IAM 550 Introduction to Engineering Computing
Computer Lab 11
Systems of linear equations
J. Raeder, December 3/5 2019

O**bjectives**:

- Practice solving linear equations.
- Practice using arrays.
- Timing algorithms and explore scaling.

Deliverables **due no later than 2 days after the end of your lab session:**

A MATLAB diary for your laboratory session (25% of your laboratory grade). This should be submitted via blackboard as an assignment no later than 2 days after your lab.

Deliverables **due one week after the lab; drop in the 550 box:**

- A lab hard-copy report summarizing your results and including all required files (m-files, tables), but **not any data files**. Make sure your name is on *all* pages of your lab report.

Task 1 of 2

Write the system of linear equations shown below in matrix form. Then perform the Gauss elimination steps by hand to bring the matrix into upper triangular form and transform the right hand side along with it. Perform the back substitution and write down the solution vector. Write numbers as fractions if needed. Remember that you can multiply any row with a constant without changing the solution. No calculator needed. Hand in your hand-written calculation.

```
20x + 40y - 20z = -100
40x – 20y + 60z =  200
60x – 80y + 20z =  180
```

Task 2 of 2

Copy the in-class code lec24-gauss2.m to lab11.m. Modify the code so that the Gauss algorithm becomes a `function x=mylin(a,b,n)`. The objective is now to take the time it takes to solve a system of size `n`, where `a` and `b` are random. To get the execution time use the function `tic` before you call `mylin`, and the function `toc` afterwards. `tic` starts the timer and `toc` returns the elapsed time. Start with n=50 and double n until it takes more than 10 seconds for a solution. Next, replace `mylin` with the built-in solver (`x=a\b`) and do the same. Make a table of the execution times versus n. How much faster is the built-in solver? Explain why the execution time T should grow as n^3 for any given solver, that is, whenever you double n, T should go up by a factor 8. The practical results are surprisingly quite a bit different, although for large n T(n) seems to approach n^3 as expected.

Name:

<u>Grading guidance:</u> Total 100 pts

Diary for lab 11: [25 pts] Can be multiple diaries if work was not done all at once.

Overall report writing [75 pts]

- Are the task 1 results correct [10 pts]?
- Is the table present [20 pts]
- Is the m-file attached, labelled, and referenced? [20 pts]
- Is the report written in a reasonably clear way and on? Note that the reports do not have to follow a specific format, they just have to be clear [25 pts]

- If the report (does not apply to task 1):
  - is mostly hand-written remove [30 pts]
  - includes a few hand-written elements remove [15 pts]