**Lab 1：Matlab Basics**

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| **Introduction**  This lab is designed to make us get familiar to the basic operation of MATLAB and the method to prove some properties of different systems. Problem 1.4 suggest us to use MATLAB to construct some counter examples for proving. In this section, we need to know how to enter the data, how to draw the diagram, how to construct the function, and how to use MATLAB to represent the meaning of each curve in the diagram. Knowledge in the lecture class is also needed. Question 1.5 asks us to set up a function and then analyze it with different examples. It requires a deeper understanding of MATLAB.  **Lab results & Analysis**：  1.4 (a) The system y [n] = sin((pi/2)x[n]) is not linear. Use the signals x1[n] = δ[n] and x2[n] = 2\*δ[n] to demonstrate how the system violates linearity.  Answer: x1[n] =δ[n] y1[n]= sin((pi/2)x1[n])  x2[n]=2\*δ[n] y2[n]= sin((pi/2)x2[n]  x2[n]=2\*x1[n] y2[n]≠2\*y1[n]  So this system is not linear.    1.4 (b) The system y[n] = x[n] + x[n + 1] is not causal. Use the signal x[n] = u[n] to demonstrate this. Define the MATLAB vectors x and y to represent the input on the interval -5≤n≤9, and the output on the interval -6≤n≤9, respectively.  Answer: The output y[n] depends on the inout in the future x[n+1], for example, y[-1] = x[-1] + x[0] = 1. Therefore , the system is not causal.    1.4 (c) The system y[n] = log(x[n]) is not stable.  Answer: the input x[n] is bounded as [0 10], but when n get close to 0, the output y[n] is going to minus infinity, so the system is not stable.    1.4 (d)  The system given in Part (a) is not invertible  Answer: x[n] = n, -20≤n≤20  y1[n]= sin((pi/2)x[n])  according to the images, the different input leads to same output, so the system is not invertible.    1.4（e）y[n]=x^3[n]  Answer: The system is not linearity.  x1[n] = n, x2[n] = n, x3[n] = x1[n]+x2[n]; -20≤n≤20  according to the image we can see that the y1[n]+y2[n] ≠ y3[n]    1.4(f) y[n]=n\*x[n]  Answer: The system is not time invariant.  Consider x1[n] = δ[n] and x2[n] =δ[n-1] = x1[n-1], draw the images using Matlab, we can see that the y2[n] ≠ y1[n-1]. Therefore the system is not time invariant.      Let x[n] = n then the y[n] = n^2, y[-3] = y[3], so this system is not invertible.  Let x[n] = 1, y[n] = n is unbounded. So this system is not stable.  1.4(g) y[n]=x[2n]  Answer：the system is neither time invariant nor causal  Let y2[n]=x[2(n-n0)] y[n]=x[2n]  y2[n]=x[2n-2n0]=y[n-2n0] ≠y[n-n0]  so the system is not time invariant.    Because y[n]=x[2n]  y[1]=x[2] y[n] depends on the future value of x[n]  the system is not causal.    1.5（a）Write a function y=diffeqn(a, x, yn1) which computes the output y[n] of the causal system determined by Eq.(1.6). The input vector x contains x[n] for 0≤n≤N - 1 and yn1 supplies the value of y[-1]. The output vector y contains y[n] for 0≤n≤N - 1. The first line of your M-file should read function y = diffeqn(a,x,yn1)  Answer:  function y=diffeqn(a,x, yni)  y=zeros(1,size(x,2));  for i=0:size(x,2)  y(1,i+1)= mul(a,x,yni,i);  end  end    function result=mul(a,x,yni,n)  if n==0  result= yni;  else  result= a\*mul(a,x,yni,n-1)+x(1,n);  end  end  1.5 (b) Assume that a = 1, y[-1] = 0, and that we are only interested in the output over the interval 0 5 n 1 30. Use your function to compute the response due to xl[n] = 6[n] and x2[n] = u[n], the unit impulse and unit step, respectively. Plot each response using stem.  Answer:    1**.**5(c) Assume again that a = 1, but that y[-1] = -1. Use your function to compute y[n] over 0 ≤ n ≤ 30 when the inputs are x1[n] = u[n] and x2[n] = 2u[n]. Define the outputs produced by the two signals to be y1[n] and y2[n], respectively. Use stem to display both outputs. Use stem to plot (2 y1[n] – y2[n]). Given that Eq. (1.6) is a linear difference equation, why isn't this difference identically zero?  Answer:  Because they have different initial values.    1.5(d) The causal systems described by Eq. (1.6) are BIB0 (bounded-input bounded-output) stable whenever la1 < 1. A property of these stable systems is that the effect of the initial condition becomes insignificant for sufficiently large n. Assume a = 1/2 and that x contains x[n] = u[n] for 0 ≤ n≤30. Assuming both y[-1] = 0 and y[-1] = 1/2, compute the two output signals y[n] for 0≤n≤30. Use stem to display both responses. How do they differ?  Answer:  y[n]=a\*y[n-1]+x[n]  y[n-1]=a\*y[n-2]+x[n-1]  y[n]=a^2\*y[n-2]+a\*x[n-1]+x[n]  y[n]=a^(n+1)\*y[-1]+a^(n)\*x[0]+……+x[n]  because a<1, y[-1] will become insignificant when n becomes large, the value will get similar.    **Note**: Please indicate meaning of the symbols in all expressions. Please indicate the coordinate and unit in all figures. | |
| **Experience**   1. It was the first time for me to use MATLAB so at the beginning I was confused to the programming language of the MATLAB. I would search for much knowledge about how to use MATLAB before I typed my code, after the practice of some problems, I got more familiar. 2. I have learned there are different ways to input the impulse function and step function, array and judge method ( x=(n==0)) are both accepted. 3. When I submitted this lab report first time I did not know the correct templet. I just copied the code after each question. Now I learn how to write a lab report in correct templet. | |
| **Score** |  |

