ECE484 FA23 MP3 Walkthrough
Filtering and Localization

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10/13

Outline

- Logistics
  - Regrade and resubmit **due 11:59pm CT next Friday(10/13**) through gradescope
  - Project pitch presentation 10/24 and 10/26

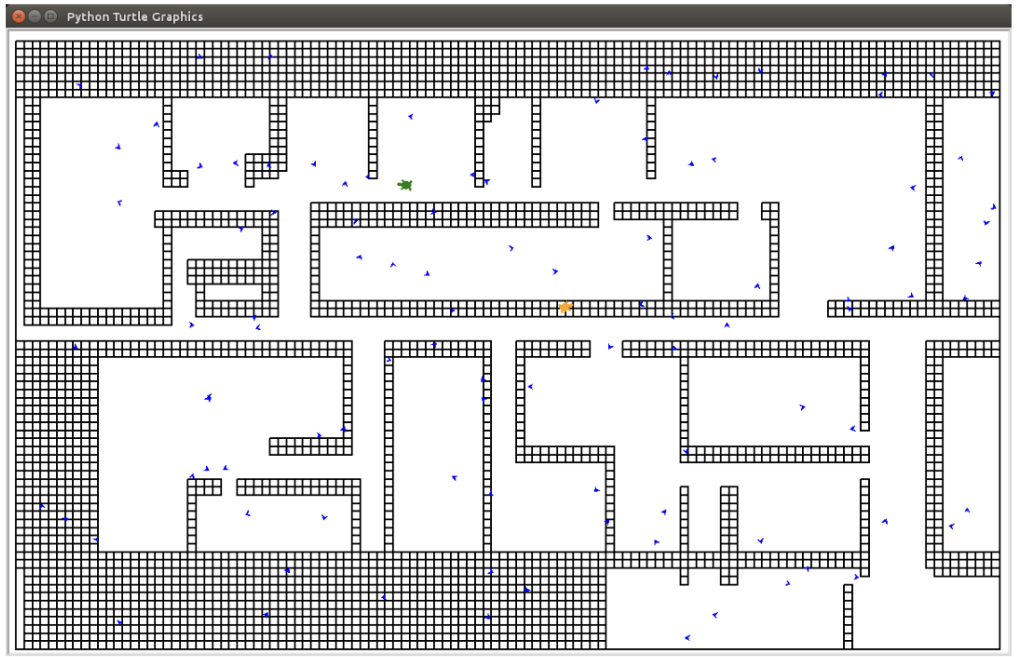
- HW3
- MP3

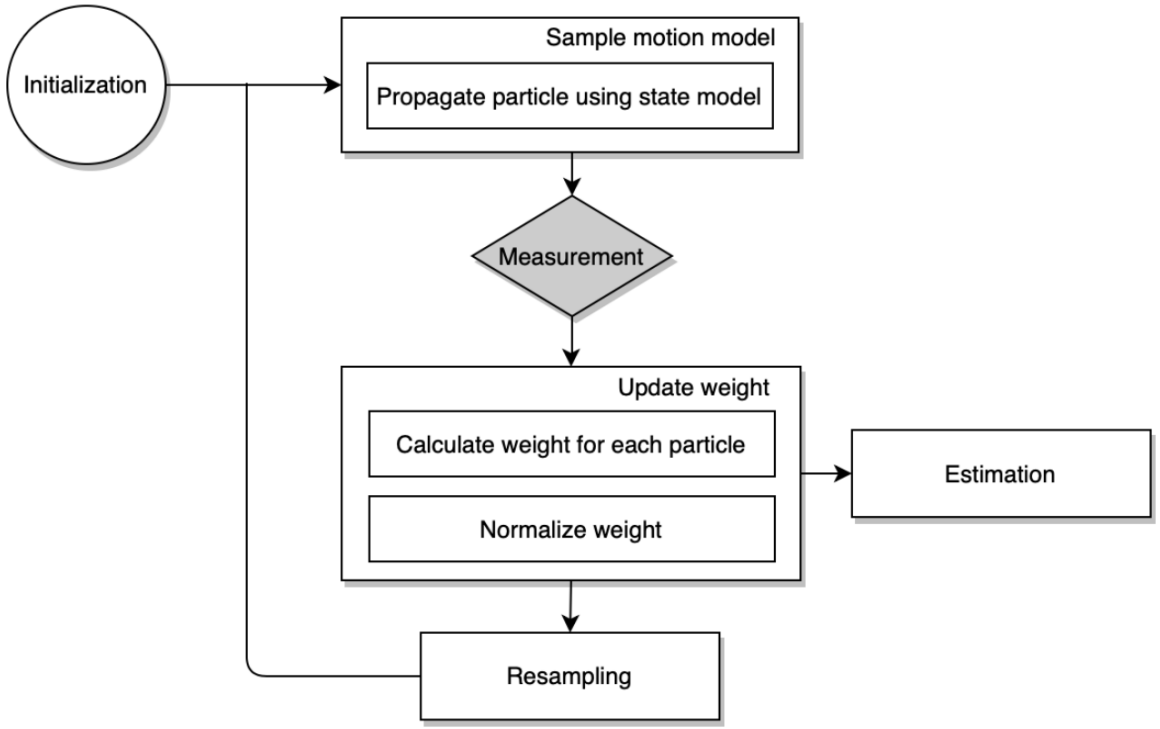
HW3

- Bayes filter update derivation (Problem 1)
