COMPUTER ENGINEERING
Escuela Politécnica Superior
Universidad Autónoma De Madrid

MICROPROCESSORS

Task 1, Part 1 (Hardware Laboratory)

Guillermo López Rodríguez
Pablo Ernesto Soëtard García

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Images and Tables List

1. Introduction

In this century, the invention of technology has changed people's life. And every technology is powered by a microprocessor. A Microprocessor is the "brain" of any computer, it is in charge of managing the different operations that programs need to be executed properly.

Since 1971, microprocessor had evolved, from the first 4-bit microprocessors as Intel 4004 to nowadays 64-bit microprocessors, containing nearly 320K times more transistors in the same space.

1.1 Purpose of the Document

This document is focused on a basic explanation of microprocessors utility, components and structure. This written its part 1 of task 1 of Hardware Laboratory.

The main goal of this first task is to provide to the reader the basic information to understand how microprocessors work, and how they have evolved through time.

1.2 Document Structure

The document is composed by 4 chapters and a final conclusion. Each chapter will contain the basic information about the topic that is declared at the title.

- **Chapter 1:** Introduction. Brief introduction about Microprocessors, purpose of the document and its structure.
- **Chapter 2**: presents advantages and drawbacks between CISC and RISC and their own features.
- **Chapter 3**: main components of microprocessors are explained.
- **Chapter 4**: shows us the principal characteristics of the industry leaders, AMD and Intel.

1.3 Acronyms and Definitions

- EPS Escuela Politécnica Superior
- HW Hardware
- STI-H Seminarios Taller de Informática HW
- UAM Universidad Autónoma de Madrid
- CISC Complex Instruction Set Computer
- RISC Reduced Instruction Set Computer
- ISA Instruction Set Architecture
- CPU Central Processing Unit
- ALU Arithmetic Logic Unit
- CUs Control Units
- EMIB Embedded Multi-Die Interconnect Bridge
- GPU Graphics Processing Unit

2. CISC vs RISC

CISC/RISC stands for different types of microprocessors with different ISAs, nowadays most frequently microprocessors are CISC ones.

The RISCs microprocessors need more instructions to make a task, but they do each one faster than a CISC one, RISC microprocessors can also change the task that are performing while doing it.

RISC focus in software,has low cycles per second and spend more transistors on memory.

RISC architecture success in several platforms such as famous consoles: PlayStation 3, Xbox, Wii... It is also present in apple devices.

The CISCs ones, can perform longer instructions but can't change the instruction task while performing it because its only one big instruction and not a long instruction divided in simpler instructions as in RISC.

However, CISC focus in hardware, has high cycles per second and transistor used for storing complex instructions.

