Introduction to Management Information Systems

Hardware

Computer Systems

Learning objectives

- categorize the type of computer system that a business uses;
- recognize the different components of a computer;
- recognize the different types of a computer;
- understanding the processor and how the computer works;
- understanding input, output and storage devices;
- being aware of the associated technologies used in information systems

Information System

1. people
2. hardware
3. software
4. communications
5. data

introduction

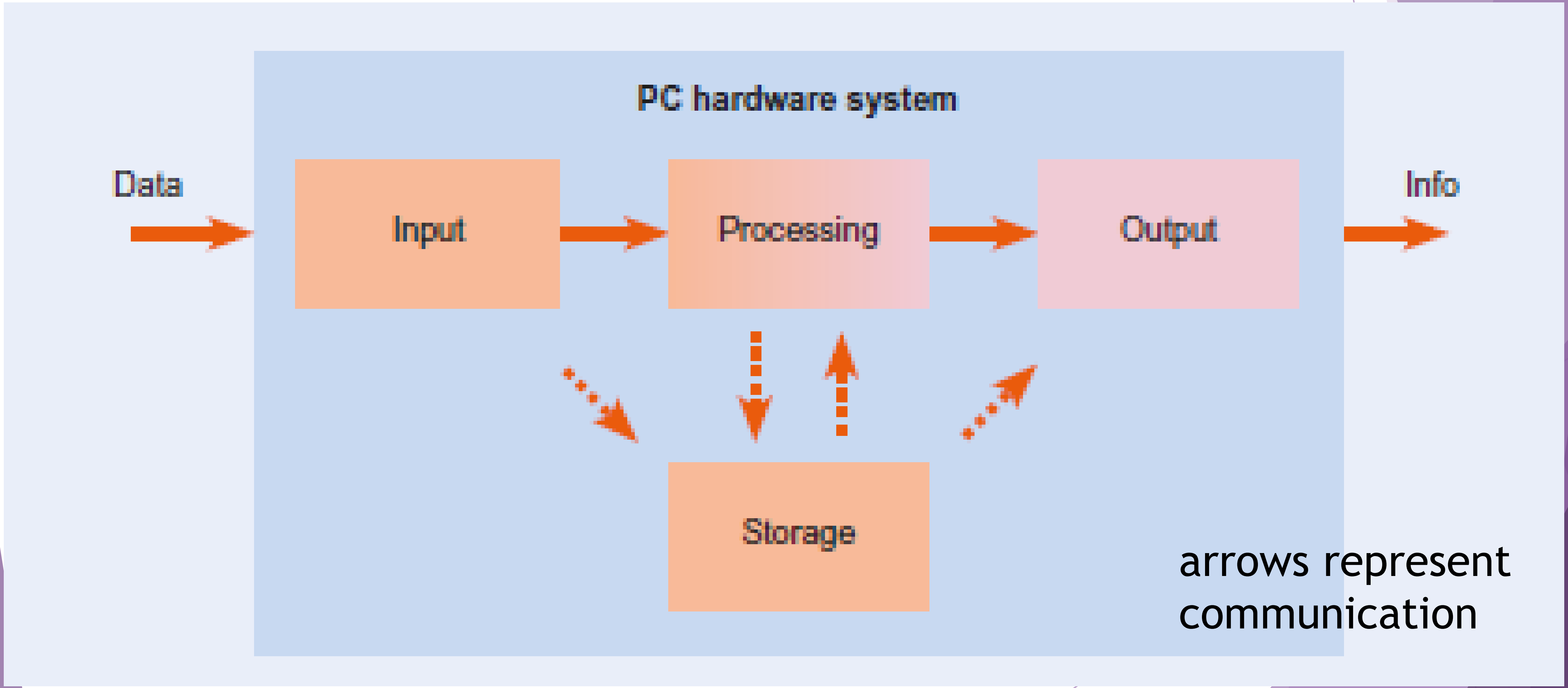
Hardware

hardware = physical components

system = components working together towards a goal

information system = converts data into information

Hardware



arrows represent communication

Hardware

input devices

- enter or capture data
- convert into the appropriate format
- human-readable form -> form computer uses

processor (CPU)

- computer ‘brain’
- carries out instructions (software)

Hardware

memory

- temporary storage of data & instructions

storage devices

- stores data & programs
- e.g. hard drive
- more permanent storage

output devices

- translates processing output
- computer-readable form -> form humans understand

device

Electricity

- Computers run on electricity
- Electricity has two states, on or off.
- So if you press a ‘G’ on the keyboard this is translated into ‘01000111’ where ‘0’ is off and ‘1’ is on.
- Eight transistors are either on or off.
- each ‘0’ or ’1’ is a bit
- 8 bits is a byte.

Transistors

Transistors changed everything.

- Vacuum tubes were used to control the electronic current in devices such as radios and TVs.
- Transistors are semiconductors of electricity used as switches for an ‘on’ or ‘off’ current.

Add agents to a part of the transistor to make it a ‘passer’ or ‘receiver’ of electrons.

- They control the movement of electrons therefore electricity.
- when the electrons are passed a circuit is complete, when they do not pass then the circuit is not complete.

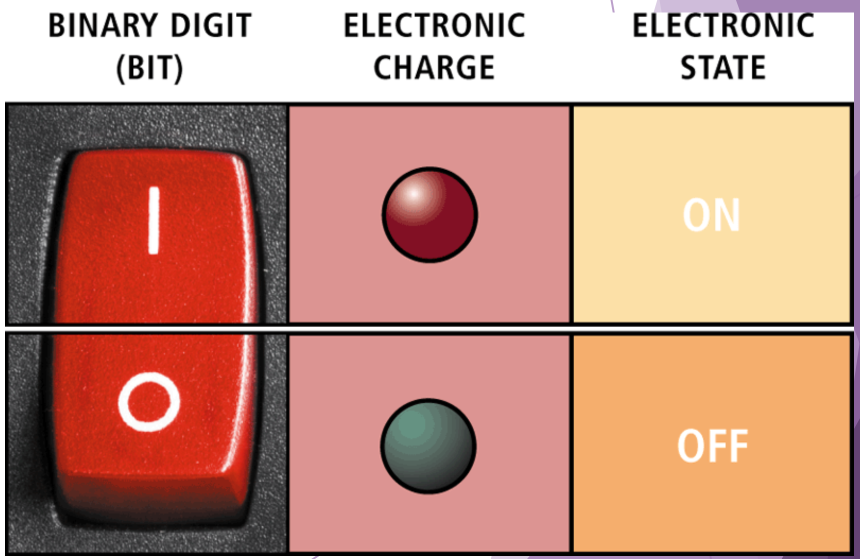
Data Representation

Analog signals are continuous and vary in strength and quality

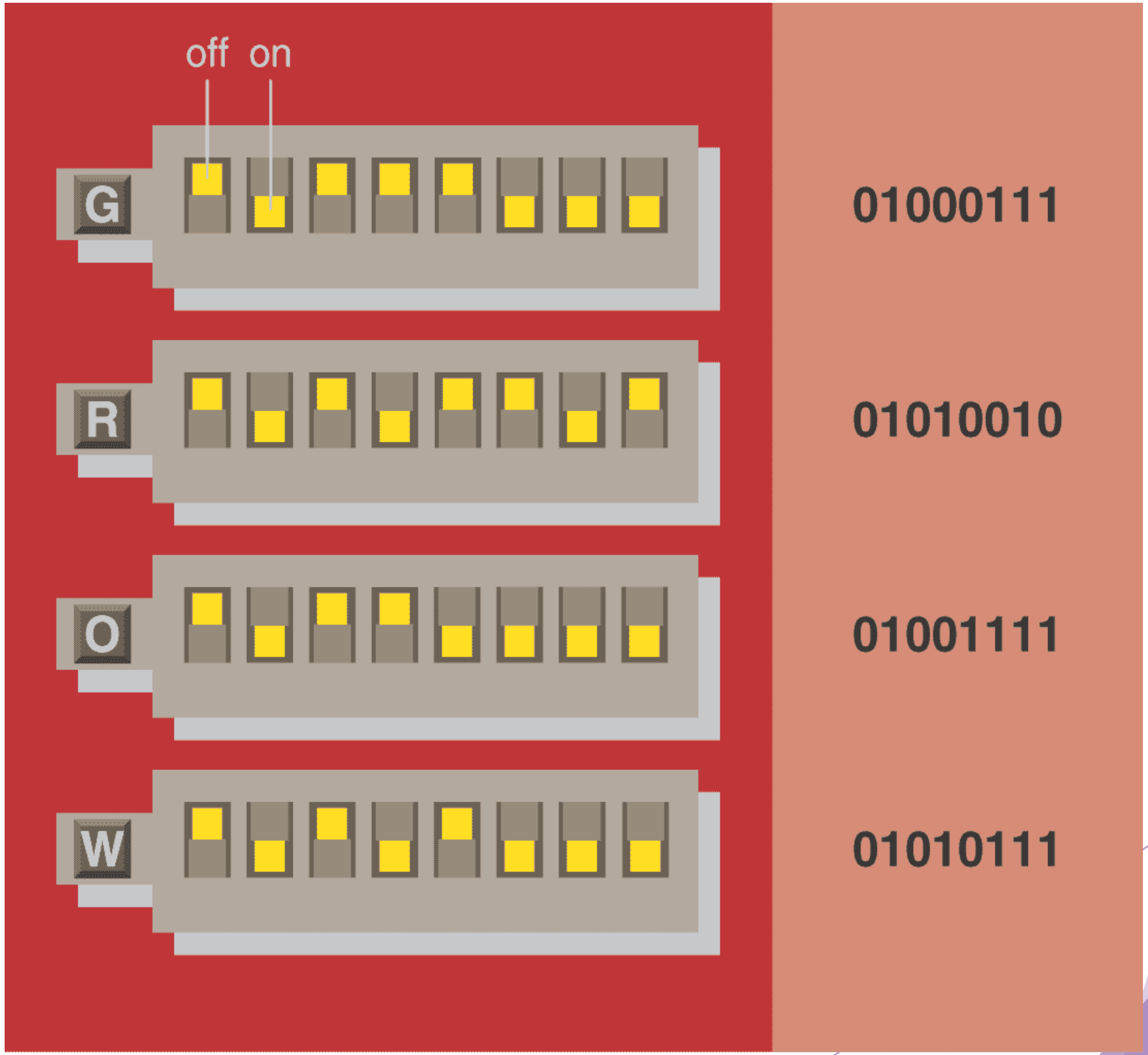
Digital signals are in one of two states: on or off

A computer circuit represents the 0 or the 1 electronically by the presence or absence of an electrical charge

Eight bits grouped together as a unit are called a byte. A byte represents a single character in the computer



