EGC 113 – Signals and Systems

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Instructors

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  - Deva Veera Venkata Sai Tejas Kotha

Class Schedule

- Classes: R203
  - Tuesday: 11 -1230 PM
  - Thursday: 11 – 1230 PM
- Tutorial:
  - Tuesday: 0515 PM – 0645 PM

Textbook and Other resources

- Textbook : Signals and Systems – Oppenheim and Willsky
    - MIT OCW – Signals and Systems

Evaluation

- Mid-Term : 25%
- End-Term : 25%
- Continuous Evaluation (Quizzes + Assignments in tutorials) : 50%
- Class attendance and participation: additional 5%

  - Assignments will be Matlab based.
  - There will be 7 quizzes of which best 6 will be counted towards final score.
  - 4 Quizzes will be announced, 3 will be pop-quizzes.
  - Please make sure you attend all sessions since make-up quizzes will NOT be conducted.

Course Objective

- **Classify signals and systems:** Classifications of various signals and systems as seen in everyday life. Signal properties such as; periodicity, absolute integrability, deterministic and stochastic character. Characterization of system properties: linearity, time-invariance, causality, stability, basic instruments associated with signals and systems study, basic examples of various signals.

- **Continuous and Digital Signals/Systems:** Principles of Sampling and Quantization

- **Time-Frequency Duality:** Representing the signal in time and frequency domain as needed. Analyzing system characteristics in both domains.

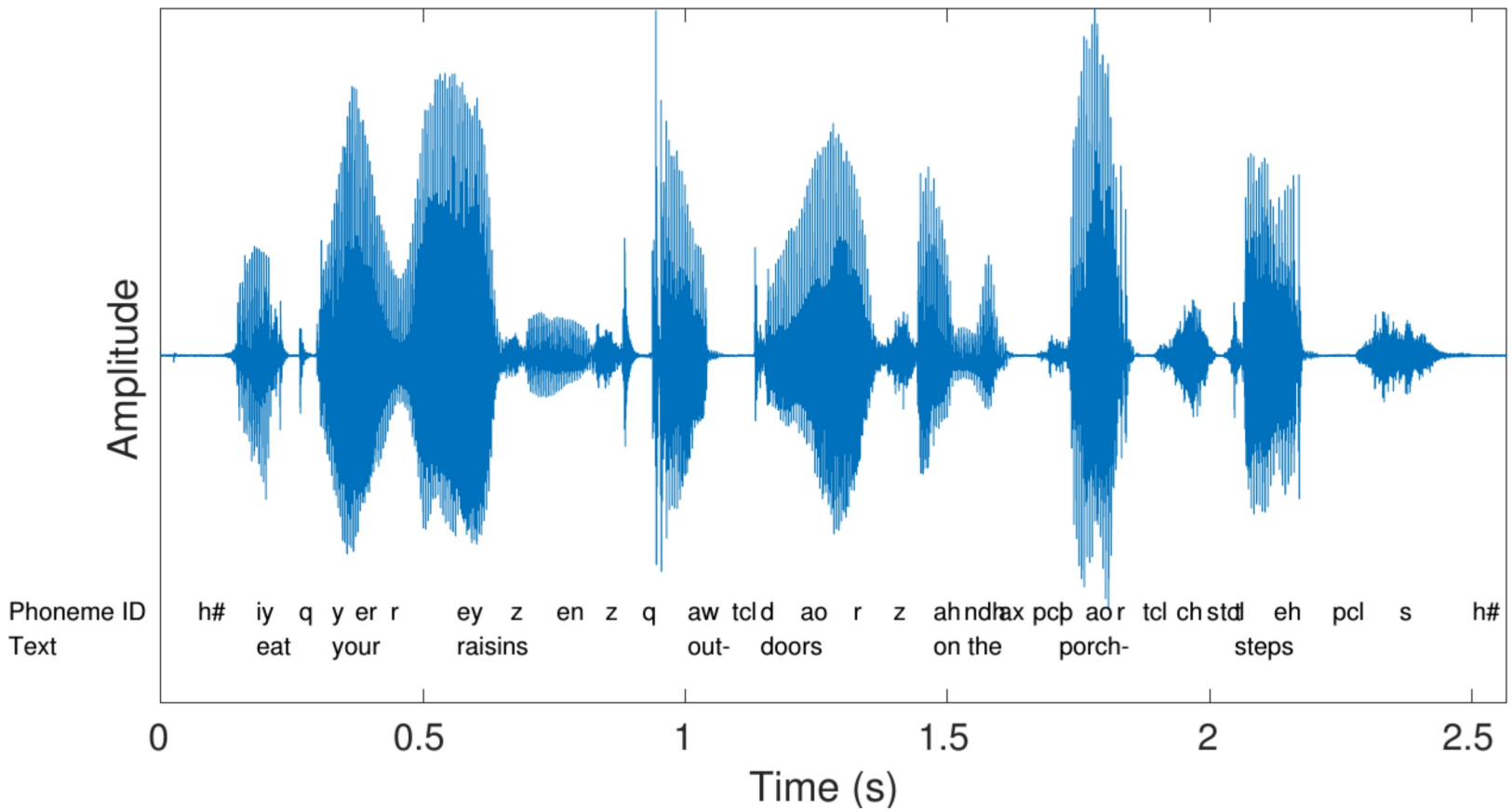
Signals?

