Infinite Ice Cream

BEBRAS
Australia

There are two ice cream sellers.
They use the same four flavours:

The first seller uses the following instructions to make ice cream:

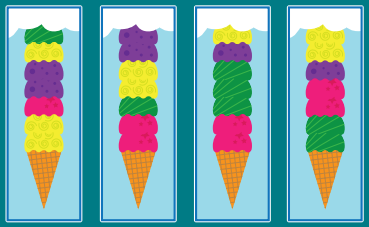
1. Start with an empty cone.
2. Pick a flavour at random, and add two scoops of that flavour.
3. Add one scoop of any different flavour.
4. If the requested height is reached, stop, otherwise go to Step 2.

The second ice cream seller does not follow any instructions.

Question

You can only see the first few scoops of the ice cream cones.

Which one is certainly from the second seller?



This question comes from Ireland

Answer

Ice cream 4

Explanation

There is only one cone that clearly does not follow the instructions as the third scoop flavour repeats twice, instead of three times or once, which would meet the requirements.

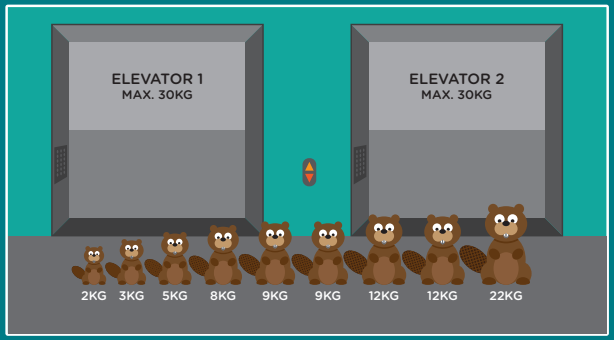
Computational Thinking: Algorithms

CSIRO digital careers

Elevator

BEBRAS
Australia

A lot of beavers need to use two lifts.
Each lift can only take a maximum of 30kg.



Question

What is the largest number of beavers these two lifts can take at once?

This question comes from Switzerland

Answer

8 beavers

Explanation

One of the lifts can take the beavers that weigh: 2kg, 3kg, 5kg, 8kg and 12kg.

The other lift can take the beavers that weigh: 12kg, 9kg and 9kg.

Computational Thinking: Evaluation

CSIRO digital careers

Park Walk

BEBRAS Australia

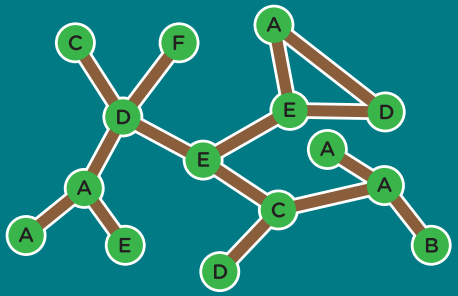
This is the map of a park:

The green circles with letters represent the trees and the brown lines are paths. Note that some letters are used to label more than one tree. Walking from tree F to tree B can be described as F D E C A B.

Last Sunday two families walked in the park.

The Wilde family's walk was B A A A C E D E E D A.
The Gilde family's walk was F D C D A E A D E D A.

Both families started their walks at the same time. Walking from one tree to another tree, down one path takes the same amount of time.



Question

How many times did the two families meet at a tree?

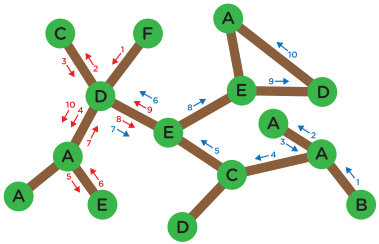
A Once B Twice C Three times D They never met at any of the trees

This question comes from Slovakia

Answer

D

They never met at any of the trees



Explanation

When you mark out the walk of the Wilde family (starting at B with a blue colour) and the Gilde family (starting at F with a red colour) you can number the trees in the time order they were visited. When you do this, you can see that both families were never at the same tree at the same time.

