

## RULES FOR COMPETITIONS «JOURNEY»

*Version 1.0 dated June 29, 2016*

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## 1. General rules

### 1.1. Description of task

1.1.1. The robot participating in Journey competitions should perform Line Follower, Labyrinth, and Kegelring tasks in sequence within one heat.

### 1.2. Categories of competitions

1.2.1. Journey competitions are held in two categories: «junior» and «senior».

1.2.2. A heat in the junior category takes five minutes, and in the senior one – three minutes.

1.2.3. In each category, the robot should pass four polygons with tasks. The tasks at the polygons for the respective categories are given in Table 1.

Table 1. Table 1. Tasks for categories at polygons

No.	Category	
	Junior (see Fig. 1)	Senior (see Fig. 2)
1	«Line Follower with Fixed Obstacle» (see Section 2)	«Line Follower with Moving Obstacle» (see Section 2)
2	Labyrinth (see Section 3)	
3	«Line Follower with Slide» (see Section 2)	«Line Follower with Inversion» (see Section 2)
4	Kegelring (see Section 4)	

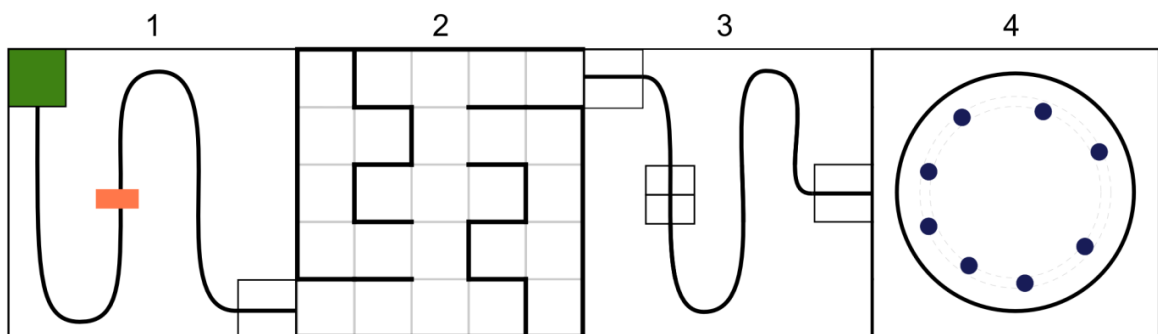


Fig. 1. Polygon layout for junior category

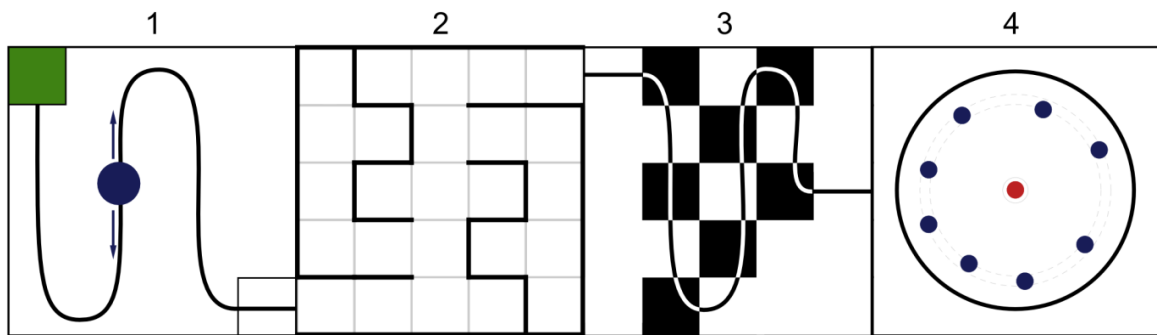


Fig. 2. Polygon layout for senior category

### 1.3. Requirements for robot

- 1.3.1. The maximal width of the robot is 25 cm, and the length is 25 cm. The robot height is unlimited.
- 1.3.2. During the competitions, the size of the robot may change but should not go beyond the limits given in Clause 1.3.1 of this Section.
- 1.3.3. The robot must be fully autonomous after the start. Otherwise, the robot should be disqualified.
- 1.3.4. It is prohibited to use any adhesive devices on the robot body for skittles collecting.

