

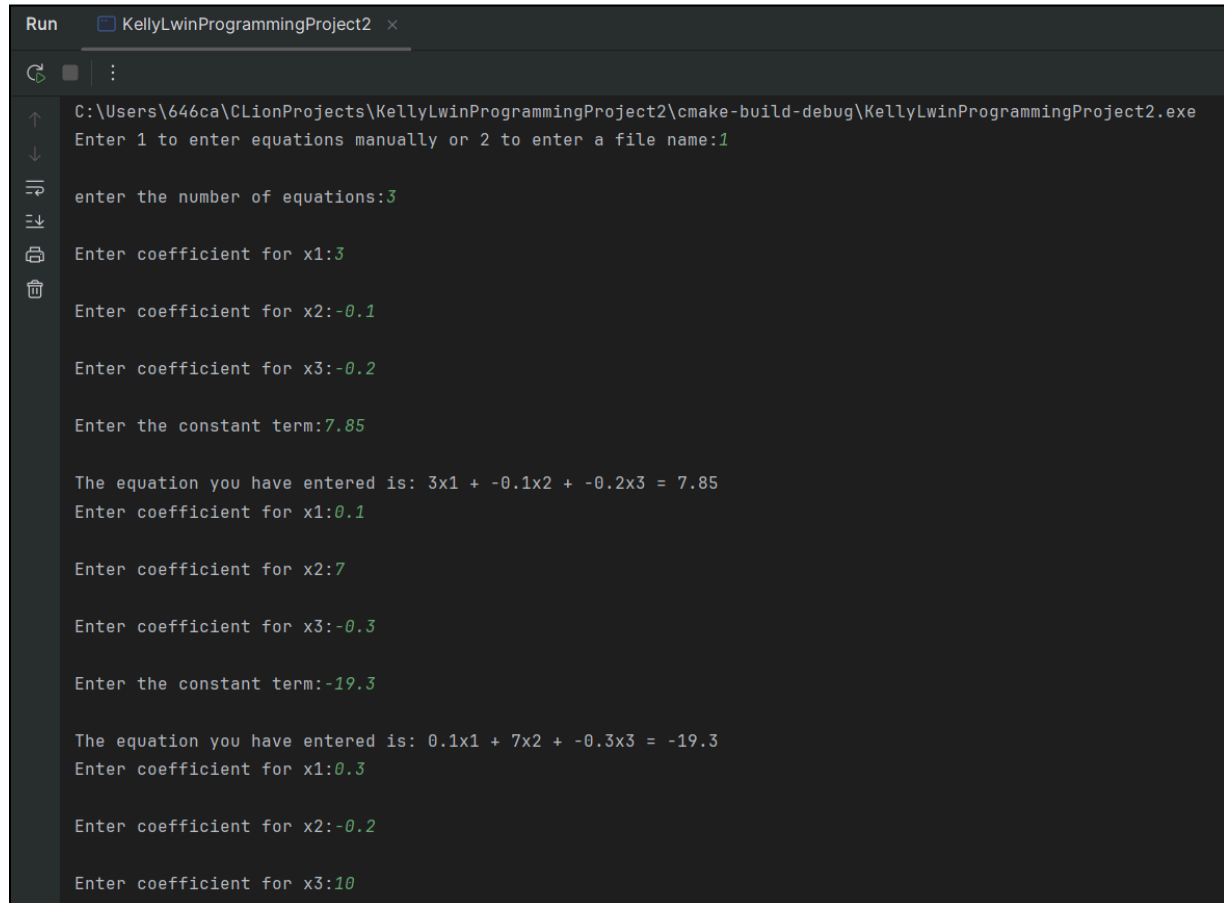
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Course: Numerical Methods (CS3010)

