Midsem Exam

Sushil Vemuri 19317

Q1

$ \text{Total Time Required to Cover a Cell} = \text{Total Time to Moving Forward} + \text{Total Time of Turning}$
$\Rightarrow \frac {\text{Total Distace Travelled Forward}} {\text{Forward speed}} + (\text{Number of Turns} \times \text{Time Taken on each Turn})$
$\Rightarrow \frac {\text{Total Distace Travelled Forward}} {\text{Forward speed}} + (\text{Number of Turns} \times \frac{\pi}{2 \times \text{Rotational Speed}})$
$\text{Rotational Speed} = 4.856 rad/s$
$\text{Forward Speed} = 0.128 m/s$

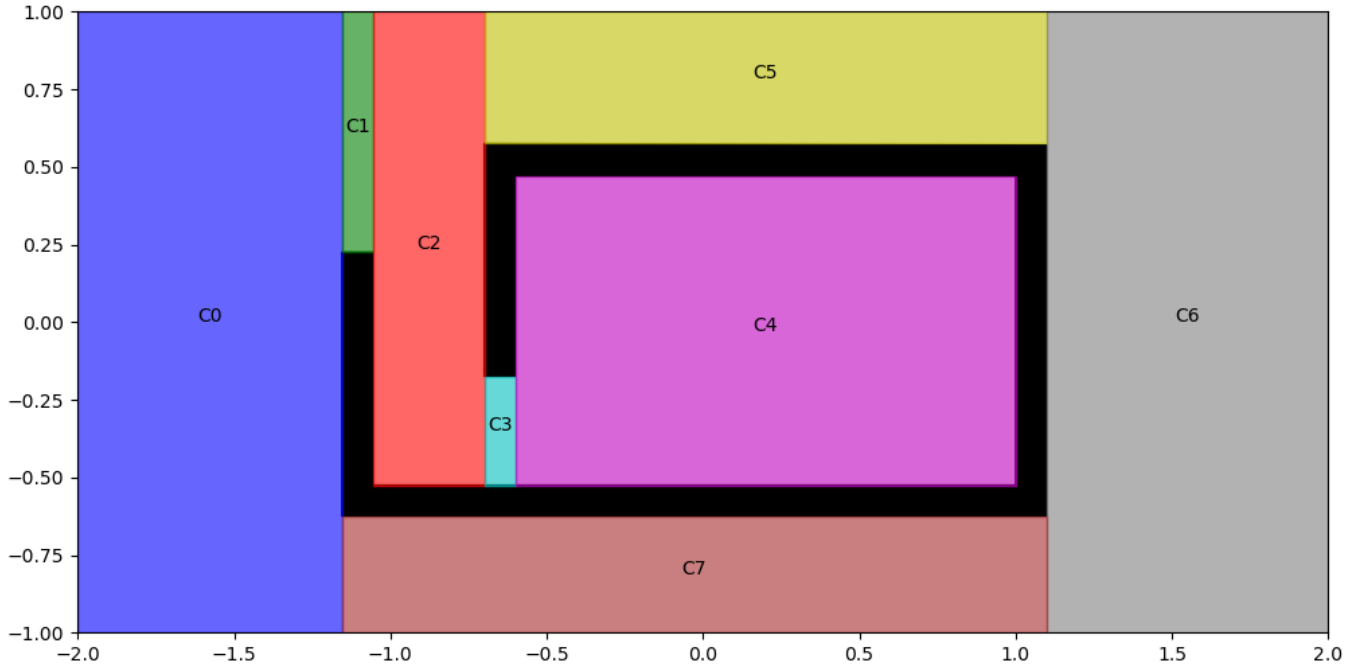
$\text{Total Time Required to Cover a Cell} = \frac {\text{Total Distace Travelled Forward}} {\text{0.128}} + (\text{Number of Turns} \times \frac{\pi}{9.712})$

