Lecture 7
Signals and Systems (ELL205)

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Heinrich Hertz

(22 February 1857 – 1 January 1894; 36 years) was a German physicist and student of Kirchhoff and Helmholtz.

He provided the conclusive evidence of existence of EM waves.

The unit of frequency — cycle per second — was named the "Hertz" in his honor.

He was also a great scholar of languages and mastered languages like Arabic and Sanskrit.

He had one wife and 2 daughters (**Mathilde Carmen Hertz, famous biologist).**

Outline of the Lecture

System Properties

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

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Stability is BIBO stability

How many of them are stable systems?

A)	$y[n]=\sum_{k=-N}^{N} x[k]$
B)	$y(t)=\int_{-\infty}^{t} x(\tau)d\tau$
C)	$y(t)=\frac{dx(t)}{dt}$
D)	$y[n]=\sum_{k=-\infty}^{n} x[k]$

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B)	$y(t) = \int_{-\infty}^{t} x(\tau)d\tau$
C)	$y(t) = \frac{dx(t)}{dt}$
D)	$y[n] = \sum_{k=-\infty}^{n} x[k]$

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Trick:

System is unstable if:

- Infinite summation
- Infinite integration
- Differentiators

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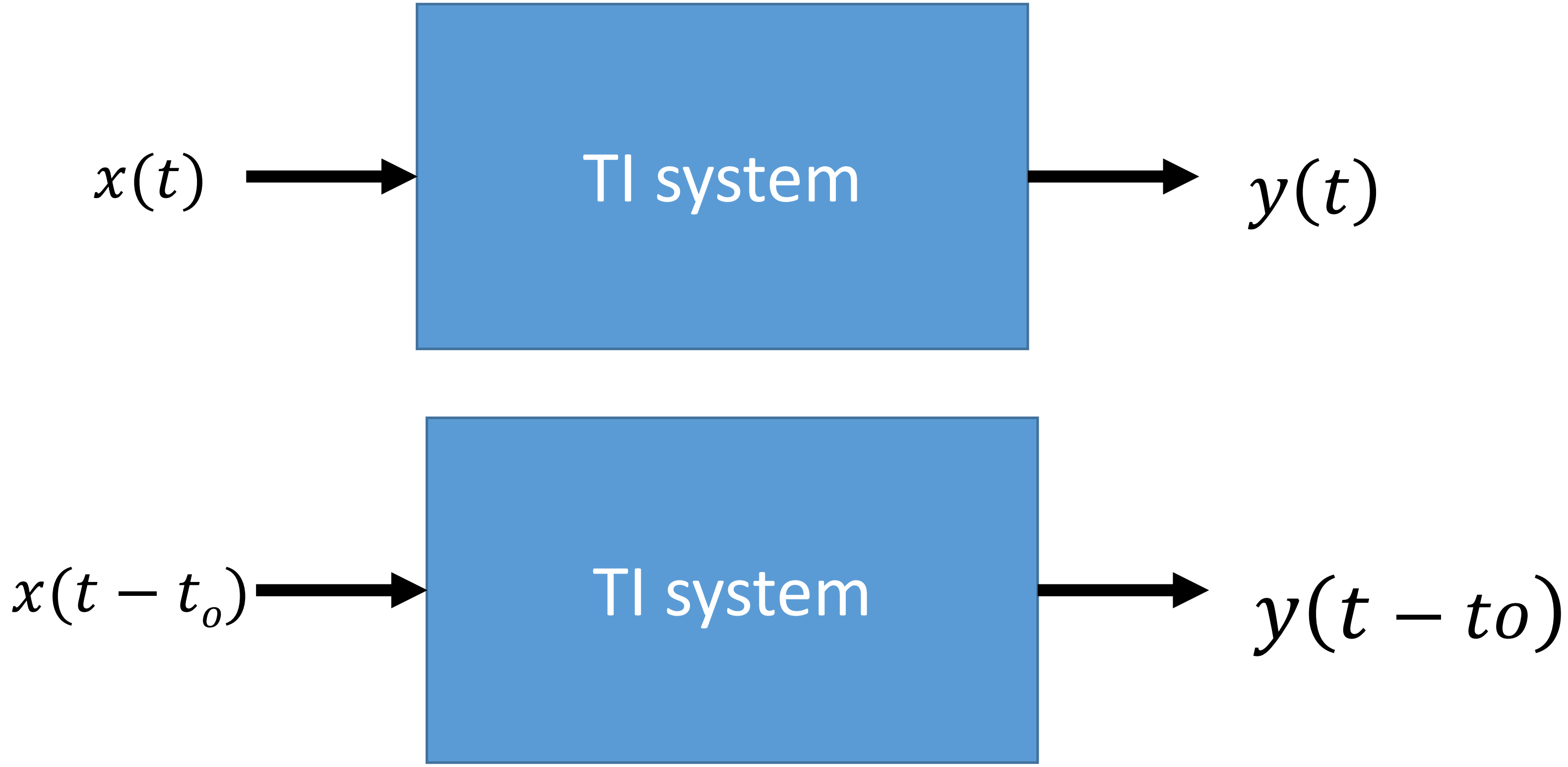

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Step 2: Change output $\mathrm{y}(t)$ to $\mathrm{y}(t - to)$

$$\mathrm{y}(t - to) = \sin(x(t - to))$$ Equ. 2

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Step 2: Change output $\mathrm{y}(t)$ to $\mathrm{y}(t - to)$

$$\mathrm{y}(t - to) = \sin(x(t - to)) \qquad \text{Equ. 2}$$

Step 3: TI if Equ. 1 and Equ. 2 matches

How many of them are time-invariant systems?

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

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Additivity

$$x_1(t) \longrightarrow y_1(t)$$

$$x_2(t) \longrightarrow y_2(t)$$

$$x_1(t) + x_2(t) \longrightarrow y_1(t) + y_2(t)$$

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Homogeneity

$$x_1(t) \longrightarrow y_1(t)$$

$$ax_1(t) \longrightarrow ay_1(t)$$

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Homogeneity

$$x_1(t) \longrightarrow y_1(t)$$

$$ax_1(t) \longrightarrow ay_1(t)$$

If $a = 0$

$$0 \longrightarrow 0$$

ZIZO

How many of them are linear systems?

A)	$y(t) = x^2(t)$
B)	$y[n] = \mathrm{Ev}\{\mathrm{x}[\mathrm{n}]\}$
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