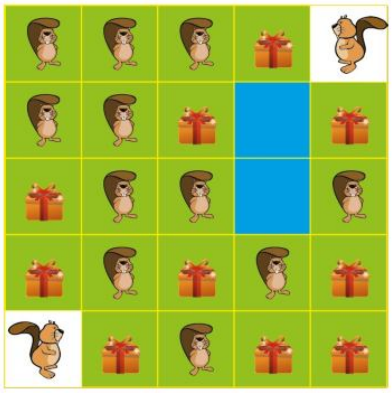
Tasks T1 – T10 carry 3 points each

T1: Beavers and Gifts

Beaver Nick is traveling from the bottom left region of the forest to his friend Ann at the top right. He only moves up and right, never down or left. Today the temperature is very cold, so he must also avoid the lake. On his way he encounters gifts and beavers. When he finds a gift, he picks it up. When he meets a beaver, he gives him a gift. He must choose a path so that he always has gifts for the beavers he meets, and in the end he must also have a gift (that is, just one gift) to give it to Ann.



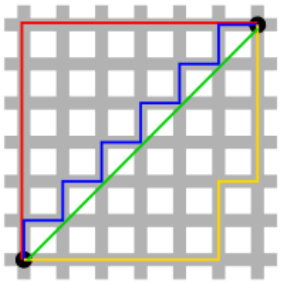
How long is the shortest valid path to Ann, counted in the number of steps (up, right) he will make?

A) 8 **B)** 9 **C)** 10 **D)** 12

It's informatics!

To determine the distance between two points we most of the time measure the length of the straight line between them. In some cases, however, we must define the distance in a different way.

Imagine a city with perfect perpendicular streets. Unless you are a bird, the minimal distance you need to cover to get from one point to another equals the number of horizontal plus the number of vertical blocks you need to pass, in whatever order. Such distance is called "Manhattan distance".

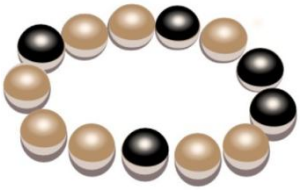


Keywords

Manhattan distance

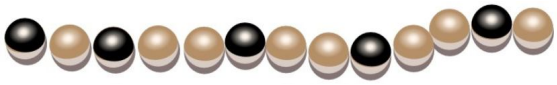
T2: Pearl bracelet

For the grand ball, a princess put on the bracelet with dark and light pearls shown to the right. After the ball, she unfastened the bracelet between two pearls and put it in a chest. The next evening, she wanted to put on the same bracelet but there were many similar bracelets in the chest.



Which of the following bracelets did the princess wear to the grand ball?

A)



B)

C)

D)

It's informatics!

The bracelet is an example of a sequence of objects. The pearls are arranged in a certain pattern. When identifying the correct bracelet you have to look for properties of this pattern. In informatics, pattern matching means finding similar objects in different sources. In image processing, the pattern matching is used for locating a small image in a bigger one. Another example is searching for a word in text using a text processor.

Keywords

Sequences
Pattern matching

T3: Price of a gift

Stefan visited his friend Tom. He brought a piece of bavarian cheese as a gift to him. In order that Tom could not read the price he tore off part of the label (see photo). But Tom was able to read the price even so.

From which information on the remaining part of the label is it possible to tell the price of the gift?

A) from information A
B) from information A and B
C) from information C
D) from information C and D

It's informatics!

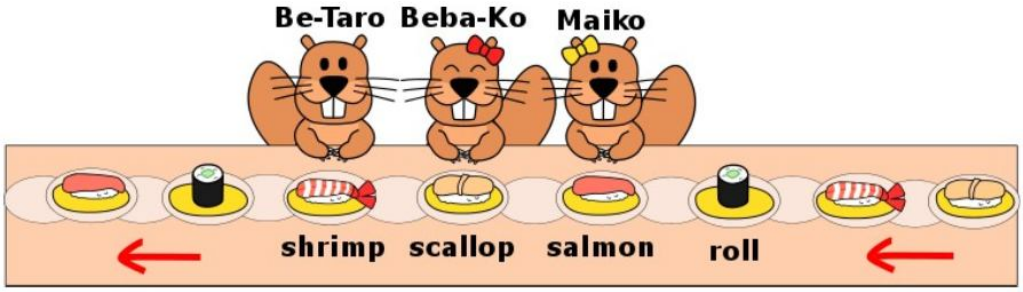
The task looks as math, but not. Who want to answer this task corectly must be able to choose from a variety of information it needs. He must understand the meaning of these numbers, codes and units and must understand information and situations in which they are used. This task is about comprehension of information. Storage, stock records, inventory replenishment and logistics are nowadays done using computer systems. Barcodes, QR codes, PIN codes, etc. facilitate business transactions.

Keywords

Information comprehension
Product code
Product storage

T4: Conveyor Belt Sushi

Be-taro, Beba-ko and Maiko go to a sushi restaurant. At the restaurant, plates of sushi pass in front of customers on a conveyor belt. Customers pick plates from the conveyor belt.
There are four kinds of sushi: shrimp, scallop, salmon and roll, that repeatedly appear in the same order.



- Be-taro picks shrimp.
- Beba-ko picks the next plate.
- Maiko picks the next plate.
- After that, they continue to pick plates each turn
- They pick only one plate at a time and do not skip any plates on the conveyor belt.

What kinds of sushi does Maiko get on her first three plates?

A) shrimp, roll, salmon
B) scallop, shrimp, roll
C) salmon, scallop, shrimp
D) shrimp, scallop, roll

It's informatics!
This is an example of an assignment with given rules. Such situations often occur, e.g. “data striping” in computer data storage. Data striping is the technique of segmenting data, such as a file, so that consecutive segments are stored on different storage devices and improve performance of the data processing. Interleaving of data access requires fewer data accesses for each storage device and reduces access conflicts by different processes. In this question, each customer is used to describe a file and each kind of plate is used to describe a storage device.

Keywords
Rules
Assignment

T5: Secret number reminder

Maciej carries a bookmark with this table on it to help him remember his secret four digit number.

1	2	3	4	5	6	7	8	9	0
A	B	C	D	E	F	G	H	I	J
K	L	M	N	O	P	Q	R	S	T
U	V	W	X	Y	Z				

If his secret number is 8526, all he has to do is to remember the words HELP. To retrieve his number, he looks up the letters of the word HELP and finds the corresponding digits in the top row of the table. Another example: The word LOVE can be used to help Maciej remember the secret number 2525.

Maciej has to remember a new secret number. Only three of the following words produce this new number. Which one does not?

