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سوال اول) مسیریابی شهرها

Breadth first tree search:

path cost: 450
depth: 3
path: [<Node Arad>, <Node Sibiu>, <Node Fagaras>, <Node Bucharest>]
number of visited nodes : 16
number of expanded nodes : 39
max memory use: 25

Breadth first graph search:

path cost: 450
depth: 3
path: [<Node Arad>, <Node Sibiu>, <Node Fagaras>, <Node Bucharest>]
number of visited nodes : 5
number of expanded nodes : 13
max memory use: 8

Depth first graph search:

path cost: 733
depth: 7
path: [<Node Arad>, <Node Timisoara>, <Node Lugoj>, <Node Mehadia>, <Node Dobreta>, <Node Craiova>, <Node Pitesti>, <Node Bucharest>]
number of visited nodes : 11
number of expanded nodes : 24
max memory use: 12

Depth first tree search:

در loop می افتد!

Depth_limited_graph_search:

path cost: 733
depth: 7
path: [<Node Arad>, <Node Timisoara>, <Node Lugoj>, <Node Mehadia>, <Node Dobreta>, <Node Craiova>, <Node Pitesti>, <Node Bucharest>]
number of visited nodes : 11
number of expanded nodes : 24
max memory use: 12

Depth limited tree search:

Cutoff می شود. یعنی قبل از اینکه به مقصد برسد به حداکثر عمق می رسد. (با هر عمقی امتحان کردم cutoff شد.)

Iterative deepening graph search:

path cost: 733
depth: 7
path: [<Node Arad>, <Node Timisoara>, <Node Lugoj>, <Node Mehadia>, <Node Dobreta>, <Node Craiova>, <Node Pitesti>, <Node Bucharest>]
number of visited nodes : 11
number of expanded nodes : 240
max memory use: 12

Iterative deepening tree search:

no answer چاپ می کند. یعنی به مقصد نمی رسد!

Uniform cost graph search:

path cost: 418
depth: 4
path: [<Node Arad>, <Node Sibiu>, <Node Rimnicu_Vilcea>, <Node Pitesti>, <Node Bucharest>]
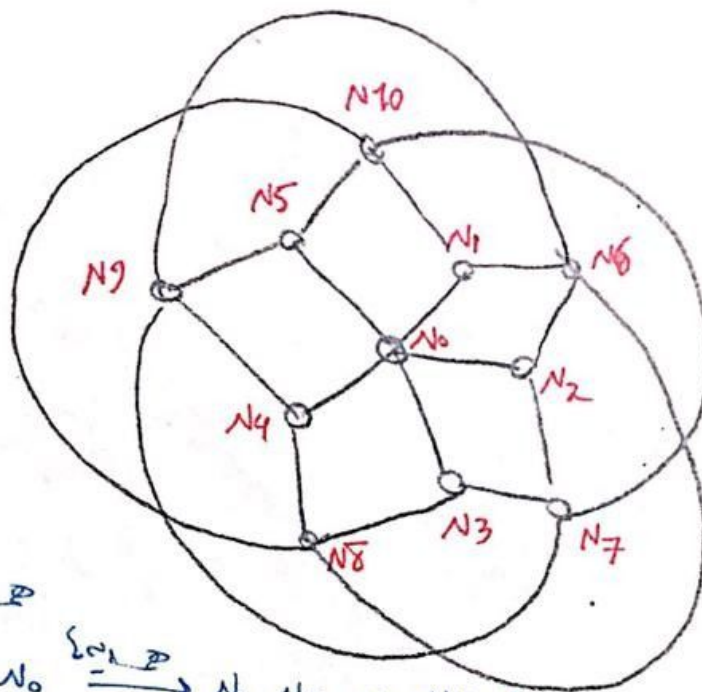number of visited nodes : 14
number of expanded nodes : 32
max memory use: 17

Uniform cost tree search:

در loop می افتد!

Greedy best first graph search:

path cost: 418
depth: 4
path: [<Node Arad>, <Node Sibiu>, <Node Rimnicu_Vilcea>, <Node Pitesti>, <Node Bucharest>]
number of visited nodes : 22
number of expanded nodes : 57
max memory use: 19

Greedy best first tree search:

در loop می افتد!

