

# **Lego NXT Robot Relay Finals**

## **Race CONTEST RULES**

*Version 1.0a – 10/03/22*

*Version 1.0b – 10/06/22*

*Version 1.0c – 10/13/22*

*Version 2.0a – 11/21/22*

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**Preamble:** Weeks 6-8 (Oct 3 – 17, 2022) conducted a line-following robot relay race. This was called the “Semi-Finals”. Five 3-person teams all successfully conducted this race. Weeks 13-15 (Nov 21 – Dec 5, 2022) conducts a more complicated relay race, called the “Finals”. It will involve 4-person teams to reinforce line-following (LF), wall-following (WF), and obstacle-avoidance (OA)

## 1. General Provisions

The run is held by each team independently. One team plays 3 robots.

*Version 1.0b added: A round-robin format will be used to determine the winner. Each race will feature 2 teams. Since there are 6 teams, there are 15 races in total; each team will compete in 5 races. Each race lasts up to 5-min.*

*Version 1.0c added: In a Team Captains meeting 10/10/22, we agreed that this Robot Relay Competition will serve as a “Semi-Finals” – a precursor to Project 2’s “Finals”. The envisioned Finals (towards Reading Week) will be more involved (details given in the future).*

**Version 2.0a:** For the Finals, one team plays 4 robots.

### 1.1. Task Description

During the race 3 robots of the same team must drive one after the other; each robot runs its leg of the oval track. The 2<sup>nd</sup> robot begins when its tail bumper sensor is hit by the 1<sup>st</sup> robot. The 3<sup>rd</sup> robot begins when its tail bumper sensor is hit by the 2<sup>nd</sup> robot. The total completion time ends when the 3<sup>rd</sup> robot crosses its finish line.

**Version 2.0a:** Similar to Semi-Finals but now have 4 robots. The 4<sup>th</sup> robot has a lit candle to extinguish (with a motorized prop).

## 2. Requirements for the Robot

- The robot must be fully autonomous and made only from Lego parts. The parts can be from the course-issued NXT Mindstorms kit, or from other Lego sources e.g. Bricklink, Lego Store, etc.  
*Version 1.0b added: Teams are not limited by the number of parts needed for their robot or robots. If the NXT Mindstorms Kit doesn’t have enough parts or isn’t included in the Kit, they should consult the professor. The lab might have extra parts in the lab’s inventory.*

**Version 2.0a:** Similar to Semi-Finals and description above. The only exception is a motorized prop, NXT adapter and related wiring.

- The 2<sup>nd</sup> and 3<sup>rd</sup> robot must have a tail bumper sensor; they can only commence their line-following run when their sensor is activated. ~~length – not more than 300 mm~~

*Version 1.0b removed “not more than 300 mm” because it didn’t make*

sense.

**Version 2.0a:** Similar to Semi-Finals and description above. However, the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> robot must have a tail bumper sensor; and can only commence their task (e.g. LF, WF, or OA) when their bumper sensor is activated.

- Each robot must fit inside the issued shoebox (12" x 9" x 5"). For robot's that can change size (e.g. extend a mechanical arm or have a collapsible bumper), the robot in its starting position must fit in the shoebox
- *Version 1.0b added: The robot does not have to be the Domabot but must still fit in the shoebox dimensions stated above. This is to encourage teams to test and explore different types of robot forms. However, the robot is restricted to only using Lego parts as stated above*

### 3. Specifications of the field

The field is a flat rectangular white surface made of no particular material with a black line on it. The track is oval. ~~There are 3 tracks so that 3 teams can compete at the same time.~~

- Width - XX mm;
- Minimum radius of curvature - XX mm.

*Version 1.0b removed: "3 tracks so that..." above.*

*Version 1.0b added: There will be two fields. A mat will be provided in each field. This allows 2 teams to compete on in a field. The competing teams will decide (e.g. coin-flip or rock-scissors-paper) which track they wish to use. Since the lab has 2 mats, this allows 2 races to be conducted (one in each field).*

*Version 1.0c added: the mats will lie on a carpeted floor*

**Version 2.0a:** The Finals consists of LF, WF and OA tasks. As such, the competition arena (Figure 2) is a departure from the one used in the Semi-Finals.

The exchange area is limited by XX mm long starting and finish lines oriented perpendicularly to the track line and symmetrical in relation to it (see Fig. 1); the shape of the line section inside the exchange area is rectilinear:

- Distance between the starting and finish lines is X mm in the light;
- Thickness of the lines is X mm;
- Lines are in black.

