

ROBOTICS 4/M

ASSIGNMENT



ROBOT WARS RETURNS: The Wild WALKERS

1. Introduction

Your assignment for the Robotics 4 and Robotics M courses is to construct and programme an autonomous *robotic gladiator* for a LEGO® version of Robot Wars®. These robots will be constructed out of LEGO Mindstorms fast prototyping equipment and programmed using the LEGO software provided with this equipment. These robots, although lethal to each other, should not prove lethal to any human (e.g. no flamethrower attachments, no chainsaws, etc). Also, your autonomous robot must compete in a Robot Wars® like competition while mimicking the walking mechanisms of biological entities e.g. humans, dogs, horses, lizards, etc.

All of the construction and programming of the LEGO robots will take place during the scheduled laboratory slots as specified in MyCampus. The activities associated with this assignment will be undertaken in teams. Each team has a total of about fifteen hours to design, construct and programme a robot for this competitive task. Try to restrict your activities to these times so that this assignment does not interfere with your other studies.

The following laboratory sheet provides you with the rules for your teams, the competition and your report for this exercise. Failure to comply with these rules will result in a reduction in your team's mark for this part of the course.

2. Robotic Gladiator

As with all robots, robotic gladiators or combat robots are constructed and programmed to perform specific tasks (i.e. to battle with other robots). Such *fit for purpose* robots are designed with their tasks in mind so that they can perform the duties assigned to them. In the case of combat robots the construction must reflect their combat purpose and for this exercise your robot must be able to compete against other robots in the field of combat.

The common construction elements that comprise a combat robot are shown in Figure 1 and described in detail below.

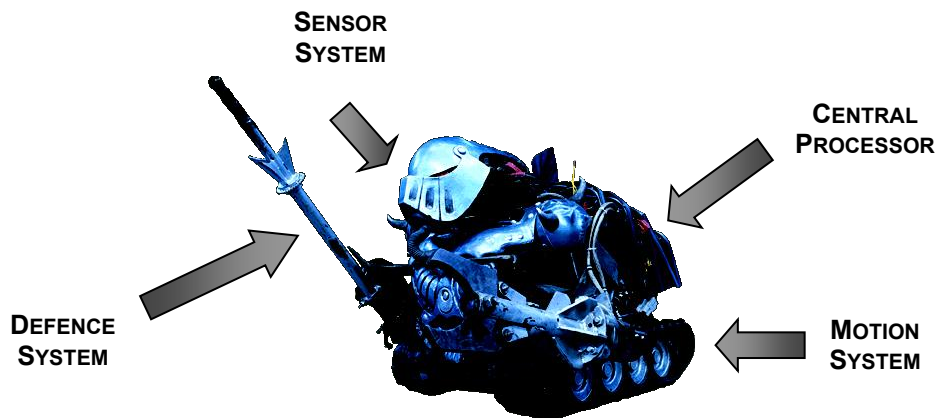


Figure 1: The Robotic Gladiator Components

Motion System: this provides the mobility necessary for your robot to pursue and flee from their adversary. In this case the motion system for your robot should mimic the walking mechanism of biological entities (i.e. no wheels or tracks, just legs). Consider the motion system considered in the first laboratory session.

Sensor System: This provides the sensory information for your robot. A combination of sensors can allow the robot to sense obstacles and other robots. This system is crucial for a fully autonomous robot.

Central Processor: This provides the brains for the robot. It determines how the robot reacts to its external environment in an autonomous manner. In this case the processor will be the NXT block.

Defence System: This system should be provided the defensive and offensive capability for your robot.

All these components must be considered when your team is constructing your competing robot for this exercise. The construction and operation of your robot must follow the competition rules outlined in the next sessions.

3. Walker Robot Wars Competition

The main aims of the Walker Robot Wars Competition is for teams to create robots that can do the following:

- To replicate the walking mechanism and gait of a biological entity e.g. bipedal or quadrupedal motion.
- To compete in a friendly gladiatorial competition against one or more robots.

The gladiatorial competition will take place in an arena defined by solid black lines instead of physical walls. Figure 2 shows a typical configuration of the arena that may be used in the competition.

