

APCS SUMMARY Chapter 1

- Java is one of today's most popular software-development languages.
- Java was developed by Sun Microsystems.
- Java is a fully object-oriented language with strong support for proper software-engineering techniques.
- A computer is a device capable of performing computations and making logical decisions at speeds millions, even billions, of times faster than human beings can.
- Computers process data under the control of sets of instructions called computer programs. These computer programs guide the computer through orderly sets of actions specified by people called computer programmers.
- The various devices that comprise a computer system (such as the keyboard, screen, disks, memory and processing units) are referred to as hardware.
- The computer programs that run on a computer are referred to as software.
- The input unit is the "receiving" section of the computer. It obtains information (data and computer programs) from various input devices and places this information at the disposal of the other units so that the information may be processed.
- The output unit is the "shipping" section of the computer. It takes information processed by the computer and places it on output devices to make it available for use outside the computer.
- The memory unit is the rapid access, relatively low-capacity "warehouse" section of the computer. It retains information that has been entered through the input unit so that the information may be made immediately available for processing when it is needed and retains information that has already been processed until that information can be placed on output devices by the output unit.
- The arithmetic and logic unit (ALU) is the "manufacturing" section of the computer. It is responsible for performing calculations such as addition, subtraction, multiplication and division and for making decisions.
- The central processing unit (CPU) is the "administrative" section of the computer. It is the computer's coordinator and is responsible for supervising the operation of the other sections.
- The secondary storage unit is the long-term, high-capacity "warehousing" section of the computer.
- Early computers were capable of performing only one job or task at a time. This form of computer operation often is called single-user batch processing.
- Software systems called operating systems were developed to help make it more convenient to use computers. Early operating systems managed the smooth transition between jobs and minimized the time it took for computer operators to switch between jobs.
- Multiprogramming involves the "simultaneous" operation of many jobs on the computer-the computer shares its resources among the jobs competing for its attention.
- Timesharing is a special case of multiprogramming in which dozens or even hundreds of users share a computer through terminals. The computer runs a small portion of one user's job, then moves on to service the next user. The computer does this so quickly that it might provide service to each user several times per second, so programs appear to run simultaneously.
- An advantage of timesharing is that the user receives almost immediate responses to requests rather than having to wait long periods for results, as with previous modes of computing.
- In 1977, Apple Computer popularized the phenomenon of personal computing.
- In 1981, IBM introduced the IBM Personal Computer. Almost overnight, personal computing became legitimate in business, industry and government organizations.

- Although early personal computers were not powerful enough to timeshare several users, these machines could be linked together in computer networks, sometimes over telephone lines and sometimes in local area networks (LANs) within an organization. This led to the phenomenon of distributed computing, in which an organization's computing is distributed over networks to the sites at which the real work of the organization is performed.
- Today, information is shared easily across computer networks where some computers called file servers offer a common store of programs and data that may be used by client computers distributed throughout the network-hence the term client/server computing.
- Java has become the language of choice for developing Internet-based applications (and for many other purposes).
- Computer languages may be divided into three general types: machine languages, assembly languages and high-level languages.
- Any computer can directly understand only its own machine language. Machine languages generally consist of strings of numbers (ultimately reduced to 1s and 0s) that instruct computers to perform their most elementary operations one at a time. Machine languages are machine dependent.
- English-like abbreviations formed the basis of assembly languages. Translator programs called assemblers convert assembly-language programs to machine language at computer speeds.
- Compilers translate high-level language programs into machine-language programs. High-level languages (like Java) contain English words and conventional mathematical notations.

High-Level Language	Assembly Language	Machine Language
a + b	ld [%fp-20], %o0	...
	ld [%fp-24], %o1	1101 0000 0000 0111
	add %o0, %o1, %o0	1011 1111 1110 1000
		1101 0010 0000 0111
		1011 1111 1110 1000
		1001 0000 0000 0000
		...

figure 1.20 The same expression in a high-level language, assembly language, and machine language

