

UKRYTE
 $\{s_1 \dots s_L\}$

FORWARD

$$\alpha_t(s_i) = P(y_{0:t}, x_t = s_i)$$

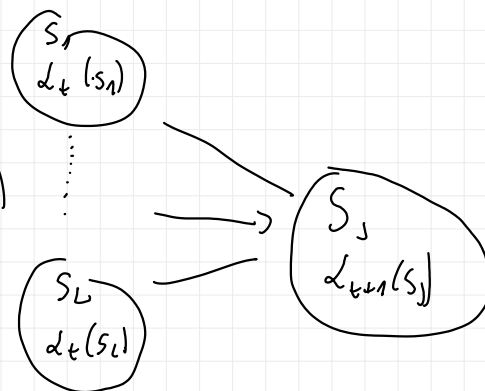
① $\alpha_0(s_i) = \mu(s_i) \cdot P(y_0 | x_0 = s_i)$

② $\alpha_{t+1}(s_j) = \left[\sum_{i=1}^L \alpha_t(s_i) A(i,j) \right] \cdot P(y_{t+1} | x_{t+1} = s_j)$

$$p(Y_{0:T} = y_{0:T} | X_{0:T} = x_{0:T}) = \prod_{k=0}^T p(y_k | x_k),$$

$$p(x_{0:T}; \mathbf{A}, \boldsymbol{\pi}) = \mathbb{P}(x_0) \prod_{k=1}^T \mathbb{P}(x_k | x_{k-1}) = \pi_{x_0} \prod_{k=1}^T \mathbf{A}(x_{k-1}, x_k).$$

③ $P(y_{0:T}) = \sum_{i=1}^L \alpha_T(s_i)$



VITERBI

$$P(x_{0:T} | y_{0:T}, \theta) = \frac{P(x_{0:T}, y_{0:T}, \theta)}{P(y_{0:T}, \theta)} = \frac{P(x_{0:T}, y_{0:T} | \theta)}{P(y_{0:T}, \theta)}$$

$$\arg \max_{x_{0:T}} P(x_{0:T} | y_{0:T}, \theta) \equiv \arg \max_{x_{0:T}} \frac{P(x_{0:T}, y_{0:T} | \theta)}{P(y_{0:T}, \theta)}$$

$$\alpha_t(s_i) = \max_{x_1, \dots, x_{t-1}} P(x_{0:t-1}, x_t = s_i, y_{0:t})$$

$y_0 \dots y_t$
 $x_t = s_i$

y_T

Pr. najb. prawdopodobieństwa

ciągła ukrytych stanów,

czyli zaobserwowano

$y_{0:t}$ i $x_t = s_i$

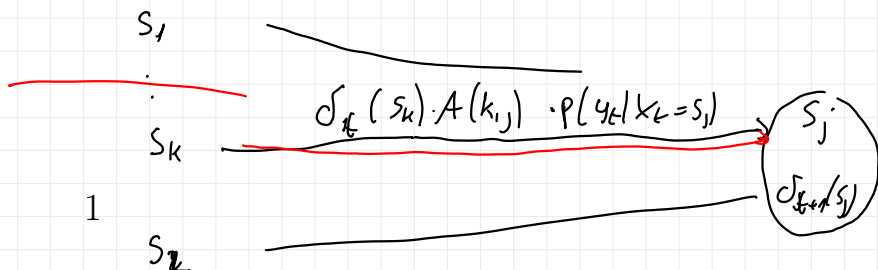
MAMY

$$\alpha_{t+1}(s_j) = \max_{s_i \in \{s_1 \dots s_L\}} \left[\alpha_t(s_i) A(i,j) \right] \cdot P(y_{t+1} | x_{t+1} = s_j)$$

