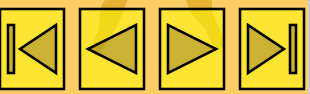
Introduction to Computing Using Java

Tutorial 8

String



Data Structure

- With the 8 primitive types, we can only store limited kinds of data.
- With the class and object concept, we can *create* and *use* other more advanced data structures for our information needs.
- There have been many commonly-used ones already defined, e.g. String

String

- The String *class* defines a convenient data type for storing and manipulating a sequence of characters, i.e. text.

- Remember how to create an object?

```
<classname>   <variable_or_field>;
<variable_or_field> = new <classname> ( ) ;
```

- Similarly, we can create a String object:

```
String myName;
myName = new String();
```

"No New?"

- *New-less* String object creation!!!

```
String myName;
myName = "*** Michael Fung! Hi :)";
```

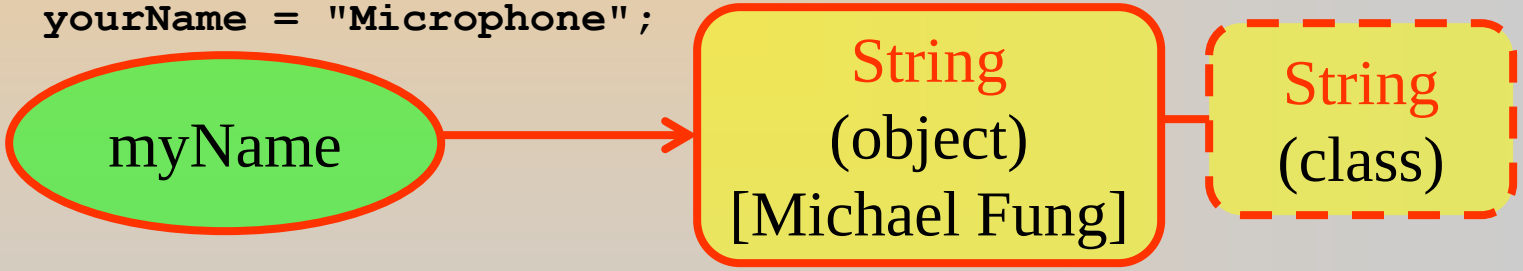
- Yes, " " creates you a *new String object* with constant content.

- This short-hand is dedicated to class String only!

String Properties

- Strings are objects, not primitives!

```
int i = 999;
int j = i;                      // copy value of i (999) to j
String myName = "Michael Fung";
String yourName = myName;   // copy object reference
yourName = "Microphone";
```



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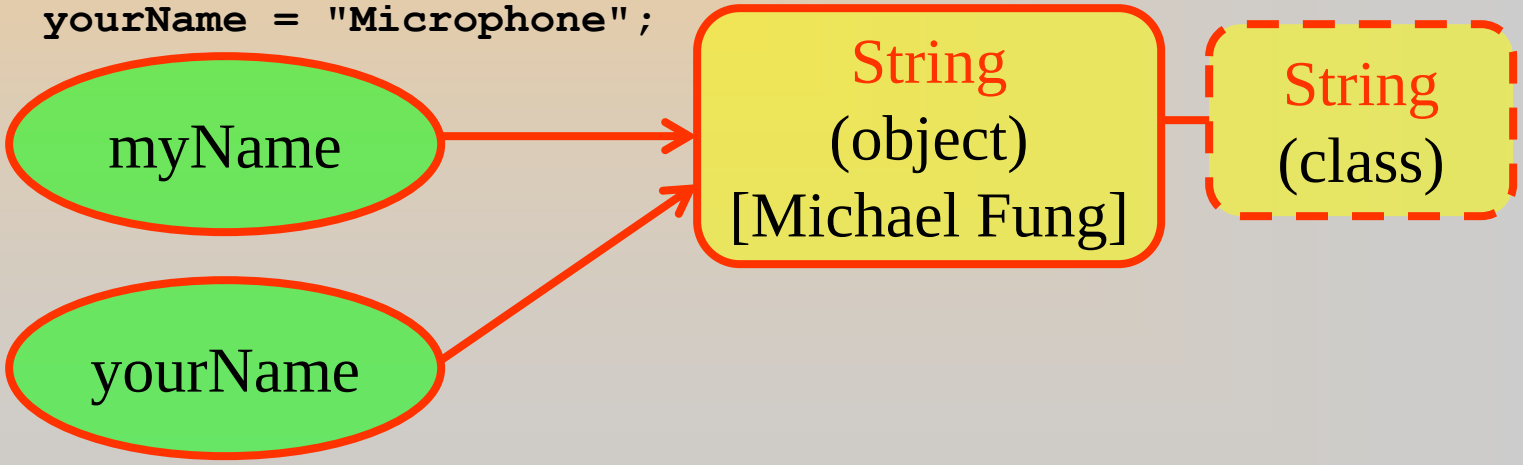

