CHAPTER 2

HARDWARE & SOFTWARE APPLICATIONS

Objectives

- Current storage (measurements, types)
- Peripheral components
- Processing
- System software (OS, NOS, utilities, virus)
- Security
- Licensing considerations and ethics

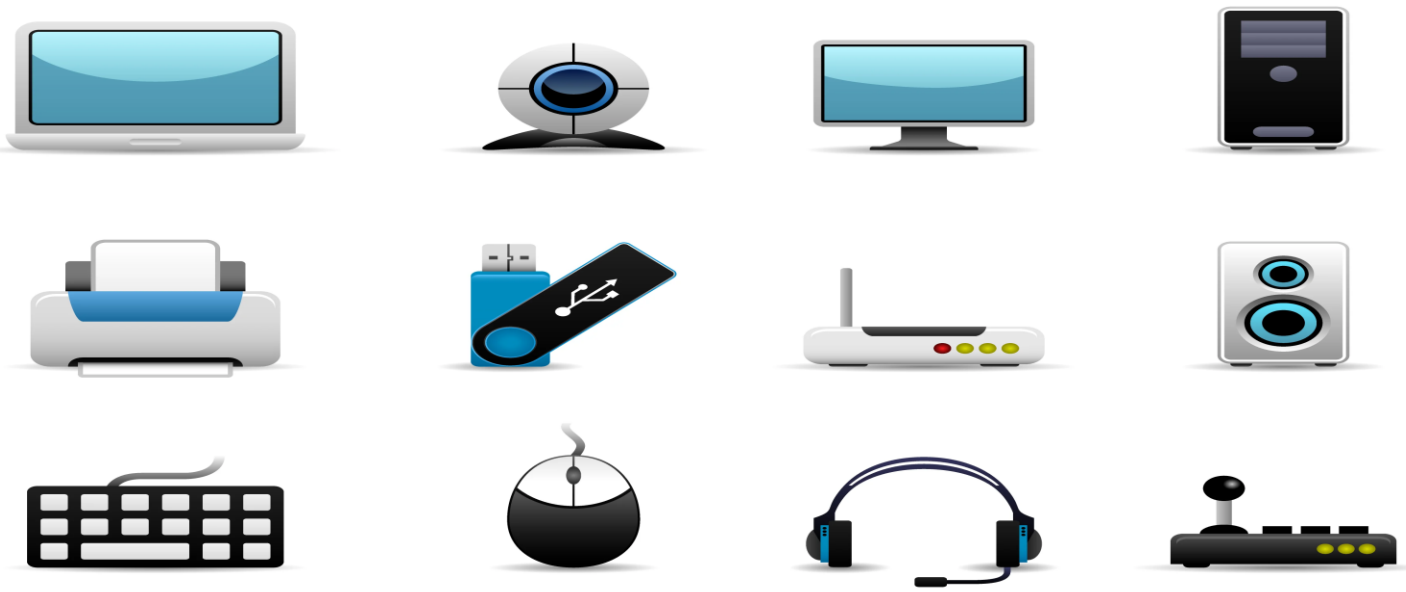
Introduction

Changes in hardware and software reflect the continuous evolution of information systems, driven by advancements in technology and changing user needs.

These innovations have had a profound impact on how we work, communicate, and interact with technology in our daily lives.

HARDWARE

- **Hardware:** The physical equipment used for input, processing, output, and storage activities of a computer system



Decisions about hardware focus on three interrelated factors

1. appropriateness for the task
2. speed
3. cost.

Components of Hardware

- **Central processing unit (CPU):** Manipulates the data and controls the tasks performed by the other components.
- **Primary storage**: Temporarily stores data and program instructions during processing.
- **Secondary storage**: Stores data and programs for future use.
- **Input technologies**: Accept data and instructions and convert them to a form that the computer can understand.
- **Output technologies**: Present data and information in a form people can understand.
- **Communication technologies**: Provide for the flow of data from external computer networks (e.g., the Internet and intranets)

Storage Measurement

As the capacities of digital devices grew, new terms were developed to identify the capacities of processors, memory, and disk storage space.

