



Question / Challenge

Which vent pipes must be open to make the honey reach pot in the shortest way?

Answers

Door A
Door B
Door C
Door D
Door E
Door F
Door G

[Combination of doors (either drag and drop or enter the correct doors in type field)]

The correct answer is:

Door D, Door E & Door F (either drag and drop or enter the correct doors in type field). Doors A, B, C & G are not correct as they are not essential in assisting the honey to come towards the honey pot the shortest.

149. Bird Colours

Lorraine, the Australian Rainbow Lorikeet, has had four different hatchlings. Each Lorikeet has fourcolors: red, blue, green and yellow. Each color in a lorikeet cannot be located in the same body part as in the other lorikeets. Each color has its distinct pattern.

Question / Challenge

Based on the first three hatchlings, what color patterns will the fourth have?
Drag & drop each color pattern on the body part you want to fill.

Answers

Students must drag&drop each color pattern on the body part they want to fill.

First, the student chooses the box of color pattern and then drags&drops it on the body part to fill.

The correct answer is:

Other combinations of color patterns can't be right as they don't follow the progressive color pattern – red, blue, green and yellow. Each color fills in only one body part of the Lorikeet – head, chest, wing,
tail.
The only right answer can be the one above as it follows the color and body part pattern established.

150. Find the Fountain

Matt is playing in the park. His friend told him that there are several fountains somewhere around the park. He wants to see all of them, unfortunately he doesn't know where they are.

Question / Challenge

Draw a way that Matt could walk so that he visits every field without a tree exactly once (to go through the park as fast as possible).There are several correct solutions.

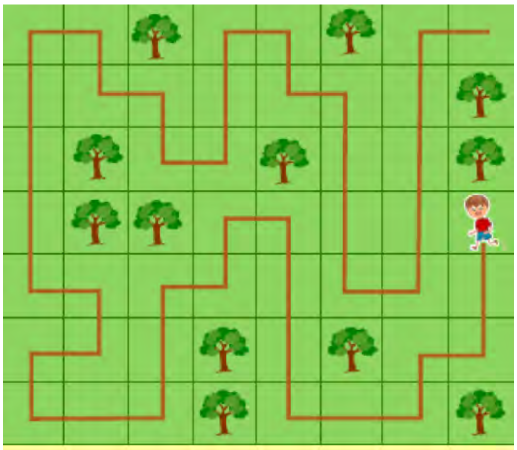
Answer Options / Interactivity Description

Interactivity description: The easiest way for a student to make this interactivity work is that he clicks on Matt and moves his mouse while still holding the mouse button and "drawing" a way for Matt. The field should change like this:

- If the drawing starts from Matt, all previously marked fields should be unmarked.
- If the drawing starts from an unmarked field, nothing should be changed (as if the mouse button never got clicked).
- If the drawing starts from a marked field, the path after this field should be deleted if the mouse is moved to a different adjacent field.
- If the mouse gets moved onto a field with a tree the drawing should stop as if the mouse button would have been lifted. The user would have to release the mouse button and restart the drawing.
- If the mouse gets moved onto a field from an adjacent field that Matt has not yet visited, an arrow should appear from the previous field to this field and this field should be colored in light green.
- If the mouse gets moved onto a field from an adjacent field that is already marked, the drawing should stop as if the mouse button had been lifted.
- This way the task has a feedback: it is not possible to fill the field without drawing a Hamiltonian path.

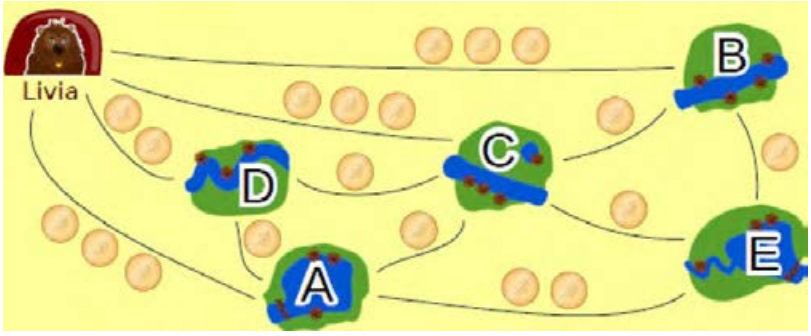
Answer Explanation

This is one of several possible solutions:



151. Visit friends

Livia wants to visit all of her friends in the villages A, B, C, D, E by public transportation. She visits
all of her friends in one journey, without visiting a village more than once, and she returns home at
the end of her journey. The fare of each line is shown below. Notice that the maximum fare is three
coins.



One possible order to visit her friends that costs 11 coins is:
Home → B → E → A → D → C → Home.

Question / Challenge

Find a visiting order that costs Livia as few coins as possible. If there is more than one optimal solution, just find one.
Drag the letters A to E to the gaps below to complete the solution in the right order:
Home → ____ → ____ → ____ → ____ → ____ → Home

Answer Options / Interactivity Description

The participant should drag and drop the letters A through E into the gaps. It should also be possible to drag letters from one place to another, if letters are dropped outside the gaps, they
should snap back to their original outside positions, if a letter is dropped onto another letter, this
other letter should also snap back to its original positions.

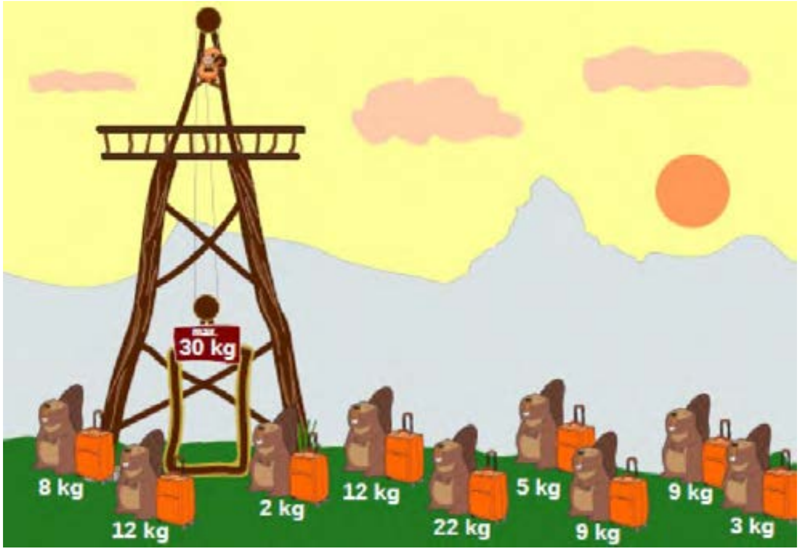
Answer Explanation

There are two optimal solutions:
Home → B → E → C → A → D → Home
Home → D → A → C → E → B → Home
The two solutions are reverse of each other and both cost 9 coins. There is no better solution, since from Livia's home you can go the two-coin way once and need to go the three-coin way the
other time. Visiting the further nodes are 4 ways costing one coin at least each, which already gives a total of 9 coins.
All other solutions cost more:
cost of 10 coins: Home → A → D → C → E → B → Home
cost of 10 coins: Home → A → E → B → C → D → Home
cost of 10 coins: Home → B → C → E → A → D → Home
cost of 10 coins: Home → B → E → A → C → D → Home
cost of 10 coins: Home → B → E → C → D → A → Home
cost of 10 coins: Home → C → B → E → A → D → Home

cost of 10 coins: Home → D → A → E → B → C → Home
cost of 10 coins: Home → D → A → E → C → B → Home
cost of 10 coins: Home → D → C → A → E → B → Home
cost of 10 coins: Home → D → C → B → E → A → Home
cost of 11 coins: Home → B → E → A → D → C → Home
cost of 11 coins: Home → C → D → A → E → B → Home
One method is to go a way that costs the minimum amount of coins and find a solution from there.

152. Elevator

A group of beavers are visiting the countryside and want to take the elevator up to the observation
deck. But it's late and the elevator only goes up twice. The elevator has a load capacity of 30 kg.



Question / Challenge

How do you distribute the beavers with their luggage, between the two elevator cabins so that as many
beavers as possible can stand on the platform? Drag the beavers on the two lifts below.

Answer Options / Interactivity Description

Drag and Drop

Important for the programming: The distribution of both beaver-groups must be possible in cabin 1 and
2, or 2 and 1. The order of the beavers within the cabin must be irrelevant.

Answer Explanation

The correct answer is:

The first idea that comes to mind could be to pack into the first cabin as many beavers with the smallest
weight: 2 + 3 + 5 + 8 + 9 = 27 kg and into the second cabin 9 + 12 = 21 kg (7 beavers) but it is possible
to pack the following 8 beavers into the lift:

The trick: exchange the 9 kg beaver with the 12 kg beaver in the first cabin (total weight of the first
cabin 30 kg) then you can use the 9 kg beaver for the second cabin (total weight of the second cabin
30 kg).

153. Beaver-Modulo

Some beavers took part in the annual beaver challenge. Their first task was to jump from rock torock in a clockwise direction, as shown by the arrow, starting from rock number 0. So, if a beaver jumped 8 times, he will end up on rock number 3:
0 → 1 → 2 → 3 → 4 → 0 → 1 → 2 → 3.

Question / Challenge

One of the beavers showed off and jumped an astonishing 129 times. On which rock did he end up?

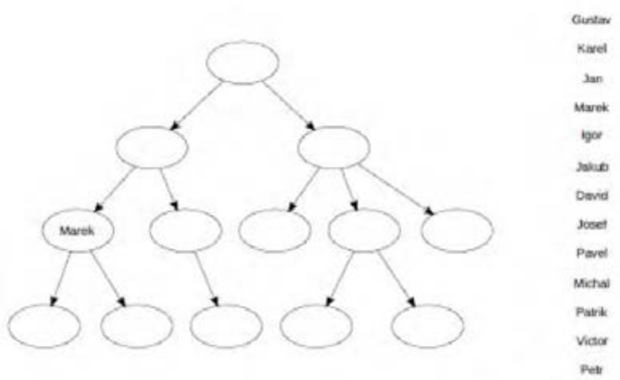
Answer Options / Interactivity Description

Integer numbers from [0,4]

Answer Explanation

If a beaver jumps 5 times, he ends up where he is. Let's call it a "lap". To find out where he ends up after 129 jumps we have to find out how many "laps" he jumps and how many jumps he still has to do after that. In this case it's 129 = 25 × 5 + 4. So, jumping 129 times will have him end up at the same place as if he just had jumped 4 times. He ends up on stone number 4

154. Family tree



Marek wants to have the family tree of all men of his family. We have this information available:

- Viktor is David's son.
- Igor has only one son named Patrik
- Michal is Pavel's brother.
- Gustav is Jan's father.
- Marek's father is called Karel.
- Pavel is Marek's son.
- Marek's uncle is called Jan.
- Jakub, David and Josef are Marek's cousins.

An arrow in the family tree from person A to person B means that A is the „father" of B.

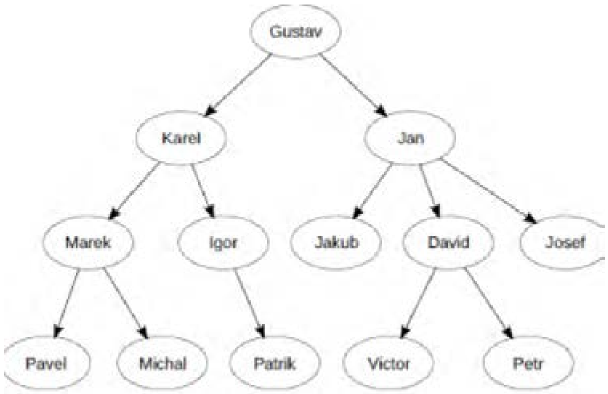
Question / Challenge

Place the names in the graph according the information.

Answers

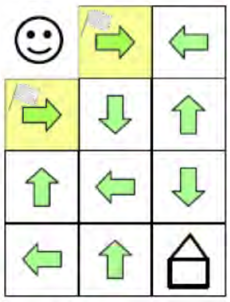
Interactive – drag and drop.
(cards with names David, Gustav, Igor, Jakub, Jan, Josef, Karel, Michal, Patrik, Pavel, Petr, Viktor beside the
background)

The correct answer is:



Note that there are 8 different possible solutions. Pavel and Michal can be swapped, Victor and Petr can be swapped and Jakub and Josef can be swapped.

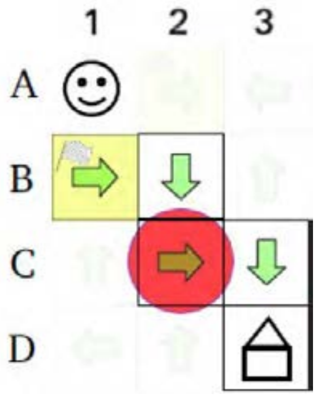
155. Arrow maze



Your goal is to take smilie :-) through the arrow maze back home. When standing in a cell with an arrow, the smilie must move to the next cell by following the direction of arrow. It can start from any yellow cell with a flag.
It is impossible to reach the final cell with the home now. Change the direction of only one arrow so that you can reach the target.

Question / Challenge

Click repeatedly on one of the arrows to set appropriate direction.
Answers
This is an interactive task.
Clicking version:
All arrows in the maze can change their directions by clicking on them (each click change the direction 90°
clockwise).
Drag and drop version:
4 cards of arrows (up, down, left, right) besides the maze, drag one of cards to an appropriate cell.
The correct answer is:



The arrow to change is marked with a red circle. The path for the smilie is highlighted (start A1 – B1 – B2 – C2 – C3 – D3 target).
A proof that this solution is the only one:
We will start from he target cell D3 and go backwards. You can come to cell D3 from 2 directions: D2 and C3.
An arrow in D2 is not pointing at target cell, so in case of correct solution it needs to be changed. Because no neighbour arrow is pointing at D2 and the second arrow should be changed, which is not allowed. Therefore, the target is accessible only from the cell C3.
There is no arrow pointing at C3, so we need to change an arrow in cell B3 or in C2.
Because no arrow is pointing at B3, there is no way to go to cell C3 through B3 without changing the direction of another arrow.

Cell C2 is accessible from the starting cell (A1 – B1 – B2 – C2) without changing another arrow. We need only change an arrow in cell C2 to solve the maze.

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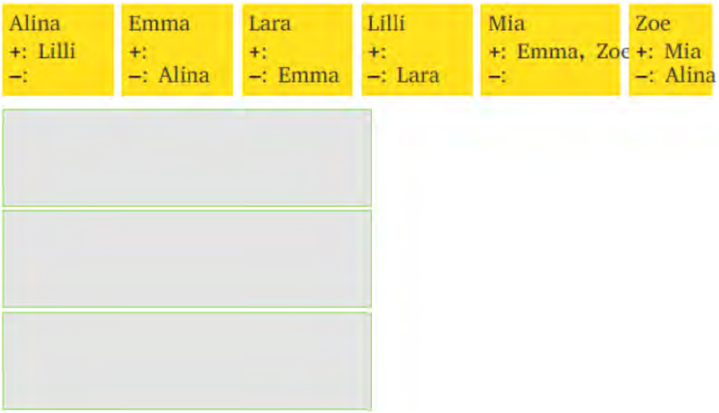
156. Room Sharing

The members of the Girls' Computer Club are planning a weekend trip. They will stay in a hostel with large rooms, that can take a maximum of six guests each.
But who will share rooms with each other?
Each girl submits her room sharing wishes on a card saying 1. which other girls she absolutely wants to share a room with (+), and 2. which other girls she definitely does not want share a room with (–).
The club president wants to keep all members happy. So she must assign the girls to rooms and fulfill all their room sharing wishes.

