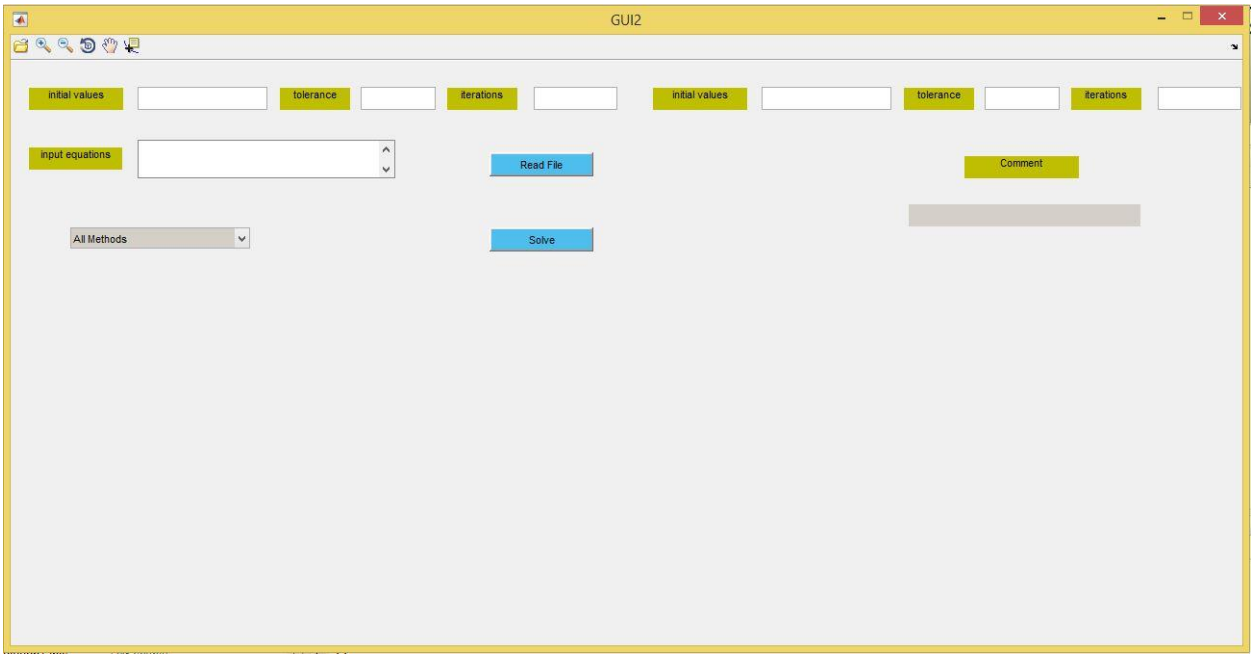
User Guide



GUI has some fileds and buttons as viewed in the photo , each one has a meaning or a function :

1. Input equations : user can enter input equations here which he want to solve , it can have spaces or tabs but must be in valid format containing x1,x2,…..,xn and their coefficients like :
   (x1+x2+2*x3 = 3 or x1 -2*x2 +2*x3 = 3)

2. Drop down list : user can select the desired method he wants to solve linear system using it by just selecting it

3. Initial value : user can enter initial value here in case of using iterative methods (it is only visible and able to be used in case of selecting an iterative method from drop down list options , otherwise it will be invisible)

   (Default value = [0,0,0,……] n zeros)

4. Tolerance : user can specify tolerance / Absolute error which is allowed in the final solutions of x1,x2,…,xn to increase accuracy
   (Default value = 0.00001)

5. Iterations : user can specify maximum number of iterations allowed it iterative method if he cares more about running time versus accuracy
   (Default value = 50)

6. Initial value , tolerance and iterations in the right half side like the mentioned above but it is used to the second iterative method (Jacobi iterative) in case of using All Methods, otherwise it will be invisible always and we use the ones in the left half side only .

7. Read File Button : allow user to choose input file (extension : ".txt") to read parameters and input equations from it , the input file must be in valid and fixed format :
   - The first line must contain number of equations we want to solve .
   - The n next line each one will contain an equation till finishing all the equations.
   - The next line don't have any fixed format but for flexibility we make it ("key name") then next line you can write ("key value")
     for example :
     {
     3
     x1+x2+x3 = 3
     x1+2*x2+x3 = 4
     x1+2*x2+3*x3 = 4
     initial
     1 2 1
     tolerance
     0.00004
     iterations
     20
     }

8. Solve Button: to solve equations with the given parameters, if the parameters are valid then we will execute method call, otherwise we will show a message “invalid input” in comment field, if inputs are valid then we will look for solutions if we can get it then display the solutions in an appropriate view depending on the selected methods like (tables, matrix representation) we will see that in sample runs section.

   Note: after solving using any method we output the solutions in a text file which is located in same directory where running GUI exists.

