Tugas 2 Komputasi Numerik
Kelompok B - 17

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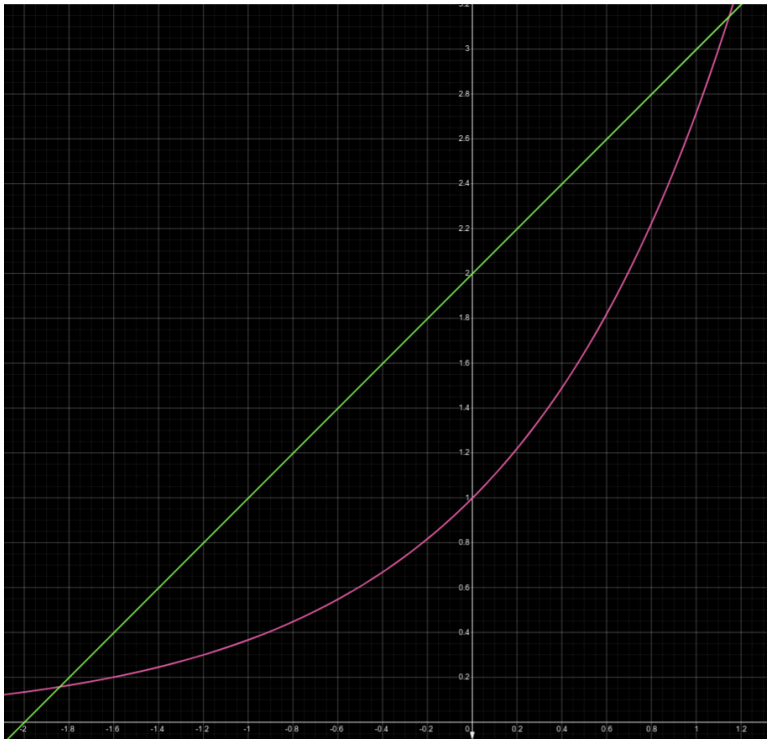
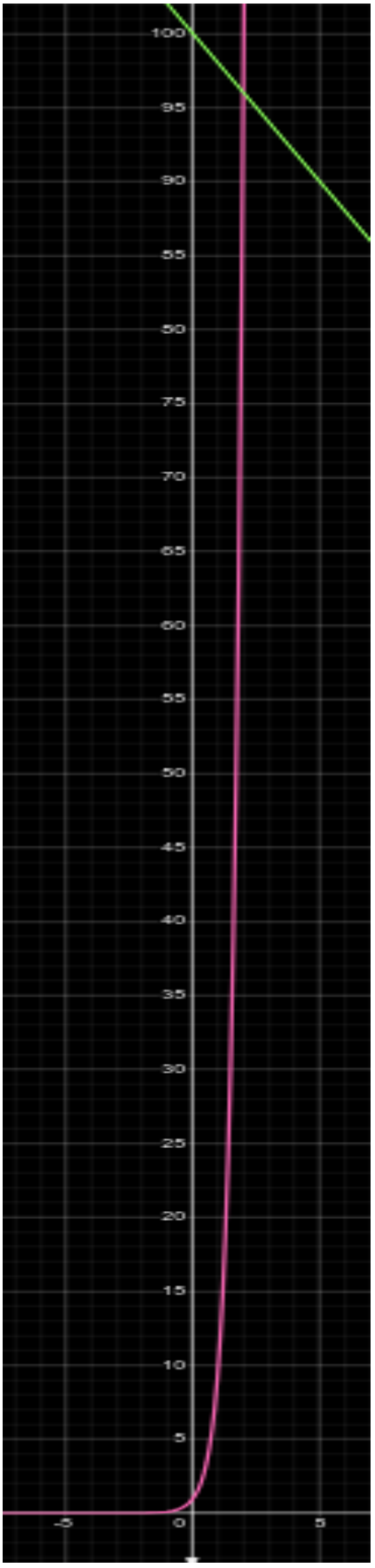
1. Metode Grafik
    a. $e^x - x - 2 = 0$
    $e^x = x + 2$
    $y = e^x$ dan $y = x + 2$

