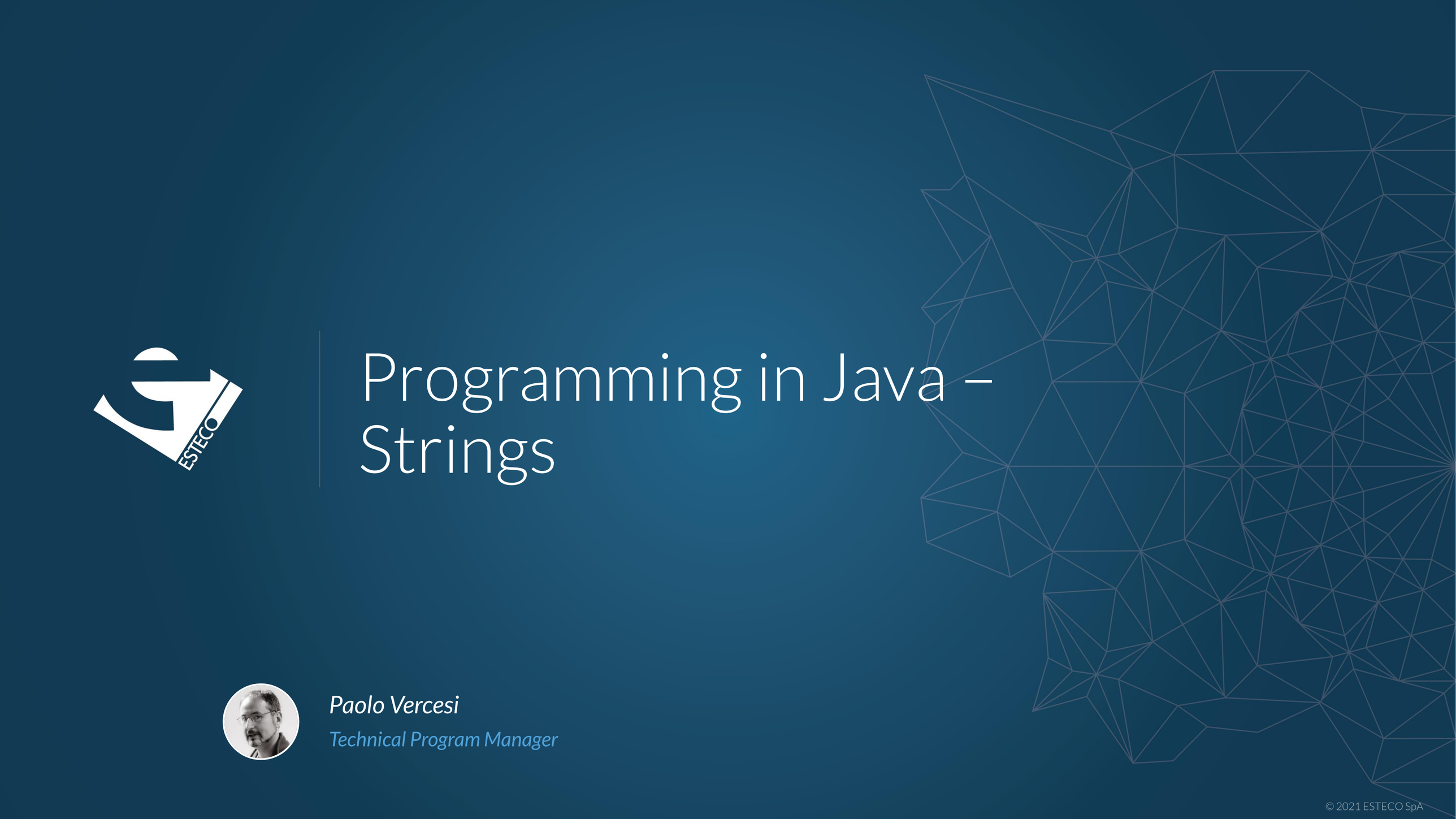


Programming in Java – Strings

Paolo Vercesi

Technical Program Manager

Strings

Strings are ubiquitous in Java and in many other programming languages

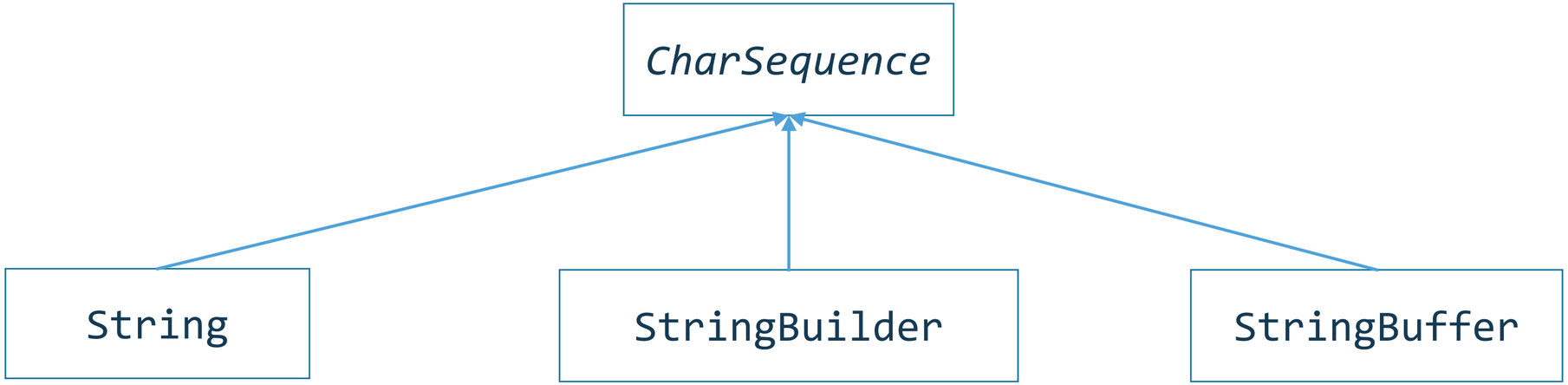
The String class is constantly updated in newer Java versions, with methods that performs common operations

Everything begins with the interface CharSequence

Modifier and Type	Method	Description
char	**charAt**(*int index*)	*Returns the char value at the specified index.*
default **IntStream**	**chars**()	*Returns a stream of int zero-extending the char values from this sequence.*
default **IntStream**	**codePoints**()	*Returns a stream of code point values from this sequence.*
static int	**compare**(**CharSequence** *cs1*, **CharSequence** *cs2*)	*Compares two CharSequence instances lexicographically.*
