Session 02
Learning the Java Language

(http://docs.oracle.com/javase/tutorial/java/index.html)

Objectives

- Study some fundamentals of Java languages: Data types, variables, arrays, operators, logic constructs.
- Pass arguments to the main method
- Input/output variables
- Object-Oriented Programming Concepts: Class, Interface, Package.

Keywords and Identifiers

- Keywords: Almost of them are similar to those in C language
- Naming Convention:

Letter	Letters
$	Digits, $
_	_

- Java is a case-sensitive language
- Identifiers must be different to keywords

Primitive Data Types - Variables

- A *primitive* is a simple non-object data type that represents a single value. Java's primitive data types are:

Type	Bytes	Minimum	Maximum
char	2	\u0000	\uFFFF
byte	1	-2^{7}	$2^{7} - 1$
short	2	-2^{15}	$2^{15} – 1$
int	4	-2^{31}	$2^{31} – 1$
long	8	-2^{63}	$2^{63} - 1$
float	4		
double	8		
boolean	true/false		

Type   var [=Initial value] ;

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Operators

Category (Descending Precedence)	Operators
Unary	`++ -- + - ! ~ (type)`

Arithmetic	`* / %`
	`+ -`

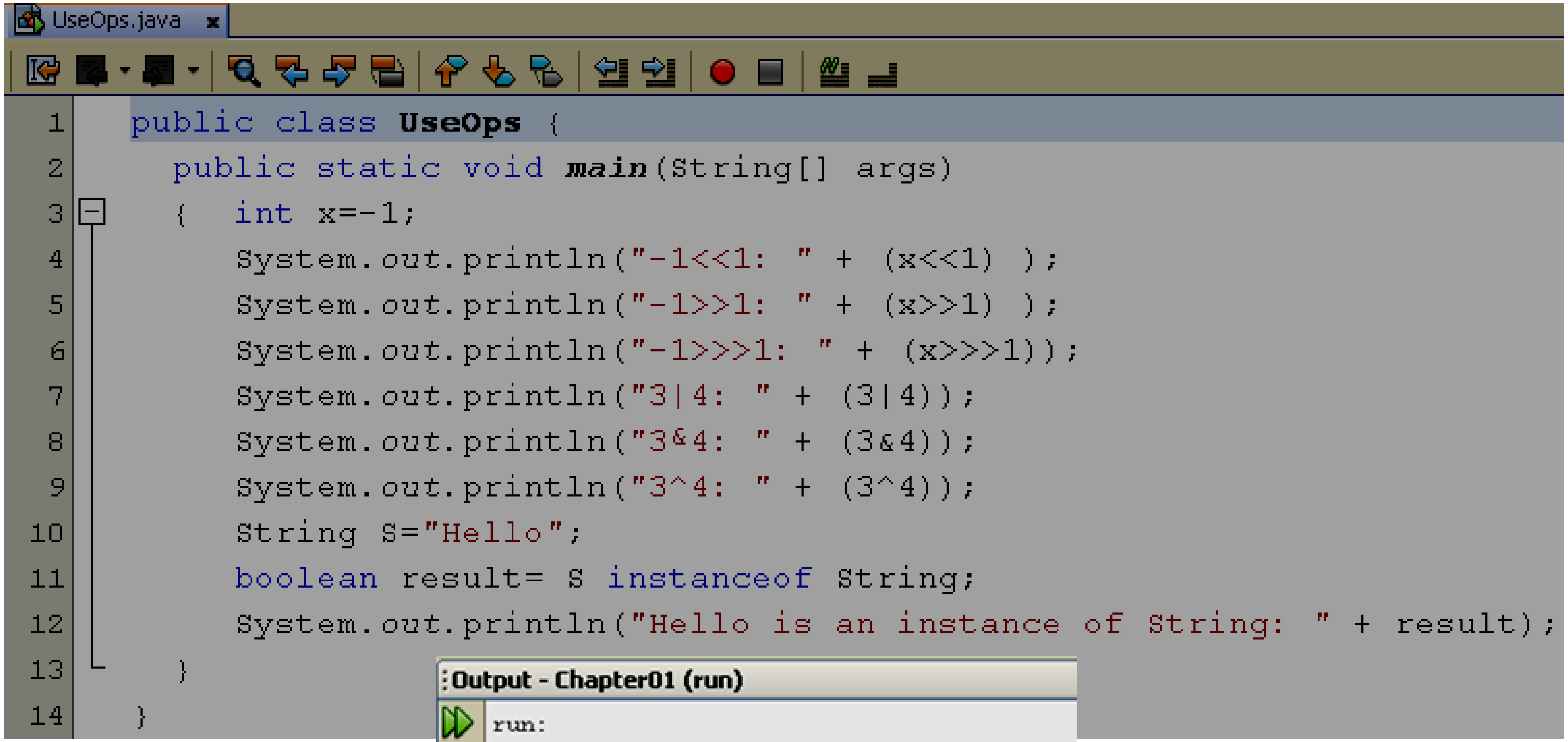
Shift	`<< >> >>>`

Comparison	`< <= > >= instanceof`
	`== !=`

Bitwise	`& ^ |`
Short-circuit	`&& ||`
Conditional	`? :`
Assignment	`= op=`

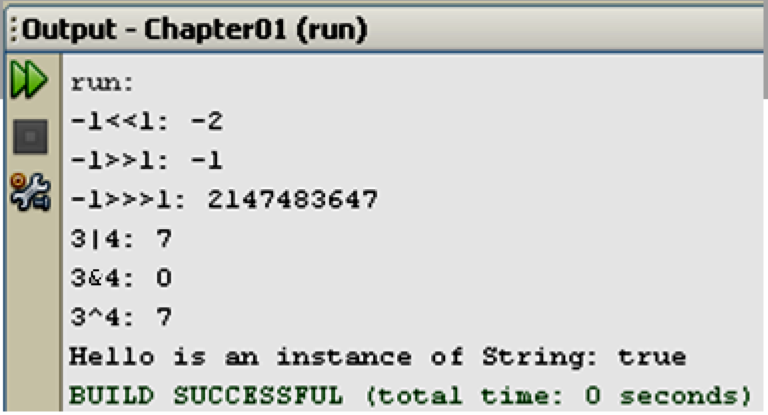
They are the same with those in C language

Using Operators Demonstration



UseOps.java

```
public class UseOps {
  public static void main(String[] args)
  {   int x=-1;
      System.out.println("-1<<1:  " + (x<<1) );
      System.out.println("-1>>1:  " + (x>>1) );
      System.out.println("-1>>>1:  " + (x>>>1));
      System.out.println("3|4:  " + (3|4));
      System.out.println("3&4:  " + (3&4));
      System.out.println("3^4:  " + (3^4));
      String S="Hello";
      boolean result= S instanceof String;
      System.out.println("Hello is an instance of String:  " + result);
  }
}
```

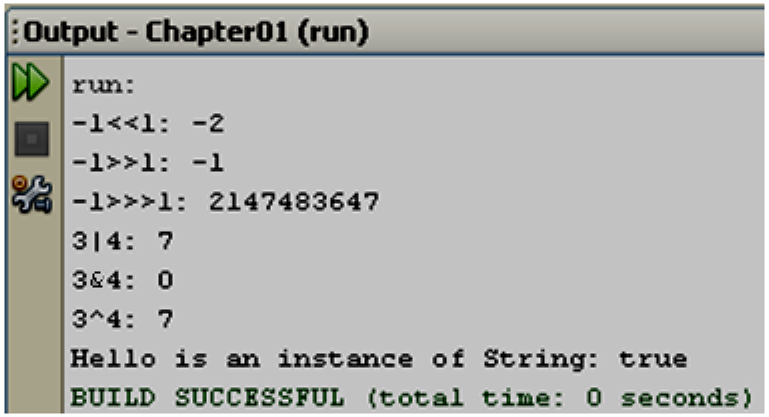


Output - Chapter01 (run)

```
run:
-1<<1: -2
-1>>1: -1
-1>>>1: 2147483647
3|4: 7
3&4: 0
3^4: 7
Hello is an instance of String: true
BUILD SUCCESSFUL (total time: 0 seconds)
```

Using Operators Demonstration

Use 2 bytes to store value



Output - Chapter01 (run)

```
run:
-1<<1: -2
-1>>1: -1
-1>>>1: 2147483647
3|4: 7
3&4: 0
3^4: 7
Hello is an instance of String: true
BUILD SUCCESSFUL (total time: 0 seconds)
```

1: ➔ 0000 0000 0000 0001
1111 1111 1111 1110 (1-complement)
-1 ➔ 1111 1111 1111 1111 (2-complement)
-1 <<1 ➔ 1111 1111 1111 1110 (-2)