- Bayes filter and Particle filter application (Problem2)
- Localization under Gaussian noise and Emergency Braking System (Problem3)

MP3

Overall Objective: Implement **Monte Carlo Localization (MCL)** to localize in ECEB environment.





MP3

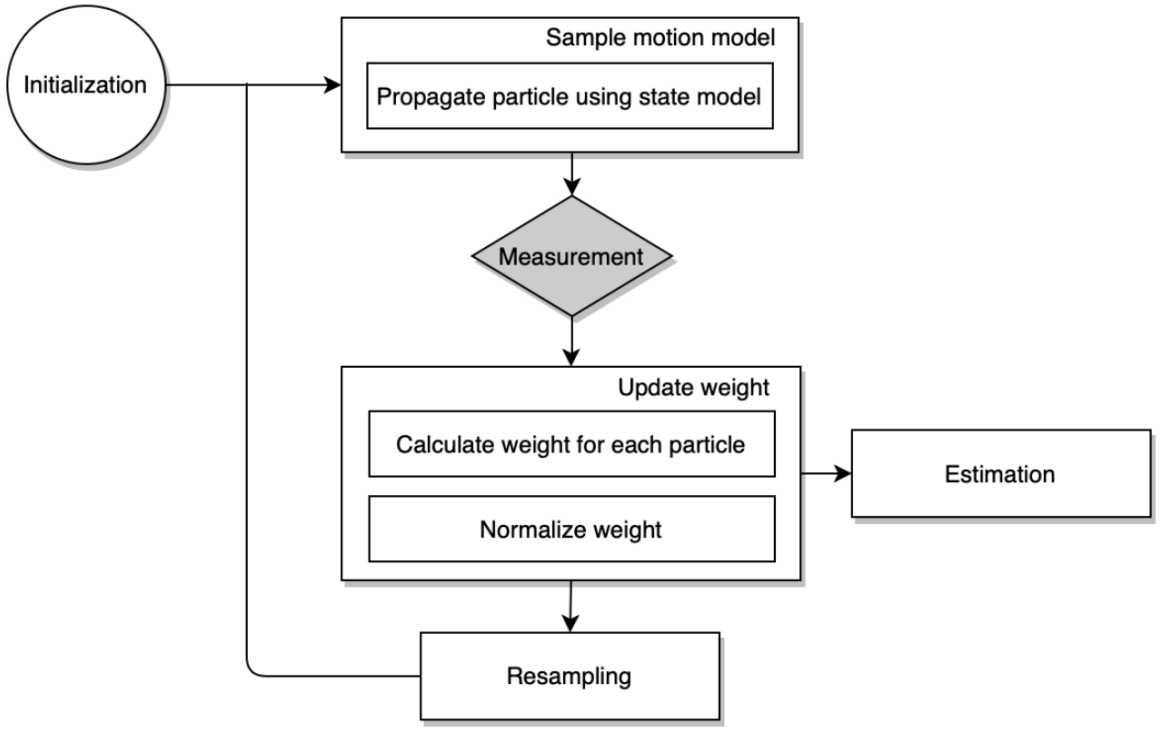
Overall Objective: Implement **Monte Carlo Localization (MCL)** to localize in ECEB environment.

