What is this class about?

Introduction to digital integrated circuits.

What will you learn?
- Understanding, designing, and optimizing digital circuits with respect to different quality metrics: cost, speed, power dissipation, and reliability
Practical Information

- **Instructors:**
  - Jan Rabaey
    - 511 Cory Hall, 3-8206, jan@eecs.berkeley.edu
    - Office hours: Mo 1:30-3pm (231 Cory); Tu 11-12:30pm (511 Cory)
  - Bora Nikolic
    - 570 Cory Hall, tbd, bora@eecs.berkeley.edu
    - Office hours: Mo 11-12:30pm; We 2-3:30pm

- **TAs:**
  - Rhett Davis, wrdavis@EECS.Berkeley.EDU - Office hours: W 12:30-2pm (297 Cory)
  - Vikram Shenoy, vshenoy@cory.EECS.Berkeley.EDU - Office hours: (297 Cory)
  - David Wang, dwang@joy.EECS.Berkeley.EDU - No Office Hours
  - Englin Yeo, yeo@cory.EECS.Berkeley.EDU - Office hour: M 5-6:30pm (297 Cory)

- **“The Paperless Class”**
  - http://infopad.eecs.berkeley.edu/~icdesign/ee141

Discussions & Labs

- **Discussion Sessions - flexible assignment**
  - M 4-5pm; 405 Davis; Englin Yeo;
  - W 4-5pm 285 Cory; Rhett Davis;

- **Labs - 353 Cory!**
  - Tu 3-6 pm (TBA),
  - We 11-2 pm (TBA),
  - Th 3-6 pm (TBA),
  - Fr 11-2pm (TBA)
Class Organization

- +/- 10 assignments
- One Integrated Design Project with 2 deliverables
- Laboratories:
  » 7 software labs
  » 2 hardware labs
- 2 midterms; 1 final
  » midterm1: Th 9/23; midterm2: Th 10/29
  » final: Fr 12/10 (8-11am)

Grading Policy

- Homeworks: 10%
- Labs: 10%
- Projects: 20%
- Midterms: 30%
- Final: 30%
Class Material

- Class notes: Web page (New stuff!) + http://infopad.eecs.berkeley.edu/~icdesign/instructors.html
- Lab Reader; Available on the web page! Selected material will be made available from Copy Central
- Check web page for the availability of tools

New Software

- Micromagic “max” and “sue”
  » A modern version of the good ol’ magic
  » On-line documentation and tutorials
- HSPICE and IRSIM for simulation
Getting Started

- Assignment 1: Getting SPICE to work - see web-page
- NO discussion sessions or labs this week.
- First discussion sessions in Week 2
- First Software Lab in Week 3

Digital Integrated Circuits

- Introduction: Issues in digital design
- The inverter - CMOS
- Combinational logic structures
- Sequential logic gates; timing
- Arithmetic building blocks
- Interconnect: R, L and C
- Memories and array structures
- Design methods
Introduction

The First Computer

The Babbage Difference Engine (1832)
25,000 parts
cost: £17,470
ENIAC - The first electronic computer (1946)

The Transistor Revolution

First transistor
Bell Labs, 1948
The First Integrated Circuits

Bipolar logic
1960’s

ECL 3-input Gate
Motorola 1966

Evolution in Complexity
Evolution in Transistor Count

Evolution in Speed/Performance
Major challenges in digital design

- The large
  » Complexity
- And the small
  » Very-high speed design (> 1 GHz)
  » Power dissipation
  » Interconnect
  » Clocking

Intel 4004 Micro-Processor
Intel Pentium (II) microprocessor

Die Area: 2.5x2.5 cm
Voltage: 0.6 V
Technology: 0.07 μm

Silicon in 2010

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The Challenge

A growing gap between design complexity and design productivity

Design Abstraction Levels