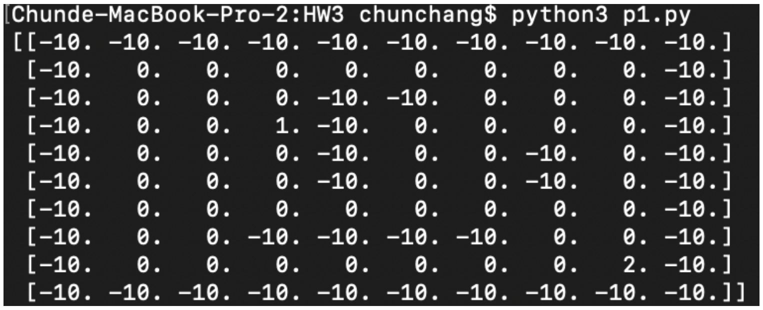
ESE 650, SPRING 2021

HOMEWORK 3

CHUN CHANG [CHUN3@SEAS.UPENN.EDU],
COLLABORATORS: JANE DOE [JANE@SEAS]

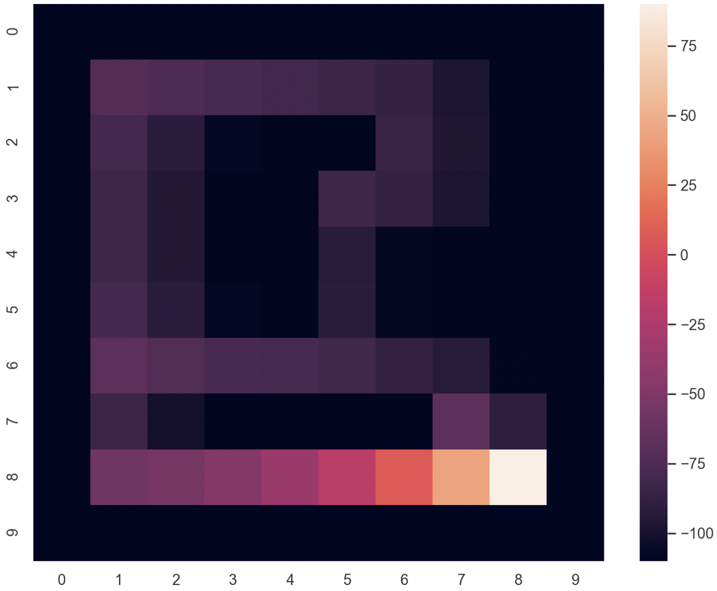
Solution 1 (Time spent: 3 hour)**.**

ENV

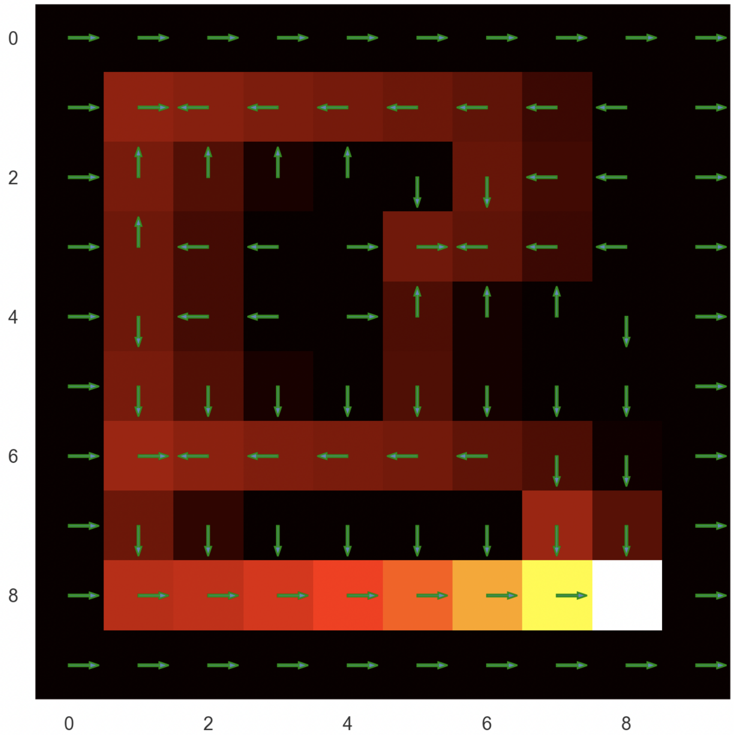


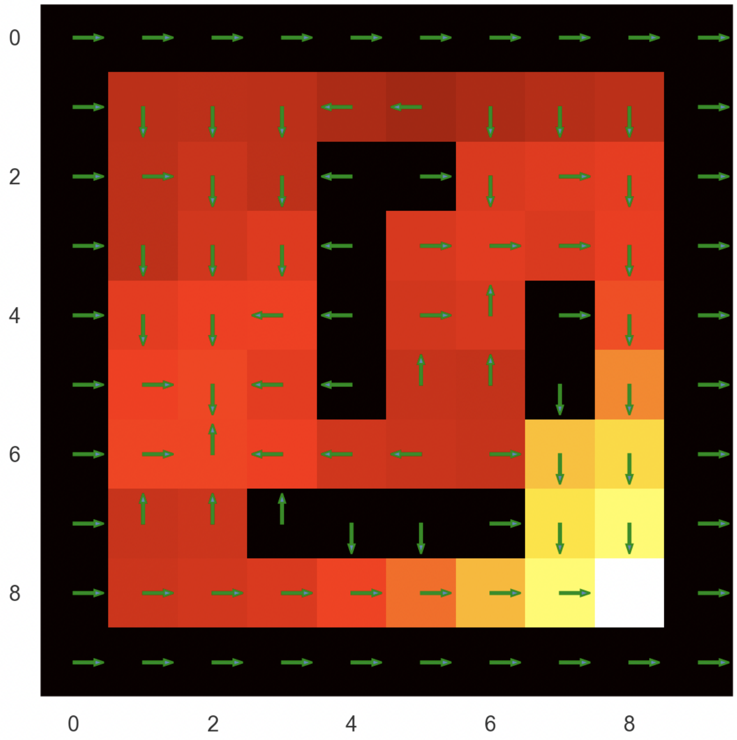
```
[Chunde-MacBook-Pro-2:HW3 chunchang$ python3 p1.py
 [[-10. -10. -10. -10. -10. -10. -10. -10. -10. -10.]
  [-10.   0.   0.   0.   0.   0.   0.   0.   0. -10.]
  [-10.   0.   0.   0. -10. -10.   0.   0.   0. -10.]
  [-10.   0.   0.   1. -10.   0.   0.   0.   0. -10.]
  [-10.   0.   0.   0. -10.   0.   0. -10.   0. -10.]
  [-10.   0.   0.   0. -10.   0.   0. -10.   0. -10.]
  [-10.   0.   0.   0.   0.   0.   0.   0.   0. -10.]
  [-10.   0.   0. -10. -10. -10. -10.   0.   0. -10.]
  [-10.   0.   0.   0.   0.   0.   0.   0.   2. -10.]
  [-10. -10. -10. -10. -10. -10. -10. -10. -10. -10.]]
```

