ENGR 132 Exam Practice
Introduction to MATLAB

Problems

Practice 1.

A section of MATLAB code has stored the variables `stop_dist`, which is the safe stopping distance of a car (in feet), and `speed`, which is the car's speed (in mph). With that information, write a MATLAB command to print the following sentence to the command window.

```
>> The stopping distance is 80.0 feet for a speed of 40 mph.
```

Make sure that your command uses the variable names rather than hardcoded values and that the numbers in the sentence are displayed exactly as shown above (values and decimal-place precision).

Solution

Practice 2.

Assume the following variables have already been assigned:

```
>> x = 10;
>> y = [1 2 3 4];
>> z = [20 40 60 80];
>> P = [30 40 50];
```

Write the MATLAB command for the following operations.

A. $N = \sqrt{\left(\frac{y}{(y+z)^2}\right)^3}$

B. $F = zy$

C. $Q = |\sin(45^o)|$

D. $s = x + e^y$

E. What displays if you type the statement `W = [x P] + z` into the Command Window? Explain your results.

Solution

Practice 3.

Write the MATLAB commands to perform the following actions:

A. Create a vector named `Bvec` consisting of 9 elements linearly spaced between (and including) 1 and 3 using the `linspace` command.

B. Convert the row vector `Rvec` below into a column vector named `Cvec`:

```
>> Rvec = [3 5 7 2 1 7]
>>
```

C. Assign the following matrix to `A_matrix`:

$$A\_matrix = \begin{bmatrix} 4 & 4 & 1 \\ 3 & 1 & 6 \\ 6 & 4 & 4 \end{bmatrix}$$

D. Starting with `A_matrix` from part C, explain (in words, not values) what each of the following lines of code does. Assume each command is entered in sequence.

D1. `c = A_matrix(3,:);`

D2. `E = A_matrix(:,2);`

D3. `H = A_matrix(1:3,2);`

D4. `Z = [c A_matrix(1,:)]`

Solution

Practice 4.

The matrix shown below has been entered into the MATLAB command window:

$$Ymatrix = \begin{bmatrix} 1 & 15 & 70 \\ 2 & 16 & 69 \\ 3 & 15.5 & 99 \\ 4 & 1.7 & 76 \end{bmatrix}$$

Write the output of the following MATLAB command:

```
>> newmatrix = Ymatrix (1:2, 2:3)
```

Solution

Practice 5.

The following MATLAB commands have been typed into the Command Window:

```
>> resistance = [0:5:35];
>> current = [1:1:8];
>> resistance.*current = voltage
```

What is displayed in the command window?

Solution

Practice 6.

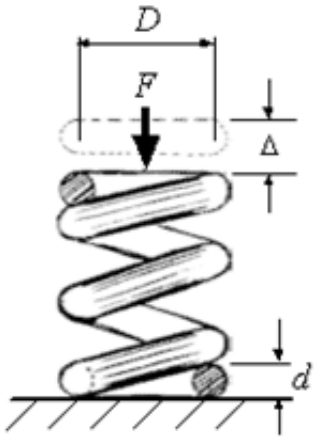
A. A vector *y* ranges from 7 to 57 in increments of 5; write the **most compact** MATLAB code to create *y*.

B. A vector *y* ranges from 21 to 1 in increments of -2; write the most compact MATLAB code to create *y*.

Solution

Practice 7.

The displacement of a spring (Δ) under an applied force (F) is related to the stiffness of the spring (K) by the equation $F = K\,\Delta$. The stiffness of a spring is itself a function of its shear modulus (G), the number of coils (N), and geometric properties D and d.



$$K = \frac{G d^4}{8 D^3 N}$$

Complete the MATLAB code below so that the spring stiffness is calculated for a series of wire diameters, number of coils, and specific set of coil diameters.

```
% --- INPUTS ---
G = 1e8 % Shear modulus in Pascals
d = [0.08 0.08 0.1 0.1 0.12 0.12 0.15 0.15] % Wire diameters (m)
D = [0.50 0.75 0.5 .75 0.50 0.75 0.50 0.75] % Coil diameters (m)
N = [5 5 5 5 4 4 4 4] % number of coils

% --- CALCULATIONS ---
K =
```

Solution

Practice 8.

A MATLAB script can be used to solve for the flight time of an object given its initial position, velocity, and trajectory angle. The beginning of such a script has been written using the ENGR 13200 template. Your task is to complete the script so that it:

- Defines the trajectory angles (theta) as a vector
- Calculates the flight times (t) for each trajectory angle (theta)
- Does NOT use loops to perform calculations (even if you know how to use them)

Conditions for this set of calculations are:

$v_0 = 3.0$ initial velocity (m/s)

$h_0 = 0.1$ initial height (m)

$a = 9.8$ acceleration due to gravity (m/s^2)

x_0 = 0.0 initial distance (m)

The trajectory angles (in radians) to be used in the calculations are

θ (theta) = 0, 0.31, 0.63, 0.94, 1.3, 1.6

Relevant equations are provided below. You do not have to worry about the signs of the quantities; the signs of velocity, position and acceleration have been accounted for already.

$$v_{y0} = v_0 \sin\theta$$

$$t = \frac{v_{y0} \pm \sqrt{{v_{y0}}^2 + 2ah_0}}{a}$$

Solution

Practice 9.

Which of the following MATLAB variable names **WILL** or **COULD** potentially generate an error?

[Circle ALL that apply]

a) `distance5`

b) `rate.08`

c) `x_displacement`

d) `2ndtime`

e) `Exp`

Solution

Practice 10.

