

TUTORIJA GENETSKI ALGOTIRMI

PRIMJER 1: Koristeći genetski algoritam optimizirati funkciju $y = -(x^2 - 1)$.

Korak 1: Kreiranje funkcije

```
function y=eksponecijalna(x)
y = -( x^2 - 1);
end
```

Korak 2: Unos parametara u Optimization toolbox (br.ulaznih varijabli 1, granica od -7 do 7)

Optimization Tool

File Help

Problem Setup and Results

Solver: **ga - Genetic Algorithm**

Problem

Fitness function: **@eksponecijalna**

Number of variables: **1**

Constraints:

Linear inequalities: A: b:

Linear equalities: Aeq: beq:

Bounds: Lower: **-7** Upper: **7**

Nonlinear constraint function:

Integer variable indices:

Run solver and view results

☐ Use random states from previous run

Start **Pause** **Stop**

Current iteration: **51** **Clear Results**

Optimization running.
Objective function value: -47.99890570887093
Optimization terminated: average change in the fitness value less than options.TolFun.

Final point: **7**

Options

Population

Population type: **Double vector**

Population size: ☒ Use default: 20
☐ Specify:

Creation function: **Constraint dependent**

Initial population: ☒ Use default: []
☐ Specify:

Initial scores: ☒ Use default: []
☐ Specify:

Initial range: ☒ Use default: [0;1]
☐ Specify:

Fitness scaling

Scaling function: **Rank**

Selection

Selection function: **Stochastic uniform**

Reproduction

Elite count: ☒ Use default: 2

Quick Reference

Genetic Algorithm
This tool corresponds to the Genetic Algorithm in the Optimization Toolbox.

Click to expand the section

Problem Setup and Results

- Problem
- Constraints
- Run solver and view results

Options
Specify options for the Genetic Algorithm.

- Population
- Fitness scaling
- Selection
- Reproduction
- Mutation
- Crossover
- Migration
- Constraint parameters

Korak 3: Unos parametara u polju Options

Populacija (Population):

Population Type: **Double vector**

Creation function: **Constraint dependent** (ovisno ograničenje)

Population size (velicina populacije): *Specify* (određena): **24**

Initial range (Pocetni omjer): *Specify* (određena): **[-7;+7]**

Populacija je zbir elemenata, koji se smjenjuju iz generacije u generaciju tokom izvršavanja algoritma.

Reproduction (reprodukcija-stvaranje)

Elite count (broj elitnih (najboljih) jedinki): *Specify* (određena): **4**

Crossover fraction (frakcija križanja): *Specify* (određena): **0.85**

Svaka jedinka predstavlja jednu kombinaciju ulaznih parametara, kodiranih na primjereni način.

Stopping criteria (Kriterij zaustavljanja)

