电子科技大学
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Glasgow College, UESTC

UESTC 3010: Team Design Project and Skills

Lecture 1b

Design Tasks – An Overview

Introduction

On this course you will be required to **design**, **build** and **demonstrate** a robot that performs certain tasks.

The tasks will be performed using **2 patios** where each patio will have 3 tasks, so the robot will demonstrate **6 tasks** in total across the two patios

General Rules

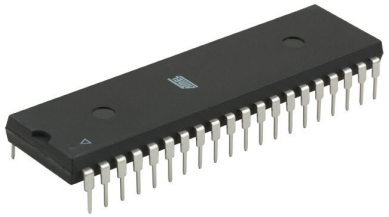
The maximum cost of the project is **1000 RMB**.

- You are free to design and implement a robot of your choice that accomplishes the tasks in this project. All parts should be listed in the bill of materials, which should be an appendix in the team final report. Excellent projects will provide full justification for the choice of components used.

General Rules

Chassis & wheels

Motor

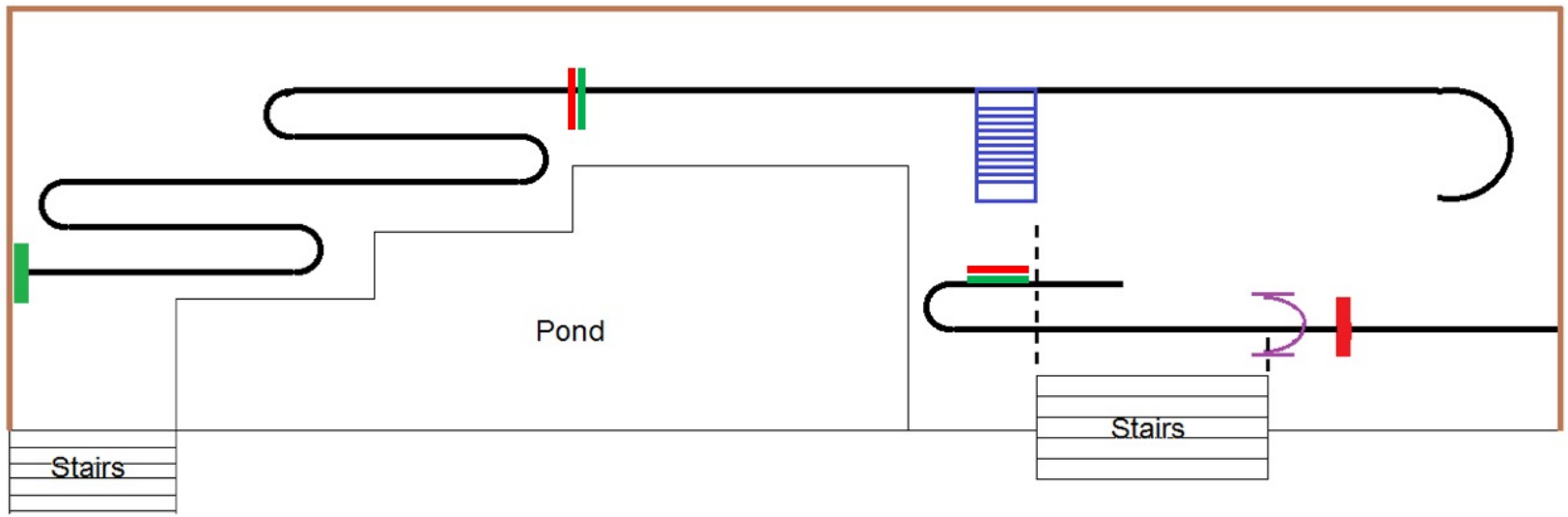


Microcontroller

Battery pack

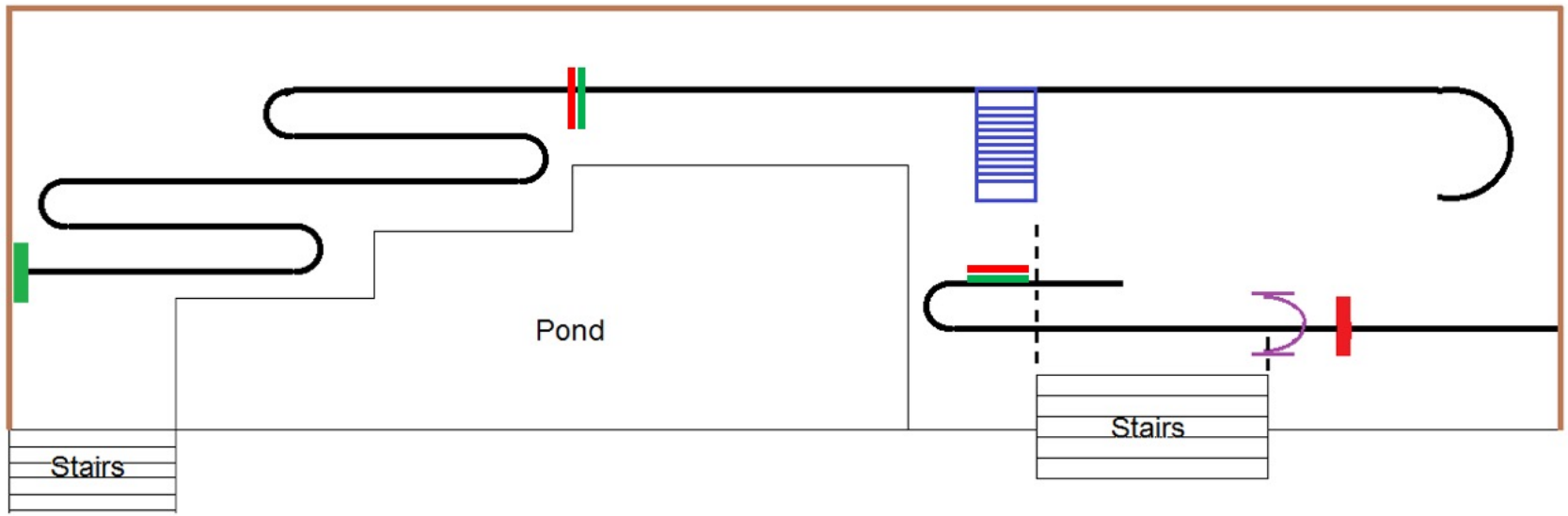
Patio 1 – Task 1

Task 1. From the start (green), follow the path of the coloured tiles to the bridge (blue) general rules



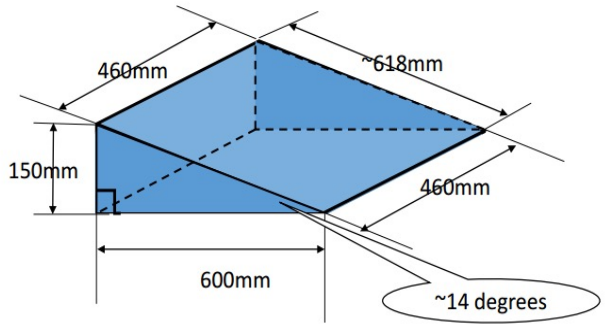
Patio 1 – Task 1

Patio 1 – Task 2



Patio 1 – Task 2

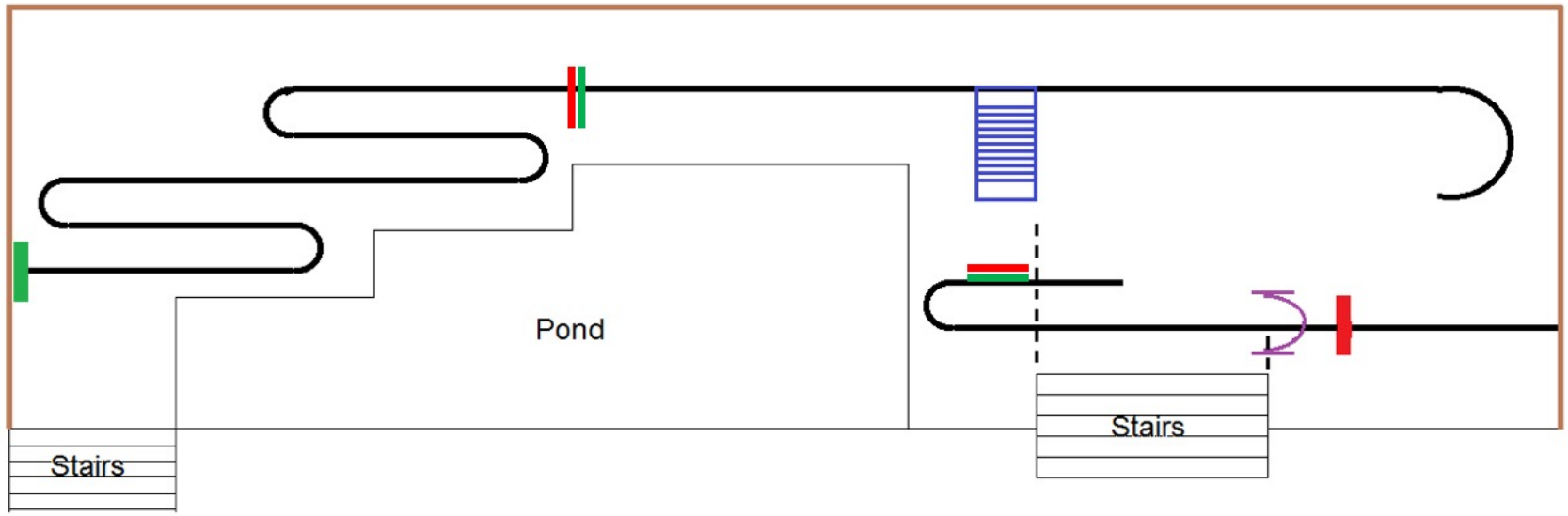
- **Task 2:** Find the bridge and cross on top of it.



