

Programs & Programming

JC 01.1

(A. Nguyen)

What is a computer program or programming?

- A program is a set of instructions that tell the computer to do a task; e.g., draw a red dot at a certain location on the screen, or total the prices of the items bought, etc.
- The act of designing and writing programs is called programming. Using a computer does not require programming skills

The Anatomy of a Computer

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Computers

- A computer in the early days used to take the space of a large room, with air-conditioning.
- A computer now takes many forms that many of us are familiar with: desktops, laptops, tablets, smart phone, smart card, etc.
- A computer's main component is the motherboard, which holds parts of the computer like CPU & memory, and allows communication among them. It also provides connectors to peripherals.

The central processing unit

- The central processing unit (CPU) is the heart of a computer
- The CPU (such as Intel Core Processor) is composed of several hundred of million transistors
- When a program is launched (e.g., when the user clicks on an icon), the CPU loads the program into memory (e.g., from the hard disk), and executes instructions, which likely involves fetching and processing of data such as arithmetic operations

Storage

- Data in **primary storage**, also called **memory** or **RAM** (random-access memory), is kept intact only when there is power.
- Data in **secondary storage** (such as hard disks or flash drives) persists even when there is no power.

Peripheral devices

- These devices are to for interaction between people & computers.
- Some examples of peripheral devices are keyboard, mouse, printer, speakers, etc.

The Java Programming Language

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About Java

- Java is a high-level programming language, which is easy for humans to understand. A program in a high-level language is translated into machine code for computers to understand.
- Java creator is James Gosling.
- Java first gained its popularity when it was used in the form of **applets**, the Java code that could be run anywhere on the Internet, in mid 1990s.

Important benefits of Java

- **Safe:** Java was designed to be used safely in browsers, so programs terminate if they try to do something unsafe
- **Portable:** Java programs may be used, *without changes*, in various Operating Systems (such as Windows, UNIX, Linux, or Macintosh operating systems). This is possible because the Java **compiler** translates a Java program into machine code to be run by a program called the **Java Virtual Machine (JVM)**, which simulates a CPU

Java for beginning students

1. It is rather involved to write even a simple Java program
2. There have been many versions of Java since official version 1 in 1997
3. It is not possible to learn everything about Java in one course, especially with the very extensive Java Library – so be patient & continue to learn beyond this course

Development Environment

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BlueJ

- BlueJ is an **integrated development environment (IDE)** for Java. So is Eclipse.
- It is “integrated” because it has all the tools ***in one place***: the programmers can type (in the **editor**), compile, and run their programs.

