

## BASICS

### "Hello, World" program

```
fun main(args: Array<String>) {  
    println("Hello, World")  
}
```

### Declaring function

```
fun sum(a: Int, b: Int): Int {  
    return a + b  
}
```

### Single-expression function

```
fun sum(a: Int, b: Int) = a + b
```

### Declaring variables

```
val name = "Marcin" // Can't be changed  
var age = 5          // Can be changed  
age++
```

### Variables with nullable types

```
var name: String? = null  
val length: Int  
length = name?.length ?: 0  
// length, or 0 if name is null  
length = name?.length ?: return  
// length, or return when name is null  
length = name?.length ?: throw Error()  
// length, or throw error when name is null
```

## CONTROL STRUCTURES

### If as an expression

```
fun bigger(a: Int, b: Int) = if (a > b) a else b
```

### For loop

```
val list = listOf("A", "B", "C")  
for (element in list) {  
    println(element)  
}
```

### When expression

```
fun numberTypeName(x: Number) = when(x) {  
    0 -> "Zero" // Equality check  
    in 1..4 -> "Four or less" // Range check  
    5, 6, 7 -> "Five to seven" // Multiple values  
    is Byte -> "Byte" // Type check  
    else -> "Some number"  
}
```

### When expression with predicates

```
fun signAsString(x: Int) = when {  
    x < 0 -> "Negative"  
    x == 0 -> "Zero"  
    else -> "Positive"  
}
```

## CLASSES

### Primary constructor

val declares a read-only property, var a mutable one

```
class Person(val name: String, var age: Int)  
// name is read-only, age is mutable
```

### Inheritance

```
open class Person(val name: String) {  
    open fun hello() = "Hello, I am $name"  
    // Final by default so we need open  
}  
class PolishPerson(name: String) : Person(name) {  
    override fun hello() = "Dzień dobry, jestem $name"  
}
```

### Properties with assessors

```
class Person(var name: String, var surname: String) {  
    var fullName: String  
    get() = "$name $surname"  
    set(value) {  
        val (first, rest) = value.split(" ", limit = 2)  
        name = first  
        surname = rest  
    }  
}
```

### Data classes

```
data class Person(val name: String, var age: Int)  
val mike = Person("Mike", 23)
```

Modifier data adds:

1. toString that displays all primary constructor properties  
print(mike.toString()) // Person(name=Mike, age=23)

2. equals that compares all primary constructor properties  
print(mike == Person("Mike", 23)) // True  
print(mike == Person("Mike", 21)) // False

3. hashCode that is based on all primary constructor properties  
val hash = mike.hashCode()  
print(hash == Person("Mike", 23).hashCode()) // True  
print(hash == Person("Mike", 21).hashCode()) // False

4. component1, component2 etc. that allows deconstruction

```
val (name, age) = mike  
print("$name $age") // Mike 23
```

5. copy that returns copy of object with concrete properties changed

```
val jake = mike.copy(name = "Jake")
```



## COLLECTION LITERALS

```
listOf(1,2,3,4) // List<Int>
mutableListOf(1,2,3,4) // MutableList<Int>

setOf("A", "B", "C") // Set<String>
mutableSetOf("A", "B", "C") // MutableSet<String>

arrayOf('a', 'b', 'c') // Array<Char>

mapOf(1 to "A", 2 to "B") // Map<Int, String>
mutableMapOf(1 to "A", 2 to "B")
// MutableMap<Int, String>

sequenceOf(4,3,2,1) // Sequence<Int>

1 to "A" // Pair<Int, String>

List(4) { it * 2 } // List<Int>
generateSequence(4) { it + 2 } // Sequence<Int>
```

