## Problem.1

### Part a)

Since the domain is a binary string of length 5, there are choices of input.

Knowing the domain is size 32, and range is size 10, there are a total of functions. So .

### Part b)

Now domain is still size 32, but range is size 5. There are a total of functions under this restriction.

One example of an objective function with this restriction is:

F(X) = sum of bits of X. i.e. F(00110) = 2, F(01111) = 4

The ratio of |Z| to |G| is

### Part c)

We know that:

Given for both and , , ,

We have:

And:

Using the NFL theorem, we get:

With the fact that |Z1|=3|Z2|, and , , we have:

Therefore, we have:

This means on average, the ES algorithm will find the global optimum with 0.3 more probability than GA in Z2.