Computer Systems

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Useful information

- Lecturer's details.
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- URL: Learning Mall
- TAs:
  - TBD

Overview

- Course info
- Types of computers
- Computer systems: overview
- Hardware
- Software
- Backward (Downward) compatibility for new hardware
- VHDL
- Hierarchy of systems
- Interacting development of hardware & software
- Hardware evolution
- Trends of computing

Course assessment

- 80 % Examination.
- 10% Assessment 1
- 10% Assessment 2

Assessment Plan

Sequence	Method	Assessment Type (EXAM or CW)	Learning Outcomes Assessed (use codes under Learning Outcomes)	Duration	Week	% of Final Mark	Resit (Y/N/S)
1	Final Exam	Final EXAM	ALL	TBD		80	S
2	Online Assessment Task 1	Online Quiz	ALL	TBD		10	S
3	Online Assessment Task 2	Online Quiz	ALL	TBD		10	S

Practical Assignments & Assessments

- Assignment solving is crucial for learning
- On spot assessment is carried out

- TAs to be organized for both on-spot assessments

Practical Assessments

- **Practical Assessments 1 (10%) and 2 (10%)**
- Practical Assessments 1 and 2 will be held in November (TBD) using Learning Mall's Quiz activity. There will be two parts (one for each assessment) covering assembly codes. The duration to complete the online Quiz activity is TBD.
  - The first part focuses on reviewing assembly codes and filling in the missing blanks.
  - The second part requires the students to convert C/C++ codes to assembly codes.

Labs & Tutorials

- There will also be 5 weeks of **tutorials (i.e. on Weeks 3,4, 5, 6 and 10**) in the LT scheduled in your timetable. No other tutorial sessions outside of these weeks indicated above.

- For each lab group, there will be 1 **lab session** per week for **Weeks 4, 5, 6, 7**in the computer lab scheduled in your timetable. No other lab sessions outside of these weeks indicated above.
- Tools to be used in the labs: Microsoft Visual Studio / Visual C++ / Inline Assembly

Lab Sessions

- On-site lab sessions will be held for 4 weeks, allowing the students to try out the assembly programming exercises delivered by the co-teacher a week before.
- Please refer to your timetable to ensure you go to the correct lab.
- Students who are unable to be on campus can try out the assembly programming exercises on their own by reviewing the uploaded tutorial videos by the co-teacher. Should there be any issue faced, the student is encouraged to book a Help Session with one of our Teaching Assistants (TAs).

On-site and Online Help Sessions

- Students can book 30-minute Help Sessions with Teaching Assistants (TAs).
- However, students are **encouraged to book a session at least a day before and to communicate with the TA on his/her issues/questions before the meeting**. This allows the TA to be better prepared to help you out.
- On-site Help Sessions, if the students so choose, will be held at the common area in the Science or nearby Buildings or via online meetings.

Recommended text

- [Wil06] Rob Williams. Computer Systems Architecture: A Networking Approach. Prentice Hall, 2nd edition.
- [Wil01] Rob Williams. Computer Systems Architecture: A Networking Approach. Prentice Hall, 1st edition.

What is our course about?

