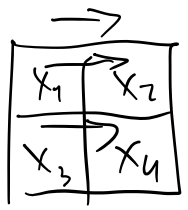
image $\sqrt{n} \times \sqrt{n}$

$x_s \in \{-1, 1\}$



$p(\text{error}) = \varepsilon$

$$P(y_s | x_s) = (1-\varepsilon)^{\frac{1+y_s x_s}{2}} \cdot \varepsilon^{\frac{1-y_s x_s}{2}}$$

$$= \exp\left\{ \frac{1+y_s x_s}{2} \log(1-\varepsilon) + \frac{1-y_s x_s}{2} \log(\varepsilon) \right\}$$

$$\propto \exp\left\{ y_s x_s \frac{1}{2} \log\left(\frac{1-\varepsilon}{\varepsilon}\right) \right\}$$

$$P(y_s | x_s) = \exp\{ y_s x_s \lambda \}$$

$$p(x_s) \propto \prod_{s \sim t} \psi_{st}(x_s, x_t)$$

$$\psi_{st}(x_s, x_t) = \begin{pmatrix} e^{J} & e^{-J} \\ e^{-J} & e^{J} \end{pmatrix}$$

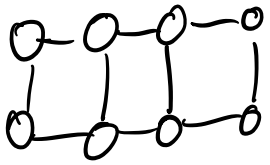
$$p(y|x) \propto p(y,x)$$

$$= p(x) \prod_s p(y_s|x_s)$$

$$= \exp\left\{ \beta \sum_{s\sim t} x_s x_t + \lambda \sum_s y_s x_s \right\}$$

$$= \prod_{s\sim t} \psi_{st}(x_s, x_t) \prod_s \psi_s(x_s)$$

$$\psi_s(x_s) = \exp\{\lambda y_s x_s\}$$



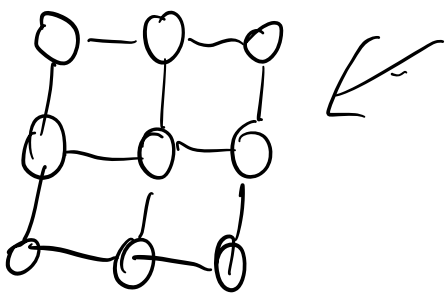
1. $M_{i\to j}(x_j) = \begin{vmatrix} \frac{1}{2} \\ \frac{1}{2} \end{vmatrix}$

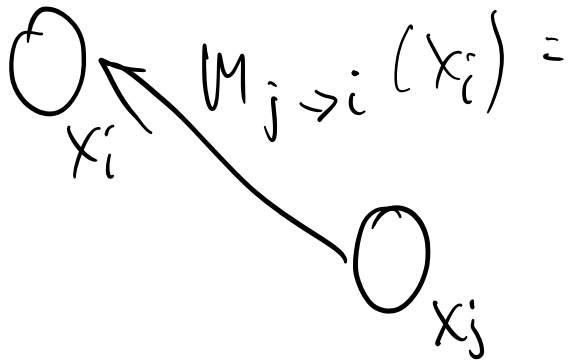
2. $M_{j\to i}(x_i) = \sum_{x_j} \psi_j(x_j)\, \psi_{ij}(x_i, x_j) \prod_{k \in N(j)\setminus i} M_{k\to j}^{(x_j)}$

3. $m_{j \to i}(x_i) = \dfrac{m_{j \to i}(x_i)}{\sum_{x_i} m_{j \to i}(x_i)}$ (normalized)

4 $b(x_i) \propto \psi_i(x_i) \prod_{k \in N(i)} m_{k \to i}(x_i)$

$$\hat{x}_i = \arg\max_{x_i} b(x_i)$$




$M_{j \to i}(x_i) =$
x_i
x_j