

1a)

initial guess = some \pm

tol = some \pm

n = 0

while $E_n > tol$

$$\left\{ \begin{array}{l} t_{n+1} = t_n - \frac{f(t_n)}{f'(t_n)} \\ n = n + 1 \end{array} \right.$$

$$t_0 = 2.2, 2.3, 2.4 \quad tol = 10^{-8}$$

$t_0 = 2.2$ converges to zero with 538 iter.

$t_0 = 2.3$ converges to zero with 540 iter.

$t_0 = 2.4$ converges to 2.5 with 5 iter.

iteration (n)	t_n	f(t)	t_n+1 - t_n
0	2.2	-3.8087760280739045	-1.720350208122199
1	0.4796497918778011	-0.17557604024986012	-0.35088529526559986
2	0.12876449661220124	-0.01630464232083959	-0.0654924417121676
3	0.06327205490003364	-0.003987315445886372	-0.0317638702451786
4	0.03150818465485504	-0.0009917799535951435	-0.015769768751627382
5	0.015738415903227658	-0.0002476363784427203	-0.007871158263712843
6	0.007867257639514815	-6.188991189159556e-05	-0.003933872321933267
7	0.003933385317581548	-1.5471280688016014e-05	-0.001966723087614171
8	0.001966662229967377	-3.8677453672006665e-06	-0.000983334918307087
9	0.0009833273116602898	-9.669316668982455e-07	-0.0004916641312368355
10	0.0004916631804234543	-2.4173262454941386e-07	-0.0002458316496372906
11	0.00024583153078616373	-6.043313787650393e-08	-0.00012291577282126873
12	0.000122915757964895	-1.5108283327824418e-08	-6.14578799109706e-05
13	6.14578780539244e-05	-3.777070760624779e-09	-3.072893914302758e-05
14	3.072893891089682e-05	-9.44267685697987e-10	-1.536446946995658e-05
15	1.536446944094024e-05	-2.360669211458589e-10	-7.682234722283641e-06
16	7.682234718656599e-06	-5.901673026904986e-11	-3.84111735955499e-06
17	3.841117359101609e-06	-1.475418256617403e-11	-1.9205586795791406e-06
18	1.920558679522468e-06	-3.688545641475481e-12	-9.602793397647762e-07
19	9.60279339757692e-07	-9.221364103646184e-13	-4.801396698792887e-07
20	4.801396698784033e-07	-2.3053410259088894e-13	-2.40069834939257e-07
21	2.4006983493914634e-07	-5.763352564770565e-14	-1.200349174695801e-07
22	1.2003491746956623e-07	-1.4408381411925368e-14	-6.001745873478398e-08
23	6.001745873478226e-08	-3.602095352981278e-15	-3.000872936739124e-08
24	3.0008729367391016e-08	-9.005238382453152e-16	-1.500436468369552e-08
25	1.5004364683695495e-08	-2.2513095956132855e-16	-7.502182341847749e-09
26	7.502182341847746e-09	-5.628273989033212e-17	-3.751091170923874e-09
27	3.751091170923872e-09	-1.4070684972583025e-17	-1.875545585461936e-09
28	1.875545585461936e-09	-3.517671243145756e-18	-9.37772792730968e-10
29	9.37772792730968e-10	-8.79417810786439e-19	-4.68886396365484e-10
30	4.68886396365484e-10	-2.1985445269660977e-19	-2.34443198182742e-10
31	2.34443198182742e-10	-5.496361317415244e-20	-1.17221599091371e-10
32	1.17221599091371e-10	-1.374090329353811e-20	-5.86107995456855e-11
33	5.86107995456855e-11	-3.4352258233845276e-21	-2.930539977284275e-11
34	2.930539977284275e-11	-8.588064558461319e-22	-1.4652699886421375e-11
35	1.4652699886421375e-11	-2.1470161396153297e-22	-7.326349943210687e-12
36	7.326349943210687e-12	-5.367540349038324e-23	-3.663174971605344e-12
37	3.663174971605344e-12	-1.341885087259581e-23	-1.831587485802672e-12
38	1.831587485802672e-12	-3.354712718148953e-24	-9.15793742901336e-13
39	9.15793742901336e-13	-8.386781795372382e-25	-4.57896871450668e-13
40	4.57896871450668e-13	-2.0966954488430955e-25	-2.28948435725334e-13
41	2.28948435725334e-13	-5.241738622107739e-26	-1.14474217862667e-13
42	1.14474217862667e-13	-1.3104346555269347e-26	-5.72371089313335e-14
43	5.72371089313335e-14	-3.276086638817337e-27	-2.861855446566675e-14
44	2.861855446566675e-14	-8.190216597043342e-28	-1.4309277232833374e-14
45	1.4309277232833374e-14	-2.0475541492608354e-28	-7.154638616416687e-15

