20CYS111 Digital Signal Processing

Introduction to Signals and Systems

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What is a signal?

*A **signal** represents the variation of a (physical / abstract) quantity over time and/or space; it typically contains information about the behavior or nature of some process / phenomenon.*

Some common examples of signals are:

- *Communication Signals (AM/FM/Cellular/WiFi/Bluetooth/optical)*
- *Audio Signals*
- *Images*
- *Video Signals*
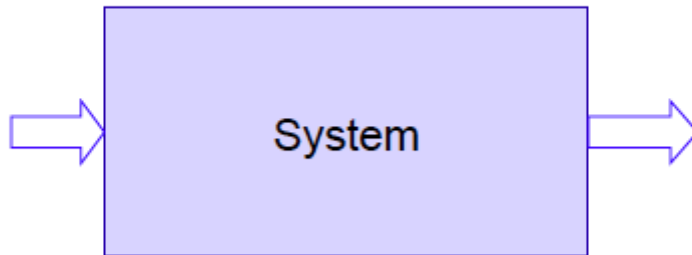- *Computer Data Transmissions*

What is a system?

*A **system** is an entity that processes one or more input signals and produces one or more output signals.*

Modern engineering systems often consist of multiple subsystems.

Input signal   Output signal
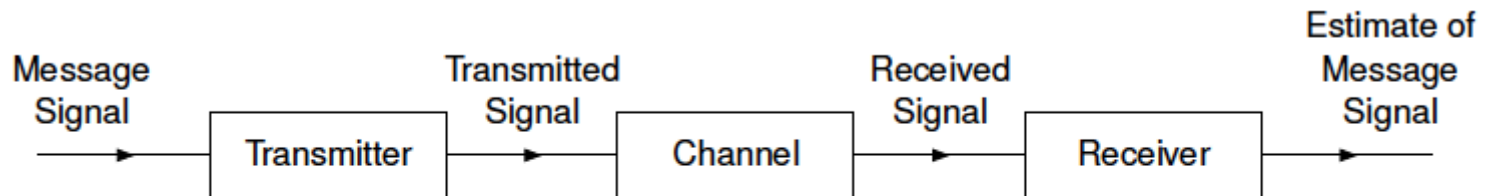
System

What is a system?

Broadly, there are two types of (sub)systems:

- ***Software (sub)Systems***

    - *A Python/C/C++/MATLAB program that takes two numbers as inputs and prints their sum as the output.*

- ***Hardware (sub)Systems***

    - *An electrical circuit consisting of a voltage source, a light buld and a switch. **Question: Identify the inputs and the outputs here.***

Modern engineering systems often consist of both hardware and software subsystems.
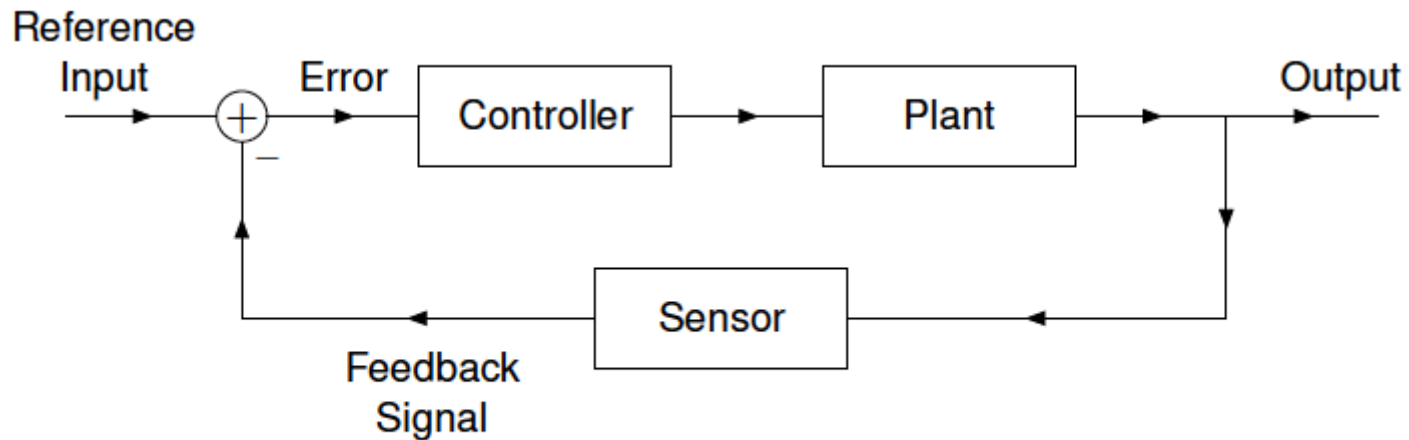
Example: A Communication System

- *A wireless communication system consists of a cell tower, a mobile phone and the intervening the wireless medium.*

General Structure of a Communication System

Example: A Control System

A control system is found inside many engineering systems, for example, disk readers, heat-seeking missiles, etc.

General Structure of a Feedback Control System

Why Study Signals and Systems?

- *To understand the unified mathematical theory of representing signals and systems that keep appearing in diverse engineering disciplines.*

- *To understand the characteristics / properties of several standard / elementary signals and systems.*

- *To apply the mathematical theory of manipulating / processing signals via appropriate systems to design practically useful systems.*

References:

[1] Simon Haykin and Barry Van Veen, Signals and Systems, Second Edition, John Wiley and Sons, 2003.

[2] Lecture Notes by Richard Baraniuk.
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