The Categories of Computers

Monday, June 12,

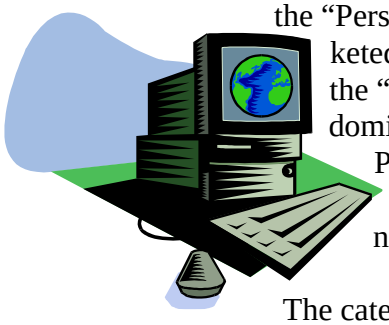
Goals and Objectives

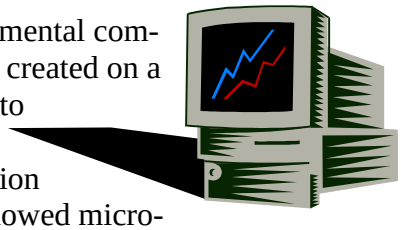
By the end of this session, the class should be aware of the four major categories of computers in the market and for what use they are.

In the hardware, computer category, there are four major groups of computers. They are the Supercomputer, mainframe, mini and micro-computer. Their definition is largely historical and an outgrowth of the different requirements that each computer generation was created for.

Microcomputers

The microcomputer is also known as the "Personal Computer". The monica or naming the "Personal Computer" is largely related to IBM who introduced and marketed the first widely available, commercialised microcomputer named the "IBM PC" where PC stood for Personal Computer. As the most dominant microcomputer in the introduction of microcomputers the IBM PC became the standard against which all microcomputers were compared and the branding that IBM created, the "PC" helped provide a name for the industry it grew.



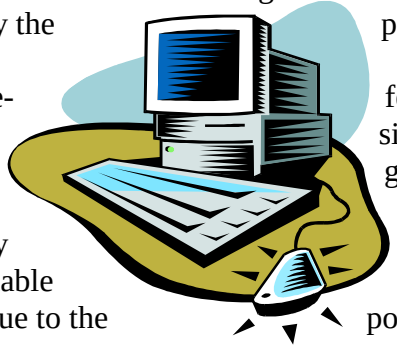


The category is termed "micro" because the fundamental component that allowed the categories development was the CPU created on a single chip (so this technology was affordable in comparison to the mini/mainframe) created with the introduction of 'microprocessors.' The lower costs in the development and production of the CPU and various components of the microcomputer allowed microcomputers to become a broad market general purpose computer.

The general appeal, or focus of microcomputers on the individual's enjoyment and productivity has been a key factor in the microcomputer developments and enhancements over the years. Where other computers were used by a broad group of people within an organisation, the microcomputer was often used by a single person for single activities. Where larger systems were focussed on the productivity of the whole department or organisation, the microcomputer was often only effective for a single individual's work.

One example of how Microcomputers differ is the use of Games. Many of the microcomputers contain games because that is what people like to do after working hard.

Microcomputers can be grouped into five smaller groups; the workstations, desktops, servers, laptops and notebooks. Each referring to the physical usage of the machines and not necessarily the power.



Workstations generally refer to machines used for intensive calculations on designs such as architecture and buildings. Desktops generally refer to machines used by business people for word processing, spreadsheeting etc, and are physically placed onto a desk. The laptop and the notebook are portable machines. Laptops generally are bigger and clumsier due to the power supply being encased in

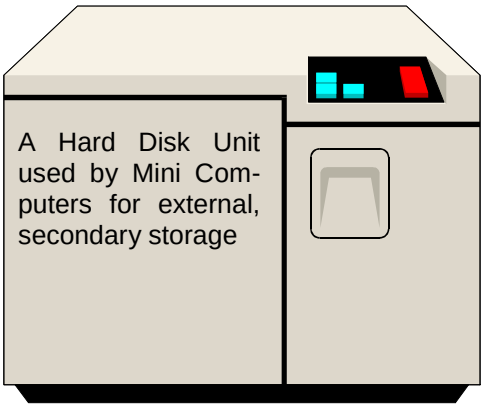
the box holding the CPU. The notebook is generally smaller. Notebooks and laptops can work on batteries allowing the user to work with it in aeroplanes, in the car and places computers are not generally available.

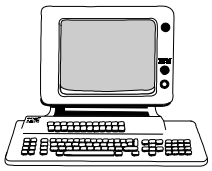
Initially designed as stand-alone machines the PC and the operating systems popular on the PCs do not integrate as well into networked environments as the other computer systems.

