

Report - Lab 8

1. Euler's method to approximate the solutions:

Problem number	Calculated Soln	Original Soln	Absolute Error
A	1.17065	1.18123	0.01058
B	4.51428	5.8741	1.35982
C	-1.01815	-1.03597	0.01782
D	0.980345	1.00225	0.021905

2. Using Linear Interpolation, Compare the approximations obtained to the actual values obtained using the exact solutions given above.

Problem number	Calculated Soln 1	Original Soln 1	Calculated Soln 2	Original Soln 2
A	1	1.00115	1.1539	1.16439
B	1.66076	1.92496	3.52616	4.39417
C	-1.10362	-1.13828	-1.02228	-1.04127
D	0.282833	0.314002	0.866552	0.886632

3. Compute the approximate order of convergence for each equation in problem 1:

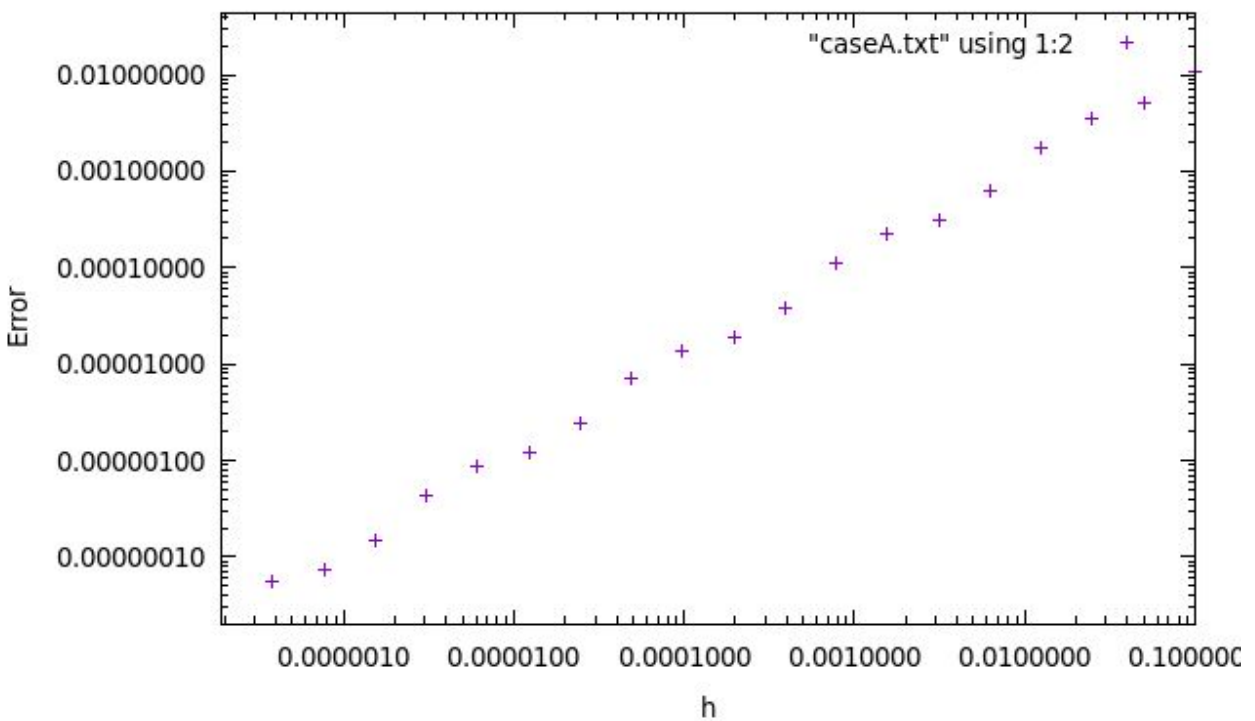
Problem A:

h	Error	Alpha
0.1	0.0105806487	1.050894211
0.05	0.0051069501	0.528283279
0.025	0.0035410536	0.9923485912
0.0125	0.0017799418	1.523287574
0.00625	0.000619228	1.003113478

0.003125	0.0003089465	0.4670182979
0.0015625	0.0002235099	0.9995339812
0.00078125	0.0001117911	1.536169363
0.000390625	0.0000385455	1.000194309
0.0001953125	0.0000192702	0.4632290074
0.0000976563	0.0000139778	0.9999709264
0.0000488281	0.0000069891	1.53697024
0.0000244141	0.0000024085	1.000012321
0.000012207	0.0000012042	0.4629937767
0.0000061035	0.0000008736	0.9999999809
0.0000030518	0.0000004368	1.537058503
0.0000015259	0.0000001505	1.000042526
0.0000007629	0.0000000753	0.4633512623
0.0000003815	0.0000000546	1.000457501
0.0000001907	0.0000000273	

