Digital Signal Processing
Lecture One
Introduction to Digital Signal Processing
Third Stage
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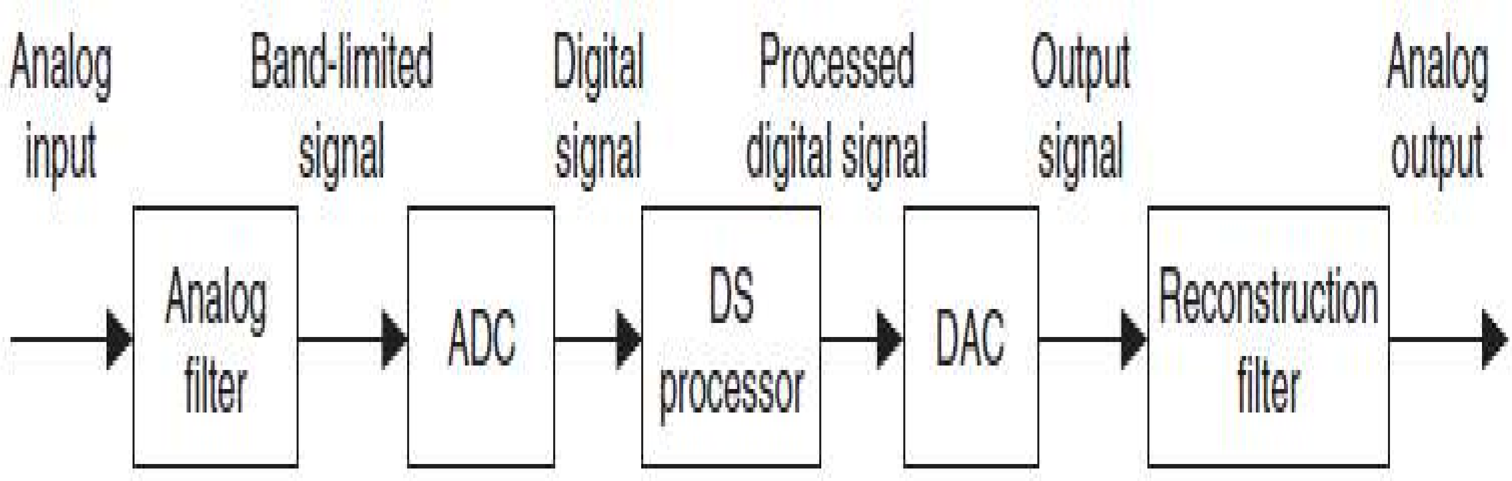
Digital Signal Processing

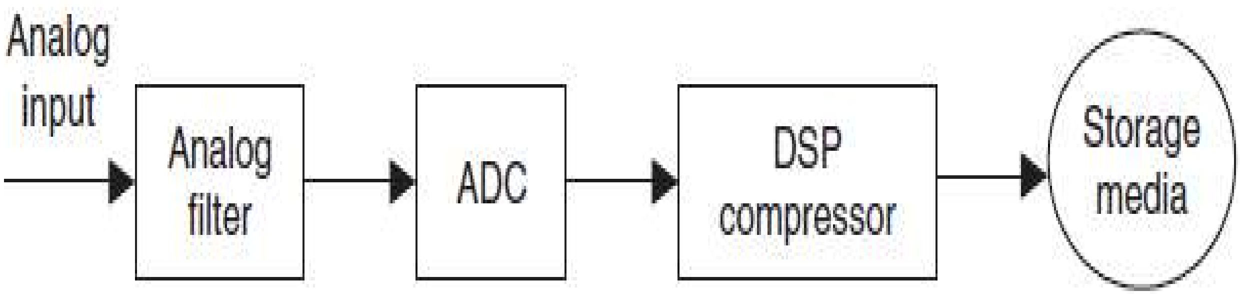
Digital signal processing (DSP) technology and its advancements have dramatically impacted our modern society everywhere. Without DSP, Medical instruments would be less efficient or unable to provide useful information for precise diagnoses if there were no digital electrocardiography (ECG) analyzers or digital x-rays and medical image systems. Without DSP, scientists, engineers, and technologists would have no powerful tools to analyze and visualize data and perform their design, and so on.



Digital Signal Processing Applications

1. Speech Coding and Compression

As shown in Figure below the analog signal is first filtered by analog low pass to remove high-frequency noise components and is then passed through the ADC unit, where the digital values at sampling instants are captured by the DS processor. Next, the captured data are compressed using data compression rules to save the storage requirement. Finally, the compressed digital information is sent to storage media. The compressed digital information can also be transmitted efficiently, since compression reduces the original data rate.



2. Digital Photo Image Enhancement

We can look at another example of signal processing in two dimensions. Figure below shows a picture of an outdoor scene taken by a digital camera on a cloudy day. Due to this weather condition, the image was improperly exposed in natural light and came out dark. The image processing technique called histogram equalization.

