Tasks:

Produce a source program for Gaussian elimination with partial pivoting and back substitution for solving a linear system $Ax = b$. And apply for function for the following system:

- generate a sub-triangular matrix L with diagonals $= 1$, and others being random numbers between 0 and 1, compute $A = LL^T$. Say the size of A is $N \times N$.
- generate a random vector b of length N with entries between 0 and 1.
- solve $Ax = b$.

1. Use Makefile. Submit source codes and screenshots.
2. Push the code to GitHub.
3. File transfer and Up-to-date in Nova cluster

Submission Files and Results:

1. Screenshot

```
(base) ubuntu@ubuntu-vm:~/Documents/chandanaWorkspace/CPRE 525 Spring 2023/CPRE525Spring2023/12. Lab Assignment 13/matrix$ make
gcc -O3 -Wall -c main.c
gcc  main.o matrix.o -o main.exe
(base) ubuntu@ubuntu-vm:~/Documents/chandanaWorkspace/CPRE 525 Spring 2023/CPRE525Spring2023/12. Lab Assignment 13/matrix$ ./main.exe

L =
 | -1.000e+00,  0.000e+00,  0.000e+00,  0.000e+00,  0.000e+00 |
 |  4.185e-01, -1.000e+00,  0.000e+00,  0.000e+00,  0.000e+00 |
 |  4.185e-01,  4.185e-01, -1.000e+00,  0.000e+00,  0.000e+00 |
 |  4.185e-01,  4.185e-01,  4.185e-01, -1.000e+00,  0.000e+00 |
 |  4.185e-01,  4.185e-01,  4.185e-01,  4.185e-01, -1.000e+00 |


L_Transpose =
 | -1.000e+00,  4.185e-01,  4.185e-01,  4.185e-01,  4.185e-01 |
 |  0.000e+00, -1.000e+00,  4.185e-01,  4.185e-01,  4.185e-01 |
 |  0.000e+00,  0.000e+00, -1.000e+00,  4.185e-01,  4.185e-01 |
 |  0.000e+00,  0.000e+00,  0.000e+00, -1.000e+00,  4.185e-01 |
 |  0.000e+00,  0.000e+00,  0.000e+00,  0.000e+00, -1.000e+00 |


A =
 |  1.000e+00, -4.185e-01, -4.185e-01, -4.185e-01, -4.185e-01 |
 | -4.185e-01,  1.175e+00, -2.434e-01, -2.434e-01, -2.434e-01 |
 | -4.185e-01, -2.434e-01,  1.350e+00, -6.823e-02, -6.823e-02 |
 | -4.185e-01, -2.434e-01, -6.823e-02,  1.525e+00,  1.069e-01 |
 | -4.185e-01, -2.434e-01, -6.823e-02,  1.069e-01,  1.700e+00 |


b =
 |  5.733e-01,  8.459e-01,  4.811e-01,  3.967e-01,  8.480e-01 |^T


x =
 |  6.279e+00,  4.788e+00,  3.439e+00,  2.711e+00,  2.697e+00 |^T
```

2. Push the code to GitHub
   a. Git status check

```
(base) ubuntu@ubuntu-vm:~/Documents/chandanaWorkspace/CPRE 525 Spring 2023/CPRE525Spring2023$ git status
On branch main
Your branch is up to date with 'origin/main'.

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   11. Lab Assignment 12/Makefile
        modified:   11. Lab Assignment 12/Peek.c
        modified:   11. Lab Assignment 12/Pop.c
        modified:   11. Lab Assignment 12/Push.c

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        11. Lab Assignment 12/11. Lab Assignment 12 Submission.pdf
        12. Lab Assignment 13/

no changes added to commit (use "git add" and/or "git commit -a")
```