Room Sharing

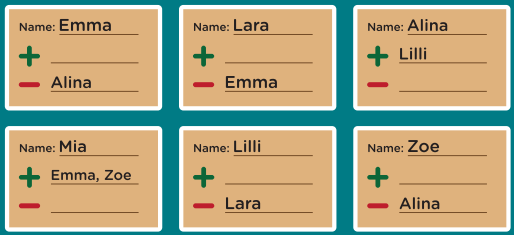
BEBRAS Australia

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:

- which other girls she absolutely wants to share a room with (+)
- 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 fulfil all their room sharing wishes.



Question

Help the club president assign the girls to their rooms by grouping the girls into three rooms.

This question comes from Germany

Answer

To fulfil everyone's wishes there is only one combination.

Room 1: Lilli and Alina
Room 2: Mia, Emma, Zoe
Room 3: Lara

Explanation

Alina picked Lilli, and Lilli did not choose a roommate, but did exclude Lara. So Lilli and Alina have a room together.

Mia picked Emma and Zoe, and for the three of them to be in a room together, Alina cannot be in a room with them, so they have a second room together.

Lara only excluded Emma, so cannot be in their room, and Lilli excluded Lara, so Lara has room to herself.

Computational Thinking:
Decomposition

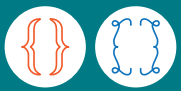
CSIRO digital careers

Brackets

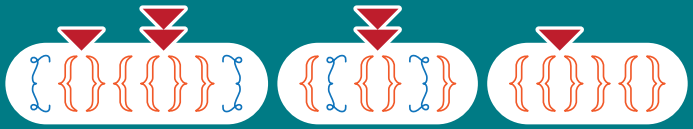
BEBRAS Australia

A jewellery shop produces bracelets.

They use bracket-shaped ornaments that come in pairs.
To make a bracelet you start with one of these pairs:

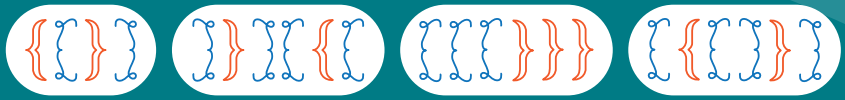


Additional bracket pairs are inserted repeatedly at any place in the bracelet, as you can see in the three examples below:



Question

Which of the following bracelets is made with the method described?



A B C D

This question comes from Austria

Answer

D is correct because it started with two paired brackets. Between these were placed a pair of other brackets and another pair was placed between the second pair.

Explanation

All other bracelets were not made according to the method described:

A. Position 3 is wrong: they placed the right side of ornament 2 before the right side of ornament 1;
B. Position 1 is wrong: you start off with a right side of ornament instead of a left side, which is not correct;
C. Position 2 is wrong: you see 3 left sides of one ornament and then 3 right sides of another ornament, so there aren't any pairs used.

Sports

BEBRAS
Australia

Bebras Fitness Gym has a volleyball court, a basketball court, a tennis court and a football field.

Anna, Bruno, Chris and Diana come to Bebras Fitness to play sports.

Anna Bruno Chris Diana

Question

Use the following information to match the player to the sport:

- Anna and Chris don't use rackets
- The volleyballer, footballer and Diana all have their training on the same day
- The footballer watches Chris play
- Bruno and the footballer run together in the morning
- Diana lives with the tennis player

This question comes from Estonia

Answer

Anna plays football, Bruno plays tennis, Chris plays volleyball and Diana plays basketball.

Explanation

Completing a check table as you go helps you solve the problem. From this, you can assign Basketball to Diana, and then Volleyball to Chris. Then through a process of elimination, the gaps are filled.

	Volleyball	Basketball	Tennis	Football
Anna				⚽
Bruno			🎾	✕
Chris	🏐		✕	✕
Diana	✕	🏀	✕	✕

Computational Thinking:
Abstraction

CSIRO digital careers

Balls

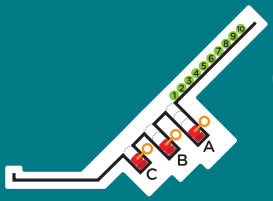
BEBRAS
Australia

Numbered balls roll down ramps. The order of the balls changes as they fall into holes. When a ball comes to a hole, if there is enough space, the ball falls in, otherwise, the ball rolls past the hole. A pin at the bottom of each hole can be pulled which ejects the balls.

