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

1-2

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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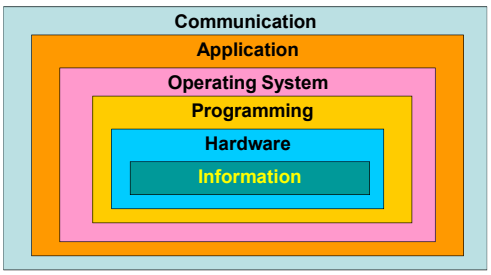
Layers of a Computing System



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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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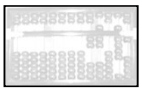
Early History of Computing



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

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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

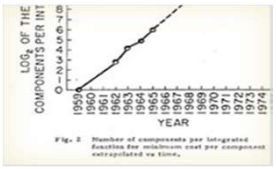
PCs, the Commercial Market, Workstations
Personal Computers were developed as new companies like Apple and Atari came into being. Workstations emerged.

1-12

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

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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

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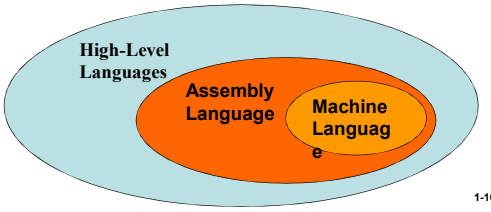
Second Generation Software (1959-1965)

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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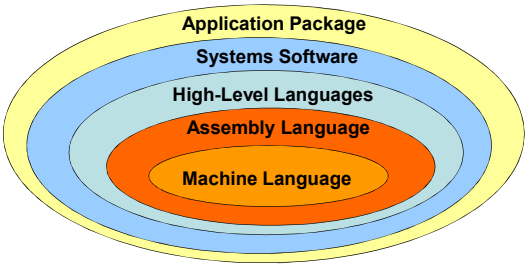
Third Generation Software (1965-1971)



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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?

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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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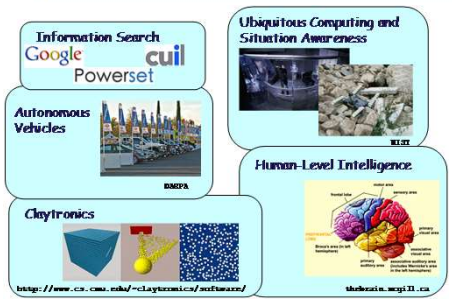
Some Challenges for CS



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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（通常是第一段的第一句）。
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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