Introduction to Minicomputers

System Overview

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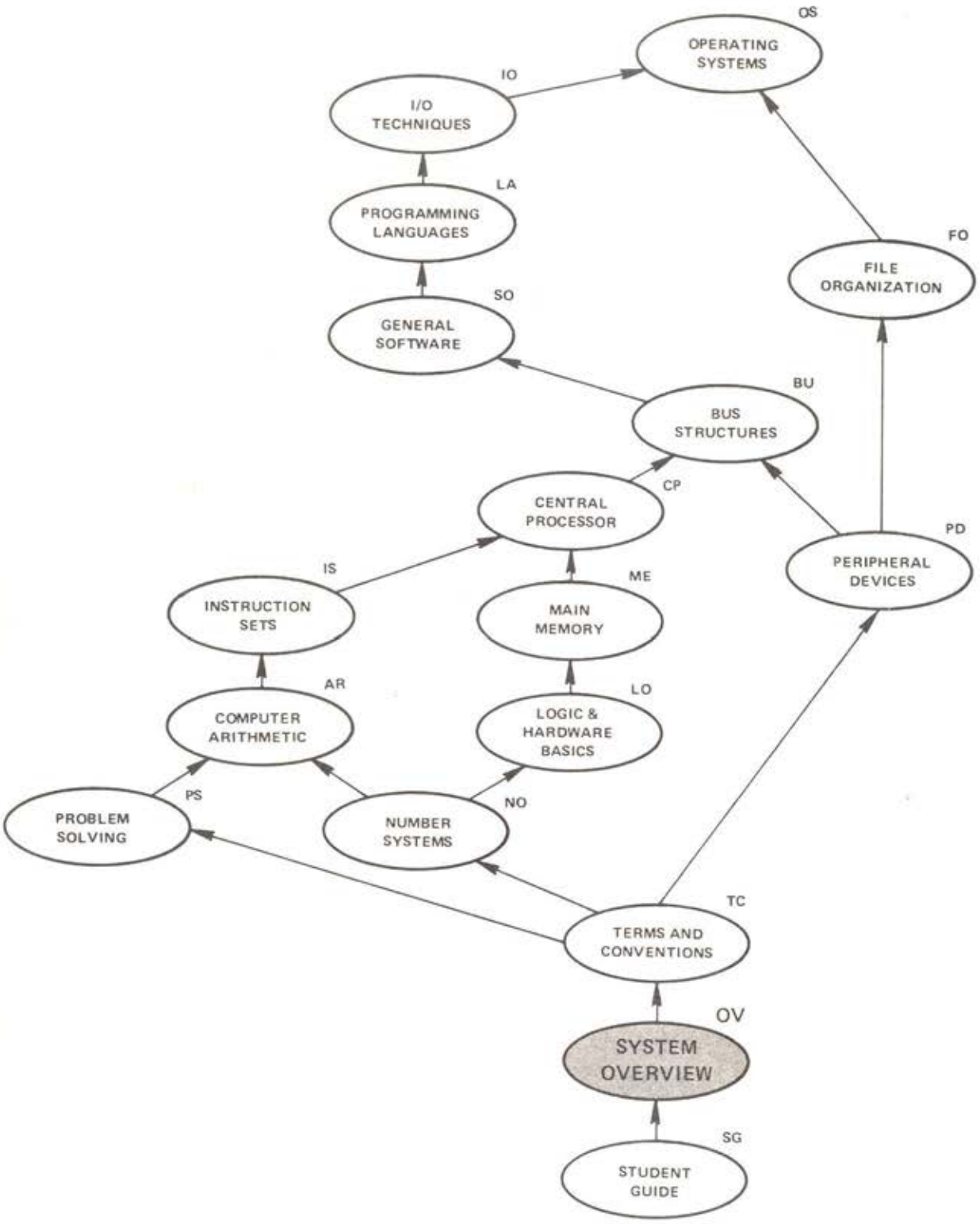
INTRODUCTION TO MINICOMPUTERS

System Overview

Student Workbook

Audio-Visual Course by Digital Equipment Corporation

COURSE MAP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System Overview

Introduction

The chilling fear that computers are "taking over" is slowly losing ground to more rational beliefs. The most important reason for this development is simply that more and more people are becoming aware of what computers are and what they can and cannot do. That is, they are becoming *literate* about computers.

