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Sessional-II (DE-36 CE)

Subject Code: EC-350
Subject: AI and DSS
Date: 11 Dec 2017
Timing: 1000 - 1100 hrs
Max Marks: 50
Max Time: 1 hr

Note: Attempt all 3 questions. Kindly write your name on the question paper and attach it with your answer sheet.

OBE Question: Q2

Q1. (4×2.5=10)

Suppose there is equality, $a + 2b + 3c + 4d = 30$, and Genetic Algorithm (GA) is used to find the values of a, b, c and d that satisfy the above equation. For this, GA uses chromosomes of the form x = a b c d, with a fixed length of four genes. Each gene can be any digit between 0 and 5. Let the initial population consist of four individuals with the following chromosomes:

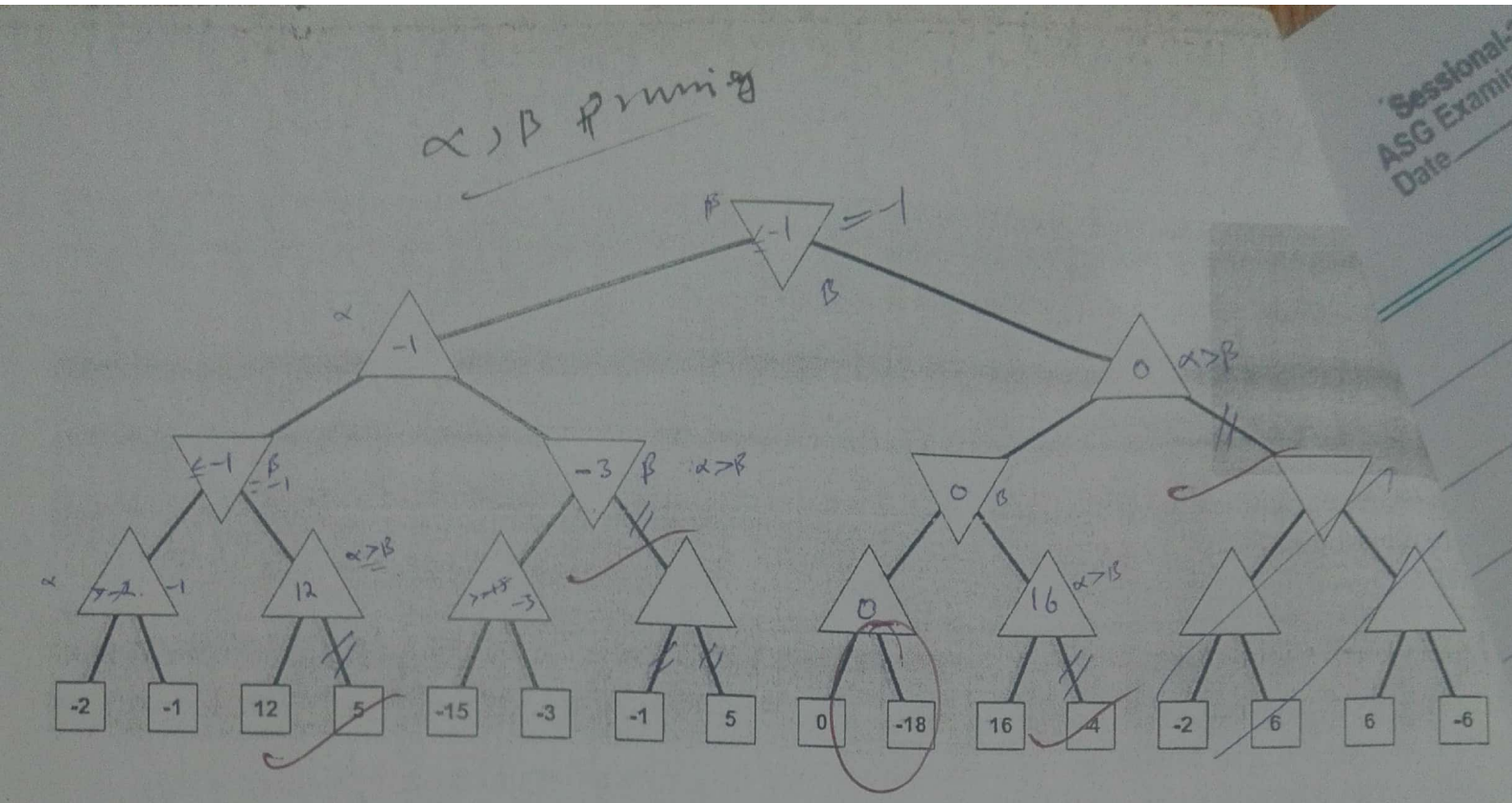
x1 = 3 5 3 5 x2 = 4 4 2 1 x3 = 1 2 4 5 x4 = 2 0 1 4

a) What is the fitness function f(x) for the above equation?
b) Evaluate the fitness of each individual, and arrange them in order with the fittest first and the least fit last.
c) By looking at the fitness function you formulated and considering that genes can only be digits between 0 and 5, find the chromosome representing the optimal solution.
d) By looking at the initial population of the algorithm, can you say whether it will be able to reach the optimal solution without the mutation operator and assuming crossover can be done at any point? Justify your answer.

Q2. (CLO 2 → PLO 2) (5+15=20)

A game tree of two players MAX and MIN is given below, where the **root node** is **MIN.**

a) Find the optimal path (sequence of moves) using **Minimax** algorithm by finding utility values at each node.
b) Now using **α-β pruning**, prune the tree wherever possible and also justify the pruning. Show the complete pruning steps and the final pruned tree.



Q3. (6+4+2+4+4=20)

The task is to recognize emotions from human speech. The data for 3 human emotions is given in table below, where pitch is measured as a feature from all speech samples.

