Introduction to Computer Engineering

CS/ECE 252, Fall 2015
Computer Sciences Department
University of Wisconsin – Madison

Karu Sankaralingam

This Course

This course will:

- Help you understand the significance and pervasiveness of computers in today’s society and economy
- Teach you how computers really operate and how they are designed
- Introduce you to concepts that students in the Computer Sciences and Computer Engineering degree program learn in depth over four years
- Prepare and motivate you for study in this degree program
- Will count towards GCR introduction to engineering requirement

Two Big Components

- What is a computer and how to build a computer?

- How to program a computer?

Course Outline

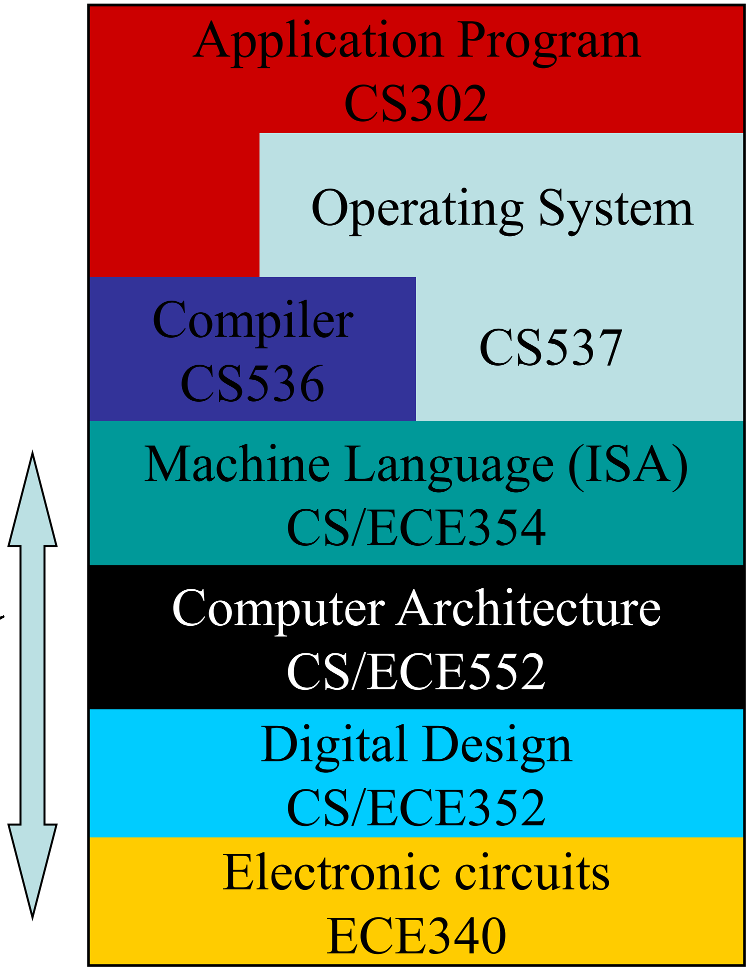
- **Prerequisite** – none
- **Major topics in course**
  - Programming
  - Numbers and representation
  - Machine language
  - Machine encoding
  - Microarchitecture – how a computer works
  - Digital logic

Abstraction and Complexity

- Abstraction helps us manage complexity
- Complex interfaces
  - Specify what to do
  - Hide details of how

- Goal: Use abstractions yet still understand details

Scope of this course



Go Over Web Page

http://www.cs.wisc.edu/~karu/courses/cs252/fall2015/

Contact Info

Course Calendar

Texts and References

Computing

Grading

Homework

Exams

Piazza Discussion

Textbook

- discovering.cs.wisc.edu
- In-browser programming and homework submission
- Login with netid

Grading

- Homework: 30%
  - 8 equally weighted (we will drop lowest of them)
- Four mid-terms: 70%
  - Equally weighted

September 28, Monday	**Midterm I (Ch. 1-3)**
October 26, Monday	**Midterm II (Ch. 4-5)**
November 23, Monday	**Midterm III (Ch. 6-7)**
December 14, Monday	**Midterm IV (Ch. 8)**

Advice

- **Textbook** – read BEFORE corresponding lecture
- **Lecture** – attend!
  - book does NOT have all the material
- **Homework** – best completed in *study groups*
  - Will reinforce in-class coverage
  - Will help you prepare for midterm exams
- **Study Groups**
  - Groups of 2-3
  - Should meet weekly, learn from each other
  - Review material & discuss homework assignments
  - Each student should *submit* his/her own homework

Logistics

- YOU play the biggest role in your grade!
- Participate in class!
  - There are no “bad” questions or answers
- No late homework
  - Lowest of eight dropped
- Don’t come late to class
- My office hours: 11:50 to 1pm M,W,F