Generations (generacije, stvaranja): *Specify* (određena): **30**

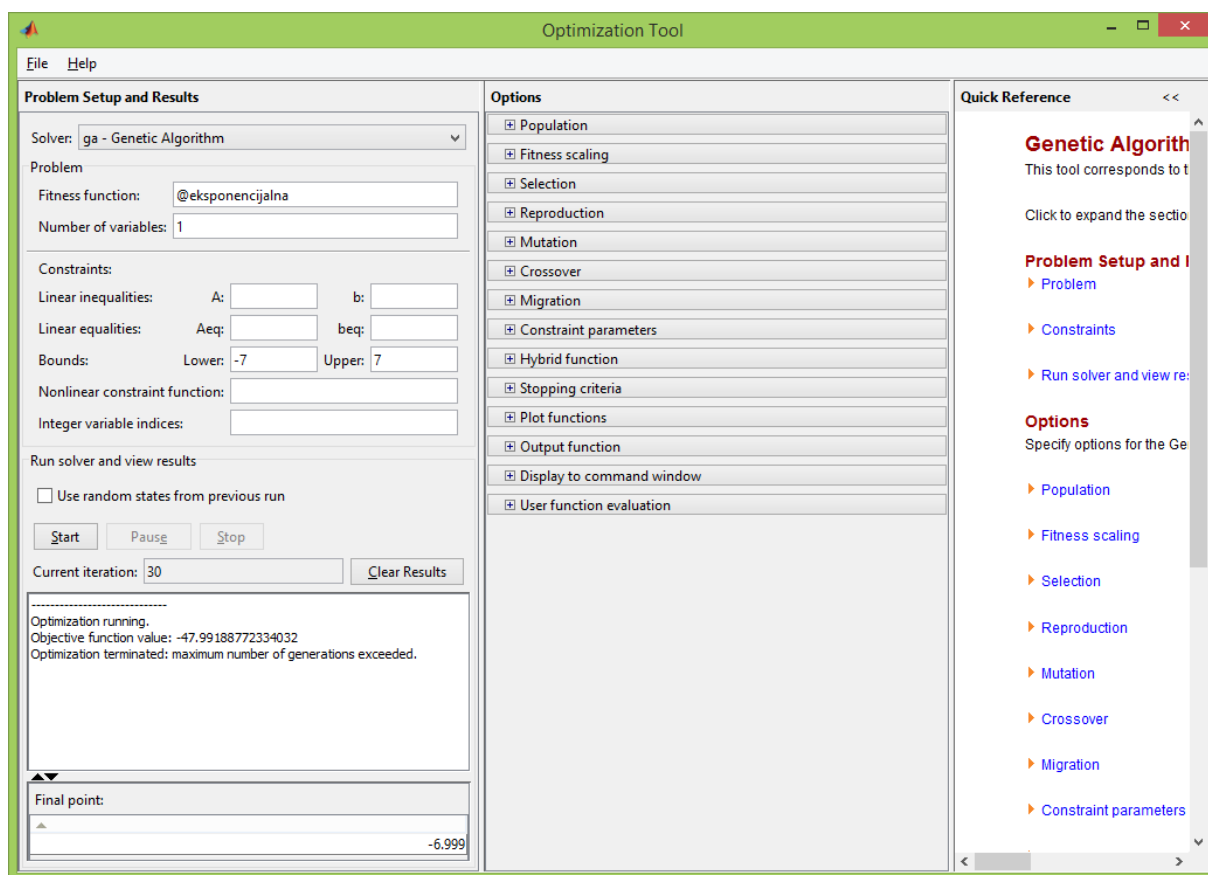
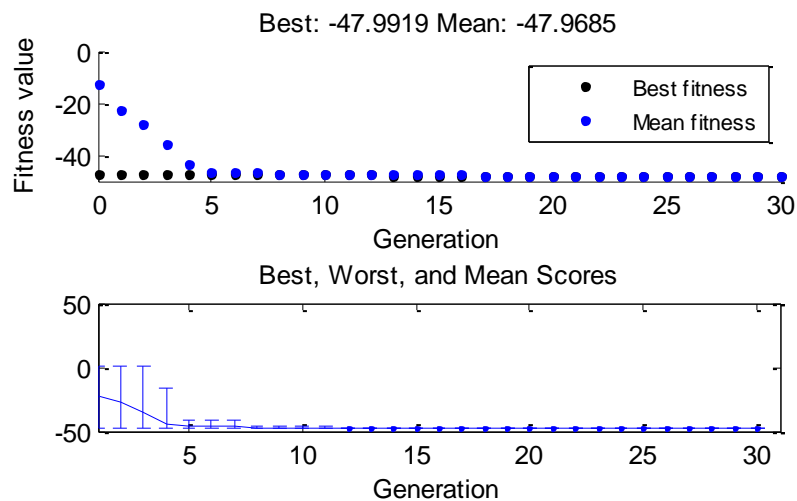
Stall generation (gubitak, razvlačenje): *Specify* (određena): **10**

Plot function (funkcije iscrtavanja)

