CS-561 - Final Exam
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1)

(B) Given parents 1101101110
0101010001

⇒ Two-point crossover operator at positions 3 and 7

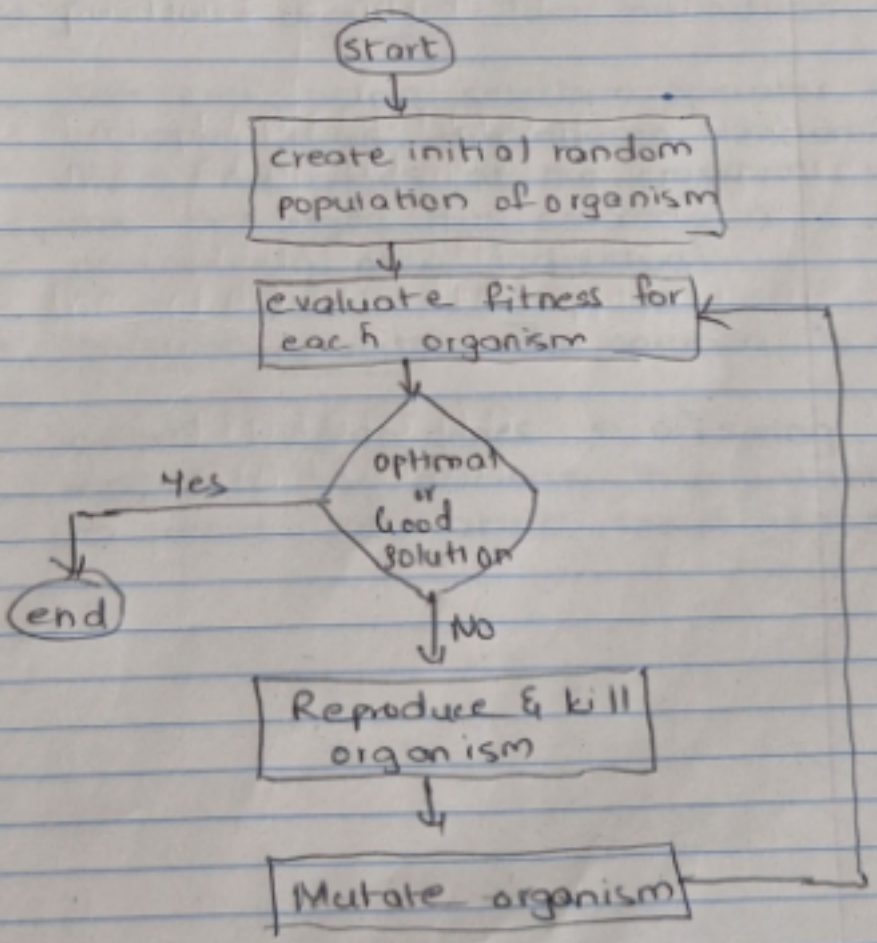
| | | |
|---|---|---|
| 1 1 0 | 1 1 0 1 | 1 1 0 |
| 0 1 0 | 1 0 1 0 | 0 0 1 |

⇒ The children after applying are

1101010110
0101101001

1

(A) Generate algorithms simulate the process of natural selection which means those species who can adapt to changes in theire environment are able to survive and reproduce and go to next generation.



Operators of Genetic Algorithm:

1) Selection operator: The idea is to give preference to the individuals with good scores and pass them to the successive generations.

2) Crossover operator: Two individuals are selected using selection operator and crossover sites are chosen randomly. Then the genes at the crossover sites are exchanged thus creating a completely new individual.

3) Mutation operator: This operator is to insert random genes in offspring to maintain the diversity in population to avoid premature convergence.

(i) The perception of optimal stability, problem better known as the linear support vector machine was designed to solve this problem that the best classifier is not necessarily that which classifies all the training data perfectly.

