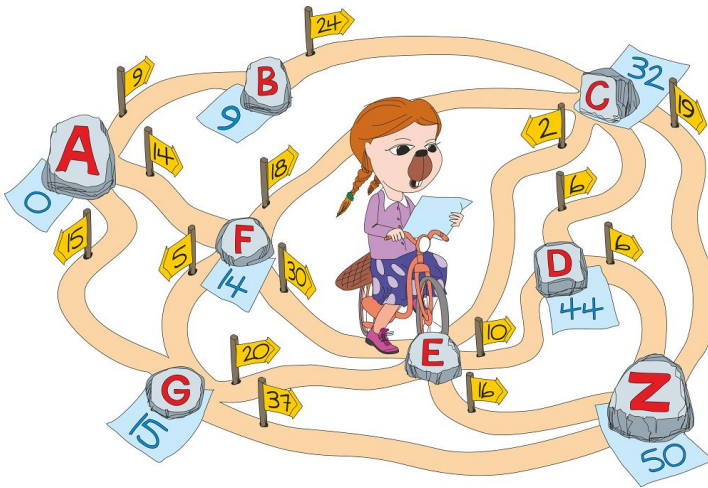


AlgoHack # Beaver 2

Bike Paths

Cleveria is a beaver biker. She explores the one-way paths that pass through the villages in her district. Each village has a village stone labeled with a single letter. All the paths have a distance and a direction. The distance and direction are given by the yellow flags.



Over the course of many different trips Cleveria leaves blue notes with a number on under a stone in each village. The notes are about the distance from village A to the village stone with the note under.

Question:

What is the meaning of the numbers she has left under the stones?

A) the shortest distance going through the least number of villages

B) the shortest distance to this village

C) the shortest distance to this village by taking a left turn at crossings if possible

D) the shortest distance to this village by taking a right turn at crossings if possible

Triangles

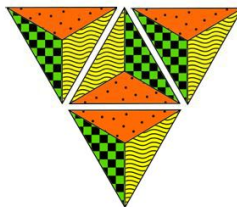
A beaver wants to create a mosaic with identical, triangle-shaped tiles.

He starts with one tile. He rotates it 90 degrees clockwise and then adds tiles on each side of the triangle-shaped tile, as shown in the picture below.

Then he rotates the whole shape 90 degrees clockwise again and adds tiles to the sides as before.



Step = 1



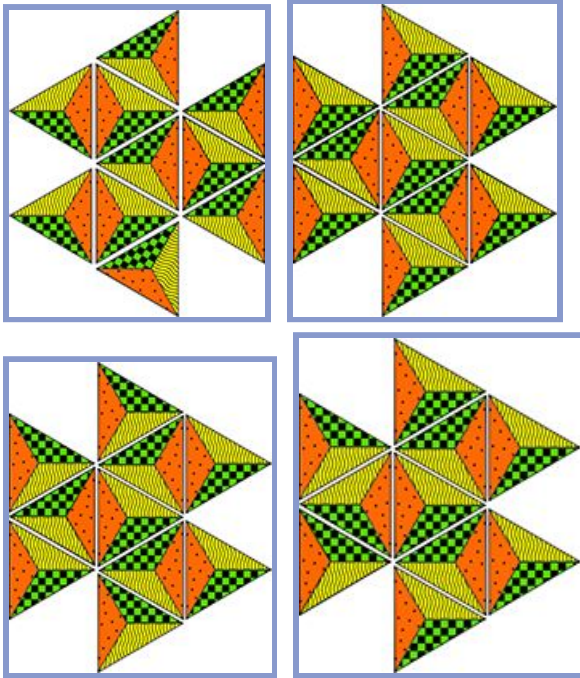
Step = 2



Step = 3

Question:

What will be the final shape of the triangles after step 3?

