

Session 02

Learning the Java Language

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

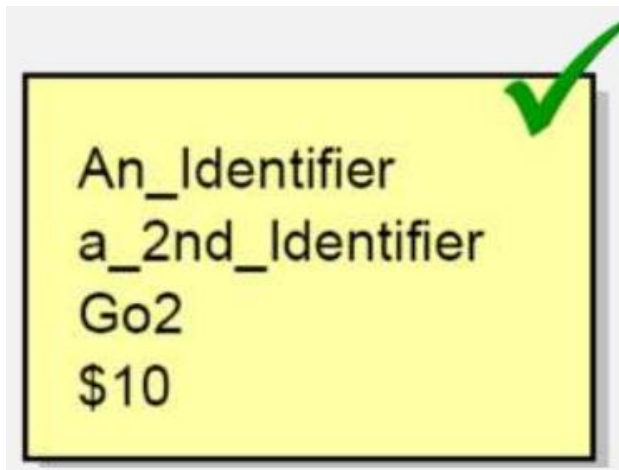
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Objectives

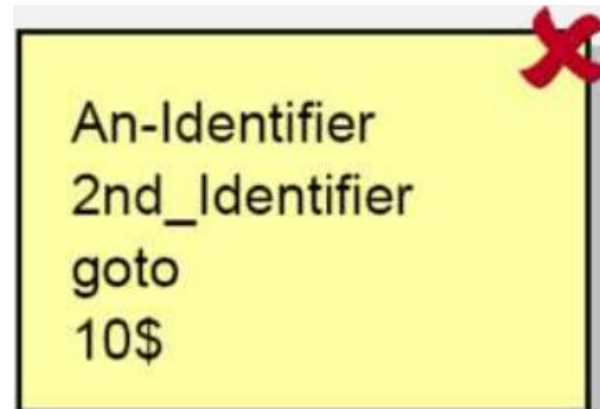
- Study some fundamentals of Java languages: Data types, variables, arrays, operators,...
- The Basic Constructs: loop, if, switch()....
- Wrapper Class
- Input/output variables
- String class
- Regular Expression
- StringBuilder, stringBuffer, StringTokenizer

Keywords and Identifiers

- Keywords: Almost of them are similar to those in C language
- Variables in Java are case sensitive and can be of unlimited sequence of letters and numbers. However, variable names must start with a letter, underscore character “_”, or a dollar sign “\$”.
- Identifiers must be different to keywords



An_Identifier
a_2nd_Identifier
Go2
\$10



An-Identifier
2nd_Identifier
goto
10\$

Naming conventions in java

- class name: should start with uppercase letter and be a noun e.g. String, Color, Button, System, Thread etc.
- interface name: should start with uppercase letter and be an adjective e.g. Runnable, Remote, ActionListener etc.
- method name: should start with lowercase letter and be a verb e.g. actionPerformed(), main(), print(), println() etc.
- variable name: should start with lowercase letter e.g. firstName, orderNumber etc.
- package name: should be in lowercase letter e.g. java, lang, sql, util etc.
- constants name: should be in uppercase letter. e.g. RED, YELLOW, MAX_PRIORITY etc.

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] ;

Operators

Category (Descending Precedence)	Operators
Unary	<code>++ -- + - ! ~ (type)</code>
Arithmetic	<code>* / %</code> <code>+ -</code>
Shift	<code><< >> >>></code>
Comparison	<code>< <= > >= instanceof</code> <code>== !=</code>
Bitwise	<code>& ^ </code>
Short-circuit	<code>&& </code>
Conditional	<code>? :</code>
Assignment	<code>= op=</code>

They are the same with
those in C language

Using Operators Demonstration

```
UseOps.java x
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)
```

Literals and Value Variables

- Character: 'a'
- String: String S="Hello";
- 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

Value variable

Stack

n

10

int n=10;

Escape sequence


- `\t` Insert a tab in the text at this point.
- `\b` Insert a backspace in the text at this point.
- `\n` Insert a newline in the text at this point.
- `\r` Insert a carriage return in the text at this point.
- `\f` Insert a formfeed in the text at this point.
- `\'` Insert a single quote character in the text at this point.
- `\"` Insert a double quote character in the text at this point.
- `\\` Insert a backslash character in the text at this point.

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)

Type Casting

- Assigning a value of one type to a variable of another type is known as **Type Casting**. In Java, type casting is classified into two types,
- Widening Casting(Implicit)

byte → short → int → long → float → double

widening

- Narrowing Casting(Explicitly done)

double → float → long → int → short → byte

Narrowing

Example casting

- `double d = 100.04;`
- `long l = (long)d; //explicit type casting`
required `int i = (int)l; //explicit type casting`
required

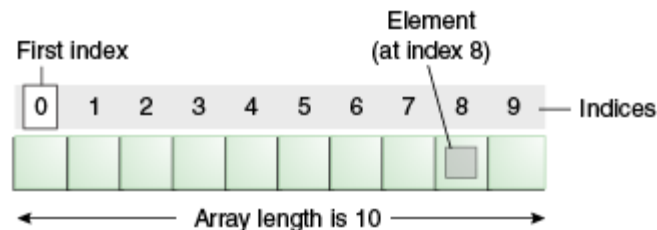
```
int a, b;  
short c;  
a = b + (int)c;
```

```
int d;  
short e;  
e = (short)d;
```

```
double f;  
long g;  
f = g;  
g = f; //error
```

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];
```

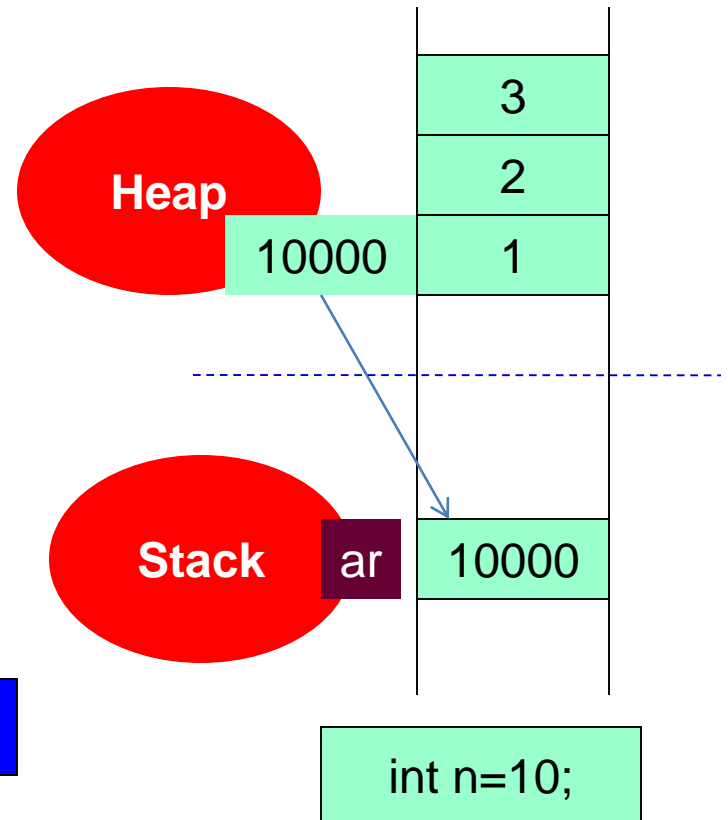
```
ar[0]=1; ar[1]=2; ar[2]=3;
```

