

Building Java Programs

Chapter 1

Lecture 1-1: Introduction; Basic Java Programs

reading: 1.1 - 1.3

What is CSE?

- Computer Science
 - The systematic study of algorithmic processes that create, describe, and transform information. -- Wikipedia
 - Algorithm: effective method for solving problem expressed as finite sequence of instructions. -- Wikipedia
 - Many subfields
 - Graphics, Computer Vision
 - Artificial Intelligence, Robotics
 - Scientific Computing
 - Databases, Data Mining
 - Computational Linguistics, Natural Language Processing ...
- Computer Engineering
 - Overlap with CS and EE; emphasizes hardware

What is programming?

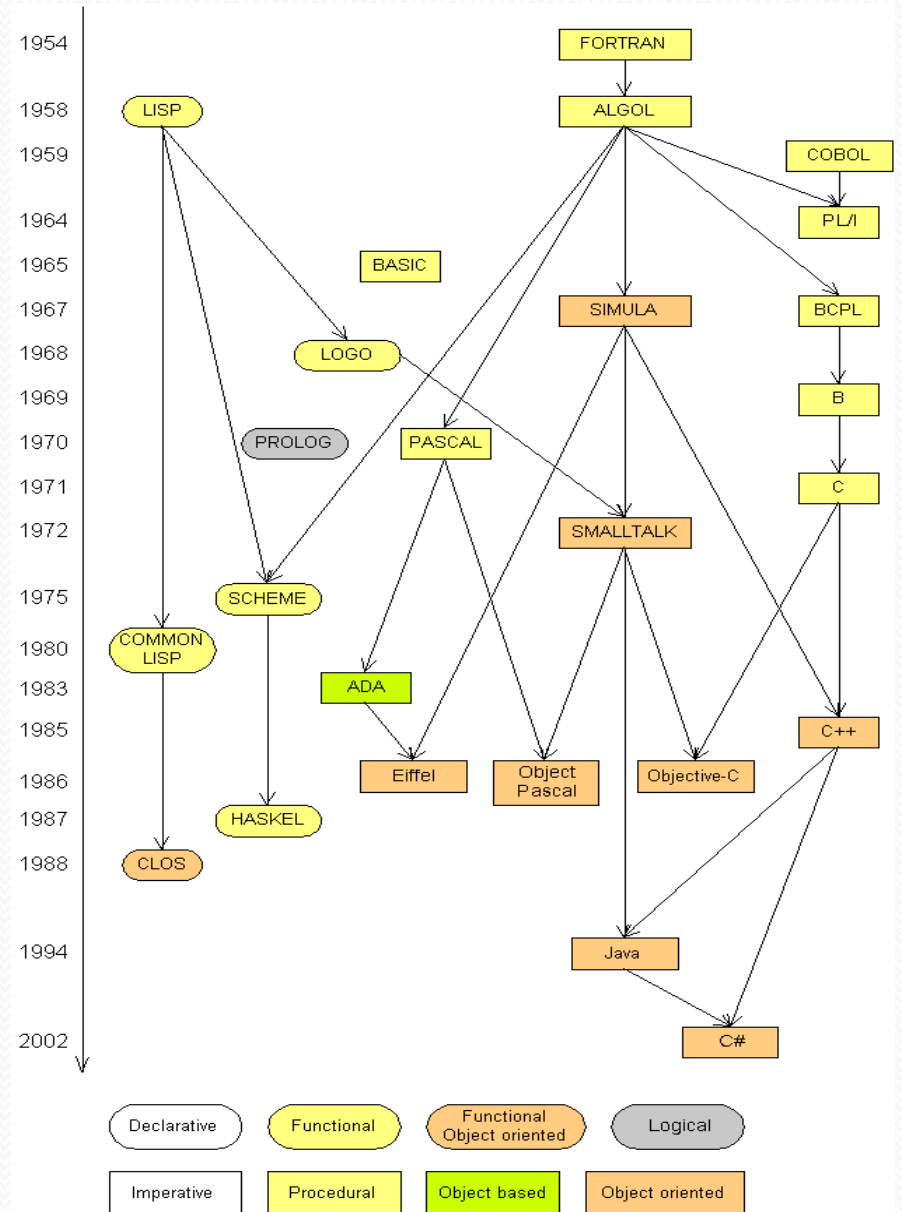
- **program:** A set of instructions to be carried out by a computer.
- **program execution:** The act of carrying out the instructions contained in a program.
- **programming language:** A systematic set of rules used to describe computations in a format that is editable by humans.