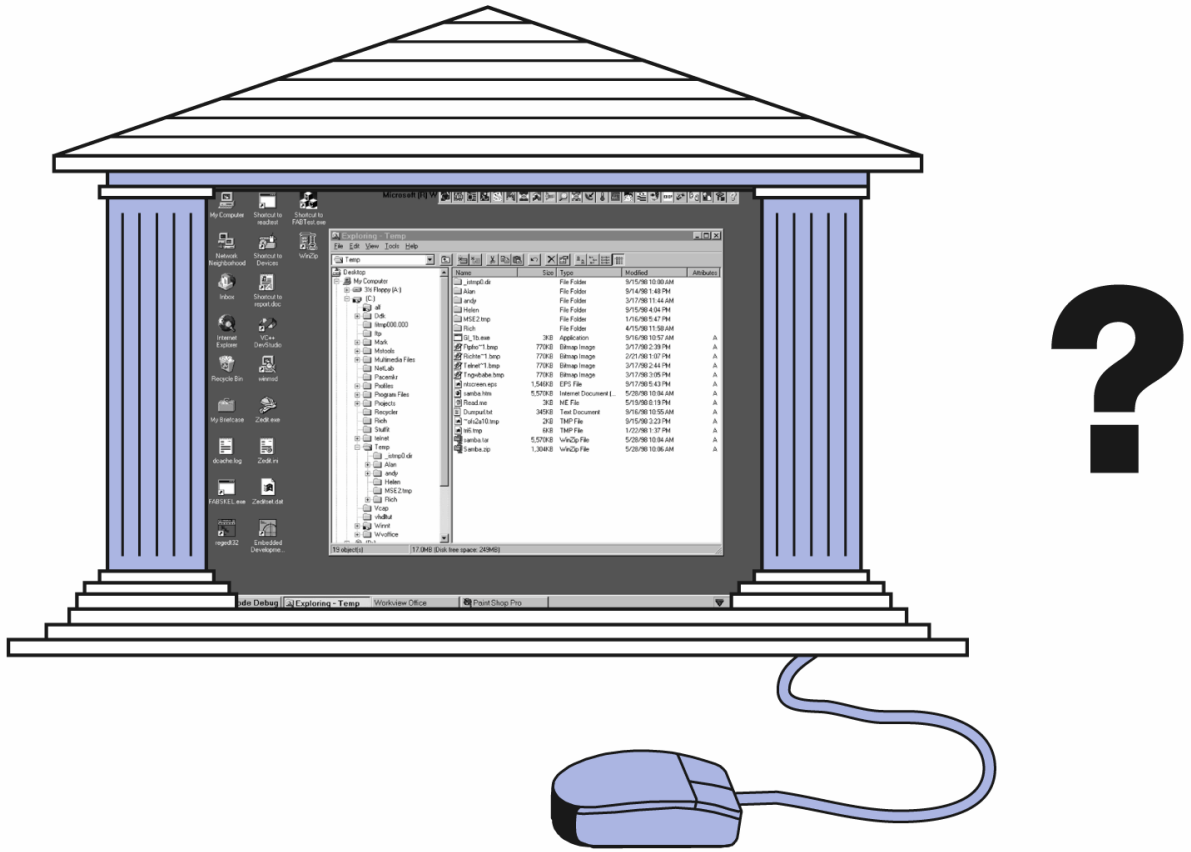


Fig. 1.1 Computer architecture.

Aims

- To introduce students to … …
  - The components of computer systems: processors, controllers, primary memory, secondary memory, peripherals, etc.
  - The inter-working of them.

Aims (cont.)

- To introduce students to the various architecture levels of computer systems.
  - The assembly language level.
  - The instruction set architecture level.
  - The micro architecture level.
  - The digital logic level.

Learning outcome

- To understand how a computer works at the machine code level.
- To understand a little about the computer hardware.
- To understand basic principle of data storage and coding of information.
- To understand the roles and organization of the major kinds of system software.

Content of the course

- Overview of computer systems: hardware and software.
- Machine architecture and instruction execution:
  - CPU and its instruction set.
  - stored program concept, program execution, overview of instruction level operations.

Content of the course

- Machine-level correspondence to higher-level constructs:
  - Simple arithmetic expressions, loops, conditional expressions, subroutines, stack and recursions.
- Building computers from logic:
  - Elementary logic gates, simple circuits, CPU, ALU, memory.

Content of the course

- Data storage:
  - main memory, mass storage, coding of information.
- Interrupt processing – service on demand.
- Introduction to operating systems.
- Basic network concepts.

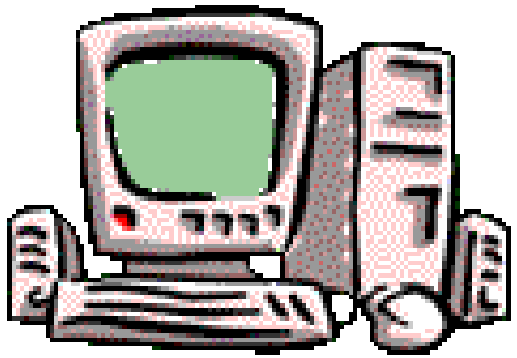
Computer Systems vs Java

- CSE105 deals (mainly) with how programs are written at high level.