```
int a2[];
```

```
int[] a3 = {1,2,3,4,5};
```

```
int a4[] = {1,2,3,4,5};
```

Array is a reference variable



example one dimensional array

```
public class DaySo {  
    int calSum(int... a) { //int[] a  
        int t=0;  
        for(int x:a)  
            t+=x;  
        return t;  
    }  
    int calMin(int... a) {  
        int t=a[0];  
        for(int x:a)  
            if(t>x)  
                t=x;  
        return t;  
    }  
}
```



```
int calMax(int... a) {  
    int t=a[0];  
    for(int x:a)  
        if(t<x)  
            t=x;  
    return t;  
}  
  
int[] sort(int... a) {  
    int t;  
    for(int i=0;i<a.length-1;i++)  
        for(int j=i+1;j<a.length;j++)  
            if(a[i]>a[j]) {  
                t=a[i];  
                a[i]=a[j];  
                a[j]=t;            }  
    return a;  
}
```

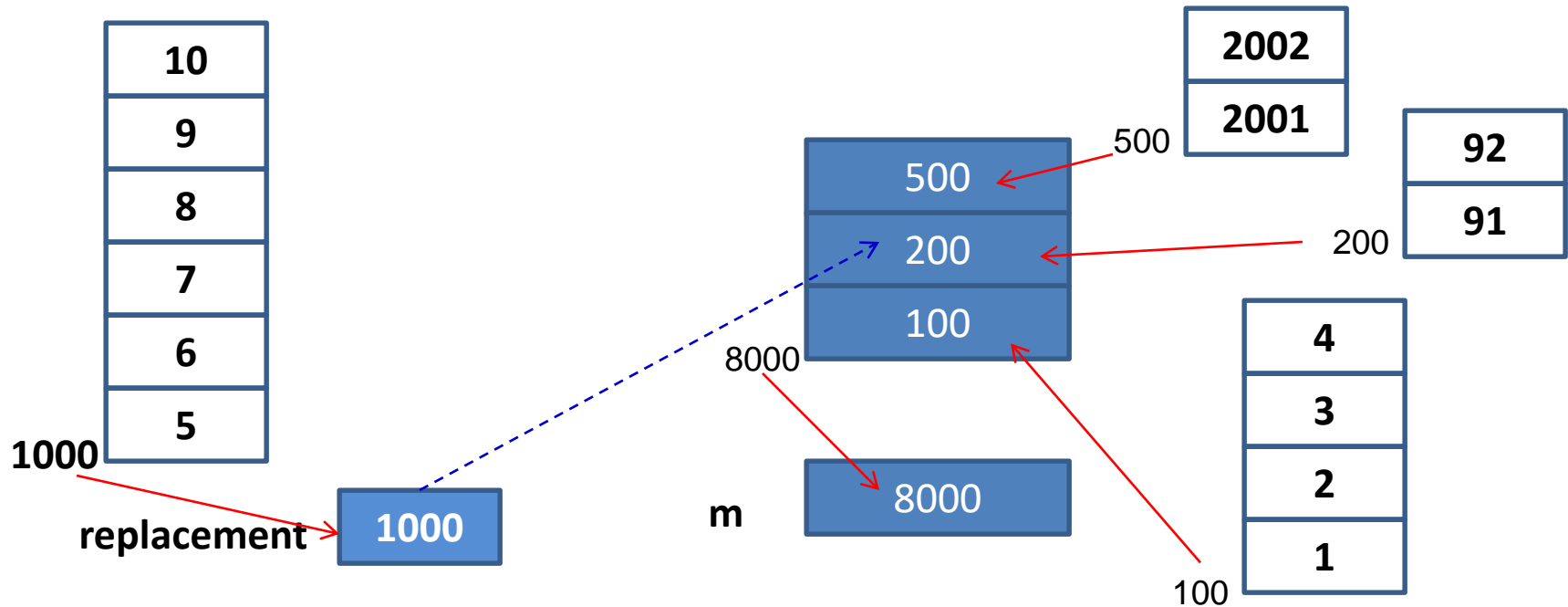
```

int[] input(int n) {
    Scanner in = new Scanner(System.in);
    int[] b = new int[n];
    for(int i=0;i<n;i++){
        System.out.print("\n thu "+i+":
    ");
        b[i]=in.nextInt();
    }
    return b;
}

void toString(int... a) {
    System.out.print("\n Day so:
    "+Arrays.toString(a));
}

```

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
```

- `int b[3][4];`
- `int row = b.length;`
- `int col = b[0].length;`

to *add* elements to an *array*

```
public double[][] add(double[][] a,  
    double[][] b) {  
    int m = a.length;  
    int n = a[0].length;  
    double[][] c = new double[m][n];  
    for (int i = 0; i < m; i++)  
        for (int j = 0; j < n; j++)  
            c[i][j] = a[i][j] + b[i][j];  
    return c;  
}
```

to *Subtract*

```
public double[][] subtract(double[][] a,  
    double[][] b) {  
    int m = a.length;  
    int n = a[0].length;  
    double[][] c = new double[m][n];  
    for (int i = 0; i < m; i++)  
        for (int j = 0; j < n; j++)  
            c[i][j] = a[i][j] - b[i][j];  
    return c;  
}
```

To multiply

```
public double[][] multiply(double[][] a,  
    double[][] b) {  
    int m1 = a.length;  
    int n1 = a[0].length;  
    int m2 = b.length;  
    int n2 = b[0].length;  
    if (n1 != m2) throw new  
        RuntimeException("Illegal matrix dimensions.");  
    double[][] c = new double[m1][n2];  
    for (int i = 0; i < m1; i++)  
        for (int j = 0; j < n2; j++)  
            for (int k = 0; k < n1; k++)  
                c[i][j] += a[i][k] * b[k][j];  
    return c;  
}
```

