Chapter 1
Computers and Digital Basics

Computer Concepts 2014

Chapter Contents

1

➢ Section A: All Things Digital

➢ Section B: Digital Devices

➢ Section C: Digital Data Representation

➢ Section D: Digital Processing

➢ Section E: Password Security

1 FastPoll True/False Questions
Answer A for True and B for False

➤ 010100 Cloud computing characterized the first phase of the digital revolution.

➤ 010200 A computer's operating system is a type of application software.

➤ 010300 Microcontrollers are special purpose microprocessors that can be embedded in devices such as refrigerators, cars, and washing machines.

➤ 010400 A bit is a binary digit, such as a 1 or 0.

1 **FastPoll True/False Questions**
Answer A for True and B for False

- 010500 ASCII and Unicode are used to represent character data.

- 010600 A megabyte is 1024 bits.

- 010700 Microprocessors are a type of integrated circuit.

- 010800 C, COBOL, and Java are examples of programming languages.

1 FastPoll True/False Questions
Answer A for True and B for False

➤ 010900 A compiler converts source code to object code.

➤ 011000 The list of codes for a microprocessor's instruction set is called machine language.

➤ 011100 A microprocessor holds data in the interpreter register.

➤ 011200 A dictionary attack is a virus that hides out in the spelling checker for your word processing software.

1 Section A: All Things Digital

- ➢ The Digital Revolution
- ➢ Data Processing
- ➢ Personal Computing
- ➢ Network Computing
- ➢ Cloud Computing
- ➢ Digital Society

1 **Question**

➢ 012100 Computers and the digital revolution have changed our lives in many fundamental ways. If you were on the front lines of the digital revolution when computers were first developed to break codes and calculate missile trajectories, you were most likely living in what time period?

➢ A. World War I
➢ B. The Roaring Twenties
➢ C. World War II
➢ D. The 1960s

1 **The Digital Revolution**

➢ The digital revolution is an ongoing process of social, political, and economic change brought about by digital technology, such as computers and the Internet

➢ The technology driving the digital revolution is based on digital electronics and the idea that electrical signals can represent data, such as numbers, words, pictures, and music

1 The Digital Revolution

➤ Digitization is the process of converting text, numbers, sound, photos, and video into data that can be processed by digital devices

➤ The digital revolution has evolved through four phases, beginning with big, expensive, standalone computers, and progressing to today's digital world in which small, inexpensive digital devices are everywhere

FIGURE 1-1

From Victrolas to stereos, and from boomboxes to iPods, music is only one aspect of life that's been affected by technology.

Velora/Shutterstock.com, Steve Bower/Shutterstock.com, Ivan Bondarenko/Shutterstock.com, © MediaTechnics

1 The Digital Revolution

FIGURE 1-2

As the digital revolution progressed, technology changed, as did the way we use it.

Expired	Tired	Uninspired	Desired
Data processing	Personal computing	Network computing	Cloud computing
Big corporate and government computers	Desktop computers	Laptop computers	Smartphones and tablets
Custom applications	Standalone applications	Monolithic software suites	Handheld apps and cloud-based apps
CB radios	Dial-up Internet access	Cable and satellite Internet access	4G and Wi-Fi Internet access
ARPANET	AOL and CompuServe	The Web and virtual worlds	Social media
Arcade games	2-D action games	3-D multiplayer games	Touchscreen micro-games

1 Data Processing

➢ Some historians mark the 1980s as the beginning of the digital revolution, but engineers built the first digital computers during World War II for breaking codes and calculating missile trajectories

➢ Computers were operated by trained technicians

➢ Back then, processing components for computers were housed in closet-sized cabinets that did not usually include a keyboard or display device

1 Data Processing

➤ Data processing is based on an input-processing-output cycle

➤ Data goes into a computer, it is processed, and then it is output

FIGURE 1-4

Data processing is the computing model for the first phase of the digital revolution. The concept of large computers performing tasks based on the input-processing-output cycle represents the primary way computers were used from the 1940s through the 1970s. Data processing installations still exist today, but other technologies emerged, making computing available to a more diverse group of users. ▶ See an example of data processing.

Input → Process → Output

1 **Personal Computing**

➢ The model for the second phase of the digital revolution, personal computing is characterized by small, standalone computers powered by local software

    ➢ Local software refers to any software that is installed on a computer's hard drive

1 Personal Computing

FIGURE 1-5

The most popular uses for personal computers were word processing and gaming; sound systems and graphics capabilities were primitive. The Internet wasn't open to public use, so computing was not a social experience.

