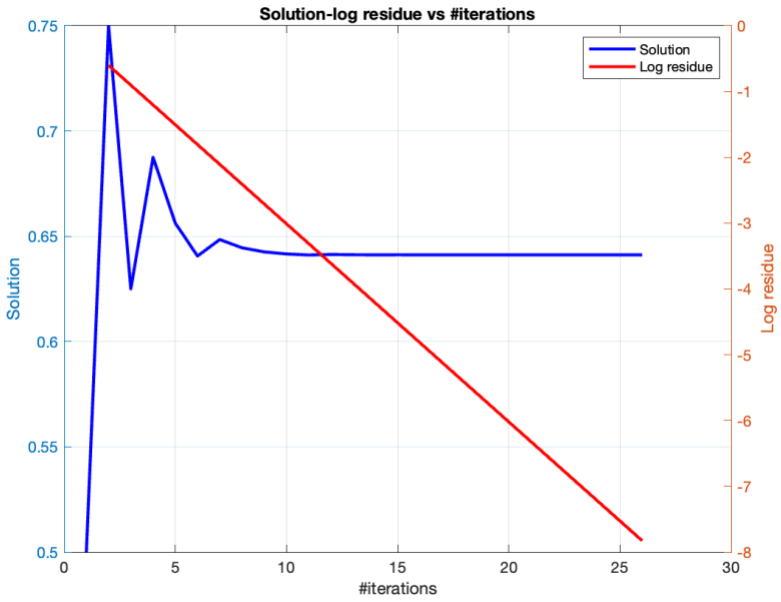
Scientific Computing (MA322)

Lab 02

Naveen Kumar A G 210123075

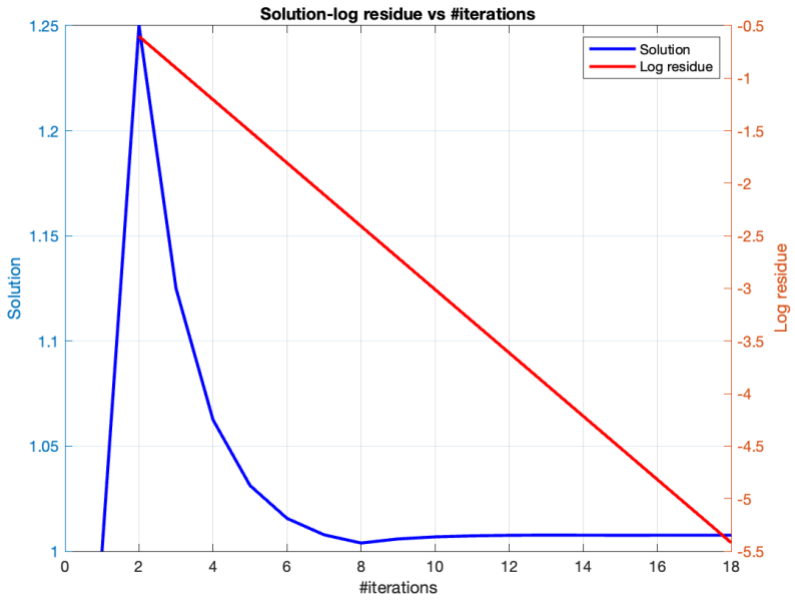
Q-1

Iteration#	Approx. Sol	Residue
1	0.5	NA
2	0.75	0.25
3	0.625	0.125
4	0.6875	0.0625
5	0.65625	0.03125
6	0.640625	0.015625
7	0.6484375	0.0078125
8	0.64453125	0.00390625
9	0.64257813	0.00195313
10	0.64160156	0.00097656
11	0.64111328	0.00048828
12	0.64135742	0.00024414
13	0.64123535	0.00012207
14	0.64117432	6.10E-05
15	0.64120483	3.05E-05
16	0.64118958	1.53E-05
17	0.64118195	7.63E-06
18	0.64118576	3.81E-06
19	0.64118385	1.91E-06
20	0.64118481	9.54E-07
21	0.64118528	4.77E-07
22	0.64118552	2.38E-07
23	0.64118564	1.19E-07
24	0.6411857	5.96E-08
25	0.64118573	2.98E-08
26	0.64118575	1.49E-08



