$\bar{x} \mapsto y?$

Discriminative

$p(y|\bar{x})$

Generative

$\boxed{p(y,\bar{x})} = \boxed{p(y|\bar{x})\,p(\bar{x})}$

$\qquad\qquad\qquad \parallel$

$\qquad\qquad\qquad p(y)p(\bar{x}|y)$

$p(y|\bar{x}) \propto p(y,\bar{x})$

Logistic regression

$$p(y|\bar{x}) = e^{\sum f_k(x,y)\theta_k}$$

$$p(y=t|\bar{x}) = \text{softmax}\left(e^{\bar{w}_t^T\bar{x}}\right) =$$

$$= \frac{e^{\bar{w}_t^T\bar{x}}}{\sum_{t'} e^{\bar{w}_{t'}^T\bar{x}}} =$$

$$= \frac{1}{Z(\bar{x})} e^{w_{1t}x_1 + \dots + w_{kt}x_k} = \sum_t \sum_k [y=t]\, x_k w_{kt}$$

features

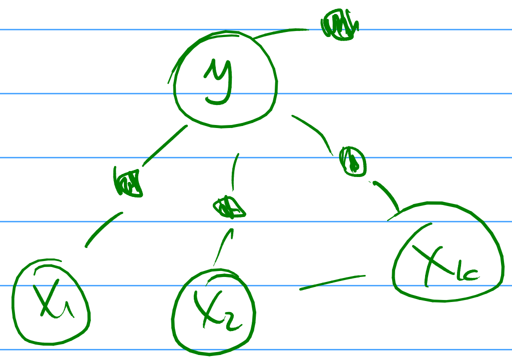
$f(y, x_k)$

$$\parallel$$

$$\frac{1}{Z(\bar{x})} \prod_{s,k} e^{f_s(y,x_k)\theta_s}$$

Новини

спорт, политика, финанси



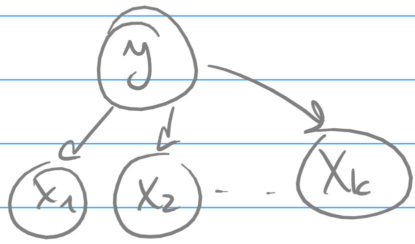
Naive Bayes

$\bar{x} = (x_1 - x_k) \mapsto y$

$$p(\bar{x},y) = p(y)\cdot p(\bar{x}|y) =$$

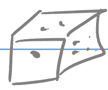
$\pi_t = p(y=t)$ $\qquad \theta_{wt}$

$$= p(y) \prod_k p(x_k|y)$$

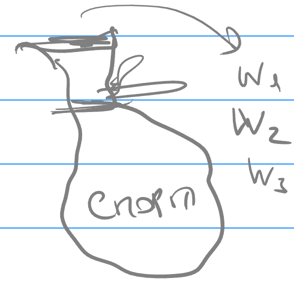


Новини

спорт, политика, рене



$y =$ „спорт"



$$p(\bar{x},y) = \prod_t \left[\pi_t^{[y=t]} \cdot \prod_w \prod_k \theta_{wt}^{[x_k=w]} \right]$$

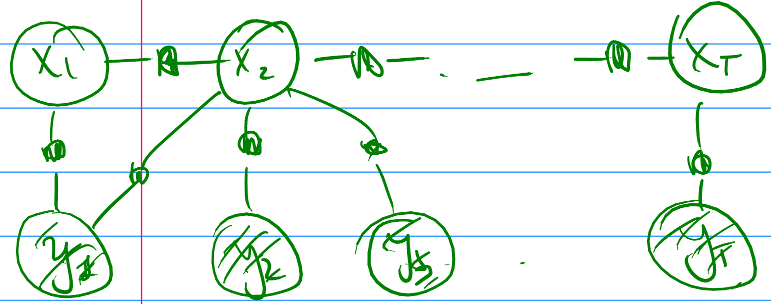
$$= e^{\sum_t [y=t] \ln\pi_t + \sum_{t,w,k} [x_k=w] \ln\theta_{wt}}$$

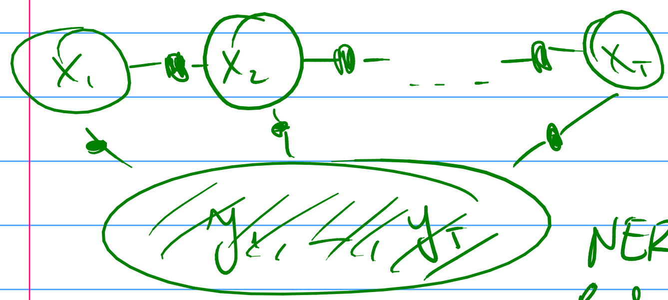
features $\qquad \ln\pi_t,\ \ln\theta_{wt}$