Courtesy of Blake Patterson

1 **Network Computing**

➢ The third phase of the digital revolution materialized as computers became networked and when the Internet was opened to public use

➢ A computer network is a group of computers linked together to share data and resources

➢ The Internet is a global computer network originally developed as a military project, and was then handed over to the National Science Foundation for research and academic use

1 Network Computing

➢ The Web (short for World Wide Web) is a collection of linked documents, graphics, and sounds that can be accessed over the Internet

➢ During the period from 1995–2010, computing was characterized by the Web, e-mail, multiplayer games, music downloads, and enormous software applications, such as Microsoft Office, Norton's Internet Security Suite, and Corel Digital Studio

1 **Cloud Computing**

➢ Local applications are being eclipsed by cloud computing, which characterizes the fourth phase of the digital revolution

➢ Cloud computing provides access to information, applications, communications, and storage over the Internet

➢ The expansion of cloud computing is due in part to convergence, a process by which several technologies with distinct functionalities evolve to form a single product

Cloud Computing

FIGURE 1-7

The "cloud" represents Internet-based services, such as applications and social media, that are available from computers and handheld digital devices.

1 Cloud Computing

➤ Convergence is important to the digital revolution because it created sophisticated mobile devices whose owners demand access to the same services available from full-size computers on their desks

➤ Social media are cloud-based applications designed for social interaction and consumer-generated content

Cloud Computing

FIGURE 1-9

Social media include many popular services.

Social networking services:
Post your profile and interact with friends
Facebook Google+ LinkedIn

Wikis:
Collaborate with others to create interlinked documents
Wikipedia Wikimedia

Media sharing:
Post and share photos, music, and videos
Flickr Photobucket YouTube Metacafe Vimeo

Blogging services:
Create online commentary arranged in chronological order
WordPress Google Blogger TypePad

Microblogging:
Post short messages and respond to other participants' messages
Twitter Tumblr

1 Digital Society

➢ Digital technologies and communications networks make it easy to cross cultural and geographic boundaries

➢ Anonymous Internet sites, such as Freenet, and anonymizer tools that cloak a person's identity, even make it possible to exercise freedom of speech in situations where reprisals might repress it

➢ Citizens of free societies have an expectation of privacy

➢ Intellectual property refers to the ownership of certain types of information, ideas, or representations

1 **Digital Society**

➢ Digital technology is an important factor in global and national economies, in addition to affecting the economic status of individuals

➢ Globalization can be defined as the worldwide economic interdependence of countries that occurs as cross-border commerce increases and as money flows more freely among countries

➢ Some individuals are affected by the digital divide, a term that refers to the gap between people who have access to technology and those who do not

➢ Digital technology permeates the very core of modern life

1 **Section B: Digital Devices**

➢ Computer Basics

➢ Computer Types and Uses

➢ Microcontrollers

1 **Question**

➤ 012200 Today, consumers can choose from a wide variety of digital devices, including personal computers, workstations, videogame consoles, smartphones, and iPods. Knowing the strengths of these devices helps you make the right choice. What is the fundamental difference between videogame consoles, personal computers, and smartphones?

  ➤ A. Video game consoles and smartphones are not classified as computers because they don't have stored program capabilities like real computers.

  ➤ B. Videogame consoles and smartphones fill specialized niches and are not replacements for personal computers.

  ➤ C. Personal computers and smartphones can be used to access the Internet, whereas videogame consoles cannot.

  ➤ D. Personal computers and smartphones have better graphics than videogame consoles.

1 Computer Basics

➤ A computer is a multipurpose device that accepts input, processes data, stores data, and produces output, all according to a series of stored instructions
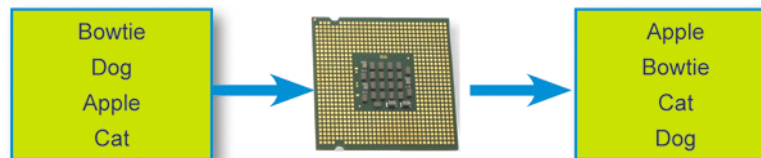

FIGURE 1-13

Computers produce output on devices such as screens and printers.
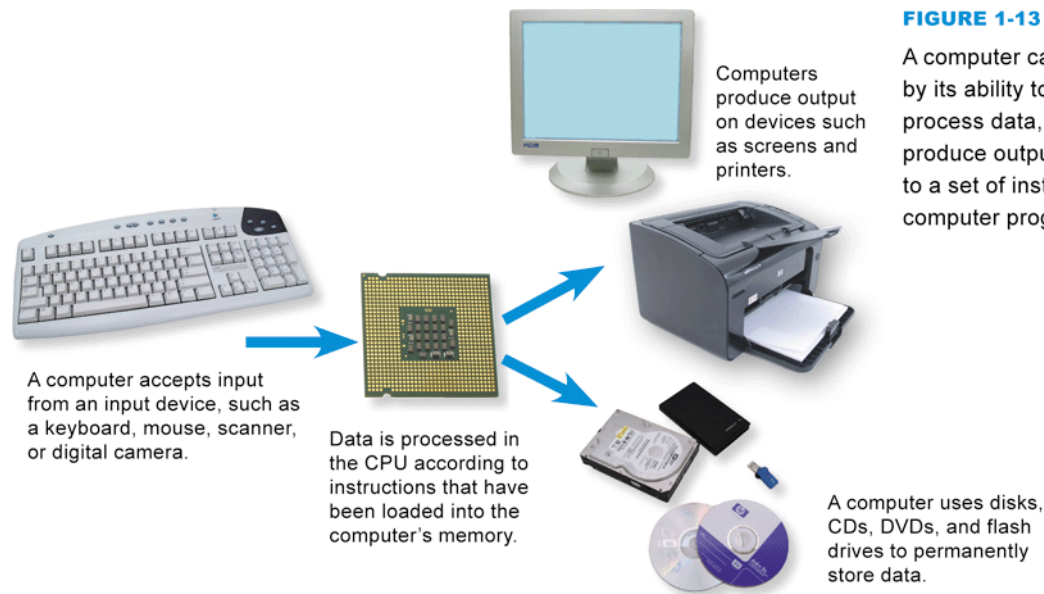
A computer can be defined by its ability to accept input, process data, store data, and produce output, all according to a set of instructions from a computer program.

