AMS 526 Homework 2

Due: Wednesday 09/26 in class

1. (10 points) Exercise 1.6.5 on p. 69 (You can use Octave instead of MATLAB for this problem, and use $m = 10$ instead of $m = 20$ if spy takes too long for $m = 20$.)

2. (10 points) Gaussian elimination can be used to compute the inverse A^{-1} of a nonsingular matrix $A \in \mathbb{R}^{n \times n}$, though it is rarely really necessary to do so.

   (a) Describe an algorithm for computing A^{-1} by solving n systems of equations, and show that its asymptotic operation count is $\frac{8}{3}n^3$ flops.

   (b) Describe a variant of your algorithm, taking advantage of sparsity, that reduces the operations count to $2n^3$ flops.

3. (10 points) Exercise 1.8.28 on p. 106

4. (20 points) Exercise 2.1.32 and 2.1.33 on p. 122

5. (10 points) Exercise 2.2.24 on p. 129

6. (10 points) Exercise 2.3.12 on p. 136

7. (30 points) Following the code template provided, write a C program implementing Gaussian elimination with no pivoting, partial pivoting, and complete pivoting. Generate several linear systems with random matrices (i.e., use a random number generator to obtain the matrix entries) and right-hand sides chosen so that the solutions are known, and compare the accuracy, residuals, and performance of the three implementations.

   Submit your program, the plots, and an analysis of your results.