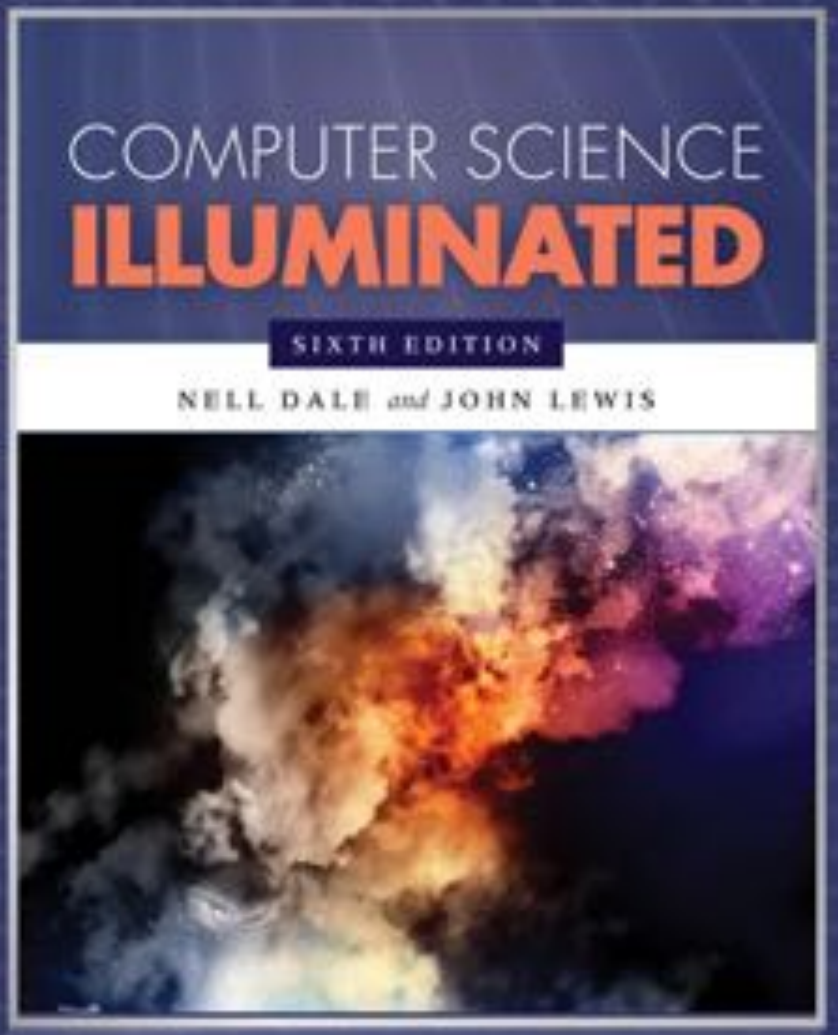
Chapter 5

Computing Components



Chapter Goals

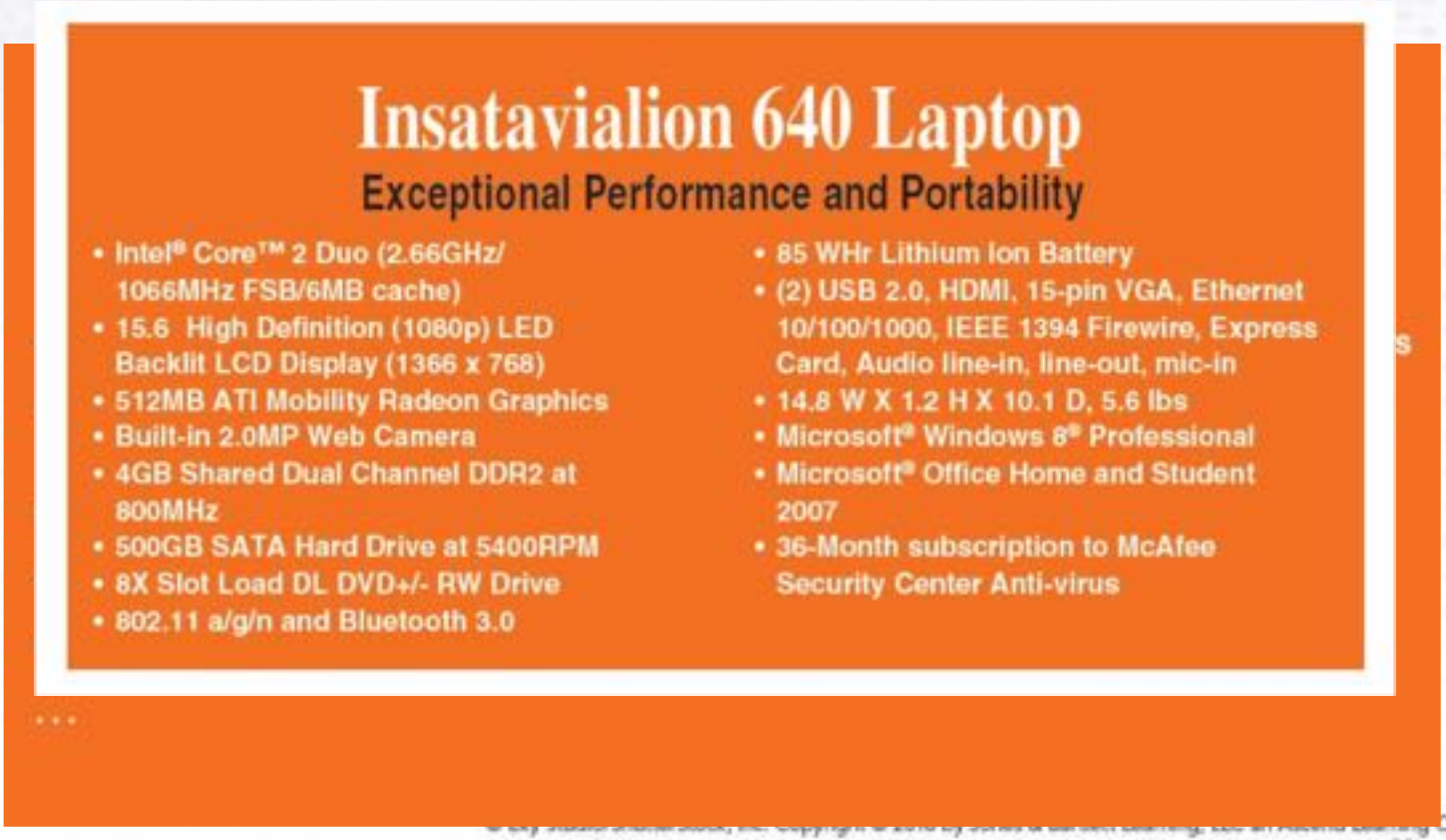
- Read an ad for a computer and understand the jargon
- List the components and their function in a von Neumann machine
- Describe the fetch-decode-execute cycle of the von Neumann machine
- Describe how computer memory is organized and accessed

Chapter Goals

- Name and describe different auxiliary storage devices
- Define three alternative parallel computer configurations
- Explain the concept of embedded systems and give examples from your own home

Computer Components

Consider the following ad:



Insatavialion 640 Laptop

Exceptional Performance and Portability

- Intel® Core™ 2 Duo (2.66GHz/ 1066MHz FSB/6MB cache)
- 15.6 High Definition (1080p) LED Backlit LCD Display (1366 x 768)
- 512MB ATI Mobility Radeon Graphics
- Built-in 2.0MP Web Camera
- 4GB Shared Dual Channel DDR2 at 800MHz
- 500GB SATA Hard Drive at 5400RPM
- 8X Slot Load DL DVD+/- RW Drive
- 802.11 a/g/n and Bluetooth 3.0
- 85 WHr Lithium Ion Battery
- (2) USB 2.0, HDMI, 15-pin VGA, Ethernet 10/100/1000, IEEE 1394 Firewire, Express Card, Audio line-in, line-out, mic-in
- 14.8 W X 1.2 H X 10.1 D, 5.6 lbs
- Microsoft® Windows 8® Professional
- Microsoft® Office Home and Student 2007
- 36-Month subscription to McAfee Security Center Anti-virus

Computer Components

What does all this jargon mean?

