

Topics Covered: This assignment covers: Evolutionary Computation (Crossover operators for permutations, and Genetic Programming).

Must be done independently.

Complete the following problems/answer the following questions.

Permutation Operators

Show the children that result from each of the GA operations described below:

(1) Cycle Crossover for the following permutations (random position to start is 4, assuming 0-based indexing):

Parent 1: A B C D E F G H I J K L M N O P

Parent 2: I C P H B O F J D K A N L G M E

(2) Order Crossover (random cross-sites, 0-based indexes, between indexes 2 and 3, and between 7 and 8):

Parent 1: A B C D E F G H I J K L M N O P

Parent 2: I C H P B O L J D K A N F G M E

(3) Non-Wrapping Order Crossover (random cross-sites, 0-based indexes, between indexes 2 and 3, and between 7 and 8):

Parent 1: A B C D E F G H I J K L M N O P

Parent 2: I C H P B O L J D K A N F G M E

(4) Partially Matched Crossover (random cross-sites, 0-based indexes, between indexes 2 and 3, and between 7 and 8):

Parent 1: A B C D E F G H I J K L M N O P

Parent 2: I C H P B O L J D K A N F G M E

Genetic Programming

For each of the following expressions in prefix notation, show how to represent it as a tree (i.e., draw the corresponding trees):

(5) $(* \quad (+ \quad 2 \quad x) \quad (/ \quad (- \quad x \quad (* \quad (\text{sqrt} \quad (* \quad 2 \quad (* \quad x \quad x))) \quad z)) \quad 5))$

(6) $(+ \quad (* \quad x \quad (\text{if-then-else} \quad (> \quad 5 \quad y) \quad 14 \quad (/ \quad z \quad 6))) \quad (- \quad y \quad (* \quad 2 \quad (\text{sqrt} \quad 5))))$

(7) Let the parents for a crossover be the trees you drew in (5) and (6). For the purposes of this problem, assume that we can index into a tree, such that the root of the tree is node 0, and that you continue counting across each depth of the tree, left to right, before moving to the next tree level. Show the children that result from crossover if the randomly selected sub-tree of the tree from question (5) is rooted at node 8 and if the randomly selected sub-tree of the tree from question (6) is rooted at node 16.