### 1.4. Order of the contests

- 1.4.1. Before competitions, all the participants hand over their robots to the zone which is inaccessible for them (quarantine). During the competitions, the participants may take robots only from the quarantine zone and only on command of the referee. After the heat the participant puts his/her robot back to the quarantine zone.
- 1.4.2. Labyrinth polygon layout changes after all the participants hand over their robots to the quarantine zone or on decision of the referee. After Labyrinth polygon layout is changed, the participants cannot hand over their robots to the quarantine zone.
- 1.4.3. Before a heat the robot is set at the start zone of polygon 1 so that none of its parts extend over the limits of such zone.
- 1.4.4. The participant starts his/her robot on the referee's command. Time is counted from this moment.
- 1.4.5. The robot should act independently only. The robot cannot be controlled by the participant (or other participants) in any way. Otherwise, the heat should be stopped, and the robot should be disqualified.
- 1.4.6. During the heat, the participants should not touch the polygon. Otherwise, the heat may be stopped on decision of the referee, and the robot - disqualified.
- 1.4.7. The robot should pass polygons according to Sections II, III and IV of this Regulation (see Table 1).
- 1.4.8. Each polygon has its own start and finish zones. Table 2 and Table 3 shows the start and finish zones of the junior and senior category polygons respectively.

Table 2. The start and finish zones at the junior category polygons (the designations of the zones are given in accordance with Fig. 4)

Polygon	Start zone	Finish zone
1. Line Follower	A	B
2. Labyrinth	B	C
3. Line Follower	C	D
4. Kegelring	D	D

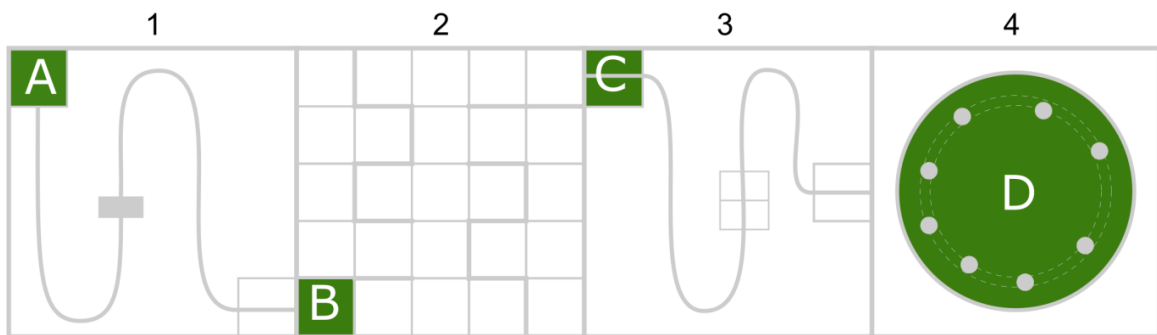


Fig. 3. The start and finish zones at the junior category polygons

Table 3. The start and finish zones at the senior category polygons (the designations of the zones are given in accordance with Fig. 4)

Direction of heat:	From base camp		To base camp	
	Start zone	Finish zone	Start zone	Finish zone
1. Line Follower	A	B	G	A
2. Labyrinth	B	C	F	G
3. Line Follower	C	D	E	F
4. Kegelring	D	E	D	E

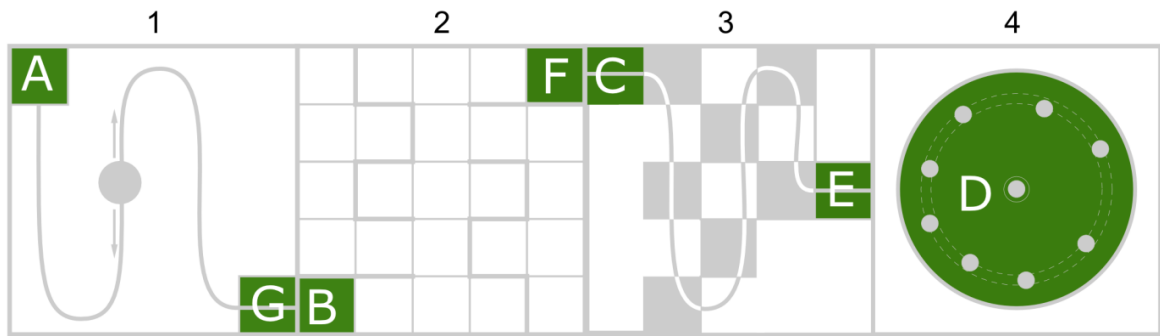
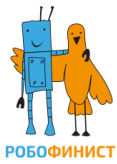