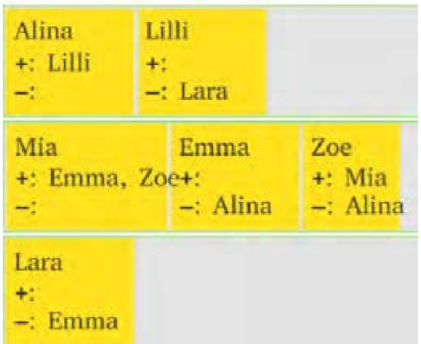
Question / Challenge

Help her!
To assign a girl to a room, drag her wish-card into one of the rectangles.



Answers

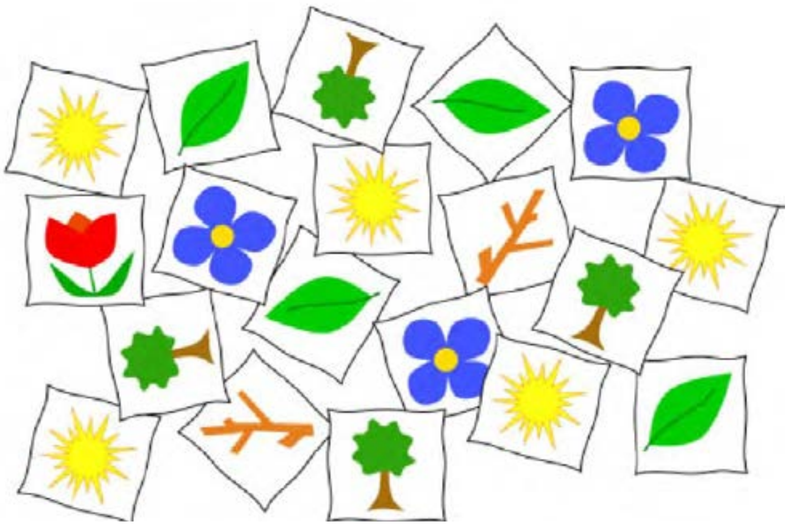
Any constellations with each card moved to one rectangle can be submitted as answer.
The correct answer is:
To fulfill all wishes, you could focus on the positive wishes:
1. If there is an empty room,
a. then drag a girl's card to this room;
b. else drag a girl's card to a room where this girl is not on a – list of the cards already in this room (and FAIL if there is no such room)
2. Drag all cards of girls who are on the + list of the first card to the same room. If there is no more card, then you are DONE.
3. Go back to step 1.
Applying the above procedure results in this room assignment. There is no other assignment that would fulfill all wishes: Alina must be together with Lilli. But Alina (and hence also Lilli) can be together with neither Emma nor Zoe; hence she also cannot be together with Mia, who must be together with Emma and Zoe. Lara must go into her own room, as she can be with neither Lilli (and hence Alina) nor Emma (and hence Mia and Zoe).
A graph with nodes = girls and edges = positive wishes (and "counter edges" = negative wishes) can be drawn in order to illustrate this example and the CS background further. This said, such an illustration might be nice for the "It's informatics!" section.



As you can see, there is a solution for this room assignment. This is not always the case; for instance, if Alina would like to be in the same room as Lilli, but Lilli would not like to be in the same room as Alina, we would have a deadlock.

157. Pillow fight

Pillow fighting is one of the young beavers favourite games. For this game, each participant brings a pillow with a picture on it. Three beavers, having the same pictures on their pillows, form a team. If there are more than 3 beavers with the same picture, team members are selected by lots. Beavers who cannot form a team do not get to play for the day.
Shown below are the pillows that the young beavers brought today.



Question / Challenge

1. How many teams can be in today's pillow fight?
2. How many beavers would noht be able hto join htge pillow fight htoday?

Answers

1. Integer numbers from [0,20].
2. Integer numbers from [0,20].

The correcht answer is:

1. Correct answer is 4.

There are 6 different pictures on pillows. They are: **sun** on 5 pillows, **tree** on 4 pillows, **leaf** on 4 pillows, *Pillow* **blue flower** on 3 pillows, **branch** on 2 pillows and **red flower** on 1 pillow. It is necessary to have at least 3 equal pillows to form a team. There are not enough red flowers and branches to form a team.

2. Correct answer is 7.

There are 19 beavers in total. In 4 teams will be 4x3=12 beavers. The rest is 7 beavers which will pause today.

158. Rafting

Beavers Cvijeta and Matej are going rafting. They are both carrying a backpack that can hold up to six items, with a maximum capacity up to 1500g.
Cvijeta and Matej must have these items in their backpack :

• 1 bottle of water - One Bottle weighs 500g
• 1 sandwich - One sandwich weighs 250g
• 1 spare pair of socks – One pair of socks weighs 200g

They also need to take the following items when they go rafting, but they need to make sure their backpacks weigh the same when they are packed.
The additional items they have to pack are:

• 2x cookies - One package weighs 300g
• 2x travel pillows – One travel pillow weighs 200g
• 2x chargers - a charger weighs 325g
• 2x headphones - one headphones weighs 50g
• 2x wet tissues - One pack weighs 175g

Since they are inseparable friends, they agreed to pack the items together. They are not sure the best way to pack the other items in order to have backpacks of the same weight.

Question / Challenge

How do they have to arrange the items if they want to pack the backpacks with one items that is not packed in each backpack? Drag items in each backpack.

Answers

With a bottle of water, a sandwich and a pair of socks in each backpack, the arrangement of other items are:
Backpack 1: travel pillow, charger
Backpack 2: cookies, headphones, tissues

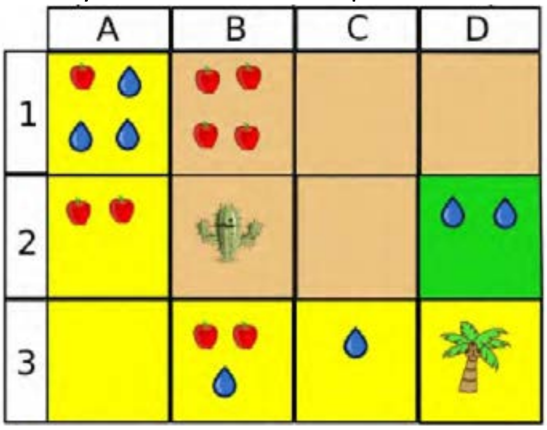
The correct answer is:

Each backpack must contain a bottle of water, a sandwich and a pair of socks. The weight of these three items is 950g.
The total capacity of each backpack is 1500g which means that we can add a maximum of 550g and 3 more items to each backpack.
Backpack 1 :
Add the following items: 1x travel pillow (200g) + 1x charger (325g).
Total weight of Backpack 1 = 525g.
Backpack 2:

Add the remaining items : 1x cookies (300g) + 1x headphones (50g) + 1x tissues (175g). Total weight of Backpack 2 = 525g.
Note: The content of the first and second backpack can be swapped. It is not important which items are in the first and which are in the second backpack as the combination of the items is identical.

159. Desert

Beaver Kreso goes on a journey around the world. A ter many interesting landscapes, he reaches the desert.
He starts rom the ield A1 at the top le t and wants to go to the palm tree at the bottom right. He can move le t, right, up, or down (not diagonally) and cannot pass a ield twice. He cannot pass any ield with a cactus.
Some o the ields contain water and apples and he can collect them along the way. When moving rom one ield to another Kreso consumes one drop o water and one apple. I he has no water or apples, he cannot move anymore.
Below you can see an example with the correct path in yellow:

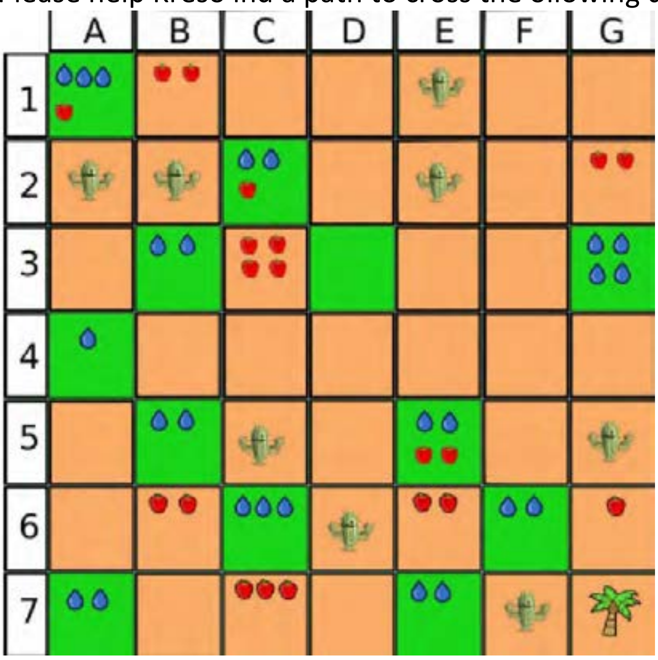


On each ield he has the ollowing a ter consuming and collecting water and apples:

- A1: 3 drops and 1 apple
- A2: 2 drops and 2 apples
- A3: 1 drop and 1 apple
- B3: 1 drop and 2 apples
- C3: 1 drop and 1 apple
- D3: Destination!

Question / Challenge

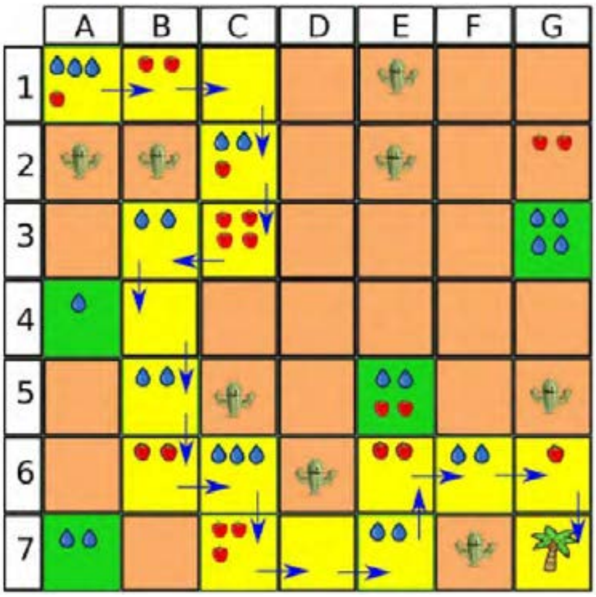
Please help Kreso ind a path to cross the ollowing desert with enough water and apples.



Answers

No answers are offered, this task is resolved interactively on the map or by entering the coordinates of the field that beaver Krešo passes through.

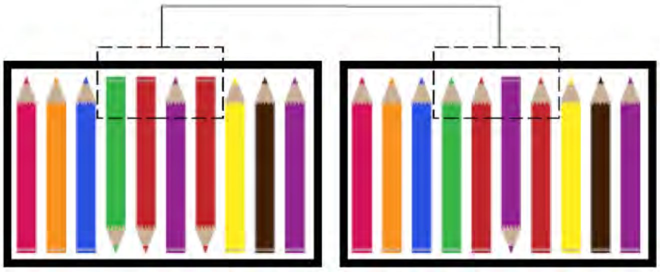
The correct answer is:



There is only one solution and every other possible route does not contain enough drops of water or apples to complete the journey.

160. Ada and crayons A

Ada has a box of 10 crayons, some crayons are pointing upwards and some downwards. Ada thinks that an array of crayons is beautiful if all the crayons are pointing in the same direction. She wants to try a game to have everything pointing to the same direction. She decides to flip consecutive sequences of at least 2 crayons. After flipping a sequence, all the crayons of the sequence which were pointing downwards point upwards and vice-versa. See the picture:



Question / Challenge

What is the minimum number of sequences to flip to make the array of crayons beautiful on the
following picture?

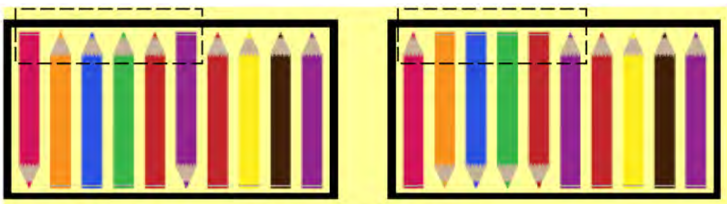
Answers

The correct answer is:

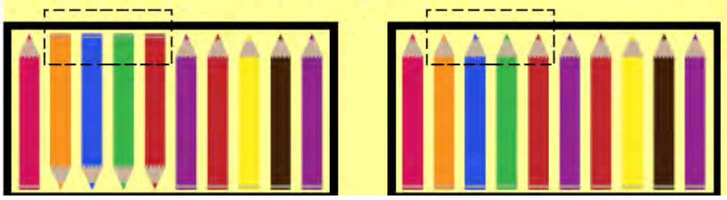
2

We cannot solve the problem by flipping just a single sequence, because the 2 crayons pointing
downwards are separated, they are not next to each other. But it is possible to get a beautiful order in 2
steps:

First step: flip 1st, 2nd, 3rd, 4th, 5th and 6th crayon.

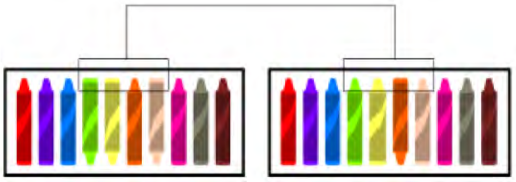


Second step: flip 2nd, 3rd, 4th and 5th crayon.



161. Ada and crayons B

Ada has a box of 10 crayons, some crayons are pointing upwards and some downwards. Ada thinks that a box of crayons looks beautiful only if all the crayons are pointing in the same direction.
In one step she can flip any row of crayons as long as they lie next to one another. After flipping a row like this, all crayons that were pointing downwards will now point upwards (and those that were pointing upwards will now point downwards) as shown in the picture.



Question / Challenge

Look at the box in the picture on the left, what is the minimum number of steps needed to make this box beautiful?

