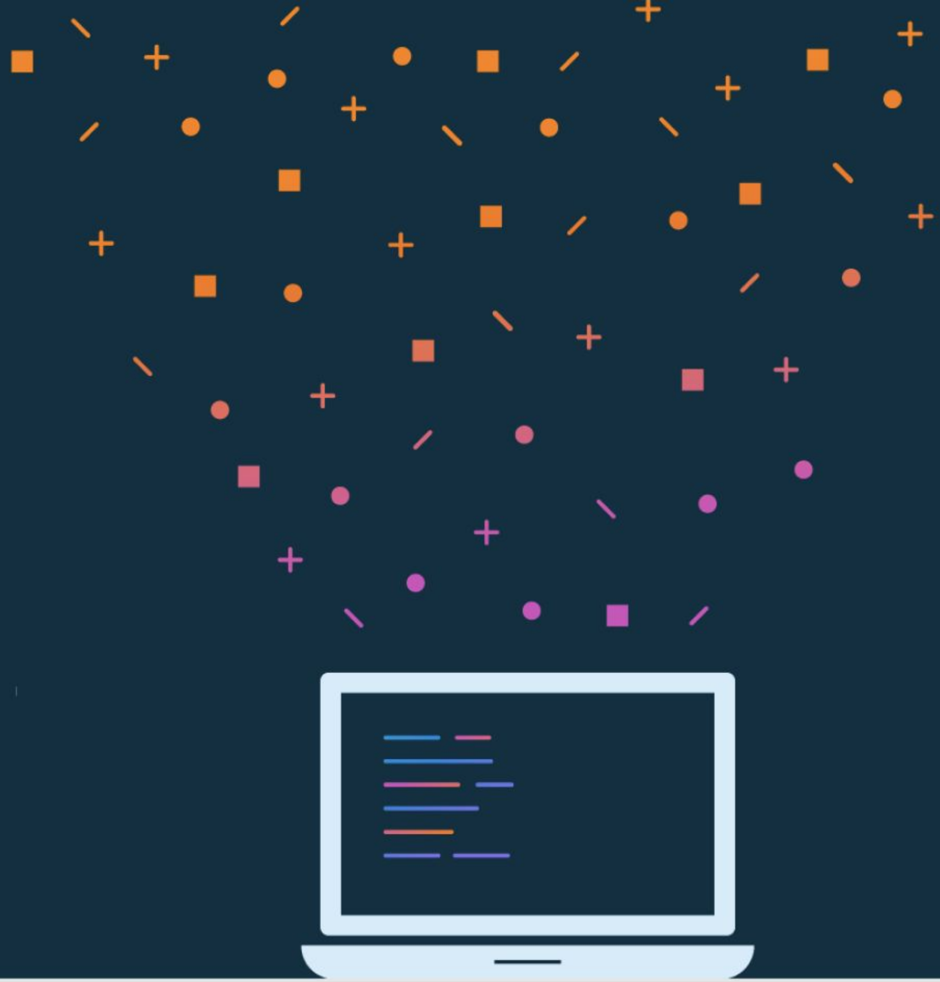
Lesson 1:
Kotlin basics

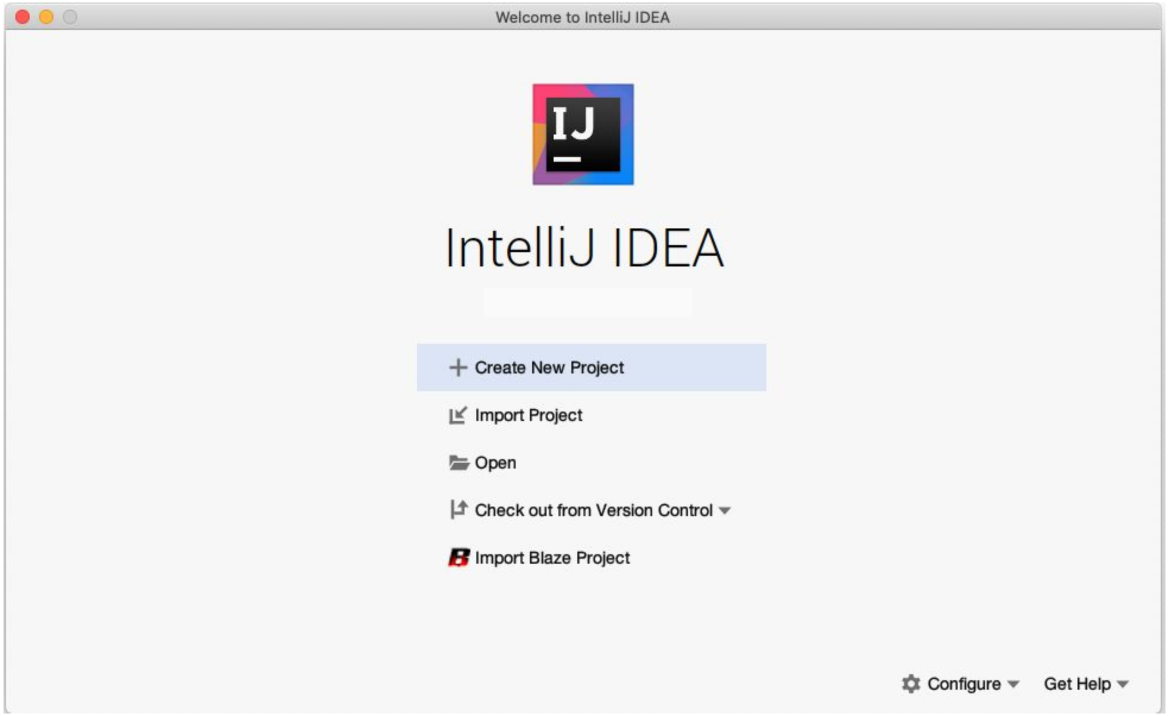


About this lesson

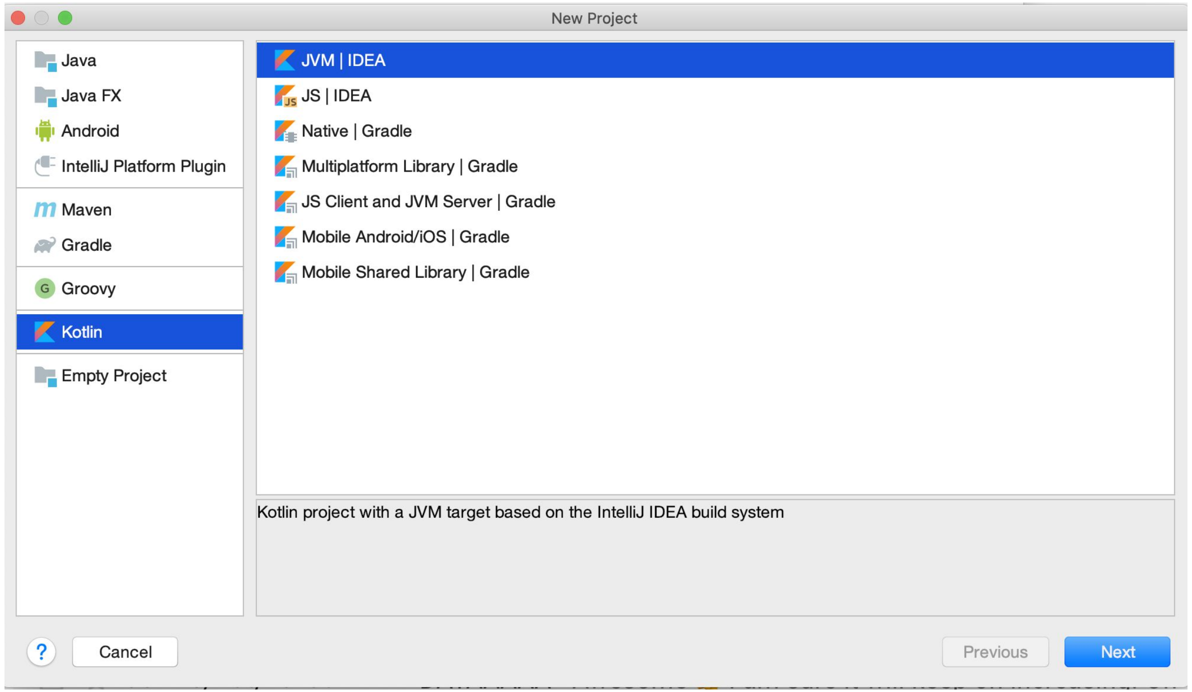
Lesson 1: Kotlin basics

Get started

