

Information Processing

Main Aims of the Unit:

This unit describes the main elements in the processing of data. These include input, output and data checking. The role of the main processor (CPU) is described and different types of software are explored. Various approaches to file organisation are considered and the importance of security in the user-interface is stressed.

Main Topics of Study:

A. Introduction

1. Definitions of hardware, software, package, program, data, parameter.
2. Overview of the range of computers currently used from lap-top to supercomputer,
3. Configuration diagram showing how the components of a computer system are related. Difference between control signal and data flow.

B. Input

1. Review of methods of data capture to include OCR, OMR, MICR, barcodes, text/image scanners, magnetic stripe, voice, touch screen, keyboard, and concept keyboard.
2. Advantages and disadvantages of these methods of data capture when compared with others. In particular, a comparison of speeds, costs, user involvement, accuracy of the data received by the computer.
3. Choose the best data capture method for a given application.
4. Conditions required for each of these data capture devices to be used. A detailed explanation of the internal operation is NOT required.

C. Data checking

1. Difference between Validation and Verification.
2. Validation checks - range, data type, presence, sequence, ...
3. Specifying the validation possible for a GIVEN SET OF DATA.
4. Check digit systems - normally using modulo-11 and weights 6,5,4,3,2,1 etc.
 - o Specify WHICH data can/should contain check digits.
 - o State the guarantees that check digit numbers provide.
 - o Calculate the check digit for a given number
 - o Validate a number which contains a check digit.
 - o The use of "X" as a check digit.

D. Output

1. Ways in which data can be represented - tables, lists, summary statistics, charts, textual reports.
2. Name the range of printers currently available - laser, ink jet...
3. Advantages and disadvantages of different types of printers.
4. Screen output. Its limitations.
5. Identifying whether screen or printer would be more suitable for a given application.
6. Types of plotters currently available. Comparison with printers.
7. Identifying whether a printer or plotter would be more suitable for a given application.
8. Other forms of output. COM. Microfiche. Applications where these might be used.

E. Processor

1. Component parts of the CPU and their functions - ALU, Control unit.
2. MAIN memory and its various forms - RAM, ROM, cache, special purpose RAM e.g. for VDU ...
3. Name registers in general use - accumulator(s), program counter (PC), Memory address (MAR), Memory data/buffer (MDR/MBR), Current instruction (CIR).
4. Fetch-execute cycle.

- o Name the steps an instruction passes through in the cycle.
- o Identify how the registers are used for basic instructions.

e.g. LDA Price, SUB Tax. This topic MUST be covered in detail.

5. Bus structures.

F. Software

1. Distinction between system software and application software.
2. Distinction between general purpose and special purpose software. Understand that the USER dictates how general purpose software is used.
3. Outline of features of operating systems including systems with multiprogramming facilities. Name different operating systems currently in use and compare in outline.
4. System software.
 - o File management software.
 - o Utility software. Sort file. Merge files.
 - o Language translators. Assembler, compiler, interpreter - basic differences.

G. Filing systems

1. Review of current storage devices - diskette, hard disc, Winchester, flash drive/pen stick, optical devices, digital versatile disk, tape and cassette...
2. The need for buffers and their role in data transfer.
3. Definitions of storage terms - file, record, field, cylinder, track, sector, header label, inter-block gap. Distinction between storage device and storage medium.
4. The structure of data stored on a storage medium.

5. Data transfer checks. Parity and its purpose. Describe odd/even parity with specific numeric examples illustrating acceptance/failure. Cyclic redundancy check.
6. File Organisation and File Access
 - Define organisation types - serial, sequential, indexed sequential, random.
 - Distinction between organisation and access. Examples of a file being accessed in more than oneway.
 - For indexed sequential organisations - an understanding of up to 2-levels of indexing.
 - Appreciation that not all record keys appear in the index. How ANY record can be accessed.
 - Overflow areas.
 - For random access - hashing algorithms. Develop a simple algorithm for a given situation.
 - For each of the four organisation methods, describe the PROGRAM sequence of steps to:
 - a. access a SINGLE record from the file
 - b. add a new record to the file
 - c. delete a record from the file.
7. Sequential master file update using an UNSORTED transaction file. Labelled system flow chart for this process.
8. Selecting the most appropriate file organisation for a given application.

