



# Beginning Snapshots

Chapter 0.

# Chapter Objectives

## Parts of the Picture

- What is Computer Science
- The History of Computing
- Introduction to Computer Systems

# Chapter Objectives

- To give an overview, to demonstrate the breadth of Computer Science
- To provide the context of today's computing by noting significant events from the past
- To describe basic components of computer systems
- To understand methods and features of programming

# What is Computer Science?

- It is not just writing computer programs
- Computer science includes:

- Algorithms
- Data structures
- Architecture
- Artificial intelligence
- Robotics
- Human-Computer communication
- Numerical and symbolic computation
- Operating Systems
- Programming Languages
- Software Engineering
- Ethical issues

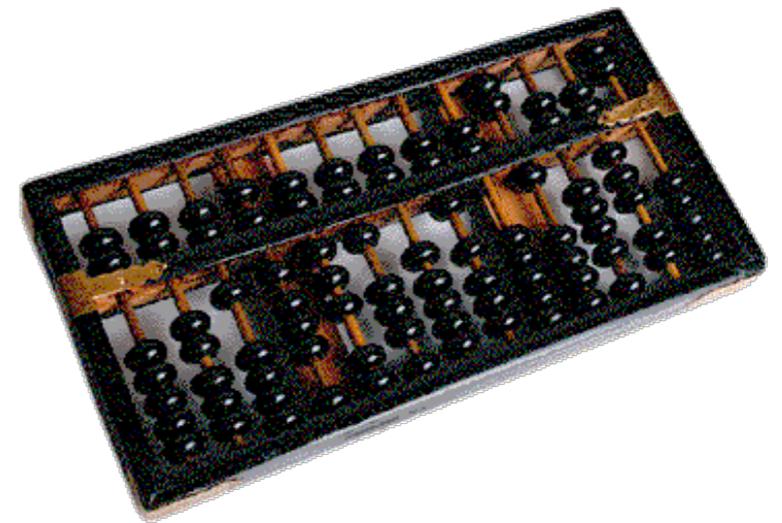
# The History of Computing



- Check out Computer History web site.
- Important concepts that shaped the history of computing:
  - The mechanization of arithmetic
  - The stored Program
  - Graphical user interface
  - The computer network

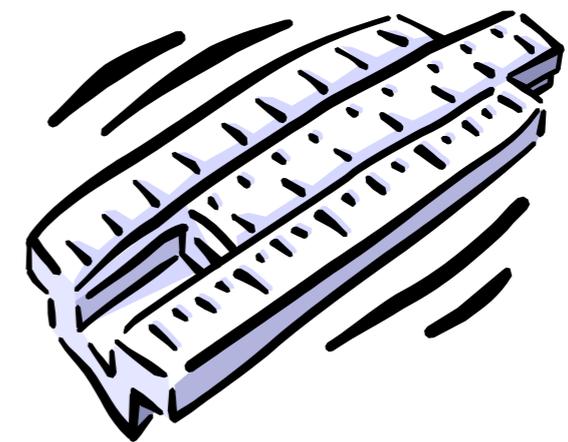
# Machines to Do Arithmetic

The abacus



- Napier's Bones
- The Pascaline
- Leibniz' calculator

The slide rule



# The Stored Program

- Program: a sequence of instructions for the computer to follow. Also called “software”
- Hardware: the chips, wires, switches, etc. on which the software instructions are executed
- Primitive example: the Jacquard Loom
  - The loom was the hardware
  - The weaving pattern cards was the software
  - The “program” was “stored” on punched cards

# Mechanical Computers

- Charles Babbage
  - Difference engine computed polynomials
  - Analytical engine
    - Provided a memory of 1000 50-digit numbers
    - Had processing, storage, input, output
    - Was never built – the technology of his day could not build his design
- Babbage called the “Father of Computing”

# Mechanical Computers

- Ada Augusta
  - Understood Babbage's machines
  - Developed "programs"
  - Could be called the first programmer
- In the 1980's a computer language (Ada) was named after her

# Electromechanical Computers

- Herman Hollerith
- Developed a punched card tabulating machine
- Used for the 1890 census
- His company was one of several which began IBM

# Electromechanical Computers

- Konrad Zuse
  - Proposed use of vacuum tubes for switching of binary circuits
  - Hitler refused to fund his design
- Alan Turing
  - Computer theorist
  - Worked on the Colossus, used to decrypt German military messages, WW2
- Grace Hopper – coder on the Harvard Mark I
  - It used electrical relays
  - Sponsored by US Navy to compute navigational tables