A computer accepts input from an input device, such as a keyboard, mouse, scanner, or digital camera.

Data is processed in the CPU according to instructions that have been loaded into the computer's memory.

A computer uses disks, CDs, DVDs, and flash drives to permanently store data.

1 **Computer Basics**

➤ Computer input is whatever is typed, submitted, or transmitted to a computer system

➤ Output is the result produced by a computer

➤ Data refers to the symbols that represent facts, objects, and ideas

➤ Computers manipulate data in many ways, and this manipulation is called processing

   ➤ Central Processing Unit (CPU)

   ➤ Microprocessor

Bowtie		Apple
Dog		Bowtie
Apple		Cat
Cat		Dog

FIGURE 1-14

An unsorted list is input into the computer, where it is processed in the CPU and output as a sorted list.

1 **Computer Basics**

➢ Memory is an area of a computer that temporarily holds data waiting to be processed, stored, or output

➢ Storage is the area where data can be left on a permanent basis when it is not immediately needed for processing

➢ A file is a named collection of data that exists on a storage medium

➢ The series of instructions that tells a computer how to carry out processing tasks is referred to as a computer program

　➢ Software

1 Computer Basics

➢ A stored program means that a series of instructions for a computing task can be loaded into a computer's memory

  ➢ Allows you to switch tasks

  ➢ Distinguishes a computer from other simpler and less versatile digital devices

Computer Basics

➤ Application software is a set of computer programs that helps a person carry out a task

➤ Software applications are sometimes referred to as apps, especially in the context of handheld devices

➤ The primary purpose of system software is to help the computer system monitor itself in order to function efficiently

    ➤ Operating system (OS)

1 Computer Types and Uses

➢ A personal computer is a microprocessor-based computing device designed to meet the computing needs of an individual

FIGURE 1-15

Personal computer designs run the gamut from drab gray boxes to colorful curvy cases.

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Courtesy of Dell, Inc.

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1 Computer Types and Uses

➤ Handheld digital devices include familiar gadgets such as iPhones, iPads, iPods, Garmin GPSs, Droids, and Kindles

➤ These devices incorporate many computer characteristics

➤ Handheld devices can be divided into two broad categories: those that allow users to install software applications (apps) and those that do not

FIGURE 1-16

Tablet computers, high-end mobile phones, and similar handheld devices allow you to install your choice of application software.

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1 Computer Types and Uses

➢ A videogame console, such as Nintendo's Wii, Sony's PlayStation, or Microsoft's Xbox, is not generally referred to as personal computer because of their history as dedicated game devices

FIGURE 1-17

A videogame console includes circuitry similar to a personal computer's, but its input and output devices are optimized for gaming.

© iStockphoto/mariusFM77

1 Computer Types and Uses

➤ The term workstation has two meanings:

➤ An ordinary personal computer that is connected to a network

➤ A powerful desktop computer used for high-performance tasks

FIGURE 1-18

A workstation resembles a desktop computer, but typically features more processing power and storage capacity.

© 2011 Hewlett-Packard Development Company, LP

Computer Types and Uses

➢ The purpose of a server is to *serve* computers on a network (such as the Internet or a home network) by supplying them with data

➢ A mainframe computer (or simply a mainframe) is a large and expensive computer capable of simultaneously processing data for hundreds or thousands of users

➢ A computer falls into the supercomputer category if it is, at the time of construction, one of the fastest computers in the world

  ➢ A compute-intensive problem is one that requires massive amounts of data to be processed using complex mathematical calculations

1 Computer Types and Uses

FIGURE 1-20

This IBM z9 mainframe computer weighs 2,807 pounds and is about 6.5 feet tall.

Courtesy of International Business Machines Corporation. Unauthorized use not permitted.