Perhaps you can remember when computers first branched out of scientific laboratories and made contact with the general public in the early sixties. Many people's first contact with computers was a harsh warning on a computer card: DO NOT FOLD, SPINDLE, STAPLE, OR MUTILATE. We're still not sure what they meant by "spindle," but we were very careful not to do it! Several years ago, one laundry delivery man purposely folded the computer card that indicated each stop on his route. This man was trying to foil his company's attempt to computerize its billing system because he felt that computerization would put some employees out of work. As it turned out, computerization helped this company grow and actually created far more jobs than the delivery man could have imagined. The problem with this situation was that the delivery man was not *computer literate.*

Not only are people becoming more computer literate, but computers seem to be becoming more people literate. Of course, it's not really the computers that are changing, but rather the people who design computers for use by others. In any event, computers are becoming easier to work with. Years ago, we had to go through miles of red tape to correct a mistake in a computer-generated bill. Today, most computer-generated bills include a telephone number that you can call to speak to real, live people if a mistake has been made. These people often have typewriters next to their phones that are connected to the computer that generated the bill. Thus they can "talk" to the computer while they talk to you and solve problems quickly and easily.

Most of the people who interact with computers as described above know little more about computers than you do. They are, however, computer literate and know how to make the computer work for them. When you finish this course, you will be computer literate, too, and you will know far more about computers than most of the people who solve problems with bills. You will have a feel for what computers can and cannot do, how they work, and how you can interact with them.

This module introduces you to computers and the types of information that they can deal with. It defines what a computer is, discusses the different types of computers, and points out the major parts of a typical computer system.

If you have not worked through the **Student Guide,** please do so before you begin this module. If you have completed the **Student Guide,** read the objectives and sample test items for Lesson I on the next page. Then follow the instructions in the text that follows.

Computer Functions

OBJECTIVES

1. Given lists of applications and advantages of computers, be able to match each application with its corresponding advantage.

2. Given a list of eight functions, be able to label those four functions that are the basic computer functions.

SAMPLE TEST ITEMS

1. Listed below are applications and advantages of computers. Next to each application, write the letter of the advantage that corresponds to the application.

Application	Advantage
Science	_____
Education	_____
Simulation	_____
•	•
•	•
•	•

Advantages

a. Allows experiments to be conducted that are too expensive, too dangerous, or too difficult to control in real environments.

b. Allows researchers to develop complex mathematical models to explain physical and sociological phenomena by providing a means for validating these models through successive calculations.

c. Functions as a unique tool to present instruction by adapting to the needs of individual students.

•
•
•

SAMPLE TEST ITEMS

2. Four items in the list below comprise the *basic functions* of a computer. Next to each item write a T if the item is a basic computer function. Write an F if it is not one of the four basic computer functions.

Function	T or F
Control	_____
Schedule	_____
Store	_____
Calculate	_____
Input	_____
Process	_____
Sequence	_____
Output	_____

View Lesson 1 in the audio-visual presentation, "System Overview." Then return to this workbook.

Computer Applications

The A/V program showed how computers are used in different applications, including business, science, education, and communication. Table 1 lists these and several other applications and indicates the advantages of using a computer in each. You may be able to add to Table 1 from your own experience. If you can, please do so.

Table 1 Computer Applications

Application	Advantages
Business	Speeds up accounting and allows businesses to work with a larger number of accounts while maintaining up-to-date information on their operations.
Recreation	Provides a unique instrument for playing games with intricate rules, strategies, and computations.
Science	Allows researchers to develop complex mathematical models to explain physical and sociological phenomena by providing a means for validating these models through successive calculations.
Education	Functions as a unique tool to present instructions by adapting to the needs of individual students.
Simulation	Allows experiments to be conducted that are too expensive, too dangerous, or too difficult to control in real environments.
Mechanical Control	Can control complex mechanical systems with intricate interaction and feedback between parts.
Engineering	Performs complex calculations and data analyses.

Basic Functions

The A/V presentation identified four basic functions that a computer performs:

1. *Input*
2. *Store*
3. *Process*
4. *Output*

These functions are performed on information called *data*. Notice that the first letters of the four basic functions can be rearranged to spell **IPSO**. This will help you remember: **I**nput, **P**rocess, **S**tore, **O**utput.

What are the differences between computers and pocket calculators? Computers can execute instructions *automatically* in sequences called *programs*. Many inexpensive calculators can input, store, process, and output data, but each step in the program must be entered by hand. Several companies now make larger, more expensive, *programmable* calculators that can also store and execute programs automatically. So, the difference between a computer and a calculator is becoming quite fuzzy. Some operations that could only be done by computers five years ago are now being performed by calculators. In fact, it may be almost impossible to tell a highly sophisticated calculator from a very simple computer.

The safest distinction that we can make is that computers generally supply more services than calculators do. Compared to calculators, computers can usually receive data from a larger variety of input devices, store a larger amount of data, process data in a larger variety of ways, and display data on a larger variety of output devices. The difference is in the quantity of services supplied – not in the quality. Many of the things that you will learn in this lesson apply to calculators as well as computers.

