Date: 04-09-2021

Experiment 4

Aim: To work with MATLAB loops, logical arrays and vectorization.

Apparatus: MATLAB Software

Objective:

1. To learn how to execute a sequence of statements more than once using different loops like for loop, while loop.
2. To learn the different applications of logical arrays.
3. To learn the benefits of vectorization by comparing the same logical code using loop and vectorization.

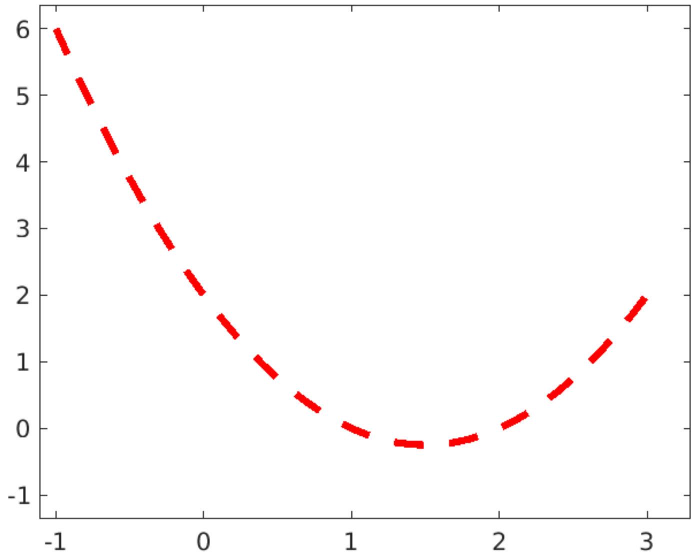
Problems:

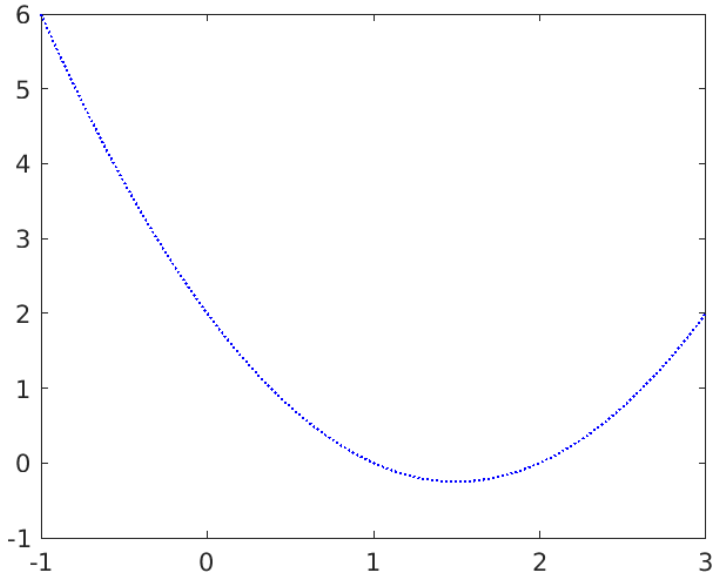
Q-1. Write an M-file to evaluate the equation $y(x)=x^2-3x+2$ for all values of x between -1 and 3, in steps of 0.1. Do this twice, once with a for loop and once with vectors. Plot the resulting function using a 3-pointthick dashed red line.

Code:

```
clc;
clear all;
close all;

x = -1:0.1:3;
for i = -1:0.1:3
    y = x.*x - 3.*x + 2;
end
disp(y);
plot(x,y,"LineStyle","--","Color","red","LineWidth",3)

figure
x1 = -1:0.1:3;
y1 = x.*x - 3.*x + 2;

disp(y1);
plot(x1,y1,"LineStyle",":","Color","blue","LineWidth",1)
```

