**Lab 1：Introduction**

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| **Author** | Name： 崔俞崧 赵奕帆 Student ID:11811305 11812020 |
| **Introduction**  In this Lab, we learned how to use matlab to analysis the signals, and we will use matlab to write functions in the Discrete-time System and to explore the functions' property. And below are the requirements of this lab assignment:  1. Try to analysis the system's property.  2. Try to construct some input signal and use them to test the system's property.  **Lab results & Analysis**：  Problem 1.4      and , they are both applied to the system . However, as we can see in the figure, ， and thus the system is not linear.      and , then we have . Since for all , , and , so the system is not causal.      In this figure, n is limited in the range of (0, 1], and from the definition of the stable, the y[n] are supposed to be bounded. However, from the figure above we may find that and thus the y[n] is not stable.      and , they are both applied to the system . As we can see in the figure 3, these two systems are identical everywhere, and thus y[n] is not invertible.        and , they are both applied to the system [n]. However for y[n], the y2 is not 3 times larger than the y1, and thus the system is not linear.      As we may see in the figure1, the y[n] ought to be bounded but not, then it is not stable. For figure2, , however, whatever the k is, the two different x[n] applied to y[n], the y[n] are always identical, and thus the y[n] is not invertible. Also, we found that so the system does not satisfy time-invariant.      As shown in the figure, , , . And thus T[x[n - 1]] ≠ y[n - 1], y[n] is not time-invertible.    We have , and then ,we found that y[1] is depend on the x[2], and thus the system is not causal.    and , then we have and , which are shown as above. We may found that the y2 and y1 are identical from the different x1 and x2. Then the system is not invertible.  Problem 1.5      function y = diffeqn(a,x,yn1)  x\_len = length(x);  y = zeros(x\_len,1);  y(1) = a\*yn1 + x(1);  if x\_len >= 2  for i=2:x\_len  y(i) = a\*y(i-1)+x(i)  end  end  end    图表, 直方图  描述已自动生成  In fig 1.5 b impulse, we apply the to the function and we got the output which is y[n] = 1.  In fig 1.5 b unitstep, we apply the to the function and we got the output which is y[n] = n.    图表  中度可信度描述已自动生成  The reason is that we have y[-1] = -1 in the differential function. So, we got and , so the system is not linear, so the difference is not zero.    图表  描述已自动生成  The first figure is y[-1] = 0,and the second figure is y[-1] = 0.5. We found that y[n] gradually close to 2.  We have  So for and the only difference at each item is which will decrease as n increase while |a|<1.  Code  1.4  **a.**  clear  clc    n = -10 : 1 : 10;    x1 = [zeros(1, 10) 1 zeros(1, 10)];  x2 = 2 .\* x1;    y1 = sin((pi / 2) \* x1);  y2 = sin((pi / 2) \* x2);    stem(n, y1,'b--o');  hold on;    stem(n, y2,'r--\*');    title('A1.1.4.a');  xlabel('n');  ylabel('y[n])');  legend('y\_1=sin((\pi/2) x\_1[n]','y\_2=sin((\pi/2) x\_2[n]')    saveas(gcf, "A1\_1\_4\_a.png")  **b.**  clear  clc    n1 = -5 : 9;  n2 = -6 : 9;  x1=[zeros(1,5), ones(1,10)];  x2=[zeros(1,4), ones(1,11)];    subplot(3,1,1);    stem(n1,x1,'b--o');  xlim([-6 10]);  title('A1.1.4.b.1');  xlabel('n');  ylabel('x[n]=u[n]');    subplot(3,1,2);  stem(n1,x2,'b--o');  xlim([-6 10]);  title('A1.1.4.b.2');  xlabel('n');  ylabel('x[n+1]=u[n+1]');    y1=[0 x1+x2];  subplot(3,1,3);  stem(n2,y1,'r--\*');  xlim([-6 10]);  title('A1.1.4.b.3');  xlabel('n');  ylabel('y[n]=x[n]+x[n+1]');    saveas(gcf, "A1\_1\_4\_b.png")  **c.**  clear  clc    xn = 0 : 0.01 : 1;  y = log(xn);    stem (xn, y, 'b--o');    title('A1.1.4.c');  xlabel('n');  ylabel('y[n]');  legend('y[n] = log(x[n])');    saveas(gcf, "A1\_1\_4\_c.png")  **d.**  clear  clc    n = -5 : 1 : 5;    x1 = [zeros(1,5) 1 zeros(1,5)];  x2 = 5 .