EE 105

Microelectronic Devices and Circuits

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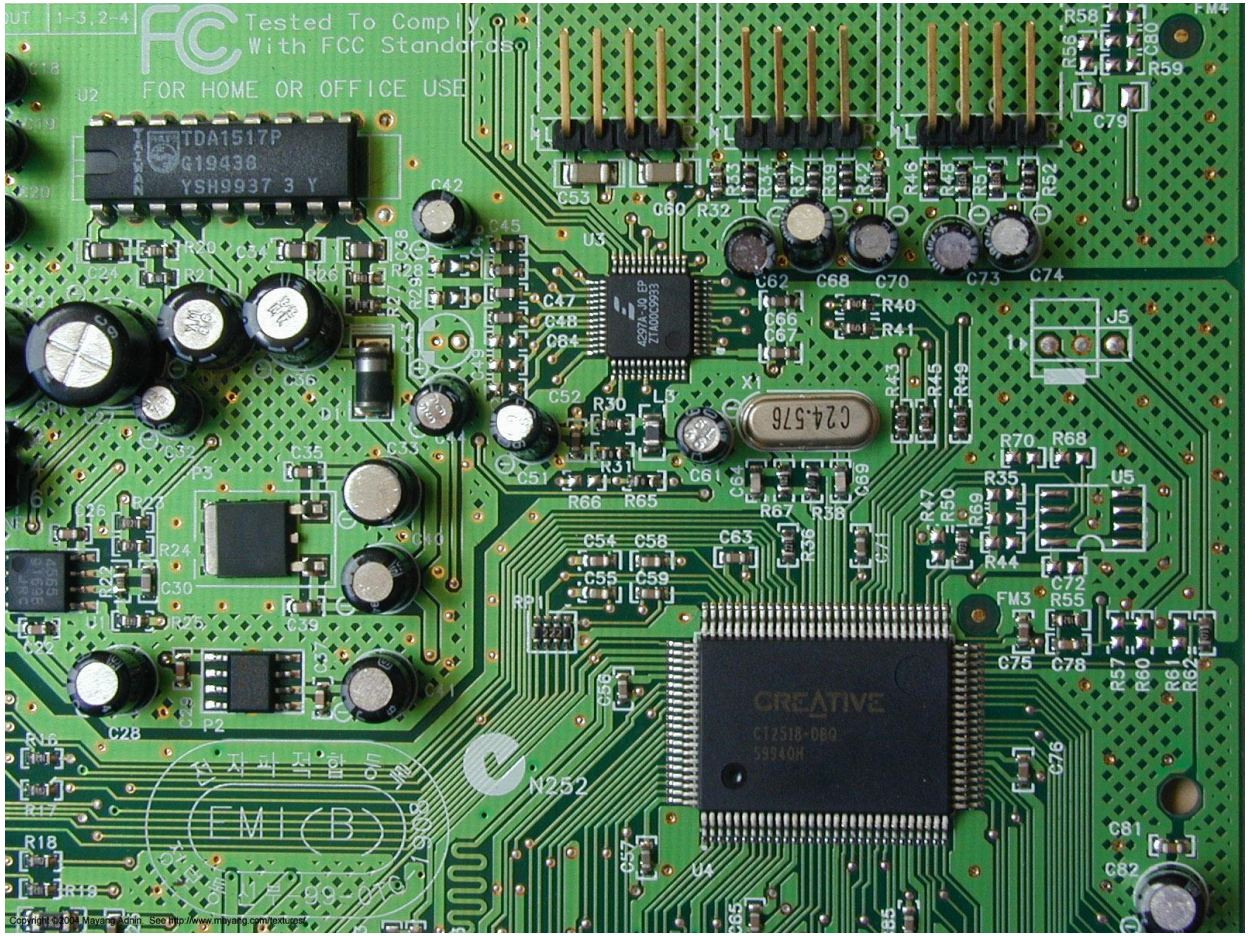
Overview

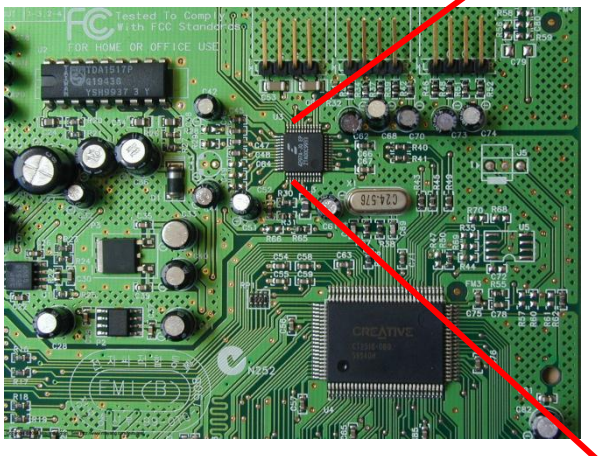
- Microelectronic Devices and Circuits
  - What is microelectronics?
  - What are microelectronic devices?
- Administrative
  - People (instructor, buddies, GSIs, reader)
  - Website(s)
  - Syllabus, exam dates
  - Textbook
  - Assignments
  - Discussions
  - Labs
  - Grades
- Microelectronic Devices

