Intro to Java

CSE 413, Autumn 2002

Programming Languages

http://www.cs.washington.edu/education/courses/413/02au/

Readings and References

- Reading
  - » Chapters 1 and 2, (Intro to Java, Java Programming Environment), *Core Java Volume 1*, by Horstmann and Cornell
- Other References
  - » "Object-Oriented Programming Concepts", Java tutorial
  - » http://java.sun.com/docs/books/tutorial/java/concepts/index.html

What is Java?

- An object-oriented programming language
  - » source code
- Application Programming Interfaces (APIs)
  - » extensive class libraries
- A virtual machine
  - » runs programs that were written in the source language and compiled to binary bytecodes

The Virtual Machine concept

- Hardware abstraction
- Many features of computer hardware: opcodes that represent fundamental computing tasks, assembly tools
- The Java VM executes opcodes stored in class files
- Note that class files could be (and are) generated by source in other languages

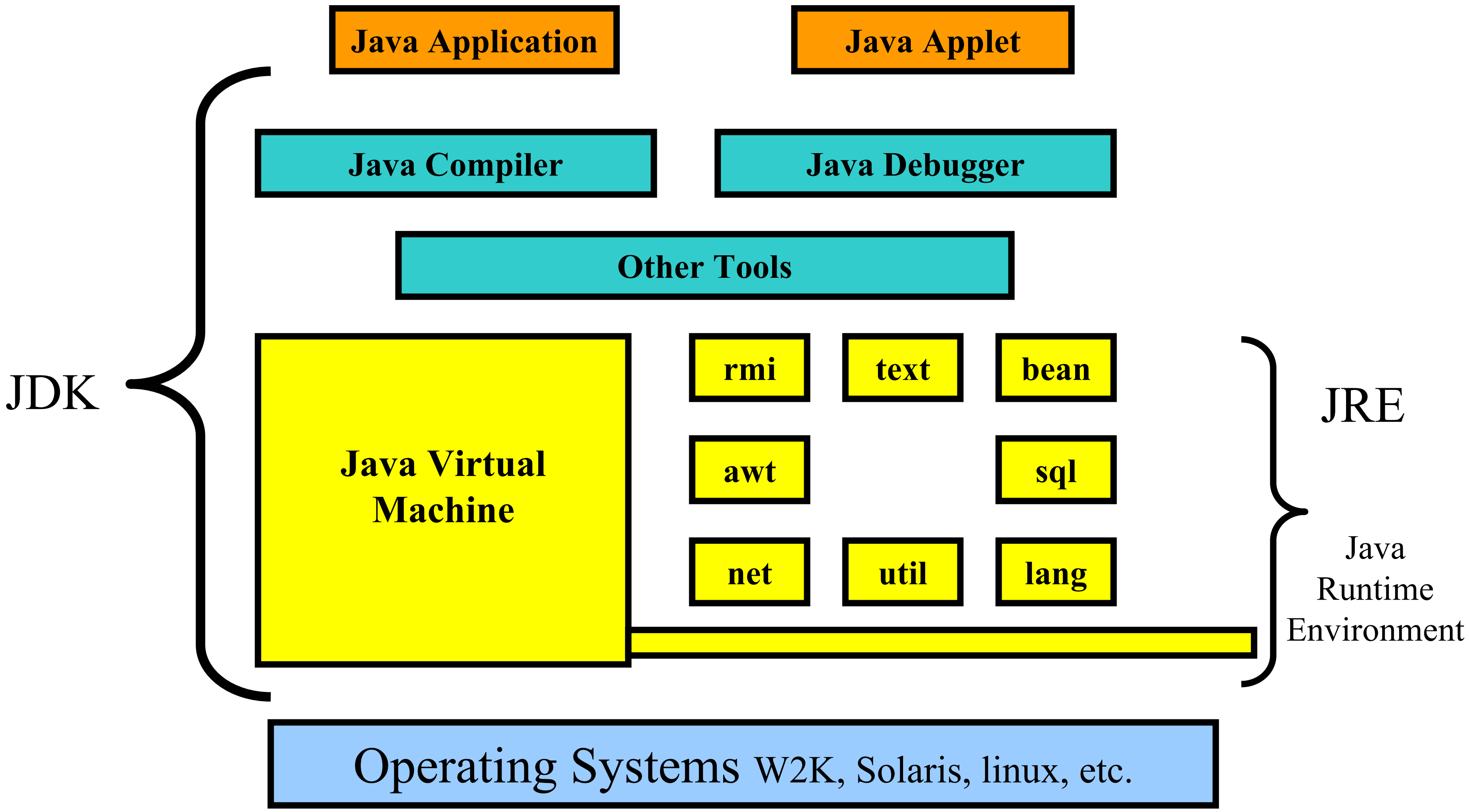
Java vs. Other Languages

- Java syntax is very much like C syntax
- Java does not explicitly support pointers or any other direct access to memory
- Java is automatically garbage-collected, so explicitly de-allocating memory is not necessary
- Java is interpreted. It is difficult (and in fact not part of the language) to compile to native machine code
- Java is dynamically linked, with run-time polymorphism

Java Environments

- Sun has developed subsets of the Java platform
- Java Enterprise Edition
  - » servers
- Java Standard Edition
  - » desktop
- Java Micro Edition
  - » mobile devices

Java Developers Kit (JDK)



Tools in the JDK

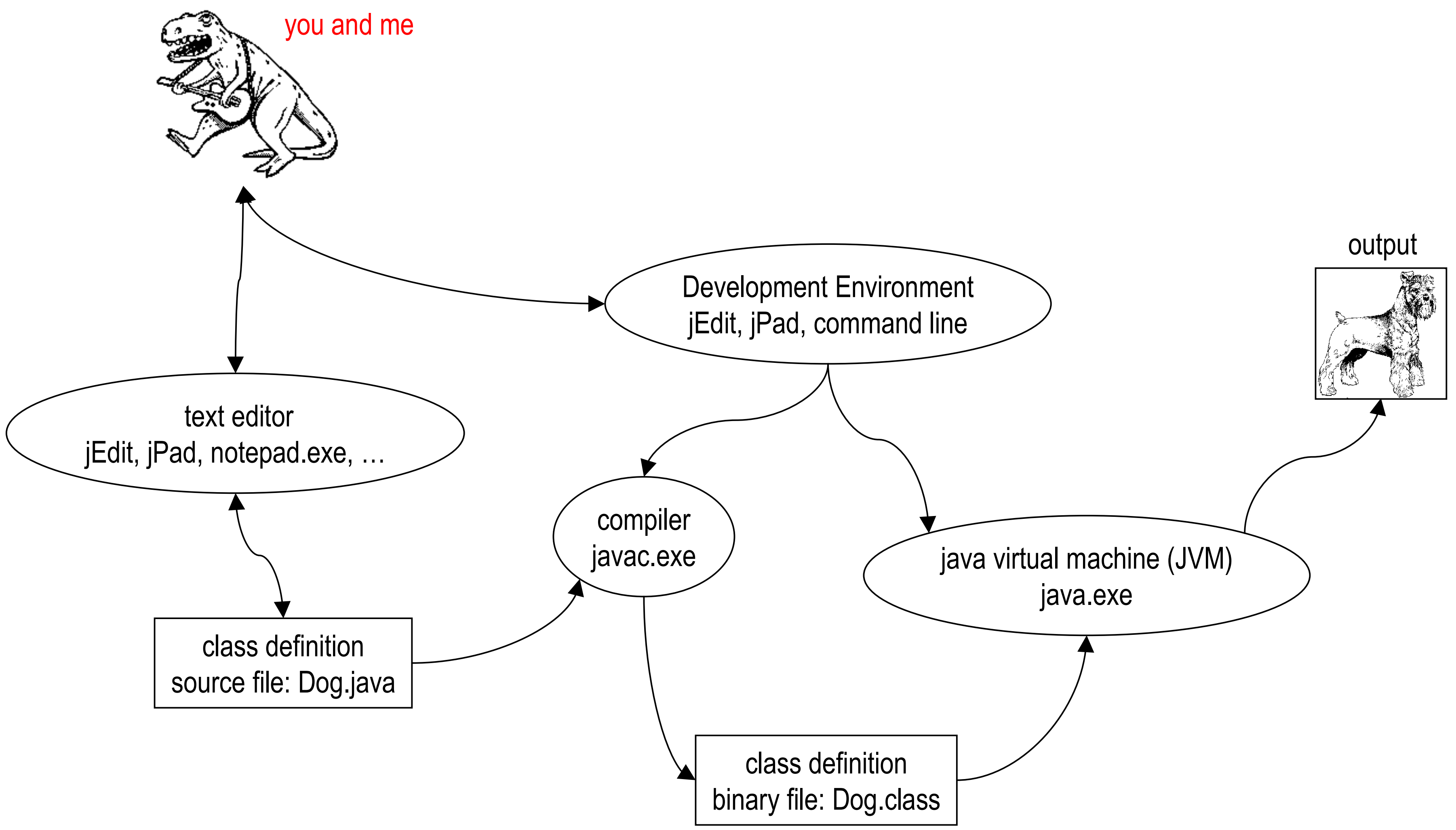
- **javac** - Java compiler
- **java** - Java interpreter
- **jdb** - Java debugger
- **appletviewer** - viewer for Java applets
- **javap** - Java bytecode disassembler
- **javadoc** - Java documentation generator
- Documentation for the JDK can be explored with your Web browser

