Project Presentation 1

ME 609 – Optimisation Methods in Engineering

Bracketing Method: ***Bounding Phase Method***

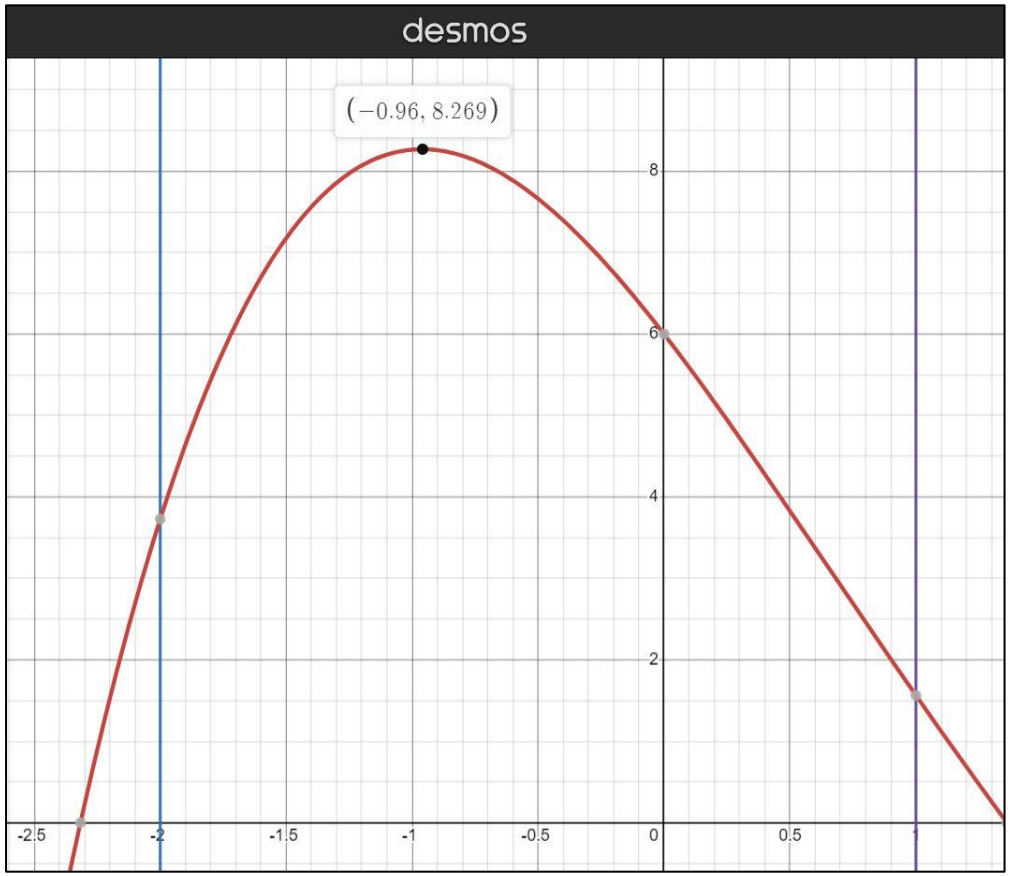
Accurate Method: ***Golden Section Search Method***

Group No : 7

Nirmal S. [234103107]
Rohith Kumar Saragadam [234103109]

Function: $8 + x^3 - 2x - 2e^x$ in the interval $(-2, 1)$

Plotting the graph on Desmos (online graphing tool) to get an idea of the function we are dealing with.

