CS 790K: Genetic Algorithms

Homework Assignment # 3

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1. **The Problem**
   Use genetic algorithms to solve the first four DeJong functions, which are on page 108 in the textbook. For the fourth function, use a random number generator that generated real numbers in the interval [-1, 1] instead of the Gaussian noise function. Each program should run at least 30 times in order to get an averaged data for a graph of performance.

2. **Problem Solving**
   Canonical genetic algorithms are used for those problems, with use of method of mapping objective functions to fitness form: different C_{max} is used for those function. Chromosomes consist of variables which are encoded into (decoded from) two's complement representation. The specifics for those functions are described in the following section.

3. **Results**

   - De Jong Function 1:
     - Chromosome: consisting of 3 variables, each using 10-bit two's compliment binary representation of -5.12 to 5.11. The first bit of the 10 bits is used for positive or negative number sign.
     - Chromosome length: 30 bits.
     - Population size: 160.
     - Generations: 400.
     - Crossover probability: 0.66.
     - Mutation probability: 0.001
     - C_{max}: 100.
     - Performance: Fig. 1 is the performance graph for this problem.
   - De Jong Function 2:
     - Chromosome: consisting of 2 variables, each using 12-bit two's compliment binary representation of -2.048 to 2.047. The first bit of the 12 bits is used for positive or negative number sign.
     - Chromosome length: 24 bits.
     - Population size: 600.
     - Generations: 200.
     - Crossover probability: 0.66.
     - Mutation probability: 0.001

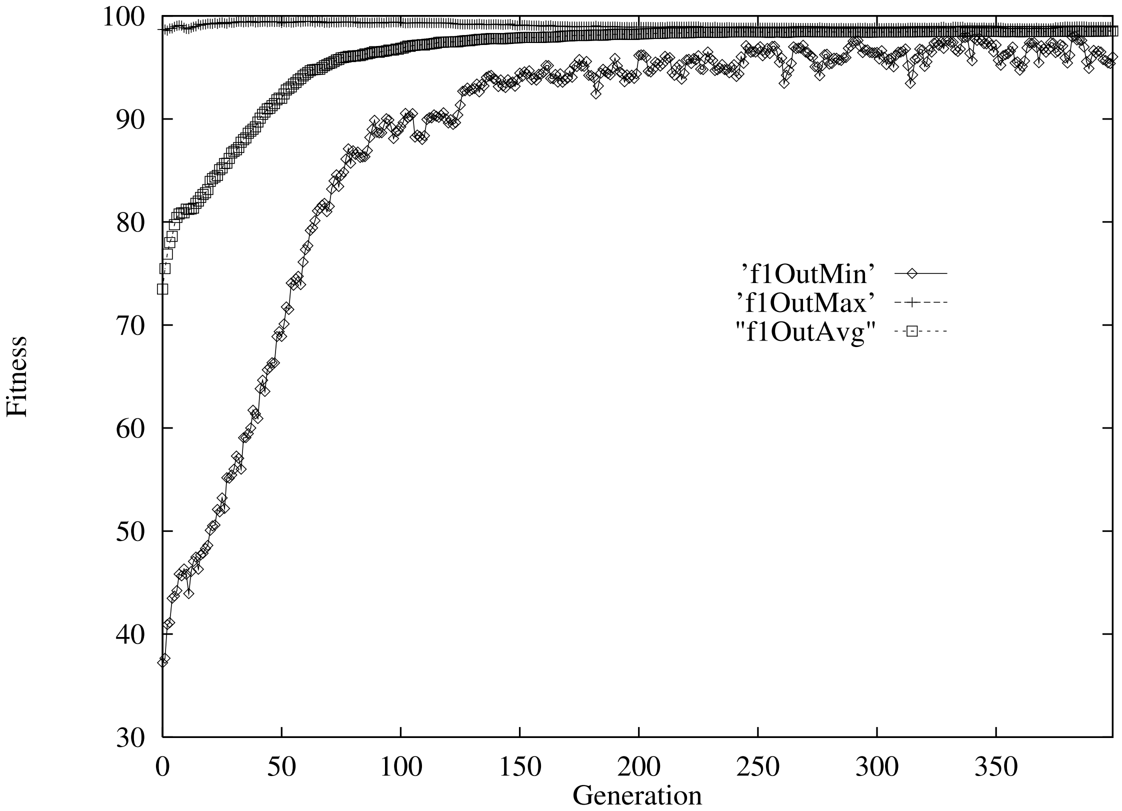

Figure 1: De Jong Function 1

- C_{max}: 4000.
- Performance: Fig. 2 is the performance graph for this problem.

- De Jong Function 3:
  - Chromosome: consisting of 5 variables, each using 10-bit two's compliment binary representation of -5.12 to 5.11. The first bit of the 10 bits is used for positive or negative number sign.
  - Chromosome length: 50 bits.
  - Population size: 250.
  - Generations: 250.
  - Crossover probability: 0.66.
  - Mutation probability: 0.01
  - C_{max}: 30.