Prefix	Represents	Example
kilo	one thousand	kilobyte=one thousand bytes
mega	one million	megabyte = one million bytes
giga	one billion	gigabyte = one billion bytes
tera	one trillion	terabyte = one trillion bytes

peta	one quadrillion	petabyte = one quadrillion bytes
exa	one quintillion	exabyte = one quintillion bytes
zetta	one sextillion	zettabyte = one sextillion bytes
yotta	one septillion	yottabyte = one septillion bytes

Types of Storage

1. Primary Storage

Main memory, stores three types of information for very brief periods of time:

- ❖data to be processed by the CPU
- ❖instructions for the CPU as to how to process the data
- ❖operating system programs that manage various aspects of the computer's operation

Types of Primary Storage

- **Registers:** Have the least capacity, stores extremely limited amounts of instructions and data.
- **Cache memory:** A type of high-speed memory that enables the computer to temporarily store blocks of data that are used more often and that a processor can access more rapidly than main memory (RAM).
- **Random access memory (RAM):** The part of primary storage that holds a software program and small amounts of data for processing.
- **Read-only memory (ROM):** A type of chip—where certain critical instructions are safeguarded.

2. Secondary Storage

Designed to store very large amounts of data for extended periods. Secondary storage has the following characteristics:

Characteristics of Secondary storage:

- It is nonvolatile.
- It takes more time to retrieve data from it than from RAM.
- It is cheaper than primary storage
- It can utilize a variety of media, each with its own technology.

Peripheral Components

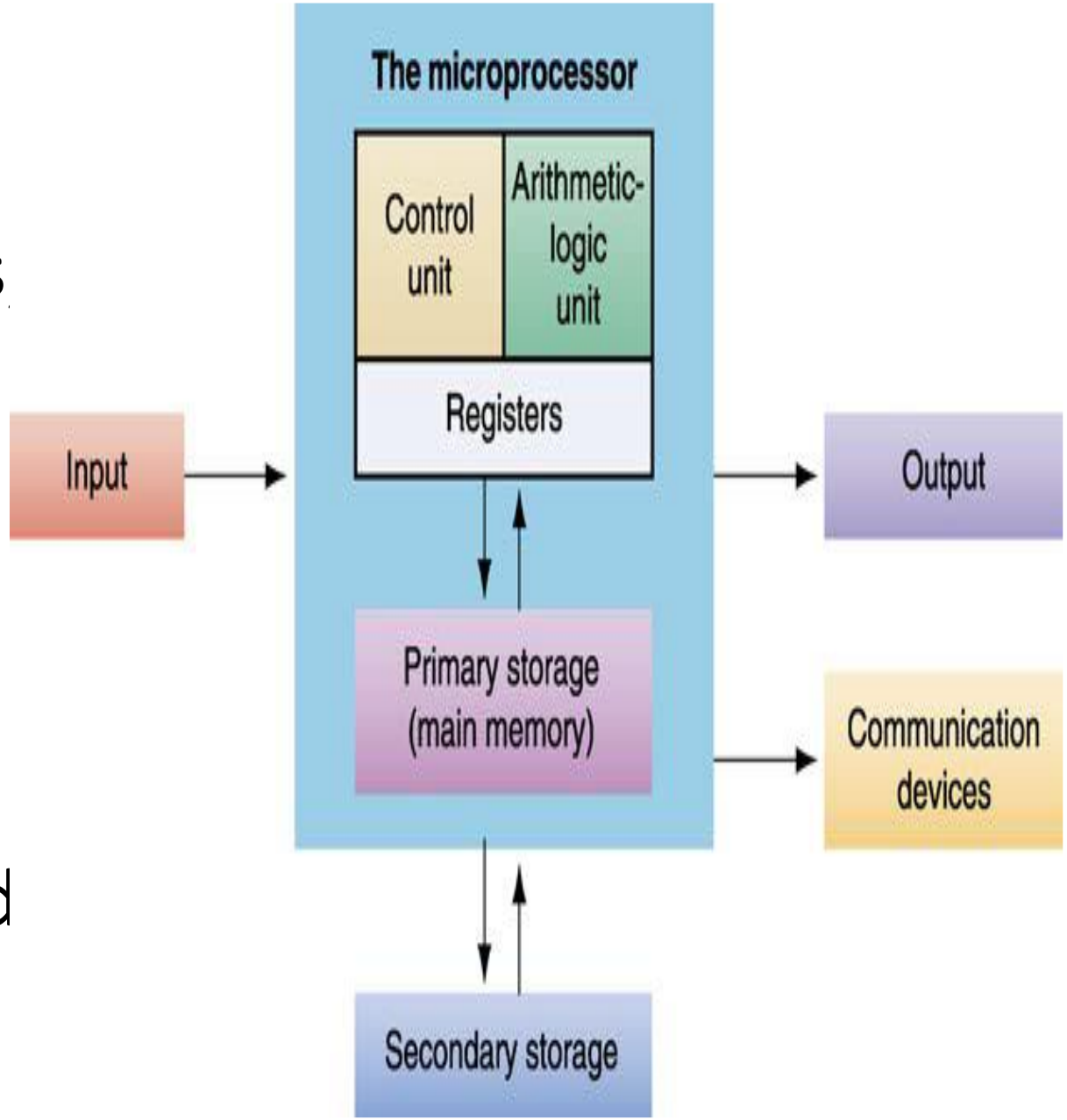
A peripheral device is generally defined as any auxiliary device such as a computer mouse or keyboard, that connects to and works with the computer in some way.

