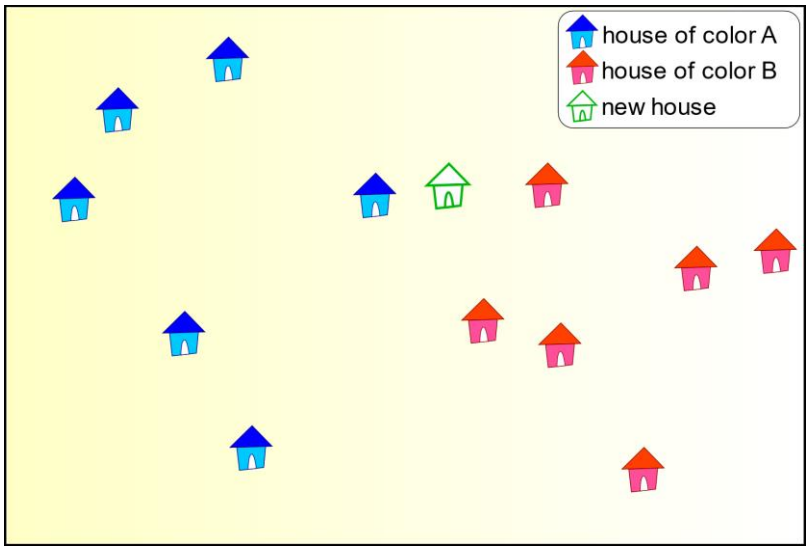
Tasks T1 – T7 carry 3 points each

T1. A New Neighbor

A new neighbor has moved into a new house in the Beaver Village. The village has a rule for coloring a new house. The rule is as follows.

- The color of a new house should be the color of the majority of the k nearest houses. If there is a tie, increase k by one (so now we have a new value for k) and apply the rule again. k is unknown to us.

The map of the Beaver Village is shown below.

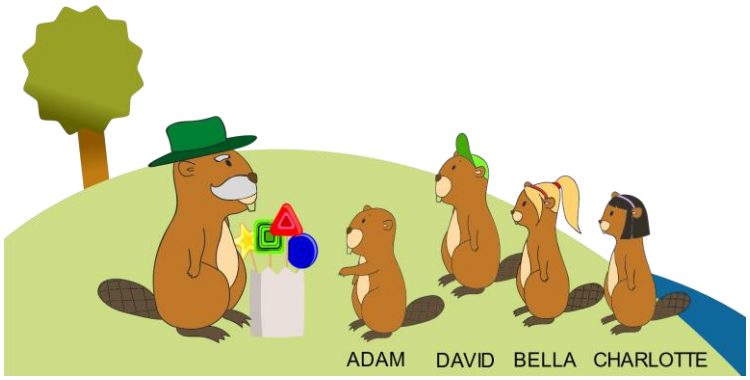


Question / Challenge

The house for the new neighbor is shown as the green house in the map. They say that the color for the new house is decided to be color B. What is the minimum possible value of k for this to happen?

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

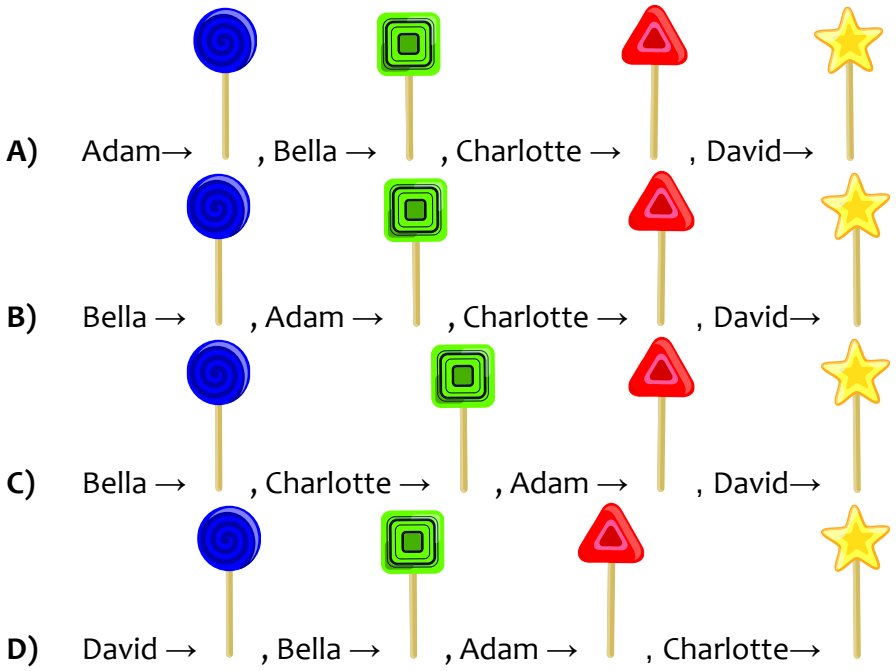
T2. Handing out Candy



A dad beaver wants to give his four children candy of different shapes and colors.
Adam says, "I don't want a red candy."
David says, "I want a star candy."
Bella says, "I want my candy to be a square or a triangle."
Charlotte: "I want a red candy."

