Mobile Device Architecture And Kotlin Programming I

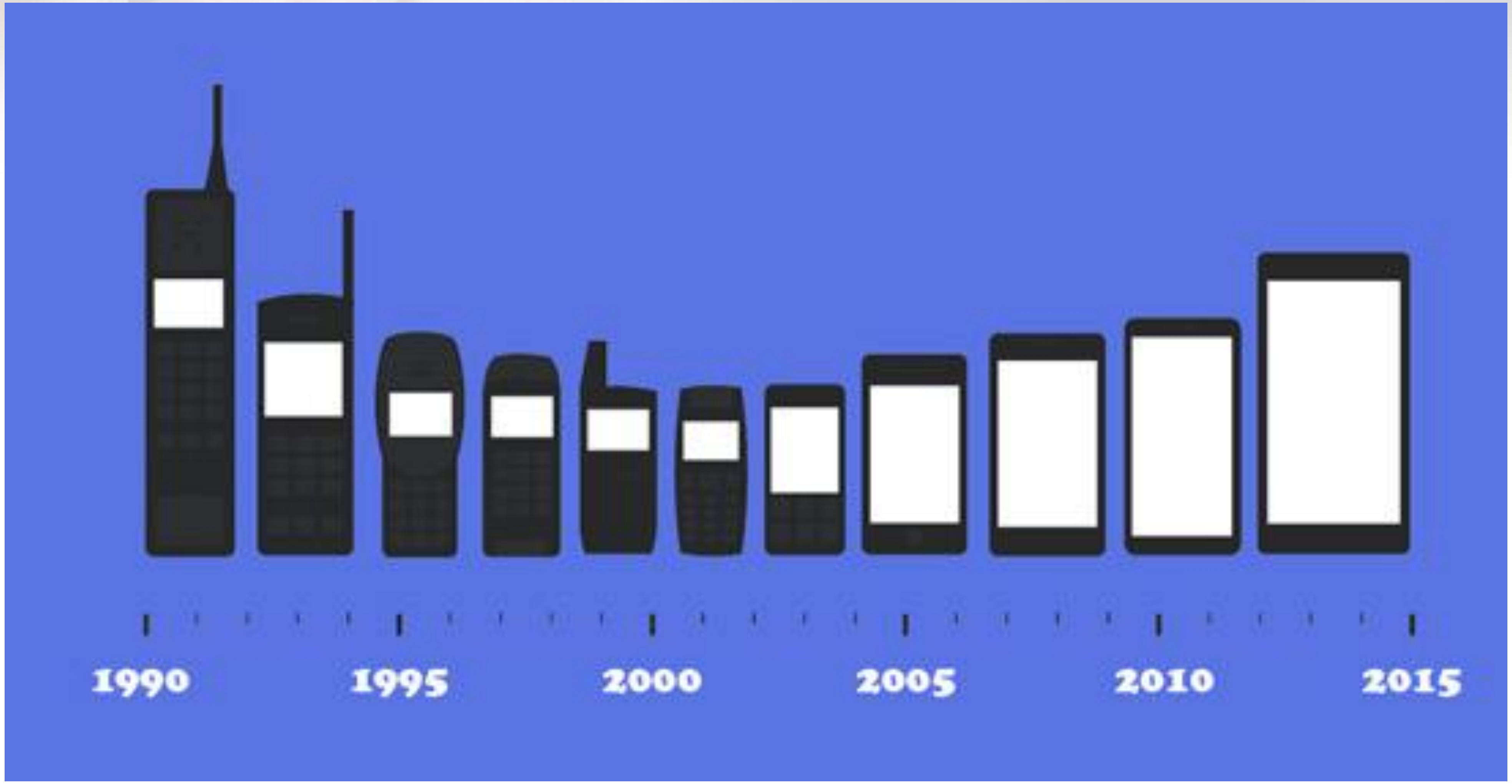
Asst. Prof. Monlica Wattana, Ph.D
Department of Computer Science,
Khon Kaen University

SC 362 007 Mobile Device Programming
CP 410 804 Programming for Mobile Application

