The sections shaded green are queries for you. In some cases, I need you to flesh out the text a bit more. In others I find the text confusing and need you to explain the concept a bit more clearly.

Any text shaded yellow is what I have included, please confirm that this is correct.

Any text shaded blue is available on doing a quick google search. Please amend this text.

### 1.1.10 Different types of input hardware based on use and classification

We have seen that hardware can be split into **input devices**, processing devices, **output devices** and storage devices. Input devices are used to get data and instructions into the computer. Input devices can further be split into direct and indirect input hardware.

**VOCABULARY**

**Input device** – is a hardware device that is used by computer users to get data and instructions into the computer.

**Output device**—a hardware device used by computer users in receiving information processed by the computer. Output devices convert data into various other forms such as audio, visual or hardcopy.

**Direct input hardware**

Direct data entry devices are specifically designed to automate or speed up the entry of data into the system by minimising human data entry. They have a wide range of uses in education, retail and business sectors. They consist of either specialist hardware, software (or both) and come in several different forms. Some examples are shown in Table 1.4.

**[Please don’t worry about the redraw instructions, it is for the illustrator and typesetter]**

|  |  |  |
| --- | --- | --- |
| **Input hardware** | **Description** | **Example** |
| Magnetic stripe reader | This device reads data from magnetic stripes on mostly banking cards, membership cards or hotel door cards. The stripe on the card holds data such as membership information. | [AW: redraw] |
| Chip reader | This device reads data from the chip on bank cards or shopping cards. The chip and pin reader work by inserting the card into a slot and then entering a PIN (personal identification number). | A picture containing person, indoor, remote, game  Description automatically generated  [AW: redraw] |
| PIN keypad | This device is used to enter data into Automated Teller Machines (ATM), EFTPOS systems, entry doors and handheld devices. | A pin keypad is shown on the chip reader above. |
| Optical mark reader | This device is used to read and input information from a form made in pen or pencil. Typically used to read multiple choice questions. The OMR shines on to the form and less light is reflected where a pencil mark has been made. | [AW: redraw] |
| Barcode reader | This device is used to scan barcodes directly from products, books and membership cards. | [AW: redraw] |
| Tap cards | These are contactless cards which are used to transmit data to a card reader. The user just taps on the reader and the process is completed. |  |
| Quick Response (QR) codes | QR codes are like barcodes but consists of black squares and dots which look like an image. The image can then be scanned/read by a smartphone camera to direct users to specific web addresses. |  |

***Table 1.4: Examples of direct input hardware***

With advances in technology, input devices have changed tremendously. Nowadays, people can track their health  and manage calls using their smart watches. A person can answer all calls and respond to emails using a smart watch. Another common trend that we see is the use of Quick Response (QR) codes in most marketing and advertising to track product information in supply chains.

**Indirect input hardware**

If the data is in human readable form, it must be converted into machine readable form so that a computer can process it. This process of data conversion is time consuming and error prone and causes delays in data processing. Some examples of indirect input devices are keyboards, mice and joysticks. When you press any key on a keyboard, it converts that character into a series of electronic pulses and sends them to the CPU.

**Activity 1.1 PAIR ACTIVITY**

Work with a partner.

Categorise the following devices into direct and indirect input hardware.

1. Mouse

2. Joystick

3. Light pen

4. Track Ball

5. Scanner

6. Graphics Tablet

7. Microphone

8. Magnetic Ink Card Reader (MICR)

9. Optical Character Reader (OCR)

10. Barcode Reader

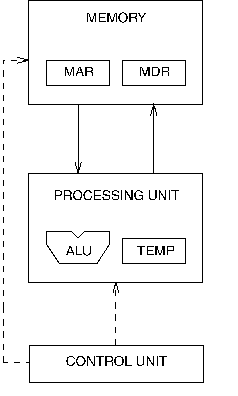
11. Optical Mark Reader (OMR)

12. Keyboard

### 1.1.11 Data transfer between memory and the CPU

**[primary and secondary memory? See below]**

The connections between the CPU and memory are shown in Figure 1.16.



**Figure 1.16: CPU interaction with memory**

[AW: PLEASE REDRAW] [for illustrator]

Communication between memory and the CPU takes place through two registers:

**Memory Address Register (MAR)**

The Memory Address Register (MAR) holds the memory location (address) of the data that needs to be accessed.