46	7.154638616416687e-15	-5.118885373152089e-29	-3.5773193082083435e-15
47	3.5773193082083435e-15	-1.279721343288022e-29	-1.7886596541041717e-15
48	1.7886596541041717e-15	-3.199303358220055e-30	-8.943298270520859e-16
49	8.943298270520859e-16	-7.998258395550138e-31	-4.471649135260429e-16
50	4.471649135260429e-16	-1.9995645988875346e-31	-2.2358245676302147e-16
51	2.2358245676302147e-16	-4.998911497218836e-32	-1.1179122838151073e-16
52	1.1179122838151073e-16	-1.249727874304709e-32	-5.589561419075537e-17
53	5.589561419075537e-17	-3.124319685761773e-33	-2.7947807095377684e-17
54	2.7947807095377684e-17	-7.810799214404432e-34	-1.3973903547688842e-17
55	1.3973903547688842e-17	-1.952699803601108e-34	-6.986951773844421e-18
56	6.986951773844421e-18	-4.88174950900277e-35	-3.4934758869222104e-18
57	3.4934758869222104e-18	-1.2204373772506925e-35	-1.7467379434611052e-18
58	1.7467379434611052e-18	-3.051093443126731e-36	-8.733689717305526e-19
59	8.733689717305526e-19	-7.627733607816828e-37	-4.366844858652763e-19
60	4.366844858652763e-19	-1.906933401954207e-37	-2.1834224293263815e-19
61	2.1834224293263815e-19	-4.767333504885518e-38	-1.0917112146631908e-19
62	1.0917112146631908e-19	-1.1918333762213794e-38	-5.458556073315954e-20
63	5.458556073315954e-20	-2.9795834405534485e-39	-2.729278036657977e-20
64	2.729278036657977e-20	-7.448958601383621e-40	-1.3646390183289885e-20
65	1.3646390183289885e-20	-1.8622396503459053e-40	-6.823195091644942e-21
66	6.823195091644942e-21	-4.655599125864763e-41	-3.411597545822471e-21
67	3.411597545822471e-21	-1.1638997814661908e-41	-1.7057987729112356e-21
68	1.7057987729112356e-21	-2.909749453665477e-42	-8.528993864556178e-22
69	8.528993864556178e-22	-7.274373634163693e-43	-4.264496932278089e-22
70	4.264496932278089e-22	-1.818593408540923e-43	-2.1322484661390445e-22
71	2.1322484661390445e-22	-4.546483521352308e-44	-1.0661242330695222e-22
72	1.0661242330695222e-22	-1.136620880338077e-44	-5.330621165347611e-23
73	5.330621165347611e-23	-2.8415522008451924e-45	-2.6653105826738056e-23
74	2.6653105826738056e-23	-7.103880502112981e-46	-1.3326552913369028e-23
75	1.3326552913369028e-23	-1.7759701255282452e-46	-6.663276456684514e-24
76	6.663276456684514e-24	-4.439925313820613e-47	-3.331638228342257e-24
77	3.331638228342257e-24	-1.1099813284551533e-47	-1.6658191141711285e-24
78	1.6658191141711285e-24	-2.774953321137883e-48	-8.329095570855642e-25
79	8.329095570855642e-25	-6.937383302844708e-49	-4.164547785427821e-25
80	4.164547785427821e-25	-1.734345825711177e-49	-2.0822738927139106e-25
81	2.0822738927139106e-25	-4.3358645642779425e-50	-1.0411369463569553e-25
82	1.0411369463569553e-25	-1.0839661410694856e-50	-5.205684731784777e-26
83	5.205684731784777e-26	-2.709915352673714e-51	-2.602842365892388e-26
84	2.602842365892388e-26	-6.774788381684285e-52	-1.301421182946194e-26
85	1.301421182946194e-26	-1.6936970954210713e-52	-6.50710591473097e-27
86	6.50710591473097e-27	-4.234242738552678e-53	-3.253552957365485e-27
87	3.253552957365485e-27	-1.0585606846381696e-53	-1.6267764786827427e-27
88	1.6267764786827427e-27	-2.646401711595424e-54	-8.133882393413713e-28
89	8.133882393413713e-28	-6.61600427898856e-55	-4.066941196706857e-28
90	4.066941196706857e-28	-1.65400106974714e-55	-2.0334705983534283e-28
91	2.0334705983534283e-28	-4.13500267436785e-56	-1.0167352991767142e-28
92	1.0167352991767142e-28	-1.0337506685919625e-56	-5.083676495883571e-29

