

BOARD OF STUDIES
NEW SOUTH WALES

COMPUTING STUDIES SYLLABUS
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SYLLABUS IN COMPUTING STUDIES

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INTRODUCTION

This Computing Studies syllabus has been developed in keeping with the principles outlined in *Computers in Education: K–12 Statement of Principles*. It is designed to assist students to learn about computers and computing so that they gain a greater understanding of the effects that computer and information technologies will have on them and society. By completing this course they will be better equipped for continuing education, for employment, for leisure and for participation in an increasingly technological world.

Computing Studies in the junior secondary years is a study of the functioning and applications of computers. At the centre of this study is the computer equipment — hardware — and the computer programs which run on it — software. These two elements provide the unique nature of the subject.

The intrinsic interest of these elements provides the stimulus for many teachers to offer the course and the motivation for many students to undertake the course. However, it is imperative that the hardware and software are not merely studied in isolation but are placed in a context.

The unifying approach that has been selected for the presentation of the content of the syllabus is that of a systems perspective which emphasises how the computer scientist investigates, and the computer professional applies, this technology. Schools are required to ensure that the course which they develop presents the material from this perspective.

The true essence of the subject is the study of how people, operating in an environment and using computer systems, which include applications formed from hardware and software, proceed to solve problems to relevance to them.

Problem-solving, in the context of the syllabus, involves developing the student's ability to analyse problems, to identify how similar problems have been solved in the past, to identify possible solutions, to determine the appropriateness of the role of the computer in the solution and to see such solutions in the context of a broader environment which consists of people, hardware and software.

In addition to the systems perspective, schools are also required to ensure that, wherever relevant, selections of the material are presented from other perspectives. By this means schools can produce courses that have a commonality and yet provide diversity to meet the needs of students by presenting material from perspectives appropriate to them.

The syllabus has been designed to meet the recognised need that some students will wish to gain a grounding in the concepts underlying the operation of computers in the solution of relevant problems — including techniques that can be applied to the development of computer programs.

The syllabus also provides opportunities for students to explore attitudes and values from a number of perspectives. It will provide an alternative 'window on the world' through which they can view technology in operation.

It has been designed to be relevant to all students who decide to undertake the subject — both girls and boys — irrespective of their background or location. It requires no previous knowledge, nor the completion of any prerequisite subjects.

RATIONALE

If people are to have control over the society in which they live, there is a need to educate future citizens to cope with and manage change, and to make informed decisions about the direction that future change is to take. For this to occur, students need to have a knowledge of the way the technology operates. Those who have this knowledge and understanding will be better equipped to use the technology to their advantage.

The continual expansion of computer technology into more and more fields of human endeavour has meant that social, recreational and work patterns are becoming less and less predictable. Traditional patterns have changed and will continue to change as new computer technologies and new applications of computer technology are developed and adopted.

Parents are expressing concern that their children will be unable to cope with these changes unless they are given at least a foundation in computing studies during the years of compulsory schooling. As a result, parents are pressing for schools to provide appropriate courses. This parental demand is linked with the demand by employers for school leavers to be more computer literate.

The students themselves identify computing studies as a valuable area of study, not only as a commodity which may enhance their employment opportunities and thus improve their quality of life, but also as an intrinsically interesting area for study. As computing has developed, it has grown into a recognised body of knowledge and processes that has academic rigour, is of interest to a wide range of students as a tool in their other subjects, and has potential to be of use to many in later life.

It is recognised that not all students will want to, nor will need to,

understand the details of ways in which computers carry out tasks. But, for the reasons given above, some provision must be made for those students who wish to undertake studies in this area.

The recognition that there exists a discrete body of knowledge based on underlying principles that can be identified as specific to computing means that there are insufficient provisions for it to be adequately covered in existing subject areas.

Existing school-based courses in computing studies have tended to be content based and sequentially taught, reflecting the order in which the course document has presented the material. This course, on the other hand, has been designed so that the material can be taught in many different sequences.

Computing studies is a dynamic area, undergoing continual change and development. Any syllabus that is based on the details of current material without addressing the broader underlying principles will have a limited useful life.

By undertaking this course, students will gain an insight into the methodology of computing. The methods developed in this subject will be directly and immediately applicable to many other subject areas. The development of such problem-solving skills is an advantage to anyone living in a complex and changing technological environment.

By providing opportunities for students to analyse systems into component parts, study the individual parts and construct new systems from the components, this course will give students a different perspective from which they can view the world and through which they can confidently face future experiences.

AIM

The aim of the course is to develop in students the abilities and confidence necessary to become competent users of computer technology; to acquire the confidence to accept challenges of change which computer technology may produce; and to be able to accept a responsible role in the control of the change.

In order to achieve this it is considered important that students:

- develop an understanding of the fundamentals of computing;
- apply these understandings in the design of solutions to appropriate problems of relevance to them;
- use a computer in the implementation of these solutions;
- appreciate the consequences of implementing solutions using computers;
- relate classroom experiences with computers to a wider societal context;
- develop an understanding of the effects of the use of computers in society.

NATURE OF THE COURSE

The syllabus has been designed to accommodate a variety of approaches to the development of teaching/learning programs. Whatever approach is taken, however, the teaching/learning program developed must ensure that a balance is achieved between descriptive and theoretical aspects of computing studies and practical, 'hands on' experiences.

The philosophy of the course requires that students be involved in a wide range of activities both within the classroom and in the wider community. The activities should provide experiences in such skills as:

investigating, eg observing, recording, organising, interpreting;
expressing, eg reporting, talking, presenting;
communicating, eg listening, reading, writing, designing;
problem-solving, including designing, developing, debugging and documenting computer programs;
using and evaluating software packages.

In all aspects of this course underlying principles should be emphasised rather than the idiosyncrasies of any particular illustrative example, whether this be a particular hardware system, software package, operating system or application.

An important concept within the syllabus is that of inter-relationships and hence teaching/learning programs should be designed which integrate the content wherever possible. Although the structure of the course is represented on the next page by a static diagram, the intent is that the teaching/learning programs developed by dynamic — crossing boundaries wherever appropriate.

The course should include opportunities for students to transfer classroom experiences to real-world applications. They should use a variety of applications packages, particularly those which have direct transferability to use in the wider community. They should solve problems and experience the use of computer-based systems which go beyond classroom use.

An important aspect of the course is the study of the effects of using the computer-based system on the human and social environment. The discussion and debate that occurs in these learning experiences should involve as many relevant perspectives as is possible.

By so doing, students will appreciate the consequences of adopting a particular solution to each problem and hence be better placed to make responsible decisions when faced with future technological change.

NATURE OF THE COURSE

The content areas to be addressed have been listed under the headings of 'Core' and a number of 'Themes'. The core contains those elements of content which are considered to be common to all of the computer-based systems discussed in the themes. Elements of content of specific relevance to particular systems are outlined in the appropriate theme.

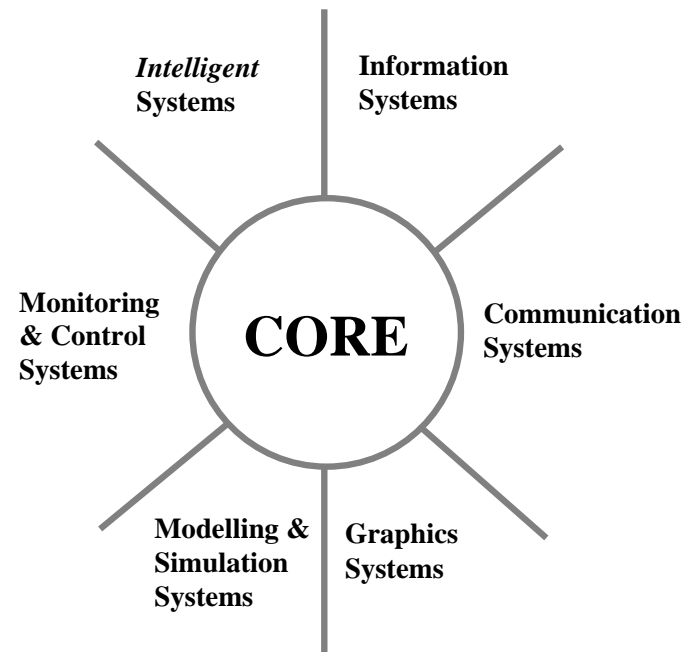
Each theme addresses a computer-based system characterising one of the variety of ways in which computers are used by people to solve problems. There are areas of overlap between systems and these provide added flexibility for schools to develop a teaching program which best meets the needs of their students.

In each theme material is presented under a set of subheadings which reflect the major content areas to be addressed. These subheadings are: Hardware, Software, Data, Applications and People.

It is not the Board's intention that each of these major content areas be taught in isolation. By adopting a systems approach to the course, schools and teachers are able to select those sections of content which are of immediate relevance to the theme being treated. Within the core and each selected theme, schools are free to present the content in any order provided that all of the sections in the selection are covered.

The material included in the core, and at least four themes, must be taught. All themes are of equal importance and time should be allocated fairly uniformly across the themes selected for study.

The structure of the syllabus can be represented by the following diagram, which shows the core and the six themes.



The grey lines indicate that there is no firm boundary between the content in the core and/or any of the themes and teaching/learning programs should not be constrained by the fact that content in the syllabus is presented in sequential sections.

Time should be allocated:
40% to the core and 60% to at least FOUR themes

COURSE OBJECTIVES

Knowledge and understanding

At the conclusion of this course of study, students should be able to demonstrate an understanding and knowledge of:

- a computer system as a configuration of computer hardware and software, functioning together in the processing of data so as to achieve a specified purpose;
- the concept of a system involving a number of levels — each system is likely to be able to be broken down into smaller systems;
- the facts that computer systems are designed by people, for use by people to perform tasks that benefit (some) people;
- data as represented electronically in computers;
- information as the result of the interpretation of processed data;
- the essential principles and concepts underlying the functioning of basic computer equipment;
- the wide variety of forms and functions of computer equipment;
- the purpose and function of different types of software;
- the purpose and function of different levels of programming languages;
- the process used in developing software solutions to various problems;
- the purpose and function of algorithms; a range of computer-based applications;
- the various roles of people working with computer-based systems.

Skills

In general, students are to be given opportunities to develop further their abilities to investigate, express and communicate their understanding of the content.

More specifically, opportunities are to be provided to develop each student's ability to:

- use a range of computer equipment safely in a classroom environment;
- identify and categorise the components of a typical computer system by function, ie input, output, storage, processing and control;
- describe the functioning of each component of a typical computer system in general terms;
- describe a range of computer hardware beyond the microcomputer system typically found in classrooms;
- represent non-computer systems diagrammatically;
- represent computer-based systems diagrammatically, in terms of the inputs to the system, the processing occurring in the system and the outputs from the system;
- describe the function of a range of computer software;
- describe a range of computer-based applications;
- use a number of software programs effectively;
- analyse simple problem-solving situations and recommend a configuration of computer hardware and software appropriate to the solution of that problem;
- represent simple procedures in an appropriate form such as diagram or pseudocode;
- use a compute programming language to write computer programs to solve simple, meaningful problems of relevance to him/her.

COURSE OBJECTIVES

Attitudes and values

Students are to be given opportunities to explore, analyse, acquire and clarify their attitudes and values with regard to computer-based systems and their applications. Students are to be encouraged to:

- appreciate that computer-based applications affect the lives of people, and that these effects may be helpful or harmful;
- make value judgements as to the benefit of using computer-based applications;
- appreciate that computers are appropriate to the solution of some problems, and inappropriate to others;
- develop confidence in the use of a range of classroom computer equipment;
- analyse a range of attitudes which people hold towards an increasingly technological world;
- develop attitudes and values related to technological change;
- develop a positive attitudes towards their roles in the control of technological change.