String Properties

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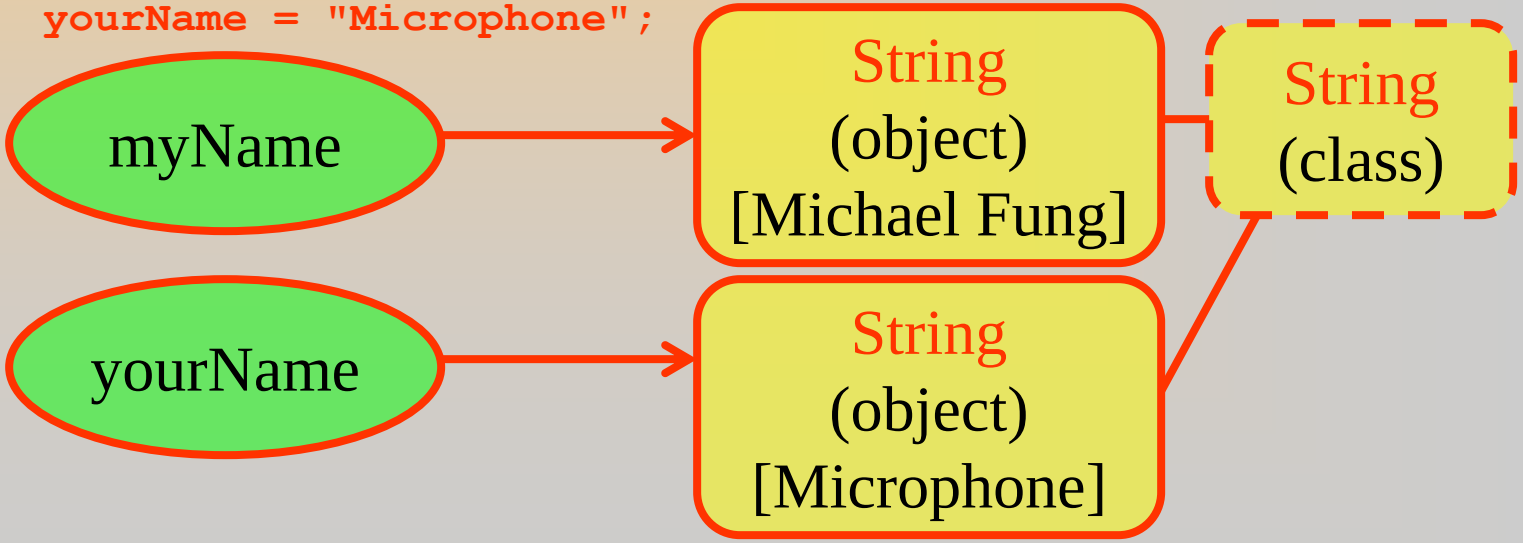