Hence approximate order of convergence ~ 1

Plot: In log-log scale:

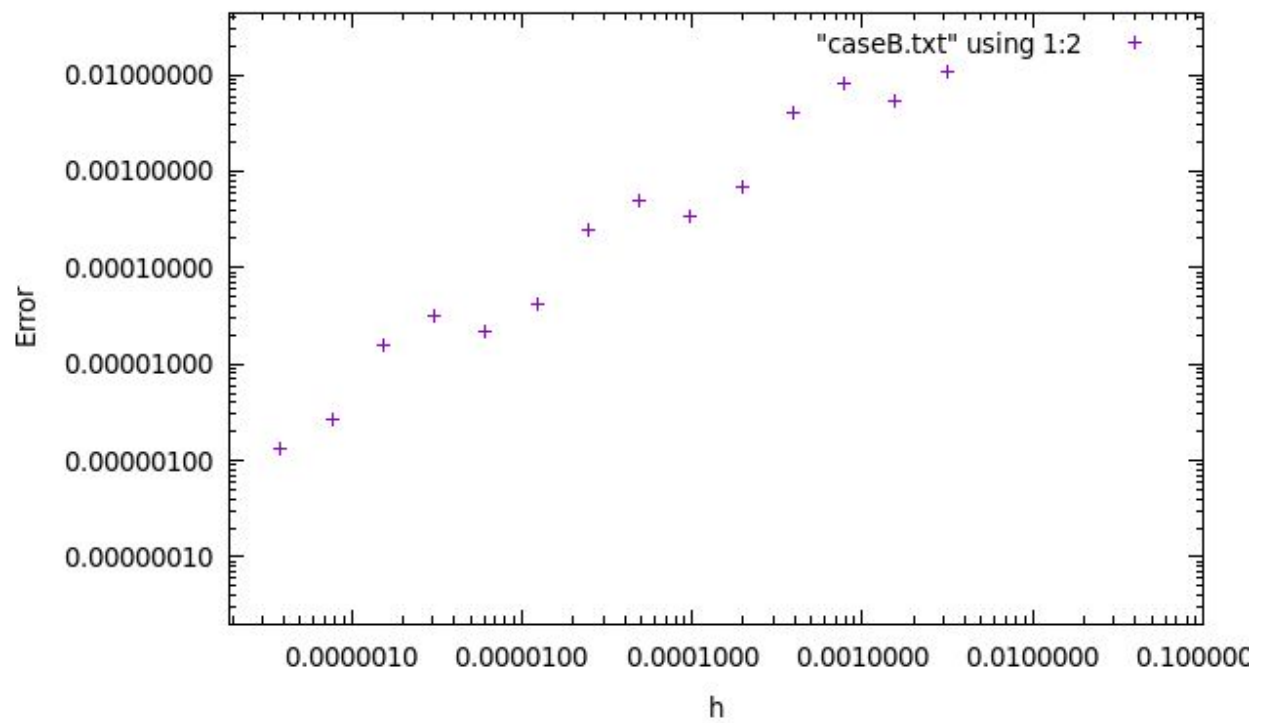


Problem B:

h	Error	Alpha
0.2	1.35982255	0.7399283299
0.1	0.8142197206	2.439768558
0.05	0.1500714568	0.8927811784
0.025	0.0808247154	-0.6218001547
0.0125	0.124372591	0.9761915873
0.00625	0.0632210541	2.547395393
0.003125	0.0108148203	0.9928112041
0.0015625	0.005434422	-0.5614645555
0.00078125	0.0080199383	0.9984659203
0.000390625	0.0040142354	2.55668842
0.0001953125	0.0006822805	0.9995485809
0.0000976563	0.000341247	-0.557581061
0.0000488281	0.0005022471	0.999903768
0.0000244141	0.0002511403	2.557282327
0.000012207	0.0000426676	0.9999795752
0.0000061035	0.0000213341	-0.5573466572
0.0000030518	0.0000313944	0.9999515319
0.0000015259	0.0000156977	2.557403003
0.0000007629	0.0000026667	1.002000001
0.0000003815	0.0000013315	

Hence approximate order of convergence ~ 1

Plot: In log-log scale:



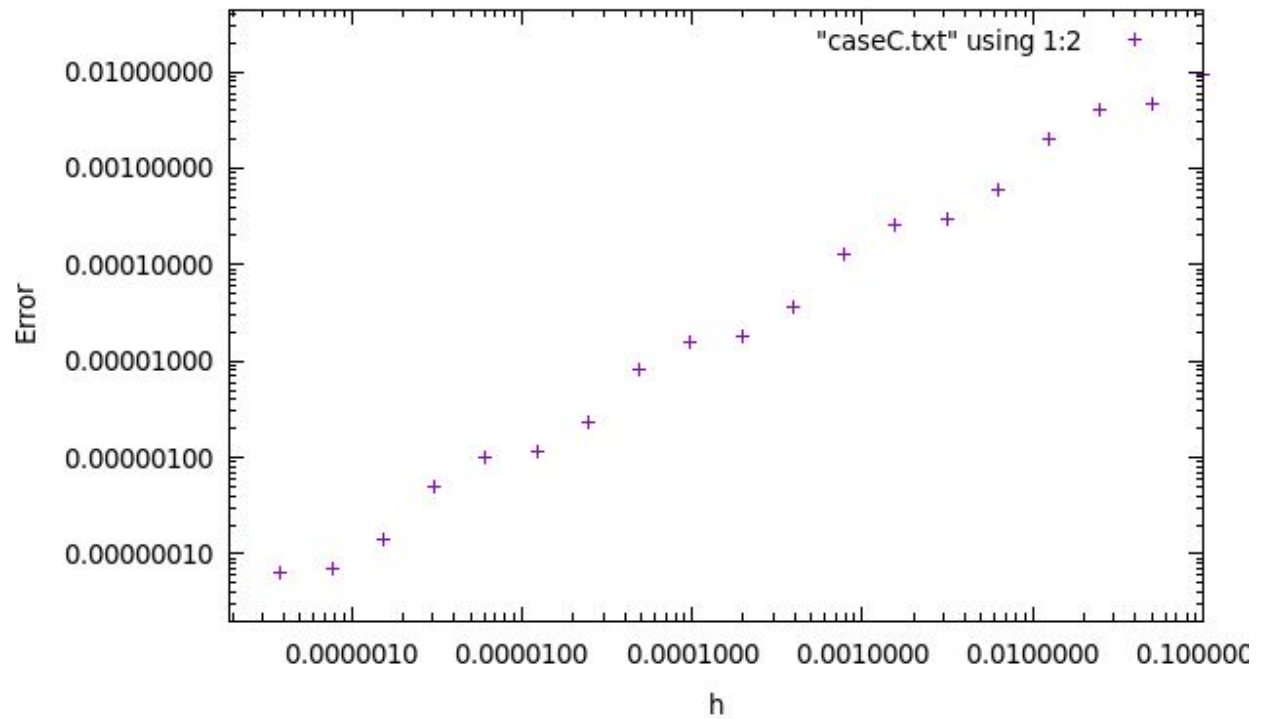
Problem C:

h	Error	Alpha
0.2	0.0250154192	1.44770243
0.1	0.0091707727	0.9839596327
0.05	0.0046366527	0.2190191425
0.025	0.0039835772	0.9778944655
0.0125	0.0020225425	1.791052655
0.00625	0.0005844362	0.9992038404
0.003125	0.0002923794	0.1906776688
0.0015625	0.0002561811	0.9986478877
0.00078125	0.0001282106	1.809984338
0.000390625	0.0000365649	0.9999509383
0.0001953125	0.0000182831	0.1888826823
0.0000976563	0.0000160395	0.9999156062
0.0000488281	0.0000080202	1.811158808
0.0000244141	0.0000022855	0.9999969424
0.000012207	0.0000011427	0.1887703816
0.0000061035	0.0000010026	0.9999946468

0.0000030518	0.0000005013	1.811232226
0.0000015259	0.0000001428	0.9999986499
0.0000007629	0.0000000714	0.188765301
0.0000003815	0.0000000627	

Hence approximate order of convergence ~ 1

Plot: In log-log scale:



Problem D:

h	Error	Alpha
0.1	0.1879265437	4.07412199
0.05	0.0111571996	0.9879433585
0.025	0.0056254156	-1.981336513
0.0125	0.0222124436	1.006076172
0.00625	0.0110595443	3.965636917
0.003125	0.0007078831	0.9993465348
0.0015625	0.0003541019	-1.959635098
0.00078125	0.0013773275	1.000383148
0.000390625	0.0006884809	3.958683898

0.0001953125	0.0000442802	0.9999595699
0.0000976563	0.0000221407	-1.958308083
0.0000488281	0.0000860401	1.000023985
0.0000244141	0.0000430193	3.95824969
0.000012207	0.0000027677	1.000000637
0.0000061035	0.0000013838	-1.958227382
0.0000030518	0.0000053773	1.00000802
0.0000015259	0.0000026887	3.958463379
0.0000007629	0.0000001729	1.000810652
0.0000003815	0.0000000864	-1.958765608
0.0000001907	0.0000000336	

In this case, it's oscillating in between may be due to round off error. Hence approximate order of convergence ~ 1

Plot: In log-log scale:

