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

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 $\eta_{a\to i}$.

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:

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

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

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

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.