Installing the JDK

- Instructions on the class software page
- JDK
  - » tools
  - » library sources
- Java API documentation
- Learning and reference materials
  - » Java tutorial

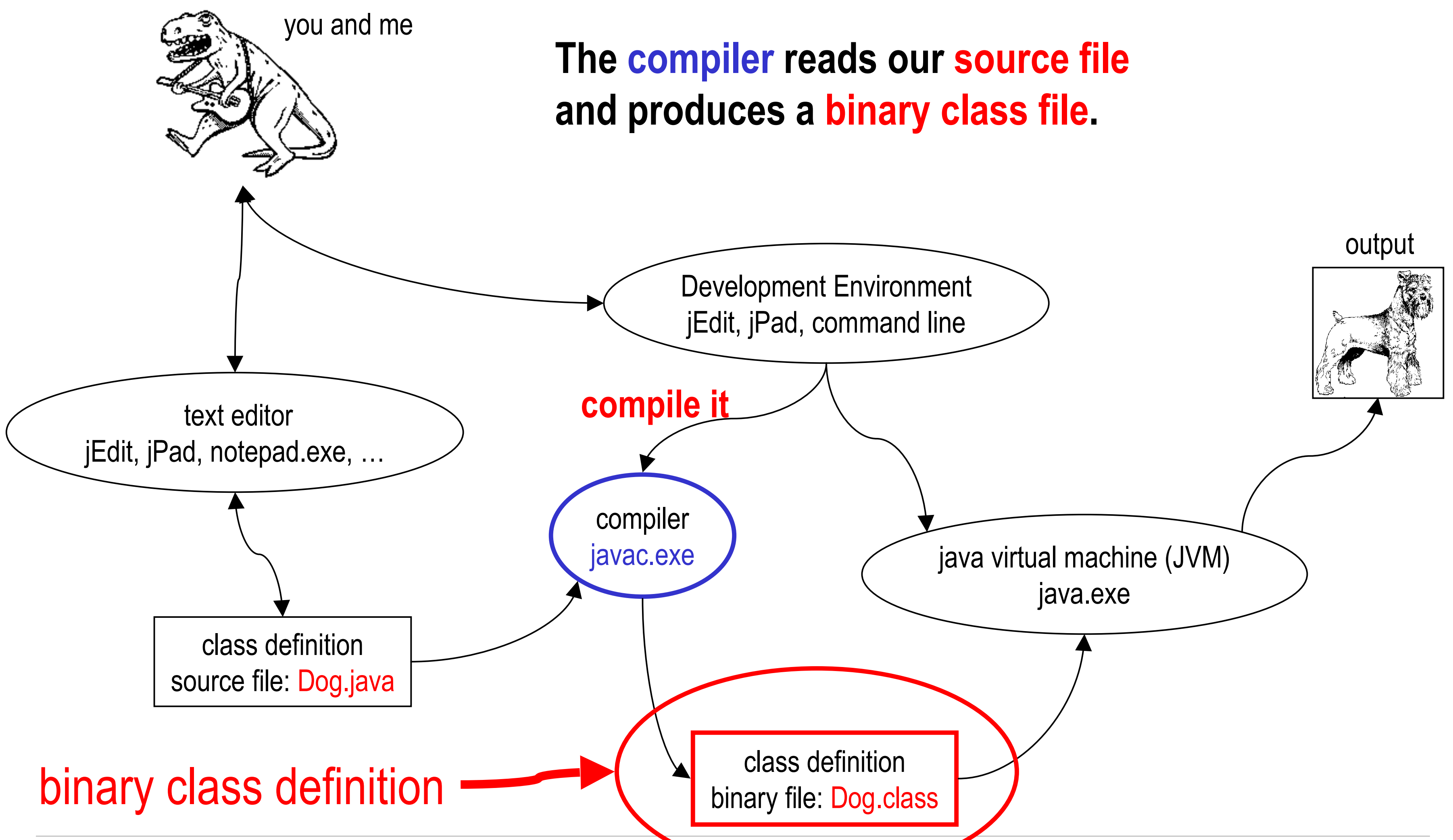
    http://java.sun.com/docs/books/tutorial/
  - » take the time to set up one-click shortcuts now

