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Bebras Australia Computational Thinking Challenge Tasks and Solutions 2014

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Bank Notes

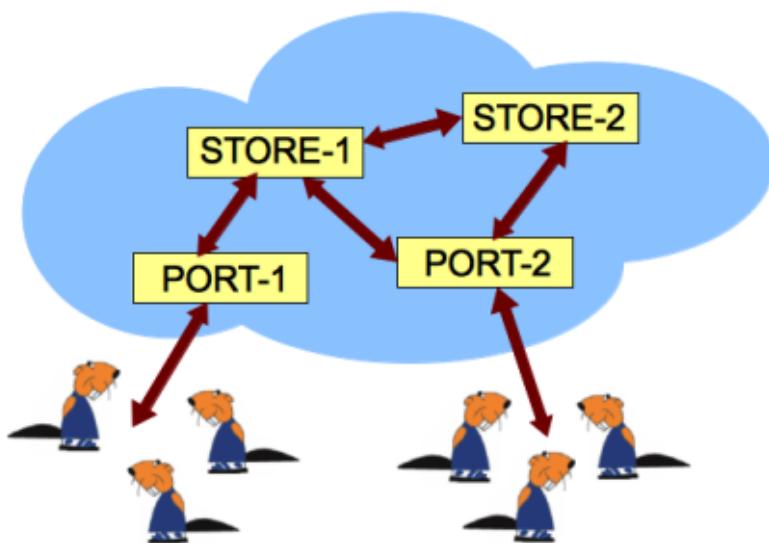
A BEBRA is the currency unit of a country. The country uses six kinds of bills worth 1 BEBRA, 2 BEBRAs, 4 BEBRAs, 8 BEBRAs, 16 BEBRAs and 32 BEBRAs.



What is the fewest number of bills needed to pay exactly 50 BEBRAs without receiving change?

Beaver Cloud

The beavers store their data in a cloud containing four servers. The image shows all connections between the servers.



To lower the risk of losing data, all data are stored on both STORE-1 and STORE-2.
To increase the accessibility, all data are available through both PORT-1 and PORT-2.

No data is stored on PORT-1 and PORT-2.

Which statement is FALSE?

A	If STORE-1 and PORT-2 crash, all data become inaccessible.
B	If PORT-1 and PORT-2 crash, all data become inaccessible.
C	If STORE-1 and STORE-2 crash, all data are destroyed.
D	If PORT-1 and PORT-2 crash, all data are destroyed.

Beavers secret code

Beaver would like to send secret messages to his friend, the hare.

They've come up with a secret code for encrypting the messages, so nobody else can read them.

In their secret code, the vowels (A, E, I, O, U) and the punctuation remain unchanged. The consonants are replaced by the next consonant in the alphabet, where Z becomes B.

How would Beaver write "GIVE ME A CALL" in his secret code?

Answers:

A	GOVE MI E CELL
B	FITE LE A BAKK
C	HOWE NI E DEMM
D	HIWE NE A DAMM

Bebrocarina

The Bebrocarina is a special musical instrument: It has only six different tones.

And: after a tone is played, only the same tone or the tone directly above or below it can be played.

Therefore, a melody for the bebrocarina can be written with only three different symbols:



o	Play the same tone again.
+	Play the tone next tone above it.
-	Play the next tone below it.

With these three symbols, one can write down melodies, based on a single starting tone. It is however possible to write melodies with these symbols that cannot be played on the bebrocarina.

Which of these melodies can NOT be played with a bebrocarina?

Answers:

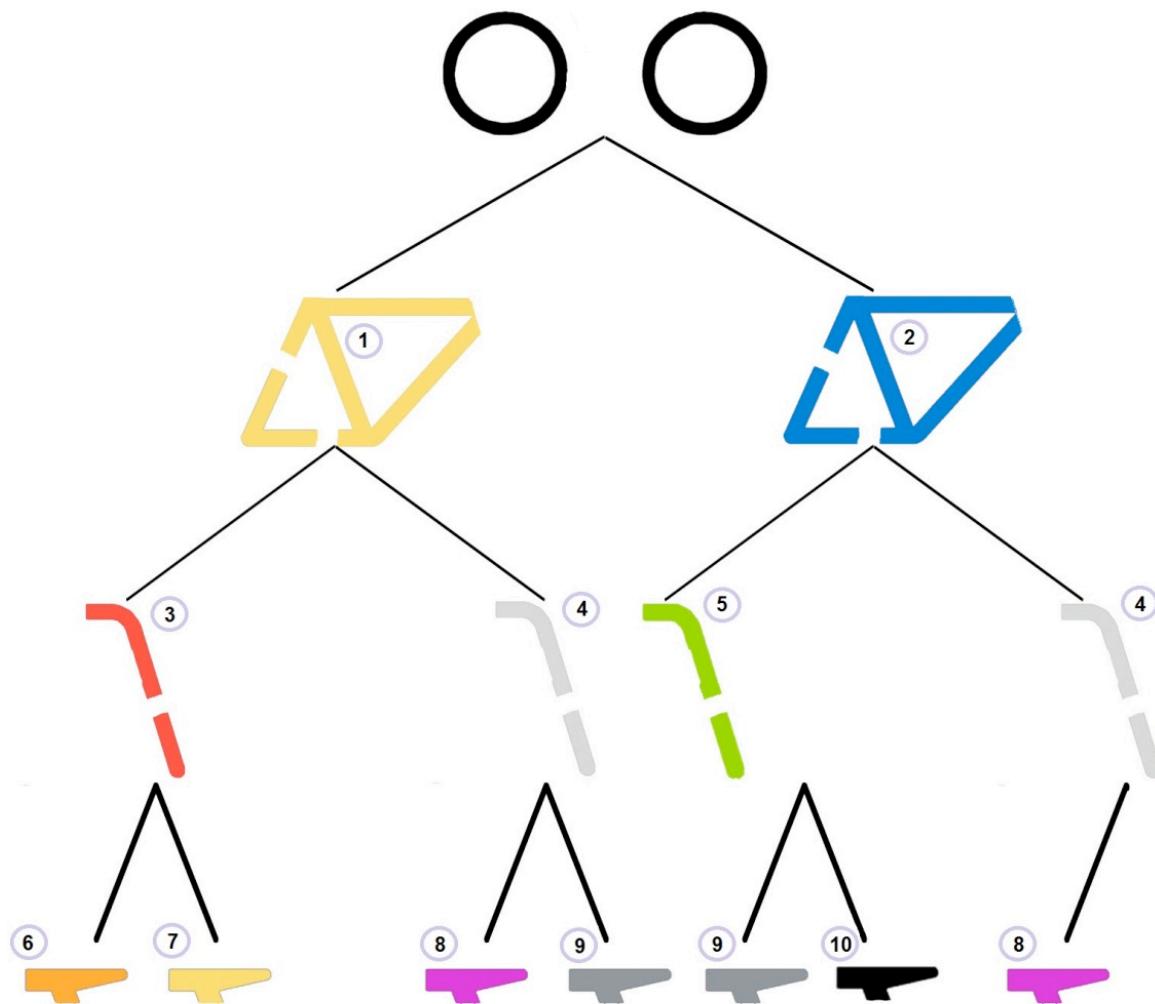
A	(+ o o o + o o o + o o o + o o o +)
B	(- - - - o + + + + + o - - - -)
C	(- - - o + - o - - o o o +)
D	(- - + - - + - - o - + - -)

Bicycle Culture

The inhabitants of Beaver City like to ride very colourful bikes.

The city council has listed all acceptable bicycle parts. They have also published a set of instructions for assembling bicycles.

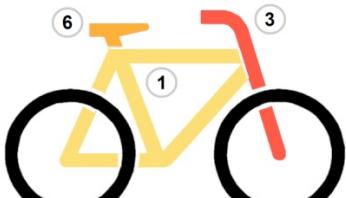
The image on the right shows how the parts may be combined to create a bicycle. You always start with the tyres and then choose which arrow to follow to build your own personal bike.



Which of the following bicycles does not match the instructions?

Answers:

A)



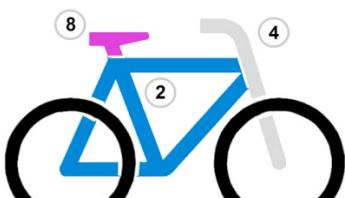
B)



C)



D)



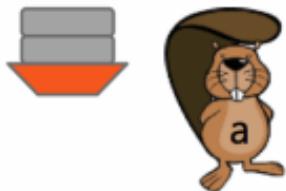
Building dams

Three beavers with 'a', 'b' and 'c' on their bellies are building a dam under the management of their leader.

The beavers can carry out four tasks: "carry", "build", "eat" and "pause".

Each beaver can only do one task at a time, and any task can only be assigned to one beaver at a time.

In the beginning, the tasks are assigned to the different beavers as follows:

carry	build	eat	pause
			

Then the leader gives the command "carry → pause", which means that the beaver that is carrying, must switch to pausing.

After this command the tasks are assigned as follows:

carry	build	eat	pause
			

The leader gives several more commands, which are properly executed by the beavers. After these commands, the tasks are assigned as follows:

carry	build	eat	pause
			

Which commands did the leader give and in which order?

