Today

• Course details
  – Lab, Policies, Schedule (web page)
  – Course objective and strategies

• My background

• Chapter 1
  – Digital systems
  – Number systems
  – Binary (base 2) arithmetic

• Chapter 2
  – Boolean algebra
Teaching Assistants

- Terry O’Neill
  Tue lab

- Satyabrata Sarangi
  Wed lab

- Contact information is on the course web page
Course Workload

- 5 unit course
  - 18 “chapters” in 20 lectures
- New way of thinking of things will take some effort
  - Algebra: use variables
  - Calculus: no concrete solutions for indefinite integrals
  - Boolean algebra, binary math
    - Not only $a + b$, but also $a \text{ AND } b$, $a \text{ XOR } b$, ...
    - $1 + 1 = 1$
    - $3 + 6 = -7$
- Passing this course requires significant effort and time
  - (Students that have already taken ECS 154A typically find the first part of the quarter very slow but later parts challenging)
Lectures and Labs

• Lectures
  – By zoom, links are on canvas
  – All lectures and exams

• Labs
  – In person
  – Wear masks at all times
    • cover your nose and mouth
    • the university takes this very seriously
  – Follow all instructions from your TA
    – https://campusready.ucdavis.edu/instructors

Student Responsibilities
Students are expected to:

- Monitor your symptoms and stay home if you are feeling sick. Take the Daily Symptom Survey to access campus facilities.

- Be fully vaccinated before the start of classes or hold an approved exception for religious or medical reasons. Additional time is granted to students who will have had no access to a vaccine before arriving on campus.

- Wear face coverings indoors and in mass transit. Unvaccinated students must also wear face coverings outdoors in crowded places.

- Test regularly as directed by campus guidelines. Testing is available at the ARC Testing Kiosk in Davis and at the Administrative Services Building in Sacramento. Students will face disciplinary action if they are out-of-date with testing requirements.

- Eat only in designated areas and never in classrooms. Students may remove their masks very briefly to drink while in class.
Lectures

• Ask questions at any time
  – Please raise your hand
  – Ask a question at any pause (zoom)

• Be respectful of others
  – Hold conversations outside of class
  – Silence phones
  – Sit in the back if you come in late or need to leave early
Course Communication

• In class during lecture
• Canvas announcements → Email
  – Time-critical announcements only
• Web page
  – Primary source of course information
• Office hours
  – Posted on the course web page
  – Let me know by the second lecture if you have a conflict
• Please see me (or TA) in person or by zoom with questions rather than email
My Teaching Philosophy

• Primary goal (mine and yours):  
  \textit{Learn digital system design well}

• Achieve this through:
  – Reading textbook
    • Objectives, Study Guide, Reading, Problems
    • Book is very complete, designed for self-study
  – Lectures
  – Solving problems on paper (homework)
  – Solving problems and building things in lab
  – Discussions with other students, TAs, myself
Grading Philosophy

- Grading serves two main purposes:
  1. Motivate you to do the work required to learn
     - Reading textbook (quizzes)
     - Lectures (quizzes)
     - Solving problems in homework (exams)
     - Solving problems in labs (lab grading, exams)
     - Discussions with others
  2. Give others an indication of how well you know the material
I assign a letter grade only for the final course grade.

You can see score statistics for each graded item on Canvas.

I look at the final exams and course record of the class and assign two key dividing points: the A/A+ and D+/C- boundaries, and assign course grades from there using equally-sized intervals.

- No required numbers of any particular letter grades.
- Absolute scores are not important; the boundaries shift according to the difficulty of the exams in any quarter.
- In fact, easy exams cause large grade drops for small errors.
- Ignore any letter grades you might see on Canvas.

