Real Time Systems Design

Lecture (2): Signals, Systems, and Specifications

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E-Lectures for Third Level
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Definition of Signals and its types

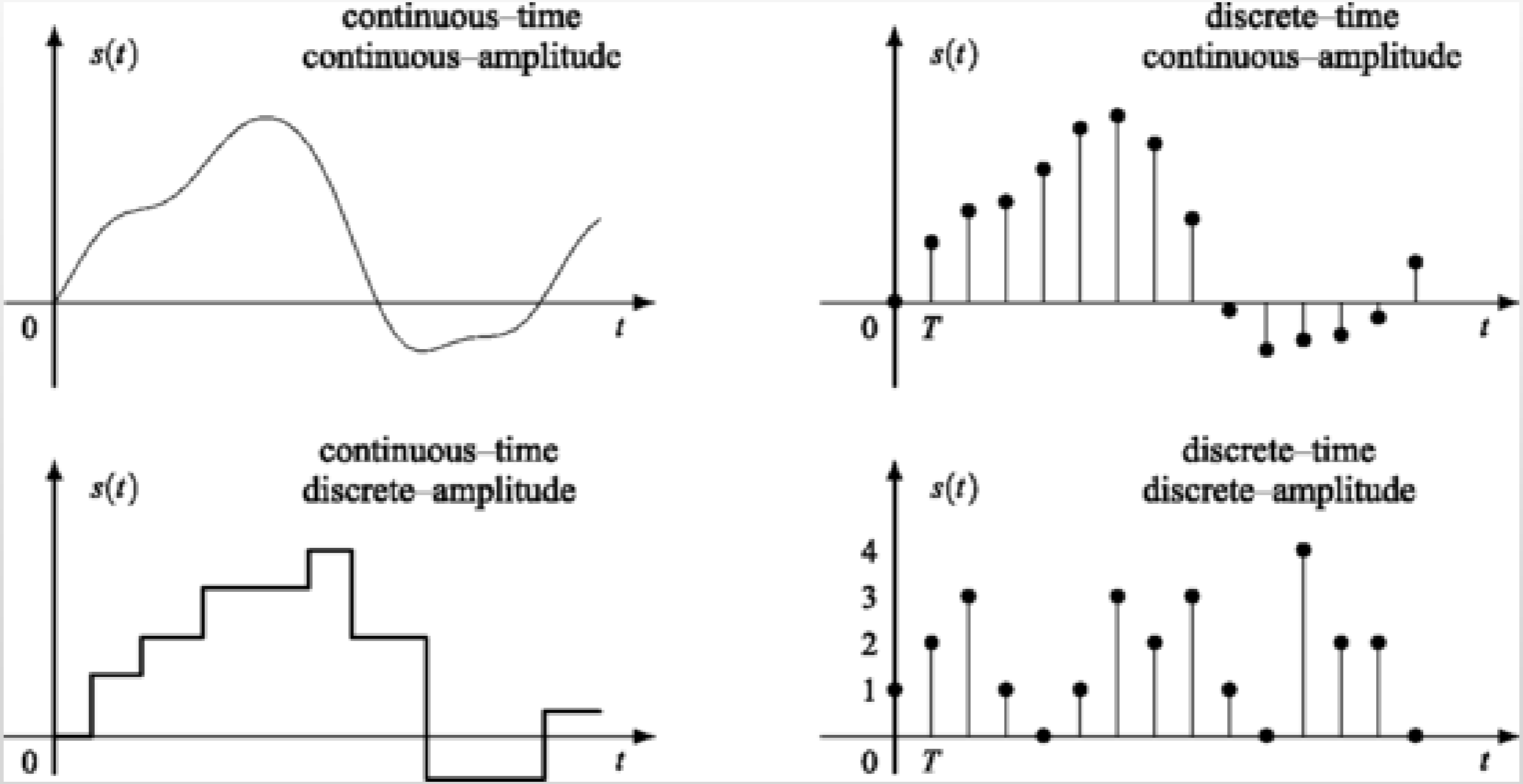
Signal is a function that "conveys information about the behavior or attributes of some phenomenon". Signal includes audio, video, speech, image, communication, geophysical, sonar, radar, medical and musical signals.