H. Processing

1. Different types of processing – batch and real-time.
2. The role of batch processing with today's sophisticated systems. Examples of batch processing currently in use.
3. Real-time systems – examples of current use.

I. Security and privacy

1. Security defined as the safeguard of hardware, software and data.
2. Distinction between security and privacy.
3. REALISTIC methods of data security – securing against
 - accidental damage or loss of data
 - deliberate sabotage.
4. Methods of achieving good privacy of data.
5. Determining the security/privacy required for a given situation.

Learning Outcomes for the Unit:

At the end of this Unit, students will be able to:

1. Describe the main configuration of a computer systems including input, output and processor
2. Identify different types of software including system and application software
3. Distinguish between different filing and processing systems
4. Understand the users role in data security

The numbers below show which of the above module learning outcomes are related to particular cognitive and key skills:

Knowledge & Understanding 1-4

Analysis 4

Synthesis/Creativity -

Evaluation 3

Interactive & group Skills -

Self-appraisal/Reflection on Practice -

Planning and Management of Learning -

Problem Solving -

Communication & Presentation -

Other skills (please specify) -

Learning and teaching methods/strategies used to enable the achievement of learning outcomes:

Learning takes place on a number of levels through lectures, class discussion including problem review and analysis. Formal lectures provide a foundation of information on which the student builds through directed learning and self managed learning outside of the class. The students are actively encouraged to form study groups to discuss course material which fosters a greater depth learning experience.

Assessment methods weightings which enable students to demonstrate the learning outcomes of the Unit:

3 hour examination: 100%

(Choose any 5 questions from 8. Each question is worth 20% of the marks.)

Indicative Reading for this Unit:

Main text Refer to the ICM website for learning material

Alternative texts & Further Reading:

Computer Science for Advanced Level by R Bradley - (Stanley Thornes)

ISBN 0 7487 4046 5 (Fourth edition).

A Level Computing by PM Heathcote & S Langfield - (Payne Galloway)

ISBN 1 904467 52 0 (Fifth edition)

Guideline for Teaching and Learning Time (10 hours per credit)

Lectures / Seminars / Tutorials / Workshops: 50 hours

Tutorial support includes feedback on assignments and may vary by college according to local needs and wishes.

Directed learning: 50 hours

Advance reading and preparation / Class preparation / Background reading / Group study / Portfolio / Diary etc

Self managed learning: 100 hours

Working through the course text and completing assignments as required will take up the bulk of the learning time. In addition students are expected to engage with the tutor and other students and to undertake further reading using the web and/or libraries.

INFORMATION PROCESSING (NEW)

Instructions to candidates:

- a) Time allowed: Three hours (plus an extra ten minutes' reading time at the start – do not write anything during this time)
- b) Answer any FIVE questions
- c) All questions carry equal marks. Marks for each question are shown in []
- d) Mark allocations are shown in [] and should determine the length and depth of your answer and the time you spend on it. A part question carrying 4 marks normally requires 4 different and valid points
- e) In definitions, do not use the word being defined in your definition e.g. avoid the word SERIAL when defining SERIAL FILE
- f) Ensure that you pay particular attention to words underlined, in CAPITALS or in **bold**. FEW OR NO MARKS will be awarded to any question where these are ignored
- g) No computer equipment, books or notes may be used in this examination
1. Read the whole question before starting this one. Select a particular company or organisation that you have studied.
- a) State the name of the company and its main functions. [2]
- b) Describe ALL the uses of computing in this company. Indicate the type of processing in EACH case. [5]
- c) Describe the specific outputs that computers produce in the company and explain who uses these and how they are used. [5]
- d) List the hardware used in the main applications of the company including the number and types of computers used. [5]
- e) Describe the input data needed to produce the results. [3]
2. a) i The PC is incremented during a fetch-execute cycle. Explain what this means and WHY it happens. [2]
- ii In the diagram below, A to D represents the sequence of events over one fetch-execute cycle.
- A _____ FETCH _____ B C _____ EXECUTE _____ D
- time
- State at which of the times A, B, C or D will the PC be incremented. [1]
- iii The PC could be altered at another time during the cycle. State the circumstances when this happens and at which point in the cycle (A, B, C and D) it occurs. [2]
- b) Memory location 4567 holds the variable X and location 4568 holds the variable Y. Referring to the fetch-execute cycle, describe IN DETAIL the sequence of events that occurs when the value $X - Y$ is calculated and the result returned to memory location R (4569). The program routine for this begins in location 1000. Show how the registers change throughout. [15]
3. a) In business, a computer user may use two types of application software – general purpose and special purpose.
- i Distinguish between the two.
- ii An employee uses a special-purpose package. Explain how his subsequent actions will be different from using a general-purpose package. [5]
- b) A user wishes to sort a very large data file of employee records (key field = employee number) so that the file is sorted by employee name – surname must be the prime key and first name the secondary key. State the information the sort program will need to achieve this. [5]
- c) Name a particular operating system. Describe FIVE major features the operating system provides. Your choices must be significantly different from each other. [10]
4. a) Outline the possible effects of a company with inadequate security in its computer system. [4]
- b) Discuss possible ways in which a computer system could be vulnerable and suggest ways of eliminating or minimising EACH. Your answer should consider:
- i accidental loss of data
- ii hardware problems
- iii deliberate acts to create problems by staff or other people [16]
5. Write notes about FIVE of the following. Each of your answers must have at least FOUR different and significant points.
- a) Comparison between the speeds of input, output, storage devices and memory
- b) Minicomputers
- c) Batch processing
- d) Plotters
- e) Distinction between special purpose and general purpose software
- f) Spooling [4 each]
6. Choose any FOUR of the following methods of data capture. For EACH:
- describe how the data input device works using appropriate diagrams
 - identify precisely a particular application that is most suited to its use
- a) Barcode reading
- b) MICR
- c) OCR

- d) OMR
 - e) Voice recognition [5 each]
- 7.
- a) Explain why there are so many different types of printers. [4]
 - b) Name FOUR specific types of printer. [4]
 - c) Select any TWO of these printers. For EACH:
 - i briefly describe an appropriate application which would need it
 - ii describe its characteristics which distinguish it from other printers [6 each]
8. Name a particular operating system and describe, in detail, FIVE significantly different tasks that it performs. [4 each]

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1.
 - a) Define the term **OMR**.
Explain, in general terms, how OMR operates. [5]
 - b) Choose THREE different major application uses of OMR and for EACH:
 - i name the application
 - ii explain how the organisation using it will prepare for its use
 - iii explain who will be the target data suppliers and how this data is collected
 - iv describe what the organisation will do once the data has been collected [5 each]

2.
 - a) Check digit validation cannot realistically be used for checking all numeric data. Identify a situation where it is appropriate and one in which it is not. [2]
 - b) Employee numbers are six digits long and are created using the modulo-11 system with traditional weights 6, 5, 4, 3, 2, 1.
Investigate the number 354287 and state whether it is valid or not. Show all stages of your working. [6]
 - c) Give specific BUSINESS examples where EACH of the following validation checks would be used. Include in your answer for EACH:
 - two realistic examples of data – one VALID and one INVALID
 - explanation of how the computer could detect the invalid one
 - i range check
 - ii format check
 - iii presence check
 - iv any other check (excluding check digit verification) [12]

3.

A company holds details of all its products on an indexed-sequentially organised file. In a telephone enquiry, a customer asks for details about product 3456. The product file is then accessed directly.

 - a) Describe all the internal processes, logical and mechanical, that occur from the moment 3456 is keyed until the details of the product appear on the screen. [10]
 - b) Explain why the file is unlikely to be held on CD-ROM. [2]
 - c) The file would not be held on magnetic tape. Explain why magnetic tape is still used for other purposes. [3]
 - d) Using the following table, add FIVE more fields that you would expect to find on this PRODUCT file. [5]

Field Name	Datatype	Purpose – how it is used
ProductName	Character	Identification and for printing on a customer invoice

4.
 - a) Distinguish CLEARLY between SYSTEM software and APPLICATION software. [2]
 - b) Program source code must be translated in order to run on a computer. Discuss the THREE main types of language translators available, distinguishing carefully between them. [9]
 - c) Discuss IN DEPTH a SPECIAL-PURPOSE business APPLICATION package you have studied. In particular:
 - i name the area of business it covers
 - ii identify who the main users are
 - iii state its main functions
 - iv describe the type of data that is input
 - v describe the outputs that it produces [9]

5.

