Text Processing

Manipulating Text

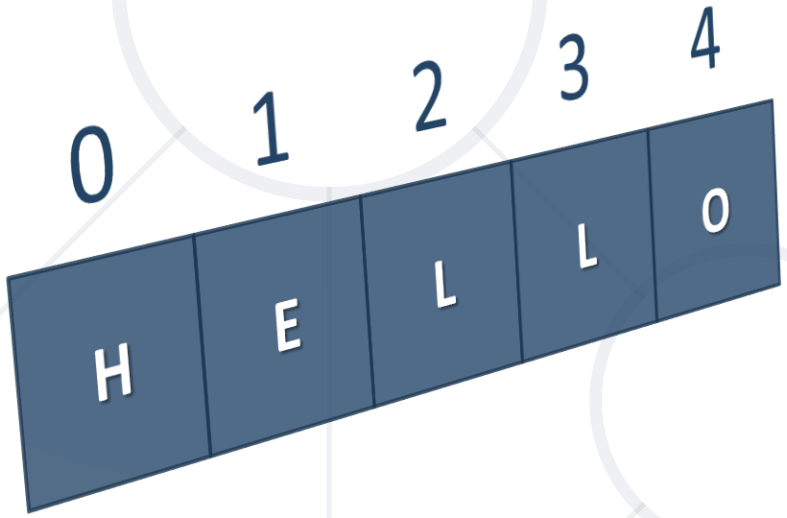

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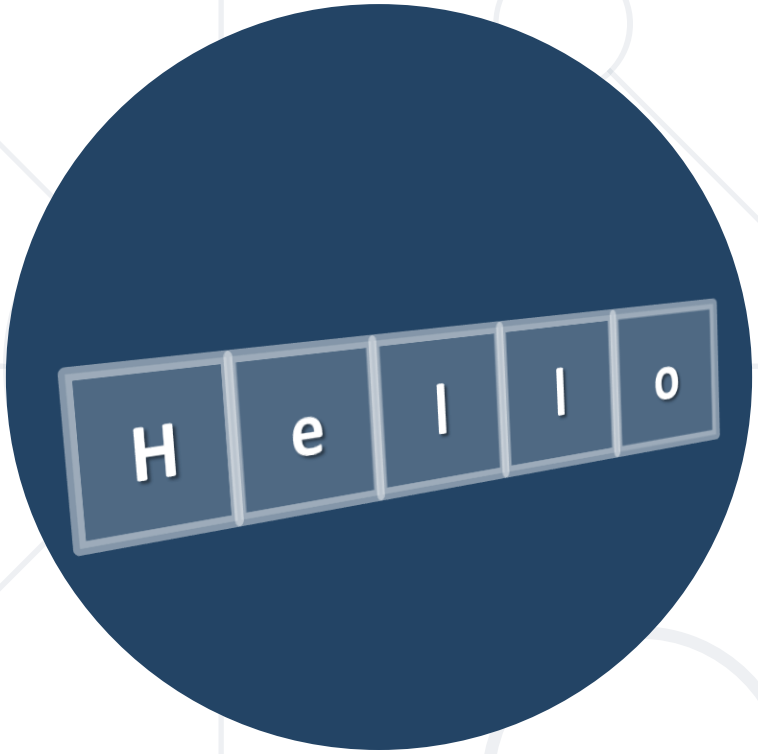
Table of Contents



Strings

What is a String?

What is a String?

- Strings are **sequences** of characters (texts)
- The string data type in Java
  - Declared by the `String`
- Strings are enclosed in double quotes:

```
String text = "Hello, Java";
```

Strings Are Immutable

- Strings are **immutable** (read-only) sequences of characters
- Accessible by **index** (read-only)

```
String str = "Hello, Java";
char ch = str.charAt(2); // l
```

- Strings use **Unicode** (can use most alphabets, e.g. Arabic)

```
String greeting = "你好"; // (lí-hó) Taiwanese
```

Initializing a String

- Initializing from a string literal:

```
String str = "Hello, Java";
```

- Reading a **string** from the console:

```
String name = sc.nextLine();
System.out.println("Hi, " + name);
```

- Converting a **string** from and to a **char array**:

```
String str = new String(new char[]{'s', 't', 'r'});
char[] charArr = str.toCharArray();
// ['s', 't', 'r']
```

Manipulating Strings

Concatenating

- Use the + or the += operators

```
String text = "Hello" + ", " + "world!";
// "Hello, world!"
```

```
String text = "Hello, ";
text += "John"; // "Hello, John"
```

