STRING REGEX

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AGENDA

- String
- Regular expression

STRING

Java String methods

- String
- StringBuffer
- StringBuilder

Class String

As you know we have a number of primitive types in Java which represents next entities:

Integer numbers (`byte, short, int, long`)

Real numbers (`float, double`)

Symbols (`char`)

Boolean (`boolean`)

For Strings represents Java doesn’t has a primitive type!!!

String

Strings, which are widely used in Java programming, are a sequence of characters.

In the Java programming language, strings are ***objects***.

The Java platform provides the ***String*** class to create and manipulate strings.

Literal automatically creates an object of type String

```
String s1 = "sun.com";
String s2 = new String("sun.com");
```

String objects are immutable.

After creating the content can not be changed.

You can always create a new string that contains all changes.

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String

String class supports multiple constructors

```
String( );          String(StringBuffer sbuf);
String(String str);     String(StringBuilder sbuild);
String(char[ ] unicodechar); ...
```

Just assignee value to variable

```
String strFirst = "First String";
```

Call constructor of String class

```
String strSecond = new String("Second String");
```

Call constructor of String class

```
char[] chA = {'A', 'B', 'C', 'D', 'E', 'F'};
String strThird = new String(chA);
String strFourth = new String(chA, 2, 4); // CDEF
```

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Basic methods

Concat strings

```
String concat(String s) or "+"
String str1 = "Hello ";
String str2 = "World!";
String str3 = str1 + str2;
String str4 = str1.concat(str2);
System.out.println(str3 + str4);
```

Get length of string

```
    int length()
// str3Length = 12
int str3Length = str3.length();
```

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Basic methods

Get part of string

- extract a substring of length m-n, starting at position n

```
String substring(int n, int m)
```

- extract a substring starting at position n

```
String substring(int n)
int indexOf(char ch)
boolean startsWith(String s)
boolean endsWith(String s)
char charAt(int position)
```

```
String str =
     "I study Java language";
int n = str.indexOf('J'); //8
char c = str.charAt(8);   //J
```

```
String str1 = str.substring(13);     // language
String str2 = str.substring(8, 12);  //Java

Boolean res = str.startsWith("I study"); //true
res = str.startsWith("Java", 8);         //true
res = str.endsWith("I study");           //false
```

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Basic methods

Working with case of symbols

```
String toLowerCase()

String toUpperCase()
```

Trim strings

```
String str = "\tTabulated String\t";
String tStr = str.trim();
```

Replace symbols

```
String str = "abracadabra";
String rStr = str.replace('a', 'o');

boolean isEmpty()
```

Basic methods

Compare strings

```
boolean equals(Object obj)
boolean equalsIgnoreCase(String s)
int compareTo(String s)
int compareToIgnoreCase(String s)
boolean contentEquals(StringBuffer obj)
```

```
String a = "a"; What will be the results?
String A = "A";
String b = "a";
System.out.println(a.equals(A));
System.out.println(a.equals(b));
System.out.println(a.equalsIgnoreCase(A));
System.out.println(a.compareTo(A));
System.out.println(a.compareToIgnoreCase(A));
System.out.println(a.contentEquals(A));
```

Example

```
public static void main(String[ ] args) {
   int i;
   char s[ ] = { 'J', 'a', 'v', 'a' };
   String str = new String(s);      // str = "Java"
   if (!str.isEmpty( )) {
      i = str.length( );            // i = 4
      str = str.toUpperCase( );     // str = "JAVA"
      String num = String.valueOf(8);   // num = "8"
      num = str.concat("-" + num);  // num = "JAVA-8"
      char ch = str.charAt(2);      // ch = 'V'
```

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Example

```
    i = str.lastIndexOf('A');     // i = 3 or -1
    num = num.replace("8","SE"); // num = "JAVA-SE"
    str.substring(0, 4).toLowerCase( );  // java
    str = num + "-8";             // str = "JAVA-SE-8"
    String[ ] arr = str.split("-");
    for (String w : arr) {
       System.out.println(w);
     }
  }
}
```

