


Mobile Programming



Kotlin Basics – Part I



Let's go! Kotlin!

■ Kotlin

- Default Programming Language for Android Development
- API document: <https://kotlinlang.org/docs/>

Environment	Language	Toolkit
Application	Java/Kotlin	SDK (Software Development Kit)
System application	C, C++	NDK (Native Development Kit)
Hardware control / kernel	C, C++	PDK (Platform Development Kit)

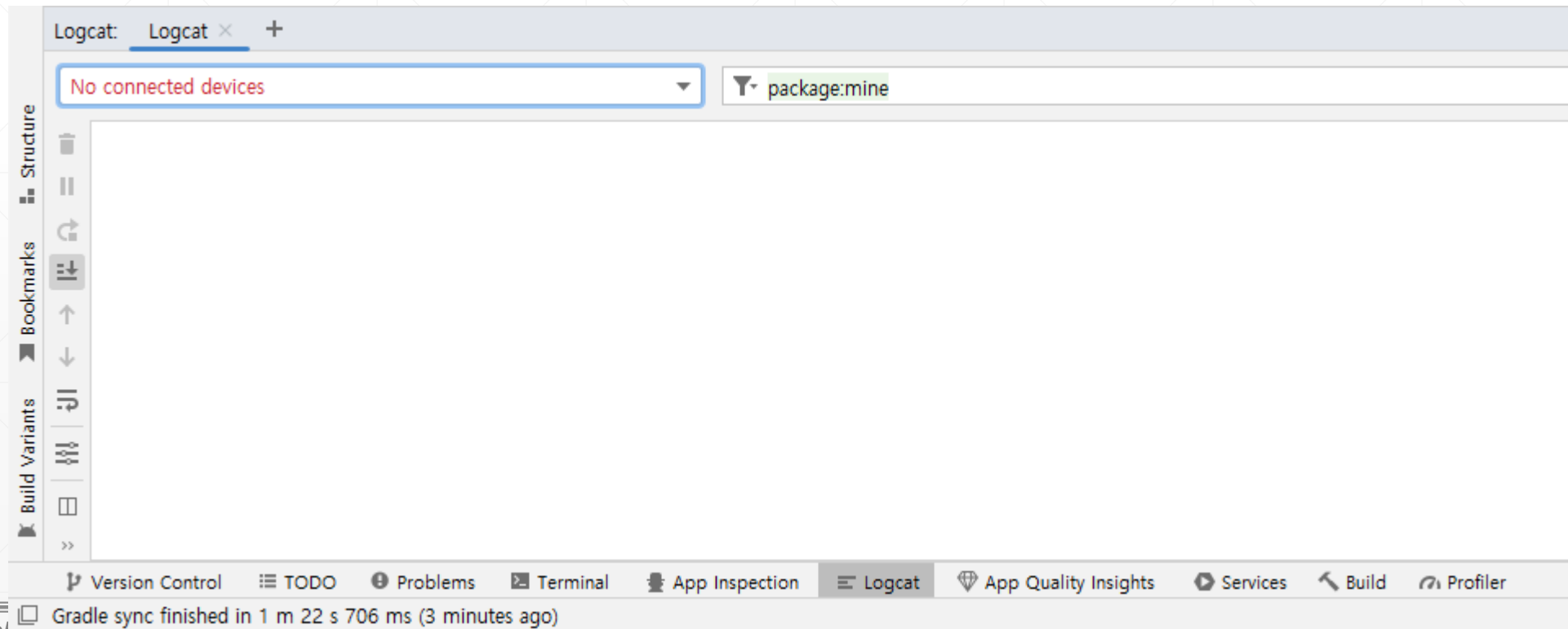


Logcat (1/6)