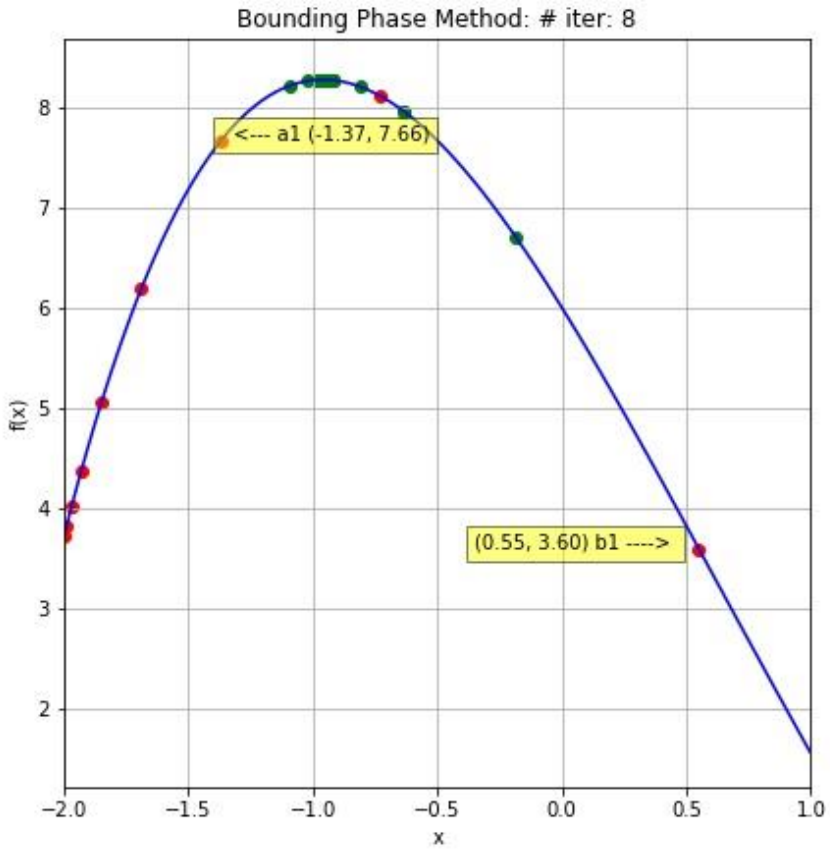


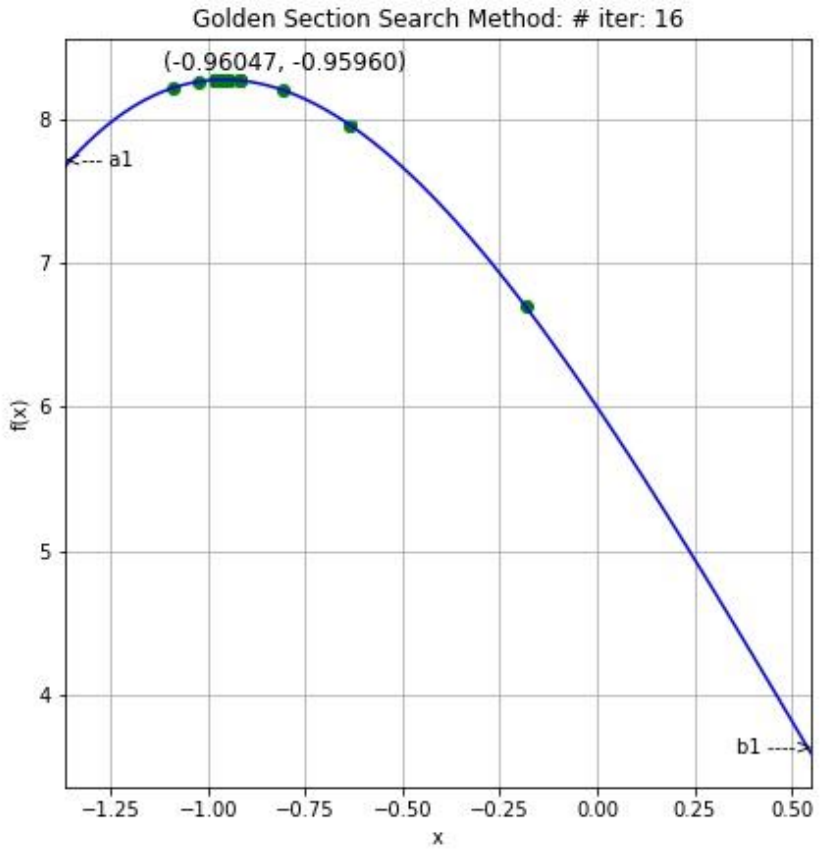
Function: $8 + x^3 - 2x - 2e^x$ in the interval $(-2, 1)$

The bracketing achieved by providing the following inputs:

$(a, b) = (-2, 1)$ $x(0) = -2$ (initial guess)