to *transpose* matrix

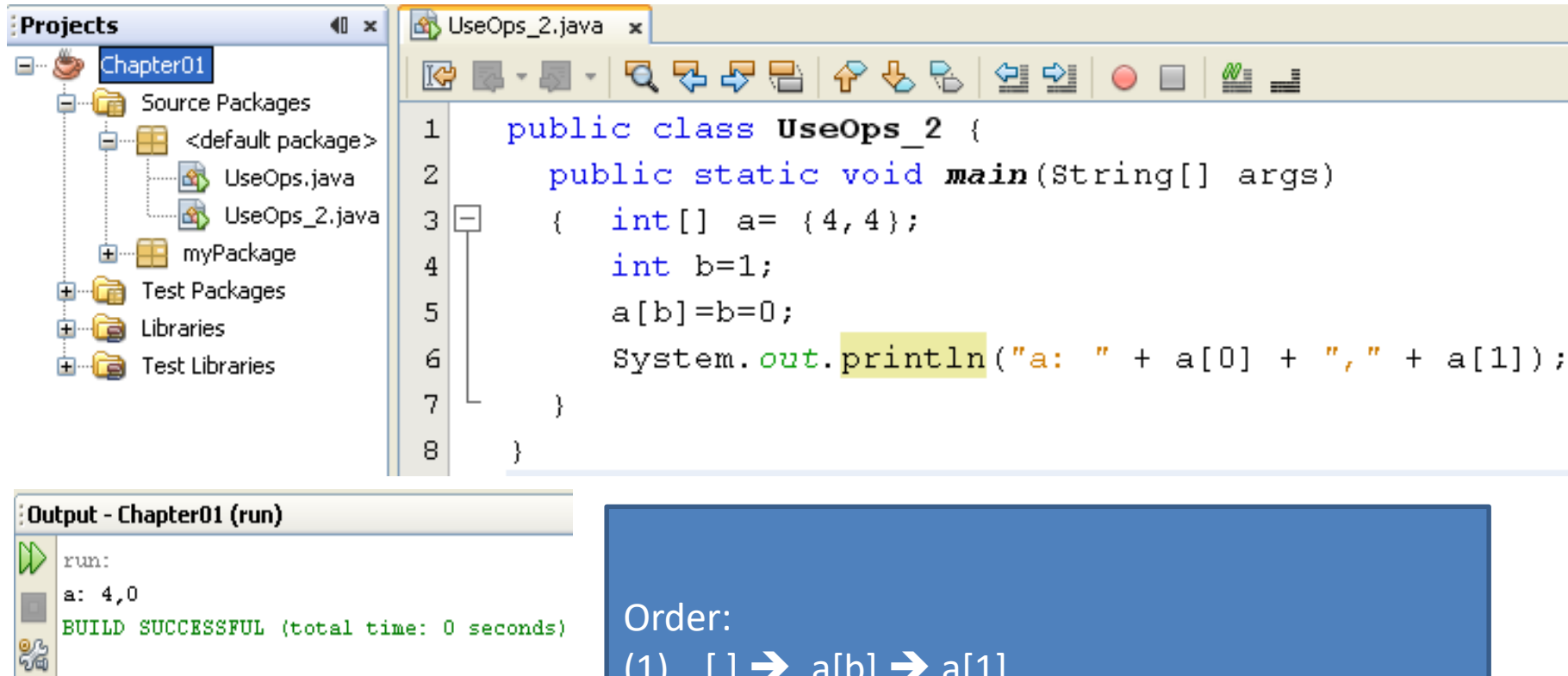
```
public double[][]  
    transpose(double[][] a) {  
    int m = a.length;  
    int n = a[0].length;  
    double[][] b = new  
    double[n][m];    for (int i = 0;  
    i < m; i++)  
        for (int j = 0; j < n; j++)  
            b[j][i] = a[i][j];  
    return b;  
}
```


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



The screenshot displays an IDE interface. On the left, the 'Projects' pane shows a project named 'Chapter01' containing 'Source Packages' (with '<default package>' and 'myPackage'), 'Test Packages', 'Libraries', and 'Test Libraries'. The 'myPackage' folder contains 'UseOps.java' and 'UseOps_2.java'. The main editor window shows the code for 'UseOps_2.java'.

```
1 public class UseOps_2 {  
2     public static void main(String[] args)  
3     {  
4         int[] a= {4,4};  
5         int b=1;  
6         a[b]=b=0;  
7         System.out.println("a: " + a[0] + "," + a[1]);  
8     }  
}
```

Below the editor, the 'Output - Chapter01 (run)' pane shows the execution results:

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

Order:

- (1) `[]` \rightarrow `a[b]` \rightarrow `a[1]`
- (2) `=` (from the right) \rightarrow `b=0` \rightarrow return 0
 \rightarrow `a[1] = 0`

The Basic Constructs

- Java provides three loop constructions. Taken from C and C++, these are:
 - while(),
 - do ,
 - for().

The *while()* Loop

```
while (boolean_condition)  
{  
    statement(s);  
}
```

Example

```
int number = 1;  
    while (number <= 200) {  
        System.out.print(number + "  
    ") ;  
        number *= 2;  
    }
```

Output:

1 2 4 8 16 32 64 128

The do Loop

```
do {  
    do_something  
    do_more  
} while (boolean_condition);
```

Example

```
// roll until we get a number other than 3
Random rand = new Random();
int die;
do {
    die = rand.nextInt();
} while (die == 3);
```

The *for()* Loop

```
for (start_expr;  
    test_expr;increment_expr) {  
    // code to execute repeatedly  
}
```


Example

- ```
for (int index = 0; index < 10; index++) {
 System.out.println(index);
}
```
- ```
for (int i = -3; i <= 2; i++) {  
    System.out.println(i);  
}
```
- ```
for (int i = 3; i >= 1; i--) {
 System.out.println(i);
}
```

# Enhanced *for* Loops

- Java's *for* loops were enhanced in release 1.5 to work more easily with arrays and collections.
- Syntax:  
for (type variable\_name:array)

```
int sumOfLengths(String[] strings) {
 int totalLength = 0;
 for (String s:strings)
 totalLength += s.length();
 return totalLength;
}
```

# Example

```
public class Example{
 public static void main(String args[]){
 int [] numbers = {10, 20, 30, 40, 50};
 for(int x : numbers){
 System.out.print(x);// numbers[i]
 System.out.print(",");
 }
 System.out.print("\n");
 String [] names ={"James", "Larry", "Tom",
"Lacy"};
 for(String name : names) {
 System.out.print(name);
 System.out.print(",");
 } } }
```

- Output:

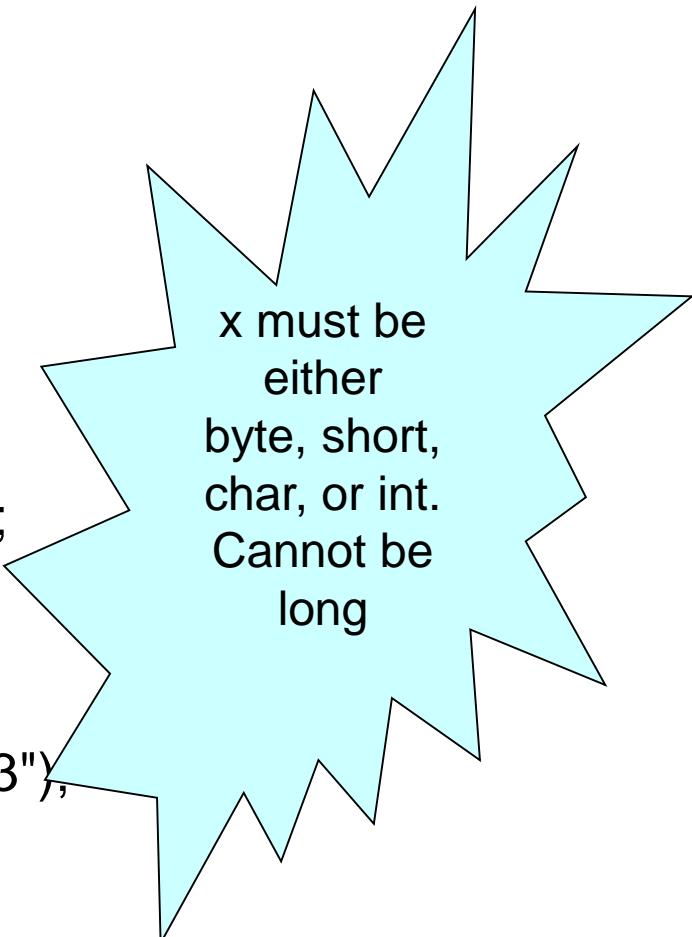
10, 20, 30, 40, 50,

James, Larry, Tom, Lacy,

# The Selection Statements

- The *if()/else* Construct
- The *switch()* Construct

```
switch (x) {
 case 1:
 System.out.println("Got a 1");
 break;
 case 2:
 case 3:
 System.out.println("Got 2 or 3");
 break;
 default:
 System.out.println("Not a 1, 2, or 3");
 break;
}
```



x must be  
either  
byte, short,  
char, or int.  
Cannot be  
long

# If example

```
class CheckNumber{
 public static void main(String
 args[]) {
 int num =10;
 if (num %2 == 0)
 System.out.println(num+" is even");
 else
 System.out.println (num+" is odd");
 }
 }
```

```
public class SwitchDemo {
 public static void main(String[] args) {
 int m = 8;
 String month;
 switch(m) {
 case 1: month = " January "; break;
 case 2: month = " February "; break;
 case 3: month = " March"; break;
 case 4: month = " April"; break;
 case 5: month = " May"; break;
 case 6: month = " June"; break;
 case 7: month = " July"; break;
 case 8: month = " August"; break;
 case 9: month = " September"; break;
 }
 }
}
```

```
case 10: month = " October"; break
case 11: month = " November"; break;
case 12: month = " December"; break;
default: month = "not a month";
 break;
}
System.out.println(month);
}
}
```



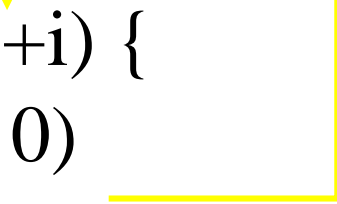
# The *continue* Statements in Loops (for, while, do)

```
for(.;.;.)
{
 //process part 1
 if(condition)
 continue;
 //process part 2
}
```

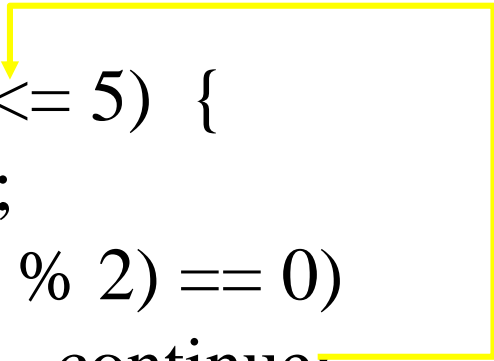
```
mainloop:for(.;.;.){
 for(.;.;.)
 {
 //process part 1
 if(boolean_exp)
 continue mainloop;
 //process part 2
 }
}
```

## *continue*

```
for (i=0; i<=5; ++i) {
 if (i % 2 == 0)
 continue;
 System.out.println("This is a " + i + " iteration");
}
```



```
i = 0;
while (i <= 5) {
 ++i;
 if (i % 2 == 0)
 continue;
 System.out.println("This is a odd iteration - " + i);
}
```



# The *break* Statements in Loops (for, while, do)

```
for(.;.;.)
{
 //process part 1
 if(condition)
 break;
 //process part 2
}
```

# Break

```
int i = 1;
while (true) {
 if (i == 3)
 break;
 System.out.println("This is a " + i + " iteration");
 ++i;
}
```

# Menu

```
while (true) {
 System.out.print("\n 1.Select 1");
 System.out.print("\n 2.Select 2");
 System.out.print("\n 3.Select 3");
 System.out.print("\n 0.Exit");
 System.out.print("\n Choose 1,2,3
or 0: ");
 Scanner in = new
Scanner(System.in);
 int c = in.nextInt();
 System.out.print("\n");
}
```

```
switch(c) {
 case 1: //to do for selecting 1
 break;
 case 2://to do for selecting 2
 break;
 case 3: //to do for selecting 3
 break;
 case 0: System.out.print("\n Bye!!!");
 System.exit(0);
 break;
 default:
 System.out.print("\n Choose 1,2,3 or 0 ");
}
}
```

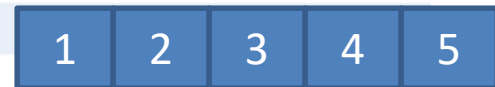
# Basic Logic Constructs example

- They are the same with those in C-statements

An enhanced for loop

```
2 package com;
3 import java.lang.*;
4 public class Chao {
5 public static void main(String args[]) {
6 System.out.println("Hello");
7 int a[] = { 1,2,3,4,5};
8 for (int i=0;i<a.length;i++) System.out.print(a[i] + ",");
9 System.out.println();
10 for (int x : a) System.out.print(x + ",");
11 System.out.println();
12 for (int x : a) x+=10;
13 for (int i=0;i<a.length;i++) System.out.print(a[i] + ",");
14 System.out.println();
15 }
16 }
```

a



x



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 * x
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);
 }
}
```

- \* 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.

