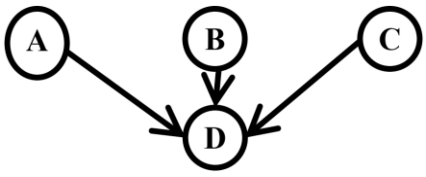
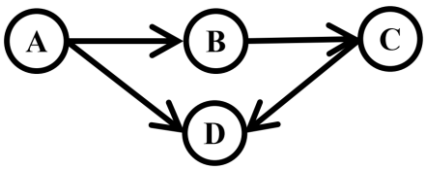
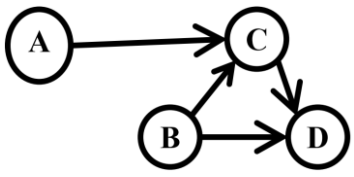
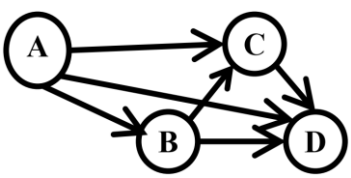
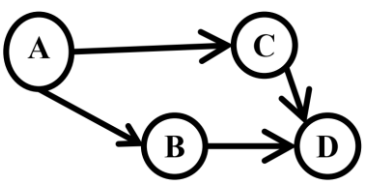
REVIEW EXERCISE 07

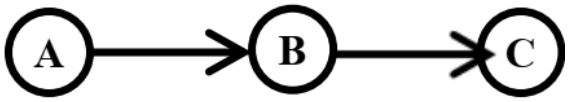
Question 1. Draw the Bayesian Network that corresponds to the conditional probability equation.

P(B|A,C) P(A) P(C|D) P(D)	P(A) P(B) P(C) P(D)	P(A|B) P(C|B) P(B) P(D)
P(B|A) P(A) P(C|D) P(D)	P(D|C) P(C|B) P(B|A) P(A)	

Question 2. Write down the factored conditional probability equation that corresponds to the graphical Bayesian Network shown.

Question 3. Given this Bayes Network.



Label the following statements about (conditional) independence as true or false. You should use the definition of joint probabilities for a Bayes Network to explain each of your answers.

a) A and C are conditionally independent given B.
b) A and C are independent.

Question 4. Consider the following problem: Metastatic cancer is a possible cause of a brain tumor and is also an explanation for an increased total serum calcium. In turn, either of these could cause a patient to fall into occasional coma. Severe headache could also be explained by a brain tumor.

a) Represent these causal links in a Bayesian Network. Let a stand for "metastatic cancer", b for "increased total serum calcium", c for "brain tumor", d for "occasional coma", and e for "severe headaches".
b) Suppose the following probabilities are given:

$P(a) = 0.2$	$P(b \mid a)=0.8$	$P(b \mid \neg a) = 0.2$	$P(c \mid a) = 0.2$
$P(c \mid \neg a)=0.05$	$P(e \mid c)=0.8$	$P(e \mid \neg c)=0.6$	$P(d \mid b, c)=0.8$
$P(d \mid b, \neg c)=0.8$	$P(d \mid \neg b, c)=0.8$	$P(d \mid \neg b, \neg c)=0.05$	

and assume that it is also given that some patient is suffering from severe headaches but has not fallen into a coma.
Calculate joint probabilities for the eight remaining possibilities (that is, according to whether a, b, and c are true or false).

c) According to the numbers given, the a priori probability that the patient has metastatic cancer is 0.2. Given that the patient is suffering from severe headaches but has not fallen into a coma, are we now more or less inclined to believe that the patient has cancer? Explain.

Question 5. Given the network below, calculate the following probabilities: $P(\neg p_3)$, $P(p_2 \mid \neg p_3)$, $P(p_1 \mid p_2, \neg p_3)$ and $P(p_1 \mid \neg p_3, p_4)$ in the following cases.

a) Apply inference by enumeration, while employing the properties of directed graphical model to manually simplify inference.
b) Apply the variable elimination algorithm. Clearly mark any new factors and how they are introduced. Eliminate variables in any choice of order.