

# Factor Graphs

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$$p(x_1, \dots, x_n) = \frac{1}{Z} \prod_a f_a(x_a)$$

BP:

$$m_{a \rightarrow i}(x_i) = \sum_{x_a | x_i = x_i} f_a(x_a) \prod_{j \in N(a) \setminus i} m_{j \rightarrow a}(x_j)$$

$$m_{i \rightarrow a}(x_i) = \prod_{b \in N(i) \setminus a} m_{b \rightarrow i}(x_i)$$

$$b(x_i) = \prod_{a \in N(i)} m_{a \rightarrow i}(x_i)$$

MP:

$$m_{a \rightarrow i}(x_i) = \max_{x_a | x_i = x_i} f_a(x_a) \prod_{j \in N(a) \setminus i} m_{j \rightarrow a}(x_j)$$

$$m_{i \rightarrow a}(x_i) = \prod_{b \in N(i) \setminus a} m_{b \rightarrow i}(x_i)$$

$$\hat{x}_i = \arg \max_{x_i} \left( \prod_{a \in N(i)} m_{a \rightarrow i}(x_i) \right)$$

LDPC - Low Density Parity Check Codes

Encoding: Generating matrix  $x = Gu$ , parity check matrix  $Ax = 0$

noisy channel:  $x_i \rightarrow y_i$

Decoding:

$$p(x_1, \dots, x_n | y) = \frac{1}{Z} \prod_i p(y_i | x_i) \prod_j 1_{\{a_j x = 0\}}$$