③ Associativity (serial concatenation)

Question for the teams

pf 1: by integration

pf 2: by system construction.

in a similar way of proving distributivity.

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* The essence of an LTI system:
  its impulse response $h(t)$ or $h[n]$

* We have learned

  Given a system ⟶ decide its classification

We will now learn

Classification #1: Memoryless. (depends only on the present)

An LTI sys is memoryless if

Classification #2: Causality (depending on the past & the present)

An LTI system is causal if

Causal

$\Leftrightarrow$ The output depends only on

$\Leftrightarrow$ The input $\delta(t)$ affects only

$\Leftrightarrow$ $h(t) \neq 0$ only for $t \geq 0$

$h(t)$ should not anticipate the $\delta(t)$

* Classification #3: Invertibility

(whether there exists an inverse system.)

Q: Suppose the inverse sys has impulse response $h_{INV}(t)$. What is $h(t) * h_{INV}(t)$

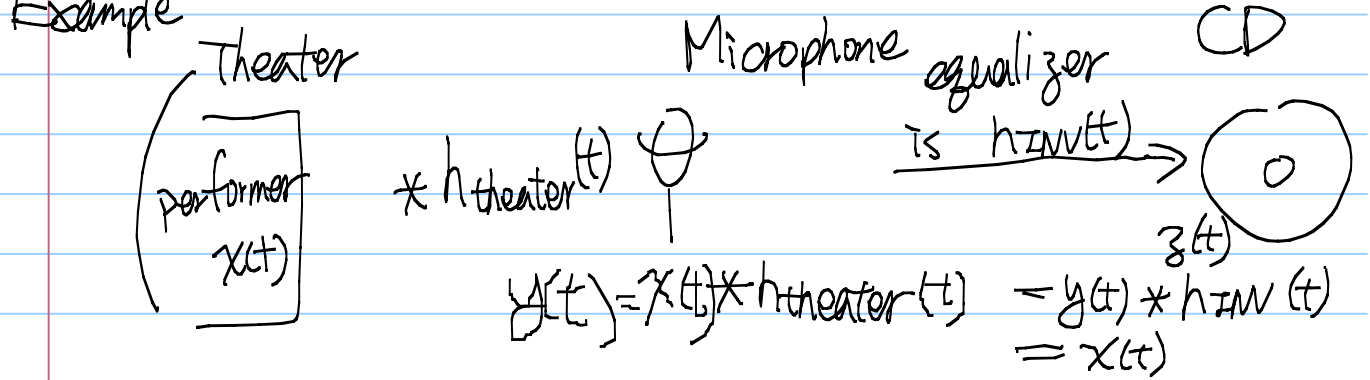
Ans:

Q: For any given $h(t)$, how to construct $h_{INV}(t)$ such that $h(t) * h_{INV}(t) = \delta(t)$?

Ans: We will answer this in the second half of the semester

Q: Why is it important to find $h_{INV}(t)$?

Example



Note Title 9/25/2014

Classification #4: Stability

(bounded input $\Rightarrow$ bounded output)

A LTI system is stable if

or

(That is a single impulse should not generate too much output. The output should die down after a while.)

Q: Classify the following system

Memoryless Causal Stable

$h_1[n] = \left(\frac{1}{2}\right)^n$

$h_2[n] = \left(\frac{1}{2}\right)^n u[n]$

$h_3(t) = e^{-|t|}$

$h_4(t) = e^{-t}u(t)$