CISC 3115 EWQ6

Java API Classes: Wrappers and Strings

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Outline

- Discussed
  - Concepts of two programming paradigms
    - Procedural and Object-Oriented
  - Designing classes for problem solving
    - Think in terms of class
    - Discover relationship of classes
- A few classes in Java API
  - Java wrapper classes for primitive values
  - BigInteger, BigDecimal
  - String, StringBuilder, StringBuffer

Wrapper Classes for Primitive Types

- Java has 8 primitive data types
  - char, byte, short, int, long, float, double, boolean
- Wrapper classes
  - Character, Byte, Short, Integer, Long, Float, Double, Boolean
  - They do not have no-arg constructors.
    - The constructors are marked as deprecated in recent release of JDK
  - The instances of all wrapper classes are immutable, i.e., their internal values cannot be changed once the objects are created

The Integer and Double Class

java.lang.Integer
-value: int +MAX_VALUE: int +MIN_VALUE: int
+Integer(value: int) +Integer(s: String) +byteValue(): byte +shortValue(): short +intValue(): int +longVlaue(): long +floatValue(): float +doubleValue():double +compareTo(o: Integer): int +toString(): String +valueOf(s: String): Integer +valueOf(s: String, radix: int): Integer +parseInt(s: String): int +parseInt(s: String, radix: int): int

java.lang.Double
-value: double +MAX_VALUE: double +MIN_VALUE: double
+Double(value: double) +Double(s: String) +byteValue(): byte +shortValue(): short +intValue(): int +longVlaue(): long +floatValue(): float +doubleValue():double +compareTo(o: Double): int +toString(): String +valueOf(s: String): Double +valueOf(s: String, radix: int): Double +parseDouble(s: String): double +parseDouble(s: String, radix: int): double

Integer and Double

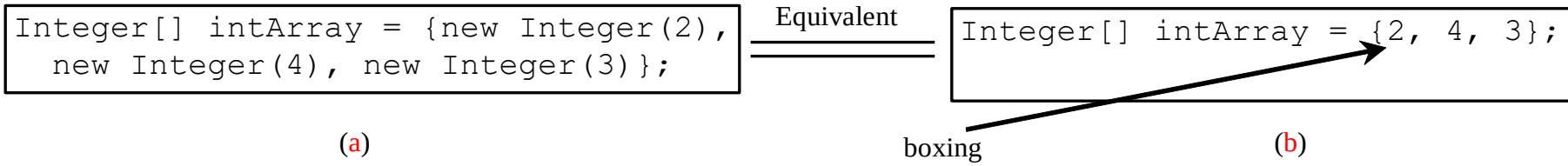
- Constructors
  - public Integer(int value)
  - public Integer(String s)
  - public Double(double value)
  - public Double(String s)
- Class constants
  - MAX_VALUE
  - MIN_VALUE
- Conversion methods
  - “convert” objects into corresponding primitive type values.

valueOf and the parsing Methods

- The valueOf convenience method
  - Double doubleObject = Double.valueOf("12.4");
  - Integer integerObject = Integer.valueOf("12");
- The parsing methods
  - int i = Integer.parseInt(“123”);
  - double d = Double.parseDouble(“3.1415”);

Boxing and Unboxing

- Java allows primitive type and wrapper classes to be converted automatically.
- Example: the following statement in (a) can be simplified as in (b)




```
Integer[] intArray = {1, 2, 3};
System.out.println(intArray[0] + intArray[1] + intArray[2]);
```

Unboxing

Questions?

- Wrapper classes of primitive data types
  - Char
  - Byte
  - Short
  - Integer
  - Long
  - Float
  - Double
  - Boolean

BigInteger and BigDecimal

- Two classes for computing very large integers or high precision floating-point values
  - Example: finance applications
  - java.math.BigInteger
  - java.math.BigDecimal

BigInteger: Example

```
BigInteger a = new BigInteger("92233720368547758O7");

BigInteger b = new BigInteger("2");

BigInteger c = a.multiply(b); // 92233720368547758O7 * 2

System.out.println(c);
```

BigDecimal: Example

```
BigDecimal a = new BigDecimal(1.0);

BigDecimal b = new BigDecimal(3);

BigDecimal c = a.divide(b, 20, BigDecimal.ROUND_UP);

System.out.println(c);
```

Quesitons?