Signals and Systems

Signals

Signal: is a description of how one parameter varies with another parameters.

A signal is defined as any physical quantity that varies with time, space, or any other independent variable or variables.

Examples of signals that we encounter frequently are speech, music, picture, and video signals.

Systems

System: is any process that produces an output signals in response to an input signal.

Classification of Signals

1. Continuous and Discrete Time Signals.

2. Analog and Digital Signals.

3. Periodic and Aperiodic Signals.

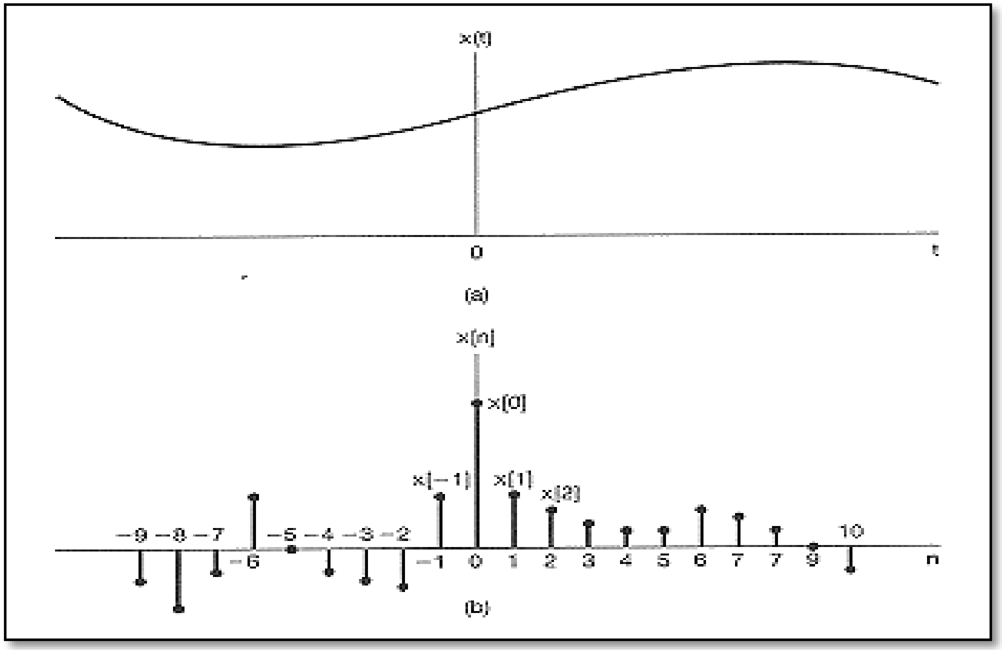
4. Energe and Power Signals.

5. Deterministic and Random Signals.

Continuous and Discrete Time signals

Continuous time signal: a signal that is specified for every real value of the independent variable as shown. Most signals in the real world are continuous time such as voltage and velocity.

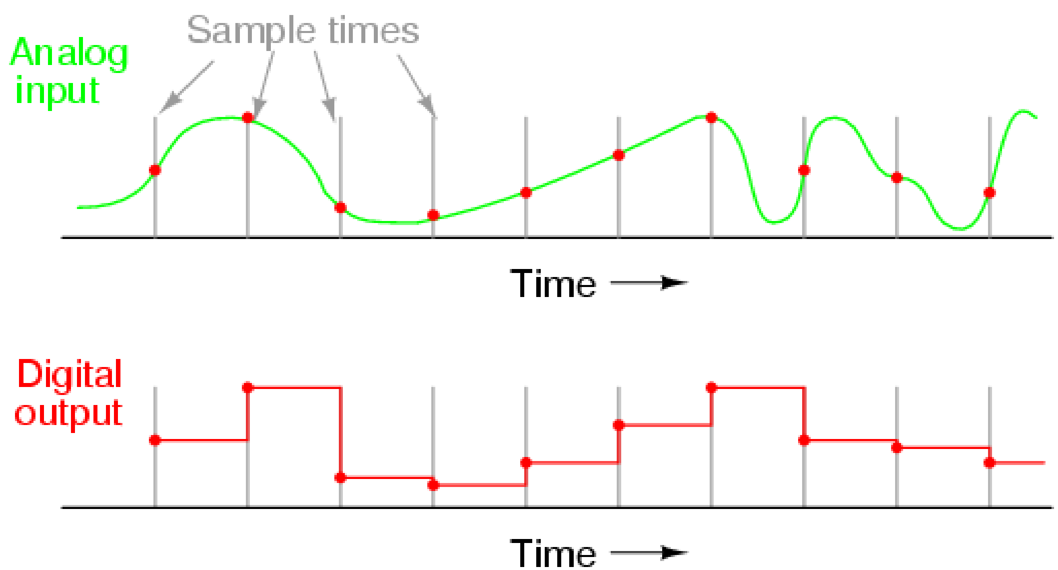
Discrete time signal: a signal that is specified only for discrete values of the independent variable. It is usually generated by sampling so it will only have values at equally spaced intervals along the time axis.