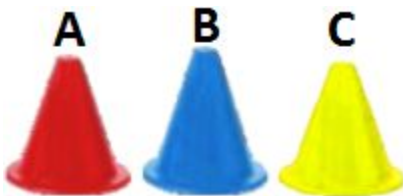


Cards and cones

Inés has a pack of cards, each card has a number written on it from 1 to 9.

The pack contains many of the same cards.

She places three coloured cones in front of her:



Inés intends to create stacks under the cones with the numbers facing up.

Each time she puts a new card on the stack it will cover the rest of the stack.

Her friend, Jules, takes notes as Inés puts cards, one at a time, under the cones.

Inés starts by placing a card with the number 5 on it under the red cone. Jules writes: **A <-- 5**

Next Inés places another card under the red cone on top of the previous one. Jules writes: **A <-- 3**

Then Inés peeps under the red cone and finds a card from the pack with the same number as she sees.

She places it under the blue cone. Jules writes **B <-- A**

Jules' final notes look like this:

A <-- 5

A <-- 3

B <-- A

B <-- 3

A <-- B

B <-- 5

A <-- 6

C <-- B

A <-- B

B <-- 1

Question:

What cards are visible when the cones are lifted?

Write the correct numbers in the spaces below the question mark.

Kix code

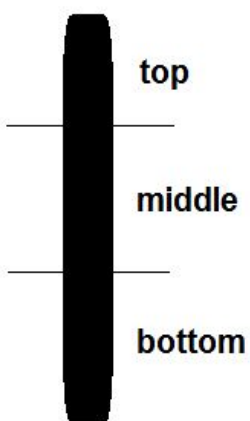
The Bebras Post Office uses postal codes that contain four characters.

To make the postal codes readable by machines, they convert the postal codes into Kix codes.

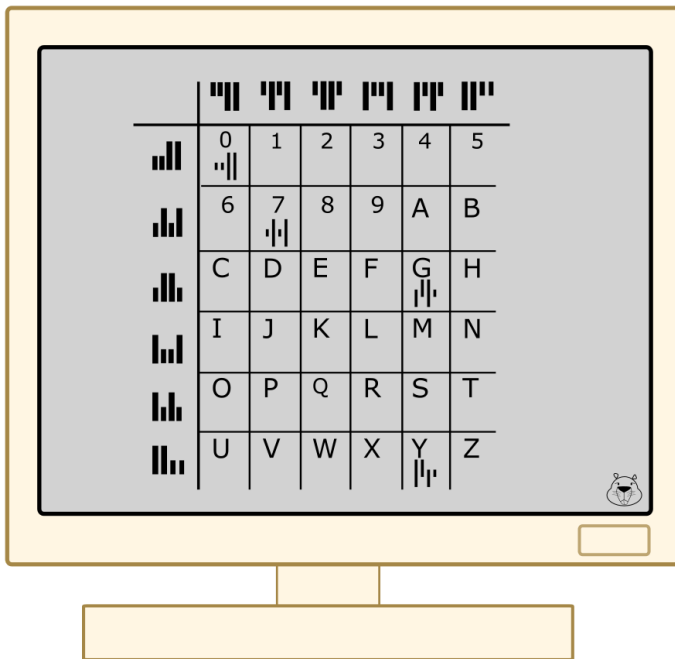
In a Kix code, each character is represented by 4 vertical bars.

A code has 2 sections: upper and lower.

The upper section contains only the middle and the top bars, while the lower section contains only the middle and the bottom bars.



This table shows the codes for several characters:



Example:

The Kix code for "G7Y0" is



Question:

Another postal code has this Kix code.



What is the postal code?	
--------------------------	--

Scanner code

Two scanners encode an image by translating its pixels into a special code. The code lists the number of all consecutive pixels of the same color (black or white), followed by the number of all consecutive pixels of the other color, and so on. Both scanners start from the top left corner, and go from left to right, and row by row.

The two scanners use different methods at the end of a row:

Scanner A processes the pixels row by row and restarts the encoding on the next row.

