Foundations of Robotics

Lab 9: Final Project

Overview

In this lab, we will put everything together and apply what we have learned so far on the Turtlebot robot. The task is to navigate in a provided environment without colliding with any obstacles and finally kick the ball to the gate. Below are some steps that you can follow.

1. Decompose the provided environment into a grid map.
2. Transform the grid map into a graph with nodes and weights assigned.
3. Run A* algorithm to search for an optimal path and return the list of waypoints.
4. Generate polynomial trajectories for the robot to follow.

We will not provide sample code in this lab. Please reuse the scripts in previous labs and combine them into a single file named `turtlebot.py` for submission.

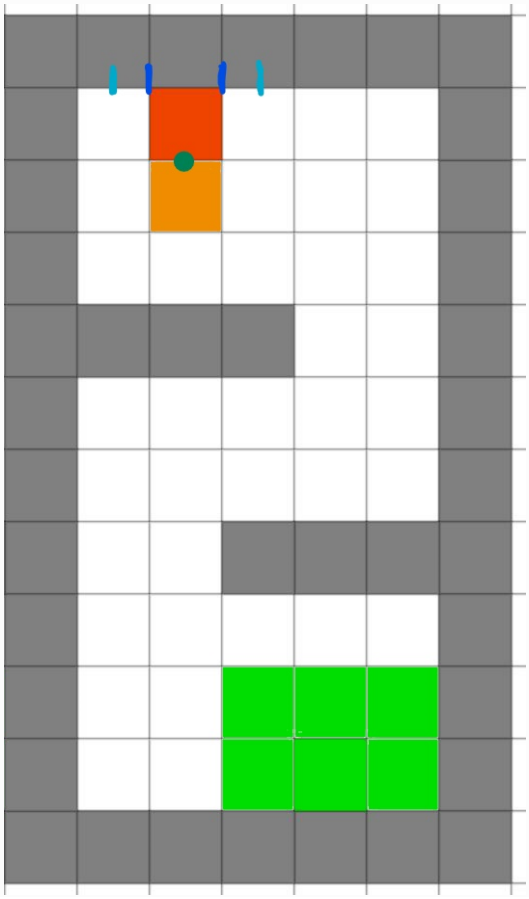
Submission

- Files to submit:
  - turtlebot.py (or .cpp)
  - screenshot or video recording to show the demo (please compress if the file size is too big)
- Grading rubric:
  - Demo that the robot is able to move from the start grid to the goal grid without colliding with obstacles.

Prepare Gazebo Simulation Environment

- Please create an environment according to the field map provided below.
- For obstacles, you can create them using a cube model and set the property to be fixed to the ground, such that they will not move if being collided by the robot.
- For the ball, you can create it using a small ball model and set the property to be not fixed, such that they can move if being collided by the robot.
- For the gate, you can use any other models as you like to mark it.
- For the origin of the map (and the reference frame of the environment), you can pick any point as you like, as long as you can complete the task in the end.

Field Map



- The grid size in this map is 0.5m, which is slightly larger than the size of the robot.
- Gray grid points are obstacles and walls that the robot should not collide with.
- Six green grid points on the bottom right corner represent the start area. Please set a variable for the starting grid point, such that you can change it easily when needed.
- On the top side, the red grid point is the goal area where the robot should stop, and the orange grid is the buffer area where the robot should pass through, in order to kick the ball.
- On the top side, the narrow gate is marked by dark blue color, and the wide gate is marked by light blue color.
- The ball is placed on the common edge between the orange and red grid point, marked by dark green color.