

Assignment 3

CS374

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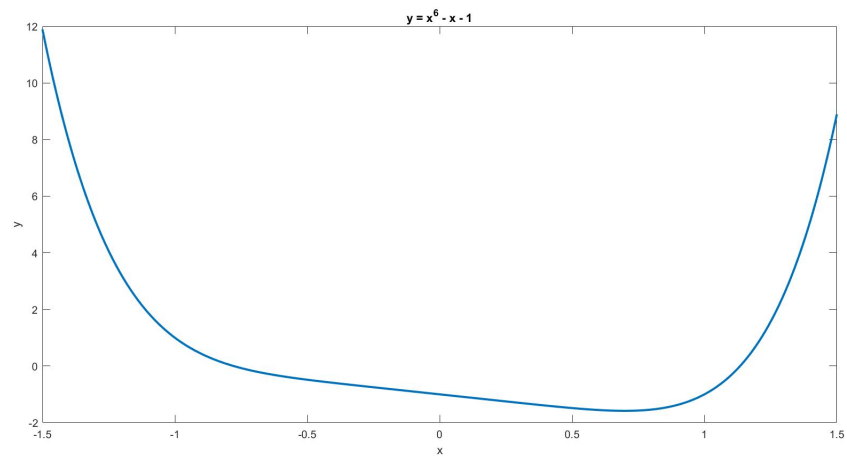
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1 Part A

1.1 Equation

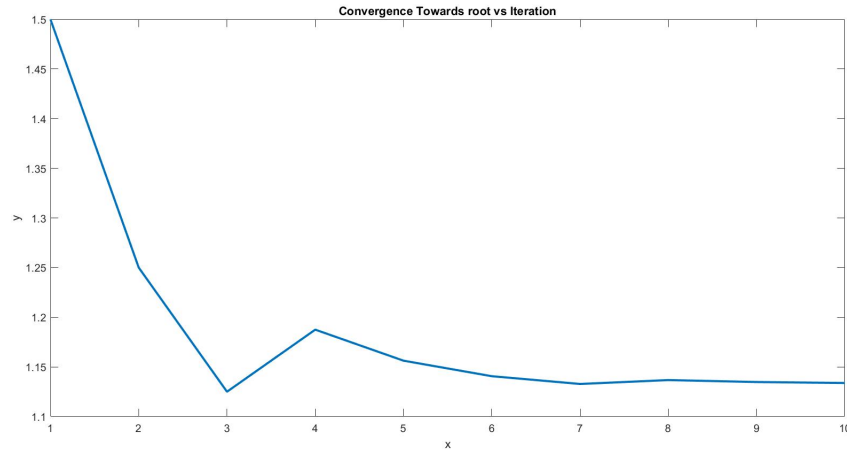
$$y = x^6 - x - 1 \quad (1)$$

1.2 Graph



- So, from the above graph we can observe that there are two real roots of these equations.

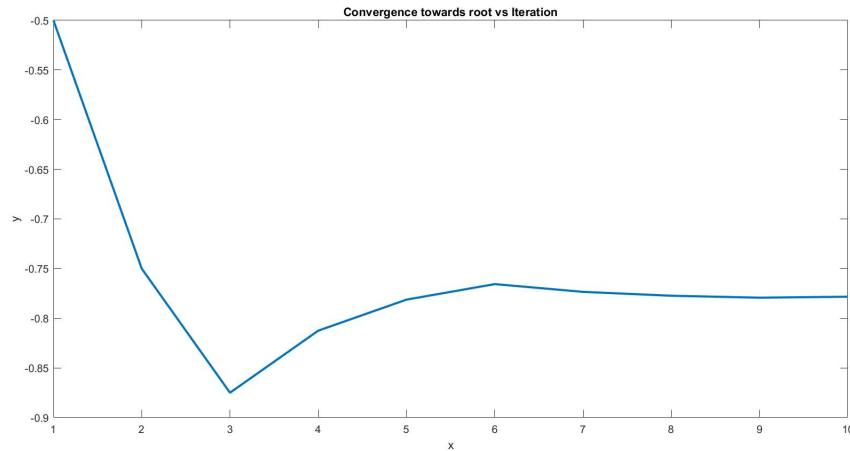
1.2.1 Assumed values : $a = 1$ and $b = 2$



- Above shown plot is of convergence of first root vs iterations
- Value of first root is 1.1338.
- Root value is obtained in 10 iterations with $\epsilon = 0.001$.

	Count	a	b	c	b-c	f(c)	f(a)*f(b)
0	1	1	2	1.5	0.5	8.89062	-61
1	2	1	1.5	1.25	0.25	1.5647	-8.89062
2	3	1	1.25	1.125	0.125	-0.0977135	-1.5647
3	4	1.125	1.25	1.1875	0.0625	0.616653	-0.152892
4	5	1.125	1.1875	1.15625	0.03125	0.233269	-0.0602553
5	6	1.125	1.15625	1.14062	0.015625	0.0615778	-0.0227935
6	7	1.125	1.14062	1.13281	0.0078125	-0.0195756	-0.00601698
7	8	1.13281	1.14062	1.13672	0.00390625	0.020619	-0.00120542
8	9	1.13281	1.13672	1.13477	0.00195312	0.000426842	-0.000403628
9	10	1.13281	1.13477	1.13379	0.000976562	-0.00959799	-8.35566e-06

1.2.2 Assumed values : $a = -1$ and $b = 0$



- Above shown plot is of convergence of second root vs iterations
- Value of second root is -0.7783 .
- Root value is obtained in 10 iterations with $\epsilon = 0.001$.

	Count	a	b	c	b-c	f(c)	f(a) * f(b)
0	1	-1	0	-0.5	0.5	-0.484375	-1
1	2	-1	-0.5	-0.75	0.25	-0.0720215	-0.484375
2	3	-1	-0.75	-0.875	0.125	0.323795	-0.0720215
3	4	-0.875	-0.75	-0.8125	0.0625	0.1002	-0.0233202
4	5	-0.8125	-0.75	-0.78125	0.03125	0.00862368	-0.00721657
5	6	-0.78125	-0.75	-0.765625	0.015625	-0.0329578	-0.00062109
6	7	-0.78125	-0.765625	-0.773438	0.0078125	-0.0124947	-0.000284217
7	8	-0.78125	-0.773438	-0.777344	0.00390625	-0.00201909	-0.00010775
8	9	-0.78125	-0.777344	-0.779297	0.00195312	0.00328119	-1.74119e-05
9	10	-0.779297	-0.777344	-0.77832	0.000976562	0.000625803	-6.62501e-06

2 Part B

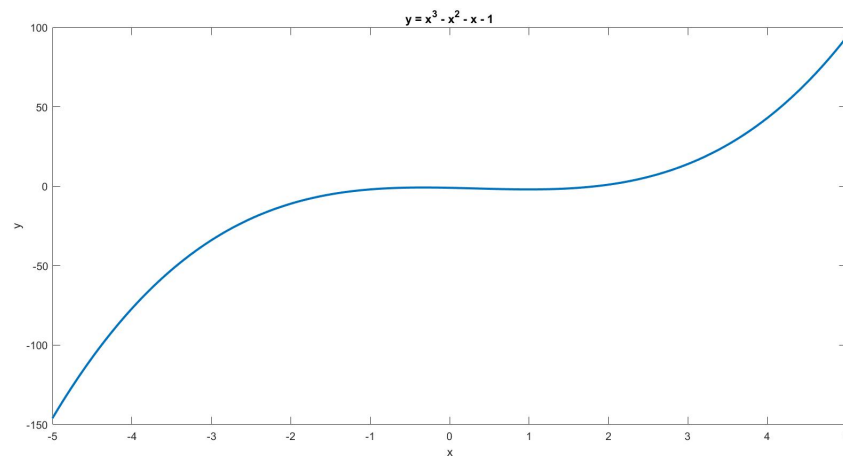
2.1 Question 1

2.1.1 (A)

Equation:

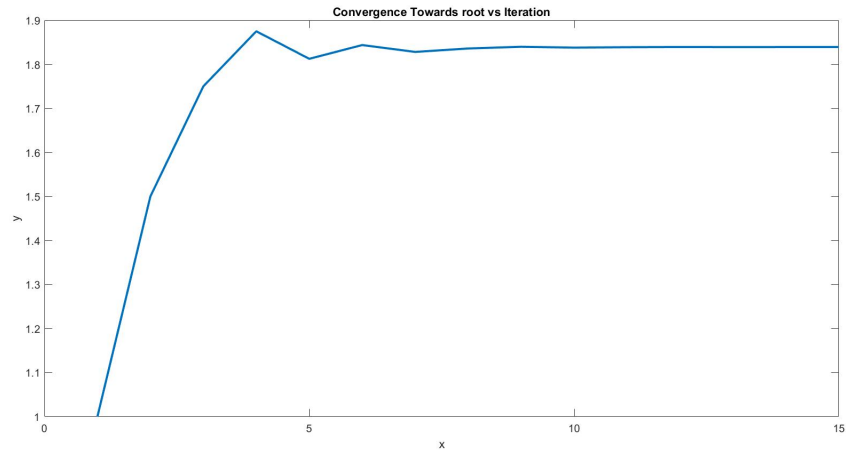
$$y = x^3 - x^2 - x - 1 \quad (2)$$

Graph:



- So, from the above graph we can observe that there is one real root of these equation.