Basically, there are two types of signals:

1- Analog signals

2- Digital signals

Signals types



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Analog signal

is any continuous signal for which the time varying feature (variable) of the signal is a representation of some other time varying quantity, i.e., analogous to another time varying signal. For example, in an analog audio signal, the instantaneous voltage of the signal varies continuously with the pressure of the sound waves.

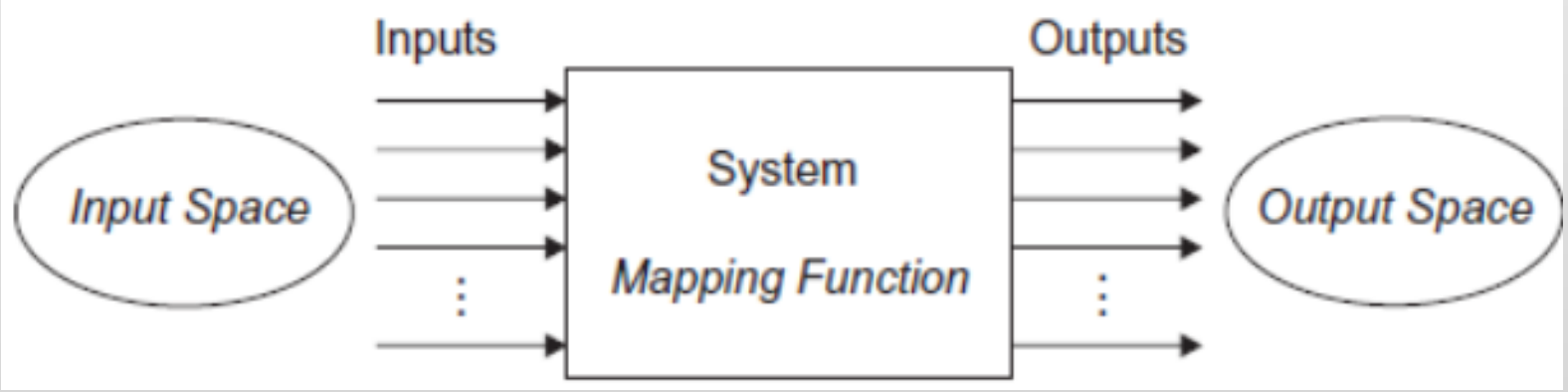
Digital signal

A signal which is discrete in nature or which is non-continuous in form can be termed as a Digital signal. This signal has individual values, denoted separately, which are not based on previous values, as if they are derived at that particular instant of time.

System definition

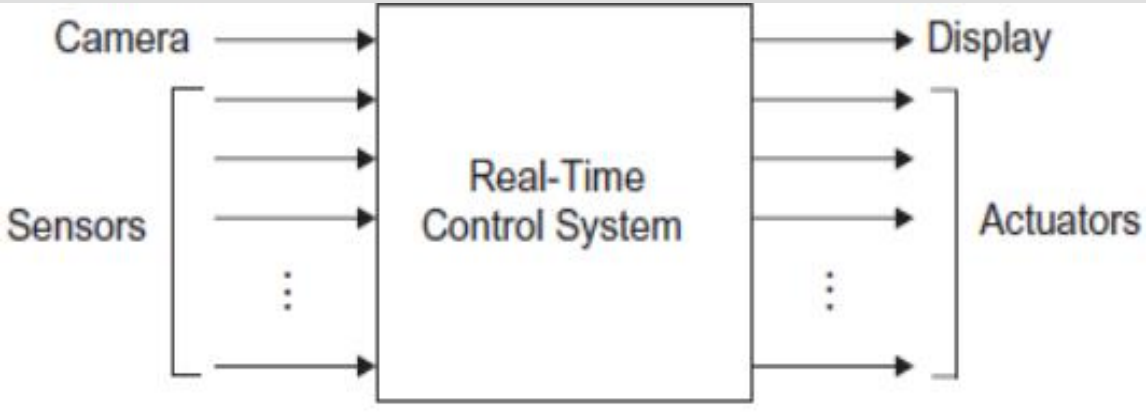
A system is a mapping of a set of inputs into a set of outputs.