Here is an example:

Question

Ten balls roll down the ramp shown below. Three holes A, B and C have space for 3, 2 and 1 balls as shown.
The pins are pulled in the order A, B, C, but each time only after all the balls have stopped rolling. What is the final result?



7 8 9 10 1 2 3 4 5 6

7 8 9 10 1 2 3 5 4 6

10 9 8 7 6 5 4 3 2 1

7 8 9 10 3 2 1 5 4 6

This question comes from Serbia

Answer

Explanation

Hole A has space for three balls, so balls 4 to 10 roll past it in order. Hole B has space for two balls, so balls 6 to 10 roll past it in order. Hole C has space for one ball, so balls 7 to 10 roll past it in order. Then the pin in Hole A is pulled and balls are ejected in the order 3,2,1 and roll to the bottom. At this point, the balls are at the bottom in the order 7,8,9,10,3,2,1.

Then the pin in Hole B is pulled and balls are ejected in the order 5,4. At this point, the balls are at the bottom in the order 7,8,9,10,3,2,1,5,4.

Finally, the pin is pulled in Hole C and ball 6 rolls to the bottom giving the correct answer.

Computational Thinking:
Abstraction

CSIRO digital careers

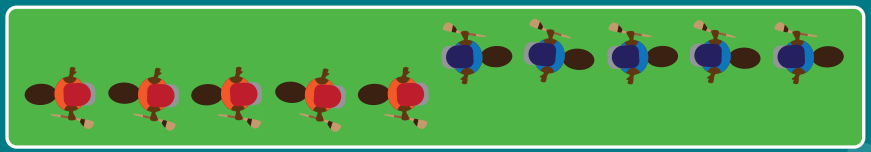
Hurlers Shake Hands

BEBRAS
Australia

Beavers enjoy playing hurling, a popular game similar to hockey.

After the game ends, the beavers in each of the two teams line up in a row and walk past the other team. As they pass each other, they shake hands. At the beginning, only the first player on each team shakes hands. Next, the first two players shake hands (see picture below). This continues until each player has shaken hands with every player on the other team.

There are 15 players on each team.



Question

If each player takes one second to shake hands and move to the next player, how many seconds of shaking hands will there be?

This question comes from Italy

Answer

29 seconds

Explanation

The amount of handshaking is exactly the length of one line plus the length of the other line, minus one.

If each team only had one player, they would be complete after 1 second. If each team had two players, the first pair would shake hands (1 second), then step forward (2nd second), then shake the remaining players hand (3rd second). This fits our formula of the number of players subtract 1: 4 -1 =3.

Computational Thinking:
Decomposition

CSIRO digital careers

Magic Potions

BEBRAS
Australia

Betaro Beaver has discovered five new magic potions: one makes ears longer, another makes teeth longer, another makes whiskers curly, another turns the nose white. The last one turns eyes white.

Betaro put each magic potion into a separate beaker. He put pure water into another beaker, so there are six beakers in total. The beakers are labelled A to F. The problem is, he forgot to record which beaker contains which magic potion!

To find out which potion is in each beaker, Betaro set up the following experiments:

Experiment 1: A beaver drinks from beakers A, B and C together

Experiment 2: A beaver drinks from beakers A, D and E together

Experiment 3: A beaver drinks from beakers C, D and F together

Question

Which beaker contains pure water?

This question comes from Japan

Answer

Beaker D

Explanation

Experiment 1 has three effects, Experiment 2 and 3 both have two effects. Therefore, there is no pure water in Experiment 1 and there is exactly one water beaker in Experiment 2 and Experiment 3. The only common beaker between experiments 2 and 3 is beaker D. Thus, D is pure water.

Computational Thinking:
Decomposition

CSIRO digital careers

Party Banner

BEBRAS Australia

Beaver Bert has a long strip of coloured paper for a party. The strip has three different colours (yellow, red, blue) in a regularly repeating pattern.
Bert's friend, James, has cut out a section of the paper, as shown in the diagram below.

James says that he will give back the missing piece of paper if Bert can correctly guess the size of the piece cut out.

Question

How many coloured squares does the missing piece of paper have?