EXERCISES

1. List below at least four computer applications. Indicate the advantages of using a computer in each.

Application	Advantages

2. Without referring to the text or to the previous exercise, list the four basic functions performed by a computer.

   a. _____

   b. _____

   c. _____

   d. _____

SOLUTIONS

1. Sample answers to this exercise are listed in Table 1. Additional applications and advantages are also possible. Discuss your unique answers with a fellow student or with your course manager.

2. Without referring to the text or to the previous exercise, list the four basic functions performed by a computer.

   a. Input

   b. Process

   c. Store

   d. Output

NOTE
These functions may be listed in any order.

EXERCISES

3. Classify each of the actions listed below as one of the four basic functions of a computer. Use the letters I, P, S, and O to indicate the functions: *input, process, store,* and *output,* respectively.

Action	Function
a. Receive data from a keyboard	_____
b. Remember the value "2"	_____
c. Show the result of a calculation	_____
d. Print a customer's address	_____
e. Add 1734 + 2198	_____
f. Read a computer card	_____
g. Alphabetize a list of names	_____
h. Remember people's telephone numbers	_____
i. Draw a graph	_____
j. Sort people by where they live to assign mail codes	_____

SOLUTIONS

3. Classify each of the actions listed below as one of the four basic functions of a computer. Use the letters I, P, S, and O to indicate the functions: *input, process, store,* and *output,* respectively.

Action	Function
a. Receive data from a keyboard	I
b. Remember the value "2"	S
c. Show the result of a calculation	O
d. Print a customer's address	O
e. Add 1734 + 2198	P
f. Read a computer card	I
g. Alphabetize a list of names	P
h. Remember people's telephone numbers	S
i. Draw a graph	O
j. Sort people by where they live to assign mail codes	P

If you had trouble completing these exercises, view the A/V program again and/or reread the text. If certain points are still not clear, consult your course manager.

Types of Computers

OBJECTIVES

1. Given a list of characteristics of analog and digital computers, be able to label those characteristics that apply to the analog computer and those that apply to the digital computer.

2. Given a list of examples of analog and digital devices, be able to label those examples that are analog and those that are digital.

3. Given a list of computer characteristics, be able to label those characteristics that describe dedicated, special-purpose, and general-purpose computers.

SAMPLE TEST ITEMS

1. Listed below are characteristics of computers. Write A or D next to each to indicate that it applies to an analog or a digital computer.

Characteristic	Analog or Digital
Makes use of a patch panel.	_____
Controlled by stored programs.	_____
Represents data by electrical voltages.	_____
Works with data that changes in a smooth, continuous manner.	_____

SAMPLE TEST ITEMS

2. Examples of analog and digital devices are listed below. Write an A or D next to each to indicate that it is an analog or a digital device.

Device	Analog or Digital
Odometer	_____
Tachometer	_____
Barometer	_____

3. Indicate that each of the following characteristics describes a dedicated (D), a special-purpose (S), or a general-purpose (G) computer by writing the correct letter in the blank space.

Characteristic	Type of Computer
Designed to solve a closely related group of tasks.	_____
Built for one specific function.	_____
Most economical.	_____

Major Families

This lesson discusses different types of computers. It begins by separating computers into two major families, *analog* and *digital*. Digital computers are further broken down into *dedicated, special purpose,* and *general purpose* computers. As a final step, general purpose computers are categorized as *minicomputers, medium-sized computers,* and *large-scale computers*. These relationships are shown in Figure 1.

