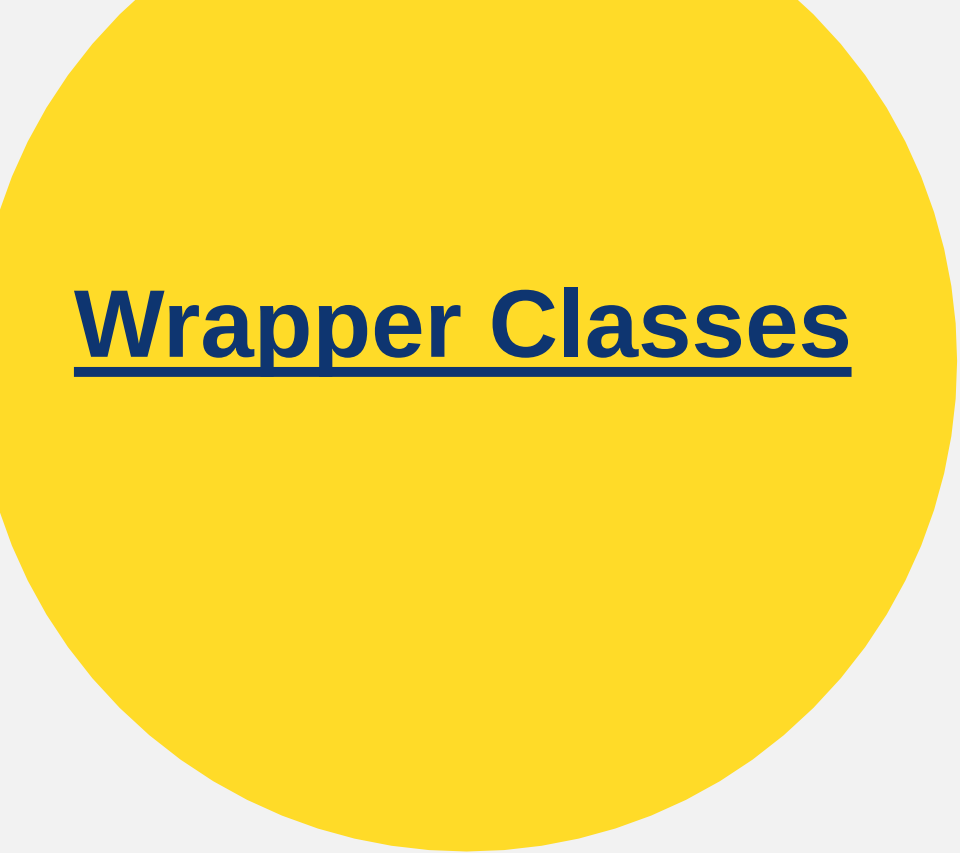
Wrapper Classes

Objectives

At the end of this session, you will be able to:

- Describe the need for wrapper classes
- Define wrapper classes
- Understand Autoboxing & Unboxing
- Understand cloning

Wrapper Classes





Wrapper Classes

- For all the primitive data types available in Java, there is a corresponding Object representation available which is known as Wrapper Classes

Need for Wrapper Classes

- All Collection classes in Java can store only Objects
- Primitive data types cannot be stored directly in these classes and hence the primitive values needs to be converted to objects
- We have to wrap the primitive data types in a corresponding object, and give them an object representation

Wrapper Classes (Contd.).

- Definition: The process of converting the primitive data types into objects is called *wrapping*

- To declare an integer ‘i’ holding the value 10, you write
- int i = 10;

- The object representation of integer ‘i’ holding the value 10 will be:

  Integer iref = new Integer(i);

- Here, class Integer is the wrapper class wrapping a primitive data type i

Wrapper Classes (Contd.).

- The Java API has provided a set of classes that make the process of wrapping easier. Such classes are called wrapper classes.
- For all the primitive data types, there are corresponding wrapper classes. Storing primitive types in the form of objects affects the performance in terms of memory and speed.
- Representing an integer via a wrapper takes about 12-16 bytes, compared to 4 in an actual integer. Also, retrieving the value of an integer uses the method **Integer.intValue()**.
- The wrapper classes are very useful as they enable you to manipulate primitive data types.

