Lecture 6
Signals and Systems (ELL205)

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Leonhard Euler

(15 April 1707 – 18 September 1783) was a Swiss mathematician.

His collected works fill 60 to 80 quarto volumes, more than anybody in the field.

In 1766, he got completely blind, and then he quoted “now I have a fewer distractions.”

After that he produced almost one mathematical paper every week.

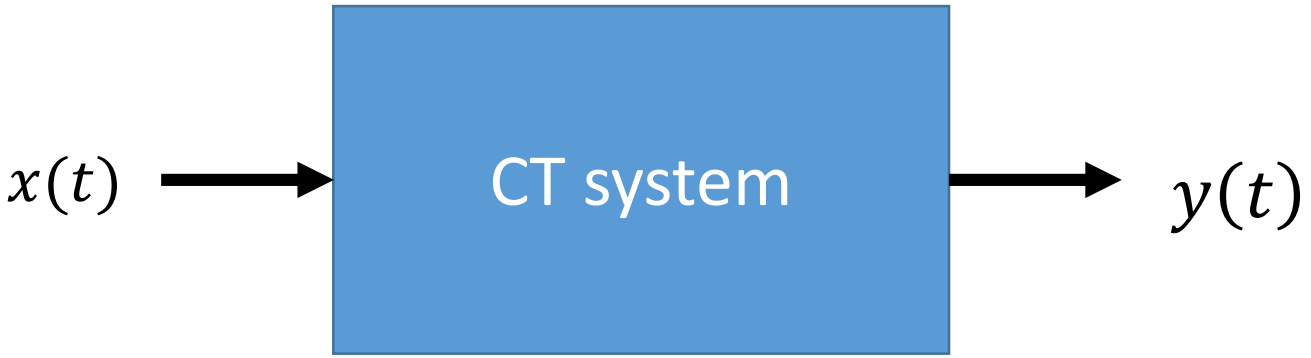
He had two wives. The second of whom he took at the age 69. He had 13 children.

Outline of the Lecture

System Properties

1. Memoryless
2. Causal
3. Invertible
4. Stable
5. Time invariant
6. Linear
7. Incrementally Linear

System



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Memoryless

A system is said to be memoryless if $y(t)$ depends only on input at time at time t , i.e.,

$$y(t) = f(x(t))$$

How many of them are memoryless systems?

A)	$y(t) = x(t^2)$
B)	$y(t) = tx(t+1)$
C)	$y[n] = nx[n] + y[n-1]$
D)	$y(t) = \frac{1}{C}\int_{-\infty}^{t} x(\tau)d\tau$

NONE !!

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Causal

A system is said to be causal if the output depends only on the current input and on the inputs in the past.

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Formal:

$$x_1(t) \equiv x_2(t) \quad \forall \quad t < to$$

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How many of them are causal systems?

A)	$y(t) = \cos(t+1)x(t)$
B)	$y(t) = \cos(t)x(t+1)$
C)	$y[n] = x[-n]$
D)	$y[n] = \sum_{k=-M}^{M} x[n-k]$

