The String Class

String class facts

- An object of the String class represents a string of characters.
- The String class belongs to the java.lang package, which does not require an import statement.
- Like other classes, String has constructors and methods.
- Unlike other classes, String has two operators, + and += (used for concatenation).

Literal Strings

- are anonymous objects of the String class
- are defined by enclosing text in double quotes. “This is a literal String”
- don’t have to be constructed.
- can be assigned to String variables.
- can be passed to methods and constructors as parameters.
- have methods you can call.

Literal String examples

```
//assign a literal to a String variable
String name = “Robert”;

//calling a method on a literal String
char firstInitial = “Robert”.charAt(0);

//calling a method on a String variable
char firstInitial = name.charAt(0);
```

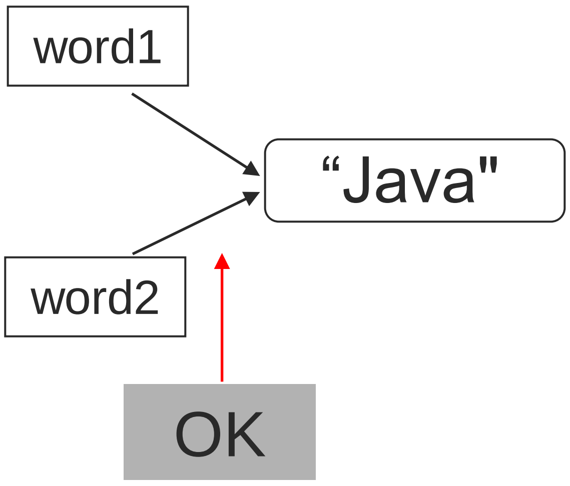
Immutability

- Once created, a string cannot be changed: none of its methods changes the string.
- Such objects are called *immutable*.
- Immutable objects are convenient because several references can point to the same object safely: there is no danger of changing an object through one reference without the others being aware of the change.

Advantages Of Immutability

Uses less memory.

```
String word1 = "Java";
String word2 = word1;
```



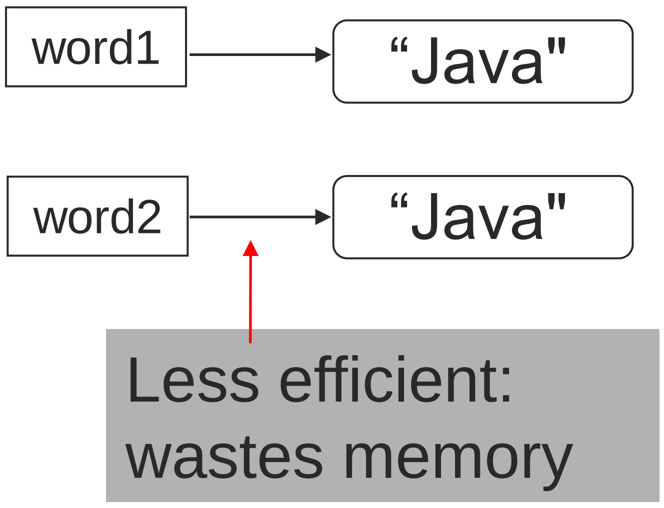
word1

word2

“Java"

OK

```
String word1 = “Java";
String word2 = new String(word1);
```



word1

“Java"

word2

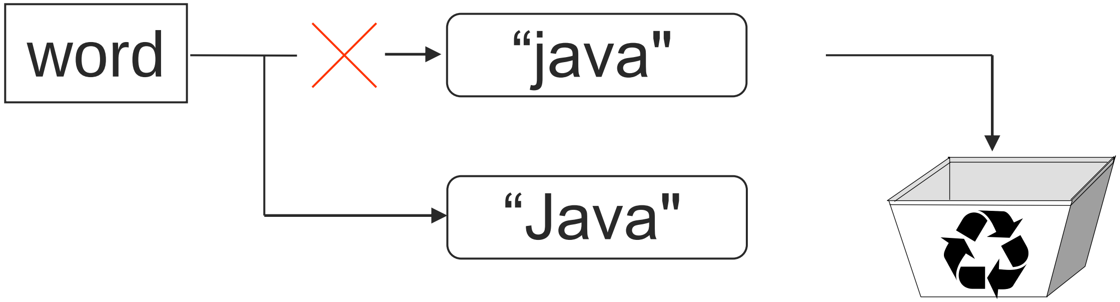
“Java"

Less efficient: wastes memory

Disadvantages of Immutability

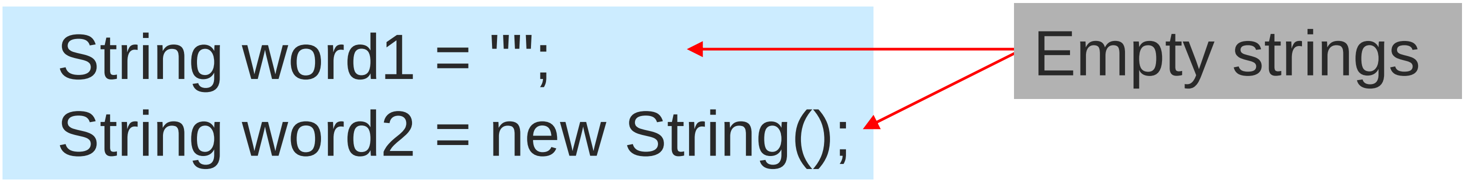
Less efficient — you need to create a new string and throw away the old one even for small changes.

```
String word = “Java";
char ch = Character.toUpperCase(word.charAt (0));
word =  ch + word.substring (1);
```