(d)

| Logic Programming | Neural Network |
| --- | --- |
| 1) It is a series of definitions that define the problem | 1) These are set of algorithms modeled after the human brain to recognize pattern |
| 2) It is used to express knowledge which does not implement program more flexible | 2) It is used to know the unseen relations in the unseen data. |
| 3) It mainly depends on reasoning and correct way of expressing. | 3) It is called as feature engineering it will solve on the right set of features for a problem |
| 4) These are not properly used due to lack of interest and investment | 4) These requires large dataset. i.e requires large amount of similar data to recognize. |
| 5) There is no proper way of representing computation concept | 5) These are expensive to train. |

2) Two fuzzy sets

tall = $0.1/4 + 0.2/4.5 + 0.4/5 + 0.6/5.5 + 0.9/6$

heavy = $0.1/100 + 0.3/130 + 0.5/150 + 0.7/200 + 0.8/300$

(a) not tall = 1 - tall

$$= \frac{1-0.1}{4} + \frac{1-0.2}{4} + \frac{1-0.4}{4} + \frac{1-0.6}{4} + \frac{1-0.9}{4}$$

$$= \frac{0.9}{4} + \frac{0.8}{4.5} + \frac{0.6}{5} + \frac{0.4}{5.5} + \frac{0.1}{6}$$

$$= 0.225 + 0.177 + 0.12 + 0.072 + 0.016$$

2) b) tall and heavy

⇒ AND means minimum value

$A \cap B = 0.1(4,100) + 0.1(4,130) + 0.1(4,150) + 0.1(4,200) + 0.1(4,300) + 0.1(4.5,100) + 0.2(4.5,130) + 0.2(4.5,150) + 0.2(4.5,200) + 0.2(4.5,300) + 0.1(5,100) + 0.3(5,130) + 0.4(5,150) + 0.4(5,200) + 0.4(5,300) + 0.1(5.5,100) + 0.3(5.5,130) + 0.5(5.5,150) + 0.6(5.5,200) + 0.6(5.5,300) + 0.1(6,100) + 0.3(6,130) + 0.5(6,150) + 0.7(6,200) + 0.8(6,300)$

$A \cap B$ :

| | 100 | 130 | 150 | 200 | 300 |
|---|---|---|---|---|---|
| 4 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 4.5 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 |
| 5 | 0.1 | 0.3 | 0.4 | 0.4 | 0.4 |
| 5.5 | 0.1 | 0.3 | 0.5 | 0.6 | 0.6 |
| 6 | 0.1 | 0.3 | 0.5 | 0.7 | 0.8 |

tall $= \frac{0.1}{4}$ AND heavy $= \frac{0.8}{300}$

$\left\{ \frac{0.1}{4} + \frac{0.8}{300} \right\}$

2

(c) not tall or heavy

$$= \left\{ \frac{0.9}{4} + \frac{0.1}{100} + \frac{0.8}{4.5} + \frac{0.3}{130} + \frac{0.6}{5} + \frac{0.5}{150} + \frac{0.1}{0.6} + \frac{0.8}{300} + \frac{0.4}{5.5} + \frac{0.7}{200} \right\}$$

(d) very tall and very heavy

$$= \frac{0.1}{4.0} + \frac{0.8}{300}$$

(e) Joe is 6 feet and 150 pounds

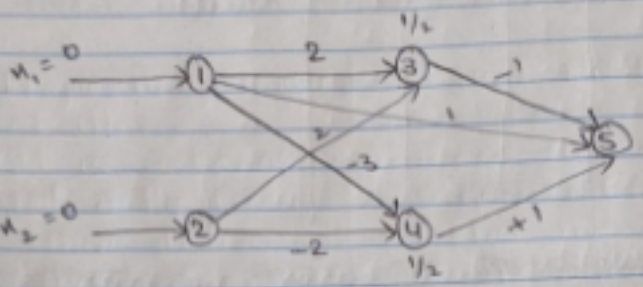
$$= \frac{0.9}{6} \qquad = \frac{0.5}{150}$$

output value $= (0.9 + 0.5) - (0.9 * 0.5)$

$= 1.4 - 0.45$

$= 0.95$

③




at node 3, there are two inputs to 3 from 1 and 2

output = weight * input value
= (0 x 2) + (0 x 2)
= 0

Given sigmoid function at 3 = $\frac{1}{1+e^{-x}}$

$= \frac{1}{1+e^{-0}}$

$= \frac{1}{2}$

at node 4, there are two inputs to 4 from 1 2 and 1

output = weight * input value
= (0 x -3) + (0 x -2)
= 0

Given sigmoid function at $u = \frac{1}{1+e^{-u}}$

$= \frac{1}{1+e^{-0}}$

$= \frac{1}{1+1} = \frac{1}{2}$

At node 5, there are three inputs from 1, 3, 4 to 5.