$delta = 0.01$ $\epsilon = 10^{-3}$

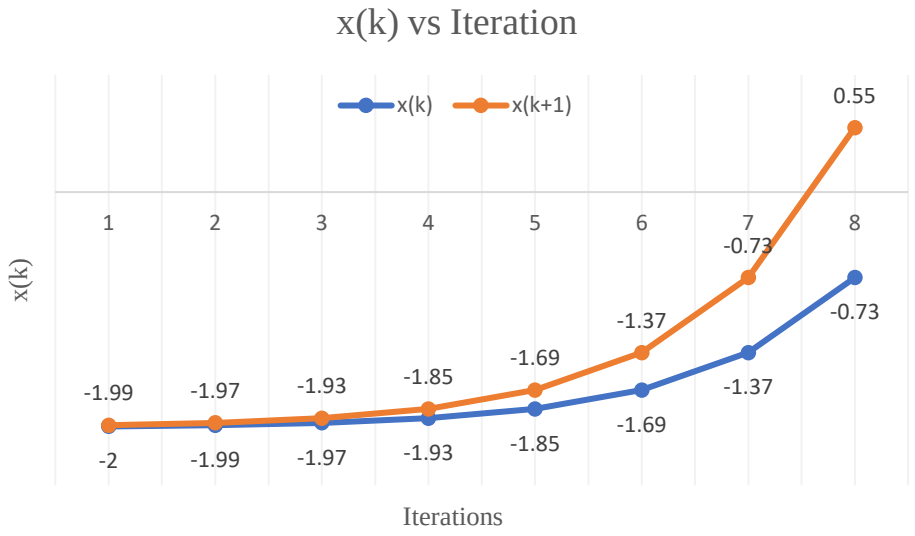


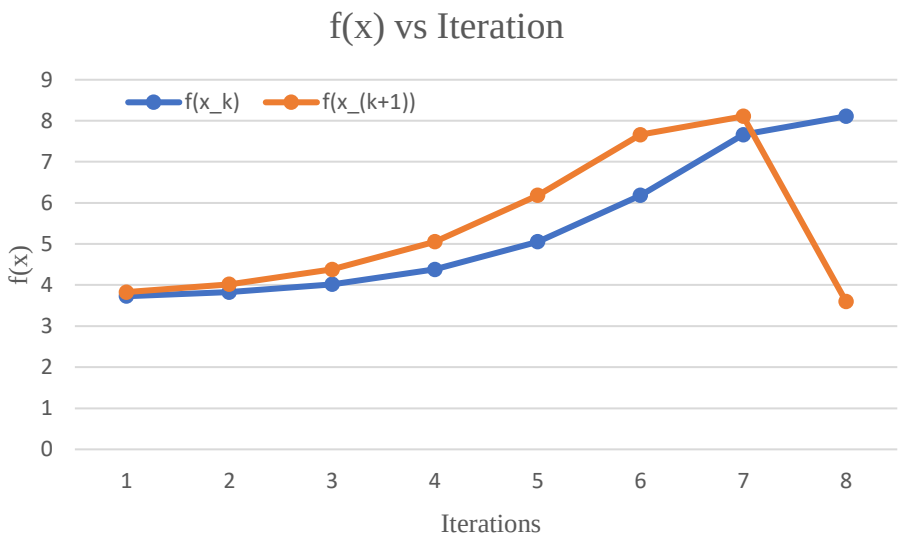


Function: $8 + x^3 - 2x - 2e^x$ in the interval $(-2, 1)$

Bounding Phase Method Iterations:

k	iter	x_k	x_(k+1)	f(x_k)	f(x_(k+1))	Continue/ Terminate
0	1	-2	-1.99	3.729329	3.82601	Continue
1	2	-1.99	-1.97	3.82601	4.015713	Continue
2	3	-1.97	-1.93	4.015713	4.380647	Continue
3	4	-1.93	-1.85	4.380647	5.053901	Continue
4	5	-1.85	-1.69	5.053901	6.184152	Continue
5	6	-1.69	-1.37	6.184152	7.660433	Continue
6	7	-1.37	-0.73	7.660433	8.107165	Continue
7	8	-0.73	0.55	8.107165	3.599869	Terminate