$x_0 \dots x_t, x_t = s_j$

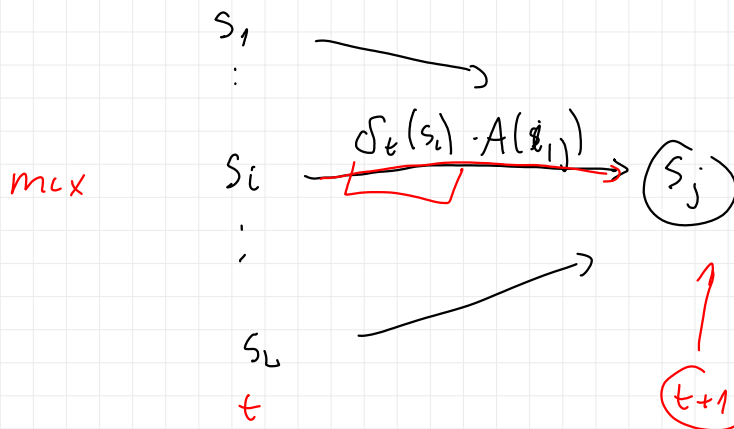
$y_0 \dots y_{t+1}$

max



$$\psi_{t+1}(s_j) = \begin{cases} \arg\max_{s_i} \delta_t(s_i) A(i,j) & t \geq 1 \\ 0 & t=0 \end{cases} \quad \text{STAN, KTÓRY} \\ \text{MAKSYMALIZUJE} \\ \text{W CAILI } t \\ \text{PRZEJSIE DO } s_j$$

$x_0 \dots x_{t-1} \quad x_t = s_i$
 $y_0 \dots y_t$



CEL

$$x_{0:T}^* = \arg\max_{x_{0:T}} P(x_{0:T}, y_{0:T}; \theta)$$

PRZECIENAJĄC

$$P^* = P(x_{0:T}^*, y_{0:T}) = \max_{x_{0:T}} P(x_{0:T}, y_{0:T}; \theta)$$

$$P^* = \max_i \delta_T(s_i)$$

$x_0 \dots x_{T-1}, x_T = s_i$
 $y_0 \dots y_T$

ALG. VITERBIEGO

①

$$\delta_0(s_i) = M(s_i) P(y_0 | x_0 = s_i)$$

$$i = 1, \dots, L$$

$$\psi_0(s_i) = 0$$

②

$$\delta_{t+1}(s_j) = \max_{s_i \in \{s_1, \dots, s_L\}} [\delta_t(s_i) A(i,j)] \cdot P(y_{t+1} | x_t = s_j)$$

$t = 1, 2, \dots, T$

→

$$\psi_{t+1}(s_j) = \arg\max_{s_i} \delta_t(s_i) A(i,j)$$

③

$$P^* = \max_{s_i} \delta_T(s_i)$$

$x_0^* \dots$

x_T^*

$$x_T^* = \arg\max_{s_i} \delta_T(s_i)$$

← NA RAZIE TYLKO

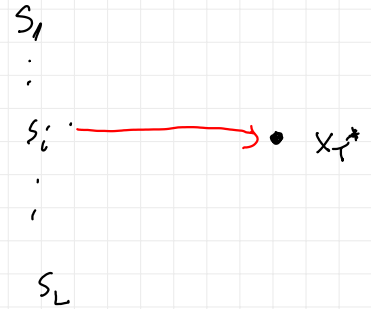
OSTATNI STAN

(4) ODTWARZANIE STANÓW:

$$\rightarrow X_t^* = \Psi_{t+1}(X_{t+1}^*) \quad t = 0, 1, \dots, T-1$$

$$\left(\text{ZOB. NP} \right) \quad \underbrace{X_{T-1}^* = \Psi_T(X_T^*)}_{\text{argmax}} = \arg \max_{s_i} \underbrace{\delta_{T-1}(s_i)}_{\text{max}} A(l, \underline{X_T^*})$$

$\delta_{T-1}(s_i)$ • Najb. prawdopodob. użycie $X_0 \dots X_{T-2}$
 • W chwili $T-1$ jest w s_i
 Gen $X_{T-1} = s_i$
 • ZAOBS. $y_0 \dots y_{T-1}$



• ~~PA~~ (l, X_T^*)

↑
to już wiemy, że jest w opt. ścieżce.

