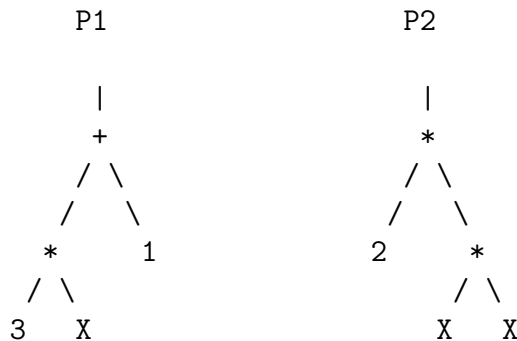


CSCI 4560/6560 Evolutionary Computation

Assignment Number 5: Due 11/9/2023

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



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.

5. [20 points] Consider a genetic algorithm using binary representation with strings of length 5. Assume that the initial population (generation 0) was as follows:

Individual	Genotype	Fitness
1	10001	20
2	11100	10
3	00011	5
4	01110	15

Assume also that a standard generational GA (using 1-point crossover and bit mutation) is used with mutation probability $p_m = 0.01$ and crossover probability $p_c = 1.0$.

- (a) Calculate a lower bound for the expected number of representatives of schema 1**** in generation 1.
- (b) Calculate a lower bound for the expected number of representatives of schema 0**1* in generation 1.