93	5.083676495883571e-29	-2.584376671479906e-57	-2.5418382479417854e-29
94	2.5418382479417854e-29	-6.460941678699765e-58	-1.2709191239708927e-29
95	1.2709191239708927e-29	-1.6152354196749413e-58	-6.354595619854464e-30
96	6.354595619854464e-30	-4.038088549187353e-59	-3.177297809927232e-30
97	3.177297809927232e-30	-1.0095221372968383e-59	-1.588648904963616e-30
98	1.588648904963616e-30	-2.523805343242096e-60	-7.94324452481808e-31
99	7.94324452481808e-31	-6.30951335810524e-61	-3.97162226240904e-31
100	3.97162226240904e-31	-1.57737833952631e-61	-1.98581113120452e-31
101	1.98581113120452e-31	-3.943445848815775e-62	-9.9290556560226e-32
102	9.9290556560226e-32	-9.858614622039437e-63	-4.9645278280113e-32
103	4.9645278280113e-32	-2.464653655509859e-63	-2.48226391400565e-32
104	2.48226391400565e-32	-6.161634138774648e-64	-1.241131957002825e-32
105	1.241131957002825e-32	-1.540408534693662e-64	-6.205659785014125e-33
106	6.205659785014125e-33	-3.851021336734155e-65	-3.102829892507062e-33
107	3.102829892507062e-33	-9.627553341835388e-66	-1.551414946253531e-33
108	1.551414946253531e-33	-2.406888335458847e-66	-7.757074731267656e-34
109	7.757074731267656e-34	-6.017220838647117e-67	-3.878537365633828e-34
110	3.878537365633828e-34	-1.5043052096617793e-67	-1.939268682816914e-34
111	1.939268682816914e-34	-3.760763024154448e-68	-9.69634341408457e-35
112	9.69634341408457e-35	-9.40190756038612e-69	-4.848171707042285e-35
113	4.848171707042285e-35	-2.35047689009653e-69	-2.4240858535211424e-35
114	2.4240858535211424e-35	-5.876192225241325e-70	-1.2120429267605712e-35
115	1.2120429267605712e-35	-1.4690480563103314e-70	-6.060214633802856e-36
116	6.060214633802856e-36	-3.672620140775828e-71	-3.030107316901428e-36
117	3.030107316901428e-36	-9.18155035193957e-72	-1.515053658450714e-36
118	1.515053658450714e-36	-2.2953875879848927e-72	-7.57526829225357e-37
119	7.57526829225357e-37	-5.738468969962232e-73	-3.787634146126785e-37
120	3.787634146126785e-37	-1.434617242490558e-73	-1.8938170730633925e-37
121	1.8938170730633925e-37	-3.586543106226395e-74	-9.469085365316962e-38
122	9.469085365316962e-38	-8.966357765565987e-75	-4.734542682658481e-38
123	4.734542682658481e-38	-2.241589441391497e-75	-2.3672713413292406e-38
124	2.3672713413292406e-38	-5.603973603478742e-76	-1.1836356706646203e-38
125	1.1836356706646203e-38	-1.4009934008696855e-76	-5.918178353323102e-39
126	5.918178353323102e-39	-3.502483502174214e-77	-2.959089176661551e-39
127	2.959089176661551e-39	-8.756208755435534e-78	-1.4795445883307754e-39
128	1.4795445883307754e-39	-2.1890521888588836e-78	-7.397722941653877e-40
129	7.397722941653877e-40	-5.472630472147209e-79	-3.6988614708269385e-40
130	3.6988614708269385e-40	-1.3681576180368023e-79	-1.8494307354134692e-40
131	1.8494307354134692e-40	-3.420394045092006e-80	-9.247153677067346e-41
132	9.247153677067346e-41	-8.550985112730014e-81	-4.623576838533673e-41
133	4.623576838533673e-41	-2.1377462781825035e-81	-2.3117884192668365e-41
134	2.3117884192668365e-41	-5.344365695456259e-82	-1.1558942096334183e-41
135	1.1558942096334183e-41	-1.3360914238640647e-82	-5.779471048167091e-42
136	5.779471048167091e-42	-3.340228559660162e-83	-2.8897355240835457e-42
137	2.8897355240835457e-42	-8.350571399150404e-84	-1.4448677620417728e-42
138	1.4448677620417728e-42	-2.087642849787601e-84	-7.224338810208864e-43
139	7.224338810208864e-43	-5.219107124469003e-85	-3.612169405104432e-43