Personal Digital Assistants. PDAs are a very recent enhancement of electronic productivity tools based on microprocessor technology. Personal Digital Assistants such as Apple's Messagepad 2000 provide business people, and technocrats, with common daily organisation tools (such as a diary, telephone book, notepad) in a small packaging usually no larger than a stenographer/short-hand notepad.

Minicomputers

Faster than the microcomputer with access to more storage space and more input and output devices, the minicomputer is used when large groups need access to data simultaneously. The minicomputer can do this because the hardware is designed for plugging in more devices, and the C.P.U. and support chips are designed more for this kind of work than the microcomputer's.

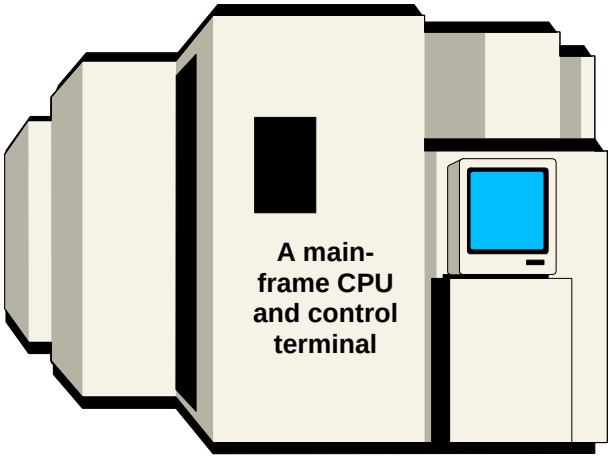

A Hard Disk Unit used by Mini Computers for external, secondary storage


Terminals used by computer operators to enter and review data do not have local hard disks nor floppy disks.

A typical mini computer may have 20 to 100 terminals connected to the mini allowing as many people to review data on screen, as well as from printouts.

The technology advancement from vacuum tubes to transistors lead to the ability of manufacturers and designers being able to create computers smaller than mainframes and consequently more affordable for a broader range of buyers. The advancement of technology to microchips and microprocessors have allowed mincomputers, although more expensive, to maintain a greater processing power and peripheral devices than the more commonly used microcomputer.

For example, large supermarkets around the world need to have their cash register send sales information to the same computer (so that the data is collected in one place). This work requires more input devices (cash registers) and output devices (screens) than the microcomputer was designed to have access to. Some organisations, like TCF and Morris Hedstrom, operate the local supermarket using local area networks and microcomputers, but tie the various (100's) supermarkets together to the central office to a minicomputer. The minicomputer is also required to work when all the sales people key in sales information at the same time, this requires a powerful machine that can work with all the input devices at the same time.


A mainframe CPU and control terminal

Minicomputers are used by medium sized business and small sites of large organisations. They are also used in factories to control automated assembly lines.

Manufacturing, large process control. Where numerous equipment have to be coordinated and operating in time-critical sequence, such as a car manufacturing plant, or chemical plant, minicomputers are

found to coordinate the many peripheral devices, collate and assess input from many other peripheral devices. The microcomputer is inadequate in processing power and peripheral connections to complete the work and mainframe computers are too expensive for the job to be cost-effective.

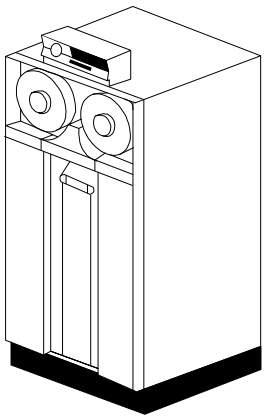
An important measure for minicomputers and mainframes is the reliability of the machine as it generally has to operate 24 hours where every minute of operation is important to the company. A minute of downtime, where the computer is not functioning correctly, is calculated in lost money for organisations. Microcomputers have not been manufactured nor warranted for critical operations and many microcomputer manufacturers explicitly state in their promotional material that the microcomputers are not designed nor intended for critical operations.

Popular makers of minicomputers include DEC - Digital Equipment Corporation who built the popular VAX minicomputer used in universities, banks and engineering firms. IBM also creates a very popular mini computer range with a branding of the AS400. Hewlett Packard has a popular minicomputer range branded the HP9000.

Mainframes

Mainframes have even more access to storage space and to input/output devices. To work with these extra devices mainframes also have more powerful 'processors'. This power is useful and required by large corporations who have large amounts of data to process.

For example, large overseas banks who have millions of customer accounts to update regular will need very powerful machines to process this data. These large banks would have a mainframe maintain their customer account records (like their bank book account balance, how much they withdrew, deposited) so that the customer can turn-up at any of the branches (local bank building) to withdraw/deposit money. So Sione who has a bank account in Nuku'alofa can take a trip to Ha'apai, turn up to the bank in Pangai, Ha'apai to withdraw some money.

