

# MATLAB: Introduction

## Part 2 – Assignment

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Assigned: September 13<sup>th</sup>

**Due: September 22<sup>nd</sup>**

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](mailto:bacalfa@cmu.edu).

### Problem 1

You are given a 4-D array,  $y = \text{randn}(2,3,40,12)$ . 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 5<sup>th</sup> *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  $H_{ij} = \frac{1}{i+j-1}$ .

## 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:

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

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 bar
$V_c$	$99 \times 10^{-6} \text{ m}^3 \text{ mol}^{-1}$

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

The temperatures for the isotherms are:

$T_1$	100 K
$T_2$	190 K
$T_3$	250 K
$T_4$	400 K