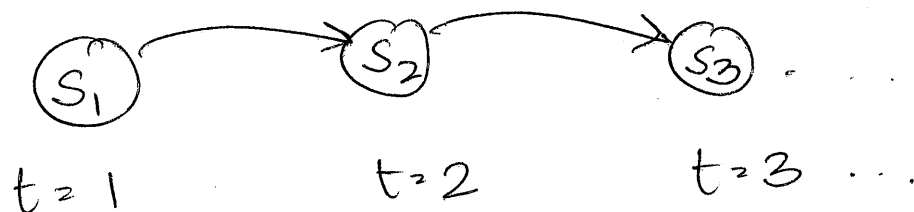


# Markov Modeling



Discrete time Markov chain

$$\begin{aligned}
 & P(X_n = i_n \mid X_{n-1} = i_{n-1}, X_{n-2} = i_{n-2}, \dots, X_0 = i_0) \\
 & \quad \quad \quad \text{First order Markov property} \\
 & \quad \quad \quad = P(X_n = i_n \mid X_{n-1} = i_{n-1}) \\
 & \quad \quad \quad \downarrow \\
 & \quad \quad \quad P(X_n = i_n \mid X_{n-1} = i_{n-1}, X_{n-2} = i_{n-2}, \dots, X_0 = i_0) \\
 & \quad \quad \quad = P(X_n = i_n \mid X_{n-1} = i_{n-1}, X_{n-2} = i_{n-2}) \quad \text{2nd order Markov property}
 \end{aligned}$$

3 states

Transition matrix

$$\begin{array}{c}
 \begin{array}{ccc}
 & S_0 & S_1 & S_2 \\
 \begin{array}{c} S_0 \\ S_1 \\ S_2 \end{array} & \begin{bmatrix} p_{00} & p_{01} & p_{02} \\ p_{10} & p_{11} & p_{12} \\ p_{20} & p_{21} & p_{22} \end{bmatrix} & \begin{array}{c} \sum = 1 \\ \sum = 1 \\ \sum = 1 \end{array}
 \end{array}
 \end{array}$$