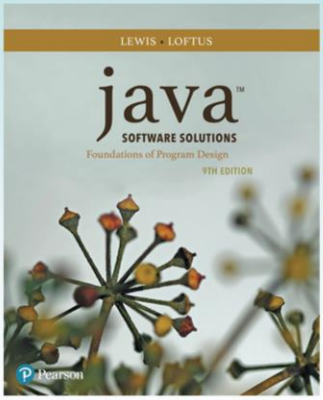
Chapter 1
Introduction



Java Software Solutions
Foundations of Program Design
9th Edition

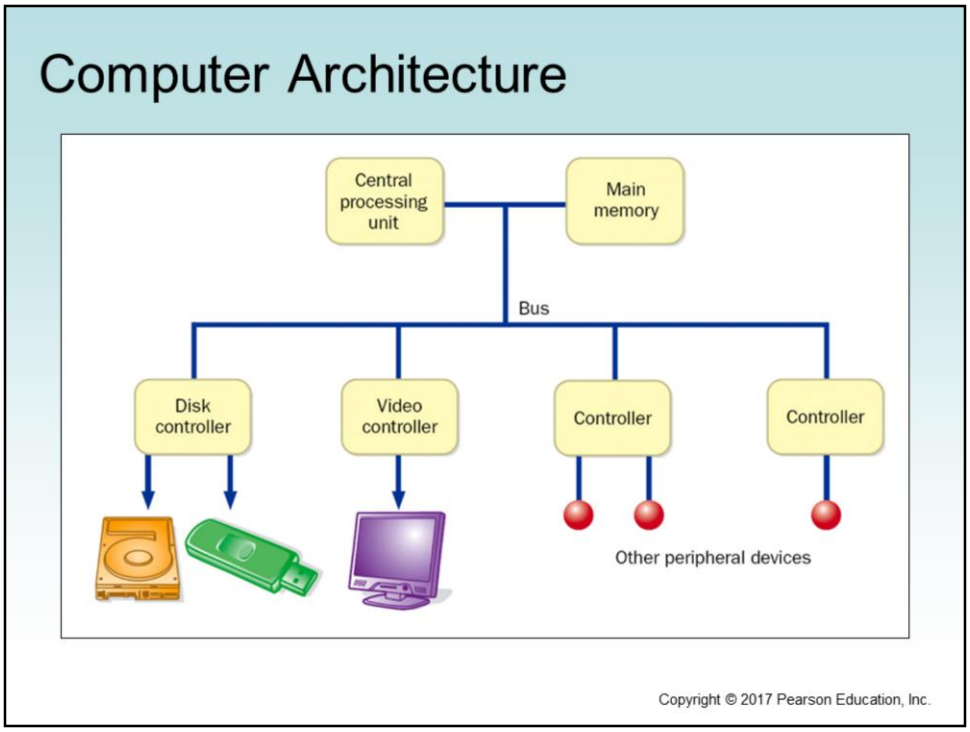
John Lewis
William Loftus

Outline

- Computer Processing
- Hardware Components
- Networks
- The Java Programming Language
- Program Development
- Object-Oriented Programming

A Computer Specification

- Consider the following specification for a personal computer:
  - Intel Dual-Core i7 processor
  - 4 GB RAM
  - 750 GB Hard Disk
  - 15” High Definition Display with 1366 x 768 resolution
  - 802.11 wireless card

