






	<b>Module Focus/Specific Learning Outcomes:</b> make sure that you write the key unit objectives to be acquired at the end of the unit.
	<b>Learning Activity:</b> Complete a learning activity. This will help you to review or practise what you have learned and to prepare you for an assignment or an examination. You will not submit learning activities to your tutor/marker. Instead, you will compare your responses to those provided in the Learning Activity Answer Key found at the end of the applicable module.
	<b>Video/Flashcard app:</b> View a video.
	<b>Stop/Caution:</b> Use caution when conducting this learning activity or experiment.
	<b>Assignment:</b> Complete an assignment. You will submit your completed assignments to your tutor/marker for assessment in accordance with the chart found in the course Introduction.
	<b>Learning Partner:</b> Ask your learning partner to help you with this task.
	<b>Note:</b> Take note of and remember this important information or reminder.
	<b>Examination:</b> Write your final examination at this time.

UNIT	VOCABULARY	SKILLS WORK	FUNCTIONS	QUIZ
<p><b>3.1</b></p> <p><b>Central processing unit</b></p>	<p><b>Lead-in activity</b></p> <p>Answering the questions (pair work/group work)</p> <p>Watch a video (group work)</p>	<p><b>Reading</b></p> <p>Main parts of a CPU</p> <p>Watch a video</p>	<p>To understand the main functions of a CPU</p> <p>To identify the components</p> <p>To broaden vocabulary connected to the topic</p>	
<p><b>3.2</b></p> <p><b>On a technical level</b></p>	<p><b>Lead-in activity</b></p> <p>Answering the questions (pair work/group work)</p>	<p><b>Reading and writing</b></p> <p>Main components of a CPU</p> <p>The CPU socket</p> <p>Two major CPU architectures</p> <p><b>Listening</b></p> <p>Watch a video overviewing CPU socket types</p>	<p>To understand three main components of a CPU</p> <p>To understand CPU sockets types</p> <p>To understand CPU architectures</p> <p>To broaden vocabulary connected to the topic</p>	
<p><b>3.3</b></p> <p><b>Cooling systems</b></p>	<p><b>Lead-in activity</b></p> <p>Answering the questions (pair work)</p>	<p><b>Reading and writing</b></p> <p>Cooling systems</p> <p><b>Listening</b></p> <p>Watch a video about computer cooling systems</p>	<p>To understand the importance of a cooling system</p> <p>To broaden vocabulary connected to the topic</p> <p>To develop critical thinking through supporting own suggestions</p>	<p>14-question test to understand better the subject</p> <p>Extra activity</p>

**In this unit, you will learn;**

- **To understand the main functions of a CPU**
- **To identify the main types of a CPU**
- **To understand the importance of a cooling system**
- **To broaden vocabulary connected to the topic**

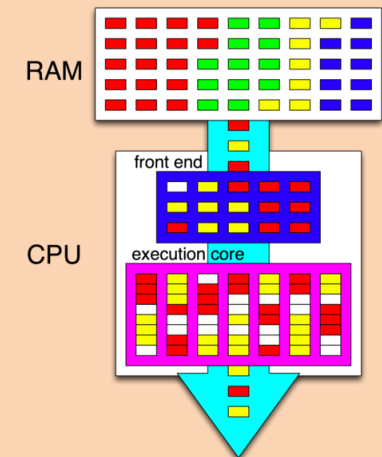
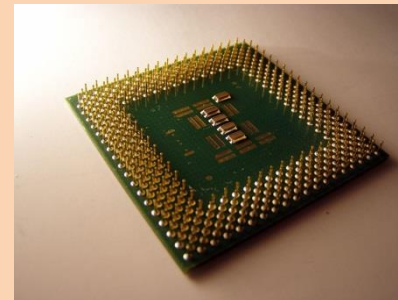
## Central processing unit

### 3.1.1 Lead-in Activity:



In pairs, discuss this question.

1. What is on the picture in a video?
2. What is a central processing unit and what is its main function?
3. Where do I find a CPU in my computer?



