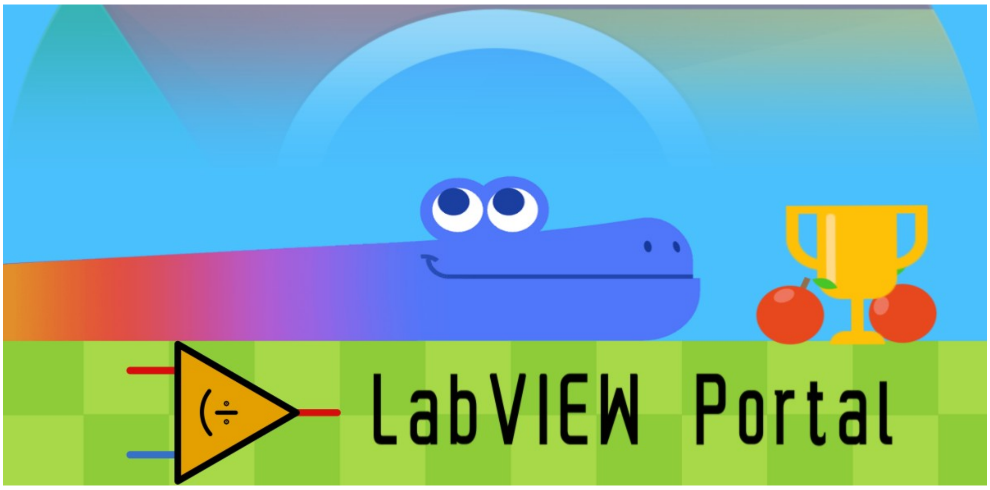
Snake Game



Snake *is the common name for a video game concept where the player maneuvers a line which grows in length, with the line itself being a primary obstacle.*

The player controls a dot, square, or object on a bordered plane. As it moves forward, it leaves a trail behind, resembling a moving snake. In some games, the end of the trail is in a fixed position, so the snake continually gets longer as it moves. In another common scheme, the snake has a specific length, so there is a moving tail a fixed number of units away from the head. The player loses when the snake runs into the screen border, a trail, other obstacle, or itself.

wikipedia.org

We are glad to inform you that registration for the **LabVIEW Portal 2021 Olympiad** is open.

The Olympiad is extramural and online, everyone can join the competition regardless of their country of residence. Communication with the organizing committee is possible in Russian or English.

Teams size is from one to three people, and registration is possible until deadline of solutions.

The team chooses its name. The name can only consist of Latin letters, numbers, underscores ("_"), periods and spaces. Period and space cannot be the first characters.

The arbiter program was developed with the LabVIEW 2015. The competition itself will be held with LabVIEW 2020 32bit. If you do not have a LabVIEW license, you can use LabVIEW Community Edition 2020.

Participants have to write their software solutions with LabVIEW without using additional libraries and toolkits. It is forbidden to call system functions and any *dlls* in solutions. The use of local and global variables, as well as any other means of transferring information between steps is also prohibited. Only methods implemented in the Arbiter are allowed.

All solution functions must have a standard execution priority.

For attempts to hack the program-arbiter, the team is disqualified.

Teams can communicate freely about the details of the competition on the forum, including posting their code. The organizers do not disclose the participants' solutions until the end of the Competition, but we can publish these solutions at the end of the competition.

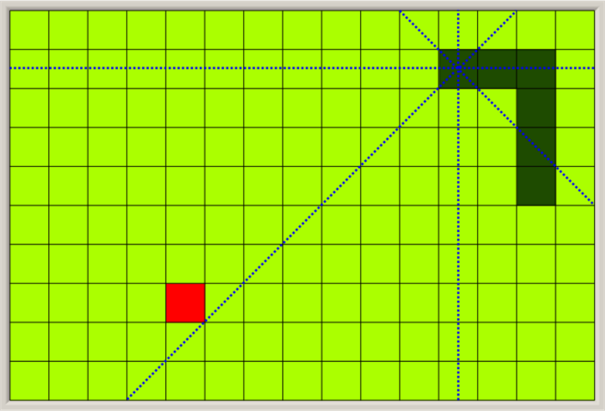
Participants must send their solutions by **12 p.m. (24:00) on April 25, 2021 (by UTC time)** to email LabVIEWPortal@yandex.ru or with a personal message to the organizers of the Olympiad:

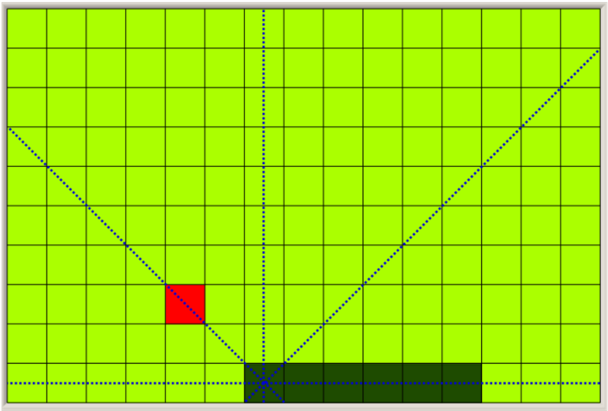
Artem.spb	https://labviewportal.org/ucp.php?i=pm&mode=compose&u=2340
IvanLis	https://labviewportal.org/ucp.php?i=pm&mode=compose&u=987
Pavel Krivozubov	https://labviewportal.org/ucp.php?i=pm&mode=compose&u=117

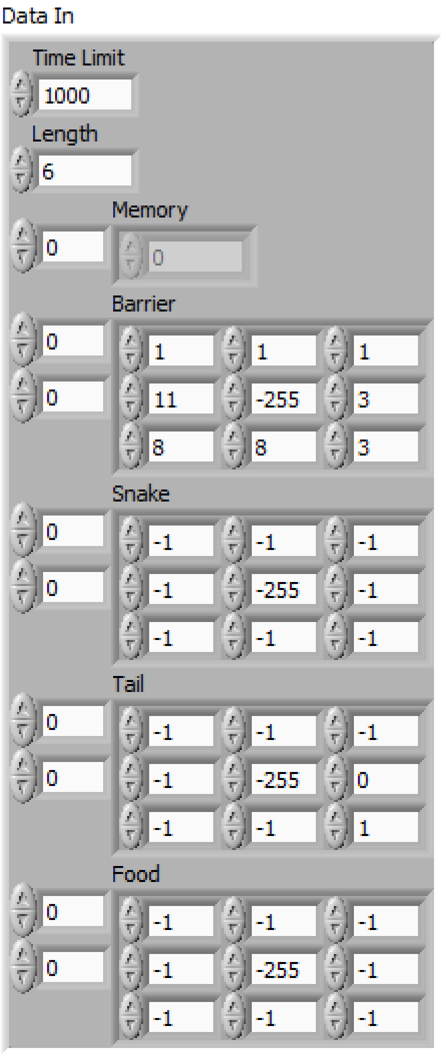
Solutions sent after the specified time will not be accepted.

The solution must contain a VI file with the same name as the command. All used subroutines (*SubVI*, *TypeDef*) are placed in a subfolder with any name, but all the names of folders and files must be written in Latin.

General structure of the world







Data In

Time Limit

1000

Length

6

Memory

0

0

Barrier

0

0

1	1	1
11	-255	3
8	8	3

Snake

0

0

-1	-1	-1
-1	-255	-1
-1	-1	-1

Tail

0

0

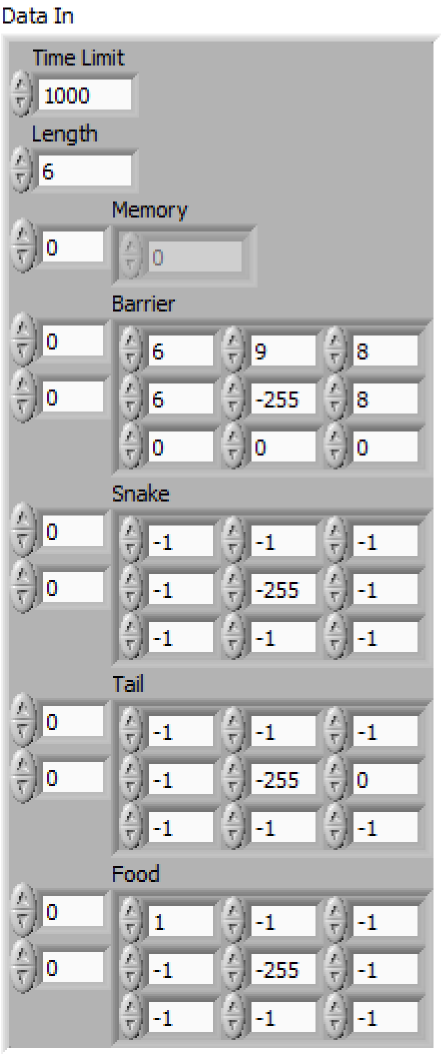
-1	-1	-1
-1	-255	0
-1	-1	1

Food

0

0

-1	-1	-1
-1	-255	-1
-1	-1	-1



Data In

Time Limit

1000

Length

6

Memory

0

0

Barrier

0

0

6	9	8
6	-255	8
0	0	0

Snake

0

0

-1	-1	-1
-1	-255	-1
-1	-1	-1

Tail

0

0

-1	-1	-1
-1	-255	0
-1	-1	-1

Food

0

0

1	-1	-1
-1	-255	-1
-1	-1	-1

The playing field is flat, discrete and has dimensions [*Xm*, *Ym*], where *Xm* is the number of cells horizontally, and *Ym* is vertical. .

