Introduction to Computer Engineering

CS/ECE 252, Spring 2013
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Computers Everywhere

- Cell phone
- Laptop
- Tablet
- Servers for Facebook, Twitter, Instagram, etc.

- All Computers
- Software/Hardware separation key

Computers!

- Engineers and scientists of all disciplines rely on computers for many aspects of their work
  - Not just word processing, spreadsheets, CAD, etc.
  - Computational methods, data mining, analysis/synthesis are fundamental to advances in many fields
- Many of the advanced techniques used in today's microprocessors were invented right here at UW
- Some of the most renowned computer design researchers in the world are on our faculty
- There is a near-100% likelihood that a Wisconsin graduate helped design the computer or processor that you own

Phenomenal Growth

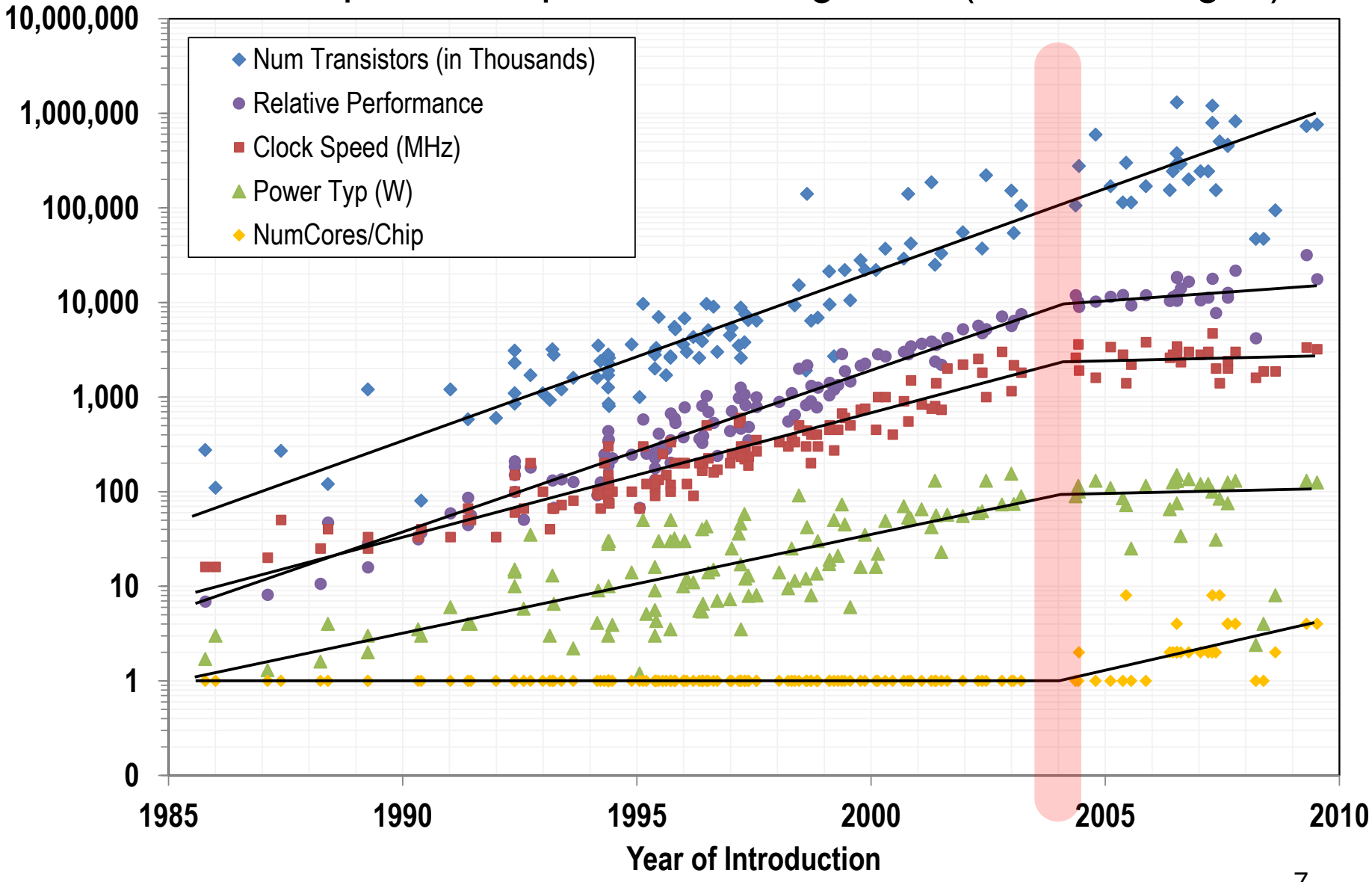
- 8MB Disk Pack
- Iphone (64GB Flash)
- (64GB/8MB = 8,000x)

- Computer useful & then 8,000x better!

