ASSIGNMENT-2

Artificial Intelligence

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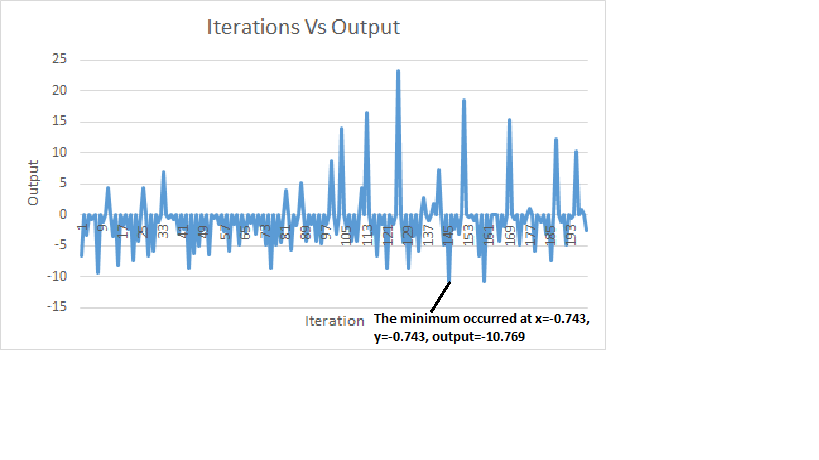
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Task 1: Ackleys Function

Notes: The following graph is drawn for various minima obtained over different values of x and y that are randomly taken between (-5,5) for the step sizes of 0.1

In this distribution we observe that the global minimum is obtained at x=-0.743, y=-0.743. the output obtained is -10.769

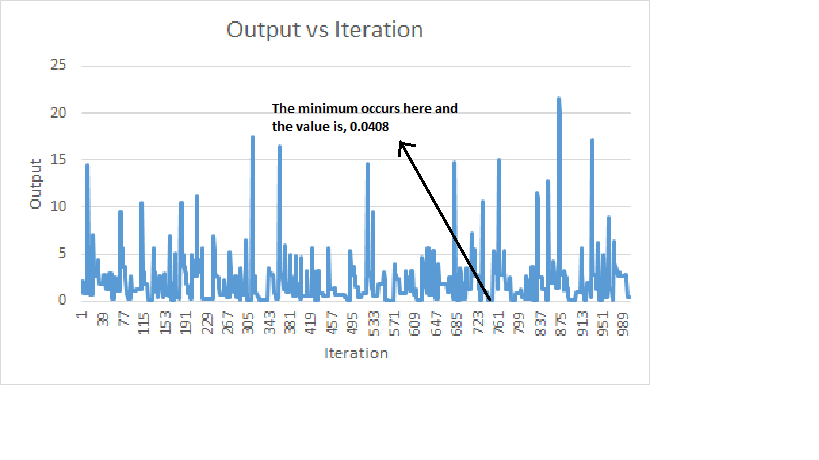


Task 2:

Differential Evolution of Ackley’s Function:

Differential evolution algorithm is applied to the Ackley’s function to obtain the global minimum of Ackley’s function.

The value of the global minimum obtained is near 0.0408 which is near to the actual global minimum of the function.



Task 3:

Comparison and conclusions from the Above two tasks:

By comparing the above two tasks we can conclude that the Differential evolution algorithm improves the solution obtained.

The Method optimizes the problem by iteratively trying to improve the candidate solution.

This is done with regard to the given measure of quality.

We have optimized the problem by maintaining the population of the candidate solutions and creating new candidate solutions by combining existing ones according to its simple formulae.

The adoption of differential evolution algorithm improves the optimization of getting the solution.

The Global Minimum is near to the actual minimum that is “0” using the differential evolution algorithm.

In conclusion, the solution obtained through differential evolution is optimal compared to normal Ackley’s function.

2)N Queens

Task 1:

For the number of queens =8 and running the program 100 times the output is

Output:

Total Runs: 100

Total Success: 12

Success Percentage: 12.0

Average number of steps: 4.0

For the number of queens =8 and running the program 100 times the output is

Output:

Total Runs: 100

Total Success: 5

Success Percentage: 5.0

Average number of steps: 7.0

Analysis: From the above task run for various number of Queens, it is observed that as the number of queens increase, the total number of possible solutions decrease the total number of possible solutions decreased from

No. of solutions=12(when N=8) to No. of solutions=5(N=16).