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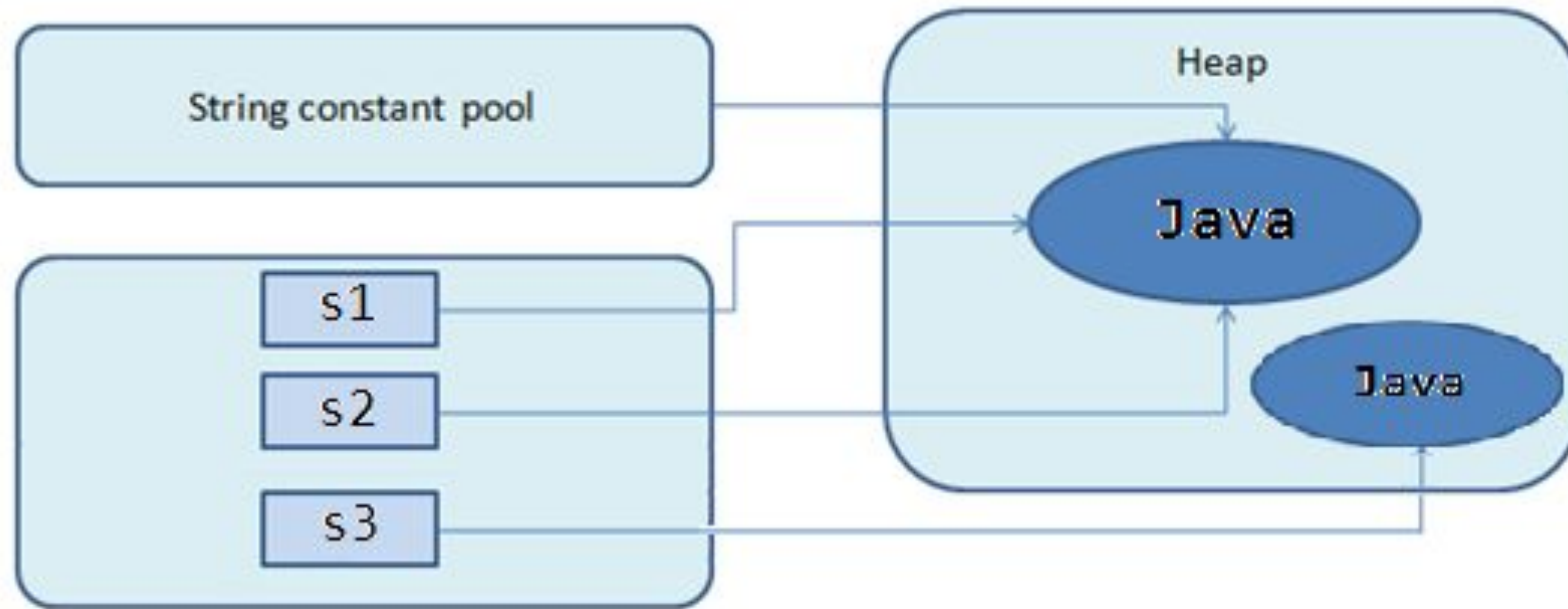
Java String methods

```
public class Appl2 {
  public static void main(String[] args) {
     String s1 = "Java";
     String s2 = "Java";
     String s3 = new String("Java");
     System.out.println(s1 + "==" + s2 + " : " + (s1 == s2));
     System.out.println(s1 + "==" + s3 + " : " + (s1 == s3));
     System.out.println(s1 + " equals " + s2 + " : " + s1.equals(s2));
     System.out.println(s1 + " equals " + s3 + " : " + s1.equals(s3));
     System.out.println(s1.hashCode());
  }
}
```

String Constant Pool



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String Formatting

```
System.out.printf("format-string" [, arg1, arg2, … ] );
```

Format String:

% [flags] [width] [.precision] conversion-character

Flags: '-' (align), '+' (sign), 0 (forces zero), ',' ' ' (space)
Width - minimum number of characters to be written to the output.
Precision - the number of digits of precision when outputting floating-point values or the length of a substring to extract from a String.
Conversion-Characters:

- **d** : decimal integer [byte, short, int, long]
- **f** : floating-point number [float, double]
- **c** : character Capital C will uppercase the letter
- **s** : String Capital S will uppercase all the letters in the string
- **h** : hashcode A hashcode is like an address.
- **n** : newline use %n instead of \n