- CSE101 deals with
  - What is going on inside the computer when the programs are run.
  - How programs are written at low level (assembly programming)

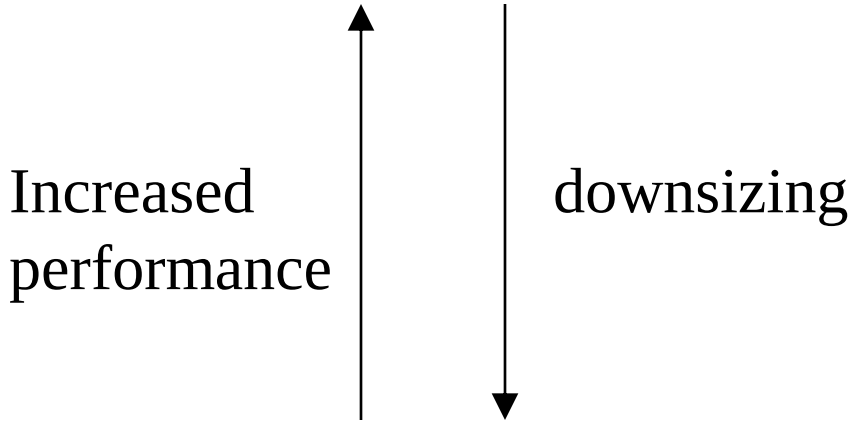
Types of Computers

- Mainframe computers (1960s)
- Supercomputers (1970s)
- Workstations (1980s)
- Microcomputers (1980s)
- Personal computers (1980s)



Types of Computers (continued)

- Microcontrollers (1980s)
  - embedded or dedicated computers: from calculators to automobiles
- Servers (1980s)
  - network
  - Web
  - Cloud
- Chip computer (?)



Computer Generations

- First (1944 to1958): vacuum tube
  - MARK I, ENIAC and UNIVAC

- Second (1959 to1963): transistor
  - IBM1401, IBM 1410 with 1402 card read/punch

- Third generation (1964 to 1970): IC
  - DEC PDP-1
  - IBM 360

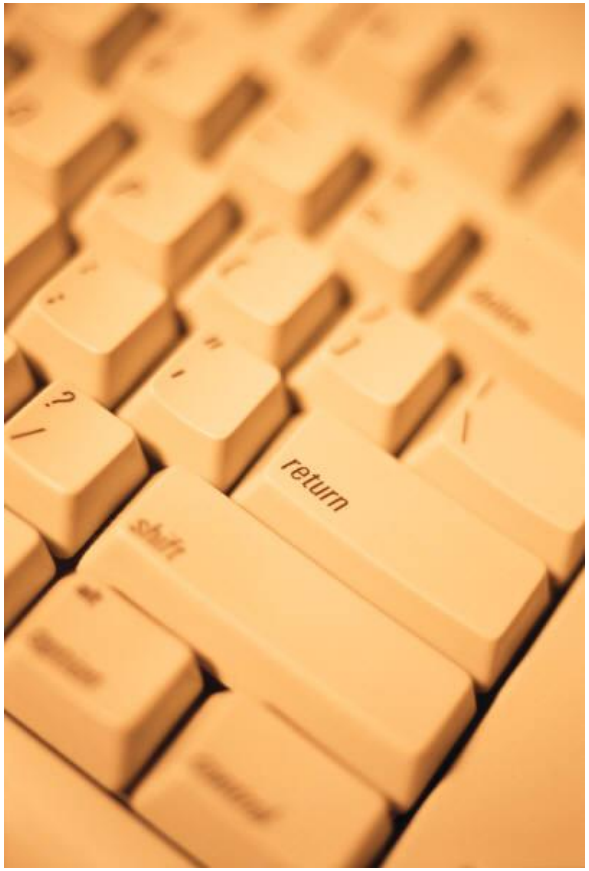
Computer Generations (continued)

- Fourth generation (1971 to now: VLSI)
  - dominated by the LSI (large-scale integrated circuits) and the VLSI (very-large-scale integrated circuits)
  - word processing, spreadsheets, database, and graphic programs became readily available
  - Cray-1 supercomputer
  - Apple II, IBM PC, Notebook PC, Palmtop, Laptop, iPhone, iPad, …

Computer Systems: hardware & software

- In the past, college computer courses tended **not** to require their students to have a comparable understanding in both fields.
- This specialisation has caused a number of serious negative results.
  - Unsuitable equipments are ordered for programmers.
  - Unsuitable software fails to exploit the performance advantages offered by revolutionary new circuits.

