Introduction to Electrical and Computer Engineering

Course Overview

Welcome!

- We are excited that you want to take this course with us!
- This overview:
  - What we will study
  - How we will study
  - How we will interact
  - Logistics of this course
  - Etc.
- We want you to succeed in this course!
- We want you to connect with us and with your peers as a first step in your studies of ECE at UMass Amherst!

Think about the big problems… (1/2)

Think about the big problems… (2/2)

- …Thanksgiving dinner!
  - Your family: "Aren't you studying ECE? What's that all about?"
  - You: "…"

Electrical and Computer Enginering

- Electrical and computer engineering systems
  - ECE technology can be found everywhere
  - Opportunity to see what ECE looks like “in the wild”
- What we will do
  - Explore a few example ECE systems
  - Discuss operation and technical background
  - Learn from good (and bad) examples
- Course goals
  - Understand the breadth of ECE discipline
  - Understand societal impact of ECE
  - Understand some technical and scientific “nuggets”
  - Understand how areas relate to courses in ECE curriculum
  - Develop general appreciation of ECE

What is Engineering?

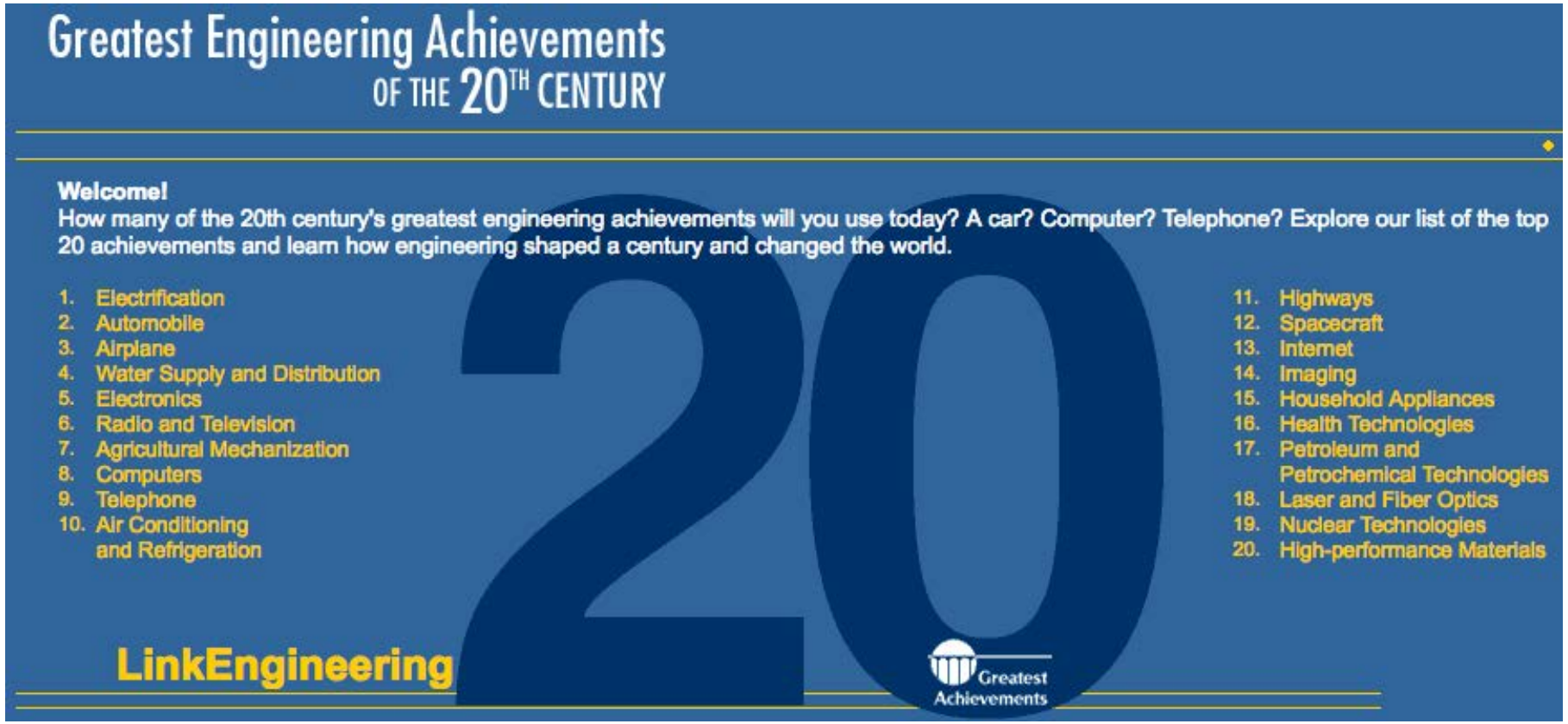
- From wikipedia.com:
  "Engineering is the application of mathematics, as well as scientific, economic, social, and practical knowledge to invent, innovate, design, build, maintain, research, and improve structures, machines, tools, systems, components, materials, processes, solutions, and organizations."
- Short version:
  "Application of science and technology to solve practical problems."
- What does this mean?...

Why is Engineering Relevant?

- What has engineering given us that is so great?

Engineering Achievements (1/2)

- National Academy of Engineering identified 20 achievements in the 20th century
  - http://www.greatachievements.org/



Engineering Achievements (2/2)

- Engineering is a "team sport"
  - Many contributions add up to large impact in many aspects of our lives
  - Innovations can impact very different areas and technologies
- Explore "timeline" on web site

Previous — Showing: Imaging — Next

1900 — Kodak Brownie camera

Eastman introduces the Kodak Brownie camera. Named after popular children's book characters, it sells for $1 and uses film that sells for 15¢ a roll. For the first time, photography is inexpensive and accessible to anyone who wants to take "snapshots." In the first year 150,000 cameras are sold, and many of the first owners are children. In the course of its long production life, the Brownie has more than 175 models; the last one is marketed as late as 1980 in England.

1913 — Hot cathode x-ray tube invented

William David Coolidge invents the hot cathode x-ray tube, using a thermionic tube with a heated cathode electron emitter to replace the cold, or gas, tube. All modern x-ray tubes are of the thermionic type.

1913 — Mammography research

Albert Solomon, a pathologist in Berlin, uses a conventional x-ray machine to produce images of 3,000 gross anatomic mastectomy specimens, observing black spots at the centers of breast carcinomas. Mammography, the resulting imaging, has been used since 1927 as a diagnostic tool in the early detection of breast cancer.

1915 — The hydrophone developed

French professor and physicist Paul Langevin, working with Swiss physicist and engineer Constantin Chilowsky, develops the hydrophone, a high-frequency, ultrasonic echo-sounding device. The pioneering underwater sound technique is improved by the U.S. Navy and used during World War I in antisubmarine warfare as well as in locating icebergs. The work forms the basis for research and development into pulse-echo sonar (sound navigation and ranging), used on naval ships as well as ocean liners.

