

AMSC/CMSC 460: Midterm 1

Prof. Doron Levy

September 29, 2016

Read carefully the following instructions:

- Write your name & student ID on the exam book and sign it.
- You may not use any books, notes, or calculators.
- Solve all problems. Answer all problems after carefully reading them. Start every problem on a new page.
- Show all your work and explain everything you write.
- Exam time: 75 minutes
- Good luck!

Problems: (Each problem = 10 points)

1. Consider the following matrix:

$$A = \begin{pmatrix} 8 & 10 & 12 \\ 10 & 20 & 30 \\ 12 & 30 & 100 \end{pmatrix}$$

- (a) Explain how to use an LU decomposition of A to solve the linear system $Ax = b$.
- (b) Find a Doolittle decomposition for A .
- (c) Find a Cholesky decomposition for A .
- (d) Show how to use Gaussian elimination with scaled row pivoting to solve

$$Ax = \begin{pmatrix} 8 \\ 10 \\ 20 \end{pmatrix}$$

2. Let $f(x) = e^x - 3x - 2$.

- (a) Use the continuity of $f(x)$ to explain why $f(x)$ has at least one positive root.
- (b) Use a graphical argument to find the exact number of positive roots of $f(x)$. (There is no need to compute the values of the roots, just how many roots there are).
- (c) Write Newton's method for finding a root of $f(x)$.
- (d) Write the Secant method for finding a root of $f(x)$. Are there any advantages or disadvantages for using the Secant method instead of Newton's method?

3. (a) Write the number 25.22 in base 2. (Compute the first 10 digits after the binary point).
- (b) Explain two possible approaches for representing the number -25 on a computer with an 8-bit word.
- (c) What will be a floating-point representation of the number 25.22 on a machine with a 32-bit word?