Homework 1

MATLAB Project of Chapter 2

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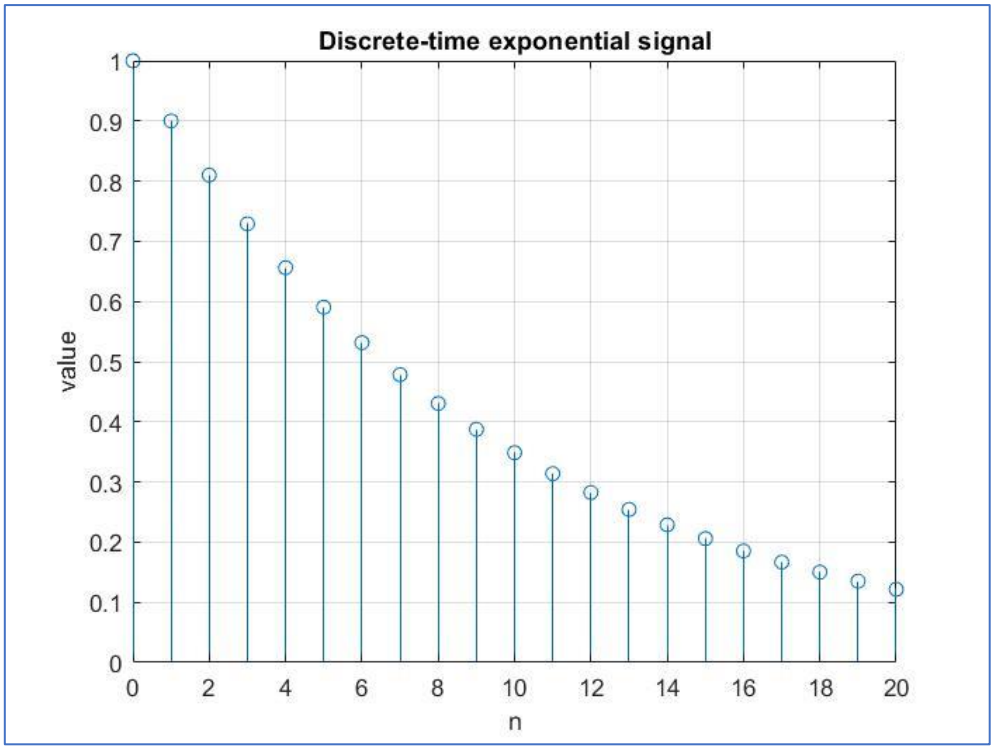
1. Problem 1

1.1 Code

```
n = 0:1:20;

stem(n,0.9.^n), grid



xlabel('n');
ylabel('value');
grid on;
title('Discrete-time exponential signal');
```

1.2 Display data in figure



2. Problem 2

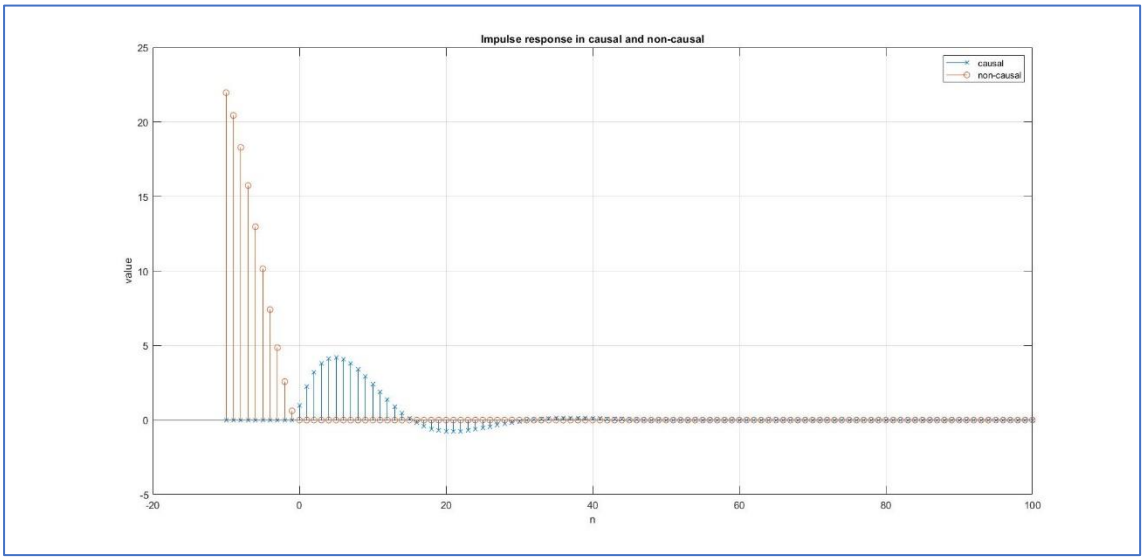
2.1 Sub-question (a)