- Intel® Core™ 2 Duo (2.66GHz/1066Mhz

FSB/6MB cache)

- 4GB Shared Dual Channel DDR2 at 800 MHz
- 500 GB SATA Hard Drive at 5400RPM
- 15.6” High Definition (1080p) LED Backlit

LCD Display (1366 x 768)

- 8X Slot Load DL DVD+/- RW Drive
- 14.8”W X 1.2”H X10.1” D, 5.6 lbs.

Be patient!
If you don't know now, you should know shortly

Computer Components (continued)

- 512 MB ATI Mobility Radeon Graphics
- 85 WHr Lithium Ion Battery
- (2) USB 2.0, HDMI, 15-Pin VGA, Ethernet 10/100/1000 IEEE 1394 Firewire, Express Card, Audio line-in, line-out, mic-in
- Microsoft® Windows 7® Professional
- Microsoft® Office Home and Student 2007
- 36-Month subscription to McAfee Security Center Anti-virus

Sizes in Perspective

Admiral Grace Murray Hopper's Illustration

- A coil of wire nearly 1,000 feet long
  - Distance traveled by an electron along the wire in the space of a microsecond
- A short piece of wire
  - In the space of a nanosecond
- A bag containing grains of pepper
  - In the space of a picosecond

Sizes in Perspective

Power of 10	Power of 2	Value of Power of 2	Prefix	Abbreviation	Derivation
10^{-12}			pico	p	Italian for *little*
10^{-9}			nano	n	Greek for *dwarf*
10^{-6}			micro	μ	Greek for *small*
10^{-3}			milli	m	Latin for *thousandth*
10^{3}	2^{10}	1024	kilo	K	Greek for *thousand*
10^{6}	2^{20}	1,048,576	mega	M	Greek for *large*
10^{9}	2^{30}	1,073,741,824	giga	G	Greek for *giant*
10^{12}	2^{40}	not enough room	tera	T	Greek for *monster*
10^{15}	2^{50}	not enough room	peta	P	Greek prefix for *five*

Powers of 10 for time, powers of 2 for storage

What is a Hertz?

Sizes in Perspective

Intel Processor

speed 2.66 GHz

SDRAM

size 4GB

speed 800 MHz

500GB SATA at 5400 RPM

Transfer rate 300MB per second

Flat screen dot pitch .28mm

To which do these apply?

Bigger is better
Faster is better
Smaller is better

Stored-Program Concept

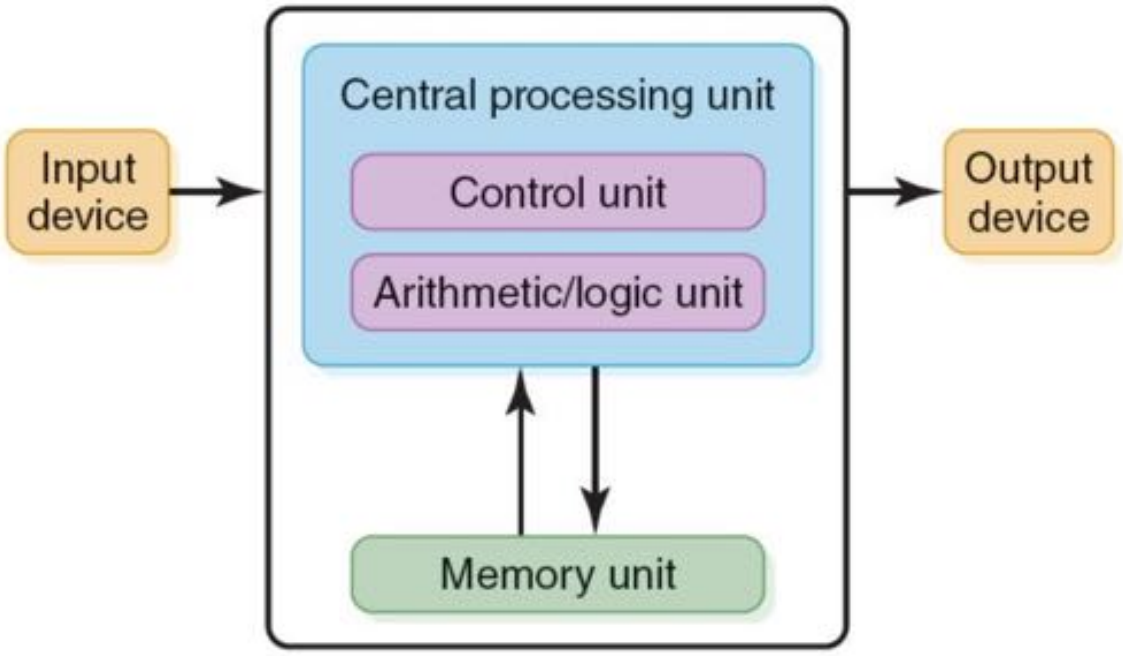


FIGURE 5.1 The von Neumann architecture.

Instructions and data both stored in memory unit

Memory

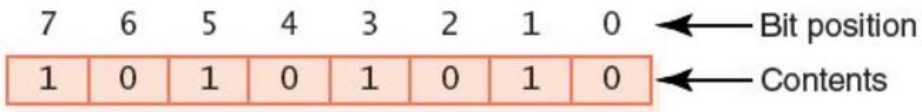
Memory

A collection of cells, each with a unique physical address

Most computers are byte-addressable

Cell at address 11111110 contains 10101010

"Little endian" bit numbering:



Address	Contents
00000000	11100011
00000001	10101001
. . .	. . .
11111100	00000000
11111101	11111111
11111110	10101010
11111111	00110011

Memory

Memory

What does 10101010 mean?

No way to answer that

Could be an instruction, a natural number, a signed integer, a character, part of an image, …

Address	Contents
00000000	11100011
00000001	10101001
. . .	. . .
11111100	00000000
11111101	11111111
11111110	10101010
11111111	00110011

Arithmetic/Logic Unit

Performs basic arithmetic operations such as addition and subtraction

Performs logical operations such as AND, OR, and NOT

Most modern ALUs have a small amount of special storage units called **registers** that can be accessed faster than main memory

Input/Output Units

Input Unit

A device through which data and programs from the outside world enter the computer system;

Can you name three?

Output unit

A device through which results stored in the computer memory are made available outside the computer system

Can you name two?