Output:






```
Command Window
  Columns 1 through 14

    6.0000    5.5100    5.0400    4.5900    4.1600    3.7500    3.3600    2.9900    2.6400    2.3100    2.0000    1.7100    1.4400    1.1900

  Columns 15 through 28

    0.9600    0.7500    0.5600    0.3900    0.2400    0.1100         0   -0.0900   -0.1600   -0.2100   -0.2400   -0.2500   -0.2400   -0.2100

  Columns 29 through 41

   -0.1600   -0.0900         0    0.1100    0.2400    0.3900    0.5600    0.7500    0.9600    1.1900    1.4400    1.7100    2.0000


  Columns 1 through 14

    6.0000    5.5100    5.0400    4.5900    4.1600    3.7500    3.3600    2.9900    2.6400    2.3100    2.0000    1.7100    1.4400    1.1900

  Columns 15 through 28

    0.9600    0.7500    0.5600    0.3900    0.2400    0.1100         0   -0.0900   -0.1600   -0.2100   -0.2400   -0.2500   -0.2400   -0.2100

  Columns 29 through 41

   -0.1600   -0.0900         0    0.1100    0.2400    0.3900    0.5600    0.7500    0.9600    1.1900    1.4400    1.7100    2.0000

>> |
```

Q-2. Examine the following for statements and determine how many times each loop will be executed in MATLAB.

(*a*) for ii = -32768:32767
(*b*) for ii = 32768:32767
(*c*) for kk = 2:4:3
(*d*) for jj = ones(5,5)

Code:

```
clc;
clear all;
close all;
c = 0;
for i = -32768:32767
    c = c +1;
end

fprintf("\n1. %d",c);

c = 0;
for i = 32768:32767
    c = c +1;
end

fprintf("\n2. %d",c);

c = 0;
for i = 2:4:3
    c = c +1;
end

fprintf("\n3. %d",c);

c = 0;
for i = ones(5,5)
    c = c +1;
end

fprintf("\n4. %d",c);
```

Output:

```
Command Window

1. 65536
2. 0
3. 1
4. 5
>>
```

Q-3. Examine the following for loops and determine the value of ires at the end of each of the loops, and also the number of times each loop executes.

(*a*) ires = 0;
```
for index = -10:10
    ires = ires + 1;
end
```

(*b*) ires = 0;
```
for index = 10:-2:4
    if index == 6
        continue;
    end
    ires = ires + index;
end
```

(*c*) ires = 0;
```
for index = 10:-2:4
    if index == 6
        break;
    end
ires = ires + index;
end
```

(*d*) ires = 0;
```
for index1 = 10:-2:4
    for index2 = 2:2:index1
        if index2 == 6
            break
        end
        ires = ires + index2;
    end
end
```

Code:

```
clc;
clear all;
close all;

fprintf("Sr.\tIres\tCount1\tCount2")
c = 0;
ires = 0;
for i = -10:10
    ires = ires + 1;
    c = c +1;
end

fprintf("\n1.\t%d\t%d",ires,c);
```

```
c = 0;
ires = 0;
for i = 10:-2:4
    if i == 6
        c = c +1;
        continue;
    end
    ires = ires + i;
    c = c +1;
end

fprintf("\n2.\t%d\t%d",ires,c);

c = 0;
ires = 0;
for i = 10:-2:4
    if i == 6
        c = c +1;
        break;
    end
    ires = ires + i;
    c = c +1;
end

fprintf("\n3.\t%d\t%d",ires,c);

c1 = 0; c2 = 0;
ires = 0;
for i1 = 10:-2:4
       for i2 = 2:2:i1
             if i2 == 6
                 break
             end
             ires = ires + i2;
             c2 = c2 +1;
       end
       c1 = c1 +1;
end


fprintf("\n4.\t%d\t%d\t%d",ires,c1,c2);
```

Output:

```
Command Window

Sr.     Ires    Count1  Count2
1.      21      21
2.      22      4
3.      18      3
4.      24      4       8

>>
```

Q-4. Examine the following while loops and determine the value of ires at the end of each of the loops and the number of times each loop executes.

