

COMPUTER ARCHITECTURE AND DESIGN'S REVIEW QUESTIONS

From "Computer Organization and Architecture" book, by W. Stallings - 8th edition - Pearson

PAGE 15 - CHAPTER 1 / INTRODUCTION

Review Questions

1.1. What, in general terms, is the distinction between computer organization and computer architecture?

Computer organization is how devices is implemented. Computer architecture is those attributes visible to the programmer.

Computer architecture refers to **those attributes of a system visible to a programmer** or, put another way, those attributes that have a direct impact on the logical execution of a program. Computer organization refers to **the operational units and their interconnections** that realize the architectural specifications.

1.2. What, in general terms, is the distinction between computer structure and computer function?

Structure is how devices are interrelated, while function is the individual characteristics of each one.

- Structure: The **way in which the components are interrelated**
- Function: The **operation of each individual component as part of the structure**

1.3. What are the four main functions of a computer?

Data movement, data storage, data processing and control.

- Data processing
- Data storage
- Data movement
- Control

1.4. List and briefly define the main structural components of a computer.

CPU: known as processor as well, it's the main computer component, responsible for the main functions of the computer; I/O: responsible for the communication between the computer and the external world; system bus: responsible for the interconnection between data storage, CPU and I/O; data storage: device responsible for data saving.

- Central processing unit (CPU): **Controls the operation of the computer and performs its data processing functions**; often simply referred to as processor.
- Main memory: Stores data.
- I/O: **Moves data between the computer and its external environment.**
- System **interconnection**: **Some mechanism that provides for communication among CPU, main memory, and I/O.**

1.5. List and briefly define the main structural components of a processor.

Control unit: manage the processor components and hence the computer itself; ALU:

make logical and arithmetic operations, being thus the processor “brain”; registers: temporary storage for data while processor operations; internal bus: interconnect control unit, ALU and registers inside processor.

- Control unit: **Controls the operation of the CPU and hence the computer**
- Arithmetic and logic unit (ALU): Performs the **computer’s data processing functions**
- Registers: **Provides storage internal to the CPU**
- CPU interconnection: **Some mechanism that provides for communication among the control unit, ALU, and registers**

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REVIEW QUESTIONS

2.1. What is a stored program computer?

A stored program computer has the program stored alongside memory, so the computer can read it from memory, allowing it being altered or set.

2.2. What are the four main components of any general-purpose computer?

Memory, Arithmetic-Logic Unit, Program Control Unit, and I/O Equipment

2.3. At the integrated circuit level, what are the three principal constituents of a computer system?

Transistors, resistors and capacitors.

2.4. Explain Moore’s law.

The number of transistors that could be put on a single chip would double each year (in fact it was revised, once it started to double each 18 months).

2.5. List and explain the key characteristics of a computer family.

A computer family share the same architecture, allowing older programs versions to be run in newer hardware machines. Along versions, you can see a faster processor speed, a larger memory capacity and an increase of the number of capacitors in a processor chip.

Similar or identical instruction set, Similar or identical operating system, Increasing speed, Increasing number of I/O ports, Increasing memory size, Increasing cost.

2.6. What is the key distinguishing feature of a microprocessor?

A microprocessor contains all the CPU elements on a single chip.

Problems

2.10. A benchmark program is run on a 40 MHz processor. The executed program consists of 100,000 instruction executions, with the following instruction mix and clock cycle count:

Instruction Type	Instruction Count	Cycles per
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		Instruction
Integer arithmetic	45000	1
Data transfer	32000	2
Floating point	15000	2
Control transfer	8000	2

Determine the effective CPI, MIPS rate, and execution time for this program.

$$\text{CPI} = 1 \times 0,45 + 2 \times 0,32 + 2 \times 0,15 + 2 \times 0,08$$

$$\text{CPI} = \mathbf{1,55}$$

$$\text{MIPS} = \frac{40 \times 10^6}{1,55 \times 10^6} = \mathbf{25,81}$$

$$T = I_c \times \text{CPI} \times \tau$$

$$T = 100.000 \times 1,55 \times (1 / 40 \times 10^6)$$

$$T = 0,0003875 = \mathbf{3,875 \times 10^{-5}}$$