Control Unit

Control unit

The organizing force in the computer

Instruction register (IR)

Contains the instruction that is being executed

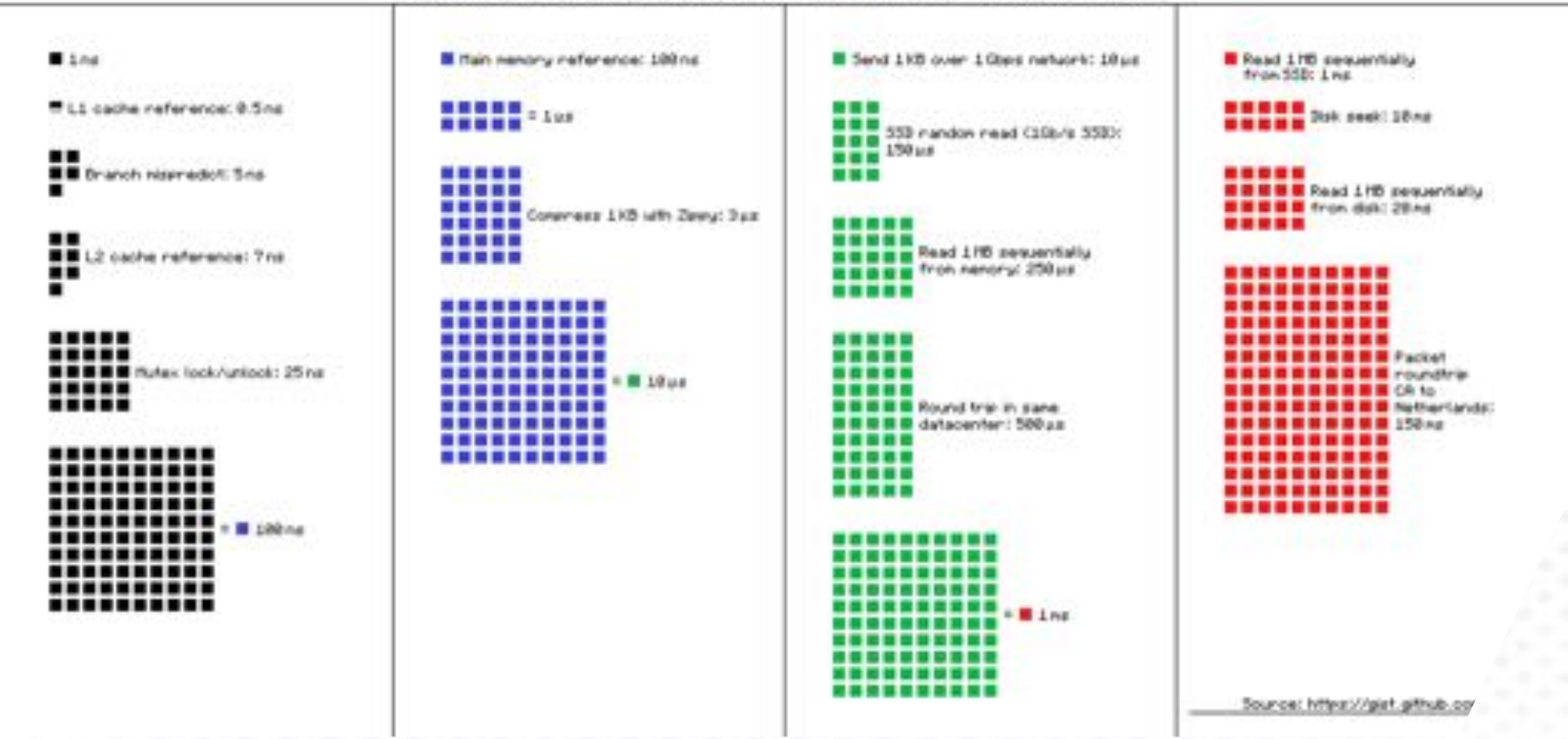
Program counter (PC)

Contains the address of the next instruction to be executed

Central Processing Unit (CPU)

ALU and the control unit called the Central Processing Unit, or CPU

Latency Numbers Every Programmer Should Know



Flow of Information

Bus

In general: A communication system that transfers data between components inside a computer or between computers; the medium (wires, optical fiber, etc.) and the protocols (rules for sharing the medium nicely)

"The" bus: Connects the CPU, main memory, I/O devices, and possibly other components (e.g. hard disk drive)

