Warning This project will seem overwhelming at first. This is likely to be the most involved project you have had to complete to this point in your career. Do not let this scare you into bad habits of looking for examples and code tutorials. If you take your time following the systematic approach and methods we discuss in class, this project is well in reach to all of you and you will learn a lot about how memory manipulations work. Remember that I am mainly evaluating your understanding of your work so taking short cuts on this project will not be helpful in the long run. Reach out early and often to me and the TA; we are here to help you through this project and any related struggles you encounter.

You will need to complete the C language programming assignment; see below. **Once you submit your completed source code to Canvas, you will need to schedule an evaluation with the instructor to demonstrate your work.** I will be evaluating your algorithms, your code formatting/commenting/documentation, the way you tested your work, the effectiveness of your implementation decisions, and your understanding of your work.

While I do not explicitly state below, I want good solid professional code. We will discuss these standards in classes, labs, and posted materials. For example, I never explicitly say for you to not use 'go to' statements. However, if you were to use them without proper reasoning then this would be considered a negative when evaluating your work.

Do not just find working code from friends, ChatGpt, Stack Overflow and the like. While it is common practice in industry to stitch together code for various problems, we must understand how the code works and what are the consequences of the code in regards to efficiency and robustness. **If all you do is present the instructor with working code but cannot explain it, you will receive a level of Inconclusive.** If you present the instructor with working code and can only give me a basic explanation of the code, the best you can receive is a level of Proficient.

--- Start Project Description ---

For this competency you will need to design, implement (and document), and test a matrix library using the C language. The library that you design should meet (at a minimum) the following goals.

- The library should target dense (non-sparse) matrices.
- The library should provide simple (but secure) access to matrix contents.
- The library should also handle vectors (specific kind of matrix).

- The library should be written for memory storage (RAM) of the matrix data. However, what would change if the matrices were store in files?
- The library should automatically management of matrix dimensions, so the programmer (*i.e.*, user of your library) does not need to keep track of them.
- The library should have an appropriate degree of error checking, recovery and control.
- The library's makefile should have built in unit testing options that are not packaged with the production build of the library.
- The library should have a switchable option for bounds checking.
- The library should have a switchable option for row/column major storage/access. The decision will be library-wide as opposed to a per matrix basis.
- The library should be able to create matrices of multiple data types (1-type per matrix instance).

Basic functionality that will be required in your library is as follows (but not exclusive too). Hint: some functionalities might just be special cases of other functionalities. Take your time to design and plan before you hack-a-way.

- Matrix initialization (Hint: this is not as simple as it sounds)
- Ability to get the row and column dimensions of a matrix
- Get a single element from the matrix at a given location
- Set a single element in the matrix
- Get a full row or column form a matrix
- Set a full row or column in a matrix
- Create a matrix from a given matrix (subset)
- Set a subset of a matrix with another matrix of matching dimensions
- Resize a matrix
- Add two matrices
- Subtract two matrices
- Multiply two matrices
- Create a deep copy of a matrix
- Check if two matrices are equivalent both as the same instance and element-wise (think .equal() and == for String in Java)
- Should be able to rotate a matrix (in-place)

This project description is left vague on purpose. In industry, you will be the one taking the idea of what we want to have and figuring out how to design and build it. Before we can implement we must design, ask questions, redesign, and plan. If you just jump into coding this project will become unmanageable and will likely lead to poor programming results and a lack of understanding (*i.e.*, a bad evaluation grade). I will be discussing this project in greater detail in labs and classes. I also encourage you to be active on

Piazza; I expect you to have questions (that is a part of the development and learning processes).