Fig. 4. The start and finish zones at the senior category polygons

- 1.4.9. The robot starts to perform a polygon task when it crosses the line which limits the start zone of such polygon after the robot is fully in the start zone.
- 1.4.10. The robot finishes performing a polygon task when it crosses the line which limits the finish zone of such polygon unless otherwise provided by the polygon task.
- 1.4.11. Depending on the category in which the robot performs, the task is considered completed if
- 1.4.11.1. *in the junior category* the robot passed the whole route, completes all the tasks at each of polygons, and stops in the finish zone;
- 1.4.11.2. *in the senior category* the robot completing polygon tasks one by one returned to Base Camp zone, and delivered the central skittle of Kegelring task (see Clause 4.2.2.3 Section 4). The skittle is considered delivered to Base Camp zone if none of its parts extends over the lines which limit such zone.
- 1.4.12. The heat is stopped or cancelled in the following cases:
- 1.4.12.1. The robot completes the task according to Clause 1.4.11 of this Section, and the participant announces it with Stop! command. In such case, the heat and time counting stop.
- 1.4.12.2. The time allocated for completing the task expired. In such case the heat is stopped.
- 1.4.12.3. The robot was disqualified according to Clauses 1.4.5, 1.4.6 of this Section. In such case, the heat is stopped, and the maximal time allocated for completing such task is registered (see Clause 1.2.2 of this section).
- 1.4.12.4. The robot was disqualified according to the respective polygon rules (Clauses 2.3.5, 2.3.6, 2.3.8 Section 2, 3.2.3 Section 3, 4.2.4 Section 4). In such case, the heat is stopped, and the participant manually sets the robot in the start zone of the next polygon. If disqualification occurred at the last polygon, the participant sets the robot in the start zone of such polygon. In such case the time counting is not stopped.

## 1.5. Counting points

- 1.5.1. The robot scores points for completing tasks at polygons:



- 1.5.1.1. *in the junior category* in accordance with Table 4;
- 1.5.1.2. *in the senior category* in accordance with Table 5.
- 1.5.2. If the robot's heat was terminated according to par. 1.4.13.3 of this section, the robot does not score the points for completing the task at the polygon at which the heat was stopped<sup>1</sup>.

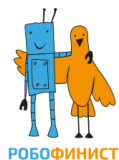
*Table 4. Scoring points in junior category*

<b>Action</b>	<b>Point</b>
The robot completes the task of polygon 1 and is fully in the start zone of polygon 2	40
The robot completes the task of polygon 2 and is fully in the start zone of polygon 3	80
The robot completes the task of polygon 3 and is fully in the start zone of polygon 4	40
The robot pushed out one skittle outside the ring at polygon 4 Kegelring	5 (for each of 8 skittles)
<b>Total maximum:</b>	<b>200</b>

- 1.5.3. The sum of the points which the robot scores as it completes tasks is the final result. If the competitions are held in several attempts, the sum of the points which the robot scores as it completes tasks in each attempt is the final result of such attempt. The maximal result of all the attempts is the final result of the robot.
- 1.5.4. The time from the beginning of the heat to the end of the heat is the final time of the robot in each attempt provided the heat is not stopped due to the robot's disqualification (according to Clause 1.4.12.3 of this Section). Otherwise, the maximal time allocated for the attempt is the final time of the robot. The final time of the attempt with the best final result is the final time of the robot.
- 1.5.5. The robot with the maximal final result is announced best.
- 1.5.6. If the final results are equal, provided the competitions were held in several attempts, the results of the remaining attempts of robots are compared in the descending order.
- 1.5.7. If the points are equal in all the attempts, the final time of each attempt is compared (in such case attempts are arranged in the descending order of the final result). The result of the robot which spends the least time in its best attempt is announced best.
- 1.5.8. If the final time is equal in each attempt, the weight of robots is compared. The

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<sup>1</sup> In the senior category, the fact that a heat is stopped in the direction from the base camp does not cancel the points which are scored at the same polygon as a heat is performed in the opposite direction.



robot with the least weight is announced best.