FIGURE 1-21

In 2012, IBM's Blue Gene/Q became the fastest supercomputer in the world. With a speed of 16.32 petaflops, the number of calculations this computer can perform in one hour would require 300 years if every person on Earth used a handheld calculator.

Lawrence Livermore National Laboratory

Microcontrollers

1

➢ A microcontroller is a special-purpose microprocessor that is built into the machine it controls

➢ Microcontrollers can be embedded in all sorts of everyday devices
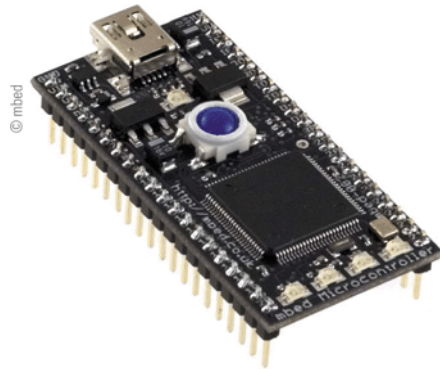
FIGURE 1-22

A microcontroller is a self-contained chip that can be embedded in an appliance, vehicle, or other device.

1 Section C: Digital Data Representation

➢ Data Representation Basics

➢ Representing Numbers, Text, Images, and Sound

➢ Quantifying Bits and Bytes

➢ Circuits and Chips

1 Question

- 012300 When you shop for digital devices, their capabilities are often touted in terms of speed and capacity. Suppose you're shopping for a USB Flash drive. A friend recommends one that's 64 GB. What does that mean?
  - A. It operates at 64 gigabits per second.
  - B. It holds 64 billion bytes of data.
  - C. It holds 64 million 0s and 1s to represent data.
  - D. It uses 64-bit ASCII code to hold data.

1 Data Representation Basics

➢ Data representation refers to the form in which data is stored, processed, and transmitted

➢ Digital data is text, numbers, graphics, sound, and video that has been converted into discrete digits such as 0s and 1s

➢ Analog data is represented using an infinite scale of values

FIGURE 1-24

A computer is a digital device, more like a standard light switch than a dimmer switch.

© MediaTechnics

1 Representing Numbers, Text, Images, and Sound

➢ Numeric data

  ➢ Binary number system

➢ Character data

  ➢ ASCII, EBCDIC, Extended ASCII, and Unicode

Decimal (Base 10)	Binary (Base 2)
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
1000	1111101000

FIGURE 1-25

The decimal system uses ten symbols to represent numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. The binary number system uses only two symbols: 0 and 1.

Representing Numbers, Text, Images, and Sound

FIGURE 1-26

The Extended ASCII code uses eight 1s and 0s to represent letters, symbols, and numerals. The first 32 ASCII characters are not shown in the table because they represent special control sequences that cannot be printed. The two blank entries are space characters.

Quantifying Bits and Bytes

Bit	One binary digit	Gigabit	2^{30} bits
Byte	8 bits	Gigabyte	2^{30} bytes
Kilobit	1,024 or 2^{10} bits	Terabyte	2^{40} bytes
Kilobyte	1,024 or 2^{10} bytes	Petabyte	2^{50} bytes
Megabit	1,048,576 or 2^{20} bits	Exabyte	2^{60} bytes
Megabyte	1,048,576 or 2^{20} bytes		

FIGURE 1-29

Quantifying Digital Data

1 **Circuits and Chips**

➢ An integrated circuit (IC) is a super-thin slice of semiconducting material packed with microscopic circuit elements

FIGURE 1-30

The first computer chips contained fewer than 100 miniaturized components, such as diodes and transistors. The chips used as the CPUs for today's computers and cutting-edge graphics cards contain billions of transistors.
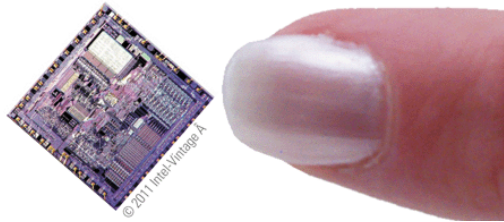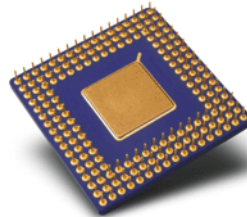
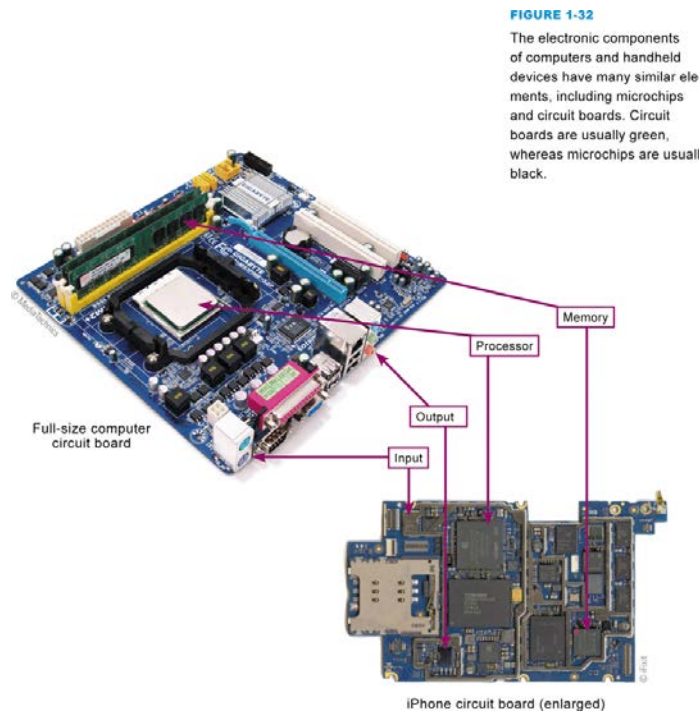A DIP has two rows of pins that connect the IC circuitry to a circuit board.