Q-2 (a)

Iteration#	Approx. Sol	Residue
1	1	NA
2	1.25	0.25
3	1.125	0.125
4	1.0625	0.0625
5	1.03125	0.03125
6	1.015625	0.015625
7	1.0078125	0.0078125
8	1.00390625	0.00390625
9	1.00585938	0.00195313
10	1.00683594	0.00097656
11	1.00732422	0.00048828
12	1.00756836	0.00024414
13	1.00769043	0.00012207
14	1.00762939	6.10E-05
15	1.00759888	3.05E-05
16	1.00761414	1.53E-05
17	1.00762177	7.63E-06
18	1.00762558	3.81E-06

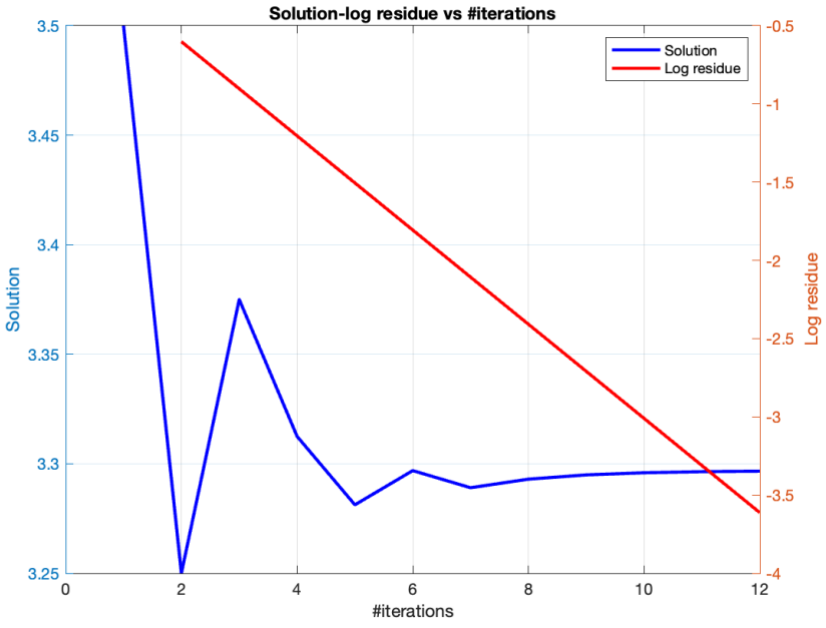


Q-2 (b)

Iteration#	Approx. Sol	Residue
1	0	NA

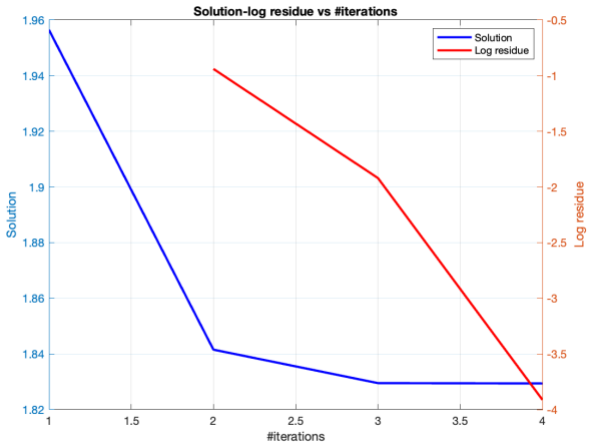
Q-2 (c)

Iteration#	Approx. Sol	Residue
1	3.5	NA
2	3.25	0.25
3	3.375	0.125
4	3.3125	0.0625
5	3.28125	0.03125
6	3.296875	0.015625
7	3.2890625	0.0078125
8	3.29296875	0.00390625
9	3.29492188	0.00195313
10	3.29589844	0.00097656
11	3.29638672	0.00048828
12	3.29663086	0.00024414



