ECE 311 Lab 3

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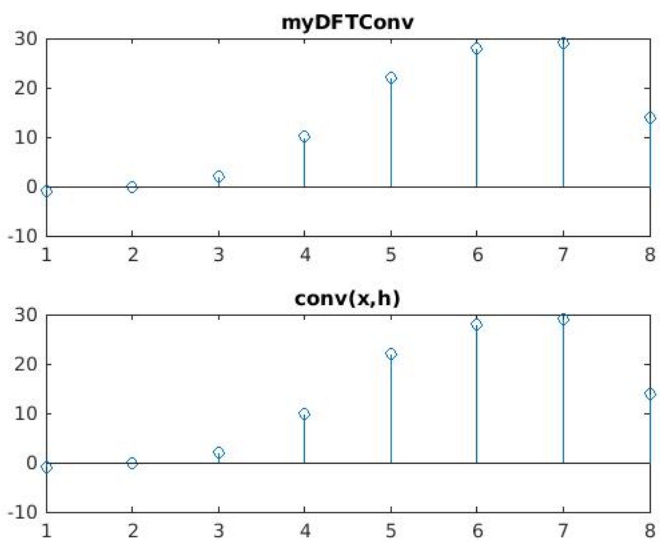
March 5, 2017

```matlab
function [ y ] = myDFTConv( x, h )

%transfer over to frequency domain
l = size(x,2) + size(h,2) - 1;
x_w = fft(x,l);
h_w = fft(h,l);

%element multiplication to get y_w
y_w = x_w.*h_w;

%return to discrete domain
y = ifft(y_w);

%plot my result
figure;
subplot(211);
stem(y);
title('myDFTConv');

%plot key
subplot(212);
stem(conv(x,h));
title('conv(x,h)');


end
```

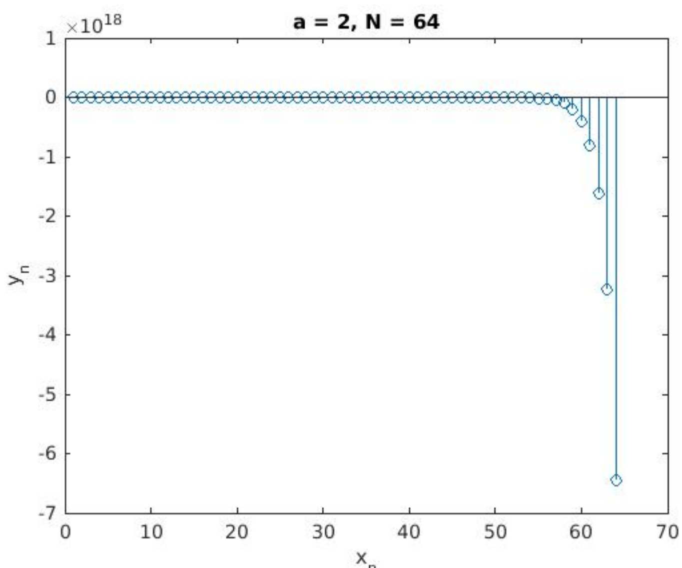
myDFTConv.m



Because of the use of fft and ifft, the time coplexity is also $O(Nlog(N))$.

```
function [ y_n ] = sys1( a,N )

%get delta function
x_n = zeros(1,N);
x_n(1) = 1;

%get shifted delta function
x_n_1 = zeros(1,N);
x_n_1(2) = 1;

y_n = zeros(1,N+1);

for i = 1:N,
    y_n(i+1) = a.*y_n(i) + 0.3.*x_n(i) -2.*x_n_1(i);
end
y_n = y_n(2:length(y_n)); % remove first element to get to N
figure;
stem(y_n);
title('a = 2, N = 64');
ylabel('y_n');
xlabel('x_n');
end
```

