Modern intelligent IT
Lab 1 (12.02.2016)
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Task 4 (Traveling Salesperson Problem)

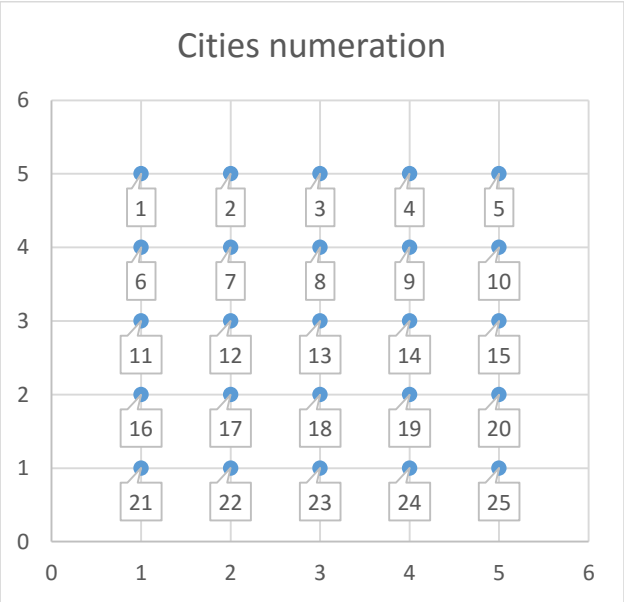
TSP with 25 cities of a fixed location

1. Assume 25 cities as shown in the next page (start from Z and return to Z).

2. Calculate distance matrix (25×25).

3. Apply GA and evolve chromosomes to be the tours of minimum length.

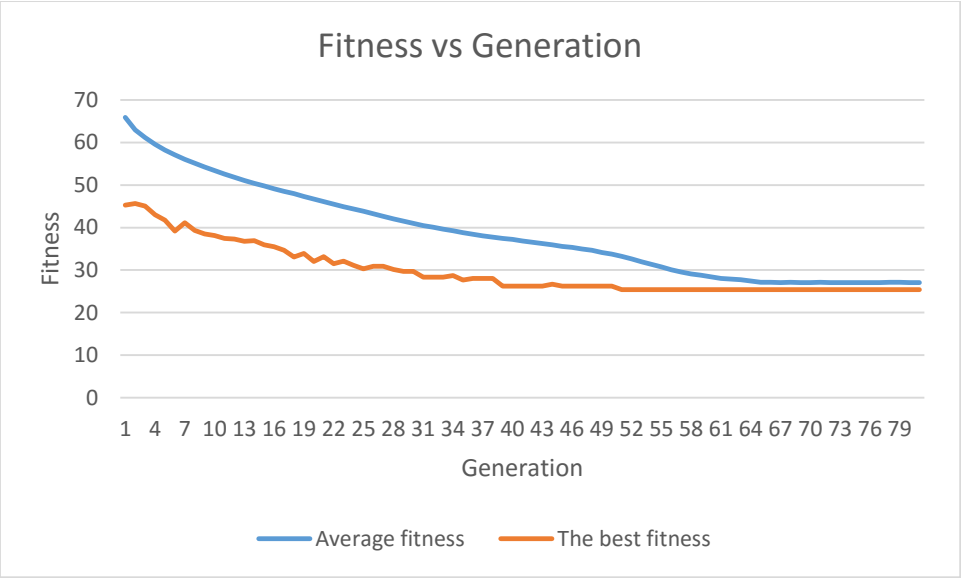
4. Also show the graph of fitness vs generation. The minimum tour in the 1st, two intermediate, and the final generation.



Distance matrix:

