* **main solution steps:**

1. Calculate fitness by sum the chromosome.
2. Creating the Selection function to do the probability for every chromosome.
3. Cumulative function to calculate the cumulative probability.
4. Function of one point cross over to select the parents by creating a random number between 0 and 1 and choose the parent when the random number is less than the cumulative in array “array containing the cumulative probability for every chromosome and take the index to bring the parent from chromosome array” , creating the child by creating a cutting point calculated by probability of cross over multiplied length of chromosome and make the loop from 0 to cutting point and another array from the cutting point to the length of chromosome.
5. Mutation function take the array of child’s and generate random number between 0 and 1 if the random number < probability of mutation flip the bit else keep it.
6. Generation function to run the code generation by generation and calculate the highest fitness and average fitness for every generation and print the final generation and the highest fitness and average for every generation.
7. Elitism to keep the highest fitness in generation to next generation.

* **The run of code:**

blue for the highest fitness.

red for the average fitness.

* The 1 run: Chromosome=[[1,0,1,0,1],[1,0,0,0,1],[1,1,0,0,1],[1,1,0,1,0],[1,1,0,0,1],[1,0,1,1,0],[0,1,0,1,0],[0,0,1,0,1],[0,0,1,1,0],[0,1,0,1,1],[0,1,1,0,0],[0,1,1,1,0],[1,0,0,1,1],[1,1,1,1,1],[0,0,0,0,0],[0,0,1,1,0],[1,1,1,0,1],[0,0,0,1,0],[0,0,0,1,1],[1,1,1,0,0]].

The final population:

[[1, 0, 1, 1, 0], [0, 1, 1, 0, 0], [0, 0, 0, 0, 0], [1, 0, 0, 1, 0], [1, 0, 0, 0, 1], [1, 1, 1, 0, 0], [1, 0, 1, 0, 0], [1, 0, 0, 0, 1], [1, 1, 0, 0, 0], [1, 0, 0, 0, 0], [1, 0, 1, 0, 0], [1, 0, 0, 0, 0], [1, 0, 0, 0, 0], [1, 0, 0, 0, 0], [1, 0, 0, 0, 0], [1, 0, 0, 0, 0], [1, 0, 0, 0, 0], [1, 0, 0, 0, 0], [0, 1, 0, 0, 1], [1, 0, 1, 1, 0]]

The highest fitness in 1 generation:5

The average fitness in 1 generation:2.55

The highest fitness in 2 generation:4

The average fitness in 2 generation:2.15

The highest fitness in 3 generation:3

The average fitness in 3 generation:1.65

The highest fitness in 4 generation:4

The average fitness in 4 generation:1.65

The highest fitness in 5 generation:3

The average fitness in 5 generation:1.55

The final population with elitism:

[[1, 0, 0, 1, 1], [1, 1, 1, 1, 0], [1, 0, 0, 1, 0], [1, 0, 1, 1, 0], [1, 0, 0, 1, 0], [1, 0, 0, 0, 0], [1, 0, 0, 1, 0], [1, 1, 0, 1, 0], [1, 1, 1, 1, 0], [1, 0, 0, 1, 1], [1, 0, 0, 1, 1], [1, 1, 1, 1, 0], [1, 0, 0, 1, 0], [1, 0, 0, 1, 0], [1, 1, 1, 1, 0], [1, 0, 0, 1, 1], [1, 0, 1, 1, 0], [1, 1, 0, 0, 1], [1, 1, 1, 1, 0], [1, 1, 1, 0, 1]]

The highest fitness in 1 generation with elitism:5

The average fitness in 1 generation with elitism:2.55

The highest fitness in 2 generation with elitism:4

The average fitness in 2 generation with elitism:2.6

The highest fitness in 3 generation with elitism:4

The average fitness in 3 generation with elitism:2.8

The highest fitness in 4 generation with elitism:4

The average fitness in 4 generation with elitism:2.4

The highest fitness in 5 generation with elitism:4

The average fitness in 5 generation with elitism:2.95

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* The 2 run:

Chromosome=[[0,0,1,0,0],[1,1,0,1,1],[0,1,0,1,1],[0,1,1,1,0],[0,0,0,0,1],[1,1,1,1,0],[0,1,0,1,0],[1,1,1,0,1],[1,0,1,1,1],[0,0,0,1,1],[1,1,1,0,0],[0,1,0,1,0],[0,0,1,1,1],[0,0,1,1,1],[0,0,1,0,1],[1,1,1,1,0],[1,0,1,0,0],[1,1,0,1,0],[0,1,0,1,1],[0,0,1,0,0]].