Patio 1 – Task2

- As shown in the sketch of Patio 1 on the previous page, the right-most edge of the bridge will be aligned with the left-most edge of one of the stairs.
- The bridge is roughly 45 cm in width and 2.2 meters in length, which includes the ramps that will be used to roll up and off the bridge.
- The surface of the bridge between the ramps will be composed of wire mesh.

Patio 1 – Task 3



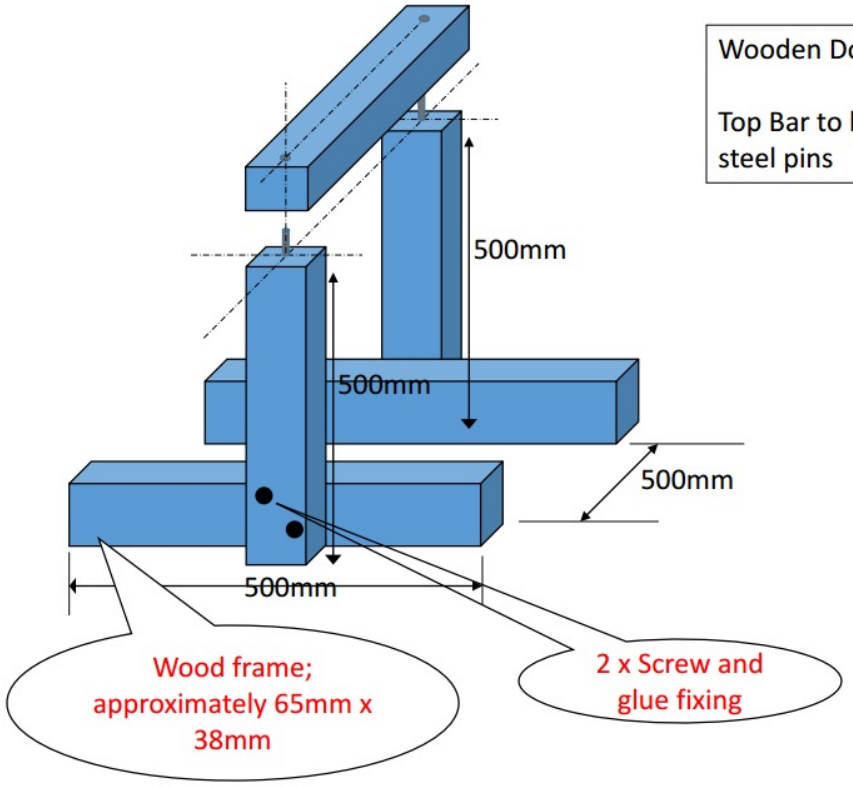
Patio 1 – Task 3

Task 3: Find the gate and go through it and then stop

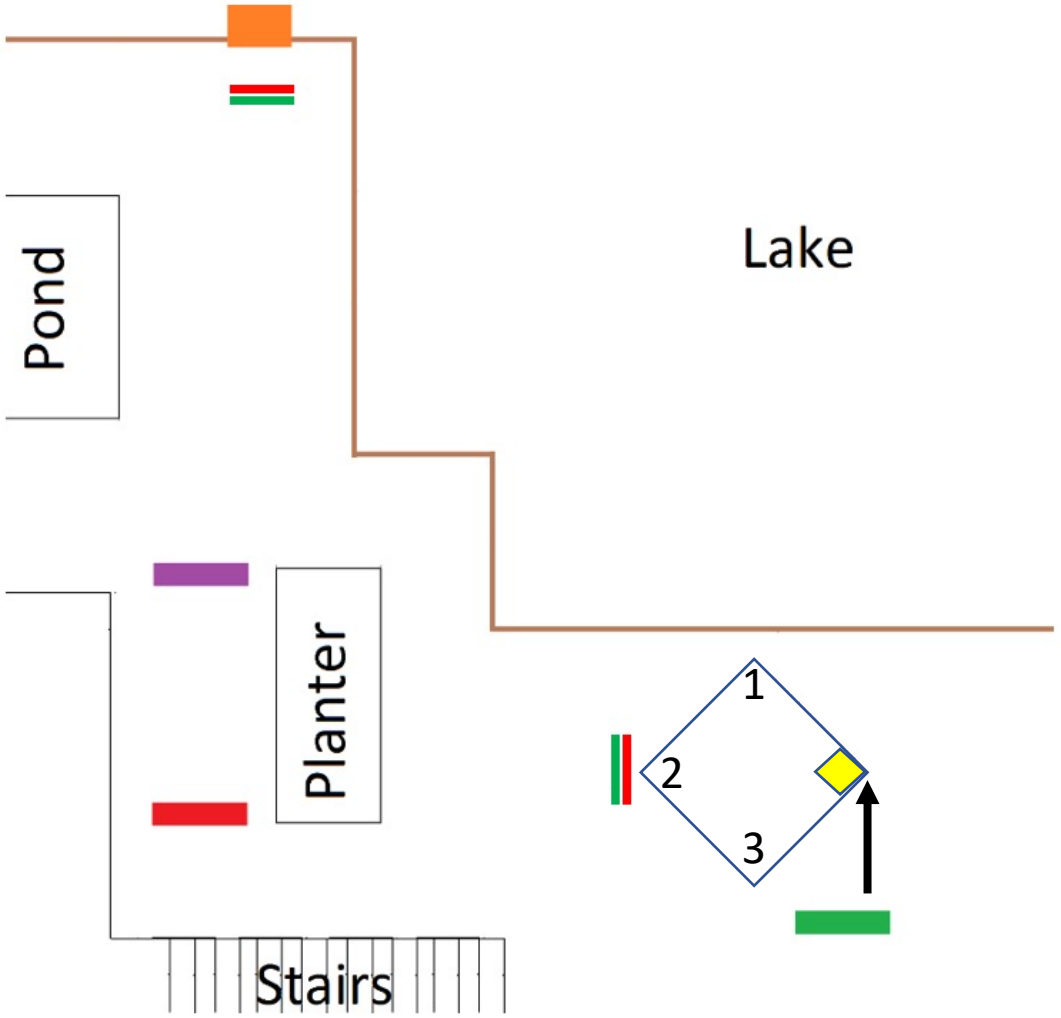
1. The gate is shown in purple in the sketch of Patio 1 while the end of the run is noted as a red box
   - The arch of the gate will be aligned with the right-most edge of one of the stairs
   - The gate will be 50 cm tall and opening between the two legs of the gate is 50 cm
   - The arch of the gate will be aligned to the strip of coloured tiles located at the end of the right-most black line should in the photo below. The left-most black line in the photo marks the alignment of the right-side of the bridge to the left-side of the staircase