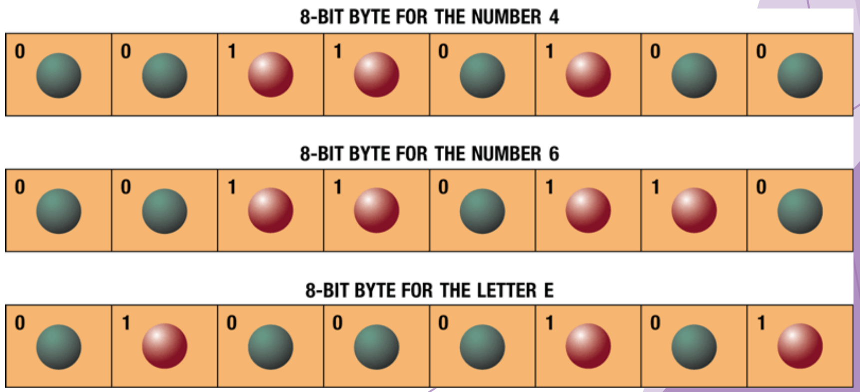
Binary data representation



Data Representation

ASCII	SYMBOL	ASCII	SYMBOL
00110000	0	01001110	N
00110001	1	01001111	O
00110010	2	01010000	P
00110011	3	01010001	Q
00110100	4	01010010	R
00110101	5	01010011	S
00110110	6	01010100	T
00110111	7	01010101	U
00111000	8	01010110	V
00111001	9	01010111	W
01000001	A	01011000	X
01000010	B	01011001	Y
01000011	C	01011010	Z
01000100	D	00100001	!
01000101	E	00100010	
01000110	F	00100011	#
01000111	G	00100100	$
01001000	H	00100101	%
01001001	I	00100110	&
01001010	J	00101000	(
01001011	K	00101001	)
01001100	L	00101010	*
01001101	M	00101011	+

- ASCII (*American Standard Code for Information Interchange*) is the most widely used coding scheme to represent data



Binary coding schemes

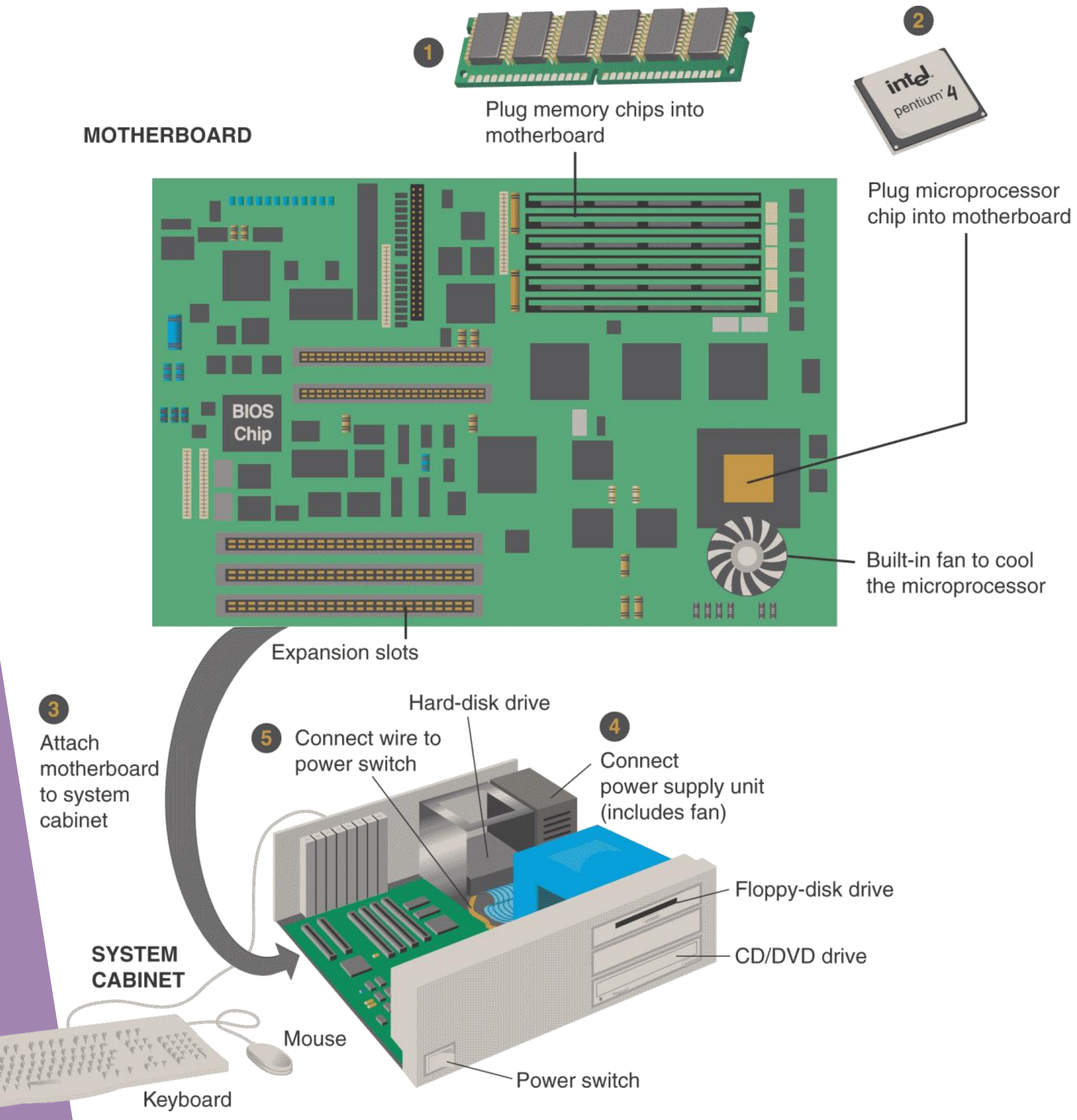
- Binary coding schemes assign a unique binary code to each letter
  - ASCII
    - Requires 7 or 8 bits per character, depending on the version
    - 8 bit Extended ASCII provides 256 characters
    - Used for PCs, Unix hosts, Macs
  - Unicode
    - Requires 16 bits per character
    - Handles 65,536 characters—used for Thai, Chinese, Japanese and Korean

Errors

- factors can interfere with a circuit (or communication line)
  - *electrical disturbance, weather, dust*
- computers check for errors using a check bit or **Parity Bit**
- even parity – even amount of ‘1’s.
  - e.g. 01001000 - 0 parity bit
- odd parity – odd amount of ‘1’s.
  - e.g. 01001000 -1 parity bit

inside a computer

on the motherboard



inside of computers

- motherboard
- CPU
- memory
- storage
- communications & input / output (I/O)
- slots / cables

The System Unit

panel 4.7

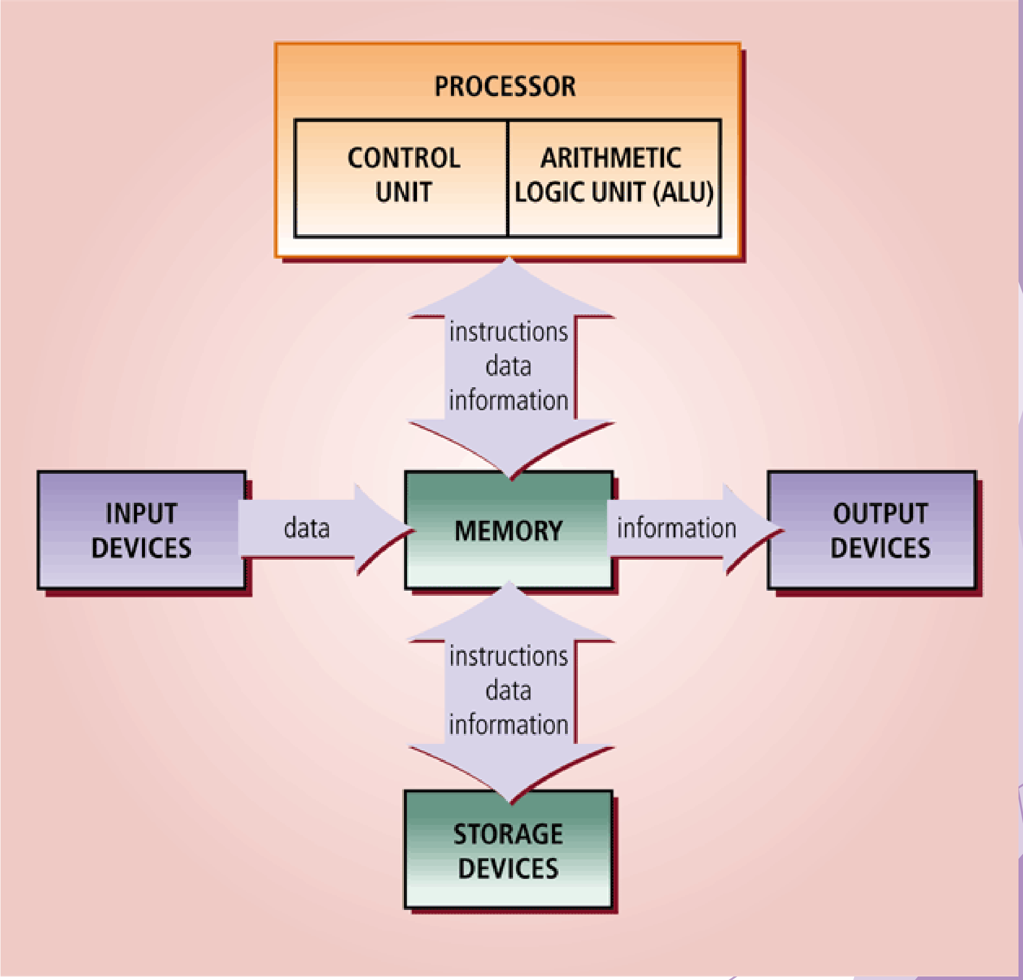
The system unit

Interior views of the box, or case. It includes the motherboard, power supply, and storage devices. (The arrangement of the components varies among models.)

Processor / CPU

The control unit directs & coordinates most operations in the computer. It deciphers instructions and carries them out

The arithmetic logic unit (ALU) performs arithmetic, comparison, and other operations



System Clock

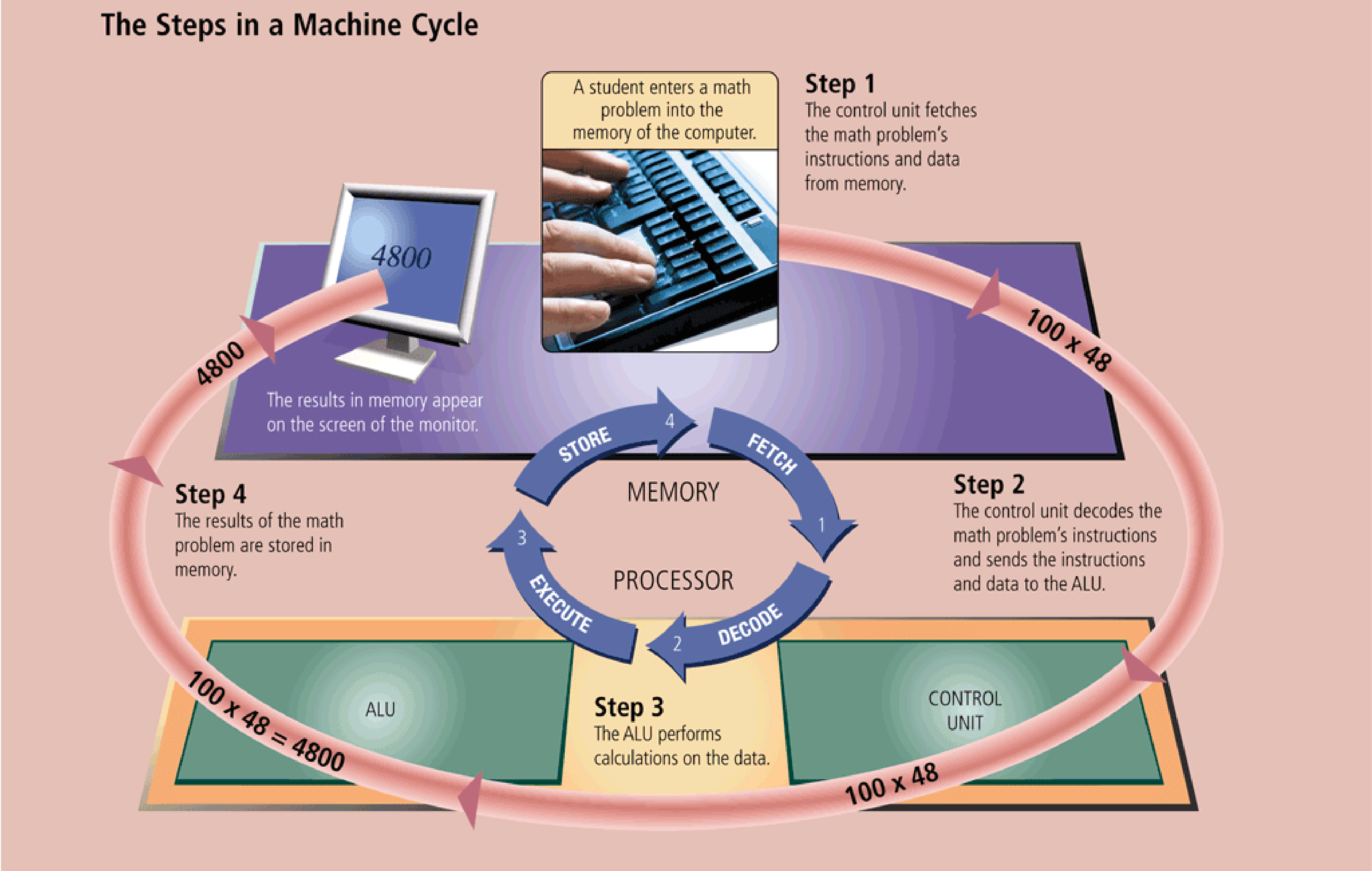
The processor contains registers, that temporarily hold data and instructions

