Types of Computers
- Enterprise Level Computers
- Personal Computers

Enterprise Level Computers
Supercomputer

- **Supercomputer**: Provide the fastest possible speed to accomplish one specific task such as solving an engineering problem or simulating a molecular process

![Figure: Cray’s Titan, one of the fastest computers that exists.](image)

Supercomputer Applications

- Most basic use is in simulation of complex events down to the molecular level
- Nuclear explosions, to the extent that bombs can be developed and tested without actually blowing them up
- Weather forecasting long-term climate simulations
- Breaking encryption codes to read emails and other messages, such as for anti-terrorism . . . or who knows what
- Not so common in the business world, but they are present, used in engineering issues such as design from diapers to automobiles, financial services and oil exploration
- Financial services include risk analysis, credit fraud detection and portfolio optimization

Supercomputer Speed Measure

- **Flops**: Floating point (e.g., multiplication and division with fractions) operations per second

<table>
<thead>
<tr>
<th>Name</th>
<th>FLOPS</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>kiloFLOPS</td>
<td>$10^3$</td>
<td>thousand</td>
</tr>
<tr>
<td>megaFLOPS</td>
<td>$10^6$</td>
<td>million</td>
</tr>
<tr>
<td>gigaFLOPS</td>
<td>$10^9$</td>
<td>billion</td>
</tr>
<tr>
<td>teraFLOPS</td>
<td>$10^{12}$</td>
<td>trillion</td>
</tr>
<tr>
<td>petaFLOPS</td>
<td>$10^{15}$</td>
<td>quadrillion</td>
</tr>
<tr>
<td>exaFLOPS</td>
<td>$10^{18}$</td>
<td>quintillion</td>
</tr>
<tr>
<td>zettaFLOPS</td>
<td>$10^{21}$</td>
<td>sextillion</td>
</tr>
<tr>
<td>yottaFLOPS</td>
<td>$10^{24}$</td>
<td>septillion</td>
</tr>
</tbody>
</table>

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Contemporary Supercomputer Speed

The fastest

- The list is compiled every 6 months at http://top500.org
- Speeds are dramatically increasing even on a six-month basis, now in the range of tens of petaFLOPS per second
- Caveat: Only unclassified systems are ranked

The mundane

- Current high end Skylake Intel I7’s are around 200 gigaflops
- Most chips are closer to 50 gigaflops or less
- Hand calculator around 10 flops
- How about yours? For Windows use QwikMark to test:
  http://download.cnet.com/QwikMark/3000-2094_4-75802785.html

Human Equivalent of a Petaflop

Better set aside some time ...

- Suppose you started doing a calculation with a hand calculator that a fast supercomputer does in 1 second, but you do one Flop per second, i.e., one floating point calculation
- You work 16 hours a day, 365 days a year, for 70 years, from age 15 to 85.
- 3,600 sec/hr, 16 hr/day $\Rightarrow$ 57,600 sec/day and 365 days/yr $\Rightarrow$ 21,024,000 sec/yr
- One petaflop is 1,000,000,000,000,000 calculations per second, so divide by the number of seconds in a year to get 47,564,688 years of manual calculation
- If you work 70 years and then pass the task on to someone else, it will take 679,496 lifetimes of calculation to accomplish 1 second of computation time on the fastest supercomputers

Mainframe (Enterprise Server)

- **Mainframe**: A large computer that represents the beginning of business computing decades ago, largely devoted to processing large sets of transactions from many sources, such as filing insurance claims or handling credit card purchases
- Large connected mainframes, such as in one of four VISA processing centers, handle many thousands of transactions per second
- Financial companies such as banking and insurance tend to define the business market in mainframes servers
- Mainframes are characterized by very high capacity for input/output and lots of security and redundant systems to maximize reliability minimizing downtime to sometimes virtually nothing
Mainframe (Enterprise Server) II

- Reliability is enhanced by redundant computing, an option in which value is computed twice and compared for consistency, such as in certain critical financial computations.
- **Hot swapping** is the process of upgrading the hardware of a computer, such as a new disk drive, while the computer continues to operate.
- Modern mainframes also can operate as **virtual machines**, in which one computer runs many processes that each act as separate physical machines such as servers.
- Choice for a business: A large, consolidated computer platform, perhaps running virtual machines, or a set of connected smaller servers.

