CSCI 4560/6560 Evolutionary Computation
Final Exam - Fall 2019

NAME:

Problem(1):

Problem(2):

Problem(3):

Problem(4):

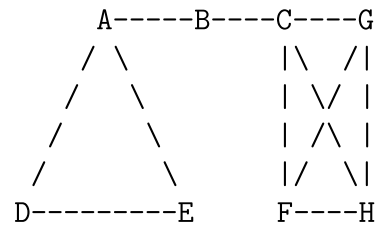
Problem(5):

Total:

1. **[10 Points]**

   The **Maximal Clique** problem is stated as follows: Given an undirected graph $G = (V, E)$ with N vertices and M edges. Find a maximal size subset of vertices X from V such that every pair of vertices u and v in X are directly connected with an edge (u, v) in E. In other words you want to find a maximal fully-connected subset of vertices.

   For example, the set of vertices $X = \{\text{C,F,G,H}\}$ constitutes a Maximal Clique for the following graph:



   Formulate the **Maximal Clique** problem as a Genetic Algorithm or another form of evolutionary optimization. You should specify:

   (a) A representation

   (b) A fitness function. Give 3 examples of individuals and their fitness values if you are solving the above example.

   (c) A set of mutation and/or crossover and/or repair operators. Intelligent operators that are suitable for this particular domain will earn more credit.

   (d) A termination criterion for the evolutionary optimization.

2. **[10 points]: Short answers please**

   (a) What is the main feature distinguishing each of the following from other evolutionary computation approaches:

      i. Genetic programming

      ii. Michigan approach classifier systems

   (b) Briefly describe two different methods for adaptive parameter control in evolutionary optimization.

   (c) Give the name of one genetic operator that exhibits positional bias and one that exhibits distributional bias.

   (d) What is over-selection in genetic programming?

3. **[10 points]:**

Consider a genetic algorithm using binary representation with strings of length 5. The fitness is to be maximized. Assume that the initial population was as follows:

Individual	Genotype	Fitness
1	10001	A
2	11100	B
3	00011	C
4	01110	D

Assume also that a Goldberg-style canonical generational GA (using proportional selection, 1-point crossover and bit mutation) is used with mutation probability $p_m = 0.01$ and crossover probability $p_c = 1.0$. The population size is kept constant at 4 individuals and all intermediate populations have 4 individuals also.

(a) If A = B = C = D = 10, what is the expected number of instances of the following schemata in the **mating pool**: 1****, 001**.

(b) If A = B = 10 and C = D = 20, what is the expected number of instances of the following schemata in the **mating pool**: 0****, 100**.

(c) Give a set of values for A, B, C, and D which makes the expected number of instances of schema 1**** in the **mating pool** twice the expected number of instances of schema 0**1* in the same pool.

4. **[10 points]: Short answers please**

   (a) Give brief definitions for the following:

      i. The Building Block hypothesis
      ii. Deception in Genetic Algorithms
      iii. The Pareto Front in multi-objective optimization

   (b) Briefly mention the major difference between each of the following pairs:

      i. Fitness sharing and crowding.
      ii. Parameter Tuning and Parameter Control in evolutionary algorithms.

5. **[10 points]:**

Consider the paper: "Promoting Creative Design in Interactive Evolutionary Computation" presented in class.

(a) According to the authors, what is the difference between aesthetically pleasing and creative systems?

(b) How did the authors compute the phenotypic distance between two images?

(c) The authors conclude that phenotypic distance (PD) search performed worse than both creativity-search (CS) and random search (RAND). In your opinion, is this conclusion sufficiently supported by the experimental results? Briefly explain.