1 exercise – Zhenya Semenyuk

Conditions

1. Create 100 random binary-chromosomes each with 1000 genes.
2. Fitness is the number of "1" in one chromosome – the more the better.
3. Select 2 chromosomes by roulette method
4. Create a child chromosome by a uniform-crossover.
5. Repeat from 2. to 5. 100 times and create the next generation.
6. Repeat 6. until the fitness value does not change any more. (

Source Code

```csharp
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using static Genetic.Constants;

namespace Genetic
{
    public static class Constants
    {
        public const int CHROMOSOMES_NUMBER = 100;
        public const int GENES_NUMBER = 1000;
        public const int GENERATIONS_NUMBER = 1000;
        public const int FINTESS_CHANGE_NUMBER = 100;
        public const int MUTATION = 10000;
        public const int MUTATION_BORDER = 10;
    }
}

namespace Genetic
{
    public class Chromosome : IComparable<Chromosome>
    {
        public List<int> Genes { get; set; }
        public double Fitness { get; set; }
        public double Probability { get; set; }
        //for roulette method
        public int Count { get; set; }
        readonly Random _rnd;

        public Chromosome(Random rnd)
        {
            _rnd = rnd;
            Genes = new List<int>();

            for (int i = 0; i < GENES_NUMBER; i++)
                Genes.Add(_rnd.Next(2));

            Fitness = Genes.Sum();
        }

        public int CompareTo(Chromosome compareChromosome)
        {
            if (compareChromosome == null)
                return -1;
            else
                return compareChromosome.Fitness.CompareTo(Fitness);
        }
```

```csharp
        public Chromosome CreateChild(Chromosome parent2)
        {
            int chooseParent;

            Chromosome child = new Chromosome(_rnd);
            child.Genes.Clear();

            for(int i = 0; i < GENES_NUMBER; i++)
            {
                chooseParent = _rnd.Next(2);

                if (chooseParent == 1)
                    child.Genes.Add(Genes.ElementAt(i));
                else
                    child.Genes.Add(parent2.Genes.ElementAt(i));
            }

            child.Fitness = child.Genes.Sum();

            return child;
        }
    }
}

using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using static Genetic.Constants;

namespace Genetic
{
    class Program
    {
        static void Main(string[] args)
        {
            List<Chromosome> chromosomes = new List<Chromosome>();
            List<Chromosome> childChromosomes = new List<Chromosome>();

            int generationCount = 0;
            // increment if fitness hasn't change
            int fitnessChangeCount = 0;
            double parentsFitness, childsFitness;
            int i;

            Random rnd = new Random(DateTime.Now.TimeOfDay.Milliseconds);

            //1-st generation
            for (i = 0; i < CHROMOSOMES_NUMBER; i++)
                chromosomes.Add(new Chromosome(rnd));

            double fitnessSumm = chromosomes.Select(x => x.Fitness).Sum();