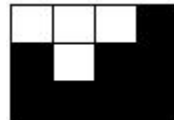
Scanner B processes the pixels row by row but does not restart the encoding on the next row.

Example:

The image on the right would be represented by the following codes:

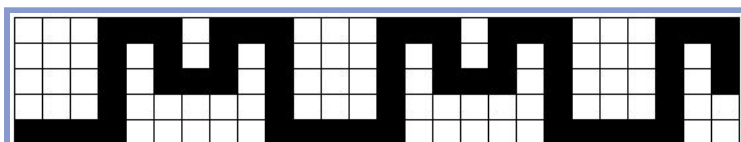
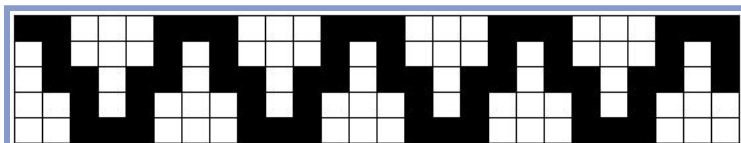
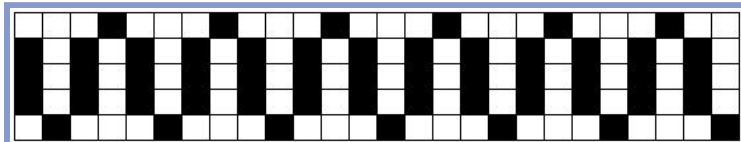
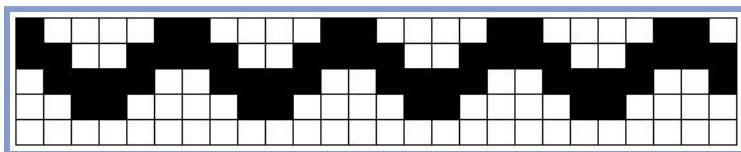
Scanner A: 3,1,1,1,2,4 (3 white, 1 black, 1 black; 1 white, 2 black, 4 black)

Scanner B: 3,2,1,6. (3 white, 2 black, 1 white, 6 black)



Question:

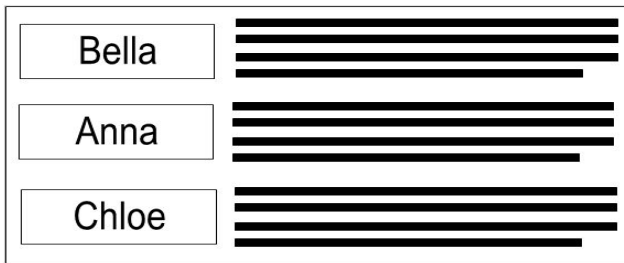
Which of the following pictures will have the same code no matter which scanner is used?



Email software

Four friends, Anna, Bella, Chloe and Diane, send emails to each other using only T-Mail or B-Mail.

When forwarding an email to another person, T-Mail always adds the new email content to the top of the existing email thread, while B-Mail always adds to the bottom.



Example:

Anna and Bella only use T-Mail.

Chloe and Diane sometimes use T-mail, and sometimes use B-Mail.

Suppose that Anna sent the first email to Chloe in a new thread.

Chloe then used B-mail to forward the email to Bella adding her own message.

Finally, Bella forwards the email to Diane, again adding her own message.

The final email thread will then look like the image shown on the right.

Question:

The following image shows another email thread. It is not clear who sent the first email.

The table on the right shows who used which email package.

Bella	
Diane	
Anna	
Chloe	
Bella	
Diane	
Chloe	

User	Email package
Anna	T-mail
Bella	T-mail
Chloe	T-mail, B-mail
Diane	T-mail, B-mail

Red and Blue Marbles

Beaver Emil is trying a new puzzle on his computer. He has to arrange a stack of marbles in a cylinder.

Rules:

The marbles must be either red or blue.

There must be at least three marbles in the cylinder at the start.

