Technische Universität München
Department of Computer Science
Prof. Michael Beetz, Ph.D.
Daniel Nyga, M.Sc.

WS 2011/2012
Worksheet 9
24.01.2012

Exercises for the Lecture Techniques in Artificial Intelligence

Inference in Bayesian Networks (2)

1) Let's consider the complexity of exact inference in Bayes Nets.

   (a) Show that exact inference in Bayesian Networks is NP-hard by reducing the 3SAT problem in propositional logic (which is known to be NP-complete) to inference in Bayesian Networks.

   (b) Show that exact inference is even #P-hard by reducing the problem of counting models of 3SAT formulas (which is known to be #P-complete) to the inference problem in Bayes Nets.

2) In the lecture you considered the Likelihood-Weighting inference algorithm which computes the inferences in the following form: Form $P(X_i = x_i \mid E = e)$ for $X_i \in X, E \subset X$. Assume you have a set of implementations of such inference algorithms for Bayesian Networks that provide the following common interface: infer(q, e), where q represents a pair (X_i, x_i) for $X_i \in X, x_i \in dom(X_i)$ and e is a set of such pairs. However we would like to support the general inferences in the following form: $P(Q = q \mid E = e)$ for $Q \subset X, E \subset X$.

   (a) Provide this form of the inferences by implementing a (not necessarily efficient) wrapper for all implementations. Formulate the wrapper in pseudocode.

   (b) How could we support such inferences for Likelihood Weighting more efficiently?