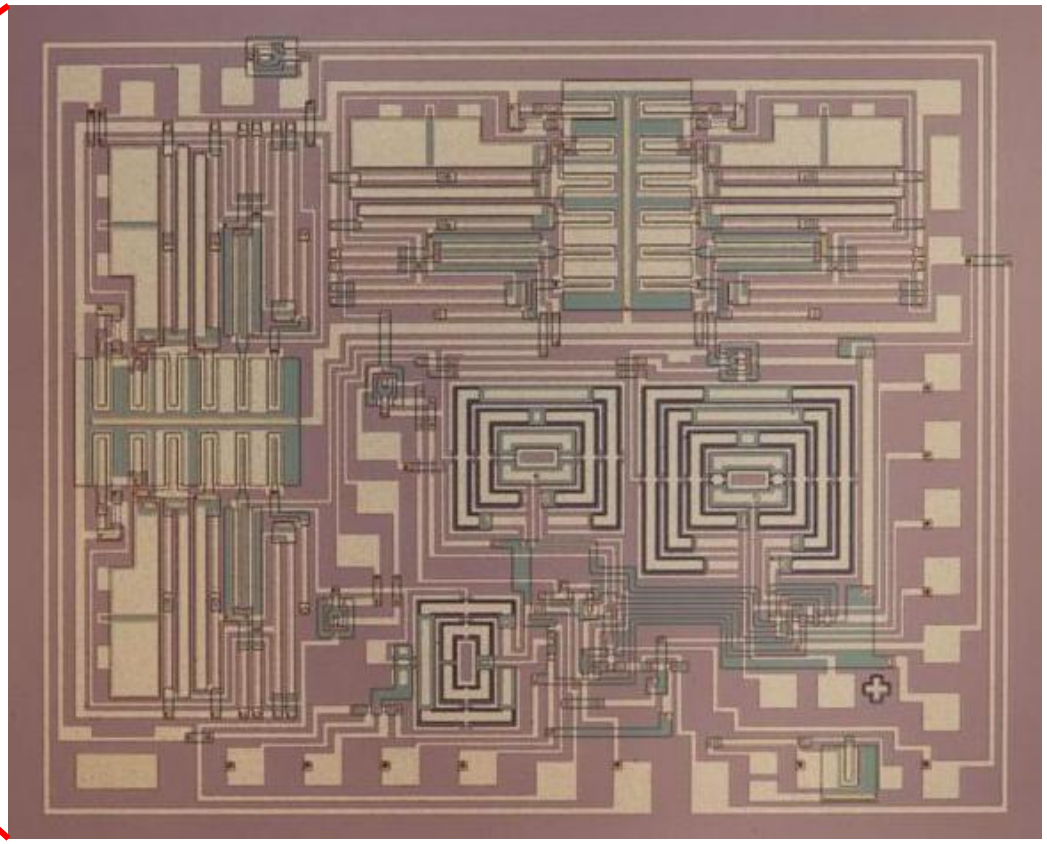
What is Microelectronics?

Electronic Circuits

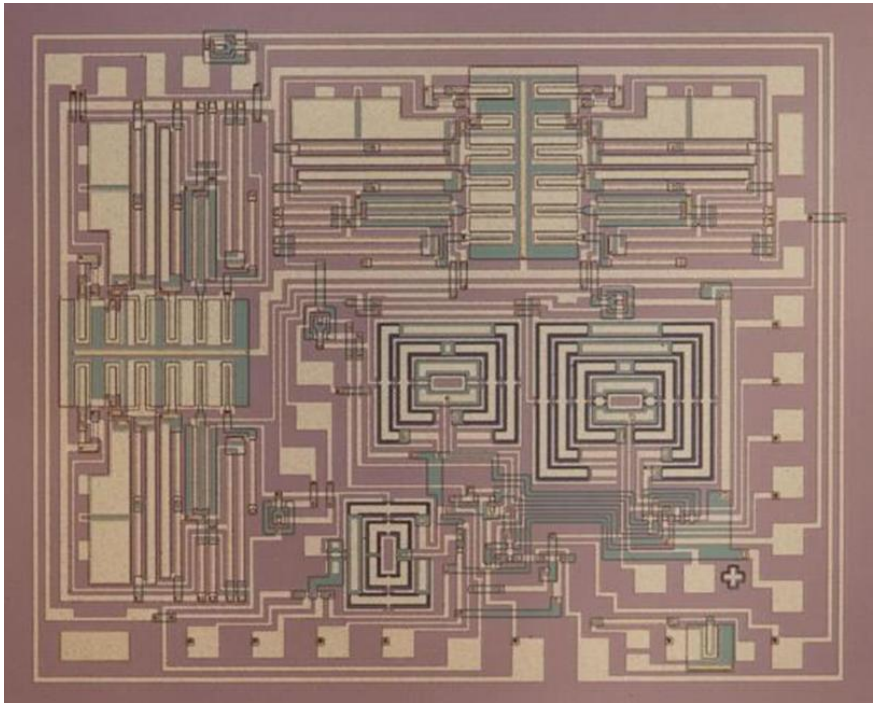


What's inside the box?

