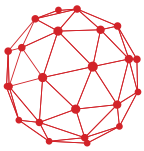

THE LONDON SCHOOL
OF MATHEMATICS
& PROGRAMMING

bjss

ask@londonsmp.co.uk — www.londonsmp.co.uk

Platinum sponsor — www.bjss.com

UK Robotics Triathlon 2019

Overview

The Robotics Triathlon of the London School of Mathematics and Programming is a cross-platform robotics competition. The event is unusual because it places no constraint on the types of controllers, construction sets or languages used by the teams.

Challenges representing the traditional robotics tasks of autonomous navigation, pick-up and delivery, as well as remote controlled operations create the opportunity for children to apply their programming and robotics skills.

There are three challenges and one bonus task in this competition. Overall score will be calculated as a sum of points from each challenge and the bonus points. Challenges can be attempted several times (see challenge descriptions for details). Teams can take breaks between those attempts to modify robot or code of the robot. Recommended size of the team is one or two students.

Practice Sessions

Robots will be able to attempt the challenges on practice fields in the morning session of the event. Practice fields may be available throughout the day, if they are not used for scoring the challenges of other teams.

Changes Compared to the Robotics Triathlon 2018

If you participated in the Robotics Triathlon 2018, here are the changes in the rules since that time:

- Scoring table for “Line Following”, “Pick-and-place” and “Maze” challenges was updated.
- Each successful attempt in “Line Following”, “Pick-and-place” and “Maze” now gives 3 bonus points.
- The maze for “Maze” and “Remove Controlled Delivery” challenges is now larger and more complicated.
- Robots can touch the maze walls in the “Maze” challenge and use contact sensors.
- We introduce two categories for the participating teams — “assisted” and “independent”.

Competition categories

To accommodate different levels of robotics experience and knowledge, we will judge this event in two categories. In both categories, teams should have an assembled robot available, and may have programs for the tasks prepared in advance.

Assisted

During the event, teams in the "assisted" category can receive advice and help on robot construction and programming from parents, teachers, siblings, friends, robots and/or other forms of artificial intelligence. Challenges will be as described in this document right now.

Independent

Teams in the "independent" category are not allowed to receive help on robot programming from anyone. If serious technical problems are encountered with the construction of the robot (for example, robot does not switch on, some wires are broken, cannot communicate with the robot, problems with the mechanical components of the robot), teams should contact one of the judges, who may allow limited help from teachers, technical staff of the London School of Mathematics and Programming or parents. We will have a separate room for the preparation of the "independent" teams, where only the participants and the judges will be allowed.

The challenges listed below will be slightly modified (made a bit harder) for the "independent" teams. And the modifications to challenges will be announced and published only on the day of the event, so that the teams can demonstrate their understanding of the code and the ability to modify and adjust it on the spot independently.

1 Line Following

Control method: Autonomous

1.1 Aim of the Challenge

A robot should autonomously travel along a black line on a white background as fast as possible. The line is 50 mm wide, and is printed in such a way that there is at least 15 cm between the line and the border of the printed field (see Figure 1).

1.2 Ranking and Points

There will be 3 minutes for a robot to finish the course. Each robot will have 3 attempts; each attempt will be timed separately, and the best time will be used for ranking.

Points will be awarded according to the rankings as specified in Table 1. Each successful attempt will give 3 bonus points.

Table 1: Scoring table for the competition results

Place	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	7^{th}	8^{th}	9^{th}	10^{th}	11^{th}	12^{th}	13^{th}	14^{th}	15^{th}
Points	50	45	40	35	30	25	20	15	10	8	6	4	3	2	1

In case a robot leaves the black line (no part of the robot is above the black line) or needs to be rescued, an attempt is considered failed, and a next attempt can be taken (if there are any

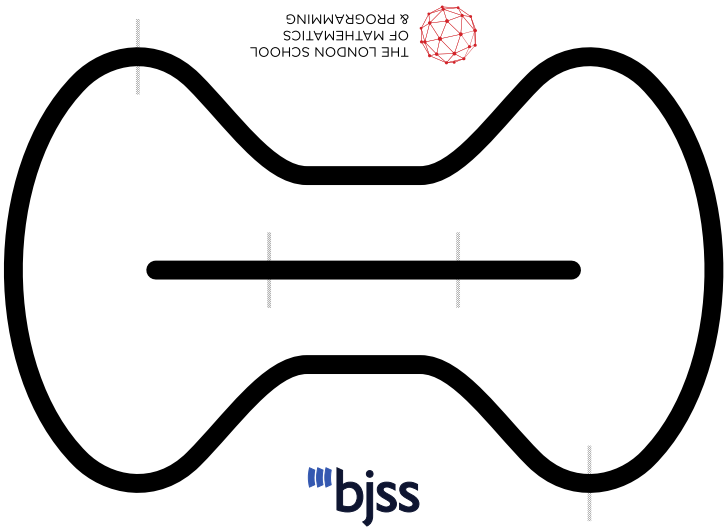

Figure 1: Map of the field for the "Line Following" and "Pick-and-place" competitions. Size of the field is 2.5 meters by 1.5 meters. "Line Following" competition uses the closed loop on this map. "Pick-and-place" competition starts on the straight line in the center part of the field.

remaining). If a robot does not manage to complete the course in 3 attempts, it will be given 0 points for this competition.