Process

Students are to be given opportunities to:

- take part in meaningful computer-based problem-solving activities;
- be involved in a range of practical activities;
- view content from each of the perspectives.

Core and theme objectives

Specific objectives for the core and each of the themes are provided in the appropriate sections of the syllabus.

PERSPECTIVES

There is a need to explore computers and computer-based systems from a number of perspectives in order to provide students with a broad approach to the subject.

A **systems** perspective has been used in this course as a unifying principle for the presentation of content. The systems perspective views computers and computer-based technology as being examples of systems designed by people to solve problems. There is a focus on the elements of computer-based systems, how these elements work together, and how the system affects and is affected by the environment in which it operates.

An **historical** perspective can be used to view the nature of developments in computer systems. This will include changes that have taken place, why they took place and what benefits or problems accompanied such developments.

This approach also addresses:

- the way developments in one area bring about changes in others;
- the narrowing gap between invention, innovation and diffusion;
- the context — including both people and events;
- how past views of the future have affected what has happened;
- what potential developments are possible.

An environmental perspective views computer-based systems as part of a broader environment, including both physical and human elements. It addresses issues such as the human/system interface and the effects of computer use on the environment. In particular, it looks at the extent and subtlety of such effects.

A **personal/societal** perspective examines how the use of computers affects and is affected by individuals and society as a whole. This includes issues such as equity, ergonomics and safety, employment, the nature of work, privacy, security, access to information and the nature of services available.

A **philosophical/ideological** perspective addresses issues which include: images of computers (how they are viewed and presented); the nature of music, art and communication; software as intellectual property (copyright); the nature of intelligence, humanness and creativity; forms of control and computers as a tool or medium.

Specific examples of issues which might be addressed are included in the CONTENT sections of the themes. The examples are not prescriptive nor exhaustive and teachers should select any issues that are current and/or relevant. These issues should be viewed from at least one, and preferably more, of the perspectives.

It is not the intention of the syllabus that all content be addressed from each of the perspectives nor that a single section of content is used as the vehicle for treating all perspectives. The intention is that, at the completion of the course, students will have been exposed to all of the perspectives by viewing appropriate sections of content from more than one of the perspectives described above.

CORE OBJECTIVES

Knowledge and understanding

At the conclusion of this course of study, students should be able to demonstrate an understanding of and knowledge about:

- systems, processing systems and computing systems;
- the refinement of systems into subsystems;
- the relationship between the input, processing and output functions of a system;
- algorithms;
- the relationship between a processor, processes and resources;
- the subsystems that make up a computer system;
- the various roles of people working with computer systems;
- the relationship between data and information;
- how data is represented in a digital computer and on storage media and how it is used;
- interfaces and protocols;
- the wide variety of forms in which hardware may exist;
- the variety of hardware associated with the functions of computer systems;
- the advantages and disadvantages of various input, output and storage devices;
- the difference between primary, secondary and off-line storage;
- the difference between ROM and RAM;
- the major functional components of the CPU;
- the role and function of software in computer systems;
- the relations between hardware and software;
- the purpose and functions of operating systems, utilities and application software;
- the variety of problems for which application packages are designed;
- the relations between different levels of programming languages; the role of pre-written library routines.

Skills

Students should be given opportunities to develop their ability to:

- represent a system diagrammatically;
- specify the relationship between Input/Process/Output by IPO charts;
- describe a simple procedure in terms of instructions;
- identify processor and resources in a simple system;
- specify a simple procedure in pseudocode and diagrammatically;
- represent a computer system diagrammatically;
- describe the roles of various people working with computers;
- use a table to translate a character in ASCII form and back;
- represent a number in binary form and hexadecimal form;
- identify various examples of encoded data;
- classify a range of hardware devices according to their function within a computer system;
- use a variety of input, output and storage devices;
- assess the appropriateness of particular input, output and storage devices for a particular application;
- select and use appropriate operating systems, utility software and application software for a particular task;
- set up a classroom computer system safely;
- compare and contrast a number of configurations for computer systems;
- complete simple problem-solving exercises from problem identification to documentation of a working program.

CORE

Systems

A system is defined as:

a collection of component parts or elements all of which function together in a regulated way so as to achieve a purpose.

Naturally occurring systems, eg the water cycle.

Systems designed by people, eg economic systems, manufacturing production systems, legal systems or computer systems.

Diagrammatic representation of systems

Processing systems: Input – Process – Output

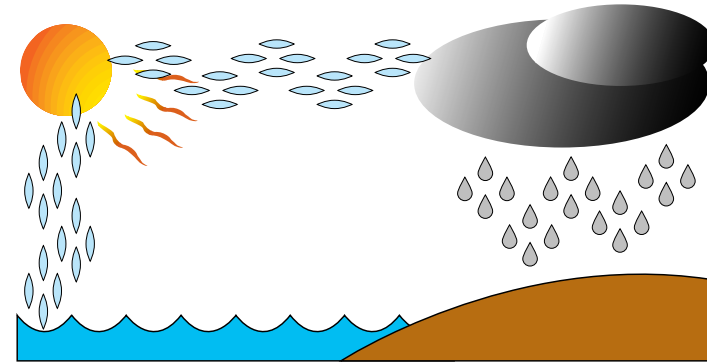
Processing systems take one or more inputs and carry out some process to produce one or more outputs.

Refinement and synthesis

Viewing systems from several different perspectives and at several levels of detail.

Analysing or refining systems into subsystems.

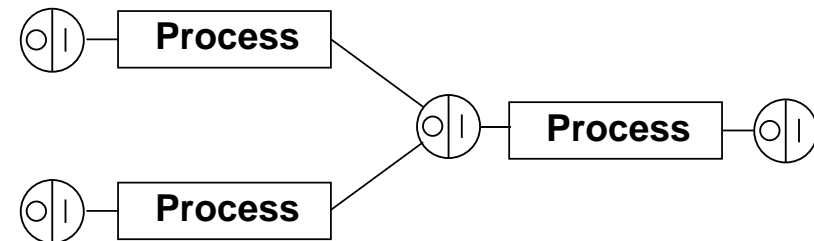
Synthesising larger and more complex systems from simpler subsystems.



The water cycle



A system



One refinement of a system

CORE

A system as a 'black box'

Internal components and functioning of a system are not considered.

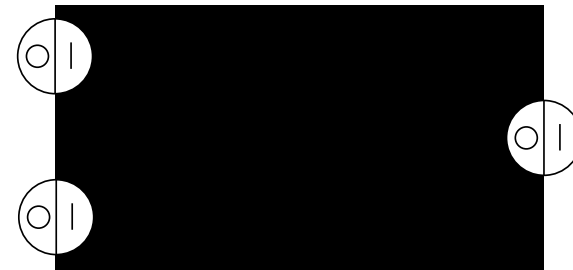
Relations between inputs and outputs.

System components

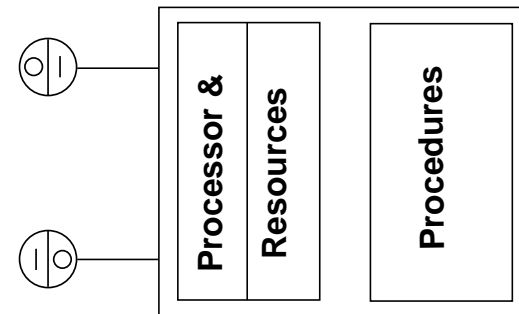
Systems as comprising:

- Procedures – sets of instructions which specify what processing is to be performed.
- Processor(s) – which carry out or execute the procedures.
- Resources – which are used by the processor to perform its task.

The processor uses resources to perform procedures.



A system as a 'black box'

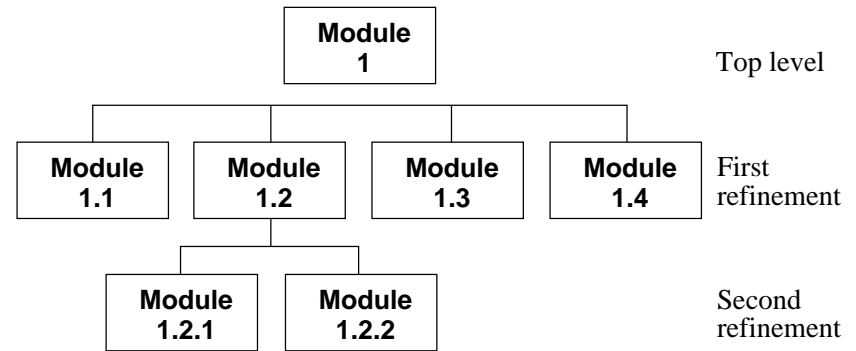


System components

CORE

Hierarchy charts

Hierarchy charts used to show levels of refinement of a process.
Modules as self-contained sub-processes.



Input – Processing – Output (IPO) charts

The Input – Process – Output chart as a means of describing the purpose and functioning of a system.

IPO charts specifying:

- the inputs to a system;
- the outputs from the system;
- the processing to be carried out by the system.

Input	Process	Output

CORE

Specifying procedures

Procedures stated in the form of algorithms.

An algorithm is an unambiguous set of steps which, when performed correctly by a processor, will result in a process being carried out in finite time.

Algorithms expressed in a number of forms, including:

English prose;
 pseudocode (structured English);
 diagrams (such as flowcharts).

Control structures

Sequence

Selection

Loop – guarded
 – unguarded

English prose

Do this, then that, then the other.

If there is time do one thing otherwise do the other.

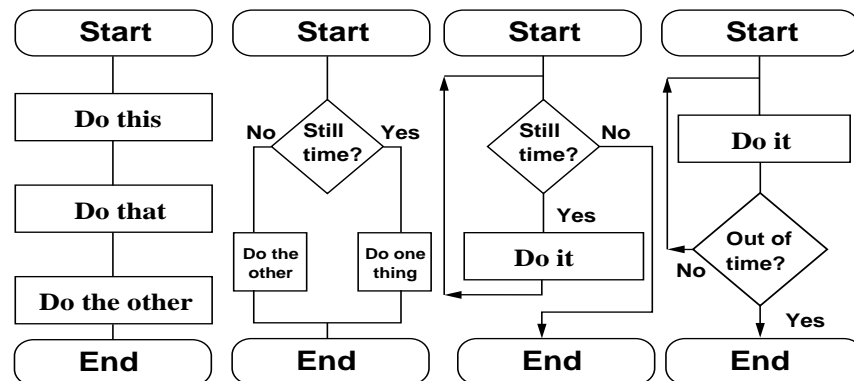
Keep doing it while you have the time.

Keep doing it until you run out of time.

Pseudocode

<p>Start</p> <p>Do this Do that Do the other</p> <p>End</p>	<p>Start</p> <p>If (still time) Do one thing Else Do the other Endif</p> <p>End</p>	<p>Start</p> <p>While (still time) Do it</p> <p>Endwhile</p> <p>End</p>	<p>Start</p> <p>Repeat Do it</p> <p>Until (out of time)</p> <p>End</p>
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Diagrams



CORE

Computer systems

A computer system considered as:

a configuration of hardware and software, functioning together, processing data, to achieve a purpose.

Computer systems viewed as a set of five cooperating sub-systems:

Input – takes data from the environment and represents it in a form suitable for processing.

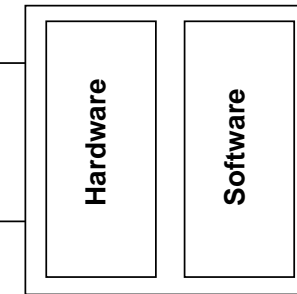
Output – takes processed data and presents it in a form which can be used outside the system.

Process – manipulates, combines and separates data.

