Summary

Step 1: Generating initial population

Initial population is generated by mutating all the bits in the original vectors and this is repeated until we get the population size of pop_length

```
#getting initial population by mutating
for i in range(pop_length):
    temp_parent = np.copy(init_vec)
    parent_population[i] = generate_individual(temp_parent)
```

Step 2: Getting errors for the initial parent population

Here we request the server to get the validation and train errors and total error is taken as sum of validation and train errors which is our fitness indirectly.

```
for i in range(pop_length):
    temp_parent = parent_population[i].tolist()
    errors = get_errors(SECRET_KEY, temp_parent)
    parent_errors[i] = errors[0] + errors[1]
    parent_te[i] = errors[0]
    parent_ve[i] = errors[1]
```

Step 3: Crossover

Crossover select follows round roulette i.e two parents are selected with the weights as probabilities generated from their weights.

Uniform crossover is implemented for the generation of children from the two parents selected.

Crossover select:

```
        for k in range(int(pop_length/2)):
            selected = np.random.choice(np.arange(0, pop_length), 2,
replace=False, p=parent_probablities)
            child_population[2*k], child_population[(2*k)+1] =
crossover(parent_population[selected[0]],
parent_population[selected[1]])
```

Crossover Function:

```
def crossover(x,y):
    #uniform crossover
    x_mod = []
    y_mod = []
    for i in range(0,len(x)):
        if random.uniform(0,1)<=0.5:
            x_mod.append(y[i])
            y_mod.append(x[i])
        else:
            x_mod.append(x[i])
            y_mod.append(y[i])
    return x_mod, y_mod
```

Step 4: Mutation

A bit of each child vector is mutated depending on the probability of 0.5

```
        for k in range(pop_length):
            temp_child = np.copy(child_population[k])
            child_population[k] = mutatenoind(temp_child)
```

Mutation:

```
def mutatenoind(vector):
    ind = random.randint(0,features-1)
    if random.uniform(0,1)<0.5:
        vector[ind] = random.uniform(-limit, limit)
    return vector
```

Step 5: Getting errors for child population

Here we get the errors for the new child population.

```
        for k in range(pop_length):
            temp_child = child_population[k].tolist()
            errors = get_errors(SECRET_KEY, temp_child)
            child_errors[k] = errors[0] + errors[1]
            child_te[k] = errors[0]
            child_ve[k] = errors[1]
```

Step 6:Getting the minimum error vector

Vector with minimum error is found here.

```
    #obtaining best vector

    for k in range(pop_length):
        if min_err==0 or min_err > child_errors[k]:
            min_err = child_errors[k]
            res_vec = child_population[k]
```

Step 7:Setting the children to next generation parents.

Here we copy the children of the present generation to parents as next generation.

```
    for k in range(pop_length):
        parent_population[k] = child_population[k]
        parent_errors[k] = child_errors[k]
        parent_te[k] = child_te[k]
        parent_ve[k] = child_ve[k]
```

Step 8: Iterations

Executing Step 3 -> Step 8 until the number of generations are completed

Diagrams:

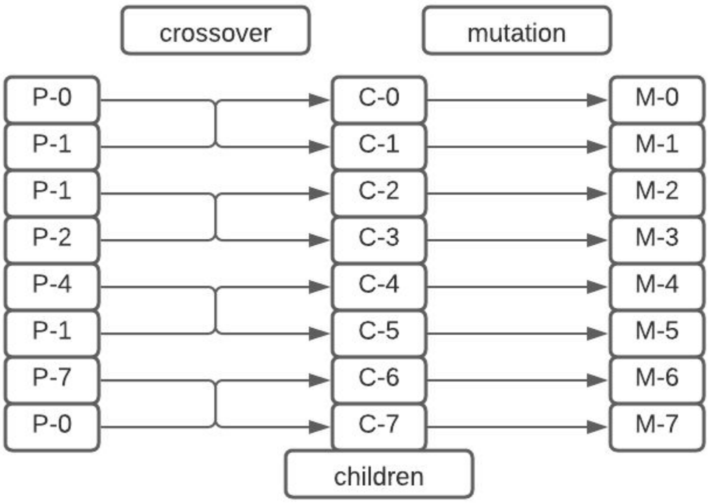
P - Parent
C - Children
M - Mutated
And the values of respective indices are given in the photos.
The second column with Parents is the selected parents for the crossover

