Assignment

Course title: Neural Network and Fuzzy system

Course code: CSE-451

Submitted TO:

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Honor code

I am Kutub uddin bearing registration no 17010302O047 hereby declaring that I myself did my assignment, I didnit directly copy any code from others. I have a complete understanding of my solutions and I can explain. I respect this honor code and I belive it will be usefull to maintain academic Integrety.

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Date: 9/10/2020

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Ans: to the question - No-01 (a)

Soln

given That,

original image shape = (100, 100, 3)

filter size = (5 x 5 x 16)

stride = 1

pad = 0

Now,

the output shape is:

$$h' = 1 + \frac{h + 2 \times pad - hh}{Stride}$$

$$= 1 + \frac{100 + 2 \times 0 - 5}{1}$$

$$= 96$$

$$w' = 1 + \frac{100 + 2 \times 0 - 5}{1}$$

$$= 96$$

So output shape is (96, 96, 16)

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Ans: to the question - 2(b)

Sdn

Number of parameters =

$$((w \times h \times c) + 1) \times \text{number of filter}$$

$$= ((5 \times 5 \times 3) + 1) \times 16$$

$$= 76 \times 16$$

$$= 1216$$

Ans: to the question - No - 01(c)

Here
input shape (28 X 28 X 16)

filter ~~shap~~ = 8 with shap (1X1)

Now, out put shap will be

$$h' = 1 + \frac{h \times 2 \times pad - hh}{stride}$$

$$= 1 + \frac{28 \times 2 \times 0 - 1}{1} = 28$$

$$W' = 1 + \frac{w \times 2 \times pad - hh}{stride}$$

$$= 1 + \frac{28 \times 2 \times 0 - 1}{1} = 28$$

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So output shap = ~~(28 x 28 x 8)~~

= (28 x 28 x 8)

Ans: to the question - no-01 (d)

given That,

conv1 filter = 16

conv2 filter = 8

stride = 1

	Activation shap
# input layer	(100, 100, 3)
# conv1 (f=5, s=1)	(96, 96, 16)
# maxPool1 (2x2)	(48, 48, 16)
# conv2 (f=3, s=1)	(46, 46, 8)
# maxpool2 (2x2)	(23, 23, 8)

∴ conv2 output shap will be : ~~(48~~ (46, 46, 8)

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Ans: to the question-No-2

Given that,

Input: ~~Sing~~ single image x of shap (5x5x3)

(b) Two filter shap (3x3x3)

Two bias for filter $b_0 = 1, b_1 = 1$

stride = 1

output dimension calculation

$$h' = 1 + \frac{h \times 2 \times pad - hh}{stride}$$

$$= 1 + \frac{5 \times 2 \times 0 - 3}{1}$$

$$= 3$$

we know that,

$$y_{ij} = \sum_{k=0}^{hh} \sum_{i=0}^{ww} x_{i+k, j+l} \cdot x w_{kl} + b_i$$

For Filter w0:

$y_{00} = 4 + (-10) + 3 + 1 = -2$

$y_{01} = 6 + (-10) + (-6) + 1 = -9$

$y_{02} = 4 + (-12) + 0 + 1 = -7$

$y_{10} = 0 + (-2) + 0 + 1 = -1$

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$y_{11} = 0 + (-4) + (-9) + 1 = -12$

$y_{12} = -1 + 4 - 3 + 1 = 1$

$y_{20} = 0 + (-2) + 9 + 1 = 8$

$y_{21} = 1 + (-2) + 15 + 1 = 15$

$y_{22} = 2 + 4 + 12 + 1 = 19$

output 1

-2	-7	-7
-1	-12	1
8	15	19

For filter w_1

$y_{00} = -6 + (-6) + 21 - 1 = 8$

$y_{01} = -1 + 0 + (-9) - 1 = -11$

$y_{02} = 6 + 0 + (-12) - 1 = -7$

$y_{10} = -8 + (-12) + 15 - 1 = -6$

$y_{11} = -1 + 2 + (-6) - 1 = -6$

$y_{12} = 9 + 6 + (-9) - 1 = 5$

$y_{20} = -8 + (-10) + 6 - 1 = -13$

$y_{21} = -2 + 2 + (-3) - 1 = -4$

$y_{22} = 10 + 12 + (-6) - 1 = 15$

output 2

8	-11	-7
-6	-6	5
-13	-4	15

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Ans: to the question - No-3 (a)

a) Soln

The Fuzzy logic Theory provides a mathematical method to apprehend the uncertainties related to the human cognitive process. For example, Thinking and reasoning and it can also handle the issue of uncertainty and lexical imprecision.