Aim:

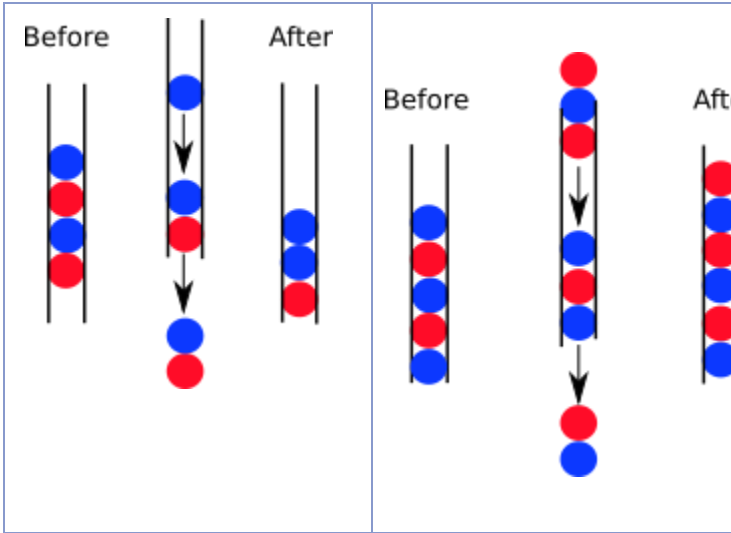
To produce a stack that never has less than 3 marbles in the cylinder when the GO button is repeatedly pressed.

What happens when GO button is pressed once:

Each click of the GO button lets the two lowest marbles drop out.

Then one of two things happen depending on the colour of the first marble to drop out:

If the first marble that drops is red :	If the first marble that drops is blue :
a new blue marble drops on the top of the cylinder.	three new marbles drop on the top of the cylinder: one red, one blue, and one red.

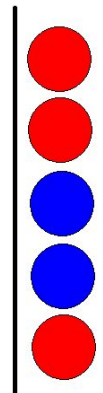


If at least three marbles remain in the cylinder after each press of the GO button, Emil will click the button again.

The game ends if two marbles or less remain in the cylinder.

Example:

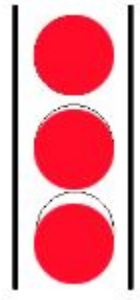
The stack shown on the right produces a game that ends after five clicks. At this point only two blue marbles will remain in the cylinder.



Question:

Produce a starting stack that consists of only three marbles, which will produce a never ending game.

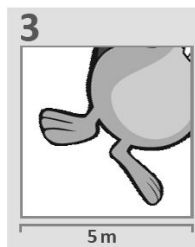
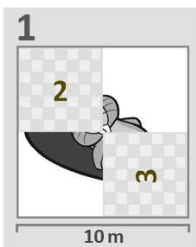
Click on the marbles to switch them to red or blue.



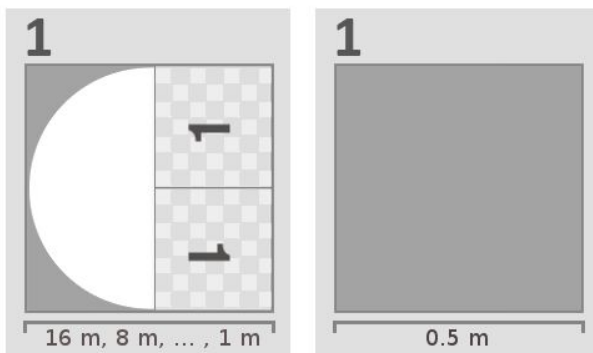
Recursive painting

Ingrid and her friends have volunteered to help paint a floor that is 16m long by 16m wide.

The instructions are printed on numbered sheets that refer to the other sheets by their number. Each sheet has a scale printed at the bottom. Here is an example floor plan from a previous project. It draws a beaver.