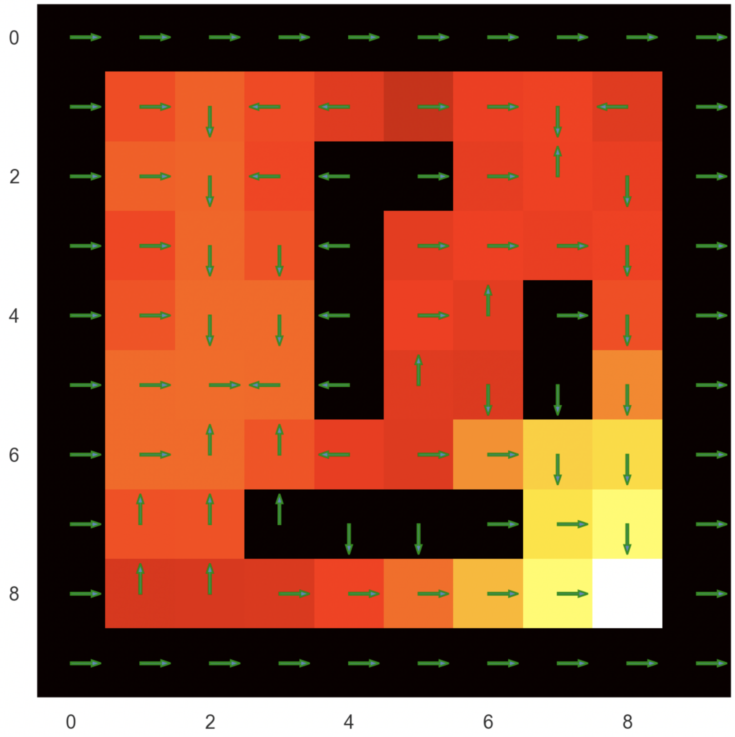
Value of first iteration



Policy Iteration




0
2
4
6
8
0
2
4
6
8


0
2
4
6
8
0
2
4
