

# A Taste of Robot Programming

## UBD STEAM Festival 2025

This document can be downloaded at <https://ailab.space/events/ubdrws2025>.

### The Challenge: Search and Rescue

It is time to put together what you have learned to program mobile robots to accomplish given tasks.

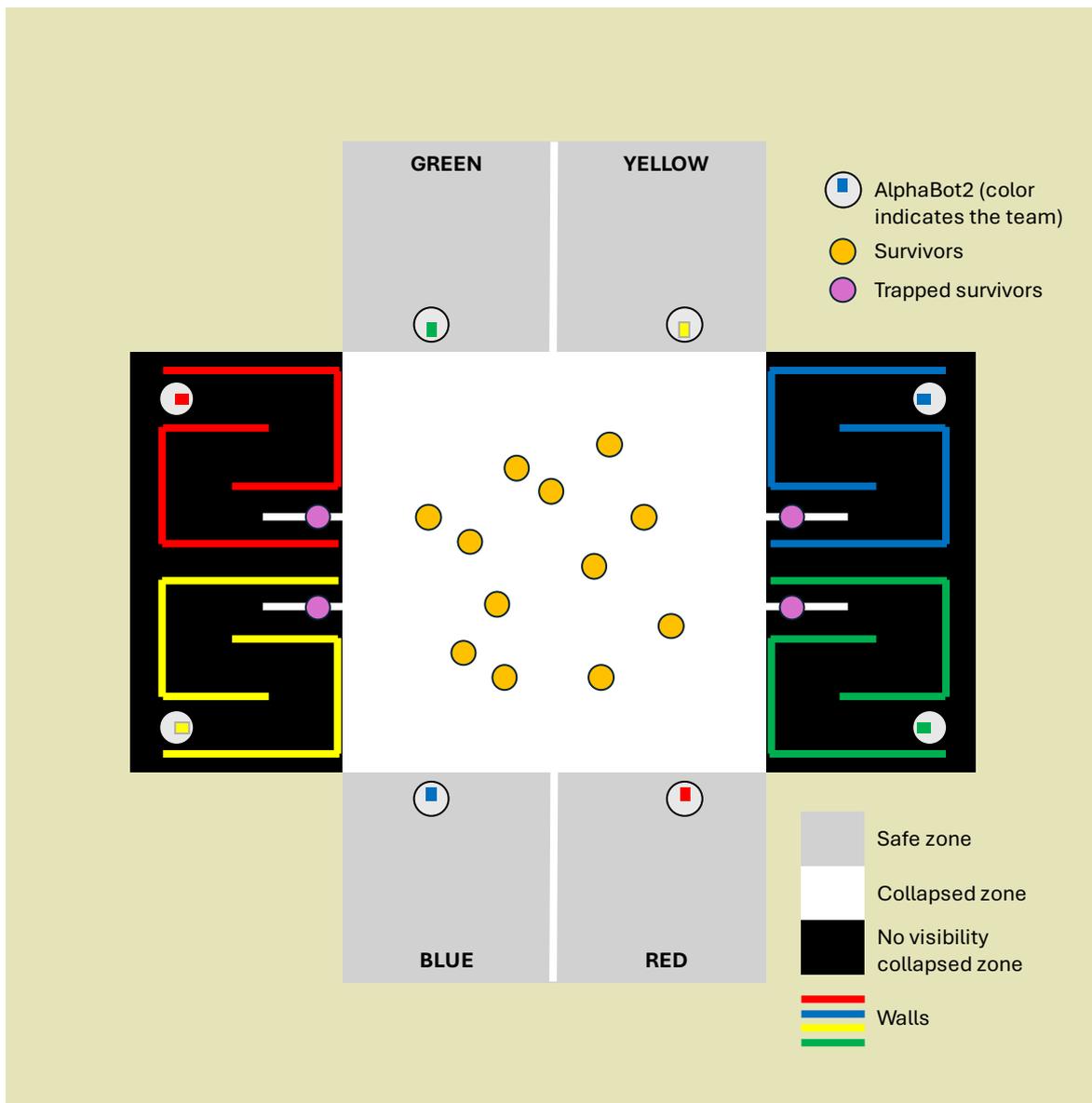


Figure 1. The game field.

## 1 The Challenge

An **earthquake** has occurred, and a **building has collapsed**. **Survivors** are trapped in the collapsed building. **Search and rescue** personnel are deployed to the scene. It is unsafe for human rescuers to enter the collapsed building as there is risk of further collapse. We need **robots!**

**Ten** robots are available for the operation. A team of operators operates **one robot**.

When there is visibility, the operators teleoperate the robot as a **manual robot** to search and rescue survivors from the **collapsed zone** to the **safe zone**. The collapsed zone is within the collapsed building and so is not directly visible to the operators. Two **surveillance robots** are deployed to provide camera streaming within the collapsed zone. The operators rely on the camera streaming to navigate their robot during the search and rescue operation.

There are areas where visibility is too low for the camera of the robots. Survivors in these areas (**no visibility collapsed zone**) need to be retrieved into the visible zone (**collapsed zone**) by the robot operating as an **autonomous robot** that use sensors to navigate through tight debris. The survivors are then rescued to the **safe zone** using teleoperation.

## 2 The Game

The game field is shown in **Figure 1** and **Figure 2**. There are autonomous and manual zones.