- What is a signal, exactly?
- A signal is a function or a data set representing a physical quantity or variable.
- Usually, the signal encapsulates information about the behaviour of a physical phenomenon, for example, electrical current flowing through a resistor, sonar sound waves propagating under water, or earthquakes.
- Mathematically, a signal is represented as a function of an independent variable t, typically representing time. Thus, a signal is denoted x(t).

Signals?

- Speech signals are sound signals, defined as pressure variations travelling through the air.
- These variations in pressure can be described as waves and correspondingly they are often called sound waves.
- Consider the acoustic speech signals being captured by a microphone and converted to a digital form.
- What might such a *signal* look like?

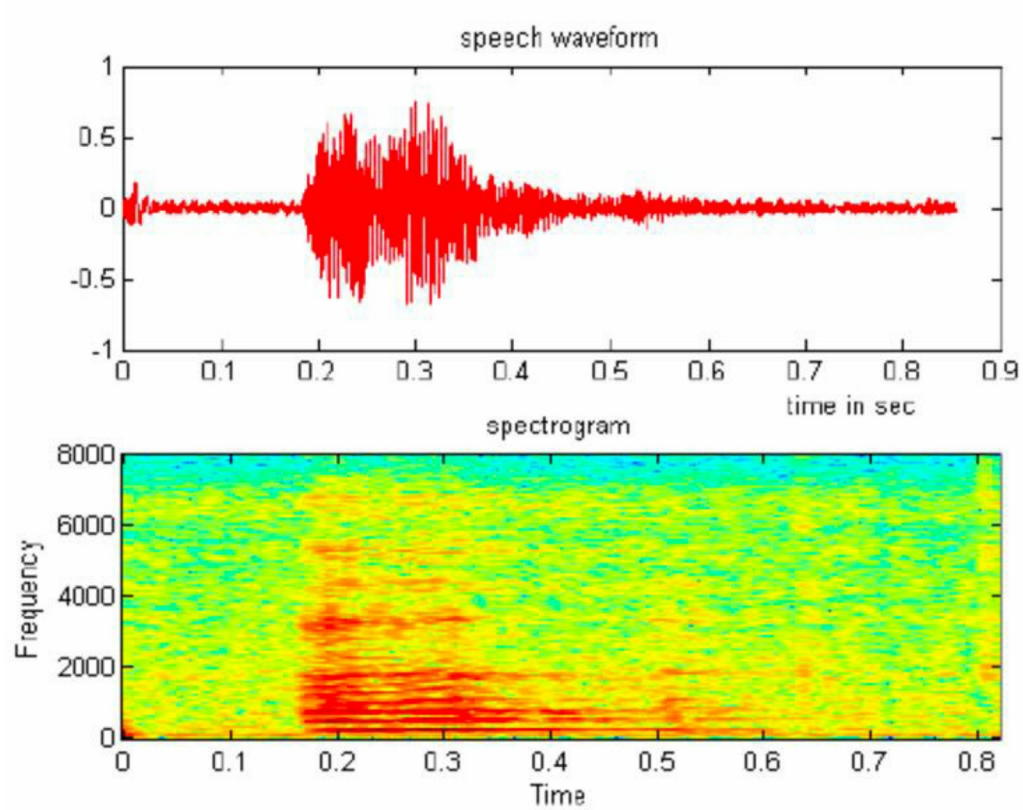
Example


Amplitude
Phoneme ID
Text
h# iy q y er r ey z en z q aw tcl d ao r z ah ndh ax pcl p ao r tcl ch stcl eh pcl s h#
eat your raisins out- doors on the porch- steps
0
0.5
1
1.5
2
2.5
Time (s)

Signals?