Task 1. Sensor model & Lidar Processing

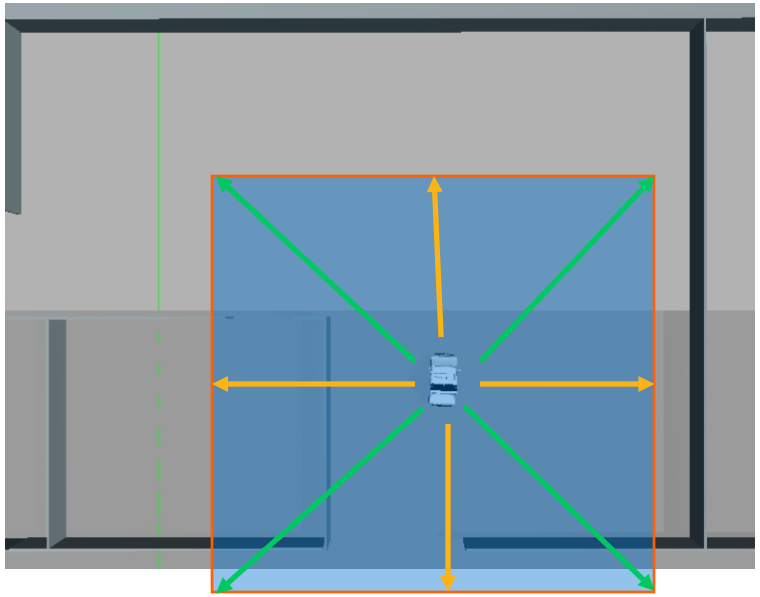
Task 2. Particle Motion Model

Task 3. Update Weight

Task 4. Resample Particle

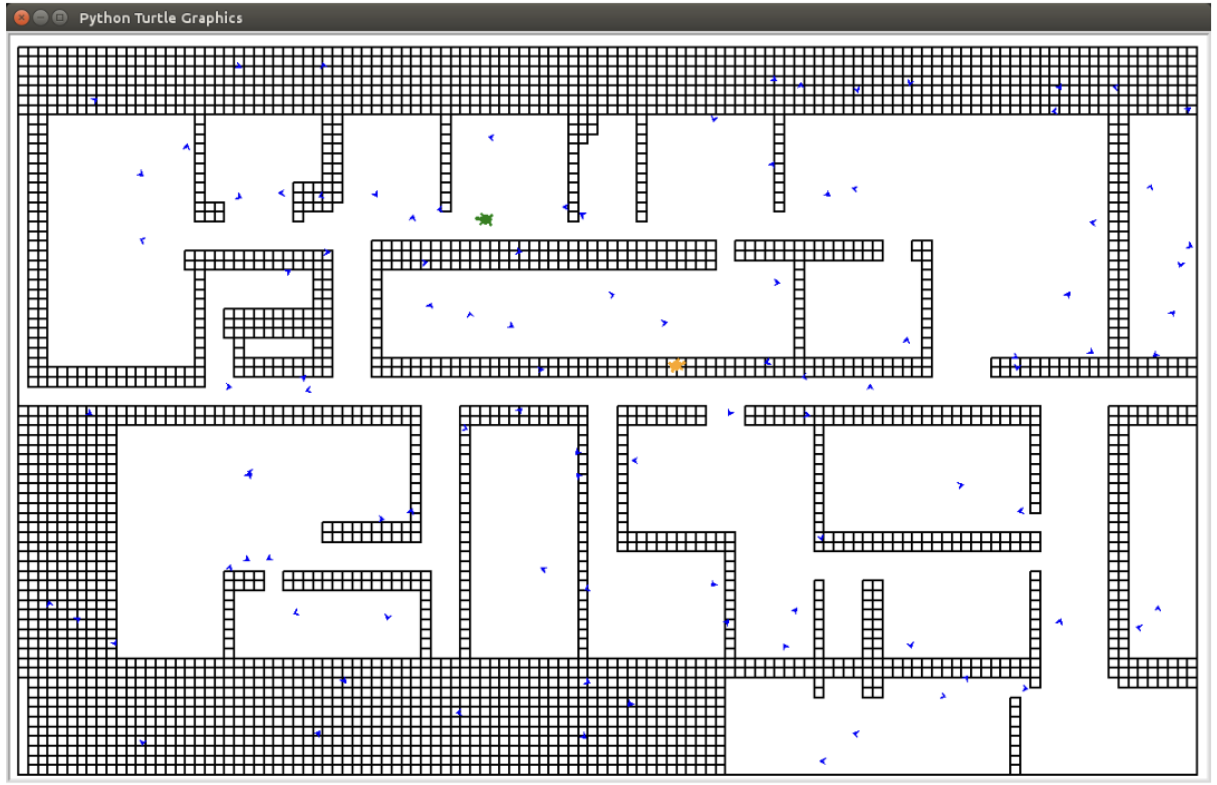


Task 1. Sensor model & Lidar Processing



- Limiting rectangle to look at.
- Sensor reading for 4 directions (front, rear, left, and right) are given.
- Add 4 additional sensor directions: front left, front right, rear left, and rear right.

Task 2. Particle Motion Model



- Initial particle are randomly sampled from the entire world.
- Consider each particle as the vehicle's current state.
- Given the vehicle dynamics function and the control, move each particle to a new position.

Task 3. Update Weight

$$weight = \sum_i e^{\frac{-(p_i - s_i)^2}{2\sigma}}$$

where p_i and s_i are the particle's and robot's sensor readings in i direction, respectively.

- Update the weight of each particles according to the sensor reading from the robot .
