

# CSCI 4560/6560 Evolutionary Computation

## Assignment Number 1: Due 9/11/2014 (in class)

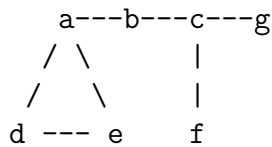
1. [20 points][MID] The *subset<sub>21</sub>* problem is stated as follows. Given a set of N positive integers  $X = \{x_1, x_2, \dots, x_n\}$ . Find a subset  $P$  of the set  $X$  such that the sum of the elements of  $P$  is equal to 21. For example, if  $N=5$  and the set  $X = \{12, 17, 3, 24, 6\}$ , the set  $P = \{12, 3, 6\}$  is a valid solution for the *subset<sub>21</sub>* problem in this example.

Formulate the *subset<sub>21</sub>* 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 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<sub>21</sub>* 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:

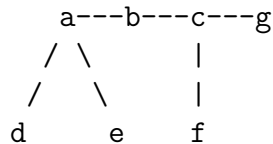
- A representation.
- A fitness function. Give 3 examples of individuals and their fitness values if you are solving the above example.

- 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 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.