

EXAM 2 – WRITTEN PORTION

NAME _____

SECTION NUMBER _____

CAMPUS MAILBOX NUMBER _____

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Written Portion	/ 40
Computer Portion	/ 60
Total	/ 100

USE MATLAB SYNTAX FOR ALL PROGRAMS AND COMMANDS YOU WRITE

Problem 1:

(4 points) Given the following code, what will be printed at the end of the code?

```
x = 10;  
y = 20;  
z = 30;  
if (x > y) | (x > z / 2)  
    x = y + z;  
elseif (y < z) & (x ~= z)  
    x = x + 10;  
end  
fprintf('x = %3i \n', x);
```

- a) x = 10
- b) x = 20
- c) x = 30
- d) x = 50
- e) none of the above: x = _____

Problem 2:

(4 points) Given the following piece of code, what will the value of sum be at the end of the code?

```
x_vec = [1.1 2.8 5.2];  
sum = 0;  
for i = 1:2  
    if x_vec(i) <= 2.0  
        sum = sum + x_vec(i);  
    elseif x_vec(i) > 5.0  
        sum = sum + i * x_vec(i) ;  
    else  
        sum = sum + 4 * x_vec(i);  
    end  
end
```

- a) sum = 1.1
- b) sum = 12.3
- c) sum = 15.6
- d) sum = 27.9
- e) none of the above: sum = _____

Problem 3:

(4 points) A main code and a simple function have been written below:

```
N = 3;
initial = 1;
running_sum = accumulator(N, initial)

function [total] = accumulator(times, start)
total = start;
for N = 1:times
    total = total + N^2;
end
```

After we run the main code, what is the value of running_sum?

- a) running_sum = 14
- b) running_sum = 15
- c) running_sum = 28
- d) none of the above: running_sum = _____
- e) The main code will not run because this is an error in calling the function.

Problem 4:

(4 points) The following code calculates the instantaneous velocity of a falling object and plots it against time. It does not work as expected. Indicate the necessary change(s) to make it work properly.

```
for t = 0.0:0.1:10.0
```

```
    t_vec(t) = t;
```

```
    v_vec(t) = - g * t;
```

```
end
```

```
plot(t_vec, v_vec);
```

Problem 5:

(4 points) Suppose we want to compute and save into a vector the velocity of an object where the initial velocity is zero and there is a constant acceleration of 2 ft/s^2 , while the current velocity is less than or equal to 100 ft/s. The first attempt is written below

```
clc
clear variables
i=1;
v1=0;
dt=1;
while v(i) <= 100
    v(i+1) = v(i) + 2*dt;
    i=i+1;
end
```

But when the code is run, the following error message appears

```
??? Undefined function or method 'v' for input arguments of type
'double'.
```

```
Error in ==> scrap at 6
while v(i) <= 10
```

Mark the correction that is needed in the original code so that it runs correctly. Do not change the while loop to a for loop – leave the while loop in the code.

Problem 6:

(4 points) Below is a code that should calculate the square and square root of integers and print them in a table, for all squared values from 1 to 450.

```
clc
clear variables

i = 0;

square = 1;

fprintf(' i      sqrt(i)   i^2 \n')

while square < 450

    root = sqrt(i);
    square = i^2;

    fprintf(' %2i    %5.2f    %4i \n',i,root,square)

end
```

The code runs forever because there is a line missing. Please write the line of code that is missing that will make the code function as planned. Write the new line of code in the correct location between the existing lines of code.

Problem 7:

(4 points) The following line of Matlab creates the 3 x 3 matrix seen at the left.

```
A = [ -1 3 -5; 4 -6 2; 8 7 2];
```

-1	3	-5
4	-6	2
8	7	2

The following lines are then executed. Fill in the 3 x 3 matrix above right with its contents after the process is complete.

```
for i = 2:3
    for j = 1:i-1
        A(i,j) = 0;
    end % for
end % for
```

Problem 8

(4 points) The following very simple Matlab program is executed.

```
for i = 1:3
    B(2,i) = 1;
end %for
```

Matlab would have which of the following values for B?

a) 1

b) $\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$

c) $\begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$

d) $\begin{bmatrix} 0 & 1 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}$

e) $\begin{bmatrix} 1 & 1 & 1 \end{bmatrix}$

Problem 9

You need a function which will calculate the sum of all diagonal elements in a square matrix. (A square matrix is one in which the number of rows and columns is the same. A diagonal element is one whose column number and row number are the same.) For example, if the matrix was

$$\begin{bmatrix} 1 & 0 & -2 \\ 2 & 2 & 4 \\ 0 & -1 & 3 \end{bmatrix}$$

we would want the function to send back a value of $6 = 1 + 2 + 3$. Assume that A is such a square matrix, but with an arbitrary number of rows. If the function header looked like

```
function value = tr(A)
```

(6 points) Write the rest of the function.

(2 point) This function would be saved in a file called

- a) tr.m
- b) function_tr.m
- c) value.m
- d) function_value.m
- e) any name you choose will be fine.