Astar graph search:

path cost: 607
depth: 5
path: [<Node Arad>, <Node Zerind>, <Node Oradea>, <Node Sibiu>, <Node Fagaras>, <Node Bucharest>]
number of visited nodes : 6
number of expanded nodes : 13
max memory use: 9

Astar tree search:

در loop می افتد!

سوال دوم) رنگ آمیزی گراف :
آدرس دهی نودها مطابق شکل زیر صورت گرفته و رنگ هر نود با 0، 1 و یا 2 مشخص شده است.

$N_0 \xrightarrow{\text{set of }P} N_1, N_2, N_3, N_4, N_5$

$N_1 \longrightarrow N_0, N_6, N_{10}$

$N_2 \longrightarrow N_0, N_6, N_7$

$N_3 \longrightarrow N_0, N_7, N_8$

$N_4 \longrightarrow N_0, N_8, N_9$

$N_5 \longrightarrow N_0, N_9, N_{10}$

$N_6 \longrightarrow N_1, N_2, N_8, N_9$

$N_7 \longrightarrow N_2, N_3, N_{10}, N_9$

$N_8 \longrightarrow N_3, N_4, N_6, N_{10}$

$N_9 \longrightarrow N_4, N_5, N_7, N_6$

$N_{10} \longrightarrow N_5, N_1, N_7, N_8$

Simulated annealing:

number of visited nodes : 1200
number of explored nodes : 10
solution :
[['n0', 0], ['n1', 1], ['n2', 2], ['n3', 2], ['n4', 1], ['n5', 1], ['n6', 0], ['n7', 0], ['n8', 0], ['n9', 2],
['n10', 2]]
value : 1

Hill climbing:

number of visited nodes : 108
number of explored nodes : 8
solution :
[['n0', 1], ['n1', 2], ['n2', 0], ['n3', 0], ['n4', 0], ['n5', 2], ['n6', 1], ['n7', 2], ['n8', 2], ['n9', 0],
['n10', 0]]
value : 1

First choice Hill climbing:

number of visited nodes : 132
number of explored nodes : 10
solution :
[['n0', 2], ['n1', 0], ['n2', 0], ['n3', 1], ['n4', 1], ['n5', 1], ['n6', 2], ['n7', 2], ['n8', 0], ['n9', 0],
['n10', 2]]
value : 1

Stochastic Hill climbing:

number of visited nodes : 120
number of explored nodes : 9
solution :
[['n0', 1], ['n1', 2], ['n2', 2], ['n3', 0], ['n4', 0], ['n5', 2], ['n6', 1], ['n7', 0], ['n8', 2], ['n9', 2],
['n10', 0]]
value : 3

Random restart Hill climbing:

number of visited nodes : 4440

number of explored nodes : 270
solution :
[['n0', 0], ['n1', 2], ['n2', 2], ['n3', 1], ['n4', 2], ['n5', 2], ['n6', 0], ['n7', 0], ['n8', 0], ['n9', 1], ['n10', 1]]
value : 1

Genetics:

generation number 0 :
best fitness : 1.8
worst fitness : 0.9
average fitness : 1.3450000000000002
generation number 1 :
best fitness : 1.7
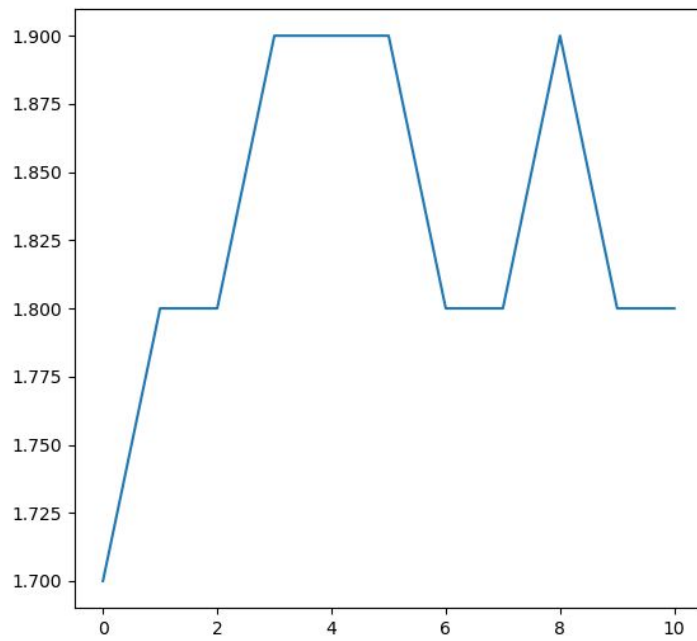worst fitness : 1.1
average fitness : 1.3559999999999999
generation number 2 :
best fitness : 1.8
worst fitness : 1.0
average fitness : 1.3709999999999996
generation number 3 :
best fitness : 1.9
worst fitness : 1.0
average fitness : 1.4319999999999995
generation number 4 :
best fitness : 1.8
worst fitness : 1.1
average fitness : 1.4320000000000004
generation number 5 :
best fitness : 1.9
worst fitness : 1.0
average fitness : 1.4009999999999991
generation number 6 :
best fitness : 1.8
worst fitness : 0.9
average fitness : 1.4360000000000022
generation number 7 :
best fitness : 1.7
worst fitness : 1.0