140	3.612169405104432e-43	-1.3047767811172507e-85	-1.806084702552216e-43
141	1.806084702552216e-43	-3.261941952793127e-86	-9.03042351276108e-44
142	9.03042351276108e-44	-8.154854881982817e-87	-4.51521175638054e-44
143	4.51521175638054e-44	-2.038713720495704e-87	-2.25760587819027e-44
144	2.25760587819027e-44	-5.09678430123926e-88	-1.128802939095135e-44
145	1.128802939095135e-44	-1.274196075309815e-88	-5.644014695475675e-45
146	5.644014695475675e-45	-3.185490188274538e-89	-2.8220073477378376e-45
147	2.8220073477378376e-45	-7.963725470686345e-90	-1.4110036738689188e-45
148	1.4110036738689188e-45	-1.990931367671586e-90	-7.055018369344594e-46
149	7.055018369344594e-46	-4.977328419178965e-91	-3.527509184672297e-46
150	3.527509184672297e-46	-1.2443321047947413e-91	-1.7637545923361485e-46
151	1.7637545923361485e-46	-3.110830261986853e-92	-8.818772961680742e-47
152	8.818772961680742e-47	-7.777075654967133e-93	-4.409386480840371e-47
153	4.409386480840371e-47	-1.9442689137417833e-93	-2.2046932404201856e-47
154	2.2046932404201856e-47	-4.860672284354458e-94	-1.1023466202100928e-47
155	1.1023466202100928e-47	-1.2151680710886146e-94	-5.511733101050464e-48
156	5.511733101050464e-48	-3.0379201777215365e-95	-2.755866550525232e-48
157	2.755866550525232e-48	-7.594800444303841e-96	-1.377933275262616e-48
158	1.377933275262616e-48	-1.8987001110759603e-96	-6.88966637631308e-49
159	6.88966637631308e-49	-4.746750277689901e-97	-3.44483318815654e-49
160	3.44483318815654e-49	-1.1866875694224752e-97	-1.72241659407827e-49
161	1.72241659407827e-49	-2.966718923556188e-98	-8.61208297039135e-50
162	8.61208297039135e-50	-7.41679730889047e-99	-4.306041485195675e-50
163	4.306041485195675e-50	-1.8541993272226175e-99	-2.1530207425978375e-50
164	2.1530207425978375e-50	-4.635498318056544e-100	-1.0765103712989188e-50
165	1.0765103712989188e-50	-1.158874579514136e-100	-5.382551856494594e-51
166	5.382551856494594e-51	-2.89718644878534e-101	-2.691275928247297e-51
167	2.691275928247297e-51	-7.24296612196335e-102	-1.3456379641236484e-51
168	1.3456379641236484e-51	-1.8107415304908374e-102	-6.728189820618242e-52
169	6.728189820618242e-52	-4.526853826227093e-103	-3.364094910309121e-52
170	3.364094910309121e-52	-1.1317134565567734e-103	-1.6820474551545606e-52
171	1.6820474551545606e-52	-2.8292836413919334e-104	-8.410237275772803e-53
172	8.410237275772803e-53	-7.073209103479833e-105	-4.205118637886401e-53
173	4.205118637886401e-53	-1.7683022758699584e-105	-2.1025593189432007e-53
174	2.1025593189432007e-53	-4.420755689674896e-106	-1.0512796594716003e-53
175	1.0512796594716003e-53	-1.105188922418724e-106	-5.256398297358002e-54
176	5.256398297358002e-54	-2.76297230604681e-107	-2.628199148679001e-54
177	2.628199148679001e-54	-6.907430765117025e-108	-1.3140995743395004e-54
178	1.3140995743395004e-54	-1.7268576912792562e-108	-6.570497871697502e-55
179	6.570497871697502e-55	-4.317144228198141e-109	-3.285248935848751e-55
180	3.285248935848751e-55	-1.0792860570495351e-109	-1.6426244679243755e-55
181	1.6426244679243755e-55	-2.698215142623838e-110	-8.213122339621878e-56
182	8.213122339621878e-56	-6.745537856559595e-111	-4.106561169810939e-56
183	4.106561169810939e-56	-1.6863844641398987e-111	-2.0532805849054694e-56
184	2.0532805849054694e-56	-4.215961160349747e-112	-1.0266402924527347e-56
185	1.0266402924527347e-56	-1.0539902900874367e-112	-5.133201462263674e-57
186	5.133201462263674e-57	-2.6349757252185916e-113	-2.566600731131837e-57