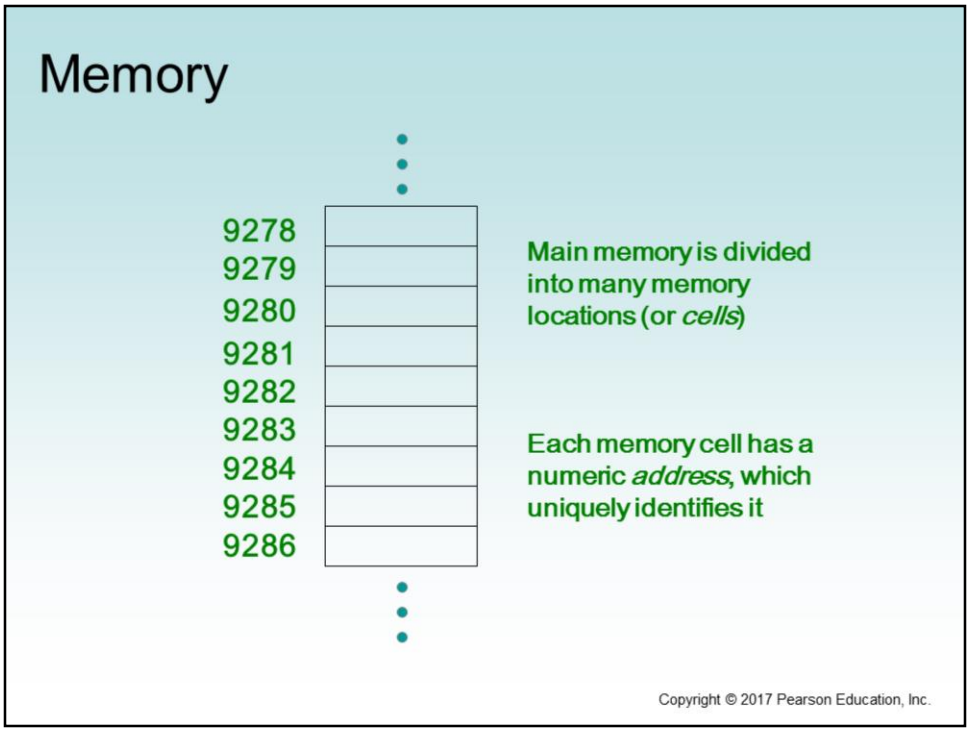


-Information is passed between components along group of wires (bus)

-Peripheral devices: components at the “outer edge” of the core components (CPU and main memory)

-Controllers: control transmission of data to/from peripheral devices

-I/O devices: look where I/O is heading! http://leapmotion.com/

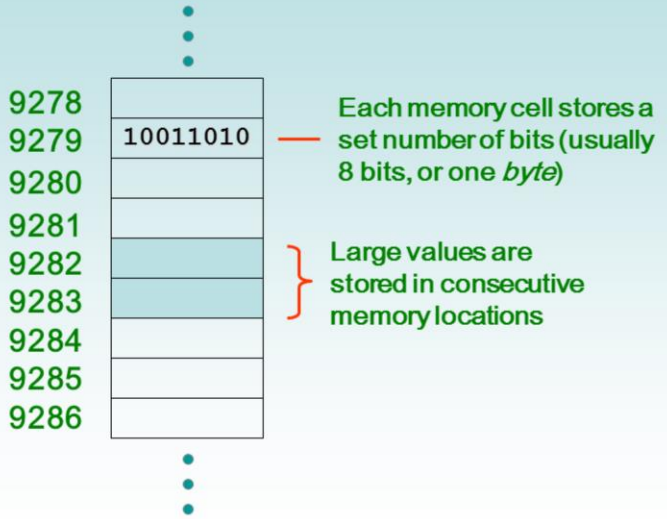


-Understanding memory is perhaps one of the most important concepts as a software developer

-Lack of knowledge of memory and how to use it leads to the majority of problems in programs (e.g. segmentation fault, crash, stack overflow, …)

-Think of an address as an address where you live (e.g. I need to know your address to access (find) you

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:

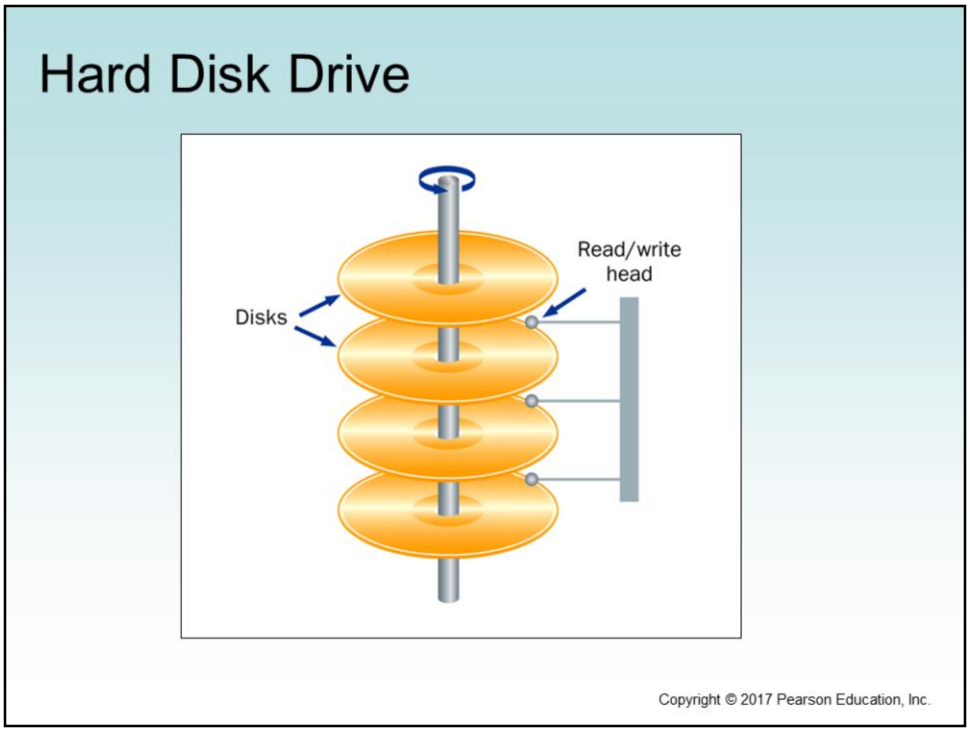
Unit	Symbol	Number of Bytes
kilobyte	KB	2^{10} = 1024
megabyte	MB	2^{20} (over one million)
gigabyte	GB	2^{30} (over one billion)
terabyte	TB	2^{40} (over one trillion)
petabyte	PB	2^{50} (a whole bunch)

-Note units of storage in base 2 (since bits are stored, 0 or 1)

Memory

- Main memory is *volatile* - stored information is lost if the electric power is removed
- Secondary memory devices are *nonvolatile*
- Main memory and disks are *direct access* devices - information can be reached directly
- The terms *direct access* and *random access* often are used interchangeably
- A magnetic tape is a *sequential access* device since its data is arranged in a linear order - you must get by the intervening data in order to access other information

-Cache: small, fast memory used by CPU to store contents of frequently used memory locations



Disk: magnetic device storing bits as magnetized particles

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 probably should be called Read-Write Memory

-ROM chips in computer typically store instructions (called BIOS – basic input/output system) needed when computer is initially turned on

Compact Discs

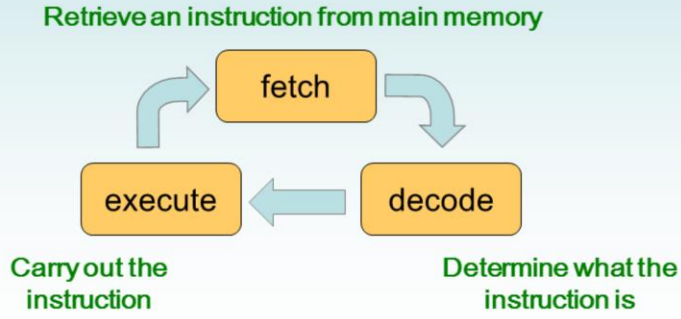
- A CD-ROM is portable read-only memory
- A microscopic pit on a CD represents a binary 1 and a smooth area represents a binary 0
- A low-intensity laser reflects strongly from a smooth area and weakly from a pit
- A CD-Recordable (CD-R) drive can be used to write information to a CD once
- A CD-Rewritable (CD-RW) can be erased and reused
- The speed of a CD drive indicates how fast (max) it can read and write information to a CD