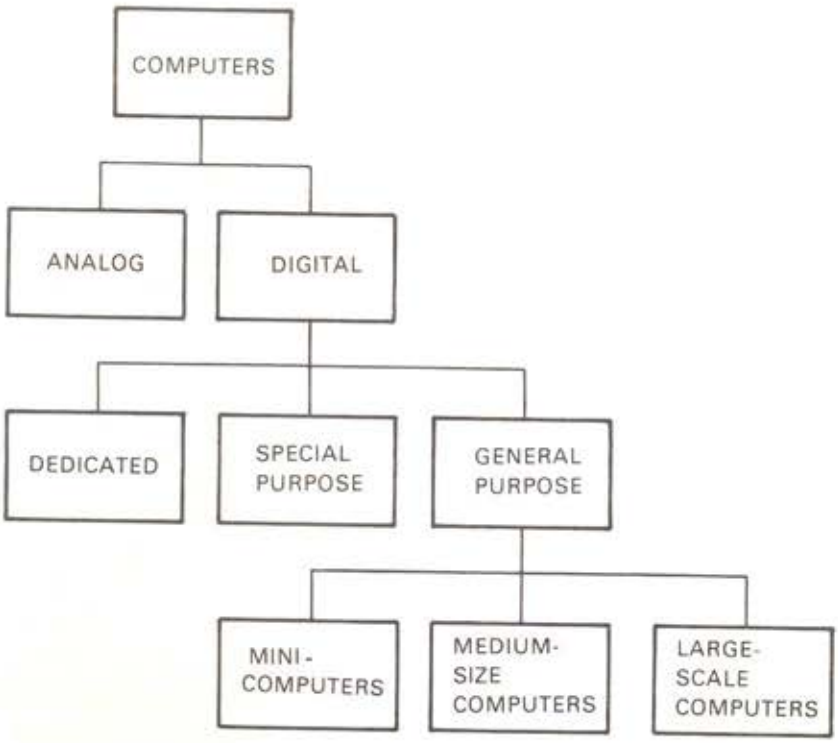


Figure 1 Types of Computers

Stop reading now and view Lesson 2 in the audio-visual program. Then return to your workbook.

The major differences between digital and analog computers are summarized in Table 2. Each of these characteristics was discussed in the audio-visual program.

Table 2 Major Differences Between Digital and Analog Computers

	Digital Computer	Analog Computer
Data represented by	digits 0 and 1	electrical voltages
Calculate by	counting digits	combining and measuring voltages
Controlled by	stored programs	connections on patch-panel
Precision	greater	limited
Quantity of data storage	large	small

Computers for Applications

Dedicated, special purpose, and general purpose computers are different in relative efficiency, speed, cost and economy of operation, and versatility. Dedicated computers are the most efficient, quickest, and most economical computers, but they are the least versatile. General purpose computers are extremely versatile, but sacrifice efficiency, speed, and economy. Thus, the first three characteristics go hand-in-hand and are gained at the expense of versatility. These relationships are shown in Figure 2.

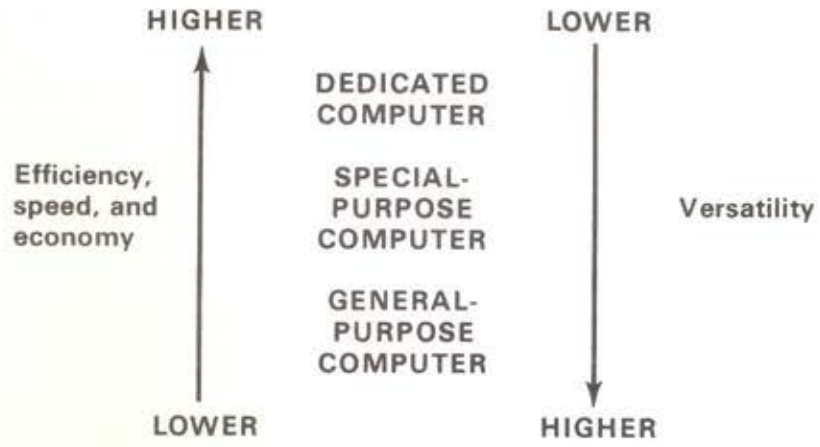


Figure 2 Differences Between Dedicated, Special Purpose, and General Purpose Computers

General purpose computers are divided into minicomputers, medium-sized computers, and large-scale computers. These machines differ in size, simplicity, power consumption, available features, data storage capability, instruction set size, and cost. Figure 3 relates these characteristics to the three computer sizes.

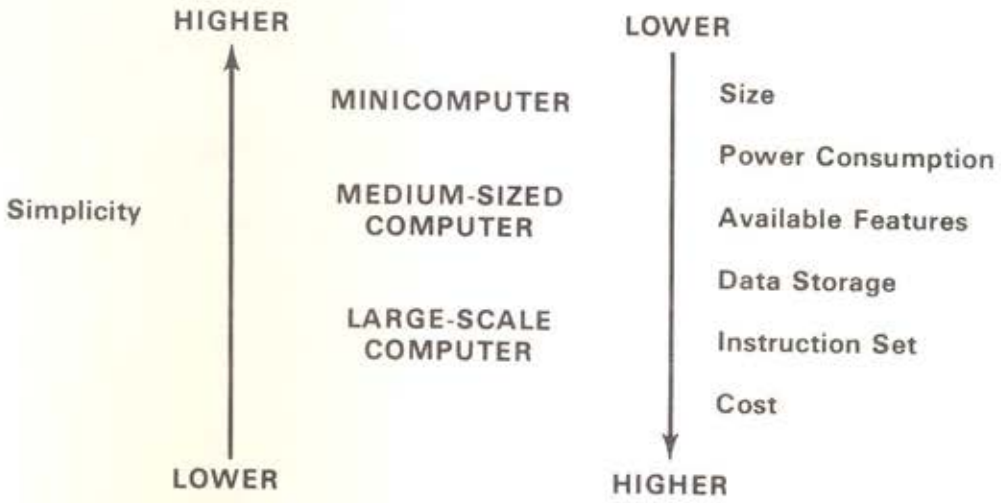


Figure 3 Differences Between Minicomputers, Medium-Sized Computers, and Large-Scale Computers

Study the figures and tables in this lesson to be sure that you understand the different types of computers. If some points are not clear, review the related sections in the A/V program. Then practice identifying different computer types with the exercises that follow.

