

# BEAVER INFORMATICS COMPETITION

## **BENJAMIN** **SAMPLE QUESTIONS**

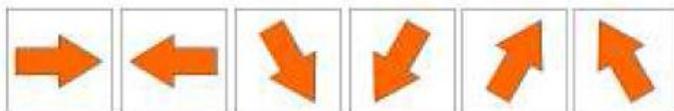
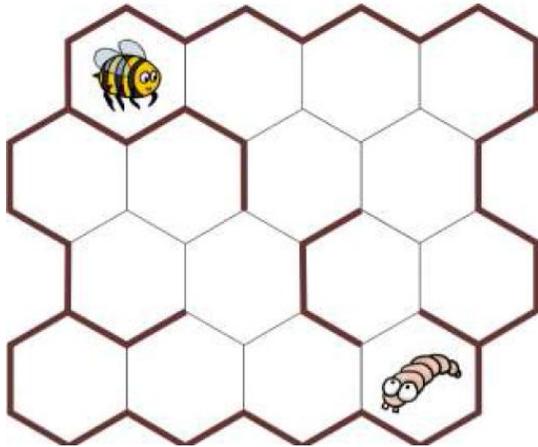
[www.Beaver.my](http://www.Beaver.my)

## 01 Bee Hive (Easy)

The bee is in the hive on its way to feed the larva. The bee wants to use the shortest path possible to get there.

### Question

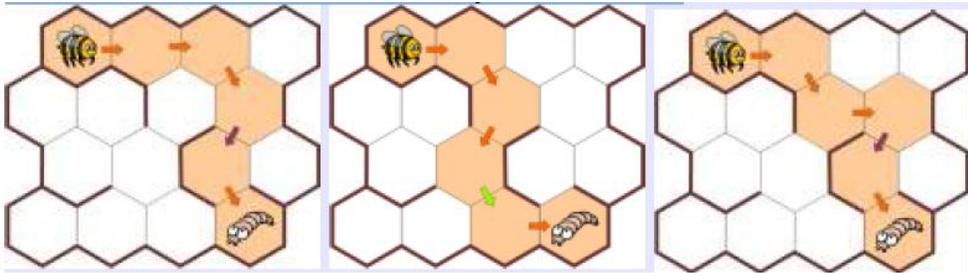
Finish a sequence of directions to help her.



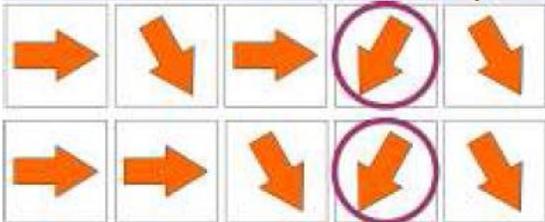
## Answer



Shortest way from the bee to the larva is 5 steps long – there are also 5 boxes for the directions. There are 3 such ways in the hive:



In the 2nd and 3rd way there is the same penultimate step – the bee has to go to left and down. We have this step set as right and down.



Therefore the only way is the first one. We can easily write it down using the directions:



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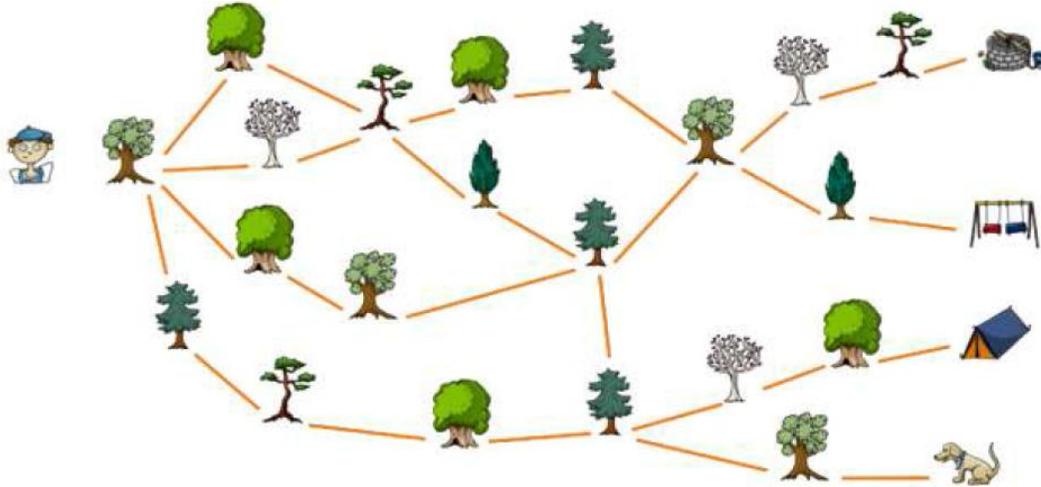
## It's informatics

In this task we create a sequence of instructions for the bee that describe how to get to the larva on 5 steps. This sequence is an algorithm. Similar tasks are common in several areas of informatics – e.g., in educational robotics when we need to navigate a robotic model or in turtle graphics where we draw images as a turtle moves.

