



UNIVERSITY OF
OXFORD



UK Bebras Computational Thinking Challenge

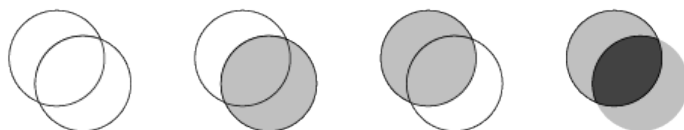
www.bebas.uk

2014

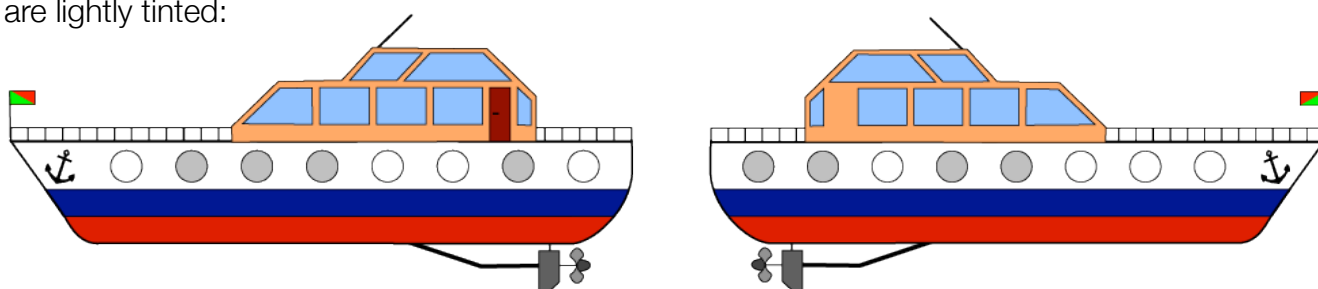


The windows of a boat are either clear or lightly tinted.

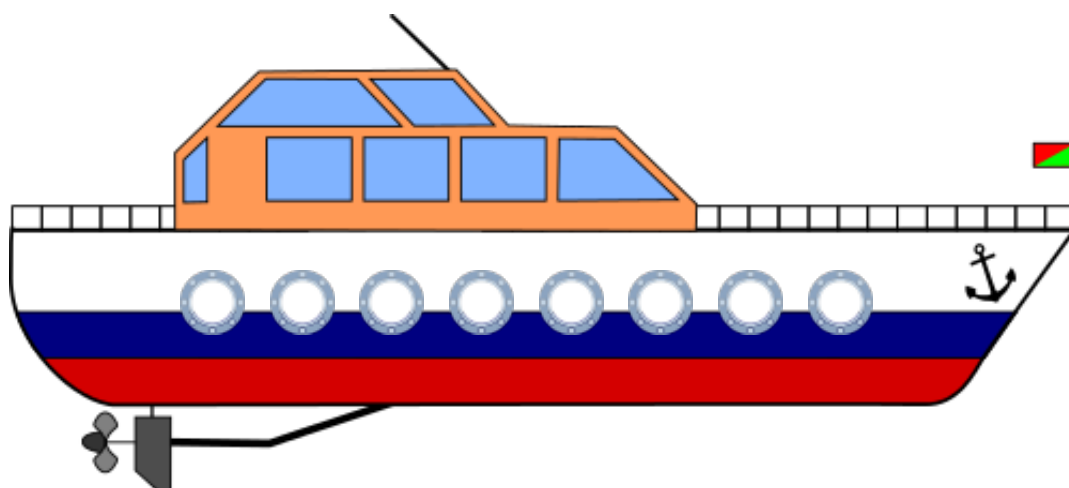
Standing beside the boat you can look through two opposite windows at once. Depending on the colours of both windows they will appear to have a new colour:



Captain Krysta has given you drawings of her boat showing which windows are clear and which are lightly tinted:



Click on the windows of the boat below to show what you would see if you stood beside it and looked through opposite windows.





At the LIFO ice cream parlour the scoops of ice cream are stacked on your cone in the exact order in which you ask for them.

What do you have to say in order to get the ice cream shown in the picture?

I would like to get an ice cream with ...

- ... Chocolate, Smurf and Strawberry!
- ... Strawberry, Smurf and Chocolate!
- ... Chocolate, Strawberry and Smurf!
- ... Strawberry, Chocolate and Smurf!



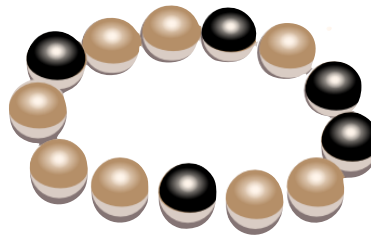
Chocolate

Smurf

Strawberry

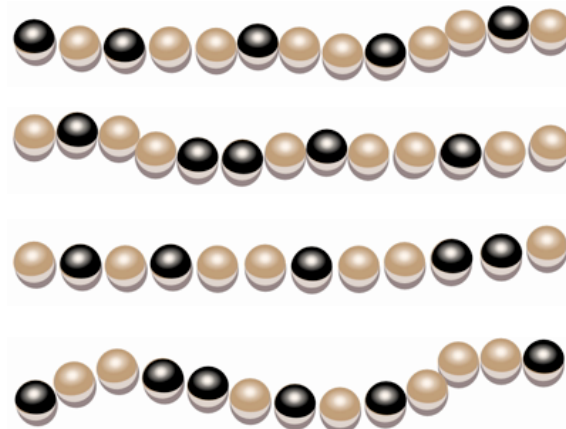


A princess has a magical bracelet that looks like this:



When she stores her bracelets in her drawer she first opens them.

Which of the four bracelets in her drawer is the magical one ?





Daniel is sending text messages from his old phone.

For every letter he has to press the proper key once, twice, three or four times, followed by a short pause.

In order to type 'C' he has to press the number 2 key three times because 'C' is the third letter written on this key.

In order to type 'HIM' he has to press the number 4 key twice, followed by the number 4 key 3 times and finally the number 6 key once.

Daniel presses exactly six times to enter the name of a friend.

What is the name of his friend?

