Question 3)

Ex 3.15>

NO, signs are not important ~~only~~
Interval between them is important

r_E → reward of hitting edge
r_A → reward for leaving box A or B.
r_B → " " " " B
r_0 → " " other action's

~~r_E~~
Suitable order
$r_E < r_0 < r_A, r_B$

$V_* = R_{t+1} + \gamma R_{t+2} \quad \cdots \quad \gamma^{n-1} R_{t+n}$

$= R_{t+1} + \gamma R_{t+2} \quad \cdots \quad \gamma^{n-1} R_{t+n} + c[1+\gamma+\gamma^2+\cdots\gamma^{n-1}]$

$V_c =$
$= V_* + c[1+\gamma+\gamma^2+\cdots\gamma^{n-1}]$

$V_c = c[1+\gamma+\gamma^2+\cdots\gamma^{n-1}]$

$V_c = c + c\gamma + c\gamma^2 + \cdots + c\gamma^{n-1}$
$-\gamma V_c = c\gamma + c\gamma^2 + \cdots + c\gamma^n$
$V_c \quad V_c(1-\gamma) = c(\gamma^n - 1)$

$V_c = \frac{c(\gamma^n - 1)}{1-\gamma} = \frac{c}{1-\gamma}$

[since $\lim_{n\to\infty} \gamma^n \to 0$ $|\gamma| < 1$

Ex 3.16 >

It will change the Maze running because in episodic task n is finite.

from equation's of 3.15

$$V_*^{\text{modified}} = V_*^{\text{original}} + \frac{c(\gamma^n - 1)}{1-\gamma}$$

so for different state's n will have different Value's.

Highest for starting state and lowest for least visited state.

Q 5)

$$V_\pi(s) = \sum_a \pi(a|s) \left(\sum_r \sum_{s'} p(s', r | s, a) [r + \gamma V_\pi(s')] \right)$$

$$= \sum_a \pi(a|s)\, q_\pi(s, a)$$

since $$q(s, a) = \sum_r \sum_{s'} p(s', r | s, a) [r + \gamma V_\pi(s')]$$

Ans 8 >

Yes, R_{t+2} depends of S_t, A_t

Let ;- S, R, A be the set of state, Reward action.

$S_1', S_2' \_\_\_\_ S_n'$ ~~be~~ represent state's after jumping to next state from initial state(s) by taking action ~~A~~ a.

$r(R_{t+2} \mid S_t = s, A = a)$ $r(.)$ → this represent PMF of R_{t+2}

Below expression represent probability being in S_i' from state s after taking action a.

$p(S_i') = \sum_r p(S_i', r \mid s, a)$ $p(.)$ is PMF. State is random variable

$E(S_i') = \sum\sum \sum \pi(a|s_i') \left(\sum_{s'} \sum rp(s', r \mid s_i', a) \right)$

$E(.)$ is ~~PMF~~ Expected reward in state s_i'

$$E[R_{t+2} \mid S_t = s, A_t = a] = \sum_{i=1}^{N} p(S_i') E(S_i')$$

Since $p(S_i')$ depends on S_t and A_t so, R_{t+2} also depend on S_t and A_t.

'N' is total number of states

Ans 9)

$$E[R_{t+2} \mid S_t = S, A_t = a] =$$

$$\sum_{i=1}^{N} p(s_i') E(s_i') \quad \text{from Ans 8.}$$

Ans 10)

$\pi(a|s)$ $a \in A$, $s \in S$ is given

$p(s', r|s, a)$ is also given.

$$V_\pi(s) = E(G_t \mid S_t = s)$$

$$= \sum_a \pi(a|s) E(G_t \mid S_t = s, A_t = a)$$

Solving for $E[G_t \mid S_t = s, A_t = a]$

$$= E[R_{t+1} + \gamma G_{t+1} \mid S_t = s, A_t = a]$$

$$= E[R_{t+1} \mid S_t = s, A_t = a] + \gamma E[G_{t+1} \mid S_t = s, A_t = a]$$

$$= \sum_{s'} \sum_r r\, p(s', r|s, a) + \gamma \sum_{s'} \sum_r p(s', r|s, a) V_\pi$$

— (ii)

