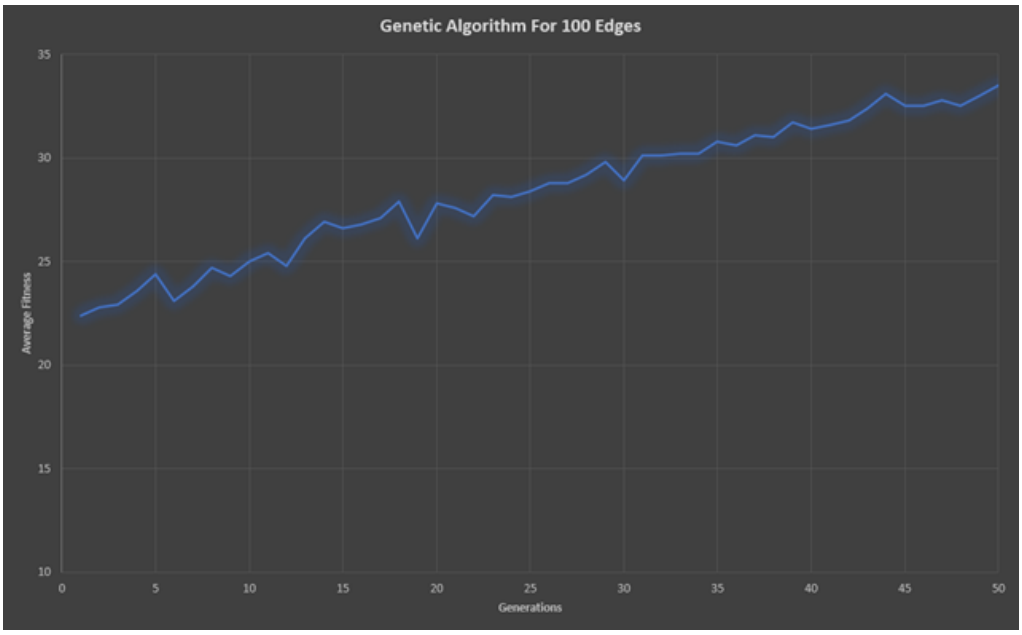
Assignment 1

Genetic Algorithm

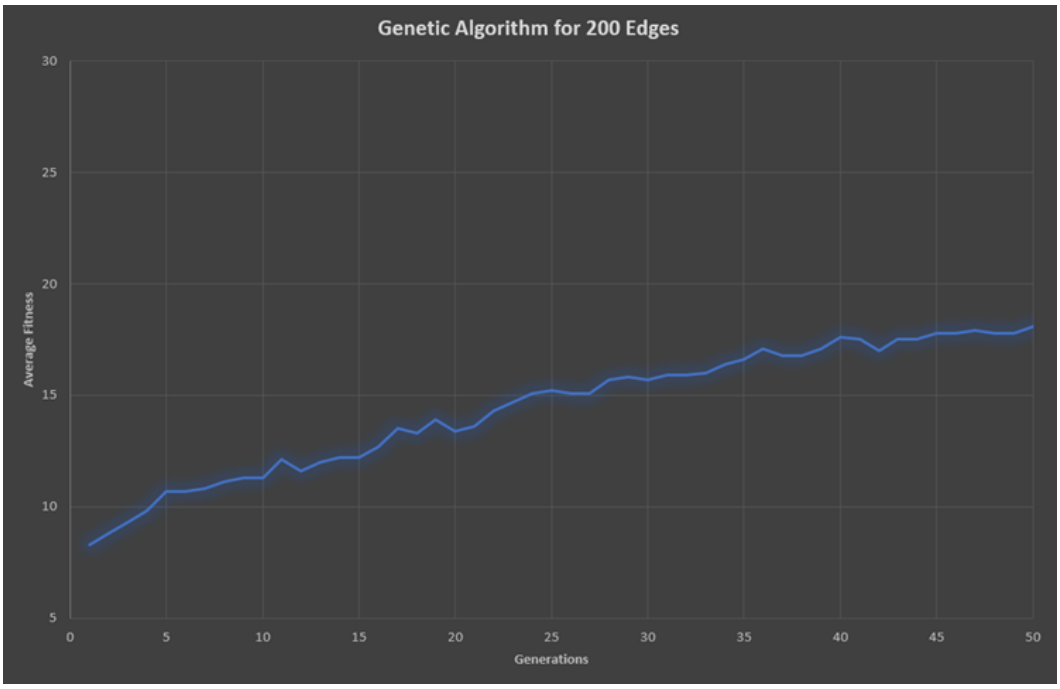
Part A:

It consists of plots for the best fitness function value obtained for the genetic algorithm (with a population size 100 and for 50 generations) for graphs having the following number of edges : 100, 200, 300, 400 and 500.

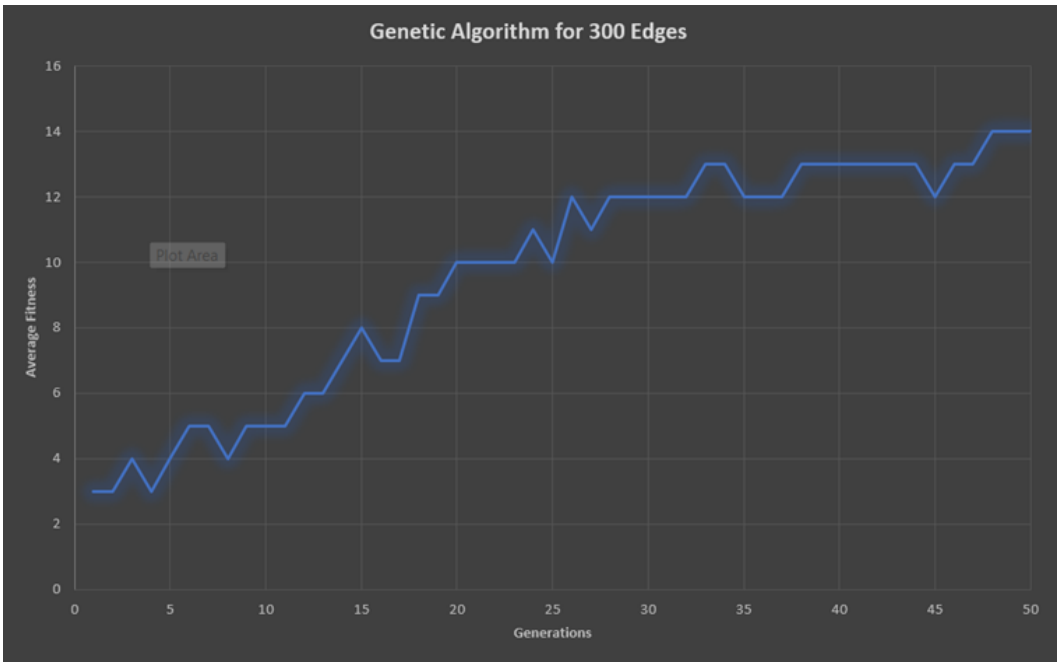
1.Graph with 100 edges



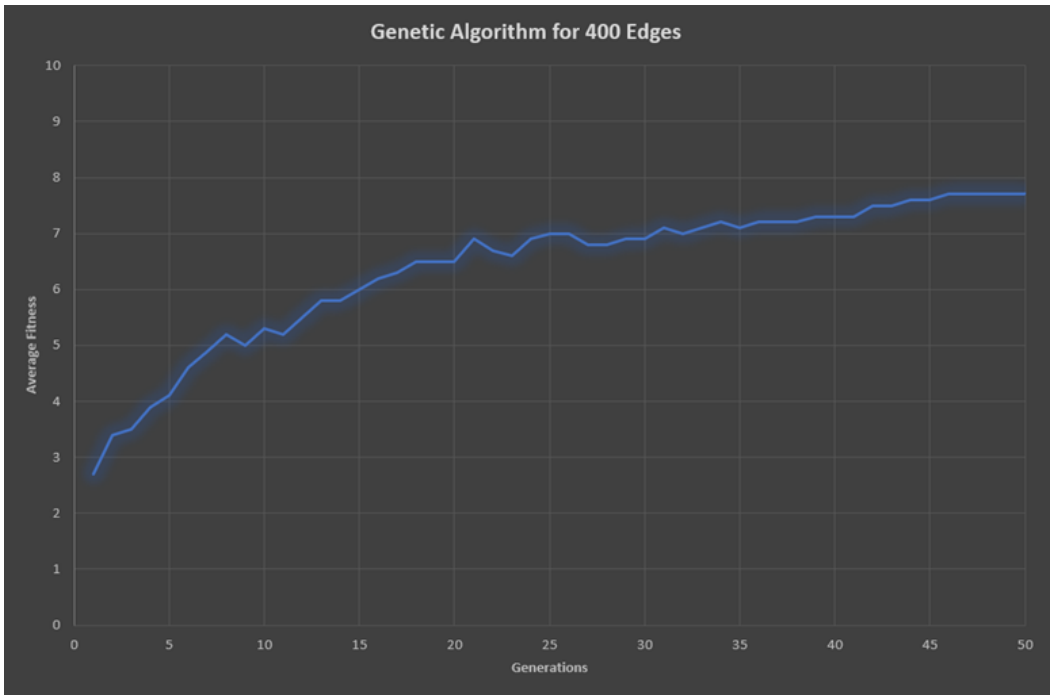