CRF | conditional random fields

linear chain CRF

$p(\bar{x}|\bar{y})$

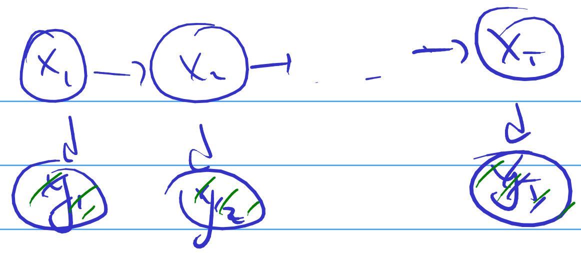




NER

POS

HMM

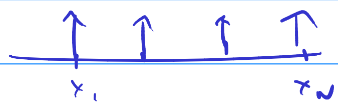


$$p(\bar{x}, \bar{y}) = p(x_1)\, p(x_2|x_1)\, p(y_1|x_1) \ldots$$

$$p(\bar{x}|\bar{\theta}), \quad L(\bar{\theta}) = \prod_{\bar{x} \in D} p(\bar{x}|\bar{\theta}) \xrightarrow[\bar{\theta}]{} \max$$

$$p(\bar{\theta}) \prod_{\bar{x} \in D} p(\bar{x}|\bar{\theta}) \xrightarrow[\bar{\theta}]{} \max$$

$$p_{model}(\bar{x}|\bar{\theta}) \approx p_{data}(\bar{x})$$



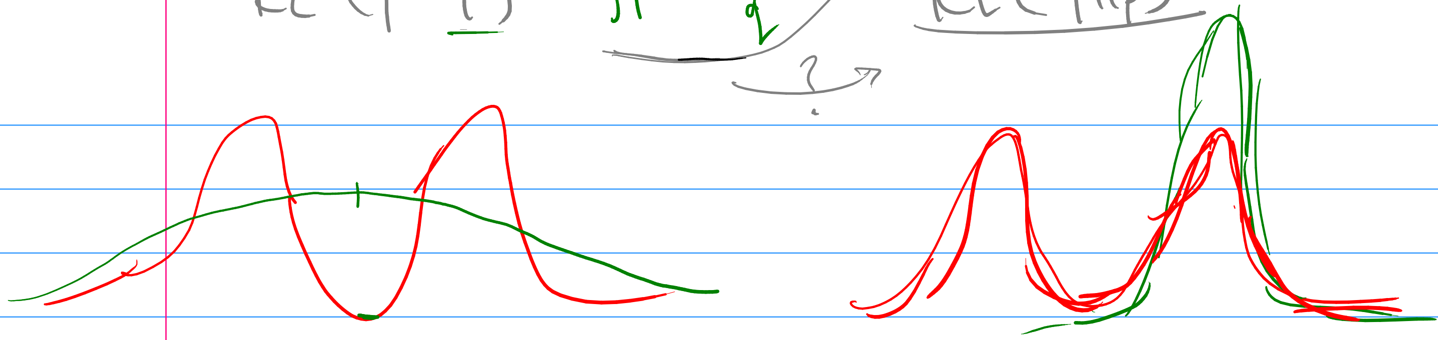
$$p_{data}(\bar{x}) = Unif(D) = Unif(\{\bar{x}_1, \ldots, \bar{x}_N\})$$

$$KL(\overset{=p}{p_{data}} \| \overset{=q}{p_{model}}) = -\int p_{data}(\bar{x}) \ln \frac{p_{model}(\bar{x})}{p_{data}(\bar{x})} d\bar{x} =$$

$$= -\sum_n \frac{1}{N} \ln \frac{p_{model}(\bar{x})}{\cancel{(1/N)}} \xrightarrow[p_{model}]{} \min$$

$KL(p\|q) = \int p \ln \frac{p}{q}$ $\qquad$ $KL(q\|p)$

?