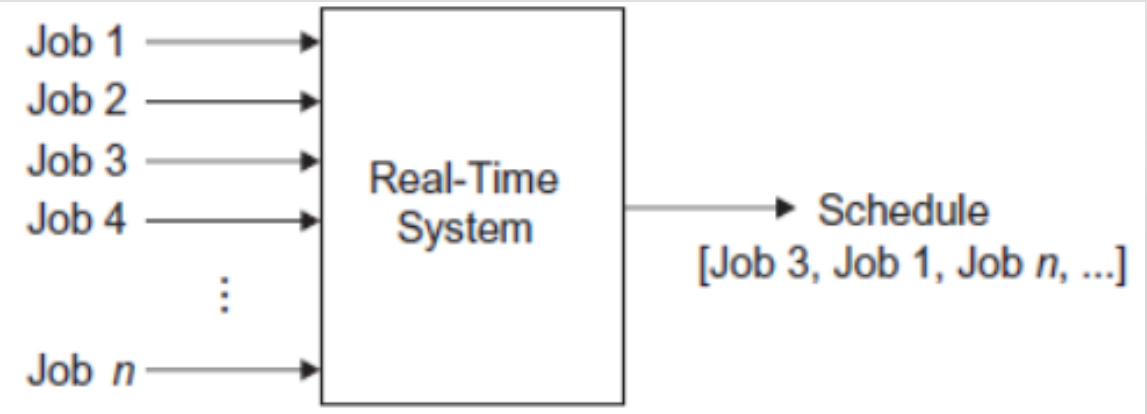
When the internal details of the system are not of particular interest, the mapping function between input and output spaces can be considered as a black box with one or more inputs entering and one or more outputs exiting the system