The **system clock** controls the timing of all computer operations

- The pace of the system clock is called the **clock speed**, and is measured in **gigahertz (GHz)**

Machine Cycle

For every instruction, a processor repeats a set of four basic operations, which comprise a machine cycle



Chips

Microprocessor

- Motherboard controls what the computer does
- The brain is the microprocessor chip
- The transistors are the key part of the microprocessor chip
- Intel Pentium / Celeron , AMD Athlon

Chipset

- Motherboard chips that control the information flow from the processor & the other system components

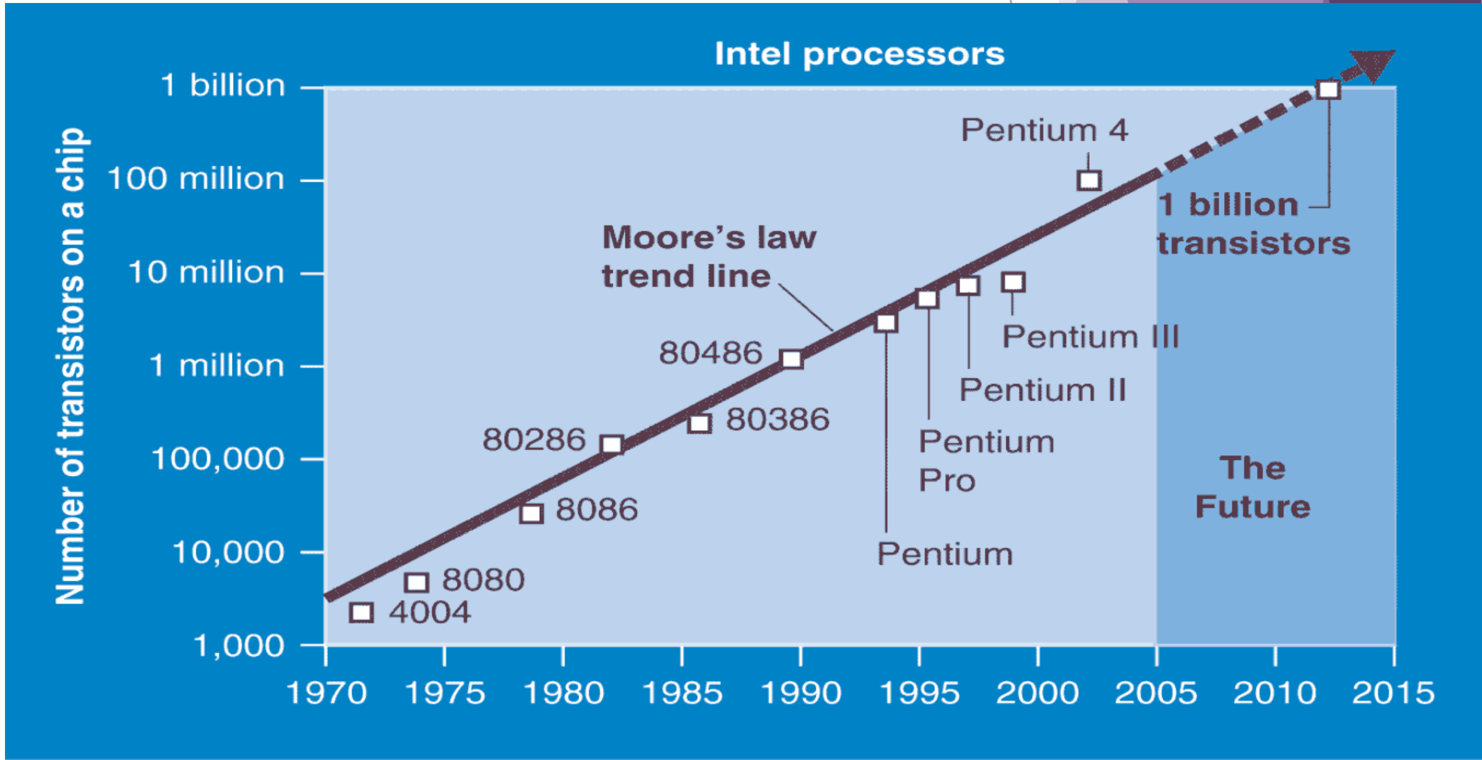
Chip

- a computer chip is a small piece of semi-conducting material normally silicon
- integrated circuits are etched onto the chip
- these circuits contain pathways for carrying an electronic current
- they contain resisters, capacitors and transistors.

Moore’s Law

Gordon Moore predicted the number of transistors on a silicon chip will double every 18 months

transistors on a chip
1961 4
1971 2,300
1979 30,000
1997 7.5 million
2008 2 billion
now?



Processor speed

- GHz gigahertz a billion cycles per second
- Other measurements for speed include:
  - MIPS (*million instructions per second*)
  - FLOPS (*floating point operations per second*)

Example:

280 teraflops = 280 trillion ops. per sec.

1 petaflop = 1,000 trillion ops. per sec.

Millisecond = 1/1000 second (thousand)

Microsecond = 1/1,000,000 second (million)

Nanosecond = 1/1,000,000,000 second (billion)

Picosecond = 1/1,000,000,000,000 second (trillion)

Multi-core processors

Multi-core processor	**Dual-core processor**	**Quad-core processor**

Multi-core processors

- faster processors require
  - more power and
  - produce more heat
- each core is treated by the operating system as a processor
  - e.g. dual-core 2 cores on one chip
- dual-core not as fast as two single-core processors but not too far away
- good for running several programs at the same time

processing

Word Size

The number of bits the processor can process at any one time

Registers

High-speed storage areas that temporarily store data during processing

Buses

transmit bits within the CPU and between CPU and other motherboard components

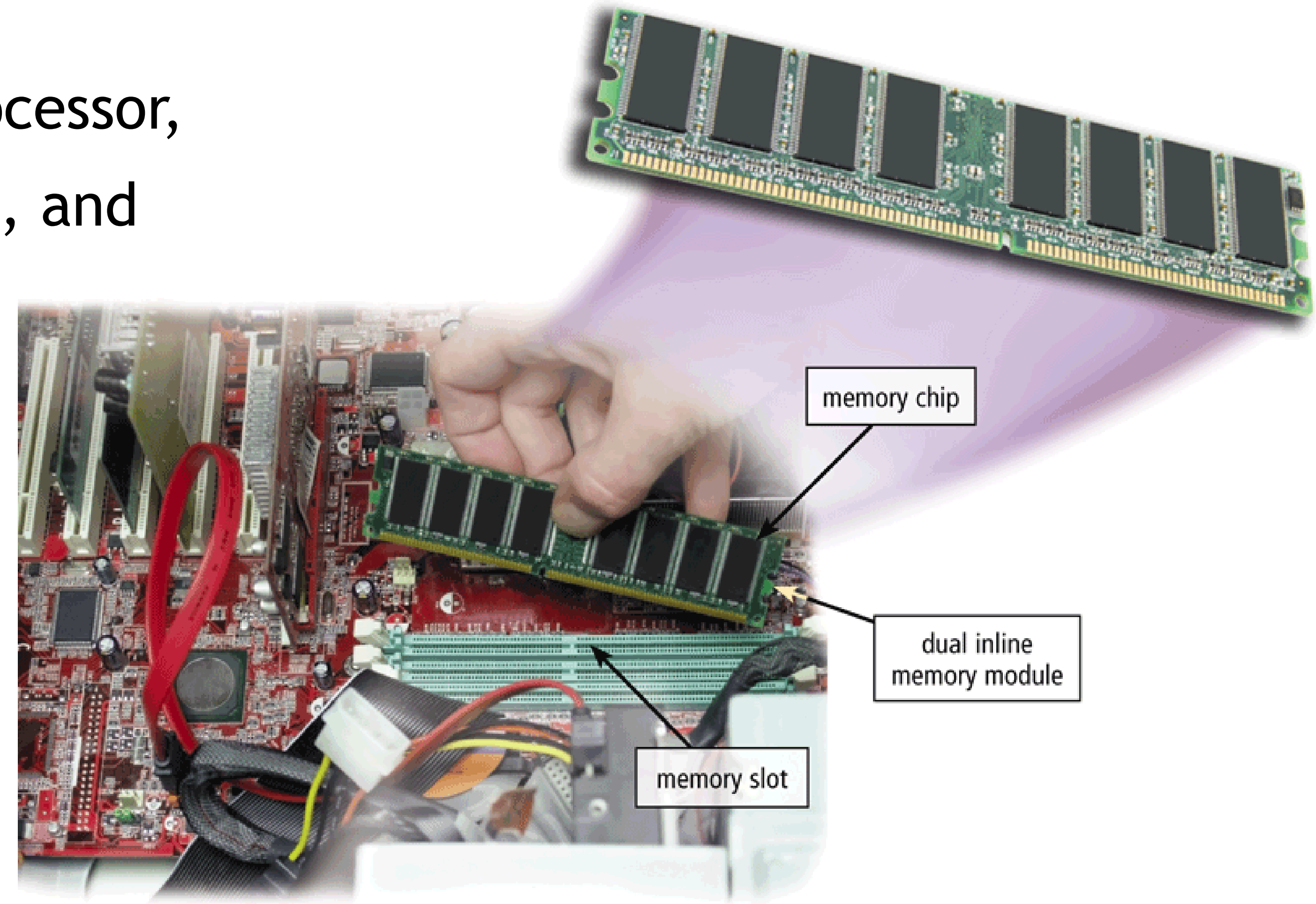
memory

memory

- consists of electronic components
- that store instructions
- waiting to be executed by the processor,
- data needed by those instructions, and
- the results of processing the data

