h1

Homework1

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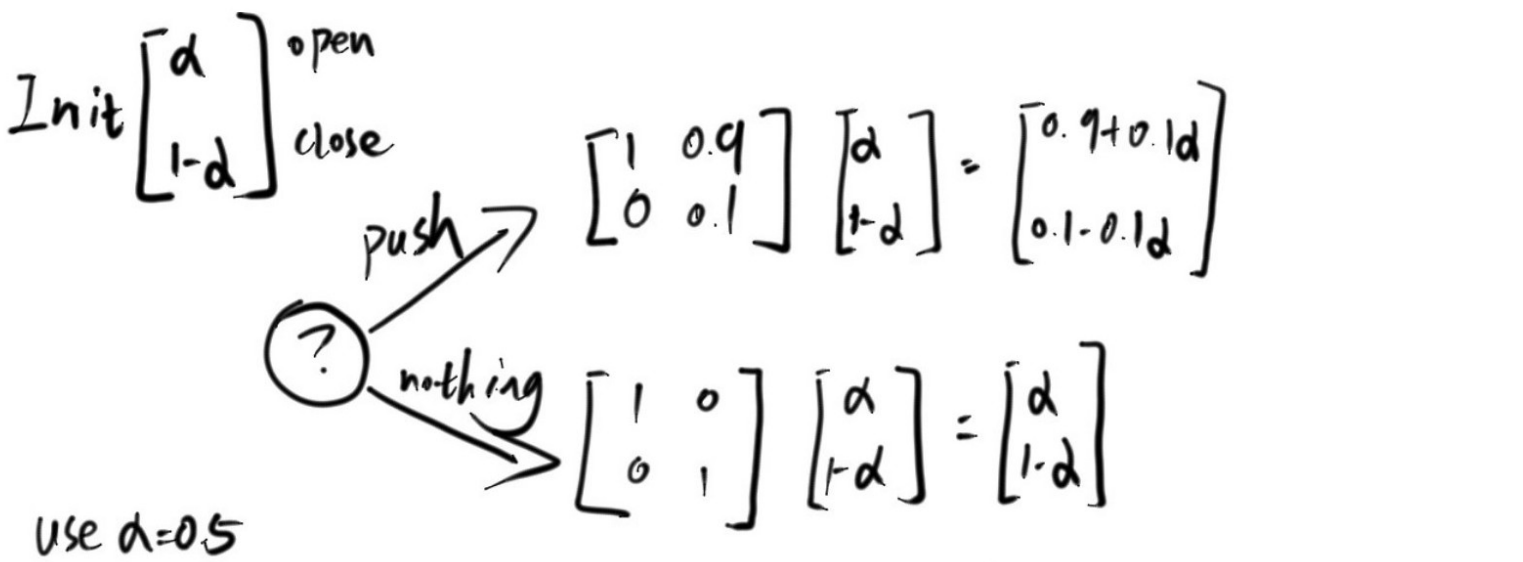
Problem 1

$\sum P(open|u,x)P(x) = 1 \times 0.5 + 0.8 \times 0.5 = 0.9$

Problem 2



use $\alpha = 0.5$

$P(x'=open|u=push)=0.95$ $P(x'=open|u=do\_nothing)=0.5$

$P(x'=close|u=push)=0.05$ $P(x'=close|u=do\_nothing)=0.5$

$$P(x'=open|z=open,u=push) = \frac{P(z=open|x'=open)\,P(x'=open|u=push)}{P(z=open|u=push)}$$

