Armstrong State University
Engineering Studies
MATLAB Marina – 1D Arrays and Vectors Exercises

1. From the MATLAB Command Window, execute the MATLAB statements in Figure 1 paying attention to the variables and their values in the MATLAB Workspace window.

```
clear all;
clc;
x1 = [13, -2, 0, 42, 87, 10];
x2 = 1 : 1 : 10;
x3 = 10.5 : 0.5 : 20;
x4 = [x2, x3];
length(x2)
length(x3)
size(x4)
```

Figure 1, MATLAB Statements for Exercise 1

2. From the MATLAB Command Window, execute the MATLAB statements in Figure 2 paying attention to the variables and their values in the MATLAB Workspace window. What does the logic operation `(x < 0)` return as a result? What does the function call `find(x < 0)` return as a result?

```
clear all;
clc;
x = [-5, 13, 8, 72, -4, 0, -1, 16, 23, 7, -8];
res = (x < 0)
ind = find(x < 0)
x(ind) = 0
```

Figure 2, MATLAB Statements for Exercise 2

3. From the MATLAB Command Window, create the following 1D arrays and assign them the specified initial values:
   a) Row vector named `v1` containing the values 0.0, 2.0, 5.0, 7.5, -5.0, and 20.
   b) Column vector named `v2` containing the values 1, -7, 3, 8, and 6.
   c) Row vector named `v3` containing the values from 0 to 99 with an increment of one.
   d) Row vector named `v4` containing the values from 0 to 99 with an increment of two.
   e) Row vector named `v5` containing 200 values linearly spaced from 0.0 to 5.0. Hint: use the built in MATLAB function `linspace`.
   f) Row vector z25 containing 25 zeros. Hint: use the built in MATLAB function `zeros`.
   g) Column vector o40 containing 40 ones. Hint: use the built in MATLAB function `ones`.
4. Enter MATLAB statements in the Command Window to perform the following operations:
   a) Create an array named `num` with the values 0.0, 2.0, 5.0, 7.5, -5.0, and 20.

b) Index the fourth element of `num` and save the result in the variable `num4`.

c) Index elements two through five of `num` and save the result in the variable `num2to5`.

d) Scale all the elements of the 1d array `num` by five and save the result in the variable `numTimes5`.

e) Add one to all the elements of the 1d array `num` and save the result in the variable `numPlusOne`.

f) Square all the elements in the 1d array `num` and save the result back in the variable `num`. You will need to either use the element power operation (.^) or element by element multiplication (.*) to multiply each element in the vector by itself.

g) Take the square root of all the elements in the 1d array `num` and save the result back in the variable `num`. MATLAB has a built in function `sqrt` for the square root.

5. Enter MATLAB statements in the Command Window to perform the following operations:

a) Create an array named `ww` with the values 78, 65, -5, 53, 88, -1, 90, and 0.

b) Determine the indices of the elements in `ww` that have values less than zero.

c) Replace the values of the elements that are less than zero with value zero. Leave the other elements unchanged.

d) Determine the indices of the elements in `ww` that have values greater than or equal to 70 and less than 90. Hint: you will need to use a compound comparison operation, i.e. `(test1) & (test2)`.

6. Write a MATLAB program that will evaluate and plot the function $f(x) = x^3 - 5x^2 + 3x + 2$ over the range x = -5 to x = 5. Make sure to use an appropriate interval between points and to use array (element by element) arithmetic operations where appropriate. Use the comment skeleton of Figure 3 as your starting point and remember to start programs with the `clear`, `clc`, and `close all` commands. To plot a vector `x` versus a vector `f` (`x` on x-axis and `f` on y-axis) use the MATLAB command `plot(x, f)`. The MATLAB functions `xlabel`, `ylabel`, and `title` can be used to label plots.

```
% create the vector x of independent variable values

% evaluate f(x) for all the values in x

% plot x versus f(x)
```

Figure 3, Comment Skeleton for Exercise 6

7. Write a MATLAB program that will evaluate and plot the function $g(t) = 5\cos(10\pi t)e^{-3.5t}$ over the time range t = 0.0 seconds to t = 0.5 seconds with an increment of 0.002 seconds. MATLAB has built in `cos` and `exp` functions for cosine and exponentials. MATLAB does not have a defined `e` constant. Make sure to use the array (element by element) arithmetic operations where appropriate.

8. Write MATLAB program to create a vector of all the integer powers of 2 starting with 2^0 and ending with 2^{15}, i.e. create the vector [1, 2, 4, 8, 16, …, 32768]. Use MATLAB vector operations to generate the vector; do not just type in the values. Use the comment skeleton of Figure 4 as your starting point.

```
% create a vector of the powers from 0 to 15

% raise 2 to power of each element in vector of powers
```

Figure 4, Comment Skeleton for Exercise 8

9. Write a MATLAB program to evaluate an approximation of the infinite series $f(x)=1-\frac{1}{x}+\frac{1}{x^2}-\frac{1}{x^3}+\cdots$ for N terms. The program should read in the value of N and x from the user and display the approximation of the infinite series. Use the comment skeleton of Figure 5 as your starting point. MATLAB has a built in function `input` that will read in values. Hint: the formula for a general term in the series is $\frac{(-1)^{m-1}}{x^{m-1}}$, assuming the terms are numbered starting with term 1.

```
% read in N and x

% create vector of term numbers in the approximation

% evaluate the general term function for each term number

% sum all of the terms
```

Figure 5, Comment Skeleton for Exercise 9

10. Write a MATLAB program that will determine the minimum, maximum, and mean (average) score of a vector of exam scores. Use the vector `scores = [78, 57, 82, 91, 81, 84, 73, 68, 24, 88]`, to test your program. MATLAB has built in `sum`, `mean`, `min`, and `max` functions for vectors and arrays.
11. Modify your program from exercise 10, so that the average is computed ignoring the lowest and highest scores, i.e. throw out the low and high score and then compute the average of the remaining scores. Use the scores vector of exercise 10 to test your script.

Last modified Tuesday, September 09, 2014