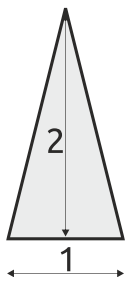
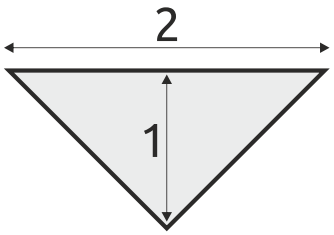
Question / Challenge

How can dad hand out the candy, so that each child gets the candy he or she wishes?



T3. Interpret programs

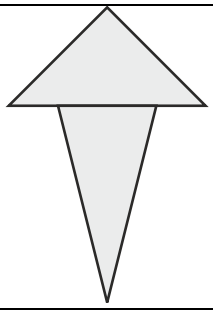
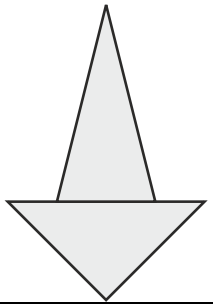
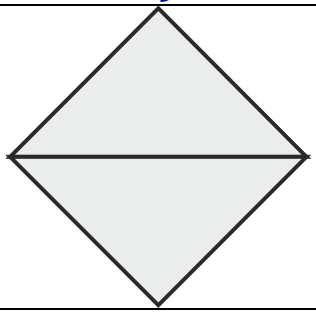
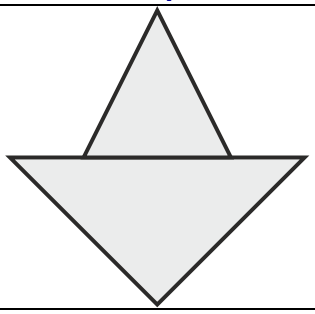
The following commands describe the drawing triangles.

draw (up, 1, 2)	draw (down, 2, 1)
	

After the drawing you will be on the same position as in start moment.
We have 4 programs:

1	2	3	4
draw (down, 2, 1) draw (up, 1, 2)	draw (down, 1, 2) draw (up, 2, 1)	draw (down, 2, 1) draw (up, 2, 1)	draw (down, 2, 1) draw (up, 1, 1)

These programs can draw 4 pictures:

P1	P2	P3	P4
			

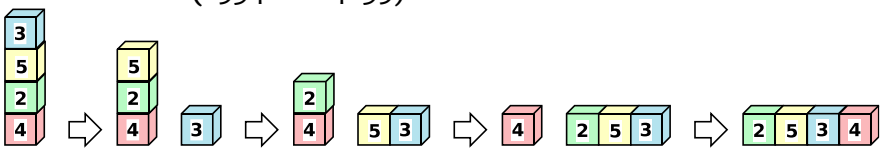
Question / Challenge

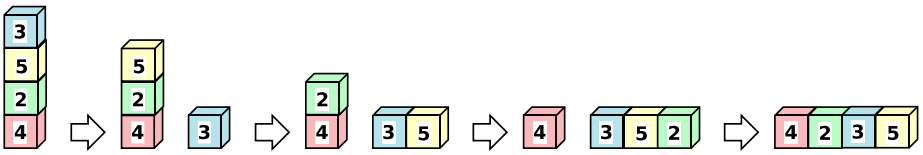
What is the correct match between the pictures and these programs?

A) Program 1 → P2, Program 2 → P1, Program 3 → P3, Program 4 → P4.
B) Program 1 → P3, Program 2 → P1, Program 3 → P1, Program 4 → P4.
C) Program 1 → P1, Program 2 → P2, Program 3 → P3, Program 4 → P4.
D) Program 1 → P4, Program 2 → P3, Program 3 → P2, Program 4 → P1.

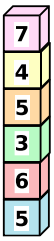
T4. Creating Numbers

Olivia, the beaver, is playing with blocks. Each block has a single digit on it. She loves to make a big tower and then use the blocks one by one, from the top, to form a number. Each time she removes one block, she can place it to the right or to the left of the number she is forming. The following figures show a tower of 4 blocks and two possible numbers that can be formed from it (2534 and 4235):





Olivia just built a new tower of 6 blocks and she wants to create the smallest possible number from it. Can you help her?



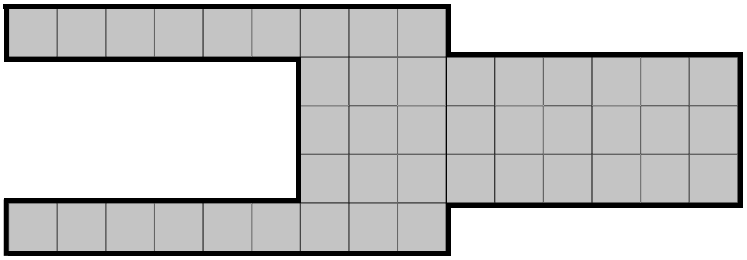
Question / Challenge

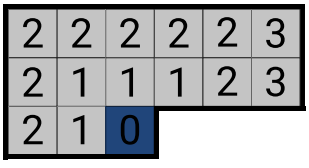
What is the smallest number that can be formed from the tower of 6 blocks shown above, following the rules?