Open IntelliJ IDEA

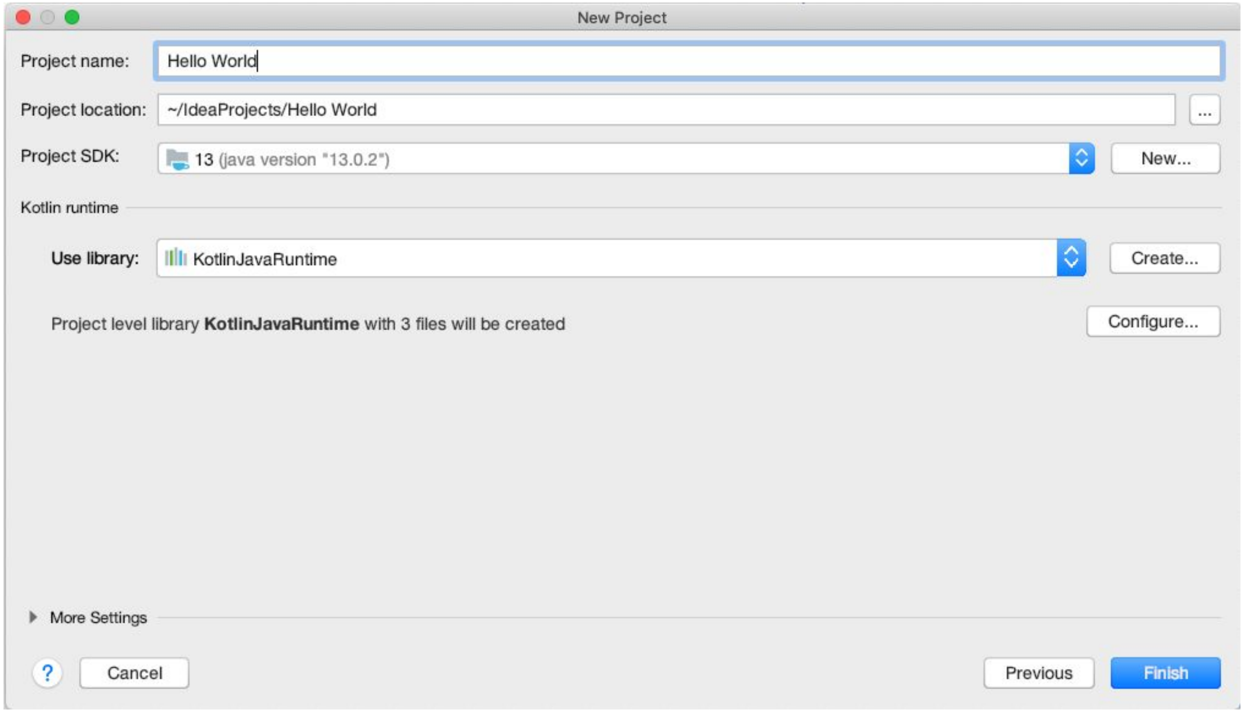


Create a new project



Kotlin project with a JVM target based on the IntelliJ IDEA build system

Name the project


New Project

Project name: Hello World

