

MATLAB Marina: Iteration, for loops

1. Create a MATLAB program consisting of the MATLAB code of Figure 1. Run the program and verify that the values in the array `numbers` are displayed. Determine the size and value(s) of the variable `k` after the loop has been executed for the program.

```
clear; clc;
numbers = 1:0.5:5;
for k = 1:1:length(numbers)
    val = numbers(k);
    fprintf('%0.1f ', val);
end
fprintf('\n');
```

Figure 1. Display Numbers Code Segment

2. Write a MATLAB program that will display the numbers from 0 to 45 with a step of 5. The program should display: 0, 5, 10, 15, 20, etc.. Use iteration (for loop) to solve this problem. Run your program and verify that it operates correctly.
3. Modify the program of Exercise 2 so that the numbers are displayed in reverse order: 45, 40, 35, ..., 5, 0.. Use iteration (for loop) to solve this problem. Run your program and verify that it operates correctly.
4. Write a MATLAB program that will display the numbers from a user specified start number to a user specified stop number. Assume that the second number the user enters will be larger than the first number. Use iteration (for loop) to solve this problem. Run your program and verify that it operates correctly. A sample run should look like:
Enter number 1: 4
Enter number 2: 9
4 5 6 7 8 9
5. Run your program of Exercise 4 for the case of the stop number being smaller than the start number, for example number 1 of 8 and number 2 of 4. What does the program do and why? How could the program Exercise 4 be modified so that the execution of the loop is avoided and a message is displayed for cases where the second number is less than the first number?
6. Complete the MATLAB program of Figure 2 that will evaluate and plot the function $f(t) = 4 - t^2 e^{-3t}$ for the time range $0 \leq t \leq 3$ seconds. Use MATLAB's colon operator and array operations to solve this problem.

```

% create array t of independent variable values

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

% plot t versus f(t)

```

Figure 2. MATLAB Program to Evaluate and Plot a Function

7. Complete the MATLAB program of Figure 3 that will evaluate and plot the function $f(t) = 4 - t^2 e^{-3t}$ for the time range $0 \leq t \leq 3$ seconds. Use iteration (for loop) and scalar operations to solve this problem.

```

% allocate space for the time and function arrays
% assuming a time interval of 0.05 seconds
numberValues = 61;
t = zeros(1,numberValues);
f = zeros(1,numberValues);

% create t and f values
% iterate over the indices of the t and f arrays

    % create next time value and store in t array

    % evaluate f(t) for the time value and store in f array

% plot t versus f(t)

```

Figure 3. MATLAB Program to Evaluate and Plot a Function

8. Write a MATLAB program to compute a factorial of a number. The number should be read from the user. You can assume the number will be an integer from 0 to 50. Do not use the built in `factorial` function; implement the factorial operation using a for loop.
9. Complete the MATLAB program of Figure 4 that will evaluate the series $1 - 1/2 + 1/4 - 1/8 + 1/16 - \dots$ for N terms where the value N is read from the user. Use MATLAB's colon operator and array operations to solve this problem.

```

% read in number of terms N

% create an array of the term numbers

% evaluate term function for each element in term number array

% sum the array of terms

```

Figure 4. MATLAB Program to Evaluate a Series

10. Complete the MATLAB program of Figure 5 that will evaluate the series $1 - 1/2 + 1/4 - 1/8 + 1/16 - \dots$ for N terms where the value N is read from the user. Use iteration (for loop) and scalar operations to solve this problem.

```
% read in number of terms N

% allocate space for result and set initial value of result

% iterate over the term numbers

    % evaluate term function for term number

    % add new term to previous result and update result
```

Figure 5. MATLAB Program to Evaluate a Series

11. The file `roddata.mat` holds measurement data on iron rods that came off a metal casting line. Write a MATLAB program that will help the quality control engineer analyze the casting line. The program should read in the rod data from the MATLAB `.mat` file and determine the number of rods whose dimensions exceed the desired tolerances. The nominal rod size is 125 cm long and 5 cm in diameter and the accepted deviation is ± 0.5 cm in length and ± 0.1 cm in diameter. The rod data file contains a two-dimensional array named `roddata`. The first column is the length data and the second column is the diameter data. Use a for loop and conditional structures rather than array operations and array comparisons to solve this problem.
12. Write a MATLAB program that will determine the minimum and maximum value of an array along with the locations of the minimum and maximum values. You may assume the array will be a 1D row array and that there will only be a single instance of the minimum and maximum values. Do not use MATLAB's `min` and `max` or `find` functions to solve this problem.
13. Write a MATLAB program that will smooth an array of noisy data using a two-point average. Assume the array of data is a 1D row array and that a backwards average will be used for the smoothing. For a backwards two-point average, $xavg_k = \frac{x_k + x_{k-1}}{2}$, except for $k = 1$ where $xavg_1 = x_1$. One could also use a forward average or a midpoint average. Use a for loop and conditional statements rather than array operations. Use the following statement to create a row vector of noisy data from a normal distribution with a mean of 10.0 and a standard deviation of 2.0 to test your program:
- ```
noisyData = 10.0 + 2.0*randn(1,100);
```
14. Write a MATLAB program that will display the columns of a 2D array. The elements of each column should be displayed one column per line, i.e. display each set of the column values

as a row. Use the 2D array `array2D = [5, 8, -2, 4; 3, 0, 2, 9];` to test your program.

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