Term Project Assignment

Evolutionary Algorithms

Computer Engineering Due: Dec. 19, 2019

Overview

In this assignment, you will experiment with some evolutionary algorithms to minimize a set of benchmark functions given below in Table 1. The first function f_1 is a high-dimensional unimodal function with only one peak in the search space. The functions f_2 and f_3 are high-dimensional multimodal functions with a lot of local optima. The function f_4 is a low-dimensional multimodal functions with only a few local optima. While the function f_1 – f_3 are scalable to any dimension, thirty-dimensional versions will be used in your experiments as indicated in column *D* of Table 1. Since these are function optimization problems, it will be natural to adopt real number representations. The recommended genetic operators are simulated binary crossover (SBX) with $\eta_c = 2$ and polynomial mutation with $\eta_m = 10$. The recommended crossover rate and mutation rate are 0.9 and 1/*D*, respectively. The population size recommended is 100. The termination condition (i.e., the maximum number of generations) for each function should be determined by trial and error.

Table 1. Benchmark functions to be tested in your experiments

Name	Function	*D*	Domain
Rosenbrock	$f_1(\mathbf{x}) = \sum_{i=1}^{D-1}\left[100(x_{i+1} - x_i^2)^2 + (1 - x_i)^2\right]$	30	$[-30, 30]^D$
Rastrigin	$f_2(\mathbf{x}) = 10D + \sum_{i=1}^{D}\left(x_i^2 - 10\cos(2\pi \cdot x_i)\right)$	30	$[-5.12, 5.12]^D$
Griewank	$f_3(\mathbf{x}) = 1 + \sum_{i-1}^{D} x_i^2 / 4000 - \prod_{i=1}^{D}\cos\left(x_i / \sqrt{i}\right)$	30	$[-600, 600]^D$
Kowalik	$f_4(\mathbf{x}) = 4x_1^2 - 2.1x_1^2 + 3^{-1}x_1^6 + x_1x_2 - 4x_2^2 + 4x_2^4$	4	$[-5, 5]^D$

Experiments

1. Implement two different versions of a standard genetic algorithm with different selection schemes, one with stochastic uniform sampling (SUS) and the other with binary tournament selection, and then compare their performances.

2. Compare the performance of restricted tournament selection (RTS) algorithm with that of the winner algorithm chosen in Experiment 1.

Conduct the above experiments separately for each of the test functions in Table 1, and see if the winners are different for different functions.

Report

You should report the results of *t*-tests obtained by conducting the test experiments at least ten times with each function. Your report is also required to include the best-so-far curve of a typical run of each algorithm on each test function. Finally, your observations and findings should be summarized with some corresponding discussions.