A) DOME **B)** NEMO **C)** NONO **D)** NEWY

It's informatics!

Secret numbers are used a lot and some people find it hard to remember them. Using a table or another tool to remember your secret number using a simple algorithm is a way to retrieve the secret information without writing it down. There are many ways of finding the word that produces a different number. One way is to convert each word to a number and check which is different. Another way is to compare the words position by position. As long as all letters at a position correspond to the same digit the words will produce the same number. For example D, N, N and N all correspond to 4, while M, M, N and W does not correspond to the same digit. Since M, M and W correspond to 3 and N corresponds to 4 we know that C is different. The benefit of the second approach is that you do not have to check every letter of every word.

Keywords

Information hiding

T6: Broken Clock

A beaver has a digital clock which uses a seven-segment display for each of four digits. Each seven-segment display represents decimal numerals as shown below:

He breaks his clock and realizes that one of segments does not light up.

Which is a possible time that the above display represents?

A)

B)

C)

D)

It's informatics!

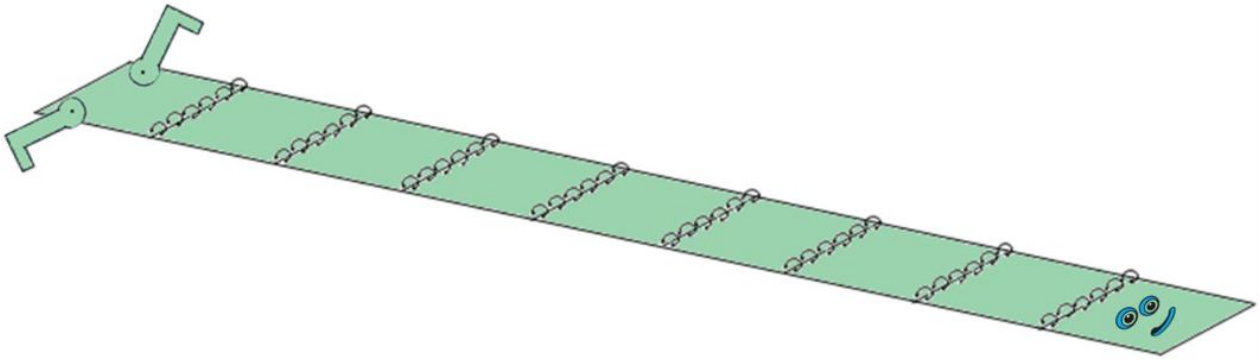
This task expects logical thinking ability. Digital clocks use seven-segment displays which are concerned with internal representation of numerals. This task is also concerned with error correcting methods.

Keywords

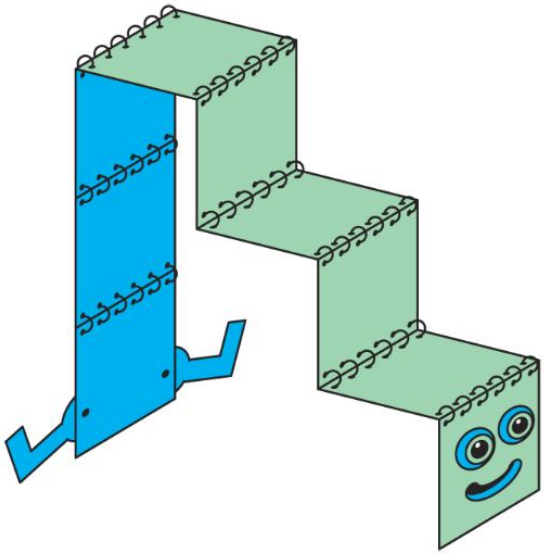
Numeric representation
Error correcting

T7: Stairs Robot Snake

Bob the Beaver is making a robot snake. The robot snake is constructed from identical square panels. Initially, Bob constructs the snake by laying out a row of square panels and connecting adjacent ones with hinges as shown in the picture below:



Bob can change the shape of the robot snake by bending it at its hinges. For example, Bob can transform the robot snake into some stairs. The stairs with 3 steps composed of a robot snake made from 9 square panels, is shown below:



How many square panels do we need to build stairs with height 7?

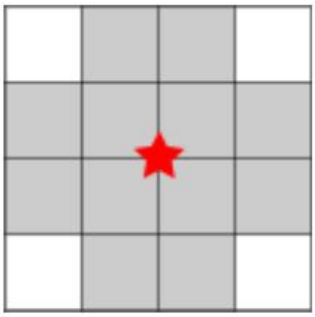
A) 21 **B)** 14 **C)** 7 **D)** 27

It's informatics!
You need to find an algorithm to count the steps. Also transformation and visualisation is needed. There is a repeated pattern, and many algorithms in computer science involve repeating a process many times, usually by way of "looping" constructs in programming languages.

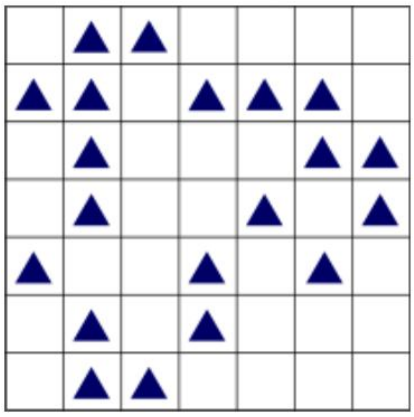
Keywords
Simple algorithmic
Simple computing

T8: Loudspeakers in a village

In Beaver Village, loudspeakers are set up in order to announce information to the villagers. As illustrated below, each speaker should be located on a point which two lines cross each other and reaches the twelve gray squares.



The below figure is a map of Beaver village where ▲ represents a location of a house.



What is the fewest number of speakers such that announcement reach to all houses?

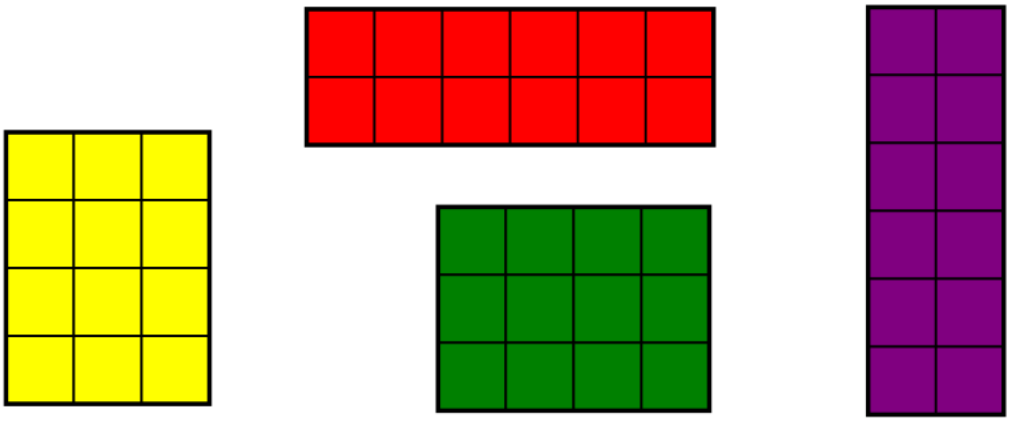
A) 2 **B)** 3 **C)** 4 **D)** 5

It's informatics!
Similar to dividing space into a number of regions, covering space with figures is applied to various uses. For example, mobile communication base stations cover efficiently wide area.

