

Report 4: evolutionary design

1) Authors:

- Sofya Aksenyuk, 150284;
- Uladzimir Ivashka, 150281;
- Piotr Górecki, 148282;

2) In the experiment, the evolutionary goal was jumping creatures that fast on land.

3) The Framscript:

```
Simulator.init();
Simulator.start();
var pusus = File.create("_logs.txt");
var out = "";
Simulator.print(pusus);
var startTime = Math.time;
while (ExpState.totaltestedcr<100000){
Simulator.step();
out += stats.st_max_fit;
out += "\n";
}
out += Math.time - startTime;
pusus.writeString(out);
pusus.close();
```

4) A list of modified values of the parameters and the script fragments in Mechastick:

-Parameter 1:

Unchanged	20
Mutated	64
Crossed over	16
Minimal similarity	0
Selection rule	Tournament (3 genotypes)
Delete genotypes	Only the worst

Fitness: return 0.0+this.velocity*1.0+this.numneurons*7.0+this.distance*10.0;

Constant	0
Life span	0
Velocity	1
Body parts	0
Body joints	0
Brain neurons	7
Brain connections	0
Distance	0
Vertical position	0
Vertical velocity	0
Criteria normalization	<input type="checkbox"/>
Similarity speciation	<input type="checkbox"/>
NSGA-II for multiple criteria	<input type="checkbox"/>

-Parameter 2:

Unchanged	20
Mutated	80
Crossed over	30
Minimal similarity	0
Selection rule	Tournament (3 genotypes)
Delete genotypes	Only the worst

Fitness: return 0.0+this.velocity*1.0+this.numneurons*7.0+this.distance*10.0;

Constant	0
Life span	0
Velocity	1
Body parts	0
Body joints	0
Brain neurons	7
Brain connections	0
Distance	0
Vertical position	0
Vertical velocity	0
Criteria normalization	<input type="checkbox"/>
Similarity speciation	<input type="checkbox"/>
NSGA-II for multiple criteria	<input type="checkbox"/>

5) Results of evolution over 10 runs of 10.000 evaluations:

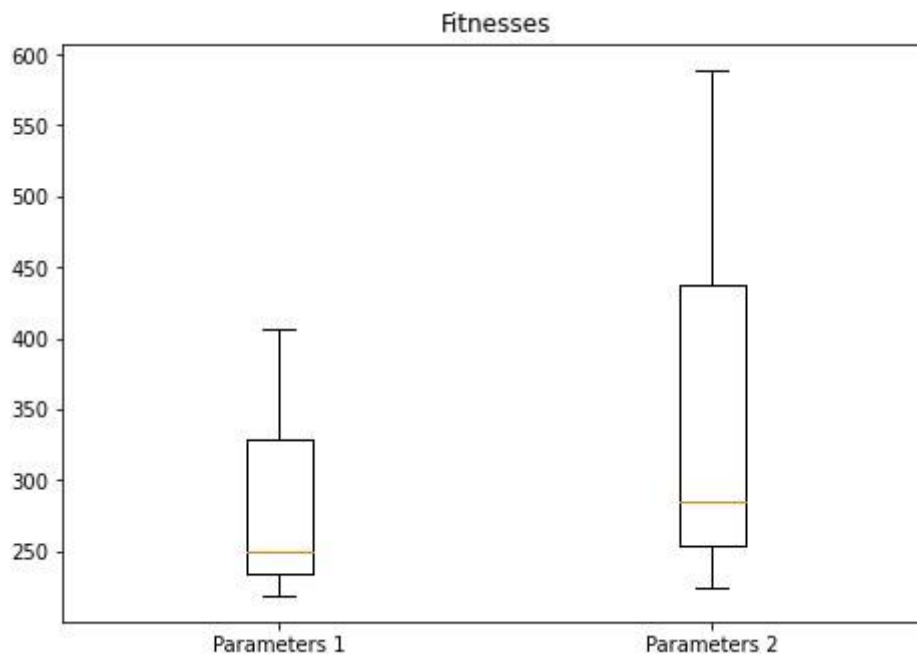
-Parameter 1:

The best genotype: $MX(X[| 0 :-0.9, G:0], rrLLX[G:-1.404]MX[| 0:0.8, -1:2.9])$

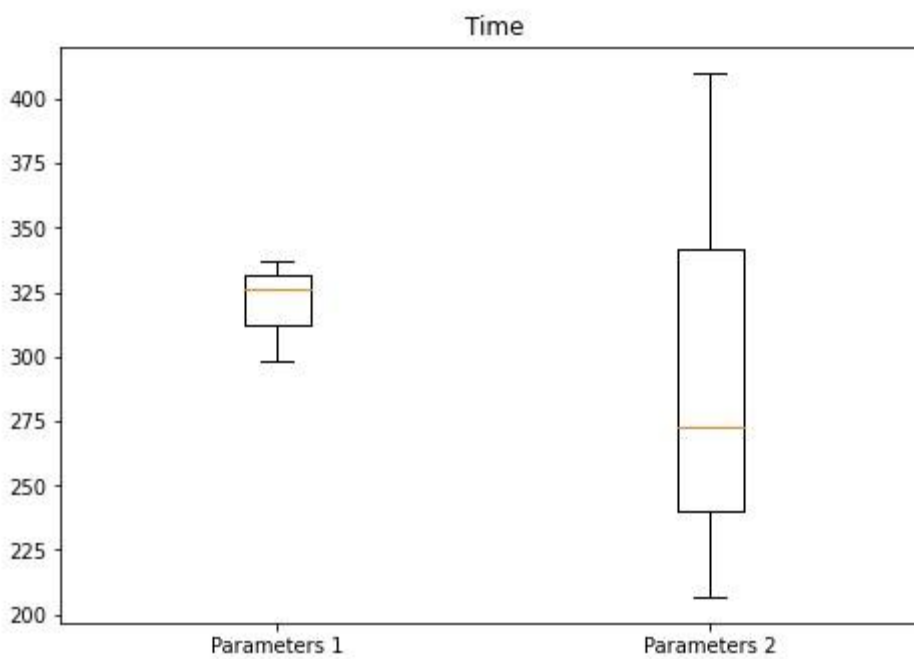
-Parameter 2:

The best genotype: $(MiiX[N, 9:-0.204, 5:1][*][*], iX[N, 6:0.871][@, -2:-0.613]LX[T][T][|, -5:-0.688, p:0.25]LX[N, 1:-4.672, 0:-1.513, -6:-1][G][|, -8:6.584][G]X[Gpart][|, r:0.872, -7:1])$

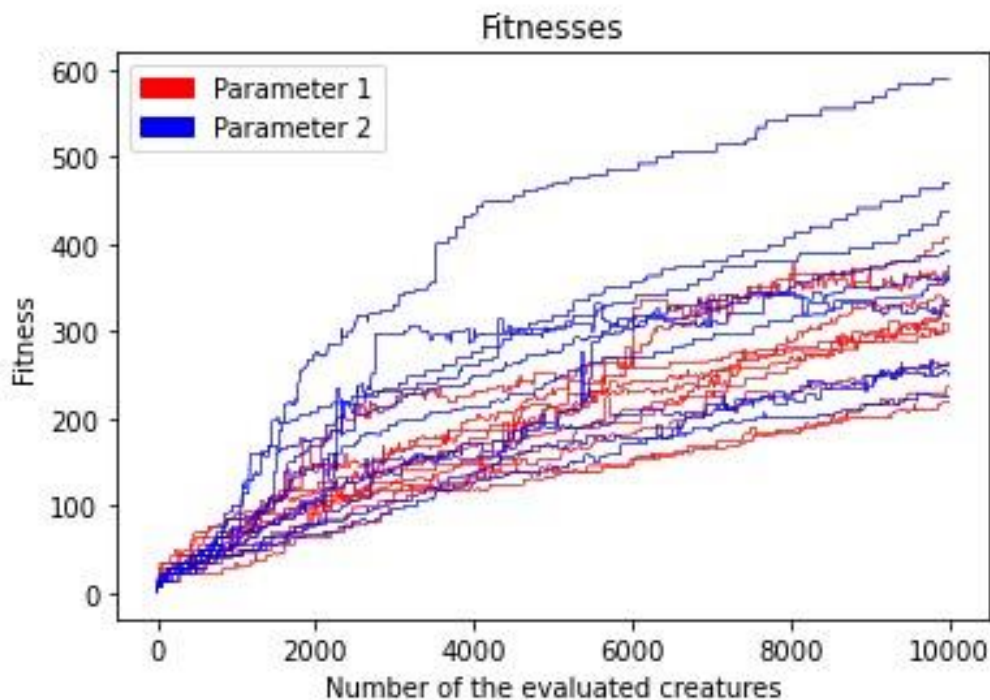
6) -Plot for fitness comparison:



-Plot for time comparison:



7) Fitness plot separately for each evolutionary run:



8) Quantitative conclusions (based on the bar plots and fitness-in-time plots):

-Based on the fitness plot, it can be clearly seen that the best (i.e. the highest) fitness is reached using Parameter 2 combination of parameters, where the probability of mutation and cross-over is higher than in Parameter 1. Nevertheless, the average fitness values of both sets of parameters are almost the same.

-Based on the time plot, the average time-spending is smaller than in Parameter 1 case, despite the fact that the maximum value belongs to Parameter 2. Apart from that, it can be noticed that the range of Parameter 2 results is much greater than in Parameter 1 case. It can be explained by the fact that in the second case the probability of mutation and cross-over is increased.

9) The behavior of the best creatures is as it was expected: they start jumping longer that increases their speed. Such improvements are caused by the changes in their genotypes: creatures get more neuron connections during evolutionary process that is the main cause of such progress.

Making comparison between the best creatures of two parameter sets, the genotype of Parameter 2 framstick is much more complicated and well-structured than Parameter 1 one.

Youtube video: <https://youtu.be/ZgpQ09tv478>