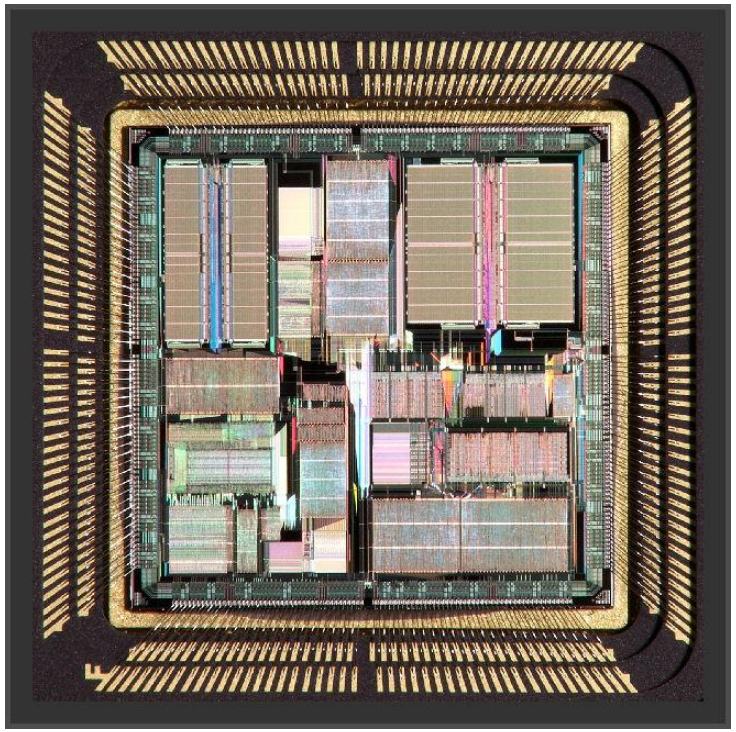




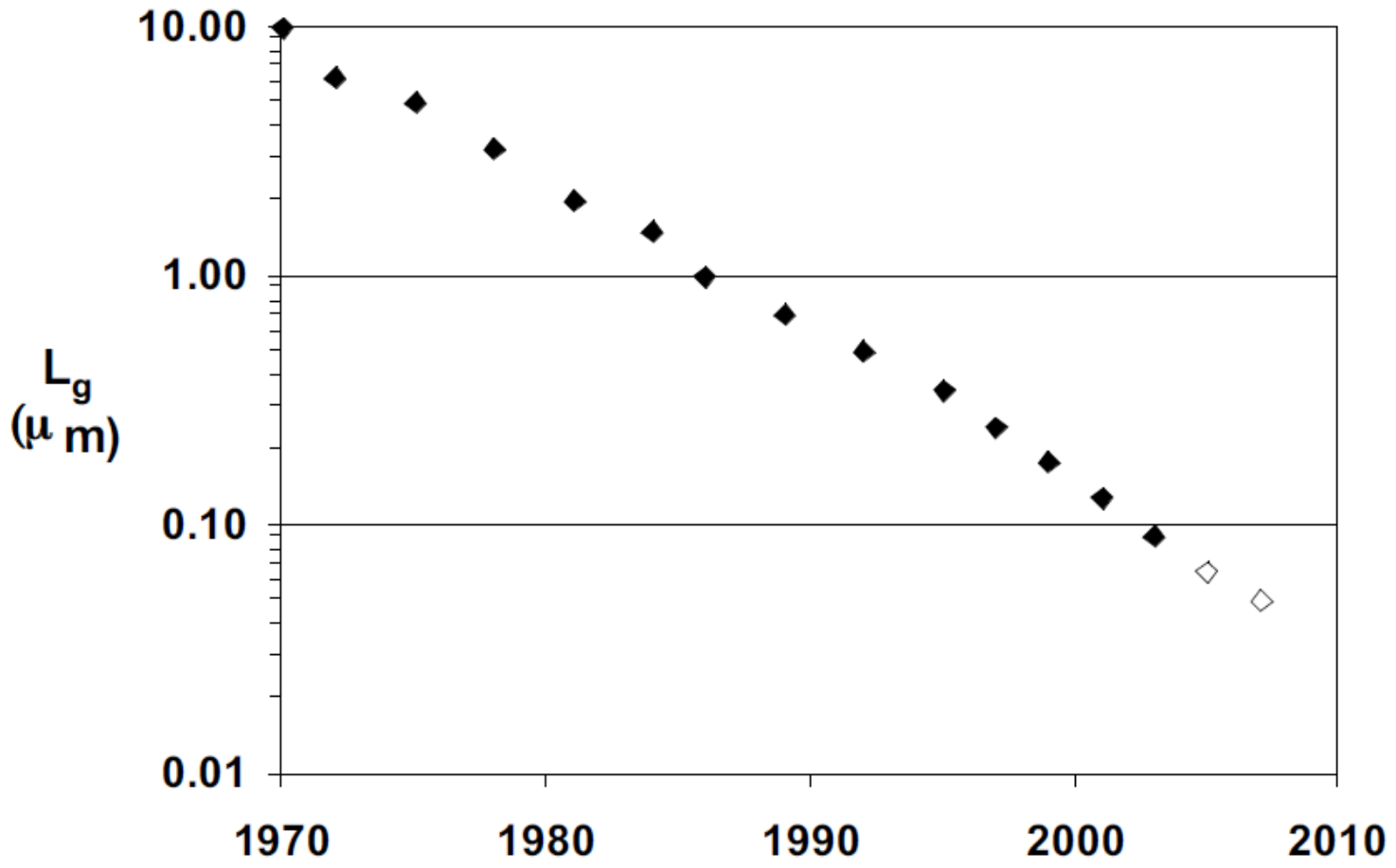
And are Microchips made of?



What's the fuss about Microelectronics?