### 3.1.2



Read the text and complete it with words from the box.

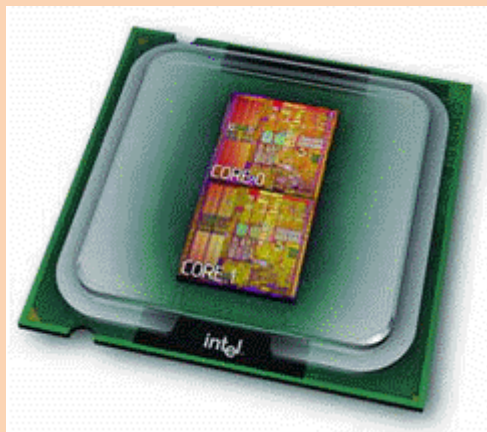
common      screen      brain      multiple      computer system      capable

The central processing unit (CPU) is considered the 1) \_\_\_\_\_ of the computer. It is sometimes referred to as the processor. Most calculations take place in the CPU. In terms of computing power, the CPU is the most important element of a 2) \_\_\_\_\_. It runs the operating system and applications, constantly receiving input from the user or active software programs. It processes the data and produces output, which may stored by an application or displayed on the 3) \_\_\_\_\_.

The CPU contains at least one processor, which is the actual chip inside the CPU that performs calculations. For many years, most CPUs only had one processor, but now it is 4) \_\_\_\_\_ for a single CPU to have at least two processors or "processing cores."

These CPUs are 5) \_\_\_\_\_ of processing multiple instructions concurrently. A CPU with two processing cores is called a dual-core CPU and models with four cores are called quad-core CPUs. High-end CPUs may have six (hexa-core) or even eight (octa-core) processors. A computer may also have more than one CPU, which each have 6) \_\_\_\_\_ cores. For example, a server with two hexa-core CPUs has a total of 12 processors.

- **Single Core CPU** - One core inside a single CPU that handles all the processing. A motherboard manufacturer might provide sockets for more than one single processor, providing the ability to build a powerful, multiprocessor computer.
- **Dual Core CPU** - Two cores inside a single CPU in which both cores can process information at the same time.



- **Triple Core CPU** - Three cores inside a single CPU that is actually a quad-core processor with one of the cores disabled.
- **Quad Core CPU** - Four cores inside a single CPU

- **Hexa-Core CPU** - Six cores inside a single CPU
- **Octa-Core CPU** - Eight cores inside a single CPU



**Language note:**

The terms "CPU" and "processor" are often used interchangeably. Some technical diagrams even label individual processors as CPUs. While this verbiage is not incorrect, it is more accurate (and less confusing) to describe each processing unit as a CPU, while each processor within a CPU is a processing core.

- *Main components of a CPU*
- *Types of a CPU*
- *CPU architectures*

**3.2.1 Lead-in Activity:**



**In pairs, discuss this question.**

1. Which parts does a CPU consist of?



**3.2.2**



**Read the text and match the highlighted words with their definitions a) – l).**

- |   |  |
|---|--|
| a) to be put or placed in                 | g) to execute or to put into operation |
| b) in a few words or briefly              | h) to maintain                         |
| c) to raise to a higher degree            | i) to be left, surplus                 |
| d) lasting for a time only, not permanent | j) to be in charge of                  |
| e) to harm                                | k) being an essential part of          |
| f) to become greater                      | l) complete, full                      |

**On a technical level, there are three main components of a CPU:**

### **1. Arithmetic Logic Unit (ALU)**

The ALU is the part of a CPU that performs all arithmetic computations including addition, subtraction, multiplication, and division. The Arithmetic Logic Unit also performs all logical operations. The ALU is a literally the **fundamental** building block of the CPU, and even the simplest processors contain an ALU.

Today's modern CPUs and graphics processing units (GPUs) in graphic cards have very complex ALUs, and some contain a number of ALUs.

### **2. Control Unit**

The CPU's control unit is **responsible for** executing or storing the results coming out of the ALU. Within the CPU, the control unit performs the functions of fetch, decode, execute, and store.