Project location: ~/IdeaProjects/Hello World

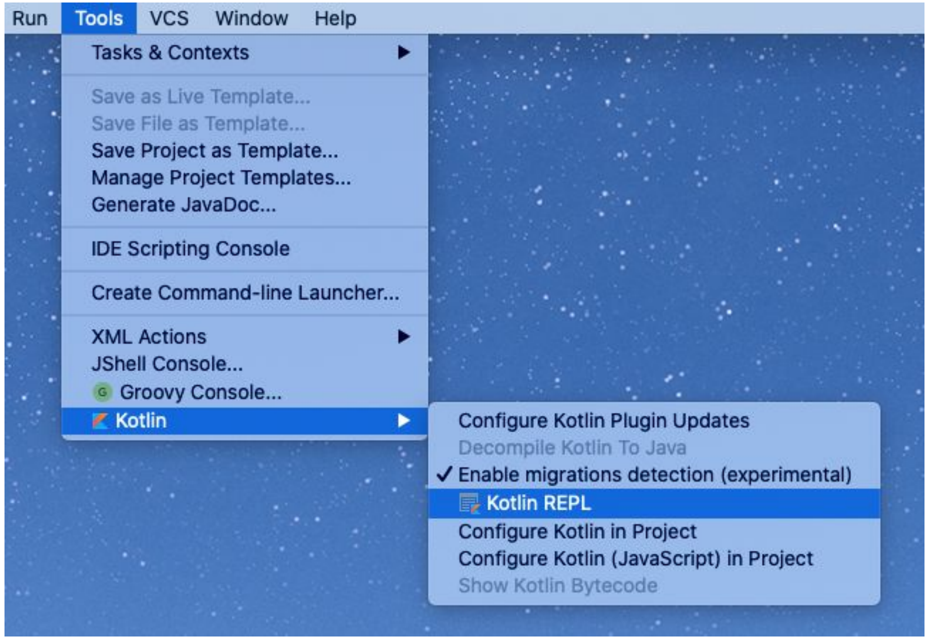
Project SDK: 13 (java version "13.0.2")

Kotlin runtime

Use library: KotlinJavaRuntime

