Java Basics

Data types specifics, Console Interface, Collections (Maps, Lists, Sets), Generics

SoftUni Team

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Data Types in Java

Integer Types

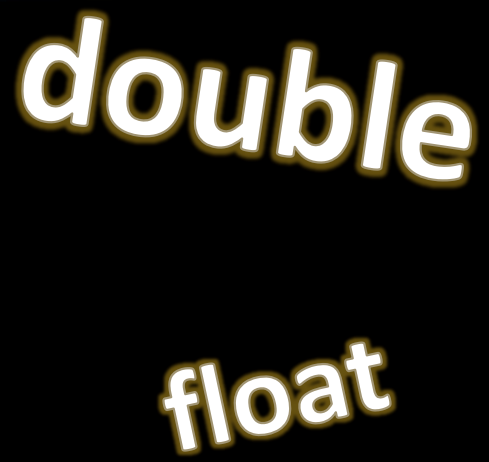
- `byte` (-128 to 127): signed 8-bit
- `short` (-32,768 to 32,767): signed 16-bit
- `int` (-2,147,483,648 to 2,147,483,647): signed 32-bit
- `long` (-9,223,372,036,854,775,808 to 9,223,372,036,854,775,807): signed 64-bit

```
byte b = 1;
int i = 5;
long num = 3L;
short sum = (short) (b + i + num);
```

Capital l is harder to confuse with 1

Floating-Point Types

- Floating-point types are:
  - `float` ($\pm 1.5 \times 10^{-45}$ to $\pm 3.4 \times 10^{38}$)
    - 32-bits, precision of 7 digits
  - `double` ($\pm 5.0 \times 10^{-324}$ to $\pm 1.7 \times 10^{308}$)
    - 64-bits, precision of 15-16 digits
- The default value of floating-point types:
  - Is `0.0F` for the `float` type
  - Is `0.0D` for the `double` type



Floating-Point Types – Examples


```
float f = 0.33f;
double d = 1.67;
double sum = f + d;
float fSum = f + d; // This will not compile
double infinity = 3.14 / 0;

System.out.println(f); // 0.33
System.out.println(d); // 1.67
System.out.println(sum); // 2.0000000013113022
System.out.println(infinity); // Infinity
```

"f" specifies a float

Double by default

BigDecimal

- The floating-point arithmetic sometime works incorrectly
  - Don't use **`float`** and **`double`** for financial calculations!
- In Java use the **`BigDecimal`** class for financial calculations:

```
import java.math.BigDecimal;
…
BigDecimal bigF = new BigDecimal("0.33");
BigDecimal bigD = new BigDecimal("1.67");
BigDecimal bigSum = bigF.add(bigD);
System.out.println(bigSum); // 2.00
```

Other Primitive Data Types

- Boolean

```
boolean b = true;
System.out.println(b); // true
System.out.println(!b); // false
```

- Character

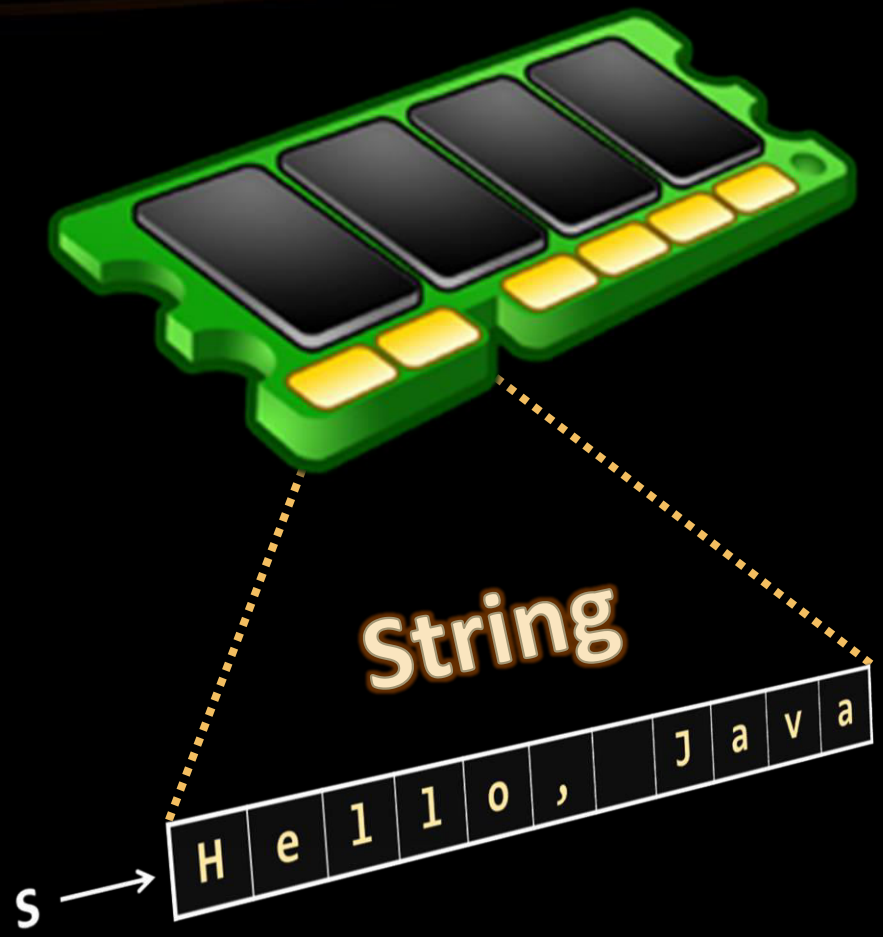
```
char ch = 'Ю';
System.out.println(ch);
char ch = '\u03A9'; // Ω
System.out.println(ch);
```