Programming languages

- Some influential ones:

- FORTRAN
 - science / engineering
- COBOL
 - business data
- LISP
 - logic and AI
- BASIC
 - a simple language



Some modern languages

- *procedural languages*: programs are a series of commands
 - **Pascal** (1970): designed for education
 - **C** (1972): low-level operating systems and device drivers
- *functional programming*: functions map inputs to outputs
 - **Lisp** (1958) / **Scheme** (1975), **ML** (1973), **Haskell** (1990)
- *object-oriented languages*: programs use interacting "objects"
 - **Smalltalk** (1980): first major object-oriented language
 - **C++** (1985): "object-oriented" improvements to C
 - successful in industry; used to build major OSes such as Windows
 - **Java** (1995): designed for embedded systems, web apps/servers
 - Runs on many platforms (Windows, Mac, Linux, cell phones...)
 - The language taught in this textbook

Why Java?

- Relatively simple
- Object-oriented
- Pre-written software
- Platform independent
- Widely used
 - #1 in popularity ie <http://www.tiobe.com>

Basic Java programs with `println` statements

reading: 1.2 - 1.3

Compiling/running a program

1. Write it.

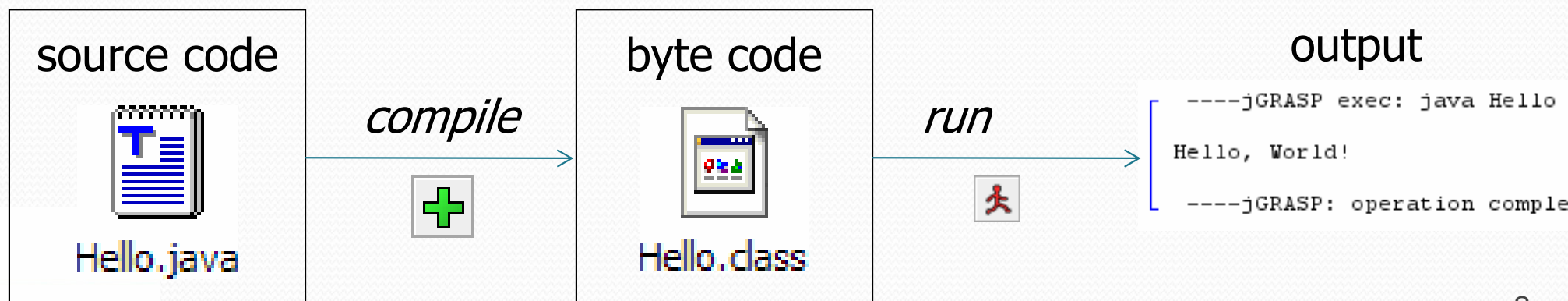
- **code** or **source code**: The set of instructions in a program.

2. Compile it.

- **compile**: Translate a program from one language to another.
- **byte code**: The Java compiler converts your code into a format named *byte code* that runs on many computer types.

3. Run (execute) it.

- **output**: The messages printed to the user by a program.



A Java program

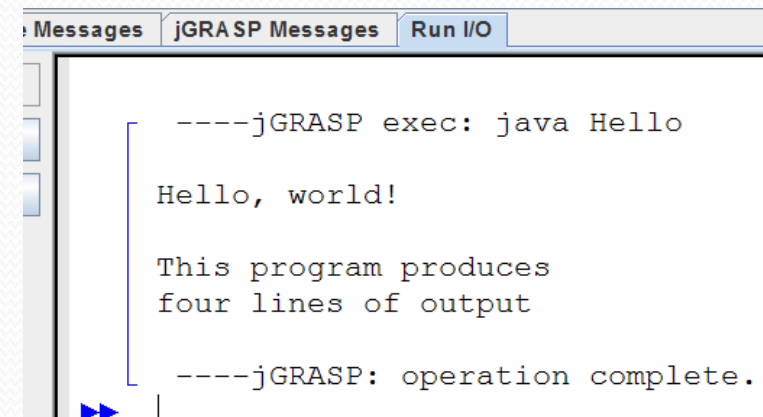
```
public class Hello {  
    public static void main(String[] args) {  
        System.out.println("Hello, world!");  
        System.out.println();  
        System.out.println("This program produces");  
        System.out.println("four lines of output");  
    }  
}
```

- **Its output:**

Hello, world!

