EEE5108/ETI5103 Digital Signal Processing.

Prof. Ciira Maina
ciira.maina@dkut.ac.ke

15th May, 2025

Course Content

1. Introduction to discrete time signals and systems
2. Discrete time system properties
3. Linear time invariant (LTI) systems
4. Frequency-domain representation of discrete time systems
5. z-transform
6. Sampling of continuous time signals
7. Filter design
8. The discrete Fourier transform

Today's Lecture

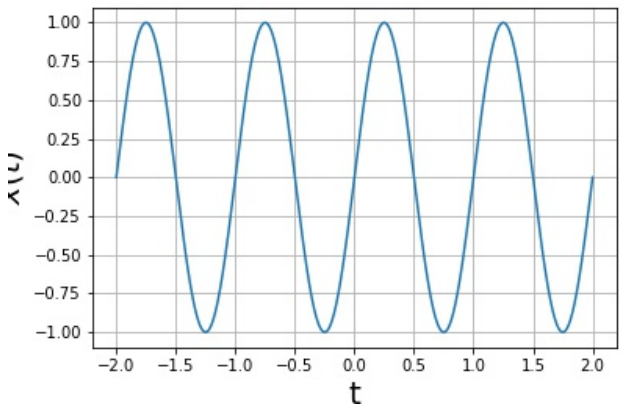
1. Introduction to discrete time signals
2. Basic discrete time signals

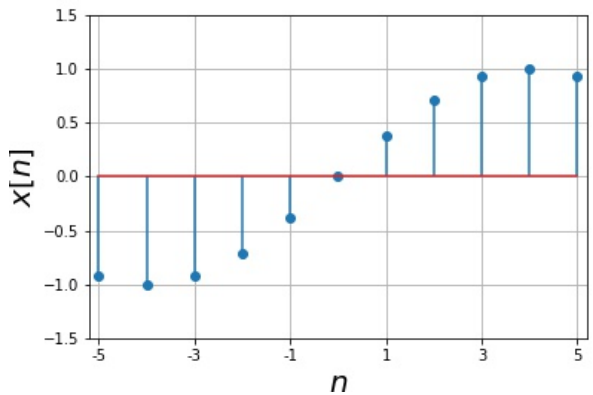
Discrete time signals - sequences

- Discrete time signals are represented mathematically as a sequence of numbers
- The sequence is indexed by the integers and the nth number in the sequence is denoted $x[n]$.
- Often these sequences arise from sampling a continuous time signal $x(t)$. The nth number in the sequence is the value of $x(t)$ at time nT_s
- $$x[n] = x(nT_s) \quad -\infty < n < \infty$$

Discrete time signals - sequences

- T_s is known as the sampling period
- Note that $x[n]$ is not defined for non-integer values of n
- Below we show the continuous time signal $x(t) = \sin(2\pi t)$ and the corresponding stem plot of the discrete time signal with $T_s = \frac{1}{8}$



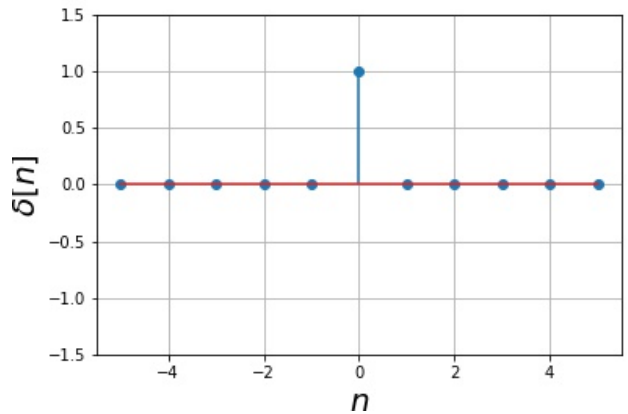


Examples in Notebook

Basic sequences

- The unit sample sequence is defined as

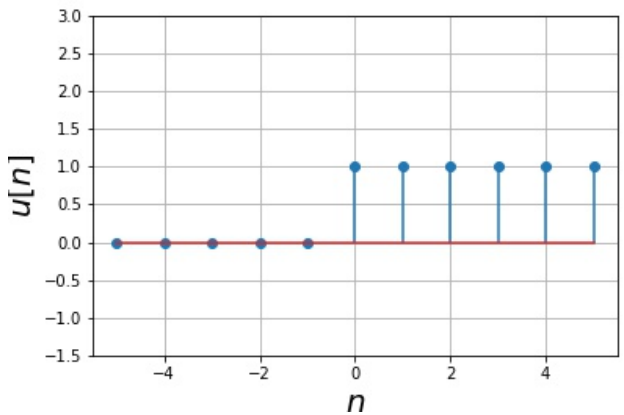
$$\delta[n] = \begin{cases} 0 & n \neq 0 \\ 1 & n = 0 \end{cases}$$



Basic sequences

- The unit step is defined as

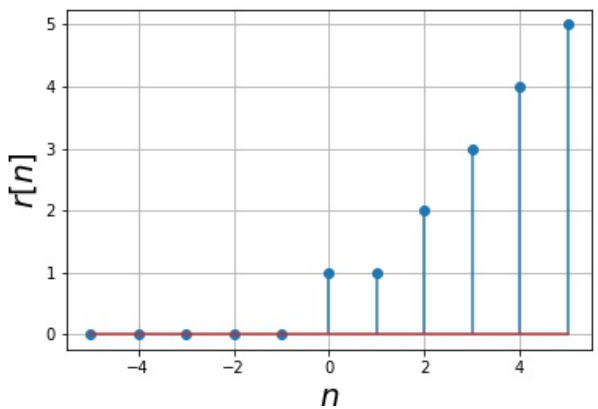
$$u[n] = \begin{cases} 1 & n \geq 0 \\ 0 & n < 0 \end{cases}$$



Basic sequences

- The unit ramp is defined as

$$r[n] = \begin{cases} n & n \geq 0 \\ 0 & n < 0 \end{cases}$$

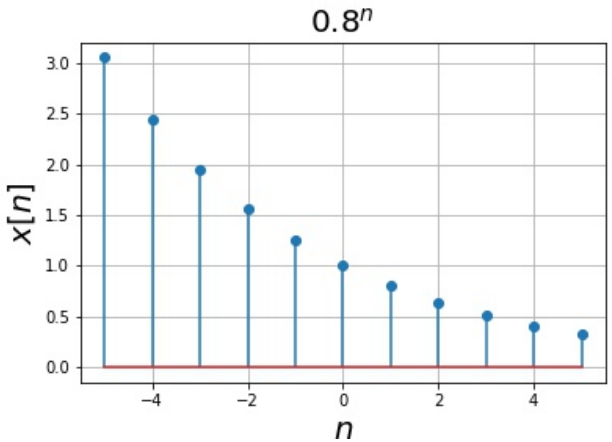


Basic sequences

- Exponential sequences have the general form

$$x[n] = A\alpha^n$$

where A and α are complex in general.



Basic sequences

- Sinusoidal sequences take the form

$$x[n] = A\cos(\omega_0 n + \phi) \quad \forall n$$

where A and ϕ are real constants.