# Following '20

Greetings from RMI!

We are back with our yearly event, Following! For aspiring roboticists, Following '20 serves as a platform for you to learn new skills, design your own robot and showcase your newfound talents to the world. So, gear up, charge your batteries, and prepare to let your robots battle it out for glory!

Theme:

Rick while testing one of his latest inventions accidently shoots Summer off to another dimension. Seeing this, Morty, being Morty, panics and goes dimension hopping with Rick to rescue his sister before their parents come back home. As the duo arrive at each dimension, they encounter odd shapes left out by the dimension travelling Summer, as clues to her location. They must decode these clues and arrive at the correct dimension. However, they must defeat the pursuing Galactic Federation Troops in order to continue their travel. Now try building a robot which could help Rick and Morty through their new mission.

Arena Description and Layout:

The arena consists of black lines arranged in a grid. A sample track is shown below. The points of intersection are known as nodes. All the nodes will have distinct 2D cartesian coordinates in the grid. Additionally, there will be a start node as shown in the sample arena. The arena consists of **25** nodes and a start node at (0, 0). Each node has a specific coordinate, denoted by X and Y axes. The numbering of the X and Y axes are shown in the figure. The thickness of all the lines is **3 cm**. The distance between the nodes will be at least **30 cm**.
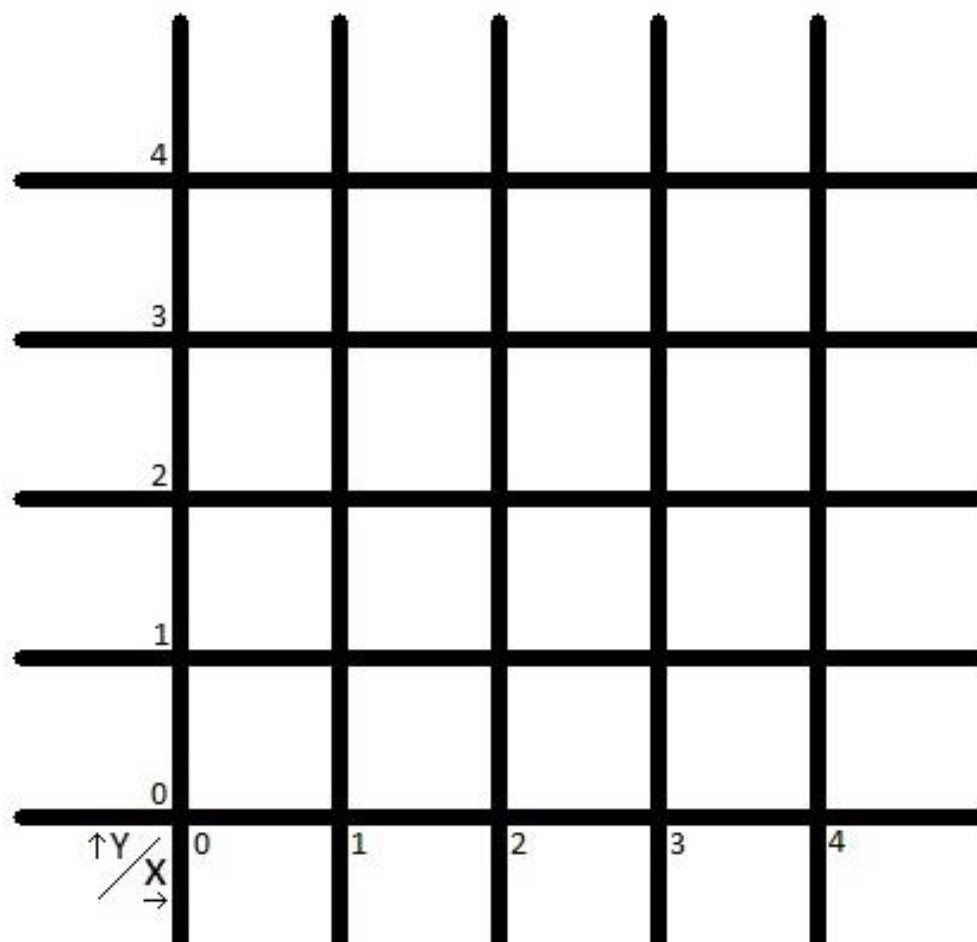
Fig. 1: Sample Grid

Phases of the problem statement:

Phase 1:

At the beginning of the task, the bot will be placed at the start node. The goal of Phase 1 is to make the bot move to any given node, with coordinates (X, Y). The coordinates of the target node can be sent to the bot via any wireless means. The bot must travel to the target node, wait for 1 second and then come back to the starting point.