Assumed values : $a = 0$ and $b = 2$



- Above shown plot is of convergence of first root vs iterations.
- Value of first root is 1.8393.
- Root value is obtained in 15 iterations with $\epsilon = 0.0001$.

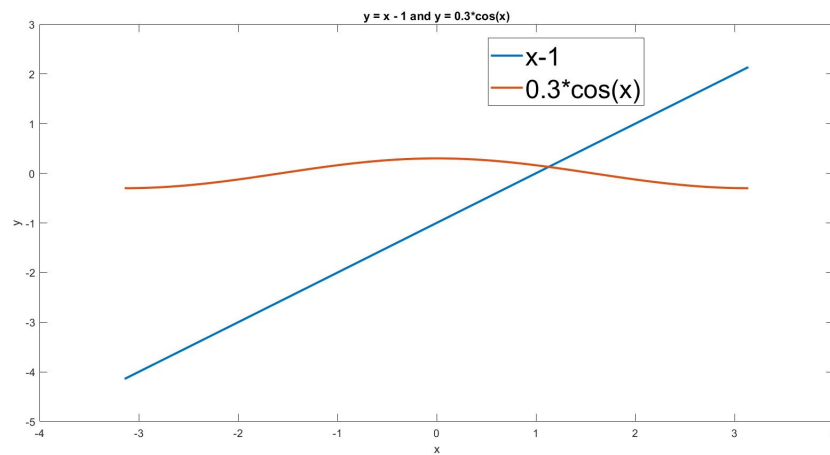
	Count	a	b	c	b-c	f(c)	f(a)*f(b)
0	1	0	2	1	1	-2	-1
1	2	1	2	1.5	0.5	-1.375	-2
2	3	1.5	2	1.75	0.25	-0.453125	-1.375
3	4	1.75	2	1.875	0.125	0.201172	-0.453125
4	5	1.75	1.875	1.8125	0.0625	-0.143311	-0.091156
5	6	1.8125	1.875	1.84375	0.03125	0.0245056	-0.0288301
6	7	1.8125	1.84375	1.82812	0.015625	-0.0604973	-0.00351191
7	8	1.82812	1.84375	1.83594	0.0078125	-0.018271	-0.00148252
8	9	1.83594	1.84375	1.83984	0.00390625	0.00304836	-0.000447741
9	10	1.83594	1.83984	1.83789	0.00195312	-0.00762852	-5.56965e-05
10	11	1.83789	1.83984	1.83887	0.000976562	-0.00229439	-2.32545e-05
11	12	1.83887	1.83984	1.83936	0.000488281	0.000375909	-6.99412e-06
12	13	1.83887	1.83936	1.83911	0.000244141	-0.000959509	-8.62481e-07
13	14	1.83911	1.83936	1.83923	0.00012207	-0.000291868	-3.60688e-07
14	15	1.83923	1.83936	1.83929	6.10352e-05	4.20037e-05	-1.09716e-07

2.1.2 (B)

Equation:

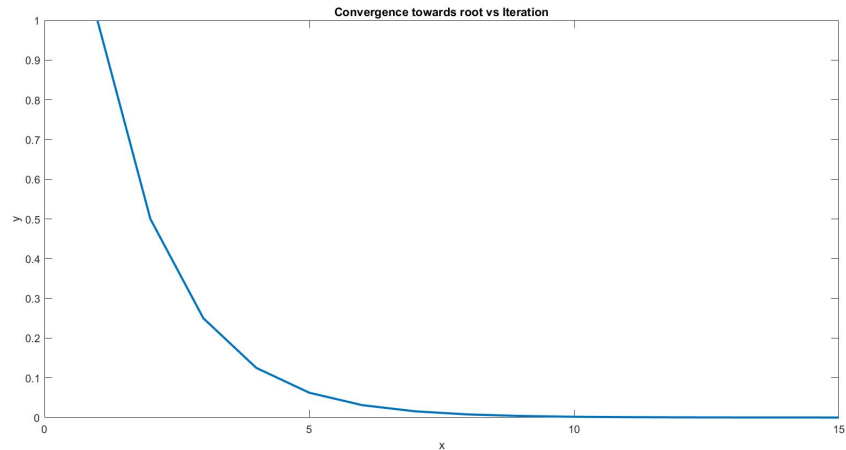
$$x = 1 + (0.3) * \cos x \quad (3)$$

Graph:



- So, from the above graph we can observe that there is one real root of these equation between 0 and 2 as both curves intersect between these two points.

Assumed values : $a = 0$ and $b = 2$



- Above shown plot is of convergence of first root vs iterations.
- Value of first root is 1.2999.
- Root value is obtained in 15 iterations with $\epsilon = 0.0001$.

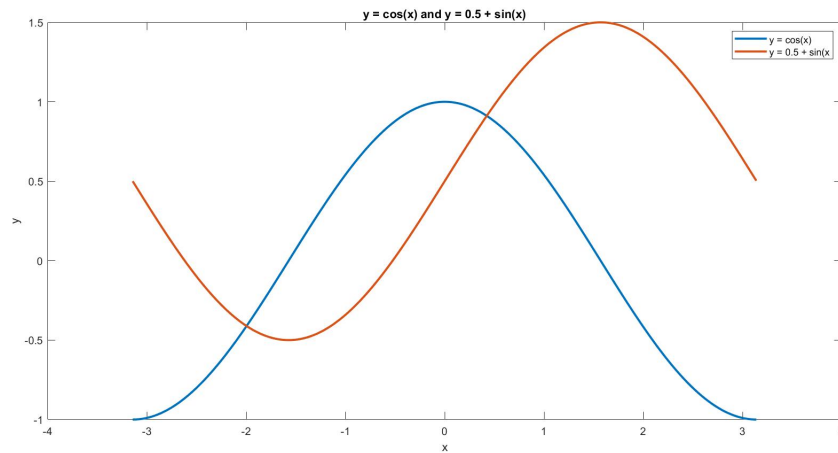
Count	a	b	c	b - c	f(c)	f(a)*f(b)
0	1	0	2	1	0.162091	-1.4623
1	2	0	1	0.5	0.763275	0.210718
2	3	0	0.5	0.25	1.04067	0.992257
3	4	0	0.25	0.125	1.17266	1.35288
4	5	0	0.125	0.0625	1.23691	1.52446
5	6	0	0.0625	0.03125	1.2686	1.60799
6	7	0	0.03125	0.015625	1.28434	1.64918
7	8	0	0.015625	0.0078125	1.29218	1.66964
8	9	0	0.0078125	0.00390625	1.29609	1.67983
9	10	0	0.00390625	0.00195312	1.29805	1.68492
10	11	0	0.00195312	0.000976562	1.29902	1.68746
11	12	0	0.000976562	0.000488281	1.29951	1.68873
12	13	0	0.000488281	0.000244141	1.29976	1.68937
13	14	0	0.000244141	0.00012207	1.29988	1.68968
14	15	0	0.00012207	6.10352e-05	1.29994	1.68984

2.1.3 (C)

Equation:

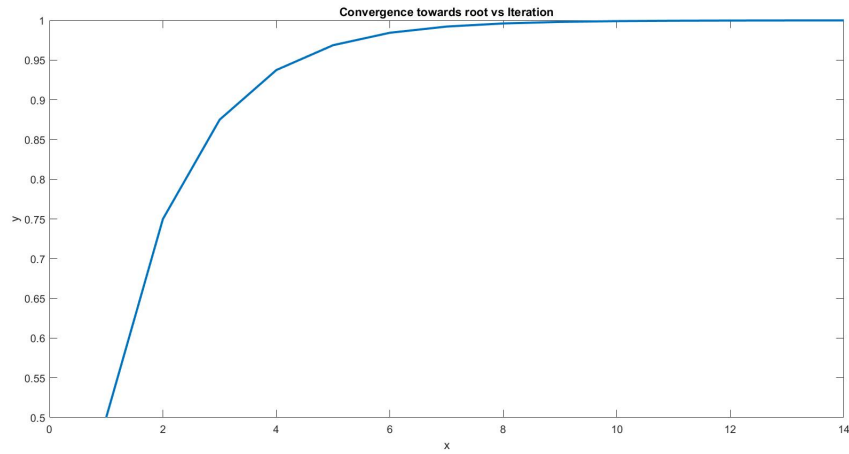
$$\cos x = 0.5 + \sin x \quad (4)$$

Graph:



- So, from the above graph we can observe that there is one positive real root i.e the smallest positive root of these equation between 0 and 1 as both curves intersect between these two points.