Patio 1 – Task 3

2. The exact point at which the robot stops after passing through the gate is not critical.



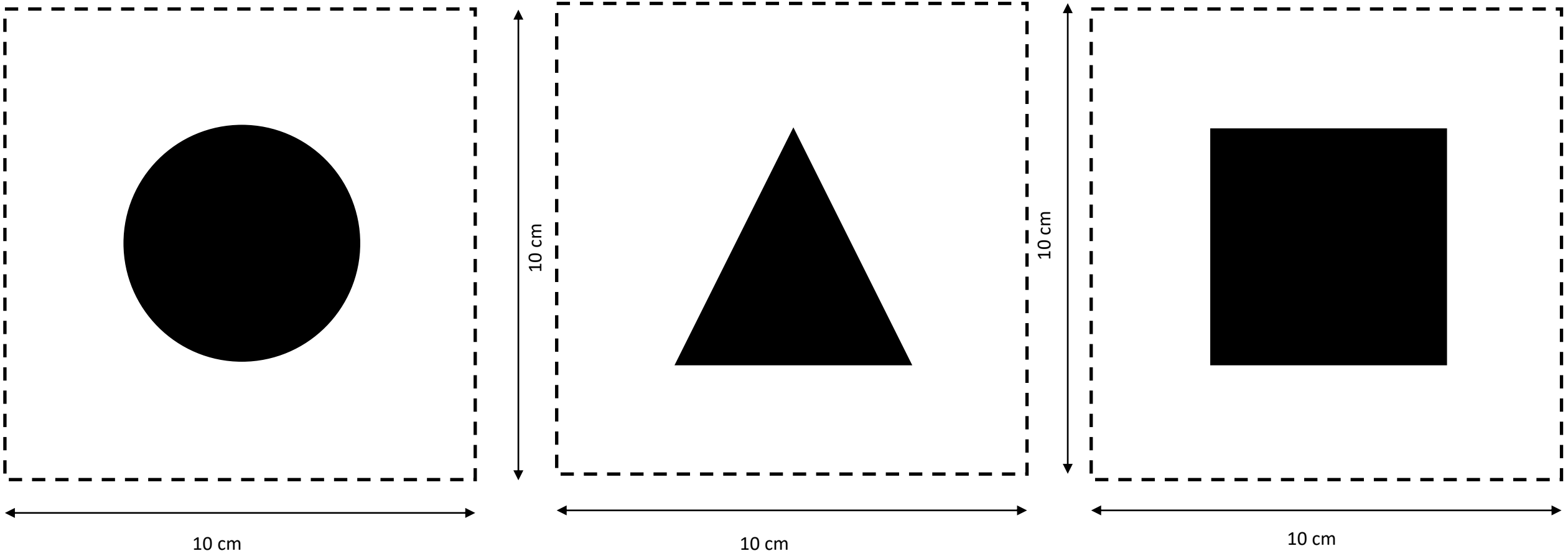
Patio 2 – Task 1



- Starting point where one of the three shapes will be placed randomly

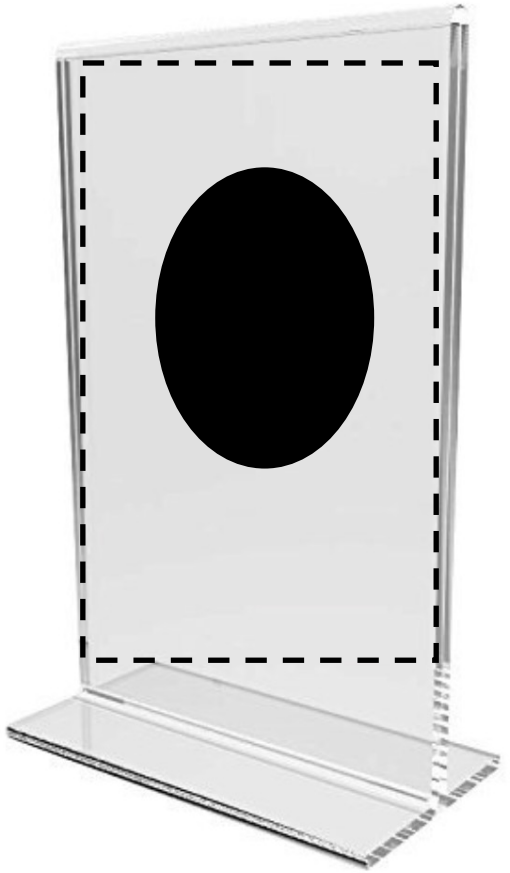
1. Circle
2. Triangle
3. Square

Patio 2 – Task 1 – shape matching



Patio 2 – Task 1

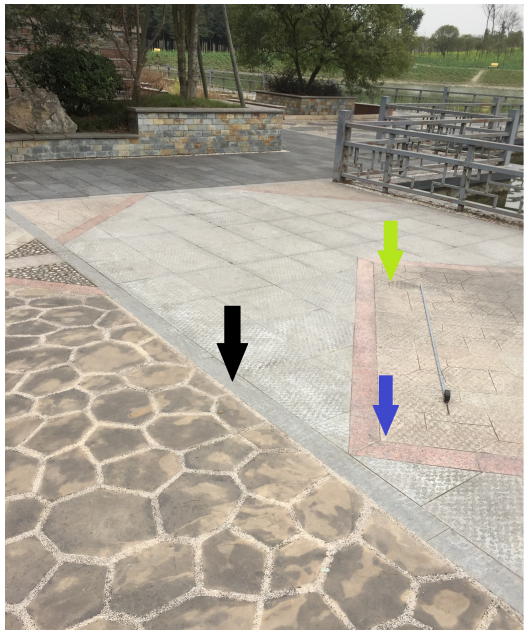
Task 1. From the start (green), match the shape on the stand of the square to determine direction, then knockout the shape on the stand at the back.



1. You will place your robot at the edge of the patterned tiles below the diamond outlined in the tiles.
    - Before you begin the program, you should place a tennis size ball on the robot , to carry the ball to the second task and release into the basket.

Patio 2 – Task 1

2. The robot should be programmed to move to the square at the right-hand side of the diamond where one of three shapes will be placed.
3. After the shape has been determined, the robot will then move to the corresponding shape in the diamond. If the shape in the first square is:
   - **A triangle**, the robot should move to the left-most tip of the diamond, knocking out the **stand with** the triangle shape.
   - **A circle**, the robot should move to the upper tip of the diamond, going over stand with the **triangle** shape.
   - **A square**, the robot should move to the lower tip of the diamond, knocking out the stand with the **square** shape.

