**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 80% chance that you will continue running at the next time step. At any time step, if you are jogging then there is a 70% 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)= 0.7* | *P(Xt+1=j|Xt=r)=0.2* |
| *r* | *P(Xt+1=r|Xt=j)=0.3* | *P(Xt+1=r|Xt=r)=0.8* |

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 50% 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)= 0.5* | *P(*m*|r)=0.9* |
| *m* | *P(m |j)=0.5* | *P(m |r)=0.1* |

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.

B’1(x=j) = 0.45

B’1(x =r) = 0.55

(see attached pdf for work)

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*).

B(X1 = j) = 0.3125

B(X1 = r) = 0.6875

(See attached pdf for work)

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, j, r*, *j*, *j*?

0.5 \* P(running to jogging) \* P(jogging to running) \* P(running to jogging) \* P(jogging to jogging)

= 0.5 \* 0.2 \* 0.3 \* 0.2 \* 0.7

= 0.42%