Miriam

Iris

Emma

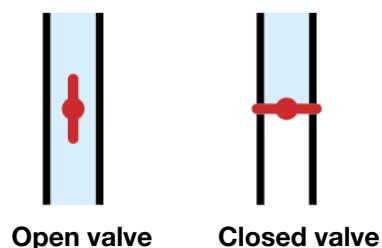
Ina





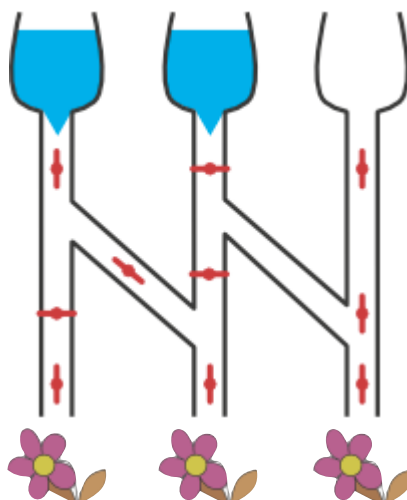
The diagram shows how a watering system is connected. The system consists of tubes and valves. Open and closed valves are shown in the diagram by the direction of the switch.

Water only flows through open valves



Which of the flowers (if any) will receive water when the valves are in the positions shown below.

Click on the flowers that will receive water so that they look bright and fresh.
Leave the flowers that will not get any water looking wilted.

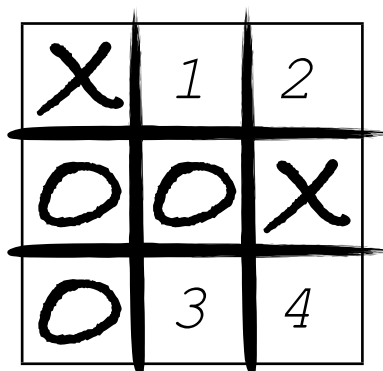




You are playing a game of tic-tac-toe with your friend. First your friend has to place an 'O', then you place your 'X'. You continue taking turns in this way. The player who places their three marks in a horizontal, vertical or diagonal line wins.

It is your turn to put an 'X' in the grid below:

Click on the grid to place your 'X' so that you have the best chance of winning.

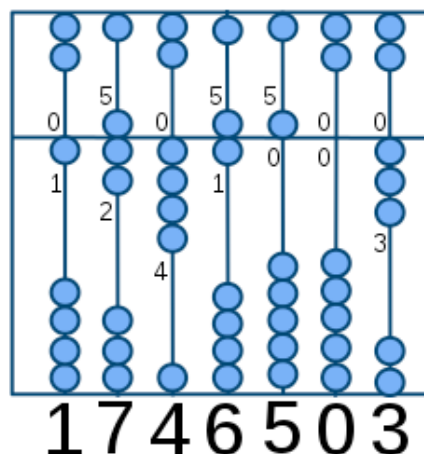




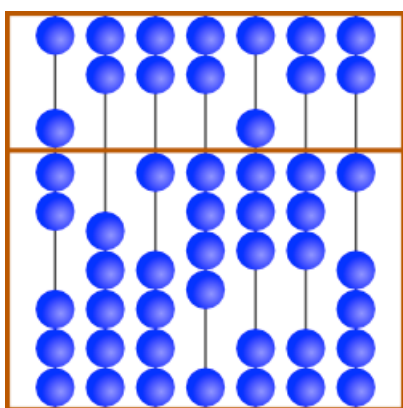
A number is represented on a Chinese abacus by the position of its beads.

The value of a bead on the top part is 5; the value of a bead on the bottom part is 1. The abacus is reset to zero by pushing the beads away from the centre.

To represent the number 1 746 503 the appropriate beads are moved towards the centre of the abacus:



What number does the following abacus represent?



Select a picture

Kits: B
Castors: B
Juniors: B

Intermediates: A
Seniors:
Elite:



Johnny has 8 photos. He wants to give one to Bella.

He asks Bella three questions to help him select the best picture.

Johnny's Question

Do you want a photo with a beach umbrella?

Do you want a photo where I wear something on my head?

Do you want a photo where you can see the sea?

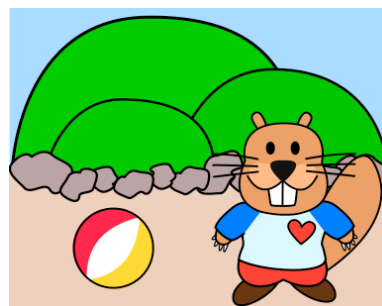
Bella's Answer

Yes

No

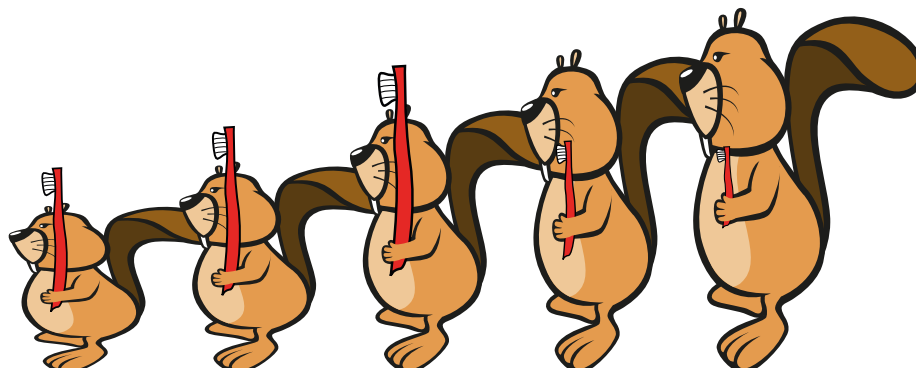
Yes

Which photo should Johnny give to Bella?





It is time for bed! Every beaver should have a toothbrush that matches their size. But look at the picture to see what has happened.



Ann Ben Chad Dan Eve

“Not so fast!” sighs mother beaver. “Eve and Chad, swap your brushes! Ann and Chad, you too!” But then she does not know how to continue.

Which two beavers still need to swap their toothbrushes so that all the beavers have the correct brushes?

