Computer Science Illuminated

SECOND EDITION

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# Chapter 01

# Introduction

## Chapter Goals

- Describe the layers of a computer system
- Describe the concept of abstraction and its relationship to computing
- Describe the history of computer hardware and software

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## Computing Systems

*What is the difference between **hardware** and **software**?*

1-3

## Computing Systems

**Hardware** The physical elements of a computing system (printer, circuit boards, wires, keyboard…)

**Software** The programs that provide the instructions for a computer to execute

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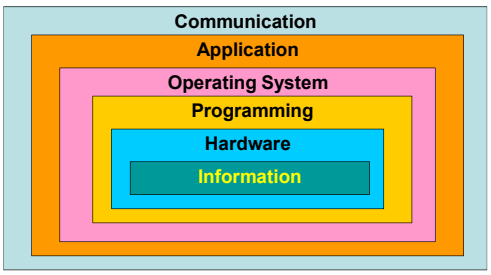
## Layers of a Computing System

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## Abstraction

**Abstraction** A mental model that removes complex details

***This is a key concept. Abstraction will reappear throughout the text – be sure to understand it!***

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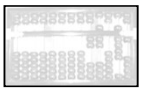
## Early History of Computing



**Abacus**
An early device to record numeric values

**Blaise Pascal**
Mechanical device to add, subtract, divide & multiply

**Joseph Jacquard**
Jacquard's Loom, the punched card

**Charles Babbage**
Analytical Engine

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## Early History of Computing

**Ada Lovelace**
First Programmer, the loop

**Alan Turing**
Turing Machine, Artificial Intelligence Testing

**Harvard Mark I, ENIAC, UNIVAC I**
Early computers launch new era in mathematics, physics, engineering and economics

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## First Generation Hardware (1951-1959)

**Vacuum Tubes**
Large, not very reliable, generated a lot of heat

**Magnetic Drum**
Memory device that rotated under a read/write head

**Card Readers → Magnetic Tape Drives**
Sequential auxiliary storage devices

1-9

## Second Generation Hardware (1959-1965)

**Transistor**
Replaced vacuum tube, fast, small, durable, cheap

**Magnetic Cores**
Replaced magnetic drums, information available instantly

**Magnetic Disks**
Replaced magnetic tape, data can be accessed directly

1-10

## Third Generation Hardware (1965-1971)

**Integrated Circuits**
Replaced circuit boards, smaller, cheaper, faster, more reliable.

**Transistors**
Now used for memory construction

**Terminal**
An input/output device with a keyboard and screen

1-11

## Fourth Generation Hardware (1971-?)

**Large-scale Integration**
Great advances in chip technology

**PCs, the Commercial Market, Workstations**
Personal Computers were developed as new companies like Apple and Atari came into being. Workstations emerged.

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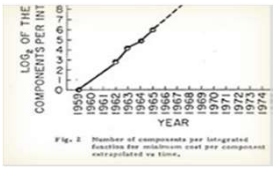
## Power of hardware innovation
## Moore's Law

**What Is Moore's Law?**
**"The number of transistors incorporated in a chip will approximately double every 24 months."**
**—Gordon Moore, Intel Co-Founder**

Moore's Law and Intel Innovation

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## Parallel Computing and Networking

**Parallel Computing**
Computers rely on interconnected central processing units that increase processing speed.

**Networking**
With the Ethernet small computers could be connected and share resources. A file server connected PCs in the late 1980s.

**ARPANET and LANs → Internet**

1-14

## First Generation Software (1951-1959)

**Machine Language**
Computer programs were written in binary (1s and 0s)

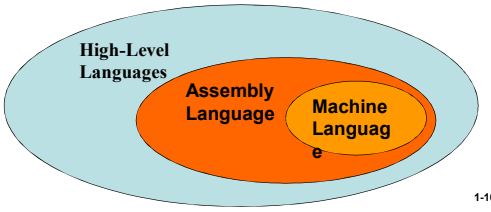
**Assembly Languages and translators**
Programs were written in artificial programming languages and were then translated into machine language

**Programmer Changes**
Programmers divide into application programmers and systems programmers

1-15

## Second Generation Software (1959-1965)

**High Level Languages**
Use English-like statements and make programming easier.
Fortran, COBOL, Lisp are examples.

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## Third Generation Software (1965-1971)

- **Systems Software**
  - utility programs,
  - language translators,
  - and the operating system, which decides which programs to run and when.
- **Separation between Users and Hardware**
  Computer programmers began to write programs to be used by people who did not know how to program

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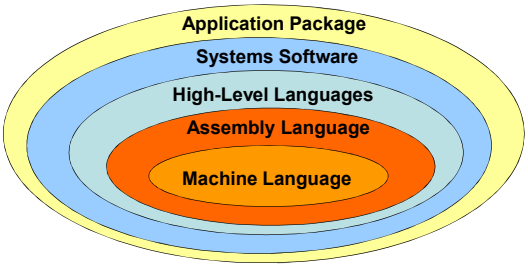
## Third Generation Software (1965-1971)

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## Fourth Generation Software (1971-1989)

**Structured Programming**
Pascal, C, C++

**New Application Software for Users**
Spreadsheets, word processors, database management systems

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## Fifth Generation Software (1990- present)

**Microsoft**
The Windows operating system, and other Microsoft application programs dominate the market

**Object-Oriented Design**
Based on a hierarchy of data objects (i.e. Java)

**World Wide Web**
Allows easy global communication through the Internet

**New Users**
Today's user needs no computer knowledge

1-20

## Computing as a Discipline

***What do you think?***

*Is Computer Science a mathematical, scientific, or engineering discipline?*

1-21

## Systems Areas of Computer Science

- **Algorithms and Data Structures**
- **Programming Languages**
- **Architecture**
- **Operating Systems**
- **Software Methodology and Engineering**
- **Human-Computer Communication**

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## Application Areas of Computer Science

- **Numerical and Symbolic Computation**
- **Databases and Information Retrieval**
- **Artificial Intelligence and Robotics**
- **Graphics**
- **Organizational Informatics**
- **Bioinformatics**

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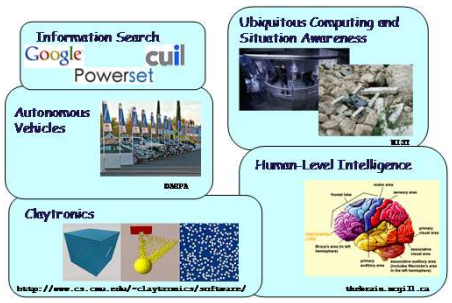
## Some Challenges for CS

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## Software Industry

- The economies of ALL developed nations are dependent on software.
- More and more systems are software controlled
- Software engineering is concerned with theories, methods and tools for professional software development.
- Expenditure on software represents a significant fraction of GNP in all developed countries.

1-25

## Challenges in software engineering

- Heterogeneity, delivery and trust.
- Heterogeneity
  - Developing techniques for building software that can cope with heterogeneous platforms and execution environments;
- Delivery
  - Developing techniques that lead to faster delivery of software;
- Trust
  - Developing techniques that demonstrate that software can be trusted by its users.

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## 作业

**作业1：在浏览器中输入［http://en.wikipedia.org/］进入维基百科；Search以下关键词，并将每个词条的解释（第一段的第一句）写在作业本上。**
**1) Computer**
**2) Computer science**
**3) Software**
**4) Software engineering**
**5) Alan Turing**
**6) Moore's law**

**[注：维基百科是 IT 人最常用的百科知识网站]**

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