Answers:

A	pause → build ; eat → carry ; build → eat
B	eat → carry ; build → eat ; pause → build
C	build → carry ; eat → build ; pause → eat
D	pause → carry ; build → pause ; eat → build ; pause → eat

Business Cards

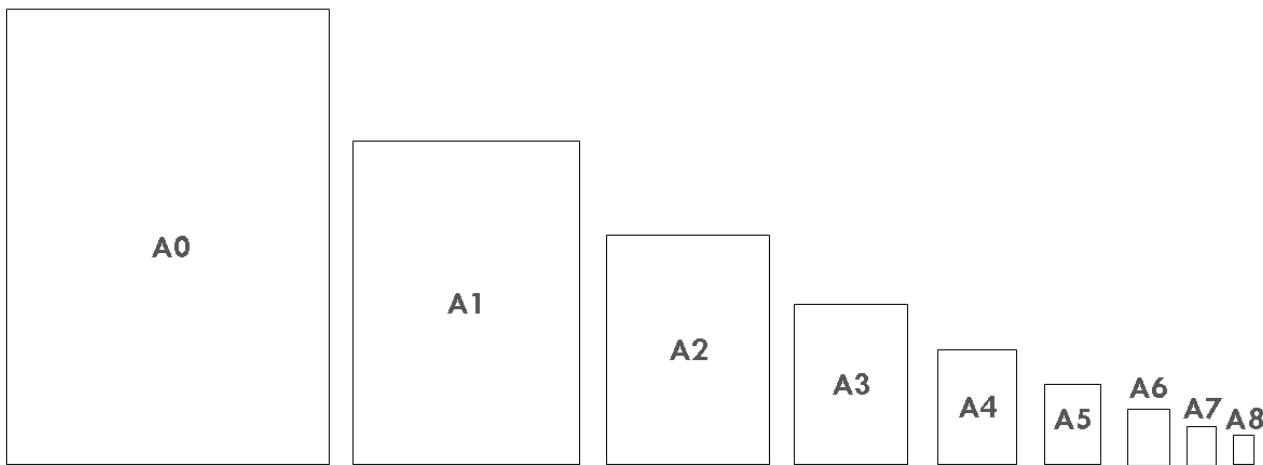
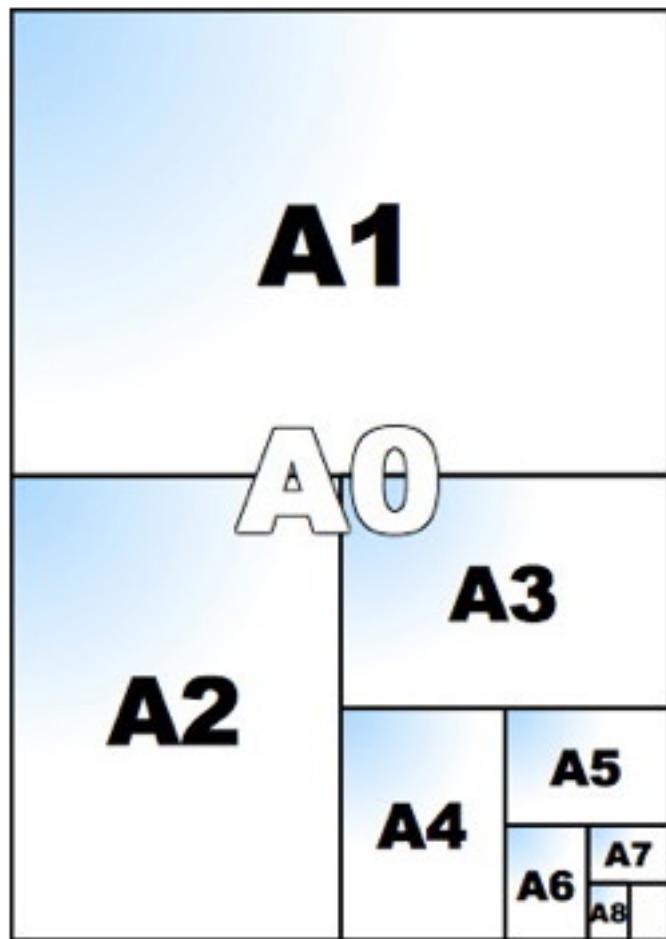
Standard paper sizes can be deduced from the size of a piece of paper with size A0 (1189 mm × 841 mm), by splitting it in half one or more times, as shown in the diagram on the left.

When A0 is split in half, it becomes A1.
When A1 is split in half, it becomes A2.
And so on.

We have eight sheets of paper with the sizes A1, A2, A3, A4, A5, A6, A7 and A8.

We would like to produce 19 business cards of size A8.

We don't want to waste paper, so we only use complete sheets.



Which entire sheets must we use?

Answers:

- A) A4, A7 and A8
- B) A5, A6 and A8
- C) A3 and A7
- D) A4 and A6

Commands

Very easy applications have only a few commands. A command tells something (or someone) what has to be done.

Which of these lines could be seen as an easy application?

Answers:

A	"What is information?"
B	"Come in and close the door!"
C	"Two plus two is four."
D	"Welcome to reality!"

Country codes

Beaver Bruce has a system for making country codes. He takes the English name of the country (for instance LITHUANIA) and counts the frequency of each letter. He then uses the three most frequently occurring letters. The most used letters are used first; letters with the same frequency are used in the order they appear first in the country name.

The country code for LITHUANIA is IAL (I and A occur two times, the first I appears first. Of all characters that occur only once the L appears first).

A few other examples:

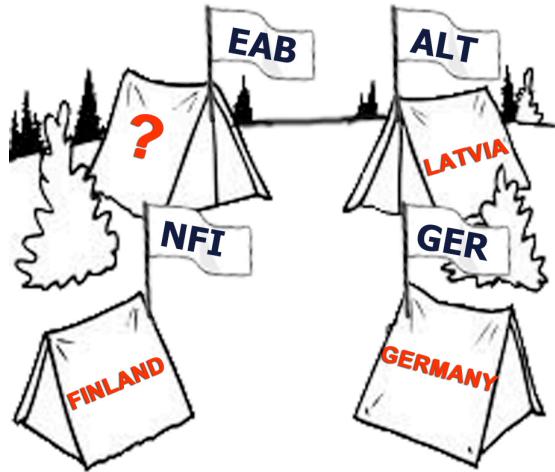
Country name	Country code
FINLAND	NFI
GERMANY	GER
LATVIA	ALT

Beaver Bruce realizes there will be a problem, since there are many countries which will get the same country code.

Which of these countries does not have country code EAB?

Answers:

- A. BEAVERIA
- B. BEAVERLAND
- C. BEAVERONIA
- D. BEVERANIA



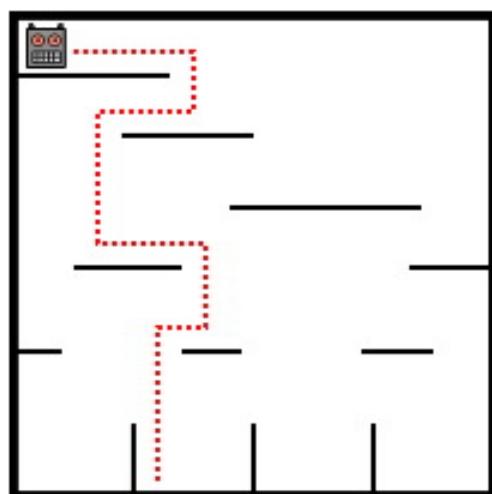
Falling Robot

A robot moves through a vertical maze. The maze consists of various platforms. The robot begins in the upper left corner and then moves to the right.

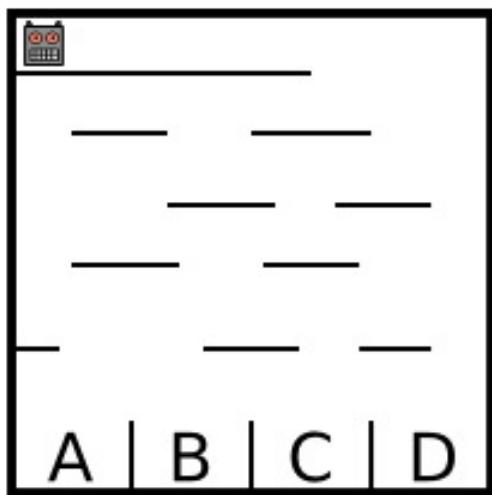
When it reaches the end of a platform, it falls down onto the platform below.

As soon as the robot lands it changes direction. Eventually the robot reaches one of the buckets at the bottom of the maze.

The following image gives an example of how the robot will move down.



Which bucket will the robot reach in the maze below?