1931-1933 — Electron microscope

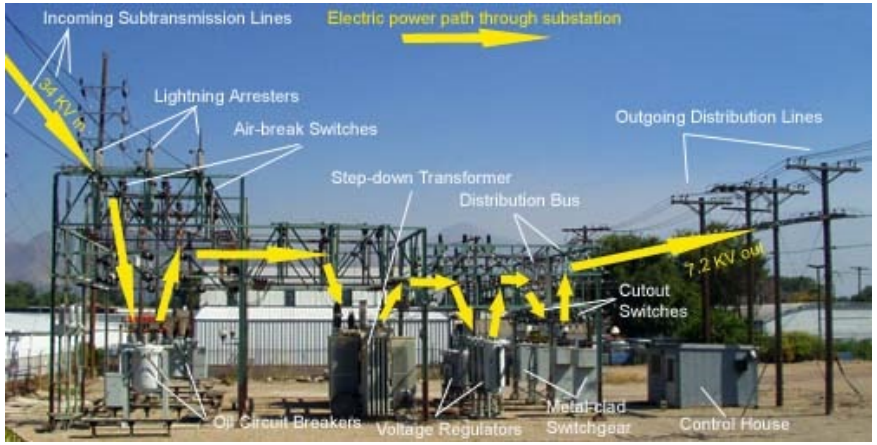
Ernst Ruska, a German electrical engineer working with Max Kroll, constructs and builds an electron microscope, the first instrument to provide better definition than a light microscope. Electron microscopes can view objects as small as the diameter of an atom and can magnify objects one million times. (In 1986 Ruska is awarded half of the Nobel Prize in physics. The other half is divided between Heinrich Rohrer and Gerd Binnig for their work on the scanning tunneling microscope; see 1981.)

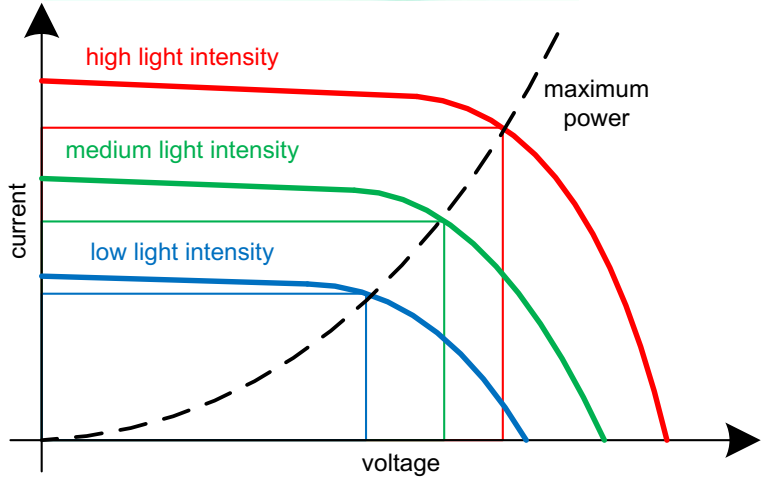
1935 — First practical radar

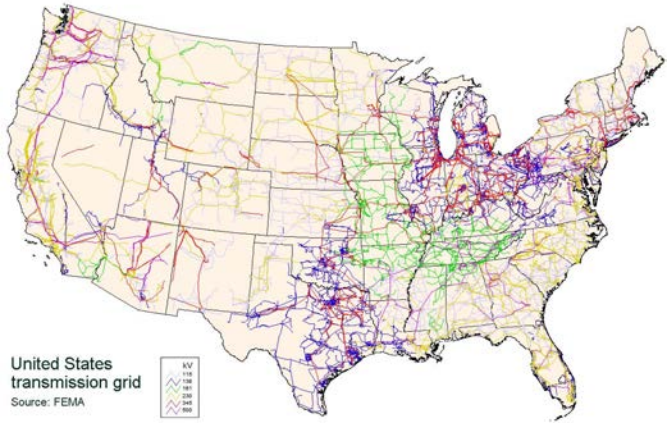
British scientist Sir Robert Watson-Watt patents the first practical radar (for radio detection and ranging) system for meteorological applications. During World War II radar is successfully used in Great Britain to detect incoming aircraft and provide information to intercept bombers.

Electrical and Computer Engineering (1/3)

- Electrical energy

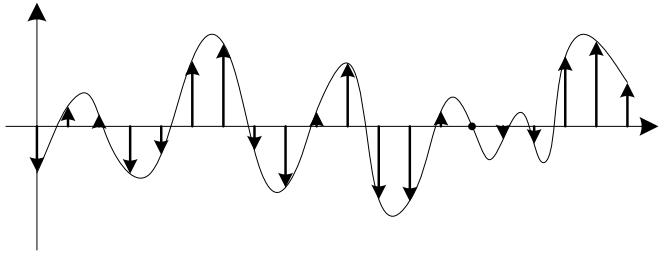


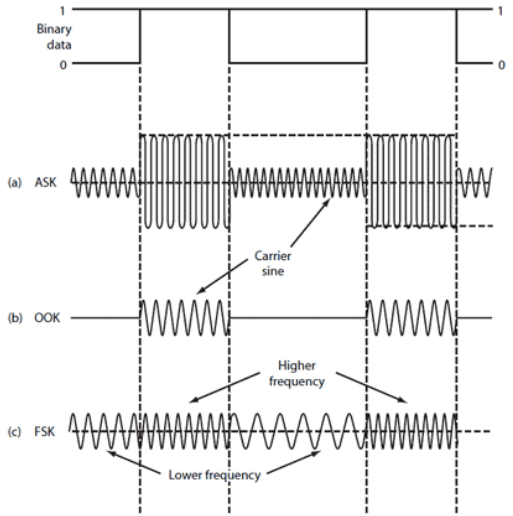


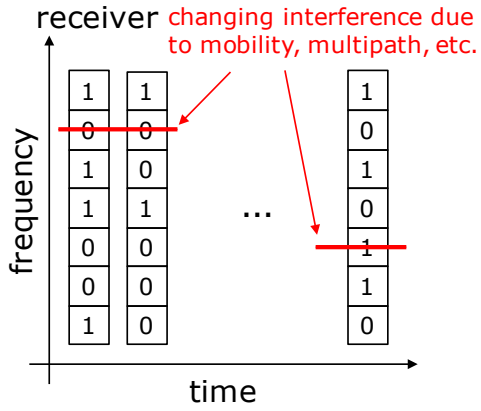


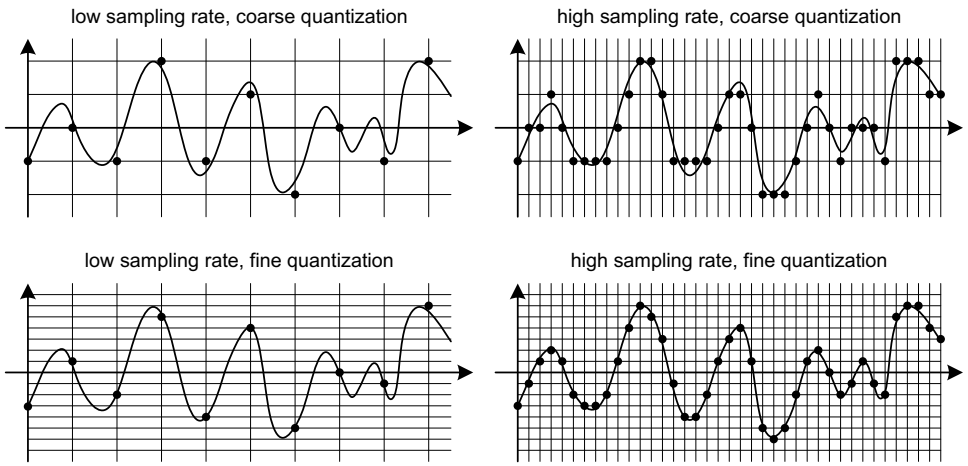
Electrical and Computer Engineering (2/3)