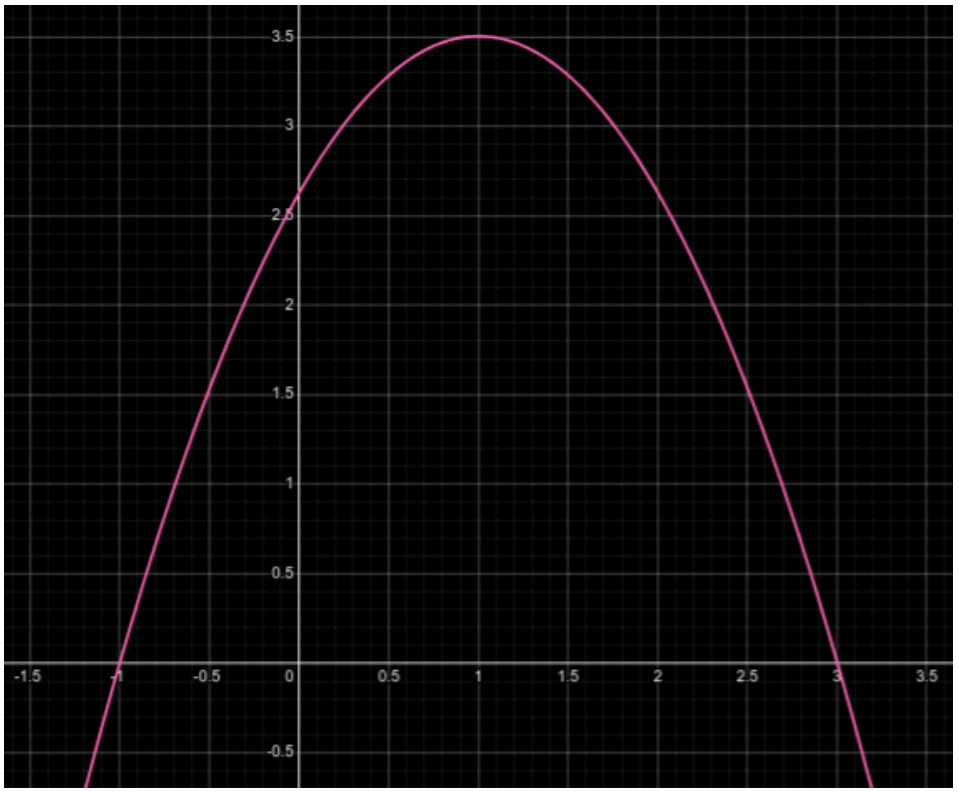


b. $10^x = 100 - 2x$

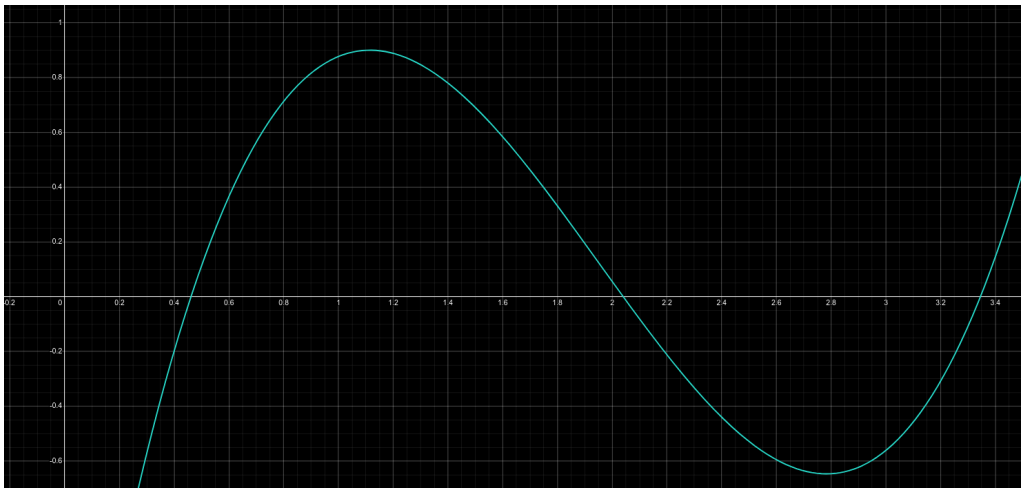
$y = 10^x$ dan $y = 100 - 2x$



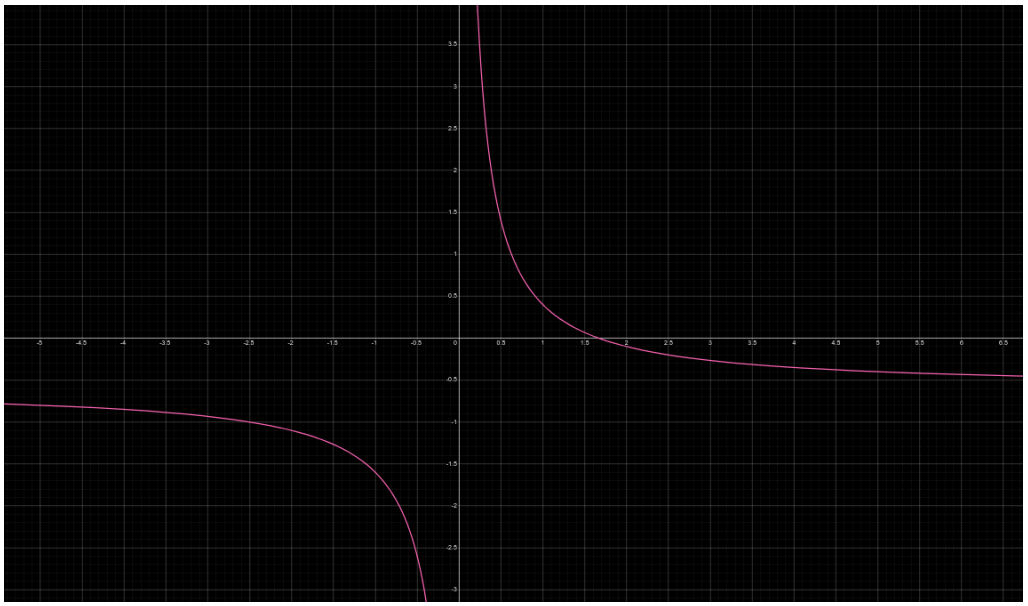
c. $-0{,}874x^2 + 1{,}75x + 2{,}627$



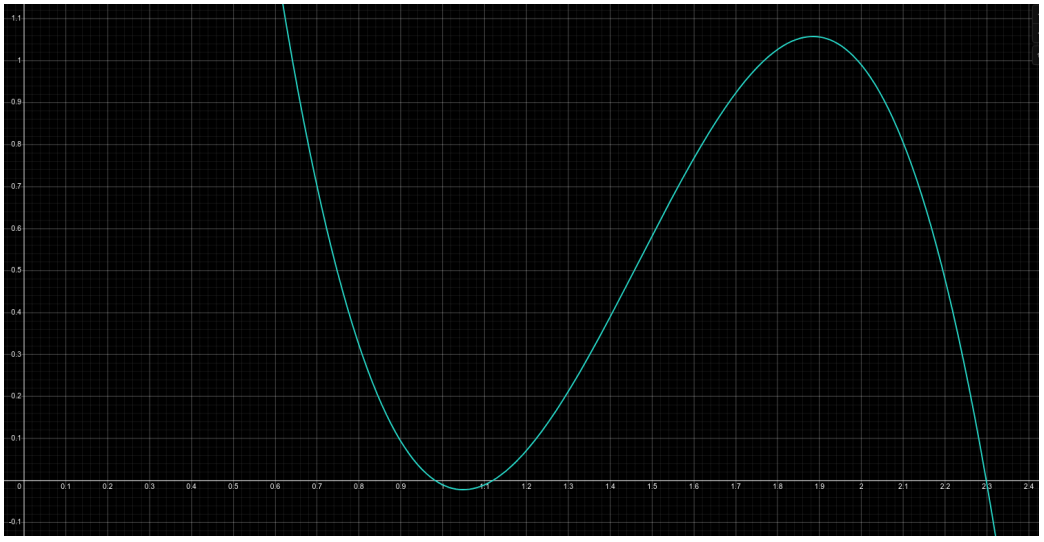
d. $-2{,}1 + 6{,}21x - 3{,}9x^2 + 0{,}667x^3$