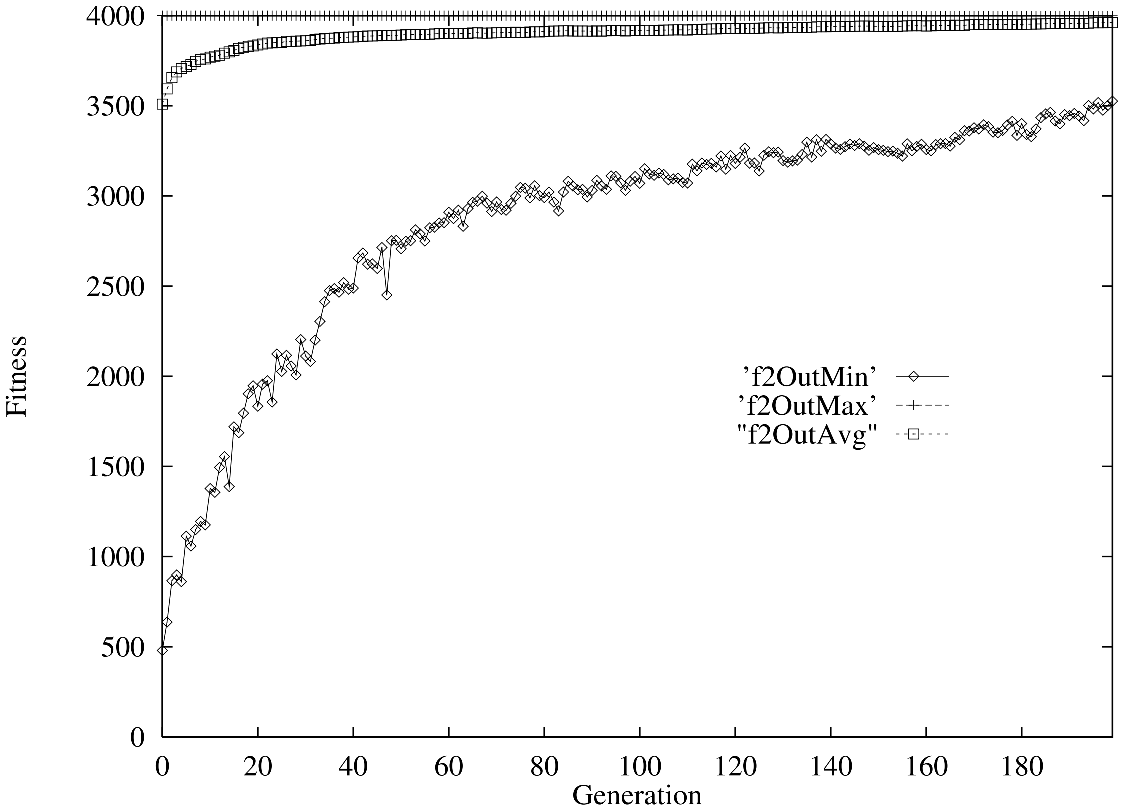

Figure 2: De Jong Function 2

  - Performance: Fig. 3 is the performance graph for this problem.

- De Jong Function 4:
  - Chromosome: consisting of 30 variables, each using 8-bit two's compliment binary representation of -1.28 to 1.27. The first bit of the 8 bits is used for positive or negative number sign.
  - Chromosome length: 240 bits.
  - Population size: 600.
  - Generations: 800.
  - Crossover probability: 0.66.
  - Mutation probability: 0.1
  - C_{max}: 1300.
  - Performance: Fig. 4 is the performance graph for this problem.