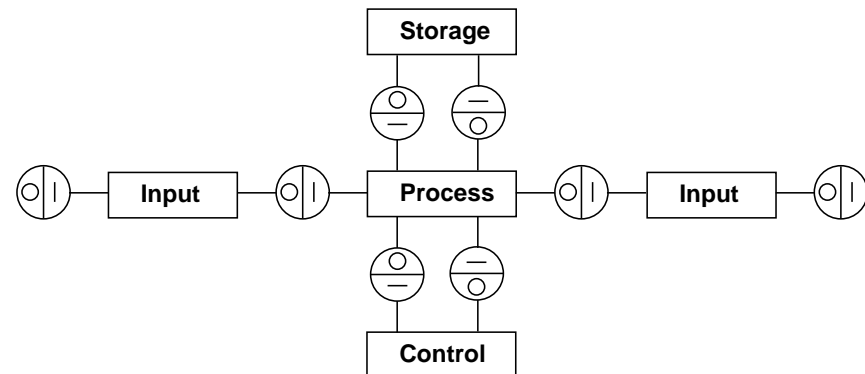
Storage – retains data for later output or processing by the system.

Control – coordinates the operations of the input, processing, output and storage subsystems.

Input data



Output data



CORE

People

Computer systems are designed by people for use by people and their use affects people.

The people concerned with the design, construction and maintenance of a computer system:

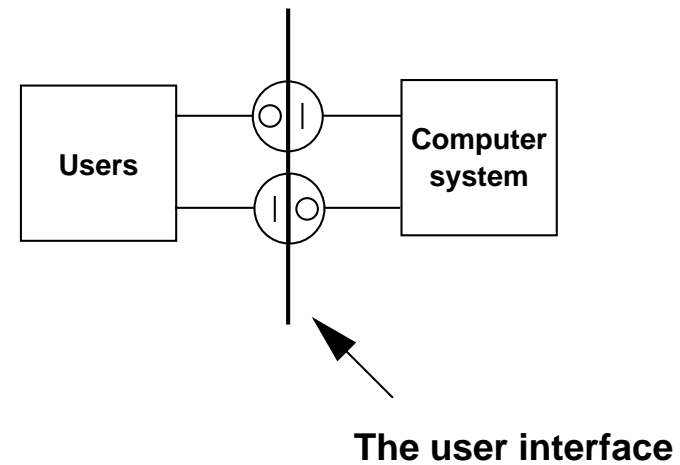
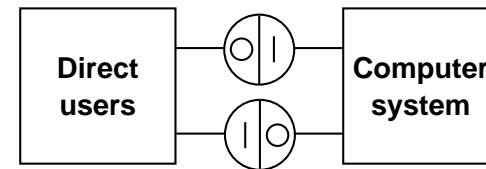
analysts, designers, engineers, programmers and support personnel.

Other people affected by computer systems:

direct users, intermediary users, indirect users.

The user interface

The way that users interact with and perceive a computer system.



CORE

Data and information

Data as individual facts represented by symbols.

Data becomes information when it is ordered and given meaning by people, and used by them to make decisions.

Data representation

Data represented in a form that the system is able to interpret and use.

Two forms of data representation: analog and digital.

Digital representation – Binary Digits (Bits)

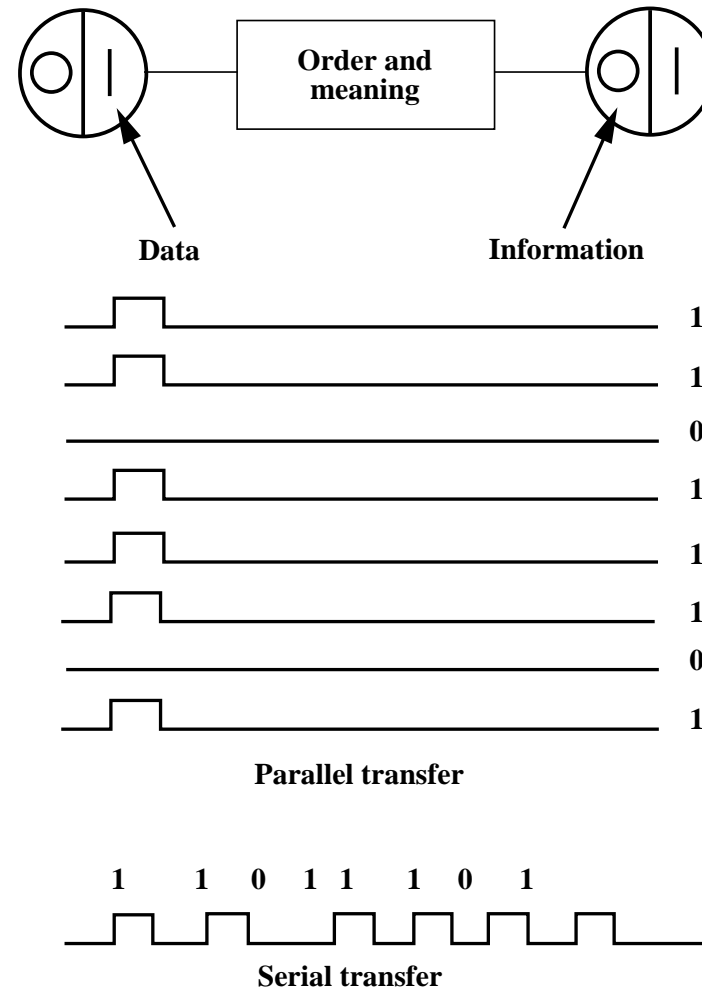
Digital interpretation – Bytes and words, hexadecimal, ASCII.

Analog representation – eg thermostat, rheostat, dial.

All data whether I/O data, instructions, or control signals represented in the same way — distinction in how such data is interpreted within the system.

Data transfer

Parallel and serial transfer.



CORE

Interfaces and protocols

An interface as the connection between two subsystems of a system or between a system and its environment (eg user interface).

Interface as a subsystem.

A protocol as a set of rules for sending or receiving data across an interface.

Media

Media as the physical material on which the data is represented. Examples may include optical, electrical, mechanical, magnetic, paper or electronic media.

Hardware

Particular set of physical units or devices associated with the various functions of computer subsystems.

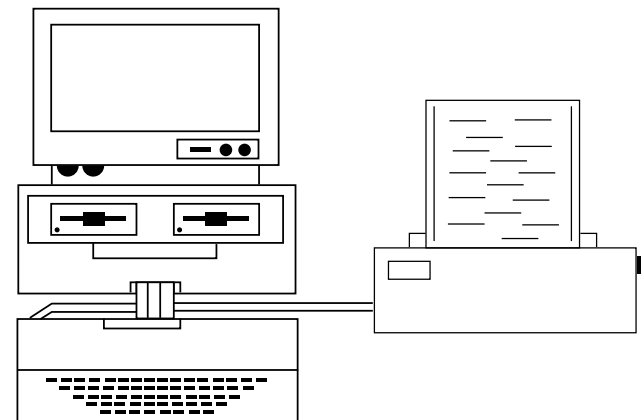
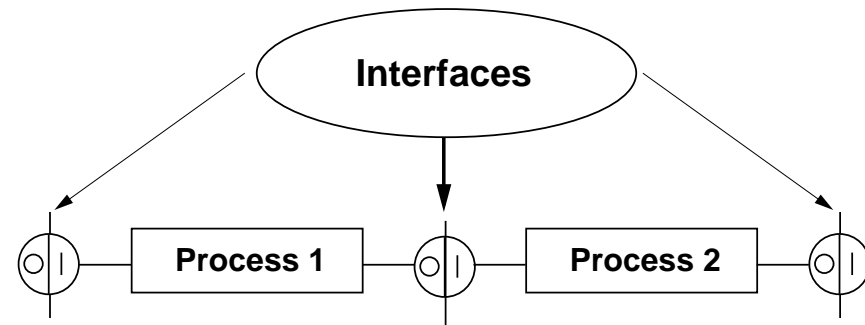
Typical computer hardware configurations

Examples ranging from microprocessor controlled devices through classroom microcomputers to mainframes.

Classification of hardware devices

Peripheral devices (peripherals): associated with input, output or secondary storage.

Central processor devices: associated with processing, control or primary storage.



CORE

Input and output devices

Input and output devices as interfaces between a system and its environment.

Conversion of data between forms that can be processed by sub-systems of a computer system and forms that can be used outside the system.

Characteristics in terms of speed, size, cost, flexibility and convenience.

Examples include:

Input – barcode wand, keyboard, mouse, joystick, graphics tablet, temperature sensor, light pen, disk drive;

Output – printer, plotter, disk drive, video screen, loud speaker.

Storage devices

Associated with retaining data for later output or processing by the system.

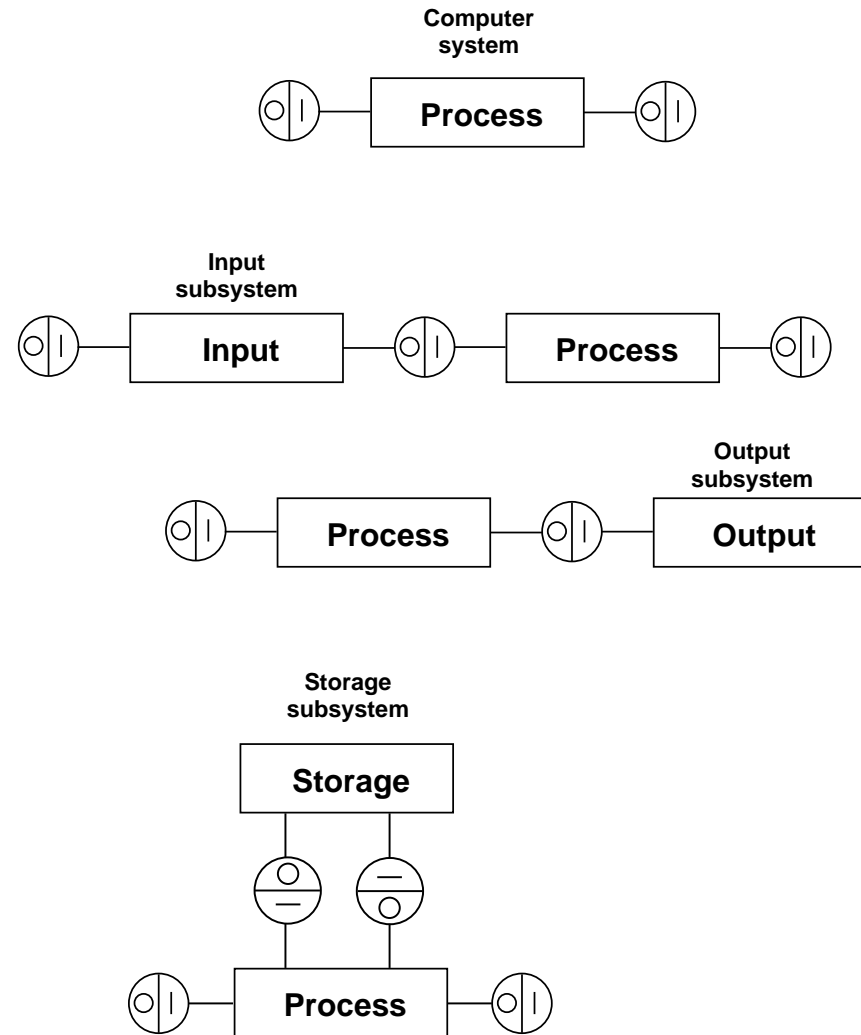
Characteristics in terms of speed, cost, flexibility, volatility, convenience and capacity.

Examples include:

primary storage (memory) – RAM and ROM;

secondary storage – disk drive, magnetic tape drive, CD-ROM;

off-line storage – paper, cards, disks and tapes.



CORE

Processing devices

Role of the Arithmetic and Logic Unit (ALU) — processing and comparisons of data.

Registers as temporary, fast-access storage locations for data being processed.

Control devices

Control signals.

Device controllers.

Coordination of input, output, storage and processing.

Central processing Unit (CPU)

The central processing unit as location of processing. Registers, ALU, control system.

