$\text{Node}(i, j) \longrightarrow \text{neighbor}: \quad \text{Node}(i-1, j)$

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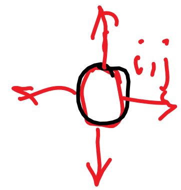

$(i, j-1) \longleftarrow (i, j) \longrightarrow (i, j+1)$

$(i+1, j)$

$1 \le i \le m$

$1 \le j \le n$

$$\pi = (\pi_0, \pi_1, \cdots, \pi_n)$$

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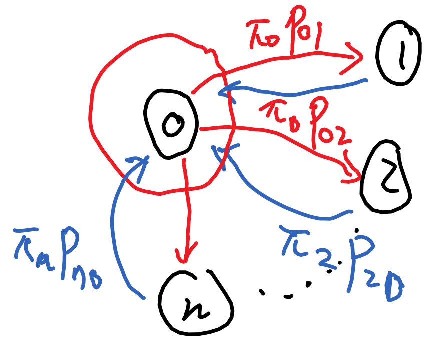
$$\begin{aligned} \pi &= \pi P, \\ \pi \mathbf{1} &= 1 \end{aligned}$$

where $\mathbf{1} = (1 \ \ldots)^T$

if $\pi = \begin{bmatrix} \pi_0 \\ \pi_1 \\ \pi_2 \\ \vdots \end{bmatrix}$ $\quad \pi = P \cdot \pi$



$$\pi_0 (\overbrace{P_{01} + P_{02} + \cdots P_{0n}}^{1 - P_{00}})$$

$$= \pi_1 P_{10} + \pi_2 P_{20} + \cdots \pi_n P_{n0}$$

$$\pi_0 (1 - P_{00}) = \pi_1 P_{10} + \pi_2 P_{20} + \ldots$$

P

$$\Rightarrow \begin{bmatrix} \pi_0 = \\ \pi_1 = \\ \pi_3 = \end{bmatrix} \begin{bmatrix} \pi_0 P_{00} + \pi_1 P_{10} + \pi_2 P_{20} + \ldots \\ \pi_0 P_{01} + \pi_1 P_{11} + \pi_2 P_{21} + \ldots \\ \ldots \quad - \ - \ - \end{bmatrix}$$

$$\pi = \pi \cdot P$$

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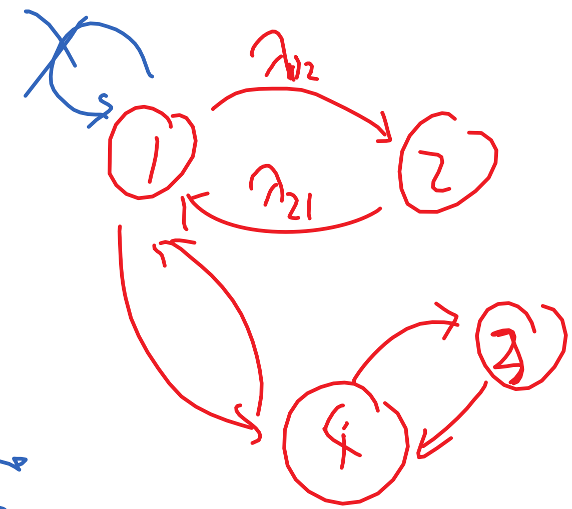
$$\begin{cases}\pi_0 = (1-\alpha)\pi_0 + \beta\pi_1\\ \pi_1 = \alpha\pi_0 + (1-\beta)\pi_1\end{cases}$$

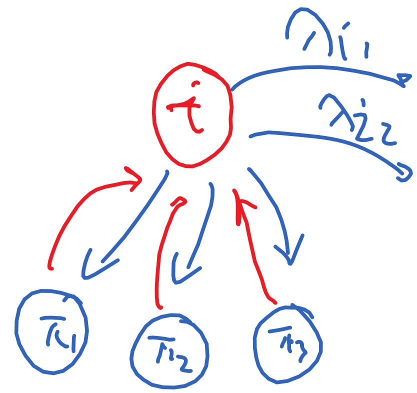
$$\pi_0+\pi_1=1 \longrightarrow \pi\cdot\mathbf{1} = 1, \quad \mathbf{1} = \begin{bmatrix}1\\1\end{bmatrix}$$

$$\pi = \pi P, \quad \pi = [\pi_0 \ \ \pi_1]$$



$$\pi_i \sum_{j\neq i}\lambda_{ij} = \sum_{j\neq i}\pi_j\lambda_{ji}$$

$$\sum_i \pi_i = 1$$



$$\pi_1\cdot\lambda_{1i} + \pi_2\cdot\lambda_{2i} + \dots$$

$$\pi\mathbf{Q} = 0 \rightarrow [0\ 0\ 0\ 0 \cdots 0]$$

$$\pi\mathbf{1} = 1$$

$$-\pi_i\sum_{j\neq i}\lambda_{ij} + \sum_{j\neq i}\pi_j\lambda_{ji} = 0 \rightarrow \text{i-th row of } \pi Q$$

3 - mode system

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$$Q = \begin{array}{c} 1 \\ 2 \\ 3 \end{array} \begin{bmatrix} -(\lambda_{12}+\lambda_{13}) & \lambda_{12} & \lambda_{13} \\ \lambda_{21} & -(\lambda_{21}+\lambda_{23}) & \lambda_{23} \\ \lambda_{31} & \lambda_{32} & -(\lambda_{31}+\lambda_{32}) \end{bmatrix}$$

$$\pi Q = 0 \Rightarrow [\pi_1 \quad \pi_2 \quad \pi_3] \cdot Q = [0 \quad 0 \quad 0]$$