A) 743565 **B)** 467535 **C)** 565347 **D)** 347565

T5. Heating

A group of beavers want to heat their cold house using 4 heating units. Their house is shown in the left image. The house is formed of multiple cells. A heating unit occupies one cell, heating the cell instantly. The hot air from a cell takes 1 minute to propagate to all its neighboring cells (cells that share vertices and/or edges). The right image exemplifies how many minutes it takes to warm an entire small room if one heating unit is placed on the blue cell.





Question / Challenge

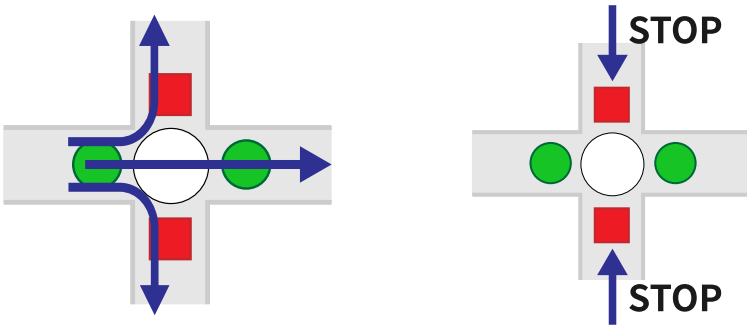
Your task is to help the beavers place 4 heater units in the house, such that the entire house is heated in as little time as possible. How long will it take to heat the entire house?

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

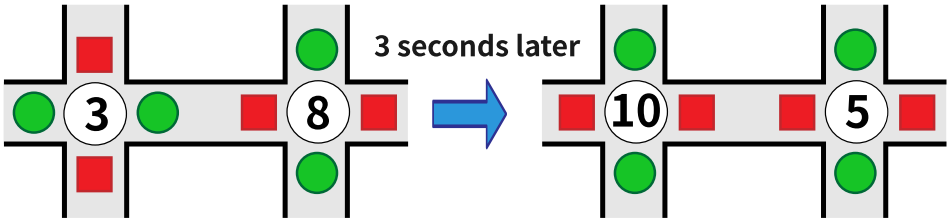
T6. Traffic Light

There are traffic lights in every intersection in Beaver City. The following are two important details of the traffic requlations:

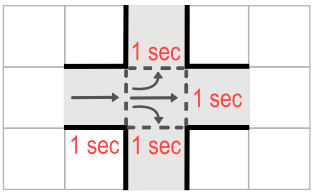
When the light is green, beavers can either go forward or make a right turn or left turn, and when the light turns red, beavers should stop and wait for the light to turn green again.



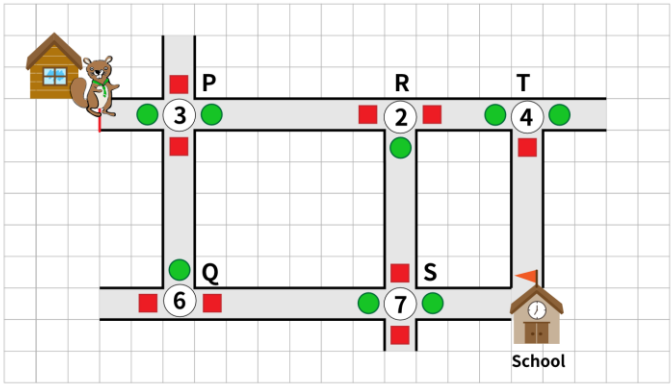
As shown in the following picture, the lights alternate between green and red every 10 seconds. Each set of traffic lights at a intersection has its own timer which keeps counting down from 10 to 0. Beavers can see the timer, and the lights will switch color when the timer hits 0.



When Little Beaver walks, it takes a second to advance one square; it also takes him one second to either cross the road or make a turn at an intersection.



The map below shows the roads connecting Little Beaver's home and school. Right when Little Beaver starts walking from his house behind the red line, the status of the timers are also shown in the map.