**Memory Data Register (MDR)**

The Memory Data Register (MDR) holds the data which is transferred between the memory and the CPU.

|  |  |
| --- | --- |
| **When reading data** | **When writing data** |
| 1. The address of the location is put in MAR. | 1. The address of the location is put in MAR. |
| 2. The memory is enabled for a read. | 2. The data is put in MDR. |
| 3. The value is put in MDR by the memory. | 3. The *write enable* signal is *asserted*. |
|  | 4. The value in MDR is written to the location specified. |

***Table 1.5: Processes for reading and writing data***

**The use of buses**

Data is transmitted from one part of a computer to another by means of buses, connecting all major internal components to the CPU and memory.

* The address bus carries the addresses of data (but not the data itself) between the processor and memory.
* The data bus carries data between the processor, the memory unit, and the input/output devices.
* The control bus carries control signals/commands from the CPU (and status signals from other devices) to control and coordinate all the activities within the computer.

**[the syllabus mentions primary and secondary storage, does the following make sense as a mention of secondary, or could you provide a paragraph?]**

**Primary and secondary memory**

The processes described above refer to data held in primary memory. When you are working with data stored in secondary memory, or wanting to write to a secondary storage device, that would be treated as an input/output or storage device and the data would be transferred from there to primary memory as a first step when reading data, or written to the device as a final step when writing data. Remember, the memory hierarchy discussed in section 1.17 where we spoke about primary memory as computers main memory and secondary storage as disks USB Solid state drives and others.

### 1.1.12 The flow/transfer of data between components

**[(Range: USB – PnP, U3, Point-to-point connections) I can’t see that the range is covered. I suggest a list or table mentioning each and very briefly if/how they are used ]**

High speed processing and fast throughput are key goals in developing computers. These goals are being achieved through the design of computer components as well as the appropriate structure and organisation of the architecture. There are also rapid advancements in the manufacture of integrated circuits resulting in faster more compact components being available at a lower cost.

The flow of data can be managed through various techniques and devices.

**USB**- USB stand for Universal Serial Bus and it allows communication between devices and host controller. The most common uses of USB flash drives are storing files, creating backups, and transferring files between computers. USB’s are plug and play. This means they do not need any manual configurations for them to work.

**U3** technology allows you to store data and software applications on the same flash drive. U3 technology was a joint venture between two disk manufacturing companies (SanDisk and M-Systems ). The technology allowed launching Windows software from flash drives. The companies have since stopped support for these devices.

**Point-to-point connections**-Data can also be transmitted via point-to-point connections. Point-to-point connections offer businesses secure and dependable network data services. However, due to criminals vandalizing the cables, point-to-point connections have recently become a nightmare in South Africa.

**[There was some repetition around buses, and I wasn’t clear about what a computer bus is. Is the following correct?]**

Remember that a data bus is a set of wires or a connector that allows the transfer of data between the processor, the memory unit, and the input/output devices. You have seen that there are different types of buses. Apart from the data bus, there is also an address bus and a control bus. The address bus is used to transfer address bits to the memory. The control bus is used to transfer control bits from control units to other components of the computer.

Collectively we refer to a computer bus. This may take the form of wired cables or be electrical wires embedded or etched into the computer motherboard PCB (Printed Circuit Board).

The function of a data bus is to allow components to communicate either with each other or with the outside world. A data bus can transfer data to and from the memory of a computer, or into or out of the CPU. It can also transfer information between two computers. The amount of data that can be transferred by a data bus is referred to as **bandwidth.** If we consider the speed of the bus or bit transfer, then one wire or bus transfers millions of bits per second.

**[I thought parallel and serial needed an intro. Is this correct?]**

Data may be transferred by serial or parallel buses and most modern computers use both. Here are the key differences between parallel and serial data buses.

|  |  |
| --- | --- |
| **Parallel data buses** | **Serial data buses** |
| Carry data on many wires simultaneously | Has one wire that carries all the bits of data |
| Each wire carries one bit of data | Most common serial data buses: Universal Serial Bus (USB), FireWire, Serial ATA, Serial Attached SCSI. |
| Most common parallel buses: Advanced Technology Attachment (ATA), PC card, Small Computer System Interface (SCSI) |  |

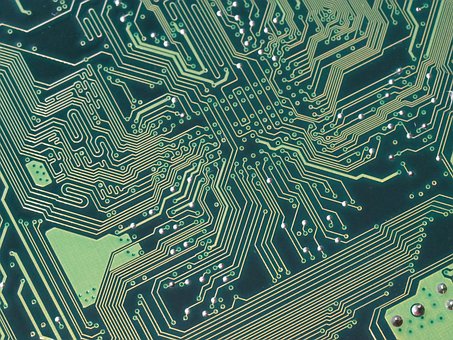
***Table 1.6: Parallel and serial data buses***

Figures 1.17 and 1.18 illustrate buses as a set of wires or connectors and as wires embedded in the motherboard respectively.