Ben and Chad

Ann and Eve

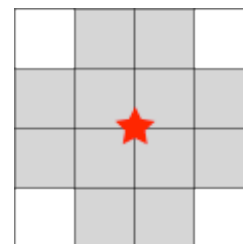
Ben and Dan

Nobody



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

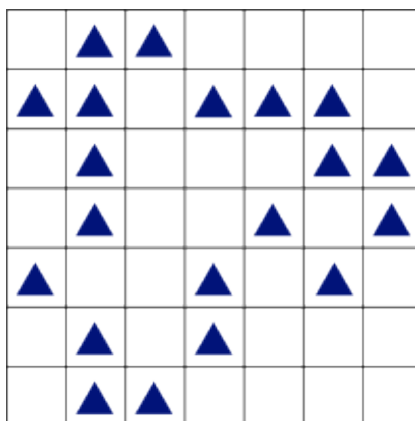
Every network tower has the coverage area shown below. The red star represents the network tower. Only in the twelve shaded squares surrounding the tower will a house get a WiFi signal.



The picture below 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.

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





The robot 'Drawbot' can drive and draw at the same time!

You can give the drawbot the following instructions: square, triangle, forward, turn.

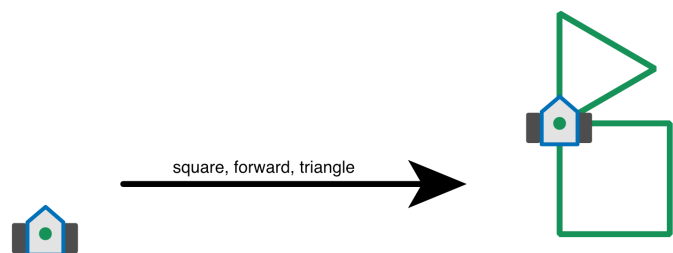
The instructions work as follows:

<p>square: Drawbot draws a square. At every corner he turns right.</p>	
<p>triangle: Drawbot draws a triangle. At every corner he turns right.</p>	
<p>forward: Drawbot drives forward on a line that has been drawn until the next corner.</p>	
<p>turn: Drawbot turns to the right until the next drawn line.</p>	

You can also give a sequence of commands to drawbot:

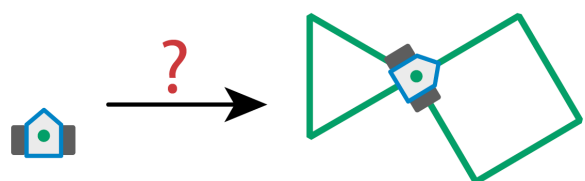
For instance: **square, forward, triangle**

The image on the right shows what will happen.



Which sequence of instructions causes this to happen?

- square, turn, forward, triangle
- triangle, turn, square
- triangle, turn, forward, square
- square, forward, square, turn, triangle





Loading Lisas

Kits:
Castors:
Juniors: C

Intermediates: B
Seniors: A
Elite:

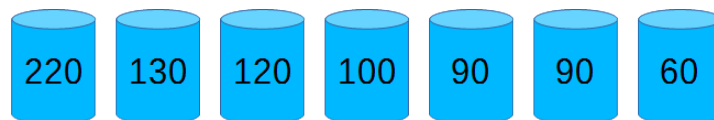


Two fishermen own two boats, named "Lisa 1" and "Lisa 2". Each boat can hold a maximum cargo of 300kg.

The fishermen are given barrels filled with fish to transport. On each barrel is a number that shows how heavy the barrel is in kilograms.

You must make sure that neither boat is overloaded.

Drag barrels onto the two boats so that the maximum possible load of fish is carried.





In the basement of a castle lives a monster. The monster is hiding in one of the yellow rooms.

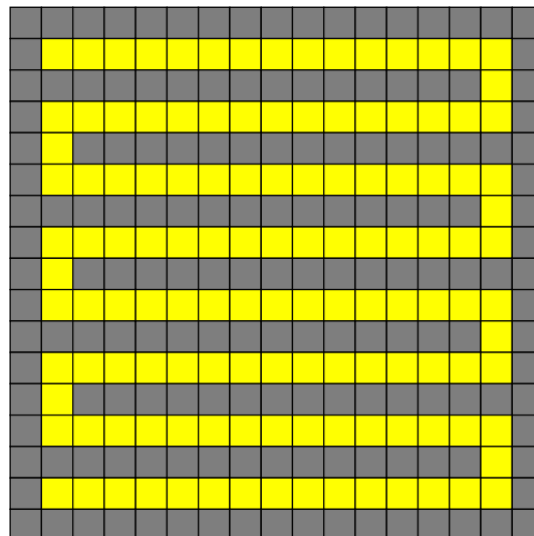
The monster can only stay in yellow rooms.

You want to catch the monster. Click on any yellow room. This will reduce the total number of yellow rooms by half. Click again on another yellow room, etc.

When there is only one yellow room left you have caught the monster.

Find the lowest number of rooms you need to click to trap the monster.

Save the lowest number of clicks required as your answer.





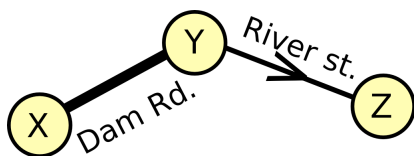
Traffic in the city

Kits:
Castors:
Juniors:

Intermediates: B
Seniors: A
Elite: A



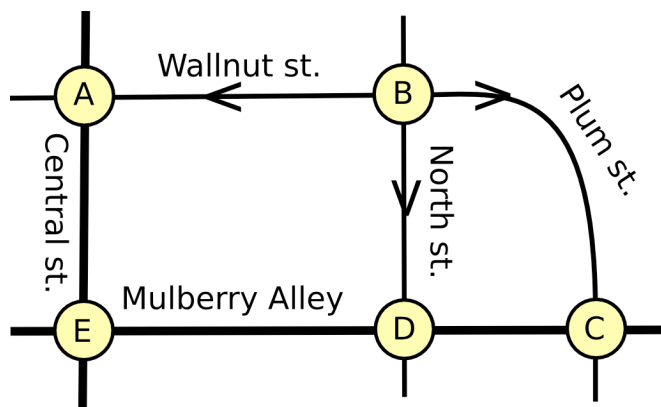
In a small village there is a one-way street and a two-way street. In order to help the village taxi driver a table is made to show which routes can be taken. Below is the map and the corresponding table.



		To		
		X	Y	Z
From	X			
	Y	✓		
	Z			

Beaversville is a little larger and also wishes to have a table for its taxi drivers:

Fill in the table for the taxi drivers.

