Probabilistic Modelling and Reasoning, Assignment 1

School of Informatics, University of Edinburgh

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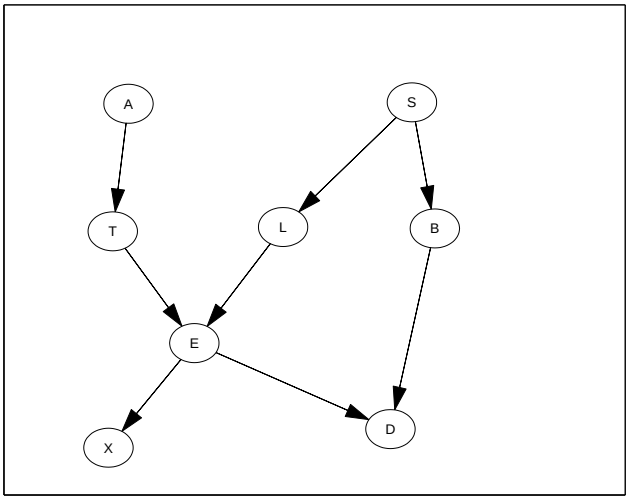
Submission Deadline : 9am Monday November 17, 2003

Please remember that plagiarism is a university offence. Do not show your work to anyone else. This assignment will contribute maximally 12.5% of your final mark in PMR.

- [25 marks] Consider the Asia Bayesian Network represented below. Calculate by hand the values for $p(D)$ and $p(D|S = yes)$, $p(D|S = no)$.



A = Visit to Asia?, S = Smoking?, T = Tuberculosis?, L = Lung Cancer?, B = Bronchitis?, E = Either T or L?, P = Positive X Ray?, D = Dyspnoea?

p(a = yes) = 0.01
p(s = yes) = 0.5
p(t = yes | a = yes) = 0.05
p(t = yes | a = no) = 0.01
p(l = yes | s = yes) = 0.1
p(l = yes | s = no) = 0.01
p(b = yes | s = yes) = 0.6
p(b = yes | s = no) = 0.3

p(e = yes | t,l) = 0 only if both T and L are"no", 1 otherwise.
p(x = yes | e = yes) = 0.98
p(x = yes | e = no) = 0.05
p(d = yes | e = yes, b = yes) = 0.9
p(d = yes | e = yes, b = no) = 0.3
p(d = yes | e = no, b = yes) = 0.2
p(d = yes | e = no, b = no) = 0.1

- [25 marks] (a) Write down a Junction Tree for the above graph. (b) Define the potentials on the cliques and separator sets. (c) Explain how the message passing scheme is implemented on this network to update the potentials so that the final graph is consistent, and the clique potentials contain the marginal potentials.

- [50 marks] Your task here is to implement in MATLAB the Junction Tree procedure that you defined for this graph. (You should not write a general Junction Tree algorithm. Just write a Junction Tree routine that works for this Asia network). To help you, I've written some routines. These routines consist of

  `merge_t.m` (merges probability tables together)
  `evidence.m` (sets tables to their evidential values)
  `absorb.m` (carries out the absorption scheme)
  `marg_table.m` (marginalises a table over a set of variables)

  An example of how these routines can be used is given in `jt_burglar.m`, which implements the Junction Tree algorithm for the earthquake/burglar problem that we encountered in the lectures.

  To download a zipped file containing all these routines (and some routines required by these facilities), point your web browser at

  `http://anc.ed.ac.uk/~dbarber/pmr/assignments.html` and download `ass1.zip`.

  Examine carefully `jt_burglar.m` as this contains all the information you need to implement your algorithm, using only the above routines.

  Calculate with your algorithm the probabilities $p(D)$ and $p(D|S = yes)$, $p(D|S = no)$, and check that they are equivalent to those calculated by hand.

To submit your project, place all files that are used to explain any part of the assignment and also all files required to run your Junction Tree routine (including those that I have given you) in a directory `subdir`. Then use the submit command from a DICE machine :
`submit msc pmr 1 subdir`
If you are an undergraduate, replace `msc` above with `ai4`.

If you have any non-electronic answers which you wish to submit (these are acceptable for the first two parts of the assignment) these must be handed in to the ITO office in Appleton Tower before the deadline.