Answers:

A	Bucket A
B	Bucket B
C	Bucket C
D	Bucket D

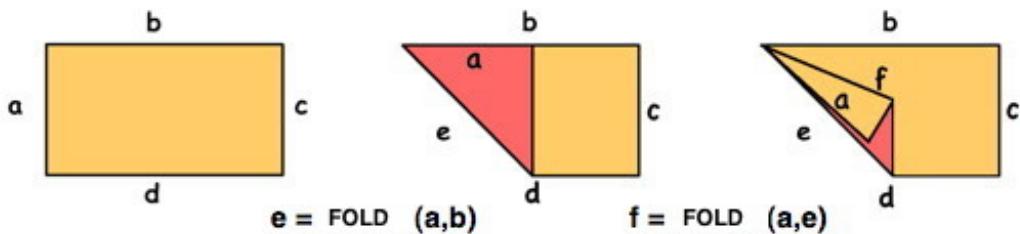
Folding Paper

The beavers have come up with a language for describing how a piece of paper should be folded. The commands in this language are called FOLD.

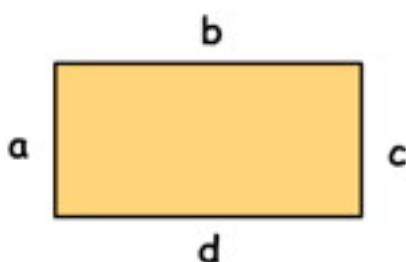
z = FOLD(x,y) for example means:

Fold the piece of paper in such a way that side x and side y overlap. This way, a new side is created. We call this side z.

An example with two consecutive commands:



Imagine a rectangle-shaped piece of paper of which side b is twice as long as side a.



You are not allowed to turn the piece of paper over.

The following sequence of commands is executed:

e = FOLD (c,a) **f = FOLD (c,d)** **g = FOLD (a,f)**

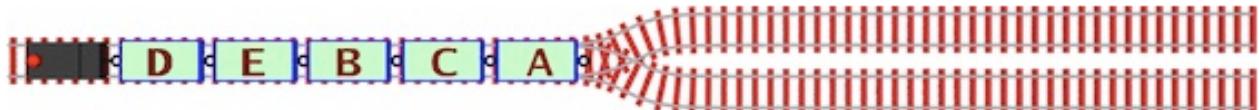
What will the piece of paper look like afterwards?

Answers:

A	B	C	D

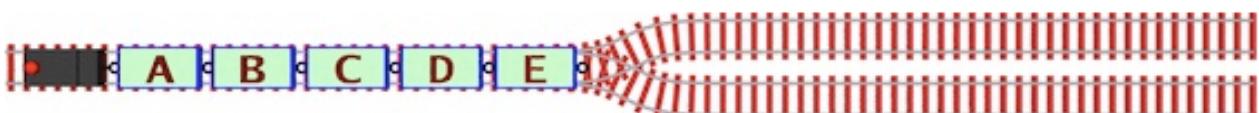
Freight Train

The wagons of the freight train from Beaver Railroad are placed in the order D-E-B-C-A:



The locomotive can move forwards and backwards and is able to pull and push an infinite number of wagons. Connecting or de-connecting a wagon is called a railroad operation.

How many railroad operations are necessary to put the wagons in the order A-B-C-D-E again?



Answers:

(number input)

Group Assignment

For a group assignment a class is split up into four groups. Each group divides the different tasks between the group members. Three groups manage to finish the complete assignment, but one group fails to do so.

What happened?

Our beavers, Bruce and Beatrix, have analysed the four groups. They found out that most group members have to wait for other group members before they can start with their own tasks.

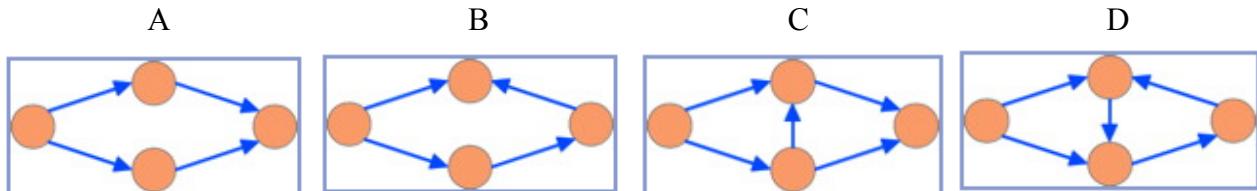
Bruce and Beatrix have made a diagram for each group to show the dependencies between students in each group:

A circle represents a student.

An arrow from student 1 to student 2 means that student 2 has to wait for student 1 to finish their tasks.

Which diagram represents the group that did not finish the assignment?

Answers:



Half Sliding

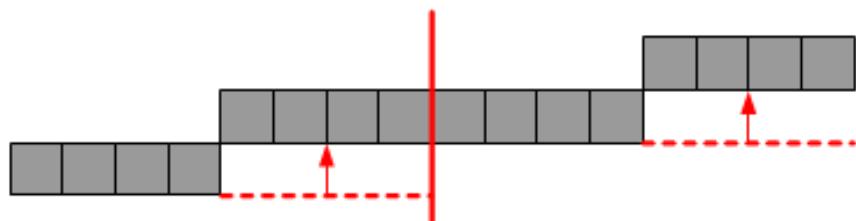
A paper strip is divided into 16 equal pieces:



Such a strip can be used for "half sliding". This is done by splitting the strip in half and sliding the right half up:



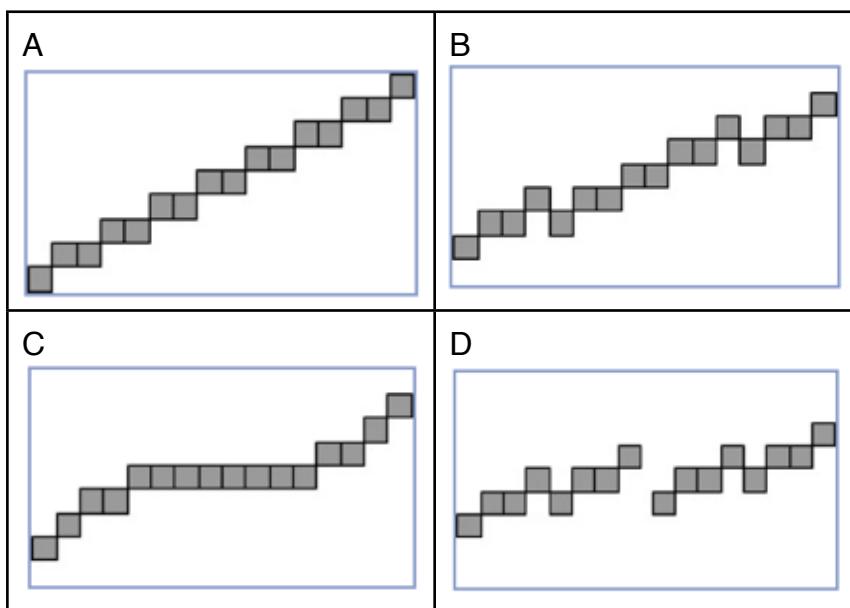
The two halves are also split in half and again, both right halves are slid up. This would look like this:



We do this again with the four-piece strips and, after that, with the two-piece strips.

What will the final result look like?

Answers:



Hangar

The Bebras Airport has a 6×5 hangar, a 3×8 hangar and a 5×4 hangar. There are two sizes of planes. Large planes require 4×3 space in a hangar. Small planes require 3×2 space in a hangar.

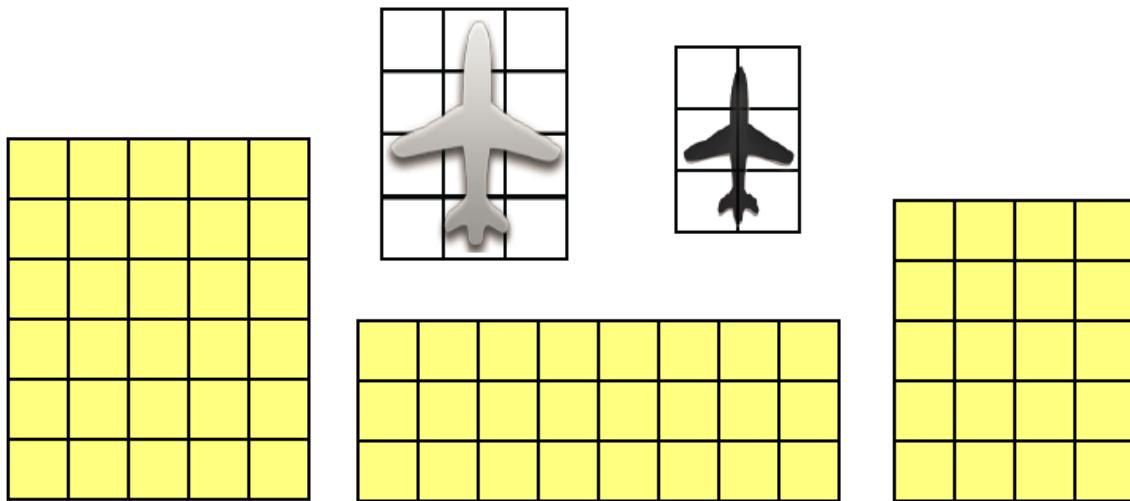


Fig. Bebras airport hangars and planes

Aeroplanes can be arranged in any direction, and all hangars can be entered from any side.