- Log monitor

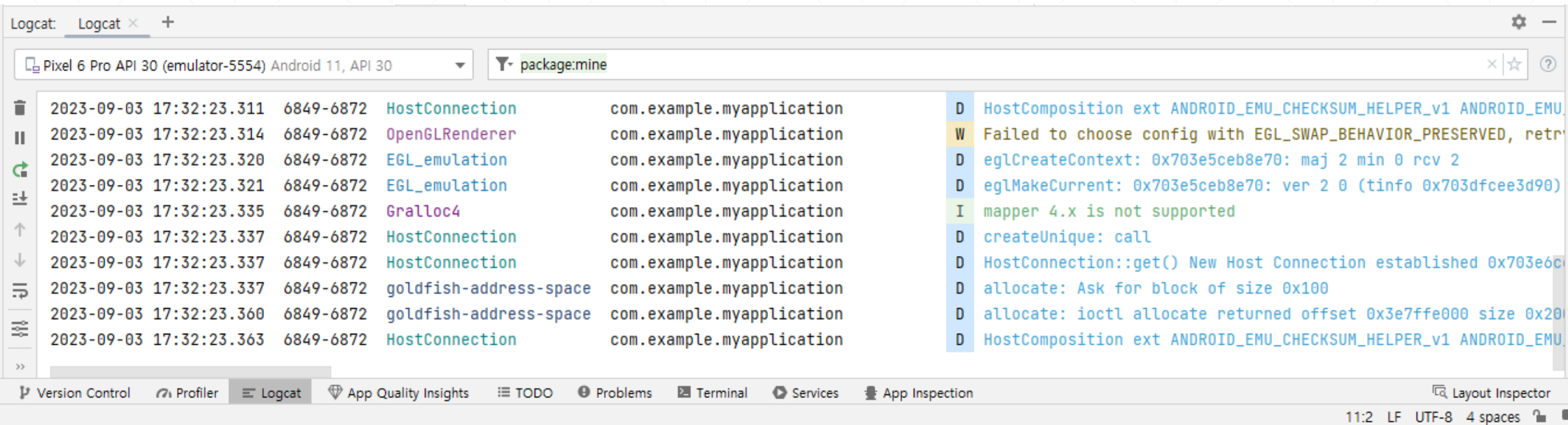
- System logs
- Application logs

- We will check the result of Kotlin codes using Logcat!



Logcat (2/6)

- Start your emulator or real device
- Then, see Logcat! What happens?



Logcat (3/6)

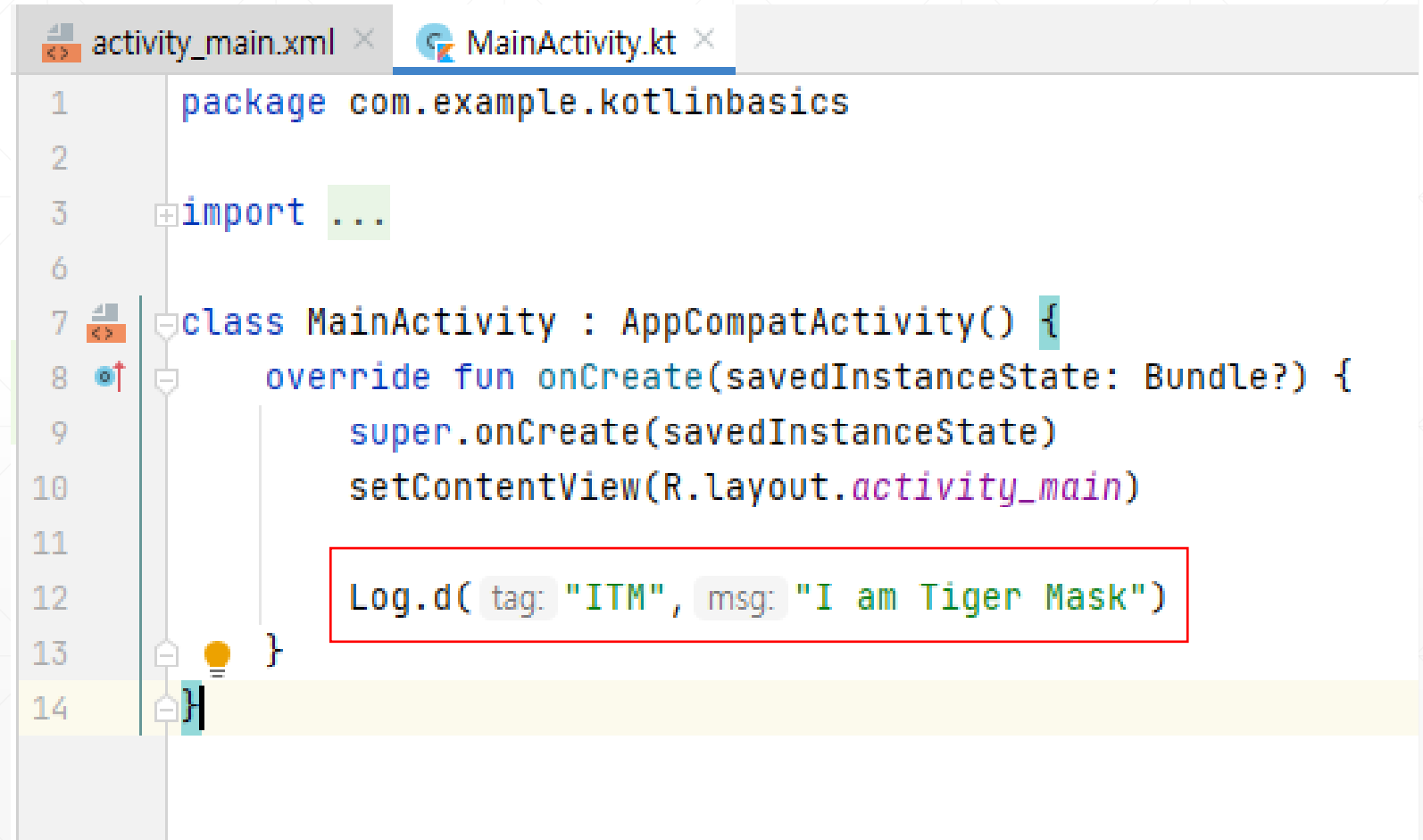
- Log : Information that is output outside the app to understand the flow of code
- Logcat : Log monitor which can be used to actually monitor logs with a variety of filter functions

