



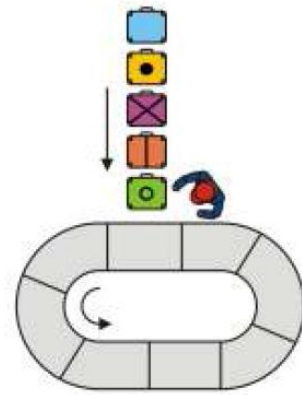
# BEAVER INFORMATICS COMPETITION

## JUNIOR SAMPLE QUESTIONS

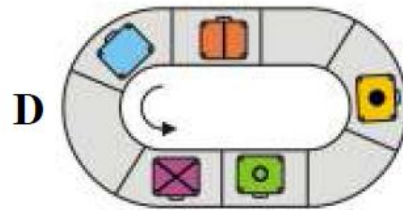
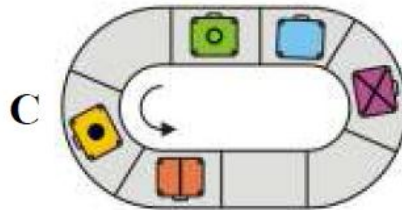
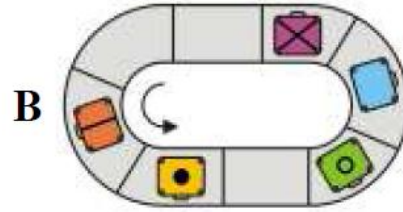
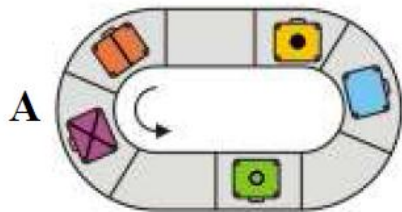
[www.Beaver.my](http://www.Beaver.my)

## 01 Airport (Easy)

The airport porter is loading the passengers' bags on the moving luggage belt. He always puts the next bag on the **third next empty place** until all five bags are placed on the luggage belt.



How does the luggage belt appear at the end of his work?



**The correct answer is B**

Answer A and D have the bags in the wrong or incorrect order. If the belt rotated in the opposite direction answer C would be correct. B is therefore correct.

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**It's Informatics!**

This is an example for scheduling with given structures and rules. Such situations often occur, e.g. an operating system of a computer must perform a scheduling of tasks, if more than one task or program should be executed. The scheduling mechanism then assigns computing power to each executed task or program. But one can imagine that such scheduling mechanisms involve much more tasks that are often interdependent and need different and limited resources. So scheduling mechanisms are much more complex as in the given task, where the way how to fill the luggage belt is not the most efficient one.

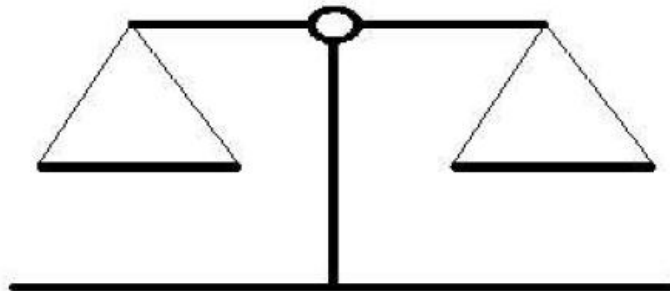
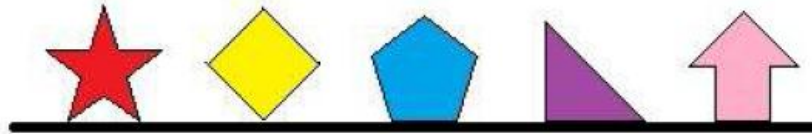
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## 02 Sort by weight (Easy)

Beaver wants to order 5 objects in ascending order by weight. The lightest object should be on the left; the heaviest object should be on the right.

Beaver can compare the weight of two objects by placing them on the scale to see which one is heaviest.

Use the scale to compare the weight of the objects and then place the objects on the second shelf in the correct order.



**Answer**

The objects can be sorted using sorting algorithms such as bubble sort, selection sort, insertion sort, etc.

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**It's Informatics!**

The goal here was to apply any kind of sorting algorithm. Sorting a list of objects using only comparisons is one of the problems of algorithmic for which the widest variety of algorithms has been created.