The String Data Type

- The String data type:
  - Declared by the `String` class
  - Represents a sequence of characters
  - Has a default value `null` (no value)
- Strings are enclosed in quotes:

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

- Strings can be concatenated
  - Using the + operator



The Object Type

- The Object type:
  - Is declared by the `java.lang.Object` class
  - Is the base type of all other types
  - Can hold values of any type

Object

```
object dataContainer = 5;
System.out.print("The value of dataContainer is: ");
System.out.println(dataContainer);

dataContainer = "Five";
System.out.print("The value of dataContainer is: ");
System.out.println(dataContainer);
```

Nullable Types: Integer, Long, Boolean, …

- Each primitive type in Java has a corresponding wrapper:
  - `int` → `java.lang.Integer`
  - `double` → `java.lang.Double`
  - `boolean` → `java.lang.Boolean`
- Primitive wrappers can have a value or be `null` (no value)

```
Integer i = 5; // Integer value: 5
i = i + 1; // Integer value: 6
i = null; // No value (null)
i = i + 1; // NullPointerException
```

Type Conversion

- Type conversion and typecasting change one type to another
  - Java supports Explicit type conversion (casting)

```
float heightInMeters = 1.74f; // Explicit conversion
double minHeight = (double) heightInMeters; // Explicit
byte dataLoss = (byte) 12345; // Explicit with data loss
```

  - Java also supports Implicit type conversion

```
double maxHeight = heightInMeters; // Implicit
//double minHeight = heightInMeters; // Compilation error!
```

Implicit casting is not allowed if data loss is possible

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Console Input and Output

Scanner and Formatted Printing

Reading From the Console

- The `java.util.Scanner` class can read strings

```
import java.util.Scanner;
…

Scanner scanner = new Scanner(System.in);
String name = scanner.nextLine();
```

- The `scanner` takes as a parameter an input stream
- `nextLine()` reads a whole line
- `next()` reads the string before the next delimiter

Reading From the Console (2)

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- The `java.util.Scanner` class also reads numbers

```
import java.util.Scanner;
…

Scanner scanner = new Scanner(System.in);
int firstNum = scanner.nextInt();
double secondNum = scanner.nextDouble();
```

- The numbers can be separated by any sequence of whitespace characters (e.g. spaces, tabs, new lines, …)
- Exception is thrown when non-number characters are entered

Printing to the Console

- Using `System.out.print()` and `System.out.println()`:

```
String name = "SoftUni";
String location = "Sofia";
double age = 3.5;

System.out.print(name);
System.out.println(" is " + age +
    " years old organization located in " + location + ".");

// Output:
// SoftUni is 0.5 years old organization located in Sofia.
```

Prints without a new line

Prints a new line

Formatted Printing

- Java supports formatted printing by `System.out.printf()`
  - `%s` – prints a string argument

```
System.out.printf("Name: %s", name);
```

  - `%f` – prints a floating-point argument

```
System.out.printf("Height: %f", height);
```

  - `%.2f` – prints a floating-point argument with 2 digits precision

```
System.out.printf("Height: %.2f", height);
```

  - `%n` – prints a new line
- Learn more at http://docs.oracle.com/javase/8/docs/api/java/util/Formatter.html