Method	Meaning	Subject
Log.v()	verbose	Output verbose data
Log.d()	debug	Output logs for debug (for developers)
Log.i()	information	Output logs for information
Log.w()	warning	Output logs for warning
Log.e()	error	Output logs for error!

Logcat (4/6)

■ The first application log

➤ Tag + message



```
1 package com.example.kotlinbasics
2
3 import ...
4
5
6
7 class MainActivity : AppCompatActivity() {
8     override fun onCreate(savedInstanceState: Bundle?) {
9         super.onCreate(savedInstanceState)
10        setContentView(R.layout.activity_main)
11
12        Log.d( tag: "ITM", msg: "I am Tiger Mask")
13    }
14 }
```

Logcat (5/6)

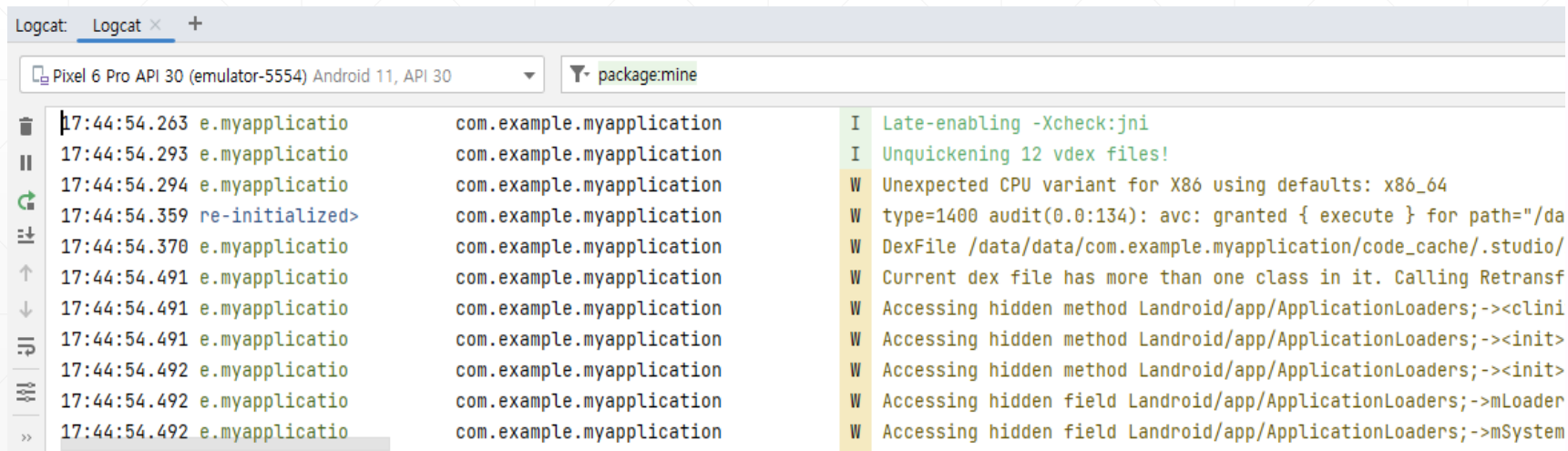
■ Run the app!

➤ Nothing happens to your app visually

■ What about the log perspective?

➤ Some text there!

Hello ITM!!

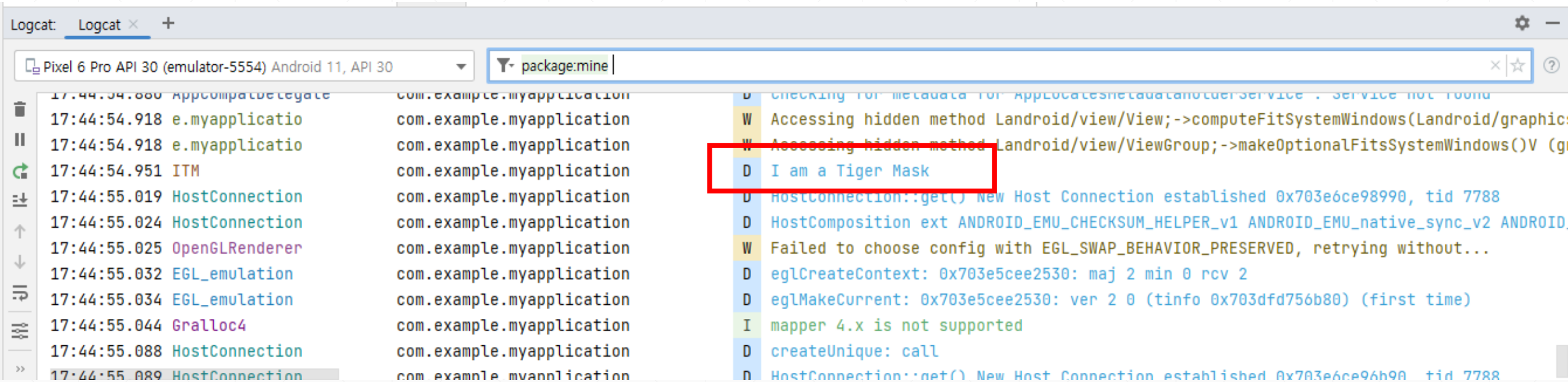


The screenshot shows the Logcat window in Android Studio. The top bar indicates the device is a Pixel 6 Pro API 30 (emulator-5554) running Android 11, API 30. The filter is set to package:mime. The log messages are as follows:

Time	Level	Class	Message
17:44:54.263	E	com.example.myapplication	
17:44:54.293	E	com.example.myapplication	
17:44:54.294	E	com.example.myapplication	
17:44:54.359	E	com.example.myapplication	re-initialized>
17:44:54.370	E	com.example.myapplication	
17:44:54.491	E	com.example.myapplication	
17:44:54.491	E	com.example.myapplication	
17:44:54.491	E	com.example.myapplication	
17:44:54.492	E	com.example.myapplication	
17:44:54.492	E	com.example.myapplication	
17:44:54.492	E	com.example.myapplication	
17:44:54.492	E	com.example.myapplication	
	I		Late-enabling -Xcheck:jni
	I		Unquickenning 12 vdex files!
	W		Unexpected CPU variant for X86 using defaults: x86_64
	W		type=1400 audit(0.0:134): avc: granted { execute } for path="/da
	W		DexFile /data/data/com.example.myapplication/code_cache/.studio/
	W		Current dex file has more than one class in it. Calling Retransf
	W		Accessing hidden method Landroid/app/ApplicationLoaders;-><clini
	W		Accessing hidden method Landroid/app/ApplicationLoaders;-><init>
	W		Accessing hidden method Landroid/app/ApplicationLoaders;-><init>
	W		Accessing hidden field Landroid/app/ApplicationLoaders;->mLoader
	W		Accessing hidden field Landroid/app/ApplicationLoaders;->mSystem

Logcat (6/6)

■ ... and our log!



The screenshot shows the Android Studio Logcat window. The top bar indicates the device is 'Pixel 6 Pro API 30 (emulator-5554) Android 11, API 30'. The filter is set to 'package:mine'. The log entries are as follows:

Time	Level	Class	Message
17:44:54.880		AppCompatActivity	
17:44:54.918	E	com.example.myapplication	e.myapplication
17:44:54.918	E	com.example.myapplication	e.myapplication
17:44:54.951	I	com.example.myapplication	ITM
17:44:55.019	H	com.example.myapplication	HostConnection
17:44:55.024	H	com.example.myapplication	HostConnection
17:44:55.025	O	com.example.myapplication	OpenGLRenderer
17:44:55.032	E	com.example.myapplication	EGL_emulation
17:44:55.034	E	com.example.myapplication	EGL_emulation
17:44:55.044	G	com.example.myapplication	Gralloc4
17:44:55.088	H	com.example.myapplication	HostConnection
17:44:55.089	H	com.example.myapplication	HostConnection
17:44:55.090	D	com.example.myapplication	Checking for metadata for AppLocalesMetadataLoaderService. Service not found
17:44:55.091	W	com.example.myapplication	Accessing hidden method Landroid/view/View; -> computeFitSystemWindows(Landroid/graphics/Rect; I)Z (method proxy)
17:44:55.092	W	com.example.myapplication	Accessing hidden method Landroid/view/ViewGroup; -> makeOptionalFitsSystemWindows()V (method proxy)
17:44:55.093	D	com.example.myapplication	I am a Tiger Mask
17:44:55.094	D	com.example.myapplication	HostConnection::get() New Host Connection established 0x703e6ce98990, tid 7788
17:44:55.095	D	com.example.myapplication	HostComposition ext ANDROID_EMU_CHECKSUM_HELPER_v1 ANDROID_EMU_native_sync_v2 ANDROID_EMU_view_system_resources_v1
17:44:55.096	W	com.example.myapplication	Failed to choose config with EGL_SWAP_BEHAVIOR_PRESERVED, retrying without...
17:44:55.097	D	com.example.myapplication	eglCreateContext: 0x703e5cee2530: maj 2 min 0 rcv 2
17:44:55.098	D	com.example.myapplication	eglMakeCurrent: 0x703e5cee2530: ver 2 0 (tinfo 0x703dfd756b80) (first time)
17:44:55.099	I	com.example.myapplication	mapper 4.x is not supported
17:44:55.100	D	com.example.myapplication	createUnique: call
17:44:55.101	D	com.example.myapplication	HostConnection::get() New Host Connection established 0x703e6ce96b90, tid 7788