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## 02 In the Forest (Easy)

Rupert went for a walk in the forest. He chose a path and at the end he found the dog.



### Question

Which trees has he passed along his path? The trees are presented in the order in which he has seen them.

- a)       
- b)       
- c)       
- d)       

**The correct answer is C**



We need to trace Rupert's path. The easiest way is to do it from the end – from the dog. We can see that last tree before the dog is . If we look at all remaining answers we see that only answer c) has both of these trees at the end. We can be sure that c) is the correct one even without tracing all the paths from Rupert.

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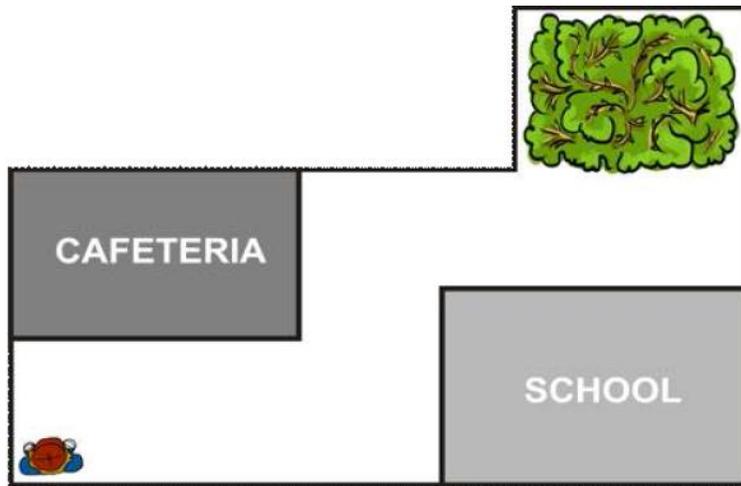
### **It's informatics**

The whole map of the forest is in fact a so called *graph*, an important structure in informatics. Here trees are *vertices* and paths between them are *edges*. Finding a path in a graph has many applications, for instance in route planning. Finding a solution backwards is an important strategy used by computer programmers for solving certain problems.

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### 03 Jeremy In The Bushes (Easy)

Children are playing a robot game – Jeremy is the robot and he listens only to these orders: forward, left, right. If he hears forward he walks right ahead until he hits an obstacle (building, fence, bush). If the children say left, Jeremy turns left but doesn't move. If the children say right, he turns right but doesn't move. Jeremy is in the left lower corner of the playground and he looks at the cafeteria. Children want to navigate him into the bushes in the right upper corner of the playground.



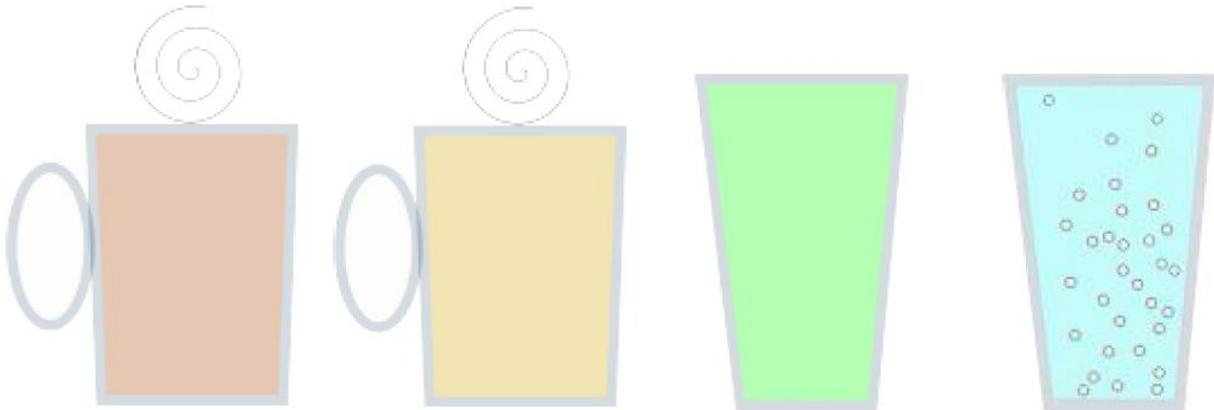
#### Question

Which orders will the children shout to navigate Jeremy into the bushes?

- a) forward, right, forward, left, forward, right, forward, left, forward
  - b) right, forward, left, forward, left, forward
  - c) right, forward, left, forward, right, forward, right
  - d) forward, right, forward, left, forward, left, forward, left, forward
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## 04 Soda Machine (Medium)



Oh no! The new soda machine has got only two buttons (A, B). But there are four drinks (warm coffee, warm tea, cold apple juice, cold soda). Carl the clever caretaker programs the machine to offer a choice of four drinks at the press of two buttons:

First press A for a warm drink and B for a cold drink.