2.1.1 Code

```
% 第 a 小題
a = 1.8*cos(pi/16);

% Initial rest conditions: causal，所以 y[n]=0,n<0
% 初始化
y1 = [1];
y1 = [y1 a*y1(1)+0.5];
y1 = [y1 a*y1(2)-0.81*y1(1)];
n_1 = 3:1:100;
for i = n_1
          y1 = [y1 a*y1(i)-0.81*y1(i-1)];
end
temp = zeros(1,10);
y1 = [temp y1]
step_1 = -10:1:100;
stem(step_1, y1, "x");
hold on;

% Initial rest conditions: noncausal,所以 y[n]=0,n>0
% 初始化
y2 = [0];
y2 = [y2 (a*y2(1)+0.5)/0.81];
y2 = [y2 (a*y2(2)-y2(1)+1)/0.81];
n_2 = 3:1:10;
for i = n_2
          y2 = [y2 (a*y2(i)-y2(i-1))/0.81];
end
y2 = fliplr(y2)
temp = zeros(1,100);
y2 = [y2 temp]
step_2 = -10:1:100;
stem(step_2, y2);
hold on;
```

```
% 設定圖標
legend('causal','non-causal')
xlabel('n');
ylabel('value');
grid on;
title('Impulse response in causal and non-causal');
```

2.1.2 Display data in figure



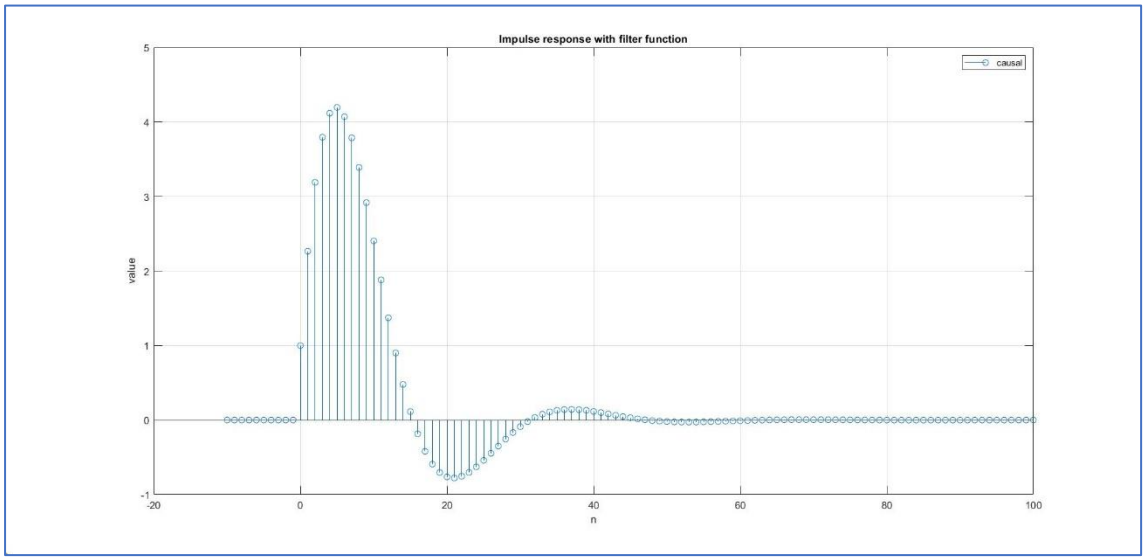
2.2 Sub-question (b)

2.2.1 Code

```
coeff = 1.8*cos(pi/16);

a = [1 -coeff 0.81];

b = [1 0.5];

n = -10:1:100;

x = (n==0);



y = filter(b,a,x);

stem(n,y);
```

```
% 設定圖標
legend('causal')
xlabel('n');
ylabel('value');
grid on;
title('Impulse response with filter function');
```