187	2.566600731131837e-57	-6.587439313046479e-114	-1.2833003655659184e-57
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536	-1.6847248183480765e-161	-2.8e-322	8.357964905082983e-162
537	-8.489283278397782e-162	-7.4e-323	4.3649059906370593e-162
538	-4.1243772877607224e-162	-1.5e-323	1.7968736055285565e-162
539	-2.327503682232166e-162	-5e-324	1.0613638328756981e-162
540	-1.2661398493564678e-162	0.0	0.0
541	-1.2661398493564678e-162	0.0	

0.5
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0.5
0.500001
0.499999
0.499988
0.500032
0.500232
0.500151
0.496103
0.514167
0.435671
0.45601
0

iteration (n)	t_n	f(t)	t_n+1-t_n	eps
0	2.4	-2.3782953636364557	0.13673559200984675	0.056973
1	2.5367355920098467	0.8220987161758242	-0.029334899218623534	0.011564
2	2.507400692791223	0.02047633955669373	-0.0007717377242539847	0.000308
3	2.506628955066969	1.802201620675752e-05	-6.804354368838972e-07	2.71E-07
4	2.5066282746315323	1.4085324346507245e-11	-5.32018873400375e-13	2.12E-13
5	2.5066282746310002	-5.986418372261646e-15		

1b)

initial guesses

$$a = 3.2$$

$$b = 3.8$$

$$\text{tol} = 10^{-8}$$

$n=0$
While $\epsilon_n > 0$

$$\left\{ \begin{array}{l} c = b - f(a) * f(b) / (f(b) - f(a)) \\ \therefore f(c) f(b) > 0 \end{array} \right.$$

$$\left. \begin{array}{l} \\ \} b = c \end{array} \right.$$

else

$$\left. \begin{array}{l} a = c \\ n = n + 1 \end{array} \right.$$

$$c = 3.54$$

$$n = 8$$

iteration (n)	t_n	t_n+1	f(n)	eps_n	Initial interval
0	3.2	3.8	-6.725591522	0.1875	3.2-3.8
1	3.8	3.406369685	12.82841858	0.103586925	
2	3.406369685	3.565491201	-8.704481116	0.046712932	
3	3.565491201	3.53938828	1.708125013	0.007320989	
4	3.53938828	3.544837003	-4.51E-01	0.001539453	
5	3.544837003	3.544906865	-5.80E-03	1.97E-05	
6	3.544906865	3.544907692	-6.87E-05	2.33E-07	
7	3.544907692	3.544907702	-8.12E-07	2.76E-09	
8	3.544907702		-9.60908E-09		

2)

$$a_0 = \text{some } \#$$

$$a_1 = \text{some } \#$$

$$\epsilon_{\text{tol}} = 10^{-6}$$

$$n=0$$

while $\epsilon_n > 0$

$$\left| \begin{array}{l} a_{n+1} = a_n - (f(a_n) + f'(a_n)) / (a_{n+1} - a_n) \\ n = n+1 \end{array} \right.$$

root1

1.875

root2

4.69

root3

7.85

iteration (n)	a_n	a_n+1	f(a)	a_n+1 - a_n	interval
0	0.1	2	1.999983333	1.9	.1-2
1	2	1.581117381	-0.565625835	-0.418882619	
2	1.581117381	1.846097084	1.999983333	0.264979703	
3	1.846097084	1.882453695	-0.565625835	0.036356611	
4	1.882453695	1.874945907	0.973856569	-0.007507788	
5	1.874945907	1.875103218	0.117497038	0.000157312	
6	1.875103218	1.875104069	-0.030578125	8.50E-07	
	1.875104069		0.00065442		

iteration (n)	a_n	a_n+1	f(a)	a_n+1 - a_n	interval
0	3	4.8	-8.966909834	1.8	3-4.8
1	4.8	4.056084055	6.316379052	-0.743915945	
2	4.056084055	4.595170375	-8.966909834	0.53908632	
3	4.595170375	4.813370669	6.316379052	0.218200294	
4	4.813370669	4.682285321	-16.62393093	-0.131085348	
5	4.682285321	4.692756671	-4.789925709	0.01047135	
6	4.692756671	4.694107323	7.207593025	1.35E-03	
7	4.694107323	4.694091111	-0.625741879	-1.62116E-05	
8	4.694091111	4.694091133	-0.071490351	2.20227E-08	
9	4.694091133		0.000868508		