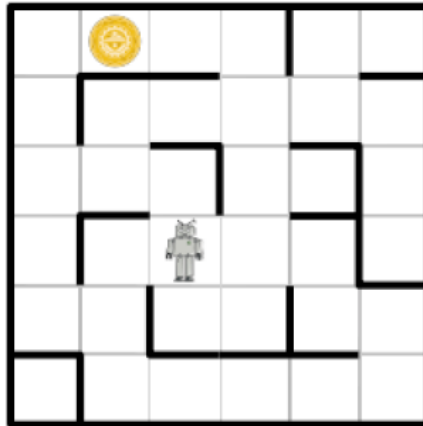


	A	B	C	D	E
A					
B					
C					
D					
E					



Some space explorers landed on an empty planet. From their ship they could see a maze with an unknown golden object in it.

The explorers dropped their robot into the maze hoping it could take a closer look at the unknown object. Unfortunately the robot broke during the fall and can now only send and receive garbled instruction about where to go.



The robot suggests four possible directions it can go. Even though the words in the instructions are garbled, there are still only four different words, each indicating north, west, east or south. When following the instructions the robot will move into an adjacent square as instructed.

Which instructions should the explorers send the robot in order for it to reach the golden object?

- A. Ha' poS poS Ha' Ha' nIH
- B. Ha' poS poS Ha' nIH Ha'
- C. Ha' Ha' poS Ha'
- D. Ha' poS nIH vl'ogh Ha' poS



Mobile phones

Kits:
Castors:
Juniors: C

Intermediates: C
Seniors: B
Elite:



The beaver family have three mobile phones but none of the batteries have any charge.
It takes 1 hour to fully charge a mobile phone but this does not need to be done all in one go.
The beaver family only have two mobile phone chargers in the house.

What is the shortest time they need to fully recharge the three phones?

3 hours

2 hours

1 hour and a half

1 hour

Beavers on the run

Kits:
Castors:
Juniors:

Intermediates: C
Seniors: B
Elite: A

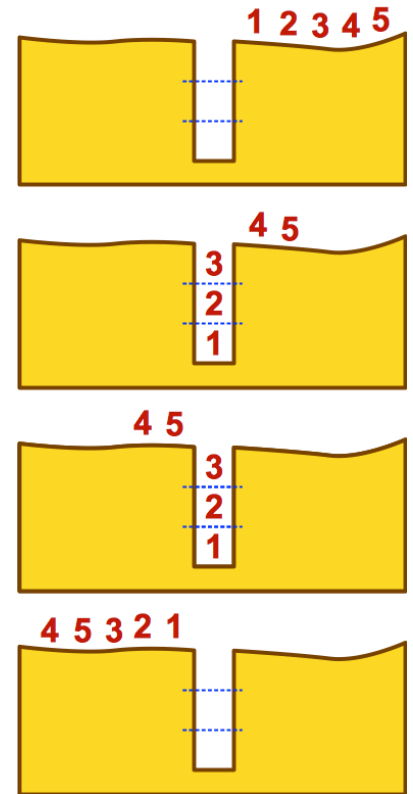


A colony of beavers is travelling through a dark forest. The path is narrow, so they travel in a row without passing.

Sometimes there is a hole in the path. A hole is passed in the following manner:

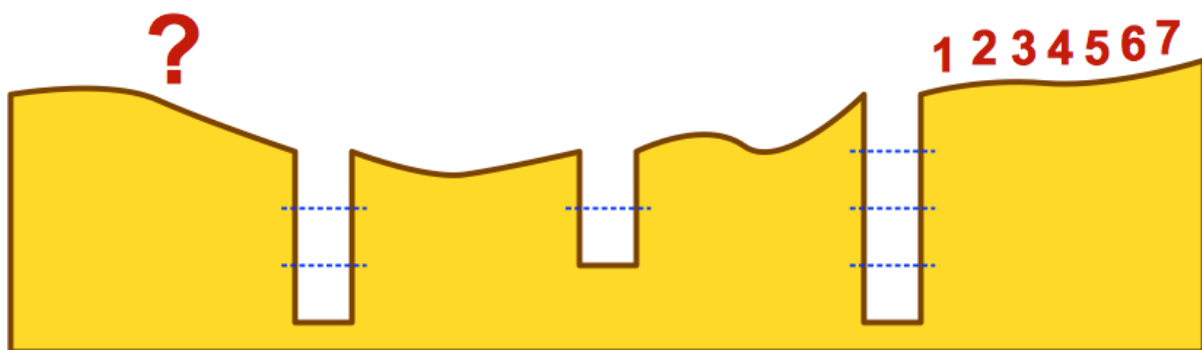
- First as many beavers jump into the hole as fit in.
- The entire colony will then pass across the hole.
- The beavers that jumped in will then climb out.

The images on the right show how five beavers pass a small hole that fits three beavers.



Question:

A colony of 7 beavers passed through the forest. They pass over 3 holes. The first hole fits 4 beavers, the second fits 2, and in the last hole fit 3 beavers.



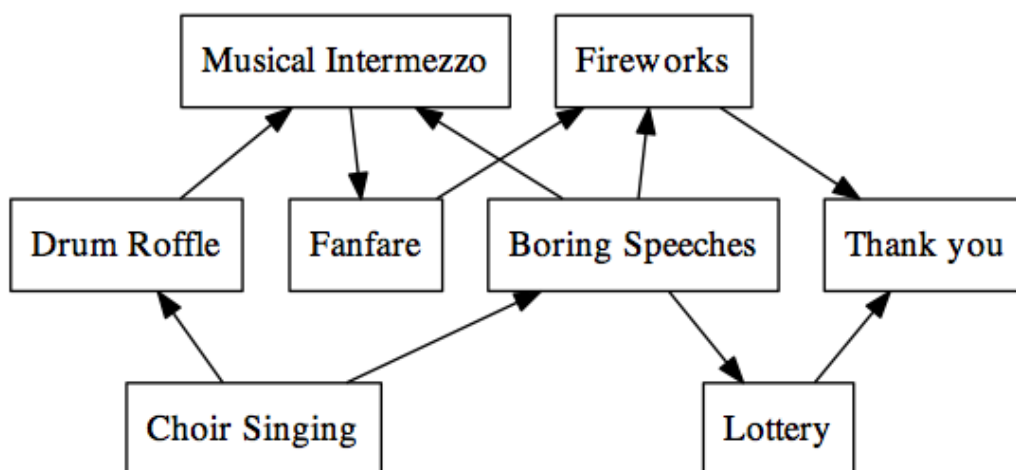
What order do the beavers find themselves after they have passed the third hole?

