UFABC

Cálculo Numérico
GRUPO 2
Lista 2

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Grupo		
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Exercício 1

Tarefa 1

1

```
 1.0000000000000000
 0.7688000000000000
 0.3865801600000001
-0.0171952883199999
-0.3130696609057276
-0.4194820888917828
-0.3303546374685648
-0.1121148364807320
 0.1274467709980197
 0.2847330011201696
```

Tarefa 2

1

```
 3.68238772807672e-16
-9.42477765070660e+00
 1.50000004934803e+01
 1.14313901976492e+01
-5.74851558112778e+00
-2.16429994342159e+00
 6.52532906614688e-01
 1.64254141130614e-01
-3.54941476485151e-02
```

2

Calculando Fj:

$$F_j''(x) = f_j(x) = \sum_{i=0}^{j} \binom{j}{i}\binom{j+i}{i}\left(\frac{x-1}{2}\right)^i$$

$$F_j'(x) = \int F_j''(x) = \sum_{i=0}^{j} \binom{j}{i}\binom{j+i}{i}\int\left(\frac{x-1}{2}\right)^i$$

$$F_j'(x) = \int F_j''(x) = \sum_{i=0}^{j} \binom{j}{i}\binom{j+i}{i}\frac{1}{2^i}\int (x-1)^i$$

$$F_j'(x) = \int F_j''(x) = \sum_{i=0}^{j} \binom{j}{i}\binom{j+i}{i}\frac{(x-1)^{i+1}}{(i+1)2^i}$$

$$F_j(x) = \int F_j'(x) = \sum_{i=0}^{j} \binom{j}{i}\binom{j+i}{i}\int\frac{(x-1)^{i+1}}{(i+1)2^i}$$

$$F_j(x) = \int F_j'(x) = \sum_{i=0}^{j} \binom{j}{i}\binom{j+i}{i}\frac{1}{(i+1)2^i}\int (x-1)^{i+1}$$

$$F_j(x) = \int F_j'(x) = \sum_{i=0}^{j} \binom{j}{i}\binom{j+i}{i}\frac{(x-1)^{i+2}}{(i+1)(i+2)2^i}$$

```
-1.00000000000000
-1.39723253269819
 0.99985871629146
 1.39623936211975
-1.00000000000000
```

3

k	$E_{m,k}$
2:	2.11503493182779e+00
3:	4.65926518784316e-01
4:	1.29124376281809e-01
5:	2.69084772919949e-02
6:	5.33968432466758e-03
7:	9.09028062504869e-04
8:	1.43031107841418e-04
9:	2.02639258984338e-05
10:	2.65731734505614e-06
11:	3.53055053414764e-07
12:	6.40173075661110e-08
13:	8.18064185281742e-08
14:	8.17986203216492e-08
15:	8.54131190219931e-08
16:	8.54097117475305e-08
17:	9.16407574269584e-08
18:	1.16811843975384e-07
19:	1.49951993488884e-07
20:	4.27778902079012e-07
21:	3.45682398533720e-06
22:	8.87621154244123e-06
23:	1.13171540656598e-03
24:	9.82341935441555e-03
25:	1.61649104520109e+01
26:	8.06008356702353e+02
27:	2.75318390686568e+04
28:	6.31996211648756e+05
29:	2.83238351837420e+07
30:	5.53545981854637e+08