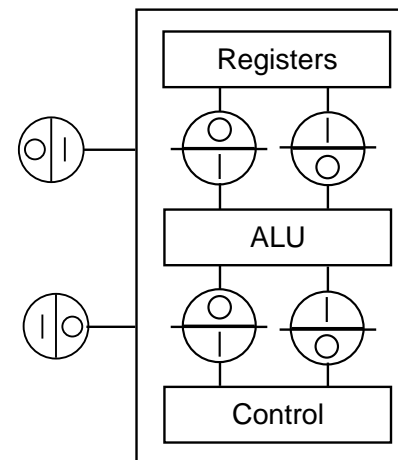
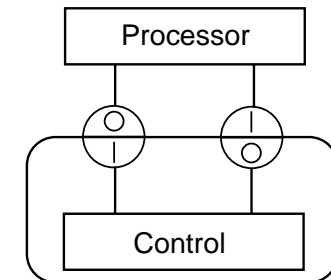
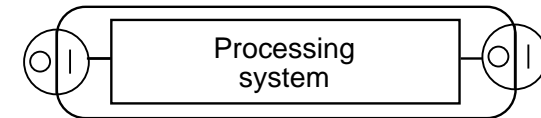
Multiprocessing systems.

Buses

Transport of data or instructions to and from memory and peripherals.

Data buses and instruction buses.

Control lines.



CORE

Software

Software or programs as sets of instructions which control the processing and movement of data within the computer system.

Software enables hardware to process data.

Software encoded and stored on a medium, in primary or secondary storage.

Blurred distinction between hardware and software — firmware.

Systems software

Support function of operating systems.

Management and control of the hardware.

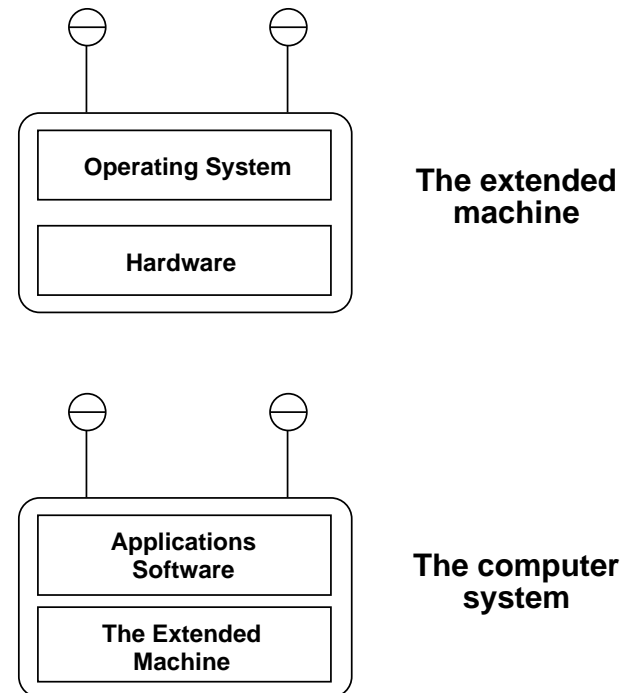
Operating system as an interface between the hardware and applications programs.

The extended machine as the system of hardware and operating system.

Utility software – disk formatters and copiers, procedure libraries, text editors, compilers and interpreters.

Applications software

Applications software or programs – written to solve a user's problem.



CORE

Programmability – the capacity of a machine to be given different programs which enable the machine to be used for different purposes.

Programming languages

Programs or sets of computer instructions – written in a programming language.

Lower level – machine specific – machine language.

Higher level – portable – enable solutions to problems to be expressed in a language closer to that used by people.

Gradation between levels.

Programming language translators – conversion of instructions in a programming language to machine language instructions.

Compilers, interpreters, assemblers.

Operation of the central processing unit

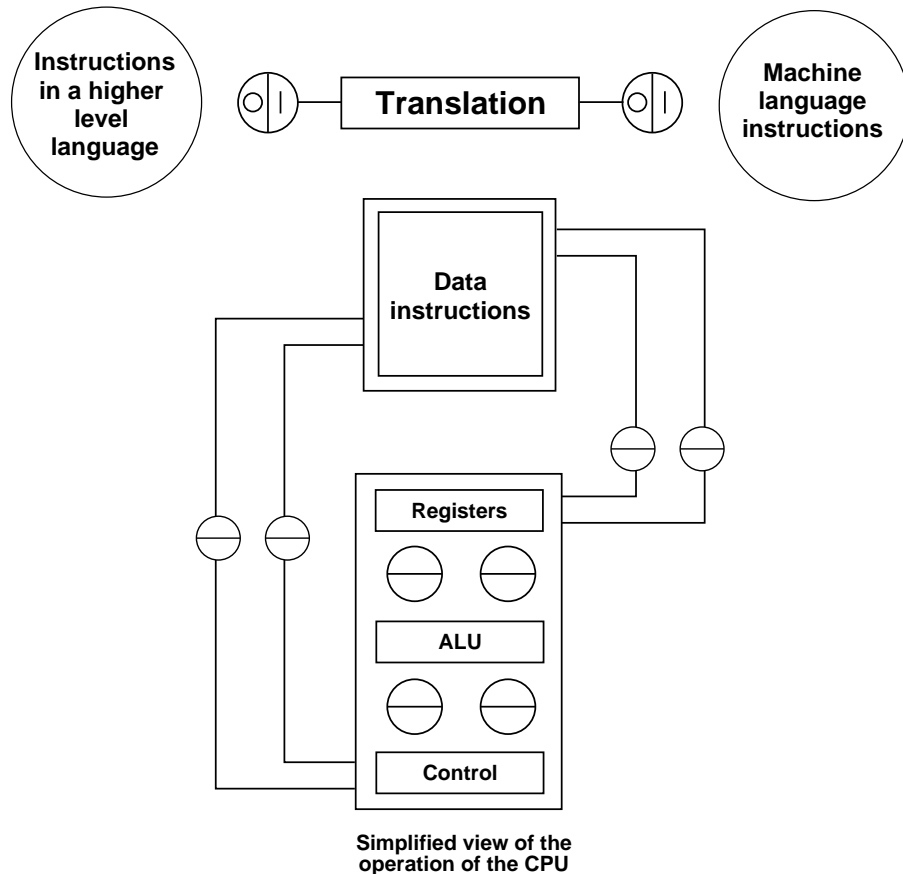
The interaction of hardware and software takes place in the CPU.

Fetching instructions from memory.

Translating and executing instructions.

Fetching, processing and storing data.

Synchronisation by the clock and control signals.



CORE

Computer solutions

Designing a computer solution as a creative process.

Balance between what computers do well and what people do well.

Computer strengths: mass storage, fast and accurate retrieval, fast and accurate processing, following instructions.

People strengths: recognising patterns, formulating goals, identifying issues, resolving ambiguity and dealing with special cases.

A computer solution is warranted when the task is too difficult, dangerous, tedious or time consuming for people.

Stages in developing a computer solution

Defining the problem

Understanding the problem and restating it in an appropriate form. Identifying key aspects and constraints.

Planning a solution

Classifying the problem.

Structuring data.

Specifying processing in general terms.

Exploring known solutions to similar problems.

Identifying resources required.

Planning test cases.

CORE

Designing a solution

Exploiting known solutions.
Using packaged solutions, modifying existing solutions or developing new solutions (programming).

Implementing the solution

Using the program with appropriate data.
Organising the output data.

Testing the solution

Checking the results with the definition of the problem.
Does the solution actually solve the problem?

Reporting the solution

Producing a statement of the solution and the method of solution.

Documentation

Documentation is developed in parallel with the development of the solution.

Documentation includes:

- problem statement;
- method of solution;
- test methods;
- results obtained;
- user manuals.

CORE

Programming

Producing a computer program that will aid in the solution of a given problem.

Programming is a creative process and has its own problem-solving methods. The activity requires repeated refinement at all stages.

The typical stages:

- define the problem clearly;
- decide on appropriate structure for the data;
- develop a sequence of actions or processes;
- refine processes – modular, structured programming;
- develop algorithms;
- code the program in an appropriate computer language;
- test and debug the program;
- prepare documentation;
- publish solution.

NOTE:

Correct solutions should always be developed, using modern techniques. It is not appropriate to develop a solution for only special cases and ‘patch’ the solution at test time.

INFORMATION SYSTEMS

Introduction

This theme introduces students to the application of computers as systems which provide information to users. In keeping with the philosophy of the syllabus, not only should students study information systems from the classroom and personal level, but also be able to relate these uses to larger, organisational information systems.

Information is data to which people attach a meaning. People choose a representation for the data. It is important to consider carefully the way data is structured, prepared and entered if the system is to work effectively. Information systems process data in order to provide information which is used by people to guide their decision-making.

Within organisations, data-processing systems perform operations to meet legal and organisational requirements, to provide information at all levels of the organisation (especially the managerial) and to provide whatever reports are necessary to outside bodies.

An important aspect of any useful information system is the output it produces, the objective being to provide accurate and up-to-date information in an appropriate form when and where it is needed.

The information systems studied are to include online systems which are used by both large and small companies, government and individuals.

In the microcomputer environment, information systems are often considered to consist of word processing, spreadsheet and database packages either provided individually or as an integrated package.

Objectives

Students should:

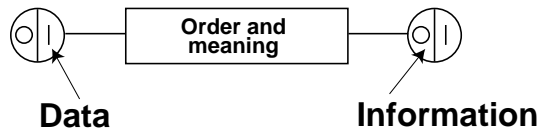
- demonstrate an understanding of the function and effects of information systems;
- manipulate text with a simple word processor;
- manipulate data on a simple spreadsheet template;
- describe the user's view of the data structures used in a database;
- search a database and produce reports to provide answer to problems posed;
- modify information on a database;
- design a simple database system using appropriate software;
- differentiate between sequential and direct access files;
- display an understanding of algorithms that generate and use simple sequential files (text files);
- demonstrate an understanding of the influence of physical devices on file concepts;
- describe some applications of a large database system;
- describe some uses of online information systems;
- show an understanding of the need to check for validity of data;
- demonstrate the importance of backup;
- discriminate between problems which can and can not be solved by the use of information systems;
- discuss the implications of information systems on people;
- demonstrate an awareness of the ways information systems can be abused;
- be aware that there may be conflict between those who want information and citizens who wish that information to remain private.

INFORMATION SYSTEMS

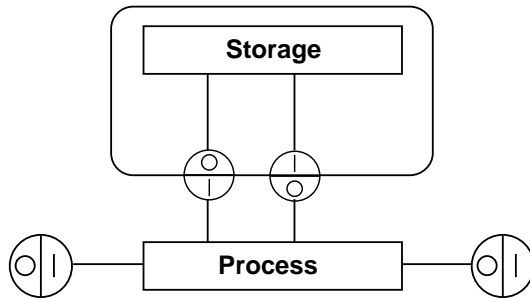
Systems representation

Data are individual facts which are represented by symbols. It is these symbols or representations which are manipulated by the computer system.

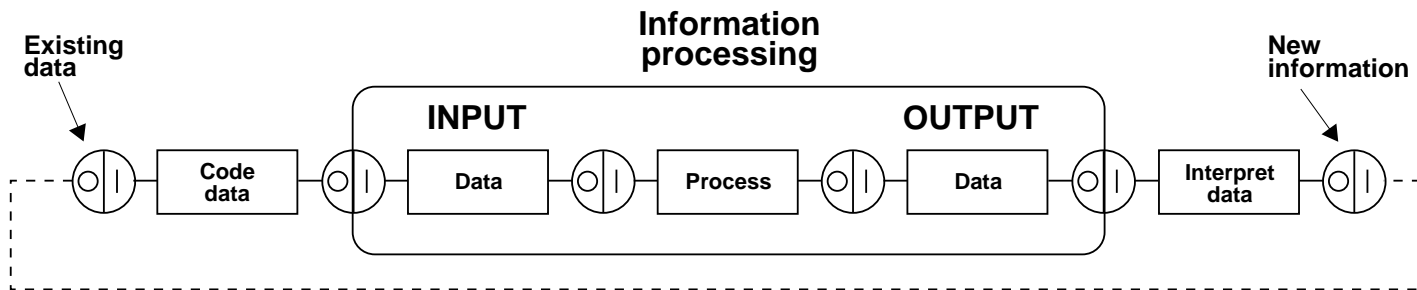
Data become information when they are combined, ordered and given meaning by people.