b. Git add and git status

```
(base) ubuntu@ubuntu-vm:~/Documents/chandanaWorkspace/CPRE 525 Spring 2023/CPRE525Spring2023$ git add .
(base) ubuntu@ubuntu-vm:~/Documents/chandanaWorkspace/CPRE 525 Spring 2023/CPRE525Spring2023$ git status
On branch main
Your branch is up to date with 'origin/main'.

Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   11. Lab Assignment 12/11. Lab Assignment 12 Submission.pdf
        modified:   11. Lab Assignment 12/Makefile
        modified:   11. Lab Assignment 12/Peek.c
        modified:   11. Lab Assignment 12/Pop.c
        modified:   11. Lab Assignment 12/Push.c
        new file:   12. Lab Assignment 13/matrix/Makefile
        new file:   12. Lab Assignment 13/matrix/main.c
        new file:   12. Lab Assignment 13/matrix/main.exe
        new file:   12. Lab Assignment 13/matrix/main.o
        new file:   12. Lab Assignment 13/matrix/matrix.c
        new file:   12. Lab Assignment 13/matrix/matrix.h
        new file:   12. Lab Assignment 13/matrix/matrix.o
```

c. Git committed the files

```
(base) ubuntu@ubuntu-vm:~/Documents/chandanaWorkspace/CPRE 525 Spring 2023/CPRE525Spring2023$ git commit -m "Adding Files"
[main 2252d73] Adding Files
 12 files changed, 399 insertions(+), 5 deletions(-)
 create mode 100644 11. Lab Assignment 12/11. Lab Assignment 12 Submission.pdf
 create mode 100644 12. Lab Assignment 13/matrix/Makefile
 create mode 100644 12. Lab Assignment 13/matrix/main.c
 create mode 100755 12. Lab Assignment 13/matrix/main.exe
 create mode 100644 12. Lab Assignment 13/matrix/main.o
 create mode 100644 12. Lab Assignment 13/matrix/matrix.c
 create mode 100644 12. Lab Assignment 13/matrix/matrix.h
 create mode 100644 12. Lab Assignment 13/matrix/matrix.o
```

d. Git push

```
(base) ubuntu@ubuntu-vm:~/Documents/chandanaWorkspace/CPRE 525 Spring 2023/CPRE525Spring2023$ git push
Username for 'https://github.com': Saichandana999
Password for 'https://Saichandana999@github.com':
Enumerating objects: 23, done.
Counting objects: 100% (23/23), done.
Delta compression using up to 8 threads
Compressing objects: 100% (16/16), done.
Writing objects: 100% (17/17), 645.34 KiB | 12.91 MiB/s, done.
Total 17 (delta 6), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (6/6), completed with 6 local objects.
To https://github.com/Saichandana999/CPRE525Spring2023.git
   49f59b6..2252d73  main -> main
```

e. Final GitHub repository

3. Files transferred and up-to-date in Nova cluster.

```
[vsc@nova ~]$ tree

└── CPRE525Spring2023
    ├── 10. lab Assignment 11
    │   ├── 10. Lab Assignment 11 Submission.pdf
    │   ├── DeleteList.c
    │   ├── DeleteList.o
    │   ├── GenerateList.c
    │   ├── GenerateList.o
    │   ├── GetKey.c
    │   ├── GetKey.o
    │   ├── GetNumberOfNodes.c
    │   ├── GetNumberOfNodes.o
    │   ├── main.c
    │   ├── main.exe
    │   ├── main.o
    │   ├── Makefile
    │   ├── node.h
    │   ├── Print.c
    │   ├── Print.o
    │   ├── SearchList.c
    │   └── SearchList.o
    ├── 11. Lab Assignment 12
    │   ├── 11. Lab Assignment 12 Submission.pdf
    │   ├── DeleteStack.c
    │   ├── DeleteStack.o
    │   ├── DisplayOptions.c
    │   ├── DisplayOptions.o
    │   ├── DisplayStack.c
    │   ├── DisplayStack.o
    │   ├── GetStackSize.c
    │   ├── GetStackSize.o
    │   ├── main.c
    │   ├── main.exe
    │   ├── main.o
    │   ├── Makefile
    │   ├── node.h
    │   ├── Option.c
    │   ├── Option.o
    │   ├── Peek.c
    │   ├── Peek.o
    │   ├── Pop.c
    │   ├── Pop.o
    │   ├── Push.c
    │   └── Push.o
    └── 12. Lab Assignment 13
        └── matrix
            ├── main.c
            ├── main.exe
            ├── main.o
            ├── Makefile
            ├── matrix.c
            ├── matrix.h
            └── matrix.o
```