Roll no: 41310
Name: Prem Vinod Bansod
Assignment: 2(SCOA)

code:

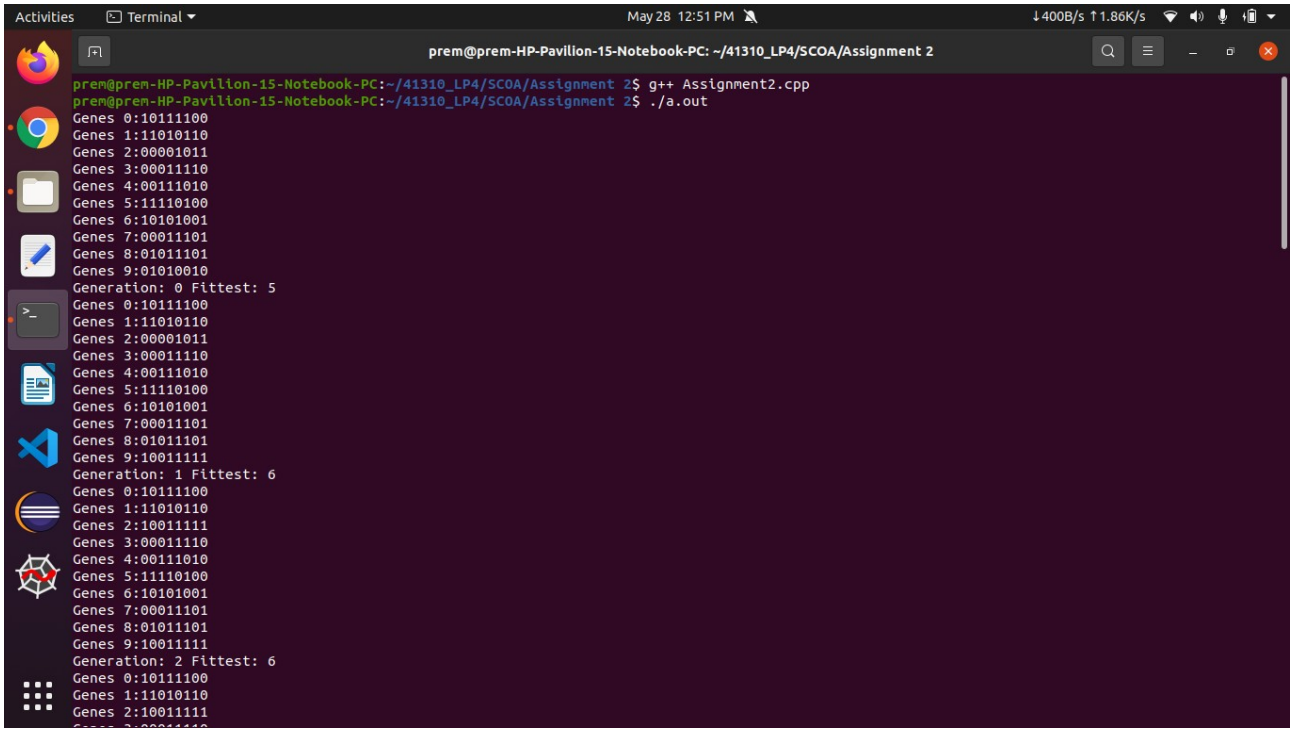
```
#include<bits/stdc++.h>
using namespace std;
class Individual {
   public:

   int fitness = 0;
   int genes[8];
   int geneLength = 8;

   Individual()
   {
         for(int i = 0;i<geneLength;i++)
         {
                  genes[i] = abs(rand())%2;
         }
         fitness = 0;
   }

   void printGenes()
   {
         for(int i = 0;i<geneLength;i++)
         {
                  cout<<genes[i];
         }
         cout<<'\n';
   }
   void calcFitness() {

      fitness = 0;
      for (int i = 0; i <geneLength; i++) {
         if (genes[i] == 1) {
            ++fitness;
         }
      }
   }
};
class Population {

   public:

   int popSize = 10;
   Individual individuals[10];
   int fittest = 0;

   Individual getFittest()
   {
```

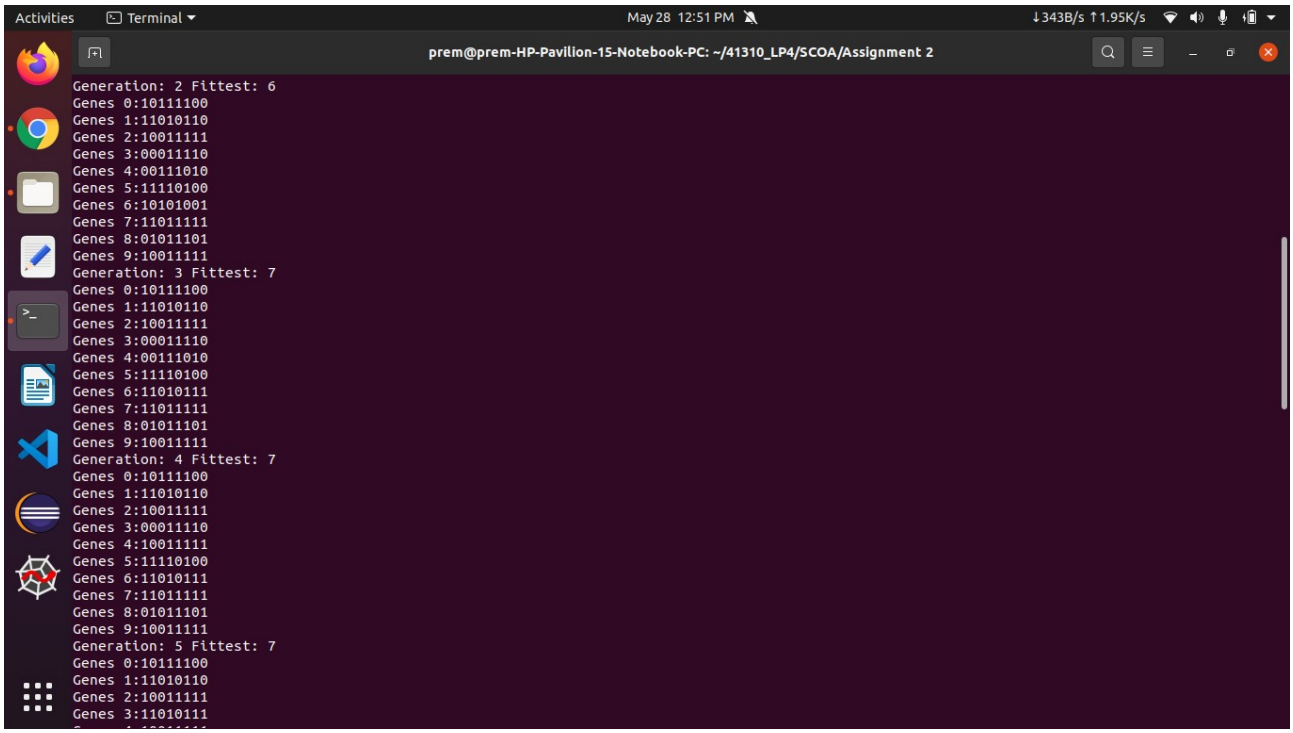
```
        int maxFit = INT_MIN;
        int maxFitIndex = 0;
        for (int i = 0; i < popSize; i++) {
            if (maxFit <= individuals[i].fitness) {
                maxFit = individuals[i].fitness;
                maxFitIndex = i;
            }
        }
        fittest = individuals[maxFitIndex].fitness;
        return individuals[maxFitIndex];
    }

    Individual getSecondFittest()