Mainframe History

- Business computing began with mainframes in the 1950’s and accelerated into the 60’s and 70’s.
- However the development of the PC and other, more powerful types of computers, tended to decentralize business computing and some even predicted mainframes would become extinct.
- The resurgence began in later 90’s, with virtual servers, the adaptation of Linux as a mainframe operating system, the development of huge data bases and much lower costs.
- Mainframe market is, and has been, totally dominated by IBM.

Server

- **Server**: Relatively high performance computer that runs server applications to perform services at the request of usually less powerful computers.
- **Client**: A relatively less powerful computer that requests work done by a server computer.
- The server and usually multiple clients operate over a network for their communication so that the server applications run on one, more powerful computer, and the client applications run on separate computers.
- The client-server model is dominate in modern computing systems, including the Internet with the web browser as the client which requests information and sometimes other services from the web server.
Physical Characteristics of Servers

- To obtain quality response time and reliability, server computers typically cost more and contain more features than regular PC’s.
- Remote monitoring of the physical state such as internal temperature
- Hot swappable, multiple hard disks
- RAID for redundant storing of each piece of information on multiple physical hard disks
- Much more RAM that also has special error checking and error correction routines

Rack Mounted Servers

- Many servers are shaped more like a pizza box
- This shape lets the servers be mounted in racks

Figure: Server computer

Figure: Hundreds of rack mounted servers joined together, in this example, to form a supercomputer

Personal Computers
**Workstation**

- **Workstation**: Desktop computer that has a more powerful processor, additional memory and enhanced capabilities than ordinary personal computers for specialized tasks such as graphic design and processing.
- Historically workstations were an important part of personal computing, the most powerful class of machines intended for use by a single individual.
- For example, when PC’s were limited to 64KB of RAM, workstations had at least 1MB of RAM.
- Today the distinction has largely disappeared as technology has advanced, so the term workstation refers more informally to a high-end PC.

**PC**

The primary business computer

- **PC**: Personal Computer, a computer designed for use by one person and inexpensive enough to be affordable for individual employees and for one or a few people for home use.
- First commercially successful PC’s were the Apple II in 1977, the IBM PC in 1981 which introduced Intel processors, and the Macintosh in 1984 which introduced the graphical windowing system that has become the basis of all modern PC’s.
- PC’s began as desktops, but laptop sales have been continually increasing as a percentage of overall sales so that today overall sales figures are almost evenly split as price and capability differentials narrow.

**Google Chromebook**

Primarily an on-line computer

- Manufactured by several companies such as Samsung and HP.
- Most work done through an Internet browser such as Chrome, but space available off-line computing.
- Powerful feature: Newer chromebooks can run Android apps.

**Figure**: Entry level HP Chromebook at $250, May, 2016.
Tablet Computer

- **Tablet computer**: Small computer about the size of a standard piece of paper, and less than 1/2 inch thick
- Microsoft tried for over a decade, but first became popular with Apple’s iPad in 2010
- Solid state drive, faster and more reliable than a whirling disk
- Virtual on-screen keyboard quite functional, or, for extended writing, add a Bluetooth keyboard to an iPad
- Microsoft blends the category of tablet and regular PC with its Surface brand of computers, as do other companies such as with the ASUS Chromebook Flip ($279 April, 2016)

The Credit Card Size Computer

The Raspberry Pi

- The $40 computer consists of the central components of a simple ARM-based Linux computer with wi-fi and bluetooth
- Most recent model also runs a customized version of Win 10
- Add a monitor, cable, a smart phone micro-USB power supply, and a standard SD card to complete the system

![Image of Raspberry Pi](image.png)

**Figure**: The credit card size Raspberry Pi, Version 3 as of Winter 2016

- Total cost of the system still under $100, and it runs LibreOffice

The Thumb Size Computer

The Intel Compute Stick

- The $299 version without an OS and $395 with Windows
- Add a monitor, including a TV with an HDMI port, and a keyboard

![Image of Intel Compute Stick](image.png)

**Figure**: Available May of 2016

- Includes Skylake Core M CPU, 4GB of RAM, 64GB of storage, and more, including a USB 3.0 slot
The End