Subject: Artificial Intelligence

Semester: BS (CS, SE) –V,VI **Marks:** 50

Dated: 19th Jan, 2023 (1230-1530) **Time:** Three Hours

Instructor: Shehla Saif, Umar Nauman, Dr Inam

Reg. No: _____

Instructions:

- Fill in the tables for Question 01, 02, 04 (a), 05 and 06 on question paper only (in provided space only). Provide complete calculations on the answer book. Failing to provide calculation or to failing to fill in the table will result in zero credit.
- Over writing/ cutting/ use of fluid/ use of pencil in Questions 01, 02, 04 (a), and 05 will result in zero credit
- Return question paper with answer sheet, failing to do so will result in cancellation of exam and zero credit in final examination.

---------- **CLO 1** ----------

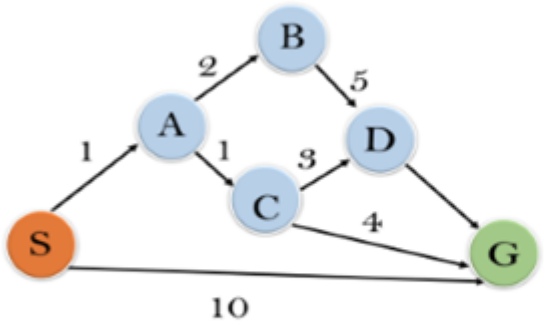
Question 01: (05 marks)

Comment, with example(s), whether Kitchen is an example of Multi Agent System or not.

---------- **CLO 2** ----------

Question 02: (2 + 1 + 1 + 1 + 3 + 2 = 15 marks)

Consider the graph and heuristic values, answer the following questions



State	h(n)
S	5
A	3
B	4
C	2
D	6
G	0

1. Using A* search, path with the highest cost from **S** to **G** will be?

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1. Using A* search from **S** to **D**, what will be the highest cost?

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1. Using A* search from **S** to **G**, what will be the intermediate cost for the path **S-A-C**?

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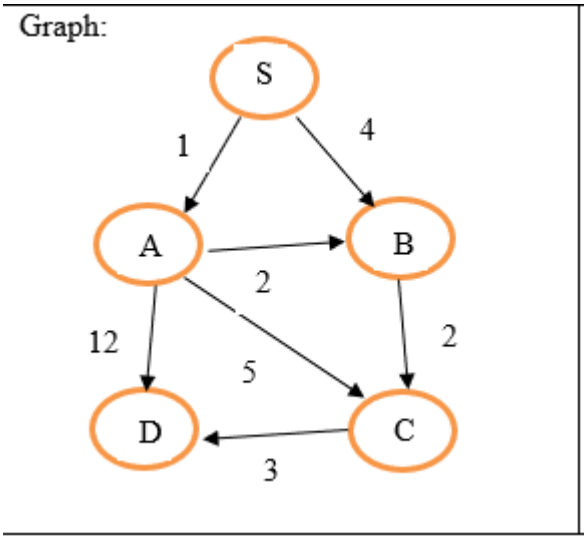
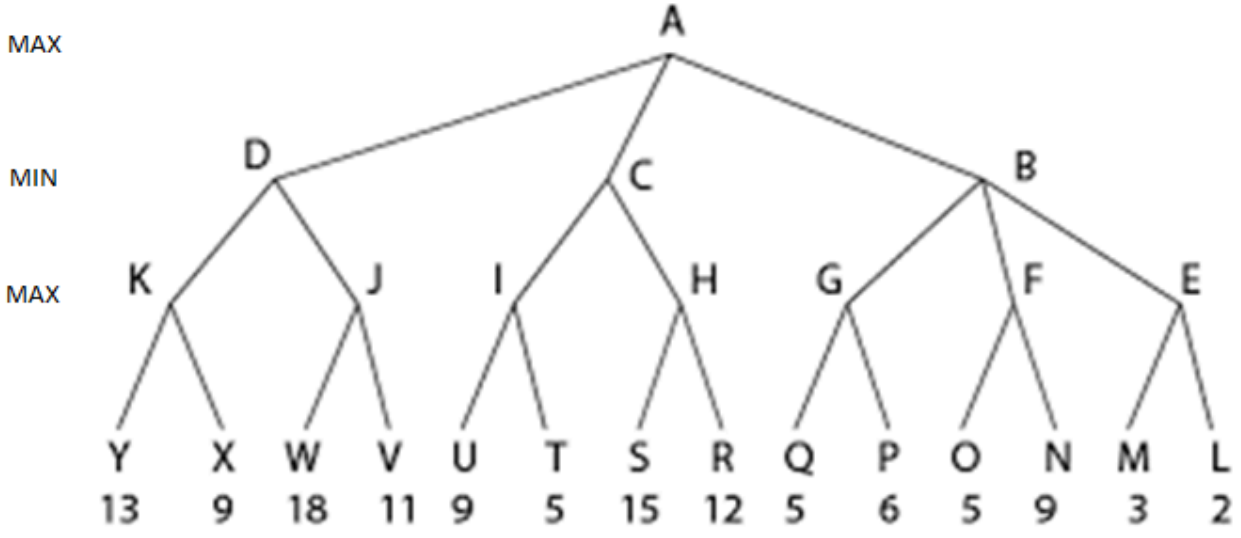
1. Using A* search from **S** to **G**, what will be the intermediate cost for starting the search path at **S**?