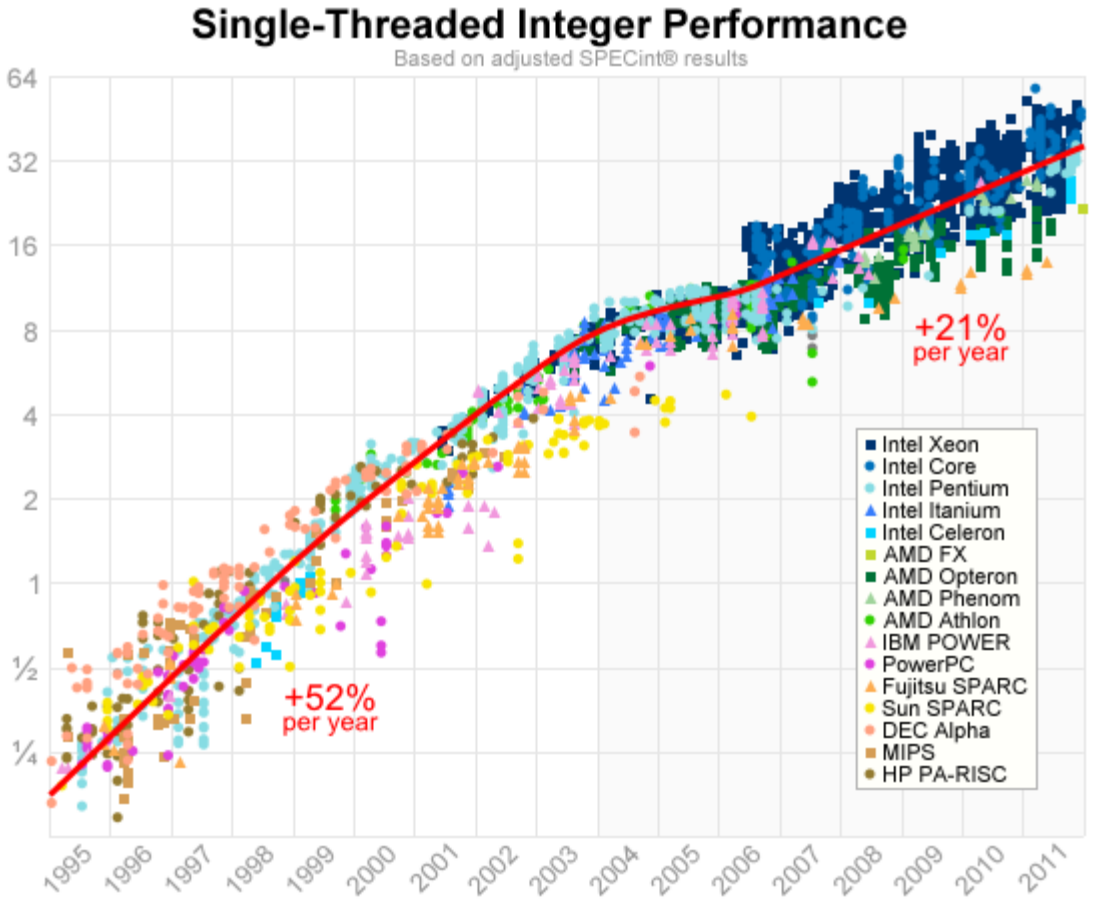


Size



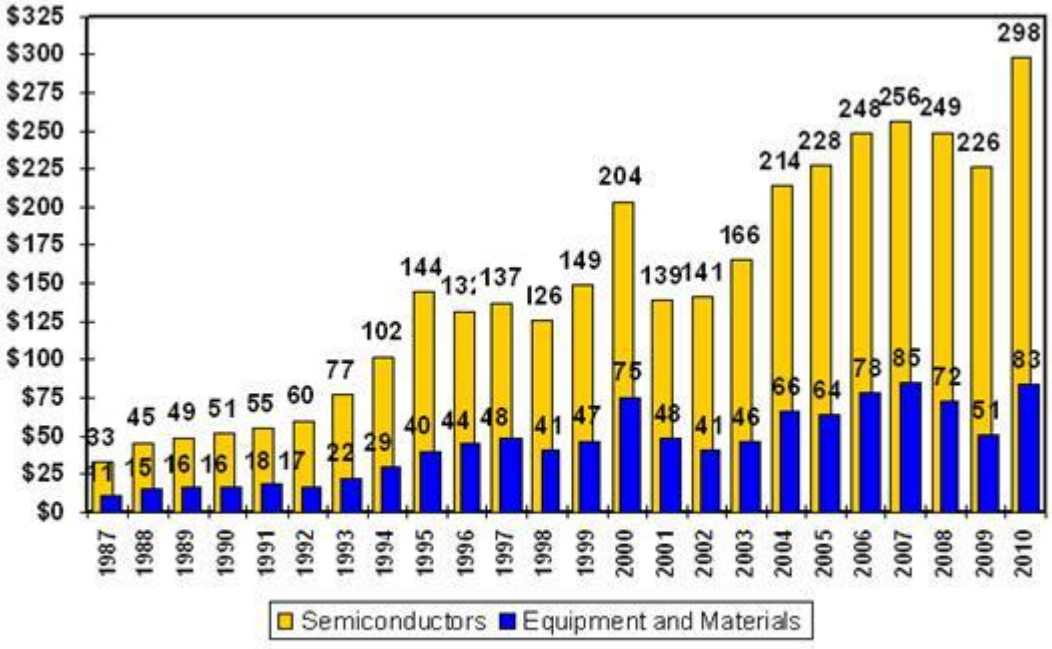
Ref: Gordon Moore, ISSCC 2003

Performance



Ref: preshing.com

Moore's Law

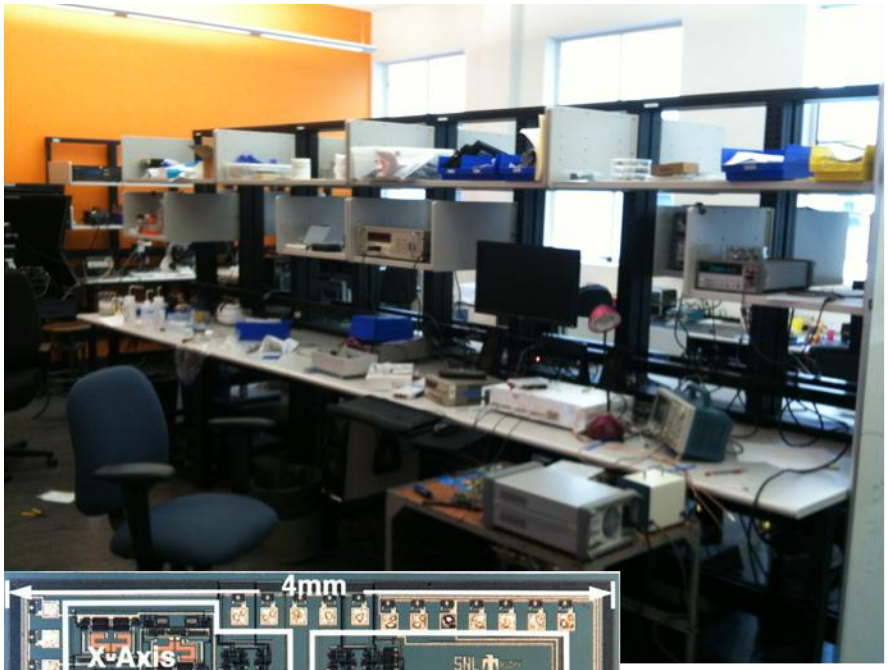


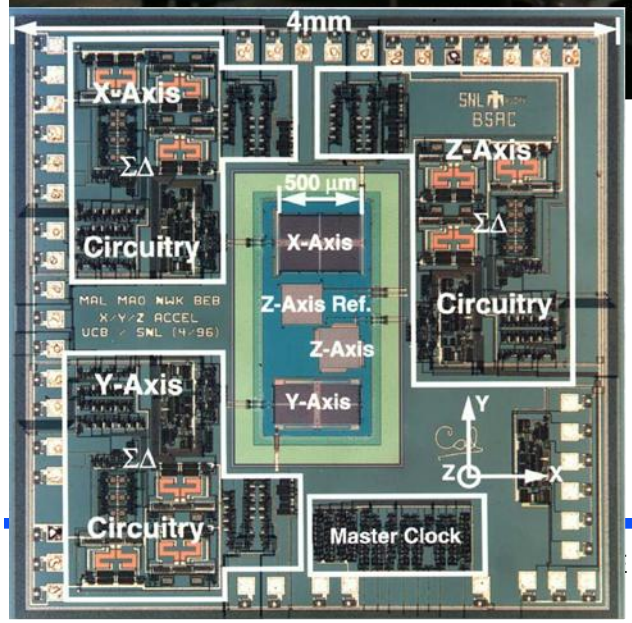
Source: *SEMI/WSTS*