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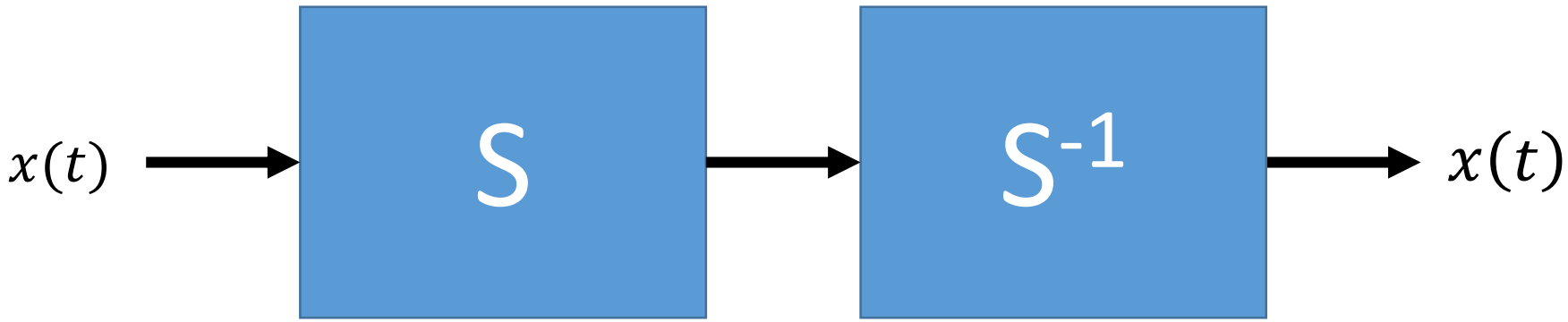

How many of them are invertible systems?

A)	$y(t) = x^2(t)$
B)	$y(t) = 0$
C)	$y[n] = x[n]$
D)	$y[n] = \sum_{k=-\infty}^{n} x[k]$

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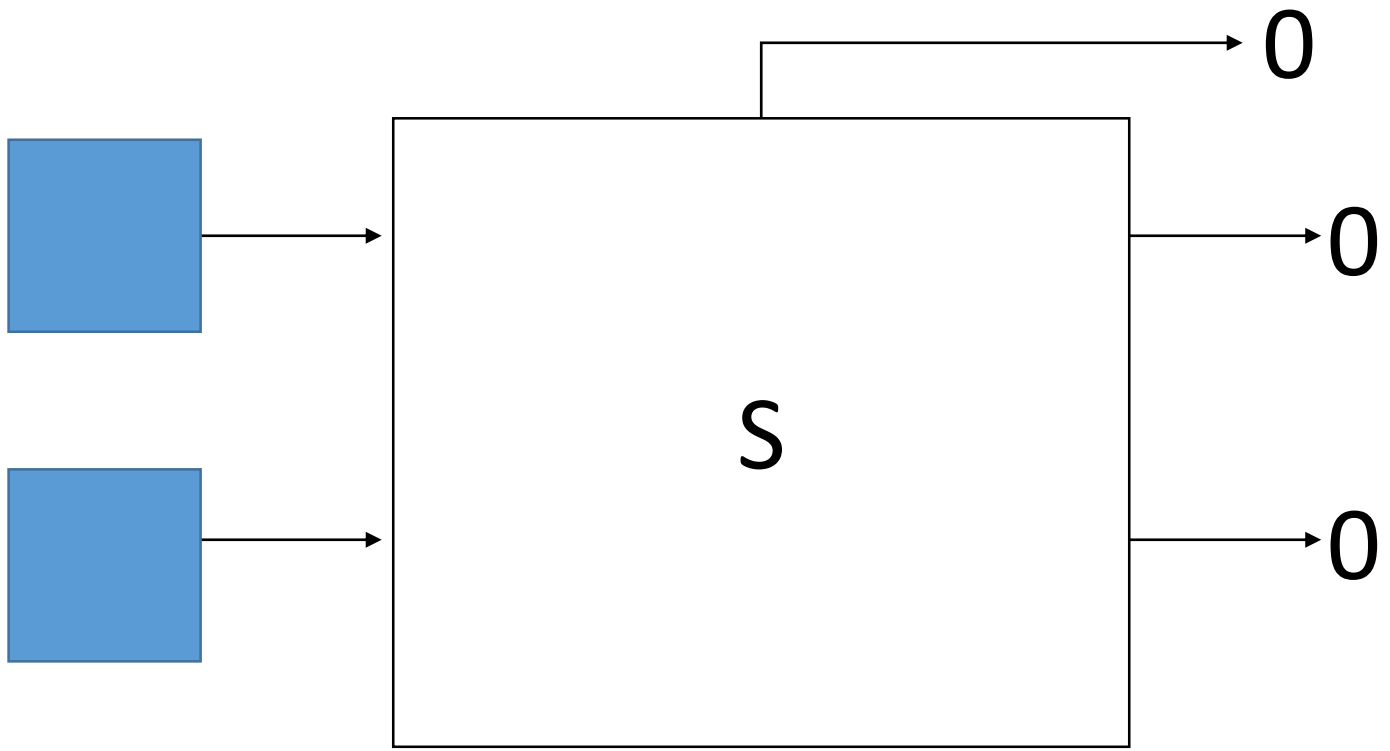
Invertibility: Discrete Time Systems