```
Casting_Convert_1.java * x
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)
```

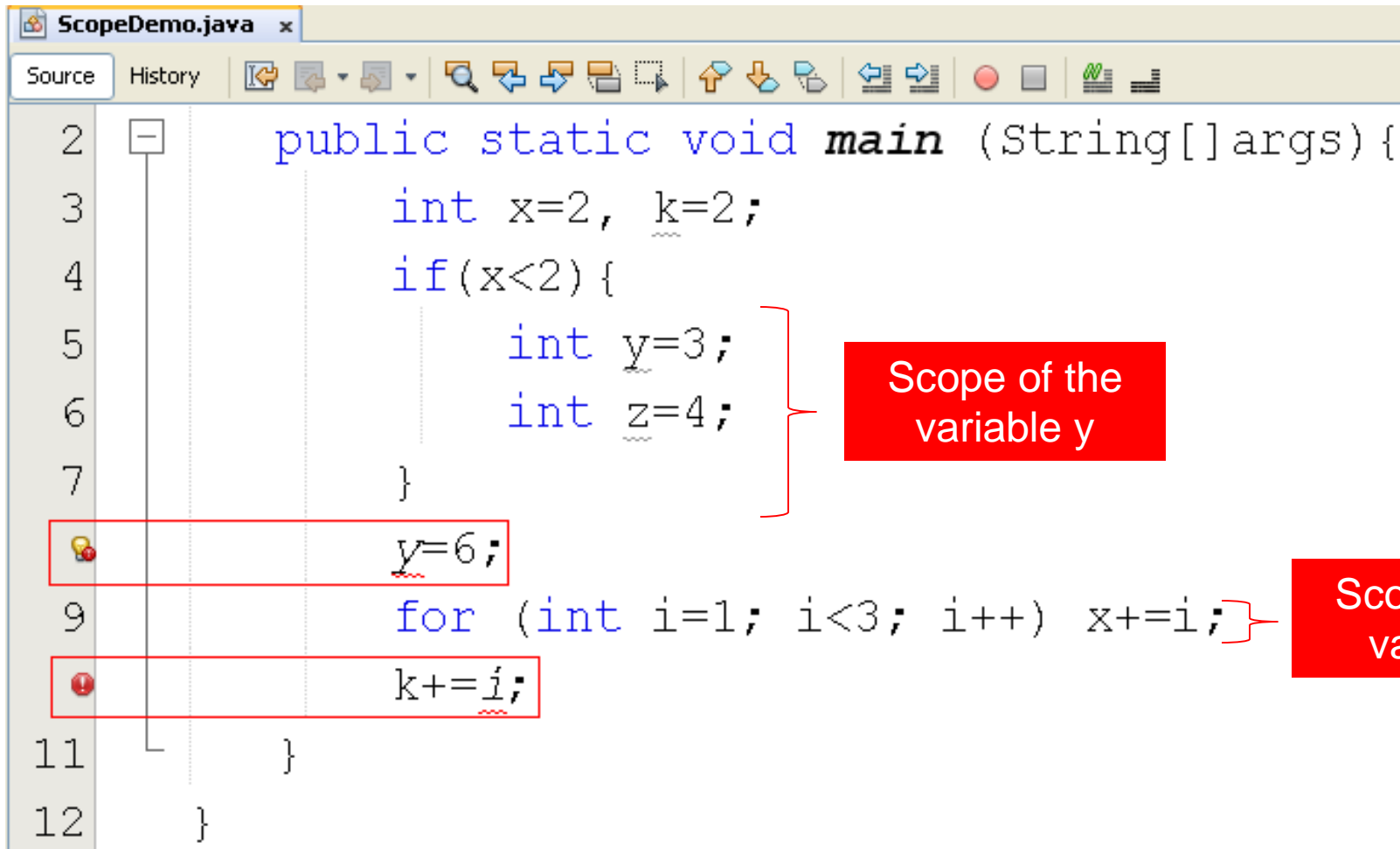
0000 0001

0000 0000

y

n

# Scope of a Variable



The screenshot shows an IDE window titled "ScopeDemo.java". The code is as follows:

```
2 public static void main (String[] args) {
3 int x=2, k=2;
4 if(x<2) {
5 int y=3;
6 int z=4;
7 }
8 y=6;
9 for (int i=1; i<3; i++) x+=i;
10 k+=i;
11 }
12 }
```

Annotations in the image:

- A red bracket on the right side of lines 5 and 6 points to a red box containing the text "Scope of the variable y".
- A red box on the left side of line 8 contains a yellow lightbulb icon and the text y=6;.
- A red bracket on the right side of line 9 points to a red box containing the text "Scope of the variable i".
- A red box on the left side of line 10 contains a red error icon and the text k+=i;

# Random class

- `import java.util.Random;`
- `Random rd=new Random();`
- `int a=rd.nextInt(n); // 0-(n-1)`
- `int t = rd.nextInt(b-a+1)  
+a; // (from a to b)`
- `Float =rd.nextFloat(); // 0-1`

# Math class

- `java.lang`
- `Math.PI`
- `Math.abs(-20);`
- `double c = Math.ceil(7.342); // 8.0`
- `double f = Math.floor(7.343); // 7.0`
- `double p = Math.pow(2, 3); // 8.0`
- `double s = Math.sin(Math.PI/2); // 1`
- `double a = Math.sqrt(9); // 3`
- `.....`

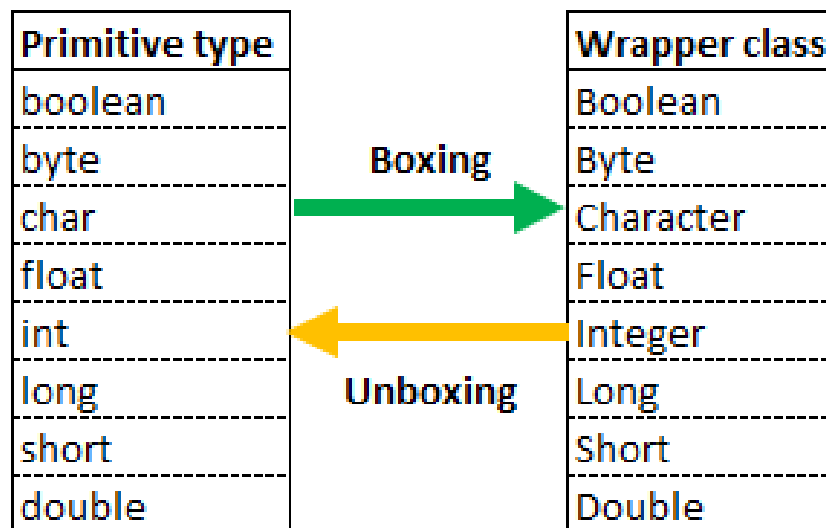
# Wrapper Class

- `java.lang`

| Primitive Type | Size   | Minimum Value                             | Maximum Value                              | Wrapper Type |
|----------------|--------|-------------------------------------------|--------------------------------------------|--------------|
| <b>char</b>    | 16-bit | Unicode 0                                 | Unicode $2^{16}-1$                         | Character    |
| <b>byte</b>    | 8-bit  | -128                                      | +127                                       | Byte         |
| <b>short</b>   | 16-bit | $-2^{15}$<br>(-32,768)                    | $+2^{15}-1$<br>(32,767)                    | Short        |
| <b>int</b>     | 32-bit | $-2^{31}$<br>(-2,147,483,648)             | $+2^{31}-1$<br>(2,147,483,647)             | Integer      |
| <b>long</b>    | 64-bit | $-2^{63}$<br>(-9,223,372,036,854,775,808) | $+2^{63}-1$<br>(9,223,372,036,854,775,807) | Long         |
| <b>float</b>   | 32-bit | 32-bit IEEE 754 floating-point numbers    |                                            | Float        |
| <b>double</b>  | 64-bit | 64-bit IEEE 754 floating-point numbers    |                                            | Double       |
| <b>boolean</b> | 1-bit  | true or false                             |                                            | Boolean      |
| <b>void</b>    | -----  | -----                                     | -----                                      | Void         |

# Autoboxing and Unboxing (1)

- java 5.0 introduces two very simple but convenient functions that unwrap wrapper objects and wrap up primitives.
- Converting a primitive value into an object of the corresponding wrapper class is called autoboxing.
- Converting an object of a wrapper type to its corresponding primitive value is called unboxing.



# Output???

- `Integer y = 567; // make a wrapper`
- `Integer y = new Integer(567);`
- `Integer x = y; //assign a second ref  
// var to THE wrapper  
System.out.println(y==x);  
y++; // unwrap, use, "rewrap"  
System.out.println(x + " " + y);  
System.out.println(y==x);`

# Autoboxing and Unboxing...(2)

- Sample of autoboxing and unboxing