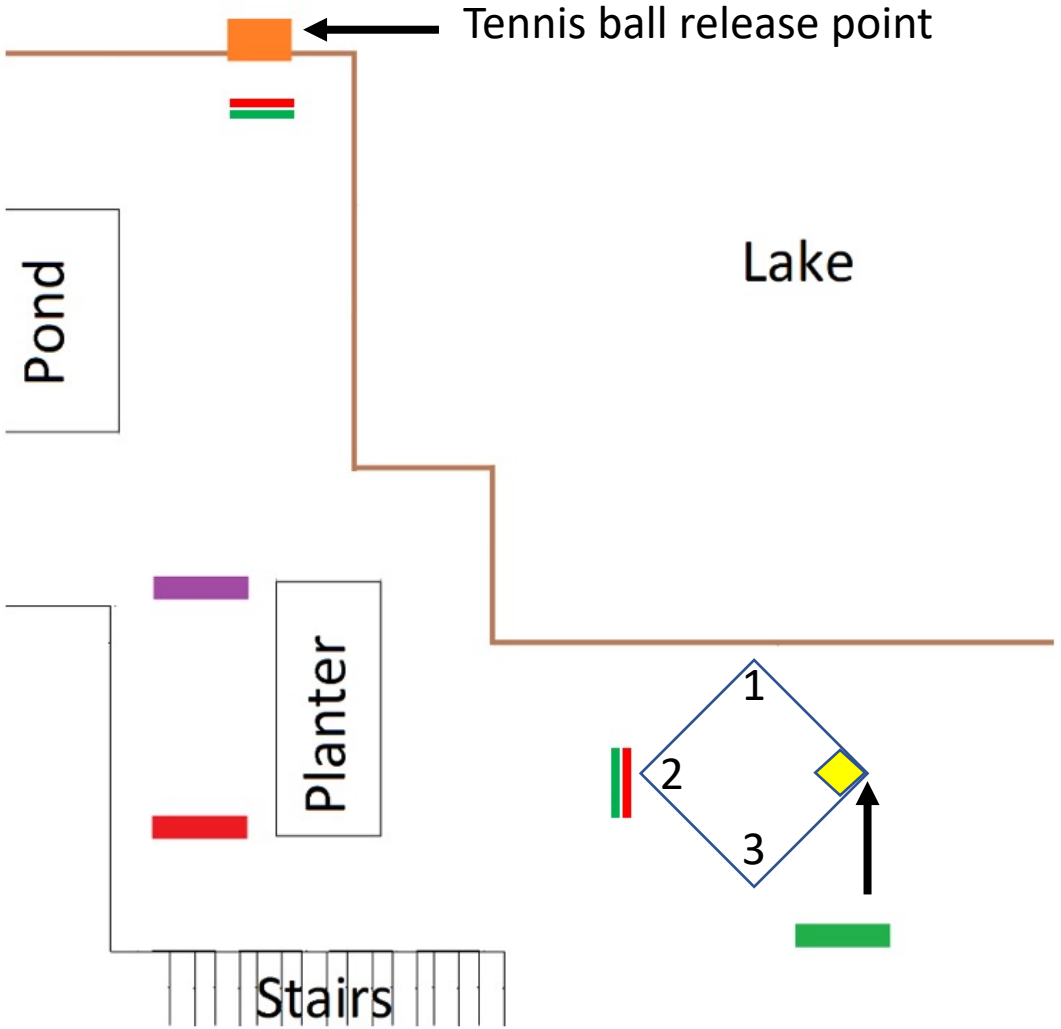


The robot can be placed anywhere along the grey stripe of tiles (black arrow) to begin traveling along the route on Patio 2.

Patio 2 – Task 1

4. After knocking out the stand with the correct shape, the robot should then move to the tennis ball release point, marked in orange on the sketch of Patio 2.
   - There are no rules associated with the path that the robot must take from the diamond to the basket. Navigation along the side of the planter and pond or the fence or other means that do not violate the general rules.