default boolean	**isEmpty**()	*Returns true if this character sequence is empty.*
int	**length**()	*Returns the length of this character sequence.*
CharSequence	**subSequence**(*int start, int end*)	*Returns a CharSequence that is a subsequence of this sequence.*
String	**toString**()	*Returns a string containing the characters in this sequence in the same order as this sequence.*

https://docs.oracle.com/en/java/javase/17/docs/api/java.base/java/lang/CharSequence.html

CharSequence implementations



Not mutable

Non mutable Strings might seem a bit odd at the beginning.

Mutable

Fast

Not thread-safe

Mutable

Slow

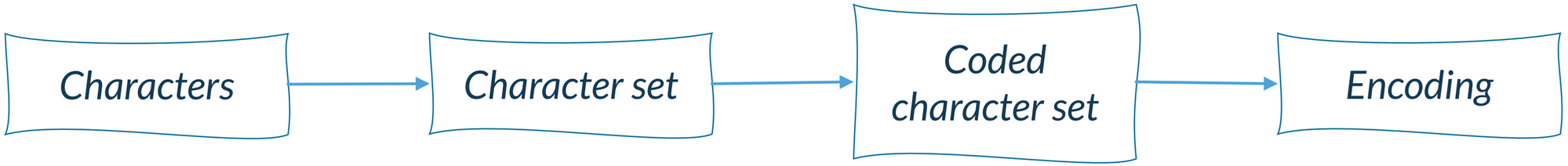
Thread-safe

StringBuilder and StringBuffer provide exactly the same methods, the only difference is in thread-safety and speed. They could be considered a sort of mutable-String or at least mutable-CharSequence.