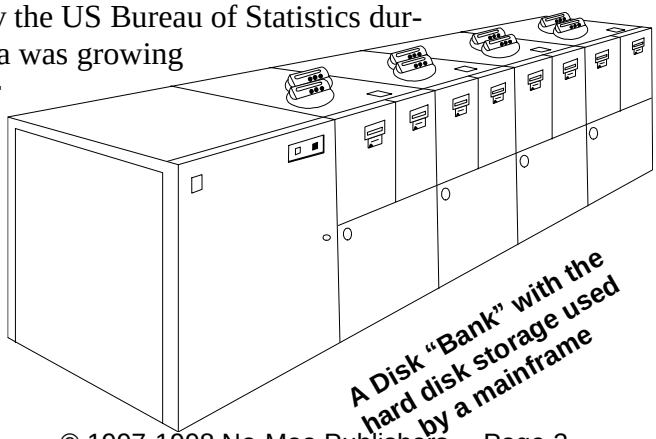


A tape back up unit, the height of a man, used by Mainframes for storing large volumes of data.

Another power of mainframes is that they are designed to connect input/output devices that span vast distances. Like the above example, to connect devices that can be as far away from each other as Nuku'alofa and Pangai, Ha'apai.

The powerful hardware and CPU chips that can support the above work can also be used for making complex calculations, and designs. Mainframes are often used by corporations who design jets or studying aerodynamics effects etc.

One major inducement for the development of these computers originally was the increasing volumes of data collected by the US Bureau of Statistics during the US Census. The volume of data was growing rapidly such that the data required over 9 years to collate, compile, and publish. As a consequence the US Census (which is carried out every 10 years) would re-occur before the data from the previous census was available for the public and the published information was already significantly inaccurate on the date of release.



A Disk "Bank" with the hard disk storage used by a mainframe

Due to the limits of existing technologies of the time, the components of the "Mainframe" were much larger than they are today and required vast spaces to store them. Hence one of the terms synonymous with mainframe computers is "Big Iron" for the literrally BIG space the machines took up and the BIG amount of metal it required to put a machine together.

The most popular maker of mainframes is I.B.M. International Business Machines, a large Multi-national Corporation headquartered in the U.S.A.

Supercomputers

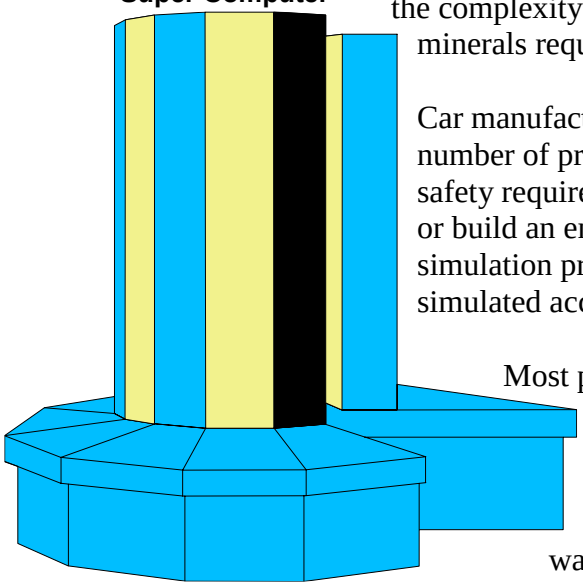
Supercomputers have been developed from the processing requirements of advanced research projects by engineers, scientists and more recently by other research fields. The supercomputer is a title generally given to computers with processing power well exceeding those of the fastest mainframes and its focus is processing data and manipulation of tha data. A significant difference between mainframes and supercomputers is the primary focus of super computers on processing capabilities independent of the many varied input/output devices expected on mainframes.

The major cause for the development of super-class computers has been the continuing need in the scientific community for faster and faster calculations. Scientists working on atomic physics, computer intensive calculations such as natural speech recognition continue to require more and more computational speed to test their theorems.

An example of the use of supercomputers is the USA National Weather Bureau for world wide weather analysis. The Bureau collects weather information from around the world and makes instant analysis of this data. This information is critical for airlines who cannot afford to be late with their knowledge of what the weather conditions are over their flight paths. The incredibly large amount of data that needs to be collected, and the requirement for the answers to become available immediately is why a supercomputer is used.

