MATH 726 — University of South Carolina
D. Meade — Spring 1996

Assignment #2: Norms and the SVD

Due: Friday, 9 February 1996

Problems from Golub and VanLoan:

Section	Page	Problems
2.5	74	# 2.5.2
		# 2.5.8
2.7	84	# 2.7.1
		(Compute $\|I\|$ in all matrix norms we have discussed.)

Other Problems

1. Graph the sets $\{x \in \mathrm{R}^2 : \|x\| = 1\}$ for the 1-, 2-, 4-, and ∞-norms. (These are the unit balls for the different norms.)

2. Graph the set $\{x \in \mathrm{R}^2 : \sum_{i=1}^{2} x_i^{1/2} = 1\}$. Why is there no 1/2-norm? (Which of the defining properties of a norm is/are not satisfied?)

3. The version of `showsvd` that I wrote adds a rank-one update to the image (matrix) at each step. Generalize the `showsvd` function so that at each step the image is updated by a matrix with rank specified by the user. Also, modify the titles to indicate relative error (in the 2-norm) between the approximate and original images.

4. Use your new version of `showsvd` to determine the lowest rank approximation which reproduces the original image with a 10%, 1%, and 0.1% relative error (in the 2-norm). How much information is needed to produce each of these approximations?

Notes

- Try to be as efficient as possible in your implementation of `showsvd`. In particular, use block matrix operations whenever possible. Matlab commands for counting, and timing, operations include `flops` and `cputime`.

- If you have any questions, please ask in class, in office hours, by e-mail, ...