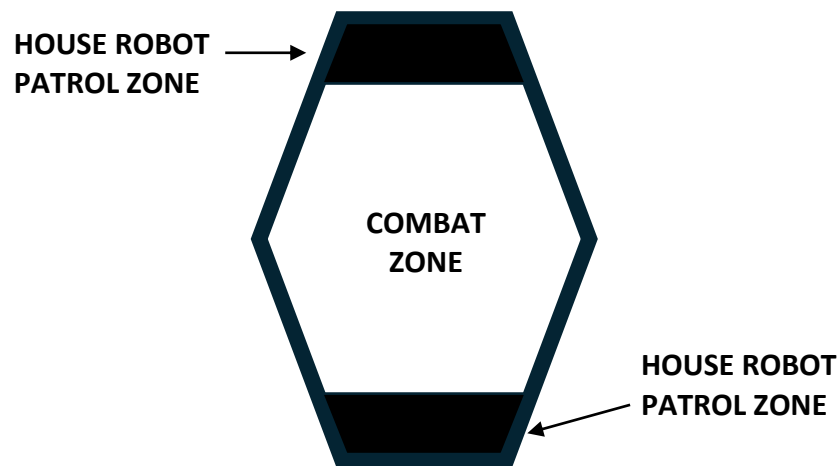


Figure 2: Arena Configuration (illustration only)

The performance of your robot will be assessed in the Walker Robot Wars Competition by means of the following 4 metrics:

- Walking – effective walking replication that is used to propel the robot (see Figure 3(a))
- Autonomy – ability of your robot to manoeuvre accurately (see Figure 3(b))
- Damage – ability of your robot to cause damage to another robot (see Figure 3(c))
- Survivability – ability of your robot to survive to the end of the competition (see Figure 3(d))

Each metric has a total of 5 marks associated with it. The robots will be ranked based on their performance in each and an associated mark awarded for their relative position in the ranking. The robot with the highest score will be the overall winner of the competition.

4. Rules

4.1 Team Rules

In order to reduce the amount of time spent on this assignment you will construct, programme and compete in teams of about 6 students. All teams should follow the team rules given below:

1. Each team must have a name and only enter **one** robot for the final competition.
2. Each team must abide by the rules.
3. Each team will be given a Mindstorms EV3 box to form the basis of their robot. Your team is responsible for this and all other equipment used for this assignment. **All equipment must be returned at the end of the assignment and put in the original box it came from.**
4. Each team will have to read and abide by the regulations set out for attending the lab.
5. Each team will split the workload equally amongst the team members. How this is achieved is up to you.
6. Each team must prepare a technical report on the construction, programming and novel features of their final robot design.
7. Each team must present a robot design at the final competition.
8. Each team is to prepare and submit a short pre-recorded presentation about the robot by the end of the course.
9. Most of the team members should be present at each laboratory session for your group. Attendance will be taken.
10. Problems encountered by your team must be reported to lecturing staff immediately.

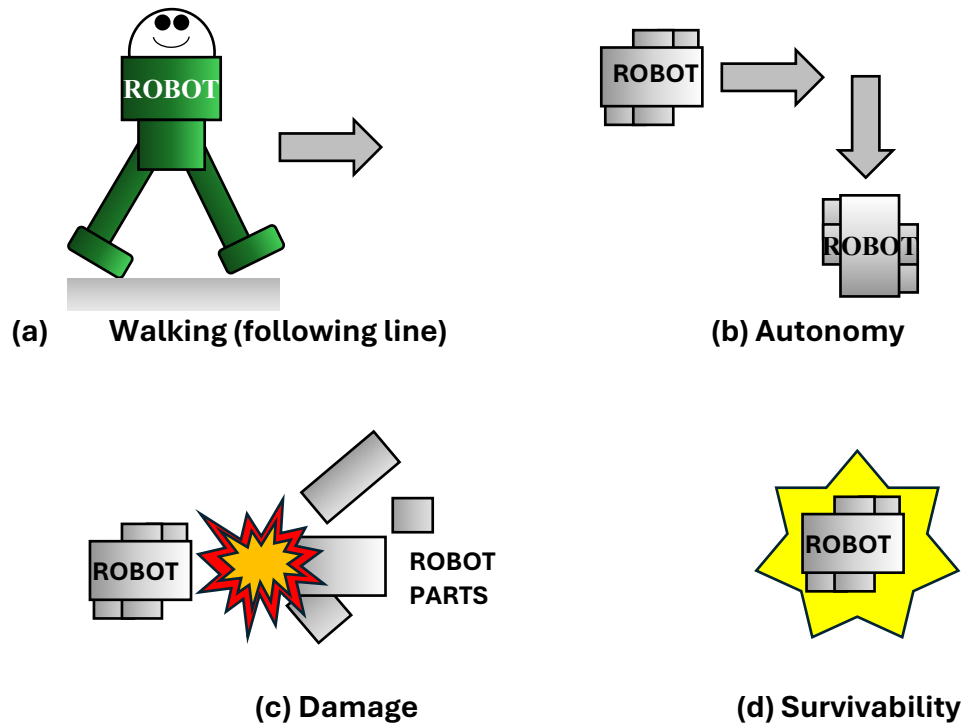


Figure 3: Schematics of Competition Metrics

4.2 Robot Construction Rules

The construction of your robot must follow the rules below. Although they present a limit on what can be used for your robot (for safety reasons), these limits and rules should not restrict your imagination, creativity and enjoyment during this assignment.

