EE15N
The Art & Science of Engineering Design
Winter Quarter 2019

PROFESSOR ANDREA GOLDSMITH
PROFESSOR MY T. LE
JANUARY 9, 2019
OUTLINE

- About Us
- Course Information
- Introduction to Engineering Design
• Born 1963
• Arrived in U.S. 1978
• B.Sc. from UC Davis 1980-1983
• Engineer at National Semiconductor & Hewlett-Packard
• Discovered Computer Networking
• Ph.D. from UC Berkeley 1990-1996
• Caught the First DotCom Boom 1996-2000
• Teaching Part-time at Stanford since 2002
• Consult to & Invest in Start-ups/Involve in Multiple NGOs
• 2 Kids: Jessica (20) & Zoe (18)
Andrea

- ME Professor Dad (UCB), Cartoonist Mom
- Undergrad at UC Berkeley 1982-1986
- Worked in Silicon Valley 1986-1989
- Fell in love with wireless.
- Ph.D. from UCB: 1989-1994
  - Summers at AT&T Bell Labs
- Taught at Caltech 1994-1999
- Moved to Stanford in 1999
  - Lots of stuff in addition to research, teaching:
    - PM advisor, Ugrad/Grad Education Committees, Faculty Senate, Budget Group, PPB, Women’s Leadership Task Force, EE Student Life Committee
- Founded two wireless companies: Quantenna (QTNA, 2006) and Accelera/Plume WiFi (2010)
- Work to promote diversity/inclusion in STEM (academia, industry, IEEE)
- Best Results: Daniel (21) and Nicole (19)
COURSE INFORMATION

- COURSE GOALS
- ADMINISTRATIVE INFORMATION
- COURSE SCHEDULE
- ASSIGNMENTS
- PROJECT
COURSE GOALS

- To introduce freshmen to the design process of an engineering project.
- To present the different functions that people play in a project.
- For students to consider what role in a project is best suited to their interests and skills.
- To introduce to students the diverse people and projects that comprise the engineering profession.
- To have fun.
LEARNING ENGINEERING DESIGN

As Marketing Requested It
As Sales Ordered It
As Engineering Designed It
As Plant Manufactured It
As Crew Modified It
What the Customer Wanted
INTRODUCTIONS

- Introduce yourself.
- Say why are you interested in this course.
- Share any thoughts on your future career.
ADMINISTRATIVE INFORMATION

- Instructors:
  - Andrea Goldsmith, Packard 371, andrea@ee, 766 8317, OHs: after class and by appointment.
  - My T. Le, drmytle@gmail.com, 224 1351, OHs: by appointment.
- Class Homepage: http://web.stanford.edu/class/ee15n/
- Admin: Dash Corbett, dashiellcorbett@stanford.edu, Packard 367,
- Grading: Class Participation 20%, Assignments 20%, Project Assignments, Presentation, and Final Report: 60%
- See Class Home Page and Handout for More Details.
**COURSE SCHEDULE**

- **WEEK 1 – JAN 9:**
  - Lecture: Introduction to Engineering Design
  - Speaker: Pejman Nozad, Pear Ventures

- **WEEK 2 – JAN 16:**
  - The Design Process
  - Speaker: Martin Casado, Andreessen Horowitz

- **WEEK 3 – JAN 23:**
  - Lecture: Design Teams and Management
  - Speaker: Ellen Levy, Silicon Valley Connect

- **WEEK 4 – JAN 30:**
  - Lecture: Defining an Engineering Problem: Requirements and Objectives
  - Speaker: Jim Fruchterman, Benetech
COURSE SCHEDULE (cont)

- WEEK 5 – FEB 6:
  - Lecture: Defining an Engineering Problem: Constraints and Design Specs
  - Speaker: Laurie Yoler, Zoox, Bose, Church & Dwight, Broadway Angels

- WEEK 6 – FEB 13:
  - Lecture: Generating Design Ideas and Choosing a Design
  - Speaker: Celia Oakley, Opener