Processing

- The core of a computer is the Central Processing Unit (CPU).
- It can be thought of as the “brains” of the device
- The CPU performs the actual computation inside any computer.
- The CPU is a microprocessor (e.g., Intel’s Core i3, i5, and i7 made up of millions of microscopic transistors embedded in a circuit on a silicon wafer or chip.

Parts of the CPU

- The **control unit** sequentially accesses program instructions, decodes them, and controls the flow of data to and from the arithmetic logic unit.
- The **arithmetic logic unit (ALU)** performs the mathematical calculations and makes logical comparisons.



Computer Speed

Hardware Components that Contribute to the Speed of a Computer

Component	Speed measured by	Units	Description
CPU	Clock speed	GHz (billions of cycles)	Hertz indicates the time it takes to complete a cycle.
Motherboard	Bus speed	MHz	The speed at which data can move across the bus.
RAM	Data transfer rate	Mb/s (millions of bytes per second)	The time it takes for data to be transferred from memory to system measured in Megabytes.
Hard Disk	Access time	Ms (millisecond)	The time it takes for the drive to locate the data to be accessed.
	MBit/s	Mbit/s	The time it takes for data to be transferred from disk to system.

Other Computing Devices

- A personal computer is designed to be a general-purpose device, able to solve many different types of problems.
- Many components have been integrated into other devices that previously were purely mechanical.
- Definition or description of what defines a computer has changed.
- Portability has been an important feature for most users.
- Here is an overview of some trends in personal computing.

Other Computing Devices

- **Portable Computers**: These include laptops, note books and netbooks (Network Books – no hard drives, depends on cloud for data and application storage). Most portables weigh less than 4 pounds with longer battery life.
- **Tablet Computers**: Uses touch screen and portable. E.g. the iPad, tablets, etc. No keyboard and self-contained.

Other Computing Devices

- **Smartphones**: Evolved from cell phones in the 1970s. Provide users with telephone, email, location, etc and function as a highly mobile computer, connect to the Internet.
- They revolutionised computing, bringing **mobility**, a feature PCs and laptops could not deliver.
- In 2018 more than 3.7 billion global mobile Internet users
- Mobile devices influenced over $1.4 trillion sales in 2016
- Mobile E-commerce in US projected to be $459.38 Billion in 2018 & 4693.36 in 2019

Integrated Computing and Internet of Things (IoT)

- IoT is a network of billions of devices, with unique network address, allowing them to connect to the Internet for the purpose of collecting and sharing data, all without the involvement of human beings.
- From automobiles to refrigerators to airplanes, computing technology is enhancing what these devices can do and is adding capabilities into our every day lives thanks in part to IoT

The Commoditization of the Personal Computer

- The PC part of everyday life, and also become a commodity.
- As commodities, there are little or no differences between computers made by different companies,
- The primary factor that controls their sale is their price.
- Apple has chosen a strategy of differentiation to avoid commoditization, hence, they can charge higher prices.

• Changes in Hardware

- 1. Miniaturization and Portability: Hardware has become smaller and more portable. Devices like smartphones, tablets, and laptops have replaced traditional desktop computers for many tasks, allowing users to work and access information from anywhere.
- 2. Increased Processing Power: Advances in microprocessor technology have led to significant increases in processing power. This has enabled more complex and resource-intensive applications, such as video editing and 3D modelling, to run smoothly on consumer devices.
- 3. Connectivity: The proliferation of high-speed internet and wireless networking technologies, including 4G and 5G, has made it possible to connect devices seamlessly. The Internet of Things (IoT) has also emerged, connecting various everyday objects to the internet.