iteration (n)	a_n	a_n+1	f(a)	a_n+1 - a_n
0	7	8	414.3774489	1
1	8	7.657489196	-215.8647684	-0.342510804
2	7.657489196	7.82540077	414.3774489	0.167911574
3	7.82540077	7.861542914	-215.8647684	0.036142144
4	7.861542914	7.854555381	207.5965224	-0.006987534
5	7.854555381	7.854756074	36.76964842	0.000200694
6	7.854756074	7.854757439	-8.812642506	1.36E-06
7	7.854757439		0.260598719	

3a)

$$x_0 = -1$$

$$\text{tol} = 10^{-6}$$

{Newton's Method}

3b)

$$x_0 = -1$$

$$\text{tol} = 10^{-6}$$

$n=1$
while $\epsilon_n > \text{tol}$

$$x_{n+1} = x_n - \frac{f'(x_n)}{[f'(x_n)]^2 - f'(x_n)f''(x_n)}$$

$$n = n+1$$

Iteration	x_n	x_n+1	x_n+1 - x_n	f(x)
0	-1	-0.59762	0.402376229	-0.17357
1	-0.59762	-0.31592	0.281699298	-0.05956
2	-0.31592	-0.1994	0.116525903	-0.00422
3	-0.1994	-0.18351	0.015884323	-1.07E-05
4	-0.18351	-0.18326	0.000257719	-4.56E-11
5	-0.18326	-0.18326	-3.36E-08	-5.55E-17
6	-0.18326			-1.67E-16

```

# Matthew Pahayo
# 2/11/2021
# computational methods
# hw 1
# question 3
# Mod. newtons method

import numpy
# create variable
import sympy as sym
x = sym.Symbol('x')

# define function, initial guess, and tol
f = sym.exp(6*x)+3*sym.ln(2)**2*sym.exp(2*x)-sym.exp(4*x)*sym.ln(8)-sym.ln(2)**3
t_0 = -1
tol = 10**-5

# lambdify funtion and its derivative
fp = sym.diff(f)
fpp = sym.diff(fp)
f = sym.lambdify(x, f)
fp = sym.lambdify(x, fp)
fpp = sym.lambdify(x, fpp)

# # get next iteration for t and declare lists
t_1 = t_0 - f(t_0)*fp(t_0)/((fp(t_0))**2-f(t_0)*fpp(t_0))
tl = [t_0, t_1]
fl = []
dtl = []

# newtons method
n = 0
while (abs(tl[n+1]-tl[n])/abs(tl[n])) > tol:
    t_np1 = tl[n+1] -
    f(tl[n+1])*fp(tl[n+1])/((fp(tl[n+1]))**2-f(tl[n+1])*fpp(tl[n+1]))
    tl.append(t_np1)
    n += 1

# define fl and dtl
for j in range(len(tl)):
    fl.append(f(tl[j]))
for k in range(len(tl)-1):
    dtl.append(tl[k+1]-tl[k])

data_fl = open("flm.txt", "a")
data_tl = open("tlm.txt", "a")
for i in range(len(tl)):
    data_tl.write(str(tl[i]) + "\n")
    data_fl.write(str(fl[i]) + "\n")
data_tl.close()

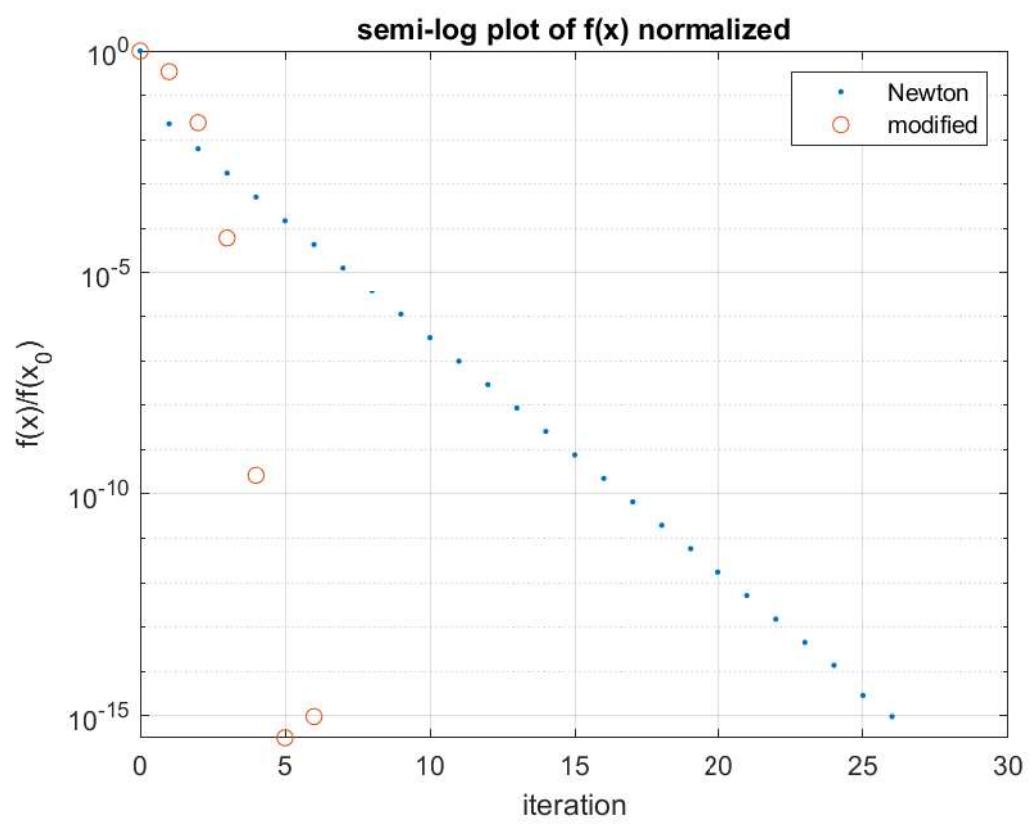
```

```
data_fl.close()

i = 0
data_dtl = open("dtlm.txt", "a")
for i in range(len(dtl)):
    data_dtl.write(str(dtl[i]) + "\n")
data_dtl.close()

print("t = " + str(t_np1))
print("total iterations = " + str(n))
print("final delta t = " + str(dtl[n-1]))

# keeps python console up; for non-IDE use
i = 1
while i == 1:
    i = input("Press enter to continue.\n")
```