$16 base; 60% growth

Year	Salary	Comments
0	$16	Base
3	$64	Still live at home
15	$16K	Buy car
24	$100K	Buy house
36	$300M	Need fundamentally new ways to spend money

Decades of exponential performance growth (but challenges)



Source: Future of Computing Performance: Game Over or Next Level?, National Academy Press, 2011
Mark Hill talk (http://www.cs.wisc.edu/~markhill/NRCgameover_wisconsin_2011_05.pptx)

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 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

Go Over Web Page

http://pages.cs.wisc.edu/~sohi/cs252/Spring2013/

Instructor & TAs

Textbook

Lecture Notes

Schedule

Computing and Simulator

Grading

Exams

Homework

Course Outline

- **Prerequisite** – none
- **Major topics in course**
  - Introduction to computers and computing
  - Information representation and manipulation
  - Logic elements and combinational Logic
  - Sequential Logic and Memory
  - Simple computer organization, design and operation
  - Machine language and instruction set architecture
  - Assembly language
  - Programming constructs

Advice

- **Textbook –** read BEFORE corresponding lecture
- **Homework –** completed in *study groups*
  - Will reinforce in-class coverage
  - Will help you prepare for midterm exams
- **Study Groups**
  - Groups of 2, should meet weekly, learn from each other
  - Review material, complete homework assignments
  - Each submitted homework should include consensus-based statement of work

Sample Homework Stats

	SP10-1	SP10-2	F10	F11
HW 1	103.1	103.6	103.7	93.7
HW 2	91.3	87.4	83.8	92.7
HW 3	97.0	94.3	89.2	82.0
HW 4	91.6	88.9	69.6	88.4
HW 5	89.7	82.5	85.2	88.2
HW 6	73.1	70.1	74.9	89.1
HW 7	74.6	68.8	94.2	58.1
HW 8	89.5	70.2	74.6	73.9

Sample Exam Stats

Exam	SP10-1	SP10-2	F10	F11
Exam I	90.8	88.0	80.9	87.2
Exam II	82.5	79.1	85.6	83.8
Exam III	77.2	70.5	67.8	64.0
Exam IV	77.9	74.3	75.3	76.0

Technology

- Technology advances at astounding rate
  - 19th century: attempts to build mechanical computers
  - Early 20th century: mechanical counting systems (cash registers, etc.)
  - Mid 20th century: vacuum tubes as switches
  - Since: transistors, integrated circuits
- 1965: Moore's law [Gordon Moore]
  - Predicted doubling of capacity every 18 months
  - Has held and will continue to hold
- Drives functionality, performance, cost
  - Exponential improvement for 40 years

Applications

- Corollary to Moore's Law:
  Cost halves every two years

  In a decade you can buy a computer for less than its sales tax today. –Jim Gray
- Computers cost-effective for
  - National security – weapons design
  - Enterprise computing – banking
  - Departmental computing – computer-aided design
  - Personal computer – spreadsheets, email, web
  - Pervasive computing – prescription drug labels
- Countless industries revolutionized