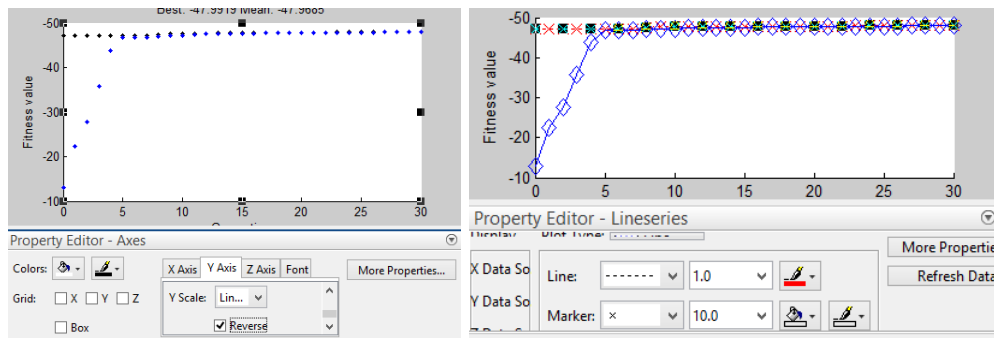
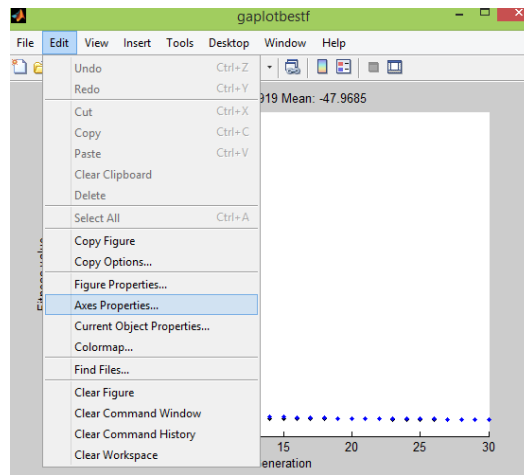
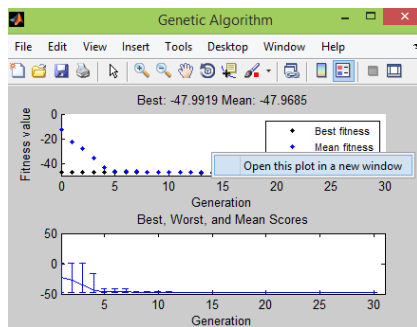
Best fitness (najbolja pogodnost-sposobnost)

Range (opseg)

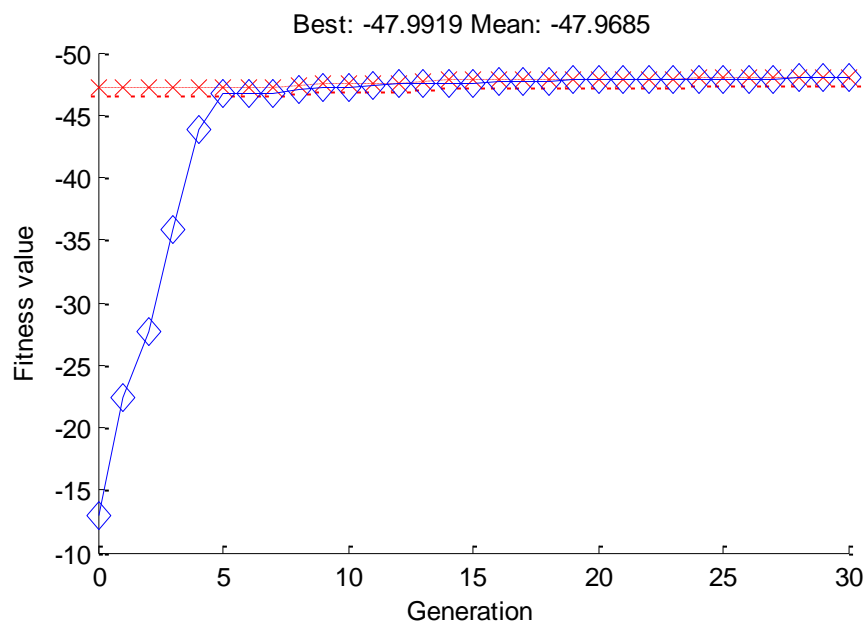
Korak 4: Ponovno pokretanje optimizacije (sa novim parametrima)