Ingrid is given the plan for the new project:

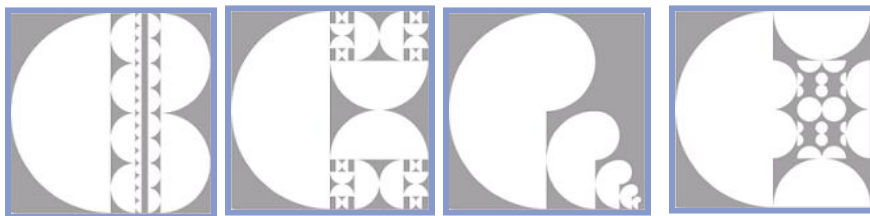


The planning sheet refers to itself and both sheets have the same number!

Ingrid's friend asks how this can be and she answers: "We can do it. The second sheet is important because it tells us when to stop."

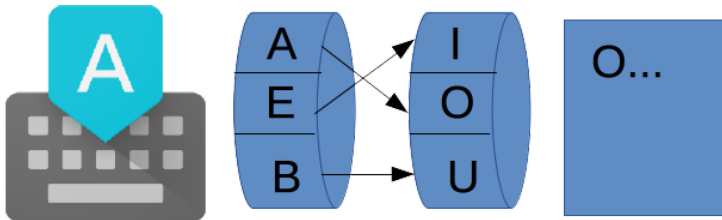
Question:

What does the painted result look like?



B-enigma

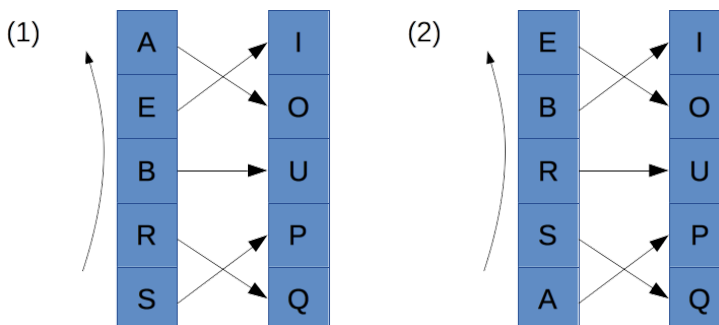
The Beavers need to communicate secretly. They decide to use a mechanism called the B-Enigma machine to hide (encrypt) their messages.



The B-Enigma works as shown above. Each time a letter is typed (e.g. "A"), the left rotor will find a letter on the right rotor according to the arrows (e.g. "O" for "A" in the first step). After typing a letter, the left rotor will move up one position.

This is shown in a different way in the diagram below. After rotating up one position the left rotor will then be in position (2). However, note that the rotor on the right never moves. The links between the two rotors (shown by the straight arrows) also remain the same.

In the diagram below, all the letters available are shown on both rotors.



Question:

The Beavers wish to send the message “BEBRAS”. What will the encrypted message be if we start from position (1)?

UOSAEB

UOOOIP

UOUQOP

UOUPQ

Swinging monkey

A leafy tree is surrounded by two bare trees and two palm trees .



Five types of bananas, say P, Q, R, S, T, are placed on the trees, a different type for each tree. A monkey swings from one tree to another tree to enjoy one banana, and then swings to another tree. It takes the monkey

- three seconds to swing from the leafy tree to any other tree, and to eat one banana (or going in the opposite direction),
- two seconds to swing from a bare tree to a palm tree or vice versa, and to eat one banana,
- seven seconds to swing between two bare trees or two palm trees while avoiding the leafy tree along the way, and to eat one banana.

The monkey swings and eats bananas of type P, Q, S, R, T, R, P.

Question:

What type of bananas can possibly be on the leafy tree if the total amount of time the monkey swings and eats is as small as possible?

P or Q or T

P or S or T

Q or S or T

Q or R or S

Selfish squirrels

16 squirrels live in a tree with five big holes one above the other.