RAM chips

- reside on a **memory module**
- inserted into **memory slots**



Memory

Memory consists of electronic components that store

- instructions waiting to be executed by the processor,
- data needed by those instructions, and
- the results of processing the data

Stores three basic categories of items:

- The operating system and other system software
- Application programs
- Data being processed and the resulting information

Memory

- Each location in memory has an address
- Memory size is measured in **kilobytes** (**KB** or **K**), **megabytes** (**MB**), **gigabytes** (**GB**), or **terabytes** (**TB**)
- petabyte: 1 quadrillion bytes
- exabyte: 1 quintillion bytes

Memory Sizes

Term	Abbreviation	Approximate Number of Bytes	Exact Number of Bytes	Approximate Number of Pages of Text
Kilobyte	KB or K	1 thousand	1,024	1/2
Megabyte	MB	1 million	1,048,576	500
Gigabyte	GB	1 billion	1,073,741,824	500,000
Terabyte	TB	1 trillion	1,099,511,627,776	500,000,000

How Memory Works

- Primary storage = “memory,” “main memory,” “RAM”; this type of memory is <u>temporary</u> and <u>volatile</u>

- Secondary storage = “storage” disks and tape; this type of memory is relatively <u>permanent</u> and <u>nonvolatile</u>

Memory

Volatile memory

Loses its contents when power is turned off

Example includes **RAM**

Nonvolatile memory

Does not lose contents when power is removed

Examples include ROM, flash memory, and CMOS

Types of Memory

<u>Memory Chip</u>

1. RAM
2. ROM
3. CMOS
4. Flash

1. Random Access Memory chips are volatile and hold:
   a. Software instructions
   b. Data before & after the CPU processes it
2. Read only memory
   a. Cannot be written on or erased without special equipment
   b. Are loaded at factory with fixed start-up instructions
3. Complementary Metal Oxide Semiconductor (CMOS)
   a. Powered by a battery
   b. Contains time, date, calendar, boot password
4. Flash memory - Nonvolatile memory that can be erased and reprogrammed more than once
   a. Doesn't require a battery
   b. Used in newer PCs for BIOS instructions

Dynamic RAM (DRAM)

Static RAM (SRAM)

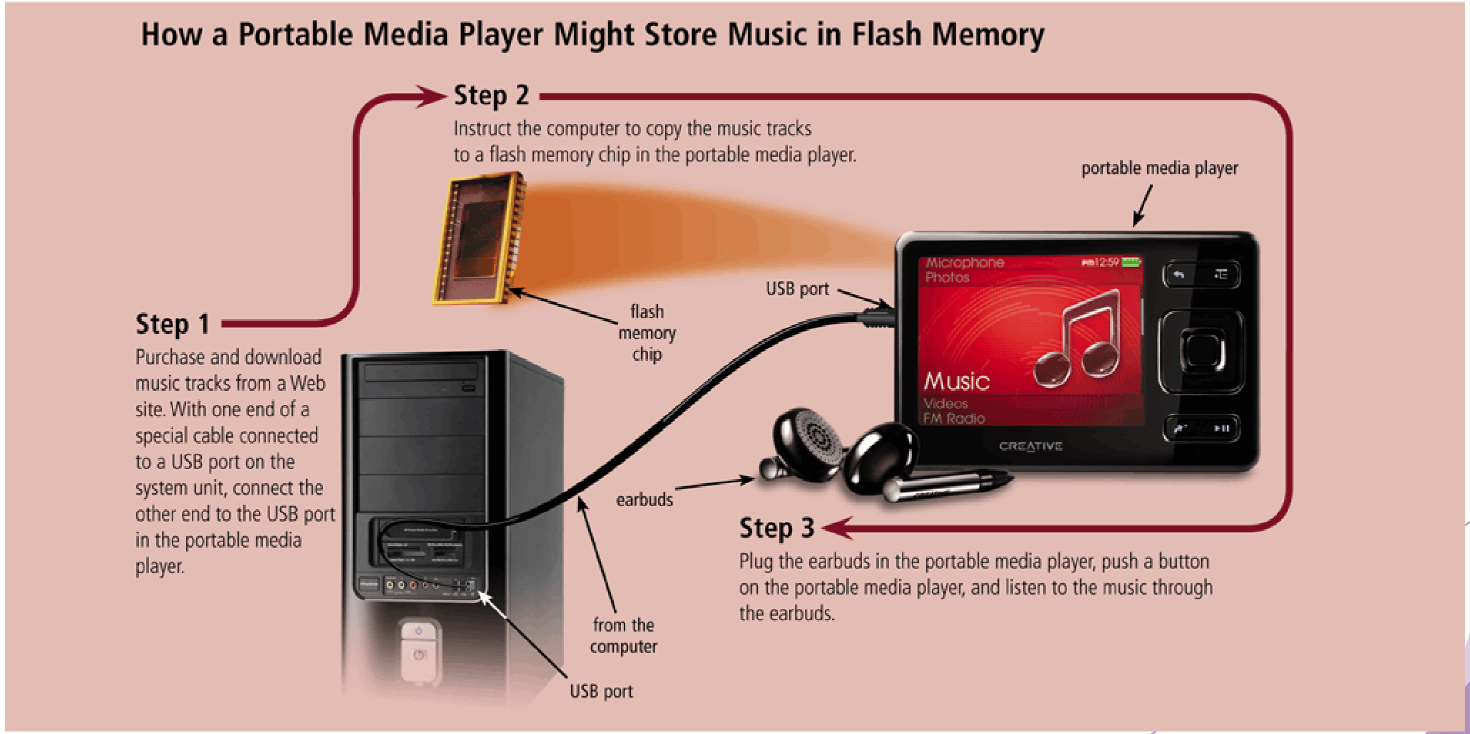
Magnetoresistive RAM (MRAM)

DRAM Variations

Name	Comments
SDRAM (Synchronous DRAM)	• synchronized to the system clock • much faster than DRAM
DDR SDRAM (Double Data Rate SDRAM)	• transfers data twice, instead of once, for each clock cycle • faster than SDRAM
DDR2	• second generation of DDR • faster than DDR
DDR3	• third generation of DDR • designed for computers with multi-core processors • faster than DDR2
RDRAM (Rambus DRAM)	• uses pipelining techniques • much faster than SDRAM

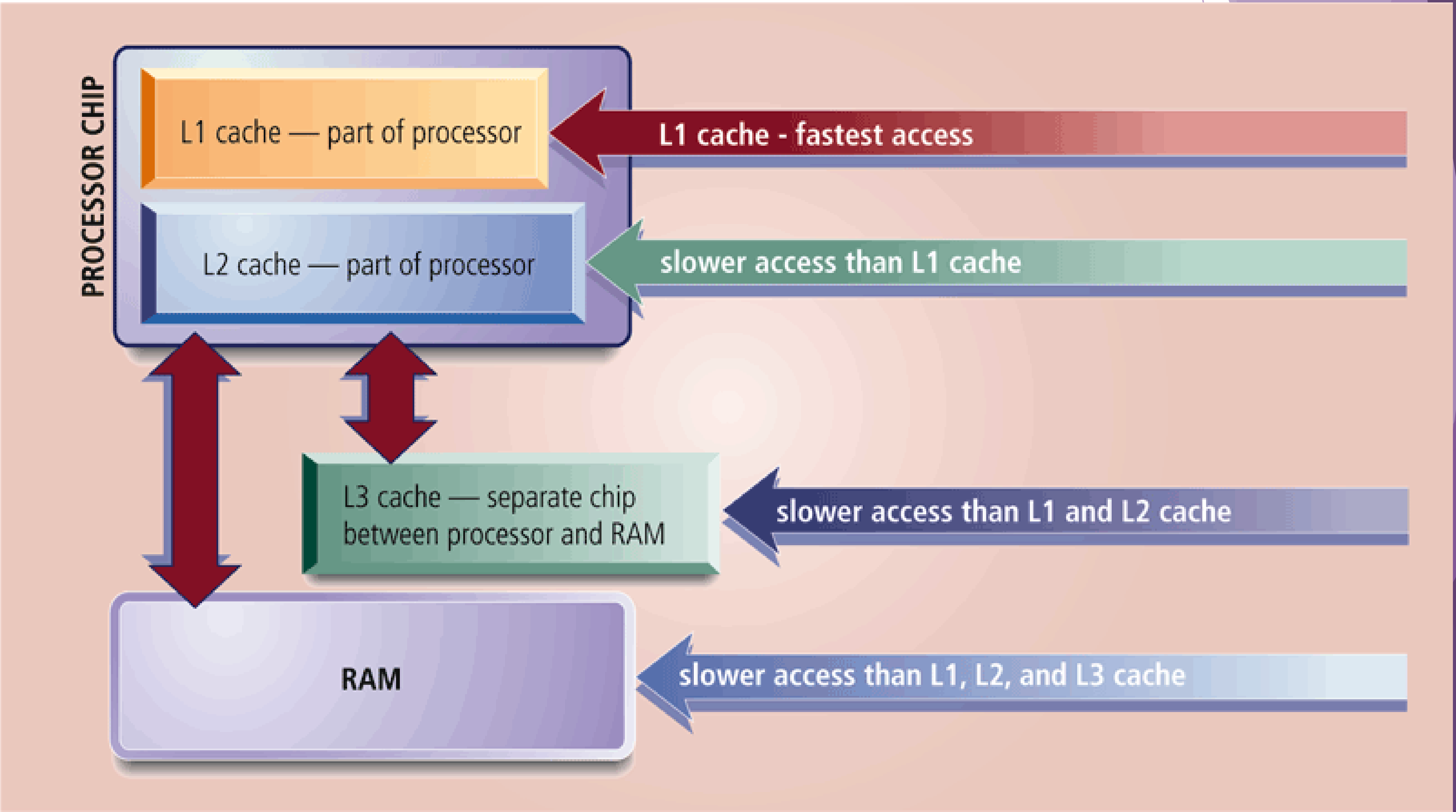
Memory

- **Flash memory** can be erased electronically and rewritten
  - **CMOS** technology provides high speeds and consumes little power



memory

Cache memory speeds the processes of the computer because it stores frequently used instructions and data



Memory

Access time is the amount of time it takes the processor to read from memory

- Measured in **nanoseconds**

Access Time Terminology

Term	Abbreviation	Speed
Millisecond	ms	One-thousandth of a second
Microsecond	μs	One-millionth of a second
Nanosecond	ns	One-billionth of a second
Picosecond	ps	One-trillionth of a second

processing

Speeding up Processing

The CPU works much faster than RAM

Cache temporarily stores instructions and data that the processor uses frequently to speed up processing

- Level 1 cache is part of the microprocessor
- Level 2 cache is SRAM external cache
- Level 3 cache is on the motherboard

Speeding up Processing

- Virtual Memory—also used to speed up processing
  - This type of memory is unused hard disk or optical (CD) space that the processor uses to extend the capacity of RAM
  - The processor goes first to L1 cache, then L2 cache, then RAM, then virtual memory
  - Each type of memory is slower than its predecessor