Initial and Final States of the board for the No. of runs=10

For Queens=8

Board Violations 5.0

0 0 0 0 0 0 0 Q

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Q 0 0 Q 0 0 0 0

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Board Violations 2.0

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Q 0 0 0 0 0 0 0

0 0 0 Q 0 0 0 0

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NO SOLUTION FOUND

Total Runs: 1

Total Success: 0

Success Percentage: 0.0

Average number of steps: 2.0

Board Violations 8.0

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Q 0 0 0 Q 0 0 0

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Board Violations 5.0

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Board Violations 3.0

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Board Violations 2.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 2

Total Success: 0

Success Percentage: 0.0

Average number of steps: 5.0

Board Violations 5.0

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Board Violations 3.0

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Board Violations 2.0

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NO SOLUTION FOUND

Total Runs: 3

Total Success: 0

Success Percentage: 0.0

Average number of steps: 3.0

Board Violations 3.0

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Board Violations 2.0

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NO SOLUTION FOUND

Total Runs: 4

Total Success: 0

Success Percentage: 0.0

Average number of steps: 2.0

Board Violations 6.0

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Board Violations 3.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 5

Total Success: 0

Success Percentage: 0.0

Average number of steps: 3.0

Board Violations 9.0

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Board Violations 5.0

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Board Violations 2.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 6

Total Success: 0

Success Percentage: 0.0

Average number of steps: 4.0

Board Violations 4.0

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Board Violations 3.0

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NO SOLUTION FOUND

Total Runs: 7

Total Success: 0

Success Percentage: 0.0

Average number of steps: 2.0

Board Violations 6.0

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Board Violations 3.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 8

Total Success: 0

Success Percentage: 0.0

Average number of steps: 3.0

Board Violations 5.0

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Board Violations 3.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 9

Total Success: 0

Success Percentage: 0.0

Average number of steps: 3.0

Board Violations 8.0

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Board Violations 6.0

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Board Violations 4.0

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Board Violations 2.0

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NO SOLUTION FOUND

Total Runs: 10

Total Success: 0

Success Percentage: 0.0

Average number of steps: 4.0

Process finished with exit code 0

Initial and Final States of the board for the No. of runs=10

For Queens=16

"C:\Users\KARTHIK JOSHI\Anaconda3\python.exe" "C:/Users/KARTHIK JOSHI/PycharmProjects/GeneticAlgo/Nqueens.py"

Enter the number of queens:16

Board Violations 20.0

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Board Violations 16.0

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Board Violations 12.0

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Board Violations 9.0

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Board Violations 6.0

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Board Violations 4.0

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Board Violations 3.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 1

Total Success: 0

Success Percentage: 0.0

Average number of steps: 8.0

Board Violations 16.0

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Board Violations 12.0

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Board Violations 8.0

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Board Violations 6.0

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Board Violations 4.0

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Board Violations 3.0

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Board Violations 2.0

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NO SOLUTION FOUND

Total Runs: 2

Total Success: 0

Success Percentage: 0.0

Average number of steps: 7.0

Board Violations 16.0

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Board Violations 12.0

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Board Violations 8.0

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Board Violations 6.0

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Board Violations 4.0

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Board Violations 3.0

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Board Violations 2.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 3

Total Success: 0

Success Percentage: 0.0

Average number of steps: 8.0

Board Violations 20.0

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Board Violations 15.0

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Q 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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Board Violations 12.0

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Board Violations 10.0

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Board Violations 8.0

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Board Violations 6.0

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Board Violations 4.0

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NO SOLUTION FOUND

Total Runs: 4

Total Success: 0

Success Percentage: 0.0

Average number of steps: 7.0

Board Violations 16.0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 Q 0

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Q 0 0 0 0 0 0 0 Q 0 0 0 0 0 0 0

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Board Violations 13.0

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Board Violations 10.0

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Board Violations 8.0

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Board Violations 6.0

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Board Violations 4.0

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Board Violations 3.0

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Board Violations 2.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 5

Total Success: 0

Success Percentage: 0.0

Average number of steps: 9.0

Board Violations 18.0

0 0 0 0 0 Q 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 Q 0 0 0 0 0 0 0 0 0 0

Q 0 0 0 0 0 0 0 0 0 0 0 0 Q 0 0

0 0 0 0 0 0 0 0 0 0 0 0 Q 0 0 0

Q 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 Q 0 0 0 0 0 0 0 0 0 0 0 0 0