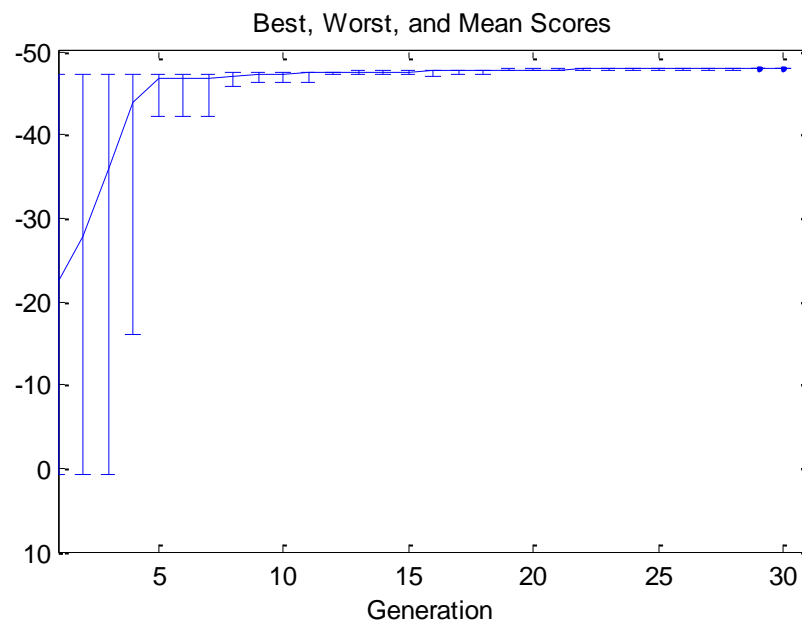
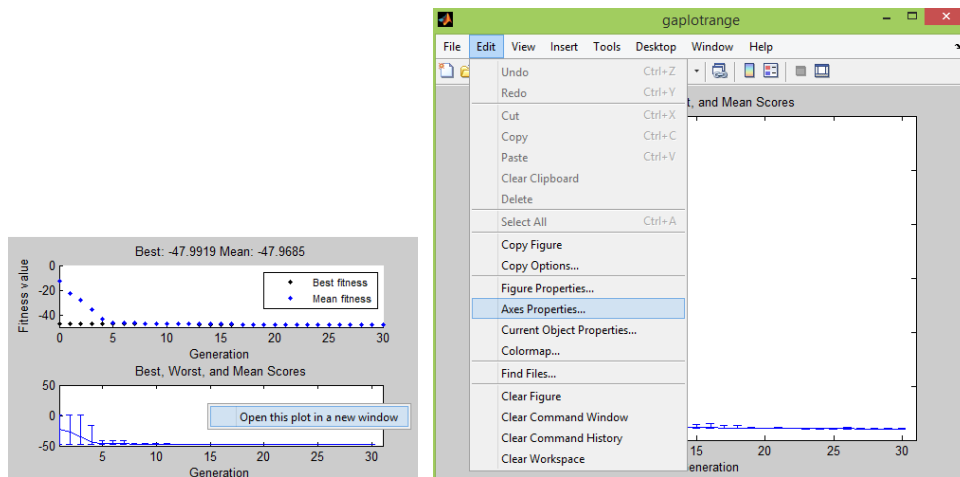
Kao što vidimo, broj iteracija sa 51 smanjen je na 30, te Final point sa 7 na -6.999.



Imamo dijagrame koji prikazuju srednju vrijednost funkcije i njenu najbolju aproksimaciju u svakoj iteraciji.



Isto uradimo i sa drugim dijagramom, koji prikazuje najbolju, najlošiju i srednju vrijednost funkcije.