```
Integer wrappedInt = 25; //boxing or auto boxing
```

```
Double area(double radius) {
 return Math.PI * radius * radius; //boxing
}
```

```
Integer wi = 234;
int times9 = wi * 9; //unboxing
```



# Return primitive types

- To return primitive types: using method **typeValue()**

```
// make a new wrapper object
Integer i2 = new Integer(42);
// byte
byte b = i2.byteValue();
// short
short s = i2.shortValue();
// double
double d = i2.doubleValue();
```

# to convert from String to a primitive type

- Using methods (static) of wrapper classes

```
static <type> parseType (String s)
```

- Example

```
String s = "123";
```

```
// int
```

```
int i = Integer.parseInt(s);
```

```
// short
```

```
short j = Short.parseShort(s);
```

```
String txt="13.5";
```

```
Double x =Double.parseDouble(txt);
```

# Java.lang.Integer Class

1. `static int MAX_VALUE:  $2^{31}-1$ .`
2. `static int MIN_VALUE :  $-2^{31}$ .`
3. `Integer(int value), Integer(String s)`
4. `java.lang.Integer.compare()`
5. `Integer obj1 = new Integer("25"); Integer obj2 = new Integer("10");`
6. `int retval = obj1.compareTo(obj2);`
7. `int retval = Integer.compare(obj1,obj2);`
8. `byte byteValue(), double doubleValue(), float floatValue()...`
9. `static int parseInt(String s), String toString(), static String toString(int i)`
10. `boolean equals(Object obj)`

# Java.lang.Double Class

- `Double(double value),`  
`Double(String s)`
- `byte byteValue(), double`  
`doubleValue(), float`  
`floatValue(), int intValue(), ..`
- `static int compare(double d1,`  
`double d2), int compareTo(Double`  
`anotherDouble)`
- `boolean isNaN(), static double`  
`parseDouble(String s), String`  
`toString(), static String`  
`toString(double d)`

# java.lang.Character Class

- static char toUpperCase(char ch)
- static char toLowerCase(char ch)
- static String toString(char c)
- String toString()
- static boolean isWhitespace(char ch)
- static boolean isUpperCase(char ch)
- static boolean isLowerCase(char ch)
- static boolean isLetter(char ch)

# Strings

- Java uses the **String**, **StringBuffer**, **StringBuilder** and **StringTokenizer** classes to encapsulate strings of characters (16-bit Unicode).

java.lang.[Object](#)

java.lang.[String](#) (implements java.lang.[CharSequence](#),  
java.lang.[Comparable](#)<T>, java.io.[Serializable](#))

java.lang.[StringBuffer](#) (implements java.lang.[CharSequence](#),  
java.io.[Serializable](#))

java.lang.[StringBuilder](#) (implements  
java.lang.[CharSequence](#), java.io.[Serializable](#))

# java.lang.String Class

- The String class represents character strings. All string literals in Java programs, such as "abc", are implemented as instances of this class.

```
String a = "A String";
```

```
String b = "";
```

- Construct a string

```
String c = new String();
```

```
String d = new String("Another
String");
```

```
String e = String.valueOf(1.23);
```

```
String f = null;
```

# String operators

- Operator +

```
String a = "This" + " is a " +
 "String";
```

```
//a = "This is a String"
```

- String with print()

```
System.out.println("answer="+1 + 2 + 3);
```

```
System.out.println("answer="+ (1+2+3));
```

```
System.out.println("Number: "+1.45);
```



# String methods

- `compare()`, `concat()`, `equals()`, `split()`, `length()`, `replace()`, `compareTo()`, `substring()`, ...
- Example
  - `String name = "Ly Lao Lo";`
  - `name.toLowerCase(); // "ly lao lo"`
  - `name.toUpperCase(); // "LY LAO LO"`
  - `" Ly Lao Lo ".trim(); // "Ly Lao Lo"`
  - `" Ly Lao Lo".indexOf('L'); // 1`
  - `" Ly Lao Lo".indexOf("La");`
  - `"Ly Lao Lo".length(); // 9`
  - `"Ly Lao Lo".charAt(5); // 'o'`
  - `"Ly Lao Lo".substring(5); // "o Lo"`
  - `"Ly Lao Lo".substring(2,5); // " La"`

- `int compareTo(String anotherString)`
- `int compareToIgnoreCase(String str)`
- `String concat(String str)`
- `boolean endsWith(String suffix)`  
`String str = "www.tutorialspoint.com";`  
`String endstr1 = ".com";`  
`String endstr2 = ".org";`  
`boolean retval1 = str.endsWith(endstr1);`  
`boolean retval2 = str.endsWith(endstr2);`
- `boolean equals(Object anObject)`
- `boolean equalsIgnoreCase(String anotherString)`
- `int indexOf(String str)`
- `int lastIndexOf(String str)`

- `public String[] split(String regex, int limit)`
- `public String[] split(String regex)`
- **1.** `String s1="Example method Split a Line into Words";`  
`String[] st1=s1.split("\\s+");`  
`for(String w1:st1){`  
`System.out.println(w1); }`
- **2.** `String s2="Who are you? Are you pretty? some have called you cute while others just call you pretty.";`  
`String[] st2=s2.split("[\\.\\?\\!]");`  
`for(String w2:st2){`  
`System.out.println(w2); }`

- `public String replaceAll (String regex, String replacement)`
  - `public String replaceFirst (String regex, String replacement)`
1. "some have called you cute while others just call *you pretty*" .  
`replaceAll ("\\s+", " ");`
  2. `String s3="Hanoi is famous for numerous rivers,lakes,and mountains alongside and in the surroundings.";`  
`System.out.println(s3.replaceAll ("\\,\\s*", ", "));`
  3. "my name is khanh my name is *java* ".  
`replaceAll ("is", "was");`

# Input/Output Data

- `import java.util.Scanner;`
- `Scanner input = new Scanner( System.in );`
- `public String next()`
- `public String nextLine()`
- `public byte nextByte()`
- `public short nextShort()`
- `public int nextInt()`
- `public long nextLong()`
- `public float nextFloat()`
- `public double nextDouble()`

# Problem with `.nextLine()` in Java

- `System.out.println("Enter numerical value");`
- `int option;`
- `option = input.nextInt();`  
`System.out.println("Enter 1st string");`  
`String string1 = input.nextLine();`  
`System.out.println("Enter 2nd string");`  
`String string2 = input.nextLine();`
- Solution:
  - `int option = input.nextInt();`
  - `input.nextLine();` // Consume newline left-over
  - `String str1 = input.nextLine();`
  - `int option = Integer.parseInt(input.nextLine());`

# Example

