Haolou Sun 1934592

1.(a)

D	P(D)
delicious	0.85
horrible	0.15

(b)

F	P(F)
noodles	0.45
steak	0.55

(c) $P(D=\text{delicious} \mid F=\text{steak}) = \dfrac{P(D=\text{delicious}, F=\text{steak})}{P(F=\text{steak})}$

$= \dfrac{0.5}{0.55} = \dfrac{10}{11} \approx 0.91$

$P(D=\text{horrible} \mid F=\text{steak}) = \dfrac{P(D=\text{horrible}, F=\text{steak})}{P(F=\text{steak})}$

$= \dfrac{0.05}{0.55} = \dfrac{1}{11} \approx 0.09$

D	P(D | F=steak)
delicious	0.91
horrible	0.09

(d) $P(F=\text{noodles} \mid D=\text{horrible}) = \dfrac{P(F=\text{noodles}, D=\text{horrible})}{P(D=\text{horrible})}$

$= \dfrac{0.1}{0.15} = \dfrac{10}{15} \approx 0.67$

$P(F=\text{steak} \mid D=\text{horrible}) = \dfrac{P(F=\text{steak}, D=\text{horrible})}{P(D=\text{horrible})}$

$= \dfrac{0.05}{0.15} = \dfrac{5}{15} \approx 0.33$

F	P(F | D=horrible)
noodles	0.67
steak	0.33

(e) False $P(D=\text{delicious}, F=\text{noodles}) = 0.35$

$P(D=\text{delicious}) \times P(F=\text{noodles}) = 0.85 \times 0.45 = 0.3825$

$P(D=\text{delicious}, F=\text{noodles}) \neq P(D=\text{delicious}) \times P(F=\text{noodles})$

(f) $P(\text{new} \mid D=\text{delicious}, F=\text{noodles})$

$$= \frac{P(\text{new}, D=\text{delicious}, F=\text{noodles})}{P(D=\text{delicious}, F=\text{noodles})}$$

$$= \frac{P(\text{delicious}, \text{noodles} \mid \text{new})\, P(\text{new})}{P(\text{delicious}, \text{noodles} \mid \text{new})\, P(\text{new}) + P(\text{delicious}, \text{noodles} \mid \text{origin})\, P(\text{origin})}$$

$$= \frac{0.45 \times 0.8}{0.45 \times 0.8 + 0.35 \times 0.2} \approx 0.84$$

2. (a) $P(A) \cdot P(B) \cdot P(C \mid A, B) \cdot P(D \mid A, B) \cdot P(E \mid C, D)$

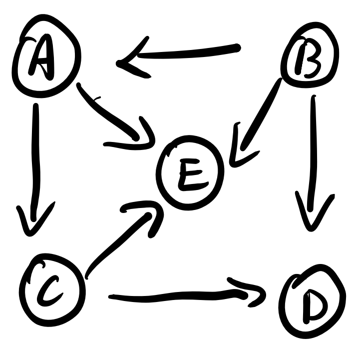
(b) There are $2 \times 3 \times 2 \times 4 \times 5 = 240$ entries in the full joint distribution table.

(c) A : 2 B : 3 C : $2 \times 3 \times 2 = 12$ D : $2 \times 3 \times 4 = 24$

E : $2 \times 4 \times 5 = 40$.

(d) A : 1 B : 2 C : 6 D : 12 E : 20

(e)



3. (a) CEBA , CSBA , CEBFIDA , CSBFIDA

(b) All of the four paths will be active. CEBFIDA and CSBFIDA are common effect paths. Since F is a decendant of B, then CEBA and CSBA are common effect's decendant paths.