Speeding up Processing

Method

1. Interleaving
2. Bursting
3. Pipelining
4. Superscalar Architecture
5. Hyper-threading

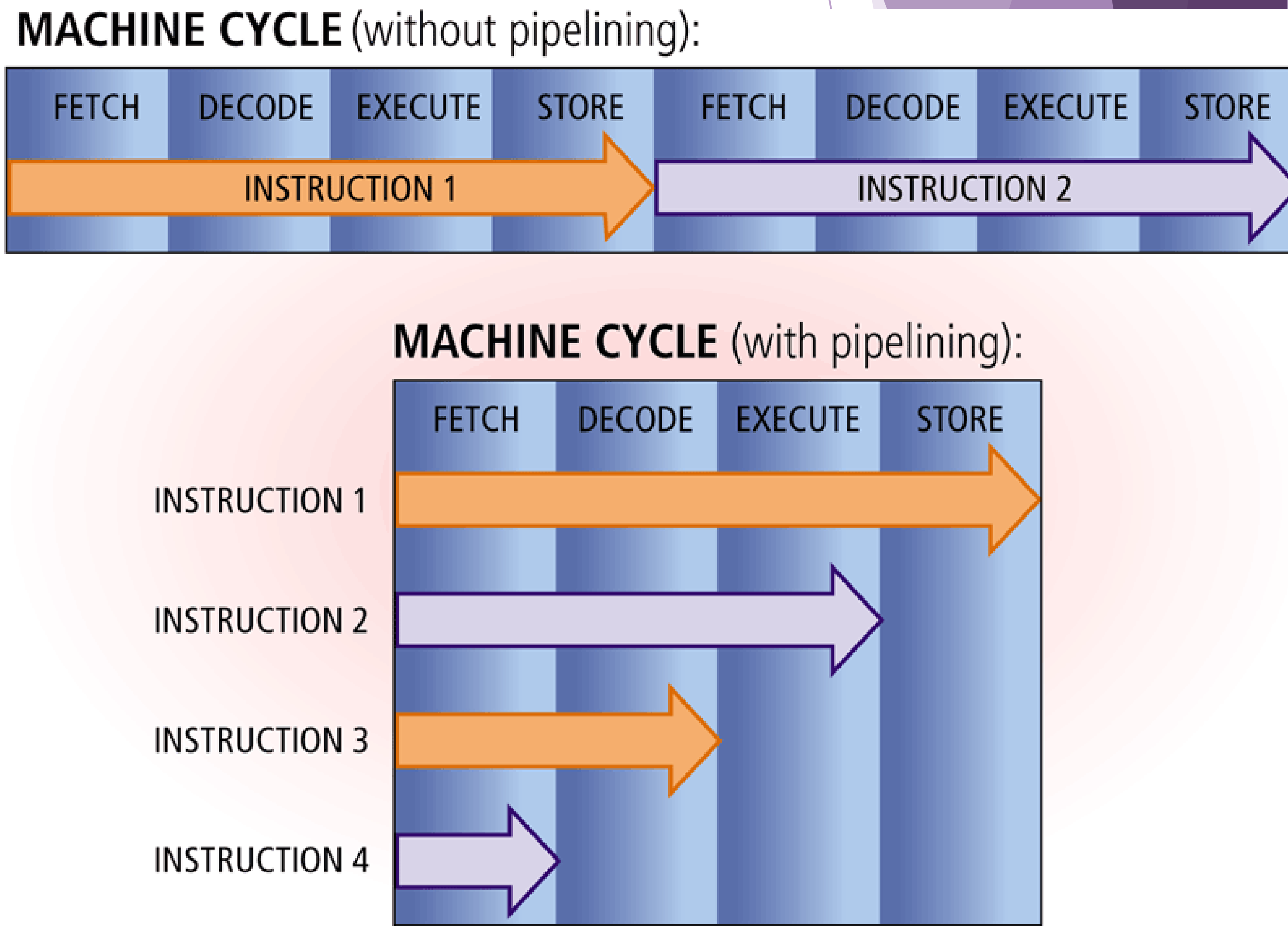
Description

1. CPU alternates communications between two or more memory banks
2. CPU grabs a block of data from memory instead of retrieving one piece at a time
3. CPU doesn’t wait for one instruction to complete before fetching its next instruction
4. The computer can execute more than one instruction per clock cycle
5. A technique used in superscalar architecture in which the OS treats the microprocessor as though it is two microprocessors

Pipelining

Most current personal computers support pipelining

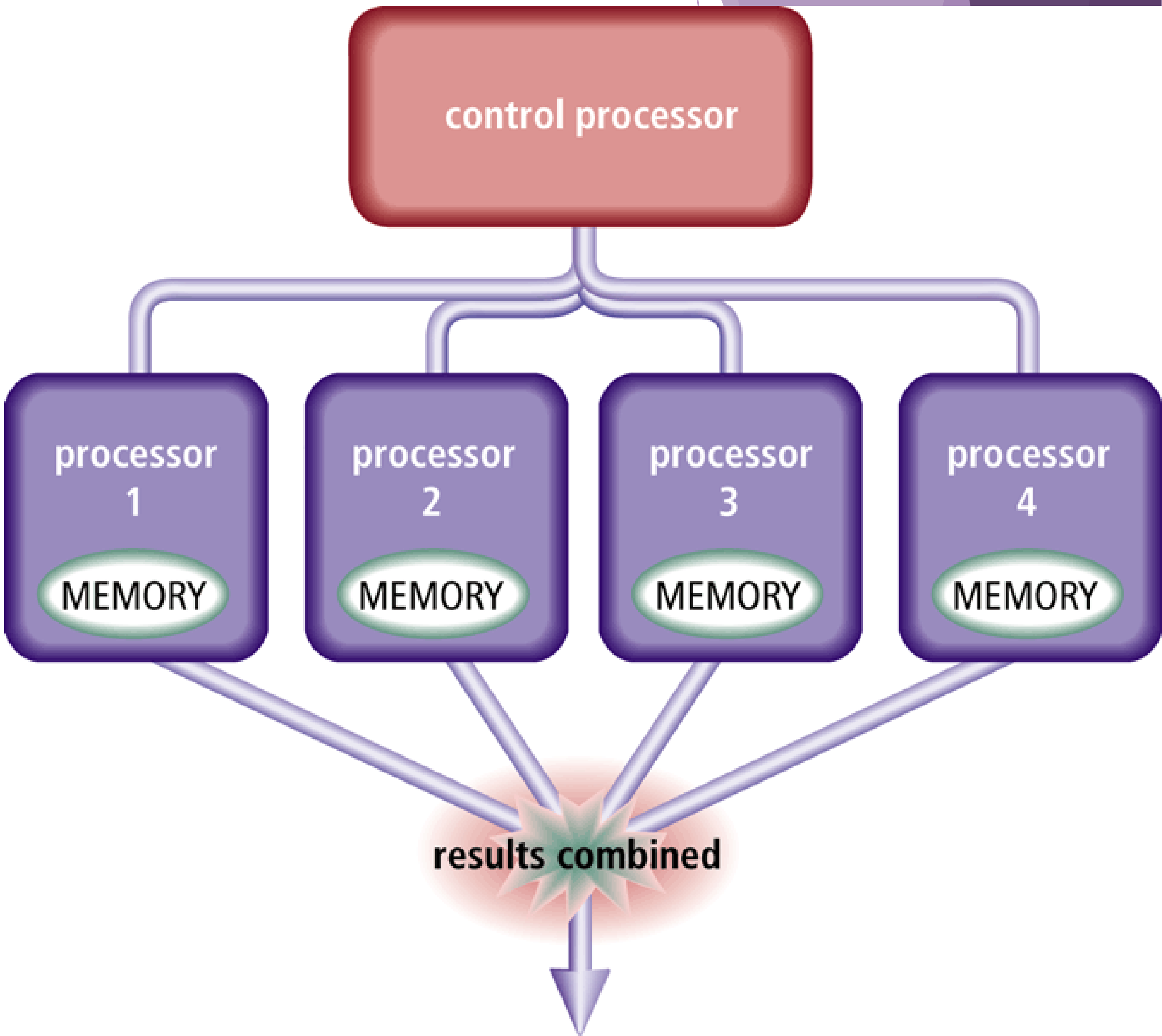
- Processor begins fetching a second instruction before it completes the machine cycle for the first instruction



Parallel processing

Parallel processing uses multiple processors simultaneously to execute a single program or task

- Massively parallel processing involves hundreds or thousands of processors



storage

storage

Hard Drives (SATA)

solid State Drives (SSD)

USB sticks

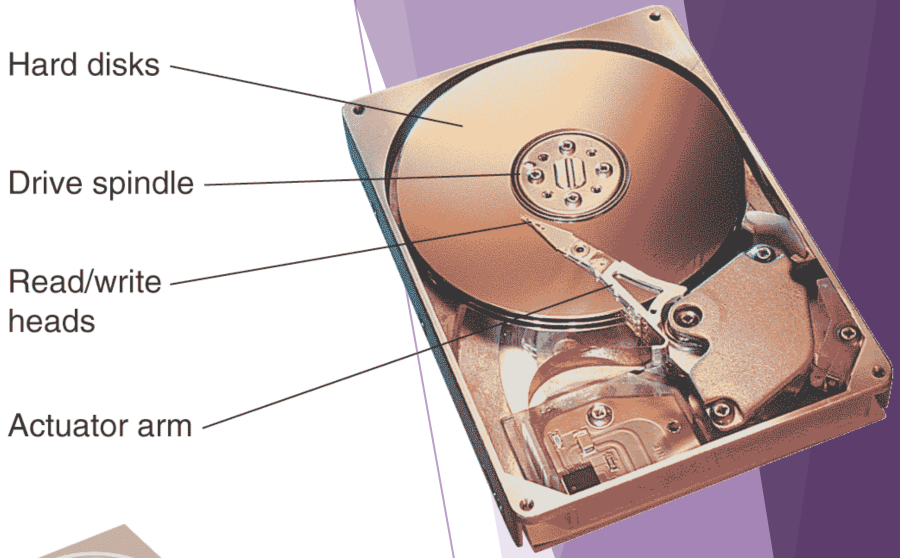
External Hard Drives

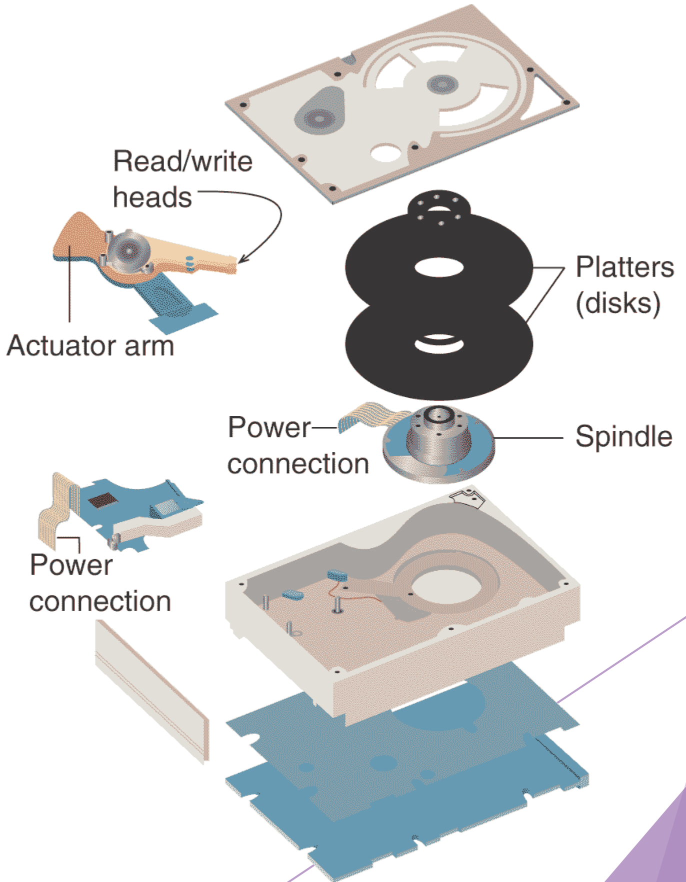
Flash memory

Magnetic tape

Optical disks (CD/DVDs)

Online secondary storage





Selecting storage devices

Speed – large quantities processed quickly & accurately

Capacity

Cost of storage – cost per megabytes

Other factors – reliability, permanence

Storage medium	Speed	Cost	Capacity	Permanency
Magnetic tape	Very slow	Very low	Very high	No
Hard disk drive	Very Fast	Low	Very high	No
CD-ROM	Slow	Low	Low	Yes
Flash Memory	Fast	Medium	Low	No
Memory	Very fast	High	Low	No/yes

Future Developments in Processing & Storage

New Technology

1. M-RAM
2. OUM
3. Nano-technology
4. Optical Computing
5. DNA Computing
6. Quantum Computing

Description of Processing Technology

1. Magnetic RAM uses miniscule magnets rather than electrical charges
2. Ovonic Multiplied Memory stores bits by generating different levels of low and high resistance on a glossy material
3. Tiny machines work at a molecular level to make nano-circuits
4. Uses lasers and light, not electricity. Uses strands of synthetic DNA to store data
5. Based on quantum mechanics and stores information using particle states

input & output devices

input

What Is Input?

