



## Junior Robotics Competition 2018 RoboJunior Search & Rescue-Secondary Level Rules

### Preface:

The field for the S&R-Secondary Level event will consist of 30 cm x 30 cm tiles or larger, with different patterns. The final selection and arrangement of tiles will be revealed at the start of each round. The tiles may be mounted on a backing material of any thickness. They have different designs. One or more tiles will be on different levels and connected with a ramp. A ramp does not exceed an incline of 30 degrees from the horizontal surface.

### Rules and Regulations:

**The Robots are required to have full autonomy. The students competing in the event must do the construction and programming of their robots without any help or interference from their teachers or mentors.**

The Judge will apply all the rules fairly and without prejudice. All decisions made by the Judge during the games are final. Any argument by a team member with the judges will result in a warning. Continued or repeated arguments will result in immediate disqualification of the team. At the conclusion of each game, the Judge will ask the captains to sign the score sheet. By signing the score sheet the captains accept the final score on behalf of the entire team.

### **1. THE ARENA**

The arena is modular by tiles, which can be used to make an endless number of different courses for the robots to traverse and also provides with the ability to add new tiles in the future.

#### **1.1. The Floor**

The floor has a white or close to white tone. The floor may be either smooth or textured and may have steps of up to 3 mm height at joins between tiles. Due to the nature of the tiles, there may be a step and/or gap in the construction of the arena. These are not intentional and will be minimized as much as possible.

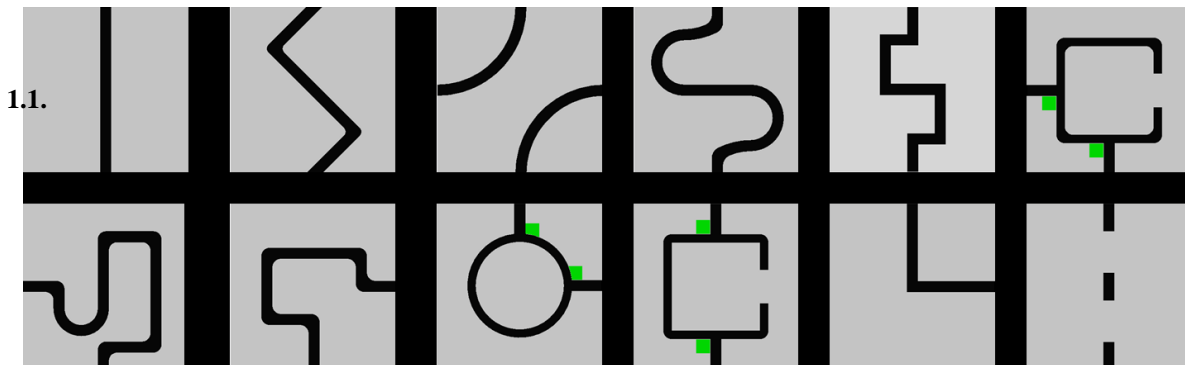
Competitors need to be aware that in some competitions, tiles may be mounted on thick backing or raised off the ground, which may make it difficult to get back on a tile should the robot come off. No provision will be made to assist robots that drive off a tile, for getting back on the tile.

Tiles will be used as ramps to allow the robots to “climb” up to and down from the elevated tile. Robots, therefore, must be designed so that they can navigate along any tile that may be placed under another tile. The minimum free height will be 25 cm.

#### **1.2. The Line**

The black line, 1-2 cm wide, may be made with standard electrical insulating tape, drawn directly on the tiles with permanent marker, or printed onto paper or other materials. The black line forms a path on the floor. The grid lines indicated in the drawings are for reference only and competitors can expect tiles to be duplicated, different and/ or omitted.

The Straight sections of the black line may have gaps with at least 5 cm of straight line before each gap. The gap is 20 cm at most. The arrangement of the tiles and paths may vary between rounds. The line will never be closer than 10 cm to any edge, so the robot will never fall off the arena.



### 1.3. The Speed Bumps, Debris, and Obstacles

The speed bumps have a maximum height of 1 cm. They are white and fixed a tile. They may be angled.