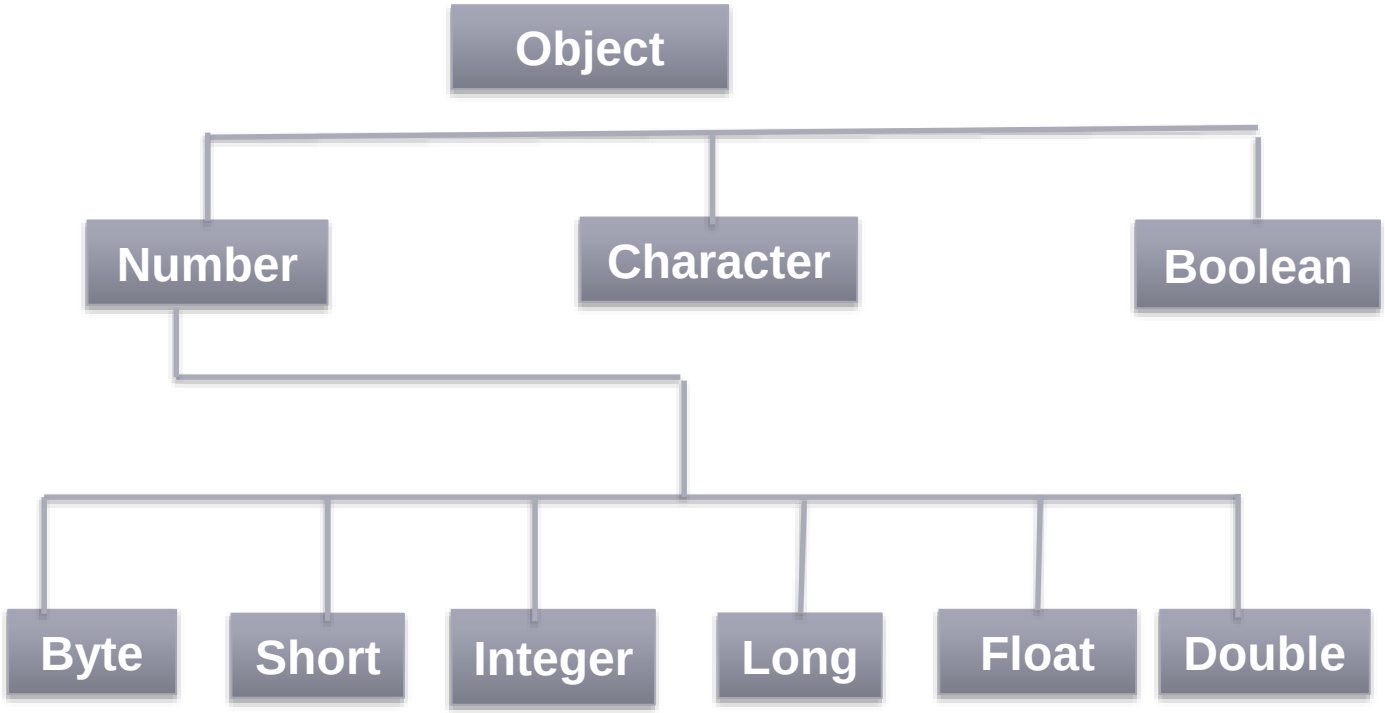
Wrapper Classes (Contd.).

- For example, you can take the integer input from the user in the form of a **String**, and convert it into integer type using the following statements:

```
String str = "100";
int j = Integer.parseInt(str);
```

- There are many more methods in the wrapper classes that help you do several operations with the data types.
- The wrapper classes also have constants like :
- **MAX_VALUE, MIN_VALUE, NaN** (Not a Number), **POSITIVE_INFINITY**, and **NEGATIVE_INFINITY**.

Wrapper Classes (Contd.).



The Integer Class

- Class Integer is a wrapper for values of type int
- Integer objects can be constructed with a int value, or a string containing a int value
- The constructors for Integer are shown here:

```
Integer( int num)
Integer(String str) throws NumberFormatException
```

- Some methods of the Integer class:

```
static int parseInt(String str) throws
  NumberFormatException
  int intValue( )
```

returns the value of the invoking object as a **int** value

Refer Java documentation for other important methods

The Integer Class(Contd.).

```
Integer i1=new Integer(100);
Integer i2=new Integer("100");
```

Few more method of Integer class (These methods also available in Long, Short, Byte, Float, Double wrapper class)

byteValue(): Returns the value of the invoking object as a byte.

doubleValue(): Returns the value of the invoking object as a double.

floatValue(): Returns the value of the invoking object as a float.

longValue(): Returns the value of the invoking object as a long.

shortValue(): Returns the value of the invoking object as a short.