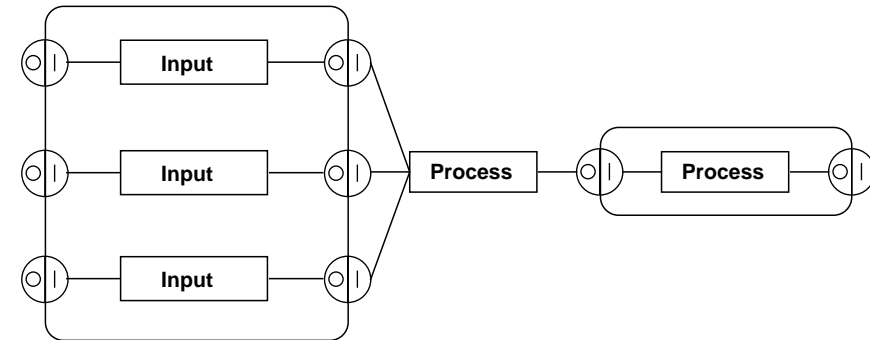
An important aspect of information systems is the use of a storage system.



Information can, in turn, be a representation of data.



Some information systems process multiple inputs, eg from terminals on a network.



Similarly, there may be multiple outputs.

INFORMATION SYSTEMS

Content

Examples of issues

1. Hardware

- 1.1 Peripheral devices and their importance (including speed of access),
eg (storage) disk drives, tape drives, drums, hard disks, CD-ROM
eg (output) printers, monitors and communication devices.
- 1.2 Storage – need for fast access and large storage.
- 1.3 Processing – need for powerful, fast processors.
- 1.4 Comparison of mainframe, mini and microcomputers.

2. Software

- 2.1 Tools to manipulate data as text – word processors (brief treatment only).
- 2.2 Tools to manipulate data as rows and columns – spreadsheets (brief treatment only).
- 2.3 Database management systems – packages with a fixed body of data for reference, updatable databases including creation of own databases.

3. Data

- 3.1 Non-text databases, eg fingerprint files, picture files.
- 3.2 Text – partially structured data.
- 3.3 Structured data
 - Arrays
 - Files – sequential
 - direct (random) access files
 - Sub-units of files – records and fields and their use.

By what means have large amounts of data been processed in the past? Eg Doomsday Book, census material – Hollerith.

In what ways are databases limited by the technology? By the hardware? By the software?

What effect has the change in power of computers had on the use of information systems?

Is the electronic ‘paperless office’ a possibility for the future?

What is meant by a ‘computer error’?

Does the design of a database control the information that we can get out of it?

Who owns software?

What is the significance of electronic data processing for an organisation as a whole?

Are word processors limited in power by using sequential files?

What errors and bias can come from data sources, data coding, data entry, editing and misfiling?

What problems can arise from these? (technical, human and social)

Who decides what data to store? To pass on?

How does the choice of data representation affect the information provided?

INFORMATION SYSTEMS

Content

Examples of issues

3.4 Data preparation, validation and verification.

3.5 Data manipulation including:
searching techniques such as linear search, binary search, use of hierarchical indices;
sorting techniques – bubble, insertion.

4. Applications

4.1 Maintenance of an organisation's data through a DP centre, computer bureau or by distributed systems, eg personnel, payroll, government records, archives.

4.2 Use of database systems in sales, orders and invoicing, inventory management, maintenance of customer information.

4.3 Online database systems, eg EFTS, home banking, videotex, airline bookings.

4.4 Computer retrieval systems, eg credit ratings, health and medicine databases, electronic publishing, real estate and legal databases, agriculture.

5. People

5.1 Providers of information services including: analysts, system managers, programmers, operators, data entry personnel.

5.2 Users of information, eg managers, users of services – both indirect and passive.

5.3 Abuse of information systems.

Who owns the data on a computer system? Can you steal it? What crime have you committed if you degrade or destroy it? What rights do you have in regard to stored information about you?

How does the *Freedom of Information Act* affect access to databases?

What measures are used to protect data in large computer systems? What measures are used to protect data when using microcomputers?

What are the effects of central records being kept such as with an 'Australia Card'?

Many applications of information systems are computerised versions of old systems. Why should this be done?

What new or different services are enabled by the use of such systems?

Why would a company use a computerised accounts system?

Why not?

How can information technology help people with motor impairment?

Should 'management information systems' be limited to management?

What advantages/disadvantages are there in having database surveillance agencies?

Who suffers from errors in large computer systems?

Are those without access to information systems 'doomed to second-class citizenship'?

Does the possession of information on an international level give too much power to too few people?

COMMUNICATION SYSTEMS

Introduction

This theme is concerned with the transfer of data/information from one location (sender, source or originator) to another (destination or receiver). Students study both the transfer of data with a computer system and between computer systems.

Thus the communication from a computer to its printer, between computers on a network, from terminals to a mainframe computer, between users and remote systems and between people using electronic information systems are all to be discussed.

The physical path over which the data flows (the link) is also an area that must be covered since the link is one of the main features that gives these systems their distinctive nature.

Communication systems have expanded to provide more immediacy of information to people whether they are in business, government or individuals in society. Their use is becoming more widespread and has implications for all.

Objectives

Students should:

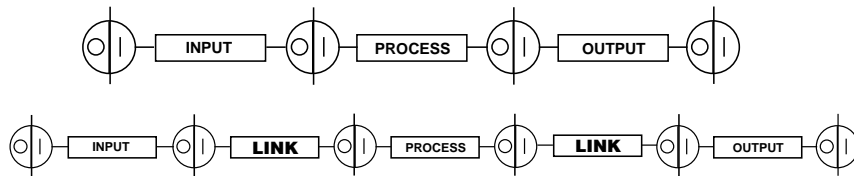
- demonstrate an understanding of the components of a variety of communication systems;
- be able to assemble a classroom communication system;
- be able to use software associated with classroom communication systems;
- be able to operate a classroom communication system;
- display an appreciation of the effects of communication technology on human communication;
- display an understanding of the use of communication systems in the information industry;
- develop an awareness of the variety of communication systems;
- develop an appreciation of the reasons for the variety of communication systems.

COMMUNICATION SYSTEMS

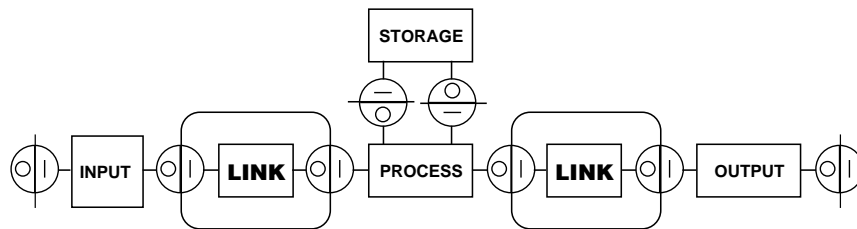
Systems representation

In studying this theme, the individual parts should be considered in the context of a system. As an example, satellite communication systems involve the satellite, ground stations (including satellite dishes) and the microwaves as the link used. While there are items of hardware, software and applications that are specific to this theme, it is the link that is peculiar to it.

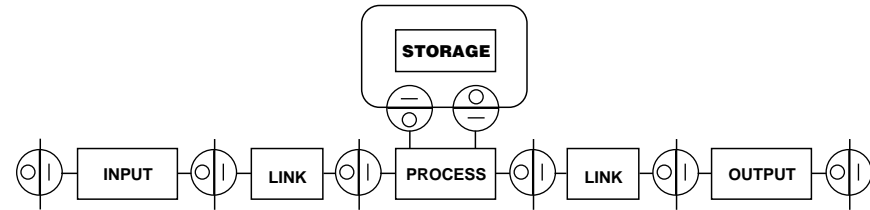
The more general system diagram can be expanded to show the link system.



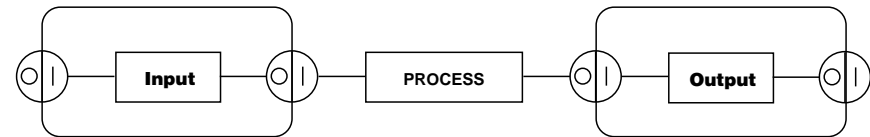
Using dial-up access to remote database systems as an example, the interface system can be studied in detail. The difference is that a more obvious link is studied — the telephone link — rather than just the transfer of information within the immediate computer system.



In addition to studying the link used in accessing remote databases, the remote databases themselves should be examined.



As with other systems, both the input systems and the output systems can be examined.



The interface between systems is an important area which should be studied.

Examples could include modems and satellite ground stations.



COMMUNICATION SYSTEMS

Content

Examples of issues

1. Hardware

There is an emphasis in this section on the link (or connection). A link is itself a system. There can be a breakdown or an impediment to communication, eg noise.

1.1 Links

A link is the connection between computer devices.

Types of link:

cables, eg coaxial, fibre optic, telephone line;
non-cables, eg infra red, microwave.

Facilitators of links including:

packet switch system on telephone lines, satellites, satellite ground stations, satellite dishes.

Buses as links.

1.2 Input/output devices,

eg MODEM – direct connect, acoustic coupler, facsimile transceiver, point of sale terminal (POST), automatic teller machine (ATM), scanners, light pen, barcode reader, credit/debit cards, ‘smart’ cards, teletext keypad/keyboard, videotex decoder, telemonitoring devices.

1.3 Networks

Direct (computer to computer communication).

Distributed processing (linking of computer systems to share storage devices, printers, other peripherals).

Dumb terminals (one controlling computer linked to terminals in different locations).

Local Area Network (LAN topologies: bus, star, ring.
Network server.

Examine changes in:

- the physical link used for communications;
- the size of the link itself (where appropriate);
- the scale of the communications – local, national, global;
- the speed;
- cost for different forms of link.

How has the growth of such systems affected the environment?

How has the increased availability of modems affected individuals?

How does the use of POSTs affect customers and retailers?

What changes in lifestyle are caused by electronic funds transfer?

In what ways are telemonitoring devices affecting businesses and individuals?

What advantages/disadvantages accrue from networking computers on an individual site?

Compare and contrast the scale of different networks such as those in an office, classroom, banking system, OTC.

Why are passwords used on many network systems? What problems can occur with these?