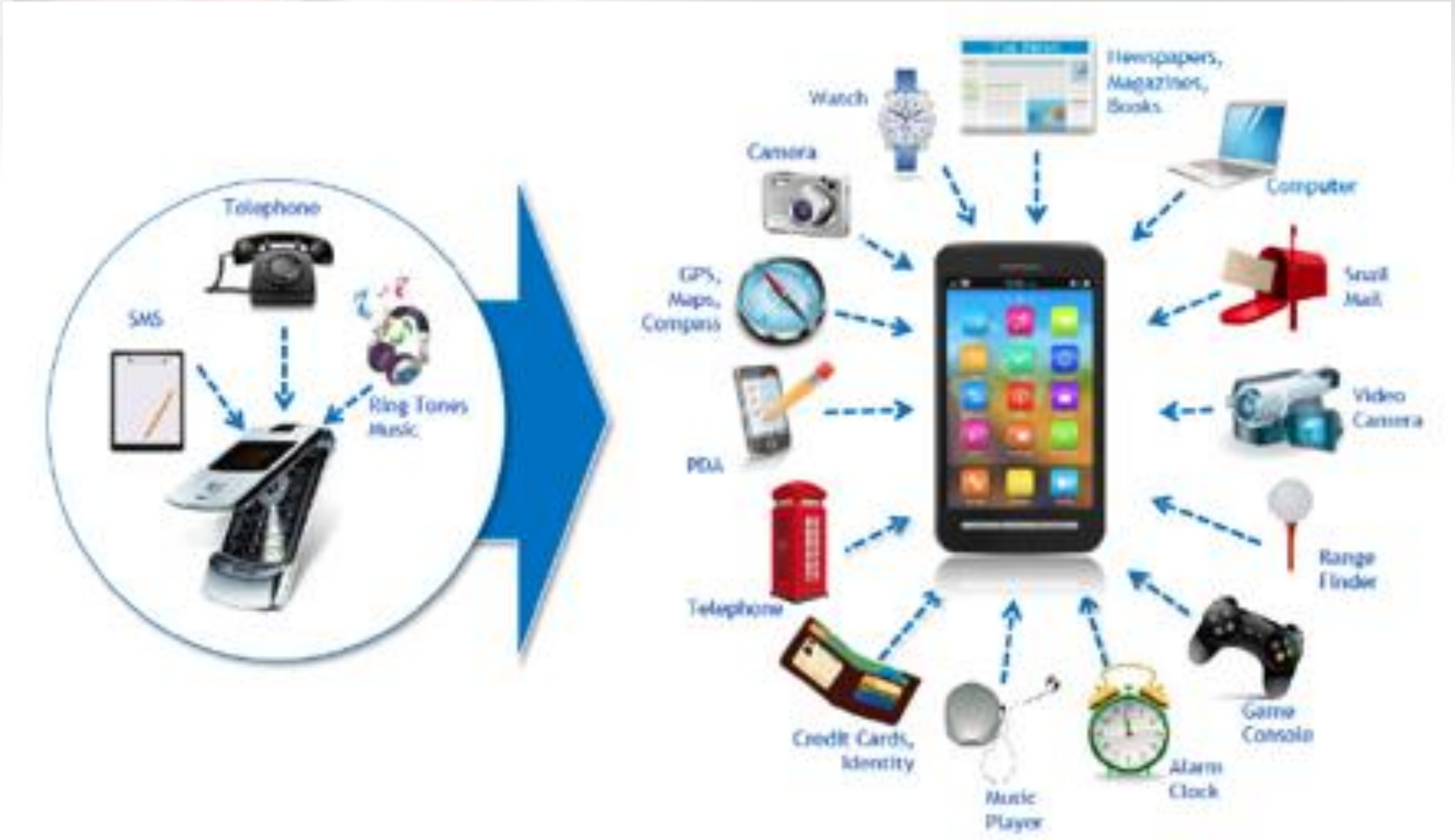
Outline

- Evolution of Mobile
- Smartphone hardware architecture
- Mobile Development
- Android Operating System
- Kotlin Programming
  - Variable
  - Array
  - Operator
  - Type Conversion
  - If...Else
  - Loop
  - Function