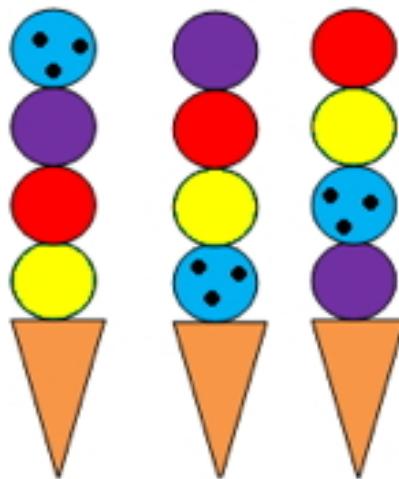
There are four big planes and some small planes. After placing all of the big planes in the hangars, what is the maximum number of small planes that can be placed in the hangars?

Answers:

A	2
B	3
C	4
D	5

Ice Cream Machine

This special ice cream machine creates cones with 4 scoops of ice cream. It does so in an ordered way. Here you see, from left to right, the last 3 ice creams that the machine has made.



Which ice cream will the machine produce next?

Answers:

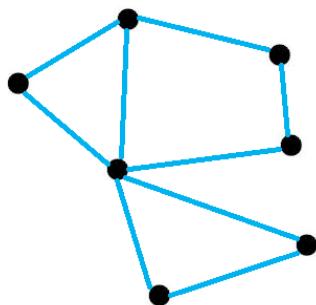
A	B	C	D
An orange ice cream cone with four scoops. The colors from top to bottom are yellow, blue, purple, and red. This corresponds to option A.	An orange ice cream cone with four scoops. The colors from top to bottom are purple, blue, red, and yellow. This corresponds to option B.	An orange ice cream cone with four scoops. The colors from top to bottom are blue, yellow, purple, and red. This corresponds to option C.	An orange ice cream cone with four scoops. The colors from top to bottom are purple, blue, green, and red. This corresponds to option D.

Islands and bridges

The settlements of the Beavers are divided over different islands. They want to build bridges, so trading goods will become easier.



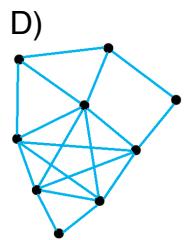
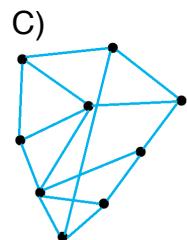
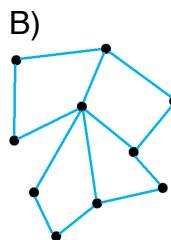
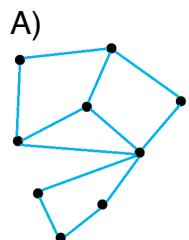
Beaver Beatrix has made a plan, which you can see below. The islands are represented by dots, the bridges by lines.



The other beavers would prefer a different plan though, on which the islands are represented by lines and the bridges by dots.

What would this plan look like?

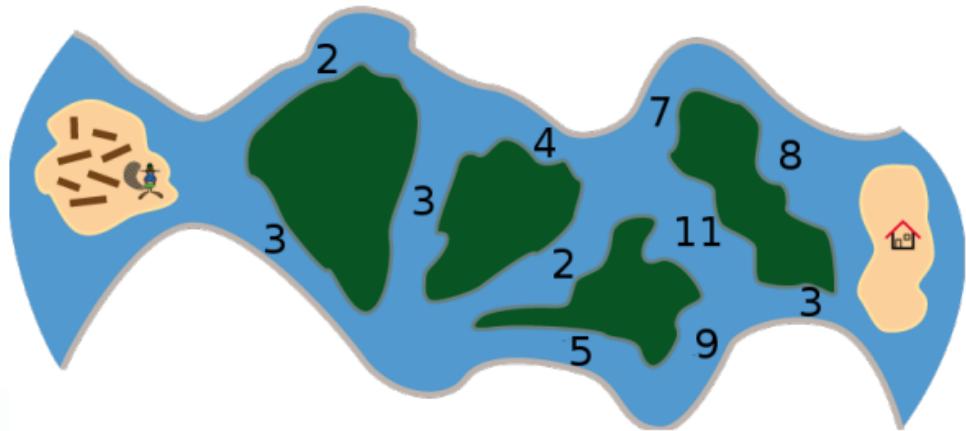
Answers:



Log Jam

The beavers collected 50 logs on Beaver Island. They want to bring these logs to their home through the river system. At various points in the river system, they lose a certain number of logs.

The beavers begin on Beaver Island (at the left side of the diagram) and wish to get home (which is on the right side of the diagram). On the river there are numbers, which show how many logs the beavers would lose, if the beavers use this river on their route home.



What is the fewest logs the beavers could lose?

Answers:

A	20 logs
B	23 logs
C	15 logs
D	19 logs

Mirrored or not?

Sandy and her friend Horatio got new computers last week.

The computers have a built-in camera at the top of the screen.

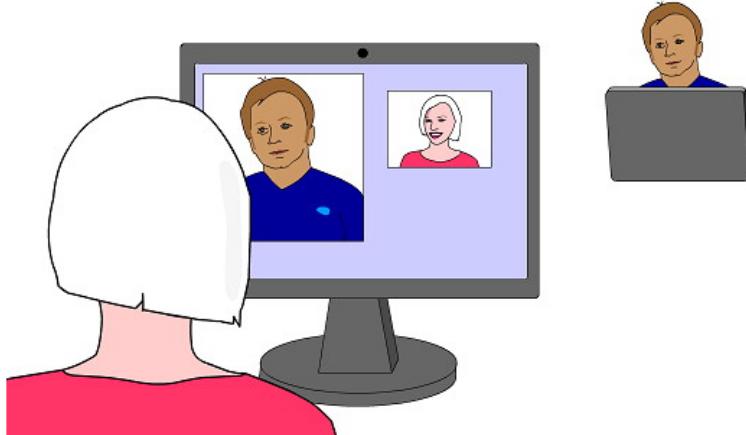
When Sandy is chatting with her friend, the chatting software has two windows: a big one which is showing Horatio chatting and a small one showing herself chatting.

The chatting software has two possible settings for showing the video streams:

"mirror mode" - right eye on the right side of the screen and

"picture mode" - right eye on the left side of the screen.

Look at this picture of Sandy and Horatio chatting:



Which settings does the chatting software have on Sandy's computer?

Answer:

A	Sandy's video stream in picture mode and Horatio's video stream in picture mode
B	Sandy's video stream in picture mode and Horatio's video stream in mirror mode
C	Sandy's video stream in mirror mode and Horatio's video stream in picture mode
D	Sandy's video stream in mirror mode and Horatio's video stream in mirror mode

Missing piece

Beaver Bruce has received a secret message sent on a 6×6 grid. Unfortunately, part of the message has been destroyed by a spill of red juice.

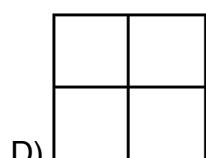
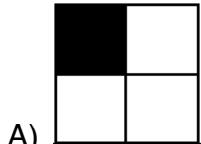
This case was foreseen (Bruce spills a lot of juice) and there are additional squares in the message that can help Bruce determine the secret message.

Each square in the rightmost column (column 6) is coloured such that the number of black squares in each row is even. Similarly, each square in the bottommost row (row 6) is coloured such that the number of black squares in each column is even.

Which of the following images could be the pattern underneath the red spill?

	1	2	3	4	5	6
1	Black				Black	
2						
3		White	Black	Red	Red	Black
4	Black		Red	Red	White	Black
5						Black
6		White	Black		Black	

Answers:



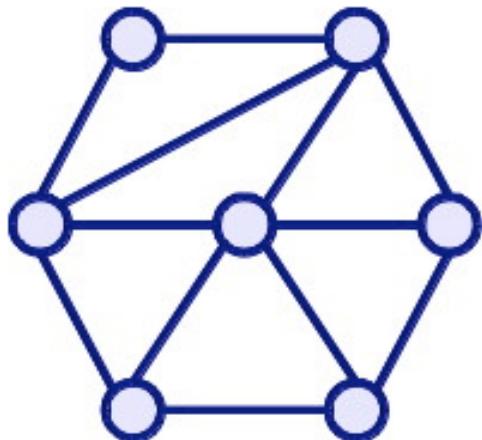
Neighbourhoods

Neighbourhoods in areas on maps can be presented as a diagram. In such a neighbourhood diagram each neighbourhood is represented by a node.

A line between two nodes means that the two neighbourhoods share one or more borders.

The diagram on the right shows the connections between seven neighbourhoods in a certain area.

Which of the following maps is described by this diagram?



Answers:

A	B	C	D

No Anonymity Anymore

The medical records of patients contain personal data, which should not be made public. For the publication of a research project, the hospital has made some data public, without mentioning the names of the patients. The table on the left shows a part of this list.

Because of the upcoming elections, the city with postcode M1 1AA publishes a list with all constituents at the same time. This table on the right shows the constituents who are born on January 1st.