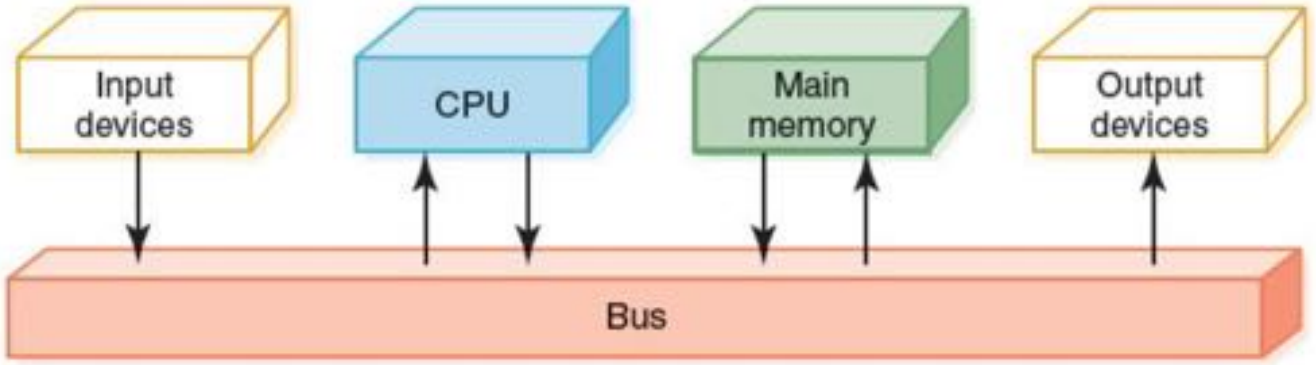
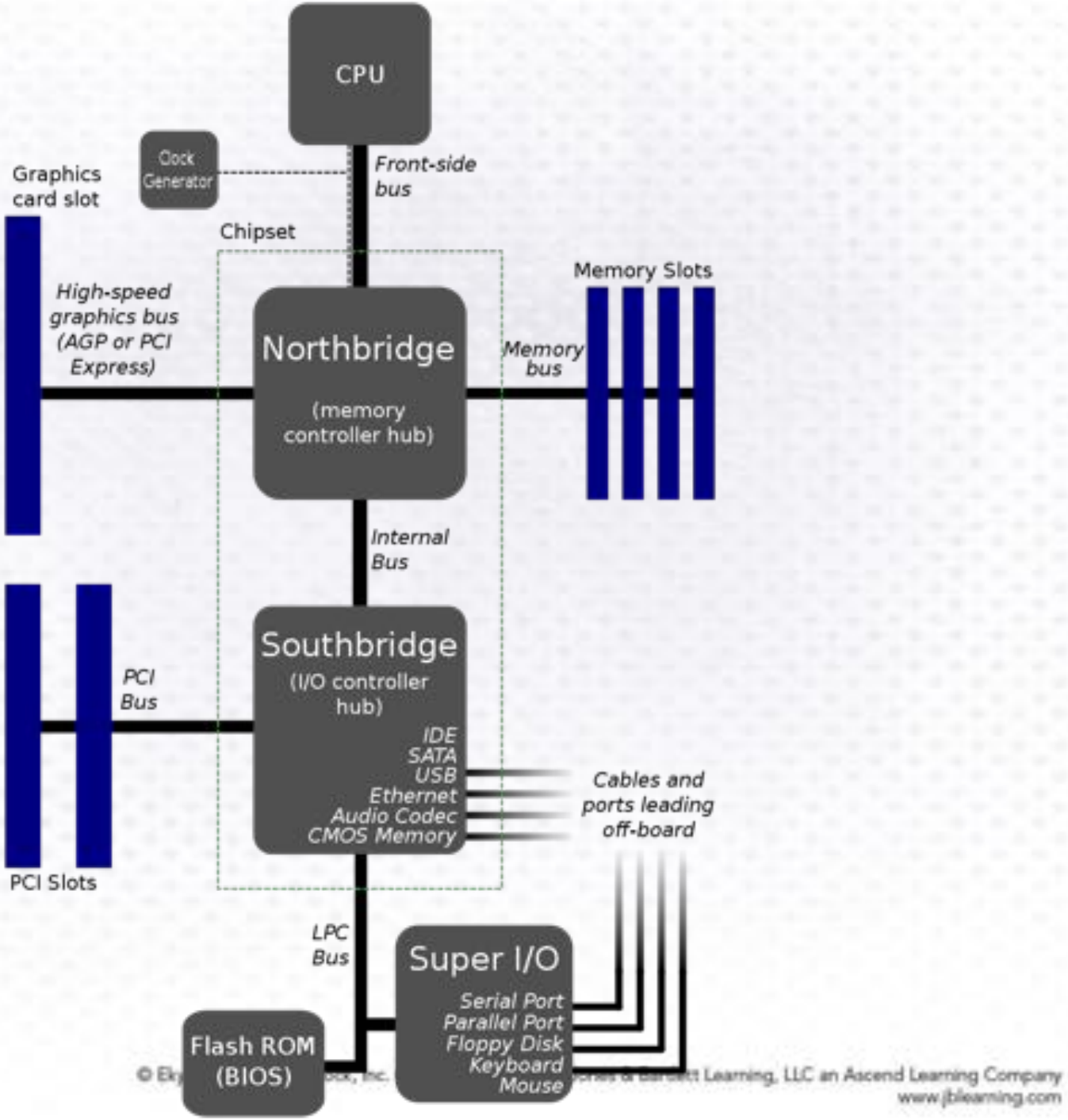
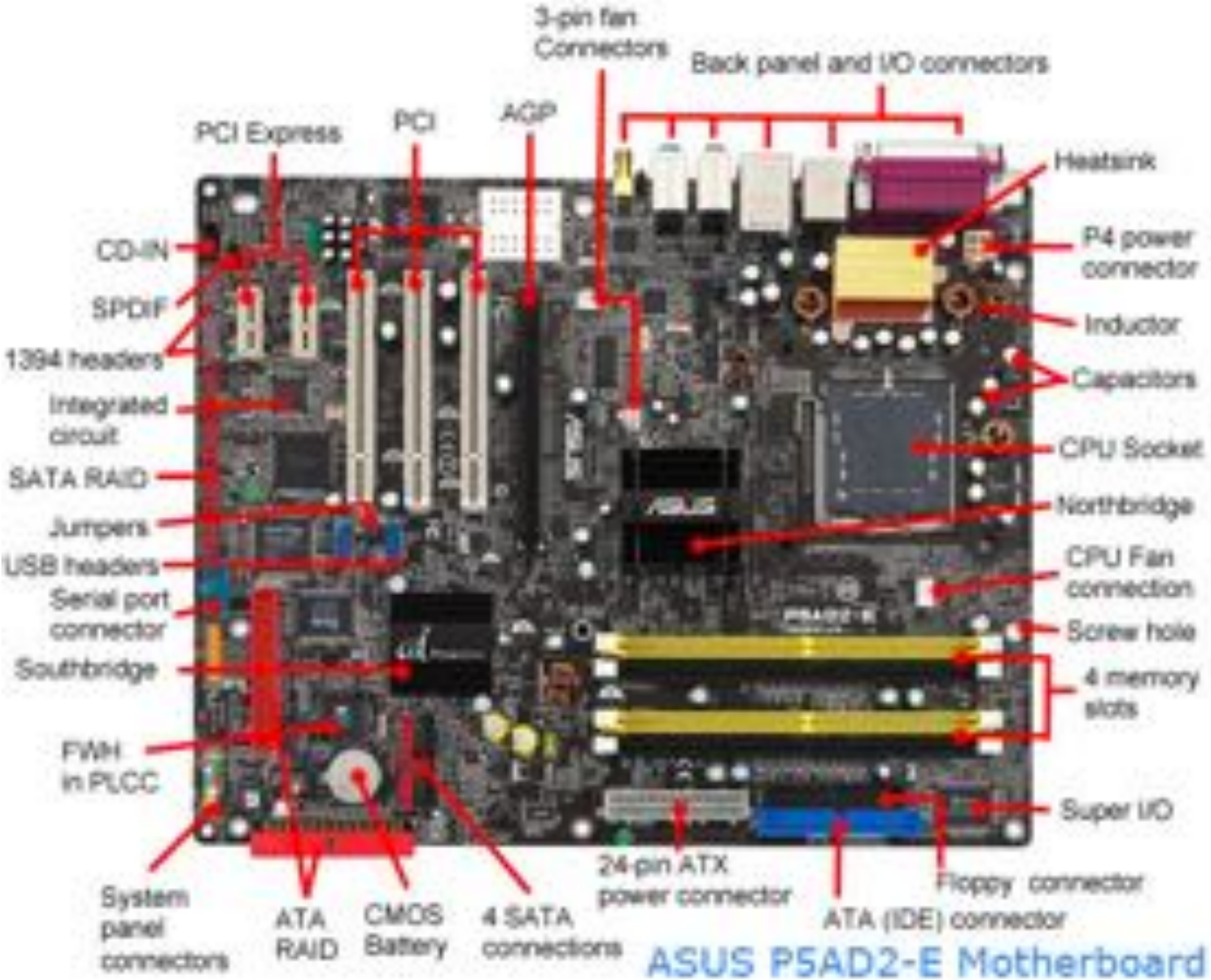


FIGURE 5.2 Data flow through a von Neumann machine


CPU
Clock Generator
Front-side bus
Graphics card slot
Chipset
Memory Slots
High-speed graphics bus (AGP or PCI Express)
Northbridge
(memory controller hub)
Memory bus
Internal Bus
Southbridge
(I/O controller hub)
PCI Bus
IDE
SATA
USB
Ethernet
Audio Codec
CMOS Memory
Cables and ports leading off-board
PCI Slots
LPC Bus
Super I/O
Serial Port
Parallel Port
Floppy Disk
Keyboard
Mouse
Flash ROM (BIOS)
Learning, LLC an Ascend Learning Company
www.jblearning.com


3-pin fan Connectors
Back panel and I/O connectors
PCI Express
PCI
AGP
Heatsink
CD-IN
SPDIF
1394 headers
Integrated circuit
SATA RAID
Jumpers
USB headers
Serial port connector
Southbridge
FWH in PLCC
P4 power connector
Inductor
Capacitors
CPU Socket
Northbridge
CPU Fan connection
Screw hole
4 memory slots
Super I/O
System panel connectors
ATA RAID
CMOS Battery
4 SATA connections
24-pin ATX power connector
ATA (IDE) connector
Floppy connector
ASUS P5AD2-E Motherboard


MemOK!
EPU
Low EMI
HDMI Interface
ASUS
P8H67-V
Anti-Surge
Windows 7 Ready!
Gb Lan
Auto Tuning
PCIe2.0 X16
GPU Boost
USB 3.0
ESD
CrossFireX Ready
SATA 6Gb/s
TurboV

What is an N-bit Processor?

