UNIT 6

INTRODUCTION TO KOTLIN

PMDM - 2DAM

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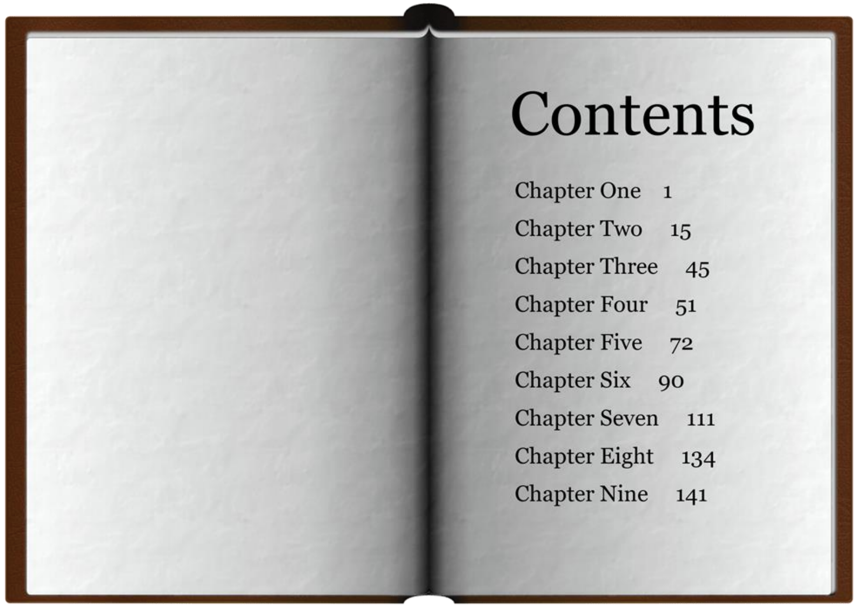
8. COMPLEX DATA TYPE



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INTRODUCTION

- Developed by JetBrains (Russia) in 2011
- Popular programming language especially in **Android development**
- Designed to be **interoperable with Java** → one can use it in projects that are already written in Java and vice versa

Key features

Security (null safety)	**Conciseness** (fewer lines of code)
Interoperability (Kotlin <-> Java)	**Functional programming** (higher-order functions, lambdas ...)
Object-oriented	Cross-platform support

INTRODUCTION

Installation

- Install the desired version of java
- Install Kotlin
- Create a “Hello World” file *hello.kt*
- Compile and Run
- One can also start some Kotlin coding and testing using a Kotlin playground

  https://play.kotlinlang.org

  https://developer.android.com/training/kotlinplayground

```
sudo apt install openjdk-11-jdk
```

```
sudo snap install --classic kotlin
```

```
fun main() {

println("Hello World!")

}
```

```
kotlinc hello.kt -include-runtime -d hello.jar
```

```
java -jar hello.jar
```

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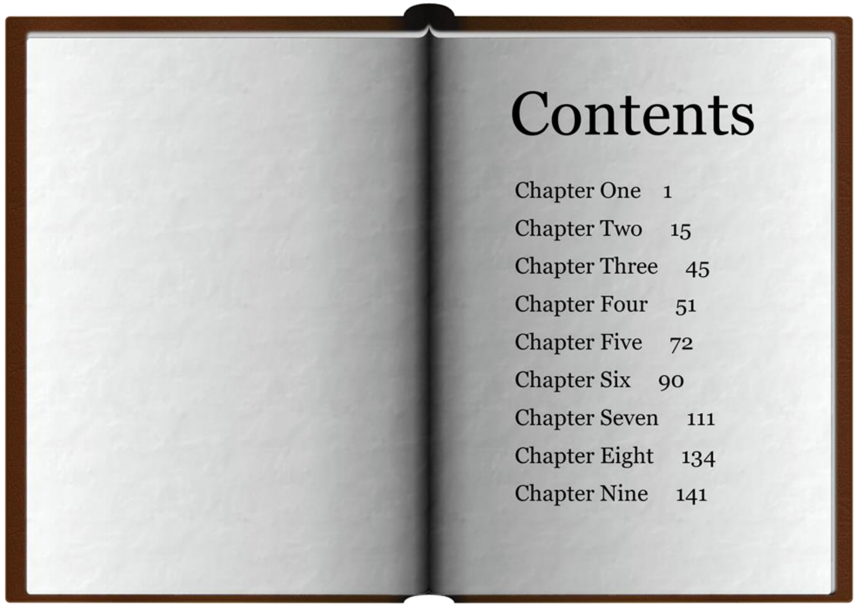

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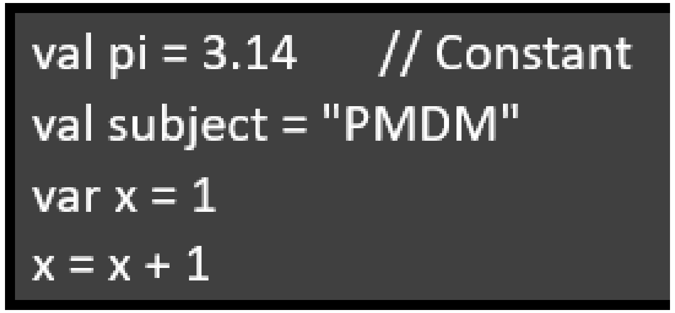
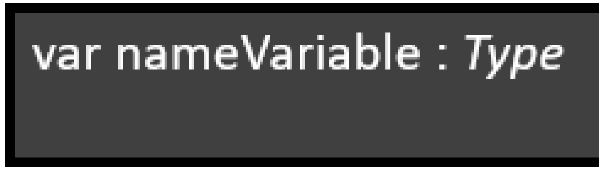
VARIABLES AND DATA TYPES

- In Kotlin data types are classes, so we can access their properties and member functions
- Use *var* to define mutable variables
- Use *val* to define immutable variables (constant values)
- It is recommended to use constant values if we know that they won’t be modified



```
val pi = 3.14      // Constant
val subject = "PMDM"
var x = 1
x = x + 1
```

Kotlin can infer the type of variables from the values with which we initialize them

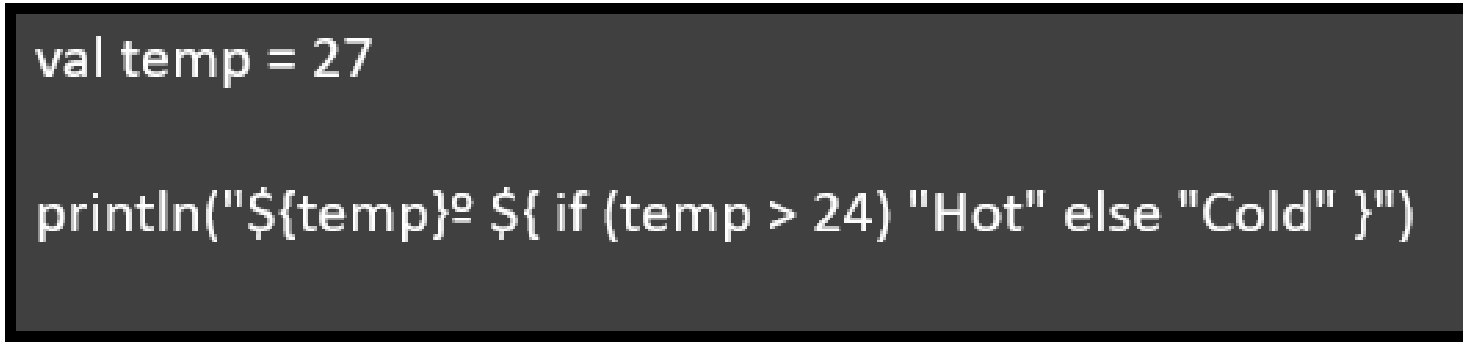


```
var nameVariable : Type
```

VARIABLES AND DATA TYPES

String Templates

- Fragments of code that will be evaluated and their result concatenated into the string
- Begin with the dollar sign *$* and consist of a **variable name or** an **expression** between keys *{}*



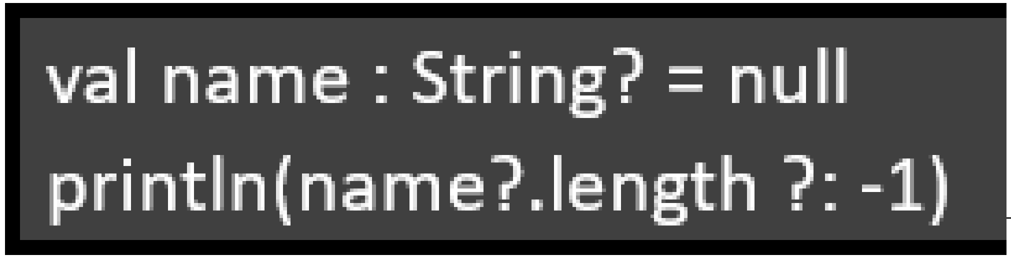
```
val temp = 27

println("${temp}º ${ if (temp > 24) "Hot" else "Cold" }")
```

VARIABLES AND DATA TYPES

Nullable Types and Elvis Operator

- Kotlin does not allow variable values to be *null* by default
- Prevents us from programming errors such as *NullPointerException*
- If we want to specify that a variable can contain a *null* value, it is necessary to **explicitly define it as *nullable***
- Kotlin provides the "?:" operator (Elvis), to specify an alternative value when the variable is *null*



```
val name : String? = null
println(name?.length ?: -1)
```

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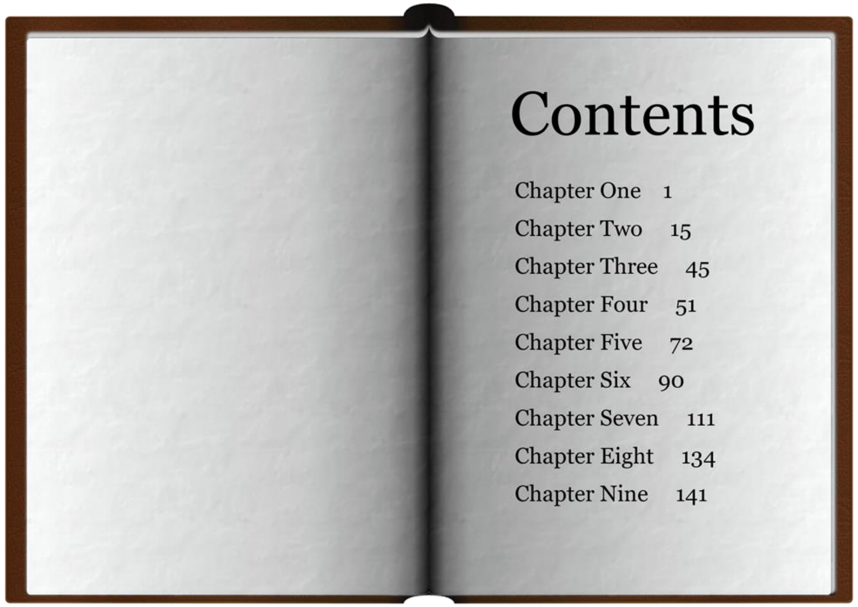

OPERATORS

ARITHMETIC OPERATORS	RELATIONAL OPERATORS	LOGICAL OPERATORS	TERNARY CONDITIONAL OPERATOR
+ - % * / ++ - -	== != <, >, <=, >= === same object ? !== not same object !	! Negation || OR && AND	variable = condition ? expression_1 : expression_2 ???

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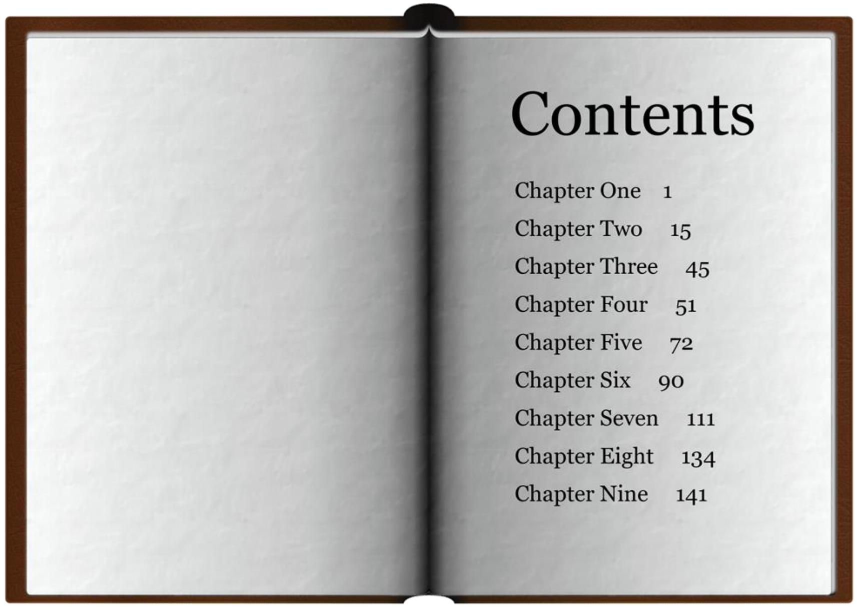

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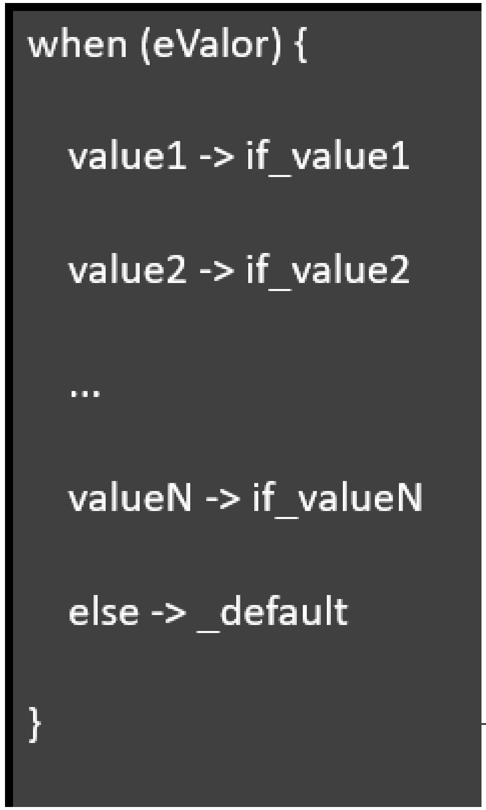
CONTROL STRUCTURE

If - else → Like in Java

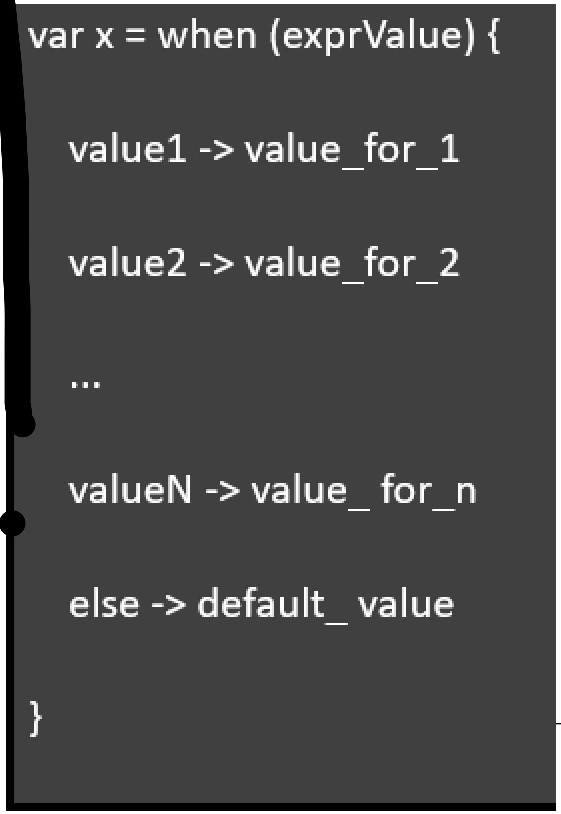
When

It can be expressed as a statement or as an expression



```
when (eValor) {

   value1 -> if_value1

   value2 -> if_value2

   ...

   valueN -> if_valueN

   else -> _default

}
```

? ?



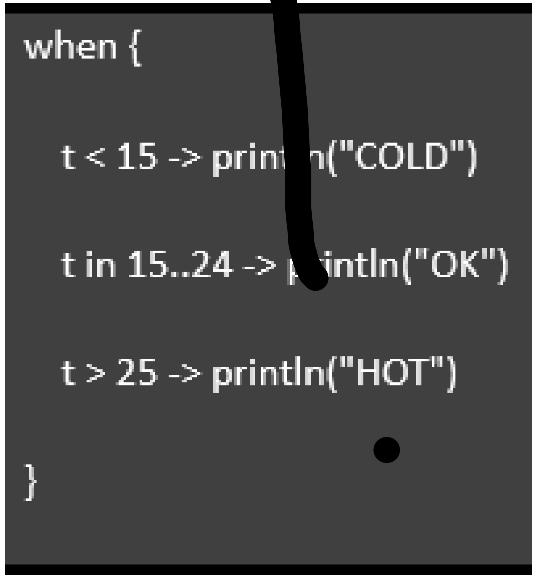
```
var x = when (exprValue) {

   value1 -> value_for_1

   value2 -> value_for_2

   ...

   valueN -> value_ for_n

   else -> default_ value

}
```

CONTROL STRUCTURE

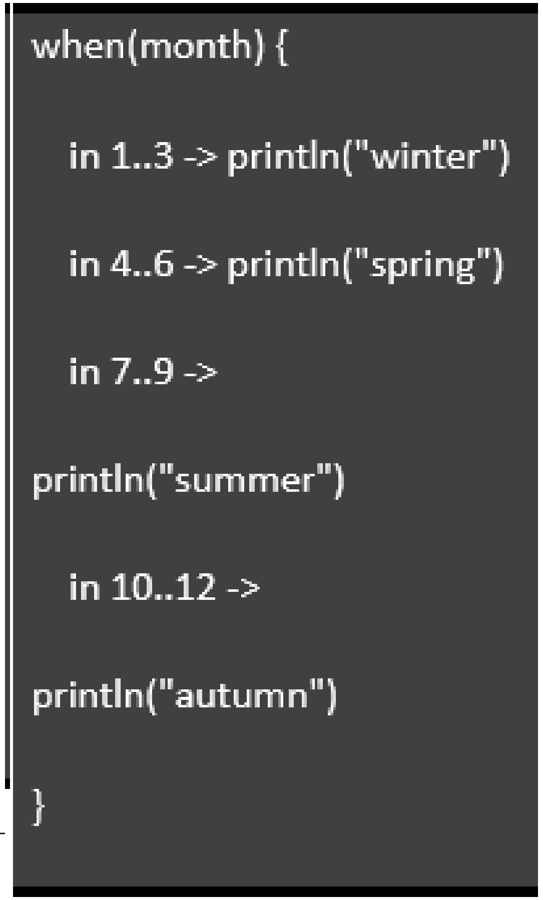
When

Also use it without arguments (as if-then-else) and with the “is” and “in” operators

? ?



```
when {

   t < 15 -> println("COLD")

   t in 15..24 -> println("OK")

   t > 25 -> println("HOT")

}
```



```
when(month) {

   in 1..3 -> println("winter")

   in 4..6 -> println("spring")

   in 7..9 ->

println("summer")

   in 10..12 ->

println("autumn")

}
```

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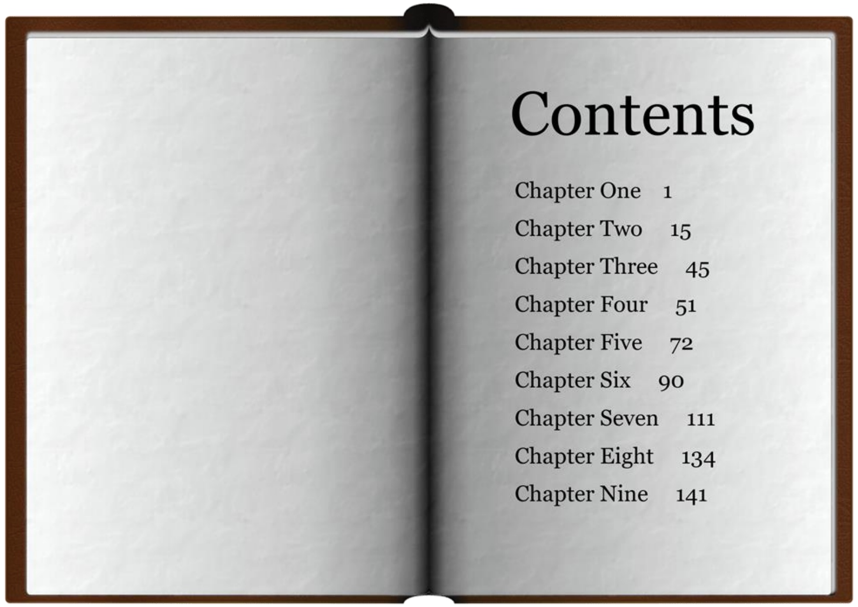