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String Formatting

Supported by String.format() and System.out.printf() methods:

```
public class StringSamples {
    public static void main(String... args) {
        final double PI = 3.1415926;
        String format = "%.2f";
        String s = String.format(format, PI);
        System.out.println(s);
        System.out.printf(format, PI);
    }
}
```

```
"C:\Program
3,14
3.14
```

Detailed tutorial with samples: https://examples.javacodegeeks.com/core-java/lang/string/java-string-format-example/

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StringBuilder and StringBuffer

String objects are immutable

Defined equal classes StringBuffer and StringBilder allow changes to lines

StringBuffer is synchronized, StringBuilder is not.

```
String s1 = new String("Hello");
String s2 = "And Goodbye";
String str = s1 + s2;
str = s1.concat(s2);
```

StringBuilder	StringBuffer

`StringBuilder sb =`
`    new StringBuilder(s1);`
`sb.append(s2);`
`str = sb.toString( );`
	`StringBuffer sa =`
	`    new StringBuffer( );`
	`sa.append(s1);`
	`sa.append(s2);`
	`String str =  sa.toString( );`

StringBuilder

Constructors

```
StringBuilder()
StringBuilder(char[] seq)
StringBuilder(int capacity)
StringBuilder(String str)
```

Methods

`append(...)` adds a string to the end of the buffer.
`insert(...)` adds a string to any location (insert the substring).
`delete(int begin, int end)` deletes a sequence of characters.
`int capacity()` returns the current capacity of the buffer.
`void ensureCapacity(int i)` changes the value of capacity
`reverse()` causes this character sequence to be replaced by the reverse of the sequence

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REGULAR EXPRESSION

“Some people, when confronted with a problem, think,
‘I know, I’ll use regular expressions.’
Now they have two problems.”

--Jamie Zawinski, in comp.lang.emacs

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*Jamie Zawinski: XEmacs author, original author of Netscape Navigator

Regular Expression

A regular expression is a kind of pattern that can be applied to text (Strings, in Java)

A regular expression either matches the text (or part of the text), or it fails to match

If a regular expression matches a part of the text, then you can easily **find** out which part

- Beginning with Java 1.4, Java has a regular expression package, java.util.regex

The regular expression "[a-z]+" will match a sequence of one or more lowercase letters

- [a-z] means any character from a through z, inclusive
- + means “one or more”

Regular Expression

Suppose we apply this pattern to the String

"Now is the time"

First, you must *compile* the pattern

```
import java.util.regex.*;
Pattern p = Pattern.compile("[a-z]+");
```

Next, you must create a *matcher* for a specific piece of text by sending a message to your pattern

```
Matcher m = p.matcher("Now is the time");
```

Neither Pattern nor Matcher has a public constructor; you create these by using methods in the Pattern class

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Regular Expression

Now that we have a matcher m:

- `m.matches()` returns true if the pattern matches the entire text string, and false otherwise
- `m.lookingAt()` returns true if the pattern matches at the beginning of the text string, and false otherwise
- `m.find()` returns true if the pattern matches **any part** of the text string, and false otherwise
- If called again, `m.find()` will start searching from where the last match was found
- `m.find()` will return true for as many matches as there are in the string; after that, it will return false
- When `m.find()` returns false, matcher m will be *reset* to the beginning of the text string (and may be used again)

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Regular Expression

```
import java.util.regex.*;
public class Appl {
  public static void main(String[] args) {
     String pattern = "[a-z]+";
     String text = "Now is the time";
     Pattern p = Pattern.compile(pattern);
     Matcher m = p.matcher(text);
     while (m.find()) {
        System.out.print(text.substring(m.start(), m.end()) + "*");
  }
}
```

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Regular Expression

abc	exactly this sequence of three letter
[abc]	any *one* of the letters a, b, or c
[^abc]	any character *except* one of the letters a, b, or c (immediately within an open bracket, ^ mean “not,” but anywhere else it just means the character ^)
[a-z]	any *one* character from a through z, inclusive
[a-zA-Z0-9]	any *one* letter or digit