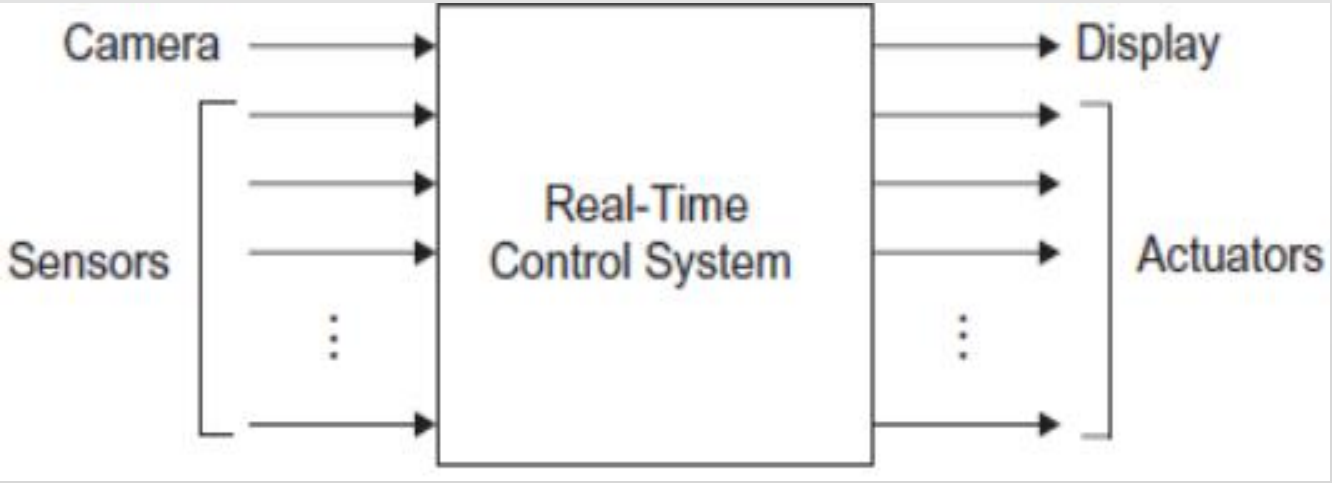
Five General Properties of any System

1. A system is an assembly of components connected together in an organized way.
2. A system is fundamentally altered if a component joins or leaves it.
3. It has a purpose.
4. It has a degree of permanence.
5. It has been defined as being of particular interest.

