

## 1 exercise

ALEXANDR MATVEYCHUK II-11

### 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(python):

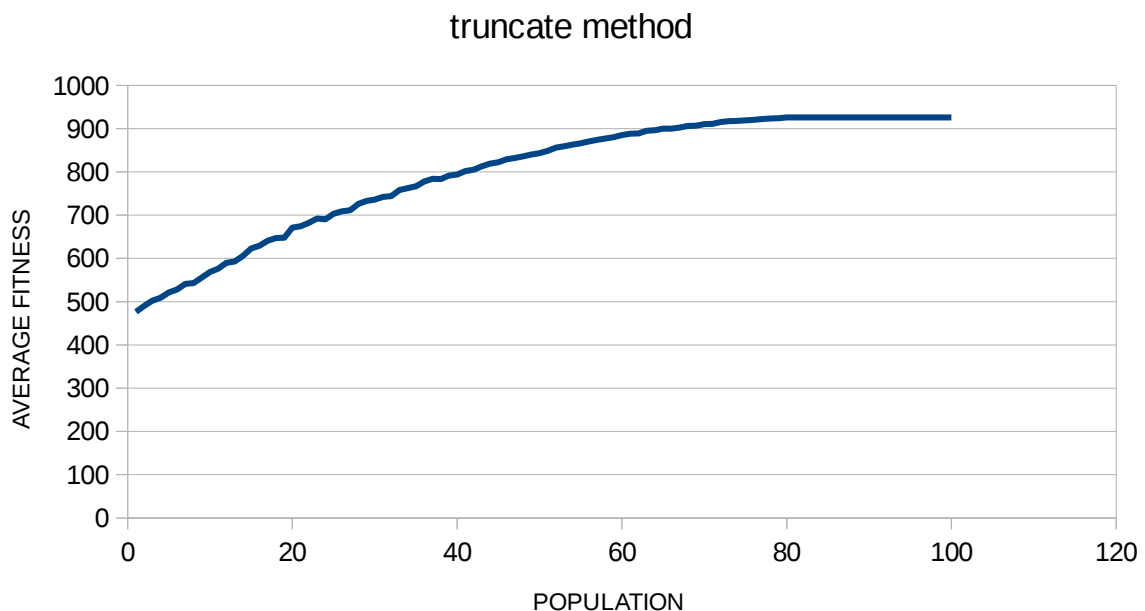
```
import random
def get_fitness(chromosome):
    return chromosome.count(1)
def roulette_select(fs):
    p = random.uniform(0, sum(fs))
    fs.reverse()
    for i, f in enumerate(fs):
        if p <= 0:
            break
        p -= f
    return i
def uniform_crossover(parents):
    child = []
    for x in range(1000):
        point = random.randint(0, 1)
        if point:
            child.append(parents[0][x])
        else:
            child.append(parents[1][x])
    # print(child)
    return child
def main():
    chromosomes = [[random.randint(0, 1) for _ in range(1000)] for _ in range(100)]
    chromosomes.sort(key=get_fitness, reverse=False)
    #fitness = [get_fitness(chromosome) for chromosome in chromosomes]
    new_chromosomes = []
    better_fitness = 0
    avg_fitness = 0
    population = 0
    hits = [0]*100
    file = open('hits.txt', 'w')
    file1 = open('fitness.txt', 'w')
    file2 = open('2', 'w')
    file3 = open('3', 'w')
    while better_fitness < 1000 and population < 500:
        fitness = [get_fitness(chromosome) for chromosome in chromosomes]
        for _ in range(100):
            mom_index = roulette_select(fitness)
            pope_index = roulette_select(fitness)
            #mom_index = random.randint(0, 49)
```