The final population:

[[0, 1, 0, 1, 1], [1, 1, 1, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [1, 1, 0, 1, 0], [1, 1, 1, 0, 0], [0, 1, 0, 1, 0], [1, 1, 1, 0, 0], [0, 1, 0, 1, 1], [0, 1, 0, 1, 0], [1, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 1, 0, 0], [1, 1, 1, 1, 0], [0, 1, 0, 1, 1], [1, 0, 1, 1, 0], [0, 1, 0, 1, 1]]

The highest fitness in 1 generation:4

The average fitness in 1 generation:2.7

The highest fitness in 2 generation:4

The average fitness in 2 generation:2.85

The highest fitness in 3 generation:4

The average fitness in 3 generation:2.25

The highest fitness in 4 generation:5

The average fitness in 4 generation:2.8

The highest fitness in 5 generation:5

The average fitness in 5 generation:2.6

The final population with elitism:

[[1, 0, 1, 1, 1], [1, 0, 1, 1, 1], [0, 1, 0, 1, 1], [1, 0, 1, 1, 1], [0, 1, 1, 1, 0], [1, 0, 0, 0, 1], [0, 1, 1, 1, 1], [0, 0, 1, 0, 1], [1, 1, 1, 1, 1], [1, 1, 1, 0, 1], [1, 1, 0, 1, 1], [0, 1, 1, 1, 0], [0, 1, 1, 1, 1], [0, 0, 1, 1, 1], [0, 1, 1, 0, 1], [1, 1, 1, 1, 1], [1, 0, 0, 0, 1], [0, 1, 0, 1, 0], [0, 1, 1, 1, 1], [0, 1, 1, 0, 1]]

The highest fitness in 1 generation with elitism:4

The average fitness in 1 generation with elitism:2.7

The highest fitness in 2 generation with elitism:5

The average fitness in 2 generation with elitism:3.3

The highest fitness in 3 generation with elitism:5

The average fitness in 3 generation with elitism:3.1

The highest fitness in 4 generation with elitism:5

The average fitness in 4 generation with elitism:3.05

The highest fitness in 5 generation with elitism:5

The average fitness in 5 generation with elitism:3.4

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* The 3 run:

Chromosome=[[0,0,1,1,1],[0,0,0,1,1],[1,1,1,1,1],[0,0,0,1,0],[0,1,1,0,1],[0,0,1,1,0],[1,1,1,1,0],[0,1,0,0,1],[0,0,1,0,1],[1,0,1,1,1],[0,1,0,0,0],[0,1,1,1,1],[1,0,1,1,1],[0,0,1,0,1],[0,0,1,1,1],[1,0,1,0,0],[0,0,1,0,0],[1,1,0,1,1],[1,1,0,1,0],[1,0,1,1,0]].

The final population:

[[1, 1, 1, 1, 0], [1, 1, 0, 1, 1], [0, 1, 0, 1, 1], [1, 0, 1, 1, 0], [0, 1, 0, 1, 1], [0, 1, 1, 1, 0], [0, 0, 0, 1, 1], [0, 1, 1, 1, 0], [0, 0, 0, 1, 1], [0, 1, 1, 1, 0], [1, 0, 1, 1, 1], [1, 0, 1, 0, 1], [1, 0, 0, 1, 1], [0, 1, 1, 1, 0], [0, 1, 0, 1, 1], [0, 1, 1, 1, 0], [0, 1, 0, 1, 1], [0, 1, 1, 1, 0], [0, 1, 1, 1, 0], [0, 1, 0, 1, 1]]

