Evolutionary Computation

Program – GA in Numerical Optimization

Mar 26, 2019

Objectives

Practice and get familiar with the most widely used evolutionary algorithm — genetic algorithm (GA). In this assignment you need to make use of the taught subject matters about GA's representation, crossover, mutation, and survivor to solve the given problem.

Problem Description

Write efficient programs to implement GAs to find the minimal solution of the Schwefel function (SCH):

$$f_{\text{SCH}}(\vec{x}) = 418.98291N - \sum_{i=1}^{N} x_i \sin\left(\sqrt{|x_i|}\right),$$

where $-512 \leq x_i \leq 511$ and $N = \mathbf{10}$. This function is a continuous, multimodal, non-convex, deceptive, and N-dimensional function with a global minimum of 0. The landscape of a 2-dimensional SCH function is plotted below.

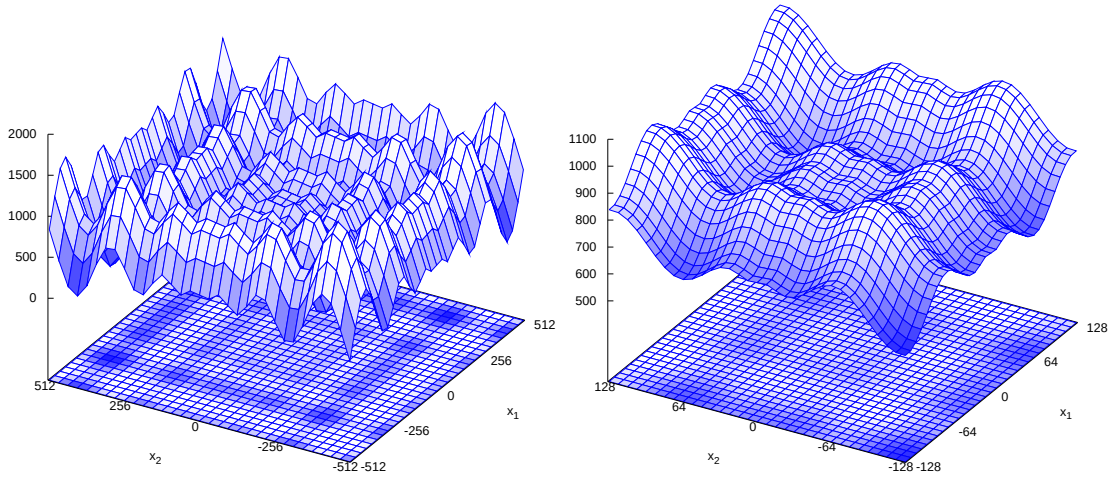


Figure 1: Fitness landscape of SCH

Requirements

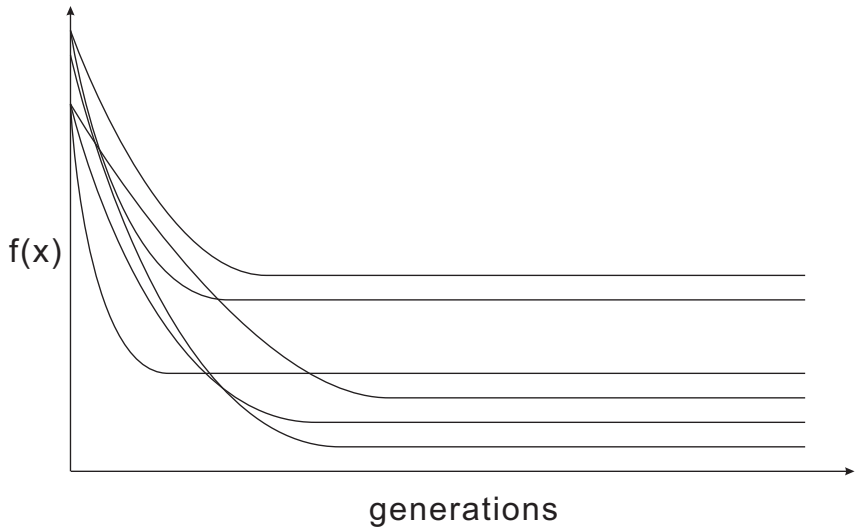
You MUST

1. Implement **binary GA** and **real-valued GA** with different **operators** to solve the SCH:

	Binary GA	**Real-valued** GA
Representation	$c_i \in 2^{10}$	$c_i \in \mathbb{R}$
Population	Generational (size **100**)	
Parent selection	Tournament Selection ($n = 2$)	
Crossover ($p_c = 0.9$)	Uniform	
	2-point	Whole Arithmetic
Mutation ($p_c = 1/\ell$)	Bit-flip	Uniform
Survivor Selection	$\mu + \lambda$	
Termination	**500** generations	

   ***code efficiency** is a key factor for evaluation of this assignment.*

2. Plot the **anytime behavior** (averaged over **30** trials) of the above GAs, e.g.,



3. **Compare** convergence speed and solution quality between different representations and operators; **give reasons** why some combination performs better (or worse).

4. **Try other setting** for p_c, p_m, n and **discuss** their effects on covergence speed and solution quality.

5. Deal with the large-scale problem: $N = \mathbf{100}$.

Submission

- **Due date: 2019/04/12**
- Source code (C/C++ or Java) + Report (PDF file, no longer than **six** A4 pages)
- Zip (or rar) to a file named "(Student ID)_SCH.zip", and **upload to iLMS system**