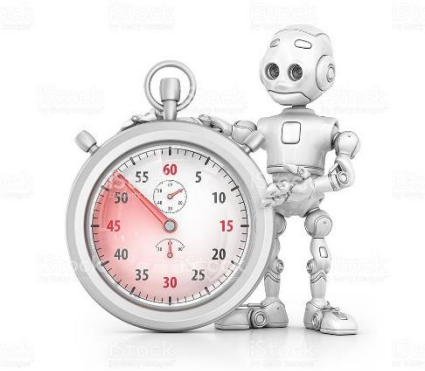
2019 Robocup challenge – Objective, requirements, and rules

Note – these rules are subject to change or modification

Version 1.0 (08/03/2019)

Scenario: This year's Robocup challenge is a race with a difference.



Objective: You have **2 minutes** to gather **up to 2 *weights* (but not 3)** using your mobile robot.

Competition: Two robots will be in the arena at the same time, collecting *weights* for their group. There will only be 3 target *weights* in the arena for each round. *Weights* are considered collected, and thus contribute to your final total weight, if they are onboard your robot.

At the end of the 2 minutes, the group with the greatest cumulative weight, made up of 1 or 2 *weights*, will be declared the winner of that round. If, by chance, you have 3 *weights* onboard at the end of the round, you will lose that round. The competition format will be *double-elimination*, so you need to lose two rounds to be eliminated.

To make matters even more interesting, there will be dummy weights in the arena that will not contribute to your overall weight.

Environment: The arena in which the race takes place is 2.4 x 4.9m with 400mm high walls. The arena will contain a number of obstacles that your robot will need to avoid or negotiate. The position of the obstacles for the final competition will not be revealed until the day of competition and will change regularly during the competition rounds, so your robot must be able to deal with these unknowns.

Within the arena, there will be 3 *weights* and a number of *dummy weights*. The shape of all *weights* will be identical (i.e. A cylinder of diameter 50mm and height 70mm with an annular groove to facilitate gripping) but vary in colour and weight. The target *weights* will be located in the same position for every round. However, the positions of the obstacles and *dummy weights* will change frequently. *Dummy weights* may have a steel insert in the top.

Within the arena there are two areas designated as bases. These areas will be coloured *green* and *blue*, different from the surrounding arena (black) and obstacles (red). These bases will measure 600mm x 600mm and include a low rim. The robots will start each round on one of these bases. The approximate layout for the fixed aspects of the arena are shown in Figure 1.

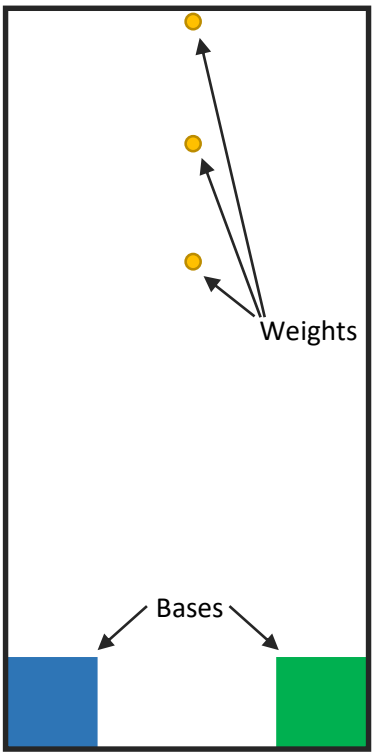
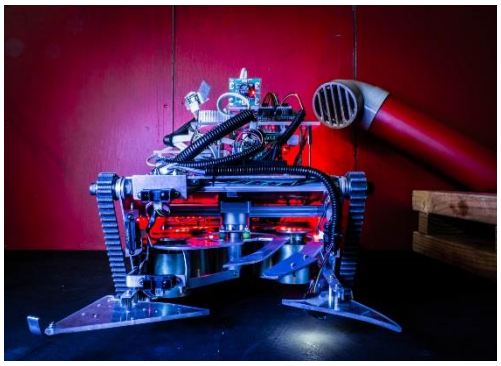


Figure 1 Arena layout

Hardware: You must construct your robot using:



Controller: Arduino Mega ADK (Atmel ATmega 2560 8-bit microcontroller). You cannot use other boards/controllers.