EXERCISES

1. Listed below are 12 characteristics of computers. Mark A or D next to each to indicate whether they apply to an *analog* or a *digital* computer, respectively.

   a. Able to store large amounts of data _____

   b. Works with data that changes in a smooth, continuous manner _____

   c. Represents data by electrical voltages _____

   d. Easy to reprogram _____

   e. Makes use of a patch-panel _____

   f. Combines voltages in order to perform arithmetic _____

   g. Limited in precision _____

   h. Calculates by counting digits _____

   i. Can store only small quantities of data _____

   j. Data represented by discrete units, 0 and 1 or ON and OFF _____

   k. Controlled by stored programs _____

   l. Able to work with great precision _____

SOLUTIONS

1. Listed below are 12 characteristics of computers. Mark A or D next to each to indicate whether they apply to an analog or a digital computer, respectively.

   a. Able to store large amounts of data ___D___

   b. Works with data that changes in a smooth, continuous manner ___A___

   c. Represents data by electrical voltages ___A___

   d. Easy to reprogram ___D___

   e. Makes use of a patch-panel ___A___

   f. Combines voltages in order to perform arithmetic ___A___

   g. Limited in precision ___A___

   h. Calculates by counting digits ___D___

   i. Can store only small quantities of data ___A___

   j. Data represented by discrete units, 0 and 1 or ON and OFF ___D___

   k. Controlled by stored programs ___D___

   l. Able to work with great precision ___D___

EXERCISES

2. Listed below are 10 applications of computers. Specify whether each would employ a dedicated computer (D), a special purpose computer (S), or a general purpose computer (G).

   a. On-board control of a rocket _____

   b. Scheduling classes for college students _____

   c. Billing customers _____

   d. Control of typesetting _____

   e. Scientific problem solving on board a ship doing oceanographic research _____

   f. Control of a city water supply _____

   g. Guidance on board an airplane _____

   h. Instruction to high school students _____

   i. Routing of telephone calls _____

   j. Analysis of data from a survey _____

SOLUTIONS

2. Listed below are 10 applications of computers. Specify whether each would employ a dedicated computer (D), a special purpose computer (S), or a general purpose computer (G).

a. On-board control of a rocket — D

b. Scheduling classes for college students — G

c. Billing customers — G

d. Control of typesetting — S, maybe D

e. Scientific problem solving on board a ship doing oceanographic research — D

f. Control of a city water supply — D, maybe S

g. Guidance on board an airplane — D

h. Instruction to high school students — G

i. Routing of telephone calls — D

j. Analysis of data from a survey — G

The answers are guidelines only. That is, one may argue that certain applications could call for different types of computers in different situations. The distinctions between dedicated, special purpose, and general purpose computers are dealt with again in Exercise 5.

EXERCISES

3. Without referring to Exercise 1 or Table 2, describe at least two major differences between analog and digital computers.

4. Without referring to Exercise 2, give two examples of analog devices and two examples of digital devices.

SOLUTIONS

3. Major differences between analog and digital computers are:

   a. Analog computers represent data by electrical voltages while digital computers represent data by discrete digits, usually 0 and 1.

   b. Analog computers calculate by combining and measuring voltages while digital computers count digits.

   c. Analog computers are controlled by connections on a patch panel while digital computers are controlled by sets of instructions called programs that are stored in their memories.

   d. Analog computers have limited precision when compared to digital computers.

   e. Analog computers cannot store as much data as digital computers.

4. Examples of analog devices are:

thermometer	radio tuner
barometer	ammeter
hygrometer	water meter
speedometer	light meter
tachometer	altimeter
micrometer	depth gauge

Examples of digital devices are:

calendar	cash register
odometer	television dial (2–13)
digital clock	gear box
taxi meter	pocket calculator
traffic light	ordinary light switch

NOTE

Some of the devices listed as "analog" above are now also available in "digital" form.