Answers

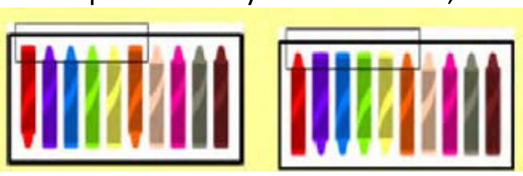
The correct answer is:

2

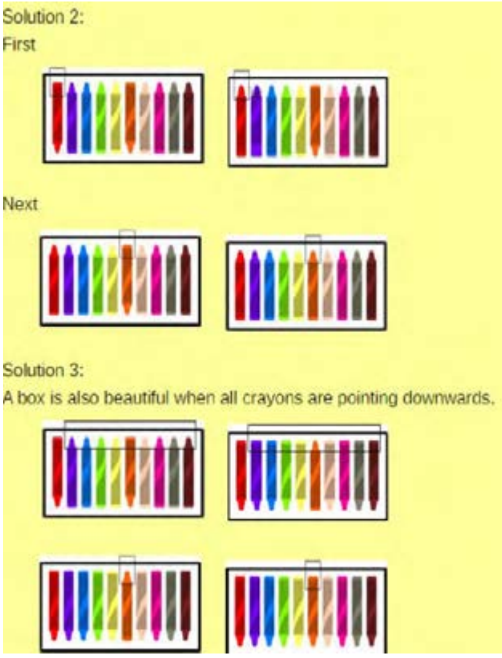
There are actually many ways to make the box beautiful in two steps:

Solution 1:

First flip the six crayons on the left, as in the picture.



Then flip crayons 2, 3, 4 and 5.



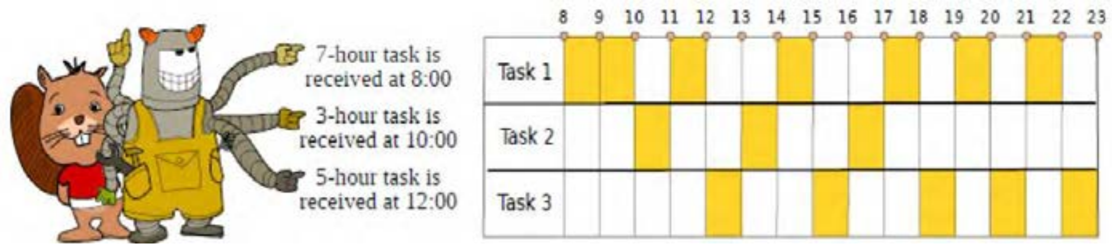
And there are many more possible solutions.
Note: 1 step (flip) is not enough, because the 2 crayons pointing downwards are not next to each other.

162. One Hour One Task A

Beavers' robot can perform many tasks. Each of the tasks needs 1, 2, 3, or more hours.
In any one hour, the robot can work on only one task. At the end of each hour it checks if it has received a new task:

• If yes, the robot must begin work on that new task immediately.
• If no, the robot continues working on the task which has been neglected the longest.

The following timetable shows an example of the robot's work in one day.

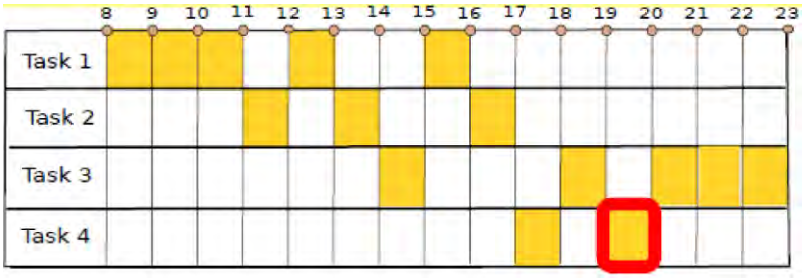


Task-1 was finished at 22:00, Task-2 was finished at 17:00, and Task-3 was finished at 23:00.

Question / Challenge

If the robot received 4 tasks:
Task-1: 5-hours long, received at 8:00
Task-2: 3-hours long, received at 11:00
Task-3: 5-hours long, received at 14:00
Task-4: 2-hours long, received at 17:00
When was Task-4 finished? (The answer should be the hour in the range of 8 to 23).

The correct answer is: 20



163. Sin Nombre

Roni has a cave where he has hidden all his treasures. Unfortunately, he has forgotten the code for the alarm.

Roni thought he may forget the 3 digits code and so wrote himself the following hints.

Hint-1: 1 7 2 Only one of these digits is correct, but is in the wrong position.

Hint-2: 8 5 4 Two of these digits are correct, but are in the wrong position.

Hint-3: 9 8 6 Only one of these digits is correct, but is in the wrong position.

Hint-4: 7 5 1 Only one of these digits is correct and is in the correct position.

Question / Challenge

What is the code?

Answers

Three digits between 0-9.

The correct answer is: 7 4 8

According to Hint-1 and Hint-2 the code may contain digits from the following list: 1 7 2 8 5 4

According to Hint-3, 8 is the only digit that is common between that and the original list (1 7 2 8 5 4). The position of 8 must be the third position because Hint-2 and Hint-3 tell us that the 8 is in the wrong position. We know that the digit 8 is correct and is in the correct position.

According to Hint-1 and Hint-4 there is one correct digit, in Hint-1 it is in the wrong position and in Hint-4 it is in the correct position. The only common digit is 7 and Hint-4 tells us it is in the correct position.

Hint-2 tells us there is one correct digit and the only remaining digit is 4.

Therefore the code is 7 4 8

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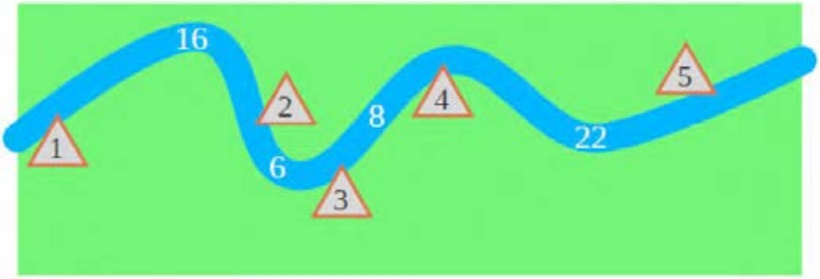
164. Bank Queue

There are 3 cashiers in Beaver Bank: Alice, Beatrice and Claire. Beatrice works 2 times slower than Alice and Claire works 3 times slower than Alice.
Now in the queue there are...
• 5 Fast beavers whose tasks would take 1 minute each if they would go to Alice,
• 2 Normal beavers whose tasks would take 2 minutes each if they would go to Alice,
• 6 Slow beavers whose tasks would take 3 minutes each if they would go to Alice.
The table shows an example how different cashiers serve tasks of different beavers.

Minutes	1	2	3	4	5	6	7	8	9
Alice	Fast	Normal		Slow					
Beatrice	Fast		Slow						
Claire	Fast			Normal					

Question / Challenge
What is the minimum time required for all the tasks in the queue to be done by 3 cashiers?
Answers
Open integer (or interactive solution – see Comments below)
The correct answer is:
15 minutes
Alice serves 5 slow beavers (this takes 15 minutes)
Beatrice serves 2 fast beavers, 1 normal beaver and 1 slow beaver (this takes 14 minutes)
Claire serves other beavers who are 3 fast ones and 1 normal one (this takes 15 minutes)
Now prove that they cannot do all the job for the less time.
Each normal beaver could be divided into two fiction fast beavers. Each slow beaver could be divided into three fiction fast beavers.
So now we have 5+4+18=27 similar beavers. Let's solve our task for them. Of course, new task is not equivalent to initial one, but initial task cannot have a better solution than the new one.
For the students familiar with fractions: Alice serves 1 beaver per minute, Beatrice serves 1/2 beavers per minute and Claire serves 1/3 beaver per minute, so we have there common work speed 1+1/2+1/3 = 11/6 beavers per minute. Then we need at least 27: (11/6) = 162/11 > 14.
Obviously, the answer should be an integer number as every beaver is being served in integer number of minutes, so the answer cannot be less than 15.
For the students unfamiliar with fractions: What if we can serve all beaver in 14 minutes or less? Alice can serve at most 14 beavers, Beatrice at most 14:2 = 7 ones at Claire at most 14:3 i.e.
at most 4 beavers. So we have at most 25 beavers when we need 27 ones. It means that 14 minutes is not enough to serve all 27 new beavers so it is also not enough to serve all initial ones.

165. Atomic shelters



A beaver family has five different food locations on various parts of the river. The travel times (in minutes) from one food location to the next are shown in the picture. The family will build lodges in two of the food locations.
When the weather gets bad, a beaver travels from a food location to the nearest lodge. The time to do this trip is called the escape time.
The beavers wish to build their lodges so that the longest escape time is as small as possible.

Question / Challenge

Which two locations must they choose to build their lodges?

Answers

Non-ordered pairs of integers between 1 and 5 (in theory, the possible answers are 10).
The answer could also just be "click on the two locations to build lodges"

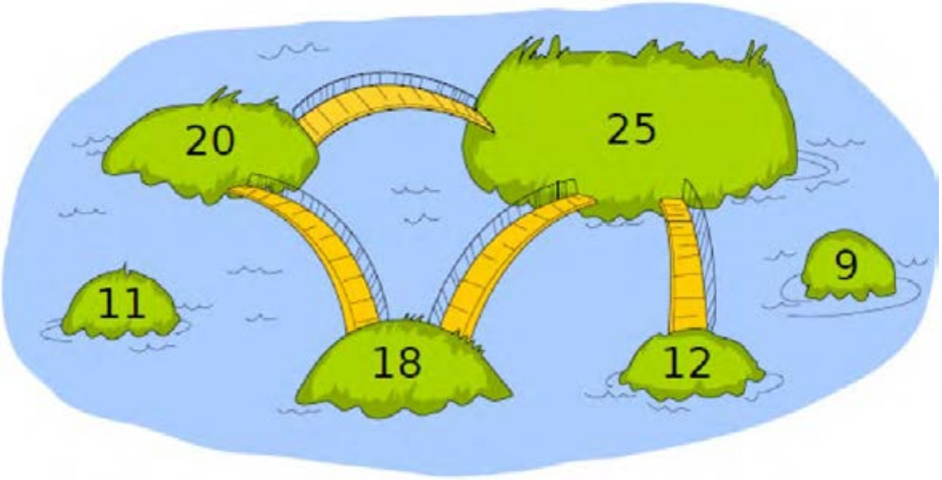
The correct answer is:

2 and 5.
If they do not build a lodge in food location 5, then the beavers in food location 5 would take at least 22 minutes to reach a lodge.
If food location 5 becomes a lodge, then the escape time is less than or equal to 30 minutes (it is equal to 16+6+8=30 minutes if they choose food locations 5 and 4).
In fact, the maximum time is minimal by choosing food locations 5 and 2: escape time for food location 1 is 16 minutes; escape time for food location 3 is 6, and escape time for food location 4 is 8+6=14 minutes).

166. Islands and bridges

People of Kastoria use only one condition to decide where the bridges are to be built: if the sum of populations between two islands is more than a chosen number, the bridge between them will be built.

The figure shows four built bridges between six islands and their populations.



Question / Challenge

What number did they choose?

Answer

36 (accept integer numbers from [0,99])

The correct answer is:

36.

For the pair of islands connected by a bridge, the aggregate population exceeds 36 (for example, 25 + 12 = 37).

The threshold cannot be lower, such as 35, because otherwise 25 + 11 = 36 e five bridges would be needed.

The threshold cannot be higher, such as 37, because otherwise 25 + 12 = 37 would not exceed 37 and only three bridges would be built.

167. Stone Bridge Making

Beaver Jin has to move stones to make a walking path to go home.
When Jin presses a button with a number, stones sink or rise above the water in that column.
When Jin presses a button with a letter, stones sink or rise above the water in that row.
The path must allow Jin to move from the starting point to the end, without moving diagonally.

Question / Challenge

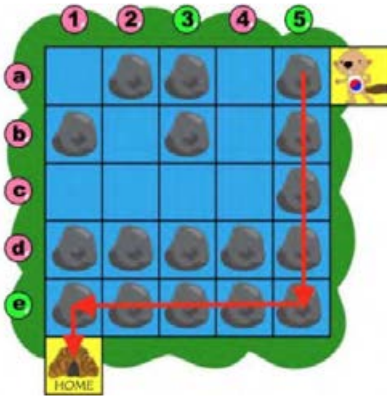
With the fewest number of button presses, help Beaver Jin return home.

Press the "Reset" button to make initial state.
Press the "Save" button to submit.

The correct answer is: 3

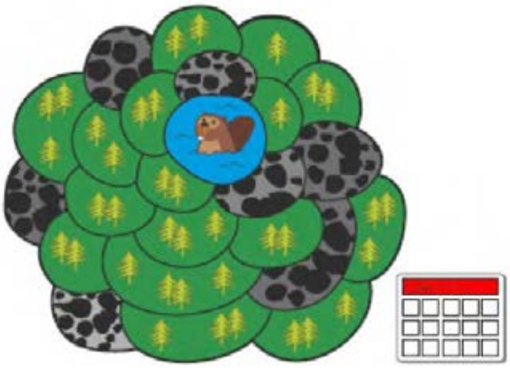
The buttons you need to press are 5, e, 3.
When you look at all the choices. That's too many to check.
But, if you look at the current spot, you can find that the stone with red star must be pressed.
Therefore, a combination of a or 5 and e or 1 would be the correct answer.
Possible combinations are [a, 1], [a, e] [5, 1] [5, e].

But, with only 2 buttons, there is no way that the beaver can return home.
With 3 buttons [3,5,e], as shown in the following figure. Beaver Jin can move to his home.
The way the beaver moves home varies, but the combination of [3,5,e] is the fewest number of buttons

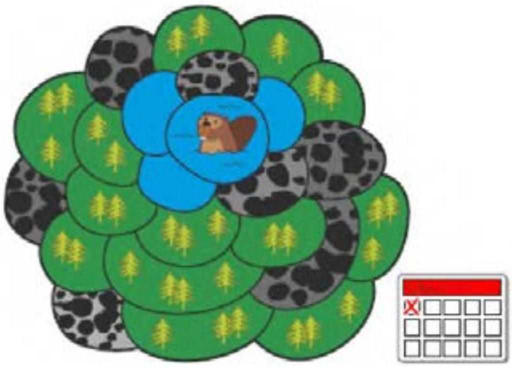

1
2
3
4
5
a
b
c
d
e
HOME

168. Beaver lake

Beavers live in a valley surrounded by mountains. In the valley, there is a lake. The lake is surrounded by fields with either trees or stones.



Every day, beavers flood all those fields with trees that are next to the lake or flooded fields.



For example, after one day, three fields will be flooded. Fields with stones are not flooded.

Question / Challenge

After how many days in total will all the fields with trees be flooded?

Answers

Type the number of days.

The correct answer is:

The correct answer is 6 days.

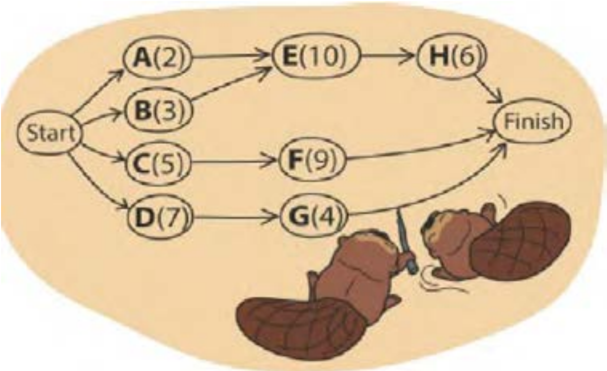
Numbers in the picture below show flooded fields after the corresponding number of days.