average fitness : 1.367
generation number 8 :
best fitness : 1.9
worst fitness : 1.0
average fitness : 1.4739999999999998
generation number 9 :
best fitness : 1.8
worst fitness : 0.9
average fitness : 1.4040000000000006
generation number 10 :
best fitness : 1.8
worst fitness : 1.0
average fitness : 1.4089999999999998

نِمودار

Mutation rate =0.2
Number Of Generations =10
Population Size =100
Tornument Size =4

- **Best fitness diagram:**

- **Worst fitness diagram:**
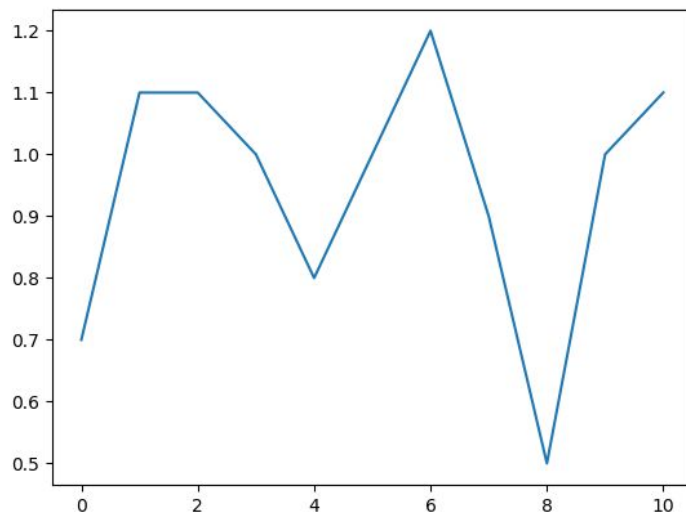
- Average fitness diagram:
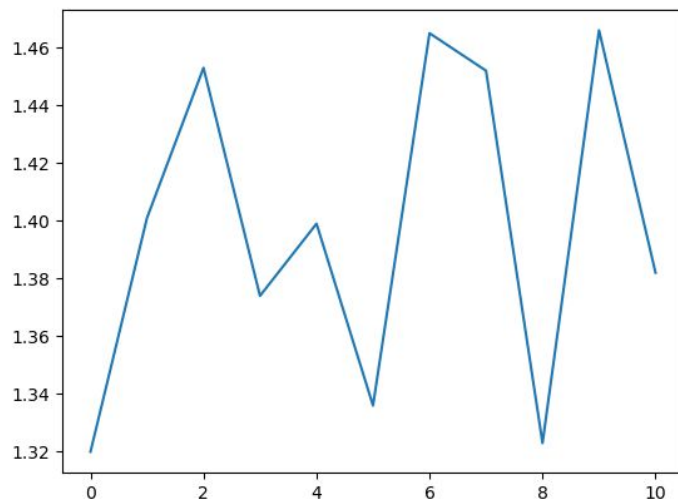
بررسی اثر افزایش اندازه جمعیت و احتمال جهش :

با افزایش احتمال جهش زمان بیشتر اجرای برنامه طول می کشد. با شروع احتمال از صفر هرچه به 0.5 نزدیک تر شویم همگرایی بیشتر و هرچه به 1 نزدیک شویم همگرایی کمتر می شود.