Microelectronics in 3 bullets

Administrative

Prof. Bernhard Boser





Introductions

- Ashkan Borna
- Brian Lambson
- Michael Roe
- YongKeong Yap

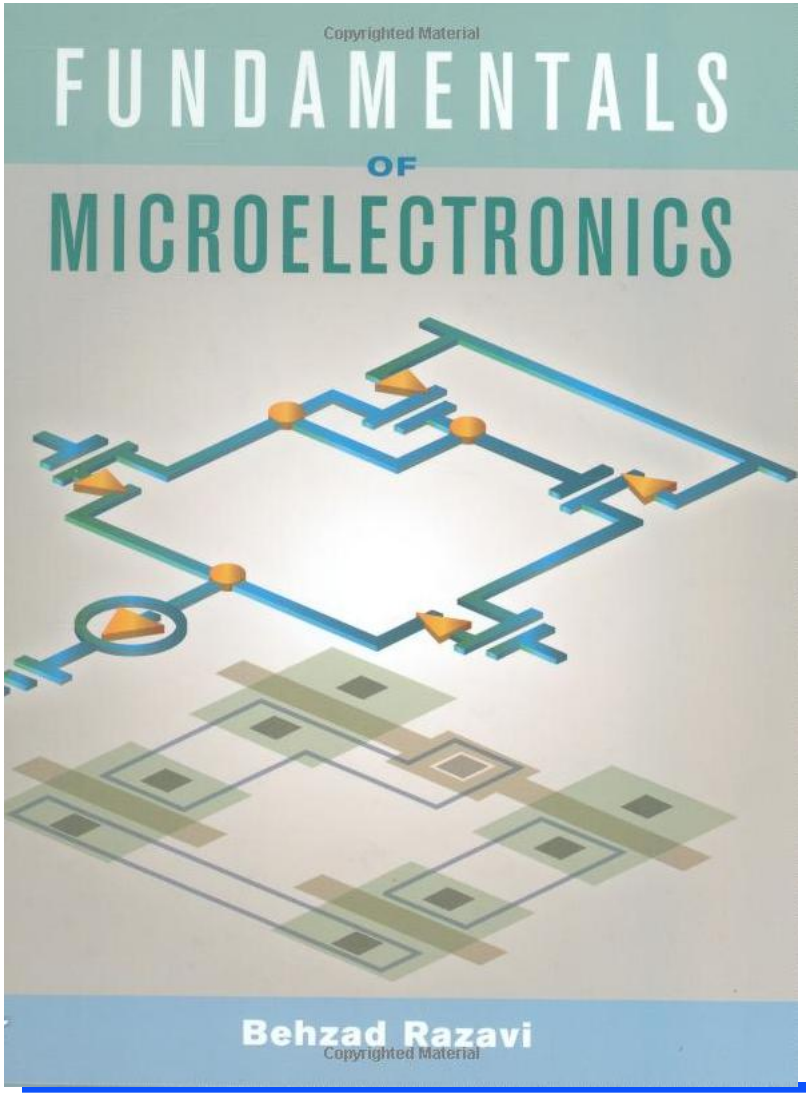
Course Web

- Bspace
  - Links to everything
  - Grades (check regularly!)

