For this semester, our test signals are either HRCE or shifted unit impulses

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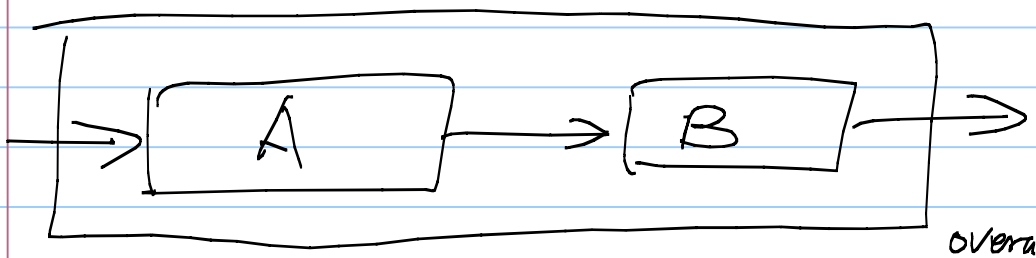
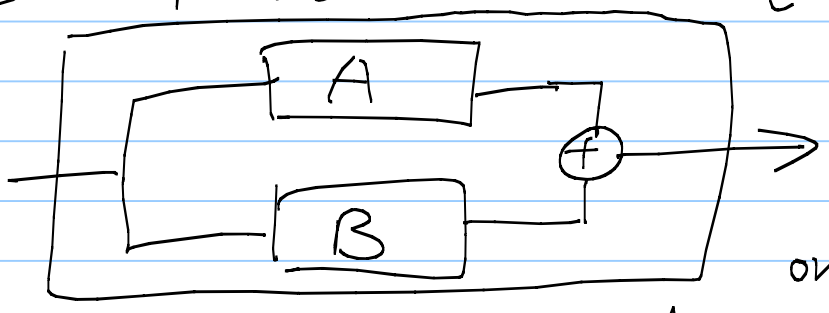
Enough of signals. Let us focus on the systems.

* Systems can be interconnected

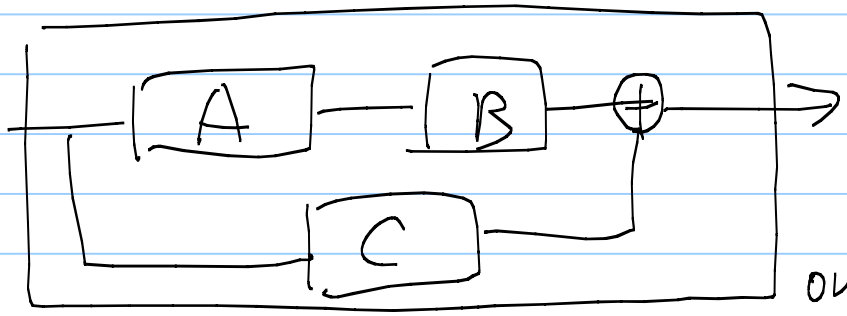
Sys 1: Serial concatenation



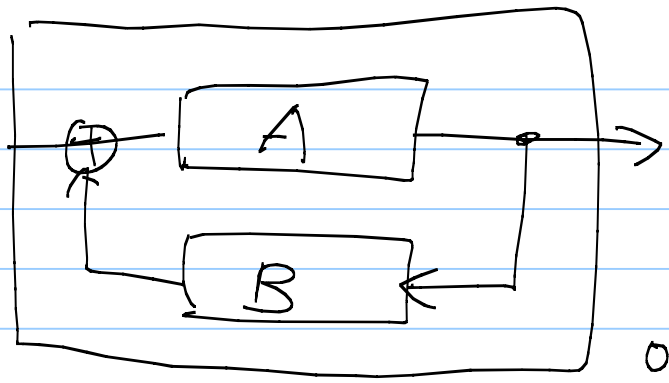
Sys 2 Parallel concatenation



Sys 3: Serial / parallel concatenation



Sys4: Feedback



* In this course, we treat all interconnections as a big system (a black box). as we are interested only in the end-to-end input/output relationship.

* How to classify a system?