31 32 33 34

This question comes from the Czech Republic

Answer

31 coloured squares

Explanation

We know the pattern ended with YRR, meaning that the James has cut out at least one B. After that, he cuts out some number of sequences of 4 (i.e., YRRB). After that, the right side of his piece of paper must have YR, since the second piece begins with RB. So, the length of his piece of paper is 1 (for B) + 4*X (where X is the number of repeated patterns YRRB) + 2 (for the YR). So, the length of her paper is 4X+3.

Looking at the possible answers, we see that 31/4 has remainder 3: that is, 31 = 4*7 + 3. So, our equation is solved when X=7. None of the other answers can be written as 4X+3.

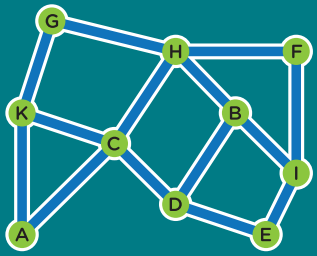
Computational Thinking:
Abstraction

CSIRO digital careers

Primary Health Care

BEBRAS
Australia

Doctor Hamid wants to build three hospitals for the beavers.
The hospitals can only be built on the places shown by a letter on the map below.
To get to a hospital, the beavers should not have to swim through more than one stream from any of these places.



Question

Choose the best three places to build the hospitals

This question comes from Switzerland

Answer

There are several correct solutions including E H K, A E H, C G I, C H I, C I K, D F K, B I K and C E H.

Explanation

Any of these options meet the doctors requirements.

Computational Thinking: Abstraction

CSIRO digital careers

Concurrent Directions

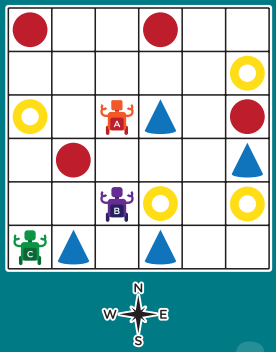
BEBRAS Australia

In a warehouse, three robots always work as a team.

When the team gets a direction instruction (N, S, E, W), all robots in the grid will move one square in that direction at the same time.

After following a list of instructions, the robots all pick up the object found in their final square.

For example, if we give the list N, N, S, S, E to the team, then robot A will pick up a cone, robot B will pick up a ring, and robot C will pick up a cone.



Question

Which list of instructions can be sent to the robots so that the team picks up exactly a sphere, a cone, and a ring?

A N, E, E, E B N, E, E, S, E C N, N, S, E, N D N, E, E, S, W

This question comes from Italy

Answer

B:

N, E, E, S, E

Explanation

Option A is incorrect because no sphere is picked up.

Option C is incorrect because no ring is picked up.

Option D is incorrect because no sphere is picked up.

Cross Country

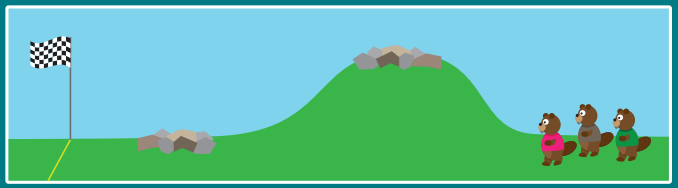
BEBRAS
Australia

Three very fast beavers will compete in a cross-country run.

Mr. Brown will overtake one beaver when running uphill. Mrs. Pink will overtake one beaver when running downhill. Mrs. Green will overtake one beaver when running across rocks.

The terrain is shown in the picture: uphill, followed by some rocks, downhill and then some more rocks.

Mrs. Pink starts in the first position, followed by Mr. Brown and Mrs. Green.



Question

In what order will they finish the race?

This question comes from South Africa

Answer

Mr. Brown, Mrs. Green, Mrs. Pink

Explanation

Mrs. Pink starts first but is then overtaken by Mr. Brown up the hill so the order is now Brown, Pink, Green.

Mrs. Green overtakes Mrs. Pink across the rocks so the order is now Brown, Green, Pink.

Mrs. Pink overtakes Mrs. Green running down hill, so the order is now Brown, Pink, Green.

Finally, Mrs. Green overtakes Mrs. Pink across the rocks so the order is now Brown, Green, Pink.