## COLLECTION PROCESSING

```
students
    .filter { it.passing && it.averageGrade > 4.0 }
    // Only passing students
    .sortedByDescending { it.averageGrade }
    // Starting from ones with biggest grades
    .take(10) // Take first 10
    .sortedWith(compareBy({ it.surname }, { it.name }))
    // Sort by surname and then name

generateSequence(0) { it + 1 }
// Infinitive sequence of next numbers starting on 0
    .filter { it % 2 == 0 } // Keep only even
    .map { it * 3 } // Triple every one
    .take(100) // Take first 100
    .average() // Count average
```

### Most important functions for collection processing

```
val l = listOf(1,2,3,4)
filter - returns only elements matched by predicate
l.filter { it % 2 == 0 } // [2, 4]
map - returns elements after transformation
l.map { it * 2 } // [2, 4, 6, 8]
flatMap - returns elements yielded from results of trans.
l.flatMap { listOf(it, it + 10) } // [1, 11, 2, 12, 3, 13, 4, 14]
fold/reduce - accumulates elements
l.fold(0.0) { acc, i -> acc + i } // 10.0
l.reduce { acc, i -> acc * i } // 24
forEach/forEach - perfons an action on every element
l.forEach { print(it) } // Prints 1234, returns Unit
l.forEach { print(it) } // Prints 1234, returns [1, 2, 3, 4]
```

```
partition - splits into pair of lists
val (even, odd) = l.partition { it % 2 == 0 }
print(even) // [2, 4]
print(odd) // [1, 3]
min/max/minBy/maxBy
l.min() // 1, possible because we can compare Int
l.minBy { -it } // 4
l.max() // 4, possible because we can compare Int
l.maxBy { -it } // 1
first/firstBy
l.first() // 1
l.first { it % 2 == 0 } // 2 (first even number)
count - count elements matched by predicate
l.count { it % 2 == 0 } // 2
sorted/sortedBy - returns sorted collection
listOf(2,3,1,4).sorted() // [1, 2, 3, 4]
l.sortedBy { it % 2 } // [2, 4, 1, 3]
groupBy - group elements on collection by key
l.groupBy { it % 2 } // Map: {1=[1, 3], 0=[2, 4]}
distinct/distinctBy - returns only unique elements
listOf(1,1,2,2).distinct() // [1, 2]
```

## Mutable vs immutable collection processing functions

```
val list = mutableListOf(3,4,2,1)
val sortedResult = list.sorted() // Returns sorted
println(sortedResult) // [1, 2, 3, 4]
println(list) // [3, 4, 2, 1]
val sortResult = list.sort() // Sorts mutable collection
println(sortResult) // kotlin.Unit
println(list) // [1, 2, 3, 4]
```

## EXTENSION FUNCTIONS TO ANY OBJECT

Returns Reference to receiver	Receiver	Results of lambda
it	also	let
this	apply	run/with

```
val dialog = Dialog().apply {
    title = "Dialog title"
    onClick { print("Clicked") }
}
```



## FUNCTIONS

### Function types

`() -> Unit` - takes no arguments and returns nothing (`Unit`).  
`(Int, Int) -> Int` - takes two arguments of type `Int` and returns `Int`.  
`((() -> Unit) -> Int` - takes another function and returns `Int`.  
`(Int) -> () -> Unit` - takes argument of type `Int` and returns function.

### Function literals

```
val add: (Int, Int) -> Int = { i, j -> i + j }
// Simple lambda expression
```

```
val printAndDouble: (Int) -> Int = {
    println(it)
    // When single parameter, we can reference it using `it`
    it * 2 // In lambda, last expression is returned
}
```

*// Anonymous function alternative*

```
val printAndDoubleFun: (Int) -> Int = fun(i: Int): Int {
    println(i) // Single argument can't be referenced by `it`
    return i * 2 // Needs return like any function
}
```

```
val i = printAndDouble(10) // 10
print(i) // 20
```

### Extension functions

```
fun Int.isEven() = this % 2 == 0
print(2.isEven()) // true
```

```
fun List<Int>.average() = 1.0 * sum() / size
print(listOf(1, 2, 3, 4).average()) // 2.5
```

