ECEN 463/863: Digital Signal Processing

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University of Nebraska-Lincoln

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Instructor

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Sources and Acknowledgments

Primary Sources

- **Textbook:**
  Discrete-Time Signal Processing, Oppenheim and Schafer, 3rd Edition
- **UNL Digital Signal Processing Archive**
  (e.g., Prof. Michael Hoffman)
- **MIT Digital Signal Processing Course**
  (e.g., 6.341/6.555J, Prof. Alan V. Oppenheim)
- **Stanford Digital Signal Processing Course**
  (e.g., EE264, Prof. Julius O. Smith III)
- **MIT OpenCourseWare (OCW)**
  https://ocw.mit.edu/

Note

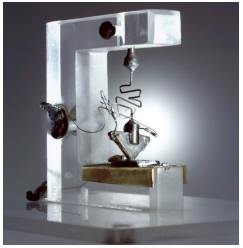
Portions of these slides are adapted from the above resources for educational purposes.

Why **Digital** Signal Processing?

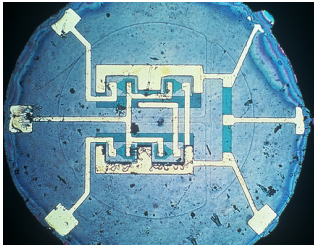
- Flexibility
- Accuracy
- Multi-purpose hardware
- Easy to implement sophisticated operations
- Today we have tremendous computer power

Why **Digital** Signal Processing?

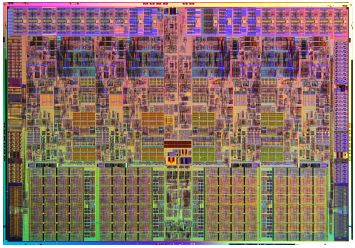
The development of low-cost and high-speed digital electronics paved the way for digital signal processing



First point contact transistor (1947)



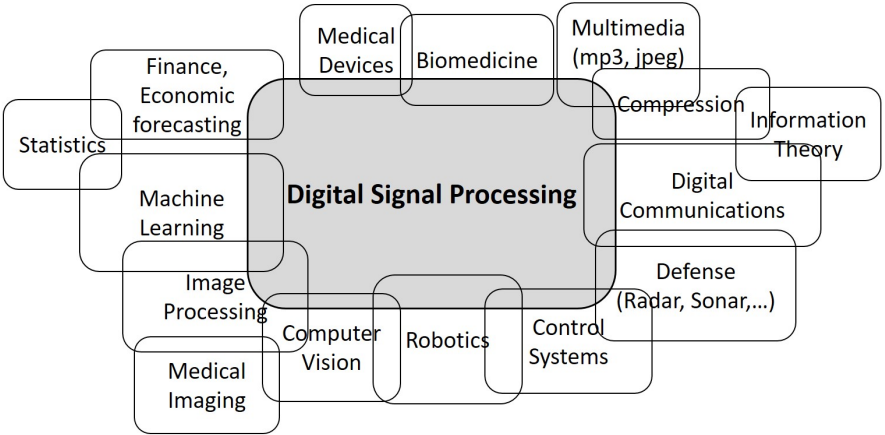
First integrated circuit (1961)



Modern processor (200X)

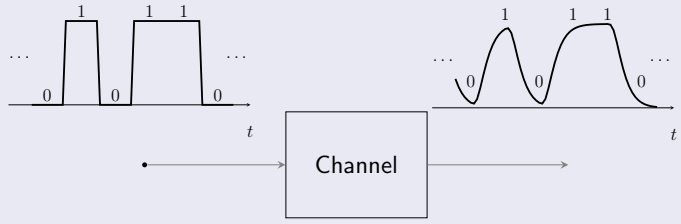
Why learn digital signal processing?

- Present in essentially all fields of modern EE
- Countless applications



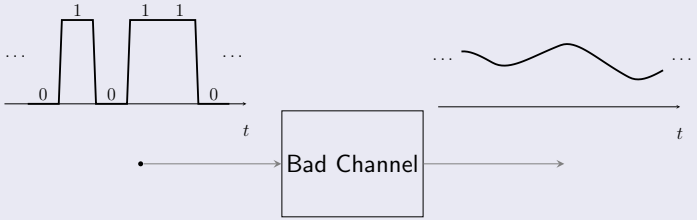
Example: Digital Communication

Problem:

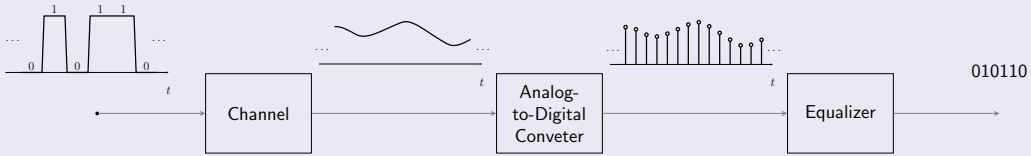


Example: Digital Communication

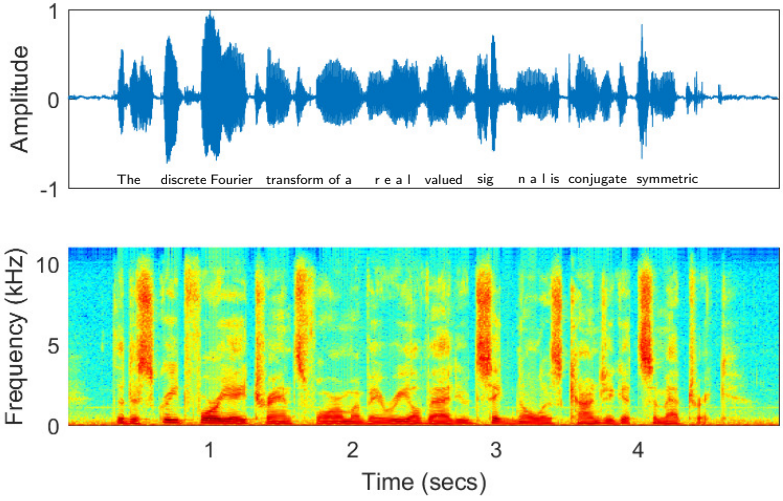
Problem:



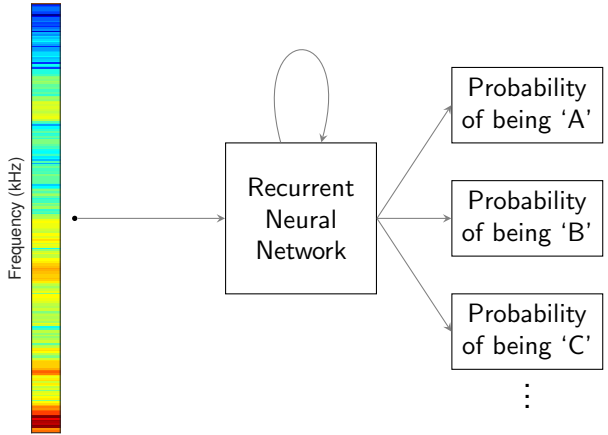
Solution:



Example: Speech Recognition

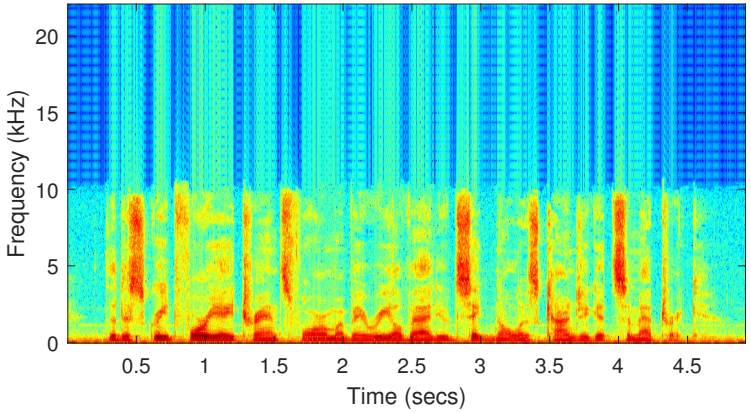


Example: Speech Recognition



Example: Speech Recognition

Spectrogram of the same speech signal, now recorded with sampling rate of 44.1 kHz



More on spectrograms and short-time Fourier transform on lecture 11.

Digital processing of analog signals

Analog-to-digital converter (ADC)

- Performs filtering, sampling, and quantization
- Sampling rate may be of tens of kHz (audio processing), or it may be of tens of GHz (optical communications)

Digital signal processor

- Performs some operation e.g., filtering, FFT, etc
- May be implemented on PCs with 64-bit floating-point precision, or on ASICs with limited arithmetic precision (e.g., 6 bits).

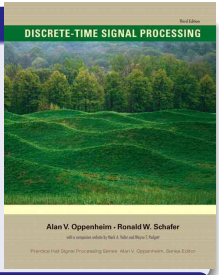
Digital-to-analog converter (DAC)

- Performs quantization and reconstruction (filtering)
- Sampling rate could be similar to ADC

Administrative: Resources

Textbook

- "Discrete-Time Signal Processing", Oppenheim and Schafer, 3rd edition, 2010.



Lecture notes

- Lecture notes will cover all the material, but further reading of the textbook is encouraged.

Canvas: canvas.unl.edu

- Lecture notes, homework assignments, Matlab code.
- Submit homework on Canvas.

Administrative: Assignments

- Assignments will typically be released on Friday and due the following Friday at 11:59pm.
- Submit a single .pdf file with your solutions online on Canvas.
- Homework assignments include analytical derivations and Matlab simulations.
- Discussion among students is encouraged, but individual solutions must be submitted.
- Late submissions will be not accepted. If you need an extension, please contact the instructor or TA in advance.

Administrative: Exams

Midterm

- In-class midterm on July 23.
- Midterm review session at 11:30 AM – 12:20 PM, on Friday, July 20, in Gates B3.
- Midterm covers lectures 1 to 7 (homeworks 1 to 3).
- Midterm is open book and open notes.

Final

- Final exam will be a 24-hour take home exam. Dates TBD.
- The final exam should take just a few hours.
- The review session for the final will be on the last lecture.

Administrative: Grading

- Homework Assignments: 40%-70%
- Exams: 30%-60% (Based on 1 or 2 Exams)

Administrative: Enrollment

- The deadline to drop a full semester course and receive 100% refund is September 2
- Last day to file a drop to remove a full semester course from student's record is September 5
- The deadline to drop a full semester course and receive 75% refund is September 5
- The deadline to drop a full semester course and receive 50% refund is September 12
- The deadline to drop a full semester course and receive 25% refund is September 19
- Last day to change a full semester course registration to or from "Pass/No Pass" is October 17
- Last day for course withdrawals noted with a grade of "W" on academic record is November 14