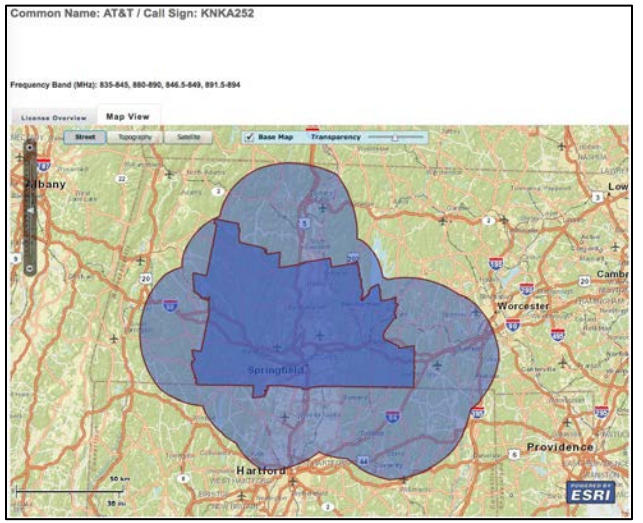
- Signals





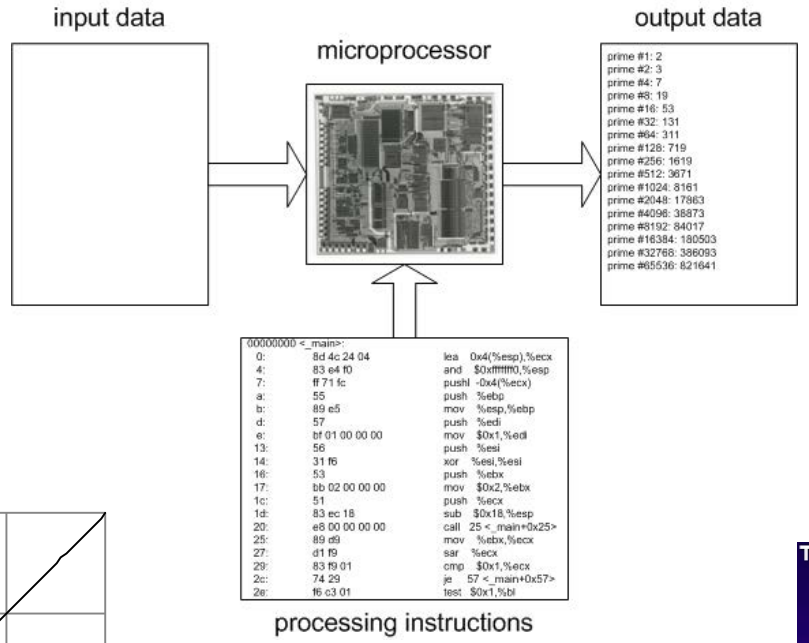


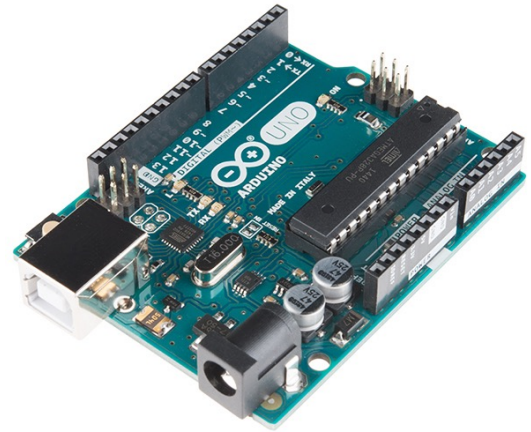


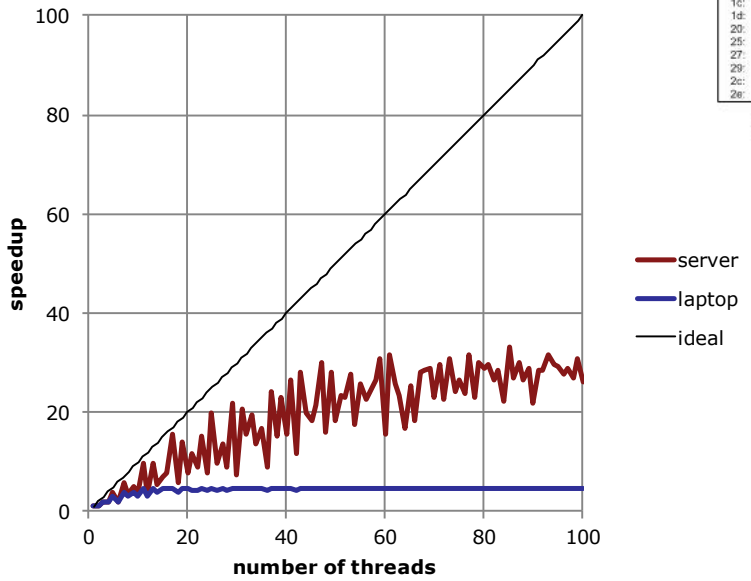


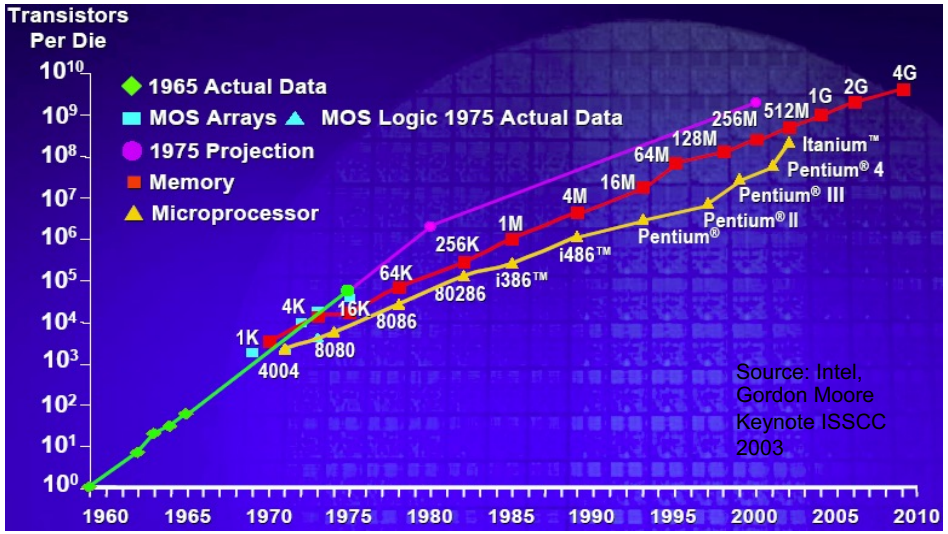
Electrical and Computer Engineering (3/3)

- Information









Course Topics

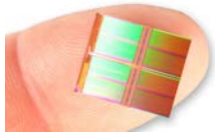
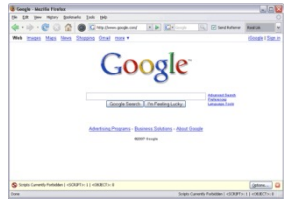
- Module 1: Digital Information and Computers
  - Big-picture system: computer / embedded systems
- Module 2: Sampling and Quantization
  - Big-picture system: MP3 player
- Module 3: Electromagnetic Signals
  - Big-picture system: analog radio
- Module 4: Wireless Communication
  - Big-picture system: cell phone
- Module 5: Feedback Control
  - Big-picture system: thermostat, self-balancing robot
- Module 6: Power
  - Big-picture system: electrical power grid





