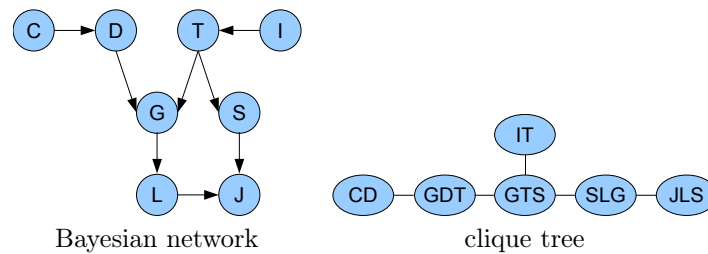


## Problem Set 5

### Due Sunday February 9, 2020 at 11:55pm

Implement clique tree calibration using belief propagation (as per algorithm 10.3 in the textbook). The supplied code has a class for a cluster graph and an associated cluster distribution. You should implement the `treecalibrate` method of the `clusterdist` class (feel free to add any additional helper methods you wish). While a `clusterdist` and `clustergraph` may be for a general graph (not just a tree), for this problem set, and for `treecalibrate` you may assume they are a tree. Or, more accurately, a forest: there is at most one path between any two clusters.

The supplied `testct.py` calculates the marginals over each variable in the Bayesian network given below, using the clique tree shown. This network is the same as the running example in the book, except that I (intelligence) has been replaced with T (test-taking ability) and I is now a parent of T, and H (happiness) has been removed.



CPTs:

$c^0$	$c^1$		$d^0$	$d^1$		$t^0$	$t^1$	$t^0, d^0$	$g^1$	$g^2$	$g^3$
0.5	0.5	$c^0$	0.4	0.6	$i^0$	0.9	0.1	$t^0, d^1$	0.3	0.4	0.3
		$c^1$	0.8	0.2	$i^1$	0.4	0.6	$t^1, d^0$	0.05	0.25	0.7
								$t^1, d^1$	0.9	0.08	0.02
									0.5	0.3	0.2

$i^0$	$i^1$		$s^0$	$s^1$		$l^0$	$l^1$	$l^0, s^0$	$j^0$	$j^1$
0.6	0.4	$t^0$	0.95	0.05	$g^1$	0.1	0.9	$l^0, s^1$	0.9	0.1
		$t^1$	0.2	0.8	$g^2$	0.4	0.6	$l^1, s^0$	0.4	0.6
					$g^3$	0.99	0.01	$l^1, s^1$	0.3	0.7
									0.1	0.9

This algorithm is pretty straight-forward as the clique tree and mapping from factors to the clique tree are already given. **However, make sure your algorithm works in general** (and not just for this example as it will be tested on other more complex examples in grading!).

Your algorithm should take linear time in the number of clusters/cliques and exponential time in the number of variables in the largest cluster/clique. You may (and should) take advantage of the fact that this is a tree and pick any node you wish as a “root” to organize your calculations.

Submit only your `clusterdist.py` file.