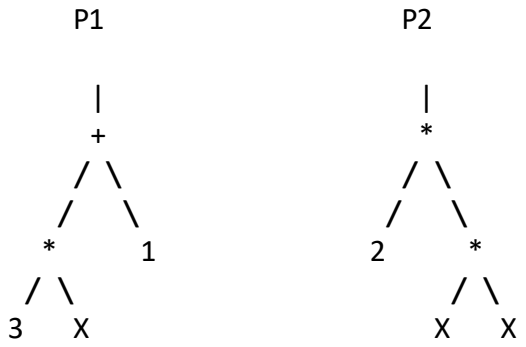
CSCI 4560/6560 Evolutionary Computation

Assignment Number 5: Due 11/13/2025

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



Assume that 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][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.

3. [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.

4. [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.