ENGR 151 Midterm Exam Solution
FALL 2023 semester

12:00PM-13:20PM, October 12th, 2023.

Name: uniqname **(write clearly)**:

By signing here, I agree to the terms of the honor code that I have neither given nor received help in completing this exam.

Please write the uniqnames of the persons to your right and left in the two boxes provided below.

Person to left:	Person to right:

Instructions: Answer all THREE parts. You are not allowed any reference materials except the cheatsheet you have prepared for this exam. You may not use electronic devices: including, but not limited to, calculators, laptops, and phones. You may not access the Internet in any way. You may not use any device that can interpret, compile, or run program code in any way. You should write your answers in the designated blank spaces of the exam. Extra paper(s) should not be needed. You are responsible for the legibility of your work. Any work that is not clear to the grader due to sloppiness or poor handwriting will be marked incorrect.

Section	Points
Matching	10
Multiple Choice	22
Short Answer	30
Total	62

1 Matching

[**Matching (10 points)**] Find the **best** match for each concept on the left-hand side with the phrase on the right (write the phrase letter in the left blank of each concept). Note that there are more items in the right column than in the left, so some answers will not be used. Some answers may also be reused.

1) J Array = [1:2:6]

2) E Array = [1:4]

3) F function

4) A script

5) C `3 < 2 < 1`

6) H `5 > 7 > 9`

7) K 'ENGR ' + '151'

8) D "ENGR " + "151"

9) I Given matrices A and B, A .* B is

10) M Given matrices A and B, A * B is

A. sequence of MATLAB commands or expressions

B. `[1 3 5 7]`

C. True

D. "ENGR 151"

E. `[1 2 3 4]`

F. reusable block of code that accepts input arguments, processes them, and returns output values

G. 'ENGR 151'

H. False

I. Element-wise multiplication

J. `[1 3 5]`

K. Arrays have incompatible sizes for this operation

L. `[1 2 3]`

M. Matrix Multiplication

N. group the data into bins and the height of a bin indicates the number of elements in the bin

O. plot a set of coordinates as scattered points

P. apply operations/functions to the whole array instead of individual elements

Q. a process to remove fluctuations and extract the underlying trend of data

R. a process to construct explicit mathematical function that has the best fit to a series of data points

2 Multiple Choice

This section of the exam consists of 11 multiple choice questions, each worth 2 points. Each question has only one correct answer.

TO MARK YOUR ANSWER, 'FILL IN' THE PARENTHESES OF YOUR CHOICE!

1. [**Multiple choice (2 points)**] Let **A** be a MATLAB matrix defined as:

$$A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{bmatrix}$$

   What is the value of A(6)?

   (a) 6

   (b) 10

   (c) 3

   (d) 7

2. [**Multiple choice (2 points)**]

   Suppose you have an image titled "flower.jpg" in your current MATLAB directory, and you would like to read the image into MATLAB, and extract only the green color channel. Which of the following options correctly achieves this?

   (a)
```
img = imread("flower.jpg");
green_channel = img(:,:,2);
```

   (b)
```
img = imread("flower.jpg");
green_channel = img(:,:,1);
```

   (c)
```
img = "flower.jpg";
green_channel = img(:,:,1);
```

   (d)
```
img = imread(flower.jpg);
green_channel = img(:,:,2);
```

3. **[Multiple choice (2 points)]**

   Given a matrix **M** with 5 rows and 7 columns, which of the following lines would extract every value of rows 2 through 4 (inclusive) of column 6?

   (a) `Values = M(2:4,6)`

   (b) `Values = M(2:5,6)`

   (c) `Values = M(2:4,:)`

   (d) `Values = M(:,6)`

4. **[Multiple choice (2 points)]**

   Given the following MATLAB code:

```
arr = [1 2 3; 4 5 6; 7 8 9];
```

   After the following code has been executed:

```
big = arr > 3;
```

   What is `big` equal to?

   (a) $\begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

   (b) $\begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$

   (c) $\begin{bmatrix} 0 & 0 & 0 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$

   (d) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

5. [**Multiple choice (2 points)**]

Given the following MATLAB code:

```
arr = [1 2 3; 4 5 6; 7 8 9];
```

After the following code has been executed:

```
big = arr > 3;
small = arr < 8;
arr(big & small) = 0;
```

What is `arr` equal to?

(a) $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$

(b) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 0 & 0 \\ 7 & 8 & 9 \end{bmatrix}$

(c) $\begin{bmatrix} 0 & 0 & 0 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$

(d) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 0 & 0 \\ 0 & 8 & 9 \end{bmatrix}$

6. [**Multiple choice (2 points)**]

What does the **hold** command do?