PRIMJER 2: Korištenjem genetskog algoritma odrediti minimalne vrijednosti za sljedeću funkciju:

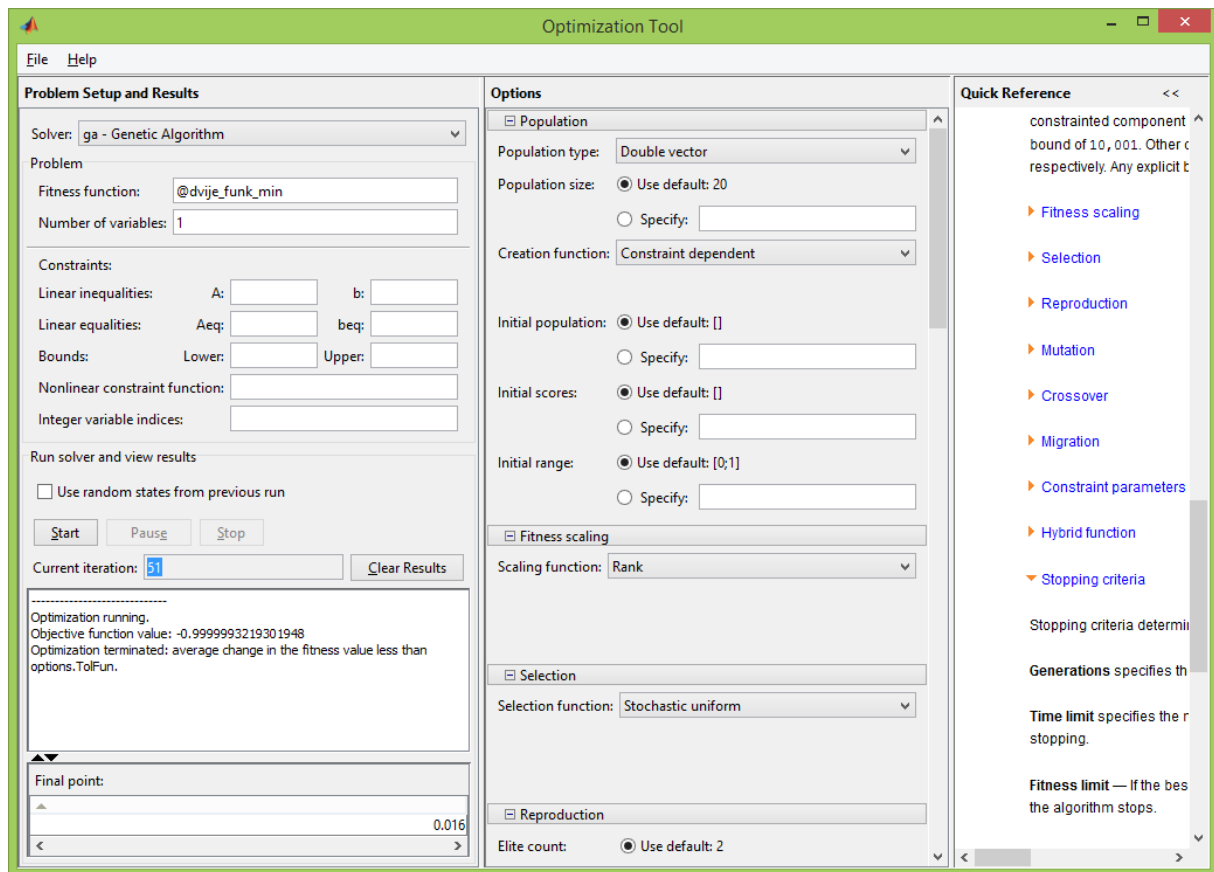
$$f(x) = \begin{cases} -\exp\left(-\left(\frac{x}{20}\right)^2\right) & \text{za } x \leq 20 \\ -\exp(-1) + (x-20)(x-22) & \text{za } x > 20 \end{cases}$$

Funkcija: `dvije_funk_min.m`

```
function y = dvije_funk_min(x)
if x<=20
    y = -exp(-(x/20).^2);
else
    y = -exp(-1) + (x-20)*(x-22);
end
```

Za otvaranje Optimization Toolboxa u komandni prozor ukucamo:

```
>> optimtool ('ga')
```



```
>> [x,f]=ga(@dvije_funk_min,1)
```

Optimization terminated: average change in the fitness value less than options.TolFun.

```
x = 0.0016
```

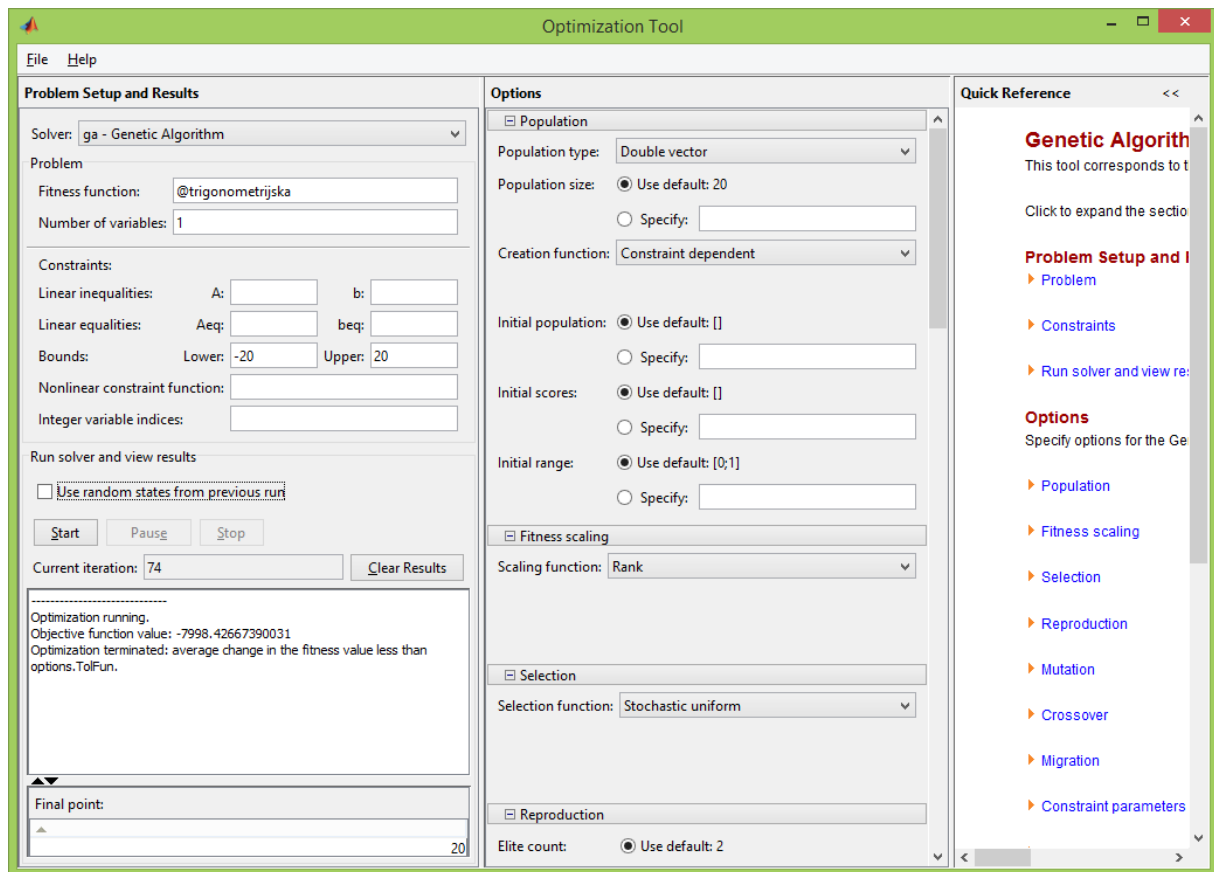
```
f = -1.0000
```

PRIMJER 3: Koristeći genetski algoritam optimizirati funkciju $y = -(x^3 - \cos(x) - 1)$.

Korak 1: Kreiranje funkcije

```
function y = trigonometrijska(x)
y = -( x^3 - cos(x) - 1);
end
```

Korak 2: Unos parametara u Optimizat. toolbox (br.ulaznih varijabli 1, granica od -20 do 20)



Korak 3: Unos parametara u polju Options

Reproduction (reprodukcija-stvaranje)

Elite count (broj elitnih (najboljih) jedinki): *Specify* (određena): **4**

Crossover fraction (frakcija križanja): *Specify* (određena): **0.25**

Podesimo opseg GA na 40 (Bounds -20,40)

Svaka jedinka predstavlja jednu kombinaciju ulaznih parametara, kodiranih na primjereni način.