Empty Strings

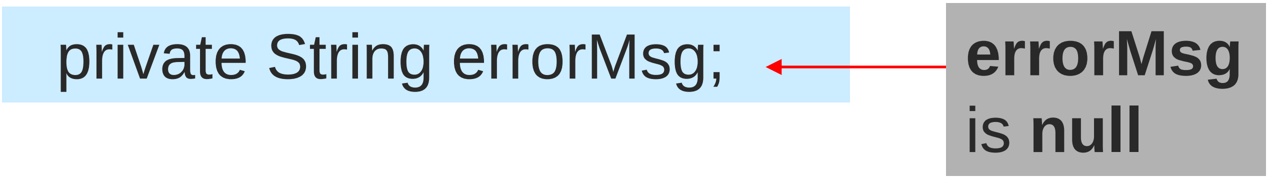
- An empty String has no characters. It's length is 0.



```
String word1 = "";
String word2 = new String();
```

Empty strings

- Not the same as an uninitialized String.



```
private String errorMsg;
```

errorMsg is **null**

No Argument Constructors

- No-argument constructor creates an empty String. Rarely used.

```
String empty = new String();
```

- A more common approach is to reassign the variable to an empty literal String. (Often done to reinitialize a variable used to store input.)

```
String empty = “”;//nothing between quotes
```

Other Constructors

Most other constructors take an array as a parameter to create a String.

```
char[] letters = {‘J’, ‘a’, ‘v’, ‘a’};
String word = new String(letters);//”Java”
```

Methods — length, charAt

int length();

- Returns the number of characters in the string

char charAt(i);

- Returns the char at position i.

Character positions in strings are numbered starting from 0 – just like arrays.

Returns:

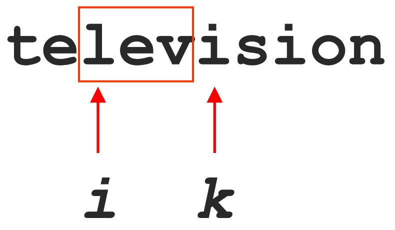
”Problem".length(); → 7

”Window".charAt (2); → ’n'

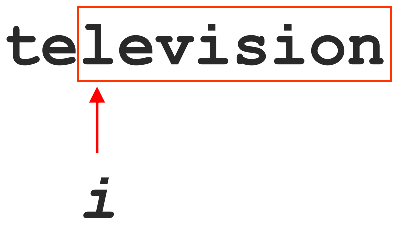
Methods — substring

Returns a new String by copying characters from an existing String.

- String subs = word.**substring** (i, k);
  - returns the substring of chars in positions from **i** to **k-1**



- String subs = word.**substring** (i);
  - returns the substring from the **i**-th char to the end



Returns:

”television".substring (2,5); → “lev"

“immutable".substring (2); → “mutable"

“bob".substring (9); → "" (empty string)

Methods — Concatenation

String word1 = “re”, word2 = “think”; word3 = “ing”;

int num = 2;

- String result = word1 **+** word2;

  //concatenates word1 and word2   “rethink“

- String result = word1.**concat** (word2);

  //the same as word1 + word2 “rethink“

- **result +=** word3;

  //concatenates word3 to result “rethinking”

- **result** += num; //converts num to String

  //and concatenates it to result “rethinking2”

Methods — Find (indexOf)

0 2 6 10 15

String name =“President George Washington";

	Returns:
name.indexOf (‘P');	0
name.indexOf (‘e');	2
name.indexOf (“George");	10
name.indexOf (‘e', 3);	
name.indexOf (“Bob");	−1
name.lastIndexOf (‘e');	15

(starts searching at position 3)

(not found)

Methods — Equality

boolean b = word1.**equals**(word2);

returns **true** if the string **word1** is equal to **word2**

boolean b = word1.**equalsIgnoreCase**(word2);

returns **true** if the string **word1** matches **word2**, case-blind

```
b = “Raiders”.equals(“Raiders”);//true
b = “Raiders”.equals(“raiders”);//false
b = “Raiders”.equalsIgnoreCase(“raiders”);//true
```

Methods — Comparisons

int diff = word1.**compareTo**(word2);

returns the “difference” **word1 – word2**

int diff = word1.**compareToIgnoreCase**(word2);

returns the “difference” **word1 – word2**, case-blind

Usually programmers don’t care what the numerical “difference” of **word1 - word2** is, just whether the difference is negative (word1 comes before word2), zero (word1 and word2 are equal) or positive (word1 comes after word2). Often used in conditional statements.

```
if(word1.compareTo(word2) > 0){
        //word1 comes after word2…
}
```