# Early Electronic Computers

- ABC computer
  - Developed by Atanasoff & Berry at Iowa State to do math & physics calculations
- ENIAC
  - Used 18,000 vacuum tubes, caused lights to dim in Philadelphia neighborhoods when turned on
  - Programmed by rewiring panels

# Early Electronic Computers

- John von Neumann
- Inventor of stored program concept
- Eckert and Mauchly
- Built the UNIVAC (UNIversal Automatic Computer)
- Used by the Census Bureau in 1950s

# Second-Generation Computers

- Characterized by use of transistors in place of vacuum tubes
- During late 1950s, early 1960s, programming languages developed
  - FORTRAN (FORmula TRANslation)
  - LISP (LISt Processing)
  - COBOL (ComBusiness Oriented Language)

# Third-Generation Computers

- Characterized by integrated circuits
  - Pioneered by Jack Kilby and Robert Noyce
- IBM System/360
  - First of 3rd generation computers
- Operating Systems developed
  - UNIX (1971)
  - MS-DOS (1981)
- PDP-8 first commercially successful minicomputer
- ARPANET beginning of the Internet (1969)
  - ARPA Advanced Research Projects Agency

# Fourth-Generation Computers

- Characterized by Very Large Scale Integrated circuits (VLSI)
  - Beginning of microprocessors and personal computers
- Other events of 1970s
  - C language developed by Dennis Ritchie
  - Ethernet
  - Altair 8800 first hobby-kit computer
  - Bill Gates, Pallen write BASIC compiler for Altair
  - Steve Jobs, Steve Wosniak develop first Apple Computers
  - First super computer CRAY 1

# Albuquerque

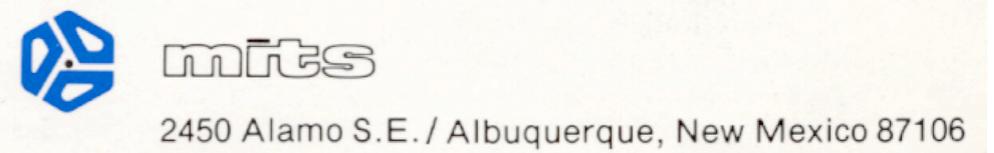


1975: speeding and  
driving without a license

1977: running a stop sign

Sundowner Hotel (2005), just west of  
Walgreen's at Central and San Pedro





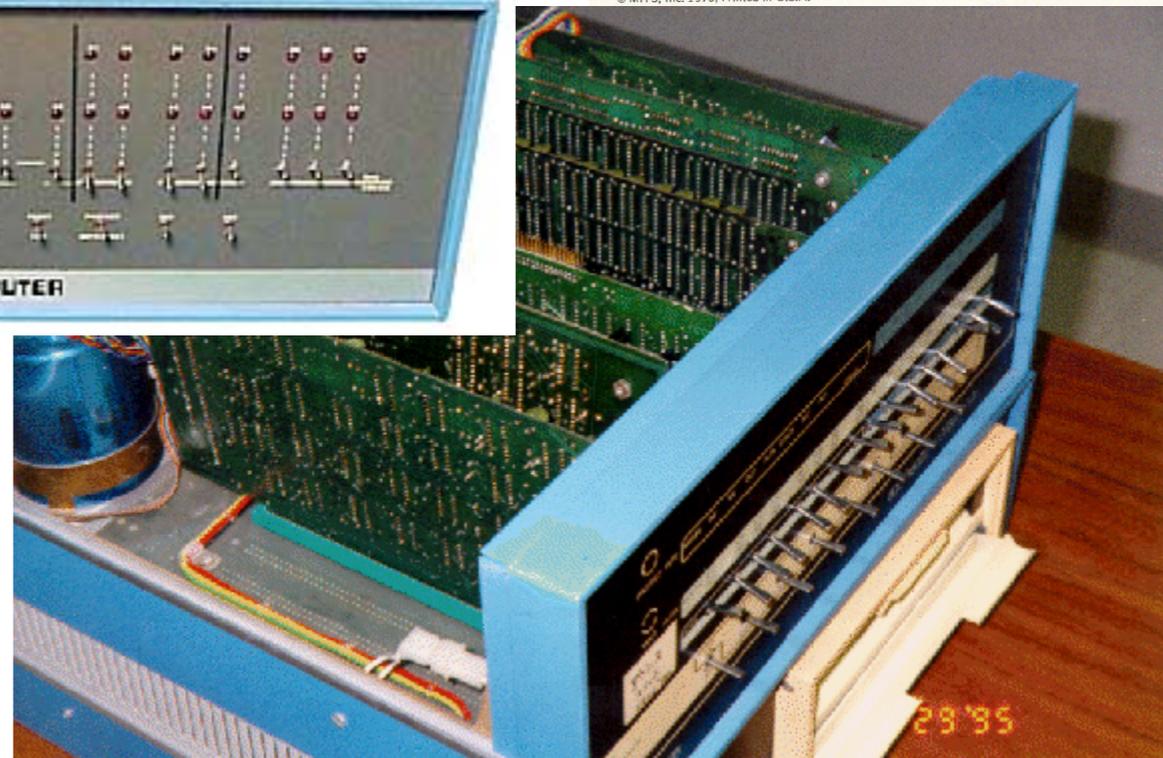
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MITS