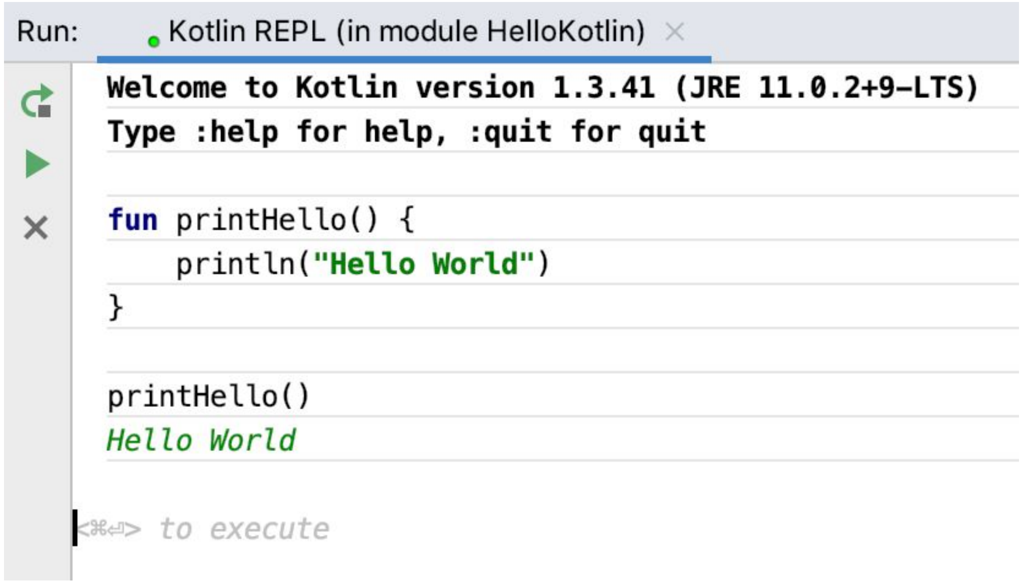
Project level library **KotlinJavaRuntime** with 3 files will be created

Open REPL (Read-Eval-Print-Loop)



It may take a few moments before the Kotlin menu appears under **Tools**.

