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Lab Worksheet 3 (03/03/2025) CELEN087

Instruction: You are suggested to complete all questions in **this worksheet** and **Homework Exercise 3** by end of this week.

1. Let n be a numerical value created in MATLAB. For example, $n = 1.25, -4, 121, 36, \pi ...$

   Write and test the statements for checking the following:

   (i) Whether n no greater than 100.

   (ii) Whether n is equal to 2.

   (iii) Whether n is an even number.

   (iv) Whether n is an odd number.

   (v) Whether n is a prime number.

   (vi) Whether n is divisible by 4.

   (vii) Whether n is an integer.

2. Create a scrip file **checkPrime.m** that determines if a value n entered by users is a prime number or not. It should output three types of messages based on the value of n:

   - `A prime number.`
   - `Not a prime number.`
   - `Not a positive integer!`

   You may use the built-in function `isprime()` in this question.

   Note: The third case is something you should always take into consideration as a program designer: when users are using your program with invalid inputs (e.g. entering an invalid number by mistake), you should display such a message reminding them about so.

3. Create scripts for computing the sum

$$\sum_{k=1}^{50} 2k = 2 + 4 + 6 + 8 + \cdots + 98 + 100$$

   (a) using For Loop.

   (b) using While Loop.

   (c) How to guarantee the correctness of your programs? In other words, what would you do to verify that the computed results given by your program is accurate?

   (d) Create a script file **evenSum.m** that prompts a message asking users to enter a positive even number n, and compute the sum $2 + 4 + 6 + \cdots + n$ using one of above For/While Loop. You should display the computation result using appropriate messages.

4. Write a script file that finds the sum of all prime numbers within 200. Here you may use the built-in function `isprime()`.

5. Predict the output of the following code segment:

```
clear;clc
v = 2:-0.25:0;
for i = 1:length(v)
    fprintf("v(%d) = %.2f\n",i,v(i))
end
```

Execute it in MATLAB and learn from the output about colon operator, `fprintf()` command, For Loop, and array index.

6. Predict the output of the following code segment:

```
clear;clc
for i=1:4
    for j=5:6
        fprintf('i=%d, j=%d\n',i,j)
    end
end
```

Execute it in MATLAB and learn from the output about how statements are executed in nested For Loops.

7. Write a MATLAB script that generates a 4×4 matrix using nested For Loops.

$$\begin{pmatrix} 0 & 3 & 3 & 3 \\ 1 & 0 & 3 & 3 \\ 1 & 1 & 0 & 3 \\ 1 & 1 & 1 & 0 \end{pmatrix}$$

- main diagonal elements take value 0.
- elements $A(i,j)$ where $i < j$ (upper triangular elements) take value 3.
- elements $A(i,j)$ where $i > j$ (lower triangular elements) take value 1.

Then modify your script so that it asks users for entering a positive integer n, and generates an $n \times n$ matrix of similar strucutre.

8. Write MATLAB scripts for solving the following problems using IF STRUCTURE.

   (i) Find the larger value out of two numbers entered by users and output a message for the result.

   (ii) Find the maximum value out of three numbers entered by the users and output a message for the result.

9. Write a script file that finds the sum of the first 200 prime numbers.

Hint: Note this question is different from Question 4. Definitely we need one variable that iterates through natural numbers 1,2,3..., and use isprime() to check prime numbers. Do we also need to create any other variables that hold important information?
Which loop structure should be used here: For loop or While loop?

10. Read and test the following programming examples.

Code example: **Linear Search** in a List.
Data structure for storing list elements: array (vector).
Algorithm (Assume there are no repeated elements in the list):

```
Step 1. Input a list and a search key.
Step 2. Compute the length of list: n = length(list).
Step 3. (Iteration)
        for i from 1 to n,
             if list(i)==key
                Output message ‘‘Found’’; % and we may END the loop EARLY
             endif
        endfor
Step 4. Output message ‘‘Not Found’’. % when all elements are checked through
```

(a) Sample MATLAB code segment:

```
clear;clc
list = input('Enter a list:\n');
key = input('Enter the search key:\n');
n = length(list);
for i=1:n % iterate through all list elements
    if list(i)==key % if key is found
        disp('Key is Found')
        break % exit (early) from For loop
    end
end
disp('Key is Not Found')
```

Execute this program in MATLAB, test it using two test cases:

(i) `list = [2,3,8,1,6], key = 5`
(ii) `list = [2,3,8,1,6], key = 1`

(b) What kind of issues do you find after testing the above codes? This program can be improved in the following way by adding a *flag* to control when to display certain message or not:

```
clear;clc
list = input('Enter a list:\n');
key = input('Enter the search key:\n');
n = length(list);
flag = 0; % set a flag for searching result
for i=1:n
    if list(i)==key
        disp('Key is Found')
        flag = 1; % key is found, update flag to 1
        break
    end
end
if flag==0 % only display following message when flag is 0
    disp('Key is Not Found')
end
```

Note: the break command in Line 8 (and Line 10) will terminate the execution of For loop, before the index variable i finally reach to n.