CS1111
Systems Organization II

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Plagiarism

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2. You must read and comply with the UCC Policy on Plagiarism www.ucc.ie/en/exams/procedures-regulations/
3. The Policy applies to *all* work submitted, including software.
4. You can expect that your work will be checked for evidence of plagiarism or collusion.
5. In some circumstances it may be acceptable to reuse a small amount of work by others, but *only* if you provide explicit acknowledgement and justification.
6. If in doubt ask your module lecturer *prior* to submission. Better safe than sorry!

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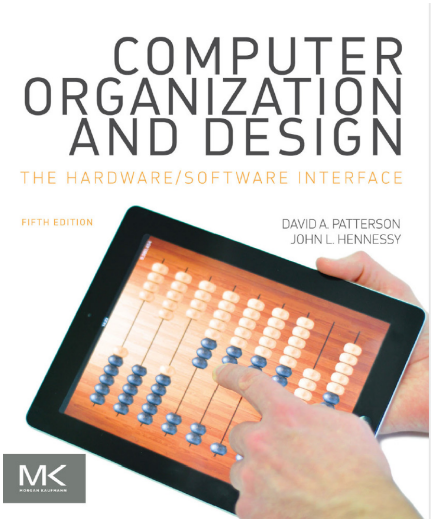
Some Text Books



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The Computer Revolution

- Computers have led to a third revolution for civilization, with the information revolution taking its place alongside the **agricultural** and the **industrial revolutions**
- The race to innovate has led to unprecedented progress since the inception of electronic computing in the late 1940s.
  - Had the transportation industry kept pace with the computer industry, for example, today we could travel from New York to London in a **second** for a **penny**.

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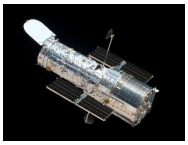
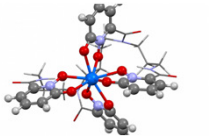
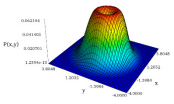
The Computer Revolution

- This technology has profoundly changed the ways in which the search for new knowledge.
- A new vein of scientific investigation:
  - Computational scientists join theoretical and experimental scientists in the exploration of new frontiers in astronomy, biology, chemistry, and physics, among others.



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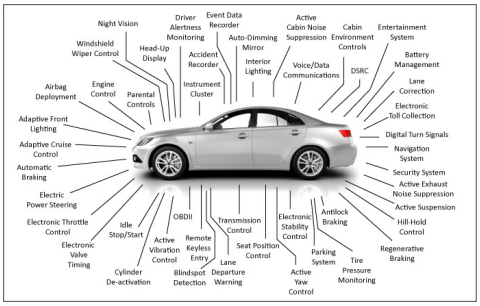
From Science Fiction to Science Fact

- *Computers in automobiles:*
  - Until microprocessors improved dramatically in price and performance in the early 1980s, computer control of cars was ludicrous.
  - Today, computers reduce pollution, improve fuel efficiency via engine controls, and increase safety through blind spot warnings, lane departure warnings, moving object detection, and air bag inflation to protect occupants in a crash.

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From Science Fiction to Science Fact

- *Mobile Phones:*
  - Advances in computer systems have led to more than half of the planet having mobile phones, allowing person-to-person communication to almost anyone anywhere in the world?



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From Science Fiction to Science Fact

- *Human genome project:*
  - Mapping and sequencing the human DNA genome would have cost hundreds of millions of dollars only 15 to 25 years ago.
  - Costs continue to drop; the average person can now afford to have his/her your own genome sequenced, allowing for individually tailored medical care.

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From Science Fiction to Science Fact

- *World Wide Web:*
  - Only in existence since 1989, the web has transformed our society. For many, the web has replaced libraries and newspapers.

Sir Tim Berners-Lee

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From Science Fiction to Science Fact

- *Search engines:*
  - As the content of the web grew in size and in value, finding relevant information became increasingly important.

Today, many people rely on search engines for such a large part of their lives that it would be a hardship to go without them.

"To Google Something"

According to Google, they are seeing over **one trillions searches performed each year**. That is about **three billion searches a day**. Needless to say, you are not alone when it comes to finding useful information via a search engine. Search Engines are right at your fingertips and have become a part of the daily life of most. They have become readily accepted in contemporary culture that the word *Google* now appears in the dictionary. Not defined only as a noun, but also as a verb as in "to Google something."