A PGA is a square chip package with pins arranged in concentric squares, typically used for microprocessors.

FIGURE 1-31

Integrated circuits can be used for microprocessors, memory, and support circuitry. They are housed within a ceramic carrier. These carriers exist in several configurations, or chip packages, such as DIPs and PGAs.

1 **Circuits and Chips**

➢ The electronic components of most digital devices are mounted on a circuit board called a system board, motherboard, or main board

FIGURE 1-32
The electronic components of computers and handheld devices have many similar elements, including microchips and circuit boards. Circuit boards are usually green, whereas microchips are usually black.

Full-size computer circuit board

Memory

Processor

Output

Input

iPhone circuit board (enlarged)

1 Section D: Digital Processing

➢ Programs and Instruction Sets

➢ Processor Logic

Question

- ➢ 012400 Programmers write computer programs for word processing, displaying photos, playing music, and showing movies. What programmers write, however, is not what a computer actually processes. Why is this the case?
  - ➢ A. Because programmers usually write programs using high-level programming languages that have to be converted into machine language that computers can work with.
  - ➢ B. Because programs are basically outlines that programmers have to fill out using op codes.
  - ➢ C. Because high-level languages are too detailed for computers to process, so programs written in these languages have to be simplified.
  - ➢ D. Because computer programmers make too many errors for programs to run successfully.
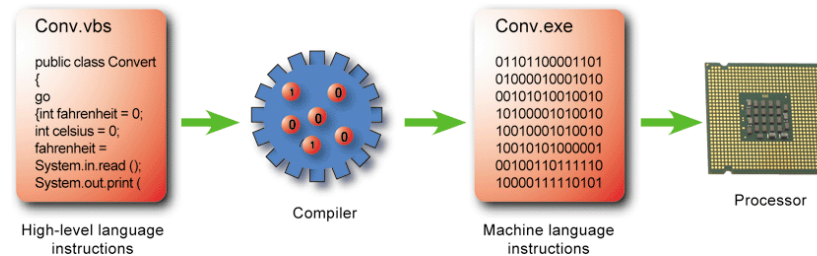
Programs and Instruction Sets

➢ Computers and dedicated handheld devices all work with digital data under the control of a computer program

➢ Computer programmers create programs that control digital devices. These programs are usually written in a high-level programming language

➢ The human-readable version of a program created in a high-level language by a programmer is called source code
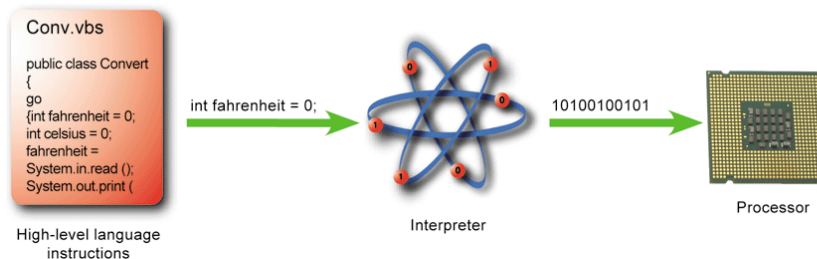
Programs and Instruction Sets

FIGURE 1-34

A compiler converts statements written in a high-level programming language into object code that the processor can execute.
▶ Watch a compiler in action.

Conv.vbs

public class Convert
{
go
{int fahrenheit = 0;
int celsius = 0;
fahrenheit =
System.in.read ();
System.out.print (

High-level language instructions

Compiler

Conv.exe

01101100001101
01000010001010
00101010010010
10100001010010
10010001010010
10010101000001
00100110111110
10000111110101

Machine language instructions

Processor

FIGURE 1-35

An interpreter converts high-level statements one at a time as the program is running.
▶ Watch an interpreter in action.

