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Session: Thursday 2-4:50

LAB 6

1) Write a program to implement the difference equation corresponding to the transfer function $H(z) = \frac{1-0.2z^{-1}}{(1-0.9z^{-1})(1+0.85z^{-1})}$. Use this program to compute and plot the impulse response of the system.

1)

Compute the impulse response:

$$H(z) = \frac{1-0.2z^{-1}}{(1-0.9z^{-1})(1+0.85z^{-1})}.$$

$$H(z) = \frac{1 - 0.2z^{-1}}{(1 - 0.9z^{-1})(1 + 0.85z^{-1})}$$

$$\Rightarrow \frac{Y(z)}{X(z)} = \frac{1 - 0.2z^{-1}}{(1 - 0.9z^{-1})(1 + 0.85z^{-1})}$$

$$\Rightarrow Y(z)\left(1 - 0.9z^{-1}\right)\left(1 + 0.85z^{-1}\right) = \left(1 - 0.2z^{-1}\right) X(z)$$

$$\Rightarrow y(n) + 0.85\,y(n-1) - 0.9\,y(n-1) - (0.9)(0.85)\,y(n-2) = x(n) - 0.2\,x(n-1).$$

$$\Rightarrow Y(n) - 0.05\,y(n-1) - 0.9\,(0.85)\,y(n-2) - x(n) + 0.2\,x(n-1)$$

$$\Rightarrow Y(n) = 0.05\,y(n-1) + 0.9\,(0.85)\,y(n-2) + x(n) - 0.2\,x(n-1)$$

$\Rightarrow \quad y(n) + 0.85\, y(n-1) - 0.9\, y(n-1)$
$- (0.9)(0.85)\, y(n-2) = x(n)$
$- 0.2\, x(n-1).$

$\Rightarrow \quad Y(n) - 0.05\, y(n-1) - 0.9\,(0.85)$
$y(n-2) - x(n) + 0.2\, x(n-1)$

$\Rightarrow Y(n) = 0.05\, y(n-1) + 0.9\,(0.85)$
$y(n-2) + x(n) - 0.2\, x(n-1)$

Since $K = 1:100$

$\Rightarrow y(K+2) = 0.05\, y(K+1)$
$+ 0.9\,(0.85)\, y(K) + x(K+2)$
$- 0.2\, x(K+1)$

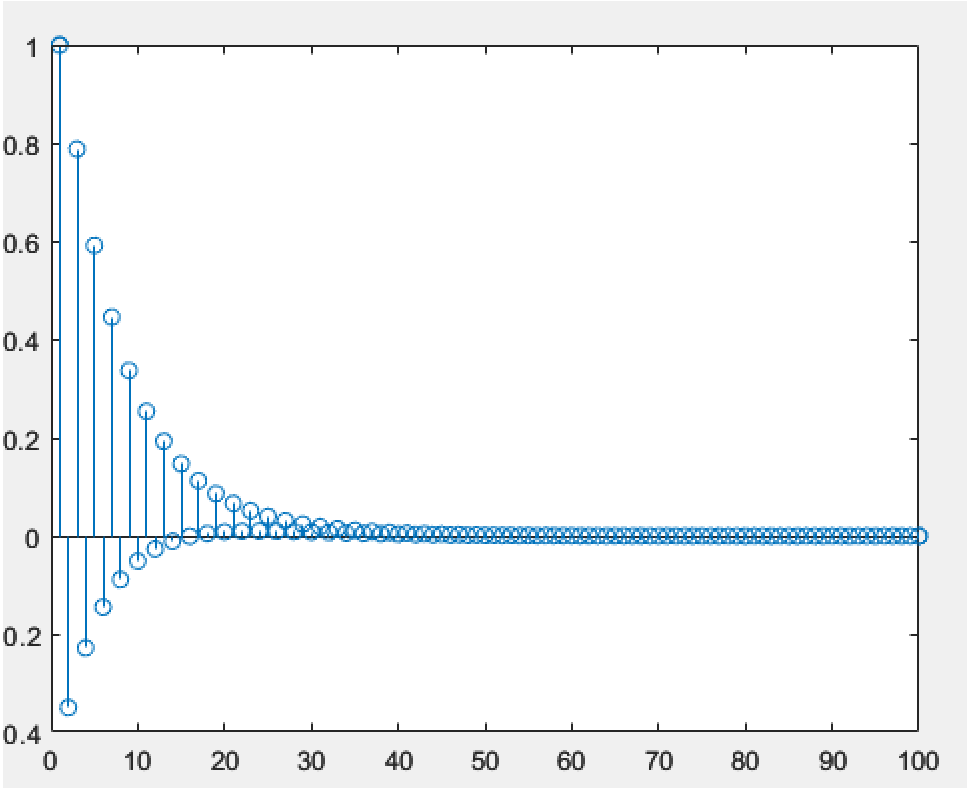
The plot impulse response of the system:

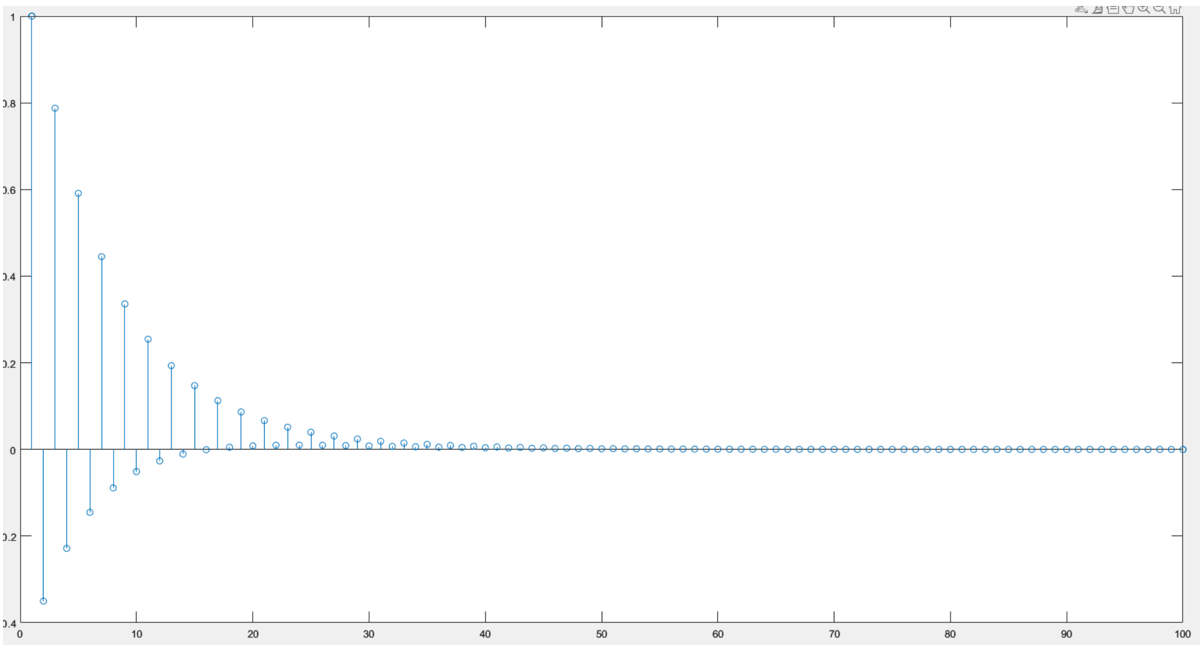
For the coding part:

```
x=[0,0,1,-0.2,zeros(1,98)];


y=zeros(1,102);
for k=1:100
    y(k+2)=0.05.*y(k+1)+0.9.*(0.85*y(k))+x(k+2)-0.2.*x(k+1);
end
stem(y(3:end))
```

For the graphing part(plot):





The highest peak of this impulse response is around 1
The lowest peak of this impulse response is around -0.35

2)

2) Repeat the above for $H(z) = \frac{1-0.2z^{-1}}{1-1.6\cos(2\pi\frac{5}{17})z^{-1}+0.64z^{-2}}$.

For computing the impulse response:

2)

$$H(z) = \frac{1-0.2z^{-1}}{1-1.6\cos(2\pi\frac{5}{17})z^{-1}+0.64z^{-2}}.$$

$$\Rightarrow \frac{Y(z)}{X(z)} = \frac{1-0.2z^{-1}}{1-1.6\cos(2\pi\frac{5}{17})z^{-1}+0.64z^{-2}}$$

$$\Rightarrow Y(z)\left(1-1.6\cos(2\pi\frac{5}{17})z^{-1}+0.64z^{-2}\right) = X(z)\left(1-0.2z^{-1}\right)$$

$$\Rightarrow Y(n) - 1.6\cos(2\pi\frac{5}{17})Y(n-1) + 0.64y(n-2) - x(n) - 0.2x(n-1) = 0$$

$$\Rightarrow Y(n) = 1.6\cos(2\pi\frac{5}{17})y(n-1) - 0.64y(n-2) + x(n]$$

$$\Rightarrow Y(z)\left(1-1.6\cos\left(2\pi\frac{5}{17}\right)z^{-1}+0.64z^{-2}\right)$$

