USES FOR
COMPUTER TECHNOLOGY

POLYCORP

New Zealand Limited

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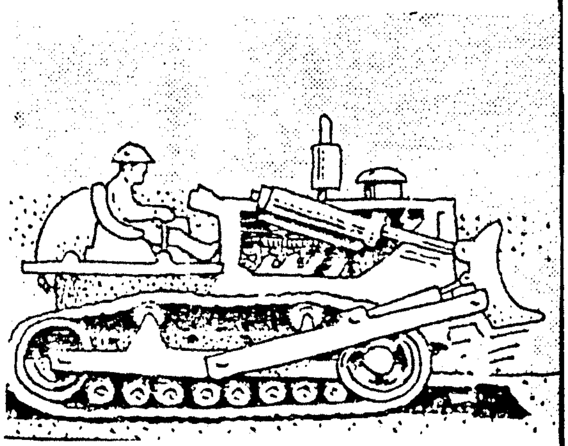
INTRODUCTION

1.1 The Mind Machine

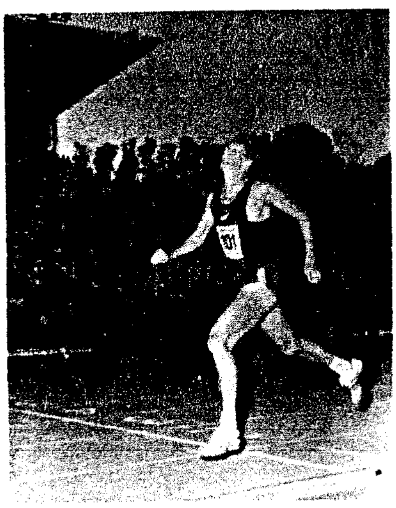
Machines help people do jobs that otherwise would be difficult and time-consuming. Machines are tools that add power to people's senses and do jobs that otherwise would need lots of muscle.



How long would it take the men to do the job the bulldozer is doing?

Machines help our senses and muscles.

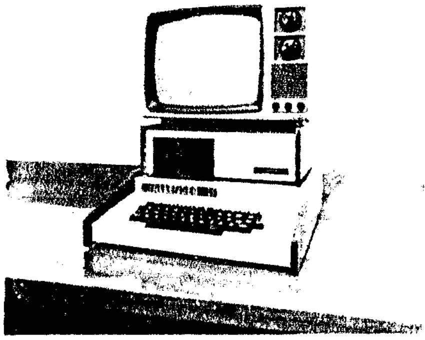
People have not lost any physical ability because machines are doing the tasks that in the past involved labour and drudgery. People can still see, hear, and smell. They have not lost the use of their arms, legs, or muscles. Often senses and muscles are used in different ways - more exciting and challenging ways. Sports men and women today achieve feats, undreamed of just a few years ago.



John Walker is one of many athletes who run times that would have amazed people just 20 years ago.

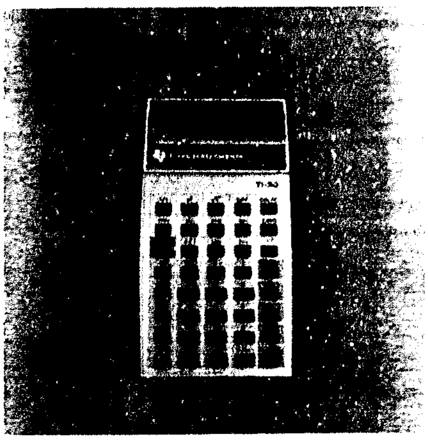
Have machines made our muscles lazy? Were people in the past fitter and healthier?

The computer is a machine. It is a tool which extends people's minds. It can do many routine tasks that our brains might do. The bulldozer seems very efficient compared with the man with the pick and shovel. The computer too, for some jobs, can seem very efficient compared with the thinking a person can do. The bulldozer can do nothing people cannot do with their muscles. The computer can do nothing people cannot do with their brains - given time.



Why is the computer called a "mind machine?"

A fear that some people have is that machines that help our minds will make our brains lazy and human beings will lose some of their intelligence.

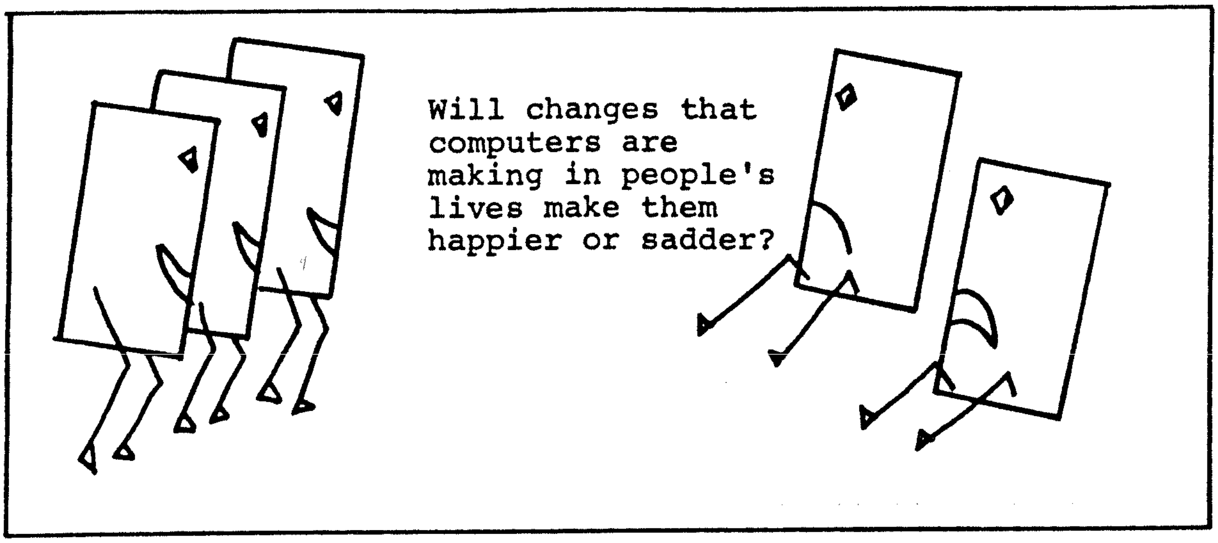


Will using a calculator make our brains lazy with arithmetic?

In the past, when manpower was used for machine power, for the majority of people life was one of drudgery. Many people, scared by the modern world, look back and think that life in so-called simpler times must have been better. In reality life for most people was short, dirty, diseased, often involving hunger and complicated by fears and superstitions.

The types of job that computers can do best are, for most people, routine and boring. In the same way as machines have taken the drudgery out of labour, with computers there is the possibility of healthier and fitter minds. Machines which extend the mind can allow people to have a greater variety of life's creative experiences and to use their minds in more meaningful ways.

This course is designed to show you some of the mind-saving tasks computers can do. It will suggest ways life might become more interesting and challenging. Such a positive future is only possible if people make the right choices about how their lives and their society are to develop. You will have the chance to discuss both the good and the bad possibilities.



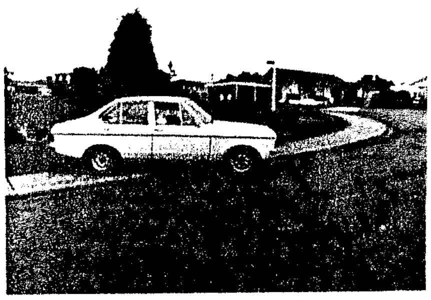
1.2 People and Machines

It is human nature to be scared of unknown situations. Some people just cannot climb a cliff face, others cannot go potholing. Often, once a fearful situation has been successfully overcome a few times and confidence grows, the fear is lost.

Are there activities that scare you?

How have you overcome your fear?

When learning to drive a car there can be many embarrassing moments. As experience develops, the use of the various pedals and levers becomes a reflex action.



How would you feel if you were this driver?

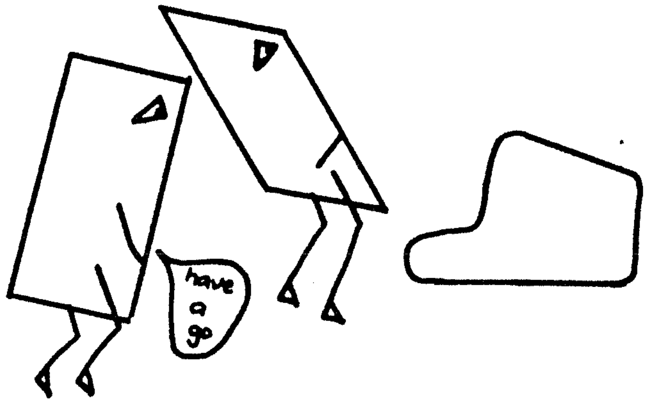
Are you ever embarrassed when you do something new?

Many people are scared of computers. They may have a fear of machines in the same way as some people are scared of cliff faces or pot holes. Some people are embarrassed when computers are mentioned because they don't know how to use them. A common excuse people make for doing nothing is:

"You can't teach an old dog new tricks!"

"I'm too old to learn that sort of thing!"

Other people feel they are not brainy enough and they will never cope with such clever gadgets.



Are you scared of machines?

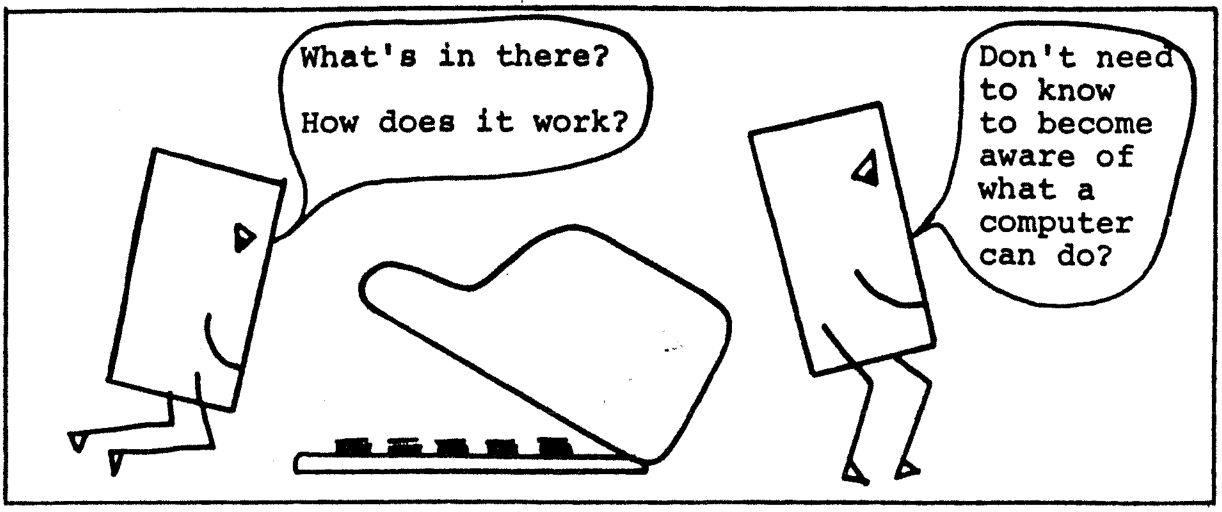
Are you embarrassed to try to use a computer?

Do you think you are too dumb to cope with these clever gadgets?

This course is designed to teach you to use a computer. As your experience and confidence grows you will use the keys and programs without having to deliberately think how; in the same way as the driver of a car uses the pedals. Any mystery about the computer will soon disappear.

It is true you need to have some brains to make a computer, to understand how its innards work, or to train it to do jobs. However, unless you are interested in these things they are unnecessary to enjoying the computer's mind-extending powers. You can drive a car without needing to know how it is made or the mechanics of what is happening under the bonnet.

In this course you will learn a little about how the innards of a computer work and how it is trained. However, your main goal should be to learn how to use the equipment and experience the variety of programs showing you the different types of jobs computers can do.



If you are interested in how a computer works or how it is trained you will need to do a more advanced course after this one is finished.

1.3 Waves of Change

"Things aren't what they used to be!"

You must have heard this cry, particularly from older people. We live in a world that is changing rapidly. Learning how to cope with change is now an important part of life and education.

Computers are adding to the wave of change people must cope with in all aspects of their lives. Many writers call it a revolution. Throughout the course you will meet some of the bigger "breakers" and discuss their effects.

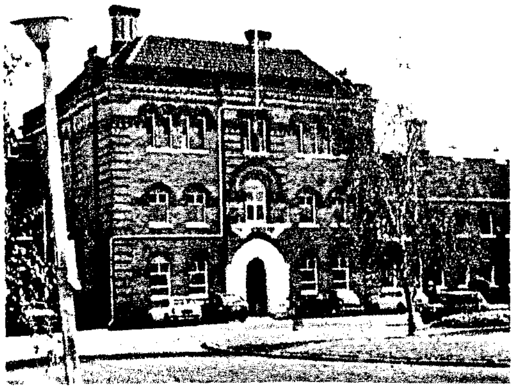
Big waves can change the shape of a beach.

Computers are changing the shape of life.

What changes have you heard that computers are making?

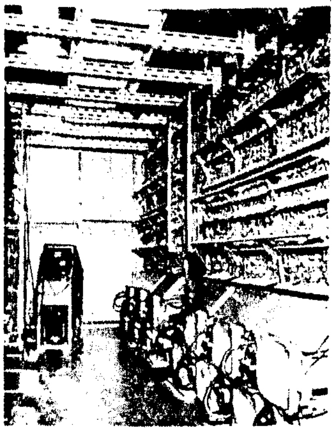
When change is occurring it gives people a choice for the sort of lives and society they will have. To make sensible choices people must understand what they are choosing between.

A main aim of this course is to give you some background in computing so that you are informed enough to understand the impact of computers in your own life and on society. Will you be able to ride the waves of change and help shape the choice of futures - positively?



People who cannot cope with change often become sick or anti-social.

Change can often be best understood in an historical setting. This helps bring understanding as to why and how the change is happening. Change has always occurred in all aspects of life. In our times the rate of change has sped up.



Computer of 1950s

Computer of 1970s

Computer of 1980s

How did computers change over three decades?

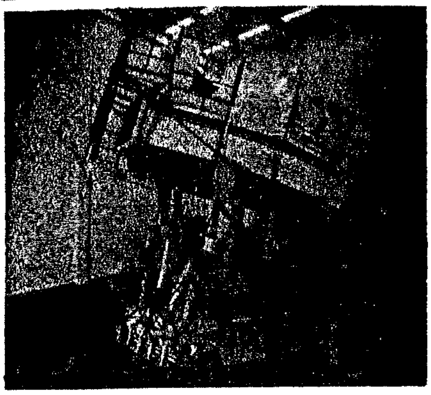
Why did their size and power change?

1.4 Self Check

1. Why is the computer called a mind machine?
2. What fears do some people have about computers and their effect on human minds?
3. Why do some people fear machines?
4. How are computers changing the world?
5. If people don't understand change what are some of the results?
6. How can history help us understand change?