e. $(1 - 0{,}6x) / x$



f. $9{,}36 - 21{,}963x + 16{,}2965x^2 - 3{,}70377x^3$



2. Metode Tabulasi
   a. $e^x - x - 2 = 0$

x	f(x)	x	f(x)	x	f(x)
-2	0.135335	-1.9	0.049569	-1.85	0.007237
-1.9	0.049569	-1.89	0.041072	-1.849	0.006394
-1.8	-0.034701	-1.88	0.032590	-1.848	0.005552
-1.7	-0.117316	-1.87	0.024124	-1.847	0.004710
-1.6	-0.198103	-1.86	0.015673	-1.846	0.003867
-1.5	-0.276870	-1.85	0.007237	-1.845	0.003025
-1.4	-0.353403	-1.84	-0.001183	-1.844	0.002183
-1.3	-0.427468	-1.83	-0.009586	-1.843	0.001342
-1.2	-0.498806	-1.82	-0.017974	-1.842	0.000500
-1.1	-0.567129	-1.81	-0.026346	-1.841	-0.000341
-1	-0.632121	-1.8	-0.034701	-1.84	-0.001183
-0.9	-0.693430	----------		----------	
-0.8	-0.750671	1.1	-0.095834	1.14	-0.013232
-0.7	-0.803415	1.11	-0.075642	1.141	-0.011103
-0.6	-0.851188	1.12	-0.055146	1.142	-0.008972
-0.5	-0.893469	1.13	-0.034343	1.143	-0.006837
-0.4	-0.929680	1.14	-0.013232	1.144	-0.004700
-0.3	-0.959182	1.15	0.008193	1.145	-0.002559
-0.2	-0.981269	1.16	0.029933	1.146	-0.000415
-0.1	-0.995163	1.17	0.051993	1.147	0.001733
0	-1.000000	1.18	0.074374	1.148	0.003883
0.1	-0.994829	1.19	0.097081	1.149	0.006036
0.2	-0.978597	1.2	0.120117	1.15	0.008193
0.3	-0.950141				
0.4	-0.908175				
0.5	-0.851279				
0.6	-0.777881				
0.7	-0.686247				
0.8	-0.574459				
0.9	-0.440397				
1	-0.281718				
1.1	-0.095834				
1.2	0.120117				
1.3	0.369297				
1.4	0.655200				
1.5	0.981689				

Akar pendekatan $e^x - x - 2 = 0$ adalah

$x_1 = -1{,}841$

$x_2 = 1.146$

b. $10^x = 100 - 2x$

x	f(x)	x	f(x)	x	f(x)
0	-99	1.9	-16.767177	1.98	-0.540741
0.1	-98.541075	1.91	-14.896948	1.981	-0.318593
0.2	-98.015107	1.92	-12.983623	1.982	-0.095937
0.3	-97.404738	1.93	-11.026196	1.983	0.127228
0.4	-96.688114	1.94	-9.023641	1.984	0.350902
0.5	-95.837722	1.95	-6.974906	1.985	0.575088
0.6	-94.818928	1.96	-4.878916	1.986	0.799786
0.7	-93.588128	1.97	-2.734570	1.987	1.024997
0.8	-92.090427	1.98	-0.540741	1.988	1.250722
0.9	-90.256718	1.99	1.703722	1.989	1.476964
1	-88	2	4	1.99	1.703722
1.1	-85.210746				
1.2	-81.751068				
1.3	-77.447377				
1.4	-72.081136				
1.5	-65.377223				
1.6	-56.989283				
1.7	-46.481277				
1.8	-33.304266				
1.9	-16.767177				
2	4				
2.1	30.092541				
2.2	62.889319				
2.3	104.126231				
2.4	155.988643				
2.5	221.227766				
2.6	303.307171				
2.7	406.587234				
2.8	536.557344				
2.9	700.128235				
3	906				

Akar pendekatan $10^x = 100 - 2x$ adalah
x = 1.982

c. $-0{,}874x^2 + 1{,}75x + 2{,}627$

x	f(x)	x	f(x)	x	f(x)
-1.5	-1.964500	-1.1	-0.355540	-1.01	-0.032067
-1.4	-1.536040	-1.09	-0.318899	-1.009	-0.028553
-1.3	-1.125060	-1.08	-0.282434	-1.008	-0.025040
-1.2	-0.731560	-1.07	-0.246143	-1.007	-0.021529
-1.1	-0.355540	-1.06	-0.210026	-1.006	-0.018019
-1	0.003000	-1.05	-0.174085	-1.005	-0.014512
-0.9	0.344060	-1.04	-0.138318	-1.004	-0.011006
-0.8	0.667640	-1.03	-0.102727	-1.003	-0.007502
-0.7	0.973740	-1.02	-0.067310	-1.002	-0.003999
-0.6	1.262360	-1.01	-0.032067	-1.001	-0.000499
-0.5	1.533500	-1	0.003000	-1	0.003000
-0.4	1.787160	----------		----------	
-0.3	2.023340	3.0	0.011000	3	0.011000
-0.2	2.242040	3.01	-0.024027	3.001	0.007505
-0.1	2.443260	3.02	-0.059230	3.002	0.004009
0	2.627000	3.03	-0.094607	3.003	0.000510
0.1	2.793260	3.04	-0.130158	3.004	-0.002990
0.2	2.942040	3.05	-0.165885	3.005	-0.006492
0.3	3.073340	3.06	-0.201786	3.006	-0.009995
0.4	3.187160	3.07	-0.237863	3.007	-0.013501
0.5	3.283500	3.08	-0.274114	3.008	-0.017008
0.6	3.362360	3.09	-0.310539	3.009	-0.020517
0.7	3.423740	3.1	-0.347140	3.01	-0.024027
0.8	3.467640				
0.9	3.494060				
1	3.503000				
1.1	3.494460				
1.2	3.468440				
1.3	3.424940				
1.4	3.363960				
1.5	3.285500				
1.6	3.189560				
1.7	3.076140				
1.8	2.945240				
1.9	2.796860				
2.0	2.631000				
2.1	2.447660				
2	2.246840				
2.3	2.028540				
2.4	1.792760				
2.5	1.539500				
2.6	1.268760				
2.7	0.980540				
2.8	0.674840				
2.9	0.351660				
3	0.011000				
3.1	-0.347140				
3.2	-0.722760				
3.3	-1.115860				
3.4	-1.526440				
3.5	-1.954500				