Select TWO of the following methods of data capture:

 - a) MICR
 - b) OCR
 - c) OMR
 - d) Barcode reading

For EACH:

 - i state a typical application which uses that method
 - ii describe the format of the data before input
 - iii describe how the appropriate input device works from the computer point of view
 - iv explain why it is the MOST appropriate method for that particular application [10 each]

6. a) In table form, list FIVE possible causes of hardware failure and state ways of minimising or eliminating EACH. [10]
b) In table form, list FIVE possible cause of data loss other than hardware failure. Again, state ways of minimising or eliminating EACH. [10]
7. Choose FOUR different types of printers. For EACH one:
• describe briefly the internal workings
• give ONE typical application for which it is MOST appropriate [5 each]
8. a) A company receives 500 orders per week through the mail for items which are not urgent and as a result BATCH PROCESSING is used.
i Explain what happens in batch processing. Describe also how BATCH TOTALS would be used and how they are calculated. [6]
ii Explain how errors detected in data submitted for batch processing are corrected. [4]
iii There is now far less batch processing than in the past. Explain why. [2]
b) i Identify the files that would be needed in THIS batch processing example. [2]
ii Draw a labelled systems diagram to show how these files would be used during the batch processing update. Describe briefly the various stages that occur in the process. [6]

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1. a) A file-handling program might contain a command to read a single record into a program buffer.
- i Describe all the steps, logical and physical, which take place to execute this command if the file has INDEXED-SEQUENTIAL organisation. [6]
 - ii Repeat this for a file organised as RANDOM. [4]
- b) It is unusual to amend a SINGLE record on a file with SERIAL organisation. However, it is realistic for small files. Describe in full how a single record can be changed without altering or losing any of the other records
- i so that a new file is created [5]
 - ii so that the SAME file area is used for the updated version [5]

2. a) Distinguish carefully between the terms validation and verification. [4]
- b) State fully the purpose of validation. [4]
- c) When a new employee joins a company, a record is placed on the employee file. Some of the fields are:

Fieldname	Datatype	Typical data
Surname	Character (20)	Smith
EmployeeID	Integer	12345
AnnualSalary	Real	12345.00
JobTitle	Character (20)	Warehouse clerk
DateOfBirth	Date	19.12.1972
EmploymentDate	Date	5.3.2007

Consider EACH FIELD IN TURN and identify the validation that can be performed by the data input program on that field. [12]

3. a) Draw a labelled diagram showing the component parts of the central processor. Omit control signals but show directions of data flow using arrows. [6]
- b) Distinguish clearly between a laptop and a desktop computer. [4]
- c) Describe the steps in the fetch-execute cycle which would be undertaken when the instruction in memory during the run is ADD X,M. Take this to mean that the contents of address M are added to register X. [10]
4. a) Printers used with large networks have different characteristics from those normally attached to microcomputers. Explain what these are. [5]
- b) Select a printer suitable for printing invoices which will be handed to customers of a car hire company when they reserve their cars. Explain why it is suitable and describe its method of printing. [7]
- c) Select a different type of printer suitable for printing tax statements to be sent to over one million customers.
- i Explain why it is suitable and describe its method of printing.
 - ii Explain why the choices you have made in each of b) and c) would not be suitable for the other. [8]
5. a) Distinguish clearly between SECURITY and PRIVACY. [4]
- b) Describe the measures that MUST be taken to ensure that PRIVACY is guaranteed in a large organisation with regards to computerised data. [10]
- c) Identify SIX significantly different measures that could be taken to ensure that data is SECURE. [6]
6. a) With the aid of a diagram, explain how a plotter is able to print diagrams in different colours and with associated text of different fonts, font sizes and at different inclinations. [8]
- b) Modern printers can print diagrams with included text. Describe applications from the world of commerce and industry where diagrams are produced and where:
- a plotter would be MORE appropriate [4]
 - a printer would be MORE appropriate [4]
- Your answers should explain why EACH is more appropriate.
Identify:
- i TWO types of printers which are able to print good quality diagrams and [4]
 - ii TWO printers which either cannot print diagrams or the quality is poor [4]
7. Name a particular operating system and describe, in detail, FIVE significantly different tasks that it performs. [4 each]