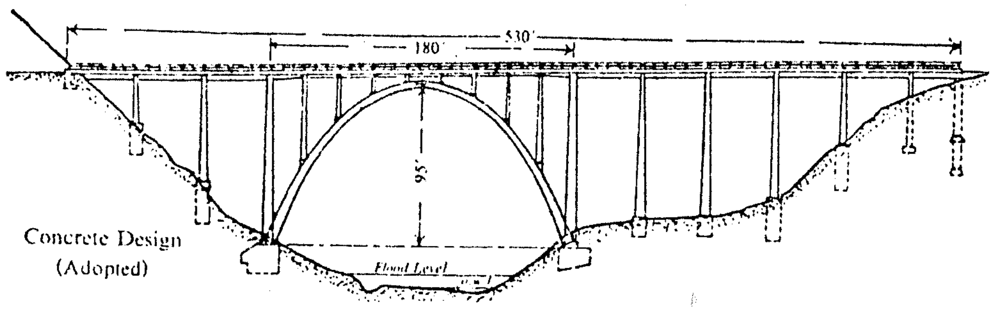
2 USING COMPUTERS TO MODEL REAL WORLD SITUATIONS

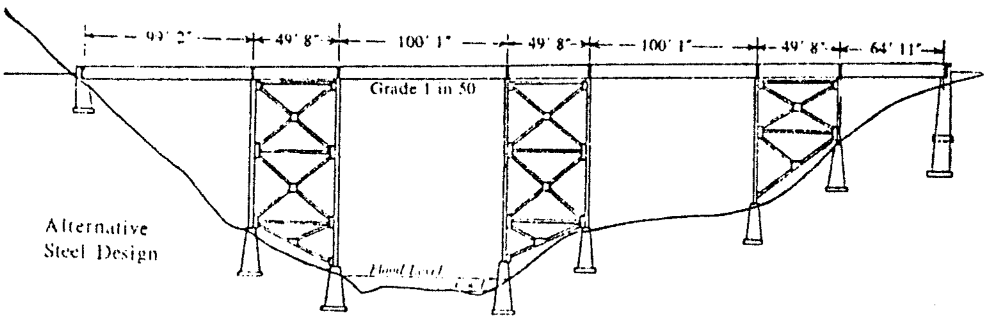
2.1 What is a Model?



In the Air New Zealand flight trainer, pilots can experience all sorts of flying conditions without endangering lives or equipment.

The machine can model all emergency conditions.





Bridge or building model

In engineering, models of planned buildings and bridges are made. The effects of earthquakes and strong winds are tested before construction starts.

Activity

1 How do chemists and doctors model the possible effects of drugs and medicines on human beings?

2 How do politicians assess the possible effects a change of policy will have on voter support?

There is no need to have a laboratory and physical models to conduct many experiments today. They can be simulated on a computer.

2.2 Examples of Computer Models

2.2.1 Traffic Control Model

The traffic flow through an intersection can be modelled:

1 A bird's eye view of the intersection can be drawn on the computer screen with all the correct lane markings

2 The vehicles can be represented by squares and the people by dots

3 The movement of vehicles and pedestrians can be watched on the computer screen

4 The computer will collect and display information about the traffic flow:

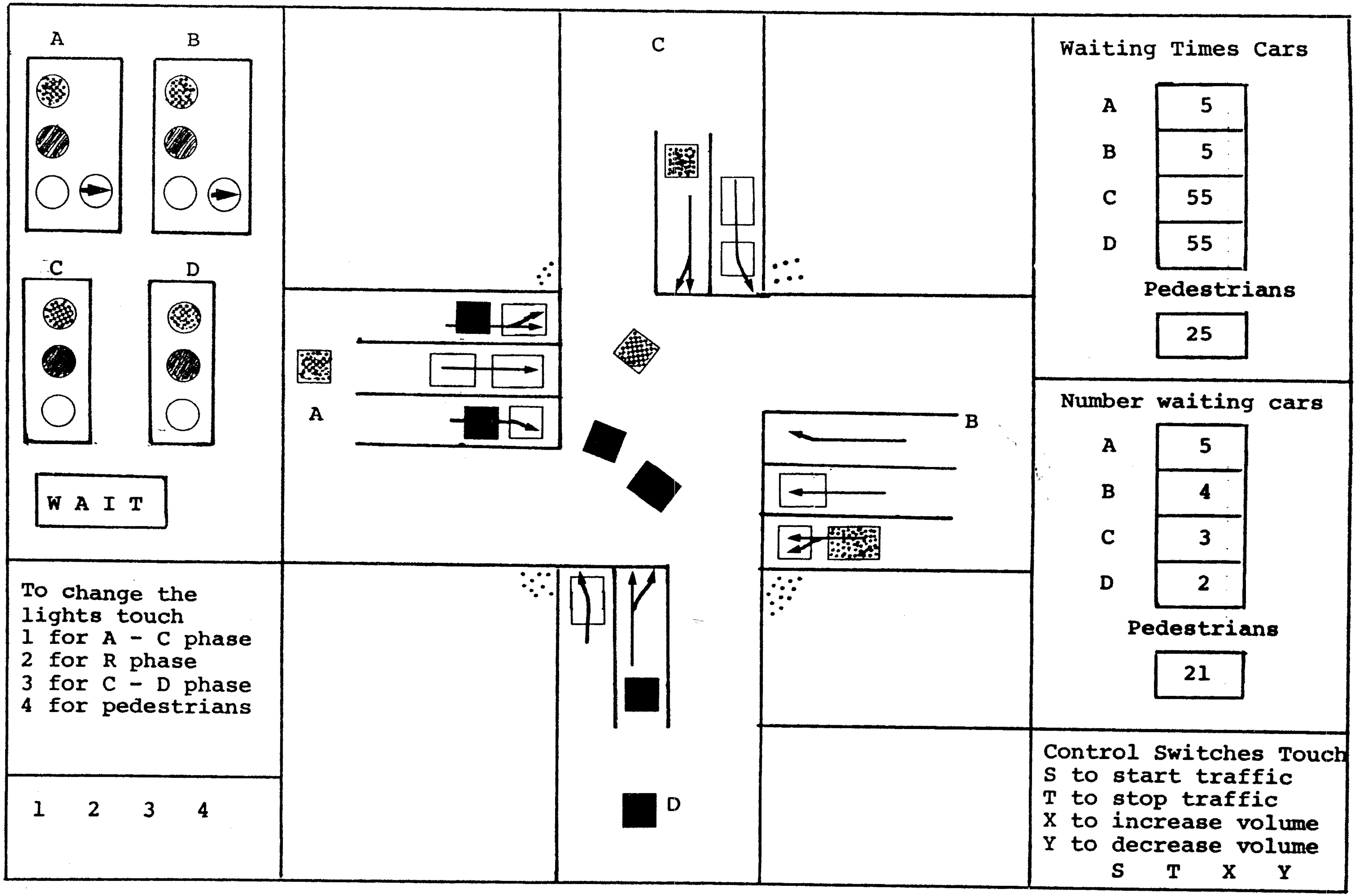
   a The colour showing on each traffic light

   b The number of cars queueing in each direction

   c The times vehicles have had to wait at the lights in each direction.

On the next page is a drawing of what the experimenter might see at one moment.

SAMPLE TRAFFIC CONTROL SCREEN



Here are photographs of the intersection modelled in the drawing of the computer screen.

Lights are on the R phasing.

This allows traffic to make right-hand turns out of the main road.

Pedestrians using the intersection.

The local fire and ambulance stations are within a short distance of the intersection.

These services need a plan for using the intersection at busy times. The computer could be used to model various plans and find the best one.

For the model to be of any use the experimenter must be able to change the variables that make up the model.

Here is a list of the things that can vary at an intersection:

1 The volume of traffic in any direction

2 The number of pedestrians

3 The lanes the traffic chooses to use

4 The road markings

5 The length of time the traffic lights permit traffic to move in any one direction or pedestrians to cross the road.

If the aim of the experiment is to improve traffic flow the experimenter will want to reduce driver frustration by ensuring:

1 Drivers and pedestrians are held up for the shortest possible length of time

2 Queues do not get too long.

Information about some of the variables will have to be collected at the intersection by the experimenter and fed into the computer. The first three items in the variables list are like this.

The volume of traffic reaching the intersection will change depending upon the time of the day and the day of the week. There is nothing the traffic engineer can do to alter these variables.

The experimenter can try out different road markings and traffic light changes. Special situations can be included such as:

1 A traffic accident

2 The movement of an ambulance or fire engine through the intersection.

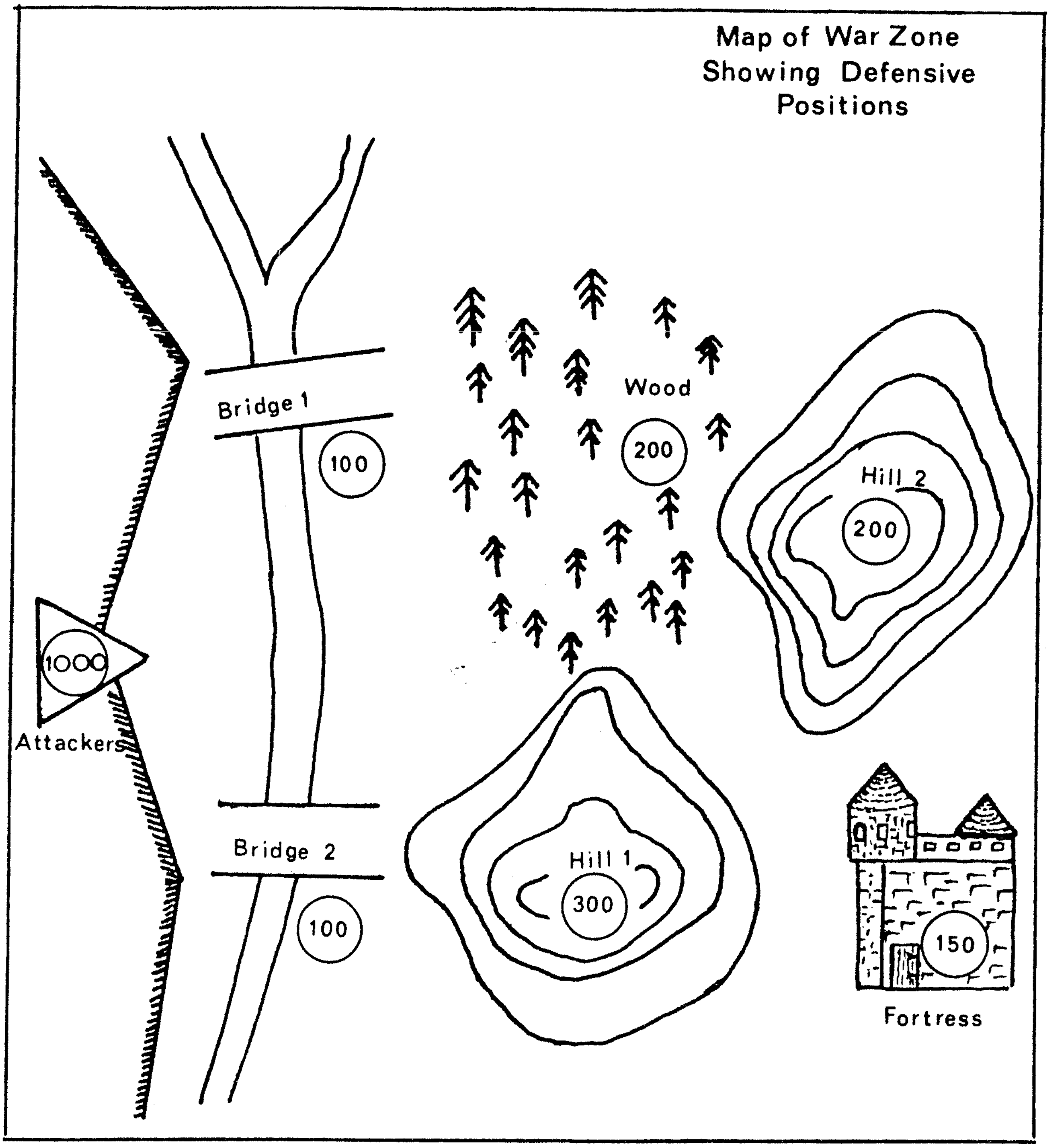
Many people enjoy their leisure time by making and using models of cars, aeroplanes and trains. In the future many people will also enjoy making and playing with computer models.

How many times have you looked at a traffic officer controlling the flow of traffic at an intersection and thought you would like to try doing that too?

2.2.2 War Games

Models are often used to try to find a best plan of action. The Armed Forces carry out war games. They do this to test the readiness of their personnel and equipment for defending New Zealand.

Some people, as a hobby, study past battles and use model soldiers and equipment. They examine the plans the commanders used. They might try to find a plan that Napoleon could have used to win the Battle of Waterloo.

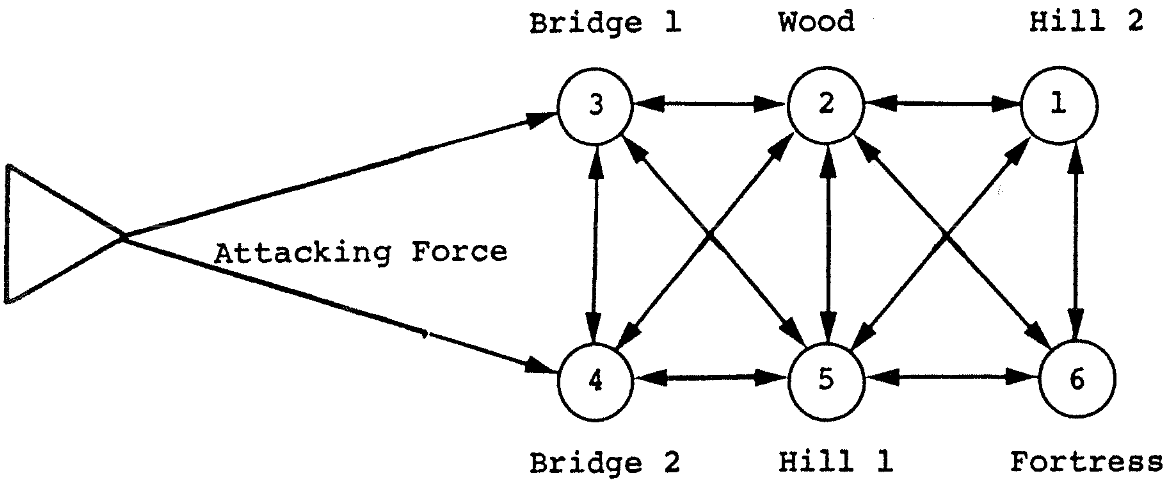


The map shows a plan of a battle field. The commander of the attackers has to decide on the "best" way to capture the fortress. It shows the six positions that are defended. The numbers in the circles are the estimates of defender numbers made by the attacking force's spies. The attacking force is not divided but uses all the soldiers to capture any position.

Here is one possible plan of action. The commander might decide to capture bridge 1, then the wood, and follow up by a direct attack on the fortress. This would leave the defenders on bridge 2, hill 1 and hill 2 to help in the defence of the fortress.

The graph below shows all the possible paths of attack.

Those of you interested in mathematics may like to try and find out how many ways the commander has to choose from.



There are many variables. See if you can pick which ones the attacking commander can control and which he must put up with.

- a How many attackers there are
- b How many defenders there are at each position
- c The losses both attackers and defenders suffer as each position is captured
- d The number of defenders who will leave other defensive positions to assist a place under attack
- e The casualties each commander is prepared to take
- f The number of defending positions attacked and the order in which this is done
- g The number of defenders who escape as each position is captured and then rejoin the fighting at another place.

What is the "best" plan may vary too:

The best plan may be:

1 One that captures the fortress in the minimum amount of time

2 One that loses the least number of attackers.

If all the information is fed into a computer programmed to assess plans, it will work out the best one. Some of the information will be known, some will be obtained by spies, other information will be calculated guess work by the commander - the result of previous experience. All games, like war games, require plans based on information and experience.