1. Each robot **must** be constructed from LEGO components only.
2. Only the LEGO equipment provided during the laboratories can be used for this assignment. Do not bring in and use your own LEGO equipment.
3. The LEGO equipment can be used within the laboratory at scheduled lab times.
4. The LEGO equipment must not be removed from the computing laboratory at anytime (other than for storage).
5. The LEGO components **must not** be glued together. Normal LEGO connection practices must be adhered to.
6. Only one EV3 control unit can be used in each robot construction.
7. No Hazardous materials should be used in the construction of your robot.
8. No water or liquid based weapons are allowed.
9. No electric shock weapons are allowed.
10. No Hazardous or lethal weapons can be used as the defence/attack mechanisms for your robot e.g. no chemical weapons, no flamethrowers, no machine guns, no nuclear devices, etc.
11. No sharp or blade weapons can be used as the defence/attack mechanisms for your robot.
12. No pointy or sharp projectiles can be used as the defence/attack mechanisms for your robot. Only use the smooth rubber projectiles provided.
13. No camera-based robot systems are allowed.

14. If a projectile weapon is used its angle of firing elevation must not exceed 30°.

3.3 Robot Programming Rules

The programming of your robot must follow the following rules. These rules should not restrict your creativity or enjoyment. They are simply to ensure that the contest is fair.

1. LEGO Scratch software and RobotC should be used to programme your robot.
2. The program for the robot should make the robot totally autonomous (i.e. self-guiding).
3. No remote controls are allowed.
4. No communication between your robot and any other robot or device is allowed during operation.

3.4 Final Competition

The final competition shall take place in the final lab session for each lab group. This will take place in a specially constructed arena. The arena floor will be a light colour and the walls will be represented by a dark colour. The house robot patrol zones shall be a dark colour. These zones will be occupied by house robots that will attack any robot that enters this area.

The competition will consist of 3 stages that constitute a mini-league. The league structure is shown below.