- BigInteger
- BigDecimal

The String Class

- Constructing a String:

```
String message = "Welcome to Java“;

String message = new String("Welcome to Java“);

String s = new String();
```

- Obtaining String length and Retrieving Individual Characters in a string
- String Concatenation (concat)
- Substrings (substring(index), substring(start, end))
- Comparisons (equals, compareTo)
- String Conversions
- Finding a Character or a Substring in a String
- Conversions between Strings and Arrays
- Converting Characters and Numeric Values to Strings

Constructing Strings

- Since strings are used frequently, Java provides a shorthand initializer (string initializer) for creating a string:
  - String message = "Welcome to Java";
- The above is the preferred method to construct String objects. However, it does have a constructor
  - String newString = new String(stringLiteral);
  - Example
    - String message = new String("Welcome to Java");

Strings Are Immutable

- A String object is immutable; its contents cannot be changed.

Strings Are Immutable: Discussion

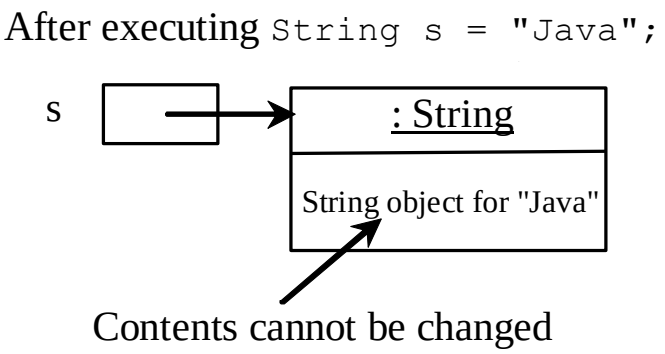
- A String object is immutable; its contents cannot be changed.
- Does the following code change the contents of the string?

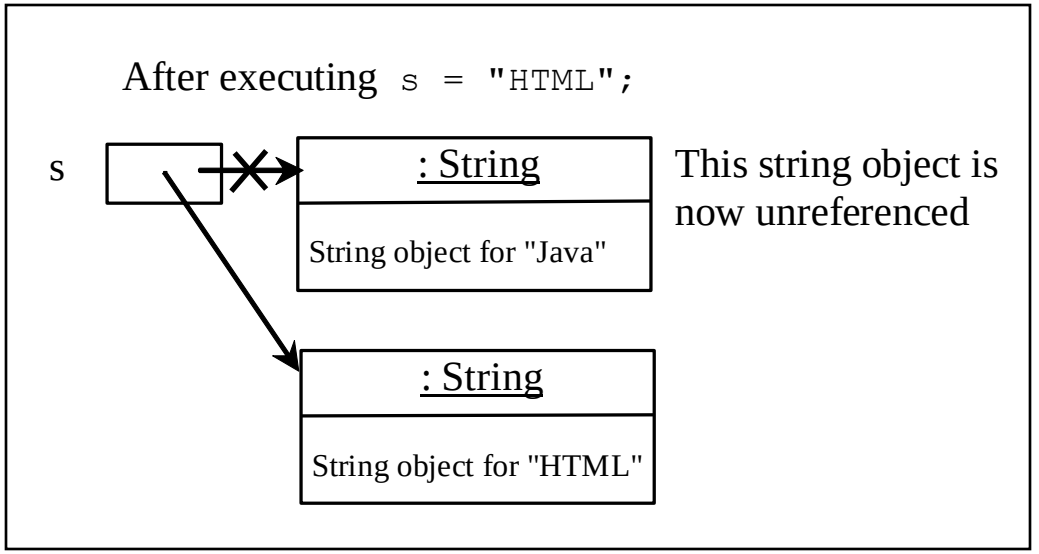
```
String s = "Java";

s = "HTML";
```

Strings Are Immutable: Example

String s = "Java";

s = "HTML";