Lists in Java

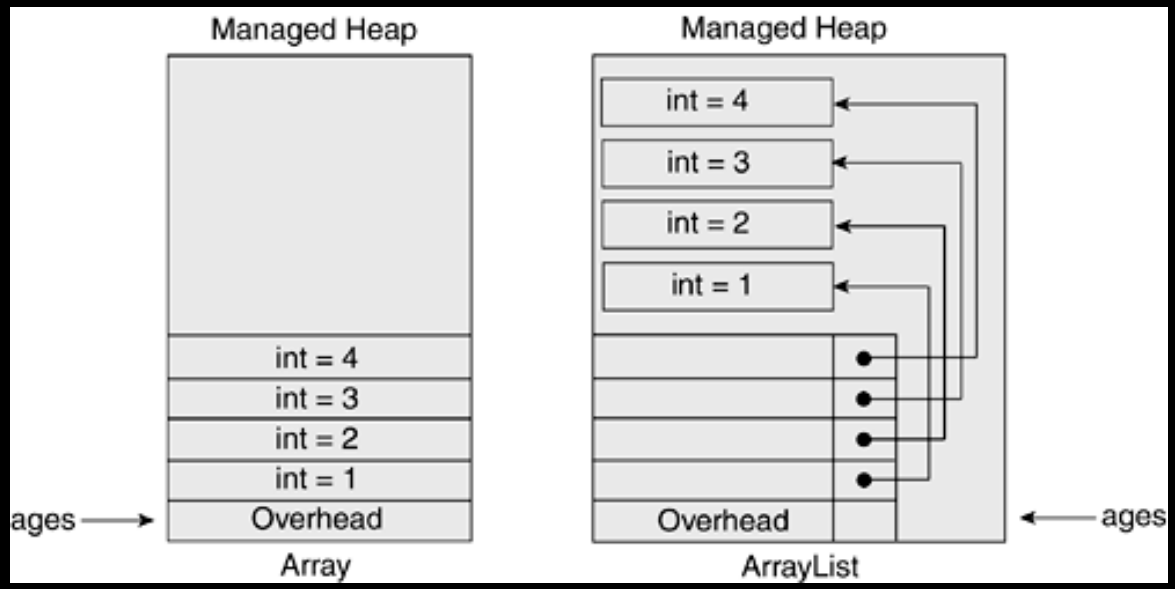
- In Java arrays have fixed length
  - Cannot add / remove / insert elements
- Lists are like resizable arrays
  - Allow add / remove / insert of elements
- Lists in Java are defined through the **`ArrayList<E>`** class
  - Where **`E`** is the type of the list, e.g. **`String`** or **`Integer`**

Prefer Interface rather than Class

```
List<Integer> numbers = new ArrayList<Integer>();
numbers.add(5);
System.out.println(numbers.get(0)); // 5
```

How array lists are stored in the memory

- Reference data type
  - Variable “ages” holds pointers to Objects in the heap as values.
  - Each Object has an address that points to a value in the memory.



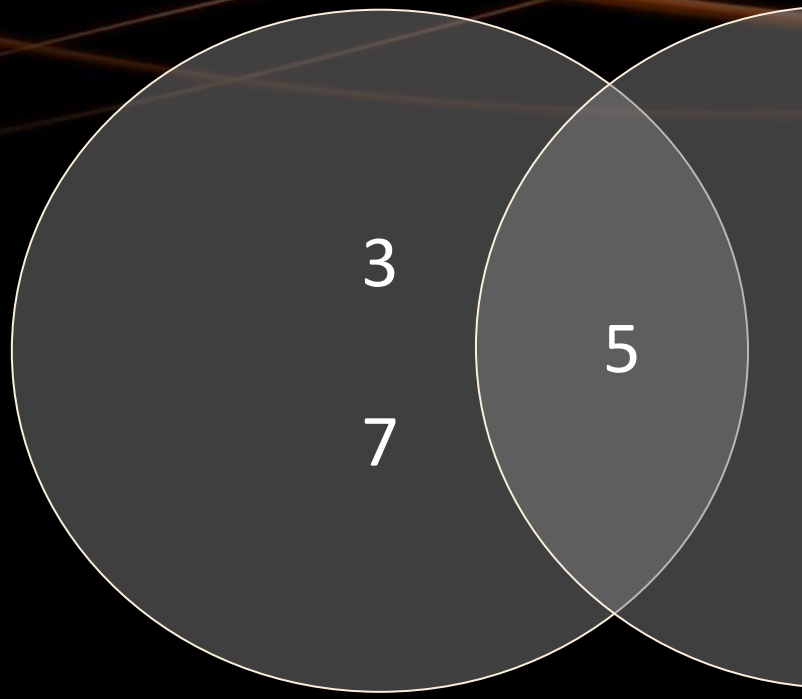
ArrayList<String> – Example


```
List<String> names = new ArrayList<String>() {{
        add("Peter");
        add("Maria");
        add("Katya");
        add("Todor");
}};
names.add("Nakov"); // Peter, Maria, Katya, Todor, Nakov
names.remove(0); // Maria, Katya, Todor, Nakov
names.remove(1); // Maria, Todor, Nakov
names.remove("Todor"); // Maria, Nakov
```

ArrayList<Integer> – Example


```
// This will not compile!
List<int> intArr = new ArrayList<int>();

// This will compile!
List<Integer> nums = new ArrayList<>(
    Arrays.asList(5, -3, 10, 25));
nums.add(55); // 5, -3, 10, 25, 55
System.out.println(nums.get(0)); // 5
System.out.println(nums); // [5, -3, 10, 25, 55]
nums.remove(2); // 5, -3, 25, 55
nums.set(0, 101); // 101, -3, 25, 55
System.out.println(nums); // [101, -3, 25, 55]
```



Sets

HashSet<E>, TreeSet<E> and LinkedHashSet<E>

Sets in Java

- A set keeps unique elements
  - Provides methods for adding/removing/searching elements
  - Offers very fast performance
- `HashSet<E>`
  - The elements are randomly ordered
- `TreeSet<E>`
  - The elements are ordered incrementally
- `LinkedHashSet<E>`
  - The order of appearance is preserved

Sets Methods

- Initialization

```
Set<String> hash = new HashSet<String>();
```

  - For easy reading you can use diamond inference syntax

```
Set<String> tree = new TreeSet<>();
```

- .size()
- .isEmpty()

```
Set<String> hash = new HashSet<>();
System.out.println(hash.size()); // 0
System.out.println(hash.isEmpty()); // True
```

HashSet<E> – add()

HashSet<E> – remove()

TreeSet<E> – add()

LinkedHashSet<E> – add()

Problem: SoftUni party

- Guests are two types:
  - Regular
  - VIPs – their tickets start with digit
- Until PARTY command, you will receive guest invitations
- Next until END command, you will receive a second list with guests that actually come to the party
- Find how many guests didn't came to the party
- Print all guests that didn’t came (VIPs first)

Reservation List

```
7IK9Yo0h
9NoBUajQ
Ce8vwPmE
SVQXQCbc
```

Solution: SoftUni party

```
Set<String> vip = new HashSet<String>();
Set<String> regular = new TreeSet<String>();
while (true)
  String input = sc.nextLine();
  if (input.equals("PARTY"))
    break;
  else
    String sign = Character.toString(input.charAt(0));
    if (numbers.contains(sign))
      vip.add(input);
    else
      regular.add(input);
//TODO: Remove from guest, that came to party
regular.addAll(vip);
//TODO: Print results
```