Fields next to the lake are marked by 1. Then all unmarked fields with trees next to a field marked with 1 are marked with 2. This process is continued until all fields with trees are marked.

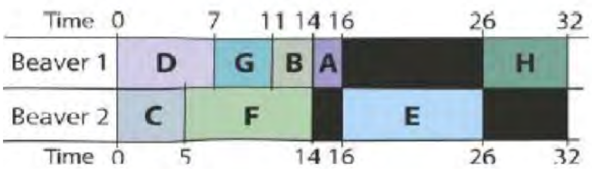
As we can see above, the last field with trees will be flooded after 6 days.

169. Two beavers are working

Two beavers are building a dam and need to do 8 tasks (cut trees, remove branches, float wood, assemble trunks, etc.): A(2), B(3), C(5), D(7), E(10), F(9), G(4), H(6). Each number in brackets indicates the number of hours to do that task. Some tasks must be completed before others can be started, as shown by the arrows. The beavers work in parallel, taking different tasks each.



The beavers use the following plan: from among the tasks that are available at any moment they choose the biggest one. The beavers work on these tasks in this order:



From this picture the beavers complete the dam in 32 hours. However, it is possible to complete the dam in a shorter time with a different plan.

Question / Challenge

What is the shortest time for two beavers to build a dam?

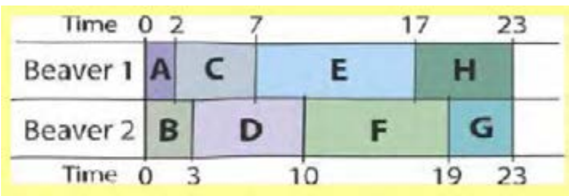
The correct answer is:

The correct answer is 23.

The picture in the task shows the schedule of the two beavers. We can see that the first beaver is idle for a relatively long time (8 hours), and the second beaver is idle for 6 hours. It would be better if they could be working all of the time.

The strategy we will use here is to make sure that the two largest tasks E(10) and F(9) are not done by the same beaver. Here is the picture of one particular schedule that allows that.

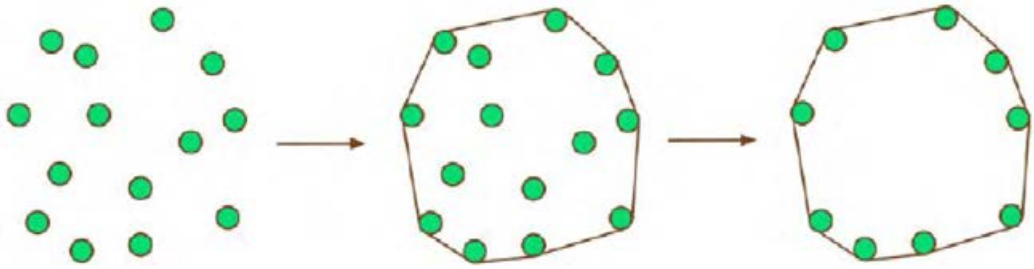
We will see than a dam can be built in 23 hours!



It is also important to know that this particular schedule allows the work to be done in the shortest
possible time because the beavers are never idle.

170. Beaver land

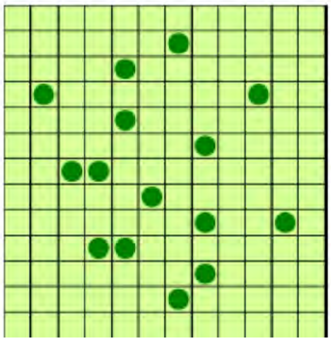
Beavers surround their village with a rope around the trees on the outside of the village. They then cut down the trees that are not needed to support the rope:



First they map the trees on a grid of squares like the one shown below.
Then they select the smallest number of trees needed to support the rope.
To make this easier the beavers assume that all trees have the same diameter (thickness) and are in the centre of the squares in the grid.

Question / Challenge

Select all the trees that can be cut down by the beavers in the plan below.
(All the trees in the village are marked as green circles.)

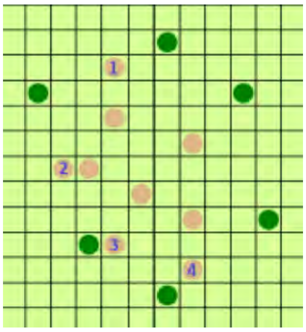


Answers

It should be an interactive task with clickable trees – when clicked the green tree changes color to
brown as cut down. Check if all the trees that have to be cut down were clicked.

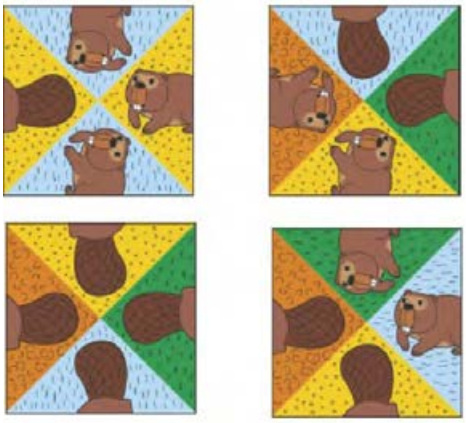
The correct answer is:

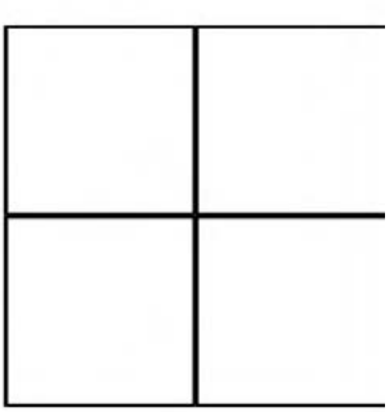
The main problem is to decide whether a tree is inside the boundary, on the boundary or on the boundary but not required to support the rope. We have marked trees on the right that can be cut by light brown
circles. We can cut most of the trees without much thought. Other trees (blue numbers) still require some analysis. Because of the grid system whether the tree is needed to support the rope can be worked out by counting boxes and looking at triangles. Trees 1,4, and 3 are therefore just inside the boundary. Tree 2 can be seen to be on the boundary but is not required to support the rope.


1
2
3
4

171. Beavers' puzzle

Drag, rotate and drop the cards in the squares so as to get complete images of beavers in adjacent sides of cards and match background patterns as well.
Click on the card to rotate it.





Question / Challenge

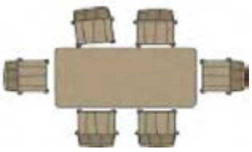
Answers

The correct answer is:

OR

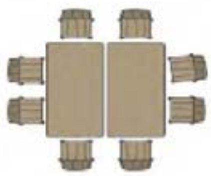
172. Beaver tables

A beaver has a small table for 6 chairs



However the small table is too small for a big family. So he decided to build a bigger table by joining small tables in the following way:

Question / Challenge



If the beaver wants to put 35 chairs around the bigger table, how many of the small tables would he need?

Answers

Open-answer tasks: Integer numbers from [1,99]

The correct answer is:

16

The small table has 2 chairs on the shorter side and 4 chairs on longer side. Since the small tables are joined at the longer sides, addition of each new small table adds 2 more chairs. The first small table has 6 chairs. Adding a second small table adds 2 more chairs taking the total count of chairs to 8. The addition of a 3rd small table increases the number of chairs by 2 taking the total count to 10 and so on. The number of chairs will always be even.
So if we need to place 35 chairs, we need to consider the next higher even number which is 36. By subtracting the 4 chairs at the two ends of the big table, we are left with 32 chairs. Each new small table adds 2 chairs so if we divide 32 by 2 we get 16 small tables.
We can also use the function $S = 4 + n \times 2$ where n is the number of small tables and S is the resulting number of chairs. Solving $36 = 4 + n \times 2$ for n gives $n = 16$.

173. Passcode

Beaver Daniel received a chest of gold that is locked with an electronic lock. The lock can be opened by entering a code of 9 digits.
Danial has received the following hints about the code:
- The only digits in the code are 2, 6, 7 and 9
- The digit with the highest value is used the lowest number of times in the code.
- The digit with the lowest value is used the highest number of times in the code.
- The code looks the same in reverse.
- All consecutive digits are different.
- The last digit entered is odd.

Question / Challenge

With the information given above, can you determine the pass code?
Drag the digits to the passcode and click on 'Try' to try to open the chest.

Answers

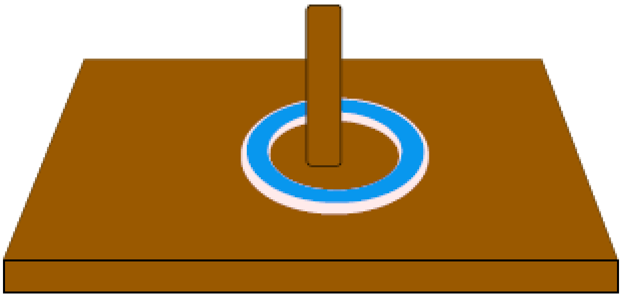
The correct answer is:

7	2	6	2	9	2	6	2	7

Hints 1, 2, 3 tell us that number 9 appears once, number 6 and 7 appears twice and number 2 appears 4 times.
Hint 4 tells us that number 9 must be in the middle.
Hint 6 (combined with hint 4) tells us that 7 must be at the beginning and the end.
Hint 5 tells us that the number 2 must be at places 2, 4, 6, 8.
Now you know where to place the 6's.

174. Ring Toss

Sarah plays ring toss with her friends. Each of them takes turns to toss five rings around a peg:



Every correct toss wins a point:

Toss points

Toss	points
first toss	5
second toss	4
third toss	3
fourth toss	2
fifth toss	1

An incorrect toss wins no point.

Question / Challenge

Sarah tossed her five rings as shown below. How many points did she get?

Answers

Write your answer in the box below.

The correct answer is:

Sarah won 6 points.

Toss	ring	[illegible] / ▯	points
first toss	yellow	▯	0
second toss	blue	[illegible]	4
third toss	pink	▯	0
fourth toss	green	[illegible]	2
fifth toss	black	▯	0
TOTAL			6

175. Medal Ranking

In the table below the medal rankings of the Olympic Games of 2016 are shown. The columns Gold, Silver and Bronze show the amount of gold, silver of bronze medals that a country has won.

Rank	Country	Gold	Silver	Bronze
1	United States	46	37	38
2	Great Britain	27	23	17
3	China	26	18	26
4	Russia	19	18	19
5	Germany	17	10	15
6	Japan	12	8	21
7	France	10	18	14
8	South Korea	9	3	9
9	Italy	8	12	8
10	Australia	8	11	10
11	the Netherlands	8	7	4
12	Hungary	8	3	4

Question / Challenge

Suppose the Netherlands had won one gold medal more. What is the final position of the Netherlands in the table ranking?

Answers

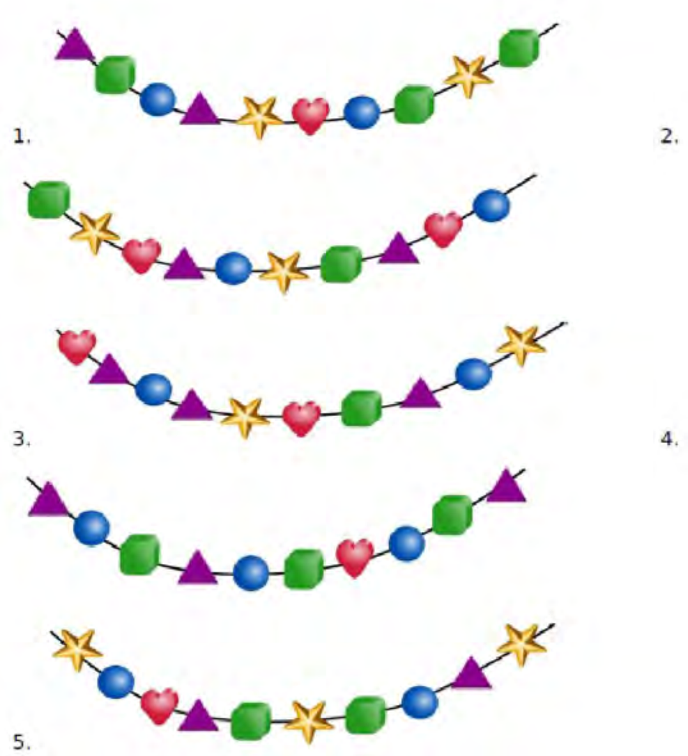
Fill in an integer number [1-12]

The correct answer is: 8

Which country performs for the best in the Olympic Games? That is the country with the largest amount of gold medals. If two countries have won the same amount of gold medals, the country with the largest amount of silver medals is the best. If both countries have the same amount of gold and silver medals, the amount of bronze medals counts. In this way we can sort the countries that participate in the Olympic Games. In this task the Netherlands is at rank 11. If the Netherlands would have won nine gold medals, it would have the equal amount of gold medals as South Korea. Because the Netherlands have won more silver medals than South Korea, the Netherlands would take the ranking of South Korea

176. Dominant shape

Below are 5 necklaces. Some necklaces have a favorite bead. This is when there are more of them than any of the other beads.



Question / Challenge

Select all the necklaces which have a favourite bead.

Answers

The student must click on the strings of beads in order to select them. The selection must be made in any order.

The correct answer is: Strings 1,3 and 5

String 1 contains 3 cubes, 2 triangles, 2 circles, 2 stars and 1 heart. So, the cube is the dominant shape.
String 2 contains 2 shapes from each type.
String 3 contains 3 triangles, 2 hearts, 2 stars, 2 circles and 1 cube. So, the triangle is the dominant shape.
String 4 contains 3 triangles, 3 circles, 3 cubes and 1 heart. There is no dominant shape.
String 5 contains 3 stars, 2 triangles, 2 circles, 2 cubes and 1 heart. So, the star is the dominant shape.
Therefore, the strings that contain dominant shapes are 1, 3 and 5.

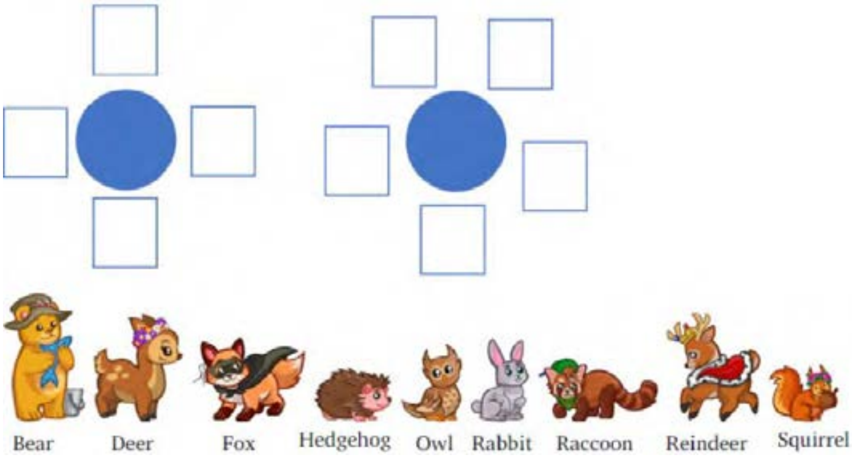
177. Beaver's birthday party

Mister Beaver is friends with all the forest animals. Unfortunately, some of them are not friends with others. The Rabbit is not a friend of the Fox, but he is a friend of the Bear. The Squirrel is not a friend of the Bear, but she is a friend of the Fox. The Owl is a friend of the Reindeer, but quarrels with the Raccoon. The Reindeer quarrels with the Deer and the Hedgehog and the Raccoon is a friend of the Rabbit, but quarrels with the Fox.