The control unit communicates with both the arithmetic logic unit (ALU) and memory, and literally directs the **entire** computer system to **carry out**, or execute, stored program instructions.

**In a nutshell** here is how a control unit works. Basically a control unit fetches or retrieves an instruction from memory and then analyses the instruction it fetched before deciding how it should be processed. Depending on the action required, the control unit will then send segments of the original instruction to the appropriate section of the processor.



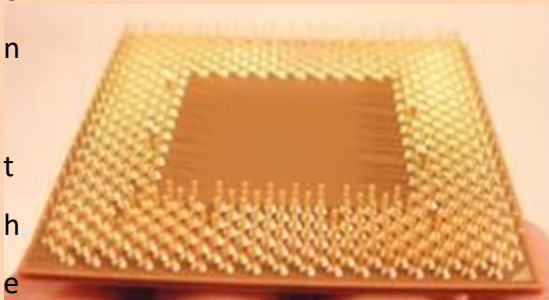
### 3. Registers

Registers are the temporary storage areas for instructions or data within the processor. Registers are basically special storage locations somewhat similar to a computer's memory though contained within the processor and exceptionally faster.

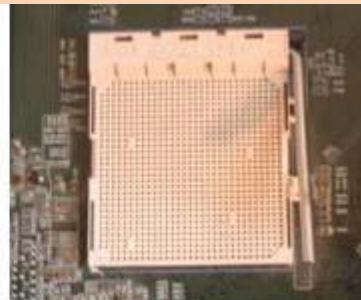
CPUs come in different form factors, each style requiring a particular slot or socket on the motherboard. Common CPU manufacturers include Intel and AMD.

The CPU socket or slot is the connection between the motherboard and the processor. Most CPU sockets and processors in use today are built around the architectures of the pin grid array (PGA) and land grid array (LGA), see pictures below. In a PGA architecture, pins

o  
n  
t  
h  
e



PGA Processor



PGA Slot



LGA Processor



LGA Slot

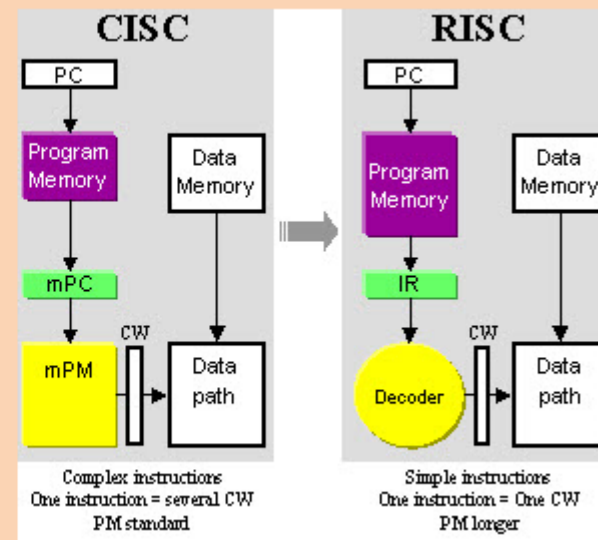
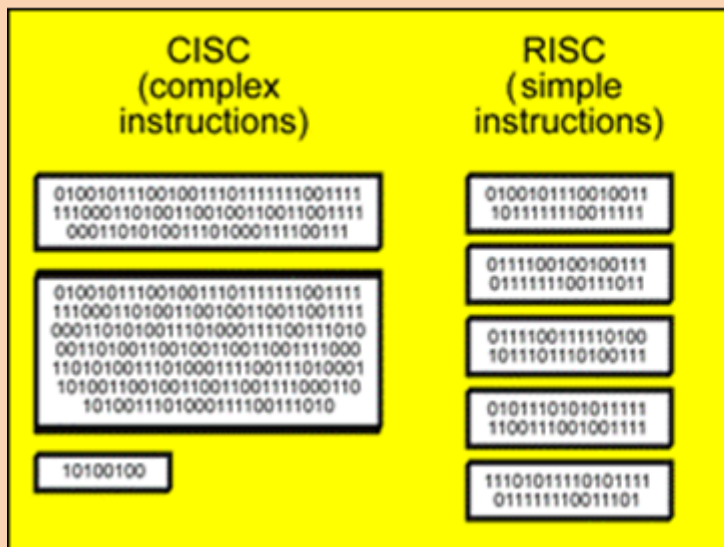
underside of the processor are inserted into the socket, usually with zero insertion force (ZIF). ZIF refers to the amount of force needed to install a CPU into the motherboard socket or slot. In an LGA architecture, the pins are in the socket instead of on the processor.

