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Lab No:	6
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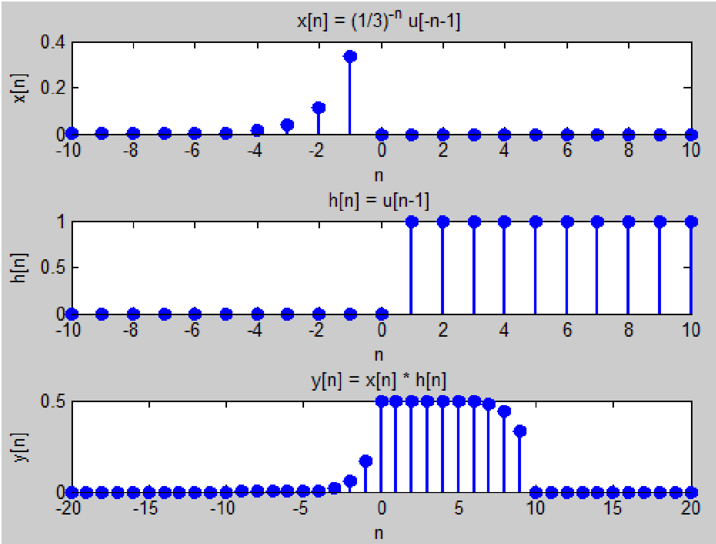
Class:	BCE – 4A

In-Lab Tasks

Task 01: Compute and plot the convolution $y[n] = x[n] * h[n]$ by any of the two procedures, where

$x[n] = \left(\frac{1}{3}\right)^{-n} u[-n-1]$ **and** $h[n] = u[n-1]$

```
n = -10:10;
x = double((1/3).^(-n) .* (n <= -1));
h = double(n >= 1);
y = conv(x, h);
ny = min(n) + min(n):max(n) + max(n);
subplot(3,1,1);
stem(n, x, 'filled', 'LineWidth', 1.5);
title('x[n] = (1/3)^{-n} u[-n-1]');
xlabel('n');
ylabel('x[n]');
subplot(3,1,2);
stem(n, h, 'filled', 'LineWidth', 1.5);
title('h[n] = u[n-1]');
xlabel('n');
ylabel('h[n]');
subplot(3,1,3);
stem(ny, y, 'filled', 'LineWidth', 1.5);
title('y[n] = x[n] * h[n]');
xlabel('n');
ylabel('y[n]');
```



Task 02: Compute and plot the convolution of following signals (by both procedures)

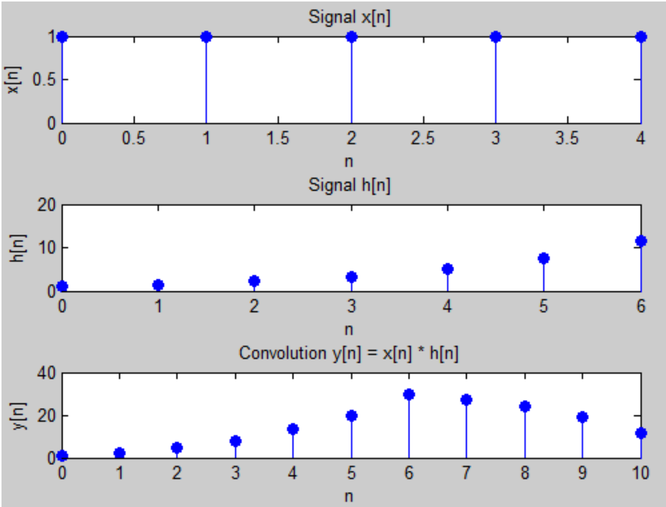
$$x[n] = \begin{cases} 1 & 0 \le n \le 4 \\ 0 & elsewhere \end{cases}$$

and

$$h[n] = \begin{cases} 1.5^n & 0 \le n \le 6 \\ 0 & elsewhere \end{cases}$$

```
n_x = 0:4;
x = ones(1, length(n_x));
n_h = 0:6;
h = 1.5.^n_h;
y = conv(x, h);
n_y = 0:(length(x) + length(h) - 2);
subplot(3, 1, 1);
stem(n_x, x, 'filled');
title('Signal x[n]');
xlabel('n');
ylabel('x[n]');
```

```
subplot(3, 1, 2);
stem(n_h, h, 'filled');
title('Signal h[n]');
xlabel('n');
ylabel('h[n]');
subplot(3, 1, 3);
stem(n_y, y, 'filled');
title('Convolution y[n] = x[n] * h[n]');
xlabel('n');
ylabel('y[n]');
```