$$4) C_p = 9.67 + 1.67 \times 10^{-4} T - 9.688 \times 10^{-7} T^2 \\ + 1.452 \times 10^{-10} T^3$$

$$C_p = 1.2$$

$$\Rightarrow g(T) = \frac{12 - 9.67 \times 10^{-4} T}{\left[9.67 \times 10^{-4} T - 9.688 \times 10^{-7} T^2 + 1.452 \times 10^{-10} T^3 \right]}$$

$$\epsilon_0 = 10^{-5}$$

$\epsilon_{n+1} > 0$
while $\epsilon_n > 0$

| $T_{n+1} = g(T_n)$
 $n = n+1$

iteration	T_n	T_n+1	eps_n	T_n+1 - T_n
0	500	1060.673162	1.121346324	560.6731621
1	1060.673162	1109.238752	0.045787516	48.56558975
2	1109.238752	1121.499972	0.011053725	12.2612199
3	1121.499972	1124.783198	0.002927532	3.283226585
4	1124.783198	1125.675149	0.000792998	0.891951168
5	1125.675149	1125.918397	0.000216091	0.243247986
6	1125.918397	1125.984804	5.90E-05	0.066406365
7	1125.984804	1126.002938	1.61E-05	0.018133993
8	1126.002938	1126.00789	4.39816E-06	0.004952344
9	1126.00789			-1126.00789

