COMP14112 exam 2012

Todd Davies

April 17, 2014

1. (a) **In the robot localization problem, why is it impossible to determine the exact pose that the robot holds? Due to this impossibility, how is the location of the robot represented?**

   The robot's sensors are noisy, and when the robot moves, there is no garentee that it moves by the amount that was intended. Because of this, there is always some degree of uncertainty in the data regarding the robot, and therefore no absolute conclusions can be drawn.

   Because of this, the robots position is represented as a probability matrix, where each pose has a probability assigned to it to indicate how likely it is that the robot is occupying that position. The sum of the probability of all the pose's is 1.

   (b) **Use the definition of probability distribution to prove that $\mathbb{P}(E \vee F) = \mathbb{P}(E) + \mathbb{P}(F \wedge E^C)$ where E^C is the complement of E.**

$$\begin{aligned}\mathbb{P}(E \vee F) &= \mathbb{P}(E) + \mathbb{P}(F) - \mathbb{P}(E \wedge F)\\ \mathbb{P}(F) &= \mathbb{P}(F \wedge E) + \mathbb{P}(F \wedge E^C)\end{aligned}$$

$$\begin{aligned}\mathbb{P}(E) + \mathbb{P}(F) - \mathbb{P}(E \wedge F) &= \mathbb{P}(E) + \mathbb{P}(F \wedge E^C)\\ \mathbb{P}(F) - \mathbb{P}(E \wedge F) &= \mathbb{P}(F \wedge E^C)\\ \mathbb{P}(F) &= \mathbb{P}(F \wedge E^C) + \mathbb{P}(E \wedge F)\\ \mathbb{P}(F) &= \mathbb{P}(F)\end{aligned}$$

   (c) **In the robot localization problem, suppose that the 1st observation received from a sensor is o_1 and the second observation is o_2 , and the probabilities of all poses are updated every time when an observation is received. Are the final probabilities obtained the same as the probabilities obtained**

by using o_2 updating first and o_1 second? Please justify your answer.

(d) **Let a single robot be at a point object located at some position in a square arena with a 22 square grid, in which there is one obstacle occupying position (1, 1). Now answer the following questions:**

(i) $\frac{1}{(2\cdot2)-1} = \frac{1}{3}$