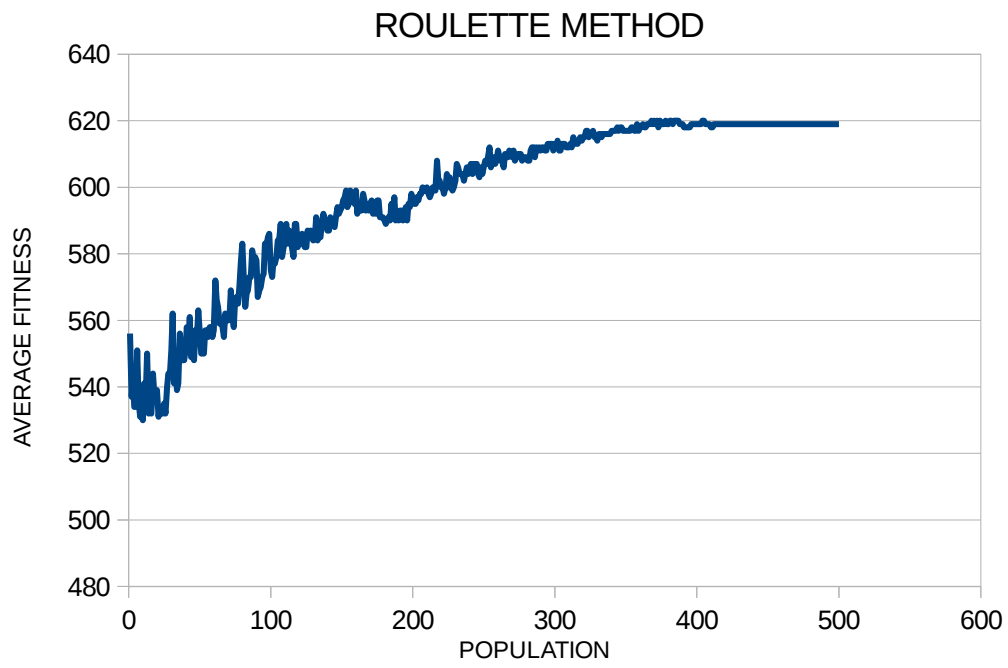
```

        #pope_index = random.randint(0, 49)
        hits[mom_index]+=1
        hits[pope_index]+=1
        parents = [chromosomes[mom_index], chromosomes[pope_index]]
        new_chromosomes.append(uniform_crossover(parents))
    new_chromosomes.sort(key=get_fitness, reverse=False)
    better_fitness = get_fitness(new_chromosomes[99])
    avg_fitness = sum(fitness)/len(fitness)
    population += 1
    if population == 1 or population ==250 or population ==500:
        for hit in hits:
            file.write(str(hit) + "\n")
        file.write("_____ \n")
        for fit in fitness:
            file1.write(str(fit)+"\n")
        file1.write("_____ \n")
    chromosomes = new_chromosomes
    new_chromosomes=[]
    #print(len(fitness), len(chromosomes))
    hits = [0] * 100
    file2.writelines(str(better_fitness)+'\n')
    file3.writelines(str(avg_fitness)+'\n')
    print(population, '|', better_fitness, '|', avg_fitness)
file.close()
file1.close()
file2.close()
file3.close()
main()

```

## Graph:





**TABLE:**

# Truncate method

| Chrom. | First population |      | Middle population |      | Last population |      |
|--------|------------------|------|-------------------|------|-----------------|------|
|        | fitness          | hits | fitness           | hits | fitness         | hits |
| 1      | 538              | 4    | 858               | 7    | 921             | 3    |
| 2      | 534              | 3    | 855               | 4    | 921             | 5    |
| 3      | 530              | 2    | 854               | 4    | 921             | 6    |
| 4      | 529              | 5    | 854               | 0    | 921             | 2    |
| 5      | 528              | 2    | 853               | 4    | 921             | 2    |
| 6      | 527              | 7    | 852               | 1    | 921             | 5    |
| 7      | 525              | 5    | 852               | 4    | 921             | 3    |
| 8      | 523              | 3    | 852               | 5    | 921             | 5    |
| 9      | 522              | 7    | 852               | 2    | 921             | 3    |
| 10     | 521              | 3    | 850               | 4    | 921             | 4    |
| 11     | 519              | 7    | 850               | 6    | 921             | 5    |
| 12     | 519              | 6    | 850               | 3    | 921             | 5    |
| 13     | 519              | 1    | 850               | 8    | 921             | 4    |
| 14     | 519              | 5    | 849               | 5    | 921             | 4    |
| 15     | 518              | 5    | 849               | 4    | 921             | 4    |
| 16     | 518              | 8    | 849               | 1    | 921             | 4    |
| 17     | 517              | 2    | 848               | 3    | 921             | 3    |
| 18     | 517              | 5    | 848               | 3    | 921             | 4    |
| 19     | 516              | 5    | 848               | 3    | 921             | 2    |
| 20     | 515              | 0    | 847               | 7    | 921             | 3    |
| 21     | 513              | 4    | 847               | 4    | 921             | 6    |
| 22     | 512              | 5    | 847               | 3    | 921             | 1    |
| 23     | 512              | 5    | 847               | 3    | 921             | 5    |
| 24     | 512              | 1    | 846               | 5    | 921             | 4    |
| 25     | 510              | 5    | 846               | 6    | 921             | 2    |
| 26     | 510              | 4    | 846               | 3    | 921             | 1    |
| 27     | 509              | 3    | 846               | 4    | 921             | 4    |
| 28     | 508              | 0    | 846               | 4    | 921             | 6    |
| 29     | 508              | 6    | 846               | 6    | 921             | 3    |
| 30     | 507              | 3    | 846               | 5    | 921             | 5    |
| 31     | 506              | 5    | 846               | 1    | 921             | 4    |
| 32     | 506              | 5    | 845               | 5    | 921             | 2    |
| 33     | 506              | 6    | 845               | 4    | 921             | 4    |
| 34     | 506              | 5    | 845               | 3    | 921             | 5    |
| 35     | 505              | 2    | 845               | 4    | 921             | 1    |
| 36     | 505              | 2    | 845               | 4    | 921             | 8    |
| 37     | 504              | 5    | 844               | 2    | 921             | 1    |
| 38     | 504              | 5    | 844               | 5    | 921             | 5    |
| 39     | 504              | 2    | 844               | 6    | 921             | 9    |
| 40     | 504              | 3    | 844               | 4    | 921             | 7    |
| 41     | 504              | 4    | 844               | 5    | 921             | 4    |
| 42     | 503              | 3    | 844               | 3    | 921             | 4    |
| 43     | 503              | 3    | 844               | 2    | 921             | 3    |
| 44     | 503              | 3    | 844               | 4    | 921             | 3    |
| 45     | 502              | 5    | 844               | 3    | 921             | 3    |
| 46     | 502              | 4    | 844               | 3    | 921             | 3    |
| 47     | 502              | 2    | 843               | 3    | 921             | 4    |
| 48     | 501              | 4    | 843               | 4    | 921             | 4    |
| 49     | 501              | 6    | 842               | 8    | 921             | 7    |
| 50     | 501              | 5    | 842               | 6    | 921             | 6    |

