

Assignment #4

Due Monday 25 February, 2013 (REVISED DATE) at the start of class

Please read Lectures 4, 5, 6, and 9 in the textbook *Numerical Linear Algebra* by Trefethen and Bau. Do these exercises:

P9. (a) Use the built-in SVD command in MATLAB to compute the SVD of

$$A = \begin{bmatrix} 3 & 0 & -1 & 0 \\ -6 & 7 & 9 & 1 \\ 3 & e & \pi & 2 \\ -9 & 7 & 10 & 1 \end{bmatrix}$$

Also, what are the condition number and rank of A , according to MATLAB's built-in commands `cond()` and `rank()`?

(b) Given a nonzero matrix $A \in \mathbb{C}^{m \times n}$ with singular values $\{\sigma_j\}$, ordered as usual so that $\sigma_1 \geq \sigma_2 \geq \dots$, and given $\epsilon \geq 0$, define the ϵ -rank of A to be the integer k so that $\sigma_j > \epsilon \sigma_1$ if $j \leq k$ and $\sigma_j \leq \epsilon \sigma_1$ if $j > k$. Show that $\epsilon\text{-rank}(A) \leq \text{rank}(A)$ for every $\epsilon \geq 0$.

(c) Write a MATLAB function with first line

```
function z = epsrank(A, myeps)
```

which computes the ϵ -rank of A . What is the 10^{-6} -rank of A in part (a)? What is the 10^{-17} -rank? How does the built-in rank command in MATLAB actually work?

Exercise 3.3 in Lecture 3. Do parts (c) and (d).

Exercise 4.1 in Lecture 4. Do parts (a), (c), and (d).

Exercise 4.4 in Lecture 4.

Exercise 5.1 in Lecture 5.

Exercise 5.2 in Lecture 5.

Exercise 9.3 in Lecture 9. I have done part (a); see one of these online:

<http://www.dms.uaf.edu/~bueler/hello.m>

<http://www.dms.uaf.edu/~bueler/hello.py>

So do parts (b) and (c).