It could mean any of these:

- N-bit general registers
- N-bit ALU
- N-bit addresses
- N-bit data bus

The Fetch-Execute Cycle

Fetch the next instruction

Decode the instruction

Get data if needed

Execute the instruction

Why is it called a cycle?

The Fetch-Execute Cycle

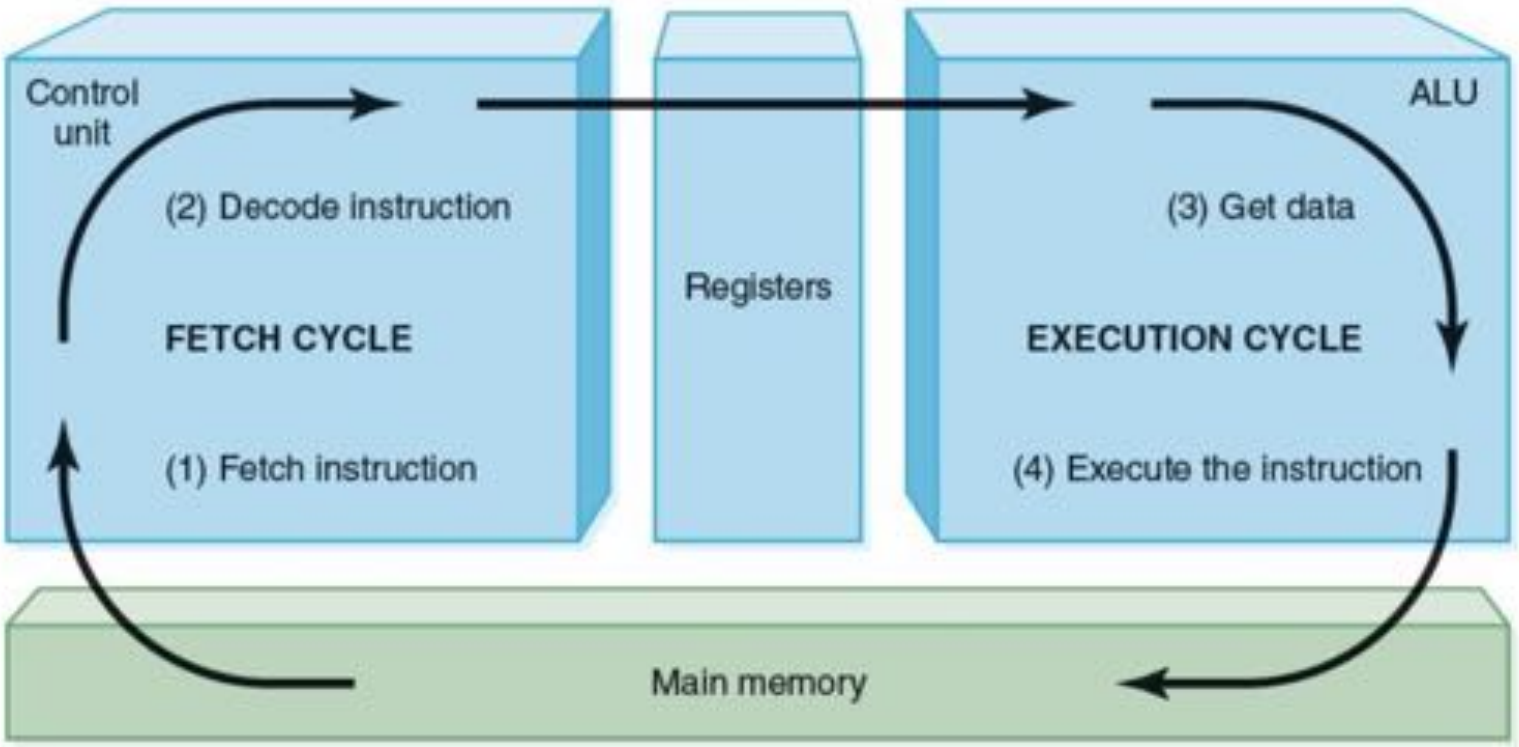


FIGURE 5.3 The fetch–execute cycle

RAM and ROM

Random Access Memory (RAM)

Memory in which each location can be accessed and changed

Read Only Memory (ROM)

Memory in which each location can be accessed but *not* changed

RAM is volatile, ROM is not

What does volatile mean?

Secondary Storage Devices

Why is it necessary to have secondary storage devices?

Can you name some of these devices?

Magnetic Tape

The first truly mass auxiliary storage device was the magnetic tape drive

Tape drives have a major problem; can you describe it?