Patio 2 – Task 2



- Starting point where one of the three shapes will be placed randomly

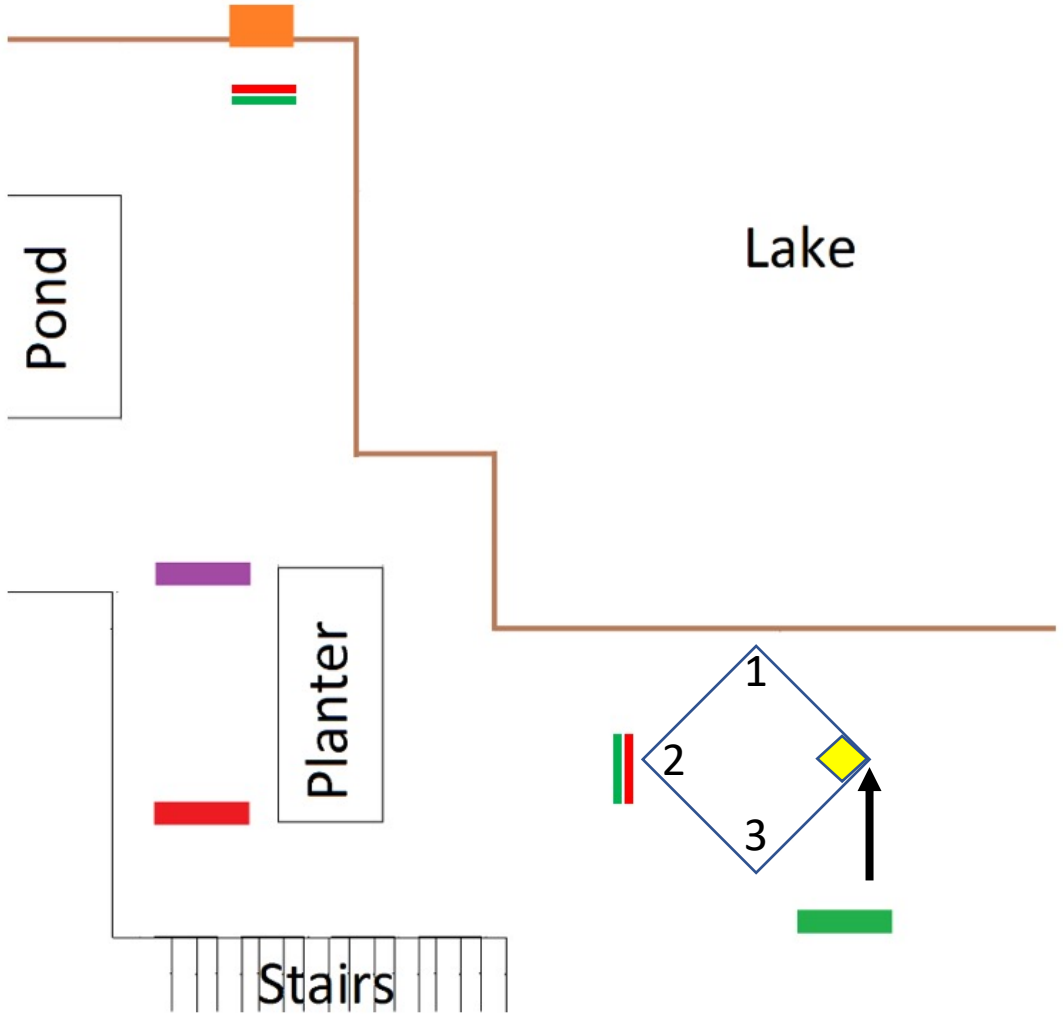
1. Circle
2. Triangle
3. Square

Patio 2 – Task 2

Task 2: Release tennis ball the basket

1. The robot should travel to the release point for the tennis ball, a basket with diameter of 25 cm which is marked in orange on the sketch of Patio 2 and in the photo below
   - The basket will be placed at the front of the lower rail of the fence.

Patio 2 – Task 3



Starting point where one of the three shapes will be placed randomly

1. Circle
2. Triangle
3. Square

Patio 2 – Task 3

Task 3: Communications

1. When the robot enters the planter area (the top edge of the planter, shown in purple in the Patio 2 sketch), the robot should stop and transmit a message to a laptop.
2. The message they must transmit from robot to laptop shall include the following data from the robot to a team laptop. The message should consist of:
   - Team Name
   - Team Member Names
   - Time of day (24-hour clock)

Patio 2 – Task 3

Task 3: Communications

3. The transmission should be a radio signal at 433 MHz at fixed data rate using a Wavesens HC-12 wireless transceiver. More detail on radio communications will be provide in a separate document shortly.

4. After the receipt of the transmission has been acknowledged, the robot should continue to the end of the route, indicated by the red box in the Patio 2 sketch and the red arrow and line in the photo below, which is the lower edge of the planter.

General Rules

1. The project demonstration for all the teams will be held on **Saturday 11th June 2022**.
    - Each team will train and program their robot to complete tasks on both Patios. However, during the demo you are only required to demonstrate your completion of the tasks on only one of the Patios. The selection of Patio number and order of exhibition will be randomly decided.

General Rules

- You are required to prepare a short video that demonstrates your execution of the tasks on the other Patio in a separate presentation. The length of the video should not be **longer than 2 minutes**.
- All teams should be prepared to demonstrate their robots at 9 am and at other times when their team is called later in the day.
- Teams should have their batteries fully charged before 9 am. Use of power packs to supplement or replace the battery will not be allowed.

General Rules

2. Each team will have **one** opportunity to complete the tasks on their assigned Patio. Additional opportunities to complete the tasks on a particular patio may be allowed if time permits. However, there is **no guarantee** that this will be allowed.

