MASSACHVSETTS INSTITVTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science
6.01—Introduction to EECS I
Fall Semester, 2007

NanoQuiz Week 13

Name:

You are a robot in a long hallway with colored segments (like the simple simulation you've been working with in this lab.) Imagine that

- You start out at the left end of the hallway, and you know for sure that you're there;

- Your transition noise is such that every time you take a step to the right there is a probability of 0.1 that you don't move and a probability of 0.1 that you move one square too far (and probability 0.8 of going one square to the right);

- Your observations are perfect;

- Hallway 1 is entirely white; and

- Hallway 2 has a pattern of three successive colors (red, green, blue, red, green, blue, etc.) as you move from left to right.

1. What is the initial belief state?

   (1,0,0,0,...,0)

2. After 10 steps to the right in hallway 1, what is the belief state like? **Don't try to calculate it!!!!** Say what states will have non-zero probability and what state will have the maximum probability.

   At each step, the transition model moves some of the probability mass from each state to 3 other states, some stays in the same state (0.1), most goes to the right by 1 (0.8) and some goes to the right by 2 (0.1).
   (1, 0, 0, 0, ...)
   (0.1, 0.8, 0.1, 0, 0, ...)
   (0.1*0.1, 0.1*0.8+0.8*0.1,0.1*0.1+0.8*0.8+0.1*0.1, 0.8*0.1+0.1*0.1, 0.1*0.1,0,...)
   At the end of step i, the peak is at square i (0-based index). There are 2*i+1 squares with non-zero probability (1 at step 0, 3 at step 1, etc). Note that the observations at each step, since they will all be white and there is no sensor error, will not affect the result.

3. After 10 steps to the right in hallway 2, what is the belief state like? **Don't try to calculate it!!!!** Say what states will have non-zero probability and what state will have the maximum probability.

   Only one square between 0 and 20 will have non-zero probability, it will have probability one. After the motion on each step, there will be 3 squares with non-zero probability (as above), but each of those will have a different color. Once we have made an observation for that step, only one of these states will have a non-zero observation probability. Once we normalize after

the observation, that state will have probability zero. For example, imagine that we move once and see blue:

(1, 0, 0, 0, …)

(0.1, 0.8, 0.1, 0, 0, …) after motion

(0, 0, 0.1, 0, 0,…) after observing blue

(0, 0, 1, 0, 0, …) after the normalization step