Replace $E[G_t \mid S_t = s, A_t = a]$ by eq (ii)

$$V_\pi(s) = \sum_a \pi(a|s) \left(\sum_{s'} \sum_{r} p(s', r | s, a) [r + \gamma V_\pi(s')] \right)$$

Ans 11)

$= 2$

$= 0.5(-1) = -0.5$

$= (0.5)^2 (10) = 2.5$

$= (0.5)^3 (-3) = -0.375$

Let $E(G_t)$ be x

$$x = c + \gamma c + \gamma^2 c \quad \cdots \quad \gamma^{n-1} c \quad - (i)$$

$$x\gamma = \gamma c + \gamma^2 c + \quad \gamma^n c \quad - (ii)$$

subtract (ii) from (i)

$$x(1-\gamma) = c - \gamma^n c$$

$$x = E[G_t] = \frac{c(1-\gamma^n)}{1-\gamma}$$

Since $|\gamma| < 1$ and $n \to \infty$ so, $\lim_{n \to \infty} \gamma^n \to 0$

$$E[G_\infty] = \frac{c}{1-\gamma}$$

Ans 12> We have $V_*(s)$ $s \in S$.

for any state s in S.

~~$\arg\max_a \sum_{s'} \{\sum_r r[p(s', r|s, a) + \gamma V_*(s')]$~~

Below

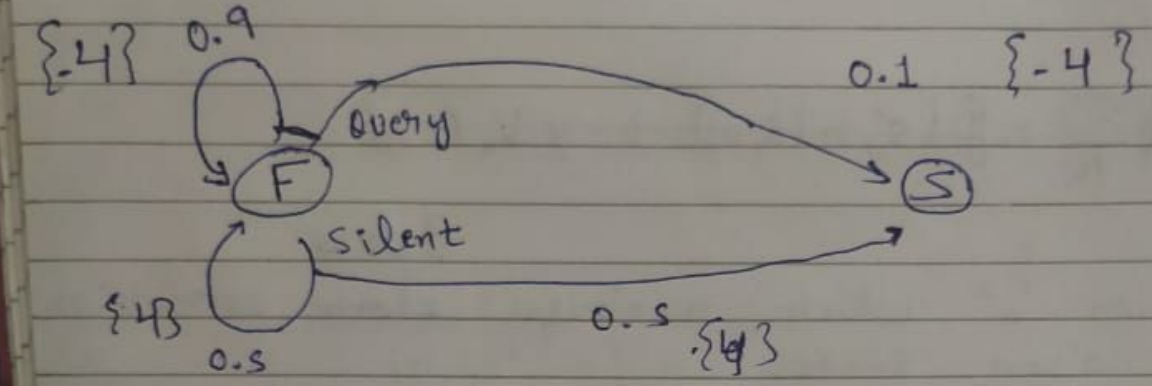
take action 'a' which maximises ~~above~~ expression for a given state.

~~if new $V_*(s)$ is greather than old $V_*(s)$ then replace old with new one.~~

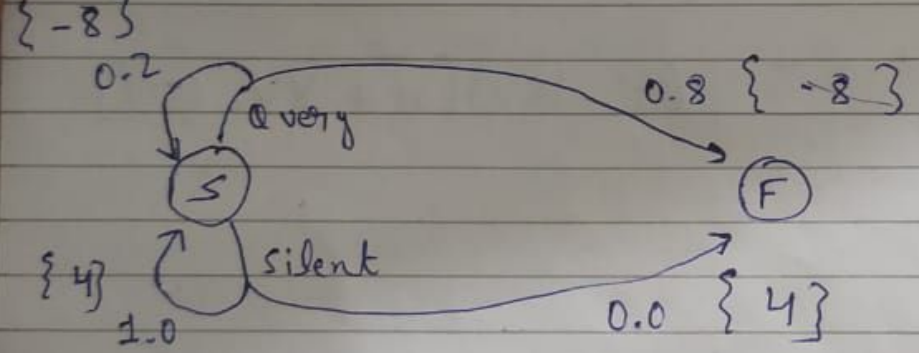
$$\arg\max_a \sum_{s'} \sum_r p(s', r|s, a)[r + \gamma V_*(s')]$$

Q 13

states = { fresh , stale }



{ I } represent ~~reward~~ reward



cost is converted into reward by changing sign.