

AMSC/CMSC460 Section 2.

Homework Set 3

Due: Th April 13, 2011. 10:45am
By the end of the class

1. Norms: Compute $\|\cdot\|_1$, $\|\cdot\|_2$, and $\|\cdot\|_\infty$,

a) Vectors Compute $\|\cdot\|_1$, $\|\cdot\|_2$, and $\|\cdot\|_\infty$ for

i) $\mathbf{a}=[1 \ 2 \ 3]$

ii) $\mathbf{a}=[1 \ 1/10 \ 3/7 \ 4/9]'$;

b) matrix: Compute $\|\cdot\|_1$, $\|\cdot\|_2$, and $\|\cdot\|_\infty$ for $\mathbf{A} = \mathbf{a} \mathbf{b}$ where

$\mathbf{a}=\sin([0; \pi/4; \pi/2])$

$\mathbf{b}=\cos([0 \ \pi/3 \ 2\pi/3 \ \pi])$

i) keeping $(2)^{1/2}$ & $(3)^{1/2}$, then using calculator on $(2)^{1/2}$ & $(3)^{1/2}$

ii) using MATLAB, plot $[1:N]'$ vs column vectors of \mathbf{A} & $[1:M]$ vs row vectors where $N \times M$ is the dimension of \mathbf{A}

2. MATLAB code writing for linear system $\mathbf{A} \mathbf{x} = \mathbf{b}$ where \mathbf{A} and \mathbf{b} are given

Note:

- You can call functions in your functions, as long as you write them all.

a) Gaussian Elimination:

(i) Write a MATLAB function pseudo-code for naïve Gaussian elimination

function $[\mathbf{x}] = \text{GaussElim_naive}(\mathbf{A}, \mathbf{b})$

(ii) Write a MATLAB function pseudo-code for Gaussian elimination with partial pivoting

function $[\mathbf{x}] = \text{GaussElim_pivp}(\mathbf{A}, \mathbf{b})$

(iii) Write a MATLAB function pseudo-code for Gaussian elimination with scaled partial pivoting

function $[\mathbf{x}] = \text{GaussElim_pivsp}(\mathbf{A}, \mathbf{b})$

(iv) Write MATLAB codes for (i)-(iv). Verification problem is given in 3.

b) LU Factorization

(i) Write a MATLAB function pseudo-code for LU factorization that returns \mathbf{L} , \mathbf{U} , and pivoting (permutation) vector \mathbf{p}

function $[\mathbf{L}, \mathbf{U}, \mathbf{p}] = \text{LU}(\mathbf{A})$

(ii) Write a MATLAB function pseudo-code for solving $\mathbf{L} \mathbf{y} = \mathbf{b}$ with \mathbf{p}

function $[\mathbf{y}] = \text{Ltri_p}(\mathbf{L}, \mathbf{b}, \mathbf{p})$

(iii) Write a MATLAB function pseudo-code for solving $\mathbf{U} \mathbf{x} = \mathbf{y}$

function $[\mathbf{x}] = \text{Utri}(\mathbf{U}, \mathbf{y})$

(iv) Write a MATLAB function pseudo-code for solving the linear system $\mathbf{A} \mathbf{x} = \mathbf{b}$ using the LU factorization.

function $[\mathbf{x}] = \text{LU_sys}(\mathbf{A}, \mathbf{b})$

3. MATLAB code application

a) Apply your code (2.a.iv) to

$$\begin{pmatrix} \varepsilon & 1 \\ 1 & 1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$

for $\varepsilon=10^n$, where $n=[-2:-2:-18]$. For each n ,

- (i) Obtain $(x_1, x_2)'$.
- (ii) Compute residual r .

b) Apply MATLAB Command “\” and repeat (a)