Complete the following written problems:

1. Markov Chain (260 Points).

Given the following Markov Chain diagram:
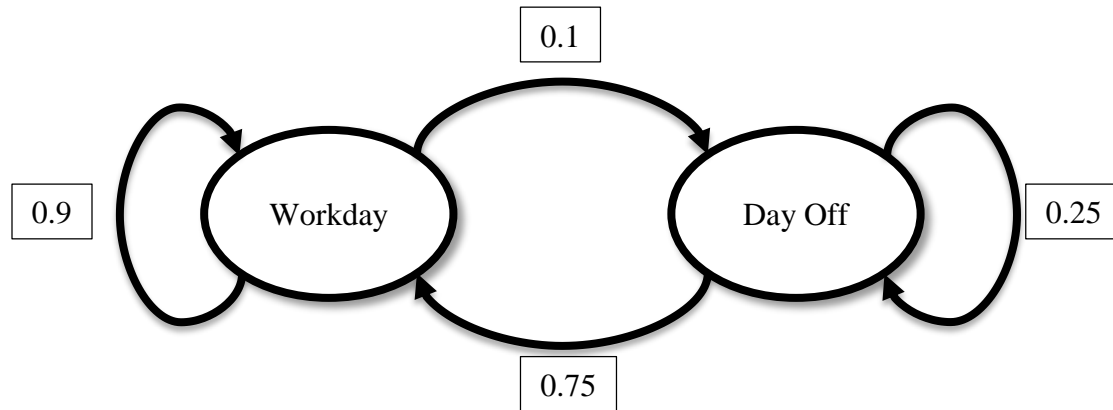
Given that the first day was a workday (i.e. $P(Day\,1 = Workday) = 1$ and $P(Day\,1 = Day\,Off) = 0$), what is the following:

a. (20 Points) What is the probability that the second day is a Workday (i.e. $P(Day\,2 = Workday)$)?

b. (20 Points) What is the probability that the second day was a Day Off (i.e.
$P(Day\ 2 = Day\ Off))$?

c. (40 Points) What is the probability that the third day was a Workday (i.e.
$P(Day\ 3 = Workday))$?

d. (40 Points) What is the probability that the third day was a Day Off (i.e.
$P(Day\ 3 = Day\ Off))$?

e. (40 Points) What is the probability that the fourth day was a Workday (i.e.
$P(Day\ 4 = Workday))$?

f. (50 Points) What is the stationary distribution for a Workday (i.e. $P(Day\ \infty = Workday))$?

g. (50 Points) What is the stationary distribution for a Day Off (i.e. $P(Day\infty = Day\ Off))$?

2. Markov Chain (230 Points).

Let $W = Workday$ and $D = Day\ Off$. We observe the following sequence of Workdays and Days Off:

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
23: W	24: W	25: W	26: W	27: W	28: W	29: W
30: W	01: W	02: W	03: W	04: D	05: W	06: D
07: D	08: W	09: W	10: W	11: W	12: W	13: D
14: W	15: W	16: W	17: W	18: W	19: W	20: W
21: W	22: W	23: W	24: W	25: W	26: W	27: W

Note: Sunday the 23rd will be considered the first day (i.e. $Day\ 1$).

a. (10 Points) What is the probability that the first day is a workday (i.e. $P(Day\,1 = Workday)$)?

b. (10 Points) What is the probability that the first day is a day off (i.e. $P(Day\,1 = Day\,Off)$)?

c. (40 Points) What is the probability that today will be a workday given that yesterday was a workday (i.e. $P(Day\,t = Workday\,|\,Day\,t-1 = Workday)$)?

d. (40 Points) What is the probability that today will be a day off given that yesterday was a workday (i.e. $P(Day\,t = Day\,Off\,|\,Day\,t-1 = Workday)$)?

e. (40 Points) What is the probability that today will be a workday given that yesterday was a day off (i.e. $P\left(Day\ t = Workday \mid Day\ t-1 = Day\ Off\right)$)?

f. (40 Points) What is the probability that today will be a day off given that yesterday was a day off (i.e. $P\left(Day\ t = Day\ Off \mid Day\ t-1 = Day\ Off\right)$)?

g. (50 Points) Given the data and calculations above, draw the associated Markov Chain diagram.

