

CSE1301 Computer Programming: Lecture 1 Computer Systems Overview

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Algorithm:
A set of instructions describing how to do a task (or process)

Program: C

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Topics

- Hardware components
- Computer networks

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Transistor

Base Collector Emitter

"semi-conductor"

Binary digit or "bit":
0 → off
1 → on

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Transistor (cont)

Base Collector Emitter

off : 0

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Transistor

Base Collector Emitter

on : 1

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Transistor

Modern-day "chips" (about 3 x 3 mm in size) can contain millions of transistors

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Gates

- **Gate:** a group of transistors
- Gates are switches that distinguish between two electrical voltages:
 - Current is low => 0
 - Current is high => 1
- Types:

AND Gate

OR Gate

NOT Gate

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Example: AND Gate

A	B	A AND B
0	0	
0	1	
1	0	
1	1	

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Gates and Boolean Algebra

AND Gate

OR Gate

A	B	A AND B	A OR B
0	0		
0	1		
1	0		
1	1		

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Gates and Boolean Algebra (cont)

NOT Gate

A	NOT A
0	1
1	0

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Gates and Boolean Algebra (cont)

A sequence of bits at a time:

A =	1 1 0 0 1 1 0 1
B =	0 1 1 0 0 1 1 0
A AND B =	

- Most PCs do 32 bits at a time ("32-bit machines"), others as many as 128 bits at a time

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0 or 1

- Gates are the basic building blocks of computers

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Hardware Components of a Typical Computer

- "Buses" allow components to pass data to each other

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Hardware Components of a Typical Computer -- CPU

Central Processing Unit (CPU)

- performs the basic operations
- consists of two parts:
 - Arithmetic / Logic Unit (ALU) - data manipulation
 - Control Unit - coordinate machine's activities

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Hardware Components of a Typical Computer -- Memory

Main Memory

- holds programs and data
- stores bits in fixed-sized chunks: "word" (8, 16, 32, or 64 bits)
- each word is stored in a cell, which has a unique address
- the cells can be accessed in any order => random-access memory or "RAM"

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Bits, Bytes, Kilo-, Mega-, Giga-, ...

- A **bit**: 0 or 1
- A **word**: chunk of bits (8, 16, 32 or 64 bits)
- a **byte** = 8 bits
- a kilobyte = 2^{10} bytes = 1024 bytes
- a megabyte = 1024 KB = 2^{20} bytes = 1,048,576 bytes
- a gigabyte = 1024 MB = 2^{30} bytes
- a terabyte = 1024 GB = 2^{40} bytes

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Hardware Components of a Typical Computer -- Peripherals

Peripheral devices –

- communicate with the outside world
- store data long term

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Hardware Components of a Typical Computer – Peripheral Devices that Communicate with the Outside World

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    graph LR
      PD[Peripheral Devices] <--> CPU[Central Processing Unit (CPU)]
      CPU <--> Mem[Memory]
    
```

- **Input/Output (I/O)**
 - **Input:** keyboard, mouse, microphone, scanner, sensors (camera, infra-red), punch-cards
 - **Output:** video, printer, audio speakers, etc
- **Communication**
 - modem, ethernet card

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Hardware Components of a Typical Computer – Peripheral Devices that Store Data Long Term

Secondary (mass) storage

Stores information for long periods of time as **files**

- Examples: hard drive, floppy disk, tape, CD-ROM (Compact Disk Read-Only Memory)

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Features of Computers – Speed CPU Speed

- CPU clock speed: in cycles per second ("hertz")
 - Example: 700MHz Pentium III, 3.2GHz P4
- but different CPU designs do different amounts of work in one clock cycle (e.g. P4 vs G5)
- “flops” (floating-point operations per second)
- “mips” (million instructions per second)

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Features of Computers – Speed System-Clock/Bus Speed

- communication between CPU, memory and peripheral devices
- depends on main board (a.k.a. "motherboard") design
 - Examples:
 - Intel 3.60GHz Pentium-4 works on a 200MHz bus speed
 - 50MHz, 60MHz, 66MHz, 100Mhz, 133MHz, 200MHz, 266MHz, and rising
 - Quad-pumped multiplies by 4

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Features of Computers – Speed Memory-Access Speed

- **RAM**
 - about 50ns (1 nanosecond = a billionth of a second), and getting faster
 - may be rated with respect to “bus speed” (e.g., PC-100, PC-133, etc)
- **Cache memory**
 - faster than main memory (less than 20ns access speed), but more expensive
 - contains data which the CPU is likely to use next

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Features of Computers – Speed Peripheral-Device Speed

- **Mass storage**
 - Examples:
 - 3.5in 1.4MB floppy disk: about 500kb/sec at 300 rpm (revolutions per minute)
 - 3.5in hard disk: average seek time about 8.5 microseconds, and 7,200 rpm
- **Communications**
 - Examples: modems at 56 kilobits per second, and network cards at 10 or 100 megabits per second
- **I/O**
 - Examples: ISA, PCI, IDE, SCSI, ATA, USB, etc....

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Features of Computers -- Reliability

Factors that affect reliability:

- heat, ventilation, “over-clocking”, power surges

Most system failures are due to software flaws rather than hardware

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Modes of communication

- Parallel communication:
 - all the bits are transferred at the same time
 - each bit on a separate line

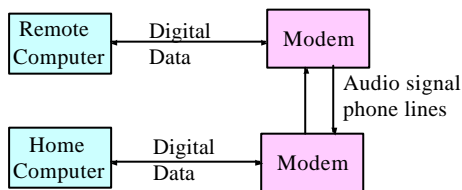


- Serial communication:
 - one bit at a time



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Modems (MOdulator-DEModulator)



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Computer Networks

- Types
 - Local Area Networks (LAN)
 - Computers in an organization
 - Example: the PCs in the lab
 - Long Haul Networks
 - Separated by hundreds or thousands of miles
 - Physical wires, telephone lines, satellites, etc
 - Example: Internet “backbone”

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Computer Networks – Method of Communication

- Each computer has an **address**
 - Example: IP address of www.monash.edu.au is 130.194.11.149
- A sender computer transmits data through the network in **packets**; each packet is tagged with the destination and return address
 - When data is too big to fit in one packet, the sender computer can split the data into several packets, labeled in sequence

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Computer Networks – Method of Communication (cont)

- The packets are sent via links from computer to computer (“**routing**”)
- Each intermediate computer receives and retransmits the message (“**hops**”)
 - The packets do not necessarily arrive in the order in which they were sent
- The recipient computer puts the packets in correct sequence and retrieves the data

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Summary

- Transistors, gates, chips, hardware
- Computer = CPU + Memory + I/O Devices
- Networks, modems
- Jargon and acronyms

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Further Reading

- Brookshear:
 - 4/e (1994): 1.1, 1.2, 2.6, 3.8
 - 5/e (1997): 1.1 - 1.3, 2.6, 3.5
 - 6/e (2000): 1.1 - 1.3, 2.5, 3.5
- Deitel&Deitel (2/e)
 - 1.2 to 1.5

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