Conv.vbs

public class Convert
{
go
{int fahrenheit = 0;
int celsius = 0;
fahrenheit =
System.in.read ();
System.out.print (

High-level language instructions

int fahrenheit = 0;

Interpreter

10100100101

Processor

1 **Programs and Instruction Sets**

➢ A microprocessor is hard-wired to perform a limited set of activities, such as addition, subtraction, counting, and comparisons, called an instruction set

➢ Each instruction has a corresponding sequence of 0s and 1s

➢ The end product is called machine code

➢ An op code (short for operation code) is a command word for an operation such as add, compare, or jump

➢ The operand for an instruction specifies the data, or the address of the data, for the operation

Programs and Instruction Sets

```
#include <stdio.h>
int main ()
{
int i;

for (i=1; i<=100; i=i+1)
  printf("%d\t",i);
return(0);
}
```

```
001001111011110111111111111100000
101011111011111100000000000010100
101011111010010000000000000100000
101011111010010100000000000100100
101011111010000000000000000011000
101011111010000000000000000011100
100011111010111000000000000011100
100011111011100000000000000011000
000000011100111000000000000011001
001001011100100000000000000000001
001010010000000100000000001100101
101011111010100000000000000011100
000000000000000001111000000010010
000000110000111111001000001000001
000101000010000011111111111110111
101011111011100100000000000011000
001111000000001000001000000000000
100011111010010100000000000011000
000011000001000000000000011101100
001001001000010000000010000110000
```
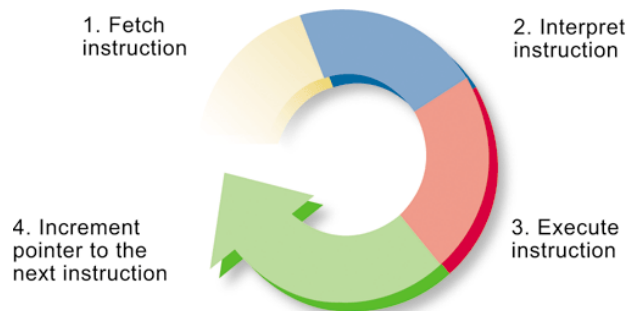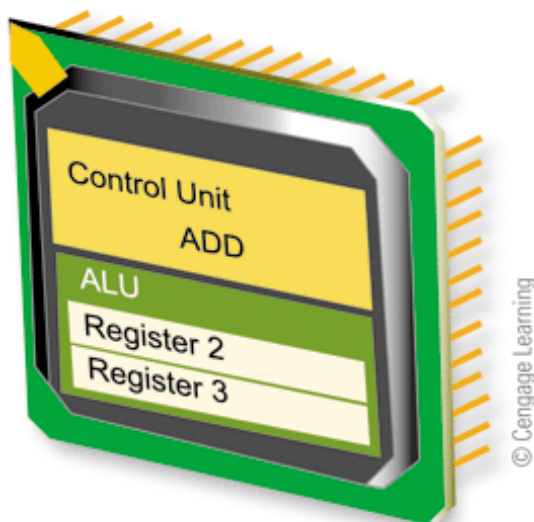
1 **Processor Logic**

➢ The ALU (arithmetic logic unit) is the part of the microprocessor that performs arithmetic operations

➢ The ALU uses registers to hold data that is being processed

➢ The microprocessor's control unit fetches each instruction, just as you get each ingredient out of a cupboard or the refrigerator

