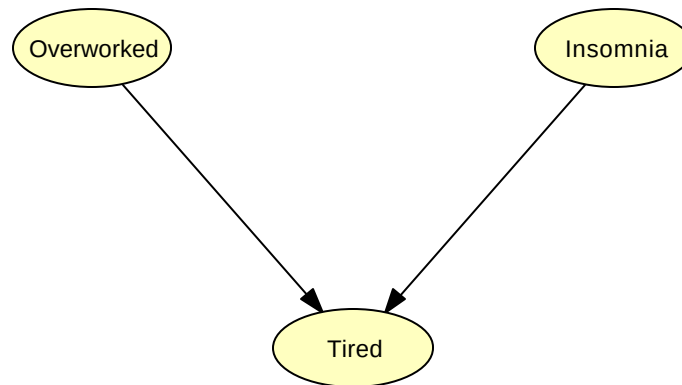


Assignment 4: Local Propagation

- 1 Consider a Bayesian Network for student behavioral problems shown below:



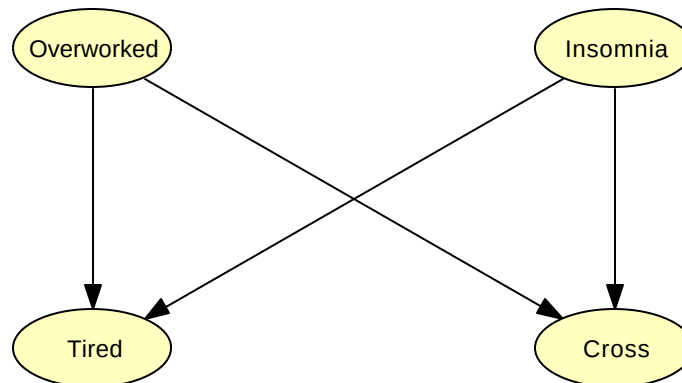
Each variable has just two values in its frame and the probabilities are as follows:

$$P(o) = 0.2; P(i) = 0.01;$$

$$P(t|o, i) = 0.98; P(t|o, \neg i) = 0.8; P(t|\neg o, i) = 0.9; P(t|\neg o, \neg i) = 0.05$$

Using Pearl's scheme, compute the posterior probability of a student being *Overworked*, given that the student is observed to be both *Tired* and an *Insomniac*.

- 2 Consider an extended Bayesian Network for student behavioral problems shown below:



Each variable has just two values in its frame and the probabilities are as follows:

$$P(o) = 0.2; P(i) = 0.01;$$

$$P(t|o, i) = 0.98; P(t|o, \neg i) = 0.8; P(t|\neg o, i) = 0.9; P(t|\neg o, \neg i) = 0.05;$$

$$P(c|o, i) = 0.96; P(c|o, \neg i) = 0.9; P(c|\neg o, i) = 0.6; P(c|\neg o, \neg i) = 0.01$$

- (a) What is the moral graph for this network?
 - (b) Is the moral graph triangulated? If not, show an optimal triangulated moral graph.
 - (c) Arrange the cliques of the triangulated moral graph in a sequence having the running intersection property (using the L & S maximum cardinality procedure) and then arrange the cliques in a join tree.
 - (d) Compute the posterior marginals for *Overworked* and *Insomnia* after absorbing observations that a given student is *Tired* and *Cross* using Lauritzen & Spiegelhalter's procedure.
- 3
- (a) Show a junction tree representation of the extended problem in Question 2.
 - (b) Compute the posterior marginals for *Overworked* and *Insomnia* after absorbing observations that a given student is *Tired* and *Cross* using the Aalborg procedure.
 - (c) Re-perform this computation using HUGIN.
 - (d) Add to the HUGIN model the observation that the student suffers from *Insomnia*, and discuss what happens to the posterior probability of the student being *Overworked* as a result.
- 4
- (a) Arrange the subsets for which we have potentials, together with the singleton subsets, in a join tree using one-step look-ahead as in the Shenoy-Shafer architecture.
 - (b) Compute the posterior marginals for *Overworked* after absorbing observations that a given student is *Tired*, *Cross*, and suffers from *Insomnia* using the Shenoy-Shafer algorithm.
 - (c) Arrange the subsets described above into a Binary Join tree.

In all the above questions, show all messages being passed.