



# BEAVER INFORMATICS COMPETITION

## CADET SAMPLE QUESTIONS

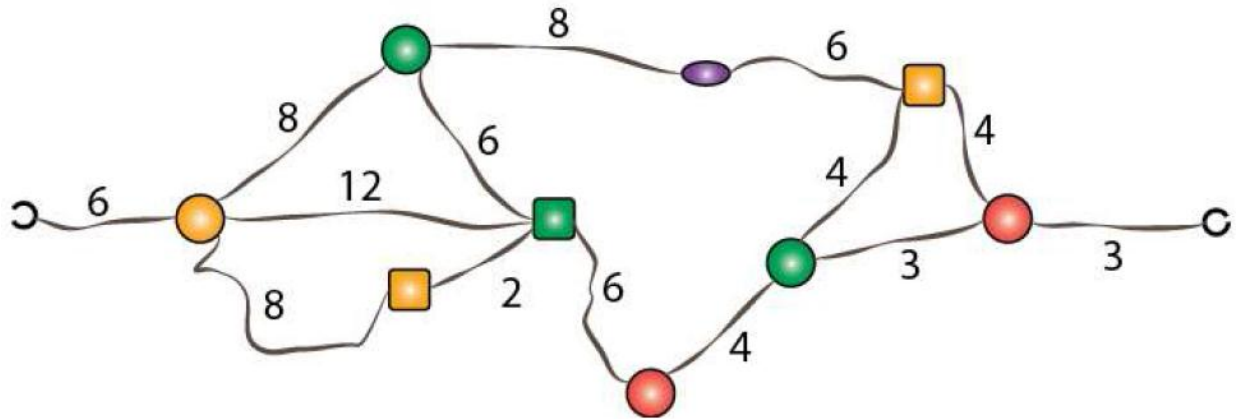
[www.Beaver.my](http://www.Beaver.my)

## 01 Necklace (Easy)

Beaver Pam made a necklace for herself. Now that it's finished, she's not sure that it will fit around her neck.

The numbers tell the lengths of the threads between pearls. Clasps are on the left and right.

How long is the necklace



**Answer (Multiple Choice)**

- A) 26
- B) 32
- C) 34
- D) 35

**The correct answer is B**

B. If we pull the clasps apart, the shortest path between them is  $6 + 8 + 2 + 6 + 4 + 3 + 3 =$

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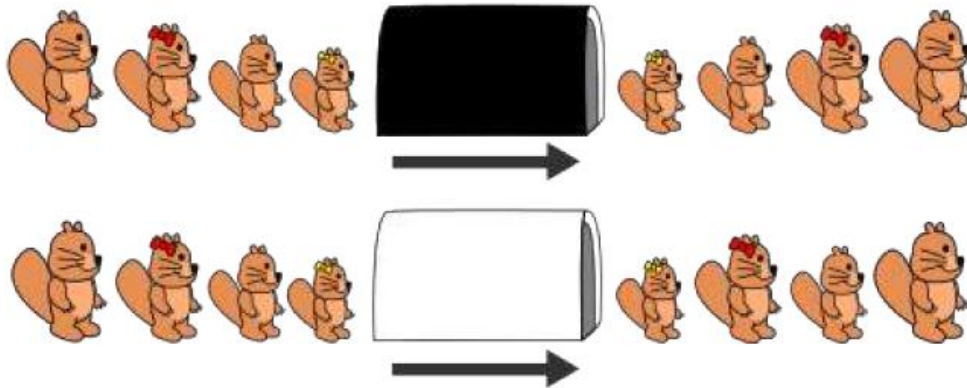
**It's Informatics**

The task is about searching the shortest path to reach the end. This is important in informatics to improve performances.

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## 02 Zebra Tunnel (Easy)

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.



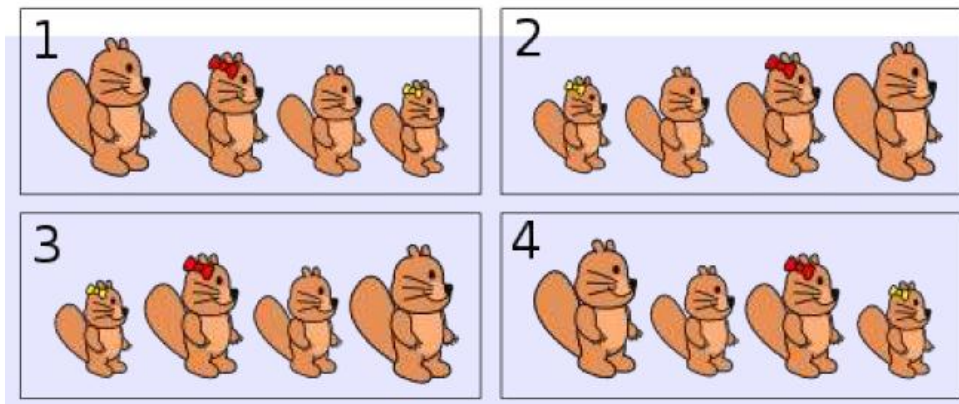
### Question

A beaver family goes through this three tunnels.