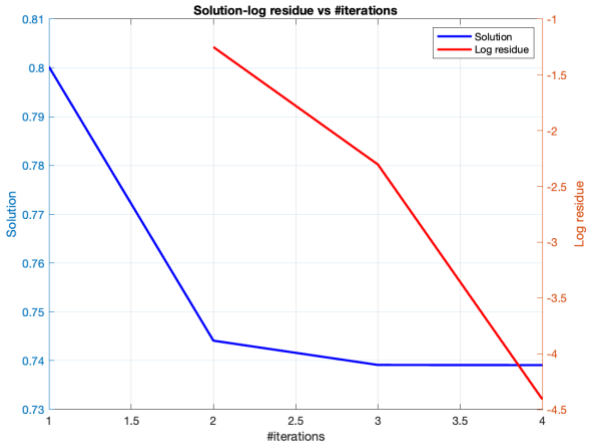
Q-3 (a)

Iteration#	Approx. Sol	Residue
1	1.95648993	NA
2	1.84153321	0.11495672
3	1.82950602	0.01202719
4	1.82938361	0.00012241



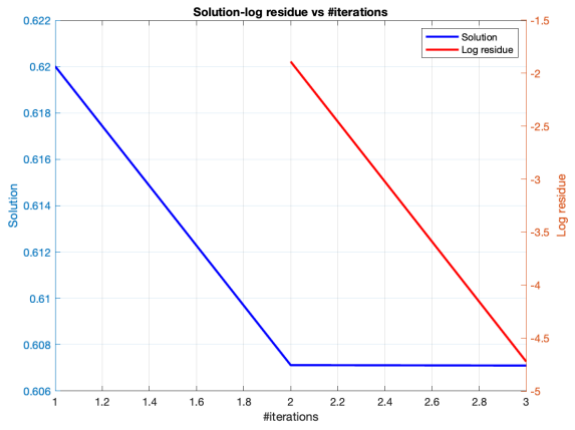
Q-3 (b)

Iteration#	Approx. Sol	Residue
1	0.80023295	NA
2	0.7440944	0.05613854
3	0.73912407	0.00497034
4	0.73908514	3.89E-05



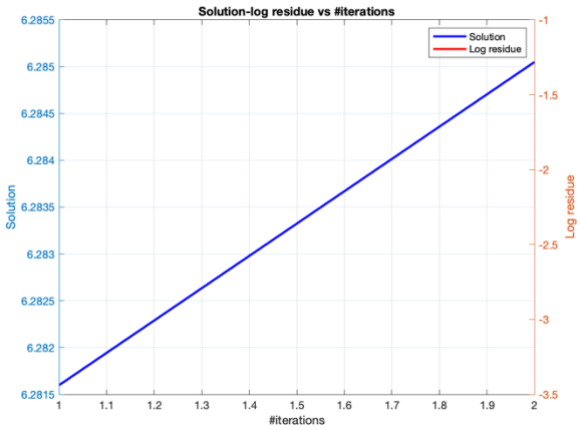
Q-3 (c)

Iteration#	Approx. Sol	Residue
1	0.62001601	NA
2	0.60712066	0.01289536
3	0.60710165	1.90E-05



Q-3 (d)

Iteration#	Approx. Sol	Residue
1	6.28159854	NA
2	6.28504926	0.00345072



Q-4

At x_0 = 0.0001

Iteration#	Approx. Sol	Residue
0	0.0001	NA

Actual error: e^(-1 / (0.0001^2)) = 6.451709693e-43429449

At x_0 = 0.00005

Iteration#	Approx. Sol	Residue
0	5.00E-05	0

Actual error: e^(-1 / (0.00005^2)) = 1.732603825e-173717793

The machine epsilon is the smallest positive number that, when added to 1.0, results in a value different from 1.0 in the floating-point representation of the computer. Use 'eps' function in MATLAB to view the machine epsilon for your computer.