1. Cell 0
   $\text{Total Time Required to Cover Cell} = \frac {19.92} {0.128} + (18 \times \frac{\pi}{9.712})$
   $= 161.44 \text{ sec}$
2. Cell 1
   $\text{Total Time Required to Cover Cell} = \frac {0.695} {0.128} + (0 \times \frac{\pi}{9.712})$
   $= 5.42\text{ sec}$
3. Cell 2
   $\text{Total Time Required to Cover Cell} = \frac {6.02} {0.128} + (6 \times \frac{\pi}{9.712})$
   $= 48.97\text{ sec}$
4. Cell 3
   $\text{Total Time Required to Cover Cell} = \frac {0.27} {0.128} + (0 \times \frac{\pi}{9.712})$
   $= 2.10\text{ sec}$
5. Cell 4
   $\text{Total Time Required to Cover Cell} = \frac {18.82} {0.128} + (36 \times \frac{\pi}{9.712})$
   $= 158.67\text{ sec}$
6. Cell 5
   $\text{Total Time Required to Cover Cell} = \frac {9.27} {0.128} + (42 \times \frac{\pi}{9.712})$
   $= 86.00\text{ sec}$
7. Cell 6
   $\text{Total Time Required to Cover Cell} = \frac {21.92} {0.128} + (20 \times \frac{\pi}{9.712})$
   $= 177.71\text{ sec}$
8. Cell 7
   $\text{Total Time Required to Cover Cell} = \frac {10.42} {0.128} + (54 \times \frac{\pi}{9.712})$
   $= 98.87\text{ sec}$

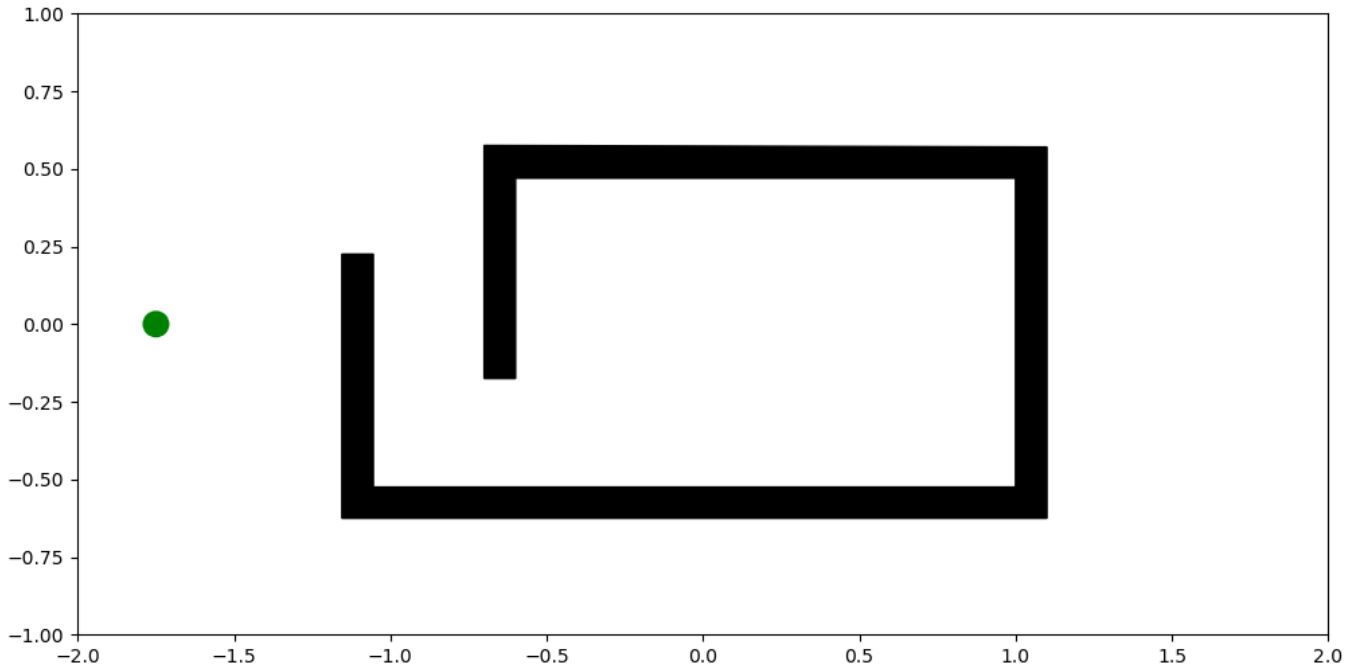
$\text{Total Time to cover all cells} = 161.44+5.42+48.97+2.10+158.67+86.00+177.71+98.87$
$= 739.18\text{ sec}$ $= 12.31\text{ min}$