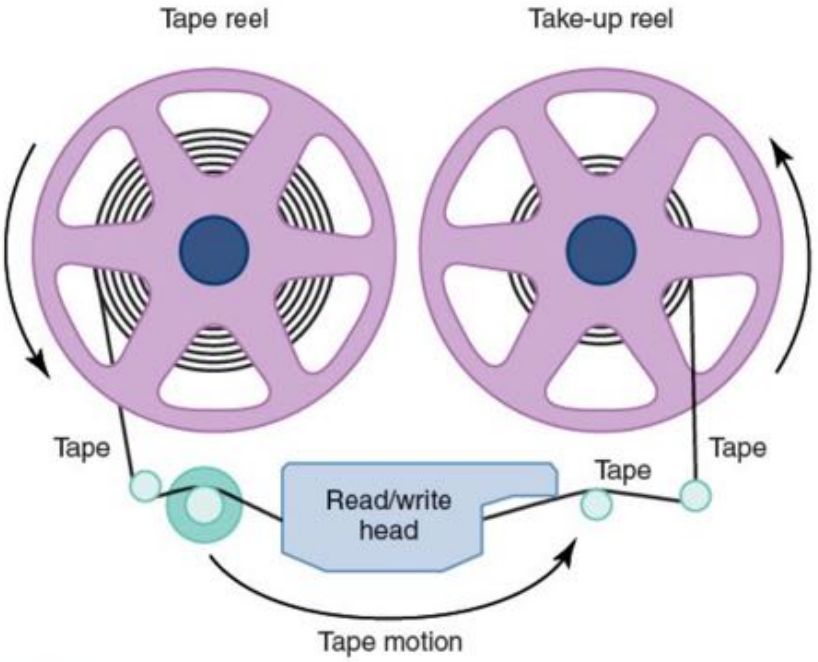


FIGURE 5.4 A magnetic tape

Magnetic Disks

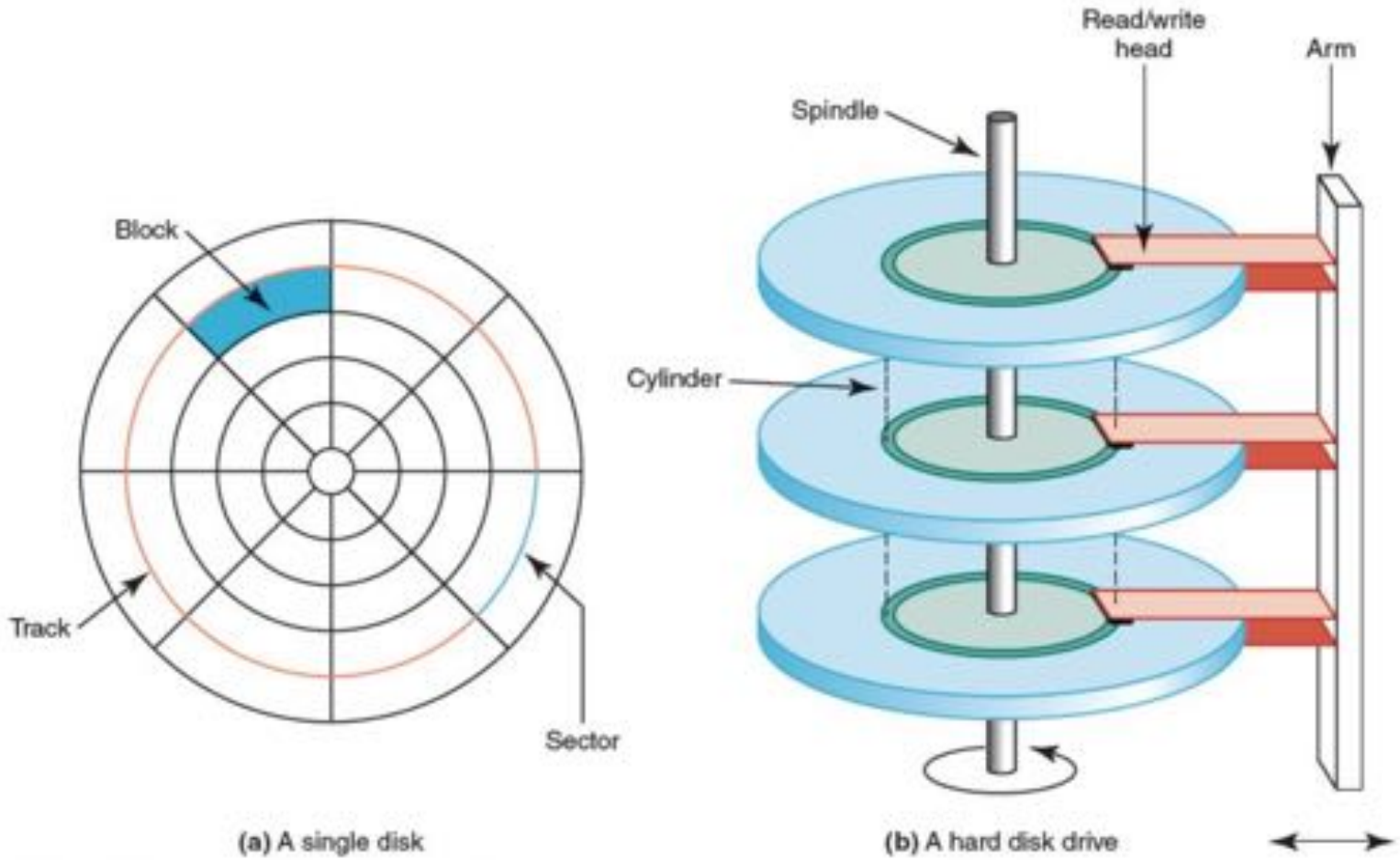


FIGURE 5.5 The organization of a magnetic disk

Magnetic Disks

Seek time

Time for read/write head to be over right track

Latency

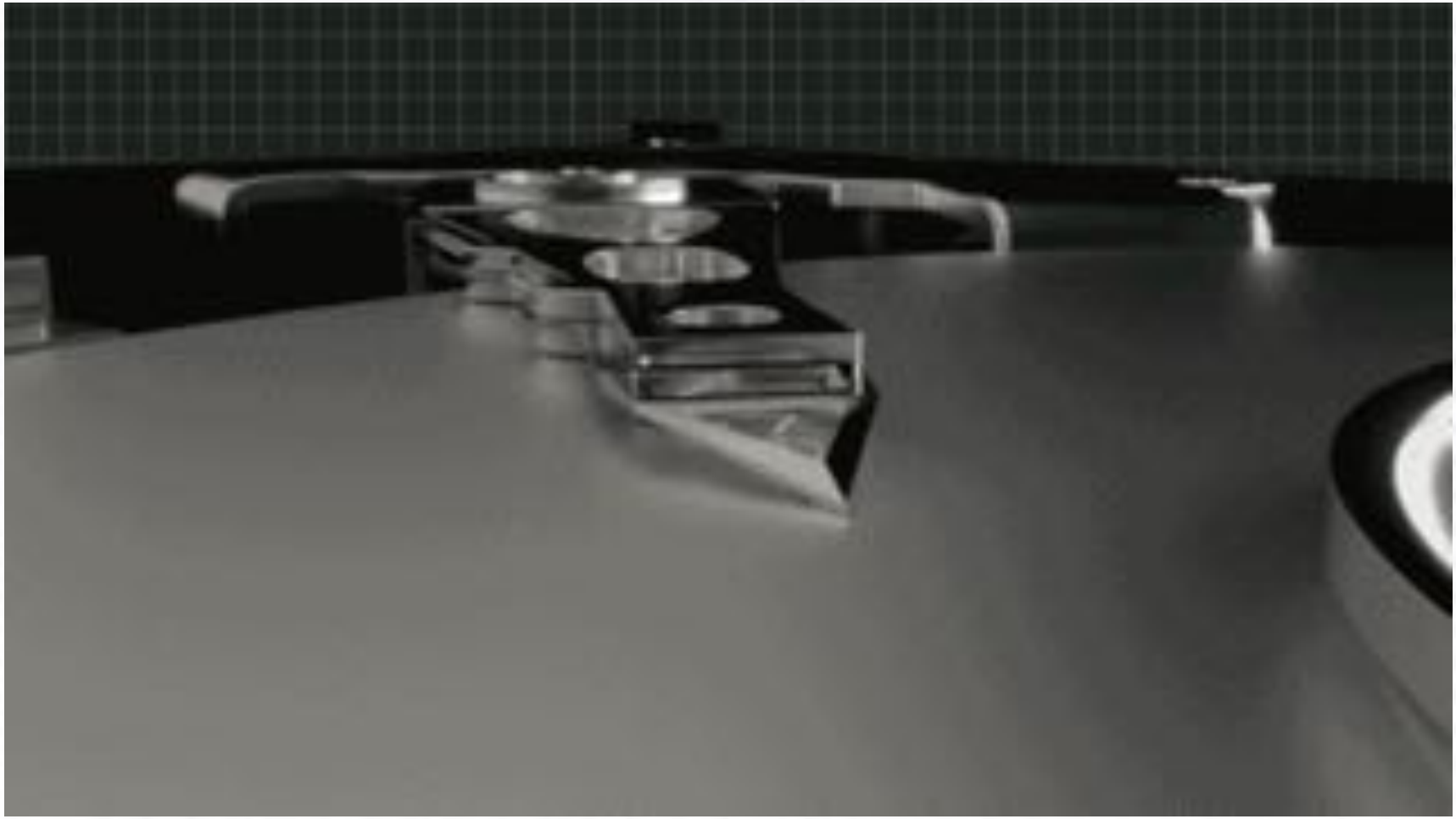
Time for sector to be in position

Access time

Can you define it?