    {
        int maxFit1 = 0;
        int maxFit2 = 0;
        for (int i = 0; i < popSize; i++) {
            if (individuals[i].fitness > individuals[maxFit1].fitness) {
                maxFit2 = maxFit1;
                maxFit1 = i;
            } else if (individuals[i].fitness > individuals[maxFit2].fitness) {
                maxFit2 = i;
            }
        }
        return individuals[maxFit2];
    }

    int getLeastFittestIndex() {
        int minFitVal = INT_MAX;
        int minFitIndex = 0;
        for (int i = 0; i < popSize; i++) {
            if (minFitVal >= individuals[i].fitness) {
                minFitVal = individuals[i].fitness;
                minFitIndex = i;
            }
        }
        return minFitIndex;
    }
    void calculateFitness() {

        for (int i = 0; i < popSize; i++) {
            individuals[i].calcFitness();
            cout<<"Genes "<<i<<":";
            individuals[i].printGenes();
        }
        getFittest();
    }

};
class GA
{
    public:
```

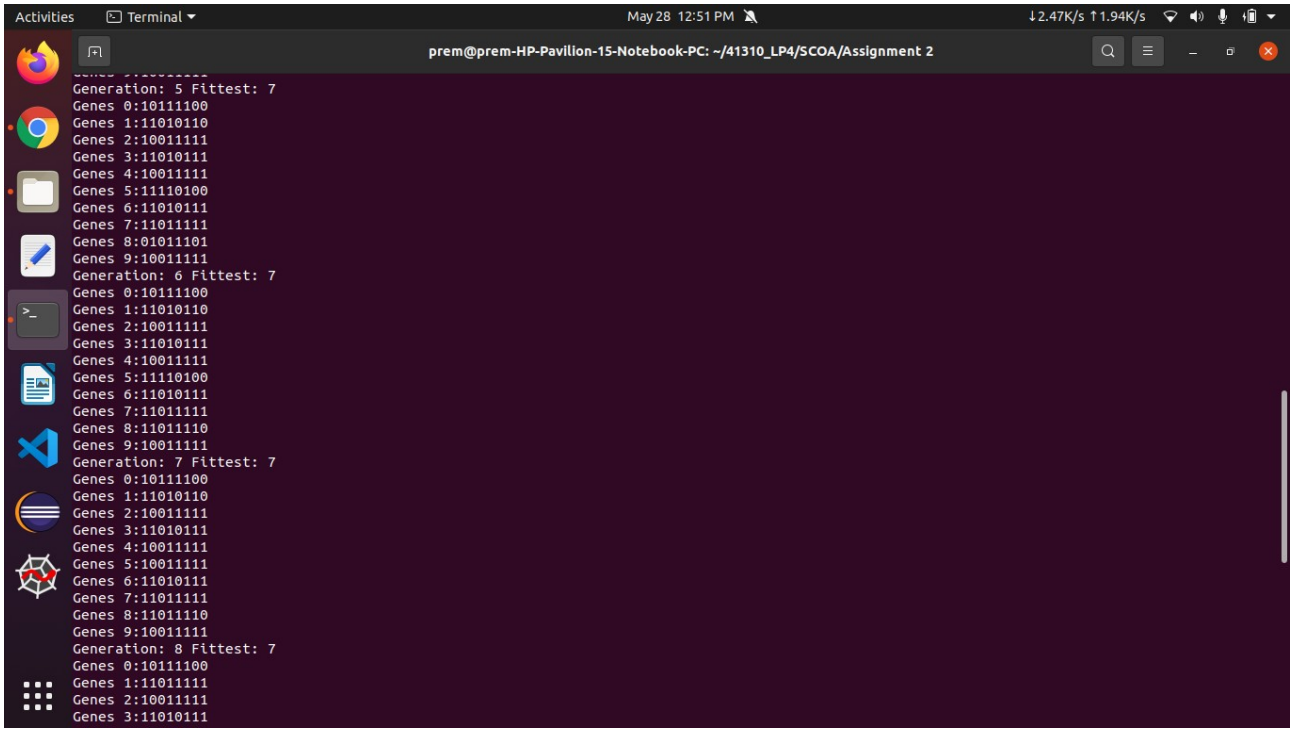
```
    Population population;
    Individual fittest;
    Individual secondFittest;
    int generationCount = 0;

    void selection() {
        fittest = population.getFittest();
        secondFittest = population.getSecondFittest();