- **Each team will be allotted 12 minutes per** run on assigned Patio for the team's robot to complete all the tasks.
- Every effort will be made to announce when a team should begin a run on their assigned patio, but it is the team's responsibility to check their scheduled demonstration time and be ready at the starting point of the first task. A team that fails to begin the run within the 5-minute window will be given a score of 0 for the first (and possibly only) run on that course.

General Rules

3. The robot must run using a program that has been previously downloaded to a microcontroller on board the robot. Instructions cannot be transmitted real-time to the robot.

4. A total of **two** beacons for both patios can be used to provide signals for the robot to follow to assist it with navigation. So **two** beacons can be used for patio 1 or **one** beacon for patio 1 and **one** beacon for patio 2, or **two** beacons for patio 2.

- Teams can propose any beacon design. The cost for the beacons should be included in the budget and bill of materials for the project.
- Team members should place the beacons that will be used for navigation on a patio at the beginning of the run and remove them immediately at the end of the run. Beacons cannot be moved once the official start of the robot run has begun.

General Rules

5. There are three tasks to be completed on each Patio. Each task carries a maximum of 10 marks.

- You will receive 10 full marks for the first task only if you complete it in the first run. You will be penalized by one mark for every external interference, touch or restart.
- To receive full marks for the second and third tasks, the transition from one task to another should be programmed (without any external interference). You will be penalized for any repositioning or restart (minus one mark for each external interference, touch or restart) for second and third tasks if it does not transit automatically from one to another.

General Rules

6. Electricals systems and all connections to circuit components and subsystems must be rugged and reliable.
   - Wires should be soldered onto PCBs, V-board, or punchboard or screwed into terminal blocks on PCBs, V-board or punchboard. Breadboard circuits are not allowed.
   - A fuse and ON-OFF switch should be placed between the battery and the rest of the robot. The fuse should be sized appropriately so that it will not be damaged during normal operation of the robot, but will create an open circuit should more current than expected be drawn from the battery.

7. Each team is expected to design a motor driver circuit and the PCB on which this circuit is constructed.

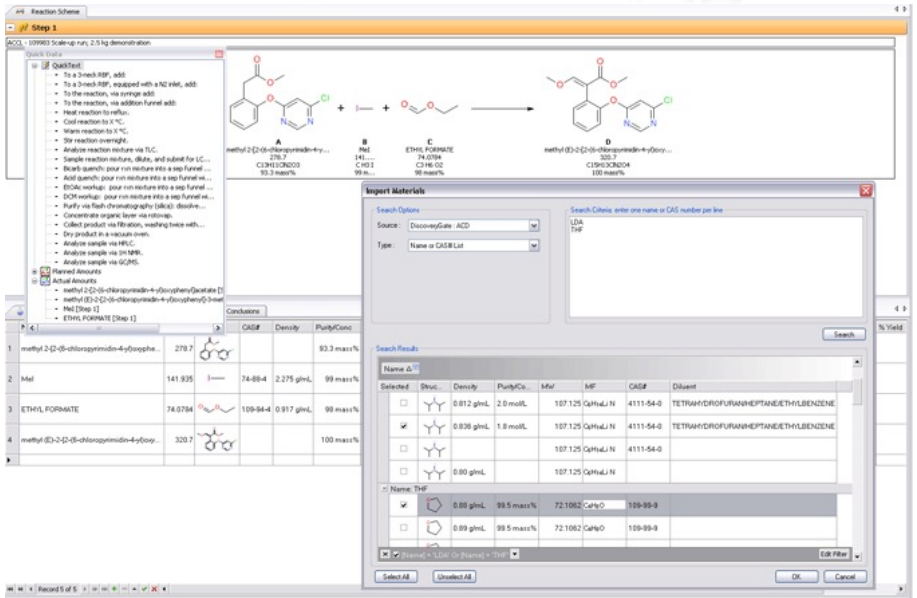
Lab Books

- You are required to keep an updated record of your project progress. Your lab books **will be assessed in weeks 7&8.**
- "*Researchers use a lab notebook to document their hypotheses, experiments and initial analysis or interpretation of these experiments. The notebook serves as an organizational tool, a memory aid, and can also have a role in protecting any intellectual property that comes from the research*" – **Wikipedia**.

Lab Books

- Paper based Laboratory Notebook

- Electronic Laboratory Notebooks



Project Planning – Gantt Charts

- GANTT charts display the tasks in a project as a box or line showing the calendar duration of the task on the horizontal axis (the horizontal length of the task box is proportional to the task duration).
- Tasks are normally arranged in date order on the vertical axis.
- The time relation of all tasks to each other (for example, tasks carried out simultaneously) is therefore clearly apparent in a GANTT chart.

Project Planning – Gantt Charts

- The project status can be easily determined at intermediate dates in the project
- Progress of individual tasks can be shown by filling in the task boxes.
- Dependencies between tasks can be indicated by lines linking tasks.