

COMPUTER ORGANIZATION AND ARCHITECTURE

Lecture 2

History and future of computers
Introduction to the internet

Dr Victoria Mukami

INTRODUCTION

This unit is a review of the history of computers. We shall look at the various generations of computers, the future of computing and the internet.

Learning objectives

By the end of this topic, you should be able to:

1. Identify the main features from each computer generation
2. Identify features and technologies that make up the future of computing
3. Define the term internet, history, and its uses.

OVERVIEW

Last week we did a review of computers. We learnt what computers are, the basic functions of a computer, the various parts of a computer and the categories of computers. We also did a brief on computer organization and architecture. Today we continue by doing a bit of a history of computers and where we intend to move in the future. This will be a preamble for next week where we will work with the inside of a computer.

EVOLUTION OF COMPUTERS

Computers have truly come a long way in development. When you think of the world before computers, it was truly diverse. There are five generations of computers since the first computer was invented. We first look at the era before the first computer.

Pre-computers

Before the first computer was invented, there were automated ways of doing basic calculations. Examples include the slide rule and the mechanical calculator. In 1890 an inventor known as Herman Hollerith invented a punch card system that aided in the 1880 census calculations. Based on his invention, the census was completed in three years and saved the US government \$5 million. This was the same inventor who founded IBM.

First Generation (the 1940s – 1956)

The first generation of computers featured vacuum tubes. A vacuum tube is a glass tube that looks like an energy saver bulb. The computers used vacuum tubes, were enormous, used huge amounts of electricity and were very expensive. The expense

was brought about by the fact that the vacuum tubes kept breaking down and had to be replaced constantly. Reprogramming the computers meant physically rewiring the machine. This was necessary anytime they had to solve a different problem. The computers used the punch card and paper tape as input and printouts as output. Examples of computers invented during this generation include UNIVAC and ENIAC. Figure 1 is an example of the first-generation computer, specifically the ENIAC machine.

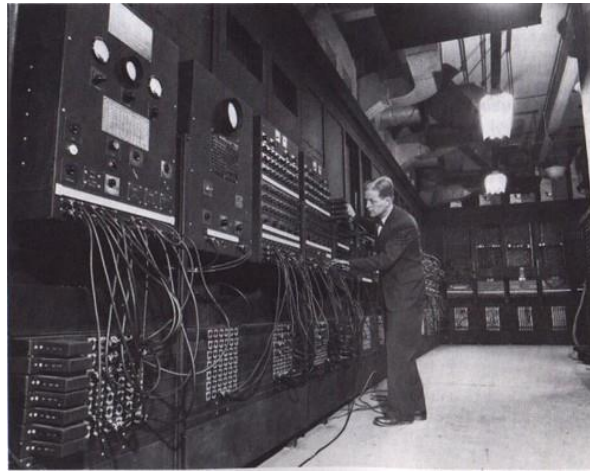


Figure 1: "Eniac" by John Morton is licensed under CC BY-SA 2.0

Second Generation (1956-1963)

The second generation of computers saw the replacement of the vacuum tube with the transistor. The computers were much smaller than the first generation. They used less electricity too than the previous generation. This generation used punch cards and magnetic tape as input and punch cards and printouts as output. Examples of the second generation include IBM1620 captioned in figure 2.



Figure 2: "IBM 1620" by twid is licensed under CC BY-SA 2.0

Third Generation (1964-1971)

The third generation saw the replacement of transistors by integrated circuits. An integrated circuit is a silicon chip that integrated thousands of transistors into the chip. These computers were smaller and more energy-efficient than their predecessors. This generation also saw the introduction of keyboards and monitors. During this era, hard drives were used for storage. Computers saw an increase in speed. An example of a computer from this generation is the Honeywell-6000 and IBM-360.