An input device is hardware that allows users to enter data and instructions into a computer

These instructions are programs, commands, and user responses

A program is a series of related instructions that tells a computer what tasks to perform and how to perform them

Programs respond to commands that a user issues

A user response is an instruction a user issues by replying to a question displayed by a program

Input to instructions

Machine Language

- A binary-type programming language (0s and 1s)
- specific to the CPU model

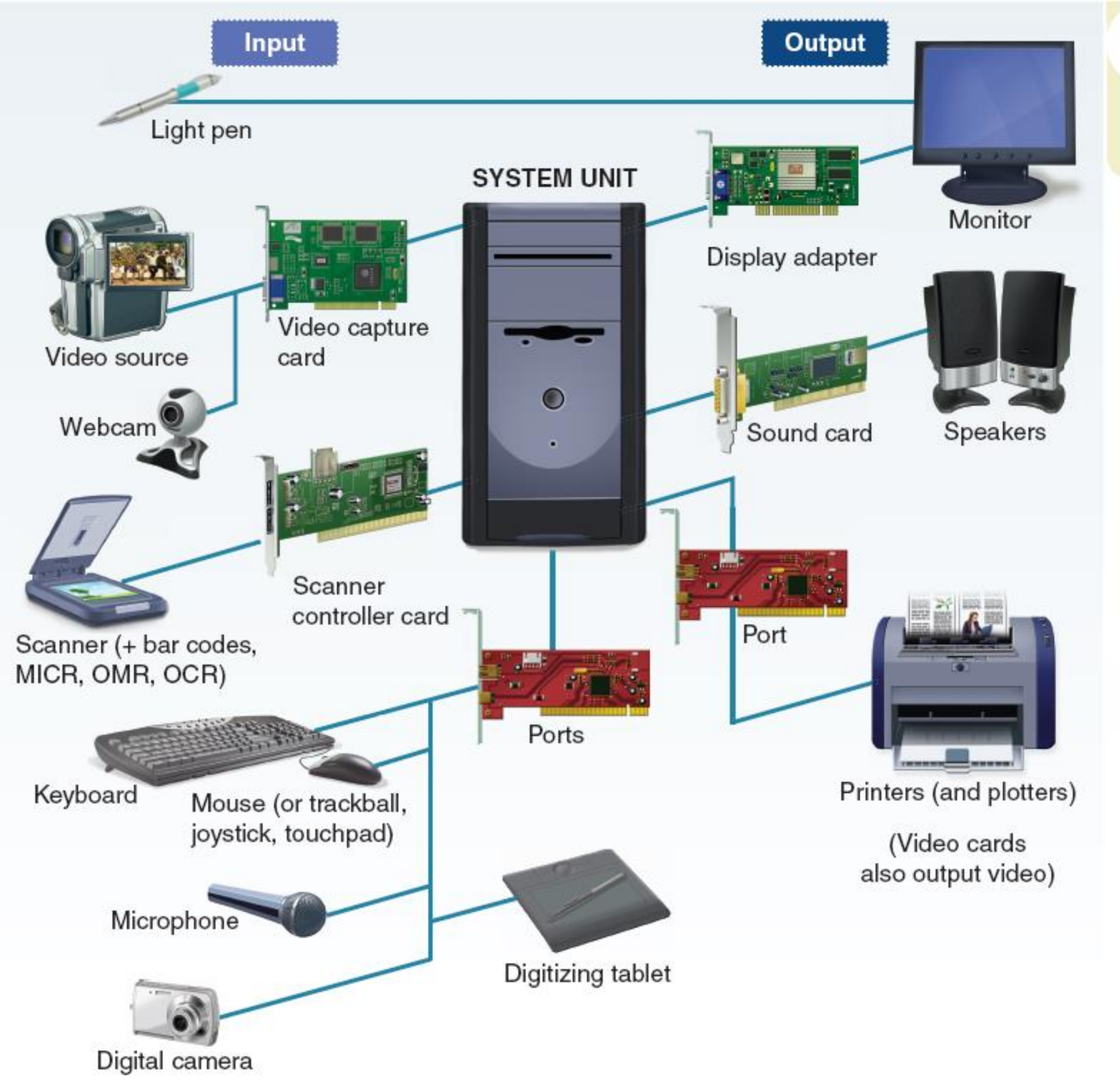
Language Translators

- converts higher-level language instructions and data
- into machine language
- so that the processor can “understand” what to d.

input & output devices

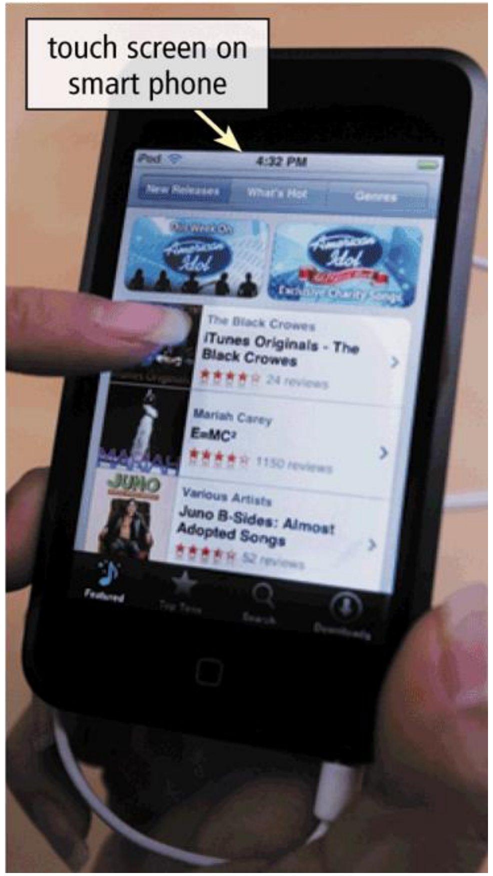
keyboard & mouse
microphones
cameras
tablets & pens
touch screens
scanners
joysticks
biometric devices

monitors
printers
speakers



Touch Screens and Touch-Sensitive Pads

A **touch screen** is a touch-sensitive display device

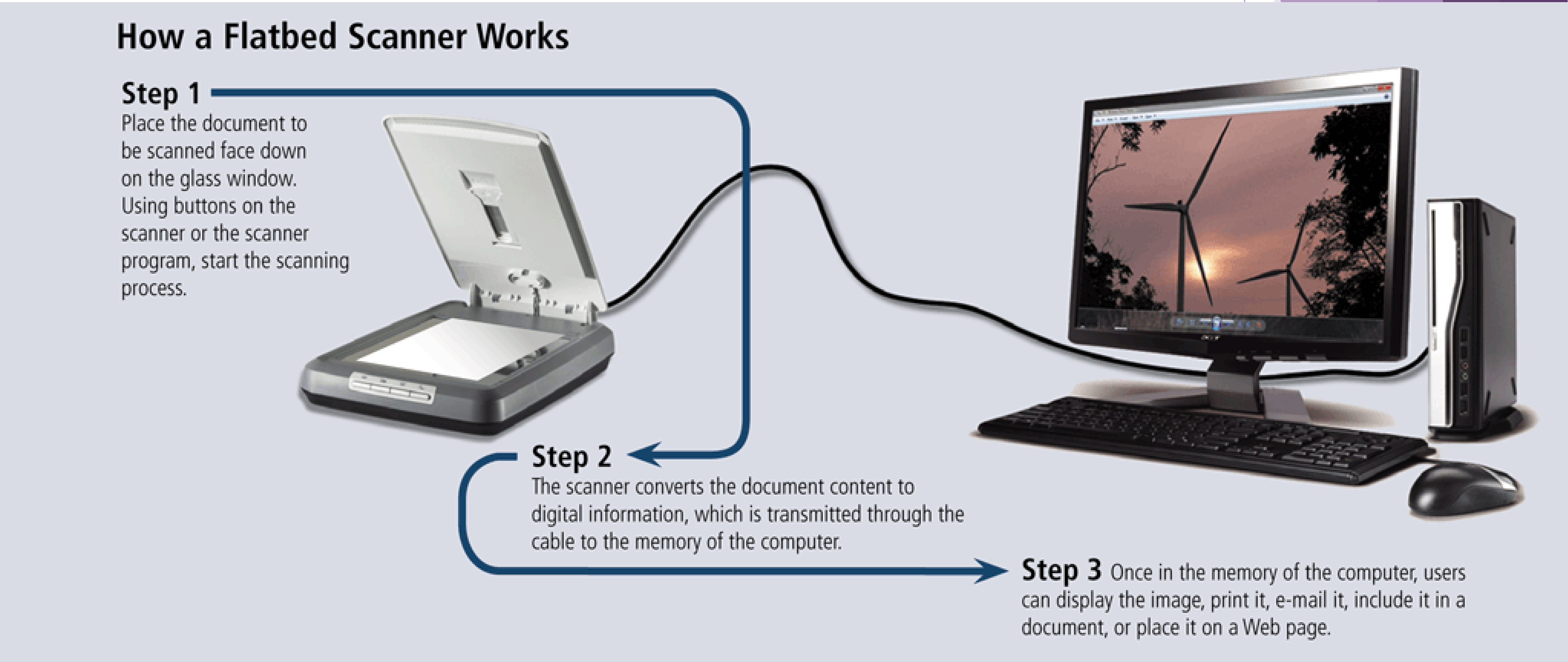


Touch Screens and Touch-Sensitive Pads

Microsoft Surface

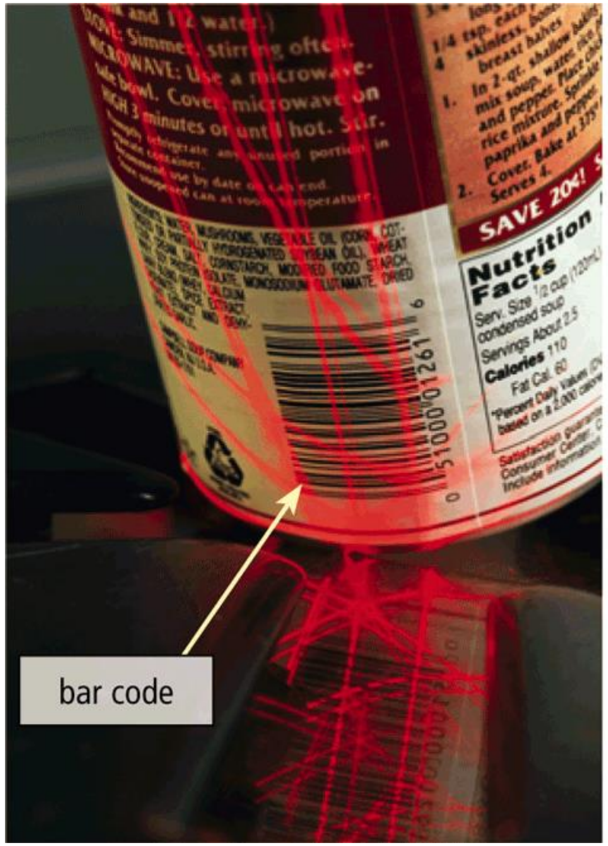
Touch-sensitive pads

Scanners and Reading Devices



Scanners and Reading Devices

- Optical character recognition (OCR)
  - Converts scanned text from images
  - to an editable text format
- Optical Mark Recognition (OMR)
  - special scanner that reads bubble marks
  - used in standardized tests (US
- A bar code reader uses laser beams to read bar codes
  - also called a **bar code scanner**
- Magnetic stripe card readers read the magnetic stripe on the back of cards