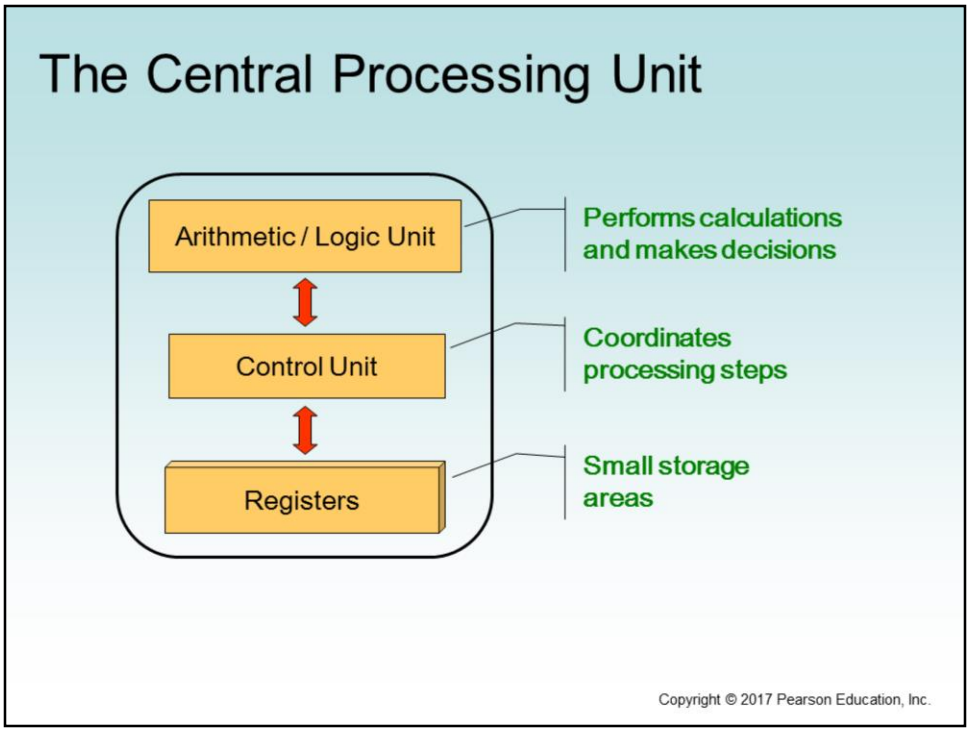
DVDs

- A DVD is the same physical size as a CD, but can store much more information
- The format of a DVD stores more bits per square inch
- A CD can store 650 MB, while a standard DVD can store 4.7 GB
  - A double sided DVD can store 9.4 GB
  - Other advanced techniques can bring the capacity up to 17.0 GB
- Like CDs, there are DVD-R discs

The Central Processing Unit

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





-3 components making up CPU

-Registers: small, very fast cache (storage in CPU)

-Arithmetic/logic unit: performs calculations and decisions

-Control unit: manages transfer of data/instructions between main memory and registers; manages execution in logic unit for operations in registers

-CPU constructed on chip call microprocessor on main circuit board

-Board also holds ROM chips, connections for controllers, system clock

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 usually measured in *gigahertz* (GHz)

-System clock frequency is estimate of how fast CPU executes instructions

-1 GHz ~= 1 billion pulses per second

Monitor

- The size of a monitor (17") is measured diagonally, like a television screen
- 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

Outline

Computer Processing

Hardware Components

Networks

The Java Programming Language

Program Development

Object-Oriented Programming

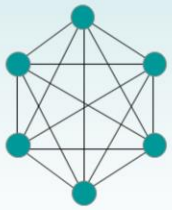
Networks

- A *network* is two or more computers that are connected so that data and resources can be shared
- Most computers are connected to some kind of network
- Each computer has its own *network address*, which uniquely identifies it among the others
- A *file server* is a network computer dedicated to storing programs and data that are shared among network users

Network Connections

- Each computer in a network could be directly connected to every other computer in the network
- These are called *point-to-point* connections

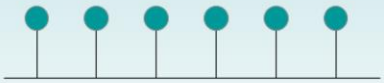
Adding a computer requires a new communication line for each computer already in the network



This technique is not practical for more than a few close machines

Network Connections

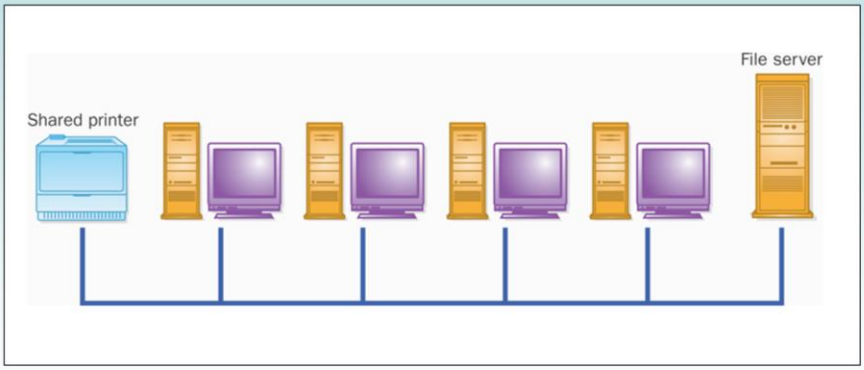
- Most networks share a single communication line
- Adding a new computer to the network is relatively easy