Assumed values : $a = 0$ and $b = 1$



- Above shown plot is of convergence of first root vs iterations.
- Value of first root is 0.9999.
- Root value is obtained in 14 iterations with $\epsilon = 0.0001$.

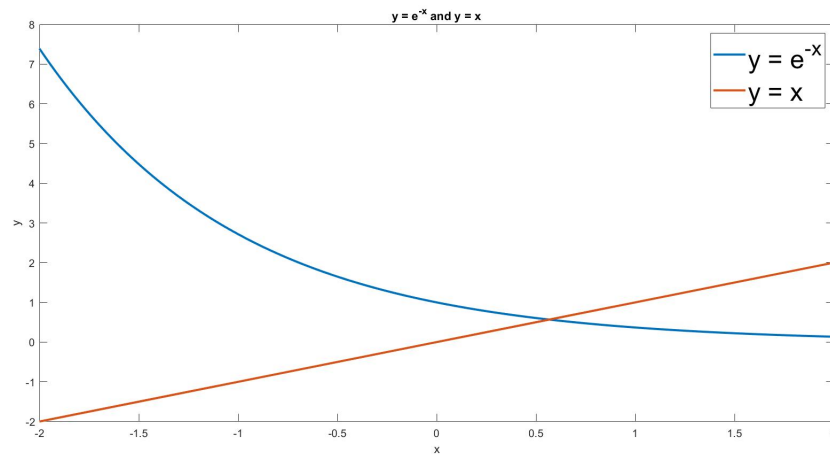
	Count	a	b	c	b-c	f(c)	f(a)*f(b)
0	1	0	1	0.5	0.5	-0.101843	-0.400584
1	2	0.5	1	0.75	0.25	-0.44995	0.0815934
2	3	0.75	1	0.875	0.125	-0.626547	0.360486
3	4	0.875	1	0.9375	0.0625	-0.714276	0.50197
4	5	0.9375	1	0.96875	0.03125	-0.757848	0.572256
5	6	0.96875	1	0.984375	0.015625	-0.779543	0.607164
6	7	0.984375	1	0.992188	0.0078125	-0.790364	0.624545
7	8	0.992188	1	0.996094	0.00390625	-0.795769	0.633215
8	9	0.996094	1	0.998047	0.00195312	-0.798469	0.637545
9	10	0.998047	1	0.999023	0.000976562	-0.799819	0.639709
10	11	0.999023	1	0.999512	0.000488281	-0.800494	0.64079
11	12	0.999512	1	0.999756	0.000244141	-0.800831	0.641331
12	13	0.999756	1	0.999878	0.00012207	-0.801	0.641601
13	14	0.999878	1	0.999939	6.10352e-05	-0.801084	0.641736

2.1.4 (D)

Equation:

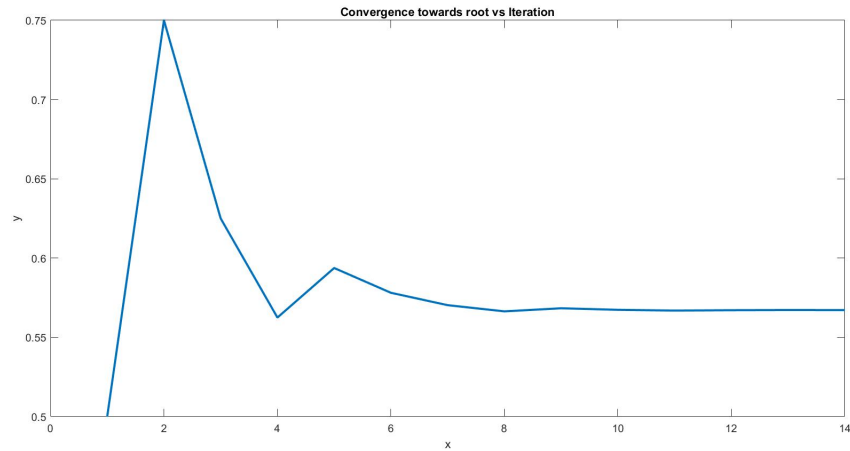
$$x = e^{-x} \quad (5)$$

Graph:



- So, from the above graph we can observe that there is one real root of these equation between 0 and 1 as both curves intersect between these two points.

Assumed values : $a = 0$ and $b = 1$



- Above shown plot is of convergence of first root vs iterations.
- Value of first root is 0.5672.
- Root value is obtained in 14 iterations with $\epsilon = 0.0001$.

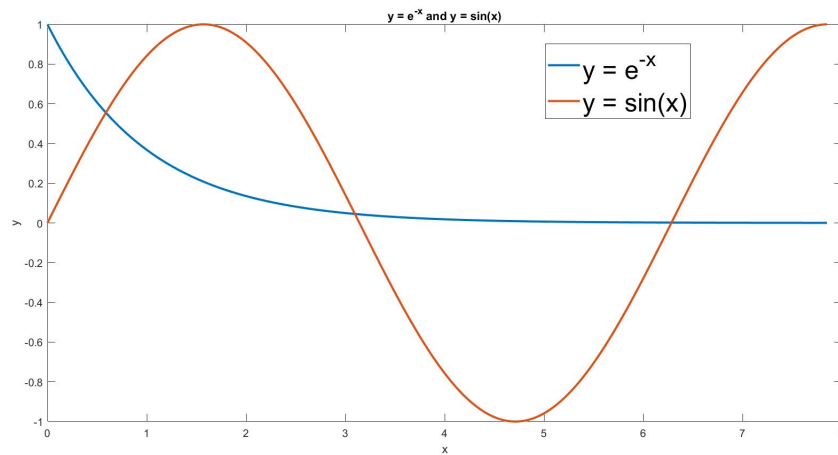
	Count	a	b	c	b - c	f(c)	f(a) * f(b)
0	1	0	1	0.5	0.5	-0.106531	-0.632121
1	2	0.5	1	0.75	0.25	0.277633	-0.0673402
2	3	0.5	0.75	0.625	0.125	0.0897386	-0.0295765
3	4	0.5	0.625	0.5625	0.0625	-0.00728282	-0.00955991
4	5	0.5625	0.625	0.59375	0.03125	0.0414975	-0.00065355
5	6	0.5625	0.59375	0.578125	0.015625	0.0171758	-0.000302219
6	7	0.5625	0.578125	0.570312	0.0078125	0.00496376	-0.000125089
7	8	0.5625	0.570312	0.566406	0.00390625	-0.0011552	-3.61502e-05
8	9	0.566406	0.570312	0.568359	0.00195312	0.00190536	-5.73415e-06
9	10	0.566406	0.568359	0.567383	0.000976562	0.000375349	-2.20108e-06
10	11	0.566406	0.567383	0.566895	0.000488281	-0.000389859	-4.33604e-07
11	12	0.566895	0.567383	0.567139	0.000244141	-7.23791e-06	-1.46333e-07
12	13	0.567139	0.567383	0.567261	0.00012207	0.00018406	-2.71674e-09
13	14	0.567139	0.567261	0.5672	6.10352e-05	8.8412e-05	-1.33221e-09

2.1.5 (F)

Equation:

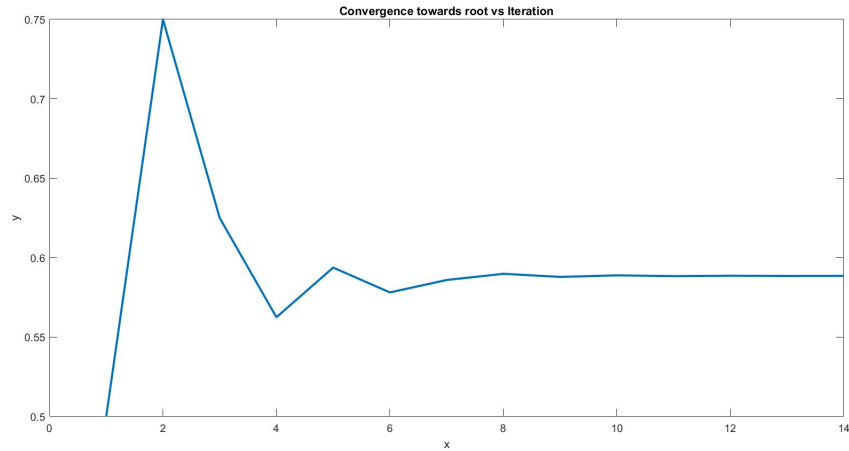
$$e^{-x} = \sin(x) \quad (6)$$

Graph:



- So, from the above graph we can observe that the two smallest real roots of these equation lie between 0 and 1 and another one between 3 and 4.

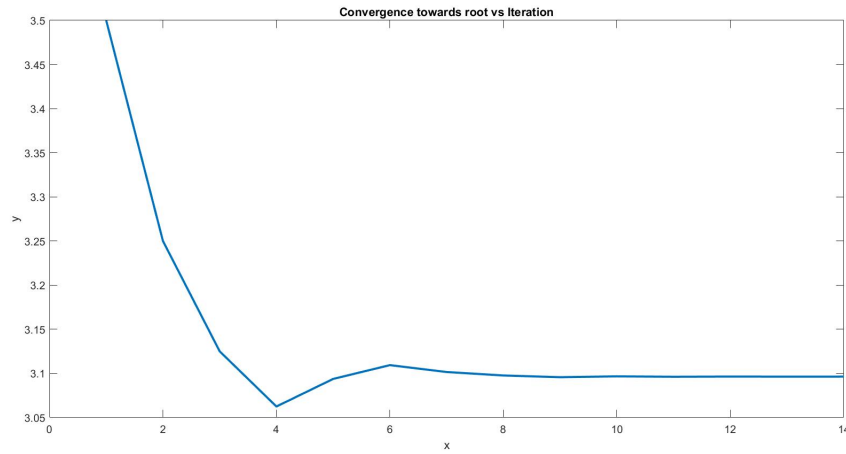
Assumed values : $a = 0$ and $b = 1$



- Above shown plot is of convergence of first root vs iterations.
- Value of first root is 0.5886.
- Root value is obtained in 14 iterations with $\epsilon = 0.0001$.

	Count	a	b	c	b-c	f(c)	f(a) * f(b)
0	1	0	1	0.5	0.5	-0.127105	-0.473592
1	2	0.5	1	0.75	0.25	0.209272	-0.0601959
2	3	0.5	0.75	0.625	0.125	0.0498358	-0.0265996
3	4	0.5	0.625	0.5625	0.0625	-0.0364802	-0.00633439
4	5	0.5625	0.625	0.59375	0.03125	0.00722068	-0.00181802
5	6	0.5625	0.59375	0.578125	0.015625	-0.0144946	-0.000263412
6	7	0.578125	0.59375	0.585938	0.0078125	-0.00360308	-0.000104661
7	8	0.585938	0.59375	0.589844	0.00390625	0.00181728	-2.60167e-05
8	9	0.585938	0.589844	0.587891	0.00195312	-0.000890782	-6.54778e-06
9	10	0.587891	0.589844	0.588867	0.000976562	0.000463777	-1.6188e-06
10	11	0.587891	0.588867	0.588379	0.000488281	-0.00021337	-4.13124e-07
11	12	0.588379	0.588867	0.588623	0.000244141	0.000125236	-9.89562e-08
12	13	0.588379	0.588623	0.588501	0.00012207	-4.40587e-05	-2.67217e-08
13	14	0.588501	0.588623	0.588562	6.10352e-05	4.05909e-05	-5.51775e-09

Assumed values : $a = 3$ and $b = 4$



- Above shown plot is of convergence of first root vs iterations.
- Value of second root is 3.0964.
- Root value is obtained in 14 iterations with $\epsilon = 0.0001$.

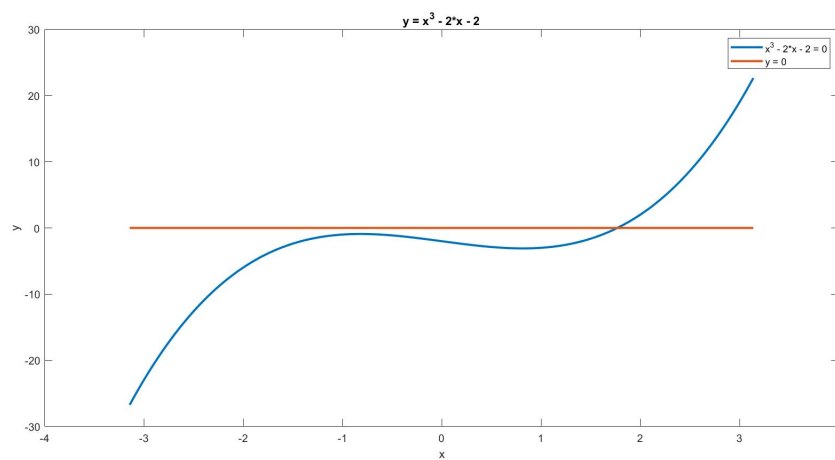
	Count	a	b	c	b-c	f(c)	f(a)*f(b)
0	1	3	4	3.5	0.5	0.380981	-0.0707938
1	2	3	3.5	3.25	0.25	0.146969	-0.0347961
2	3	3	3.25	3.125	0.125	0.027345	-0.0134231
3	4	3	3.125	3.0625	0.0625	-0.0322396	-0.0024975
4	5	3.0625	3.125	3.09375	0.03125	-0.00249276	-0.000881593
5	6	3.09375	3.125	3.10938	0.015625	0.0124168	-6.81647e-05
6	7	3.09375	3.10938	3.10156	0.0078125	0.0049594	-3.0952e-05
7	8	3.09375	3.10156	3.09766	0.00390625	0.00123264	-1.23626e-05
8	9	3.09375	3.09766	3.0957	0.00195312	-0.000630235	-3.07268e-06
9	10	3.0957	3.09766	3.09668	0.000976562	0.00030116	-7.76853e-07
10	11	3.0957	3.09668	3.09619	0.000488281	-0.000164548	-1.89802e-07
11	12	3.09619	3.09668	3.09644	0.000244141	6.83035e-05	-4.95553e-08
12	13	3.09619	3.09644	3.09631	0.00012207	-4.81229e-05	-1.12392e-08
13	14	3.09631	3.09644	3.09637	6.10352e-05	1.00902e-05	-3.28696e-09

2.1.6 (F)

Equation:

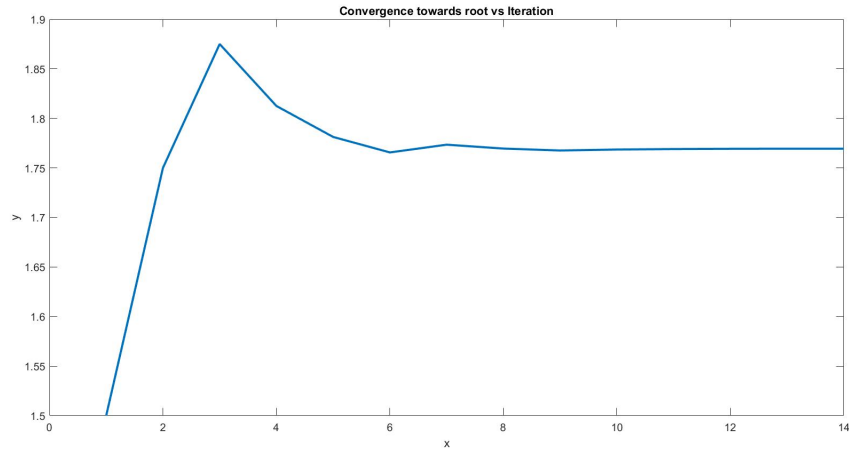
$$x = x^3 - 2 * x - 2 \quad (7)$$

Graph:



- So, from the above graph we can observe that there is one real root of these equation between 1 and 2.