- 4756123
- 6574321
- 2165347
- 5761432



Organizing a 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 Intermezzo can only happen after both the Drum Roffle and the Boring Speeches have finished.



Rearrange the events of the day in the box below.

Drag them into an order that follows the rules shown in the diagram.

Fireworks

Lottery

Thank you

Boring Speeches

Drum Roffle

Choir Singing

Fanfare










Musical Intermezzo



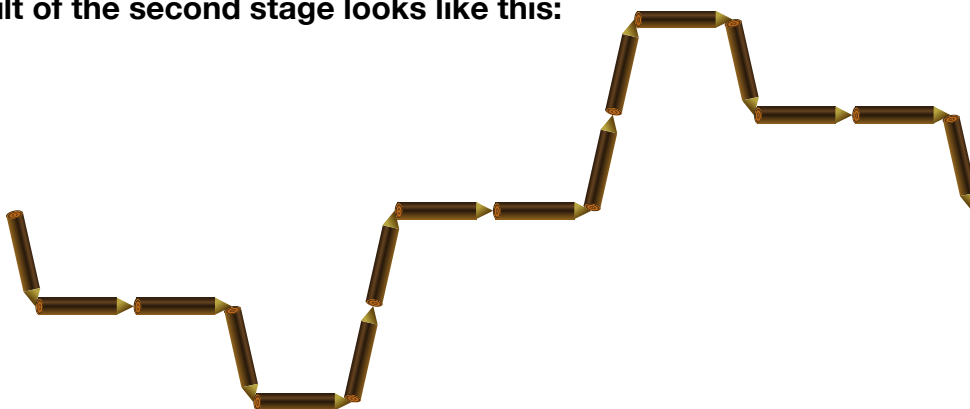
When beavers gnaw on trees they enjoy placing the pieces in a special way.

The beavers start with a single log. In stage one a big log is gnawed into smaller logs. In the next stage each individual log is again gnawed into even smaller logs but always keeping to the starting pattern. This keeps repeating.

Here are three examples. On each line you see how the beaver started, the result after stage one and the result after stage two.

		Stage 1	Stage 2
Example 1			
Example 2			
Example 3			

If the result of the second stage looks like this:



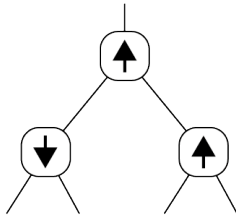
What was the first stage?



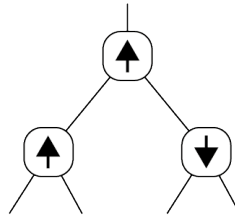


Hans constructed three machines, which were all supposed to output the second largest value from a list of four numbers.

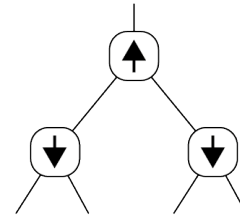
Machine 1



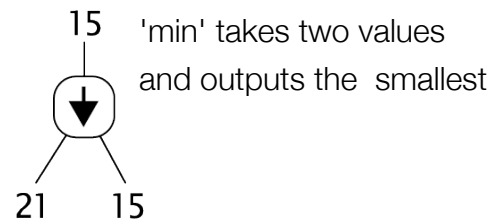
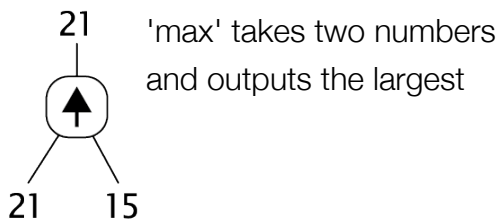
Machine 2



Machine 3



The machines can use two different components, called 'max' and 'min'.



In other words, if numbers represented by a , b , c and d are input to a machine in this order, the results would be as follows:

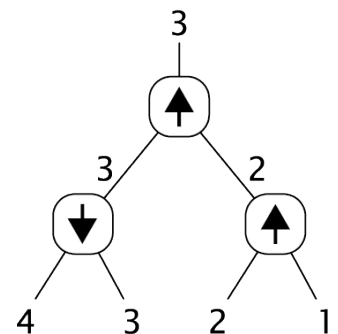
Machine 1: outputs $\max(\min(a,b), \max(c,d))$

Machine 2: outputs $\max(\max(a,b), \min(c,d))$

Machine 3: outputs $\max(\min(a,b), \min(c,d))$

For example, if Hilda inputs the numbers 4, 3, 2, 1 into Machine 1, the output she will get is 3, which is indeed the second largest value.

However, as she continued working with the devices she quite quickly realised that none of the machines actually work. In fact, she only needed to try two number combinations in order to discover this.



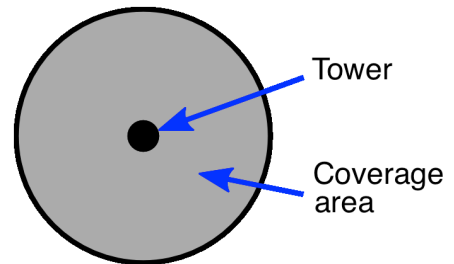
Which of the following combinations did she use to prove none of the machines work?

- 1, 2, 4, 3 and 2, 3, 4, 1
- 2, 1, 3, 4 and 2, 3, 4, 1
- 1, 4, 2, 3 and 2, 3, 4, 1
- 1, 4, 2, 3 and 4, 1, 2, 3



