

inference :  
 $\text{argmax}_{y \in Y} \hat{y}_t$   
 $\hat{y}_t \in \mathbb{R}^{|Y|}$

B-PER I-LOC

B-LOC

$$\sum_{t=1}^L \mathcal{L}_t(y_t, \hat{y}_t)$$



$$P(y|x, w) = \frac{1}{Z(x, w)} \exp \left( \sum_{j=1}^d w_j \underbrace{\sum_{i=1}^n f_j(y_{i-1}, y_i, x_i, i)}_{F_j(y, x)} \right)$$

$$= \frac{1}{Z(x, w)} \exp \left( \sum_{i=1}^n \sum_{j=1}^d w_j f_j(y_{i-1}, y_i, x_i, i) \right) =$$

$$= \frac{1}{Z(x, w)} \exp \left( \sum_{i=1}^n G_{x, i} [y_{i-1}, y_i] \right)$$

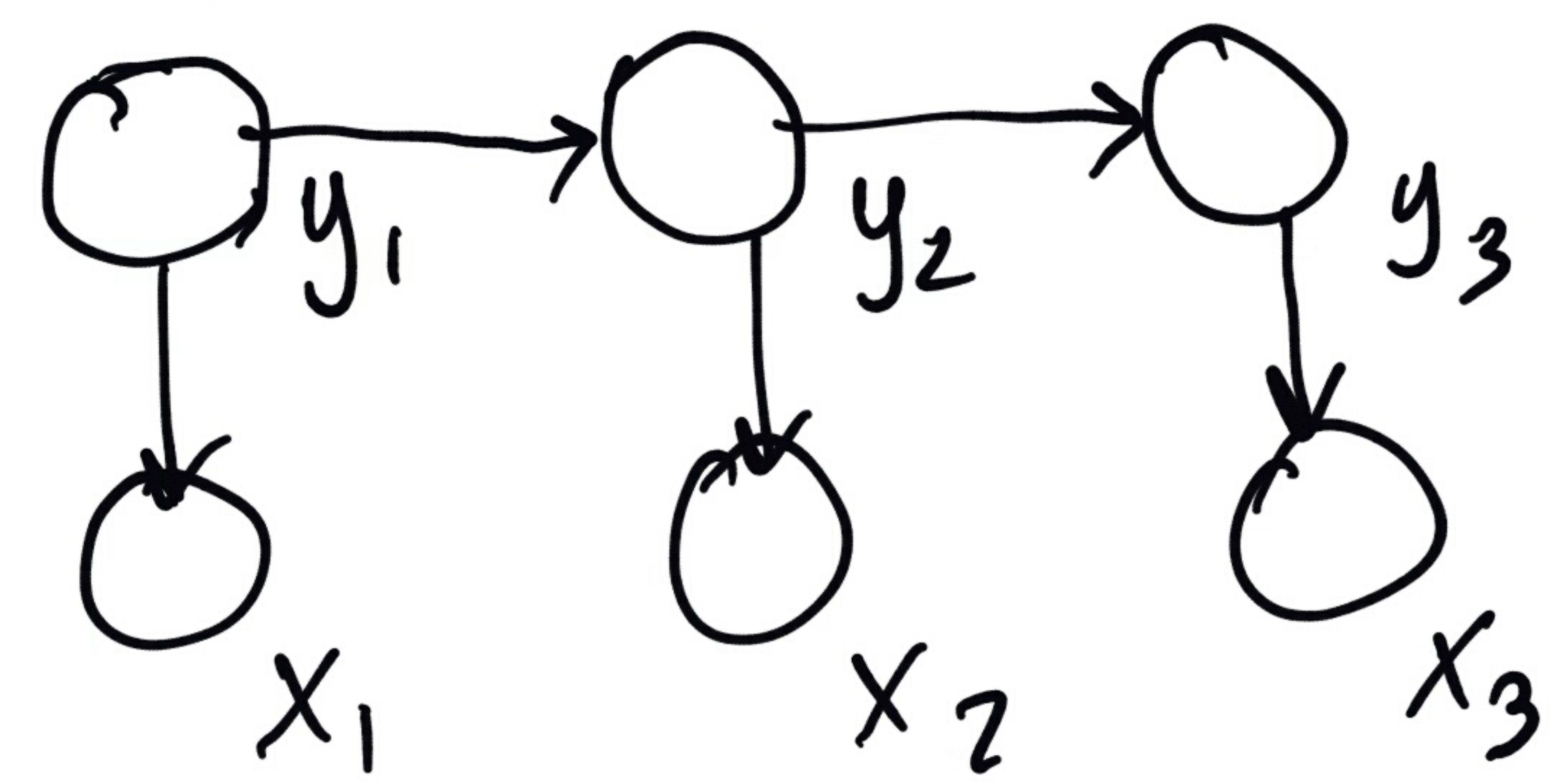
(1.  $w = ?$

→ 2. наугад  $y$  no  $x$



HMM

$$P(x, y) = P(x|y) P(y) =$$
$$= \underline{P(y_1)} \prod_{i=2}^n \underline{P(y_i|y_{i-1})} \prod_{i=1}^n \underline{P(x_i|y_i)}$$



$y_0 = \langle \text{START} \rangle$

$$\prod_{i=1}^n P(y_i|y_{i-1}) P(x_i|y_i)$$



$$\begin{aligned}
 \textcircled{1} \quad P(y_i = v \mid y_{i-1} = u) &= \textcircled{A_{vu}} = \\
 &= \frac{\sum_y \sum_{i=2}^{|y|} \mathbb{I}[y_i = v, y_{i-1} = u]}{\sum_y \sum_{i=2}^{|y|} \mathbb{I}[y_{i-1} = u]}