There are several players on the field - “Snakes”. Players take turns, and all changes that occurred as a result of the player's actions are recorded in the game world, and the next player receives the actual information.

Snake

At the beginning of the round, all Snakes have initial length *Ls* and are placed on the field. During the game, the length of the Snake changes, the food eaten increases the length by 1 (the tail increases), every *Sd* moves the length decreases by 1 (the tail is cut off).

At the beginning of each step, the snake receives information about the state of the world: 4 arrays 3*3 with distances to the obstacle (*Barrier*), enemy (*Snake*), own body (*Tail*) and food (*Food*) in this direction. Any objects on the field are not transparent, which means that the snake sees only the nearest object and has no information about what is behind it. Distance in all directions has an integer value and determines the number of cells to the object.

In case of colliding with an obstacle (board), the opponent's body or its own body (movement in the opposite direction is unacceptable), the Snake dies and turns into an obstacle, the team gets a number of score points equal to the number of moves from the start of the round *Ps*.

The use of local variables, shift registers, files, or other methods to store information is prohibited. Each snake has its own memory size 1024 bytes and can store information necessary for its functioning. If the allocated amount of memory is exceeded, it will be truncated to the specified size.

Food

Food on the field is placed randomly in free cells (if any), the amount of food on the field at the beginning of each turn is *Fs*. After the food has been eaten, in the next step, it appears in a random place.

Movement

The snake moves in one of four absolute directions: up, down, right or left.

The time per step (making a decision) is limited and during the round decreases from *Tmax* (3000 ms) to *Tmin* (10 ms). The current timeout value is transmitted along with the current world information.

If during the timeout the snake function has not completed its work, then the arbiter considers that the snake continues to move in the same direction.

Competitions

Before the start of the competition (first round), all participants are randomly assigned to groups. The number of participants in the group depends on the playing field and does not change during the round.

During one round, several rounds (games) are held between the members of each group with a change in the initial position of the players, the change is performed "in a circle". The number of rounds is determined by the number of participants in the group.

At the end of round, the points are calculated for each team received for the round within the group.

Before the next round (second and subsequent), all participants are ranked in accordance with the points gained for all previous rounds and redistributed into groups.

Determination of the winner of the competition

The Pr of score points earned by the Snake for a round are determined at the end of the round (death of all Snakes). The Snake that made the least number of steps Ps receives 0 points, and the highest receives 1 point. The rest of the teams are distributed between 0 and 1 in accordance with the number of steps taken. The calculation example is shown in the table.

$$Pr_i = \frac{Ps_i - min(Ps)}{max(Ps) - min(Ps)}$$

Team	Number of steps *Ps*	min max	Shift $Ps_i - min(Ps)$	max	Score $Pr_i = \frac{Ps_i - min(Ps)}{max(Ps) - min(Ps)}$
Snake_1	50	30 60	20	30	20 / 30 = **0.666667**
Snake_2	40		10		10 / 30 = **0,333332**
Snake_3	60		30		30 / 30 = **1**
Snake_4	30		0		0 / 30 = **0**

During one game tour, opponents can play several round (game), and the result score is calculated as:

$$Pt = \sqrt{\sum (Pr_i)^2}$$

The competition is held according to the Swiss system (with some modifications) and the total score is determined as:

$$P = \sqrt{\sum (Pt_i)^2}$$

The distribution of opponents into groups in the first round is determined by drawing lots (random distribution). Groups for the next rounds are determined by ranking, according to the total score in the previous rounds.

If by the results of the last round opponents claiming a prize place scored an equal number of points, then to determine the winner additional rounds are held.

An example

Let's say 13 teams take part in the competition. There will be three opponents on the field at the same time. To determine opponents in the first round, the players are randomly assigned to groups.