Create a printHello() function

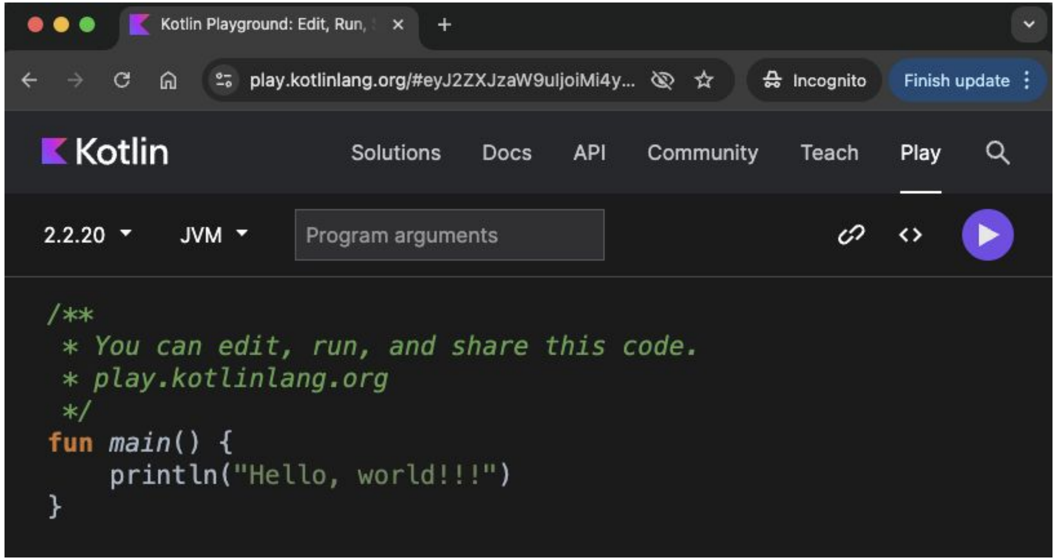


```
Welcome to Kotlin version 1.3.41 (JRE 11.0.2+9-LTS)
Type :help for help, :quit for quit

fun printHello() {
    println("Hello World")
}

printHello()
Hello World

<⌘⏎> to execute
```

Press **Control+Enter** (**Command+Enter** on a Mac) to execute.

Alternative

Use Kotlin Playground



```kotlin
/**
 * You can edit, run, and share this code.
 * play.kotlinlang.org
 */
fun main() {
    println("Hello, world!!!")
}
```

Operators

Operators

● Mathematical operators	`+ - * / %`
● Increment and decrement operators	`++ --`
● Comparison operators	`< <= > >=`
● Assignment operator	`=`
● Equality operators	`== !=`

Math operators with integers

```
1 + 1      =>     2

53 - 3     =>     50

50 / 10    =>     5

9 % 3      =>     0
```

Math operators with doubles

```
1.0 / 2.0    =>    0.5

2.0 * 3.5    =>    7.0
```

Math operators

```
1+1
⇒ kotlin.Int = 2
```

```
53-3
⇒ kotlin.Int = 50
```

```
50/10
⇒ kotlin.Int = 5
```

```
1.0/2.0
⇒ kotlin.Double = 0.5
```

```
2.0*3.5
⇒ kotlin.Double = 7.0
```

⇒ indicates output from your code.

Result includes the type (`kotlin.Int`).

Numeric operator methods

Kotlin keeps numbers as primitives, but lets you call methods on numbers as if they were objects.

```
2.times(3)
⇒ kotlin.Int = 6

3.5.plus(4)
⇒ kotlin.Double = 7.5

2.4.div(2)
⇒ kotlin.Double =
1.2
```

Data types

Integer types

Type	Bits	Notes
Long	64	From -2^{63} to $2^{63}-1$
Int	32	From -2^{31} to $2^{31}-1$
Short	16	From -32768 to 32767
Byte	8	From -128 to 127

Floating-point and other numeric types

Type	Bits	Notes
Double	64	16 - 17 significant digits
Float	32	6 - 7 significant digits
Char	16	16-bit Unicode character
Boolean	8	True or false. Operations include: || - lazy disjunction, && - lazy conjunction, ! - negation

Operand types

Results of operations keep the types of the operands

```
6*50
⇒ kotlin.Int = 300

6.0*50.0
⇒ kotlin.Double = 300.0

6.0*50
⇒ kotlin.Double = 300.0
```

```
1/2
⇒ kotlin.Int = 0

1.0/2.0
⇒ kotlin.Double = 0.5
```

Type casting

Assign an `Int` to a `Byte`

```
val i: Int = 6
val b: Byte = i
println(b)
```

```
⇒ error: type mismatch: inferred type is Int but Byte was
expected
```

Convert `Int` to `Byte` with casting

```
val i: Int = 6
println(i.toByte())
```

```
⇒ 6
```

Underscores for long numbers

Use underscores to make long numeric constants more readable.

```
val oneMillion = 1_000_000
val idNumber = 999_99_9999L
val hexBytes = 0xFF_EC_DE_5E
val bytes = 0b11010010_01101001_10010100_10010010
```

