SECTION 3

The Structure and organisation of digital computer Software and Hardware

Input / Output

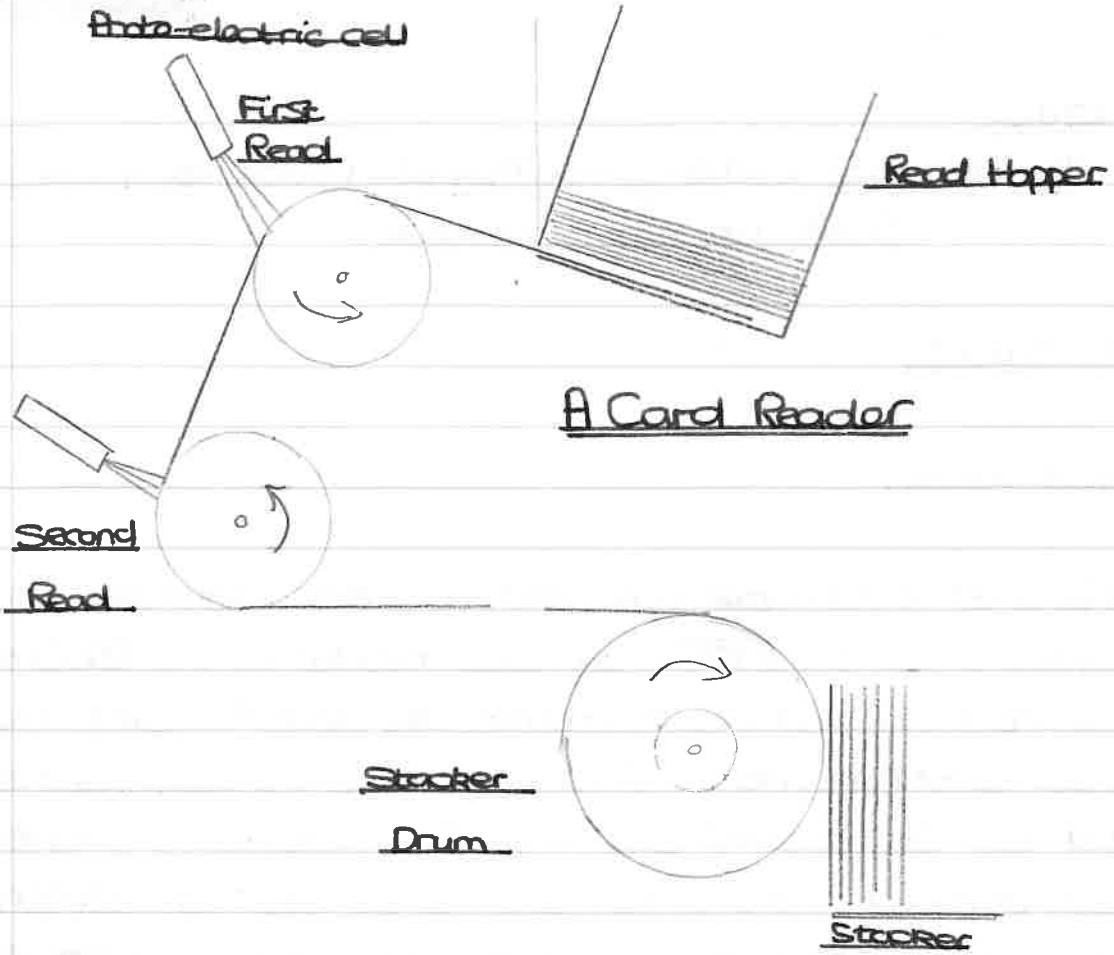
① Punched Cards

Punched cards have been used to input information into computers since the 1950's. It was invented in the 1880's by Herman Hollerith, and is also known as the Hollerith card. The standard card measures 7·375 inches by 3·25 inches, and is divided into 80 columns and 12 rows. Characters are represented by holes punched in the cards. Each character is represented by 1-3 rectangular holes, only one character is represented per column, therefore each card can hold up to 80 characters

A machine called a Keypunch is used to make the holes in the cards. This has a keyboard like that of a typewriter. At the same time as the hole is made, on some machines the characters are printed at the top, but some machines need seperate interpreters. It is then checked on a verifier.

These cards are then read with a card reader which converts the statement into the computers own code. Light is shone onto the cards and the presence or absence of holes is detected by a photo-electric cell. Then the code is registered. Each card is read twice to avoid error. If the two readings are different the card is rejected. The information is then entered into the computer. Machines can read up to 2000 cards a minute, but the average is 1000 cards a minute

Advantages	Disadvantages
Relatively Cheap	Bulky
Easy to sort and correct	Slow Transfer rate
	Easily damaged - Short Life



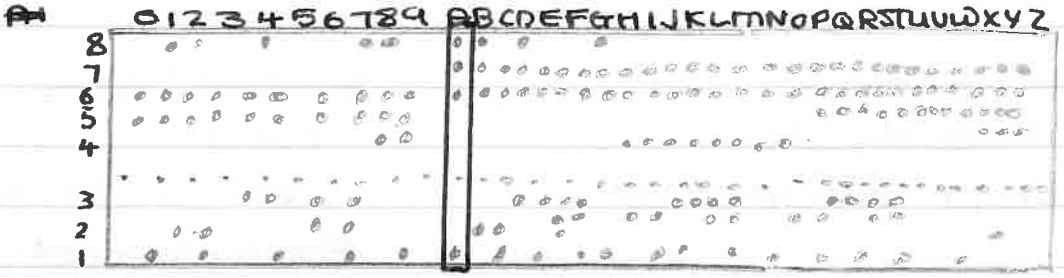
A Card Reader

Paper Tape

Paper Tape is a continuous strip of paper, similar to punched cards. It has holes made in it across it's width (One inch (25.5mm)). The most common form of paper tape ha eight channels or tracks. There are ten characters to the inch. Paper tape can be up to hundreds of feet long. It is punched very much like punched cards, via a special keyboard, similar to that of a typewriter. It is read in a purpose built machine by photo-electric cells. Odd/even parity tracks are used to detect errors*. The speed varies from 100-2000 characters per second

*as in magnetic media

Eight Channel Paper Tape.



Advantages of Using Paper Tape	Disadvantages of Using Paper Tape
Compact	Difficult to interpret code visually
Simple to handle	Error correct requires new tape
Data does not get out of sequence	

22·9·83

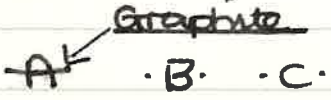
Human / Machine readable input.

1) Mark reading

Mark reading is ~~for~~ a system for reading pen or pencil marks on specially pre-printed documents. The marks have to be in the right place, e.g in multiple choice exam questions These marks are read optically, using a system based on the reflectance of light, the mark mean a drop in the light reflected

Mark Sensing

This is very similar to mark reading in that marks are made on pre-printed sheets. The marks must be made with a pencil. The graphite from the pencil conducts electricity ∴ so the computer tests all marks in the right area for conductivity. Its use for this is again in multiple choice answer papers



2) Optical character recognition (OCR)

This device not only detects the presence of a character, but can also distinguish one character from another by its shape. This is both machine and human

readable. The special characters (like normal letters and numbers, but rather square) are typed on to the document

There a two main sets of characters OCR-A, the American set and OCR-B, its European counterpart. The words are scanned photo electrically at up to 2500 characters per second (100-1600 documents per minute) Readers are expensive. Characters that are not recognised are thrown out. It is used by banks, insurance companies etc.

OCR A type

3 Magnetic Ink Character recognition (MICR)

This recognises characters printed in special magnetic ink. It is used in banking and processing ~~checks~~ cheques. There are two stand sets of characters, E13B for the USA and UK, and CMC7 for the rest of Europe. E13B has numbers 0-9 and four special characters. CMC7 has A-Z plus 0-9 and five special characters. A high level of printing accuracy is required and so it expensive. It can handle 2500 documents a minute.

E13B

CMC7

Light Pen

The light pen was developed in the 1950's and come into common use in the 1960's. It is a rod shaped device connected to a graphics terminal by a wire. It can be used for drawing or moving items on a screen. Inside there is a photo-sensitive cell, which takes the ligh emitted from the screen and sends the information to the computer. To energize the cell the spot under the pen must be the right colour and intensity. A cross or spot appears on the screen to tell the operator to start. To draw something the commands DRAW or MOVE are used to refer to moving / drawing spots, lines, or vector on the screen. A large ammount of software is needed. A type of light pen is used in supermarkets to read bar codes.

Audible signal Receivers and Generators:

These are systems that can analyse and identify words or phrases spoken into the system. Each word should be followed by a short break. A word could be a digit, a word in any language, a short phrase, or several digits. 300 voice-data-entry (V.D.E) systems are available. The vocabulary ranges from 64 to 192 words

The computer has to learn each persons pronunciation by listening to it ten times. It can be reprogrammed at any time. The word is changed into a string of binary bits which are matched against the stored vocabulary. The best match is taken and displayed on the VDU. Computers can also produce spoken words, but more slowly than in normal speech.

Chacters and line printers

There are two different techniques used in printing, impact and non-impact. A impact printer hammers the

ink onto the paper like a normal typewriter. Non-impact printers form characters by chemical or electronic means and is more expensive because special paper is used. The operation is silent and speeds of +- 2000 lines per minute and above, but carbon paper cannot be used: There are two types of line printer, chain and drum, they are both impact printers. A character printer prints one character at a time, ranging from 10-120 characters per second. They are quite slow. Teleprinters use this method. Line printers are more complex and expensive. They go upto 136 characters per second (200,2000 lines per minute). Because it is so fast it looks like it is printing a whole line at a time. All the letters as are printed, then the bs and so on until the line is complete. There are two ~~two~~ types of line printer, chain and drum. Chain printers are more common. A chain with six sets of characters rotates in a horizontal plane over a set of hammers, as the right character goes past it is pressed onto the paper to print a characters. It is so fast a whole line appears to be printed at once. The drum system is similar, they are both impact printers

Graph Plotters

These are special devices for plotting graphs onto paper, or plastic and metal plates. They are accurate to within one thousandth of an inch Plotters may be driven on line or off-line. Computers dedicated to design work will have one on-line. It gets its instructions from magnetic or paper tape. It may take many minutes to complete a graph. There are two types of plotter, drum and flat-bed. The paper is fixed to the drum and a pen is suspended from a bar which moves to plot the graph. This is used for routine tracing like fashion designs. On the flat-bed plotter the paper lies flat. The pen moves up and down on a gantry. Colour graphs are possible, some beds are as large as 6m x 15m

V·D·U's

V·D·U stands for Video Display Unit. It contains a cathode ray tube like that of a television. Images are put on a screen rather than ink on paper. A keyboard is normally fitted underneath the screen. There are two types of V·D·U, ones that only have alphanumeric characters (alphabet and digits 0–9), and those which can display special graphics as well. They vary in size from 8–20 inches and can display up to 30 lines. There can be up to 80 characters per line, so a full screen can display 2400 characters in a few seconds. Colour V·D·Us can be used to show graphs and do maps, and two or three dimension images of certain objects. They can be linked up to ~~computers~~ printers to provide hard copies of what is on the screen.