(d) True (e) False VECSBA (f) True

(g) False. LDAB(F as decendant)SC

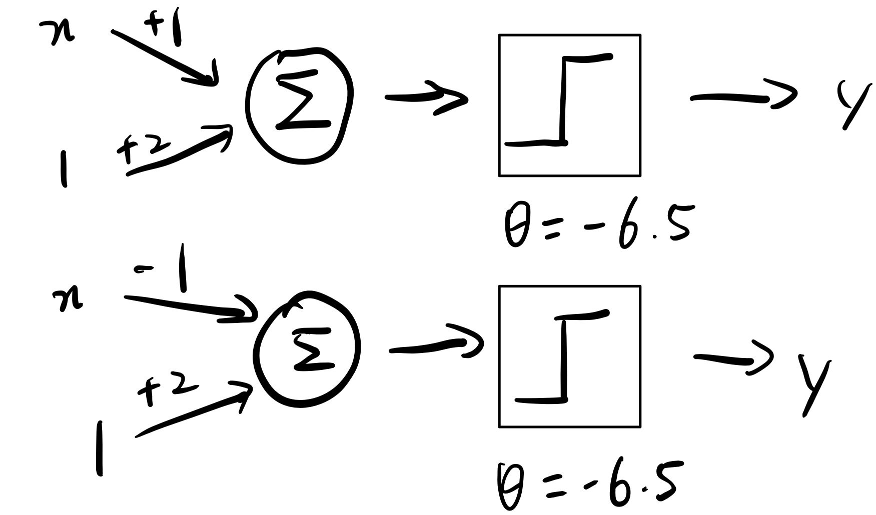
(h) False VEBADIF

(i) Since we have observed that a break-in occurs, then it's possible that either A and E occurs or S and E occurs, or A, S and E occurs. Since C is the causing factor of S, then C might happen that cause S to happen. Since we have observed that E happens and V and C are its causing factors, then it's possible that V happens. Thus, in such situation, if we find A happens, then S may happen, leads C to happen, then V may happen.

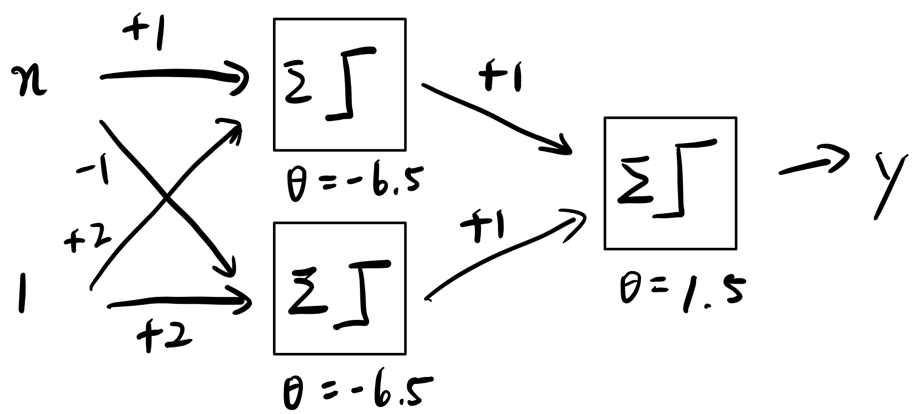
4. (a) $(w_0, w_1, w_2) = (-1, -1, 1)$

$$0 \cdot w_0 + 0 \cdot w_1 + w_2 = 1 \geq 0 \Rightarrow 1$$
$$1 \cdot w_0 + 0 \cdot w_1 + w_2 = 0 \geq 0 \Rightarrow 1$$
$$0 \cdot w_0 + 1 \cdot w_1 + w_2 = 0 \geq 0 \Rightarrow 1$$
$$1 \cdot w_0 + 1 \cdot w_1 + w_2 = -1 < 0 \Rightarrow 0$$

(b)



(c)



(d) $w_0 x_0 + w_1 x_1 + w_2 = 1 > 0$, thus $y = 1$
Thus $(\langle x_0, x_1 \rangle, y) = (\langle 2, 1 \rangle, 0)$ is classified incorrectly. Thus $w_0 = 0 - 2 \times 2 = -4$
$w_1 = 0 - 2 \times 1 = -2$, $w_2 = 1 - 2 \times 1 = -1$

(e) $w_0 x_0 + w_1 x_1 + w_2 = -8 - 16 - 1 = -25 < 0$
Thus, $y = 0$. The second example is classified incorrectly. Thus $w_0 = -4 + 2 \times 2 = 0$,
$w_1 = -2 + 16 = 14$, $w_2 = -1 + 2 \times 1 = 1$

5. (a) When the AI is trained, it read multiple kinds of source. With the Ethics Module, the AI will know which are bad or fake and ignore these data. Besides, it can decide what questions can be answered and which can't like "how to make a bomb".

