جامعة بيرزيت
BIRZEIT UNIVERSITY

Strings

Constructing Strings

String newString = **new** **String**(stringLiteral);

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

Since strings are used frequently, Java provides a shorthand **initializer** for creating a **string**:

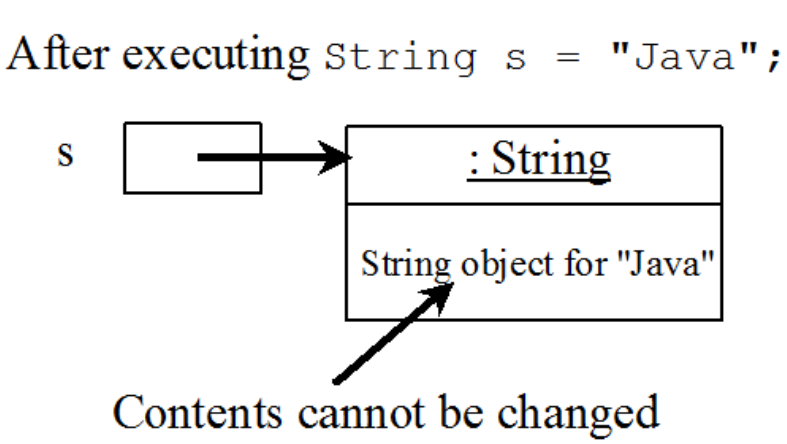
String message = "Welcome to Java";

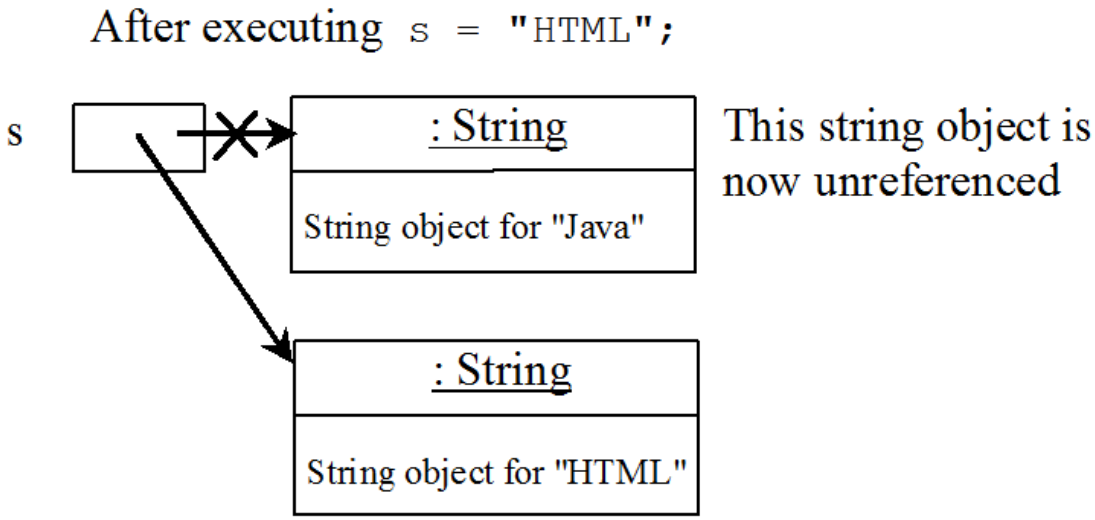
Strings Are Immutable

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

❖ Does the following code change the contents of the string **s**?

```
String s = "Java";
s = "HTML";
```



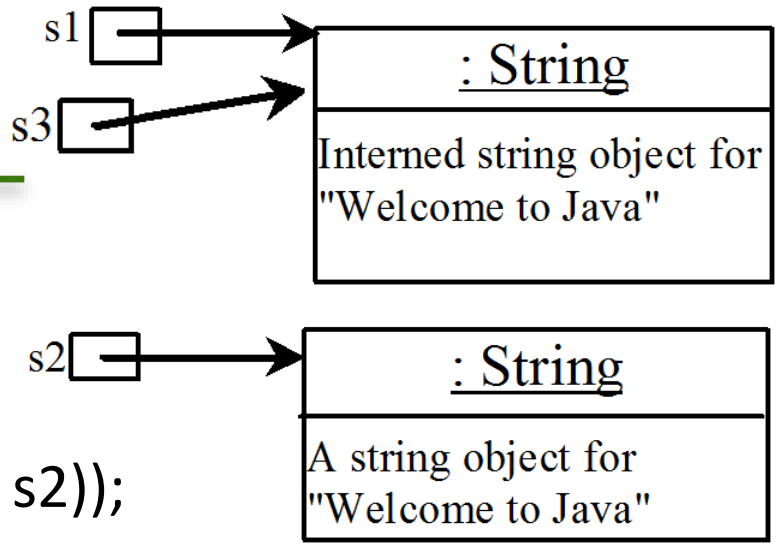


Interned Strings

❖ Since strings are immutable and are frequently used, **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**.

