CSCI 4560/6560 Evolutionary Computation

Assignment Number 5: Due 12/1/2022

1. **[20 points]** Consider the following two genetic programming individuals:

```
      P1                 P2

       |                  |
       +                  *
      / \                / \
     /   \              /   \
    *     1            2     *
   / \                      / \
  3   X                    X   X
```

Assume the the fitness is based on the following set of I/O pairs:

X	F(X)
1	4
2	6
3	11
4	16

(a) If the fitness (to be maximized) is taken to be the number of pairs an individual computes correctly for all the I/O pairs, compute the fitness for P1 and P2.

(b) If the fitness (to be minimized) is taken to be the sum of the square errors for all the I/O pairs, compute the fitness for P1 and P2.

(c) Give 4 examples of individuals that may result from the crossover of P1 and P2.

2. **[20 points][MID]: Short answers please!**

(a) Why is a (μ, λ) evolution strategy usually better than a $(\mu + \lambda)$ evolution strategy for optimization in a dynamically changing fitness landscape?

(b) Mention **one** way to reduce selection pressure in modern Evolutionary Programming when used for continuous functional optimization.

(c) Identify **two** points of difference between Genetic Algorithms and classical Evolutionary Programming using finite state machines.

3. **[20 points][FIN]: Short answers please!**

(a) Why is sharing more suitable for generational rather than steady state GAs?

(b) Why is crowding more suitable for steady state rather than generational GAs?

(c) Explain why diversity maintenance is usually **more** important in multi-objective evolutionary optimization than in single-objective evolutionary optimization.

(d) It is observed that most multi-objective evolutionary optimization methods are generational GAs. Why do you think this happened? Do you think this was a correct decision by the researchers? Briefly justify your answer.

4. **[20 points][FIN]**

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

      i. Genetic programming

      ii. Multi-objective optimization

   (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.