\* [zeros(1,5) 1 zeros(1,5)];    y1 = sin((pi/2) \* x1);  y2 = sin((pi/2) \* x2);    subplot(3, 1, 1);  stem(n, x1);  title('A1.1.4.d.1');  xlabel('n');  ylabel('x\_1[n]');    subplot(3, 1, 2);  stem(n, x2);  title('A1.1.4.d.2');  xlabel('n');  ylabel('x\_2[n]');    subplot(3, 1, 3);  stem(n, y1, 'b--o');  hold on;  stem(n, y2, 'r--\*');  legend('(sin(\pi/2) x\_1[n])','(sin(\pi/2) x\_2[n])');  title('A1.1.4.d.3');  xlabel('n');  ylabel('y[n]');    saveas(gcf, "A1\_1\_4\_d.png")  **e.**  clear  clc    n = 1 : 1 : 10;  x1 = 1 : 1 : 10;  x2 = 3 .\* x1;  y1 = x1 .^ 3;  y2 = x2 .^ 3;      stem (n, y1, 'b--o');  hold on  stem (n, y2, 'r--\*');    title('A1.1.4.e');  xlabel('x[n]');  ylabel('y[n] = x^3[n]');  legend({'x[n]=u[n]','x[n]=3u[n]'});    saveas(gcf, 'A1\_1\_4\_e.png');  **f.**  clc  clear    n = -10 : 1 : 10;    % demonstrate the system is not stable:  x1 = (ones(1, 21));  y1 = x1 .\* n;      subplot(2, 1, 1);  stem(n, y1, 'b--o');  title('A1.1.4.f.1');  xlabel('x[n] = u[n]');  ylabel('y[n] = nx[n]');    % demonstrate the system is not invertible:  subplot(2, 1, 2);  x2 = [zeros(1, 10) 1 zeros(1, 10)];  x3 = [zeros(1, 10) 10 zeros(1, 10)];  y2 = x2 .\* n;  y3 = x3 .\* n;  stem(n, y2, 'g--o');  hold on  stem(n, y3, 'r--\*');  title('A1.1.4.f.2');  xlabel('x[n] = k\delta[n]');  ylabel('y[n] = nx[n]');  **g.**  clear  clc    n = -5 : 1 : 5;    % demonstrate the system is not time-incariant:  x1 = [zeros(1,5) 1 zeros(1,5)];  x2 = [zeros(1,6) 1 zeros(1,4)];  x3 = [zeros(1,7) 1 zeros(1,3)];    subplot(3,1,1);  stem(n,x1);  title('A1.1.4.g.1');  xlabel('n')  ylabel('x[n]=¦Ä[n]');    subplot(3,1,2);  stem(n,x2);  title('A1.1.4.g.2');  xlabel('n')  ylabel('T[x[n-1]]=x[2n-1]=\delta[n-1]');    subplot(3,1,3);  stem(n,x3);  title('A1.1.4.g.3');  xlabel('n')  ylabel('y[n-1]=x[2(n-1)]=\delta[n-2]');    saveas(gcf, "A1\_4\_g\_1.png");    % demonstrate the system is not causal:  figure(2)  n = -5:1:5;  x4= [zeros(1,7) 1 zeros(1,3)];  y4=[zeros(1,6) 1 zeros(1,4)];    subplot(2,1,1);  stem(n,x4);  title('A1.1.4.g.1');  xlabel('x[n]=¦Ä[n-2]')    subplot(2,1,2);  stem(n,y4);  title('A1.1.4.g.2');  xlabel('y[n]=x[2n]=¦Ä[n-1]')    saveas(gcf, "A1\_4\_g\_2.png")    % demonstrate the system is not invertible:  figure(3);  y1 = (zeros(1,11));  y2 = (zeros(1,11));    subplot(2,1,1);  stem(n, y1,'r--o');  title('A1.1.4.g.1');  xlabel('x\_1[n]=\delta[n+1]');  ylabel('y\_1[n]=\delta[n+1/2]');    subplot(2,1,2);  stem(n, y1,'b--\*');  title('A1.1.4.g.2');  xlabel('x\_2[n]=\delta[n+3]');  ylabel('y\_2[n]=\delta[n+3/2]');    saveas(gcf, "A1\_4\_g\_3.png");  1.5  **a.**  function y = diffeqn(a,x,yn1)  x\_len = length(x);  y = zeros(x\_len,1);  y(1) = a\*yn1 + x(1);  if x\_len >= 2  for i=2:x\_len  y(i) = a\*y(i-1)+x(i)  end  end  end  **b.**  close all;  clc;  t = [0:30];  impulse = t==0;  unitstep = t>=0;  out1 = diffeqn(1,impulse,0);  out2 = diffeqn(1,unitstep,0);  subplot(2,1,1);  stem(t,out1,'r--');  title('1.5 b impulse');  xlabel('x1[n]=δ[n]');  subplot(2,1,2);  stem(t,out2,'g--');  title('1.5 b unitstep');  xlabel('x2[n]=u[n]');  saveas(gcf,'1\_5\_b.png');  **c.**  close all;  clc;  t = [0:30];  x1 = t>=0;  x2 = 2 \* x1;  y1 = diffeqn(1,x1,-1);  y2 = diffeqn(1,x2,-1);  subplot(3,1,1);  stem(t,y1,'r--');  title('1.5 c y1');  subplot(3,1,2);  stem(t,y2,'g--');  title('1.5 c y2');  y3 = 2 \* y1-y2;  subplot(3,1,3);  stem(t,y3,'b--');  title('1.5 c y3');  saveas(gcf,'1\_5\_c.png');  **d.**  close all;  clc;  n=[0:30];  x=n>=0;  a=0.5;  yn1=0;  y1=diffeqn(a,x,yn1);  yn1=0.5;  y2=diffeqn(a,x,yn1);  subplot(2,1,1);  stem(n,y1,'r--')  title('1.5 (d) y[-1]=0');  subplot(2,1,2);  stem(n,y2,'b--');  title('1.5 (d) y[-1]=0.5');  saveas(gcf, "1\_5\_d.png")  **Note**: Please indicate meaning of the symbols in all expressions. Please indicate the coordinate and unit in all figures. | |
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