Debris is made of small materials (toothpicks, small wooden dowel, etc) with a maximum height of 3 mm. It will not be fixed on a tile but may be spread on the floor covering more than one tile, and may be spread towards or adjacent to walls.

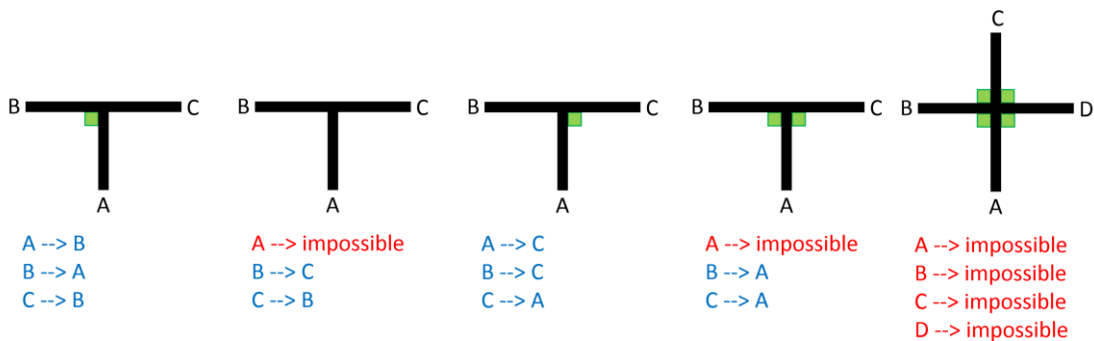
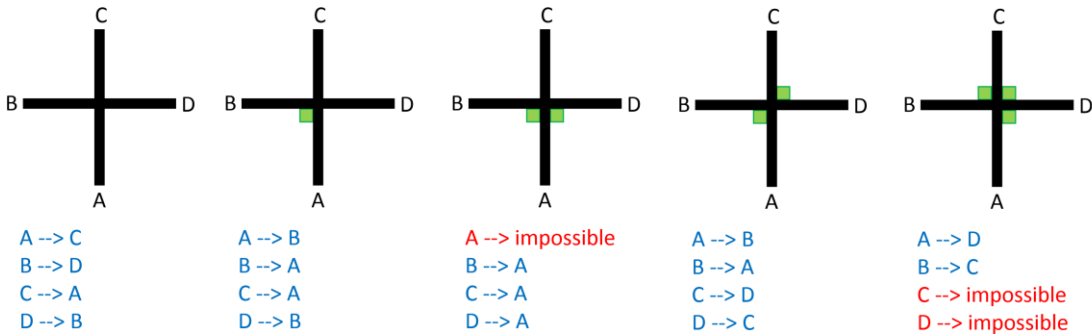
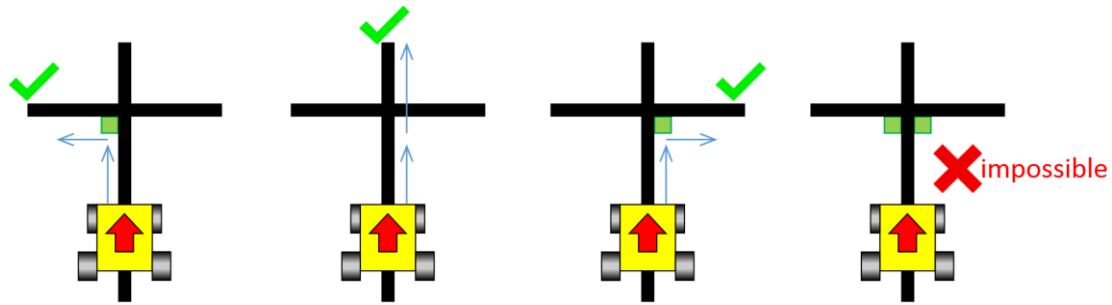
Obstacles may consist of bricks, blocks, weights and other large, heavy items. Obstacles will be at least 15 cm high. An obstacle does not occupy more than one line. A Robot is expected to navigate around an obstacle or may push it. Note that the obstacles may be very heavy or even fixed to the floor. Obstacles that are moved in any way will remain where they are moved to, even if it ends up prohibiting your robot from proceeding.