Our Environment



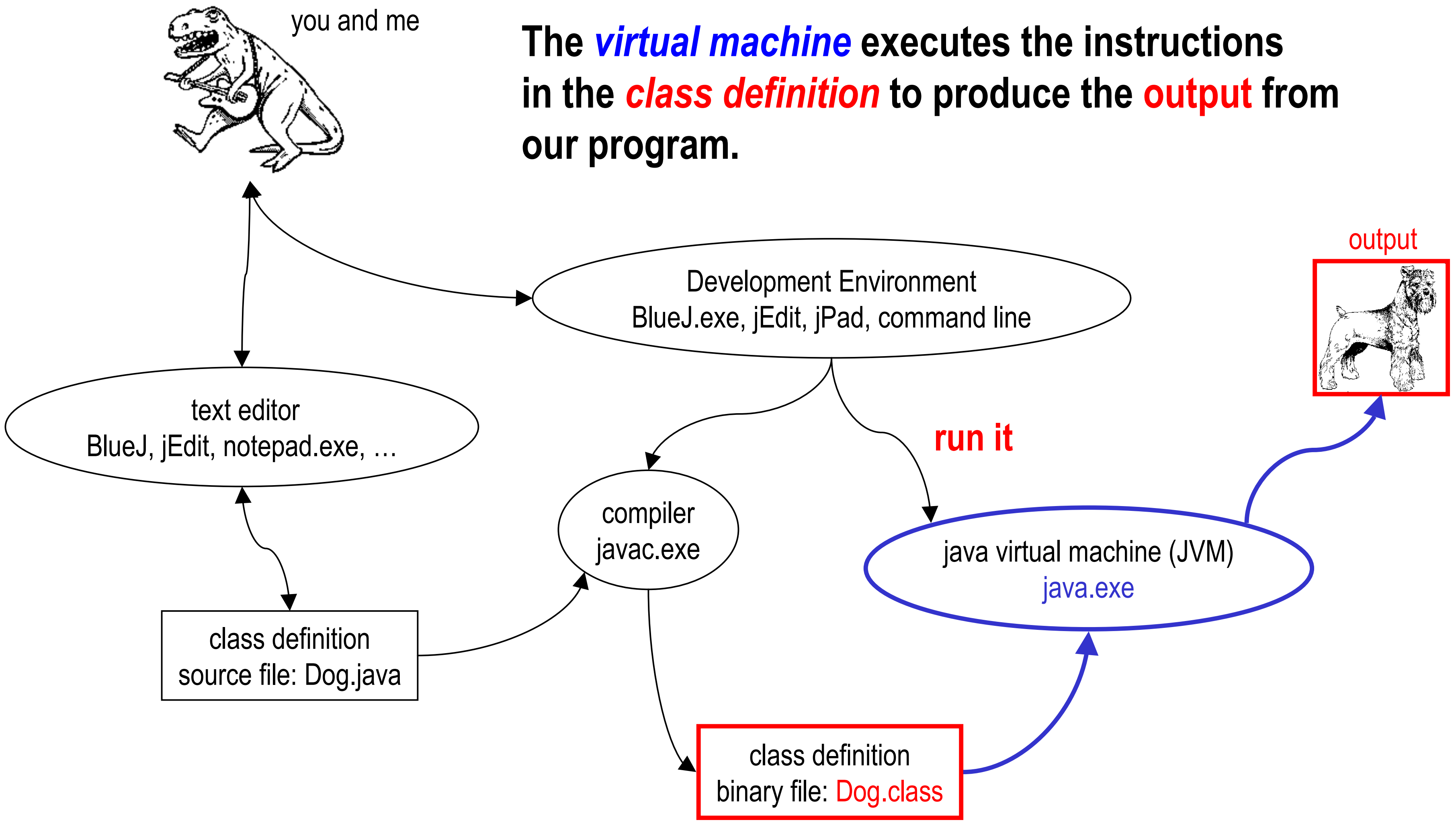
Compile it

The compiler reads our source file and produces a binary class file.