Phase 2:

The bot will start from the start node. Shapes printed on an A4 sheet will be shown to the laptop camera. Your task is to read and decode the X and Y coordinates of the target node from the shapes (For more details, refer Image Processing Guidelines section). The bot then has to move to the decoded target node and wait there until another set of shapes is shown. This will specify the next target node.
This process will be repeated two more times with different shapes. Shapes corresponding to the Start Node will be shown at the end, which implies that the bot must return to the starting node.

Phase 3:

Similar to Phase 2 printed out shapes are shown to the laptop camera to decode coordinates. After finding the coordinates while the bot travels to the target node obstacles would be randomly places by organisers on the track. The bot should be able to detect the obstacle present on the track and reroute its path to reach the target node. Negative points will be awarded if the bot doesn't identify the obstacle and touches it.
This process will be repeated two more times with different shapes. Shapes corresponding to the Start Node will be shown at the end, which implies that the bot must return to the starting node.
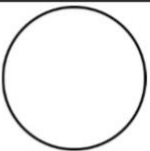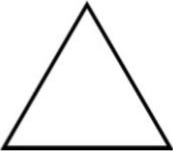
NOTE:

In case the bot moves to a point which does not match the image processing result, the bot will be reset to the correct node by the organiser, before the next set of shapes is shown to the laptop. (e.g: If the IP detects (2,3) and the bot moves to any other point, then the organiser will reset the bot to (2,3))

IMAGE PROCESSING (IP) GUIDELINES:

The shapes for determining the coordinates will be printed on an A4 sheet in solid black. The sheet will then be shown to the laptop's camera. There will be two shapes on the sheet. The X-coordinate will be determined by the outer hollow shape. The Y-coordinate will be determined by the filled shaped shape inside the hollow shape.

The following table represents the relation between the various shapes and coordinates.

Shapes	Coordinate Value
⬤ ◯	0
(solid half-circle) (hollow half-circle)	1
▲ △	2
■ □	3
(solid rectangle) (hollow rectangle)	4

Fig. 2: The solid shape would be placed inside the hollow shape and will be shown together on the same sheet. The participant's code must differentiate between the two shapes and figure out the coordinate. The solid polygon placed on the left will determine the Y coordinate and the hollow polygons placed to the right will determine the X coordinate.

For example, a solid circle will represent an Y coordinate 0 and a hollow square will represent an X coordinate 3.
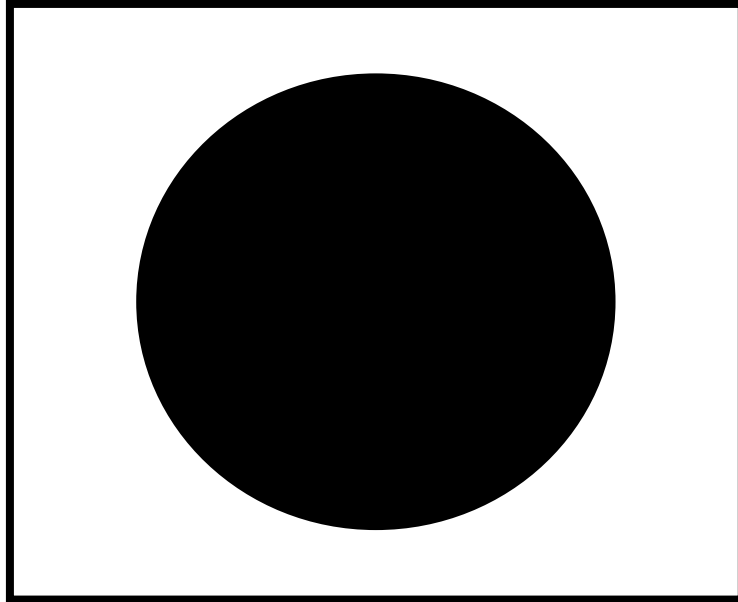
Fig. 3: A sample image representing the coordinate (3, 0)
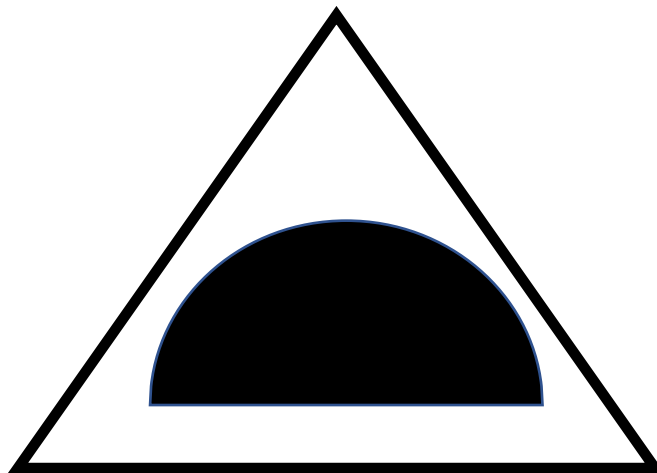
Fig. 4: A sample image representing the coordinate (2, 1)