6th October

Backing Store – Magnetic Tape

Magnetic tape is widely used. Standard tape is ½ inch by 2400ft (732m). It is made of plastic, and one side is covered in iron oxide with can be magnetised and to demagnetised to record information. The recorded information is in the form of magnetised and not magnetised spots. Standard tape has either 7 or 9 tracks, 9 track being more modern. Characters are recorded across the tape in a frame. A parity track is also included to help prevent mistakes The most common is even parity. This means that if a track contains an odd number of "spots," another "spot" is added to make it an even number. If there is already an even number of "spots" then nothing is added. Spots are 1's, and non magnetised "spots" are 0's. If there is not an even number of 1s then it is rejected.

A tape drive is the device used to read and write (record) on the magnetic tape. The tape drive is controlled by the computer, but machines are available that can put

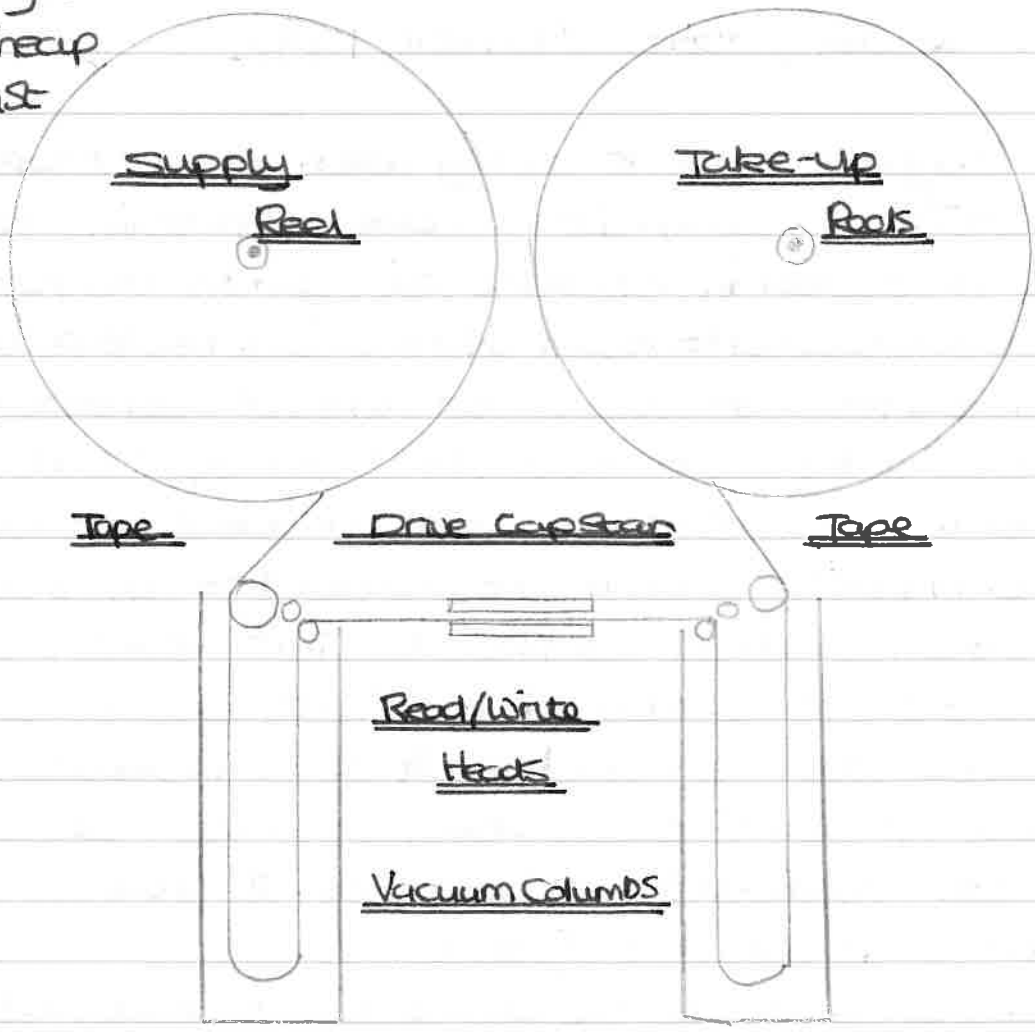
information onto tape without the use of a computer, these are known as key-to-tape systems. Before passing over the head the magnetic tape loops down into two vacuum chambers each side. This prevent the tape from snapping when stopping, starting or changing speed. An average transfer rate of between 30,000 and 320,000 characters per second is common.. A standard tape can hold between 10 and 40 million characters. To do the same thing on punch cards it would take a minimum of 125,000 and 500,000

Advantages

They can be recorded over
Easy to use
Cheap
Fast

Disadvantages

It is prone to damage
Dust cause distortion

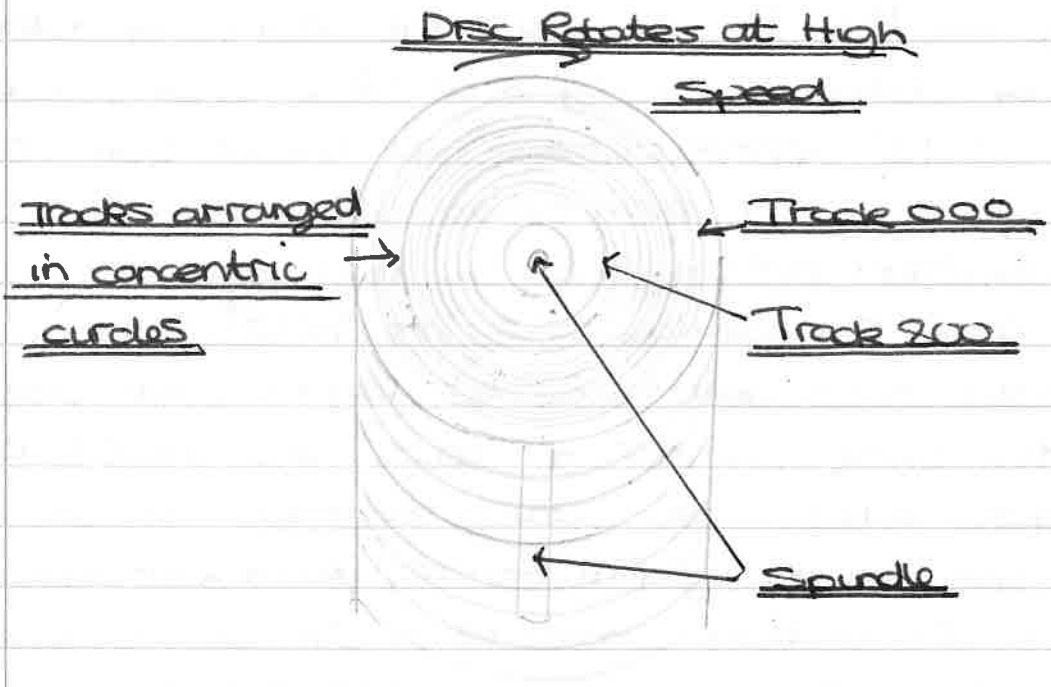


Backing Store – Magnetic Disc

Magnetic Discs is the most commonly used form of storage media. It can hold large volumes of data. Each item of data is easily accessible, in any order. A disc is 12" approximately and thicker than a normal record. It is coated with oxide, like a tape. As with tape the magnetized spot signifies a 1 bit, and its absence is a 0bit. On average there are 800 tracks on a disk arranged in concentric circles. Because each track has the same number of "spots" the inner tracks have the "spots" much more closely together. Six or more discs can be arranged in stacks, possibly containing over 200 million characters. Disc drives turn the discs at between 2400 and 3600rpm. The heads float 1/400th" (0.064mm) above the disc, so dust can be a problem. Discs are re-usable. There are two types of drive, fixed head and moving head. On a fixed head there is a head for every track, and on moving head the same head moves up and down. Fixed head drives find the correct track more quickly. Transfer rates are between 100,000, and 2,000,000 characters a second

For	Against
Large Capacity,	Drives are expensive
Direct access to items	Discs are more expensive
selected at random,	than reel to reel tape
fast,	Heavy
Re-usable,	
Easy	
Relatively Cheap for discs	

A Stack of magnetic discs mounted on a Spindle



Random and Serial access

If you have, for example, 100 patients records on a magnetic disc and you want the 67th file, you can get it straight away. This is know as Direct or Random Access. If, on the other hand, you are using magnetic tape you cannot do this. The reads have to over files 1–66 before you can have access to No 67. This is slower than Random access and is called Sequential or serial access.