The highest fitness in 1 generation:5

The average fitness in 1 generation:2.75

The highest fitness in 2 generation:5

The average fitness in 2 generation:3.15

The highest fitness in 3 generation:5

The average fitness in 3 generation:2.75

The highest fitness in 4 generation:5

The average fitness in 4 generation:2.3

The highest fitness in 5 generation:4

The average fitness in 5 generation:2.35

The final population with elitism:

[[1, 0, 1, 1, 0], [1, 1, 1, 1, 1], [1, 0, 1, 1, 1], [1, 1, 1, 1, 1], [0, 0, 0, 1, 1], [1, 1, 1, 1, 0], [0, 0, 0, 1, 1], [1, 0, 1, 1, 0], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [0, 0, 1, 1, 1], [1, 1, 1, 1, 1], [0, 0, 0, 1, 1], [1, 1, 1, 1, 0], [1, 0, 1, 1, 1], [1, 0, 1, 1, 1], [0, 0, 1, 1, 0], [1, 0, 0, 1, 0], [1, 0, 1, 1, 1], [1, 1, 1, 1, 1]]

The highest fitness in 1 generation with elitism:5

The average fitness in 1 generation with elitism:2.75

The highest fitness in 2 generation with elitism:4

The average fitness in 2 generation with elitism:2.35

The highest fitness in 3 generation with elitism:5

The average fitness in 3 generation with elitism:3.15

The highest fitness in 4 generation with elitism:5

The average fitness in 4 generation with elitism:3.8

The highest fitness in 5 generation with elitism:5

The average fitness in 5 generation with elitism:3.65

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* The 4 run:

Chromosome=[[1,0,1,1,1],[0,1,0,1,1],[1,1,1,1,1],[0,1,0,1,0],[0,1,1,1,1],[1,0,1,1,0],[1,1,1,1,1],[0,1,1,0,1],[1,0,1,0,1],[1,1,1,1,1],[0,1,1,0,0],[1,1,1,1,1],[1,0,1,1,1],[0,1,1,0,1],[1,0,1,1,1],[1,1,1,0,0],[0,1,1,0,0],[1,1,0,1,1],[1,1,0,1,1],[1,0,1,1,0]].

The final population:

[[1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [1, 1, 1, 0, 1], [1, 0, 1, 1, 1], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [1, 0, 0, 0, 1], [1, 1, 1, 0, 0], [1, 1, 1, 0, 0], [1, 1, 0, 0, 0], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [1, 1, 0, 0, 0], [0, 1, 0, 1, 1], [1, 1, 1, 0, 1], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [0, 1, 1, 1, 1]]

The highest fitness in 1 generation:5

The average fitness in 1 generation:3.55

The highest fitness in 2 generation:5

The average fitness in 2 generation:3.35

The highest fitness in 3 generation:5

The average fitness in 3 generation:3.6

The highest fitness in 4 generation:5

The average fitness in 4 generation:4.15

The highest fitness in 5 generation:5

The average fitness in 5 generation:3.9

The final population with elitism:

[[1, 1, 1, 0, 1], [1, 1, 1, 1, 1], [1, 0, 1, 0, 1], [1, 1, 1, 1, 1], [1, 0, 1, 1, 1], [1, 0, 1, 1, 1], [1, 1, 1, 1, 1], [1, 0, 1, 1, 1], [1, 1, 1, 1, 1], [1, 0, 1, 1, 1], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [0, 0, 1, 1, 1], [1, 0, 0, 1, 1], [1, 1, 1, 1, 1], [0, 1, 0, 1, 1], [1, 1, 1, 1, 1], [1, 1, 1, 0, 1], [1, 0, 1, 1, 1], [1, 1, 1, 1, 1]]

The highest fitness in 1 generation with elitism:5

The average fitness in 1 generation with elitism:3.55

The highest fitness in 2 generation with elitism:5

The average fitness in 2 generation with elitism:3.75

The highest fitness in 3 generation with elitism:5

The average fitness in 3 generation with elitism:3.7

The highest fitness in 4 generation with elitism:5

The average fitness in 4 generation with elitism:4.4

The highest fitness in 5 generation with elitism:5

The average fitness in 5 generation with elitism:4.25

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* The 5 run:

Chromosome=[[0,0,1,1,1],[0,0,0,1,1],[0,1,1,1,1],[0,0,0,1,0],[0,1,0,1,1],[0,0,1,1,0],[0,1,1,1,1],[0,0,1,0,1],[0,0,1,0,1],[0,1,1,1,1],[0,0,1,0,0],[0,1,1,1,1],[0,0,1,1,1],[0,0,1,0,1],[0,0,1,1,1],[0,1,1,0,0],[0,0,1,0,0],[1,0,0,1,1],[0,1,0,1,1],[0,0,1,1,0]].