-1 ➔ 1111 1111 1111 1111
-1 >>1 ➔ 1111 1111 1111 1111

-1 ➔ 1111 1111 1111 1111
-1 >>>1 ➔ 0111 1111 1111 1111 (2147483647)

3 ➔ 0000 0000 0000 0011
4 ➔ 0000 0000 0000 0100
3|4 ➔ 0000 0000 0000 0111 (7)

3 ➔ 0000 0000 0000 0011
4 ➔ 0000 0000 0000 0100
3&4 ➔ 0000 0000 0000 0000 (0)

3 ➔ 0000 0000 0000 0011
4 ➔ 0000 0000 0000 0100
3^4 ➔ 0000 0000 0000 0111 (7): XOR BIT

Literals and Value Variables

- Character: ‘a’
- String: String S=“Hello”;
- Escape sequences: see the page 10
- Integral literals:

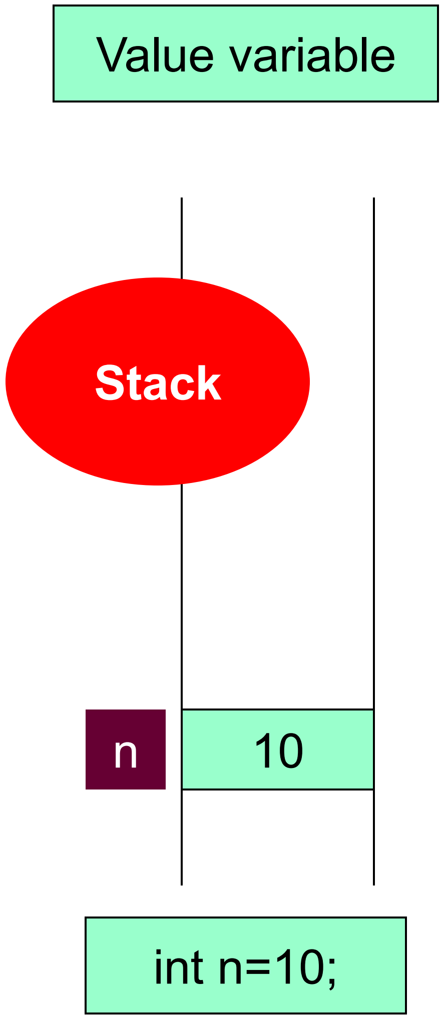
  28, 0x1c, 0X1A (default: int).
  123l, 123L (long)
- Floating point:

  1.234 (default: double)

  1.3f   1.3F

  1.3E+21

  1.3d   1.3D

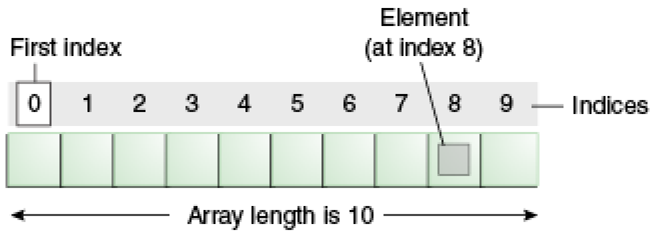


Java Expressions

- Java is an expression-oriented language. A simple expression in Java is either:
  - A constant: 7, false
  - A char - literal enclosed in single quotes: 'A', '3'
  - A String - literal enclosed in double quotes: "foo"
  - The name of any properly declared variables: x
  - Any two|one of the preceding types of expression that are combined with one of the Java binary operators: i++, x + 2, (x + 2)

One Dimensional Arrays (1)

- An *array* is a container object that holds a fixed number of values of a single type.
- The length of an array is established when the array is created.
- Each item in an array is called an *element*, and each element is accessed by its numerical *index.*



One Dimensional Arrays (2)

- Declaring a Variable to Refer to an Array

  `int[] anArray;`

  or `float anArrayOfFloats[];`

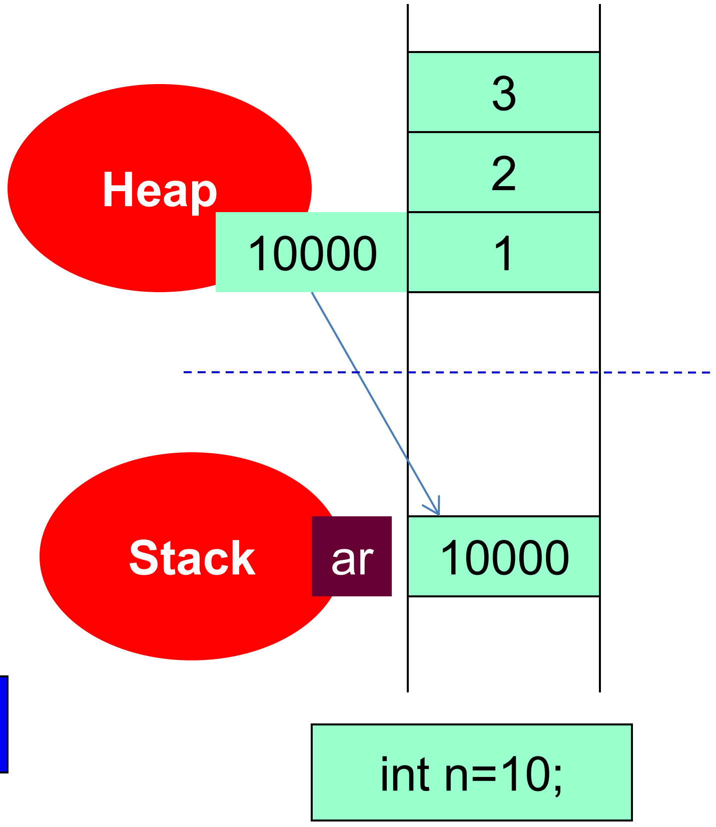
- Creating, Initializing, and Accessing an Array

  `anArray = new int[10];`

- Copying Arrays
  - Use arraycopy method from System class.

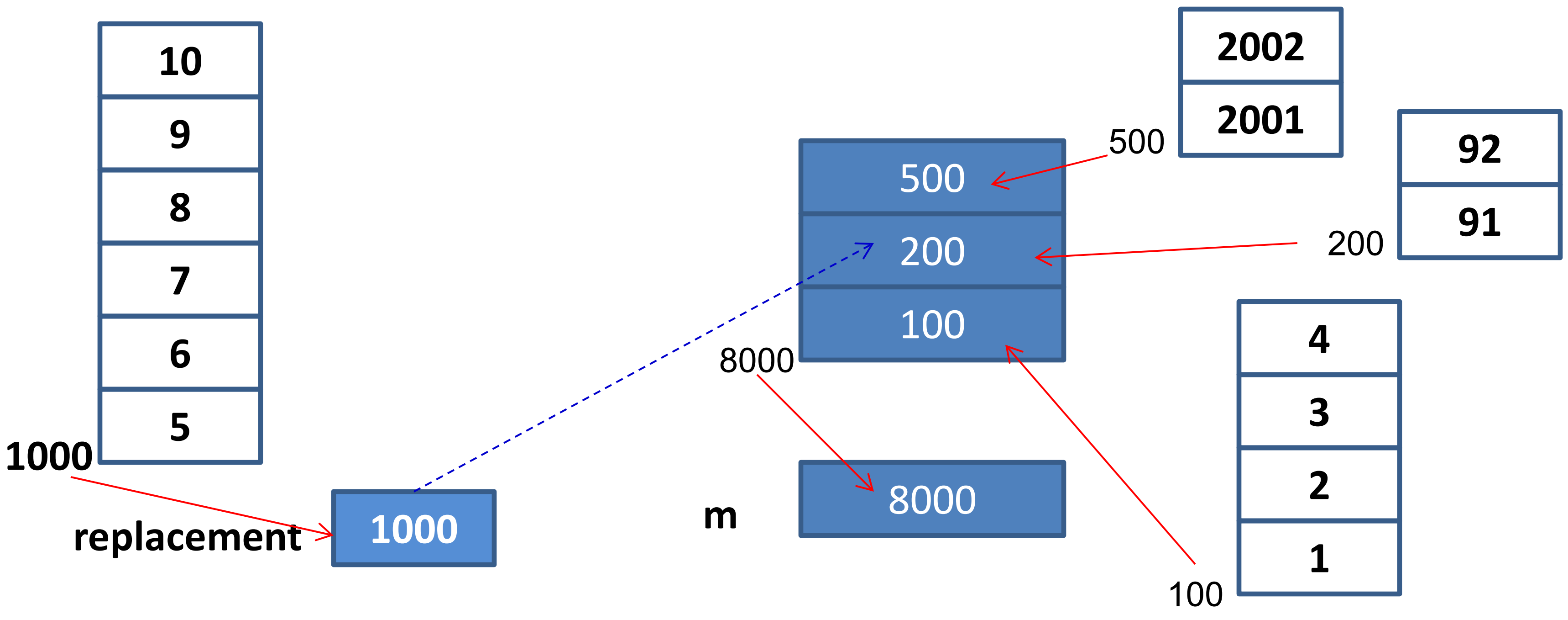
One Dimensional Arrays (3)

```
int[] ar;
ar= new int[3];
ar[0]=1; ar[1]=2; ar[2]=3;
int a2[];
int[] a3 = {1,2,3,4,5};
int a4[] = {1,2,3,4,5};
```