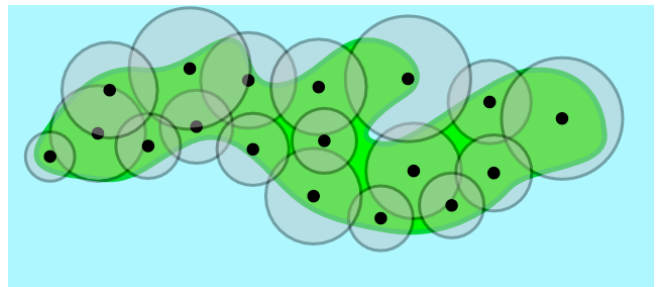
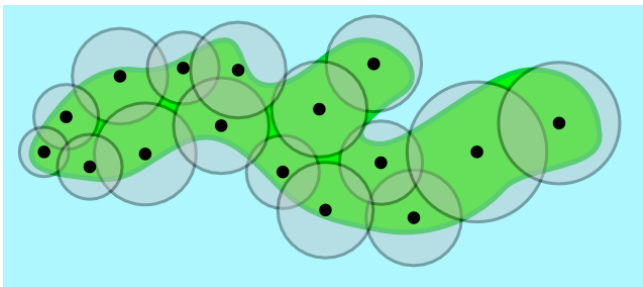
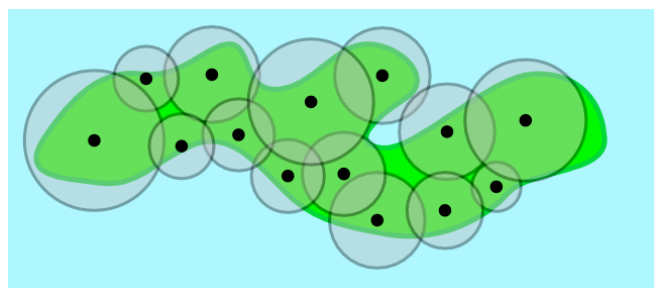
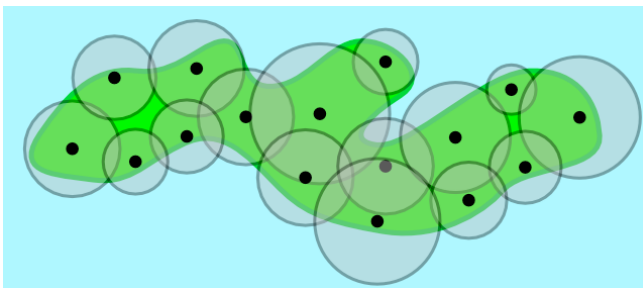
On a small green island a network of mobile phone towers is setup. Every tower covers a circular area of the island.

When the coverage area of two towers overlaps the towers are said to be directly connected. Towers can also be indirectly connected if there is a chain of directly connected towers between the two towers.



The operators want to make the network of towers Storm Proof. This means that even if one tower breaks down all other towers must still be connected, either directly or indirectly.

Which system shown below is a way to create a storm proof network on the island?





The instructions for a **1-tree**:

Step forward 1 step to make one footprint, go back in your own prints.



When you know how to make a 1-tree, you can learn how to make a **2-tree**:

Step forward 2 steps to make two footprints.

Turn left and make a 1-tree.

Turn right and make a 1-tree.

Go back in your own prints.



It is easy to explain how to create a **3-tree** because a 3-tree consists of 2-trees:

Step forward 3 steps to make three footprints.

Turn left and make a 2-tree.

Turn right and make a 2-tree.

Go back in your own prints.



In a similar way you can create a 4-tree.

Which of the following trees is a proper 4-tree?



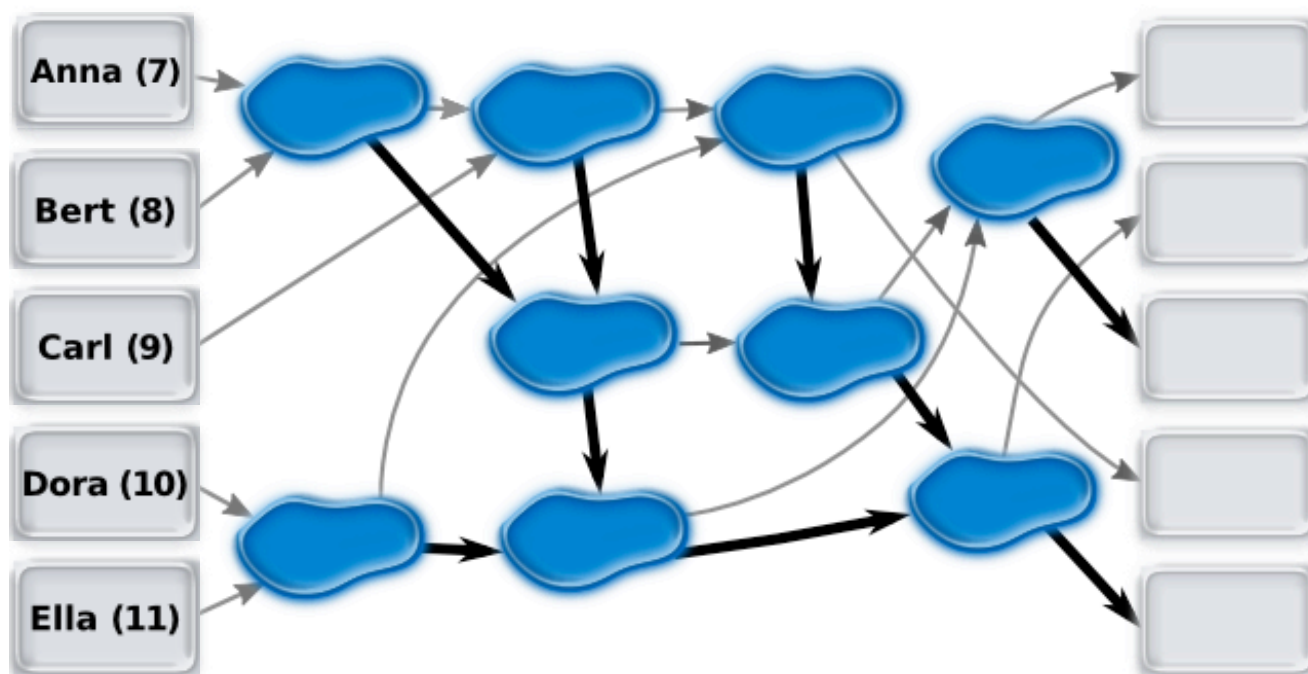


Anna (age 7), Bert (age 8), Carl (age 9), Dora (age 10) and Ella (age 11) are playing a game where they jump from puddle to puddle.

They have placed arrows between the puddles, and they all start on the left side as indicated.

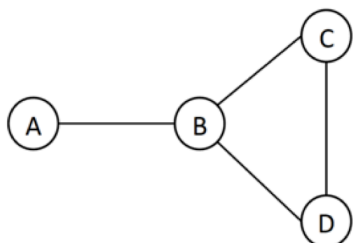
When a child jumps into a puddle he or she waits for a second child to arrive. The oldest child will then jump following the thick arrow, the youngest, follows the narrow arrow.