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

### Answer



### **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**

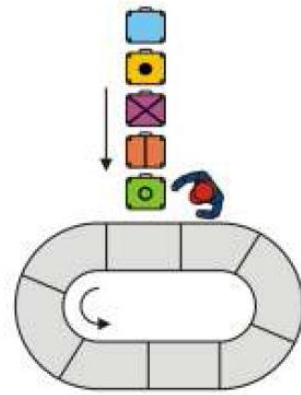
It is important to capture the essential of algorithms. There are two instructions given by two tunnels: reverse or interchange the first and the last beaver. In this situation the sequence of the instructions is not important because a second tunnel of the same kind reverse the order to the starting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

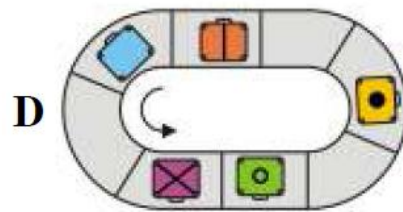
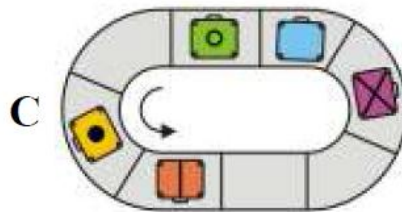
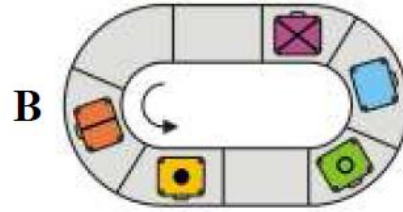
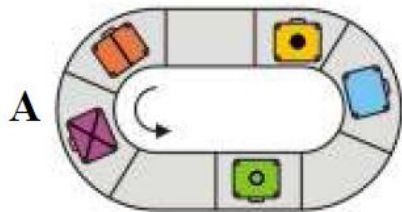
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### 03 Airport (Medium)

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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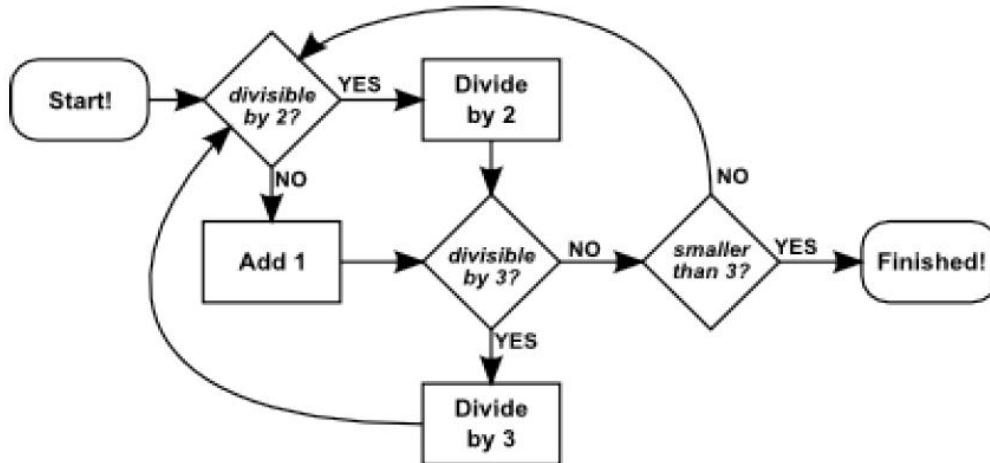
**It's Informatics!**

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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## 04 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".