The machine epsilon for the computer used is: 2.2204e-16

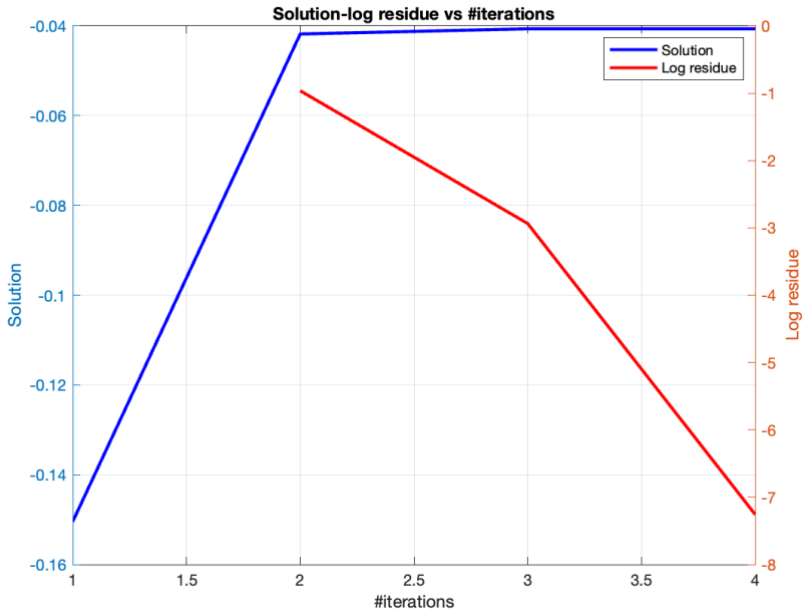
At x_0 = 0.0001 and 0.00005, the actual errors are much lesser than the machine epsilon, hence are represented as 0. So, these values are accepted as zeros of the function though they are clearly not.

For values of x_0 below 0.00005, error value only decreases resulting it being misclassified as a solution.

Q-5

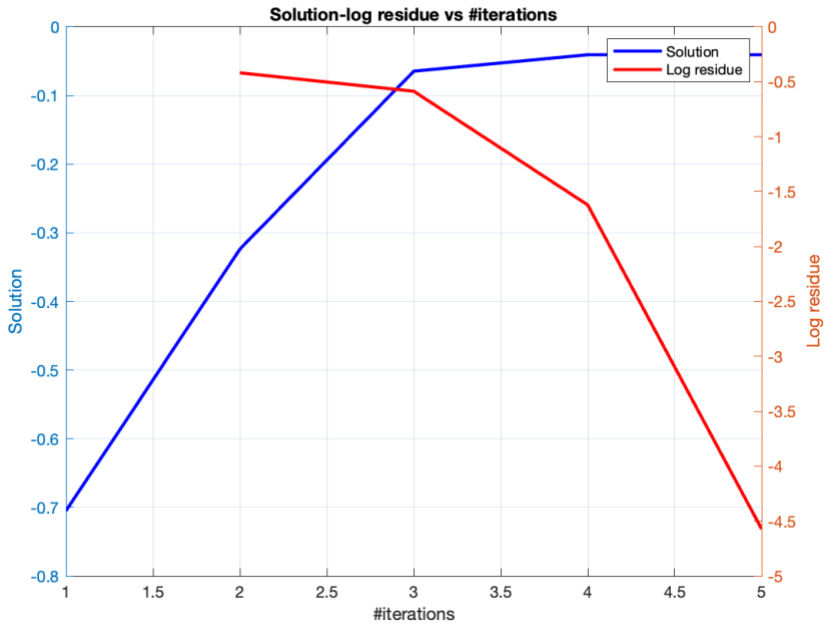
Newton's Method
At [-1, 0]