Mutation rate =0.2
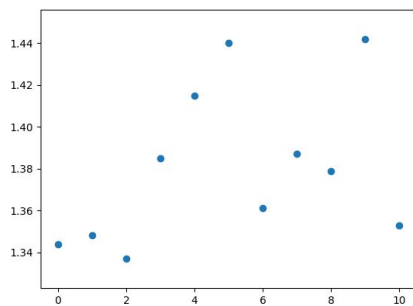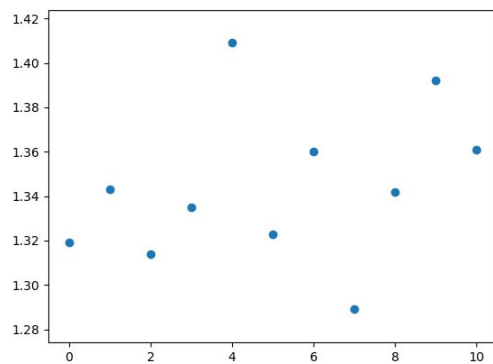

Mutation rate =0.4
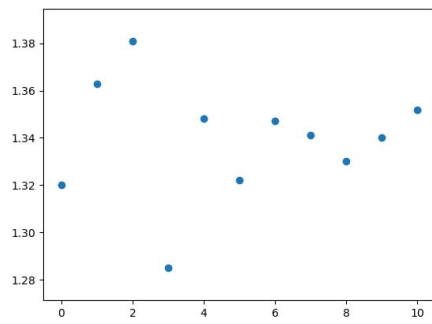
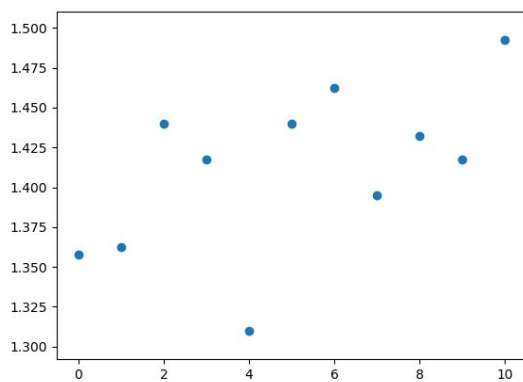Mutation rate =0.5
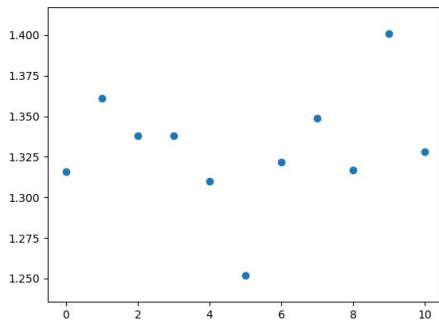
Mutation rate =0.6
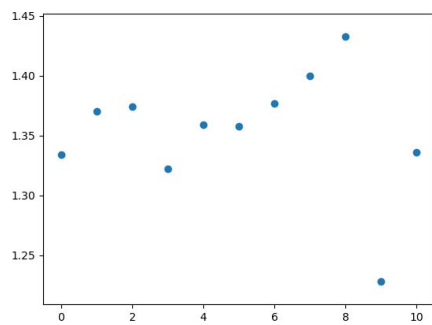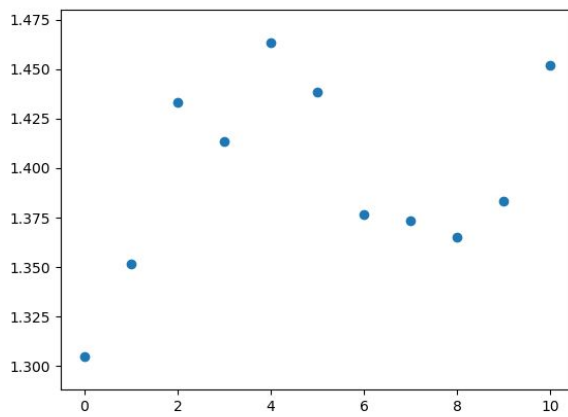

