Digital Signal Processing
Lecture 2 - Discrete-Time Signals

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Overview

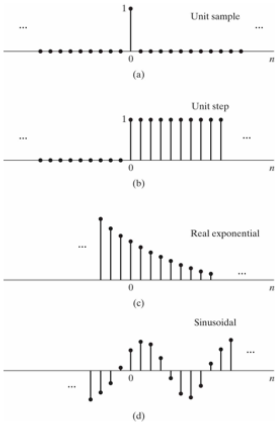
Recap

- Essential components of DSP
  - Frequency analysis
  - Sampling
  - Filter
- Different types of signals
  - continuous vs. discrete vs. digital
  - deterministic vs. random
- Interesting applications of sinusoids

Basic sequences

- Unit sample sequence (or impulse sequence):
  $$\delta[n] = \begin{cases} 0, & n \neq 0, \\ 1, & n = 0 \end{cases}$$
- Unit step sequence: $u[n] = \begin{cases} 1, & n \geq 0, \\ 0, & n < 0 \end{cases}$
- Exponential sequence: $x[n] = A\alpha^n$
  - real sequence
  - complex sequence
- Sinusoid sequence: $x[n] = A\cos(\omega_0 n + \phi)$

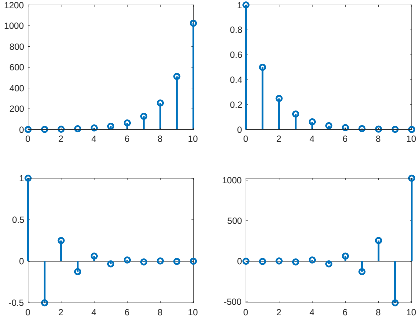
Basic sequences (cont')



- What are their relationships?

Exponential sequences

Different scenarios of complex exponential sequences.



On definition

- $\delta(t)$ vs. $\delta[n]$
- Properties of the δ functions

On periodicity

- Continuous-time periodic signals: $x(t) = x(t + T)$
- Discrete-time periodic signals: $x[n] = x[n + N]$
- Exercises: What is the period of the following signals
  - $x[n] = \cos(\pi n/8)$
  - $x[n] = \cos(\pi n/4)$
  - $x[n] = \cos(\pi n)$
  - $x[n] = \cos(7\pi n/4)$
- Questions:
  - Is it always true that the higher the frequency, the lower the period?
  - Is it true that the sinusoidal sequence is always periodic?

On periodicity (cont')

Period vs. frequency for D-T signals.