Parent_Index	Parents
0	[0.00000000e+00 -1.45799022e-12 -9.10196964e+00 -3.62202492e+00 -1.75214813e-10 -8.12336033e+00 1.57069765e+00 2.29423303e-05 -2.04721003e-06 5.58003417e+00 9.98214034e-10]
1	[0.00000000e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 -2.18451278e+00 -2.04721003e-06 2.05931644e+00 9.98214034e-10]
2	[6.06415262e+00 -1.45799022e-12 8.11788774e+00 -2.63083299e+00 -7.18713174e+00 -1.83669770e-15 1.57069765e+00 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]
3	[0.00000000e+00 -1.45799022e-12 -9.10196964e+00 9.18172045e+00 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 2.29423303e-05 -2.04721003e-06 2.05931644e+00 6.17989643e+00]
4	[-3.00277349e+00 -1.45799022e-12 -1.33686910e-01 4.62010753e-11 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 2.29423303e-05 -2.04721003e-06 5.58003417e+00 6.17989643e+00]
5	[0.00000000e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 2.29423303e-05 1.66190400e+00 -1.59792834e-08 9.98214034e-10]
6	[0.00000000e+00 -1.45799022e-12 6.39913284e+00 4.62010753e-11 6.80148355e+00 -1.83669770e-15 8.52944060e-16 -8.32202200e-01 -2.04721003e-06 5.58003417e+00 6.17989643e+00]
7	[0.00000000e+00 3.63439195e+00 -8.74256386e+00 4.62010753e-11 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 2.29423303e-05 -2.04721003e-06 5.58003417e+00 7.59983348e-01]

Child_Index	Child	Selected
0	[0.00000000e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]	[0 1]
1	[6.06415262e+00 -1.45799022e-12 8.11788774e+00 -2.63083299e+00 -1.75214813e-10 -1.83669770e-15 1.57069765e+00 -2.18451278e+00 -2.04721003e-06 2.05931644e+00 9.98214034e-10]	[0 1]
2	[0.00000000e+00 -1.45799022e-12 -9.10196964e+00 4.62010753e-11 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 -2.18451278e+00 -2.04721003e-06 2.05931644e+00 6.17989643e+00]	[1 2]
3	[0.00000000e+00 -1.45799022e-12 -8.74256386e+00 9.18172045e+00 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 2.29423303e-05 -2.04721003e-06 2.05931644e+00 9.98214034e-10]	[1 2]
4	[-3.00277349e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 -2.18451278e+00 -2.04721003e-06 5.58003417e+00 9.98214034e-10]	[4 1]
5	[0.00000000e+00 -1.45799022e-12 -1.33686910e-01 4.62010753e-11 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 2.29423303e-05 -2.04721003e-06 2.05931644e+00 6.17989643e+00]	[4 1]
6	[6.06415262e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 1.57069765e+00 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]	[7 0]
7	[0.00000000e+00 -1.45799022e-12 8.11788774e+00 -2.63083299e+00 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 2.29423303e-05 1.66190400e+00 -1.59792834e-08 9.98214034e-10]	[7 0]

```
+-----------+---------------------------------------------------------------------+
| Mut_Index |                            Mutated_Child                            |
+-----------+---------------------------------------------------------------------+
|     0     | [ 0.00000000e+00 -8.18985883e+00 -8.74256386e+00  4.62010753e-11 |
|           |  -7.18713174e+00 -1.83669770e-15  8.52944060e-16 -5.56761517e-02 |
|           |           1.66190400e+00 -1.59792834e-08  9.98214034e-10]          |
|     1     | [ 6.06415262e+00 -1.45799022e-12 -9.17448430e+00 -2.63083299e+00 |
|           |  -1.75214813e-10 -1.83669770e-15  1.57069765e+00 -2.18451278e+00 |
|           |          -2.04721003e-06  2.05931644e+00  9.98214034e-10]          |
|     2     | [ 0.00000000e+00 -1.45799022e-12 -9.10196964e+00  4.62010753e-11 |
|           |  -1.75214813e-10 -1.83669770e-15  8.52944060e-16 -2.18451278e+00 |
|           |          -2.04721003e-06  2.05931644e+00  6.17989643e+00]          |
|     3     | [ 0.00000000e+00 -1.45799022e-12 -8.74256386e+00  9.18172045e+00 |
|           |  -1.75214813e-10  9.52162766e+00  8.52944060e-16  2.29423303e-05 |
|           |          -2.04721003e-06  2.05931644e+00  9.98214034e-10]          |
|     4     | [-3.00277349e+00 -1.45799022e-12 -8.74256386e+00  4.62010753e-11 |
|           |  -1.75214813e-10 -1.83669770e-15  8.52944060e-16 -2.18451278e+00 |
|           |          -2.04721003e-06  5.58003417e+00  9.98214034e-10]          |
|     5     | [ 0.00000000e+00  3.58983483e+00 -1.33686910e-01  4.62010753e-11 |
|           |  -1.75214813e-10 -8.12336033e+00  8.52944060e-16  2.29423303e-05 |
|           |          -2.04721003e-06  2.05931644e+00  6.17989643e+00]          |
|     6     | [ 6.06415262e+00 -1.45799022e-12 -8.74256386e+00  4.62010753e-11 |
|           |  -7.18713174e+00 -1.83669770e-15  1.57069765e+00 -5.56761517e-02 |
|           |           1.66190400e+00 -1.59792834e-08  9.98214034e-10]          |
|     7     | [ 0.00000000e+00 -7.56183776e+00  8.11788774e+00 -2.63083299e+00 |
|           |  -1.75214813e-10 -8.12336033e+00  8.52944060e-16  2.29423303e-05 |
|           |           1.66190400e+00 -1.59792834e-08  9.98214034e-10]          |
+-----------+---------------------------------------------------------------------+
```

