**Project 4 - Question 8**

This non-programming problem is part of Project 4. Please add your answers to this document and submit your completed document along with your solution to the Pac-Man project.

Suppose you are (attempting) to complete a marathon. You alternate between jogging and running. We will model your movement over time (in terms of seconds) as a Hidden Markov Model.

Let *j* be the state in which you are jogging and *r* be the state in which you are running.

At any time step, if you are running then there is a 60% chance that you will continue running at the next time step. At any time step, if you are jogging then there is a 20% chance you will continue jogging at the next time step.

Fill in the table with the transition probabilities as described above, where the row corresponds to *Xt+1* and the column to *Xt*.

|  |  |  |
| --- | --- | --- |
|  | *j* | *r* |
| *j* | *P(Xt+1=j|Xt=j)=* | *P(Xt+1=j|Xt=r)=* |
| *r* | *P(Xt+1=r|Xt=j)=* | *P(Xt+1=r|Xt=r)=* |

Now suppose there is evidence in the form of how close you are to other competitors in the marathon. If you are running then there is a 90% chance there is a person within 10 meters of you. If you are jogging there is a 30% chance there is a person within 10 meters of you. Let’s denote the condition that there is a person within 10 meters of you as *m* and let’s denote the complementary condition (that there is *not* a person within 10 meters of you) as $¬$*m*.

Fill in the table with the conditional probabilities of the evidence based on the description above.

|  |  |  |
| --- | --- | --- |
|  | *J* | *r* |
| *m* | *P(m|j)=* | *P(*m*|r)=* |
| $¬$*m* | *P(*$¬$*m |j)=* | *P(*$¬$*m |r)=* |

Assume there is a 50% chance you are initially jogging, *P(X0=j)=0.5*. Compute the values for the passage of time for *j* and *r*, at *t*=1.

Now factor in the evidence that there is a person within 10 meters of you at *t*=1. Compute the beliefs *B*(*X1=j*) and *B*(*X1=r*).

Assume there is a 50% chance you are initially jogging, *P(X0=j)=0.5*. What is the probability of producing the exact sequence *r, r, r*, *j*, *r*?

How would you change the transition probabilities so that you never change your movement (jogging/running) in between seconds? Provide the corresponding values.