Lecture 8

## Manipulating Independent Variables

## Systems: Properties & Definitions



Linear vs Nonlinear

A system is linear if superposition hold for all input cases to determine corresponding outputs

Proof for Linearity



Linear if

Time-Invariance vs Time-Variance

A system is time invariant if the rules for mapping input signal to output signal do not change with time.

Test for time invariance

Same as the other thing up there, except n can be shifted by q

System is time invariant if for all values n, q.

Causality vs Non-Causality

Can the output respond to stimulus “event” on input before the “event” occurs at the input?

- Yes (NON-Causal)

- No (Causal)

- Basically, means you’re predicting the future

Static vs Dynamic

Static

No memory or history used to map input output

Dynamic

History or memory is used to map input output

Stable vs Unstable

If a system with inputs that are bounded in strength always produced output signals that are also bounded in strength

- System is “BIBO Stable”

- “Bounded Input, Bounded Output”

## LTI Systems

- Combining Linearity and Time-Invariance makes systems very useful and provides powerful analysis tools



Impulse Impulse Response of LTI System

Linearity

Time-Invariance

Both

LTI Formula