Sample runs

First Example

Inputs {

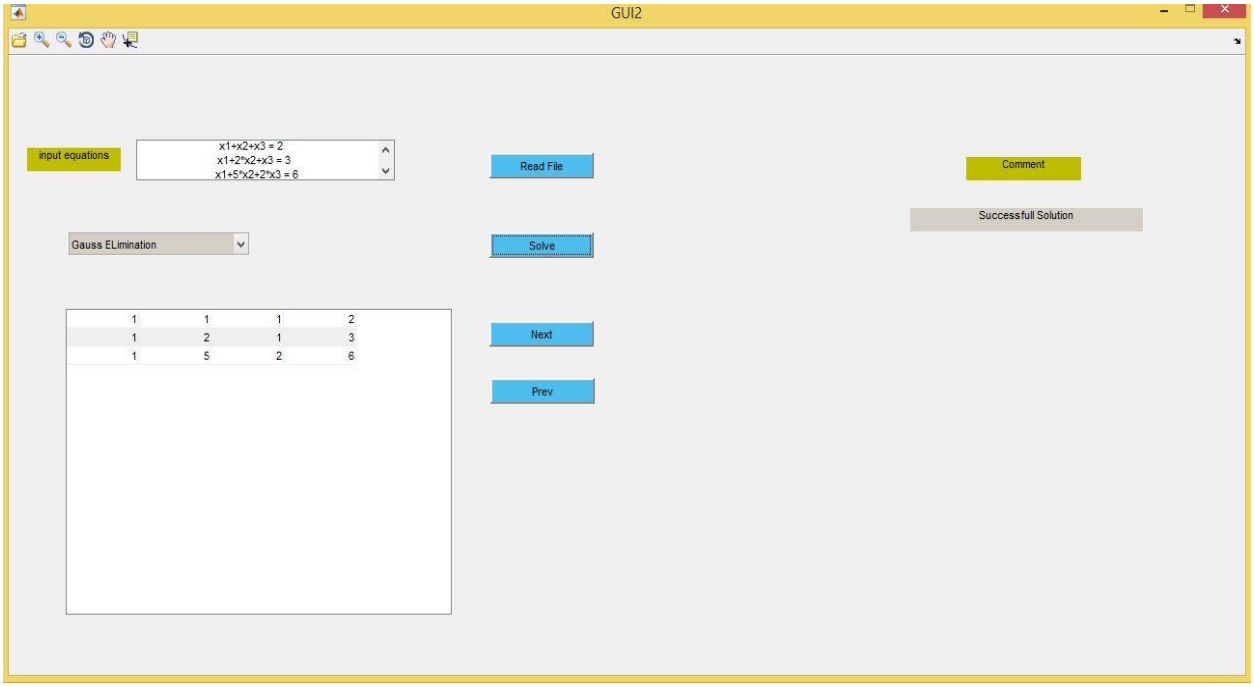
x1+x2+x3 = 2

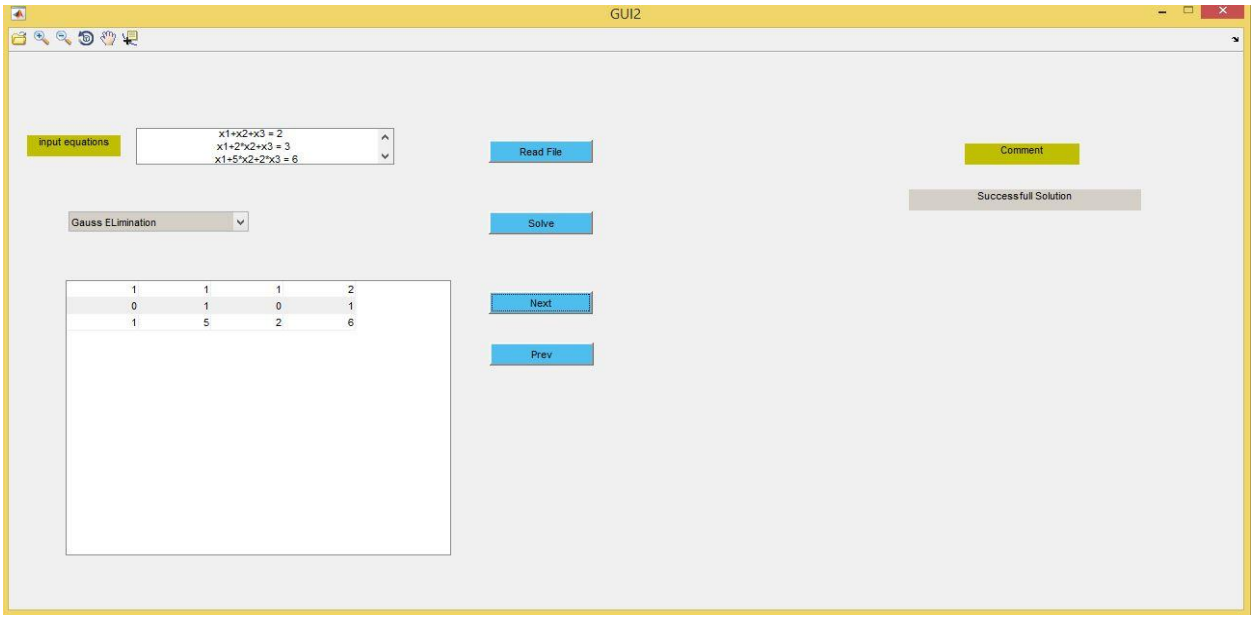
x1+2*x2+x3 = 3

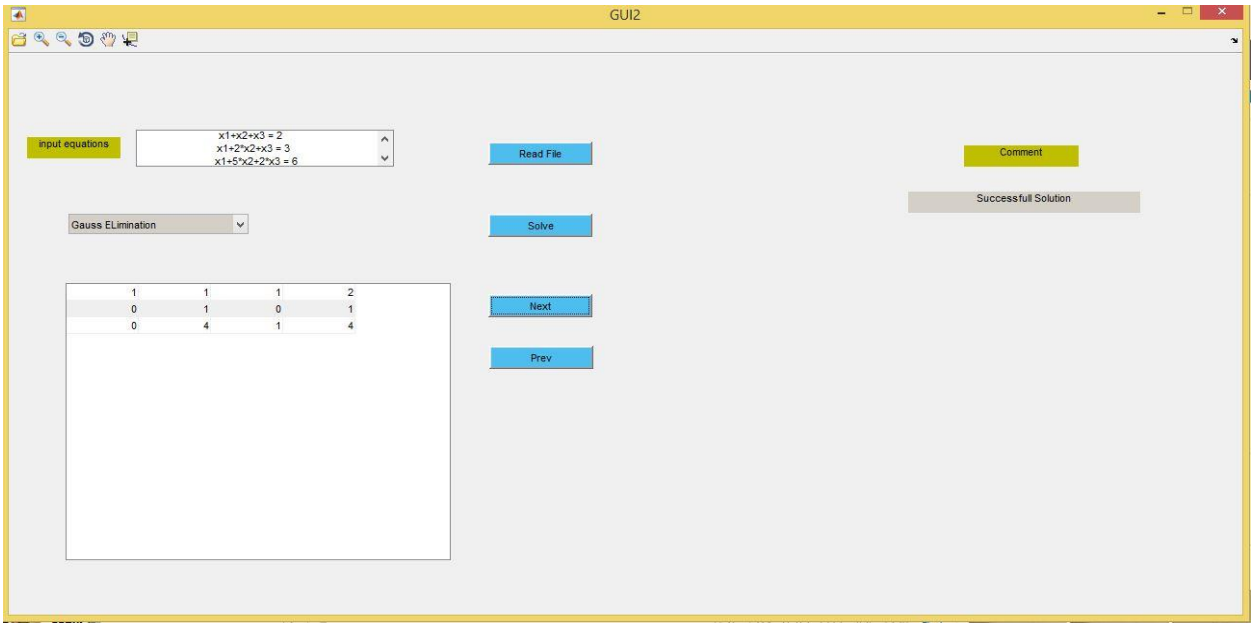
x1+5*x2+2*x3 = 6

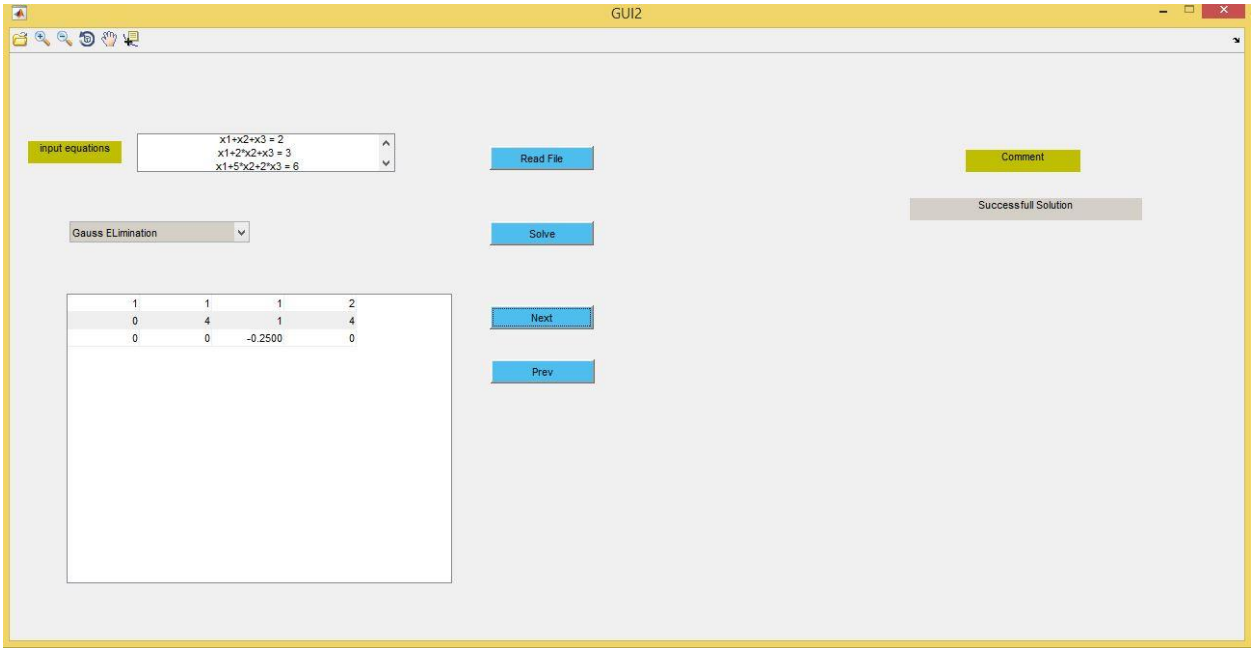
}

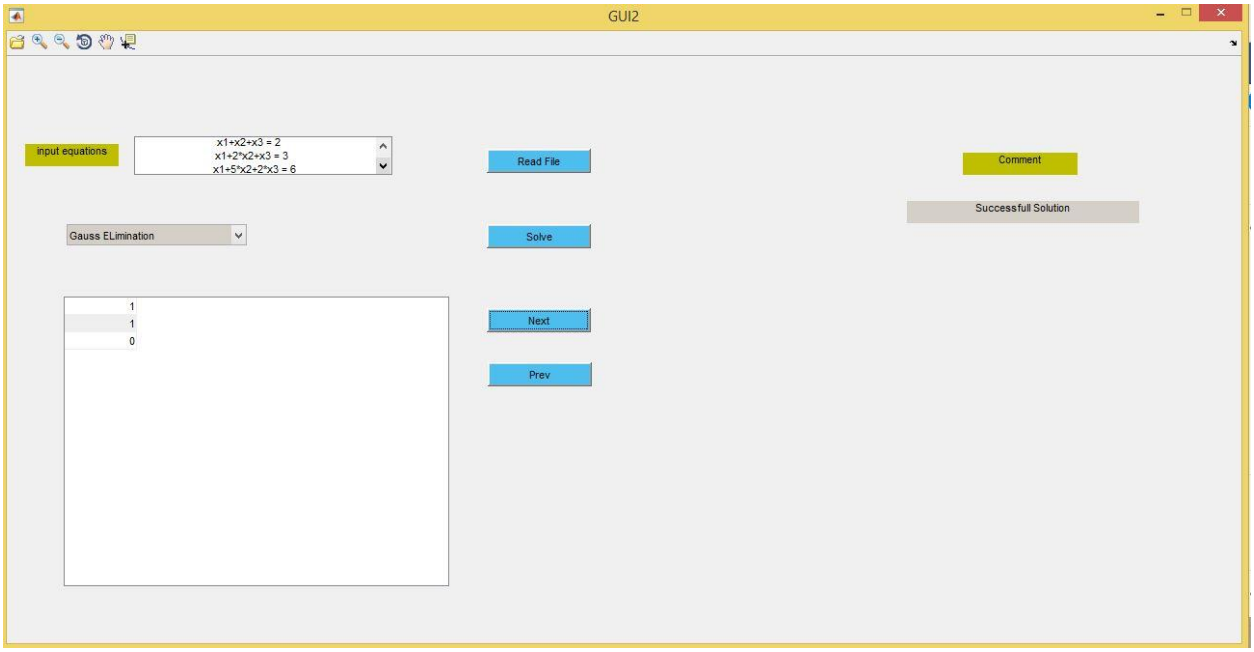