6
8

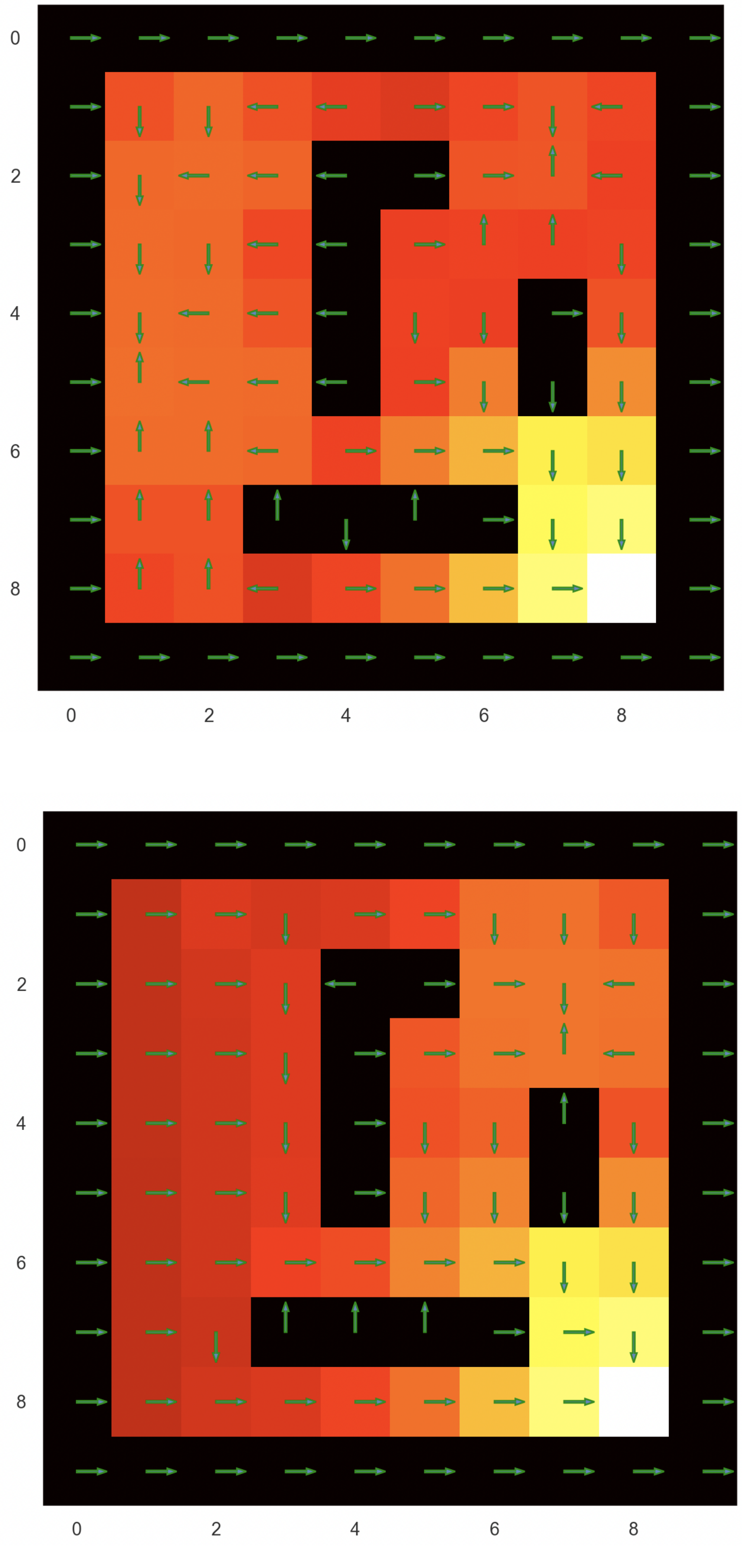
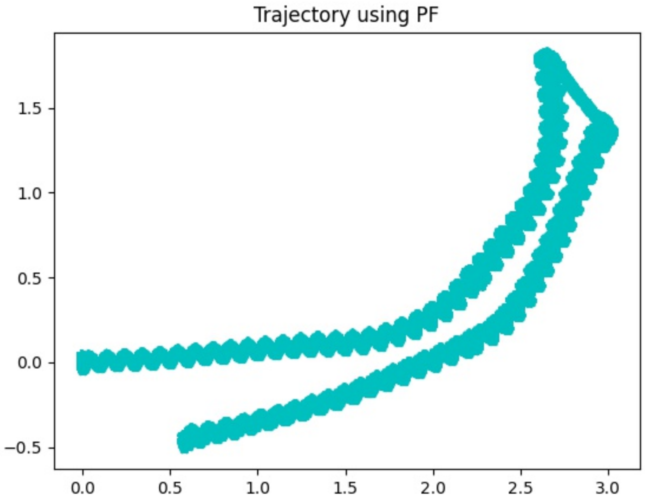
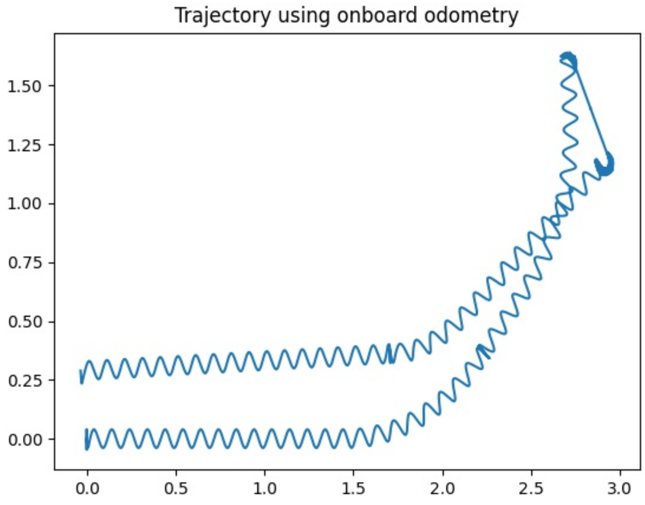