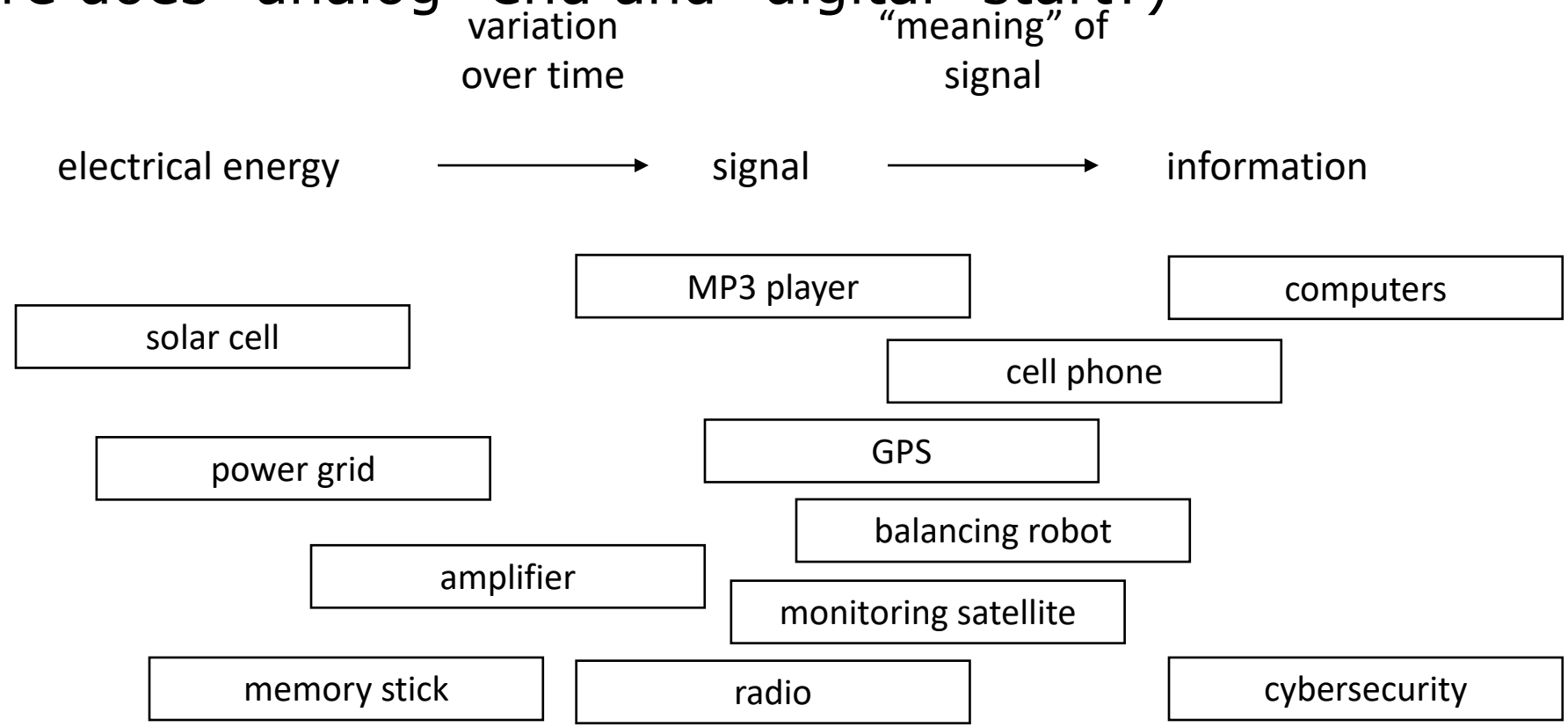
- Module 7: Optical Sensor
  - Big-picture system: digital camera
- Module 8: Signals and Timing
  - Big-picture system: Global Positioning System
- Module 9: Remote Sensing
  - Big-picture system: environmental monitoring satellite
- Module 10: Analog Circuits
  - Big-picture system: amplifier
- Module 11: Data Storage
  - Big-picture system: memory stick / disk drive
- Module 12: Cybersecurity
  - Big-picture system: Internet



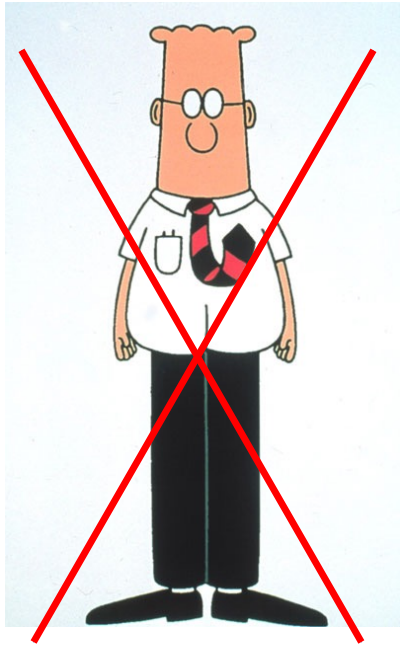
Structuring “E & C”

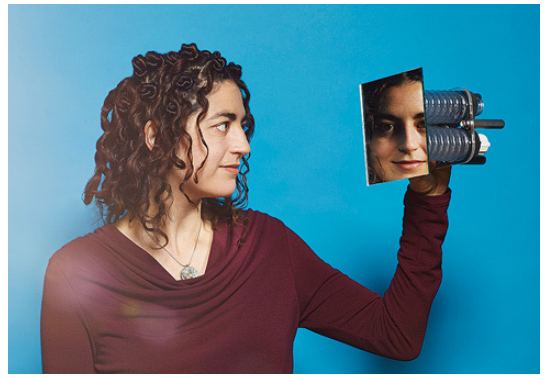
- Thinking about topics in a general structure
  - Where does “electrical” end and “computer” start? (Where does “analog” end and “digital” start?)



21st Century ECE Professionals

- ECE profession often perceived as nerdy
  - Caused by few examples overemphasized in the media
- 21st century ECE engineers are different
  - Societal impact of ECE is very high





From IEEE Spectrum "Dream Jobs 2014":

About this Course

- 12 “modules” of content
- Structure of each module:
  - Lectures
  - Discussions
  - Per-module Homework assignment (Moodle/Gradescope)
    - Work with peers, but submit your own work
  - Per-module exam (Moodle)
    - Work by yourself, no notes, etc.

Your Instructors (1/3)

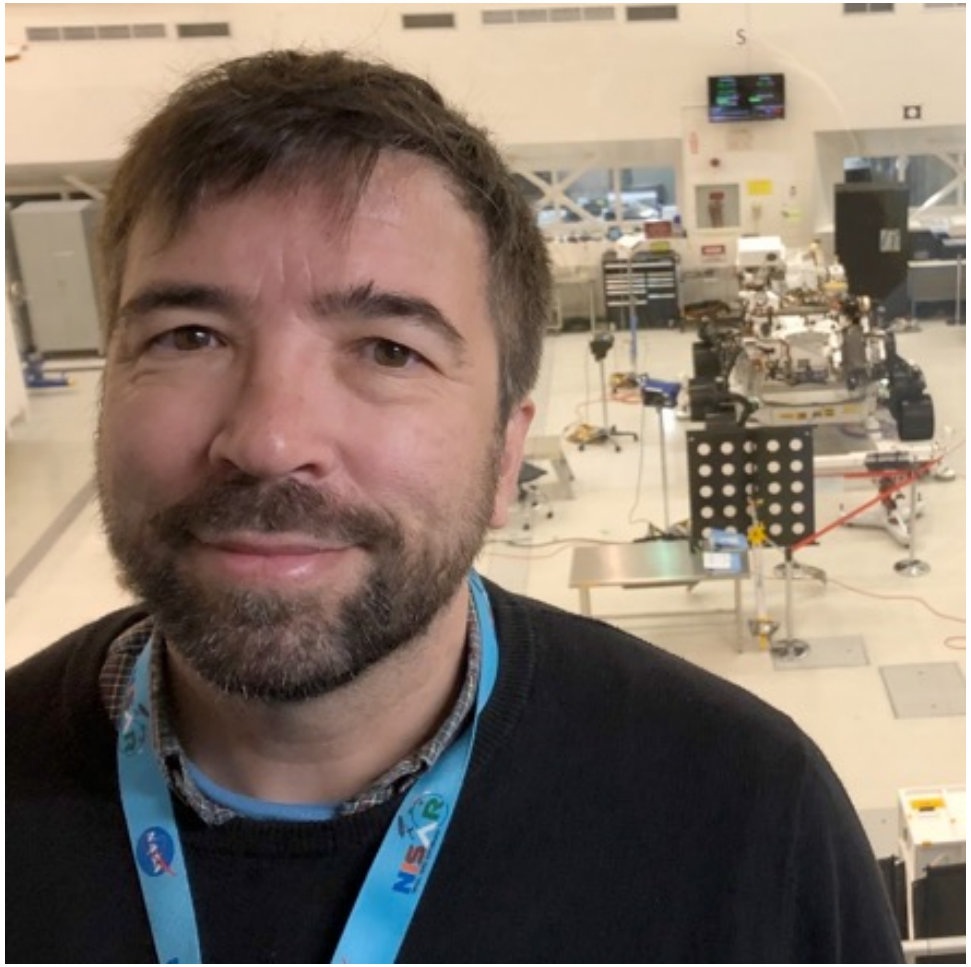
- Prof. Tilman Wolf
- Professor of ECE
- Undergrad degree from University of Stuttgart, Germany
- Ph.D. in computer science from Washington University in St. Louis
- Research area: computer network, embedded systems, cybersecurity
- Other courses: data structures and algorithms, graduate computer networks
- Contact: wolf@umass.edu

