CECS 451
Assignment 10
Total: 29 Points

General Instruction

- Submit your work in the Dropbox folder via BeachBoard (Not email or in class).

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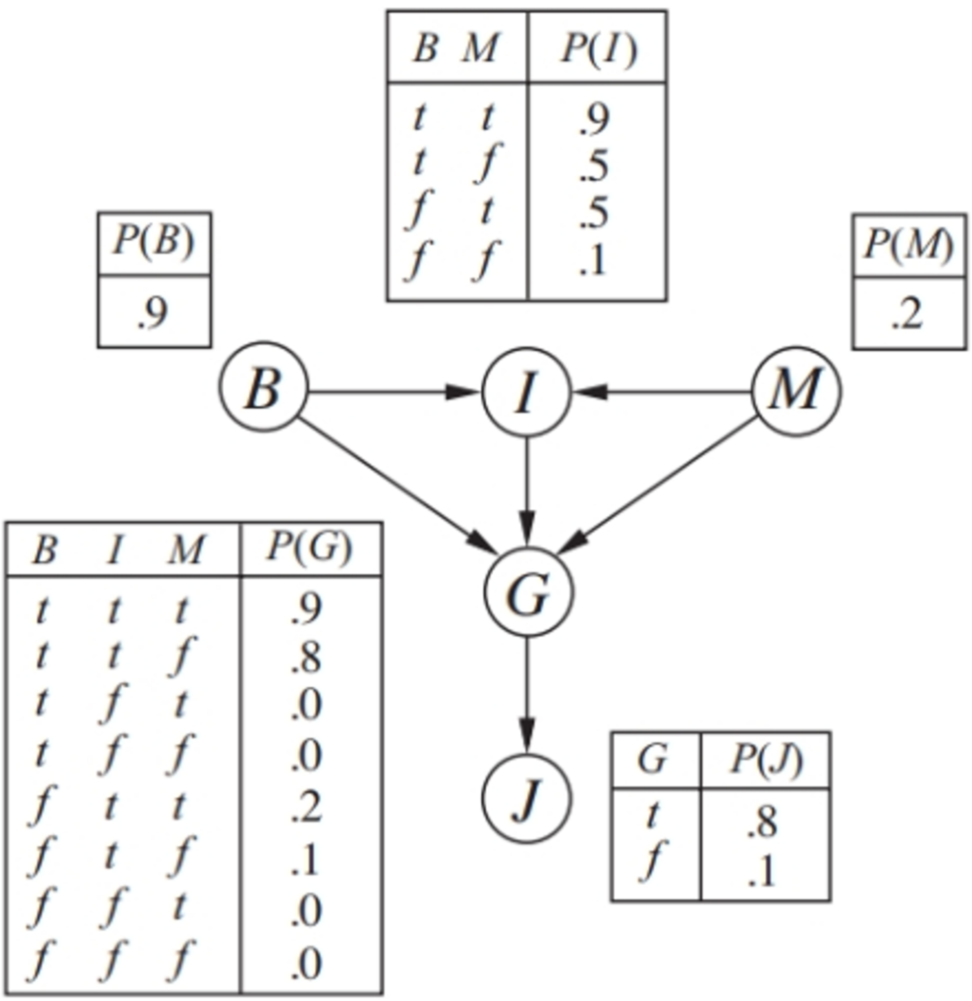
1. Consider the Bayes net shown in Figure 1. Write answers with a scale of 4, i.e., 0.1234. (You don't need to show the calculation steps.)
   (a) (2 points) Calculate the value of $P(b, i, \neg m, g, j)$.
   (b) (3 points) Calculate the value of $\vec{P}(J|b, i, m)$.
   (c) (4 points) Calculate the value of $\vec{P}(J|\neg b, \neg i, m)$.



$P(B)$
.9

B	M	$P(I)$
t	t	.9
t	f	.5
f	t	.5
f	f	.1

$P(M)$
.2

B	I	M	$P(G)$
t	t	t	.9
t	t	f	.8
t	f	t	.0
t	f	f	.0
f	t	t	.2
f	t	f	.1
f	f	t	.0
f	f	f	.0

G	$P(J)$
t	.8
f	.1

Figure 1: A simple Bayes net with Boolean variables.

2. (6 points) In Figure 2, suppose we observe an unending sequence of days on which the umbrella appears. As the days go by, the probability of rain on the current day increases toward a fixed point, we expect that $\vec{P}(R_t|u_{1:t}) = \vec{P}(R_{t-1}|u_{1:t-1}) = \langle \rho, 1-\rho \rangle$. Find ρ with a scale of 4, i.e., 0.1234. (You don't need to show the calculation steps.)

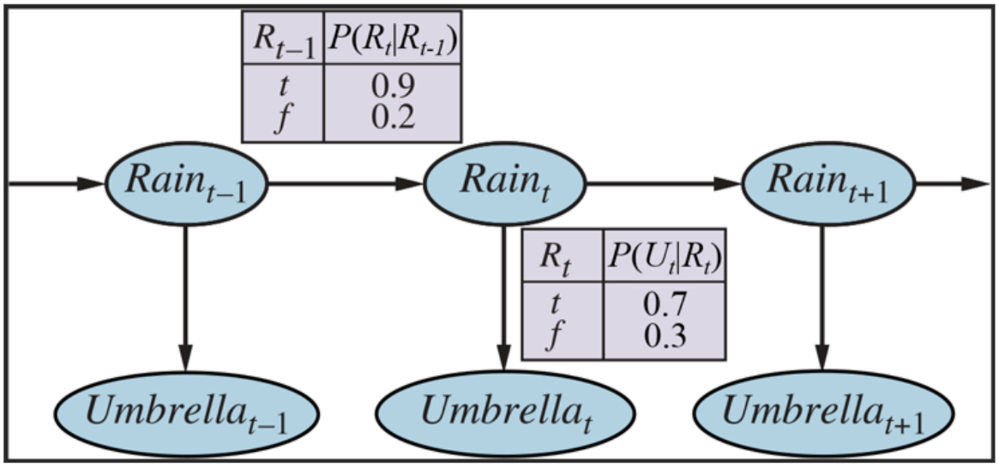


Figure 2: Bayesian network structure and conditional distributions describing the umbrella world. The transition model is $\vec{P}(R|R_{t-1})$ and the sensor model is $\vec{P}(U|R_t)$.

3. A professor wants to know if students are getting enough sleep. Each day, the professor observes whether they have red eyes. The professor has the following domain theory:

   - The prior probability of getting enough sleep, with no observations, is 0.7.
   - The probability of getting enough sleep on night t is 0.8 given that the student got enough sleep the previous night, and 0.3 if not.
   - The probability of having red eyes is 0.2 if the student got enough sleep, and 0.7 if not.

   (a) (6 points) Formulate this information as a hidden Markov model. Give a Bayesian network and conditional distributions.

   (b) (8 points) Consider the following evidences, and compute $\vec{P}(ES_2|\vec{e}_{1:2})$ with a scale of 4, i.e., 0.1234. (You don't need to show the calculation steps.)

   - $\vec{e}_1$ = red eyes
   - $\vec{e}_2$ = not red eyes