

Appendices

A Survey propagation subroutines

Here, we provide details regarding the subroutines regarding the message passing updates SP-Update [Line 6] and the marginalization procedure Marginalize [Line 9] used in Algorithms 1 and 2.

Algorithm 3 SP-Update($V, C, \{\eta_{a \rightarrow i}\}$)

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1: for all  $a \in C, i \in V(a)$  do
2:   for all  $j \in V(a) \setminus i$  do
3:      $\eta_{j \rightarrow a}^u \leftarrow \left[ 1 - \prod_{b \in C_a^u(j)} (1 - \eta_{a \rightarrow j}) \right] \prod_{b \in C_a^s(j)} (1 - \eta_{a \rightarrow j})$ 
4:      $\eta_{j \rightarrow a}^s \leftarrow \left[ 1 - \prod_{b \in C_a^s(j)} (1 - \eta_{a \rightarrow j}) \right] \prod_{b \in C_a^u(j)} (1 - \eta_{a \rightarrow j})$ 
5:      $\eta_j^0 \leftarrow \prod_{b \in C(j) \setminus a} (1 - \eta_{a \rightarrow j})$ 
6:   end for
7:    $\triangleright$  Compute new message
8:    $\eta'_{a \rightarrow i} \leftarrow \prod_{j \in V(a) \setminus i} \frac{\eta_{j \rightarrow a}^u}{\eta_{j \rightarrow a}^u + \eta_{j \rightarrow a}^s + \eta_j^0}$ 
9: end for
10: return  $\{\eta'_{a \rightarrow i}\}$ 

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A.1 SP-Update

If we let $C_a^s(i)$ to be the set of clauses where i appears with the same sign as in clause a and $C_a^u(i)$ to be the remaining clauses, then the subroutine in Algorithm 3 provides the message passing equations required to update $\eta_{a \rightarrow i}$.

A.2 Marginalize

We can estimate the approximate marginals $\mu_i(0), \mu_i(1), \mu_i(*)$ for each variable i by normalizing the following quantities so that they sum to one:

$$\mu_i(1) \propto \left[1 - \prod_{a \in C_-(i)} (1 - \eta_{a \rightarrow i}^*) \right] \prod_{a \in C_+(i)} (1 - \eta_{a \rightarrow i}^*) \quad (1)$$

$$\mu_i(0) \propto \left[1 - \prod_{a \in C_+(i)} (1 - \eta_{a \rightarrow i}^*) \right] \prod_{a \in C_-(i)} (1 - \eta_{a \rightarrow i}^*) \quad (2)$$

$$\mu_i(*) \propto \prod_{a \in C(i)} (1 - \eta_{a \rightarrow i}^*) \quad (3)$$

where $C(i)$ denotes the set of clauses that i appears in and $C_-(i)$ and $C_+(i)$ are the clause subsets where i appears negated and unnegated respectively.