    }
    void crossover() {
        int crossOverPoint = abs(rand())%population.individuals[0].geneLength;
        for (int i = 0; i < crossOverPoint; i++) {
            int temp = fittest.genes[i];
            fittest.genes[i] = secondFittest.genes[i];
            secondFittest.genes[i] = temp;

        }

    }

    void mutation() {
        int mutationPoint = abs(rand())%population.individuals[0].geneLength;
        if (fittest.genes[mutationPoint] == 0) {
            fittest.genes[mutationPoint] = 1;
        } else {
            fittest.genes[mutationPoint] = 0;
        }

        mutationPoint = abs(rand())%population.individuals[0].geneLength;

        if (secondFittest.genes[mutationPoint] == 0) {
            secondFittest.genes[mutationPoint] = 1;
        } else {
            secondFittest.genes[mutationPoint] = 0;
        }
    }
    Individual getFittestOffspring() {
        if (fittest.fitness > secondFittest.fitness) {
            return fittest;
        }
        return secondFittest;
    }
    void addFittestOffspring() {
        fittest.calcFitness();
        secondFittest.calcFitness();
        int leastFittestIndex = population.getLeastFittestIndex();
        population.individuals[leastFittestIndex] = getFittestOffspring();
    }
};
int main()
{
```

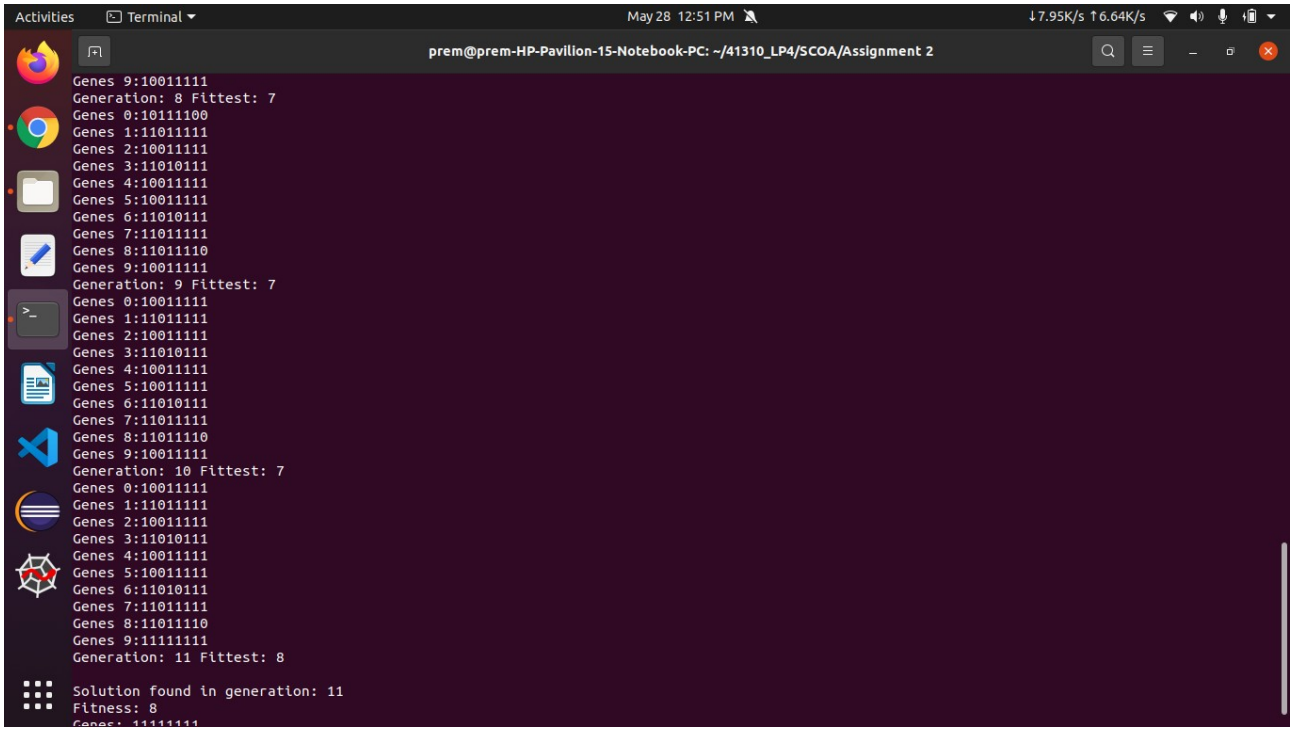
```
    GA ga;

    ga.population.calculateFitness();

    cout<<"Generation: "<<ga.generationCount<<" Fittest: "<< ga.population.fittest<<"\n";

    while (ga.population.fittest < ga.population.individuals[0].geneLength) {
       ++ga.generationCount;

       ga.selection();

       ga.crossover();

       if (abs(rand())% ga.population.individuals[0].geneLength+2<
ga.population.individuals[0].geneLength) {
          ga.mutation();
       }
       ga.addFittestOffspring();
       ga.population.calculateFitness();

       cout<<"Generation: "<<ga.generationCount<<" Fittest: "<< ga.population.fittest<<"\n";
    }

    cout<<"\nSolution found in generation: "<<ga.generationCount<<'\n';
    cout<<"Fitness: "<<ga.population.getFittest().fitness<<'\n';
    cout<<"Genes: ";
    for (int i = 0; i < ga.population.individuals[0].geneLength; i++) {
       cout<<ga.population.getFittest().genes[i];
    }
    cout<<"\n";
       return 0;
}
```

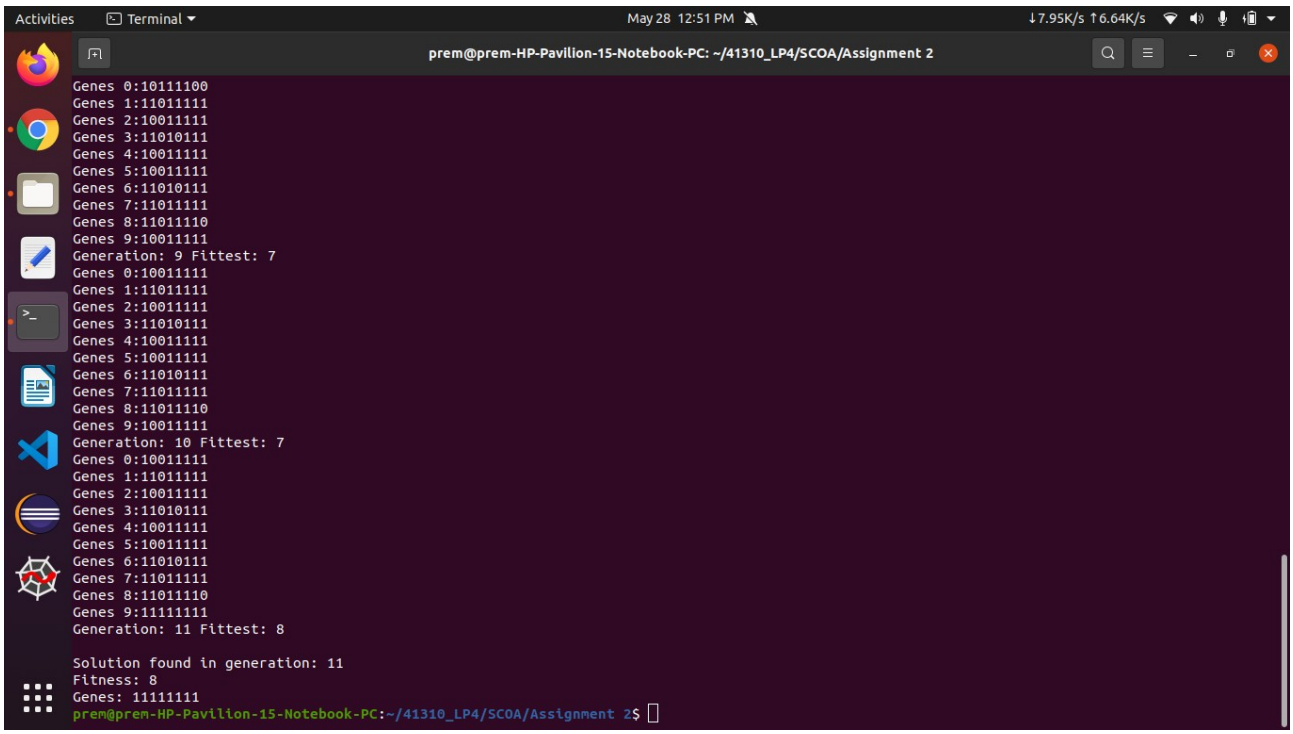
output:


Activities
Terminal
May 28 12:51 PM
↓400B/s ↑1.86K/s
prem@prem-HP-Pavilion-15-Notebook-PC: ~/41310_LP4/SCOA/Assignment 2
prem@prem-HP-Pavilion-15-Notebook-PC:~/41310_LP4/SCOA/Assignment 2$ g++ Assignment2.cpp
prem@prem-HP-Pavilion-15-Notebook-PC:~/41310_LP4/SCOA/Assignment 2$ ./a.out