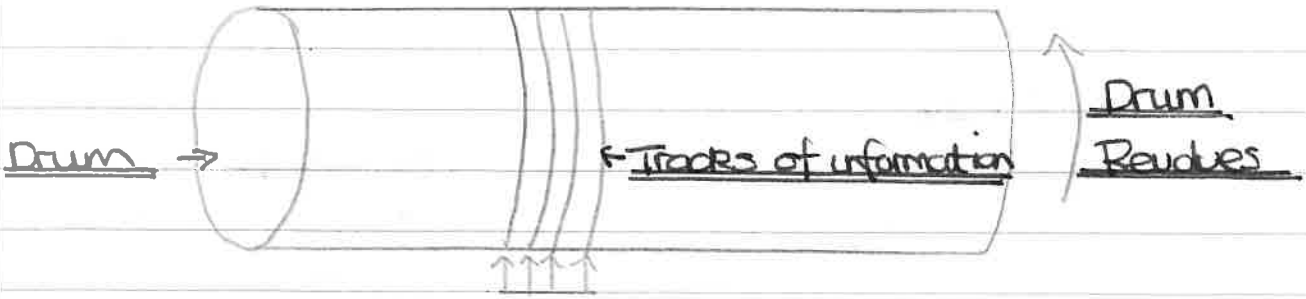
Floppy Disc / Diskette

A floppy disc or diskette is a low cost, small sized storage media for use with micro-computers, word processors. It is a flexible disc, 7½" (190·5mm) in diameter and 1/40" (0·64mm) thick, enclosed in a plastic envelope for protection. The whole

Disc (or Diskette) goes into the Disc drive, envelope and all, and is easy to load and unload. The method of information recording and retrieving is similar to that of a magnetic disc. It can only hold 250,000 characters They are very cheap, and becoming more popular for use with micro- and home computers

Magnetic Drum

This is similar to a magnetic disc but the information is in tracks out the outer surface of a drum or cylinder. They are about 3ft (914mm) long The outer surface is covered in ferro-oxide, enabling "spots" to be magnetised or demagnetised. The is a head for every track, and the tracks are arranged parallel. Drums can hold up to 10,000,000 characters of information. This provides fast access to information. Drums are more expensive than magnetic discs and is only used for where high speed is important. Its use is declining



A magnetic Drum

Analog and digital signals

Definitions

1. **Digital Signal**

Digital signals are signals that are represented by digits (numbers). The signals vary in steps, but these steps can be very small

2. **Analog signal**

Analog signals are continuously variable signals such as a hand moving round on a clock or the rotation of a shaft of an electric motor

Examples

1) **Digital Speedometer**

0	0	6	7	.	4

Advantage

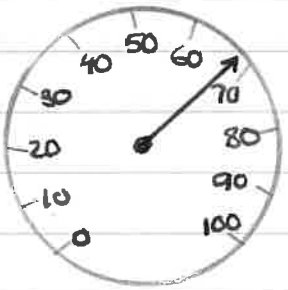
Can be read more accurately

Disadvantage

You can't see the range and all the readings

Normal hand rotation speedometer

Analog Speedometer



Advantage

You can see all the readings and the range

Disadvantage

Less accurately read

2) **Digital Clock/watch**

Discrete signal produced by Quartz which emits a signal at very regular intervals

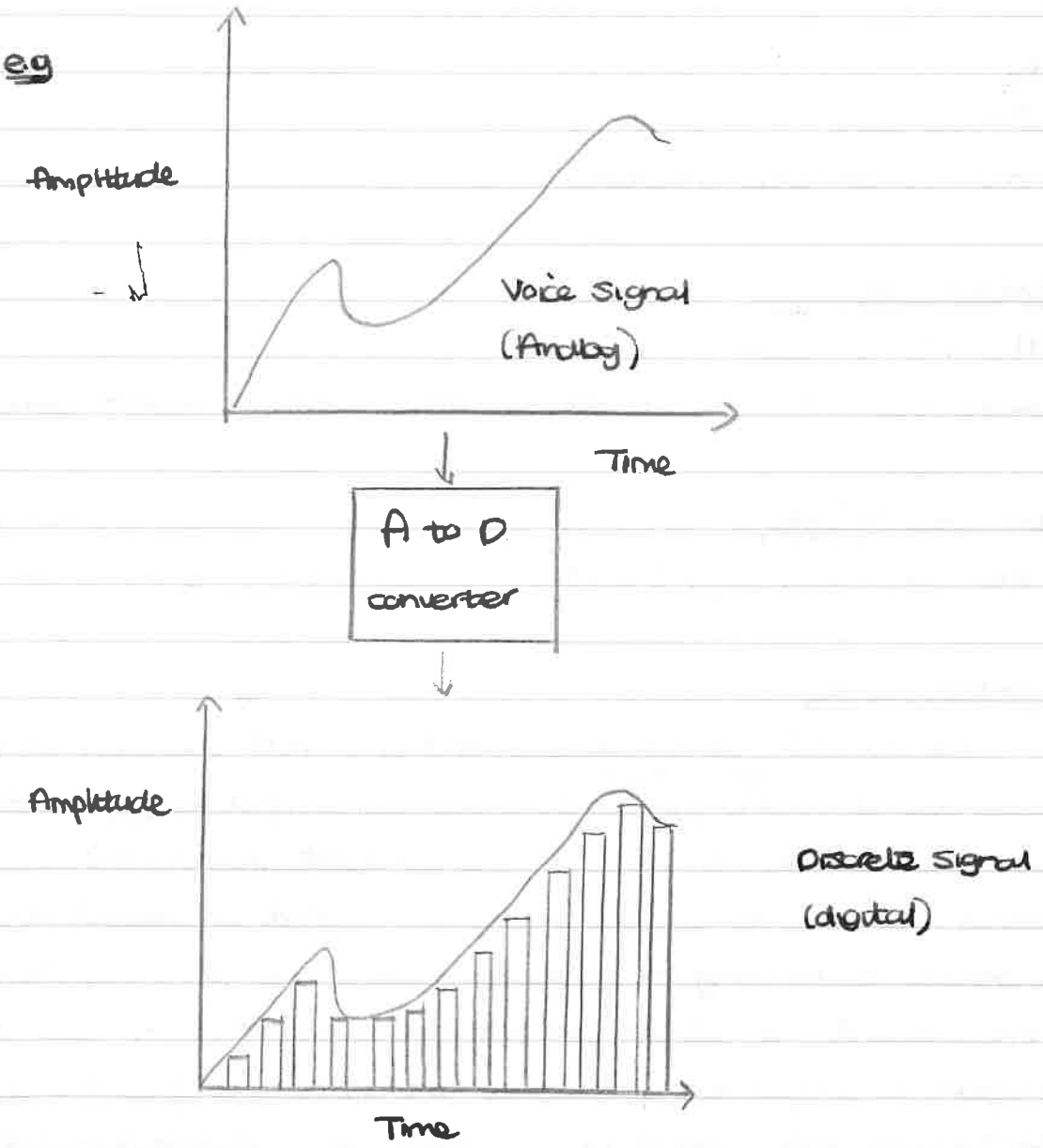
Normal Analog clock/watch

Continuous signal, parts moving all the time

3 Analog Output - human voice

Voice is a continuous signal and if we want to use an audible signal receiver then we must have some way to convert analog signals to digital signals

Analog/digital converter (A to D)



An analog digital converter is used in most modern computers because a lot of the information is in a continuous form (eg any physical reading like temperature) which must be converted to digital.

A digital to analog converter also exists to convert output into a

continuous form

Central Processing Unit

Control Unit

Shelley + Hunt p 13 + 18

Function, Instruction Register, Program counter and jumps

ALU

p 13 + 20 SHH,

function + arithmetic operations

Central Memory

SHH p 17 + 18 Cores

Semiconductors, Volatile, non-Volatile, IPS, address, access time, fig 1.7 p17

Fetch - Execute cycle

p 218 definition, fig 1.5 p 14.

Control Unit

The function of the control unit is to put things in or take things out of memory and decode them. Numbers and be manipulated in the A.L.U under the control of the C.U. The CU reads instructions from the Central Memory to a part of the C.U called an instruction register. The process of reading an instruction into the IR and then decoding or executing it is called the fetch-execute program. Just before a program is obeyed the address of the location is placed in a register called the program counter or PC. When this has been done, the next location is placed in the P.C. If a program contains GOTO statements then it will be necessary to jump from location to location like jumping in between lines in the actual program. Operation and address this is called.

Arithmetic Logic Unit (A.L.U)

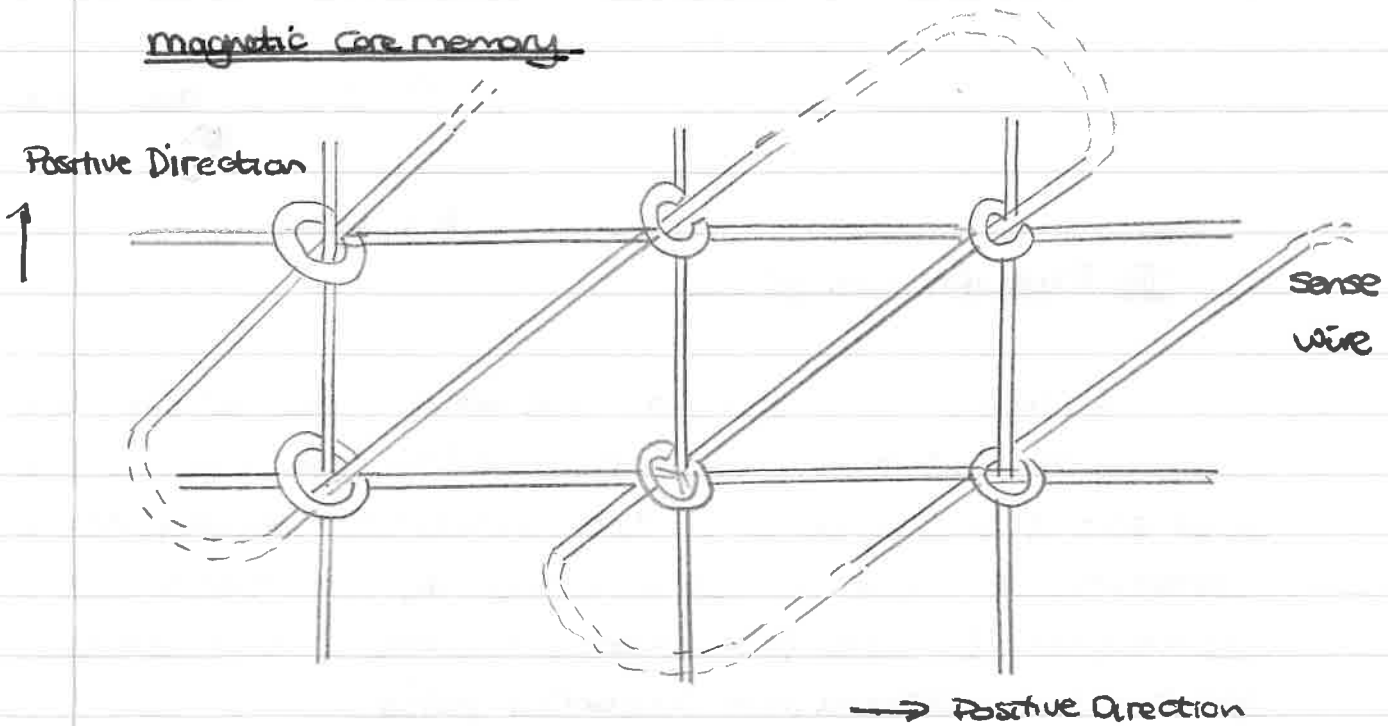
The main component of the A.L.U is the accumulator

which is used when the unit is performing arithmetic. It is similar to a CM storage location. The A.L.U performs the arithmetic functions needed to be done in the program. It can perform the main four basic arithmetic operations (addition, subtraction, multiplication, division) and also comparison operations ( ) < = >= <= <>) and logical operations (NOT, AND, OR, NAND, NOR). Subtraction is performed by the complementation method