*Table 5. Scoring points in senior category*

<b>Action</b>	<b>Point</b>
The robot completes the task of polygon 1 and is fully in the start zone of polygon 2	40
The robot completes the task of polygon 2 and is fully in the start zone of polygon 3	80
The robot completes the task of polygon 3 and is fully in the start zone of polygon 4	40
The robot pushes out one skittle outside the ring at polygon 4 (except for the central skittle)	5 (for each of 8 skittles)
The robot pushes out the central skittle outside the ring at polygon 4	0
The robot is fully in the start zone of polygon 3 and delivers the central skittle to such zone	40
The robot is fully in the start zone of polygon 3 and does not deliver the central skittle to such zone	20
The robot completes the task of polygon 3, is fully in the start zone of polygon 2 and delivers the central skittle to such zone	40
The robot completes the task of polygon 3, is fully in the start zone of polygon 2 and delivers the central skittle to such zone	20
The robot completes the task of polygon 2, passes the labyrinth by the shortest route, is fully in the start zone of polygon 1 and delivers the central skittle to such zone	80
The robot completes the task of polygon 2, passes the labyrinth not by the shortest route, is fully in the start zone of polygon 1, delivers the central skittle to such zone, or completes the task of polygon 2, passes the labyrinth not by the shortest route, is fully in the start zone of polygon 1, and does not deliver the central skittle to such zone	40
The robot completes the task of polygon 2, passes the labyrinth not by the shortest route, is fully in the start zone of polygon 1 and does not deliver the central skittle to such zone	20
The robot completes the task of polygon 1, is fully in the finish zone of polygon 1 and delivers the central skittle to such zone	40
The robot completes the task of polygon 1, is fully in the finish zone of poly-	20

gon 1 and does not deliver the central skittle to such zone	
<b>Total maximum:</b>	<b>440</b>

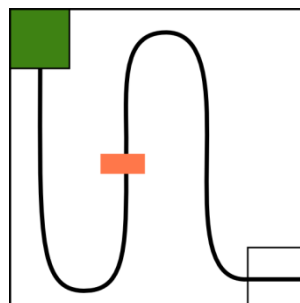
## 2. Line Follower

### 2.1. Description of polygon

- 2.1.1. The polygon is a white rectangular field marked with a black line.
- 2.1.2. The line is 50 mm wide.
- 2.1.3. The line curvature radius is over 300 mm at any point of such line.
- 2.1.4. The minimum distance at which the line should approach the end of the competitive field must be at least 15 cm when measured from the center line.
- 2.1.5. The start and finish zones are limited with the black line in the form of a square 20 mm thick.

### 2.2. Additional Features

- 2.2.1. Line Follower polygons have additional complications: «fixed obstacle», «slide», «moving obstacle» and «inversion».
- 2.2.2. At Line Follower with Fixed Obstacle polygon, an obstacle in the form of a solid parallelepiped fixed to the field and having such dimensions as  $(250\pm 5)\times(120\pm 5)\times(65\pm 2)$  mm (W×H×D) (see Fig. 5) is put in an arbitrary place across the line.



*Fig. 5. Line Follower with Moving Obstacle polygon*

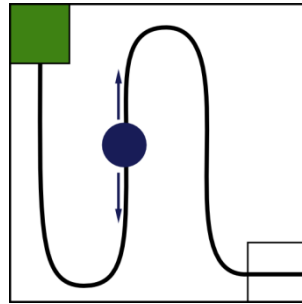
**Recommendation:** a standard single building brick may be used as an obstacle.

- 2.2.3. An obstacle in the form of an autonomous robot moving along the same line fragment as the main robot is set at Line Follower with Moving Obstacle polygon (see Fig. 6). The line fragment along which the obstacle moves is limited with special markers. Having reached the marker, the obstacle changes its direction to the opposite one.
  - 2.2.3.1. The participating robot should pass the obstacle with the latter moving in the same or opposite direction.
  - 2.2.3.2. The robot acting as an obstacle has a cylindrical shape. The cylinder is 160 mm in diameter, and 200 mm high.