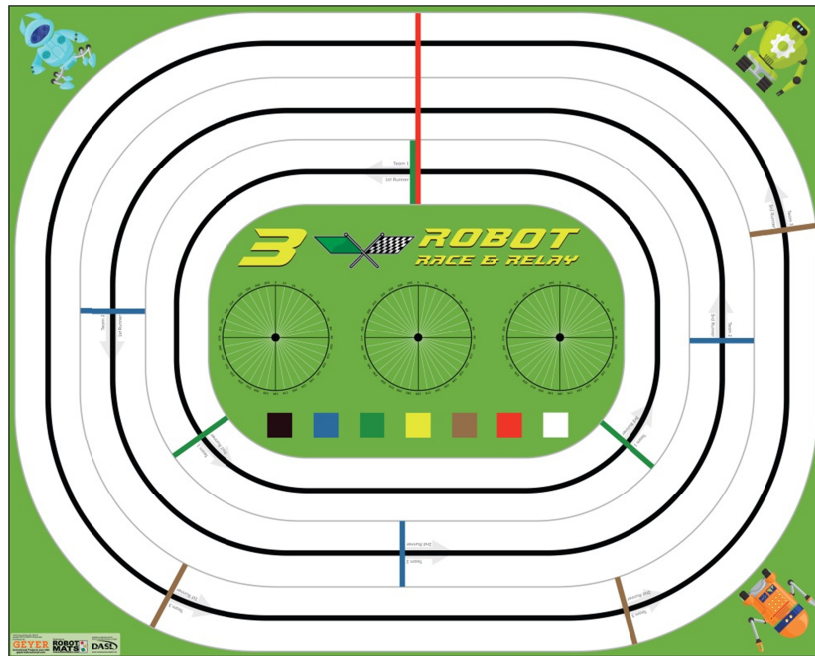
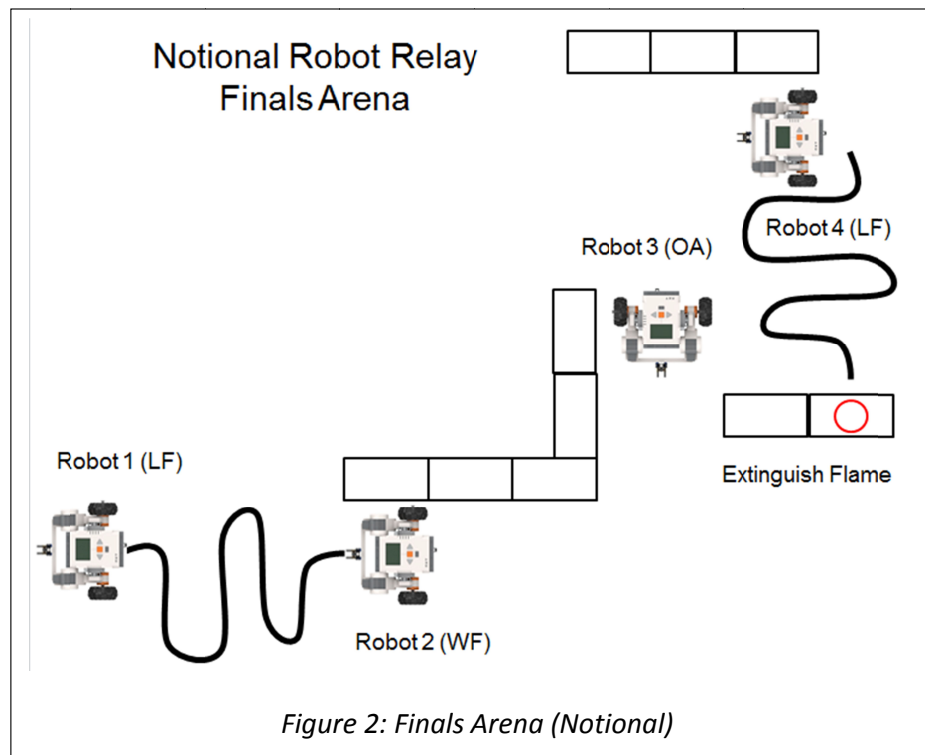


Figure1. Field



## 4. Contest Procedure

- Version 1.0b added: When a team isn't racing, they can modify their robot(s). Modification examples include: replacing or using different Lego parts;

completing changing the design (but must fit the shoebox); and changing or recharging batteries. Teams cannot modify when they are called to race or during a race.

