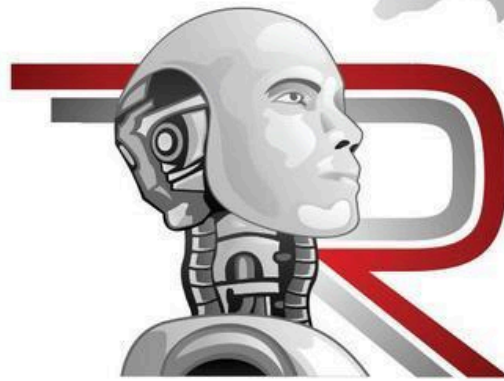


RoboRAVE
Australia



Line Follow - SPRINT

Revision 3 - Updated 17/04/2024.

2024 Official Game Manual
RoboRAVE Australia

Our motto: *"Today's Play, Tomorrow's Pay."*



Revision History		
Revision	Date	Description/Changes
1	27/01/2024	2024 Challenges Released
2	04/02/2024	Graphics updated. Added a scoring rubric.
3	17/04/2024	Team limit increased to 5.

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1.0 Overview

1.1 What is Line Follow – SPRINT?

Line Follow - SPRINT is an electrifying robotics competition that demands precision, creativity, and speed. Competitors are tasked to design, build, & program an autonomous robot capable of navigating a predefined track by following a marked line. The primary objective is to quickly reach the end of the track while successfully delivering ping pong balls into an elevated tower. The complexity of the challenge increases through the divisions as the tracks include more intersections, thinner lines, and surprise obstacles!

Robots in the Line Follow - SPRINT competition must exhibit agility and precision akin to a seasoned athlete. Any deviation from the line or contact with obstacles can lead to time penalties. The added complexity of following a line and creating a delivery mechanism offers challenges to builders and coders alike. This competition spans across all age divisions providing an inclusive and rewarding experience.

Competitors seeking an easier alternative to Line Follow – SPRINT should consider the a-MAZE-ing challenge. Those seeking a harder challenge should instead compete in Mouse Labyrinth.

1.2 Who can compete in a team?

Line Follow – SPRINT is offered to students in the following divisions:

- 1) Elementary School (ES) – Ages 8-10
- 2) Middle School (MS) – Ages 11-13
- 3) High School (HS) – Ages 14-18
- 4) University/Professional (UP) – Ages 19+

The division a team enters is dependent on the oldest team member in that team at the time of registration. Teams can choose to enter a higher age division but cannot enter a lower one.

Teams should consist of 1-5 competitors. Teams with more than 5 members will not be allowed to compete in the competition or will be forced to register additional teams to compete.

1.3 What are the requirements for the robot?

Robots must fit all of the following criteria to be eligible to compete:

- 1) The total cost of the robot does not exceed \$1,500 USD.
- 2) Robots can be made from any platform and material.
- 3) The robot is completely autonomous and does not use any remote-control features.
 - a. Devices such as remotes or tethers cannot be used to control the robot.
 - b. Programs can be run from an external device (e.g., laptop) at Home as long the device isn't operated while the robot is not at Home.
- 4) The robot must be able to demonstrate a line-following algorithm in their program.
 - a. Codes that use pre-determined paths to solve a track are not permitted.
 - b. An algorithm should apply to more than one variation of a track.
- 5) Multiple sensors, motors, and processing units are permitted on the robot.
- 6) The robot's maximum length, width, and height is 50 cm.

2.0 Operating the Game

2.1 How does an official game run?

Home Run (1 Ball):

- 1) Robots will start at the Home Line with only one ping-pong ball and can leave once the timer starts. The robot can only be interacted with while it is at Home or on the Home Line.
- 2) The robot will receive points as it follows the track to the tower, successfully delivers one ping-pong ball, and travels back to Home autonomously.
- 3) If the robot is unsuccessful, it can attempt another run. However, the timer will continue until the game finishes.

Bonus Ball Run (5 Balls):

- 1) Once the robot has completed a Home Run, it can attempt as many Bonus Ball runs as time permits.
- 2) The robot can leave Home with up to five ping-pong balls, delivering as many as it can successfully in the tower. Once it has finished depositing the balls, it can be picked up and returned Home by the competitors. It does not need to travel back Home autonomously.

