University of TEHRAN

Probabilistic Graphical Models

Problem Set 9

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

- Score decomposition; greedy hill climbing
- Bayesian model averaging
- Likelihood function for incomplete data; discuss decomposability of likelihood function for incomplete data.
- Read A.5.1 and A.5.2.2 and briefly summarize the main points. Solve the question in slide 17.
- Explain gradient ascent for Bayesian networks with an example (explain the steps).

* Write down all formulas in your written summary and explain in detail each step of the derivation. In your audio file, only mention the main points of the derivations.

Problem 2: Structural Expectation Maximization
The Structural EM is a popular algorithm for structure learning in the presence of incomplete data. In this exercise, you need to apply the structural EM on five incomplete datasets obtained from the dataset Asia (problem 2, HW8). For each incomplete dataset, you need to randomly set $\alpha\%$ of the data points to NA. Drop observations if all features are missing (NA). Generate the datasets for $\alpha = 0.01, 0.1, 0.3, 0.6, 0.8$. Report BIC scores of the learned networks on the original fully observed data as well as the BIC score of the network obtained from the greedy hill climbing algorithm. Set a random seed in the beginning of your code so your results are reproducible.

Submit your solutions to naser.elmi@ut.ac.ir and fahimehpalizban@ut.ac.ir by Ordibehesht 16, 1398.