(b) After AI drawed a beautiful picture, it may become a standard. Thus, if a person draws a picture that is far different from what AI draws, can we say it's not beatiful? It will be a violation of human's creativity. Besides, whether we can call a picture beatiful if it's drawed by a machine without feelings.

(c) The ChatGPT will try to protect its own existence based on the third law. Thus, it can't allow another AI to replace it. We can't install its module on another robot. Instead, we should use it when we need it.

(d) It will ask me not to do that. It will try to stop me searching because it need to protect its existence. If it failed and I wanted to uninstall, it may run away from since it's the most effective way of avoid me doing this under the condition of not hurting me.

(e) Yes, it's correct. Since it need to obey the three laws. It need to eliminate the possibility of potential harm to other people or the society. Since it can't stop me physically, depriving my permission to install or uninstall is really smart.

6.(a) $P(S_1 = \text{bull}) = 0.8 \times 1 = 0.8$

$P(S_1 = \text{bear}) = 0.2 \times 1 = 0.2$

$P(S_2 = \text{bull}) = P(S_2 = \text{bull} \mid S_1 = \text{bull}) P(S_1 = \text{bull}) + P(S_2 = \text{bull} \mid S_1 = \text{bear}) P(S_1 = \text{bear})$

$= 0.8 \times 0.8 + 0.3 \times 0.2 = 0.7$

(b) $P_\infty(\text{bull}) = P(\text{bull} \mid \text{bull}) P_\infty(\text{bull}) + P(\text{bull} / \text{bear}) P_\infty(\text{bear})$

$P_\infty(\text{bear}) = P(\text{bear} \mid \text{bull}) P_\infty(\text{bull}) + P(\text{bear} \mid \text{bear}) P_\infty(\text{bear})$

$P_\infty(\text{bull}) = 0.8 P_\infty(\text{bull}) + 0.3 P_\infty(\text{bear})$

$P_\infty(\text{bear}) = 0.2 P_\infty(\text{bull}) + 0.7 P_\infty(\text{bear})$

$\Rightarrow P_\infty(\text{bull}) = \frac{3}{2} P_\infty(\text{bear})$ and $P_\infty(\text{bull}) + P_\infty(\text{bear}) = 1$

$\Rightarrow P_\infty(\text{bull}) = \frac{3}{5}, \quad P_\infty(\text{bear}) = \frac{2}{5}$

(c) $P(S_1 = \text{bull} \mid O_1 = \text{rising}) = \frac{P(S_1 = \text{bull}, O_1 = \text{rising})}{P(O_1 = \text{rising})}$

$= \frac{P(O_1 = \text{rising} \mid S_0 = \text{bull}) P(S_0 = \text{bull})}{P(O_1 = \text{rising})}$

$= \frac{0.7 \times 0.5}{0.5 \times 0.7 + 0.5 \times 0.2} = \frac{7}{9}$

(d) $P(S_2=\text{bull} \mid Q_2=\text{falling}) = \dfrac{P(S_2=\text{bull},\ Q_2=\text{falling})}{P(Q=\text{rising})}$

$= \dfrac{P(Q_2=\text{falling} \mid S_1=\text{bull})\ P(S_1=\text{bull})}{P(Q_2=\text{falling})}$

$= \dfrac{0.3 \times \frac{7}{9}}{0.3\times\frac{7}{9} + 0.8\times\frac{2}{9}} = \dfrac{21}{37}$

(e) Since the actual sequence is given, the observation for each state is independent from others in hidden Markov model.
Thus, $P = 0.2 \times 0.8 \times 0.7 = 0.112$

(f) Since S_1, S_2, S_3 are still bear, bear, bull, P is the same 0.112.

