Exercises Chapter 1

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

**Answer:**

|  |  |  |
| --- | --- | --- |
|  | Computer architecture | Computer organiztion |
| Definition | Attributes of a system visible to the programmer.  Have a direct impact(affect) on the logical execution of a program. | The operational units and their interconnections that realize the architectural specifications. |
| Attributes include | Instruction set, number of bits used to represent various data types, I/O mechanisms, techniques for addressing memory. | Hardware details transparent to the programmer, control signals, interfaces between the computer and peripherals, memory technology used. |

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

**Answer:**

* Structure is the way in which components relate to each other.
* Function is the operation of individual components as part of the structure.
  1. What are the four main functions of a computer?

**Answer:** A computer can perform four basic functions: Data processing, Data storage, Data movement, control.

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

**Answer:** There are four main structural components of a computer:

* CPU: Controls the operation of the computer and performs its data processing functions.
* 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. List and briefly define the main structural components of a processor.

**Answer:** A processor has four major structural components:

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

**Short answer**

01. **Computer architecture** refers to those attributes of a system visible to a programmer.

02. **Computer organization** refers to the operational units and their interconnections that realize the architectural specifications.

03. Control signals, interfaces between the computer and peripherals, and the memory technology used are all examples of **organizational** attributes.

04. The instruction set, the number of bits used to represent various data types, I/O mechanisms and techniques for addressing memory are all examples of **architectural** attributes.

05. The **370** architecture is the architecture of IBM’s mainframe product line.

06. **Structure** is the way in which the components are interrelated.

07. **Function** is the operation of each individual component as part of the structure.

08. The basic functions that a computer can perform are: data processing, data movement, control, and **data storage**.

09. When data are received from or delivered to a device that is directly connected to the computer, the process is known as **I/O (input/output).**

10. The four main structural components of the computer are: main memory, I/O, system interconnection, and **CPU**.

11. Often referred to as processor the **CPU** controls the operation of the computer and performs its data processing functions.

12. A common example of system interconnection is by means of a **system bus**, consisting of a number of conducting wires to which all the other components attach

13. The major structural components of the CPU are: control unit, register, CPU interconnection, and **ALU (arithmetic and logic unit)**.

14. The **control unit** controls the operation of the CPU and hence the computer.

Exercises Chapter 2

2.1 What is a stored program computer?

**Answer:** A stored program computer based on von Neumann model. The von Neumann model states that not only the data but also the program must be stored in memory. Program represented in a form suitable for storing in memory alongside data (program = data + instructions).

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

**Answer**: Four main components of any general-purpose computer:

- Arithmetic and logic unit (ALU)

- Control unit

- Main memory

- Input/Output (I/O)

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

**Answer**: A computer consists of gates, memory cells, and interconnections among these elements.

2.4 Explain Moore’s law.

**Answer**: There is a doubling of the number of transistors on a chip every 18 months in the 1970s.

The consequences of Moore’s law are profound:

1. The cost of a chip has remained virtually unchanged during this period of

rapid growth in density. This means that the cost of computer logic and memory

circuitry has fallen at a dramatic rate.

2. Because logic and memory elements are placed closer together on more

densely packed chips, the electrical path length is shortened, increasing

operating speed.

3. The computer becomes smaller, making it more convenient to place in a

variety of environments.

4. There is a reduction in power and cooling requirements.

5. The interconnections on the integrated circuit are much more reliable than

solder connections. With more circuitry on each chip, there are fewer interchip

connections.

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

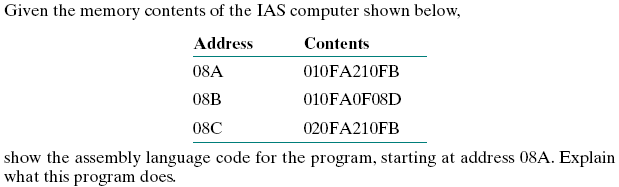
**Answer**:

* Similar or identical instruction set: Different computers in the same family could use the same or similar instruction sets. Lower end machines may contain a subset of the instruction set of higher end machines. This would make software move up the chain, though software written for a higher end machine might not work on a lower end system (due to missing instructions).
* Similar or identical operating system: The OS may be shared by the systems of the same family, though there may be more high end features in the OS of higher end machine.
* Increasing speed: As one moves though the models of the family, the higher end the machine, the faster speed.
* Increasing number of I/O port: There is an increase in the number of ports going from lower end to higher end.
* Increasing memory size: Size of the main memory increases going from lower end to higher end.