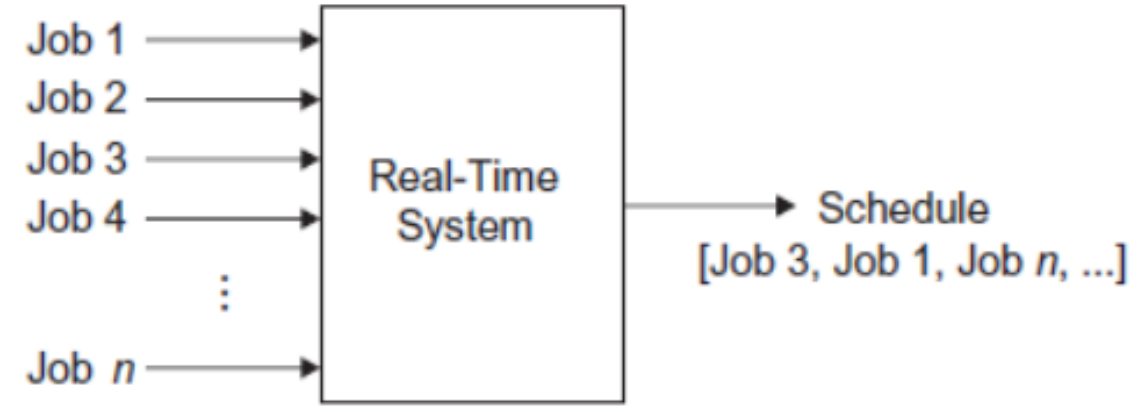


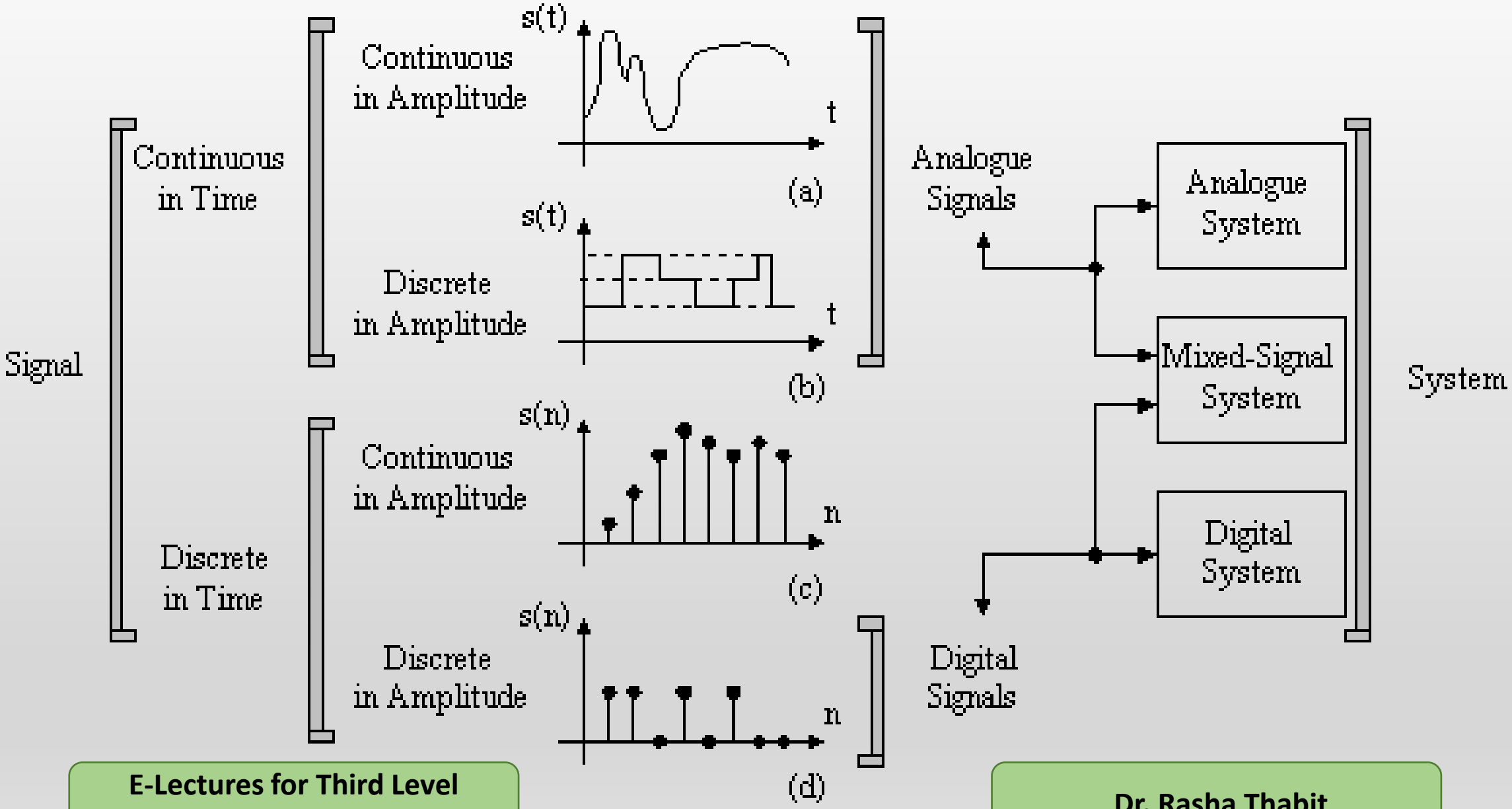


Every real - world entity, whether organic or synthetic, can be modeled as a system. In computing systems, the inputs represent digital data from hardware devices or other software systems. The inputs are often associated with sensors, cameras, and other devices that provide analog inputs, which are converted to digital data, or provide direct digital inputs. The digital outputs of computer systems, on the other hand, can be converted to analog outputs to control external hardware devices, such as actuators and displays, or used directly without any conversion (Figure below).



Modeling a real - time (control) system, is somewhat different from the more traditional model of the real - time system as a sequence of jobs to be scheduled and performance to be predicted, which is comparable with that shown in Figure below. The latter view is simplistic in that it ignores the usual fact that the input sources and hardware under control may be highly complex. In addition, there are other, “ sweeping ” software engineering considerations
that are hidden by the model shown in Figure below.





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Terms definitions for Real-Time systems

- **Response time:** The time between the presentation of a set of inputs to a system and the realization of the required behavior, including the availability of all associated outputs.
- **Failed system:** is a system that cannot satisfy one or more of the requirements stipulated in the system requirements specifications.
- **Embedded Systems:** An embedded system is a system containing one or more computers (or processors) having a central role in the functionality of the system, but the system is not explicitly called a computer.

Summary

- ✓ Definition of signal
- ✓ Types of signals
- ✓ Definition of systems
- ✓ Five General Properties of any System
- ✓ Signals and systems classification
- ✓ Terms definitions for Real-Time systems