APROG – Algoritmia e Programação

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Bibliography:
Big Java Late Objects
Book by Cay S. Horstmann

Chapter Goals

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- To learn about computers and programming To
- describe an algorithm with pseudocode
- To learn about the Java programming language
- To recognize compile-time and run-time errors

Computer Programs

- Computers are programmed to perform many different tasks.
- Computers execute very basic instructions in rapid succession.
- A computer program is a sequence of instructions and decisions.
- Programming is the act of designing and implementing computer programs.
- The physical computer and peripheral devices are collectively called the hardware.
- The programs the computer executes are called the software.

The Anatomy of a Computer

- Central processing unit (CPU) performs
  - Program control
  - Data processing
- Storage
  - Memory (Primary storage)
  - Secondary storage
- Peripherals
  - To interact with human users
- Networks

Central Processing Unit

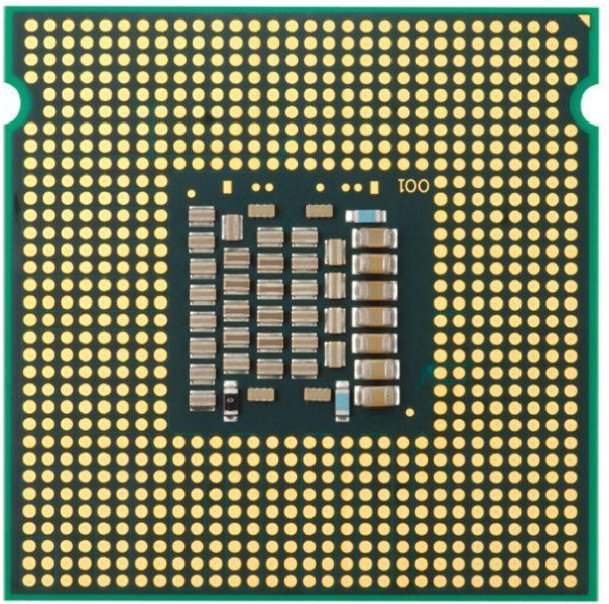

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Figure 1 Central Processing Unit

A Hard Disk

Figure 2 Hard Disk

Schematic Diagram of a Computer

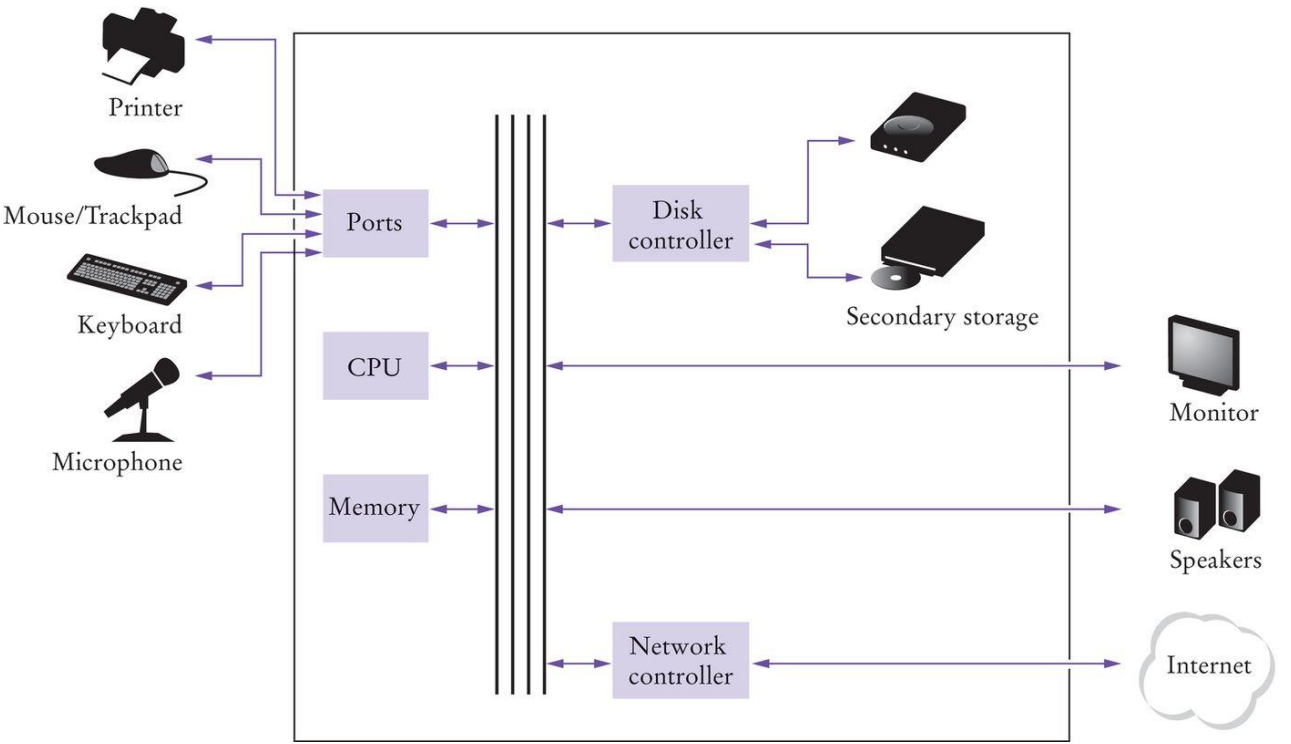


Figure 3 Schematic Design of a Personal Computer

Problem Solving: Algorithm Design

- **Algorithm:** A sequence of steps that is:
  - unambiguous
  - executable
  - terminating

An Algorithm for Solving an Investment Problem

- The problem:

  You put $10,000 into a bank account that earns 5 percent interest per year. How many years does it take for the account balance to be double the original?