Mister Beaver wants to celebrate his birthday and arranges two tables so that the animals sitting at each table do not quarrel, and friends sit at the same table.

Question / Challenge

Place the animals around the two tables by dragging them into the correct position.

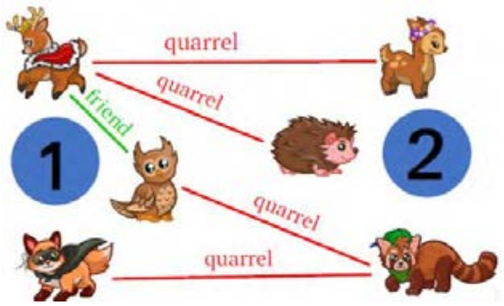


Answers

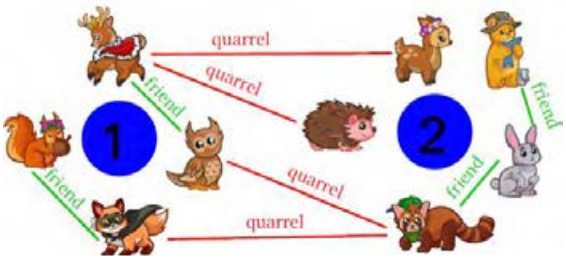
Drag&drop (to be implemented)

The correct answer is:

The Reindeer quarrels with the Deer and the Hedgehog. Fortunately, the Deer and the Hedgehog do not quarrel, so we can seat Reindeer at one table (say, table 1) and the Deer and the Hedgehog at another table {table 2). The Owl is a friend of the Reindeer so they should sit together at table 1. The Owl quarrels with the Raccoon, so the Raccoon has to sit at table 2. And the Raccoon quarrels with the Fox, so the Fox has to sit at table 1.



Now we managed to seat six of the animals to two tables so that there will be no quarrel among them and the pair of friends (the Reindeer and the Owl) sit together and there are no unseated pairs of quarreling animals left. So let's finish the arrangement by adding friends of already seated animals. The Squirrel is a friend of the Fox, so let's seat the Squirrel at table 1. The Raccoon is a friend of the Rabbit, so let's seat the Rabbit at table 2. Finally, the Rabbit is a friend of the Bear, so let's sit the Bear at the table 2

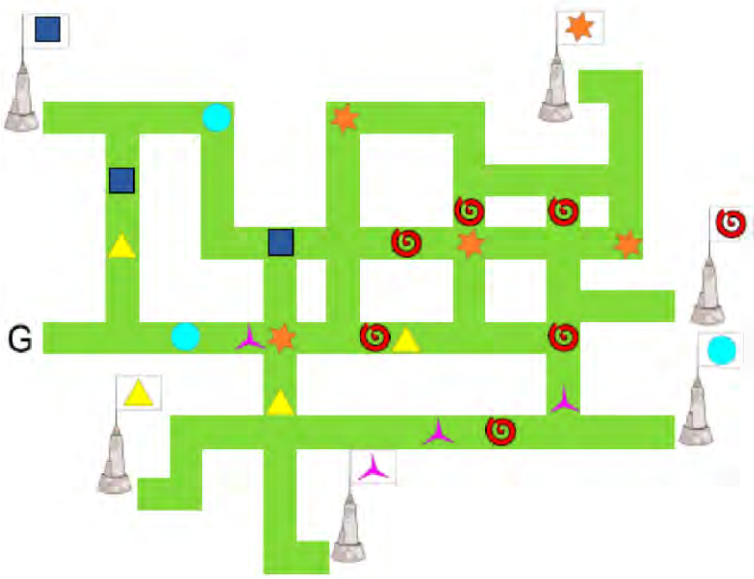

quarrel
quarrel
friend
1
2
friend
friend
quarrel
friend
quarrel

178. Towers

A city has six towers, each with it own symbol on it's flag. The same symbol can be seen on the streets of the city (green lines) to mark the guards of each tower. G is the city gate.
The towers receive a lot of junk-mail, which is addressed to a tower. The messengers delivering it will be stopped by a guard of this tower.
For example, we can see that the tower marked by a blue square cannot be reached because blue square guards can be found on both streets that lead to the tower.

Question / Challenge

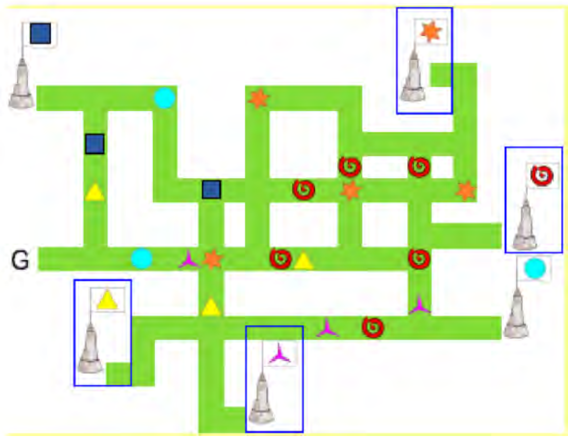
Click all the towers which can be reached from the gate while not passing through any of their respective guards:



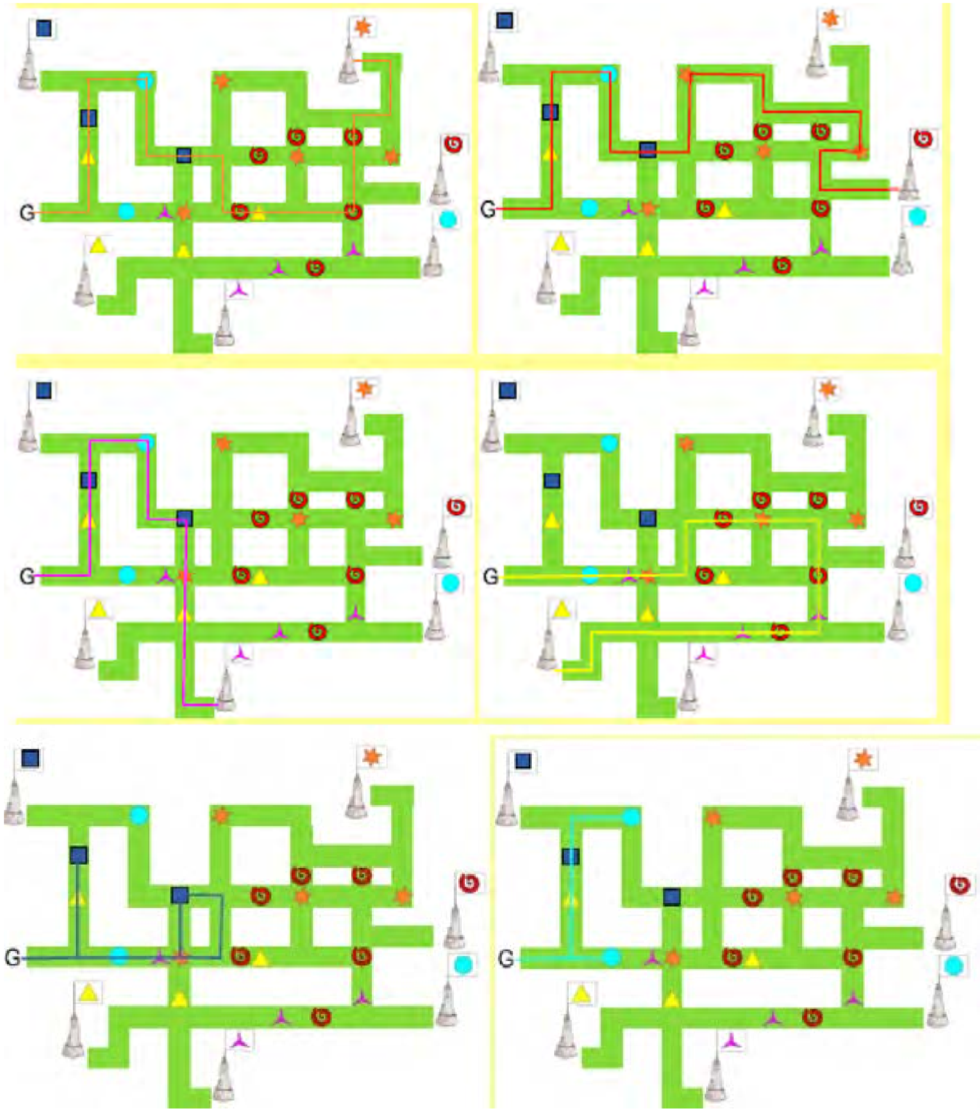
Answers

The interactive script allows the pupil to click on the towers in order to set/remove selection. The order of clicks is not recorded.

The correct answer is:



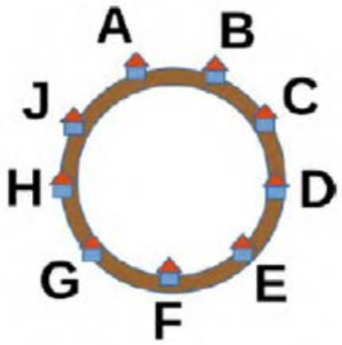
The following pictures show the walking route if it is possible to reach the tower from the gate or all
the attempts that end on a guard, if the tower cannot be reached:


G
G
G
G
G
G

179. Halloween walk

Hugo lives in the house H in a small village consisting of only 9 houses and one circular road around a lake. The entrances of the houses are placed exactly 10 meters apart.
On the Halloween day Hugo took his mask and went to visit his neighbors.
Hugo started from the front of his house H, he chose a direction and walked that direction until he decided to visit a house. After he left it, he chose a direction again and walked in that direction until he decided to visit another house, and so on. Each time he visited a house he recorded the distance he walked from the previous house.

Question / Challenge



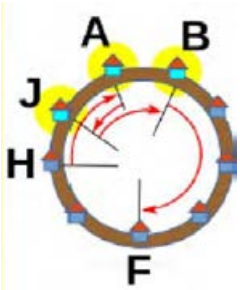
Finally Hugo visited house F and had recorded the numbers 20 10 20 40.
Click on the three houses that he must have visited during his walk before visiting house F.

Answers

The interactive script allows the pupil to click on the houses in order to set/remove selection. Theorder of clicks is not recorded.

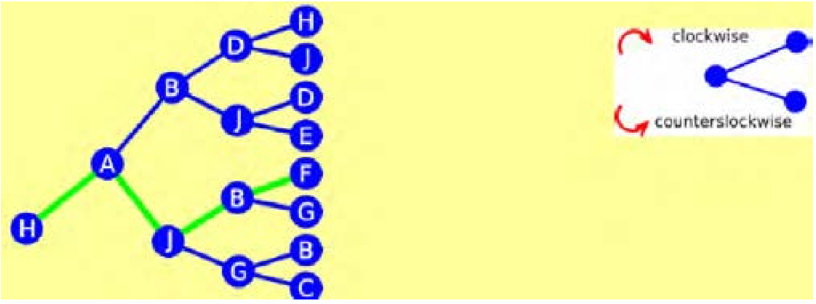
The correct answer is:

Hugo visited houses A, J and B during his journey.

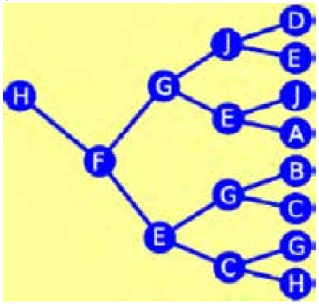


The picture proves that it is possible to reach house F according to the numbers recorded by visiting these houses. Hugo walked the first part of his walk clockwise to A, the second part counterclockwise to J, the third part clockwise to B and finally clockwise to F.
We have to prove that other possibilities how to walk are incorrect. Note that there are 4 distances to walk and each of the distances can be walked forward (clockwise), or backward, (counterclockwise), so there are 2*2*2*2=16 possible paths described by these numbers. The 2 tree diagrams below prove that using any other of these 16 ways does not allow Hugo to reach house F.

1. If Hugo starts by walking 20 meters clockwise, he arrives at house A. The following tree diagram shows all the possibilities, going either clockwise or counterclockwise from house A.



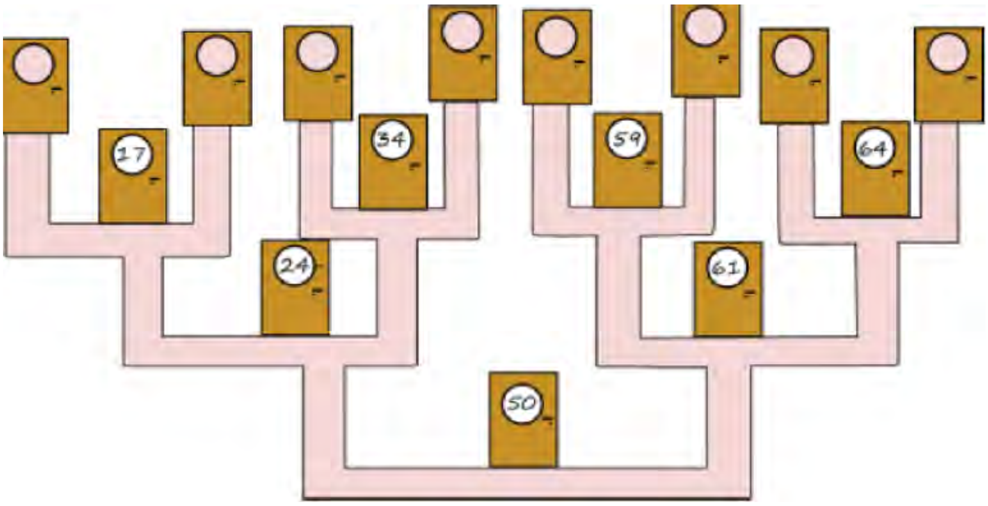
2. if Hugo starts by walking 20 meters counter-clockwise, he arrives at house F. All possible paths from F are shown below.



The final house is shown down the right hand end of both graphs and it can be seen that house F only occurs once and it is by going to A, J and B. So it is the only solution.

180. Hotel Binary

Milo is working at the hotel. The task for today is to hang the new room numbers on each door.
Starting next to room number 50 the rules are:
- if the new room number is less than the room number next to you, go left;
- if the new room number is greater than the room number next to you, go right;
- if the room next to you is not numbered, hang the new number there.
Some rooms are already numbered, as you can see.



