ENPM661- Planning for Autonomous Robots

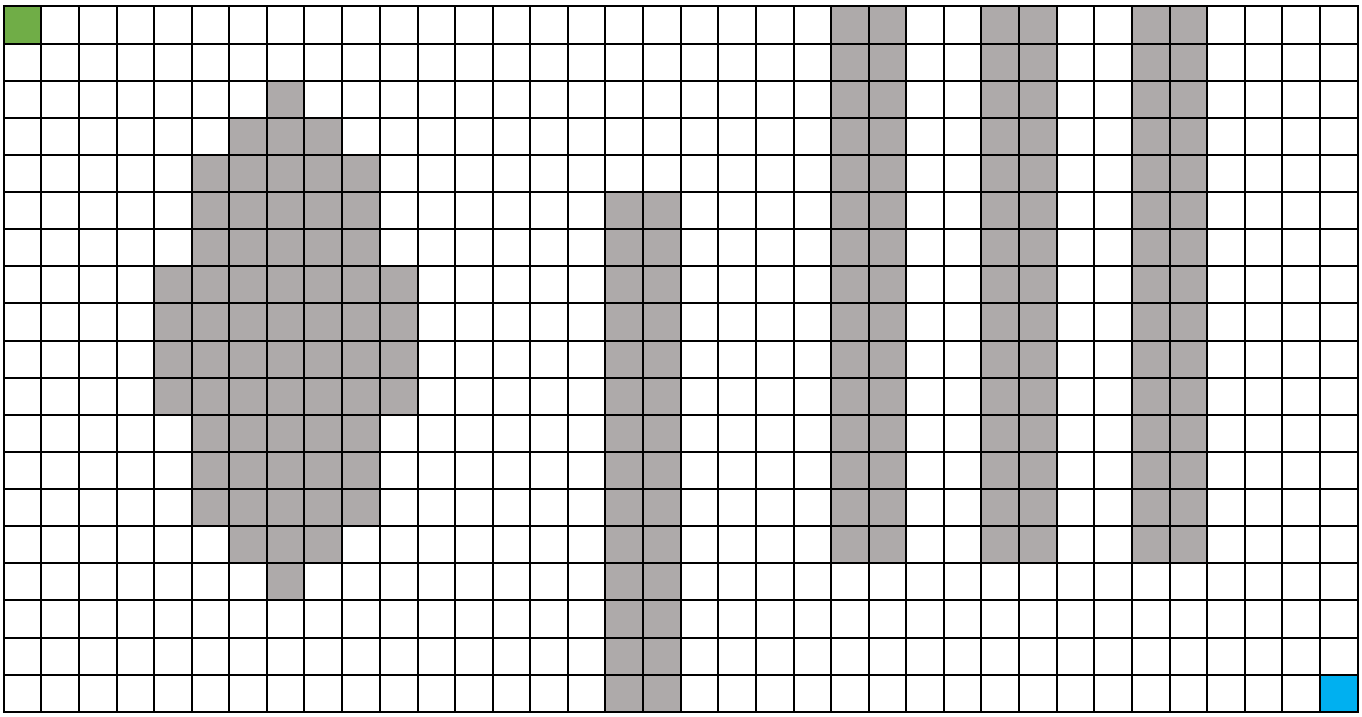
Final take-home exam

Due: 14th May 2024, 11:59 pm

Question 1 (6 marks)

