Chandler Bottomley
862005947
EE 111 lab 4

Abstract:
For lab 4 we are recreating a microphone and its capability to filter out echos. This is important because this system is responsible for all recorded audio. For this lab we are showing 3 different tasks and how well each task is able to deal with echos/noise.

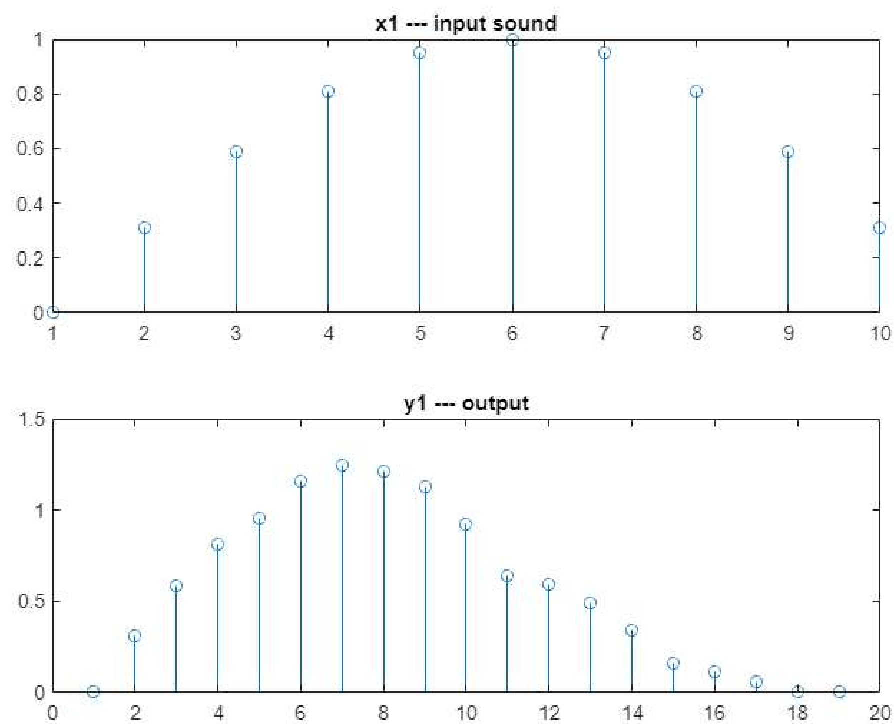
Task 1:

lab4_task1.m

```
n  = 0:9;
m = length(n);
x1 = sin(pi*n/10).*(heaviside(n)-heaviside(n-10));
h1 = zeros(1,m);
h1(1) = 1;
h1(5)  = 0.5;
h1(8) = 0.2;

y1 = conv(x1,h1);

figure(1);
subplot(2,1,1);
stem(x1);
title('x1 --- input sound');
subplot(2,1,2);
stem(y1);
title('y1 --- output');
```



For this task we wanted to see the difference between the input x[n] (voice from mouth) compared to the output of the system y[n] (output voice) and we wanted to compare the differences in the signals and show how the output is distorted.

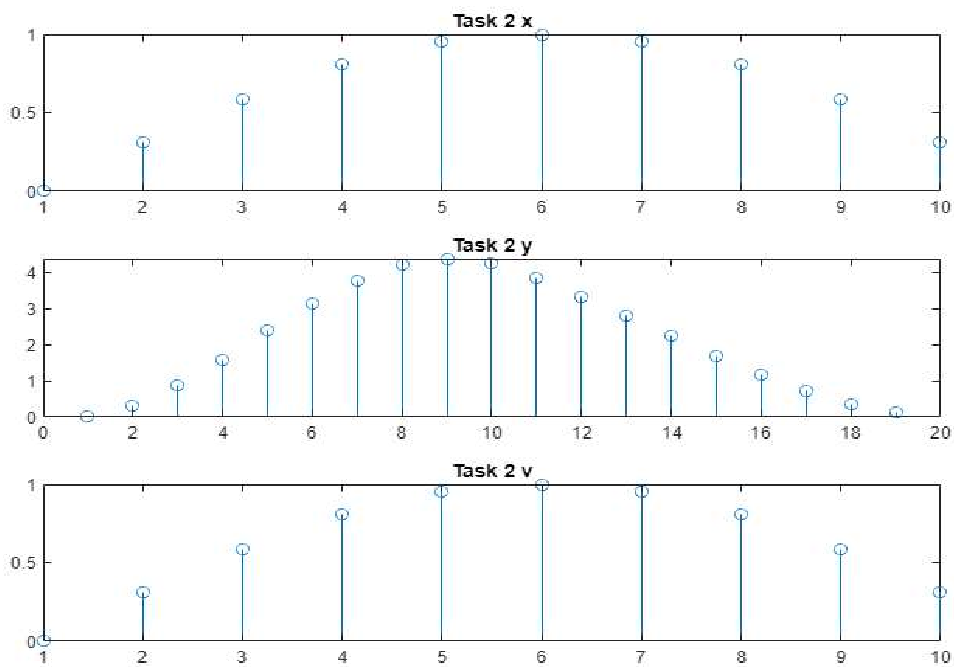
Task 2:

lab4_task1.m × lab4_task2.m ×

```
n  = 0:9;
x2 = sin(pi*n/10).*(heaviside(n)-heaviside(n-10));
h2 = 0.9.^n;
g2 = [1,-0.9];
y2 = conv(x2,h2);
v2_1 = conv(y2, g2);

v2 = v2_1(1:10);

figure(2);
subplot(3,1,1);
stem(x2);
title('Task 2 x');
subplot(3,1,2);
stem(y2);
title('Task 2 y');
subplot(3,1,3);
stem(v2);
title('Task 2 v');
```



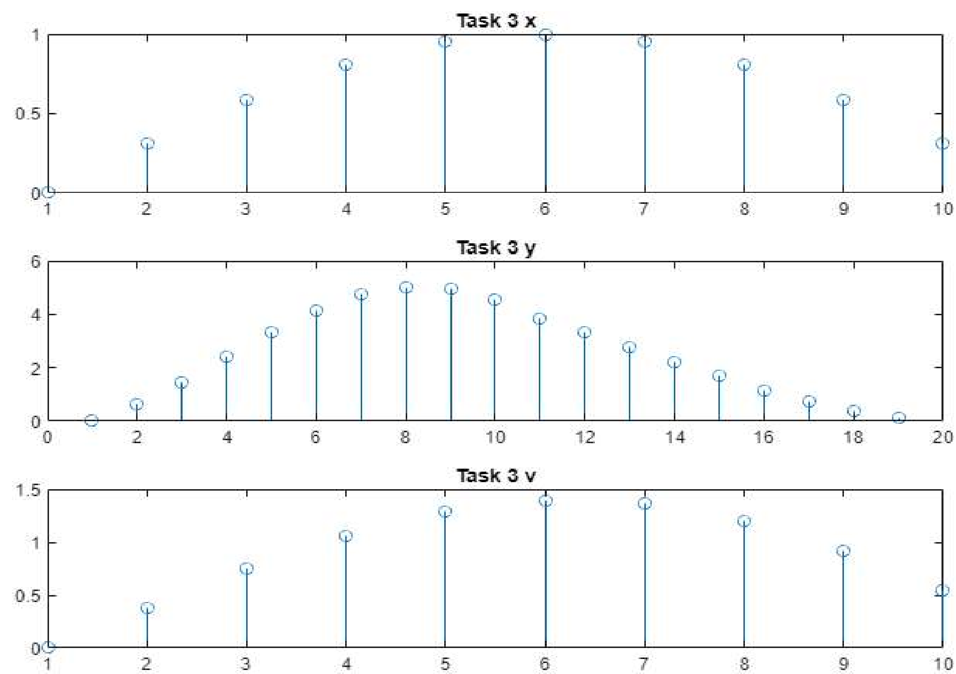
For this task we are testing the same as task 1 but for task 2 we are testing with the filter g[n] δ[n] − 0.9δ[n − 1] . In this task we have y[n] as the unfiltered signal and we have v[n] as the filtered voice. In this case we can see that g[n] is a perfect echo cancellation filter since it has the same output as x.

Task 3:

lab4_task1.m × lab4_task2.m × lab4_task3.m × +

```
n  = 0:9;
x3 = sin(pi*n/10).*(heaviside(n)-heaviside(n-10));
h3 = 0.9.^n;
h3(1) = h3(1) + 1;
H3 = fft(h3);
G = 1./H3;
g3 = ifft(G);
y3 = conv(x3, h3);
v3_1 = conv(y3, g3);
v3 = v3_1(1:10);


figure(3);
subplot(3,1,1);
stem(x3);
title('Task 3 x');
subplot(3,1,2);
stem(y3);
title('Task 3 y');
subplot(3,1,3);
stem(v3);
title('Task 3 v');
```



For this task we are following a similar process to task 2 but instead we are testing another filter where we have h[n] = = 0.9 nu[n] + δ[n]. In this task we can see that our filter is not quite perfect since it varied from x[n].

Conclusion:

This lab showed us how we can use ideas from this class to make an echo filter that is used for microphones. From this lab we could see that our best filter was from task 2 but the most realistic filter was from Task 3.