
Assignment One Grading Rubric

Wang Liang

1. *Explain why the order in which items are listed in the representation is unimportant for the naïve approach to the knapsack problem, but makes a big difference if we use the decoder approach.*

- a) In naïve representation, every bit in the genotype is translated into the phenotype, so the order is unimportant. – 2 Points
- b) Basic illustration of decoding scheme – 6 Points
- c) In representation with decoding, for the same genotype, different item order may be decoded into different phenotypes. So the order is important – 2 Points

If some statement is ambiguous but related to a key point from the above, half score will be given.

2. *Find a problem where EAs would certainly perform very poorly compared to alternative approaches. Explain why you expect this to be the case.*

This is an open-ended question. Many answers deserve full score.

In some cases, 1 point is taken if someone doesn't offer an alternate approach in solving the specific problems in which GA performs poorly.

3.

[20 points] The $subset_{21}$ problem is stated as follows. Given a set of N positive integers $X = \{x_1, x_2, \dots, x_n\}$. Find a subset P of the set X such that the sum of the elements of P is equal to 21. For example, if $N=5$ and the set $X = \{12, 17, 3, 24, 6\}$, the set $P = \{12, 3, 6\}$ is a valid solution for the $subset_{21}$ problem in this example.

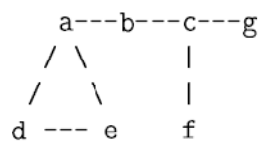
Formulate the $subset_{21}$ problem as a Genetic Algorithm optimization. You may use binary representation, OR any representation that you think is more appropriate. you should specify:

- A fitness function. Give 3 examples of individuals and their fitness values if you are solving the above example (i.e. $X = \{12, 17, 3, 24, 6\}$).
 - A set of mutation and/or crossover and/or repair operators. Intelligent operators that are suitable for this particular domain will earn more credit.
 - A termination criterion for the Genetic Algorithm optimization which insures that you terminate with a valid solution for the $subset_{21}$ problem if a solution exists.
- a) Fitness function: many answers are appropriate. (10 points). But if someone chooses the fitness function without taking the absolute value, such as (21-SumOfSubset), 4 points will be taken because GA can not work in that way. And if the illustrative examples are not given, 1 point off.
 - b) Mutation or Crossover operations: any operations suitable for integer representation can earn full credit. (5 points)
 - c) Termination Criteria: should be coherent with the fitness function and guarantee a valid solution when terminated. (5 points).

4.

[20 points] The **graph k-coloring** problem is stated as follows: Given an undirected graph $G = (V, E)$ with N vertices and M edges and an integer k . Assign to each vertex v in V a color $c(v)$ such that $1 \leq c(v) \leq k$ and $c(u) \neq c(v)$ for every edge (u, v) in E . In other words you want to color each vertex with one of the k colors you have and no two adjacent vertices can have the same color.

For example, the following graph can be 3-colored using the following color assignments: $a=1, b=2, c=1, d=2, e=3, f=2, g=3$



Formulate the **graph k-coloring** problem as an evolutionary optimization. You may use a vector of integer representation, OR any representation that you think is more appropriate. you should specify:

- A representation.
 - A fitness function. Give 3 examples of individuals and their fitness values if you are solving the above example.
 - A set of mutation and/or crossover and/or repair operators. Intelligent operators that are suitable for this particular domain will earn more credit.
 - A termination criterion for the Genetic Algorithm optimization which insures that you terminate with a valid solution for the **graph k-coloring** problem if a solution exists.
- a) Representation: integer or permutation representation (5 points)
 - b) Fitness function: number of conflicts or any other suitable fitness functions. (10 points). If the fitness function is not to be minimized or maximized, 4 points off. And if the illustrative examples are not given, 1 point off.
 - c) Mutation or Crossover operations: any operations appropriate for the selected representation will be acceptable. If the operations are not for the selected representation, 2 points off. (4 points)
 - d) Termination Criteria: should be coherent with the fitness function and guarantee a valid solution when terminated. (1 points).