Genetic Algorithms (CS464)

ANSWER ALL QUESTIONS

1- Crossover and mutation are the main operators of a Genetic Algorithm.

a- Differentiate between single-point and multiple-point crossover, on both binary and floating point representations.

b- Show by example- using binary strings- how can a 2-point crossover be carried out.

c- Explain the operation of the mutation operator on both binary and floating point representations.

d- Discuss the mechanics of non-uniform mutation on floating point representation- Apply using the following function:

$$\Delta(t, y) = y.(1 - r^{(1 - t/T)})$$

where r is a random number from [0..1].

(6 points)

2- a- Prove that any string of length m is an instance of 2^m different schemas.

b- Define the fitness f of bit string x with length m = 4, to be the integer represented by the binary number x. (eg. f(0011)=3, f(1111)=15). What is the average fitness of the schema **1* under f? What is the average fitness of schema *0** under f?

(6 points)

3- Calculate the probability that a binary chromosome with length L will not be changed by applying the usual bit-flip mutation with Pm=1/L.

(6 points)

4- Given a medical cancer information system with governing variables x1, x2 and x3. It is required to infer the decision D. The following information is provided,

       x1 range 0..100 with fuzzy sets L, M, H.

       x2 range 0..100 with fuzzy sets L, M, H.

       x3 range 0..100 with fuzzy sets L, M, H.

and D with decisions Malignant: M and Benign: B.

The following decision blocks apply,

DB1:

       IF x1=L AND x2=L THEN y=L

       IF x1=M AND x2=H THEN y=H

DB2:

       IF x3=L AND y=L THEN D=B

       IF x3=M AND y=H THEN D=M

Intermediate variable y is

       y range 0..100 with fuzzy sets VL, L, M, H, VH

determine the decision D for x1= 30, x2=70 and x3=30.

(6 points)

5- Given a stock market information system with governing variables x1, x2 and x3. It is required to infer the decision D. The following information is provided,

       x1 range 0..100 with fuzzy sets L, M, H.

       x2 range 0..100 with fuzzy sets L, M, H.

       x3 range 0..100 with fuzzy sets L, M, H.

and D with decisions Sell:S and Buy: B and Hold: H.

The following decision blocks apply,

DB1:

       IF x1=L AND x2=L THEN y=L

       IF x1=M AND x2=H THEN y=H

DB2:

       IF x3=L AND y=L THEN D=B

       IF x3=M AND y=H THEN D=S

       IF x3=H AND y=M THEN D=H

Intermediate variable y is
    y range 0..100 with fuzzy sets VL, L, M, H, VH
determine the decision D for x1= 30, x2=70 and x3=30.
(6 points)

6-The conformational 3D structure of a chemical molecule defines its function. Each bond in the molecule has a 3-tuple <A, F, alpha> where A=distance in Angestroms, F=the force on the bond and alpha is its angle in 3D. Assuming that there is a tool that evaluates the energy of the molecule given the current set of 3-tuples and that the stable form of the molecule is that of lowest energy structure, Design a system with Genetic Algorithms that predicts the conformational 3D structure.
(6 points)

7-To predict the genes responsible of cancer, biopsy specimens are taken from donors, some with cancer and the rest free. Each specimen is placed on a chip called 'microarray' that determines the levels of activity of different genes. This data is ported into a datafile. It is required to design a system with genetic algorithms to predict the responsible genes.
(6 points)

8-Design a logic circuit with only NAND gates to perform XOR function with Genetic programming.
(6 points)

9-Evolve a fuzzy rule model for a stockmarket given previous history data. The antecedents of the fuzzy rules are OP=OpenPrice and PDP=Previous Day Price. The output of the rule is CP=ClosePrice. Design the model with genetic algorithms.
(6 points)

10-It is required to predict the path of a land-to-land missile given parameters such as time, pressure, angle, force, gravity and the missile coordinates in 3D. The missile should hit the target with accuracy 95%. Design the path with genetic algorithms.
(6 points)

AMR BADR