$$= \frac{0.8\times0.95}{0.8\times0.95+0.3\times0.05} \approx 0.981$$

in the same way,

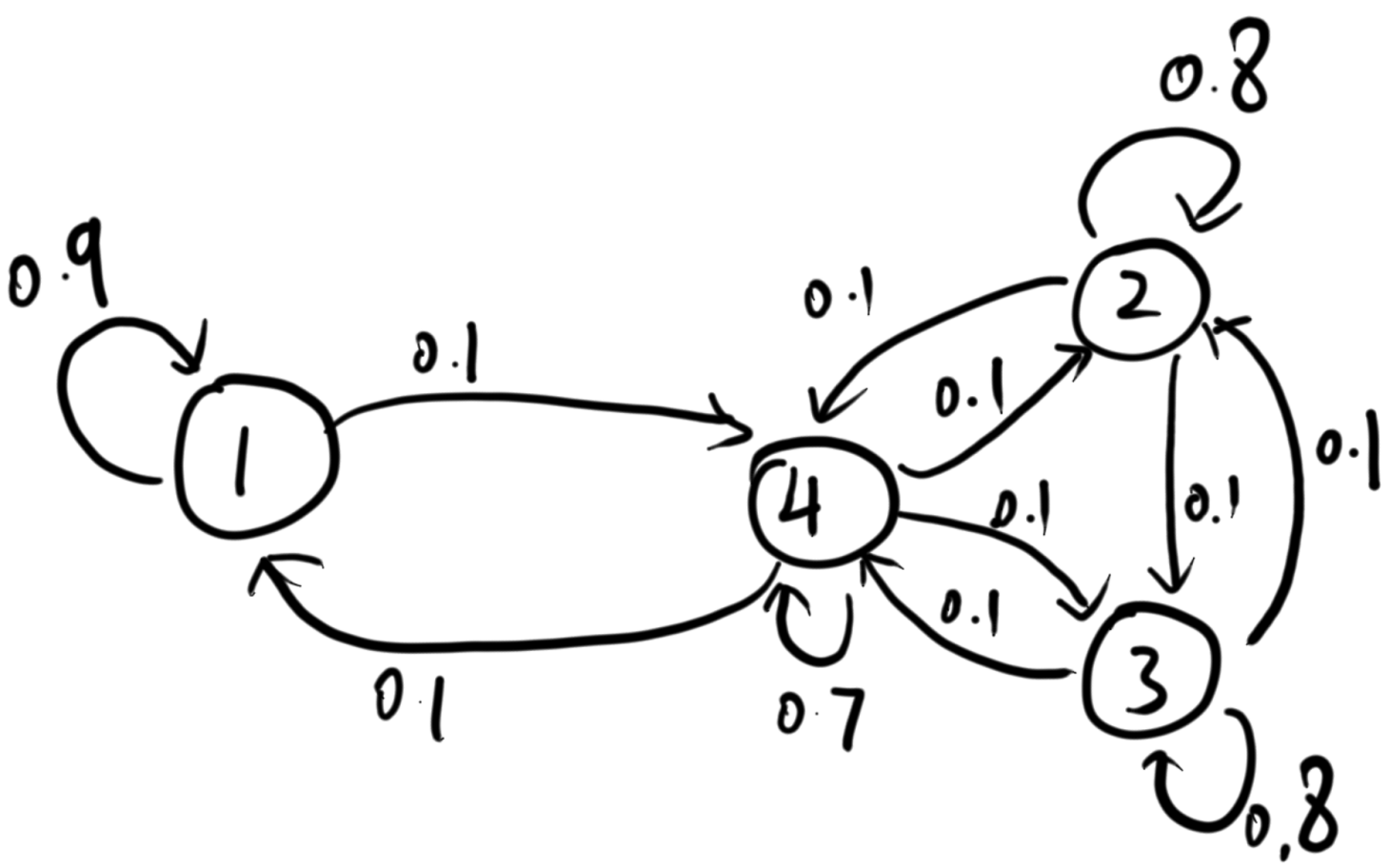
$$P(x'=close|u=push,z=open) = \frac{0.3\times0.05}{0.8\times0.95+0.3\times0.05} \approx 0.019$$

$$P(x'=open|u=do\_nothing,z=close) = \frac{0.2\times0.5}{0.2\times0.5+0.7\times0.5} \approx 0.222$$

$$P(x'=close|u=do\_nothing,z=close) = \frac{0.7\times0.5}{0.2\times0.5+0.7\times0.5} \approx 0.778$$

Problem 3

1.



2.

$$\begin{bmatrix} 0.9 & 0 & 0 & 0.1 \\ 0 & 0.8 & 0.1 & 0.1 \\ 0 & 0.1 & 0.8 & 0.1 \\ 0.1 & 0.1 & 0.1 & 0.7 \end{bmatrix} \begin{bmatrix} P(A_1) \\ P(A_2) \\ P(A_3) \\ P(A_4) \end{bmatrix} = \begin{bmatrix} P(A_1) \\ P(A_2) \\ P(A_3) \\ P(A_4) \end{bmatrix}$$

$$\begin{cases} P(A_1) = 0.25 \\ P(A_2) = 0.25 \\ P(A_3) = 0.25 \\ P(A_4) = 0.25 \end{cases}$$

3.

let $g_{1\to4}$ represent robot go through the door from 1 to 4

$$P(g_{1\leftrightarrow4} \mid g_{m\to n}) = \frac{P(g_{1\to4}) + P(g_{4\to1})}{g(m\to n)}$$

$$= \frac{\frac{1}{4}(0.1+0.1)}{\frac{1}{4}(0.1+0.2+0.2+0.3)}$$

$$= \frac{1}{4}$$

Problem 4

$$bel(x_t) = P(x_t | u_{1:t}, z_{1:t})$$

$$= \eta P(z_t | x_t, u_{1:t}, z_{1:t-1}) P(x_t | u_{1:t}, z_{1:t-1})$$

$$= \eta P(z_t | x_t) \sum_{x_{t-1}} P(x_t | u_{1:t}, z_{1:t-1}) P(x_{t-1} | u_{1:t}, z_{1:t-1})$$

$$= \eta P(z_t | x_t) \sum_{x_{t-1}} P(x_t | u_t, x_{t-1}) bel(x_{t-1})$$

Problem 5

$$bel(x_{0:t}) = P(x_{0:t} | u_{1:t}, z_{1:t})$$

$$= \eta_1 P(x_t | u_{1:t}, z_{1:t}, x_{0:t-1}) P(x_{0:t-1} | u_{1:t}, z_{1:t-1})$$

$$= \eta_2 P(z_t | u_{1:t}, z_{1:t-1}, x_{0:t}) P(x_t | u_{1:t}, z_{1:t-1}, x_{0:t-1}) bel(x_{t-1})$$

$$= \eta_2 P(z_t | x_t) P(x_t | x_{t-1}, u_t) bel(x_{t-1})$$