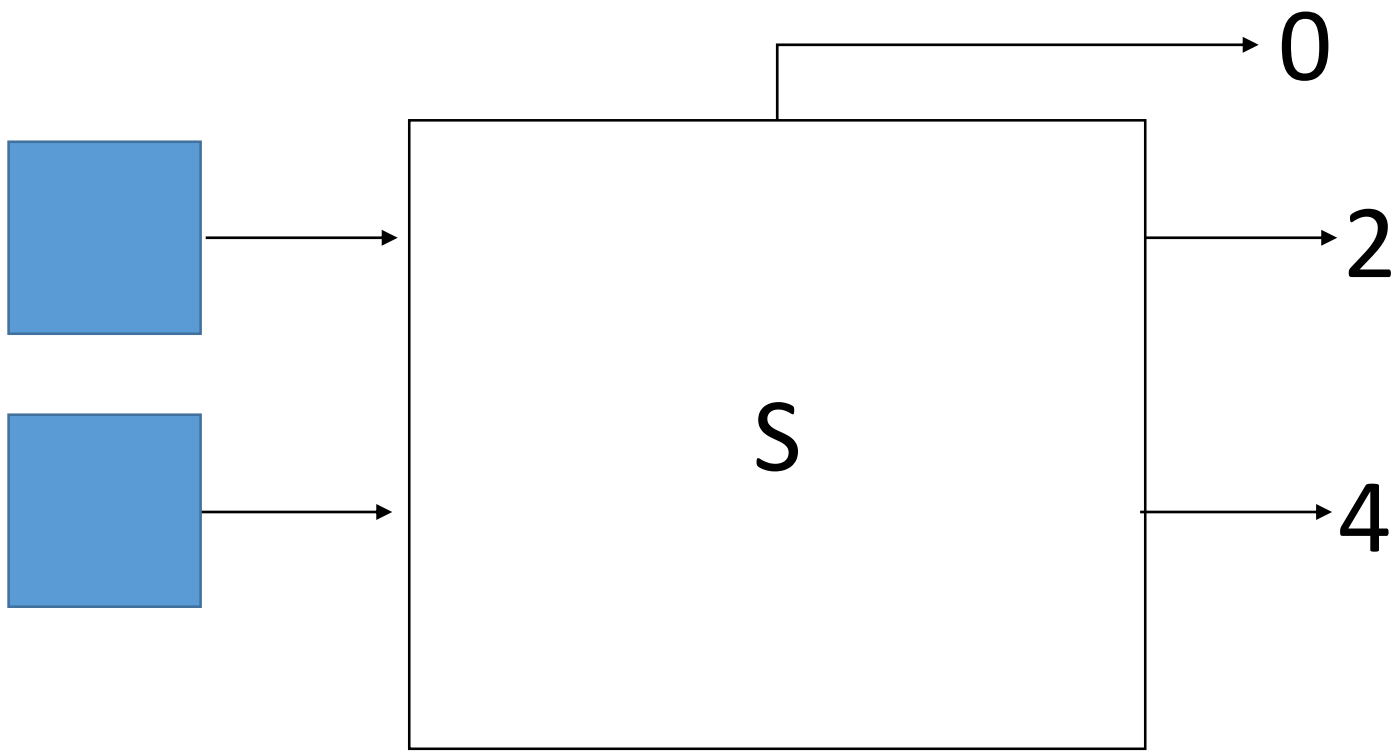
1. $y[n] = 0$



System is **not** invertible.