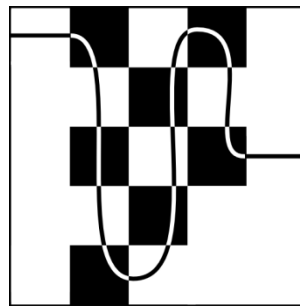
2.2.3.3. The obstacle body is painted white and designed of PVC.

2.2.3.4. The max. speed of the obstacle is 10 cm/s.



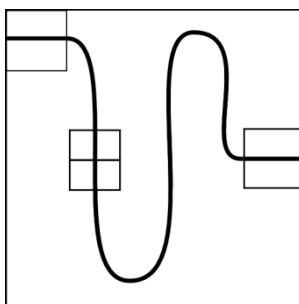
*Fig. 6. Line Follower with Moving Obstacle polygon*

2.2.4. The Line Follower with Inversion polygon is divided into the squares which are  $(30\pm 2)\times(30\pm 2)$  mm in size and painted black and white in the staggered order so that the start and finish squares are white. The line color is opposite to the color of the square which such line crosses (see Fig. 7).

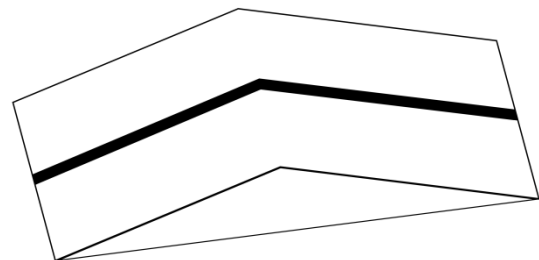


*Fig. 7. Line Follower with Inversion polygon (3 in the senior category)*

2.2.5. At the Line Follower with Slide polygon, a white two-slope slide is set with the base angle of max.  $15^\circ$  and the width of 30 cm, and marked with a black line which is similar to that used at the polygon.



*Fig. 8. Line Follower with Slide polygon*

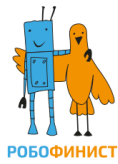


*Fig. 9. Slide*

## 2.3. Procedure for completing task

2.3.1. During the heat the robot is to pass from the start zone to the finish zone along the line with which the polygon is marked.

2.3.2. The heat time is counted from the moment when the robot crosses the line



which limits the start zone to the moment when the robot crosses the line which limits the finish zone.

- 2.3.3. The robot crosses the line when its foremost part touches or crosses the line.
- 2.3.4. The heat time is registered with the electronic gate system or by the referee with the stopwatch depending on the availability of the equipment. In any case the registered time is considered final.
- 2.3.5. The robot wandering in the contest field should be disqualified.
- 2.3.6. The robot is considered to have left the contest polygon when any supporting point of such robot touches the surface outside the polygon. The robot leaving the contest field should be disqualified.
- 2.3.7. The robot is considered to have left the line, when no part of it is above the line.
- 2.3.8. The line may be left only tangentially from the outside, provided the length of the section which the robot passes tangentially does not exceed three lengths of the robot body.
- 2.3.9. If the robot leaves the line for more than 5 seconds, it must be disqualified.
- 2.3.10. Any avoidance of the obstacle by the robot is not considered leaving the line provided it lasted for less than 10 seconds.

## 3. Labyrinth

### 3.1. Description of polygon

- 3.1.1. The Labyrinth polygon has the size of 150x150 cm and is divided into cells with the size of  $30 \pm 2$  cm (see Fig. 10).
- 3.1.2. The polygon surface is white.
- 3.1.3. Wall with height of 10 cm and a thickness of  $17 \pm 1$  mm can be installed between the cells. Walls are also set around the whole perimeter of the labyrinth except for the cells with the start and finish zones. Gaps and overhangs with the size of max. 5 mm are allowed between the walls.
- 3.1.4. The extensions of the lines from neighboring Line Follower polygons are in the start and finish zones. The line enters the cell max. by one half of the length of such cell.
- 3.1.5. The location of the walls changes just before the attempt.
- 3.1.6. The labyrinth walls are laid out so that only one path which does not cross itself is available between any two cells of such labyrinth.