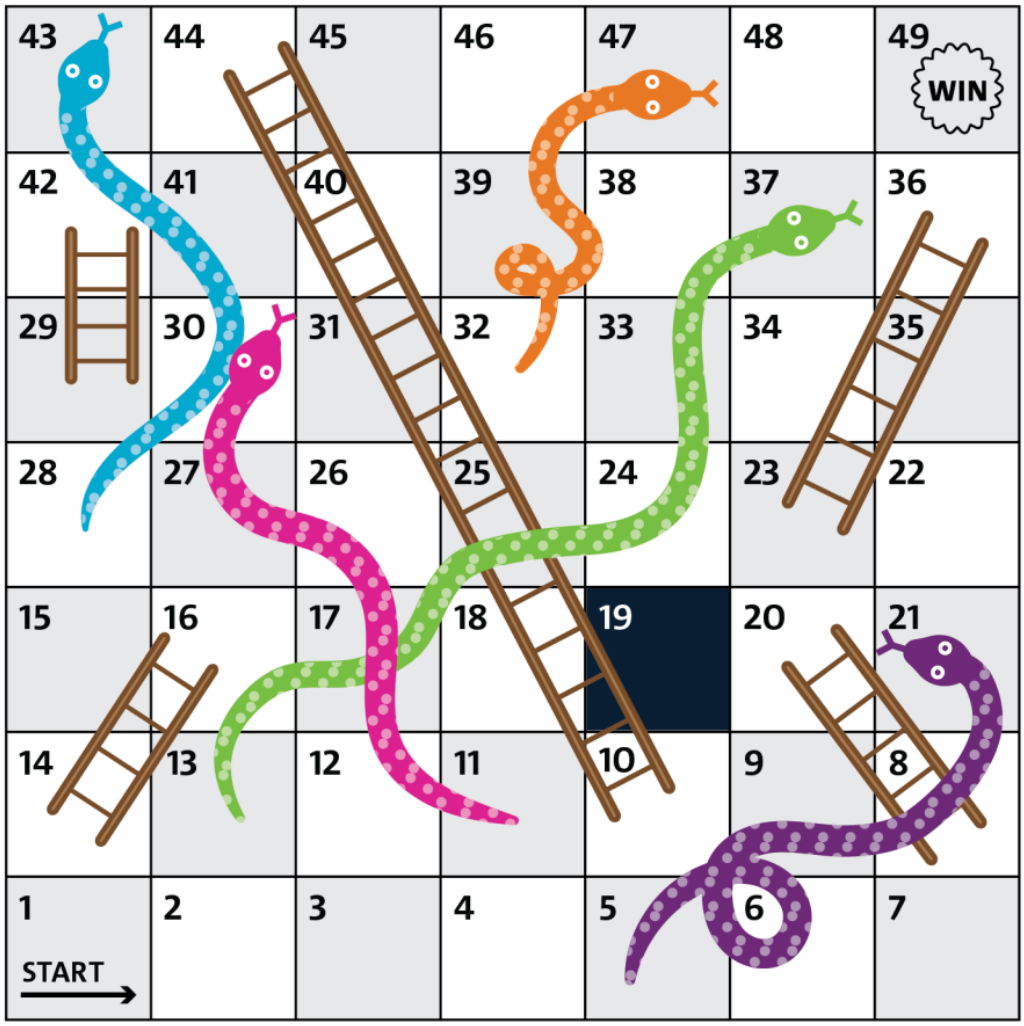
Question / Challenge

Based on the timer, if Little Beaver wants walk to school without stopping for any red lights and without crossing the same intersection twice, which route should he take?

A) P→R→T→SCHOOL
B) P→Q→S→SCHOOL
C) P→R→S→SCHOOL
D) P→Q→S→R→T→SCHOOL

T7. Snakes and Ladders

The game of Snakes and Ladders is played by rolling a common dice (giving values 1 to 6) and moving that many places from your current cell position. Each player starts from cell number 1, and a player wins when they reach the last cell (49).



If you reach a cell with a snake's head, you will slide down to the snake's tail. That is, if you land on cell 21, the snake will take you back down to cell 5. And if you reach a cell with the bottom of a ladder, you will climb up to the top of that ladder. That is, if you land on cell 23, the ladder will take you up to cell 36.

Question / Challenge

If you are at cell 19, what is the minimum number of dice rolls to win?

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

Tasks T8 – T14 carry 4 points each

T8. Magic Drink Machine

A beaver Cobi has a mysterious blue color machine as shown in Fig. 1. There are two funnels in the machine.

- If a beaver pours chocolate milk into both funnels, white milk comes out.
- If a beaver pours white milk into either of the funnels, chocolate milk comes out.
- If a beaver connects two machines and pours chocolate milk into both funnels as shown in Fig. 2, then chocolate milk comes out. Note, the middle green connection has no effect on the type of milk.

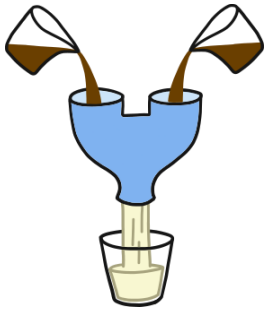


Fig. 1

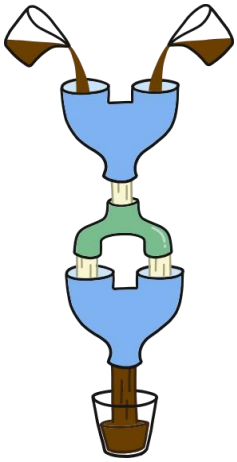


Fig. 2

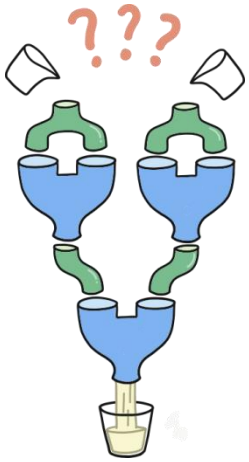


Fig. 3

Question / Challenge

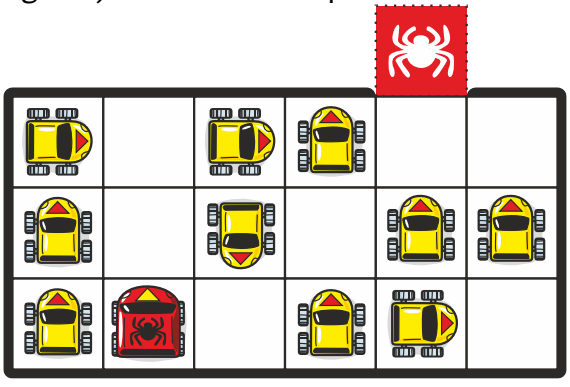
What type of milk should be poured into both funnels so that white milk comes out when connecting three machines as shown in Fig. 3?

