

## Linear Convolution

### Aim:

To find linear convolution of following sequences with and without built in function.

- 1.  $x(n) = [1 \ 2 \ 1 \ 1]$   
 $h(n) = [1 \ 1 \ 1 \ 1]$
- 2.  $x(n) = [1 \ 2 \ 1 \ 2]$   
 $h(n) = [3 \ 2 \ 1 \ 2]$

### Theory:

**Linear convolution** is a mathematical operation used to combine two signals to produce a third signal. It's a fundamental operation in signal processing and systems theory.

### **Mathematical Definition:**

Given two signals,  $x(t)$  and  $h(t)$ , their linear convolution is defined as:

$$y(t) = x(t) * h(t) = \int_{-\infty}^{\infty} x(\tau)h(t - \tau) d\tau$$

### **Applications:**

**Filtering:** Convolution is used to filter signals, removing unwanted frequencies or noise.

**System Analysis:** The impulse response of a system completely characterizes its behaviour, and convolution can be used to determine the output of the system given a known input.

**Image Processing:** Convolution is used for tasks like edge detection, blurring, and sharpening images.

### Program:

#### **1. With built-in function:**

```
clc;
clear all;
close all;
x1 = input("Enter first Sequence");
h1 = input("Enter second Sequence");
y1 = conv(x1,h1);
```

```

disp("The convoluted sequence is: ");
disp(y1);

l = length(x1);
m = length(h1);
k = l+m-1;
n1 = 0:1:l-1;
n2 = 0:1:m-1;
n3 = 0:1:k-1;
subplot(1,3,1);
stem(n1,x1,"o");
xlabel("n");
ylabel("Amplitude");
title("x(n)");
grid on
xlim([-1 l+1]);
ylim([0 max(x1)+2]);
subplot(1,3,2);
stem(n2,h1,"o");
xlabel("n");
ylabel("Amplitude");
title("h(n)");
grid on
xlim([-1 m+1]);
ylim([0 max(h1)+2]);

subplot(1,3,3);
stem(n3,y1,"o");
xlabel("n");
ylabel("Amplitude");
title("y(n)");

```

```
grid on
xlim([-1 k+1]);
ylim([0 max(y1)+2]);
```

## **2. Without built-in function:**

```
clc;
clear all;
close all;
x1 = input("Enter first Sequence");
h1 = input("Enter second Sequence");
l = length(x1);
m = length(h1);
k = l+m-1;
y1 = zeros(1,k);
for i=1:l
    for j=1:m
        y1(i+j-1) = y1(i+j-1) + x1(i)*h1(j);
    end
end
disp("The convoluted sequence is: ");
disp(y1);

n1 = 0:1:l-1;
n2 = 0:1:m-1;
n3 = 0:1:k-1;
subplot(1,3,1);
stem(n1,x1,"o");
xlabel("n");
ylabel("Amplitude");
title("x(n)");
```

```
grid on
xlim([-1 l+1]);
ylim([0 max(x1)+2]);
```

```
subplot(1,3,2);
stem(n2,h1,"o");
xlabel("n");
ylabel("Amplitude");
title("h(n)");
```

```
grid on
xlim([-1 m+1]);
ylim([0 max(h1)+2]);
```

```
subplot(1,3,3);
stem(n3,y1,"o");
xlabel("n");
ylabel("Amplitude");
title("y(n)");
```

```
grid on
xlim([-1 k+1]);
ylim([0 max(y1)+2]);
```

**Result:**

Performed Linear Convolution using with and without built-in function.

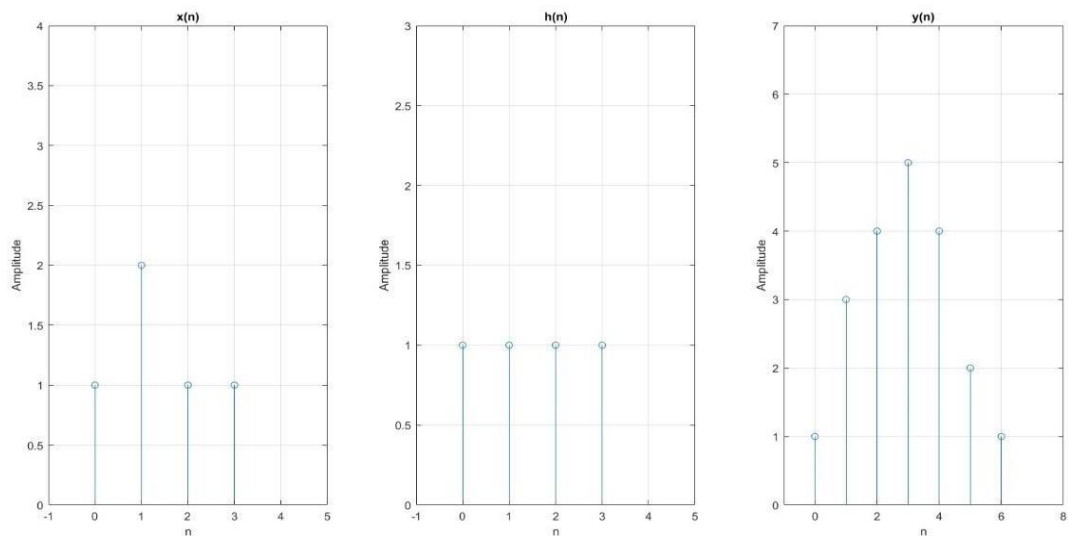
**Observation:**

a) Enter first Sequence [ 1 2 1 1]

Enter second Sequence [1 1 1 1]

The convoluted sequence is:

1 3 4 5 4 2 1



b) Enter first Sequence [1 2 1 2]

Enter second Sequence [3 2 1 2]

The convoluted sequence is:

3 8 8 12 9 4 4

