



Digital Signal Processing

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We desire “the best” solution. In many cases, a computer can find this solution for us; this branch of engineering is called Optimization. In this class, you will learn the basics of optimization and explore some of its applications. You will utilize math (primarily matrix mathematics) and computer programming as your tools in this exploration. Your efforts will come together through creations and analysis of visual applications.

Session Breakdown

Everyday consists of a 2.5 hour morning session and a 3.5 afternoon session. Nicholas Dwork will lead the morning session; the Teaching Assistants will lead the afternoon session. The morning session will focus on presenting new material. The afternoon session will focus on learning and exploring that material by tackling relevant challenges. Each morning session will be broken into multiple sub-sessions; each sub-session will consist of material from one subject: Math, Physics, Programming, Image Processing, Audio processing, or Computer Graphics. There will be short breaks between sessions that will consist of meditations, stretching, or short demonstrations. We will also be discussing topics like communication, presentations, truth, logic, and the future (often with short video prompts).

Opportunities to Learn

Assignments: Due dates are printed on the top of the assignment; the due date is rigid. Assignment solutions must be immaculate.

Main Applications: As engineering consultants, you are asked to satisfy several customer desires. You are tasked with delivering at least one solution to your customer (*Me!*).

Final Presentation: Our class will make a presentation during the final week of the quarter. You will be placed into a group of two or three other students who completed similar applications.

Resources

Course website: www.stanford.edu/~ndwork/si2016

Introduction to Matrix Methods and Applications by Boyd and Vandenberghe

Available online for free at: <http://stanford.edu/class/ee103/mma.html>

Week 1: **The Basics, Initial Applications**

Sets, Vectors, Matrices

Programming: Variables, Flow, Scope, Loops, If .. then .. else, Images, Plotting

Guest Lecture: Uzair Sikora - making a microscope

Week 2: **Computer Graphics, Physics of Light**

Math: Applications - finding the answer

Programming: Mathematics with Python

Field Trips: *The Hive*; *3D-QLab*

Guest Lecture: *Jonathan Blow*

Week 3: **Computer Vision, Videos**

Math: Demystification - how does the computer do it?

Field Trip: *OCT Lab Tour*

Example Main Applications:

Forensic video analysis

Space vehicle navigation

Image fusion

Velocity estimation

Integrated circuit cell placement

Message encryption

Image denoising

Note:

- This schedule is a guideline and subject to change based on the interests of the students
- This course will require an enthusiasm in mathematics. We will be exploring some advanced math concepts and focus on the rigor of thought associated with mathematics.
- Above all, from this course, I hope you get an accurate understanding of what it means to be an engineer.