- If you cannot access bspace:

http://www.eecs.berkeley.edu/~boser/courses/105

Textbook



- You'll have to read it
- Homework tells you what
- The lecture does not repeat the book
- Typically the reading is ahead of the lecture
- Enables meaningful in-class discussions

Webcast

Lecture Notes

- Posted on course-web after the lecture

Syllabus & Exam Dates

EE 105: Microelectronic Devices and Circuits

Prof. Bernhard E. Boser

Home Information Lectures Piazza Webcast Archive

Week	Date	Topic	HW	Lab
1	8/23	Electronics		
2	8/28	Semiconductors	HW1	Introduction to SPICE
	8/30	pn Junction		
3	9/4	Diodes		Test Equipment
	9/6	Bipolar Transistors (BJTs)		
4	9/11	Transistor Models		BJT Characterization
	9/13	Small & Large Signal Behavior		
5	9/18	Midterm Review		Makeup Labs
	9/20	***Midterm 1***		
6	9/25	Transistor Amplifiers		Common Emitter
	9/27	Biasing		
7	10/2	Voltage Gain		Common Collector & Base
	10/4	Input/output resistance		
8	10/9	Transistor Configurations		Bias Circuits
	10/11	Current Mirror		
9	10/16	Midterm Review		Makeup Labs
	10/18	***Midterm 2***		
10	10/23	Frequency Response		Frequency Response
	10/25	Miller Approximation		

Assignments

- Posted Friday
- Due following Friday
- 6-10 hours to complete
  - Reading
  - Problem solving
- Get help from
  - Instructor
  - GSIs
  - Friends
  - Discussions
  - Piazza
  - Google
  - …
- But turn in your own work!

UC Berkeley, EECS Department — B. E. Boser
EECS 105 — H1: EE40 Review & Semiconductors

Due in the "EE 105 box" near 125 Cory Hall by 5pm on Friday 8/31/2012.

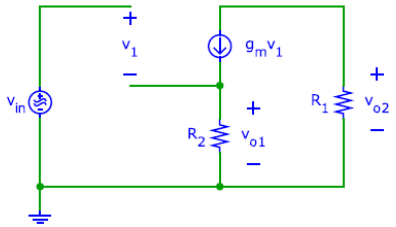
Read Chapters 1 and 2 in B. Razavi: Fundamentals of Microelectronics

Review

1. A 16 Megapixel digital camera chip capable of operating 1000 frames per second (i.e. 1000 frames are recorded each second). How many analog-to-digital converters (ADCs) are required to operate in parallel if a single ADC requires 6.9 ns to convert the output from one pixel of the camera chip?

2. The peak output from a microphone is 2.7 mV. Calculate the voltage gain in dB (deci-Bel) required to produce a 6.3 V peak input for a headset.

3. Calculate v_{o1}/v_{in} and v_{o2}/v_{in} for $g_m = 4.9\,\text{mS}$, $R_1 = 9.8\,\text{k}\Omega$, $R_2 = 44\,\text{k}\Omega$. We'll recognize this seemingly arbitrary circuit later in the course as the small signal model of a transistor amplifier.



4. Find the value of g_m such that $-v_o/v_{in} = 3.6$ for $R_1 = 21\,\text{k}\Omega$, $R_2 = 1.8\,\text{k}\Omega$. The circuit represents an important transistor configuration.

Discussions

Laboratories

- You must complete all labs to pass the course!
- 3 hour lab sessions
  - Do prelabs to finish on time
  - Makeup labs if you miss one or do not finish
- Work in groups of two
  - Not three (or four or …)
  - One feels lonely
- Sign up for lab NOW
  - Mike to mike

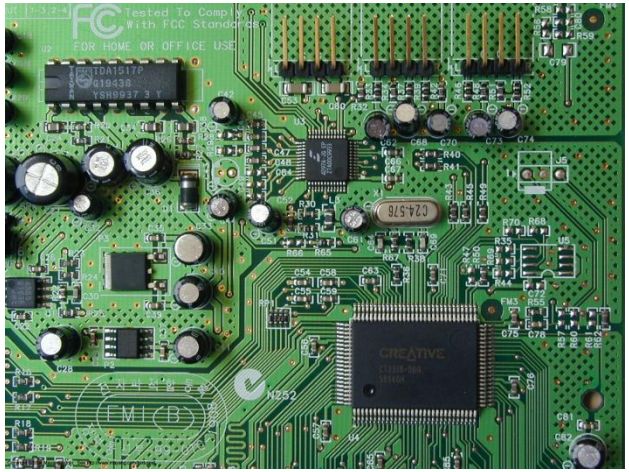
Grades

- Homework (15%)
- Labs (15%)
  You must complete all labs to pass the course!
- Midterms (30%)
- Final (40%)

