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.
- 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.
- 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
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

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.

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.

Data processing is based on an input-processing-output cycle. Data goes into a computer, it is processed, and then it is output.

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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.

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.

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

- 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.

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.

Section B: Digital Devices

- Computer Basics
- Computer Types and Uses
- Microcontrollers

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.
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 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

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

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

- 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

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

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

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

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Question

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.

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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.

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Representing Numbers, Text, Images, and Sound

- Numeric data
  - Binary number system
- Character data
  - ASCII, EBCDIC, Extended ASCII, and Unicode

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Quantifying Bits and Bytes

<table>
<thead>
<tr>
<th>Bit</th>
<th>One binary digit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte</td>
<td>8 bits</td>
</tr>
<tr>
<td>Kilobyte</td>
<td>1,024 or 2^10 bits</td>
</tr>
<tr>
<td>Megabyte</td>
<td>1,048,576 or 2^20 bits</td>
</tr>
</tbody>
</table>

| Gigabyte | 2^30 bits |
| Terabyte | 2^40 bits |
| Petabyte | 2^50 bits |
| Exabyte | 2^60 bits |

Chapter 1: Computers and Digital Basics
1 Circuits and Chips

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

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

1 Section D: Digital Processing

- Programs and Instruction Sets
- Processor Logic

1 Question

- Programs and Instruction Sets

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

- 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.

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.

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.

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

- Do not use a password based on public information about you, such as your name, Social Security number, date of birth, etc. If you are not sure what kind of personal information is safe to use in a password, it is best to avoid using it.
- Avoid passwords that contain your entire user ID or your entire email address in either a literal or encrypted form.
- Avoid using passwords that you use to log in to other accounts, especially if they are for the same service provider.
- Use a mix of uppercase and lowercase letters, numbers, and special characters. A stronger password consists of a combination of all three, rather than just one type of character.
- Consider using a tool or web-based password manager to remember and generate strong passwords.
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

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

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