$$= X(z)\left(1-0.2z^{-1}\right)$$

$$\Rightarrow Y(n)-1.6\cos\left(2\pi\frac{5}{17}\right)Y(n-1)$$

$$+0.64y(n-2)-x(n)-$$

$$0.2x(n-1)=0$$

$$\Rightarrow Y(n)=1.6\cos\left(2\pi\frac{5}{17}\right)y(n-1)$$

$$-0.64y(n-2)+x(n)$$

$$+0.2x(n-1)$$

Since $k=1:100$

$$\Rightarrow Y(k+2)=1.6\cos\left(\frac{2\pi(5)}{17}\right)y(k+1)$$

$$-0.64y(k)+x(k+2)-0.2x(k+1)$$

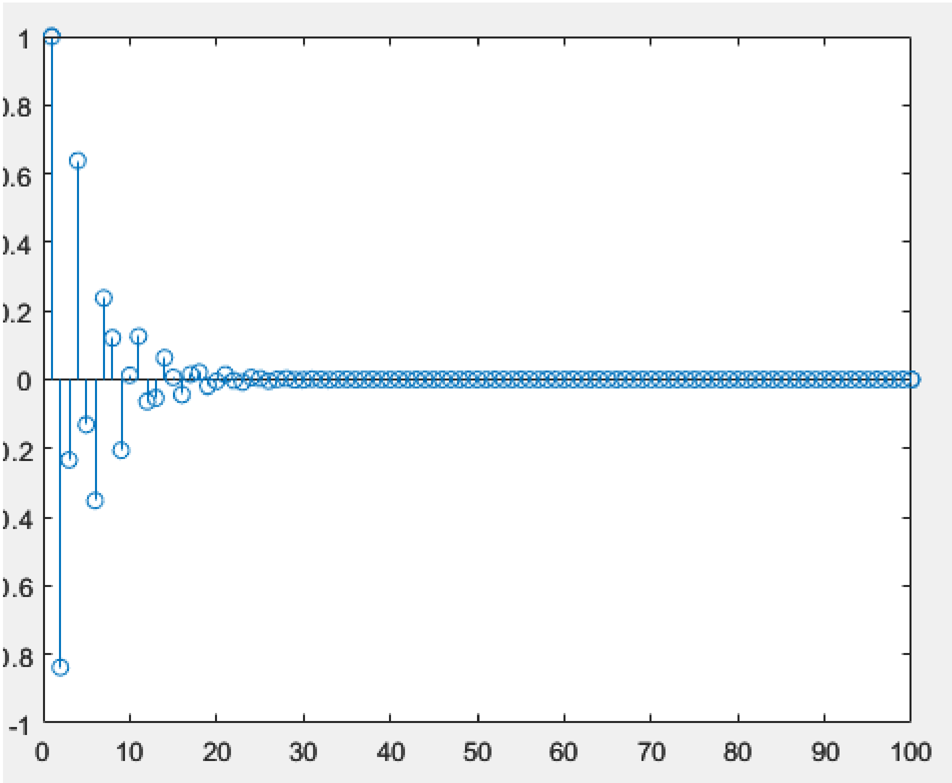
Plot impulse response of the system:

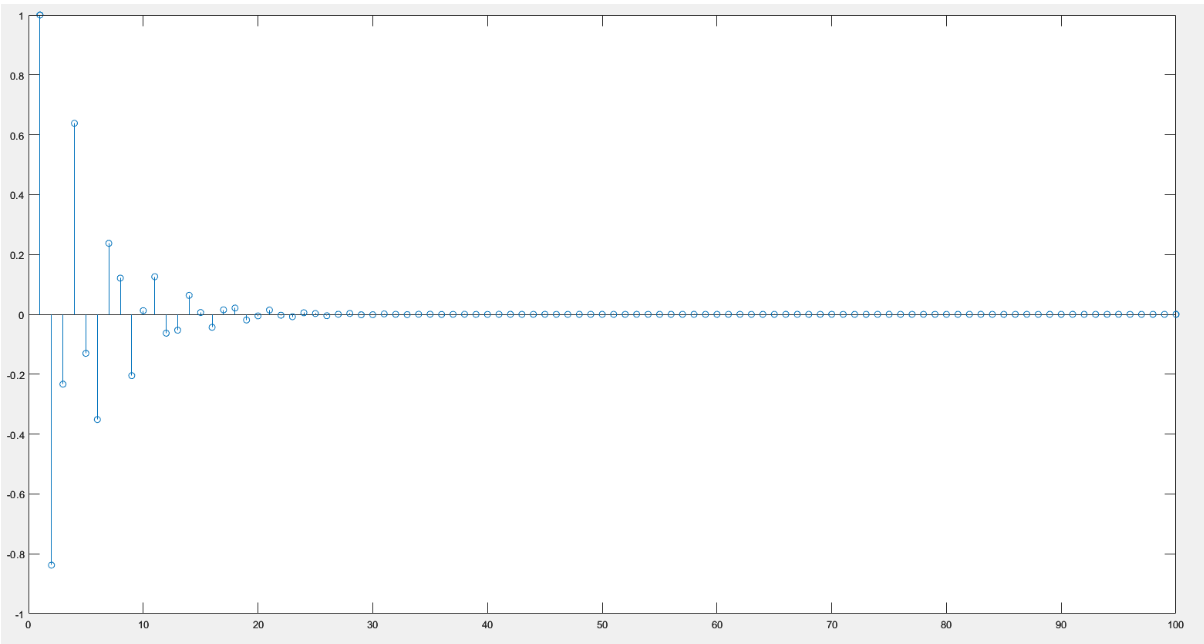
For the coding part:

```
x=[0,0,1,-0.2,zeros(1,98)];


y=zeros(1,102);
for k=1:100
    y(k+2)=1.6*cos(2*pi*5/17).*y(k+1)-0.64.*y(k)+x(k+2)-0.2.*x(k+1);
end
stem(y(3:end))
```

For the graphing part:(plot):





The highest peak of this impulse response is around 1
The lowest peak of this impulse response is around -0.85