Central Memory

Purely a unit for holding information as binary digits in words or locations. It is a set of magnetic ferrite rings called cores, about the size of a pinhead. But now the trend is toward semiconductor memories, each element being a transistor but the information is lost when switched off. It is said to volatile as opposed to core storage which is non-volatile The storage elements are arranged in planes (layers). An eight bit word will have 8 planes. A common name for the CM is a core store, another is Immediate Access Store (I.A.S). Information is stored as patterns in the words of the CM for use by the CU. To get at the information the CU must know the address of the location. For a 32K CM each location will be numbered from 0 to 32767. The time taken for the CU to access this information is called the access time

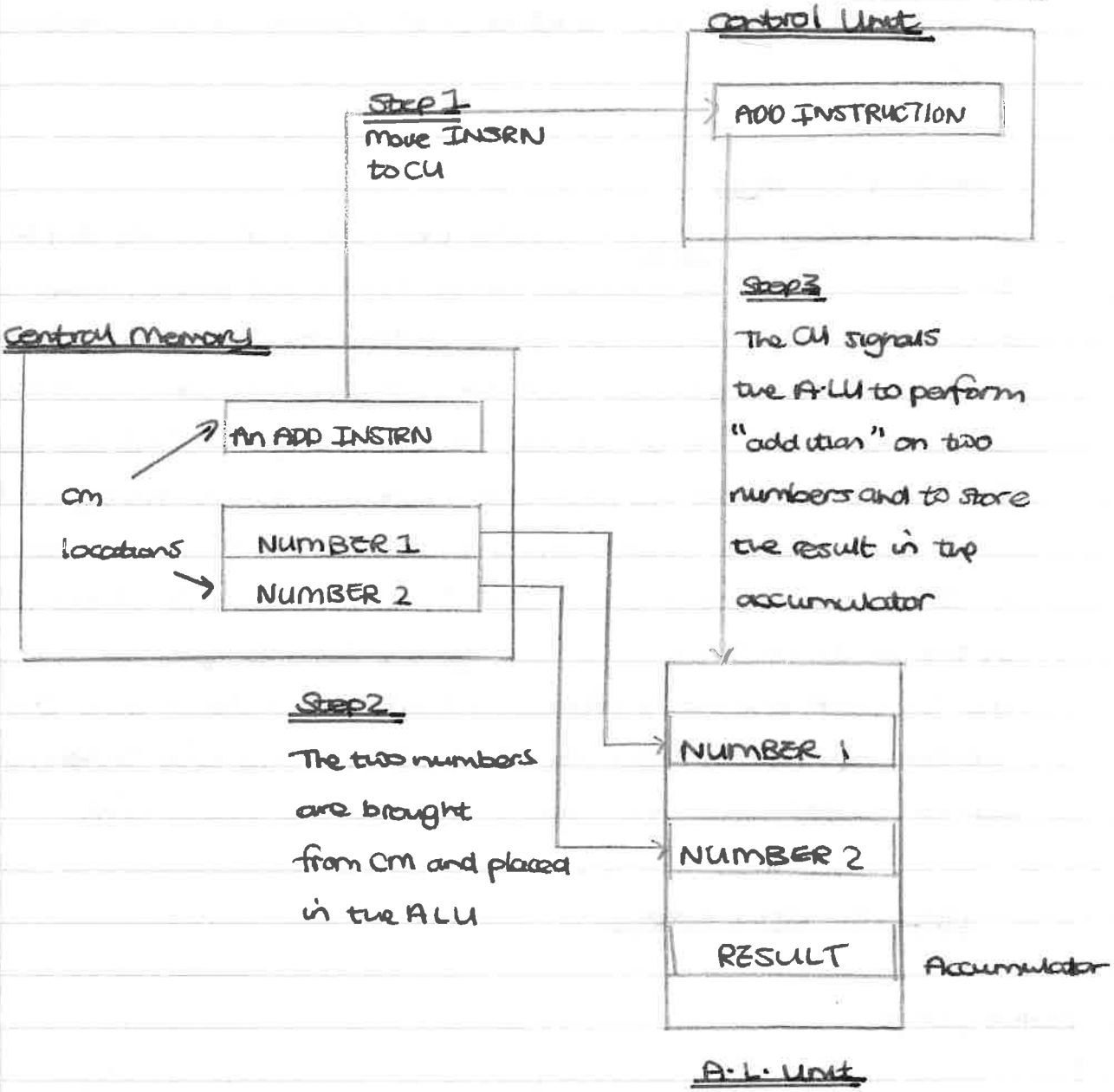
Magnetic Core memory



Fetch-Execute cycle

Refers to the process whereby the control unit must first fetch an instruction from the main memory before it can execute it

Three steps involved in the execution of an instruction by the CU



The fetch-execute cycle

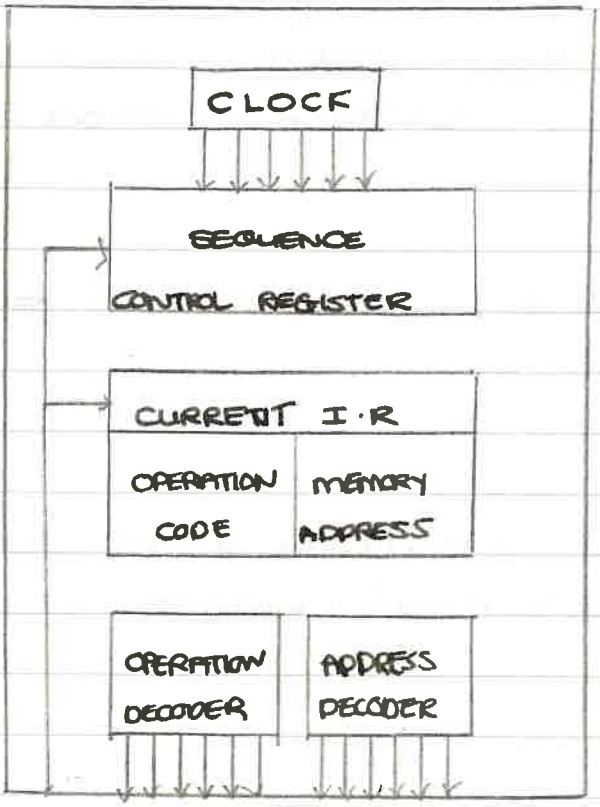
During the fetch phase an instruction is fetched from the main memory. Next the instruction is decoded by logic circuits to find out what sort of instruction it is. Finally during the execute phase the appropriate action is taken e.g a number might be loaded into the accumulator. The cycle fetch-decode-execute is then repeated for the next instruction in a sequential fashion

Andreas Vurnuls 4P1

12/20

1983 Paper II Section B Q11

Below is an example of a computer control unit.



a) Explain the function of each of the sections in the diagram (14 marks)

b) Explain what happens at each of the two important steps of the instruction cycle: fetch, execute. (6 marks)

a) CLOCK - The clock in the control unit is to time the feton-execute cycle and make sure that everything is done at the same speed and timing might be needed during the program e.g reaction timer
It controls, the movement of bits in the memory as and timers as well.

SEQUENCE CONTROL REGISTER - this checks to see that everything is done in the correct sequence. i.e. Starting at location 101, then after the contents of memory location 101 have been obeyed the contents of location 102 will be obeyed, then 103, 104 etc
The numbers are entered into the Sequence control register just before the contents of the location are obeyed ~~and~~. It contains the address of the next instruction to be executed.

1

2

CURRENT INSTRUCTION REGISTER:

~~Each instruction is read from the central memory into the Instruction Register~~ The Instruction Register contains the location of the next instruction expected. The current Instruction Register contains the number of the instruction being ~~at~~ executed at the moment. This plays a part in the fetch-execute cycle. It also contains the instruction itself 2

Operation Code

This is part of a machine code instruction ~~specify~~ specifying the operation to be performed

Memory Address 3

This is the part of the machine code instruction which supplies the address of the data in main memory for the operation code to work upon.

Operation Decoder

This decodes the operation code for it to be executed 2

Address Decoder

This decodes the part of the machine code instruction known as the memory address, ready for it to be executed.

b) FETCH

In the fetch part of the cycle, the control unit fetchs the instruction from the main memory, so that it can be interpreted by the operation decoder. 2

EXECUTE

In this part of the cycle the intruction is interpreted and is then executed (performed)

Errors

Syntax / mis punching errors

These are caused by mis-typing, or misconstruction of a BASIC statement e.g

LAT A+B+C= X which should be

LET X=A+B+C

These errors are detected during the compiling stage. They are called Compiler Diagnostics and help the programmer trace the mistakes

Execution time errors

These are errors detected whilst the program is running such as "Invalid Input" or "Number too large" or "Number too small". There are also logic errors such as GOTOing to the wrong part of the program or a line number that doesn't exist. This is systems Diagnostics

Hardware faults causing errors

Sometimes hardware faults can cause errors, such as loose connections, or the read/write head being incorrectly placed, or mis-reading the information. This is also systems diagnostics.

Data preparation Staff

There are many people involved in data preparation. If a computer uses punched-cards, then the job will involve operating a card punch, and also copy typing. The information typed often makes no sense to the typist.

Today, they are more likely to use a keyboard and a VDU, or a key to disk machine. There may be 50 or more staff, all very good typists, in a large computer installation. Some will be verifying the data typed in by others.

Several other jobs are also necessary, ie somebody to gather the data, and see if special requests have to be taken into account. Some large departments may employ a librarian to look after output. A data preparation supervisors will be in charge, and responsible for the whole operation.

It is not necessary for these people to have a knowledge of computers, they are employed to type information, not understand it.

Computer Operator

A computer operator is responsible for the smooth and efficient running of the computer system. eg to make sure the correct tape or disk is loaded, that the printer doesn't run out of paper. The operator will run under the guidance of a schedule of jobs to be done. It may be that a company wants to keep the computer running day and night, so computer operators may have to agree to undertake shift work.

In a large installation there may be several operators under a chief operator. It is not necessary for these people to have a detailed knowledge, but an "O" or "A" level standard education, together with special training and an interest in computers is usually required

Computer Programmer

There are several levels at which programmers operate. The is a team who code the ideas of the systems analyst, so that they will work on a particular computer system. A chief programmer controls the team and sort out any problems that may arise. Programmers are usually educated to

"A" level or beyond, and have a detailed knowledge of computer languages. It is also possible to join a team and learn on the job.