Strings

Strings are any sequence of characters enclosed by double quotes.

```
val s1 = "Hello world!"
```

String literals can contain escape characters

```
val s2 = "Hello world!\n"
```

Or any arbitrary text delimited by a triple quote (""")

```
val text = """
    var bikes = 50
"""
```

String concatenation

```
val numberOfDogs = 3
val numberOfCats = 2

"I have $numberOfDogs dogs" + " and $numberOfCats cats"

=> I have 3 dogs and 2 cats
```

String templates

A template expression starts with a dollar sign (`$`) and can be a simple value:

```
val i = 10
println("i = $i")
=> i = 10
```

Or an expression inside curly braces:

```
val s = "abc"
println("$s.length is ${s.length}")
=> abc.length is 3
```

String template expressions

```
val numberOfShirts = 10
val numberOfPants = 5
"I have ${numberOfShirts + numberOfPants} items of clothing"

=> I have 15 items of clothing
```

Variables

Variables

- Powerful type inference
    - Let the compiler infer the type
    - You can explicitly declare the type if needed
- Mutable and immutable variables
    - Immutability not enforced, but recommended

Kotlin is a statically-typed language. The type is resolved at compile time and never changes.

Specifying the variable type

Colon Notation

```
var width: Int = 12
var length: Double = 2.5
```

Important: Once a type has been assigned by you or the compiler, you can't change the type or you get an error.

Mutable and immutable variables

- Mutable (Changeable)

```
var score = 10
```

- Immutable (Unchangeable)

```
val name = "Jennifer"
```

Although not strictly enforced, using immutable variables is recommended in most cases.

var and val

```
var count = 1

count = 2

val size = 1

size = 2

=> Error: val cannot be reassigned
```

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Conditionals

Control flow

Kotlin features several ways to implement conditional logic:

- If/Else statements
- When statements
- For loops
- While loops

if/else statements

```
val numberOfCups = 30
val numberOfPlates = 50

if (numberOfCups > numberOfPlates) {
    println("Too many cups!")
} else {
    println("Not enough cups!")
}
```

```
=> Not enough cups!
```

if statement with multiple cases

```kotlin
val guests = 30
if (guests == 0) {
    println("No guests")
} else if (guests < 20) {
    println("Small group of people")
} else {
    println("Large group of people!")
}
```

```
⇒ Large group of people!
```

Ranges

- Data type containing a span of comparable values (e.g., integers from 1 to 100 inclusive)
- Ranges are bounded
- Objects within a range can be mutable or immutable

Ranges in if/else statements

```
val numberOfStudents = 50
if (numberOfStudents in 1..100) {
    println(numberOfStudents)
}

=> 50
```

Note: There are no spaces around the "range to" operator `(1..100)`

when statement

```
when (results) {
    0  -> println("No results")
    in 1..39 -> println("Got results!")
    else -> println("That's a lot of results!")
}
⇒ That's a lot of results!
```

As well as a `when` statement, you can also define a `when` expression that provides a return value.

for loops

```
val pets = arrayOf("dog", "cat", "canary")
for (element in pets) {
    print(element + " ")
}
⇒ dog cat canary
```

You don’t need to define an iterator variable and increment it for each pass.

for loops: elements and indexes

```
for ((index, element) in pets.withIndex()) {
    println("Item at $index is $element\n")
}
```

```
⇒ Item at 0 is dog
Item at 1 is cat
Item at 2 is canary
```

for loops: step sizes and ranges

```
for (i in 1..5) print(i)

⇒ 12345

for (i in 5 downTo 1) print(i)

⇒ 54321

for (i in 3..6 step 2) print(i)

⇒ 35

for (i in 'd'..'g') print (i)

⇒ defg
```

while loops

```
var bicycles = 0
while (bicycles < 50) {
    bicycles++
}
println("$bicycles bicycles in the bicycle rack\n")
```

```
⇒ 50 bicycles in the bicycle rack
```

```
do {
    bicycles--
} while (bicycles > 50)
println("$bicycles bicycles in the bicycle rack\n")
```

```
⇒ 49 bicycles in the bicycle rack
```

repeat loops

```
repeat(2) {
     print("Hello!")
}

⇒ Hello!Hello!
```

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Lists and arrays

Lists

- Lists are ordered collections of elements
- List elements can be accessed programmatically through their indices
- Elements can occur more than once in a list

An example of a list is a sentence: it's a group of words, their order is important, and they can repeat.