Google was 21 years old on Sept 4th 2019

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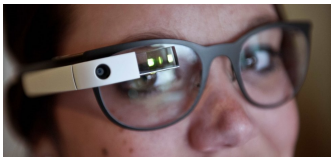
From Science Fiction to Science Fact

- Glasses that augment reality
- The cashless society
- Cars that can drive themselves



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Classes of Computing Machine

- **The Personal Computer(PC)**
  - A computer designed for use by an individual, usually incorporating a graphics display, a keyboard, and a mouse.
  - This class of computing drove the evolution of many computing technologies and is only about 35 years old!

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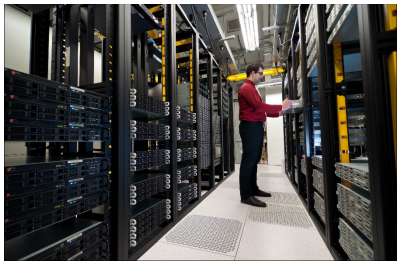
Classes of Computing Machine

- **Server**
  - A computer used for running larger programs for multiple users, often simultaneously, and typically accessed only via a network.
  - Servers are built from the same basic technology as desktop computers, but provide for greater computing capability, storage, and input/output capacity. In general, servers also place a greater emphasis on dependability, since a crash is usually more costly than it would be on a single user PC.
  - Servers span the widest range in cost and capability. At the low end, a server may be little more than a desktop computer without a screen or keyboard and cost a thousand dollars. These low-end servers are typically used for file storage, small business applications, or simple web serving. At the other extreme are **supercomputers.**



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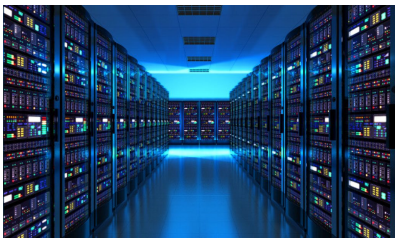
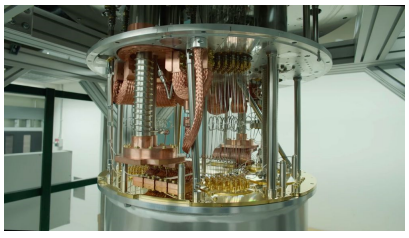
Classes of Computing Machine

- **Supercomputers**
  - Consist of tens of thousands of processors and many **terabytes** of memory, and cost tens to hundreds of millions of dollars.
  - Supercomputers are usually used for high-end scientific and engineering calculations, such as **weather forecasting**, **oil exploration**, **protein structure determination**, and other large-scale problems.
  - Such supercomputers represent the peak of computing capability, but represent a relatively small fraction of servers and a relatively small fraction of the overall computer market in terms of total revenue.
  - **Quantum Computing.**





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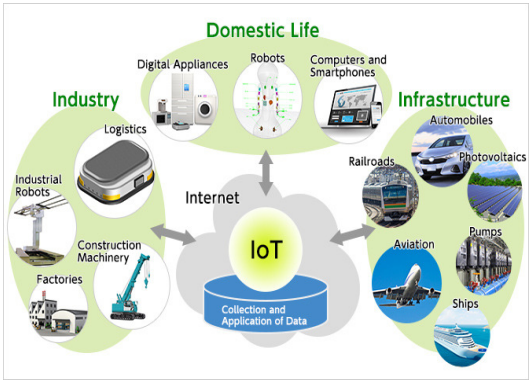
Classes of Computing Machine

- **Embedded computer**
  - A computer inside another device (most users never realize that they are using a computer) used for running one predetermined application or collection of software.
  - Embedded computers include the microprocessors found in your **car**, the computers in a **television** set, and the networks of processors that control a modern **airplane** or **cargo ship**.
  - Embedded computers often have lower tolerance for failure.
  - Dependability is achieved primarily through simplicity—the emphasis is on doing one function as perfectly as possible



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The 2^X vs. 10^Y bytes ambiguity

- **Terabyte (TB)**
  - Originally 1,099,511,627,776 (2^{40}) bytes, although communications and secondary storage systems developers started using the term to mean 1,000,000,000,000 (10^{12}) bytes.
  - To reduce confusion, we now use the term **tebibyte (TiB)** for 2^{40} bytes, defining *terabyte* (TB) to mean 10^{12} bytes.
- The full range of decimal and binary values and names are shown below:

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The 2^X vs. 10^Y bytes ambiguity

Decimal term	Abbreviation	Value	Binary term	Abbreviation	Value	% Larger
kilobyte	KB	10^3	kibibyte	KiB	2^{10}	2%
megabyte	MB	10^6	mebibyte	MiB	2^{20}	5%
gigabyte	GB	10^9	gibibyte	GiB	2^{30}	7%
terabyte	TB	10^{12}	tebibyte	TiB	2^{40}	10%
petabyte	PB	10^{15}	pebibyte	PiB	2^{50}	13%
exabyte	EB	10^{18}	exbibyte	EiB	2^{60}	15%
zettabyte	ZB	10^{21}	zebibyte	ZiB	2^{70}	18%
yottabyte	YB	10^{24}	yobibyte	YiB	2^{80}	21%

These prefixes work for bits as well as bytes, so *gigabit* (Gb) is 10^9 bits while *gibibits* (Gib) is 2^{30} bits.