## DELEGATES

**Lazy** - calculates value before first usage

```
val i by lazy { print("init "); 10 }
print(i) // Prints: init 10
print(i) // Prints: 10
```

**notNull** - returns last setted value, or throws error if no value has been set

**observable/vetoable** - calls function every time value changes. In vetoable function also decides if new value should be set.

```
var name by observable("Unset") { p, old, new ->
    println("${p.name} changed $old -> $new")
}
name = "Marcin"
// Prints: name changed Unset -> Marcin
```

**Map/MutableMap** - finds value on map by property name

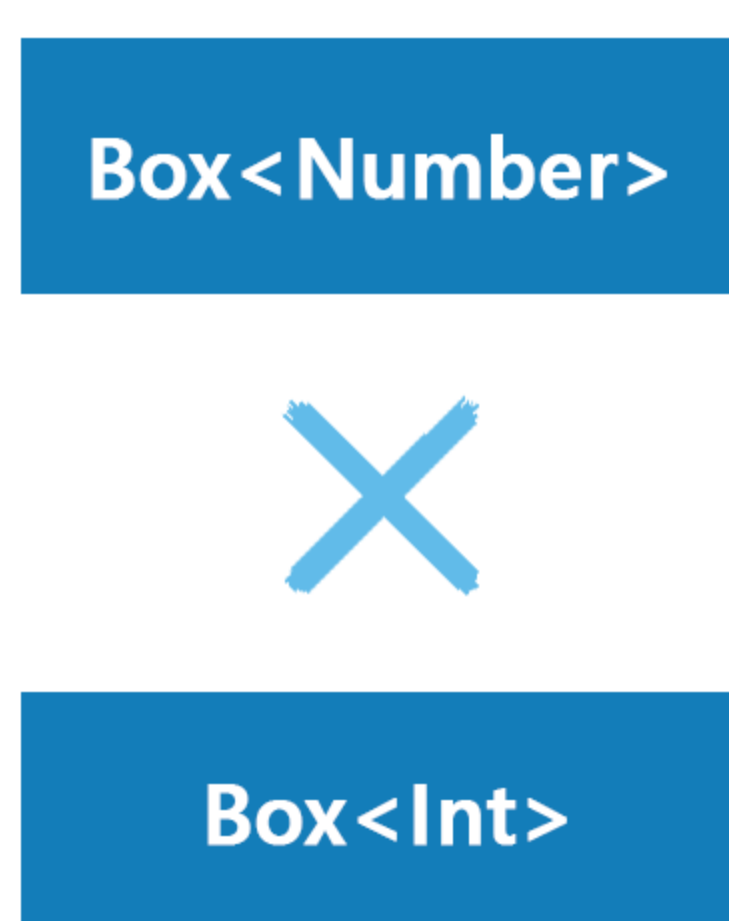
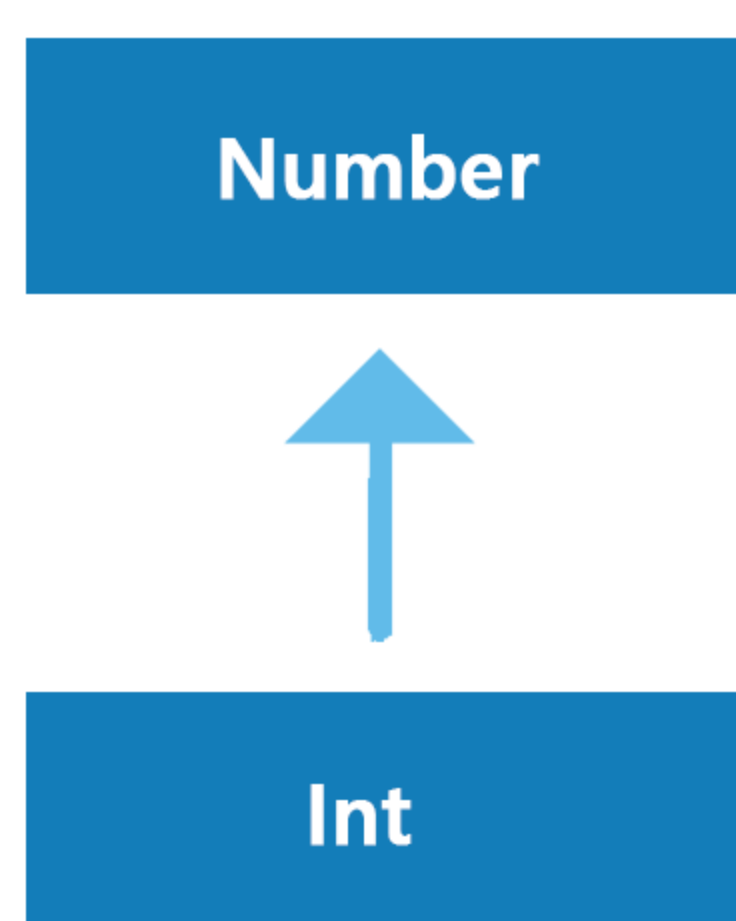
```
val map = mapOf("a" to 10)
val a by map
print(a) // Prints: 10
```