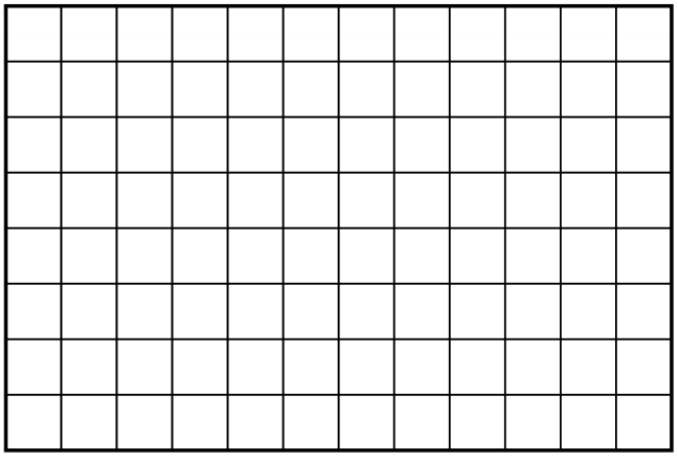
Keywords
Covering

T9: Colourful Table

A little beaver would like to pave his new room with different coloured tiles:



He decided that he will not rotate or cut the tiles in any way.



He wants to make his room as colorful as possible.

What is the maximum number of different colours he can use to pave the room in the picture?

A) 1 **B)** 2 **C)** 3 **D)** 4

It's informatics!
The partition on the subsets of given sizes is one of the classical problems in the Algorithms theory. It is packing problem, where we have an area and we decide how to cover the area with certain shapes.

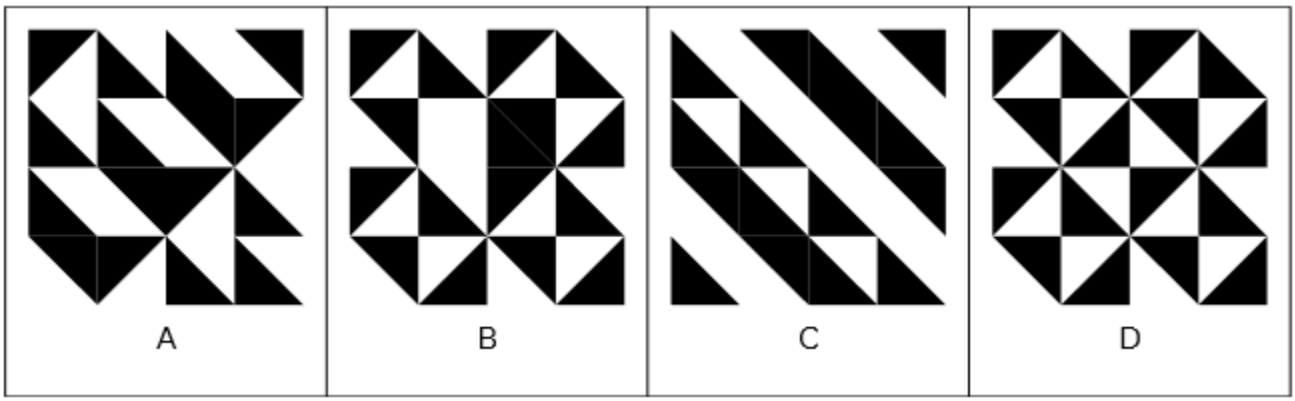
Keywords
Partition
Graphical algorithm

T10: Truchet

A beaver has 16 tiles of the same type. By rotating them he can form different looks.

He wants to decorate his bathroom wall by filling a square area with these 16 tiles. Now he is planning the design.

Which of the following patterns can NOT be made with these tiles?



It's informatics!

Information can not only be represented by bits or letters. You can use pictures too. The tile is the basic form of Truchet tiles. These are square tiles decorated with patterns that are not rotationally symmetric. When placed within a square tiling of the plane, they can form varied patterns, and the orientation of each tile can be used to visualize information associated with the tile's position within the tiling. There are more kind of Truchet tiles.

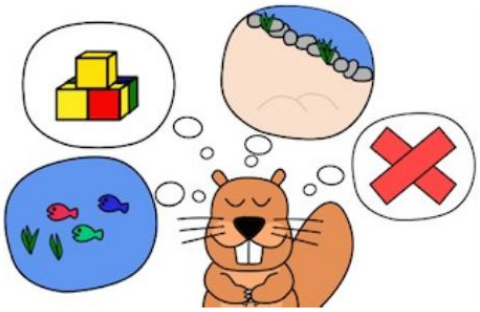
Keywords

Pattern
Visualisation

Tasks T11 – T20 carry 4 points each

T11: Beaver's playing places

A beaver decides the place where to play today according to the following rules.



If today is a sunny day, he swims "in the river".
If today is a rainy day but yesterday was a sunny day, he plays "in the house".
If today is the second continuous rainy day, he plays “on the bank of the river".
If today is at least the third continuous rainy day, he does not play.

The following table is the weather record for November.

Date	1 Nov.	2 Nov.	3 Nov.	4 Nov.	5 Nov.	6 Nov.	7 Nov.	8 Nov.
Weather								

Where does he play on 7 Nov.?

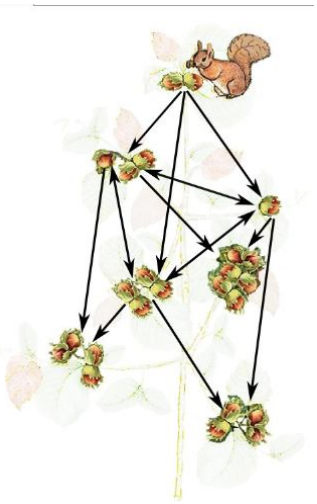
A) in the river **B)** in the house **C)** on the bank of the river **D)** He does not play.