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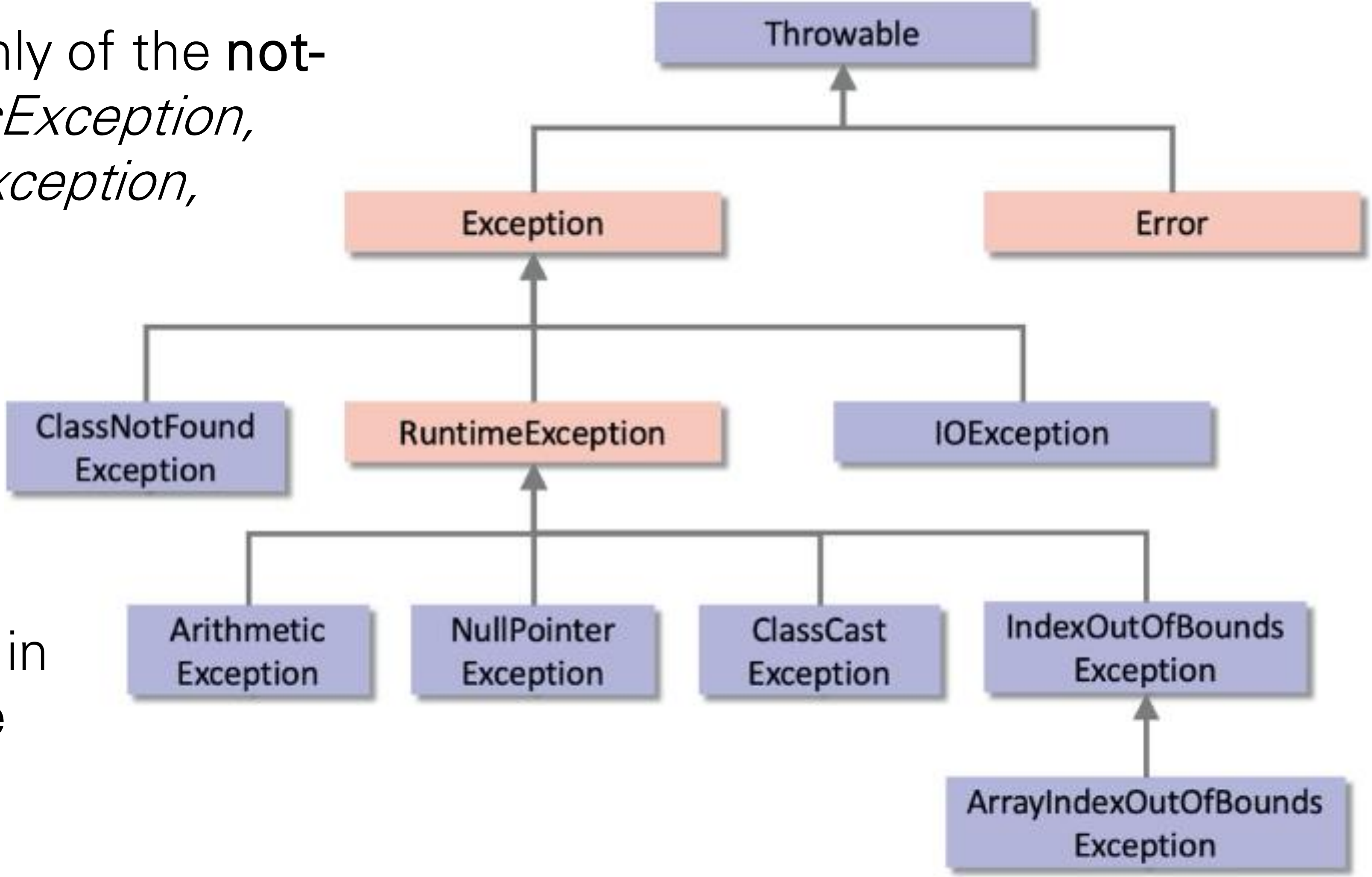
EXCEPTIONS

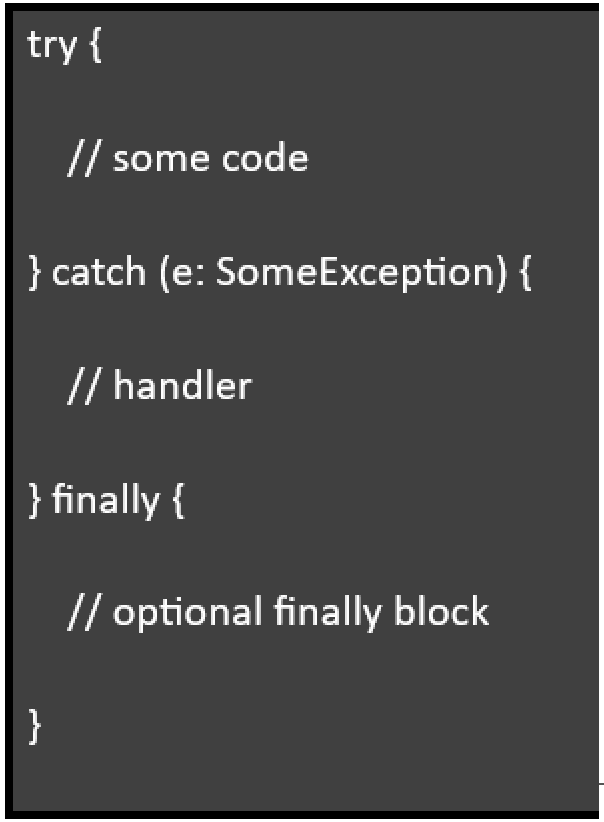
Exceptions in Kotlin are only of the **not-reviewed** type: *ArithmeticException, ArrayIndexOutOfBoundException, NullPointerException...*



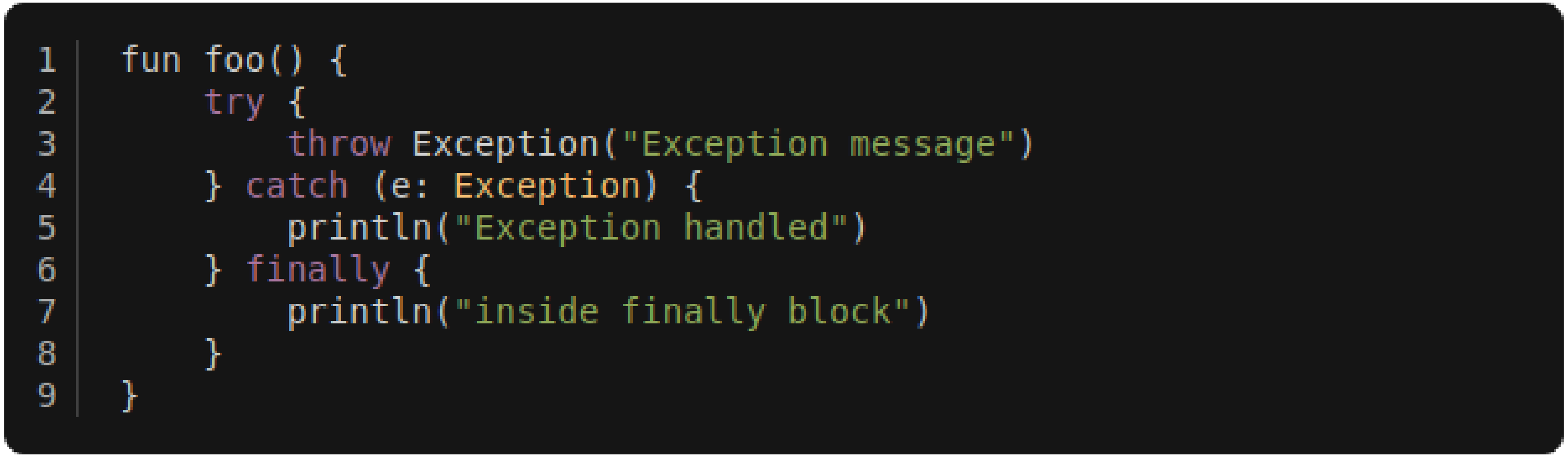
throws can not be included in function declarations where they may occur

EXCEPTIONS

This does not mean that we cannot handle exceptions or throw exceptions in our code



```
try {

   // some code

} catch (e: SomeException) {

   // handler

} finally {

   // optional finally block

}
```



```
fun foo() {
    try {
        throw Exception("Exception message")
    } catch (e: Exception) {
        println("Exception handled")
    } finally {
        println("inside finally block")
    }
}
```

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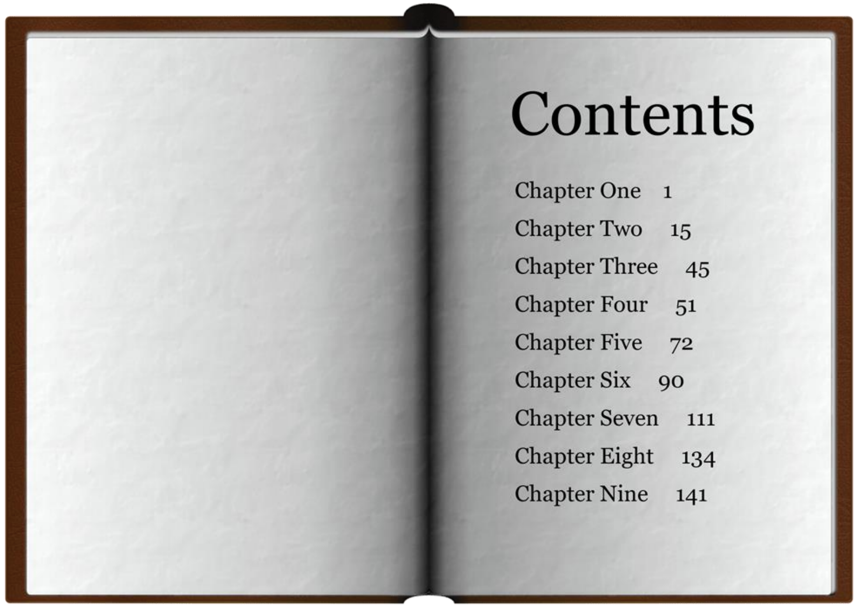

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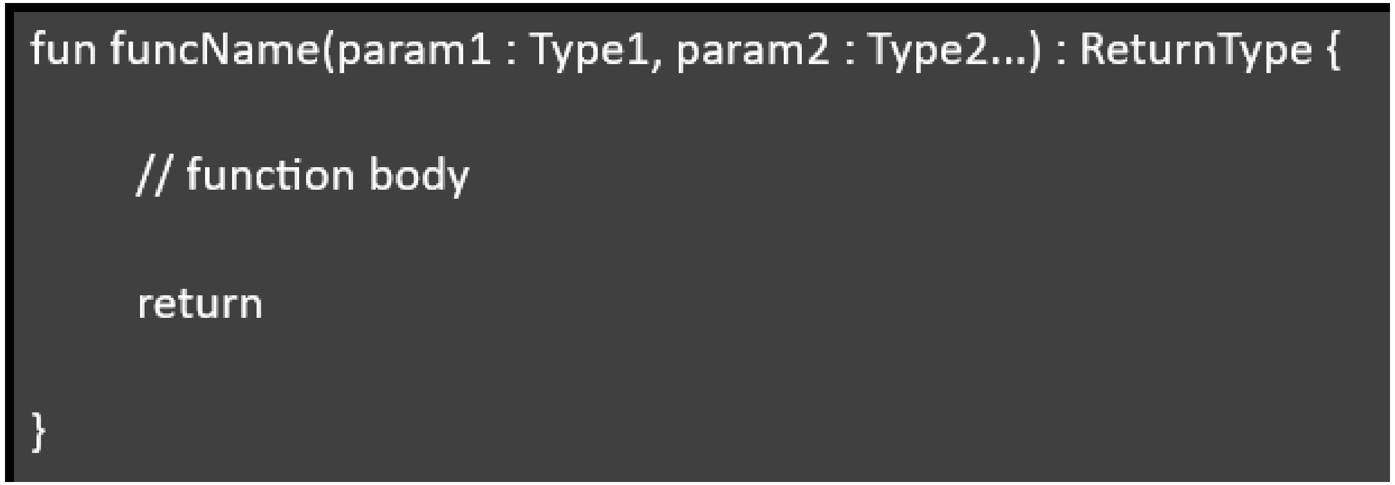
FUNCTIONS

Definition and Invocation



```
fun funcName(param1 : Type1, param2 : Type2...) : ReturnType {

    // function body

    return

}
```

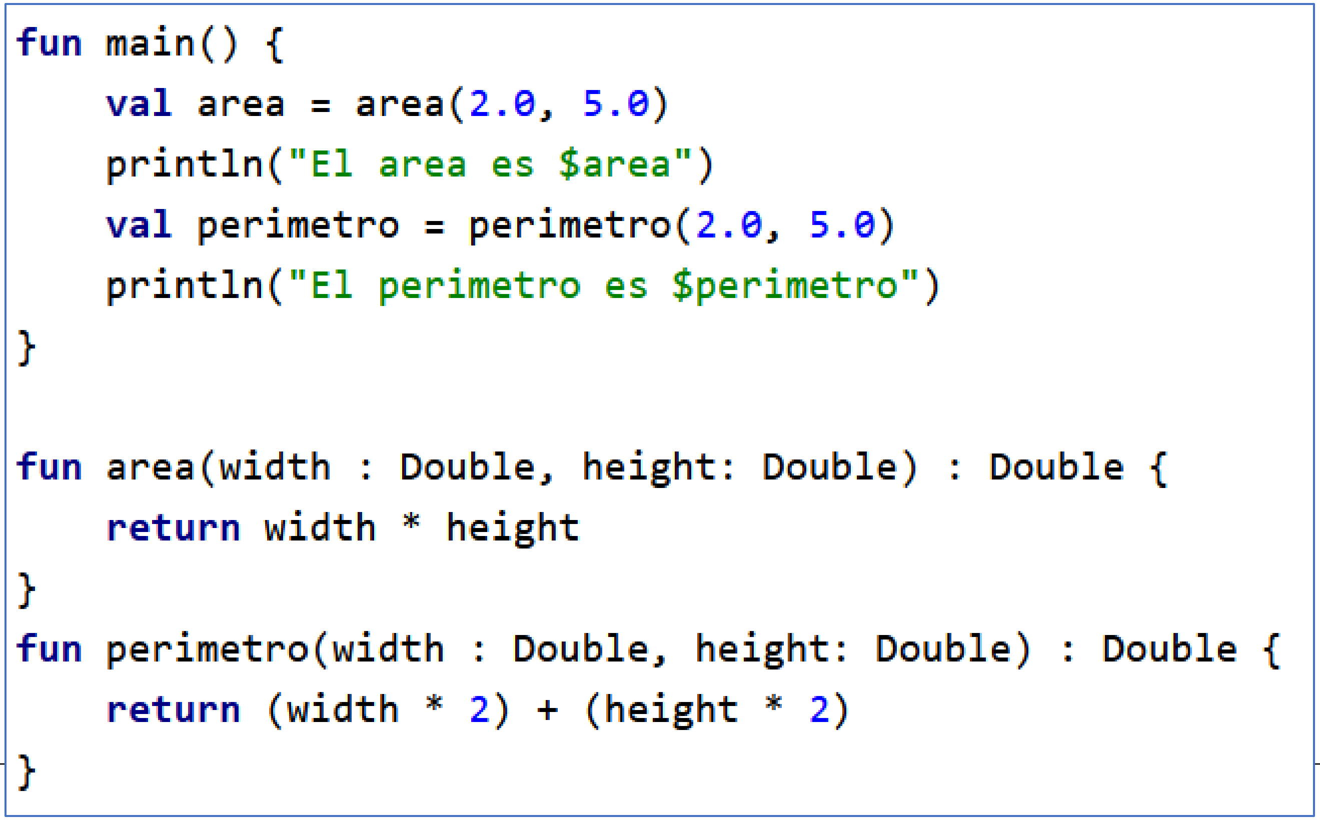
How did we call that in Java?

- Function parameters are specified in the form *parameter : Type*
- These types must necessarily be specified
- Return type may be specified after the parenthesis
- When the function does not return a value, its default return type is *Unit*

FUNCTIONS

Definition and Invocation

- Write a program that asks for the width and height of a rectangle and displays its area and perimeter. Implement a function for each thing

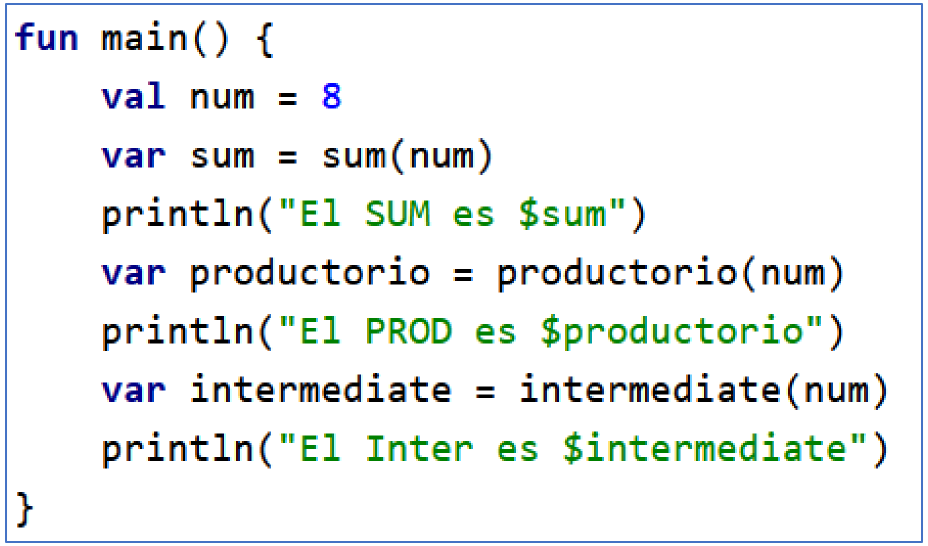


```
fun main() {
    val area = area(2.0, 5.0)
    println("El area es $area")
    val perimetro = perimetro(2.0, 5.0)
    println("El perimetro es $perimetro")
}

fun area(width : Double, height: Double) : Double {
    return width * height
}
fun perimetro(width : Double, height: Double) : Double {
    return (width * 2) + (height * 2)
}
```

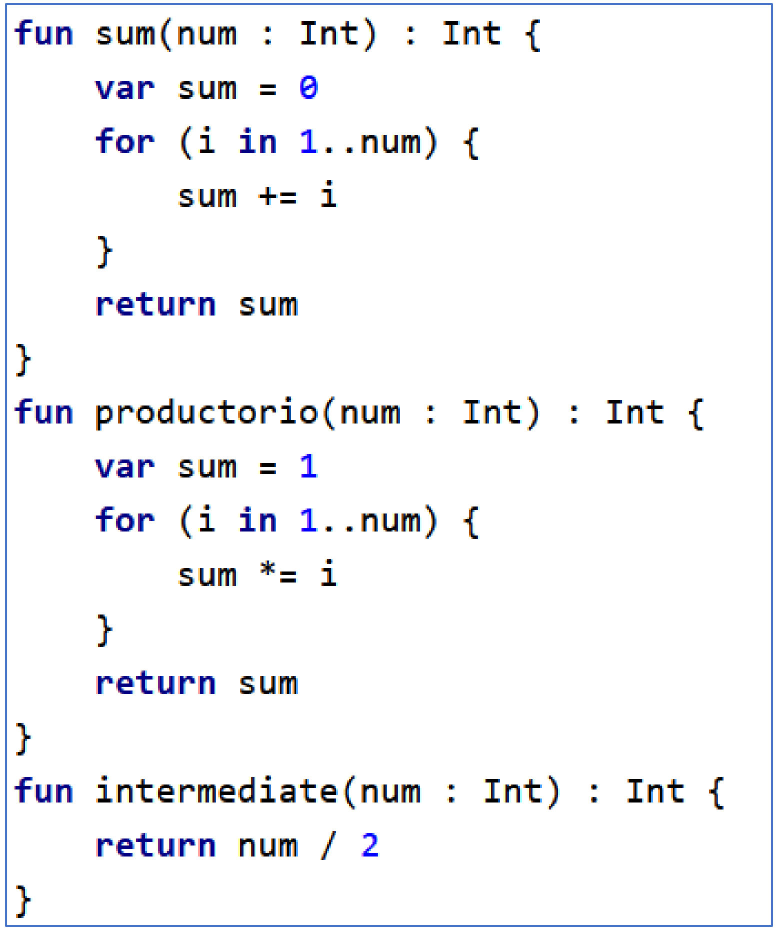
FUNCTIONS

Definition and Invocation

- Write a program that asks for an integer value N and then show: the SUM from 1 to N, the "*productorio*" from 1 to N and the intermediate value between 1 and N. Implement a function for each thing



```
fun main() {
    val num = 8
    var sum = sum(num)
    println("El SUM es $sum")
    var productorio = productorio(num)
    println("El PROD es $productorio")
    var intermediate = intermediate(num)
    println("El Inter es $intermediate")
}
```