parents, fitness prob	
P-0	0.2
P-1	0.16
P-2	0.128
P-3	0.1024
P-4	0.8192
P-5	0.06553
P-6	0.05242
P-7	0.209

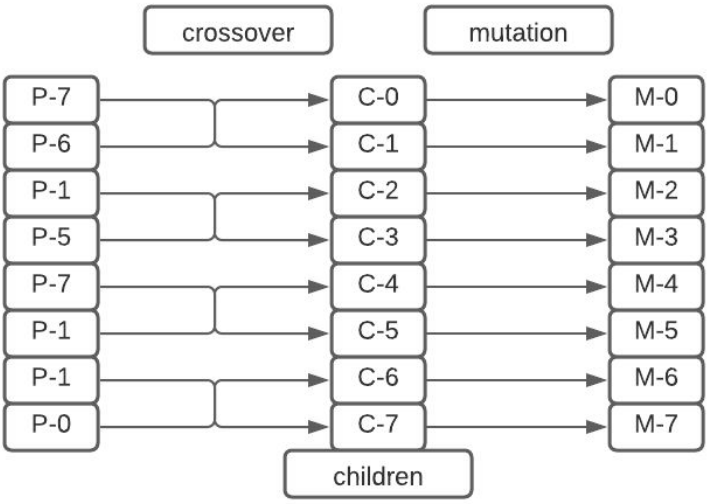


Parent_Index	Parents
0	[0.00000000e+00 -8.18985883e+00 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]
1	[6.06415262e+00 -1.45799022e-12 -9.17448430e+00 -2.63083299e+00 -1.75214813e-10 -1.83669770e-15 1.57069765e+00 -2.18451278e+00 -2.04721003e-06 2.05931644e+00 9.98214034e-10]
2	[0.00000000e+00 -1.45799022e-12 -9.10196964e+00 4.62010753e-11 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 -2.18451278e+00 -2.04721003e-06 2.05931644e+00 6.17989643e+00]
3	[0.00000000e+00 -1.45799022e-12 -8.74256386e+00 9.18172045e+00 -1.75214813e-10 9.52162766e+00 8.52944060e-16 2.29423303e-05 -2.04721003e-06 2.05931644e+00 9.98214034e-10]
4	[-3.00277349e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 -2.18451278e+00 -2.04721003e-06 5.58003417e+00 9.98214034e-10]
5	[0.00000000e+00 3.58983483e+00 -1.33686910e-01 4.62010753e-11 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 2.29423303e-05 -2.04721003e-06 2.05931644e+00 6.17989643e+00]
6	[6.06415262e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 1.57069765e+00 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]
7	[0.00000000e+00 -7.56183776e+00 8.11788774e+00 -2.63083299e+00 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 2.29423303e-05 1.66190400e+00 -1.59792834e-08 9.98214034e-10]