Your Instructors (2/3)

- Prof. Kris Hollot
- Department Head and Professor of ECE
- B.S. from West Virginia University
- M.S. from Syracuse University
- Ph.D. in electrical engineering from University of Rochester
- Research area: theory and application of control theory
- Other courses: senior design project
- Contact: hollot@ecs.umass.edu

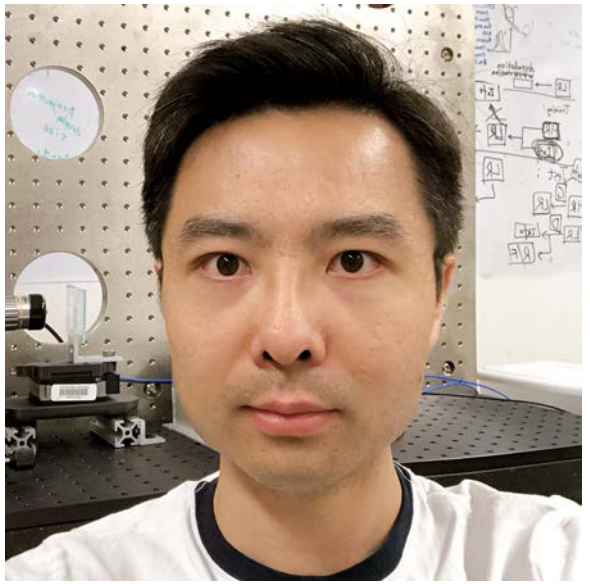
Your Instructors (3/3)

- Prof. Paul Siqueira
- Professor of ECE
- Undergrad degree from Iowa State University
- Ph.D. in electrical engineering from University of Michigan
- Research area: radar interferometry, polarimetry, micro- and millimeter-wave instrument development, and remote sensing science for terrestrial applications
- Other courses: introduction to radar systems, microwave engineering
- Contact: siqueira@ecs.umass.edu



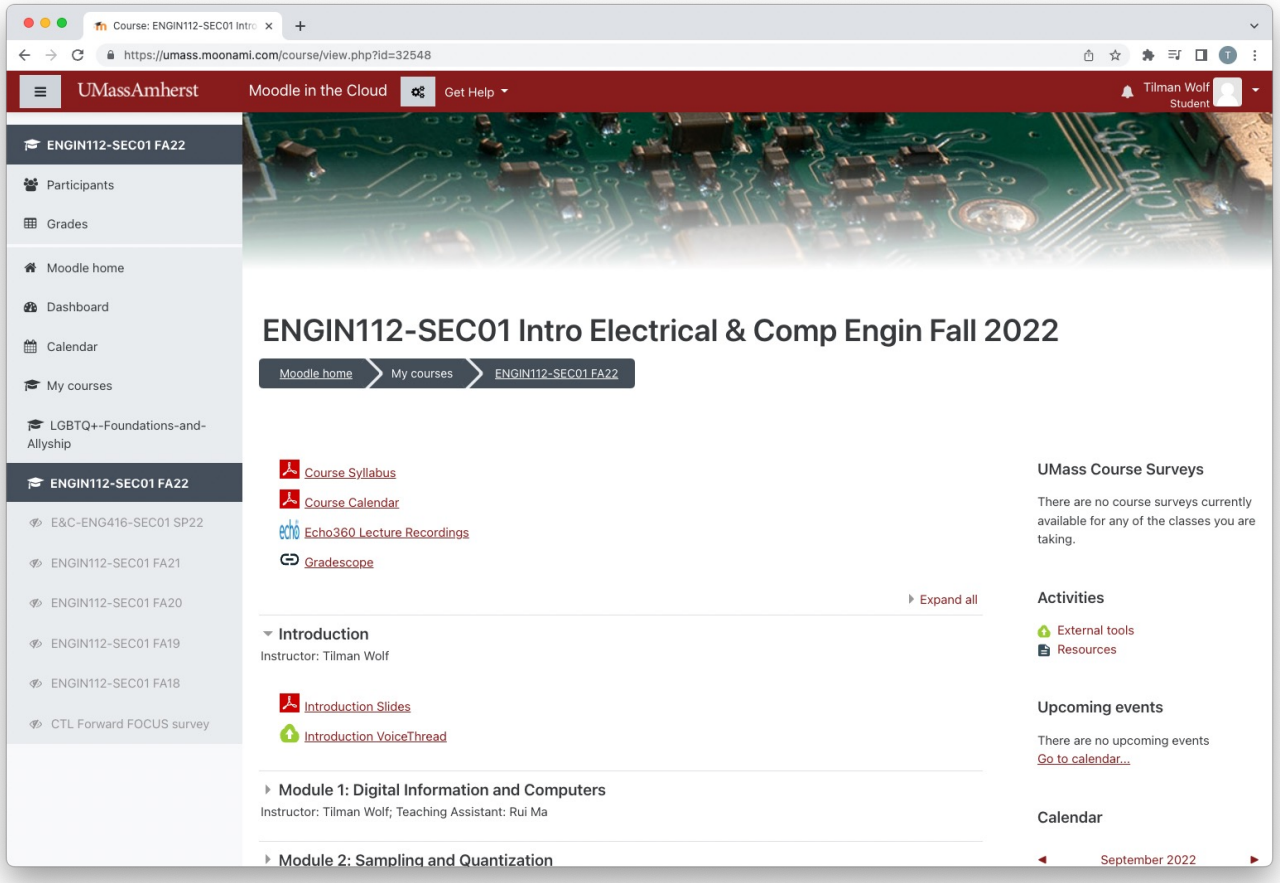
Teaching Assistants

- TAs help with this course in many ways:
  - Teach discussions
  - Grade homework
  - Manage scores on Moodle
  - Answer questions
  - Etc.
- TAs
  - Bo Guan
  - Samantha Klein
  - Rui Ma