Solving using Gauss Elimination with showing every step using Next and Previous Buttons which are allowed and visible only in Direct Methods



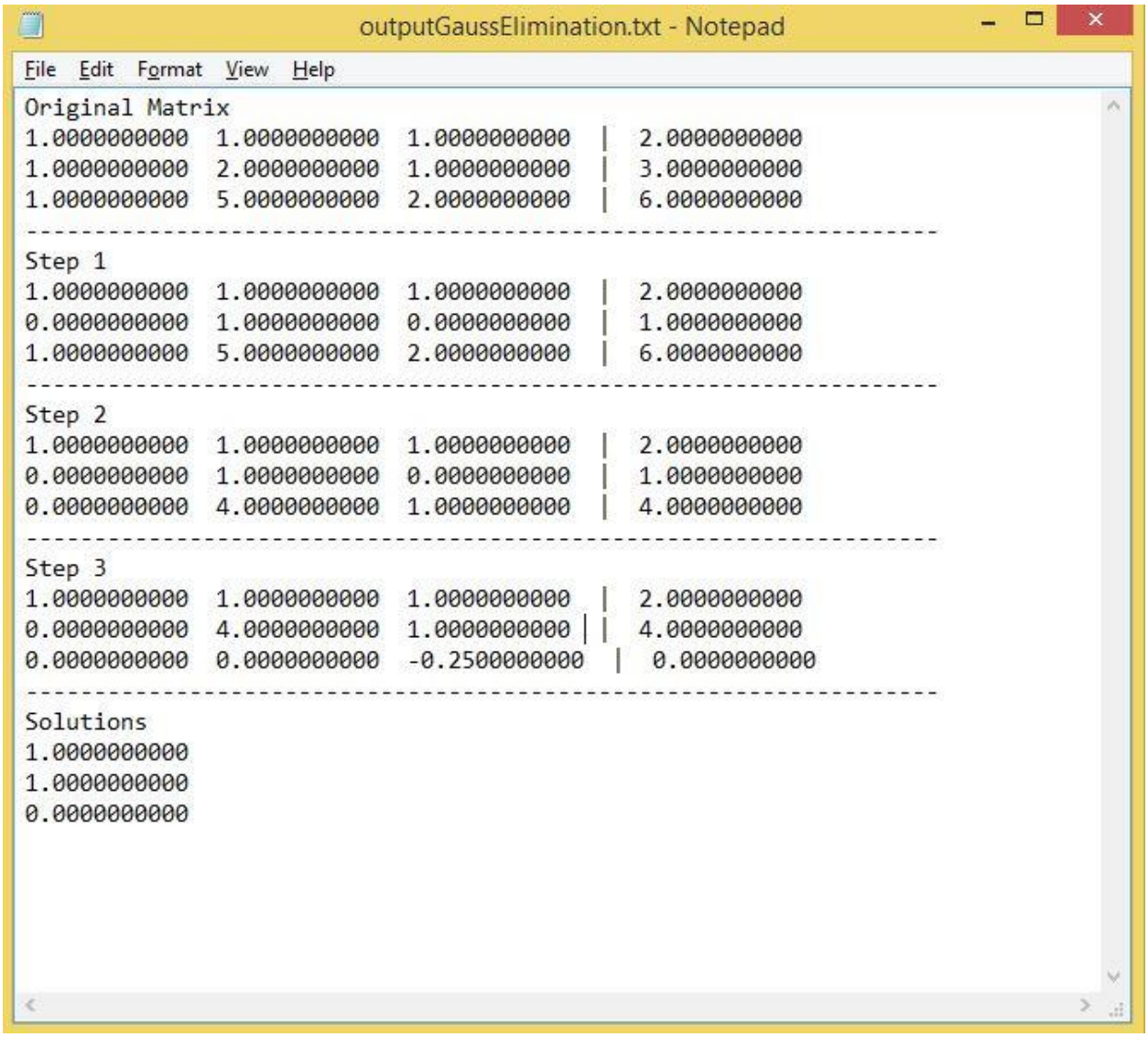

GUI2
input equations
x1+x2+x3 = 2
x1+2*x2+x3 = 3
x1+5*x2+2*x3 = 6
Read File
Comment
Successfull Solution
Gauss ELimination
Solve
1 1 1 2
0 1 0 1
1 5 2 6
Next
Prev