E.g.

```
Integer i1=new Integer(20);
 double d1=i1.doubleValue();
```

The Integer Class – The Conversion Methods

- To understand the conversion methods from Integer class explained in the next few pages, you need to be aware of Digital Number System.
- If you are not familiar with Digital Number System, you are advised to go through the content available in the given link, before you proceed with understanding the methods described in the following pages.

https://www.tutorialspoint.com/computer_logical_organization/digital_number_system.htm

Integer.toBinaryString(int) method

Prototype :

```
public static String toBinaryString(int i)
```

- This method is used to create a String representation of the argument passed, as an unsigned integer in base 2(with no extra leading 0s (zeros)).
- In other words, this method is used to return a String representation of an integer in its binary form.
- What do we mean by this? Let us try to understand.

Integer.toBinaryString(int) continues..

- How do we represent the number 10, as an unsigned integer in base 2?
- This is same as asking, how do we represent 10 as a binary number?
- In Binary Number System,

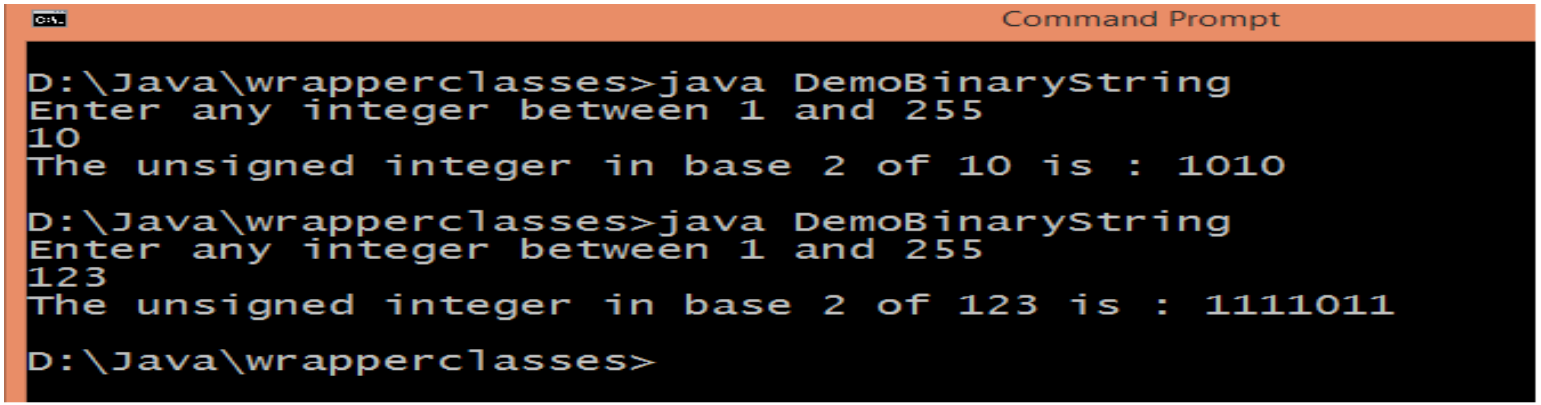
  10 is represented as 00001010

  &

  123 is represented as 01111011.
- So, when we invoke this method by passing the integer argument 10, **Integer.toBinaryString(10)**, it will return a String containing the value “1010”(leading zeroes are automatically removed) and if we invoke this method with the integer 123 as an argument, it should return the String“1111011”

Demo – Integer.toBinaryString(int)

```
import java.util.Scanner;
class DemoBinaryString {
    public static void main(String[] args) { Scanner x = new
      Scanner(System.in); System.out.println("Enter any integer
      between 1 and 255"); int i = x.nextInt();
      String s = Integer.toBinaryString(i);
System.out.println("The unsigned integer in base 2 of "+i+ "is : "+s);
}
}
```



Integer.toOctalString(int) method

Prototype :

```
public static String toOctalString(int i)
```

- This method is used to create a String representation of the integer argument passed, as an unsigned integer in base 8. The integer value passed to this method is converted to a String of ASCII digits in Octal, i.e. base 8 with no extra leading 0s(zeros).
- In short, this method will convert an integer into an octal number and return it as a string.
- What do we mean by this? Let us try to understand.

Integer.toOctalString(int) continues..