|     |     |   |     |   |     |   |
|-----|-----|---|-----|---|-----|---|
| 51  | 501 | 0 | 842 | 0 | 921 | 0 |
| 52  | 500 | 0 | 841 | 0 | 921 | 0 |
| 53  | 500 | 0 | 841 | 0 | 921 | 0 |
| 54  | 500 | 0 | 841 | 0 | 921 | 0 |
| 55  | 500 | 0 | 841 | 0 | 921 | 0 |
| 56  | 500 | 0 | 841 | 0 | 921 | 0 |
| 57  | 500 | 0 | 841 | 0 | 921 | 0 |
| 58  | 500 | 0 | 841 | 0 | 921 | 0 |
| 59  | 500 | 0 | 841 | 0 | 921 | 0 |
| 60  | 500 | 0 | 841 | 0 | 921 | 0 |
| 61  | 499 | 0 | 840 | 0 | 921 | 0 |
| 62  | 499 | 0 | 840 | 0 | 921 | 0 |
| 63  | 499 | 0 | 840 | 0 | 921 | 0 |
| 64  | 499 | 0 | 839 | 0 | 921 | 0 |
| 65  | 499 | 0 | 839 | 0 | 921 | 0 |
| 66  | 498 | 0 | 839 | 0 | 921 | 0 |
| 67  | 498 | 0 | 839 | 0 | 921 | 0 |
| 68  | 498 | 0 | 839 | 0 | 921 | 0 |
| 69  | 496 | 0 | 839 | 0 | 921 | 0 |
| 70  | 496 | 0 | 838 | 0 | 921 | 0 |
| 71  | 496 | 0 | 838 | 0 | 921 | 0 |
| 72  | 495 | 0 | 838 | 0 | 921 | 0 |
| 73  | 494 | 0 | 838 | 0 | 921 | 0 |
| 74  | 494 | 0 | 838 | 0 | 921 | 0 |
| 75  | 494 | 0 | 838 | 0 | 921 | 0 |
| 76  | 493 | 0 | 838 | 0 | 921 | 0 |
| 77  | 493 | 0 | 838 | 0 | 921 | 0 |
| 78  | 491 | 0 | 838 | 0 | 921 | 0 |
| 79  | 490 | 0 | 837 | 0 | 921 | 0 |
| 80  | 488 | 0 | 837 | 0 | 921 | 0 |
| 81  | 487 | 0 | 837 | 0 | 921 | 0 |
| 82  | 486 | 0 | 836 | 0 | 921 | 0 |
| 83  | 486 | 0 | 836 | 0 | 921 | 0 |
| 84  | 485 | 0 | 836 | 0 | 921 | 0 |
| 85  | 485 | 0 | 836 | 0 | 921 | 0 |
| 86  | 483 | 0 | 836 | 0 | 921 | 0 |
| 87  | 482 | 0 | 835 | 0 | 921 | 0 |
| 88  | 482 | 0 | 835 | 0 | 921 | 0 |
| 89  | 481 | 0 | 835 | 0 | 921 | 0 |
| 90  | 479 | 0 | 835 | 0 | 921 | 0 |
| 91  | 478 | 0 | 834 | 0 | 921 | 0 |
| 92  | 476 | 0 | 834 | 0 | 921 | 0 |
| 93  | 476 | 0 | 834 | 0 | 921 | 0 |
| 94  | 475 | 0 | 833 | 0 | 921 | 0 |
| 95  | 475 | 0 | 833 | 0 | 921 | 0 |
| 96  | 473 | 0 | 833 | 0 | 921 | 0 |
| 97  | 471 | 0 | 832 | 0 | 921 | 0 |
| 98  | 470 | 0 | 832 | 0 | 921 | 0 |
| 99  | 468 | 0 | 831 | 0 | 921 | 0 |
| 100 | 468 | 0 | 826 | 0 | 921 | 0 |