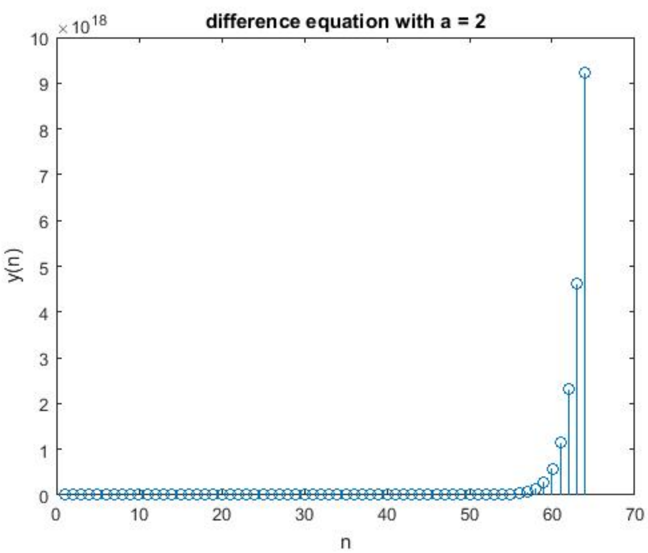
sys1.m

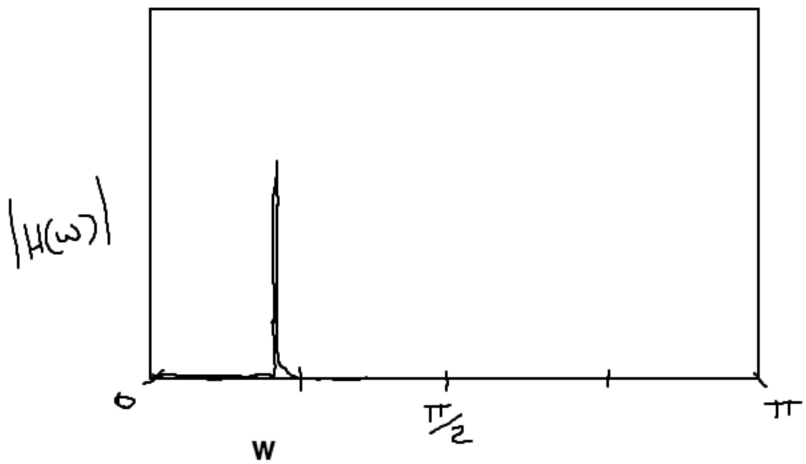


Notice that this function is in the order of $-e^x$ therefore, it is not stable $\lim_{x_n \to \infty} y_n = -\infty$. The system is causal, however, by the finite difference equation, output only depends on past or current inputs.

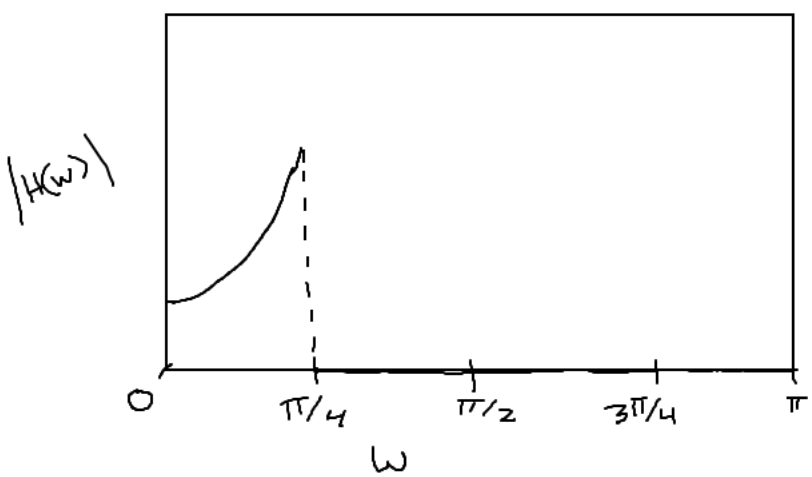
```
function [ y_n ] = sys2( x_n, a )
N = 64; % length always 64
y_n = zeros(1,N+1);

for i = 1:64,
    y_n(i+1) = a*y_n(i) + x_n(i).^2;
end
    y_n = y_n(2:length(y_n)); % remove first element to shorten to 64

    figure;
    stem(y_n);
    title('difference equation with a = 2');
    xlabel('n');
    ylabel('y(n)');
end
```