GUI2
input equations
x1+x2+x3 = 2
x1+2*x2+x3 = 3
x1+5*x2+2*x3 = 6
Read File
Comment
Successfull Solution
Gauss ELimination
Solve
1 1 1 2
0 1 0 1
0 4 1 4
Next
Prev


GUI2
input equations
x1+x2+x3 = 2
x1+2*x2+x3 = 3
x1+5*x2+2*x3 = 6
Read File
Comment
Successfull Solution
Gauss ELimination
Solve
1 1 1 2
0 4 1 4
0 0 -0.2500 0
Next
Prev


GUI2
input equations
x1+x2+x3 = 2
x1+2*x2+x3 = 3
x1+5*x2+2*x3 = 6
Read File
Comment
Successfull Solution
Gauss ELimination
Solve
1
1
0
Next
Prev

The output will be :



Second Example

Inputs {

x1+x2+x3 = 2

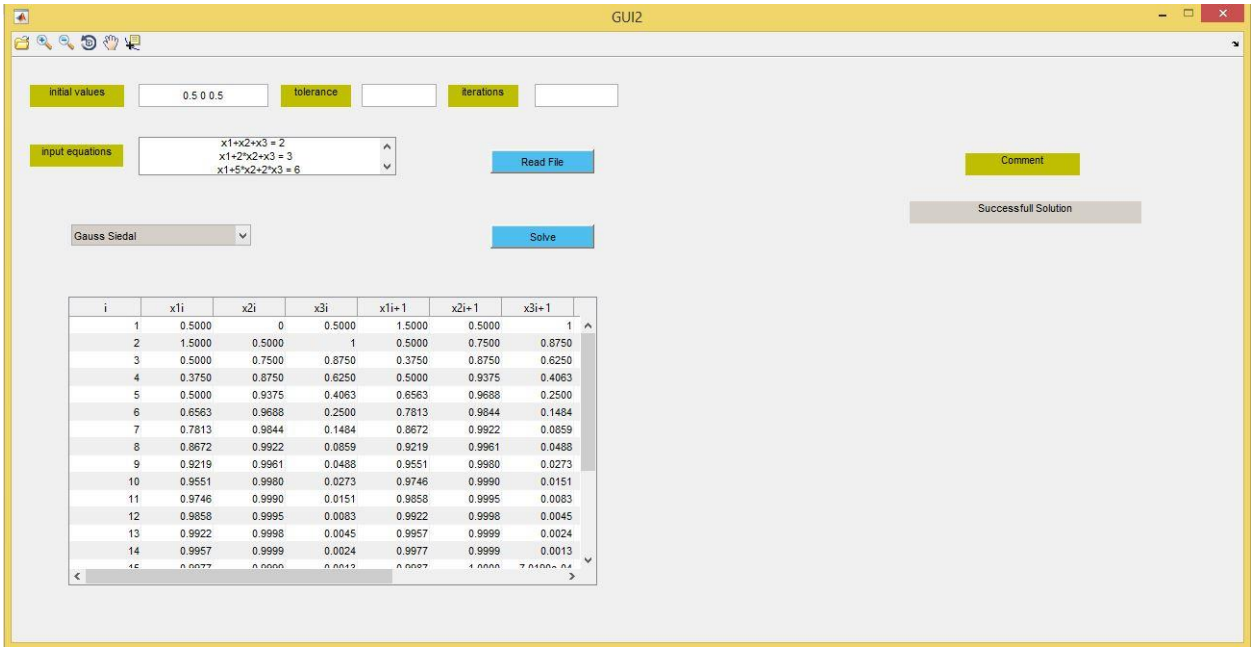
x1+2*x2+x3 = 3

x1+5*x2+2*x3 = 6

}

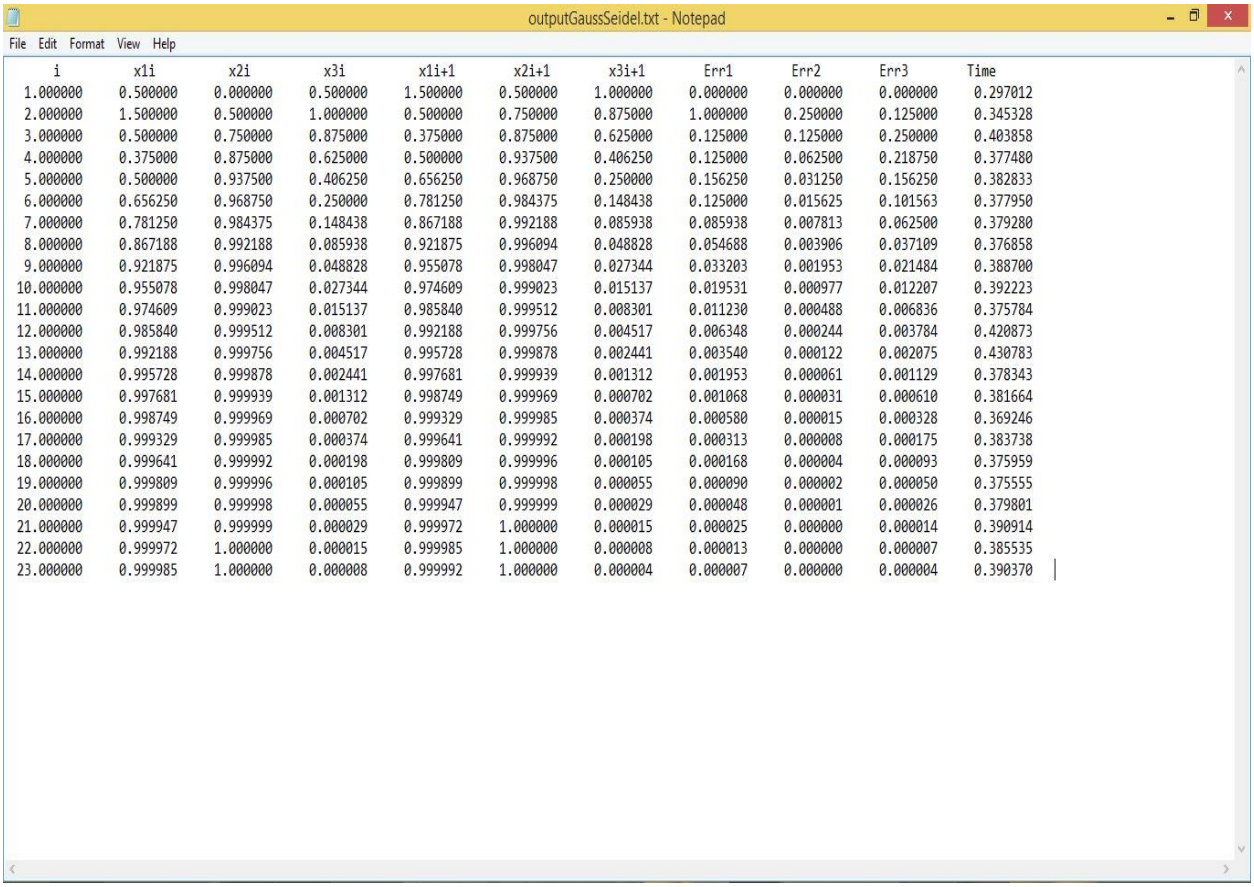
Solving using Gauss Seidel with initial value = [0.5 , 0 , 0.5]

Output data will be viewed in table format .