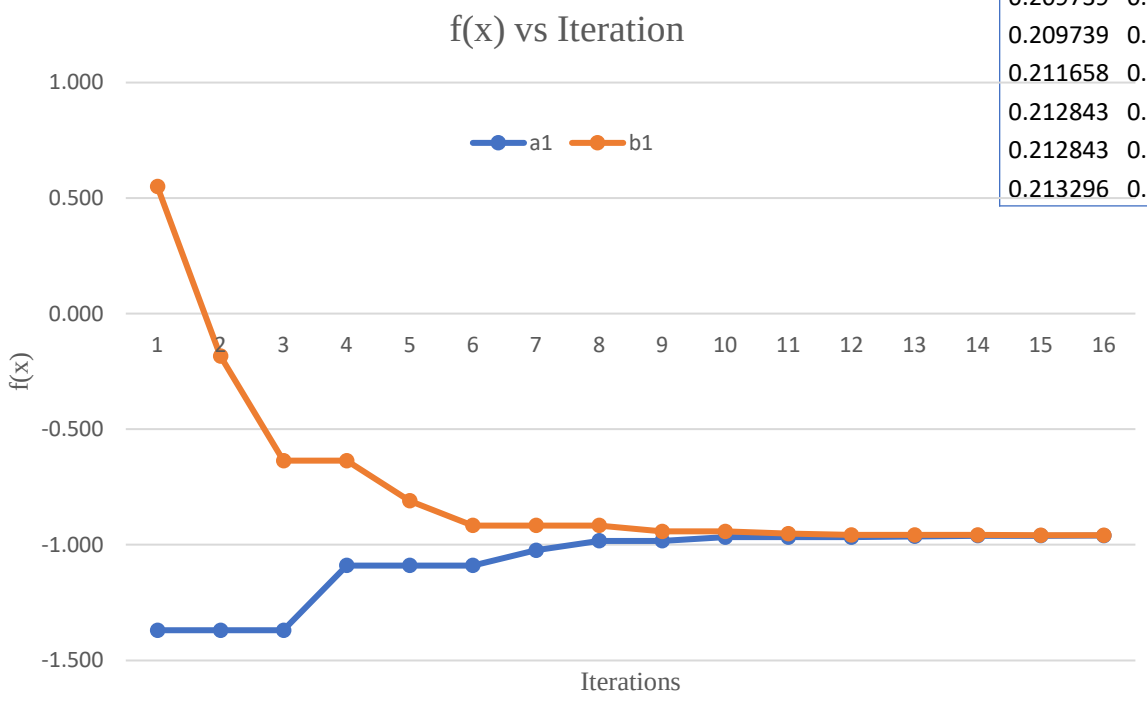




Function: $8 + x^3 - 2x - 2e^x$ in the interval $(-2, 1)$

Golden Section Search Method

aw	bw	lw	w1	w2	f(w1)	f(w2)	Continue/ Terminate	Iter	a1	b1
0	1	1	0.618	0.382	6.695904	7.956962	Continue	**1**	**-1.370**	**0.550**
0	0.618	0.618	0.381924	0.236076	7.95723	8.263398	Continue	**2**	**-1.370**	**-0.183**
0	0.381924	0.381924	0.236029	0.145895	8.263423	8.212644	Continue	**3**	**-1.370**	**-0.637**
0.145895	0.381924	0.236029	0.291761	0.236058	8.198676	8.263408	Continue	**4**	**-1.090**	**-0.637**
0.145895	0.291761	0.145866	0.23604	0.201616	8.263417	8.26778	Continue	**5**	**-1.090**	**-0.810**
0.145895	0.23604	0.090145	0.201605	0.18033	8.267776	8.256047	Continue	**6**	**-1.090**	**-0.917**
0.18033	0.23604	0.05571	0.214759	0.201612	8.269458	8.267778	Continue	**7**	**-1.024**	**-0.917**
0.201612	0.23604	0.034429	0.222888	0.214763	8.268415	8.269458	Continue	**8**	**-0.983**	**-0.917**
0.201612	0.222888	0.021277	0.214761	0.209739	8.269458	8.269311	Continue	**9**	**-0.983**	**-0.942**
0.209739	0.222888	0.013149	0.217865	0.214762	8.269246	8.269458	Continue	**10**	**-0.967**	**-0.942**
0.209739	0.217865	0.008126	0.214761	0.212843	8.269458	8.269474	Continue	**11**	**-0.967**	**-0.952**
0.209739	0.214761	0.005022	0.212843	0.211658	8.269474	8.269439	Continue	**12**	**-0.967**	**-0.958**
0.211658	0.214761	0.003104	0.213576	0.212843	8.269478	8.269474	Continue	**13**	**-0.964**	**-0.958**
0.212843	0.214761	0.001918	0.214029	0.213576	8.269474	8.269478	Continue	**14**	**-0.961**	**-0.958**
0.212843	0.214029	0.001185	0.213576	0.213296	8.269478	8.269478	Continue	**15**	**-0.961**	**-0.959**
0.213296	0.214029	0.000733	0.213749	0.213576	8.269477	8.269478	Terminate	**16**	**-0.960**	**-0.959**



