VRIJE UNIVERSITEIT AMSTERDAM
EXAM EVOLUTIONARY COMPUTING
12.08.2002

Note 1 Your name must be written on each sheet in CAPITALS.

Note 2 You can answer the questions in English or in Dutch.

Points to be collected: 62.

Your grade: points collected divided by 6.2 and rounded up.

1. We are to solve a travelling salesman problem with evolutionary computing. That is, we have 50 cities and we know the pairwise distances between them (say, by a a lookup table). We are looking for the shortest round trip through all cities containing each city exactly once. Specify an EA suitable[1] for solving this problem. In particular, give

   (a) **(4p)** a representation (the syntax of the chromosomes and a mapping between chromosomes and round trips),

   (b) **(4p)** a fitness function (how the data are used for evaluating chromosomes),

   (c) **(2p)** an appropriate selection mechanism,

   (d) **(2p)** an appropriate crossover operator,

   (e) **(2p)** an appropriate mutation operator,

   (f) **(2p)** a stop condition.

2. Explain what the following notions mean in EAs and illustrate each type with a simple example:

   (a) **(3p)** deterministic parameter control,

   (b) **(3p)** adaptive parameter control,

   (c) **(3p)** self-adaptive parameter control.

3. Sketch the differences and similarities between Genetic Algorithms, Evolution Strategies and Evolutionary Programming with respect to

   (a) **(3p)** representation,

   (b) **(3p)** mutation,

   (c) **(3p)** crossover,

   (d) **(3p)** self-adaptation.

   Make a table to present your comparison.

[1] The EA does not have to be "smart" (efficient). But the representation and the operators should be such that a solution can be found.

4. **(3p)** Consider the following statement:

   'There is no survival-of-the-fittest in a generational GA.'

   Is this true or not? Give arguments.

5. Give the definition of

   (a) **(2p)** a schema (in GAs),

   (b) **(2p)** instance of a schema,

   (c) **(2p)** order of a schema,

   (d) **(2p)** length of a schema,

   (e) **(2p)** fitness of a schema.

   (f) **(4p)** What is the Schema Theorem in GAs?

6. **(4p)** Given the mutation rate p_m in a GA, what is the probability that a certain binary chromosoom of length L will not be changed by bit-flip mutation?

7. (a) **(2p)** To what type of problems is Genetic Programming well-suited (e.g., optimization, classification, constraint satisfaction, machine learning, etc.)?

   (b) **(2p)** What is the most distinguishing feature (e.g., representation, crossover/mutation, selection, etc.) of Genetic Programming with respect to other EC "dialects"?