i	x1i	x2i	x3i	x1i+1	x2i+1	x3i+1
1	0.5000	0	0.5000	1.5000	0.5000	1
2	1.5000	0.5000	1	0.5000	0.7500	0.8750
3	0.5000	0.7500	0.8750	0.3750	0.8750	0.6250
4	0.3750	0.8750	0.6250	0.5000	0.9375	0.4063
5	0.5000	0.9375	0.4063	0.6563	0.9688	0.2500
6	0.6563	0.9688	0.2500	0.7813	0.9844	0.1484
7	0.7813	0.9844	0.1484	0.8672	0.9922	0.0859
8	0.8672	0.9922	0.0859	0.9219	0.9961	0.0488
9	0.9219	0.9961	0.0488	0.9551	0.9980	0.0273
10	0.9551	0.9980	0.0273	0.9746	0.9990	0.0151
11	0.9746	0.9990	0.0151	0.9858	0.9995	0.0083
12	0.9858	0.9995	0.0083	0.9922	0.9998	0.0045
13	0.9922	0.9998	0.0045	0.9957	0.9999	0.0024
14	0.9957	0.9999	0.0024	0.9977	0.9999	0.0013

The output file will be :


outputGaussSeidel.txt - Notepad

File Edit Format View Help

i	x1i	x2i	x3i	x1i+1	x2i+1	x3i+1	Err1	Err2	Err3	Time
1.000000	0.500000	0.000000	0.500000	1.500000	0.500000	1.000000	0.000000	0.000000	0.000000	0.297012
2.000000	1.500000	0.500000	1.000000	0.500000	0.750000	0.875000	1.000000	0.250000	0.125000	0.345328
3.000000	0.500000	0.750000	0.875000	0.375000	0.875000	0.625000	0.125000	0.125000	0.250000	0.403858
4.000000	0.375000	0.875000	0.625000	0.500000	0.937500	0.406250	0.125000	0.062500	0.218750	0.377480
5.000000	0.500000	0.937500	0.406250	0.656250	0.968750	0.250000	0.156250	0.031250	0.156250	0.382833
6.000000	0.656250	0.968750	0.250000	0.781250	0.984375	0.148438	0.125000	0.015625	0.101563	0.377950
7.000000	0.781250	0.984375	0.148438	0.867188	0.992188	0.085938	0.085938	0.007813	0.062500	0.379280
8.000000	0.867188	0.992188	0.085938	0.921875	0.996094	0.048828	0.054688	0.003906	0.037109	0.376858
9.000000	0.921875	0.996094	0.048828	0.955078	0.998047	0.027344	0.033203	0.001953	0.021484	0.388700
10.000000	0.955078	0.998047	0.027344	0.974609	0.999023	0.015137	0.019531	0.000977	0.012207	0.392223
11.000000	0.974609	0.999023	0.015137	0.985840	0.999512	0.008301	0.011230	0.000488	0.006836	0.375784
12.000000	0.985840	0.999512	0.008301	0.992188	0.999756	0.004517	0.006348	0.000244	0.003784	0.420873
13.000000	0.992188	0.999756	0.004517	0.995728	0.999878	0.002441	0.003540	0.000122	0.002075	0.430783
14.000000	0.995728	0.999878	0.002441	0.997681	0.999939	0.001312	0.001953	0.000061	0.001129	0.378343
15.000000	0.997681	0.999939	0.001312	0.998749	0.999969	0.000702	0.001068	0.000031	0.000610	0.381664
16.000000	0.998749	0.999969	0.000702	0.999329	0.999985	0.000374	0.000580	0.000015	0.000328	0.369246
17.000000	0.999329	0.999985	0.000374	0.999641	0.999992	0.000198	0.000313	0.000008	0.000175	0.383738
18.000000	0.999641	0.999992	0.000198	0.999809	0.999996	0.000105	0.000168	0.000004	0.000093	0.375959
19.000000	0.999809	0.999996	0.000105	0.999899	0.999998	0.000055	0.000090	0.000002	0.000050	0.375555
20.000000	0.999899	0.999998	0.000055	0.999947	0.999999	0.000029	0.000048	0.000001	0.000026	0.379801
21.000000	0.999947	0.999999	0.000029	0.999972	1.000000	0.000015	0.000025	0.000000	0.000014	0.390914
22.000000	0.999972	1.000000	0.000015	0.999985	1.000000	0.000008	0.000013	0.000000	0.000007	0.385535
23.000000	0.999985	1.000000	0.000008	0.999992	1.000000	0.000004	0.000007	0.000000	0.000004	0.390370

Third Example

Inputs {

2*x1+x2+x3 = 2

2*x1+6*x2+x3 = 3

x1+4*x2-2*x3 = 6

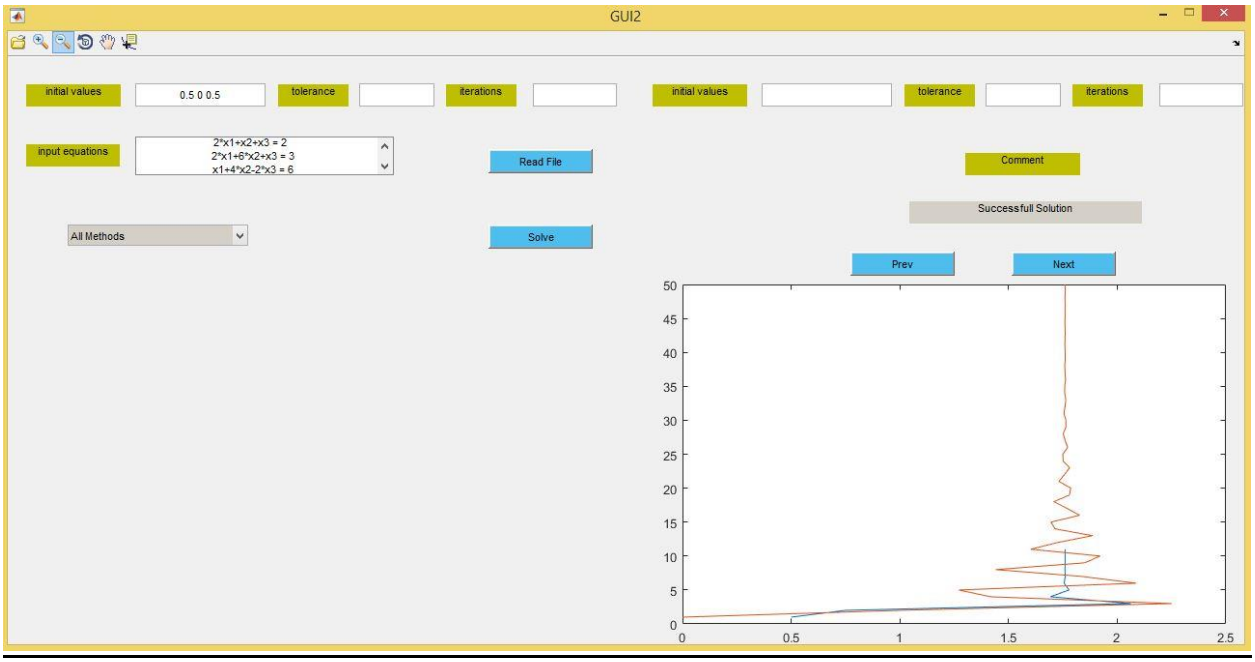
}

Solving using All Methods with initial value = [0.5 , 0 , 0.5]