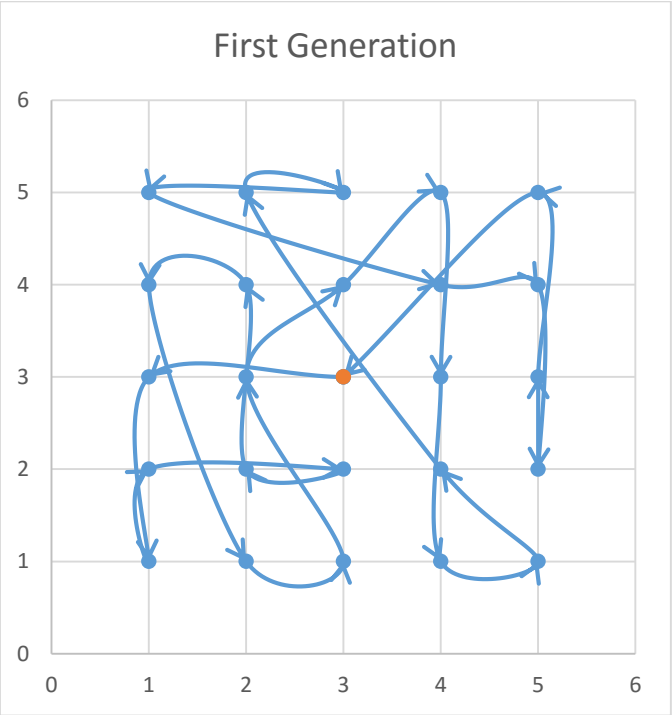
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	0	1	2	3	4	1	1.41	2.24	3.16	4.12	2	2.24	2.83	3.6	4.47	3	3.16	3.61	4.24	5	4	4.12	4.47	5	5.66
2	1	0	1	2	3	1.41	1	1.41	2.24	3.16	2.24	2	2.24	2.8	3.61	3.16	3	3.16	3.61	4.24	4.12	4	4.12	4.47	5
3	2	1	0	1	2	2.24	1.41	1	1.41	2.24	2.83	2.24	2	2.2	2.83	3.61	3.16	3	3.16	3.61	4.47	4.12	4	4.12	4.47
4	3	2	1	0	1	3.16	2.24	1.41	1	1.41	3.61	2.83	2.24	2	2.24	4.24	3.61	3.16	3	3.16	5	4.47	4.12	4	4.12
5	4	3	2	1	0	4.12	3.16	2.24	1.41	1	4.47	3.61	2.83	2.2	2	5	4.24	3.61	3.16	3	5.66	5	4.47	4.12	4
6	1	1.41	2.24	3.162	4.12	0	1	2	3	4	1	1.41	2.24	3.2	4.12	2	2.24	2.83	3.61	4.47	3	3.16	3.61	4.24	5
7	1.41	1	1.41	2.236	3.16	1	0	1	2	3	1.41	1	1.41	2.2	3.16	2.24	2	2.24	2.83	3.61	3.16	3	3.16	3.61	4.24
8	2.24	1.41	1	1.414	2.24	2	1	0	1	2	2.24	1.41	1	1.4	2.24	2.83	2.24	2	2.24	2.83	3.61	3.16	3	3.16	3.61
9	3.16	2.24	1.41	1	1.41	3	2	1	0	1	3.16	2.24	1.41	1	1.41	3.61	2.83	2.24	2	2.24	4.24	3.61	3.16	3	3.16
10	4.12	3.16	2.24	1.414	1	4	3	2	1	0	4.12	3.16	2.24	1.4	1	4.47	3.61	2.83	2.24	2	5	4.24	3.61	3.16	3
11	2	2.24	2.83	3.606	4.47	1	1.41	2.24	3.16	4.12	0	1	2	3	4	1	1.41	2.24	3.16	4.12	2	2.24	2.83	3.61	4.47
12	2.24	2	2.24	2.828	3.61	1.41	1	1.41	2.24	3.16	1	0	1	2	3	1.41	1	1.41	2.24	3.16	2.24	2	2.24	2.83	3.61
13	2.83	2.24	2	2.236	2.83	2.24	1.41	1	1.41	2.24	2	1	0	1	2	2.24	1.41	1	1.41	2.24	2.83	2.24	2	2.24	2.83
14	3.61	2.83	2.24	2	2.24	3.16	2.24	1.41	1	1.41	3	2	1	0	1	3.16	2.24	1.41	1	1.41	3.61	2.83	2.24	2	2.24
15	4.47	3.61	2.83	2.236	2	4.12	3.16	2.24	1.41	1	4	3	2	1	0	4.12	3.16	2.24	1.41	1	4.47	3.61	2.83	2.24	2
16	3	3.16	3.61	4.243	5	2	2.24	2.83	3.61	4.47	1	1.41	2.24	3.2	4.12	0	1	2	3	4	1	1.41	2.24	3.16	4.12
17	3.16	3	3.16	3.606	4.24	2.24	2	2.24	2.83	3.61	1.41	1	1.41	2.2	3.16	1	0	1	2	3	1.41	1	1.41	2.24	3.16
18	3.61	3.16	3	3.162	3.61	2.83	2.24	2	2.24	2.83	2.24	1.41	1	1.4	2.24	2	1	0	1	2	2.24	1.41	1	1.41	2.24
19	4.24	3.61	3.16	3	3.16	3.61	2.83	2.24	2	2.24	3.16	2.24	1.41	1	1.41	3	2	1	0	1	3.16	2.24	1.41	1	1.41
20	5	4.24	3.61	3.162	3	4.47	3.61	2.83	2.24	2	4.12	3.16	2.24	1.4	1	4	3	2	1	0	4.12	3.16	2.24	1.41	1
21	4	4.12	4.47	5	5.66	3	3.16	3.61	4.24	5	2	2.24	2.83	3.6	4.47	1	1.41	2.24	3.16	4.12	0	1	2	3	4
22	4.12	4	4.12	4.472	5	3.16	3	3.16	3.61	4.24	2.24	2	2.24	2.8	3.61	1.41	1	1.41	2.24	3.16	1	0	1	2	3
23	4.47	4.12	4	4.123	4.47	3.61	3.16	3	3.16	3.61	2.83	2.24	2	2.2	2.83	2.24	1.41	1	1.41	2.24	2	1	0	1	2
24	5	4.47	4.12	4	4.12	4.24	3.61	3.16	3	3.16	3.61	2.83	2.24	2	2.24	3.16	2.24	1.41	1	1.41	3	2	1	0	1
25	5.66	5	4.47	4.123	4	5	4.24	3.61	3.16	3	4.47	3.61	2.83	2.2	2	4.12	3.16	2.24	1.41	1	4	3	2	1	0