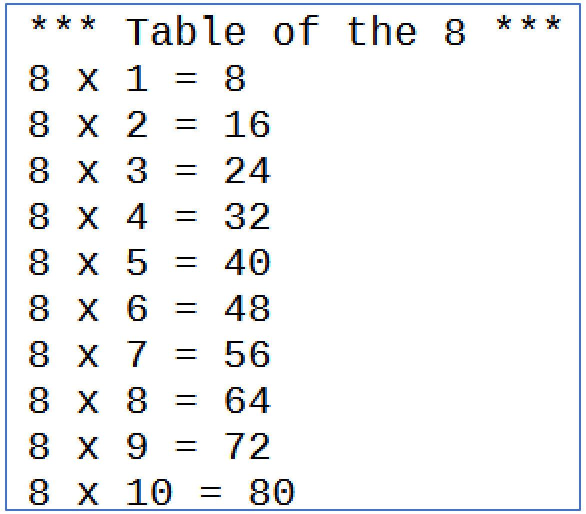


```
fun sum(num : Int) : Int {
    var sum = 0
    for (i in 1..num) {
        sum += i
    }
    return sum
}
fun productorio(num : Int) : Int {
    var sum = 1
    for (i in 1..num) {
        sum *= i
    }
    return sum
}
fun intermediate(num : Int) : Int {
    return num / 2
}
```

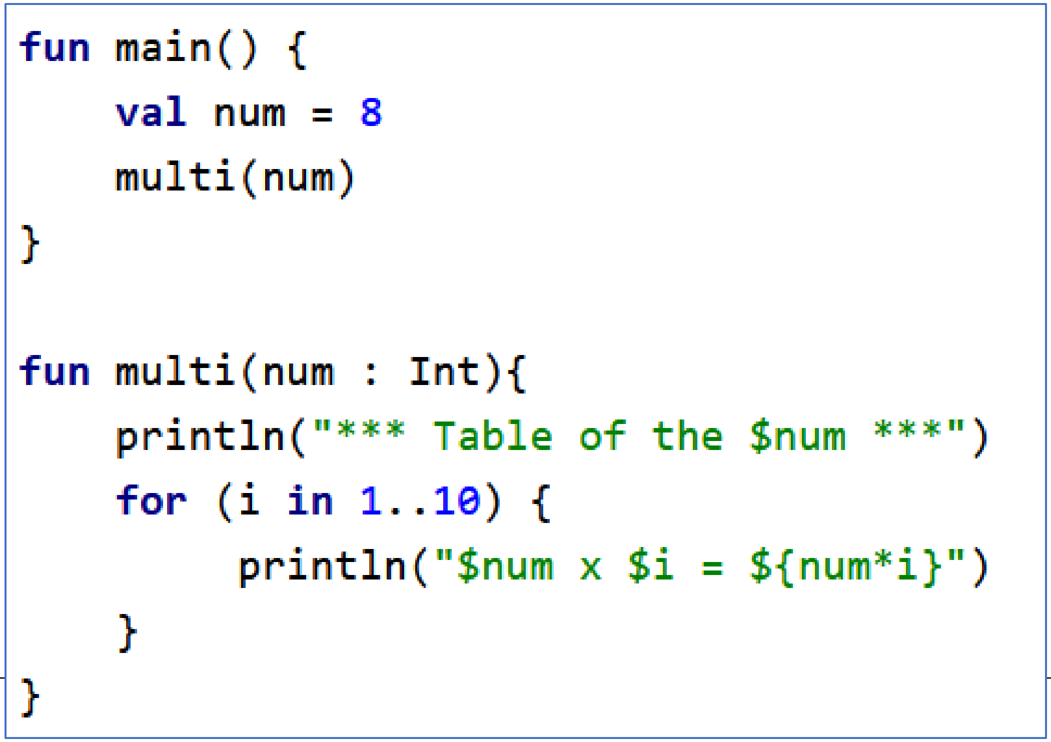
FUNCTIONS

Definition and Invocation

- Make a program that writes the multiplication table of an integer. Implement a function that receives as parameter a number and displays on the screen the multiplication table of this number



```
*** Table of the 8 ***
8 x 1 = 8
8 x 2 = 16
8 x 3 = 24
8 x 4 = 32
8 x 5 = 40
8 x 6 = 48
8 x 7 = 56
8 x 8 = 64
8 x 9 = 72
8 x 10 = 80
```

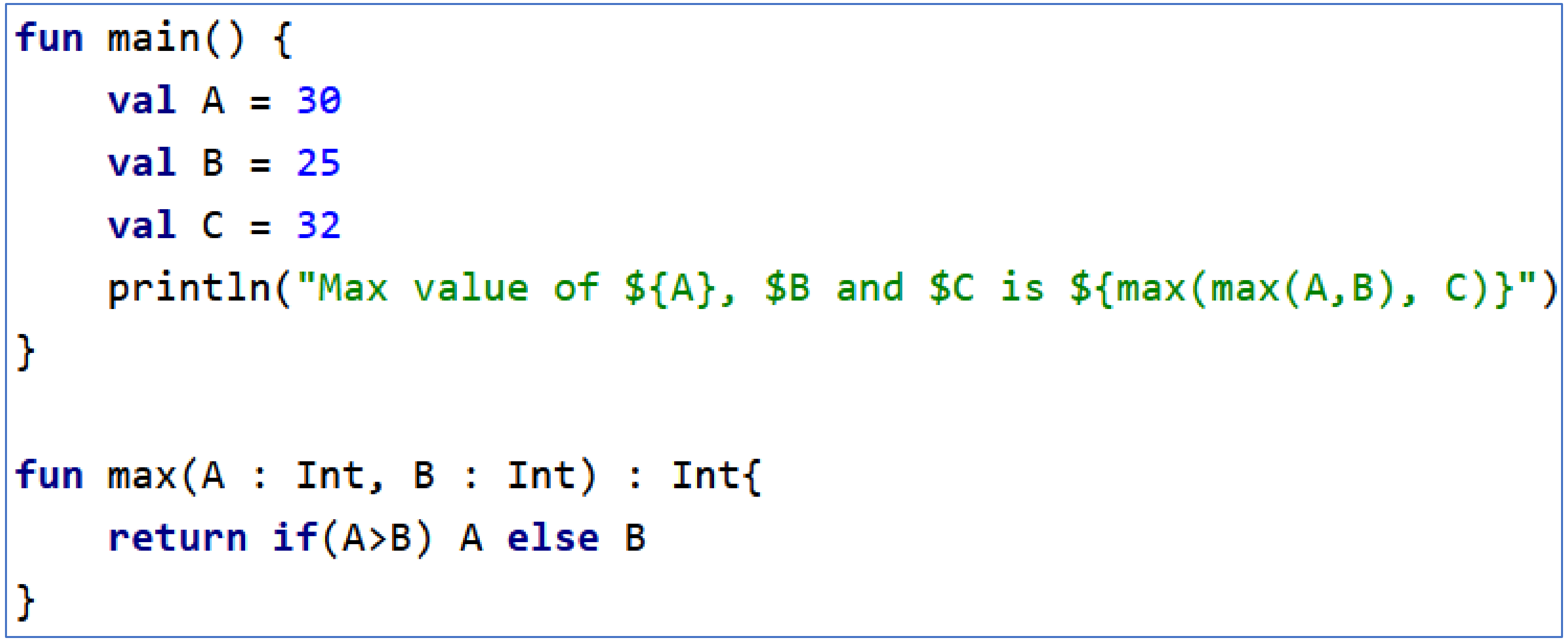


```
fun main() {
    val num = 8
    multi(num)
}

fun multi(num : Int){
    println("*** Table of the $num ***")
    for (i in 1..10) {
        println("$num x $i = ${num*i}")
    }
}
```

FUNCTIONS

Definition and Invocation

- Make a program that tells which of a given set of three integer values is the highest. Implement it by creating only one function to which **we pass two values (not three)** and return the maximum of the two values.



```
fun main() {
    val A = 30
    val B = 25
    val C = 32
    println("Max value of ${A}, $B and $C is ${max(max(A,B), C)}")
}

fun max(A : Int, B : Int) : Int{
    return if(A>B) A else B
}
```

FUNCTIONS

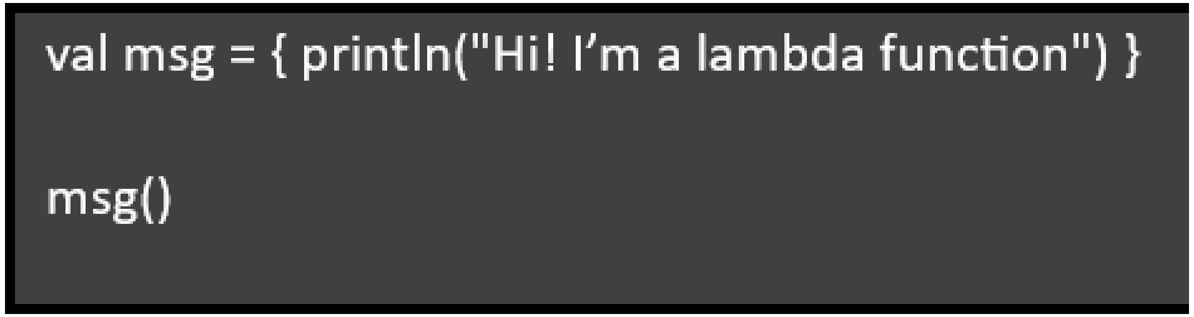
Lambda Expressions

- Represents the block of a function and simplifies the code
- Characteristics:
  - It has no *fun* keyword and access modifiers (private, public or protected)
  - It is an anonymous function (no name)
  - Return type is inferred by the compiler
  - The last expression is considered the return value

FUNCTIONS

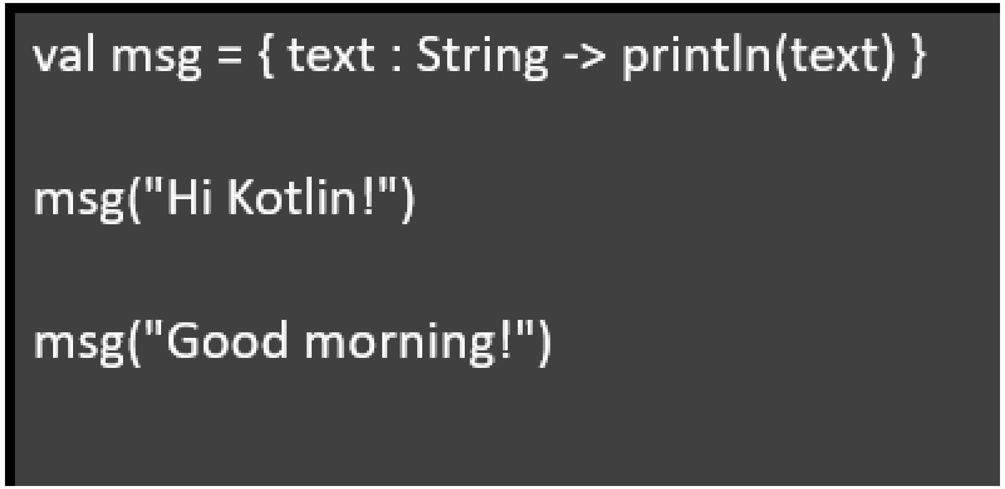
Lambda Expressions

Without parameters and assigned to a variable



```
val msg = { println("Hi! I’m a lambda function") }

msg()
```

With parameters

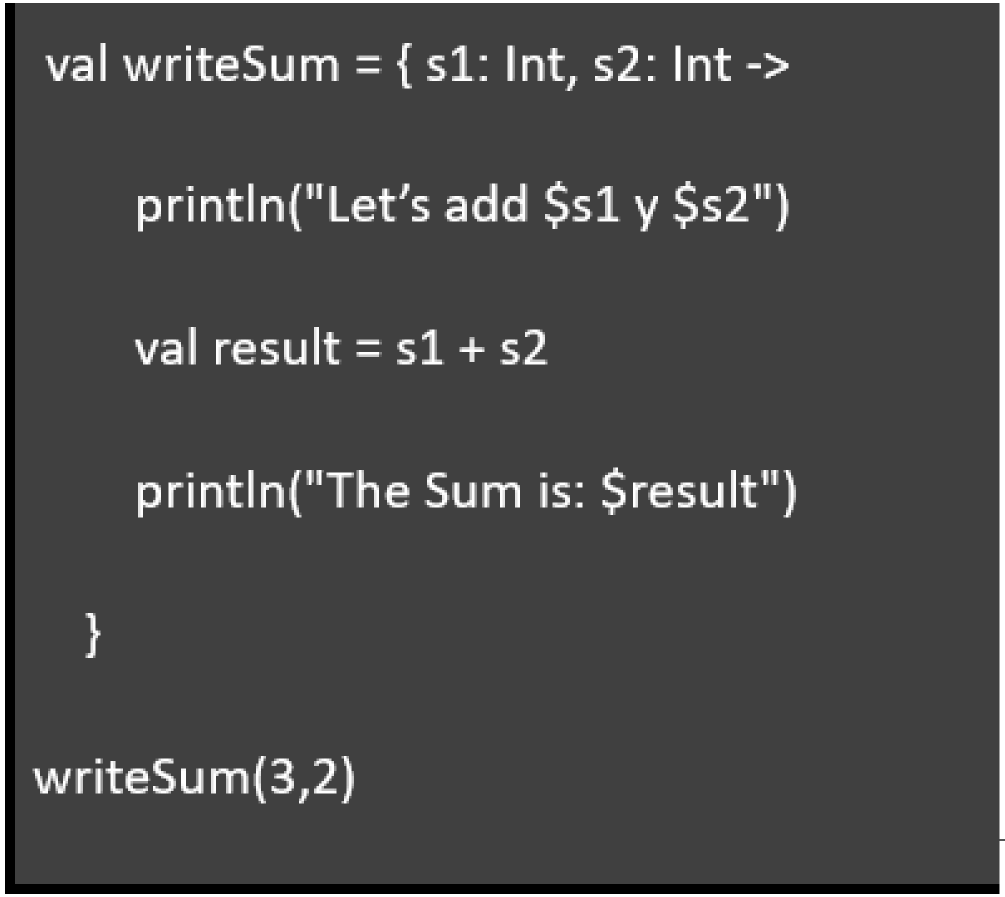


```
val msg = { text : String -> println(text) }

msg("Hi Kotlin!")

msg("Good morning!")
```

FUNCTIONS

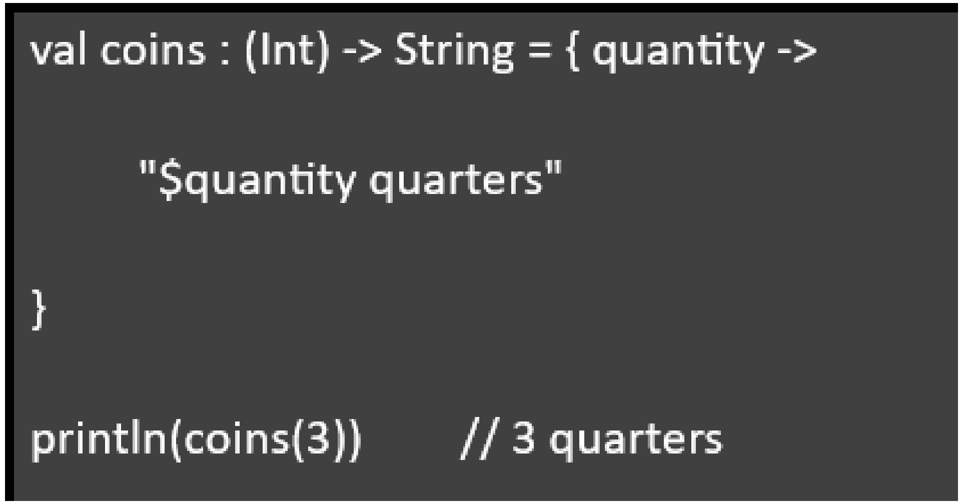
Lambda Expressions

With N parameters

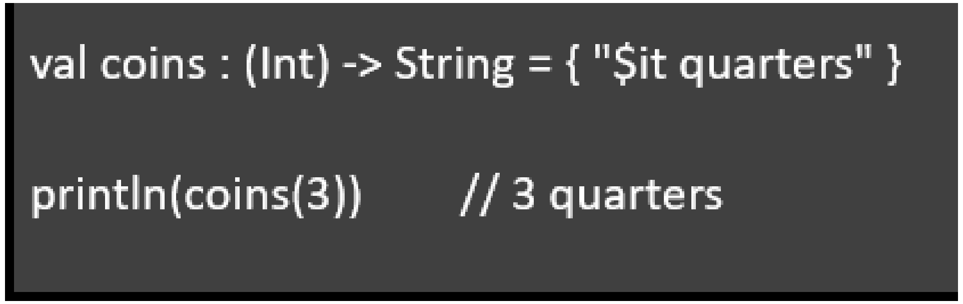


```
val writeSum = { s1: Int, s2: Int ->
      println("Let’s add $s1 y $s2")
      val result = s1 + s2
      println("The Sum is: $result")
  }
writeSum(3,2)
```

Omitting parameters



```
val coins : (Int) -> String = { quantity ->
       "$quantity quarters"
}
println(coins(3))      // 3 quarters
```



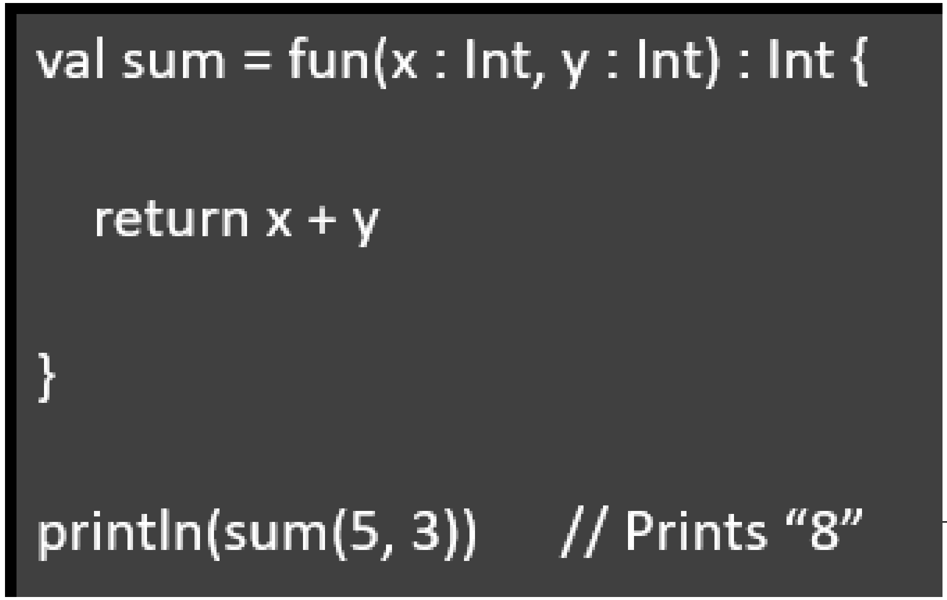
```
val coins : (Int) -> String = { "$it quarters" }
println(coins(3))      // 3 quarters
```

use of *it* when only one param

FUNCTIONS

Anonymous Functions

- These functions can be assigned to variables or passed as arguments to other functions
- They are often used to implement functional interfaces, such as *Runnable* or *OnClickListener*

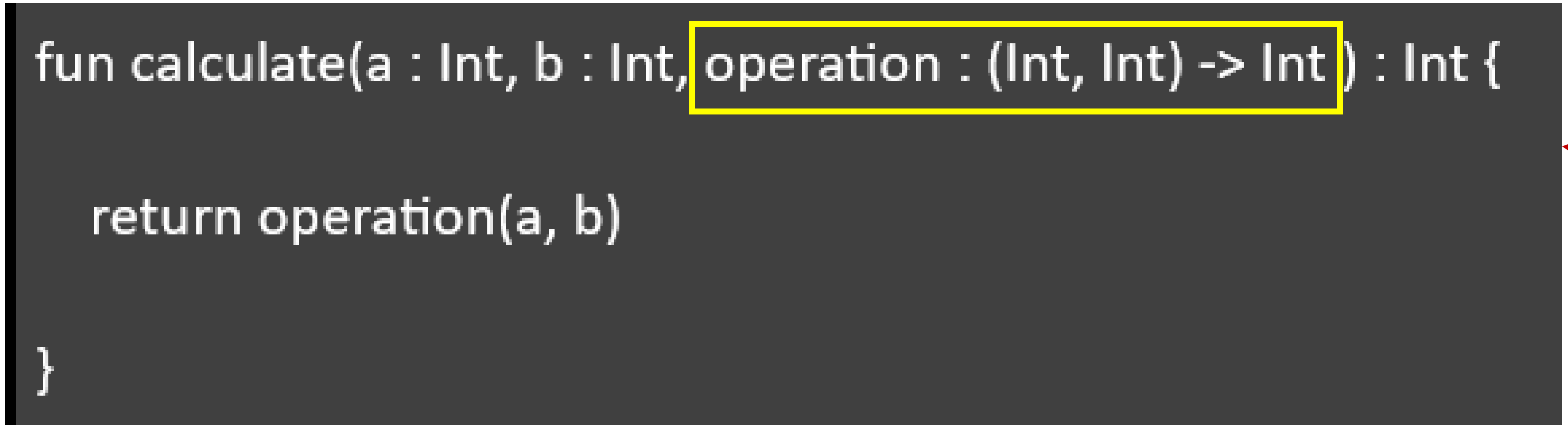


```
val sum = fun(x : Int, y : Int) : Int {
   return x + y
}
println(sum(5, 3))     // Prints “8”
```

