Engineering 13300 HW 9 MA 1
MATLAB 1: Introduction to MATLAB
Individual Tasks

Guidelines for Tasks 6–8:

1. Tasks 6–8 are individual tasks. You may seek help from classmates, the instructional team or others but the work you submit should be your own. If you collaborate with others and use information developed together or by someone else, ALWAYS document and reference that material.
2. Each individual is responsible to submit their own assignment to Gradescope.

****Note**: For 6-7 individual tasks, use the `ENGR133_Fa21_MA1_Answersheet` document

Task 6 (of 8):

Learning Objectives: The following exercise highlights the usage of MATLAB as a Calculator

Part A:

Use MATLAB to calculate the value of each expression. Record the MATLAB command and the result of each of the variables on the ***answer sheet***.

$$p = (2+7)^3 + \frac{273^{2/3}}{2} + \frac{55^2}{3}$$

$$q = 2^3 + 7^3 + \frac{273^2}{2} + 55^{\frac{2}{3}}$$

$$r = \left|1 - 0.4 \cdot \tan^{-1}\left(\frac{\pi}{6}\right)\right|$$

Part B:

Define `x` and `z` as `x = 9.6` and `z = 8.1`. Then evaluate each expression. Record the MATLAB command and result of each variable on the answer sheet.

$$a = xz^2 - \left(\frac{2z}{3x}\right)^{3/5}$$

$$b = \frac{443z}{2x^3} + \frac{e^{-xz}}{x+z}$$

$$c = \ln(z)$$

$$d = \log(z)$$

Hint: "ln(·)" or "$\log_e(\cdot)$" is commonly known as the natural logarithm and "log(·)" or "$\log_{10}(\cdot)$" is commonly known as log to the base 10.

Task 6 Files: `Ma1_Ind_username.pdf (answer sheet)`

Task 7 (of 8):

Learning Objectives: The following exercise demonstrates matrix manipulations

Part A:

In the script file, create the matrix shown:

$$Amatrix = \begin{bmatrix} 2 & 5 & 8 & 5 \\ 10 & 9 & 1 & 4 \\ 6 & 3 & 2 & 10 \end{bmatrix}$$

To create a matrix, you will need to create multiple rows of vectors. For example, to create matrix

$$x = \begin{bmatrix} 1 & 3 \\ 9 & 2 \end{bmatrix}$$

type `x = [1,3;9,2]` or `x = [1 3;9 2]`. Note that semicolons separate each row in the matrix. You can also use "enter" (a new line) to start a new row.

Now type each of the command in the table below in your script, run the script, and find out what each of the commands do. Write comments for each of the lines describing the function of the commands.

Command
`Bvector = Amatrix(1,:)`
`Cvector = Amatrix(2,:)`
`Dvector = Amatrix(:,3)`
`sort(Dvector)`
`Amatrix(3)= 30; Amatrix`
`Evector = linspace(1,25,4)`
`Fvector = Evector*5`
`Amatrix(1:2)`
`Amatrix(2:3)`
`Amatrix(1:2,2:3)`

***Notes:*

- *If you need help completing this Problem, use the **MATLAB help function** to look up the terms `colon`, `sort`, and `linspace`.*
- *You do not need to submit these commands in the answersheet or the `.m` file with these commands; Task 7 Part A is intended to prepare you for Task 7 Part B.*

Part B:

Write a MATLAB command for each function in the table below. Record the command you used on the answer sheet:

Function
Create **`Bmatrix`** with values identical to **`Amatrix`** except the middle row is **`Bvector`**.
Create **`Gvector`** by extracting the third row in **`Amatrix`**.
Extract element in row 2, column 3 from **`Amatrix`**
Replace the value 2 in **`Amatrix`** (row 1 and column 1) with the value 55.