### 1.4. The Intersections

Intersections can be placed anywhere except in the evacuation zone. They are always perpendicular, but may have 3 or 4 branches.

The intersection markers indicate the path that the robot should follow. They are 25 mm x 25 mm green squares. If no green markers are placed at an intersection, the robot should continue going straight.

The marker is always placed just before the intersection. The robot should turn towards the green marker. (See images below for possible cases).



### 1.5. The Doorway

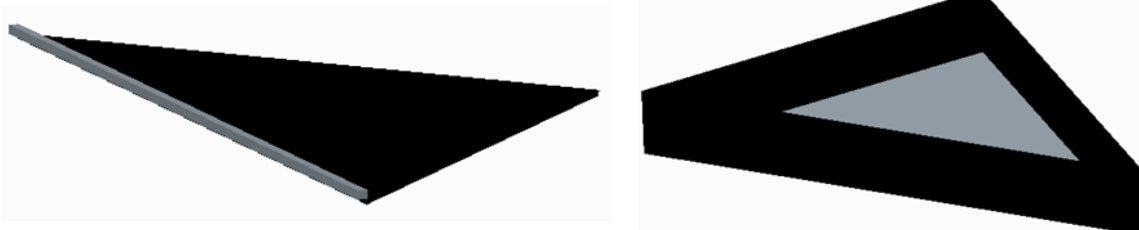
The arena may have doorways which are 25 cm wide and 25 cm high. They are placed perpendicular to the line



## 1.6. The Evacuation Zone

The "evacuation zone" is approximately 120 cm by 90 cm with walls in the 4 sides that are at least 10 cm high. It does not have an exit door. The black line ends at the entrance of the evacuation zone. At the entrance to the evacuation zone, there is a 25 mm x 250 mm strip of reflective silver tape on the floor.

Inside the evacuation zone, robots are required to utilize some form of search strategy to locate the victims. For the early rounds, the Evacuation Point is a black painted tile in the shape of right angled triangle with 30 cm x 30 cm sides and a bump of 5 mm (left figure below). In later rounds, the Evacuation Point is a hollow, black painted, right angled wooden piece, with 30 cm x 30 cm sides and a height of 6 cm. (right figure below).



## 1.7. The Victims

Victims may be located anywhere on the floor of the evacuation zone. They take the form of light plastic balls, approximately 5 cm in diameter and are covered with aluminium foil tape. Teams need to be prepared for minor variations. The surface of the balls is silver coloured and reflects light.

## 1.8. The Environmental Conditions

Teams should expect the environmental conditions at the venue to be different from the conditions at their school. Teams must come prepared to adjust their robots to the light and magnetic conditions at the venue. While the organizers and judges will try their best to minimize external lighting interference, it is not possible for them to foresee all unexpected ones such as camera flash from spectators.

## 1.9. All Measurements

All measurements in the rules have a tolerance of 5%.

## 2. THE ROBOT AND THE TEAM

- 2.1. A team is composed of 2 to 4 members. A team can compete with one qualified robots. The substitution of robots during the competition within the team or with other teams is forbidden.
- 2.2. For each round, the team designates a Team Captain who manually starts the robot. The Team Captain is the only member allowed to handle the robot when instructed by the Judge. No member is allowed to step or lean on any part of the arena. Only team members participating in the round are allowed to be near the arena.
- 2.3. The Robot must be controlled autonomously. The use of lasers, of a remote control or manual control, or passing information (by sensors, cables, wirelessly, etc.) to the robot is not allowed. It is forbidden to use pre-mapped type of dead reckoning (movements predefined based on known locations before game play).
- 2.4. Robots are not allowed to damage the field or any part of the arena in any way. Robot must be able to pass through a doorway without moving it from its original position.
- 2.5. Any robot kit or building blocks, either available on the market or built from raw hardware, may be used if the design and construction of the robot are primarily and substantially the original work of the students.
- 2.6. Any commercially produced robot kits or sensor components that are specifically marketed to complete any single major task of this event will be disqualified. For example, pre-programmed sensors with special features for line-following are not allowed. If there is any doubt, the teacher-in-charge should verify with the Competition Coordinator or the Chief Judge at least a week before the start of the competition. Any team found to be in violation of this rule during the competition will be immediately disqualified.
- 2.7. Bluetooth Class 2, 3 and ZigBee communications are the only wireless communication types allowed in this competition. Robots that have other types of wireless communications on board will need to be removed or disabled for possible interference with other robots. Teams that do not comply will face immediate disqualification.
- 2.8. The teams that do not abide by the specifications/regulations are not allowed to participate. If violations are detected during a running game (round), the team is disqualified for that game. If similar violations occur repeatedly, the Judge can disqualify the offending team from the competition.