Recall
Signals:
① DT vs CT
② periodic vs. aperiodic
③ ∞ energy / finite power
④ Even/odd/neither

Systems
① Memory
② Invertibility
③ Causality
④ Stability
~~⑤~~ Time-Invariance
~~⑥~~ Linearity — discussed in Week1

* Watch online video 1.6.345

① With memory vs. memoryless

- A system is "memoryless" if $y(t)$ at time t depends only on the instantaneous value of $x(t)$ at time t, not $x(s): s<t$, nor $x(s): s>t$.
- A system that is not memoryless is called "with memory"

Example: Classify

$y(t) = [2x(t)]^{2/3}$ M.L

$y(t) = x(t+1)$ W.M

$y(t) = \int_{-\infty}^{t} x(s)ds$ W.M

$y(t) = x(2t)$ W.M

$y[n] = x[n] - x[n-1]$ W.M

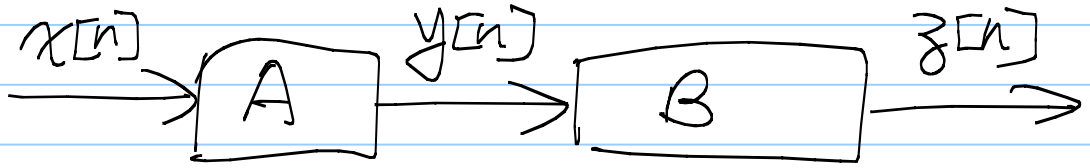
② Invertible vs. Non-invertible

A system is invertible if given the output $y(t)$, the input $x(t)$ can be deduced.

* Invertible vs. non-invertible

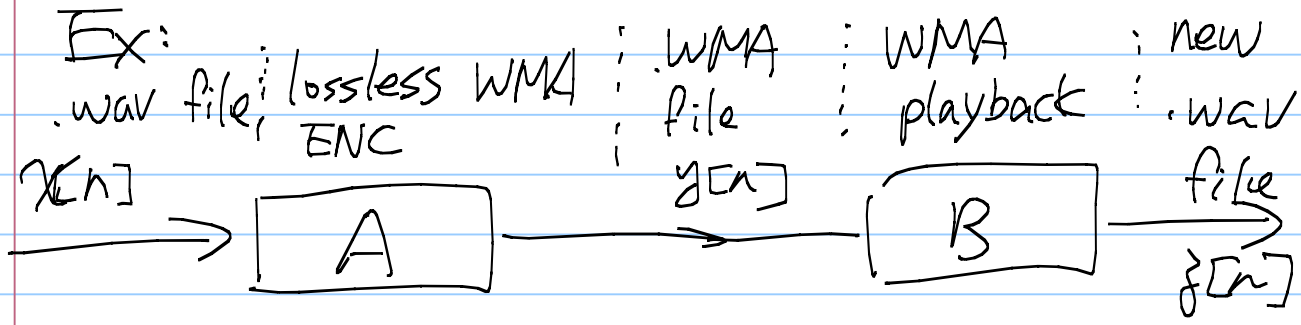
Note Title 1/27/2010

Namely, an inverse system can be created



$x[n] = z[n]$ are of the same shape.

Ex:



Ex: Classify

$y(t) = 2x(t)$

$y(t) = \sin(x(t))$

Question for the teams

Consider a sliding window averaging system

$$y[n] = \begin{cases} \dfrac{1}{\min(5,n)+1} \displaystyle\sum_{k=\max(0,n-5)}^{n} x[k] & \text{if } n > 0 \\ x[n] & n \le 0 \end{cases}$$

That is

$$y[-1] = x[-1]$$

$$y[0] = x[0]$$

$$y[1] = \frac{1}{2}\left(x[0] + x[1]\right)$$

$$y[2] = \frac{1}{3}\left(x[0] + x[1] + x[2]\right)$$

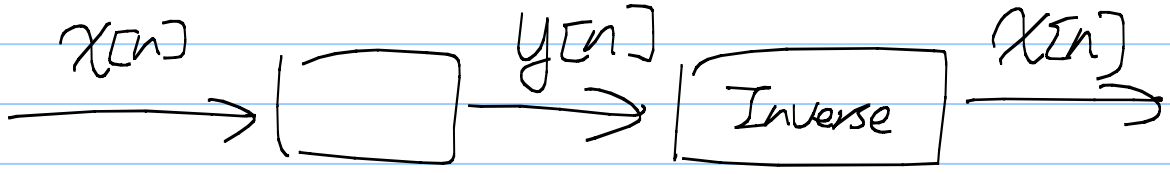
$$\vdots$$

$$y[5] = \frac{1}{6}\left(x[0] + \cdots x[5]\right)$$

$$y[6] = \frac{1}{6}\left(x[1] + \cdots + x[6]\right)$$

$$y[n] = \frac{1}{6}\left(x[2] + \cdots + x[n]\right)$$

Q: Construct the corresponding inverse system



Hint: You may want to use "feedback" in your system.