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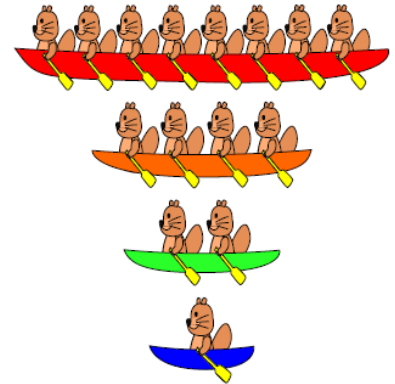
## 03 Bebras Rowing (Easy)

### Body

Some beavers would like to attend a rowing tournament.

They have four boats available, one for eight beavers, one for four beavers, one for two beavers and one for a single beaver. However, the rules of the tournament state that every beaver may only participate in one contest.

The trainer of the beaver is asked to write down for each type of boat whether they are going to participate(1) or not (0) starting from the largest boat. For instance if ten students participate, he would have to write down 1010.



### Question

This time thirteen beavers are going to participate. What does the trainer have to write down?

- A. 0111
- B. 1011
- C. 1101
- D. 1110

**The correct answer is C**

The code represents a number in the binary system (see below). Thus A is  $0111=4+2+1=7$ , B is  $1011=8+2+1=11$ , C.  $1101=8+4+1=13$  and D is  $1110=8+4+2=14$ .

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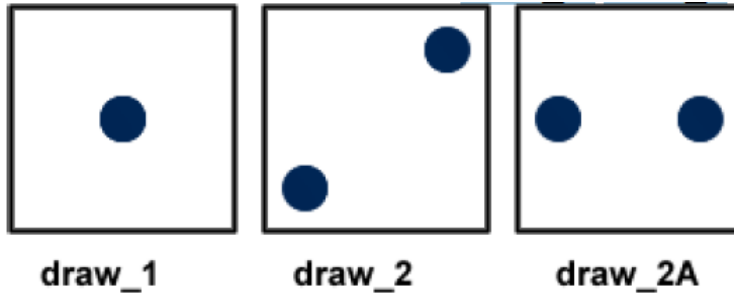
**It's informatics**

The binary system is a numeral system like the standard decimal system. The difference is that instead of allowing ten different digits (0 to 9), only the digits 0 and 1 are used. The weight of each figure at position  $n$  is not  $10^n$ , but  $2^n$ . To convert this number to the decimal system, you have to multiply each digit by its position weight, so  $1101=1 \cdot 2^3+1 \cdot 2^2+0 \cdot 2^1+1 \cdot 2^0=8+4+0+1=11$ .

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## 04 Dice (Medium)

We have three commands **draw\_1**, **draw\_2** and **draw\_2A** that draw dots like this:



The command **turn90** rotates the already drawn picture, for example combination of commands **draw\_2A**, **turn90** draws this picture:



Combining these commands we can draw dice with many different composition of dots, for example commands **draw\_1**, **draw\_2**, **turn90** draw this picture:



### Question

Which sequence of commands was used to draw this picture?

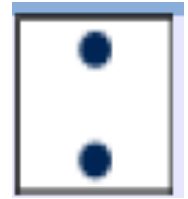


- a) **draw\_2A**, **turn90**, **draw\_2**, **draw\_1**
  - b) **draw\_2A**, **draw\_2**, **turn90**, **draw\_2**
  - c) **draw\_2**, **draw\_2A**, **turn90**, **draw\_2**
  - d) **draw\_2**, **turn90**, **draw\_2**, **draw\_2A**
-



### **The correct answer is D**

In the sequences of commands a), b) and c) the command draw\_2A draws two dots horizontally. After drawing them the command turn90 (which is used later in the sequence) rotates them. So each of the images drawn by sequences a), b) and c) contains these dots. We see that such dots are not part of the questioned picture. The questioned picture is therefore drawn by the command sequence d).



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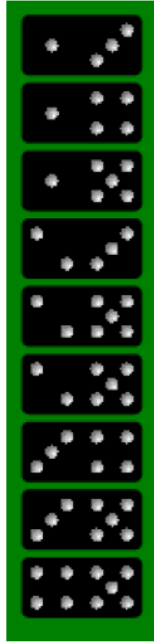
### **It's informatics**

To draw pictures is done by following a list of instructions. This is an example of a very simple imperative programming language, with a set of only three commands and without any arguments. Each command can be also seen as a procedure; the use of procedure is an important part of informatics and programming.