Constructors

Constructor	Description
String(*)*	*Initializes a newly created String object so that it represents an empty character sequence.*
String(*byte[], …)*	*Many constructors converting bytes into characters. They work well for characters in the US-ASCII character set, otherwise pay attention to the encoding.*
String(*char[] value, …)*	*A couple of constructors to create Strings from character arrays.*
String(*int[] codePoints, int offset, int count)*	*Allocates a new String that contains characters from a subarray of the Unicode code point array argument.*
String(**String** *original)*	*Initializes a newly created String object so that it represents the same sequence of characters as the argument; in other words, the newly created string is a copy of the argument string.*
String(**StringBuffer** *buffer)*	*Allocates a new string that contains the sequence of characters currently contained in the string builder argument.*
String(**StringBuilder** *builder)*	*Allocates a new string that contains the sequence of characters currently contained in the string builder argument.*

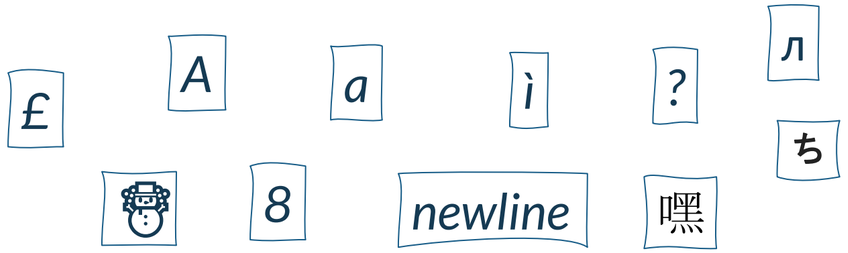
Character sets and encoding



To know everything about character sets and encodings:
https://www.joelonsoftware.com/2003/10/08/the-absolute-minimum-every-software-developer-absolutely-positively-must-know-about-unicode-and-character-sets-no-excuses/

Character

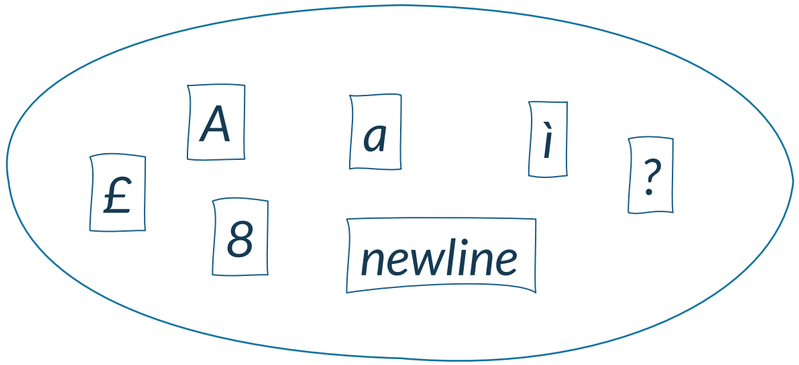
A character is a minimal unit of text that has semantic value.

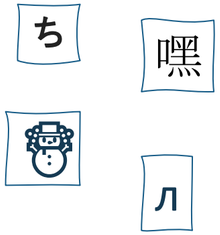


https://docs.oracle.com/javase/tutorial/i18n/text/terminology.html

Character set

A character set is a collection of characters that might be used by multiple languages. For example, the Latin character set is used by English and most European languages, though the Greek character set is used only by the Greek language.





Unicode terminology – Coded character set

A coded character set is a character set where each character is assigned a unique number (code point).