EXERCISES

5. Without referring to Figure 2, identify each of the following characteristics as descriptive of dedicated computers (D), special purpose computers (S), or general purpose computers (G).

   a. Capable of performing whatever tasks it can be programmed to do _____

   b. Extremely efficient _____

   c. Built for one special function _____

   d. The most versatile type of computer _____

   e. The computer with about medium speed _____

   f. Most economical _____

   g. Designed to solve a closely related group of tasks _____

SOLUTIONS

5. Without referring to Figure 2, identify each of the following characteristics as descriptive of dedicated computers (D), special purpose computers (S), or general purpose computers (G).

   a. Capable of performing whatever tasks it can be programmed to do — G

   b. Extremely efficient — D

   c. Built for one special function — D

   d. The most versatile type of computer — G

   e. The computer with about medium speed — S

   f. Most economical — D

   g Designed to solve a closely related group of tasks — S

If you had trouble completing these exercises, view the A/V program again and/or reread the text. If certain points are still not clear, consult your course manager.

Major System Units

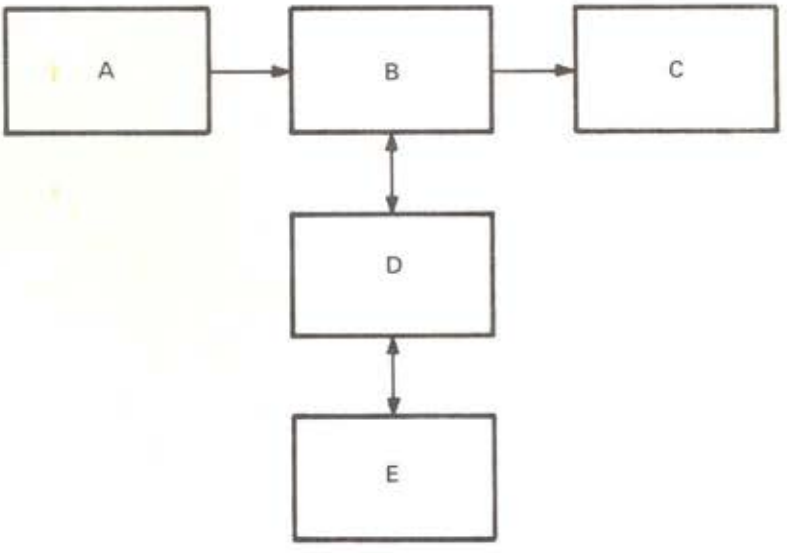
OBJECTIVES

1. Given a simple block diagram of a computer system and a list of the major units that comprise the system, be able to match each unit with its position in the diagram, and indicate those units that form the computer mainframe.

2. Given a list of examples of computer hardware and software, be able to label each to indicate that it is hardware or software.

SAMPLE TEST ITEMS

1. Below is a simple block diagram of a computer system and a list of the major units that comprise the computer system. Next to the name of each unit, write the letter that corresponds to the unit's position in the diagram.



Unit	Position in Diagram
Main Memory	_____
Output	_____
Auxiliary Storage	_____
Input	_____
Central Processor	_____

SAMPLE TEST ITEMS

2. Listed below are the five major units of a computer system. In the blank spaces, write a T if the unit is part of the computer mainframe. Write an F if the unit is not part of the computer mainframe.

Unit	Part of Mainframe
Main Memory	_____
Output	_____
Auxiliary Storage	_____
Input	_____
Central Processor	_____

3. Indicate that each of the items below is part of a computer's hardware (H) or software (S).

Item	H or S
Auxiliary Storage	_____
Input Unit	_____
Program	_____
Central Processor	_____
Instructions	_____

View Lesson 3 of the audio-visual presentation, "System Overview." The program will tell you when to return to this workbook.

Major System Units

There are five major units that work together to create a computer *system*. The functions of these units are summarized in Table 3, and the paths by which data can flow between them are shown in Figure 4.

Table 3 Major Computer Units

Unit	Function
Input	• Transfers instructions and data from various media into the computer system. Possible media include punched cards, paper or magnetic tape, teletypewriters, etc.
Central Processor or CPU	• Controls and supervises all other units. • Performs all logical and mathematical computations. • Executes instructions specified in programs.
Main Memory	• Provides storage with very fast access. • Stores computer instructions for the program that is *currently* running and *small* amounts of data.
Auxiliary Storage	• Provides storage with slower access than main memory but far greater capacity. • Stores computer programs until they are needed and *large* amounts of data.
Output	• Transfers information from the computer system onto various media. Possible media are punched cards, paper or magnetic tape, teletypewriters, display screens, high-speed printers, etc.