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## 05 Domino circles (Medium)

Build a largest possible circle with the following dominoes such that the same numbers touch. You may use the following animation for your tests. If you click on a tile in the circle, it will flip.



### Question

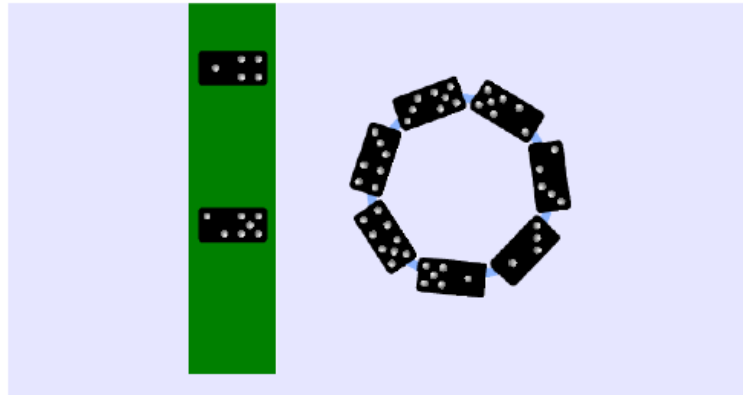
What is the largest number of above dominoes that can form a circle?

### Answer

- A) 6
  - B) 7
  - C) 8
  - D) 9
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**The correct answer is 7.**

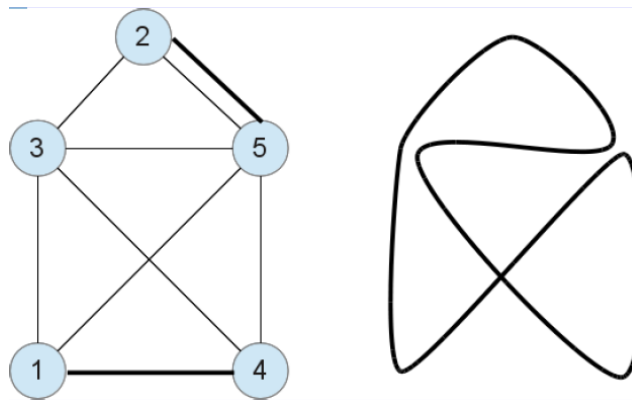
Of every number appears an *even number* of times in the circle. The numbers 1, 2, 4 and 5 each appear an odd number of times. So we have to leave out at least 2 dominoes. The following pictures shows, that one can make a circle with 7 dominoes:



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### It's informatics

This problem can be modelled using a graph, where each number is a vertex and each domino is an edge:

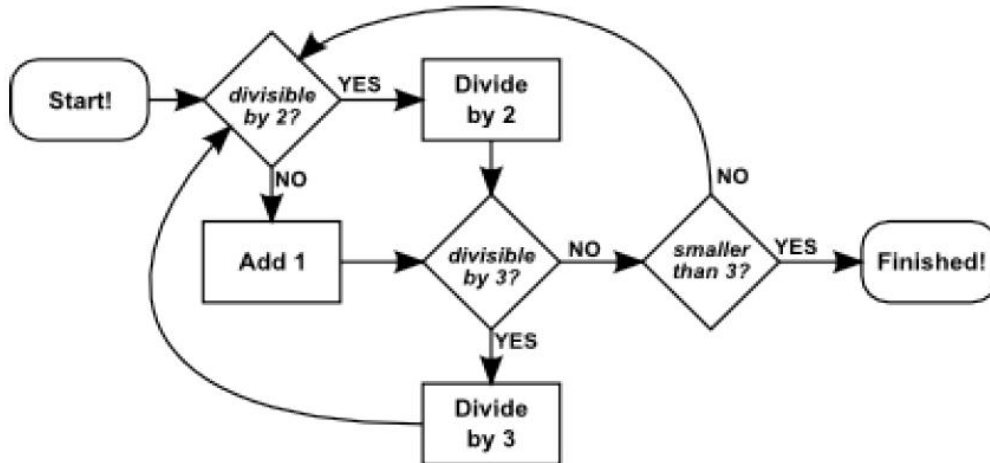


A domino circle is now a closed path which can be drawn without lifting the pen. Such a path is called a “Eulerian Path”. It has the property that from any vertex an even number of edges is used (as many times).

