Worksheet week 23

April 25, 2022

1 Problem 1

Two solutions A = 0101101 and B = 1011000 are given to you as binary representation for a phenotype. Using 2 point crossover at point 1 and 3 to create 2 new individuals A' and B'. **IMPORTANT, keep track of which child you call A' and B'!**. Apply swap mutation to both A' and B' at points 2 and 5. Decode the individuals A' and B' into decimal values. What are the values of A' and B' ?

2 Problem 2

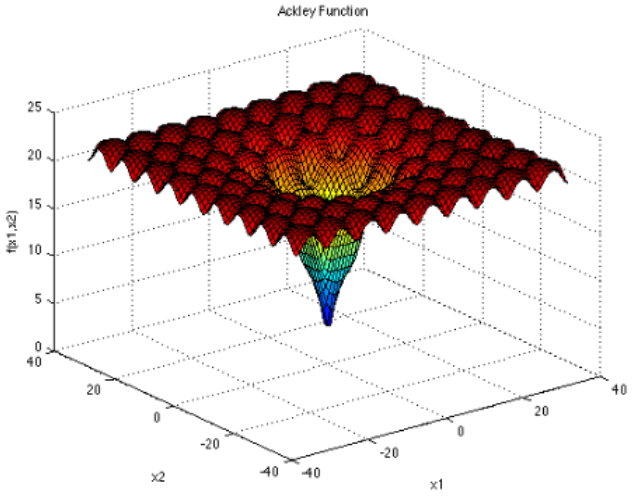
Given the population shown below, calculate the fitness using the given values of x and the fitness function $-0.3x^3 + 2x^2 - x + 12$. Use fitness proportionate selection to calculate probability of selection of the solutions and then place a,b,c,d,e in the order 1,2,3,4,5 on the roulette wheel. If you draw a random number of 0.31 from a random number generator which individual is selected from the population ?

Individual	x
a	3.27
b	-1.2
c	9
d	-0.22
e	7.5

3 Problem 3

Implement a evolutionary algorithm to solve the Ackley function. The function and its form is given in the figure below. Set a=20, b 0.2 and $c = 2\pi$ and d =2 and limit the values of $-20 \leq x_1 \leq 20$and $-20 \leq x_2 \leq 20$. Use real value representation and 100000 fitness evaluations as stopping criteria. You can use any mutation and/or re-combintaion and/ or selection technique of your choice.

ACKLEY FUNCTION



$$f(\mathbf{x}) = -a\exp\left(-b\sqrt{\frac{1}{d}\sum_{i=1}^{d}x_i^2}\right) - \exp\left(\frac{1}{d}\sum_{i=1}^{d}\cos(cx_i)\right) + a + \exp(1)$$

Figure 1: Ackley Function

Run the algorithm 30 times and plot the mean best fitness as a function of time to show the performance of your algorithm.

4 Problem 4

Advanced: Create two new versions of the algorithm developed in problem 3 by modifying the mutation and/or re-combination or selection techniques. Compare the performance of the new variants of the algorithm with the previous implementation using the mean best fitness plot.