RULES:

● A team can have a maximum of three members.
● Maximum robot size is 30cm x 30cm x 30cm.
● Extra points will be awarded for self-fabrication of any sensors.
● Each team can have one trial run to test both phases (not considered for evaluation) and a maximum of two final runs for each phase (best of two).
● The code can be changed between 2 phases. Any changes in the code made after a run in a phase will deem the previous run invalid and extra runs will not be given.
● No two points on the bot can have a potential difference greater than 13V.
● The bot must be powered only by onboard batteries.
● Choice of the microcontroller is left to the participant.
● Maximum time for completing a phase is 10 minutes, beyond which the current trial ends.
● The starting procedure of the bot should be simple and should not involve giving the bot manual force or impulse in any direction.
● Participants are allowed to adjust sensors (Gain, Position etc.), change speed settings and make repairs, without changing the code between runs.
● Participants **are not allowed** to touch the robot during a run or damage the arena in any way. Failure to comply will result in disqualification.
● The decisions of the organisers are final.
● Readymade Robotic kits are not allowed.

POINTS DISTRIBUTION:

Key:

X_{start} - Starting x coordinate = 2.

Y_{start} - Starting y coordinate = -1

X_{target} - Target x coordinate.

Y_{target} - Target y coordinate.

$X_{detected}$ - x coordinate detected by Image Processing Code.

$Y_{detected}$ - y coordinate detected by Image Processing Code.

$X_{reached}$ - Last reached x coordinate of the robot before stopping.

$Y_{reached}$ - Last reached y coordinate of the robot before stopping.

PHASE-1:

● +25 Points for traversing the grid and going to a specified node from the starting node. If not "$25 - 5*(|X_{target} - X_{reached}| + |Y_{target} - Y_{reached}|)$" points will be awarded.

● +25 Points for coming back to the start node from the specified node. If not "$25 - 5*(|X_{start}- X_{reached}| + |Y_{start} -Y_{reached}|)$" points will be awarded.

PHASE-2:
● +25 Points for recognizing the polygon and determining the X and Y-coordinate of the target node.

●+12.5 Points If either of the coordinates determined is wrong.

●+0 Points If both the coordinates determined are wrong.

● +25 Points for the bot to move to the target node provided both coordinates have been successfully determined, if not "$25 - 5*(|X_{detected}-X_{reached}| + |Y_{detected}-Y_{reached}|)$" points will be awarded. As mentioned earlier, the bot will be reset to the correct node.
● In case of tie, the time for completion of this phase may be used as a judging criterion.

PHASE-3:
● +25 Points for recognizing the polygon and determining the X and Y-coordinate of the target node.

●+12.5 Points If either of the coordinates determined is wrong.

●+0 Points If both the coordinates determined are wrong.

● +25 Points if the bot detects the obstacle in the path and reroutes and reaches the target node provided both coordinates have been successfully determined, if not "$25 - 5*(|X_{detected}-X_{reached}| + |Y_{detected}-Y_{reached}|)$" points will be awarded. As mentioned earlier, the bot will be reset to the correct node.

● -10 Points if the bot doesn't detect the obstacle or touch the obstacle.

BONUS:
● Top 2 fastest teams in TASK 1 will gain +20 points.
● Top 2 teams with compact/best design will get +20 points.
● Usage of self-fabricated boards/sensors (should be working) will add 30 points to your score. Partial points also will be awarded based on the complexity of the board being designed. The magnitude of the points will be decided by the organizers after scrutiny.

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