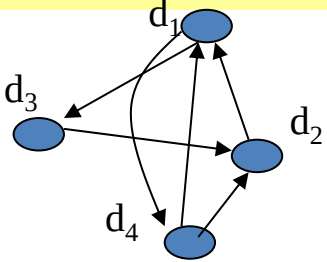
# The PageRank Algorithm

Random surfing model: At any page,

With prob. $\alpha$, randomly jumping to another page

With prob. (1-$\alpha$), randomly picking a link to follow.

**p($d_i$): PageRank score of $d_i$ = average probability of visiting page $d_i$**




**Transition matrix**

$$M = \begin{bmatrix} 0 & 0 & 1/2 & 1/2 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 1/2 & 1/2 & 0 & 0 \end{bmatrix}$$

**$M_{ij}$ = probability of going from $d_i$ to $d_j$**

$$\sum_{j=1}^{N} M_{ij} = 1$$

probability of visiting page dj at time t+1

probability of at page di at time t

**"Equilibrium Equation":**

$$p_{t+1}(d_j) = (1-\alpha)\sum_{i=1}^{N} M_{ij}\, p_t(d_i) + \alpha \sum_{i=1}^{N} \frac{1}{N}\, p_t(d_i)$$

**N= # pages**

Reach dj via following a link

Reach dj via random jumping

**dropping the time index**

$$p(d_j) = \sum_{i=1}^{N} [\tfrac{1}{N}\alpha + (1-\alpha)M_{ij}]\, p(d_i)$$

$$\vec{p} = (\alpha I + (1-\alpha)M)^T \vec{p}$$

**$I_{ij}$ = 1/N**

We can solve the equation with an iterative algorithm