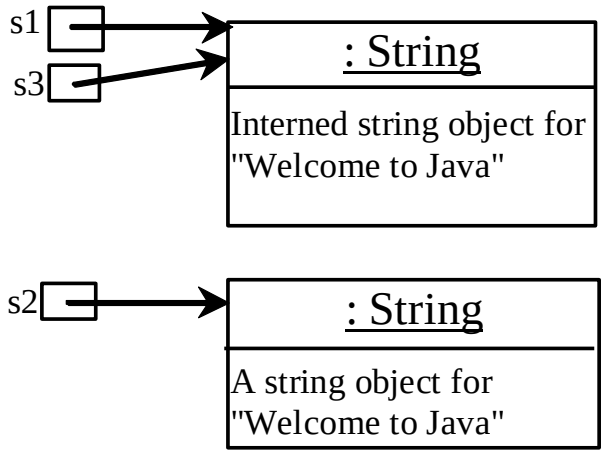
Interned Strings

- To improve efficiency and save memory, the JVM uses a unique instance for string literals with the same character sequence. Such an instance is called *interned*.

Interned Strings: Discussion

- What should we observe?

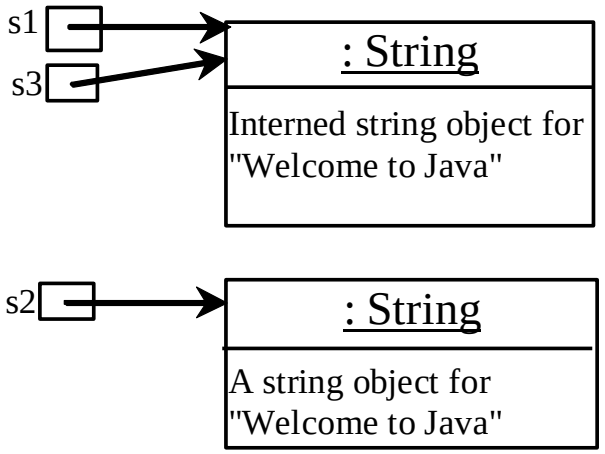
```
String s1 = "Welcome to Java";

String s2 = new String("Welcome to Java");

String s3 = "Welcome to Java";

System.out.println("s1 == s2 is " + (s1 == s2));
System.out.println("s1 == s3 is " + (s1 == s3));
```



Interned Strings: Discussion: Answer

- What should we observe?

```
String s1 = "Welcome to Java";

String s2 = new String("Welcome to Java");

String s3 = "Welcome to Java";

System.out.println("s1 == s2 is " + (s1 == s2));
System.out.println("s1 == s3 is " + (s1 == s3));
```



display

s1 == s is false

s1 == s3 is true

A new object is created if you use the new operator.

If you use the string initializer, no new object is created if the interned object is already created.

Replacing and Splitting Strings

java.lang.String	
+replace(oldChar: char, newChar: char): String	Returns a new string that replaces all matching character in this string with the new character.
+replaceFirst(oldString: String, newString: String): String	Returns a new string that replaces the first matching substring in this string with the new substring.
+replaceAll(oldString: String, newString: String): String	Returns a new string that replace all matching substrings in this string with the new substring.
+split(delimiter: String): String[]	Returns an array of strings consisting of the substrings split by the delimiter.

Replacing Strings: Examples

- "Welcome".replace('e', 'A’)
  - returns a new string, WAlcomA.
- "Welcome".replaceFirst("e", "AB")
  - returns a new string, WABlcome.
- "Welcome".replace("e", "AB")
  - returns a new string, WABlcomAB.
- "Welcome".replace("el", "AB")
  - returns a new string, WABcome.

Splitting Strings: Examples

```
String[] tokens = "Java#HTML#Perl".split("#", 0);
for (int i = 0; i < tokens.length; i++) {
  System.out.print(tokens[i] + " ");
}
```

Patterns

- We can match, replace, or split a string by specifying a pattern, commonly known as *regular expression*.
  - To be discussed in depth in “Theoretical Computer Science (CISC 3230) “
- Two simple patterns are used in this discussion

Matching Patterns: Examples

```
"Java".matches("Java");

"Java".equals("Java");

"Java is fun".matches("Java.*");

"Java is cool".matches("Java.*")
```

Replacing and Splitting with Patterns

- The replaceAll, replaceFirst, and split methods can be used with a regular expression.