Task 7 Files (same file as Task 6, keep working in this file):

1. `Ma1_Ind_username.pdf (answersheet)`

Task 8 (of 8): Matrix manipulation

Problem Steps

1. Download the script `Ma1_matrix_magic_template.m` file.
2. Open template and complete the header information.
    a. Add the problem set number, your name, and your section-team number.
    b. List any additional contributors who worked with your team.
3. Use MATLAB to learn what these built-in functions do: `zeros` and `sum`.
4. In the `INITIALIZATION` section of your script file, create matrices `A` and `vals`, using the steps described below.
    a. Use the function **`zeros`** to create a 4x4 matrix named `A`.

$$A = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

    b. Use MATLAB matrix creation commands to create a matrix, `vals`, that matches the matrix below. **Note:** The numbers are not sequential.

$$vals = \begin{bmatrix} 1 & 3 & 2 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 15 & 14 & 16 \end{bmatrix}$$

5. In the `COPY & CONCATENATE` section of your script file, perform the following:
   Note: Do not hardcode assignments unless told to do so.
    a. Copy the center 2x2 matrix of `vals` and assign it to `M`.
    b. Copy from `vals` a 2-element row vector `[3 2]` and assign it to `C`.
    c. Copy from `vals` a 2-element row vector `[15 14]` and assign it to `D`.
    d. Create 1x4 row vector `E` that concatenates `D` between the first and fourth elements in the first row of `vals` to create the vector `[1 15 14 4]`, and uses square brackets to complete the concatenation in one line of code.
    e. Create 1x4 row vector `F` that concatenates `C` between the first and fourth elements in the fourth row of `vals` to create the vector `[13 3 2 16]`, and uses square brackets to complete the concatenation in one line of code.

6. In the `REPLACE MATRIX ELEMENTS` section of your script file, perform the following:
    a. Use only `M`, `E`, and `F` to replace the first row of `A`, the fourth row of `A`, and the center 2x2 matrix of `A`. Matrix `A` should look like the matrix below once these replacements are complete.

$$A = \begin{bmatrix} 1 & 15 & 14 & 4 \\ 0 & 6 & 7 & 0 \\ 0 & 10 & 11 & 0 \\ 13 & 3 & 2 & 16 \end{bmatrix}$$

b. Complete the following replacements **without hardcoding values**:
   - Replace the 0 directly below the 1 in matrix `A` with the 12 from matrix `vals`.
   - Replace the 0 directly above the 13 in matrix `A` with the 8 from matrix `vals`.
   - Replace the 0 directly below the 4 in matrix `A` with the 9 from matrix `vals`.
   - Replace the 0 directly above the 16 in matrix `A` with the 5 from matrix `vals`.

7. In the `FINAL MATRIX` section of your script file, perform the following:
   a. Create a vector `X` that contains the sums of the columns of `A`.
   b. Concatenate vector `X` to the bottom of matrix `A` to create a new matrix, `G`. Concatenation requires the use of square brackets.
   c. Create a vector `Y` that contains the sums of the rows of `G`.
   d. Concatenate vector `Y` to the right of matrix `G` to create a new matrix, `H`. Concatenation requires the use of square brackets.
   e. Replace the lower right corner value of `H` with the sum of the first four values on the diagonal from the upper left corner and moving toward the lower right corner.
8. In the `FORMATTED TEXT DISPLAY` section of your script file, use three **`fprintf`** statements to display your results as shown:
   Note: Do not hardcode the numerical values within your **`fprintf`** statements; use array indexing of `H` to identify the appropriate values of `H` to display.
   After doing step 8.e, the value in the center of `H` is ___.
   After doing step 8.e, the value in the upper left of `H` is ___,
   and the value in the upper right of `H` is ___.
   After doing step 8.e, the value in the lower left of `H` is ___,
   and the value in lower right of `H` is ___.
9. **Publish** your script as `Ma1_matrix_magic_team_`*`teamnumber`*`_report.pdf` [refer the 'how to publish' demo video]

Task 8 Files: `Ma1_matrix_magic_team_`*`teamnumber`*`_report.pdf`