Akar pendekatan $-0{,}874x^2 + 1{,}75x + 2{,}627$ adalah

$x_1 = -1$

$x_2 = 3.003$

d. $-2,1 + 6,21x - 3,9x^2 + 0,667x^3$

x	f(x)	x	f(x)	x	f(x)
0	-2.100000	0.4	-0.197312	0.46	-0.003717
0.1	-1.517333	0.41	-0.163520	0.461	-0.000674
0.2	-1.008664	0.42	-0.130343	0.462	0.002362
0.3	-0.569991	0.43	-0.097779	0.463	0.005393
0.4	-0.197312	0.44	-0.065822	0.464	0.008417
0.5	0.113375	0.45	-0.034470	0.465	0.011436
0.6	0.366072	0.46	-0.003717	0.466	0.014448
0.7	0.564781	0.47	0.026440	0.467	0.017455
0.8	0.713504	0.48	0.056005	0.468	0.020456
0.9	0.816243	0.49	0.084982	0.469	0.023451
1	0.877000	0.5	0.113375	0.47	0.026440
1.1	0.899777	----------		----------	
1.2	0.888576	2	0.056000	2.04	0.000766
1.3	0.847399	2.01	0.042151	2.041	-0.000609
1.4	0.780248	2.02	0.028326	2.042	-0.001983
1.5	0.691125	2.03	0.014530	2.043	-0.003356
1.6	0.584032	2.04	0.000766	2.044	-0.004730
1.7	0.462971	2.05	-0.012962	2.045	-0.006103
1.8	0.331944	2.06	-0.026649	2.046	-0.007475
1.9	0.194953	2.07	-0.040291	2.047	-0.008847
2	0.056000	2.08	-0.053886	2.048	-0.010219
2.1	-0.080913	2.09	-0.067428	2.049	-0.011591
2.2	-0.211784	2.1	-0.080913	2.05	-0.012962
2.3	-0.332611	----------		----------	
2.4	-0.439392	3.3	-0.108021	3.34	-0.013217
2.5	-0.528125	3.31	-0.085141	3.341	-0.010734
2.6	-0.594808	3.32	-0.061717	3.342	-0.008246
2.7	-0.635439	3.33	-0.037743	3.343	-0.005751
2.8	-0.646016	3.34	-0.013217	3.344	-0.003251
2.9	-0.622537	3.35	0.011865	3.345	-0.000746
3	-0.561000	3.36	0.037508	3.346	0.001765
3.1	-0.457403	3.37	0.063716	3.347	0.004282
3.2	-0.307744	3.38	0.090493	3.348	0.006804
3.3	-0.108021	3.39	0.117842	3.349	0.009332
3.4	0.145768	3.4	0.145768	3.35	0.011865
3.5	0.457625				

Akar pendekatan $-2,1 + 6,21x - 3,9x^2 + 0,667x^3$ adalah

$x_1 = 0.461$

$x_2 = 2.041$

$x_3 = 3.345$

e. (1 – 0,6x) / x

x	f(x)	x	f(x)	x	f(x)
-2	-1.100000	1.6	0.025000	1.66	0.002410
-1.9	-1.126316	1.61	0.021118	1.661	0.002047
-1.8	-1.155556	1.62	0.017284	1.662	0.001685
-1.7	-1.188235	1.63	0.013497	1.663	0.001323
-1.6	-1.225000	1.64	0.009756	1.664	0.000962
-1.5	-1.266667	1.65	0.006061	1.665	0.000601
-1.4	-1.314286	1.66	0.002410	1.666	0.000240
-1.3	-1.369231	1.67	-0.001198	1.667	-0.000120
-1.2	-1.433333	1.68	-0.004762	1.668	-0.000480
-1.1	-1.509091	1.69	-0.008284	1.669	-0.000839
-1	-1.600000	1.7	-0.011765	1.67	-0.001198
-0.9	-1.711111				
-0.8	-1.850000				
-0.7	-2.028571				
-0.6	-2.266667				
-0.5	-2.600000				
-0.4	-3.100000				
-0.3	-3.933333				
-0.2	-5.600000				
-0.1	-10.600000				
0	undefined				
0.1	9.400000				
0.2	4.400000				
0.3	2.733333				
0.4	1.900000				
0.5	1.400000				
0.6	1.066667				
0.7	0.828571				
0.8	0.650000				
0.9	0.511111				
1	0.400000				
1.1	0.309091				
1.2	0.233333				
1.3	0.169231				
1.4	0.114286				
1.5	0.066667				
1.6	0.025000				
1.7	-0.011765				
1.8	-0.044444				
1.9	-0.073684				
2	-0.100000				

Akar pendekatan (1 – 0,6x) / x adalah
x = 1.667

f. $9{,}36 - 21{,}963x + 16{,}2965x^2 - 3{,}70377x^3$

x	f(x)	x	f(x)	x	f(x)
0	9.360000	0.9	0.093417	0.98	0.001460
0.1	7.322961	0.91	0.077748	0.981	0.000772
0.2	5.589630	0.92	0.063316	0.982	0.000095
0.3	4.137783	0.93	0.050100	0.983	-0.000571
0.4	2.945199	0.94	0.038075	0.984	-0.001226
0.5	1.989654	0.95	0.027221	0.985	-0.001871
0.6	1.248926	0.96	0.017516	0.986	-0.002505
0.7	0.700792	0.97	0.008936	0.987	-0.003129
0.8	0.323030	0.98	0.001460	0.988	-0.003741
0.9	0.093417	0.99	-0.004935	0.989	-0.004343
1	-0.010270	1	-0.010270	0.99	-0.004935
1.1	-0.010253	---	---	---	---
1.2	0.071245	1.1	-0.010253	1.11	-0.005403
1.3	0.212002	1.11	-0.005403	1.111	-0.004874
1.4	0.389795	1.12	0.000239	1.112	-0.004337
1.5	0.582401	1.13	0.006652	1.113	-0.003792
1.6	0.767598	1.14	0.013813	1.114	-0.003240
1.7	0.923163	1.15	0.021700	1.115	-0.002679
1.8	1.026873	1.16	0.030291	1.116	-0.002111
1.9	1.056507	1.17	0.039563	1.117	-0.001535
2	0.989840	1.18	0.049494	1.118	-0.000951
2.1	0.804651	1.19	0.060062	1.119	-0.000360
2.2	0.478717	1.2	0.071245	1.12	0.000239
2.3	-0.010185	---	---	---	---
2.4	-0.684276	2.2	0.478717	2.29	0.046672
2.5	-1.565781	2.21	0.437527	2.291	0.041069
2.6	-2.676922	2.22	0.394685	2.292	0.035448
2.7	-4.039920	2.23	0.350169	2.293	0.029808
2.8	-5.676999	2.24	0.303957	2.294	0.024150
2.9	-7.610382	2.25	0.256026	2.295	0.018474
3	-9.862290	2.26	0.206354	2.296	0.012779
		2.27	0.154920	2.297	0.007066
		2.28	0.101700	2.298	0.001334
		2.29	0.046672	2.299	-0.004416
		2.3	-0.010185	2.3	-0.010185