The CPU executes a program, which is a sequence of stored instructions. Each model of processor has an instruction set, which it executes. The CPU executes the program by processing each piece of data as directed by the program and the instruction set. While the CPU is executing one step of the program, the **remaining** instructions and the data are stored nearby in a special memory called cache. Two major CPU architectures are related to instruction sets:

- **Reduced Instruction Set Computer (RISC)** - Architectures use a relatively small set of instructions. RISC chips are designed to execute these instructions very rapidly.
- **Complex Instruction Set Computer (CISC)** - Architectures use a broad set of instructions, resulting in fewer steps per operation.

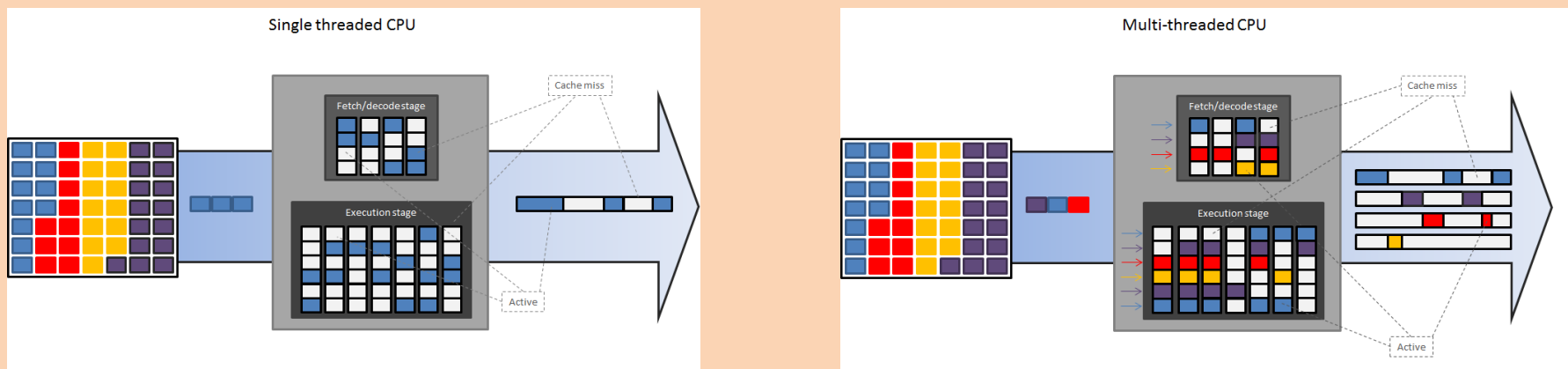
The CISC instructions are decoded before being executed in a modern processor. This **preserves** compatibility with older software.

Some Intel CPUs incorporate hyperthreading to **enhance** the performance of the CPU. With hyperthreading, multiple pieces of code (threads) are executed simultaneously in the CPU. To an operating system, a single CPU with hyperthreading performs as though there are two CPUs when multiple threads are being processed.



Some AMD processors use hypertransport to enhance CPU performance. Hypertransport is a high-speed, low-latency connection between the CPU and the Northbridge chip.

The power of a CPU is measured by the speed and the amount of data that it can process. The speed of a CPU is rated in cycles per second, such as millions of cycles per second, called megahertz (MHz), or billions of cycles per second, called gigahertz (GHz). The amount of data that a CPU can process at one time depends on the size of the front side bus (FSB). This is also called the CPU bus or the processor data bus. Higher performance can be achieved when the width of the FSB **increases**. The width of the FSB is measured in bits. A bit is the smallest unit of data in a computer. Current processors use a 32-bit or 64-bit FSB.