Question / Challenge

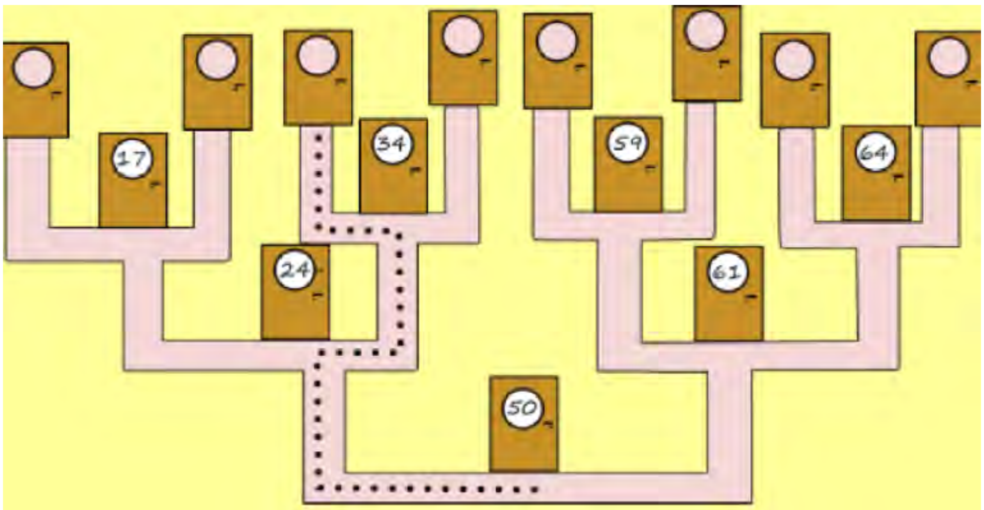
Milo needs to hang the number 29. Following these rules, click on the door Milo should hang the
room number.

Answers

The interactive script allows the pupil to click on doors that have no numbers to set the selection.
The script maintains at most one door selected.

The correct answer is:

The correct answer is:



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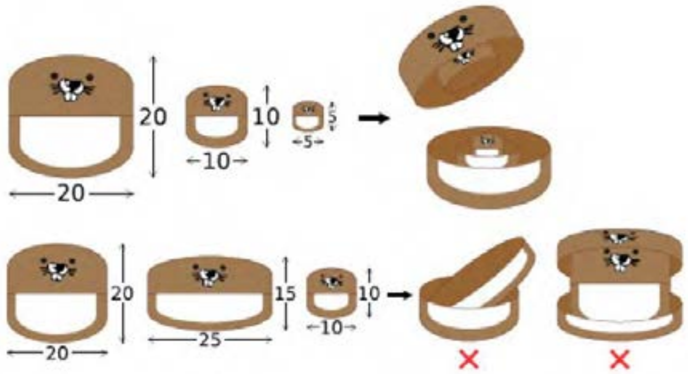
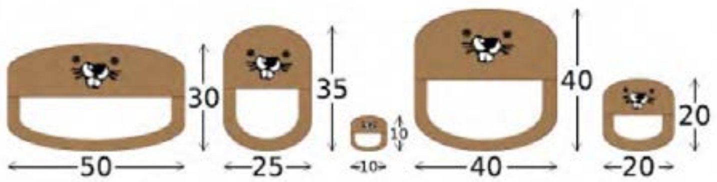
Starting next to room 50, as 29 is less than 50 you move left. There next room number is 24 and as 29 is greater than 24 you move right. The following room number is 34 and because 29 is less than 34, you move left. Finally the next room is empty, so the new number will be hung.

181. Beaver nesting doll(I)

A beaver nesting doll is a set of wooden dolls that all fit inside each other. Each doll can be opened from the middle to show another doll with smaller width and smaller height inside. Emily has been told that her Beaver nesting dolls are magic. If she makes a wish, the more layers of dolls, the faster her wish comes true.



The following shows all the beaver nesting dolls Emily has. She wants to combine as many dolls as she can.



Question / Challenge

How many layers of beaver nesting dolls can Emily get?

Answers

An integer

The correct answer is:

4

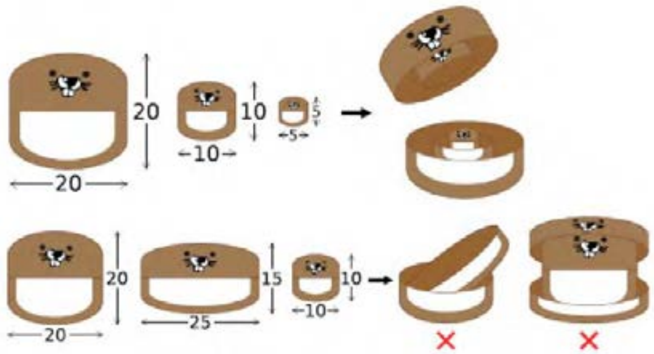
According to the question, each beaver nesting doll in the answer has to have a smaller width and height than
another. If we first sort the beaver nesting dolls by their width in decreasing order, then we can make sure their
width won't stop all the dolls from nesting.

Now we need to pick as many dolls as we can from the ordered dolls. Remember the dolls you pick must have decreasing height. If you choose the biggest doll here, then you can get a nesting doll with three layers. However, if you don't use the biggest doll, you can get a nesting doll with four layers.

Of course, you can start by sorting dolls by their height, then try to pick as many dolls as you can with decreasing width.

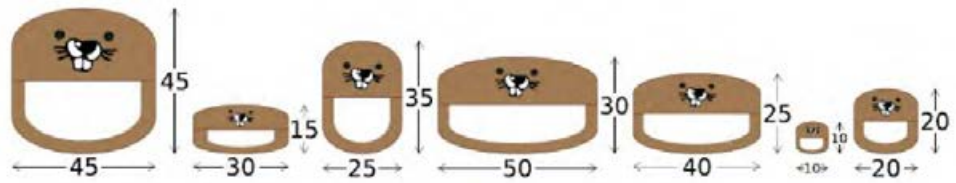
182. Beaver nesting doll(II)

A beaver nesting doll is a set of wooden dolls that all fit inside each other. Each doll can be opened from the middle to show another doll with smaller width and smaller height inside. Emily has many similarly designed beaver nesting dolls. She wants to organize her dolls.



Question / Challenge

The following picture shows all the dolls Emily has. What is the fewest number of dolls that could be
sitting on Emily's shelf after nesting?



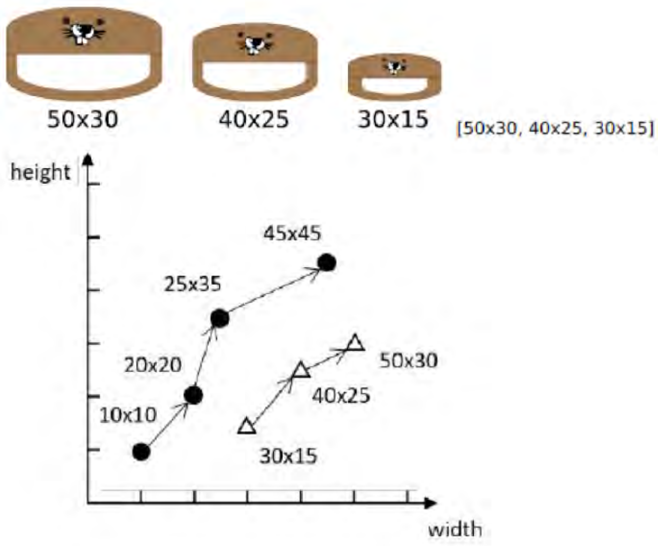
Answers

An integer

The correct answer is:

2

Arrange the nesting dolls into two groups


50x30
40x25
30x15
[50x30, 40x25, 30x15]
height
45x45
25x35
20x20
10x10
50x30
40x25
30x15
width

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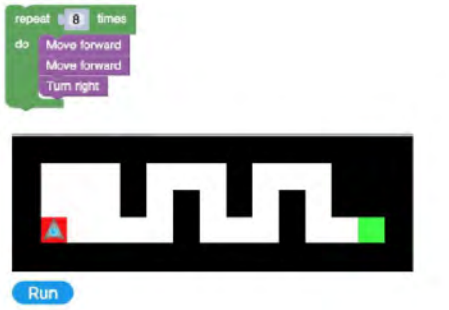
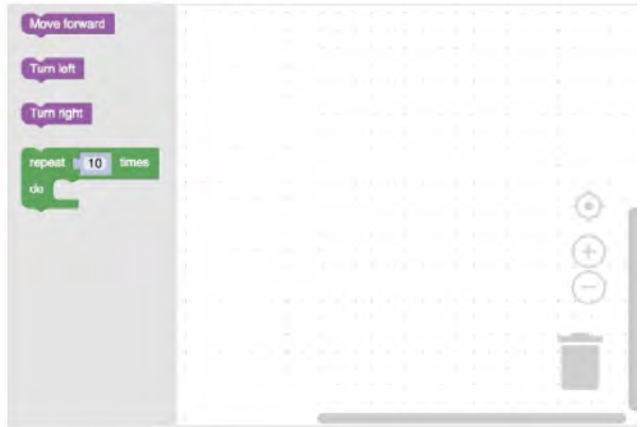
183. Smallest Program

The program shown below drives the triangular robot.
Following these instructions, the robot drives in a small square twice and ends up back where it started.
(You can try it out below by dragging blocks into the workspace and pressing the Run button.)
The whole program uses only 4 code blocks:





Question / Challenge

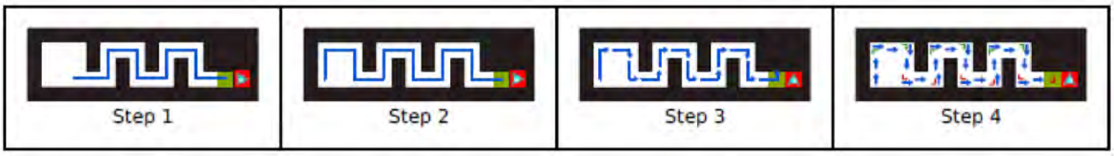
Find the minimum number of code blocks needed to get the robot to the green square.
(Enter your answer below and press Save.)
Here is a link to an interactive version of the task:
https://challenge.tcsocc.uk/?action=question_standalone&que_id=115&t=7ebef9d257
Optional: This task uses a Blockly playground but only uses loops and move blocks so does not require the interface
to be learnt.

Answers

The correct answer is:

The answer is 9.
Here is a solution:

This was arrived at by writing producing a simple but long answer and then pattern spotting to see which combination of loops were possible and then which combination of possible loops required the least number of code blocks.
Somebody may be difficult to spot patterns in this task. However you can recognize the patterns if you will check and analyze series of the code blocks one by one from the back. There are many available combinations of instructions (code blocks) because of a lot of paths at the front, but there are only one path from the middle point to the end. It makes you spot pattern more easier. (See the pictures below).



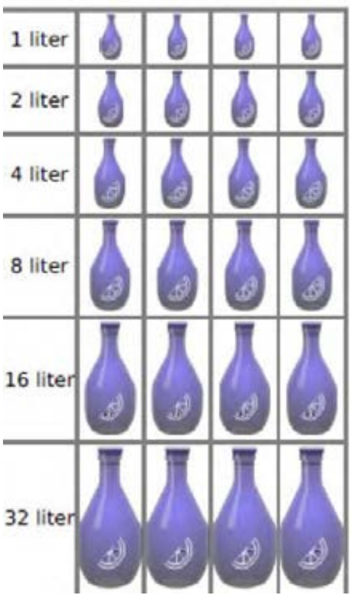
If all the blocks consist of a minimal pattern repetition in your program, the program has used the least number of instructions.

184. Lemonade party

Janet made 37 liters of lemonade at home and now she wants to take it for a celebration at the school. She has several empty bottles with various sizes but she wants to use the smallest number of them to bottle exactly 37 liters of lemonade.

Question / Challenge

Click on the bottles that she should use.



Answers

The student can click on all the bottles to make them empty or full.

The correct answer is:

The best solution is a 32-liter bottle, a 4-liter bottle and a 1-liter bottle.

This is a binary counting problem. Note that it never makes sense to select multiple bottles of a single size; if you select 2 bottles of 8 liters, it makes more sense to select a single bottle of 16 liters.

There are therefore a minimum of three bottles required.

185. Happy Binary Cake

Beavers are decorating cakes. They want to make each cake different. Therefore they will place a different combination of candles on each cake. They have two colors of candles, red and yellow. All cakes must have at least one candle, and the order of the colors of the candles does matter. For example the combination red-yellow is different from yellow-red, even though they each have one red and one yellow candle.

Examples:

The beavers want to use the lowest total number of candles possible, so they start decorating cakes with 1 candle first, then move on to cakes with two candles, then cakes with three candles, etc.

Question / Challenge

If the beavers have 14 cakes to decorate, how many candles will they need to use?

Answers

Open integer

The correct answer is:

34.

The first two cakes each have a single candle (red, yellow) = 2 candles.

The next four cakes have two candles (red-yellow, red-red, yellow-red, yellow-yellow) = 8 candles.

The next eight cakes all have three candles = 24 candles.

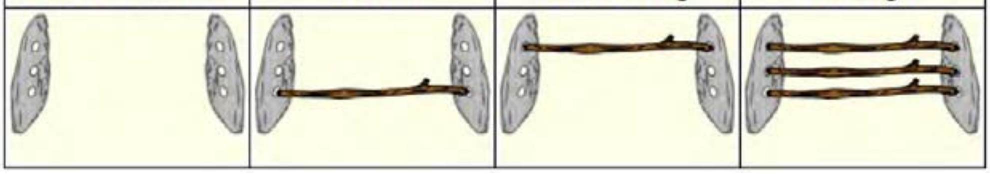
So the solution is 2 + 8 + 24 = 34 candles.

186. Binary Gate

The beavers are hospitable and they like visit each other. However, sometimes they are not at home. Therefore, they need to leave a message for their guests using an informational gate.

The beavers has come up with 4 different messages, as follows:

We are at home. Please come in.	We will come back at noon.	We will come back in the evening.	We will be back at midnight.



changing the place of these logs.
He knows that the logs must meet the following conditions:
– The logs can only either be attached horizontally, or be removed completely.
– The shape and orientation of the logs are not important.
But he does not know exactly how many messages are possible.

Question / Challenge

What is the maximum number of messages that are possible, including the 4 original messages?

Answers

Answers need to be integer number.