- Use the concat() method

```
String greet = "Hello, ";
String name = "John";
String result = greet.concat(name);
System.out.println(result); // "Hello, John"
```

Joining Strings

- `String.join("", …)` concatenates strings

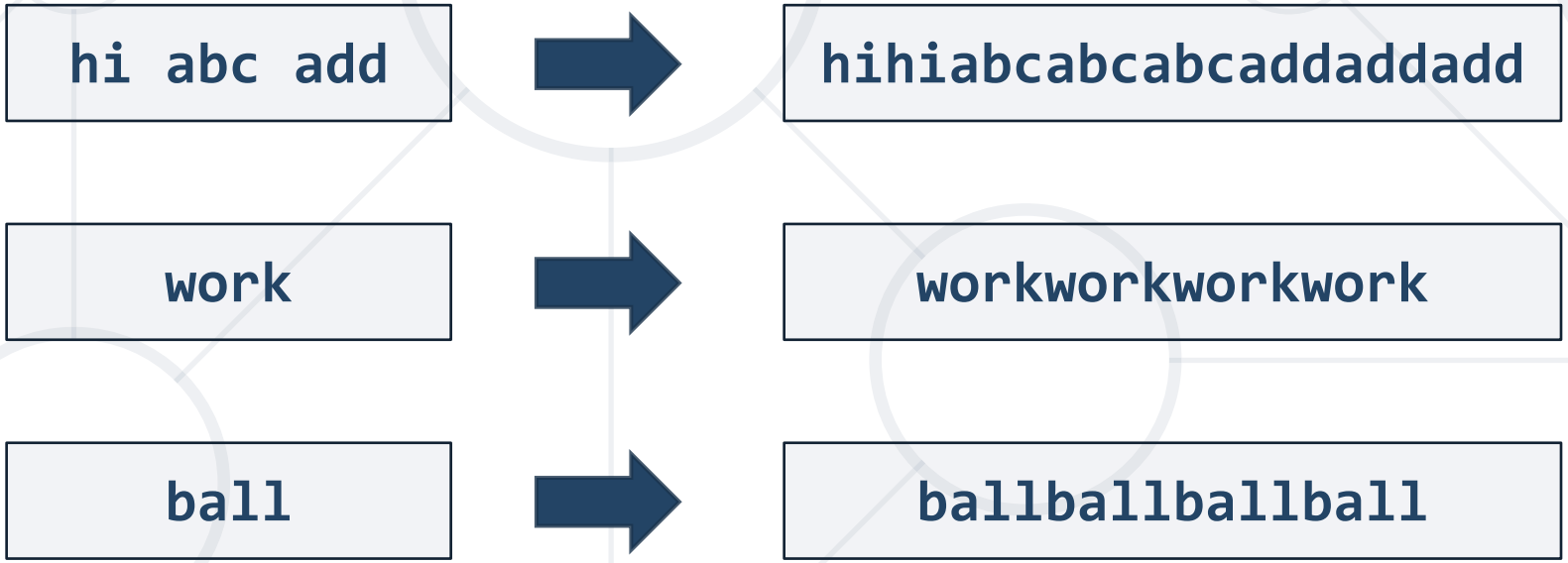
```
String t = String.join("", "con", "ca", "ten", "ate");
// "concatenate"
```

- Or an array/list of strings
  - Useful for repeating a string

```
String s = "abc";
String[] arr = new String[3];
for (int i = 0; i < arr.length; i++) { arr[i] = s; }
String repeated = String.join("", arr); // "abcabcabc"
```

Problem: Repeat Strings

- Read an array from strings
- Repeat each word **n** times, where **n** is the length of the word



Check your solution here: https://judge.softuni.bg/Contests/1669/Text-Processing-Lab

Solution: Repeat Strings (1)

```
String[] words = sc.nextLine().split(" ");
List<String> result = new ArrayList<>();
for (String word : words) {
  result.add(repeat(word, word.length()));
}
System.out.println(String.join("", result));
```

Check your solution here: https://judge.softuni.bg/Contests/1669/Text-Processing-Lab

Solution: Repeat Strings (2)

```
static String repeat(String s, int repeatCount) {
  String[] repeatArr = new String[repeatCount];
  for (int i = 0; i < repeatCount; i++) {
    repeatArr[i] = s;
  }
  return String.join("", repeatArr);
}
```

Substring

- `substring(int startIndex, int endIndex)`

```
String card = "10C";
String power = card.substring(0, 2);
System.out.println(power); // 10
```

- `substring(int startIndex)`

```
String text = "My name is John";
String extractWord = text.substring(11);
System.out.println(extractWord); // John
```