Tarefa 3

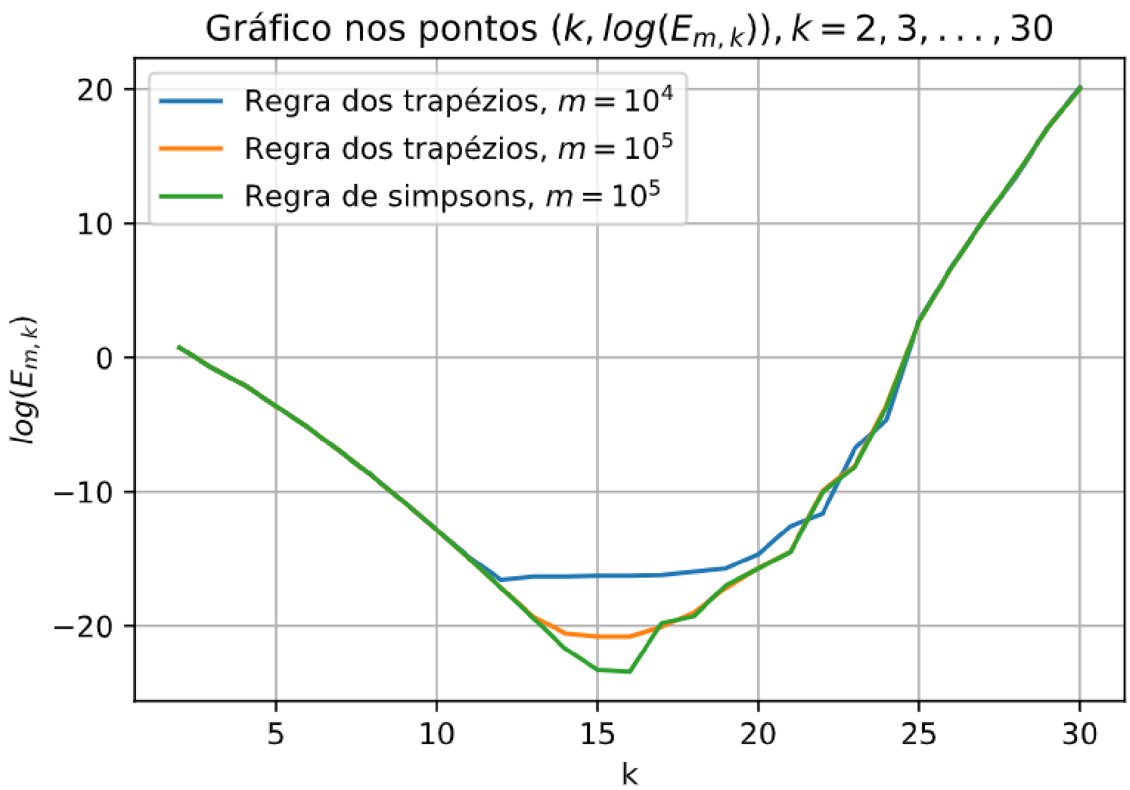
1

k	$E_{m,k}$
2:	2.11503492469818e+00
3:	4.65926464544369e-01
4:	1.29124439127210e-01
5:	2.69084511087114e-02
6:	5.33968375352623e-03
7:	9.08993954670978e-04
8:	1.43100759776971e-04
9:	2.02307850438732e-05
10:	2.64888284640108e-06
11:	3.18983395197758e-07
12:	3.49643232144814e-08
13:	4.11725054050294e-09
14:	1.17126508492049e-09
15:	9.29157750739762e-10
16:	9.26677068413539e-10
17:	1.90554283463484e-09
18:	5.54045820333471e-09
19:	3.52349232013438e-08
20:	1.51336258191748e-07
21:	5.19428687839607e-07
22:	4.91237719886239e-05
23:	3.11854119275257e-04
24:	3.13908388204767e-02
25:	1.46038575116924e+01
26:	7.92886577361134e+02
27:	2.79339942297951e+04
28:	7.36587510863195e+05
29:	2.70155667257183e+07
30:	5.04067924555524e+08

2

k	$E_{m,k}$
2:	2.11503492462615e+00
3:	4.65926463996488e-01
4:	1.29124439761996e-01
5:	2.69084508442367e-02
6:	5.33968374774285e-03
7:	9.08993610154563e-04
8:	1.43101463317530e-04
9:	2.02304504324236e-05
10:	2.64879763656189e-06
11:	3.18669965637675e-07
12:	3.57451284127563e-08
13:	3.73634190253824e-09
14:	3.71193520365409e-10
15:	7.75705055744424e-11
16:	6.76469991134354e-11
17:	2.57319254792776e-09
18:	4.27741986275265e-09
19:	4.35734730519499e-08
20:	1.46938716083511e-07
21:	5.04027302783427e-07
22:	4.44097319431958e-05
23:	2.83294860920602e-04
24:	2.61204323414179e-02
25:	1.48496450634439e+01
26:	7.87244507788824e+02
27:	2.79479769930506e+04
28:	7.48088065720730e+05
29:	2.68074731799837e+07
30:	4.99992309400118e+08

3



A regra de integração mais eficiente é a regra de simpsons, pois atinge os menores valores de erros.

