HW2 Data Report for Math/CS 471

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Abstract

This is the HW2 report. This report is made all through LaTeX.

1 Question 1

We run the script and see the output. The iteration is ten times.

2 Question 2

Please see the newtonS.f90.Template file. The do-while loop is used for approximating the absolute error.

3 Question 3

In newtonS.f90.Template file, I add linear and quadratic convergence right after the x output. So for every iteration there should be a total of 6 outputs.

4 Question 4

4.1 Convergence

The first number is linear convergence and the second is quadratic convergence.
Rate of convergence for 'x' is 0.5000000000000000E+00 and 0.5000000000000000E+00.
Rate of convergence for 'x*x' is 0.5000000000000000E+00 and 0.1407374883553280E+15.
Rate of convergence for 'sin(x)+cos(x*x)' is 0.1633240749027686E-04 and 0.7677507053309917E+00.
The results are read from the file when the iteration reaches maximum.

4.2 Convergence discussion

$f'(x)$ is ('1.d0', '2.d0*x', 'cos(x)-2.d0*x*sin(x*x)'). For the first one, when x comes closer to its root, there should not be very big change happening since $f'(x)$ is already a constant. However, when it comes to the second one, it is difficult to determine convergence since x still exists in the equation. The third is better since they are cos() and sin(), which is more possible to give a final rate of convergence I think when it comes to quadratic convergence. The data also proves this quadratic convergence when it reaches fifth and sixth iteration in case three.

4.3 Modified Newton's method discussion

I think I will implement Modified Newton's method on case two since the multiplicity m of the root is known in advance (I know what $f'(x)$ is as soon as I have a x). $-m \times (\text{f'(x)/f(x)}) = x_{n+1} - x_n$. So I will just modify newtonS.f90.Template file.

5 Question 5

>> is actally more useful.

6 Question 6

One good method writing double slashes at the end of each output data row has not come up though.

7 Tabulated Data

Explanation: Table 1: the first character is the case ('x', 'x*x' , 'sin(x)+cos(x*x)'). The second number is the iteration number. The third one is x value, the forth one is dx. Table 2: Explanation: the first character is the case ('x', 'x*x' , 'sin(x)+cos(x*x)'). The second numbe is the iteration number. The third one is linear convergence and the forth one is quadratic convergence.

7.1 Table1without convergence

x	01	0.0000000000000000E+00	0.5000000000000000E+00
x	02	0.0000000000000000E+00	-0.0000000000000000E+00
x*x	01	-0.2500000000000000E+00	0.2500000000000000E+00
x*x	02	-0.1250000000000000E+00	0.1250000000000000E+00
x*x	03	-0.6250000000000000E-01	0.6250000000000000E-01
x*x	04	-0.3125000000000000E-01	0.3125000000000000E-01
x*x	05	-0.1562500000000000E-01	0.1562500000000000E-01
x*x	06	-0.7812500000000000E-02	0.7812500000000000E-02
x*x	07	-0.3906250000000000E-02	0.3906250000000000E-02
x*x	08	-0.1953125000000000E-02	0.1953125000000000E-02
x*x	09	-0.9765625000000000E-03	0.9765625000000000E-03
x*x	10	-0.4882812500000000E-03	0.4882812500000000E-03
x*x	11	-0.2441406250000000E-03	0.2441406250000000E-03
x*x	12	-0.1220703125000000E-03	0.1220703125000000E-03
x*x	13	-0.6103515625000000E-04	0.6103515625000000E-04
x*x	14	-0.3051757812500000E-04	0.3051757812500000E-04
x*x	15	-0.1525878906250000E-04	0.1525878906250000E-04
x*x	16	-0.7629394531250000E-05	0.7629394531250000E-05
x*x	17	-0.3814697265625000E-05	0.3814697265625000E-05
x*x	18	-0.1907348632812500E-05	0.1907348632812500E-05
x*x	19	-0.9536743164062500E-06	0.9536743164062500E-06
x*x	20	-0.4768371582031250E-06	0.4768371582031250E-06
x*x	21	-0.2384185791015625E-06	0.2384185791015625E-06
x*x	22	-0.1192092895507812E-06	0.1192092895507812E-06
x*x	23	-0.5960464477539062E-07	0.5960464477539062E-07
x*x	24	-0.2980232238769531E-07	0.2980232238769531E-07

x*x	25	-0.1490116119384766E-07	0.1490116119384766E-07
x*x	26	-0.7450580596923828E-08	0.7450580596923828E-08
x*x	27	-0.3725290298461914E-08	0.3725290298461914E-08
x*x	28	-0.1862645149230957E-08	0.1862645149230957E-08
x*x	29	-0.9313225746154785E-09	0.9313225746154785E-09
x*x	30	-0.4656612873077393E-09	0.4656612873077393E-09
x*x	31	-0.2328306436538696E-09	0.2328306436538696E-09
x*x	32	-0.1164153218269348E-09	0.1164153218269348E-09
x*x	33	-0.5820766091346741E-10	0.5820766091346741E-10
x*x	34	-0.2910383045673370E-10	0.2910383045673370E-10
x*x	35	-0.1455191522836685E-10	0.1455191522836685E-10
x*x	36	-0.7275957614183426E-11	0.7275957614183426E-11
x*x	37	-0.3637978807091713E-11	0.3637978807091713E-11
x*x	38	-0.1818989403545856E-11	0.1818989403545856E-11
x*x	39	-0.9094947017729282E-12	0.9094947017729282E-12
x*x	40	-0.4547473508864641E-12	0.4547473508864641E-12
x*x	41	-0.2273736754432321E-12	0.2273736754432321E-12
x*x	42	-0.1136868377216160E-12	0.1136868377216160E-12
x*x	43	-0.5684341886080801E-13	0.5684341886080801E-13
x*x	44	-0.2842170943040401E-13	0.2842170943040401E-13
x*x	45	-0.1421085471520200E-13	0.1421085471520200E-13
x*x	46	-0.7105427357601002E-14	0.7105427357601002E-14
x*x	47	-0.3552713678800501E-14	0.3552713678800501E-14
x*x	48	-0.1776356839400250E-14	0.1776356839400250E-14
x*x	49	-0.8881784197001252E-15	0.8881784197001252E-15
sin(x)+cos(x*x)	01	-0.9351046647281536E+00	-0.4351046647281536E+00
sin(x)+cos(x*x)	02	-0.8546415960180649E+00	0.8046306871008869E-01
sin(x)+cos(x*x)	03	-0.8493901358009870E+00	0.5251460217077924E-02
sin(x)+cos(x*x)	04	-0.8493688627401134E+00	0.2127306087358230E-04
sin(x)+cos(x*x)	05	-0.8493688623926731E+00	0.3474402480610000E-09
sin(x)+cos(x*x)	06	-0.8493688623926731E+00	-0.0000000000000000E+00