Example




```
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 == s2 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.

String Comparisons

java.lang.String	
+equals(s1: Object): boolean	Returns true if this string is equal to string s1.
+equalsIgnoreCase(s1: String): boolean	Returns true if this string is equal to string s1 case-insensitive.
+compareTo(s1: String): int	Returns an integer greater than 0, equal to 0, or less than 0 to indicate whether this string is greater than, equal to, or less than s1.
+compareToIgnoreCase(s1: String): int	Same as compareTo except that the comparison is case-insensitive.
+regionMatches(toffset: int, s1: String, offset: int, len: int): boolean	Returns true if the specified subregion of this string exactly matches the specified subregion in string s1.
+regionMatches(ignoreCase: boolean, toffset: int, s1: String, offset: int, len: int): boolean	Same as the preceding method except that you can specify whether the match is case-sensitive.
+startsWith(prefix: String): boolean	Returns true if this string starts with the specified prefix.
+endsWith(suffix: String): boolean	Returns true if this string ends with the specified suffix.

String Comparisons

```
String s1 = new  String("Welcome");
String s2 = “Welcome";

if (s1.equals(s2)){
   // s1 and s2 have the same contents
}

if (s1 == s2) {
   // s1 and s2 have the same reference
}
```

String Comparisons

compareTo(Object object)

```
String s1 = new String("Welcome");
String s2 = “Welcome";

if (s1.compareTo(s2) > 0) {
      // s1 is greater than s2
}
else if (s1.compareTo(s2) == 0) {
         // s1 and s2 have the same contents
        }
        else {
           // s1 is less than s2
        }
```

String Length, Characters, and Combining Strings

java.lang.String	
+length(): int	Returns the number of characters in this string.
+charAt(index: int): char	Returns the character at the specified index from this string.
+concat(s1: String): String	Returns a new string that concatenate this string with string s1.

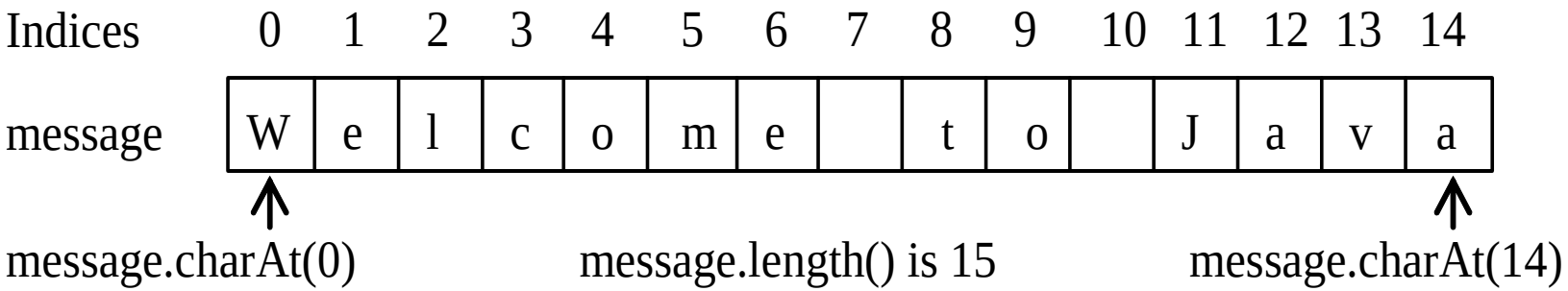
Finding String Length

Finding string length using the **length()** method:

```
message = "Welcome to Java";
message.length();   // returns 15
```

Retrieving Individual Characters in a String

- Do not use **message[0]**
- Use **message.charAt(index)**
- Index starts from **0**



String Concatenation

String s3 = s1.concat(s2);

String s3 = s1 + s2;

s1 + s2 + s3 + s4 + s5

same as

(((s1.concat(s2)).concat(s3)).concat(s4)).concat(s5);

Extracting Substrings

java.lang.String	
+substring(beginIndex: int): String	Returns this string's substring that begins with the character at the specified beginIndex and extends to the end of the string, as shown in Figure 8.6.
+substring(beginIndex: int, endIndex: int): String	Returns this string's substring that begins at the specified beginIndex and extends to the character at index endIndex – 1, as shown in Figure 8.6. Note that the character at endIndex is not part of the substring.

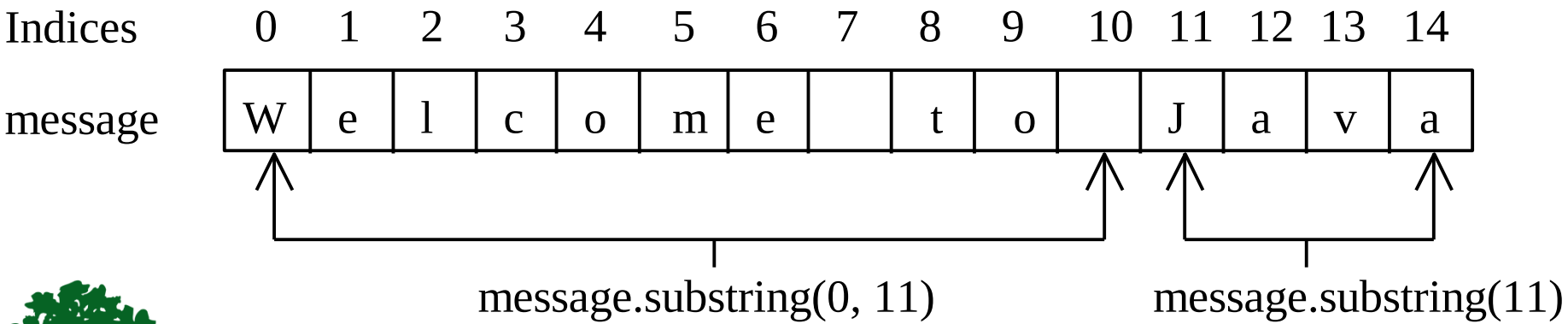
Extracting Substrings

❖ You can extract a single character from a **string** using the **charAt** method.

❖ You can also extract a substring from a **string** using the **substring** method in the **String** class.

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

String  s2 =  s1.substring(0, 11)    +    "HTML";
```



Converting, Replacing, and Splitting Strings

java.lang.String	
+toLowerCase(): String	Returns a new string with all characters converted to lowercase.
+toUpperCase(): String	Returns a new string with all characters converted to uppercase.
+trim(): String	Returns a new string with blank characters trimmed on both sides.
+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.

Examples

"Welcome".toLowerCase()

returns a new string, **welcome**

"Welcome".toUpperCase()

returns a new string, **WELCOME**

" Welcome ".trim()

returns a new string, **Welcome**

"Welcome".replace('e', 'A')

returns a new string, **WAlcomA**

"Welcome".replaceFirst("e", "AB")

returns a new string, **WABlcome**

"Welcome".replaceAll("e", "AB")

returns a new string, **WABlcomAB**

Splitting a String

```
String s1 =  "Java#HTML#Perl“;

String[] tokens = s1.split( "#" , 0);

for (int i = 0; i < tokens.length; i++)

        System.out.println( tokens[i]  );
```

Displays:

Java

HTML

Perl

Matching, Replacing and Splitting by Patterns

❖ You can **match**, **replace**, or **split** a string by specifying a pattern.

❖ This is an extremely useful and powerful feature, commonly known as ***regular expression***.

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

Matching, Replacing and Splitting by Patterns

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

❖ For 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);
```

Here the regular expression **[$+#]** specifies a pattern that matches **$**, **+**, or **#**.

So, the output is **aNNNbNNNNNNc**

Matching, Replacing and Splitting by Patterns

❖ 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]);
```

```
Java
C
C#
C++
```

Finding a Character or a Substring in a String

java.lang.String	
+indexOf(ch: char): int	Returns the index of the first occurrence of ch in the string. Returns -1 if not matched.
+indexOf(ch: char, fromIndex: int): int	Returns the index of the first occurrence of ch after fromIndex in the string. Returns -1 if not matched.
+indexOf(s: String): int	Returns the index of the first occurrence of string s in this string. Returns -1 if not matched.
+indexOf(s: String, fromIndex: int): int	Returns the index of the first occurrence of string s in this string after fromIndex. Returns -1 if not matched.
+lastIndexOf(ch: int): int	Returns the index of the last occurrence of ch in the string. Returns -1 if not matched.
+lastIndexOf(ch: int, fromIndex: int): int	Returns the index of the last occurrence of ch before fromIndex in this string. Returns -1 if not matched.
+lastIndexOf(s: String): int	Returns the index of the last occurrence of string s. Returns -1 if not matched.
+lastIndexOf(s: String, fromIndex: int): int	Returns the index of the last occurrence of string s before fromIndex. Returns -1 if not matched.