Quando k > 20 temos uma instabilidade que faz o erro calculado crescer, isso acontece devido a limitação da máquina, quando atinge valores extremamente pequenos.

Tarefa 4

1

Matriz:

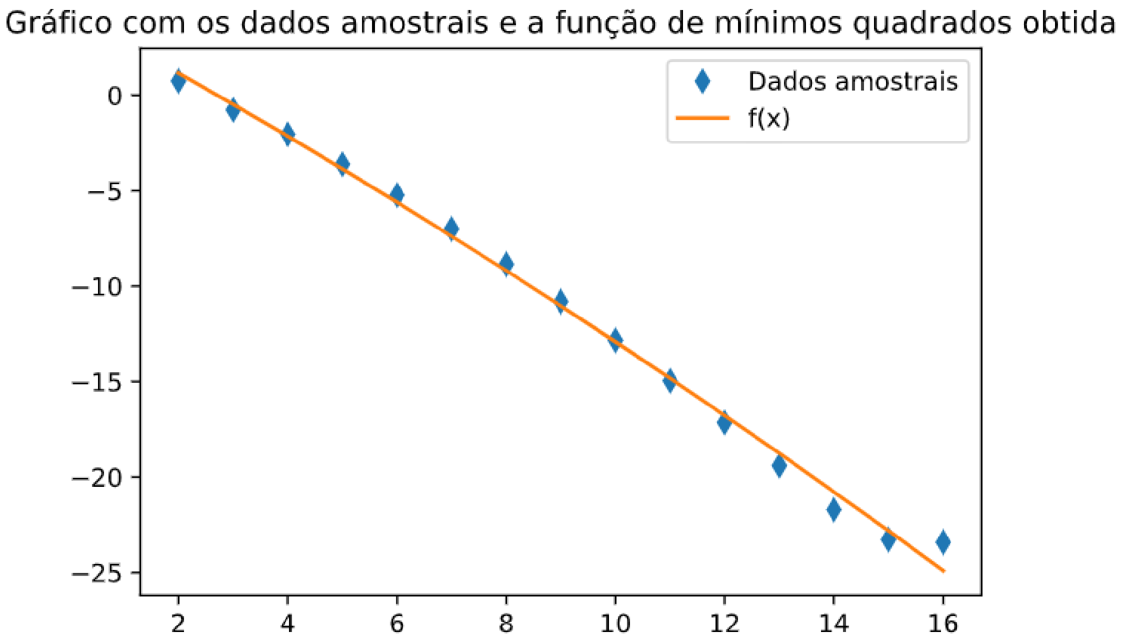
```
[15,   135,   1495]
[135,  1495,  18495]
[1495, 18495, 243847]
```

Vetor de termos independentes:
[-170.33636413008873 -2054.4245235020608 -26431.99577106991]

2

[4.345932955328876, -1.5567567737710966, -0.016965347157808588]

3



Exercício 2

1

t_j	x_j	y_j	z_j
0.00	0.741600000000000	0.741600000000000	-0.483200000000000
0.02	0.731170970533011	0.745950320550440	-0.477121291083451
0.04	0.658402867431580	0.799590053264362	-0.457992920695942
0.06	0.557003355652040	0.869250617463324	-0.426253973115364
0.08	0.451011369794600	0.931476398956622	-0.382487768751223
0.10	0.356477564467200	0.970952668723200	-0.327430233190400
0.12	0.282974254183295	0.978997057978758	-0.261971312162053
0.14	0.234942884003160	0.952207445980743	-0.187150329983903
0.16	0.212887051254730	0.891259096050379	-0.104146147305108
0.18	0.214419077796467	0.799843854417347	-0.014262932213814
0.20	0.235168111411200	0.683744205619200	0.081087682969600
0.22	0.269557714046352	0.550034957314017	0.180407328639631
0.24	0.311460873742406	0.406405306491320	0.282133819766274
0.26	0.354740356217940	0.260594018192671	0.384665625589388
0.28	0.393682291206025	0.119930426979885	0.486387281814090
0.30	0.423330867763200	-0.009026049484800	0.585695181721600
0.32	0.439731991898758	-0.120755216255752	0.681023224356994
0.34	0.440093738998478	-0.210961578700892	0.770867839702414
0.36	0.422871412643429	-0.276683365134823	0.853811952491394
0.38	0.387785000550931	-0.316332488617931	0.928547488067000
0.40	0.335776797491200	-0.329672862924800	0.993896065433600
0.42	0.268916944159673	-0.317744508558813	1.048827564399140
0.44	0.190264610111475	-0.282740905563377	1.092476295451903