8. a) Describe the differences between high- and low-level languages, illustrating your answer with brief examples of coding. Discuss the differences during the processes of
- writing a program
 - correcting program errors
 - translating a program
 - run-time [10]
- b) Define the term UTILITY program. Give TWO examples of utility programs, explaining what EACH achieves. [5]
- c) Briefly describe FIVE significantly different features of an operating system. Your examples can be from different types of operating systems provided you indicate which type.

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1. All parts of this question relate to a retail company.

- a) Explain why validation is performed when data is first input. [2]
- b) Part of a record for a current sales transaction is shown below:

Purchaser	Quantity	Date of purchase
William Blake	250	21/5/2010

- Take EACH of the three fields in turn and describe the validation that can be undertaken. [8]
- c) Product codes are six digits long and use a traditional check digit system. The modulo-11 method is used with weights of 6-5-4-3-2-1.
 - i William Blake orders product 531987. Explain how this number can be checked WITHOUT the need to refer to the product file.
Prove that this product number is valid, showing all working and explaining the steps. [5]
 - ii Explain why the next product number in sequence CANNOT be 531988. [2]
 - iii Calculate the next product number in sequence after 531987. Again, show all your working. [3]

2. The table below shows the contents of part of memory at a given time during the running of a program. The contents are shown in their most convenient forms but are of course held in binary.

ADDRESS	CONTENTS	MEANING
2000	5000	Store location P
4100	SUB P	Subtract contents of P from accumulator
4101	BPZ G	If content of accumulator is positive or zero, branch to G
6123	STP	Location G. STOP. End the program

Value of Program Counter (PC) = 4100
 Contents of accumulator = 8500

Describe IN DETAIL:

- the events that occur during the next TWO fetch-execute cycles and the contents of registers as they change
- the purpose of EACH register the first time you refer to it [20]

- a) Explain why there are so many different types of printers. [4]
- b) Name FOUR specific types of printer. [4]
- c) Select any TWO of these printers. For EACH:
 - i briefly describe an appropriate application which would need it
 - ii describe its characteristics which distinguish it from other printers [6 each]

4. A company holds its 8000 product RECORDS on its product file. This MASTER file is organised as SEQUENTIAL using product number as the KEY field. On the file are details of products numbered 4567, 5678, 6789 and 7890.

- a) Define carefully the FOUR terms above in CAPITAL letters. [8]
- b) A single new product (product number 7000) is to be added to this file. A program is available to do this. Describe carefully the steps this PROGRAM will take. [4]
- c) Unaware that the product has already been added to the file, a different stock controller also tries to add 7000 to the file. Describe the features needed in the PROGRAM to handle the problem this could cause. [2]
- d) The SINGLE product 6789 is being discontinued and should be removed from the stock file. Again, a program is available to do this. Describe the steps this PROGRAM takes. [4]
- e) Explain what data would need to be held on file for each product so that a program run could print a list of those products which need reordering because they are running low. [2]

- a) Outline the possible effects of a company with inadequate security in its computer system. [4]
- b) Discuss possible ways in which a computer system could be vulnerable and suggest ways of eliminating or minimising EACH. Your answer should consider:
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7. a) List FIVE causes of computer hardware failure. For EACH, state a precaution that could be taken to minimise or eliminate that problem. [10]
- b) List FIVE possible causes of data loss other than through hardware failure. For EACH, state a precaution that could be taken to minimise or eliminate the problem. [10]
8. Read the whole question before starting this one. Select a particular company or organisation that you have studied.
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