Letter Grade Assignments

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Fail</td>
</tr>
<tr>
<td>D-</td>
<td>Below Average</td>
</tr>
<tr>
<td>D+</td>
<td>Average</td>
</tr>
<tr>
<td>C-</td>
<td>Above Average</td>
</tr>
<tr>
<td>A/</td>
<td>Excellent</td>
</tr>
<tr>
<td>A+</td>
<td>Outstanding</td>
</tr>
</tbody>
</table>

(not actual grade data)
Working With Others

• Collaboration
  – Asking questions and explaining principles produces better work and dramatically increases learning
  – Working with others
    • Do homework and prelabs with classmates nearby
    • Ask each other questions, help each other—regarding principles, and approaches to solving only
  – See Course Collaboration Policy on web page

• Dishonesty
  – Copying produces similar work, stunts learning, is not fair to honest students, and is not allowed in this course
    • Students engaged in dishonest work will be referred to Student Judicial Affairs
    • I will try to keep in-class exams honest
    • Steps will be taken to keep out of class work honest
Penalties for Violating the *Policy on Student Conduct and Discipline*

- **Penalties**
  - Minimum penalty: meetings with SJA officer, zero grade on work, record with SJA
  - Permanent F grade on your transcript, no credit for the class
  - One to three quarter suspension from the university
  - Permanent dismissal from all ten campuses of the University of California. Permanent notation on your transcript.
Penalties for Violating the *Policy on Student Conduct and Discipline*

- Several perspectives
  - Personal obvious reasons
  - ECE and UCD (especially for those inclined to share work with someone doing poorly in class)
    Cheating harms our major and university’s reputation among employers who interview our graduates.

- In summary: The purpose of the penalties and me mentioning them is so that no one will get one!!! Don’t do anything that violates the Policy on Student Conduct!
Penalties for Violating the *Policy on Student Conduct and Discipline*

- **Typical scenario:**
  - Someone shares code/design with another
  - They get caught
  - The “Copier” feels terrible guilt for causing a friend to get a zero
  - The “Sharer” deeply regrets sharing resulting in a zero when he/she should have had a full score
Cheating Websites
chegg, coursehero, etc.

• The university has recently taken a very strong stand against paying for work (2-quarter suspension for first offense last year)

• Key take-away messages:
  – Do not post assignments
  – Of course do not use any unpermitted outside material in work you submit
  – Of course do not post solutions
  – Two students did last year and got caught!!!
Submitting Work

• Unless announced otherwise, materials due must be submitted through canvas as instructed
• Only pdf format
  – It greatly simplifies grading
• Homework drop box on the second floor of Kemper
Course Web Page

http://www.ece.ucdavis.edu/~bbaas/18/

• This link is posted on the canvas home page
Lab Items NOT To Buy

- Four-module-wide protoboard
My Background

• My education
  – Westmont College  Physics
  – Cal Poly, San Luis Obispo  Mechanical/Electrical Engineering
  – Stanford  Electrical Engineering

• My research
  – VLSI (chip) design
  – Processor architectures
  – Digital signal processing (DSP) algorithms

• Work experience
  – Mechanical engineering internships
  – Hewlett-Packard, Computer Systems Division
  – Atheros Communications
Areas of Research

- Processor architectures
  - Programmable
  - Special-purpose
- DSP algorithms
- Circuits
- VLSI design
- Software tools and applications

\[ G_c(m,n) = \alpha(m) \sum_{i=0}^{N-1} \left\{ \alpha(n) \sum_{k=0}^{N-1} g(i,k) \cos \left( \frac{\pi(2k+1)n}{2N} \right) \cos \left( \frac{\pi(2i+1)m}{2N} \right) \right\} \]
Advancing CMOS Technologies

- Moore’s “Law” (Observation) was made in 1965 and notes that transistor density doubles every year (every 1.5 years now)
Moore’s Law – The number of transistors on integrated circuit chips (1971-2018)

Moore’s law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important as other aspects of technological progress – such as processing speed or the price of electronic products – are linked to Moore’s law.

GC2: 16 nm, 23.6 billion transistors

The data visualization is available at OurWorldinData.org. There you find more visualizations and research on this topic.

Licensed under CC-BY-SA by the author Max Roser.
Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten
New plot and data collected for 2010-2015 by K. Rupp
New data added by B. Baas
Note: Each processor capable of independent program execution
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Consumer Products’ Trends

- Analog based → Digital based
  - Music: records, tapes → CDs, MP3s
  - Video: VHS, 8mm → DVD, Blu-ray, H.264, H.265
  - Telephony: analog mobile (1G) → digital (4G, LTE,…)
  - Television: NTSC/PAL → digital (DVB, ATSC, ISDB, …)
- Many products use digital data and “speak” digital: computers, networks, digital appliances
Consumer Products’ Trends

• Analog based vs. Digital based
  – iPhone apps???
Future Applications

• Very limited power budgets
• Require significant digital signal processing