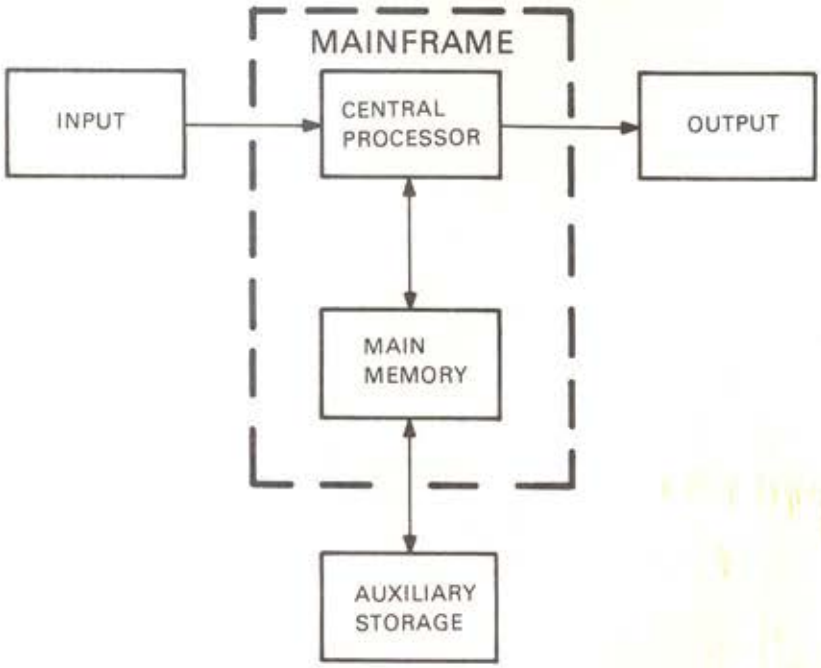


Figure 4 Data Paths Between Major Computer Units

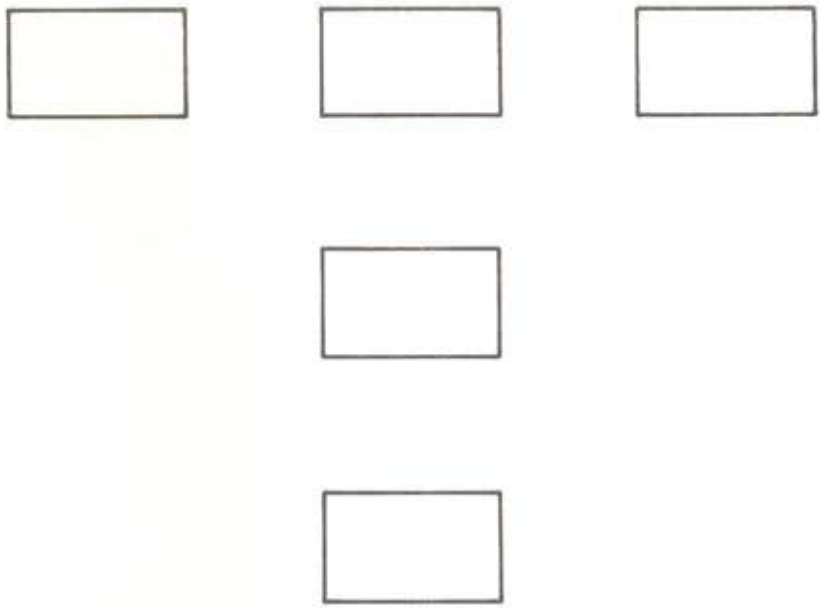
Hardware and Software

Hardware and software are contrasted, respectively, as the *equipment* and *programs* that make up a computer system. It might help you to understand these "wares" by using this workbook as an analogy. The cover and pages of this workbook are its hardware, while the language in which it is written is its software. Thus, a text printed on microfilm is useless unless you have a microfilm reader (the right hardware), and the most exciting story written in Russian is quite dull unless you can read that language (the right software). All of the computer units listed in Table 3 are part of the hardware. The instructions that programmers write to control these units make up the software.

When you feel that you understand the major units that make up a computer system, do the exercises that follow.