- How do we represent the number 10, as an unsigned integer in base 8?
- Simply put, how do we represent 10 as an octal number?
- In Octal form,

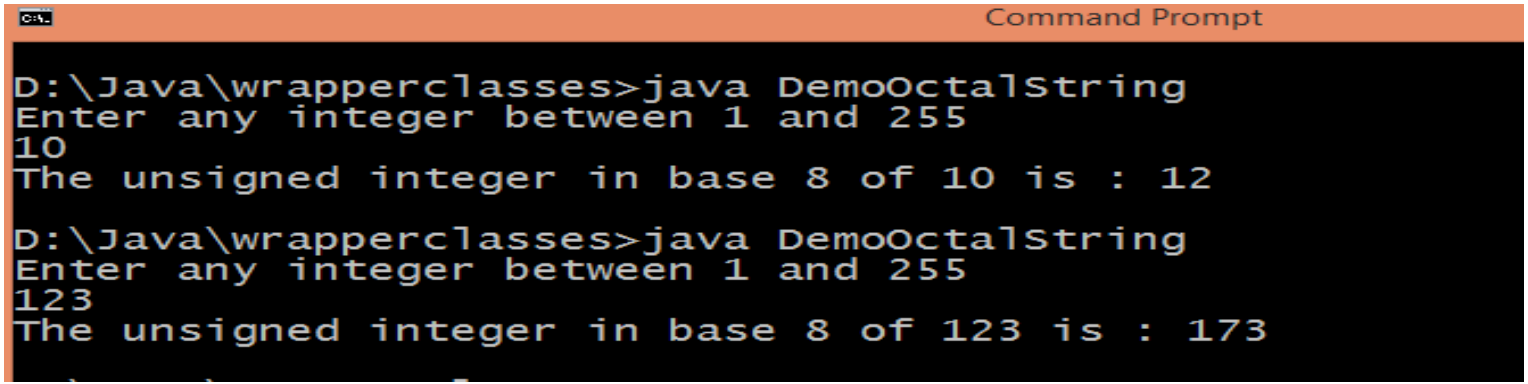
  10 is represented as 12

  &

  123 is represented as 173.
- So, when we invoke this method by passing the integer argument 10, **Integer.toOctalString(10)**, it will return a String containing the value “12” and if we invoke this method with the integer 123 as an argument, it should return the String “173”

Demo – Integer.toOctalString(int)

```
import java.util.Scanner;
public class DemoOctalString {
    public static void main(String[] args) { Scanner x = new
      Scanner(System.in); System.out.println("Enter any integer
      between 1 and 255"); int i = x.nextInt();
      String s = Integer.toOctalString(i);
System.out.println("The unsigned integer in base 8 of "+i+ "is : "+s);
}
}
```



Integer.toHexString(int) method

Prototype :

```
public static String toHexString(int i)
```

- This method is used to create a String representation of the argument passed, as an unsigned integer in base 16. The integer value passed to this method is converted to a String of ASCII digits in hexadecimal, i.e. base 16 with no extra leading 0s(zeros).
- In short, this method is used to return a String representation of an integer in its hexadecimal form.
- What do we mean by this? Let us try to understand.

Integer.toHexString(int) continues..

- How do we represent the number 10, as an unsigned integer in base 16?
- In hexadecimal form,

  10 is represented as "a"

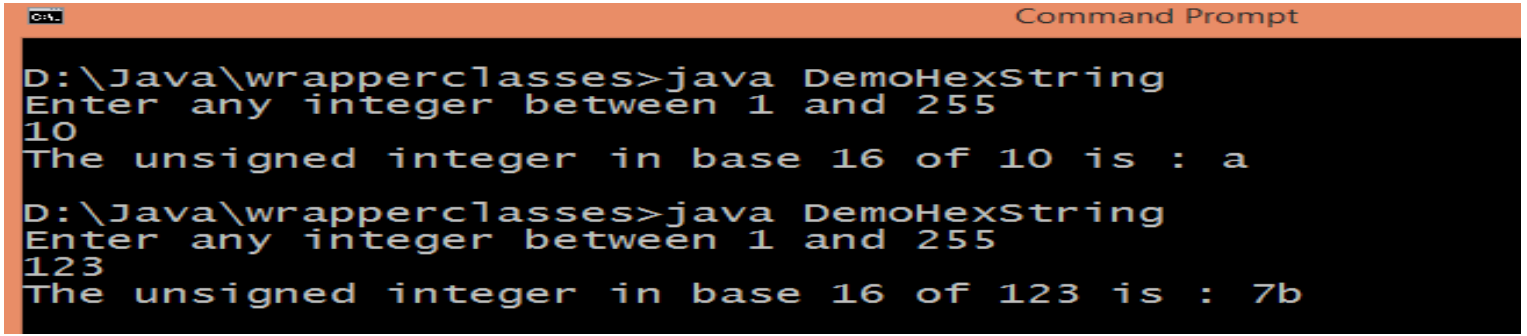
  &

  123 is represented as "7b"