iteration	T_n	T_n+1	eps_n	T_n+1 - T_n
0	2000	1533.222171	0.233388915	-466.7778291
1	1533.222171	1277.617812	0.166710581	-255.6043594
2	1277.617812	1173.118071	0.081792645	-104.4997403
3	1173.118071	1139.429205	0.02871737	-33.68886569
4	1139.429205	1129.719711	0.008521367	-9.709494318
5	1129.719711	1127.026405	0.002384048	-2.693306553
6	1127.026405	1126.287663	0.000655479	-0.73874162
7	1126.287663	1126.085669	0.000179345	-0.201993553
8	1126.085669	1126.030486	4.90E-05	-0.055183385
9	1126.030486	1126.015414	1.34E-05	-0.015072206
10	1126.015414	1126.011297	-3.65572E-06	-0.004116398
11	1126.011297			-1126.011297

```

# Matthew Pahayo
# 1/28/2021
# computational methods
# hw 1
# question 1
# newtons method
# q1_nm.py

# create variable
import sympy as sym
x = sym.Symbol('x')

# define function, initial guess, and tol
f = 2*sym.sin(x**2)-3*sym.sin(x**2)+x**2*sym.sin(x**2)
t_0 = 2.2
tol = 10**-8

# lambdify funtion and its derivative
fp = sym.diff(f)
f = sym.lambdify(x, f)
fp = sym.lambdify(x, fp)

# get next iteration for t and declare lists
t_1 = t_0 - f(t_0)/fp(t_0)
tl = [t_0, t_1]
fl = []
dtl = []

# newtons method
n = 0
while (abs(tl[n+1]-tl[n])/abs(tl[n])) > tol:
    t_np1 = tl[n+1] - f(tl[n+1])/fp(tl[n+1])
    tl.append(t_np1)
    n += 1

# define fl and dtl
for j in range(len(tl)):
    fl.append(f(tl[j]))
for k in range(len(tl)-1):
    dtl.append(tl[k+1]-tl[k])

data_fl = open("fl.txt", "a")
data_tl = open("tl.txt", "a")
for i in range(len(tl)):
    data_tl.write(str(tl[i]) + "\n")
    data_fl.write(str(fl[i]) + "\n")
data_tl.close()
data_fl.close()

i = 0

```

```
data_dtl = open("dtl.txt", "a")
for i in range(len(dtl)):
    data_dtl.write(str(dtl[i]) + "\n")
data_dtl.close()

print("t = " + str(t_np1))
print("total iterations = " + str(n))
print("final delta t = " + str(dtl[n-1]))

# keeps python console up; for non-IDE use
i = 1
while i == 1:
    i = input("Press enter to continue.\n")
```

```

# Matthew Pahayo
# 2/11/2021
# computational methods
# hw 1
# question 1
# false position
# q1_fp.py

import numpy as nu

def f(x):
    f = 2*nu.sin(x**2)-3*nu.sin(x**2)+x**2*nu.sin(x**2)
    return f

a = 3.2
b = 3.8
tol = .00000001
cl = [a, b]
fl = [f(a), f(b)]
eps = []

i = 0
while abs(cl[i+1] - cl[i])/abs(cl[i]) >= tol:
    c = b-f(b)*(b-a)/(f(b)-f(a))
    eps.append(abs(cl[i+1] - cl[i])/abs(cl[i]))
    if f(c)*f(b) > 0:
        b = c
    if f(c)*f(b) < 0:
        a = c
    cl.append(c)
    fl.append(f(c))
    i += 1

eps.append(abs(cl[i+1] - cl[i])/abs(cl[i]))

i=0
data_fl = open("fl.txt", "a")
data_cl = open("cl.txt", "a")
for i in range(len(cl)):
    data_cl.write(str(cl[i]) + "\n")
for g in range(len(fl)):
    data_fl.write(str(fl[g]) + "\n")
data_cl.close()
data_fl.close()

i = 0
data_eps = open("eps.txt", "a")
for i in range(len(eps)):
    data_eps.write(str(eps[i]) + "\n")
data_eps.close()

```

```
print(c)
n = 1
while n == 1:
    n = input("Press enter to continue.")
```

```

# Matthew Pahayo
# 2/11/2021
# computational methods
# hw 1
# question 2
# secant method
# q2.py

import numpy as np

def f(x):
    return np.cosh(x)*np.cos(x)+1

# define tol, guess a_0 and a_1
# a_0 != 0, because of stopping criteria
tol = 10**-6
a_0 = 7
a_1 = 8

# declare lists
al = [a_0, a_1]
fl = [f(a_0), f(a_1)]
dal = []

# secant method
# evaluates function at a_n
n = 0
while (abs(al[n+1]-al[n])/abs(al[n])) > tol:
    a_np1 = al[n+1] - f(al[n+1])/(f(al[n+1])-f(al[n]))*((al[n+1])-al[n])
    al.append(a_np1)
    fl.append(f(al[n]))
    n += 1

# defines dal list
for k in range(len(al)-1):
    dal.append(al[k+1]-al[k])

i=0
data_fl = open("fl.txt", "a")
data_al = open("al.txt", "a")
for i in range(len(al)):
    data_al.write(str(al[i]) + "\n")
    data_fl.write(str(fl[i]) + "\n")
data_al.close()
data_fl.close()

i = 0
data_dal = open("dal.txt", "a")
for i in range(len(dal)):
    data_dal.write(str(dal[i]) + "\n")

```

```
data_dal.close()

print("a = " + str(a_np1))
print("total iterations = " + str(n))
print("final delta a = " + str(dal[n-1]))
```