Genes 0:10111100
Genes 1:11010110
Genes 2:00001011
Genes 3:00011110
Genes 4:00111010
Genes 5:11110100
Genes 6:10101001
Genes 7:00011101
Genes 8:01011101
Genes 9:01010010
Generation: 0 Fittest: 5
Genes 0:10111100
Genes 1:11010110
Genes 2:00001011
Genes 3:00011110
Genes 4:00111010
Genes 5:11110100
Genes 6:10101001
Genes 7:00011101
Genes 8:01011101
Genes 9:10011111
Generation: 1 Fittest: 6
Genes 0:10111100
Genes 1:11010110
Genes 2:10011111
Genes 3:00011110
Genes 4:00111010
Genes 5:11110100
Genes 6:10101001
Genes 7:00011101
Genes 8:01011101
Genes 9:10011111
Generation: 2 Fittest: 6
Genes 0:10111100
Genes 1:11010110
Genes 2:10011111


Activities
Terminal
May 28 12:51 PM
↓343B/s ↑1.95K/s
prem@prem-HP-Pavilion-15-Notebook-PC: ~/41310_LP4/SCOA/Assignment 2
Generation: 2 Fittest: 6
Genes 0:10111100
Genes 1:11010110
Genes 2:10011111
Genes 3:00011110
Genes 4:00111010
Genes 5:11110100
Genes 6:10101001
Genes 7:11011111
Genes 8:01011101
Genes 9:10011111
Generation: 3 Fittest: 7
Genes 0:10111100
Genes 1:11010110
Genes 2:10011111
Genes 3:00011110
Genes 4:00111010
Genes 5:11110100
Genes 6:11010111
Genes 7:11011111
Genes 8:01011101
Genes 9:10011111
Generation: 4 Fittest: 7
Genes 0:10111100
Genes 1:11010110
Genes 2:10011111
Genes 3:00011110
Genes 4:10011111
Genes 5:11110100