Function: $8 + x^3 - 2x - 2e^x$ in the interval $(-2, 1)$

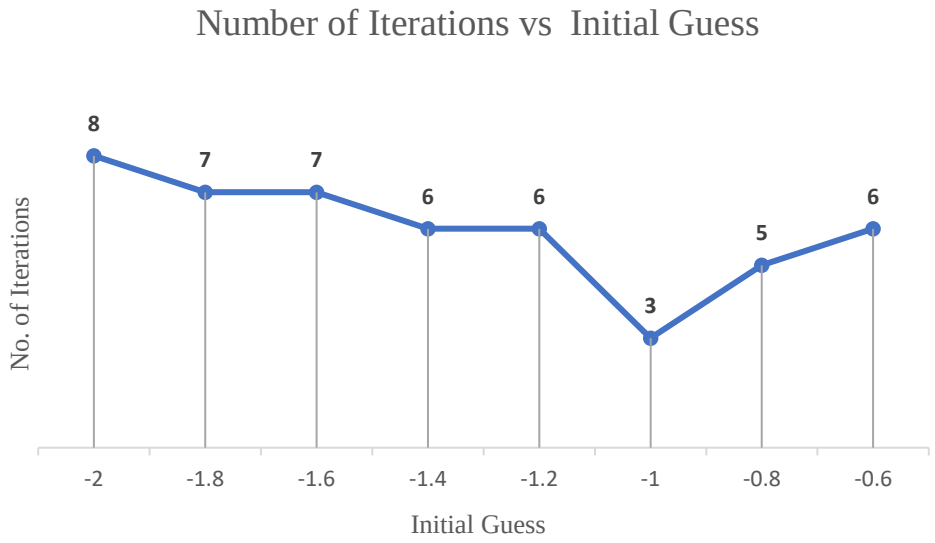
Extracting data by running the program for iterations changing *x(0)*, *epsilon* and *delta*