Activities

1 In the games that you play, whether it be noughts and crosses, chess or poker, in order to win plans have to be made and followed.

Choose a game that you know and write a paragraph about the best way to play the game.

For example, have you worked out the strategy for noughts and crosses? You should be able to find a way of playing so you never can lose, but must always win or draw.

2 When you play a team sport it is usual to work out a plan to beat the opposition. Your captain is in charge of making the plan work.

Choose a sport you play and briefly describe a plan that your team used to win an important match. How did your captain lead the team to this win?

3 In medicine, body organs such as the heart, lungs and blood system can be modelled on the computer.

Can you suggest useful reasons for doing this?

2.3 The Limitations of Models

A few years ago a group of scientists and economists called "The Club of Rome" published a book called The Limits to Growth. It made newspaper headlines. It predicted the end of the world as we know it, if the world continued to develop as in the previous one hundred years. It suggested four possible disasters:

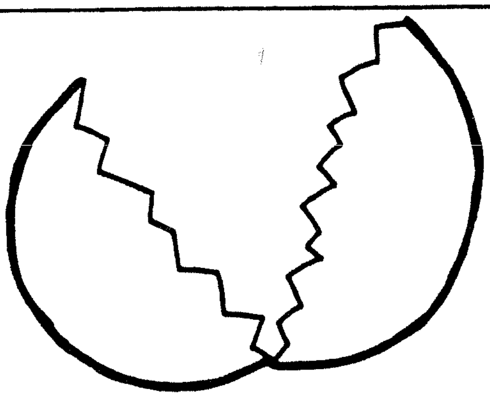
a The world would run out of raw materials

b Over-population would occur

c Food supplies would run out

d Pollution would poison the world

A computer was used to make the model of the world that gave these predictions. Data was fed into the machine about current population growth patterns and resource use.



The Club of Rome's computer model of the world predicted a collapse of civilization as we know it. Resources, population, food and pollution problems would become impossible.

Many scientists argued that the Club of Rome's results were wrong. These scientists used different data and came up with different answers.

When computer models are used it must be remembered:

a They are only as good as the information fed into the machine

Computer people have a word for this:

gigo

It means "garbage in garbage out."

b Real world situations are always very complicated. Often in computer models, variables have to be simplified or ignored. Therefore computer models are used to look for trends rather than exact results.

The Club of Rome's report and the trend it predicted came from data. This data may have been right or wrong. Either way, it was a major factor in producing today's public awareness of many world problems:

a Pollution and environmental problems

b The need for population planning.

Activities

1 Draw cartoons to illustrate:

a Gigo

b Trends.

2 Your school computer library may have a number of games such as chess, draughts and backgammon. If you have played these games with the computer you will have noticed that at times the computer makes silly moves. This is not the computer's fault. It happens because the model of the game the programmer has made has not taken all possible variables into account.

Play some games with the computer and look for some possible moves the programmer has left out.

3 The local city council has decided that the city bus system needs to be improved. Bus routes that suite the public better are to be found:

a Suggest ways a computer model might help

b List variables that would have to be considered

c To keep the model simple can some of the variables be ignored without damaging the model?

2.4 Self Check

1 What is a model or simulation?

2 Why are models useful?

3 How can a computer help with models?

4 What are variables?

5 What are the two main types of variables in a computer model?

6 What examples of computer models do you know about?

7 What are the good and bad aspects of computer modelling?

8 What are the limitations of computer models?

Project Starters

a Choose a model you think would be good to make on the computer.

1 What is your model trying to do?

2 Draw a picture of what you would see on the screen.

3 List the variables that must fit the real situation.

4 List the variables that the modeller can control as the program is run.

5 What are some of the simplifications you have had to make to keep the model simple?

b The city or town you live in probably has a developed plan. Look over the plan.

1 Find out how this plan was prepared.

2 Make a map of your locality showing proposed developments.

c In this unit a model helped you experience one aspect of each of two jobs:

A traffic officer controlling an intersection.

An army commander planning an attack.

Think of one aspect of a job you are interested in and model it.

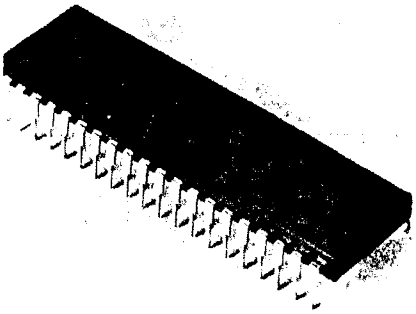
Describe the task you are modelling.

Make a drawing of the computer screen with your model laid out.

What variables would the programmer have to consider when building your model on the computer?

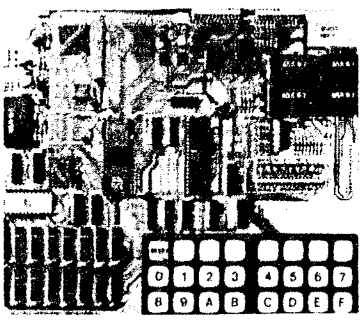
3 COMPUTERS AS CONTROL DEVICES

3.1 Microprocessors

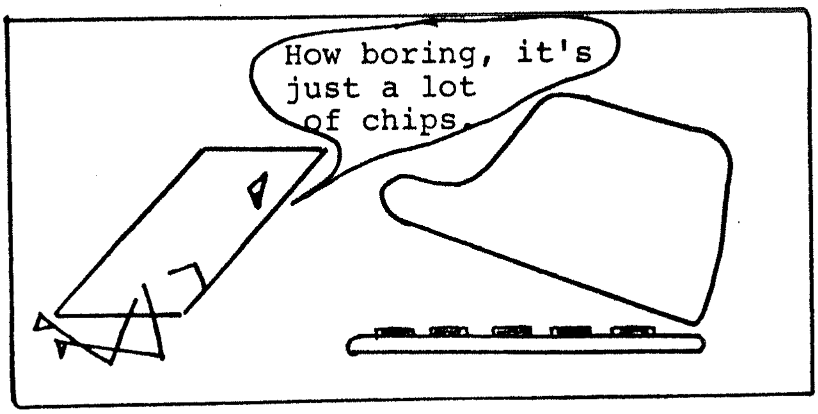


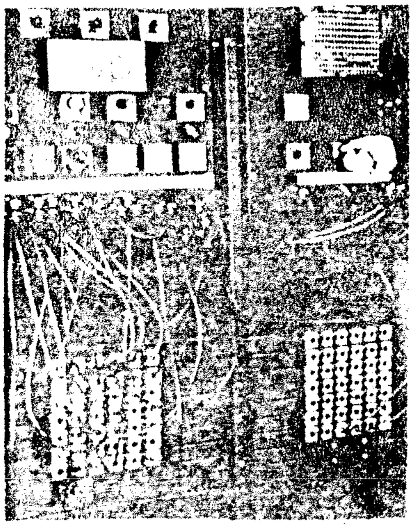
This black box that looks like a caterpillar contains a very tiny part at its centre called a microprocessor or a chip.

The chip is only 5mm by 5mm. It was invented by an engineer, Ted Hoff, in the early 1970s. The chip contains all the logic that makes computers and smart machines work.

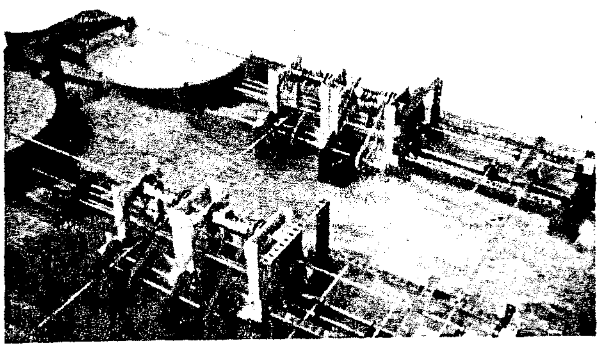


Computers are made out of the black caterpillar boxes in which the chips sit. There are no moving parts or flashing lights. Computers and smart machines work by moving electrons.





Computers built in the 1950s contained masses of wires. In the chip these wires have been miniaturized within the chip. Computers of the 1980s are smaller, use less electricity and are more efficient.



One of New Zealand's first computers being taken to Auckland's Museum of Transport and Technology. The micro-computer your school owns would have cost a fraction of this machine's cost and will do much more.

3.2 Smart Machines

3.2.1 What Makes a Machine Smart?

Microprocessors are increasingly being used inside machines to make them "smart". The chip replaces many of the mechanical parts of the machine. They also add brain power by having the ability to remember, do arithmetic and make simple decisions.

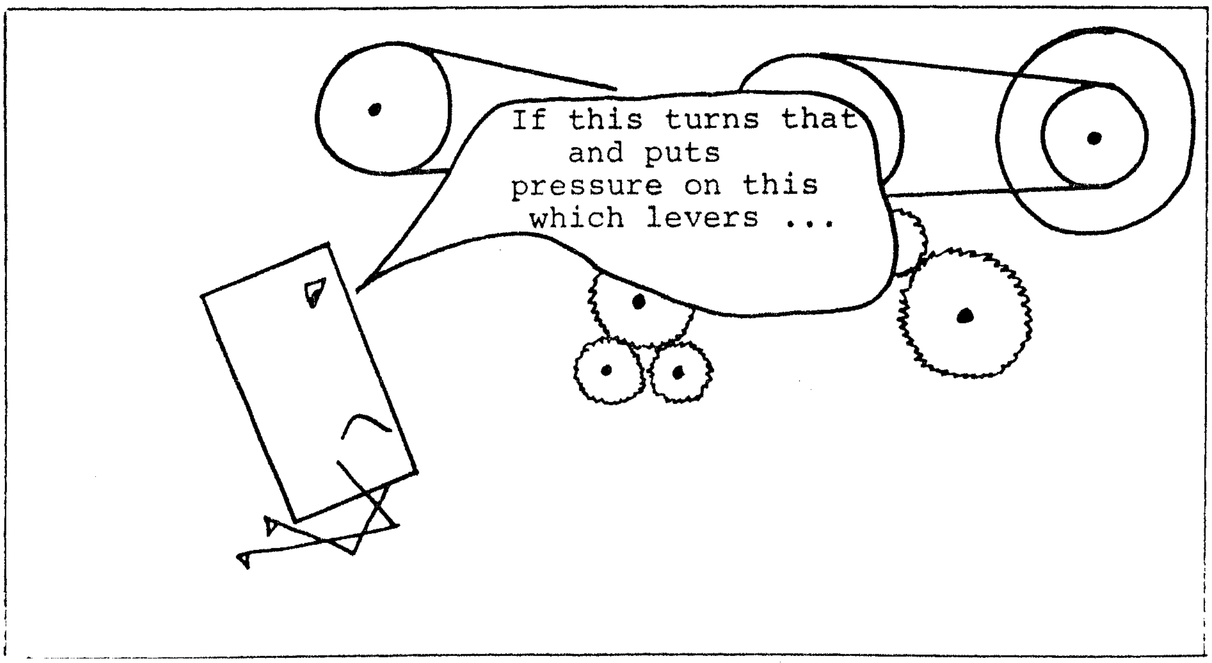
The smart scales at a butcher's shop not only weigh the meat but calculate and display the price.

Many smart watches can be used as calculators as well as time pieces.

Many people are fascinated by Museums of Transport and Technology. Many of the gadgets in museums are operated mechanically, so it is possible to see how and why the movement in the machine develops. The genius of the inventor can be admired.

When microprocessors and electrons control a machine it just seems to do the job it should without any obvious reason.

Machines are being made smart because it is more efficient to move electrons than mechanical parts.



Activities

1 List the smart machines you have seen or used. In each cast write a sentence or two about the smart things the machine does.

2 Choose a household appliance. Write a paragraph describing how it has been improved over the past fifty years. How could it be improved in the future? You could consider:

   a The human labour needed to use the appliance

   b The human thought needed to control the appliance

   c Any effects microprocessors have had or could have.

3 Microprocessors can be used in toys and games to make them smart. Electronic battleships and computer chess are very popular.

   a Think of a game or toy you have enjoyed

   b How could it be made into an electronic game or toy?

   c What makes electronic games and toys fascinating for many people - both children and adults?

   You could answer these questions by drawing pictures or writing paragraphs.

4 Choose a machine that you have seen at a Museum of Transport and Technology that really caught your attention. What was it about the machine that fascinated you?

3.3 Computers Used to Control Other Machines

Electronics engineers can design ways of plugging machines and appliances into a computer. The computer can collect information from the device plugged into it - temperature, time, pressure, colour ... The computer can be trained to assess the information it gets. It can then use a program to control the action of the plugged-in machine.

3.4 Examples of Computer Control

3.4.1 Computer Control of a Tape Recorder

A tape recorder could be linked to the computer.

The computer could be trained to do such tasks as:

a Start the tape at a given time

b Play the tape for a given length of time

c Find a given place on the tape

d Play a given length of tape.

3.4.2 Telephone Control

It is possible to design a system for the home where the computer links and controls the telephone and household appliances. This combination gives rise to many imaginative possibilities. Here are a few:

a When you ring a friend the telephone may be engaged. The computer could ring the number periodically for you and call you when the line is free.

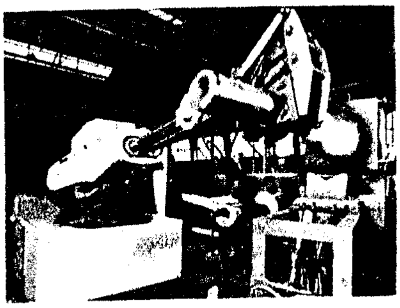
b A family driving home after a few days away could call up the computer and have it turn on the heating and air conditioning.