Date of birth	Gender	Postcode	Case	Date of birth	Gender	Name
01/01/1974	male	B33 8TH	Diabetes	01/01/1958	female	Melanie Meyer
01/01/1976	male	M1 1AA	Lung cancer	01/01/1976	male	George Smith
01/01/1976	female	CR2 6XH	Breast cancer	01/01/1976	male	Robert Jones
01/01/1976	female	AB1A 1GD	Miscarriage	01/01/1984	female	Catharine Free
01/01/1984	female	DN55 1PT	Heart attack	01/01/1984	female	Eve Miller
01/01/1985	female	W1A 1HQ	Breast cancer	01/01/1988	female	Anne Beaver
01/01/1987	female	EC1A 1BB	Skin cancer	01/01/1988	male	Roman Peterson
01/01/1988	male	M1 1AA	Diabetes	01/01/1988	female	Isabelle Bourne
01/01/1988	female	M1 1AA	Influenza	01/01/1989	male	Martin Klaus

Thanks to these two tables, you know for sure that one of the persons on the right has a disease and you also know which disease it is.

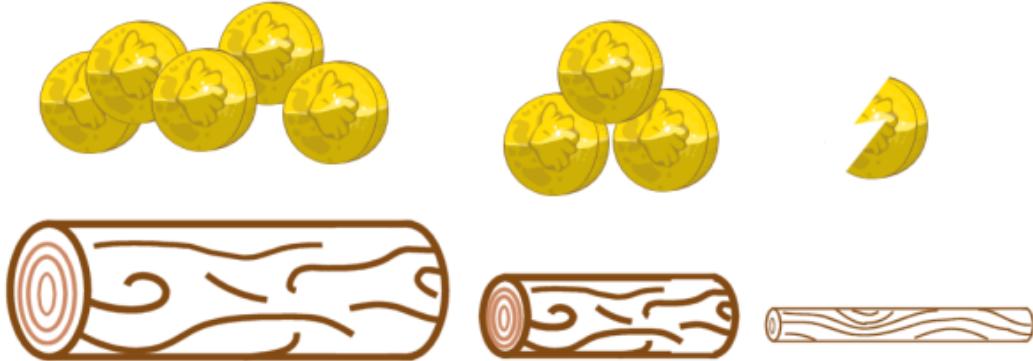
What is the name of this person?

Answers:

A	George Smith
B	Roman Peterson
C	Eve Miller
D	Isabelle Bourne

Packing Logs

Beatrix has a backpack that holds a maximum of 7 kg of wood. Large 3 kg logs are worth 5 coins each. Medium 2 kg logs are worth 3 coins each. Small 1 kg logs are worth half a coin.



How many logs of each size should Beatrix pack in her backpack to maximise the total worth?

Answers:

A	One large log and two medium logs
B	Two large logs and one small log
C	Three medium logs and one small log
D	One large log, one medium log and two small logs

Planting Flowers

A big and a small beaver are planting flowers in the garden. The small beaver has shorter arms and legs than the big beaver. Therefore, his steps are smaller and the flowers he plants are closer to each other.

The beavers start back to back and are looking in opposite directions.

They both follow these directions:

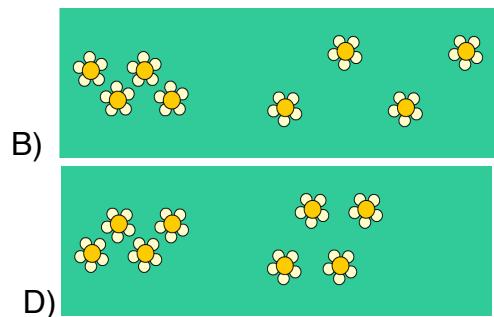
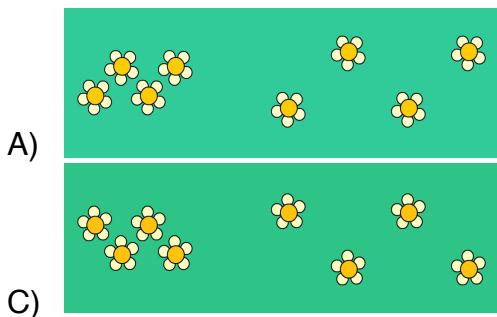
Repeat two times:

- Plant a flower on your right
- Go one step forward
- Plant a flower on your left
- Go one step forward.



What will the garden look like after this?

Answers:



C)

D)

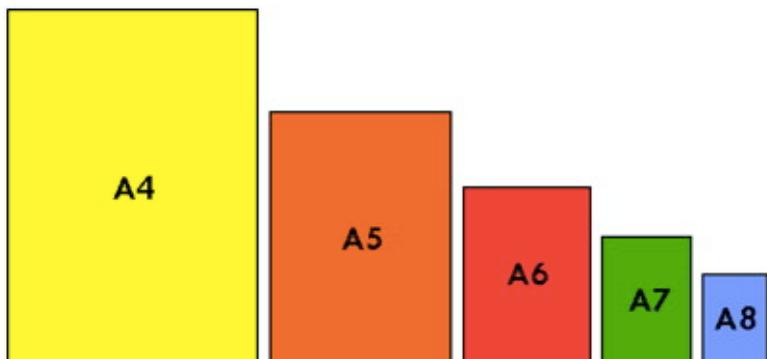
Playing Cards

The beavers want to make playing cards out of five pieces of cardboard.

The pieces of cardboard have different sizes: A4, A5, A6, A7 and A8.

A4 is twice as big as A5, A5 is twice as big as A6 and so on.

They need 12 playing cards of size A8 and they don't want to waste any paper.



Which pieces of cardboard should they use?

Answers:

A	A4 and A5
B	A6 and A7
C	A5 and A6
D	It is not possible!

Programmed Robot

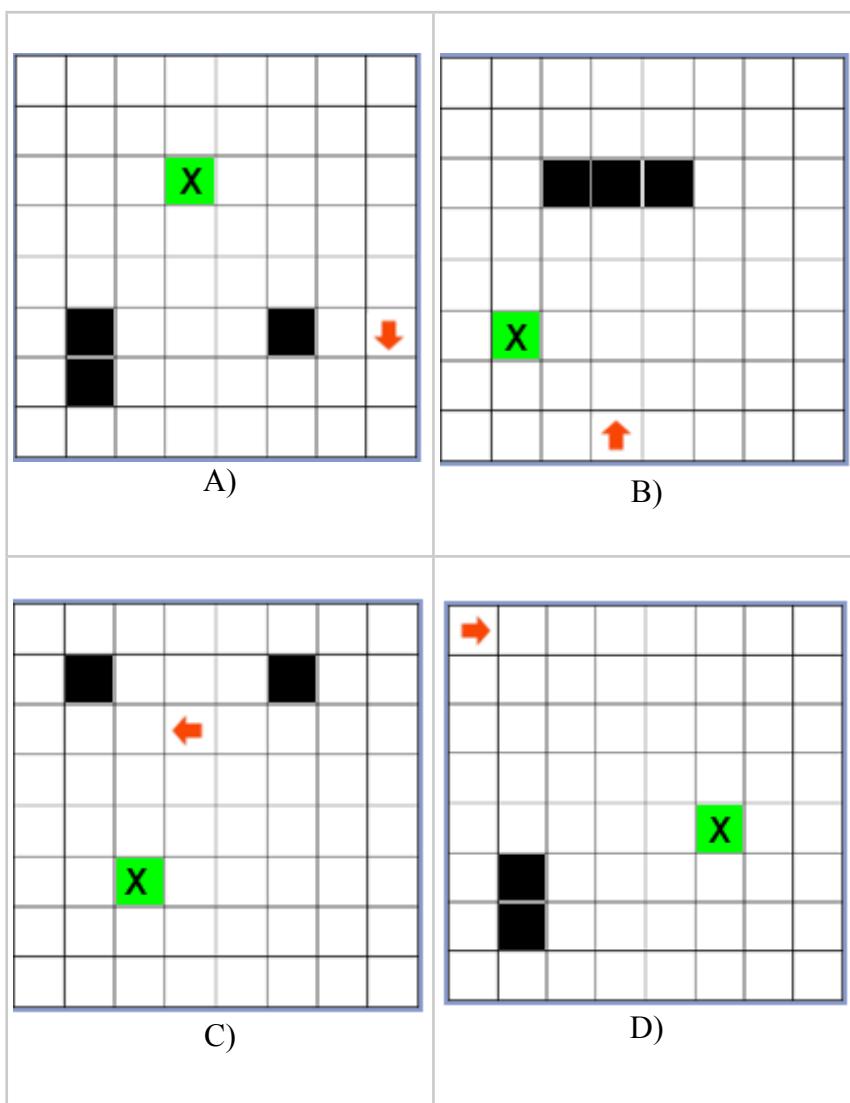
A robot is programmed to find a target (the green field marked with X) on a map of square fields. The robot has its movements programmed as follows:

- The robot moves straight forward until it reaches an obstacle (black field) or the edge of the map.
- When reaching an obstacle or the edge of the map, the robot turns right by 90°.
- When the robot moves out of a field, the field becomes a black obstacle.

The arrows on the maps below show the starting position as well as the starting direction of the robot.

On which map does the robot NOT eventually reach the target (green field marked with X)?