(*a*) ires = 1;
while mod(ires,10) ~= 0
ires = ires + 1;
end

(*b*) ires = 2;
while ires <= 200
ires = ires^2;
end

(*c*) ires = 2;
while ires > 200
ires = ires^2;
end

Code:

```
clc;
clear all;
close all;

fprintf("Sr.\tIres\tCount")


c = 0;
ires = 1;
while mod(ires,10) ~= 0
    ires = ires + 1;
    c = c +1;
end
fprintf("\n1.\t%d\t%d",ires,c);


c = 0;
ires = 2;
while ires <= 200
    ires = ires^2;
    c = c +1;
end
fprintf("\n2.\t%d\t%d",ires,c);



c = 0;
ires = 2;
while ires > 200
    ires = ires^2;
    c = c +1;
end
fprintf("\n3.\t%d\t%d",ires,c);
```

Output:

```
Command Window

Sr.     Ires    Count
1.      10      9
2.      256     3
3.      2       0

>>
```

Q-5. What is contained in array arr1 after each of the following sets of statements have been executed in MATLAB?

(*a*) arr1 = [1 2 3 4; 5 6 7 8; 9 10 11 12];
mask = mod(arr1,2) == 0;
arr1(mask) = -arr1(mask);

(*b*) arr1 = [1 2 3 4; 5 6 7 8; 9 10 11 12];
arr2 = arr1 <= 5;
arr1(arr2) = 0;
arr1(~arr2) = arr1(~arr2).^2;

Code:

```
clc;
clear all;
close all;

arr1 = [1 2 3 4; 5 6 7 8; 9 10 11 12];
mask = mod(arr1,2) == 0;
arr1(mask) = -arr1(mask);

fprintf("1.----------arr1---------- \n")
disp(arr1);

arr1 = [1 2 3 4; 5 6 7 8; 9 10 11 12];
arr2 = arr1 <= 5;
arr1(arr2) = 0;
arr1(~arr2) = arr1(~arr2).^2;

fprintf("2.----------arr1---------- \n")
disp(arr1);
```

Output:

```
Command Window

1.----------arr1----------
     1    -2     3    -4
     5    -6     7    -8
     9   -10    11   -12

2.----------arr1----------
     0     0     0     0
     0    36    49    64
    81   100   121   144

>>
```

Q-6. Write a MATLAB program to evaluate the function

$$y(x) = ln\frac{1}{1-x}$$

for any user-specified value of x, where ln is the natural logarithm (logarithm to the base e). Write the program with a while loop, so that the program repeats the calculation for each legal value of x entered into the program. When an illegal value of x is entered, terminate the program. (Any x>=1 is considered an illegal value.)

Code:

```
clc;
clear all;
close all;

while (true)
    s = "\n\nEnter Your X value: ";
    x = input(s);

    if x>=1
        fprintf("\nInvalid X value (Illegal)");
        break;
    else
        y = log(1/(1-x));
        fprintf("\nY is: %f",y);
    end
end
```

Output:

```
Command Window

Enter Your X value:
0.2

Y is: 0.223144

Enter Your X value:
0.005

Y is: 0.005013

Enter Your X value:
1.2

Invalid X value (Illegal)
```

Q-7. The n^{th} Fibonacci number is defined by the following recursive equations:

$$f(1)=1;$$
$$f(2)=2;$$
$$f(n)=f(n-1)+f(n-2)$$

Therefore, $f(3)=f(2)+f(1)=2+1=3$, and so forth for higher numbers. Write an M-file to calculate and write out the n^{th} Fibonacci number for $n>2$, where n is input by the user. Use a while loop to perform the calculation.

Code:

```
clc;
clear all;
close all;

s = "Enter Your N value: ";
n = input(s);
a = 0;
b = 1;
fprintf("%d %d ",a,b);
i = 3;
sum  = 0;

while (i<=n)
    c = a+b;             %performs add operation on previous two  values
    fprintf("%d ",c);    % It prints from third value to given length
    a=b;
    b=c;
    i=i+1;
end

fprintf("\n\nLast Value till %d th is: %d ",n,c);
```

Output:

```
Command Window

Enter Your N value:
15
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377

Last Value till 15 th is: 377
>> |
```

Q-8. The current flowing through the semiconductor diode shown in Figure 4.7 is given by the equation

$$i_D = I_o(e^{\frac{qv_D}{kT}} - 1)$$

Where, i_D = voltage across the diode, in volts

v_D = current flow through the diode, in amps

I_o = leakage current of the diode, in amps

q = charge on an electron, 1.602×10^{-19} coulombs

k = Boltzmann's constant, 1.38×10^{-23} joule/K

T = temperature, in kelvins (K)

