



# United International University (UIU)

## Dept. of Computer Science & Engineering (CSE)

Final Exam: Spring 2024

Course Code: CSE 3811, Course Title: Artificial Intelligence

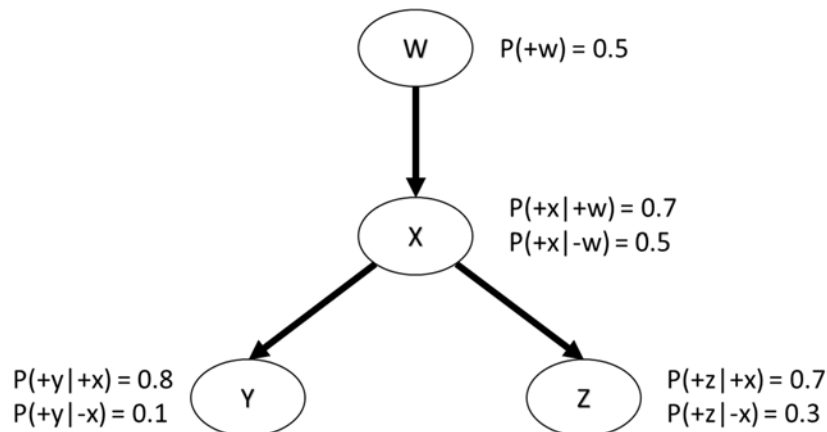
Total Marks: 40

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. ]

1. A particular birth defect of the heart is rare; a newborn infant will have the defect D with probability  $P[D] = 10^{-4}$ . In the general exam of a newborn, a particular heart arrhythmia A occurs with a probability of 0.99 in infants with the defect. However, arrhythmia also appears with a probability of 0.1 in infants without the defect. A lab test for the defect is performed when the arrhythmia is present. The lab test result is either positive (event T+) or negative (event T-). In a newborn with a defect, the lab test is positive with probability  $p = 0.999$  independent from test to test. The lab test is negative in a newborn without the defect with probability  $p = 0.999$ . If the arrhythmia is present and the test is positive, heart surgery (event H) is performed.
  - a. Write the formula for the Bayes' Rule. [1]
  - b. If an infant is picked at random, what is the probability that it does not have the defect? [2]
  - c. Given the arrhythmia A is present, what is the probability that the infant has the defect D? [3]
  - d. Given that the infant has defect D, what is the probability that heart surgery is performed? [4]
2. Answer the following questions for the following bayes net where every random variable is boolean: [1+1+2+5]
  - a. How many entries in total will be required to represent all variables in the network in a single joint distribution table?
  - b. How many entries in total will be required to represent the bayesian network with fully local conditional probability tables?
  - c. Calculate  $P(-y)$
  - d. Calculate  $P(+x \mid -y)$  separately using
    - i. Inference by Enumeration
    - ii. Variable Elimination



3. Suppose you are designing a classifier agent that will be able to recommend whether a patient should be prescribed Drug 1 or Drug 2 based on the patient's Age, Gender, BP and Cholesterol. The following data has been observed from history of previous patients:

Serial No.	Age	Gender	BP	Cholesterol	Drug
1	Young	Female	High	Normal	Drug 1
2	Young	Female	High	High	Drug 1
3	Middle-aged	Female	High	Normal	Drug 2
4	Senior	Female	Normal	Normal	Drug 2
5	Senior	Male	Low	Normal	Drug 2
6	Senior	Male	Low	High	Drug 1
7	Middle-aged	Male	Low	High	Drug 2
8	Young	Female	Normal	Normal	Drug 1
9	Young	Male	Low	Normal	Drug 2
10	Senior	Male	Normal	Normal	Drug 2
11	Young	Male	Normal	High	Drug 2
12	Middle-aged	Female	Normal	High	Drug 2
13	Middle-aged	Male	High	Normal	Drug 1
14	Senior	Female	Normal	High	Drug 1

- a) Your task is to learn a Decision tree based on this data to recommend whether a particular patient should be prescribed Drug 1 or Drug 2. Which should be the attribute in the root node of the decision tree? Just find the attribute at the **root node**. Show detailed calculation. [7]
- b) For a new data instance with **Age=Middle-aged, Gender=Female, BP=Low and Cholesterol=Normal**, Determine if the customer is likely to take the offer using Naive Bayes Classifier. Use **Laplacian smoothing with k=1**. [7]

4. A Tech company wants to predict their Customers' reviews based on their recent judgment. They have recently conducted a survey among **80** people for two(2) consecutive years that yielded following trends:  
Initially, **44** people were **Satisfied** with the service, **20** people's feedback was **Neutral** while the others were **Unsatisfied**.

The company reviewed their system policy which changed the scenario.

- Among the Unsatisfied people, 4 changed their review to Satisfied, 4 to Neutral while the others did not change their opinion.
- The Satisfied people showed great loyalty with 33 of them retaining their opinion. 8 people turned Neutral, 3 to Unsatisfied.
- Of the 20 Neutral people, 7 changed to Satisfied, 4 changed to Unsatisfied and others remained as before.

From the given survey,

- a) The company wants to document these trends in a table. Help them find out the **Transition Trend** in a tabular format. [3]
- b) Help the company to predict what percentage of their customers will be in the **Satisfied** category after 3 years? [2]
- c) The company wants to predict the long run probability of a customer being in the 3 categories mentioned above. Help them out. [2]