### 3. THE GAME

#### 3.1. Pre-game Inspection

The robots will be examined by the Judge before the start of the competition, before any round if the robots are modified, or if requested by the Judge. Although highly unlikely to occur, it is illegal for two or more teams to have identical robots, whether identical in programming or construction.

Team members will be asked to explain the operation of their robots, in order to verify that construction and programming of the robot is their own work. Members will be asked about their preparation efforts.

#### 3.2. Practice Periods

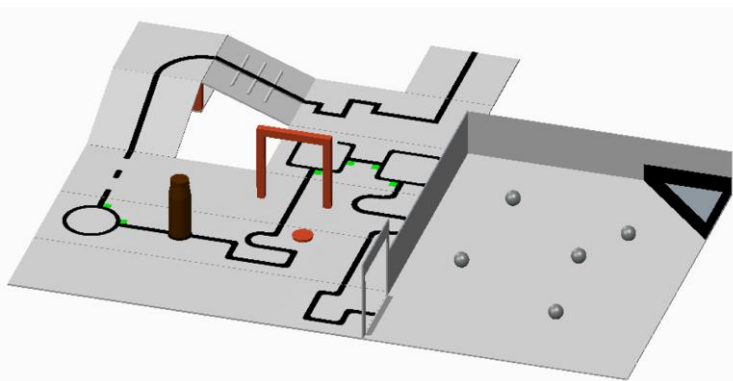
1. Every team will be given access to the arena for calibration, testing, and practice. The allotted time will be the same for each team and the duration will be decided by the Judge for each modified round.
2. At the end of the "practice period" of each round, the Judge will call for the start of the games. All teams should be ready to play according to the schedule prepared by the Judge and distributed at the first day of the competition. Note that this schedule may be changed by the Judge at any time if necessary.

#### 3.3. Game Zone

An area around the game fields is called the "game zone". A round where progress is monitored and points are awarded is called a "scoring run" Remember that only members of the team currently playing are allowed in the game zone, and only the captain of the run is allowed to interact with the robot during a scoring run. The captain can move the robot only when asked by the Judge.

#### 3.4. The Scoring Run

1. Before the scoring run starts the captain decides which tiles should be **checkpoints** and must place the orange markers on these tiles to identify them. In addition to the start tile, there are two checkpoints for each run. The start tile is implicitly a checkpoint and there is no need to place a marker on it. The markers are orange pucks, similar in size to a hockey puck, and are supplied by the organizers.
2. It is not allowed to place the two checkpoint markers on the same tile. Once the scoring run has begun, the markers location cannot be changed. If a robot moves a marker, it is still the original tile that is the checkpoint. The marker is only there for everyone to remember where the checkpoints are located.
3. Before the start of the scoring run, the team is given a maximum of 2 minutes to make final calibration. Calibration is defined as taking sensor readings and modifying the robot's programming to accommodate for such sensor readings. Any and all pre-mapping activities will result in immediate disqualification of the robot for the round. Teams may calibrate their robot in as many locations as desired on the arena, but they must be done by the end of the 2 minutes. A robot is not permitted to move using its own power while calibrating.
4. Once a team is ready to perform a scoring run, they must notify the Judge. To begin a scoring run, the robot is placed on the starting tile of the course as indicated by the Judge. Once a scoring run has begun, no more calibration is permitted; this includes changing of code/code selection.
5. Once the scoring run has begun, the robot that is competing is not permitted to leave the competition area. A robot will be given a maximum time of 8 minutes to complete the course. The time for each run will be kept by the Judge.
6. The teams are not allowed to give their robot any advance information about the field. A robot is supposed to recognize the field by itself, and must follow the line completely to enter the evacuation zone.
7. Modifying the robot during a run is prohibited; which includes remounting parts that have fallen off. All parts that the robot is losing intentionally or unintentionally will be left in the arena until the run is over. Neither the team captain nor a judge is allowed to remove parts from the arena during a run.



