

## ACM40290: NUMERICAL ALGORITHMS

### Assignment 4: LINEAR ALGEBRA AND STABILITY

**Purpose.** The original purpose of MATLAB was to allow the user to do computations with matrices without all the tedious detail needed in general programming languages. Today, MATLAB is the best, although not necessarily the fastest, system for matrix calculations.

**Exercise.**

- (1) Use MATLAB to solve  $Ax = b$ , where

$$A = \begin{pmatrix} 5 & 7 & 6 & 5 \\ 7 & 10 & 8 & 7 \\ 6 & 8 & 10 & 9 \\ 5 & 7 & 9 & 10 \end{pmatrix} \quad b = \begin{pmatrix} 23 \\ 32 \\ 33 \\ 31 \end{pmatrix}$$

The exact answer is  $x^T = [1111]$  (Check by calculating  $Ax$ ).

Answer the following:

- (a) What is the relative error in the calculated  $\hat{x}$ ?
  - (b) What is the residual vector  $r = b - A\hat{x}$ ?
  - (c) What is  $\text{cond}(A)$ ?
  - (d) Use MATLAB's `lu(A)` to find the factors  $L$ ,  $U$ , and  $P$ .  
Show how these factors are related to  $A$ .
- (2) Change the element  $a_{23}$  of  $A$  from 8 to  $8 - \frac{1}{10}$  and repeat question (1) Explain what has happened and identify where precisely the problem lies, using any further calculations you think necessary.

**Due: 12pm Thursday, November 16th 2017**