Chapter 1
Computers and Digital Basics

Computer Concepts 2014
Chapter Contents

- Section A: All Things Digital
- Section B: Digital Devices
- Section C: Digital Data Representation
- Section D: Digital Processing
- Section E: Password Security
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.
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.
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.
Section A: All Things Digital

- The Digital Revolution
- Data Processing
- Personal Computing
- Network Computing
- Cloud Computing
- Digital Society
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
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.
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.
# The Digital Revolution

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

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

- Computer Basics
- Computer Types and Uses
- Microcontrollers
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.
A computer is a multipurpose device that accepts input, processes data, stores data, and produces output, all according to a series of stored instructions.
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

![Diagram showing input, processing, and output]
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
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
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)
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.
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.
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.
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
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.
Computer Types and Uses

FIGURE 1-20

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

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.
Microcontrollers

- 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
Section C: Digital Data Representation

- Data Representation Basics
- Representing Numbers, Text, Images, and Sound
- Quantifying Bits and Bytes
- Circuits and Chips
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.
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.
Representing Numbers, Text, Images, and Sound

- Numeric data
  - Binary number system

- Character data
  - ASCII, EBCDIC, Extended ASCII, and Unicode

<table>
<thead>
<tr>
<th>Decimal (Base 10)</th>
<th>Binary (Base 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>101</td>
</tr>
<tr>
<td>6</td>
<td>110</td>
</tr>
<tr>
<td>7</td>
<td>111</td>
</tr>
<tr>
<td>8</td>
<td>1000</td>
</tr>
<tr>
<td>9</td>
<td>1001</td>
</tr>
<tr>
<td>10</td>
<td>1010</td>
</tr>
<tr>
<td>11</td>
<td>1011</td>
</tr>
<tr>
<td>1000</td>
<td>111101000</td>
</tr>
</tbody>
</table>

**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.
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.

<table>
<thead>
<tr>
<th>ASCII Code</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>00010000</td>
<td>?</td>
</tr>
<tr>
<td>00010010</td>
<td>D</td>
</tr>
<tr>
<td>00010011</td>
<td>E</td>
</tr>
<tr>
<td>00010100</td>
<td>F</td>
</tr>
<tr>
<td>00010101</td>
<td>G</td>
</tr>
<tr>
<td>00010110</td>
<td>H</td>
</tr>
<tr>
<td>00010111</td>
<td>I</td>
</tr>
<tr>
<td>00011000</td>
<td>J</td>
</tr>
<tr>
<td>00011001</td>
<td>K</td>
</tr>
<tr>
<td>00011010</td>
<td>L</td>
</tr>
<tr>
<td>00011011</td>
<td>M</td>
</tr>
<tr>
<td>00011100</td>
<td>N</td>
</tr>
<tr>
<td>00011101</td>
<td>O</td>
</tr>
<tr>
<td>00011110</td>
<td>P</td>
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<td>W</td>
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<tr>
<td>00100110</td>
<td>X</td>
</tr>
<tr>
<td>00100111</td>
<td>Y</td>
</tr>
<tr>
<td>00101000</td>
<td>Z</td>
</tr>
</tbody>
</table>

Chapter 1: Computers and Digital Basics
### Quantifying Bits and Bytes

#### FIGURE 1-29
Quantifying Digital Data

<table>
<thead>
<tr>
<th>Bit</th>
<th>One binary digit</th>
<th>Gigabit</th>
<th>$2^{30}$ bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte</td>
<td>8 bits</td>
<td>Gigabyte</td>
<td>$2^{30}$ bytes</td>
</tr>
<tr>
<td>Kilobit</td>
<td>1,024 or $2^{10}$ bits</td>
<td>Terabyte</td>
<td>$2^{40}$ bytes</td>
</tr>
<tr>
<td>Kilobyte</td>
<td>1,024 or $2^{10}$ bytes</td>
<td>Petabyte</td>
<td>$2^{50}$ bytes</td>
</tr>
<tr>
<td>Megabit</td>
<td>1,048,576 or $2^{20}$ bits</td>
<td>Exabyte</td>
<td>$2^{60}$ bytes</td>
</tr>
<tr>
<td>Megabyte</td>
<td>1,048,576 or $2^{20}$ bytes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.

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.
Circuits and Chips

The electronic components of most digital devices are mounted on a circuit board called a system board, motherboard, or main board.
Section D: Digital Processing

- Programs and Instruction Sets
- Processor Logic
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.
Chapter 1: Computers and Digital Basics

1 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.

FIGURE 1-35
An interpreter converts high-level statements one at a time as the program is running.

Watch an interpreter in action.
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.
#include <stdio.h>
int main ()
{
    int i;

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

FIGURE 1-36
The source code program in the left column prints numbers from 1 to 100. This source code is converted to machine language instructions shown in the right column that the computer can directly process.
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.
FIGURE 1-37
The control unit fetches the ADD instruction, then loads data into the ALU’s registers where it is processed.

FIGURE 1-38
The instruction cycle includes four activities.
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

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.
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.
Authentication Protocols

**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.

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!]](##)
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.
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!!I. 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 bjfe1fe123 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.
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.
Secure Passwords

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