• Changes in Hardware

- 4. Cloud Computing: The rise of cloud computing has transformed hardware usage. Instead of relying solely on local servers and storage, organizations can now access and store data and applications on remote servers via the internet, reducing the need for on-site infrastructure.
- 5. Quantum Computing (Emerging): Quantum computing is an emerging technology that has the potential to revolutionize computing by performing complex calculations at speeds impossible for classical computers. While still in its early stages, it holds promise for solving complex problems in fields like cryptography and materials science.

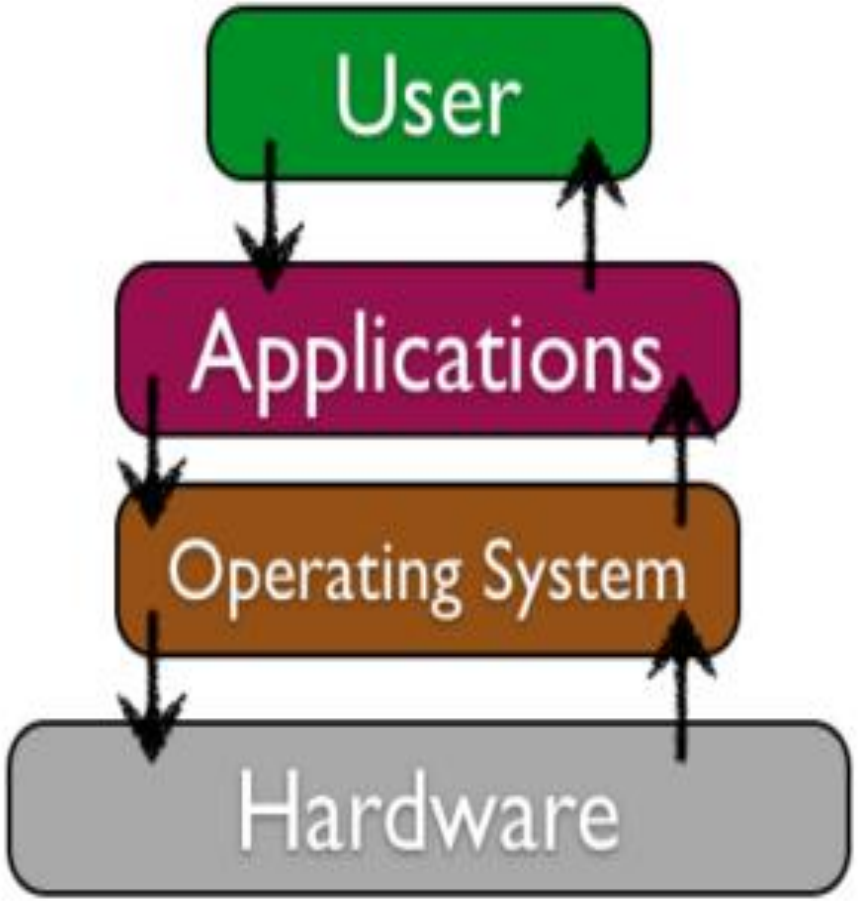
SOFTWARE

Software

- The set of instructions, data or programs used to operate computers and execute specific tasks.
- The set of instructions that tells the hardware what to do.
  Software
  is created by developers through the process of programming
- Without software, the hardware would not be functional
- The first software applications for computers in business were developed in the early 1950s.
- There are two types of Software

1. **Operating systems**

- Operating systems provide you with these key functions:
  1. managing the hardware resources of the computer;
  2. providing the user-interface components;
  3. providing a platform for software developers to write applications.



2. **Application Software**

- Performs specific tasks such as word processing, accounting, video games, etc

Productivity Software

- Standard tools for the workplace.
- These programs allow office employees to complete their daily work efficiently.

- These include:
  - ❖ Word Processing
  - ❖ Spreadsheet
  - ❖ Presentation
  - ❖ Others

Utility Software and Programming Software

- **Utility software:** Programs that allow you to fix or modify your computer in some way.
- E.g. anti-malware software and programs that totally remove software you no longer want installed.
- These types of software packages were created to fill shortcomings in operating systems.

- **Programming software:** Purpose is to produce software.
- These programs provide developers with an environment to write code, test it, and convert/compile it into the format that can then be run on a computer.
- They are typically identified as the *Integrated Development Environment* (IDE); and
- Are provided free from the corporation that developed the programming language that will be used to write the code.