Then press A for coffee and B for tea, or A for Apple juice and B for Soda, respectively.

Example: Press B – A for apple juice.

### Question

Which instruction is correct?

### Answer

- A) Press A – A for two warm beverages.
  - B) Press A – B for a warm tea.
  - C) Press B – B for a cold tea.
  - D) Press B for soda.
-

## The correct answer is B

Every drink is chosen by pressing two buttons.

- A) A – A: A then A means Warm & Coffee. This is only one warm beverage.
  - B) A – B: A then B means Warm & Tea. That will do.
  - C) B – B: B then B means Cold & Soda. Cold tea isn't available.
  - D) B: B means Cold Beverage. Then the machine will be waiting for another input.
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## It's informatics

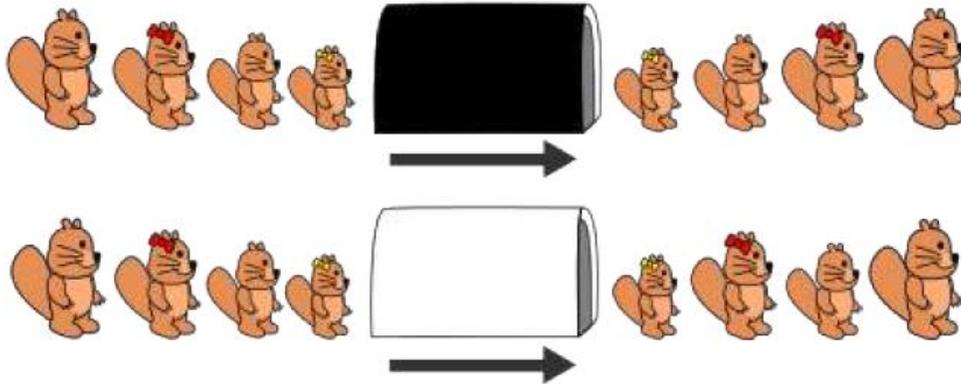
It's informatics because it refers to coding. With 2 buttons you need a code length of 2 (first press X, then press Y) for the coding of 4 drinks.

Furthermore it's informatics in relation to finite state automata. These are imaginary automata for the purpose of modelling the behaviour of real machines. If you want to describe the soda machine controller in terms of a finite state automaton, you need a state „Start“. From „Start“ there is a transition to „Warm“ by pressing A and a transition to „Cold“ by pressing B. From „Warm“ there are transitions to „Coffee“ and „Tea“. From „Cold“ there are transitions to „Apple juice“ and „Soda“. The state diagram is helpful to answer the question, as A – A clearly results in a Coffee, B – B in a Soda. B results in the „Warm“-State.

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## 05 Zebra Tunnel (Medium)

There are two kinds of tunnels in Bebras Land. When beavers enter a black tunnel one after the other, they come out in reverse order. When beavers enter a white tunnel one after the other, when they come out only the first and the last beaver are interchanged.



### Question

A beaver family goes through this three tunnels.



In what order are they arranged when they come out of the last tunnel?

### Answer

1		2	
3		4	

### **Picture 3 is the correct answer.**

If the beavers are numbered like 4-3-2-1 from the biggest to the smallest one you can see the changes as the following:

4-3-2-1 → black tunnel: 1-2-3-4 → white tunnel: 4-2-3-1 → black tunnel: 1-3-2-4

You also can change the order of the tunnels. So the second black one would reverse the first that you can take off these tunnels and do just the instruction from the white tunnel: 4-3-2-1 → white tunnel: 1-3-2-4.

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### **It's informatics**

It is important to capture the essential of algorithms. There are two instructions given by two tunnels: reverse or interchange the first and the last beaver. In this situation the sequence of the instructions is not important because a second tunnel of the same kind reverse the order to the starting situation.

Besides, here the tunnels represent two ways to put data in a structure and retrieve it later. The white one is about Last In First Out structure (or stack): imagine a stack of plates. You can only add a plate on the top of it, and retrieve one from the top. Then the last plate put in is the first to be removed: it reverses the order. LIFO (or queue) is another basic way to store and retrieve data.

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## 06 Spinning toy (Hard)

Beavers discovered a piece of wood into which worms made a system of tunnels and pits. A handy father used it to make a toy. In the beginning we put a marble in the middle. The goal is to get the marble out by turning the wheel to the left (L) and right (R). By each turn the marble runs to the next pit or at the end out of the wheel.

By which of the following sequences the marble reaches the exit?



Answer (Multiple Choice)

- A) LRRLR
  - B) RLRL
  - C) LRRLRL
  - D) LRRRRL
-

### **The correct answer is C**

The problem is difficult to solve if one has to imagine turning the wheel left and right (unless (s)he turn the monitor or prints the image on a sheet of paper). It is, however, quite easy if we recognize that we are actually searching through a path in a tree – a common task in past Bebras competitions.

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### **It's Informatics**

Describing paths in binary trees is a common operation in computer science.

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