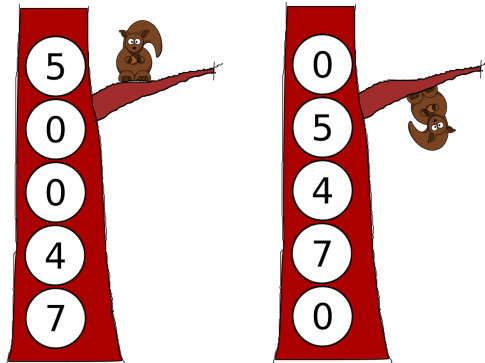
Each day all of the squirrels find out how many squirrels are in their hole and the neighbouring holes above and below it.

The next night, each squirrel secretly either stays where they are or moves to a hole above or below it, whichever currently has the lowest number of squirrels in. If they are the same, the squirrels prefer their current hole to the hole above. They also prefer a high hole to a low hole.

Example:

Today there are 5, 0, 0, 4 and 7 squirrels in the holes from top to bottom as shown below. Tomorrow all 5 squirrels in the top hole will move to the hole below (0 neighbors is better than 4). The 7 squirrels

from the bottom hole will move up (4 neighbors is better than 6) and the 4 squirrels from the hole next to the bottom will go up (0 neighbors is better than 3)

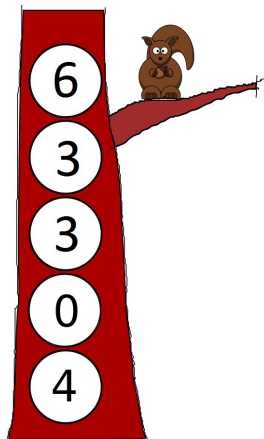


Today

Tomorrow

Question:

Here is a different situation that squirrels find themselves in:



After how many days will all the squirrels end up together in the same hole?

2 , 3 , 4 , never

The game

Beaver Big is playing a game with Beaver Small.

They start from the leftmost box (Box 5). **Beaver Big goes first.**

She can choose to move Up or Down:

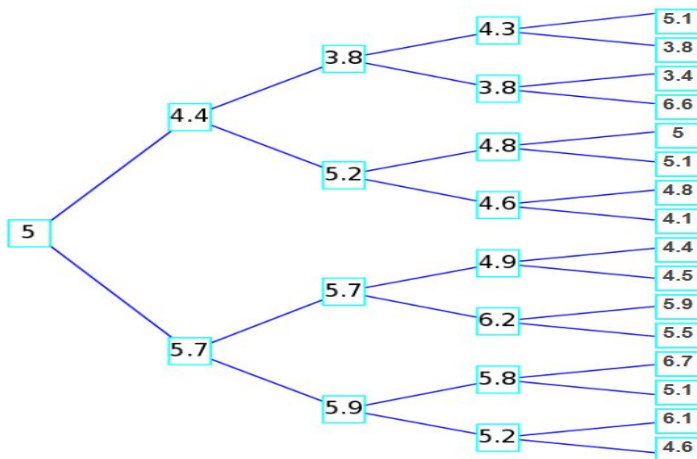
Up will move to Box 4.4; Down will move to Box 5.7.

Then, it is Beaver Small's turn to choose Up or Down. From then on they take turns until, finally, Beaver Small chooses a box in the rightmost column.

Because both beavers can see all the numbers on the game board all the time, they are able to plan their moves accordingly.

Question:

Beaver Big plays so that the final box will have the biggest possible value and Beaver Small plays to get the smallest possible value. If both always play as well as they possibly can, what will the number in the final box be?



L-game

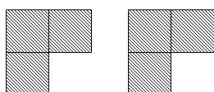
Kiki and Wiwi are playing L-Game on a 4x4 board. They take turns placing L-shaped pieces so that

- every piece placed by Kiki is oriented as shown below,
- every piece placed by Wiwi is oriented as shown below,
- every piece is placed entirely on the board, and
- no two pieces overlap.