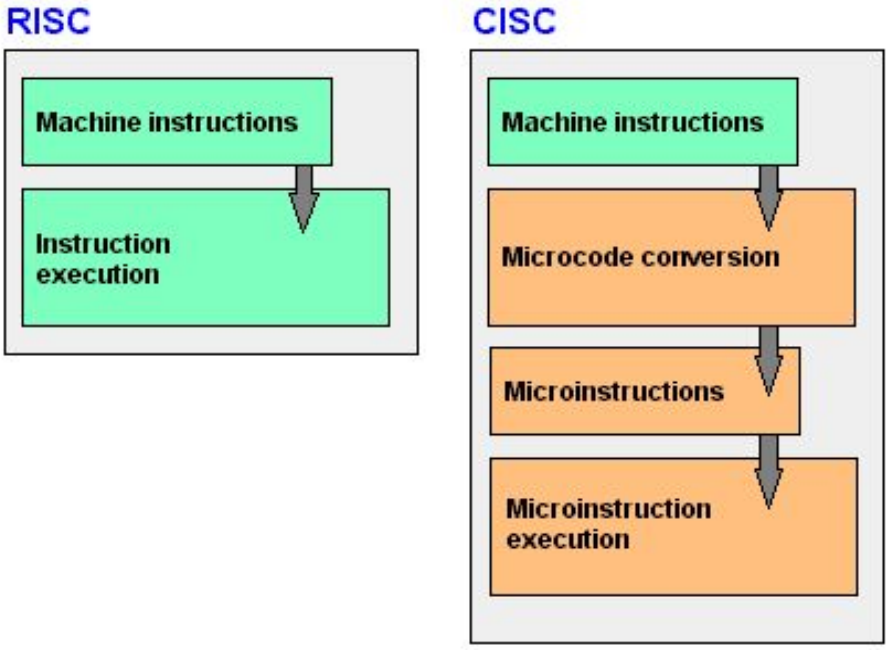

Image 1, RISC vs CISC schematic

3. Main Components of Microprocessors

Microprocessors are ICs that have most of the necessary functions of a CPU.

These ICs contain different cores, each one is a single microprocessor itself which contains components embedded, such as:

- CUs: Control Units,receive signals from the CPU for moving data. It also direct the arithmetic and logic unit. Control Units are multiple devices like decoder,control logic circuit...And these devices communicate with the microprocessor.

- I/O Units: Input is the information that we transmit to the computer from the outside world by hardware that humans can use,for example, keyboard, mouses... then processor analyse this information and provide us an answer which is shown in a output devices such as monitor or printer.

- ALU: Arithmetic Logic Unit perform math operation such as additions, subtraction, division..What is more, it takes care of Boolean function used for circuit design. The processor transmits instructions to ALU.

- Registers: they are temporary data holding places. Each register has a specific function like instruction register or memory address register.

- Cache: advanced processors have memory caches that store the last data used by the CPU. This memory caches increase the speed in the computing process because CPU needn’t go to the RAM.

- Buses: Microprocessor have a system of buses to move data between processor and the random access memory (RAM). It is necessary to coordinate themselves and control multiple tasks.

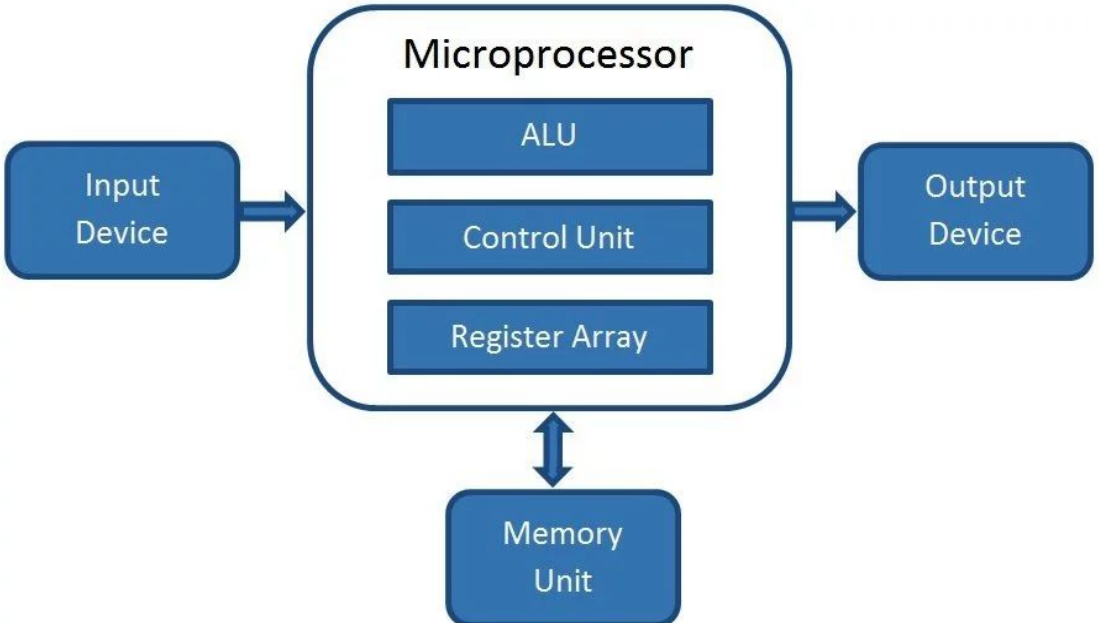

Image 2, Microprocessor schematic

4. Intel vs AMD

Nowadays Intel and AMD are the main microprocessors manufacturers. Although Intel is the most known brand of microprocessors world wilde, AMD is having a great feedback of gaming users, which are those users who look for more power compared to the velocity that Intel microprocessors offer.