2.2 What are the rules in an official game?

The following rules are enforced during official competition games by the referee:

- 1) The referee will ensure the team and robot are compliant with the rules in 1.2 and 2.3. If the referee believes any of the eligibility criteria are not met, the Head Referee will be brought in to determine further actions.
 - a. A team or robot that does not meet the eligibility criteria will usually not be allowed to compete and be required to make changes based on the Head Referee's decision.
- 2) The game lasts for up to 3 minutes timed by the referee and is the only time the robot can score points. It is played on a predetermined field that complies with the rules in 3.0. The field is revealed on the day of the competition.
- 3) Robots are placed with the front of the robot overhanging or touching the Home Line at the start of the game or for any additional runs. It must start beyond the Home Line.
- 4) A ball is defined as successfully delivered if it leaves the robot and enters the tower at the top. Balls that bounce out of the tower without rolling out the back do not count.
- 5) There are several cases when a robot needs to be returned Home and the run reset.
 - a. If a competitor touches the robot or the field outside of Home.
 - i. Referees can choose to end the match if the field interference has a significant effect on the robot's performance.
 - b. With the referee's permission, competitors can return the robot Home for any reason.
 - c. If the robot loses contact with the line, such that the robot has not been travelling in the direction of the track for over 5 seconds.
 - d. The robot skips or cuts across a segment of the track such that it has a significant effect on the robot's performance.
- 6) Only competitors can operate and manipulate the robot during the game. Remember, "Players Play, Coaches Coach, Parents Cheer".

3.0 Competition Field

3.1 How is the field constructed?

All official Line Follow fields will fit the following description:

- 1) The field totals 150cm long x 75cm wide.
- 2) Official fields are printed stickers applied to a white PVC vinyl background.
- 3) All tracks begin at a Home Line that creates a T-intersection with the track line. Home is defined as anywhere outside of the field or behind the Home Line.
- 4) A cardboard Tower that measures 35cm long x 10cm wide x 20cm tall is placed behind an identical T-intersection at the opposite end of the field.
- 5) Each Tower has a 10cm x 10cm opening on the top front side for ping pong balls to be dropped into. Any delivered balls roll through the Tower into a second 10cm x 10cm opening at the back bottom.
- 6) Towers are held in place with four Velcro pads in each corner directly onto the field.
- 7) A semi-circle pipe is centrally placed behind the back of the Tower to collect ping pong balls that roll out the back of the Tower.
- 8) Ping-pong balls should be 3.8-4.2cm in diameter.

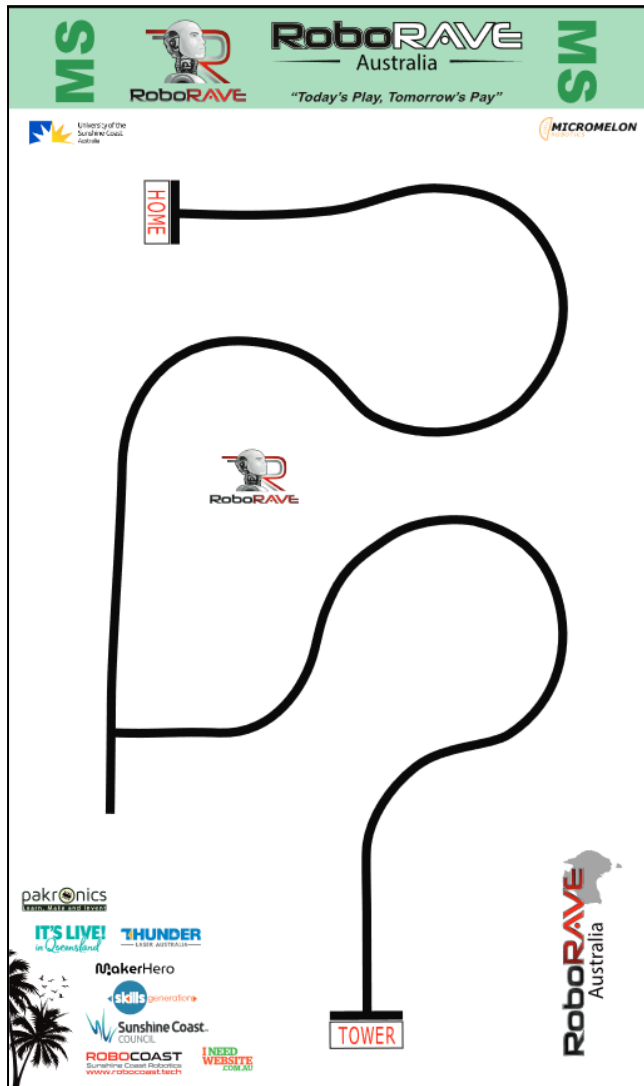
Example MS field and standard Line Follow – SPRINT field setup.



Competitors on an MS field.



Competitors on an UP field.



3.2 What obstacles will the robot face?

In-Line Follow – SPRINT there are several types of obstacles robots must overcome in each division, these include:

- 1) Intersections (MS/HS/UP) – The track will run perpendicular to another line, forming a T-intersection. In one direction the track will terminate after a few centimetres while the other continues towards the tower.
- 2) Broken Line (UP) – The track will terminate for a given distance before continuing in a straight line from the termination point.
- 3) Segmented Line (UP) – The track will stop being continuous and become segmented into several 0.75 cm squares for a given distance.
- 4) Colour Variation (UP) – The colour of the line may change from black to a distinctly different colour for a given distance (e.g., red, green).