0.46	0.103692527990930	-0.227847070753713	1.124154542762782
0.48	0.013682565415507	-0.157045857866726	1.143363292451219
0.50	-0.074900000000000	-0.074900000000000	1.149800000000000
0.52	-0.157045857866726	0.013682565415508	1.143363292451219
0.54	-0.227847070753713	0.103692527990931	1.124154542762782
0.56	-0.282740905563377	0.190264610111475	1.092476295451903
0.58	-0.317744508558813	0.268916944159673	1.048827564399140
0.60	-0.329672862924800	0.335776797491200	0.993896065433600
0.62	-0.316332488617931	0.387785000550931	0.928547488067001
0.64	-0.276683365134823	0.422871412643430	0.853811952491393
0.66	-0.210961578700890	0.440093738998478	0.770867839702414
0.68	-0.120755216255751	0.439731991898757	0.681023224356994
0.70	-0.009026049484800	0.423330867763200	0.585695181721600
0.72	0.119930426979885	0.393682291206027	0.486387281814089
0.74	0.260594018192671	0.354740356217941	0.384665625589388
0.76	0.406405306491319	0.311460873742402	0.282133819766274
0.78	0.550034957314018	0.269557714046355	0.180407328639630
0.80	0.683744205619202	0.235168111411202	0.081087682969599
0.82	0.799843854417350	0.214419077796466	-0.014262932213815
0.84	0.891259096050379	0.212887051254730	-0.104146147305109
0.86	0.952207445980745	0.234942884003161	-0.187150329983902
0.88	0.978997057978760	0.282974254183292	-0.261971312162053
0.90	0.970952668723199	0.356477564467198	-0.327430233190403
0.92	0.931476398956624	0.451011369794601	-0.382487768751223
0.94	0.869250617463319	0.557003355652036	-0.426253973115366
0.96	0.799590053264361	0.658402867431575	-0.457992920695944
0.98	0.745950320550441	0.731170970533021	-0.477121291083450
1.00	0.741600000000009	0.741600000000002	-0.483200000000000

2

j	t_j^*	$px(t_j^*)+py(t_j^*)+pz(t_j^*)$
0	0.00	1.000000000000000
1	0.02	1.000000000000002
2	0.04	1.000000000000002
3	0.06	1.000000000000002
4	0.08	1.000000000000000
5	0.10	1.000000000000000
6	0.12	1.000000000000000
7	0.14	0.999999999999999
8	0.16	1.000000000000002
9	0.18	1.000000000000002
10	0.20	1.000000000000000
11	0.22	1.000000000000000
12	0.24	0.999999999999999
13	0.26	1.000000000000002
14	0.28	0.999999999999998
15	0.30	0.999999999999998
16	0.32	1.000000000000004
17	0.34	1.000000000000000
18	0.36	0.999999999999998
19	0.38	1.000000000000002
20	0.40	1.000000000000000
21	0.42	1.000000000000000
22	0.44	1.000000000000007
23	0.46	0.999999999999998
24	0.48	0.999999999999996
25	0.50	1.000000000000000
26	0.52	1.000000000000009
27	0.54	1.000000000000002
28	0.56	1.000000000000009
29	0.58	0.999999999999999
30	0.60	1.000000000000000
31	0.62	1.000000000000000
32	0.64	0.999999999999998
33	0.66	1.000000000000007
34	0.68	0.999999999999998
35	0.70	0.999999999999989
36	0.72	1.000000000000007
37	0.74	0.999999999999996
38	0.76	0.999999999999957
39	0.78	1.000000000000022
40	0.80	1.000000000000027
41	0.82	1.000000000000011
42	0.84	1.000000000000000
43	0.86	1.000000000000047
44	0.88	0.999999999999989

45	0.90	0.9999999999999947	48	0.96	0.9999999999999916
46	0.92	1.0000000000000016	49	0.98	1.0000000000000111
47	0.94	0.9999999999999895	50	1.00	1.0000000000000107

3