

Hardware and Software

• **Hardware**

- the physical, tangible parts of a computer
- keyboard, monitor, wires, chips, data

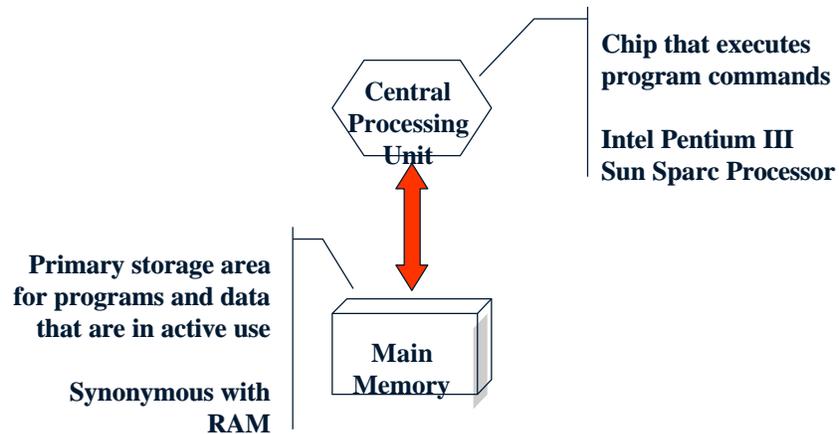
• **Software**

- programs and data
- a *program* is a series of instructions

• **A computer requires both hardware and software**

• **Each is essentially useless without the other**

CPU and Main Memory



Secondary Memory Devices

Secondary memory devices provide long-term storage

Central Processing Unit

Information is moved between main memory and secondary memory as needed

Hard disks
Floppy disks
ZIP disks
Writable CDs
Tapes

Main Memory

Hard Disk

Floppy Disk

Input / Output Devices

Monitor

Central Processing Unit

I/O devices allow user interaction

Keyboard

Monitor screen
Keyboard
Mouse
Bar code scanner
Light pen
Touch screen

Main Memory

Hard Disk

Floppy Disk

Digital Information

- **Computers store all information digitally:**
 - numbers
 - text
 - graphics and images
 - audio
 - video
 - program instructions
- **In some way, all information is *digitized* - broken down into pieces and represented as numbers**

Binary Numbers

- **Once information is digitized, it is represented and stored in memory using the *binary number system***
- **A single binary digit (0 or 1) is called a *bit***
- **Devices that store and move information are cheaper and more reliable if they only have to represent two states**
- **A single bit can represent two possible states, like a light bulb that is either on (1) or off (0)**
- **Combinations of bits are used to store values**

Bit Combinations

| <u>1 bit</u> | <u>2 bits</u> | <u>3 bits</u> | <u>4 bits</u> | |
|--------------|---------------|---------------|---------------|------|
| 0 | 00 | 000 | 0000 | 1000 |
| 1 | 01 | 001 | 0001 | 1001 |
| | 10 | 010 | 0010 | 1010 |
| | 11 | 011 | 0011 | 1011 |
| | | 100 | 0100 | 1100 |
| | | 101 | 0101 | 1101 |
| | | 110 | 0110 | 1110 |
| | | 111 | 0111 | 1111 |

Each additional bit doubles the number of possible combinations

Bit Combinations

- Each combination can represent a particular item
- There are 2^N combinations of N bits
- Therefore, N bits are needed to represent 2^N unique items

How many
items can be
represented by

| | |
|----------|------------------|
| 1 bit ? | $2^1 = 2$ items |
| 2 bits ? | $2^2 = 4$ items |
| 3 bits ? | $2^3 = 8$ items |
| 4 bits ? | $2^4 = 16$ items |
| 5 bits ? | $2^5 = 32$ items |

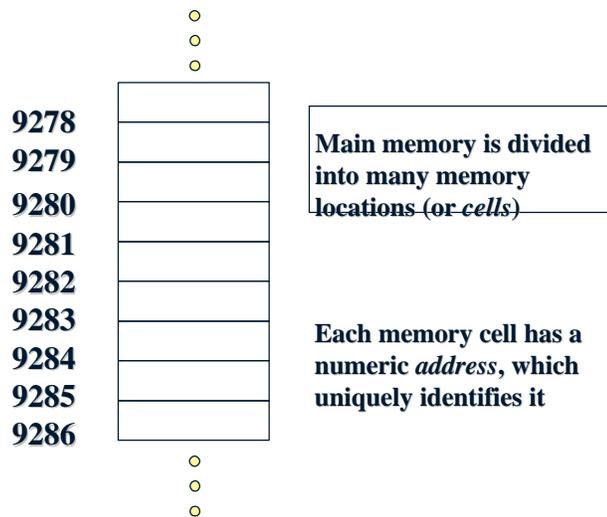
A Computer Specification

• Consider the following specification for a personal computer:

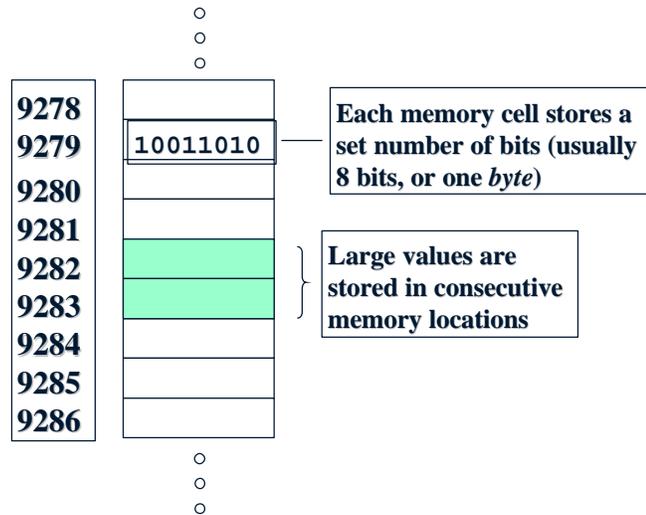
- 600 MHz Pentium III Processor
- 256 MB RAM
- 16 GB Hard Disk
- 24x speed CD ROM Drive
- 17" Multimedia Video Display with 1280 x 1024 resolution
- 56 KB Modem

• What does it all mean?

Memory



Storing Information



Storage Capacity

- Every memory device has a *storage capacity*, indicating the number of bytes it can hold
- Capacities are expressed in various units:

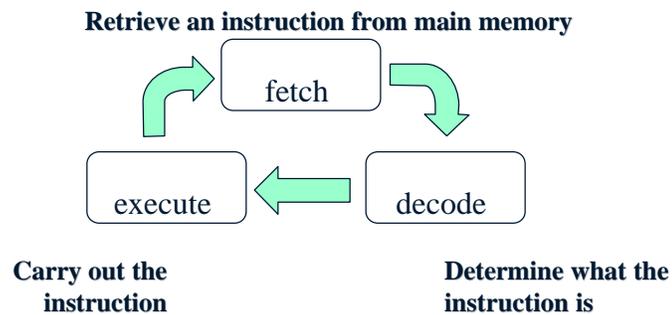
| <u>Unit</u> | <u>Symbol</u> | <u>Number of Bytes</u> |
|-------------|---------------|----------------------------|
| kilobyte | KB | $2^{10} = 1024$ |
| megabyte | MB | 2^{20} (over 1 million) |
| gigabyte | GB | 2^{30} (over 1 billion) |
| terabyte | TB | 2^{40} (over 1 trillion) |

RAM vs. ROM

- **RAM - Random Access Memory (direct access)**
- **ROM - Read-Only Memory**
- **The terms RAM and main memory are basically interchangeable**
- **ROM could be a set of memory chips, or a separate device, such as a CD ROM**
- **Both RAM and ROM are random (direct) access devices!**
- **RAM should probably be called Read-Write Memory**

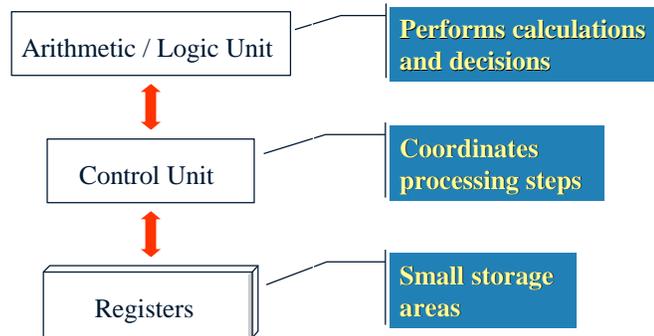
The Central Processing Unit

- **A CPU is also called a *microprocessor***
- **It continuously follows the *fetch-decode-execute* cycle:**



The Central Processing Unit (CPU)

- **The CPU contains:**



The Central Processing Unit

- **The speed of a CPU is controlled by the *system clock***
- **The system clock generates an electronic pulse at regular intervals**
- **The pulses coordinate the activities of the CPU**
- **The speed is measured in *megahertz* (MHz)**

Monitor

- **The size of a monitor (17") is measured diagonally, like a television screen**
- **Most monitors these days have *multimedia* capabilities: text, graphics, video, etc.**
- **A monitor has a certain maximum *resolution* , indicating the number of picture elements, called *pixels*, that it can display (such as 1280 by 1024)**
- **High resolution (more pixels) produces sharper pictures**