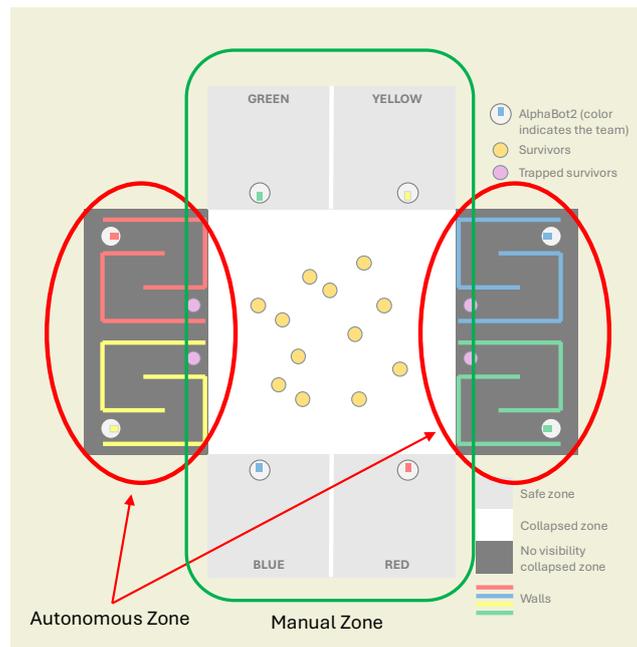


Figure 2. Autonomous and manual zones of the game field.

You will **form ten teams**. Each team will comprise **one robot** and the members (**maximum of 5**) that operate this robot. Your team will program and operate one AlphaBot2 mobile robot to complete the challenge.

#### Game rules:

- You have **5 minutes** to **practice** teleoperate the robot to rescue survivors.
- After the practice session, each robot has **5 minutes** to rescue survivors from the collapsed zone (white) to its own safe zone (grey) using the robot as a **manual robot**.
- There are four entrances (safe zone) to the collapsed zone (white), so **4 robots will operate in each round of 5 minutes**. There will be 3 rounds to allow all the 10 robots to perform the rescue.
- After the manual operation, there is a break of 10 minutes. Each team should be programming their robot to perform the autonomous task to navigate the maze in the **no visibility collapsed zone** (black) to save the **trapped survivor**.
- **4 autonomous robots will operate in each round of 5 minutes**. There will be 3 rounds to allow all the 10 robots to perform the rescue.
- The order of deploying the robots in manual and autonomous mode will be the same, i.e. the robots in the first round of the manual operation will also be in the first round of the autonomous operation.
- **Figure 1** shows the positions of the robots at the start of the game in each round. **Survivors** will be at random positions.

- Only autonomous robots can operate in the **autonomous zone**. This is team specific, i.e. as assigned in the Figure 1.
- Both autonomous and manual robots can operate in the **manual zone**. This is irrespective of the team.
- Operators of the manual robots are not allowed to view the game field. They will be seated away and **facing away** from the game field. They will view the screens showing the camera streams from the two surveillance robots deployed in the collapsed zone.
- The goal of robots is to **rescue (push) the survivors** from the **collapsed zone** (white) to the **safe zone** (grey).
- **Trapped survivors** can only be retrieved from the **no visibility collapsed zone** (black) to the **collapsed zone** (white) by the **autonomous robot**.
- Any robots (irrespective of type and team) can rescue any survivor (including trapped survivor) from the collapsed zone (white) to the safe zone (grey). A robot will receive points for survivors saved into its **own safe zone**.
- The **autonomous robot can be turned into manual robot** (by the program, i.e. automatically) when it is in the collapsed zone (white). It can continue to rescue survivors in the collapsed zone (white).
- **Points** are given to each team based on the survivors they have rescued.
- Participants are not allowed to handle the robots in collapsed zone (white and black); **-10 points**. Robots stuck in these zones shall be retrieved by a facilitator.
- A robot is not allowed to enter the safe zone of the other teams; **-10 points**. Robots stuck in this zone shall be retrieved by a facilitator.
- The points are awarded as below:
  - **1 point** for each survivor rescued from the collapsed zone (white) to the safe zone (grey) of the robot's team/color.
  - **4 points** for the trapped survivor rescued from the no visibility collapsed zone (black) to the collapsed zone (white).
  - **2 points** for the autonomous robot to signal (buzzer for 10 seconds) that he has retrieved the trapped survivor.
  - **-0.25 point** for each retrieval of a robot from the collapsed zone (white or black).
  - Points are only awarded if the team **claims the points** on the spot, i.e. whenever the robot has achieved one of the above tasks. You claim the points by informing (show) the assigned **facilitator** that the robot has completed a task.
  - The scene is chaotic, and people are busy. **You will not earn points if you don't claim.**
- The team with the highest point at the end of the game will be the **winner**.

### 3 Preparation

You have **5 minutes** to practice your robot in **manual** mode, and **20 minutes** to program your robot in **autonomous** mode. This is what you should do:

#### **Manual robot:**

1. **Practice** rescuing (push) from collapsed zone (white) to the safe zone (grey).
2. Familiarize yourself with running the teleoperation program, and practice controlling the robot remotely, i.e. facing away from the game field. You will rely on the camera web streaming. There will be time delay (lagging) in what you see, therefore you want to adapt to the delay. This is true in real-life situations as well.
3. If you wish, you may modify the teleoperation program to make it easier to control the robot. For e.g., changing the speed of the robot.

#### **Autonomous robot:**

1. Discuss and work together to design and implement robot behavior that can successfully complete the mission.
2. You will be using the functions learned from the workshop to give intelligence to the robot.
3. Sometimes you need to rely on luck to deal with uncertainties. This is true in real-life situations as well.
4. In this workshop, you will be given hints and ideas to help you complete the autonomous program.

**Have fun! Good luck!**

- The End -