Emotions	Happy	Anger	Sad	Anger	Sad	Sad	Anger	Anger
Pitch	34	35	37	39	40	41	44	47

a) Divide the data equally from halfway into **2 parts**. Use 1st part as training and 2nd part as testing. Using *k*NN classifier with *k*=3, compute the classification accuracy for the test data.

(b) Now use 2nd part of the data as training and 1st part as testing. Again calculate classification accuracy for the test data.

(c) Compute the average classification accuracy for part (a) and (b).

(d) Make a single confusion matrix based on the results calculated in part (a) and (b).

(e) Compute the individual accuracies for the **3** types of emotions using confusion matrix. Also compute the overall classification accuracy using confusion matrix.

Q. No: 1 ::

(a) What is the fitness function f(x) for the above equation? (eq = a+2b+3c+4d = 30)

```
def fitness (x)
    valA = x[0] + x[1]*2 + x[2]*3 + x[3]*4
    fitnessV = abs (30 - valA)
    return fitnessV
```

In the above function, value returned is the fitness measure. More it is close to zero more fit the chromosome is. Minimum is better. 2.5

(b) Evaluate & arrange. (x = a b c d)

x1 = 3 5 3 5

fitness val = abs(30 - (3 + 10 + 9 + 20))

fitness val = abs (30 - 42)

fitness val = 12.

x2 = 4 4 2 1

fitness val = abs (30 - (4 + 8 + 6 + 4))

fitness val = 8

$x_3 = 1\ 2\ 4\ 5$

fitness val = abs(30 − (1+4+12+20))

fitness val = 7

$x_4 = 2014$ fitness val = 9

Rearranging.

1 $x_3 = 1\ 2\ 4\ 5$

2 $x_2 = 4\ 4\ 2\ 1$

~~3 $x_1 = 3\ 5\ 3\ 5$~~

3 $x_4 = 2\ 0\ 1\ 4$

4 $x_1 = 3\ 5\ 3\ 5$

2.5

(c). Find the best chromosome.

We can formulate many solutions that will be optimal according to this function. One of them is.

$x_x = 2\ 1\ 2\ 5$

fitness val will be 0 for this chromosome.

2.5

(d)

Using only crossover chromosome can reach optimal solution.

Crossover x3 & x4 after 1st gene.

$x_{3'} = 1\ 0\ 1\ 4$

$x_{41} = 2\ 2\ 4\ 5$

Crossover x_{31} & x_1 after 2nd gene.

$x_{32} = 1035$

$x_{11} = 2214$

Fitness of $x_{32} = 1035$ is 0
it has achieved ~~most~~ optimal solution using only crossover.

2.5

Note ⇒ Done all calculations WITHOUT calculator. Kindly ignore calculation mistakes if any

Q3] where H → Happy A → Angry S → Sad

	Pitch	Emotions
1	3.4	H
2	3.5	A
3	3.7	S
	3.9	A
5	4.0	S
6	4.1	S
7	4.4	A
8	4.7	A

3 classes ⇒ H, A, S

Feature ⇒ Pitch

a) 1st part as Train 2nd part as Test

Use KNN k = 3

accuracy for test data

Training

① for ~~40~~ Pitch = 40

$d_1 = \sqrt{(40-34)^2} = 40-34 = 6$

$d_2 = 40-35 = 5$

$d_3 = 40-37 = 3$

$d_4 = 40-39 = 1$

Pitch	Emotions
① 34	H
② 35	A
③ 37	S
④ 39	A

k = 3 ⇒ d_2, d_3, d_4

↓ ↓ ↓

A S A

Testing

So class of ~~40~~ 40 = A

however predicted was S

Pitch	Emotions		Predicted
40	S	×	A
41	S	×	A
44	A	✓	A
47	A	✓	A

(2) for pitch = 41

$d_1 = 41 - 34 = 7$

$d_2 = 41 - 35 = 6$

$d_3 = 41 - 37 = 4$

$d_4 = 41 - 39 = 2$

$d_2 \to d_3, d_4$

↓ ↓ ↓

A S A

⇒ A

distance	pitch 44		pitch 47
pitch-34	10		13
pitch-35	9	d_2	12
pitch-37	7	d_3	10
pitch-39	5	d_4	8

d_2 d_3, d_4 (in both)

A S A

So again both have class A

$$\text{Accuracy} = \frac{\text{Correct}}{\text{Total}} = \frac{2}{4} = \frac{1}{2} \times 100$$

$$= 0.5 \times 100$$

$$= 50\%$$

(b) 2nd as training 1st as testing

$d_1 = \sqrt{(40 - \text{pitch})^2}$ $d_2 = \sqrt{(41 - \text{pitch})^2}$ $d_3 = \sqrt{(44 - \text{pitch})^2}$

$d_4 = \sqrt{(47 - \text{pitch})^2}$

	pitch			
	34	35	37	39
d_1	6	5	3	1
d_2	7	6	4	2
d_3	10	9	7	5
d_4	13	12	10	8

Training

1	40	S
2	41	S
3	44	A
4	47	A

In all cases we got minimum distances at d_1, d_2, d_3

d_1 d_2 d_3

S S A

So class is S

Testing

Pitch	Emotion		Predicted
34	H	X	S
35	A	X	S
37	S	✓	S
39	A	X	S

Accuracy = $\frac{\text{correct}}{\text{Total}} \times 100$

$= \frac{1}{4} \times 100 = 25\%$

(c) Avg classification Acc

Average = $\frac{0.25 + 0.5}{2} \times 100$

$= \frac{0.75}{2} \times 100$

$= 37.5\%$

(d) Confusion matrix

For Happy Mode

Class/Pred	H	A	S
H	TP	FN	FN
A	FP	TN	TN
S	FP	TN	TN