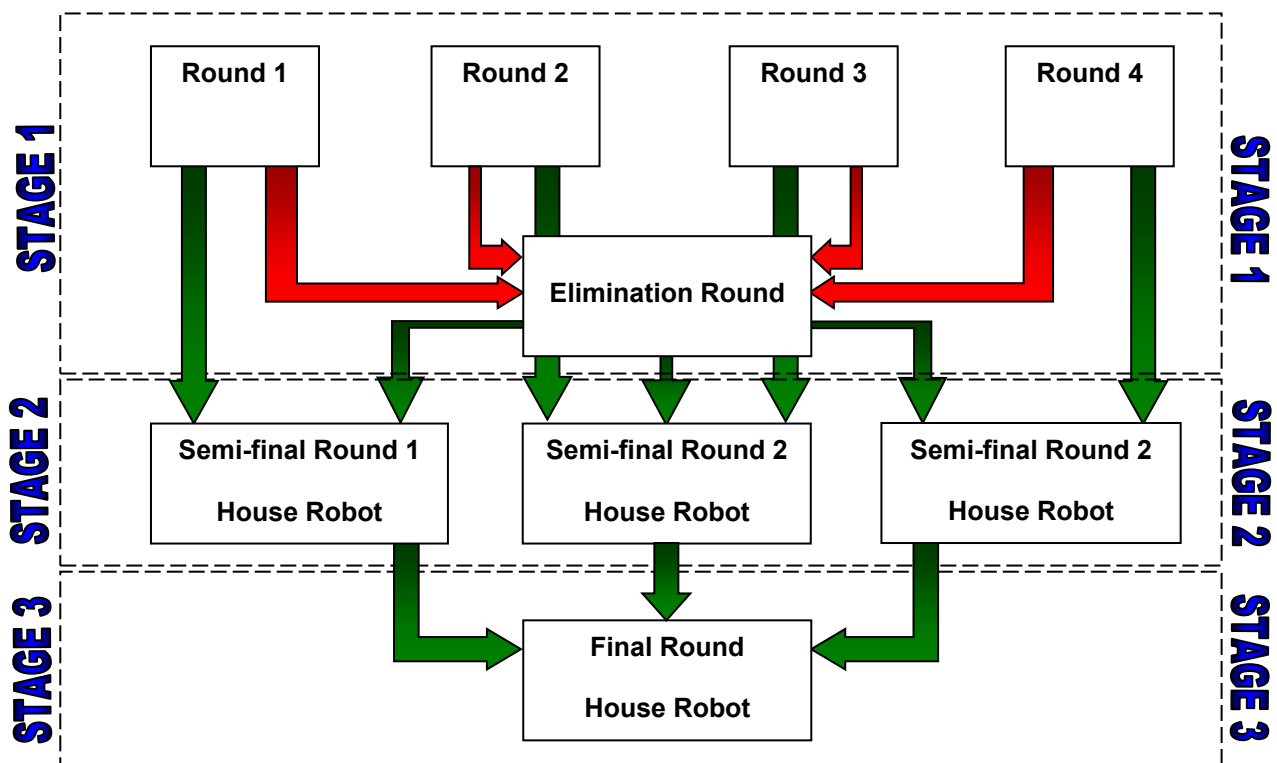


Figure 4: Example Competition League Structure (illustration only)

Stage 1 involves each team participating in 1 round of combat. The winning robot from each round shall proceed to Stage 2 of the competition. The losing robots shall combat in an Elimination Round and the subsequent top robots shall proceed to Stage 2.

Stage 2 involves the winners from the Stage 1 rounds and the top robots from the Elimination Round. This stage consists of 3 semi-final rounds and 1 house robot shall be present in each round. The winning robots from these semi-final rounds compete in Stage 3.

Stage 3 involves the winning robots from Stage 2. This is the final round and a house robots shall be present during the combat. After the round the robots shall be ranked into 1st, 2nd and 3rd places. The team with the winning robot shall be the winners of this year's LEGO Walker Robot Wars Competition.

The rules for the competition are given below.

1. Each robot must operate autonomously. No remote controls can be used.
2. Each combat round of the competition shall last 1 minute.
3. House robots can only attack a competing robot in the *house robot patrol zones*.
4. The judging panel shall decide the winning robot from each round.
5. The judging panel's decision is **FINAL**.
6. No modifications to or assistance for the robots are allowed during combat.
7. No team member is allowed to enter the arena during combat.
8. No robot substitutions are allowed during the competition.
9. If a winning robot cannot proceed to the next round, the robot defeated by this immobilised robot shall proceed in its place.
10. 5 minutes period of preparation shall be provided at the beginning of each round. Any robot unable to operate after this period will be disqualified.
11. Any team breaking any of these rules shall be disqualified.

5. Assessment

This assignment constitutes 20% of your final mark for Robotics 4 and Robotics M respectively. The mark assigned to you for this part of the course is made up of three components: *the team presentation*, *the team report* and *the competition performance*. Details of these are provided below.

5.1 The Team Recorded Presentation

Each team shall record a short presentation describing their robot and the design methodology behind them. These presentations will last no more than 5 minutes. The individuals involved with construction will present the design of the robot and the students involved with the programming will present the strategy and path planning aspects for the robot. This presentation constitutes 10% of your assignment mark. The University's late submission rules will apply to the submission of your team's presentation. The submission window for the rerecorded presentation is from 9am on 23rd March 2026 until 4:30pm on 27th March 2026 via the moodle presentation submission portals.

5.2 The Team Report

This should be a concise technical report outlining the construction and programming of your robot. The report should consider the main design features of your robot, how it was constructed, the main program structure, analyse the autonomous performance of your robot and it is fit for purpose features. A description of how your team worked together should also be included in the report. Also, a *construction guide* outlining the stages involved in building your robot is required (see moodle page for Lego CAD packages). This technical report constitutes 70% of your assignment

mark. The University's late submission rules will apply to the submission of your team's report. The submission window for the report is from 9am on 20th April 2026 until 4:30pm on 24th April 2026 via the moodle presentation submission portals.

5.3 Competition Performance

The performance of your robot shall also be evaluated during the competition. Marks shall be awarded based on ranking in the first rounds of Stage 1 of the competition (as described above). This performance evaluation constitutes 20% of your assignment mark. A mark of zero shall be given for teams who do not submit a robot competitor without good reason. This part of the mark will be determined on the day of the competition, which will be the last lab session for each lab group.

6. Begin Construction

Now you can begin the construction of your gladiatorial robot. The design and performance of your robot is only limited by your own imagination. Enjoy the process of designing, constructing, and programming your robots. Let battle commence!

Dr Euan McGookin
January 2026