Data Type (1/3)

- Very similar to modern programming languages

Type	Size (bits)	Min value	Max value
Byte	8	-128	127
Short	16	-32768	32767
Int	32	-2,147,483,648 (-2^{31})	2,147,483,647 ($2^{31} - 1$)
Long	64	-9,223,372,036,854,775,808 (-2^{63})	9,223,372,036,854,775,807 ($2^{63} - 1$)

Type	Size (bits)	Significant bits	Exponent bits	Decimal digits
Float	32	24	8	6-7
Double	64	53	11	15-16

Data Type (2/3)

■ Very similar to modern programming languages

➤ The type Boolean represents boolean objects that can have two values: true and false

➤ Characters are represented by the type Char

- Character literals go in single quotes: '1'
 - Special characters start from an escaping backslash \. The following escape sequences are supported: \t, \b, \n, \r, \', \", \\ and \\$
 - To encode any other character, use the Unicode escape sequence syntax: '\uFF00'
- <https://symbl.cc/en/unicode/blocks/>

➤ Strings in Kotlin are represented by the type String

- A string value is a sequence of characters in double quotes ("")

Data Type (3/3)

■ String template

- Template expressions - pieces of code that are evaluated and whose results are concatenated into the string
- Template expression starts with a dollar sign (\$) and consists of either
 - Name
 - Expression in curly braces

```
val i = 10  
println("i = $i") // prints "i = 10"
```

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

```
Log.d("ITM", "i = $i")  
Log.d("ITM", "$s.length is ${s.length}")
```

Variable and Constant

- Variables that can be reassigned use the *var* keyword

```
var x = 5 // `Int` type is inferred  
x += 1
```

- You can just 'declare' a variable with its type definition
- e.g) var x: Int

- Read-only local variables are defined using the keyword *val*

- They can be assigned a value only once

```
val a: Int = 1 // immediate assignment  
val b = 2     // `Int` type is inferred  
val c: Int    // Type required when no initializer is provided  
c = 3         // deferred assignment
```

Conditional Expression (1/5)

■ if statement

- if (single condition)
- if else (exclusive condition)
- if else if ... else (branches)

■ Conditions

- Equality checks: $a == b$ and $a != b$
- Comparison operators: $a < b$, $a > b$, $a <= b$, $a >= b$
- $||$: disjunction (logical OR)
- $\&\&$: conjunction (logical AND)
- $!$: negation (logical NOT)

Conditional Expression (2/5)

■ if statement

```
var max = a
if (a < b) max = b
```

```
// With else
var max: Int
if (a > b) {
    max = a
} else {
    max = b
}
```

```
// As expression
val max = if (a > b) a else b
```

```
val max = if (a > b) {
    print("Choose a")
    a
} else {
    print("Choose b")
    b
}
```

```
var a = 10
var b = 20
```

```
val max = if (a > b){
    Log.d( tag: "ITM", msg: "choose A!")
    a
}
else{
    Log.d( tag: "ITM", msg: "choose B!")
    b
}
Log.d( tag: "ITM", msg: "Higher value was $max!")
if (max > 10) Log.d( tag: "ITM", msg: "Hmm~ smells good!")
```

Conditional Expression (3/5)

■ when statement

- Very similar to switch-case statements in other languages
- Basic syntax

```
when (parameter) {  
    condition1 -> action1  
    condition2 -> action2  
    else -> { // Note the block  
        action3  
    }  
}
```

