United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam: Fall 2022

Course Code: CSE 3811, Course Title: Artificial Intelligence

Total Marks: 40 Duration: 2 hours

Answer all questions. Marks are indicated in the right side of each question.

[Any examinee found adopting unfair means will be expelled from the trimester/program as per UIU disciplinary rules.]

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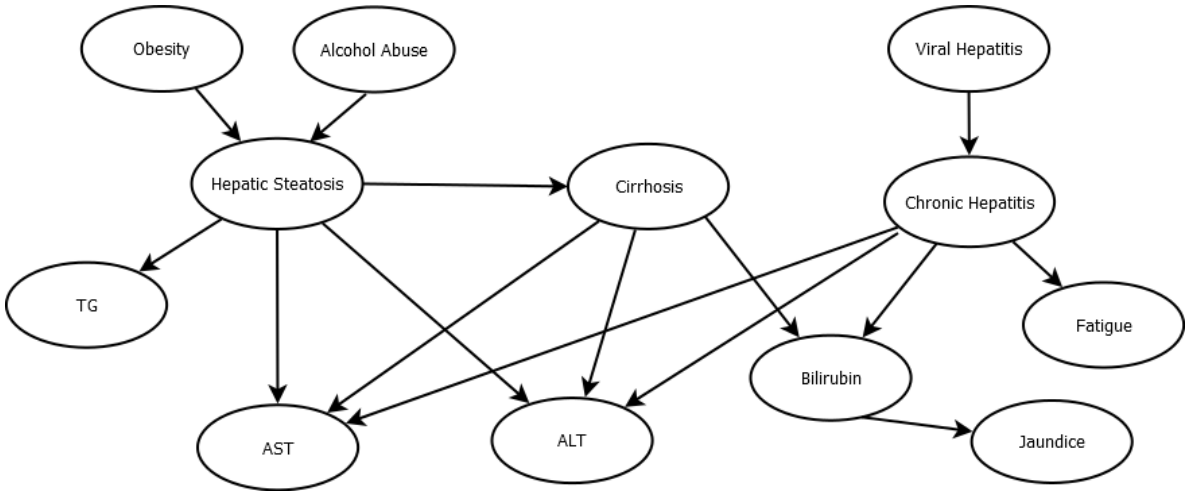
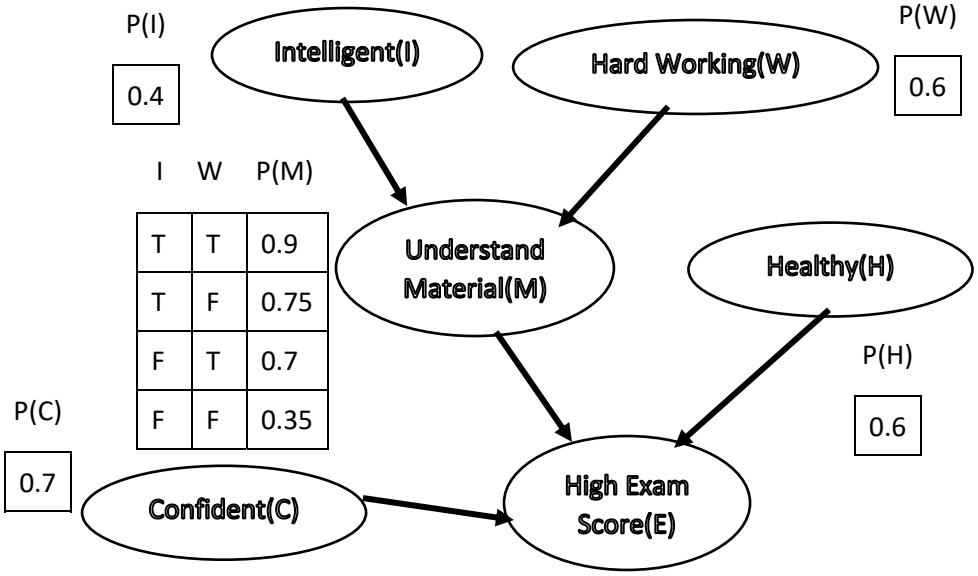
1) a) Consider the following Bayesian Network, where all the random variables are Boolean. How many probability entries are required for the bayes net? How many probability entries are required to represent the variables in a full joint probability distribution? Explain your calculations. **[2+1=3]**



