EE421 Lecture 1

Outline: What is a signal? what is a system?

**Signal**

Signals are **FUNCTIONS of INDEPENDENT VARIABLES** that carry information.

**Ex 1:** Current in an electric circuit

$I(t)$ is a function of $t$

$t$ is the independent variable.

**Ex 2:** Stock Price

$T[n]$ is the stock price of AT&T on day $n$.

$T[0.5]$ is not defined!!

**Ex 3:** Image coordinate system

$[x, y]$ represents the image coordinate.

At $(0,0)$, $R = 50$, $G = 50$, $B = 10$ Red

At $(1, 40)$, $R = 70$, $G = 100$, $B = 95$ Green

Red, Green, Blue
In this course, we’ll focus on 1-D signal

⇒ only one independent variable.

Two types

1. Continuous-time Signal
   \[ x(t) \quad : \text{continuous-time} \quad t = 0 \ldots \infty \]
   Ex: voltages, & current, temperature "Physical World"

2. Discrete-time Signal
   \[ x[n] \quad \in \mathbb{Z} : \text{Discrete-time} \quad n = 0, 1, 2, 3, \ldots \]
   Ex: stock price, everything that can be handled by a computer.

What is a System?

\[
\begin{array}{c}
\text{input signal} \
\rightarrow 
\text{System} \
\rightarrow 
\text{output signal}
\end{array}
\]

Linear System — Focus

Design Goal of a system is to generate an output given an input

Linear System provides an efficient way to generate the output
⇒ Convolution
1. Continuous-time System

\[ x(t) \rightarrow CT \text{ System} \rightarrow y(t) \]

2. Discrete-time System

\[ x[n] \rightarrow DT \text{ System} \rightarrow y[n] \]

3. Mixed-Signal System

\[ x(t) \rightarrow MS \text{ System} \rightarrow y[n] \]

\[ x[n] \rightarrow MS \text{ System} \rightarrow y(t) \]

Examples

![RLC circuit diagram]

Example

average salary
housing price
productivity

Gross Domestic Product indicator

DT
Example

thermometer -\rightarrow \text{Data Acq} -\rightarrow \text{Computer} -\rightarrow \text{temp.dat}

Input \rightarrow \text{Mixed Signal} \rightarrow \text{Output}