THE UNIVERSITY OF HONG KONG

FACULTY OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE

Quiz 2

COMP3270 Artificial Intelligence

Time: 50 min

Only approved calculators as announced by the Examinations Secretary can be used in this examination. It is the candidates' responsibility to ensure that their calculator operates satisfactorily, and candidates must record the name and type of the calculator used on the front page of the examination script.
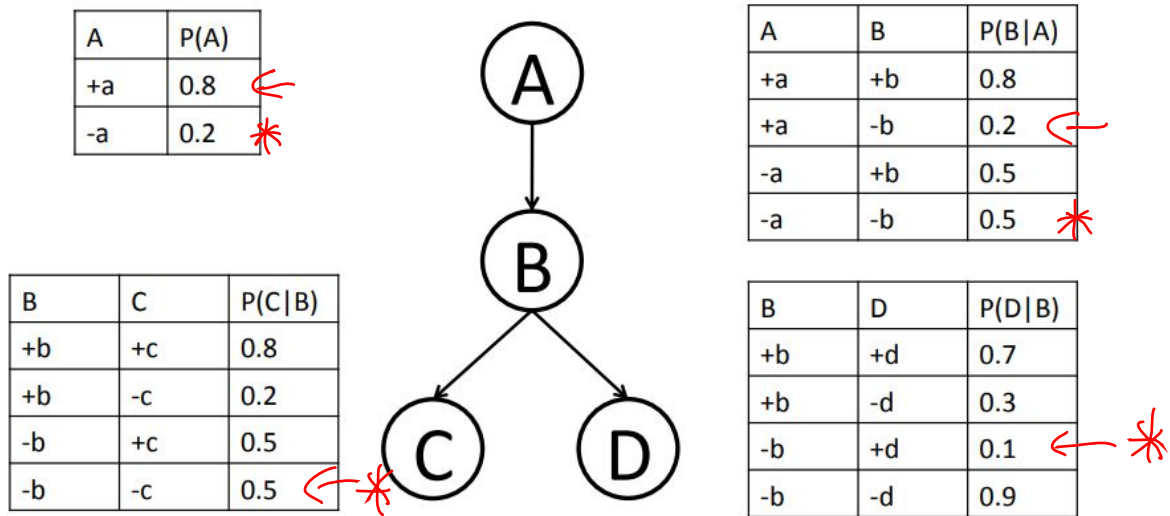
Calculator Brand: _____   *Calculator Model:*_____

Answer questions in the space provided.
Write your University No. on every page.

Question	Max. Mark	Your Mark (examiner use only)
1	6	
2	2	
3	4	
4	8	
Total	20	

Question 1 (6 marks): Consider the joint distribution P(A,B,C,D) defined by the Bayes' net below.

A	P(A)
+a	0.8
-a	0.2

A	B	P(B|A)
+a	+b	0.8
+a	-b	0.2
-a	+b	0.5
-a	-b	0.5

B	C	P(C|B)
+b	+c	0.8
+b	-c	0.2
-b	+c	0.5
-b	-c	0.5

B	D	P(D|B)
+b	+d	0.7
+b	-d	0.3
-b	+d	0.1
-b	-d	0.9

Compute the following quantities:

1.1 (1 mark): P(+a) = _____ 0.8 _____

1.2 (2 mark): P(+a, -b, -c, +d) = _____ 0.8 * 0.2 * 0.1 * 0.5 = 0.008 _____

1.3 (3 mark): P(+a | -b, -c, +d) = _____ $\dfrac{0.008}{0.008 + 0.2*0.5*0.1*0.5}$ = 0.615 _____

Question 2 (2 marks): Let $B \perp C \mid A$, i.e., B is independent of C given A. Fill in the missing entries of the joint distribution P(A, B, C).

A	B	C	P(A, B, C)
0	0	0	0.01
0	0	1	0.02
0	1	0	0.03
0	1	1	X = 0.06
1	0	0	0.01
1	0	1	0.1
1	1	0	Y
1	1	1	Z

$\sum = 0.23$

$B \perp C \mid A$

$\Rightarrow \quad \dfrac{X}{0.03} = \dfrac{0.02}{0.01}$

$\Leftrightarrow X = 0.06$

$0.23 + Y + Z = 1.0$

$\Leftrightarrow Y + Z = 0.77$

$\dfrac{Z}{Y} = \dfrac{0.1}{0.01} = 10$

$\Rightarrow \quad Y = 0.07, \quad Z = 0.7$

Question 3 (4 marks): In this question we are trying to find Waldo. Waldo randomly moves around floors A, B, C, and D. Waldo's location at time t is X_t. At the end of each timestep, Waldo stays on the same floor with probability 0.5, goes upstairs with probability 0.3, and goes downstairs with probability 0.2. If Waldo is on floor A, he goes down with probability 0.2 and stays put with probability 0.8. If Waldo is on floor D, he goes upstairs with probability 0.3 and stays put with probability 0.7.