A) white milk, white milk
B) white milk, chocolate milk
C) chocolate milk, white milk
D) chocolate milk, chocolate milk

T9. Robot parking

Robot cars in a fenced area can move around according to the following rules:
One *move* of a robot can be either:

- one square forward
- one square backward
- turn left (90 degrees) in the current square, or
- turn right (90 degrees) in the current square.



In addition, only the spider car can move outside the fenced area to the spider square.

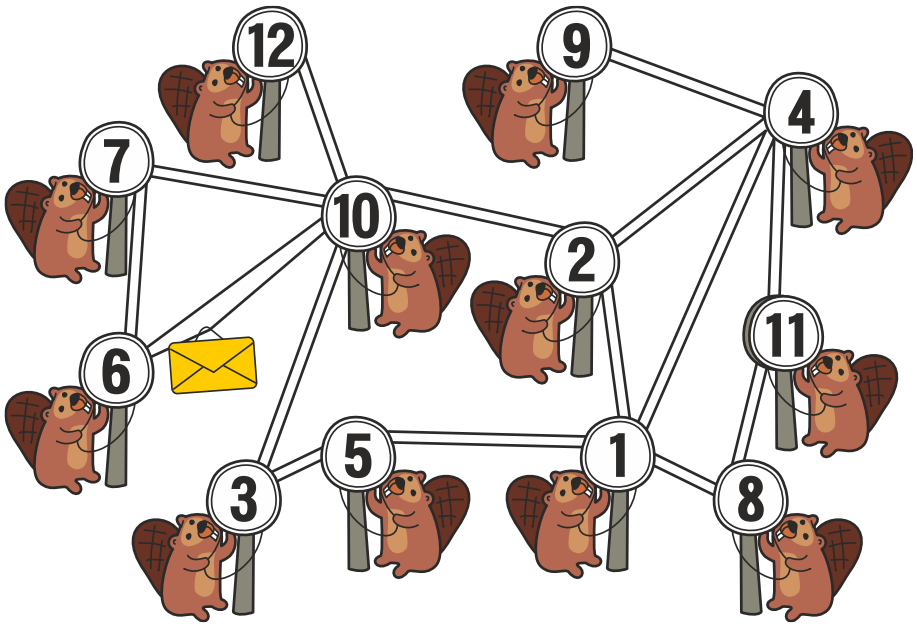
Question / Challenge

What is the minimum number of robot moves needed to get the spider car to the spider square?

A) 9 **B)** 11 **C)** 12 **D)** 14

T10. Spreading the news

There is a large colony of beavers, where 12 Beavers live. Each one has his own hole but as we can see on the picture the holes are connected with ropes the beavers use to transfer the messages.



The beavers really like to be informed about the events as quickly as possible. Whenever one hears a good story he immediately uses all the ropes in his hole to inform the other beavers. For example, if the beaver in the hole 8 hears a story, he informs beavers in holes 1 and 11. The next ones who will hear the story, are the beavers in holes 2, 4 and 5 and so on, till all the beavers know the latest story.

Question / Challenge

Which beaver you should inform if you wanted the story will be known to all beavers as soon as possible?

A) 2 **B)** 4 **C)** 7 **D)** 12

T11. Echo cipher

Do you know how to add two letters? It's easy: both letters become the numbers of their order in alphabet. This order is given below.

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
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

The result of adding two letters, then, is a letter whose order in alphabet is a result of addition of those numbers.

Thus, for A+A, we find 1+1 = 2, and 2 gives us B. Thus A+A = B.

$$\begin{array}{rcl} A & \leftrightarrow & 1 \\ +\ A & \leftrightarrow & +\ 1 \\ =\ B & \leftrightarrow & =\ 2 \end{array}$$

Similarly, A+B=C, and C+E=H.
If resulting number is bigger than number of letters in the alphabet, we can start again from the beginning of the alphabet, Thus, Z+A = A, and Y+C = B.

Jaroslav uses this addition of letters for encrypting his memories. He works so: first he thinks up one number - he calls it '*modus*'. He writes one word and then once more the same word below the first one it but shifted to the right as many positions as corresponds to the Modus.

For example, if the *modus* is 3, it looks like:

R A B B I T
R A B B I T

Then he writes the result of the addition of the letters in the same column in 3rd row. The text in the 3rd row is the encrypted text.

Example: Taking *modus* as 2, and applying the encryption on the word 'BEAR'

B E A R
+ B E A R
= B E C W A R

So the word 'BEAR' upon encryption with modus 2 becomes 'BECWAR'.

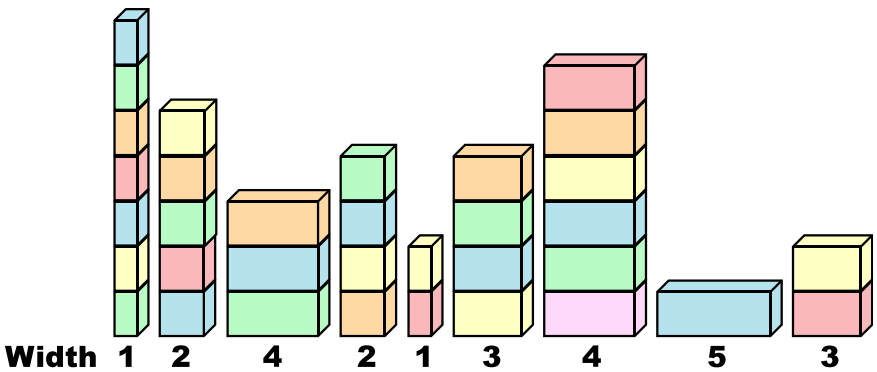
Question / Challenge

We have an encrypted text of which the 10 first letters are ACDGDQGPE. We don't know the modus for this encryption. The start of the original text is one of the four options given below. Which one is it?