Return `true` or `false`

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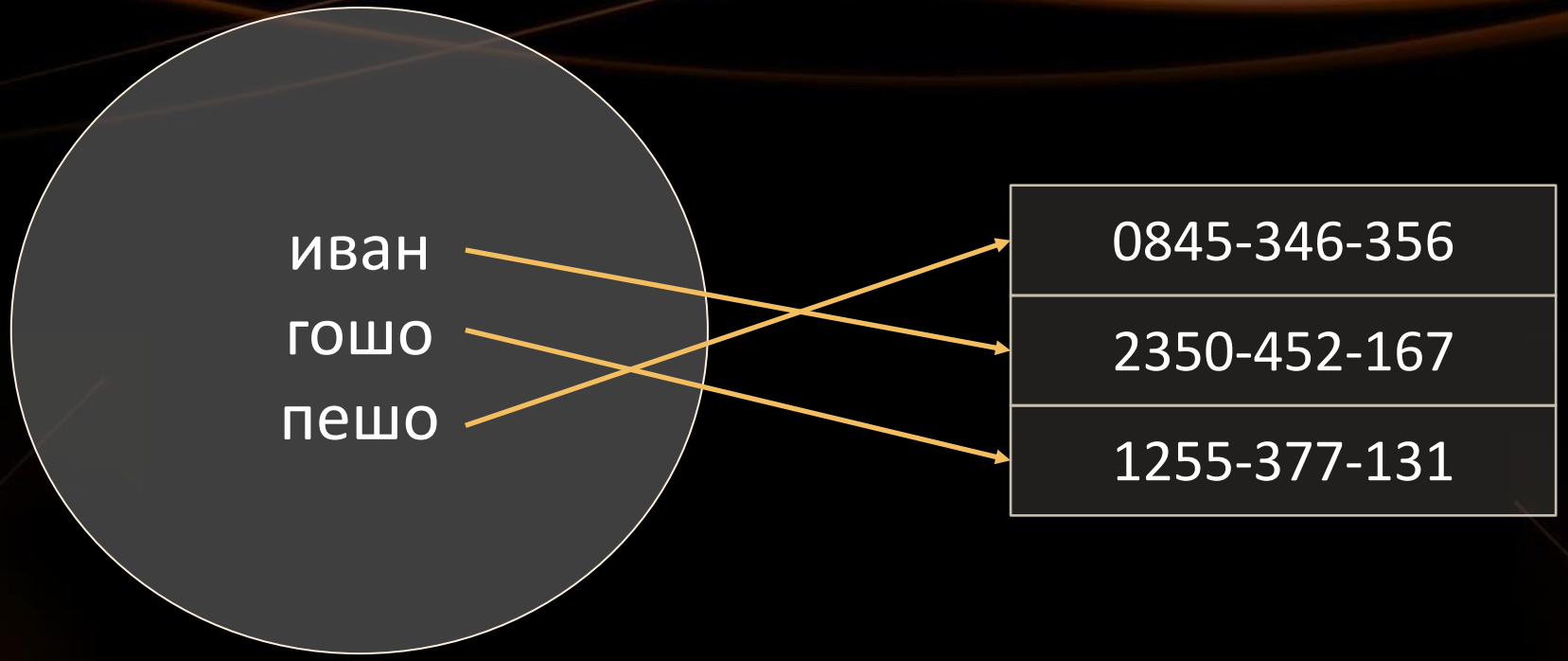


Associative Arrays

`HashMap<Key, Value>`

Associative Arrays (Maps)

- Associative arrays are arrays indexed by keys
  - Not by the numbers 0, 1, 2, …
- Hold a set of pairs `<key, value>`
- Traditional array