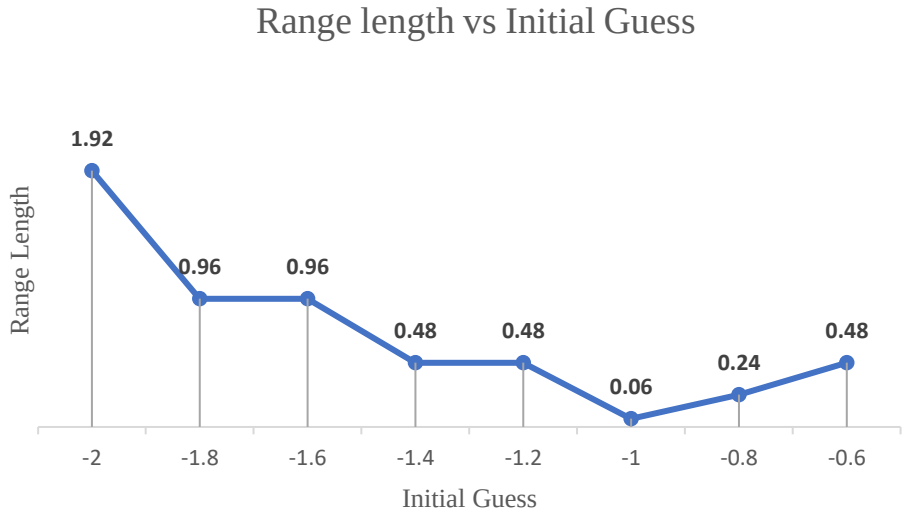
a	b	l	x(0)	delta	Bounding Iterations	a1	b1	l1	epsilon	Golden Section Iterations	final_a	final_b	final_l
-2	1	3	-2	0.01	8	-1.37	0.55	1.92	0.001	16	-0.96047	-0.9596	0.000869
-2	1	3	-1.8	0.01	7	-1.49	-0.53	0.96	0.001	16	-0.96026	-0.95982	0.000435
-2	1	3	-1.6	0.01	7	-1.29	-0.33	0.96	0.001	16	-0.96024	-0.9598	0.000435
-2	1	3	-1.4	0.01	6	-1.25	-0.77	0.48	0.001	16	-0.96022	-0.96	0.000217
-2	1	3	-1.2	0.01	6	-1.05	-0.57	0.48	0.001	16	-0.96025	-0.96003	0.000217
-2	1	3	-1	0.01	3	-0.99	-0.93	0.06	0.001	16	-0.96017	-0.96014	0.0000272
-2	1	3	-0.8	0.01	5	-0.87	-1.11	0.24	0.001	16	-0.96011	-0.96022	0.00011
-2	1	3	-0.6	0.01	6	-0.75	-1.23	0.48	0.001	16	-0.96001	-0.96022	0.00022
-2	1	3	-1.4	0.01	6	-1.25	-0.77	0.48	0.0001	21	-0.96016	-0.96014	1.96E-05
-2	**1**	**3**	**-1.4**	**0.01**	**6**	**-1.25**	**-0.77**	**0.48**	**0.00001**	**25**	**-0.96015**	**-0.96015**	**2.86E-06**
-2	1	3	-1.4	0.01	6	-1.25	-0.77	0.48	0.01	11	-0.96114	-0.95873	0.002411
-2	1	3	-1.6	0.1	4	-1.3	-0.1	1.2	0.001	16	-0.96051	-0.95996	0.000543
-2	1	3	-1.6	0.05	5	-1.25	-0.05	1.2	0.001	16	-0.96038	-0.95984	0.000543
-2	1	3	-1.6	0.005	8	-1.285	-0.325	0.96	0.001	16	-0.96033	-0.9599	0.000435
-2	1	3	-1.6	0.001	10	-1.345	-0.577	0.768	0.001	16	-0.96036	-0.96001	0.000348

Function: $8 + x^3 - 2x - 2e^x$ in the interval $(-2, 1)$

Changing ***initial guess*** $x(0)$ for Bounding Phase Method

a	b	l	x(0)	delta	Bounding Iterations	a1	b1	l1
-2	1	3	**-2**	0.01	**8**	-1.37	0.55	**1.92**
-2	1	3	**-1.8**	0.01	**7**	-1.49	-0.53	**0.96**
-2	1	3	**-1.6**	0.01	**7**	-1.29	-0.33	**0.96**
-2	1	3	**-1.4**	0.01	**6**	-1.25	-0.77	**0.48**
-2	1	3	**-1.2**	0.01	**6**	-1.05	-0.57	**0.48**
-2	1	3	**-1**	0.01	**3**	-0.99	-0.93	**0.06**
-2	1	3	**-0.8**	0.01	**5**	-0.87	-1.11	**0.24**
-2	1	3	**-0.6**	0.01	**6**	-0.75	-1.23	**0.48**

