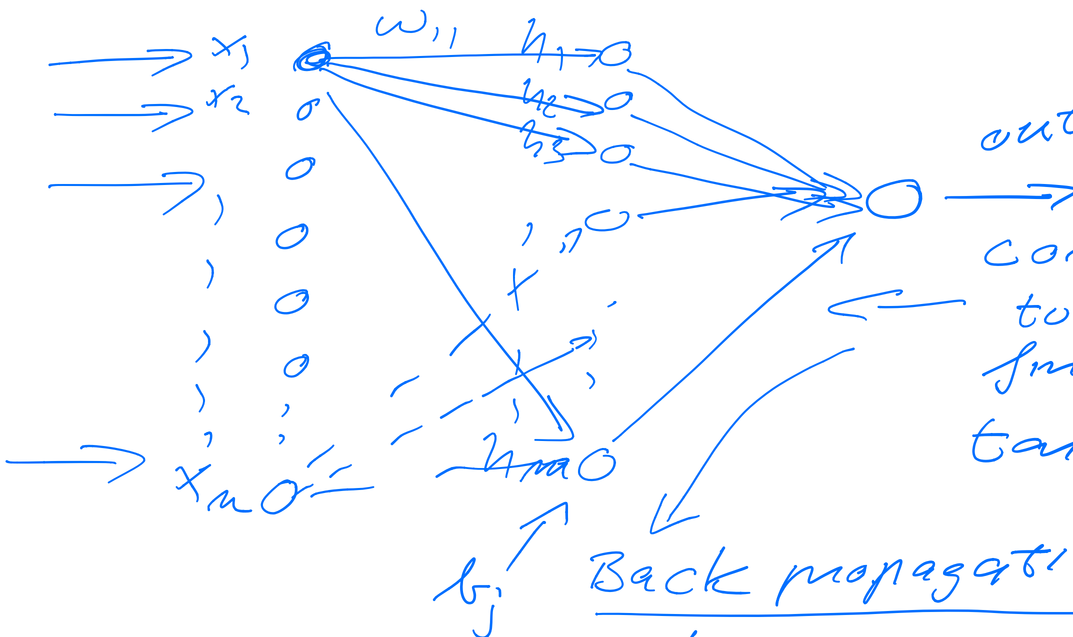
Neural Network (Feed Forward)

Input Layer   hidden Layer   output



output

compare to final target

Back propagation

algo + gradient descent

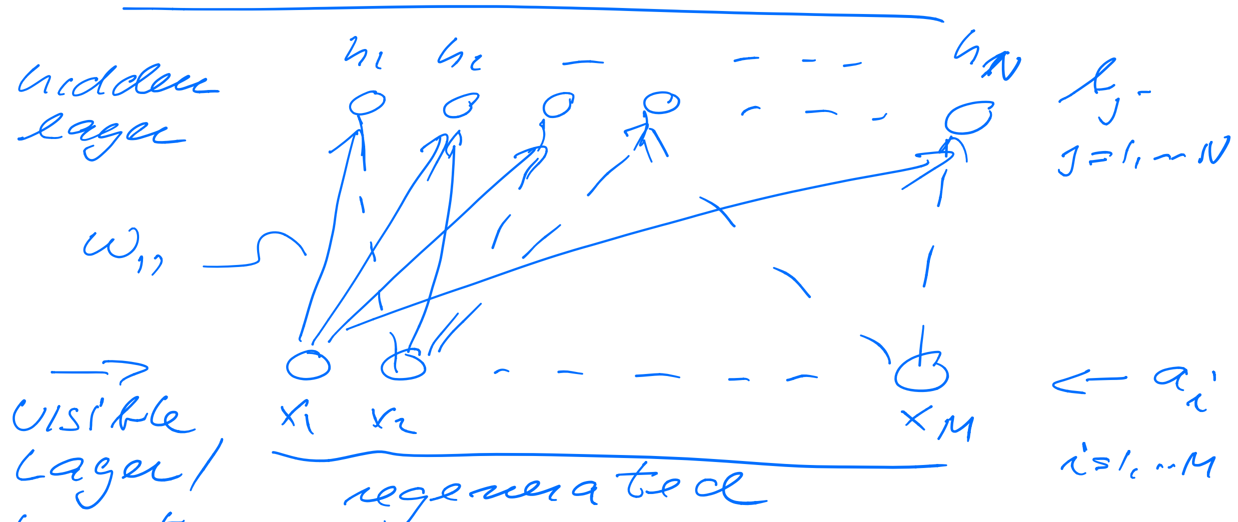
By optimizing the cost function

Regression $\underline{MSE} = \frac{1}{n}\sum_{i=1}^{n}(t_i - \underline{y_i})^2$

depends on w_{ij} and bias b_i

w_{ij} and b_j initialized with random values.

Boltzmann Machine



$\mathbf{x} = [x_1, x_2, x_3, \ldots, x_M]$ $\mathbf{h} = [h_1 h_2 \ldots h_N]$

Restricted BM = RBM

no cross-talk between nodes in same layer.

parameters of the model

a_i, b_j, w_{ij} play same as variational parameter in standard VMC calculation.

Define probability Distribution

$$P(\mathbf{x},\mathbf{h}) = \frac{1}{Z} e^{-E(\mathbf{x},\mathbf{h})/T}$$

$T = 1$

Normalization factor

$$Z = \sum_{x\,h} e^{-E(x,h)}$$

or $\iint dx\,dh\, e^{-E(x,h)}$

$$P(x) = \sum_{h} e^{-E(x,h)}$$

Marginal probability

interpret this as $|\psi(x)|^2$

$$Z = \sum_{i=x_1}^{x_M} \sum_{j=h_1}^{h_N} e^{-E(x_i,h_j)}$$

Types of Boltzmann machines

- Binary-Binary

x_i and h_j take only two values

$$E(x,h) = -\sum_{i=1}^{M} x_i a_i - \sum_{j=1}^{N} h_j b_j - \sum_{ij}^{MN} x_i w_{ij} h_j$$

- Gaussian-Binary

$$E(x,h) = \sum_{i=1}^{M} \frac{(x_i-a_i)^2}{2\sigma_i^2} - \sum_{j=1}^{N} b_j h_j$$

$$- \sum_{i,j}^{m,n} x_i w_{ij} h_j$$