Computer Hardware



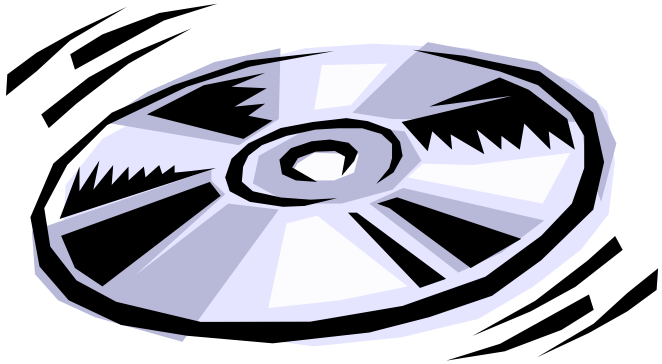
- 5 categories
  - input
  - processing
  - output
  - storage
  - communications

Computer Software

- System software
  - communication with hardware
  - resource management
  - facilitates communication among application programs

Computer Software

- Applications software
  - benefits or assists the user



Computer Systems: hardware & software

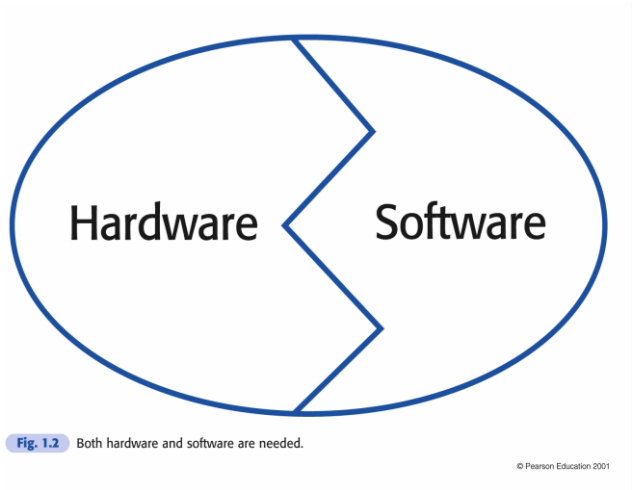


Fig. 1.2 Both hardware and software are needed.

- We treat Computer Systems "…as a study of the interaction of hardware and software which determines the performance of … computer systems." [Wil01]

Backward (Downward) Compatibility for new hardware

- Most software written for computers with old hardware can be run on computers with newer hardware

- Why Downward Compatibility?

VHDL

- The split between those concerned with hardware and those concerned with software.
- The appearance and wide-spread using of VHDL might reverse this trend.
- VHDL.
  - Very high speed integrated circuits Hardware Description Language.
  - A programming language to be used to specify both the structure and function of hardware circuits.
  - Supports computer simulations as well as providing input to automatic layout packages which arranges the final circuits.