➢ The term instruction cycle refers to the process in which a computer executes a single instruction
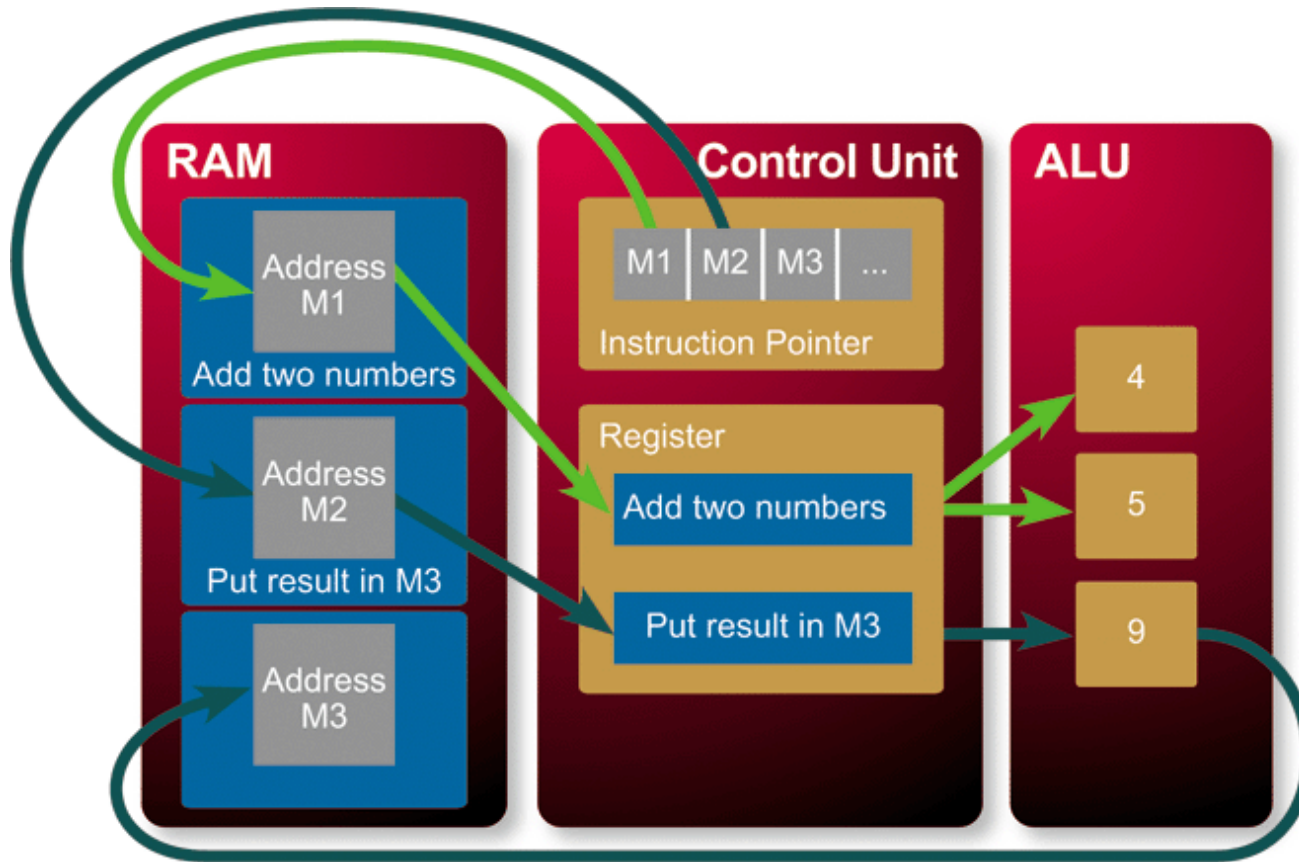
Processor Logic

FIGURE 1-37

The control unit fetches the ADD instruction, then loads data into the ALU's registers where it is processed.

1. Fetch instruction

2. Interpret instruction

4. Increment pointer to the next instruction

3. Execute instruction

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FIGURE 1-38

The instruction cycle includes four activities.

Processor Logic

FIGURE 1-39

The control unit's instruction pointer indicates M1, a location in memory. The control unit fetches the "Add two numbers" instruction from M1. This instruction is then sent to the ALU. The instruction pointer then changes to M2. The processor fetches the instruction located in M2, moves it to a register, and executes it.

▶ See how it works.

Section E: Password Security

- ➢ Authentication Protocols
- ➢ Password Hacks
- ➢ Secure Passwords

Question

- 012500 Security experts stress that the use of "strong" passwords can prevent identity theft and help to keep your computer files secure. Which of the following passwords is likely to be the most secure?

  - A. 12345 because it is all numbers.

  - B. Hippocampus, because it is a long and unusual word.

  - C. Il2baomw, because it combines numbers with a nonsense word.

  - D. Football88, because it combines a word and numbers.

1 Authentication Protocols

➢ Security experts use the term authentication protocol to refer to any method that confirms a person's identity using something the person knows, something the person possesses, or something the person is

  ➢ A person can be identified by biometrics, such as a fingerprint, facial features (photo), or retinal pattern

  ➢ A user ID is a series of characters—letters and possibly numbers or special symbols—that becomes a person's unique identifier

  ➢ A password is a series of characters that verifies a user ID and guarantees that you are the person you claim to be

1 # Authentication Protocols

User Name & Password

*Enter a
User Name: _____ (Must be at least 8 characters)

*Enter a
Password: _____ (Must be at least 8 characters and include one number)

*Confirm
Password: _____

View our privacy policy to learn how we protect your information.

ENROLL NOW!»

FIGURE 1-41

When you create an account, you are usually required to enter a user ID and password. Then you are required to confirm the password to make sure you typed it correctly.

Password Hacks

➢ When someone gains unauthorized access to your personal data and uses it illegally, it is called identity theft

➢ Hackers employ a whole range of ways to steal passwords

➢ A dictionary attack helps hackers guess your password by stepping through a dictionary containing thousands of the most commonly used passwords

➢ The brute force attack uses password-cracking software, but its range is much more extensive than the dictionary attack

Password Hacks

➢ If hackers can't guess a password, they can use another technique called sniffing, which intercepts information sent out over computer networks

➢ An even more sophisticated approach to password theft is phishing

➢ A keylogger is software that secretly records a user's keystrokes and sends the information to a hacker

1 Secure Passwords

FIGURE 1-44

Tips for Creating Secure
Passwords

- Use passwords that are at least eight characters in length. The longer the password, the tougher it is to crack.

