**Lab 1：Introduction**

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| **Author** | Name： 夏伟鹏 刘龙飞 Student ID 11812517 11813213 |
| **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 ask us to use MATLAB to construct some  counter examples for proving. In this part we need to know the method of data input, drawing diagrams, building functions and how to indicate the meaning of each curve in diagram while using MATLAB. The knowledge in lecture class is also needed. Problem 1.5 asks us to build a function and use different examples to analyze it. It requires deeper understanding about 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: x[n]=u[n] is the input of the system,and it is zero when n≤0  So the output y[n] should be zero when n≤0 if it is causal.  Now y[-1] ≠0, 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 not bounded, so the system is not stable.    1.4 (d)  The system given in Part (a) is not invertible  Answer: x1[n]= δ[n] x2[n]=5\*δ[n]  y1[n]= sin((pi/2)x1[n]) y2[n]= sin((pi/2)x2[n])  y1[n]=y2[n]  The different input leads to different output, so the system is not invertible.    1.4（e）y[n]=x^3[n]  Answer: The system is not linearity.  x1[n]= δ[n] x2[n]=2\*δ[n] y1[n]=x1^3[n] y2[n]=x2^3[n]  y2[n]≠2\*y1[n] so the system is not linearity.      1.4(f) y[n]=n\*x[n]  Answer: The system is not time invariant.  For time variant system, it should obey x[n-n0] → y[n-n0]  Let y2[n]=n\*x2[n] x2[n]=x1[n-n0] y1[n]=n\*x1[n]  y1[n-n0]=(n-n0)\*x1[n-n0] while y2[n]=n\*x1[n-n0]  y1[n-n0]≠y2[n] the input x[n-n0] will not lead to y[n-n0]  so the system is not time invariant.  The proof use x1[n]=u[n] and x2[n]=u[n-1]  n\*u[n-1] ≠y[n-1]=(n-1)\*u[n-1]    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,yn1)  N = length(x);  for n =1:N  if n == 1  y(n) = a \* yn1 + x(n)  else y(n) = a \* y(n-1) + x(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) n1 = -5:9;**

**n2 = -6:9;**

**x = [zeros(1,5) ones(1,10)];%x=x[n]=u[n]**

**x1 = [x 0];%x1=x[n+1]=u[n+1]**

**y = [0 x] + x1;**

**subplot(3,1,1);**

**stem(n1,x);**

**xlabel("n");**

**ylabel("x[n]");**

**subplot(3,1,2);**

**stem(n2,x1);**

**xlabel("n");**

**ylabel("x[n+1]");**

**subplot(3,1,3)**

**stem(n2,y);**

**xlabel("n")**

**ylabel("y[n]");**

**title("y[n]=x[n]+x[n+1]");**

**1.4 (c) x=linspace(0,10,100);**

**y=log(x);**

**stem(x,y);**

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

**xlabel('x[n]')**

**legend('y[n]','Location','NorthWest')**

**1.4 (d) nx1=[-5:5];**

**nx2=nx1;**

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

**x2=5\*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 (e) n = -5:5;**

**x1 = (n==0);**

**x2 = 2\*x1;**

**y1 = x1.^3;**

**y2 = x2.^3;**

**figure(1)**

**stem(n,y1,"b-o")**

**hold on**

**stem(n,y2,"r-v")**

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

**title("y[n]=x^3[n]")**

**xlabel("n")**

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

**1.4 (f) n = -5:5;**

**x1 = (n>=0);**

**x2 = (n>=1);%%%Ê¹x2[n]=x1[n-1]**

**y1 = n.\*x1;**

**y2 = n.\*x2;%%%y2[n]=n\*x1[n-1]**

**y3 = (n-1).\*x2;%%%y3[n]=y1[n-1]**

**figure(1)**

**stem(n,y2,"b-o")**

**hold on**

**stem(n,y3,"r-v")**

**legend("n\*x1[n-1]","y1[n-1]")**

**title("y[n] = n\*x[n]")**

**xlabel("n")**

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

**1.4 (g) n = -5:5;**

**x1 = n;**

**x2 = n-2;%%%x2[n]=x1[n-2]**

**y1 = 2\*n;%%%y1[n]=x1[2n]**

**y2 = 2\*(n-2);%%%y2[n]=x1[2(n-2)]**

**y3 = 2\*n-2;%%%y3[n]=y1[n-2]**

**figure(1)**

**stem(n,y2,"b-o")**

**hold on**

**stem(n,y3,"r-v")**

**legend("x[2(n-2)]","y[n-2]")**

**title("y[n]=x[2n]")**

**xlabel("n")**

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

**n = -5:5;**

**x = n;**

**y = 2\*n;%y[n]=x[2n]**

**subplot(2,1,1)**

**stem(n,x)**

**xlabel("n")**

**ylabel("x[n]");**

**subplot(2,1,2)**

**stem(n,y)**

**xlabel("n")**

**ylabel("y[n]");**

**1.5 (b) for n = 0:30**

**if n == 0**

**x1(n+1) = 1;**

**else**

**x1(n+1) = 0;**

**end**

**x2(n+1) = 1;**

**end**

**n = linspace(0,30,31);**

**y1 = diffeqn(1,x1,0);**

**y2 = diffeqn(1,x2,0);**

**subplot(2,1,1)**

**stem (n,y1)**

**xlabel("n")**

**ylabel("y1");**

**subplot(2,1,2)**

**stem (n,y2)**

**xlabel("n")**

**ylabel("y2");**

**1.5 (c) for n = 0:30**

**x1(n+1) = 1;**

**x2(n+1) = 2;**

**end**

**n = linspace(0,30,31);**

**y1 = diffeqn(1,x1,-1);**

**y2 = diffeqn(1,x2,-1);**

**y3 = 2\*y1 - y2;**

**subplot(3,1,1)**

**stem(n,y1)**

**xlabel("n")**

**ylabel("y1");**

**subplot(3,1,2)**

**stem(n,y2)**

**xlabel("n")**

**ylabel("y2");**

**subplot(3,1,3)**

**stem(n,y3)**

**xlabel("n")**

**ylabel("2y1-y2");**

**1.5 (d) for n = 0:30**

**x(n+1) = 1;**

**end**

**n = linspace(0,30,31);**

**y1 = diffeqn(0.5,x,0);**

**y2 = diffeqn(0.5,x,0.5);**

**subplot(2,1,1)**

**stem(n,y1)**

**xlabel("n")**

**ylabel("y1");**

**subplot(2,1,2)**

**stem(n,y2)**

**xlabel("n")**

**ylabel("y2");**