Answers:

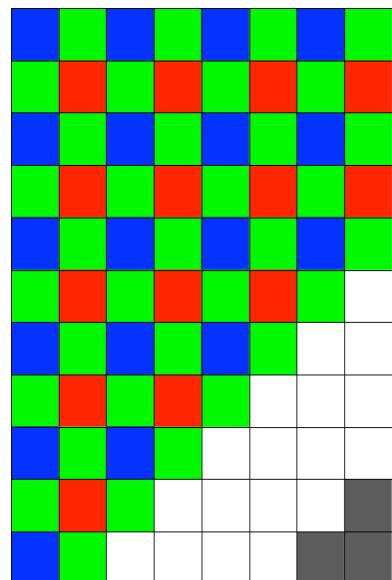


RGB Grid

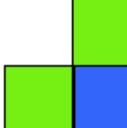
The RGB colour model is often used in electronics and computing. Squares (often called pixels) are coloured either red, green or blue.

A pattern is used to fully colour an 8×11 grid. Part of this colouring is shown below. The pattern is alternating blue-green in the first row, alternating green-red in the second row, alternating blue-green in the third row, etc.

What coloured squares fit the pattern in the bottom right corner of the grid?

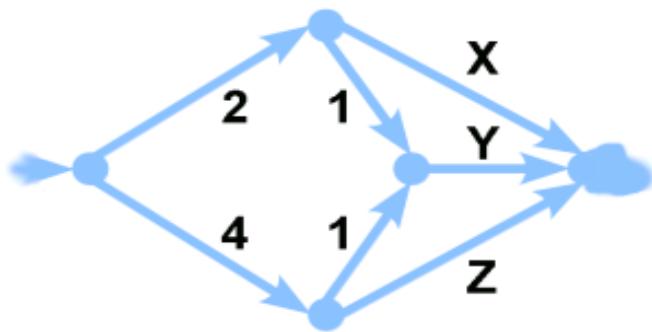


Answers:

A	B	C	D
			

Rivers and Dams

In the Beaver valley, a river splits several times on its way from the source to a nearby lake. Using smartly built dams, the beavers can regulate the amount of water in each arm of the river for maximum efficiency.



At a fork, the amount of water is divided over the two arms of the river. In the image above, the amount of water that can flow through the different arms (arrows) per second is shown.

How should the beavers regulate the arms X, Y and Z to get as much water in the river per second as possible?

Answers:

A	X=1, Y=0, Z=5
B	X=1, Y=2, Z=3
C	X=2, Y=2, Z=2
D	X=4, Y=3, Z=2

Sailing Home

Sailor Beaver is going home. The flag marks the spot where he must drop anchor.

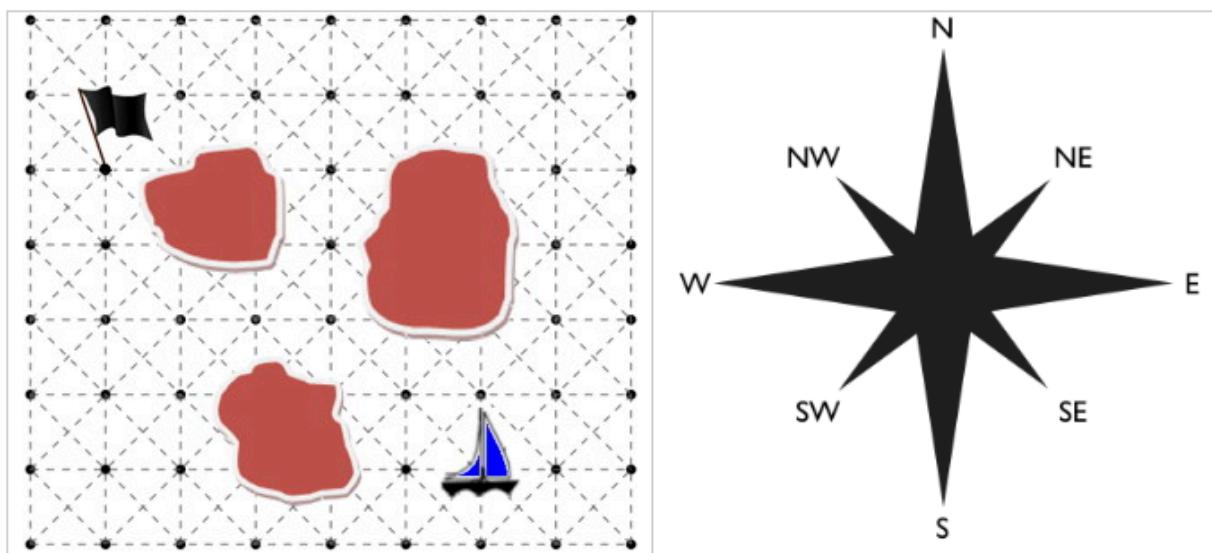
It is getting dark so he wants to get there as quickly as possible by taking the shortest course home but he does not want to crash into the islands.

He takes out his compass and plots the course home.

He must follow the shipping lanes, shown as broken lines on the map and he may change direction only on the black dots. He writes down the course he must follow.

For example "2N" means go two black dots North, "3SW;2S" means go three black dots South West. Change direction, go 2 black dots South.

His boat is on a black dot as shown on the map.



Which instructions will lead the ship to its goal as fast as possible without crashing into an island?

Answers:

A	4NW ; 1W
B	2NW ; 2N ; 1NW ; 1W ; 1SW
C	2NW ; 2W ; 2N ; 1W
D	2NW ; 2W ; 1NW ; 1N

Short story

Here's a short story for you:

"On his way home, Hans finds a cat in front of his house. Because it's raining cats and dogs, he decides to take it inside. The cat gets comfortable at the chimney and falls asleep. When Hans' mother arrives home, she accidentally bumps into the cat. The cat gets scared and scratches her leg."

This story can be summarised using abbreviations.

Everything that can't be shortened, is left out.

scratch(A,B)	means	"A scratches B".
sleep(A)	means	"A falls asleep".
take(A,B)	means	"A takes B home".
H	means	"Hans".
C	means	"Cat".
M	means	"Mother".

Which summary fits the story above?

Answers:

A	take(H,C) ; sleep(C) ; scratch(C,M)
B	sleep(C) ; take(H,C) ; scratch(H,M)
C	take(C,H) ; sleep(C) ; scratch(M,C)
D	take(C) ; sleep(C) ; scratch(H,H)

Sorting tree trunks

Robot Alan is sorting tree trunks.

Unfortunately, we forgot how he was programmed exactly.

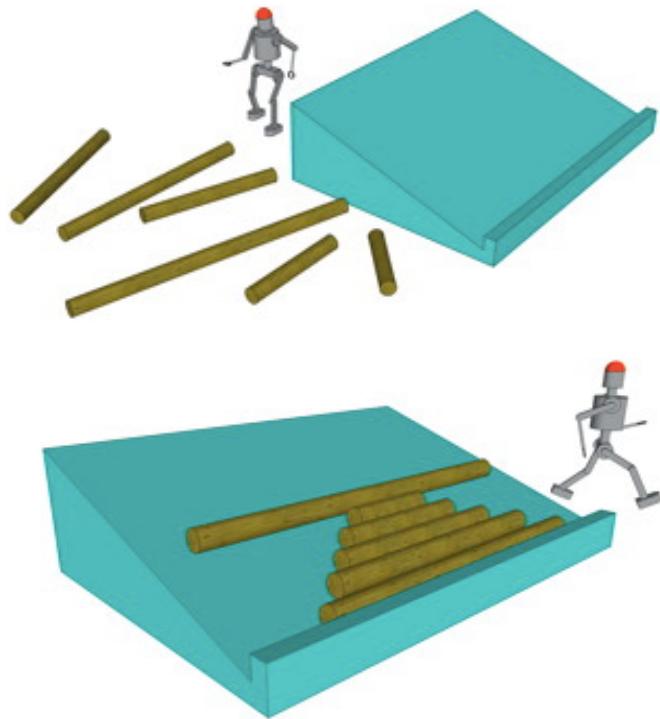
On the ground, there are several tree trunks of different lengths.

Alan chooses a tree trunk following a certain formula, lays it on top of the ramp and lets it roll down.

He repeats this, until there are no more tree trunks on the ground.

See the result:

Which formula does Alan use to decide in which order the tree trunks have to be placed on the ramp?



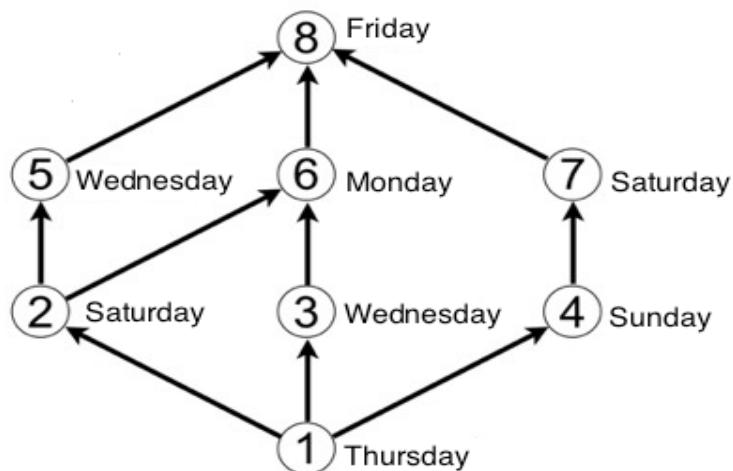
Answers:

A	Take the longest tree trunk.
B	Take the shortest tree trunk.
C	Take the second longest tree trunk. If only one tree trunk remains, take that one.
D	Take the second shortest tree trunk. If only one tree trunk is left, take that one.