Genes 6:11010111
Genes 7:11011111
Genes 8:01011101
Genes 9:10011111
Generation: 5 Fittest: 7
Genes 0:10111100
Genes 1:11010110
Genes 2:10011111
Genes 3:11010111


Activities
Terminal
May 28 12:51 PM
↓2.47K/s ↑1.94K/s
prem@prem-HP-Pavilion-15-Notebook-PC: ~/41310_LP4/SCOA/Assignment 2
Generation: 5 Fittest: 7
Genes 0:10111100
Genes 1:11010110
Genes 2:10011111
Genes 3:11010111
Genes 4:10011111
Genes 5:11110100
Genes 6:11010111
Genes 7:11011111
Genes 8:01011101
Genes 9:10011111
Generation: 6 Fittest: 7
Genes 0:10111100
Genes 1:11010110
Genes 2:10011111
Genes 3:11010111
Genes 4:10011111
Genes 5:11110100
Genes 6:11010111
Genes 7:11011111
Genes 8:11011110
Genes 9:10011111
Generation: 7 Fittest: 7
Genes 0:10111100
Genes 1:11010110
Genes 2:10011111
Genes 3:11010111
Genes 4:10011111
Genes 5:10011111
Genes 6:11010111
Genes 7:11011111
Genes 8:11011110
Genes 9:10011111
Generation: 8 Fittest: 7
Genes 0:10111100
Genes 1:11011111
Genes 2:10011111
Genes 3:11010111


Activities
Terminal
May 28 12:51 PM
↓7.95K/s ↑6.64K/s
prem@prem-HP-Pavilion-15-Notebook-PC: ~/41310_LP4/SCOA/Assignment 2
Genes 9:10011111
Generation: 8 Fittest: 7
Genes 0:10111100
Genes 1:11011111
Genes 2:10011111
Genes 3:11010111
Genes 4:10011111
Genes 5:10011111
Genes 6:11010111
Genes 7:11011111
Genes 8:11011110
Genes 9:10011111