Becoming Familiar with Your Programming Environment

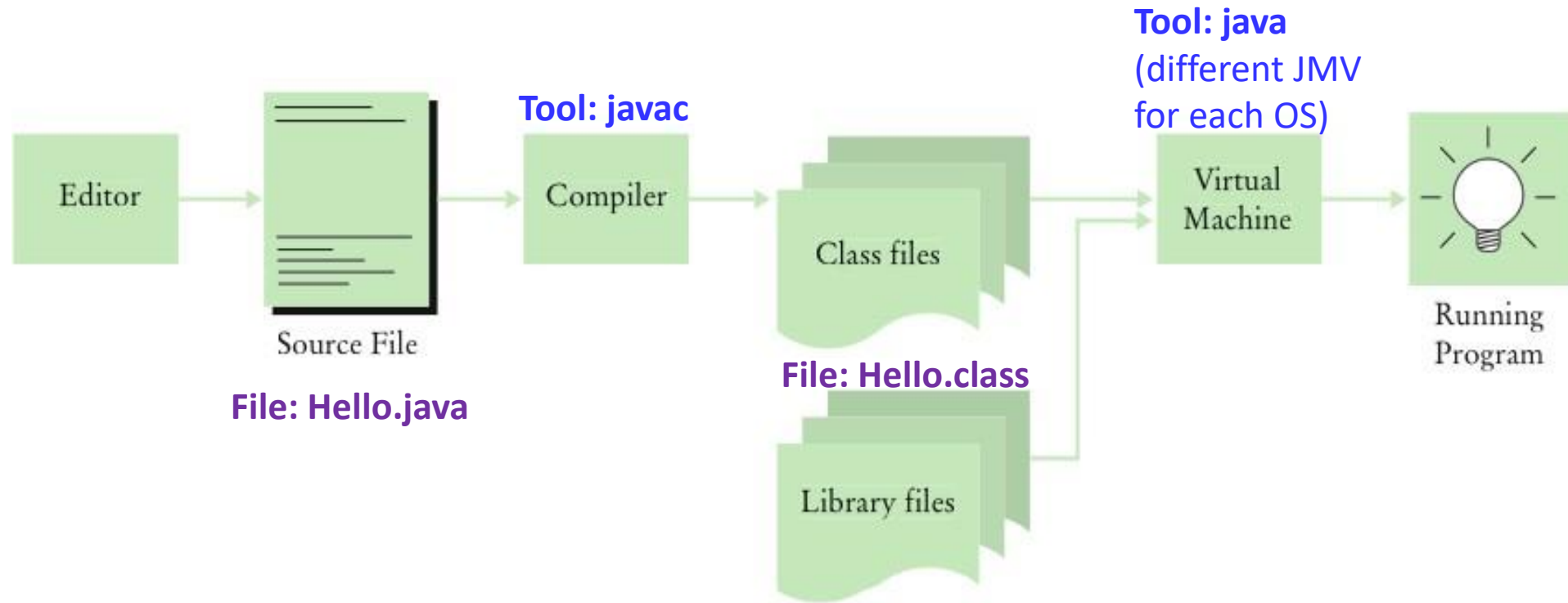


Figure 6 From Source Code to Running Program

Backing up

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Why & how to back up

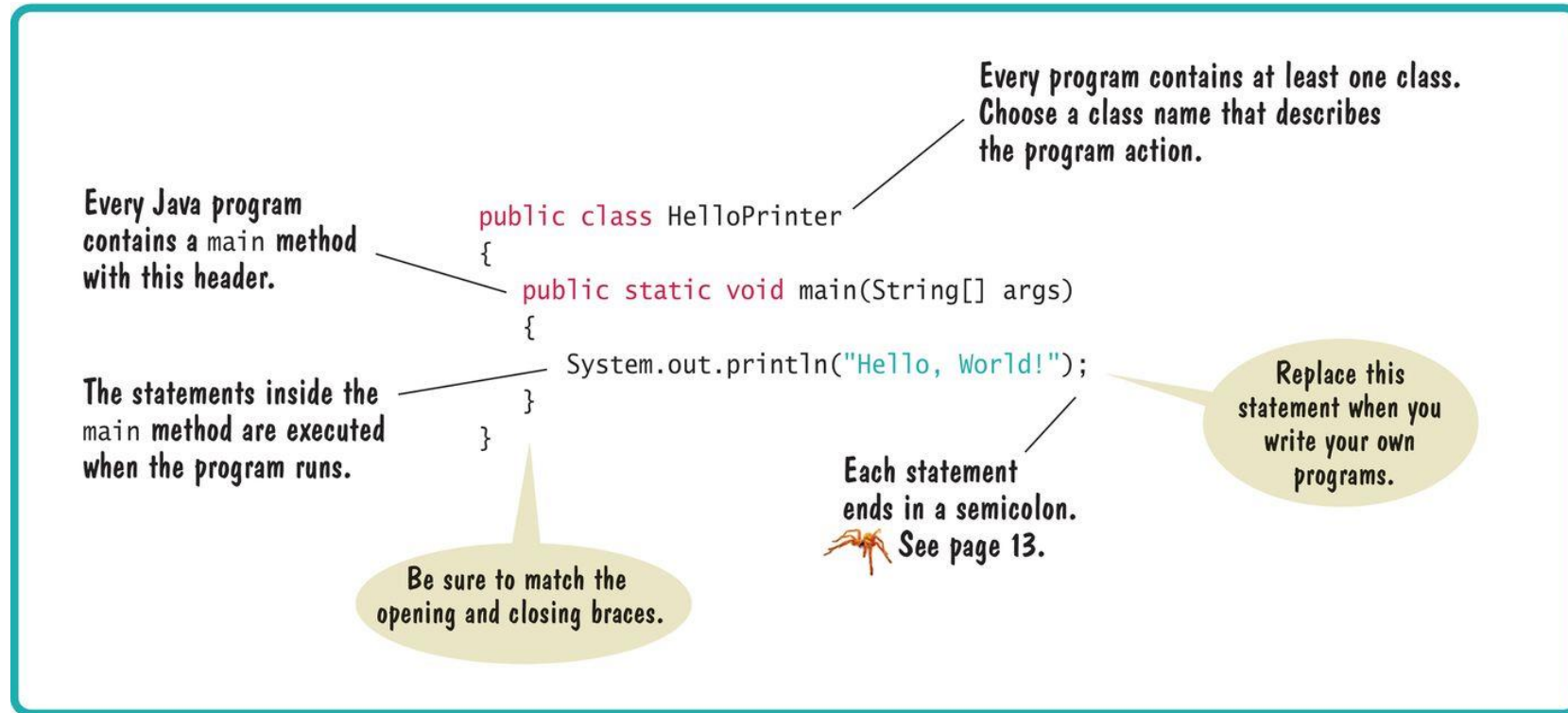
- Back up your files so that you can go back to them if/when the file you are working on is (1) was accidentally deleted, or (2) is somehow corrupt, or (3) is totally messed up with the updates you just made.
- Back up often, perhaps after each day/week.
- Rotate your back-ups; for example, have one back-up for 1 day/week ago, one for 2 days/weeks ago, one for 3 days/weeks ago.
- Be careful: replace the oldest back-up, not the other way around
- Check you back-up once in a while to ascertain that the files are useable.