Computer manager

It is the computer managers responsibility to make sure all the analysts programmers, operators etc operate as an efficient computer system. Although he would be very experienced in computing, he is not allowed to get too deeply involved with any of the teams. He sorts out problems of the financial nature, e.g allocation of finances, future policy etc. The computer manager would be one of the senior managers in any enterprise.

Technical Support

A large number of people are required on the engineering side to build and service machines.

Research Engineers

A person posessing high academic qualifications and knowledge of computer systems. He must invent new ideas and put them to practice. They are usually only employed by computer manufacturers or universities. They work on projects which may not be implemented for more than 20 years.

Design and Developement engineers

Once an idea has been brought of, these people try to put it into practice. They build prototypes to confirm the idea will work. If it works then they will assemble and test the final machines.

Commissioning engineers

Commissioning is the name given to installing a computer at a customers site, and these people check the installation to make sure it works alright.

Maintenance engineer.

If the computer developes a fault, then the maintenance engineer identifies and corrects the fault as soon as possible

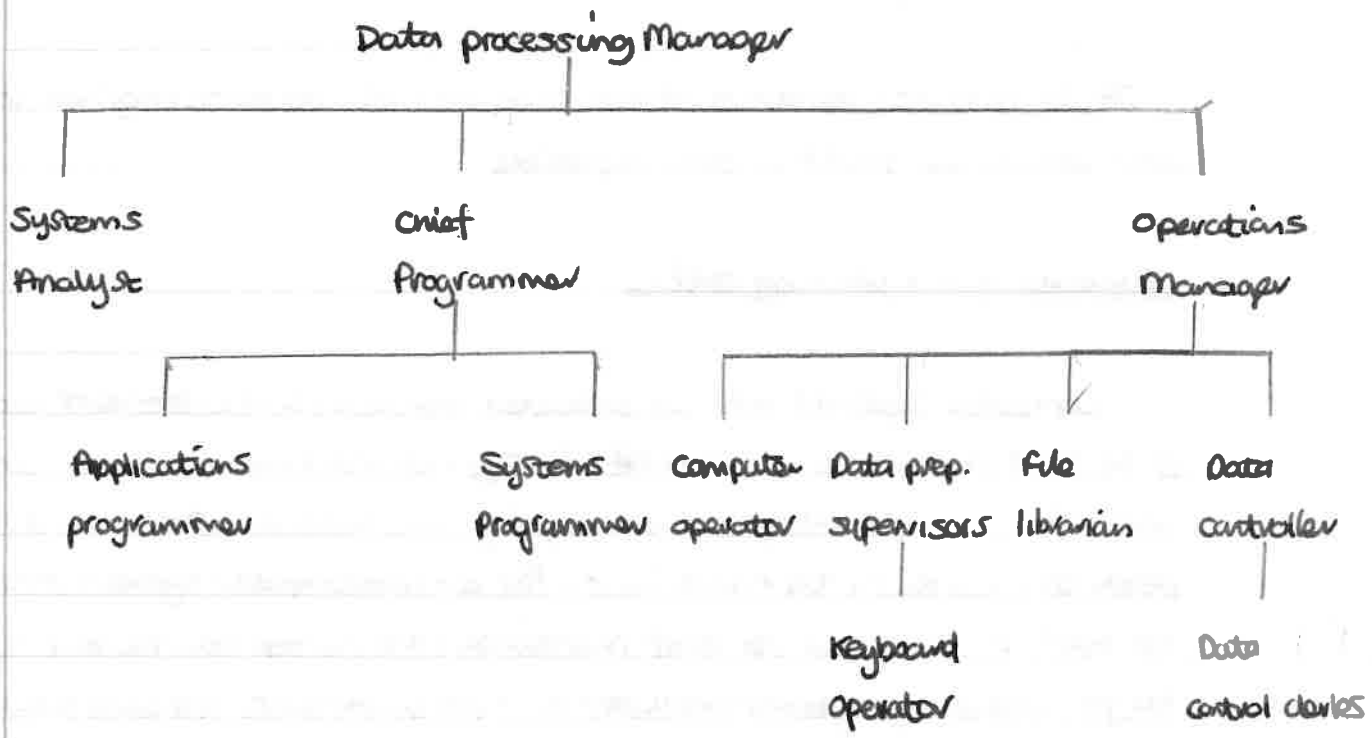
Education and training staff.

Computer systems are complicated devices, and customers need training if the system is to be operated efficiently - Courses are wide ranging, and vary from simple software to developing complicated systems and training people to maintain the machines. For a microcomputer system, there is no need to have all the staff mentioned, one person can be employed to do the job, including systems analysts and programmers, and also training other people to use the micro.

Systems analysis:

Much work over many months has to be done to find out if a computer data processing system would be useful. This is called systems analysis and is done under the control of a systems analyst. The work covers everything from the conception of the idea to the final installation.

Firstly you have to decide whether a new system is to be installed, or whether a manual system is in operation already. If so, how does it work, could efficiency be improved. Much discussion usually takes place, and an initial report is produced, called a feasability study.


Data processing Manager
Systems Analyst
Chief Programmer
Operations Manager
Applications programmer
Systems Programmer
Computer operator
Data prep. supervisors
File librarian
Data controller
Keyboard Operator
Data control clerks

Software

If the computer user is to communicate with the computer and the computer with the user they must use the same language. Computers use electrical signals to process information and humans use speech. Computers, however, cannot understand speech as it is too complex for them. Therefore we have to use a language that the computer can understand as well as humans. There are many such languages. The computer language that you already know is called B.A.S.I.C.

Name 3 other computer languages ... PASCAL .....
... COBOL, ALGOL .....

A computer has its own internal language called machine code and before it can execute your program it must be able to interpret your program as a collection of machine code instructions. This is done in one of two ways.

(a) *Interpreter* – This is a machine code program often stored in the R.O.M. which compares a program statement with a list of keywords. e.g. PRINT, GOTO, INPUT etc. The appropriate machine code subroutine is then executed. The process is then repeated for subsequent lines of program.

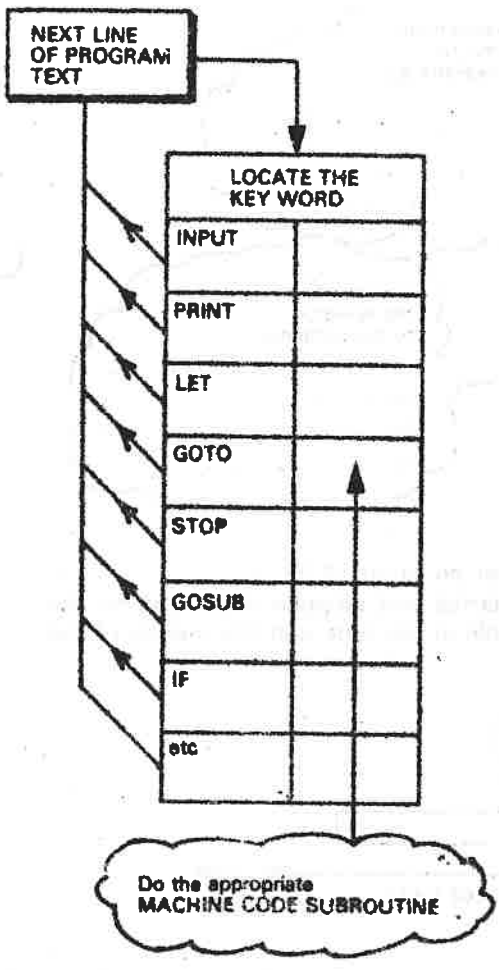
The process of interpretation is very time consuming and results in slow running programs because ..it ....
.. it translates it one line into a time .....

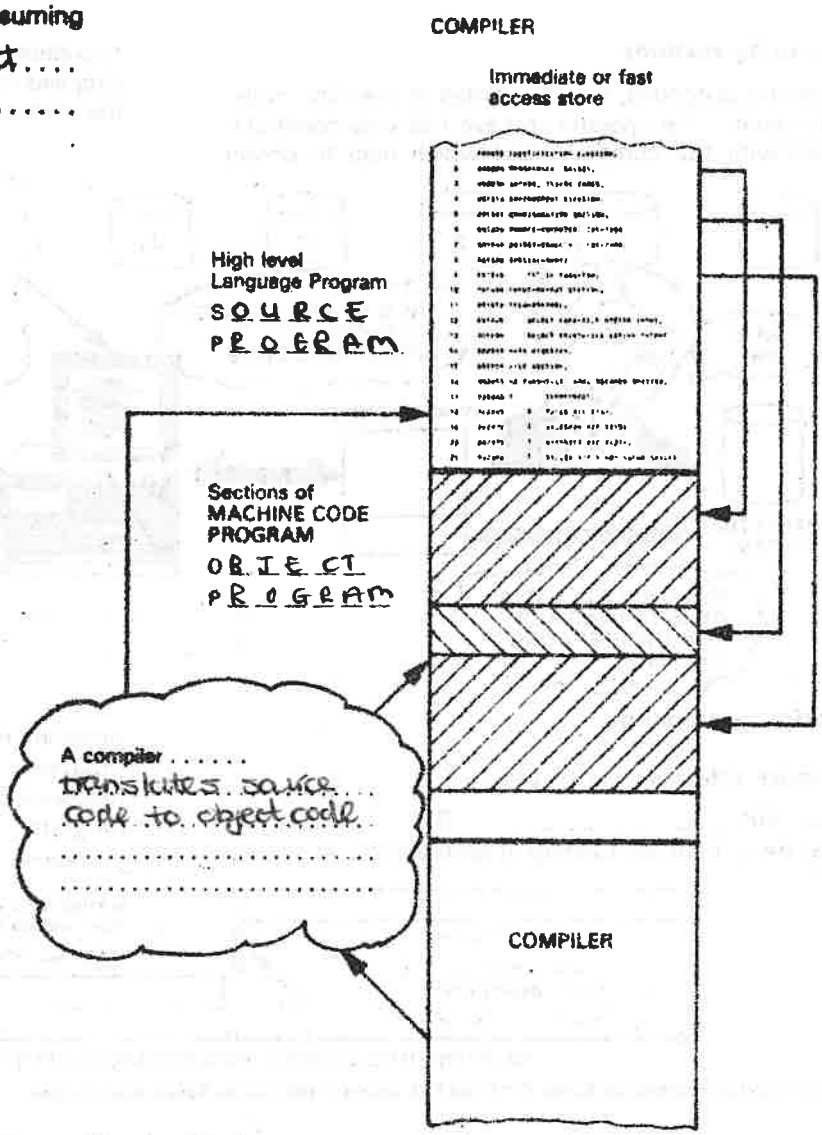
(b) *Compiler* – This is a complex machine code program stored on disk and loaded into the immediate memory when required. It operates in the following way.

