Laplace Transform Part 5

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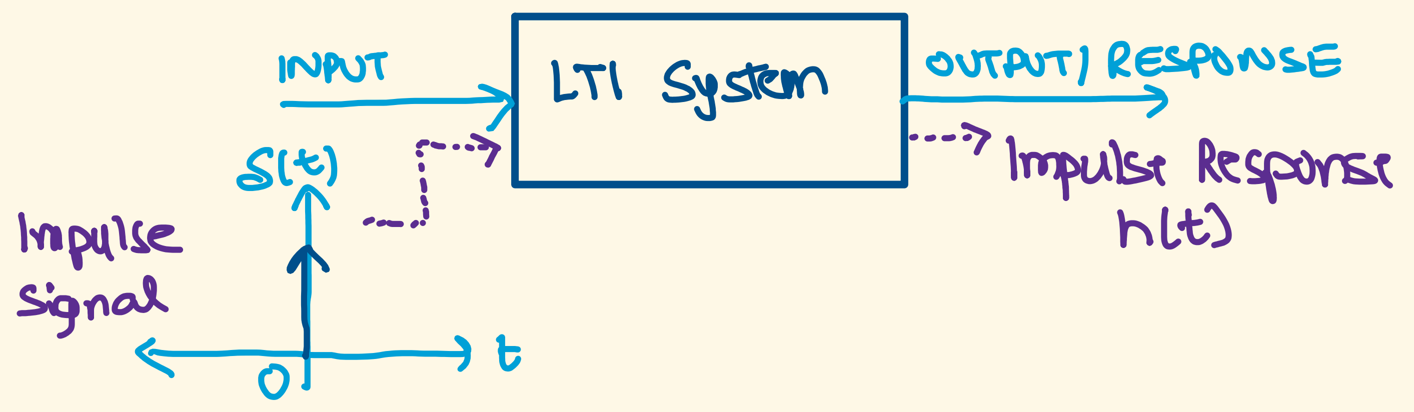
1. Impulse response of an LTI system :-

↳ Linear Time Invariant



- The impulse response of a system is the response of a system when the input is an impulse signal.
- The Impulse Response of an LTI system is represented as $h(t)$.
- The impulse response in an characteristic of an LTI system. The output of a system to any input is calculated by convolving the input with the Impulse Response of the system.

2. Convolution Property of Laplace Transform :-

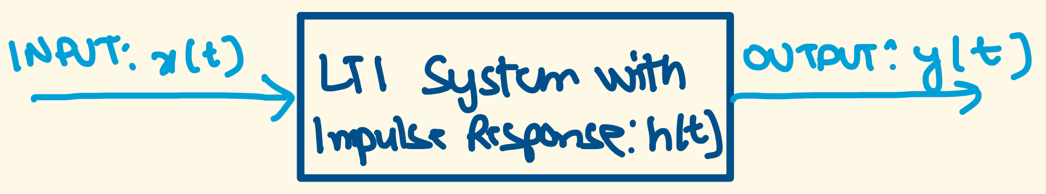
If,

$$x(t) \rightleftharpoons X(s)$$
$$y(t) \rightleftharpoons Y(s)$$

then,

$$\underbrace{x(t) * y(t)}_{\text{convolution}} \rightleftharpoons X(s) \cdot Y(s)$$

- Convolution in time domain is the multiplication in frequency domain.



In time domain $y(t)$ can be calculated as:

$$y(t) = x(t) * h(t)$$

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

where $\tau \to$ dummy variable

In frequency domain,

$$L[x(t)] = X(s)$$
$$L[h(t)] = H(s)$$

By convolution Property:

$$L[y(t)] = X(s) \cdot H(s)$$
$$Y(s) = X(s) \cdot H(s)$$

$$\Rightarrow y(t) = L^{-1}[Y(s)]$$

simple multiplication

Note: In time domain, we can clearly see, it's difficult / complicated to calculate $y(t)$ as we need to solve the convolution integral.

However, it is much easier to calculate $y(t)$ in frequency domain as we don't have to solve any integral. (it's just simple multiplication).

3. References:

1. Neso Academy

—— x —— THE END —— x ——