# Roulette method

| Chrom. | First population |      | Middle population |      | Last pop. |      |
|--------|------------------|------|-------------------|------|-----------|------|
|        | fitness          | hits | fitness           | hits | fitness   | hits |
| 1      | 461              | 0    | 588               | 0    | 619       | 0    |
| 2      | 466              | 2    | 588               | 1    | 619       | 2    |
| 3      | 469              | 2    | 589               | 3    | 619       | 0    |
| 4      | 470              | 2    | 590               | 3    | 619       | 3    |
| 5      | 474              | 2    | 590               | 2    | 619       | 6    |
| 6      | 480              | 0    | 590               | 1    | 619       | 1    |
| 7      | 480              | 6    | 590               | 3    | 619       | 1    |
| 8      | 481              | 1    | 590               | 1    | 619       | 2    |
| 9      | 484              | 2    | 592               | 6    | 619       | 1    |
| 10     | 485              | 2    | 592               | 7    | 619       | 2    |
| 11     | 485              | 2    | 592               | 2    | 619       | 1    |
| 12     | 486              | 3    | 592               | 7    | 619       | 3    |
| 13     | 486              | 3    | 592               | 3    | 619       | 4    |
| 14     | 486              | 3    | 592               | 1    | 619       | 4    |
| 15     | 487              | 2    | 593               | 1    | 619       | 0    |
| 16     | 488              | 2    | 593               | 0    | 619       | 3    |
| 17     | 488              | 2    | 593               | 1    | 619       | 1    |
| 18     | 488              | 4    | 594               | 5    | 619       | 1    |
| 19     | 489              | 3    | 594               | 1    | 619       | 2    |
| 20     | 489              | 1    | 594               | 4    | 619       | 2    |
| 21     | 490              | 2    | 594               | 3    | 619       | 1    |
| 22     | 490              | 4    | 594               | 3    | 619       | 2    |
| 23     | 490              | 0    | 594               | 3    | 619       | 4    |
| 24     | 490              | 0    | 595               | 7    | 619       | 0    |
| 25     | 490              | 1    | 595               | 3    | 619       | 2    |
| 26     | 490              | 3    | 595               | 3    | 619       | 0    |
| 27     | 491              | 6    | 595               | 0    | 619       | 4    |
| 28     | 491              | 1    | 595               | 6    | 619       | 1    |
| 29     | 491              | 2    | 595               | 2    | 619       | 1    |
| 30     | 492              | 3    | 595               | 1    | 619       | 2    |
| 31     | 492              | 2    | 595               | 1    | 619       | 3    |
| 32     | 493              | 1    | 596               | 0    | 619       | 0    |
| 33     | 493              | 2    | 596               | 5    | 619       | 5    |
| 34     | 493              | 0    | 596               | 3    | 619       | 4    |
| 35     | 493              | 2    | 596               | 3    | 619       | 2    |
| 36     | 494              | 2    | 596               | 3    | 619       | 1    |
| 37     | 494              | 3    | 596               | 2    | 619       | 4    |
| 38     | 495              | 2    | 596               | 0    | 619       | 1    |
| 39     | 496              | 1    | 596               | 3    | 619       | 0    |
| 40     | 496              | 2    | 596               | 2    | 619       | 4    |
| 41     | 496              | 1    | 597               | 2    | 619       | 2    |
| 42     | 497              | 0    | 597               | 3    | 619       | 0    |
| 43     | 497              | 2    | 597               | 2    | 619       | 1    |
| 44     | 497              | 2    | 597               | 2    | 619       | 2    |
| 45     | 497              | 0    | 597               | 2    | 619       | 4    |
| 46     | 497              | 3    | 597               | 2    | 619       | 2    |
| 47     | 498              | 1    | 597               | 0    | 619       | 1    |
| 48     | 498              | 1    | 597               | 0    | 619       | 4    |
| 49     | 498              | 3    | 597               | 0    | 619       | 3    |
| 50     | 499              | 3    | 597               | 2    | 619       | 2    |