Teams	**Game tour 1**					
	After draws	**Groups**	**Round 1.1**	**Round 1.2**	**Round 1.3**	**Result**
Snake_1	Snake_6	***1***	0	0.2	0	**0.200000**
Snake_2	Snake_13		1	0	1	**1.414214**
Snake_3	Snake_2		0.4	1	0.7	**1.284523**
Snake_4	Snake_9	***2***	1	1	1	**1.732051**
Snake_5	Snake_11		0	0.1	0	**0.100000**
Snake_6	Snake_1		0.7	0	0.5	**0.860233**
Snake_7	Snake_4	***3***	0	0	0	**0.000000**
Snake_8	Snake_8		0.9	1	1	**1.676305**
Snake_9	Snake_3		1	0.8	0.7	**1.459452**
Snake_10	Snake_12	***4***	1	1	1	**1.732051**
Snake_11	Snake_7		0	0	0	**0.000000**
Snake_12	Snake_10		0.3	0.7	0.9	**1.178983**
Snake_13	Snake_5	**–**				**1.000000**

After the first game tour teams distribute this way.

Results		**Game tour 2**					***Total score***
Team	**Score**	**Groups**	**Round 2.1**	**Round 2.2**	**Round 2.3**	**Result**	
Snake_9	**1.732051**	***1***	0	0.2	0	**0.200000**	***1.743560***
Snake_12	**1.732051**		1	0	1	**1.414214**	***2.236068***
Snake_8	**1.676305**		0.4	1	0.7	**1.284523**	***2.111871***
Snake_3	**1.459452**	***2***	1	1	1	**1.732051**	***2.264950***
Snake_13	**1.414214**		0	0.1	0	**0.100000**	***1.417745***
Snake_2	**1.284523**		0.7	0	0.5	**0.860233**	***1.545962***
Snake_10	**1.178983**	***3***	0	0	0	**0.000000**	***1.178983***
Snake_5	**1.000000**		0.9	1	1	**1.676305**	***1.951922***
Snake_1	**0.860233**		1	0.8	0.7	**1.459452**	***1.694108***
Snake_6	**0.200000**	***4***	1	1	1	**1.732051**	***1.743560***
Snake_11	**0.100000**		0	0	0	**0.000000**	***0.100000***
Snake_4	**0.000000**		0.3	0.7	0.9	**1.178983**	***1.178983***
Snake_7	**0.000000**	***–***				**1.000000**	***1.000000***

After the second round results are here.

Results		**Game tour 3**					***Total score***
Team	**Score**	**Groups**	**Round 3.1**	**Round 3.2**	**Round 3.3**	**Result**	
Snake_3	**2.264950**	***1***	0	0.2	0	**0.200000**	***2,273763***
Snake_12	**2.236068**		1	0	1	**1.414214**	***2,645751***
Snake_8	**2.111871**		0.4	1	0.7	**1.284523**	***2,471841***
Snake_5	**1.951922**	***2***	1	1	1	**1.732051**	***2,457641***
Snake_9	**1.743560**		0	0.1	0	**0.100000**	***1,746425***
Snake_6	**1.743560**		0.7	0	0.5	**0.860233**	***1,944222***
Snake_1	**1.694108**	***3***	0	0	0	**0.000000**	***1,694108***
Snake_2	**1.545962**		0.9	1	1	**1.676305**	***2,280351***
Snake_13	**1.417745**		1	0.8	0.7	**1.459452**	***2,034699***
Snake_10	**1.178983**	***4***	1	1	1	**1.732051**	***2,095233***
Snake_4	**1.178983**		0	0	0	**0.000000**	***1,178983***
Snake_7	**1.000000**		0.3	0.7	0.9	**1.178983**	***1,545962***
Snake_11	**0.100000**	***–***				**1.000000**	***1,004988***

If the competition was held in three rounds, then the places would be distributed as follows.

Team	Result	Place
Snake_12	2.645751	***1***
Snake_8	2.471841	***2***
Snake_5	2.457641	***3***
Snake_2	2.280351	***4***
Snake_3	2.273763	***5***
Snake_10	2.095233	***6***
Snake_13	2.034699	***7***
Snake_6	1.944222	***8***
Snake_9	1.746425	***9***
Snake_1	1.694108	***10***
Snake_7	1.545962	***11***
Snake_4	1.178983	***12***
Snake_11	1.004988	***13***

Suppose that the two top lines were taken by the teams with an equal number of points. In this case, they will take part in an additional round of several rounds and will take first and second places, respectively.

The minimum number of rounds required for a fair determination of the prize three, depending on the number of participants:

Teams	Game tours
7 – 8	5
9 – 16	6
17 – 32	7
33 – 64	8
65 – 128	9
129 – 256	10
257 – 512	11
513 – 1024	12
1025 – 2048	13
2049 – 4096	14
4097 – 8192	15