String Properties

- String objects can be concatenated (joined together) using a special operator '+'

```
String myName   = "Michael Fung";
String yourName = "Microphone";
String concat   = myName + " is...";
System.out.println(concat);
String hello    = concat + yourName;
System.out.println(hello);
----------------------------------------
Michael Fung is...
Michael Fung is...Microphone
```

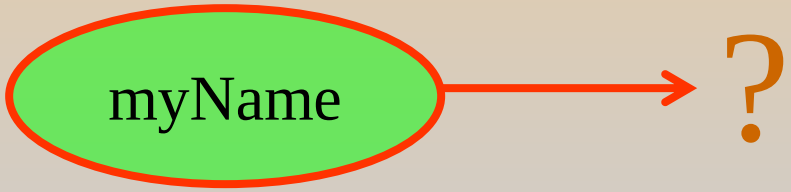
- Class String is privileged to have the '+'.

String Properties

- Content of a **`String`** object could be *empty*.

```
String myName;
myName = "";
String yourName;
```

- ***`null`*** object reference ≠ **`String`** object **`""`**



String Properties

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String yourName;
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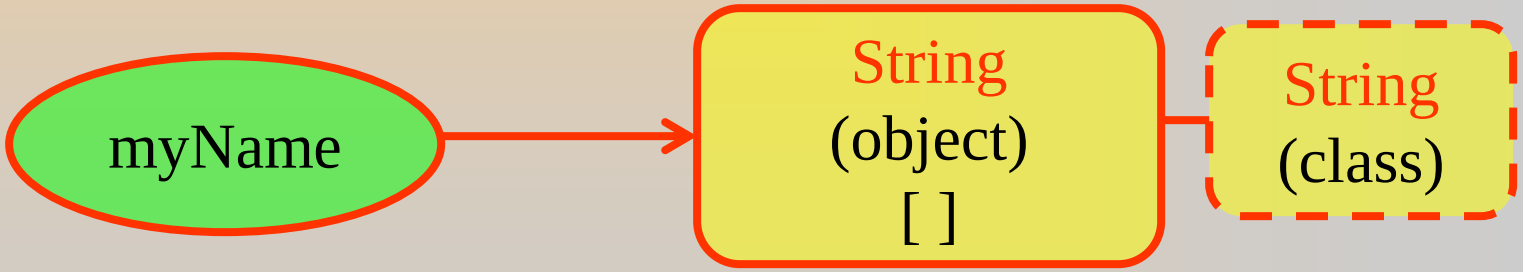
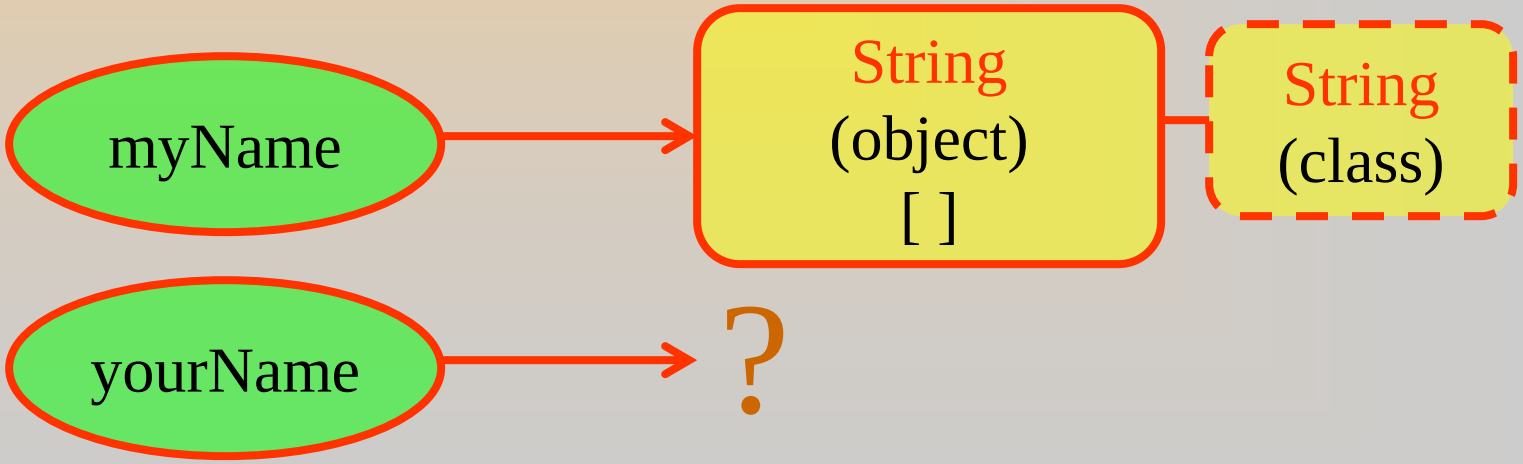


