Question 5. **Dynamic Bayesian Networks**

The AI faculty decide to build an agent to guess the mood of Dean Zvi Galil from hour to hour (so visits to the Dean's office can be carefully timed). After detailed observation, they determine that when the Dean is in a good mood, there is a 75% chance he will be in a good mood an hour later. But when he is in a bad mood, there is a 50% chance he will be in a bad mood an hour later. Unfortunately the Dean's mood can't be observed directly. However, through careful study the faculty have determined that when the Dean is in a good mode, the likelihood that he will send a reminder email about CIOS is 80%, but there is only a 60% chance of sending a CIOS email when he is in a bad mood.

(a) Draw a dynamic Bayesian network model for this problem. Be sure to show at least two time slices. Label the nodes in your graph. Use the random variable M to indicate the Dean's mood. M can take on the values "good" or "bad." Use the random variable C to indicate whether a CIOS email was sent. C can take on the values "true" or "false." Use subscripts on M and C to indicate time slices.

(b) Fill in the conditional probability tables for the transition model and sensor model elements of the DBN. Be sure the columns and rows are labeled properly in the spaces provided.

Transition Model:

Sensor Model:

(c) The faculty have no knowledge of the Dean's mood prior to the first day of Finals Week. Give the distribution for the Dean's mood.

$P(M_0) =$

(d) On the first day of Finals Week, the Dean sends a CIOS reminder email. Compute the normalized probability distribution for the Dean's mood on the first day of Finals Week, given that $C = 1$. Show your work to be eligible for partial credit.

$P(M_1|C_1 = 1) =$