Assumed values : $a = 1$ and $b = 2$



- Above shown plot is of convergence of first root vs iterations.
- Value of first root is 1.7693.
- Root value is obtained in 14 iterations with $\epsilon = 0.0001$.

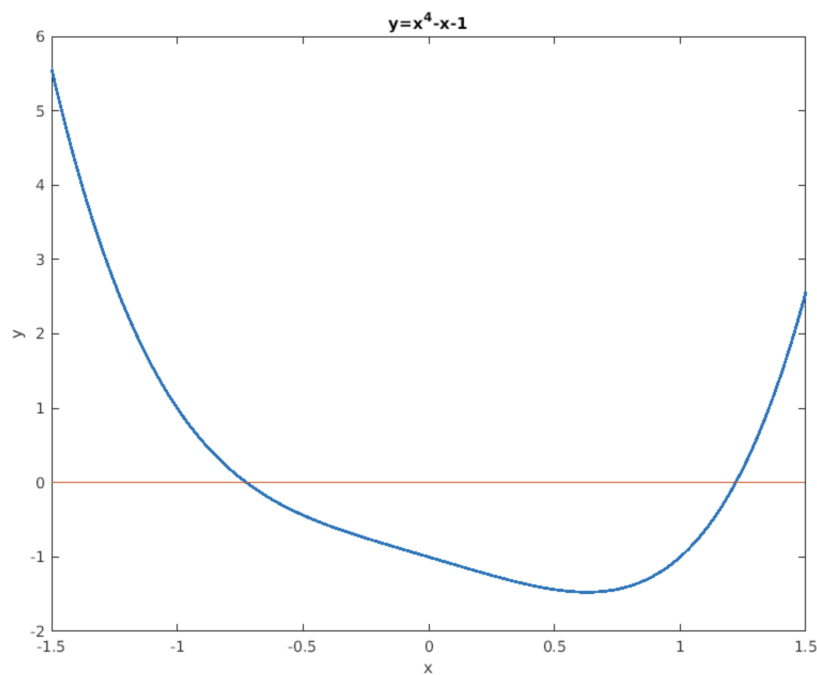
	Count	a	b	c	b-c	f(c)	f(a)*f(b)
0	1	1	2	1.5	0.5	-1.625	-6
1	2	1.5	2	1.75	0.25	-0.140625	-3.25
2	3	1.75	2	1.875	0.125	0.841797	-0.28125
3	4	1.75	1.875	1.8125	0.0625	0.329346	-0.118378
4	5	1.75	1.8125	1.78125	0.03125	0.0891418	-0.0463142
5	6	1.75	1.78125	1.76562	0.015625	-0.0270348	-0.0125356
6	7	1.76562	1.78125	1.77344	0.0078125	0.0307288	-0.00240993
7	8	1.76562	1.77344	1.76953	0.00390625	0.00176603	-0.000830746
8	9	1.76562	1.76953	1.76758	0.00195312	-0.0126546	-4.77441e-05
9	10	1.76758	1.76953	1.76855	0.000976562	-0.00544934	-2.23483e-05
10	11	1.76855	1.76953	1.76904	0.000488281	-0.00184292	-9.62368e-06
11	12	1.76904	1.76953	1.76929	0.000244141	-3.87656e-05	-3.25465e-06
12	13	1.76929	1.76953	1.76941	0.00012207	0.000863551	-6.84611e-08
13	14	1.76929	1.76941	1.76935	6.10352e-05	0.000412373	-3.34761e-08

2.1.7 (G)

Equation:

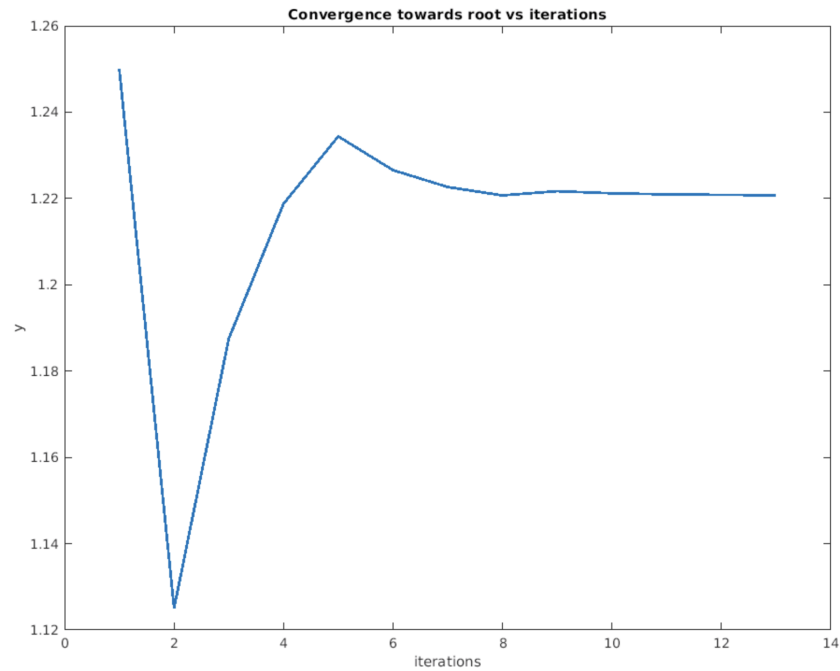
$$y = x^4 - x - 1 \quad (8)$$

Graph:



- So, from the above graph we can observe that there are two real roots of this equation between $(-1,0)$ and $(1,2)$.

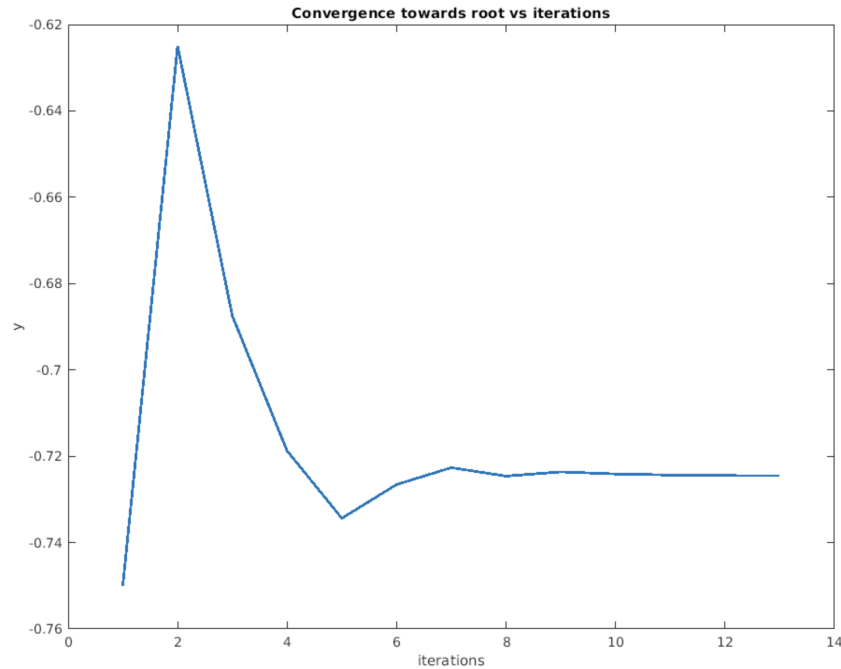
Assumed values : $a = 1$ and $b = 1.5$



- Above shown plot is of convergence of positive root vs iterations.
- Value of first root is 1.2217.
- Root value is obtained in 13 iterations with $\epsilon = 0.0001$.

Count	a	b	c	b-c	f(c)	f(a)*f(b)
1	1	1.5	1.25	0.25	0.19140625	-2.5625
2	1	1.25	1.125	0.125	-0.523193359375	-0.19140625
3	1.125	1.25	1.1875	0.0625	-0.198959350585938	-0.100142478942871
4	1.1875	1.25	1.21875	0.03125	-0.0124807357788086	-0.0380820631980896
5	1.21875	1.25	1.234375	0.015625	0.0872307419776917	-0.00238889083266258
6	1.21875	1.234375	1.2265625	0.0078125	0.0368240512907505	-0.001088703842413
7	1.21875	1.2265625	1.22265625	0.00390625	0.0120347964111716	-0.000459591254465153
8	1.21875	1.22265625	1.220703125	0.001953125	-0.000257075749686919	-0.000150203114159586
9	1.220703125	1.22265625	1.2216796875	0.0009765625	0.00588032016912621	-0.00000309385430973137

Assumed values : $a = -1$ and $b = -0.5$



- Above shown plot is of convergence of negative root vs iterations.
- Value of first root is -0.7245.
- Root value is obtained in 13 iterations with $\epsilon = 0.0001$.