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## 06 Flowchart computing (Medium)

In school, the little beavers make complicated calculations using flowchart. They start with a number at **Start!** and follow the instructions:



### Question

When starting with the number 18, what is the number when finished?

### Answer

Open integer. (Input by student)

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**The correct answer is 2.**

Start with **18**. Divisible by 2? Yes, so divide by 2. We get **9**. Divisible by 3? Yes, so we divide by 3. We get **3**. Divisible by 2? No, so we add 1 and get **4**. Divisible by 3? No. Smaller than 3? No. Divisible by 2? Yes, so we divide by 2 and get **2**. Divisible by 3? No. Smaller than 3? Yes. We're finished with the number **2**. By the way, the only possible outputs (provided all numbers are positive) are 1 and 2.

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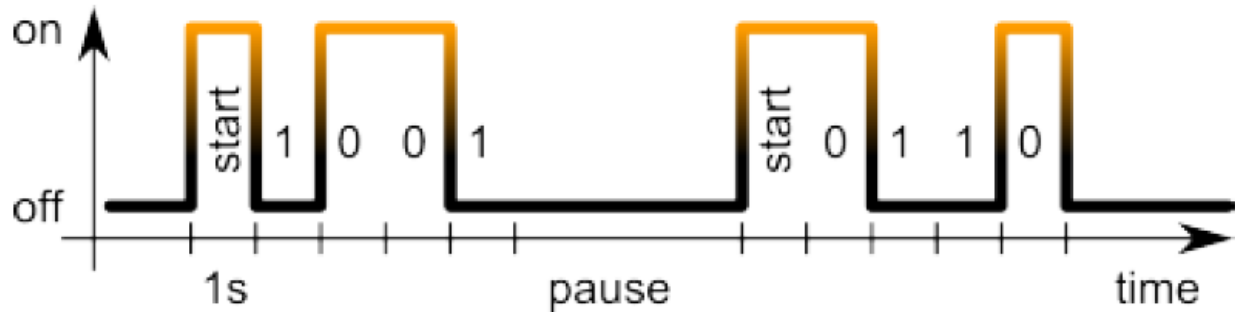
**It's informatics**

Flowcharts (the graphics in the task) are used in informatics to visualize the functioning of important parts of computer programs. Quite often flow charts are used to describe the reaction of a program to different possible user actions. There are even programming languages that are programmed graphically, for instance "Scratch".

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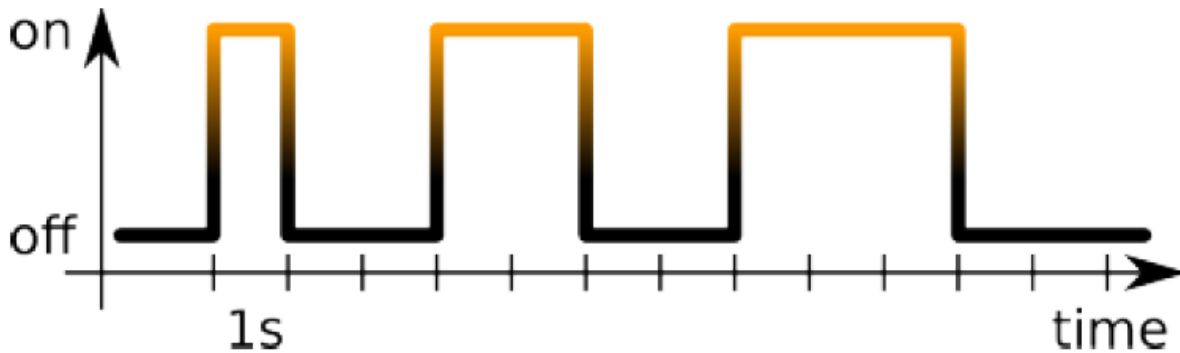
## 07 Serial Transmission (Medium)

Beavers Alice and Bob want to send signals in the night using a flashlight. They transmit sequences of 4 symbols '0' or '1'. Before each sequence they turn on the light for 1 second. If the symbol is '0', the light is on for 1 second and if the symbol is '1', the light is off for 1 second. After each sequence a pause of at least 1 second is made. For example, the sequences '1001' and '0110' are transmitted as follows:



### Question

Which sequence or sequences are transmitted in the following diagram?



