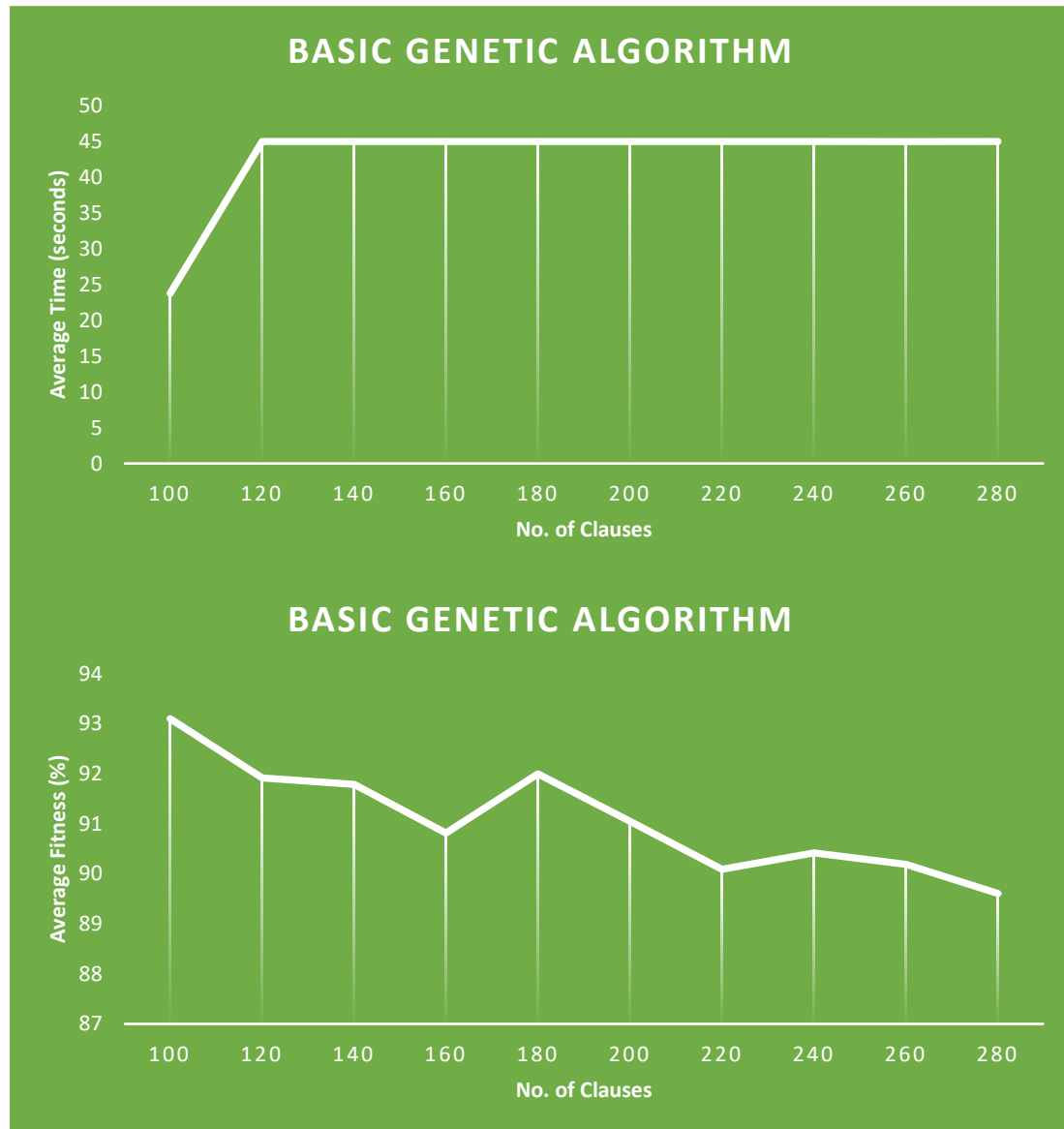# Artificial Intelligence

Programming Assignment 1

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# Basic Genetic Algorithm

Without any improvement with population size 20, the algorithm is not that good at finding the optimal solution.



## BASIC GENETIC ALGORITHM

(Average Time (seconds) vs No. of Clauses)

## BASIC GENETIC ALGORITHM

(Average Fitness (%) vs No. of Clauses)

