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using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace lab3_siit_
{
    class Dot
    {
        public List<double> chromo;
        public double fit;
        public Dot(List<double> chromo)
        {
            this.chromo = chromo;
            fit = getFit(chromo);
        }
        private double getFit(List<double> chromo)
        {
            double fit = chromo.Count;
            for (int i=0;i<chromo.Count;i++)
            {
                double temp = chromo[i]* chromo[i] - Math.Cos(2 * Math.PI * chromo[i]);
                fit += temp;
            }
            return fit;
        }
    }
}

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namespace lab3_siit_
{
    class Population
    {
        public List<Dot> dogs;
        public double theBestFit;
        public double avarageFit;
        public Population(List<Dot> dogs)
        {
            this.dogs = dogs;
            theBestFit = getTheBestFit(dogs);
            avarageFit = getAvarageFit(dogs);
        }
        public double getTheBestFit(List<Dot> dogs)
        {
            double bestFit = 9999;
            for (int i = 0; i < dogs.Count; i++)
                if (bestFit > dogs[i].fit)
                    bestFit = dogs[i].fit;
            return bestFit;
        }
        public double getAvarageFit(List<Dot> dogs)
        {
            double avarageFit = 0;
            for (int i = 0; i < dogs.Count; i++)
                avarageFit += dogs[i].fit;
            avarageFit /= dogs.Count;
            return avarageFit;
        }
    }
}

using System;
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using System.Linq;

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```

using System.Text;
using System.Threading;
using System.Threading.Tasks;

namespace lab3_siit_
{
    class GA
    {
        Random random;
        List<Population> histor;
        public GA()
        {
            random = new Random();
            List<Dot> dots = new List<Dot>();
            for (int i = 0; i < 20; i++)
            {
                List<double> chromo = new List<double>();
                for (int j = 0; j < 20; j++)
                {
                    chromo.Add(random.NextDouble() % 2 - 1);
                }
                dots.Add(new Dot(chromo));
            }
            //Sorting by fit
            for (int i = 0; i < dots.Count; i++)
            {
                for (int j = dots.Count - 1; j > i; j--)
                {
                    if (dots[j].fit > dots[j - 1].fit)
                    {
                        Dot tempDot = dots[j];
                        dots[j] = dots[j - 1];
                        dots[j - 1] = tempDot;
                    }
                }
            }
            Population startPopulation = new Population(dots);
            histor = new List<Population>();
            histor.Add(startPopulation);
            int k = 0;
            while (!isReady(histor))
            {
                Thread.Sleep(10);
                histor.Add(getNextPupulation(histor[k]));
                k++;
            }
        }
        private Population getNextPupulation(Population parent)
        {
            List<Dot> childrenPopulationDots = new List<Dot>();

            for (int i = 0; i < 10; i++)
            {
                List<Dot> childrenDots = getChildren(
                    parent.dots[random.Next() % 10 + 10],
                    parent.dots[random.Next() % 10 + 10]
                );
                childrenPopulationDots.AddRange(childrenDots);
            }
            //Sorting by fit
            for (int i = 0; i < childrenPopulationDots.Count; i++)
            {
                for (int j = childrenPopulationDots.Count - 1; j > i; j--)
                {
                    if (childrenPopulationDots[j].fit > childrenPopulationDots[j - 1].fit)
                    {
                        Dot tempDot = childrenPopulationDots[j];
                        childrenPopulationDots[j] = childrenPopulationDots[j - 1];
                        childrenPopulationDots[j - 1] = tempDot;
                    }
                }
            }
            Population childrenPopulation = new Population(childrenPopulationDots);
            return childrenPopulation;
        }
    }
}

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}

Boolean isReady(List<Population> histor)
{
    if (histor.Count < 100)
        return false;
    else
    {
        for (int i = histor.Count - 100; i < histor.Count; i++)
        {
            if (histor[histor.Count - 100].avarageFit != histor[i].avarageFit)
                return false;
        }
        return true;
    }
}

private List<Dot> getChildren(Dot father, Dot mother)
{
    List<Dot> childrenDots = new List<Dot>();
    int pointCross = random.Next()%20;
    List<double> firstChromo = new List<double>();
    List<double> secondChromo = new List<double>();
    for (int j = 0; j < 20; j++)
    {
        if(j<pointCross)
        {
            firstChromo.Add(father.chromo[j]);
            secondChromo.Add(mother.chromo[j]);
        }
        else
        {
            firstChromo.Add(mother.chromo[j]);
            secondChromo.Add(father.chromo[j]);
        }
    }

    childrenDots.Add(new Dot(firstChromo));
    childrenDots.Add(new Dot(secondChromo));

    //Mutation
    for (int j = 0; j < childrenDots.Count; j++)
    {
        int prob = random.Next(0, 20);
        if (prob == 7)
        {
            int number = random.Next(20);
            childrenDots[j].chromo[number] = random.NextDouble() % 2 - 1;
        }
    }
    return childrenDots;
}
}
}
}

```