            foreach (var chr in chromosomes)
                chr.Probability = chr.Fitness / fitnessSumm;
            chromosomes.Sort();
            //1-st generation
            Console.WriteLine("Calculating...");

            Chromosome mother, father;

            while (generationCount != GENERATIONS_NUMBER)
            {
                //if (fitnessChangeCount > FINTESS_CHANGE_NUMBER)
```

```csharp
                    //     break;

                    chromosomes.Sort();
                    parentsFitness = chromosomes.Average(x => x.Fitness);

                    if (generationCount % 100 == 0)
                        Console.WriteLine($"Generation {generationCount}: - Average fitness: {parentsFitness}");

                    //create child from 2 parents and add to the population 100 times
                    for (i = 0; i < CHROMOSOMES_NUMBER; i++)
                    {
                        //roulette
                        mother = ChooseParent(chromosomes, rnd);
                        father = ChooseParent(chromosomes, rnd);

                        childChromosomes.Add(father.CreateChild(mother));

                        //truncate method

//childChromosomes.Add(chromosomes.ElementAt(rnd.Next(CHROMOSOMES_NUMBER / 2))
                        //     .CreateChild(chromosomes.ElementAt(rnd.Next(CHROMOSOMES_NUMBER / 2))));
                    }
                    //if (generationCount == 0 || generationCount == 500 || generationCount == 999)
                    //{
                    //     foreach (var chromosome in chromosomes)
                    //         Console.WriteLine($"Probability - {chromosome.Probability}, was chosen {chromosome.Count} times ");
                    //}

                    childsFitness = childChromosomes.Average(x => x.Fitness);

                    if ((int)childsFitness == (int)parentsFitness)
                        fitnessChangeCount++;

                    chromosomes.Clear();
                    chromosomes.AddRange(childChromosomes);
                    childChromosomes.Clear();

                    fitnessSumm = chromosomes.Select(x => x.Fitness).Sum();

                    foreach (var chr in chromosomes)
                        chr.Probability = chr.Fitness / fitnessSumm;

                    generationCount++;
                }
            }

        public static Chromosome ChooseParent(List<Chromosome> chromosomes, Random rnd)
        {
            double probabilitySum, parentProbability;
            Chromosome parent = null;
            probabilitySum = 0.0;
            parentProbability = rnd.NextDouble();

            for (int j = 0; j < GENES_NUMBER; j++)
            {
                if (probabilitySum < parentProbability)
                    probabilitySum += chromosomes.ElementAt(j).Probability;
                else
                {
                    parent = chromosomes.ElementAt(j - 1);
                    break;
```
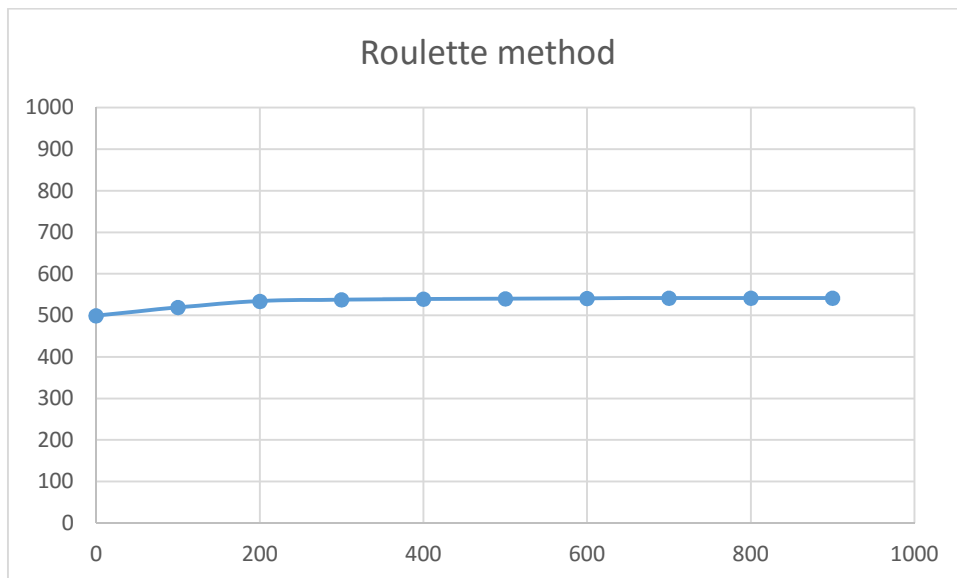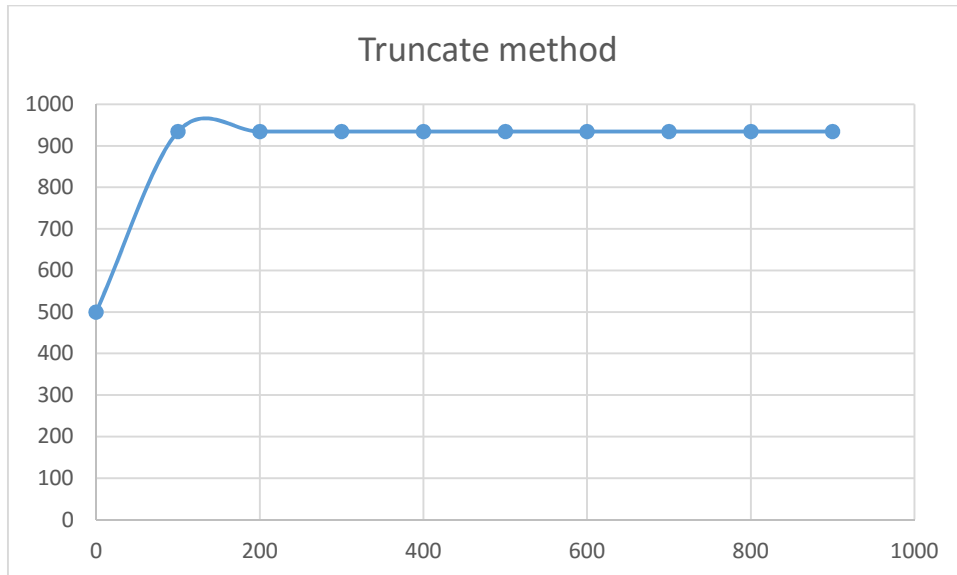
```
                }
            }

            return parent;
        }
    }
}
```