String Properties

- Content of a **`String`** object could be *empty*.

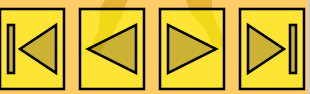
```
String myName;
myName = "";
String yourName;  // no assignment means null
```

- ***`null`*** object reference ≠ **`String`** object **`""`**



String Fields?!

- If we glance through the Java Reference Manual or Java books, we seldom find the names of the fields defined in class String!
- They are **`private`** and inaccessible by us.
- They are encapsulated and well-protected.



String Methods

- To manipulate a String object, we must use the provided *methods*.
- Under clever and considerate design, the method names are *self-explanatory*.
- To get the *length* of a String object,

```
String myName = "Michael Fung";
System.out.println(myName.length());      // message
```

- **Ooops**… to get the length of an array,

```
int[ ] even_numbers = {2, 4, 6, 8, 10, 12, 14, 16};
System.out.println(even_numbers.length);  // property
```

String Methods

- Print a String vertically!

```
String myName = "Michael";
for (int i = 0; i < myName.length(); i++)
  System.out.println(myName.charAt(i));
-------------------------------------------
M
i
c
h
a
e
l
```

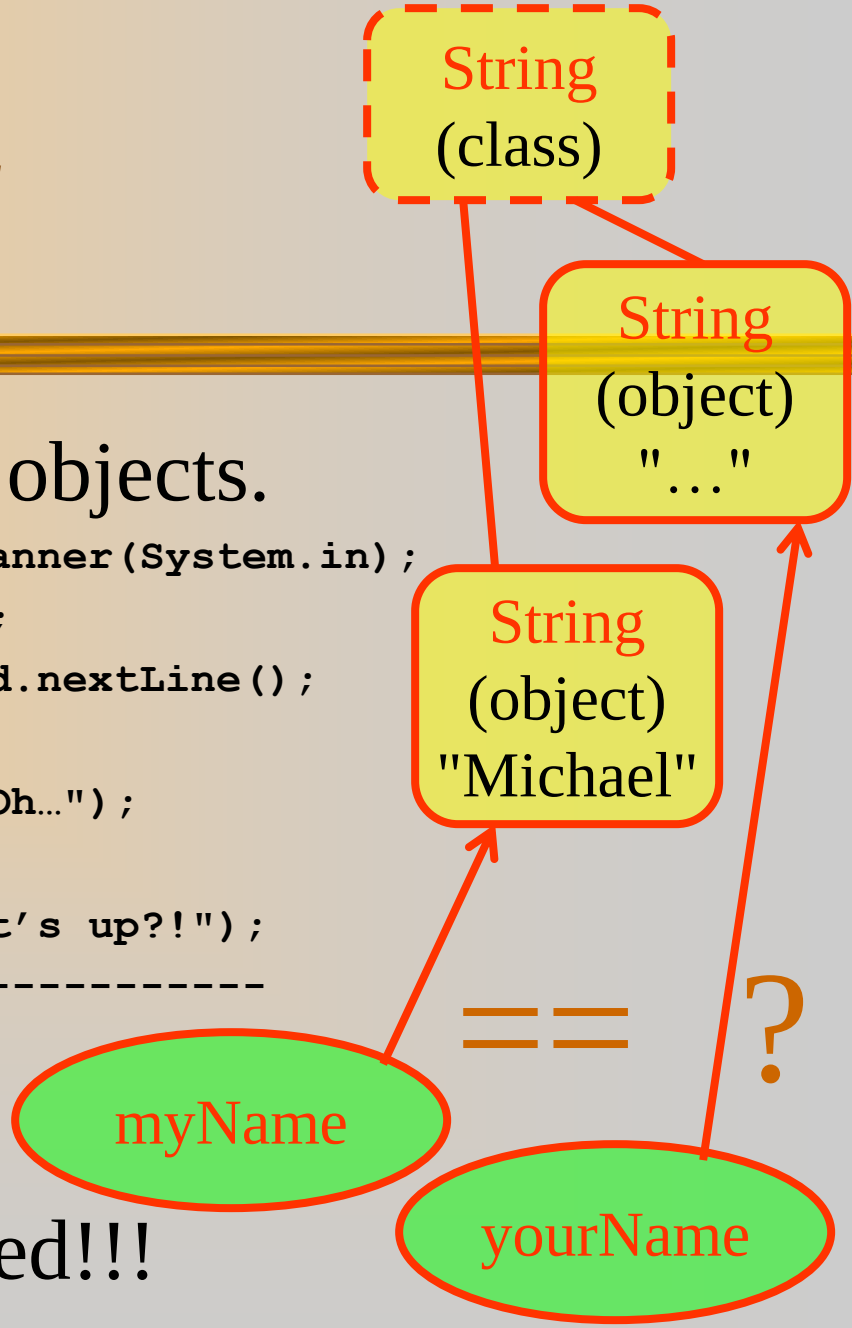
- The instance method **`char charAt(int)`** returns you a **`char`** at the i^{th} position of the String object.