- Interpreter programs directly execute high-level language programs without the need for compiling those programs into machine language.
- Although compiled programs execute much faster than interpreted programs, interpreters are popular in program-development environments in which programs are recompiled frequently as new features are added and errors are corrected.
- Objects are essentially reusable software components that model items in the real world. Modular, object-oriented design and implementation approaches make software-development groups more productive than is possible with previous popular programming techniques such as structured programming. Object-oriented programs are often easier to understand, correct and modify.
- Java originated at Sun Microsystems as a project for intelligent consumer-electronic devices.
- When the World Wide Web exploded in popularity in 1993, Sun people saw the immediate potential of using Java to create Web pages with so-called dynamic content.
- Java is now used to create Web pages with dynamic and interactive content, to develop large-scale enterprise applications, to enhance the functionality of Web servers, to provide applications for consumer devices and so on.
- Java programs consist of pieces called classes. Classes consist of pieces called methods that perform tasks and return information when they complete their tasks.

- Most Java programmers use rich collections of existing classes in Java class libraries.
- FORTRAN (FORmula TRANslator) was developed by IBM Corporation between 1954 and 1957 for scientific and engineering applications that require complex mathematical computations.
- COBOL (COMmon Business Oriented Language) was developed in 1959 by a group of computer manufacturers and government and industrial computer users. COBOL is used primarily for commercial applications that require precise and efficient manipulation of large amounts of data.
- Pascal was designed at about the same time as C. It was created by Professor Nicklaus Wirth and was intended for academic use.
- Basic was developed in 1965 at Dartmouth College as a simple language to help novices become comfortable with programming.
- Structured programming is a disciplined approach to writing programs that are clearer than unstructured programs, easier to test and debug and easier to modify.
- Most high-level languages-including C and C++-generally allow the programmer to write programs that perform only one activity at a time. Java, through a technique called multithreading, enables programmers to write programs with parallel activities.
- The Internet was developed more than three decades ago with funding supplied by the Department of Defense. Originally designed to connect the main computer systems of about a dozen universities and research organizations, the Internet today is accessible by hundreds of millions of computers worldwide.
- The Web allows computer users to locate and view multimedia-intensive documents over the Internet.
- Java programs normally go through five phases to be executed: edit, compile, load, verify and execute.
- Java program file names end with the .java extension.
- The Java compiler (javac) translates a Java program into bytecodes-the language understood by the Java interpreter. If a program compiles correctly, the compiler produces a file with the .class extension. This is the file containing the bytecodes that are interpreted during the execution phase.
- An application is a program that is normally stored and executed on the user's local computer.
- Applications are loaded into memory. then executed by the java interpreter.
- For organizations wanting to do heavy-duty information-systems development, Integrated Development Environments (IDEs) are available from the major software suppliers. The IDEs provide many tools for supporting the software-development process.
- Object orientation is a natural way of thinking about the world and of writing computer programs.
- Humans think in terms of objects. We possess the marvelous ability of abstraction, which enables us to view screen images as people, planes, trees and mountains rather than as individual dots of color (called pixels for "picture elements").
- Humans learn about objects by studying their attributes and observing their behaviors. Different objects can have similar attributes and can exhibit similar behaviors.
- Object-oriented design (OOD) models real-world objects. It takes advantage of class relationships, where objects of a certain class-such as a class of vehicles-have the same characteristics. It takes advantage of inheritance relationships, and even multiple-inheritance relationships, where newly created classes of objects are derived by absorbing characteristics of existing classes and adding unique characteristics of their own.
- OOD encapsulates data (attributes) and functions (behavior) into objects; the data and functions of an object are intimately tied together.

- Objects have the property of information hiding. This means that, although objects may know how to communicate with one another across well-defined interfaces, objects normally are not allowed to know how other objects are implemented.
- Languages such as Java are object-oriented-programming in such a language is called object-oriented programming (OOP) and allows designers to implement the object-oriented design as a working system.
- In Java, the unit of programming is the class from which objects are eventually instantiated (a fancy term for "created"). Java classes contain methods (which implement class behaviors) and attributes (which implement class data).
- Java programmers concentrate on creating their own user-defined types, called classes. Each class contains data and the set of functions that manipulate that data. The data components of a Java class are called attributes. The function components of a Java class are called methods.
- An instance of a user-defined type (i.e., a class) is called an object.
- Classes can also have relationships with other classes. These relationships are called associations.
- With object technology, we can build much of the software we will need by combining "standardized, interchangeable parts" called classes.
- The process of analyzing and designing a system from an object-oriented point of view is called object-oriented analysis and design (OOAD).
- An application is a program that executes using the Java interpreter.
- A comment that begins with // is called a single-line comment. Programmers insert comments to document programs and improve program readability.
- A string of characters contained between double quotation marks is called a string, a character string, a message or a string literal.
- Blank lines, space characters, newline characters and tab characters are known as white-space characters. White-space characters outside strings are ignored by the compiler.
- Keyword class introduces a class definition and is immediately followed by the class name.
- Keywords (or reserved words) are reserved for use by Java. Keywords must appear in all lower-case letters.

