

# Number Systems, More History, Hardware and Software

CSCI 10 - Santa Clara University - Fall 2016  
Michael J. Bannister

## Announcements

- Please call me **Michael** or Professor Bannister
- If you are interested in skipping this class, talk to me!
- All enrolled students will be added to Piazza today
- Homework will be posted Thursday afternoon, and due Wednesday

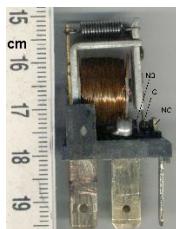
## MATH 190

- Problem-Solving Seminar: Putnam Exam Prep!
- Can take for 0-2 credits
- Org Meeting: Today 6:30pm in O'Connor 31
- Contact: Corey Irving ([cfirving@scu.edu](mailto:cfirving@scu.edu))

## Number Systems

## Last Time: Digital Circuits

- In 1705 Gottfried Wilhelm Leibniz showed, using binary numbers, that the rules of arithmetic and boolean logic could be combined
- In 1937 Claude Shannon showed that electrical circuits were capable of expressing boolean logic



Combined we have the 1st step to modern computers!

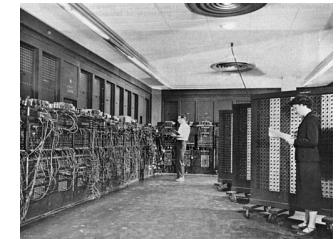
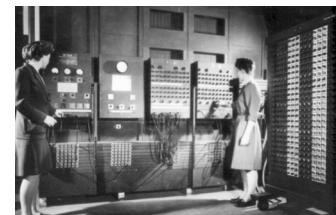
## History

## Base Conversion

- Today people like to work with numbers in base 10
- Computers like numbers in bases: 2 (binary), 8 (octal), 16 (hex), 32 and 64
- Conversion is not hard but will require practice  
(examples on board)

## ENIAC

- Univ. Pennsylvania (1935-45)
- 1st Electric General Purpose Computer
- 5k math ops per second
- Total weight is 30 tons
- 1st program: calculation for design of the hydrogen bomb

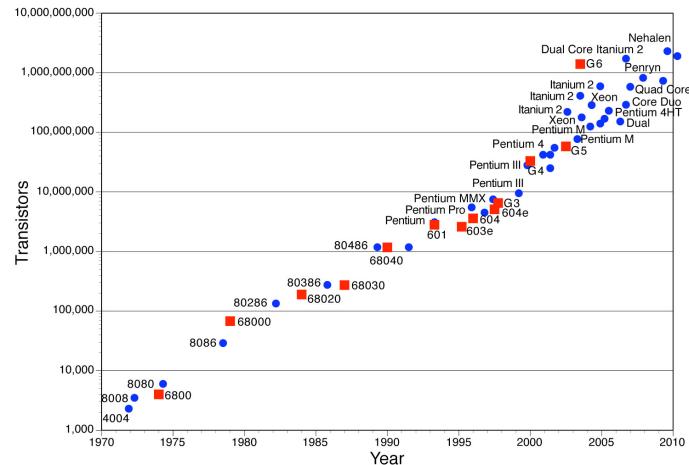


# Transistors (1950s)

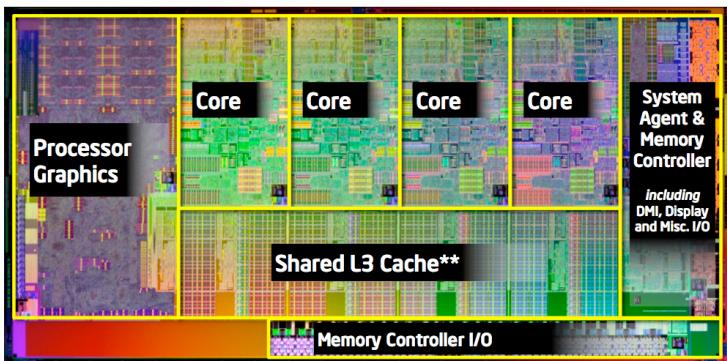
- Smaller, faster, lower power and more reliable than vacuum tubes
- Typical CPU 1-10 billion transistors
- Can be as small as 14nm; nm = a billionth of a meter!
- Developed by Shockley using silicon in Mountain View