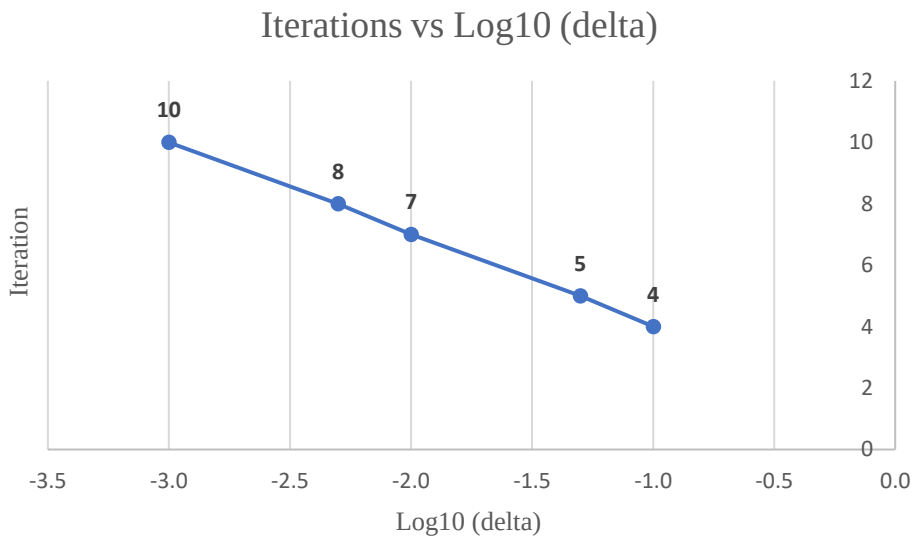


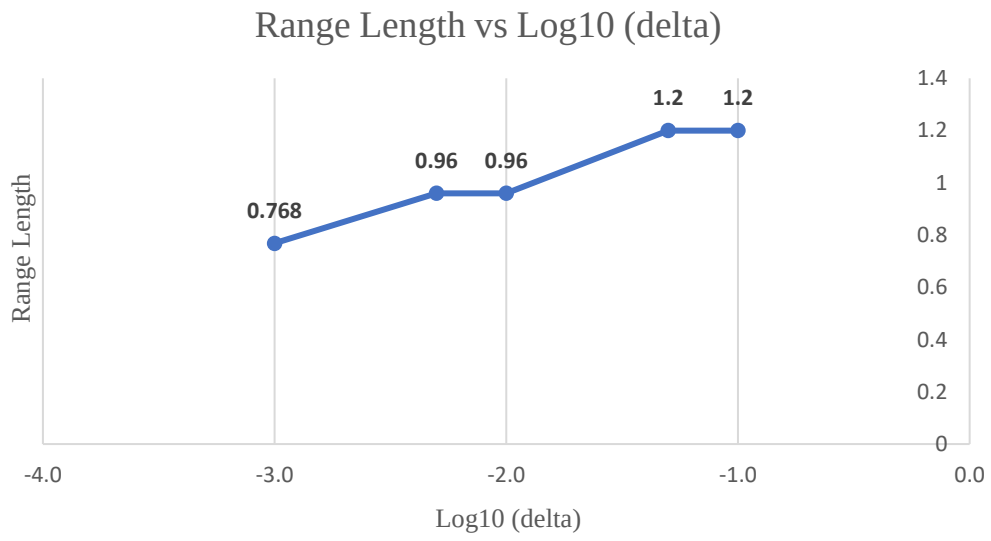


Function: $8 + x^3 - 2x - 2e^x$ in the interval $(-2, 1)$

Changing ***delta*** for Bounding Phase Method

a	b	l	x(0)	delta	Log Delta	Bounding Iterations	a1	b1	l1
-2	1	3	-1.6	0.1	**-1.0**	**4**	-1.3	-0.1	**1.2**
-2	1	3	-1.6	0.05	**-1.3**	**5**	-1.25	-0.05	**1.2**
-2	1	3	-1.6	0.01	**-2.0**	**7**	-1.29	-0.33	**0.96**
-2	1	3	-1.6	0.005	**-2.3**	**8**	-1.285	-0.325	**0.96**
-2	1	3	-1.6	0.001	**-3.0**	**10**	-1.345	-0.577	**0.768**