- Calculating by hand

year	interest	balance
0		10000
1	10000.00 x 0.05 = 500.00	10000.00 + 500.00 = 10500.00
2	10500.00 x 0.05 = 525.00	10500.00 + 525.00 = 11025.00
3	11025.00 x 0.05 = 551.25	11025.00 + 551.25 = 11576.25
4	11576.25 x 0.05 = 578.81	11576.25 + 578.81 = 12155.06

An Algorithm for Solving an Investment Problem - continued

- The steps in the algorithm

Start with a year value of 0, a column for the interest, and a balance of $10,000.

year	interest	balance
0		10000

Repeat the following steps while the balance is less than $20,000

Add 1 to the year value.
Compute the interest as balance x 0.05 (i.e., 5 percent interest).
Add the interest to the balance.

year	interest	balance
0		10000
1	500.00	10500.00
14	942.82	19799.32
15	989.96	20789.28

Report the final year value as the answer.

Pseudocode

- **Pseudocode:** An informal description of of a sequence of steps for solving a problem
  - Describe how a value is set or changed:

```
total cost = purchase price + operating cost
Multiply the balance value by 1.05.
Remove the first and last character from the word.
```

  - Describe decisions and repetitions:

```
If total cost 1 < total cost 2s
While the balance is less than $20,000
For each picture in the sequence
```

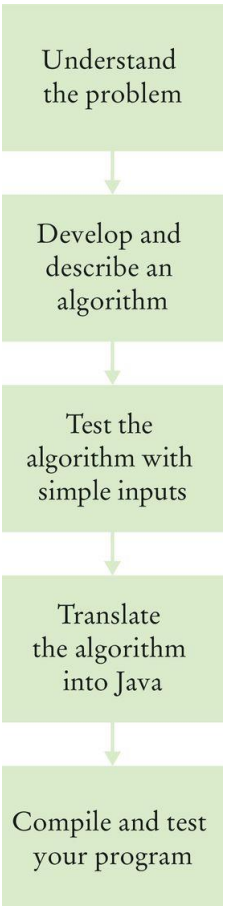
  - Use indentation to indicate which statements should be selected or repeated

```
For each car
    operating cost = 10 x annual fuel cost
    total cost = purchase price + operating cost
```

  - Indicate results:

```
Choose car1.
Report the final year value as the answer.
```

From Algorithm to Programs



The Java Programming Language

- Safe
- Portable
- Platform-independent
  - Distributed as instructions for a virtual machine
- Vast set of library packages
- Designed for the Internet

Java Versions

Version	Year	Important New Features
1.0	1996	
1.1	1997	Inner classes
1.2	1998	Swing, Collections framework
1.3	2000	Performance enhancements
1.4	2002	Assertions, XML support
5	2004	Generic classes, enhanced `for` loop, auto-boxing, enumerations, annotations
6	2006	Library improvements
7	2011	Small language changes and library improvements
8	2014	Function expressions, streams, new date/time library
…		

Becoming Familiar with Your Programming Environment

- An editor is a program for entering and modifying text, such as a Java program.
- Java is case sensitive.
- Java compiler translates source code into class files.
- Class files contain instructions for the Java virtual machine.