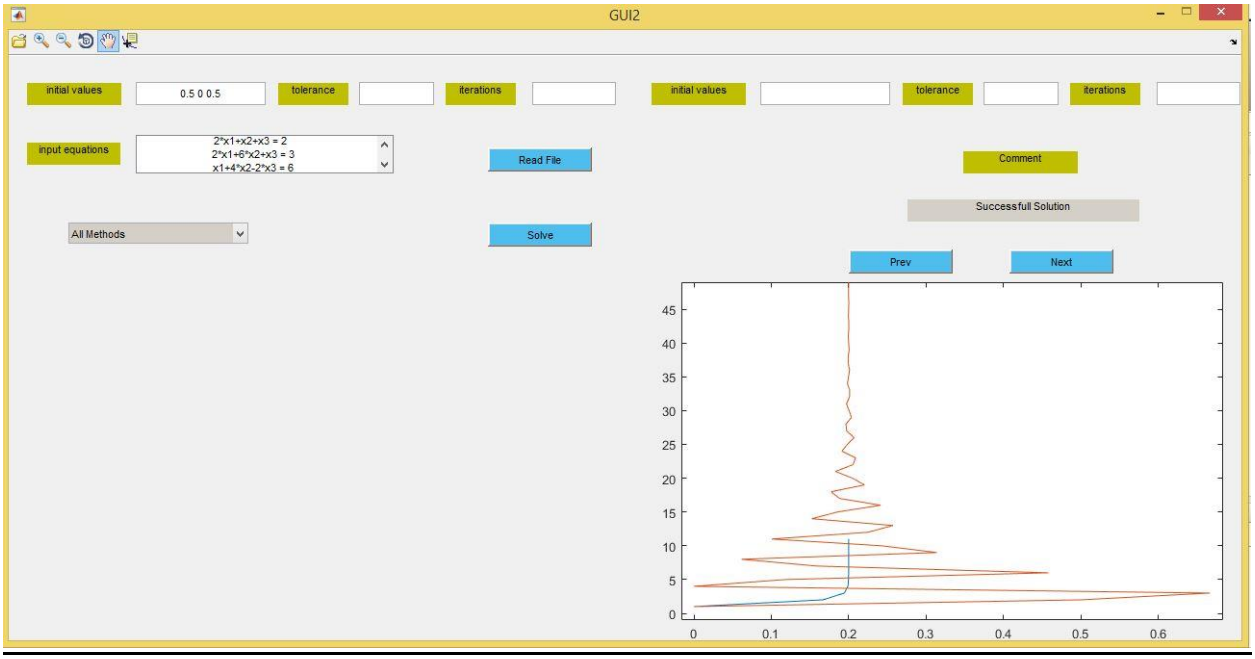
For Gauss Seidel Method.

The Curves between number of iterations and approximate root at this iterations will be plotted in case of using all methods and will be like :