### Answer

- A) 1100 and 0011
- B) 0011 and 1100
- C) 1100 and 0001
- D) 1010 and 0011

### **The correct answer is A**

A) is correct (1100 and 0011). The pause starts 5 seconds after the flashlight is turned on the first time. 7 seconds later the second sequence starts.

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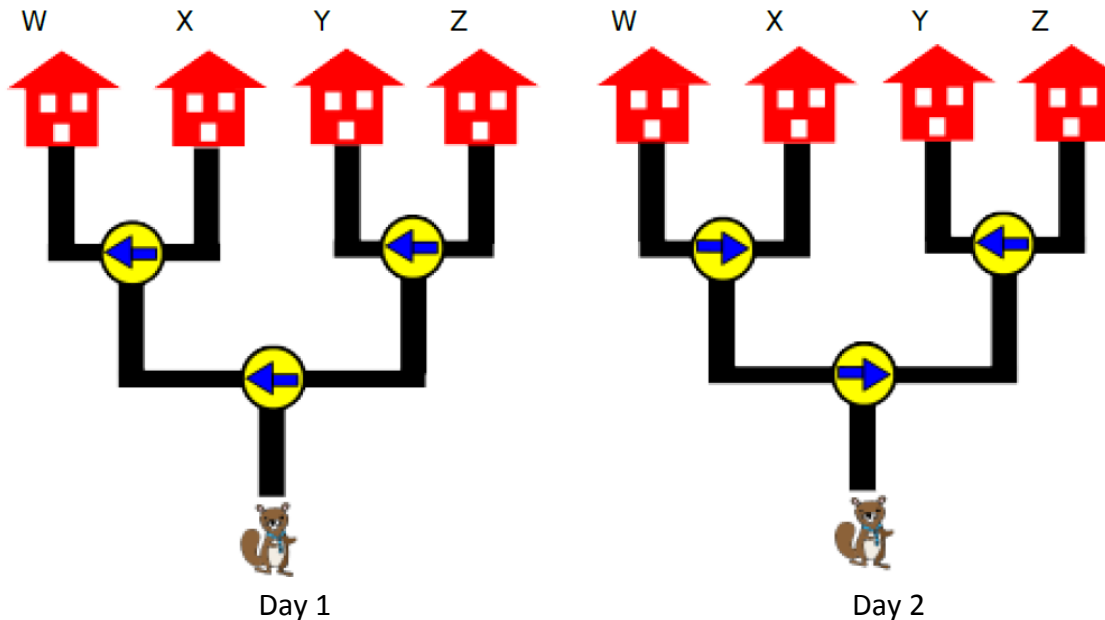
### **It's informatics**

This task describes the core of the RS232 protocol for data exchange over a serial cable. Some GPS devices and many programmable microcontrollers use this protocol for its simplicity. Turned off corresponds to a negative voltage and turned on to a positive voltage. Normally one uses 8 Bits (Symbols '0' or '1') which make up 1 Byte (instead of only four like in this task).

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## 08 Visiting Friends (Medium)

Mr. Beaver has 4 friends living in different villages, and he plans to visit one of these friends every afternoon. Initially, all arrows point to the left road. When passing the intersection, Mr. Beaver would switch the arrow to the opposite direction. For example, on day 1, Mr. Beaver takes the road on the left at the first intersection, takes the left road on the second intersection, and reaches Village W. On day 2, Mr. Beaver turns right at the first intersection, then left at the second intersection, and arrives Village Y.



### Question

Which village will Mr. Beaver visit on day 30?

### Answer

- a) Village
- b) Village X
- c) Village Y
- d) Village Z



**The correct answer is C**

Village Y. When encountering an intersection, he takes the road on the left for odd number encounters, and the road on the right on even number encounters. Day 30 is an even number encounter at the first intersection, so Mr. Beaver will take the road on the right and the other hand, the second intersection will be Mr. Beaver's odd number encounter, so he will take the road on the left. Another way to look at it: 4 days later, the state will be the same as it was. So day 1 is the same as day 5 and day 9 and so on, and day 30 is the same as day 2.