Comparison Examples

```
//negative differences
diff = “apple”.compareTo(“berry”);//a before b
diff = “Zebra”.compareTo(“apple”);//Z before a
diff = “dig”.compareTo(“dug”);//i before u
diff = “dig”.compareTo(“digs”);//dig is shorter
```

```
//zero differences
diff = “apple”.compareTo(“apple”);//equal
diff = “dig”.compareToIgnoreCase(“DIG”);//equal
```

```
//positive differences
diff = “berry”.compareTo(“apple”);//b after a
diff = “apple”.compareTo(“Apple”);//a after A
diff = “BIT”.compareTo(“BIG”);//T after G
diff = “huge”.compareTo(“hug”);//huge is longer
```

Methods — trim

String word2 = **word1.trim ()**;

returns a new string formed from **word1** by
removing white space at both ends
does not affect whites space in the middle

```
String word1 = “ Hi Bob “;
String word2 = word1.trim();
//word2 is “Hi Bob” – no spaces on either end
//word1 is still “ Hi Bob “ – with spaces
```

Methods — replace

String word2 = word1.**replace**(oldCh, newCh);

returns a new string formed from **word1** by replacing all occurrences of **oldCh** with **newCh**

```
String word1 = “rare“;
String word2 = “rare“.replace(‘r’, ‘d’);
//word2 is “dade”, but word1 is still “rare“
```

Methods — Changing Case

String word2 = word1.**toUpperCase**();
String word3 = word1.**toLowerCase**();

returns a new string formed from **word1** by converting its characters to upper (lower) case

```
String word1 = “HeLLo“;
String word2 = word1.toUpperCase();//”HELLO”
String word3 = word1.toLowerCase();//”hello”
//word1 is still “HeLLo“
```

Replacements

- Example: to “convert” word1 to upper case, replace the reference with a new reference.

```
word1 = word1.toUpperCase();
```

- A common bug:

```
word1.toUpperCase();
```

word1 remains unchanged

Numbers to Strings

Three ways to convert a number into a string:

1. String s = "" + num;

```
s = “” + 123;//”123”
```

2. String s = Integer.toString (i);

   String s = Double.toString (d);

```
s = Integer.toString(123);//”123”
s = Double.toString(3.14); //”3.14”
```

3. String s = String.valueOf (num);

```
s = String.valueOf(123);//”123”
```

Integer and **Double** are “wrapper” classes from **java.lang** that represent numbers as objects. They also provide useful static methods.

StringBuffer

- A StringBuffer is like a String, but can be modified.
- The length and content of the StringBuffer sequence can be changed through certain method calls.
- StringBuffer defines three constructors:
  - StringBuffer()
  - StringBuffer(int size)
  - StringBuffer(String str)

StringBuffer Operations

- The principal operations on a StringBuffer are the append and insert methods, which are overloaded so as to accept data of any type.

Here are few append methods:

```
StringBuffer append(String str)
StringBuffer append(int num)
```

- The append method always adds these characters at the end of the buffer.

StringBuffer Operations

- The insert method adds the characters at a specified point.

Here are few insert methods:

```
StringBuffer insert(int index, String str)
StringBuffer insert(int index, char ch)
```

Index specifies at which point the string will be inserted into the invoking StringBuffer object.

StringBuffer Operations

- **delete() -** Removes the characters in a substring of this StringBuffer. The substring begins at the specified start and extends to the character at index end - 1 or to the end of the StringBuffer if no such character exists. If start is equal to end, no changes are made.

```
public StringBuffer delete(int start, int end)
```

StringBuffer Operations

- **replace() -** Replaces the characters in a substring of this StringBuffer with characters in the specified String.

```
public StringBuffer replace(int start, int end,
   String str)
```

- **substring() -** Returns a new String that contains a subsequence of characters currently contained in this StringBuffer. The substring begins at the specified index and extends to the end of the StringBuffer.

```
public String substring(int start)
```

StringBuffer Operations

- **reverse() -** The character sequence contained in this string buffer is replaced by the reverse of the sequence.

```
public StringBuffer reverse()
```

- **length() -** Returns the length of this string buffer.

```
public int length()
```

StringBuffer Operations

- **capacity() -** Returns the current capacity of the String buffer. The capacity is the amount of storage available for newly inserted characters.

```
public int capacity()
```

- **charAt() -** The specified character of the sequence currently represented by the string buffer, as indicated by the index argument, is returned.

```
public char charAt(int index)
```

Examples: StringBuffer

```
StringBuffer sb = new StringBuffer(“Hello”);
  sb.length();
  sb.capacity();
  sb.charAt(1);
  sb.setCharAt(1,’i’);
  sb.setLength(2); //
  sb.append(“l”).append(“l”);
  sb.insert(0, “Big “);
```

Examples: StringBuffer

```
sb.replace(3, 11, “”);
sb.reverse();
```

StringBuilder

- StringBuilder is the same as the StringBuffer class
- The StringBuilder class is not synchronized and hence in a single threaded environment, the overhead is less than using a StringBuffer.