Large oil companies use supercomputers to analyse their geological findings and weapons developers use supercomputers to test out new theories and strategies. Again, the incredible amounts of data that geologists collect, and the complexity of matching data with what can be potentially oil or minerals requires very powerful computing facilities.

The Cray XMP Super Computer



Car manufacturers simulate in three dimensions a car design and the number of probable accidents that can occur to manage the design safety requirements of vehicles without having to solder any metal or build an engine. Supercomputers have been required for this simulation process due to the complex calculations evaluating a simulated accident and the display in three dimensions.

Most people do not currently need the ability to chart their own world weather map so the supercomputer is not for everyone. Supercomputers usually require specially built facilities and a large staff of computer technicians and computer engineers to maintain the hardware and software.

The most commonly known Supercomputer brand is the "Cray", from Cray Research the first company to develop a "Super" computer. The distinctive, good looks of the Cray Super Computer housed elaborate electronics in a look good box that was poured through with liquid coolant to keep the system cool while it works.

History in the Making

Prior to electronic computers, mechanical devices used for calculations tabulations used mechanical gearing to tabulate occurrences of events and were problematic due to the wear (malfunctions) that occur with moving pieces of machinery and the problems of creating accurate finishes on the mechanical devices to fit the designs.

The First Electric Calculating Machines – Herman Hollerith

To solve the problem, Herman Hollerith invented a calculating, tabulating machine that used electricity rather than mechanical gears. Holes representing information to be tabulated were punched in cards with the location of each hole representing a specific piece of information (male, female, age, etc.) The cards were then inserted into the machine and metal pins used to open and close electrical circuits.

Hollerith's machine was immensely successful and based on its success and together with some friends they formed a company that eventually became known as International Business Machines (IBM).

The first *computer-like* machine is generally thought to be the Mark I, which was built by a team from IBM and Harvard University. The Mark I used mechanical telephone relay switches to store information and accepted data on punched cards, processed it and then output the new data. Because it could not make decisions about the data it processed, the Mark I was not, however, a real computer but was instead a highly sophisticated calculator. It was, nevertheless, impressive and has now been dismantled (decommissioned) with parts of it on display at the Undergraduate Science building at Harvard University.

The First Electronic Computer – Eniac.

In 1943 work began on the *Electronic Numerical Integration and Calculator*, or ENIAC. It was originally a secret military project which was to be used to calculate the trajectory of artillery shells. In one of its first demonstrations it was given a problem that would have taken a team of mathematicians three days to solve. It solved the problem in twenty seconds.

ENIAC was different from the Mark I in several important ways. First, it occupied 1500 square feet, which is the same area taken up by the average two bedroom house and it weighed 30 tons. Second, it used 17,000 vacuum tubes instead of relay switches. Most importantly, because it was able to make decisions, it is considered to be the first true computer.

ENIAC had two major shortcomings. First, it was difficult to change its instructions to allow the computer to solve different problems. It had originally been designed only to compute artillery trajectory tables, but when it needed to work on another problem it could take up to three days of wire pulling, re-plugging and switch flipping to change instructions. Second, because the tubes it contained were constantly burning out, the ENIAC was unreliable.

The mainframe grew out of vacuum tubes and as technology improved the mainframe became smaller and less expensive. Correspondingly, the organisations who could afford the original expensive machines had more money to spend on more features, capabilities so although the mainframe decreased significantly in size, it still remained a large creature using up a lot of electricity and space.

The Stored Program Computer – John von Neumann

In the late 1940's, John von Neumann considered the idea of storing computer instructions and data in memory, which was accessed by a central processing unit, or CPU. The CPU would control all the functions of the computer electronically so that it would not be necessary to flip switches or pull wires to change the instructions. Now it would be possible to solve many different problems by simply typing in new instructions at the keyboard. Together with other computer scientists, von Neumann designed and built the EDVAC (Electronic Discrete Variable Automatic Computer) and the EDSAC (Electronic Discrete Storage Automatic Computer).

With the development of the concept of stored instructions or "programs", the modern computer age was ready to begin. Since then the development of new computers has progressed rapidly, but von Newmann's concept has remained, for most part, unchanged. The next computer to employ von Neumann's concepts was the UNIVersal Automatic Computer, called UNIVAC, developed in 1951.

Computers at this time continued to use many vacuum tubes which made them large and expensive. UNIVAC weighed 35 tons. These computers were so expensive to purchase and run that only the largest corporations and the US government could afford them. Their ability to perform up to 1000 calculations per second, however, made them popular.

The Transistor – BELL Laboratories.