fuzzy set	crisp set
A fuzzy set determined by its intermediate boundaries.	a crisp set is defined by crisp ~~boundeta~~ boundaries
fuzzy set elements are permitted to be party accommodated by the set.	crisp set elements can have a total membership or non-membership
fuzzy set follows The infinite-valued logic	crisp set is on bt-valued logic

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Ans: to the question - No - 3 (b)

Soh membership function:

A membership function define if an element is a part of a set or not

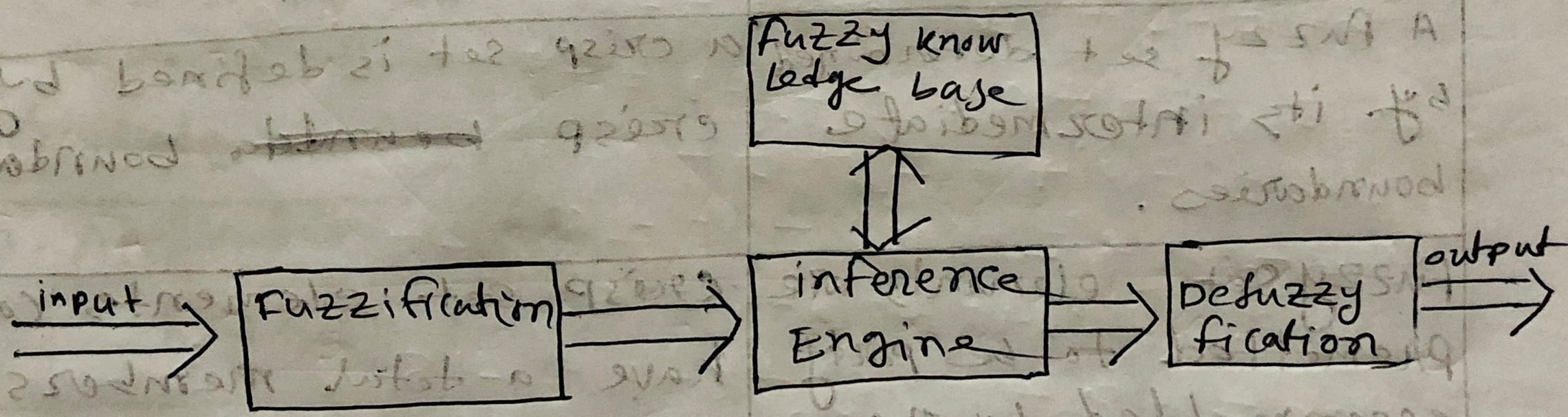
For example:

8 is not a membership of set A.

and 5 is a member ~~ship~~ of set A.

Fuzzy logic controller Architecture:

It has four main parts.



Fuzzification: it convert crisp input into fuzzy set. crisps values are the extract input measured by sensors.