- Use a combination of letters, numbers, and special characters such as $, #, if permitted.

- Use uppercase and lowercase letters if the hosting computer is case sensitive.

- Use a passphrase based on several words or the first letters of a verse from a favorite poem or song. For example, the words from the nursery rhyme "Jack and Jill went up the hill" can be converted to jjwuth. You can then insert special characters and numbers, and add some uppercase letters to create a password that still makes sense to you personally, such as J&J w^th!ll. This type of password appears random to anyone else but you.

- Do not use a password based on public information such as your phone number, Social Security number, driver's license number, or birthday. Hackers can easily find this information, and other personal facts such as names of your spouse, children, or pets.

- Avoid passwords that contain your entire user ID or part of it. A user ID of bjeffe coupled with a password of bjeffe123 is an easy target for password thieves.

- Steer clear of words that can be found in the dictionary, including foreign words. Dictionary attacks can utilize foreign language dictionaries. Even common words spelled backwards, such as drowssap instead of password, are not tricky enough to fool password-cracking software.

1 Secure Passwords

➤ Strive to select a unique user ID that you can use for more than one site

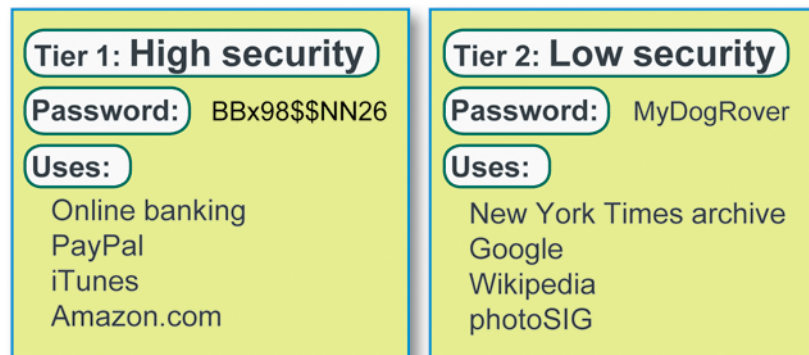➤ Maintain two or three tiers of passwords

FIGURE 1-45

Tiered passwords reduce the number of user IDs and passwords that you have to remember; however, the disadvantage is that a hacker who discovers one of your passwords will be able to use it to access many of your accounts.

1 **Secure Passwords**

➤ A password manager (sometimes called a keychain) stores user IDs with their corresponding passwords and automatically fills in login forms
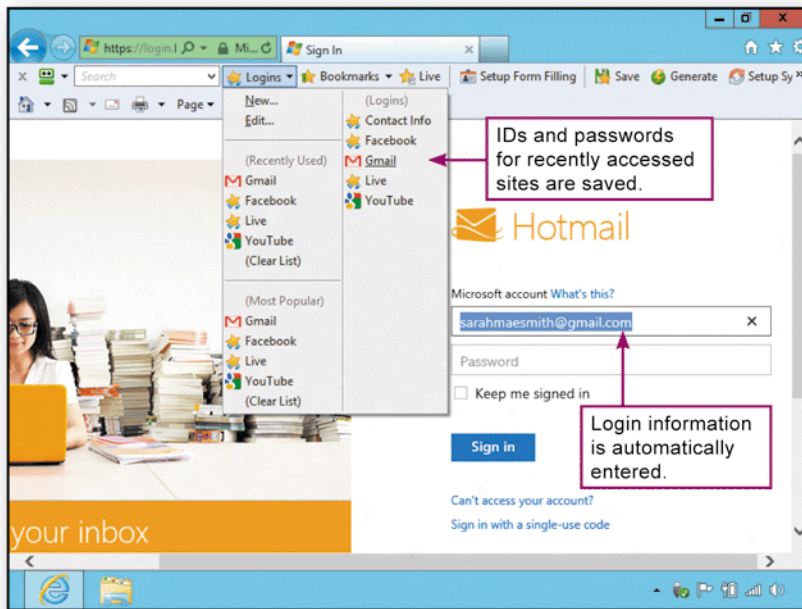
FIGURE 1-47

Password managers help you keep track of all your passwords. ▶ If you've never used a password manager and want to see how one works, start the guided tour for this figure in your interactive eBook.

IDs and passwords for recently accessed sites are saved.

Login information is automatically entered.

FIGURE 1-48

Some password managers are portable so that you can carry them with you on a USB flash drive.

Vydrin/Shutterstock.com

1 **What Do You Think?**

➤ 013100 From what you have learned, do you think that academic research articles should be available for free?

   ➤ A. Yes   B. No   C. Not sure

➤ 013200 Do you agree with magazine and news companies that quality content requires a paywall?

   ➤ A. Yes   B. No   C. Not sure

➤ 013300 Do you support efforts to make information accessible through back channels such as WikiLeaks?

   ➤ A. Yes   B. No   C. Not sure

Chapter 1 Complete

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