- With comma

```
when (parameter) {  
    condition1, condition2 -> action1  
    else -> { // Note the block  
        action2  
    }  
}
```

```
val grade = "A+"  
when(grade){  
    "A+" -> Log.d("ITM","Oh.. great..!!")  
    "B+" -> Log.d("ITM","Hey?")  
    else -> {  
        Log.d("ITM","I don't know who you are.")  
    }  
}
```

```
val grade = "F"  
when (grade) {  
    "A+","B+","C+" -> Log.d("ITM", "Oh.. great..!!")  
    "A","B","C" -> Log.d("ITM", "Hey?")  
    else -> {  
        Log.d("ITM", "I don't know who you are.")  
    }  
}
```

Conditional Expression (4/5)

■ when statement

- in or !in syntax for a range check

```
val score = 89
when (score) {
  in 90..100 -> Log.d("ITM", "A+")
  else -> Log.d("ITM", "resit!!!")
}
```

- when without a parameter

- Replacement for an if- else if chain

```
val score = 49
when {
  score > 90 -> Log.d("ITM", "A+")
  score in 50..89 -> Log.d("ITM", "A0")
  else -> Log.d("ITM", "resit!!!")
}
```


Conditional Expression (5/5)

■ when statement

➤ Type checking (is syntax)

```
val x:Any =20.5
when (x){
  is Int -> Log.d("ITM", "It's Int type!")
  is String -> Log.d("ITM", "it' String type!")
  else -> Log.d("ITM", "What is this?")
}
```

➤ when as expression

```
val myScore = 80

var myGrade = when (myScore){
  in 90..100 -> "A+"
  else -> "F"
}
Log.d("ITM", "my score is $myScore, so my grade is $myGrade")
```

Array (1/3)

■ Set of data with a fixed length

➤ Initialization

- `Array()` constructor takes the size and the function that returns values of array elements given its index
- `arrayOf()` takes items as input and create an array of them

➤ `get()/set()` functions (`[]` operator)

➤ size property

➤ ...

■ Primitive-type array

➤ `ByteArray`, `ShortArray`, `IntArray`, `LongArray`, `CharArray`, `FloatArray`, `DoubleArray`, `BooleanArray`

Array (2/3)

■ Examples

```
val x: IntArray = intArrayOf(1, 2, 3) // use these values to create intArray
val y = arrayOf("one","two","three")
val arr = IntArray(5) // create IntArray with size of 5
val arr2 = IntArray(5) { 42 } // create IntArray with size of 5, values of 42
var arr3 = IntArray(5) { it+1 } // create IntArray with size of 5, values of index+1
var arr4 = Array(5){i -> i*i}
```

```
Log.d("ITM","x.size: ${x.size}")
Log.d("ITM","arr.size: ${arr.size}")
```

```
Log.d("ITM",Arrays.toString(x))
Log.d("ITM",Arrays.toString(y))
Log.d("ITM",Arrays.toString(arr))
Log.d("ITM",Arrays.toString(arr2))
Log.d("ITM",Arrays.toString(arr3))
Log.d("ITM",Arrays.toString(arr4))
```

Array (3/3)

■ Some utilities

- get/set ([])
- first()/last()
- sort(), sortedArray()
- ...

```
val arr: IntArray = IntArray(10){it+1}
val first = arr[0]
val first2 = arr.first()
val first3 = arr.get(0)
val last = arr.last()
```

```
Log.d("ITM", "${Arrays.toString(arr)}")
Log.d("ITM", "first: $first $first2 $first3 last: $last")
```

```
arr[0] = 100
arr.set(1, 200)
```

```
Log.d("ITM", "${Arrays.toString(arr)}")
```

```
arr.sort() // in-place sorting
val arr2 = arr.sortedArrayDescending() // return a new sorted array (desc.)
```

```
Log.d("ITM", "${Arrays.toString(arr)}")
Log.d("ITM", "${Arrays.toString(arr2)}")
```

Collections (1/2)