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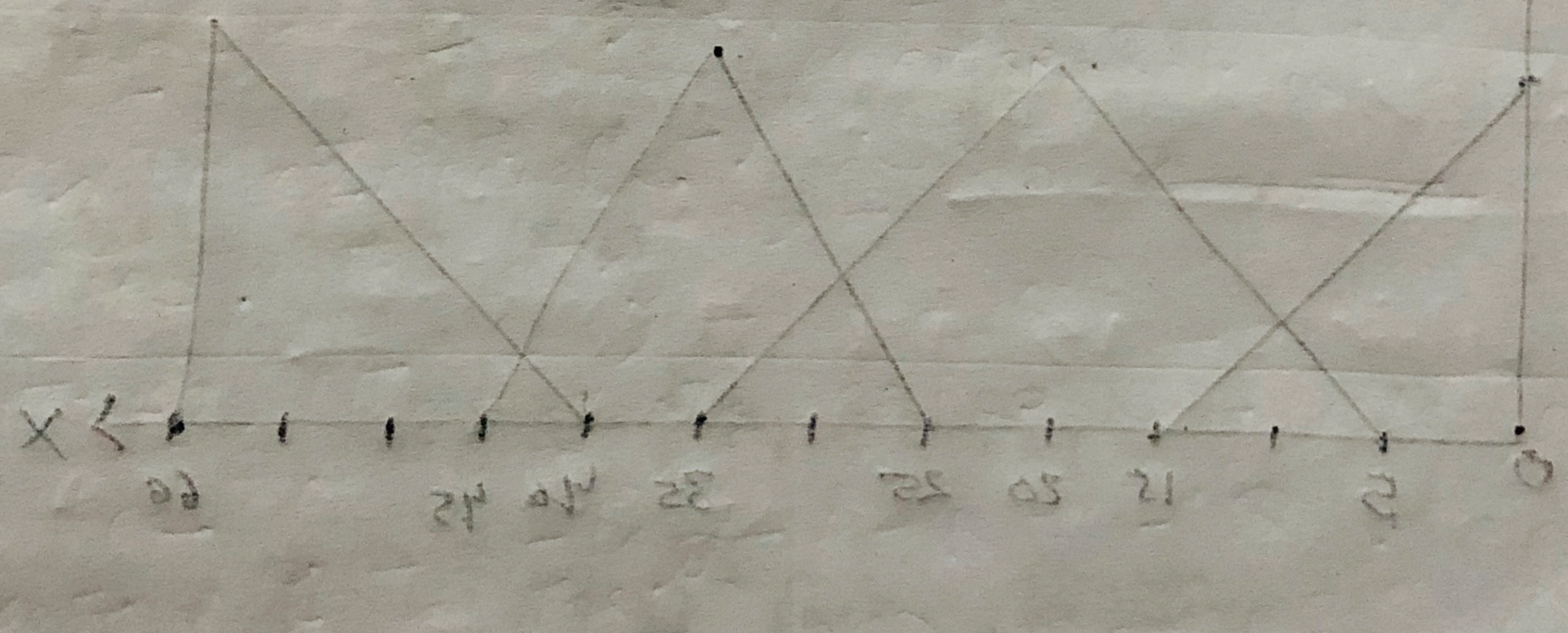
Fuzzy knowledge base:- It contains a set of If-Then rules carefully designed using linguistic variables.

Enference Engine: It makes decision using fuzzy logic based on the fuzzy inputs and rules.

Defuzzification: It converts fuzzy decision into crisp value.



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Ans: to the question-No-@3-(c)

Triangular membership function:

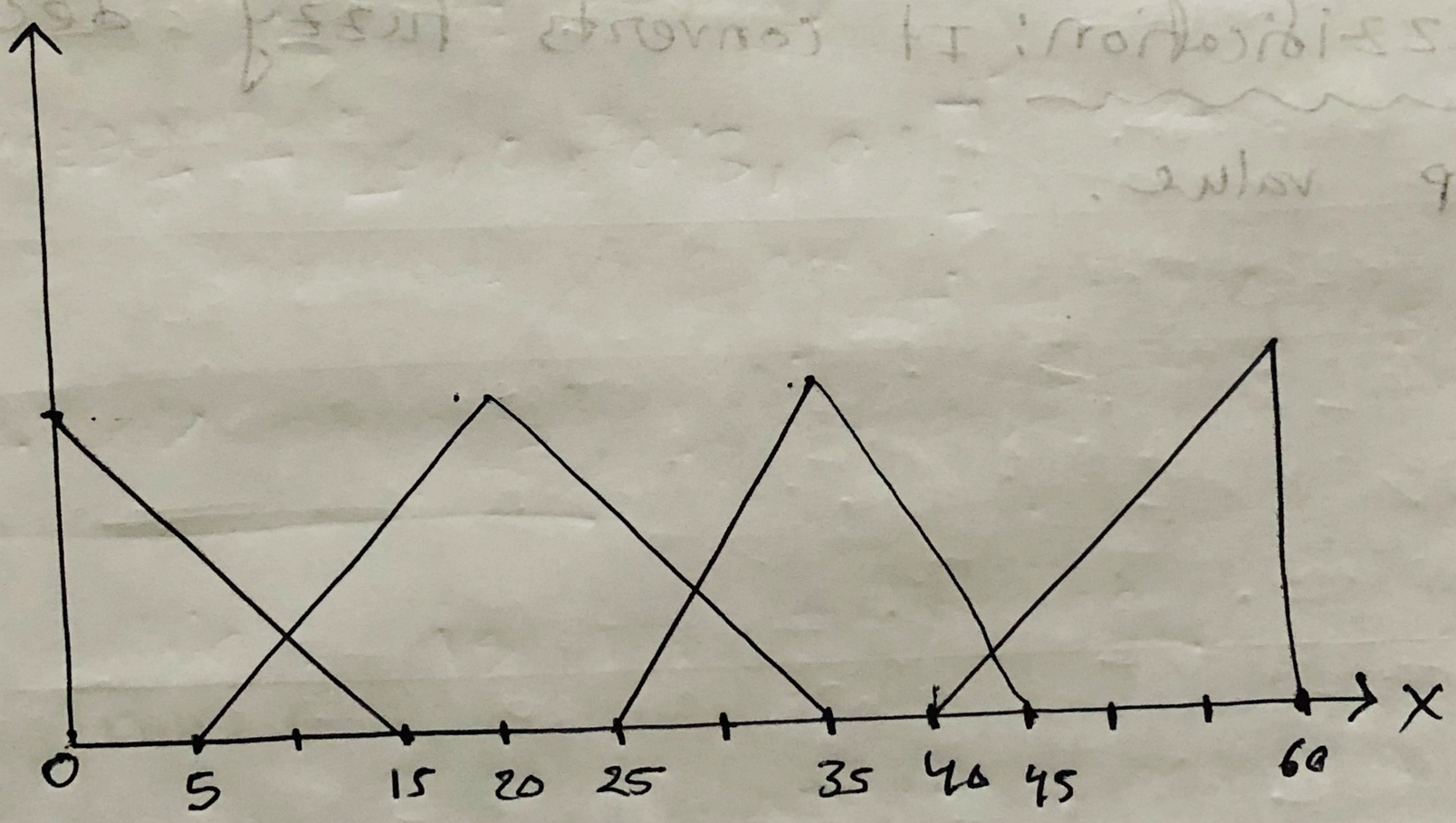
Here,

Cold = [0, 0, 15]

Normal = [5, 20, 35]

Hot = [25, 35, 45]

very Hot = [40, 60, 60]



Now Here crisp input

$T_1 = 4$

$T_2 = 28$

$T_3 = 37$

$T_4 = 42$

∴ Temperature (T_1) fuzzification:

$$Cold = \frac{15 - T_1}{15 - 0} = \frac{15 - 4}{15 - 0} = 0.266$$

$$Normal = \frac{t_1 - 5}{20 - 5} = \frac{11 - 5}{20 - 5} = 0.4$$

Hot = 0

Very Hot =

∴ fuzzy = [0.266, 0.4, 0, 0]

Temperature (t_2) fuzzyfication:

$T_2 = 28$

∴ Cold = 0

$$Normal = \frac{35 - t_2}{35 - 20} = \frac{35 - 28}{35 - 20} = 0.466$$

$$Hot = \frac{t_2 - 25}{35 - 25} = \frac{28 - 25}{35 - 25} = 0.3$$

Very Hot = 0

∴ Fuzzy = [0, 0.466, 0.3, 0]

temperature (t_3) fuzzification:

Here

$T_3 = 37$

Cold = 0

Normal = 0

$$\therefore Hot = \frac{45 - t_3}{45 - 35} = \frac{45 - 37}{45 - 35} = 0.8$$

very Hot = 0

∴ Fuzzy = [0, 0, 0.8, 0]