TAs

- Angie Lin
- Kai Zhao
- William Galliher

- Total 9 hours of office hours; use for help on material, homeworks

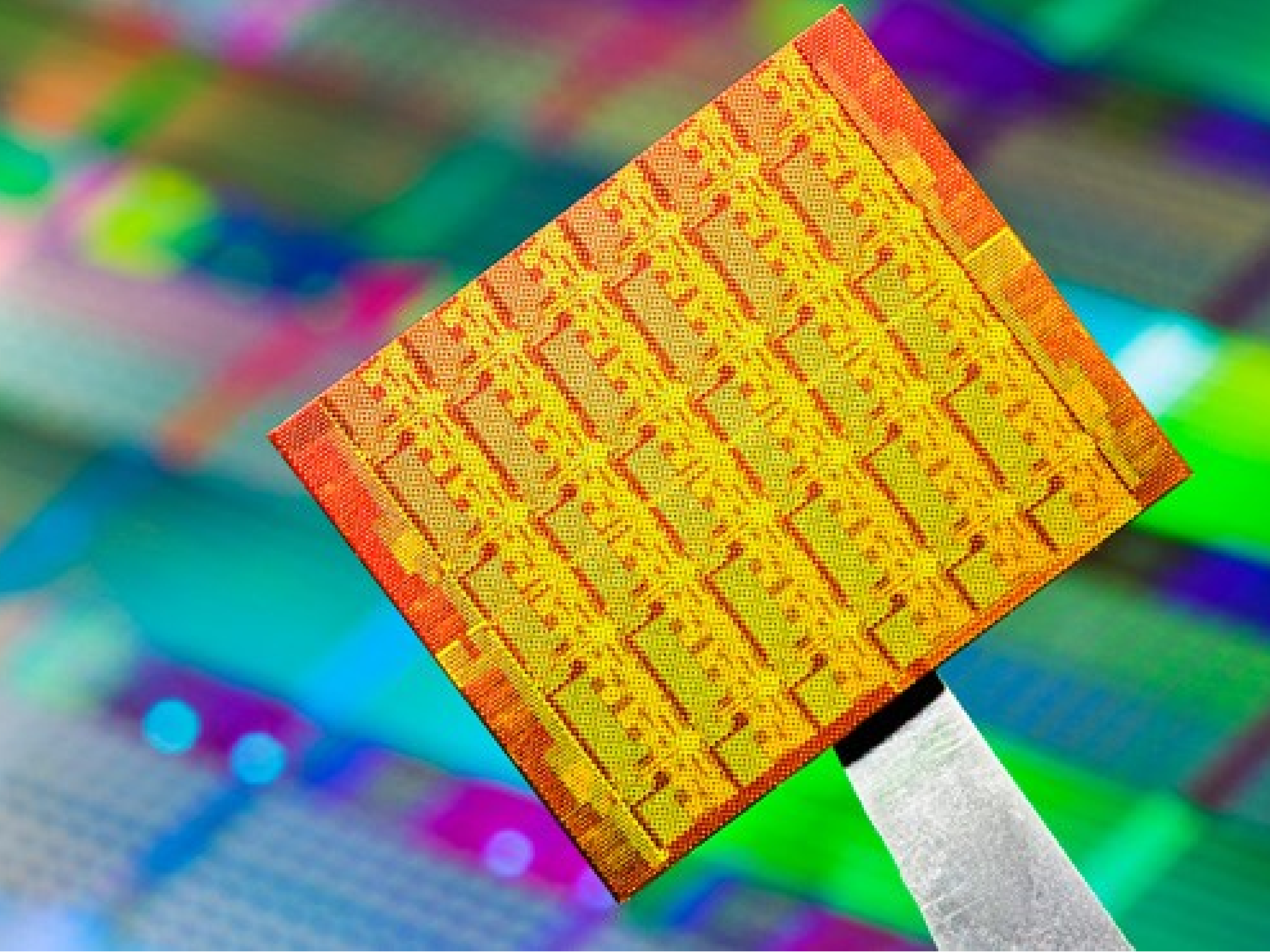
Lets write out first program!

```
from googlemaps import Client
api_key = "AIzaSyADna65ndIZRBBvx-V213ZLqHxO5KMyApY"
gmaps = Client(api_key)
origin = "1210 W. Dayton St., Madison, WI"
destination = "1605 Linden Dr, Madison, WI"
d = gmaps.directions(origin, destination)

print d.distance

for x in d.steps
    print x['html_instructions']
```

