**Sudoku Solver using Genetic Algorithms**

**Problem statement:**

Solving a 9 by 9 sudoku based on predefined sudoku rules using Genetic Algorithms.

Sudoku rules:

1. Each row must have numbers from 1 to 9 exactly once
2. Each column must have number from 1 to 9 exactly once
3. Each subsection(dividing the row and column by √9) must have number from 1 to 9 exactly once

**Genetic Algorithm for the solver:**

1. Empty space in sudoku was denoted by 0.
2. We randomly fill the empty space with a digit from 1 to 9.
3. Fitness score is calculated based on the number of filled spaces that follow the above rules.
4. Top 50% of the population size based on the fitness score is selected for breeding.
5. From the selected individuals 2 parents were randomly chosen which mate to produce 2 children.
6. The first child was produced taking the first half of the first parent and other half of the second parent. Vice-versa was done for the second child.
7. If fitness score doesn’t change for 20 generations mutation is performed where we change 1 empty space randomly.
8. Steps 3-6 are repeated till we reach a fitness score of 9x9=81 which means the sudoku has been solved.

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**Results:**

**Original unsolved sudoku**

2 1 9 5 4 0 0 7 8

5 4 3 8 0 6 9 0 0

0 7 0 2 1 9 3 0 5

4 0 2 0 6 5 8 9 1

7 6 5 1 0 8 2 3 4

0 9 0 4 3 2 5 6 7

3 2 1 0 5 4 7 8 9

6 0 4 9 8 0 1 0 3

9 0 7 3 0 1 4 5 6

GENERATION =1

FITNESS = 63

GENERATION =2

FITNESS = 63

GENERATION =3

FITNESS = 63

GENERATION =4

FITNESS = 63

GENERATION =5

FITNESS = 64

GENERATION =6

FITNESS = 64

GENERATION =7

FITNESS = 64

GENERATION =8

FITNESS = 64

GENERATION =9

FITNESS = 64

GENERATION =10

FITNESS = 64

GENERATION =11

FITNESS = 64

GENERATION =12

FITNESS = 66

GENERATION =13

FITNESS = 66

GENERATION =14

FITNESS = 66

GENERATION =15

FITNESS = 66

GENERATION =16

FITNESS = 66

GENERATION =17

FITNESS = 66

GENERATION =18

FITNESS = 66

GENERATION =19

FITNESS = 66

GENERATION =20

FITNESS = 66

GENERATION =21

FITNESS = 67

GENERATION =22

FITNESS = 67

GENERATION =23

FITNESS = 67

GENERATION =24

FITNESS = 69

GENERATION =25

**Mutation Performed**

FITNESS = 69

GENERATION =26

FITNESS = 69

GENERATION =27

FITNESS = 69

GENERATION =28

FITNESS = 69

GENERATION =29

FITNESS = 69

GENERATION =30

FITNESS = 69

GENERATION =31

FITNESS = 69

GENERATION =32

FITNESS = 69

GENERATION =33

FITNESS = 69

GENERATION =34

FITNESS = 70

GENERATION =35

FITNESS = 72

GENERATION =36

FITNESS = 72

GENERATION =37

FITNESS = 72

GENERATION =38

FITNESS = 72

GENERATION =39

FITNESS = 73

GENERATION =40

FITNESS = 73

GENERATION =41

FITNESS = 73

GENERATION =42

FITNESS = 74

GENERATION =43

FITNESS = 75

GENERATION =44

FITNESS = 75

GENERATION =45

FITNESS = 77

GENERATION =46

FITNESS = 81

**GENERATION = 47**

2 1 9 5 4 3 6 7 8

5 4 3 8 7 6 9 1 2

8 7 6 2 1 9 3 4 5

4 3 2 7 6 5 8 9 1

7 6 5 1 9 8 2 3 4

1 9 8 4 3 2 5 6 7

3 2 1 6 5 4 7 8 9

6 5 4 9 8 7 1 2 3

9 8 7 3 2 1 4 5 6

**Total execution time: 13.715 seconds!**

**Unit test:**



1. Unit test for mating of 2 individuals
2. Unit test for mutation of a random element of 1 individual
3. Unit test for selecting the top 50% of the individuals