```
InputOutputDemo.java x
1 /* Write a program that will accept an array of integers then
2 print out entered value and the sum of values
3 */
4 import java.util.Scanner;
5 public class InputOutputDemo {
6 public static void main (String args[])
7 {
8 int a[]; // array of integers
9 int n; // number of elements of the array
10 int i; // variable for traversing the array
11 Scanner sc= new Scanner(System.in); // object for the keyboard
12 System.out.print("Enter number of elements: ");
13 n = Integer.parseInt(sc.nextLine());
14 a = new int[n]; // mem. allocating for elements of the array
15 for (i=0;i<n;i++)
16 {
17 System.out.print("Enter the " + (i+1) + "/" + n + " element: ");
18 a[i]=Integer.parseInt(sc.nextLine());
19 }
20 System.out.print("Entered values: ");
21 for (i=0;i<n;i++) System.out.format("%5d", a[i]);
22 int S=0;
23 for (int x: a) S+=x;
24 System.out.println("\nSum of values: " + S);
25 }
26 }
```

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

`n= sc.nextInt();`

```
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)
```

# Regular Expression in Java

- The `java.util.regex` package primarily consists of three classes: [Pattern](#), [Matcher](#), and [PatternSyntaxException](#).
  - A **Pattern** object is a compiled representation of a regular expression. The `Pattern` class provides no public constructors. To create a pattern, you must first invoke one of its public static compile methods, which will then return a `Pattern` object.
  - A **Matcher** object is the engine that interprets the pattern and performs match operations against an input string.
  - A **PatternSyntaxException** object is an unchecked exception that indicates a syntax error in a regular expression pattern.



| Modifier | Description                                                                     |
|----------|---------------------------------------------------------------------------------|
| i        | Perform case-insensitive matching                                               |
| g        | Perform a global match                                                          |
| gi       | Perform a global case-insensitive match                                         |
| ^        | Get a match at the beginning of a string                                        |
| \$       | Get a match at the end of a string                                              |
| [xyz]    | Find any character in the specified character set                               |
| [^xyz]   | Find any character not in the specified character set                           |
| \w       | Find any Alphanumeric character including the underscore                        |
| \d       | Find any single digit                                                           |
| \s       | Find any single space character                                                 |
| ?        | Find zero or one occurrence of the regular expression                           |
| *        | Find zero or more occurrence of the regular expression                          |
| +        | Find one or more occurrence of the regular expression                           |
| ()       | Find the group of characters inside the parentheses & stores the matches string |
| X{n}     | Matches any string that contains a sequence of <i>n</i> X's                     |
| X{n,m}   | Matches any string that contains a sequence of X to Y <i>n</i> 's               |

**"^\\((?\\d{3}\\)?)?-?\\s\*\\d{3}\\s\*-?\\d{4}\$"**

```

public class MatchPhoneNumber {
 public static boolean isPhoneValid(String
phone) {
 boolean retval = false;
 String regex =
"^\\ (?\\d{3}\\.?)?-?\\s*\\d{3}\\s*-?\\d{4}$";
retval = phone.matches(regex);
 if (retval)
 System.out.println("MATCH "+phone + "\\n");
 return retval; }
 public static void main(String args[]) {
 isPhoneValid("(234)- 765 -8765");
 isPhoneValid("999-585-4009");
 isPhoneValid("1-585-4009"); }
}

```

```

public class MatchRollNumber {
 public static boolean isRollNumber(String
id) {
 boolean retval = false;
 String regex =
 "^[Bb]{1}\\d{2}[A-Za-z]{4}\\d{3}$";
 //"^[NXnx]{1}\\d{3}[A-Za-z]{4}$"
 retval = id.matches(regex);
 if (retval)
 System.out.println("MATCH "+id+ "\n");
 return retval; }
 public static void main(String args[]) {
 isRollNumber("B13DCCN765");
 isRollNumber(" B13DCCN8584");
 isRollNumber("b12dcat321"); }}

```

# ***StringBuffer, StringBuilder Classes***

- Java's **StringBuffer** and **StringBuilder** classes represent strings that can be dynamically modified.
  - StringBuffer is **threadsafe**.
  - StringBuilder (introduced in 5.0) is not threadsafe.
- Almost of their methods are the same as methods in the String class.
- These classes do not use string pool, thus we cannot write `StringBuffer t = "ABC";`
- We cannot use the operator `+` to their objects.

**Thread:** Unit of code (method) is running

**Multi-threading program:** A program has some threads running concurrently. If 2 threads access common data, their values are not un-predictable. So, in multi-thread programming, JVM supports a mechanism in which accesses to common resources must carry out in sequence based on synchronized methods.

**Threadsafe class:** A class with synchronized methods.

# ***StringBuilder***

public final class **StringBuilder** extends [Object](#)  
implements [Serializable](#), [CharSequence](#)

- The StringBuilder class was introduced in 5.0. It is nearly identical to StringBuffer.
- Major difference: string builders are **not threadsafe**.
- If you want multiple threads to have **concurrent access** to a mutable string, use a string buffer.
- If your mutable string will be accessed only by a single thread, there is an advantage to using a string builder, which will generally execute faster than a string buffer.

# ***StringBuilder*** - Class constructors

| Constructor & Description                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>StringBuilder()</b><br><br>This constructs a string builder with no characters in it and an initial capacity of 16 characters.                               |
| <b>StringBuilder(int capacity)</b><br><br>This constructs a string builder with no characters in it and an initial capacity specified by the capacity argument. |
| <b>StringBuilder(String str)</b><br><br>This constructs a string builder initialized to the contents of the specified string.                                   |

# ***StringBuilder*** - Class methods

**StringBuilder append(String str)** This method appends the specified string to this character sequence.

[StringBuilder append\(StringBuffer sb\)](#) This method appends the specified StringBuffer to this sequence.

**char charAt(int index)** This method returns the char value in this sequence at the specified index.

[StringBuilder delete\(int start, int end\)](#) This method removes the characters in a substring of this sequence.

[StringBuilder deleteCharAt\(int index\)](#) This method removes the char at the specified position in this sequence.

[int indexOf\(String str\)](#) This method returns the index within this string of the first occurrence of the specified substring.

[int indexOf\(String str, int fromIndex\)](#) This method returns the index within this string of the first occurrence of the specified substring, starting at the specified index.

**int length()** This method returns the length (character count).

**StringBuilder replace(int start, int end, String str)** This method replaces the characters in a substring of this sequence with characters in the specified String.

[StringBuilder reverse\(\)](#) This method causes this character sequence to be replaced by the reverse of the sequence.

[String substring\(int start\)](#) This method returns a new String that contains a subsequence of characters currently contained in this character sequence.

[String substring\(int start, int end\)](#) This method returns a new String that contains a subsequence of characters currently contained in this sequence.

[String toString\(\)](#) This method returns a string representing the data in this sequence.

[StringBuilder insert\(int offset, String str\)](#) This method inserts the string into this character sequence.



# Example

1. `StringBuilder s=new  
StringBuilder("D14- ");  
s.append("CN");//D14- CN`
2. `s.insert(4,"CQ");//D14-CQ CN`
3. `s.delete(3,5);// D14 CN`
4. `s.reverse();`

# Normal Text