key	0	1	2	3	4
value	8	-3	12	408	33

- Associative array

key	value
John Smith	+1-555-8976
Lisa Smith	+1-555-1234
Sam Doe	+1-555-5030

Maps Methods

- Initialization

```
HashSet<String, Integer> hash = new HashSet<String>();
```

Type of keys

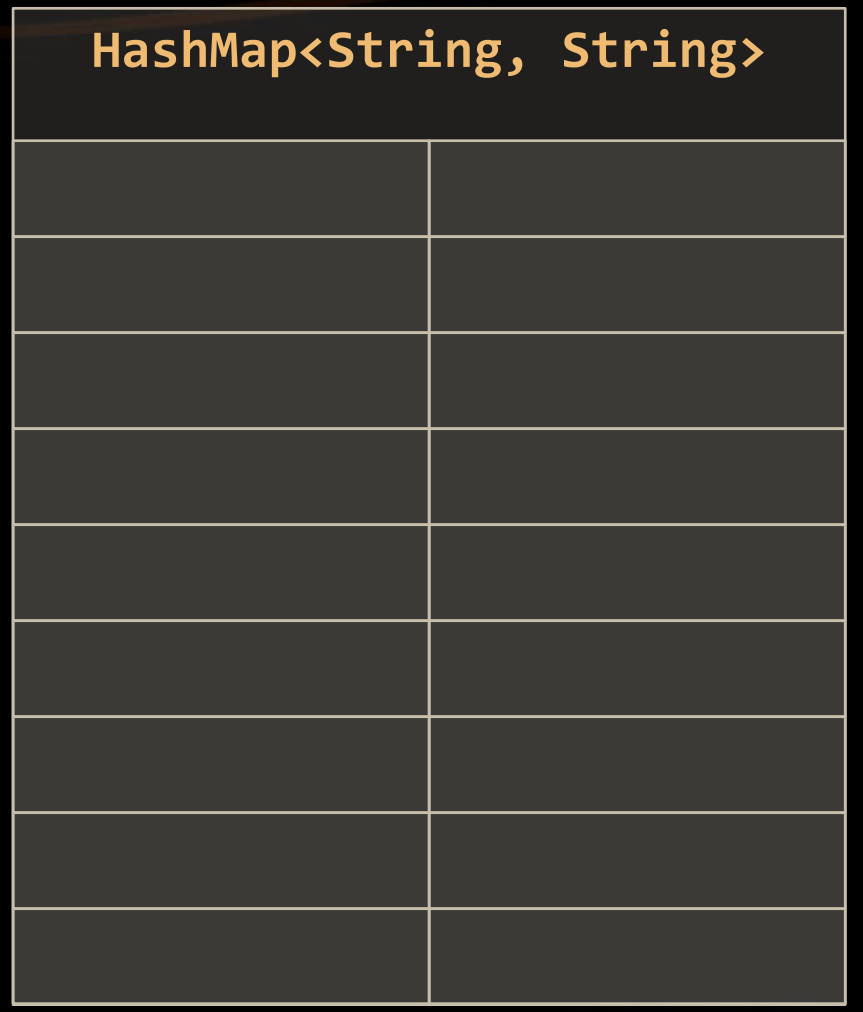
Type of values

- .size()
- .isEmpty()

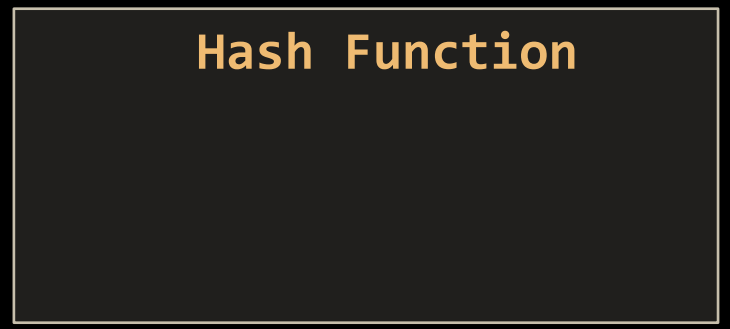
```
Set<String> hash = new HashSet<>();
System.out.println(hash.size()); // 0
System.out.println(hash.isEmpty()); // True
```

HashMap<K, V> – put()

Hash Function



HashMap<K, V> – remove()



HashMap<String, String>	
Gosho	0881-456-987
Pesho	0881-123-987
Alice	+359-899-55-592
Key	Value

Looping Through Maps - Example

```
Map<String, Integer> vehicles = new HashMap<>();
vehicles.put("BMW", 5);
vehicles.put("Mercedes", 3);
vehicles.put("Audi", 4);
vehicles.put("BMW", 10);
for(String key: vehicles.keySet())
  System.out.println(key + " - " + vehicles.get(key));
```

Override first value

Return set of all keys

Return value for key

```
Audi - 4
Mercedes - 3
BMW - 10
```

TreeMap<K, V> – put()

Peter	+359 888 123 456

Tree Map<String, String>	
Key	Value

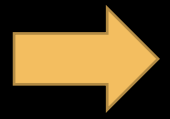
HashMap<K, V>, TreeMap<K, V>, LinkedHashMap<K, V>

- `size()` – the number of key-value pairs
- `keySet()` – a set of unique keys
- `values()` – a collection of all values
- Basic operations – `put()`, `remove()`, `clear()`
- Boolean methods:
  - `containsKey()` – checks if a key is present in the dictionary
  - `containsValue()` – checks if a value is present in the dictionary

Problem: Academy Graduation

- Write a program that:
  - Read list of students and their score for some courses
  - Print on console sorted list with average score for each student

Student	Java Advanced	Java OOP
Gosho	3.75	5
Mara	4.25	6
Pesho	6	4.5



Student	Average
Gosho	4,375
Mara	5,125
Pesho	7,25

Solution: Count Same Values in Array

```
Map <String,Double[]> graduationList = new TreeMap<>();
for (int i = 0; i < numberOfStudents; i++) {
  String name = scanner.nextLine();
  String[] scoresStrings = scanner.nextLine().split(", ");
  Double[] scores = new Double[scoresStrings.length];

  for (int j = 0; j < scoresStrings.length; j++) {
    scores[j] = Double.parseDouble(scoresStrings[j]);
  }
  graduationList.put(name, scores);
}
//TODO print results
```

Summary

1. Java Intro - minimal Java program
2. Data Types
3. Console Interface
4. Collection
5. Generics

Java Basics

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