INF3490 Report

Mandatory Assignment 1

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Exhaustive Search

The the shortest tour among the first 10 cities with their lengths are :

Tour										Length
Barcelona	Belgrade	Berlin								4024.99
Barcelona	Belgrade	Berlin	Brussels							4241.89
Barcelona	Belgrade	Bucharest	Berlin	Brussels						4983.38
Barcelona	Belgrade	Bucharest	Budapest	Berlin	Brussels					5018.81
Berlin	Copenhagen	Brussels	Barcelona	Belgrade	Bucharest	Budapest				5487.89
Brussels	Dublin	Barcelona	Belgrade	Bucharest	Budapest	Berlin	Copenhagen			6667.49
Berlin	Copenhagen	Hamburg	Brussels	Dublin	Barcelona	Belgrade	Bucharest	Budapest		6678.55
Copenhagen	Hamburg	Brussels	Dublin	Barcelona	Belgrade	Istanbul	Bucharest	Budapest	Berlin	7486.31

The time and length for the cities are :

Cities	Length	Time
3	4024.99	4.51E-005
4	4241.89	8.01E-005
5	4983.38	0.0003988743
6	5018.81	0.0021159649
7	5487.89	0.0163500309
8	6667.49	0.1439259052
9	6678.55	1.4120280743
10	7486.31	15.4784359932

Exhaustive search algorithm solves the problem for n cities using n!(factorial) steps, so for the algorithm to solve 24 cities ; 24!(factorial) would roughly take 6.204484e+23 steps.
If for 10 cities it takes 15.48 seconds then it would roughly take
(10! / 15.48) * (24!) seconds
which is 1.46 × 10^29.