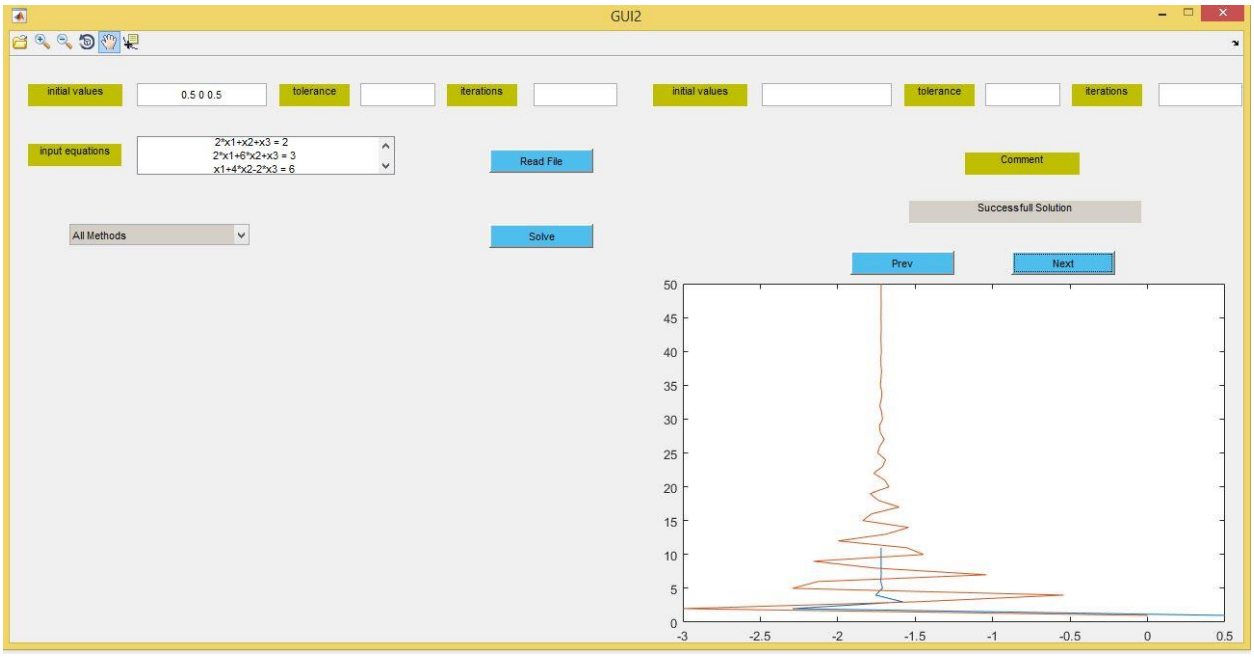
<u>Curve for x1</u>



Curve for x2

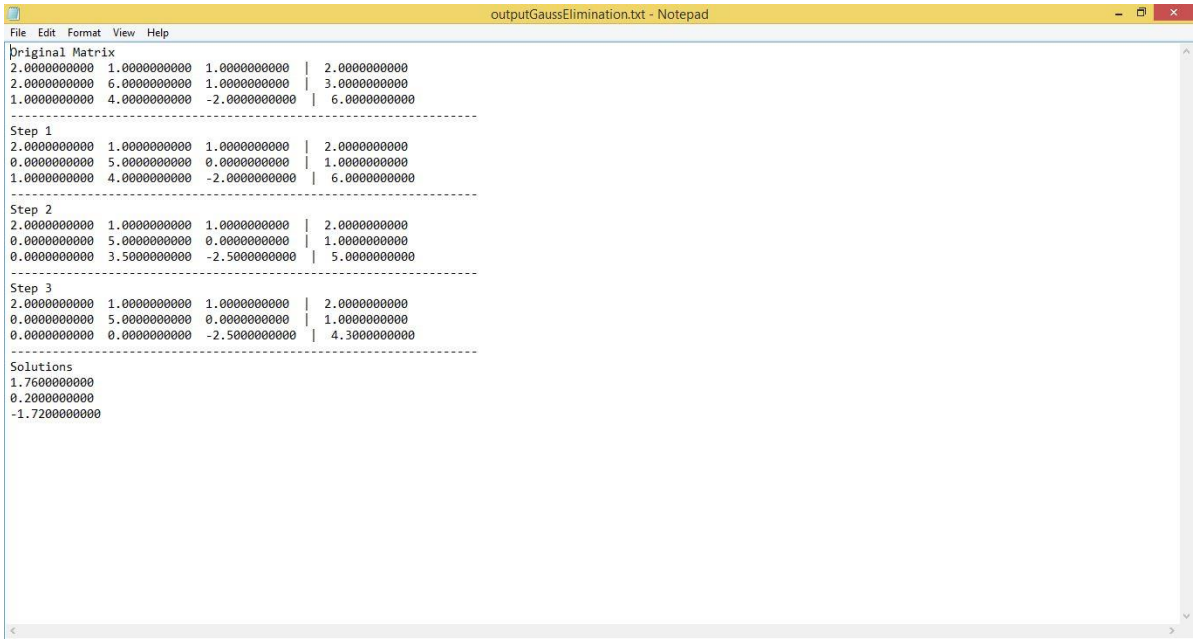


Curve for x3

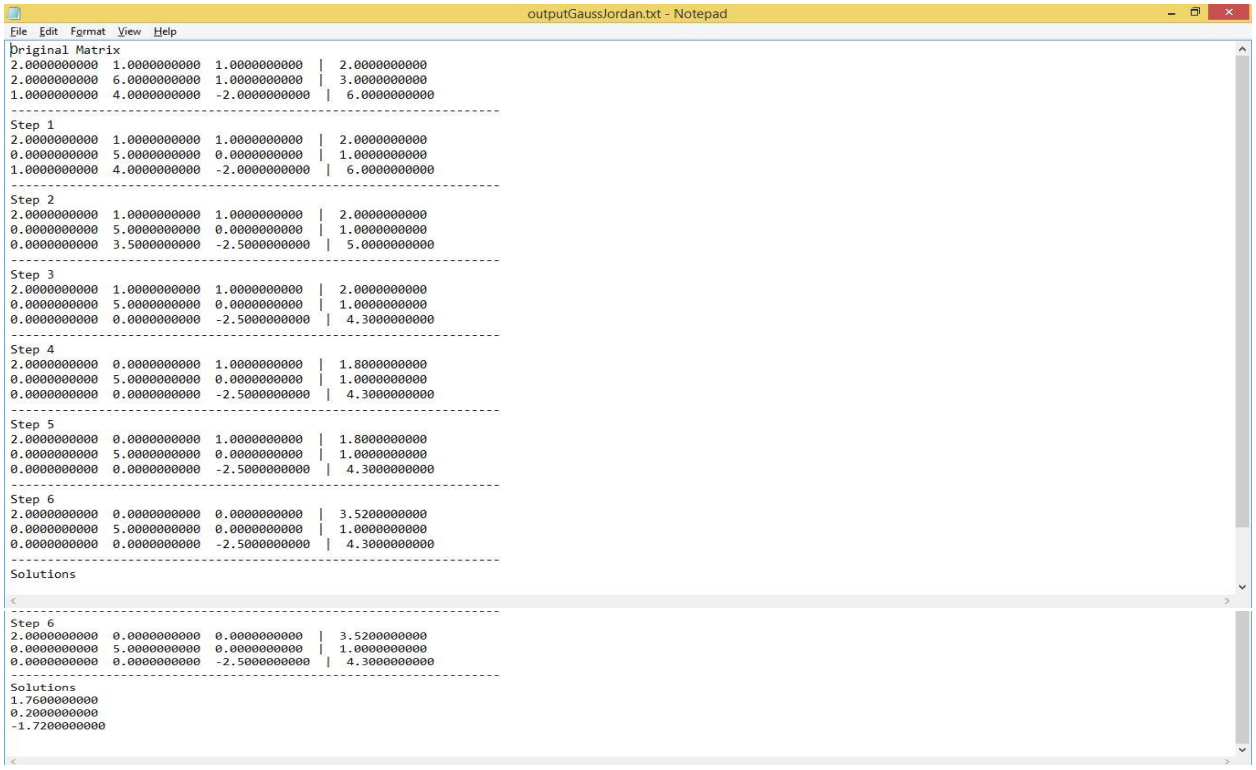


The output Files :

- Gauss Elimination File :



- Gauss Jordan File :



- LU Decomposition File :

outputLUDecomposition.txt - Notepad

File Edit Format View Help

```
Matrix A
2.0000000000  1.0000000000  1.0000000000
2.0000000000  6.0000000000  1.0000000000
1.0000000000  4.0000000000  -2.0000000000
----------------------------------------------------------------------
Step 1 to get U
3.0000000000  1.0000000000  1.0000000000
0.0000000000  6.0000000000  0.0000000000
1.0000000000  4.0000000000  -1.0000000000
----------------------------------------------------------------------
Step 2 to get U
3.0000000000  1.0000000000  1.0000000000
0.0000000000  6.0000000000  0.0000000000
0.0000000000  3.5000000000  -1.5000000000
----------------------------------------------------------------------
Matrix U
3.0000000000  1.0000000000  1.0000000000
0.0000000000  6.0000000000  0.0000000000
0.0000000000  0.0000000000  -1.5000000000
----------------------------------------------------------------------
Matrix L
1.0000000000  0.0000000000  0.0000000000
1.0000000000  1.0000000000  0.0000000000
0.5000000000  0.7000000000  1.0000000000
----------------------------------------------------------------------
Y Solutions
2.0000000000
1.0000000000
4.3000000000
----------------------------------------------------------------------
X Solutions
1.7600000000
0.2000000000
-1.7200000000
```

- Gauss Seidel File :

outputGaussSeidel.txt - Notepad

File Edit Format View Help

i	x1i	x2i	x3i	x1i+1	x2i+1	x3i+1	Err1	Err2	Err3	Time
1.000000	0.500000	0.000000	0.500000	0.750000	0.166667	-2.291667	0.000000	0.000000	0.000000	0.280881
2.000000	0.750000	0.166667	-2.291667	2.062500	0.194444	-1.579861	1.312500	0.027778	0.711806	0.378859
3.000000	2.062500	0.194444	-1.579861	1.692708	0.199074	-1.755498	0.369792	0.004630	0.175637	0.408618
4.000000	1.692708	0.199074	-1.755498	1.778212	0.199846	-1.711203	0.085503	0.000772	0.044295	0.464212
5.000000	1.778212	0.199846	-1.711203	1.755679	0.199974	-1.722212	0.022533	0.000129	0.011009	0.536877
6.000000	1.755679	0.199974	-1.722212	1.761119	0.199996	-1.719449	0.005440	0.000021	0.002763	0.533473
7.000000	1.761119	0.199996	-1.719449	1.759727	0.199999	-1.720138	0.001392	0.000004	0.000689	0.424804
8.000000	1.759727	0.199999	-1.720138	1.760069	0.200000	-1.719966	0.000343	0.000001	0.000173	0.499120
9.000000	1.760069	0.200000	-1.719966	1.759983	0.200000	-1.720009	0.000087	0.000000	0.000043	0.409948
10.000000	1.759983	0.200000	-1.720009	1.760004	0.200000	-1.719998	0.000021	0.000000	0.000011	0.520069
11.000000	1.760004	0.200000	-1.719998	1.759999	0.200000	-1.720001	0.000005	0.000000	0.000003	0.449175