The final population:

[[0, 1, 1, 1, 0], [0, 1, 0, 0, 1], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 1], [0, 1, 1, 1, 0], [0, 1, 1, 1, 1], [0, 1, 1, 1, 1], [0, 1, 0, 1, 1], [0, 1, 1, 1, 0], [0, 1, 1, 1, 1], [0, 1, 1, 1, 1], [0, 0, 0, 1, 1], [0, 0, 1, 1, 0], [0, 1, 0, 1, 1], [0, 1, 1, 1, 1], [0, 1, 0, 1, 0], [0, 1, 0, 1, 1], [0, 1, 1, 1, 0], [0, 1, 0, 1, 1]]

The highest fitness in 1 generation:4

The average fitness in 1 generation:2.55

The highest fitness in 2 generation:5

The average fitness in 2 generation:3.05

The highest fitness in 3 generation:5

The average fitness in 3 generation:3.05

The highest fitness in 4 generation:4

The average fitness in 4 generation:2.95

The highest fitness in 5 generation:4

The average fitness in 5 generation:3.4

The final population with elitism:

[[0, 1, 0, 1, 1], [0, 1, 0, 1, 1], [0, 1, 1, 1, 1], [0, 1, 1, 1, 1], [0, 1, 1, 1, 0], [0, 1, 0, 1, 1], [0, 1, 0, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 0], [0, 1, 0, 1, 1], [0, 0, 1, 1, 1], [1, 1, 1, 1, 0], [0, 0, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 1], [0, 0, 1, 1, 0], [0, 1, 1, 1, 0], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 1, 1, 1, 1]]

The highest fitness in 1 generation with elitism:4

The average fitness in 1 generation with elitism:2.55

The highest fitness in 2 generation with elitism:3

The average fitness in 2 generation with elitism:2.15

The highest fitness in 3 generation with elitism:4

The average fitness in 3 generation with elitism:2.05

The highest fitness in 4 generation with elitism:4

The average fitness in 4 generation with elitism:2.7

The highest fitness in 5 generation with elitism:4

The average fitness in 5 generation with elitism:2.95

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* The 6 run:

Chromosome=[[0,0,0,1,1],[0,0,0,0,1],[0,0,1,1,1],[0,0,0,0,0],[0,0,0,1,1],[0,0,0,1,0],[0,0,1,1,1],[0,0,0,0,1],[0,0,0,0,1],[0,0,1,1,1],[0,0,0,0,0],[0,0,1,1,1],[0,0,0,1,1],[0,0,0,0,1],[0,0,0,1,1],[0,0,1,0,0],[0,0,1,0,0],[0,0,0,1,1],[0,1,0,0,1],[0,0,1,1,0]]

The final population:

[[0, 0, 0, 1, 1], [0, 0, 1, 1, 0], [0, 0, 1, 1, 0], [0, 1, 0, 1, 1], [0, 1, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 0], [0, 0, 0, 1, 0], [0, 0, 0, 1, 1], [0, 0, 1, 1, 0], [0, 1, 0, 1, 1], [0, 0, 1, 1, 0], [0, 0, 1, 1, 0], [0, 0, 0, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 0, 1], [0, 0, 1, 1, 1], [1, 0, 1, 1, 1], [0, 0, 1, 0, 0], [0, 1, 0, 1, 1]]

The highest fitness in 1 generation:3

The average fitness in 1 generation:1.65

The highest fitness in 2 generation:3

The average fitness in 2 generation:1.5

The highest fitness in 3 generation:4

The average fitness in 3 generation:2.15

The highest fitness in 4 generation:3

The average fitness in 4 generation:2.25

The highest fitness in 5 generation:4

The average fitness in 5 generation:2.75

The final population with elitism:

[[1, 0, 1, 0, 1], [1, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 0, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 0, 1, 1], [0, 0, 1, 1, 0], [0, 0, 1, 1, 0], [0, 0, 0, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 0, 1, 0], [0, 0, 0, 0, 0], [0, 1, 1, 0, 1], [0, 0, 1, 1, 1], [0, 0, 0, 1, 0], [0, 0, 0, 1, 1]]

The highest fitness in 1 generation with elitism:3

The average fitness in 1 generation with elitism:1.65

The highest fitness in 2 generation with elitism:3

The average fitness in 2 generation with elitism:1.3

The highest fitness in 3 generation with elitism:3

The average fitness in 3 generation with elitism:2.05

The highest fitness in 4 generation with elitism:3

The average fitness in 4 generation with elitism:2

The highest fitness in 5 generation with elitism:4

The average fitness in 5 generation with elitism:2.4

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* The 7 run:

Chromosome=[[0,0,0,1,0],[0,0,0,0,0],[0,0,1,1,0],[0,0,0,0,1],[0,0,0,1,0],[0,0,0,1,1],[0,0,1,1,0],[0,0,0,0,0],[0,0,0,0,0],[0,0,1,1,0],[0,0,0,0,1],[0,0,1,1,0],[0,0,0,1,0],[0,0,0,0,0],[0,0,0,1,0],[0,0,1,0,1],[0,0,1,0,1],[0,0,0,1,0],[0,1,0,0,0],[0,0,1,1,1]].

The final population:

[[1, 0, 0, 1, 1], [1, 0, 1, 0, 0], [0, 0, 0, 1, 0], [1, 0, 0, 1, 0], [0, 1, 0, 1, 1], [1, 0, 0, 1, 0], [1, 0, 0, 1, 0], [0, 1, 0, 1, 0], [1, 0, 1, 1, 1], [1, 0, 1, 1, 0], [0, 0, 0, 1, 1], [0, 0, 1, 1, 1], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [1, 0, 0, 1, 1], [1, 0, 1, 1, 0], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [1, 0, 1, 0, 0], [1, 0, 0, 1, 1]]

The highest fitness in 1 generation:3

The average fitness in 1 generation:1.25

The highest fitness in 2 generation:3

The average fitness in 2 generation:1.7

The highest fitness in 3 generation:4

The average fitness in 3 generation:2.05

The highest fitness in 4 generation:4

The average fitness in 4 generation:2.55

The highest fitness in 5 generation:3

The average fitness in 5 generation:2.35

The final population with elitism:

[[0, 0, 1, 1, 1], [0, 0, 1, 1, 0], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 1, 1, 0, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 1, 0, 1, 0], [0, 0, 1, 1, 1], [0, 0, 0, 1, 1], [0, 0, 1, 1, 1], [0, 1, 1, 1, 0], [0, 0, 1, 1, 1], [0, 1, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 1], [0, 0, 1, 1, 0], [0, 0, 1, 1, 1]]

The highest fitness in 1 generation with elitism:3

The average fitness in 1 generation with elitism:1.25

The highest fitness in 2 generation with elitism:4

The average fitness in 2 generation with elitism:1.8

The highest fitness in 3 generation with elitism:4

The average fitness in 3 generation with elitism:2.8

The highest fitness in 4 generation with elitism:4

The average fitness in 4 generation with elitism:3.2

The highest fitness in 5 generation with elitism:4

The average fitness in 5 generation with elitism:2.85

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* The 8 run :

Chromosome=[[0,1,0,1,0],[0,1,0,0,0],[0,1,1,1,0],[0,1,0,0,1],[0,1,0,1,0],[0,1,0,1,1],[0,1,1,1,0],[0,1,0,0,0],[0,1,0,0,0],[0,1,1,1,0],[0,1,0,0,1],[0,1,1,1,0],[0,1,0,1,0],[0,1,0,0,0],[0,1,0,1,0],[0,1,1,0,1],[0,1,1,0,1],[0,1,0,1,0],[0,1,0,0,0],[0,1,1,1,1]].