### 3.2. Procedure for completing task

- 3.2.1. During the heat the robot is to pass from the start zone to the finish zone.
- 3.2.2. The robot is considered to have reached the cell if any of its supporting points touches the cell surface.
- 3.2.3. If the robot is not leaving the cell within 30 seconds it should be disqualified.

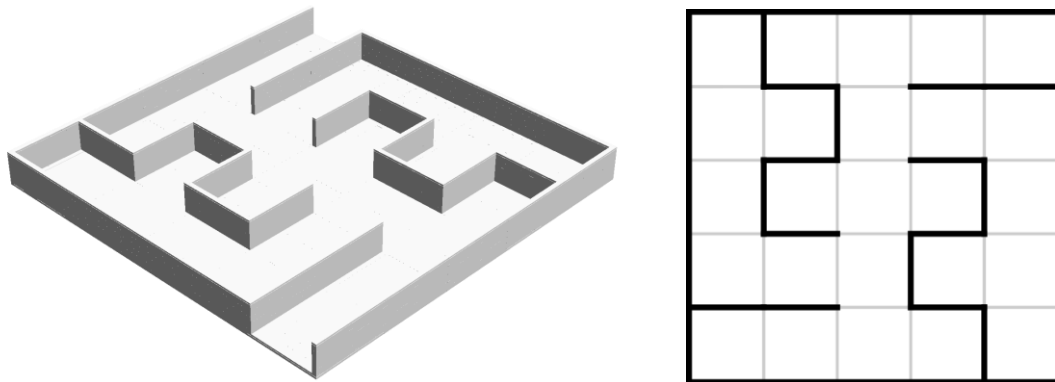


Fig. 10. Labyrinth polygon layout option

## 4. Kegelring

### 4.1. Description of polygon and skittles

- 4.1.1. The polygon is a field with a ring which is a circle 1 m in diameter and limited along its perimeter with a line 50 mm thick (see Fig. 11).
- 4.1.2. The polygon is white.
- 4.1.3. The limiting line is black.
- 4.1.4. Skittles are rigid cylinders which are 70 mm in diameter and 120 mm high and weigh max. 50 g.
- 4.1.5. Skittles have a mat one-tone surface.

**Recommendation:** skittles can be fabricated of empty standard soda cans (330 ml). An empty can should only be wrapped with a regular sheet of paper.

### 4.2. Procedure for completing task

- 4.2.1. Depending on the category in which the robot performs, it is supposed to:
  - 4.2.1.1. *in the junior category* push out all skittles outside the ring. stop inside the ring after all skittles are out;
  - 4.2.1.2. *in the senior category* push outside the ring all the skittles, except for the central skittle which is set in the center of the ring. Capture the central skittle and deliver it to the finish zone after all the skittles are out.
- 4.2.2. Carry out the following procedures before the heat.
  - 4.2.2.1. Eight skittles to be pushed outside the ring are placed in the ring (blue ones on Fig. 11). Skittles should evenly be spaced inside the circumference of the ring: max. two skittles should be in each fourth part of the ring. Skittles are put no closer than 12 cm and no further than 15 cm from the black limiting line;
  - 4.2.2.2. The participant of the heat can adjust the position of skittles as he/she thinks fit (provided it agrees with Clause 4.2.2.1 of this Section). The referee approves the final layout.
  - 4.2.2.3. In the senior category, another skittle (the central skittle) is put in the center of

the ring. Such skittle is to be delivered to the base camp (the red one on Fig. 11).

- 4.2.3. The skittle is considered outside the ring if none of its part is inside the ring at some point in time.
- 4.2.4. The robot is considered to have left the contest polygon when any supporting point of such robot touches the surface outside the polygon. The robot leaving the contest field should be disqualified.

