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Main EXAM
COSC 6367
Evolutionary Programming
Fall 1997

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Grade:

The test is open text book. You have 110 minutes to complete the test. The test is slightly too long. I assume you solve 90% of the problems in the available time.

Do not write on separate sheets of paper. If you do not have sufficient space use additional pages at the end or back sides. Write your socsec. number on every sheet.

1) TRANSPORTATION PROBLEM [18]

a) Apply the initialization procedure discussed on page 186 of our textbook to the following transportation problem assuming the following sequence of (unvisited) random numbers: 2-3-4-5-6-7-8-9-10-11-12-1. What does the obtained matrix look like? [6]

b) What drawbacks do you see in the initialization procedure, if it is applied to non-linear, real-valued transportation problems? Propose a method to overcome the drawback! [8]

c) Assume you have to solve a non-linear balanced transportation problem that allows for real-valued solutions using an EP-approach. What crossover operator would you use and why? [4]

2) APPLY EC TO A PROBLEM[18]
Assume you have to use EC to solve the following "Mastermind" problem: the objective is to find the correct color assignment for a 1024x1024 chess board — each position can be colored either green, yellow, red or blue. There is an oracle function *ora* that you can call for a given color map that gives you the number of correctly assigned colors for the given map. The objective is to find the correct color assignment for the 1024x1024 chess-board using an evolutionary computing approach (minimizing the number of calls of *ora*). Describe your EC-approach, including the chosen chromosomal representation, selection method, crossover and mutation operators... you plan to employ to solve the above problem!

3) USING EC FOR NUMERICAL OPTIMIZATION [10]
Assume that the following 6-variable function $f(x_1, x_2, x_3, x_4, x_5, x_6)$ has to be maximized:
$f(x_1, x_2, x_3, x_4, x_5, x_6) := e^{(x_1+x_2+x_3+x_4+x_5*x_5)} - x2*x5*x6 - x3*x6$
with the following constraint:
(C) $x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 + x_6^2 \leq 1$
Give a sketch(**not a detailed description with justifications**) how an evolutionary computation approach could solves the above maximization problem might look like. Specify the chromosomal representation, your fitness function, and the genetic operators you might employ for this problem. Explain how your approach will cope with the constraint C!

4) PREMATURE CONVERGENCE [6]
Assume you apply a classical GA that employs crossover, mutation and roulette wheel selection to particular problem, and you face the problem of premature convergence when running your GA. What system parameters would you change in your efforts to overcome the problem? Do you think that scaling the fitness function might be helpful to overcome premature convergence? Give reasons for your answers!

5) QUESTIONS [20]

a) What is difference between ES(4+7) and ES(4,7)? [3]

b) How does the crossover operator in genetic programming work? [3]

c) What is symbolic regression, and how is it different from classical regression? [3]

d) What is gametogenesis and how is it different from classical GAs? [5]

d) In project1 you developed a system that computes distance preserving mapping from n-dimensional to 2-dimensional space. What commericial and scientific applications do you see for using such a system? [6]

6) BUCKET BRIGADE ALGORITHM [10]
In traditional classifier systems a chain of rules frequently solves a problem jointly. How does the classical bucket brigade algorithm make sure that rules responsible for a particular, correct decision are rewarded equally? How does the classical bucket brigade algorithm make sure that rules responsible for a particular, incorrect decision are punished? What role does the bucket brigade algorithm play in traditional classifier systems?