- So, when we invoke this method by passing the integer argument 10, **Integer.toHexString(10)**, it will return a String containing the value “a”(leading zeroes are automatically removed) and if we invoke this method with the integer 123 as an argument, it should return the String “7b”

Demo – Integer.toHexString(int)

```
import java.util.Scanner;
public class DemoHexString {
    public static void main(String[] args) { Scanner x =
      new Scanner(System.in);
      System.out.println("Enter any integer between 1
      int i = x.nextInt();
      String s = Integer.toHexString(i);
System.out.println("The unsigned integer in base 8 of "+i+ "is : "+s);
}
}
```



The Character Class

- Character class is a wrapper class for character data types.
- The constructor for Character is:
  - **Character(char c)**
  - Here, c specifies the character to be wrapped by the Character object
- After a Character object is created, you can retrieve the primitive character value from it using:
  - **char charValue( )**

Refer Java documentation for other important methods

The Character Class

The **Character** class contains the following constants:

MAX_VALUE - The largest character value.

MIN_VALUE - The smallest character value.

TYPE - The Class object for char.

Few more functions from Character class:

```
static String toString(char c)
```

Returns a String object representing the specified char.

```
static char toLowerCase(char ch)
```

Converts the character argument to lowercase

```
static char toUpperCase(char ch)
```

Converts the character argument to uppercase .

The Boolean Class

- The Boolean class is a wrapper class for boolean values
- It has the following constructors:
  - **Boolean(boolean bValue)**
    - Here, bValue can be either true or false
  - **Boolean(String str)**
    - The object created by this constructor will have the value true or false depending upon the string value in str – “true” or “false”
    - The value of str can be in upper case or lower case

Refer Java documentation for other important methods

The Float Class

- Class Float is a wrapper for floating-point values of type float
- Float objects can be constructed with a float value, or a string containing a floating-point value
- The constructors for float are shown here:

```
Float( float num)
Float( String str) throws NumberFormatException
```

- Some methods of the Float class:

```
static Float valueOf( String str) throws
  NumberFormatException
float floatValue( )
```

returns the value of the invoking object as a **float** value

Refer Java documentation for other important methods

The Double Class

- Class Double is a wrapper for floating-point values of type double
- Double objects can be constructed with a double value, or a string containing a floating-point value
- The constructors for double are shown here:

```
Double( double num)
Double( String str) throws NumberFormatException
```

- Some methods of the Double class:

```
static Double valueOf( String str) throws NumberFormatException
double doubleValue( )
```

returns the value of the invoking object as a **double** value

Refer Java documentation for other important methods

The Long Class

- Class Long is a wrapper for values of type long
- Long objects can be constructed with a long value, or a string containing a long value
- The constructors for long are shown here:

```
Long( long num)
Long( String str) throws NumberFormatException
```

- Some methods of the Long class:

```
static Long valueOf(String str) throws NumberFormatException
long  longValue( )
```

returns the value of the invoking object as a **long** value

Refer Java documentation for other important methods

Example

```
long ln=999;
Long lng=new Long(ln);
Long ls=new Long("666");
System.out.println("long value="+lng.longValue());
System.out.println("long value from string
version="+ls.longValue());
```

Output:

long value=999

long value from string version=666

The Short Class

- Class Short is a wrapper for values of type short
- Short objects can be constructed with a short value, or a string containing a long value
- The constructors for short are shown here:

```
Short( short num)
Short( String str) throws NumberFormatException
```

- Some methods of the Short class:

```
static Short valueOf( String str) throws NumberFormatException
short shortValue( )
```

returns the value of the invoking object as a **short** value

Refer Java documentation for other important methods

Example

```
short s=9;
    Short sh=new Short(s);
    Short ls=new Short(“6");
    System.out.println("short value="+sh.shortValue());
    System.out.println("short value from string
version="+ls.shortValue());
```

Output:

short value=9

short value from string version=6

The Byte Class

- Class Byte is a wrapper for values of type byte
- Byte objects can be constructed with a byte value, or a string containing a long value
- The constructors for byte are shown here:

```
Byte( byte num)
Byte( String str) throws NumberFormatException
```