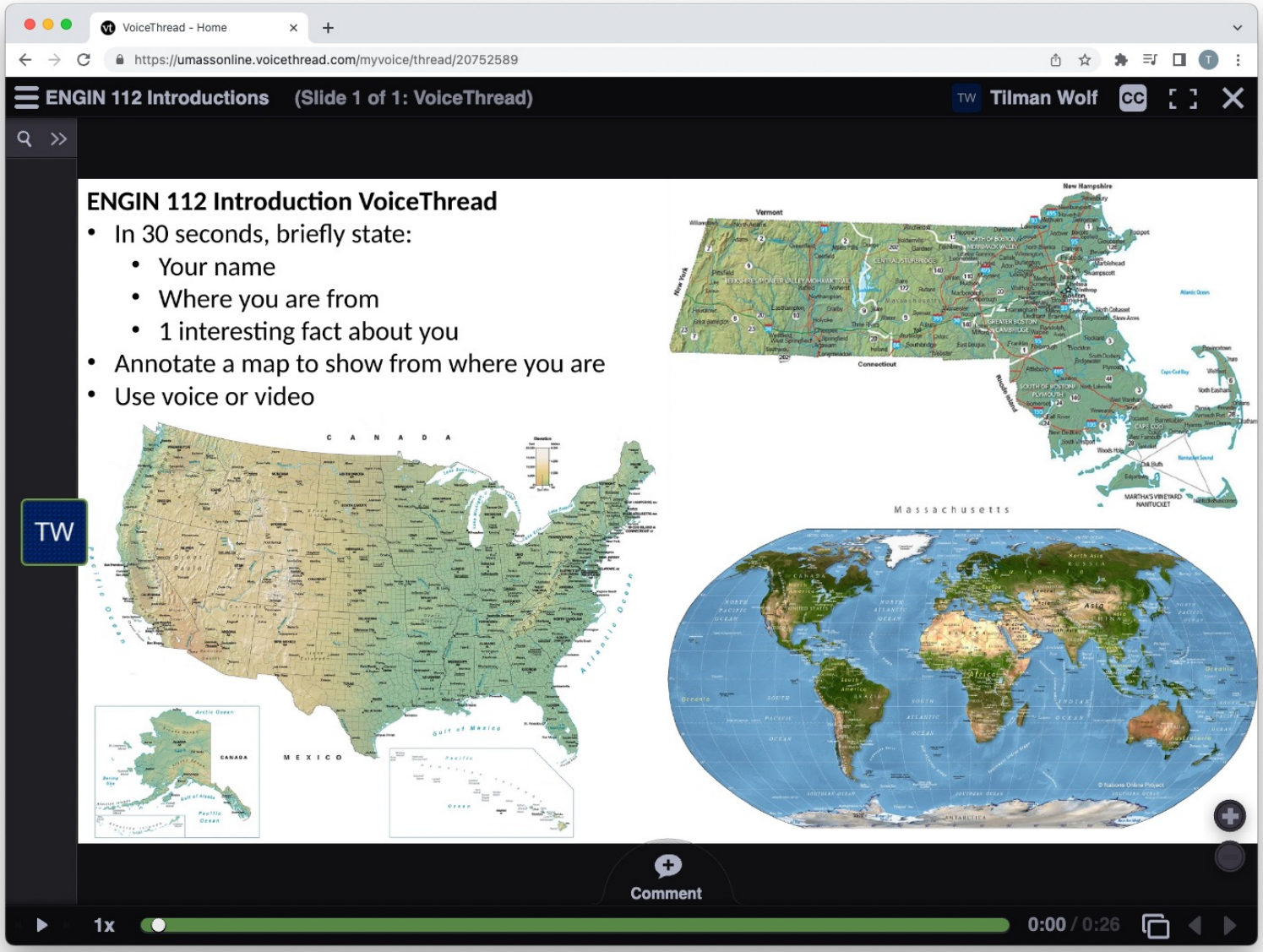
Learning Management System

- We use Moodle for this course
  - https://umass.moonami.com/



Introduce Yourself!

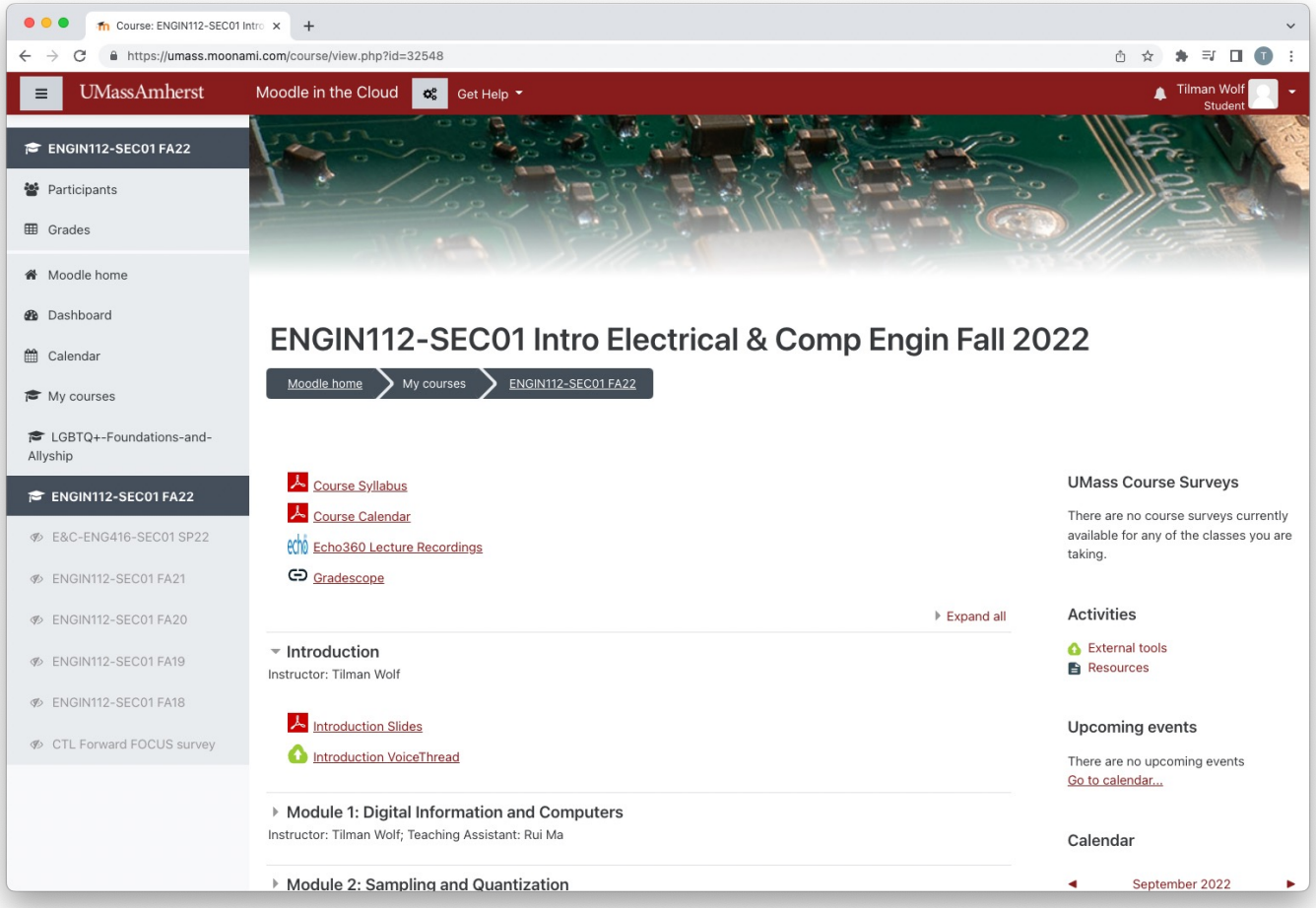
- Please record brief VoiceThread
  - Link on Moodle page