FIGURE 1. final result

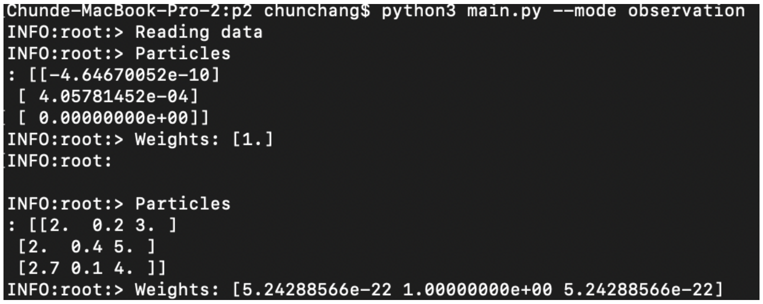
Solution 2 (Time spent: 15 hour)**.** Your solution goes here.

Dynamics



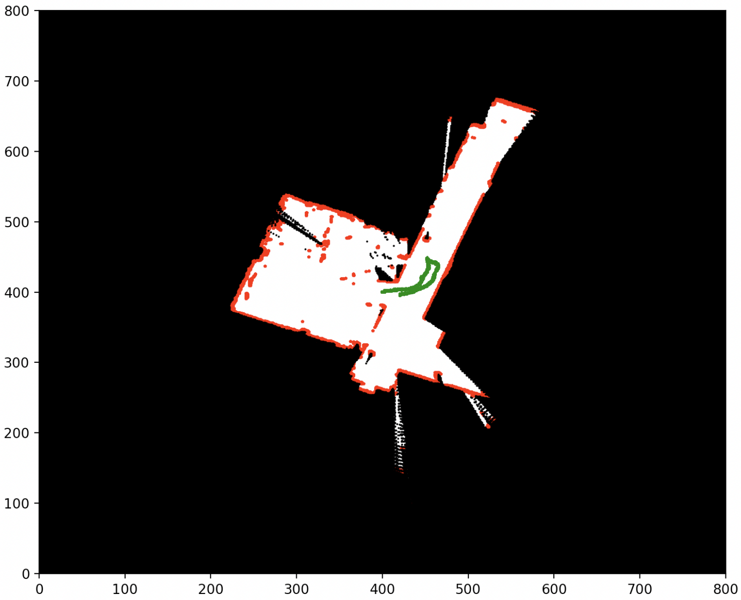


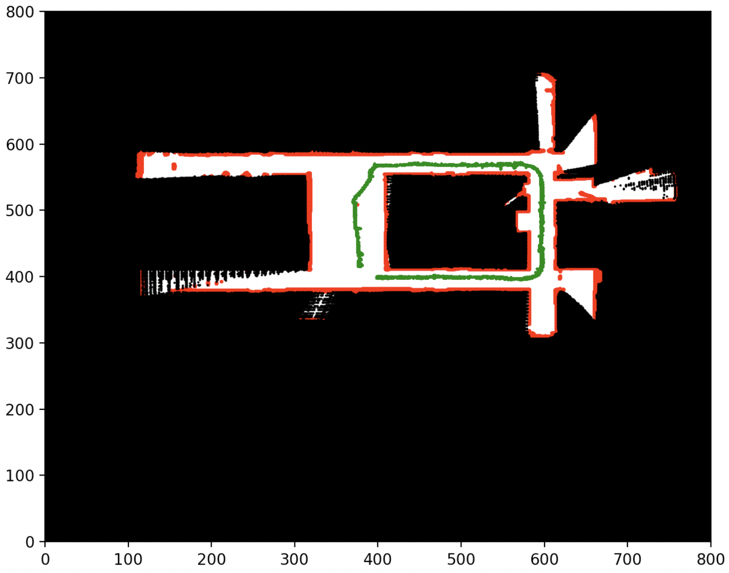
Obeservations

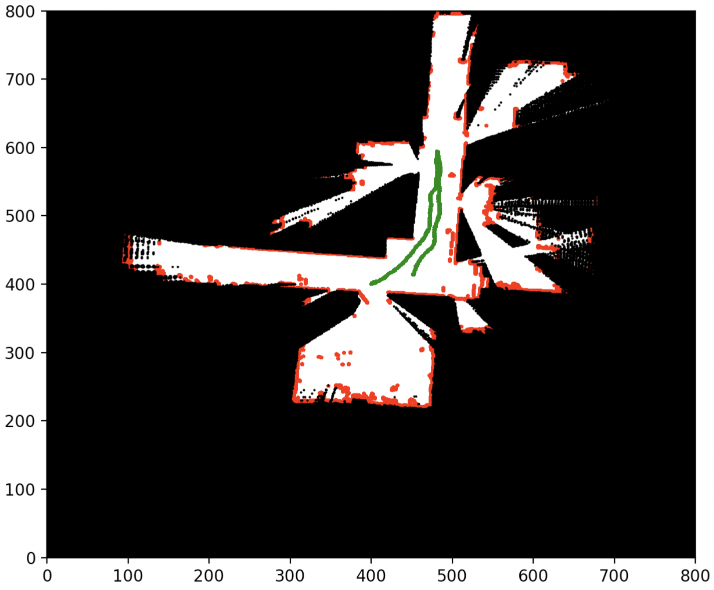


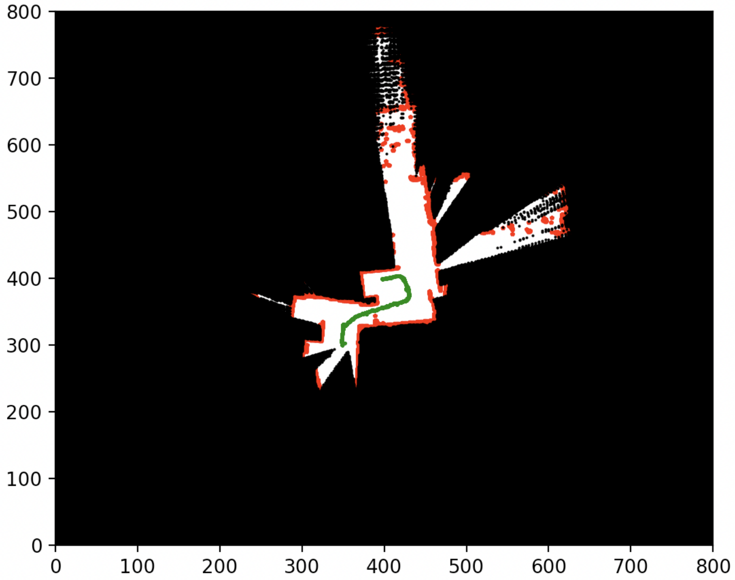
```
Chunde-MacBook-Pro-2:p2 chunchang$ python3 main.py --mode observation
INFO:root:> Reading data
INFO:root:> Particles
: [[-4.64670052e-10]
 [ 4.05781452e-04]
 [ 0.00000000e+00]]
INFO:root:> Weights: [1.]
INFO:root:

INFO:root:> Particles
: [[2.  0.2 3. ]
 [2.  0.4 5. ]
 [2.7 0.1 4. ]]
INFO:root:> Weights: [5.24288566e-22 1.00000000e+00 5.24288566e-22]
```

SLAM




800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800


800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800



In the observation step, I iterate through the particles and generate the proposals for each particle using rays2World. Then I convert the occupancy coordinates seen by the lidar to the indices in cell map. Thirdly, by counting the number of matching occupancy grids between proposal and previous belief, I update the weight of each particle.

After getting the weight of the particles, by using the particle with the largest weight, I use the proposal generated by the particle to update the belief.

For updating the belief(map.cell), I populate the free grids within lidar range with the bressenham method, then add the log of occupancy to the occupied grids and log of free to the free grids.

In the end, using the log map and the threshold to update where is occupied. And check if resampling is needed and use the low variance sampling method.

For tuning, I crank up the variance of theta because the the yawing seems drift as time goes.