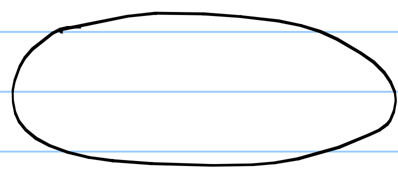
⑥ Linearity vs. Non-linearity. See Lectures 1–3.

Signals.



Systems

Why LTI systems?

① The analysis is simple & elegant.

② A lot of systems can be well approximated by a LTI system.

Linear: ① double the input, the output is also doubled
② Combine two inputs, the outputs are also combined.

Time-Invariant: When do we apply the input signal does not matter.

Ex: → [amplifier] →

→ [Wireless Ch] →

→ [Equalizer] →

$\boxed{\text{DT-LTI}}$ Use the ____________ as the test signals

$x_k[n] =$

$x_1[n] \quad \cdots \quad x_k[n]$

We know

$x[n] =$

$y_1[n] \quad \quad y_k[n]$

$\Rightarrow y[n] =$

Notice that if the input is $\delta[n]$

$$\delta[n] = x_0[n] \longrightarrow \boxed{\text{LTI}} \xrightarrow{y_0[n]}$$

We thus say $y_0[n]$ is the (unit) ____________ of the system. For convenience, we denote ____________

Def: An ____________ $h[n]$ is the output when the input is an impulse. (S08, MT1Q1)

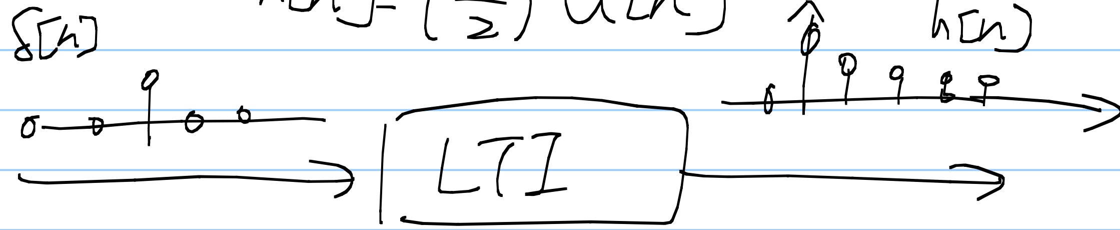
Question: Can we express $y_1[n]$ by $y_0[n]$ $= h[n]$?

Ans:

* Theorem: For a DT-LTI sys. with impulse response $h[n]$. The input/out relationship can be characterized by

Example: Suppose

$$h[n] = \left(\frac{1}{2}\right)^n u[n]$$



For a new input $x[n] = \begin{cases} n & \text{if } 0 \le n \le 2 \\ 0 & \text{otherwise} \end{cases}$

Find the output $y[n]$, and plot $y[n]$ vs. n.

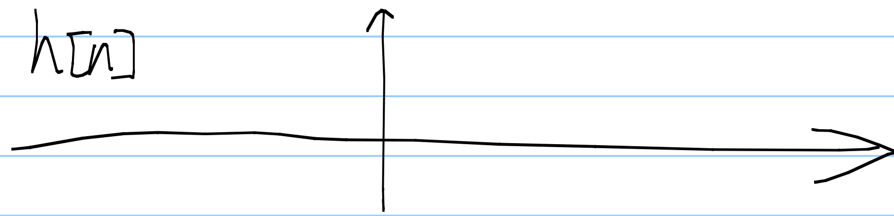
Ans:

See Examples 2.2 to 2.4 for visualization of the above computation.

An alternative solution (conceptually simpler but computationally harder)

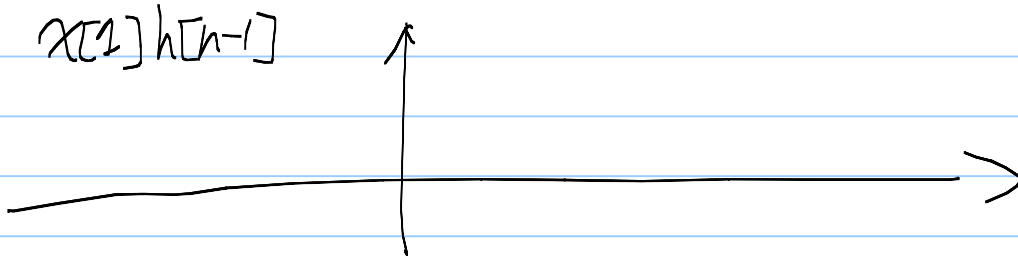
$x[n]$

$h[n]$



$x[0]h[n]$

$x[1]h[n-1]$



$x[2]h[n-2]$

Add them together