Lectures

- Lectures are held in-person
  - MWF 1:25-2:15
  - Morrill 1, N375
- Lecture recordings are available on Moodle/ Echo360:

echo Echo360 Lecture Recordings



Discussions

- In-person meeting
- Discussion focuses on Module of previous week
  - Held by Teaching Assistant
  - Please bring your questions about course material / homework
- There are no discussions this and next week
  - First discussion 9/19/2022
- Calendar with all course events on Moodle…

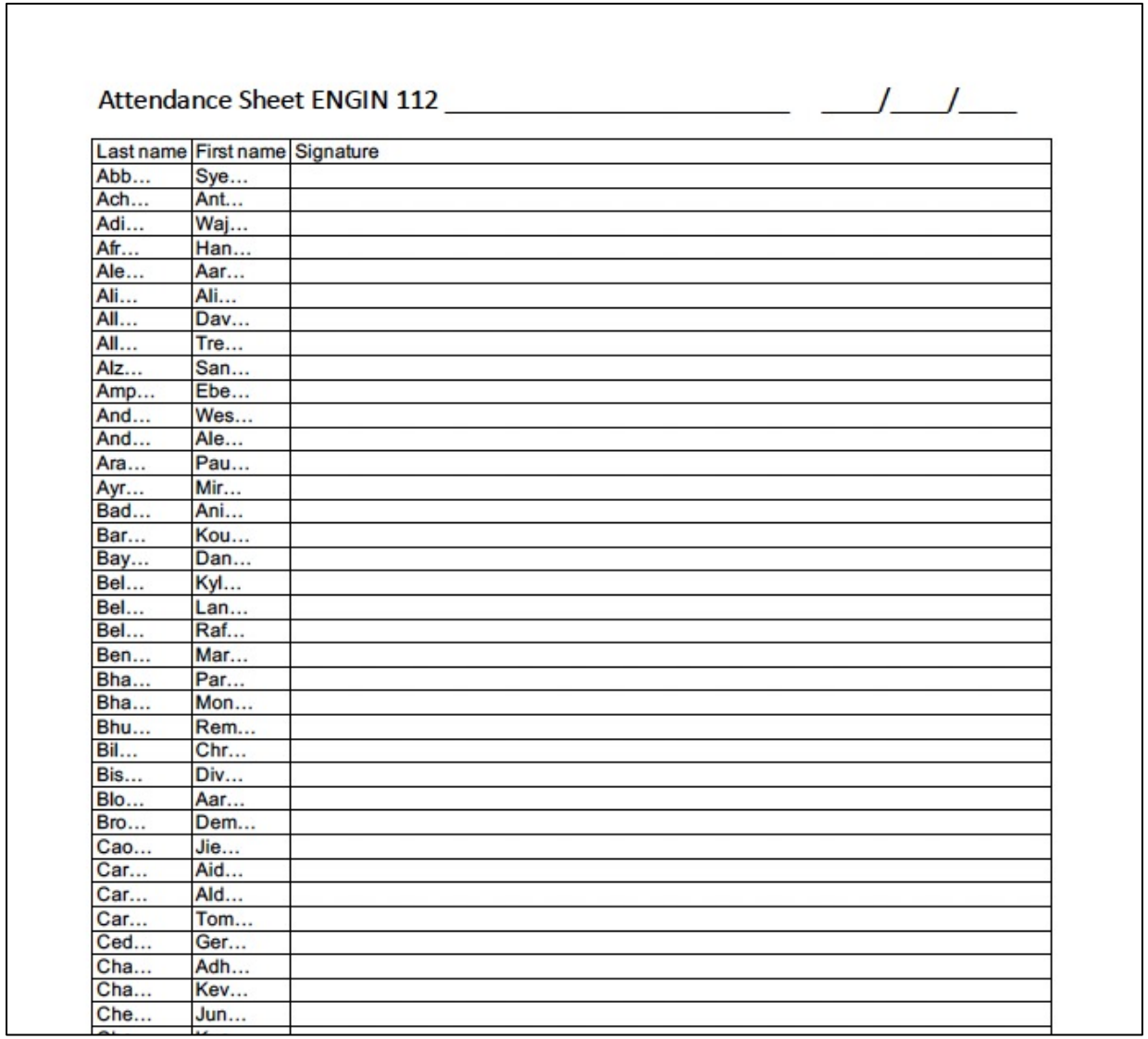
ENGIN 112 Fall 2022 Calendar

September 2022

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6 First Day of Classes No Discussions	7 Lecture: Introduction No Discussions	8 No Discussions	9 Lecture: Module 1	10
11	12 Lecture: Module 1 No Discussions	13 No Discussions	14 Lecture: Module 1 No Discussions	15 No Discussions	16 Lecture: Surprise (Elab II, room 119)	17
18	19 Lecture: Module 2 Discussions 1	20 Discussions 1	21 Lecture: Module 2 Discussions 1	22 Discussions 1	23 Lecture: Module 2 Homework 1 due	24
25	26 Lecture: Module 3 Discussions 2	27 Discussions 2	28 Lecture: Module 3 Discussions 2	29 Discussions 2	30 Lecture: Module 3 Homework 2 due	

Attendance

- Attendance is taken
  - Lectures
  - Discussions
- Record attendance by signing attendance sheet
- Attendance starts Friday