Array is a reference variable

Multiple Dimensional Arrays



```
int m[][]= { {1,2,3,4}, {91,92}, {2001,2002}};
int[] replacement = {5,6,7,8,9,10};
m[1]= replacement;
```

m[i][j]

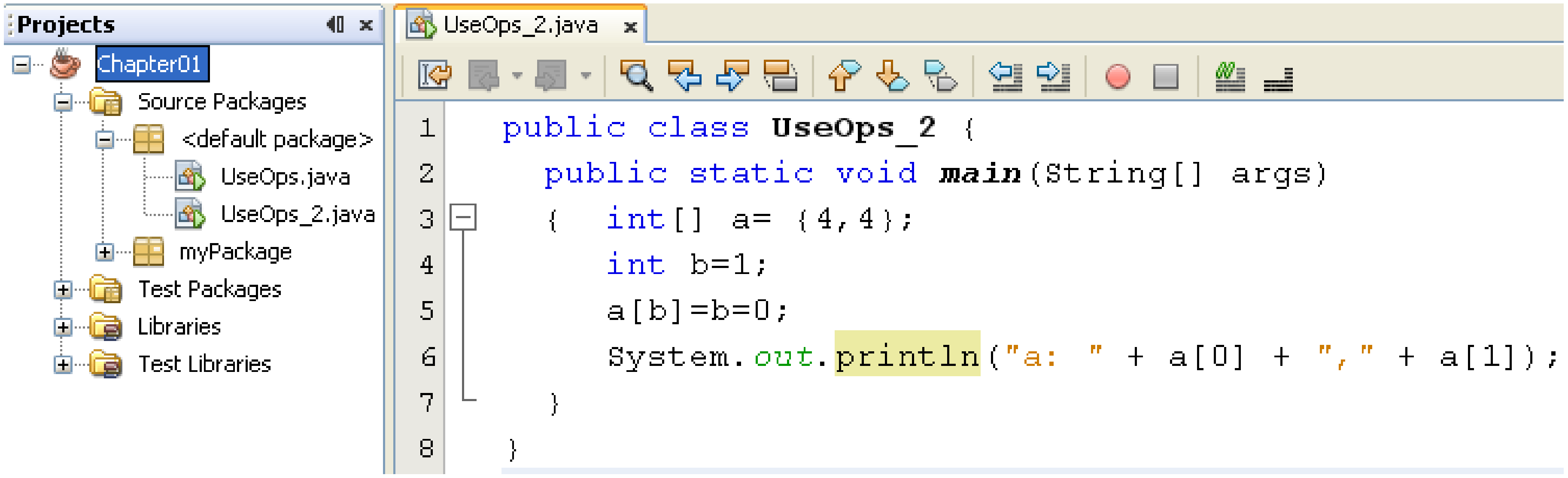
```
int[][] m; // declare a matrix
int r=10, c=5; // number of rows, columns
m= new int[r][c]; // memory allocate
```

Evaluating Expressions and Operator Precedence

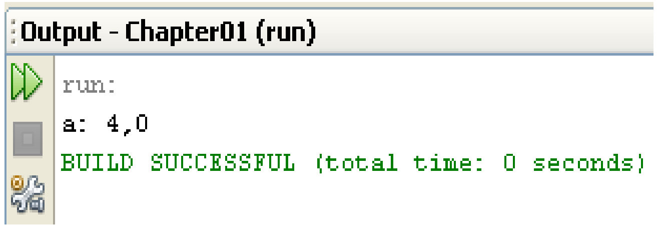
- The compiler generally evaluates such expressions from the innermost to outermost parentheses, left to right.

```
int x = 1; int y = 2; int z = 3;
int answer = ((8 * (y + z)) + y) * x;
would be evaluated piece by piece as follows:
((8 * (y + z) ) + y) * x
((8 * 5) + y) * x
(40 + y) * x
42 * x
42
```

Operator Precedence- Evaluation Order



```java
public class UseOps_2 {
  public static void main(String[] args)
  {   int[] a= {4,4};
      int b=1;
      a[b]=b=0;
      System.out.println("a: " + a[0] + "," + a[1]);
  }
}
```



```
run:
a: 4,0
BUILD SUCCESSFUL (total time: 0 seconds)
```

Order:
(1) [ ] ➔ a[b] ➔ a[1]
(2) = (from the right) ➔ b=0 ➔ return 0
➔ a[1] = 0

Basic Constructs

- They are taken from C-language
- Selection

  if, if … else

  switch (char/int exp)… case … default…
- Loops

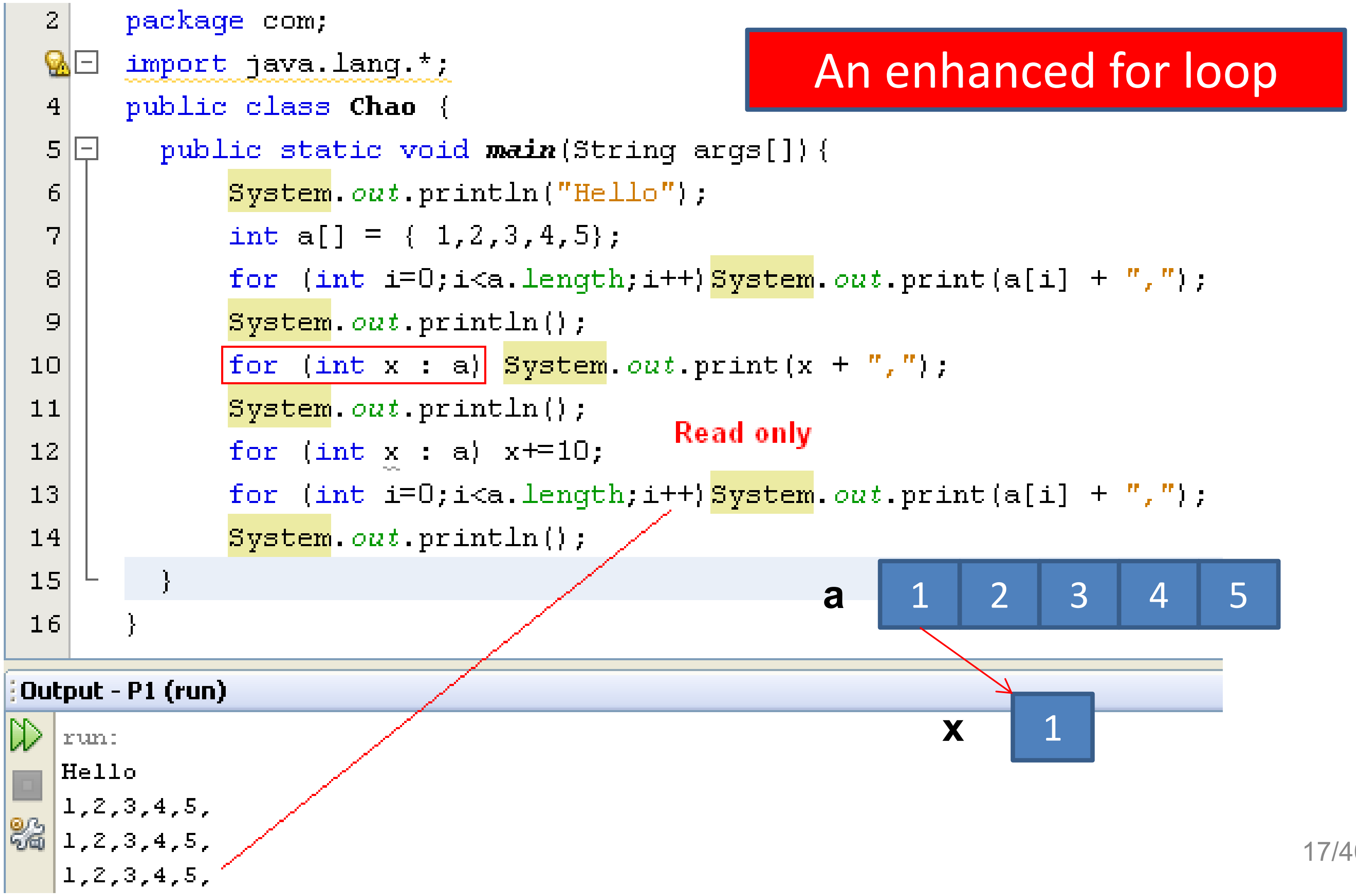
  for

  do… while

  while

Basic Logic Constructs

- They are the same with those in C-statements



```
package com;
import java.lang.*;
public class Chao {
  public static void main(String args[]){
      System.out.println("Hello");
      int a[] = { 1,2,3,4,5};
      for (int i=0;i<a.length;i++) System.out.print(a[i] + ",");
      System.out.println();
      for (int x : a) System.out.print(x + ",");
      System.out.println();
      for (int x : a) x+=10;
      for (int i=0;i<a.length;i++) System.out.print(a[i] + ",");
      System.out.println();
  }
}
```

