

---

# Probabilistic Graphical Models

## Problem Set 1

---

Hesam Montazeri  
Samaneh Maleknia  
Naser Elmi  
Bahman 16, 1397  
(Feb 5, 2019)

### Problem 1: Reading Summary

Write a half-page summary of lecture 1 (max: 1 page). Accompany your report by an audio file (max: 10 minutes) in which you explain in your words important topics of the lecture, particularly:

- Definition of PGMs
- Representation, inference, learning
- Random variables, joint and marginal distributions, conditional probabilities
- Bayes' rule, chain rule
- Conditional independence and its importance
- Querying a distribution
- Give a simple example of a Bayesian network and write down its joint distribution.

### Problem 2: Breast cancer

Approximately 1% of women have breast cancer. A woman with breast cancer has a 85% chance of a positive test from a mammogram. For women without cancer, there is a 10% chance of false positive result .

1. What is the probability a woman has breast cancer given that she just had a positive test?
2. What is the probability a woman has breast cancer given that she just had a negative test?

Now suppose the results of breast MRI are also available. Assume results of breast MRI and mammography are independent given presence or absence of cancer is known. The chance of positive result from the breast MRI for a woman with cancer is 97% while there is a 30% chance of false positive result for a woman without cancer.

3. Write down the probabilities that a woman has breast cancer for all four different results of mammogram and breast MRI (negative-negative, negative-positive, positive-negative, positive-positive).
4. Can you draw a Bayesian network for this problem?

(Numbers given in this exercise are chosen for educational purposes and do not reflect actual sensitivities and specificities of these tests.)

Submit your solutions to [naser.elmi@ut.ac.ir](mailto:naser.elmi@ut.ac.ir) by Bahman 28, 1397.