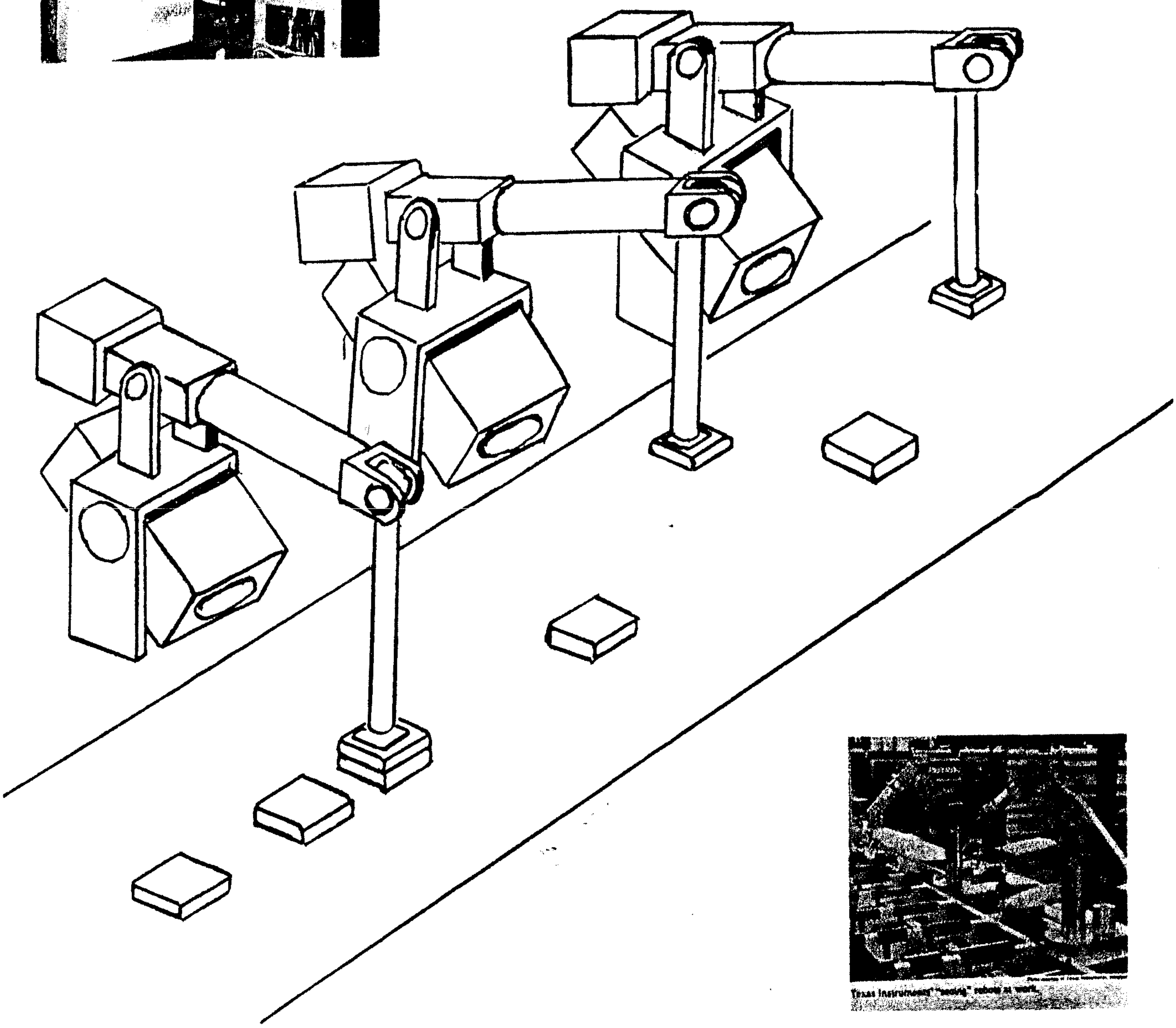
c The house could have burglar alarms attached to the computer which would telephone the police if entry was forced.

d The computer could answer the telephone while you are out and record messages.

e Door locks could be replaced by electronic locks that recognized voices or card keys like bank cards.

3.4.3 Robotic Arm, Eye and Movement





Texas Instruments' "seeing" robots at work.

Model of a conveyor belt with components moving under the eyes of three robotic arms.

The computer via the robotic eye can be trained to recognize components on a conveyor belt by some characteristic such as:

a The shape of the component

b Its colour, or a colour marking on it

c A code number, or marking on it

The computer can be programmed to respond and produce some planned action by the arm on the component. Possible actions are:

a Shift the component from the conveyor belt

b Label the component in some way

c Drill holes or bend some part of it.

<u>Activities</u>

1 Suggest how a computer might be used when the following machines and appliances are plugged in.

a A refrigerator

b A stove

c A television set

d A garden sprinkler system

e A glass house

f A motor car

g A sewing machine

2 Robotic eyes and arms have an important use where conditions are unsafe for human beings. Can you suggest some of these unsafe situations?

3 Many factories are being automated. Smart machines are replacing human workers. What are the special features of factory work that make automation possible and desirable?

3.5 Robots

3.5.1 A Survey of Developments

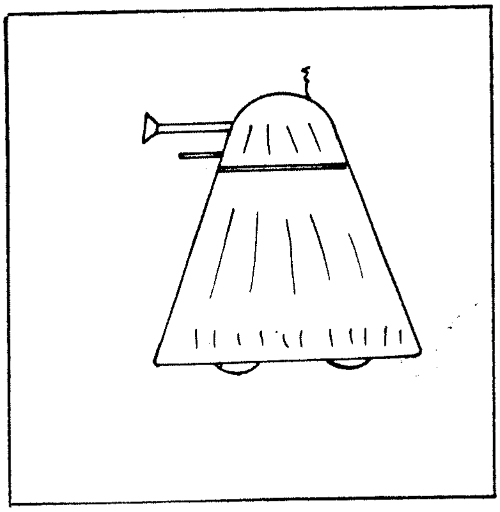
The word robot was first used in a play written in 1920 by Karel Capek. It comes from a Czech expression meaning drudgery. The purpose of the robots in the play was to provide cheap, flexible and undemanding labour, willing and able to work for long hours.

Since 1920 robots have become a common part of Science Fiction work, where they can be programmed for both good and bad purposes. Science Fiction robots usually copy many of the capabilities human beings possess.

1 They see, hear, feel and speak

2 They move

3 They think



K9 in the television program Dr Who is a computer that has senses similar to human beings.

Robots like this are not yet possible. However many scientists are working on the problems involved:

a "Voice" synthesisers

b "Eyes" that recognize colours and shapes

c "Ears" that understand words

d "Intelligence" that can understand English sentences

e "Movement" around a building that is logical.

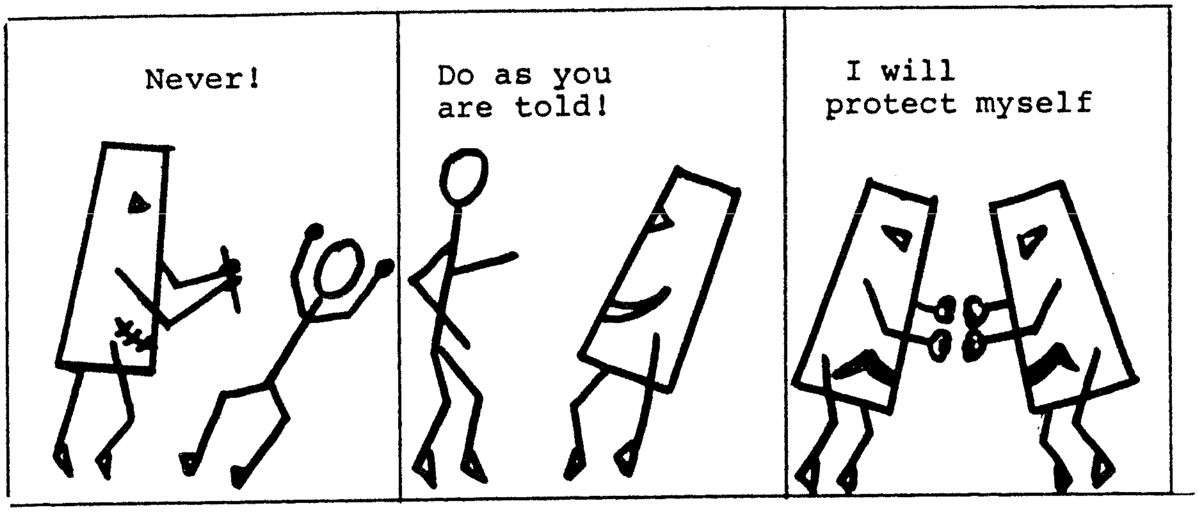
The invention of microprocessors has made a solution to these problems a possibility. Science Fiction type robots may become a reality in the near future.

A scientist and science fiction writer Isaac Asimov, has suggested three laws for controlling robots:

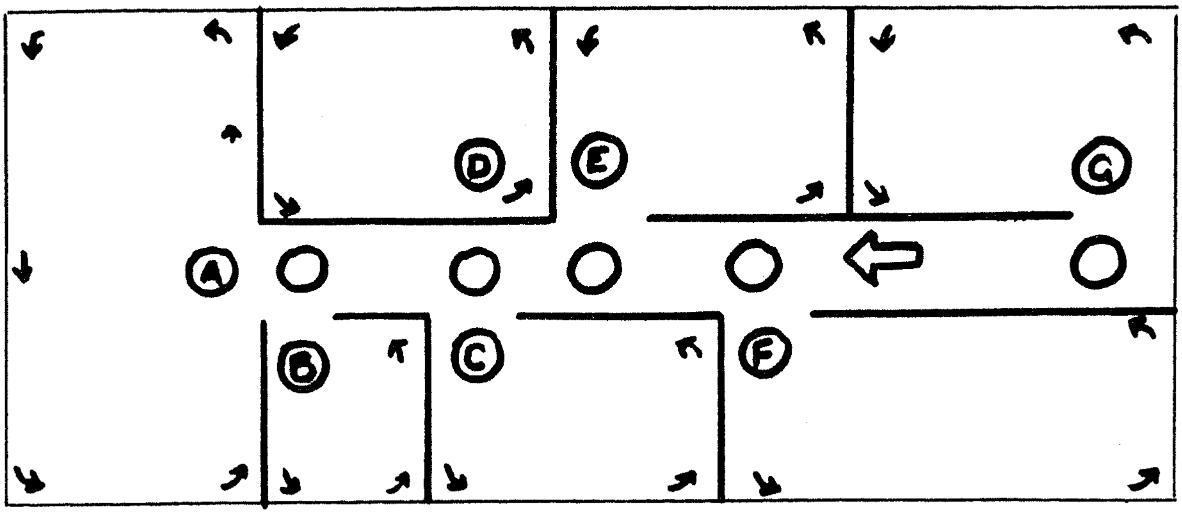
1 A robot may not injure a human being, or through inaction, allow a human being to come to harm.

2 A robot must obey the orders given to it by human beings except where such orders would conflict with the first law.

3 A robot must protect its own existence as long as such protection does not conflict with the first or second law.



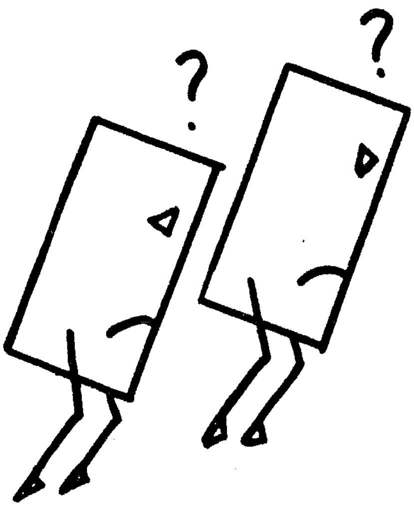
3.5.3 Example of Planned Robotic Movement

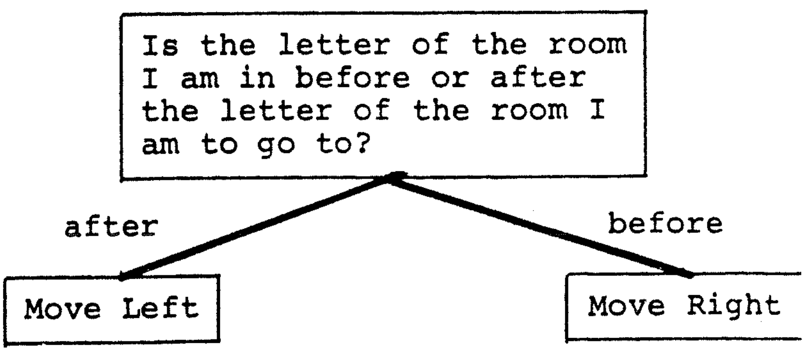


The drawing is a plan of a building with seven rooms labelled just inside the doorways with the letters A to G. A robot ⇨ is used to do tasks in the building. The following scheme has been planned to train the robot to move from room to room.

The main path for the robot is laid out using the circles ○ in the corridor. The circles are outside each doorway. When instructed to go to a particular room the robot moves from circle to circle using its robotic eye. At each doorway it checks the letter of the room. When it comes to the correct room it moves around the path laid down using arrows and does any programmed tasks.

The movement down the corridor will be logical because the robot can be trained to know the order of the alphabet. If the robot is in room D and is told to go to room B it will move along the corridor to the left because A is before D in the alphabet and rooms are labelled from left to right.





Activities

1 Discuss or debate the following suggestions.

a Organizations should not install robots if they will hurt workers economically, socially or physically.

b Organizations may only install robots on those tasks which while currently performed by people are tasks where the person is like a robot, not the robot like a person.

2 List jobs you feel could be better done by robots than by people. State why you believe robots would be better. Here are some factors you could consider.

a Labour

i The job is unpleasant
ii It is difficult to find people willing to do the job
iii Work conditions are poor
iv People don't stay in the job for very long

b Economic

i Robots are more efficient
ii The quality of the work done by robots is better

c Managerial

i Robots are easier to control
ii Planning is easier with robots

3 Consider either:

a A science fiction book you have read

or

b A science fiction film you have seen where robots are part of the plot.

i Name the book or film
ii Describe how the robots were used for good or bad in the plot of the story
iii Did the robots obey Isaac Asimov's three laws?
iv Write down and discuss with a friend any law you would like to add to Isaac Asimov's three.

4 Draw a picture or cartoon of a robot doing a task you believe is suited for it.

Why do you feel a robot rather than a person should do this job?

Self Check

1 What is a microprocessor or chip?

2 What is a smart machine?

3 How have microprocessors changed computers?

4 Why are microprocessors being used in machines?

5 How can computers control other machines?

6 What is automation?

7 Why are smart machines used to replace human workers?

8 What types of job are suitable for computer control rather than human control?

9 What examples of computer control do you know about?

10 What are the good and bad aspects of the computer used as a control device?

Project Starters

1 How are microprocessors made?

2 Describe the automation in a local factory. Find out why management changed to automation.

3 It is the year 2050. How have robots developed and changed the life style of people. Consider both good and bad possibilities.

4 Design a smart machine that you believe could be made in New Zealand and could be sold both here and overseas.

4 COMPUTERS AS FILING CABINETS

4.1 The Information Explosion

The quantity of information produced by industry, commerce, government and the academic world is increasing dramatically. Once it was possible to be a world acknowledged leader in many different fields of knowledge. Bertrand Russell (1872-1970) was possibly the last person famous for his individual discoveries in several disciplines; mathematics, philosophy and social reform. Today it is only possible to be a leader in a small specialist branch of any field of knowledge. While new discoveries and inventions are made daily, and the sum total of human knowledge grows with increasing speed, these achievements are team rather than individual efforts.

Date	Estimated number of years needed for knowledge to double
1800	50
1950	10
1970	5

Knowledge is growing at an increasing rate

The revolution in the volume of knowledge has brought with it a revolution in the means of dealing with it. Information must be:

Stored

Copied

Transmitted

Displayed

Changed

Photography, movie pictures and television brought new ways of displaying picture information.

Telegraphy, telephone and radio brought new ways of sending audio information.

The computer brought new ways of storing information and doing the clerical tasks on it previously only done by the human brain:

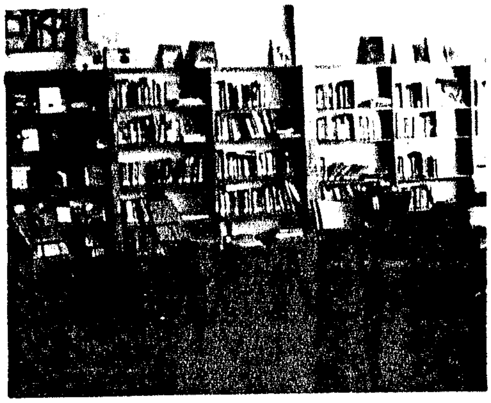
New ways of doing old jobs.

Once upon a time ...

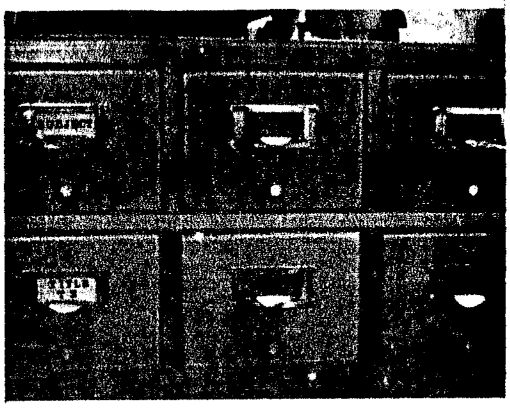
But nowadays ...