It's informatics!
This is a Finite-State Automata problem. In this problem, even if it is same rainy day, playing place depends on the weather “state” of the previous day. That means, even if it is same rainy day, it's not same state. By this problem, the idea of “state transition” will be noticed. The approaches of the state transition is an important concept that is used in the design of programs, such as a vending machine.

Keywords
Finite-State Automata

T12: Nuts

A squirrel picks two hazelnuts from the top of the hazel bush. She wants to collect as many hazelnuts as she can. To do this, she has to jump from one branch into another and pick them up, but she can only jump in the direction of the arrows.



How many hazelnuts can she collect after three jumps?

A) 13 nuts **B)** 14 nuts **C)** 15 nuts **D)** 16 nuts

It's informatics!

The problem is reduced to a complete exhaustive search of all possible variants. It is important not to skip the correct answer. This develops skills in organizing a complete exhaustive search. With a large number of variants, one should be able to cut off obviously suboptimal branches. This problem can also be viewed as a dynamic programming problem.

Keywords

Exhaustive search
Dynamic programming

T13: Beaver Pearls

Beaver girl Lisa wants to make a bracelet using components of her old necklace with light and dark wooden pearls. She needs six dark wooden pearls. The remaining part of the necklace she wants to give to her little sister Sara.

Lisa sequentially takes pearls from the old necklace one by one, each of them from the right or the left end of the necklace until she has got the needed six dark wooden pearls. She wants to take as few light wooden pearls as possible so that the present for her sister would remain as long as possible.

How many light wooden pearls Lisa has to remove from the old necklace at least?

A) 3 **B)** 4 **C)** 5 **D)** 6

It's informatics!

Similar problems for finding ways to get some desired product (the six dark pearls in the task) with minimal waste (the light pearls in the task) are often solved in factories. Of course, the amounts of data involved are much bigger and the restrictions on how the materials must be processed are much more complicated in a factory. In general this kind of approach for getting a solution to a problem by considering all possibilities for breaking the problem up into smaller sub-problems and combining the solutions for sub-problems into solutions for the original problem is called dynamic programming.

With very large data sets also optimizing the data storage and data access becomes important. To model a necklace where pearls can be removed from either end, a data structure called double ended queue could be used.

Keywords

Algorithms
Dynamic programming
Abstract data types
Data storage
Optimizing

T14: Follow the squirrel

Pavel is standing in a park in the middle of a crossroad of eight paths.

He he facing the tree when he sees a squirrel jumping down from the tree.
The squirrel then runs around the park and Pavel try to follow it by turning around without leaving the crossroad.
First he turns by 2 paths to the left, so now he faces the bush.
Then he turns by 4 paths to the right,
by 4 paths to the left,
by 1 path to the left,
by 4 paths to the right,
and finally by 6 paths to the right.

What is facing Pavel after all his turns?

A) 

B) 

C) 

D) 

It's informatics!
The topic of this task is following sequences of instructions. Understanding sequences of instructions is an important pre-knowledge to programming a this also to informatics.

Keywords
Turning
Instructions
Sequences of instructions

T15: Lazy Beaver

A lazy beaver hires five strong beavers to work for him. Everyday, each working beaver receives instruction to either collect logs from the forest and bring to the warehouse, or take logs away from the warehouse for processing. If a beaver is on vacation, he does not add or remove logs from the warehouse. The warehouse initially has 100 logs.

	Collect	**Process**
Beaver A	add 81 logs to warehouse	Take away 81 logs from warehouse
Beaver B	add 27 logs to warehouse	Take away 27 logs from warehouse
Beaver C	add 9 logs to warehouse	Take away 9 logs from warehouse
Beaver D	add 3 logs to warehouse	Take away 3 logs from warehouse
Beaver E	add 1 logs to warehouse	Take away 1 logs from warehouse

For example, if Beavers A and D are on vacation, Beaver B's order is "Collect" and Beavers C and E's are to "Process", then at the end of the day, the warehouse will have 100+27-9-1 = 117 logs.

What is the work order of each beaver if the warehouse is to have 168 logs at the end of the day?

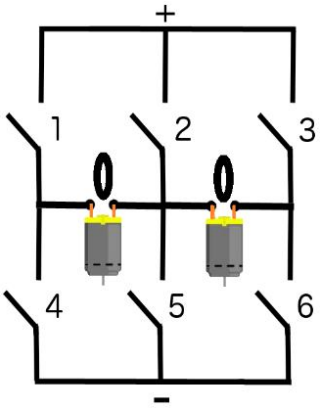
A) Collect: Beavers A, D, E; Process: Beavers C, D.
B) Collect: Beavers A, E; Process: Beavers B, D; Vacation: Beaver C.
C) Collect: Beavers A, B; Process: Beavers D, E; Vacation: Beaver C.
D) Collect: Beaver A; Process: Beavers C, D, E; Vacation: Beaver B.

It's informatics!
Some early computers were based on a ternary system. Instead of machines being based on a binary system (0 or 1; true or false; on or off) like computers today, these older computers were based on three possible values. They had some computational advantages.

Keywords
Balanced ternary numbers
Setun

T16: Bebro-robot

A team of young beavets to build a robot with two motors and six electronic switches. Each motor activate one wheel. The switches are numbered 1 to 6.A wheel will go forward if the current flows from its left motor entry point to its right one. Similarly, a wheel will go backward if the current flows from its right motor entry point to its left one; otherwise, it does not move.



The current starts at the '+' point (at the top) and will try to reach the '–' point (at the bottom).

The beavers want the robot to move clockwise. All the switches are initially opened. **Which of the following choice of switches to close makes the motors turn as desired?**

A) 2, 4 and 6 **B)** 3 and 4 **C)** 1 and 6 **D)** 1, 3 and 5

It's Informatics!
The switches can be programmable electronics (transistors with micro-controllers). It can also refer to graph traversals. With a given set of rules, the students have to find the only solution that is suitable and which satisfies the requirements.

Keywords
Routing
Electronics programming
Graph

T17: Liver Oil

Beaver Tommy likes to fill his tummy with delicacies like cod-liver oil. His grandma keeps thick cod-liver oil in a huge jar with a capacity of 15 scoops and uses it for various purposes. She never uses more than 10 scoops of oil at a time.

