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HW4

1. $P(open|u) = P(open|u, open) \cdot P(open) + P(open|u, close) \cdot P(close)$

$= 1 \times 0.5 + 0.8 \times 0.5$

$= 0.9$

2. $Bel(x_0) = 0.5$. $x_0 = open$. or $x_0 = close$.

After $z = open$ $u = do\_nothing$

$\overline{Bel}(x_1) = \sum_{x} P(x_1|u_1, x_0) Bel(x_0)$.

$\therefore \overline{Bel}(x_1) = P(x_1|u_1 = do\_nothing, x_0 = open) \times Bel(x_0 = open) + P(x_1|u_1 = do\_nothing, x_0 = close) \times Bel(x_0 = close)$.

$Bel(x_1) = \eta \cdot \overline{Bel}(x_1) \cdot P(z_1 = open | x_1)$

$\therefore \overline{Bel}(x_1 = open) = 1 \times 0.5 + 0 \times 0.5 = 0.5$

$\overline{Bel}(x_1 = close) = 0 \times 0.5 + 1 \times 0.5 = 0.5$

$Bel(x_1 = open) = \eta \cdot \overline{Bel}(x_1 = open) \cdot P(z = open | x_1 = open) = 0.4\eta$.

$Bel(x_1 = close) = \eta \overline{Bel}(x_1 = close) \cdot P(z = open | x_1 = close) = 0.15\eta$.

$\therefore \eta = (0.4 + 0.15)^{-1} \approx 1.8182$

$Bel(x_1 = open) \approx 0.727$

$Bel(x_1 = close) \approx 0.273$.

Scanned with CamScanner

$\overline{Bel}(x_2) = \sum_{x_1} P(x_2 | u_2 = push, x_1) \cdot Bel(x_1)$.

$\therefore \overline{Bel}(x_2 = open) = 1 \times Bel(x_1 = open) + 0.9 \times Bel(x_1 = close)$.

$= 0.9727$

$\overline{Bel}(x_2 = close) = 0 \times Bel(x_1 = open) + 0.1 \times Bel(x_1 = close)$

$= 0.0273$.

$\therefore Bel(x_2 = open) = \eta \cdot P(z_2 = open | x_2 = open) \cdot \overline{Bel}(x_2 = open)$.

$= 0.77816\eta$

$Bel(x_2 = close) = \eta \cdot P(z_2 = open | x_2 = close) \cdot \overline{Bel}(x_2 = close)$

$= 0.00819$

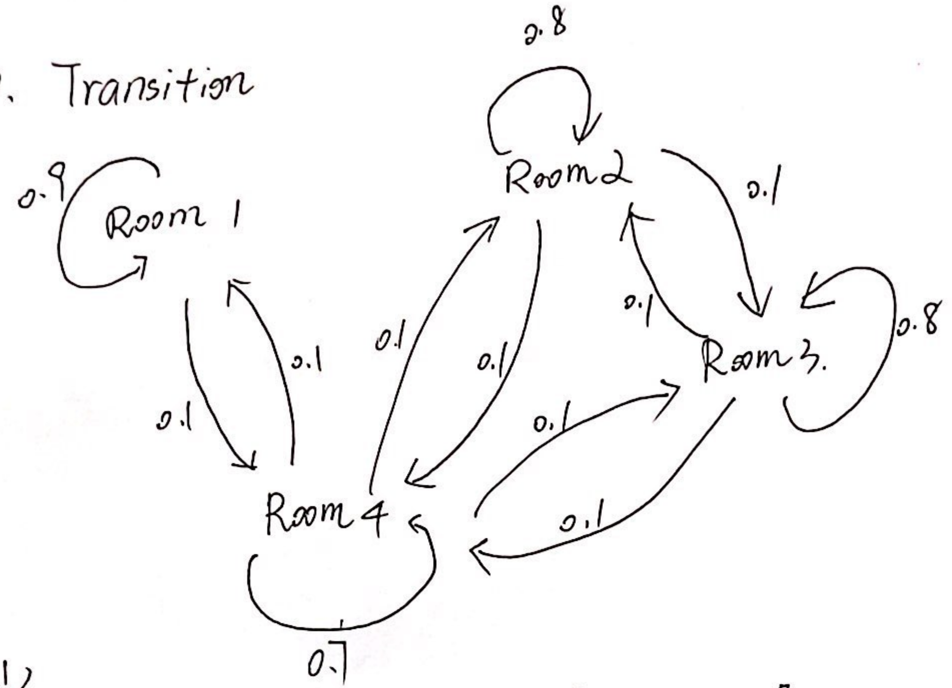
$\eta = (0.00819 + 0.77816)^{-1} \approx 1.2717$.

$\therefore Bel(x_2 = open) \approx 0.990$.

$Bel(x_2 = close) \approx 0.010$

Scanned with CamScanner

3. Transition



(1)

∵ Markov model:

$$MK = \begin{bmatrix} R_1 \\ R_2 \\ R_3 \\ R_4 \end{bmatrix} \cdot \begin{bmatrix} R_1 & R_2 & R_3 & R_4 \end{bmatrix} = \begin{bmatrix} 0.9 & 0 & 0 & 0.1 \\ 0 & 0.8 & 0.1 & 0.1 \\ 0 & 0.1 & 0.8 & 0.1 \\ 0.1 & 0.1 & 0.1 & 0.7 \end{bmatrix}$$

(2). Assume the robot is in Room 1 at first.

∴ $P_0 = [1, 0, 0, 0]$.

$P_1 = P_0 \cdot Mk$

∴ $P_n = P_{n-1} \cdot Mk$.

By using Matlab, I found that the static status was that

$P_{12} = [0.25 \quad 0.25 \quad 0.25 \quad 0.25]$

which means the probability of the robot staying at each room is 0.25.

(3). $P(\text{between 1 and 4} \mid \text{going through a door}) = \dfrac{P(1\to4) \times P(\text{at } R_1) + P(4\to1)P(\text{at } R_4)}{P(\text{going through a door})}$

$$= \frac{0.25 \times (0.1 + 0.1)}{0.25 \times (0.1 + 0.3 + 0.2 + 0.2)} = \frac{1}{4}$$