3. Hidden Markov Model (140 Points).

Given the following Hidden Markov Model diagram:
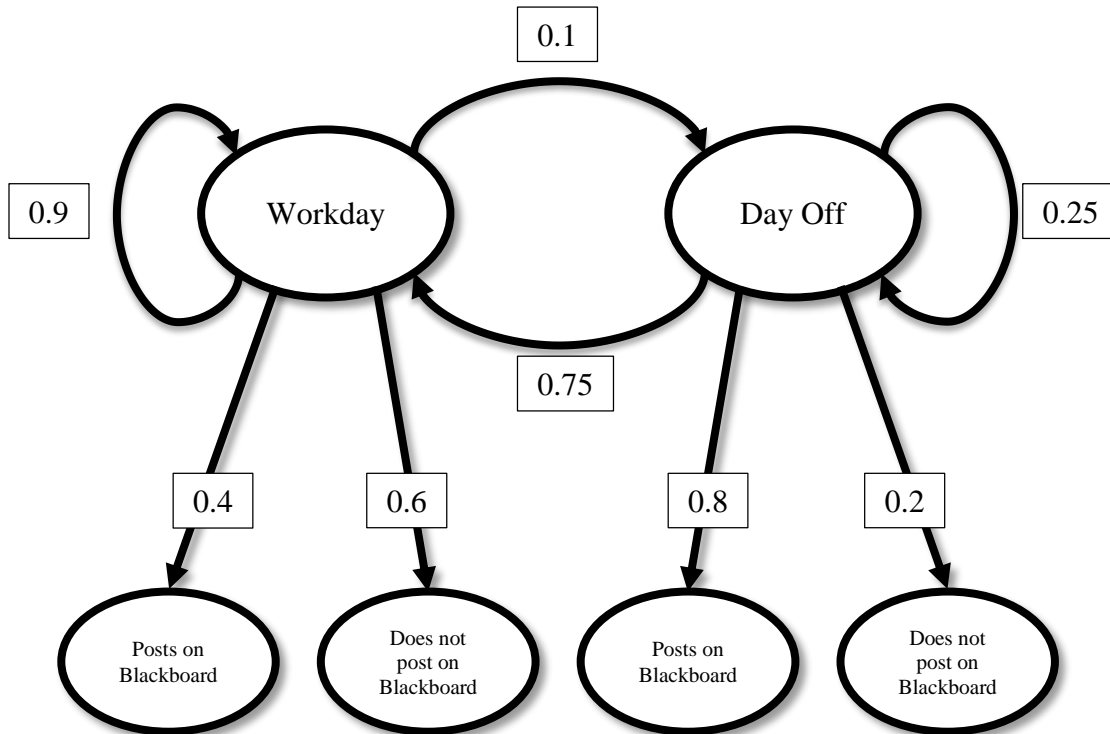
In this Hidden Markov Model, the observable events are whether the person of interest posts on Blackboard are does not post on Blackboard. The hidden events are that the person of interest is either working or has the day off on that day.

For the following problem, assume that:

$$P(Day\,1 = Workday) = 0.5 \text{ and } P(Day\,1 = Day\,Off) = 0.5$$

a. (10 Points) What is the probability that the person of interest posts on Blackboard on Day 2 given that they worked on Day 2 (i.e. $P(Day\,2 = Posts\ on\ Blackboard | Day\,2 = Workday)$)?

b. (20 Points) What is the probability that the person of interest works on Day 2 (i.e. $P(Day\ 2 = Workday))$?

c. (20 Points) What is the probability that the person of interest has the day off on Day 2 (i.e. $P(Day\ 2 = Day\ Off))$?

d. (40 Points) What is the probability that you observe the person of interest posting on Day 2 (i.e. $P(Day\ 2 = Posts\ on\ Blackboard))$?

e. (50 Points) What is the probability that the person of interest worked given that you observed them post on Day 2 (i.e. $P\left(Day\ 2 = Workday \mid Day\ 2 = Posts\ on\ Blackboard\right)$)?

5. (50 Points).

Describe what the C++ code for your Research Project does.

This assignment has no programming problems.

After completing Assignment 08, create an `assignment_08_lastname.pdf` file for your written assignment.

Upload your `assignment_08_lastname.pdf` file for your written assignment to the Assignment 08 location on the BlackBoard site: .