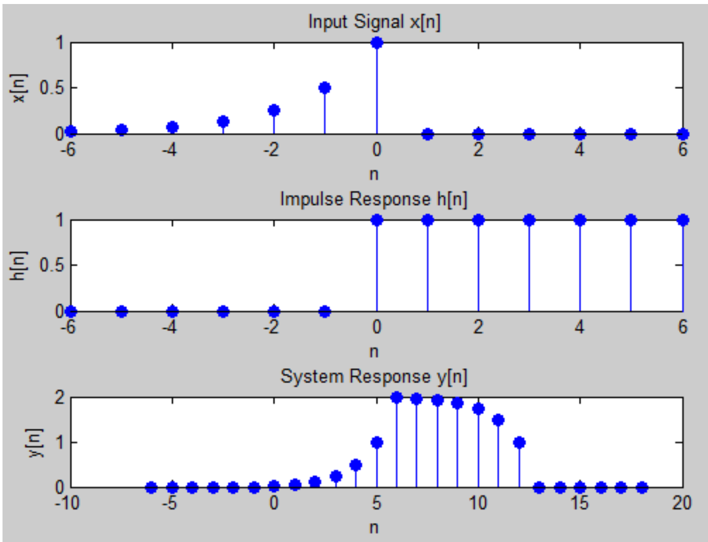
Task 03: Consider and LTI system with input $x[n]$ and unit impulse response $h[n]$ specified as

$x[n] = 2^n u[-n]$

$h[n] = u[n]$

Compute the response of the system (by both methods) where we have $-6 \le n \le 6$.

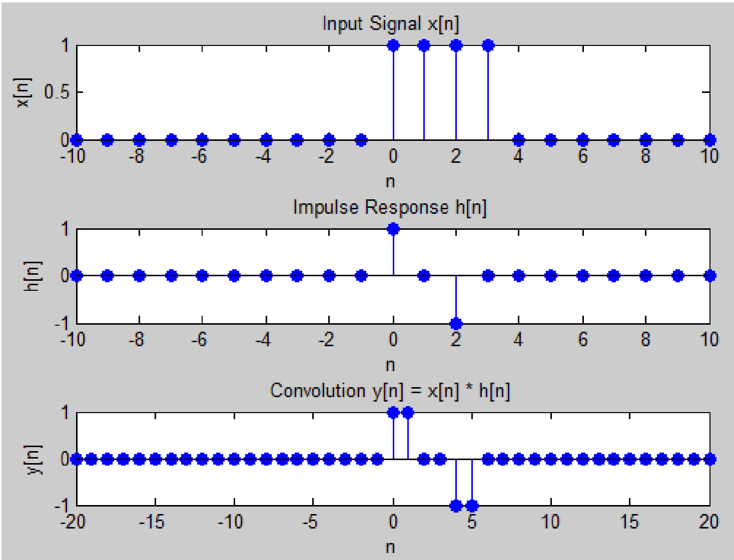
```
n = -6:6;
x = double((2.^n) .* (n <= 0));
h = double(n >= 0);
y = conv(x, h);
n_y = -6:6 + (length(h) - 1);
subplot(3, 1, 1);
stem(n, x, 'filled');
title('Input Signal x[n]');
xlabel('n');
ylabel('x[n]');
subplot(3, 1, 2);
stem(n, h, 'filled');
title('Impulse Response h[n]');
xlabel('n');
ylabel('h[n]');
subplot(3, 1, 3);
stem(n_y, y, 'filled');
```



```
title('System Response y[n]');
xlabel('n');
ylabel('y[n]');
```

Task 04: Compute (by both procedures) and graph the convolution $y[n]=x[n]*h[n]$, where $x[n]=u[n]-u[n-4]$ and $h[n]=\delta[n]-\delta[n-2]$.

```
n = -10:10;
x = (n >= 0) - (n >= 4);
h = (n == 0) - (n == 2);
y = conv(x, h);
n_y = -20:20;
subplot(3, 1, 1);
stem(n, x, 'filled');
title('Input Signal x[n]');
xlabel('n');
ylabel('x[n]');
subplot(3, 1, 2);
stem(n, h, 'filled');
title('Impulse Response h[n]');
xlabel('n');
ylabel('h[n]');
subplot(3, 1, 3);
stem(n_y, y, 'filled');
title('Convolution y[n] = x[n] * h[n]');
xlabel('n');
ylabel('y[n]');
```