**1.4 （a）nx1=[-5:5];**

**nx2=nx1;**

**x1=[zeros(1,5) 1 zeros(1,5)];**

**x2=2\*x1;**

**y1=sin((pi/2)\*x1);**

**y2=sin((pi/2)\*x2);**

**figure(1)**

**stem(nx1,y1,'b-o')**

**hold on**

**stem(nx2,y2,'r-v')**

**legend('y1:The response of x1','y2:The response of x2')**

**title('y[n]=sin((pi/2)\*x[n])')**

**xlabel('n')**

**ylabel('y[n]')**

**1.4 (b)**

n=-5:9;

x=[0,0,0,0,0,1,1,1,1,1,1,1,1,1,1];

x2=[0,0,0,0,1,1,1,1,1,1,1,1,1,1,1];

y=x+x2;

stem(n,y);

legend('y[n]');

xlabel('n');

ylabel('y[n]')

**1.4 (c)**

n=0:0.2:20

x=0:0.2:20;

y=log(x);

stem(n,y);

legend('y[n]');

xlabel('n');

ylabel('y[n]')

**1.4 (d)**

x=-20:20;

n=-20:20;

y=sin(pi/2\*x)

stem(n,y);

legend('y[n]');

xlabel('n');

ylabel('y[n]')

**1.4 (e)**

n=-20:20;

x=-20:20;

y1=x.\*x.\*x;

y2=x.\*x.\*x;

x3=x+x;

y3=x3.\*x3.\*x3;

stem(n,y3);

hold on;

stem(n,y1+y2);

hold off;

legend('y3[n]','y1[n]+y2[n]');

xlabel('n');

ylabel('y[n]')

title('advenced assignment')

**1.4 (f)**

n=-5:5;

x1=[0,0,0,0,0,1,0,0,0,0,0];%x1[n] = δ[n]

x2=[0,0,0,0,0,0,1,0,0,0,0];%x2[n] = δ[n-1]

y1=n.\*x1;

y2=n.\*x2;

x3=n;

x4=1;

stem(n,y1);

legend('y1[n]');

title('x1[n] = δ[n]')

hold off;

stem(n,y2);

legend('y2[n]');

title('x2[n] = δ[n-1]')

hold off

**1.4 (g)**

n=-5:5;

x1=n;

x2=n-2;

y1 = 2\*n;

y2 = 2\*[n-2];%x[2(n-2)]

y3 = 2\*n-2;%y[n-2]

stem(n,y2);

hold on;

stem(n,y3);

legend('x[2(n-2)]','y(n-2)');

hold off;

stem (n,x1);

legend('x[n]');

stem(n,y1);

legend('y[n]');

**1.5 (b)**

zero=zeros(1,29);

x1=[1 zero];

x2=ones(1,30);

y1=diffeqn(1,x1, 0);

y2=diffeqn(1,x2, 0);

index=0:30;

stem(index,y1);

hold on

stem(index,y2);

hold off

title("1.5(b)plot")

xlabel("n");

ylabel("y[n]");

legend('y1[n]','y2[n]');

**1.5 (c)**

X1 = ones(1,30);

X2 = ones(1,30)\*2;

y1=diffeqn(1,X1, -1);

y2=diffeqn(1,X2, -1);

index=0:30;

stem(index,y1);

hold on

stem(index,y2);

hold on

stem(index,2\*y1-y2);

hold off

title("1.5(b)plot")

xlabel("n");

ylabel("y[n]");

legend('y1[n]','y2[n]','2y1[n]-y2[n]');

**1.5 (d)**

X = ones(1,30);

y1=diffeqn(0.5,X, 0);

y2=diffeqn(0.5,X, 0.5);

index=0:30;

stem(index,y1);

hold on

stem(index,y2);

hold off

title("1.5(d)plot")

xlabel("n");

ylabel("y[n]");

legend('y1[n]','y2[n]');