Cairo University **Final Exam**
Faculty of Computers & Information **Jan 2011**
Dept of Computer Science (BSc) **Time 2 hrs**

Genetic Algorithms

ANSWER ALL QUESTIONS

1- 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)

2- Discuss whether there is survival of the fittest in a generational GA.
(6 points)

3- Taking the reproductive schema growth equation of schema theory,

$$eta(S, t+1) = eta(S, t). eval(S, t)/ averagePopFitness(t) [1-Pc.d(S)/(m-1)-o(S).Pm]$$

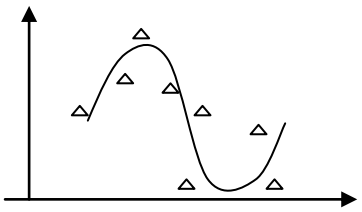
assume that $o(S).Pm = 0$ and $d(S) = m-1$, then the equation becomes:

$$eta(S, t+1) = eta(S, t). eval(S, t)/ averagePopFitness(t) [1-Pc]$$

Discuss the mechanics of the algorithm when $Pc = 0$ and $Pc = 1$ under the following conditions:
a- low population size
b- high population size
c- Elitism
(6 points)

4- Given a population of PopSize Individuals, which are bit-strings of length L. Let the frequency of allele 1 be 0.3 at position *i*, that is 30% of all individuals contains a 1 and 70% a 0. How does this allele frequency change after performing *k* crossover operations with one-point crossover?
(6 points)

5- The problem of interpolation of a curve given a set of data points is important in scientific and business domains. Design a system that performs such an interpolation as shown in the diagram below.



(6 points)

6- Usually when designing a neural network for a certain system, the number of hidden layer neurons is pre-set and the structure is fully interconnected. This is not the optimal case. These pre-set values and structure is not necessarily the best to generalize on a specific dataset. Design a system that evolves the optimal structure and number of hidden layer neurons given a certain problem.
(6 points)

7- A fuzzy system is composed of fuzzy sets and associated fuzzy rules. When designing a fuzzy system, the fuzzy sets are first pre-defined. Then, fuzzy rules are evolved that match the definition given for the fuzzy sets. This is not the optimal case. Defined fuzzy sets cannot sometimes describe the criteria of the problem under consideration. It is required to design a system that evolves optimal distribution of fuzzy sets. For simplicity, apply on triangular fuzzy sets.
(6 points)

8- Real-time optimization necessitates finding a good solution quickly. This problem is found in robot navigation where a robot tries to find its way out of a maze. A sample rule that can be applied to control robot actions is:

IF obstacle on right AND obstacle on front THEN turn left.

It is required to design a system that controls the actions of such a robot by real-time evolution of decision rules.
(6 points)

9- Lending Process is one of the main sources of money for banks. Banks take the data of customers before they accept or reject a customer. Some customers abide with pay times and some do not. It is required to design a system to determine the main criteria by which a bank can judge whether to accept or reject a new customer initially.
(6 points)

10- Consider Evolution Strategies

a-Write a basic algorithm for evolution strategies [2p]
b-Discuss the concept of the 1/5 rule. [2p]
c-Discuss the different strategies adopted for selection. [2p]
(6 points)

AMR BADR