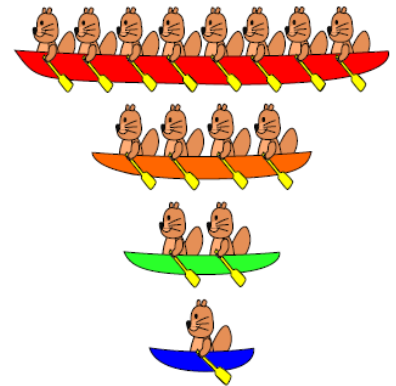
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## 05 Bebras Rowing (Medium)

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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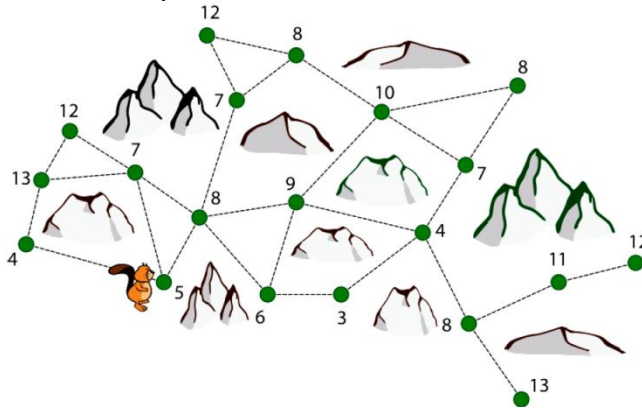
**It's informatics**

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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## 06 The Highest Tree (Medium)

The map shows the trees in the Beaver Forest, and their heights. Beavers can't see far in the forest since there are too many rocks and beavers are too small to look over them. Two trees in the map are connected if they are visible from each other.



Beaver Jacob wants to impress Sarah by cutting down the highest tree he can find. How will he look for it? He starts at the tree of height 5, as shown in the picture. He will walk to the highest tree he can see in the vicinity (for instance, he can initially choose between 4, 7 and 8, so he goes towards 8). He repeats this until he finds such a tree that all trees he can see around are smaller.

How tall is the tree he will eventually find and cut down?

### Answer (Multiple Choice)

- A) 9
  - B) 10
  - C) 12
  - D) 13
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### **The correct answer is B**

B. He goes 5 -> 8 -> 9 -> 10. There are some taller trees in the forest, but his search path does not lead him to them.

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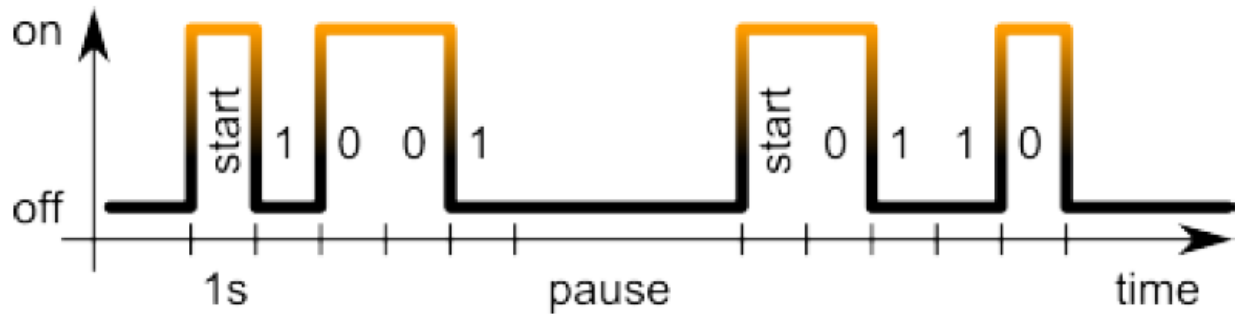
### **It's Informatics**

This search algorithm is called local optimization and the task also shows its weakness: when computer (or a beaver) uses it, it can get stuck in a local optimum instead of finding a global one. From the didactic perspective, this is an exercise in strictly following a list of prescribed instructions to the point of getting a "wrong" (or, more accurately, undesired) answer although the "correct" (desired) answer is obvious.

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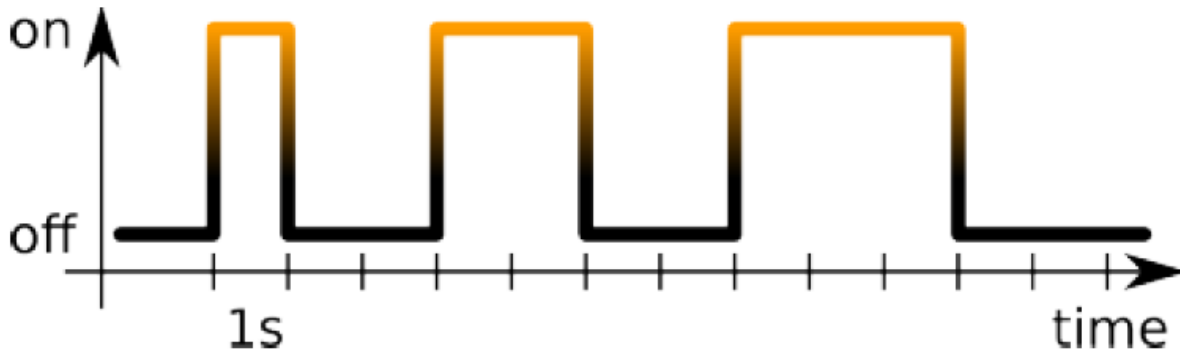
## 07 Serial Transmission (Hard)