Akar pendekatan $9{,}36 - 21{,}963x + 16{,}2965x^2 - 3{,}70377x^3$ adalah

$x_1 = 0.982$

$x_2 = 1.12$

$x_3 = 2.298$

3. Metode Bolzano

a. $x^3 - 3x + 1 = 0$, ($x_0 = 1,5$; s/d 3D)

$x_0 = 1,5$

$F(x_0) = (1,5)^3 - 3(1,5) + 1 = -0,125$

Cari x_1 agar $F(x_1)$ bernilai positif

$x_1 = 2$

$F(x_1) = (2)^3 - 3(2) + 1 = 3$

Iterasi 1

$x_2 = (x_1 + x_2) / 2 = (1,5 + 2) / 2 = 1,75$

$F(x_2) = (1,75)^3 - 3(1,75) + 1 = 1,109375$

$F(x_2)$ positif dan $F(x_2) < F(x_1)$, maka x_2 menggantikan x_1.

Nilai $x_0 = 1,5$ dan $x_1 = 1,75$ untuk iterasi berikutnya.

Iterasi 2

$x_2 = (x_1 + x_2) / 2 = (1,5 + 1,75) / 2 = 1,625$

$F(x_2) = (1,625)^3 - 3(1,625) + 1 = 0,416015625$

x_2 telah mencapai 3D.

Iterasi	x_0	x_1	x_2	$F(x_0)$	$F(x_1)$	$F(x_2)$
1	1,5	2	1,75	-0,125	3	1,109375
2	1,5	1,75	1,625	-0,125	1,109375	0,416015625

Nilai x_2 mendekati 1,625.

b. Cos x = 3x, (x_0=0,3; s/d 5D)

Cos x - 3x = 0

$x_0 = 0,3$

$F(x_0) = \text{Cos}\ (0,3) - 3(0,3) = 0,0553365$

Cari x_1 yang $F(x_1)$ negatif

$x_1 = 0,4$

$F(x_1) = \text{Cos}\ (0,4) - 3\ (0,4) = -0,278939$

Iterasi 1

$x_2 = (x_1 + x_2) / 2 = (0,3 + 0,4) / 2 = 0,35$

$F(x_2) = \text{Cos } (0,4) – 3\ (0,4) = - 0,110627$

$F(x_2)$ negatif dan $F(x_2) > F(x_1)$, maka x_2 menggantikan x_1.

Nilai $x_0 = 0,3$ dan $x_1 = 0,35$ untuk iterasi berikutnya.

Iterasi 2

$x_2 = (x_1 + x_2) / 2 = (0,3 + 0,35) / 2 = 0,325$

$F(x_2) = \text{Cos } (0,325) – 3\ (0,325) = - 0,0273493$

$F(x_2)$ negatif dan $F(x_2) > F(x_1)$, maka x_2 menggantikan x_1.

Nilai $x_0 = 0,3$ dan $x_1 = 0,325$ untuk iterasi berikutnya.

Iterasi 3

$x_2 = (x_1 + x_2) / 2 = (0,3 + 0,325) / 2 = 0,3125$

$F(x_2) = \text{Cos } (0,3125) – 3\ (0,3125) = - 0,0140679$

$F(x_2)$ positif dan $F(x_2) > F(x_0)$, maka x_2 menggantikan x_0.

Nilai $x_0 = 0,3125$ dan $x_1 = 0,325$ untuk iterasi berikutnya.

Iterasi 4

$x_2 = (x_1 + x_2) / 2 = (0,3125 + 0,325) / 2 = 0,31875$

$F(x_2) = \text{Cos } (0,31875) – 3\ (0,31875) = - 0,0662212$

x_2 telah mencapai 5D.

Iterasi	$\mathbf{x_0}$	$\mathbf{x_1}$	$\mathbf{x_2}$	$\mathbf{F(x_0)}$	$\mathbf{F(x_1)}$	$\mathbf{F(x_2)}$
1	0,3	0,4	0,35	0,0553365	-0,278939	-0,110627
2	0,3	0,35	0,325	0,0553365	-0,110627	-0,0273493
3	0,3	0,325	0,3125	0,0553365	-0,0273493	0,0140679
4	0,3125	0,325	0,31875	0,0140679	-0,0273493	-0,0662212

Nilai x_1 mendekati 0,31875.

c. $10^x = 100 - 2x$, (x_0=2; s/d 4D)

$10^x - 100 + 2x = 0$

$x_0 = 2$

$F(x_0) = 10^2 - 100 + 2(2) = 4$

Cari x_1 yang $F(x_1)$ negatif

$x_1 = 1{,}9$

$F(x_1) = 10^{1,9} - 100 + 2(1{,}9) = -16{,}76718$

Iterasi 1

$x_2 = (x_1 + x_2) / 2 = (2 + 1{,}9) / 2 = 1{,}95$

$F(x_2) = 10^{1,95} - 100 + 2(1{,}95) = -6{,}97491$

$F(x_2)$ negatif dan $F(x_2) > F(x_1)$, maka x_2 menggantikan x_1.

Nilai $x_0 = 2$ dan $x_1 = 1{,}95$ untuk iterasi berikutnya.

