CSCI 4560/6560 Evolutionary Computation
Final Exam - Fall 2016

NAME:

Problem(1):

Problem(2):

Problem(3):

Problem(4):

Problem(5):

Total:

1. **[10 Points]**

   The *Partition* problem is stated as follows. Given a set of N positive integers $X = \{x_1, x_2, \ldots, x_n\}$ separate them into two subsets P_1 and P_2 such that the difference between the sum of the elements in P_1 and the sum of the elements in P_2 is minimized. For example, if N=5 and the set $X = \{12, 17, 3, 24, 16\}$, the sets $P_1 = \{12, 24\}$ and $P_2 = \{17, 3, 16\}$ constitute an optimal solution for the *Partition* problem in this example as they have equal sums.

   Formulate the *Partition* problem as a Genetic or Evolutionary Algorithm optimization. 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. $X = \{12, 17, 3, 24, 16\}$).
   - A set of mutation and/or crossover and/or repair operators. Intelligent operators that are suitable for this particular problem domain will earn more credit.
   - A termination criterion for the evolutionary optimization.

2. **[10 points]:**

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

      i. Genetic programming

      ii. Classifier systems

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

      i. Success rate and mean best fitness.

      ii. Absolute and relative evidence in parameter control in evolutionary algorithms.

      iii. [**For 6560 students only**] Rank based and depth based fitness assignment methods in evolutionary multi-objective optimization.

3. **[10 points]:**

Consider a genetic algorithm using binary representation with strings of length 5. 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 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]:**

   (a) Give brief definitions for the following:

      i. Building Block hypothesis

      ii. Deception in Genetic Algorithms

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

      i. Michigan approach and Pittsburgh approach in classifier systems

      ii. Fitness sharing and crowding.

      iii. Parameter Tuning and Parameter Control in evolutionary algorithms.

5. **[10 points]:**

Consider the paper: "An empirical study on GAs without parameters" presented in class.

(a) Give one possible advantage for using the proposed approach over parameter tuning.

(b) What did the authors use as an alternative to setting the population size parameter?

(c) What representation did the authors use? Give your opinion regarding their choice of representation.