Run it

The *virtual machine* executes the instructions in the *class definition* to produce the output from our program.



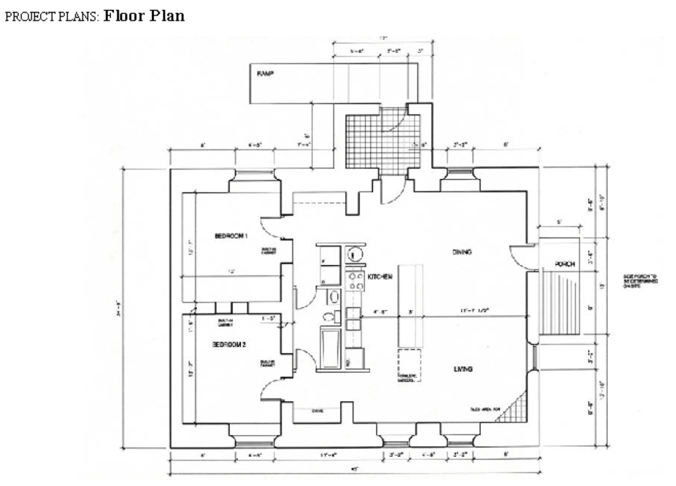
Objects and Classes

- A class is a definition of a *type of thing*
  - » The class definition is where we find a description of how things of this type behave.
- An object is a *particular thing*
  - » There can be many objects of a given class. An object is an *instance* of a class.
  - » All objects of a given class exhibit the same behavior.

What is a Java class?

- A class is a *template* or *blueprint* for building objects
- A class is like a dictionary definition, while objects are like things in the real world that “are” whatever is defined
- A class definition generally resides on disk long term
  - » the original class definition is written in Java (the .java file) then translated into a more compact form (the .class file) by the compiler
  - » the class definition can be used over and over to create more objects, just like a blueprint can be used over and over to build more houses
- An object resides in memory and is generally discarded during or at the end of a program run

Houses are instances of blueprints



class

objects

http://vcourses.caup.washington.edu:8900/public/CM599/index.html

Instantiate - create an object

- Once we create a class definition using an editor and the compiler, we can *instantiate* it with the "**`new`**" operator
  - » to *instantiate* means to create objects based on the class definition
  - » **`Oval moon = new Oval(100,100,20,20,Color.gray,true);`**
- We can then manipulate these objects to do the work that needs to be done
- Note that many classes have already been defined for us
  - » There are 2723 classes defined in the standard Java libraries from Sun - see the JavaAPI documentation

Class Concepts

- Class definitions have two important components:
  - » state
  - » behavior or interface
- State is expressed using fields in the class definition
- Behavior is expressed using methods
- Together, fields and methods are called class members

Class Concepts: State

- State is a complete description of all the things that make a class a class.
- For example, part of the state of class Employee is the Employee's UWNetID
  - » All objects of class Employee will have a UWNetID specified.
- State is stored in data members
  - » also known as fields, member variables, instance variables, properties