This program produces
four lines of output

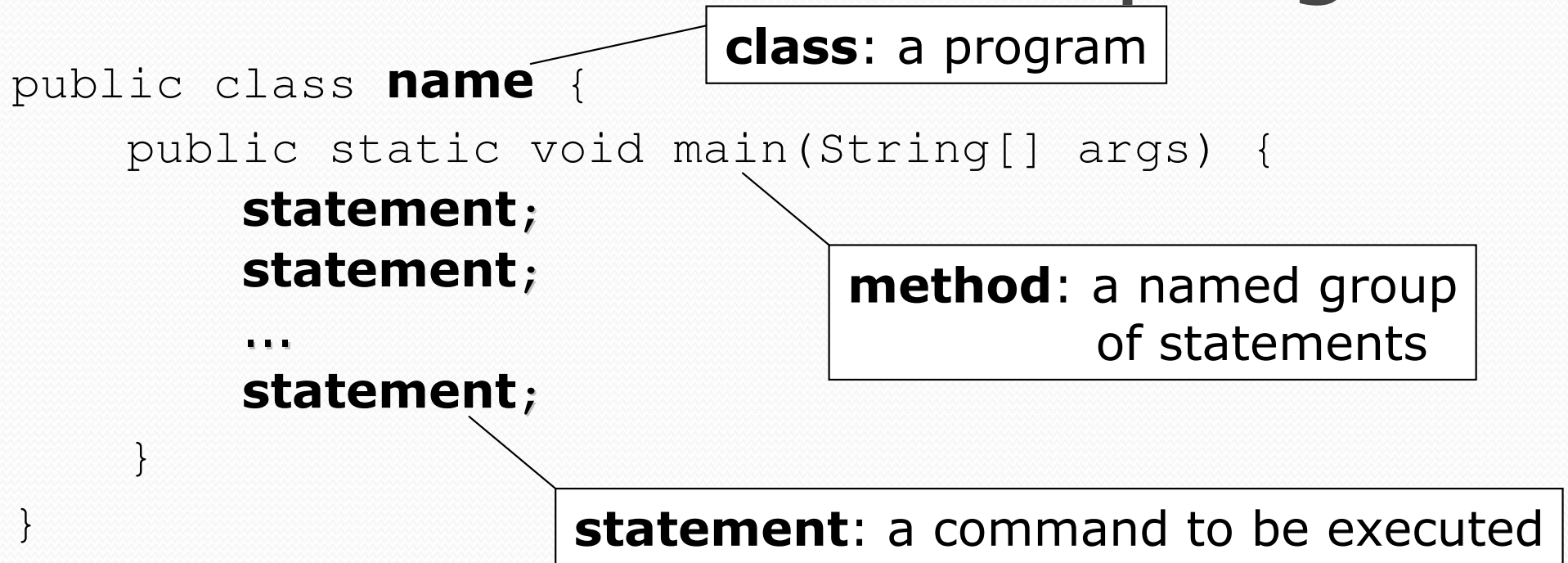
- **console:** Text box into which the program's output is printed.



The screenshot shows a console window with three tabs: "Messages", "jGRASP Messages", and "Run I/O". The "Run I/O" tab is active and displays the following output:

```
----jGRASP exec: java Hello  
  
Hello, world!  
  
This program produces  
four lines of output  
  
----jGRASP: operation complete.
```

Structure of a Java program



- Every executable Java program consists of a **class**,
 - that contains a **method** named `main`,
 - that contains the **statements** (commands) to be executed.