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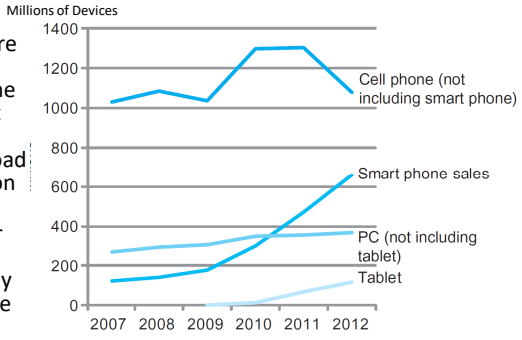
The PostPC Era

- The **personal mobile device (PMD)**.
  - Replacing the PC, PMDs are battery operated with wireless connectivity to the Internet and typically cost hundreds of dollars, and, like PCs, users can download software ("apps") to run on them.
  - Unlike PCs, they no longer have a keyboard and mouse, and are more likely to rely on a touch-sensitive screen or speech input. Today's PMD is a smart phone or a tablet computer, but tomorrow it may include electronic glasses.



The rapid growth time of tablets and smart phones versus that of PCs and traditional cell phones.

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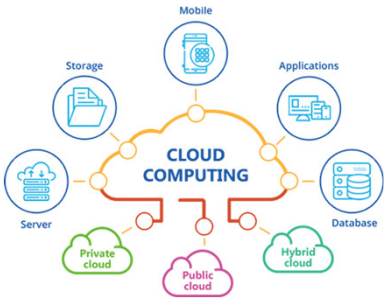
The PostPC Era

- **Cloud Computing**
  - Taking over from the traditional server
    - relies on giant datacenters that are now known as *Warehouse Scale Computers* (WSCs).
  - Companies like Amazon and Google build these WSCs containing ~100,000 servers and then let companies rent portions of them so that they can provide software services to PMDs without having to build WSCs of their own.
  - Indeed, **Software as a Service (SaaS)** deployed via the cloud is revolutionizing the software industry just as PMDs and WSCs are revolutionizing the hardware industry.
  - Today's software developers will often have a portion of their application that runs on the PMD and a portion that runs in the Cloud.



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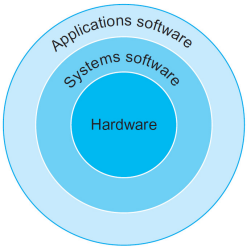
Below Your Program

- A typical Application may consist of millions of lines of code and rely on sophisticated software libraries that implement complex functions in support of the application.
- The hardware in a computer can only execute extremely simple **low-level** instructions.
- To go from a complex application to the simple instructions involves several layers of software that **interpret** or **translate** high-level operations into simple computer instructions, an example of the great idea of **abstraction**.



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Below Your Program

- Systems Software
  - Software that provides services that are commonly useful, including operating systems, compilers, loaders, and assemblers.
  - **operating system** lies between (interfaces) a user's program and the hardware and provides a variety of services and supervisory functions. Among the most important functions are:
    - Handling basic input and output operations
    - Allocating storage and memory
    - Providing for protected sharing of the computer among multiple applications using it simultaneously.
    - Examples of operating systems in use today are Linux, iOS, and Windows.


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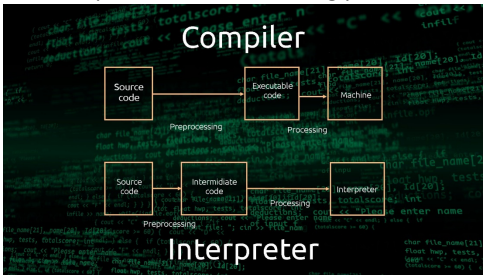
Below Your Program

- **Compilers** perform another vital function: the translation of a program written in a **high-level language**, such as C, C, Java, or Visual Basic into instructions that the hardware can execute. Given the sophistication of modern programming languages and the simplicity of the instructions executed by the hardware, the *translation from a high-level language program to hardware instructions is complex*.
- **Interpretation** examines at each instruction in the high-level language, in turn, decodes them and executes them immediately. No translated program is generated. Here, the interpreter is in control of the computer. To it, the high-level program is just data.
- Both compilation and interpretation, and increasingly, a combination of the two, are widely used.



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