

# Numerical Analysis

## Homework 2. LU Decomposition

**Due: March 17, 2015**

Given an  $n \times n$  nonsingular matrix  $\mathbf{A}$ , LU decomposition is an efficiency and direct method to solve the linear system  $\mathbf{Ax} = \mathbf{b}$ , where  $\mathbf{x}$  is the unknown vector and  $\mathbf{b}$  is the right-hand side. Please add the following nonmember functions in your `MAT.h` header file.

```
MAT &luFact(MAT &m1);           // LU decomposition
VEC fwdSubs(MAT &m1, VEC b);     // forward substitution
VEC bckSubs(MAT &m1, VEC b);     // backward substitution
```

Update your `MAT.cpp` source file to define these functions properly. Then write a `C++` program to test these functions. Again, seven files are provided for your testing of the program: `m3.dat`, `m4.dat`, `m5.dat`, `m6.dat`, `m7.dat`, `m8.dat`, and `m9.dat`. The first line of each file is the dimension of the system. Followed by the  $n \times n$   $\mathbf{A}$  matrix and the right hand side vector  $\mathbf{b}$ .

While testing your program, please use the unix command `time` to record the CPU spent on each matrix. Plot the CPU time vs. the dimension of the system and write your observations in `hw02.pdf` file.

### Notes.

1. For this homework you need to turn in a `C++` program that solves a linear system. Please name this program `hw02.cpp`. The header and definition files for both `VEC` and `MAT` classes, `VEC.h`, `VEC.cpp`, `MAT.h` and `MAT.cpp`, also need to be turned in.
2. A `pdf` file is also needed. This file should include a plot that shows the CPU time as a function of the linear dimension of the system. Also, state your observations in this report. Please name this report `hw02a.pdf`.
3. Submit your `hw02.cpp`, `VEC.h`, `VEC.cpp`, `MAT.h`, `MAT.cpp` and `hw02a.pdf` on EE workstations. Please use the following command to submit your homework 2.

```
~ee407002/bin/submit hw02 hw02.cpp VEC.h VEC.cpp MAT.h MAT.cpp hw02a.pdf
```

where `hw02` indicates homework 2.

4. Your report should be clearly written such that I can understand it. The writing, including English grammar, is part of the grading criteria.
5. It is known that these seven matrices are nonsingular and diagonally dominant. No pivoting is needed in LU decomposition of these seven matrices. Thus, no pivoting is required for this homework.