# Improved Genetic Algorithm

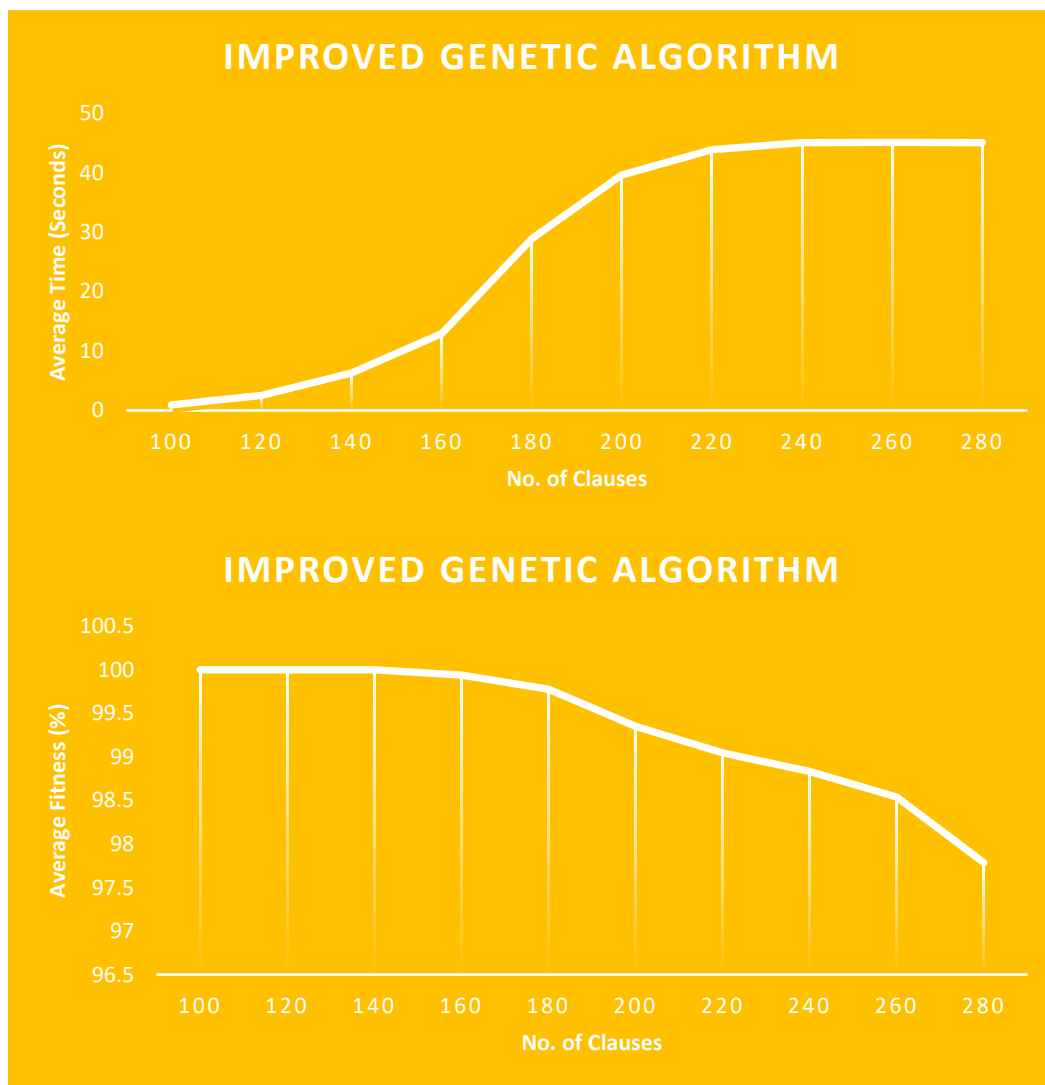After trying all possible combinations of improvements, the one I selected was the following:

Mutation: Basic,

Propagation (nextPopulation creation): Basic,

Selection (of parents): Select 5 parents at random and then select best 2 out of them.

Population size = 30

This gave the following results:

# Failed Attempts at Improving

**Crossover Point:**

Instead of choosing random crossover point, choosing the point that maximizes the child's fitness did not result in any improvement.

**Mutation:**

Instead of one, choosing multiple positions to mutate actually degraded the performance.

**Elitism:**

Average fitness after implementing elitism remains similar to the best model implemented but the average time taken increases by about 10x.

**Culling:**

Culling was also a similar story. The improvement in the fitness model was very less to be anything meaningful.

# Difficulties and Problems

According to the graphs seen above it seems like Genetic algorithm struggles to find a good solution when number of clauses increases. This was somewhat neutralized by the improved GA suggested but not to the extent that it leads to optimal solution.

Genetic algorithm is very time consuming. GA is usually hit and trial. The above two points and having so many parameters to change makes it incredibly difficult to find the best set of parameters. Also, genetic algorithm depends on the fitness function very much. This is another reason, genetic algorithm is difficult to implement in this problem, because there might be some different fitness specification that could have given better answer but it would have only been possible to find with rigorous research.

# Difficulty in the 3SAT problem

3SAT is an NP-Complete problem. Which makes it impossible to find optimal solution for. Moreover, increasing the number variables should make it easier to get the answer for. Whereas increasing the number of clauses will make it harder to get the satisfiability. That is number of variables increases keeping the number of clauses, the probability of getting 100% satisfiability will increase (in a way the degrees of freedom will increase), due in general more variable options to change in same number of clauses. Whereas increasing the number of clauses keeping the number of variables constant makes it harder to attain satisfiability because now there are more clauses to satisfy with same number of variables which implies more restrictions on variables in general.