The user program referred to as the SOURCE PROGRAM is changed into sections of machine code by the compiler so that a new version of the user program is produced and stored in immediate memory. The new version of the program in machine code is known as the OBJECT PROGRAM. Once the program has been compiled, the source program and compiler can be deleted from immediate memory to create space for the object program at run time.

The advantage of a compiler over an interpreter is that once the object program has been produced, it can run at a speed many times faster than one which has been interpreted.
Give two disadvantages of a compiler over an interpreter.

a) If there are errors it must be re-compiled ..
b) It must be loaded, it takes up memory ....





Software 5.2

Computer languages

There are many different computer languages. These fall into two groups
(a) High level
(b) LOW LEVEL

Complete the names of the high level languages below

BASIC COBOL
ALGOL PASCAL
FORTRAN COMAL

A high level language is one in which a single line of program can represent many tens of machine code instructions. A low level language on the other hand is one in which one line of program corresponds to only one or two machine code instructions.

Name three low level languages

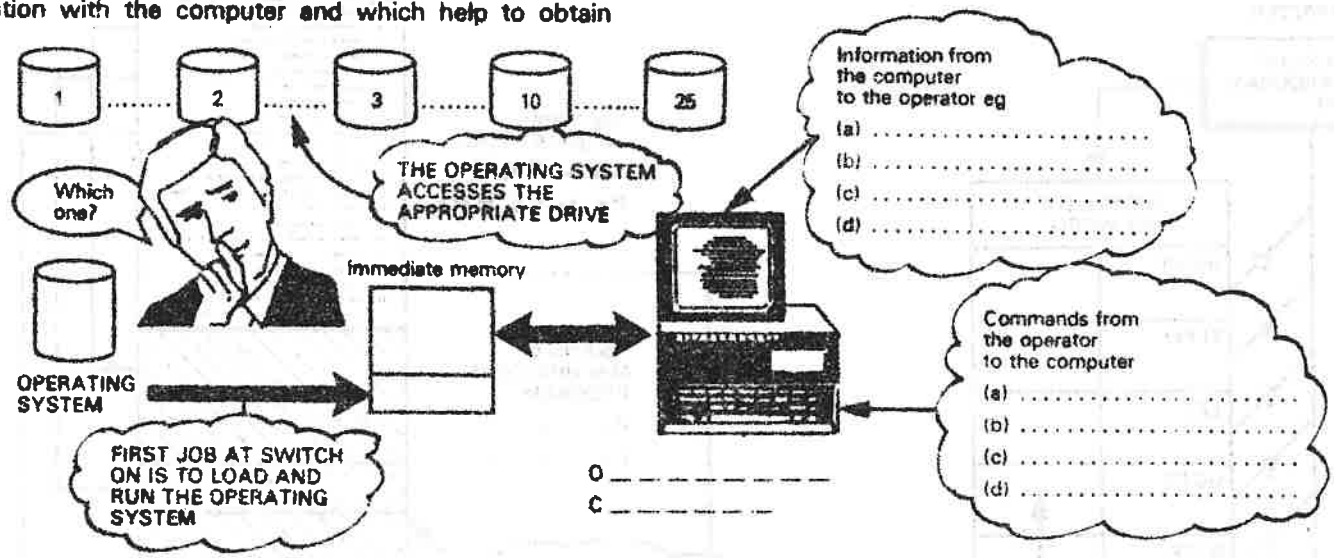
(a) ~~Assembler~~ Sir (b) ~~Machine code~~ cesil (c) plan...

Below is a table summarising the various advantages and disadvantages of high level, low level and machine code languages. Complete the table.

	High level	Low level	Machine code
Advantages	1) Similar to English 2) Easy..to.learn.....	1) Only needs an assembler not a COMPILER 2) Fast, memory efficient	1) very fast..... 2) does not need to be translated
Disadvantages	1) Needs a compiler or interpeter..... 2) Slow, takes memory..	1) Has a large 'instruction set' 2) Is not human..... readable.....	1) Programs contain many instructions 2) very hard to learn..

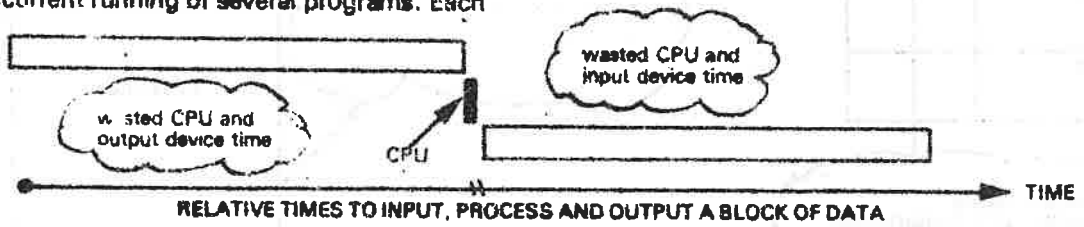
Operating systems

These are programs, usually written in machine code, which enable the operator to have two way communication with the computer and which help to obtain maximum efficiency from the hardware. They are often supplied by the manufacturer and are as important as the hardware.



Multiprogramming

To make effective use of the H _ _ _ _ _ _ _ _ some OP _ _ _ _ _ _ _ _ S _ _ _ _ _ _ _ allow the concurrent running of several programs. Each program is given an order of P _ _ _ _ _ _ _ Y. Programs are started and stopped depending on the hardware available at the time and the priority of the program.



RELATIVE TIMES TO INPUT, PROCESS AND OUTPUT A BLOCK OF DATA

Software and systems

Software

Definition

Computer program designed to aid the user in performing a task. A software package is a set of programs, fully documented, so that anyone not knowing a great deal about computers can still have the benefit of them and and giving all information necessary.

There are two types of software, those used for applications, and the operating system

Application program

Definition

Written by a user for a certain application and stored on some form of media, as opposed to being in ROM as operating systems are. Examples are Educational programs and games

Library programs

A set of programs on a related topic which can be used on their own or together e.g a set of Chemical Equations, engineering, all the mathematical functions available using BASIC

Purpose

Provide ready-written programs, with easy access to information, and also a reliable program without errors

Systems Programs

Definition

Controls the computer system, and improves the operation. It is a program or set of programs

Utility programs

A simple program written to perform one task or set of tasks.

e.g

- operating system
- Compiler software
- Trace program

Operating Systems

Definition

software which controls the overall operations (physical) of the computer.

Purpose

To ensure the smooth running of computer executions until a user program is running. Also to ensure the hardware is used to its full potential.

Functions

1. Controls the selection of input/output media and the operation of them.
2. Control the scheduling, loading, and running of programs.
3. Deals with errors if and when they occur and keep the system running

when present

4. Can communicate with interactive users, on errors, loading etc.

5. Maintains security, checks passwords etc and avoids use of defective equipment.

Processing Systems

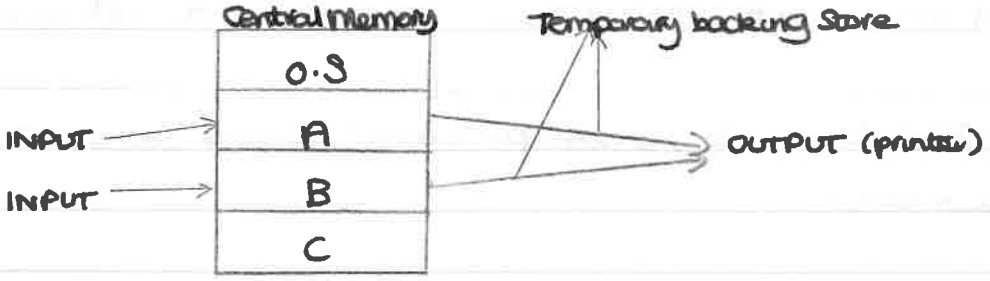
1) Batch processing system (p22 Letts)

Programs are collected and processed continually, in order, in one long computer run. Only one program is processed at a time, but as soon as it has finished the next program is entered and processed. It is a continual process. This is called batch processing, and operating systems that use this mode are called batch operating systems.

2 Multiprogramming (p23 Letts)

One of the problems with a batch operating system is that only one program at a time is being processed. Although only one thing can be processed at any one time, the operating system organises everything so that if more than one program is resident in the memory at the time, the central processing time and power is efficiently shared between all program. If, for example, one program is having information printed out, and a second awaiting input, then a third program could be using the CPU for further processing. Because of the fact that more than one program is in the memory at any one time, such a system is called a multiprogramming system.

Spooling



~~Not~~ If there is a lot of information to be printed out, then this will be stored in a temporary backing store, instead of having to wait to be printed. When the printer is not being used the information is loaded and printed.

Batch Processing

Advantages

1. Work is done by trained computer personnel
2. The user doesn't have to be present while the program is being run.
3. Less expensive than interactive computing.

Disadvantages

1. Slow. only one program in memory at one time.
2. No action can be taken to correct errors until afterwards, when corrected, the program must be submitted again.
3. Too expensive for small scale use.

To cut down the cost, you can take programs to a data processing bureau to be processed for you.

Real-Time Processing

Defn

A real-time system is one which can input data, process it and output the results very quickly without any significant delay. This then means that the output can be used to influence the source and type of input

Example

1. Airline flight booking system
2. Computer controlling a space flight.
3. Any interactive game which requires immediate response from the user via the keyboard.
4. Computer controlled robots in car-factories, which can sense the position of certain objects, and then act on it.

Advantages

1. Very fast response.
2. The input can influence the output

Disadvantages

1. Expensive
2. Very specific applications, can only be used to do one job.

Multi-access Systems

Allows a number of users to appear to use the computer at any one time. There will be many users, each with an on-line terminal. This makes the user think he is the only person using the system. Because so many people have access at one time, this is called a multiaccess system. The operating system is quite complex, to deal with each user as quickly as possible. Because of this it is like "talking" to the computer, and is sometimes known as conversational mode. On larger machines it is possible to have several different programming languages at the same time.

A way of implementing a multiaccess system is by what is called time sharing, with everyone getting a share of the processors time, each share called a time slice. If for example there are 500 users, the processor will be used for each in turn, and after the 500th user it will go back to the first and start again. The response, for a good system, should take no more than one or two seconds, unless the system is being heavily used.