**Figure 1.17: Data bus by means of wires and connectors**

[AW: redraw] [for illustrator]



**Figure 1.18: Connections on the motherboard PCB form part of the computer bus**

**Data transfer from Universal Serial Bus (USB)**

When the software requires data transfer to occur between itself and the USB, it sends a block of data called an *I/O Request Packet (IRP)* to the appropriate location, and the software is later notified when this request is completed successfully or terminated by error.

The actual data is sent across the bus in *packets*. Each packetis a bundle of data along with information concerning the source, destination and length of the data, as well as error detection information.

**[the following is possibly too complex for this level and uses terminology they have not encountered. I think leave out, unless there is a good reason to keep it in.]**

~~Each packet is made up of parts called~~ *~~fields~~* ~~including the following, summarised in Table 1.7. The numbers represent the size of the field in bits, unless otherwise indicated.~~

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ~~Sync(8)~~ | ~~PID(8)~~ | ~~Address~~ | ~~Endpoint~~ | ~~Data (0-1 023 bytes)~~ |

***~~Table 1.7: A typical data packet~~***

* ~~An eight-bit~~ *~~SYNC~~* ~~synchronisation field used by inputs to correct their timing for accepting data. This marks the start of a data packet.~~
* ~~The 8-bit Packet Identifier (~~*~~PID~~*~~) which uses 4 bits to determine the type, and hence format, of the packet data. The remaining 4 bits are a 1's complement of this, acting as check bits. Part of this field determines which of the four groups (token, data, handshake, and special) the packet belongs to, and specifies an input, output or setup instruction.~~
* ~~An~~ *~~address field~~* ~~gives the address of the function on the end of the pipe to be used.~~
* ~~The 4-bit~~ *~~endpoint field~~*~~, gives the appropriate endpoint which sends or receives the packet.~~
* ~~The~~ *~~data field~~* ~~may~~~~consist of 0-1 023 bytes.~~

### 1.1.13 Factors to consider when choosing an input device

**[Range: Ergonomic considerations, Wireless vs cables). … There is no mention of ergonomics]**

We have seen in Section 1.10 that input devices are peripherals from which computers receive data. Keyboards, mice, scanners, and webcams are some examples. If you select the right accessories, you can extend the capabilities of your computer and increase productivity. Make the most of your next computer accessory purchase by understanding the factors to consider when selecting input devices. When it comes to devices, the concept of ergonomics comes into play. Ergonomics is concerned with device considerations that fit the user's purpose and intentions, with obvious safety and efficiency in mind for the chosen purpose. Users choose devices that are more comfortable for them while also serving the intended purpose. Here are some of the factors to consider:

**[The following blue shaded text is the very first occurrence on a google search. Please supply relevant original text that also refers to ergonomic considerations.]**

* **User needs-** When selecting a device, it is critical to identify the user's requirements. Some users place a premium on convenience and efficiency. Others may place a higher value on satisfaction. For example, when capturing large amounts of data, one can choose to use a keyboard if his or her typing speed is fast. Some people may prefer to scan the document.
* **Initial cost-** Users choose a device based on their ability to pay. Of course, some users are more concerned with the quality and design of the devices they use.
* **Maintenance Cost**- The lifespan of a product is an important consideration when selecting devices. A brand that easily breaks or has problems will not be on the top of the list of choices because the costs of repair or service may exceed the cost of the product. Let’s take for example, wireless or wired mouse and keyboard. Discuss with your classmate which one would you choose and why. Also discuss some common brands that you would consider over the ones which you do not prefer.
* **Mode Of Transmission**- In most cases, if one uses the devices away from the office, wireless devices are more preferred. If concern is on uninterrupted communication, wired connections are ideal.
* **Compatibility With Available Hardware**- configuring devices every time when they are connected on to a new device can be taxing. Purchasing devices which are plug and play and also compatible with most hardware and software saves a lot of time.
* **User- Friendliness**- Usability is a key factor when selecting devices. If the user’s technical skills are weak, it is ideal to select devices which do not require a lot of expertise. Plug and play devices are user friendly as it requires the user to connect only and will be ready for use.