Number of variables: 1

Constraints:

Linear inequalities: A: b:

Linear equalities: Aeq: beq:

Bounds: Lower: -20 Upper: 40

Nonlinear constraint function:

Integer variable indices:

Run solver and view results

☐ Use random states from previous run

Start Pause Stop

Current iteration: 76 Clear Results

Optimization running.
Objective function value: -63998.337371077556
Optimization terminated: average change in the fitness value less than options.TolFun.

Final point:

40

Reproduction

Elite count: ☐ Use default: 2 ☒ Specify: 4

Crossover fraction: ☐ Use default: 0.8 ☒ Specify: 0.25

Mutation

Mutation function: Constraint dependent

Crossover

Crossover function: Scattered

Migration

Direction: Forward

Fraction: ☒ Use default: 0.2 ☐ Specify:

Click to expand the section

Problem Setup and Options

Problem

Constraints

Run solver and view results

Options

Specify options for the Genetic Algorithm

Population

Fitness scaling

Selection

Reproduction

Mutation

Crossover

Migration

Constraint parameters

Mutation (zamjena, promjena)

Mutation function: Adaptive feasible (prilagodljivo izvođenje)

Mutation

Mutation function: Adaptive feasible

Crossover (križanje)

Crossover function: Two point

Crossover

Crossover function: Two point

Plot function (funkcije iscrtavanja)

Best fitness (najbolja pogodnost-sposobnost)

Range (opseg)

Stopping (zaustavljanje)

Genealogy (postanak)

Plot functions

Plot interval: 1

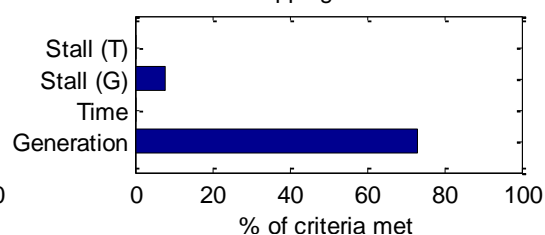
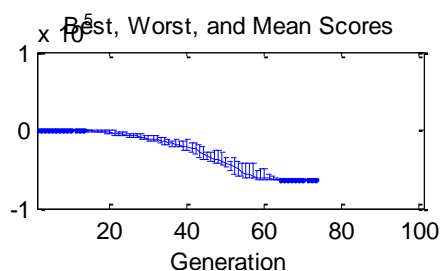
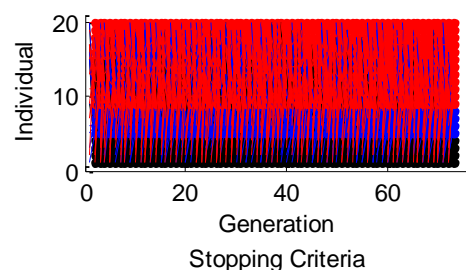
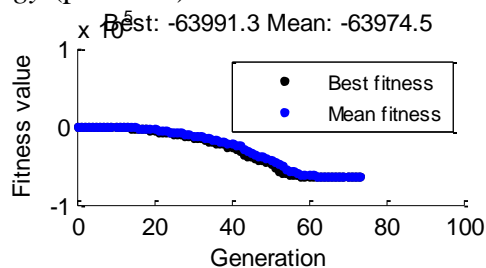
☒ Best fitness ☐ Best individual ☐ Distance

☐ Expectation ☒ Genealogy ☒ Range

☐ Score diversity ☐ Scores ☐ Selection

☒ Stopping ☐ Max constraint

☐ Custom function:



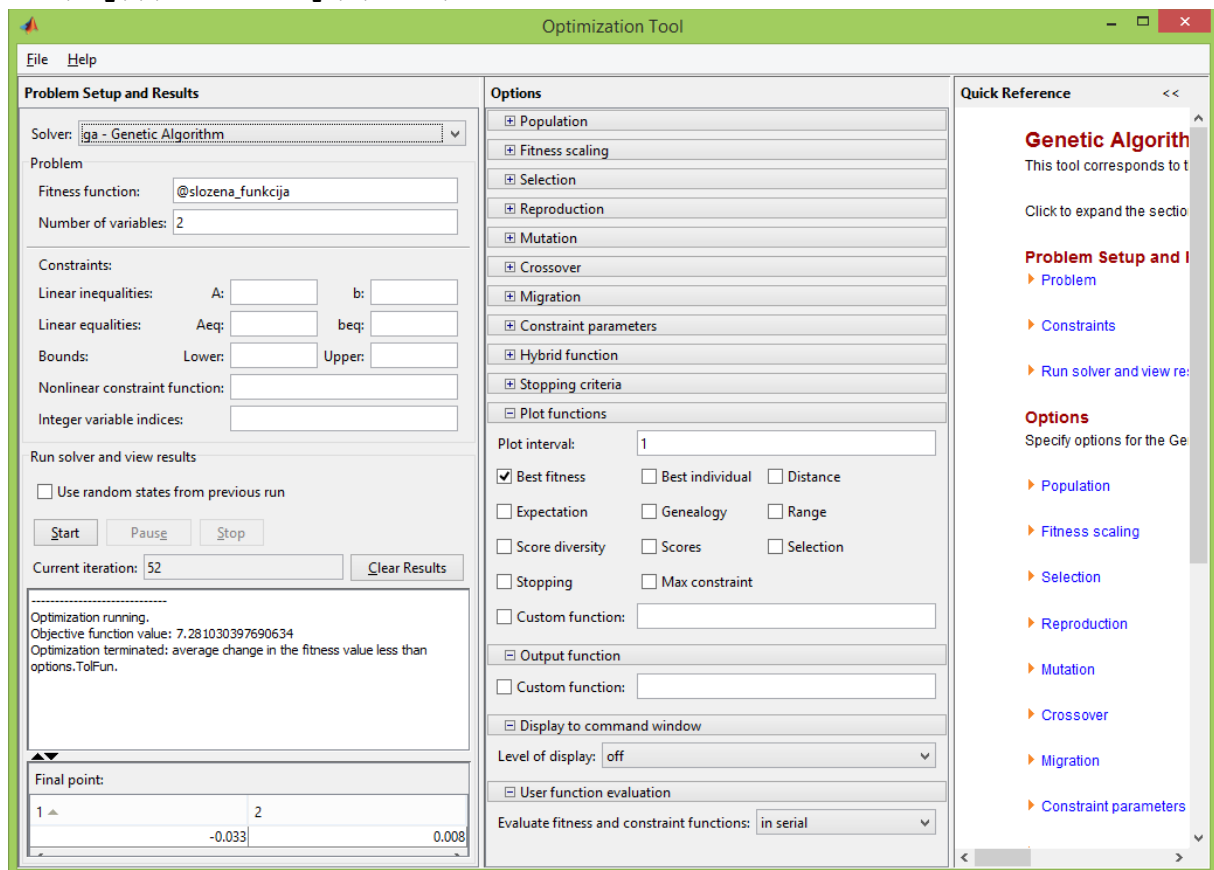
PRIMJER 4: Koristeći GA optimizirati složenu funkciju:

$$f(x, y) = \frac{1}{20} \left\{ -20 \times e \left[-0.2 \sqrt{\frac{1}{2} (x^2 + y^2)} \right] - e \left[\frac{1}{2} (\cos(cx) + \cos(cy)) \right] + 20 + e + 5.7 \right\}$$

ukoliko je $c = 2\pi$, a granice x i y su u ovisnosti od funkcije.

Funkcija `slozena_funkcija.m`

```
function z = slozena_funkcija(in)
a = 20; b = 0.2; c = 2*pi; d = 5.7; f = 20;
n = 2;
x= in(:,1); y= in(:,2);
z = (1/f) * ( -a*exp(-b*sqrt((1/n)*(x.^2+y.^2))) -exp((1/n)*(cos(c*x) +
cos(c*y))) + a + exp(1) + d);
```



Best: 7.28103 Mean: 8.92688