Regular Expression

If one pattern is followed by another, the two patterns must match consecutively

For example, [A-Za-z]+[0-9] will match one or more letters immediately followed by one digit
The vertical bar, |, is used to separate alternatives
For example, the pattern abc|xyz will match either abc or xyz

X? optional, X occurs once or not at all

X* X occurs zero or more times

X+ X occurs one or more times

X{n}X occurs exactly n times

X{n,} X occurs n or more times

X{n, m} X occurs at least n but not more than m times

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Regular Expression

.	any one character except a line terminator
\d	a digit: [0-9]
\D	a non-digit: [^0-9]
\s	a whitespace character: [\t\n\x0B\f\r]
\S	a non-whitespace character: [^\s]
\w	a word character: [a-zA-Z_0-9]
\W	a non-word character: [^\w]
^	the beginning of a line
$	the end of a line
\b	a word boundary
\B	not a word boundary

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Regular Expression

In some implementations, a quantifier in regular expressions corresponds to the maximum line length is possible

For example, often expect that the expression (`<.*>`) will be found in the text tag HTML. However, if the text is more than one HTML-tag, this expression matches the entire string containing a set of tags.

```
   <p><b>Beginning with bold text</b> next, text
body,<i>italic text</i> end of text.</p>
```

Solved problem:

Take into account characters that are not relevant to the desired pattern (`<[^>]*>` for the above case)

Regular Expression

```
import java.util.regex.*;

public class Appl {
public static void main(String[] args) {
    //String pattern = "[a-z]+";
    //String text = "Now is the time";
    //
    //String pattern = "<.*>";
    //String pattern = "<[^>]*>";
    //String text = "<p><b>Beginning with bold text</b> next, text
    body,<i>italic text</i> end of text.</p>";
    String pattern = "\\w+(\\.\\w+)*@(\\w+\\.)+\\w+";
    String text = "my.mail@ua.ua";
```

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Regular Expression

```
    Pattern p = Pattern.compile(pattern);
    Matcher m = p.matcher(text);

    if (m.matches()) {
      System.out.print("Matches the entire text string");
    }
    m.reset();
    System.out.println();
    while (m.find()) {
      System.out.print(text.substring(m.start(), m.end()) + "*");
    }
  }
}
```

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Capturing group

In regular expressions, parentheses are used for **grouping**, but they also capture (keep for later use) anything matched by that part of the pattern

Example: ([a-zA-Z]*)([0-9]*) matches any number of letters followed by any number of digits

If the match succeeds, \1 holds the matched letters and \2 holds the matched digits

In addition, \0 holds everything matched by the entire pattern

Capturing groups are numbered by counting their *opening parentheses* from left to right:

```
( ( A ) ( B ( C ) ) )
1 2     3   4
```

\0 = \1 = ((A)(B(C))),   \2 = (A),   \3 = (B(C)),   \4 = (C)

Example: ([a-zA-Z])\1 will match a double letter, such as letter

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Capturing group

If m is a matcher that has just performed a successful match, then

- m.group(***n***) returns the String matched by capturing group ***n***
  - This could be an empty string
  - This will be null if the pattern as a whole matched but this particular group didn’t match anything
- m.group() returns the String matched by the entire pattern (same as m.group(0))
  - This could be an empty string

If m didn’t match (or wasn’t tried), then these methods will throw an IllegalStateException

Example. Pig Latin

Pig Latin is a spoken “secret code” that many English-speaking children learn

- There are some minor variations (regional dialects?)

The rules for (written) Pig Latin are:

- If a word begins with a consonant cluster, move it to the end and add “ay”
- If a word begins with a vowel, add “hay” to the end

Example:

regular expressions are fun!
egularray expressionshay arehay unfay!