COMMUNICATION SYSTEMS

Content	Examples of issues
<p>2. Software</p> <p>2.1 Word processor as a tool for creating text to be communicated.</p> <p>2.2 Communication software: to access remote databases, videotex, electronic mail etc. Preparation of data for transmission via electronic mail.</p> <p>2.3 Network software and operating systems.</p> <p>3. Data</p> <p>3.1 Standards</p> <p>Different systems present data in different ways. There is a need for common information formats and procedures for the transfer of data – protocols. Transmission rates.</p> <p>3.2 Ways of representing binary information, eg printed page, barcodes, magnetic, electronic.</p> <p>Ways of transmitting binary information, eg pulses, including electrical, light, tones, electromagnetic waves.</p> <p>3.3 Error detection and correction, eg parity.</p>	<p>Consider the general issue of ethics and confidentiality.</p> <p>Why do people feel free to read what is showing on a monitor when they would not read another person's written document?</p> <p>Should information be private?</p> <p>Consider the right of creators of information compared with the rights of users of information.</p> <p>Who owns information?</p> <p>Consider the increasing convergence of telecommunication and computer technologies.</p> <p>Why are standards required for data transmission?</p> <p>What changes have occurred in the methods of representing data?</p> <p>What changes have occurred in the methods of transmitting data?</p> <p>What effects have these changes had on global politics and world peace?</p>

COMMUNICATION SYSTEMS

Content	Examples of issues
<p>4. Applications</p> <p>4.1 Communication. Use of a word processor for the creation of data for communication and for access to information.</p> <p>4.2 Commercial, eg monitoring conditions such as temperature, illegal entry etc; eg transfer of information; eg services to the public such as Electronic Funds Transfer Systems (EFTS).</p> <p>4.3 Educational. Include aspects of both formal and informal learning.</p> <p>4.4 Domestic, eg monitoring conditions such as temperature, illegal entry etc; eg recreational.</p> <p>4.5 Government.</p> <p>4.6 Defence.</p> <p>5. People</p> <p>5.1 Recipients of information.</p> <p>5.2 Originators of information.</p> <p>5.3 The user interface.</p> <p>5.4 Using communications to overcome disadvantage, eg isolated, physically handicapped.</p> <p>5.5 Indirect and passive users.</p>	<p>Explore changes, brought about by communication systems, that have occurred in:</p> <ul style="list-style-type: none"> • the nature of work; • financial services; • consumer services; • lifestyle; • speed of communication; • costs of communication. <p>In what ways has the progress of communication technology reduced the world to a 'global village'?</p> <p>How does rapid communication change community standards and cultural values?</p> <p>In what ways do individuals have greater access to information?</p> <p>How do communication systems affect the ability of government organisations to collect and access information on Australian citizens?</p> <p>In what ways has the human interface with computers changed? Compare and contrast the ways in which people were required to program early computing devices with 'user friendly' systems on current computers.</p> <p>Has the use of computer communication systems enhanced human communication?</p> <p>Is 'tapping the link' a crime in itself or is a crime only committed when information so obtained is used?</p>

GRAPHICS SYSTEMS

Introduction

In this theme, systems that produce information in a non-text form provide the basis for the study. The development of such systems has produced very powerful tools for the rapid manipulation of data and the production of information in a pictorial form to assist people in solving problems.

The systems range in scope from flight simulators, which combine the operation of aircraft controls with computer generated displays of continually changing environments, down to simple graphics generation on microcomputers. The scope of use of graphics systems is continually expanding, both as dedicated systems and by being incorporated in other applications such as word processors.

The use of graphics systems in computer aided design allows a designer to produce and manipulate screen displays, thus freeing the user to concentrate on the creative aspects of problem-solving.

The major features of these systems are the need for large amounts of storage, fast processing power and a range of specialised peripheral devices.

The emphasis in this theme should be on developing each student's awareness of the range of applications and their effects, and on using appropriate graphics systems to solve problems of relevance to them.

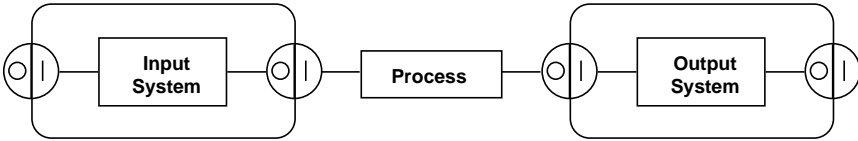
Objectives

Students should:

- demonstrate an understanding of how a computer produces graphics;
- describe a range of input/output devices used for the creation of graphics;
- develop an awareness of the variety of ways in which computer graphics can be produced;
- use appropriate packages to create their own computer graphics;
- solve simple design problems using appropriate graphics software;
- examine the use of computer graphics in industry;
- compare and contrast early methods of graphics creation with modern computer graphics;
- display an appreciation of the power of computer graphics as a means of communication;
- discuss computer generated graphics as an art form.

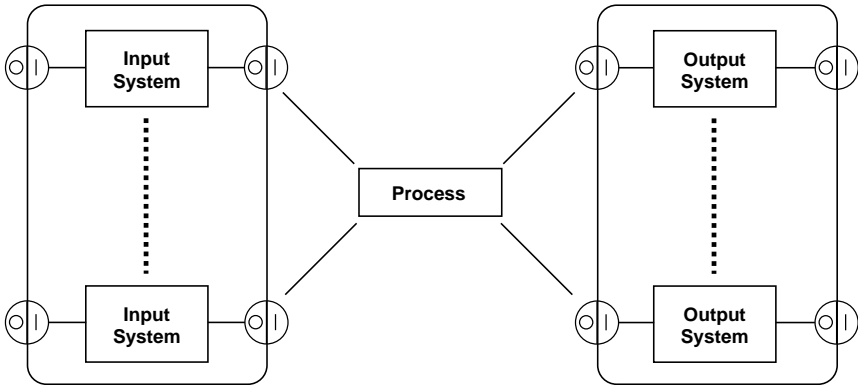
GRAPHICS SYSTEMS

Systems representation



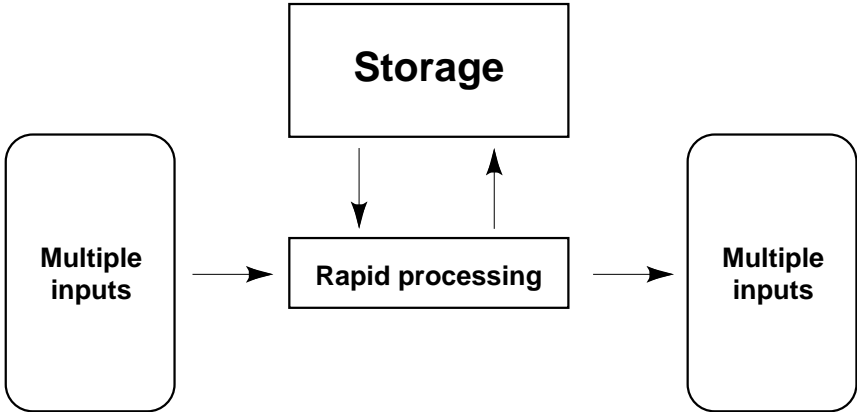
Basic system

Graphics systems have specialised input and output systems. They use, for example; graphics tablets, light pens, video cameras, mouse, joy sticks, video recorders etc for input; and plotters, colour monitors, video tapes etc for output.



Multiple inputs, multiple outputs

Some graphics systems use multiple inputs and multiple outputs. Examples include CAD systems, systems to create video clips and TV logos.



The major features of graphics systems are the need for large amounts of storage, fast processing power and a range of specialised peripheral devices.

GRAPHICS SYSTEMS

Content

Examples of issues

1. Hardware

- 1.1 Range of input devices,
eg keyboard, mouse, joystick, graphics tablet, light pen,
sound, voice actuator, concept keyboard, digitiser.
- 1.2 Range of output devices,
eg monitor, plotter, printer, braille printer, video.
- 1.3 Storage devices,
eg video disk, compact disk, optical disks.
- 1.4 Restrictions caused by:
CPU, memory, resolution of output device.
- 1.5 Dedicated graphics systems.

2. Software

- 2.1 Programming languages.
Graphics oriented languages, eg turtle graphics.
General purpose languages, eg Pascal.
Device independent graphics languages.
- 2.2 Graphics packages,
eg painting, desk top publishing, curve sketching.
- 2.3 Special effects,
eg animation, holography, text and graphics mixture.
3D graphics – shading, smoothing, transformations,
hidden lines.

How has the development of non-keyboard input devices enhanced the opportunities of individuals?

What considerations should be addressed in specifying a program with graphics output?

What technological advances have influenced the development of computer generated graphics?

What effects has the inclusion of graphics capabilities in software packages had on the educational use of computers?

Investigate the changing methods of creating animated images.

Do computerised methods of animation creation surpass manual methods?

What is art?

To what extent do system restrictions affect an individual's creativity?

To what extent has computer graphics assisted the transformation of mental images to graphics methods?

GRAPHICS SYSTEMS

Content

Examples of issues

3. Data

- 3.1 Data for graphics output is stored in memory in the same form as other data. The software translates data to graphics.
- 3.2 Pixel, memory location correspondence. 0 pixel off, 1 on.
- 3.3 Memory mapping.
- 3.4 Raster graphics, vector graphics.
- 3.5 Low resolution, high resolution.

4. Applications

- 4.1 Industry,
eg charts and graphs, facsimile, animated advertising, professional presentations, photo typesetting, photo reproduction, simulations.
- 4.2 Computer Assisted Design / Computer Assisted Manufacture,
eg architecture, engineering, cartography, design.
- 4.3 Education.
- 4.4 Entertainment,
eg TV logos, games, storyboarding, cartoons, video clips, movies.

Discuss the advantages of graphical representations of data.

Discuss methods of data input to graphic systems.

How has the availability of computer graphics affected the nature of work for some individuals?

How have computer graphics affected specific industry applications?

Investigate the dangers associated with the ability to manipulate graphic images.

To what extent has the complexity of images created with computer graphics made the distinction between reality and fantasy difficult?

How have forms of entertainment altered since the introduction of computer graphics? What effects have these changes had on individuals?

GRAPHICS SYSTEMS

Content	Examples of issues
<p>5. People</p> <ul style="list-style-type: none">5.1 Visual communication of images.5.2 Enhancement of the lives of the disabled by the range of alternative input and output devices.5.3 Creators of graphics.5.4 Users of graphics.5.5 Those indirectly affected by graphics.	<p>What changes (in a selected industry) can be attributed to computer generated graphics?</p> <p>How has the development of computer graphics enhanced human communication?</p> <p>How have graphics images affected human communications?</p>

MODELLING AND SIMULATION SYSTEMS

Introduction

This theme is concerned with the application of computers as problem-solving tools which enable people to simulate situations. A model is a representation of some aspect of the real world. A simulation is an experiment conducted using a model of a situation. There are many different types of models used for simulations, including mathematical models, physical models and computer models.

A computer simulation involves the development of a computer system, both hardware and software, which imitates the situation being modelled.

Computer simulations are developed where an experiment in the real situation is dangerous, expensive, time-consuming or impossible to conduct.

The basis of computer simulation is the development of (generally large numbers) of equations which represent the relationships among the elements of the system being modelled. The power of the computer in simulation lies in its ability to carry out large amounts of calculation quickly and with high precision and accuracy.

Computer models have the added advantage of being capable of representing hypothetical situations for which no real world example is available for study.

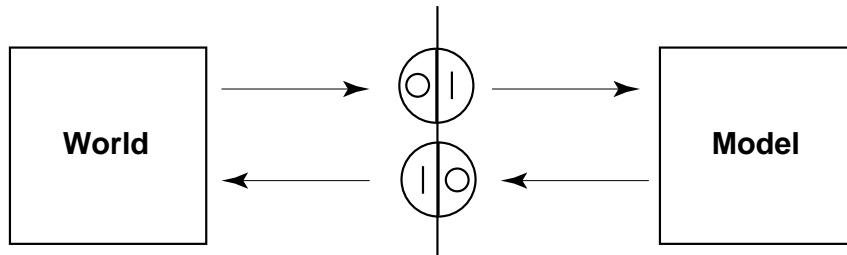
Objectives

Students should:

- understand the concept of modelling and simulation;
- understand that most models are simplifications of complex real world systems;
- be aware of the range of areas in which a computer is used for simulation and modelling;
- be able to construct a computer model of a simple situation;
- demonstrate an understanding of the limits and benefits of such a model;
- realise that the accuracy of the model determines the degree to which the simulation mirrors reality;
- be able to manipulate a simple computer model by using a simulation program;
- understand the advantages and disadvantages in using a computer to simulate a situation;
- understand the need for high speed, memory capacity, and precision in computer modelling;
- be aware of the limitations of speed and capacity in small systems such as microcomputers and the advantages of super-computers in modelling and simulation.