intel®
Xeon® 7500
E44476 01 IC3
0080



New materials Extend Performance of 90nm Planar Transistors

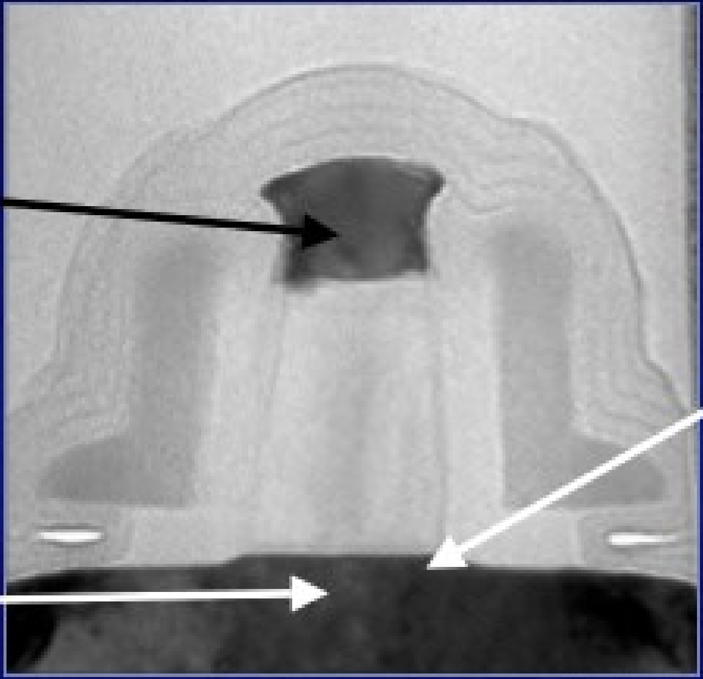
Changes made

Gate

Silicide added

Channel

Strained silicon



Transistor

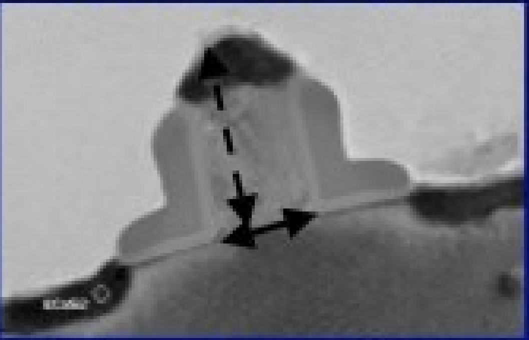
Future options

High-k gate dielectric

New transistor structure

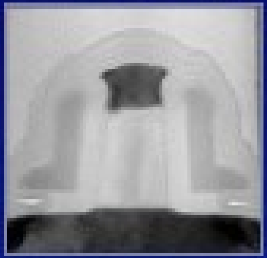
Accelerated Scaling of Planar Transistors

130nm Node



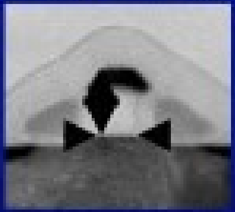
70nm Length
(Production2001)

90nm Node



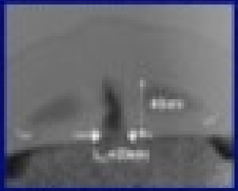
50nm Length
(Production in 2003)

65nm Node



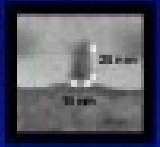
30nm Prototype
(Production in 2005)

45nm Node



20nm Prototype
(Production in 2007)

32nm Node



15nm Prototype
(Production in 2009)

Intel

Two Big Components

- What is computer and how to build a computer?
- How to program a computer?
- Main idea: Abstraction

Next Class & Announcements

- Read Chapter 1 *BEFORE* class
- Chapter 1 – overview
- HW-1 assigned; due Sep 11th.

CS/ECE 252 Lecture 1: Programming 2015 September 2

Course Introduction:

- Instructors:
    - Professor:
        - Karu Sankaralingam; CS 6367; MWF 11:50 - 1:00
    - TAs:
        - Annie Lin; CS 6352; M 1:30-3:00; W 3:20-4:50
        - William Galliher; CS 7367; MWF 2:30 - 3:30
        - Kai Zhao; CS 1308; TR 12:45 - 2:15 + open office hours + appointment
- This course help you understand what are computers and what computers help you do
- Exposure to computer science and computer engineering
- 4 credits
- Two big components: What is a computer? How to program a computer?
- Prerequisites: none
- Topics:
    - Programming
    - Number representation: everything is represented in 0's and 1's
    - Machine encoding: how a computer represents a program
    - How computers are built
    - Digital logic: transistors could be on or off; transistor == boolean logic
    - Abstraction: use transistor to build logic gates, use gates to build circuits, use circuits to build processors

Course Logistics:

- Web page: http://pages.cs.wisc.edu/~karu/courses/cs252/fall2015/wiki/index.php
- Book: http://discovering.cs.wisc.edu/text/box.xml
- Homework: Submit online via Learn@UW
- Piazza: https://piazza.com/class/ie0hgwa9s8k623

- Grades:
    - 30%: 8 homeworks weighted equally, lowest dropped
    - 70%: 4 midterms weighted equally

- Advice:
    - Read textbook before corresponding lecture
    - Attend lecture
    - Ask questions
    - Form study groups

Program Example:

- Get directions from googlemaps
    - Set up client using api key
    - Get directions
    - For loop to print turn by turn directions

- Laptop connects to router
- Router connects to data center
- Data center has racks of computers
- Computers have microprocessors
- Microprocessors have transistors

Moore's law: number of transistors in an integrated circuit doubles every 1.5 years

- Shrinking transistors
    - Can have more transistors
    - Faster switching
    - Cheaper

Assignment:

- Read chapter 1 before next class, Friday Sep 4th.
- Homework 1
    - Assign on Friday Sept 4th
    - Due on Friday Sept 11th