Class & its parts

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Syntax 1.1 Java Program



String

- A Java `String` is a sequence of characters, expressed inside a pair of **double** quotes in Java
- `System.out.print` or `println` expects **one** parameter/input, such as **one** `String`
- If you have various pieces of text to be printed with 1 statement, you can concatenate them with `+` (i.e., plus sign). For example, if you have a person's name in a variable called `name`, you can do:

```
System.out.println("Hello, " + name);
```
- The plus sign is also used for addition, when there are **2 numeric operands**; e.g., `3+4` will result in `7`

Characters

- A Java `character` may be typed with a key from the keyboard, or expressed as a hexadecimal value (see Unicode Table later)
- A Java `char` is contained in **single** quotes – ***NOTE:*** `String`, in **double** quotes
- Example: `'A'`

Characters (cont.)

- **Escape sequence** is a character that, when typed with a key on the keyboard, will cause confusion in the Java syntax. Thus, it is expressed with a backslash: `\t` (tab), `\n` (new line), `\"` (double quotes).

- Different ways to print blank line:

```
System.out.println("");    // empty String
System.out.println();      // no parameter
System.out.println("\n");  // "new line" escape seq.
```

- Examples of escape sequence:

```
System.out.println("Hello, World\n");
System.out.println("He said \"hi\"");
```

Unicode Characters

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Unicode Character

- A Unicode character represents a text character, and occupies 2 bytes, or 16 bits
- There are 2^{16} (i.e., 65,536) different possible values
- The original ASCII character set is now part of the Unicode character set

Unicode Table

- To find a character/symbol, search for “unicode table” on the Internet:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0000																
0010																
0020		!	"	#	\$	%	&	'	()	*	+	,	-	.	/
0030	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
0040	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O

Unicode Table (cont.)

- The first row & the first column (i.e., headers) identify the values of the characters, in hex
- To identify a character/symbol, read the two values and add them; e.g., character **A** is stored as $0040 + 1 = \mathbf{0041}$

- Note:

- **B** is 1 more than **A**
- **C** is 1 more than **B**, etc.
- character **1** is stored as **0030**
- lower-case chars are “larger”

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0030	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
0040	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
0050	P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_
0060	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
0070	p	q	r	s	t	u	v	w	x	y	z	{		}	~	¸

Unicode Table (cont.)

- The value of the smiley is $2630 + A = 263A$

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2630	☰	☷	☱	☴	☵	☶	☳	☲	⚔️	😞	😊	😄	🌑	🌓	🌒	♀
2640	♀	♂	♍	♎	♏	♐	♑	P	♈	♉	♊	♋	♌	♍	♎	♏

Unicode Table (cont.)

- To print the character in Java, as char:

```
System.out.print ( '\u264A' );
```

- Or as String:

```
System.out.print ("Hello, World \u264A");
```

- The `print` statement expects a `String`, so when the value passed to it is not a `String`, it is converted to `String` automatically

Convention & Errors

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Convention

- Convention are “rules” used by programmers for other programmers
- Always write comments to **explain** what you do in Java code, for yourself & fellow programmers
- There are 3 ways to signal a comment:
 - Text within `/** ... */` is for documentation purpose understood by Javadoc
 - Text within `/* ... */` is for documentation purpose for a block of code, or to disable Java code
 - Text after `//` is for documentation purpose for one statement, or to disable one Java statement
- Indent for each block – BlueJ does this automatically

Compile-time/syntax errors

- Upper-cases and lower-cases are **not** interchangeable; e.g., `totalCount` and `totalcount` are two different variables
- Reserved words must be spelled as-is; e.g., `class` is not `Class`
- There must be a semi-colon at the end of each statement

Run-time/logic errors

- If “Hello, Word” was accidentally typed (instead of “Hello, World”), the compile would be successful and program would run. However, the result would not be the programmer’s intention. This is called run-time or logic error.
- To avoid this kind of errors, the programs must be tested thoroughly, and different test cases considered. Even so, it is difficult to have 100% bug-free programs

Algorithms

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About algorithms

- An algorithm is a sequence of steps with 3 properties: unambiguous, executable, terminating
- Pseudocode is a way to describe an algorithm in concise English, understood by humans but not computers
- Pseudocode is the draft, to be used for coding later
- The equal sign (=) in pseudocode & programming languages means “assigned to” or “gets”; it does NOT mean “equals to” like in math

THE END