Searching (1)

- `indexOf()` - returns the first match index or -1

```
String fruits = "banana, apple, kiwi, banana, apple";
System.out.println(fruits.indexOf("banana"));     // 0
System.out.println(fruits.indexOf("orange"));     // -1
```

- `lastIndexOf()` - finds the last occurrence

```
String fruits = "banana, apple, kiwi, banana, apple";
System.out.println(fruits.lastIndexOf("banana")); // 21
System.out.println(fruits.lastIndexOf("orange")); // -1
```

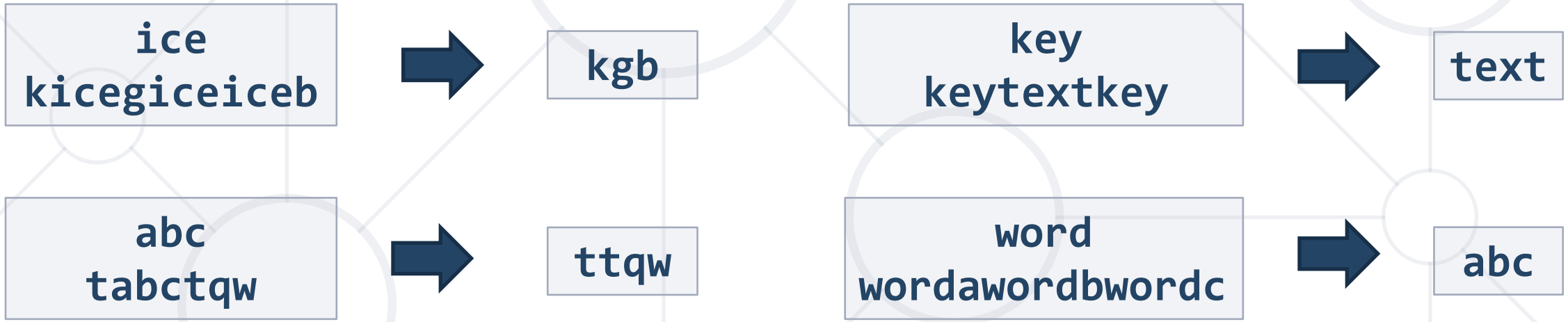
Searching (2)

- `contains()` - checks whether one string contains another

```
String text = "I love fruits.";
System.out.println(text.contains("fruits"));
// true
System.out.println(text.contains("banana"));
// false
```

Problem: Substring

- You are given a **remove word** and a **text**
- Remove all substrings that are equal to the remove word



Check your solution here: https://judge.softuni.bg/Contests/1669/Text-Processing-Lab

Solution: Substring

```
String key = sc.nextLine();
String text = sc.nextLine();

int index = text.indexOf(key);
while (index != -1) {
  text = text.replace(key, "");
  index = text.indexOf(key);
}

System.out.println(text);
```

Check your solution here: https://judge.softuni.bg/Contests/1669/Text-Processing-Lab

Splitting

- Split a string by given pattern

```
String text = "Hello, john@softuni.bg, you have been
using john@softuni.bg in your registration";
String[] words = text.split(", ");
// words[]: "Hello", "john@softuni.bg","you have been…"
```

- Split by multiple separators

```
String text = "Hello, I am John.";
String[] words = text.split("[, .]+");
// "Hello", "I", "am", "John"
```

Replacing

- `replace(match, replacement)` - replaces **all** occurrences
  - The result is a new **string** (strings are **immutable**)

```
String text = "Hello, john@softuni.bg, you have been
using john@softuni.bg in your registration.";
String replacedText = text
        .replace("john@softuni.bg", "john@softuni.com");
System.out.println(replacedText);
// Hello, john@softuni.com, you have been using
john@softuni.com in your registration.
```

Problem: Text Filter

- You are given a string of banned words and a text
  - Replace all banned words in the text with asterisks (*)

```
Linux, Windows
It is not Linux, it is GNU/Linux. Linux is merely the
kernel, while GNU adds the functionality...
```

```
It is not *****, it is GNU/*****. ***** is merely
the kernel, while GNU adds the functionality...
```

Check your solution here: https://judge.softuni.bg/Contests/1669/Text-Processing-Lab

Solution: Text Filter (1)

```
String[] banWords = sc.nextLine.split(", ");
String text = sc.nextLine();
for (String banWord : banWords) {
  if (text.contains(banWord)) {
    String replacement = repeatStr("*",
     banWord.length());
    text = text.replace(banWord, replacement);
  }
}
System.out.println(text);
```

contains(…) checks if string contains another string

replace() a word with a sequence of asterisks of the same length

Check your solution here: https://judge.softuni.bg/Contests/1669/Text-Processing-Lab