■ Container to store a number of objects dynamically

➤ List

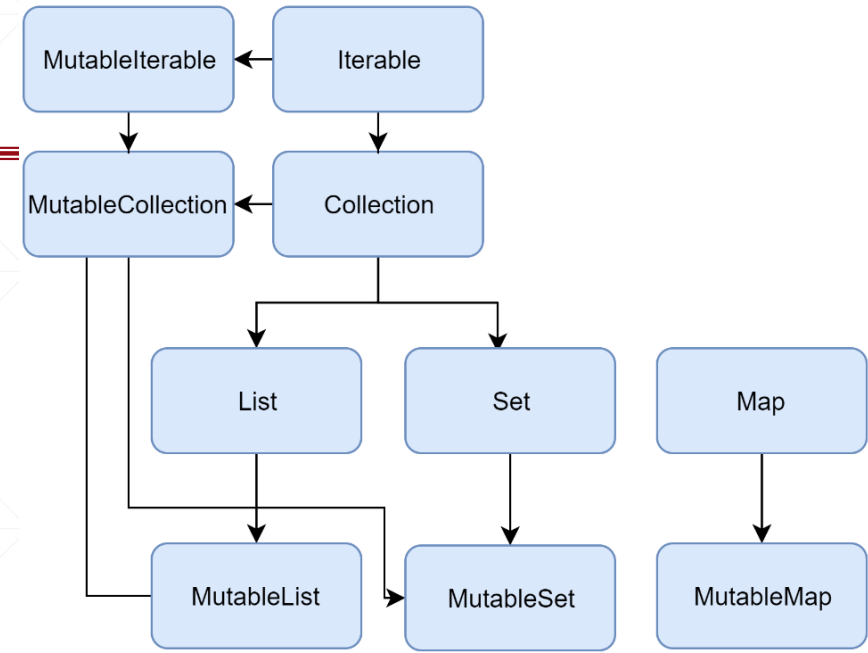
- Ordered collection with access to elements by indices
- Elements can occur more than once in a list

➤ Set

- Collection of **unique** elements
- Reflects the mathematical abstraction of set: a group of objects **without repetitions**
- The order of set elements has no significance

➤ Map (or dictionary)

- A set of **key-value pairs**
- Keys are unique, and each of them maps to exactly one value
- Values can be duplicates



Collections (2/2)

■ Immutable collections

- A **read-only** interface that provides operations for accessing collection elements

■ Mutable collections

- Extends the corresponding read-only interface with write operations: adding, removing, and updating its elements

■ Construction of collections

- `listOf()`, `mutableListOf()`
- `setOf()`, `mutableSetOf()`
- `mapOf()`, `mutableMapOf()`

Collections: List (1/2)

- Stores elements in a specified order and provides indexed access to them
 - Very similar to the array!
- Elements can duplicate
 - List can contain any number of equal objects or occurrences of a single object

```
val numbers = listOf("one", "two", "three", "four")  
Log.d("ITM", "Number of elements: ${numbers.size}")  
Log.d("ITM", "Third element: ${numbers.get(2)}")  
Log.d("ITM", "Fourth element: ${numbers[3]}")  
Log.d("ITM", "Index of element \"two\"  
${numbers.indexOf("two")}")
```

Collections: List (2/2)

■ List-specific write operations

- add()
- removeAt()
- shuffle()
- Indexing ([])

```
val numbers = mutableListOf(1, 2, 3, 4)
numbers.add(5)
numbers.removeAt(1)
Log.d("ITM", "${numbers}")
```

```
numbers[0] = 0
numbers.shuffle()
Log.d("ITM", "${numbers}")
```


Collections: Set (1/2)

■ Stores unique elements

- Their order is generally undefined!

```
val numbers = setOf(1, 2, 3, 4)
Log.d("ITM", "Number of elements: ${numbers.size}")
if (numbers.contains(1)) Log.d("ITM", "1 is in the set")
```

```
val numbersBackwards = setOf(4, 3, 2, 1)
Log.d("ITM", "The sets are equal: ${numbers == numbersBackwards}")
```

- No support of [] , get() operations

Collections: Set (2/2)

■ Set-specific write operations

➤ add()

➤ remove()

```
val depts = mutableSetOf("ITM")  
Log.d("ITM", "Number of elements: ${depts.size}")  
Log.d("ITM", "${depts}")
```

```
depts.add("IISE")  
depts.add("AIX")  
depts.add("Computer")  
Log.d("ITM", "${depts}")
```

```
depts.remove("Data science")  
depts.remove("IISE")  
Log.d("ITM", "${depts}")
```

Collections: Map (1/2)

■ Stores key-value pairs (or entries)

- keys are unique, but different keys can be paired with equal values

■ Creation

- `mapOf<KeyType, ValueType>()`
- `mutableMapOf<KeyType, ValueType>()`
- `Pair()` type or “Key” to “value” data can be used for initialization

■ Map-specific write functions

- `put()`
- `remove()`

Collections: Map (2/2)

■ Example

```
val studentGrade = mutableMapOf<String, Int>()  
studentGrade.put("Jeong", 100)  
studentGrade.put("Kim", 90)  
studentGrade.put("Hong", 80)  
studentGrade.put("Park", 70)
```

```
Log.d("ITM", "${studentGrade}")
```

```
Log.d("ITM", "${studentGrade.get("Jeong")}")  
Log.d("ITM", "${studentGrade.get("Wow")}")
```

```
studentGrade.put("Jeong", 0)  
Log.d("ITM", "${studentGrade}")
```

Equivalent form!

```
val studentGrade = mutableMapOf<String, Int>  
("Jeong" to 100, "Kim" to 90, "Hong" to 80, "Park" to 70)
```

```
val studentGrade = mutableMapOf<String, Int>  
(Pair("Jeong", 100), Pair("Kim", 90), Pair("Hong", 80), Pair("Park", 70),)
```

Try to run these initialization codes!