|     |     |   |     |   |     |   |
|-----|-----|---|-----|---|-----|---|
| 51  | 500 | 1 | 597 | 2 | 619 | 1 |
| 52  | 500 | 2 | 597 | 1 | 619 | 3 |
| 53  | 501 | 1 | 597 | 2 | 619 | 2 |
| 54  | 501 | 4 | 597 | 3 | 619 | 1 |
| 55  | 502 | 2 | 597 | 2 | 619 | 2 |
| 56  | 502 | 2 | 598 | 3 | 619 | 1 |
| 57  | 502 | 1 | 598 | 2 | 619 | 1 |
| 58  | 502 | 0 | 598 | 0 | 619 | 1 |
| 59  | 503 | 1 | 598 | 1 | 619 | 2 |
| 60  | 504 | 1 | 598 | 1 | 619 | 6 |
| 61  | 504 | 0 | 598 | 0 | 619 | 3 |
| 62  | 505 | 3 | 598 | 0 | 619 | 3 |
| 63  | 506 | 1 | 598 | 0 | 619 | 1 |
| 64  | 506 | 1 | 598 | 2 | 619 | 2 |
| 65  | 507 | 2 | 598 | 3 | 619 | 1 |
| 66  | 507 | 0 | 598 | 1 | 619 | 3 |
| 67  | 507 | 1 | 598 | 1 | 619 | 2 |
| 68  | 507 | 4 | 598 | 4 | 619 | 3 |
| 69  | 508 | 2 | 598 | 1 | 619 | 1 |
| 70  | 509 | 4 | 598 | 2 | 619 | 3 |
| 71  | 509 | 0 | 598 | 0 | 619 | 0 |
| 72  | 509 | 5 | 599 | 2 | 619 | 2 |
| 73  | 510 | 0 | 599 | 0 | 619 | 1 |
| 74  | 510 | 2 | 599 | 4 | 619 | 2 |
| 75  | 510 | 3 | 599 | 2 | 619 | 2 |
| 76  | 510 | 3 | 599 | 0 | 619 | 3 |
| 77  | 510 | 1 | 599 | 1 | 619 | 3 |
| 78  | 511 | 4 | 599 | 1 | 619 | 1 |
| 79  | 511 | 3 | 600 | 1 | 619 | 0 |
| 80  | 511 | 2 | 600 | 6 | 619 | 1 |
| 81  | 511 | 1 | 600 | 1 | 619 | 2 |
| 82  | 511 | 2 | 600 | 2 | 619 | 1 |
| 83  | 512 | 3 | 600 | 2 | 619 | 3 |
| 84  | 512 | 4 | 600 | 3 | 619 | 3 |
| 85  | 513 | 4 | 600 | 1 | 619 | 1 |
| 86  | 513 | 0 | 600 | 0 | 619 | 3 |
| 87  | 514 | 3 | 601 | 1 | 619 | 3 |
| 88  | 514 | 2 | 601 | 1 | 619 | 3 |
| 89  | 514 | 3 | 601 | 1 | 619 | 2 |
| 90  | 515 | 0 | 601 | 2 | 619 | 4 |
| 91  | 517 | 2 | 601 | 1 | 619 | 0 |
| 92  | 519 | 1 | 601 | 1 | 619 | 1 |
| 93  | 520 | 0 | 602 | 0 | 619 | 4 |
| 94  | 520 | 1 | 602 | 1 | 619 | 2 |
| 95  | 526 | 4 | 602 | 1 | 619 | 2 |
| 96  | 527 | 6 | 602 | 5 | 619 | 4 |
| 97  | 528 | 3 | 602 | 1 | 619 | 1 |
| 98  | 532 | 1 | 603 | 2 | 619 | 0 |
| 99  | 534 | 2 | 603 | 1 | 619 | 2 |
| 100 | 553 | 3 | 604 | 5 | 619 | 1 |