if today is rainy, tomorrow $\frac{1}{3}$ rainy $\frac{2}{3}$ sunny.

if today is sunny, $\frac{1}{2}$ rainy $\frac{1}{2}$ sunny.

Markov chain: $X_0, X_1, \cdots$

$$\mathcal{S} = \{R, S\}.$$

$$Q = \begin{bmatrix} \frac{1}{3} & \frac{2}{3} \\ \frac{1}{2} & \frac{1}{2} \end{bmatrix}$$

if two rainy/sunny day $\Rightarrow$ must be sunny/rainy tomorrow.

New Markov chain: $Y_n = (X_n, X_{n-1})$ $n \geq 1$.

$$\begin{array}{c} \\ (R,R) \\ (R,S) \\ (S,R) \\ (S,S) \end{array} \begin{array}{c} \begin{array}{cccc} (R,R) & (R,S) & (S,R) & (S,S) \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{3} & \frac{2}{3} & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \end{array}$$