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Temperature (Tu) fuzzification:

here Tu = u2

Cold = 0

Normal = 0

$\therefore$ Hot = $\frac{u5 - tu}{45 - 35} = \frac{u5 - u2}{45 - 35} = 0.3$

$\therefore$ very Hot = $\frac{Tu - u0}{60 - u0} = \frac{u2 - u0}{60 - u0} = 0.1$

$\therefore$ Fuzzy = [0, 0, 0.3, 0.1]

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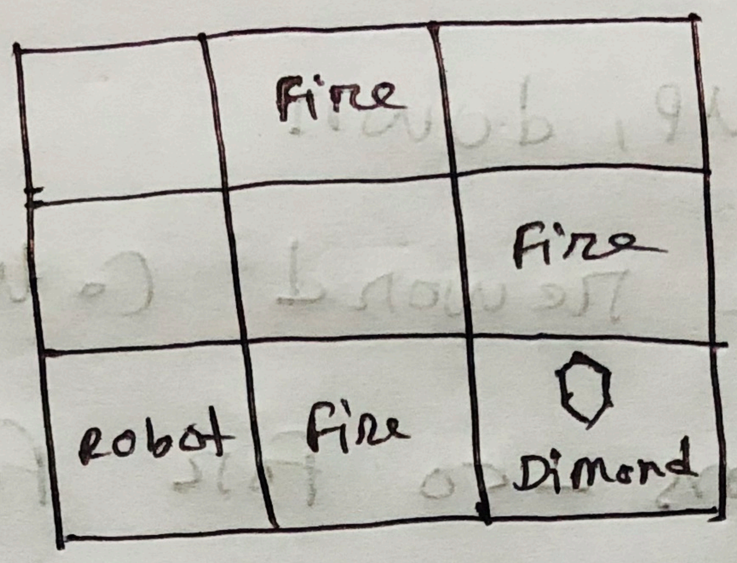
Ans: to the question - no - 4(a)



Game: Finding Diamond

The goal of the finding robot game to find the diamond. " Finding Diamond game marker Decission process (MDP)

will be —

① state: The states would be all of the sensor heading that robot get of each time step suppose when robot go to near of fire its bits sensor detet the nopness of state will be noting present, Fire present or diamond present

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② Action: The action could be move left, Right, UP, down

③ Reward: The reword could be -1 of every actions -50 for falling on the fire square, +1000 for getting Diamond

The markov decission process (MDP) of "Frozen Lake" is given below.

① State: The state would be walkable position, falling into the water, holes

② Action: The action could be move left, Right, UP, Down but often move position is not fixed as the environment is uncertain

Reward: The reward would be -1 for every move, -10 for falling on to the hole -5 for move to the unwalkable position and ~~+1000~~ +100 for reach the goal.

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Ans: to the question - no - 4(b)

- state value: our agent will follow a policy so its return a value for its each current policy or state. which is state value. Expected future return for a give state

$$V(s) = \mathbb{E}\left[G_t \mid S_1 = S\right]$$

$$V_\pi(s) = \mathbb{E}_\pi\left[G_t \mid S_t = S\right]$$

- Action value: From current state agent take an action. For each action agent Return a value which called action value.

$$q_\pi(S,a) = \mathbb{E}\left[G_t \mid S = S, \underbrace{A_t = a}_{\text{action value}}\right]$$

- policy: A policy defines the agents behaiver at a given time. A policy Is a mapping from perceived states of the environment to actions to be taken when in those state.

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- Reward signal: For each movment agent get a value as a reward suppose a self driving car as an agent if The car Reach destination then will get +10 reward or if crash then it will get -100 reward and each second = -1 it means maximize or minimize. The reward where feedback is delayed it is Reward signal.

- Markov property: suppose we have a car which is in running situation we know the current position of the car. But if we want to get the next position we have to know the current position also with current car speed of the car. So This has markov property.

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Ans: to the question - no - 4(c)

The value iteration algorithm:

The preceding example can be used to get the gist of a more general procedure called the value iteration algorithm. This allows us to numerically calculate the values of the states of markov decision processes with known transition probabilities and reward.