MODELLING AND SIMULATION SYSTEMS

Systems representation

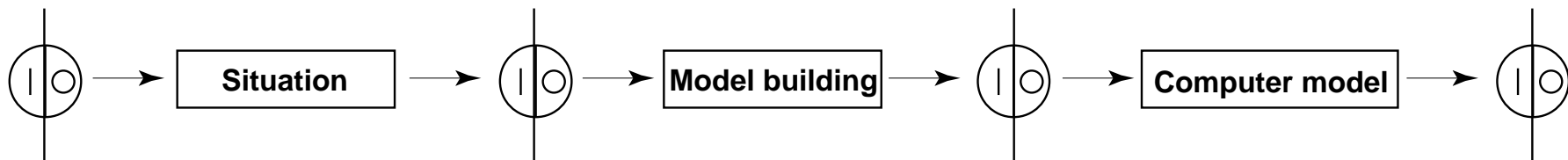


A model as a mirror of the world

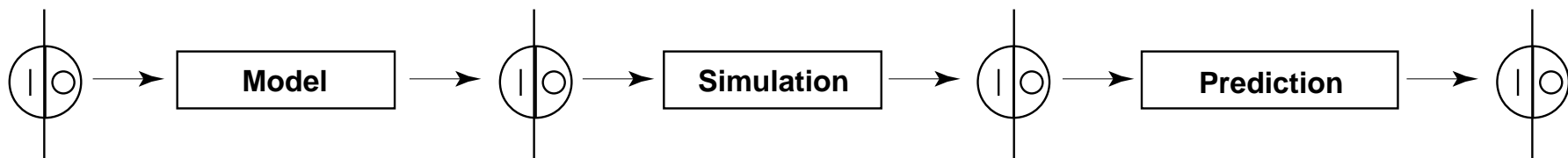
A model is a representation or mirror of some aspects of the real world.

The process of model building involves taking the essential features of a situation and representing them in a computer model.

The computer model is used to conduct an experiment or simulation which enables predictions to be made about the world that has been modelled.



The process of building a model



Simulation used to make predictions

MODELLING AND SIMULATION SYSTEMS

Content

Examples of issues

1. Hardware

1.1 The most important aspect of hardware for simulation is the ability to perform computations quickly and with high precision. Complex simulations require mainframes or super-computers with high speed, large word-length processors and the facility for parallel processing.

1.2 Simulators, eg flight simulators.

1.3 Analog to digital (A/D) converters to convert continuous signals into digital signals.

D/A convertors.

1.4 Analog computers.

1.5 Parallel processors.

2. Software

2.1 Modelling and simulation software is usually complex.

2.2 There are specific simulation languages such as DYNAMO or SIMULA and general purpose computational languages such as FORTRAN, BASIC or SMALLTALK.

2.3 Packages for developing models, eg spreadsheets.

2.4 Simulation programs in business, science, mathematics.

Specialised hardware is being developed to support high speed computation and high precision.

What applications have encouraged these developments?

How were such computations performed in the past?

Discuss the difficulties that occur in designing valid and useful models.

What are the problems that have to be overcome in developing a computer program that correctly emulates a sophisticated model?

How can we be sure that the results of a simulation are reliable?

How are simulation programs tested and used?

MODELLING AND SIMULATION SYSTEMS

Content

Examples of issues

3. Data

3.1 Data in a computer simulation represents the state of the model at any particular time.

Variables, parameters and queues.

3.2 Most situations are made up of a number of continuous processes occurring simultaneously. These need to be represented by digital data being processed serially in a digital electronic computer.

3.3 Parallel processing.

Analog data.

4. Applications

4.1 Computing formulas.

4.2 Simulators, eg flight, space shuttle, 'war games'.

4.3 Games, eg political, business, adventure, arcade games.

4.4 Business simulations and financial modelling.

4.5 Ecological simulations, demography.

4.6 Scientific, eg nuclear reactor design, planetary motion.

4.7 Forecasting, eg weather, economics.

4.8 Research and generation of theories from computer experiments, eg cognitive modelling.

How important is the accuracy and completeness of data to a simulation?

To what extent does the fact that models are a personal, social or cultural representation of reality affect the outcomes of a simulation?

What are the advantages and disadvantages of graphical and picture output in simulation?

Why are computers used for simulation?

What are the effects of using computers for simulation?

What are the advantages and disadvantages of computer simulation?

Does the availability of sophisticated, computer-based simulations increase or diminish the likelihood of global conflict?

MODELLING AND SIMULATION SYSTEMS

Content

Examples of issues

5. People

- 5.1 System designers.
- 5.2 Trainees using simulators.
- 5.3 Managers using results of simulation to make decisions.
- 5.4 Indirect users, eg those affected by planning and decision making.

What are the effects of modelling and simulation systems on the nature of work, training and decision-making?

Has decision-making been improved by computer simulation?

Why have humans always sought to forecast the future?

How can simulation and modelling enable us to gain a broader understanding of the world not available by direct experience?

Are forecasts obtained from computer simulations more reliable than those obtained from other means?

How can simulations enable us to understand social and peace issues on a global scale?

MODELLING AND SIMULATION SYSTEMS

Introduction

In this theme, students study computing as it is applied to the monitoring of conditions in an environment and the processing of inputs from sensors to produce output signals which control the actions of some device.

There is a need to differentiate, functionally, between the control system and the system that is being controlled, although they may both be considered to be part of the one monitoring and control system.

The control system is concerned with the transformation of the acquired data into a suitable response or output.

The controlled system is the object of the output and uses this data to carry out appropriate functions.

The use of sensors as the input devices and the range of end effectors, including robotic device, are important to an understanding of this theme.

The idea that the output of the system can become the input to the same system as feedback, is a key element.

In completing this theme it is desirable that students make use of devices for monitoring and control, including programmable equipment.

Objectives

Students should:

- recognise that a computer control system is one which transforms input data into a suitable response or output;
- demonstrate an understanding of a variety of different sensors that provide input to monitoring or control systems;
- demonstrate an understanding of different output devices connected to monitoring and control systems;
- show an appreciation of the differences between an open loop and a closed loop control system;
- discuss the use of monitoring and control systems in industry;
- be able to design, construct and test a simple computer control system;
- show an appreciation of the effects of computer controlled systems on people.

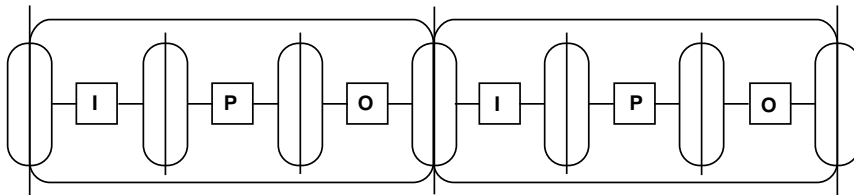
MONITORING AND CONTROL SYSTEMS

Systems representation

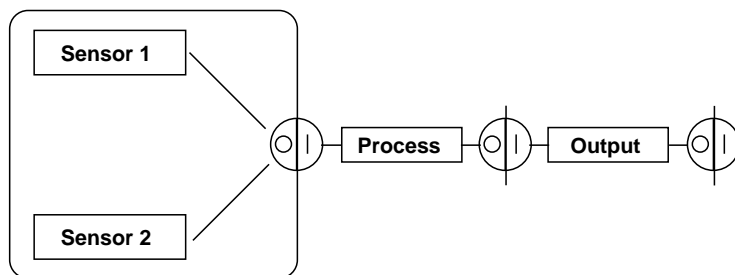
Open loop system



Determined systems are ones in which a particular input is processed to produce a specific output. The input may be from a sensor or a command from a keyboard which is processed to produce a particular output such as activating a switch. Examples include washing machines and assembly lines.

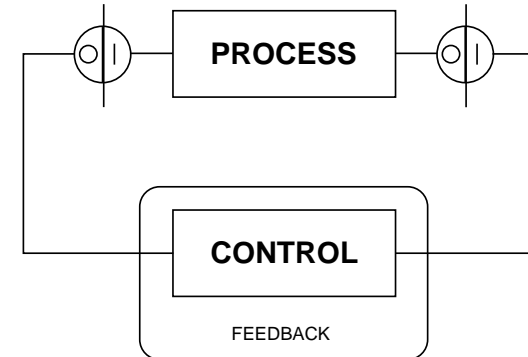


The output from one system may provide the input for another.

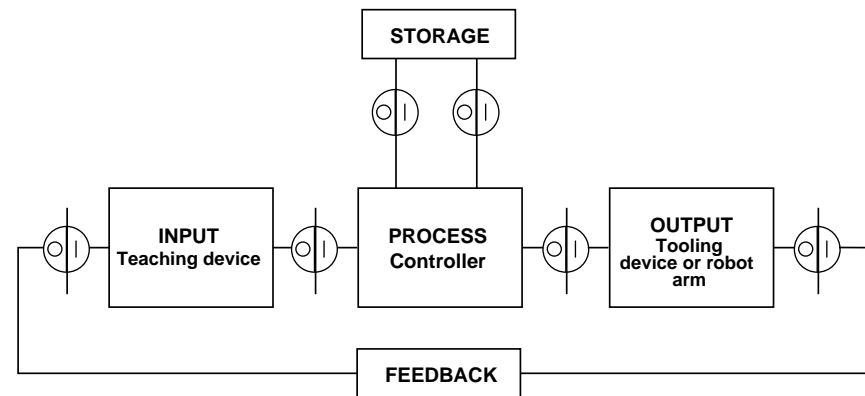


More than one sensor may provide the input to the system.

Closed loop system



Adaptive systems take the output from the system and use it as feedback to control the behaviour of the system. In this case, a given input may produce a variety of outputs depending upon the additional input from the feedback system.



A robot example

MONITORING AND CONTROL SYSTEMS

Content	Examples of issues
<p>1. Hardware</p> <p>1.1 Sensors, eg image recognition, light sensors, optical, magnetic field, temperature, pH, tactile, sonar ranging, acoustic such as sound sensors and speech recognition, limit switches, potentiometers.</p> <p>1.2 Interfaces The interface is the way in which subsystems of the system are joined. Examples in the classroom could include interface cards and ports for lining peripheral devices to a microcomputer.</p> <p>1.3 Storage devices Storage devices for programs and data.</p> <p>1.4 End effectors The 'mechanical' nature of effectors, eg grippers, tools, switches.</p> <p>1.5 Robot devices Definition of robots. Reprogrammable – specific purpose. Adaptive – non-adaptive.</p> <p>1.6 A to D and D to A converters.</p>	<p>Can computers see, feel, hear, etc?</p> <p>How can the control mechanisms of systems such as 'Star Wars' be tested?</p> <p>What applications would be served by a reprogrammable system?</p> <p>Discuss the financial aspects of using computer control systems.</p> <p>Is it possible to develop computer controlled systems that can pick up an egg and still have the strength to lift heavy objects?</p> <p>What were the contributions of Capek's play <i>R.U.R.</i> (Rossum's Universal Robots) and the writings of Isaac Asimov to the origin of robotics?</p> <p>In what way has science fiction influenced the development of robotics? How do modern robots differ from those described in science fiction?</p> <p>In what ways do robots resemble humans and in what ways do they differ?</p>

MONITORING AND CONTROL SYSTEMS

Content

Examples of issues

2. Software

- 2.1 Software responsible for coordinating input from sensors, processing of information (including storage), logical decision-making and manipulation of end effectors.
- 2.2 Specific robot languages, eg A Manufacturing Language (AML). Specific commands in general purpose languages.

3. Applications

Computer controlled systems are often used for jobs that are dirty, dangerous or dull — particularly repetitive tasks.