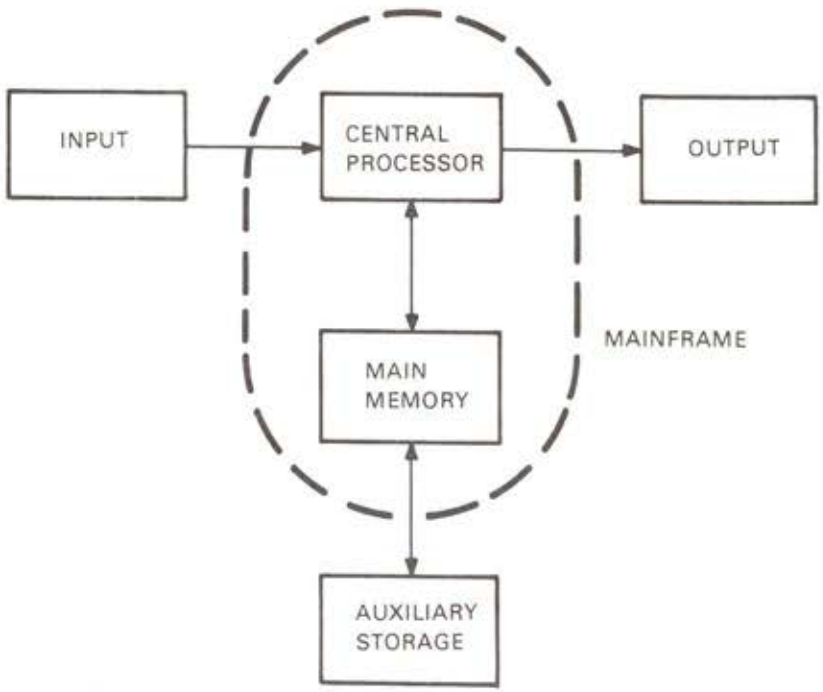
EXERCISES

1. Without referring to Figure 4, complete the diagram below by labeling the input, central processor (CPU), main memory, auxiliary storage, and output units. Circle the units that are part of the computer mainframe, and place arrows between the boxes to show how data flows between them.



SOLUTIONS

1. Without referring to Figure 4, complete the diagram below by labeling the input, central processor (CPU), main memory, auxiliary storage, and output units. Circle the units that are part of the computer mainframe, and place arrows between the boxes to show how data flows between them.



EXERCISES

2. Indicate whether each of the items below is part of a computer's hardware (H) or software (S).

   a. Main memory _____

   b. Instructions _____

   c. CPU _____

   d. Output unit _____

   e. Auxiliary storage _____

   f. Programs _____

   g. Central processor _____

   h. Input unit _____

   i. Mainframe _____

SOLUTIONS

2. Indicate whether each of the items below is part of a computer's hardware (H) or software (S).

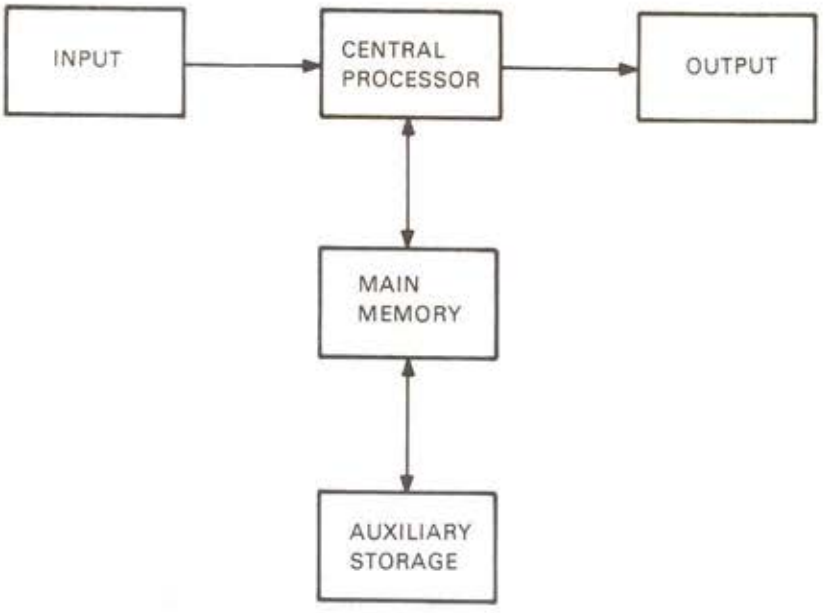
a.	Main memory	H
b.	Instructions	S
c.	CPU	H
d.	Output unit	H
e.	Auxiliary storage	H
f.	Programs	S
g.	Central processor	H
h.	Input unit	H
i.	Mainframe	H

EXERCISES

3. Sketch a simple block diagram of a computer system and label the major units. *Do not* refer to Figure 4 or Exercise 1.

4. Without referring to Figure 4 or to Exercise 1, name the components that make up the computer mainframe.

3. Sketch a simple block diagram of a computer system and label the major units. *Do not* refer to Figure 4 or Exercise 1.



4. The components that make up the computer mainframe are the *central processor* (or CPU) and the *main memory.*

> If you had trouble completing these exercises, view the A/V program again and/or reread the text. If certain points are still not clear, consult your course manager.

Take the test for this module and evaluate your answers before studying another module.