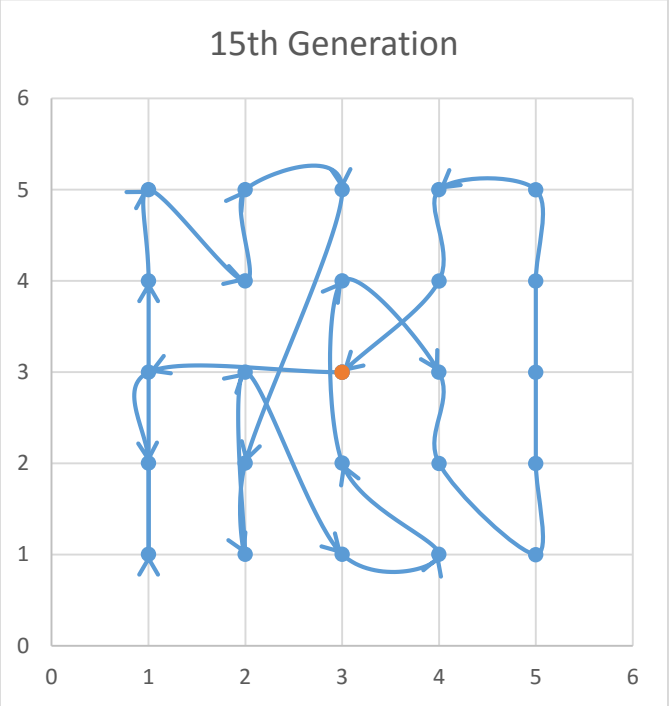
I got an optimal result with 20.000 chromosomes in population and 15% chance of a mutation(swap of two genes) in less than 80 generations.

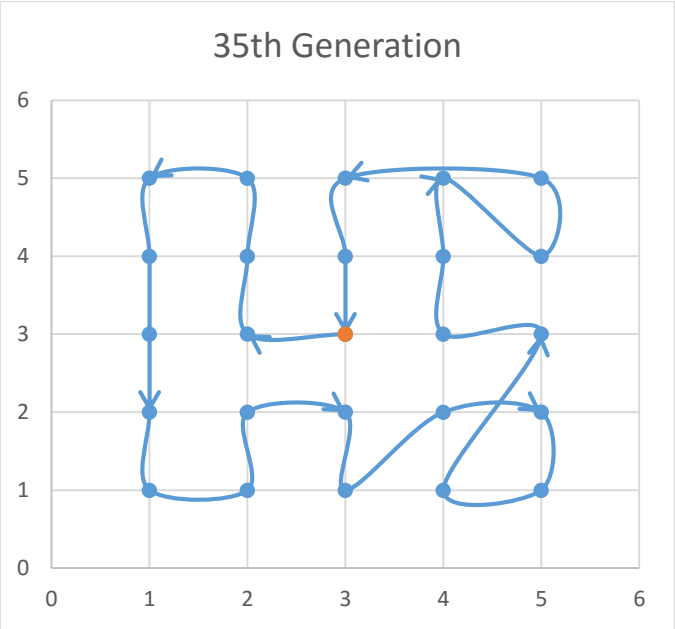


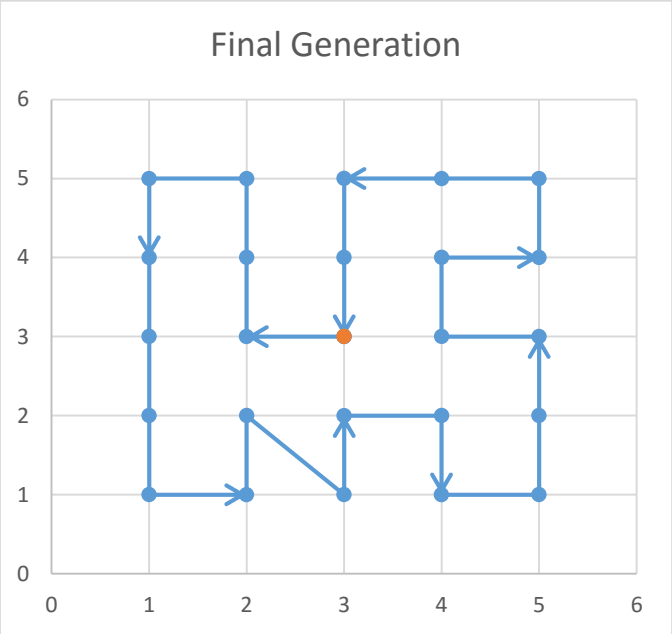
Solution is ~25.414213562373096

Unfortunately, sometimes it looks like routes cross the same city more than 1 time but they don't. I tried to make graphics look better but sometimes Excel doesn't work in the way that I want. I tried to generate results that are more beautiful but those situations seem unreachable.






35th Generation
0
1
2
3
4
5
6


Final Generation
0
1
2
3
4
5
6