Invertibility: Discrete Time Systems

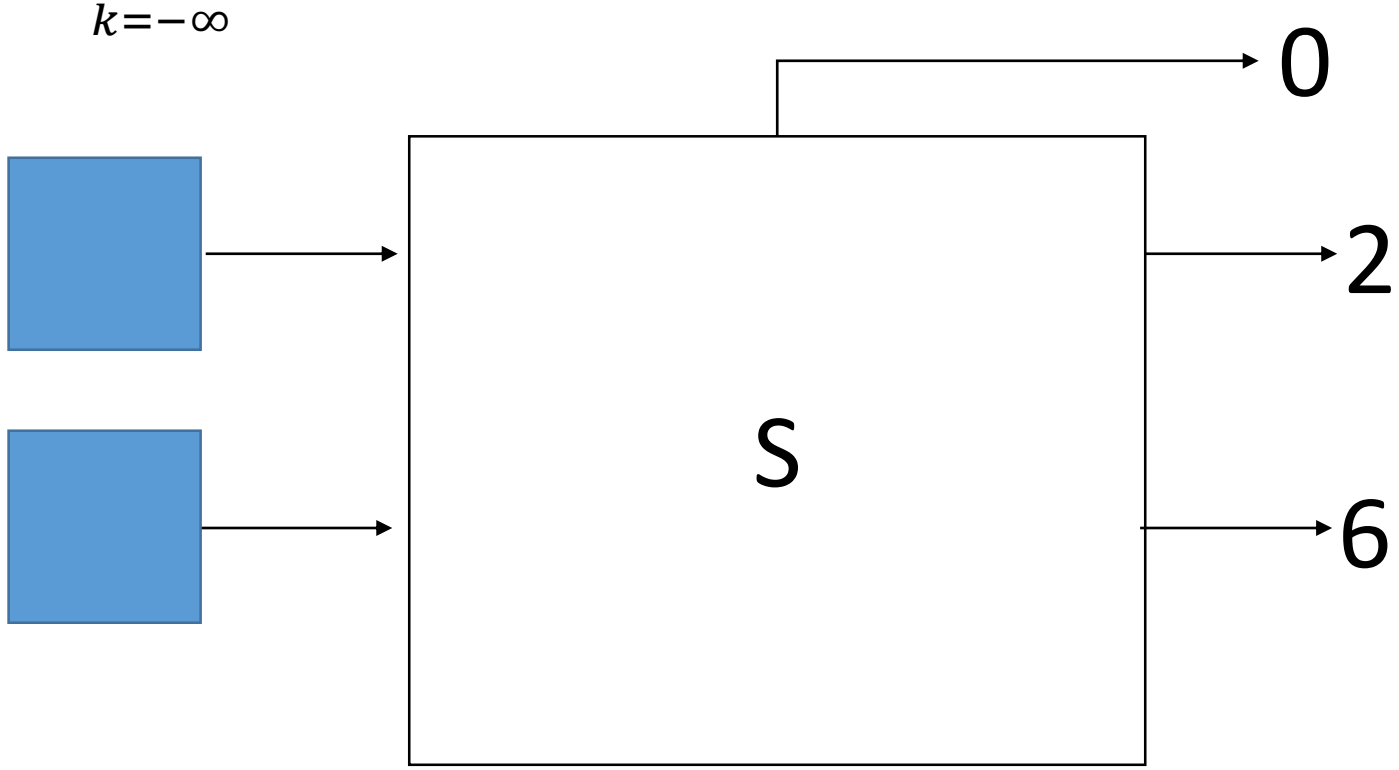
2. $y[n] = x[n]$



System is invertible.