7.2 Table2with convergence

x	01	0.1000000000000000E+01	0.1000000000000000E+01
x	02	0.5000000000000000E+00	0.5000000000000000E+00
x*x	01	0.1000000000000000E+01	0.1000000000000000E+01
x*x	02	0.2500000000000000E+00	0.2500000000000000E+00
x*x	03	0.5000000000000000E+00	0.2000000000000000E+01
x*x	04	0.5000000000000000E+00	0.4000000000000000E+01
x*x	05	0.5000000000000000E+00	0.8000000000000000E+01
x*x	06	0.5000000000000000E+00	0.1600000000000000E+02
x*x	07	0.5000000000000000E+00	0.3200000000000000E+02
x*x	08	0.5000000000000000E+00	0.6400000000000000E+02
x*x	09	0.5000000000000000E+00	0.1280000000000000E+03

x*x	10	0.5000000000000000E+00	0.2560000000000000E+03
x*x	11	0.5000000000000000E+00	0.5120000000000000E+03
x*x	12	0.5000000000000000E+00	0.1024000000000000E+04
x*x	13	0.5000000000000000E+00	0.2048000000000000E+04
x*x	14	0.5000000000000000E+00	0.4096000000000000E+04
x*x	15	0.5000000000000000E+00	0.8192000000000000E+04
x*x	16	0.5000000000000000E+00	0.1638400000000000E+05
x*x	17	0.5000000000000000E+00	0.3276800000000000E+05
x*x	18	0.5000000000000000E+00	0.6553600000000000E+05
x*x	19	0.5000000000000000E+00	0.1310720000000000E+06
x*x	20	0.5000000000000000E+00	0.2621440000000000E+06
x*x	21	0.5000000000000000E+00	0.5242880000000000E+06
x*x	22	0.5000000000000000E+00	0.1048576000000000E+07
x*x	23	0.5000000000000000E+00	0.2097152000000000E+07
x*x	24	0.5000000000000000E+00	0.4194304000000000E+07
x*x	25	0.5000000000000000E+00	0.8388608000000000E+07
x*x	26	0.5000000000000000E+00	0.1677721600000000E+08
x*x	27	0.5000000000000000E+00	0.3355443200000000E+08
x*x	28	0.5000000000000000E+00	0.6710886400000000E+08
x*x	29	0.5000000000000000E+00	0.1342177280000000E+09
x*x	30	0.5000000000000000E+00	0.2684354560000000E+09
x*x	31	0.5000000000000000E+00	0.5368709120000000E+09
x*x	32	0.5000000000000000E+00	0.1073741824000000E+10
x*x	33	0.5000000000000000E+00	0.2147483648000000E+10
x*x	34	0.5000000000000000E+00	0.4294967296000000E+10
x*x	35	0.5000000000000000E+00	0.8589934592000000E+10
x*x	36	0.5000000000000000E+00	0.1717986918400000E+11
x*x	37	0.5000000000000000E+00	0.3435973836800000E+11
x*x	38	0.5000000000000000E+00	0.6871947673600000E+11
x*x	39	0.5000000000000000E+00	0.1374389534720000E+12
x*x	40	0.5000000000000000E+00	0.2748779069440000E+12
x*x	41	0.5000000000000000E+00	0.5497558138880000E+12
x*x	42	0.5000000000000000E+00	0.1099511627776000E+13
x*x	43	0.5000000000000000E+00	0.2199023255552000E+13
x*x	44	0.5000000000000000E+00	0.4398046511104000E+13
x*x	45	0.5000000000000000E+00	0.8796093022208000E+13
x*x	46	0.5000000000000000E+00	0.1759218604441600E+14
x*x	47	0.5000000000000000E+00	0.3518437208883200E+14
x*x	48	0.5000000000000000E+00	0.7036874417766400E+14
x*x	49	0.5000000000000000E+00	0.1407374883553280E+15
sin(x)+cos(x*x)	01	0.1000000000000000E+01	0.1000000000000000E+01
sin(x)+cos(x*x)	02	0.4351046647281536E+00	0.4351046647281536E+00
sin(x)+cos(x*x)	03	0.1849280764672121E+00	0.4250197514723320E+00
sin(x)+cos(x*x)	04	0.6526547273506428E-01	0.8111233362254442E+00
sin(x)+cos(x*x)	05	0.4050884895680481E-02	0.7713825732711236E+00
sin(x)+cos(x*x)	06	0.1633240749027686E-04	0.7677507053309917E+00