

**CS416 Spring 2007**

Prof. Wright

**Assignment #6**

**Due March 23, 2007**

1. Find by hand the  $LU$  factorization (without pivoting) of the matrix

$$A = \begin{bmatrix} 2 & 3 & 0 \\ -1 & 2 & -1 \\ 3 & 0 & 2 \end{bmatrix},$$

writing out the Gauss transformations you used to eliminate each sub-diagonal element, and their inverses. Use the  $LU$  factors to solve the linear system  $Ax = b$ , where  $b = (8, 0, 9)^T$ .

2. Write a Matlab code `lunaive.m` to form the  $LU$  factorization of a square matrix  $A$ . (The first lines for your code are given in a stub on the class web site.) Your routine should return an error code if a small pivot is encountered during the factorization. Specifically, if it encounters a situation in which the multiplier needed to eliminate the  $(i, j)$  element of the matrix would be greater than  $10^6$  in magnitude (or is infinite), it returns an error argument with value  $i$ . See the comments in the stub for details.
3. Write a Matlab code `lsol.m` that solves a unit lower triangular system for a given matrix  $L$  and right-hand side  $b$ . Write a Matlab code `usol.m` that solves an upper triangular system for a given matrix  $U$ .
4. Write a code `as6.m` that tests your codes above on the following data. In each case, write out  $L$ ,  $U$ , and the solutions  $x$ , and check that each solution is satisfactory by writing out the norm of  $Ax - b$ .

(a)  $A = \begin{bmatrix} 3 & 4 & 3 \\ 1 & 5 & -1 \\ 6 & 3 & 7 \end{bmatrix}$  and the two right hand sides  $b = (10, 7, 15)^T$   
and  $b = (0, 3, 2)^T$ . (Perform the LU factorization only once.)

(b)  $A = \begin{bmatrix} 1 & 3 & 2 & 1 \\ 4 & 2 & 1 & 2 \\ 2 & 1 & 2 & 3 \\ 1 & 2 & 4 & 1 \end{bmatrix}$ ,  $b = (-2, 2, 1, -1)^T$ .

Hand in hard copies of your codes `as6.m`, `lunaive.m`, `lsol.m`, `usol.m`, and your output together with your written answers. Put your codes in a directory called `homework6`. From the parent directory of `homework6`, run the following command:

```
handin -c cs416-1 -a hwk6 -d homework6
```