Replacing with Patterns: Example

- The following statement returns a new string that replaces $, +, or # in "a+b$#c" by the string NNN.

```
String s = "a+b$#c".replaceAll("[$+#]", "NNN");

System.out.println(s);
```

- where the regular expression [$+#] specifies a pattern that matches $, +, or #. So, the output is aNNNbNNNNNNc.

Splitting with Patterns: Example

- The following statement splits the string into an array of strings delimited by some punctuation marks.

```
String[] tokens = "Java,C?C#,C++".split("[.,:;?]");


for (int i = 0; i < tokens.length; i++)
  System.out.println(tokens[i]);
```

String: The valueOf Method

- The String class provides several static valueOf methods for converting a character, an array of characters, and numeric values to strings.
- Example
  - String.valueOf(5.44).
  - The return value is a string consisting of characters ‘5’, ‘.’, ‘4’, and ‘4’.

Questions?

- The String class.
- Strings are immutable.
- String initializer and String constructors
- Manipulating strings
  - Matching, replacing, and splitting
- String concatenation
- String's valueOf method

String Builder and StringBuffer

- These two classes represent string objects as well. However, they are mutable.
- We can add, insert, or append new contents into a StringBuiler or StringBuffer objects.
- StringBuffer is synchronized, which means that it can used safely in concurrent programming (but also slower than StringBuilder)
  - To be discussed in the future

StringBuilder: Constructors

java.lang.StringBuilder	
+StringBuilder()	Constructs an empty string builder with capacity 16.
+StringBuilder(capacity: int)	Constructs a string builder with the specified capacity.
+StringBuilder(s: String)	Constructs a string builder with the specified string.

StringBuilder: Modify String Content

java.lang.StringBuilder	
+append(data: char[]): StringBuilder	Appends a char array into this string builder.
+append(data: char[], offset: int, len: int): StringBuilder	Appends a subarray in data into this string builder.
+append(v: *aPrimitiveType*): StringBuilder	Appends a primitive type value as a string to this builder.
+append(s: String): StringBuilder	Appends a string to this string builder.
+delete(startIndex: int, endIndex: int): StringBuilder	Deletes characters from startIndex to endIndex.
+deleteCharAt(index: int): StringBuilder	Deletes a character at the specified index.
+insert(index: int, data: char[], offset: int, len: int): StringBuilder	Inserts a subarray of the data in the array to the builder at the specified index.
+insert(offset: int, data: char[]): StringBuilder	Inserts data into this builder at the position offset.
+insert(offset: int, b: *aPrimitiveType*): StringBuilder	Inserts a value converted to a string into this builder.
+insert(offset: int, s: String): StringBuilder	Inserts a string into this builder at the position offset.
+replace(startIndex: int, endIndex: int, s: String): StringBuilder	Replaces the characters in this builder from startIndex to endIndex with the specified string.
+reverse(): StringBuilder	Reverses the characters in the builder.
+setCharAt(index: int, ch: char): void	Sets a new character at the specified index in this builder.

StringBuilder: Examples

- stringBuilder.append("Java");
- stringBuilder.insert(11, "HTML and ");
- stringBuilder.delete(8, 11)
- stringBuilder.deleteCharAt(8)
- stringBuilder.reverse()
- stringBuilder.replace(11, 15, "HTML")
- stringBuilder.setCharAt(0, 'w')

StringBuilder: toString, length, capacity, setLength, charAt

java.lang.StringBuilder	
+toString(): String	Returns a string object from the string builder.
+capacity(): int	Returns the capacity of this string builder.
+charAt(index: int): char	Returns the character at the specified index.
+length(): int	Returns the number of characters in this builder.
+setLength(newLength: int): void	Sets a new length in this builder.
+substring(startIndex: int): String	Returns a substring starting at startIndex.
+substring(startIndex: int, endIndex: int): String	Returns a substring from startIndex to endIndex-1.
+trimToSize(): void	Reduces the storage size used for the string builder.

Questions?

- String
  - Immutable
- StringBuilder
  - Mutable, not thread-safe, fast
- StringBuffer
  - Mutable, thread-safe, slow