United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam: Spring 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. An AI robot is trying to store five items in a storage that has six shelves side by side. One shelf can contain only one item. While storing the items, the robot must satisfy the following constraints:

   - Item 1 cannot be stored on the first shelf.
   - Item 2 must be stored on the third shelf.
   - Item 3 cannot be stored adjacent to Item 2.
   - Item 4 must be adjacent to Item 3.
   - Item 5 cannot be stored adjacent to Item 4.

   a. Formulate this problem as a CSP. **[3]**
   b. Draw the constraint graph. **[2]**
   c. Show the steps followed by backtracking search algorithm with minimum remaining values heuristic and derive a solution. **[3]**

2. a. Suppose meningitis causes a patient to have a stiff neck 50% of the time. Moreover, the probability that any person has meningitis is 1 in 10,000 and the probability that any person without meningitis has a stiff neck is 5%. If a person has a stiff neck, what is the probability that he has meningitis? **[3]**

   b. An online survey has been done among 300 gamers about their favorite games to understand which games are popular now. Among those gamers, *PUBG* was the favorite of 80 gamers and among those 50 were *male* and 30 were *female*. CoD was the favorite of 60 gamers among which 60% were *male*. 70 gamers' favorite was Minecraft, among which 10% were female. The rest of the gamers loved FIFA and among them 10 were *female*.

   i. Find the joint distribution table P(G, gN) for the two variables, G (Game) and gN (Gender). **[3]**
   ii. Find P(gN | G='FIFA') **[2]**
   iii. Find P(G='PUBG'|gN='male') **[1]**

3.

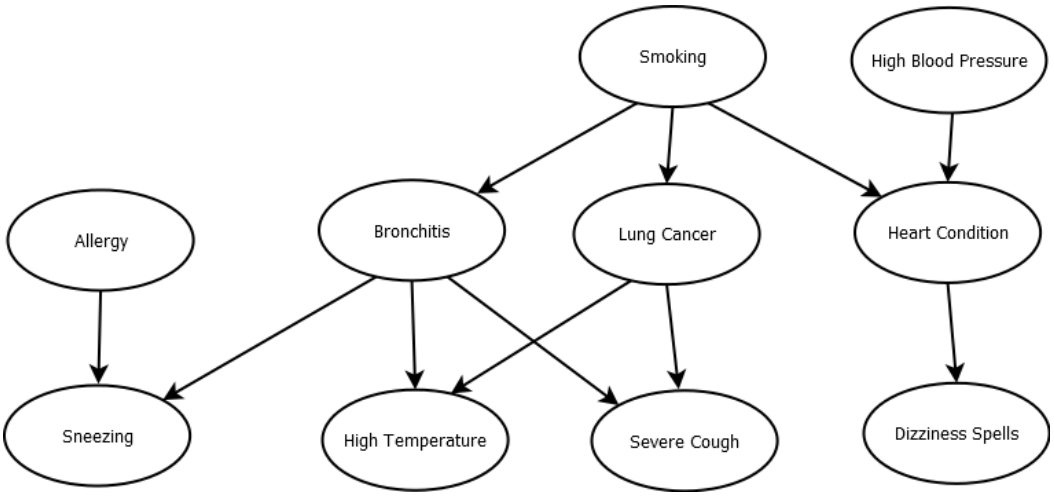

Figure 1: Bayesian Network for Ques: a and b

a. Consider the **Bayesian Network** at figure 1, 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. **[1.5+1.5=3]**

b. Consider the **Bayesian network** at figure 1. Determine whether the following probability expressions are true or false. Explain your reasoning very briefly. **[2]**

i. P(Lung Cancer|Sneezing , Smoking) = P(Lung Cancer|Smoking)
ii. P(High Temperature|Heart Condition, Allergy) = P(High Temperature|Allergy)

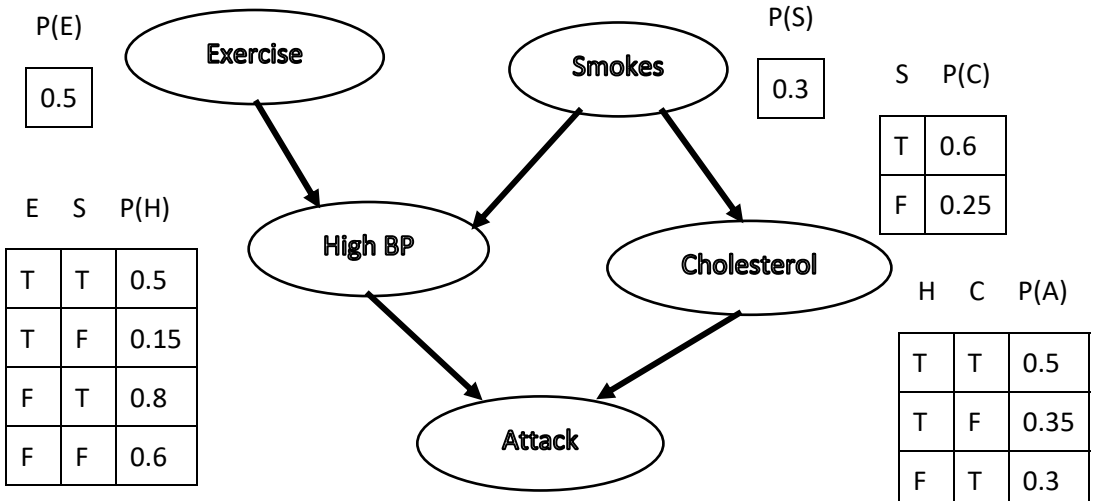

Figure 2: Bayesian Network for Ques: c

c. Consider the **Bayesian Network** at figure 2, with all Boolean random variables. Determine the following probability information from this network. **[1 + 4]**

i. P(+e, -s, +c, -h, -a)
ii. P(+s|-a, -e)

4. Suppose you are analyzing the relocation pattern of people in your country. You have calculated the probabilities of people relocating from one area to another. The following matrix represents these probabilities: **[3 + 4 = 7]**

Next Year → This Year ↓	Dhaka	Barishal	Khulna
Dhaka	0.8	0.1	0.1
Barishal	0.2	0.7	0.1
Khulna	0.3	0.2	0.5

a. Suppose in the year 2022, the distribution in Dhaka, Barishal & Khulna is 90%, 5%, and 5% respectively. Modeling the scenario as a Markov model, what will be the percentage of people to be living in *Dhaka*, *Barishal*, and *Khulna* in **2023** and **2026**?

b. Determine the probability of relocating to each city in the long run (**stationary distribution**).

5. Consider the following data collected from a medical center to detect whether a patient is covid infected or has seasonal flu symptoms. Use Naive bayes classifier to determine the probability that a new patient **has *flu* given that** he/she **has *low fever*, *no sore throat*, and *no body ache***? **[6]**

Fever Level	**Sore throat**	**Body ache**	**Diagnosis**
High	yes	no	Covid-19
Moderate	yes	yes	Covid-19
Low	yes	yes	Covid-19
Low	no	no	Covid-19
Moderate	yes	no	Covid-19
Low	no	yes	Flu
High	no	yes	Flu
High	yes	no	Flu
High	no	no	Flu
Moderate	no	yes	Flu