The final population:

[[1, 1, 0, 0, 0], [0, 1, 0, 0, 0], [0, 1, 0, 0, 0], [1, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 0, 0], [1, 1, 0, 0, 0], [0, 1, 0, 0, 0], [1, 1, 0, 1, 0], [1, 1, 0, 0, 0], [0, 1, 0, 0, 0], [1, 1, 0, 0, 0], [0, 1, 0, 0, 0], [1, 1, 0, 0, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [1, 1, 0, 0, 0], [0, 1, 0, 0, 0], [0, 1, 0, 0, 0], [1, 1, 0, 0, 0]]

The highest fitness in 1 generation:4

The average fitness in 1 generation:2.2

The highest fitness in 2 generation:4

The average fitness in 2 generation:2.25

The highest fitness in 3 generation:4

The average fitness in 3 generation:2.3

The highest fitness in 4 generation:5

The average fitness in 4 generation:2.1

The highest fitness in 5 generation:4

The average fitness in 5 generation:1.75

The final population with elitism:

[[0, 1, 0, 1, 1], [0, 1, 0, 1, 0], [0, 1, 1, 1, 1], [0, 1, 0, 1, 1], [0, 1, 0, 1, 1], [0, 1, 1, 1, 0], [0, 0, 0, 0, 0], [1, 1, 0, 1, 0], [0, 1, 0, 1, 1], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 0, 0, 1, 1], [0, 0, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 0], [0, 1, 0, 1, 1], [0, 1, 1, 1, 0]]

The highest fitness in 1 generation with elitism:4

The average fitness in 1 generation with elitism:2.2

The highest fitness in 2 generation with elitism:3

The average fitness in 2 generation with elitism:2.1

The highest fitness in 3 generation with elitism:3

The average fitness in 3 generation with elitism:2.2

The highest fitness in 4 generation with elitism:4

The average fitness in 4 generation with elitism:2.2

The highest fitness in 5 generation with elitism:4

The average fitness in 5 generation with elitism:2.35

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* The 9 run :

Chromosome=[[0,1,1,1,0],[0,1,1,0,0],[0,1,1,1,0],[0,1,1,0,1],[0,1,1,1,0],[0,1,1,1,1],[0,1,1,1,0],[0,1,1,0,0],[0,1,1,0,0],[0,1,1,1,0],[0,1,1,0,1],[0,1,1,1,0],[0,1,1,1,0],[0,1,1,0,0],[0,1,1,1,0],[0,1,1,0,1],[0,1,1,0,1],[0,1,1,1,0],[0,1,1,0,0],[0,1,1,1,1]].

The final population:

[[0, 1, 1, 0, 1], [1, 1, 1, 1, 1], [0, 1, 1, 0, 1], [1, 1, 1, 0, 1], [1, 1, 1, 0, 1], [1, 1, 1, 0, 1], [1, 1, 1, 0, 1], [1, 0, 1, 0, 1], [0, 1, 1, 0, 1], [1, 1, 1, 1, 1], [1, 1, 1, 1, 1], [1, 0, 1, 0, 1], [1, 1, 1, 1, 1], [0, 1, 1, 1, 1], [0, 1, 0, 1, 1], [1, 1, 1, 1, 1], [0, 1, 0, 0, 1], [0, 1, 1, 1, 1], [0, 1, 1, 1, 1], [0, 1, 1, 1, 1]]

The highest fitness in 1 generation:4

The average fitness in 1 generation:2.85

The highest fitness in 2 generation:5

The average fitness in 2 generation:3.7

The highest fitness in 3 generation:5

The average fitness in 3 generation:3.85

The highest fitness in 4 generation:5

The average fitness in 4 generation:4.1

The highest fitness in 5 generation:5

The average fitness in 5 generation:3.75

The final population with elitism:

[[0, 1, 1, 1, 1], [0, 1, 1, 1, 1], [0, 1, 1, 1, 1], [0, 1, 1, 1, 0], [0, 1, 0, 1, 1], [0, 1, 1, 1, 0], [1, 1, 1, 1, 0], [0, 0, 1, 1, 1], [0, 1, 0, 0, 0], [1, 1, 0, 1, 0], [1, 1, 1, 0, 1], [0, 1, 1, 1, 1], [0, 0, 0, 1, 0], [0, 0, 0, 1, 0], [0, 1, 1, 0, 0], [0, 0, 0, 1, 1], [0, 0, 0, 1, 1], [0, 0, 1, 0, 0], [0, 1, 1, 1, 1], [0, 1, 1, 1, 1]]

The highest fitness in 1 generation with elitism:4

The average fitness in 1 generation with elitism:2.85

The highest fitness in 2 generation with elitism:5

The average fitness in 2 generation with elitism:3.7

The highest fitness in 3 generation with elitism:5

The average fitness in 3 generation with elitism:2.8

The highest fitness in 4 generation with elitism:4

The average fitness in 4 generation with elitism:2

The highest fitness in 5 generation with elitism:4

The average fitness in 5 generation with elitism:2.85

Chart, line chart

Description automatically generated

Chart, line chart

Description automatically generated

* The 10 run:

Chromosome=[[0,1,1,0,0],[0,1,1,0,0],[0,1,1,0,0],[0,1,1,0,1],[0,1,1,0,0],[0,1,1,0,1],[0,1,1,0,0],[0,1,1,0,0],[0,1,1,0,0],[0,1,1,0,0],[0,1,1,0,1],[0,1,1,0,0],[0,1,1,0,0],[0,1,1,0,0],[0,1,1,0,0],[0,1,1,0,1],[0,1,1,0,1],[0,1,1,0,0],[0,1,1,0,0],[0,1,1,0,1]].

The final population:

[[0, 1, 1, 0, 0], [0, 1, 1, 0, 1], [0, 1, 1, 0, 0], [0, 1, 0, 0, 1], [0, 1, 1, 0, 1], [1, 1, 1, 0, 1], [0, 1, 0, 0, 1], [0, 0, 1, 1, 1], [0, 1, 1, 0, 1], [0, 1, 1, 0, 1], [0, 1, 1, 0, 0], [0, 0, 1, 0, 1], [0, 1, 1, 0, 1], [0, 1, 1, 0, 1], [0, 1, 1, 0, 0], [0, 1, 0, 0, 1], [0, 1, 1, 0, 1], [0, 1, 1, 0, 1], [0, 1, 1, 0, 1], [0, 1, 1, 0, 1]]

The highest fitness in 1 generation:3

The average fitness in 1 generation:2.3

The highest fitness in 2 generation:4

The average fitness in 2 generation:2.9

The highest fitness in 3 generation:4

The average fitness in 3 generation:2.75

The highest fitness in 4 generation:5

The average fitness in 4 generation:2.9

The highest fitness in 5 generation:3

The average fitness in 5 generation:2.45

The final population with elitism:

[[0, 0, 1, 0, 1], [0, 1, 1, 0, 1], [0, 1, 1, 0, 1], [0, 1, 1, 0, 1], [0, 0, 1, 0, 1], [0, 1, 1, 0, 1], [0, 0, 1, 0, 1], [1, 0, 1, 0, 0], [1, 0, 1, 0, 1], [0, 1, 1, 0, 1], [0, 1, 0, 0, 1], [0, 1, 1, 0, 0], [0, 1, 1, 0, 1], [0, 0, 1, 0, 1], [0, 1, 1, 0, 1], [1, 0, 0, 0, 1], [0, 0, 1, 0, 0], [0, 1, 0, 0, 1], [0, 0, 1, 0, 0], [1, 1, 0, 0, 1]]

The highest fitness in 1 generation with elitism:3

The average fitness in 1 generation with elitism:2.3

The highest fitness in 2 generation with elitism:3

The average fitness in 2 generation with elitism:2.75

The highest fitness in 3 generation with elitism:4

The average fitness in 3 generation with elitism:2.6

The highest fitness in 4 generation with elitism:3

The average fitness in 4 generation with elitism:2.4

The highest fitness in 5 generation with elitism:3

The average fitness in 5 generation with elitism:2.35

Chart, line chart

Description automatically generated

Chart, line chart

Description automatically generated