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8. A team captain may elect to stop the scoring run early at any time but must clearly indicate that to the Judge. The team will be awarded all points achieved up to the call for end of round.
9. The scoring run ends when the time expires, when the team captain calls the end of the round or when all the victims are successfully rescued.

### 3.5. Victim Placement

The Judge will place the victims (represented by the balls) at random in the Evacuation Zone. The number of victims will be decided by the Judge and will be the same for all teams during a round.

### 3.6. Evacuation Point Placement

The Judge will place the "evacuation point" (represented by black triangle tile or wooden triangular piece) at any of the three corners of the "evacuation zone" which is not adjacent to the entrance door. The location of the "evacuation point" will be the same for all teams during a round.

## 4. SCORING

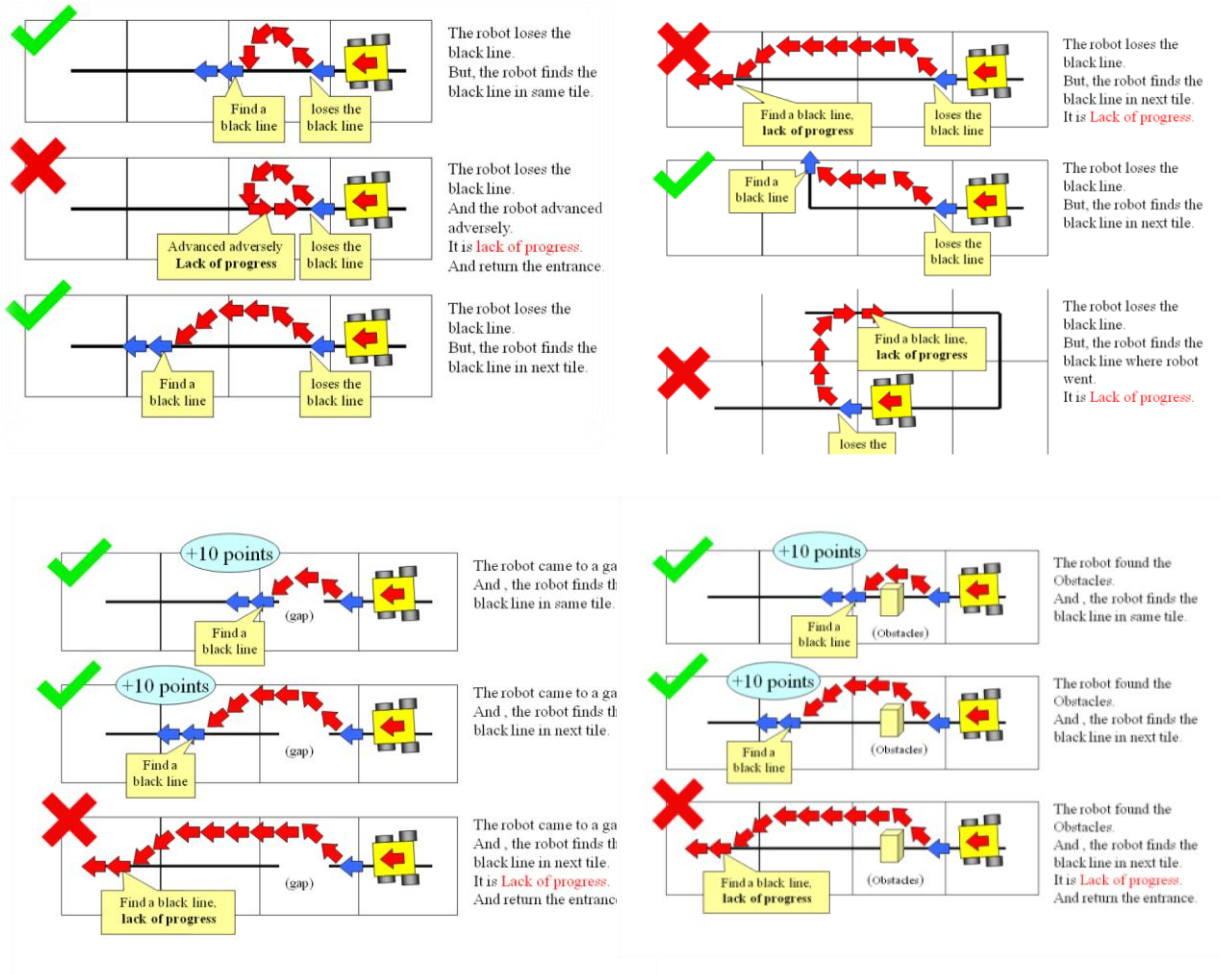
- 4.1. The team is awarded points when their robot successfully completes a tile. For each tile that the robot successfully completes in the first attempt, the team is awarded 3 points. When the robot successfully completes tiles in the second attempt, the team is awarded 2 points per tile. When the tiles are successfully completed in the third attempt, the team is awarded 1 point per tile. (See also 4.4 below).
- 4.2. The terms "successfully completing a tile" and "successfully negotiating a hazard" are defined as completely following the line, navigating through line gaps, intersections, speed bumps, debris, obstacles, and going through a doorway without human interaction.
- 4.3. Additional points are awarded when the robot successfully negotiates each hazard; gaps in the line, speed bumps, debris, intersections, and obstacles. (See also 4.5 below) Points are awarded for successfully negotiating each hazard as follows:
  - 10 points are awarded for successfully negotiating a tile with one or more speed bumps.
  - 10 points are awarded for successfully negotiating a tile with debris.
  - 10 points are awarded for negotiating each tile with gaps in the line
  - 10 points are awarded for successfully negotiating an intersection. Successfully negotiating a tile with two intersections will be rewarded with 20 points.
  - 10 points are awarded for passing around an obstacle or pushing it aside and continuing through the course.
