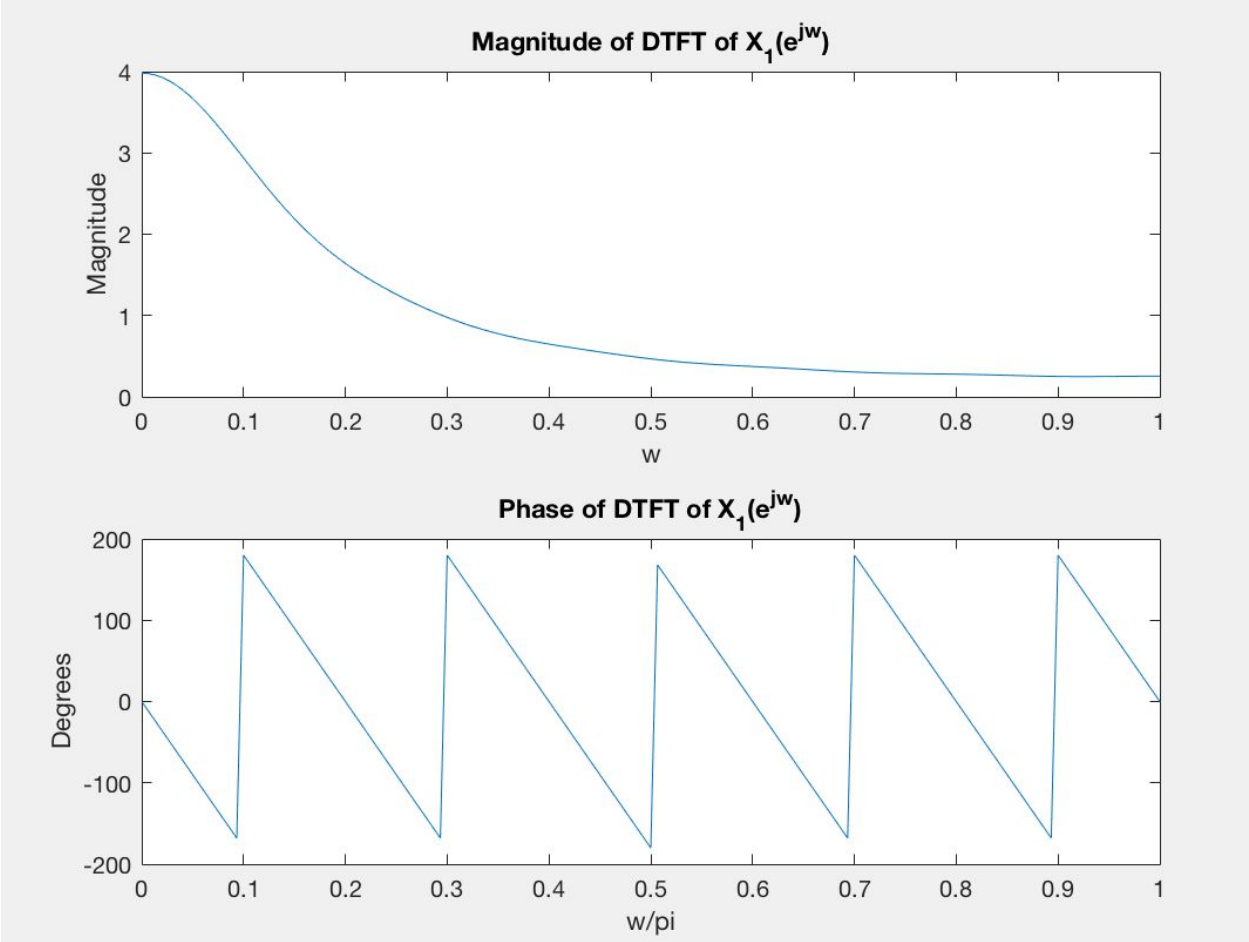
Jeremy Liem

EE 442

Homework 2



Code:

```
%% EE 442 Homework 2 2018

% Ingle & Proakis

n1 = -10 : 10;
x1 = 0.6.^abs(n1);
N1 = length(n1);
N = 300;
```

```
x1 = [x1,zeros(1,N-N1)];
X1 = fft(x1, N);
w = (0:N/2)*2*pi/N;
magx1 = abs(X1(1:N/2+1));
phax1 = angle(X1(1:N/2+1))*180/pi;
figure;
subplot(2,1,1);
plot(w/pi,magx1);
title('Magnitude of DTFT of X_1(e^{jw})');
xlabel('w');
ylabel('Magnitude');
subplot(2,1,2);
plot(w/pi, phax1);
title('Phase of DTFT of X_1(e^{jw})');
xlabel('w/pi');
ylabel('Degrees');
```

