Assignment #6

Due Monday, 19 October, 2015 at the start of class

Please read Lectures 6, 7, 8, and 9 in the textbook *Numerical Linear Algebra* by Trefethen and Bau. Do these exercises:

P15. *This problem replaces Exercise 9.3, which I have already done and for which I have posted the result of online. See*[1]

`bueler.github.io/M614F15/matlab/hello.m`
`bueler.github.io/M614F15/matlab/svdhello.m`

(a) Write a MATLAB program `hi.m` that sets up the 4×9 matrix A with entry zero everywhere the image below is black and one everywhere it is white. Reproduce this image using `imagesc(A)` and `colormap gray`.

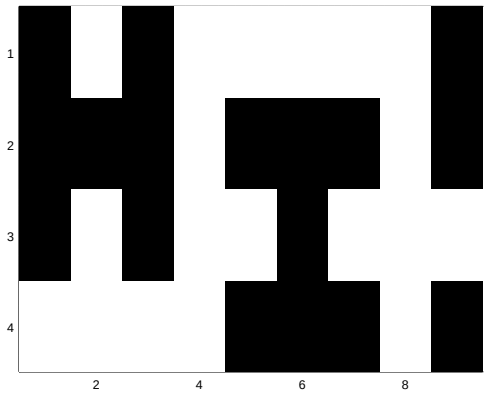

FIGURE 1. A 4×9 matrix with entry equal to zero where this is black and one where it is white.

(b) By some kind of exact by-hand calculation, explain why A has full rank; note it is "wide" with $m < n$, not "tall". After correctly stating the form of the reduced SVD for A,[2] use `svd()` to generate it. Confirm from this result that the matrix is full rank.

(c) Show,[3] with `subplot()` to put all images together in one, the rank $1, 2, 3$ approximations of A, along with A itself. That is, show all the lower-rank "compressed" approximations A_ν which are generated by using the SVD, as in Theorems 5.8.

[1] *If using Python see* `bueler.github.io/M614F15/matlab/hello.py`.

[2] It is *not* equation (4.2) in this "wide" case.

[3] You can use a `.m` program or do this at the command line. Either way, include all the commands which do use the reduced SVD to generate the images.

Exercise 5.3 in Lecture 5.

Exercise 5.4 in Lecture 5.

Exercise 6.1 in Lecture 6.

Exercise 6.3 in Lecture 6. (*Hint: Yes, you can use the SVD.*)

Exercise 6.4 in Lecture 6.

Exercise 7.1 in Lecture 7.

Exercise 7.4 in Lecture 7. (*Hint: Think about formula* (7.8).)