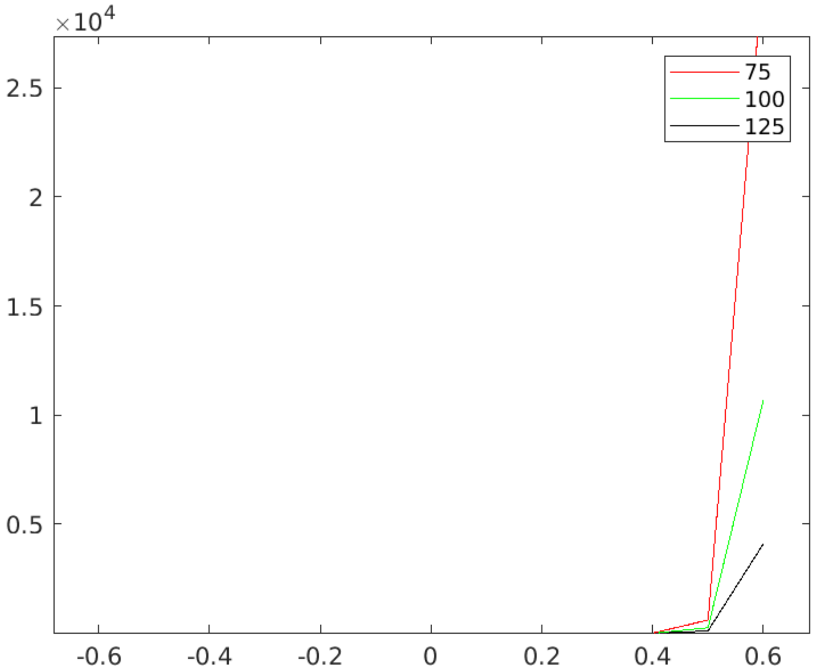
The leakage current I_o of the diode is 2.0 μA. Write a program to calculate the current flowing through this diode for all voltages from -1.0 V to +0.6 V, in 0.1 V steps. Repeat this process for the following temperatures: 75°F and 100°F, and 125°F. Create a plot of the current as a function of applied voltage, with the curves for the three different temperatures appearing as different colors.

Code:

```
clc;
clear all;
close all;

t=[75,100,125];
format long;
color=['r','g','k'];
c=1;
I0=2 * 10^-6;
V=-1:0.1:0.6;
k=1.38 * 10^-23;
q=1.602 * 10^-19;
for i=t
    i=(i - 32) * 5/9 + 273.15;
    temp=(q/(k*i))*V;
    I=I0*(exp(temp)-1);
    plot(V,I,color(c));
```

```
    hold on
    c=c+1;
    I=[];
end
legend('75','100','125');
```

Output:



Q-9. Engineers often measure the ratio of two power measurements in *decibels*, or dB. The equation for the ratio of two power measurements in decibels is

$$dB = 10\, log_{10} \frac{P_2}{P_1}$$

where P_2 is the power level being measured and P_1 is some reference power level. Assume that the reference power level P_1 is 1 watt, and write a program that calculates the decibel level corresponding to power levels between 1 and 20 watts, in 0.5 W steps. Plot the dB-versus-power curve on a log-linear scale.