 \end{aligned}$$


$$\begin{aligned}
 P(x_i = z \mid y_i = u) &= \textcircled{B_{zu}} = \\
 &= \frac{\sum_{y,x} \sum_{i=1}^{|y|} \mathbb{I}[x_i = z, y_i = u]}{\sum_{y,x} \sum_{i=1}^{|y|} \mathbb{I}[y_i = u]}
 \end{aligned}$$

$$P(y_1 = u) = C_u$$



1. обучение  $\rightarrow$  запам. стр-к  
2. выбор по  $x$   $y$  (Алгоритм Витерби)

$$\arg \max_{y \in Y^{|x|}} p(y|x)$$

$$\left\{ \arg \max p(y_i | x) \right\}_{i=1}^{|x|}$$


---

$$p(y|x, w) = \frac{1}{Z(x, w)} \exp \left( \sum_{i=1}^n \sum_{j=1}^d w_j f_j(y_{i-1}, y_i, x_{i,i}) \right)$$



$$P(y|x) = \frac{P(y,x)}{P(x)} = \frac{1}{Z(x)} P(x|y) P(y) =$$

$$= \frac{1}{Z(x)} \prod_{i=1}^n P(x_i|y_i) P(y_i|y_{i-1}) =$$

$$= \frac{1}{Z(x)} \exp \left( \underbrace{\sum_{i=1}^n (\log P(x_i|y_i))}_{w_1=1} + \underbrace{\log P(y_i|y_{i-1})}_{w_2=1} \right)$$

CRF

$$P(y|x, w) = \frac{1}{Z(x, w)} \exp \left( \sum_{i=1}^n \sum_{j=1}^d w_j f_j(y_{i-1}, y_i, x_i, i) \right)$$