Overclocking is a technique used to make a processor work at a faster speed than its original specification. Overclocking is not a recommended way to improve computer performance and can result in **damage** to the CPU. The opposite of overclocking is CPU throttling. CPU throttling is a technique used when the processor runs at less than the rated speed to conserve power or produce less heat. Throttling is commonly used on laptops and other mobile devices.

3.2.3



To watch a video overviewing CPU components, please click on the icon.

3.2.4




Explain briefly the functions of the following components in a CPU:

1. Control unit (CU)
2. Arithmetic and logic unit (ALU)
3. Registers

3.2.5



Watch a video  overviewing CPU socket types and decide whether the statements are true or false.

1. Intel LGA 1366 came out in 2006.
2. LGA 1156 allowed AMD to create new CPUs that integrated Northbridge right onto a CPU itself.
3. Intel LGA 1155 is also called socket H1.
4. The socket 940 supported CPUs that can use DDR-RAM.
5. The Socket AM2 had 960 pins.
6. AM2+ can potentially operate on an AM2 motherboard.
7. Socket FM1 was released in 2011.

3.2.6



The following table shows the specifications of three computer systems. Which of the computers in the table has the slowest CPU?

	COMPUTER A	COMPUTER B	COMPUTER C
PROCESSOR	Intel Celeron 700 MHz	Intel Pentium 4 1.6 GHz	Intel Pentium III 650 MHz
RAM	128 MB	128 MB	192 MB

3.2.7



Suggest one way to improve the performance of Computer B based on the table above.

# Cooling systems

### 3.3.1 Lead-in Activity:



In pairs, discuss these questions.

1. Under what conditions do computer components perform better?
2. What can happen if too much heat builds up in a computer?
3. What devices are used to cool computer components?



### 3.3.2 Reading part:



#### COOLING SYSTEMS

The flow of current between the electronic components generates heat. Computer components perform better when kept cool. If the heat is not removed, the computer may run slower. If too much heat builds up, computer components can be damaged.


Increasing the air flow in the computer case allows more heat to be removed. A case fan installed in the computer case makes the cooling process more efficient. In addition to a case fan, a heat sink draws heat away from the CPU core. A fan on top of the heat sink moves the heat away from the CPU.

Other components are also susceptible to heat damage and are sometimes equipped with fans. Video adapter cards also produce a lot of heat. Fans are dedicated to cool the graphics-processing unit (GPU).

Computers with extremely fast CPUs and GPUs might use a water-cooling system. A metal plate is placed over the processor, and water is pumped over the top to collect the heat that the processor generates. The water is pumped to a radiator to release the heat into the air and is then recirculated.

3.3.3



**Watch a video  about computer cooling systems and decide whether the statements are true or false.**

1. Heat sink is copper or aluminium piece put on top of a hot component.
2. Heat sinks remain cool so that you can touch them anytime.
3. Fans can be physically connected to heat sinks.
4. Fans may be of different sizes and speeds, but they usually have the same noise levels.
5. Liquid cooling is not used in computers nowadays.

3.3.4



**QUIZ - please click on the icon to take a quiz.**



## Extra activity I - Central Processing Unit (CPU)

### Overview

This activity is designed to give a basic understanding of the workings of a computer.

### Description

For this activity we define a computer as being comprised of three components:

**CPU** - Control Unit & Arithmetic Logical Unit

**Memory**

**Display** (acting as the output)

You are given a simple computer program to run ([Program1](#), [Program2](#)), this is the input to the system.

The “CPU” needs to fetch instructions and data from memory and execute the instructions (CU). It also needs to perform mathematical and logical functions (ALU) and tell the “Display” what to do.

The “Display” need to hide what they are drawing, only once the program is completed, can the result be shown.

### Setup

Assign your role.

