classmate
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Ranish Jamode CS307 Quiz 3

a) let us first identify the model (π, A, B)

States : Tick , Tock Observations: Backpack , Briefcase, Bag

(Initial State Prob)
π → tick works 3 days a week & Tock works 4

$\therefore$ π = [P(tick) , P(Tock)]
= [3/7 , 4/7]

(State transition prob)

$$A \rightarrow \begin{bmatrix} 0.4 & 0.6 \\ 0.4 & 0.6 \end{bmatrix}$$

Tick stays on ~~time~~ duty 1-0.6
= 0.4 (40% of time)
Tock stays on duty 1-0.4
= 0.6 (60% of time)

as transifition from
Tick → Tick : 0.4
Tick → tock : 0.6
Tock → Tock : 0.6
Tock → Tick : 0.4

Symbol Emission Probablities
B →

for tick
P(Briefcase | tick) = 0.4
P(Backpack | tick) = 0.4
P(Bag | tick) = 0.2

for tock
P(Briefcase | tock) = 0.3
P(Backpack | tock) = 0.3
P(Bag / tock) = 0.4

$$\therefore B \rightarrow \begin{bmatrix} 0.4 & 0.4 & 0.2 \\ 0.3 & 0.3 & 0.4 \end{bmatrix}$$

B) now we need

P (tick, tock, tick, Bagpack Briefcase, Bag | model)

P (States, observation | model)

$= \pi_{S1} \cdot A_{S1 \to S2} \cdot A_{S2 \to S3} \cdot B_{S1,O1} \cdot B_{S2,O2} \cdot B_{S3,O3}$

1) $P(\text{tick}) = 3/7$

2) Transition to tock $P(\text{Tick} \to \text{Tock}) = 0.6$

3) Transition back to tick $P(\text{Tock} \to \text{Tick}) = 0.4$

4) Observation of Backpack given tick
$P(\text{Backpack} \mid \text{tick}) = 0.4$

5) Observation of Briefcase given tock
$P(\text{Briefcase} \mid \text{tock}) = 0.3$

6) observation of Bag given tick
$P(\text{Bag} \mid \text{tick}) = 0.2$

∴ Total Probablity

$$= \frac{3}{7} \times \frac{6}{10} \times \frac{4}{10} \times 0.4 \times 0.3 \times 0.2$$

$$= 0.0024685714$$

3
3
4

c) Calculating likelyhood P(Back pack, Briefcase, Bag | model)

at T=1 ie 1st observation

$\alpha_1(\text{tick}) = \pi(\text{tick}) \cdot B(\text{Backpack} \mid \text{tick}) = \frac{3}{7} \times 0.4 = 0.1714$

$\alpha_1(\text{tock}) = \pi(\text{tock}) \cdot B(\text{Backpack} \mid \text{tock}) = \frac{4}{7} \times 0.3 = 0.1714$

now recursion at $t=2$ (2nd obs Briefcase

$\alpha_2(\text{tick}) = [\alpha_1(\text{tick}) \cdot A(\text{Tick} \to \text{Tick}) + \alpha_1(\text{tock}) \cdot A(\text{tock} \to \text{Tick})] \times B(\text{Briefcase} \mid \text{Tick})$
$= 0.0549$

$\alpha_2(\text{tock}) = [\alpha_1(\text{tick}) \cdot A(\text{tick} \to \text{tock}) + \alpha_1(\text{tock}) \cdot A(\text{tock} \to \text{Tock})] \times B(\text{Briefcase} \mid \text{tock})$
$= 0.0617$

Now observation 3 $t=3$

$\alpha_3(\text{tick}) = [\alpha_2(\text{tick}) \cdot A(\text{tick} \to \text{tick}) + \alpha_2(\text{tock}) \cdot A(\text{tock} \to \text{tick})] \times B(\text{Bag} \mid \text{tick})$
$= 0.0093$

$\alpha_3(\text{tock}) = [\alpha_2(\text{tick}) \cdot A(\text{tick} \to \text{tock}) + \alpha_2(\text{tock}) \cdot A(\text{tock} \to \text{tock})] \times B(\text{Bag} \mid \text{tick})$

$= 0.0280$

$p(\text{Backpack, Briefcase, Bag} \mid \text{model})$
$= \alpha_3(\text{tick}) + \alpha_3(\text{tock})$

$= 0.0373$