Analog and Digital Signal

Analog signal: signal whose amplitude can take on any value in a continuous range it is corresponds to a continuous y-axis.

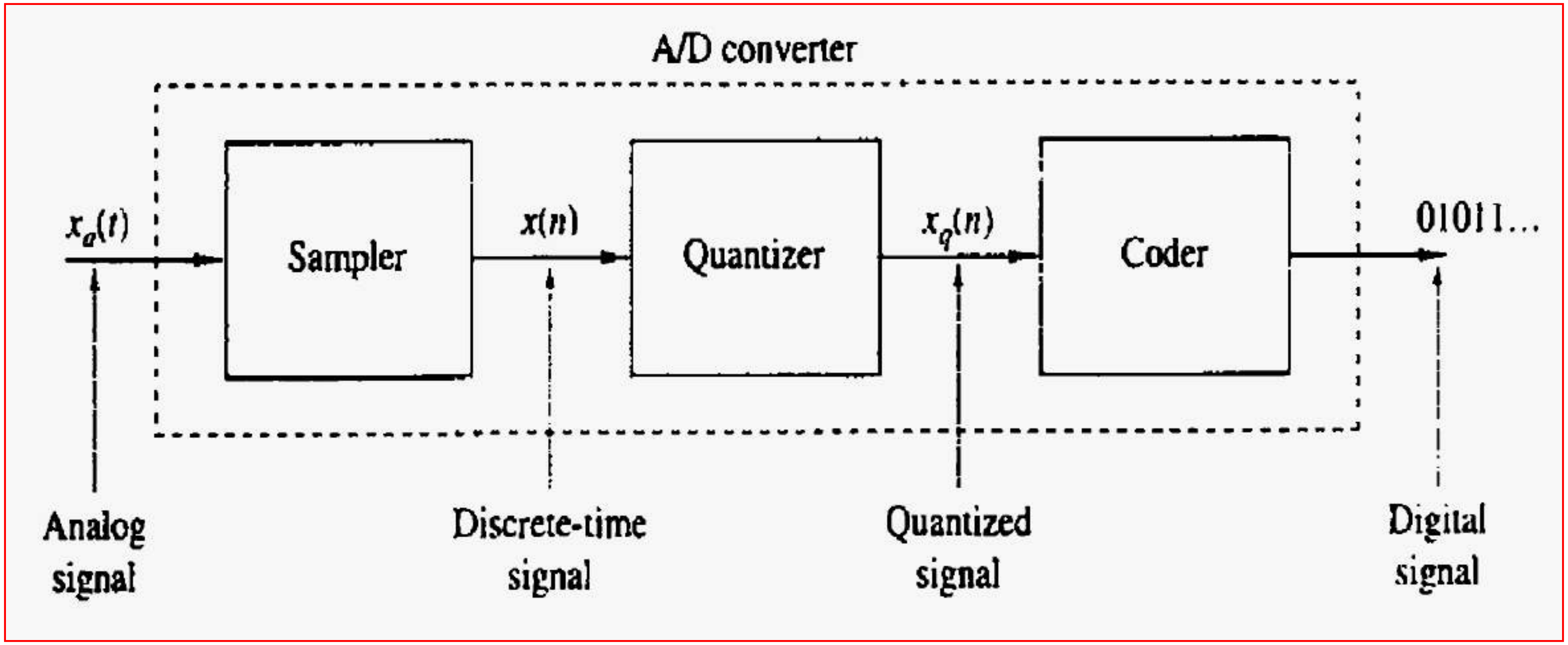
Digital signal: a signal whose amplitude can take on only a finite number of values. It is corresponds to a discrete y-axis.



Analog – to – Digital and Digital – to Analog Conversion

Most signals of practical interest, such as biological signals are analog. To process analog signals by digital means, it is first necessary to convert them in digital form. That is, to convert them to a sequence of numbers having finite precision. This procedure is called analog – to – digital (A/D) conversion.

Conceptually, we view A/D conversion as a three – step process. This process is illustrated in the figure below



•**Sampling:** This is the conversion of continuous – time signal into a discrete – time signal obtained by taking "samples" of the continuous – time signal at discrete – time instants. Thus, if xa(t) is the input to the sampler, the output is xa(nT) ≡ x(n), where T is called the sampling interval.

•**Quantization:** This is the conversion of a discrete – time continuous – valued signal into a discrete – time, discrete – valued (digital) signal. The value of each signal sample is represented by a value selected from a finite set of possible values. The difference between the unquantized sample x(n) and the quantized output xq(n) is called the quantization error.

•**Coding:** In the coding process, each discrete value xq(n) is represented by a b – bit binary sequence.