b) Consider the following Bayesian Network, with all Boolean random variables. Determine the following probability information from this network. **[3 + 4=7]**

i. P(+i|-h, +e, -c, +w) using inference by enumeration.

ii. P(+m|-h, -e, +c) using variable elimination.



C	M	H	P(E)
T	T	T	0.9
T	T	F	0.8
T	F	T	0.75
T	F	F	0.8
F	T	T	0.7
F	T	F	0.6
F	F	T	0.45
F	F	F	0.2

2) A tourism company offers special discount card to its customers. Last year, they called many customers and a fraction of the customers accepted the offer. Here is the data that was collected by the Manager:

Serial No.	Job Type	Income Level	Likes to Hangout	Tours per year	Offer Taken
1	Engineer	High	Yes	2	Yes
2	Doctor	High	Yes	1	No
3	Engineer	Medium	No	3	Yes
4	Teacher	Medium	No	2	Yes
5	Doctor	High	Yes	3	Yes
6	Engineer	Medium	No	2	Yes
7	Teacher	High	Yes	1	No
8	Doctor	High	No	1	No
9	Teacher	High	No	2	Yes
10	Teacher	Medium	Yes	3	Yes
11	Engineer	High	No	1	No
12	Engineer	High	No	2	No

a) Your task is to learn a Decision tree based on this data to predict whether a particular customer will take the offer or not. Which should be the attribute in the root node of the decision tree? Just find the attribute at the root node. Show detailed calculation. **[6]**

b) For a new data instance with Job Type = Doctor, Income Level = High, Likes to Hangout = No, Tours per year = 2, Determine if the customer is likely to take the offer using Naive Bayes Classifier. **[6]**

3) There are two boxes containing coins. The first box contains 60 gold coins and 40 silver coins. The second box contains 25 gold coins and 75 silver coins. One of the two boxes is randomly chosen (both boxes have probability 0.5 of being chosen) and then a coin is picked up at random from the chosen box. If a silver coin is picked up, what is the probability that it comes from the first box? **[4]**

4) A survey has been done on UIU students to assess their interest in hostel accommodation. The data obtained is as follows:
200 of them were male students. Among the male students, 80 were juniors (first and second year) with 50% interested in hostel accommodation and the rest were seniors with 70% interested in hostels. Among the 100 females, 70 were juniors with 60% interested in hostels and the rest were seniors with 80% interested in hostels.
   a) Based on this data, construct a full joint distribution among the three random variables Gender(G), Category(C) and Interest in hostel accommodation(H) **[3]**
   b) Calculate the following probabilities from your table:
      i) Probability of a student being a junior **[1.5]**
      ii) Probability of a female student not being interested in hostels **[1.5]**

5) Consider the following story and your knowledge of it: **[5]**

- You missed today's class
- If you missed today's class, it had been because of rain, or there had been no class today, or both
- If there was no class today, UIU had been closed today
- If you missed today's class because of rain, you did not go on roaming today
- You were not home today
- If you were not home today, either you had gone to UIU today, or had gone to roaming today
- You did not go to UIU today

Form the knowledge base (KB) of the above story. Can you entail whether the "UIU had been closed today" from the knowledge base?

6) Convert the following English sentences into predicate logic using variables, quantifiers, objects and relations:
   a) A father of someone isn't a woman **[1]**
   b) A mother of someone is a woman **[1]**
   c) Mary is the mother of Chris **[1]**