Figure 3: "IBM 360, Computer History Museum, Mountain View, California, USA" by gruntzooki is licensed under CC BY-SA 2.0

Fourth Generation (1971-2010)

Some say that we are still in the fourth generation while others see the fourth generation as having ended during 2010. The fourth-generation saw the introduction of a microprocessor replacing the integrated circuit from the previous generation. A microprocessor is a single chip with millions of transistors. An example is the intel i7 chip manufactured in 2008 that has approximately 2.99 billion transistors compared to the intel 8086 chip manufactured in 1978 that contained 29,000 transistors. This generation also saw the invention and use of the mouse due to the availability of a graphical user interface on computers.

Fifth Generation (2010 – Present)

This generation is still in progress. The main feature of this generation was the introduction of artificial intelligence. Artificial intelligence involves computers being programmed with human intelligence. In other words, computers can think like human beings, learn from experience, and can mimic human actions. This generation has seen an advancement of smaller computers with the world's smallest computer being smaller than a grain of rice. This generation has also seen the use of quantum computing and nano computing to make advancements to the world of computers.

Artificial Intelligence

Artificial Intelligence is a computing field that focuses on coming up with computers that are capable to perform operations like the human mind [3]. While previously artificial intelligence meant that machines mimicked the human thought process, this has changed with the aim being the production of intelligent output [3]. There are several areas of artificial intelligence research. Some of the more common areas include natural language processing, expert systems and machine learning.

Natural language processing is an area of artificial intelligence that develops systems that can understand written and spoken words by human beings.

Expert systems are programs that act like various human experts and try to give the same advice that a lawyer or a doctor would give.

Machine learning is where computers analyse data and use any patterns to draw conclusions and adjust how the artificial intelligence system acts [3].

FUTURE OF COMPUTING

Over the years various technologies have been created that have made computers smaller, faster, and efficient. Computers have come a long way from the vacuum tube to the microprocessor. Intending to improve computers in the future, several technologies exist. These are discussed below.

3D Chips

As seen in the fourth generation, a microprocessor is a chip that has millions of transistors. This chip is normally a silicon mound that is used to hold the various transistors. Major advancements have been done where within the fourth generation, the silicon chip has been able to hold from thousands of transistors to billions presently. While this progress is exponential it is foreseen that in the future it may not be possible to add any more transistors. This then sets the pace for 3D-Chips.

Three-dimensional chips are one of the solutions to the silicon dilemma. 3-D chips increase the number of components that can go onto a small chip [4]. A 3D chip aims to pack components and layer them vertically, one after the other making it 3D in architecture.

Nanotechnology

Nanotechnology is another technology that is aimed at replacing the current technology used to develop computers and their components. Nanotechnology can be defined as “the science of creating tiny computers and components by working at the individual atomic and molecular levels” [4]. Nanotechnology looks at how smaller components can be used to add processing capabilities while maintaining performance and size. 3D chips discussed above have been tested with various nanotechnology components and the results show great impact.

Quantum Computing

Quantum computing is not a new trend as it emerged in the 1970s. Quantum computing involves using quantum mechanics so that computers work faster and process-specific problems faster. Several quantum computing computers exist although these machines are not considered as fully functioning quantum computing computers [4].

THE INTERNET

When we speak about the internet, so many people get so many ideas. Some talk about it being the cloud up there, some think it's how we communicate, some think it's how we send an email and many other examples. The internet by definition is considered the largest connection of computers globally. In other words, the largest

network in the world. The internet is used to link students to lecturers, from universities to other universities, from governments to other governments. The internet is largely responsible for opening the globe to great opportunities.

The internet evolved from what is known as the ARPANET which was a project of the U.S. Department of Defence whose aim was to allow scientists and military personnel to work collaboratively on military projects [1]. While the original ARPANET had only 4 computers connected to it, the current internet has a billion hosts connected to it. Sometimes the internet gets confused for the **world wide web** (WWW). The worldwide web is a collection of resources found on the internet.