Consider the following graph



1. Using GBFS from **S** to **C**, what will be the final path?

Consider the following graph for alpha-beta pruning and answer the following questions



1. Final Value at node B will be

---------- CLO 3 ----------

Question 03: (2 +3 = 05 marks)

Apply CSP along with cryptarithmetic to solve:

T W O

+ T W O

F O U R

1. List all constraints
2. List the values of all the digits used in the question

---------- CLO 4 ----------

Question 04: (5 + 5 = 10 marks)

1. Express the following sentences using first order logic (FOL). Alongside universal and/or existential quantifiers, use appropriate symbols for objects and functions.

Sentences	**FOL**
"Frank bought a dvd."	
"Frank bought something."	
"Susan bought everything that Frank bought."	
"If Frank bought everything, so did Susan."	
"Everyone bought something."	

1. With the help of the following table, prove that the logical equivalency mentioned below always holds.

$$\neg(\ \alpha \Rightarrow (\beta \wedge \gamma)\ ) \equiv (\alpha \wedge \neg\beta) \vee (\alpha \wedge \neg\gamma)$$

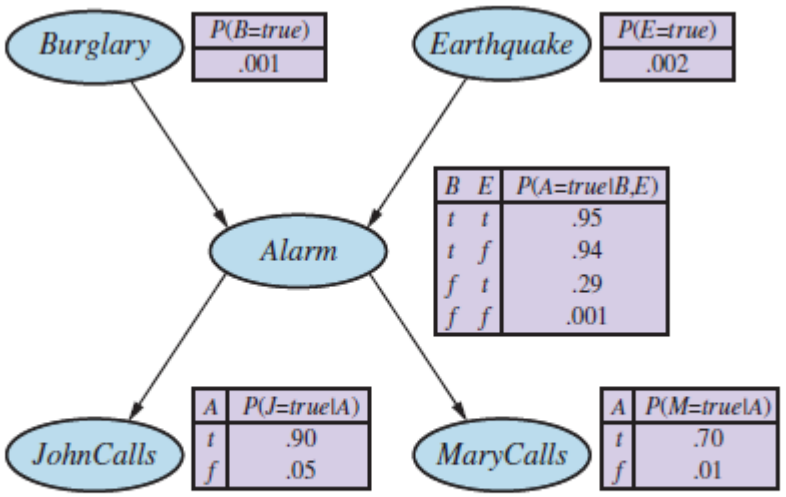
$$
\begin{aligned}
(\alpha \wedge \beta) &\equiv (\beta \wedge \alpha) \quad \text{commutativity of } \wedge \\
(\alpha \vee \beta) &\equiv (\beta \vee \alpha) \quad \text{commutativity of } \vee \\
((\alpha \wedge \beta) \wedge \gamma) &\equiv (\alpha \wedge (\beta \wedge \gamma)) \quad \text{associativity of } \wedge \\
((\alpha \vee \beta) \vee \gamma) &\equiv (\alpha \vee (\beta \vee \gamma)) \quad \text{associativity of } \vee \\
\neg(\neg\alpha) &\equiv \alpha \quad \text{double-negation elimination} \\
(\alpha \Rightarrow \beta) &\equiv (\neg\beta \Rightarrow \neg\alpha) \quad \text{contraposition} \\
(\alpha \Rightarrow \beta) &\equiv (\neg\alpha \vee \beta) \quad \text{implication elimination} \\
(\alpha \Leftrightarrow \beta) &\equiv ((\alpha \Rightarrow \beta) \wedge (\beta \Rightarrow \alpha)) \quad \text{biconditional elimination} \\
\neg(\alpha \wedge \beta) &\equiv (\neg\alpha \vee \neg\beta) \quad \text{De Morgan} \\
\neg(\alpha \vee \beta) &\equiv (\neg\alpha \wedge \neg\beta) \quad \text{De Morgan} \\
(\alpha \wedge (\beta \vee \gamma)) &\equiv ((\alpha \wedge \beta) \vee (\alpha \wedge \gamma)) \quad \text{distributivity of } \wedge \text{ over } \vee \\
(\alpha \vee (\beta \wedge \gamma)) &\equiv ((\alpha \vee \beta) \wedge (\alpha \vee \gamma)) \quad \text{distributivity of } \vee \text{ over } \wedge
\end{aligned}
$$

---------- **CLO 5** ----------

Question 05: (5 + 5 + 5 = 15 marks)

1. Consider the following data set. Apply Naive Bayes approach to determine the probability of Alarm has sounded and neither the burglary not the earthquake occurred, but John and Mary both did not call?

1. Consider the following data set. Apply Naive Bayes approach to determine the probability of Alarm has not sounded and both the burglary and the earthquake occurred, but John and Mary both called?



A typical Bayesian network, showing both the topology and the conditional probability tables (CPTs). In the CPTs, the letters *B*, *E*, *A*, *J*, and *M* stand for *Burglary*, *Earthquake*, *Alarm*, *JohnCalls*, and *MaryCalls*, respectively.

P(H|X) = P(X|H) P(H) / P(X)

1. Consider the problem of changing a flat tire. The goal is to have a good spare tire properly mounted onto the car's axle, where the initial state has a flat tire on the axle and a good spare tire in the trunk. To keep it simple, our version of the problem is an abstract one, with no sticky lug nuts or other complications. There are just four actions: removing the spare from the trunk, removing the flat tire from the axle, putting the spare on the axle, and leaving the car unattended overnight. We assume that the car is parked in a particularly bad neighborhood, so that the effect of leaving it overnight is that the tires disappear.

---------- CLO 1 to CLO 6 ----------

Question 06: (1 + 1 + 1 + 1 + 0.5 + 0.5 = 5 marks)

If we are to create an AI based problem solver for the game of "checkers", answer the question:

a) How would you represent the problem and why

b) What search strategy will you use and why?

c) What heuristic value will you use and why?

d) How will you use predicates and/or propositions to describe any state?

e) Does this involve uncertainty and planning, and how?