Truncate method

Roulette method

In the 1-st generation

Probability - 0,0106947587670986, was chosen 3 times

Probability - 0,0106547034908173, was chosen 0 times

Probability - 0,0106547034908173, was chosen 4 times

Probability - 0,0106346758526767, was chosen 5 times

Probability - 0,0106146482145361, was chosen 1 times

Probability - 0,0106146482145361, was chosen 2 times

Probability - 0,0105545653001142, was chosen 3 times

Probability - 0,0105145100238329, was chosen 4 times

Probability - 0,0105145100238329, was chosen 3 times

Probability - 0,0104944823856923, was chosen 1 times

Probability - 0,0104744547475516, was chosen 3 times

Probability - 0,0104744547475516, was chosen 1 times

Probability - 0,010454427109411, was chosen 3 times

Probability - 0,0104343994712704, was chosen 0 times

Probability - 0,0104143718331297, was chosen 4 times

Probability - 0,0104143718331297, was chosen 2 times

Probability - 0,0103943441949891, was chosen 0 times

Probability - 0,0103542889187078, was chosen 1 times

Probability - 0,0103542889187078, was chosen 4 times

Probability - 0,0103142336424265, was chosen 6 times

Probability - 0,0102942060042859, was chosen 0 times

Probability - 0,0102942060042859, was chosen 1 times

Probability - 0,0102541507280046, was chosen 0 times

Probability - 0,0101940678135827, was chosen 3 times

Probability - 0,0101940678135827, was chosen 3 times

Probability - 0,0101540125373015, was chosen 1 times

Probability - 0,0101540125373015, was chosen 3 times

Probability - 0,0101540125373015, was chosen 1 times

Probability - 0,0101139572610202, was chosen 1 times

Probability - 0,0101139572610202, was chosen 3 times

Probability - 0,0101139572610202, was chosen 1 times

Probability - 0,0101139572610202, was chosen 4 times

Probability - 0,0101139572610202, was chosen 1 times

Probability - 0,0101139572610202, was chosen 0 times

Probability - 0,0100939296228796, was chosen 0 times

Probability - 0,0100939296228796, was chosen 1 times

Probability - 0,0100739019847389, was chosen 4 times

Probability - 0,0100739019847389, was chosen 1 times

Probability - 0,0100538743465983, was chosen 1 times

Probability - 0,0100538743465983, was chosen 1 times

Probability - 0,0100538743465983, was chosen 2 times

Probability - 0,0100338467084577, was chosen 3 times

Probability - 0,010013819070317, was chosen 0 times

Probability - 0,010013819070317, was chosen 1 times

Probability - 0,0099937914321764, was chosen 0 times

Probability - 0,0099937914321764, was chosen 5 times

Probability - 0,0099937914321764, was chosen 1 times

Probability - 0,00997376379403577, was chosen 4 times

Probability - 0,00997376379403577, was chosen 2 times

Probability - 0,00997376379403577, was chosen 0 times

Probability - 0,00997376379403577, was chosen 1 times

Probability - 0,00997376379403577, was chosen 6 times

Probability - 0,00995373615589513, was chosen 2 times

Probability - 0,0099337085177545, was chosen 3 times

Probability - 0,0099337085177545, was chosen 1 times

Probability - 0,0099337085177545, was chosen 1 times

Probability - 0,00991368087961387, was chosen 4 times

Probability - 0,00991368087961387, was chosen 2 times

Probability - 0,00989365324147323, was chosen 0 times

Probability - 0,00989365324147323, was chosen 2 times

Probability - 0,00989365324147323, was chosen 2 times

Probability - 0,0098736256033326, was chosen 3 times

Probability - 0,0098736256033326, was chosen 1 times

Probability - 0,0098736256033326, was chosen 1 times

Probability - 0,00985359796519196, was chosen 0 times

Probability - 0,00985359796519196, was chosen 4 times

Probability - 0,00985359796519196, was chosen 0 times

Probability - 0,00985359796519196, was chosen 1 times

Probability - 0,00985359796519196, was chosen 3 times

Probability - 0,00983357032705133, was chosen 1 times

Probability - 0,0098135426889107, was chosen 0 times