Becoming Familiar with Your Programming Environment

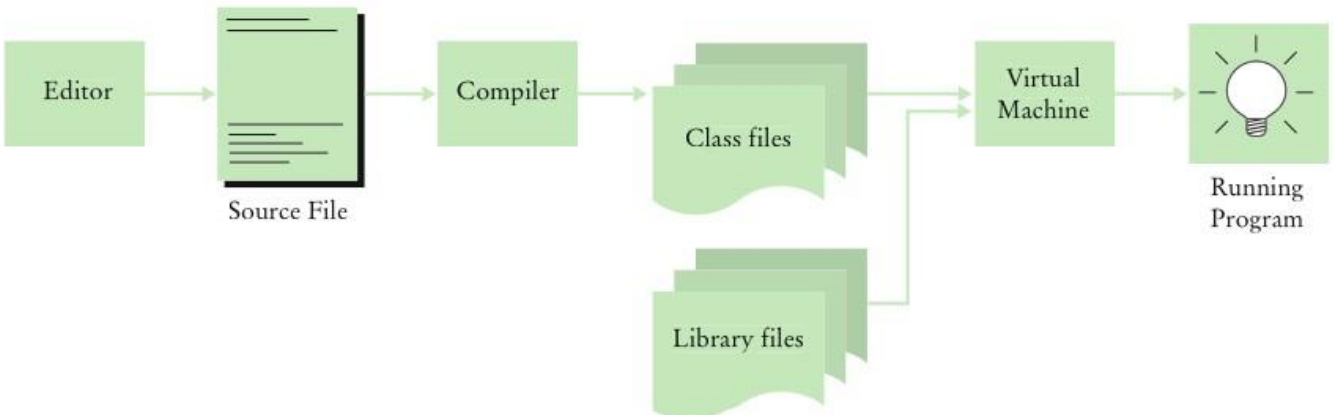


Figure 6 From Source Code to Running Program

Analyzing Your First Program: Class Declaration

- Classes are the fundamental building blocks of Java programs:
- Declaration of a class called `HelloPrinter`

```
public class HelloPrinter
```

- In Java, every source file can contain, at most one public class.
- The name of the public class must match the name of the file containing the class:

  Class `HelloPrinter` must be contained in a file named `HelloPrinter.java`

Analyzing Your First Program: Methods

- Each class contains declarations of methods.
- Each method contains a sequence of instructions.
- A method contains a collection of programming instructions that describe how to carry out a particular task.
- A method is called by specifying the method and its arguments.

Analyzing Your First Program: main Method

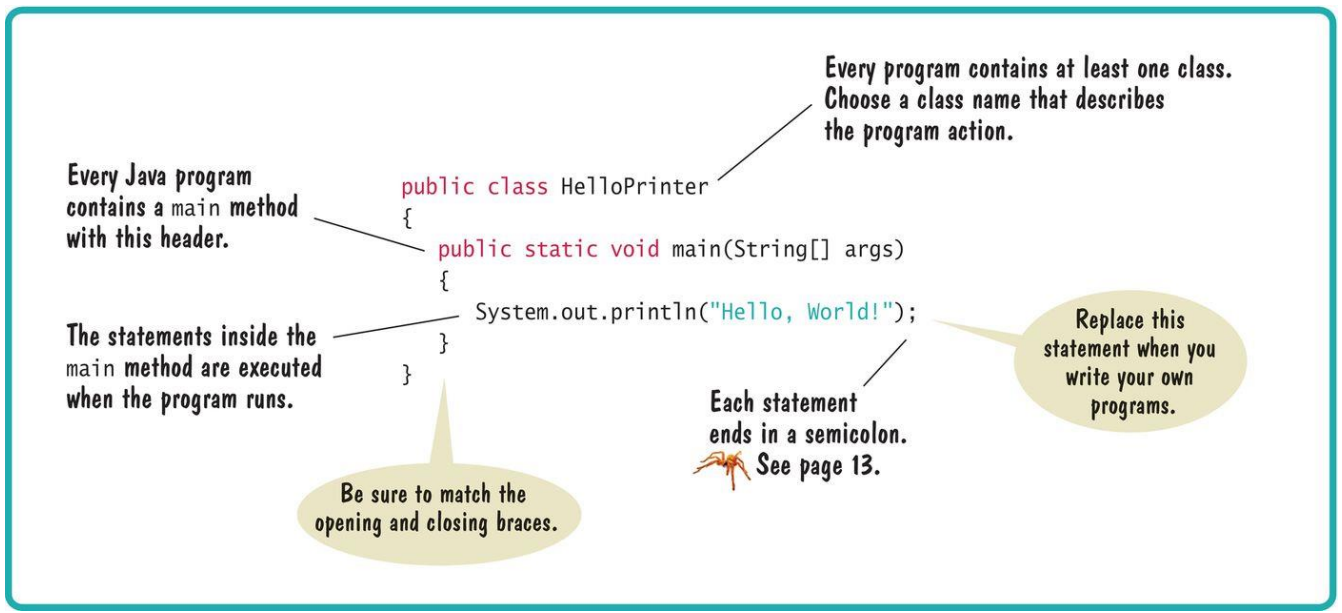
- Every Java application contains a class with a `main` method

  When the application starts, the instructions in the `main` method are executed

- Declaring a main method

```
public static void main(String[] args)
{
   . . .
}
```

Java Program



Analyzing Your First Program: Strings

- **String:** a sequence of characters enclosed in double quotation marks:

```
"Hello, World!"
```

Analyzing Your First Program: Printing

- You can print numerical values

```
System.out.println(3 + 4);
```

  evaluates the expression 3 + 4

  displays the number 7.

- `System.out.println` method prints a string or a number and then starts a new line.

  The sequence of statements

```
System.out.println("Hello");
System.out.println("World!");
```

  Prints two lines

```
Hello
World!
```

- There is a second method, `System.out.print`, that you can use to print an item without starting a new line

Errors

- A compile-time error (syntax error)

  is a violation of the programming language rules

  detected by the compiler.

```
System.ou.println("Hello, World!");
```

- A run-time error (logic error)

  causes a program to perform an action that the programmer did not intend.

```
System.out.println("Hello, Word!");
```

- Exception - a type of run-time error

  Generates an error message from the Java virtual machine

  This statement

```
System.out.println(1 / 0)
```

  Generates this run-time error message

```
"Division by zero"
```