EXAM 2 – Computer PORTION

For this problem, you should turn in three codes. The main program should be called `lastname_firstname.m` (all lower case). The function to be written for part b) should be called `lastname_firstname_threshold.m`. The function to be written for part c) should be called `lastname_firstname_6sec_avg.m`. Include your name, section number, and CM number in the header section of all your code files. You do not need to add any other comments but these. Remember, there should be no output other than what is asked for.

NOTE: Your code should be general enough to process any data file with the given specifications. Do no hard code any specific number (e.g. row number) in you code.

Problem (60 pts)

Download the Excel spreadsheet named “velocitydata.xls” from the course web page at <http://www.rose-hulman.edu/ME123/courseware.shtml>

It contains two columns of data. The first column is a list of instants in time, and the second column contains velocity measurements from an anemometer (shown at right) placed in a hurricane as a gust front moves through. The units of time are seconds, and the units for velocity are mph. The data set extends for 30 seconds with each data point separated by a constant time interval ($\Delta t = 0.03$ sec).

You must do the following tasks:

- [10 pts] Have your main program read in the data stored in the Excel spreadsheet. Split the columns into separate vectors, and plot velocity versus time. Be sure to put appropriate axis labels and a title on your plot.
- [25 pts] Create a function that will count how many velocity measurements are greater than 40 mph. The function call should look like this:

```
[N_highvelocity] =
lastname_firstname_threshold(velocitydata);
```

where `N_highvelocity` is the number of data points with velocities greater than 40 mph and `velocitydata` is the matrix that you obtained by reading the Excel file.

Your main program should call this function and then print to the screen the number of data points over 40 mph. This output should look like this:

```
The number of data points over 40 mph is: ###.
```



TURN THE PAGE

- c) [25 pts] Create a function that will generate a vector filled with average velocities from consecutive 6-second chunks of the velocity data. The function call should look like this:

```
[V_6sec] = lastname_firstname_6sec_avg(velocitydata);
```

where V_{6sec} is a vector of the 6-sec average values and $velocitydata$ is the matrix that you obtained by reading the Excel file. Figure 1 below illustrates how these chunks will look in the 30-second set of data that you have been given. Each chunk has 200 data points in it. You will find an average velocity for each of the 5 chunks shown in the figure.

Your function should use “for” loops to accomplish this task.

Your main program should call this function and then print to the screen (in a single `fprintf` command) the vector of average values.

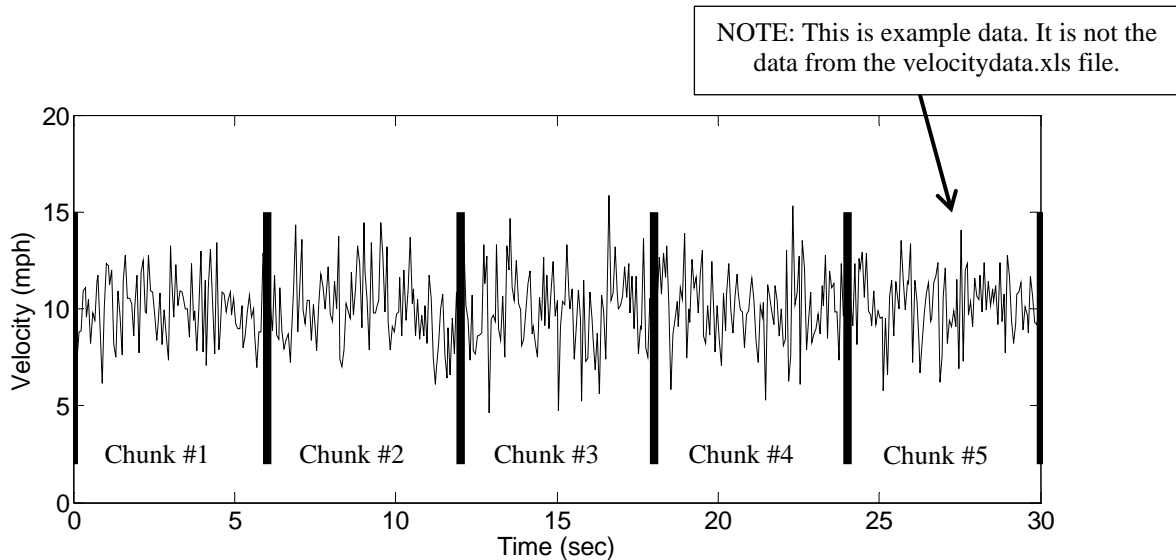


Figure 1 Example velocity data showing how the 6-second chunks of data are arranged. You must find the average velocity for each chunk.

When you are done, post your m-file to the correct DFS folder:

1. Launch a Windows Explorer window by clicking on the folder icon menu bar at the bottom of your screen.
2. Click on the “DFS Root” folder in the upper left corner of the Explorer window
3. Double-click on Academic Affairs.
4. Double-click on ME.
5. Double-click on ME123.
6. Double-click on Exams.
7. Double-click on the folder with your section number.
8. Copy and paste your m-file to this folder.