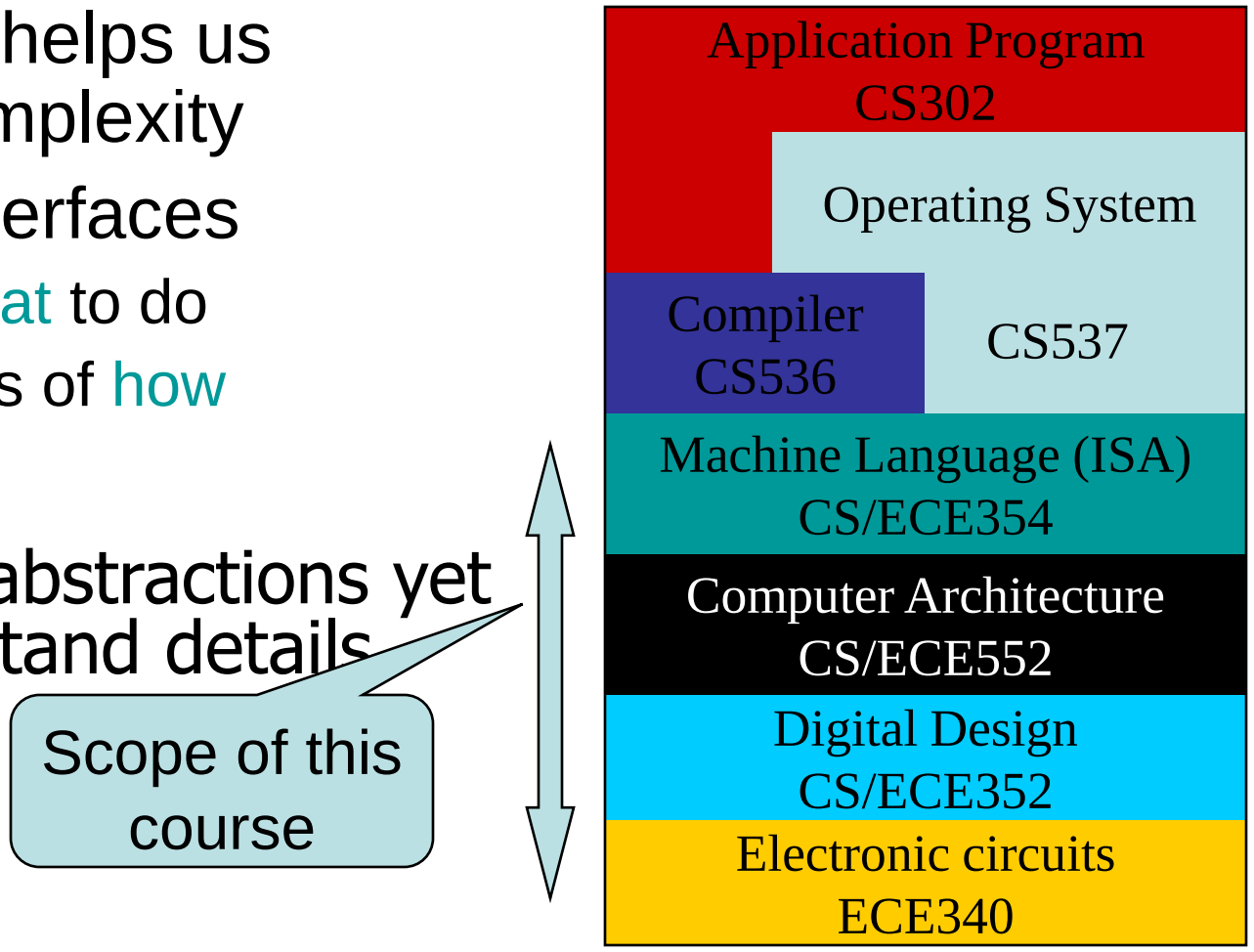
Some History

Date	Event	Comments
1947	1st transistor	Bell Labs
1958	1st IC	Jack Kilby (MSEE ’50) @TI, Winner of 2000 Nobel prize
1971	1st microprocessor	Intel (calculator market)
1974	Intel 4004	2300 transistors
1978	Intel 8086	29K transistors
1989	Intel 80486	1M transistors
1995	Intel Pentium Pro	5.5M transistors
2006	Intel Montecito	1.7G transistors
2011	10-Core Xeon Westmere	2.8G transistors
2012	62-Core Xeon Phi	5.0G transistors

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



Computer As a Tool

- Many computers today are embedded
  - Fixed functionality
  - Appliance-like
  - Not really programmable by end user
- Not the focus of this course!
  - Instead, programmable computers
  - Learn to think of computer as a tool
- Program?
  - Algorithm or set of steps that computer follows
  - Human brains wired to work this way