String Methods

- Compares 2 String objects.

```
Scanner keyboard = new Scanner(System.in);
String myName = "Michael";
String yourName = keyboard.nextLine();
if (myName == yourName)
  System.out.println("Uk…Oh…");
else
  System.out.println("What's up?!");
-----------------------------------
What's up?!
```

- We are comparing the references indeed!!!

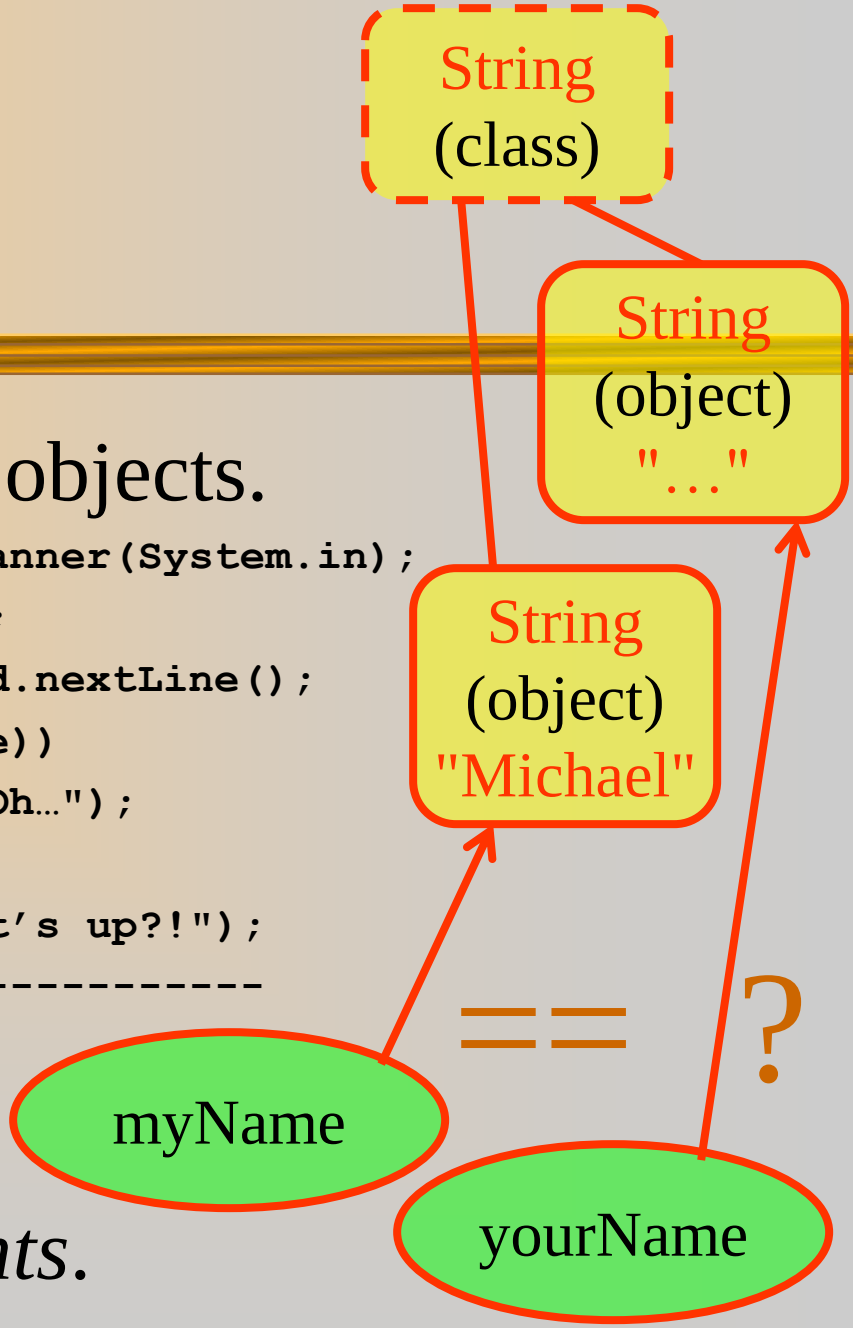


String Methods

- Compares 2 String objects.

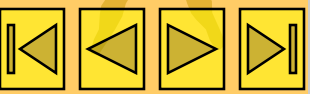
```
Scanner keyboard = new Scanner(System.in);
String myName = "Michael";
String yourName = keyboard.nextLine();
if (myName.equals(yourName))
  System.out.println("Uk…Oh…");
else
  System.out.println("What's up?!");
-----------------------------------
Uk…Oh…
```

- We want to compare the *contents*.



Further Reading

- Readings and References
  - Section 2.1 Character Strings
  - Section 3.2 The String Class



StringBuilder

- Strings are constants or String objects are immutable. In other words, their values cannot be changed after they are created.

- In contrast, Java provides StringBuilder class which enables StringBuilder objects to be mutable.

StringBuilder

```
String yourName = new String("Mike");
String yourNameNew;

yourNameNew = yourName.concat("FUNG"); // yourName + "FUNG"
System.out.println("Your name is: " + yourName);
System.out.println("Your new name is: " + yourNameNew);


StringBuilder myName = new StringBuilder("Michael");
// append the specified string to this character sequence.
myName.append("FUNG");
System.out.println(myName);
```

StringBuilder

- In Java, String.concat( ) instance method, String operator "+" and String operator "+=" creates a new String object as a result while StringBuilder.append( ) will not.

- Therefore, the following timing experiments with String is a lot slower than that with StringBuilder.

StringBuilder

- StringBuilder is more efficient than String.

```
public static void testString () {

    String s = "";
    int repeat = 50000;

    long begin = System.currentTimeMillis();

    for (int i = 0; i < repeat; i++)
        s += "java";

    long elapsed = System.currentTimeMillis() - begin;

    System.out.println("The time for "
                       + s.getClass().getName()
                       + " is: " + elapsed
                       + " millisecond");
}
```

StringBuilder

```
run:
The time for java.lang.StringBuilder is: 0 millisecond
The time for java.lang.String 12422 millisecond
成功构建 (总时间: 12 秒)
```

- StringBuilder is more efficient than String.