Transfer rate

Rate at which data moves from the disk to memory



Optical Disks

CD

A compact disk that uses a laser to read information stored optically on a plastic-coated disk; data is evenly distributed around spiral track

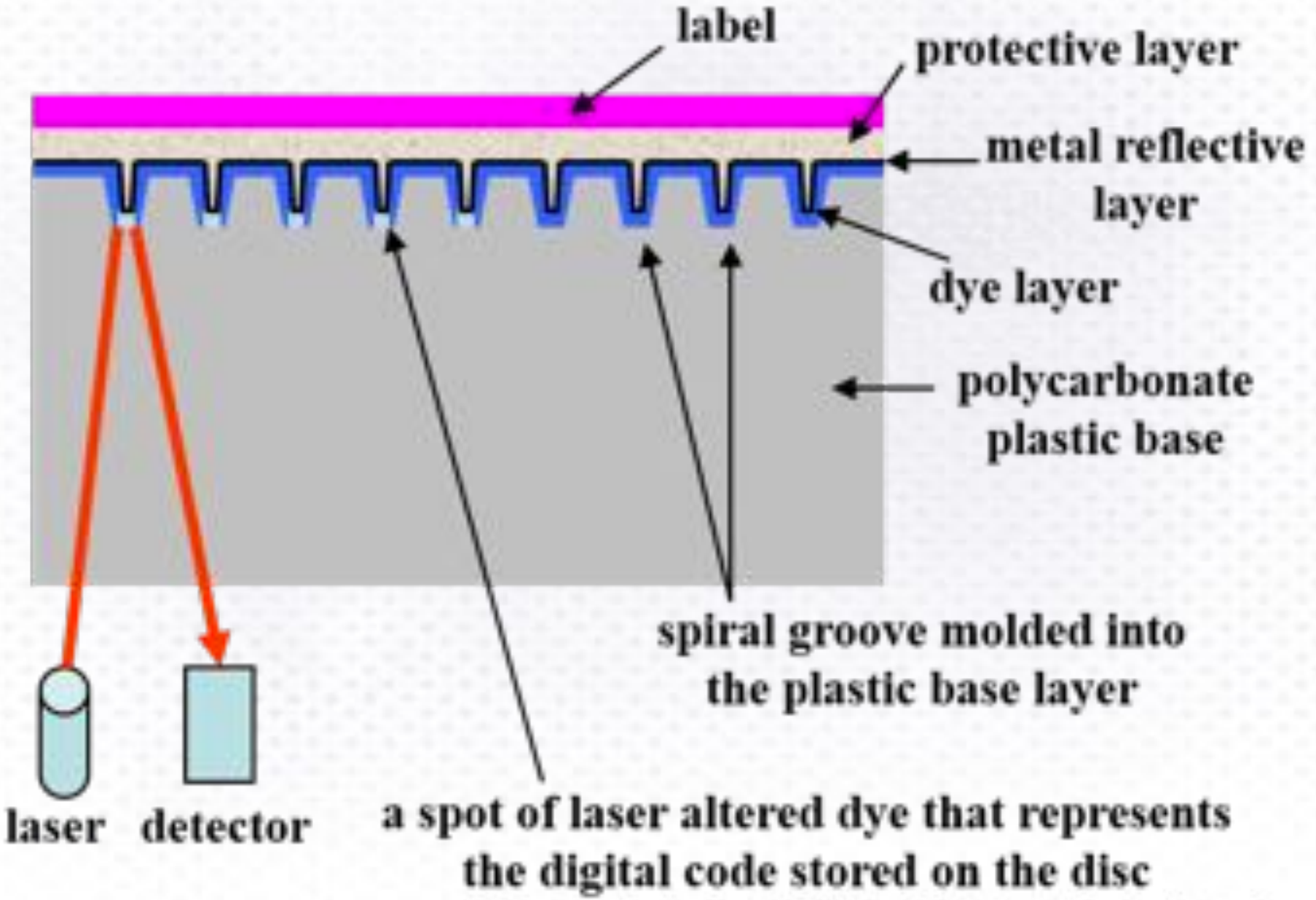
- CD-ROM read-only memory
- CD-DA digital audio
- CD-WORM write once, read many
- RW or RAM both read from and written to

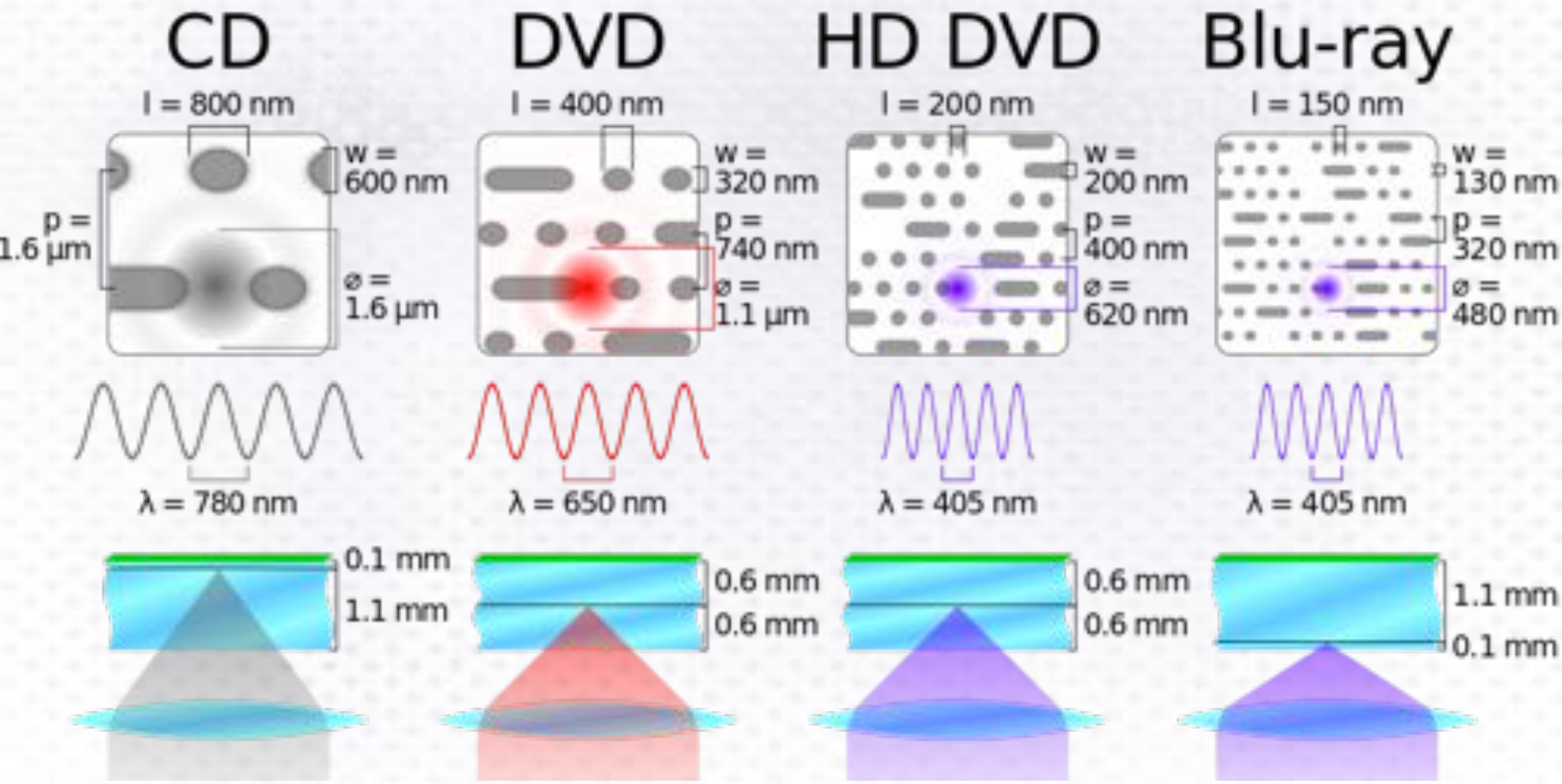
DVD

Digital Versatile Disk, used for storing audio and video

Blu-ray

Higher capacity DVD allowing higher resolution video, etc.





