MATLAB: Introduction
Part 2 – Assignment

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Assigned: September 13th
Due: September 22nd

This assignment will **not** be graded; therefore, it is optional. Use it as a form of exercising what we covered in class. It is recommended that you create a function or script M-file with code cells corresponding to the problems and/or their parts (let us call it *main* M-file). This function or script can then call other M-files or subfunctions. Publish your *main* M-file to HTML. Finally, compress all the necessary files into a `.zip` or `.tar` file and e-mail it to me at bacalfa@cmu.edu.

Problem 1

You are given a 4-D array, `y = randn(2,3,40,12)`. Do the following operations:

Comment 1: What is the difference between the functions `rand` and `randn`?
Comment 2: For convenience, the key will not show the resulting `y` array after the assignments. Focus on the array slicing part instead.

(a)

Retrieve all elements of the first *page* and *chapter*. What are the resulting dimensions?

(b)

Retrieve all elements until half the number of *pages* of the 5th *chapter*. What are the resulting dimensions?

(c)

Assign the value of e (Euler's number) to row 1, columns 1 and 2, *pages* 1 through 10, and *chapters* 3 through 5.

(d)

Assign the matrix `ones(3,40)` to row 2, columns 1 through 3 (all columns), *pages* 1 through 40 (all *pages*), and *chapter* 12. Is this operation allowed? Use a `try-catch` block to catch any possible exception.

(e)

Assign the matrix `eye(3)` to all rows, all columns, *page* 15, and *chapter* 1. Is this operation allowed? Use a `try-catch` block to catch any possible exception.

Problem 2

Calculate the sum:

$$\sum_{i=1}^{N} \frac{1}{i} + \frac{1}{(i+2)(i+3)}$$

where $N = 50$.

Problem 3

Create an `8-by-8` Hilbert matrix.

Hint: A Hilbert matrix has its entries of the form $H_{ij} = \dfrac{1}{i+j-1}$.

Problem 4

Create the following piecewise function:

$$f(x) = \begin{cases} 0, & x < 0 \\ x, & 0 \leq x \leq 1 \\ 2 - x, & 1 \leq x \leq 2 \\ 0, & x > 2 \end{cases}$$

Plot $f(x)$ for $x \in [-3,\ 3]$.

Problem 5

A simple Equation of State (EOS) is van der Waals' equation given by:

$$P = \frac{RT}{V - b} - \frac{a}{V^2}$$

where P is the pressure, V is the molar volume, T is the temperature, R is the universal gas constant, a and b are parameters that provide a measure of the attraction between molecules and the volume excluded by a mole of molecules, respectively.

In addition, the parameters can be calculated as follows:

$$a = 3P_cV_c^2$$
$$b = \frac{V_c}{3}$$

where P_c is the critical pressure and V_c is the critical molar volume.

Plot a 3-D surface with contours of P as a function of V and T for methane. In a separate figure, plot four isotherms (constant temperature curves). Some data for methane are as follows:

P_c	$46.4\,\mathrm{bar}$
V_c	$99 \times 10^{-6}\,\mathrm{m^3\,mol^{-1}}$

Also, $R = 8.314472 \times 10^{-5}\,\mathrm{m^3\,bar\,K^{-1}\,mol^{-1}}$.

The temperatures for the isotherms are:

T_1	$100\,\mathrm{K}$
T_2	$190\,\mathrm{K}$
T_3	$250\,\mathrm{K}$
T_4	$400\,\mathrm{K}$