Difference Tournament Selection and Real-Number Encoding Makes in GA

Mh. Samadi

***Abstract*— In this essay we'll put to test two different issues. One is a different type of selection algorithm called tournament selection and the other is real-number encoding instead of bit-wise encoding.**

I. INTRODUCTION

Tournament selection is a type of selection that is both random and at the same time works better for parents with better fitness. It chooses k (tournament size) different people from the population randomly. Then it chooses 2 parents with a probability that is in proportion with how good they are. If k is 1, tournament selection is the same as random selection.

Up until now, we've been using bit-wise encoding for our genes. Another goal this essay is willing to achieve is to test to see if real-number encoding works better. In this essay we'll compare the new results of each part (separately) with basic results of a bit-wise coded algorithm.

In this essay we'll use PyGAD. PyGAD is an open-source Python library for building the genetic algorithm and optimizing machine learning algorithms. It works with Keras and PyTorch.

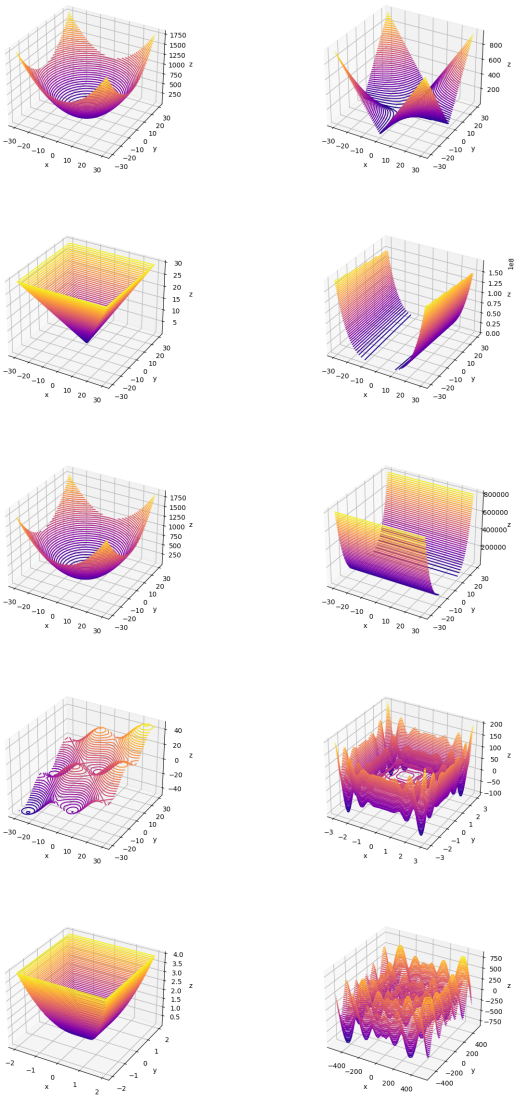
II. IMPLEMENTATION

For the first test the new GA algorithm we'll be ran 10 times for each test function and the results will form an final average result. The test functions used are thoroughly explained in their own dedicated subsection (2.A). The only difference between this version of the algorithm and the version used for the basic results of the last essay is that this time algorithm is using tournament selection. The algorithm will be optimizing a 10D version of each test function.

For the second test the same conventions apply but the only difference will be real-number encoding. A third test also exists to compare the application of both tournament selection and rel-number encoding to the basic algorithm.

A. Test Function

The test functions used in this essay are shown in the following section:



from left to right, top to bottom we have f1, f2,

f4, f5, f6, f7, f8, rastrigin, schwefel and schwefel problem test functions.

III. Results

Here are the results compared to the basic algorithm. All test functions are 10D.

-	basic	test1	test2	test3
f1	-8.42	-0.23	-8.02	-0.24
f2	-57e12	-1.16	-31e12	-1.19
f4	-0.74	-0.37	-0.7	-0.41
f5	-13e8	-69	-81e5	-164
f6	-5.9	-0.26	-6.26	-0.31
f7	-60e5	-4.41	-15e6	-4.8
f8	273	505	379	582
rastrigin	35e5	73e4	4e6	73e4
schwefel	-10	-0.14	-12	-0.16
schwefelP	344	534	265	621

As seen in the results, real-number encoding doesn't really help but it also slightly makes the results worse. It might be because of two reasons. Floats are made of bits anyways. In the basic algorithm we use 16 bools for each dimension and for a real-number encoding 64 bit floats are used. It doesn't make that big of a difference and it actually widens the search domain hence making the algorithm work more to find an answer. Adding precision helps if it is needed which is not true in our case.

The real difference is made when using the tournament selection instead of the roulette algorithm. It vastly enhances the algorithm by giving some chance to the slightly worse genes for selection while giving the better ones more chance at the same time.