Recruitment:

Sensor-based Mapping Challenge

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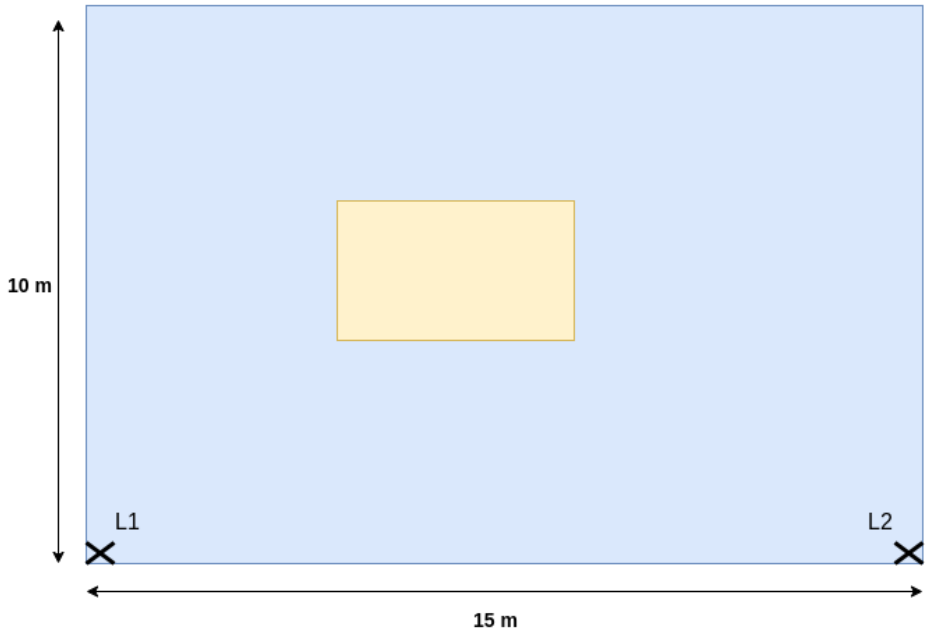
Generate Occupancy Grid Map

Learning maps from sensor data is one of the fundamental tasks in robotics. Maps represent the environment for the robot and are useful for most robotic tasks like localisation, planning etc. Occupancy grid map is one such popular approach to represent the environment.

The challenge is to generate a 2D occupancy grid map of an industrial work area of size: 10 x 15 m. In it, we know there is a rectangular object whose dimensions are unknown. There are two laser sensors (L1 and L2) positioned in the two corners of the room, as shown in the below figure. Laser sensors gives the distances to the object or room every 10°. The distance measurements for each angle and laser are given in the below table.
Note: The **Angle** column contains all the angles in clockwise order for each laser.



Angle (degrees)	**L1** (m)	**L2** (m)
0	10	15
10	10.154	15.231
20	10.642	15.963
30	8	10
40	6.57	7.779
50	7.779	7.779
60	10	11.547
70	15.962	10.642
80	15.231	10.154
90	15	10

Table 1: Laser (L1 and L2) measurements at every 10° angle

Problems

1. Generate 2d occupancy grid map of the above work area. Write a source code to generate the map.
2. Calculate (approximate) dimension and position of a rectangular object. Write your answer in a ReadMe file.
3. Find representative test cases, edge cases or error conditions in your algorithm and write unit tests to test them.
4. Think about what would you do in a more complex scenario e.g., unstructured environment or concave shaped work area. Write your thoughts in a ReadMe file.

Some Tips

- Write clean code in C++/Python (NumPy, SciPy, matplotlib, seaborn) and if required feel free to use other external libraries (ROS, OpenCV etc.).
- Visualise laser measurements to gain intuition.
- Assume any fixed grid resolution as per convenience (e.g., 0.1m, 0.5m, 1m) or generalise it for any grid size.
- If your algorithm doesn't produce sensible result try visualising the various stages to help the debugging process.
- Make full use of online resources and example code.

Deliverables

Submit the following items in a single zip file.

1. Image of 2D occupancy grid map
2. Clean source code for generating the map.
3. ReadMe file outlining the steps carried out and answers to above questions.