Network Operating System (NOS)

- ✓Runs on a server, giving the server the capability to manage data, users, groups, security, applications, and other networking functions.
- ✓The basic purpose of the NOS is to allow shared file and printer access among multiple computers in a network such as LAN, a private network or to other networks.
- ✓Examples of NOS include Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X, Novell NetWare, and BSD.

Network Operating System (NOS)

Advantages

1. Centralized servers are highly stable.
2. Security is server managed.
3. Upgradation of new technologies and hardware can be easily integrated into the system.
4. It is possible to remote access to servers from different locations and types of systems.

Disadvantages

1. High cost of buying and running a server.
2. Dependency on a central location for most operations.
3. Regular maintenance and updates are required.

Applications for the Enterprise

- Applications developed in the 1990s to bring an organization's information under centralized control.
- The Enterprise Resource Planning (ERP) system (sometimes just called enterprise software) was developed to bring together an entire organization within one program.
- ERP software utilizes a central database that is implemented throughout the entire organization.
- Some of the more well-known ERP systems include those from SAP, Oracle, and Microsoft.

Here are some key points about ERP

- **A software application.** ERP is an application that is used by many of an organization's employees.
- **Utilizes a central database.** All users of the ERP edit and save their information from the same data source.
- **Implemented organization-wide.** ERP systems include functionality that covers all of the essential components of a business. An organization can purchase modules for its ERP system that match specific needs such as order entry, manufacturing, or planning

So why implement an ERP system?

- If done properly, an ERP system can bring an organization a good return on their investment.
- By consolidating information systems across the enterprise and using the software to enforce best practices, most organizations see an overall improvement after implementing an ERP.

Mobile Applications

- Mobile devices such as smartphones and electronic tablets also have operating systems and application software.
- These mobile devices are in many ways just smaller versions of personal computers.
- A mobile app is a software application designed to run specifically on a mobile device.
- Smartphones are becoming a dominant form of computing, with more smartphones being sold than personal computers.

Cloud Computing

- The “cloud” refers to applications, services, and data storage located on the Internet.
- Cloud service providers rely on giant server farms and massive storage devices that are connected via the Internet.
- Cloud computing allows users to access software and data storage services on the Internet.
- You probably already use cloud computing in some form.
- E.G., if you access your e-mail via your web browser, you are using a form of cloud computing if you are using Google Drive’s applications.

Cloud Computing

- **Advantages**
- No software to install or upgrades to maintain.
- Available from any computer that has access to the Internet.
- Can scale to a large number of users easily.
- New applications can be up and running very quickly.
- Services can be leased for a limited time on an as-needed basis.
- Your information is not lost if your hard disk crashes or your laptop is lost or stolen.
- You are not limited by the available memory or disk space on your computer.

- **Disadvantages**
- Your information is stored on someone else's computer.
- You must have Internet access to use it.
- You are relying on a third-party to provide these services

Cloud Computing

- Cloud computing has the ability to really impact how organizations manage technology.
- For example, why is an IT department needed to purchase, configure, and manage personal computers and software when all that is really needed is an Internet connection?
- **Using a Private Cloud**
- Many organizations are nervous about control of their data and some of their applications by using cloud computing.
- However, they see the value in reducing the need for installing software and adding disk storage to local computers.
- They can use a private cloud, the basic idea is for the cloud service provider to section off web server space for a specific organization.
- The organization has full control over that server space while still gaining some of the benefits of cloud computing.

Virtualization

- The process of using software to simulate a computer or some other device.
- For example, using virtualization a single physical computer can perform the functions of several virtual computers, usually referred to as Virtual Machines (VMs).
- Organizations implement virtual machines to reduce the number of physical servers needed to provide the necessary services to users.
- This reduction in the number of physical servers also reduces the demand for electricity to run and cool the physical servers.

Open-Source Software

- Open-source software makes the source code available for anyone to copy and use.
- The open-source movement has led to the development of some of the most used software in the world such as the Firefox browser, the Linux operating system, and the Apache web server.
- There are thousands of open-source applications available for download.
- For example, you can get the productivity suite from Open Office.
- One good place to search for open-source software is sourceforge.net, where thousands of programs are available for free download.

Computer Virus

- Is a malicious piece of computer code designed to spread from device to device.
- A subset of malware, these self-copying threats are usually designed to damage a device or steal data.