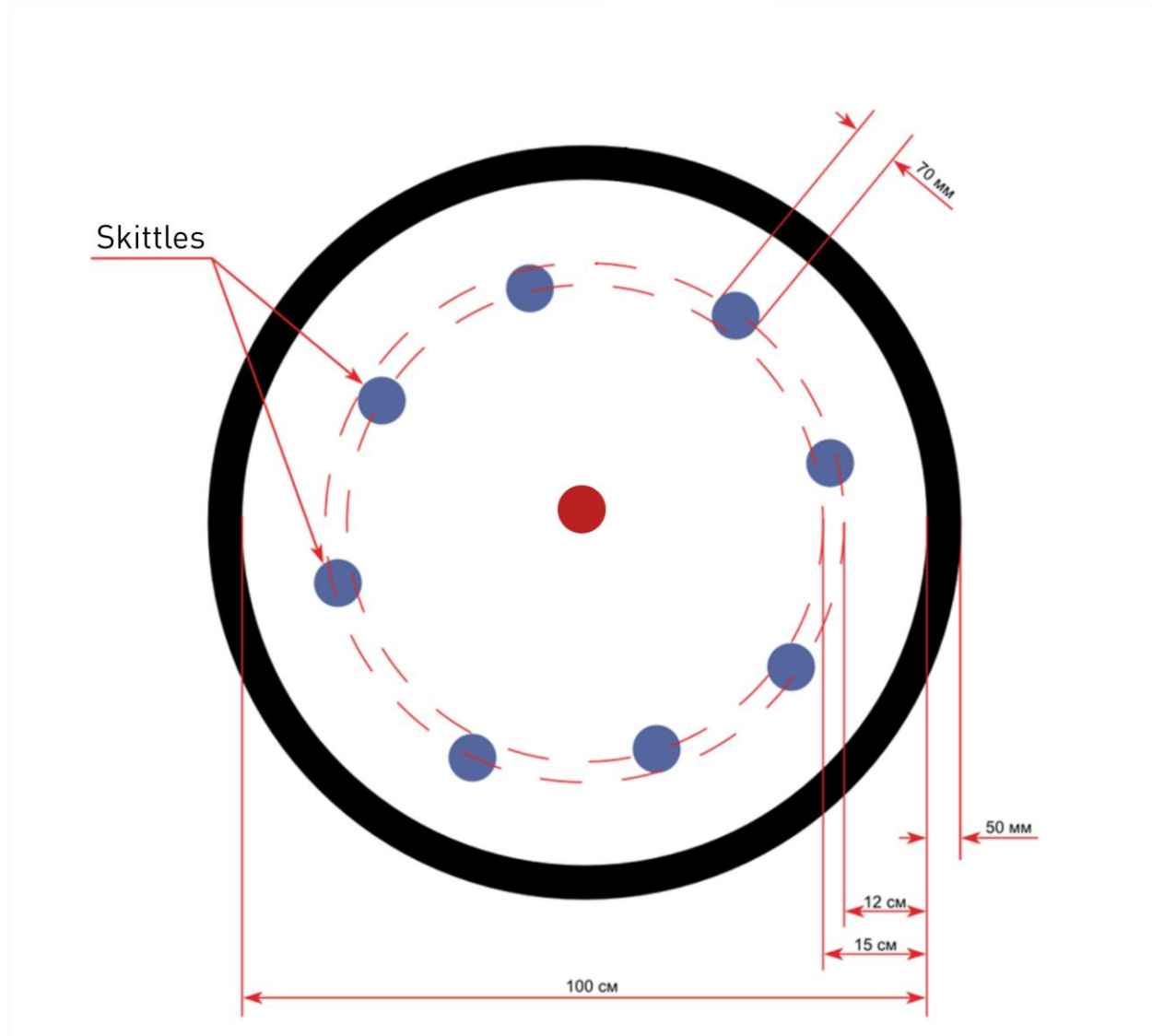
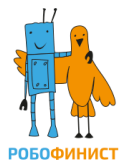


Fig. 11. Marking kegelring polygon

## 5. Change Log

### 5.1. Version 1.0

- 5.1.1. Version 1.0 of this Regulation was drawn up on June 30, 2016 based on the regulations of such competitions as Labyrinth (version 2.0), Labyrinth: There and



# ROBOFINIST

Back (version 2.0), Kegelring for Beginners (version 2.6) and Line Follower (version 4.2), Inverted Line (version 1.0), Road 2 (version 1.1).