EE 341 Lab 4

Convolution in MATLAB: conv(A,B)

-Convolves vectors A and B
-Works for filtering if you have an input A and an impulse response B (order doesn't matter)
-The length of the output is the MAX([LENGTH(A)+LENGTH(B)-1,LENGTH(A),LENGTH(B)])

Filtering in MATLAB: filter(B,A,X)

Referencing the difference equation:

a(1)*y(n) = b(1)*x(n) + b(2)*x(n-1) + ... + b(nb+1)*x(n-nb)- a(2)*y(n-1) - ... - a(na+1)*y(n-na)

-Filters the data in vector X with the filter described by vectors A and B representing the coefficients in the difference equation.
-The length of the output is the same at the length of the input

Filter vs. Conv

A FIR filter requires no feedback and has a finite impulse response. This means all the coefficients of y are zero except a(1) which means it is non-recursive. The impulse response of a FIR filter is simply the b(n) coefficients.

a(1)*y(n) = b(1)*x(n) + b(2)*x(n-1) + ... + b(nb+1)*x(n-nb)

The filter command is required for applying an IIR filter to an input, because the impulse response can't be read from b(n). Filter allows you to filter the input based on the a(n) and b(n) coefficients. The function frevalz provided with the lab helps illustrate IIR and FIR filters.

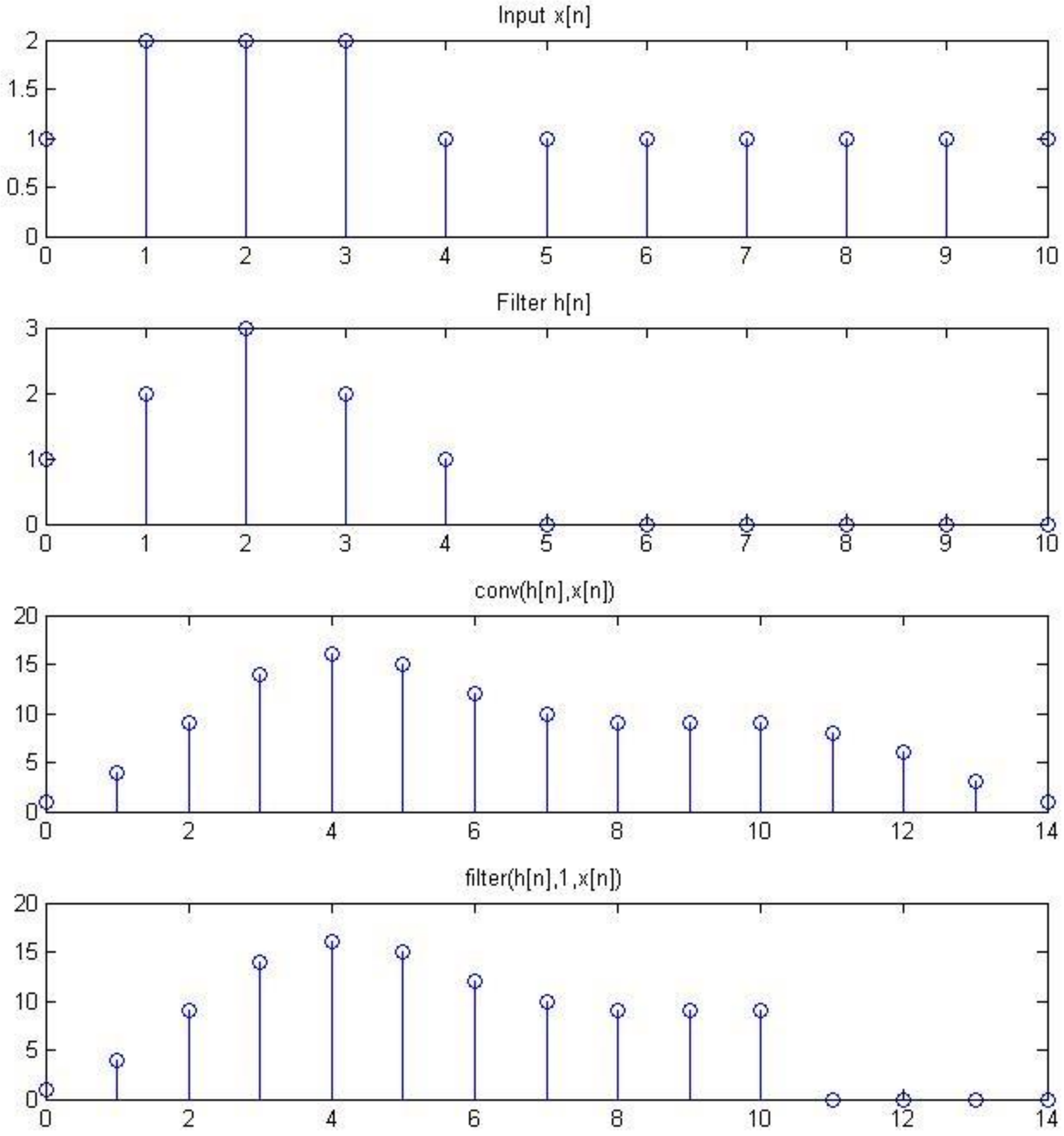
Frevalz (MATLAB frevalz01(B,A,Ts))

-Plots the Pole Zero, Impulse response, Magnitude and the Phase of the filter described by the coefficients in vectors b and a.

-Ts is the time step in the impulse response plot and is optional

Simple filter example

```
h=[1 2 3 2 1];
x=[ 1 2 2 2 1 1 1 1 1 1 1 ];
subplot(4,1,2); stem(0:10,[h zeros(1,6)]); title('Filter h[n]');
subplot(4,1,1); stem(0:10,x); title('Input x[n]');
subplot(4,1,3);stem(0:14,conv(h,x)); title('conv(h[n],x[n])');
subplot(4,1,4); stem(0:length(conv(h,x))-1,[filter(h,1,x) zeros(1, 4)]);
title('filter(h[n],1,x[n])');
```


Input x[n]
0
0.5
1
1.5
2
0
1
2
3
4
5
6
7
8
9
10
Filter h[n]
0
1
2
3
0
1
2
3
4
5
6
7
8
9
10
conv(h[n],x[n])
0
5
10
15
20
0
2
4
6
8
10
12
14
filter(h[n],1,x[n])
0
5
10
15
20
0
2
4
6
8
10
12
14