The people who design and manufacture Altair Computer Products.

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1975 MITS (Micro  
Instrumentation and  
Telemetry Systems)  
Altair 8800



The name "Altair" came from an episode of Star Trek,  
or simply the name of a star ...

# The Graphical User Interface (or GUI)

- Human-computer interaction was done with a difficult and cryptic command line interface
- Doug Englebart at Xerox PARC developed graphical interface, first to use a “mouse”
  - Concept went unused until Steve Jobs saw it
  - He adapted the concept for the Macintosh
  - Microsoft responded with Windows operating system
  - X Window system developed at M.I.T. for Unix

# Networks

- Definition  $\Rightarrow$  two or more computers connected to exchange resources
  - Hardware resources
  - Software resources
  - Data
- Early networking
  - Timesharing, mainframe to terminals via modems
  - ARPANET connected research center computers for the Department of Defense

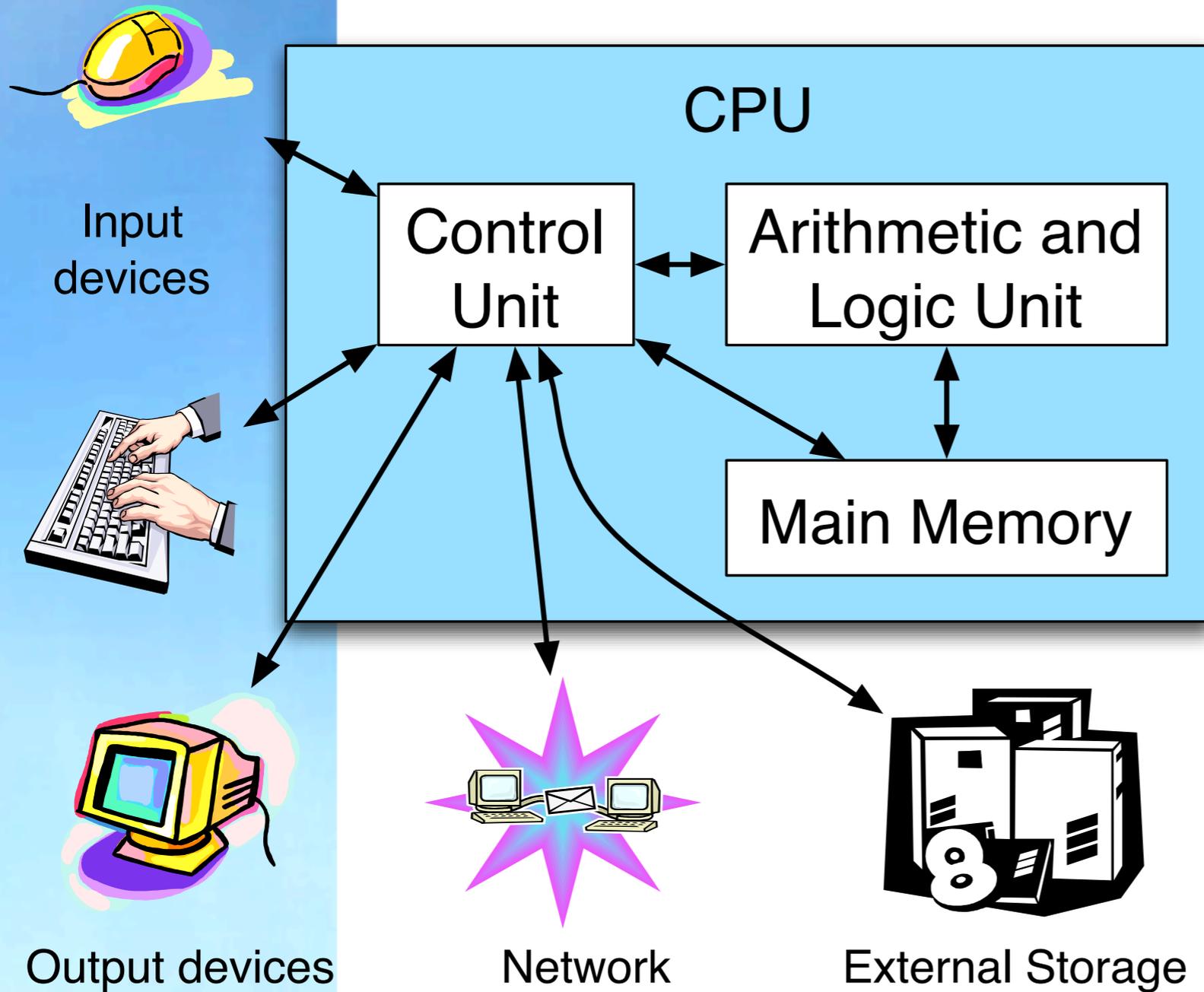
# Networks

- The Internet
  - Grew out of the ARPANET as popularity and the number of host computers grew
  - Internet service providers enable even home computers to be wired into the global digital infrastructure
- Local Area Networks (LANs)
  - Enabled by Ethernet hardware and network operating systems
  - PC users share resources

# Introduction to Computer Systems

- Babbage's Analytical Engine was designed with capabilities of ...
  - Processing
  - Storage
  - Input
  - Output
- This is still a common feature in most modern computers

# Processing



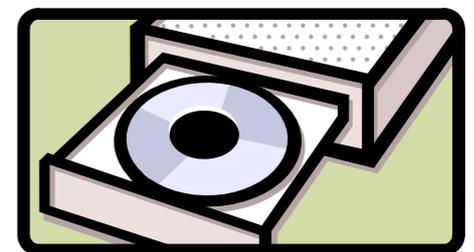
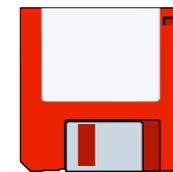
- Major components of a computer
  - CPU or Central Processing Unit
  - Primary (internal) memory
  - Secondary (external memory)
  - Control Unit
  - Arithmetic Logic Unit
  - Input devices
  - Output devices

# Storage

- Main Memory
  - Internal, primary, random access memory (RAM)
  - Stores instructions and data
- Cache memory
  - Smaller quantity of high speed memory
- Registers
  - Specific high speed memory locations used repeatedly by instructions
  - Three orders of magnitude faster than RAM

# Storage

- Secondary, external, auxiliary storage
- Needed because internal memory is volatile – loses contents when power is off