- Jacobi Iterative File :

outputJacobiIterative.txt - Notepad

File Edit Format View Help

i	x1i	x2i	x3i	x1i+1	x2i+1	x3i+1	Err1	Err2	Err3	Time
1.000000	0.000000	0.000000	0.000000	1.000000	0.500000	-3.000000	0.000000	0.000000	0.000000	0.242039
2.000000	1.000000	0.500000	-3.000000	2.250000	0.666667	-1.500000	1.250000	0.166667	1.500000	0.458919
3.000000	2.250000	0.666667	-1.500000	1.416667	0.000000	-0.541667	0.833333	0.666667	0.958333	0.489714
4.000000	1.416667	0.000000	-0.541667	1.270833	0.118056	-2.291667	0.145833	0.118056	1.750000	0.568842
5.000000	1.270833	0.118056	-2.291667	2.086806	0.458333	-2.128472	0.815972	0.340278	0.163194	0.555227
6.000000	2.086806	0.458333	-2.128472	1.835069	0.159144	-1.039931	0.251736	0.299190	1.088542	0.403346
7.000000	1.835069	0.159144	-1.039931	1.440394	0.061632	-1.764178	0.394676	0.097512	0.724248	0.461806
8.000000	1.440394	0.061632	-1.764178	1.851273	0.313899	-2.156539	0.410880	0.252267	0.392361	0.417241
9.000000	1.851273	0.313899	-2.156539	1.921320	0.242332	-1.446566	0.070047	0.071566	0.709973	0.429901
10.000000	1.921320	0.242332	-1.446566	1.602117	0.100654	-1.554675	0.319203	0.141678	0.108109	0.436206
11.000000	1.602117	0.100654	-1.554675	1.727011	0.225074	-1.997633	0.124894	0.124419	0.442957	0.433233
12.000000	1.727011	0.225074	-1.997633	1.886280	0.257269	-1.686348	0.159269	0.032195	0.311285	0.469826
13.000000	1.886280	0.257269	-1.686348	1.714539	0.152298	-1.542323	0.171740	0.104971	0.144025	0.440361
14.000000	1.714539	0.152298	-1.542323	1.695012	0.185541	-1.838134	0.019527	0.033243	0.295811	0.432531
15.000000	1.695012	0.185541	-1.838134	1.826297	0.241352	-1.781412	0.131284	0.055811	0.056722	0.468466
16.000000	1.826297	0.241352	-1.781412	1.770030	0.188136	-1.604149	0.056266	0.053215	0.177264	0.425963
17.000000	1.770030	0.188136	-1.604149	1.708006	0.177348	-1.738712	0.062024	0.010789	0.134563	0.517977
18.000000	1.708006	0.177348	-1.738712	1.780682	0.220450	-1.791301	0.072676	0.043102	0.052589	0.454373
19.000000	1.780682	0.220450	-1.791301	1.785426	0.204990	-1.668759	0.004744	0.015460	0.122542	0.489219
20.000000	1.785426	0.204990	-1.668759	1.731885	0.182985	-1.697308	0.053541	0.022005	0.028549	0.484976
21.000000	1.731885	0.182985	-1.697308	1.757162	0.205590	-1.768088	0.025277	0.022605	0.070780	0.547858
22.000000	1.757162	0.205590	-1.768088	1.781249	0.208961	-1.710240	0.024088	0.003371	0.057849	0.541107
23.000000	1.781249	0.208961	-1.710240	1.750639	0.191290	-1.691454	0.030610	0.017671	0.018786	0.538663
24.000000	1.750639	0.191290	-1.691454	1.750082	0.198362	-1.742100	0.000558	0.007072	0.050646	0.608378
25.000000	1.750082	0.198362	-1.742100	1.771869	0.206989	-1.728234	0.021787	0.008627	0.013866	0.548001
26.000000	1.771869	0.206989	-1.728234	1.760622	0.197416	-1.700087	0.011246	0.009573	0.028147	0.505299
27.000000	1.760622	0.197416	-1.700087	1.751335	0.196474	-1.724857	0.009287	0.000942	0.024770	0.475961
28.000000	1.751335	0.196474	-1.724857	1.764191	0.203698	-1.731385	0.012856	0.007224	0.006528	0.501723
29.000000	1.764191	0.203698	-1.731385	1.763844	0.200500	-1.710509	0.000348	0.003197	0.020876	0.526536
30.000000	1.763844	0.200500	-1.710509	1.755004	0.197137	-1.717077	0.008839	0.003363	0.006569	0.888799
31.000000	1.755004	0.197137	-1.717077	1.759970	0.201178	-1.728224	0.004966	0.004041	0.011146	0.718667
32.000000	1.759970	0.201178	-1.728224	1.763523	0.201381	-1.717659	0.003553	0.000202	0.010565	0.525600
33.000000	1.763523	0.201381	-1.717659	1.758139	0.198435	-1.715477	0.005384	0.002945	0.002181	0.484615
34.000000	1.758139	0.198435	-1.715477	1.758521	0.199867	-1.724060	0.000382	0.001431	0.008582	0.407639
35.000000	1.758521	0.199867	-1.724060	1.762097	0.201170	-1.721006	0.003576	0.001303	0.003053	0.299097

30.000000	1.763844	0.200500	-1.710509	1.755004	0.197137	-1.717077	0.008839	0.003363	0.006569	0.888799
31.000000	1.755004	0.197137	-1.717077	1.759970	0.201178	-1.728224	0.004966	0.004041	0.011146	0.718667
32.000000	1.759970	0.201178	-1.728224	1.763523	0.201381	-1.717659	0.003553	0.000202	0.010565	0.525600
33.000000	1.763523	0.201381	-1.717659	1.758139	0.198435	-1.715477	0.005384	0.002945	0.002181	0.484615
34.000000	1.758139	0.198435	-1.715477	1.758521	0.199867	-1.724060	0.000382	0.001431	0.008582	0.407639
35.000000	1.758521	0.199867	-1.724060	1.762097	0.201170	-1.721006	0.003576	0.001303	0.003053	0.299097
36.000000	1.762097	0.201170	-1.721006	1.759918	0.199469	-1.716613	0.002178	0.001701	0.004394	0.391191
37.000000	1.759918	0.199469	-1.716613	1.758572	0.199463	-1.721103	0.001347	0.000006	0.004490	0.525877
38.000000	1.758572	0.199463	-1.721103	1.760820	0.200660	-1.721789	0.002248	0.001197	0.000686	0.498912
39.000000	1.760820	0.200660	-1.721789	1.760564	0.200025	-1.718270	0.000256	0.000635	0.003519	0.681253
40.000000	1.760564	0.200025	-1.718270	1.759123	0.199524	-1.719668	0.001442	0.000501	0.001398	0.523137
41.000000	1.759123	0.199524	-1.719668	1.760072	0.200237	-1.721392	0.000950	0.000714	0.001723	0.389077
42.000000	1.760072	0.200237	-1.721392	1.760577	0.200208	-1.719490	0.000505	0.000029	0.001902	0.400020
43.000000	1.760577	0.200208	-1.719490	1.759641	0.199723	-1.719296	0.000936	0.000485	0.000194	0.452170
44.000000	1.759641	0.199723	-1.719296	1.759787	0.200002	-1.720735	0.000146	0.000280	0.001439	0.493436
45.000000	1.759787	0.200002	-1.720735	1.760366	0.200194	-1.720102	0.000579	0.000191	0.000633	0.500173
46.000000	1.760366	0.200194	-1.720102	1.759954	0.199895	-1.719430	0.000412	0.000299	0.000672	0.446500
47.000000	1.759954	0.199895	-1.719430	1.759767	0.199920	-1.720233	0.000187	0.000025	0.000803	0.450034
48.000000	1.759767	0.199920	-1.720233	1.760156	0.200116	-1.720276	0.000389	0.000196	0.000043	0.453435
49.000000	1.760156	0.200116	-1.720276	1.760080	0.199994	-1.719689	0.000077	0.000122	0.000587	0.440747
50.000000	1.760080	0.199994	-1.719689	1.759848	0.199922	-1.719972	0.000232	0.000072	0.000283	0.444436