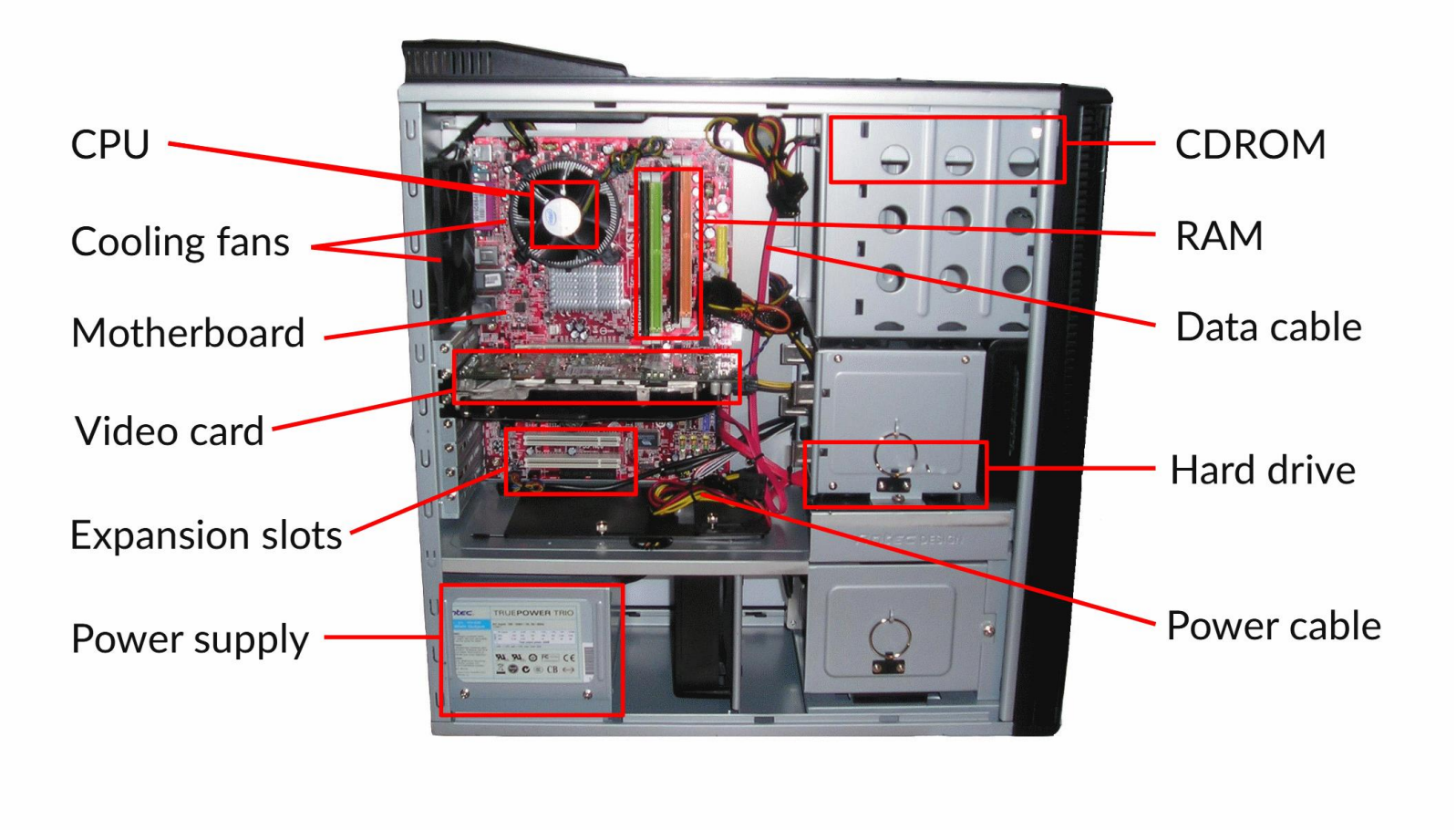
Module 1

Computers and the Internet (from 10k feet)

Section 1–1

Introduction to Computers

What's Inside a Computer?