An enhanced for loop

Read only

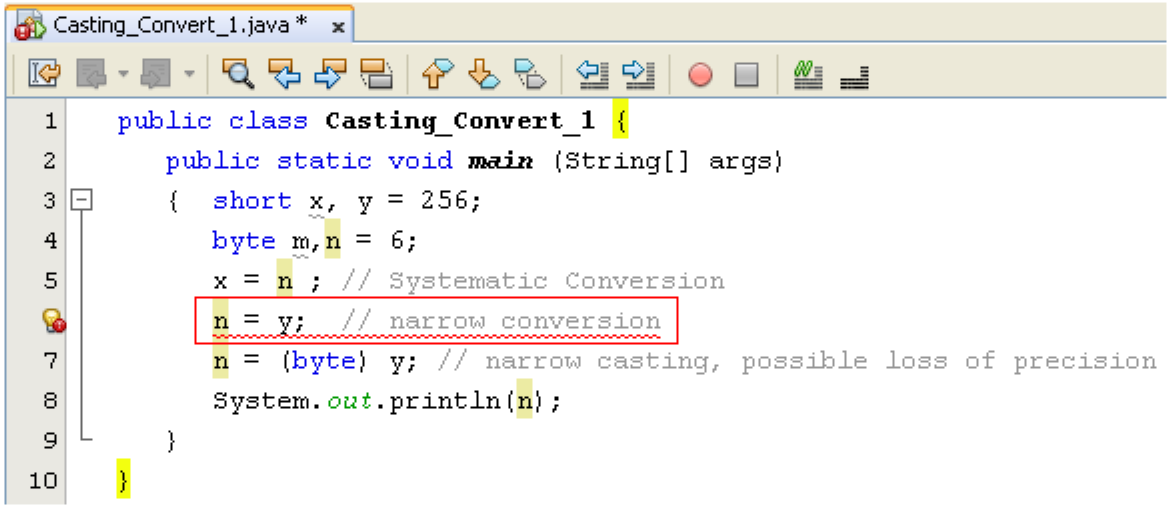
Output - P1 (run)

```
run:
Hello
1,2,3,4,5,
1,2,3,4,5,
1,2,3,4,5,
```

The String type

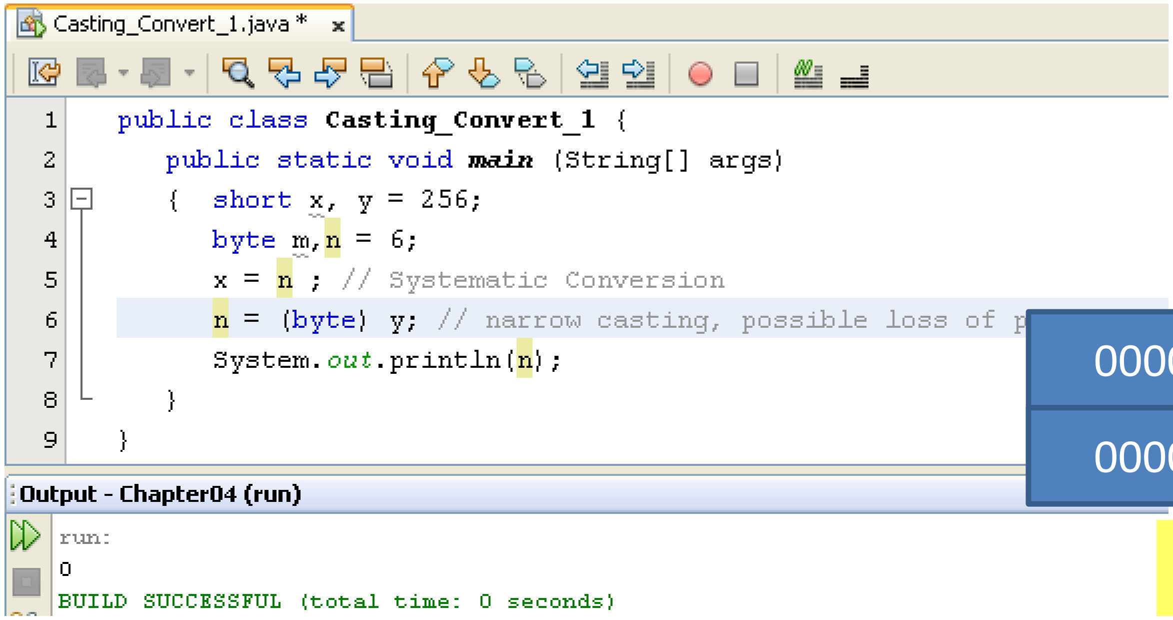
- A String represents a sequence of zero or more Unicode characters.
  - String name = "Steve";
  - String s = “”;
  - String s = null;
- String concatenation.
  - String x = "foo“ + "bar“ + "!";
- Java is a case-sensitive language.

Type Conversions and Explicit Casting



Casting_Convert_1.java *

```
public class Casting_Convert_1 {
   public static void main (String[] args)
   {  short x, y = 256;
      byte m,n = 6;
      x = n ; // Systematic Conversion
      n = y;   // narrow conversion
      n = (byte) y; // narrow casting, possible loss of precision
      System.out.println(n);
   }
}
```



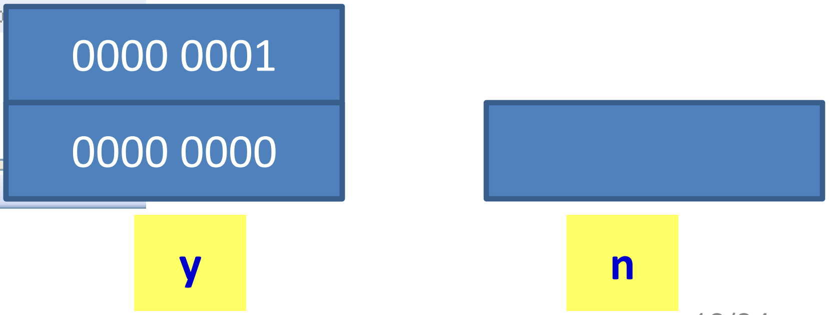
Casting_Convert_1.java *

```
public class Casting_Convert_1 {
   public static void main (String[] args)
   {  short x, y = 256;
      byte m,n = 6;
      x = n ; // Systematic Conversion
      n = (byte) y; // narrow casting, possible loss of p
      System.out.println(n);
   }
}
```