4.2 Methods of Storing Information

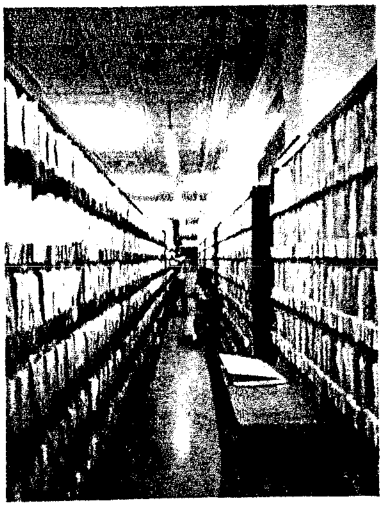
4.2.1 Traditional Methods



Libraries



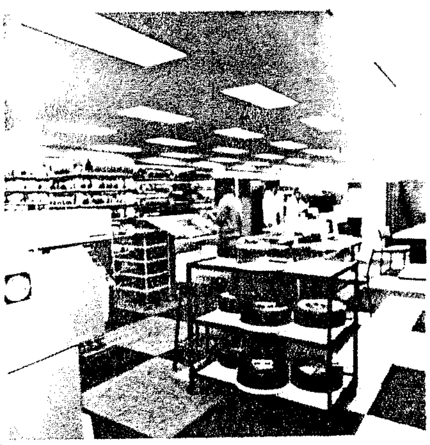
Filing Cabinets



Archives

Books and documents require large volumes of space. Storage, retrieval and clerical jobs are done by human beings. The system can become very inefficient if the file clerks and librarians have not done a conscientious job. Information can be lost, hard to find or become out of date ...

4.2.2 Discs



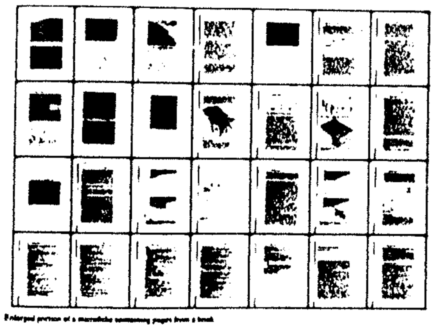
Information is stored on the surface of a disc with a special surface using a code and magnetism. The computer can control the disc and:

either - put information into the code and onto the disc

or - read information from a disc, decode it and then display it on the computer screen.

The unit with the display screen is often called the VDU - visual display unit.

4.2.3 Microfiche



Enlarged sample of Microfiche

Information is filmed and miniaturized. About 200 ordinary A4 pages can be fitted onto a piece of film the size of a postcard. The film is read using a microfilm reader which projects an enlarged image of the page on the screen.

4.3 Clerical Duties

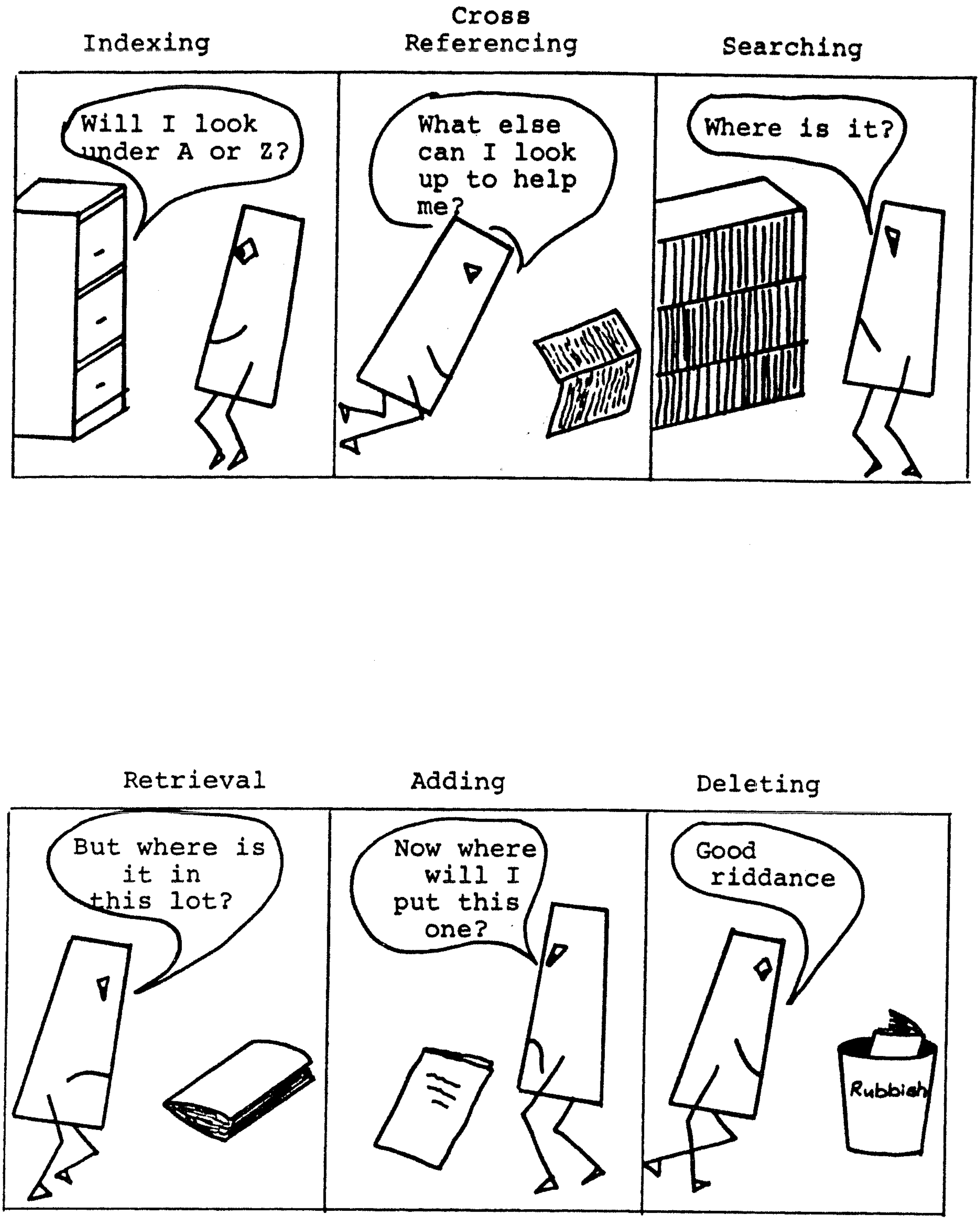
The clerical duties carried out on stores of information are the same whether done by computer or human beings. An efficient system must have the following:

a A good indexing and cross referencing system

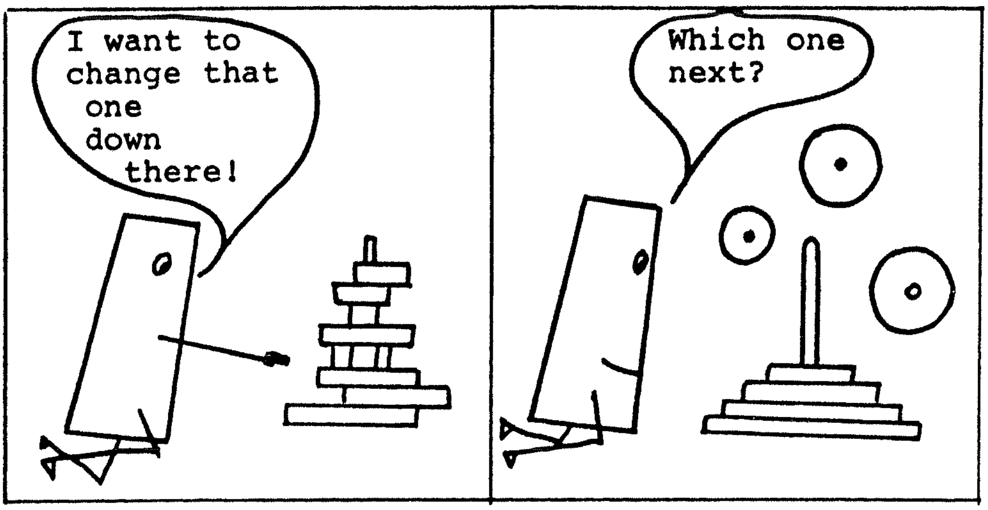
b Rapid means of searching for and retrieving information

c Simple methods for adding, deleting and updating information.

d A simple way of keeping the whole library of information in order.


Indexing
Will I look under A or Z?
Cross Referencing
What else can I look up to help me?
Searching
Where is it?
Retrieval
But where is it in this lot?
Adding
Now where will I put this one?
Deleting
Good riddance
Rubbish

Updating Ordering



An important part of clerical and librarian work is to do maintenance jobs, like those illustrated above, on file records.

Activities

1 Find out how your school library is kept in order and the books indexed.

2 Your school will keep a file for each pupil. It will have been started when you enrolled. Find out:

a How the files are stored

b How the files are indexed

c What is on record

d Who maintains the files

e Who uses the files and why

f What happens to the file when you leave school.

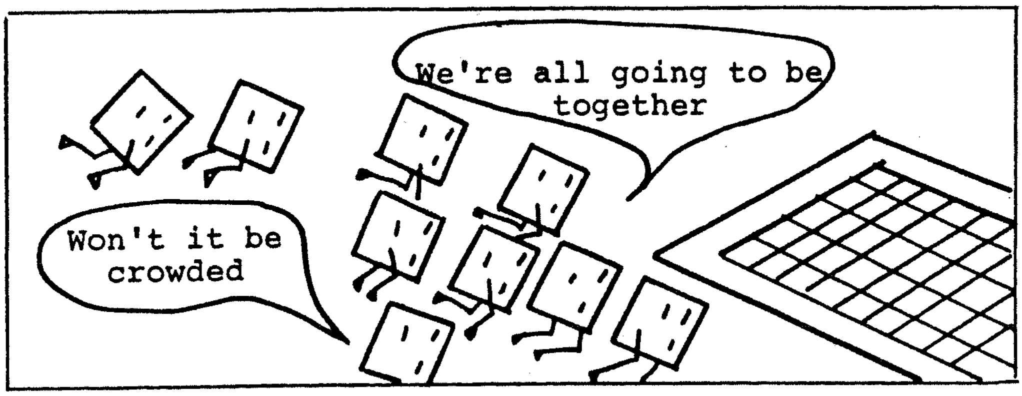
3 Discuss with your parents how important family documents are stored and organized.

4 Make a list of all the organizations you know of that keep files about people. Find out why the files are kept.

4.4 Advantages of Modern Storage Methods

4.4.1 Hard Copy

Documents are called hard copy. Often hard copy contains signatures or photographs. This type of information cannot be stored on discs easily; microfiche or traditional storage methods must be used. Microfiche saves space and keeps many documents together on the one piece of film.



4.4.2 Data Bases

A file of information about people or knowlege makes up what is called a data base. Clerical jobs have to be done on data bases frequently, therefore they can be efficiently stored on disc. Some advantages of computer data bases over traditional methods are:

a The disc file is always intact so a record can never be lost or put in the wrong place.

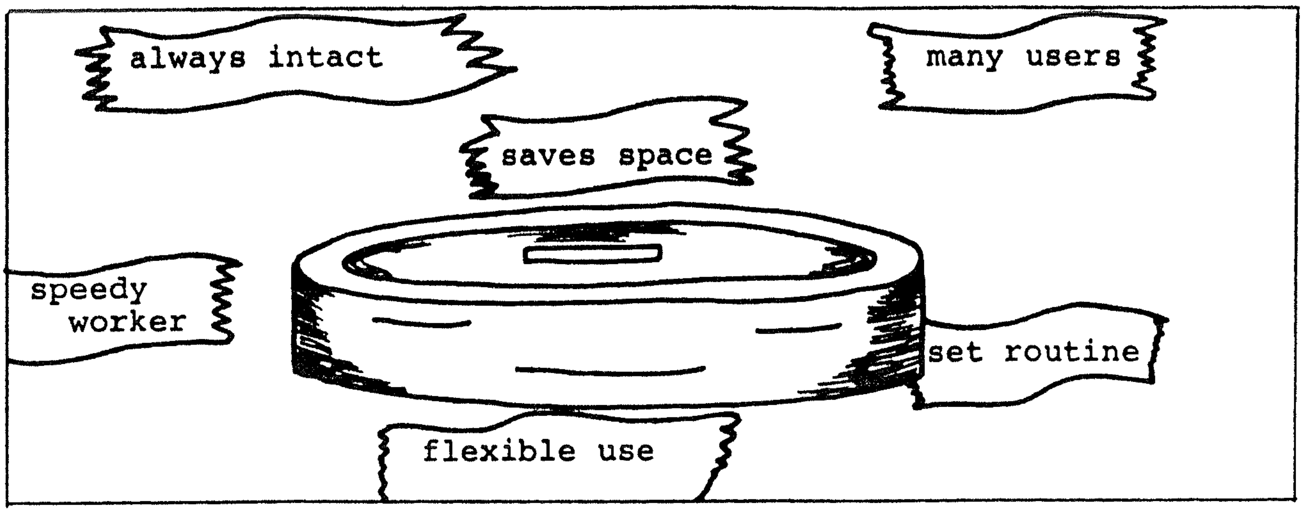
b More than one person at a time can use a record from a disc.

c A lot of information can be put on a disc so they save space as compared to what is needed for traditional hard copy systems.

d A computer is trained to have clerical jobs done using a set routine. This means all records are kept in the same way.

e The computer can do clerical tasks very quickly, compared to human clerks.

f Systems can be made for cross referencing the records in a file. This means the file can be used for several different information gathering tasks.



4.5 Example of the Computer Used as a Filing Cabinet

4.5.1 Business Records

Businesses keep many files about their work:

a Finance

- i Information needed to prepare a balance sheet of all the company's accounts
- ii Money owed by the company
- iii Money owed to the company
- iv Credit Control
- v The company's budget
- vi Assets owned by the company

b Manufacturing

- i A record of all the stocks of raw materials and finished products
- ii The costs involved in making each product

c Marketing

- i A history of all the sales of the company's products.
- ii An estimate of future sales of each product.

d Administration

- i The employee payroll
- ii Superannuation records
- iii Personnel records
- iv A list of shareholders

e Analytical

- i Statistics for management showing how the company is performing.
- ii Methods for planning the best way to do a job.

Most large companies have a computer division to look after their data bases.

The business data capture department of CCL

4.5.2 Keeping an Encyclopedia About Computers

The computer can be used to keep an encyclopedia of the rapidly growing and changing knowledge about computers.

A record on the VDU screen could look like this:

Number:	00224
Item:	Floppy Disc
Description:	Device
Key Words:	Disc, Information, Store
Entry:	A thin flexible plastic disc about the size of a 45 rpm record. The disc has magnetic surfaces that are used to store information in computer readable form.

Explanation:

Item: The word giving what the entry is about.