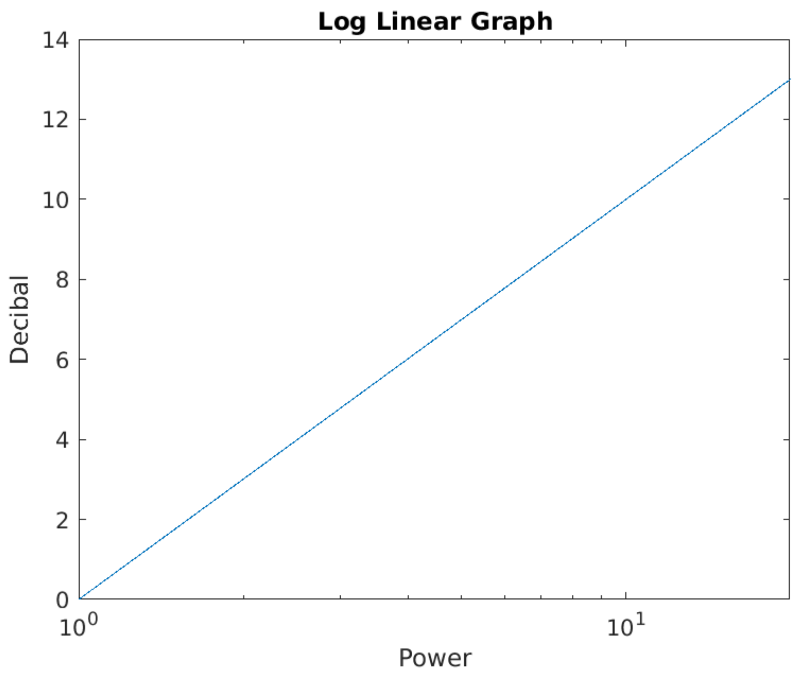
Code:

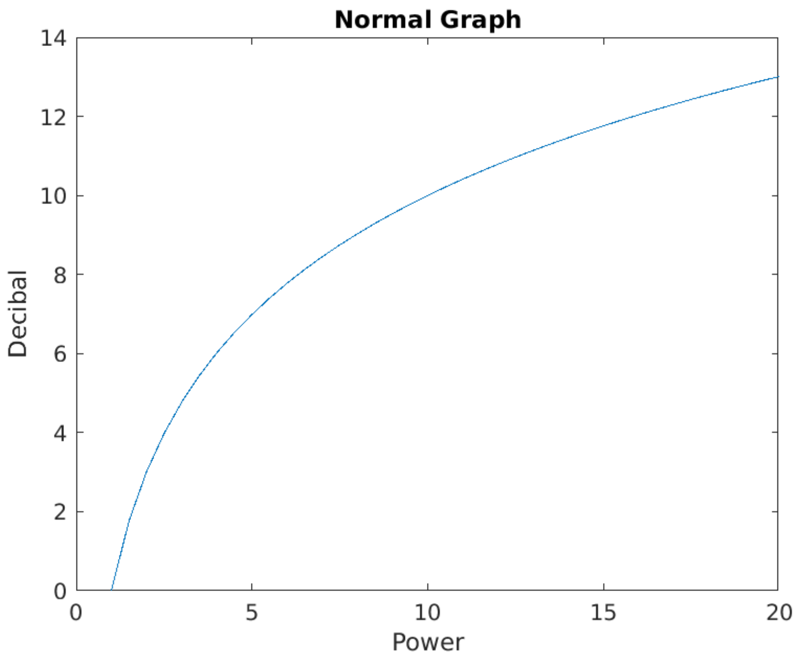
```
clc;
clear all;
close all;

p1 = 1;
p2 = 1:0.5:20;

dB = 10 .* log10(p2./p1)

figure(1)
plot(p2,dB);
ylabel("Decibal");
xlabel("Power");
title("Normal Graph");
```

```
figure(2)
semilogx(p2,dB);
ylabel("Decibal");
xlabel("Power");
title("Log Linear Graph");
```

Output:

```
Command Window

dB =

  Columns 1 through 14

         0    1.7609    3.0103    3.9794    4.7712    5.4407    6.0206    6.5321    6.9897    7.4036    7.7815    8.1291    8.4510    8.7506

  Columns 15 through 28

    9.0309    9.2942    9.5424    9.7772   10.0000   10.2119   10.4139   10.6070   10.7918   10.9691   11.1394   11.3033   11.4613   11.6137

  Columns 29 through 39

   11.7609   11.9033   12.0412   12.1748   12.3045   12.4304   12.5527   12.6717   12.7875   12.9003   13.0103
```





Conclusion:

From this experiment we came to learn different types and ways to plot graphs, use for and while loops. As using for loops we came to understand how we have to provide different types of conditions in for loop. We even got acquainted with break and continue statements. We learnt about the while iterative loops also.