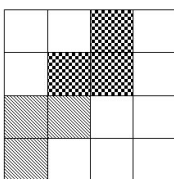
Pieces cannot be moved after they are placed. A player loses the game when it is their turn but it is not possible to place a piece according to the rules above.

An example where Kiki goes first is shown below. In this example, Kiki can win the game by placing a piece in the bottom-right corner.

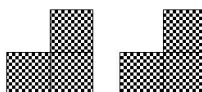
Kiki's orientation



First two moves



Wiwi's orientation

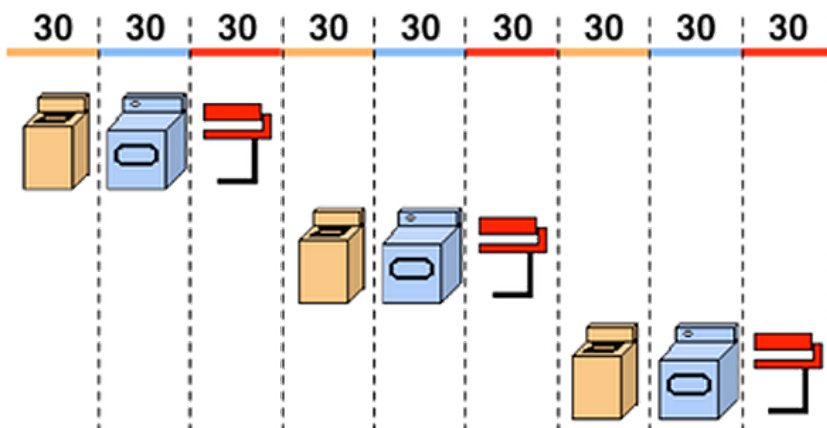


Question : Kiki has nine possible first moves. In how many of them is she guaranteed to win no matter how pieces are placed in following turns? 0, 1, 2, 3

Fast laundry

Beaver Joe has started a new laundry business. He has got three machines: a washer, a dryer and a pressing iron. Every machine is connected through its own timer which provides for half an hour of electricity.

So, when a client arrives, he needs 90 minutes for all of the three procedures. And three clients using the machinery consequently need 270 minutes.

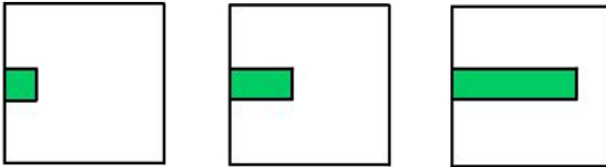


But now, there are three beavers arriving which are really busy. Each one of them has enough clothes for a load of its own. But they agree that they want to finish as quickly as possible. How many minutes does it take for all three of them to finish their laundry?

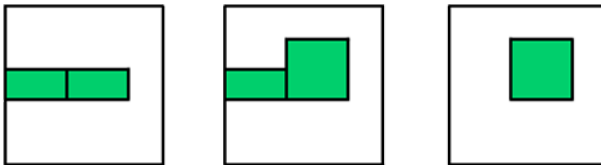
A) 90 minutes B) 120 minutes C) 150 minutes D) 270 minutes

Plant Life

Beaver invented a programming language based on of plant life.
The visual object **a** has three operations: `grow()`, `split()` and `die()`.
The following program explains the semantics:



`a.grow(east); a.grow(east) ; a.grow(east)`



`b,c = a.split(); c.grow(north); b.die();`

Please note, that only an oblong object may execute the `split()` Operation producing two shorter Objects of equal size. A square cannot be split. Beaver wants to write a program that transforms the left image to the right image. Which could be the first four commands of this program?



Caps lock

The key Caps Lock is set on a keyboard. Now beaver starts repeatedly pressing keys: "Caps Lock", "A" and "S". What is the 16 character of sequence that appears on a screen?

The key Caps Lock is set on a keyboard. Now beaver starts repeatedly pressing keys: "Caps Lock", "A" and "S". What is the 68 character of sequence that appears on a screen?

Which triangle fits in the marked spot?