X_0	$P(X_0)$
A	0.1
B	0.2
C	0.3
D	0.4
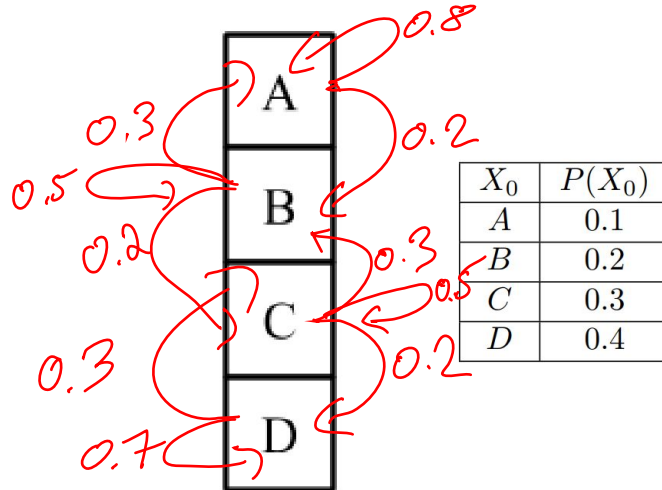
Fill in the table below with the distribution of Waldo's location at time t = 1.

X_1	$P(X_1)$
A	$0.1 * 0.8 + 0.2 * 0.3 = 0.14$
B	$0.2 * 0.5 + 0.3 * 0.3 + 0.1 * 0.2 = 0.21$
C	$0.3 * 0.5 + 0.4 * 0.3 + 0.2 * 0.2 = 0.31$
D	$0.4 * 0.7 + 0.3 * 0.2 = 0.34$

Question 4 (8 marks):

Based only on the structure of the Bayes' Net given below, circle whether the following conditional independence assertions are guaranteed to be true, guaranteed to be false, or cannot be determined by the structure alone.
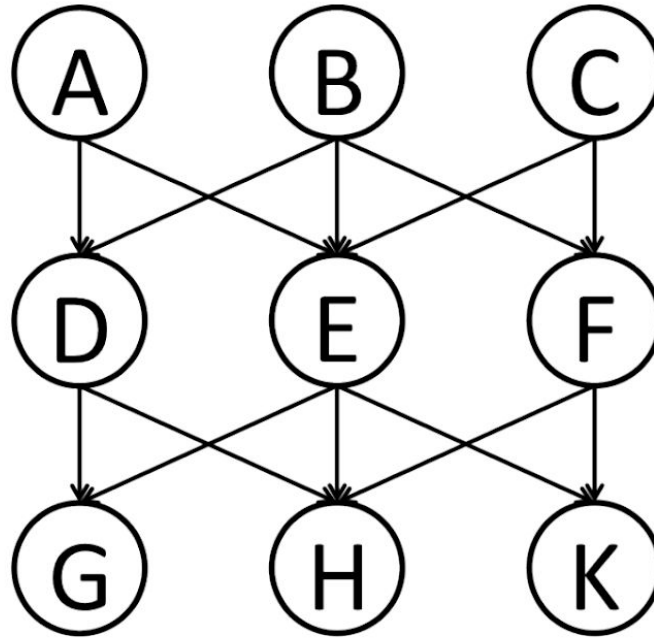
1	$A \perp\!\!\!\perp C$	Guaranteed false	Cannot be determined	Guaranteed true
2	$A \perp\!\!\!\perp C \mid E$	Guaranteed false	Cannot be determined	Guaranteed true
3	$A \perp\!\!\!\perp C \mid G$	Guaranteed false	Cannot be determined	Guaranteed true
4	$A \perp\!\!\!\perp K$	Guaranteed false	Cannot be determined	Guaranteed true
5	$A \perp\!\!\!\perp G \mid D, E, F$	Guaranteed false	Cannot be determined	Guaranteed true
6	$A \perp\!\!\!\perp B \mid D, E, F$	Guaranteed false	Cannot be determined	Guaranteed true
7	$A \perp\!\!\!\perp C \mid D, F, K$	Guaranteed false	Cannot be determined	Guaranteed true
8	$A \perp\!\!\!\perp G \mid D$	Guaranteed false	Cannot be determined	Guaranteed true

END OF PAPER
You may use this page to draft your answer