- Some methods of the Byte class:

```
static Byte valueOf( String str) throws NumberFormatException
byte byteValue( )
```

returns the value of the invoking object as a **byte** value

Refer Java documentation for other important methods

AutoBoxing & UnBoxing

- Java 5.0 introduced automatic conversion between a primitive type and the corresponding wrapper class
- During assignment , the automatic transformation of primitive type to corresponding wrapper type is known as autoboxing
- Primitive types ----------→ wrapper type

  (autoboxing)
- E. g. `Integer i1=10;`
- During assignment , the automatic transformation of wrapper type into their primitive equivalent is known as Unboxing
- wrapper type ----------→ primitive type

  (unboxing)
- E. g.

```
int i=0;
i=new Integer(10);
```

AutoBoxing & UnBoxing (Contd.).

- Boxing conversion converts values of primitive type to corresponding values of reference type. But the primitive types can not be widened/ Narrowed to the Wrapper classes and vice versa.

Wrong!!!

```
byte  b    = 12;
Integer I1=b;
```

Wrong!!!

```
byte  b    = 12;
Integer I1=(Integer)b;
```

Right!!!

```
byte  b    = 12;
Integer I1=(int)b;
```

Quiz

What is the output of the following code?

```
class Test {
void m1(Integer i1) {
System.out.println("int value=" + i1);
}

public static void main(String a[]) {
Test t = new Test();
t.m1(10);
}
}
```

Quiz

What is the output of the following code?

```
class Test {
public void m1(Double x) {
System.out.println("Double");
}
public void m1(long x) {
System.out.println("long");
}
public static void main(String[] args) {
int x = 0;
Test t = new Test();
t.m1(x);
Long l1 = 10L;
t.m1(l1); }}
```

In Function Overloading Widening /Narrowing Beats Boxing/UnBoxing

Quiz(Contd.).

What is the output of the following code?

```
class Test {
static void fun(int i) {
System.out.println("int");
}
static void fun(Integer i) {
System.out.println("Integer");
}
public static void main(String args[]) {
byte b = 10;
fun(b);
}}
```

Quiz(Contd.).

What is the output of the following code?

```
class Test {
public static void main(String ar[]) {
    int x = 10;
    Integer y = new Integer(10);
    System.out.println(x == y);
}
}
```

Quiz(Contd.).

Which of the following is not a Wrapper Class?

1. Byte
2. Short
3. Integer
4. Long
5. String
6. Float
7. Double
8. Character
9. Boolean

The Cloneable Interface

- When you make a copy of an object reference:
  - The original and copy are references to the same object
  - This means a change to either variable also affect the other

- The clone( ) method:
  - is a protected member of Object,
  - can only be invoked on an object that implements Cloneable

- Object cloning performs a bit-by-bit copy

The Cloneable Interface(contd.).

- Objects can be cloned only of those classes that implement the **Cloneable** interface.
- The **Cloneable** interface has no members. It is a marker interface and is used to indicate that a class allows a bitwise copy of an object.
- If you call **clone( )** on a class that does not implement **Cloneable**, a **CloneNotSupportedException** is thrown.
- **When a clone is made, the constructor for the object being cloned is not called**.
- A clone is simply an exact copy of the original.

Example on cloning

```
class XYZ implements Cloneable {
int a;
double b;

XYZ cloneTest() {
try {
    return (XYZ) super.clone();
} catch (CloneNotSupportedException e) {
    System.out.println("Cloning Not Allowed");
    return this;
}
}
}
```

Example on cloning (Contd.).

```
class CloneDemo1 {
    public static void main(String args[])  {
  XYZ x1 = new XYZ();
  XYZ x2;
  x1.a = 10;
  x1.b = 20;
  x2 = x1.cloneTest(); // cloning x1
  System.out.println("x1 : " + x1.a + " " + x1.b);
  System.out.println("x2 : " + x2.a + " " + x2.b);
  x1.a = 100;
  x1.b = 200;
  System.out.println("x1 : " + x1.a + " " + x1.b);
  System.out.println("x2 : " + x2.a + " " + x2.b);
    }
}
```

Output :

x1 : 10 20.0
x2 : 10 20.0
x1 : 100 200.0
x2 : 10 20.0

Summary

In this module, you were able to:

- Describe the need for wrapper classes
- Define wrapper classes
- Understand Autoboxing & Unboxing
- Understand cloning

Thank you