Iteration#	Approx. Sol	Residue
1	-0.1504525	NA
2	-0.0418168	0.10863568
3	-0.0406593	1.16E-03
4	-0.0406593	5.52E-08



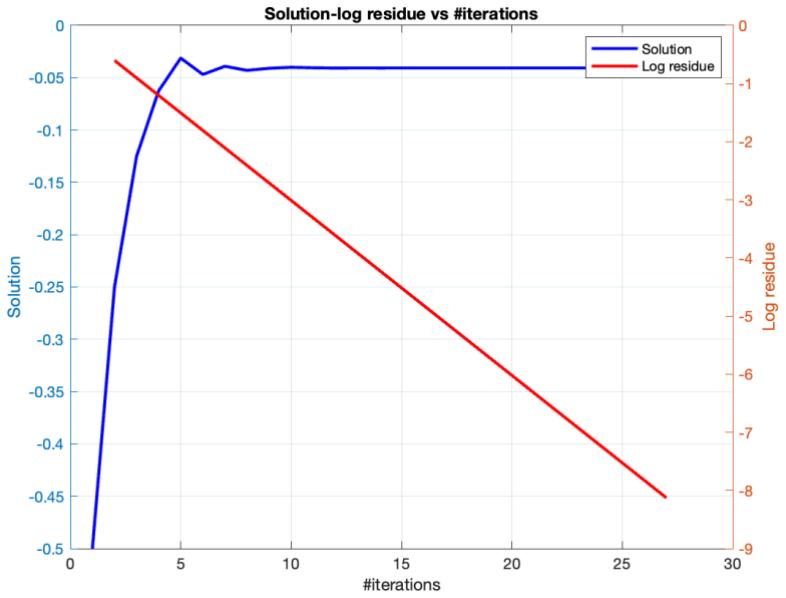
At [0, 1]

Iteration#	Approx. Sol	Residue
1	-0.7050919	NA
2	-0.3237932	0.3812987
3	-0.0646037	2.59E-01
4	-0.0406862	2.39E-02
5	-0.0406593	2.69E-05



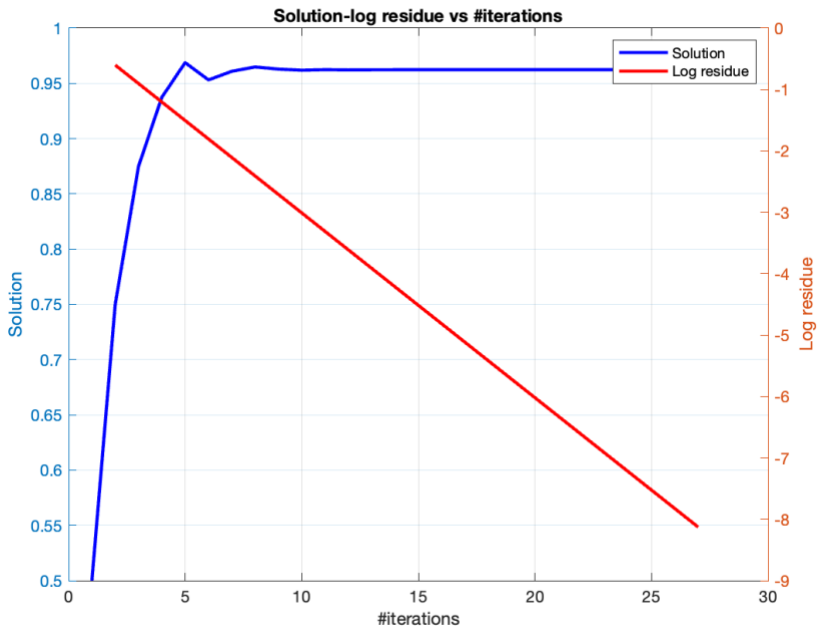
Bisection Method
At [-1, 0]