Computer Systems: hierarchy of systems

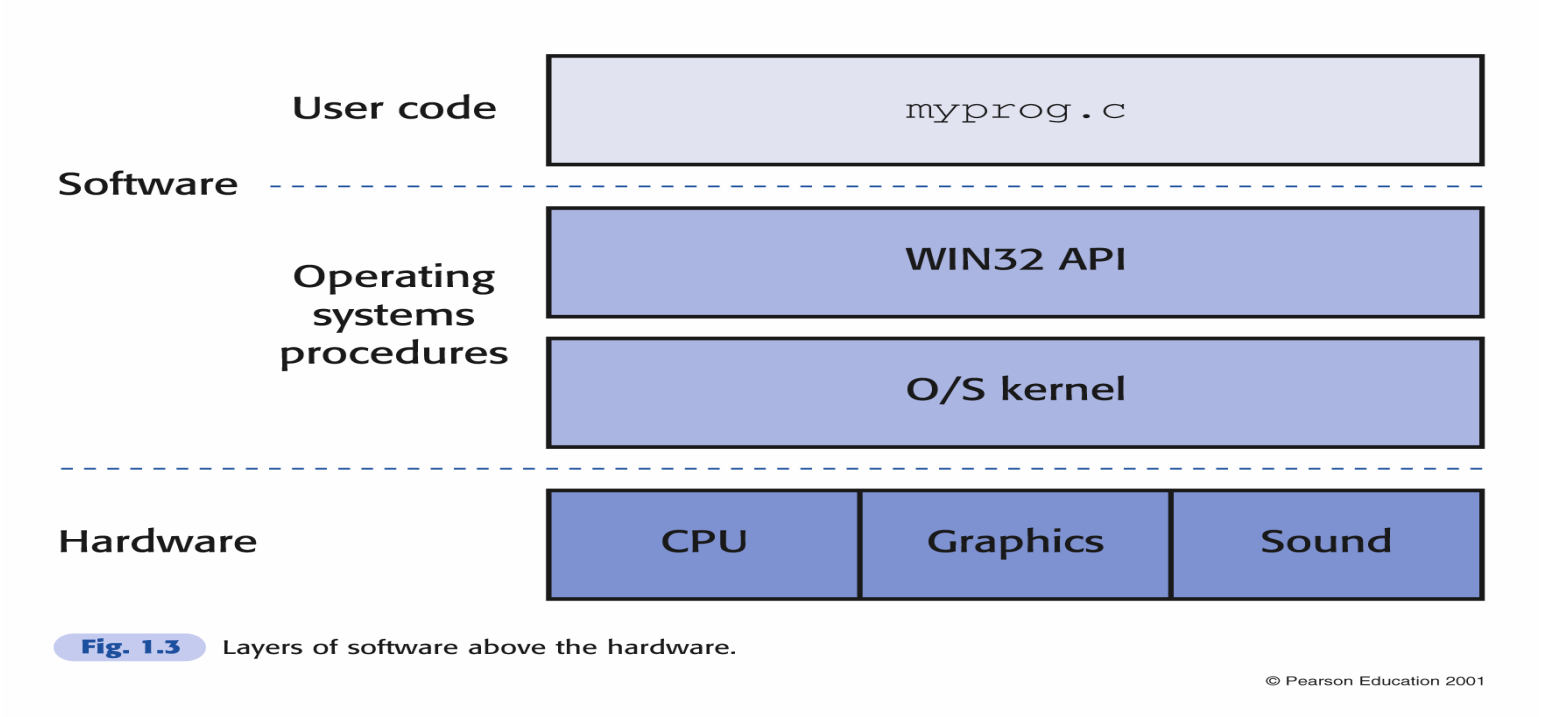


Fig. 1.3 Layers of software above the hardware.

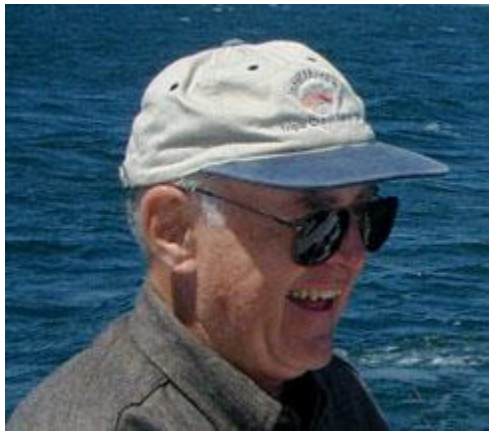
- "…computers can always be viewed as hierarchical ordered systems which can be broken down into simple component parts… in order to fully understand their operations." [Wil01]
- What are the benefits for a system to be designed in a hierarchy?

Advantages of the operating system

- Functionalities of hardware systems can be brought out by operating systems and thus offered to the user.
- The user's programs interact with hardware systems through the functionalities provided by operating systems.
  - Ease of programming.
  - Protection for the system and for other users.
  - Fairness and efficiency of using system resources

Hardware evolution: Moore's Law

- Gordon Moore (January 3, 1929 -).
  - One of the founders of Intel Corporation.
- Moore's Law (empirical).
  - The amount of circuitry (number of transistors) which can be placed on a given chip area approximately doubles every two years.



Hardware evolution: Moore's Law

Hardware evolution: Moore's Law (cont.)

- Moore's Law.
  - A circuit designed 24 months ago can now be shrunk to fit into an area of half the size.
  - It is sometimes quoted as every 18 months.
  - But Intel's official Moore's Law page states that it is every two years.

    http://www.intel.com/technology/mooreslaw/

Interacting development of hardware & software: Examples

- Windowing interfaces –WIMPs.
- A by-product of the microprocessor revolution, which allowed all users to have fast bitmapped graphics on their desks.