Flash Drives

Flash Memory

- Nonvolatile
- Can be erased and rewritten

Supports USB mass storage standard

FIGURE 5.6 Flash drive

© Brian A. Jackson/Shutterstock, Inc.

Touch Screens

Touch screen

A computer monitor that can respond to the user, touching the screen with a stylus or finger

There are four types

- Resistive
- Capacitive
- Infrared
- Surface acoustic wave (SAW)

Touch Screens

Resistive touch screen

A screen made up of two layers of electrically conductive material

- One layer has vertical lines, the other has horizontal lines
- When the top layer is pressed, it comes in contact with the second layer which allows electrical current to flow
- The specific vertical and horizontal lines that make contact dictate the location on the screen that was touched

Touch Screens

Capacitive touch screen

A screen made up of a laminate applied over a glass screen

- Laminate conducts electricity in all directions; a very small current is applied equally on the four corners
- When the screen is touched, current flows to the finger or stylus
- The location of the touch on the screen is determined by comparing how strong the flow of electricity is from each corner

Touch Screens

Infrared touch screen

A screen with crisscrossing horizontal and vertical beams of infrared light

- Sensors on opposite sides of the screen detect the beams
- When the user breaks the beams by touching the screen, the location of the break can be determined

Touch Screens

Surface acoustic wave (SAW)

A screen with crisscrossing high frequency sound waves across the horizontal and vertical axes

- When a finger touches the surface, corresponding sensors detect the interruption and determine location of the touch

Embedded Systems

Embedded systems

Computers that are dedicated to perform a narrow range of functions as part of a larger system

Empty your pockets or backpacks.

How many embedded systems do you have?

Parallel Computing

Four general forms:

- Bit-level parallelism
  - Bits can be processed simultaneously
  - Ex: Increasing word size
- Instruction-level parallelism
  - Instructions can be executed simultaneously
  - Ex: Pipelining (overlapping instructions)
  - Ex: Superscalar (multiple execution units)
- Data-level parallelism
  - Data subjected to same operation sequence simultaneously
  - Ex: Calculation of all student's GPAs simultaneously
- Task-level parallelism
  - Entire tasks can be completed simultaneously
  - Ex: Google servers – simultaneous independent searches
  - Ex: "Pipelined" processors

Shared Memory Parallel Processor

Communicate through shared memory

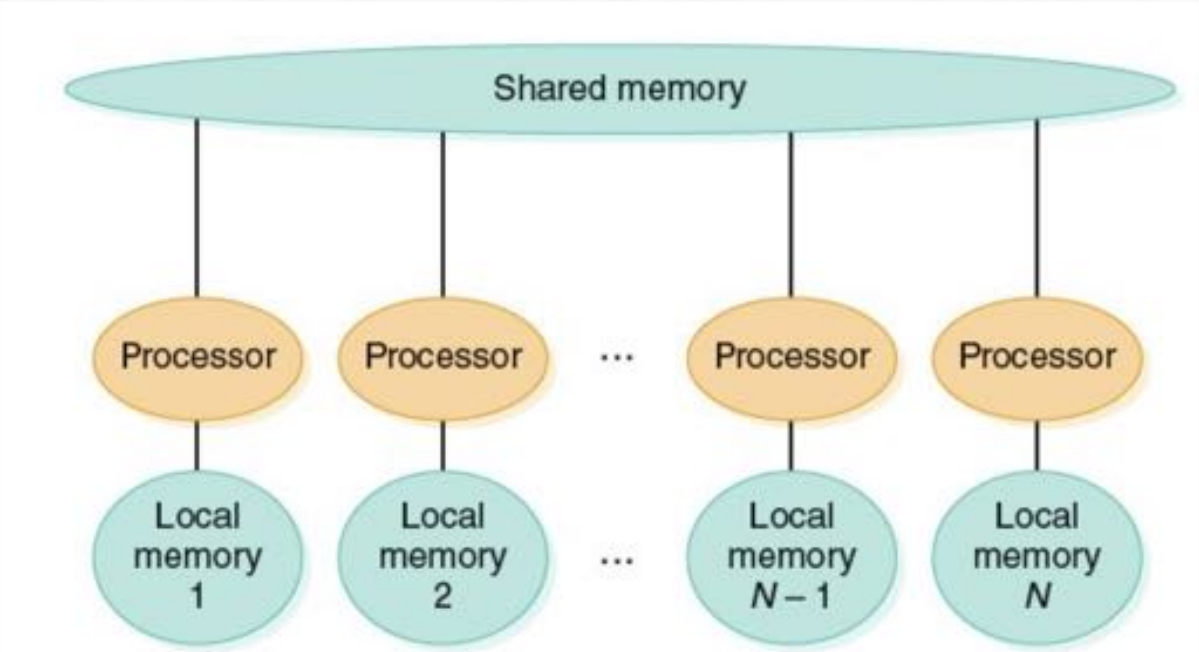


FIGURE 5.10 A shared-memory parallel processor

Ethical Issues

Is Privacy a Thing of the Past?

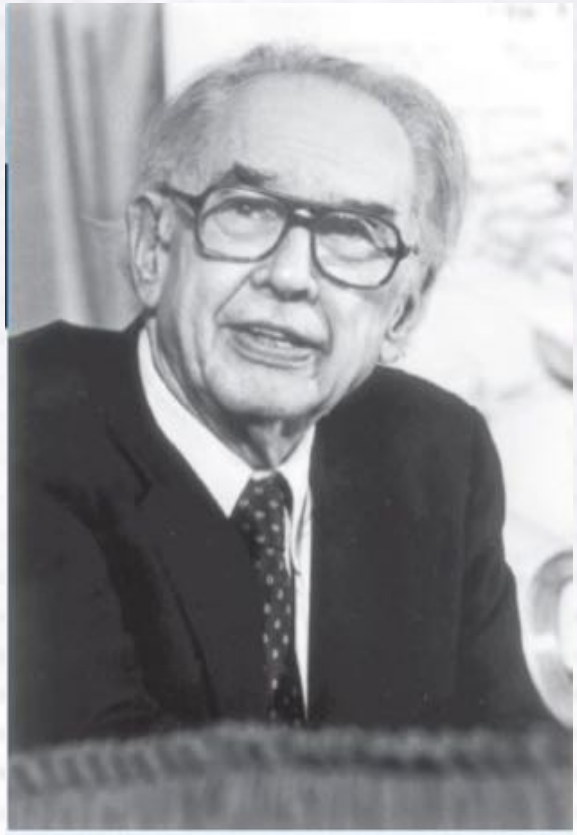
What does Austin Bay say about the printing press? The camera? The telegraph? The telephone?

Do you agree that personal privacy is “all but dead and gone”?

What, if anything, needs to be done about it?

What does Bay say about the future of institutional and state secrecy?

Who am I?



Courtesy of ISU Photo Service

A lawsuit determined my legacy. What was it all about?

Do you know?

?

Maurice Wilkes made what far-reaching Discovery within six weeks of beginning to program?

What was stolen at Target during the 2013 Christmas shopping season?

Bush received 4,258 votes and Kerry received 260 votes, out of 638 votes cast. ???

Why have spies infiltrated the fantasy world of virtual games?

What did President Obama refuse to give up?