Iteration#	Approx. Sol	Residue
1	-0.5	NA
2	-0.25	0.25
3	-0.125	1.25E-01
4	-0.0625	6.25E-02
5	-0.03125	0.03125
6	-0.046875	0.015625
7	-0.0390625	0.0078125
8	-0.0429688	0.00390625
9	-0.0410156	0.00195313
10	-0.0400391	0.00097656
11	-0.0405273	0.00048828
12	-0.0407715	0.00024414
13	-0.0406494	0.00012207
14	-0.0407104	6.10E-05
15	-0.0406799	3.05E-05
16	-0.0406647	1.53E-05
17	-0.040657	7.63E-06
18	-0.0406609	3.81E-06
19	-0.040659	1.91E-06
20	-0.0406599	9.54E-07
21	-0.0406594	4.77E-07
22	-0.0406592	2.38E-07
23	-0.0406593	1.19E-07
24	-0.0406592	5.96E-08
25	-0.0406593	2.98E-08
26	-0.0406593	1.49E-08
27	-0.0406593	7.45E-09



At [0, 1]

Iteration#	Approx. Sol	Residue
1	0.5	NA
2	0.75	0.25
3	0.875	1.25E-01
4	0.9375	6.25E-02
5	0.96875	0.03125
6	0.953125	0.015625
7	0.9609375	0.0078125
8	0.96484375	0.00390625
9	0.96289063	0.00195313
10	0.96191406	0.00097656
11	0.96240234	0.00048828
12	0.9621582	0.00024414
13	0.96228027	0.00012207
14	0.96234131	6.10E-05
15	0.96237183	3.05E-05
16	0.96238708	1.53E-05
17	0.96239471	7.63E-06
18	0.96239853	3.81E-06
19	0.96239662	1.91E-06
20	0.96239758	9.54E-07
21	0.96239805	4.77E-07
22	0.96239829	2.38E-07
23	0.96239841	1.19E-07
24	0.96239847	5.96E-08
25	0.96239844	2.98E-08
26	0.96239842	1.49E-08
27	0.96239842	7.45E-09

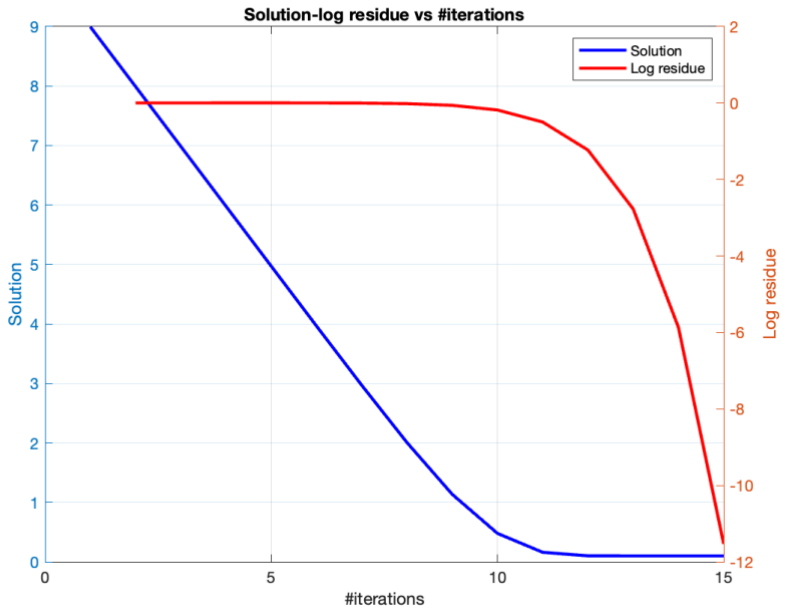


Newton's method gives incorrect solution for the function at the interval [0, 1]. This is due to the fact that the nature of the function changes at ~0.5959 from decreasing to increasing.

It is further observed that by changing the initial point from 0.5 to 0.6 for Newton's method, the solution obtained is same as the one obtained with bisection method.