Drag the names of the children to the right side of the field to show where each child ends.





Both of the pictures show the same information about friendships between beavers that live in a lodge.



	A	B	C	D
A		○		
B	○		○	○
C		○		○
D		○	○	

For example, beaver A is only friends with beaver B (and beaver B is also friends with beaver A). If beaver A wishes to become friends with beaver C, he would need to get an introduction by Beaver B. The following diagram shows the friendships between 7 beavers.

	A	B	C	D	E	F	G
A		○	○	○			
B	○		○	○			
C	○	○		○			
D	○	○	○		○		
E				○		○	○
F					○		○
G					○	○	

What is the minimum number of introductions beaver A needs in order to become friends with beaver G?

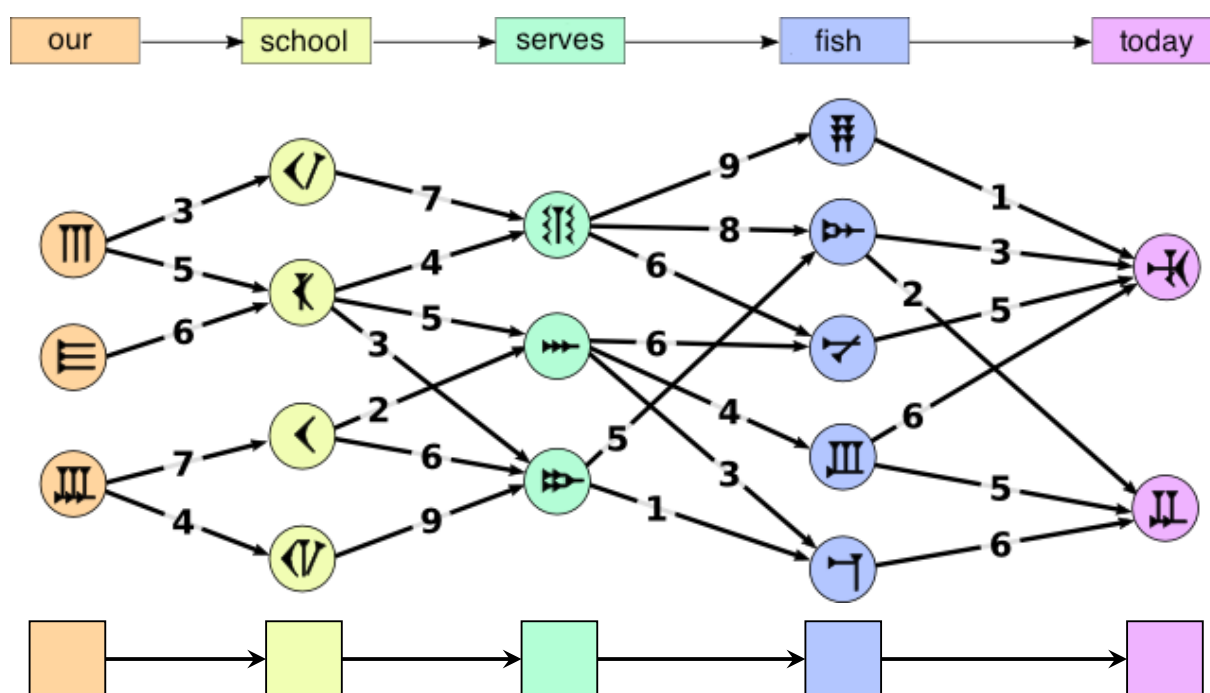
1 2 3 or 4



Aeysha is trying to translate an English sentence into an ancient language. Every word translates into a foreign symbol. There are several possible symbols for each word. Betty wants to find the best translation.

Under each English word Betty has written down the possible foreign symbols. Between each pair of symbols, she has indicated how well they fit together in that order. (A higher number means a better fit.)

The best translation would be the five symbols which produce the highest total maximum score. Betty has prepared the translation of 'our school serves fish today':



Determine the best translation.

Drag the correct symbol into the empty space underneath each word.



A robot has been programmed to draw rectangles. It can execute the following instructions:

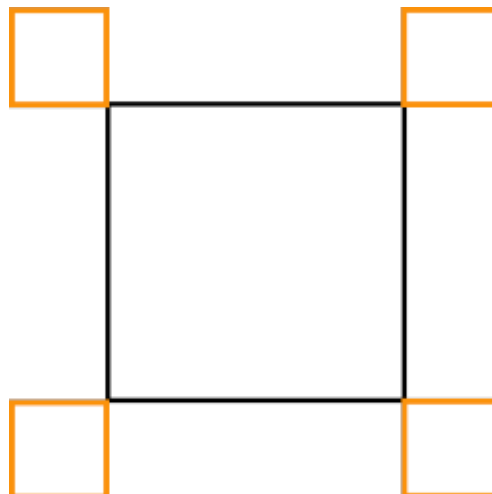
Orange	draw an orange line of length 1
Black	draw a black line of length 1
Turn	turn 90° clockwise

Besides those simple instructions the robot can also execute complex instructions by combining instructions.

If A and B are instructions (either simple or complex) the robot can do:

A, B	first execute A and then execute B
$n \times (B)$	execute B n -times

The robot must draw this pattern:



Which set of instructions does **NOT** result in the requested drawing?

$4 \times (2 \times (\text{Orange}, \text{Turn}), \text{Orange}, 3 \times (\text{Black}), \text{Orange}, \text{Turn})$

$4 \times (2 \times (\text{Orange}, \text{Turn}), 3 \times (\text{Black}), 2 \times (\text{Orange}, \text{Turn}))$

$4 \times (3 \times \text{Black}, 3 \times (\text{Orange}, \text{Turn}), \text{Orange})$

$4 \times (\text{Black}, 3 \times (\text{Orange}, \text{Turn}), \text{Orange}, 2 \times (\text{Black}))$



Young beavers Amy, Beavy, Cuttree, Diggy and Eary, want to play a game with you.

They all stand in a line. Then they each count how many beavers are taller than they are both in front of them and behind. They give you the results on a slip of paper:

Name	No. of taller beavers	
	infront	behind
Amy	1	2
Beavy	3	1
Cuttree	1	0
Diggy	0	0
Eary	2	0

In what order are the beavers standing?