So far, each of the systems we have looked at provide peripheral handlers. These are software routines which control the handling of peripherals, for example disks or printers. Peripheral handlers concentrate on the exact details of how input and output is accomplished.

Interactive processing.

Def:

Interactive computing is a method of computer use where the user and the computer communicate with one another in the form of a conversation. eg using a terminal linked to a time sharing system, using an airline seat booking system (real time) or using a microcomputer via keyboard or screen

Interactive single-user systems

One person having all the attention of the processor, ie a home micro-computer.

Case Study

The Drive you need car company

This is a national network of car hire facilities. They are trying to develope a policy which allows a driver to collect a car at one branch, and return to car to any other branch. Business is booming, but, there is a problem, as each branch is run individually, and so they don't know when to expect a car, or if they will run out

They decided to engage a company of computer consultants to undertake a feasibility study. The first few days were spent doing and analysis of how information is communicated between branches, and it was found out there was no laid down procedure, they relied on telephone calls.

A solution involved the installation of a central computer based in Burmingham, connected to regional computers, these in turn connected to local branches. A driver is employed to ensure that all the cars are evenly distributed throughout the country.

Because of the priority given to people who book ondays in advance, it is necessary that the files be updated immediately, or be some car could get booked twice

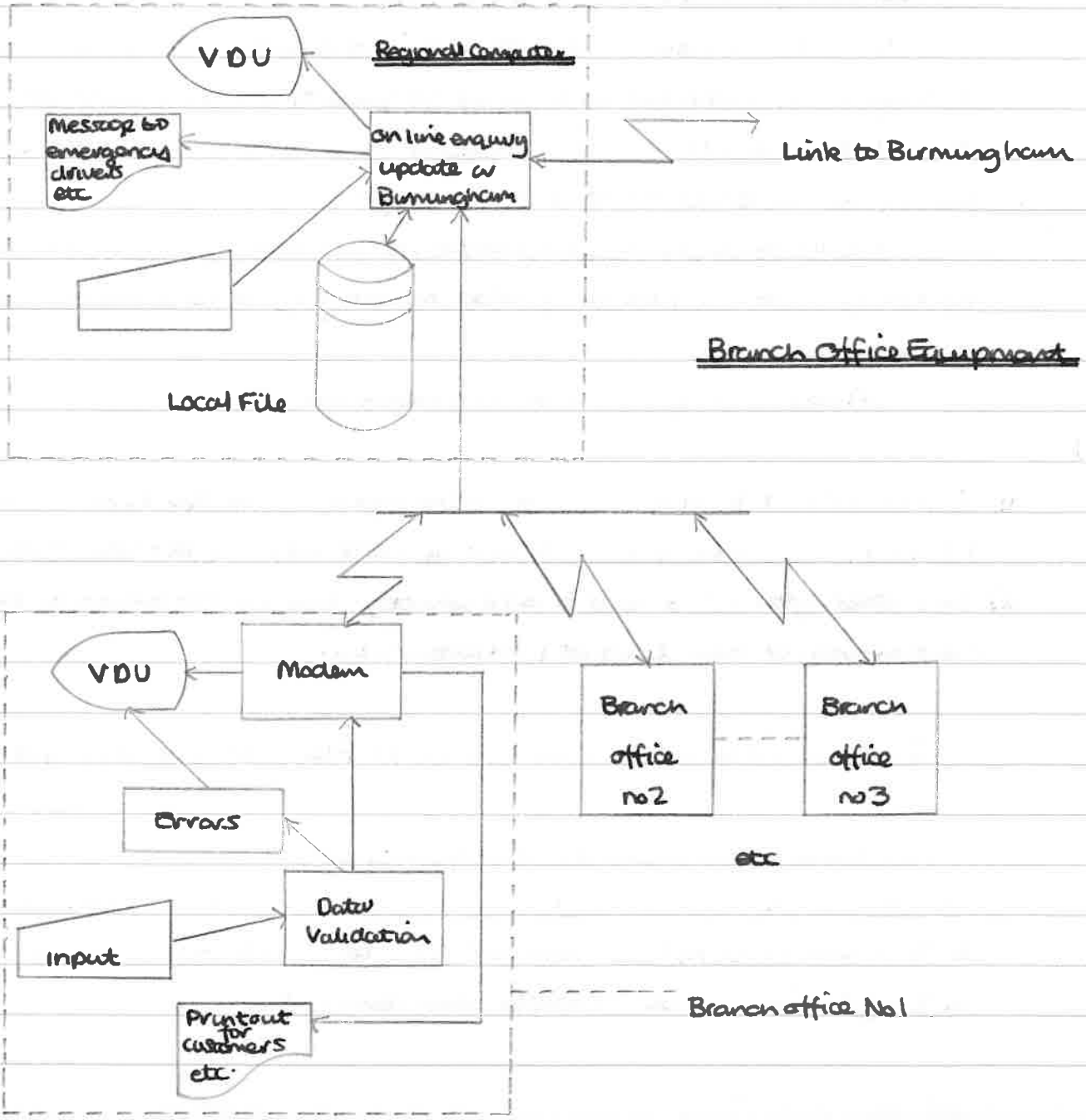
A two-tier system car has therefore evolved

1) Information at local level is kept on the regional computer system, and all the local files can be updated without the needs to reference the master system.
2) The master system only needs to be updated when a car is known to be going out of an area, or when it arrives from another area.

In the second case the local and master-files will have to be updated.

When one branch runs low on a type of car, the computer can check all the branches, to find out which one has got them all, and instruct them to send them back. Also a customer in Brighton could book a car in Aberdeen in 3 days time, and the computer could relay this.

The analyses therefore have to design several independant, but not un-connected systems to design, and one master system to be installed in Burmingham. Besides acting as a Nationwide coordinator, it could also be used to gather information and statistically analyse it, and identify seasonal trends and incorporate this information into future planning of the bussiness. During the nine months it took to install the system, the users at all the branch offices were fully trained. After a modest increase in prices, the computer was paid for in 3 years, and gave the Drive-you-mad Car Company an enviable reputation for reliability. A continental network extension is in the process of being carried out and the Birmingham computer is used to handles the accounts and payroll. Customer relations have never been better and the business has shown a large increase in profit.



Advantages

1. Relatively cheap - can be used in the home.
2. You can use it when you want for as long as you want.
3. Small and portable, and more robust than main-frames.
4. Can be expanded, and use less power - cheap to run

Disadvantages

1. Slow and less versatile - only BASIC language normally
2. Smaller amounts of memory
3. Less powerful peripherals
4. Operating systems cannot be changed - firmware

Multiprocessing

More than one processor linked to the same peripherals.

e.g.

A company which has two processors, one used for important jobs, and one for the less important. The second one could also act as a back-up.

Distributed processing

A network of processors, which comes under a main processor, each terminal being a processor.

Exam Questions

1. January 1984 Preparation Exam Paper II Section A Qu 7

7. For each of the applications given below state whether the method of data processing would be off-line, on-line, real-time, or batch. In each case give a reason for your choice

A. A bank cash dispenser which can also give a report of a current balance in a customers account.

B An examination board system for collecting marks from examiners using mark sense forms.

C. An automatic device in a car which can set and maintain a given speed on a motorway

2. June 1980 Paper II Section A Qu 9

9. Explain the term interactive computing.

3. Section B Qu 13

13 Define each of the following terms and give an example of how they are used in computing:

A Simulation

B Multi-access

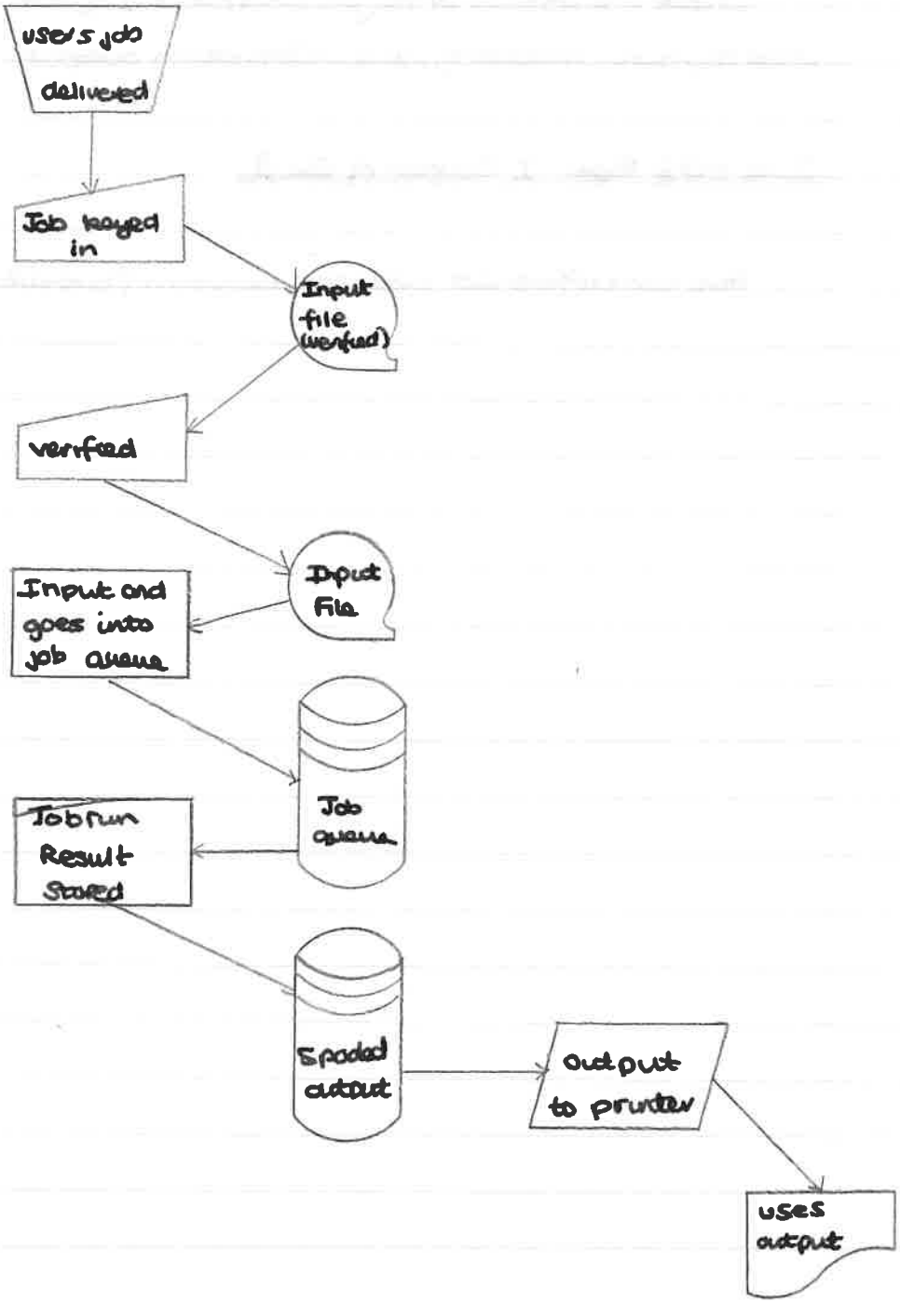
p77 6.1

Systems flowcharts

Manual operation

operation on data

Batch processing system



Exam questions

January 1984 Preparation exam Paper II Section B Qu 13 a)

Each one of the following in their jobs collects and stores data. Choose one and answer the question.