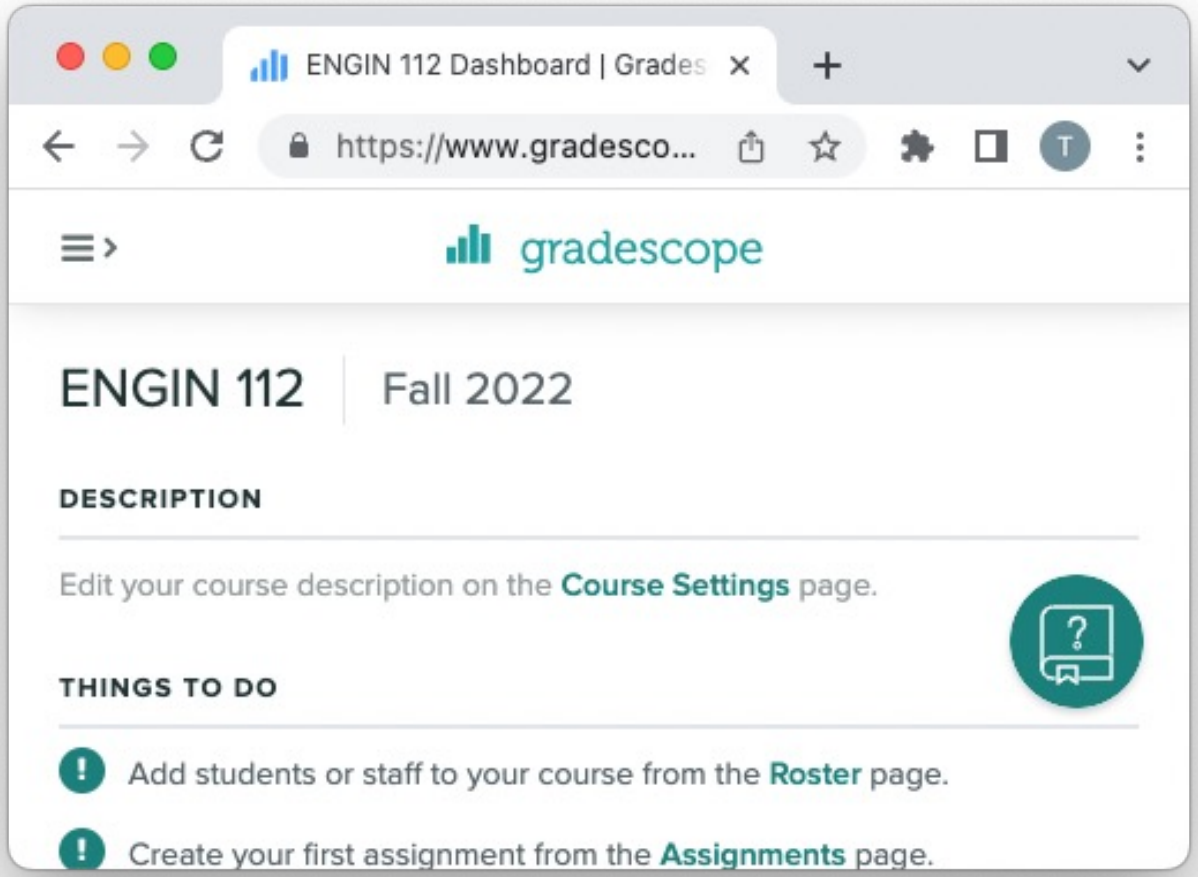


Attendance Sheet ENGIN 112 _____ ___/___/___

Last name	First name	Signature
Abb…	Sye…	
Ach…	Ant…	
Adi…	Waj…	
Afr…	Han…	
Ale…	Aar…	
Ali…	Ali…	
All…	Dav…	
All…	Tre…	
Alz…	San…	
Amp…	Ebe…	
And…	Wes…	
And…	Ale…	
Ara…	Pau…	
Ayr…	Mir…	
Bad…	Ani…	
Bar…	Kou…	
Bay…	Dan…	
Bel…	Kyl…	
Bel…	Lan…	
Bel…	Raf…	
Ben…	Mar…	
Bha…	Par…	
Bha…	Mon…	
Bhu…	Rem…	
Bil…	Chr…	
Bis…	Div…	
Blo…	Aar…	
Bro…	Dem…	
Cao…	Jie…	
Car…	Aid…	
Car…	Ald…	
Car…	Tom…	
Ced…	Ger…	
Cha…	Adh…	
Cha…	Kev…	
Che…	Jun…	

Homework

- Posted on Moodle
  - Covers material of one Module
- Submitted via Gradescope
  - Submit typed or handwritten answers via Gradescope
  - Grading results on Gradescope
  - Regrading requests via Gradescope
- Feel free to work with peers on homework assignments
  - You are expected to submit your own work!



Per-Module Exams

- Short exam via Moodle
  - Covers material of one Module
  - Questions/answers via Moodle
  - Timed exam with limited duration
- Available for one week after homework deadline
- Closed notes exam
  - You are required to take the exam by yourself without any help

Final Exam

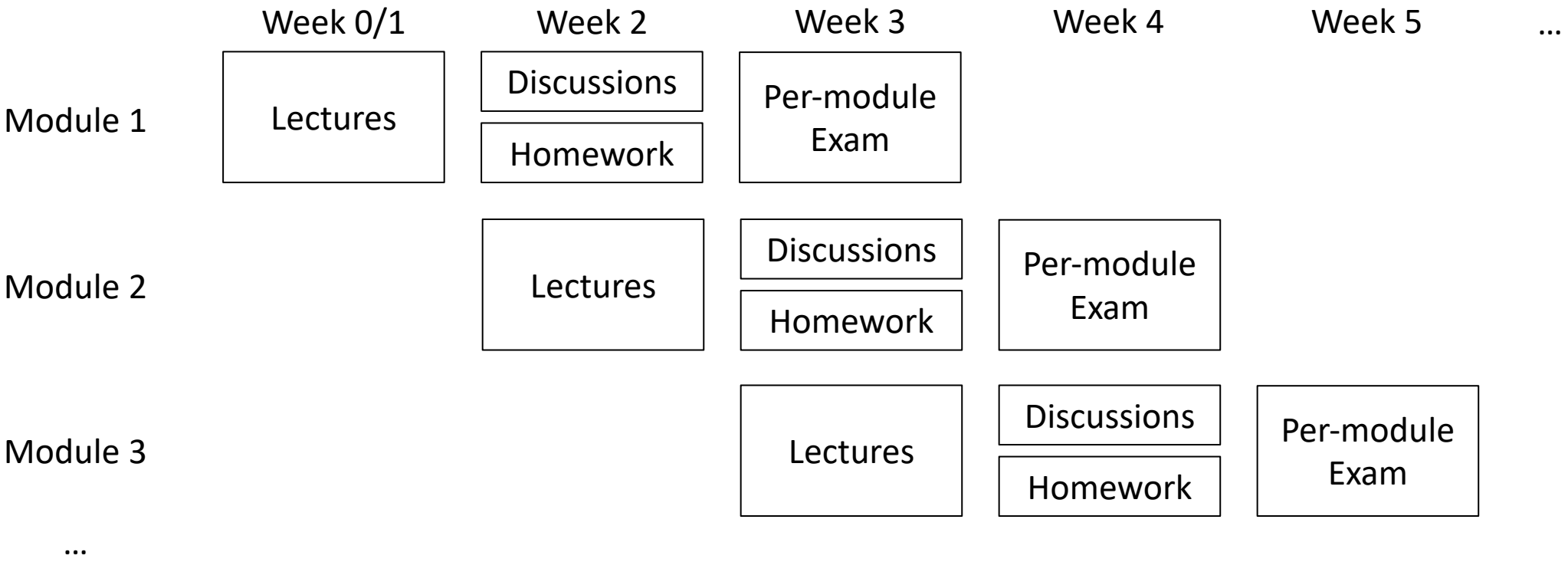
- One in-person exam covering all material

Grading

- Grade is determined by the weighted sum:
  - Attendance: 10%
    - You may miss three lectures or discussion without negative impact on grade
  - Homework: 40%
    - Lowest homework grade will be ignored
  - Per-module exams: 40%
    - Lowest per-module exam grade will be ignored
  - Final Exam: 10%

Timeline

- Modules overlap



Interactions

- We provide many opportunities for live interactions
  - Lectures
  - Discussions
  - Peer collaborations
  - Office hours
  - Email
  - Online discussion
- Engage with us and with your peers!

Important Notice!

- Lectures are recorded and posted
  - Access only within in this course
- Please be aware that your presence and participation will be visible to others in this course
- If you have any questions, please let an instructor know

Classroom Etiquette

- From Dean of Students: Campus Policies:
  "The University of Massachusetts Amherst strives to create an environment of academic freedom that fosters the personal and intellectual development of all community members. In order to do this, the University protects the rights of all students, faculty and staff to explore new ideas and to express their views. A necessary condition for these pursuits is an acceptance of the spirit of inquiry and a respect for diverse ideas and viewpoints. For true academic freedom to exist, this acceptance and respect must exist in both the overall campus environment and in the classroom. […]"
- Please be respectful in virtual and in physical environments

Diversity, Equity, and Inclusion

- Respect goes beyond the classroom…

Contacting Instructors

- If you have a question, feel free to contact us
  - Email usually works best
- A few suggestions
  - Check web site and Moodle first
  - Figure out who is most likely to have answer
    - Administrative questions: Prof. Wolf
    - Questions about modules: instructor and/or TA who teach that module
  - Use your umass.edu email address
  - Make it look professional
- Please use “ENGIN 112” in the subject line
- Please do not just send one-liners
- Expectation for response: Usually within one business day

Questions?

Friday: Module 1

- Computers
  - How computers operate
  - How computers differ (or not)
    - Functionality
    - Performance
  - Parallel computing
  - Modularity