Exam Evolutionary Computing
8. 1. 2015

NOTES:

1. YOUR NAME MUST BE WRITTEN ON EACH SHEET IN CAPITALS.
2. Answer the questions in English.
3. Points to be collected: 90, free gift: 10 points, maximum total: 100 points.
4. Grade: total number of points divided by 10.
5. This is a closed book exam (no materials are allowed).

QUESTIONS

1. You have to solve a cutting problem for a glass production company using an evolutionary algorithm. You are given large rectangular sheets of glass of dimensions $W \times H$. These master sheets have to be cut into identical smaller panels of given dimensions $a \times b$. The goal is to have as many small panels as possible cut out of every large master sheet. Because of the glass cutting method, only orthogonal cuts are allowed and a cut must completely bisect the enclosing rectangle. Please specify:
   (a) **(5 pt)** a representation, that is, the syntax of the chromosomes (genotypes) and a mapping between chromosomes and phenotypes,
   (b) **(5 pt)** an appropriate fitness function,
   (c) **(2 pt)** an appropriate recombination operator,
   (d) **(2 pt)** an appropriate mutation operator,
   (e) **(2 pt)** an appropriate parent selection mechanism,
   (f) **(2 pt)** an appropriate survivor selection mechanism,
   (g) **(2 pt)** an initialization method,
   (h) **(2 pt)** a stop condition,
   (i) **(8 pt)** how your EA handles constraints (if applicable).
2. (a) **(3 pt)** What is the difference between a permutation representation and an integer representation?
   (b) **(3 pt)** Name 3 mutation operators for a permutation representation and explain them.
   (c) **(3 pt)** Explain how discrete recombination operators work on a real valued representation.
   (d) **(3 pt)** Name 3 fitness based replacement strategies and explain them.
   (e) **(3 pt)** What is the difference between $(\mu + \lambda)$-selection and (μ, λ)-selection and when is one preferred above the other?

3. (a) **(3 pt)** What are the typical stages in optimising on a 1-dimensional fitness landscape? Describe each stage.
   (b) **(4 pt)** Draw the general scheme of EAs
   (c) **(8 pt)** How can you compare the performance of two different EAs?

4. (a) **(2 pt)** For what kind of problems is differential evolution typically applied to?
   (b) **(5 pt)** Give the technical summary tableau of a differential EA.
   (c) **(5 pt)** Show with an example how the evolutionary cycle of a differential EA works (hint: you need a mutant vector)

5. Describe two parameter control mechanisms for the mutation probability p_m parameter of a GA with binary representation.
   (a) **(5 pt)** An adaptive with local (individual) scope.
   (b) **(5 pt)** A self-adaptive with a global (population) scope.

6. **(8 pt)** Consider the following statement:

   'Recombination is more useful than mutation.'

   Is this statement correct or not? Give arguments.