There are various uses for the internet and access to vast resources to the web. Traditional uses like email and mail lists complement newer uses like entertainment, publishing, and research. The uses vary on the user. For instance, while at home an individual may use the internet to watch content online, to chat with others or to find out information like recipes. While at school, a student may use the internet to research, take classes, attend distance learning lessons, and submit assignments. At the office uses range from communication to research and team organization.

There are various ways in which one can connect to the internet. Some include digital subscriber lines (DSL), Fibre, Fixed Wireless, or Wi-Fi. This will be discussed in detail during the networking lecture. For one to access the internet, there are specific companies that would commercially provide internet access at a fee.

Access Provider: This is a business or company that provides internet to individuals or businesses at a fee. Examples of such companies include Safaricom, Liquid Telkom, Faiba. These companies charge a monthly amount to access the internet. For instance, fibre to the home is charged at approximately 3000KES for 8Mbps speed. An internet service provider (ISP) is another name sometimes used interchangeably with the access provider.

Internet Address: For one to be able to access the internet, they need what is called an internet address. An internet protocol (IP) address is a number that uniquely identifies each device connected to the computer [1]. An IP address is a numeric number made of four parts each of three numbers. An example of an IP address is 172.16.0.5. IP addresses will vary on one's location, but each IP address will be

allocated a corresponding domain name. For instance, the IP Address: 197.138.40.19 corresponds to www.health.go.ke

Types of websites

A document stored on the web is called a **webpage**. A **website** on the other hand is a collection of various web pages. Websites are categorized based on various needs. Some categories like news, marketing, educational and entertainment websites are self-explanatory. Examples of news websites include www.nation.co.ke while an educational website would be www.anu.ac.ke. We review several other types below.

Portal

This is a site that offers several services within the same website. For instance, government services can mainly be accessed from a single portal. Within Kenya, this portal is known as e-Citizen. Citizens can apply for passports, business permits, police clearance certificates among other services. A school portal may be able to offer access to tuition enquiries, class notes, attendance records, registration among other services.

Blog

Several informal sites exist that are owned by individuals or companies. A blog is normally in the format of a diary containing posts on various dates that explore any subject [1]. A blog is normally aligned to the author's interest. For instance, the blog <https://bikozulu.co.ke/> is by a writer known as Jackson Biko and is a tribute to everyday stories.

Wiki

A wiki is a site where various authors collaborate to write, edit and post various subject matter online. Wikis are normally open for modification by the public [1]. One of the most famous wikis is Wikipedia.

Social Network

A social network is an area online where members who share common interests can interact with each other. Most members will share stories, podcasts, videos, memes and pictures. Some examples of social networks include Facebook, Instagram and YouTube.

Web Application

A web app is a site where users can access and interact with software through any browser without having to install the software on their machines [1]. Web apps may either provide access free of charge or may charge to access services. Some examples include Google Sheets, One Drive and Netflix.

SUMMARY

During the lecture, we have managed to look back at the history of computers. We reviewed the five generations of computers, their main characteristics, and inventions. Additionally, we peeked at the future of computers and the direction they are taking. Finally, the term internet was introduced, and the various types of websites were reviewed.

DISCUSSION TOPIC

The internet has opened the globe and aided in sharing of information, collaboration across continents and even opened a global market leading to the term globalization. If the internet was to fail, would there be catastrophic consequences and if so, what are some of the things that can be done to mitigate this?

REFERENCES

- [1] G. Shelly and M. Vermaat, Discovering Computers — Fundamentals: Your Interactive Guide to the Digital World. Boston, MA: Course Technology, 2012.
- [2] W. Stallings, Computer Organization and Architecture Designing for Performance. Hoboken, NJ: Pearson Education, Inc, 2016.
- [3] A. Evans, K. Martin and A. Poatsy, Technology in Action. New York, NY: Pearson, 2020
- [4] D. Morley and C. Parker, Understanding Computers: Today and Tomorrow. Boston, MA: Course Technology, 2017.