# Moore's Law



# Modern "Chip" Design

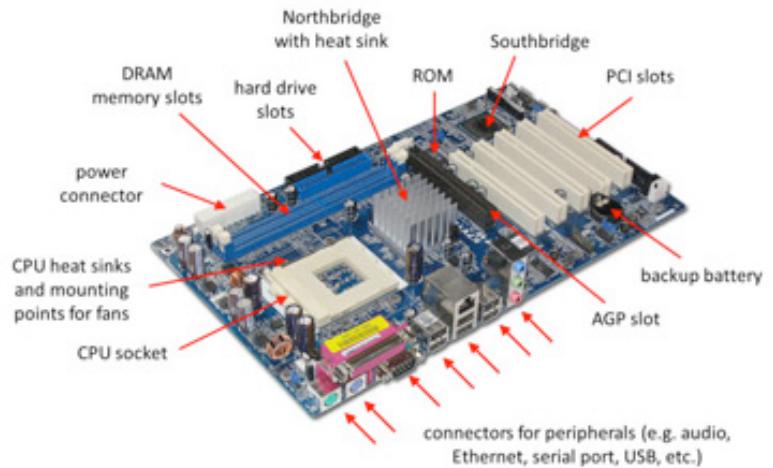


# Hardware



## Computers!

## Motherboard & Components



## Central Processing Unit (CPU)



CPU



Cooler

## Random-access memory (RAM)



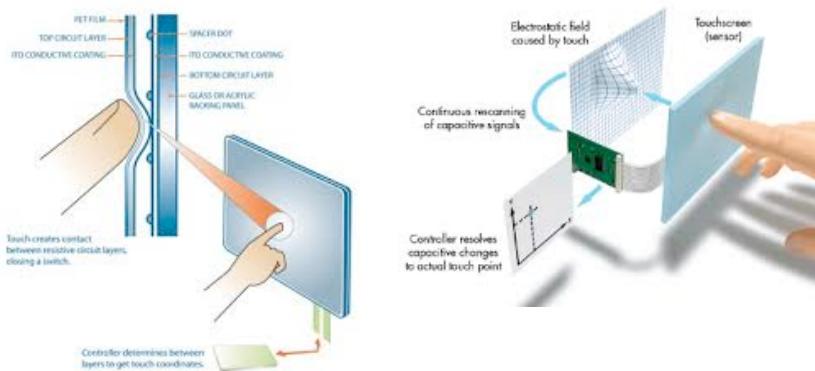
## Hard Disk & Solid State Drives



## Human Computer Interfaces (HCI)



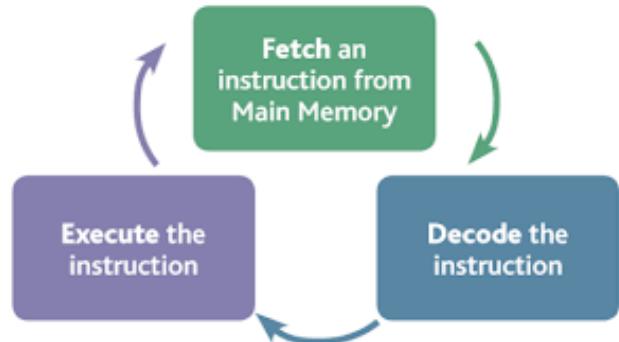
## Touch Screens



## Networking



## Fetch-decode-execute cycle



## Software

## Operating Systems



## Programming

### Program:

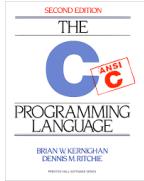
A set of instructions to be executed by the computer

Instructions consist of one or more 64 bit integer

### Programming language:

A formal languages convertible to CPU instructions, typically with emphasis on human readability

# Programming Languages



Assembly