The idea behind the value iteration algorithm is to merge a truncated policy evaluation step & policy improvement into the same algorithm.

Basically, the value iteration algorithm computes the optimal state value function by iteratively improving the estimate of V(s). The algorithm initializes V(s) to arbitrary random values

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It repeatedly updates the Q(s,a) an V(s) values until the converge. value iteration is guaranteed to converge to the optimal values. The following pseudo - code express this proposed algorithm

Initialize V(s) to arbitrary values

Repeat until V(s) converge

FOR all states

$$Q(s,a) \leftarrow \sum_{s'} P^{a}_{ss'} \left(R(s,a) + \gamma V(s') \right)$$

$$V(s) \leftarrow \max_{a} Q(s,a)$$

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Ans: to the question - no-5 (a)

Soln

Transfer learning:

Transfer learning is a machine learning method where a model developed for a task is reused as the starting point for a model on a second task. It is a popular approach in deep learning where pre-trained models are used as the starting point on computer vision and natural language processing task given the vast compute and time resources required to develop neural Network models on These problem

For example: knowledge gained while learning to recognize cars could apply when trying to recognize trucks.

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Ans: to the question NO-5(5)

Soln

parameter	Hyper parameter
1. They are required for making prediction	1. They are required for estimating the model parameter
2. They are not set manually	2. They are set manually
3. The final parameter found after training will decide how the model will perform the unseen data	3. The choice of Hyper parameters decide how efficients The training is.

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Ans: to the question - No - 5(c)

Soln

Given That,

Input, $x = (2, 2, 1)$

weights, $w = (0.5, -0.2, 0)$

bias $b = 0.1$

Now

Transpose of w

$$w^T = \begin{pmatrix} 0.5 \\ -0.2 \\ 0 \end{pmatrix}$$

$$\therefore x \cdot w^T = (2 \times 0.5 + 9 \times (-0.2) + (1 \times 0))$$

$$= 1 - 0.4 + 0 = 0.6$$

$$\therefore x \cdot w^T + b = 0.6 + 0.1 = 0.7$$

For $\text{Relu}(0, 0.7) = 0.7$

For sigmoid, When Threshold 0.7, Then The sigmoid activation, we have activation output = 1

$$\therefore \text{sigmoid}, \sigma(z) = \frac{1}{1 + e^{-z}} = \frac{1}{1 + e^{-0.7}}$$

$$= 0.668$$

$$= 0.67$$

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Ans: to the question - no - 5(d)

soln

given that,

$$L_2 = [a_0, a_1, a_2, a_3, a_4, a_5]$$

value choose randomly

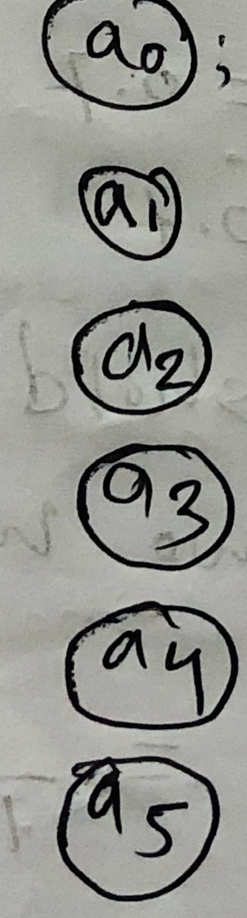
$$\pi = [\pi_0, \pi_1, \pi_2, \pi_3, \pi_4, \pi_5$$

$$\therefore \pi' = [0.2, 0.7, 0.9, 0.3, 0.6, 0.4]$$

∴ output will be ~~a~~ 2

$$L_3 = [a_0, a_0, 0, a_3, 0, a_5]$$

Now dropout a_1, a_2, a_4 & the L_3 layer becomes:



L_2

Fig: L_2 layer

a0 ; This is the L_2 layer

a0 ; keep a_0, a_3 & a_5

a_1

a_2

a3

a4

a5

L_3

Figure: output layer