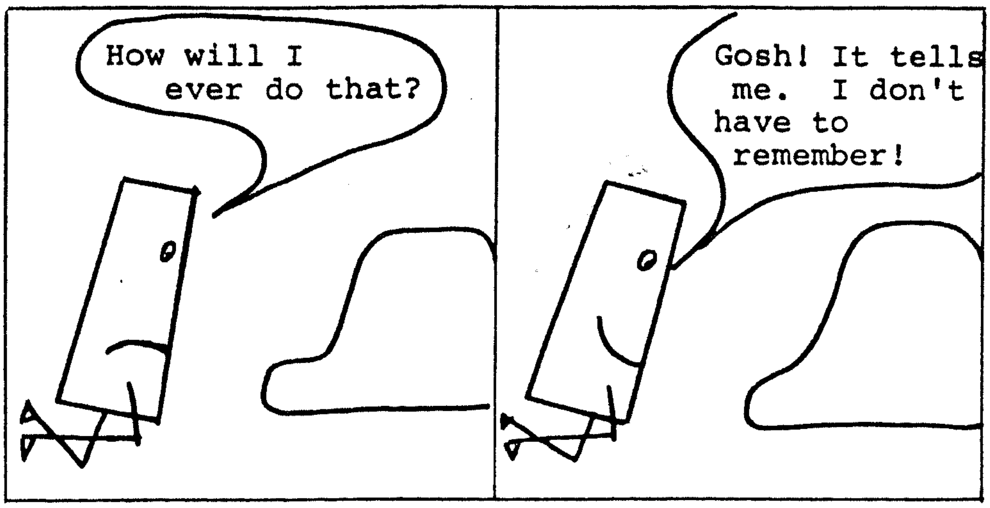
Description: The file could include a number of different types of record. The description word allows like types of records to be found easily. Examples:

- Records about devices
- Records about careers in computing
- Records about jargon words used in computing
- Records about people who have worked on computer developments.

Key Words: The most important words in the entry. Key words allow records to be cross-referenced. Someone wanting to know about computer storage can enter the word 'store' and the computer will find all records with 'store' as key words.

Entry: A brief encyclopedia like explanation of the item.

All clerical tasks can be performed on a file of records by using a set of routines under computer control. To start a routine off the computer displays a menu on the VDU. The person doing a job on the file touches the number of the task to be done. The computer then shows the instructions for the task on the screen.



Menu

Touch the activity of your choice

1 List all items alphabetically

2 List of items by description

3 Examine one record

4 Add a record to the file

5 Update a record

6 Delete a record from the file

7 Keyword Search

1	2	3	4	5	6	7

Activities

1 Many libraries use microfiche. Visit a local library using this type of storage system and find out how it is used.

2 Find out how the encyclopedias in your school library cross reference items.

3 Find out what files are kept by the following organizations:

a Police

b Inland Revenue Department

c Traffic Department

d Banks

e Insurance Companies

f Retail Stores

g Army, Air Force and Navy

h Post Office

4.6 Machine Codes

All information fed into the computer is changed by the computer into machine usable code. It is processed or stored in this code. The machine automatically translates items back into ordinary language before displaying anything on the screen.

The table on the next page gives a commonly used code. Each letter, digit or special symbol has its own code made up of eight of the digits 1 or 0. The table is read by fitting the row and column headings into the box:

b8	b7	b6	b5	b4	b3	b2	b1

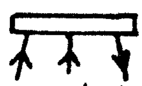
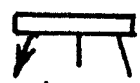
Example of Machine Code:

If the words MACHINE CODE are to be stored in the computer then:

a 12 characters are required (One is needed for the space)

b 96 bits are used. "Bit" is the word used to describe the 1s and 0s of the code.

Codes with only two symbols are used because transistors or magnetism are used to store information in the computer or on a disc. 1 corresponds to a current flowing or a dot being magnetized one way.
0 corresponds to a current not flowing or a dot magnetized another way.

 spot magnetized one way	 spot magnetized other way	 transistor conducting current	 transistor not conducting current

ASCII CHARACTER CODES

			b8	0	0	0	0	0	0
			b7	0	0	1	1	1	1
			b6	1	1	0	0	1	1
			b5	0	1	0	1	0	1
b4	b3	b2	b1						
0	0	0	0	SPACE	0	@	P		p
0	0	0	1	!	1	A	Q	a	q
0	0	1	0	"	2	B	R	b	r
0	0	1	1	#	3	C	S	v	s
0	1	0	0	$	4	D	T	d	t
0	1	0	1	%	5	E	U	e	u
0	1	1	0	&	6	F	V	f	v
0	1	1	1	'	7	G	W	g	w
1	0	0	0	(	8	H	X	h	x
1	0	0	1	)	9	I	Y	i	y
1	0	1	0	*	:	J	Z	j	z
1	0	1	1	+	;	K		k	
1	1	0	0			L		l	
1	1	0	1	-	=	M		m	
1	1	1	0	.		N		n	
1	1	1	1	/	?	O	_	o	

ASCII - American Standard Code For
Information Interchange

M	0	1	0	0	1	1	0	1
A	0	1	0	0	0	0	0	1
C	0	1	0	0	0	0	1	1
H	0	1	0	0	1	0	0	0
I	0	1	0	0	1	0	0	1
N	0	1	0	0	1	1	1	0
E	0	1	0	0	0	1	0	1
	0	0	0	0	0	0	0	0
C	0	1	0	0	0	0	1	1
O	0	1	0	0	1	1	1	1
D	0	1	0	0	0	1	0	0
E	0	1	0	0	0	1	0	1

All information inside the computer is in a code of bits made up of 1s and 0s

When computers were first invented in the 1940's and early 1950's everyone using a machine had to work in machine code. Now special words and keys are used.

All translation is done automatically by the machine. The codes are only of interest to the computer engineer.

Activities

1 Computers do arithmetic in code. Find out from your mathematics teacher how this is done.

2 Increased use is being made of codes for everyday information. Post codes, tax codes and vehicle licence codes are but three.

a Make a list of other common information which is written in code.

b Many people worry about codes and feel they may become "just a number" in society. Why do they feel bad about this?

Self Check

1 What is the Information Explosion?

2 What type of activities are done using information?

3 What type or clerical jobs are done on files?

4 What sorts of storage methods were used before computers?

5 What automatic storage methods are available?

6 What is hard copy?

7 What is a data base?

8 What advantages do discs have for storage?

9 When is microfiche best used for storage?

10 What is a menu in a computer program?

11 Information is not stored in computers or on discs in English. What code is used?

Project Starters

1 Find out from a local business that has a computer how their files are maintained. Some questions you might ask are:

   a Who designed the file?

   b What does each record look like and why?

   c How often are records updated? Who does this?

   d How is this done?

   e How often are new records started and old ones deleted?

   f How are errors avoided?

   g How is the file kept safe from damage?

2 Find out how discs are organized as information stores.

   a How does the computer know where to put information on a disc?

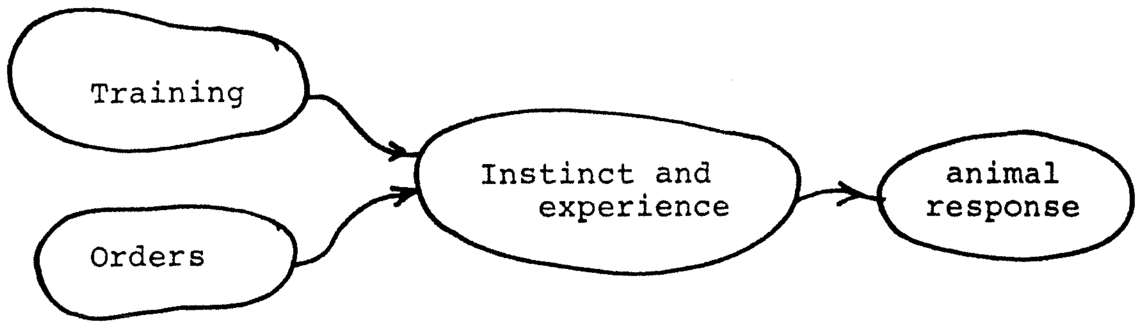
   b How does it know where to find the information it is searching for?

3 Find out how computers are trained to do some of their clerical tasks. Often what is an efficient way for a human being to do a job is not efficient for a machine. For example, how does a computer sort a list of names into alphabetical order?

5 MACHINE INTELLIGENCE

5.1 Training

Animals can be trained using a system of trust and rewards. The animal trusts the keeper and knows there will be a reward at the end of the exercise. The response is to key words and movements that the keeper makes. Most animal actions are a result of instinct and experience.



Computer work follows a similar pattern to animal training:

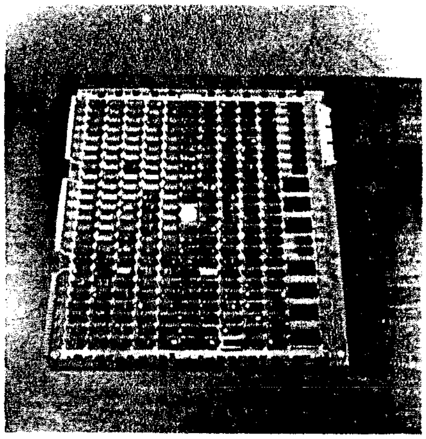
a The instincts computers have built into them are:

   i An ability to do simple arithmetic

   ii An ability to remember information

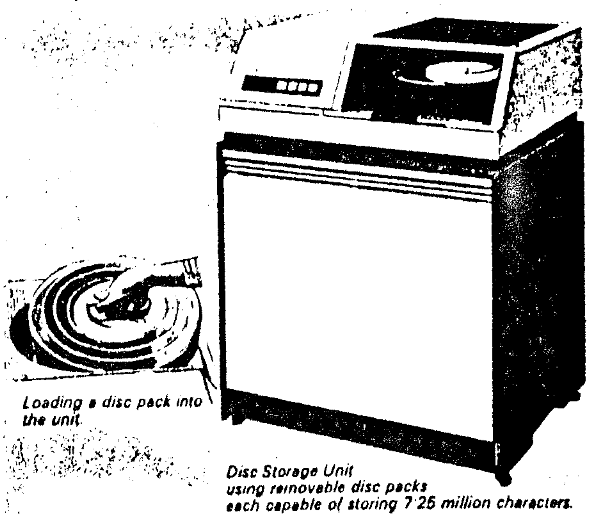
   iii A routine for carrying out instructions it recognises.

There are very few computers with even the most limited ability to learn from experience. The black caterpiller chips in the circuit board have the logic to do these three jobs built into them.



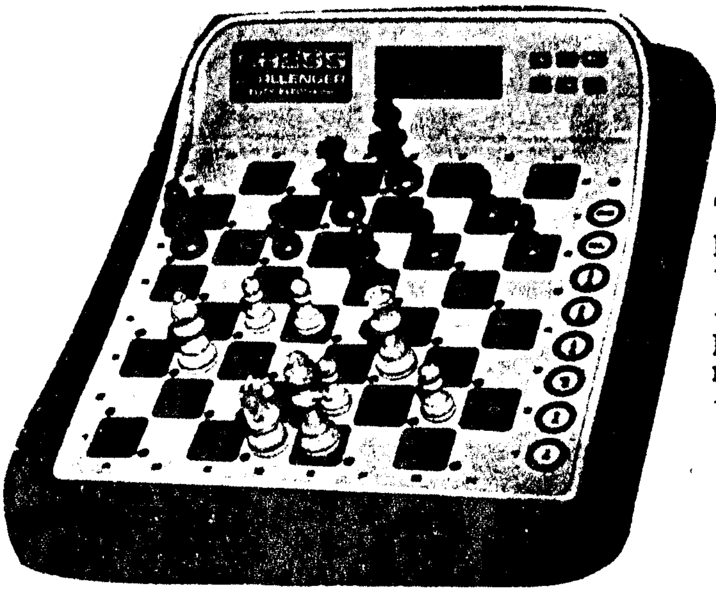
Computer circuitboard

b Before a computer will do a job it must be trained. This training is the computer program. Everytime a particular job is to be done the machine must be re-programmed. Programs are usually written in a special language and kept in code on tapes or discs. Before the computer is used the program on the tape or disc is loaded into the machine.

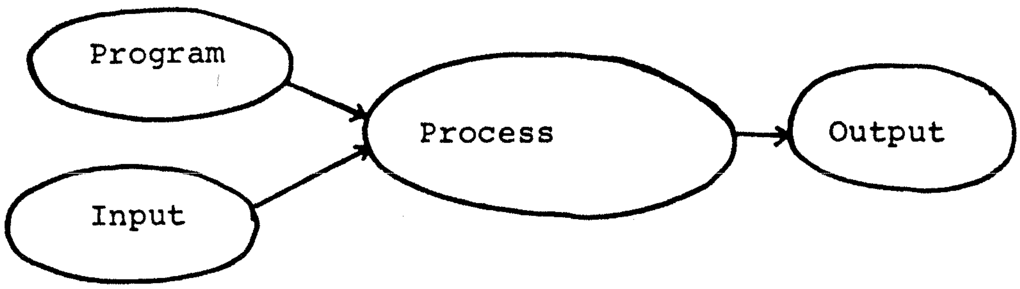


Computer together with disc. Programs on the disc are loaded into the machine. This is machine training.

c Finally the computer can be given the orders for the particular job. These orders are the input. When you play a game with the computer, the program trains the computer in how to play. Your moves are the input.



The computer only plays chess because the program tells it how to. The player gives the machine input as the game is played.



<u>Activity</u>

1 a If you have a pet describe the training you have given it.

b What are the similarities and differences in this training and the responses your pet makes to those needed in computer work.

c Does your pet learn from experience? Why can't a computer learn from experience easily?

5.2 Clever Machines

To watch a computer in action can be awe inspiring. They seem to do so many things better than human beings.

Mathematics

Arithmetic can be done at "lightening" speeds and with 100% accuracy.

Data from experiments and surveys can be fed in and shown automatically on graphs drawn to the right scale. Geometry figures can be drawn and transformed on command.

Simulations

Models can be built to copy situations from life. Experiments can be carried out on these models that otherwise might be dangerous or costly.

Games

The computer will play games such as chess, draughts and backgammon. The level of ability at which the computer will play can challenge even the best tournament players.

<u>Language</u>

The computer can be used to translate material from one language to another.

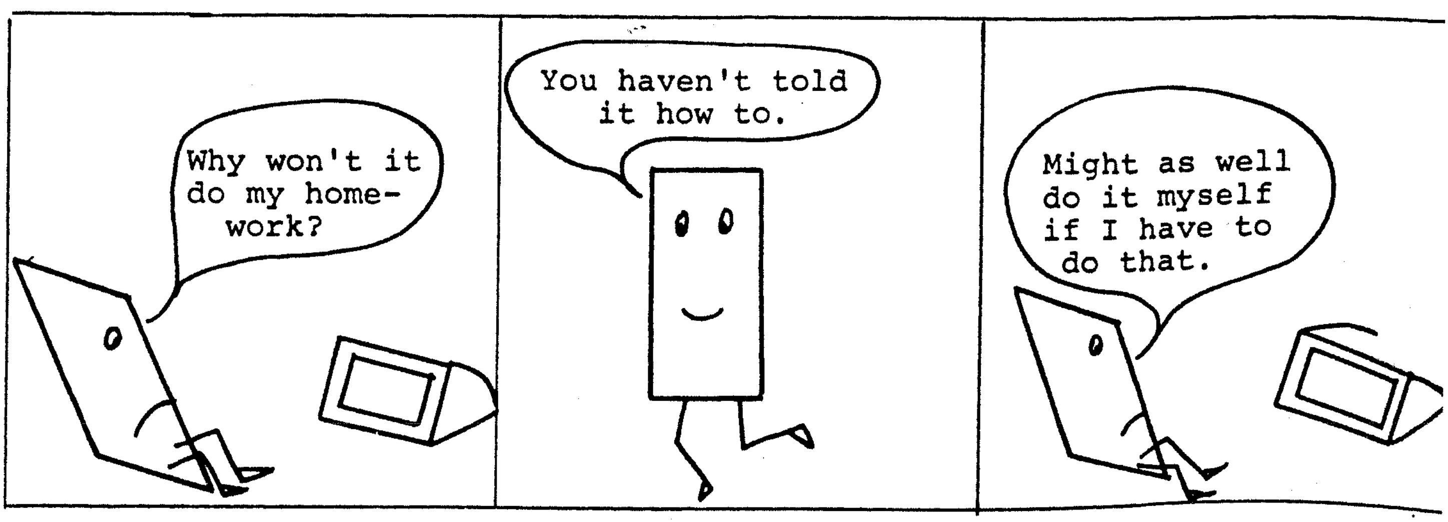
Work is advancing to give computers the ability to speak and to recognize speech.