Questions …

Microelectronic Devices

Devices



- Resistors

Active Devices

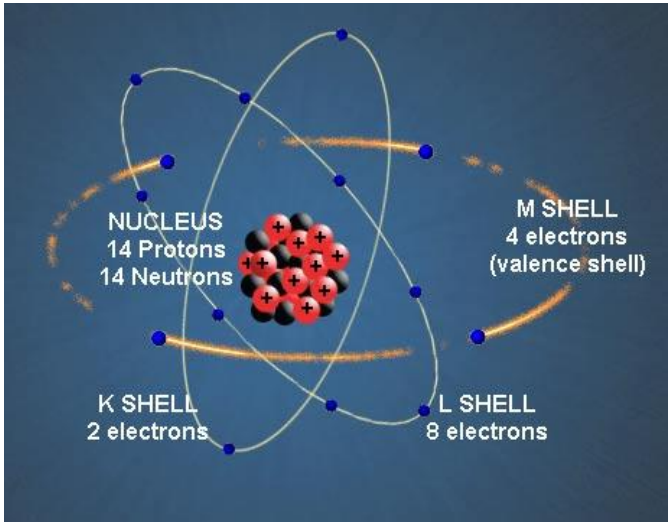
Active Device Requirements

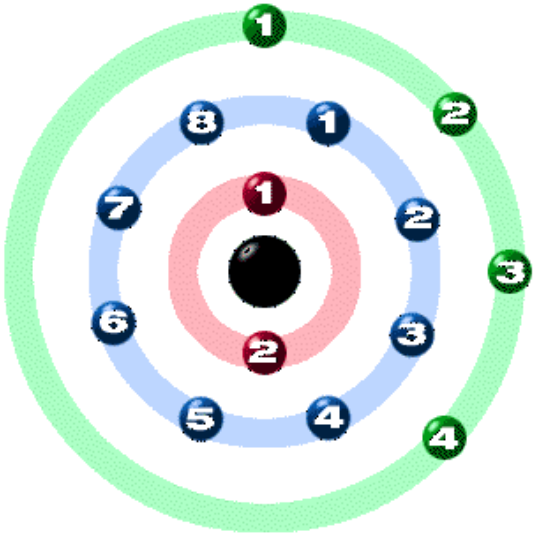
- Modulate current flow

Active Device Examples

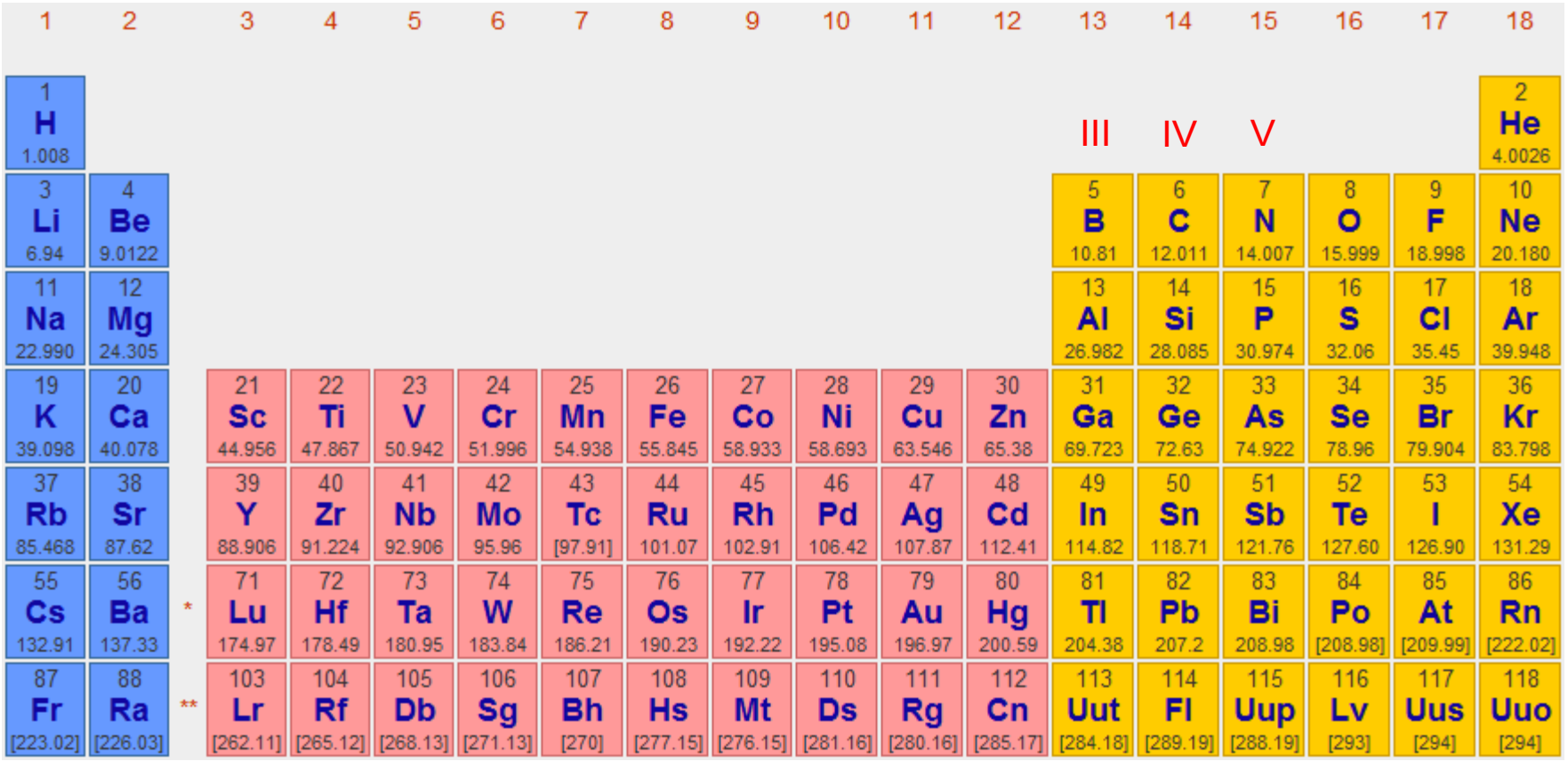
Semiconductors

Conductors, Insulators, Semiconductors