(a) Pauses execution of the program

(b) Adds subsequent plots to existing plot

(c) Overwrites existing plot with subsequent plots

(d) Prevents a variable from being changed

7. [**Multiple choice (2 points)**]

   If you have a matrix **img** which represents a 2D image in MATLAB, which of these commands removes all the green colors in the matrix?

   (a) img(:,:,1) = 255

   (b) img(:,:,'green') = 255

   (c) img(:,:,2) = 0

   (d) mg(:,:,remove('g'))

8. [**Multiple choice (2 points)**]

   The following script is executed on an ENGR 151 student's computer:

```
k = 0;
for i = 1:10
    for j = 1:10
        if(mod(i, 2) == 0 || mod(j, 3) == 0)
            continue;
        end
        k = k + 1;
    end
end
disp(k)
```

   What value is printed by the **disp(k)** command?

   (a) 35

   (b) 30

   (c) 40

   (d) 85

9. [**Multiple choice (2 points)**]

   Choose which of the following statements is true:

   (a) Break is used to exit the loop and continue with the next iteration.

   (b) The 'otherwise' block is mandatory in a switch statement.

   (c) A and B

   (d) None of the above

10. **[Multiple choice (2 points)]**

You would like to store the following data into some data structure in MATLAB:

- The string "engr151"
- The integer 151
- The matrix A = [1 2; 3 4]

Which of the following data structures could store all three pieces of data in one object?

(a) Array

(b) Cell Array

(c) Variable

11. **[Multiple choice (2 points)]**

Which of the following lines of code returns a logical value of 1 in MATLAB?

(a) `"abc" < "aba"`

(b) `"abc" < "abd"`

(c) `"abc" = "abc"`

(d) `0 + 1`

3 Short Answer

1. **Short Answer Question (10 points)**

   (a) **(3 points)** Write a single command (that is, one line) which creates a matrix called A that has 100 rows and 90 columns, and each value of A is a 5. You **must** use a built-in MATLAB function, and your line **must not** display any output when it is run. No credit will be given for answers attempted to directly write out the matrix A. Write your line in the space below.

```
A = 5 * ones(100, 90);
```

   (b) **(7 points)**Write a MATLAB function called getRectangleData(). Your function must:

   i. Take in as arguments two numbers, *width* and *height*

   ii. Return as outputs two numbers, the *area* of the rectangle and the *perimeter* of the rectangle

   Write your function in the space below.

```
function [area, perimeter] = getRectangleData(width, height)
    area = width * height
    perimeter = 2 * (width + height);
end
```

2. **Short Answer Question (10 points)** Write a program in MATLAB that prints the squares of numbers from 1 to 10 (inclusive), each on a separate line.

   (a) **(5 points)** For part A, you must use **only a for loop**. No credit will be given for answers that use a while loop. Write your code in the space below.

```
for i = 1:10
    square = i^2;
    disp(square);
end
```

   (b) **(5 points)** For part B, you must use **only a while loop**. No credit will be given for answers that use a for loop. Write your code in the space below.

```
i = 1;
while i <= 10
    square = i^2;
    disp(square);
    i = i + 1;
end
```

3. **Short Answer Question (10 points)** You are tasked with writing a MATLAB script for a food stand. Write a MATLAB script that takes a maximum of **5 orders** from the user (not from a file) and prints a specific output depending on the order input. The workflow is described as follows:

   (a) Take an input from the user from the command window:
   - If the input is "pizza", print "One pizza coming up!"
   - If the input is "cheeseburger", print "Cheeseburger!"
   - If the input is "hotdog", print "We are unfortunately out of hotdogs :("
   - If the input is "quit", print "Thank you for ordering", **exit the loop, and end the program** (even if the program did not take a total of 5 orders)
   - If the input is none of the above, print "I do not recognize that item"

   (b) Repeat (Note: a maximum of 5 orders should be taken)

Hint: Use the input function to receive input from the user from the command window
Example:

```
>> input_str = input("Enter something: ", 's')
Enter something: something

input_str =

    'something'
```

Explanation of example input command:

- "Enter something: " is the prompt. For our MATLAB script, the prompt should be "What would you like to order?"
- 's' ensures that the user input is read as text
- input_str stores the user input
- The type for input_str is an array of characters

You may **NOT** use repeated code.

Write your code here:

```
for i = 1:5
    input_str = input("What would you like to order? ", 's');
    if(input_str == "pizza")
        disp('One pizza coming up!')
    elseif(input_str == "cheeseburger")
        disp('Cheeseburger!')
    else if(input_str == "hotdog")
        disp('we are unfortunately out of hotdogs')
    elseif(input_str == "quit")
        disp('Thank you for ordering!')
        break
    else
        disp('I do not recognize that item')
    end
end
```