**Wireless vs wired connection**

**[I filled out this section a bit, correct?]**

Cables are typically faster than a wireless connection, and also offer other advantages. Cable connections are more secure and stable than wireless connections. Most input devices these days can connect to the computer via a cable plugged into a USB port. Modern computers may be fitted with several USB ports. An input/output port is a socket into which the device cable is plugged.

Most wireless connections these days are achieved by use of Bluetooth technology. There are numerous options available for Bluetooth mice, keyboards, scanners and barcode readers.

### 1.1.14 Different types of output hardware

Output devices are used to provide information or the results of computer processing to users. Examples include monitors, printers, projectors and plotters. The output may be in the form of audio, visual, print or data. Output devices are used to present the computer data to users in human understandable form. Let’s examine some common types of output hardware.

**Monitor**

A computer’s principal output device is a monitor, or screen, often known as a Visual Display Unit (VDU). It displays the processed data as text and images. Monitors have evolved from the old-style terminals which had Cathode-Ray Tube (CRT) monitors to flat screens which may be LCD, LED, OLED or plasma.

**Printer**

The printer is an output device that creates a hard copy of the processed data or information. Printers are divided into two categories:

* Impact printers
* Non-impact printers

*Impact printer*

An impact printer uses an ink ribbon. Characters are printed onto paper by striking an ink ribbon against it with a hammer or print head. Impact printers are relatively cheap, making them ideal for large scale printing. Common examples of impact printers include dot matrix, daisy wheel, line and chain printers.

*Non-impact printers*

These printers print characters without the use of a ribbon. They are faster than impact printers because they are not printing a character at a time. They print one full page at a time producing quality printouts. Common examples are laser and inkjet printers.

**Plotter**

A plotter is a type of [printer](https://www.techtarget.com/whatis/definition/printer) that interprets commands from a computer to make line drawings on paper with one or more automated pens. Some examples of plotters include drum plotters, flatbed plotters, electrostatic plotters, and inkjet plotters.

**Projector**

A projector is an output device that reproduces images by projecting them onto a screen, wall, or other surface using images created by a computer or Blu-ray player.

**Speakers**- A computer speaker allows users to listen to audio from electronic devices. Speakers move back and forth as they receive electrical input from devices. In response, the outer cone vibrates, creating sound waves which users hear or listen to. Computer speakers produce sound by transmitting signals created by the sound card in the computer.

**[Could add speakers to include the audio element?]**

### 1.1.15 The purpose and use of devices such as docking stations for mobile and laptop computers

Docking stations enable users with a [laptop or mobile computer](https://www.computerhope.com/jargon/l/laptop.htm) to convert it into a [desktop computer](https://www.computerhope.com/jargon/d/desktopc.htm) when at the office or at home. The docking station will typically be connected to the mains power and various input and output devices. By *docking* your laptop, you can then recharge it and have access to the screens, printer, mouse, speakers or whatever other devices may also be attached. For example, a business user could use a laptop on the road to create a document. On returning to the office, they could attach the laptop to the docking station to use their monitor, speakers, and [printer](https://www.computerhope.com/jargon/p/printer.htm). Docking stations are now commonly used by developers for adding additional displays to reduce having to switch through multiple tabs on one display. Figure 1.19 shows an example of a docking station.



***Figure 1.19: Ultra-slim docking station***

[AW: please redraw] [for illustrator]

There are other types of docking stations such as a cradle for a portable media player that serves to charge and connect the unit to a receiving device, or a cradle for charging a cell phone.

**Activity 1.2 INDIVIDUAL ACTIVITY**

1. Define the term *system unit*.

2. What is the purpose of the CPU?

3. Identify the FIVE stages of the information processing cycle.

4. The rate at which one operation is completed in a second is measured in \_\_\_\_\_\_\_\_.

5. Identify THREE main components of the CPU.

6. List THREE differences between Reduced Instruction Set Computing (RISC) and Complex Instruction Set Computing (CISC).

7. List and describe the FOUR key functions of a computer.

8. Define *memory hierarchy*.

9. Identify the TWO types of RAM.

10. What do you understand by the term *secondary memory*?

11. List THREE examples each of input, processing and output hardware devices.