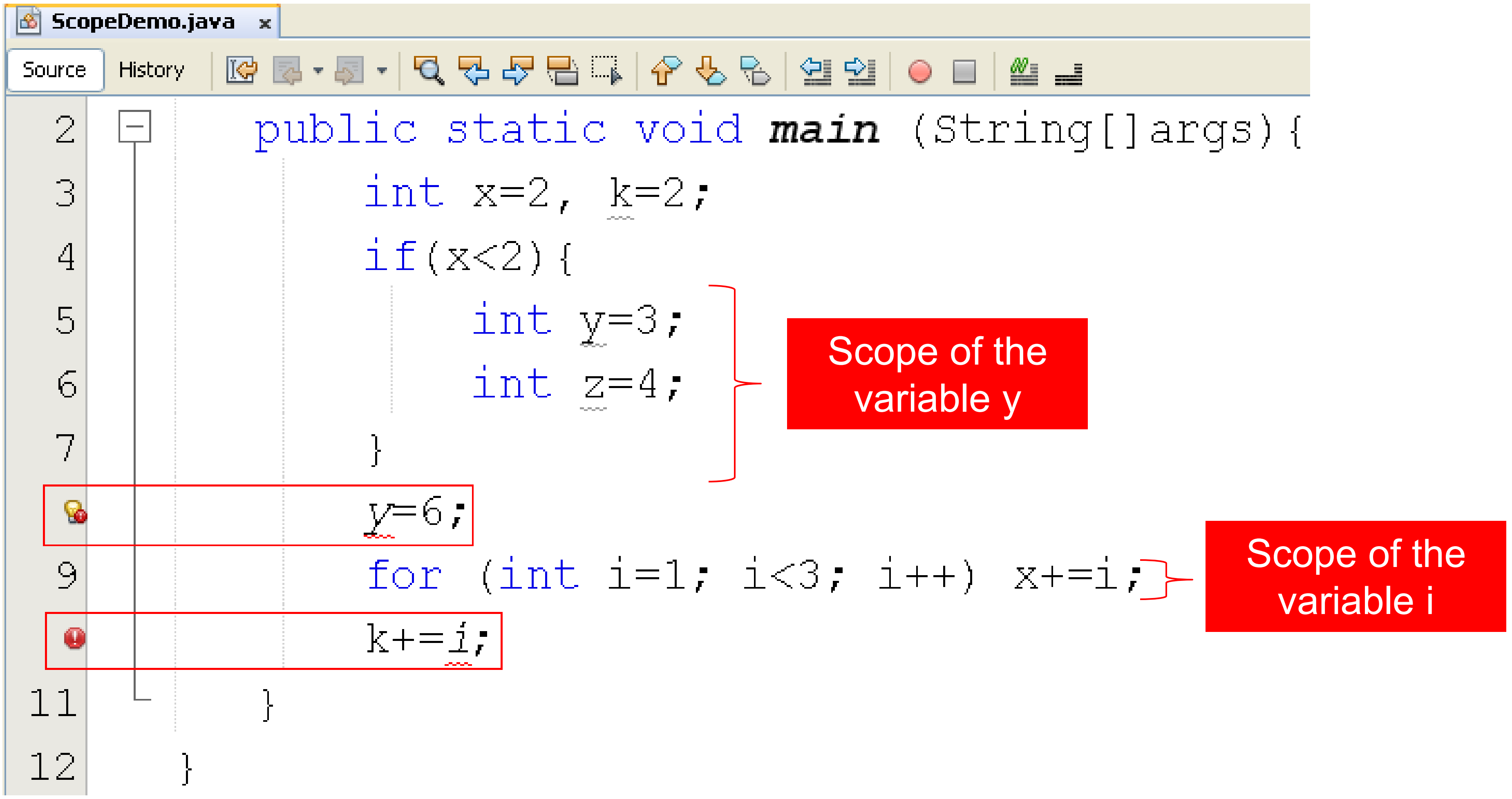
Output - Chapter04 (run)

```
run:
0
BUILD SUCCESSFUL (total time: 0 seconds)
```

* Widening Conversion: OK
- Narrowing conversion: Not allowed. We must use explicit casting.
- A boolean can not be converted to any other type.
- A non-boolean can be converted to another non-boolean type.

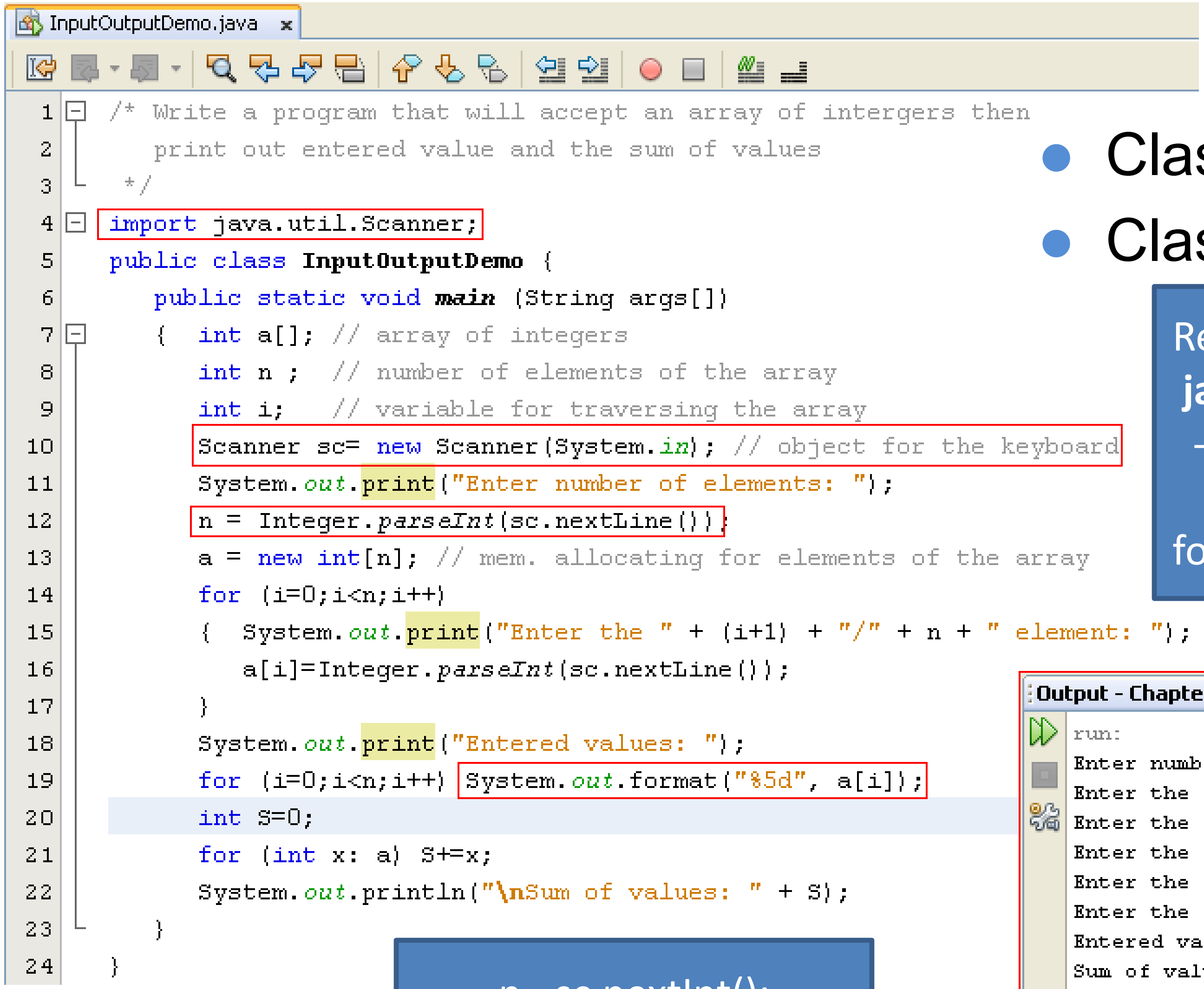


Scope of a Variable



```
    public static void main (String[]args){
        int x=2, k=2;
        if(x<2){
            int y=3;
            int z=4;
        }
        y=6;
        for (int i=1; i<3; i++) x+=i;
        k+=i;
    }
}
```

Input/Output Data



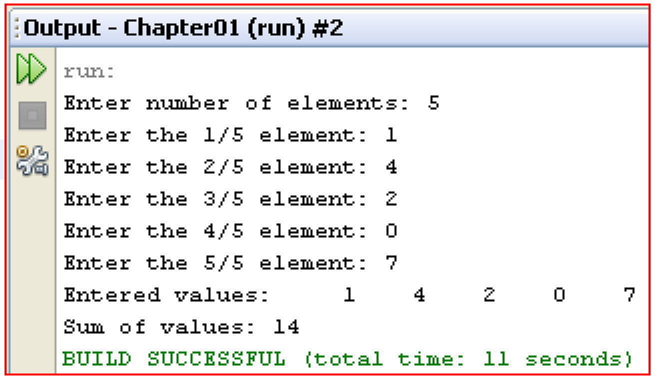
InputOutputDemo.java

```java
/* Write a program that will accept an array of intergers then
   print out entered value and the sum of values
 */
import java.util.Scanner;
public class InputOutputDemo {
   public static void main (String args[])
   {  int a[]; // array of integers
      int n ;  // number of elements of the array
      int i;   // variable for traversing the array
      Scanner sc= new Scanner(System.in); // object for the keyboard
      System.out.print("Enter number of elements: ");
      n = Integer.parseInt(sc.nextLine());
      a = new int[n]; // mem. allocating for elements of the array
      for (i=0;i<n;i++)
      {  System.out.print("Enter the " + (i+1) + "/" + n + " element: ");
         a[i]=Integer.parseInt(sc.nextLine());
      }
      System.out.print("Entered values: ");
      for (i=0;i<n;i++) System.out.format("%5d", a[i]);
      int S=0;
      for (int x: a) S+=x;
      System.out.println("\nSum of values: " + S);
   }
}
```

