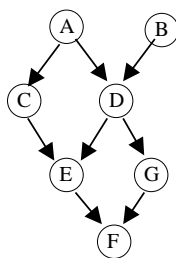


Advanced AI Techniques (WS06/07)

Exercise sheet 2

Deadline: 14:00 o'clock (ct), Tuesday, November 14, 2006

Exercise 1 (4 points) Consider the the structure of the Bayesian network below:

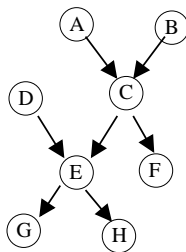


Suppose we have the query $P(G)$ and the following elimination ordering: first A , then B, C, D, E, F . Show what the variable elimination algorithm will do on this graph by listing for each variable eliminated, the new factor generated and the factors used to generate the new factor. The factors should be written in the form

$$f_{X_j}(X_1, \dots, X_k)$$

for eliminated variables X_j and some set of variables X_1, \dots, X_k .

Exercise 2 (4 points) Consider the the structure of the Bayesian network below:



In order to apply the junction tree algorithm on this network, we first have to construct its moral graph and then its join tree. Show both of them and the corresponding steps in order to construct them.

Exercise 3 (4 points) Assume a fully observed training data set. Derive for this case the maximum-likelihood estimate (MLE) for a multinomial distribution, i.e., for a random variable with $0 < n < \infty$ many states. Hint, maximize the log-likelihood function using a Lagrange coefficient to enforce the constraint

$$\sum_{i=0}^n \theta_i = 1 .$$