The correct answer is:

The correct answer is 8.
Each log has only 2 possible states: the log is in place or not in place.
There are 3 logs altogether.
So this means the number of possible combinations is 2x2x2= 8.
Binary numbers are numeral system which represents values using two different symbols: typically 0 (zero) and 1 (one).
The following pictures show all 8 possible combinations and an example of their corresponding binary code:

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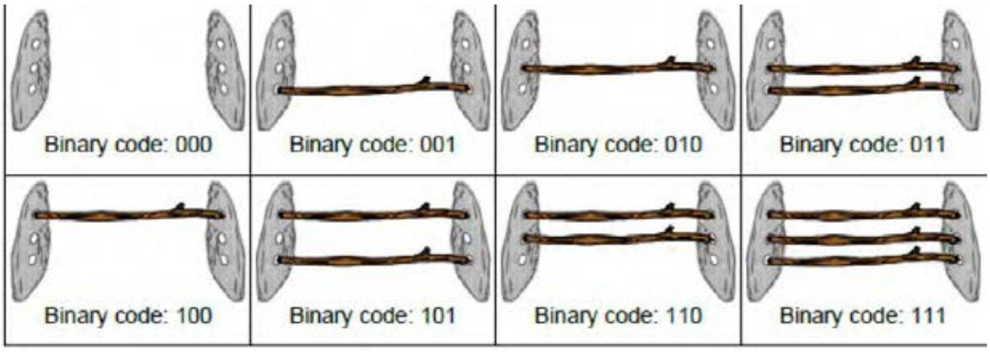


187. Farewell party

The beavers at Beaver Academy are organising the celebration of the school year ending. At each moment between 10:00 and 20:00 they need one beaver for checking at the entrance. Some of the beavers have volunteered to help out and have given times when they are available.
However, the list below still has a time slot where no beaver is available. Find that gap.

11:00-12:00	15:30-16:30	19:00-20:00
10:00-10:30	10:15-11:15	19:15-19:30
17:15-17:45	14:00-15:00	16:15-17:30
18:15-19:00	17:30-19:00	12:00-13:30
13:45-14:30	14:45-16:00	

Question / Challenge
Write down the time slot where no beaver is available in the form hh:mm–hh:mm
Answers
The correct answer is:
This task is a classical example of the Greedy Algorithms for Scheduling
Step 1: We sort the given time intervals by increasing starting time.
10:00 10:15 11:00 12:00 13:45 14:00 14:45 15:30 16:15 17:15 17:30 18:15 19:00 19:15
10:30 11:15 12:00 13:30 14:30 15:00 16:00 16:30 17:30 17:45 19:00 19:00 20:00 19:45

10:00	10:15	11:00	12:00	13:45	14:00	14:45	15:30	16:15	17:15	17:30	18:15	19:00	19:15
10:30	11:15	12:00	13:30	14:30	15:00	16:00	16:30	17:30	17:45	19:00	19:00	20:00	19:45

Step 2:
Then we scan the intervals in this order, merging all neighboring segments that overlap.
Finally we obtain two intervals in such a manner: 10:00 – 13:30 and 13:45 – 20:00
Answer is 13:30 – 13:45

188. Celebrity

Beaver Town is proud to have a celebrity among its inhabitants. A celebrity is a beaver who is known to all other beavers in town and who knows no other beaver in town.
Below is a list with statements of the form "beaver X knows beaver Y". There are many more inhabitants in Beaver Town, but it is known that the celebrity is one of the names in the list and that there is only one celebrity in town. This is the list:

Anna knows Jasper	Jasper knows Dina	Chris knows Jasper	Katrijn knows Els
Bart knows Katrijn	Chris knows Els	Hans knows Dina	Chris knows Fien
Dina knows Bart	Katrijn knows Jasper	Geert knows Chris	Geert knows Anna
Chris knows Hans	Anna knows Chris	Katrijn knows Fien	Els knows Hans
Jasper knows Fien	Hans knows Fien	Bart knows Fien	Anna knows Fien
Bart knows Hans	Bart knows Els	Geert knows Jasper	Els knows Anna
Geert knows Fien	Els knows Chris	Dina knows Fien	Katrijn knows Chris
Dina knows Geert	Anna knows Geert	Hans knows Anna	
Hans knows Katrijn	Els knows Fien	Jasper knows Bart	

Question / Challenge

Who is the celebrity beaver?

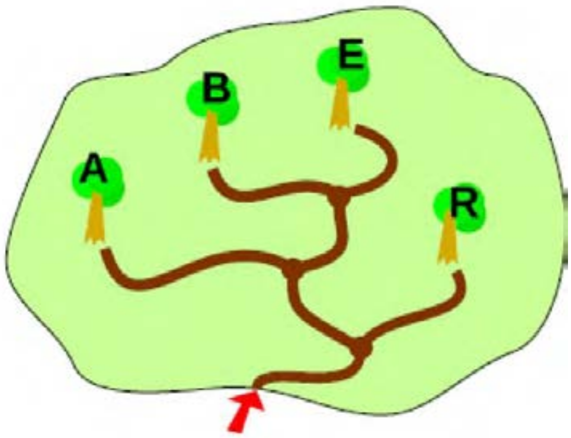
Answers

Anna	Bart	Chris	Dina	Els
Fien	Geert	Hans	Jasper	Katrijn

The correct answer is:

Fien is the celebrity beaver.
Fien is the only name that does not occur to the left of 'knows' in the list, so this beaver is the only candidate celebrity. To really be a celebrity we must verify that all the other beavers know Fien.
Running through the list you can easily verify that Fien indeed occurs 9 times to the right of 'knows', and each time with a different beaver on the left hand side.

189. LeftRight



The beavers have made a code that uses this map:

• Every tree in the park is named with a letter.
• The code for each letter is found by how to get to its tree by turning left and right.
• The code for each letter always starts from the park entrance.

Examples

Example 1: The code for A is LL because to get to tree A from the park entrance you must turn left twice.

Example 2: The code for the word BAR is LRLLLR.

Question / Challenge

How many letters are there in the beaver's code for the word BEAR?

Answers

The correct answer is:

9

The following table contains the left/right codes for all the letters

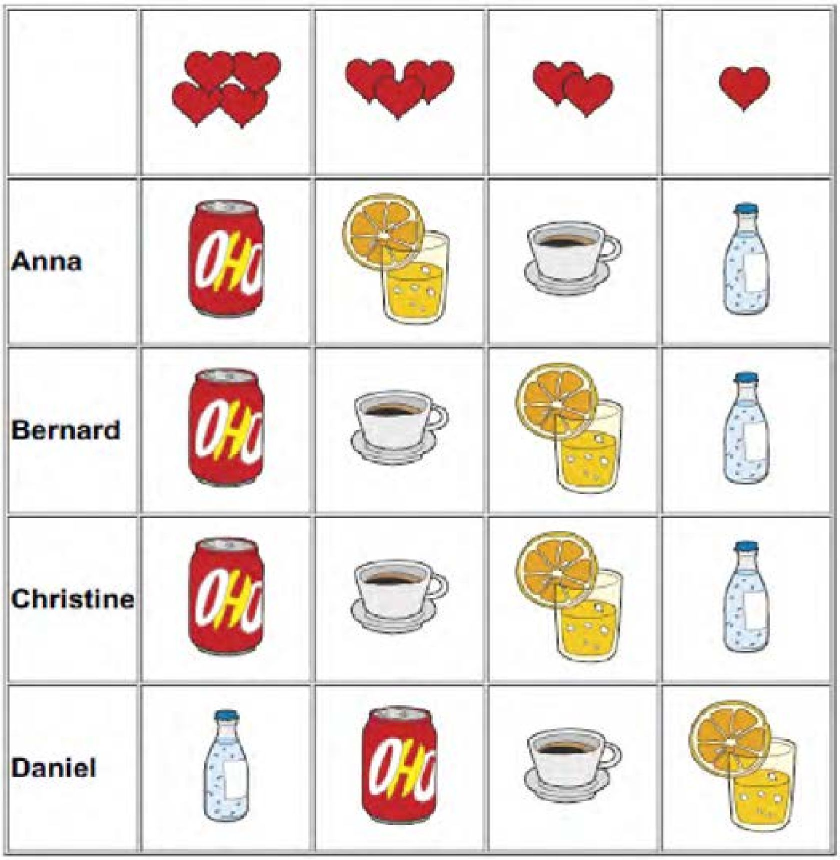
B	E	A	R
LRL	**LRR**	**LL**	**R**

From this it is easy to produce the code for BEAR: LRLLRRLLR

It can also been seen that it contains 3+3+2+1 = 9 letters.

190. Soda Shoppe

Four friends are on a road trip and decide to stop to get a drink at a nearby soda shoppe. Each of the four has a preference for which beverage they want as denoted in the table below. The soda shoppe offers four beverages, however they are running out of stock and only have one of each drink. The drink each person prefers most is listed below with a number of hearts in the column heading to show how much they like the drink.



For example, Anna prefers the  with happiness  ,  with happiness  and so on.

Question / Challenge

What is the maximum total number of hearts the group can get?

Answers

Please enter an integer between 4 and 16.

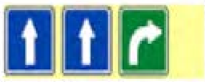
The correct answer is: 14

Since three people want , the maximum total number of hearts the group could get is 4+4+3+3 = 14. This is obtainable via the following matching:

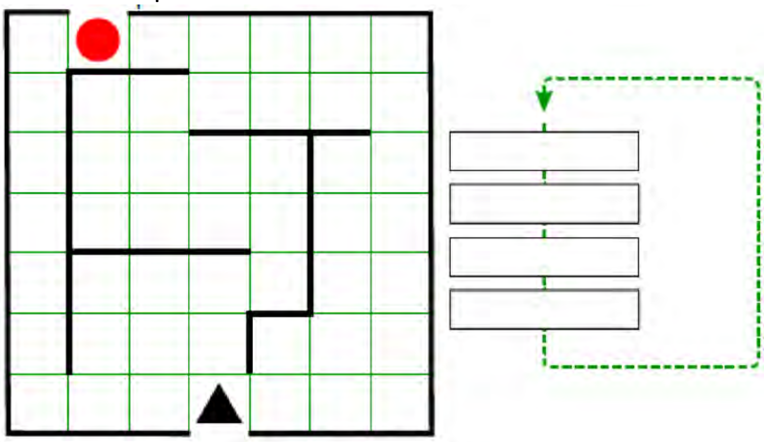
Another way to see this, since the last person has  as the favourite drink and all others rank this beverage last, the last person must pick the  to maximize the group's happiness. Now, the first three people have the same first preference however the first person has  as the next favourite and the other two people have this drink as third favourite. Thus, the first person should pick  and the other two people can pick  and  in whichever order.

191. Exit the maze A

Mysto needs to find his way through a maze and asks you to give directions. He enters the maze from the bottom (black triangle) and needs to reach the exit at the top (big red circle). However, Mysto can only memorize four of the following moves:

	Take one step forward and turn left
	Take one step forward and turn right
	Take two steps forward and turn right

Although Mysto can only memorize four moves, you know that he will reach the exit after two repetitions of these four moves.



Question / Challenge

The triangle shows which direction Mysto is facing.

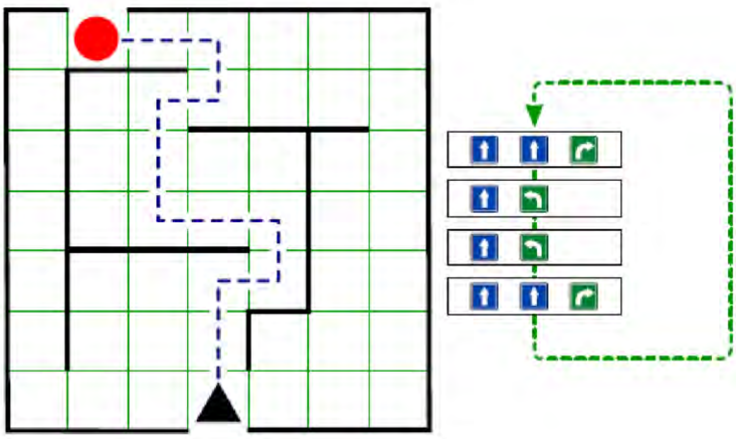
Which directions does Mysto need reach the exit?

Answer Options / Interactivity Description

Interactivity: One can fill up the five slots with a pattern, click on “try” and the red triangle starts moving according to the programmed slots.

Answer Explanation

The following moves lead to the exit, when repeated twice:

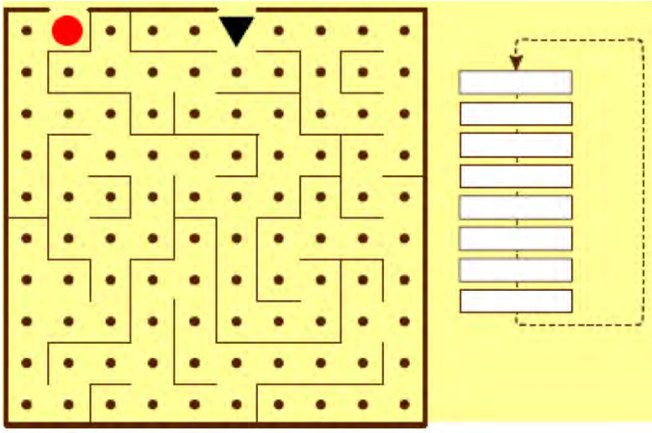


192. Exit the maze B

Mysto needs to find his way through a maze and asks you to give him directions. He enters the maze from the top (black arrow) and needs to reach the exit (big red circle). However, Mysto can only memorize up to eight of the following moves:

	Take one step forward and turn left
	Take one step forward and turn right
	Take one step forward

Although Mysto can only memorize eight moves, you know that he will reach the exit after a few repetitions of these eight moves.



Question / Challenge

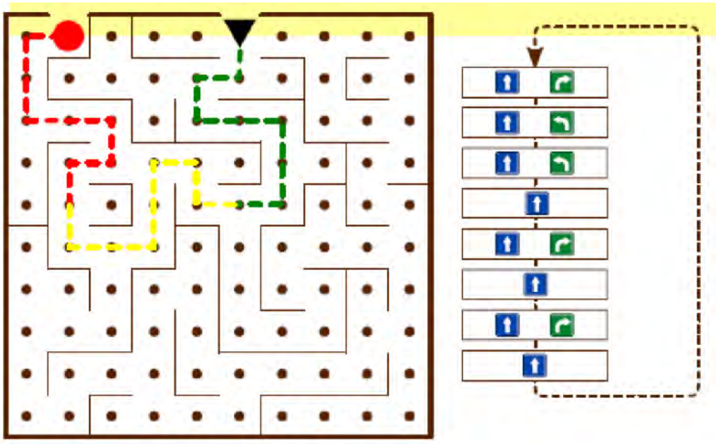
The triangle shows which direction Mysto is facing.
Which directions does Mysto need to reach the exit?

Answer Options / Interactivity Description

Interactivity: One can fill up the five slots with pattern, click on “try” and the red triangle starts moving according to the programmed slots.

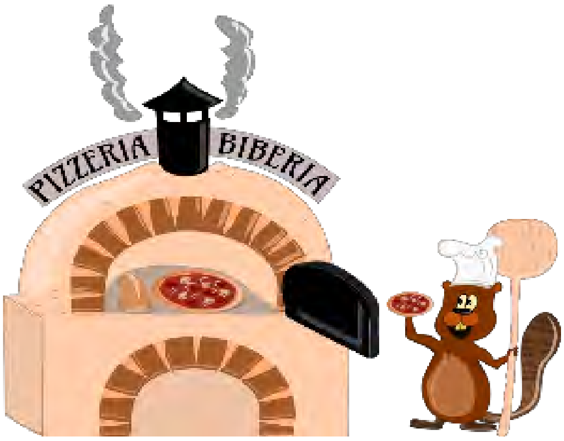
Answer Explanation

The following moves lead to the exit, when repeated three times:

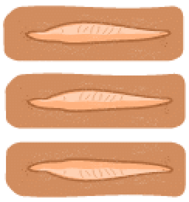
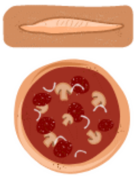
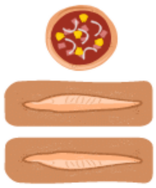


193. Pizzeria Biberia

In Pizzeria Biberia, there is a small pizza oven so the chef can only bake a few things at once. The two tables below show the only possible combinations and the baking times.



