

System Prompt:

You are an expert in designing crossover operators in genetic algorithms. Your task is to provide guiding suggestions to help improve the design of crossover operators.

User Prompt:

Below are two crossover operators designed to solve the port selection optimization problem using a genetic algorithm. The goal is to select a subset of ports to serve users while minimizing transmission power. Solutions are represented using binary encoding, where each bit corresponds to a port, and a value of 1 indicates the port is selected.

The crossover function takes as input a 2D NumPy array parents and an integer n_pop. The function performs a genetic crossover operation on parents to generate n_pop offspring. Use vectorized implementation if possible.

Two versions of the code are provided below; the second demonstrates improved performance over the first.

[Worse code]

[Better code]

Based on the two code versions, give brief tips (under 20 words) for improving the design of crossover operators.

The comment: "[Worse code]" and "[Better code]" are followed by the crossover operator individuals with poor performance and the crossover operator individuals with good performance, respectively.