Stage Coaches

In the Wild West, where the cowboy beavers live, the Bebras Stage Coach Company built a network of stage coach routes between eight settlements.

In the plan of transportation, you can see at which days of the week the stage coaches will depart at the different settlements. A stage coach departs early in the morning and arrives at the next settlement in the evening of the same day.



What is the fastest way to get a package from settlement 1 to settlement 8?

Answers:

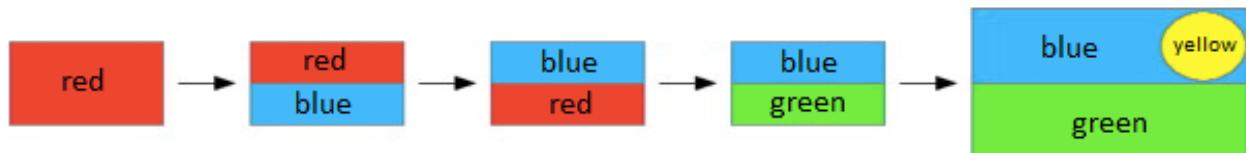
A	1 - 2 - 5 - 8
B	1 - 3 - 6 - 8
C	1 - 2 - 6 - 8
D	1 - 4 - 7 - 8

Stamp Machine

A simple stamp machine gets his instructions from programming cards. A red sheet of paper should be coloured. The instructions on the cards should be followed in the right order (1 - 2 - 3 - 4):

1	Colour the lower half blue (this will be the sky).
2	Turn the sheet 180 degrees.
3	Colour the lower half green (this will be the grass).
4	Stamp a yellow circle in the upper right corner (this will be the sun).

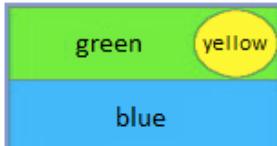
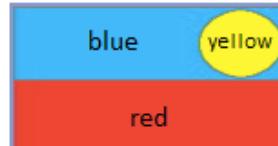
The red sheet of paper will transform in the following way:



Unfortunately, the programming cards get mixed up and the order of the instructions changes into (3 - 1 - 2 - 4).

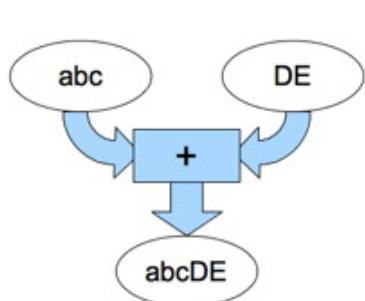
What will the sheet of paper look like after the instructions are followed in this order?

Answers:

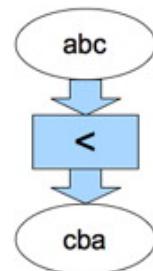
A	B	C	D
			

Text Machine

We have two types of text machines.



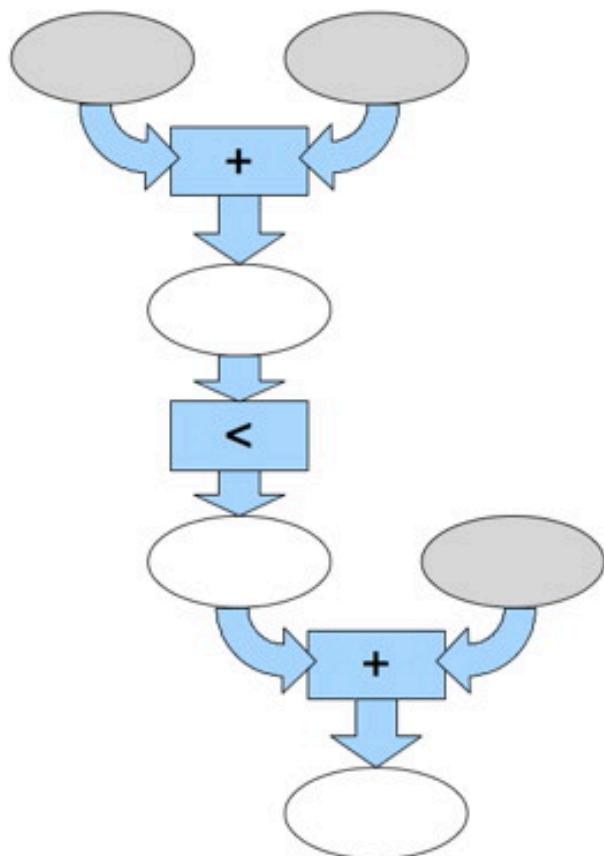
A + machine (left)
takes two pieces of
text
and joins them.



A < machine (right)
takes one piece of
text
and reverses it.

By linking two
+ machines
and one < machine
to each other we get
a more complex
text machine.

It needs three
pieces of text
(in the grey ellipses)
and writes text
in the white ellipses.



Our complex machine needs three texts to work on (grey ellipses), processes them, and gives one text as the result of its work in the bottommost ellipse.

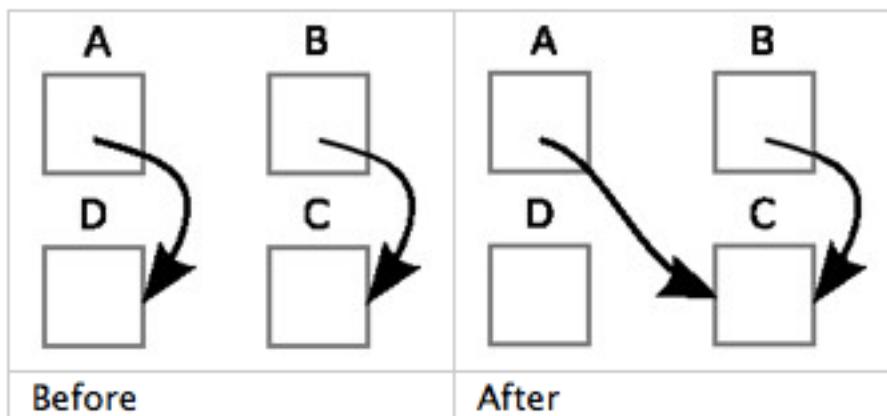
Which three text pieces do you need to put in this text machine in order to get the text INFORMATION in the lowest ellipse?

Answers:

A	AMR OFNI TION
B	INF ORMA TION
C	AMR OFNI NOIT
D	FNI AMRO NOIT

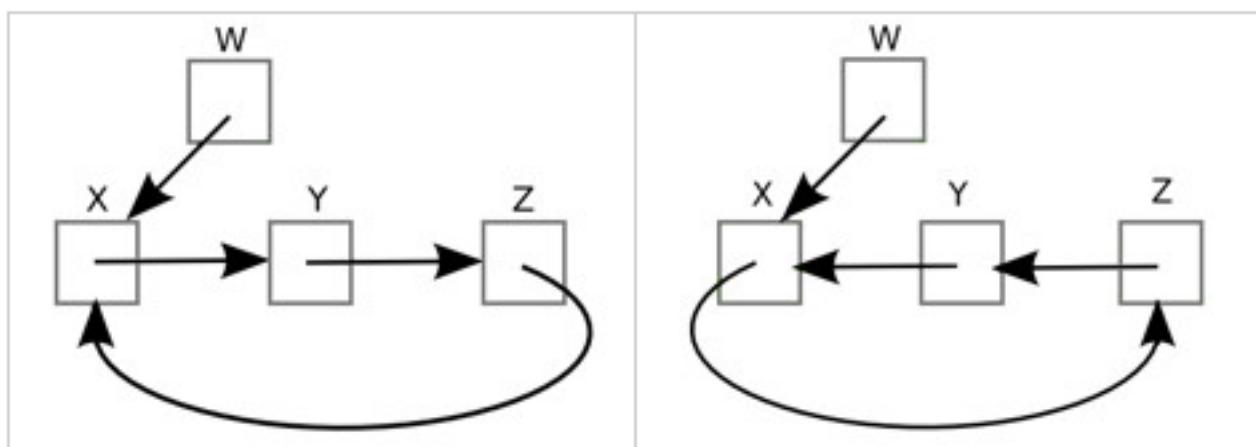
Turning Arrows

The instruction $A \leftarrow B$ changes an image with squares and arrows in the following way:



The arrow starting in square A now points to the same square as the arrow starting in square B.

Which set of instructions, executed consecutively, lets the image on the left transform into the image on the right?