Child_Index	Child	Selected
0	[0.00000000e+00 -1.45799022e-12 8.11788774e+00 9.18172045e+00 -1.75214813e-10 9.52162766e+00 8.52944060e-16 2.29423303e-05 1.66190400e+00 2.05931644e+00 9.98214034e-10]	[7 6]
1	[0.00000000e+00 -7.56183776e+00 -8.74256386e+00 -2.63083299e+00 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 2.29423303e-05 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]	[7 6]
2	[6.06415262e+00 3.58983483e+00 -8.74256386e+00 4.62010753e-11 -1.75214813e-10 -8.12336033e+00 1.57069765e+00 2.29423303e-05 1.66190400e+00 2.05931644e+00 6.17989643e+00]	[1 5]
3	[0.00000000e+00 -1.45799022e-12 -1.33686910e-01 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]	[1 5]
4	[0.00000000e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 9.52162766e+00 1.57069765e+00 2.29423303e-05 1.66190400e+00 2.05931644e+00 9.98214034e-10]	[7 1]
5	[6.06415262e+00 -1.45799022e-12 -8.74256386e+00 9.18172045e+00 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]	[7 1]
6	[0.00000000e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]	[1 0]
7	[6.06415262e+00 -8.18985883e+00 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 1.57069765e+00 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]	[1 0]

```
+-----------+---------------------------------------------------------------------+
| Mut_Index |                            Mutated_Child                            |
+-----------+---------------------------------------------------------------------+
|     0     | [-8.86461319e+00 -1.45799022e-12  8.11788774e+00  9.18172045e+00 |
|           |  -1.75214813e-10  9.52162766e+00  8.52944060e-16  2.29423303e-05 |
|           |          1.66190400e+00  2.05931644e+00  9.98214034e-10]          |
|     1     | [ 0.00000000e+00 -7.56183776e+00 -8.74256386e+00 -2.63083299e+00 |
|           |  -1.75214813e-10 -8.12336033e+00  8.52944060e-16  2.29423303e-05 |
|           |         -2.04721003e-06 -1.59792834e-08  9.98214034e-10]          |
|     2     | [ 6.06415262e+00  3.58983483e+00  2.80187390e+00  4.62010753e-11 |
|           |  -1.75214813e-10 -8.12336033e+00  1.57069765e+00  2.29423303e-05 |
|           |          1.66190400e+00  2.05931644e+00  6.17989643e+00]          |
|     3     | [ 0.00000000e+00 -1.45799022e-12 -1.33686910e-01 -2.69041797e+00 |
|           |  -7.18713174e+00 -1.83669770e-15  8.52944060e-16 -5.56761517e-02 |
|           |         -2.04721003e-06 -1.59792834e-08  9.98214034e-10]          |
|     4     | [ 0.00000000e+00 -1.45799022e-12 -8.74256386e+00  4.62010753e-11 |
|           |  -7.18713174e+00  9.52162766e+00  1.57069765e+00  2.29423303e-05 |
|           |          1.66190400e+00  2.05931644e+00 -2.72936404e+00]          |
|     5     | [ 6.06415262e+00 -1.45799022e-12 -8.74256386e+00  9.18172045e+00 |
|           |  -1.75214813e-10 -1.83669770e-15  8.52944060e-16 -5.56761517e-02 |
|           |         -2.04721003e-06 -1.59792834e-08  9.98214034e-10]          |
|     6     | [ 0.00000000e+00 -1.45799022e-12 -8.74256386e+00  4.62010753e-11 |
|           |  -7.18713174e+00 -1.83669770e-15  8.52944060e-16 -5.56761517e-02 |
|           |          1.66190400e+00 -1.59792834e-08  9.98214034e-10]          |
|     7     | [ 6.06415262e+00 -8.18985883e+00 -8.74256386e+00  4.62010753e-11 |
|           |  -7.18713174e+00 -1.83669770e-15 -7.67442815e+00 -5.56761517e-02 |
|           |          1.66190400e+00 -1.59792834e-08  9.98214034e-10]          |
+-----------+---------------------------------------------------------------------+
```