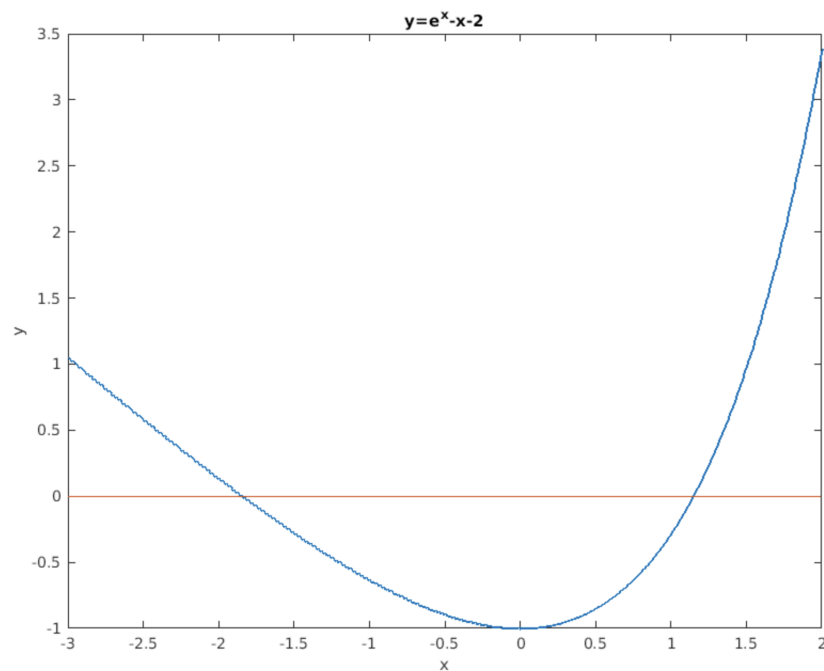
Count	a	b	c	b-c	f(c)	f(a)*f(b)
1	-1	-0.5	-0.75	0.25	0.06640625	-0.4375
2	-0.75	-0.5	-0.625	0.125	-0.222412109375	-0.029052734375
3	-0.75	-0.625	-0.6875	0.0625	-0.0890960693359375	-0.0147695541381836
4	-0.75	-0.6875	-0.71875	0.03125	-0.0143728256225586	-0.0059165358543396
5	-0.75	-0.71875	-0.734375	0.015625	0.0252266526222229	-0.000954445451498032
6	-0.734375	-0.71875	-0.7265625	0.0078125	0.00523358955979347	-0.00036257827918007
7	-0.7265625	-0.71875	-0.72265625	0.00390625	-0.00461743003688753	-0.0000752214701229548
8	-0.7265625	-0.72265625	-0.724609375	0.001953125	0.000296062105917372	-0.0000241657336341313
9	-0.724609375	-0.72265625	-0.7236328125	0.0009765625	-0.00216368028395664	-0.00000136704606064705
10	-0.724609375	-0.7236328125	-0.72412109375	0.00048828125	-0.000934559179711414	-0.000000640583741400099
11	-0.724609375	-0.72412109375	-0.724365234375	0.000244140625	-0.00031943618602881	-0.000000276687558849773
12	-0.724609375	-0.724365234375	-0.7244873046875	0.0001220703125	-0.0000117339681506845	-0.0000000945729499419028
13	-0.724609375	-0.7244873046875	-0.72454833984375	0.00006103515625	0.000142152334882795	-0.00000000347398332145902

2.2 Question 2

2.2.1 Equation:

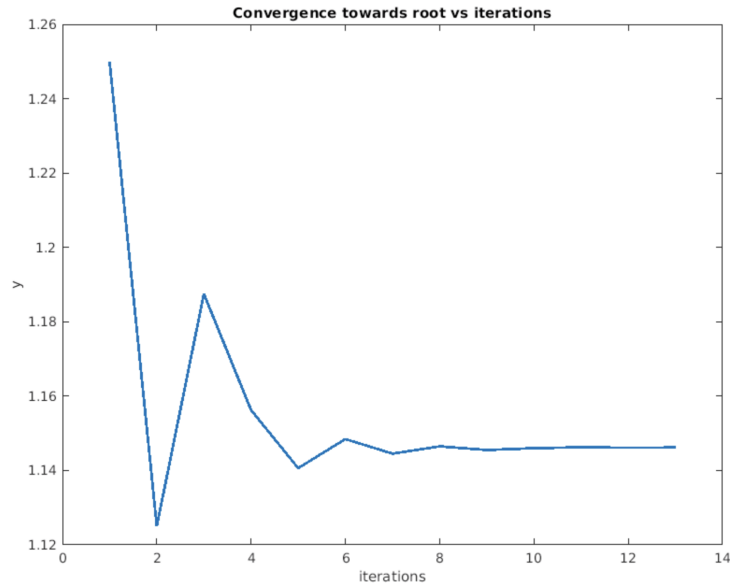
$$y = e^x - x - 2 \quad (9)$$

2.2.2 Graph:



- So, from the above graph we can observe that there are two real roots of this equation between $(-2, -1)$ and $(1, 2)$.

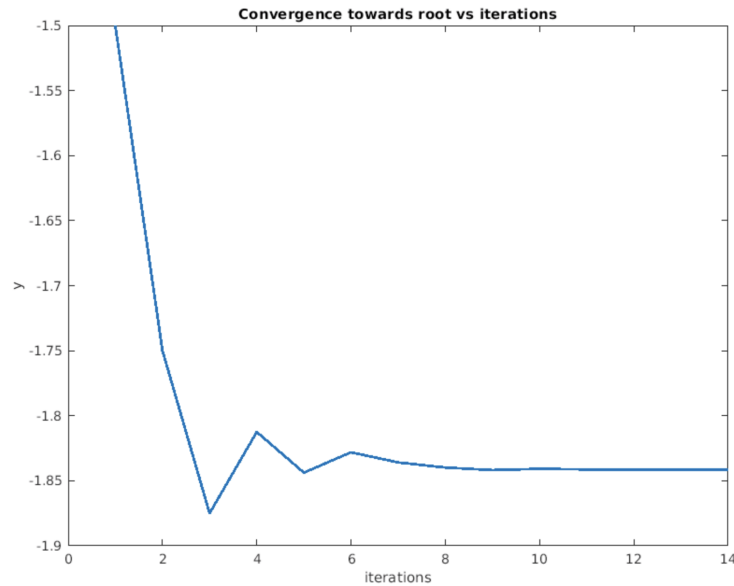
Assumed values : $a = 1$ and $b = 1.5$



- Above shown plot is of convergence of first root vs iterations.
- Value of positive root is 1.4618.
- Root value is obtained in 13 iterations with $\epsilon = 0.0001$.

Count	a	b	c	b-c	f(c)	f(a)*f(b)
1	1	1.5	1.25	0.25	0.240342957461841	-0.276559649917379
2	1	1.25	1.125	0.125	-0.044783151081969	-0.0677089785188954
3	1.125	1.25	1.1875	0.0625	0.0913737679386735	-0.0107633149755009
4	1.125	1.1875	1.15625	0.03125	0.0217434275388384	-0.00409200525452638
5	1.125	1.15625	1.140625	0.015625	-0.0119017937614081	-0.000973739200511644
6	1.140625	1.15625	1.1484375	0.0078125	0.00482458647719053	-0.000258785790233376
7	1.140625	1.1484375	1.14453125	0.00390625	-0.00356256736187044	-0.0000574212332356001
8	1.14453125	1.1484375	1.146484375	0.001953125	0.000625006920975224	-0.0000171879143181605
9	1.14453125	1.146484375	1.1455078125	0.0009765625	-0.00147027941448918	-0.00000222662925760947
10	1.1455078125	1.146484375	1.14599609375	0.00048828125	-0.000423011228297021	-0.00000091893480982314
11	1.14599609375	1.146484375	1.146240234375	0.000244140625	0.000100904078065511	-0.000000264384945335869
12	1.14599609375	1.146240234375	1.1461181640625	0.0001220703125	-0.000161077014322331	-0.0000000426835580026704
13	1.1461181640625	1.146240234375	1.14617919921875	0.00006103515625	-0.0000300923282878784	-0.0000000162533276277399

Assumed values : $a = -1$ and $b = -0.5$



- Above shown plot is of convergence of first root vs iterations.
- Value of negative root is -1.8414.
- Root value is obtained in 14 iterations with $\epsilon = 0.0001$.