Chassis: You have the choice of using a supplied tracked chassis, or building your own custom chassis from scratch.

Sensors/actuators/structure: You will be provided with:

i. A box of parts including various sensors, actuators, and structural elements such as aluminium plate, rods, acrylic etc.
ii. A budget of $50 which you can use to order additional components.
iii. 200g of material for 3D printing. Additional material will come out of your $50 budget at 5c/g.

Technical support: Julian Murphy

The fine print:

1. Robots

1.1. **Robots must be autonomous**. There can be no human intervention in the robot's operation, either physically or via software during the competition.

1.2. Robots must have a defined *front end* that will be used for aligning the start direction.

1.3. Robots must be controlled by the supplied Arduino Mega ADK (Atmel ATmega 2560 8-bit microcontroller). You cannot use other boards/controllers – unless you build one from discrete components (good luck with that!).

1.4. In addition to the Arduino and the tracked chassis components, you will be provided with:

1.4.1. A box of parts including various sensors, actuators, and structural elements such as aluminium plate, rods, acrylic etc.

1.4.2. A budget of $50 which you can use to order additional components. (see 5. Procurement).

1.4.3. 200g of material for 3D printing. Additional material will come out of your $50 (1.4.2) at 5c/g

1.5. All robots need to meet general safety standards, including:

1.5.1. Lasers must be below 5mW, unless approved by Julian Phillips.

1.5.2. Spinning devices must travel at under 200rpm, unless adequate guarding is in place.

1.5.3. It is compulsory to use the power cut-off module, in between the battery and any electronics.

1.5.4. No naked flames allowed, this includes any form of flame thrower.

1.5.5. No chemically explosive or EMP devices.

1.5.6. Voltage within your device should not exceed 100v DC.

2. Environment

2.1. The competition will take place in a 2.4 x 4.9m meter arena with 400mm high walls. The walls and floor of the arena will be coloured black.

2.2. Within the arena will be two areas designated as home base.

2.2.1. These areas will be coloured blue and green.

2.2.2. The base area is defined as the 600 x 600mm coloured space.

2.2.3. There will be a low 'rim' attached to the floor within each base (~10mm high).

2.2.4. The bases will be located as per Figure 1.

2.3. The arena will contain a number of obstacles that your robot will need to negotiate. Obstacles include walls, ramps and speed-bumps.

2.3.1. All gaps between walls (including arena walls) will be greater than 0.4m.

2.3.2. Vertical obstacles (e.g. walls and pipes) will be coloured red.

2.3.3. Horizontal obstacles (speed bumps) will be the same colour as the arena floor.

2.3.4. Speed-bumps will be rectangular in profile and up to 25mm high.

2.3.5. Ramps may be up to 100mm high, with a maximum gradient of 30%.

3. ***Weights***

3.1. Within the arena, there will be 3 target *weights.*

3.1.1. The position of the target *weights* will remain fixed throughout the competition.

3.1.2. The target *weights* will be located approximately as per Figure 1.

3.1.3. The target *weights* will consist of 1x 1.0kg *weight,* 1x 0.75kg *weight, and* 1x 0.5kg *weight.*

3.2. All target *weights* will outwardly look identical.

3.2.1. Steel cylinder of diameter 50mm and height 70mm with an annular groove to facilitate gripping.

3.3. Within the arena, there will be a number of *dummy weights*.

3.3.1. *Dummy weights* will be the same size and shape as target *weights*, but constructed of non-conducting plastic.

3.3.2. *Dummy weights* may have a steel insert in the top.

3.4. *Weights* may be placed against arena or obstacle walls.

3.5. If a *weight* is knocked over during a round, it will be left on its side for the remainder of the round.

4. Competition

4.1. The competition consists of a number of rounds in which two robots are present in the arena simultaneously.

4.1.1. Robots will begin each round on their respective base, facing a specified direction.

4.1.2. The start direction will be specified by the organisers for each round.

4.1.3. Each round lasts for 2 minutes.

4.2. The robot possessing (i.e. onboard) the greatest cumulative weight from 1 or 2 *weights* at the end of the round will be declared the winner.

4.3. If a robot has 3 *weights* on board at the end of the round, the opposing robot will be declared the winner.

4.4. A *weight* will be considered ***onboard*** a robot when it is off the ground and completely under the control of the robot i.e. if the robot is picked up off the ground, the *weights* come with the robot.

4.5. *Weights* onboard a robot are not considered safe and can therefore be pilfered by the opposing group, provided that no deliberate damage is inflicted during the raid (as per clause 4.15 about damage).

4.6. *Dummy weights* do not contribute to the overall cumulative weight.

4.7. If two robots finish with no target *weights*, the group with the greatest number of *dummy weights* will be declared the winner (via more successful pick-ups).

4.8. In the unlikely event that two robots finish the round tied according to 4.7, the lightest robot will be declared the winner.

4.9. In the almost impossible event that two robots finish the round tied according to 4.7 and weight exactly the same, the robot that has obviously travelled the greatest distance during the round (at the discretion of the competition judge on the day) will be declared the winner. If one robot has not obviously travelled further than another, then the robot that is furthest from its base (in a straight line) will be declared the (dubious) winner.

4.10. In the 'this is just getting ridiculous' event that the round is tied according to 4.9, we'll flip a coin…

4.11. There will be no restarts of robots. If a robot malfunctions or is damaged accidentally, it must continue to the end of the round without intervention.

4.11.1. If both teams malfunction at the start of a round, the round may restart at the discretion of the competition judge on the day.

4.12. Robots can be repaired between rounds. However, they must be ready in time for their next round.

4.13. If a robot is late to its round, it will be disqualified. This decision will be made at the discretion of the competition judge. There will be no discussion or appeal.

4.14. Both robots must remain inside the arena at all times. If a robot ventures outside the arena, **whichever robot was responsible will be disqualified** (i.e. if a robot takes itself outside the arena, it will be disqualified. If one robot is placed outside the arena by the opposition, the opposition will be disqualified).

4.15. Any deliberate damage to the other robot during a knockout round will result in **immediate disqualification**. This is not Robot Wars! However, cunning methods to inhibit your competition that do not result in damage will be permitted. The decision on whether any damage is accidental or deliberate will be made by the judge on the competition day – there will be no discussion or appeal, so be careful!

4.16. In the event that one robot is *captured* by another, any *weights* onboard the captured robot will be considered property of the captor.

4.16.1. A robot is considered ***captured*** if no part of it is touching the ground and its movements are completely under the control of the captor – i.e. the captor must be able to move the captive robot at will and without restriction.

4.17. When the competition is completed, the design will be stripped down to the original components by the team and all parts returned to Julian – unless your robot is so damned awesome that you are requested to return the robot in one piece for a victory parade.

4.18. The competition draw will be determined and circulated prior to the competition

5. Procurement

5.1. When spending your budget, **items must be ordered through Julian** and be able to be purchased using a credit card. If you buy any items yourself, or bring them from home, you **will not be reimbursed**.

5.2. Any items not ordered through Julian will be assessed for value (either on production of a receipt, or Julian's experience) and that amount deducted from your budget. This is not an all-out robot-beauty pageant, there are cost and hardware constraints, just like in the real-world.

5.2.1. Second-hand items will be valued at their current 'new' price (if you were to buy that item today)

5.3. Procurement requests should be submitted to Julian via email and procurement will take place fortnightly, unless agreed in advance.

5.4. All materials used from the supplied parts kit or additional procurement shall be identified in a bill of materials in the design document.

5.5. No budget credit will be given for unused items in the supplied parts kit.

Milestones:

To encourage testing of concepts and components during the development of your robot and preparation of reports, each group must pass two simple milestones and submit a brief document to demonstrate each of these.

The milestones themselves are not worth any marks, but any group that fails to submit a satisfactory document will receive a 10% penalty on their grade for the relevant design report.

More details will be made available on Learn.

Reporting:

We have produced guidelines for each of the three reports that are required for this project. These guideline documents will be available on Learn. Basically, the structure of the three reports is:

1. Conceptual design report – present and evaluate several possible concepts and select one to take forward
2. Detailed design report – present the detailed design of your selected concept to a level that a competent engineer (or mechatronics student) could assemble a working version of your design.
3. Design evaluation report - critically evaluate the performance of your final design and compare it against competing designs in the context of this competition.

These reports have strict page limits to ensure that you present only relevant and important information. Several examples of each type from previous years will be made available on Learn.