2 Pick-and-place

Control method: Autonomous

2.1 Aim of the Challenge

A soft sponge is installed in an upright position in a holder platform. The center of the sponge is located on top of a straight black line with width of 50 mm (the black line is located in the middle of the map as shown on Figure 1). The side facing the robot is of a light color and reflects light quite well. A robot is placed at some distance along this straight line from the sponge and the sponge holder, so that no part of the robot is crossing the starting line.

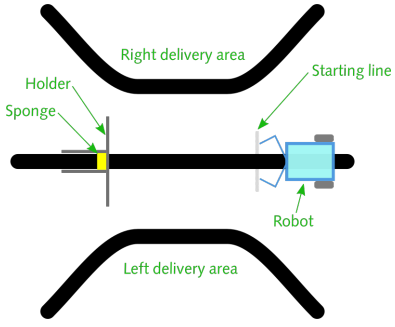

Figure 2: "Pick-and-place" competition — initial setup

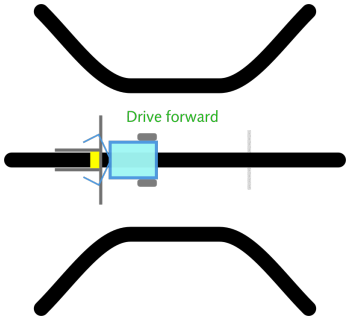

Figure 3: Robot drives forward.

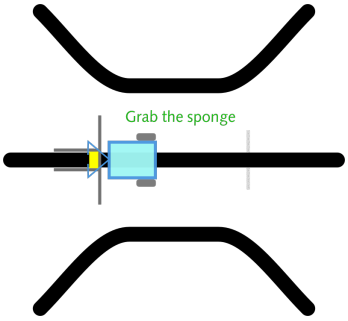

Figure 4: Robot grabs the sponge.

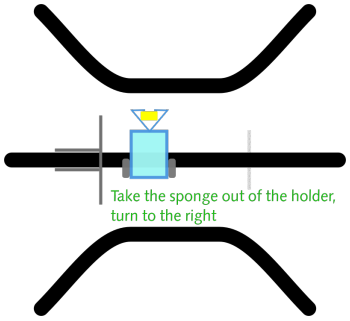

Figure 5: Turns to the right.

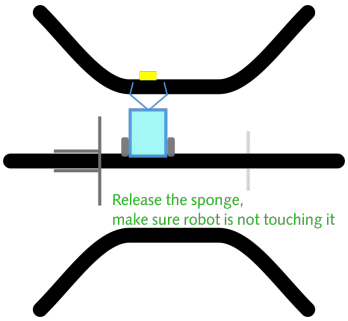

Figure 6: Robot drives towards the delivery area and releases sponge.

The robot should drive straight along the black line, stop in front of the sponge, grab it with a gripper or any other similar appliance, take the sponge out of the holder (the easiest way is to just drive backwards), then turn either left or right (to be announced on the competition day), take the sponge over the next black line and release it. Sequence of actions for a delivery to the right delivery area is shown on Figures 3 – 6.

The height of the sponge is around 7 cm. To accommodate different sizes of the grippers, there are 2 kinds of sponges - a rectangular one with the width of 5.5 cm, and an inverted T-shape one with the width in the upper part of around 4 cm. Participants can select whichever type of the sponge to use, depending on the construction of the robot.

The height of the platform is 1.5 cm, so the gripper should be located at least 2 cm above the floor.

2.2 Ranking and Points

There will be 5 minutes for a robot to finish the course. Each robot will have 3 attempts; each attempt will be timed separately and the best result will be used for scoring.

Points will be awarded according to the rankings as specified in Table 1. Each successful attempt will give 3 bonus points.

Only the complete sequence of actions will be considered for scoring; in the end, the sponge should not be touching any part of the robot and should be located on or behind the bounding black line. If a robot does not manage to complete the course in 3 attempts, it will be given 0 points for this competition.

3 Maze

Control method: autonomous

3.1 Aim of the Challenge

A robot should navigate a maze autonomously as fast as possible. Map of the maze is shown on Figure 7, actual dimensions of the maze will be within plus-minus 2 cm of what is shown on the map. At the beginning of this task the robot will be placed inside the maze, in the lower left corner. The robot will need to reach the upper right corner. It is allowed for the robot to bump into the walls of the maze, and the use of contact or proximity sensors is recommended.