Whenever she needs oil, she checks if there is enough and if not, she adds 10 scoops of fresh oil (or less if the jar fills). The added oil perfectly mixes with any oil in the jar. Afterwards, she takes the requested amount of oil out of the jar. At the beginning of the August there were 10 scoops of oil in the jar and here is a record of its consumption:

2. 8. 2014	2 scoops	Fish salad
4. 8. 2014	5 scoops	Fish pie
5. 8. 2014	2 scoops	Facial mask
7. 8. 2014	4 scoops	Fried fish
8. 8. 2014	8 scoops	5 o'clock liver oil with friends
9. 8. 2014	2 scoops	Refilling scent lamps
12. 8. 2014	4 scoops	Donation to charity
13. 8. 2014	3 scoops	Sore throat remedy
15. 8. 2014	1 scoop	Oiling the bicycle
16. 8. 2014	7 scoops	Fish pie
17. 8. 2014	4 scoops	Impregnating fur
20. 8. 2014	3 scoops	Mayonnaise
22. 8. 2014	4 scoops	Fried fish
23. 8. 2014	8 scoops	Fried chips
25. 8. 2014	3 scoops	Fish salad

When did the oldest cod-liver oil, which ended up in Tommy's fish salad on 25. 8. 2014, come into the jar?

A) On 13. 8. 2014. **B)** On 16. 8. 2014. **C)** On 17. 8. 2014. **D)** On 25. 8. 2014.

It's informatics!

The task actually defines the following algorithm to handle the jar. Here variable jar represents current amount of the oil in the jar:

```
Get_from_jar ( amount ):
    if jar < amount then // refill
    jar← jar + min( 10 scoops, (15 – jar) scoops)
    jar← jar – amount
    return
```

Every computer scientist must be able to follow given rules and to determine what was going on between the given initial and final state.

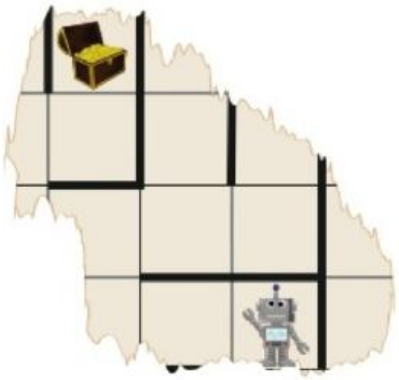
Keywords

Simulation

T18: Through the Maze

Last year, there was a competition in which the beavers had to retrieve a treasure from a maze using a robot. There was only a single path leading to the chest. The robot was very fragile, so they had to be careful not to hit any walls.

This year they must repeat the endeavor, but a hungry young beaver ate most of the map! This is all that remained.



Last year, they used one of the following paths to guide the robot to the treasure chest and back, but they forgot which one. Help them!

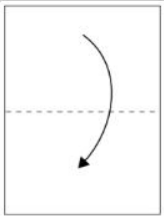
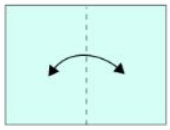
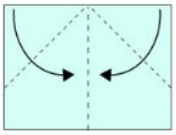
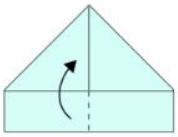
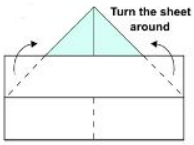
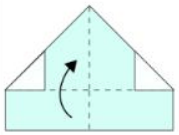
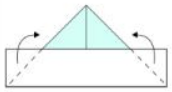
A) LLURUURULLLDDRUDLUURRRDLDDLDRR
B) LLURULURULLDDRUDLUURRDRLDDLDRR
C) LLURUURULLLLDRUDLURRRRDLDDLDRR
D) LLLLLULUURDRURRRLDLULDDRURRRRL

It's informatics!
When a program fails, programmers must find the errors by either tracing its execution, as we did for answers C and D, or by finding more clever ways of discovering what may be going wrong, like for answer B, where we discovered that the program is not symmetric in the way it ought to be.

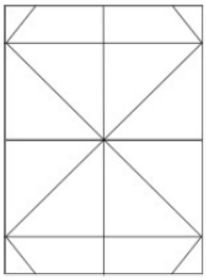
Keywords
Programming
Debugging

T19: Origami sheet

Martin followed instructions 1-7 below to create a cap by folding a sheet of paper. One side of the paper is white and the other one is light blue:

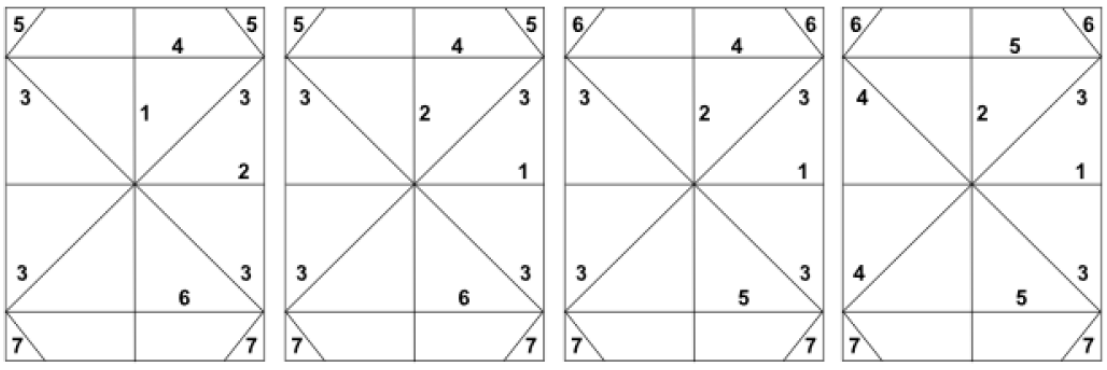
1.	2.	3.	4.	5.	6.	7.
						
Fold the sheet's top to its bottom.	Fold the left side to the right one and then back.	Fold the top corners so that they touch each other.	Fold the front extra lower part of the paper upwards	Fold the corners backwards and then turn the whole assembly around horizontally.	Fold the front extra lower part of the paper upwards	Fold the corners backwards.

Martin then unfolded the cap and observed that the folding lines were visible on the paper.



He started thinking about which folding line was produced by which instruction step.

Which picture shows the correct association of folding lines with instruction steps? The numbers in the pictures correspond to the instruction numbers above.



It's informatics!