- 3.1 Controlled systems, eg thermostats in refrigerators, heaters, and ovens, thermistors, pressure controls such as pressure cookers.
- 3.2 Computer controlled systems
Closed loop and feedback systems,

eg environmental control, space probes, flight simulators, automatic trains, computerised warehouses, automated assembly lines, some manufacturing applications such as welding, painting and materials handling, missiles, special purpose machines such as divers and shearing machines, Sydney Coordinated Adaptive Traffic System (SCATS).
- 3.3 Robots,
eg industrial robots, domestic robots, programmable toys.

In what ways do programs written for monitoring and control systems differ from those written for other applications?

Why are computer controlled systems gaining widespread acceptance?

Who gains from their use?

Who loses from their use?

Consider the effects of the use of computer controlled systems in industry on the quality of life of workers.

MONITORING AND CONTROL SYSTEMS

Content	Examples of issues
<p>3.4 Relatives of robots, eg prosthetic devices such as bionic limbs, exoskeletons — like some forms of iron lungs, telecherics, locomotive devices.</p> <p>4. Data</p> <p>Information from sensors tends to be analog. This needs to be converted to digital form. Output data may need to be converted from digital back to analog.</p> <p>Systems may be required to process rapidly, multiple inputs providing large amounts of data, in real-time.</p> <p>5. People</p> <p>5.1 System designers.</p> <p>5.2 ‘Training’ of robots — reprogramming.</p> <p>5.3 Maintenance technicians and engineers.</p> <p>5.4 Research and development.</p> <p>5.5 Literary portrayals of robots and robotics.</p>	<p>How have computer controlled systems incorporated into prosthetic devices affected the life style of disadvantaged people?</p> <p>What technological advances have aided the development of sensors for use in control systems?</p> <p>Consider the effects of displacement of people by robotic devices.</p> <p>What are Asimov’s three laws of robotics? What relevance do these have in the real world of the late twentieth century?</p> <p>How are robots represented in movies, cartoons, advertisements etc?</p> <p>Why have domestic robotic devices not been as readily acceptable in practice as portrayed in science fiction?</p>

INTELLIGENT SYSTEMS

Introduction

This theme calls upon students to view themselves as intelligent systems. The purpose of this is to have students compare their behaviour and capabilities to those of computing systems.

People are able to communicate by written and oral language. They can reason about the world around them, they can learn, they can introspect, and they can be aware of the limits of their knowledge. These are attributes that make people consider a system to be *intelligent*. Computers are able to perform these functions only in simplistic ways, if at all.

Students should appreciate the difficulties that exist in using computers to do tasks which, when done by people, are regarded to be intelligent. Students will need to become more familiar with what is meant by intelligence, why it is hard to represent human intelligence in computer programs, what kinds of human intelligence can presently be copied by computers and what aspects of human intelligence are still too complex for computer emulation.

The study of this theme should allow students to use themselves as a model of 'intelligence', comparing their own capabilities with that of a computer. It is not intended to include the study of human intelligence.

Objectives

Student should:

- be able to identify attributes of an *intelligent* computer system;
- examine applications of *intelligent* systems;
- use a simple *intelligent* system;
- identify the potential and limitations of *intelligent* systems;
- examine the role people play in using *intelligent* systems;
- examine the development of *intelligent* systems;
- describe methods of representing data for use in a system;
- identify the implications of different methods of data representation in *intelligent* systems;
- compare and contrast human and computer problem-solving on a particular task.

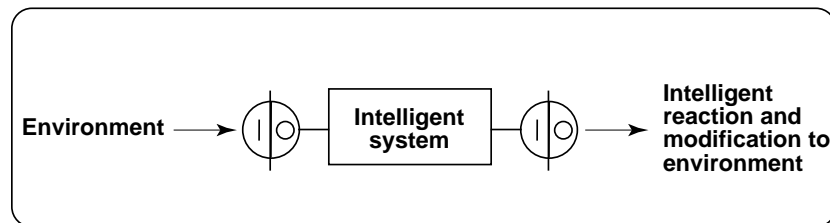
INTELLIGENT SYSTEMS

Systems representation

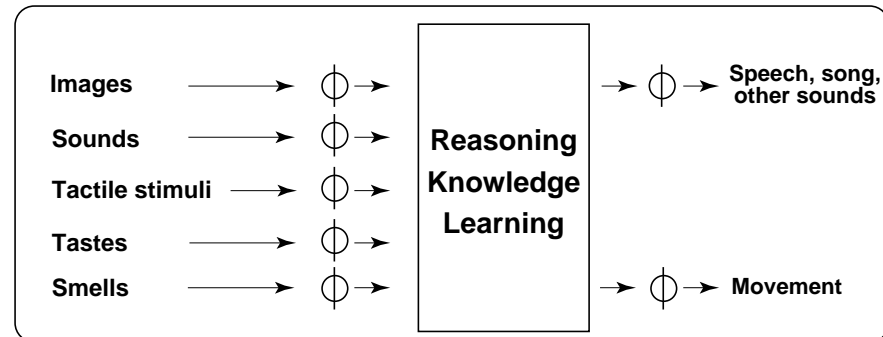
An *intelligent* system is one that receives data from the environment through one of a range of input devices, reacts to that data and produces what the human user would consider an *intelligent* response.

Humans use their reasoning, knowledge and feelings to react to data gained through sight, sound, touch, taste and smell. Computers use electronic means to gain data from keyboards, cameras, microphones and measuring devices. The computer then uses a program to react to this data in a *reasonable* manner.

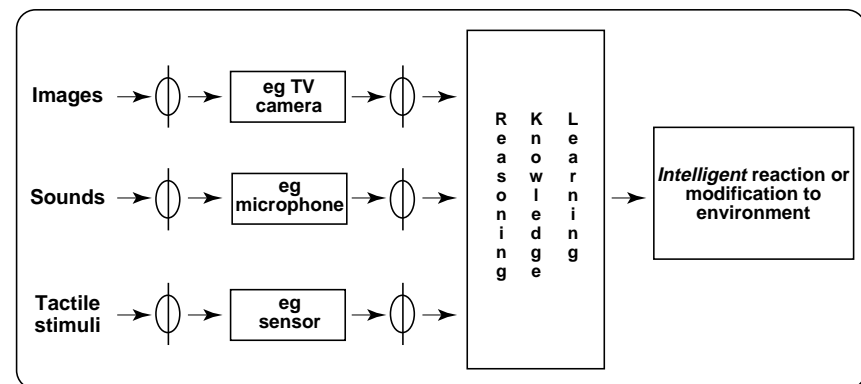
1. An intelligent system



2. A simplified view of the human as an intelligent system.



3. Now consider an example of another refinement that uses a computer based *intelligent* system.



INTELLIGENT SYSTEMS

Content

Examples of issues

1. Hardware

- 1.1 Input devices,
eg TV cameras, scanners, microphones, pressure sensors,
remote control, conventional devices.
- 1.2 Processing,
eg large memory requirements, fast processing requirements.
- 1.3 Output devices,
eg speech synthesisers, robotic arms, conventional devices.
- 1.4 Robots,
eg adaptive and non-adaptive robots.

2. Software

- 2.1 Computer languages most appropriate to *intelligent* systems:
non-procedural languages, including rule-based systems.
- 2.2 Demons: independent programs that spring into life when
they are relevant *of* knowledge that springs into your head
when it is appropriate.
- 2.3 Explanations: software that explains its decisions/conclusions.

3. Data

- 3.1 Data representation and reasoning.
Methods of representation and ease of solution.

- Which computer devices can be compared with humans?
- Are computers able to differentiate readily between stimuli?
- How does human analysis of data differ from computer analysis?
- Why do humans make robots that look like humans?
- are robots and computer-based machines as flexible as humans?
- Where are adaptive robotic devices used? Why?
- Why use software tools to build *intelligent* systems?
- Compare the difficulty in modelling human thought processes in
a procedural and non-procedural style.
- Can a computer *think*?
- Why use different data representations?
- Problems are easier when viewed the 'right' way. Discuss.

INTELLIGENT SYSTEMS

Content

Examples of issues

4. Applications

- 4.1 Adaptive robots.
- 4.2 Expert systems,
eg Medical (MYCIN, CADUCEUS), business decision-making, educational (ANIMALS).
- 4.3 Natural Language,
eg translation from English to Russian to English by a computer program producing:
‘out of sight, out of mind’ = ‘invisible, insane’.

5. People

- 5.1 The users
Categories of people who use *intelligent* systems.
Reasons for using them.
- 5.2 The creators.
- 5.3 The indirect/passive users.

In what ways are humans superior to robots?

In what ways are robots superior to humans?

Expert systems and *intelligent* systems are increasingly popular in computer literature. Why?

In what ways are *intelligent* systems in fiction affecting the development of *intelligent* systems in real life?

What is knowledge engineering?

Why do some computer experts see Natural Language as the key to developments in expert systems?

Who uses *intelligent* systems?

Who gains from their usage? Who may be disadvantaged by their use?

Who is likely to be excluded from their use?

What effects do *intelligent* systems have on specialised knowledge and those who possess it? What effect do they have on non-specialists who now have access to specialised knowledge?

Who constructs *intelligent* systems?

How do we identify experts? Can experts be wrong? Can expert systems be wrong?

Can *intelligent* systems have any effect on people far removed from their use?

ASSESSMENT

Assessment of a student's experiences in their course is to include activities in which the student is required to investigate (observe, record, organise, interpret), express (report, talk, present), communicate (listen, read, write, design) and solve problems.

Through such assessment procedures teachers will be able to measure the extent to which each student has achieved the objectives of this course. taking into account the NATURE OF THE COURSE.

Assessment techniques should be selected which measure:

- the student's knowledge and understanding of the concepts and principles presented;
- the level and extent to which the student has acquired the skills related to the content of the course;
- the student's awareness of and sensitivity towards the impact of the use of computer systems on the values, attitudes and opinions each holds as a student and as member of society at large.

In assessing whether or not a student has satisfactorily studied this course for the purpose of an accredited award, the latter area should not be included. While this area is an important component of school-based assessment and reporting, assessment of student development in this area should be restricted to descriptive comments.

The widest possible range of assessment procedures are to be used. These may include research projects, practical assignments, fieldwork and excursions, discussions and debates, and teacher observation of the students at work. It is not possible for all of the objectives to be assessed by means of 'pen and paper' tests.

At times, assessment will be more appropriate if it takes place during a unit of work rather than at its completion.

The assessment procedures selected must reflect both the core and the four themes selected and take into consideration the weighting of 40% for the core and 60% for the themes.

EVALUATION

Evaluation is an essential part of the process of curriculum development and implementation. It is concerned with educational improvement in the areas of teaching programs, organisation, teaching strategies, assessment procedures, resource management and all other aspects of curriculum.

It is essential that evaluation considers all outcomes, both intended and unintended.

The responsibility for program evaluation rests with individual schools. Evaluation should ensure that the particular Computing Studies program implemented is compatible with the intentions of this syllabus.

It is therefore appropriate for schools to consider at least the following questions.

- Has the teaching program been based primarily on a consideration of the needs, interests and abilities of the students?
- Were aims and objectives determined mainly by this consideration?
- Were teaching strategies, class organisations and content chosen because of their suitability for attaining these aims and objectives?
- Did the selected content meet the requirements for all students to have adequate experience in each of the core and four themes?
- Did the teaching program provide opportunities for all students to acquire the knowledge, understandings and skills and to develop their attitudes, values and opinions as set down in the aims and objectives statements throughout the syllabus?
- Did the assessment procedures employed emphasise establishing what the students could actually do?
- Did the teaching program meet the requirements of all across-the-curriculum policies endorsed by the Board?
- Did the teaching program enable the student to meet the requirements for an accredited award?
- Were the stated objectives found to be appropriate to the needs of the students and the resources available?
- Did the teaching program make specific arrangements to cater for the needs of all students?