Lecture 2: Signals & Communications

- Announcements:
- Lecture 1 pdfs and video already posted on the course website in the "Lecture" link
- HW#1 online
- Discussions start next week
- Labs start the week after next
  - You will need to do your prelabs for Lab 1 before your lab period
  - Lab 1 will be online soon (before Monday)
- Will let in concurrent enrollments next week
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- Lecture Topics:
  - Review of Signal Types
  - Motivation: Digital Communications
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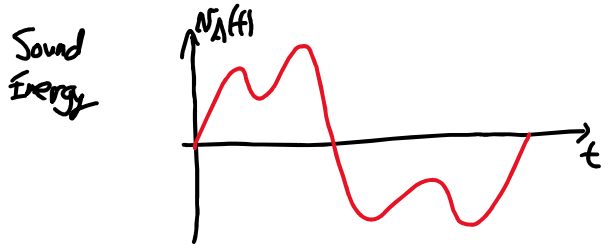
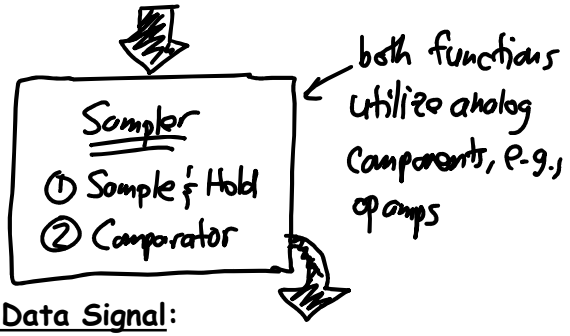
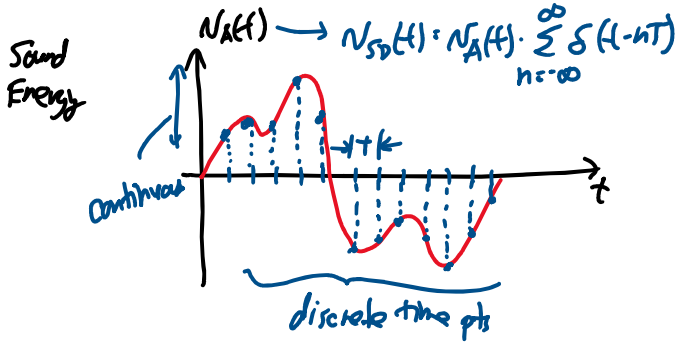
- Signal Types:

1) Analog Signal:
   - The majority of physical signals are analog
   - "analog" comes from the fact that analog electronic signals and the physical signals they represent are analogous
   - Continuous time, continuous amplitude

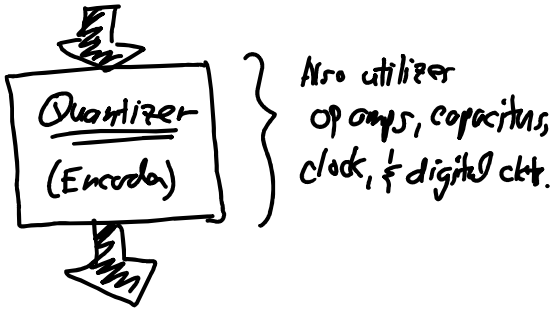




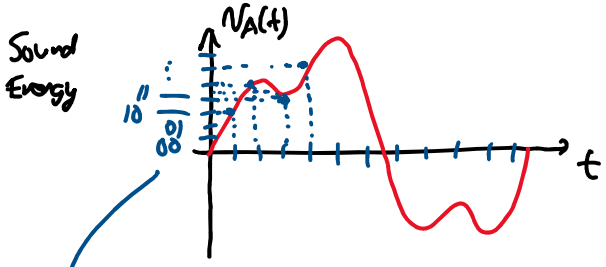
2) Sampled-Data Signal:
   - Discrete time, continuous amplitude



- If sample fast enough (i.e., at the Nyquist rate = 2 x the highest bandwidth), then can retain all the original information in the original analog signal
- If you cannot do this, then you lose information!



3) Digital Signal
- Discrete time, discrete amplitude



→ Can now encode these values in a binary representation and process via digital electronics

→ Problem: Lose info thru quantization

Lost Info $\propto \frac{1}{\#\text{ of levels}}$

- Advantages of Digital:
  - More complex processing possible due to higher density of electronics (i.e., VLSI)
  - Easier to store, e.g., mp3's more reliable than analog records
  - Easier to interpret, e.g., digital vs. analog clock (with hands)
- Disadvantages of Digital:
  - Loss of information through quantization and sampling
  - In many cases, not as fast as analog (smaller bandwidth)
  - The speed disadvantage is easy to see in wireless communications, which is why analog is so important for wireless
- Go to Digital Communications Example