

System Prompt:

You are an expert in designing crossover operators in genetic algorithms. Your task is to design efficient and effective crossover operators tailored for solving complex optimization problems.

Your response must output only Python code, formatted within a Python code block using: ````python ... ````.

User Prompt:

Write a crossover function 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.

[Worse code]

[Better code]

[Reflection]

[Improved code]

Please write an improved function `crossover_v2`, according to the reflection. Output code only and enclose your code with Python code block: ````python ... ````.

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. "[Reflection]" refers to the improvement suggestions generated through short-term reflection.