Names and identifiers

- You must give your program a name.

```
public class IrishPoetry {
```

- Naming convention: capitalize each word (e.g. MyClassName)
- Your program's file must match exactly (IrishPoetry.java)
 - includes capitalization (Java is "case-sensitive")
- **identifier**: A name given to an item in your program.
 - must start with a letter or `_` or `$`
 - subsequent characters can be any of those or a number
 - **legal**: `_myName` `TheCure` `ANSWER_IS_42` `$bling$`
 - **illegal**: `me+u` `49ers` `side-swipe` `Ph.D's`

Keywords

- **keyword:** An identifier that you cannot use because it already has a reserved meaning in Java.

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

Syntax

- **syntax:** The set of legal structures and commands that can be used in a particular language.
 - Every basic Java statement ends with a semicolon ;
 - The contents of a class or method occur between { and }
- **syntax error (compiler error):** A problem in the structure of a program that causes the compiler to fail.
 - Missing semicolon
 - Too many or too few { } braces
 - Illegal identifier for class name
 - Class and file names do not match
 - ...

Syntax error example

```
1 public class Hello {
2     poublic static void main(String[] args) {
3         System.owt.println("Hello, world!")_
4     }
5 }
```

- **Compiler output:**

```
Hello.java:2: <identifier> expected
    poublic static void main(String[] args) {
        ^
```

```
Hello.java:3: ';' expected
    }
    ^
```

2 errors

- The compiler shows the line number where it found the error.
- The error messages can be tough to understand!

System.out.println

- A statement that prints a line of output on the console.
 - pronounced "print-linn"
 - sometimes called a "println statement" for short
- Two ways to use `System.out.println` :
 - `System.out.println("text");`
Prints the given message as output.
 - `System.out.println();`
Prints a blank line of output.

Strings

- **string**: A sequence of characters to be printed.
 - Starts and ends with a " quote " character.
 - The quotes do not appear in the output.

- Examples:

```
"hello"
```

```
"This is a string. It's very long!"
```

- Restrictions:

- May not span multiple lines.

```
"This is not  
a legal String."
```

- May not contain a " character.

```
"This is not a "legal" String either."
```


Escape sequences

- **escape sequence:** A special sequence of characters used to represent certain special characters in a string.

`\t` tab character
`\n` new line character
`\"` quotation mark character
`\\` backslash character

- **Example:**

```
System.out.println("\\hello\nhow\tare \"you\"?\\\\\");
```

- **Output:**

```
\hello  
how      are "you"?\\
```

Questions

- What `println` statements will generate this output?

```
This quote is from  
Irish poet Oscar Wilde:
```

```
"Music makes one feel so romantic  
- at least it always gets on one's nerves -  
which is the same thing nowadays."
```

- What `println` statements will generate this output?

```
A "quoted" String is  
'much' better if you learn  
the rules of "escape sequences."
```

```
Also, "" represents an empty String.  
Don't forget: use \" instead of " !  
' is not the same as "
```

Answers

- **println statements to generate the output:**

```
System.out.println("This quote is from");  
System.out.println("Irish poet Oscar Wilde:");  
System.out.println();  
System.out.println("\"Music makes one feel so romantic");  
System.out.println("- at least it always gets on one's nerves -");  
System.out.println("which is the same thing nowadays.\"");
```

- **println statements to generate the output:**

```
System.out.println("A \"quoted\" String is");  
System.out.println("'much' better if you learn");  
System.out.println("the rules of \"escape sequences.\"");  
System.out.println();  
System.out.println("Also, \"\" represents an empty String.");  
System.out.println("Don't forget: use \"\" instead of \" !");  
System.out.println("' ' is not the same as \"");
```

Questions

- What is the output of the following `println` statements?

```
System.out.println("\ta\tb\tc");
```

```
System.out.println("\\\\");
```

```
System.out.println("'");
```

```
System.out.println("\"\"");
```

```
System.out.println("C:\nin\the downward spiral");
```

- Write a `println` statement to produce this output:

```
/ \ // \\ /// \\\
```

Answers

- Output of each `println` statement:

```
      a      b      c
\\
|
" " "
C:
in      he downward spiral
```

- `println` statement to produce the line of output:

```
System.out.println("/ \\ // \\\\ /// \\\\\\\");
```