Computational Thinking: Decomposition

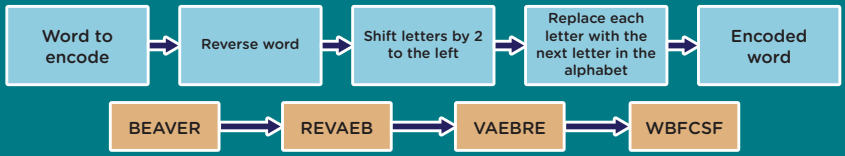
CSIRO digital careers

You Won't Find It

BEBRAS Australia

Beaver Alex and Beaver Betty send each other messages using the following sequence of transformations on every word.

For example, the word "BEAVER" is transformed to "WBFCSF".



Beaver Betty receives the encoded message "PMGEP" from Beaver Alex.

PMGEP

Question

What did Beaver Alex want to say?

RIVER, KNOCK, FLOOD or LODGE

This question comes from Belgium

Answer

Flood

Explanation

The steps of the transformation, applied in the reverse order, are:

“PMGEP” > “OLFDO” > “DOOLF” > “FLOOD”

That is:

PMGEP

Replace each letter with the previous in the alphabet;

OLFDO

Shift letters by 2 to the right;

DOOLF

Reverse word.

FLOOD

Computational Thinking:
Decomposition

CSIRO digital careers

Throw the Dice

BEBRAS Australia

After school the young beavers often play together.
To avoid quarrels about where to play, they throw a normal six-sided die.
The decision is found according to this rule:

```
1 IF   the first throw is greater than the second throw
2 THEN we go to play in the woods
3 ELSE
4     IF   the third throw is less than the first throw
5     THEN we go to play at the river
6     ELSE we go to play on the sport field
```

Question

Which sequence of throws will send the young beavers to the sports field?

This question comes from Germany

Answer

Explanation

The first throw of 3 is not greater than the second throw of 3, so the ELSE-IF branch decides. The third throw of 3 is not greater than the first 3 thrown so the rule sends the young beavers to the sporting field.

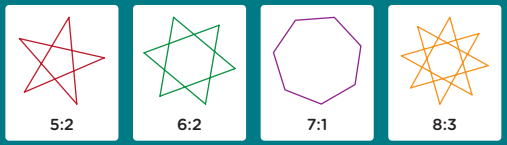
Drawing Stars

BEBRAS Australia

Stella the beaver loves to draw stars. She has devised a system for labeling her stars according to their shape. She uses two numbers:

- A number of points on the star.
- A number indicating if a line from a point is drawn to the nearest point (the number is 1), the second closest point (the number is 2), etc.

Here are four examples of Stella's labelling system:



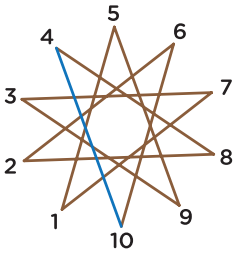
Question

How would Stella label the following star?

This question comes from Switzerland

Answer

10:4



Explanation

The star has 10 points so the first number must be 10. The points each connect to another point, 4 points away so the second number must be 4.

Computational Thinking:
Decomposition

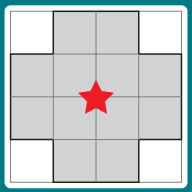
CSIRO digital careers

Village Network

BEBRAS
Australia

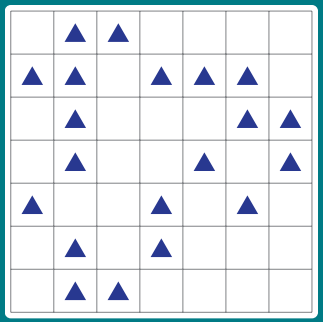
A village is receiving a new wireless network consisting of several network towers. The network will offer WiFi to all the villagers.

Every network tower has the coverage area shown below.
The red star represents the network tower. Only in the twelve shaded squares surrounding the tower will a house get a WiFi signal.



The picture shows a map of the village divided into squares.
Every triangle represents a house.

A network tower cannot be built inside a square, only on the cross point of the village squares.
The coverage areas may overlap.



