0.1. Deep RBM

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0.2. Semi RBM

0.2.1. Exploiting the SRBM structure

Clamped free energy can be written in the form:

$$\begin{aligned}\mathcal{F}^c(\mathbf{v}) =& \sum_{\mathbf{h}} e^{-E(\mathbf{v},\mathbf{h})} = e^{\mathbf{b}'\mathbf{v}} \sum_{h_1} ... \sum_{h_m} e^{-E(\mathbf{v},\mathbf{h})} \\ =& e^{\mathbf{b}'\mathbf{v}} \sum_{h_1} e^{h_1(c_1+W_{1\bullet}\mathbf{v})} ... \sum_{h_m} e^{h_m(c_m+W_{m\bullet}\mathbf{v})} \\ =& e^{\mathbf{b}'\mathbf{v}} \prod_{j=1}^{m} \left(1+e^{c_i+W_{i\bullet}\mathbf{v}}\right)\end{aligned} \tag{1}$$

0.3. Boltzmann Machine

$$E(\mathbf{v},\mathbf{h}) = -\sum_i a_i v_i - \sum_j b_j h_j - \sum_{i,j} v_i w_{ij} h_j = -\frac{1}{2}\mathbf{v}^T\mathbf{V}\mathbf{v} - \frac{1}{2}\mathbf{h}^T\mathbf{J}\mathbf{h} - \mathbf{h}^T\mathbf{W}\mathbf{v}$$

This approximation this time will be used two times, first for $P(\mathbf{h}|\mathbf{v})$ and the second time for the variational free energy. We have:

$$KL\left(Q(\mathbf{h}|\mathbf{v}) \| P(\mathbf{h}|\mathbf{v})\right)$$

0.4. GBRBM