Solution: Text Filter (2)

```
private static String repeatStr(String str, int length) {
  String replacement = "";
  for (int i = 0; i < length; i++) {
    replacement += str;
  }
  return replacement;
}
```

Check your solution here: https://judge.softuni.bg/Contests/1669/Text-Processing-Lab

Live Exercises

Building and Modifying Strings

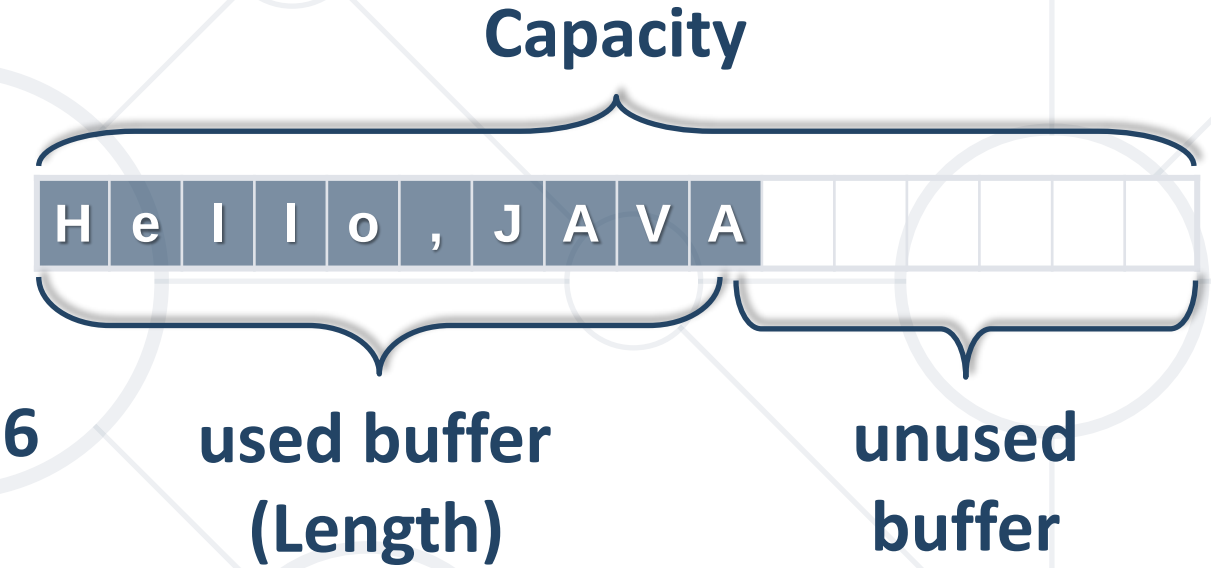
Using the StringBuilder Class

StringBuilder: How It Works?

StringBuilder:

`length()` = 10

`capacity()` = 16



- **StringBuilder** keeps a buffer space, allocated in advance
  - Do not allocate memory for most operations → performance

Using StringBuilder Class

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- Use the **StringBuilder** to build/modify strings

```
StringBuilder sb = new StringBuilder();
sb.append("Hello, ");
sb.append("John! ");
sb.append("I sent you an email.");
System.out.println(sb.toString());
// Hello, John! I sent you an email.
```

Concatenation vs. StringBuilder (1)

- **Concatenating** strings is a **slow** operation because each iteration **creates** a **new string**

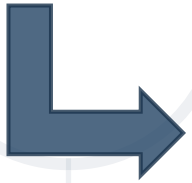
```
System.out.println(new Date());
String text = "";
for (int i = 0; i < 1000000; i++)
  text += "a";
System.out.println(new Date());
```

```
Tue Jul 10 13:57:20 EEST 2018
Tue Jul 10 13:58:07 EEST 2018
```

Concatenation vs. StringBuilder (2)

- Using **StringBuilder**

```
System.out.println(new Date());
StringBuilder text = new StringBuilder();
for (int i = 0; i < 1000000; i++)
  text.append("a");
System.out.println(new Date());
```



```
Tue Jul 10 14:51:31 EEST 2018
Tue Jul 10 14:51:31 EEST 2018
```

StringBuilder Methods (1)

- `append()` - appends the string representation of the argument

```
StringBuilder sb = new StringBuilder();
sb.append("Hello Peter, how are you?");
```

