Group Assignment: Robonaut
Bayes Filter Assumptions

1. Can you think of an example in which a previous measurement actually interferes with the current one in the real world?

Scenario 1: In the case of mobile robotics, obstacles can be broadly and roughly classified as stationary, movable, and moving. But one of the basic assumptions in the implementation of the Bayes filter is that the world is static. To be specific, if a moving object like another robot or a human is in the vicinity, then the state estimation won't be possible unless you establish that an object is moving - based on the previous and current readings. This would violate the Markov assumption.

Scenario 2: In the case of mobile robotics,The kidnapping problem considers that the mobile robot is teleported to a similar place without being told. In this case, one robot is unaware that it has been kidnapped; in the update stage, after detecting landmarks by laser with the assumption that all previous measurements are independent, the data association process fails and the robot feels the same location and takes incorrect action, so it is unable to recover its position.

Scenario 3: In Multi Robot Localization to improve the robots' global pose estimation, each robot maintains its own, local belief function while exchanging data with each other. When the two robots meet each other for the first time, they measure their relative positions and exchange their information regarding the propagated estimation to update them. Assume the belief to be distributed among the team such that each robot i carries bel (i).

Whenever a relative measurement takes place, the two involved robots communicate. This is the only occasion where communication takes place. In other words, once a Robot2 receives a broadcast from Robot 1 that contains first robot's belief with a relative range measurement, it uses this information to update its estimate of its own position.

Scenario 4: In case of sensor data lost, for example, the robot is located in environments such as mines or places where sensor data may be lost due to environmental conditions, the measurements of the previous step should be used until the laser data is recovered.

2. Find two other examples that show the difficulty of implementing a perfect Bayes filter in a real-world scenario and describe each in a couple of sentences.

1. Huge memory requirement and immense computation complexity: As the map area increases along with higher discretization and the robot's degrees of freedom, all contribute to higher memory requirements for storage as all the possible states are required during the update and prediction steps. Similarly, these stored values are then used in the computation during the aforementioned steps which lead again to higher computation requirement.

2. Extreme confidence: There needs to be proper checks to prevent the belief from getting to zero. This causes problems in changing the belief in case new evidence shows a contrary outcome.

3. Not Optimal solution: Most of the time, this optimal solution to nonlinear recursive estimation can't be found in practice because it involves a number of integrals that don't have analytical solutions.

4. Prior Probability: The initial prior probability contributes to the belief and also the final probability in Bayes filter. There can be situations where the prior probability is not available and hence taken arbitrarily which can increase or decrease the probability by a significant percentage.