<u>Control</u>

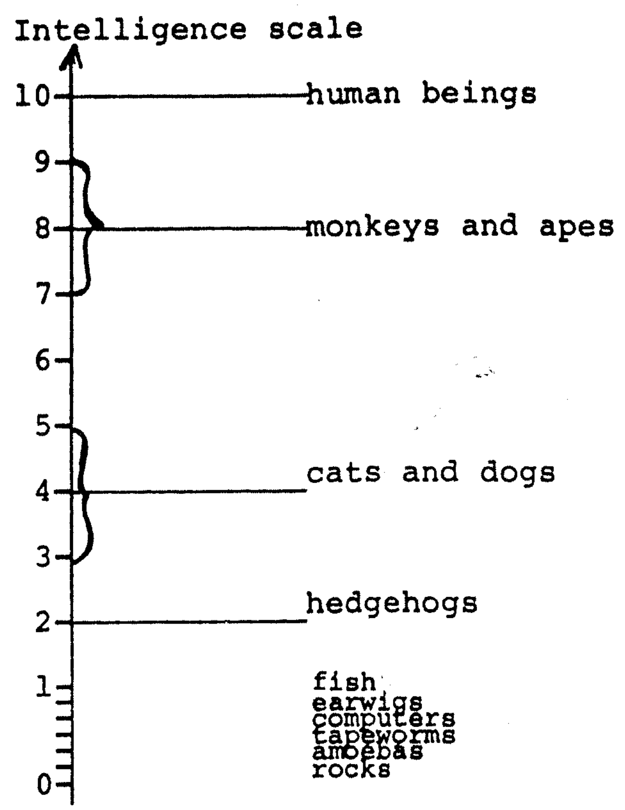
Computers can be used to control other machines. They can take temperatures or pressures or weights. Any physical measurement is possible. They can assess these measurements and act according to the results.

The computer never gets tired, bored or error prone nor does it need a coffee break...

Despite all these apparently very clever activities the computer is really very dumb. The computer will only do as it is told. If it is not programmed for a job it can't do it. If it is programmed wrongly the machine will do the job wrongly, it won't learn from its mistakes. The computer cannot be blamed, the person who wrote the program must be blamed.



5.3 Intelligence



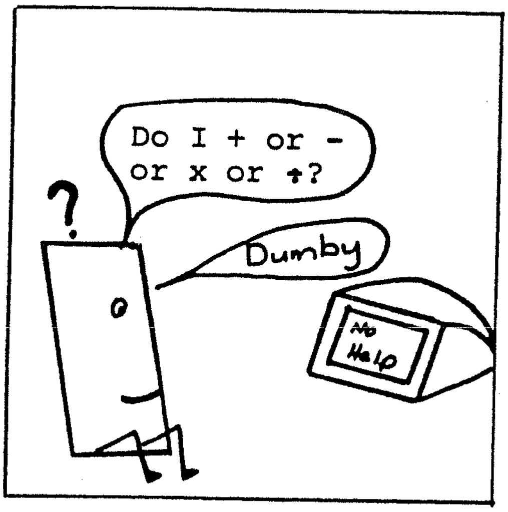
(Mighty Micro pg 167)

Present computers have a level of intelligence somewhere between that of a tapeworm and an earwig. Computers that seem intelligent are fooling you. The intelligence comes from the programmer not the machine.

Mathematics

Simple arithmetic like adding and multiplying has to be remembered. At primary school you spend many hours memorizing families of facts. The computer with a built in memory never fogets the families of facts.

Knowing tables perfectly doesn't make you good at mathematics. You have to know which family of facts to use when you are given a maths problem to solve. You use your intelligence to do this. The computer cannot solve the simplest maths problem unless the programmer has told it which family of facts to use.

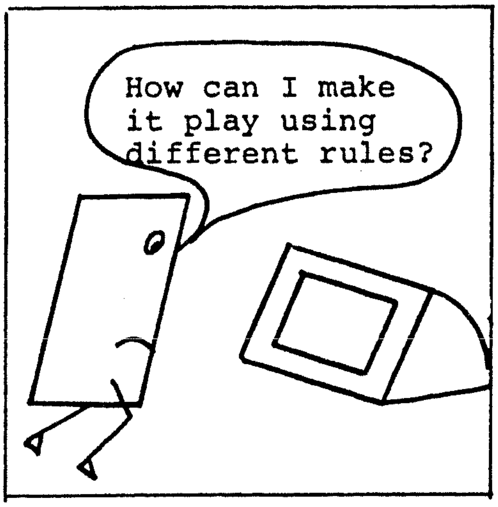


Games

If a computer plays a good game all this means is the programmer has done a good job and taken every possible sort of move into account.

When you and a friend play a game you might decide, for a change, to alter the rules. For example in draughts you can make it compulsory to take the pieces if it is possible to.

In chess you might put a time limit on each move. You and your friend will be intelligent enough to adapt to the change. With a computer there will be no change unless you reprogram the machine. There is no ability in the machine to adapt.



Activities

1 What is the difference between being clever and being intelligent?

2 a Is an animal which uses instinct to survive intelligent?

b Is an animal trained to do tricks intelligent?

3 In the game of naughts and crosses what are the different types of move that can be made?

4 A good way to learn about computer programming is to take games and look at the program, then try to make changes to the way it is played. Try this wish more simple programs from the school program library.

5.4 Programs

Programmers are people who train a computer. They provide the instructions which the machine follows to do a job. They do this in special languages. The computer will only obey a few special words. These words must be put together in the right way to get a job done.

There are many computer languages. Each machine is built to use one or more of these languages. When you buy a program you have to be sure it is in a language for your machine.

Some Computer Languages

BASIC

COBOL

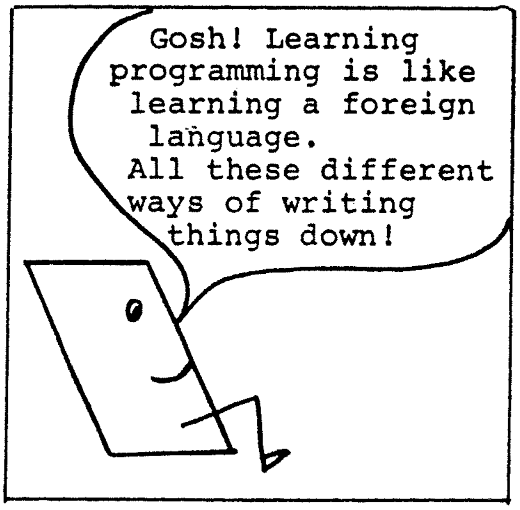
PASCAL

FORTRAN

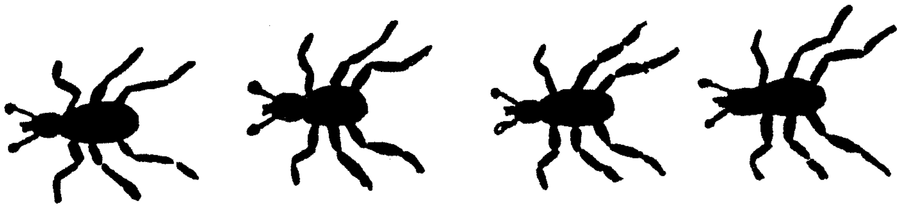
P L I

R P G

You do not need to know a language to use a program. However if you are going to create things for the computer to do you will have to use the language for your machine. This may take you quite a long time to learn.



A programmer has to be a very patient logical type of person. Every possibility has to be taken into account. A lot of time is spent before a program is written planning the logic to be used. When a program is finished it may contain hundreds even thousands of instructions. Before a program is used it is tested many times with every possible type of data. All the bugs are found and corrected.



Activities

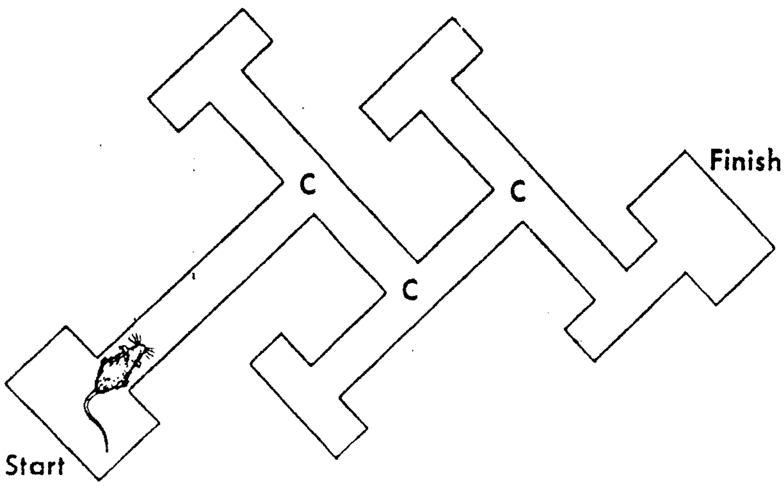
1 Speak to people who know about computer programming.

a Get them to show you a program

b Ask them how they go about planning, writing and testing their programs.

5.5 Example of Planning A Computer Program

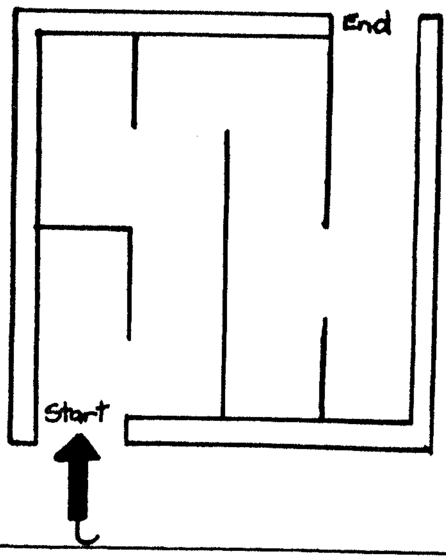
5.5.1 The Robotic Mouse



Mouse Running a Maze

Scientists have found out a lot about learning by watching mice run through mazes and seeing how good they get. When you were young many of the fun and games books you owned will have had mazes in them. They help you develop skills useful at school. Many adults enjoy mazes. In the seventeenth and eighteenth century many rich people made mazes in their gardens out of hedge plants.

Can the intelligence a mouse needs to run a maze be copied by the computer? The logic a programmer needs to consider follows.



The robotic mouse

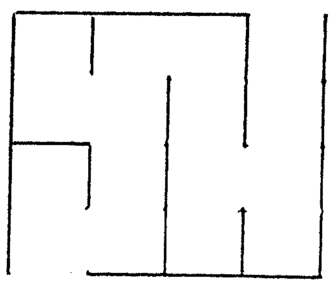
will run through the maze.

What intelligence must the computer have to do this?

5.5.2 Mouse Intelligence

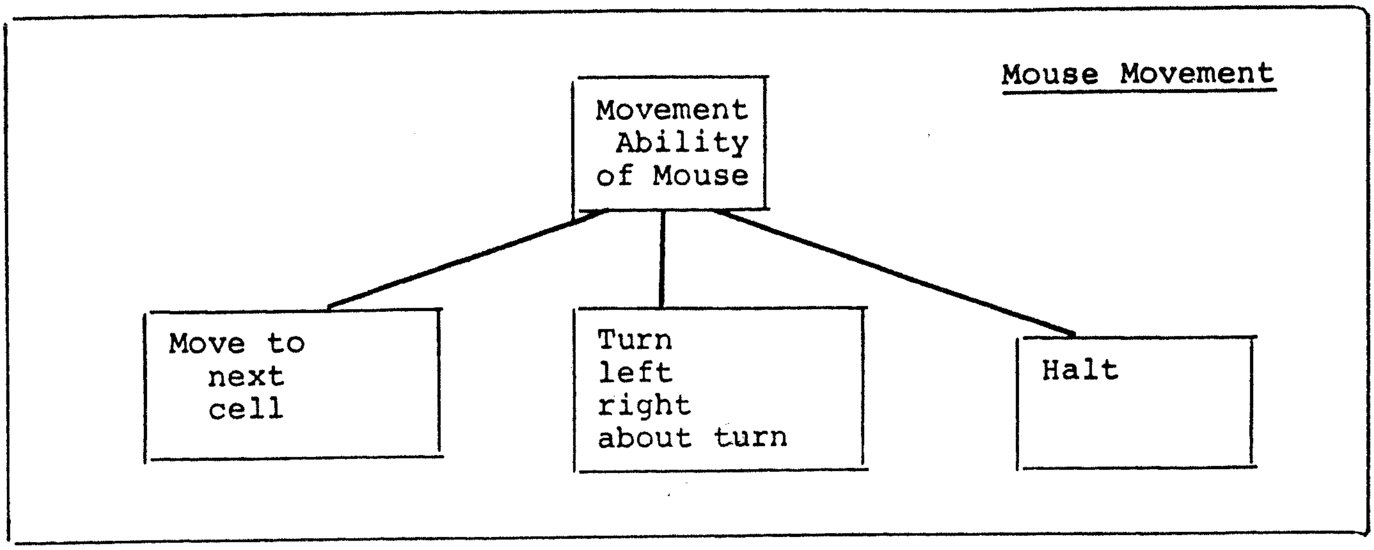
There are two aspects to the intelligence that must be given to the mouse.

Mouse Senses	The mouse must be able to collect information.
Mouse Movement	The mouse must be able to move.

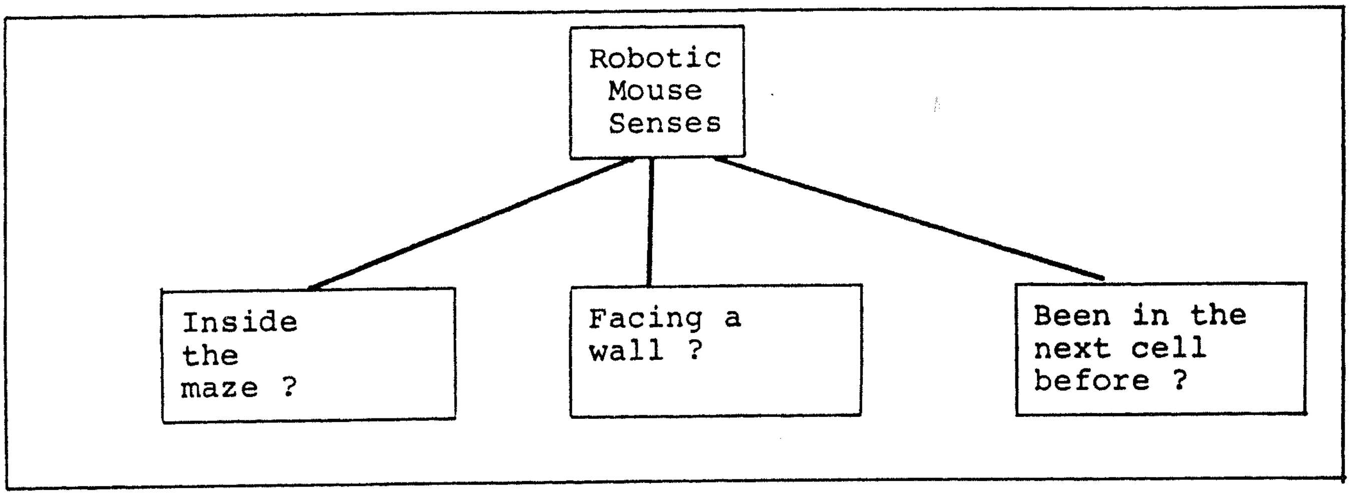


The maze is divided up into 16 squares called cells.