Network traffic must take turns using the line, which introduces delays

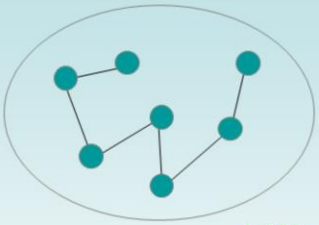
Often information is broken down in parts, called *packets*, which are sent to the receiving machine and then reassembled

A Computer Network



Local-Area Networks

A *Local-Area Network* (LAN) covers a small distance and a small number of computers

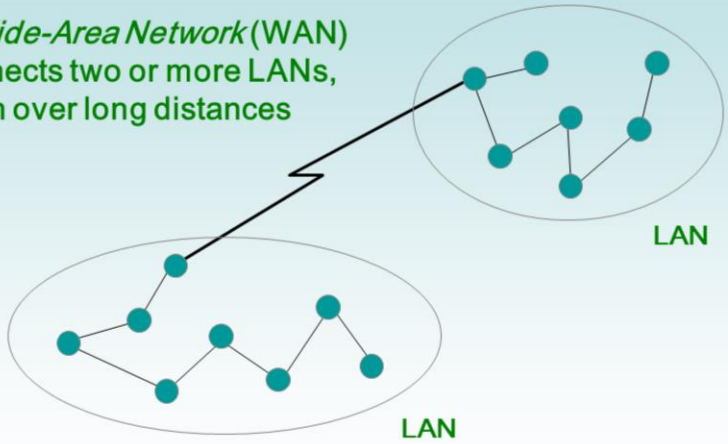


LAN

A LAN often connects the machines in a single room or building

Wide-Area Networks

A *Wide-Area Network* (WAN) connects two or more LANs, often over long distances



The Internet

- The *Internet* is a WAN which spans the planet
- The word Internet comes from the term *internetworking*
- It started as a United States government project, sponsored by the Advanced Research Projects Agency (ARPA)
  - originally it was called the ARPANET
- The Internet grew quickly throughout the 1980s and 90s

TCP/IP

- A protocol is a set of rules that determine how things communicate with each other
- The software that manages Internet communication follows a suite of protocols called *TCP/IP*
- The *Internet Protocol* (IP) determines the format of the information as it is transferred
- The *Transmission Control Protocol* (TCP) dictates how messages are reassembled and handles lost information

IP and Internet Addresses

- Each computer on the Internet has a unique *IP address*, such as:

```
204.192.116.2
```

- Most computers also have a unique Internet name, which also is referred to as an *Internet address*:

```
hector.vt.edu
```

- The first part indicates a particular computer (`hector`)
- The rest is the *domain name*, indicating the organization (`vt.edu`)

Domain Names

- The last part of a domain name, called a *top-level domain* (TLD), supposedly indicates the type of organization:

edu	educational institution
com	commercial entity
org	non-profit organization
net	network-based organization

Sometimes the suffix indicates the country:

uk	United Kingdom
au	Australia
ca	Canada
se	Sweden

Additional TLDs have been added:

biz, info, tv, name

Domain Names

- A domain name can have several parts
- Unique domain names mean that multiple sites can have individual computers with the same local name
- When used, an Internet address is translated to an IP address by software called the *Domain Name System* (DNS)
- There is no one-to-one correspondence between the sections of an IP address and the sections of an Internet address

The World Wide Web

- The *World Wide Web* allows many different types of information to be accessed using a common interface
- A *browser* is a program which accesses network resources and presents them
  - Popular browsers: Internet Explorer, Safari, Firefox
- Resources presented include:
  - text, graphics, video, sound, audio, executable programs
- A Web document usually contains *links* to other Web documents, creating a *hypermedia* environment
- The term Web comes from the fact that information is not organized in a linear fashion

The World Wide Web

- Web documents are often defined using the *HyperText Markup Language* (HTML)
- Information on the Web is found using a *Uniform Resource Locator* (URL):

```
http://www.google.com

http://www.whitehouse.gov/issues/education
```

- A URL specifies a protocol (http), a domain, and possibly specific documents
- You can also use a browser with other protocols, such as ftp

-Note a URL is NOT just an IP address, it contains a protocol (e.g. http), a domain name (the IP address), and the document to access (or index.html if none given)