

Lecture 4

Genetic algorithms

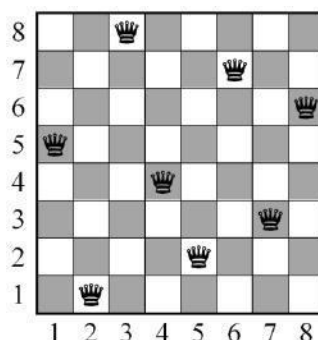
Task 1. N-queens puzzle

The N-queens puzzle is the problem of placing N chess queens on an N×N chessboard so that no two queens threaten each other. By threatening, we mean that no two queens share the same row, column, or diagonal.

The number of solutions depending on the size of the chessboard:

<i>n</i>	Size of solution space (<i>n</i> !)	Number of solutions
1	1	1
2	2	0
3	6	0
4	24	2
5	120	10
6	720	4
7	5040	40
8	40320	92
9	362880	352
10	3628800	724
11	39916800	2680
12	479001600	14200
13	6227020800	73712
14	87178291200	365596
15	1307674368000	2279184
16	20922789888000	14772512
17	355687428096000	95815104
18	6402373705728000	666090624
19	121645100408832000	4968057848
20	2432902008176640000	39029188884
21	51090942171709440000	314666222712
22	1124000727777607680000	2691008701644
23	25852016738884976640000	24233937684440
24	620448401733239439360000	227514171973736
25	1551121004330985984000000	2207893435808352
26	403291461126605635584000000	22317699616364044

Exemplary solution of eight queens puzzle:



Task 2. Advertising campaign

The maximum cost of the advertising campaign of a new product is set to 150 000 PLN. Various advertising channels are considered with different prices depending on the number of purchased ads emissions.

Advertising channel	Measure	The unit price for a number of emissions >3	The unit price for a number of emissions ≤3
TVP 1	15 seconds	3 400 PLN	5 600 PLN
TVP 2	15 seconds	2 400 PLN	4 600 PLN
POLSAT	15 seconds	2 400 PLN	5 100 PLN
RADIO "Z"	0.5 minutes	1 400 PLN	2 400 PLN
RMF-FM	0.5 minutes	1 200 PLN	2 200 PLN
WPROST	1 page	3 400 PLN	3 400 PLN
SUPER-EKSPRES	1/2 page	1 300 PLN	1 300 PLN
DIRECT MAIL	20 000	2 500 PLN	2 500 PLN

We have the data on how large a group of recipients we will reach using a one-off advertising emission on the particular channel.

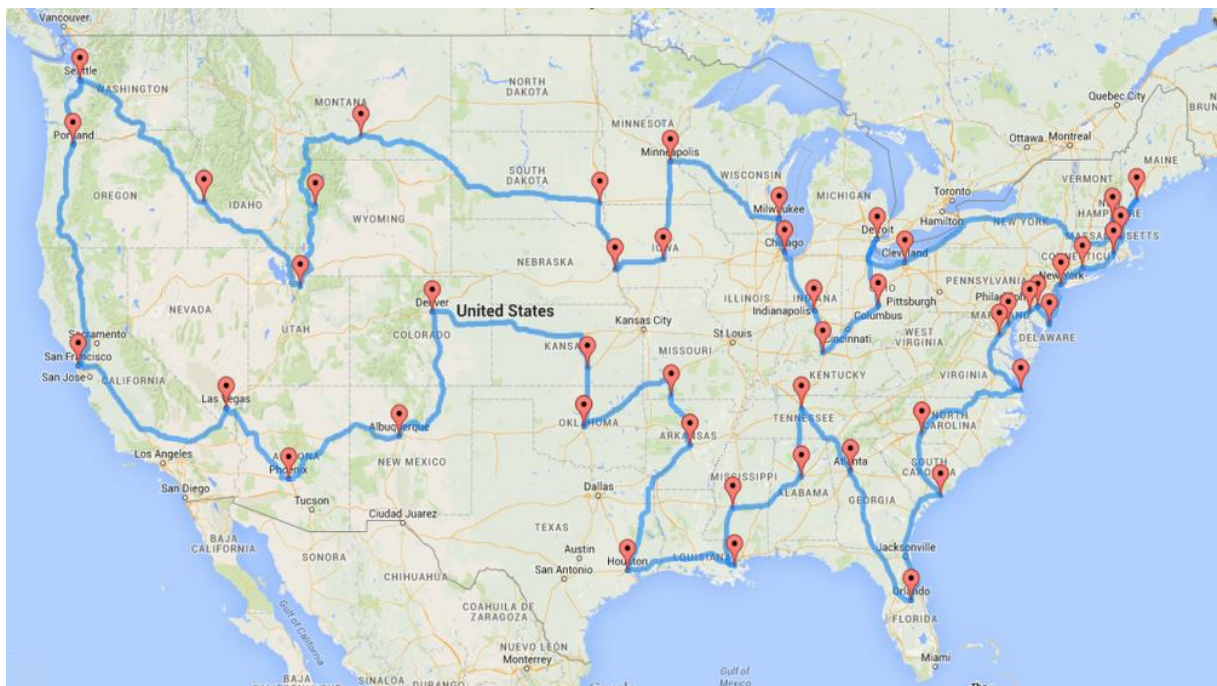
Advertising channel	Number of recipients
TVP 1	200 000
TVP 2	130 000
POLSAT	145 000
RADIO "Z"	75 000
RMF-FM	55 000
WPROST	210 000
SUPER-EKSPRES	150 000
DIRECT MAIL	20 000

Maximize the total audience of the advertising campaign by specifying how many times to use a given advertising channel.

Task 3. Travelling salesman problem (TSP)

In the travelling salesperson problem, a salesperson, who lives in one of the cities, is expected to make a round trip visiting all the other cities and returning home. It doesn't matter which city is the starting point. The requirement is that the total distance travelled be as small as possible.

The *distances.csv* file contains sets of information about the distances between cities.



Links:

- <https://people.sc.fsu.edu/~jburkardt/datasets/tsp/tsp.html>
- <https://www.math.uwaterloo.ca/tsp/data/>