The mouse must be able to move from cell to cell when there is an opening.



The mouse must be able to sense whether it is inside the maze or not. If it is facing a wall or an opening. It is has been in a particular cell before or not. This is done by getting the mouse to drop a spoor each time it leaves a cell in the maze.



The mouse can either

Run through the maze without any plan - no logic

or

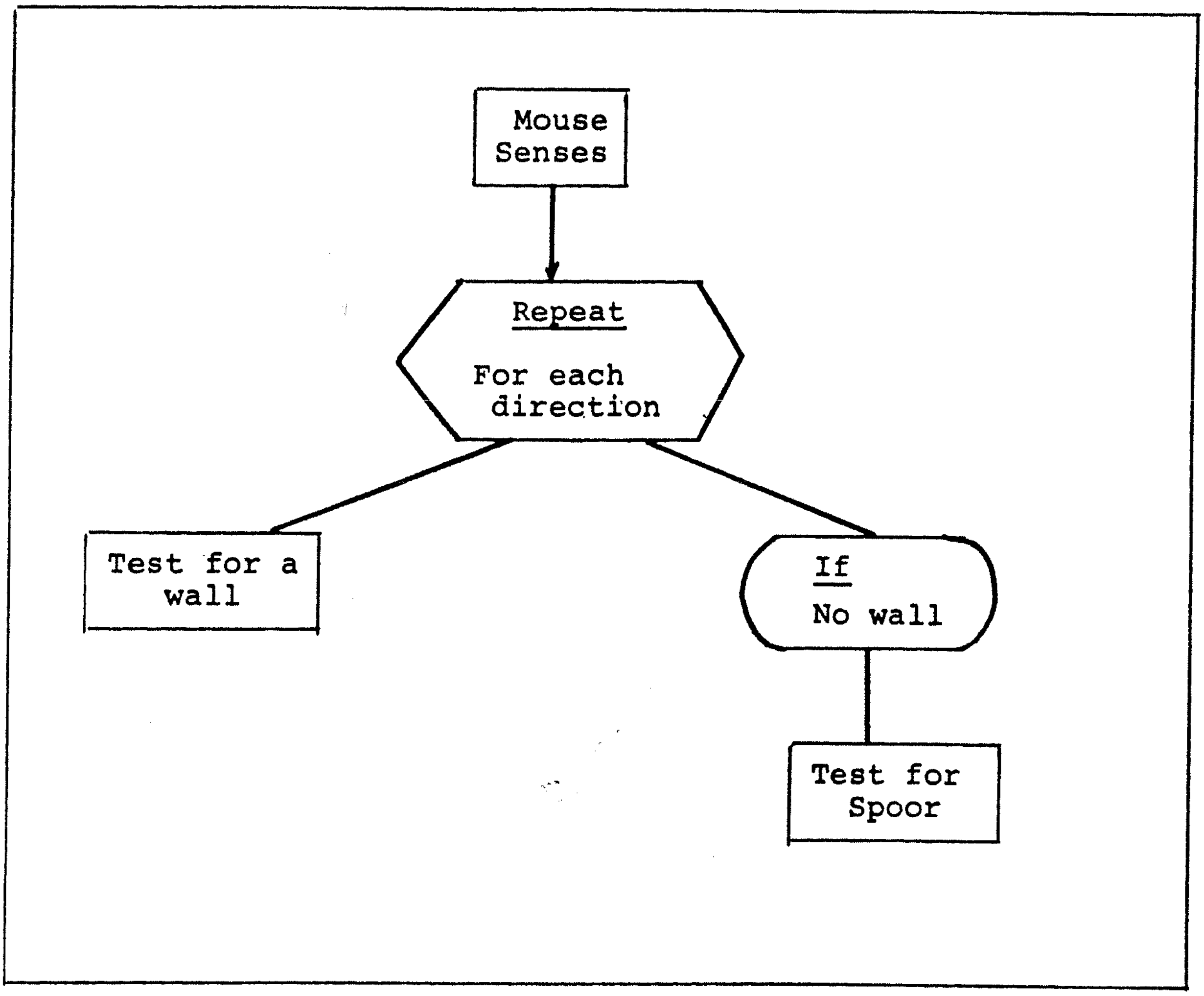
It can run using some plan. If the mouse uses logic it should usually get out quicker than without a plan.

5.5.3 The Logical Approach

If the mouse has a choice at any stage between going into a cell with spoor or one without spoor it always chooses the one without. Each time the mouse goes into a new cell it collect the following information:

a Is there a wall to the left, to the front or to the right?

b Where there is an opening is there a spoor in the cell ahead?

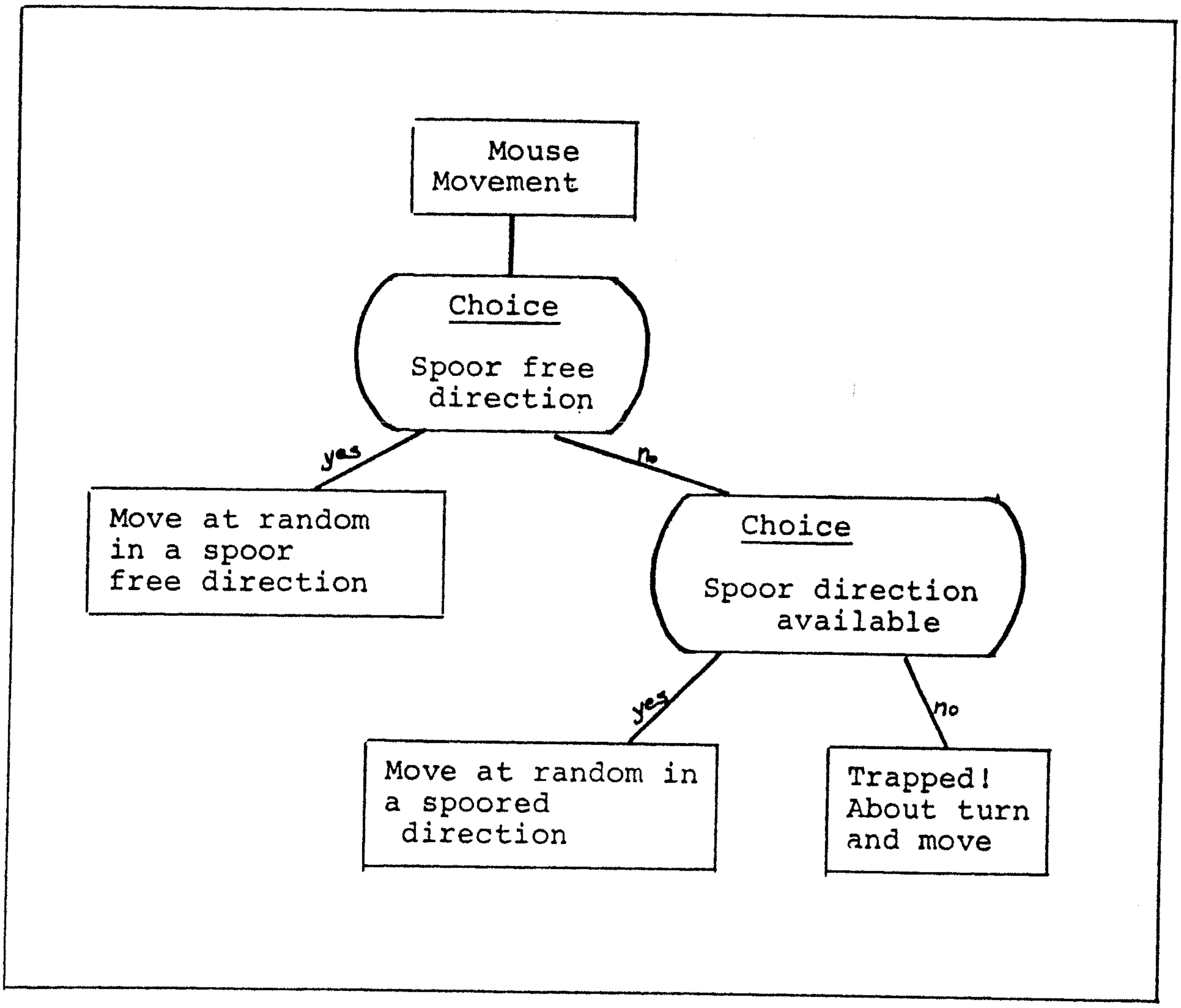


Once all the information is collected the mouse must decide where to move.

a If there are cells to move into without spoor it moves into any one of them at random. This means it just chooses any one without thinking ahead. The mouse prefers a cell where it hasn't been before.

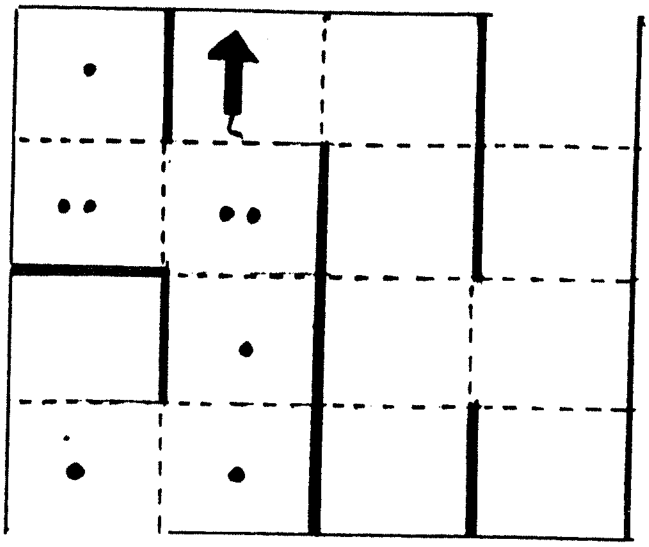
b If there are cells to move into with spoor it moves into any one of them at random.

c If the mouse is trapped it turns around and moves back from where it has come.



5.5.4 Three Examples of the Mouse's Choices

The drawings shows a mouse in the maze. The table shows the information the mouse has collected and the movement it prefers.

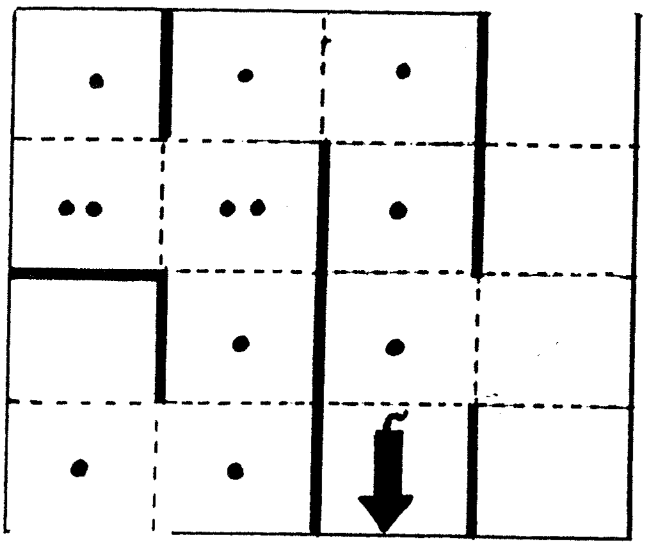


Logic Table for Next Move

	For-ward	Left	Right
A Wall?	Yes	Yes	No
Spoor in next cell	-	-	No

Preferred Movement

To The Right

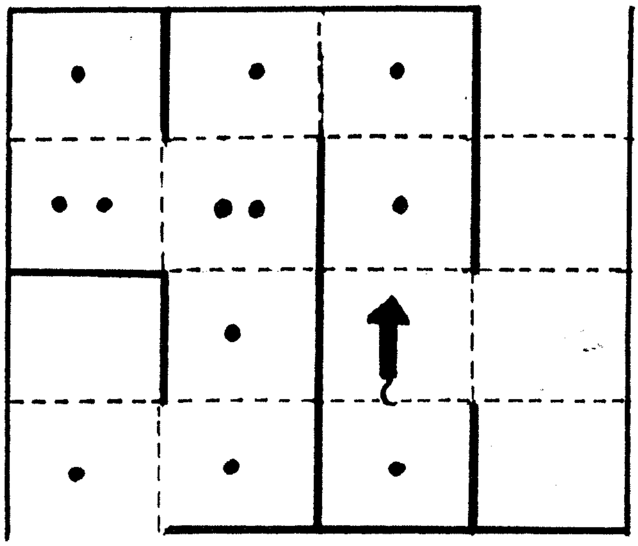


Logic Table for Next Move

	For-ward	Left	Right
A wall?	Yes	Yes	Yes
Spoor in next cell	-	-	-

Preferred Movement

About Turn and Move



Logic Table For Next Move

	Forward	Left	Right
A Wall?	No	Yes	No
Spoor in next cell	Yes	-	No

Preferred Movement

To The Right

You will now understand that a simple idea takes a lot of work to analyse. All programming starts out like this. Fortunately this type of work can be left to specialist people with the interest and ability to think logically. Perhaps you have enjoyed this mouse problem. If so you may be interested in learning to program. On the other hand the mouse problem may have puzzled you and you may thoroughly dislike it. If so perhaps programming is not for you.

Activities

1 Mouse logic is hard to understand until you get used to it. One way to understand it better is to draw the maze in chalk outside on the ashphalt. Move through the maze yourself. Use the mouse logic when you are in a cell to decide how to move to the next cell. When you have a choice of cells to move into, toss a coin to decide which way to go.

2 Draw diagrams of a maze. Place the mouse at various positions inside the maze. Draw a logic table for the next move and give the preferred movement.

3 Discuss with your science teacher maze experiments with animals and insects. See if you can arrange to do some experiments.

Self Check

1 What instincts are built into a computer?

2 What is computer training?

3 How are programs kept?

4 What is input?

5 How does animal training compare to computer training?

6 What are some of the clever things computers can do?

7 Why is the computer dumb?

8 Why can't the computer make mistakes?

9 Why can't computers learn?

10 How intelligent are computers?

11 Is a computer a good mathematician?

12 What is a computer program?

13 What are computer languages?

14 What are programming bugs?

15 How are bugs removed from programs?

16 What has to be done before a program is written?

Project Starters

1 Find out the logic used by programmers when they make computer games such as computer draughts or computer chess.

2 Work out the logic needed to play naughts and crosses.

EPILOGUE

The Industrial Revolution that started about three centuries ago replaced the energy of man and animal by mechanical energy. This revolution changed rural subsistence societies into urban and relatively affluent ones. It produced a chain of technological transformations that changed production, transportation, communications, warfare, the size of human populations and the natural environment.

This booklet has concentrated on the question:

> What type of task can the computer do?

Now the question must be asked:

> What will be the consequences of the computer revolution on people and the institutions of society?

The following would need to be looked at:

1. The impact of computers on technology, in particular communications, information and energy.
2. The impact on the nature of work and of leisure.
3. The consequences for privacy and individual liberty.
4. The impact on people's view of themselves, the universe and their place and goals in it.
5. The impact on how people relate to one another; their family and social relationships.