2.6 What is the key distinguishing feature of a microprocessor?

**Answer**: They contain all the components of a CPU on a single chip.

2.7



**Answer**:

Assembly code:

* 08A: LOAD M(0FA) , STOR M(0FB)

Left instruction: 010FA

Opcode: 01(h)

Address: 0FA

Load data in the 0FA memory word to AC

Right instruction: 210FB

Opcode: 21(h)

Address: 0FB

Store AC to the 0FB memory word

* 08B: LOAD M(0FA) , JUMP +M(08D)

Left instruction: 010FA

Opcode: 01(h)

Address: 0FA

Load data in the 0FA memory word to AC

Right instruction: 0F08D

Opcode: 0F(h)

Address: 08D

If number in the AC is nonnegative, take next instruction from left half of 08D memory word.

* 08C: LOAD -M(0FA) , STOR M(0FB)

Left instruction: 020FA

Opcode: 02(h)

Address: 0FA

Load data in the 0FA memory word (but with the minus -) to AC

Right instruction: 210FB

Opcode: 21(h)

Address: 0FB

Store AC to the 0FB memory word

**Short answer**

01. The ENIAC was designed to help the Army’s **Ballistic Research Laboratory**, which was the agency responsible for developing range and trajectory tables for new weapons.

02. The first task of the **ENIAC** was to perform a series of complex calculations that were used to help determine the feasibility of the hydrogen bomb.

03. The first publication of the idea of the stored-program concept was in a proposal by John von Neumann for a new computer known as the **EDVAC**.

04. The IAS computer consists of a main memory, an ALU, I/O, and a **control unit**.

05. The **UNIVAC 1** was the first successful commercial computer and was commissioned by the Bureau of the Census for the 1950 calculations.

06. A **data channel** is an independent I/O module with its own processor and instruction set.

07. The **multiplexor** is the central termination point for data channels, the CPU, and memory.

08. The term **embedded** system refers to the use of electronics and software within a product, designed to perform a dedicated function, as opposed to a general-purpose computer such as a laptop or desktop system.

Exercises Chapter 3

3.1 What general categories of functions are specified by computer instructions?

**Answer**: The catergories are processor-memory, processor-I/O, data processing and control.

3.2 List and briefly define the possible states that define an instruction execution.

**Answer**:

* Instruction address calculation (iac): Determine the address of the next instruction to be executed.
* Instruction fetch (if): Read instruction from its memory location into the processor.
* Instruction operation decoding: Analyze instruction to determine type of operation to be performed and operands to be used.
* Operand address calculation (oac): If the operation involves reference to an operand in memory or available via I/O, then determine the address of the operand.
* Operand fetch (of): fetch the operand from memory or read it in from I/O.
* Data operation: Perform the operation indicated in the instruction.
* Operand store (os): write the result into memory or output to I/O.

3.3 List and briefly define two approaches to dealing with multiple interrupts.

**Answer**:

* Disabling interrupts: processor has the ability to and will ignore the specific interrupts. Those interrupts remain pending and will be checked after the processor has enabled interrupts.
* Interrupt service routine (ISR): priorities assigned to the different types of interrupts. Interrupt service routines with higher priorities can interrupt one with lower priority, in which case the ISR with the lower priority is put on the stack until that ISR is completed.

3.4 What types of transfers must a computer’s interconnection structure (e.g., bus) support?

**Answer**: There are 6 types of transfers that must a computer’s interconnection structures supports:

* Memory to processor
* Processor to memory
* I/O to processor
* Processor to I/O
* I/O to memory
* Memory to I/O

3.5 What is the benefit of using a multiple-bus architecture compared to a single-bus architecture?

**Answer**: It is efficient, since if only one bus is for everything, only one device can then communicate at a time, since if more than one device were to try and send data on the single bus, transmission would be garbled.

**Short answer**

01. A **memory address** register specifies the address in memory for the next read or write.

02. A **memory buffer** register contains the data to be written into memory or receives the data read from memory.

03. The most common classes of interrupts are: program, timer, I/O and **hardware failure**.

04. A(n) **timer** interrupt is generated by a timer within the processor and allows the operating system to perform certain functions on a regular basis.

05. A(n) **I/O** interrupt is generated by an I/O controller to signal normal completion of an operation, request service from the processor, or to signal a variety of error conditions.

06. A **disabled** interrupt simply means that the processor can and will ignore that interrupt request signal.

07. The collection of paths connecting the various modules is called the **interconnection** structure.

08. A **bus** is a communication pathway connecting two or more devices.

09. The **control** lines are used to control the access to and the use of the data and address lines.

10. Bus lines can be separated into two generic types: **dedicated** and multiplexed.

11. With **asynchronous** timing the occurrence of one event on a bus follows and depends on the occurrence of a previous event.