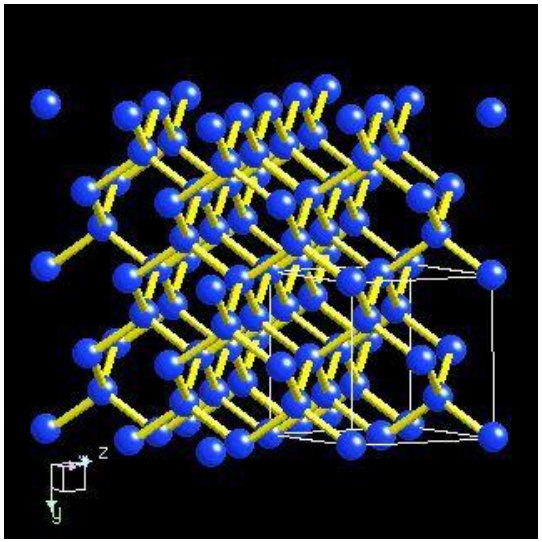


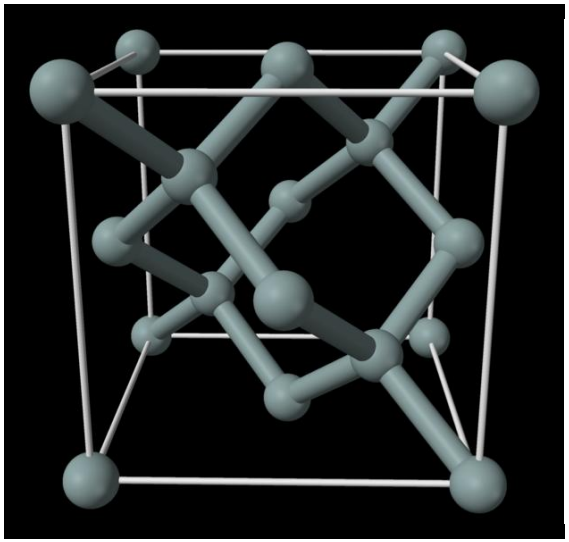


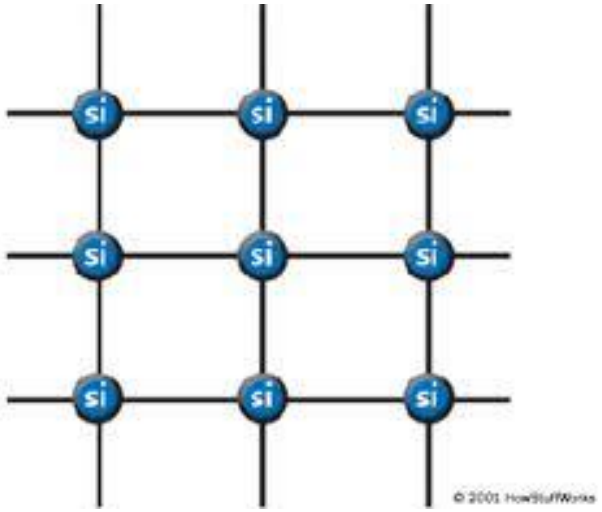
Semiconductors



Silicon Crystal





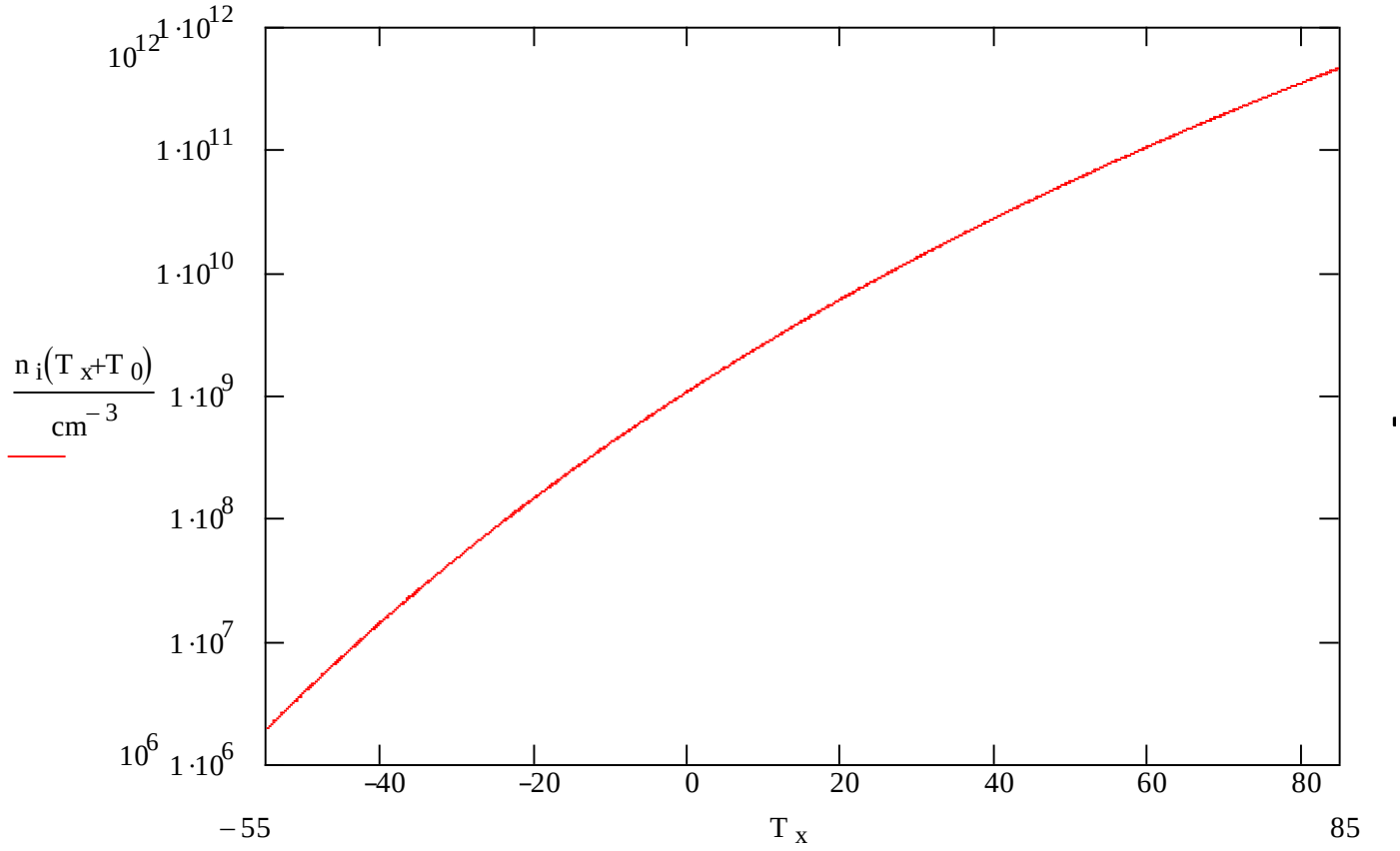


Density:
5×10^{22} atoms / cm^3

Distance between atoms:
0.22 nm

Bandgap

Intrinsic Carrier Concentration n_i



Semiconductors Summary