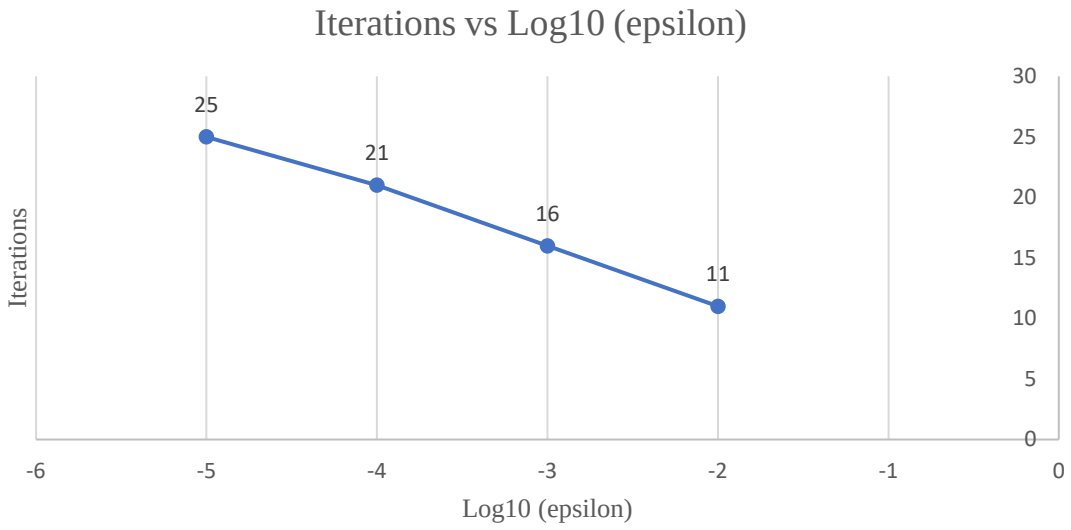


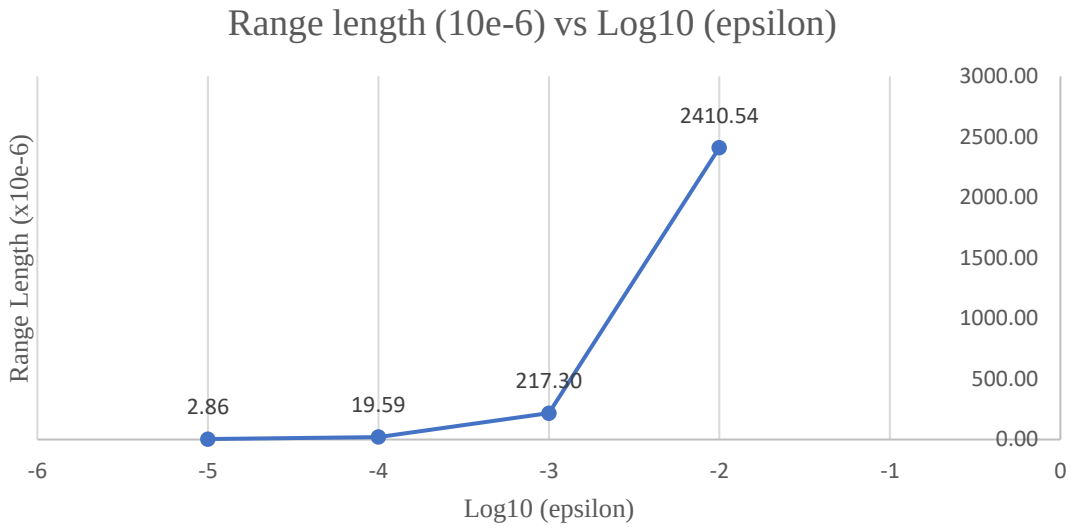


Function: $8 + x^3 - 2x - 2e^x$ in the interval $(-2, 1)$

Changing ***epsilon*** for
Golden Section Search Method

a1	b1	l1	epsilon	Log(epsilon)	Golden Section Iterations	final_a	final_b	final_l	Final L
-1.25	-0.77	0.48	0.01000	**-2**	**11**	-0.96114	-0.95873	0.002411	**2410.54**
-1.25	-0.77	0.48	0.00100	**-3**	**16**	-0.96022	-0.96	0.000217	**217.30**
-1.25	-0.77	0.48	0.00010	**-4**	**21**	-0.96016	-0.96014	0.000020	**19.59**
-1.25	-0.77	0.48	0.00001	**-5**	**25**	-0.96015	-0.96015	0.000003	**2.86**





Results and Observation

Bounding Phase Method	Golden Section Search Method
As the *initial guess* $x^{(0)}$ approaches the solution point, the *number of iterations* and reduces to a minimum. With the *reduction in delta*, the *final range decreases*, but the *number of iteration increases.*	The *number of iterations* only depend upon the value of *epsilon.*