Iterasi 2

$x_2 = (x_1 + x_2) / 2 = (2 + 1{,}95) / 2 = 1{,}975$

$F(x_2) = 10^{1,975} - 100 + 2(1{,}975) = -1{,}64391$

$F(x_2)$ negatif dan $F(x_2) > F(x_1)$, maka x_2 menggantikan x_1.

Nilai $x_0 = 2$ dan $x_1 = 1{,}975$ untuk iterasi berikutnya.

Iterasi 3

$x_2 = (x_1 + x_2) / 2 = (2 + 1{,}975) / 2 = 1{,}9875$

$F(x_2) = 10^{1,9875} - 100 + 2(1{,}9875) = 1{,}1378$

x_2 telah mencapai 4D.

Iterasi	**x_0**	**x_1**	**x_2**	**$F(x_0)$**	**$F(x_1)$**	**$F(x_2)$**
1	2	1,9	1,95	4	-16,76718	-6,97491
2	2	1,95	1,975	4	-6,97491	-1,64391
3	2	1,975	1,9875	4	-1,64391	1,1378

Nilai x_2 mendekati 1,9875.

d. $\ln x = 1 + 1/x^2$, (x_0=3; s/d 4D)

$\ln x - 1 - 1/x^2 = 0$

$x_0 = 3$

$F(x_0) = \ln (3) - 1 - 1/(3)^2 = - 0,0124988$

Cari x_1 yang $F(x_1)$ positif

$x_1 = 3,1$

$F(x_1) = \ln (3,1) - 1 - 1 / (3,1)^2 = 0,0273438$

Iterasi 1

$x_2 = (x_1 + x_2) / 2 = (3 + 3,1) / 2 = 3,05$

$F(x_2) = \ln (3,05) - 1 - 1/(3,05)^2 = 0,00764361$

$F(x_2)$ positif dan $F(X_2) < F(X_1)$, maka x_2 menggantikan x_1.

Nilai $x_0 = 3$ dan $x_1 = 3,05$ untuk iterasi berikutnya.

Iterasi 2

$x_2 = (x_1 + x_2) / 2 = (3 + 3,05) / 2 = 3,025$

$F(x_2) = \ln (3,025) - 1 - 1/(3,025)^2 = -0,00237106$

x_2 telah mencapai 4D.

Iterasi	**X_0**	**X_1**	**X_2**	**$F(X_0)$**	**$F(X_1)$**	**$F(X_2)$**
1	3	3,1	3,05	-0,0124988	0,0273438	0,00764361
2	3	3,05	3,025	-0,0124988	0,00764361	-0,00237106

Nilai x_2 mendekati 3,025.

e. $e^x - \ln x = 20$, (x_0=3; s/d 5D)

$y = e^x - \ln x - 20 = 0$

$x_0 = 3$

$F(x_0) = e^3 - \ln (3) - 20 = -1,01308$

Cari x_1 yang $F(x_1)$ positif

$x_1 = 3,1$

$F(x_1) = e^{3,1} - \ln (3,1) - 20 = 1,06655$

Iterasi 1

$x_2 = (x_1 + x_2) / 2 = (3 + 3{,}1) / 2 = 3{,}05$

$F(x_2) = e^{3{,}05} – \ln (3{,}05) – 20 = 0{,}000202832$

$F(x_2)$ positif dan $F(x_2) < F(x_1)$, maka x_2 menggantikan x_1.

Nilai $x_0 = 3$ dan $x_1 = 3{,}05$ untuk iterasi berikutnya.

Iterasi 2

$x_2 = (x_1 + x_2) / 2 = (3 + 3{,}05) / 2 = 3{,}025$

$F(x_2) = e^{3{,}025} – \ln (3{,}025) – 20 = - 0{,}512906$

$F(x_2)$ negatif dan $F(x_2) > F(x_0)$, maka x_2 menggantikan x_0.

Nilai $x_0 = 3{,}025$ dan $x_1 = 3{,}05$ untuk iterasi berikutnya.

Iterasi 3

$x_2 = (x_1 + x_2) / 2 = (3{,}025 + 3{,}05) / 2 = 3{,}0375$

$F(x_2) = e^{3{,}0375} – \ln (3{,}0375) – 20 = - 0{,}257989$

$F(x_2)$ negatif dan $F(x_2) > F(x_0)$, maka x_2 menggantikan x_0.

Nilai $x_0 = 3{,}0375$ dan $x_1 = 3{,}05$ untuk iterasi berikutnya.

Iterasi 4

$x_2 = (x_1 + x_2) / 2 = (3{,}0375 + 3{,}05) / 2 = 3{,}04375$

$F(x_2) = e^{3{,}04375} – \ln (3{,}04375) – 20 = - 0{,}129305$

X_2 telah mencapai 5D.

Iterasi	**X_0**	**X_1**	**X_2**	**$F(X_0)$**	**$F(X_1)$**	**$F(X_2)$**
1	3	3,1	3,05	-1,01308	1,06655	0,000202832
2	3	3,05	3,025	-1,01308	0,000202832	-0,512906
3	3,025	3,05	3,0375	-0,512906	0,000202832	-0,257989
4	3,0375	3,05	3,04375	-0,257989	0,000202832	-0,129305

Nilai x_2 mendekati 3,04375.

f. $10^x - 1$, (x_0=0; s/d 4D)

$10^x - 1 = 0$

$x_0 = 0$

$F(x_0) = 10^0 - 1 = 0$

4. Metode Regula Falsi

a. Sin x = 5x – 2, (x_0=0,4; s/d 4D)

Sin x – 5x + 2 = 0

$x_0 = 0{,}4$

$F(x_0)$ = Sin(0,4) – 5(0,4) + 2 = 0,389418

Cari x_1 agar $F(x_1)$ bernilai negatif

$x_1 = 0{,}5$

$F(x_1)$ = Sin(0,5) – 5(0,5) + 2 = -0,0205745

Iterasi 1

$$x_2 = x_1 - \frac{F(x1).(x0-x1)}{F(x0)-F(x1)}$$

$$x_2 = (0{,}5) - \frac{(-0{,}0205745).(0{,}4-0{,}5)}{0{,}389418-0{,}0205745}$$

$$x_2 = (0{,}5) - \frac{(-0{,}0205745).(0{,}4-0{,}5)}{0{,}389418-0{,}0205745}$$

$x_2 = (0{,}5) – (0{,}00557811)$

$x_2 = 0{,}494422$

$x_2 \approx 0{,}4944$ (4D)

b. $e^x = 2x + 21$, (x_0=3; s/d 4D)