Date: March 23rd, 2025

Assignment: Programming Project 2 Report

Test 1 (using the coefficients the user enters themselves)



```
Run KellyLwinProgrammingProject2 x
C:\Users\646ca\CLionProjects\KellyLwinProgrammingProject2\cmake-build-debug\KellyLwinProgrammingProject2.exe
Enter 1 to enter equations manually or 2 to enter a file name:1
enter the number of equations:3
Enter coefficient for x1:3
Enter coefficient for x2:-0.1
Enter coefficient for x3:-0.2
Enter the constant term:7.85
The equation you have entered is: 3x1 + -0.1x2 + -0.2x3 = 7.85
Enter coefficient for x1:0.1
Enter coefficient for x2:7
Enter coefficient for x3:-0.3
Enter the constant term:-19.3
The equation you have entered is: 0.1x1 + 7x2 + -0.3x3 = -19.3
Enter coefficient for x1:0.3
Enter coefficient for x2:-0.2
Enter coefficient for x3:10
```

Run

KellyLwinProgrammingProject2 x



Enter coefficient for x1:0.3

Enter coefficient for x2:-0.2

Enter coefficient for x3:10

Enter the constant term:71.4

The equation you have entered is: $0.3x_1 + -0.2x_2 + 10x_3 = 71.4$

enter the desired stopping error:0.0004

enter the initial guess:0 0 0

---Jacobi Iterative Method---

Iteration 1: [2.6167 -2.7571 7.1400]T: 1.0000

Iteration 2: [3.0008 -2.4885 7.0064]T: 0.0608

Iteration 3: [3.0008 -2.4997 7.0002]T: 0.0016

Iteration 4: [3.0000 -2.5000 7.0000]T: 0.0001

Desired error reached after 4 iterations.

---Gauss-Seidel Iterative Method---

Iteration 1: [2.6167 -2.7945 7.0056]T: 1.0000

Iteration 2: [2.9906 -2.4996 7.0003]T: 0.0594

Iteration 3: [3.0000 -2.5000 7.0000]T: 0.0012

Iteration 4: [3.0000 -2.5000 7.0000]T: 0.0000

Desired error reached after 4 iterations.

Process finished with exit code 0

Test 2 (user enters the file name of the file that has the coefficients)

Input file content:

linearEquations.txt				
1	2	-1	0	1
2	-1	3	-1	8
3	0	-1	2	-5

Program Output:

```
Run KellyLwinProgrammingProject2 x
C:\Users\646ca\CLionProjects\KellyLwinProgrammingProject2\cmake-build-debug\KellyLwinProgrammingProject2.exe
Enter 1 to enter equations manually or 2 to enter a file name:2
enter file name:linearEquations.txt
enter the desired stopping error:0.00004
enter the initial guess:0 0 0
```

```
---Jacobi Iterative Method---
Iteration 1: [0.5000 2.6667 -2.5000]T: 1.0000
Iteration 2: [1.8333 2.0000 -1.1667]T: 0.6772
Iteration 3: [1.5000 2.8889 -1.5000]T: 0.2807
Iteration 4: [1.9444 2.6667 -1.0556]T: 0.1924
Iteration 5: [1.8333 2.9630 -1.1667]T: 0.0913
Iteration 6: [1.9815 2.8889 -1.0185]T: 0.0609
Iteration 7: [1.9444 2.9877 -1.0556]T: 0.0301
Iteration 8: [1.9938 2.9630 -1.0062]T: 0.0200
Iteration 9: [1.9815 2.9959 -1.0185]T: 0.0100
Iteration 10: [1.9979 2.9877 -1.0021]T: 0.0066
Iteration 11: [1.9938 2.9986 -1.0062]T: 0.0033
Iteration 12: [1.9993 2.9959 -1.0007]T: 0.0022
Iteration 13: [1.9979 2.9995 -1.0021]T: 0.0011
Iteration 14: [1.9998 2.9986 -1.0002]T: 0.0007
Iteration 15: [1.9993 2.9998 -1.0007]T: 0.0004
Iteration 16: [1.9999 2.9995 -1.0001]T: 0.0002
Iteration 17: [1.9998 2.9999 -1.0002]T: 0.0001
Iteration 18: [2.0000 2.9998 -1.0000]T: 0.0001
Iteration 19: [1.9999 3.0000 -1.0001]T: 0.0000
Iteration 20: [2.0000 2.9999 -1.0000]T: 0.0000
Desired error reached after 20 iterations.
```

```
---Gauss-Seidel Iterative Method---
Iteration 1: [0.5000 2.8333 -1.0833]T: 1.0000
Iteration 2: [1.9167 2.9444 -1.0278]T: 0.3885
Iteration 3: [1.9722 2.9815 -1.0093]T: 0.0187
Iteration 4: [1.9907 2.9938 -1.0031]T: 0.0062
Iteration 5: [1.9969 2.9979 -1.0010]T: 0.0021
Iteration 6: [1.9990 2.9993 -1.0003]T: 0.0007
Iteration 7: [1.9997 2.9998 -1.0001]T: 0.0002
Iteration 8: [1.9999 2.9999 -1.0000]T: 0.0001
Iteration 9: [2.0000 3.0000 -1.0000]T: 0.0000
Desired error reached after 9 iterations.

Process finished with exit code 0
```