2.Graph with 200 edges



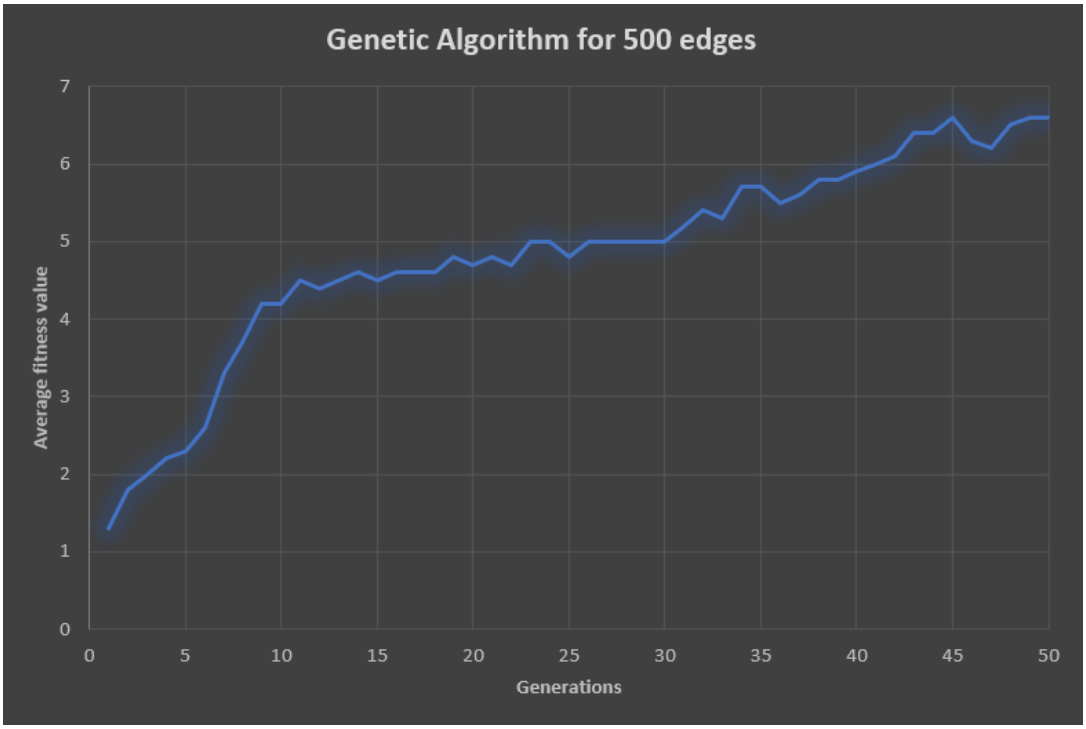
3.Graph with 300 edges



4.Graph with 400 edges



5.Graph with 500 edges



PART B:

1. Varying population size:
   After changing the population size from 100 to 200, there is not much difference between the best fitness value we get for each generation.