Generation: 9 Fittest: 7
Genes 0:10011111
Genes 1:11011111
Genes 2:10011111
Genes 3:11010111
Genes 4:10011111
Genes 5:10011111
Genes 6:11010111
Genes 7:11011111
Genes 8:11011110
Genes 9:10011111
Generation: 10 Fittest: 7
Genes 0:10011111
Genes 1:11011111
Genes 2:10011111
Genes 3:11010111
Genes 4:10011111
Genes 5:10011111
Genes 6:11010111
Genes 7:11011111
Genes 8:11011110
Genes 9:11111111
Generation: 11 Fittest: 8
Solution found in generation: 11
Fitness: 8


Activities
Terminal
May 28 12:51 PM
↓7.95K/s ↑6.64K/s
prem@prem-HP-Pavilion-15-Notebook-PC: ~/41310_LP4/SCOA/Assignment 2
Genes 0:10111100
Genes 1:11011111
Genes 2:10011111
Genes 3:11010111
Genes 4:10011111
Genes 5:10011111
Genes 6:11010111
Genes 7:11011111
Genes 8:11011110
Genes 9:10011111
Generation: 9 Fittest: 7
Genes 0:10011111
Genes 1:11011111
Genes 2:10011111
Genes 3:11010111
Genes 4:10011111
Genes 5:10011111
Genes 6:11010111
Genes 7:11011111
Genes 8:11011110
Genes 9:10011111
Generation: 10 Fittest: 7
Genes 0:10011111
Genes 1:11011111
Genes 2:10011111
Genes 3:11010111
Genes 4:10011111
Genes 5:10011111
Genes 6:11010111
Genes 7:11011111
Genes 8:11011110
Genes 9:11111111
Generation: 11 Fittest: 8
Solution found in generation: 11
Fitness: 8
Genes: 11111111
prem@prem-HP-Pavilion-15-Notebook-PC:~/41310_LP4/SCOA/Assignment 2$