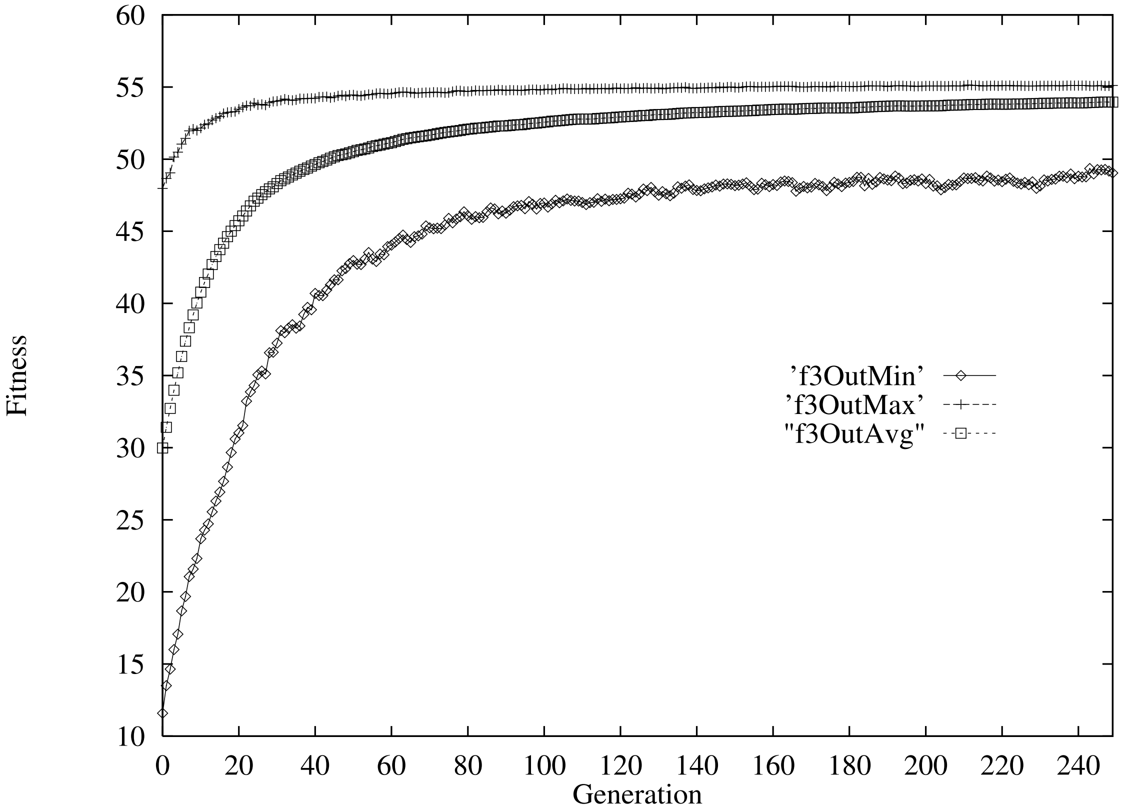

Figure 3: De Jong Function 3

4. **The Code**
   Attached is the code for evaluation of the fitness for each function. It includes *main(), eval1(), decode1(), eval2(), decode2(), eval3(), decode3(), eval4(), decode4()*.

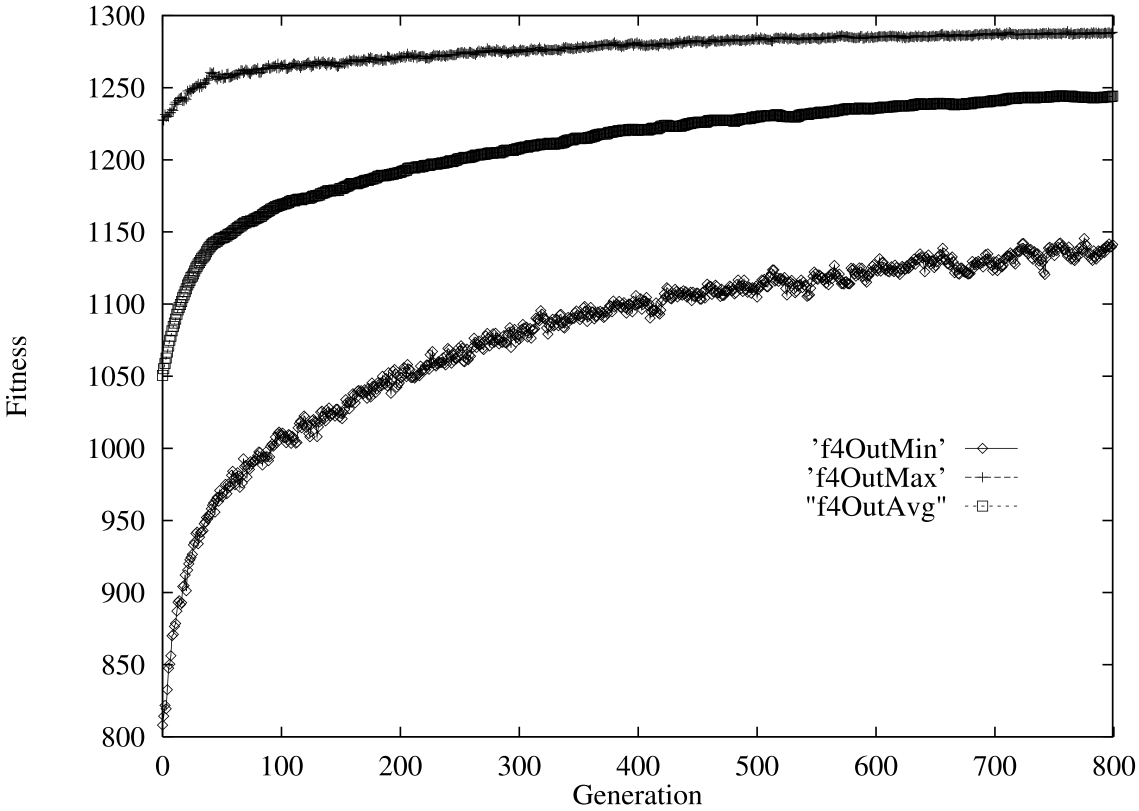

Figure 4: De Jong Function 4