- Will it vary depending on speaker?
  - In what way will the signal change?
  - Will the signal look different when spoken by male/female speaker?
- Will it vary based on what is being spoken?
  - Speech volume
  - Speech content
  - Speaker gender

Example


speech waveform
1
0.5
0
-0.5
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
time in sec
spectrogram
8000
6000
4000
2000
0
Frequency
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Time

Example

- Images are also signals; 2D signals.

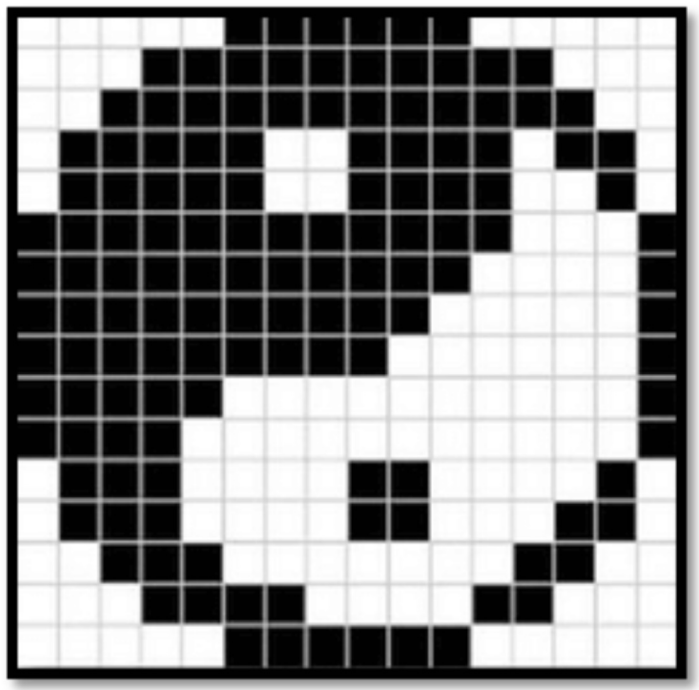
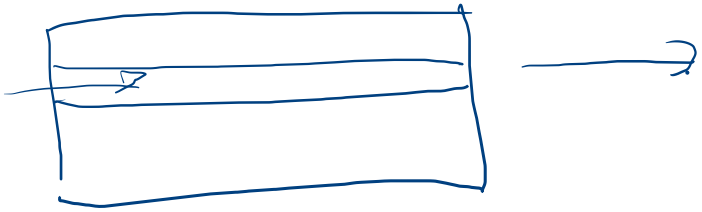


Fig. Binary image

Systems

bus
car
two wheeler



Course Outline

- Signals:
  - Types of signals: Classifying the signals depending upon the periodicity, analog/digital, energy etc
  - Basic Signal waveforms used for construction of any signals.
  - Simple Signal manipulations
- Systems:
  - System properties: Stability, linearity, time invariance etc
  - Time vs frequency domain analysis of signals and systems.

Course Schedule

Week	Dates	Topics
1	August 1	Introduction to Signals and Systems
2	Aug 6, 8	Classification of signals, their properties. Important basic signals
3	Aug 13	Properties of signals
4	Aug 20, 22	Sampling and Quantization
5	Aug 27, 29	Properties of Systems, Linear Time Invariant Systems
6	Sept 3, 5	Convolution and Correlation
7	Sept 10, 12	Time vs. Frequency Domain Representation
8	Sept 17, 19	Fourier Transform
9	Sept 24, 26	Review before midterm

Course Schedule

Week	Date	Topics
10-11	Oct 1, 3, 8, 10	Midterm and Midterm break
12	Oct 15, 17	Discrete time Fourier Series
13	Oct 22, 24	Discrete Time Fourier Transform
14	Oct 29, 31	Discrete Time Fourier Transform
15	Nov 5, 7	Discrete Fourier Transform
16-17	Nov 12, 14	Laplace and Z transform
18	Nov 26, 28	Recap
19		Endterm