- Class java.lang.System
- Class java.util.Scanner

Refer to Java documentation:
java.lang.String class,
- the **format** method,
  - format string

for more details



Output - Chapter01 (run) #2

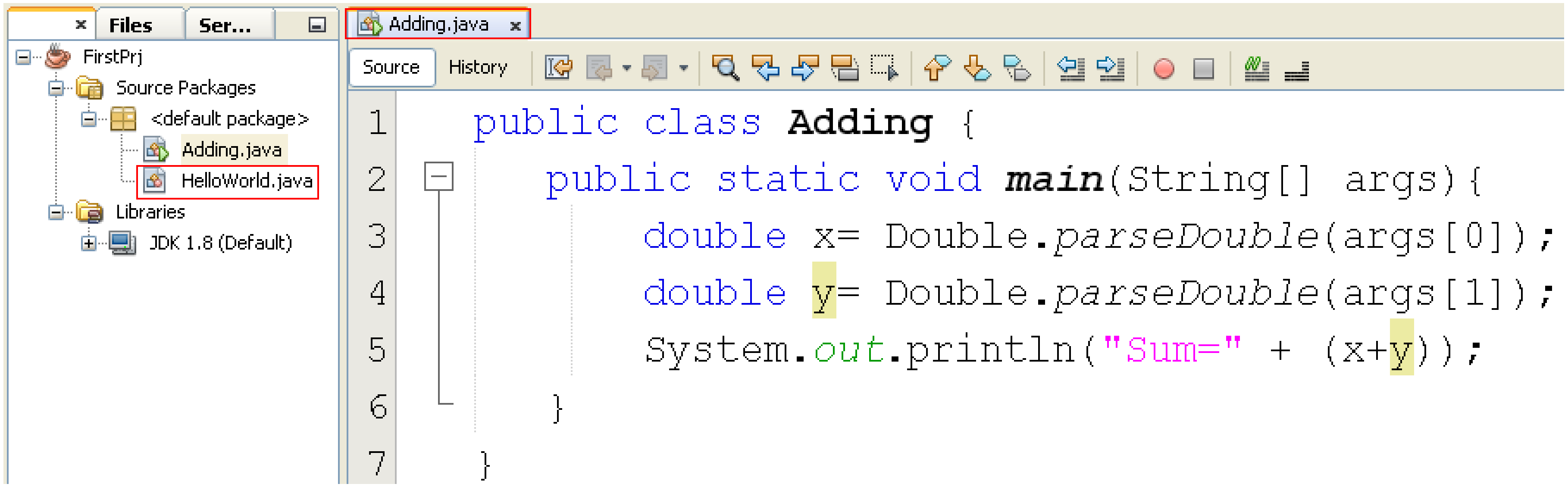
```
run:
Enter number of elements: 5
Enter the 1/5 element: 1
Enter the 2/5 element: 4
Enter the 3/5 element: 2
Enter the 4/5 element: 0
Enter the 5/5 element: 7
Entered values:     1    4    2    0    7
Sum of values: 14
BUILD SUCCESSFUL (total time: 11 seconds)
```

n= sc.nextInt();

Elements of Java Style

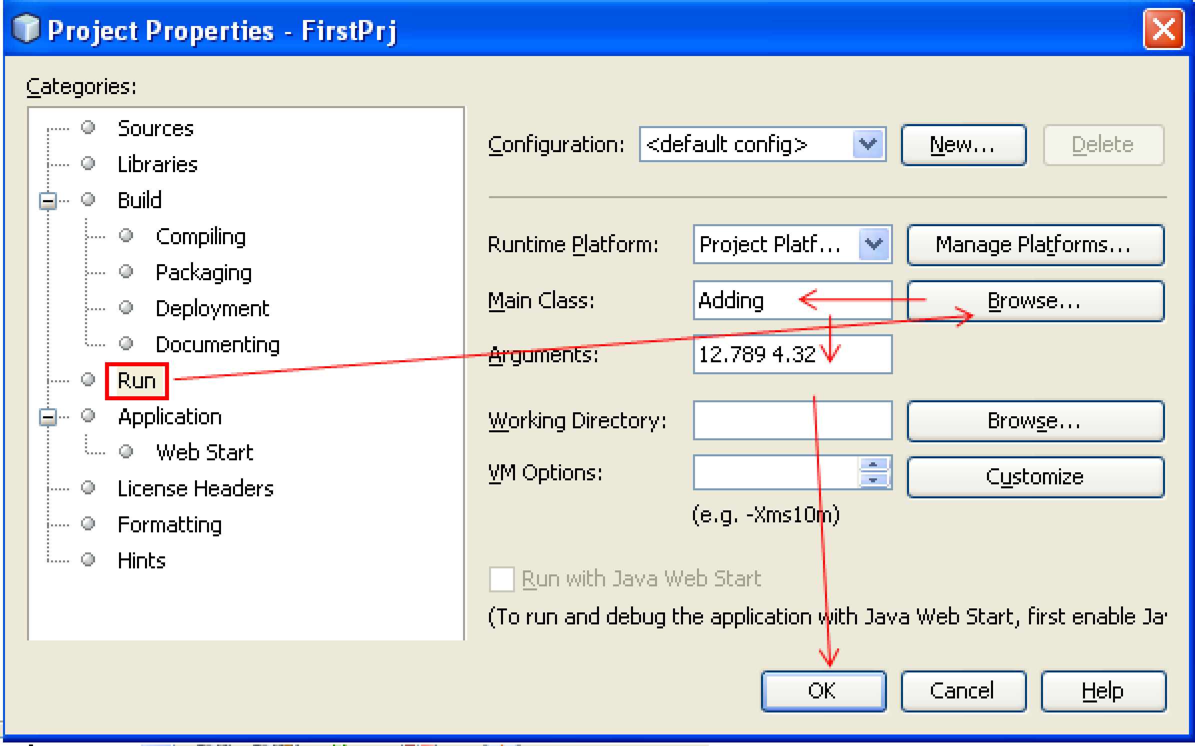
- Proper Use of Indentation
  - Statements within a block of code should be indented relative to the starting/ending line of the enclosing block.
- Use Comments Wisely
- Placement of Braces
  - Opening brace at the end of the line of code that starts a given block. Each closing brace goes on its own line, aligned with the first character of the line con.
- Descriptive Variable Names

Pass Arguments to the method main



```java
public class Adding {
    public static void main(String[] args){
        double x= Double.parseDouble(args[0]);
        double y= Double.parseDouble(args[1]);
        System.out.println("Sum=" + (x+y));
    }
}
```

Pass Arguments to the method main



Configuration: <default config>

Runtime Platform: Project Platf...

Main Class: Adding

Arguments: 12.789 4.32

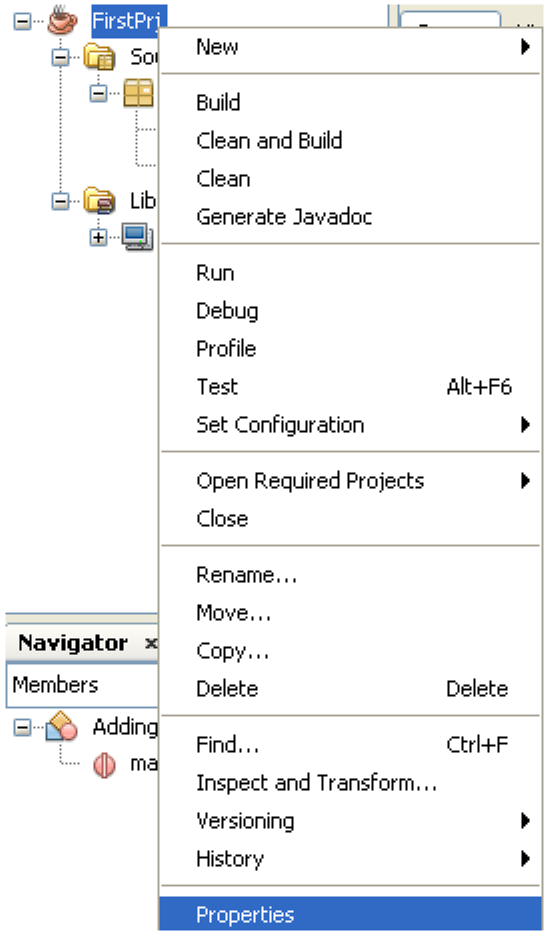
Working Directory:

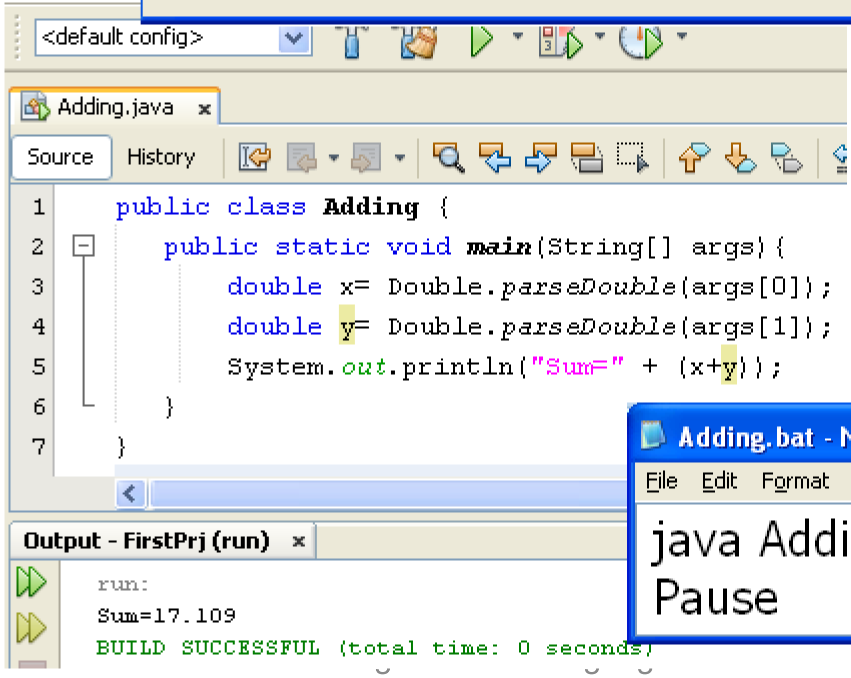
VM Options:

(e.g. -Xms10m)

Run with Java Web Start

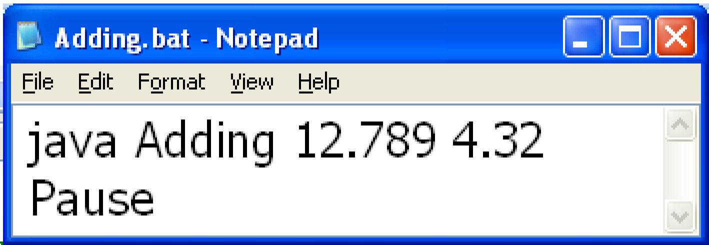
(To run and debug the application with Java Web Start, first enable Ja





```
public class Adding {
    public static void main(String[] args){
        double x= Double.parseDouble(args[0]);
        double y= Double.parseDouble(args[1]);
        System.out.println("Sum=" + (x+y));
    }
}
```

```
run:
Sum=17.109
BUILD SUCCESSFUL (total time: 0 seconds)
```



```
java Adding 12.789 4.32
Pause
```

What Is an Object?(1)

- Objects are key to understanding *object-oriented* technology.
- Examples of real-world objects: your dog, your desk, your television set, your bicycle.
- Real-world objects share two characteristics: They all have ***state*** and ***behavior.***
  - Dogs have **state (name, color, breed, hungry)** and behavior (barking, fetching, wagging tail).

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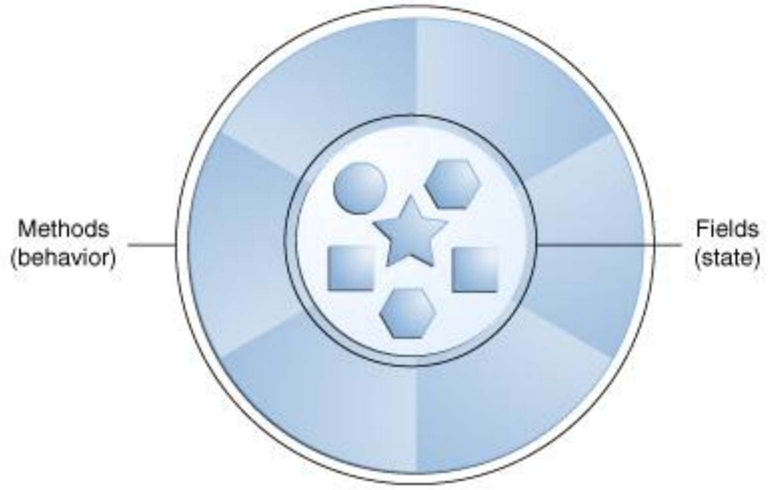
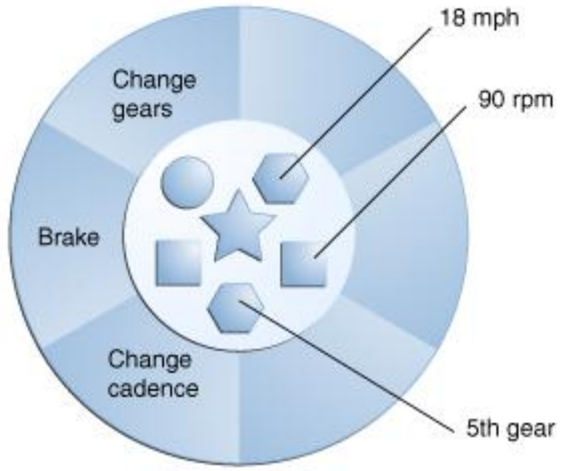
What Is an Object?(2)

- Software objects are conceptually similar to real-world objects: they too consist of state and related behavior.
- An object stores its state in *fields* and exposes its behavior through *methods*.





What Is an Object?(3)

- Software objects provides a number of benefits:
  - Modularity
  - Information-hiding
  - Code re-use
  - Pluggability and debugging ease

What Is a Class?

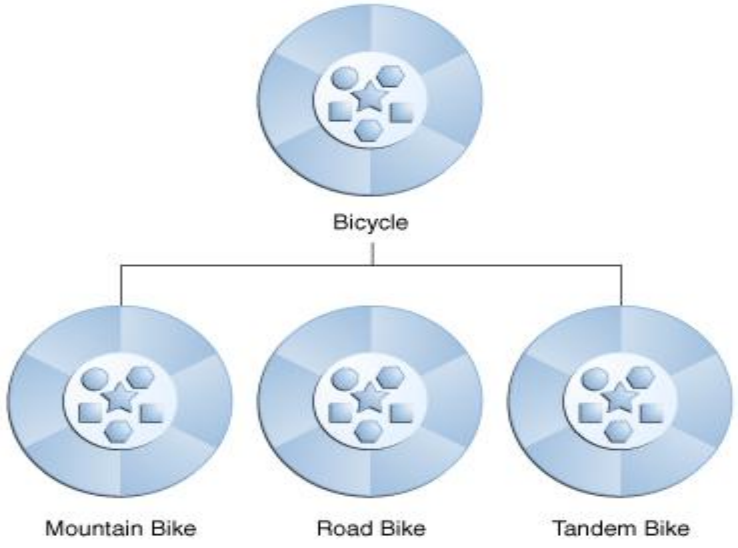
- A *class* is the blueprint from which individual objects are created.
  - Your bicycle is an *instance* of the *class of objects* known as bicycles.

```
class Bicycle {

    int cadence = 0;
    int speed = 0;
    int gear = 1;

    void changeCadence(int newValue) {
         cadence = newValue;
    }

    void changeGear(int newValue) {
         gear = newValue;
    }

    void speedUp(int increment) {
         speed = speed + increment;
    }

    void applyBrakes(int decrement) {
         speed = speed - decrement;
    }

    void printStates() {
         System.out.println("cadence:" +
             cadence + " speed:" +
             speed + " gear:" + gear);
    }
}
```

What Is Inheritance?

- Object-oriented programming allows classes to *inherit* commonly used state and behavior from other classes.
    - Bicycle now becomes the *superclass* of MountainBike, RoadBike, and TandemBike

```
class MountainBike
extends Bicycle {
// new fields and methods defining
// a mountain bike would go here
}
```



What Is an Interface?

- An interface is a group of related methods with empty bodies.