Q2

Cells:

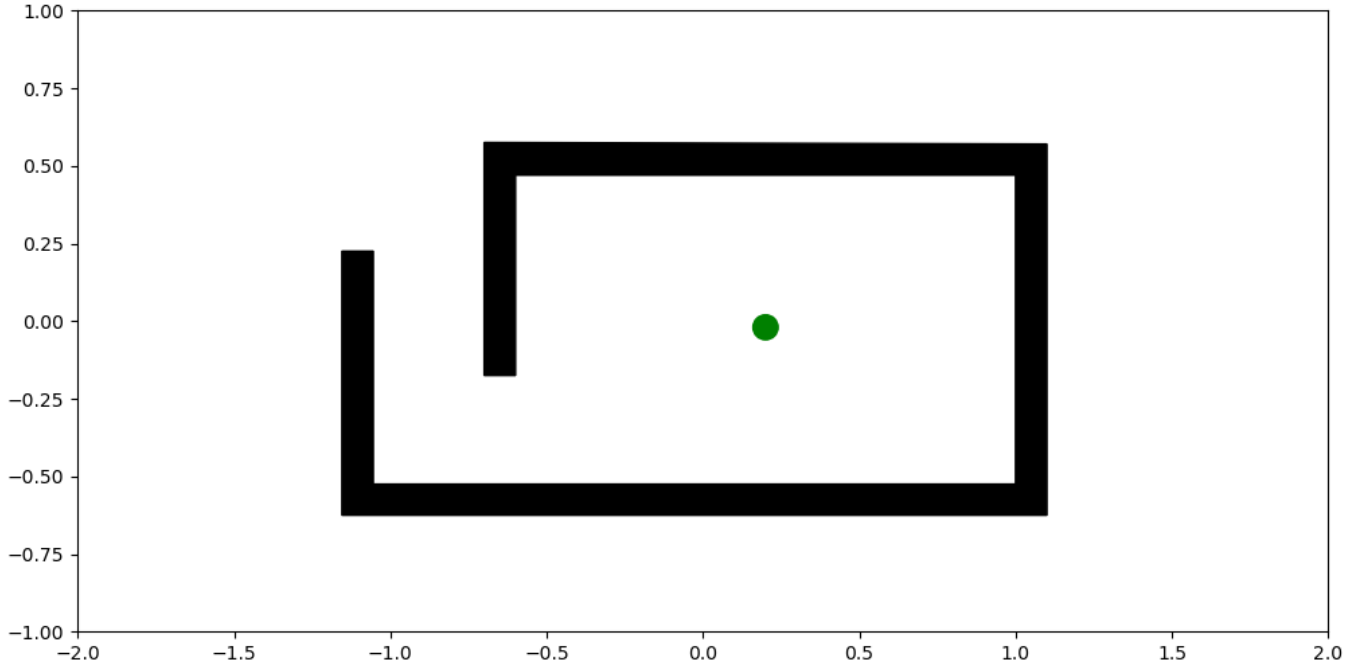


Old Start Location:



In this Case the path followed is $ C0 \to C1 \to C2 \to C3 \to C4 \to C3 \to C2 \to C5 \to C6 \to C7 $

New Start Location:

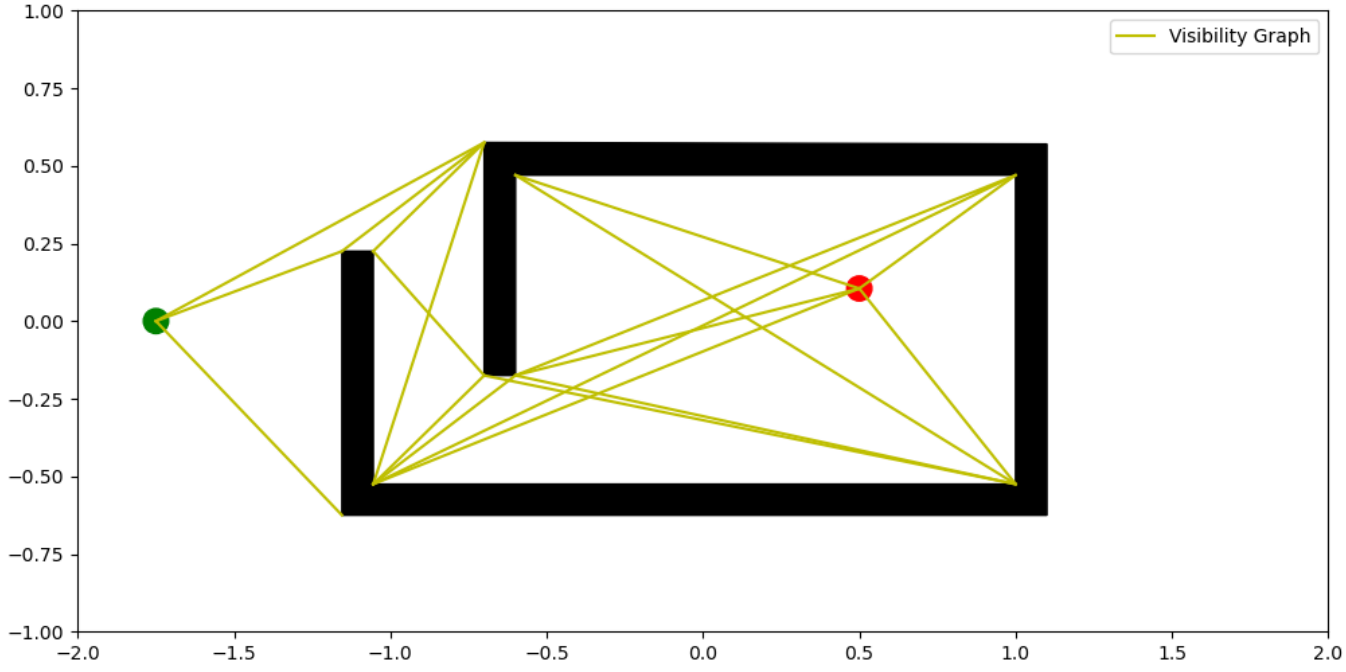


In this Case the path followed is $ C4 \to C3 \to C2 \to C5 \to C6 \to C7 \to C0$