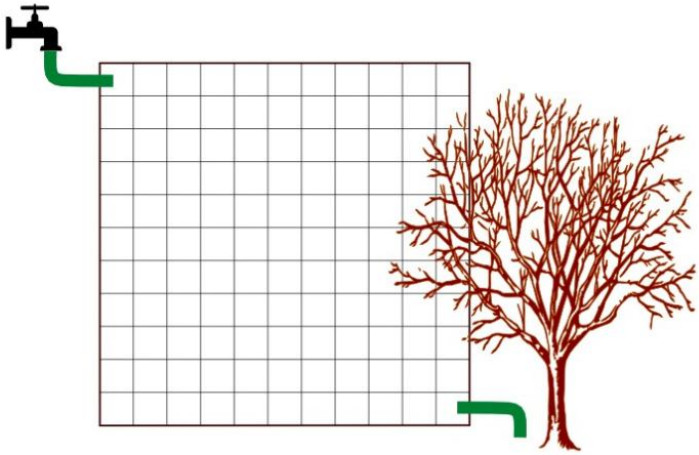
To be able to understand a sequence of actions precisely expressed in a specific language (for example a graphical one like in this task) is an important for programming (writing computer programs, which is an important part of informatics). When programming, it is also very important to look at the result of a program and understand which parts of the result were created by which part of the program. This helps to debug programs, i.e. to find incorrect parts of the result and the corresponding incorrect parts of the program.

Keywords

Origami
Pictorial algorithms
Debugging

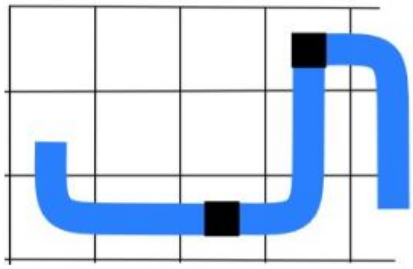
T20: Watering the tree

Linda wants to water her dry apple tree in the garden. She has to prepare a tube which connect the tap with the tree.



Only tubes of specific shape are available. They can be joined with junctions of two types (see picture below).

There is an example how to create the tube from several pieces:



How many pieces of tube is necessary at least to add to join the tap with the tree?

A) 6 **B)** 7 **C)** 8 **D)** 9

It's informatics!

What you had to do in the task is called combinatorial optimization: the problem of finding the optimal solution with a limited set of object – like pipes, in this case. The proof that we need at least eight pipes is related to another interesting subject: that of the distance between two points. We usually measure straight distances. Now, imagine a city with perfect perpendicular streets. The minimal distance you need to cover to get from one point to another is not equal to the length of a straight line (unless you happen to be a bird), but the number of horizontal plus the number of vertical blocks you need to pass, in whatever order. Such distance is called "Manhattan distance", by the (mostly perpendicular) streets and avenues of Manhattan in New York.

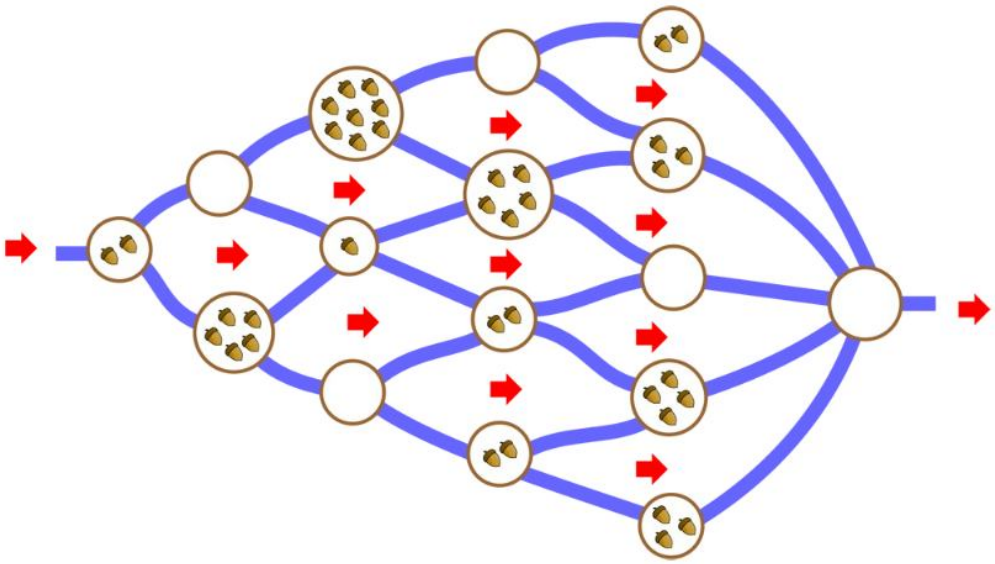
Keywords

Water

Tasks T21 – T30 carry 5 points each

T21: Collect the acorns

Beaver Billy is fond of acorns. He wants to swim down the river and collect all acorns on the islands that he can pass by. Alas, the current is strong, so he can only swim downstream.



What is the maximum number of acorns that he can take?

A) 13 **B)** 15 **C)** 16 **D)** 18

It's informatics!

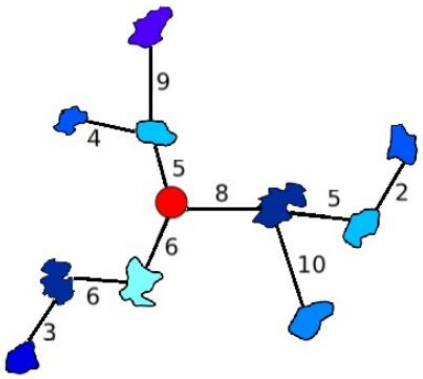
Finding the best possible value when there are a lot of options, for instances different routes the taken, is a common problem where a computer program can be used. The algorithm to find the solution for this problem is called dynamic programming. It is used when you want to avoid to make the same calculations over and over again. Instead of these calculations, a table is used. Algorithms to find a quick solution are very important in computer science.

Keywords

Dynamic programming
Optimizing

T22: Hide and seek

Sven the polar bear plays hide-and-seek with Harriette the hippo. Harriette hides in any of the blue lakes. Sven starts in the red circle and has only 50 seconds to find Harriette. He can only move along the lines and each line takes a certain number of seconds to travel in one direction. If he finds Harriette the hippo, he shouts "ooooooooohhhh" so everybody can hear him.



How many of the possible hiding places can Sven visit in 50 seconds?

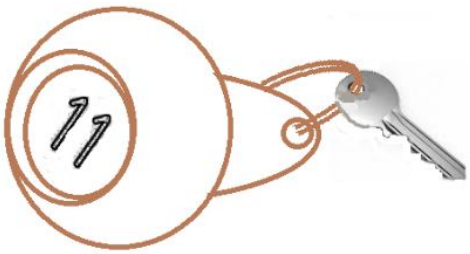
A) 4 **B)** 5 **C)** 6 **D)** 7

It's informatics!
A network of places with paths connecting them is called a graph. In this case it's a tree because it contains no cycles. Efficient algorithms for exploring trees and other graphs are important in computer science because it's a common way to store large amounts of data.