  - No points are awarded for passing through a doorway, however, every robot is required to pass through doorways and not go around them.
  - 20 points are awarded for each victim rescued and placed in the evacuation zone.
- 4.4. When the robot fails to reach the next checkpoint after the third attempt, the Judge directs the team captain to place the robot on that checkpoint and the run continues from there. No points are awarded for any tile or obstacle skipped due to moving to that checkpoint.
- 4.5. Points for each tile are awarded once (3 points, 2 points, or 1 point, depending on the attempt). Points for completing each hazard (gap, speed bump, intersection, and obstacle) can only be awarded once per run and not at each attempt through the course.
- 4.6. Successful victim rescue: Robots are awarded 20 points for successfully rescuing each victim. A successful victim rescue occurs when the victim is moved to the evacuation point (it needs to be completely inside of the evacuation point, and no part of the robot be in contact with the victim).
- 4.7. Ties in scoring will be resolved on the basis of the time taken by each robot to complete the course (this does not include calibration time).

## 5. LACK OF PROGRESS

- 5.1. A lack of progress occurs when:
  - The robot loses the black line without regaining it by the next tile in the sequence. Refer to the different scenarios shown in the figures next page.
  - A robot does not follow the correct direction at an intersection.
  - A robot is escaping the evacuation room. When the robot has entered the evacuation room it is not allowed to go back to the line again.



- 5.2. The team captain can also call for a "lack of progress" if the robot is stuck or is in danger.
- 5.3. If a "lack of Progress" happens, the robot must be positioned at the previous checkpoint facing the evacuation zone, and checked by the Judge.
- 5.4. Only the team captain is allowed to restart the robot. Note that changing the programs and/or modifying the robot is strictly forbidden. There is no limit to the number of restarts within a score run.
- 5.5. If a lack of progress happens in the evacuation zone the location of the victims will not be moved. Those rescued will remain in the evacuation zone. A victim that is under the control of a robot when "lack of progress" is called will be released by the Judge and placed at least 30 centimeters away from the robot.