Collections: Transformation (1/3)

■ map()

- Creates a collection from the results of a function on the elements of another collection
- Applies **the given lambda function** to each subsequent element **and returns the list of the lambda results**
- Order of results is the same as the original order of elements

```
val numbers = setOf(1,2,3,4,5)
val numbers2 = numbers.map {it*2}
```

```
Log.d("ITM", "${numbers}")
Log.d("ITM", "${numbers2}")
```

```
val studentGrade = mutableMapOf<String, Int>()
studentGrade.put("Jinwoo", 100)
studentGrade.put("Kim", 90)
studentGrade.put("Hong", 80)
studentGrade.put("Park", 70)
```

```
val grade = studentGrade.mapValues { it.value / 10 }
Log.d("ITM", "${grade}")
```

Collections: Transformation (2/3)

■ zip()

- **Builds pairs** from elements with the same positions in both collections
- Returns the List of Pair objects
- If the collections have different sizes, the result of the zip() is the smaller size
 - The last elements of the larger collection are not included in the result

```
val colors = listOf("red", "brown", "grey")
```

```
val animals = listOf("fox", "bear", "wolf")
```

```
Log.d("ITM", "${colors zip animals}")
```

```
val twoAnimals = listOf("fox", "bear")
```

```
Log.d("ITM", "${colors.zip(twoAnimals)}")
```

```
Log.d("ITM", "${colors.zip(animals) { color, animal -> "The ${color.replaceFirstChar { it.uppercase() }} is $animal" }}")
```

Collections: Transformation (3/3)

■ filter()

- When called with a predicate, filter() returns the collection elements that match it
- For both List and Set, the resulting collection is a List, for Map it's a Map

```
val numbers = listOf("one", "two", "three", "four")
```

```
val longerThan3 = numbers.filter { it.length > 3 }
```

```
Log.d("ITM", "$longerThan3")
```

```
val numbersMap = mapOf("key1" to 1, "key2" to 2, "key3" to 3, "key11" to 11)
```

```
val filteredMap = numbersMap.filter { (key, value) -> key.endsWith("1") && value > 10 }
```

```
Log.d("ITM", "$filteredMap")
```

Collections: Retrieval

■ first()/last()

- Search a collection for elements matching a given predicate
- first()/find(): you will receive the first element on which the predicate yields true!
- last()/findLast(): returns the last element matching a given predicate!
- First() & last() can throw exceptions if no element is found

```
val numbers = listOf("one", "two", "three", "four", "five", "six")  
Log.d("ITM", numbers.first { it.length > 3 })  
Log.d("ITM", numbers.last { it.startsWith("f") })
```

```
val numbers2 = listOf(1, 2, 3, 4)  
Log.d("ITM", "${(numbers2.find { it % 2 == 0 })}")  
Log.d("ITM", "${(numbers2.findLast { it % 2 == 0 })}")
```


Collections: Aggregate

■ minOrNull()/maxOrNull()

- Return the smallest and the largest element respectively
- On empty collections, they return null

■ average()

- Returns the average value of elements in the collection of numbers

■ sum()

- Returns the sum of elements in the collection of numbers

■ count()

- Returns the number of elements in a collection

```
val numbers = listOf(6, 42, 10, 4)
```

```
Log.d("ITM", "Count: ${numbers.count()}")  
Log.d("ITM", "Max: ${numbers.maxOrNull()}")  
Log.d("ITM", "Min: ${numbers.minOrNull()}")  
Log.d("ITM", "Average: ${numbers.average()}")  
Log.d("ITM", "Sum: ${numbers.sum()}")
```

Collections: Iterator

- Object that provides access to the elements sequentially without exposing the underlying structure of the collection
- Usage
 - `Iterator()`: to obtain an iterator instance from the collection
 - `Next()`: returns the element and moves the iterator position to the following element if it exists
 - `hasNext()`: checks if the following element exists

```
val numbers = listOf("one", "two", "three", "four")
val numbersIterator = numbers.iterator()
while (numbersIterator.hasNext()) {
    Log.d("ITM", numbersIterator.next())
}
```

Q&A

- Next week (eClass video)
 - Kotlin Basics (Part II & III)