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**It's informatics**

This task can be solved with top-down analysis that determines which road to take for each intersection. Also, this task can be solved by observing the periodicity from the simulation, which is a common skill to solve problems in informatics. It is about modulo counting.

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## 09 From A to C (Hard)

You have got a mini robot that can execute the following commands:

**V** - a step forward

**L (angle)** - rotation to the angle given within the brackets left,

**R (angle)** - rotation to the angle given within the brackets right

If more than one command should be executed, the commands can be strung together using the operation "+". For example "V + L(20) + V + R(2)" means that first the robot should make a step forward, then turn left 20 degrees, then make a step forward and then turn right 2 degrees.

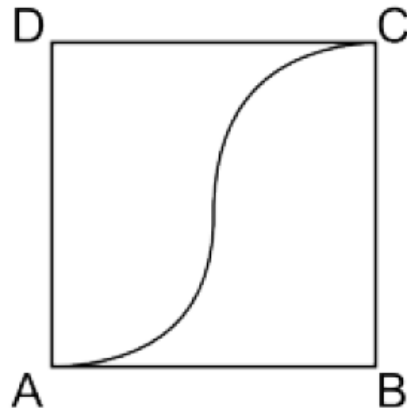
To be able to repeat a set of commands, operation "\*" can be used. For example "20\*(V)" means to repeat 20 times the action, which is given within the brackets after the "\*", namely to make a step forward. So this example will result in 20 steps forward.

For example  $180*(V+L(1))$  draws a half circle.

At the beginning the mini robot is positioned at point A and looks in the direction B.

**Which of the predefined command combinations brings the mini robot from A to C along curved path?**

- A)  $90*(V+L(1)+V+R(1))$
- B)  $90*(V+L(1))+90*(V+R(1))$
- C)  $90*(V+L(1))+R(30)+90*(V+R(1))$
- D)  $L(90)+90*(V+L(1))+R(90)+90*(V+R(1))$



## The correct answer is B

The first part "90 \*(V+ L(1) )" means that the following actions are repeated 90 times: one step forward and a rotation to the left by one degree. So the robot will first move into direction B but after each step will turn to left and will finally be oriented upwards. Analogous the second part "90 \* (V+ R(1))" will be executed afterwards, which causes that the robot moves to point C with the final orientation to the left.

A) is false, because due to the partial sequence "V + R (1)" the path of the robot differs from the green line.

C) is incorrect because the partial sequence "R (30)" will cause a different path as the intended one.

D) is incorrect because the partial sequence "L (90)" at the beginning leads the robot in the wrong direction.

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## It's Informatics!

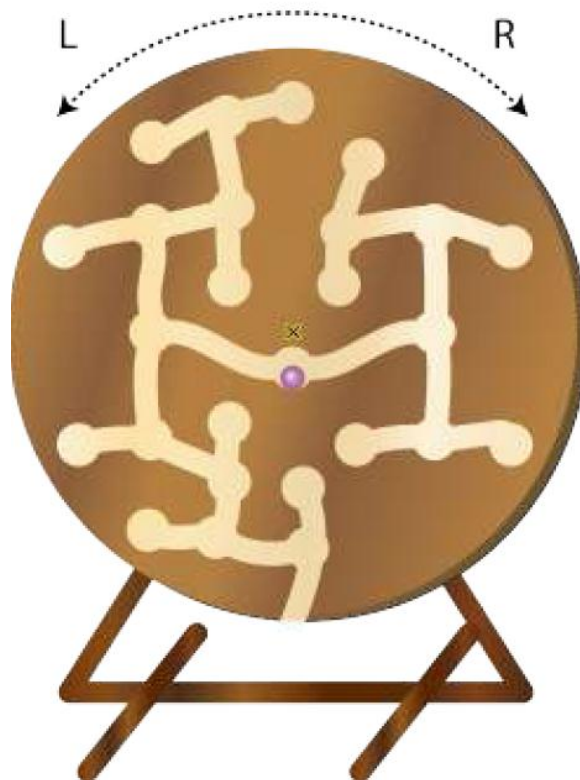
The robot starts in an initial state (point A, sight direction AB) and performs program commands until it reaches the end of the code. If you specify the correct robot code sequences, then it is possible to bring the robot from the starting-point to the finish. It could be just one wrong command in the entire code to lead the robot to a wrong way.

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## 10 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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