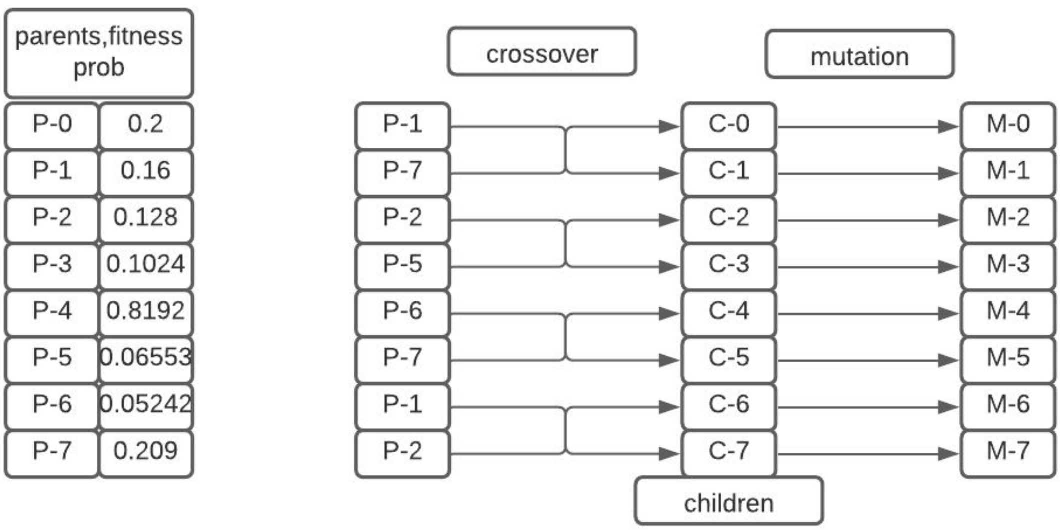
parent,fitness prob	
P-0	0.2
P-1	0.16
P-2	0.128
P-3	0.1024
P-4	0.8192
P-5	0.06553
P-6	0.05242
P-7	0.209



Parent_Index	Parents
0	[-8.86461319e+00 -1.45799022e-12 8.11788774e+00 9.18172045e+00 -1.75214813e-10 9.52162766e+00 8.52944060e-16 2.29423303e-05 1.66190400e+00 2.05931644e+00 9.98214034e-10]
1	[0.00000000e+00 -7.56183776e+00 -8.74256386e+00 -2.63083299e+00 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 2.29423303e-05 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]
2	[6.06415262e+00 3.58983483e+00 2.80187390e+00 4.62010753e-11 -1.75214813e-10 -8.12336033e+00 1.57069765e+00 2.29423303e-05 1.66190400e+00 2.05931644e+00 6.17989643e+00]
3	[0.00000000e+00 -1.45799022e-12 -1.33686910e-01 -2.69041797e+00 -7.18713174e+00 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]
4	[0.00000000e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 9.52162766e+00 1.57069765e+00 2.29423303e-05 1.66190400e+00 2.05931644e+00 -2.72936404e+00]
5	[6.06415262e+00 -1.45799022e-12 -8.74256386e+00 9.18172045e+00 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]
6	[0.00000000e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]
7	[6.06415262e+00 -8.18985883e+00 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 -7.67442815e+00 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]

Child_Index	Child	Selected
0	[0.00000000e+00 -1.45799022e-12 -1.33686910e-01 -2.69041797e+00 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 -2.04721003e-06 2.05931644e+00 9.98214034e-10]	[1 7]
1	[-8.86461319e+00 -1.45799022e-12 8.11788774e+00 9.18172045e+00 -7.18713174e+00 9.52162766e+00 8.52944060e-16 2.29423303e-05 1.66190400e+00 -1.59792834e-08 9.98214034e-10]	[1 7]
2	[6.06415262e+00 -7.56183776e+00 -8.74256386e+00 -2.63083299e+00 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]	[2 5]
3	[0.00000000e+00 -8.18985883e+00 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 -7.67442815e+00 2.29423303e-05 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]	[2 5]
4	[0.00000000e+00 -1.45799022e-12 8.11788774e+00 4.62010753e-11 -7.18713174e+00 9.52162766e+00 1.57069765e+00 2.29423303e-05 1.66190400e+00 2.05931644e+00 9.98214034e-10]	[6 7]
5	[-8.86461319e+00 -1.45799022e-12 -8.74256386e+00 9.18172045e+00 -1.75214813e-10 9.52162766e+00 8.52944060e-16 2.29423303e-05 1.66190400e+00 2.05931644e+00 -2.72936404e+00]	[6 7]
6	[0.00000000e+00 -8.18985883e+00 -1.33686910e-01 -2.69041797e+00 -7.18713174e+00 -1.83669770e-15 -7.67442815e+00 -5.56761517e-02 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]	[1 2]
7	[6.06415262e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]	[1 2]