$e^x - 2x – 21 = 0$

$x_0 = 3$

$F(x_0) = e^3 – 2(3) – 21 = -6{,}91446$

Cari x_1 agar $F(x_1)$ bernilai positif

$x_1 = 3{,}5$

$F(x_1) = e^{3.5} – 2(3.5) – 21 = 5.11545$

Iterasi 1

$$x_2 = x_1 - \frac{F(x1).(x0-x1)}{F(x0)-F(x1)}$$

$$x_2 = 3{,}5 - \frac{5.11545.(3-3.5)}{-6{,}91446-5.11545}$$

$x_2 = 3,5 – 0,212614$

$x_2 = 3,28739$

$x_2 \approx 3,2874$ (4D)

c. Cos x = 3x, (x_0=0,3; s/d 5D)

Cos x - 3x = 0

$x_0 = 0,3$

$F(x_0)$ = Cos (0,3) – 3(0,3) = 0,0553365

Cari x_1 agar $F(x_1)$ bernilai negatif

$x_1 = 0,4$

$F(x_1)$ = Cos (0,4) – 3(0,4) = - 0,278939

Iterasi 1

$x_2 = x_1 - \frac{F(x1).(x0-x1)}{F(x0)-F(x1)}$

$x_2 = 0,4 - \frac{(-0,278939).(0,3-0,4)}{0,0553365-(-0,278939)}$

$x_2 = 0,4 – 0,0834458$

$x_2 = 0,316554$

$x_2 \approx 0,31655$ (5D)

d. ln x = 1 + 1/x^2, (x_0=3; s/d 4D)

ln x - 1 - 1/x^2 = 0

$x_0 = 3$

$F(x_0)$ = ln (3) - 1 - 1/3^2 = - 0,0124988

Cari x_1 agar $F(x_1)$ bernilai positif

$x_1 = 3,1$

$F(x_1)$ = ln (3,1) - 1 - 1/$(3,1)^2$ = 0,0273438

Iterasi 1

$x_2 = x_1 - \frac{F(x1).(x0-x1)}{F(x0)-F(x1)}$

$x_2 = 3,1 - \frac{(0,0273438).(3-3,1)}{(-0,0124988)-0,0273438}$

$x_2 = 3,1 – 0,0686296$

$x_2 = 3,03137$

$x_2 \approx 3,0314$ (4D)

e. $x^x = 10$, (x_0=2,5; s/d 4D)

$x^x - 10 = 0$

$x_0 = 2,5$

$F(x_0) = (2,5)^{2,5} - 10 = - 0,117882$

Cari x_1 agar $F(x_1)$ bernilai positif

$x_1 = 2,6$

$F(x_1) = (2,6)^{2,6} - 10 = 1,99308$

Iterasi 1

$x_2 = x_1 - \frac{F(x1).(x0-x1)}{F(x0)-F(x1)}$

$x_2 = 2,6 - \frac{1,99308.(2,5-2,6)}{-0,117882-1,99308}$

$x_2 = 2,6 - 0,0944157$

$x_2 = 2,50558$

$x_2 \approx 2,5056$ (4D)

f. $x^3 - 100=0$, (x_0=4; s/d 3D)

$F(x_0) = 4^3 - 100 = -36$

Cari x_1 agar $F(x_1)$ bernilai positif

$x_1 = 5$

$F(x_1) = 5^3 - 100 = 25$

Iterasi 1

$x_2 = x_1 - \frac{F(x1).(x0-x1)}{F(x0)-F(x1)}$

$x_2 = 5 - \frac{25.(4-5)}{-36-25}$

$x_2 = 5 - 0,409836$

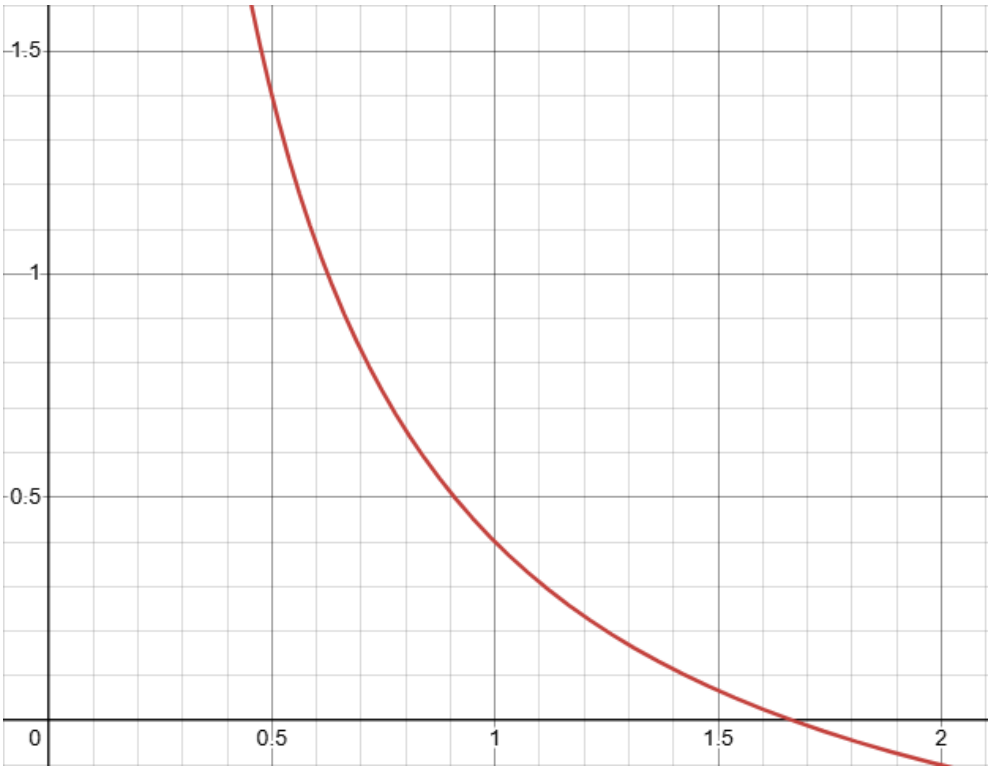
$x_2 = 4,59016$

$x_2 \approx 4,590$ (3D)