sys2.m





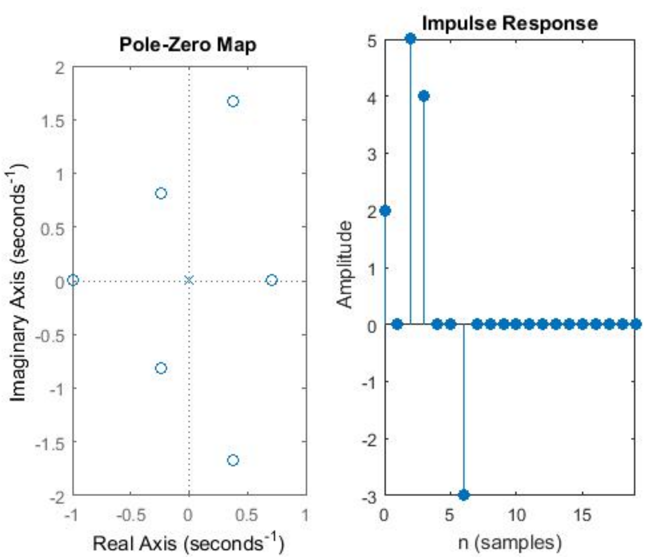
We can see on the interval from $\omega = 0 to \pi$, that there is only one point where the magnitude is not zero. Therefore, there is a spike at that point.



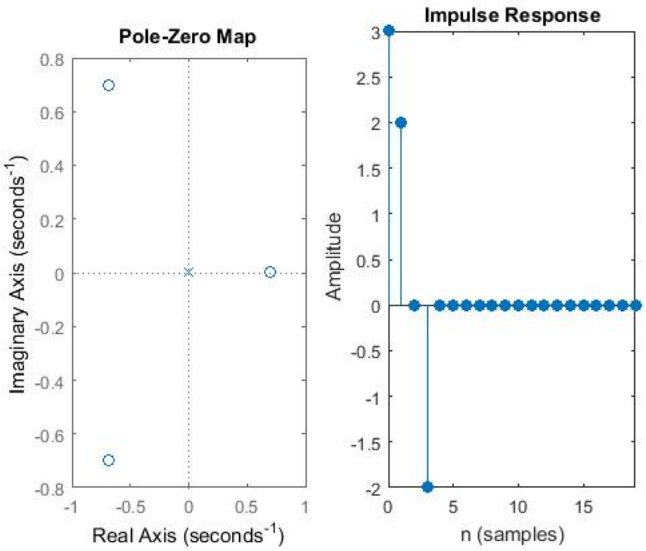
We can see on the interval from $\omega = 0 to \pi$ that there is a minimum at $\omega = 0$ and a maximum at $\omega = \pi/4$ so the graph is increasing until that point.

```
function [ ] = pzplot_impz( a,b )
S = tf(b,a);
N = 20;

figure;
subplot(121);
pzplot(S);
subplot(122);
impz(b,a,N);
end
```

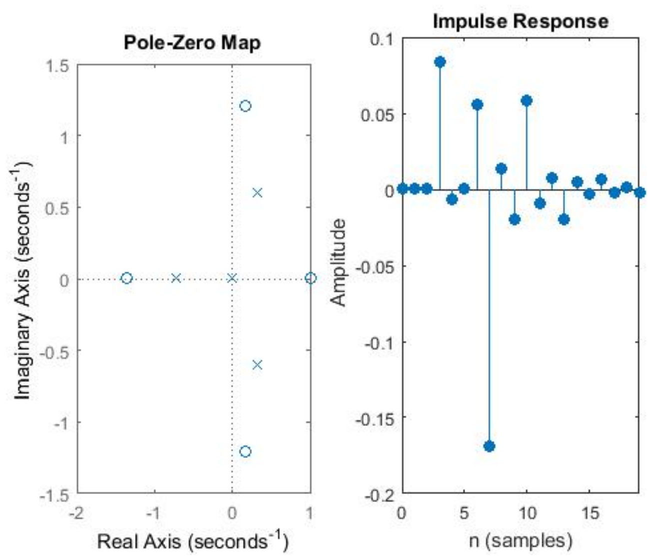
pzplot_impz.m



With $a = [1,0,0,0,0,0,0]$ and $b = [2,0,5,4,0,0,-3]$ There are no poles on the unit circle so the system is most likely stable.



With $a = [1, 0, 0, 0]$ and $b = [3, 2, 0, -3]$



With $a = [12, 1, 0, 4, 0, 0, 0, 0]$ and $b = [0, 0, 0, 1, 0, 0, 1, -2]$

$H(z) = z/(z + e^{-i8\pi/10})(z +^{i8\pi/10})$
$= z/z(z + e^{-i8\pi/10} + e^{i8\pi/10})$
$= 1/(z + 2cos(4\pi/5))$
$= (z^{-1})/(1 + z^{-1}2cos(4\pi/5))$
$a = [1, 2cos(4\pi/5)], b = [0, 1]$