US-ASCII

Code point	Character
0	NUL
1	SOH
…	…
65	A
66	B
67	C
…	…
126	~
127	DEL

Windows-1252/ISO-8859-1

Code point	Character
0	NUL
1	SOH
…	…
65	A
66	B
67	C
…	…
254	þ
255	ÿ

Windows-1250

Code point	Character
0	NUL
1	SOH
…	…
65	A
66	B
67	C
…	…
254	ţ
255	˙

Windows-1252 and ISO-8859-1 are not the same character set, but they differs for some code points assigned to control codes
For HTML5 they can be considered the same https://www.w3.org/TR/encoding/

Unicode

The Unicode standard defines 144,697 characters and their respective code points. This character set is called Universal Coded Character Set (UCS, Unicode).

Positions 0 through 255 of UCS and Unicode are the same as in ISO-8859-1.

Positions 0 through 127 of UCS are the same as in US-ASCII.

Positions 0 through 65535 of UCS (Basic Multilingual Plan) cover all the commonly used languages

How do we encode this information in computers?

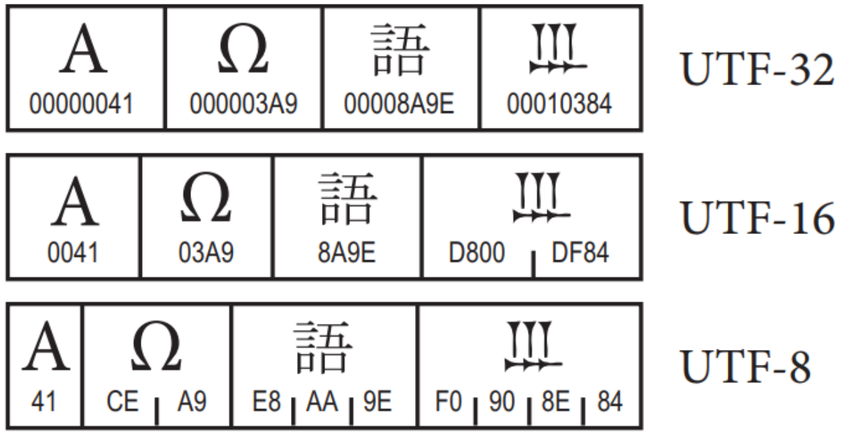
Encodings

1 byte is enough to encode the whole US-ASCII and ISO-8859-1 character sets.

For characters sets with more than 256 characters with need to use multibyte encodings.

Generally, a character sets define its own encoding and so the term charset is used to refer to both the character set and the encoding. E. g. HTTP and HTML define a charset parameter and attribute, respectively, to define the combination character set/encoding.

UCS is currently the most important character sets and it has multiple encodings, so this character set is represented by the name of the encoding, UTF-8, UTF-16, or UTF-32.



Java characters

The Java primitive type char uses
16 bit to represent characters.

So the char type is not able to represents all Unicode characters. Indeed, Java internally represents text in 16-bits code units using UTF-16.

The char type does not represent characters but code units, this is relevant only when we are using a language outside the Basic Multilanguage Plane. E. g. the cuneiform language, Phoenician, etc.

Encodings supported by Java

Every implementation of the Java platform is required to support the following standard charsets. Usually, every implementation supports many more charsets.

Charset	Description
US-ASCII	Seven-bit ASCII, a.k.a. ISO646-US, a.k.a. the Basic Latin block of the Unicode character set
ISO-8859-1	ISO Latin Alphabet No. 1, a.k.a. ISO-LATIN-1
UTF-8	Eight-bit UCS Transformation Format
UTF-16BE	Sixteen-bit UCS Transformation Format, big-endian byte order
UTF-16LE	Sixteen-bit UCS Transformation Format, little-endian byte order
UTF-16	Sixteen-bit UCS Transformation Format, byte order identified by an optional byte-order mark

When in doubt, use UTF-8.