Jeremy Liem

EE 442

5.30 $x(n) = \{5, -4, 3\}$

$Y(k)$ = 8 point DFT

$y(n)$: $Y(k) = W_8^{5k} X(-k)_8$

$DFT[x((n-m))_N R_N] = W_N^{km} X(k)$

$Y(n) = IDFT\left(W_8^{5k} X(-k)_8\right)$

$= IDFT\left[X((-k))_8\right]_{n \to n-5}$

$= [x((5-n))_8 R_8]$

$X(-n)\{3, -4, 5\}$

$x[5-n] = \{0, 0, 0, 3, -4, 5, 0, 0\}$

5.31

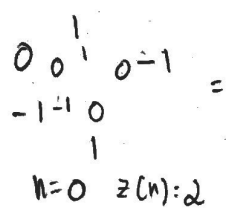
i) N-Point circular convolution

$N=5$

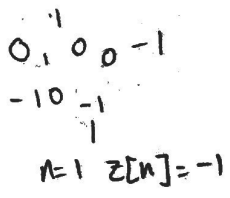
$x_1(n) = \{1, -1, 1, -1\} \to \{1, -1, 1, -1, 0\}$

$x_2(n) = \{1, 0, -1, 0\} \to \{1, 0, -1, 0, 0\}$

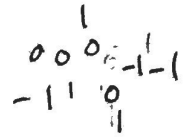
$N = 5$



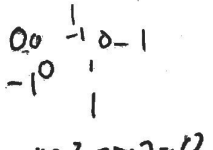
$n=0$ $z(n)=2$



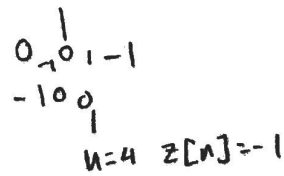
$n=1$ $z[n]=-1$



$n=2$ $z[n]=0$



$n=3$ $z[n]=0$



$n=4$ $z[n]=-1$

$x_3[n] = [2, -1, 0, 0, -1]$

ii) Linear convolution

$$\begin{array}{cccc} & & 1 & -1 \\ 0 & -1 & 0 & 1 \end{array} \qquad \begin{array}{cc} 1 & -1 \end{array}$$

$$x_4[n] = [1, -1, 0, 0, -1, 1, 0]$$

iii) Error

$$e(n) = x_5 = x_3 - x_4$$

$$= [2, -1, 0, 0, -1]$$
$$[1, -1, 0, 0, -1] \; -$$
$$= [1, 0, 0, 0, 0]$$

This shows than e(n) is just a shifted version of $x_4(n+5)$ since $\hat{e}(1:2) = x_4(6:7)$

4.

$$x(n) = \left(\frac{1}{3}\right)^n u(n)$$
$$Y(k) = X\left(e^{j2\pi k/7}\right)$$

using hint

$$\sum_{r=-\infty}^{\infty} x(n-rN) = \sum_{0}^{\infty} \left(\frac{1}{3}\right)^n \Rightarrow \left(\frac{1}{3}\right)^n + \left(\frac{1}{3}\right)^{n+7} + \left(\frac{1}{3}\right)^{n+14} + \ldots \left(\frac{1}{3}\right)^{n+\infty}$$

$$= \sum_{r=0}^{\infty} \left(\frac{1}{3}\right)^{n+7i} = \left(\frac{1}{3}\right)^n \sum_{i=0}^{\infty} \left(\frac{1}{3}\right)^{7i}$$

$$= \left(\frac{1}{3}\right)^n \frac{1}{1 - \left(\frac{1}{3}\right)^7}$$