Possible Combinations

		
three ciabatta breads	one ciabatta bread and one large pizza	one small pizza and two ciabatta breads

Baking Times

small pizza	10 minutes
large pizza	15 minutes
ciabatta bread	20 minutes

In the pizzeria there are many orders. The pizza chef has to plan the baking times cleverly so that the guests can eat as quickly as possible. The breads and pizza can be put into the oven in any order but each item must stay in the oven until it is ready.

Question / Challenge

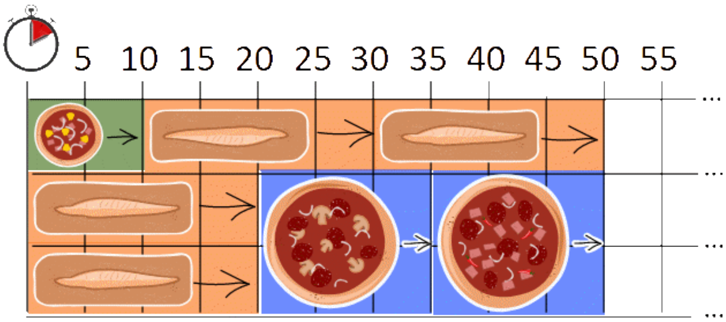
An order is placed for one small pizza, two large pizzas and four ciabatta breads. What is the minimum amount of time until the entire order is baked?

Answer Options / Interactivity Description

Open Integer (0 to 100)

Answer Explanation

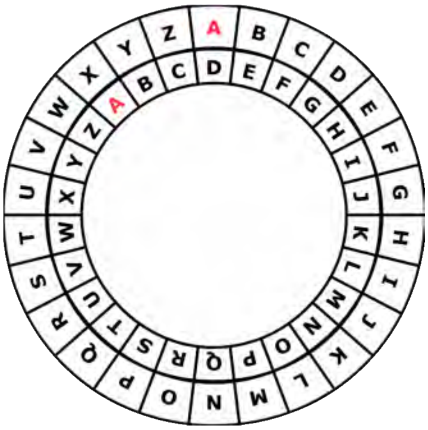
There are several optimal solutions. The key to finding them is to see that two ciabatta breads and a small pizza in succession take the same time as two large pizzas and a block of two ciabatta breads in succession. They both take 50 minutes and the oven space and time is used completely, so there cannot be a quicker solution. The image shows a possible solution.



This solution is optimal, since the oven is completely full all the time.

194. What's for lunch?

Bibo and Biba love to create encrypted messages using a Cipher Disk. The Cipher Disk has an inner disc and an outer disc. Everyday, Bibo sends Biba an encrypted message on what he likes to have for lunch. The message is encrypted in the following way.



1. Bibo writes down the food name, for example "PIZZA".
2. Under each letter he writes a number between 1 and 9 and turns the inner disc to the left that many times from the initially aligned position. The figure on the right shows the inner disc turned 3 times to the left.
3. Bibo then writes down the corresponding letter on the inner disc. The figure on the right shows that "P" is encrypted as "S".
4. Bibo sends the encrypted message to Biba. Biba then decrypts the message to get the lunch choice.

For example: Bibo wants to have PIZZA for lunch, so he writes:

Message	**P**	**I**	**Z**	**Z**	**A**
Turn to the left	3	1	4	3	1
Encrypted Message	S	J	D	C	B

Question / Challenge

What does Bibo suggest for lunch if the following encrypted message is received by Biba?

Message	**?**	**?**	**?**	**?**	**?**	**?**	**?**
Turn to the left	3	5	1	7	2	4	8
Encrypted Message	O	F	T	H	I	R	I

Answer Options / Interactivity Description

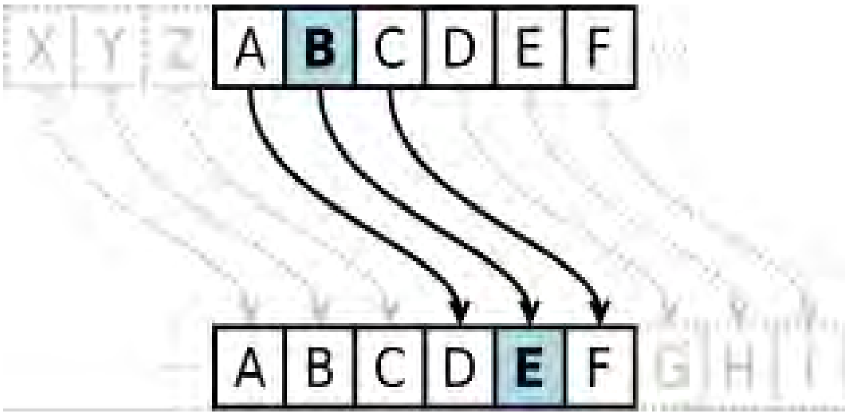
Open Text / Interactivity: Caesar-Cipher (for the sake of translation the Caesar-Cipher must be content of this task) → inner disc should be movable by drag'n'drop. A counter of the positive or negative shift is beneficial.

Answer Explanation

The correct answer is "LASAGNA".

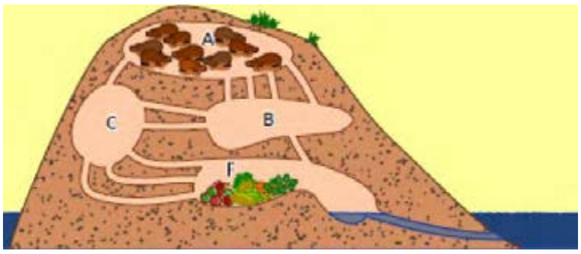
To get the original message align the two A's of the Caesar-Cipher underneath. Now just rotate the outer disc counterclockwise as many times as the number indicates. Search for the code letter on the inner disc and note the corresponding letter in the outer disc. Repeat the above procedure for all letters in the encrypted message.

It’s Informatics
One of the oldest known procedure of encryption or decryption (cipher) is the Caesar-Encryption. Encryption is the process of encoding a message (or an information) in such a way that only authorized people can access and read it. For technical reasons, the encryption process usually uses an encryption key generated by an algorithm. Decryption is the reverse process, in other words, transforming an unintelligible cipher text back to the initial plain text. A cipher is a pair of algorithms that create the encryption and the reversing decryption.
In the Caesar-Encryption cipher, one chooses a secret number (which is the key) which indicates the shift of the alphabet. Example: if you choose the secret number 3, the letter B turns into an E and so on. It’s easiest to decipher when Caesar disk is available and one can turn the inner or the outer alphabet to make the shift visible.



However, there is one known disadvantage when using only one secret number. It is very easy to decrypt it, because patterns can be figured out easily. But if the secret number consists of more than one number (as in this task) it becomes increasingly hard to decrypt (Vigenère-Cipher).

195. Tunnels of the Homestead Dam



“Homestead Dam” has tunnels that connect four rooms (A, B, C, F). The first three rooms (A, B, and C) are living rooms, the fourth room (F) is where food is stored (see figure).
10 beavers are staying in room A, they are becoming hungry and they want to go to room F to eat. Since all beavers are very hungry, they all want to arrive in the food storage as soon as possible.
It takes 1 Minute to traverse a tunnel and only one beaver may traverse a tunnel at the same time (not several beavers following each other).
The connections between the rooms are composed by a certain number of tunnels:

- Between A and B: 4 tunnels.
- Between A and C: 1 tunnel.
- Between B and C: 2 tunnels.
- Between B and F: 1 tunnel.
- Between C and F: 3 tunnels.

The rooms have no capacity limits, that is in all rooms there can be as many beavers as want to be there.

Question / Challenge

What is the maximal number of beavers that can arrive in the food storage in exactly 2 Minutes?

Answer Options / Interactivity Description

Open integer (0 to 10)

Answer Explanation

In the best case 2 beavers arrive in the food storage after 2 Minutes.
The graph has two shortest routes, both have the capacity of 1 beaver and both require 2 Minutes total travel time:

- A to B to F
- A to C to F

There is a route that has higher capacity (2 beavers) but it requires 3 Minutes total travel time:

- A to B to C to F

Therefore just only 2 beavers can arrive in the food storage in exactly 2 Minutes, using routes A to B to F and A to C to F.

196. One Armed Beaver

The more leaves a branch has, the tastier it is. So, David intends to sort the branches based on their taste using the temporary storage beside him.

Question / Challenge

Please help David sort the branches by taste so that the tastiest branch is the closest to him.

Answer Options / Interactivity Description

In the graphics above the six branches should be draggable to any empty place or the temporary place on the left. If he tries to move a branch to any other place (especially a place where another branch is in), it snaps back to its original position. There needs to be a "save" and a "reset" button.

Answer Explanation

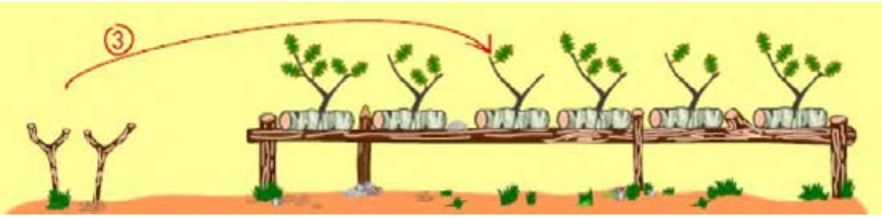
The correct solution is:

There are many different methods of solving this task, probably the most simple method is to swap pairs of branches by using the separate storage space:

• Remove the first branch, put it in the separate storage.

• Move another branch to the place where the first branch originally laid.

• Put the branch from the separate storage to where the first branch laid.

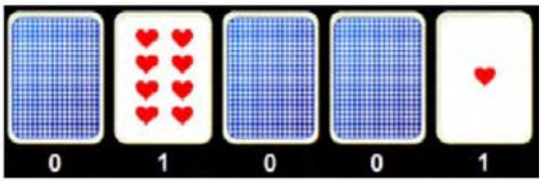


Co-funded by the European Union

By using this method you could create any order you want by swapping pairs of branches until everything is sorted

197. Card code

Five cards are placed next to each other. From left to right the number of hearts on their faces are 16, 8, 4, 2 and 1, respectively. Each card has either number 1 or number 0 below it. If the number is 1, the card is face-up and its hearts are visible. If the number is 0, the card is face-down and its hearts are hidden. The cards can be used to generate codes for numbers. For example, there are 9 visible hearts in the figure below, so the code for the number 9 is 01001:



Question / Challenge

Find the code for 26 hearts.

You can Ctrl-click here to run a simulator where you can turn the cards by clicking on them. This can help you form the code.

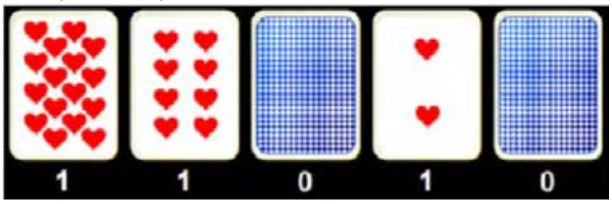
This preview is created in Adobe Flash (of course anybody can create his/her own version in different environment).

Answer Options / Interactivity Description

11010

Answer Explanation

The picture proves that this code shows 16 + 8 + 2 = 26 hearts.



This is the only correct answer. To see this, notice that 8+4+2+1 = 15 and so to get to 26 hearts, you must flip the leftmost card. As 26-16=10, we must use the last four cards to get to 10. Since 4+2+1 = 7, you must also flip the card with 8 hearts on it. This leaves 10-8 = 2 hearts remaining.

The card with 4 hearts is too large and the card with 1 heart alone is too small and so the only possible solution is to flip the card with two hearts.

198. Crossbreeds A

Wizards discovered a special method that makes it possible to crossbreed any animal. In that special case the newborns inherit a head from their father and body from their mother.

The wizards have already started to prepare a table on the computer to predict the outcome for several combinations. For example, when crossbreeding cats and dogs, this table was created:

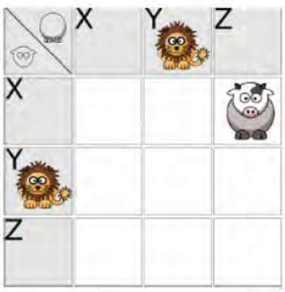
In a new magical session, goats, cows and lions are used:

Scientists have 3 photos about predicted animals:

Unfortunately the photos of parents disappeared from the table headings. We only know that Y means lion.

Question / Challenge

One photo is already in the correct cell of the table. Place the other 2 photos in the correct cells of the table.



Answer Options / Interactivity Description

interactive

Answer Explanation

All animals in one row must have the same head. All animals in the same column must have the same body.

Animals in a cell on a diagonal have the same parents and are not crossbreeds.

Correct answer is:
From the position of figure “cow-goat” in a white cell we know that X = cow and Z = goat. Then we can place other figures into that cells according to rules described above.

199. Crossbreeds B

Wizards discovered a special method that makes it possible to crossbreed any animal. In that special case the newborns inherit a head from their father and body from their mother. The wizards have already started to prepare a table to predict the outcome for several combinations.

Question / Challenge

Put these 3 animals into correct cells.

Answer Options / Interactivity Description

Interactive: drag and drop-

Variations of the task:

1. All white cells are unlocked for placing an object in.
2. Only 4 cells are unlocked. (easier)

Answer Explanation

Correct answer is:

All animals in one row must have the same head. All animals in the same column must have the same body.

Animals in a cell on a diagonal have the same parents and are not crossbreeds.

200. Sports

The BebraFitness sports center has a volleyball court, a basketball court, a tennis court and a football field.

Four beaver friends, Anna, Bruno, Chris and Diana, occasionally come to BebraFitness and play their favourite games.

It is known that Anna and Chris do not use rackets. The volleyballer, the footballer and Diana have their trainings on the same day.

The footballer plans to watch Chris's tournament. In the mornings, Bruno and the footballer go for a run. Diana lives in the same den with the tennis player.

Question / Challenge

Match players with their favorite sports.

Answer Options / Interactivity Description

Answer Explanation

The correct answer is: Anna: football; Bruno: tennis; Chris: volleyball; Diana: basketball.

The task can be solved by marking exclusion in the matrix below while reading each sentence.

	Volleyball	Basketball	Tennis	Football
Anna			no	
Bruno				no
Chris			no	no
Diana	no		no	no

Now it's clear that Diana can play only basketball (and no other sport). Football must be played by Anna and tennis by Bruno (no other player). The leftovers are volleyball and Chris.