Keywords
Trees
Optimization

T23: Hotel rooms keys

In a hotel, the rooms are numbered with two digits. The first digit indicates on which floor the room is located; the second digit indicates the distance from the elevator to the room.



A customer comes and asks for a room, but he really does not want to walk much. So any room which takes less walking to reach it is better than a room with more walking. If multiple rooms involve the same amount of walking, the customer prefers the lower floor.

Sort the available room keys based on how much the customer would like them. On the left you should place the room key that the customer will like the best; on the right the room key that he likes the least. The following room keys are available: 12, 25, 11, 43, 22, 15, 18, 31, 44, 52

A) 18, 15, 12, 11, 25, 22, 31, 44, 43, 52
B) 52, 43, 44, 31, 22, 25, 11, 12, 15, 18
C) 11, 31, 12, 22, 52, 43, 44, 15, 25, 18
D) 11, 12, 15, 18, 22, 25, 31, 43, 44, 52

It's informatics!

In computer science, radix sort is a non-comparative integer sorting algorithm that sorts data with integer keys by grouping keys by the individual digits which share the same significant position and value. A positional notation is required, but because integers can represent strings of characters (e.g., names or dates) and specially formatted floating point numbers, radix sort is not limited to integers. Radix sort dates back as far as 1887 to the work of Herman Hollerith on tabulating machines.

Keywords

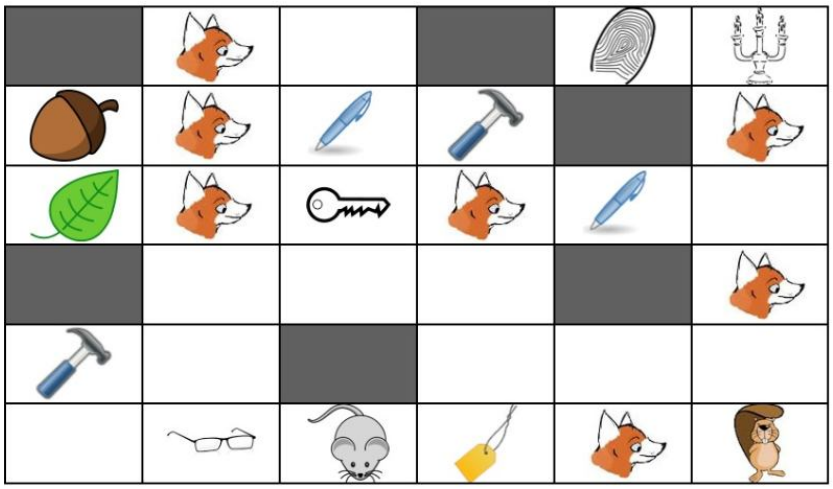
Sort
Radix sort

T24: Beaver

Beaver 007 is on a secret mission in Fox Land. He has to collect as many unique items as possible in the museum; however, the museum is guarded by foxes.

The following grid represents the museum. Beaver 007 can walk on the white squares, but not on the grey ones. He cannot walk on squares where a fox is, except if he has a mouse and gives that to the fox.

Beaver 007 enters the building from the right bottom.



What is the greatest number of unique items that Beaver 007 can have at the end of his mission?

A) 6 **B)** 7 **C)** 8 **D)** 9

It's informatics!

Finding his way in a labyrinth, subject to constraints is important in informatics. It is somewhat related to planning algorithms used by autonomous robots that have to find their way by their own.

Keywords

Puzzle
Algorithm
State space exploration

T25: Laterality

Psychologists made a test of laterality in the classroom consisting of three tasks and answers were stored in a computer. The tasks were:

1. Clasp hands: they recorded whether left or right thumb was above.

2. Look at the picture and immediately tell, which animal do you see: they recorded whether student saw a head of rabbit or duck.

3. Give a clap: they recorded whether left or right hand was above.

The psychologists have to come up with a different code for each possible outcome of the three task test.
How many different codes should there be at least?

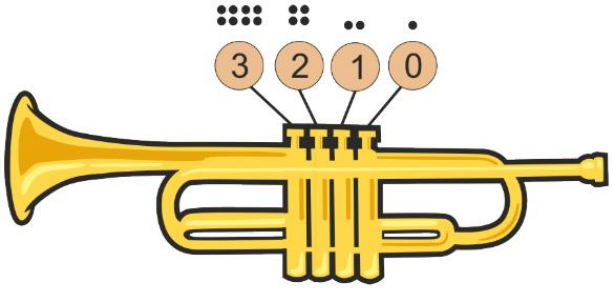
A) 1 **B)** 3 **C)** 8 **D)** 16

It's informatics!
Encoding of information is one of the basic problems in informatics. Moreover, the codes have to be designed in such a way that they are from a rich enough domain that one can distinguish between different information.

Keywords
Information units
Digital literacy

T26: Binary Trumpet

The binary Beaver trumpet has four numbered valves so you can play a range of 16 pitches. The lowest pitch is played if all valves are open and is represented by zero black dots. The highest pitch is played when all valves are pressed and is represented by 15 black dots. Generally, the more black dots you accumulate by pressing valves the higher the tone.



For example: 2 & 0 represents that the valves 2 and 0 are pressed and pitch #5 (4+1) is played. 3 & 1 & 0 represents that the valves **3, 1 and 0** are pressed and pitch #11 (8+2+1) is played. Because Pitch #5 is lower than pitch #11 these two tones are ordered increasingly.

Which of the following four-tone sequences is ordered by increasing pitches?

	1st tone	2nd tone	3rd tone	4th tone
A)	2 & 1 & 0	3 & 0	3 & 2 & 1 & 0	1 & 0
B)	1 & 0	2 & 1 & 0	2 & 1	3 & 1 & 0
C)	2 & 1 & 0	3	3 & 0	3 & 2 & 0
D)	3 & 0	3	3 & 2 & 1 & 0	3 & 2 & 1

It's informatics!

There are two ways to solve the task. The innocent one is to simply count and accumulate the black dots each cell and compare them tone for tone.

The smart way is to recognize the logic of the binary numeral system. Use 2 as base number and the hole numbers for power and you get:

empty = 0
2^0 = 1
2^1 = 2
2^2 = 4
2^3 = 8

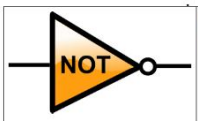
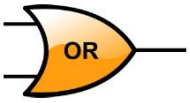
So the black dots stand for the result of two powered by the particular hole number.