**CPU** ([working with the program counter sheet](#)) will request instructions and data from memory, as required. These parts will also process any necessary calculations, writing results back to memory and instructing the display how to plot the data.



**Memory** ([working with memory and program worksheet](#)) keeps hold of the program and passes one instruction at a time onto the CPU.

It also keeps constant track of the current values of x and y.

**Display** ([working with display grid](#)) responds to the plot command from the CPU by marking the screen as instructed.

## Activity

The **CPU** begins, by asking for the first instruction from memory. Then it 'processes' it:

If the instruction starts with the work PLOT, the **CPU** needs to ask for the current value of x and the current value for y and then passes these values on to the **Display**, together with the plot command.

If the instruction begins with ADD or SUB, then the **CPU** needs to ask the **Memory** for the current value of the required variable(s). It then needs to calculate the result and tell the **Memory** the new value of the variable to be stored.

When the **Display** receives an instruction it needs to plot the value of x and the value of y on the display grid.

## Example

For this example, assume that the program begins with the following instructions:

**Add 4 to x**

**Add 6 to y**

**Plot (x, y)**

**The group should handle these instructions as follows:**

**CPU** asks for (fetches) the instruction (add 4 to x) from the **Memory**

**CPU** asks the **Memory** for the value of x.

**CPU** adds 4 to the value of x and tells the **Memory** to store the new value for x.

**CPU** is now finished with this instruction and places a 'tick' next to the number 1, to keep track of which instruction to ask for next.

**CPU** asks for (fetches) the instruction (add 6 to y) from the **Memory**

**CPU** asks the value of y from the **Memory**.

**CPU** adds 6 to the value of y and tells the Memory to store the new value for y.

**CPU** is now finished with this instruction and places a 'tick' next to the number 2, to keep track of which instruction to ask for next.

**CPU** asks for (fetches) the instruction (plot x, y) from the **Memory**

**CPU** asks the value of x from the **Memory**.

**CPU** asks the value of y from the **Memory**.

**CPU** tells the **Display** to plot the value of x and y.

etc.

1. What happens if the CPU tells the display to plot an x or y value that is greater than 9?
2. What happens if the CPU is faster than the display?
3. What happens if the display is faster than the CPU?



### Extra activity II – The Game, (Whiteboard)

## Sources:

### Picture sources available under public domain licence [2015-12-12]

[https://upload.wikimedia.org/wikipedia/commons/thumb/2/27/Hyper-threaded CPU.png/478px-Hyper-threaded CPU.png](https://upload.wikimedia.org/wikipedia/commons/thumb/2/27/Hyper-threaded_CPU.png/478px-Hyper-threaded_CPU.png)

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<https://sites.google.com/site/thedenniglessons/resources/active-learning/central-processing-unit-all-ages>

<https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbX0aGVkZW5uaWdsZXNzb25zfGd4OjcwYjIOTlMND3YjQwNTU>

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<https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbX0aGVkZW5uaWdsZXNzb25zfGd4OjFiNDE1OTk1MjQ5MDQxZDU>

<https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbX0aGVkZW5uaWdsZXNzb25zfGd4OjNhNjhjYTY3NzE0MDNiZTU>

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<https://youtu.be/-nE9bYZKrnI?t=4s>

<https://www.youtube.com/watch?v=4eOZkXySqaM>

<https://www.youtube.com/watch?v=M3Rx0vut8TU>

**GLAFKA's sources:**

VIDEO, " What is on the picture in a video? ": <https://youtu.be/cKRlpj8BIOW?list=UUiwKO-pQO-xj1WoSBjPn1-A>

VIDEO, " Where do I find a CPU in my computer?": <https://youtu.be/SWIAvSX-ZdU?t=25s>

VIDEO, " Whiteboard, CPU": <https://youtu.be/q7O5Y6HcTZI?list=UUiwKO-pQO-xj1WoSBjPn1-A>

Quiz: [http://glafka.cz/evet/unit3/quiz\\_u3/CPU\\_unit3.htm](http://glafka.cz/evet/unit3/quiz_u3/CPU_unit3.htm)