United International **University (UIU)**

Dept. of Computer Science & Engineering (CSE)

Final Exam: Summer 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.]

1. Consider the following 7 tiles. You need to fill each tile with one of the four colors: Red, Green, Blue, White in such a way that all the 7 tiles are distinguishable after assigning the colors (Hint: *Do not assign same color to adjacent tiles*).

1	3	4		
2		6	5	7

   However, some tiles have requirements that must be met:

      Tile 6 must be colored with Red

      Tile 2 must be colored with either White or Blue

      Tile 7 must be colored with either Red or Blue

   Now formulate this problem as a CSP. Draw the **constraint graph**. Show the steps followed by a backtracking search algorithm and derive a solution that **uses both Minimum remaining value and Least Constraining Value heuristics**.   **[3+2+3]**

2. a. There are three baskets containing red and blue balls. There are 5 red and 7 blue balls in the first basket. In the second basket there are 4 red and 6 blue balls. In the third basket there are 6 red and 3 blue balls. Suppose a basket is chosen randomly (each basket has equal probability of being chosen) and a ball is picked up from the chosen basket. If the ball picked up is blue in color, what is the probability it came from the third basket?   **[3]**
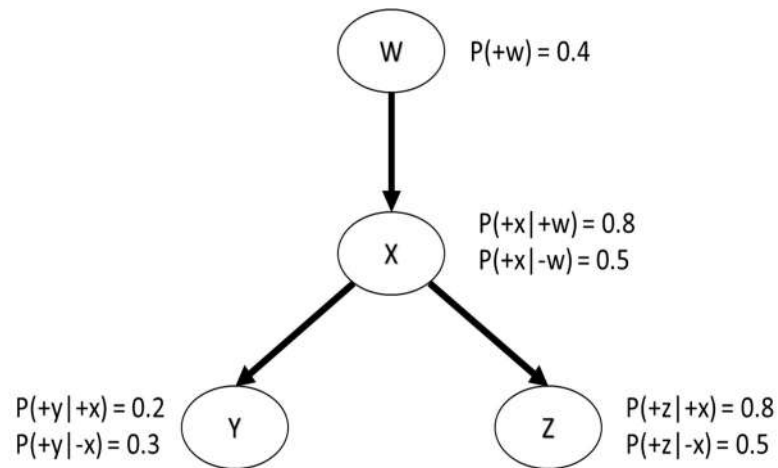
   b. Suppose you are doing a survey on 200 kids visiting an amusement park to decide on promotional offers. 30% of the kids are aged below 5, 35% are of age 5-10 and the rest are above 10 years of age. There are three types of promotional items available for kids to choose from. Half of the kids below 5 choose toys, 30% choose snacks and the rest choose 3D show tickets. Among the kids aged 5-10, 30% choose toys, 30% choose snacks and the rest choose tickets. Among the kids above 10, 20% choose toys, 30% choose snacks and the rest choose tickets. Now answer the following:

      i.   Construct a full joint probability distribution table with two random variables Age(A) and Items(I).   **[3]**

      ii. Find the conditional probability P(A|snacks).   **[3]**

3. Answer the following questions for the following bayes net where every random variable is boolean:

[**2+2+3+3**]

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 | -y)

W   P(+w) = 0.4

X   P(+x|+w) = 0.8
    P(+x|-w) = 0.5

P(+y|+x) = 0.2
P(+y|-x) = 0.3   Y

Z   P(+z|+x) = 0.8
    P(+z|-x) = 0.5

4. You are analyzing the trend of your company's stock market price. You have calculated the transition probability of how the price changes daily shown in the table below.

Price tomorrow → Price Today ↓	High	Medium	Low
High	0.5	0.3	0.2
Medium	0.1	0.8	0.1
Low	0.1	0.2	0.7

a. Given today (Day 1) the stock price of your company is high
   i.   What is the probability of the price being low in Day 3?   [2.5]
   ii. What is the probability of the price being low in Day 4?   [1.5]

b. Determine the probability of the price being High, Medium and Low in the long run (stationary distribution).   [3]

5. Consider the following dataset which contains four features and a label of some sample emails. The features are *Caps Lock, Grammatical Error, Length, From contact* and the label is *Is_Spam,* which represents weather the email is spam or not.

Caps Lock	Grammatical Error	Length	From contact	Is_Spam
Off	Many	Short	No	Yes
Off	Few	Short	No	Yes
On	Many	Medium	No	Yes
Off	Few	Medium	No	No
On	Many	Long	No	Yes
On	None	Long	No	Yes
Off	Few	Short	Yes	No
Off	Many	Short	No	No
Off	Few	Medium	Yes	No
Off	None	Medium	No	No
Off	None	Long	Yes	No
On	Few	Long	No	No

Use Naive Bayes classifier with Laplacian smoothing (**K = 2**) to determine the probability of an email with the features <**On, Few, Medium, No**> being a spam. Show details calculation. **[6]**