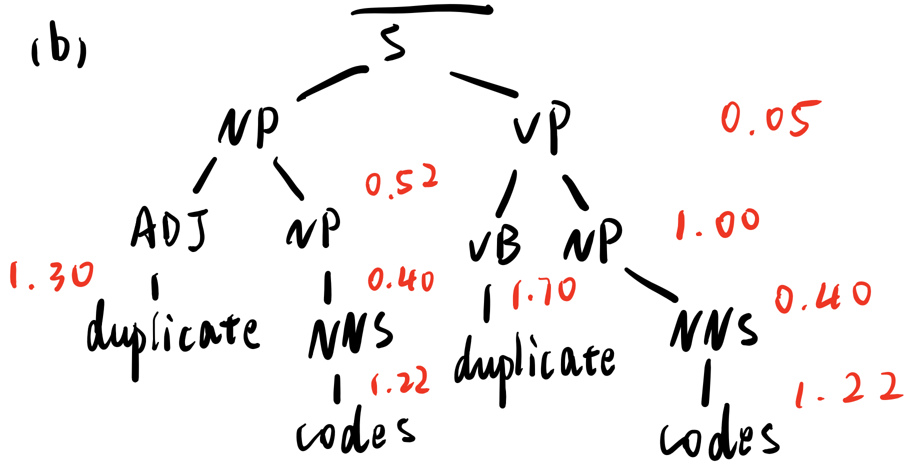
(g) The same likely.

(h) All bears. $S_0 = S_1 = S_2 = S_3 = \text{bear}$.
Then $P = 0.8 \times 0.8 \times 0.8 = 0.512$

7.(a)

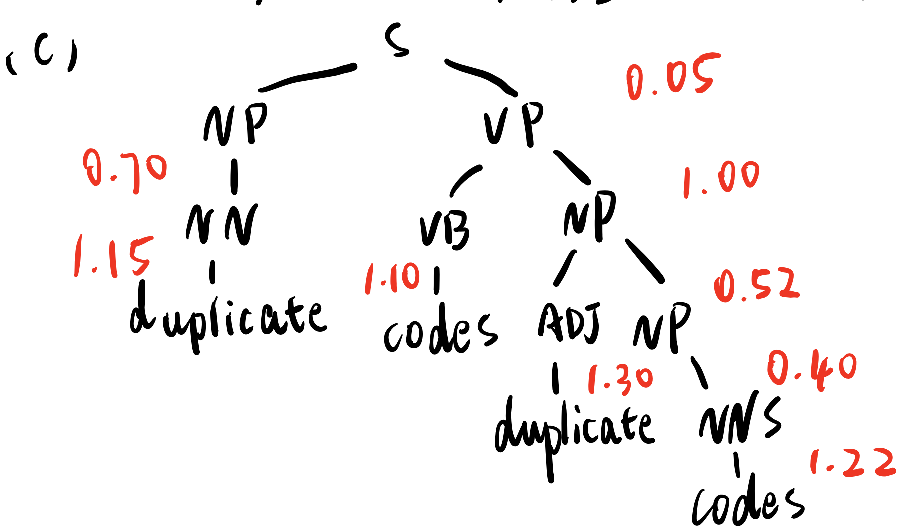
0.9	0.05	0.08	1.10
0.3	0.52	0.02	1.70
0.2	0.70	0.06	1.22
0.4	0.40	0.07	1.15
0.1	1.00	0.05	1.30
0.8	0.10		
0.5	0.30		

(b)



Score = 0.05 + 0.52 + 1.00 + 1.30 + 0.40 + 1.22 + 1.70 + 0.40 + 1.22 = 7.81

(c)



Score = 0.70 + 1.15 + 0.05 + 1.00 + 1.10 + 0.52 + 1.30 + 0.40 + 1.22 = 7.44

(d) $P_1 = 10^{-7.81} = 1.5 \times 10^{-8}$

$P_2 = 10^{-7.44} = 3.6 \times 10^{-8}$

$P_2 > P_1$, thus the second parse is more probable.