A) ACDCMETALL
B) ACCUMULATE
C) ABBEYROAD
D) ABBREVIATE

T12. Towers of Blocks

Sam, the little beaver, is playing with his toy blocks. Each block is the same height, but different width. He built nine beautiful towers, each one made with blocks of the same width.



There are two ways to change the height of a tower: adding blocks to the top or removing blocks from the top. Either way, the energy cost to change the height of a tower is proportional to the width and the number of the blocks. For example: Removing 2 blocks from a tower with the width of 1 costs 2*1 = 2 units of energy; and adding 4 blocks to a tower with the width of 3 costs 4*3 = 12 units of energy.

Sam wants all towers to be the same height, and he wants to spend as little energy in total as possible.

Question / Challenge

In total, what is the minimum amount of energy that will cost Sam to make all towers the same height?

A) 27 **B)** 39 **C)** 45 **D)** 49

T13. Password Security

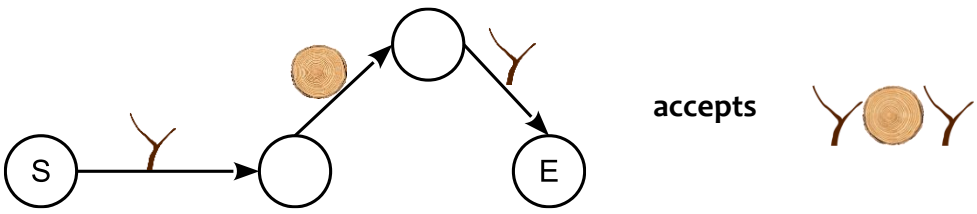
The beavers make up a set of passwords for securing their lodge. The passwords consist of only these two beaver symbols:  and  .

They use password checkers to make sure a given password is acceptable.

The beavers use circles and arrows to describe how a checker works:

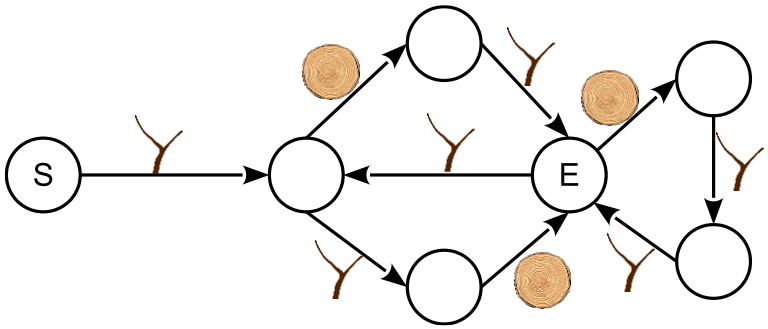
- A checker always starts at the circle "S".
- The checker reads passwords symbol by symbol from left to right. At each circle, the checker reads one symbol.
- If at the current circle there is an outgoing arrow labeled with the current symbol, the checker follows that arrow to the next circle; otherwise the checker stops and does not accept the password.
- Also, if there are no more symbols to read, the checker stops. Only when the checker stops at the circle "E" will it accept the password.

For example, this simple checker accepts only one password:



Question / Challenge

The beavers come up with several sets of symbols to create passwords.
From which set can you create a password that the password checker below accepts?



A) 4 x , 8 x

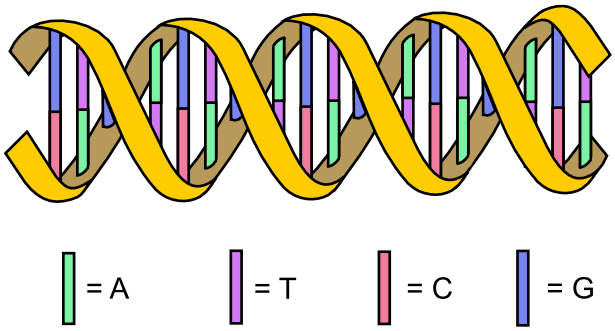
B) 3 x , 4 x

C) 5 x , 8 x

D) 5 x , 7 x

T14. DNA sequence

Every creature has a sequence of DNA that determines the genes of a creature. The sequence of DNA is formed from several nitrogen bases which can be formed from 4 types namely Adenine (A), Guanine (G), Cytosine (C), and Thymine (T). DNA can mutate to form a new series that is different from the original sequence.



