

CSCI 4560/6560 Evolutionary Computation

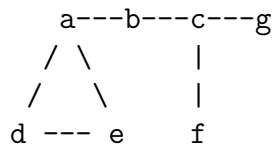
Assignment Number 1: Due 9/14/2023 (by eLC)

1. [20 points][MID] 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 or Evolutionary Algorithm optimization. You may use binary 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 (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 evolutionary optimization which insures that you terminate with a valid solution for the $subset_{21}$ problem if possible without running indefinitely.
2. [20 points][MID] 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:

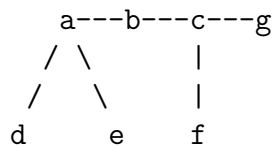
- A representation.

- 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 evolutionary optimization which insures that you terminate with a valid solution to the **graph k-coloring** problem if possible without running indefinitely.

3. [20 points][FIN]

The **minimum vertex cover** problem is stated as follows: Given an undirected graph $G = (V, E)$ with N vertices and M edges. Find a minimal size subset of vertices X from V such that every edge (u, v) in E is incident on at least one vertex in X . In other words you want to find a minimal subset of vertices that together touch all the edges.

For example, the set of vertices $X = \{a, c\}$ constitutes a minimum vertex cover for the following graph:



Formulate the **minimum vertex cover** problem as a Genetic Algorithm or another form of evolutionary optimization. You may use binary 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 evolutionary optimization which insures that you terminate with a valid solution to the **minimum vertex cover** problem if possible without running indefinitely.