ARTIFICIAL INTELLIGENCE (CS60045)
(Class Test – 3)

Oct 8, 2021 **Answer ALL questions** Time 1 hour, 40 marks

All parts of a question must be answered in the same place

1. [GraphPlan] Consider the following propositional planning problem.

   Start state: ¬A, ¬B, ¬C, D.

   Goal: A, B, C, ¬D.

   Actions:

   · Action 1 has preconditions A, B, C and effect ¬D.

   · Action 2 has preconditions ¬A, ¬B and effects A and B.

   · Action 3 has preconditions ¬B, ¬C and effects B and C.

   · Action 4 has precondition B and effect ¬B.

   Answer the following questions:

   (a) On a full fresh page, draw the planning graph as far as state level S_3, where the start state is at state level S_0 and the first action level is A_0. Do not add any mutex links at this point.

   (b) Now make a copy of the planning graph of part (a) on another fresh page and add the mutex links (recall that mutex links may exist between actions, as well as propositions.

   (c) Give an example of each of the following types of mutexes, if it exists in your planning graph:

   [1] Inconsistent effects

   [2] Interference

   [3] Competing needs

   (d) At which level in the planning graph will all goals first be present simultaneously? Will the GraphPlan algorithm be able to extract a working plan without extending it beyond this level? Explain your answer.

   (e) A fixpoint is reached in a planning graph at level k if $S_k = S_{k+1}$. What is the minimum value of k in this planning graph?

   [4+4+3+4+2 = 17 marks]

2. [Reasoning about Uncertainty] Answer the following questions:

   (a) Consider the random variables, A, B, and C. For each of the following equalities indicate whether it is valid (always true).

   [1] $P(AB) = P(A)P(B) – P(A \mid B)$

   [2] $P(AB) = P(A)P(B)$

   [3] $P(AB) = P(A \mid B)P(B) + P(B \mid A)P(A)$

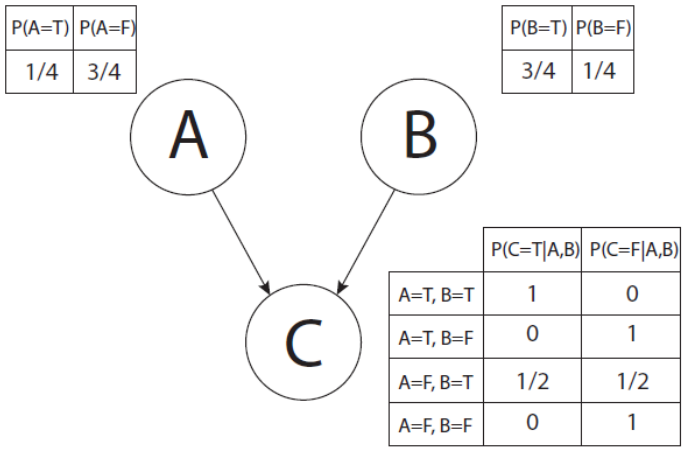
   [4] $P(A) = \Sigma_{b \in B} P(A \mid B=b)P(B=b)$

   [5] $P(AC) = \Sigma_{b \in B} P(A \mid B=b)P(C \mid B=b)P(B=b)$

   [6] $P(ABC) = P(C \mid A)P(B \mid CA)P(A)$

(b) Suppose we are given that: P(A) = 0.5, P(B | A) = 1, P(B) = 0.75. Find the value of P(B | ¬A)

(c) Consider the following Bayes network:



P(A=T)	P(A=F)
1/4	3/4

P(B=T)	P(B=F)
3/4	1/4

	P(C=T|A,B)	P(C=F|A,B)
A=T, B=T	1	0
A=T, B=F	0	1
A=F, B=T	1/2	1/2
A=F, B=F	0	1

Compute the following probabilities. Show all the steps.

[1] P(ABC)

[2] P(AB)

[3] P(C)

[4] P(B | C)

[5] P(AB | C)

[6+2+10 = 18 marks]

3. [Partial Order Planning] Discuss the working of the partial order planning algorithm on the following problem:

Initial State: ON(A, Table), ON(B, Table), ON(C, Table)

Goal State: ON(A,B), ON(B,C), ON(C,A)

Actions: The usual actions of the Blocks World

[5 marks]