Vormi is a creature that can mutate in 3 ways, as follows (new graphics have not been inserted, available in the folder):

1. Substitution: Changes one base component with another base component in the DNA sequence.
   Example: AGGTC becomes AGGTA (change C to A)
2. Deletions: Elimination of one of the base components of the DNA sequence.
   Example: AGGTC becomes AGTC (delete one G)
3. Duplication: Addition of base components to the DNA sequence repeatedly.
   Example: AGGTC becomes AGGTTC (duplicate T)

Question / Challenge

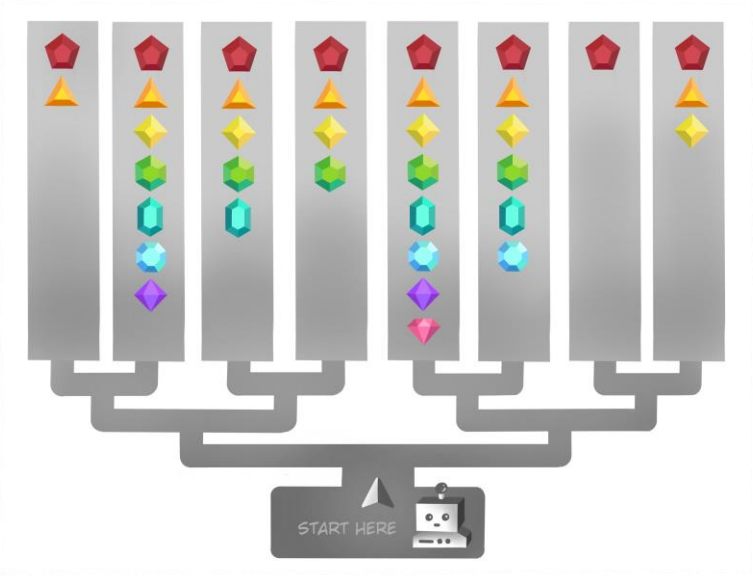
Given four DNA sequences of Vormi creature. Which sequence cannot be generated from 3 gene mutations if the initial DNA sequence from Vormi is "GTATCG" ?

A) "GCAATG"
B) "ATTATCCG"
C) "GAATGC"
D) "GGTAAAC"

Tasks T15 – T21 carry 5 points each

T15. Robot Maze Game

Alice and Bob are controlling a robot in a maze with gems. The robot starts at the location in the maze shown below. The robot will keep following the path until a fork in the maze is reached. One of the players decides which path (left or right) the robot should take. The robot will then follow the path again until a fork is reached, and so on.



Alice and Bob take turns deciding, with Alice going first.
The game ends when the robot reaches a dead end. It then takes all the gems there. Alice wants to make the robot end up with highest number of gems possible, while Bob wants to make the robot end up with the least.
Alice and Bob both know that each one will try to outsmart the other. So if for example Bob will direct the robot towards the fork where 2 or 7 gems are reachable, he knows that Alice will command the robot to chose the path towards 7 gems.

Question / Challenge

How many gems will the robot end up with?

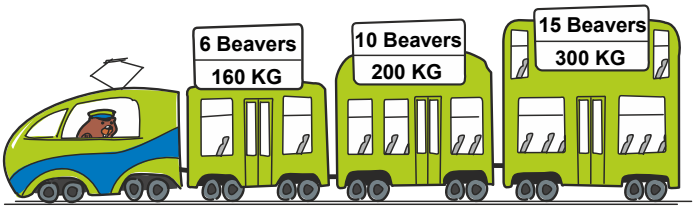
A) 1 **B)** 3 **C)** 5 **D)** 8

T16. Train Trip

Eight beaver families would like to go on a train trip. The train has a limited number of seats and limits the weight of luggage. The families' data is presented in the following table:

Family	Number of members	Luggage weight [kg]
Avsec (A)	3	50
Bizjak (B)	4	80
Cerar (C)	5	110
Dolenc (D)	4	80
Erjavec (E)	2	40
Furlan (F)	3	70
Gabric (G)	6	130
Hacin (H)	5	100

The train company had the following train carriage composition, with the number of available seats and the luggage limits written on the diagram:



Question / Challenge

How many families can go on a trip, if:

- every beaver must sit on its own seat,
- all members of the same family must sit in the same carriage,
- the luggage has to be in the same carriage as the family members, and
- the weight of the luggage has to be within the limits of each carriage?

A) 1 **B)** 3 **C)** 6 **D)** 7

T17. Beaver Meetings

Beaver Kim went to the weekly market. While doing his shopping he met two other beavers there, Beavers b1 and b2. Beavers b1 and b2 also met two beavers at the market. How many beavers could have been at the market so that beavers Kim, b1 and b2 were able to meet two beavers each?

We can represent the beavers and the potential beavers they came into contact with at the market with a graphic shown below:

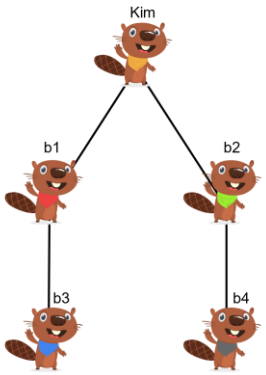


Figure 1

Beaver Kim met beaver b1 and beaver b2.
Beaver b1 met beaver Kim and beaver b3.
Beaver b2 met beaver Kim and beaver b4.
In this case, at least 5 beavers were at the market.