Immutable list using listOf()

Declare a list using `listOf()` and print it out.

```kotlin
val instruments = listOf("trumpet", "piano", "violin")
println(instruments)
```

```
⇒ [trumpet, piano, violin]
```

Mutable list using mutableListOf()

Lists can be changed using `mutableListOf()`

```
val myList = mutableListOf("trumpet", "piano", "violin")
myList.remove("violin")

⇒ kotlin.Boolean = true
```

With a list defined with `val`, you can't change which list the variable refers to, but you can still change the contents of the list.

Arrays

- Arrays store multiple items
- Array elements can be accessed programmatically through their indices
- Array elements are mutable
- Array size is fixed

Array using arrayOf()

An array of strings can be created using `arrayOf()`

```
val pets = arrayOf("dog", "cat", "canary")
println(java.util.Arrays.toString(pets))
⇒ [dog, cat, canary]
```

With an array defined with `val`, you can't change which array the variable refers to, but you can still change the contents of the array.

Arrays with mixed or single types

An array can contain different types.

```
val mix = arrayOf("hats", 2)
```

An array can also contain just one type (integers in this case).

```
val numbers = intArrayOf(1, 2, 3)
```

Combining arrays

Use the + operator.

```
val numbers = intArrayOf(1,2,3)
val numbers2 = intArrayOf(4,5,6)
val combined = numbers2 + numbers
println(Arrays.toString(combined))

=> [4, 5, 6, 1, 2, 3]
```

Comparison

Collection	Can change length?	Can change elements?	Example
`Array`	No	Yes	`arrayOf(1, 2, 3)`
`List` (immutable)	No	No	`listOf(1, 2, 3)`
`MutableList`	Yes	Yes	`mutableListOf(1, 2, 3)`

Null safety

Null safety

- In Kotlin, variables cannot be null by default
- You can explicitly assign a variable to null using the safe call operator
- Allow null-pointer exceptions using the `!!` operator
- You can test for null using the elvis (`?:`) operator

Variables cannot be null

In Kotlin, `null` variables are not allowed by default.

Declare an `Int` and assign `null` to it.

```
var numberOfBooks: Int = null

⇒ error: null can not be a value of a non-null type Int
```

Safe call operator

The safe call operator (`?`), after the type indicates that a variable can be `null`.

Declare an `Int?` as nullable

```
var numberOfBooks: Int? = null
```

In general, do not set a variable to null as it may have unwanted consequences.

Testing for null

Check whether the `numberOfBooks` variable is not `null`. Then decrement that variable.

```
var numberOfBooks = 6
if (numberOfBooks != null) {
    numberOfBooks = numberOfBooks.dec()
}
```

Now look at the Kotlin way of writing it, using the safe call operator.

```
var numberOfBooks = 6
numberOfBooks = numberOfBooks?.dec()
```

The !! operator

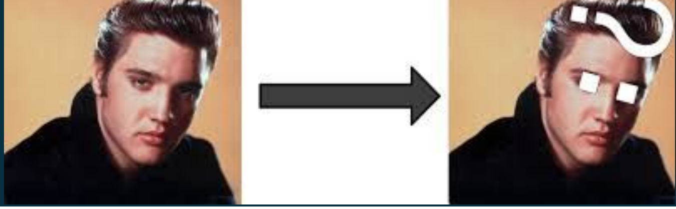
If you're certain a variable won't be null, use `!!` to force the variable into a non-null type. Then you can call methods/properties on it.

```
val len = s!!.length
```

throws NullPointerException if s is null

Warning: Because `!!` will throw an exception, it should only be used when it would be exceptional to hold a null value.

Elvis operator



Chain null tests with the `?:` operator.

```
numberOfBooks = numberOfBooks?.dec() ?: 0
```

The `?:` operator is sometimes called the "Elvis operator," because it's like a smiley on its side with a pompadour hairstyle, like Elvis Presley styled his hair.

Summary