Mut_Index	Mutated_Child
0	[0.00000000e+00 -1.45799022e-12 -1.33686910e-01 -2.69041797e+00 -1.75214813e-10 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 -2.04721003e-06 7.71388421e+00 9.98214034e-10]
1	[-8.86461319e+00 -1.45799022e-12 8.11788774e+00 9.18172045e+00 -7.18713174e+00 9.52162766e+00 8.52944060e-16 2.29423303e-05 1.66190400e+00 -1.59792834e-08 9.98214034e-10]
2	[6.06415262e+00 -7.56183776e+00 -8.74256386e+00 -2.63083299e+00 -1.75214813e-10 -8.12336033e+00 8.52944060e-16 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]
3	[0.00000000e+00 -8.18985883e+00 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 -7.67442815e+00 2.29423303e-05 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]
4	[0.00000000e+00 -1.45799022e-12 8.11788774e+00 4.62010753e-11 -7.18713174e+00 9.52162766e+00 1.57069765e+00 2.29423303e-05 1.66190400e+00 2.05931644e+00 3.62026263e+00]
5	[-8.86461319e+00 -1.45799022e-12 -8.74256386e+00 9.18172045e+00 -1.75214813e-10 9.52162766e+00 8.52944060e-16 2.29423303e-05 1.66190400e+00 2.05931644e+00 -2.72936404e+00]
6	[0.00000000e+00 -8.18985883e+00 -1.33686910e-01 -2.69041797e+00 -7.18713174e+00 -4.18775142e+00 -7.67442815e+00 -5.56761517e-02 -2.04721003e-06 -1.59792834e-08 9.98214034e-10]
7	[6.06415262e+00 -1.45799022e-12 -8.74256386e+00 4.62010753e-11 -7.18713174e+00 -1.83669770e-15 8.52944060e-16 -5.56761517e-02 1.66190400e+00 -1.59792834e-08 9.98214034e-10]



Fitness Function

Fitness value decides the performance of the individual and it decides whether the individual can participate in the next generation or not.

We have considered Total Error(To.E) as Validation Error(V.E) + Train Error(T.E).

And fitness is inversely proportional to Total Error i.e More the Total Error less the fitness, Less the Total Error more the fitness.

Then based on this fitness order probabilities are provided.

Crossover Function

1)crossover select: We have followed round roulette for the selection operation i.e selecting the parents randomly with their probabilities as their weight for selection. This is simply like spinning a roulette with different sector areas depending on the probabilities assigned to the parents.

2)Crossover: We have followed uniform crossover i.e the exchange of bits only happen with certain probability which is 0.5 in our case.

Mutations:

Mutation takes place with a probability of 0.5 and the mutation value is generated randomly in the range of -10 to 10 which is the range of bits.

Hyperparameters:

We have taken pop_size as 15,
Mutation is performed uniformly with a probability of 0.5 on each beat because to provide diverse crossover with symmetry.

Statistical Information:

These are the best results with following parameters:
1)pop_size = 10, generations = 10
Total Error: 2.378859e+12, Train Error: 1.235363e+12 Validation Error: 1.143496e+12

2)pop_size = 14, generations = 10
Total Error: 3.962122e+11, Train Error : 2.405765e+11, Validation Error: 1.556357e+11

3)pop_size = 15, generations = 8
Total Error: 4.790865e+11, Train Error : 2.101262e+11, Validation Error: 2.689603e+11

Heuristics applied:

We have taken Total Error as 0.1*train_error + 0.9*validation_error because the given vector is said to be overfit so we made less contribution of train_error but the end results are like both train and validation error came out to be nearly equal, because the initial population is taken by mutating the original given vector so we cannot say that all the population is overfit as it is generated randomly.Then we have considered Total Error as train + validation and this has given better results than before.

At the start we did not add any probabilities to the individuals we have considered total error as the inverse weight to do the random selection for crossover but after that we took a probability distribution in which the best elements has the more probability independent of their weights and depending on the sorting order. This performed better than the previous selection method.

For every generation we have added a fixed vector which is the best result we got from previous executions with a lower probability so that it can contribute a little bit to it. In the submission we took that vector as [0]*features.

Performance:

Train Error: 2038170908419.4585
Validation Error : 3210177724757.5415
This can perform better than this by finding better parameters because not every time we require both exploration and exploitation of resources so we can set our parameters according to them.

This performs well on unseen data because of the randomisation we do in crossover and mutation. So the vectors in whole generations are very randomised in which some of them perform better due to the learning from the older generations.