Probability - 0,0098135426889107, was chosen 2 times

Probability - 0,00979351505077006, was chosen 2 times

Probability - 0,00979351505077006, was chosen 2 times

Probability - 0,00979351505077006, was chosen 2 times

Probability - 0,00977348741262943, was chosen 1 times

Probability - 0,00977348741262943, was chosen 3 times

Probability - 0,0097534597744888, was chosen 3 times

Probability - 0,0097534597744888, was chosen 0 times

Probability - 0,00973343213634816, was chosen 4 times

Probability - 0,00971340449820753, was chosen 2 times

Probability - 0,00971340449820753, was chosen 3 times

Probability - 0,00971340449820753, was chosen 3 times

Probability - 0,00969337686006689, was chosen 1 times

Probability - 0,00967334922192626, was chosen 1 times

Probability - 0,00965332158378562, was chosen 4 times

Probability - 0,00963329394564499, was chosen 4 times

Probability - 0,00959323866936372, was chosen 5 times

Probability - 0,00959323866936372, was chosen 3 times

Probability - 0,00959323866936372, was chosen 0 times

Probability - 0,00957321103122309, was chosen 2 times

Probability - 0,00955318339308245, was chosen 3 times

Probability - 0,00953315575494182, was chosen 1 times

Probability - 0,00949310047866055, was chosen 2 times

Probability - 0,00949310047866055, was chosen 3 times

Probability - 0,00947307284051992, was chosen 1 times

Probability - 0,00947307284051992, was chosen 0 times

Probability - 0,00943301756423865, was chosen 0 times

Probability - 0,00941298992609802, was chosen 4 times

Probability - 0,00939296228795738, was chosen 3 times

In the 500-th generation

Probability - 0,0100479265742677, was chosen 1 times

Probability - 0,0100479265742677, was chosen 3 times

Probability - 0,0100294221054385, was chosen 4 times

Probability - 0,0100294221054385, was chosen 5 times

Probability - 0,0100294221054385, was chosen 2 times

Probability - 0,0100294221054385, was chosen 0 times

Probability - 0,0100294221054385, was chosen 5 times

Probability - 0,0100294221054385, was chosen 5 times

Probability - 0,0100294221054385, was chosen 2 times

Probability - 0,0100294221054385, was chosen 4 times

Probability - 0,0100294221054385, was chosen 0 times

Probability - 0,0100294221054385, was chosen 3 times

Probability - 0,0100109176366092, was chosen 5 times

Probability - 0,0100109176366092, was chosen 2 times

Probability - 0,0100109176366092, was chosen 2 times

Probability - 0,0100109176366092, was chosen 2 times

Probability - 0,0100109176366092, was chosen 0 times

Probability - 0,0100109176366092, was chosen 3 times

Probability - 0,0100109176366092, was chosen 5 times

Probability - 0,0100109176366092, was chosen 1 times

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Probability - 0,0100109176366092, was chosen 2 times

Probability - 0,0100109176366092, was chosen 0 times

Probability - 0,0100109176366092, was chosen 4 times

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Probability - 0,0100109176366092, was chosen 1 times

Probability - 0,0100109176366092, was chosen 1 times

Probability - 0,0100109176366092, was chosen 2 times

Probability - 0,00999241316778002, was chosen 1 times

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Probability - 0,0099739086989508, was chosen 3 times

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Probability - 0,0099739086989508, was chosen 1 times

Probability - 0,0099739086989508, was chosen 4 times

Probability - 0,0099739086989508, was chosen 1 times

Probability - 0,0099739086989508, was chosen 0 times

Probability - 0,00995540423012157, was chosen 0 times

Probability - 0,00995540423012157, was chosen 0 times

In the 1000-th generation

Probability - 0,01, was chosen 0 times

Probability - 0,01, was chosen 3 times

Probability - 0,01, was chosen 2 times

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