Baum welch

OUT TEOM →

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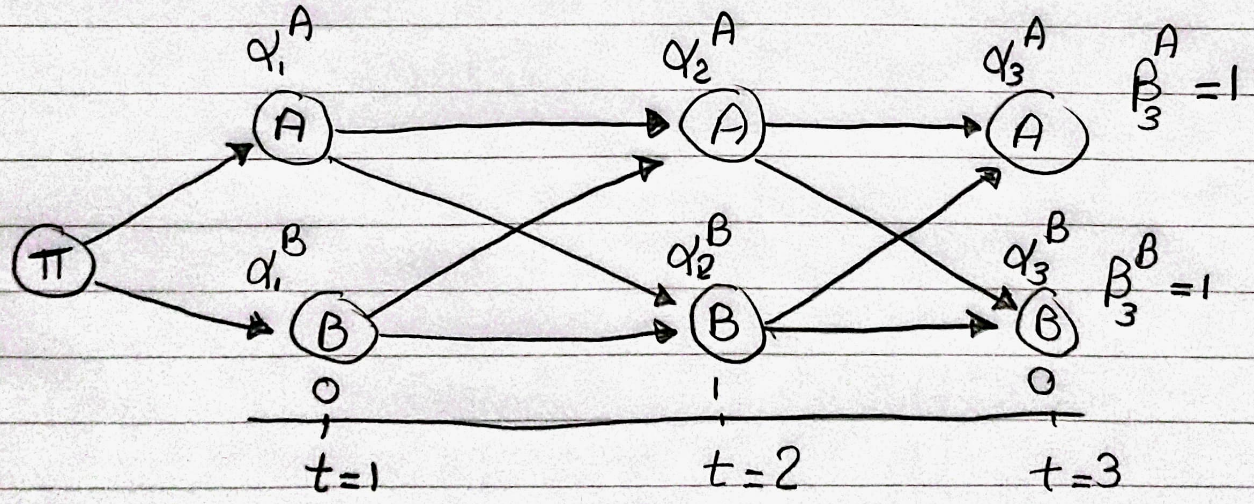
STEP 1 → intial sequence :-

$$\pi = \begin{bmatrix} 0{,}99 & 0{,}01 \end{bmatrix}$$

$$P = \begin{array}{c|cc} & A & B \\ \hline A & 0{,}99 & 0{,}01 \\ B & 0{,}01 & 0{,}09 \end{array}$$

$$E = \begin{array}{c|cc} & 0 & 1 \\ \hline A & 0{,}8 & 0{,}2 \\ B & 0{,}1 & 0{,}9 \end{array}$$



STEP 2 → Forward →

general Form : $\alpha_t^j = \sum_{i=1}^{S} \alpha_{t-1}^i P_{ij} E_j(O_t)$

$\therefore \alpha_1^A = 0.99 * 0.8 = 0.792$

$\alpha_2^A = \alpha_1^A P_{AA} E_A(1) + \alpha_1^B P_{BA} E_A(1) = 0.18818$

$\alpha_3^A = \alpha_2^A P_{AA} E_A(0) + \alpha_2^B P_{BA} E_A(0) = 0.12426401$

$\alpha_1^B = 0.01 * 0.1 = 0.001$ $\quad \alpha_2^B = \alpha_1^A P_{AB} E_B(1) + \alpha_1^B P_{BB} E_B(1)$
$= 0.008019$

$\alpha_3^B = \alpha_2^A P_{AB} E_B(0) + \alpha_2^B P_{BB} E_B(0) = 0.0009507$

Backword →

general Form → $\beta_t^i = \sum \beta_{t+1}^K P_{iK} E_K(O_{t+1})$

PuT $\beta_3^A = 1$ & $\beta_3^B = 1$

$\beta_2^A = \beta_3^A P_{AA} E_A(0) + \beta_3^B P_{AB} E_B(0) = 0.793$

$\beta_1^A = \beta_2^A P_{AA} E_A(1) + \beta_2^B P_{AB} E_B(1) = 0.157977$

$\beta_2^B = \beta_3^A P_{BA} E_A(0) + \beta_3^B P_{BB} E_B(0) = 0.107$

$\beta_1^B = \beta_2^A P_{BA} E_A(1) + \beta_2^B P_{BB} E_B(1) = 0.096923$

Mobayed

التاريخ / / ٢٠٢   الموضوع :

STEP 3 → update: use Forward & Backward

① Calculate $\varepsilon_t^{t-1\; ij}$

Forward Emission Backward

general-Form → $\varepsilon_t^{t-1\; ij} = \dfrac{\alpha_t^{i} \, P_{ij} \, E_j(O_{t+1}) \, \beta_{t+1}^{j}}{\sum_i \sum_j \alpha_t^{i} \, P_{ij} \, E_j(O_{t+1}) \, \beta_{t+1}^{j}}$

Ex

① $\varepsilon_t^{AA} = \dfrac{\alpha_t^{A} \, P_{AA} \, E_A(O_{t+1}) \, \beta_{t+1}^{A}}{\varepsilon_t^{AA} + \varepsilon_t^{AB} + \varepsilon_t^{BA} + \varepsilon_t^{BB}}$

② $\varepsilon_t^{AB} = \dfrac{\alpha_t^{A} \, P_{AB} \, E_B(O_{t+1}) \, \beta_{t+1}^{B}}{\varepsilon_t^{AA} + \varepsilon_t^{AB} + \varepsilon_t^{BA} + \varepsilon_t^{BB}}$ وهكذا →

② Calculate γ_t^{i}

general Form → $\gamma_t^{i} = \sum_{j=1} \varepsilon_t^{ij}$

Ex $\gamma_1^{A} = \sum [\varepsilon_1^{AA}, \varepsilon_t^{AB}]$ ② $\gamma_1^{B} = \sum [\varepsilon_1^{BA}, \varepsilon_1^{BB}]$

③ $\gamma_2^{A} = \sum [\varepsilon_2^{AA}, \varepsilon_2^{AB}]$ وهكذا →

$\therefore \overset{t-1}{\varepsilon}{}^{ij}_{t} \Longrightarrow$ Expected No. of Transition Form S_i To S_J

$\xrightarrow{Ex} \varepsilon^{AA}_1 + \varepsilon^{AB}_2$

$\sum_{t=1}^{t-1} y^i_t \longrightarrow$ Expected No. of Transition S_i

$\xrightarrow{Ex} y^A_1 + y^A_2$

To update $\rightarrow$

① $\pi = y^i_1 = [\, y^A_1 \quad y^B_1 \,] \longrightarrow$ intial distribution

② $\bar{a}_{iJ} = \dfrac{\sum_{t=1}^{T-1} \varepsilon^{iJ}_t}{\sum_{t=1}^{T-1} y^i_t}$ in Transition Matrix

$$P = \begin{array}{c} \\ A \\ B \end{array} \begin{array}{c} \begin{array}{cc} A & B \end{array} \\ \begin{bmatrix} P_{AA} & P_{AB} \\ P_{BA} & P_{BB} \end{bmatrix} \end{array}$$

Ex $\bar{P}_{AA} = \dfrac{\varepsilon^{AA}_1 + \varepsilon^{AB}_2}{y^A_1 + y^A_2}$

③ $\bar{b}^K_J = \dfrac{\sum_{T=1,\, O=K}^{T} y^J_t}{\sum_{T=1}^{T} y^J_t}$