Cairo University
Faculty of Computers and Information

Final Exam

Department: Computer Science
Course Name: Genetic Algorithms **Date: 3/1/2013**
Course Code: CS464 **Duration: 2 hours**
Instructor(s): Prof Dr Amr Badr **Total Marks: 60 marks**

ANSWER ALL QUESTIONS

Question 1 [6 marks]

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.

Question 2 [6 marks]

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, x2, 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 OR x2=L THEN y=L
IF x1=M AND x2=H THEN y=H
IF x1=H AND x2=M THEN y=M

DB2:

IF x3=L AND y=L THEN D=B
IF x3=M OR not 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.

Question 3 [6 marks]

Discuss whether there is survival of the fittest in a generational GA.

Question 4 [6 marks]

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: low population size, high population size and Elitism.

Question 5 [6 marks]
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?

Question 6 [6 marks]
Design a Genetic Algorithm for the the design of a fighter aircraft. Assume that parameters x1…xm affect the design. It is required for the aircraft to minimize it size (so that it is not detected by radars quickly) and to maximize its capacity of bombs and air-to-air missiles. Design the objectives and operators of the genetic algorithm.

Question 7 [6 marks]
Given a base unit of a 4-bit adder. It is required to design a 'general' adder for n-bits using genetic programming.

Question 8 [6 marks]
Consider the problem of desalination of sea water. It is required to design a system for the dynamic control of the amount of dissolvents (minerals) dissolved in water so that it is suitable for drinking. As it is known, drinking water that is not composed of a minimal amount of minerals causes sickness to humans. You should show all operators and aspects of the designed system.

Question 9 [6 marks]
Consider the problem of control of a nuclear plant. It is required to design a system for the efficient, fast and dynamic control of the nuclear plant taking into account the main indicators of catastrophe. Show your design and assumptions clearly.

Question 10 [6 marks]
Design a genetic programming system that acts as a classifier to a given dataset. Assume the dataset is composed of x1…xm inputs and one output y.