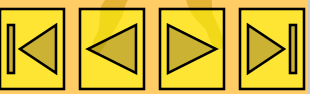
```
public static void testStringBuilder () {

    StringBuilder sb = new StringBuilder();
    int repeat = 50000;

    long begin = System.currentTimeMillis();

    for (int i = 0; i < repeat; i++)
        sb.append("java");

    long elapsed = System.currentTimeMillis() - begin;

    System.out.println("The time for "
                       + sb.getClass().getName()
                       + " is: " + elapsed
                       + " millisecond");
}
```

Exercise 1

- Write a program that computes your initials from your full name and displays them.

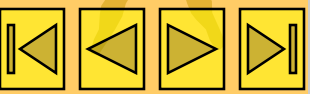
  e.g. Input: Michael Fung

  Output: M.F.



Exercise 1 Solution

```
String myName = "Michael Fung";
String myInitials = "";
int length = myName.length();

for (int i = 0; i < length; i++) {
    char c = myName.charAt(i);
    if (c > 64 && c < 91) {     // check if it is uppercase
        myInitials += c + ".";
    }
}
System.out.println("My initials are: " + myInitials);
```



Exercise 2

- Write a program that replaces all ‘t’s with ‘l’s in a string where ‘t’ is not at the beginning or at the end of the string.

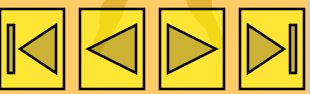
  e.g.

  Input: toyhettowortdhat

  Output: toyhelloworldhat

Exercise 2 Solution

```
String str = "toyhettowortdhat";
int len = str.length();

//get the substring of str from the start index of 1 and the
//end index of (len-1), notice that (len-1) is exclusive
String substr = str.substring(1, len-1);
//replace all 't's with 'l's
substr = substr.replace('t', 'l');
//concatenate the starting part, substring and the end part
str = str.substring(0,1) + substr + str.substring(len-1);
System.out.println(str);
```



Exercise 3

- Write a program that firstly separates a name to several parts around the match of white space like ‘ ’, then converts the first letter of each part from lowercase to uppercase and finally outputs all parts.

e.g.

Input: jackie smith

Output: Jackie

Smith

Exercise 3 Solution (w/ array)

```
String name = "jackie smith";
//seperate the name into several parts
String [] strArr = name.split(" ");

System.out.printf("There are totally %d parts "
                  + "in this name:\n", strArr.length);

for (int i = 0; i < strArr.length; i++)
{
        //convert the first letter of each part to uppercase
        String part = strArr[i].substring(0, 1).toUpperCase()
                    + strArr[i].substring(1);
        System.out.println(part);
}
```

Exercise 4

- Write a program that removes leading and trailing white spaces, and then finds the number of words, number of letters as well as the index of the third word in the resulting string, all without white space.

  e.g. Input: "__I,love,Java,a,lot____"

  Output: 5, 13, 7

  i.e. Trim to "I,love,Java,a,lot"

  → 5 words, 13 letters, 'J' of 'Java' is at index 7

Exercise 4 Solution

```
String str = "   I,love,Java,a,lot  ";
str = str.trim();
String [] words = str.split(",");

//the number of all words
System.out.printf("The total number of words is %d.\n", words.length);

//calculate the number of all letters
int letterSum = 0;
for (int i = 0; i < words.length; i++) {
          int letterNum = words[i].length();
          letterSum += letterNum;
}
System.out.printf("The total number of letters is %d.\n", letterSum);

//find the index of the third word in the string without white spaces
int indexOf3 = str.indexOf(words[2]);
System.out.printf("The index of the third word '%s' is %d.\n",
                                                  words[2], indexOf3);
```

END