Invertibility: Discrete Time Systems

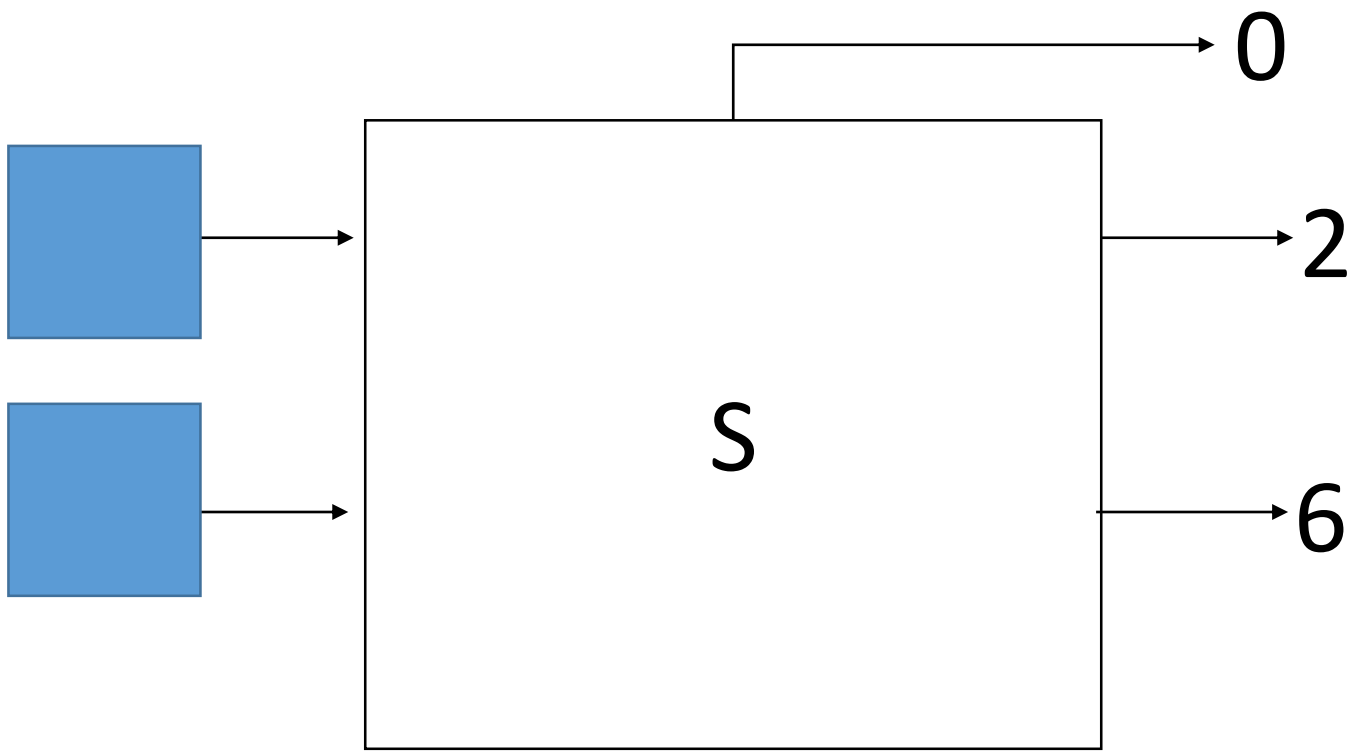
3. $y[n] = \sum_{k=-\infty}^{n} x[k]$ *Hint:* $y[n] - y[n-1] = x[n]$



System is invertible.

Invertibility: Discrete Time Systems

3. $y[n] = x[n] - x[n-1]$



System is **not** invertible.

Invertibility: Discrete Time Systems

3. $y[n] = x[n] - x[n-1]$

$x[n-1]$ is **unknown.**

Hence, system is **not** invertible.

But, if $x[n-1] = 0$, system becomes invertible.