- **The *motherboard* is the big circuit board that holds all the other parts together**
  - It provides fast connectivity between the major components within the computer

CPU and RAM

- **Connected to the motherboard is a *CPU (central processing unit)***
  - Also called "the processor", it is "the brain" of the computer
  - It executes instructions that a programmer wrote to control the processing of data
  - It gets HOT when running, and is usually attached under a fan and a heat sink!
  - Most modern CPUs have more than one processor core (dual-core, quad-core, etc)

- **Also connected to the motherboard is *RAM (random access memory)***
  - RAM is very fast memory that holds instructions and data *while the computer is running*
    - It is *volatile storage* and does NOT provide long-term storage and files; if you turn the computer off, it's erased
  - Personal computers often have 8GB or 16GB of RAM, although there may be more or less

Persistent Storage

- ***Persistent* (or *non-volatile*) storage holds data even when the computer is turned off**

- ***Disk drives* provide non-volatile storage for files**
  - May be very large (125GB - 2TB or more!) and inexpensive, though slower than RAM
  - There are two basic types of disk drives
    - Hard disk drives (HDD) store data on a magnetically coated platter that spins at a high speed
    - Solid state drives (SSD) store data on non-volatile semiconductor chips that have no moving parts

- **Computers often provide some type of removable storage device as well, including:**
  - USB connections for reading/writing to flash drives
  - Optical disc drives for reading/writing to DVDs or CD-ROMs
  - Floppy disk drives for reading/writing to ancient floppy disks

Expansion Cards

- **Other important "cards" that plug into expansion slots on the motherboard may include:**
  - a NIC card (network interface card) that is an adapter that allows the computer to connect to a network
  - a wireless NIC card that lets a computer use radio signals to connect to a network wirelessly
  - a video or graphics card that is an adapter to let the computer output display on a monitor
  - a sound card to let the computer play sound from speakers

- **Finally, there are power-related items within the case**
  - a power supply
  - a heat sink and one or more fans to help dissipate the heat

How do you Connect Peripherals to a Computer?

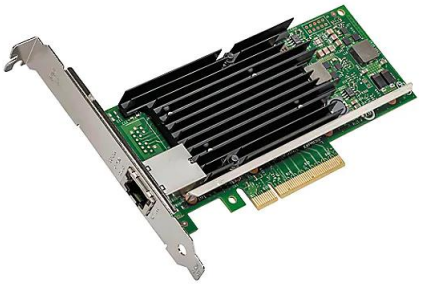
- **Connectors provide a way to connect a peripheral device to your computer**





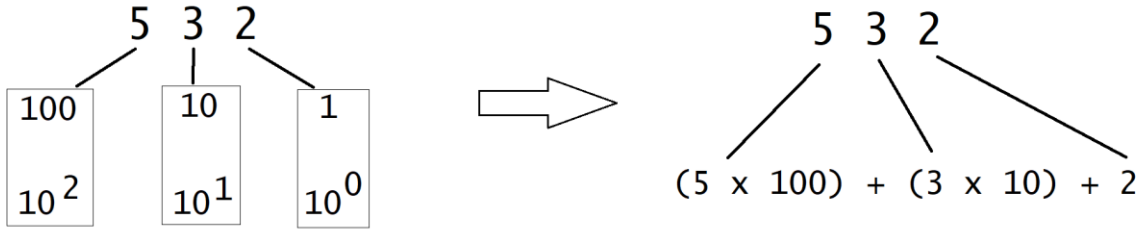
- **The main ones used today include:**
  - USB provides a hot-swappable connection for data transfer (includes USB 2.0, USB 3.0, USB-C)
  - HDMI carries high-speed video and sound
  - Firewire (mostly used by Apple)
  - PS/2 (older) often used for keyboards and mice
  - VGA and DVI used for video signals for monitors

Question - Identify These!



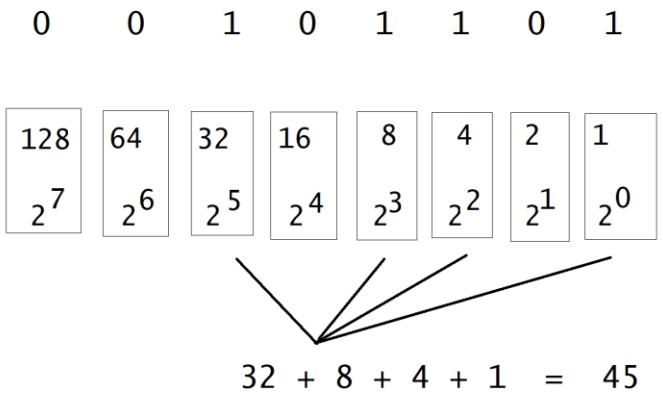
Counting Like a Computer

- **When we count as human beings, we use numbers that are powers of 10**
  - Every digit can be one of 10 different values 0 - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 (decimal numbers)



- **But we measure quantity in the computing world with numbers that are powers of 2**
  - Every digit can be one of 2 different values 0 - 1 (binary numbers)
  - Each *binary digit* (**bit**) represents an on / off state

What does the number 45 look like in binary?