$f_j(y_{i-1}, y_i, x_i, i) =$



$$f_1(y_{i-1}, y_i, x_i, i) = \mathbb{I}[y_i = 'B - PEP']$$


---

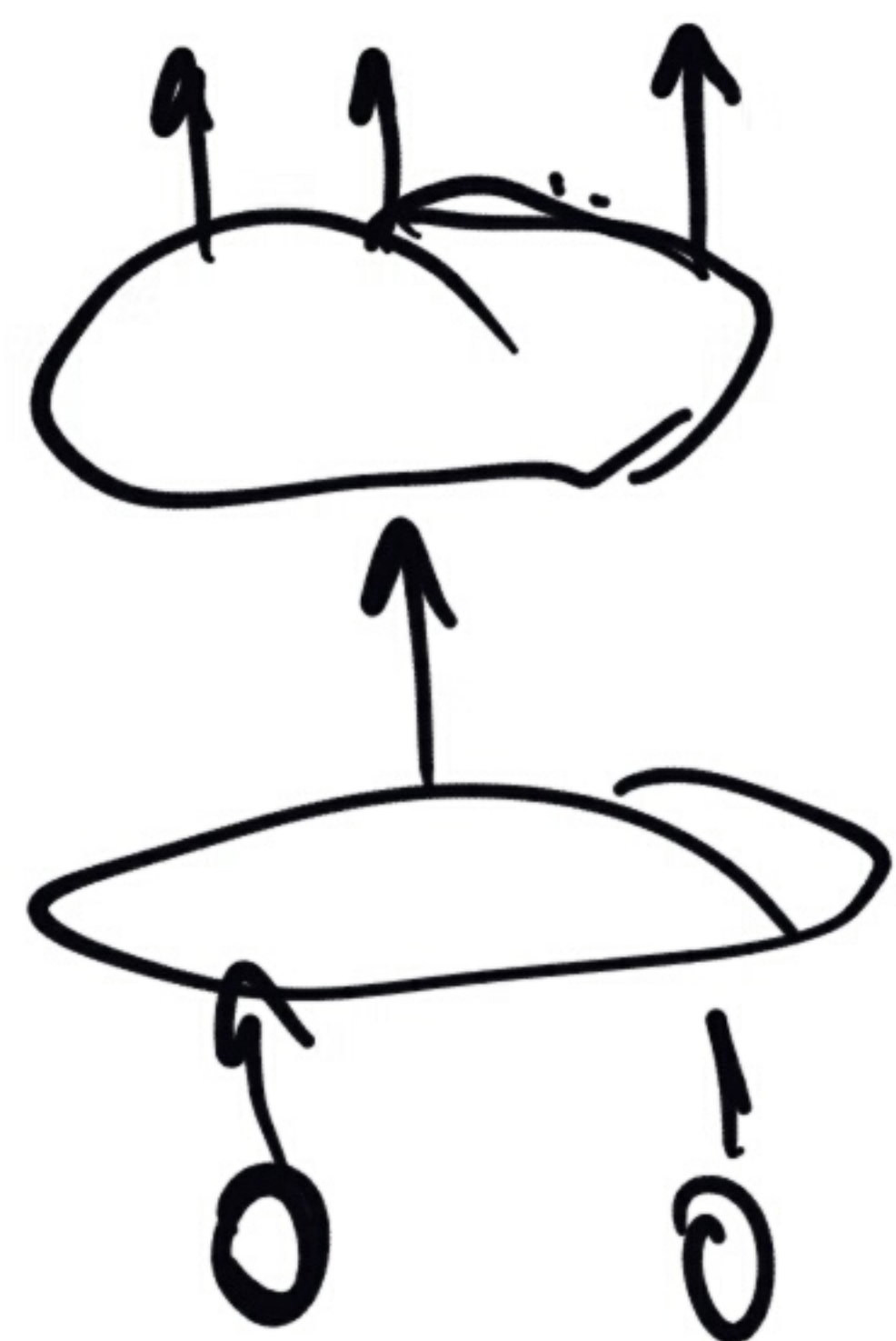
$$\begin{aligned} > f_2(y_{i-1}, y_i, x_i, i) &= \log A[v = y_i, u = y_{i-1}] \\ f_3(y_{i-1}, y_i, x_i, i) &= \log B[z = x_i, u = y_{i-1}] \end{aligned}$$

