Computational Intelligence *fourth* assignment

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1) **traveling salesman:**

in this question we have to implement genetic algorithm to find minimum length of Hamilton cycle in graph.

I have a class of Ant that represent each individual component in genetic algorithm.

Each Ant has a chromosome, the **chromosome** represents the **path** which that ant goes. It starts with 0 and end by 0. And it has all other nodes inside of itself, and it means Hamilton cycle!
for example : `[1, 3, 5, 7, 6, 4, 2, 1]`

In the beginning we have 35 Ants and each one initialized by **random chromosomes**.

Fitness function: calculates length of the path of chromosome we **sort** Ants by their fitness and then we do <u>Elitism</u> and take 50% of Ants that have best fitness.

And its to create **new generation**, we choose 50% of bests Ants and pair them randomly and produce children (**cross over** chromosomes and **mutation** randomly), and then add them to our population.

We do this for constant number of times (like 1000 times) and after that, we choose best Ant and shows its chromosome(path)

I show graph with list of edges:

- aa means there is no connection
- length of path to themselves is zero

```
4  aa = 99999
5  Edges = [[0,12,10,aa,aa,aa,12],
6            [12,0,8,12,aa,aa,aa],
7            [10,8,0,11,3,aa,9],
8            [aa,12,11,0,11,10,aa],
9            [aa,aa,3,11,0,6,7],
10           [aa,aa,aa,10,6,0,9],
11           [12,aa,9,aa,7,9,0]]
12
```

- there was a problem in doc, minimum path length is 63 (not 62).

- in genetic algorithm sometimes we cannot find optimum solution, and because of that sometimes(barely) my code cannot find best path (length of 63).

- The result should look like this:

```
answer path : [1, 3, 5, 7, 6, 4, 2, 1]
path length : 63
Generation: 1000
```
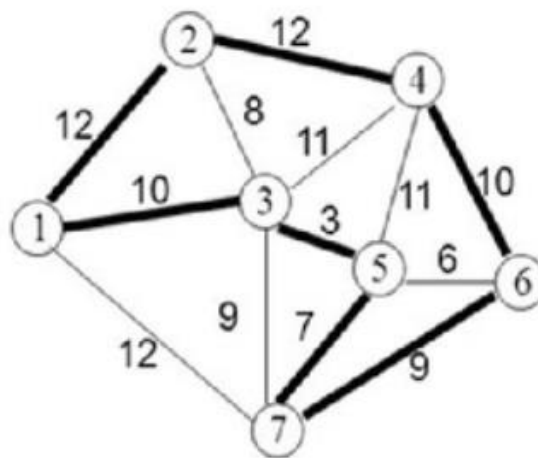
2) Find the root of equation

equation: $9x^5 - 194.7x^4 + 1680.1x^3 - 7227.94x^2 + 15501.2x - 13257.2$

I solved this equation just like Q1, but there were some differences:

- **Chromosome** was a 64 bit of 0 and 1, first index was sign bit, the next 8 bit was for whole number, and the rest of them was for fractional part on number.

- **Fitness function** calculates answer of equation (y) and returns absolute value of that. smaller fitness function is better.

- Cross over breaks the chromosomes of mother and father in one place ant change them to produce child chromosome.

- I used 300 Ants at the beginning
- This algorithm finishes after 250 iterations but the difference is that if **accuracy** becomes less than 0.001, algorithm stops.
- All other things are like before.
- The result should look like this:

```
approximate Answer is :  4.883415157135174
best chromosome:  1000001000011111011000101001110100110010010011010110100010111101
generation:  9
```