A REPORT

ON

PROGRAMMING ASSIGNMENT-1

Prepared in partial fulfillment of the Course

ARTIFICIAL INTELLIGENCE (CS F407)

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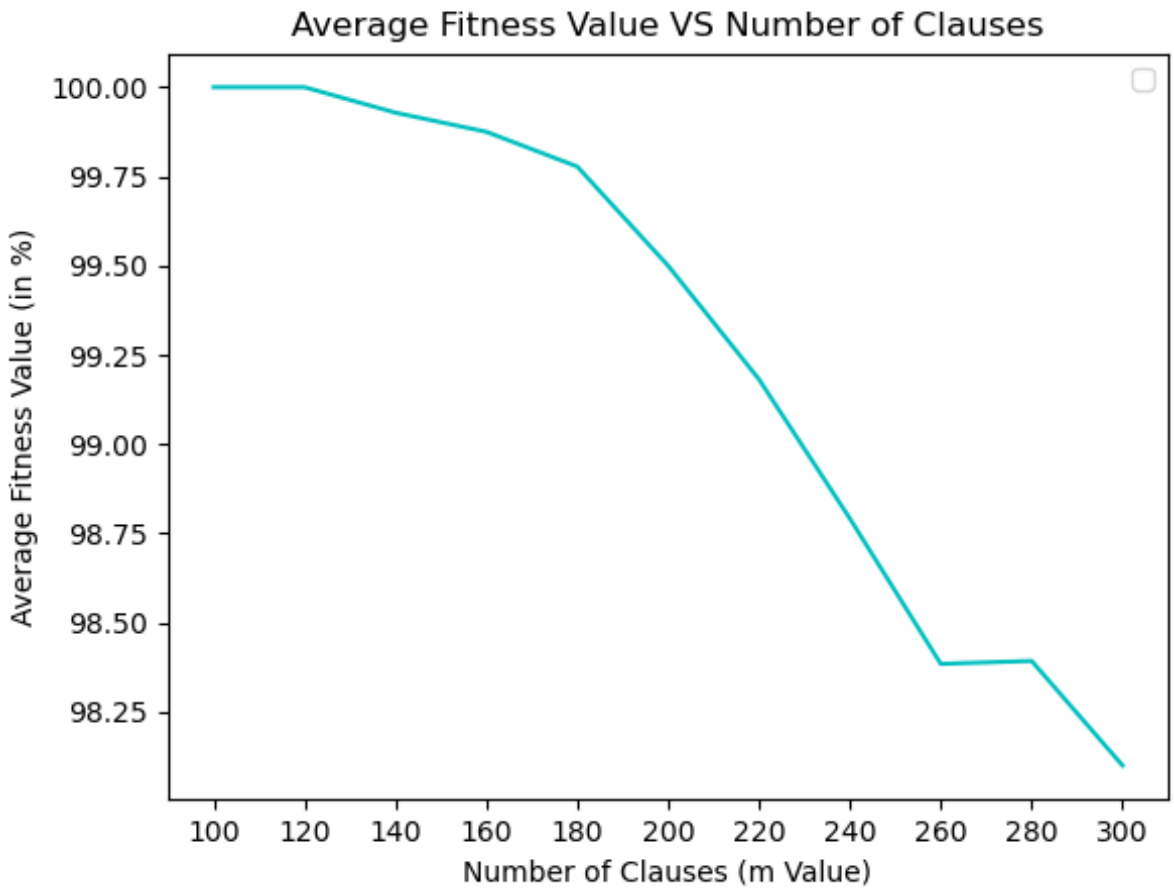
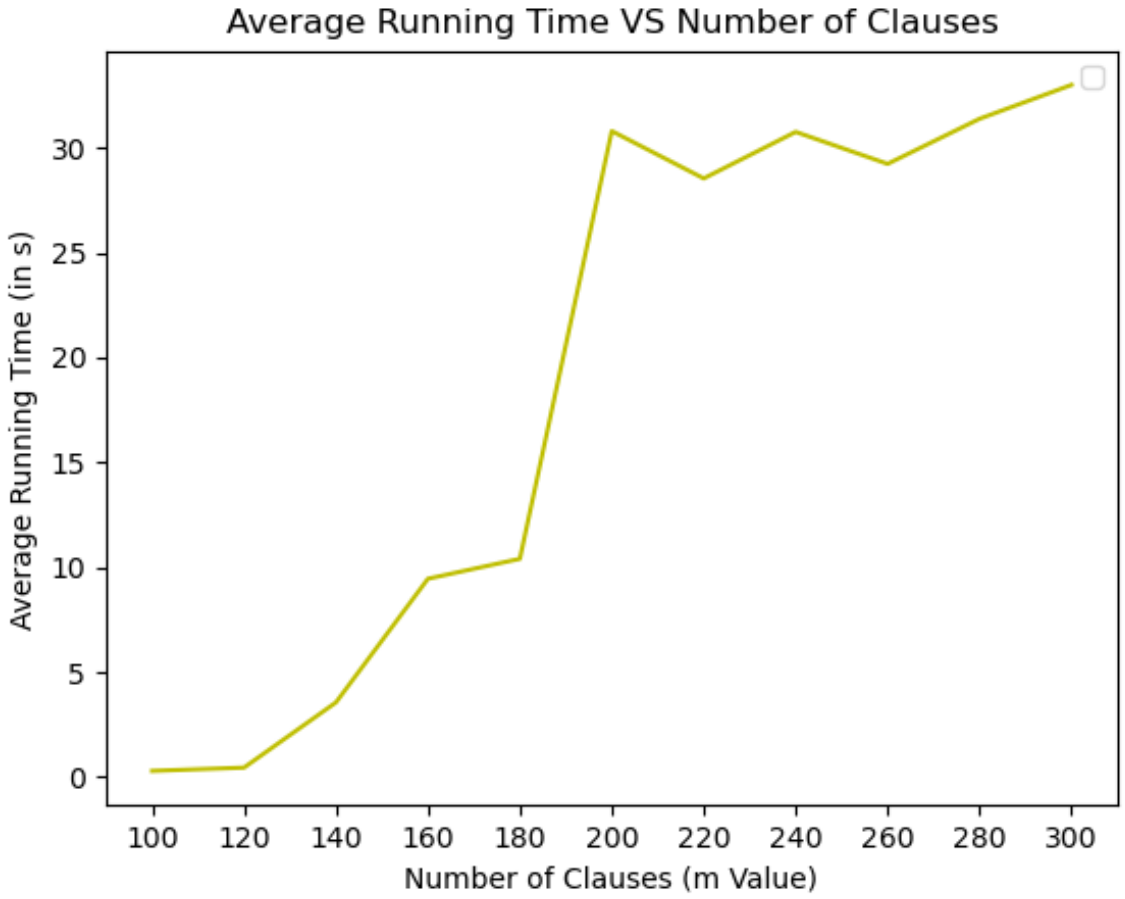
I. *Graph showing Average Fitness Function Value for 10 randomly generated 3-CNF sentences for each m value in range (100,120,140....300)*