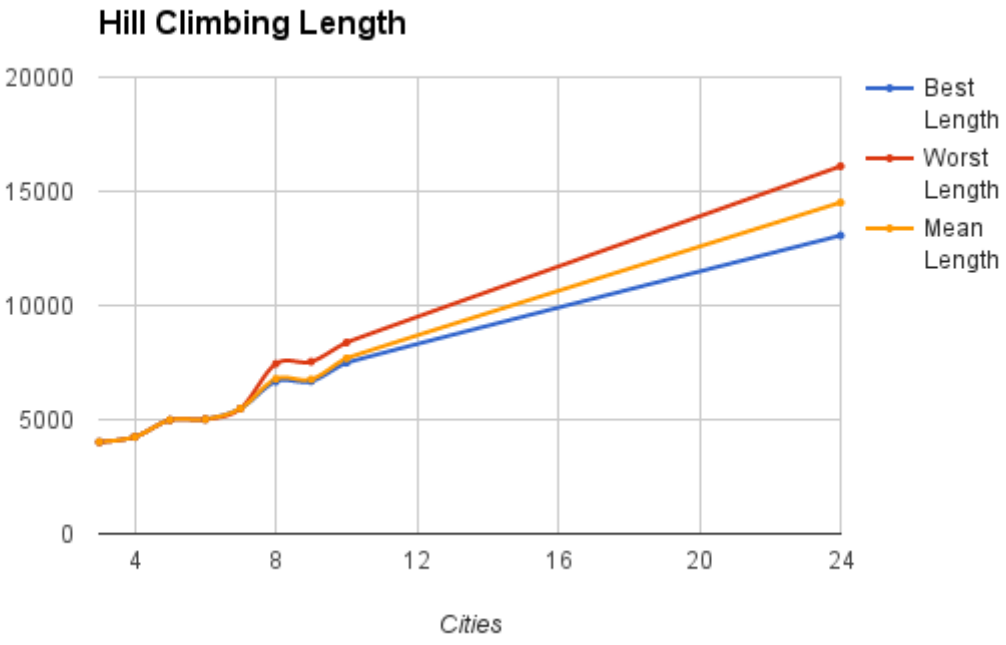
Hill Climbing Search

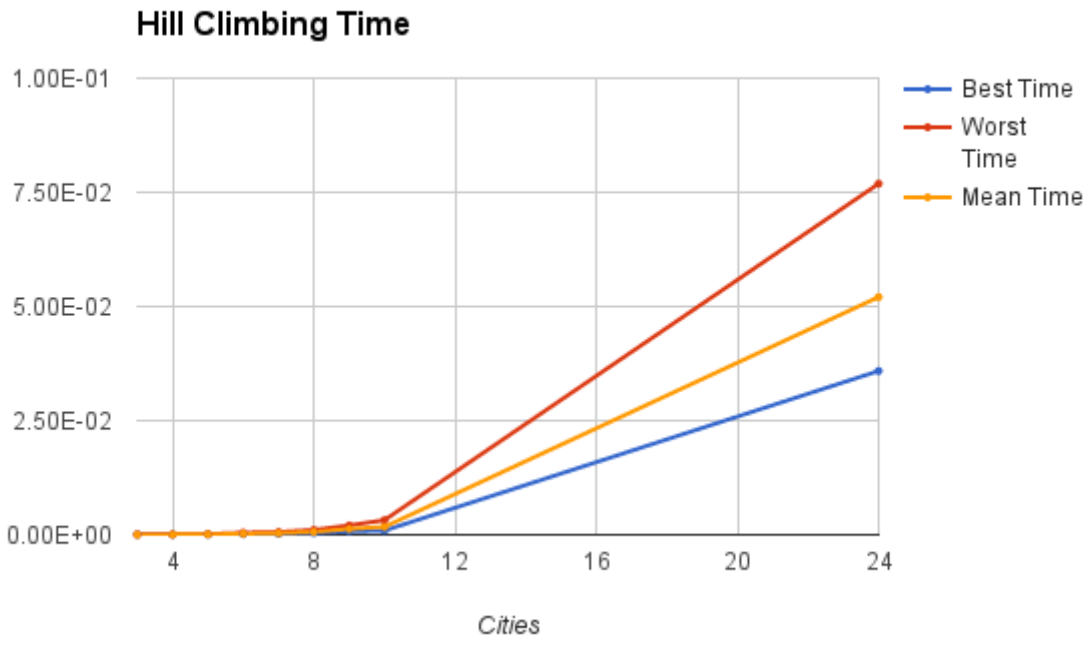
With the hill climbing algorithm the time taken for the 10 cities and all 24 cities are:

Cities	Best Time	Worst Time	Mean Time
3	2.38E-005	5.51E-005	2.65E-005
4	3.81E-005	7.39E-005	5.39E-005
5	5.60E-005	0.0001630783	1.03E-004
6	1.37E-004	0.0004470348	0.0002409339
7	0.0001950264	0.0006170273	0.0003432631
8	0.0003929138	0.0010659695	0.0006322265
9	0.0007200241	0.0020580292	0.0012837768
10	0.0009129047	0.0032110214	0.0017276168
24	0.0358769894	0.076884985	0.0520761251

The lengths for the cities are :

Cities	Best Length	Worst Length	Mean Length
3	4024.99	4.02E+003	4024.99
4	4241.89	4.24E+003	4241.89
5	4983.38	4983.38	4983.38
6	5018.81	5018.81	5018.81
7	5487.89	5487.89	5487.89
8	6667.49	7446.53	6784.346
9	6678.55	7539.18	6764.613
10	7486.31	8377.24	7683.1875
24	13066.91	16097.94	14512.7015





Comparison between Hill climbing and exhaustive search

Cities	Time
3	1.85E-005
4	2.62E-005
5	2.96E-004
6	1.88E-003
7	1.60E-002
8	1.43E-001
9	1.41E+000
10	1.55E+001

Genetic Algorithm

For the population size 3
I have chosen to use 1000 generations for the algorithm.
And the results for the time are :

Cities	Best Time	Worst Time	Mean Time
5	0.0391969681	0.0405738354	0.039844584
10	0.0547850132	0.0576579571	0.05564537
24	0.1066029072	0.1192610264	0.109993112

The lengths are :

Cities	Best Length	Worst Length	Mean Length
5	4983.38	4983.38	4983.38
10	7486.31	8391.05	7671.71
24	18309.36	22106.18	20090.5545