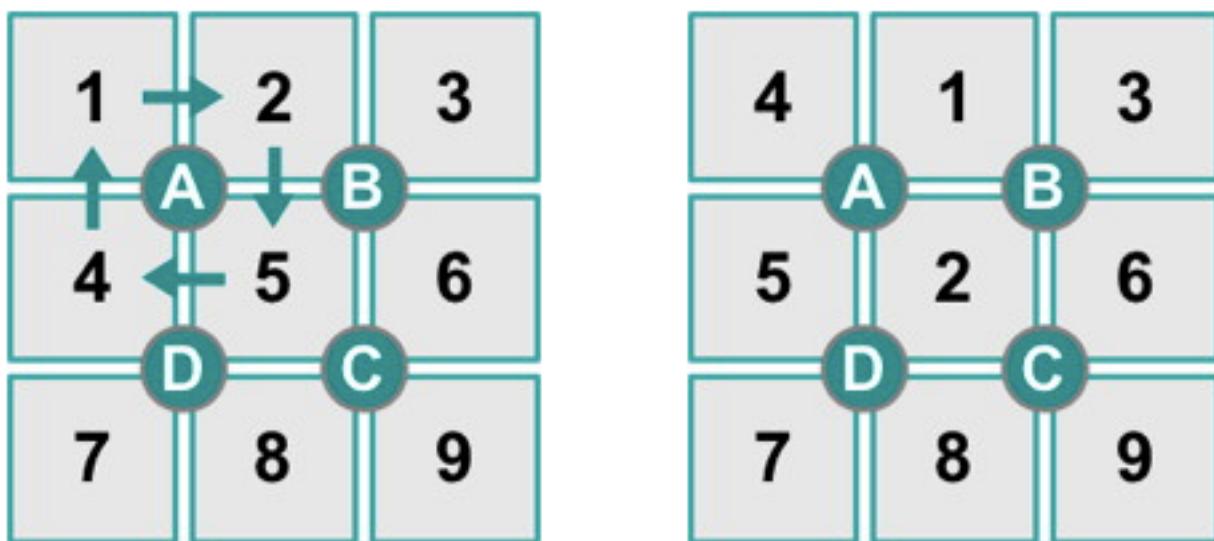
Answers:

A	$X \leftarrow Y, Y \leftarrow Z, Z \leftarrow X$
B	$Z \leftarrow Y, X \leftarrow Z, Y \leftarrow W$
C	$X \leftarrow Z, Z \leftarrow X, Y \leftarrow W$
D	$Z \leftarrow X, X \leftarrow Y, Y \leftarrow W$

Turning numbers

In the game of "Turning Numbers" you can scramble the numbers 1 to 9. At the start of every game, the numbers are orientated as shown in the picture on the left.

When you push button A, B, C or D, the numbers around make a quarter turn. For example: when you push button A, the numbers will be placed as shown in the image on the right side.



You start a new round and push the following buttons:

D, C, B, B.

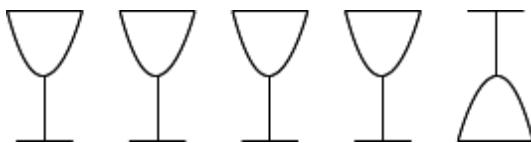
Where will the number 4 be at the end?

Answers:

A	B	C	D

Turning Glasses

There are five drinking glasses on the table. One of them is turned upside down.



In this game, you have to get all glasses upright again. But: you have to turn exactly three glasses every turn.

How many turns do you need at least to get all the glasses standing upright?

Answers:

- A) 2 turns
- B) 5 turns
- C) 3 turns
- D) it is impossible!

Vigenère encryption

Beavers Beatrix and Bruce encrypt their private messages, so others cannot read them. They use the same key for encrypting and decrypting the messages. The key they use is CAB.

Beatrix encrypts a message to Bruce:

Key, as often as needed	CABCABCABCA B
Message without spaces	WHENDOWEMEE T
Encrypted message	ZIGQEQQZFOHF V

Because the C is the third letter in the alphabet, the first letter in the message (W) is replaced by the letter which comes three places after it in the alphabet (Z).

Because the A is the first letter in the alphabet, the second letter in the message (H) is replaced by the letter which comes one place after it in the alphabet (I). And so on, until the complete message has been encrypted.

Bruce
answers:
DUGOFXHO

When do they meet?

Answers:

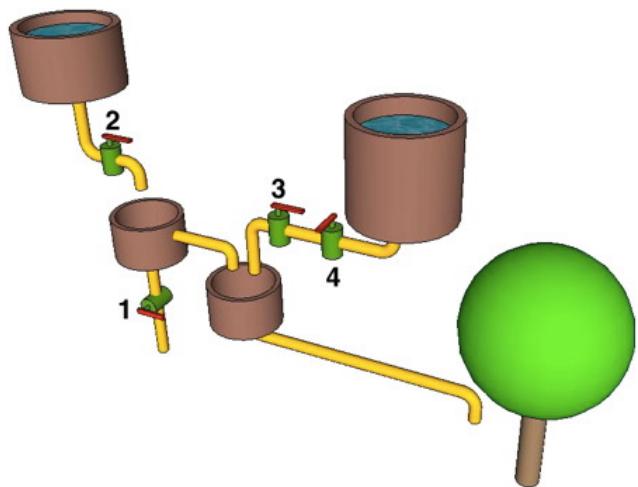
(text input)

Watering a tree

The beaver has made a pipe system for watering his apple tree.

Valves 1, 2, 3 and 4 can be opened or closed independently.

In which case does the water reach the apple tree?



Answers:

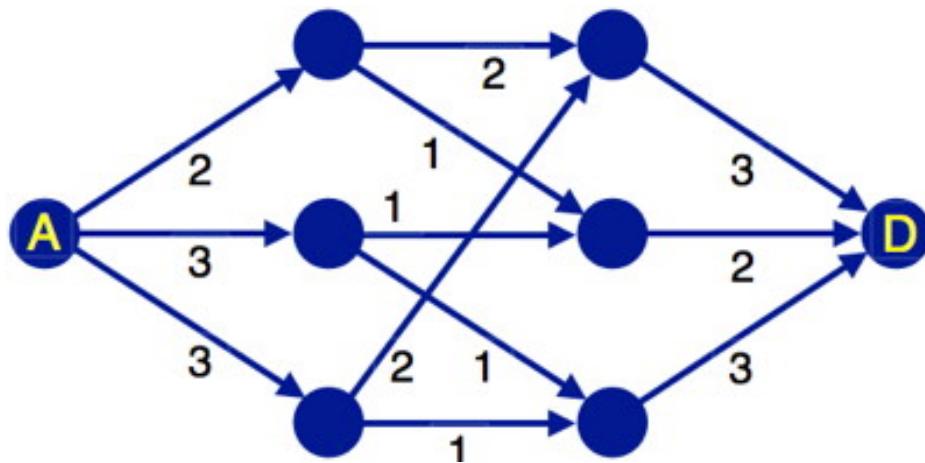
A	Valve 1 closed, 2 open, 3 closed, 4 closed
B	Valve 1 open, 2 closed, 3 closed, 4 open
C	Valve 1 open, 2 open, 3 closed, 4 closed
D	Valve 1 closed, 2 closed, 3 closed, 4 open

Wood streams

In forest (A) is an area where the beavers fell trees for their dams. They transport the tree trunks to their new project - the biggest dam of all times (D) - through an infrastructure of channels.

The arrows represent the channels, the dots are points where the water splits up or comes together.

Every channel has a restricted capacity. The numbers next to the channels show how many tree trunks can be transported through the channels in one minute.



How many tree trunks can be transported from A to D at most in one minute?

Answers:

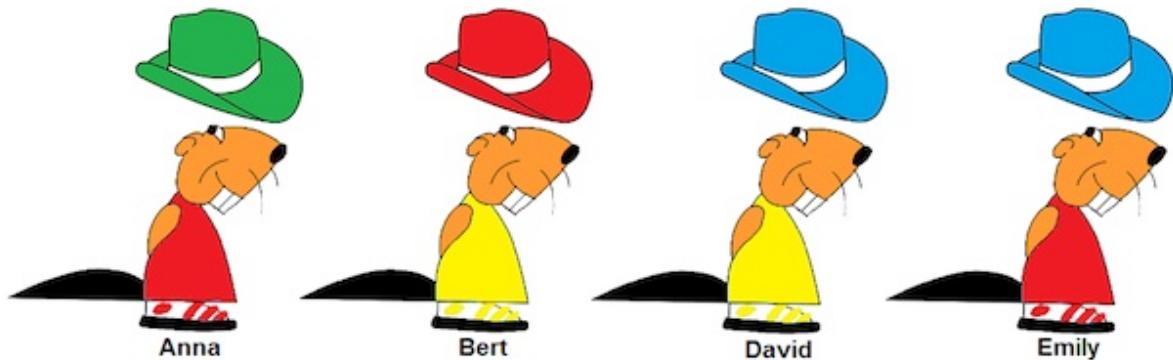
(number input)

The Wrong Hat

Anna, Bert, David and Emily Beaver have two rules for choosing what clothes to wear:

- Normally, they wear a hat of their favourite colour.
- They wear a shirt with a different colour than the hat.

One day, they change hats, just for fun. Now they all wear a hat of another colour than their favourite one.



Which beaver owns the green hat?

Answers:

- A) Anna
- B) Bert
- C) David
- D) Emily

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