The number of obstacles varies in each division, with an increased number in higher divisions.

Division:	Intersections	Broken Line	Segmented Line	Colour Variation
ES				
MS	1			
HS	2			
UP	3-5	0-2	0-2	0-2

3.3 What can help my robot navigate the field?

The track line is a black line designed to be used by sensors and cameras to navigate the robot to the tower.

- 1) There will be a leading 20cm straight line before the Tower's line with no obstacles.
- 2) The track line will be no closer than 10cm from the edge of the field or an advertisement.
- 3) The thickness of the line is dependent on the division.
 - a. ES/MS – 1.25 cm black line
 - b. HS/UP – 0.75 cm black line
- 4) (ES/MS) The radius of a curve is restricted to be no less than 15 cm.

4.0 Points and Scoring

Challenge:	Maximum Points per Mission			
	ES	MS	HS	UP
4.1.1 Leaving Home	20p	20p	10p	10p
4.1.2 Obstacles	N/A	5p (1x)	5p (2x)	*5p (4x)
4.1.3 Reaching the Tower	10p	10p	10p	10p
4.1.4 Ball Delivery	10p	10p	10p	10p
4.1.5 Returning Obstacles	N/A	5p (1x)	5p (2x)	*5p (4x)
4.1.6 Returning Home	20p	20p	10p	10p
4.2.1 Bonus Balls	2p per ball	2p per ball	2p per ball	2p per ball
Total Maximum Points (excluding bonus balls)	60p	70p	60p	*80p +

** Number of obstacles can vary for UP.

4.1 What points are earned in the Home Run?

Points are only awarded the first time a specific task is completed in a game.

- Leaving Home (20p/10p)** – If the robot successfully leaves Home, it earns 20 points in ES/MS and 10 points in HS/UP.
 - Leaving Home means the robot has completely passed the Home line.
- Obstacles (5p)** – For every obstacle the robot successfully passes for the first time it earns 5 points.
 - Completing an obstacle means the robot has completely passed the obstacle.
 - Note the ES division does not have any obstacles.
- Reaching the Tower (10p)** – If the robot reaches the tower, it earns 5 points.
 - Reaching the tower means the front of the robot is within 10 cm of the base of the tower.
- Ball Delivery (10p)** – If the robot successfully delivers 1 ball into the tower it earns 5 points.
- Returning Obstacles (5p)** - For every obstacle the robot successfully passes for the first time on its way back from the tower it earns 5 points.
 - Completing an obstacle means the robot has completely passed the obstacle.
 - Note the ES division does not have any obstacles.
- Returning Home (20p/10p)** – If the robot successfully returns Home, it earns 20 points in ES/MS and 10 points in HS/UP.
 - Returning Home means any part of the robot is touching or overhanging the Home Line.

4.2 What points are earned in a Bonus Ball Run?

The points for Bonus-Ball Runs cannot be earned until a successful Home Run has been completed.

- Bonus Balls (2p)** – For every ball successfully delivered the robot earns 2 points.

5.0 Finals

5.1 How are the top teams selected?

The finals are used at the official competition to determine the top teams in a division. They put the best of the best live against each other to find the best team and robot. The teams for the Line Follow – SPRINT Finals are determined as follows:

- 1) Teams will complete official timed games on the day. The number of games on the day is determined by the Event Director but will be a minimum of three.
 - a. An official game is any game operated by a referee with a recorded score.
- 2) The best game from the day for each team will be the only one considered for the finals.
- 3) The teams with the top 8 or 16 best games in each division will be brought forward to the finals.
 - a. If there is a draw between two teams, then both teams will progress.
- 4) If the divisions were collapsed due to low team numbers, each division should run its finals as if they weren't collapsed.
 - a. Teams from different divisions should not compete against each other in the finals.
 - b. Depending on the size of the division, they may result in an automatic victory.

5.2 How do the finals work?

The finals for Line Follow – SPRINT are operated under the following rules:

- 1) The top teams in each division compete against each other in an additional set of games. Each team will have one opportunity to do their best run to get into the Grand Final.
- 2) The score achieved in the finals determines the team's final ranking, excluding the top 3 teams, who instead progress to the Grand Final.
- 3) The top 3 teams will compete in one last set of matches to determine 1st, 2nd, and 3rd place, awarded in order of highest points scored in the Grand Final.
- 4) All three positions will receive awards for recognition of their achievements.

6.0 Appendix

Example Line Follow – SPRINT fields from the 2023 competition. Not indicative of future fields.