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

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**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**

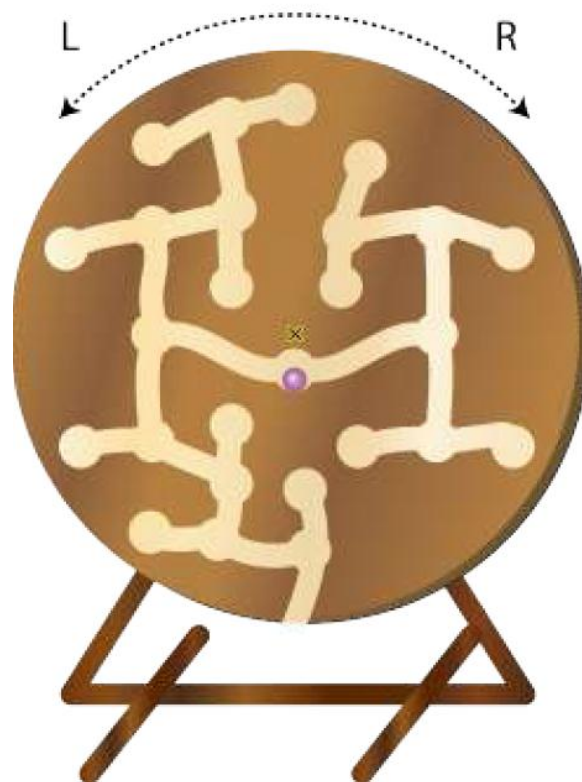
This task describes the core of the RS232 protocol for data exchange over a serial cable. Some GPS devices and many programmable microcontrollers use this protocol for its simplicity. Turned off corresponds to a negative voltage and turned on to a positive voltage. Normally one uses 8 Bits (Symbols '0'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

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## 08 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**

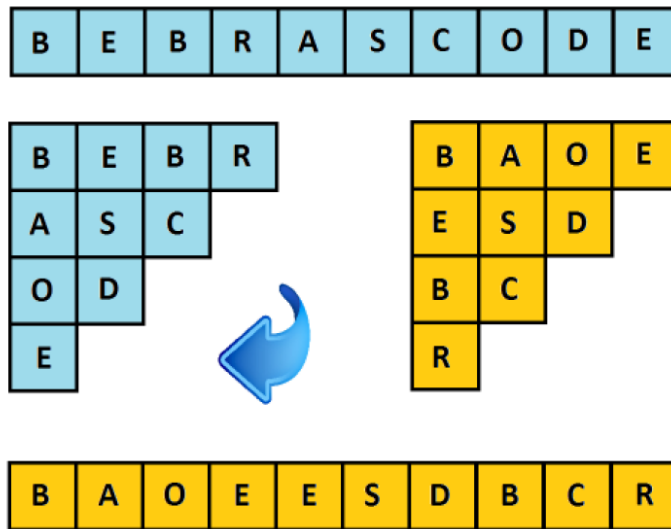
Describing paths in binary trees is a common operation in computer science.

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## 09 Triangle Code (Hard)

Beaver Betty wants to send messages to a friend, but she does not want others to be able to read it. So she tries to write them in an encrypted way. She decides to split her messages into pieces which are 10 characters long, and apply the following method to each piece:

1. Put the characters in a triangle, as shown in blue below.
2. Flip the triangle
3. Write the characters in their new order as shown in yellow below.



### Question

A piece of Betty's encrypted message is "Hro?oeuwYA?".

Enter the original message here:

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## **The answer is “HowAreYou?”.**

Here encryption and decryption use the same technique. If you write the encrypted message in a triangle, flip the triangle and write the result as one word, then you will get the original message.

Hro?oeuwYA

Written as triangle:

Hro?

oeu

wY

A

Flip the triangle:

HowA

reY

ou

?

Read it line to line:

HowAreYou?

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## **It's informatics**

Hiding and retrieving information are important subjects in computer science. A lot of research is done on encryption and decryption algorithms. A few thousand years ago people used encryption methods such as this one.

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