Class Concepts: Behavior

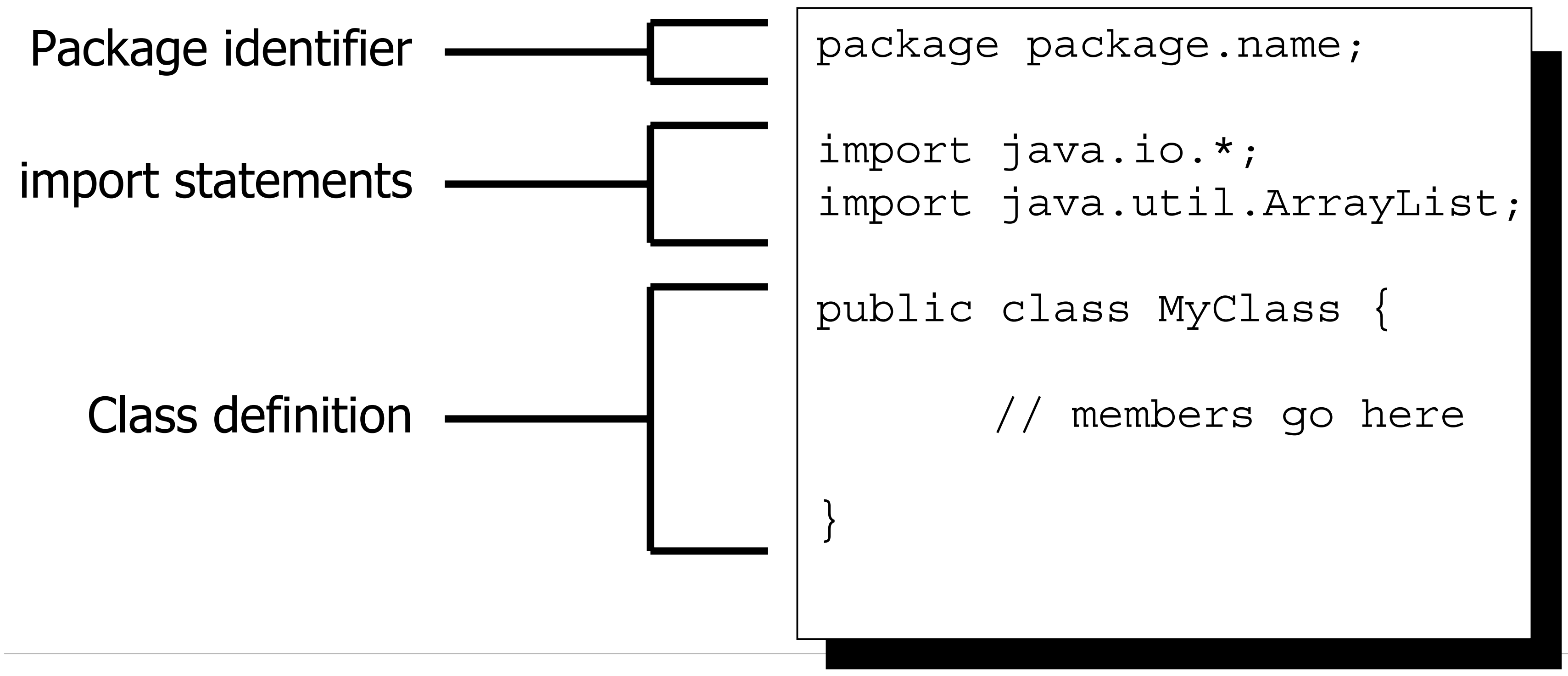
- Behavior of a class defines how other classes may interact with it. It indicates the capabilities of the class to "do" things.
- For example, a BaseballPlayer class might define such behavior as hit, pitch, stealBase, etc.
- Behavior is defined in methods
  - » Methods look like functions in C, methods in C++, subroutines in Fortran, etc

Structure of Source File

- Source file must have same name as name of public class it contains
- Simple structure in order
  - » package definition (Optional)
  - » package and/or class import statements (Optional)
  - » Class definition (multiple are allowed but can be messy)

Structure of Source File

Three components to a Java source file, in order



```
package package.name;

import java.io.*;
import java.util.ArrayList;

public class MyClass {

      // members go here

}
```

Packages

- A way to group related classes
- A key part of Java's encapsulation mechanism
- Class is permanently associated with its package
- Period (.) separated name mirrors directory structure where classes are stored
- "Default" package is the current directory
- Classes without a package identifier are in the default package

import - help the compiler find classes

- A class' full name includes its package.
  - » java.util.ArrayList or java.io.FileReader
- Usually it is more convenient simply to use the class name without the package
- The `import` statement allows this shortcutting
- Classes can be imported individually, or all classes in a package can be imported
- java.lang.* is imported automatically by the compiler
- is not like #include in C/C++

Example class

```
public class Dog  {
  public Dog(double rate) {
      consumptionRate = rate;
      weight = 20;
  }
  public void bark() { ... }
  public double getRate() { ... }
  public void eat(double pounds) { ... }

  private double consumptionRate;
  private double weight;
}
```

Basic Libraries Sample Members

- java.lang - Object class, numbers, strings, System, Exceptions, Threads and more
- java.io - streams, readers, writer, files
- java.util - Dates, Locales, data structures, zip
- java.net - Sockets, URLs, datagrams, InetAddresses, connections
- java.awt, javax.swing - Graphics, Layout, Event, User Interaction

Documenting Source Code

- // - single line comment
- `/* multiple line comment */`
- `/** javadoc style comment */`
- javadoc utility provides automatic generation of documention from code comments

Javadoc Tags

- The javadoc utility supports several “tag” fields in javadoc comments
  - » @param -- passed parameter description
  - » @return -- returned value description
  - » @throws -- error indicators
- javadoc formats these and includes them in the generated documentation