

Linear Algebra – Assignment 3

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Instruction 1

Compute the LU decomposition of the given matrix. Using matlab, my code in the Inst_1to3.m script accomplishes this by using the built in matlab lu function. The results of the procedure resulted with these matrices which I have extracted from the LU_Decomposition_Inst1_1.txt and have represented it in a spreadsheet.

Lower			Upper		
0.5	-0.5	1	8	0	0
0.5	1	0	4	2	0
1	0	0	0	-3	-3.5

Instruction 2

Use decomposition to determine the solution with the given Ax matrix. Using matlab, my code in the Inst_1to3.m script accomplishes this by doing $y = L \backslash Ax$, then $x = U \backslash y$ with x being the final solution and U and L the previously computed lower and upper matrices of A in instruction 1. The results of the procedure resulted with the following matrix which I have extracted from Lu_Decomposition_Inst2.txt and have represented it in a spreadsheet.

Solution
1
2
3

Instruction 3

Given the two matrices A and B, compute their LU decompositions and compare. Using a very similar procedure in instruction 1, my matlab code accomplishes this task in my Inst_1to3.m script. The results are shown below in spreadsheet form which were extracted from the LU_Decomposition_Inst_3.txt output file produced by the script. The differences between B's and C's LU decomposition are similar to each others as well as A's LU decomposition, but they are all a little different by simply changing very few values on the original matrix diagonal line.

B Lower			B Upper		
0.5	-0.5	1	8	4	2
0.5	1	0	0	2	-4
1	0	0	0	0	-5
C Lower			C Upper		
0.25	0	1	8	4	4
0.5	1	0	0	2	-5
1	0	0	0	0	-3

Instruction 4

Generate the ill conditioned matrix represented the flow of water through a unknown material using different values of n (21,41,81,161) and a (1.0, 1.0e-1,1.0e-3, 1.0e-5, 1.0e-7 and 1.0e-9, 1.0e-11, 1.0e-13, 1.0e-15) with dx being 1. Formulating an algorithm to accommodate the diagram's specifications was tricky, but was accomplished in my Inst_4.m script. Please view the Inst4.txt output file for all script results. Based on my results from the procedure, the condition number appears to increase as N increases and as A decreases. The solutions of h appear to change as N or A changes. Below is just a tiny part of the Inst4.txt output file to demonstrate my observations.

N:21 a:1.00e+00

Cond:1.00000e+01 Sol:[4;1.599609375;0;0.400390624999999;1;0.0996093750000017;-
0.75;0.0253906249999985;0.8125;0.00585937500000105;-0.796874999999999;0.00195312499999937;0.800781249999999;0;-
0.799804687499999;0.000488281250000214;0.800048828124999;-0.000366210937500207;-
0.799987792968749;0.00039672851562519;0.800003051757812;-0.000389099121093954;1.20000076293945]

4.0000e+00

1.5996e+00

0.0000e+00

4.0039e-01

1.0000e+00

9.9609e-02

-7.5000e-01

2.5391e-02

8.1250e-01

5.8594e-03

-7.9687e-01

1.9531e-03

8.0078e-01

0.0000e+00

-7.9980e-01

4.8828e-04

8.0005e-01

-3.6621e-04

-7.9999e-01

3.9673e-04

8.0000e-01

-3.8910e-04

1.2000e+00

N:21 a:1.00e-01

Cond:1.60000e+01 Sol:[4;2.25319602272727;0;-0.253196022727274;1;0.753196022727274;-0.750000000000001;-
0.628196022727273;0.812500000000001;0.659446022727273;-0.796875000000001;-0.651633522727272;0.800781250000001;0;-
0.860020661157025;-0.00538540101427509;0.859531079246637;0.00534089356787619;-0.859535125378128;-
0.00534126139801165;0.859535091939025;0.005341258358093;-0.495898728579018]

4.0000e+00

2.2532e+00

0.0000e+00

-2.5320e-01

1.0000e+00

7.5320e-01

-7.5000e-01

-6.2820e-01

8.1250e-01

6.5945e-01

-7.9688e-01

-6.5163e-01

8.0078e-01

0.0000e+00

-8.6002e-01

-5.3854e-03

8.5953e-01

5.3409e-03

-8.5954e-01

-5.3413e-03

8.5954e-01

5.3413e-03

-4.9590e-01

N:81 a:1.00e-07

Cond:6.90000e+01 Sol:[4;2.39999984000147;0;-0.399999840001472;1;0.899999840001472;-0.75;-
0.774999840001472;0.8125;0.806249840001472;-0.796875;-0.798437340001471;0.800781250000002;0.800390465001473;-
0.799804687500001;-0.799902183751472;0.800048828125;0.800024254063972;-0.79998779296875;-
0.799993736485847;0.800003051757813;0.800001365880378;-0.79999237060547;-
0.79999458531745;0.800000190734864;0.79999935368904;-0.79999952316285;-
0.79999816159614;0.80000001192093;0.79999845961937;-0.79999997019768;-
0.79999838511356;0.800000000745059;0.79999840374001;-0.79999999813736;-
0.7999983990834;0.800000000046567;0.79999840024755;-0.79999999998836;-
0.79999839995651;0.800000000002911;0.79999840002927;-0.79999999999273;0;0.800000079999249;8.42632856522956e-15;-
0.800000079999249;-8.47741620809123e-15;0.800000079999249;8.32097240768319e-15;-0.800000079999249;-8.18041474595233e-
15;0.80000007999925;7.95463622048072e-15;-0.80000007999925;-7.73170014128897e-15;0.800000079999249;7.92549234951149e-15;-
0.80000007999925;-8.13089077420933e-15;0.80000007999925;8.2282043065483e-15;-0.80000007999925;-8.39616053347016e-
15;0.80000007999925;8.61748454103637e-15;-0.80000007999925;-8.72890207389591e-15;0.80000007999925;8.85050420093565e-15;-
0.80000007999925;-8.8150933524896e-15;0.80000007999925;8.83076156452497e-15;-0.80000007999925;-8.87390640016828e-
15;0.80000007999925;8.78986194706036e-15;-0.80000007999925;-9.03554332293933e-15;0.80000007999925;9.12217317951786e-15;-
0.79999967999929]

4.0000e+00

2.4000e+00

0.0000e+00
-4.0000e-01
1.0000e+00
9.0000e-01
-7.5000e-01
-7.7500e-01
8.1250e-01
8.0625e-01
-7.9688e-01
-7.9844e-01
8.0078e-01
8.0039e-01
-7.9980e-01
-7.9990e-01
8.0005e-01
8.0002e-01
-7.9999e-01
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8.3210e-15
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-8.1804e-15
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7.9546e-15
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8.0000e-01
7.9255e-15
-8.0000e-01
-8.1309e-15
8.0000e-01
8.2282e-15
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8.6175e-15
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-8.7289e-15
8.0000e-01
8.8505e-15
-8.0000e-01
-8.8151e-15
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8.7899e-15

-8.0000e-01

-9.0355e-15

8.0000e-01

9.1222e-15

-8.0000e-01