- Robots are given 5 minutes to complete the task.
- Before the start of the race, all 3 robots are placed in the exchange area along the line one after the other.

*Version 1.0c added: Teams are given a 3-min "Approach the Track" announcement. During this time, a team can calibrate their robots. After 3-min, the judge signals "Ready-Set-Go" and the team can initiate Robot 1 to begin (e.g. touch its button, bumper, etc). If Robot 1 fails to start, the team can continue trying to start it even though the race has started.*

- After starting, the robot must drive its lap along the track and touch the tail bumper sensor of the next robot in the exchange area.
- During the tail bumper contact, both robots may be partially in the exchange area.
- The robot that pushed the next robot's bumper sensor must stop in the exchange area

*Version 1.0c added: This includes Robot 3 (the last robot in the relay team). A weighted wall will be placed slightly beyond the finishing line. This way, Robot 3 will not be able to move beyond the wall after it crosses the finishing line.*

- The track driving is interrupted, the time does not stop, the robots return to their original position in the exchange area and restart in the following cases:
  - the robot's tail bumper fails to start the robot;
  - the robot left the exchange area without its tail bumper sensor being activated by the first robot;
  - the Operator touched a robot while it was moving;
  - the robot left the line for more than 5 seconds;
  - the robot that passed the baton left the exchange area.

*Version 1.0b removed: the baton because it doesn't make sense*

**Version 2.0a:** Points will be awarded for each completed task as follows:

| T<br>a<br>s<br>k | Description  | Points |
|------------------|--|--------|
| 1                | Robot 1 follows line; taps Robot 2; and Stops                          | 2      |
| 2                | Robot 2 Starts following a wall divider; makes left turn; taps Robot 3 | 2      |

|   |  |                    |
|---|--|--------------------|
| 3 | Robot 3 Starts moving to dead-end; turns right; and taps Robot 4 | 2                  |
| 4 | Robot 4 Starts line following; stops and blows out candle        | 2 + 2 (for candle) |
|   |  | 10 points total    |

If a robot fails its task, then the team may elect to **forfeit** the related point and incur a **5-second penalty** and then initiate the next robot. For example if Robot 1 failed to complete line following and tapping Robot 2, the team forfeits 2 points. They then wait 5-seconds. They can then physically push Robot 2's bumper sensor it can commence it's wall-following task.

- The race ends when the race time expires.
- *Version 1.0b added: The winner of a particular race is the first team to successfully cross the finish line. The winner of the Robot Relay Competition is the team with the most number of wins (as per Round Robin format)*
- *Version 1.0b added: If both teams crossed the finishing line at the same time, the race will be repeated until a winner is determined*
- *Version 1.0b added: if both teams failed to cross the finishing line e.g. batteries too weak or died; parts fell off and robot can no longer move, then the team whose three robots have collectively traveled the most distance is the winner of that race.*

## 5. Disqualification

In the following cases the robot will be disqualified:

- The robot is non-autonomous (external control of the robot).
- Uses any non-Lego parts including tape, glue, screws etc
- *Version 1.0b: The robot's initial configuration on it's starting line, does not fit in the shoebox (dimensions given above)*

## 6. Scoring

~~The team with the fastest completion time wins.~~

*Version 1.0b struck out the above and added: A table of each team's wins will be recorded and displayed during the competition.*

**Version 2.0a:** The Table given in Section 4 outlines how points are awarded. Completion time will also be recorded and be used to settle and point ties.

## 7. Procedure for Determining the Winner

~~The winner is the team with the fastest time.—~~

*Version 1.0b struck out the above and added: The team with the most number of wins from the Round Robin format is the winner.*

**Version 2.0a:** Unlike the Semi-Finals, there is no Round Robin format. Rather, each team is given two runs. The best run is their final score. The run sequence is determined from a team's placement in the Semi-Finals:

|                      |                      |
|----------------------|----------------------|
| Run 1: Team Aaron    | Run 5: Team Aaron    |
| Run 2: Team Gabriel  | Run 6: Team Gabriel  |
| Run 3: Team VIK      | Run 7: Team VIK      |
| Run 4: Team Roadkill | Run 8: Team Roadkill |