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Board Violations 14.0

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Board Violations 11.0

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Board Violations 8.0

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Board Violations 6.0

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Board Violations 5.0

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Board Violations 4.0

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Board Violations 3.0

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Board Violations 2.0

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NO SOLUTION FOUND

Total Runs: 6

Total Success: 0

Success Percentage: 0.0

Average number of steps: 9.0

Board Violations 20.0

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Q 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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Board Violations 15.0

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Board Violations 10.0

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Board Violations 7.0

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Board Violations 5.0

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Board Violations 4.0

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Board Violations 3.0

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Board Violations 2.0

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NO SOLUTION FOUND

Total Runs: 7

Total Success: 0

Success Percentage: 0.0

Average number of steps: 8.0

Board Violations 13.0

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Board Violations 9.0

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Board Violations 6.0

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Board Violations 4.0

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Board Violations 3.0

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Board Violations 2.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 8

Total Success: 0

Success Percentage: 0.0

Average number of steps: 7.0

Board Violations 14.0

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Board Violations 11.0

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Board Violations 9.0

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Board Violations 7.0

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Board Violations 6.0

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Board Violations 4.0

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Board Violations 3.0

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Board Violations 2.0

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Board Violations 1.0

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NO SOLUTION FOUND

Total Runs: 9

Total Success: 0

Success Percentage: 0.0

Average number of steps: 9.0

Board Violations 22.0

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Board Violations 17.0

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Board Violations 13.0

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Board Violations 10.0

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Board Violations 8.0

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Board Violations 6.0

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Board Violations 4.0

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Board Violations 3.0

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NO SOLUTION FOUND

Total Runs: 10

Total Success: 0

Success Percentage: 0.0

Average number of steps: 9.0

Process finished with exit code 0

**Task 2: Genetic Algorithm for n Queens:**

Genetic algorithm has been implemented to n queens and following were the outcomes.

Enter the number of queens:8

Took 2 generations

Took 65 generations

Took 145 generations

Took 10 generations

Took 17 generations

Took 2 generations

Took 62 generations

Took 65 generations

Took 49 generations

Took 23 generations

Took 69 generations

Took 47 generations

Took 23 generations

Took 4 generations

Took 54 generations

Took 112 generations

Took 20 generations

Took 98 generations

Took 10 generations

Took 72 generations

Took 30 generations

Took 29 generations

Took 53 generations

Took 26 generations

Took 57 generations

Took 18 generations

Took 20 generations

Took 23 generations

Took 22 generations

Took 65 generations

Took 49 generations

Took 30 generations

Took 16 generations

Took 15 generations

Took 73 generations

Took 23 generations

Took 24 generations

Took 16 generations

Took 73 generations

Took 92 generations

Took 2 generations

Took 19 generations

Took 13 generations

Took 49 generations

Took 76 generations

Took 196 generations

Took 182 generations

Took 51 generations

Took 22 generations

Took 13 generations

Took 75 generations

Took 2 generations

Took 29 generations

Took 195 generations

Took 131 generations

Took 52 generations

Took 24 generations

Took 18 generations

Took 97 generations

Took 71 generations

Took 107 generations

Took 2 generations

Took 41 generations

Took 52 generations

Took 2 generations

Took 2 generations

Took 4 generations

Took 92 generations

Took 61 generations

Took 49 generations

Took 33 generations

Took 64 generations

Took 26 generations

Took 46 generations

Took 58 generations

Took 16 generations

Took 56 generations

Took 53 generations

Took 28 generations

Took 23 generations

Took 84 generations

Took 109 generations

Took 89 generations

Took 46 generations

Took 64 generations

Took 269 generations

Took 2 generations

Took 2 generations

Took 62 generations

Took 94 generations

Took 60 generations

Took 25 generations

Took 26 generations

Took 112 generations

Took 2 generations

Took 119 generations

Took 2 generations

Took 25 generations

Took 84 generations

Took 26 generations

Note: No. of generations denote the steps taken to reach the solution for 1 run.

The above Task is run for 100 times and No. of generations are calculated for each run.

**Enter the number of queens:16**

Took 354 generations

Took 1954 generations

Took 7884 generations

Took 1064 generations

Took 1141 generations

Took 256 generations

Took 3876 generations

Took 2266 generations

Took 18146 generations

Took 5472 generations

**Note:** From the task it is clearly observed that the Number of steps taken from N=8 to the steps taken to reach the solution when N=16 has drastically increased.

The time taken to execute the problem also increased.