```
public class WrapperDemo {
 public static String normalText(String line)
 {
 String out = "";
 line = line.toLowerCase();
 line = line.replaceAll("\\s+", " ");
 line = line.replaceAll(" \\. ", "\\.");
 line = line.replaceAll("\\.", "\\.");
 line = line.replaceAll(" \\. ", "\\.");
 line = line.replaceAll("\\,", "\\,");
 line = line.replaceAll("\\,", "\\,");
 line = line.replaceAll("\\s+", " ");
 line = line.trim();
 }
}
```

```
out=line;
boolean isCap = true;
char c;
StringBuilder strb = new StringBuilder("");
for (int i = 0; i < out.length()-1; i++) {
 c = out.charAt(i);
 if (c == '.') {
 isCap = true;
 }
 if (isCap && Character.isAlphabetic(c)) {
 c = Character.toUpperCase(c);
 isCap = false;
 }
 strb.append(c);
}
```

```
 out = strb.toString();
 if (out.charAt(out.length()-1) != '.') {
 out = out + ".";
 }
 return out;
}

public static void main(String[] args) {
 String line="We were both young ,
 when I first saw you .
 i close my eyes and the flashback
starts";
 System.out.println(normalText(line));
}
```

# Reversible

```
public boolean reversing(int n) {
 StringBuilder sn=new
 StringBuilder(Integer.toString(n));
 return
 sn.toString().equals(sn.reverse().to
 String());
}
```

# The *StringBuffer* - *threadsafe*

public final class **StringBuffer** extends [Object](#)  
implements [Serializable](#), [CharSequence](#)

```
public class StringBufferDemo {
 public static void main(String args[]){
 StringBuffer sBuf= new StringBuffer ("01234567");
 System.out.println(sBuf);
 sBuf.append("ABC");
 System.out.println(sBuf);
 sBuf.insert(2, "FAT PERSON");
 System.out.println(sBuf);
 sBuf.reverse();
 System.out.println(sBuf);
 }
}
```

run:

01234567

01234567ABC

01FAT PERSON234567ABC

CEA765432NOSREP TAF10

# Constructors

## Constructor & Description

### **StringBuffer()**

This constructs a string buffer with no characters in it and an initial capacity of 16 characters.

### **StringBuffer(int capacity)**

This constructs a string buffer with no characters in it and the specified initial capacity.

### **StringBuffer(String str)**

This constructs a string buffer initialized to the contents of the specified string.

- `public synchronized StringBuffer append(String s)`
- `public synchronized StringBuffer insert(int offset, String s)`
- `public synchronized StringBuffer replace(int startIndex, int endIndex, String str)`
- ..... • •

# Example: StringBuffer vs StringBuilder

```
public class ConcatTest{
 public static void main(String[] args){
 long startTime = System.currentTimeMillis();
 StringBuffer sb1 = new StringBuffer("Java");
 for (int i=0; i<10000; i++){
 sb1.append("D14CN-PTIT"); }
 System.out.println("the total time (StringBuffer) : "
+ (System.currentTimeMillis() - startTime) +
"ms");
 startTime = System.currentTimeMillis();
 StringBuilder sb2 = new StringBuilder("Java");
 for (int i=0; i<10000; i++){
 sb2.append("D14CN-PTIT"); }
 System.out.println("the total time (StringBuilder) : "
+ (System.currentTimeMillis() - startTime) +
"ms");
 } }
```

the total *time* (StringBuffer) : 15ms

the total *time* (StringBuilder): 0ms



# StringTokenizer Class

- The **java.util.StringTokenizer** class allows you to break a string into tokens. It is simple way to break string.
- Constructors:
  - StringTokenizer(String str): creates StringTokenizer with specified string and delimiter.
  - StringTokenizer(String str, String delim): creates StringTokenizer with specified string and delimiter.

# Methods of StringTokenizer class

| Public method                               | Description                                                     |
|---------------------------------------------|-----------------------------------------------------------------|
| <code>boolean hasMoreTokens()</code>        | checks if there is more tokens available.                       |
| <code>String nextToken()</code>             | returns the next token from the StringTokenizer object.         |
| <code>String nextToken(String delim)</code> | returns the next token based on the delimiter.                  |
| <code>boolean hasMoreElements()</code>      | same as <code>hasMoreTokens()</code> method.                    |
| <code>Object nextElement()</code>           | same as <code>nextToken()</code> but its return type is Object. |
| <code>int countTokens()</code>              | returns the total number of tokens.                             |

# Example

```
import java.util.StringTokenizer;
public class Simple{
public static void main(String
 args[]) {
 StringTokenizer st = new
StringTokenizer("I work at HN.I am
a lecturer.I love HN.", "\\.");
 while(st.hasMoreTokens()) {
System.out.println(st.nextToken());
 } } }
```

- By default StringTokenizer breaks String

```
String str = "I am sample string and will be
tokenized on space";
```

```
StringTokenizer dt=new StringTokenizer(str);
```

```
while (dt.hasMoreTokens()) {
```

```
 System.out.println(dt.nextToken());}
```

- Multiple delimiters

```
String s ="Who am i?Lan is my friend.I love
Lan!How Lan love Him? of course i know!";
```

```
StringTokenizer mt = new StringTokenizer(s,
".?!");
```

```
while (mt.hasMoreTokens()) {
```

```
 System.out.println(mt.nextToken());
```

```
}
```

# Summary

- The traditional features of the language, including: variables, arrays, data types, operators, and control flow.
- Wrapper class, 4 String classes
- Regular Expression for data validation