abstract	do	implements	protected	throws
boolean	double	import	public	transient
break	else	instanceof	return	true
byte	extends	int	short	try
case	false	interface	static	void
catch	final	long	strictfp	volatile
char	finally	native	super	while
class	float	new	switch	
const*	for	null	synchronized	
continue	goto*	package	this	
default	if	private	throw	

figure 1.19 Java reserved words

- By convention, all class names in Java begin with a capital letter. If a class name contains more than one word, the first letter of each word should be capitalized.
- An identifier is a series of characters consisting of letters, digits, underscores (-) and dollar signs (\$) that does not begin with a digit, does not contain any spaces and is not a keyword.

- Java is case sensitive-that is, uppercase and lowercase letters are different.
- A left brace, {, begins the body of every class definition. A corresponding right brace, }, ends each class definition.
- Java applications begin executing at method main.
- Methods are able to perform tasks and return information when they complete their tasks.
- The first line of method main must be defined as public static void main(String args[])
- A left brace, {, begins the body of a method definition. A corresponding right brace, }, ends the method definition's body.
- System.out is known as the standard output object. System.out allows Java applications to display strings and other types of information in the command window from which the Java application executes.
- The escape sequence \n indicates a newline character. Other escape sequences include \t (tab), \r (carriage return), \\ (backslash) and \" (double quote).

Escape sequence	Description
\n	Newline. Position the screen cursor to the beginning of the next line.
\t	Horizontal tab. Move the screen cursor to the next tab stop.
\r	Carriage return. Position the screen cursor to the beginning of the current line; do not advance to the next line. Any characters output after the carriage return overwrite the characters previously output on that line.
\\	Backslash. Used to print a backslash character.
\"	Double quote. Used to print a double-quote character. For example, <pre>System.out.println("\"in quotes\"");</pre> displays <pre>"in quotes"</pre>

Fig. 2.5 Some common escape sequences.

- Method println of the System.out object displays (or prints) a line of information in the command window. When println completes its task, it automatically positions the output cursor to the beginning of the next line in the command window.
- Every statement must end with a semicolon (also known as the statement terminator).
- The difference between System.out's print and println methods is that print does not position to the beginning of the next line in the command window when it finishes displaying its argument. The next character displayed in the command window appears immediately after the last character displayed with print.
- Java contains many predefined classes that are grouped into categories of related classes called packages. The packages are referred to collectively as the Java class library or the Java applications programming interface (Java API).
- The compiler uses import statements to locate classes required to compile a Java program.
- A static method is called by following its class name by a dot (.) and the name of the method.
- A variable is a location in the computer's memory where a value can be stored for use by a program. The name of a variable is any valid identifier.
- All variables must be declared with a name and a data type before they can be used in a program.
- Declarations end with a semicolon (;) and can be split over several lines, with each variable in the declaration separated by a comma (forming a comma-separated list of variable names).

- Variables of type int hold integer values (whole numbers such as 7, -11, 0 and 31,914).
- Types such as int, float, double and char are primitive data types. Names of primitive data types are keywords of the Java programming language.