Gen. models

Explicit density $\qquad$ Implicit density

$p(\bar{x})$

NB $\quad p(\bar{x}, y) = p(y) \prod_k p(x_k|y)$

HMM $\quad p(\bar{x}, \bar{y}) = \ldots$

$\bar{z} \sim N(\bar{0}, I)$

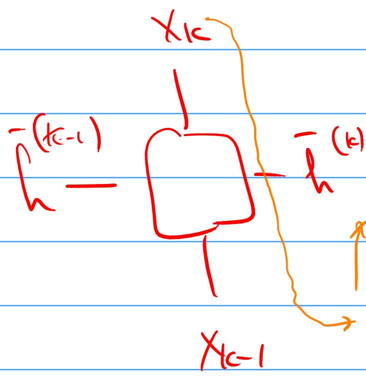
$x_1 \ldots x_K$

$$p(\bar{x}) = p(x_1)\, p(x_2|x_1)\, p(x_3|x_1, x_2) \ldots p(x_n|x_1 \ldots x_{n-1})$$

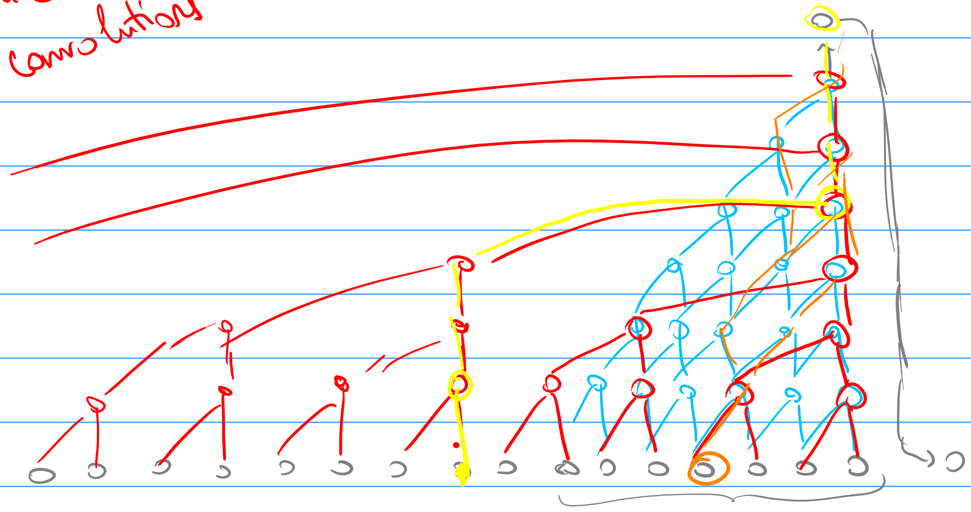
$$= \prod_k p(x_k | \bar{x}_{<k})$$

$\approx$ NN

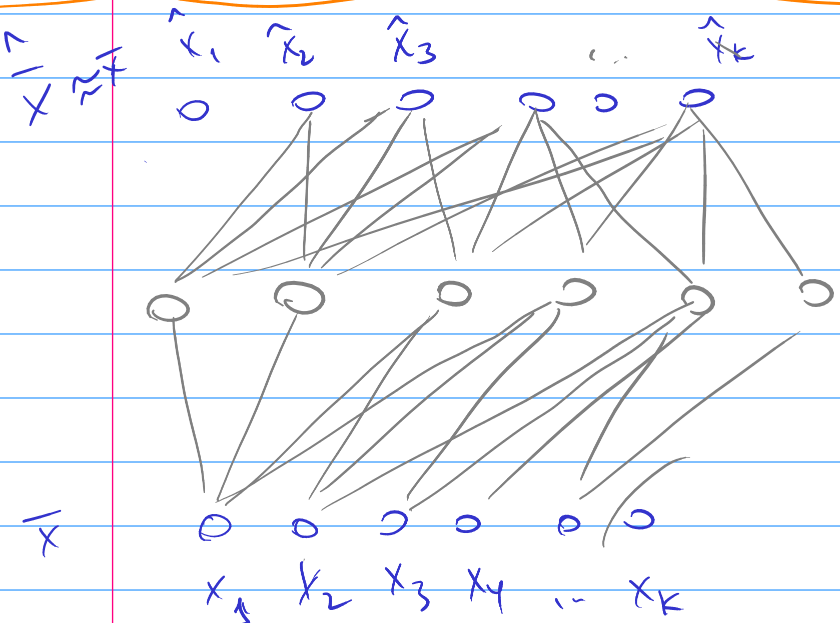
$$p(\bar{x}_k|\bar{x}_{<k}) = p(\bar{x}_k | \bar{x}_{k-1}, \bar{h})$$



dilated convolutions



MADE



$$p(\bar{x}) = \prod p(x_i \mid \bar{x}_{<i})$$

$\bar{X} =$