2. Varying the number of generations:
   Increasing the number of generations makes a difference, but there is not much growth after a certain point.
3. Varying mutation rate:
   The algorithm was tried with multiple mutation rates (0.05, 0.1, 0.2, 0.3). It gave the best results when the mutation rate was 0.1.

4. Taking the best of the previous generations:
   Taking a certain number of best states from the previous generation and treating them as a part of the new generation improved the fitness value by almost 5-6 units in an average case.

[150 Generations]
Improving the algorithm with this approach got a perfect solution in almost every case for 50 edges; It also got a maximum fitness value of 45 for the case of 100 edges. For the case of 200 edges, it reached a maximum value of 32.
The number of bests states from the previous generation, which was mentioned earlier, was taken to be 20. The algorithm was tried for different numbers (10, 15, 20, 25), out of which, 20 gave the best results.

[10000 Generations or 45sec runtime]
The algorithm got the perfect solution for 50 edges in the 29th generation (best case).
It took the algorithm almost 350 generations to reach a maximum fitness value of 48 in case of 100 edges.
In the case of 200 edges, the algorithm reached a maximum fitness of 34 in almost 600

generations, but the fitness value did not flinch after that for the whole execution time.

```
Roll no : 2020A7PS1394G
Number of edges :  50
Best state :
0:G, 1:R, 2:R, 3:B, 4:B, 5:B, 6:B, 7:R, 8:G, 9:B, 10:G, 11:G, 12:G, 13:B, 14:R, 15:B, 16:R, 17:G, 18:G, 19:B, 20:G, 21:R, 2
2:R, 23:B, 24:G, 25:G, 26:B, 27:G, 28:B, 29:R, 30:G, 31:R, 32:G, 33:R, 34:R, 35:G, 36:G, 37:R, 38:R, 39:B, 40:B, 41:B, 42:R
, 43:G, 44:G, 45:B, 46:B, 47:B, 48:G, 49:R
Fitness value of best state :  50
Time taken :  0.08086633682250977
```

```
Roll no : 2020A7PS1394G
Number of edges :  100
Best state :
0:G, 1:B, 2:G, 3:B, 4:R, 5:R, 6:G, 7:R, 8:G, 9:G, 10:G, 11:B, 12:R, 13:B, 14:R, 15:R, 16:R, 17:G, 18:R, 19:R, 20:R, 21:R, 2
2:G, 23:R, 24:B, 25:R, 26:G, 27:B, 28:B, 29:B, 30:G, 31:R, 32:B, 33:G, 34:B, 35:G, 36:G, 37:R, 38:G, 39:G, 40:G, 41:G, 42:R
, 43:R, 44:B, 45:B, 46:R, 47:B, 48:B, 49:R
Fitness value of best state :  50
Time taken :  0.5551276206970215
```

```
Roll no : 2020A7PS1394G
Number of edges :  200
Best state :
0:B, 1:R, 2:B, 3:B, 4:R, 5:B, 6:B, 7:G, 8:G, 9:G, 10:B, 11:G, 12:B, 13:G, 14:R, 15:R, 16:R, 17:B, 18:R, 19:R, 20:R, 21:B, 2
2:R, 23:B, 24:R, 25:R, 26:R, 27:G, 28:G, 29:B, 30:B, 31:G, 32:G, 33:B, 34:B, 35:G, 36:B, 37:G, 38:B, 39:R, 40:B, 41:R, 42:B
, 43:B, 44:B, 45:R, 46:B, 47:G, 48:B, 49:G
Fitness value of best state :  29
Time taken :  45.01626253128052
```