FUNCTIONS

Anonymous Functions

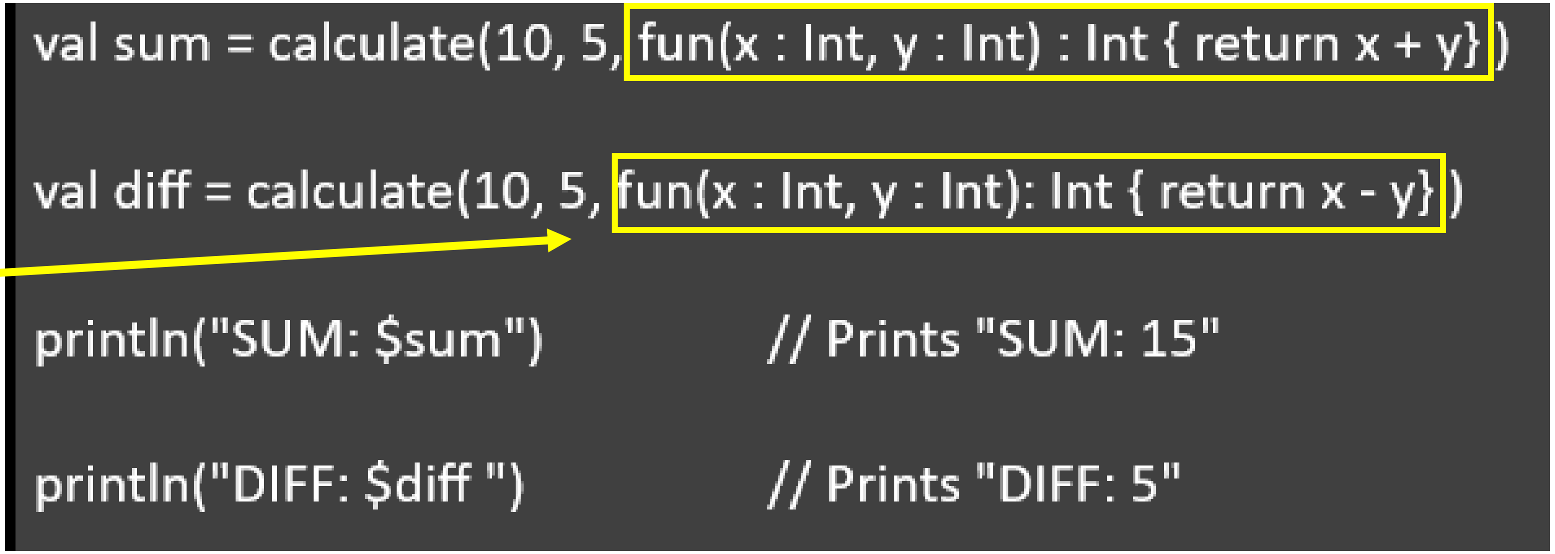
“Normal” function



```
fun calculate(a : Int, b : Int, operation : (Int, Int) -> Int ) : Int {

    return operation(a, b)

}
```

Which are the parameters and the return types?

Anonymous functions as parameters



```
val sum = calculate(10, 5, fun(x : Int, y : Int) : Int { return x + y})

val diff = calculate(10, 5, fun(x : Int, y : Int): Int { return x - y})

println("SUM: $sum")            // Prints "SUM: 15"

println("DIFF: $diff ")         // Prints "DIFF: 5"
```

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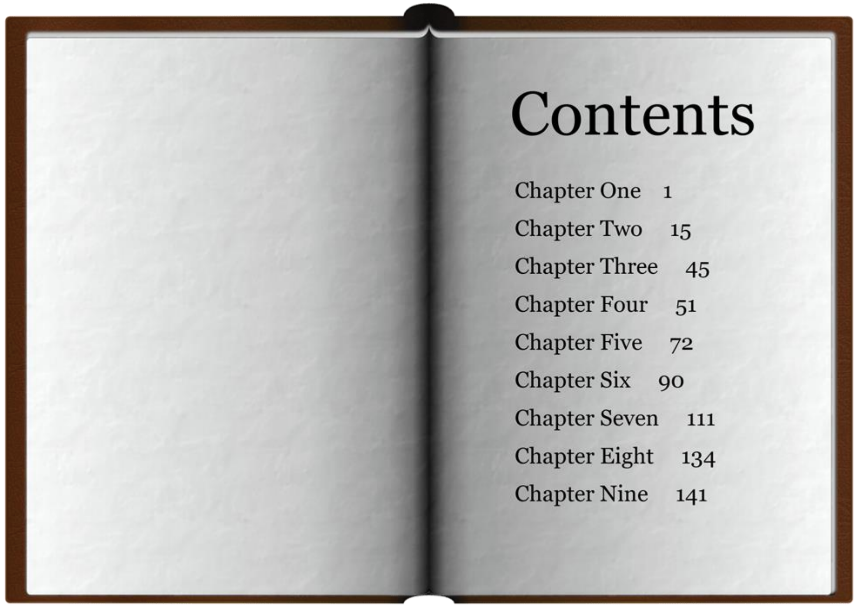

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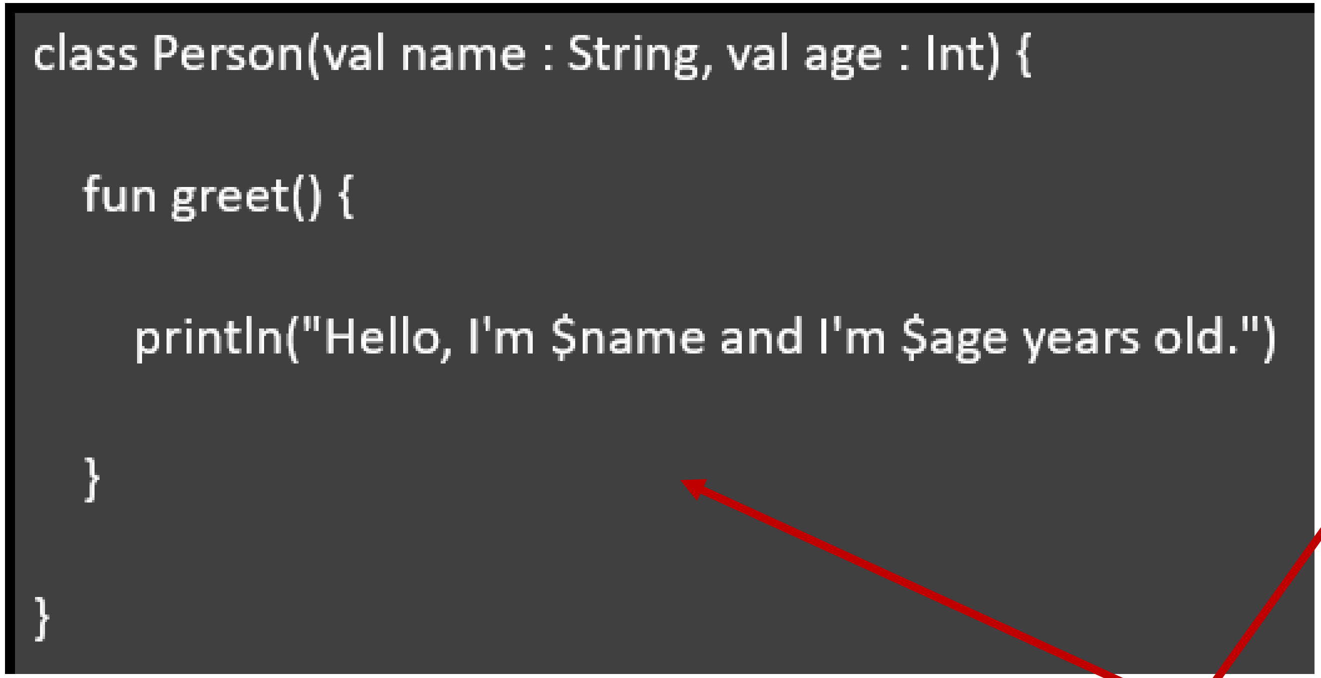
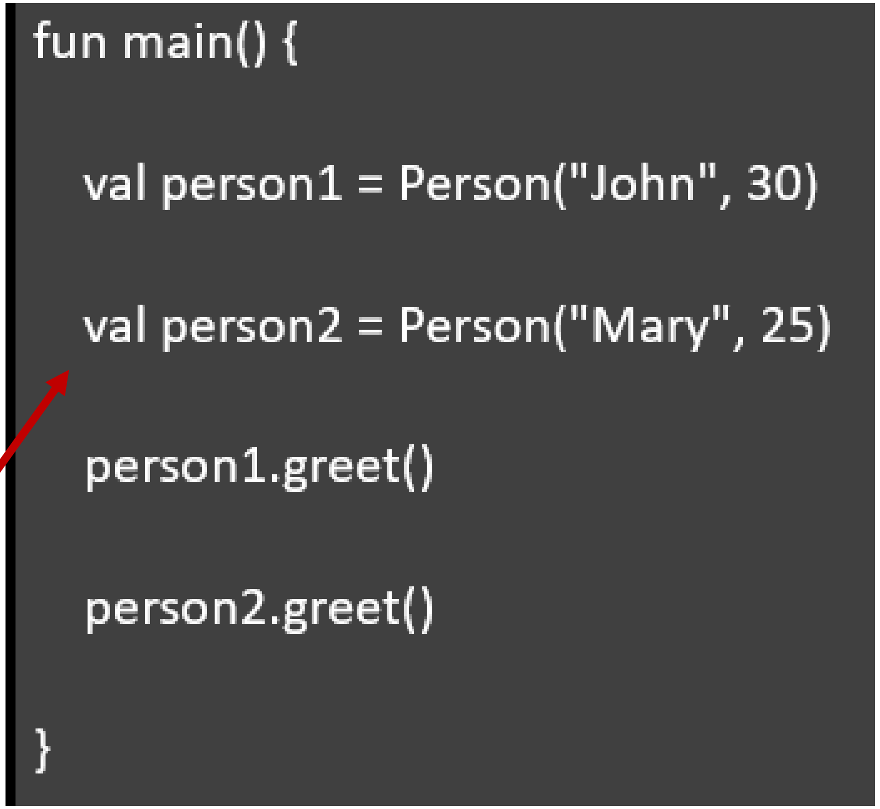
OBJECT ORIENTED PROGRAMMING (OOP)

Classes and Objects



```
class Person(val name : String, val age : Int) {

    fun greet() {

        println("Hello, I'm $name and I'm $age years old.")

    }

}
```



```
fun main() {

    val person1 = Person("John", 30)

    val person2 = Person("Mary", 25)

    person1.greet()

    person2.greet()

}
```

How did we code that in Java?

Classes and Objects

DIY

Create a class called Person that will represent the main data of a person: ID, name, surname and age.
Add the following methods to the class:

- toString: Returns the information of the object: “ID:... Name:... etc.".
- isFullAge: Returns true if over the age of 18
- isRetired: Returns true if 65 years of age or older
- ageDiff: Returns the age difference between the person and another person

Instantiate two objects of the class Person and:

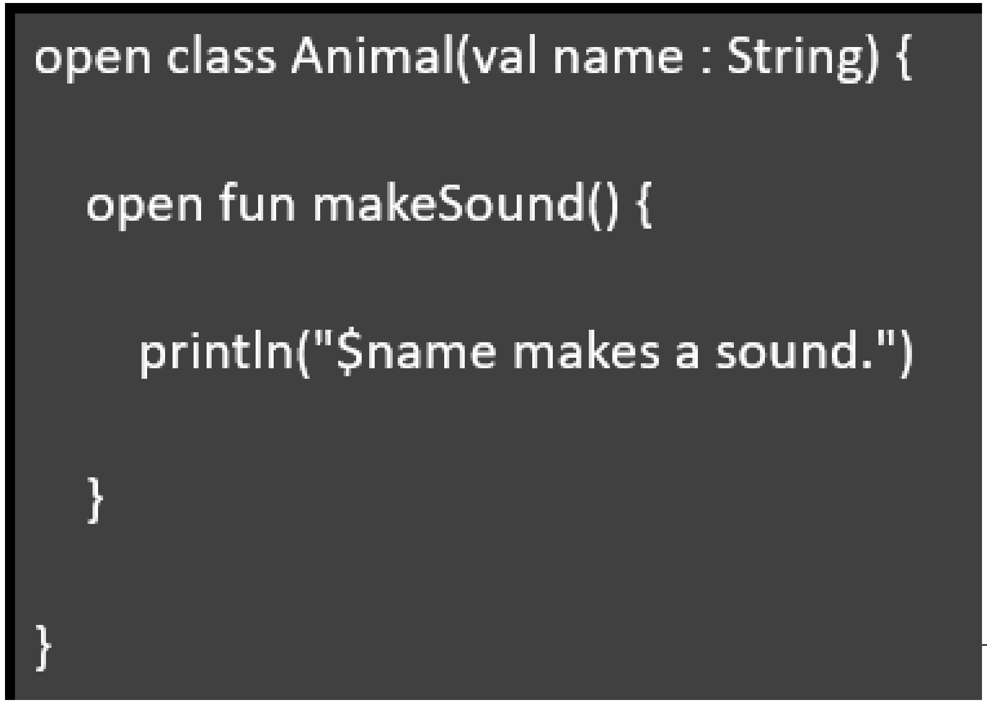
- Print their characteristics on the screen, showing whether or not they are above 18 and/or retired
- Displays a message with the age difference between them

OBJECT ORIENTED PROGRAMMING (OOP)

Inheritance

What’s that?

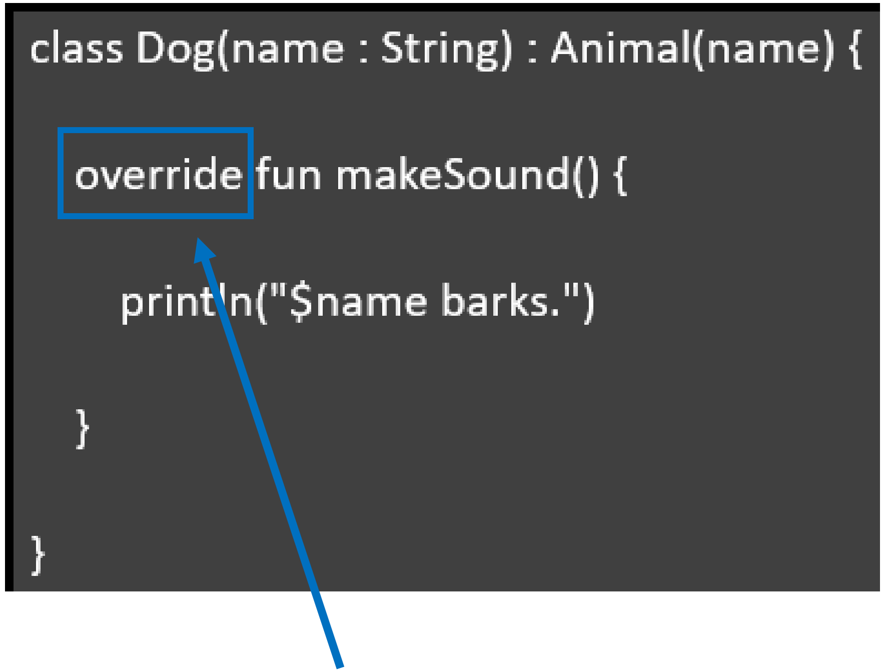
- Kotlin classes and their functions are *final* **by default**
- To allow a class to be extended it must be marked ***open***
- To allow class functions and fields to be overridden, they must also be marked *open*



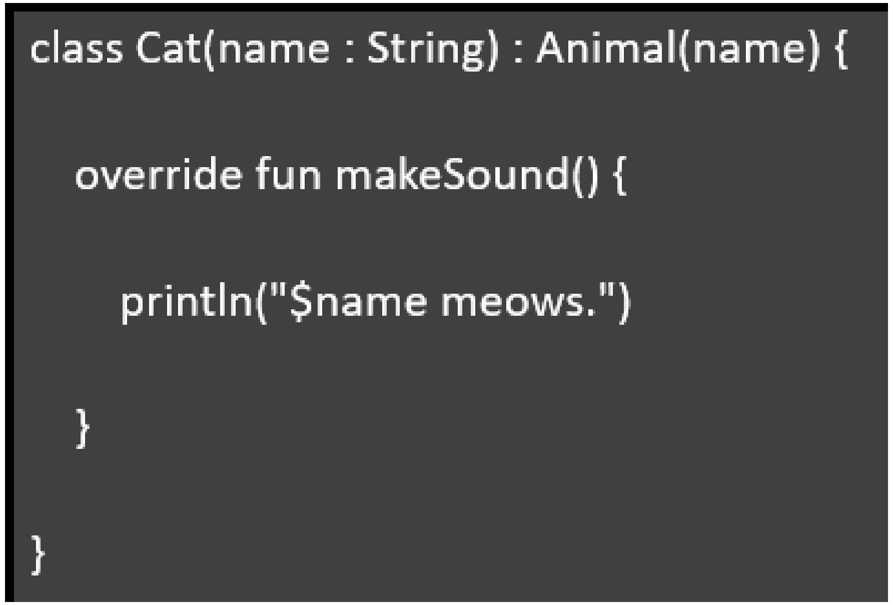
```
open class Animal(val name : String) {

    open fun makeSound() {

        println("$name makes a sound.")

    }

}
```

OBJECT ORIENTED PROGRAMMING (OOP)

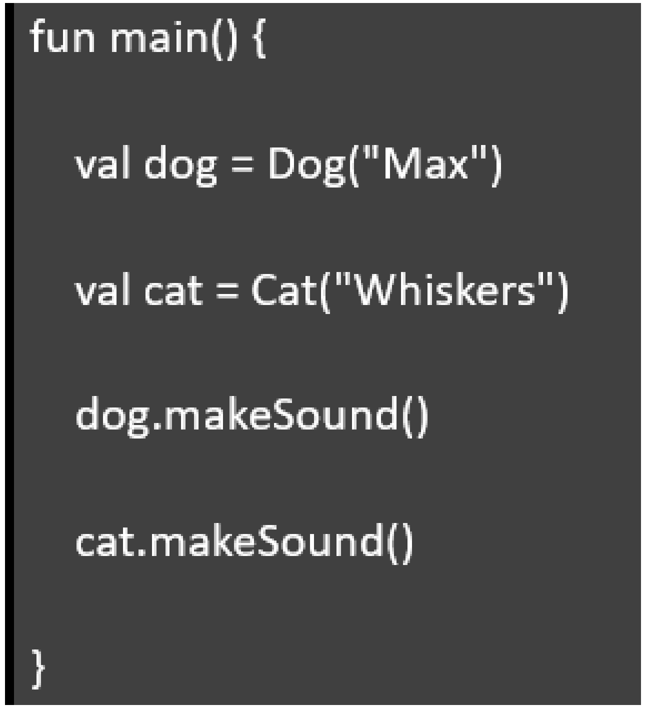
Inheritance



```
class Dog(name : String) : Animal(name) {

  override fun makeSound() {

    println("$name barks.")

  }

}
```



```
class Cat(name : String) : Animal(name) {

  override fun makeSound() {

    println("$name meows.")

  }

}
```



```
fun main() {

  val dog = Dog("Max")

  val cat = Cat("Whiskers")

  dog.makeSound()

  cat.makeSound()

}
```

One has to define that the parent function will be overridden

Inheritance

DIY

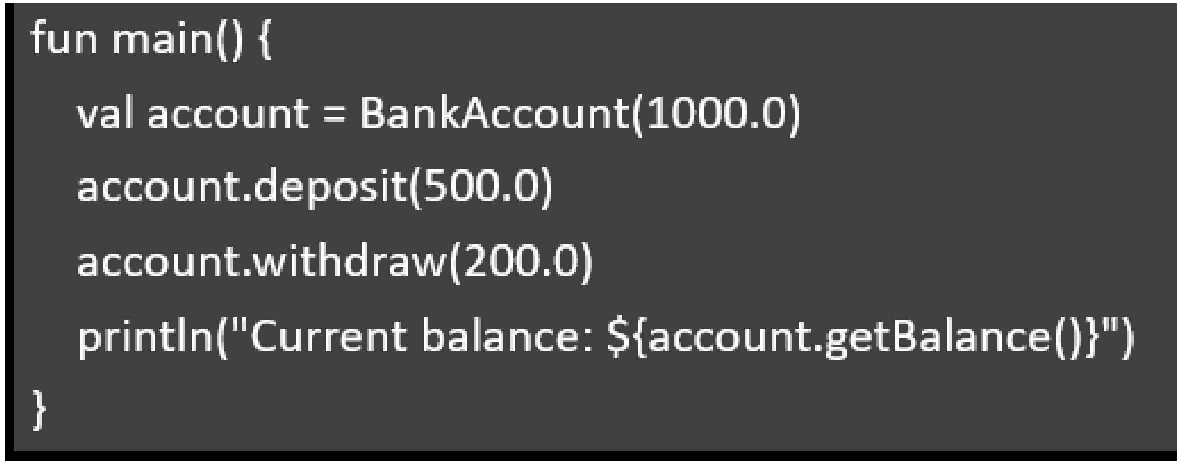
Create subclasses Student and Teacher from Person:

- Student will have a ‘level‘ attribute and Teacher a ‘center’ one.
- Update the toString() method to include the new attributes
- Instantiate a person of each type, show their attributes and the age difference between them

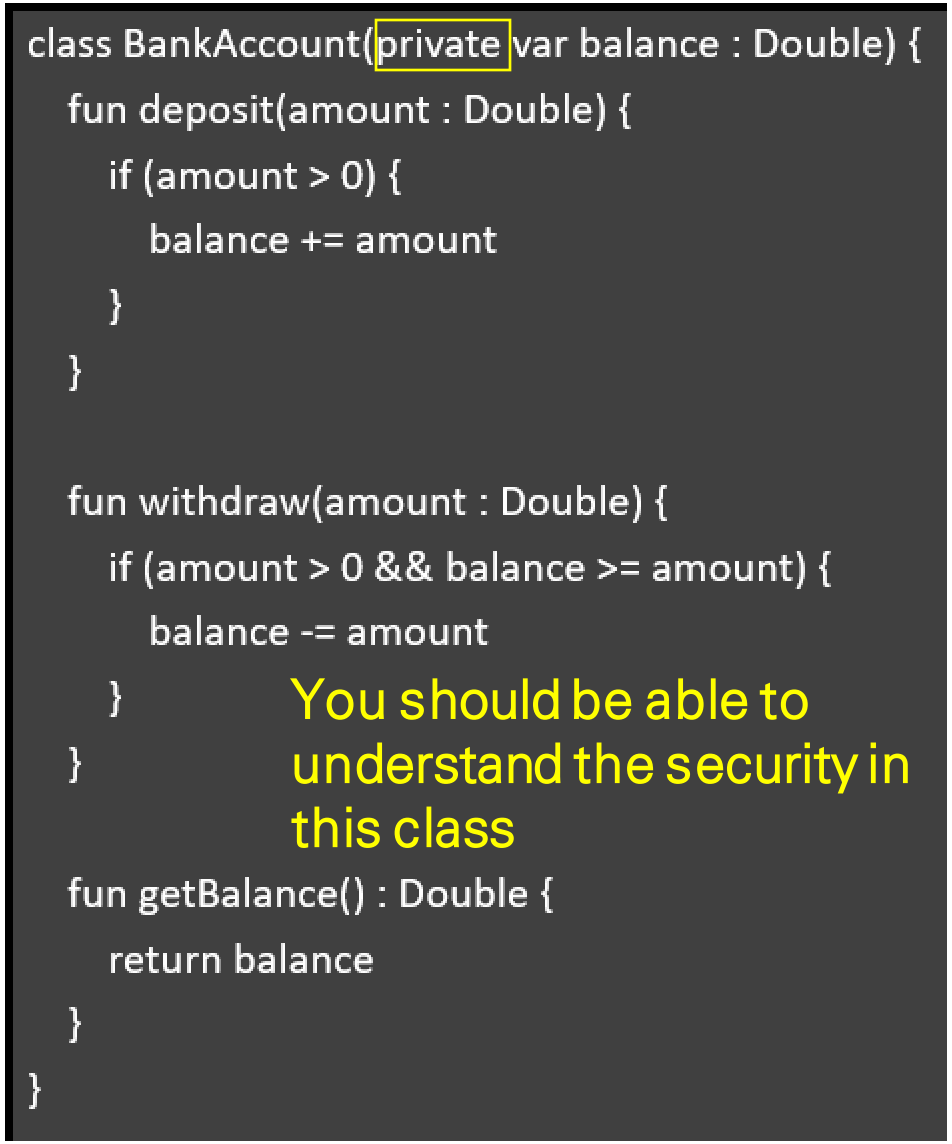
OBJECT ORIENTED PROGRAMMING (OOP)

What’s that? Encapsulation

Kotlin allows you to control access to a class's properties and methods using access modifiers like *private, protected, internal* (module) and *public* (default)



```
fun main() {
    val account = BankAccount(1000.0)
    account.deposit(500.0)
    account.withdraw(200.0)
    println("Current balance: ${account.getBalance()}")
}
```



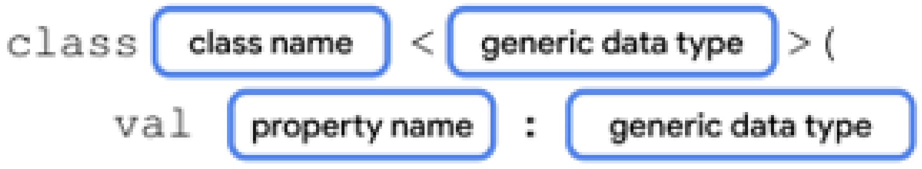
```
class BankAccount(private var balance : Double) {
    fun deposit(amount : Double) {
        if (amount > 0) {
            balance += amount
        }
    }

    fun withdraw(amount : Double) {
        if (amount > 0 && balance >= amount) {
            balance -= amount
        }
    }

    fun getBalance() : Double {
        return balance
    }
}
```

You should be able to understand the security in this class

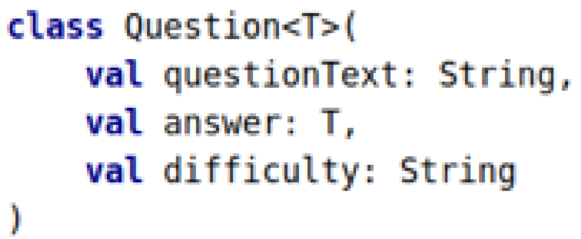
OBJECT ORIENTED PROGRAMMING (OOP)

What's that? **Use of Generics**

Definition:



```
class [class name] < [generic data type] > (
    val [property name] : [generic data type]
)
```



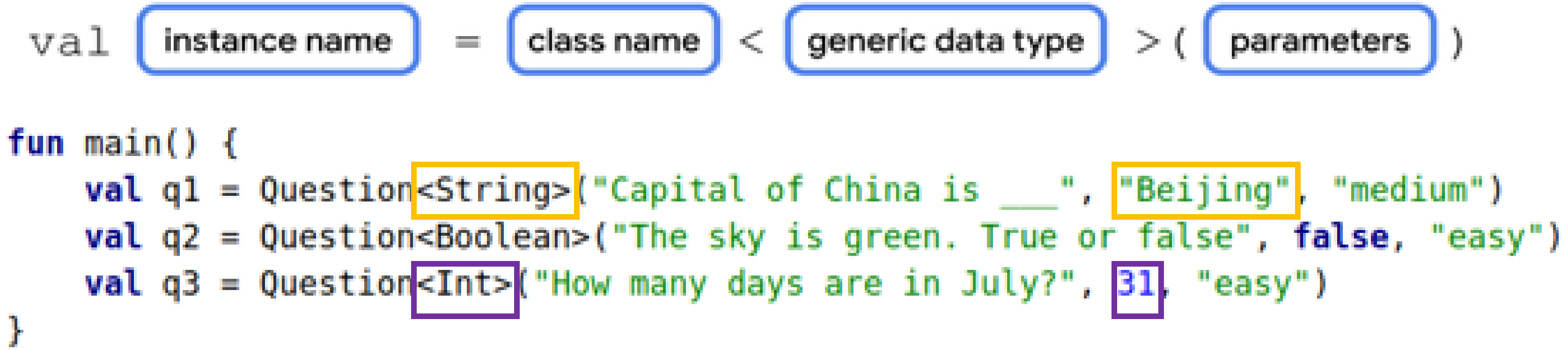
```
class Question<T>(
    val questionText: String,
    val answer: T,
    val difficulty: String
)
```

DIY

Can a class have more than one generic?

```
class Question <T, Q> (
    val questionText : String,
    val answer : T,
    val difficulty: Q
)
```

Use:

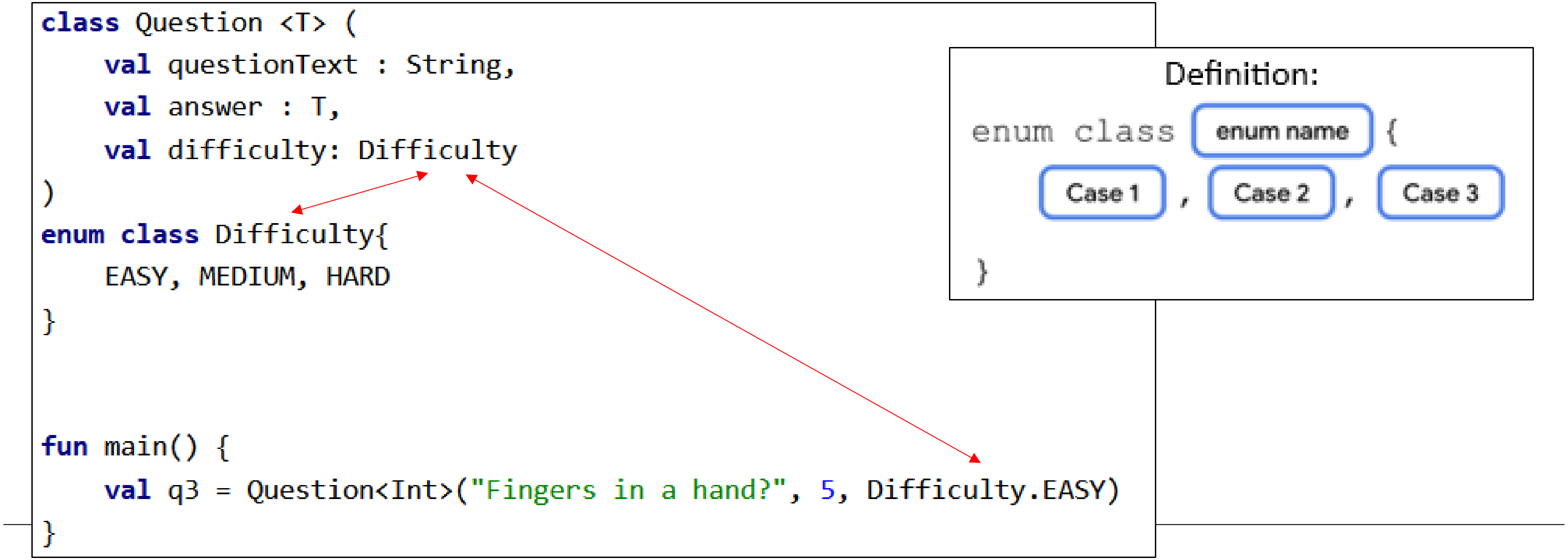


```
val [instance name] = [class name] < [generic data type] > ( [parameters] )

fun main() {
    val q1 = Question<String>("Capital of China is ___", "Beijing", "medium")
    val q2 = Question<Boolean>("The sky is green. True or false", false, "easy")
    val q3 = Question<Int>("How many days are in July?", 31, "easy")
}
```

OBJECT ORIENTED PROGRAMMING (OOP)

ENUM classes

- Used to prevent programmers and users wrong typing
- Force a given set of values to be the only accepted ones (type-safe)



```
class Question <T> (
    val questionText : String,
    val answer : T,
    val difficulty: Difficulty
)
enum class Difficulty{
    EASY, MEDIUM, HARD
}


fun main() {
    val q3 = Question<Int>("Fingers in a hand?", 5, Difficulty.EASY)
}
```

Definition:

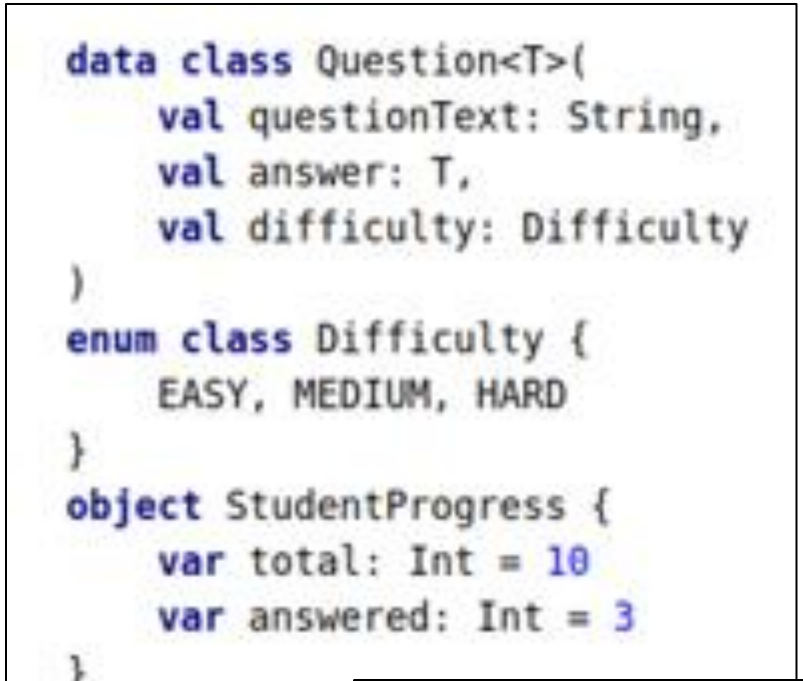
```
enum class  enum name  {
     Case 1 ,  Case 2 ,  Case 3
}
```

Singleton Objects

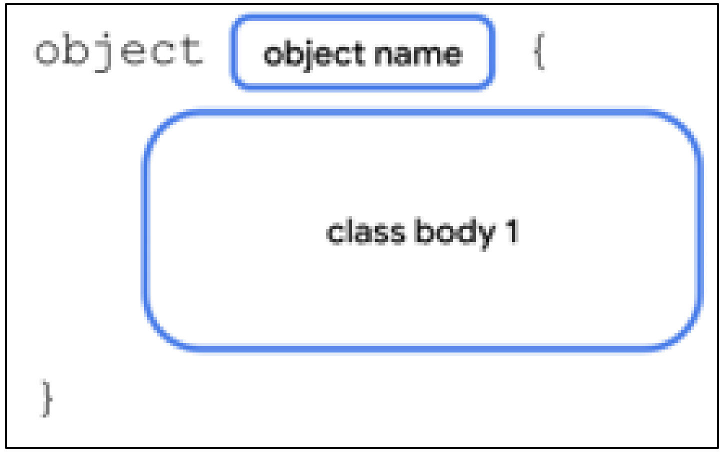
- There are cases where you want a class to **only have one instance**. For example:
  - Player stats in a mobile game for the current user
  - Interacting with a single hardware device, like sending audio through a speaker
  - Authentication, where only one user should be logged in at a time
- In the above scenarios, you'd probably need to use a class but only one instance of that class --> **Singleton Object**
- A singleton can't have a constructor as you can't create instances directly. Instead, all the properties are defined within the curly braces and are given an initial value

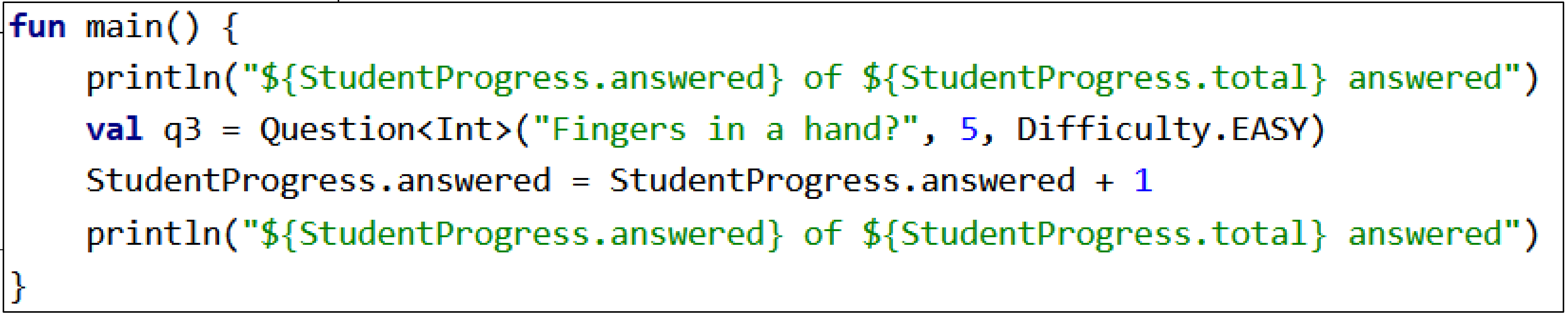
OBJECT ORIENTED PROGRAMMING (OOP)

Singleton Objects



```
data class Question<T>(
    val questionText: String,
    val answer: T,
    val difficulty: Difficulty
)
enum class Difficulty {
    EASY, MEDIUM, HARD
}
object StudentProgress {
    var total: Int = 10
    var answered: Int = 3
}
```

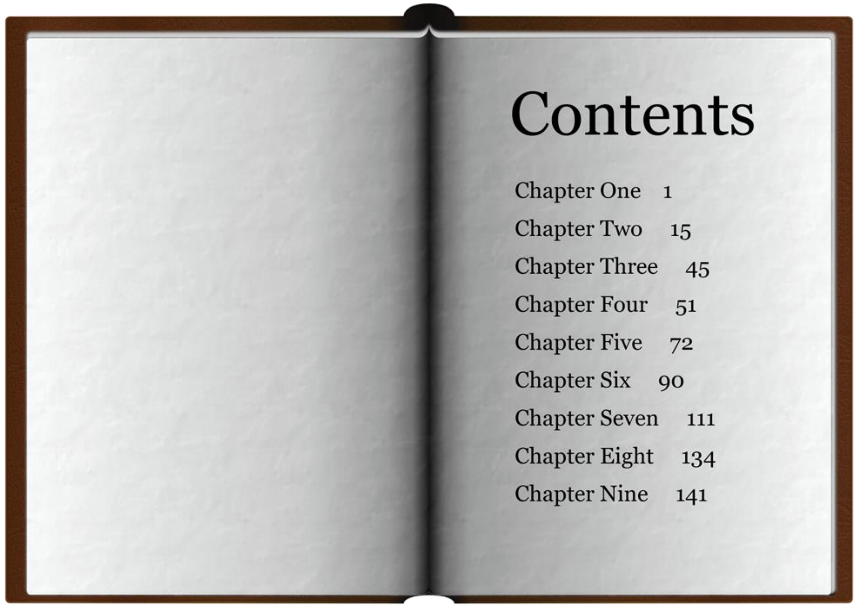




```
fun main() {
    println("${StudentProgress.answered} of ${StudentProgress.total} answered")
    val q3 = Question<Int>("Fingers in a hand?", 5, Difficulty.EASY)
    StudentProgress.answered = StudentProgress.answered + 1
    println("${StudentProgress.answered} of ${StudentProgress.total} answered")
}
```

Content

1. INTRODUCTION
2. VARIABLES AND DATA TYPES
3. OPERATORS
4. CONTROL STRUCTURE
5. EXCEPTIONS
6. FUNCTIONS
7. OBJECT ORIENTED PROGRAMMING
8. COMPLEX DATA TYPES



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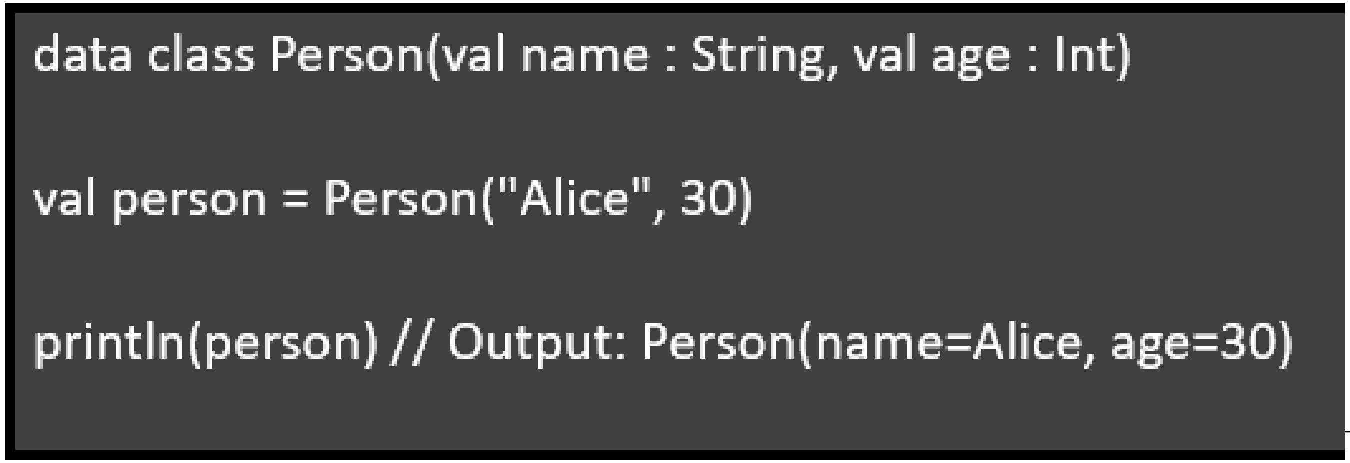
COMPLEX DATA TYPES