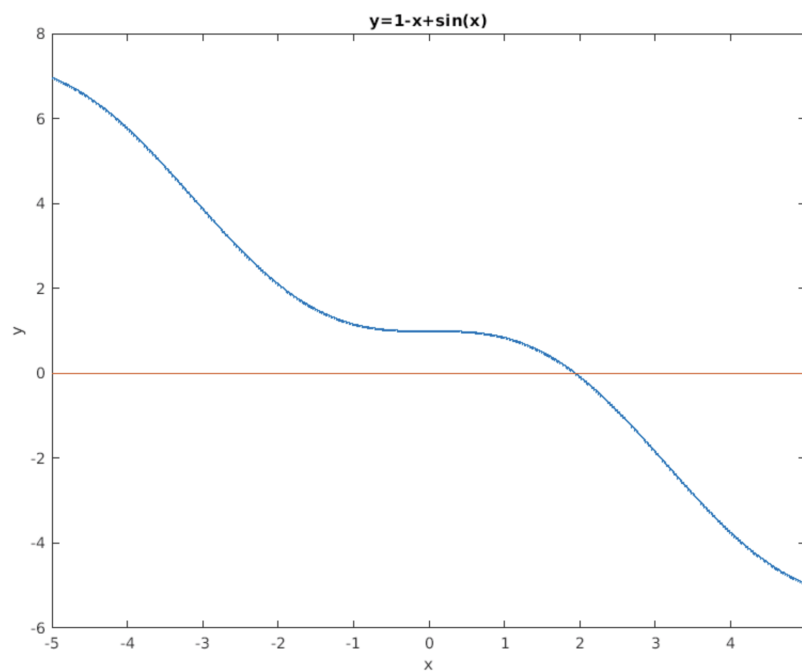
Count	a	b	c	b-c	f(c)	f(a)*f(b)
1	-2	-1	-1.5	0.5	0.27686983985157	-0.0855482148687488
2	-2	-1.5	-1.75	0.25	0.0762260565495549	-0.0374702581959879
3	-2	-1.75	-1.875	0.125	-0.0283549668449283	-0.0103160749531441
4	-1.875	-1.75	-1.8125	0.0625	0.0242544875460415	-0.00216138730618226
5	-1.875	-1.8125	-1.84375	0.03125	-0.00197297604949842	-0.000687735190208735
6	-1.84375	-1.8125	-1.828125	0.015625	0.011160374631956	-0.0000478535230211977
7	-1.84375	-1.828125	-1.8359375	0.0078125	0.00459856576905193	-0.0000220191518522789
8	-1.84375	-1.8359375	-1.83984375	0.00390625	0.00131400673145987	-0.00000907286012438275
9	-1.84375	-1.83984375	-1.841796875	0.001953125	-0.000329182282543528	-0.00000259250381005003
10	-1.841796875	-1.83984375	-1.8408203125	0.0009765625	0.000492487892417515	-0.00000043254773513952
11	-1.841796875	-1.8408203125	-1.84130859375	0.00048828125	0.0000816717126910227	-0.000000162118288551049
12	-1.841796875	-1.84130859375	-1.841552734375	0.000244140625	-0.000123750559141822	-0.00000002688488080287
13	-1.841552734375	-1.84130859375	-1.8414306640625	0.0001220703125	-0.0000210382416350186	-0.0000000101069201115843
14	-1.8414306640625	-1.84130859375	-1.84136962890625	0.00006103515625	0.000030317030943694	-0.00000000171822922633955

2.3 Question 3

2.3.1 Equation:

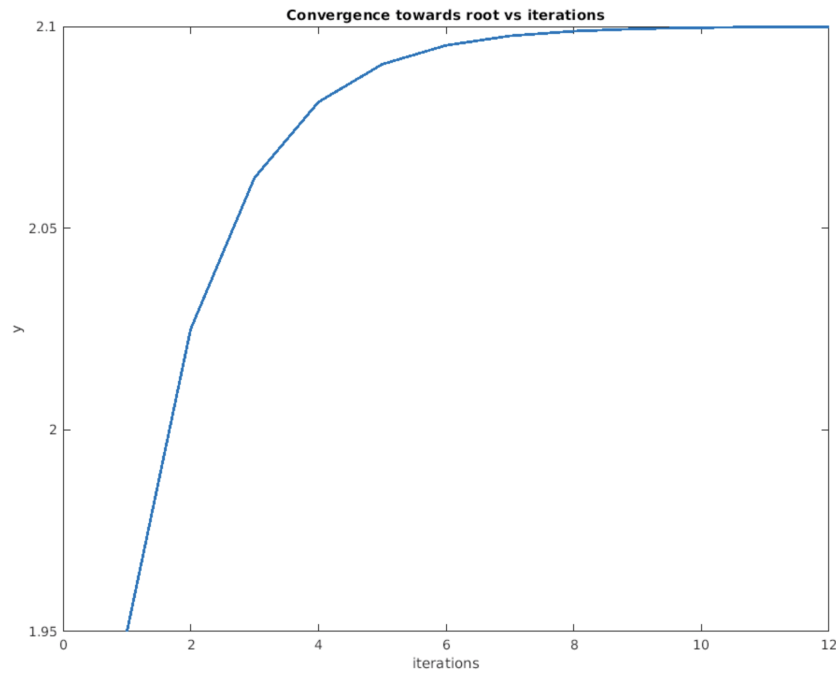
$$y = 1 - x + \sin(x) \quad (10)$$

2.3.2 Graph:



- So, from the above graph we can observe that there is one real root of these equation between 1 and 3.

Assumed values : $a = 1.8$ and $b = 2.1$



- Above shown plot is of convergence of first root vs iterations.
- Value of smallest positive root is 2.0999.
- Root value is obtained in 12 iterations with $\epsilon = 0.0001$.

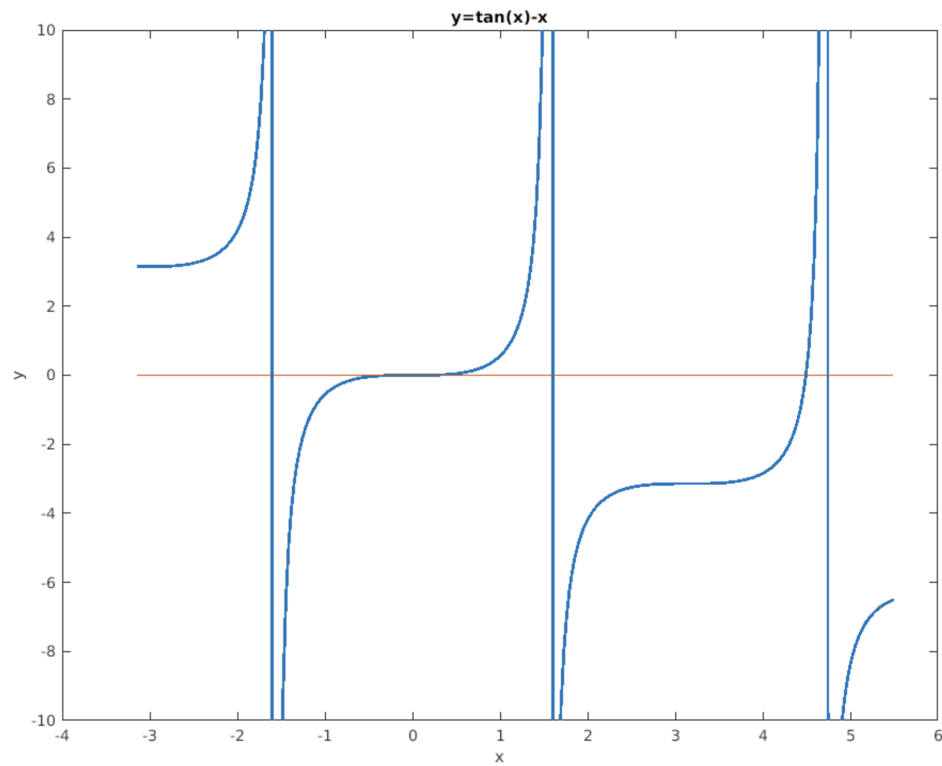
Count	a	b	c	b-c	f(c)	f(a)*f(b)
1	1.8	2.1	1.95	0.15	-0.021040284996131	-0.0411654906222407
2	1.95	2.1	2.025	0.07499999999999997	-0.126389301052571	0.00498214241012206
3	2.025	2.1	2.0625	0.03750000000000001	-0.180970214203622	0.0299278026450446
4	2.0625	2.1	2.08125	0.01875000000000003	-0.208727055096767	0.0428520516389646
5	2.08125	2.1	2.090625	0.009374999999999991	-0.222720704177794	0.0494246115738789
6	2.090625	2.1	2.0953125	0.004687499999999973	-0.229746159386041	0.0527381766026688
7	2.0953125	2.1	2.09765625	0.002343750000000009	-0.233266022251003	0.0544017385910095
8	2.09765625	2.1	2.098828125	0.001171875000000027	-0.235027734676474	0.0552352091481128
9	2.098828125	2.1	2.0994140625	0.000585937499999911	-0.235909035783343	0.0556523661491228
10	2.0994140625	2.1	2.09970703125	0.000292968749999734	-0.236349797515962	0.0558610499963913
11	2.09970703125	2.1	2.099853515625	0.000146484375000089	-0.236570206171519	0.0559654182462152
12	2.099853515625	2.1	2.0999267578125	0.0000732421875002665	-0.236680417445915	0.0560176089513605