2.2.2 Display data in figure



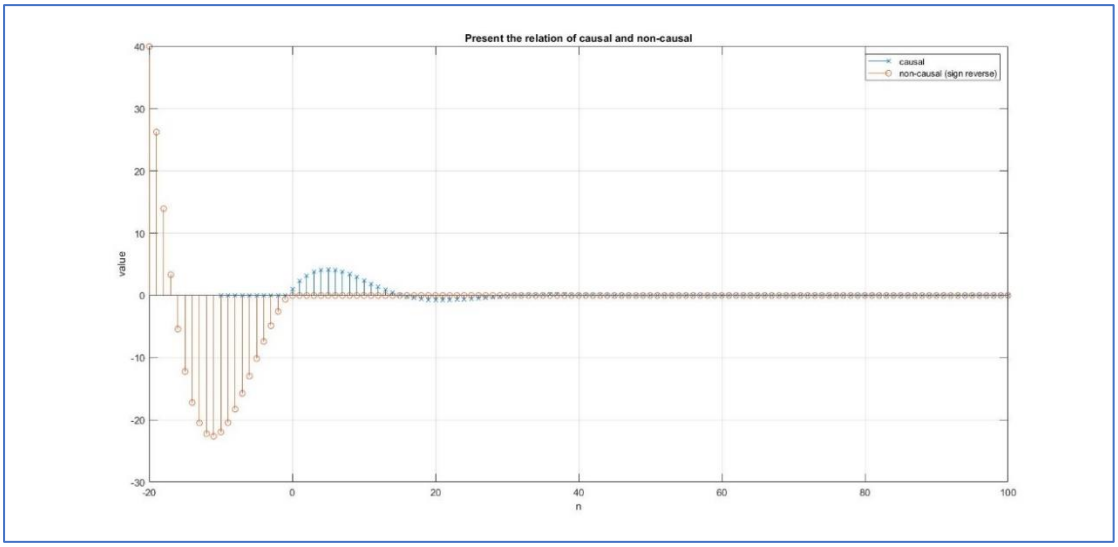
2.3 Relation of causal and non-causal

2.3.1 Code

```
% 第 a 小題
a = 1.8*cos(pi/16);
% Initial rest conditions: causal，所以 y[n]=0,n<0
% 初始化
y1 = [1];
y1 = [y1 a*y1(1)+0.5];
y1 = [y1 a*y1(2)-0.81*y1(1)];
n_1 = 3:1:100;
for i = n_1
          y1 = [y1 a*y1(i)-0.81*y1(i-1)];
end
temp = zeros(1,10);
y1 = [temp y1]
step_1 = -10:1:100;
stem(step_1, y1, "x");
hold on;
```

```
% Initial rest conditions: noncausal,所以 y[n]=0,n>0
% 初始化
y2 = [0];
y2 = [y2 (a*y2(1)+0.5)/0.81];
y2 = [y2 (a*y2(2)-y2(1)+1)/0.81];
n_2 = 3:1:20;   % 算到-20
for i = n_2
          y2 = [y2 (a*y2(i)-y2(i-1))/0.81];
end
y2 = fliplr(y2);
temp = zeros(1,100);
y2 = [y2 temp];
% 正負號反轉
n_2 = 1:1:121;
for i = n_2
          y2(i) = y2(i)*-1;
end
step_2 = -20:1:100;
stem(step_2, y2);
hold on;

% 設定圖標
legend('causal','non-causal (sign reverse)')
xlabel('n');
ylabel('value');
grid on;
title('Present the relation of causal and non-causal');
```

2.3.2 Display data in figure



2.3.3 說明

從 impulse response 的遞迴推導中，我發現 causal 和 non-causal 的解之間除了差了一個負號外，彼此之間的數學表示式有些許相似，因此我推測 non-causal 的計算在物理上的意義是「計算出該訊號尚未發生的可能」。為了驗證我的推論，我透過 matlab 將 non-causal 的解繼續往後計算到 n=-20，再將 non-causal 的解極性顛倒，最後將 causal 的解和 non-causal 的解進行疊圖，從圖中可以推論 non-causal 的解確實可以視為 causal 解尚未發生的可能。

除了透過上述方法粗糙的驗證自己的推論外，未來應該從 causal 解的 delay，更嚴謹的驗證 non-causal 的物理意義是否可視為訊號尚未發生的可能。