Example

Constructor to create a String from a sequence of bytes

```
String(byte[] bytes, String charsetName)
String(byte[] bytes, Charset charset)
```

Methods to encode a String into a sequence of bytes

```
byte[] getBytes(String charsetName)
byte[] getBytes(Charset charset)
```

Literals

```
String s1 = "abc";
String s2 = "© or \u00A9 are the same";
String s3 = "A multiline\nString!";
String s4 = "I\tlove\ttabs";
String s5 = "Windows loves \\backslashes\\";
String s6 = "I hate to \"escape\" double quotes";
String s7 = """
        We can use "text blocks"
        since Java 15""";
String s8 = "\ud800\udf84 two characters, one codepoint"
String s9 = "\ud800\udf85"
```

Length of a String

Length of a string, the number of Unicode code units in the string.

```
string.length()
```

Number of Unicode code points in the string.

```
string.codePoints().count()
```

Test if the string is empty.

```
public boolean isEmpty()
```

Test if the string contains blank characters only.

```
public boolean isBlank()
```

String concatenation and conversion

When we concatenate a primitive type to a String, Java invokes one the String.valueOf() methods.

```
public static String valueOf(boolean b);
public static String valueOf(byte b);
public static String valueOf(char c);
public static String valueOf(short s);
public static String valueOf(integer i);
public static String valueOf(float f);
public static String valueOf(double d);
```

When we concatenate an object reference to a String, Java invokes the String.valueOf(Object) method.

```
public static String valueOf(Object obj) {
    return (obj == null) ? "null" : obj.toString();
}
```

What happens if we invoke toString() on a null reference?

```
Object o1 = null;
System.out.println(o1.toString());
```

Character extraction

```
public char charAt(int index)

public int codePointAt(int index)

public String substring(int beginIndex)

public String substring(int beginIndex, int endIndex)

public CharSequence subSequence(int beginIndex, int endIndex)

public Stream<String> lines()
```

String comparison

```
public boolean equals(Object anObject)

public boolean contentEquals(StringBuffer sb)

public boolean contentEquals(CharSequence cs)

public boolean equalsIgnoreCase(String anotherString)

public int compareTo(String anotherString)

public int compareToIgnoreCase(String str)

public boolean regionMatches(int toffset, String other, int ooffset, int len)
public boolean regionMatches(boolean ignoreCase, int toffset,
                             String other, int ooffset, int len)
public boolean startsWith(String prefix, int toffset)

public boolean startsWith(String prefix)

public boolean endsWith(String suffix)

public boolean contains(CharSequence s)
```

Searching strings

```
public int indexOf(int ch)
public int indexOf(int ch, int fromIndex)
public int lastIndexOf(int ch)
public int lastIndexOf(int ch, int fromIndex)
public int indexOf(String str)
public int indexOf(String str, int fromIndex)
public int lastIndexOf(String str)
public int lastIndexOf(String str, int fromIndex)
```

Modifying a String

```
public String concat(String str)
public String replace(char oldChar, char newChar)
public String replace(CharSequence target, CharSequence replacement)
public String toLowerCase(Locale locale)
public String toLowerCase()
public String toUpperCase(Locale locale)
public String toUpperCase()
public String trim()
public String strip()
public String stripLeading()
public String stripTrailing()
public String indent(int n)
public String stripIndent()
public String translateEscapes()
public String repeat(int count)
```

Regular expressions

```
public boolean matches(String regex)
public String replaceFirst(String regex, String replacement)
public String replaceAll(String regex, String replacement)
```

Splitting and joining Strings

```
public String[] split(String regex, int limit)

public String[] split(String regex)

public static String join(CharSequence delimiter, CharSequence... elements)

public static String join(CharSequence delimiter,
Iterable<? extends CharSequence> elements)
```

Format

```
public static String format(String format, Object... args)
public static String format(Locale l, String format, Object... args)
public String formatted(Object... args)
```

Thank you!

esteco.com