1. Cartoonists
2. Detectives in a murder hunt.
3. Pharmacists in a large hospital.

Choose one aspect of the job and draw a system flowchart to show data capture, processing, and information output.

June 1982 Paper I Section A Qu 8

Give two differences between program flowcharts and systems flowcharts.

14/35.

Exam Questions — Give references to question-years etc

1. A bank cash dispenser

This is real time process. It gets input, processes it, adjusts the balance, and prints output very quickly. ✓ 1

An examination board

This is an off-line process. It is not done under the control of the processor. ✓ Not enough

Cruise control

This is an on-line process. The speed of the car is under the control of the computer. (3) 1

2. Interactive Computing

This is a method of use of a computer, where the user and computer communicate in the form of a conversation eg using a terminal connected to a time-share system, or an airline booking system. (1) Not own words

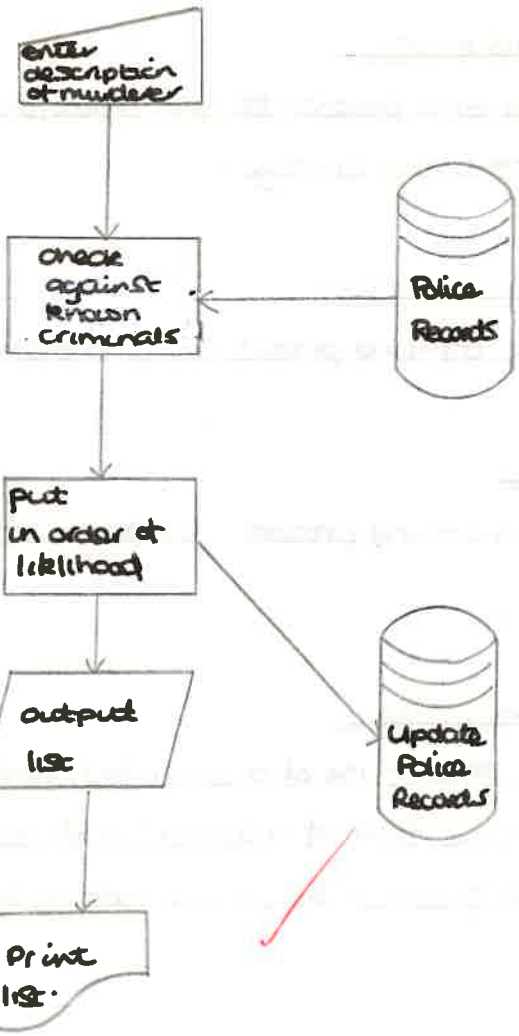
3 Simulation

This is a real-time process. The computer is used to simulate a real-life situation, for training purposes, or as a game on a home micro. eg flight simulation to help train airline pilots in complete safety. The results (output) depend upon what the pilot does to the controls (input), in a lifesize mockup of a cockpit. This saves time and a money in training and saves lives. (2) Not enough for the marks 2

Multi-access

In a multiaccess system, a number of users are allowed to appear to be using the computer at any one time, via terminals. Each user is dealt with as quickly as possible, like being able to "talk" to the computer. An example of this is time-sharing, every user is given a slice of the processors time called a time-slice (2)

4. A system flowchart for a detective in a murder house.



5

(5)

5. Two differences between system flowcharts and program flowcharts are.

1) A large number of specialised symbols are used in a system flowchart.

(1) 1 + program

2) A program flowchart is more logical than a system flowchart.

not necessarily

(see Unit 14.1). The following system flowchart is a simplified version of the computerized system used:

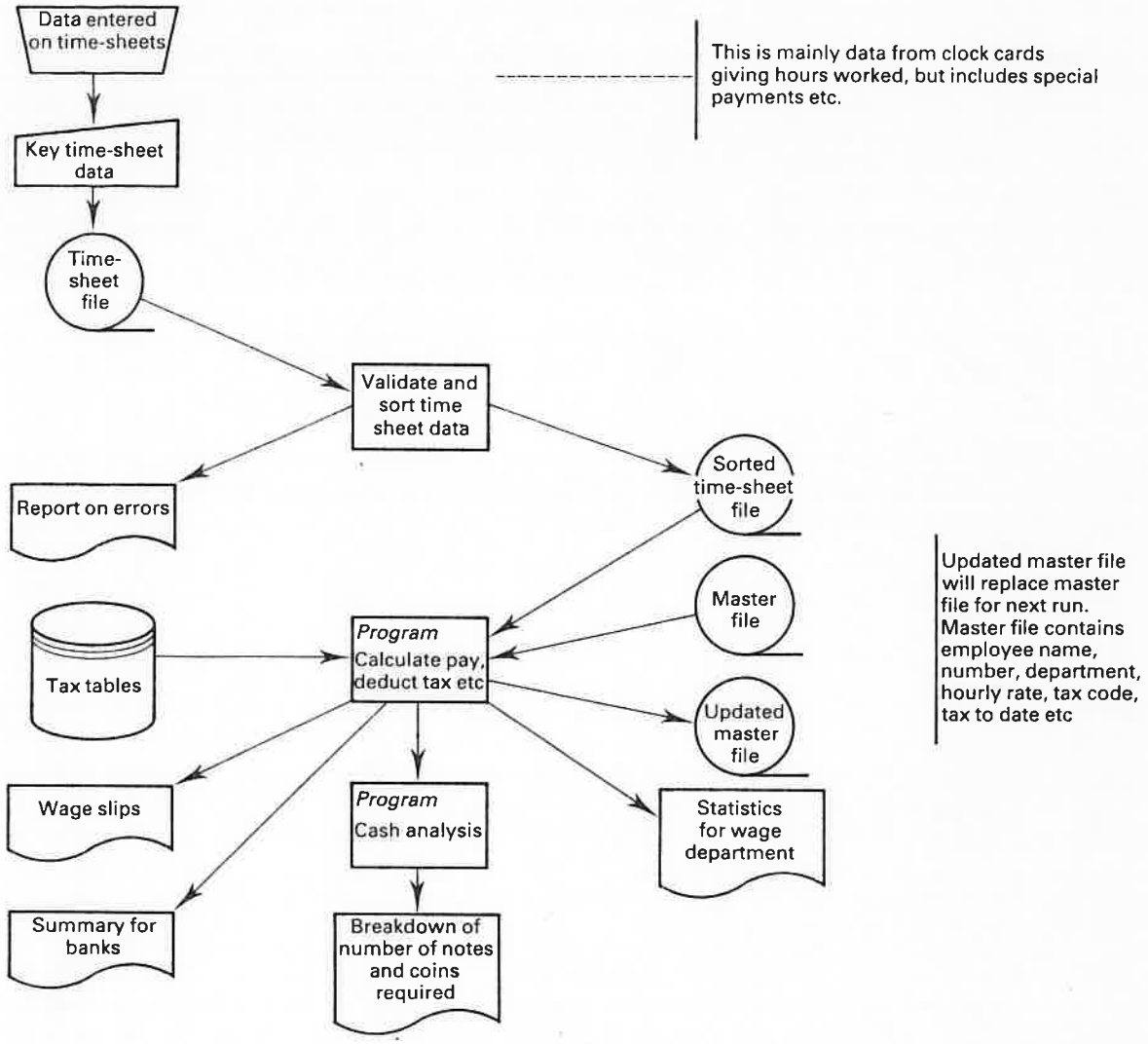


Fig. 10.2 System flowchart for a payroll application (see Unit 14)

10.3.3 Program flowcharts

A **program flowchart** is a flowchart showing the sequence of operations performed by a computer program.

A **block diagram** consists of rectangular boxes containing messages and with lines connecting them. A **block flowchart** of a program shows only its main procedures.

An **outline program flowchart** shows the general operations carried out by a program. It should show:

(*i*) all input and output operations,
(*ii*) how each type of data is processed,
(*iii*) the main modules of the program,
(*iv*) where execution of the program starts and stops.

A **detailed program flowchart** shows all operations carried out by a computer program. It should:

(*i*) be sufficiently detailed to enable a program to be written directly from it,
(*ii*) avoid language which is too directed towards a particular computer or a particular programming language.

An **algorithm** is a series of instructions or procedural steps for the solution of a specific problem. A program flowchart is an example of a flowchart which represents an algorithm. Flowcharts of algorithms have been used throughout this book e.g. Fig. 3.2.

Fig. 10.2 Structure of a typical application program [1]

p 57 Letts

Selection Sort

The computer sorts through the list of numbers, and selects the lowest number or character, and puts it to the front of a list. This process is then repeated to find the second, third, fourth lowest number etc. until the list is in numerical of alphabetical order.

e.g 3, 1, 2,
↑
lowest

132 - second lowest no

Final list 1,2,3 in ~~numerical~~ numerical order.

p 38 Letts

Bubble sort.

1983 - January Paper I Section B Qu 10.

With the aid of diagrams explain how the following numbers would be sorted into ascending order using a systematic method such as a bubble sort.

87, 73, 5, 12.

Algorithm

1. Read numbers
2. Sort numbers
3. Print results

1st Refinement -

1. Read 4 numbers
2. Sort numbers into ascending order.
3. Print numbers in ascending order.

2nd Refinement

1.1 Reserve memory space for variables.

1.2 Start loop.

1.3 Read in four numbers.

1.4 Finish loop.

2.1 Compare numbers in pairs.

2.2 If the first number is bigger than the second, then swap them.

2.3 Repeat until the numbers are in order

3.1 Print numbers in order: 5, 12, 73, 87.