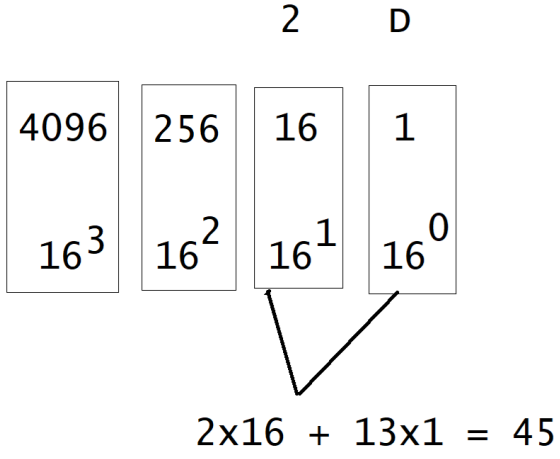
Word Sizes

- **When you bought a computer, do you remember if the marketing material said it was a 32-bit or 64-bit CPU processor?**
  - A 32-bit computer has a "word size" of 32 bits
    - This means the biggest signed whole number that it can fit in a word is 2,147,483,647 which is determined by the binary number 01111111111111111111111111111111
    - Note: Why does the binary number above start with a 0? Signed binary numbers uses the high-order bit to indicate the number is negative!
  - A 64-bit computer has a "word size" of 64 bits
    - This means the biggest signed whole number that it can fit in a word is 9,223,372,036,854,775,807

Hexadecimal (Base 16) numbers

- **Because base 2 numbers can consist of many, many digits… programmers often use another numbering system called hexadecimal (base 16)**
  - Each digit can be one of 16 different values: 0 - 9 and A - F (where A = 10, B = 11, etc)

What does the number 45 look like in hexadecimal?



- **You will rarely see binary as a programmer, but a web programmer often uses hex numbers for color (RGB) values**
  - We will see examples soon
  - For example, the color red can be represented by the hex number FF0000 in CSS; the first two digits are a hex value for red, the next two are for green, and the last 2 are for blue

Exercise - How Old Are You?

- **Let's figure out how old you are using alternate bases…**
- **in Base 2?**

```
___  ___  ___  ___  ___  ___  ___  ___
128   64   32   16    8    4    2    1
```

digits are 0 - 1

- **in Base 10 (this should be easy)?**

```
___  ___  ___
100   10    1
```

digits are 0 - 9

- **in Base 16?**

```
___  ___  ___
256   64    1
```

digits are 0 - 9 and A - F (representing 10 - 15)

What does KB, MB, GB and TB Actually Mean?

- **The smallest "unit" of memory you can access is 8 bits… which is called a** *byte*

- **Programmers use the term KB for** ***kilobyte***
  - When describing file sizes, a kilobyte is 1024 bytes

- **Not 1000?**
  - The International System of Units defines 1K as 1000
  - Software makers use base 2 numbers and define 1K as 1024

- **Usually, programmers use the term MB for megabyte…. 1024 units of 1KB**
  - That means 1024 x 1024, or 1,048,576 bytes

UNIT	SIZE	BYTES
1 Bit	Single 0 or 1 binary digit	--
1 Byte	8 bits	1 byte
1 Kilobyte (KB)	1024 bytes	1024 bytes
1 Megabyte (MB)	1024 KB	1,048,576 bytes
1 Gigabyte (GB)	1024 MB	1,073,741,824 bytes
1 Terabyte (TB)	1024 GB	1,099,511,627,776 bytes

Storage Capacity and Network Speeds

- **It gets more confusing when you introduce hardware**
  - According to software manufacturers, 1 KB = 1024 bytes
    - Which means 1 TB = 1024 * 1024 * 1024 * 1024 = 1,099,511,627,776 bytes.
  - But hard disk makers don't think average consumers can understand this issue about "kilo" so they use 1 KB = 1000 bytes and 1 TB = 1,000,000,000,000 bytes
  - Either way you look at it, 1 TB is a lot of capacity!

- **When we specify internet speeds, we specify in *bits per second***
  - What download speed do you get from your internet provider?
  - Today I got 222 **Mbps** (megabits per second)
    - That is 232,783,872 **bits** per second or 29,097,984 **bytes** per second

Which Holds More Data?

Floppy disk - 1.44 MB

USB thumb drives … It depends on the size you buy! 8GB? 256GB?

Internal HDD - 10TB drive

Exercise – Decimal to Binary

- **How would you write the following Base10 (Decimal) numbers in Binary**
  - 15

    ——————————
  - 32

    ——————————
  - 117

    ——————————
  - 946

    —————————— ——————————

Exercise – Binary to Decimal

- **How would you write the following Binary numbers in Decimal (Base10)**
  - 00000100

    ——————————
  - 00001101

    ——————————
  - 00110101

    ——————————
  - 01010101 10101010

    —————————— ——————————