Classes and Data Classes

- Data Classes are a special type of class designed primarily for holding data
- They automatically provide useful functions like `toString()`, `equals()`, and `hashCode()` based on their properties
- A data class needs to have at least one parameter in its constructor



```
data class Person(val name : String, val age : Int)

val person = Person("Alice", 30)

println(person) // Output: Person(name=Alice, age=30)
```

COMPLEX DATA TYPES

Classes and Data Classes

- Create and instantiate a HighSchool data class to keep track of the number of students and teachers in a given high-school (include a name parameter)
- Modify the classes to use the new HighSchool data class
- Increase the high-school parameters on every Student/Teacher instantiation
- Show center people totals on screen at the end

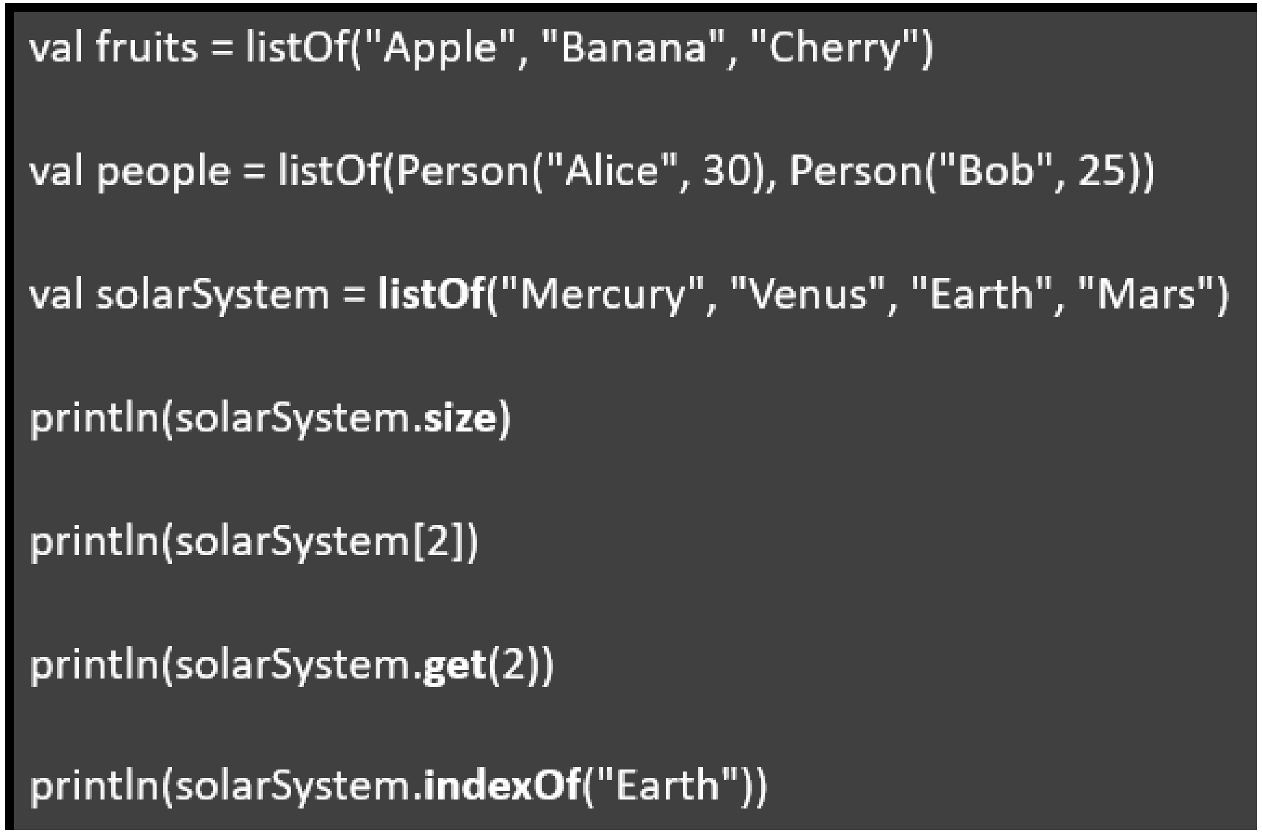
DIY

COMPLEX DATA TYPES

List / Mutablelist

Guess what?

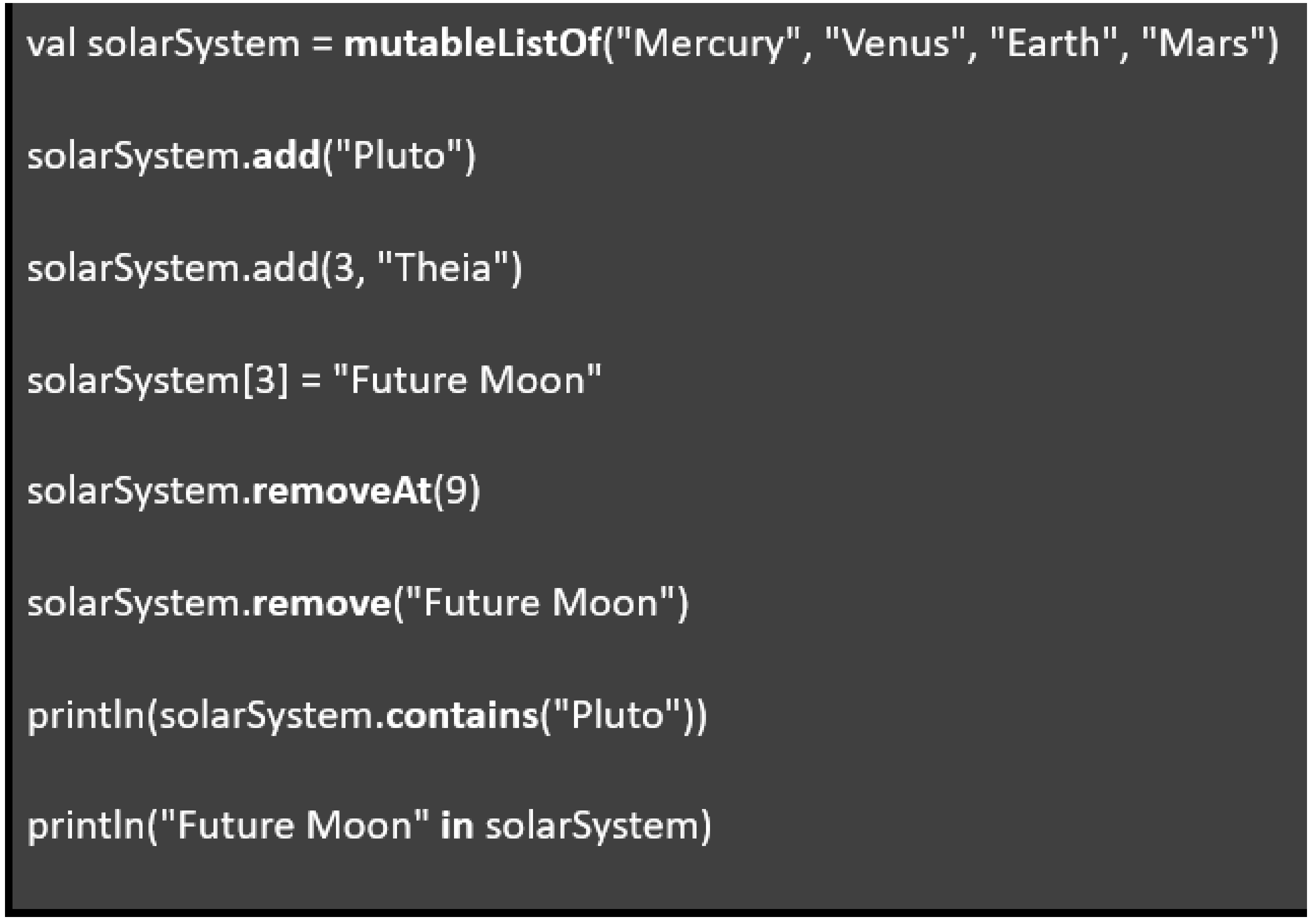
- **Ordered** collections that can store elements **of the same or different types**
- *List* is an interface that defines properties and methods related to a read-only ordered collections
- *MutableList* extends the *List* interface by defining methods to modify a list



```
val fruits = listOf("Apple", "Banana", "Cherry")

val people = listOf(Person("Alice", 30), Person("Bob", 25))

val solarSystem = listOf("Mercury", "Venus", "Earth", "Mars")

println(solarSystem.size)

println(solarSystem[2])

println(solarSystem.get(2))

println(solarSystem.indexOf("Earth"))
```

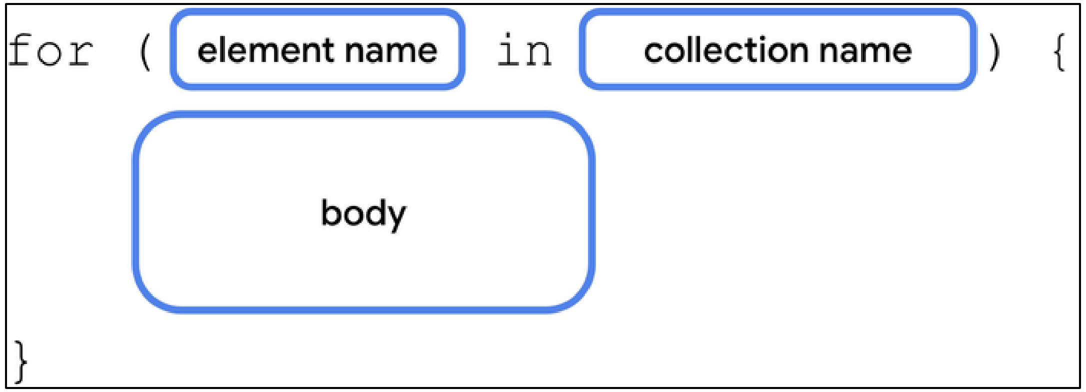
COMPLEX DATA TYPES

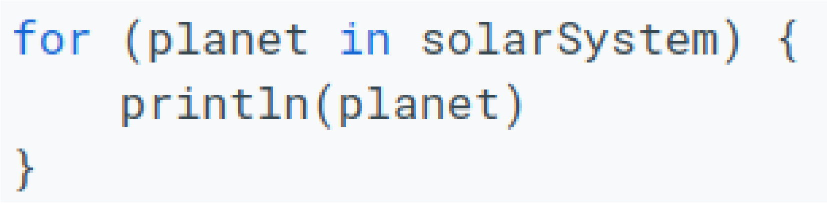
List / MutableList



```
val solarSystem = mutableListOf("Mercury", "Venus", "Earth", "Mars")

solarSystem.add("Pluto")

solarSystem.add(3, "Theia")

solarSystem[3] = "Future Moon"

solarSystem.removeAt(9)

solarSystem.remove("Future Moon")

println(solarSystem.contains("Pluto"))

println("Future Moon" in solarSystem)
```

Lists are collections easy to iterate using a *for* loop





```
for (planet in solarSystem) {
    println(planet)
}
```

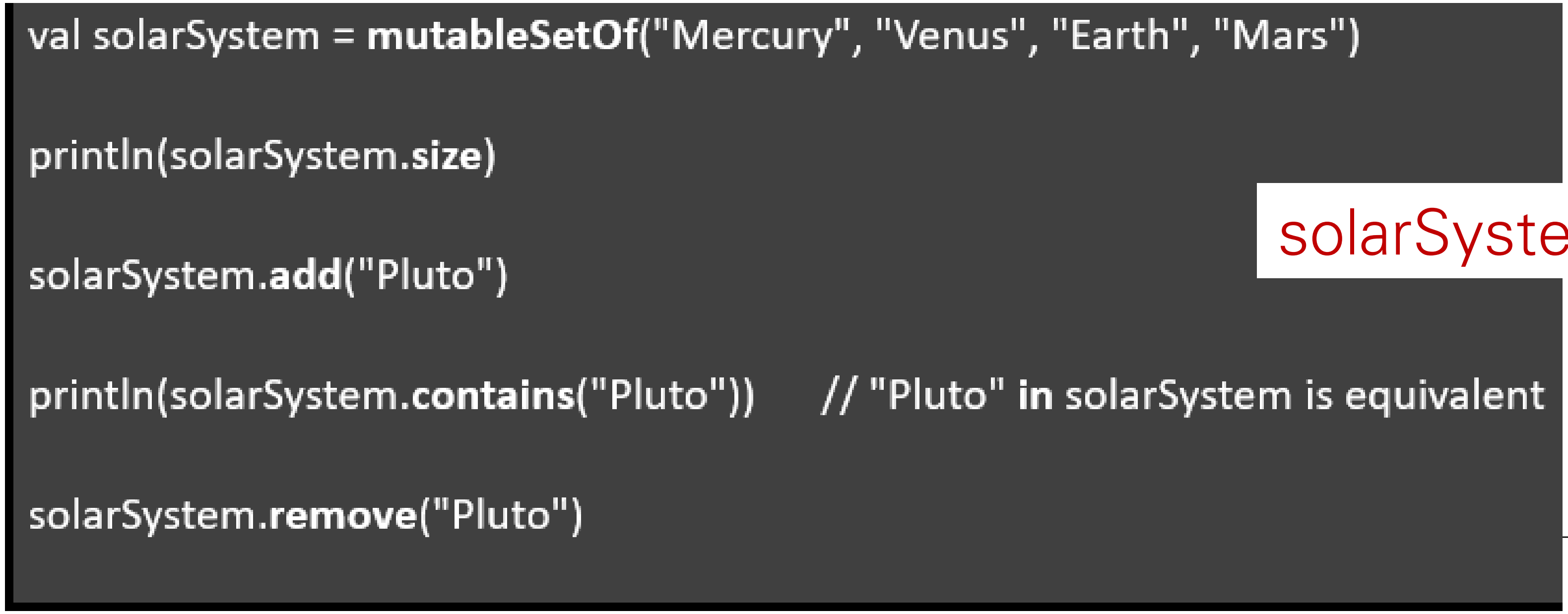
DIY

COMPLEX DATA TYPES

Set / MutableSet

Guess what?

- Collection that has **no order and no duplicate values** (due to *hash code*)
- Hash code is an *Int* produced by *hashCode()* of any Kotlin class
- A small change to the object results in a vastly different hash code
- **Searching** for a specific element in a set is **faster than in lists**
- But sets tend to **use more memory than lists** for the same amount of data



```
val solarSystem = mutableSetOf("Mercury", "Venus", "Earth", "Mars")

println(solarSystem.size)

solarSystem.add("Pluto")

println(solarSystem.contains("Pluto"))     // "Pluto" in solarSystem is equivalent

solarSystem.remove("Pluto")
```

solarSystem.**removeAt**(2) ???

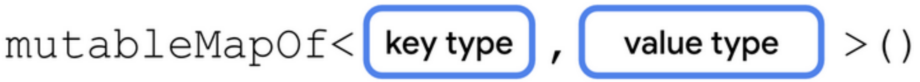
COMPLEX DATA TYPES

Map / MutableMap

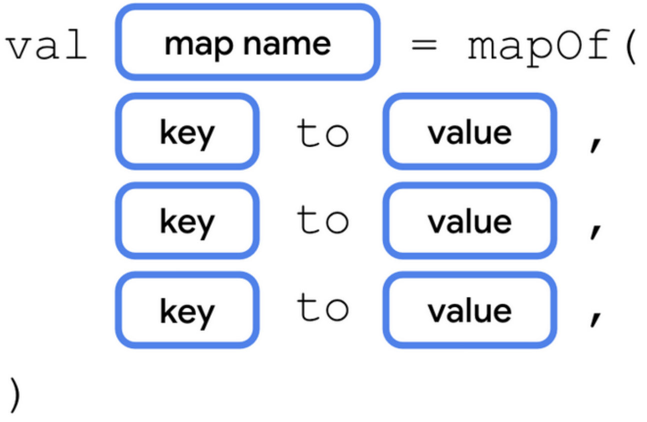
Guess what?

Maps **associate keys with values**, allowing you to create complex data structures to represent relationships or configurations

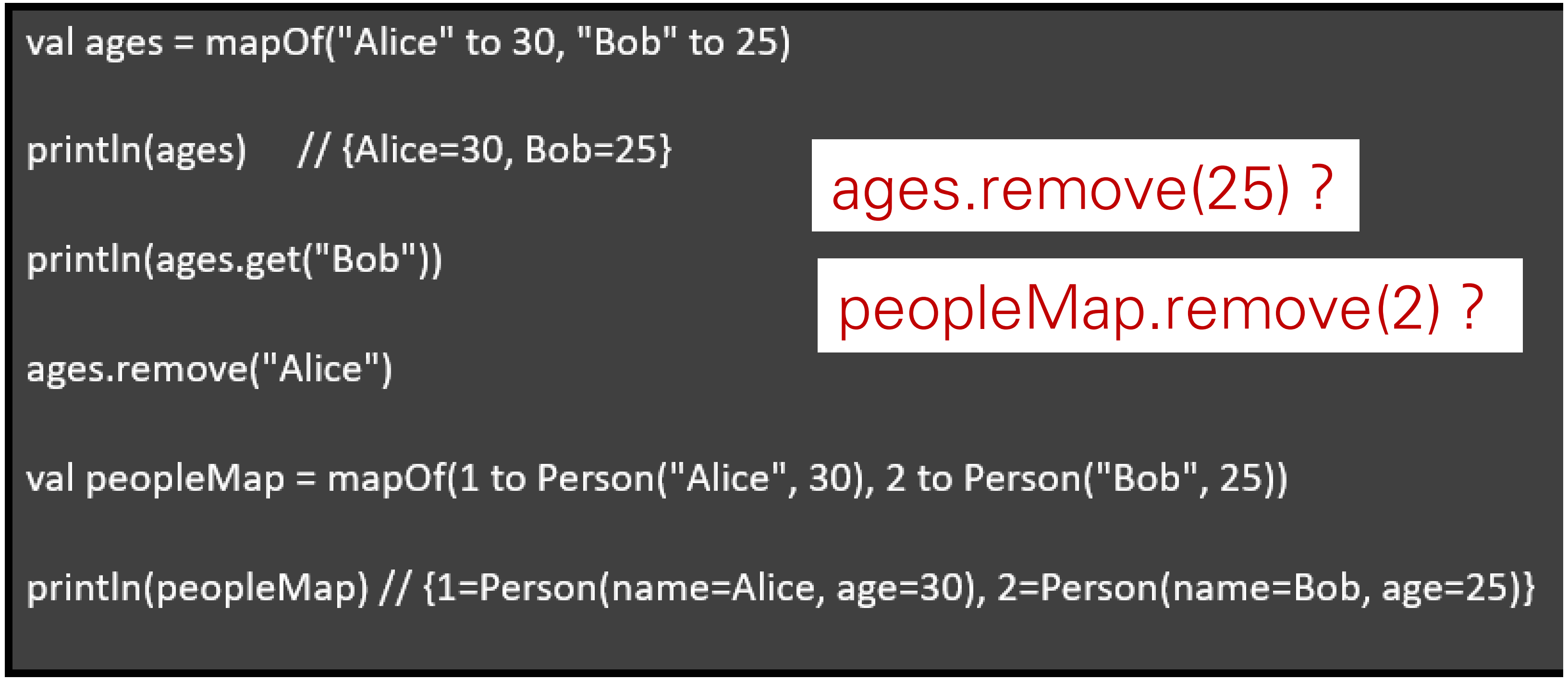
DIY



```
mutableMapOf< key type , value type >()
```



```
val map name = mapOf(
        key to value ,
        key to value ,
        key to value ,
)
```



```
val ages = mapOf("Alice" to 30, "Bob" to 25)

println(ages)     // {Alice=30, Bob=25}

println(ages.get("Bob"))

ages.remove("Alice")

val peopleMap = mapOf(1 to Person("Alice", 30), 2 to Person("Bob", 25))

println(peopleMap) // {1=Person(name=Alice, age=30), 2=Person(name=Bob, age=25)}
```

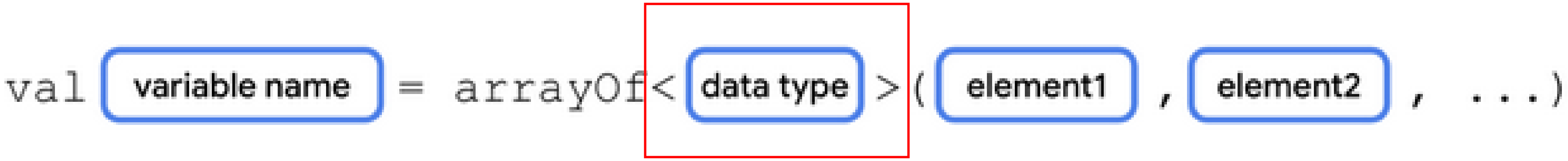
ages.remove(25) ?

peopleMap.remove(2) ?

