

# GMDL, HW3

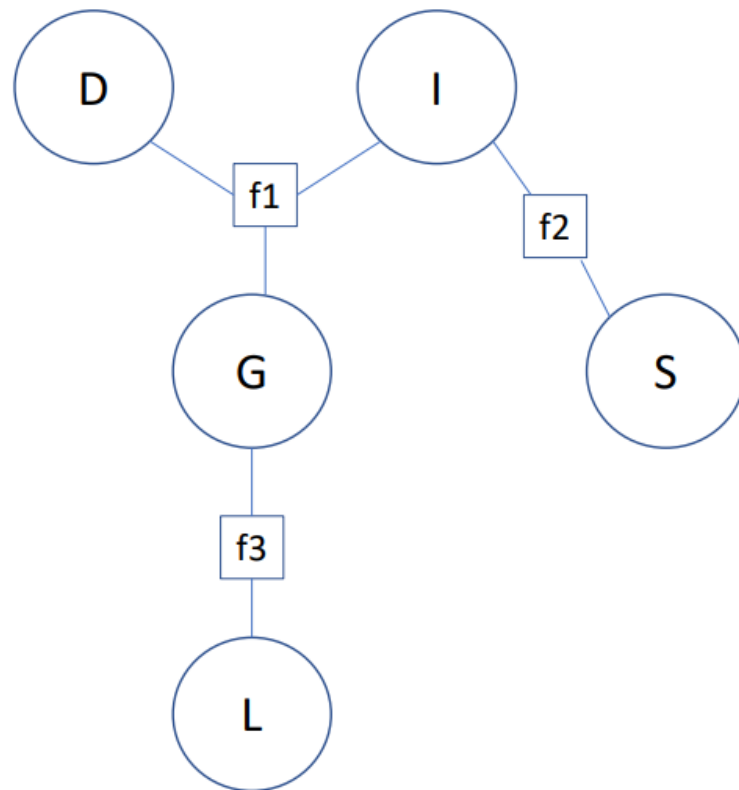
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## Computer Exercise 1

The following graph is the undirected factor graph, corresponding to the Student example given in the assignment:



The nodes  $D, I, G, S, L$  stand for Difficulty, Intelligence, Grade, SAT and Letter accordingly. In addition,  $f_1, f_2$  and  $f_3$  are the factors added in the appropriate locations.

Our Python code includes the Belief Propagation algorithm for this example.

We performed the calculations in the following order, which ensures that each calculation is being performed exactly once:

1. Initiate messages from leaf variables to 1:

- $\mu_{S \rightarrow f_2} = 1$
- $\mu_{L \rightarrow f_3} = 1$
- $\mu_{D \rightarrow f_1} = 1$

2. Calculate  $\mu_{f_2 \rightarrow I}(i)$

3. Calculate  $\mu_{f_3 \rightarrow G}(g)$

4. Calculate  $\mu_{G \rightarrow f_1}(g)$

5. Calculate  $\mu_{f_1 \rightarrow I}(i)$

**6. Calculate  $p(I)$**

7. Calculate  $\mu_{I \rightarrow f_1}(i)$

8. Calculate  $\mu_{f_1 \rightarrow D}(d)$

**9. Calculate  $p(D)$**

10. Calculate  $\mu_{I \rightarrow f_2}(i)$

11. Calculate  $\mu_{f_2 \rightarrow S}(s)$

**12. Calculate  $p(S)$**

13. Calculate  $\mu_{f_1 \rightarrow G}(g)$

**14. Calculate  $p(G)$**

15. Calculate  $\mu_{G \rightarrow f_3}(g)$

16. Calculate  $\mu_{f_3 \rightarrow L}(l)$

**17. Calculate  $p(L)$**

Our results are:

$I$	$p(I)$
0	0.7
1	0.3

$D$	$p(D)$
0	0.6
1	0.4

$S$	$p(S)$
0	0.7249999999999999
1	0.27499999999999997

$G$	$p(G)$
1	0.36200000000000004
2	0.2884
3	0.3496

$L$	$p(L)$
0	0.497664
1	0.5023360000000001