Pointing Devices

- Pen input
  - Use a pen-like stylus for input rather than typing on a keyboard
  - Use handwriting recognition to translate cursive writing into data

(Source: http://img.epinions.com)

Biometric Input

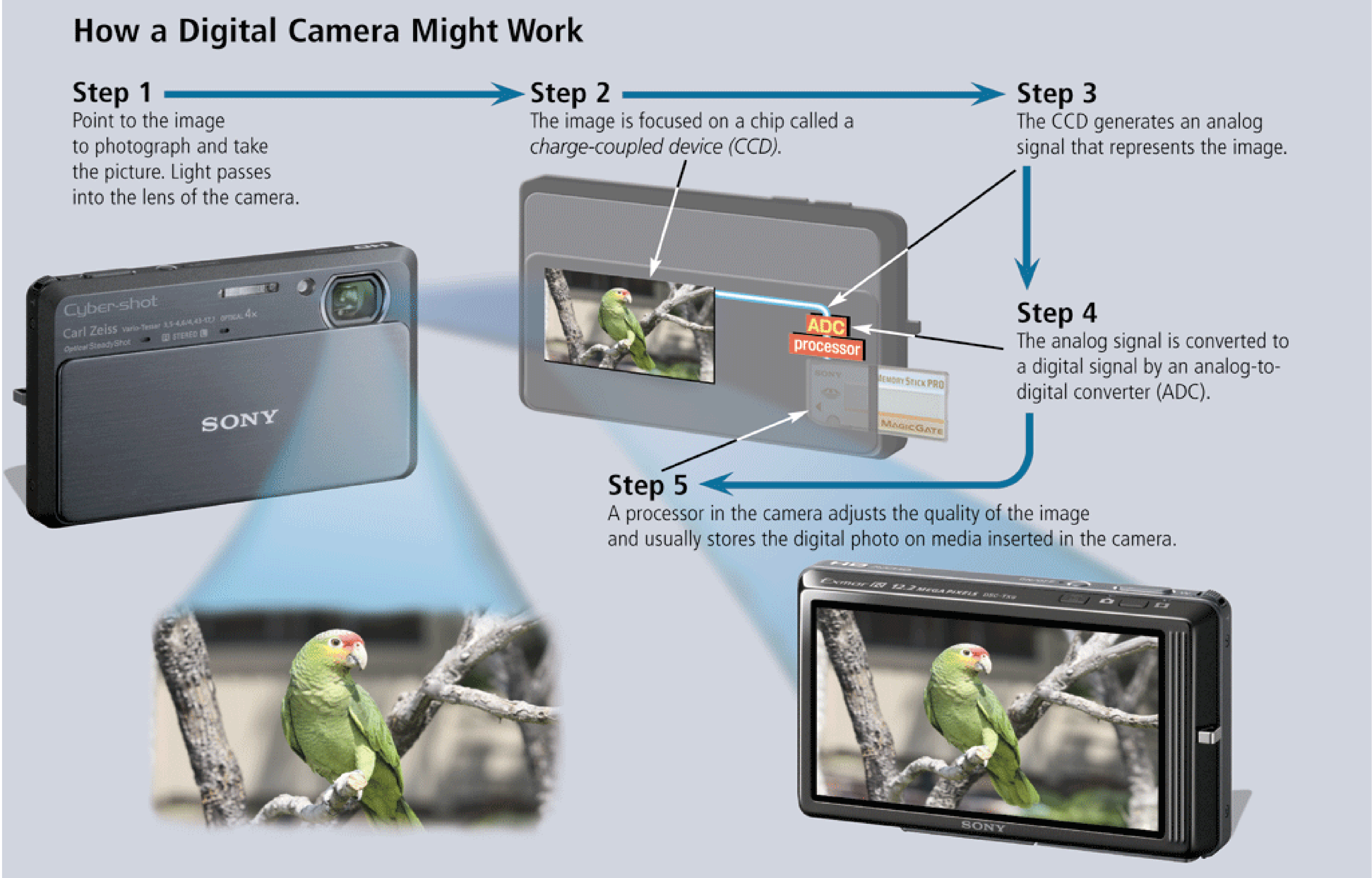
- Biometrics authenticates a person's identity by verifying a personal characteristic

Fingerprint reader	Face recognition system	Hand geometry system	Voice verification system
Signature verification system	Iris recognition system	Retinal scanners	

fingerprint reader

hand geometry system

Digital Cameras



Video, audio & speech input devices

Cameras

Webcams

Microphones

Voice control

Test-to-speech (TTS) systems

Intelligent personal assistants

e.g. Siri

Speech understanding systems

choosing input devices

Considerations

- Volume
- Speed
- Accuracy
- Complexity
- Cost
- Frequency of use

output

Output Devices

- Hard copy
  - Paper, printer
  - permanent
- Soft copy
  - Screen, monitor
  - Temporary
  - Alternative display - projector

monitors

Most modern monitors feature a Liquid Crystal Display (LCD)

More reliable and energy efficient than their predecessors

monitors

- LEDs (Light Emitting Diodes)
  - provide the backlight
  - better energy efficiency
- latest OLED (Organic Light Emitting Diode) technology
  - Does not need a backlight,
  - allowing for better quality images and thinner screens

printers

- Laser printers
- Inkjet printers
- Considerations
  - Price
  - Quantity
  - Quality of print required
  - Paper quality (cost)
  - colour

Other output devices

- multi-function devices = *printers with scanning, faxing and photocopying*
- Audio – speakers
- MIDI devices – instruments
- Computer output to microfilm (COM)
- Speech synthesis

selecting output devices

- Appropriateness
- Permanence
  - Is a permanent record required?
- Response time
  - What does the user require?
- Speed
  - Depends on use
- Cost