For the matrix shown below, which one of the following MATLAB commands generates only 5 as an output?

$$Kmatrix = \begin{bmatrix} 2 & 10 & 5 \\ 3 & 5 & 6 \\ 2.4 & 8 & 4.5 \end{bmatrix}$$

[Circle ALL that apply]

a) `>> Kmatrix(3,1)`

b) `>> Kmatrix(5:6)`

c) `>> Kmatrix(2,2)`

d) `>> Kmatrix(2,3)`

e) `>> Kmatrix(1,3)`

Solution

Practice 11.

The following MATLAB commands have been typed into the Command Window:

```
>> radius= [1:5:16];
>> a_value= [100    110    120    130];
>> cost= 300;
>> k = [2  4;  6  8];
```

Which of the following MATLAB commands will generate an error if typed next?

[Circle ALL that apply]

a) `>> x=log(cost);`
b) `>> x=sin(radius).*a_value;`
c) `>> x = radius*a_value;`
d) `>> x= sum(a_value)*radius;`
e) `>> x= a_value.*k;`

Solution

Practice 12.

The following MATLAB commands were typed into the Command Window:

```
>> A= [36, 81; 16, 25]
>> B= sqrt(A)
>> C=B(2,:)
```

What is the value of `C(1,2)`?

Solution

Practice 13.

Use the matrix shown below to answer the following questions:

$$Ymatrix = \begin{bmatrix} 1 & 15 & 70 \\ 2 & 16 & 69 \\ 3 & 15.5 & 99 \\ 4 & 1.7 & 76 \end{bmatrix}$$

A. Write the output of the following MATLAB command:

```
>> newmatrix = Ymatrix (3:4, 2:3)
```

B. Write the MATLAB code to create `Zmatrix`, which is `Ymatrix` with the value of 1.7 replaced with 17. The original `Ymatrix` should remain in its original form. Use vector or matrix assignments.

Solution

Practice 14.

The following values for m, n, p and q have already been entered into the MATLAB command window. For each of the following questions, write a single line of code to be typed into the MATLAB command window to perform the requested operation.

```
>> m = [4 5 3; 3 0 1; 1 3 2]
>> n = [1 3 3]
>> p = [4 2 1]
>> q = 10
```

A. Add vectors n and p and multiply the result by q. Store the result as 'x' and suppress the output.

B. Extract the second row of matrix m. Multiply each element of the resulting vector by the corresponding element of vector n. Store the resulting vector as 'y' and do not suppress the output.

C. Divide each element in vector n by the corresponding element in vector p to obtain a new vector. Add the elements of the resulting vector together and store the result as z. Suppress the output.

Solution

Solutions

Practice Solution 1

```
fprintf('The stopping distance is %.1f feet for a speed of %.0f
mph.',stop_dist,speed)
```

Practice Solution 2

A.	`N = sqrt((y./(y+z).^2).^3)` *or* `N = ((y./(y+z).^2).^3).^(1/2)`
B.	`F = z.*y`
C.	`Q = abs(sin(45*pi/180))` *or* `Q = abs(sind(45))`
D.	`s = x + exp(y)`
E.	`W = 30 70 100 130` Scalar x is concatenated to the left of P and then the resulting vector is added to vector z

Practice Solution 3

A.	`Bvec = linspace(1,3,9)`
B.	`Cvec = Rvec'` OR

	`Cvec = transpose(Rvec)`

C.	`A_matrix = [4 4 1; 3 1 6; 6 4 4]` OR
	`A_matrix = [4 4 1` (with or without semicolon at end of rows 1&2)
	`3 1 6`
	`6 4 4]`

D1.	Assigns the third row of A_matrix to a 1x3 row vector named c
D2.	Assigns the second column of A_matrix to a 3x1 column vector named E
D3.	Assigns rows 1-3 of second column of A_matrix to a 3x1 column vector named H Note: E = H
D4.	Concatenation of the third row of A_matrix followed by the first row to create a 1x6 row vector

Practice Solution 4

$$newmatrix = \begin{bmatrix} 15 & 70 \\ 16 & 69 \end{bmatrix}$$

Practice Solution 5

Error: The expression to the left of the equals sign is not a valid target for an assignment.

Practice Solution 6

A. `y = [7:5:57]`
B. `y = [21:-2:1]`

Practice Solution 7

```
K = G*d.^4./(8*D.^3.*N)
```

Practice Solution 8

```
%% INPUTS
init_vel = 3.0;    % initial velocity in m/s
init_ht = 0.1;     % initial height in meters
grav_a = 9.8;      % acceleration due to gravity in m/s 2
init_dist = 0.0;   % initial distance in meters

% defines vector of trajectory angles in radians
theta = [0, 0.31, 0.63, 0.94, 1.3, 1.6]
```

```
%% CALCULATIONS

% Calculates the velocity component in y-direction
vel_y0 = init_vel*sin(theta)

% Calculates the flight times (maximum only)
flight_time = (vel_y0 + sqrt((vel_y0).^2 + 2*grav_a*init_ht))./grav_a
```

Practice Solution 9

(a) (b) (c) (d) (e)

Practice Solution 10

(a) (b) (c) (d) (e)

Practice Solution 11

(a) (b) (c) (d) (e)

Practice Solution 12

5

Practice Solution 13

A. $\begin{bmatrix} 15.5 & 99 \\ 1.7 & 76 \end{bmatrix}$

B.
```
Zmatrix = Ymatrix
Zmatrix(4,2)=17   or   Zmatrix(8) = 17
```

Practice Solution 14

A.
```
>> x = q * (n+p);
```

B.
```
y = m(2,:) .* n
or
y = m(2,1:3) .* n
```

C.
```
>> z = sum(n./p);
```