# CS 480 – WRITTEN ASSIGNMENT 4

There are five questions. Please submit your solutions through Blackboard.

1. We are given the following joint distribution for variables A, B, and C. Please compute the requested probabilities. Show each probability distribution as a table/vector. Feel free to use a calculator.

A	B	C	P(A, B, C)
T	T	T	0.014
T	T	F	0.126
T	F	T	0.012
T	F	F	0.048
F	T	T	0.392
F	T	F	0.168
F	F	T	0.144
F	F	F	0.096

   a. P(A, C)

   b. P(C) – you can use your answer to part a to compute the answer to this question.

   c. P(A|C) – you can use your answers to parts a and b to compute the answer to this question.

   d. P(A, B | C) – you can use your answers from previous parts if they are relevant.

2. We are given the following Bayesian network over X_2, X_3, ..., X_9. Note that there is no X_1.
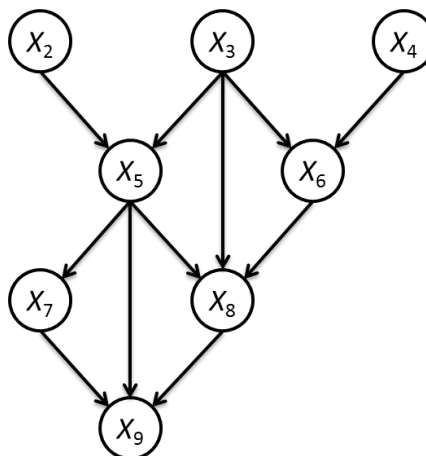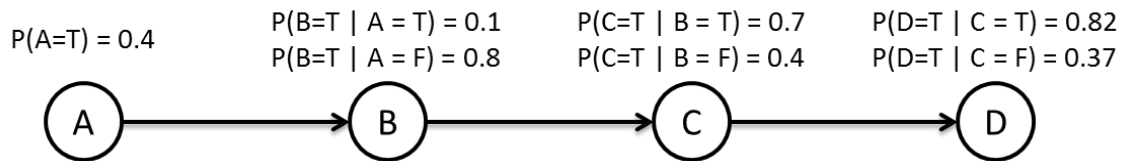

   a. What is the Bayesian network factorization of the joint $P(X_2, X_3, ..., X_9)$?

b. Assume X_i can take i possible values (for e.g., X_2 is binary, X_3 can take on 3 possible values, …, X_9 can take on 9 possible values)

    i. What is the number of independent parameters required to represent the full joint using the naïve table representation? Show your work.

    ii. What is the number of independent parameters required for this network? Show your work.

3. We are given the following Bayesian network. Please compute the requested probabilities using variable elimination.

$P(A=T) = 0.4$

$P(B=T \mid A = T) = 0.1$
$P(B=T \mid A = F) = 0.8$

$P(C=T \mid B = T) = 0.7$
$P(C=T \mid B = F) = 0.4$

$P(D=T \mid C = T) = 0.82$
$P(D=T \mid C = F) = 0.37$

$$A \longrightarrow B \longrightarrow C \longrightarrow D$$

a. $P(B)$

b. $P(C|A=T)$

c. $P(A, B \mid C=T, D=F)$.

4. We are given the following decision network.

$$P(X=T) = 0.4$$

$P(Y=T \mid X=T) = 0.2$
$P(Y=T \mid X=F) = 0.7$

$P(Z=T \mid Y=T) = 0.9$
$P(Z=T \mid Y=F) = 0.2$

a / ~a
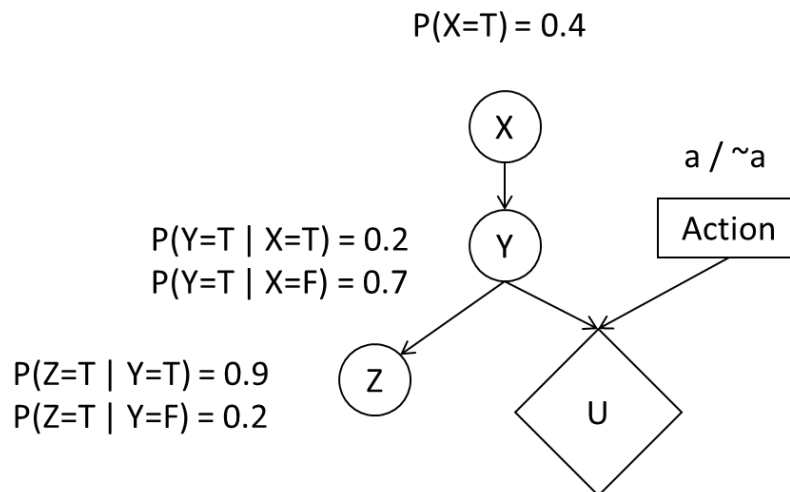
Action

Y	Action	U(Y, Action)
T	a	800
T	~a	400
F	a	200
F	~a	1000

a. What action should you take?

b. What is the value of information of Z?

c. What is the value of information of X?

d. Given Z=T, what is the value of information of X?

5. Here is the umbrella network we saw in class, except P(rain) = p, and P(~rain) = (1-p). What is the value of p where the agent is indifferent between taking the umbrella and not taking it?

take/don't take

Take Umbrella

$P(rain) = p$

Umbrella

Rain

$P(umb \mid take) = 1.0$
$P(umb \mid {\sim}take) = 0.0$

Happiness

$U({\sim}umb, {\sim}rain) = 100$
$U({\sim}umb, rain) = 0$
$U(umb, {\sim}rain) = 20$
$U(umb, rain) = 70$