$$P(y|x) = \frac{1}{Z(x)} \exp \left( \sum_{i=1}^n \underset{\uparrow}{w_1} f_1(\dots) + \underset{\uparrow}{w_2} f_2(\dots) \right)$$

$$\alpha, (1-\alpha)$$

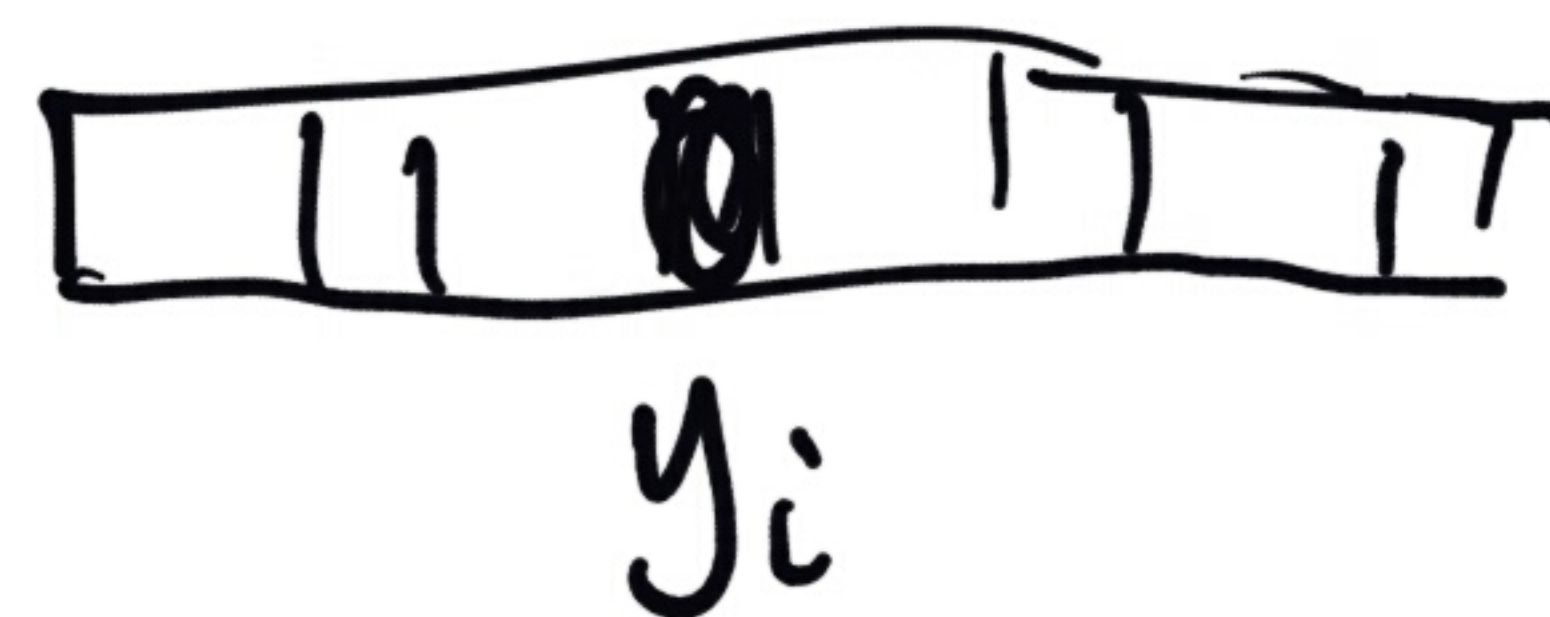


$$P(y|x) = \frac{1}{Z(x)} \exp \left( \sum_{i=1}^n w_1 f_1(\dots) + w_2 f_2(\dots) \right)$$



$$f_1(y_{i-1}, y_i, x_i, i)$$

Выход NN  
на  $i$ -ой  $\omega$ -те,  
соотв.  $y_i$



$$f_j(y_{i-1}, y_i, x_i, i)$$

log A