Design of the maze is following "The Minimal Maze" challenge of the "Pi Wars" competition in Cambridge, UK (https://piwars.org/).

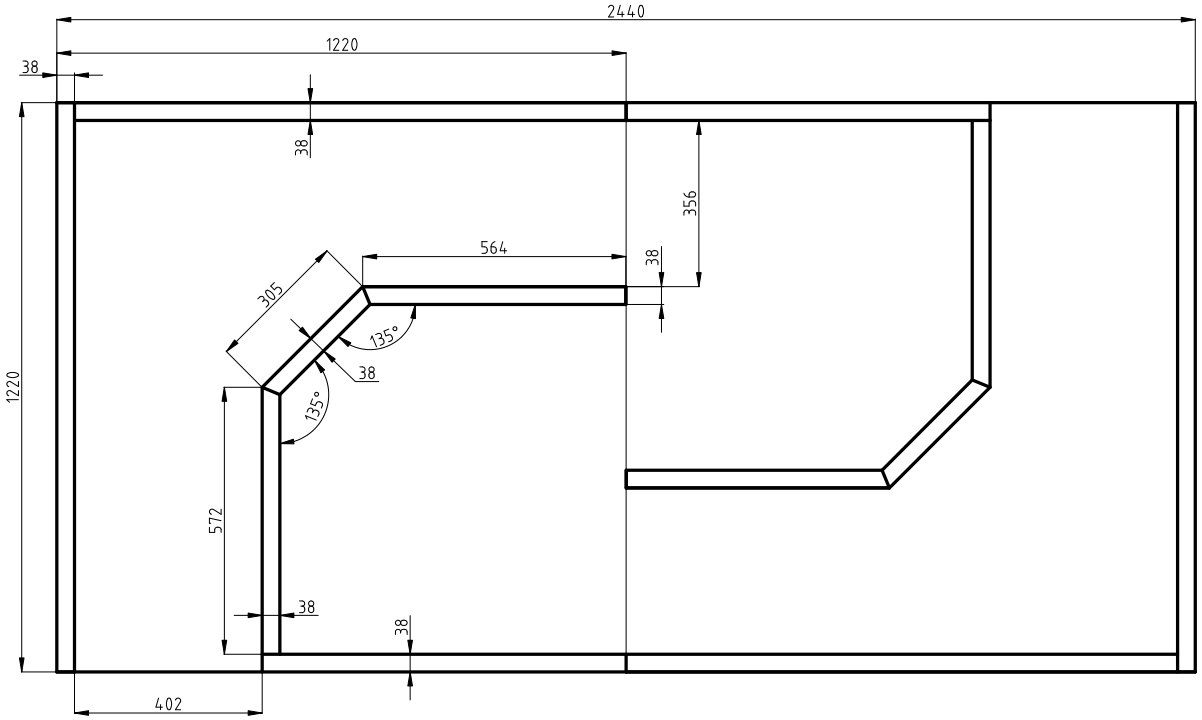

Figure 7: Robot starts in the lower left corner of the maze, and should reach the top right corner. Dimensions shown are in millimetres. Height of the maze walls is around 63 millimetres. Wood for construction of this maze can be bought in a B&Q shop, where it is sold as "CIs timber (t)38mm (w)63mm (l)2400mm".

3.2 Ranking and Points

There will be 5 minutes for a robot to finish the course. Each robot will have 3 attempts; each attempt will be timed separately and the best result will be used for scoring.

Points will be awarded according to the rankings as specified in Table 1. Each successful attempt will give 3 bonus points.

Bonus Task — Remote Controlled Delivery

Control method: manual

Aim of the challenge

A remote controlled robot will be provided for this competition. Participant should control this robot to navigate a maze shown on Figure 7, taking a golf ball from the lower left corner of a maze to the upper right. At the start of the obstacle course the robot and the ball are separate.

In the case a ball goes out of bounds of the field or it is stuck in any obstacle in such a way that a robot cannot retrieve it, the ball will be recovered by a judge and placed near to the place where it was stuck in a convenient position. There will be a 20 seconds penalty for each recovery.

Ranking and Points

There will be 3 minutes for a robot to finish the course. Each participant will have 2 attempts; each attempt will be timed separately and the best result will be used for scoring.

Points will be awarded according to the rankings as specified in Table 2.

Table 2: Scoring table for the bonus task

Place	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	7^{th}	8^{th}	9^{th}	10^{th}	11^{th}	12^{th}	13^{th}	14^{th}	15^{th}
Points	20	16	13	11	10	8	7	6	5	4	3	2	2	1	1