Finding a Character or a Substring in a String

String s = "Welcome to Java";

s.indexOf('W')	returns **0**
s.indexOf('x')	returns **-1**
s.indexOf('o', 5)	returns **9**
s.indexOf("come")	returns **3**
s.indexOf("Java", 5)	returns **11**
s.indexOf("java", 5)	returns **-1**
s.lastIndexOf('a')	returns **14**

Convert Character and Numbers to Strings

- The **String** class provides several static **valueOf** methods for converting a character, an array of characters, and numeric values to strings.
- These methods have the same name **valueOf** with different argument types **char**, **char[]**, **double**, **long**, **int**, and **float**.
- For example, to convert a **double** value to a **string**, use **String.valueOf(5.44)**. The return value is string consists of characters **'5'**, **'.'**, **'4'**, and **'4'**.

You can convert a numeric string into a number. To convert a string into an `int` value, use the `Integer.parseInt` method, as follows:

```
int intValue = Integer.parseInt(intString);
```

where `intString` is a numeric string such as `"123"`.

To convert a string into a `double` value, use the `Double.parseDouble` method, as follows:

```
double doubleValue = Double.parseDouble(doubleString);
```

where `doubleString` is a numeric string such as `"123.45"`.

If the string is not a numeric string, the conversion would cause a runtime error. The `Integer` and `Double` classes are both included in the `java.lang` package, and thus they are automatically imported.

You can convert a number into a string, simply use the string concatenating operator as follows:

```
String s = number + "";
```

The Character Class

java.lang.Character	
+Character(value: char)	Constructs a character object with char value
+charValue(): char	Returns the char value from this object
+compareTo(anotherCharacter: Character): int	Compares this character with another
+equals(anotherCharacter: Character): boolean	Returns true if this character equals to another
+isDigit(ch: char): boolean	Returns true if the specified character is a digit
+isLetter(ch: char): boolean	Returns true if the specified character is a letter
+isLetterOrDigit(ch: char): boolean	Returns true if the character is a letter or a digit
+isLowerCase(ch: char): boolean	Returns true if the character is a lowercase letter
+isUpperCase(ch: char): boolean	Returns true if the character is an uppercase letter
+toLowerCase(ch: char): char	Returns the lowercase of the specified character
+toUpperCase(ch: char): char	Returns the uppercase of the specified character

Examples

Character c = new Character('b');

c.compareTo(new Character('a'))	returns **1**
c.compareTo(new Character('b'))	returns **0**
c.compareTo(new Character('c'))	returns **-1**
c.compareTo(new Character('d')	returns **-2**
c.equals(new Character('b'))	returns **true**
c.equals(new Character('d'))	returns **false**

StringBuilder and StringBuffer

❖ The **StringBuilder/StringBuffer** class is an alternative to the **String** class.

❖ In general, a **StringBuilder/StringBuffer** can be used wherever a **String** is used.

❖ **StringBuilder/StringBuffer** is more **flexible** than **String**.

❖ You can **add**, **insert**, or **append** new contents into a string buffer, whereas the value of a **String** object is fixed once the string is created.

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.

Modifying Strings in the Builder

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.

Examples

```
StringBuilder sb = new StringBuilder(“Welcome to “);

sb.append("Java");
sb.insert(11, "HTML and ");
sb.delete(8, 11) ;
                              // changes the builder to Welcome Java
sb.deleteCharAt(8) ;
                              // changes the builder to Welcome o Java
sb.reverse() ;
                              // changes the builder to avaJ ot emocleW
sb.replace(11, 15, "HTML") ;
                          // changes the builder to Welcome to HTML
sb.setCharAt(0, 'w') ;
                              // sets the builder to welcome to Java
```

The toString, capacity, length, setLength, and charAt Methods

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.