2.4 Question 4

2.4.1 Equation:

$$y = \tan(x) - x \quad (11)$$

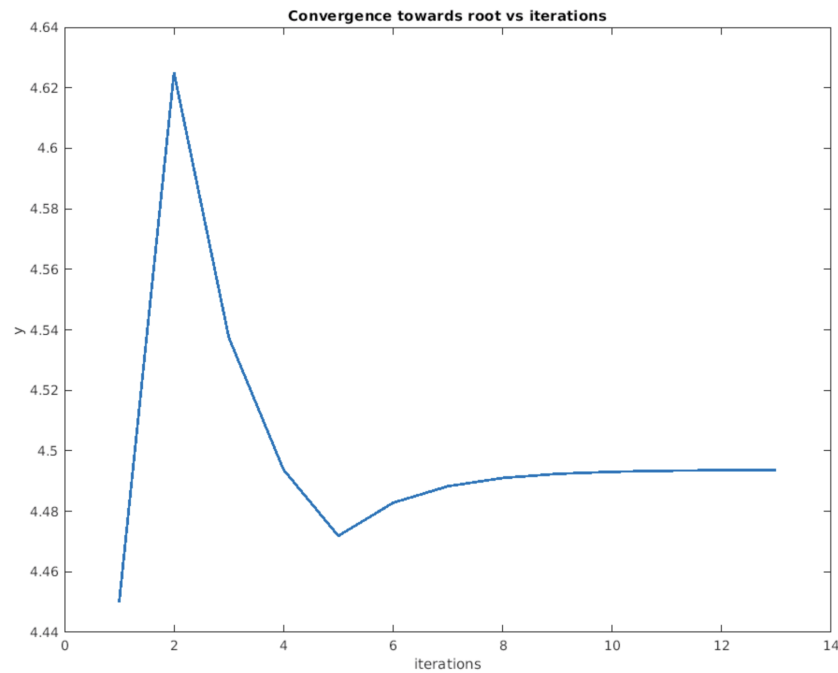
2.4.2 Graph:



- So, from the above graph we can observe that there are infinitely many positive real roots possible for this equation, smallest of which lies between 4 and 5.

2.4.3 Smallest positive real root

Assumed values : $a = 4.1$ and $b = 4.8$

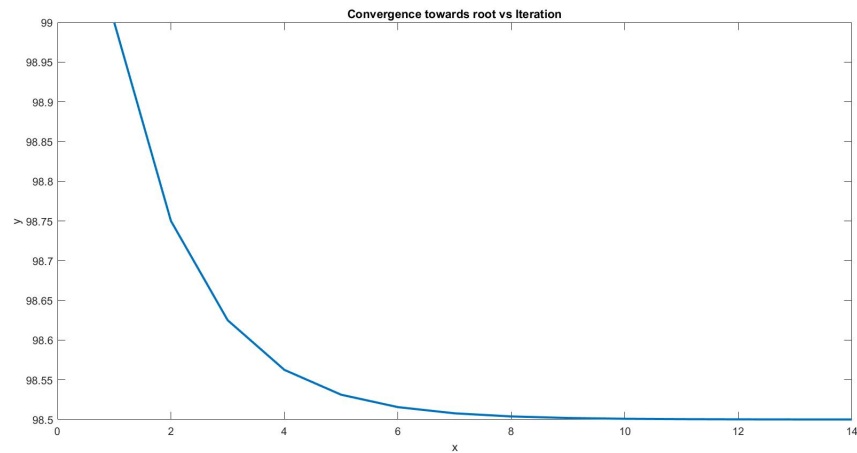


- Above shown plot is of convergence of first root vs iterations.
- Value of smallest positive root is 4.4935.
- Root value is obtained in 12 iterations with $\epsilon = 0.0001$.

Count	a	b	c	b-c	f(c)	f(a)*f(b)
1	4.1	4.8	4.45	0.350000000000001	-0.726731427052054	43.3183776790059
2	4.45	4.8	4.625	0.175	6.78894586984415	11.7620541472109
3	4.45	4.625	4.5375	0.087500000000004	1.12199760099147	-4.93374032017099
4	4.45	4.5375	4.49375	0.043750000000002	0.0068868525229755	-0.81539091771751
5	4.45	4.49375	4.471875	0.0218750000000005	-0.39459475275175	-0.00500489216191902
6	4.471875	4.49375	4.4828125	0.0109374999999998	-0.203761338948013	-0.00271751586854128
7	4.4828125	4.49375	4.48828125	0.00546874999999947	-0.101095458454941	-0.00140327429121899
8	4.48828125	4.49375	4.491015625	0.00273437500000018	-0.047793487859277	-0.000696229513121772
9	4.491015625	4.49375	4.4923828125	0.00136718750000053	-0.0206288267009977	-0.00032914670244546
10	4.4923828125	4.49375	4.49306640625	0.000683593749999822	-0.00691527470999542	-0.000142067687211791
11	4.49306640625	4.49375	4.493408203125	0.000341796874999467	-0.0000253348545173893	-0.0000476244770836006
12	4.493408203125	4.49375	4.4935791015625	0.000170898437500178	0.00342797137655815	-0.000000174477406752299
13	4.493408203125	4.49358	4.49349365234375	0.0000854492187496447	0.00170062221287104	-0.0000000868471561148753

2.4.4 Positive real root near $x = 100$

Assumed values : $a = 98.5$ and $b = 99.5$



- Above shown plot is of convergence of approximate root vs iterations.
- The value of $\tan(x)$ is infinite at 98.96 which is in the range of assumed values hence we can't find the exact root.
- Root value is obtained in 14 iterations with $\epsilon = 0.0001$.

	Count	a	b	c	b-c	f(c)	f(a) * f(b)
0	1	98.5	99.5	99	0.5	-124.093	9761.03
1	2	98.5	99	98.75	0.25	-94.0622	11972.8
2	3	98.5	98.75	98.625	0.125	-95.754	9075.35
3	4	98.5	98.625	98.5625	0.0625	-96.1818	9238.58
4	5	98.5	98.5625	98.5312	0.03125	-96.3446	9279.86
5	6	98.5	98.5312	98.5156	0.015625	-96.4163	9295.56
6	7	98.5	98.5156	98.5078	0.0078125	-96.45	9302.48
7	8	98.5	98.5078	98.5039	0.00390625	-96.4664	9305.74
8	9	98.5	98.5039	98.502	0.00195312	-96.4745	9307.32
9	10	98.5	98.502	98.501	0.000976562	-96.4785	9308.1
10	11	98.5	98.501	98.5005	0.000488281	-96.4805	9308.49
11	12	98.5	98.5005	98.5002	0.000244141	-96.4815	9308.68
12	13	98.5	98.5002	98.5001	0.00012207	-96.482	9308.77
13	14	98.5	98.5001	98.5001	6.10352e-05	-96.4822	9308.82