Mutation rate =0.8
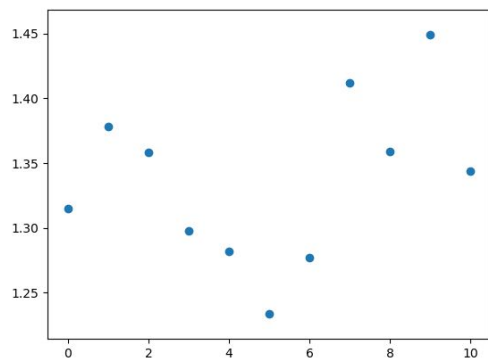
Mutation rate =0.9

با افزایش اندازه جمعیت زمان بیشتر اجرای برنامه طول می کشد(300 به بعد خیییییلی طول کشید!). با افزایش اندازه جمعیت همگرایی بیشتر بیشتر می شود اما کیفیت نتایج کاهش میابد.
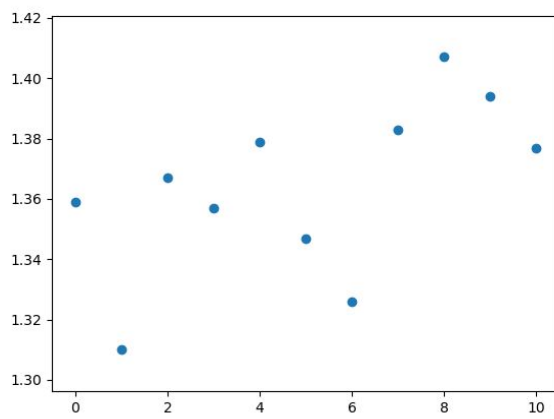
Mutation rate =0.2 :
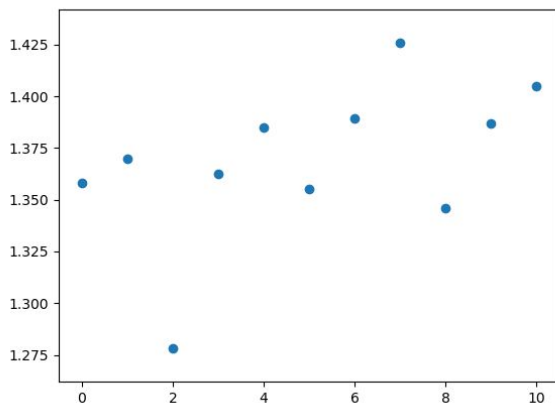Population Size =40
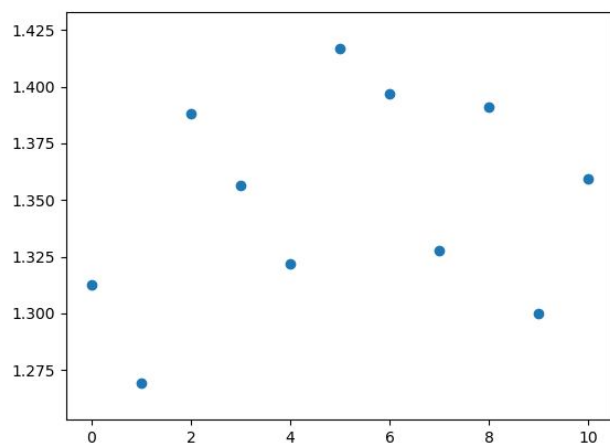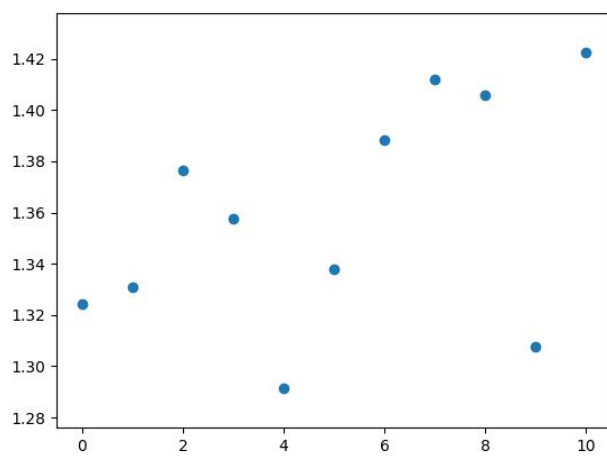

Population Size =60

Population Size =100

Population Size =120

Population Size =160

Population Size =200

Population Size =300