Task 05: Compute (by both procedures) and graph the convolution $y[n]$, where

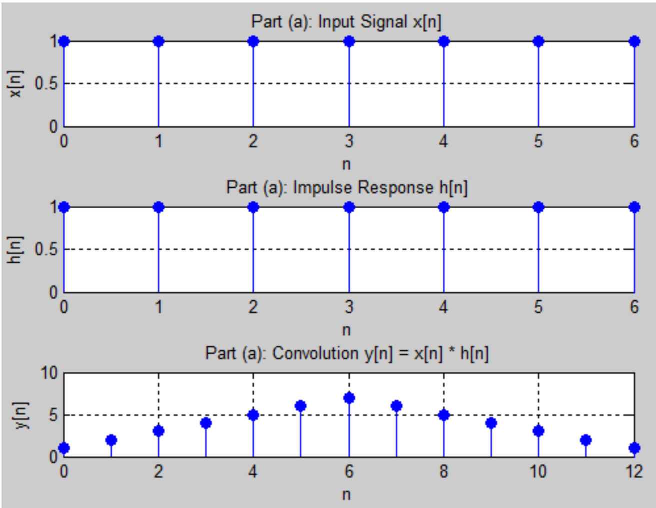
(a) $y[n]=u[n]*u[n], 0\le n\le 6$

(b) $y[n]=3\delta[n-4]*(3/4)^n u[n], 0\le n\le 5$

(a)

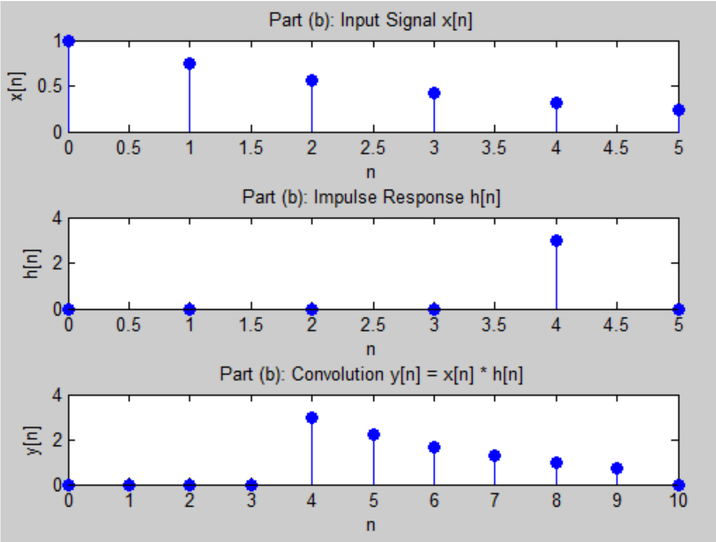
```
n_a = 0:6;
x_a = ones(1, length(n_a));
h_a = ones(1, length(n_a));
y_a = conv(x_a, h_a);
n_y_a = 0:(length(y_a)-1);
subplot(3, 1, 1);
stem(n_a, x_a, 'filled');
title('Part (a): Input Signal x[n]');
xlabel('n');
ylabel('x[n]');
grid on;
subplot(3, 1, 2);
```

```
stem(n_a, h_a, 'filled');
title('Part (a): Impulse Response h[n]');
xlabel('n');
ylabel('h[n]');
grid on;
subplot(3, 1, 3);
stem(n_y_a, y_a, 'filled');
title('Part (a): Convolution y[n] = x[n] * h[n]');
xlabel('n');
ylabel('y[n]');
grid on;
```



(b)

```
n_b = 0:5;
x_b = (3/4).^n_b;
h_b = zeros(1, 6);
h_b(5) = 3;
y_b = conv(h_b, x_b);
n_y_b = 0:(length(x_b) + length(h_b) - 2);
subplot(3, 1, 1);
stem(n_b, x_b, 'filled');
title('Part (b): Input Signal x[n]');
xlabel('n');
ylabel('x[n]');
subplot(3, 1, 2);
stem(0:5, h_b, 'filled');
title('Part (b): Impulse Response h[n]');
xlabel('n');
ylabel('h[n]');
subplot(3, 1, 3);
stem(n_y_b, y_b, 'filled');
title('Part (b): Convolution y[n] = x[n] * h[n]');
xlabel('n'); ylabel('y[n]');
```



Post-Lab Tasks

Critical Analysis / Conclusion

Performing these convolution tasks helps in understanding how systems process signals, especially in Linear Time-Invariant (LTI) systems.
By working on these tasks, you gain hands-on experience with signal behavior, improve problem-solving skills, and strengthen MATLAB proficiency. This knowledge is crucial for real-world applications in engineering, research, and technology development.

Lab Assessment		
Lab Task Evaluation	**/6**	**/10**
Lab Report	**/4**	
Instructor Signature and Comments		