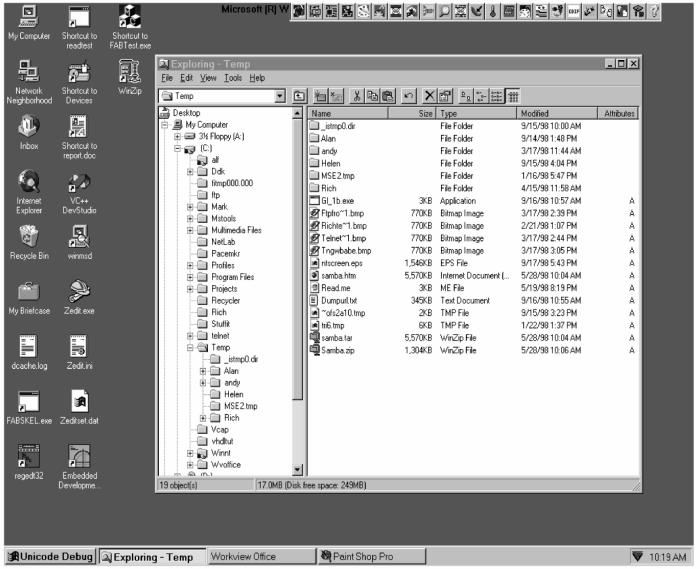


Fig. 1.7 Windows NT Explorer used as a directory browser.

Interacting development of hardware & software: Examples

- The Internet – connecting all networks.
- The launch of Netscape browser boosted the use of Internet greatly!

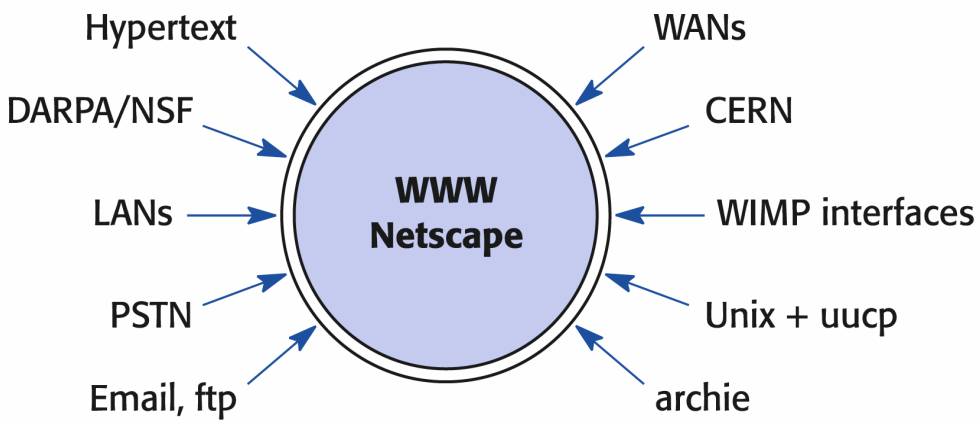


Fig. 1.9 Influences on the World Wide Web.

Trends of Computing

- Scientific computing - computation
- Business computing - data
- Personal computing - interaction
- Pervasive computing – ubiquity
- Mobile computing - mobility

- What is next?

Q&A

- Mention four architectural levels of computer systems.
- What does CPU stand for? ALU?
- What are the components of a computer system?
- Mention 4 different types of computers.
- ‘Servers’ are facilitated via the availability of ?
- Define the areas of study for ‘computer systems’.
- Define ‘Downward Compatibility’.
- What is the description language that can be used to design high speed IC hardware?

Q&A

- What are the advantages of having a hierarchical approach to computer system?
- What is Moore's Law?
- Functionalities of hardware systems can be brought out by what and thus offered to the user?
- What are the advantages of having 'operating systems' wrapping around the computer hardware?
- WIMP stand for? WIMP is available due to the development of ?
- What is the focus of scientific computing ?
- What is the focus of business computing ?
- What is the major characteristic of personal computing?

Readings

- [Wil06] Chapter 1. Introduction: software – hardware interface.
- See Review and Exercises at the end of every chapter.
- See also Readings at the end of Chapter 1, especially the list of Web sites.