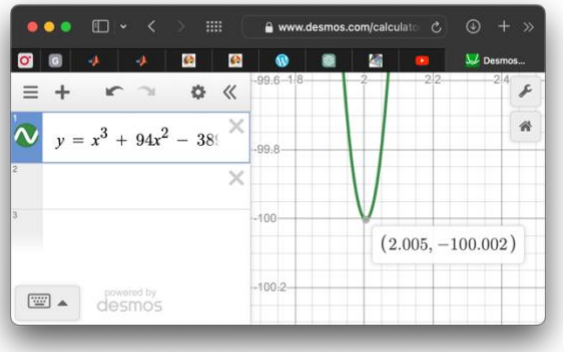
Q-6

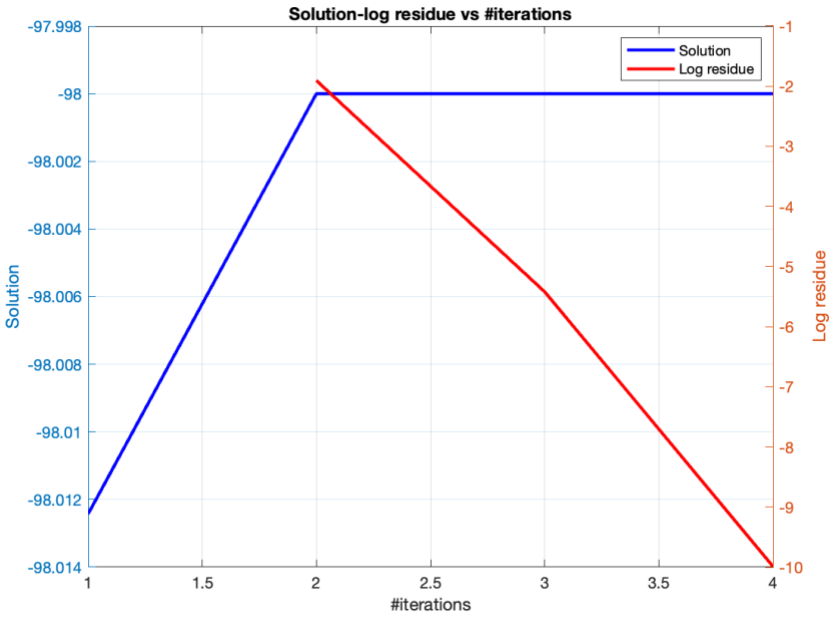
Iteration#	Approx. Sol	Residue
1	8.99588377	NA
2	7.99092199	1.00496178
3	6.98494508	1.01E+00
4	5.97791917	1.01E+00
5	4.97038159	1.00753758
6	3.96475266	1.00562893
7	2.96900933	0.99574333
8	2.00631771	0.96269161
9	1.13625475	0.87006297
10	0.47956482	0.65668992
11	0.16153824	0.31802658
12	0.10269547	0.05884278
13	0.10099928	0.00169618
14	0.10099793	1.35E-06
15	0.10099793	2.95E-12



Q-7

Iteration#	Approx. Sol	Residue
1	-98.012428	NA
2	-98.000004	0.01242396
3	-98	3.81E-06
4	-98	1.03E-10





Newton's method gives solution for the function at -98. This is due to the fact that the nature of the function changes at ~2.005 from decreasing to increasing.

It is further observed that by changing the initial point from 2 to 2.006 for Newton's method, the solution obtained is closer to the initial point.

Iteration#	Approx. Sol	Residue
1	501.796006	NA
2	325.398506	176.3975
3	208.380456	1.17E+02
4	131.181534	7.72E+01
5	80.7893307	50.392203
6	48.5137517	32.275579
7	28.4515592	20.0621925
8	16.4932515	11.9583077
9	9.70831178	6.7849397
10	6.04780392	3.66050786
11	4.18151247	1.86629145
12	3.32716014	0.85435233
13	3.04113309	0.28602705
14	3.00082855	4.03E-02
15	3.00000035	8.28E-04
16	3	3.49E-07