- Use the given weight Gaussian Kernel function to compute the weight.
- Be sure to normalize the weights.

Task 4. Resample Particles

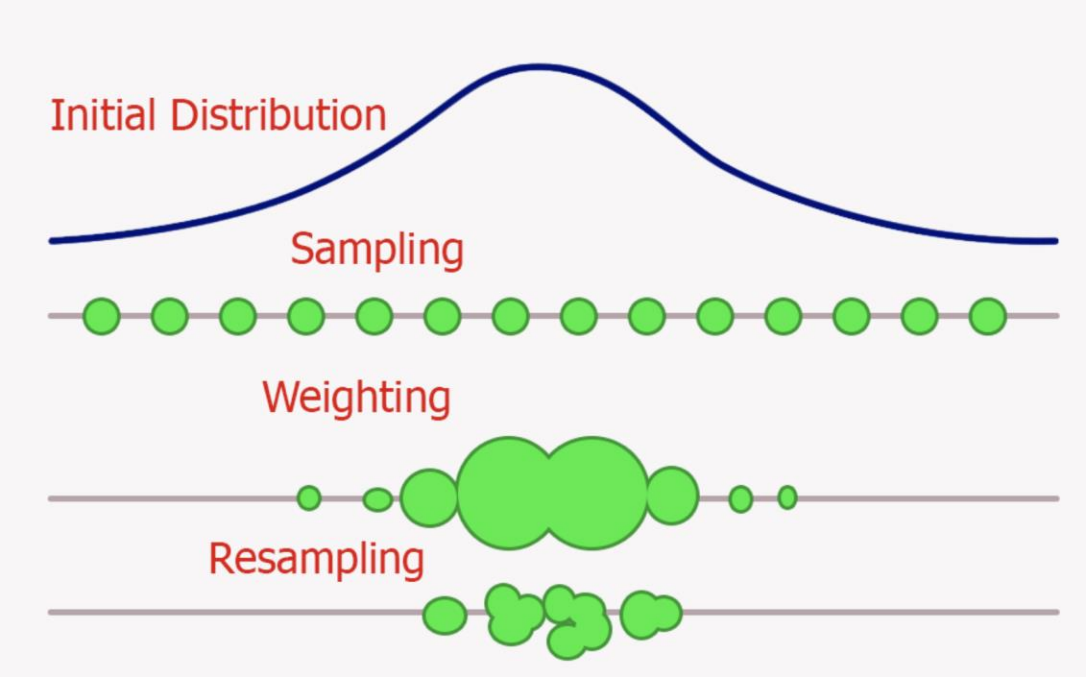


Image Credit: Martin Dimitrov

- Resample particles according to the weights.

1. Calculate an array of the cumulative sum of the weights.
2. Randomly generate a number and determine which range in that cumulative weight array to which the number belongs.
3. The index of the range would correspond to the particle that should be created.
4. Repeat sampling until you have the desired number of samples

Metrics

- Position estimation error: Euclidean distance between actual position and the estimated position
- Orientation estimation error
- Convergence speed

Grading

- HW (100 pts)
- MP3 (100pts)
  - Report 90 pts
  - Demo 10 pts
- MP3 (bonus 10 pts)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