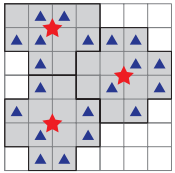
Question

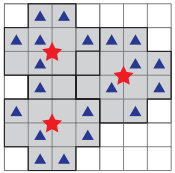
What is the minimum number of network towers required to provide coverage to every house?

This question comes from Japan

Answer

3 network towers





Explanation

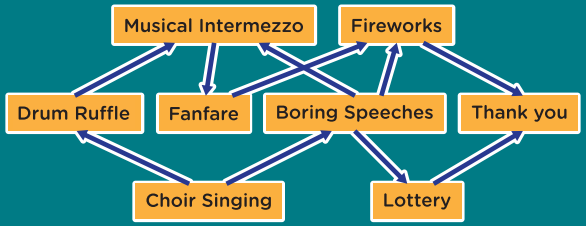
Two towers would not cover the whole area.

Ceremony

BEBRAS
Australia

Organising Festive Day is a lot of work in Bebras City.
All the events must occur in a specific order.

The diagram shows all the events that must be included. The arrows indicate that an event has to occur before another event. For example, the Musical Intermission can only happen after both the Drum Ruffle and the Boring Speeches have finished.



Question

What are the first and last things to happen at Festive Day?

This question comes from France

Answer

First: Choir Singing
Last: Thank you

Explanation

First: Choir Singing as it has no arrows pointing to it, nothing has to come before it.

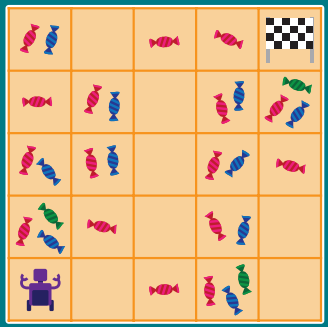
Last: Thank you as it has no arrows coming from it, meaning it does not have to proceed anything.

Candy Maze

BEBRAS
Australia

A robot is programmed to collect as many sweets as possible. It does this while walking through cells. Each cell in the grid below has either 0, 1, 2 or 3 sweets.

The robot begins in the bottom-left and ends in the top-right. The robot can only move to the right or upwards.



Question

How many sweets will the robot collect in this grid?

10 12 14 16

This question comes from Canada

Answer

14 sweets

2	0	1	1	
1	2	0	2	3
2	2	0	2	1
3	1	0	2	0
0	0	1	3	0

2	0	1	1	
1	2	0	2	3
2	2	0	2	1
3	4	0	2	0
0	0	1	3	0

8	9	10	12	14
6	9	9	11	14
5	7	7	9	10
3	4	4	6	6
0	0	1	4	4

Explanation

One approach to this problem is to use a “diagonal sweep” method of counting. You can start by creating a table like the one to the right that shows how many sweets in each square.

Move along each square in the table and calculate the maximum number of sweets that could be gathered after reaching this position. You do this by adding the number of sweets in the square you are calculating to the ‘Highest number gathered (either left or below the square)’.

In this bold example you can see that the top right bolded square has a maximum of 4 by adding the 1 sweet already in the square to the highest number which is the square to the left with 3.

Continue doing this process until all squares have been tallied.

Funtime School

BEBRAS Australia

The teachers at Funtime School like to include games in their lessons.

At the end of one day, one teacher invites his students to play a game. The winner gets to leave school before the others are dismissed.

Rules of the game:
The school has one corridor with five doors in a row. The students form a queue and take turns to walk down the corridor. When they get to an open door, they must close it and move to the next door. When they get to a closed door, they must open it, go into the classroom, leave the door open and wait there until the teacher dismisses them.

At the start of the game all the doors are closed.

If a student finds all the doors are open, after shutting each of them, they can head home for their tea!

Question

If the students are numbered 1 to 35,
which student gets to leave school first?

This question comes from Slovenia

Answer

The 32nd student

Explanation

This question can be solved with Binary Counting, where 0 is a closed door and 1 is an open door.

Start: 00000 All doors closed

1st student: 00001 The first is closed; open and enter

2nd student: 00010 Shut the first door, the second is closed, open and enter

Only by the 32nd student will 11111 occur.

Computational Thinking:
Decomposition

CSIRO digital careers