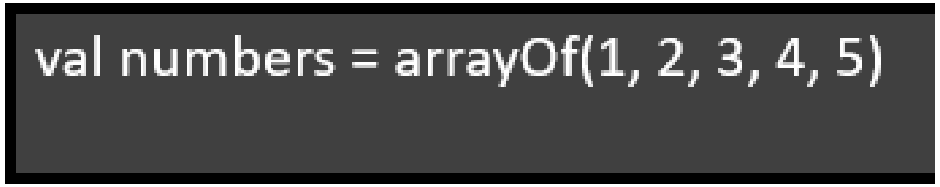
COMPLEX DATA TYPES

Arrays

- Arrays are fixed-size collections that can store elements **of the same type**
- The data type is optional as it can be inferred



```
val variable name = arrayOf< data type >( element1 , element2 , ...)
```

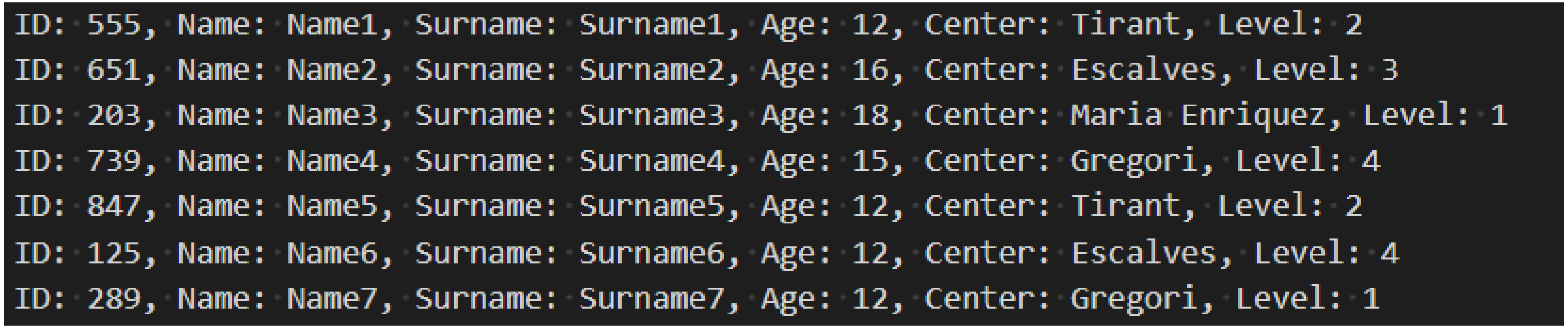


```
val numbers = arrayOf(1, 2, 3, 4, 5)
```

COMPLEX DATA TYPES

Exercise – Part 1

- Create a collection of Students and add 20 students
- Give incremental name and surnames. Age, level and ID must be random (between numbers that make sense) and center must be a random HighSchool object among 5 predefined ones
- Show the resulting Students

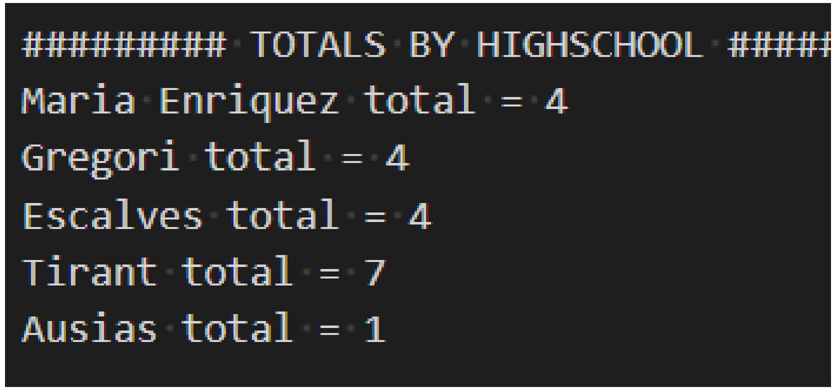


```
ID: 555, Name: Name1, Surname: Surname1, Age: 12, Center: Tirant, Level: 2
ID: 651, Name: Name2, Surname: Surname2, Age: 16, Center: Escalves, Level: 3
ID: 203, Name: Name3, Surname: Surname3, Age: 18, Center: Maria Enriquez, Level: 1
ID: 739, Name: Name4, Surname: Surname4, Age: 15, Center: Gregori, Level: 4
ID: 847, Name: Name5, Surname: Surname5, Age: 12, Center: Tirant, Level: 2
ID: 125, Name: Name6, Surname: Surname6, Age: 12, Center: Escalves, Level: 4
ID: 289, Name: Name7, Surname: Surname7, Age: 12, Center: Gregori, Level: 1
```

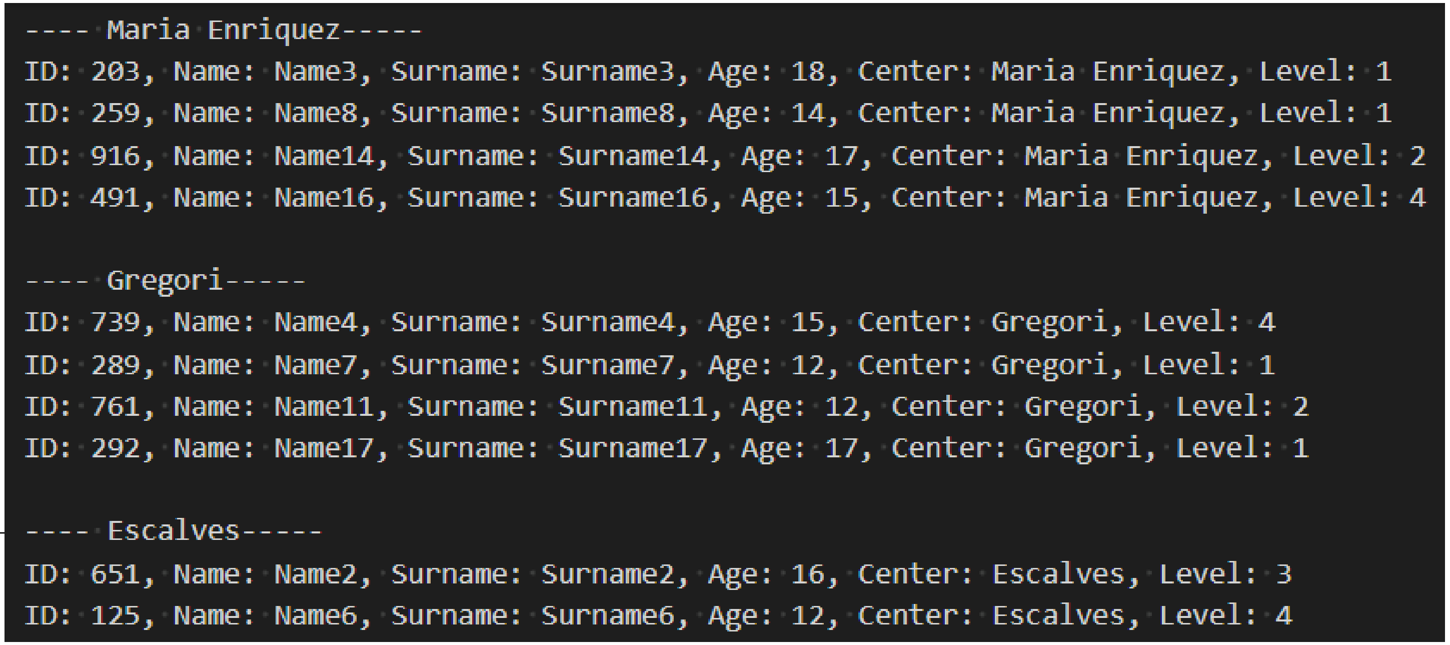
COMPLEX DATA TYPES

Exercise – Part 2

- Surf the collection and create a Map with
  - **Keys** = High Schools names
  - **Value** = collection of students
- Then print the total number of students per High School
- Print the detail of each student per High School



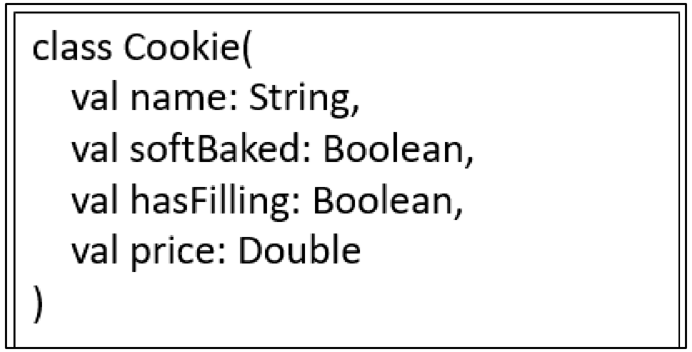
```
########## TOTALS BY HIGHSCHOOL #####
Maria Enriquez total = 4
Gregori total = 4
Escalves total = 4
Tirant total = 7
Ausias total = 1
```



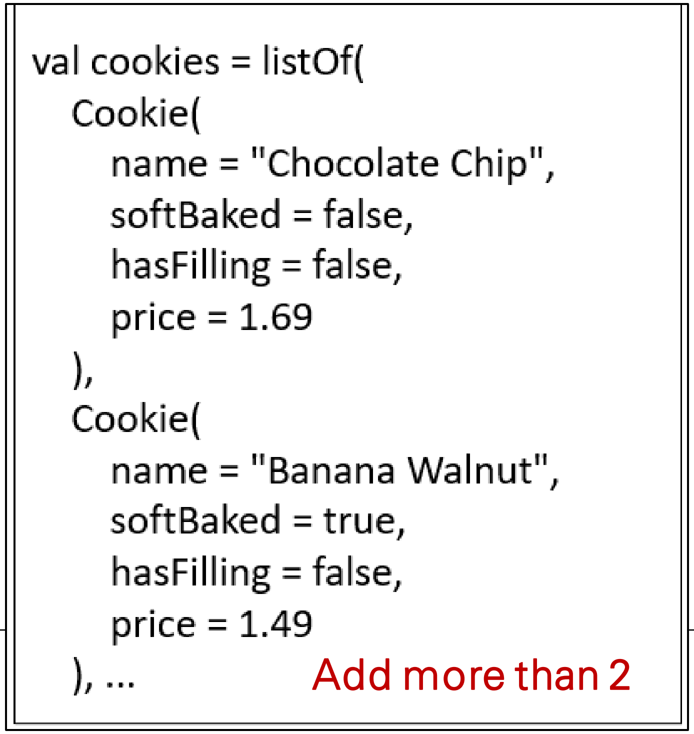
```
---- Maria Enriquez-----
ID: 203, Name: Name3, Surname: Surname3, Age: 18, Center: Maria Enriquez, Level: 1
ID: 259, Name: Name8, Surname: Surname8, Age: 14, Center: Maria Enriquez, Level: 1
ID: 916, Name: Name14, Surname: Surname14, Age: 17, Center: Maria Enriquez, Level: 2
ID: 491, Name: Name16, Surname: Surname16, Age: 15, Center: Maria Enriquez, Level: 4

---- Gregori-----
ID: 739, Name: Name4, Surname: Surname4, Age: 15, Center: Gregori, Level: 4
ID: 289, Name: Name7, Surname: Surname7, Age: 12, Center: Gregori, Level: 1
ID: 761, Name: Name11, Surname: Surname11, Age: 12, Center: Gregori, Level: 2
ID: 292, Name: Name17, Surname: Surname17, Age: 17, Center: Gregori, Level: 1

---- Escalves-----
ID: 651, Name: Name2, Surname: Surname2, Age: 16, Center: Escalves, Level: 3
ID: 125, Name: Name6, Surname: Surname6, Age: 12, Center: Escalves, Level: 4
```

High-order Functions – forEach()

- A higher-order function is a function that takes functions as parameters or returns a function
- *forEach()* can be combined with string templates and lambdas to iterate along a collection and perform actions on each element

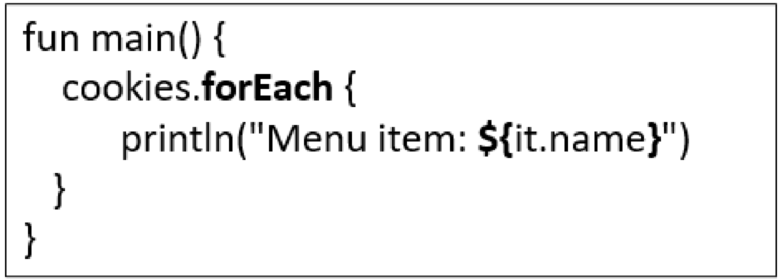


```
class Cookie(
    val name: String,
    val softBaked: Boolean,
    val hasFilling: Boolean,
    val price: Double
)
```



```
val cookies = listOf(
    Cookie(
        name = "Chocolate Chip",
        softBaked = false,
        hasFilling = false,
        price = 1.69
    ),
    Cookie(
        name = "Banana Walnut",
        softBaked = true,
        hasFilling = false,
        price = 1.49
    ), ...
```

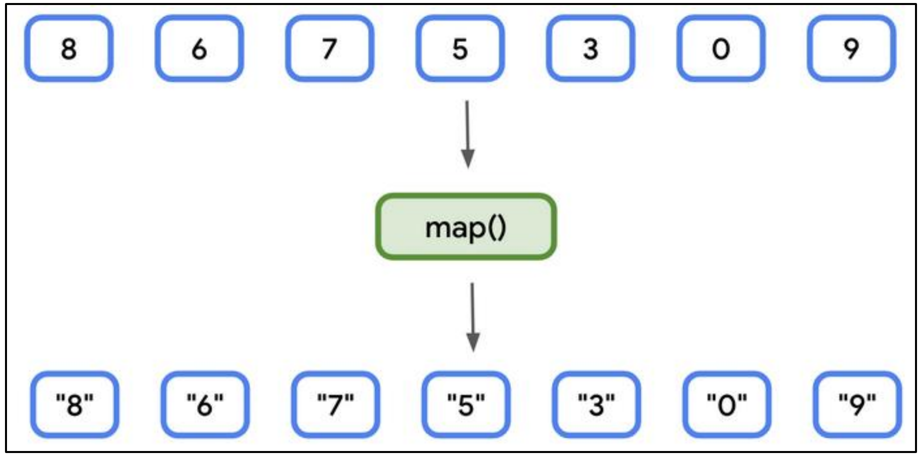
Add more than 2

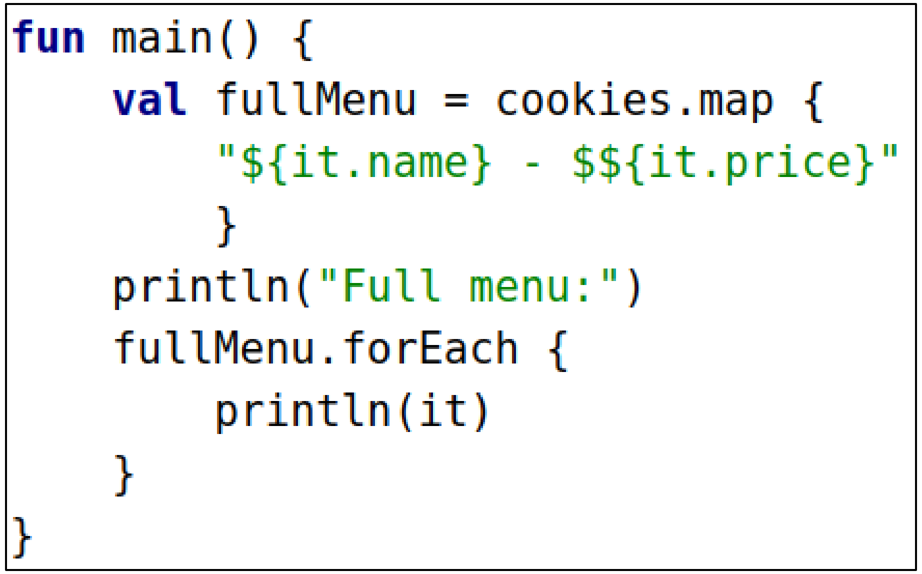


```
fun main() {
    cookies.forEach {
            println("Menu item: ${it.name}")
    }
}
```

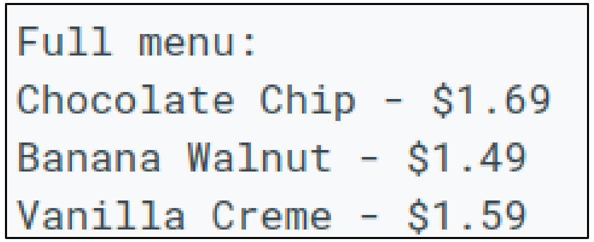
High-order Functions – map()

Lets you transform a collection into a new collection with the same number of elements while adding some transformation





```
fun main() {
    val fullMenu = cookies.map {
        "${it.name} - $${it.price}"
        }
    println("Full menu:")
    fullMenu.forEach {
        println(it)
    }
}
```

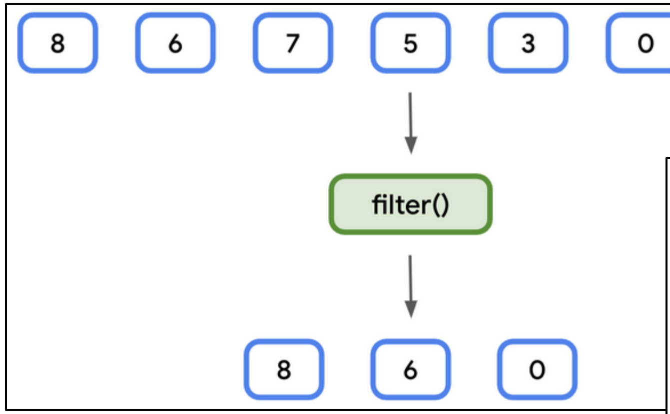


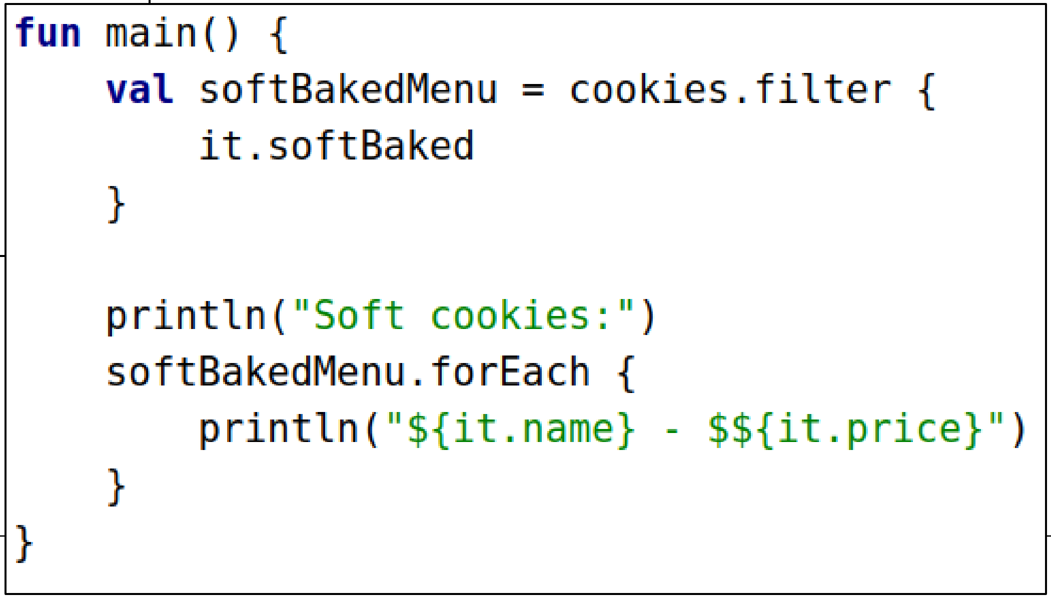
```
Full menu:
Chocolate Chip - $1.69
Banana Walnut - $1.49
Vanilla Creme - $1.59
```

COMPLEX DATA TYPES

High-order Functions – filter()

- Lets you create a subset of a collection
- The lambda has a single parameter representing each item in the collection and returns a Boolean value





```
fun main() {
    val softBakedMenu = cookies.filter {
        it.softBaked
    }

    println("Soft cookies:")
    softBakedMenu.forEach {
        println("${it.name} - $${it.price}")
    }
}
```