- WEEK 7 – FEB 20:
  - Lecture: Why Things Fail
  - Speaker: Steve Rummage, David Wright Tremaine LLP

- WEEK 8 – FEB 27: Field Trip
WEEK 9 – MAR 6:
- Lecture: Communicating the Design and Prototyping
- Speaker: Lee Redden, Blue River Technology

WEEK 10 – MAR 13:
- Lecture: Beyond the 1st Generation. Engineering Products that have Changed the World and Benefit Humanity. The Ethical Engineer.
- Speakers Panel: Wren Dougherty, Nathan Hall-Snyder & Sally Thornton

Finals Week:
- MAR 21, 3:30-6:30PM: Final Presentations
- Project Reports Due March 21 at 3:30PM
WRITING ASSIGNMENTS

- Two writing assignments are required
  - 3-5 pages
  - Include references

- Deadlines:
  - First Report due January 30 (Week 4)
  - Second Report due February 27 (Week 8)

- Topics of the assignments should be from different categories
WRITING ASSIGNMENT CATEGORIES

- Report on how society shapes technology or vice versa.
  - Examples: stem cell research, cell phones, nuclear power, the Internet, Twitter, Facebook,…

- A case study of a complex engineering project.
  - Examples: the IPOD/iPhone, Google search, the space shuttle, the power grid, MRIs, electric or self-driving cars.

- Describe in more detail an engineering project executed by one of our guest speakers.

- Pick your own topic related to engineering design.
A term project will be used to illustrate the design concepts introduced in the course.

The project will be designed by a team of 3 to 4 students

- Form teams, decide project, 1 paragraph Problem Statement that your project will solve due 1/23.
- Revised Problem Statement, Preliminary list of project roles and tasks and Objective tree for your project due 2/6
- Other project assignments: morph chart and gallery method sketches (Feb 20), final design choice and related charts (February 27), detailed design (Mar 6)
- Projects from last class posted on course website

Project requirements include interim documents, a final report, and a final presentation

We will help with the formation of project ideas and teams
What would you like to do a project about?
ENGINEERING DESIGN

Some Questions

- What is engineering design?
- Who participates?
- What processes are needed?
- How is success measured?
**Textbook definition:** A thoughtful process for generating plans or schemes for devices, systems, processes that attain given objectives while adhering to specific constraints

- Design is a thoughtful process that can be understood
- There are formal methods for this process
- The form and function of a design are separate yet related
- **Design specifications:**
  - Detail how the design should perform
  - Provide a metric for success
People have been designing things for a long time

Examples of great designs from antiquity:
- Great Pyramids in Egypt
- Mayan Cities and Temples
- Great Wall of China

No records survive from these projects

Basic design method in the past (and present)
- Trial and error
- Excessive resources
DESIGN EVOLUTION: PYRAMIDS & CELL PHONES

Mastaba

1st analog (1G) cell phone aka “the brick”
DESIGN EVOLUTION: PYRAMIDS & CELL PHONES

Step Pyramid

Analog “Flip” phone (birth of mobile devices)
DESIGN EVOLUTION: PYRAMIDS & CELL PHONES

Bent Pyramid

iPhone 3GS
(birth of the smartphone)
What is common to both design evolutions?
Device to be built of wood, reeds and taffeta. "A small model can be made of paper with a spring like metal shaft that after having been released, after having been twisted, causes the screw to spin up into the air."
EXAMPLE: COLLAPSE OF A WALKWAY

Place: Regency Hyatt Hotel, Kansas City
Date: July 17, 1981
Result: 114 deaths
more than 200 injuries

https://www.youtube.com/watch?v=VnvGwFegbC8
ENGINEERING DESIGN IS DIFFICULT

- Design problems are ill-defined
  - The purpose of the design is not always clear
- Design problems are ill-structured
  - Cannot directly apply formulas or algorithms
  - Use-cases and operating environments not fully known
- Design problems are open-ended
  - Problems usually have several acceptable solutions
  - Tradeoffs change as technology evolves
TODAY’S SPEAKER

PEJMAN NOZAD

PEAR VENTURES