The following graph shows the average fitness function value calculated for 3 randomly generated 3-CNF sentences for 11 different values of m in range (100,120,140,….300). As we can get a 100% fitness function value till 120 clauses but after that the fitness function values keeps on decreasing as we increase the clauses.

II. *Graph showing Average Running Time for 10 randomly generated 3-CNF sentences for each m value in range (100,120,140....300)*



The following graph shows the average running time calculated for 3 randomly generated 3-CNF sentences for 11 different values of m in range (100,120,140,….300). As we can see the average running time is less than 5s till 140 clauses but keeps on increasing as we increase the clauses but as we terminate program if fitness function doesn't change for 25secs so we can see after 200 clauses the program generally terminates in around 30-35 secs.

III. Improvements made in the Base Genetic Algorithm to find a better Fitness Function Value and the Failed Approaches

The following improvements were made in the GA to find a better Fitness function value:

- Population Size was increased from 20 to half of the length of the sentences.
- The parents with a best fitness function values from the population were added in the new population which guaranteed that the overall fitness will never decrease over time.
- 2 children were generated instead of 1 child from 2 parents using the crossover technique and the child with a better fitness function was added in the new population.
- The mutation probability was also changed and both the generated children were mutated and then the child with a better fitness function between the two was added in the new population.
- The parents with a best fitness function values from the population were added in the new population which guaranteed that the overall fitness will never decrease over time.
- The GA was coded to terminate if the time crosses 45s or the value of the best fitness function remained constant for a time period of more than 25 secs.

The following approaches failed in improving GA to find a better Fitness function value:

- The number of generations were limited it decrease the running time to find the best fitness function but it failed to give the best fitness values.
- The old population was added to the new population along with the children generated by the old population and then the new population was sorted according to fitness value to keep the best parents but it did not do any improvement to the algorithm and instead increased the running time of program.

IV. *Problems where the GA algorithm might find it difficult to find a good solution*

The running time to find a good solution increases linearly as the numbers of clauses are increased and it becomes difficult to find a 100% fitness function value after a certain threshold of number of clause, also after the threshold the fitness function value keeps on decreasing as we increase the number of clause.

The 3-CNF sentence in n variables is completely satisfiable only for a certain number of clauses as for one clause to be satisfied another clause may need to be unsatisfied. The better solution is only in comparison to other solutions and hence as a result, the stop criterion is not clear every time and can be improved.

V. *Difficulty of satisfying a 3-CNF sentence in n variables and when does a 3-CNF sentence become difficult to satisfy*

If we try to increase the n value then it may become difficult to satisfy the sentence using the GA model for the 3-CNF sentence as there are only a limited number of possible 3-CNF clauses.

For high values of n, if we try to increase the mutation rate then it is likely that we mutate an undesirable variable which can lead to the decrease in the fitness function value.

Also, for some states the fitness function value for the model may not change during the reproduction and it may have to be depend upon the mutation to change that state's fitness value and hence it may be possible that we could go several generations without the fitness value improving or changing.