The most significant difference between those two brands are:

- On the one hand, Intel is looking for more clock speed and, on the other hand, AMD is trying to boost their microprocessor power by adding more cores.

- Because of AMD's attempt to increase their cores more and more, these decisions had produced more power consumption, therefore their microprocessors reach a higher temperature than Intel's ones. This mean that the money that you save purchasing an AMD microprocessor instead of an Intel microprocessor, is the money that you have to invest purchasing a good refrigeration system.

- In the GPU side, Intel is the winner, since none of AMD's microprocessors work without a graphic card. But this AMD's microprocessors problem is going to be sorted out by implementing a new technology called EMIB, that would allow Intel chips to share power between their cores and third party graphic chips, as AMD ones. That would be fulfilled by the end of this year, and would result on a reduction of laptop's sice.

- Overclocking: to overclock a microprocessor is to enhance its performance by speeding up its clock. Usually Intel offers more capacity of overclocking to their microprocessors than AMD, specially for their "K" class, which can raise up their clock speed 300 to 400 MHz more than the stipulated by the fabricant. This boost mean also that the microprocessor gets hotter. Therefore, a good refrigeration circuit is needed to extend the microprocessor life.

Conclusion

Moore's Law has been very important for a few years in microprocessors and chips in our computers. This law says that every two years we can double the number of transistor in a single integrated circuit, decreasing costs and improving performance. But this law has boundaries, transistors can not be smaller than an atom, and we are reaching these scales nowaday.

In 2020 we will maybe have 7 nanometres processors which is consider like the least size reachable.

This mean that we must find a new way to encrease the power of microprocessors without using transistors anymore. A great aspirant to solve this problem is quantum computing, since it can operate with 3 bits per qubit instead of the abitual 2 bits that transistors can handle.

Unfortunately engineers and physicist are still working in this technology and troubleshooting. Therefore, nowadays it seems impossible to build up a "quantum laptop", but maybe in the future quantum microprocessors would be even in our smartphones.

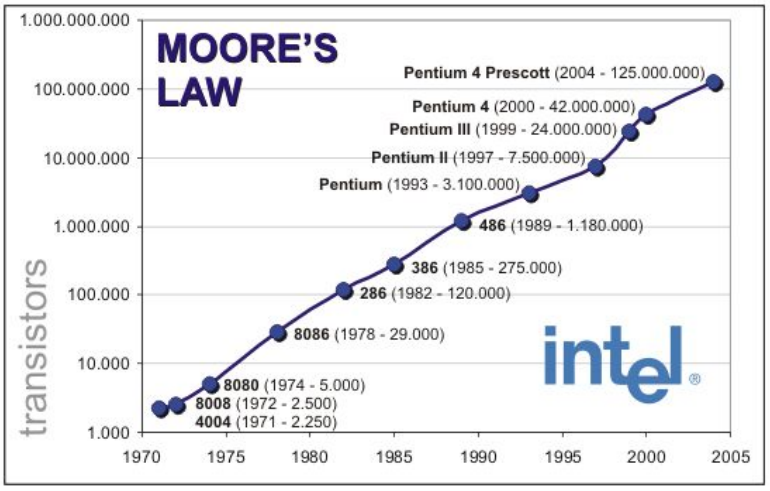

Image 3, Moore's Law graphic

Mobile features

Huawei P20 Lite : Hisilicon kirin 659 octa-core

Xiao Mi Redmi Note 4X: MediaTek Helio X20 deca-core

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