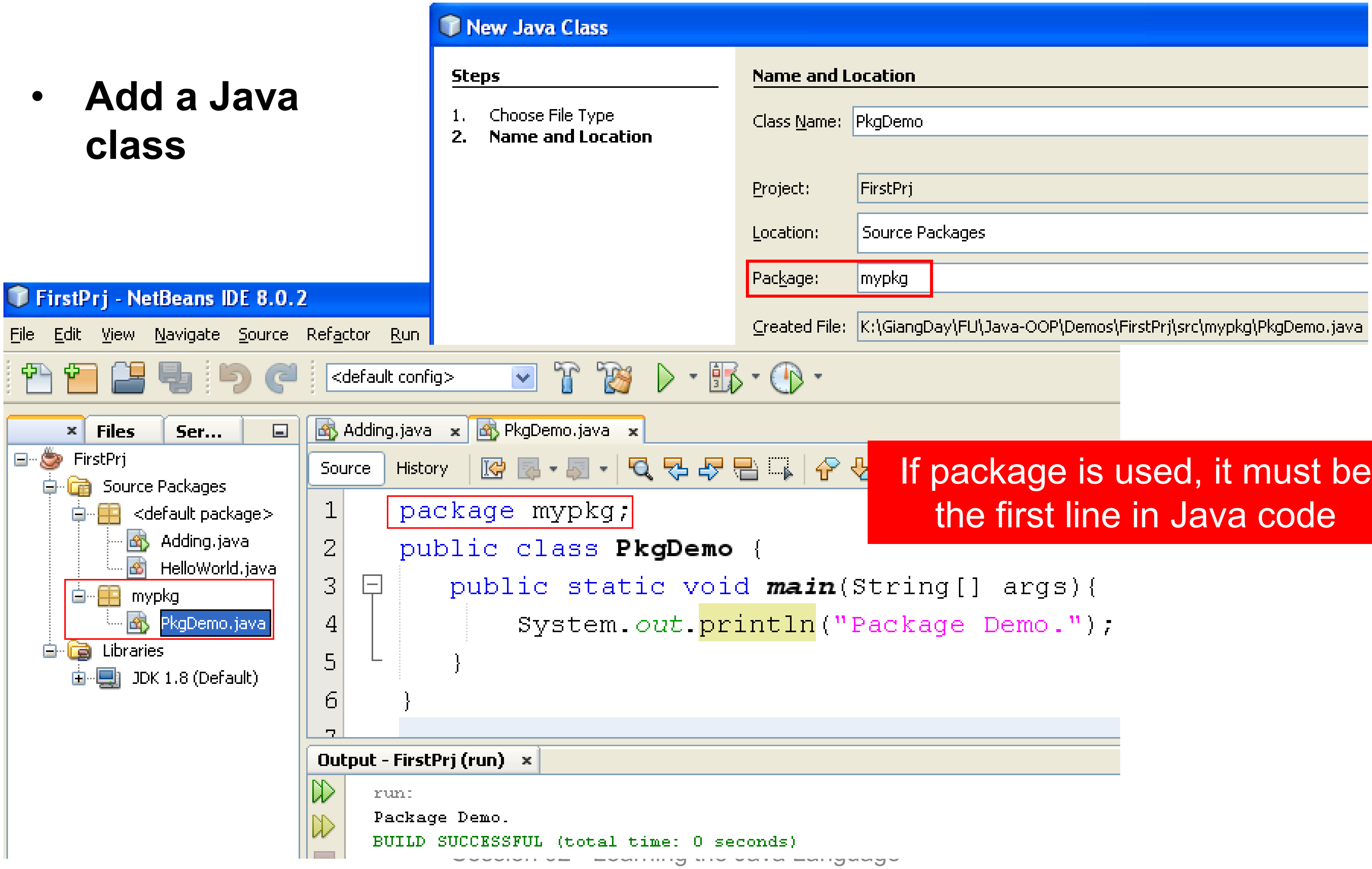
```
interface Bicycle {
/ wheel revolutions per minute
void changeCadence(int newValue);
void changeGear(int newValue);
void speedUp(int increment);
void applyBrakes(int decrement);
}
```

What Is a Package?

- A package is a namespace that organizes a set of related classes and interfaces.
- The Java platform provides an enormous class library (a set of packages) suitable for use in your own applications called API.
  - For example, a String object contains state and behavior for character strings.

User-Defined Package

- **Add a Java class**



Name and Location

Class Name: PkgDemo

Project: FirstPrj

Location: Source Packages

Package: mypkg

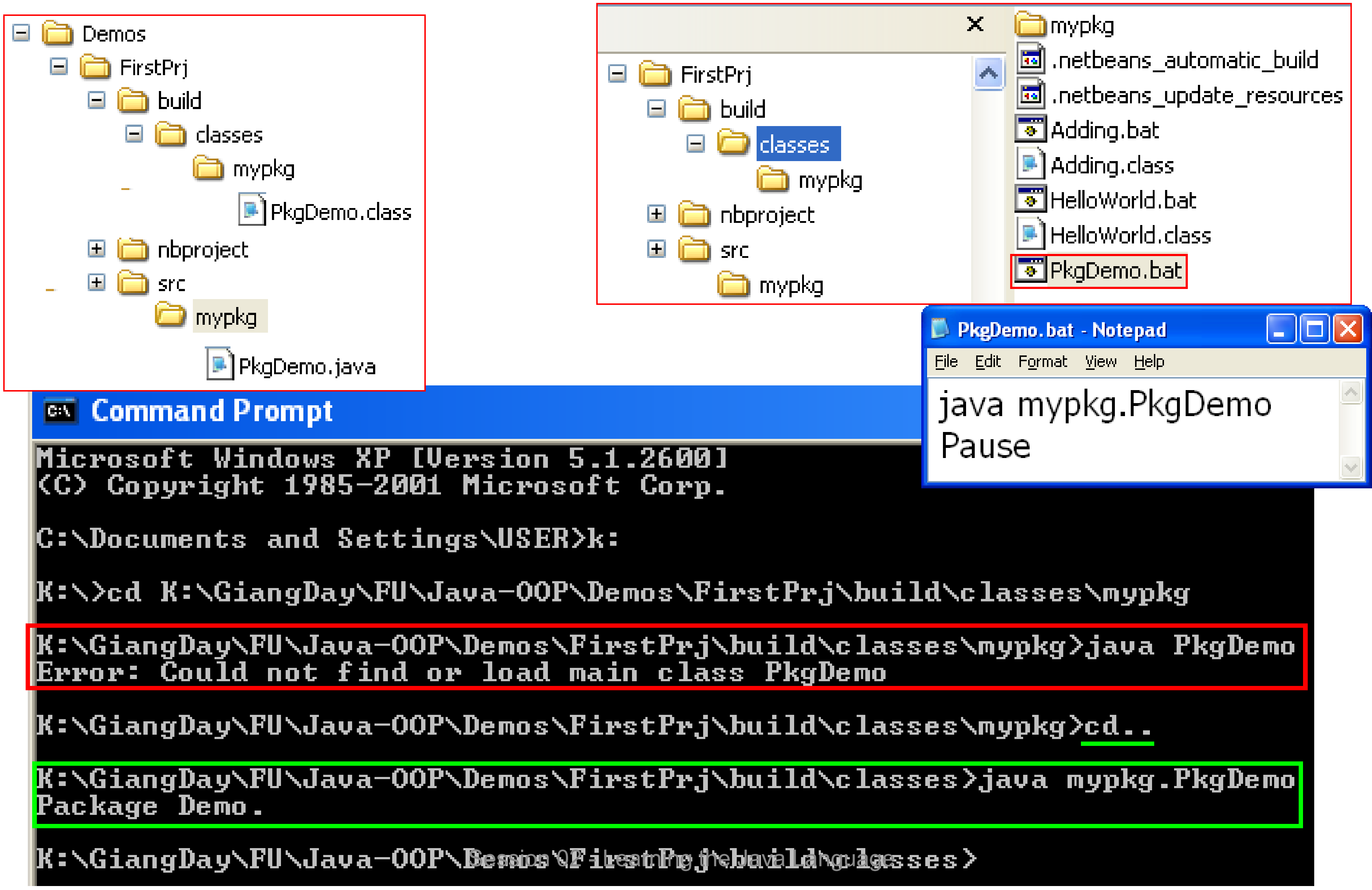
Created File: K:\GiangDay\FU\Java-OOP\Demos\FirstPrj\src\mypkg\PkgDemo.java

```
package mypkg;
public class PkgDemo {
    public static void main(String[] args){
        System.out.println("Package Demo.");
    }
}
```

```
run:
Package Demo.
BUILD SUCCESSFUL (total time: 0 seconds)
```

If package is used, it must be the first line in Java code

User-Defined Package



```
java mypkg.PkgDemo
Pause
```

```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\USER>k:

K:\>cd K:\GiangDay\FU\Java-OOP\Demos\FirstPrj\build\classes\mypkg

K:\GiangDay\FU\Java-OOP\Demos\FirstPrj\build\classes\mypkg>java PkgDemo
Error: Could not find or load main class PkgDemo

K:\GiangDay\FU\Java-OOP\Demos\FirstPrj\build\classes\mypkg>cd..

K:\GiangDay\FU\Java-OOP\Demos\FirstPrj\build\classes>java mypkg.PkgDemo
Package Demo.

K:\GiangDay\FU\Java-OOP\Demos\FirstPrj\build\classes>
```

Summary

- The core concepts behind object-oriented programming: objects, interfaces, classes, and inheritance.
- The traditional features of the language, including variables, arrays, data types, operators, and control flow.