Output = weight x input value

$= \left(\frac{1}{2} \times -1\right) + \left(\frac{1}{2} \times 1\right) + 0(0 \times 1)$

$= \frac{1}{2} - \frac{1}{2}$

$= 0$

given sigmoid function at $5 = \frac{1}{1+e^{-y}}$

$= \frac{1}{1+e^{-0}}$

$= \frac{1}{1+1}$

$= \frac{1}{2}$

$= 0.5$

4)

| E1 | E2 | E3 | E4 | Guilty |
|---|---|---|---|---|
| 1 | 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 |

(a) Probability that sissy is the murderer given the available evidence

There are two guilty conditions

Fint condition

$= P(G=1) \Big/ E_1=1, E_2=1, E_3=1, E_4=0$

$= P(G=1) * P(E_1=1/G=1) * P(E_2=1/G=1) * P(E_3=1/G=1) * P(E_4=0/G=$

$= \frac{2}{5} * \frac{1}{2} * \frac{2}{2} * \frac{2}{2} * \frac{1}{3}$

$= \frac{1}{15}$

Second condition

$$P(G=1) \Big/ E_1=0, E_2=1, E_3=1, E_4=1$$

$$= P(G=1) * P\left(E_1=0 / G=0\right) * P\left(E_2=1 / G=1\right) * P\left(E_3=1 / G=1\right) * P\left(E_4=1 / G=1\right)$$

$$= \frac{2}{5} * \frac{2}{3} * \frac{2}{2} * \frac{2}{2} * \frac{1}{2}$$

$$= \frac{2}{15}$$

Answer = Firstcondition + Secondcondition

$$= \frac{1}{5} + \frac{2}{15}$$

$$= \frac{3}{15}$$

$$= \frac{1}{5}$$

(b) Probability she is not the murderer

$$= 1 - \frac{1}{5}$$

$$= \frac{4}{5}$$

4)

| $E_1$ | $E_2$ | $E_3$ | $E_4$ | Guilty |
|---|---|---|---|---|
| 1 | 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 |

(a) Guilty two cases he has 3 odds

$= \frac{3}{4} + \frac{3}{4} = \frac{3}{4}$

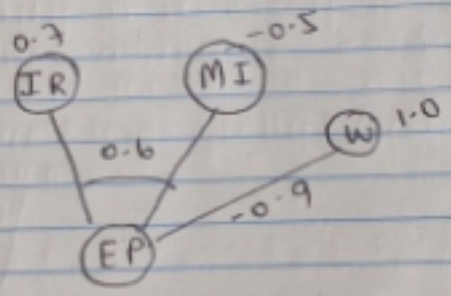
(b) $1 - \frac{3}{4} = \frac{1}{4}$

5) Given rules

if (inflation rate is) low and (manufacturing index) high then CF = 0.6

if (war) then (economic prosperity) CF = -0.9

if (economic prosperity) then (jobs) CF = 1.0




IR and MI = min (0.7, -0.5)
= -0.5 x weight
= -0.5 x 0.6
= 0.3

W = 1.0 * -0.9
= -0.9

EP = 1 - min (abs (0.3, -0.9))
= 1 - 0.3
= 0.7

6)

(a) Travelling Salesman Problem is the challenge of finding the shortest yet most efficient route for a person to take given a list of specific destinations. There are lot of different routes to choose from but finding the best one i.e least distance or cost is a toughest problem to solve. If we start at destination A, salesman has to find shortest route to A from all the destinations in middle

(b) TSP is an NP-complete problem that means if we had an efficient algorithm for any one of them we would have efficient algorithms for all of them. These are the hardest problems in NP. Till now no such efficient algorithm is found.

(c) If we use genetic algorithm for TSP

Fitness score is defined as the length of the path described by the gene. Lesser the path length fitter is the gene. The fittest of all the genes in the gene pool survive the population test and move to the next iteration

Mutation: Suppose there are 5 cities A, B, C, D, E, salesman is in city A and hast to find the shortest route to travel to A

It will represent as

A B D E C A