Extra Credit

```
Run KellyLwinProgrammingProject2 x
C:\Users\646ca\CLionProjects\KellyLwinProgrammingProject2\cmake-build-debug\KellyLwinProgrammingProject2.exe

n = 20:
jacobi time: 0.0002 seconds
gauss-seidel time: 0.0001 seconds

n = 50:
jacobi time: 0.0004 seconds
gauss-seidel time: 0.0003 seconds

n = 100:
jacobi time: 0.0008 seconds
gauss-seidel time: 0.0007 seconds

Process finished with exit code 0
```

```
Run KellyLwin_CS3010_ProgrammingProject1 x
C:\Users\646ca\CLionProjects\KellyLwin_CS3010_ProgrammingProject1\cmake-build-debug\KellyLwin_CS3010_ProgrammingProject1.exe

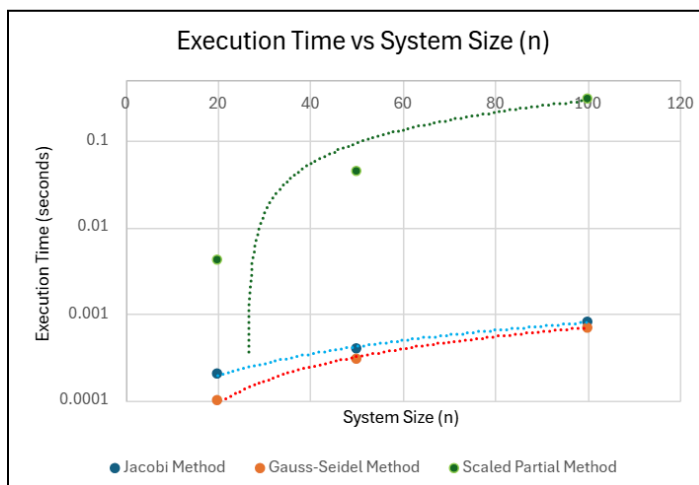
n = 20:
Gaussian Elimination with Scaled partial pivoting method time: 20: 0.0043 seconds

n = 50:
Gaussian Elimination with Scaled partial pivoting method time: 50: 0.0453 seconds

n = 100:
Gaussian Elimination with Scaled partial pivoting method time: 100: 0.3134 seconds

Process finished with exit code 0
```

I tested my programs with large values of n such as 20, 50, and 100 and random values for coefficients in the system. I did not run into any issues. Below is the graph of how the time increases as the number of equations increases for different methods.



The logarithmic scale is used so that Gauss-Seidel and Jacobi lines would not appear flat when visualizing.

- The Jacobi and Gauss-Seidel methods handle bigger systems well — their execution time grows slowly as the system size increases.
- In contrast, the Scaled Partial Method doesn't scale well — its execution time increases quickly and becomes much slower for larger systems.