- Media used
  - Magnetic disks (floppy disks, hard drives)
  - Optical media (CDs, DVDs)



# Storage

- Binary storage
  - Storage locations are a collection of two-state values (either 0 or 1 – Binary digiTs)
  - These are called BITS
- Bytes
  - 8 bits make a byte
  - 1024 bytes make a kilobyte
  - Note kilo (1000) not quite accurate
  - Computer memory established in multiples of powers of 2 ...  $2^{10} = 1024$
  - 1024 kilobytes = 1 Megabyte = 1,048,576 bytes
  - 1024 Megabytes = 1 Gigabyte = 1,073,741,824 bytes

# Input and Output



- Input devices

- Convert instructions and data into binary form

- Transmit to the CPU

- Output devices

- Convert binary contents of memory into meaningful symbols for humans to view

- Outputs information as graphics, sounds, video, and even robotic movement



# Input and Output

- Communication between CPU and I/O devices
- Specific or general connections to these peripheral devices called ports
- Ports connect to the computer's bus

# Operating Systems

- Required for a computer to be general purpose
- The tasks of the operating system (OS) include...
  - Interface between user and system hardware
  - Environment in which other software programs can run
- Hardware and OS together make up a platform
- Examples:
  - DOS, Windows, UNIX

# Programming

- Definition  $\Rightarrow$  instructions for the hardware to perform
- Instructions are stored in memory
- Written in machine language
- Made up of ...
  - Command or operator
  - Address of the value to be operated upon, operand
- Stored in binary form

# Programming

- Assembly language
- Easier to read, understand than list of binary codes
- Uses mnemonics in place of numeric codes
- Translation program called an assembler converts mnemonics into binary machine code

# Programming

- High level languages
  - Instructions read like English and algebra
    - Called source code
  - Easier to read/understand than assembly language
  - Must be translated into machine language by compiler
    - Called object code

# Programming

- Text editor creates source code
- Compiler creates object code
- Linker gathers portions of object code from ...
  - Compiler output
  - Libraries of special routines
- ... produces executable code

