CSCI 4560/6560 Evolutionary Computation

Assignment Number 1: Due 9/22/2022 **(by eLC)**

1. **[20 points]**[**MID**] The $subset_{21}$ problem is stated as follows. Given a set of N positive integers $X = \{x_1, x_2, \ldots, x_n\}$. 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

```
    a---b---c---g
   / \      |
  /   \     |
 d --- e    f
```

   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:

```
    a---b---c---g
   / \      |
  /   \     |
 d     e    f
```

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.