- `length()` - holds the length of the string in the buffer

```
sb.append("Hello Peter, how are you?");
System.out.println(sb.length()); // 25
```

- `setLength(0)` - removes all characters

StringBuilder Methods (2)

- `charAt(int index)` - returns char on index

```
StringBuilder sb = new StringBuilder();
sb.append("Hello Peter, how are you?");
System.out.println(sb.charAt(1)); // e
```

- `insert(int index, String str)` – inserts a string at the specified character position

```
sb.insert(11, " Ivanov");
System.out.println(sb);
// Hello Peter Ivanov, how are you?
```

StringBuilder Methods (3)

- `replace(int startIndex, int endIndex, String str)` - replaces the chars in a substring

```
sb.append("Hello Peter, how are you?");
sb.replace(6, 11, "George");
```

- `toString()` - converts the value of this instance to a String

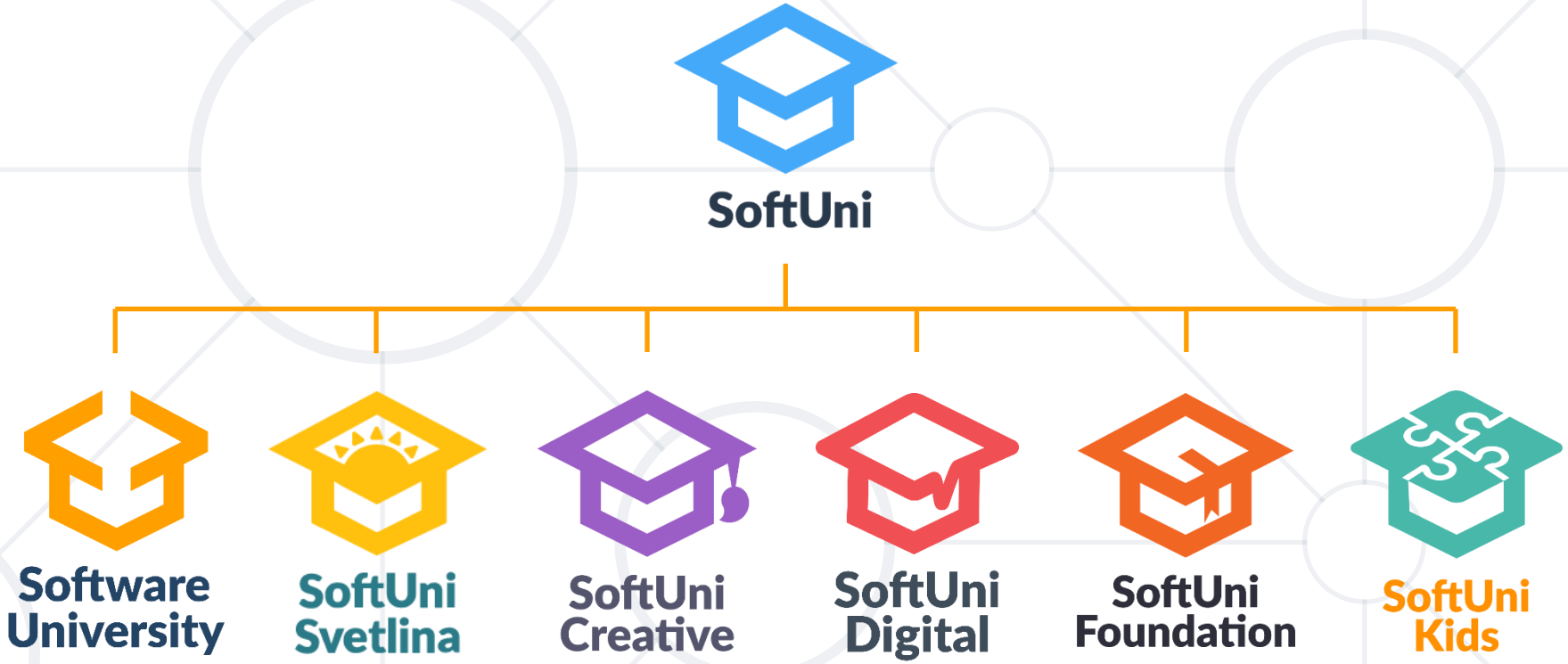
```
String text = sb.toString();
System.out.println(text);
// Hello George, how are you?
```

Live Exercises

Summary

- Strings are **immutable** sequences of Unicode characters
- String processing methods
  - `concat()`, `indexOf()`, `contains()`, `substring()`, `split()`, `replace()`, …
- **StringBuilder** efficiently builds/modifies strings

Questions?



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