❑Some computer viruses are programmed to harm your computer by damaging programs, deleting files, or reformatting the hard drive.

❑Others simply replicate themselves or flood a network with traffic, making it impossible to perform any internet activity.

Examples of Computer Viruses

Worms - A type of virus that, unlike traditional viruses, usually does not require the action of a user to spread from device to device.

Trojans - A virus that hides within a legitimate-seeming program to spread itself across networks or devices.

Ransomware - A type of malware that encrypts a user's files and demands a ransom for its return. Ransomware can be, but isn't necessarily, spread through computer viruses.

Computer virus protection

- ✓Use antivirus protection and a firewall
- ✓Get antispyware software
- ✓Always keep your antivirus protection and antispyware software up-to-date
- ✓Update your operating system regularly
- ✓Increase your browser security settings
- ✓Avoid questionable Websites
- ✓Only download software from sites you trust.

• Software Licensing and Ethics

- Making copies of software without the manufacturer's explicit permission is known **as *piracy*—is illegal.**
- The Business Software Alliance a nonprofit trade association dedicated to promoting a safe and legal digital world, collects, investigates, and acts on software piracy tips.
- The BSA has calculated that piracy costs software vendors around the world billions of dollars annually.
- Most of the tips the BSA receives come from current and past employees of off ending companies.

•Software Licensing and Ethics

- A company can copyright its software to protect their investment, which means that the Copyright Office grants the company the exclusive legal right to reproduce, publish, and sell that software.
- IS managers are finding it increasingly difficult to supervise their software assets. In fact, the majority of chief information officers (CIOs) are not confident that their companies were in compliance with software licensing agreements.

•Personal Information Security

Keep your software up to date. Whenever a software vendor determines that a security flaw has been found in their software, an update will be released so you can download the patch to fix the problem. You should turn on automatic updating on your computer to automate this process.

Install antivirus software and keep it up to date.

There are many good antivirus software packages on the market today,

• Personal Information Security

Be smart about your connections. When connecting to a Wi-Fi network in a public place, be aware that you could be at risk of being spied on by others sharing that network. It is advisable not to access your financial or personal data while attached to a Wi-Fi hotspot.

Make your passwords long, strong, and unique. Your passwords should be long (at least 12 random characters) and contain at least two of the following: uppercase and lowercase letters, digits, and special characters. Passwords should not include words that could be tied to your personal information, such as the name of your pet.

- **Personal Information Security**

Be suspicious of strange links and attachments. When you receive an e-mail, tweet, or Facebook post, be suspicious of any links or attachments included there. Do not click on the link directly if you are at all suspicious. Instead, if you want to access the website, find it yourself with your browser and navigate to it directly.

Backup your data. Just as organizations need to backup their data, individuals need to so as well. The same rules apply. Namely, do it regularly and keep a copy of it in another location. One simple solution for this is to set up an account with an online backup service to automate your backups.

• Changes in Software

- 1. **Operating Systems**: Operating systems have evolved significantly. Windows, macOS, and Linux continue to dominate the desktop market, while iOS and Android dominate the mobile market. Additionally, open-source operating systems like Android have gained popularity.
- 2. **User Interfaces**: Graphical user interfaces (GUIs) have become more intuitive and user-friendly. Touchscreen interfaces are now the norm for mobile devices, and voice-based interfaces (e.g., Siri, Alexa) are becoming increasingly prevalent.
- 3. **Software as a Service (SaaS):** The SaaS model has gained traction, offering software applications on a subscription basis via the cloud. Popular examples include Google Workspace, Microsoft 365, and Adobe Creative Cloud.
- 4. **Open-Source Software**: Open-source software has seen widespread adoption in various fields. Linux, Apache, and MySQL are examples of open-source software that underpin many web servers and data centers.

• Changes in Software

- 5. **Artificial Intelligence and Machine Learning**: AI and machine learning have become integral to many software applications, enabling features like natural language processing, image recognition, and recommendation systems.
- 6. **Cybersecurity Software**: With the increasing threats to data and privacy, cybersecurity software has become more sophisticated. This includes antivirus programs, firewalls, intrusion detection systems, and encryption tools.
- 7. **Mobile Apps**: The proliferation of mobile apps has transformed how we use smartphones and tablets. App stores like Apple's App Store and Google Play offer a vast array of applications for everything from social networking to gaming and productivity.