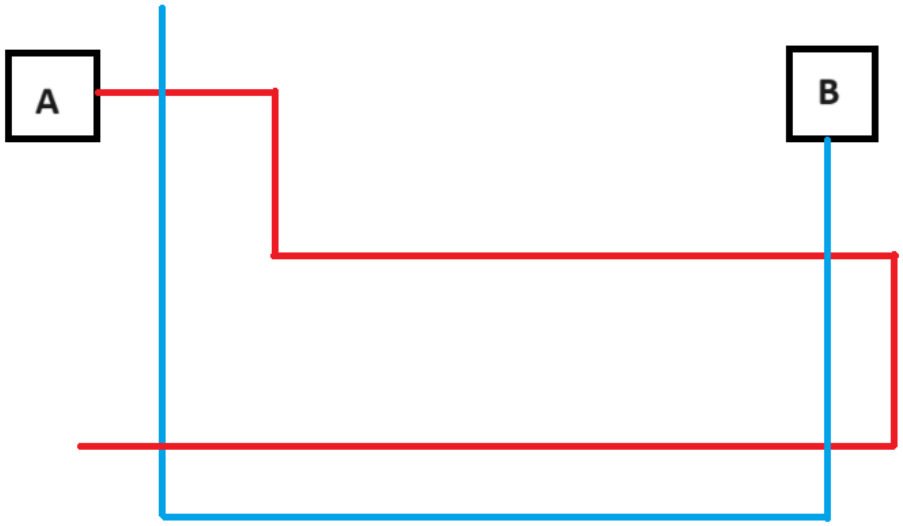
Employ the use of Bug Algorithm and Bug2 algorithm to go from start point (green) to end point (blue). Present your answers as a diagram. Explain any differences you see between the two. To learn about the two algorithms, read the following: http://www.cs.cmu.edu/~motionplanning/lecture/Chap2-Bug-Alg_howie.pdf

Remember that the bug agent can only sense its immediate surroundings, which is an 8-cell region in our case (2 top and bottom, 2 left and right and 4 diagonals).



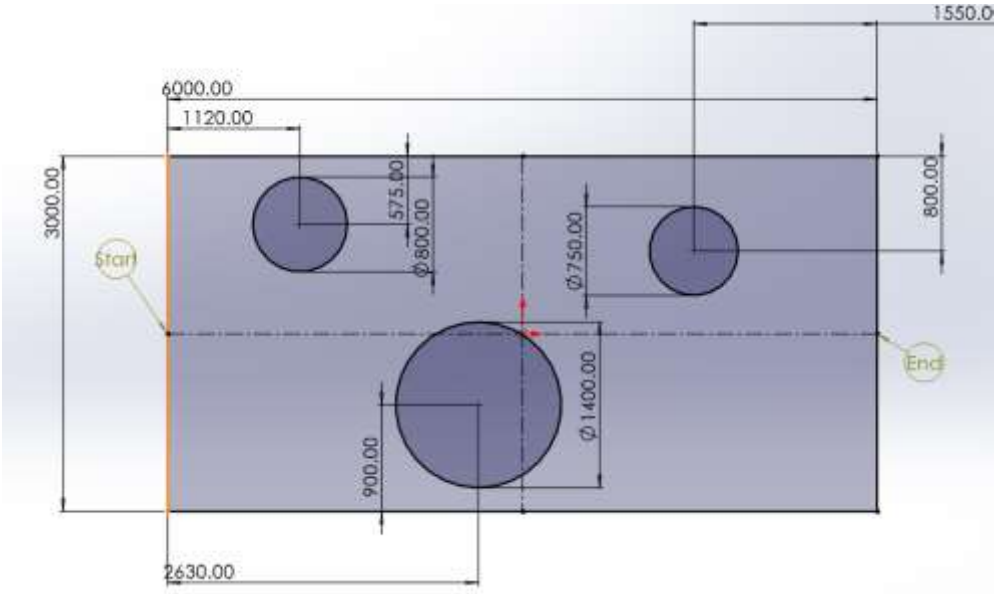
Question 2 (6 marks)

Sketch the state space for the two robots moving along the fixed paths shown below and show a velocity tuning graph. Then show a feasible solution to avoid contact between these two robots.



Question 3 (10 marks)

Find a solution for the following path planning problem using bi-directional A* algorithm and plot your results.



Now, solve the same problem using a potential force-field implementation. In short, the robot and the obstacles are assumed to be charged positively while the goal is negatively charged. This causes the robot to move towards the goal while avoiding the obstacles.

https://www.cs.cmu.edu/~motionplanning/lecture/Chap4-Potential-Field_howie.pdf

Your implementation can be a step-wise process where the robot moves a fixed length in the direction of the resultant instantaneous force, and the forces are recalculated with every iteration. The following variables will have to be selected and tuned by you:

- Charge on the robot,
- Charge on the goal,
- Charge density on the obstacles,
- Anything else that you might need

Compare your plot with the bidirectional A* results.

Question 4 (8 marks)

Summarize the following paper in one page, focusing on the motivation, method, advantages, results, and conclusion. (The paper will be linked in assignment description / in announcements)