## 6. CODE OF CONDUCT

### 6.1. Fair Play and Behaviour

All team members are expected to play a fair and clean game. It is important that the participants learn from each other as well as enjoy the competition. Team members and robots are not allowed to cause damage to any part of the arena.

All participants (team members, teachers-in-charge and chaperons) are expected to treat each other with respect and to adhere to the rules and regulations of the competition. Participants must follow the directions of the Search & Rescue-Secondary Level Judges and of the RoboJunior Officials.

Teams will be responsible for checking update information (schedules, meetings, announcements, etc.) during the event. Update information will be provided by the Judges. All teams are required to compete in the two days of the competition.





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### 6.2. Teacher-In-Charge and Mentors

The teacher-in-charge and mentors (chaperons, parents, or visitors) are not allowed to assist in the construction or programming of the robots. For safety reasons, only the teacher-in-charge and the officially registered chaperon(s) are allowed to stay at the team's work areas, but not around the arena. These teachers and chaperons must refrain from touching the robots or giving any verbal directions to repair or re-program any robot. Violators may risk the disqualification of their team.

### 6.3. Decisions of the Judges.

All decisions during the game are made by the Judge who is in charge of the arena and of the participants around it. All the decisions made by the Judge are final.

A team captain (or any team member through their team captain) has the right to voice a concern to the Judge. The communication should be conducted calmly and with respect. No rude arguments with the Judges by the team members, teachers or chaperons are allowed. Such rude arguments will result in a warning. If the argument continues or another rude argument occurs, this may result in immediate disqualification of the team from the competition.

At the conclusion of the scoring round, the team captains must review and sign the score sheet. By signing the score sheet the captains accept the final score on behalf of the entire team.

## 7. ADDITIONAL REQUIREMENTS

### 7.1. Robot Construction:

Robots must be constructed exclusively by the student members of a team. Mentors, teachers, parents or companies may not be involved in the design, construction, and assembly of robots.

For the construction of a robot, any robot kit or building block may be used as long as the design and construction are primarily and substantially the original work of a team. This means that commercial kits may be used but must be substantially modified by the team. It is not allowed to mainly follow a construction manual, or to just change unimportant parts.

Indications for violations are the use of commercial kits that can basically only be assembled in one way, or that robots from different teams, build from the same commercial kit, all basically function or look similar.

Robots must be constructed in a way that they can be started by the captain without the help of another person.

### 7.2. Robot Programming:

Robots must be programmed exclusively by student members of the team. Mentors, teachers, parents or companies should not be involved in the programming and debugging of robots.

For the programming of the robots, any programming language, interface or integrated development environment (IDE) may be used. The use of programs that come together with a commercial kit (especially sample programs or presets) or substantial parts of such programs are not allowed. It is not allowed to use sample programs, not even if they are modified.

### 7.3. Robot Inspection and Team Member Interviews:

Team members should make sure that the Judge inspects and certifies their robot during the practice period and before any scoring run. The Judge may request other inspections if necessary. The inspections may include verification of the robot's construction and/or programming.

The S&R-Secondary Level Judges may arrange for a technical interview for all team members during the event. The judges will go around interacting with the students. The interview will be set up as a casual conversation in a "questions and answers" atmosphere. The main objective of the interview is to discuss the technical challenges which the students faced during the construction and programming of the robots. The judges will be looking for innovative solutions to the different challenges.

A team will not fail an interview except if the judges determine that the students did not follow sections 7.1 and 7.2 above. Failing the interview may disqualify the team from maintaining (if applicable) their first, second or third place. It is acceptable that different team members have varied skills in programming and/or construction.



## APPENDIX

Sample arena:

Four (or more rounds) will be played by each team. For each round, the tiles will be arranged in different ways to form different layouts of the arena. Below is just one sample of an arena for demonstrative purposes only.

