



# United International University (UIU)

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

Final Exam

Summer 2019

Course Code: CSI 341 Course Title: Artificial Intelligence

Total Marks: 40

Duration: 2 hours

There are **7** questions. **Answer all questions.** Marks are indicated in the right side of each question.

1. a. Imagine the following scenario: You are trying to divide eight students in three groups for a project show. The three groups are for Machine learning, Software engineering and Networking. The assignment of groups to students is subject to the following constraints:

Student 1, 2 and 3 must be in different groups as they will be group leaders.

Student 4 and 7 want the same group as they are close friends.

Student 5 will not be in Software engineering group.

Student 3 and 6 don't like each other and won't be in the same group.

Formulate this problem as a CSP. Draw the constraint graph. Provide a solution using backtracking algorithm. [4+1+3=8]

- b. What should be a suitable objective function to use with local search for solving a map-coloring problem? Will it be a maximization or a minimization problem then? [2]

2. A survey has been done in a furniture shop that sells both furniture and electronics items to assess the probability of customers being interested in each type of product. The data obtained is as follows:

200 customers participated in the survey, 60% of them male. Among the male customers 40 are young, 30 are middle-aged and the rest are old. Among the young males, 20% are interested in buying furniture and the rest in electronics. The middle-aged male group is divided equally in both sections. For the old males, 30 are interested in furniture and the rest in electronics. The women group has 20 young, 30 middle-aged and 30 old customers. Among the young women, half are interested in buying electronics and the rest in furniture. In both the middle-aged and the old women's group one-third are interested in buying electronics and the rest in furniture.

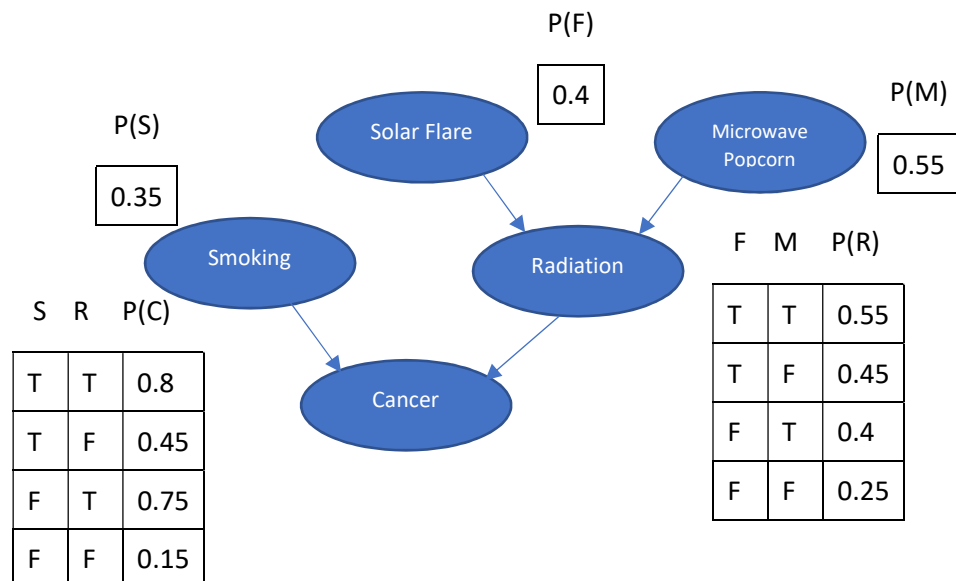
- a. Based on this data, construct a full joint distribution among the three random variables Gender(G), Age(A) and Type of Product(T). [3]

- b. Calculate the following probabilities from your table:

i. Probability of a customer being interested in Electronics. [1]

ii. Probability of an old customer not being interested in Furniture. [2]

3. A diagnostic test has a probability 0.95 of giving a positive result when applied to a person suffering from a certain disease, and a probability 0.15 of giving a (false) positive when applied to a non-sufferer. It is estimated that 1% of the population are sufferers. Suppose that the test is now administered to a person about whom we have no relevant information relating to the disease (apart from the fact that he/she comes from this population). Calculate the following probabilities:[3]
- that the test result will be positive.
  - that, given a positive result, the person is a sufferer.
  - that the person will be misclassified.
4. Suppose you are given the following scenario describing the functions of a car:
- If the battery is on, the radio will work properly, the lights will turn on and the ignition will work. If the ignition works and there is gas, the engine will start. If the engine starts the car will move.
- Design a Bayesian network (without the probability tables) with suitable boolean random variables depicting the above scenario. [2]
  - How many probability entries are required to represent all probabilities in the network you designed?[1]
  - How many entries will be required if you used full joint probability distribution instead?[1]
5. Consider the following Bayesian network:



Now answer the following questions:

- a. What is the probability of radiation?[2]
- b. What is the probability of cancer if you smoke but never use a microwave?[4]

6. Suppose the following data is collected from an eye hospital on what kind of contact lenses are suitable for a patient:

Age	vision	astigmatism	Tear production	Lens type
Young	Near	No	Reduced	None
Young	Near	No	Normal	Soft
Young	Near	Yes	Reduced	None
Young	Far	No	Normal	Soft
Young	Far	Yes	Normal	Hard
Middle-aged	Near	No	Reduced	None
Middle-aged	Near	No	Normal	Soft
Middle-aged	Near	Yes	Normal	Hard
Middle-aged	Far	Yes	Reduced	None
Middle-aged	Far	No	Normal	Soft
Old	Near	Yes	Normal	Hard
Old	Near	No	Reduced	None
Old	Far	No	Reduced	None
Old	Far	No	Normal	Soft
Old	Far	Yes	Reduced	None

Given that a patient is old, has far sightedness, has astigmatism and tear production is normal, what lens type should be suggested? Determine using Naïve Bayes classifier with Laplacian smoothing constant  $k=1$ . [5]

7. Suppose you are the owner of a book store with three sections: Books, Toys and Stationaries. You are trying to decide how many sales associates to place in every section. For this, you have calculated the probabilities of a customer moving from one section to another one every minute. The transition probabilities are given below:

Next minute → This minute ↓	B	T	S
B	0.5	0.2	0.3
T	0.3	0.6	0.1
S	0.5	0.1	0.4

Suppose a customer is in the books section right now.

- a. Determine the probability that he will move to Toys section two minutes later.[2]
- b. Determine the probability of visiting each section in the long run (stationary distribution).[4]