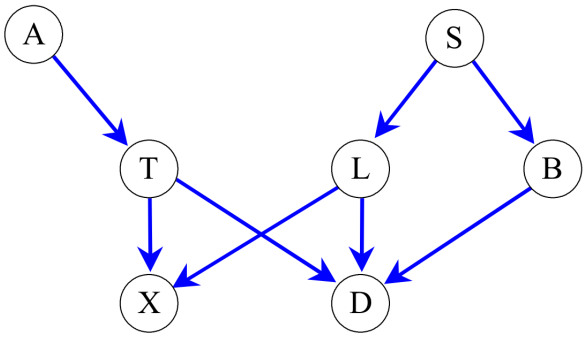
Tutorial 3: Probability propagation

1. In tutorial no 3 we obtained the following Bayesian Network to model dyspnea.



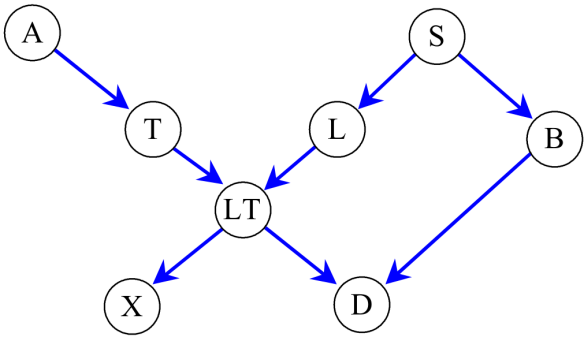
   (a) The network is intialised with prior probabilities allocated to A and S based on data about the local population. What λ and π messages will be sent during this initialisation?

   (b) A patient arrives, and the only fact that is known about him is that he is a smoker. Thus the node S only is instantiated. What λ and π messages will be sent following the instantiation of S?

   (c) The patient is given an XRay and it is found to be positive. What λ and π messages will be sent following the instantiation of X?

   (d) The patient is now examined further and found to suffer from dyspnea. What would happen if we try to propagate the evidence under these circumstances?

2. As mentioned in the solution to tutorial 3, Neopolitan has a neat solution to the same causal network which is to introduce a new node standing for Lung Cancer or Tuberculosis.



   What would you expect the link matrix joining T and L with LT to be?

   (NB all three nodes are binary valued with l_1 meaning Lung cancer present, and l_2 Lung Cancer not present, etc.)

3. Given the net of question 2, and assuming that the node LT contains the following information:
   $\lambda_X(LT) = (0.3, 0.7)$
   $\lambda_D(LT) = (1, 1)$
   $\pi_{LT}(T) = (0.4, 0.6)$
   $\pi_{LT}(L) = (0.5, 0.5)$
   What is the posterior probability distribution of LT?

   The node T is suddenly instantiated to state t_2 (tuberculosis is not present) what messages are sent from LT. (assuming that the conditional probability matrix is as given in question 2).

4. In the network of question 2 there is just one loop. What instantiations ensure that the propagation of probabilities will terminate?