5. Analisis fungsi $f(x) = \frac{(1-0.6x)}{x}$, $x_0 = 2$

Menggunakan 4 metode dengan 3 iterasi untuk penentuan tingkat presisi dan akurasi tertinggi

1. Grafik



Didapatkan akar fungsi berada di sekitar titik 1,6

2. Tabulasi

f(x) = (1-0.6x)/x		
Iterasi	x	f(x)
1	2,000000	-0,100000
2	1,750000	-0,028571
3	1,500000	0,066667

Didapatkan perubahan tanda di antara interval 1,75 dan 1,5, maka kita dapat menyimpulkan bahwa $x \approx 1,5$ dan $x > 1,5$ jika kita menggunakan tabulasi dengan $|\Delta x| = 0,25$

3. Regula Falsi

f(x) =	(1-0.6x)/x			
iterasi	x0	x1	c	f(x)
1	1,000000	3,000000	2,200000	-0,145455
2	1,000000	2,200000	1,880000	-0,068085
3	1,000000	1,880000	1,752000	-0,029224

Didapatkan bahwa $x \approx 1,752$

4. Bolzano

f(x) =	(1-0.6x)/x			
iterasi	x0	x1	c	f(x)
4	1,000000	3,000000	2,000000	-0,100000
5	1,000000	2,000000	1,500000	0,066667
6	1,500000	2,000000	1,750000	-0,028571

Didapatkan bahwa $x \approx 1,75$

Dari empat metode tersebut kita mendapatkan data sebagai berikut

Metode	x	Eror
Tabulasi	1,500000	10,00%
Regula falsi	1,752000	5,12%
Biseksi	1,750000	5,00%

Dengan meng-eliminasi metode tabel(soalnya dari gambar tidak bisa kita menentukan nilai asli). Maka kita akan mendapatkan data berikut dan kita dapat menarik kesimpulan bahwa :

- Presisi : Biseksi
- Akurasi : Biseksi

Tetapi hal ini hanya berlaku jika kita menggunakan 3 iterasi dengan x0=2. Karena setelah saya cek, jika kita menggunakan sampai lebih dari iterasi, maka metode yg menghasilkan nilai paling akurat adalah dengan menggunakan regula falsi :) .

6. Bolzano (bisection method) dibuat menggunakan bahasa python agar mudah melakukan visualisasi.
Hal yg dibutuhkan sebelum menjalankan kode:

- Install python
- Install package numpy
- Install package matplotlib
- Install package pandas
- Ketik fungsi yg akan dihitung di kode(ini gabisa ngambil dari input soalnya nnti aga ribet kalo misal inputnya adalah polinomial berderajat tinggi atau fungsi transenden dsb, jadi ketik di kode nya aja)

Input kode :

- X1 = titik kiri sebagai acuan awal algoritma
- X2 = titik kanan sebagai acuan awal algoritma
- Iterasi = jumlah iterasi yg diinginkan

Pada kasus ini, kita mencoba menghitung nilai dari fungsi $f(x) : e^x - 3 = 0$
Kode : https://github.com/Ichann-san/bolzano_bisek/tree/main

```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np

def f(x):
    return np.exp(x) - 3  #f(x) = e^x - 3, ganti aj klo maw

def bisection_method(a, b, n):
    if f(a) * f(b) >= 0:
        print("Interval tidak valid! f(a) dan f(b) harus memiliki tanda
berbeda.")
        return []

    results = []
    for i in range(n):
        c = (a + b) / 2
        results.append((i + 1, a, b, c, f(c)))

        if abs(f(c)) < 1e-6:
            break
        elif f(a) * f(c) < 0:
            b = c
        else:
            a = c
```

```
    return results

def plot_bisection(a, b, n):
    results = bisection_method(a, b, n)
    if not results:
        return

    x = np.linspace(a - 1, b + 1, 400)
    y = f(x)

    plt.figure(figsize=(8, 5))
    plt.plot(x, y, label='f(x)')
    plt.axhline(0, color='black', linewidth=1)

    for i, (iter_num, a, b, c, fc) in enumerate(results):
        plt.scatter(c, f(c), color='red', label=f'Iterasi {iter_num}'
if i == 0 else "")
        plt.annotate(f'{c:.4f}', (c, f(c)), textcoords="offset points",
xytext=(0,10), ha='center')

    plt.xlabel('x')
    plt.ylabel('f(x)')
    plt.title('Visualisasi Metode Bolzano dengan f(x) = e^x - 3')
#ganti aj klo maw ini fungsinya
    plt.legend()
    plt.show()

    df = pd.DataFrame(results, columns=["Iterasi", "a", "b", "c",
"f(c)"])
    print(df.to_string(index=False))

x1 = input("Masukkan nilai x1(titik pertama): ")
x2 = input("Masukkan nilai x2(titik kedua): ")
iterasi = input("Masukkan jumlah iterasi: ")
plot_bisection(float(x1), float(x2), int(iterasi))
```

Dengan input :

- X1 = -10
- X2 = 9
- Iterasi = 20

Maka didapatkan

Iterasi	a	b	c	f(c)
1	-10.000000	9.000000	-0.500000	-2.393469
2	-0.500000	9.000000	4.250000	67.105412
3	-0.500000	4.250000	1.875000	3.520819
4	-0.500000	1.875000	0.687500	-1.011263
5	0.687500	1.875000	1.281250	0.601138
6	0.687500	1.281250	0.984375	-0.323861
7	0.984375	1.281250	1.132812	0.104375
8	0.984375	1.132812	1.058594	-0.117685
9	1.058594	1.132812	1.095703	-0.008715
10	1.095703	1.132812	1.114258	0.047306
11	1.095703	1.114258	1.104980	0.019166
12	1.095703	1.104980	1.100342	0.005193
13	1.095703	1.100342	1.098022	-0.001769
14	1.098022	1.100342	1.099182	0.001710
15	1.098022	1.099182	1.098602	-0.000030
16	1.098602	1.099182	1.098892	0.000840
17	1.098602	1.098892	1.098747	0.000405
18	1.098602	1.098747	1.098675	0.000187
19	1.098602	1.098675	1.098639	0.000079
20	1.098602	1.098639	1.098620	0.000024

Dengan grafik :