Project: Unlock Boxes

Instructions

Groups: Each team will be a maximum of 4 students.

Access to project codes: https://github.com/AybukeOzturk/In512_Project_Student

Submission: you will submit to Moodle a document explaining your strategy (maximum 5 pages) + your program **(fully commented**) written using Python.

Be careful! The document + program should have just the group number (e.g., group1.pdf, group1.zip), which is given by the professor. **If you submit your work by email, it will not be considered, and you will get a penalty. (minus 3 points)**

Due date: The deadline is 2 days before your last session until 23:30. If the documents are sent after that deadline, you will have minus 5 points. (Each group can find the submission date and time on Moodle)

Evaluation: During the last session, you will show your code and explain your strategy. Your codes will be tested in a different environment.

Aim: To finish the task, collect keys and go to boxes by visiting the minimum number of cells. (the same cell might be visited).

The robots are blind to everything outside the cells they currently occupy. Their success is to explore and communicate efficiently by navigating in a grid and unlocking the secrets within boxes.

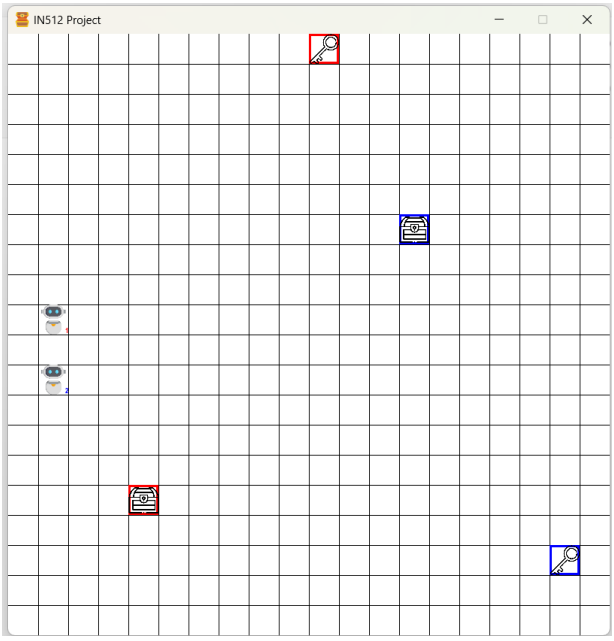

Figure 1: Example Grid with 2 robots, 2 boxes, and 2 keys.

Environment, Robot, Key and Box Constraints:

We choose a discrete representation of the environment using the notion of a grid as presented in Figure 1. In this grid, two robots are presented with red  and blue  digit colors. The two keys are presented with red  and blue  colors. The boxes are presented with red  and blue  colors. **Remark**: In each grid, there is enough space to store several robots at the same time. (no collision)

The robot will divide the environment into several cells of two dimensions. Each cell will represent a position: X and Y. For the details see the given project code from GitHub.

Task Description

Their mission is clear: Each robot must locate a unique key and its corresponding box. The keys and boxes are color-coded and personalized for each robot. Robots need to crack the code to unveil the treasures within the boxes by using the keys and visiting **the minimum number of cells**, but they can only achieve this by sharing crucial information.

Communication Protocol

In the environment, there's a possibility that a robot may stumble on a key or a box that belongs to another robot. When this happens, the robots are programmed to use communication protocols. The blind discoverer must send a message to all other robots, about the location of the found key or box. The goal is to ensure that each robot is equipped with the necessary information to unlock its box.

Optimizing keys and boxes

The question arises: How can these blind robots optimize their strategy to find the keys and boxes? At this level, there are some hints of robots' benefit. As presented in Figures 2 and 3, each key and box have some values. For keys, the key cell has a value of 1, and the closest cells around have a value of 0.5 and the second-closest layer cells have a value of 0.25. For each box, the box cell has a value of 1, the closest cells around have a value of 0.6, and the second-closest layer cells have a value of 0.3. **Remark**: The key and box are not very close in the environment, and the values don't dominate each other's cells.

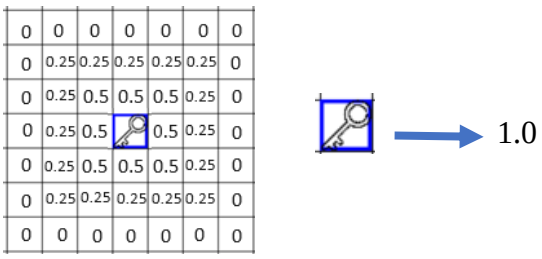

Figure 2: Environment representation of a key

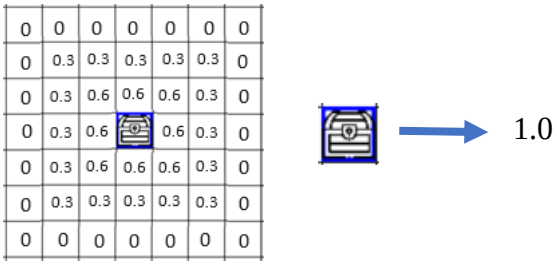

Figure 3: Environment representation of a box

Project limitations:

- The robots are blind. They cannot see the cells around. (only info comes from standing cell)
- You can record previously visited cells (if you want.)
- Robots only inform each other when they come across any items (key or box – when they visit the item cell)
- There will be obstacles to avoid with other cell values. You need to create the obstacles as presented in Figure 4. They are always L-shaped with different orientations.
- You need to test your code with the number of robots 2,3,4 and the number of L-shaped obstacles 2,3,4.

  Remark: The location of all robots, keys, boxes, obstacles, and the size of the grid will be different in the evaluation.

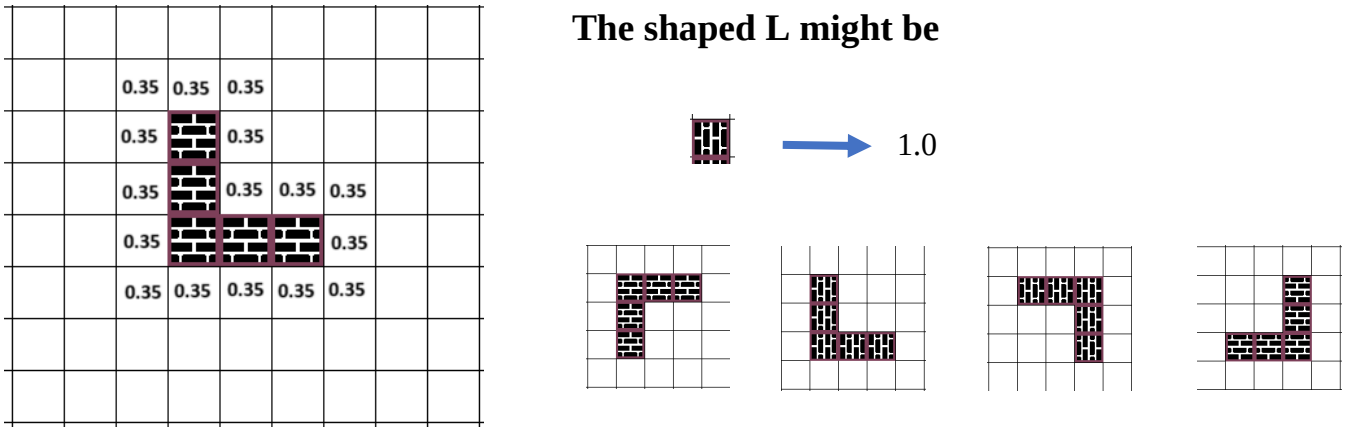

Figure 4: Environment representation of a obstacle