Middle East Technical University | Department of Computer Engineering

CENG 462

Artificial Intelligence

Spring 2023-2024

Assignment 5

Regulations

1. The homework is due by **23:55 on May 29th, 2024**. Late submission is not allowed.
2. Submissions are to be made via ODTUClass, do not send your homework via e-mail.
3. You can use any typesetting tool (LaTex, Word, etc.) or handwriting while typing/writing your answers. However, your answer must be clearly writen and easily readable.
4. Upload your answers as a single **pdf** file named *yourStudentId_HW4.pdf*. **Submissions that violate the naming convention will incur a grade reduction of 10 points.**
5. Send an e-mail to **garipler@metu.edu.tr** if you need to get in contact.
6. **This is an individual homework, which means you have to answer the questions on your own. Any contrary case including but not limited to getting help from automated tools, sharing your answers with each other, extensive collaboration etc. will be considered as cheating and university regulations about cheating will be applied.**

Question 1 (30 pts)

a. Draw the Bayesian Network representing the causal relations below (you do not need to -and cannot- give the associated probability tables):

- Social Injustice causes Poverty.
- Poverty causes high Crime Rate.
- Warm Climate causes high Crime Rate.
- Warm Climate causes high Ice Cream Consumption.
- High Crime Rate causes a high sales volume of Home Security Systems.

Hint: Your nodes are SI (encodes Social Injustice), P (Poverty), WC (Warm Climate), CR (high Crime Rate), ICC (high Ice Cream Consumption), HSS (high sales volume of Home Security Systems).

b. According to the Bayesian Network you have drawn at part-a of this question, is there a causal dependence between high Ice Cream Consumption and high sales volume of Home Security Systems? Is there a statistical dependence (i.e. correlation) between those two? Explain briefly (with *a few* sentences).

Question 2 (70 pts)

The Bayesian Network given at the Figure 1 below represents a (very simplified) medical diagnosis system with a set of 4 possible symptoms (Shortness of Breath, Chest Pain, Cough, Fever), and two diseases of interest (Lung Disease, Cold). It also indicates the probabilistic relation between smoking and lung disease. Answer the following questions (from a to f) according to that Bayesian Network and the attached conditional probability tables. Show your calculations for each of the questions (otherwise you will not be able to get any points).

a. What is the probability of having both chest pain and shortness of breath for a person who smokes?

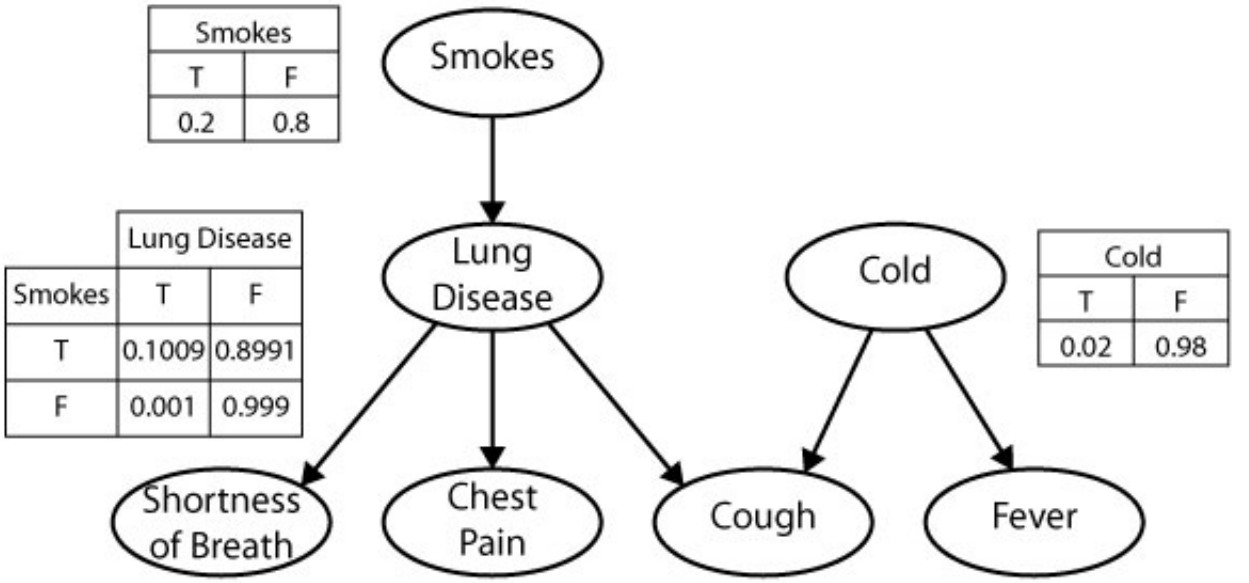
b. What is the probability of having lung disease for a person having cough?

c. For a person who has fever and lung disease, what is the probability of having cough?

d. What is the probability of having lung disease for a person who smokes and has chest pain?

e. For a person who has cough and who does not have cold, what is the probability of having lung disease?

f. Given a person has both shortness of breath and cough, what is the probability that this person smokes?



Smokes	
T	F
0.2	0.8

	Lung Disease	
Smokes	T	F
T	0.1009	0.8991
F	0.001	0.999

Cold	
T	F
0.02	0.98

	Shortness of Breath	
Lung Disease	T	F
T	0.208	0.792
F	0.01	0.99

	Chest Pain	
Lung Disease	T	F
T	0.208	0.792
F	0.01	0.99

		Cough	
Lung Disease	Cold	T	F
T	T	0.7525	0.2475
T	F	0.505	0.495
F	T	0.505	0.495
F	F	0.01	0.99

	Fever	
Cold	T	F
T	0.307	0.693
F	0.01	0.99

Figure1. Medical Diagnosis Bayesian Network