There are two further potential solutions to the same question:

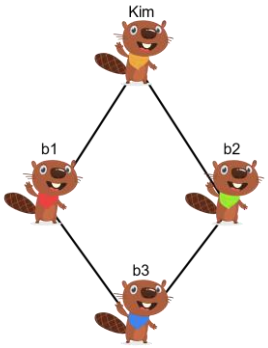


Figure 2

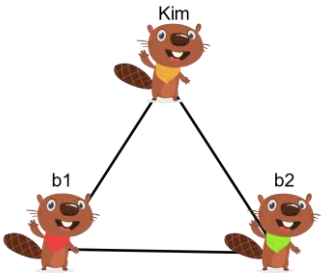


Figure 3

In the cases above, at least 4 beavers (Figure 2) or 3 beavers (Figure 3) were at the market.

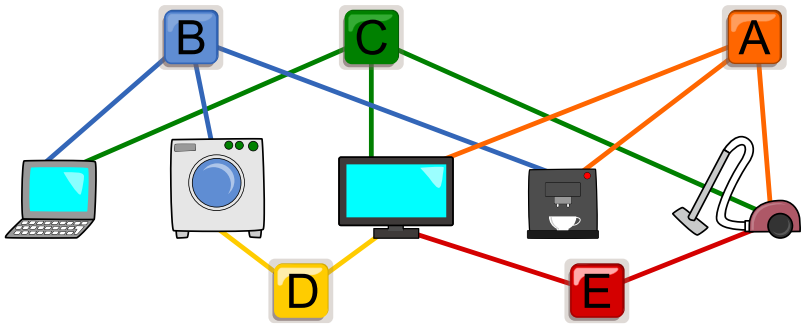
Question / Challenge

The following week, beaver Kim went to the market again and met three other beavers there. The number of beavers that these other three beavers met at the market are two, five and five respectively.
What is the ***smallest*** possible number of beavers that were present at the market?

A) 5 **B)** 6 **C)** 7 **D)** 8

T18. Household appliances

In B-taro's house, there are five household appliances (computer, washing machine, TV, coffee machine, and vacuum cleaner), and five buttons (A, B, C, D, and E) to control those appliances. You can change the on/off state of the appliances by pressing the buttons. However, the buttons are designed to be inconvenient. As the buttons are connected to multiple appliances, each button changes the on/off state of multiple appliances at the same time.



- Button A is connected to TV, coffee machine, and vacuum cleaner.
- Button B is connected to PC, washing machine, and coffee machine.
- Button C is connected to PC, TV, and vacuum cleaner.
- Button D is connected to washing machine and TV.
- Button E is connected to TV and vacuum cleaner.

Question / Challenge

What is the correct sequence of buttons to press to turn on only the TV and coffee machine?

A) E, C, B, A **B)** C, B, A, D **C)** D, A, E, C **D)** B, D, C, E

T19. Money bags

Dan the beaver usually carries his iron coins in waterproof bags, to prevent them from rusting while he is swimming. Today, he has 63 one-Bebro coins and wants to put them in some bags so that he can pay any amount from 1 Bebro to 63 Bebros by just handing over the bags without opening them.

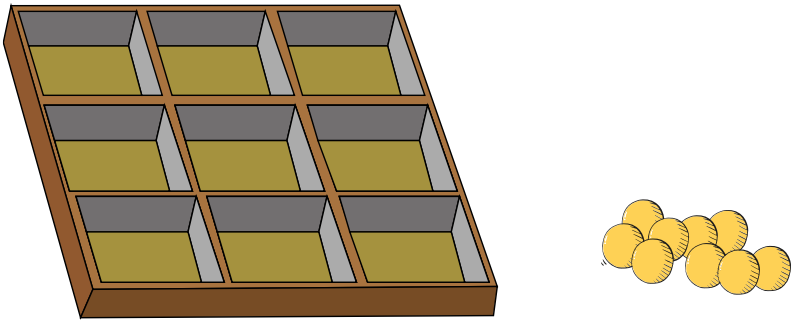
Question / Challenge

What is the smallest number of bags he needs?

A) 2 **B)** 4 **C)** 6 **D)** 8

T20. Sixteen Marbles and Boxes

Hira has a box with 9 trays, as well as 9 marbles:



Hira chooses between 0 and 9 marbles and places them in the box according to the following rules:

- Each marble is in a different tray.
- The total number of marbles in each row is even.
- The total number of marbles in each column is even.

Question / Challenge

In how many different ways can Hira place the marbles in the box?

A) 12 **B)** 16 **C)** 64 **D)** 512

T21. Stickers

Betty Beaver is playing with four kinds of stickers that contain the words ABBA, GAGA, GIBB and IGGY. She creates a word by using the stickers on an empty piece of paper. When a sticker is used at some position, it covers four characters starting from this position. Betty has a lot of stickers of each kind.

For example, one of the ways to create the word GIABIGGYGA would be to use the stickers as follows (asterisks mean empty positions):

1. GIBB at position 1: GIBB******
2. ABBA at position 3: GIABBA****
3. GAGA at position 7: GIABBAGAGA
4. IGGY at position 5: GIABIGGYGA

Question / Challenge

Which of the following 4 words can be created by Betty's stickers?

A) AGGIBBAGAGGYBAGGY
B) AGGIBBAGAGGABABGA
C) AGGIBAAGGGGABABGA
D) AGIIBAAGAGYABABGA