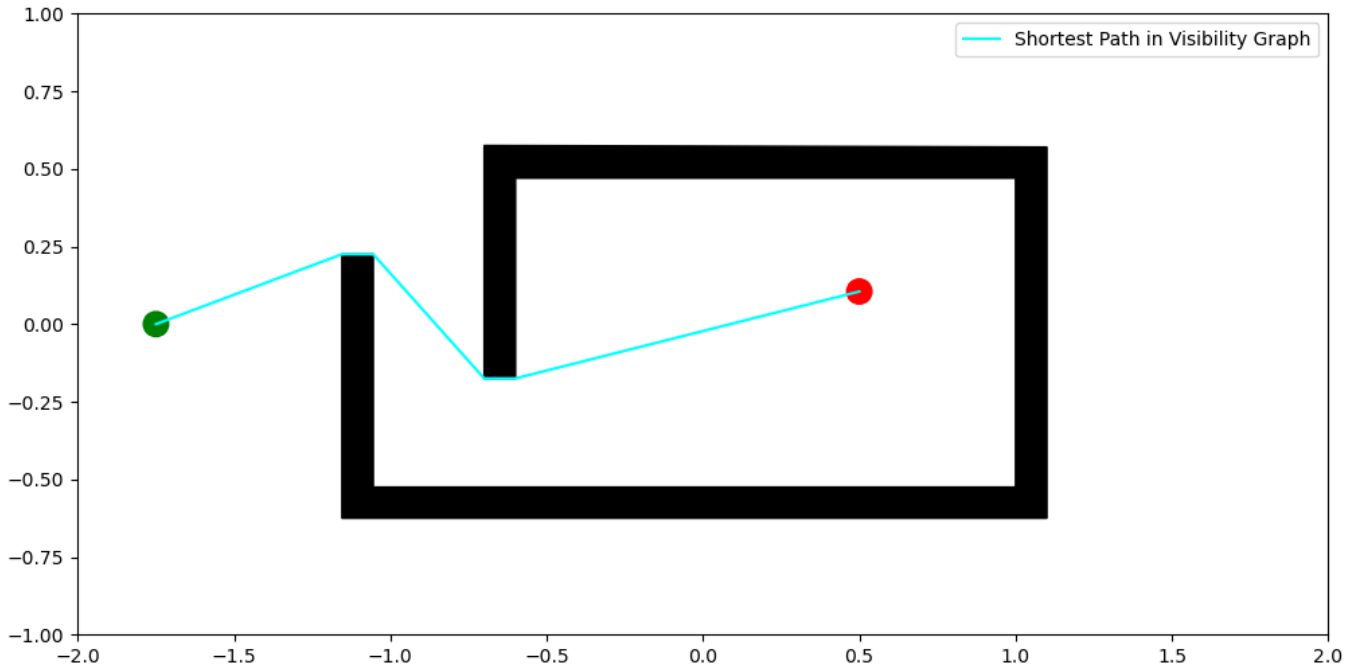
Therefore, the time for completion is lowered with this new start point.

Q3

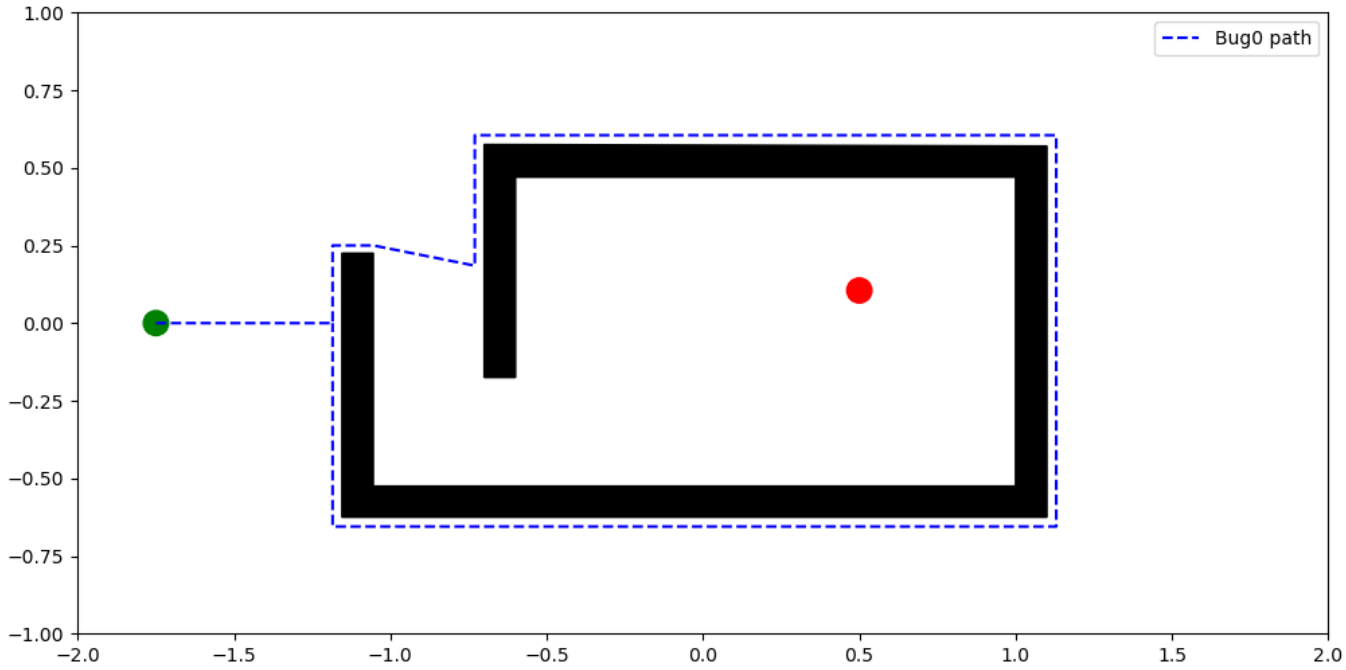
Visibility Graph:



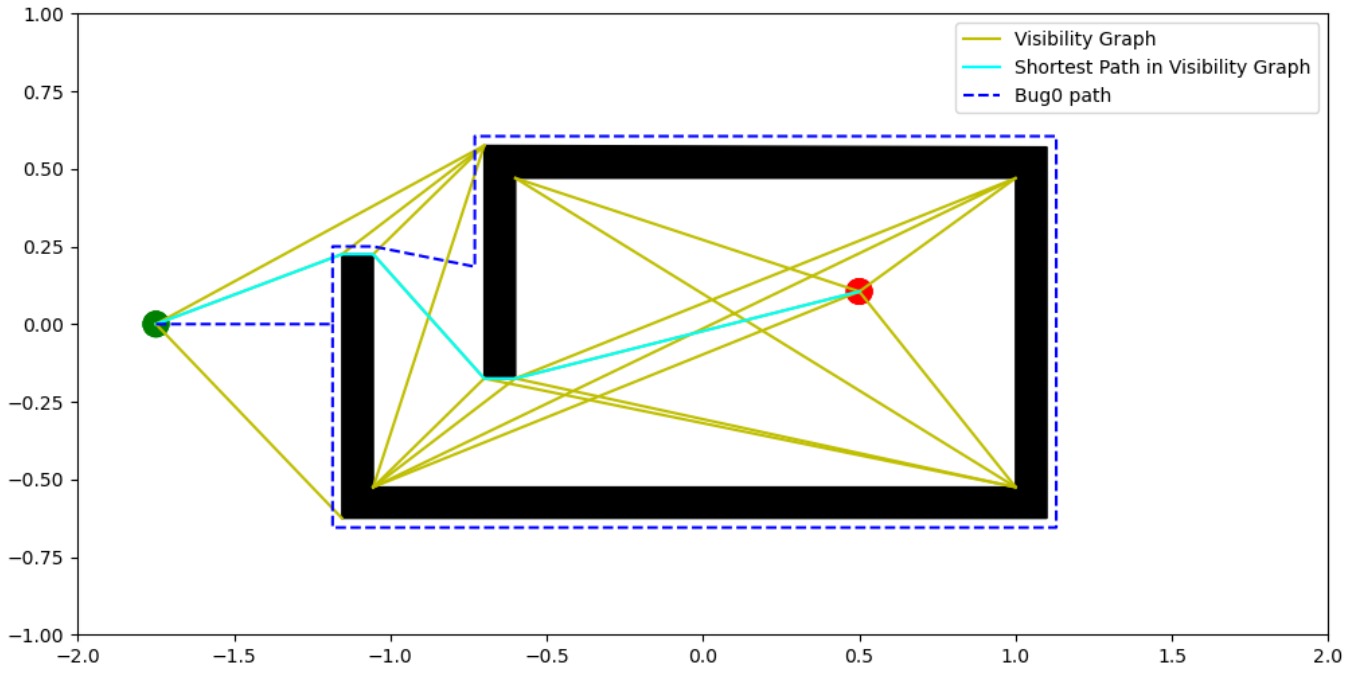
Manual Shortest Path on Visibility Graph:



Bug0 Path:

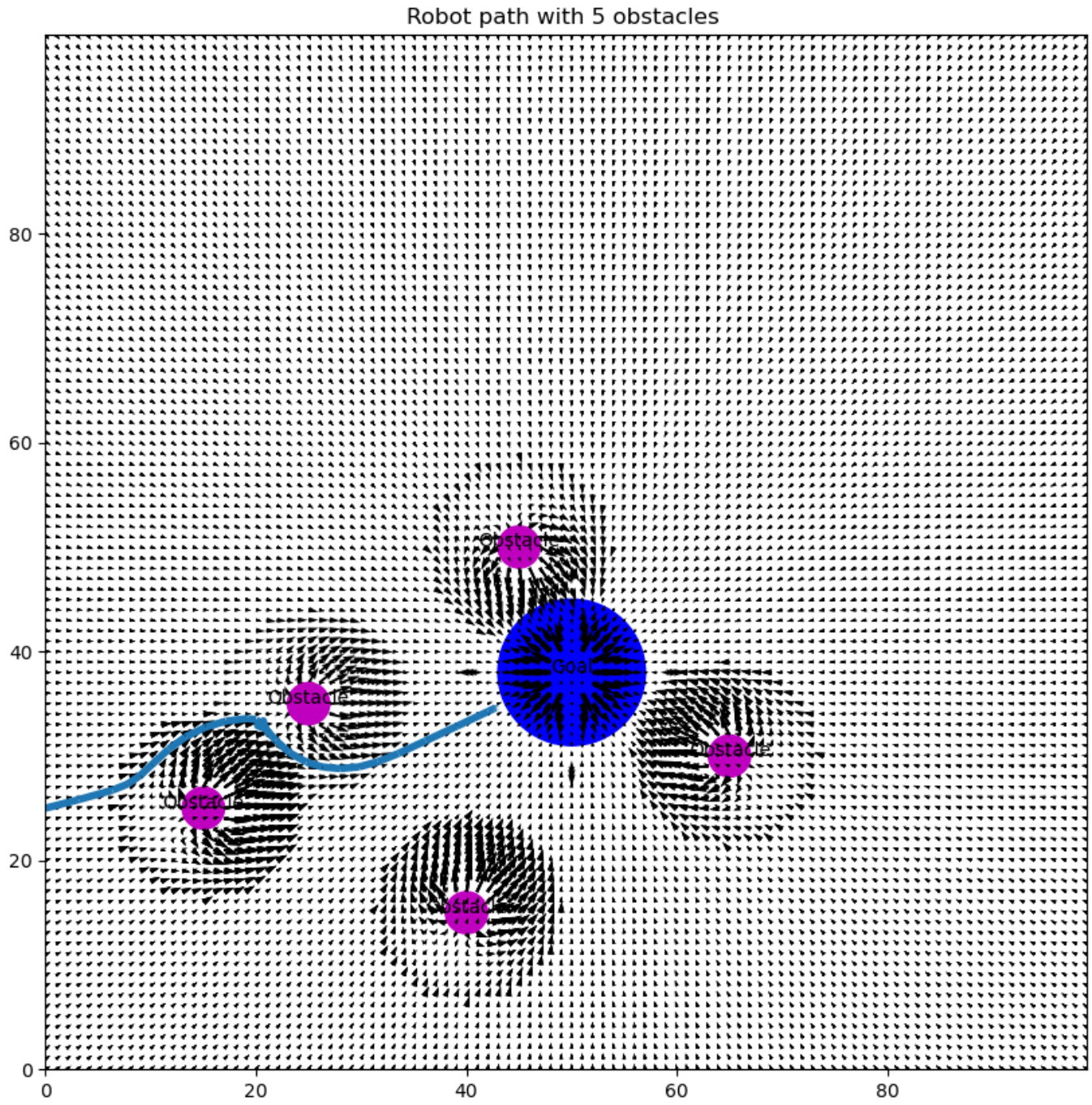


All Together:



Q4

Parameters Used: α = 50, β = 50, s = 7, r = 2



Q5

My solution to the Pursuer Evader Problem was using the Art gallery Theorem to find the lest number of points which have complete visibility of the entire environment. With 2 pursuers we can occupy more of these points than if we had only 1 pursuer. So, we can see a lot more area with 2 pursuers. Thus 2 pursuers are better than 1.

Q6

To ensure both pursuers dont collide, we will implement an obstacle avoidance algorithm like bug2 where in both the robots take a right turn whenever they encounter an obstacle. This ensures than when both bots are going to collide, they start moving in a circular pattern and reach their goal.