Type	Size in bits	Values	Standard
boolean		true or false [Note: The representation of a boolean is specific to the Java Virtual Machine on each computer platform.]	
char	16	'\u0000' to '\uFFFF' (0 to 65535)	(ISO Unicode character set)
byte	8	-128 to +127 (-2^7 to $2^7 - 1$)	
short	16	-32,768 to +32,767 (-2^{15} to $2^{15} - 1$)	
int	32	-2,147,483,648 to +2,147,483,647 (-2^{31} to $2^{31} - 1$)	
long	64	-9,223,372,036,854,775,808 to +9,223,372,036,854,775,807 (-2^{63} to $2^{63} - 1$)	
float	32	<i>Negative range:</i> -3.4028234663852886E+38 to -1.40129846432481707e-45 <i>Positive range:</i> 1.40129846432481707e-45 to 3.4028234663852886E+38	(IEEE 754 floating point)
double	64	<i>Negative range:</i> -1.7976931348623157E+308 to -4.94065645841246544e-324 <i>Positive range:</i> 4.94065645841246544e-324 to 1.7976931348623157E+308	(IEEE 754 floating point)

Fig. 4.16 The Java primitive data types.

- A prompt directs the user to take a specific action.
- A variable is assigned a value by using an assignment statement, which uses the assignment operator, =. The = operator is called a binary operator, because it has two operands.
- Java has a version of the + operator for string concatenation that enables a string and a value of another data type (including another string) to be concatenated.
- Every variable has a name, a type, a size and a value.
- When a value is placed in a memory location, the value replaces the value previously in that location. When a value is read out of a memory location, the variable's value remains unchanged.
- The arithmetic operators are binary operators, because they operate on two operands.
- Integer division yields an integer result.
- Arithmetic expressions in Java must be written in straight-line form to facilitate entering programs into the computer.
- Operators in arithmetic expressions are applied in a precise sequence determined by the rules of operator precedence.

Operator(s)	Operation(s)	Order of evaluation (precedence)
()	Parentheses	Evaluated first. If the parentheses are nested, the expression in the innermost pair is evaluated first. If there are several pairs of parentheses on the same level (i.e., not nested), they are evaluated left to right.
*, / and %	Multiplication Division Modulus	Evaluated second. If there are several of this type of operator, they are evaluated from left to right.
+ or -	Addition Subtraction	Evaluated last. If there are several of this type of operator, they are evaluated from left to right.

Fig. 2.17 Precedence of arithmetic operators.

- Parentheses may be used to force the order of evaluation of operators.
- When we say that operators are applied from left to right, we are referring to the associativity of the operators. Some operators associate from right to left.

Operators	Associativity	Type
()	left to right	parentheses
* / %	left to right	multiplicative
+ -	left to right	additive
< <= > >=	left to right	relational
== !=	left to right	equality
=	right to left	assignment

Fig. 2.21 Precedence and associativity of the operators discussed so far.

- Java's if structure allows a program to make a decision based on the truth or falsity of a condition.
- If the condition is met (i.e., the condition is true), the statement in the body of the if structure executes. If the condition is not met (i.e., the condition is false), the body statement does not execute.
- Conditions in if structures can be formed by using the equality operators and relational operators.

Standard algebraic equality or relational operator	Java equality or relational operator	Example of Java condition	Meaning of Java condition
<i>Equality operators</i>			
=	==	x == y	x is equal to y
≠	!=	x != y	x is not equal to y
<i>Relational operators</i>			
>	>	x > y	x is greater than y
<	<	x < y	x is less than y
≥	>=	x >= y	x is greater than or equal to y
≤	<=	x <= y	x is less than or equal to y

Fig. 2.19 Equality and relational operators.

- Every variable declared in a method must be initialized before it can be used in an expression.

Other helpful info:

Assignment operator	Sample expression	Explanation	Assigns
<i>Assume: int c = 3, d = 5, e = 4, f = 6, g = 12;</i>			
+=	c += 7	c = c + 7	10 to c
-=	d -= 4	d = d - 4	1 to d
*=	e *= 5	e = e * 5	20 to e
/=	f /= 3	f = f / 3	2 to f
%=	g %= 9	g = g % 9	3 to g

Fig. 4.12 Arithmetic assignment operators.

Operator	Called	Sample expression	Explanation
++	preincrement	++a	Increment a by 1, then use the new value of a in the expression in which a resides.
++	postincrement	a++	Use the current value of a in the expression in which a resides, then increment a by 1.
--	predecrement	--b	Decrement b by 1, then use the new value of b in the expression in which b resides.
--	postdecrement	b--	Use the current value of b in the expression in which b resides, then decrement b by 1.

Fig. 4.13 The increment and decrement operators .