external storage

Enterprise Storage

availability

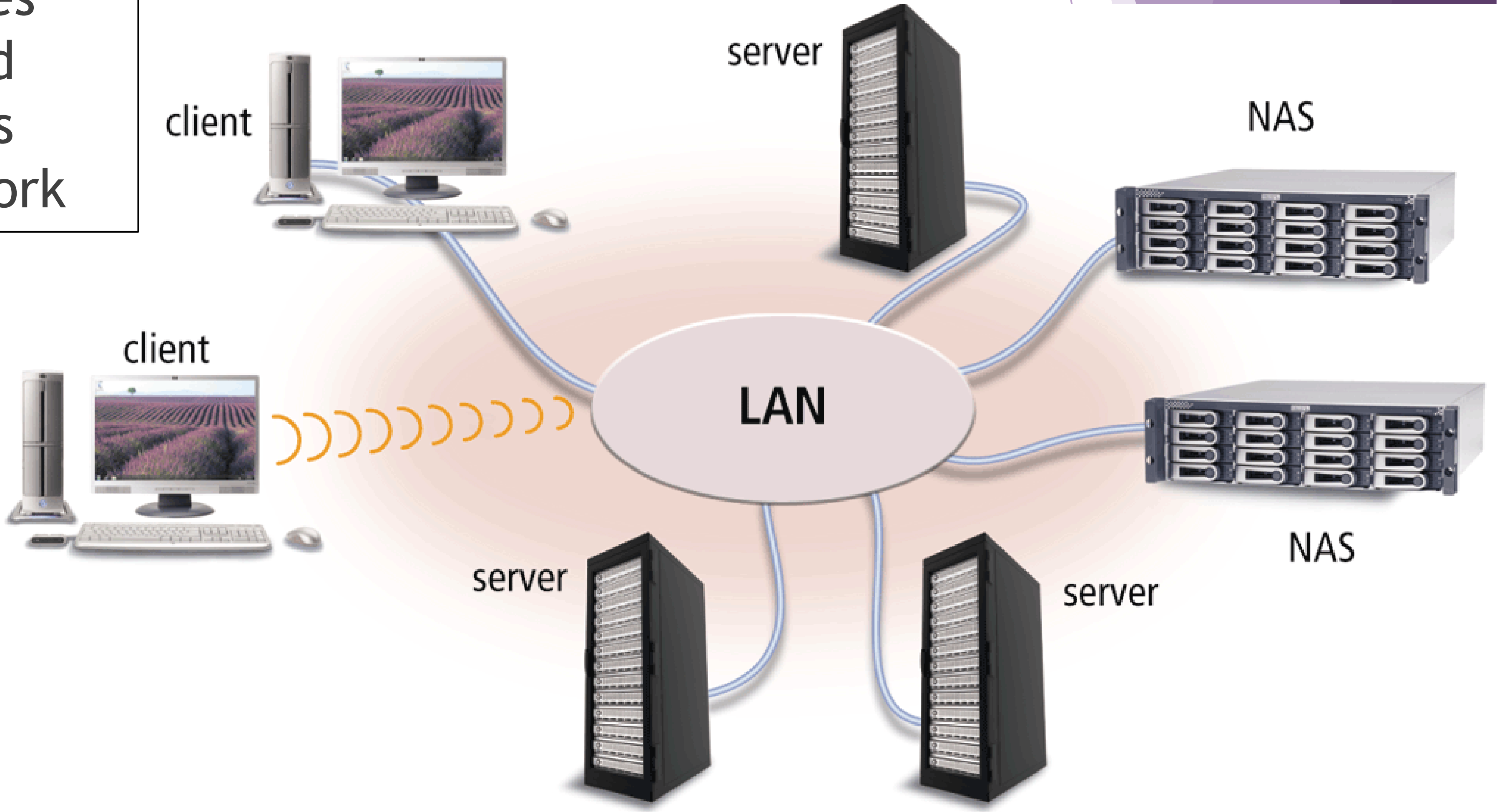
protection

organization

backup

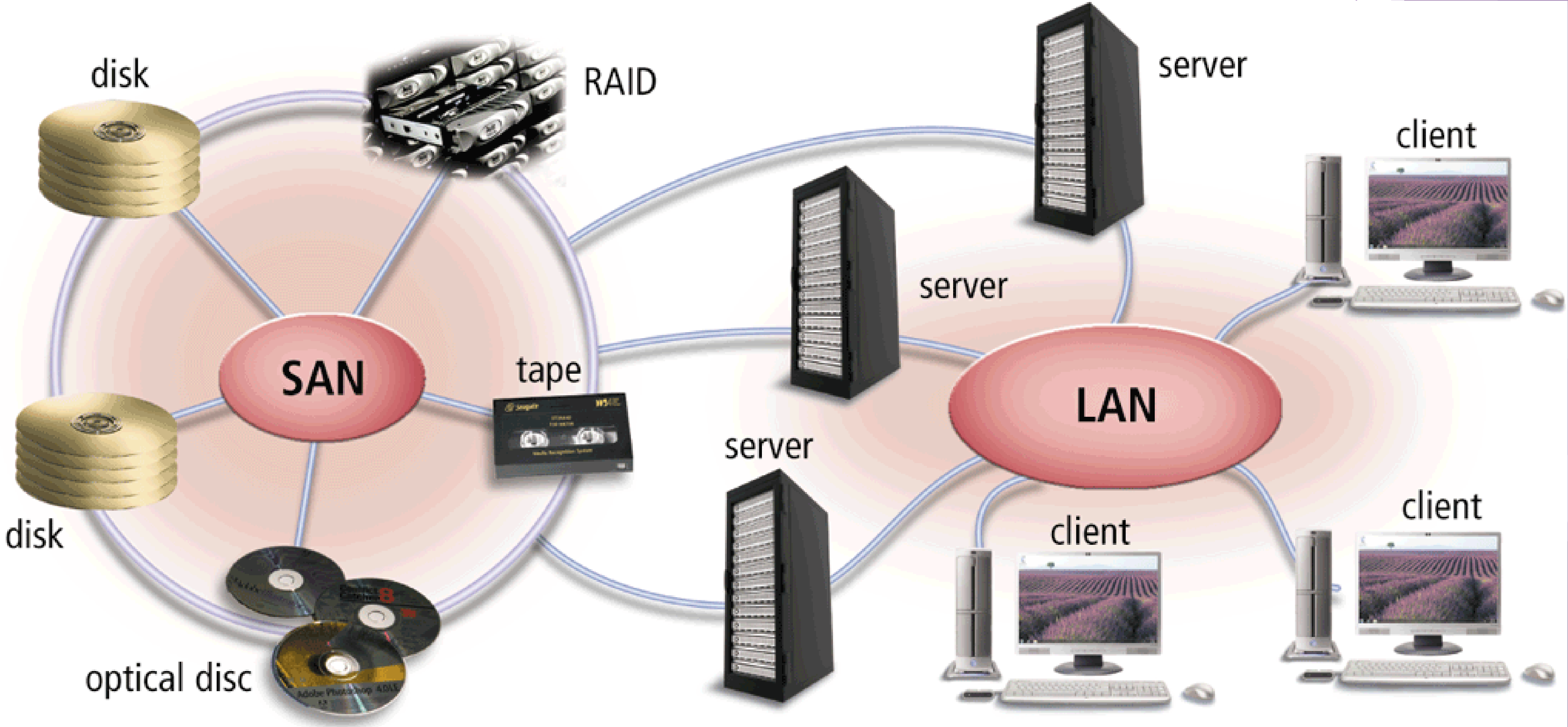
Network attached Storage (NAS)

a server that provides storage to users and information systems attached to the network



Storage Area Network (SAN)

a high-speed network that provides storage to other servers to which it is attached



Thin client

- a small terminal-like computer
- processing done on a server
- relies on a server for data storage and processing

Cloud Computing

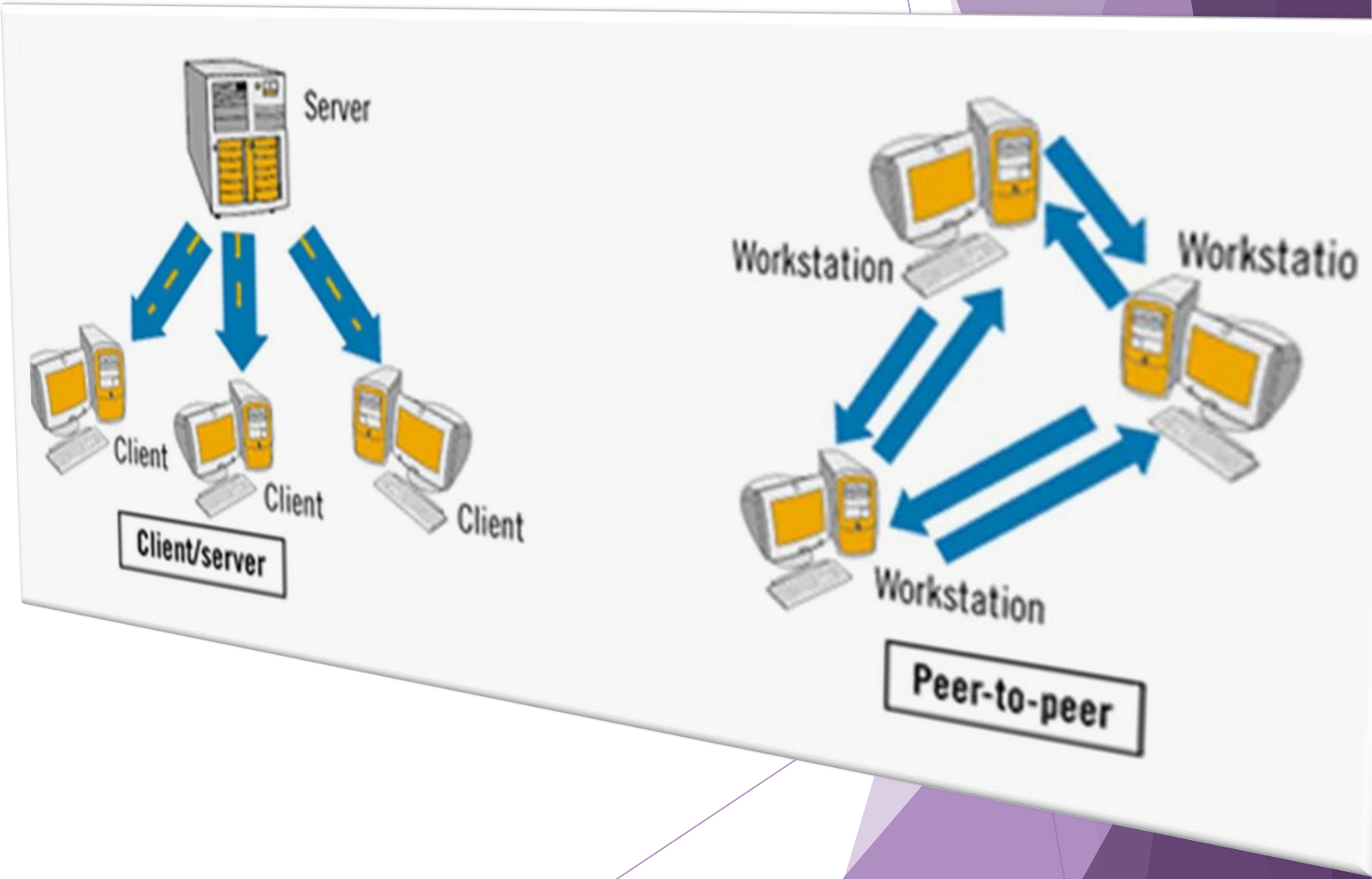
Cloud computing is an Internet service that provides computing needs to computer users

computer architecture

- Server is a central computer
  - Hold data and programs
  - Connect to and supplies services for clients
- Clients are computers like PCs or other devices
  - linked by a wired or wireless network
  - The entire network is called a **client/server** network

Peer-to-peer (P2P)

All computers on the network communicate directly with each other without relying on a server



(Source: Shelly et al.)

Enterprise Hardware

- A blade server packs a complete computer server on a single card (called a blade) rather than a system unit

- The individual blades insert in a blade server chassis

Virtualization

Virtualization is the practice of sharing or pooling computing resources

Virtual computing involves simulating a complete computer system in software

Server virtualization

- Provides the capability to divide a physical server logically into many virtual servers

Storage virtualization

- Provides the capability to create a single logical storage device from many physical storage devices

types of computers

types of computers

- PC
- laptop
- tablets
- phones (mobile / cell)

categories of computers

1. Supercomputers
2. Mainframe Computers
3. Microcomputers (PCs)
4. Microcontrollers

supercomputers

- Priced from $1 million to $350 million
- High-capacity machines with thousands of processors
- Multi-user systems
- Used for U.S. Census, weather forecasting, designing aircraft, etc.

(Source: www.chemistry.msu.edu)

mainframes

- Priced from $5,000 to $5 million
- Water-cooled or air-cooled
- Used by banks, airlines, colleges for millions of transactions

Traditionally

- large, extremely powerful machines
- designed for large-scale data-processing activities.

Recently

- has declined steadily over the past four decades.
- PCs have more power than earlier mainframes
- Now considered legacy systems

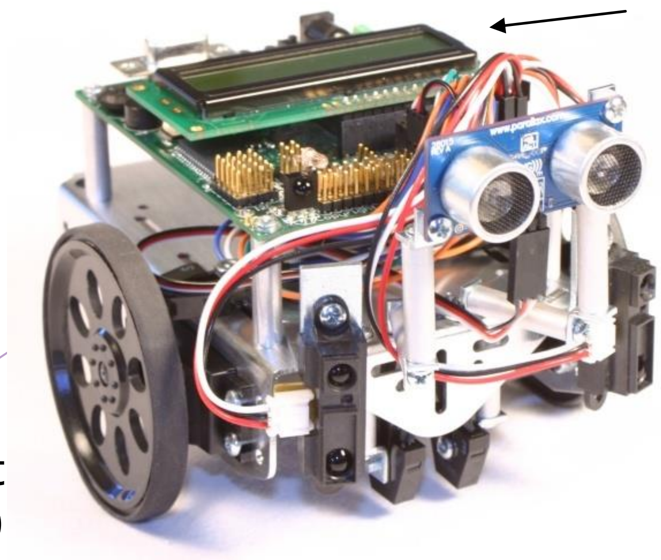
(Source: www.skullbox.net)

microcomputers (PCs)

- Personal computers that cost $500 to $5000
- stand-alone or in a network
- include:
  - PCs - desktop, tower
  - Laptops - notebooks, netbooks,
  - Tablets / phones - mobile internet devices (MIDs), personal digital assistants (PDAs)

microcontrollers
devices with processors

- Also called embedded computers
- Tiny, specialized microprocessors inside vehicles, robots & appliances
  - car engines,
  - microwave ovens
  - blood-pressure monitors,
  - air bag sensors, vibration sensors,
  - digital cameras, keyboards, etc.



IntelliBrain Robot
(Source: RidgeSoft, 2009, p. 1)

embedded computers

Adaptive cruise control systems detect if cars in front of you are too close and, if necessary, adjust the vehicle's throttle, may apply brakes, and/or sound an alarm.

Advanced airbag systems have crash-severity sensors that determine the appropriate level to inflate the airbag, reducing the chance of airbag injury in low-speed accidents.

Tire pressure monitoring systems send warning signals if tire pressure is insufficient.

Drive-by-wire systems sense pressure on the gas pedal and communicate electronically to the engine how much and how fast to accelerate.

Cars equipped with wireless communications capabilities, called *telematics*, include such features as navigation systems, remote diagnosis and alerts, and Internet access.

Thank you!

any questions?