## VISIBILITY MODIFIERS

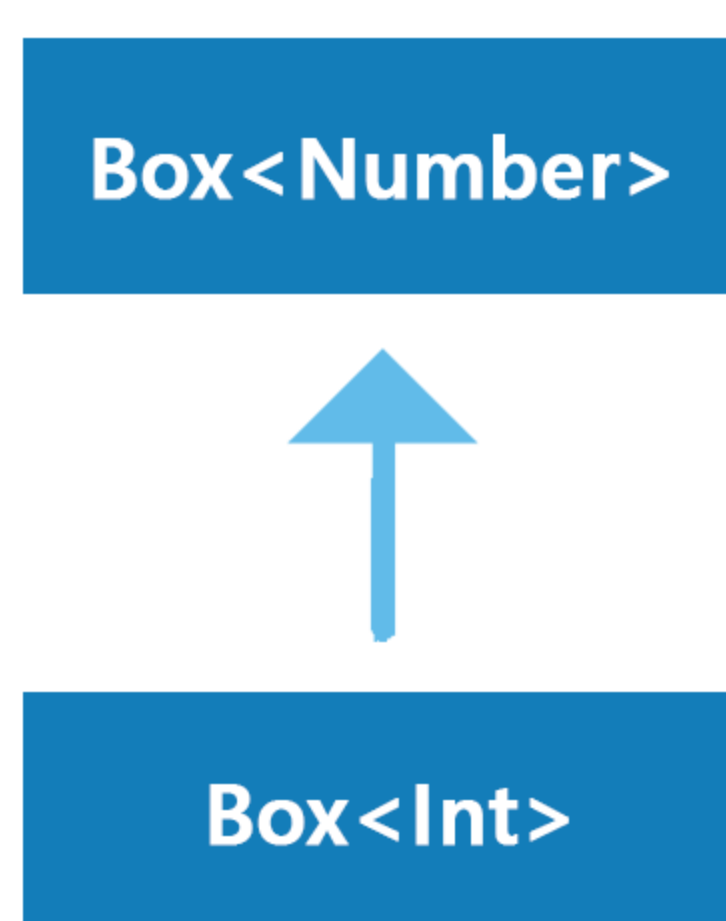
Modifier	Class members	Top-level
Public (default)	Visible everywhere	Visible everywhere
Private	Visible only in the same class	Visible in the same file
Protected	Visible only in the same class and subclasses	Not allowed
Internal	Visible in the same module if class is accessible	Visible in the same module

## VARIANCE MODIFIERS

**Invariance**  
class Box <T>



**Covariance**  
class Box <out T>



**Contravariance**  
class Box <in T>