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Example. Pig Latin

Suppose word holds a word in English

Also suppose we want to move all the consonants at the beginning of word (if any) to the end of the word (so string becomes ingstr)

```
Pattern p = Pattern.compile("([^aeiou]*)(.*)");
Matcher m = p.matcher(word);
if (m.matches()) {
  System.out.println(m.group(2) + m.group(1));
}
```

Note the use of (.*) to indicate “all the rest of the characters”

Example. Pig Latin

```
static Pattern wordPlusStuff = Pattern.compile("([a-zA-Z]+)([^a-zA-Z]*)");
static Pattern consonantsPlusRest = Pattern
                    .compile("([^aeiouAEIOU]+)([a-zA-Z]*)");

public static String translate(String text) {
    Matcher m = wordPlusStuff.matcher(text);
    String translatedText = "";
    while (m.find()) {
        translatedText += translateWord(m.group(1)) + m.group(2);
    }
    return translatedText;
}
```

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Example. Pig Latin

```
private static String translateWord(String word) {
   Matcher m = consonantsPlusRest.matcher(word);
   if (m.matches()) {
      return m.group(2) + m.group(1) + "ay";
   } else
   return word + "hay";
}

public static void main(String[] args) {
   String text = "Test text, my tttext, for execution!!!";
   System.out.println(text);
   String translatedText = translate(text);
   System.out.println(translatedText);
}
```

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Double backslashes

Backslashes have a special meaning in regular expressions; for example, \b means a word boundary

The Java compiler treats backslashes specially; for example, \b in a String or as a char means the backspace character

Java syntax rules apply first!

- If you write "\b[a-z]+\b" you get a string with backspace characters in it--this is *not* what you want!
- Remember, you can quote a backslash with another backslash, so "\\b[a-z]+\\b" gives the correct string

Note: if you *read in* a String from somewhere, you are not *compiling* it, so you get whatever characters are actually there

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Escaping metacharacters

A lot of special characters--parentheses, brackets, braces, stars, plus signs, etc.--are used in defining regular expressions; these are called metacharacters

Suppose you want to search for the character sequence a* (an a followed by a star)

- "a*" - doesn't work; that means "zero or more as"
- "a*" - doesn't work; since a star doesn't *need* to be escaped (in Java String constants), Java just ignores the \
- "a*" - *does* work; it's the three-character string a, \, *

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Spaces

There is only one thing to be said about spaces (blanks) in regular expressions, but it's important:

Spaces are significant!

A space stands for a *space* - when you put a space in a pattern, that means to match a space in the text string

It's a *really bad idea* to put spaces in a regular expression just to make it look better

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Regular expressions are a language

Regular expressions are *not* easy to use at first

- It's a bunch of punctuation, not words
- The individual pieces are not hard, but it takes practice to learn to put them together correctly
- Regular expressions form a miniature programming language
  - It's a different kind of programming language than Java, and requires you to learn new thought patterns
- In Java you can't just *use* a regular expression; you have to first create Patterns and Matchers
- Java's syntax for String constants doesn't help, either

Despite all this, regular expressions bring so much power and convenience to String manipulation that they are well worth the effort of learning

Practical tasks

1. Enter surname, name and patronymic on the console as a variable of type String. Output on the console:
   - surnames and initials
   - name
   - name, middle name and last name
2. The user name can be 3 to 15 characters of the Latin alphabet, numbers, and underscores. Using regular expressions implement checking the user name for validity. Input five names in the main method . Output a message to the console of the validation of each of the entered names.

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Practical tasks

1. Enter the two variables of type String. Determine whether the first variable substring second. For example, if you typed «IT» and «IT Academy» you must receive true.
2. Enter surname, name and patronymic on the console as a variable of type String. Output on the console:

   surnames and initials

   name

   name, middle name and last name

   The user name can be 3 to 15 characters of the Latin alphabet, numbers, and underscores. Using regular expressions implement checking the user name for validity. Input five names in the main method . Output a message to the console of the validation of each of the entered names.

Homework

1. Enter in the console sentence of five words.
   - display the longest word in the sentence
   - determine the number of its letters
   - bring the second word in reverse order
2. Enter a sentence that contains the words between more than one space. Convert all spaces, consecutive, one. For example, if we introduce the sentence "I   am   learning   Java   Core», we have to get the "I'm learning Java Core»
3. Implement a pattern for US currency: the first symbol "$", then any number of digits, dot and two digits after the dot. Enter the text from the console that contains several occurrences of US currency. Display all occurrences on the screen.

THANKS

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