If the result of the lambda expression is true, the item is included

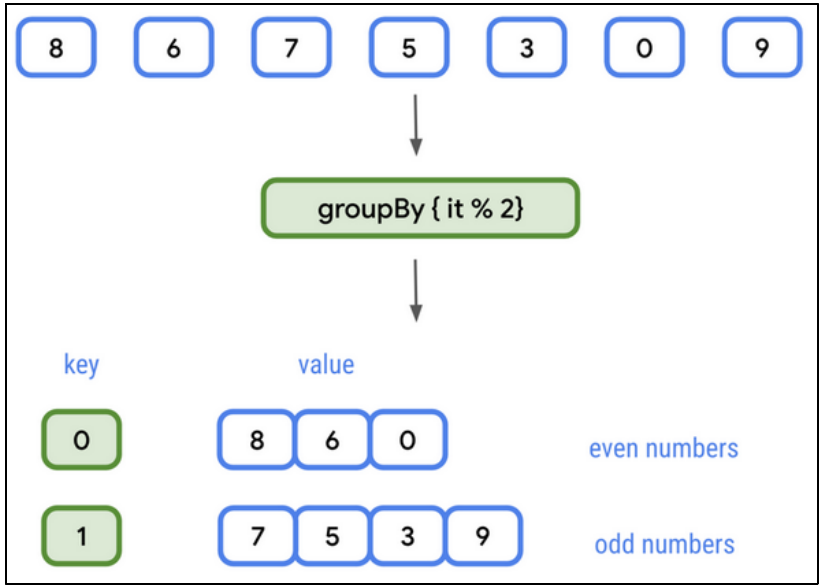
If the result is false, it is not

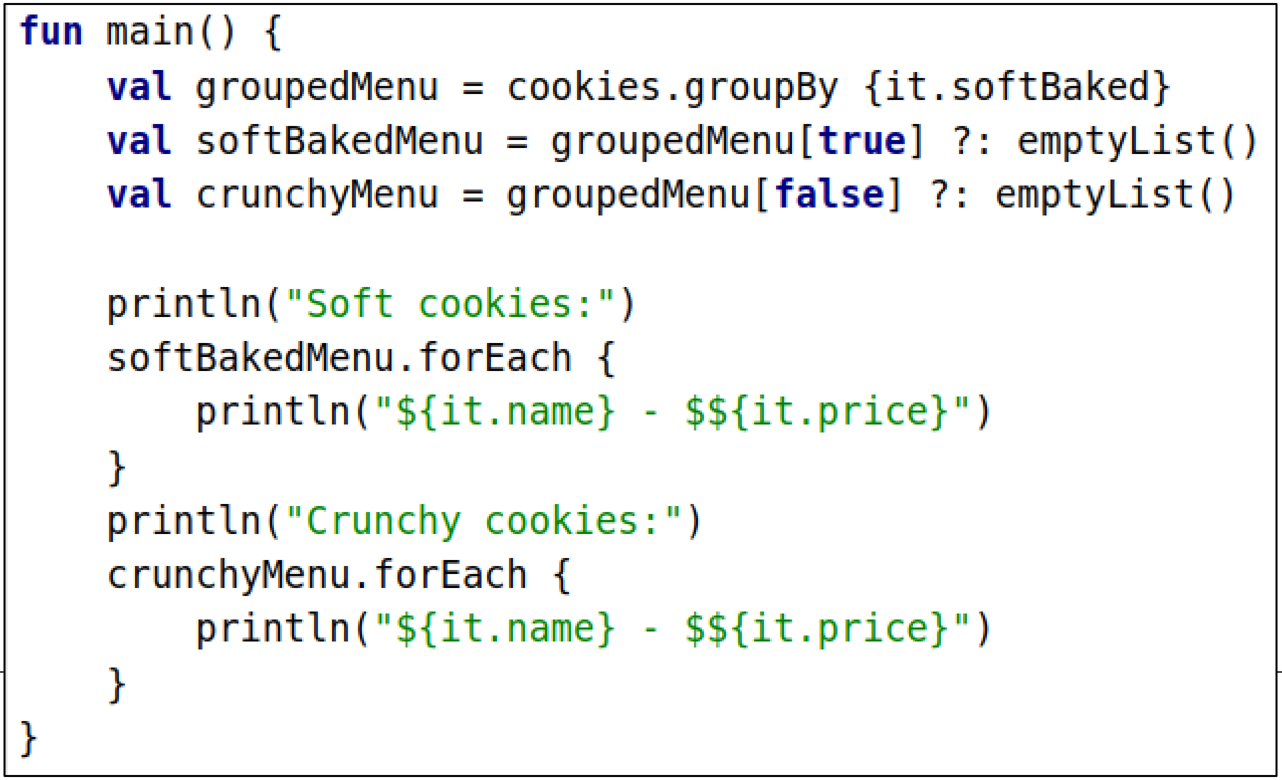
COMPLEX DATA TYPES

High-order Functions – groupBy()

List
groupBy()
Map

- Used to turn a list into a map, based on a function
- Each **unique return** value of the function **becomes a** ***key*** in the resulting map
- The *values* for each key are **all the items that produced that unique return** value





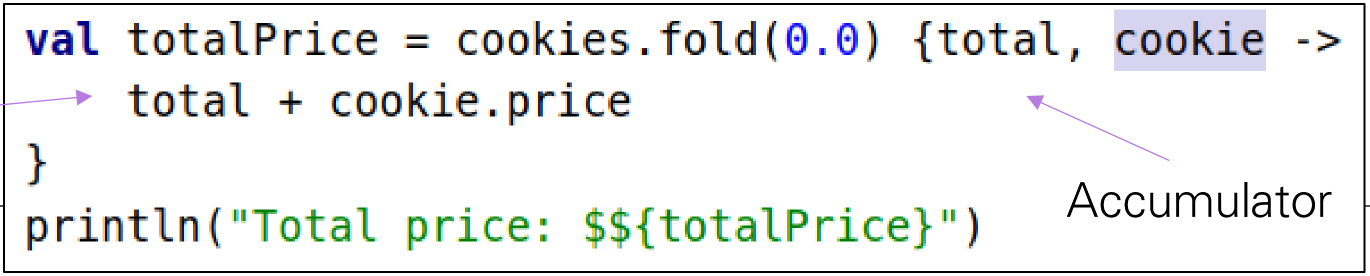
```
fun main() {
    val groupedMenu = cookies.groupBy {it.softBaked}
    val softBakedMenu = groupedMenu[true] ?: emptyList()
    val crunchyMenu = groupedMenu[false] ?: emptyList()

    println("Soft cookies:")
    softBakedMenu.forEach {
        println("${it.name} - $${it.price}")
    }
    println("Crunchy cookies:")
    crunchyMenu.forEach {
        println("${it.name} - $${it.price}")
    }
}
```

High-order Functions – fold()

- Used to generate **a single value from a collection**
- The fold() function takes two parameters:
  - An initial value
  - A lambda expression that returns a value with the same type as the initial value
- The lambda expression additionally has two parameters:
  - **Accumulator**: Each time the lambda expression is called, the accumulator is equal to the return value from the previous time the lambda was called
  - The second is the **same type as each element** in the collection

Initial value of accumulator

total = total + cookie.price
return total



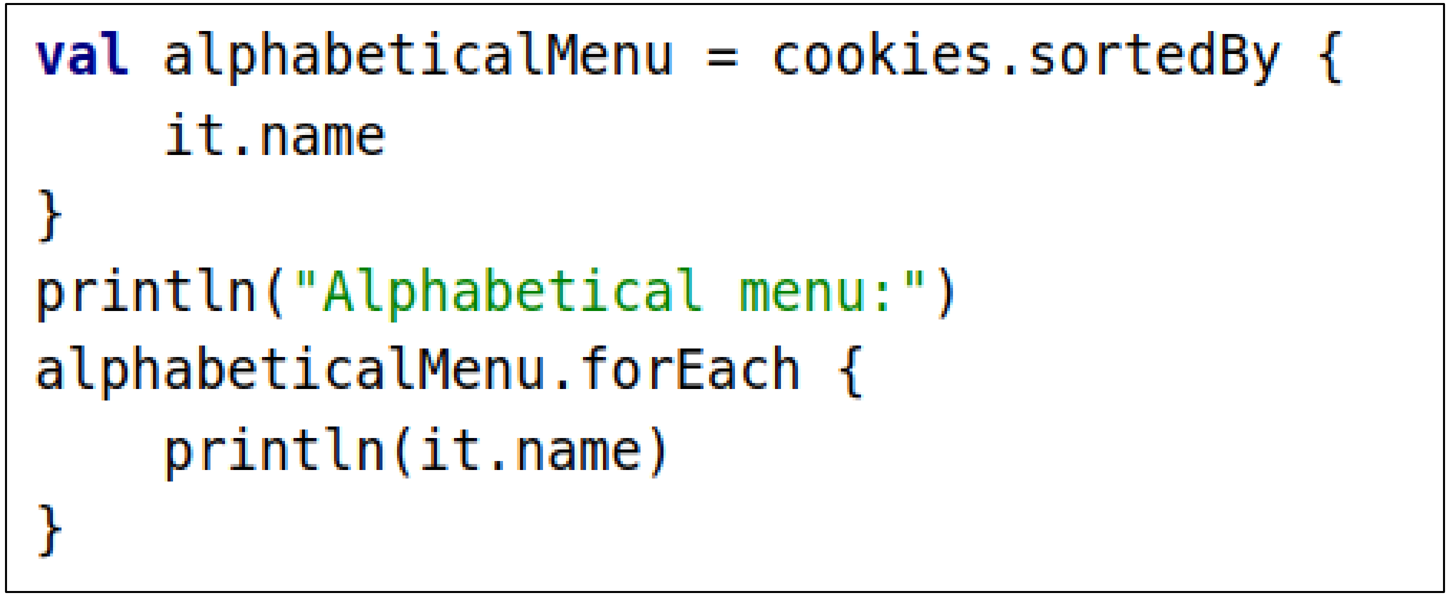
```
val totalPrice = cookies.fold(0.0) {total, cookie ->
    total + cookie.price
}
println("Total price: $${totalPrice}")
```

Accumulator

COMPLEX DATA TYPES

High-order Functions – sortedBy()

- Lets you specify a lambda that returns the property you'd like to sort by
- As far as the data type has a natural sort order, it will be sorted just like a collection of that type

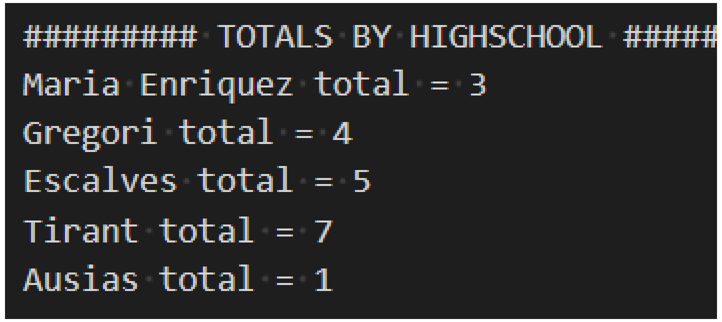


```
val alphabeticalMenu = cookies.sortedBy {
    it.name
}
println("Alphabetical menu:")
alphabeticalMenu.forEach {
    println(it.name)
}
```

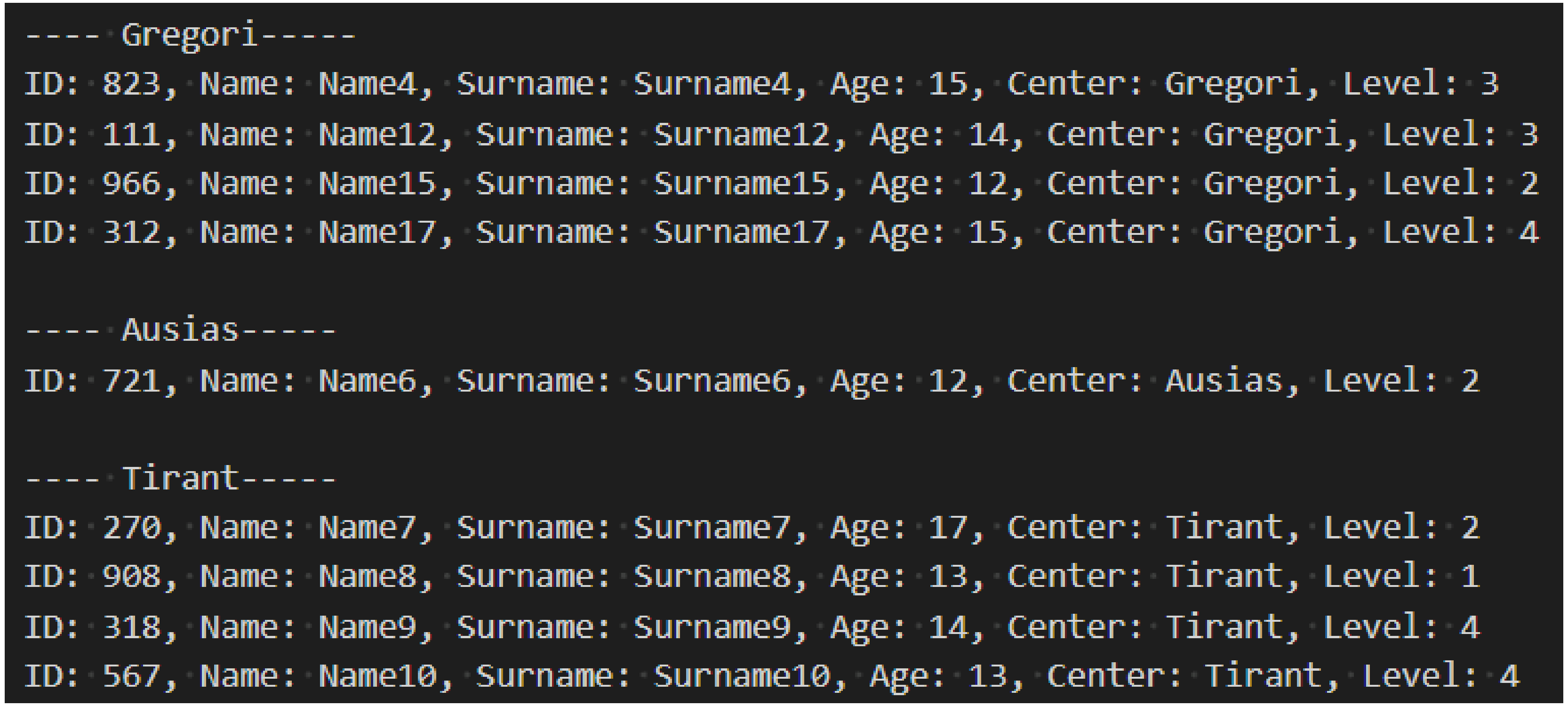
COMPLEX DATA TYPES

Exercise

- Improve the previous program (Collections) by using High-Order functions
- Results must be the same



```
######### TOTALS BY HIGHSCHOOL #####
Maria Enriquez total = 3
Gregori total = 4
Escalves total = 5
Tirant total = 7
Ausias total = 1
```



```
---- Gregori-----
ID: 823, Name: Name4, Surname: Surname4, Age: 15, Center: Gregori, Level: 3
ID: 111, Name: Name12, Surname: Surname12, Age: 14, Center: Gregori, Level: 3
ID: 966, Name: Name15, Surname: Surname15, Age: 12, Center: Gregori, Level: 2
ID: 312, Name: Name17, Surname: Surname17, Age: 15, Center: Gregori, Level: 4

---- Ausias-----
ID: 721, Name: Name6, Surname: Surname6, Age: 12, Center: Ausias, Level: 2

---- Tirant-----
ID: 270, Name: Name7, Surname: Surname7, Age: 17, Center: Tirant, Level: 2
ID: 908, Name: Name8, Surname: Surname8, Age: 13, Center: Tirant, Level: 1
ID: 318, Name: Name9, Surname: Surname9, Age: 14, Center: Tirant, Level: 4
ID: 567, Name: Name10, Surname: Surname10, Age: 13, Center: Tirant, Level: 4
```

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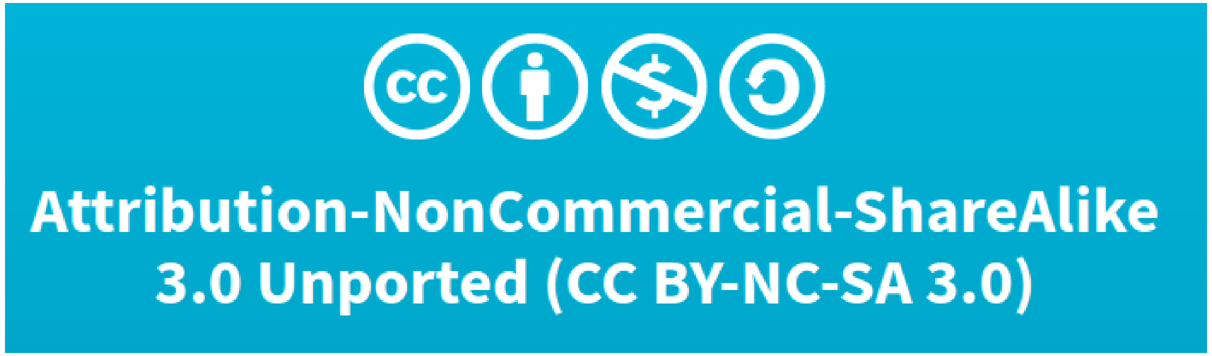

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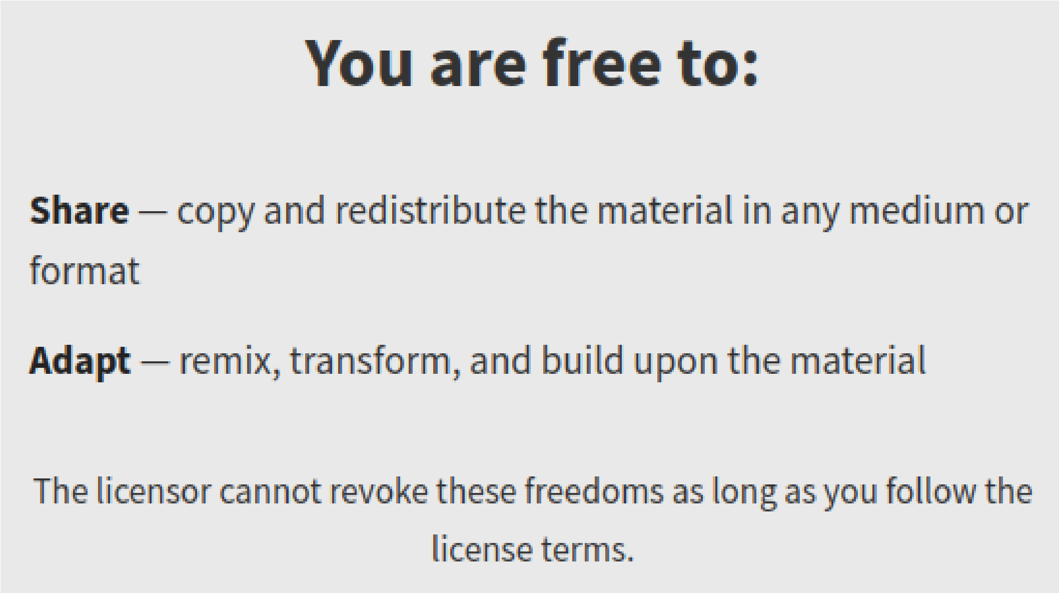

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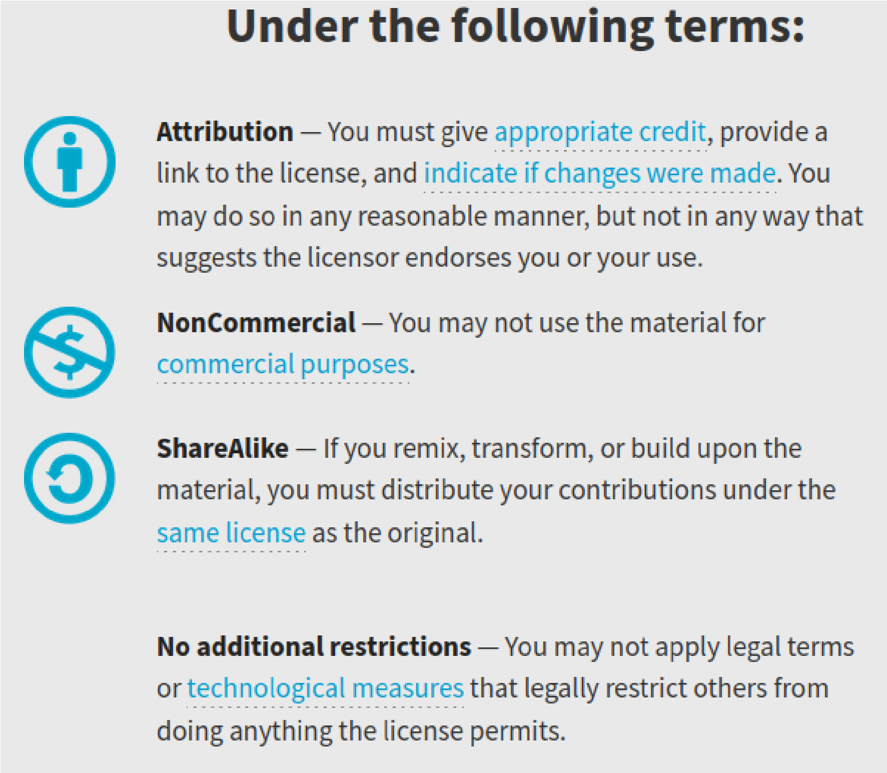

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