Keywords

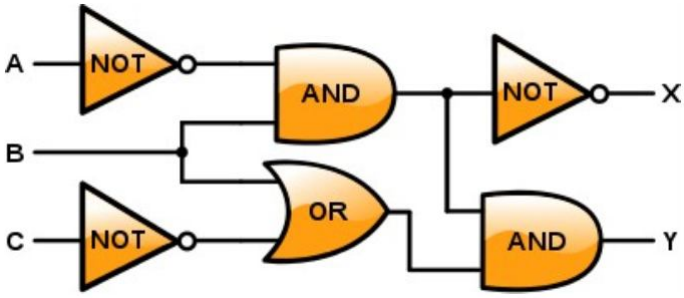
Binary numeral system, pitch (music)

T27: Logic circuit

Logic gates have one or two inputs on the left, and one output on the right. They switch ON or OFF a current on the output, depending on the currents of the inputs

	If the input is ON, the output is OFF. If the input is OFF, the output is ON.
	The output is ON, except if both inputs are OFF.
	The output is ON only when both inputs are ON.

If input A is OFF, and inputs B and C are ON, what will the outputs X and Y be?



A) X is OFF, Y is OFF **B)** X is OFF, Y is ON **C)** X is ON, Y is OFF **D)** X is ON, Y is ON

It's informatics!

Logic gates are the fundamental building blocks of digital electronics, like computer processors. Zeroes and Ones are represented by switching on or off electrical currents. In todays processors, billions of such gates are fitted together to make a computer work. The analysis of such networks can be done using boolean algebra. One can for instance show, that input C has no effect in the above network.

Keywords

Logic gates
Boolean algebra

T28: Binary counter

Little beavers use a weird counter, which only uses two digits: 0 and 1. Every time the counter is pressed, it changes the rightmost 0 to 1, and every digit 1 on its right to 0.

For example, when it is pressed:

- the number 01001 changes to 01010.
- the number 01011 changes to 01100.
- the number 01111 changes to 10000.

The first number in the counter is 00000. After how many presses will the counter show 11111?

A) 15 **B)** 16 **C)** 31 **D)** 32

It's informatics!

The described numbers are binary numbers, which represents values using two symbols, typically 0 and 1. The reason for this is that there are only two states an electrical circuit can be in: either off or on. Since computers can only understand either 0 (off) or 1 (1), they use the binary number system.

Keywords

Binary number
Number system

T29: Birthday party

Beaver Louis remembers his wonderful 10th year birthday, but he is a bit worried because now he has to prepare a new birthday party. He only knows these two recipes:

For 5 pancakes	For 1 cake
100 g of flour 20 ml of milk 1 egg	100 g of sugar 100 g of flour 100 g of butter 2 eggs

On his shelf, he only has the following ingredients:

- 6 eggs;
- 200 g of butter;
- 500 g of sugar;
- 500 g of flour;
- 60 ml of milk.

He can do any of the two recipes more than one time, but he cannot do any recipe partially (that is preparing half a cake or only one pancake, for example).

Beaver Louis wants to use the maximum ingredients and searches for the best combination between the two recipes. Which of the following statements is true?

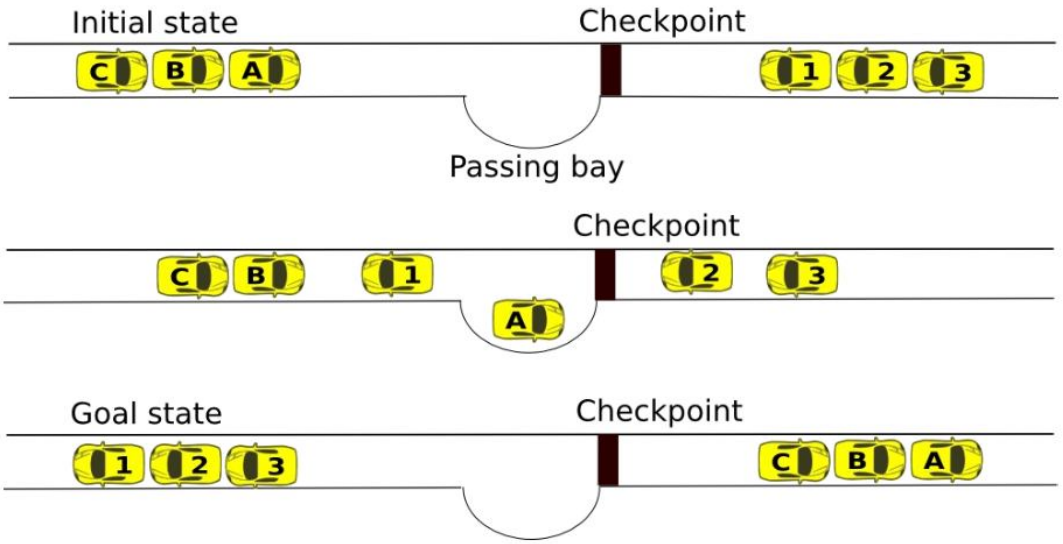
A) No matter which combination, some sugar will always remain.
B) No matter which combination, some milk will always remain.
C) It is possible to use up all the ingredients.
D) It is impossible to cook both recipes.

It's informatics!
That problem is related to constraint programming, where a solution to a problem under constraints have to be found. One way to solve the problem is to explore the whole state space of solutions.

Keywords
Constraint programming
Chinese remainder theorem
Combinatorics

T30: Car Passing

Six cars are trapped on a narrow road. Three of the cars (A, B, and C) are going in the same direction, and there are three others cars (1, 2, and 3) going in the opposite direction. Fortunately, cars can use a passing bay for one car at the time near the checkpoint (as in the initial state figure). This checkpoint counts the number of cars driven through it. Each car can go forwards or backwards along the straight road or stop on the road or in the passing bay.



What is the minimum number of passes past the checkpoint to drive all cars from the initial state to the goal state?

A) 6 passes **B)** 9 passes **C)** 15 passes **D)** 18 passes

It's informatics

This is a sorting problem, in which the elements in a list should be sorted into a required permutation. Students will also apply the concepts of FIFO and LIFO like how the queue and the stack operate.

Keywords

Sorting
Queue
Stack

CORRECT ANSWERS

Task #	Answer	Task #	Answer	Task #	Answer
1.	**A**	11.	**C**	21.	**D**
2.	**B**	12.	**C**	22.	**C**
3.	**B**	13.	**B**	23.	**C**
4.	**C**	14.	**C**	24.	**B**
5.	**C**	15.	**D**	25.	**C**
6.	**A**	16.	**D**	26.	**C**
7.	**A**	17.	**C**	27.	**B**
8.	**B**	18.	**A**	28.	**C**
9.	**D**	19.	**B**	29.	**A**
10.	**B**	20.	**C**	30.	**D**