It was BELL Laboratories' invention of the transistor that made smaller and less expensive computers possible, with increased calculating speeds of up to 10,000 calculations per second. Although the size of the computers shrank, they were still large and expensive. In 1963, IBM, using ideas it had learned while working on projects for the military, introduced the first medium-sized computer named the "model 650." It was still expensive, but it was capable of handling the flood of paperwork produced by the many government agencies and businesses.

These new computers also saw a change in the way data was stored. Punched cards were replaced by magnetic tape and high speed reel-to-reel tape machines. Using magnetic tape gave computers the ability to read (access) and write (store) data quickly and more reliably.

Another important advance occurring at the time was the development of programming languages. Previously, computers had to be programmed by setting different switches to their On or Off positions. The first programming languages were very similar, being strings of 1's and 0's representing the status of the switches (1 for On, and 0 for Off). These were called "low-level" languages. Languages such as FORTRAN (FORmula TRANslator), which was the first popular "high-level" language, allowed programmers to use English-like instructions such as READ and WRITE. With them, it was possible to type instructions directly into the computer or on punched cards, eliminating the time consuming task of re-writing.

A number of high-level languages have been developed since that time including COBOL (Common Business Oriented Language), BASIC (Beginner's All-purpose Symbolic Instruction Code), Ada, C, and Pascal.

Cobol was commissioned by the US Department of Defence in 1959 to provide a common language for use on all computers and the development committee was chaired by Commodore Grace Murray Hopper of the US Navy.

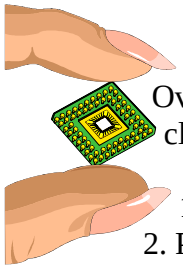
The Integrated Circuits and the Microprocessor

The next major technological advancement was the replacement of the transistor by tiny integrated circuits or "chips." Chips are blocks of silicon with logic circuits etched onto their surface. They are smaller and cheaper than transistors and can contain thousands of circuits on a single chip. Integrated circuits also give computers tremendous speed allowing them to process information at a rate of 1,000,000 calculations per second.

One of the most important benefits of using integrated circuits is to *decrease the cost* and size of computers. The IBM System 360 was one of the first computers to use integrated circuits and was so popular with businesses that IBM had difficulty keeping up with the demand. Computers had come down in size and price to such a point that smaller organisations such as universities and hospitals could now afford them.

A very important advance to occur in the early 70's was the invention of the microprocessor, an entire CPU on a single chip. In 1970, Marcian Hoff, an engineer at Intel Corporation, designed the first of these chips. As a result, in 1975 the ALTAIR microcomputer was born which led to the creation of small software companies such as Microsoft and in 1977 Stephen Wozniak and Steven Jobs designed and built the first mass market microcomputer, the Apple. Microcomputers were inexpensive and engineers, hobbyists were able to take their computers home.

The computer revolution had finally come home for many.



Homework Review Questions - Video Assignments

Over the next week, watch at least one of these videos, and be prepared to discuss in class what type of computer was used, and what was it used for.

1. War Games
2. Patriot Games (Harrison Ford)
3. Star Trek
4. Star Wars
5. Tron
6. Rambo Part II
7. Jurassic park
8. Air Force One
9. Face-Off
10. Men-In-Black
11.
12.

Questions.

What was the movie about?
For what purpose was the computer used?
How did it help the hero/heroine solve his/her problem?

Review Questions

1. A mainframe is the name of one of the 4 types of computers give the names of the

other two:

2. For the above 3 types, give 4 features that one can use to differentiate between them

3. Give one application of mainframe computers

4. Computers are sometimes referred to as “digital computers”. Define what is meant by this term.

5. What was so important about Von Neumann’s contribution.

Sources and References

Presley, Bruce and William Freitas, A guide to structured programming in Basic for the IBM PC and Comptabiles 3rd Edition, (Pennington, Lawrenceville Press, 1992)
Corel CD Office Companion
Long, Larry, Introduction to Computers and Information Systems, 4th Ed. (Englewood Cliffs, Prentice Hall, 1994)
Beekman, George, Computer Currents, Navigating Tomorrow’s Technology, (Redwood City, The Benjamin/Cummings Publishing Co, Inc, 1994)
Siliva, Tonga. Liahona High School 1997 Term 4 Final Exam, Computer Studies Form 5 (TSC)

http://www.tongatapu.net.to/compstud/ - Computer Studies Course Notes
http://www.tongatapu.net.to - **Tonga** on the **'NET**

Tonga on the **'NET** is available on all networked computers at Queen Salote College and participating schools.