Diggy, Cuttree, Amy, Beavy, Eary

Amy, Cuttree, Diggy, Eary, Beavy

Diggy, Amy, Cuttree, Beavy, Eary

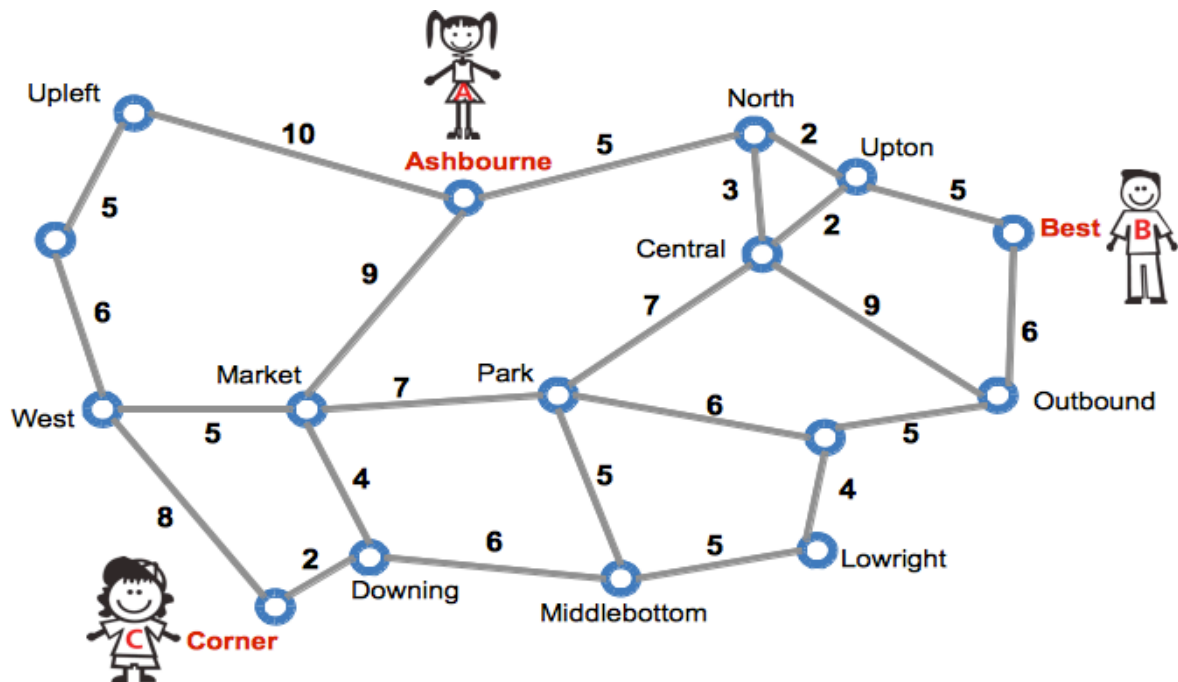
Diggy, Amy, Eary, Beavy, Cuttree



Three friends Anne, Bernie and Clara live in a city with an underground train system.

The map of the system below shows the stations and connections between the stations.

The map also indicates how many minutes each connection takes.



Anne lives next to Ashbourne station, Bernie's nearest station is Best, and Clara's is Corner. They wish to select a station for a meeting. None of the friends should take more than 15 minutes of travel to reach the meeting point.

Which stations qualify as possible meeting points?

Click on all of the stations that would qualify as suitable meeting points.



True or false

Kits:
Castors:
Juniors:

Intermediates:
Seniors:
Elite:

C



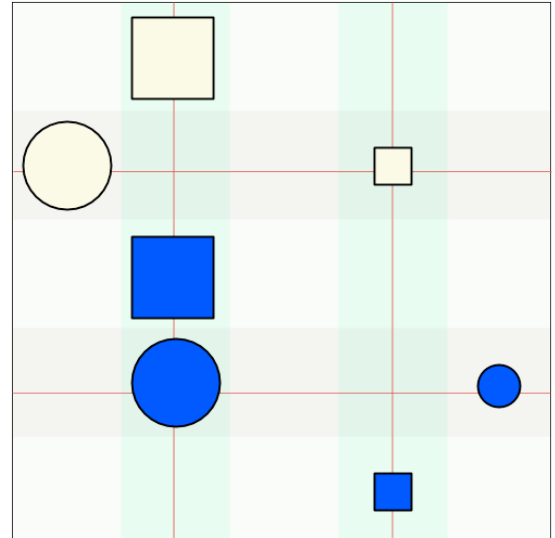
Alice and Tom are playing a game of "True or False" on their colourful, magnetic whiteboard in their classroom.

Alice has stuck seven different magnetic shapes on the board.

She then makes four statements about the shape, colour, size and position of the shapes.

Only one statement is allowed to be true.

Tom must figure out which one it is.



Which of the following statements is true?

- A. There are two shapes X and Y, so that X is dark blue and Y is pale yellow and X is higher than Y.
- B. For all pairs of shapes X and Y, if X is a square and Y is a circle, then X is higher than Y.
- C. For all pairs of shapes X and Y, if X is small and Y is big, then X is to the right of Y.
- D. For all pairs of shapes X and Y, if X is light yellow and Y is dark blue, then X is below Y.

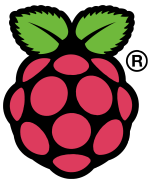
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The UK Bebras is free to enter in 2014 thanks to the sponsorship of the following organisations.



Oxford University is now the National Organising Body of the competition. The University's support for the UK section of this international competition will include hosting events for top achieving students.

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The Raspberry Pi Foundation is a registered charity dedicated to the advancement of education in computing and the use computing technology across other subjects, including STEM and the creative arts. In pursuit of its charitable mission the Foundation designs and sells the Raspberry Pi computer, a small credit card sized Linux computer that retails for \$35. Proceeds from selling Raspberry Pis are ploughed back into supporting educational projects aligned to the Foundations goals via the Raspberry Pi Education Fund. Through this fund, the Raspberry PI Foundation is a proud sponsor of the Beaver UK informatics competition.

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The Computing at School (CAS) Working Group aims to promote the teaching of computer science at school. The support and encouragement of this organisation and its members have been of great importance in enabling the UK to enter the Bebras community successfully this year.

www.computingatschool.org.uk