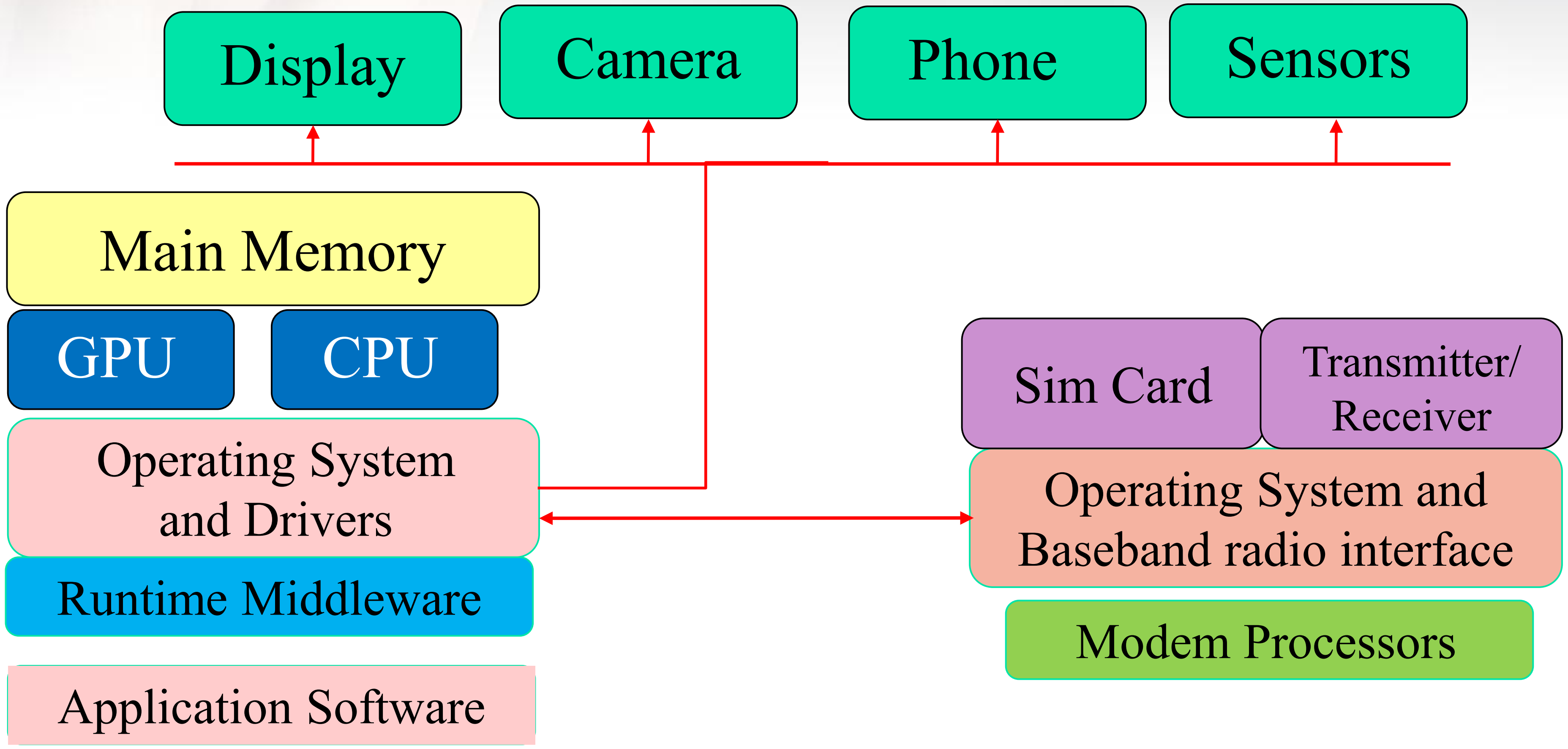
Evolution of Mobile Hardware



Evolution of Mobile Functionality/Software



Smartphone Hardware Architecture



Mobile Operating System

- Windows Phone

Windows Phone

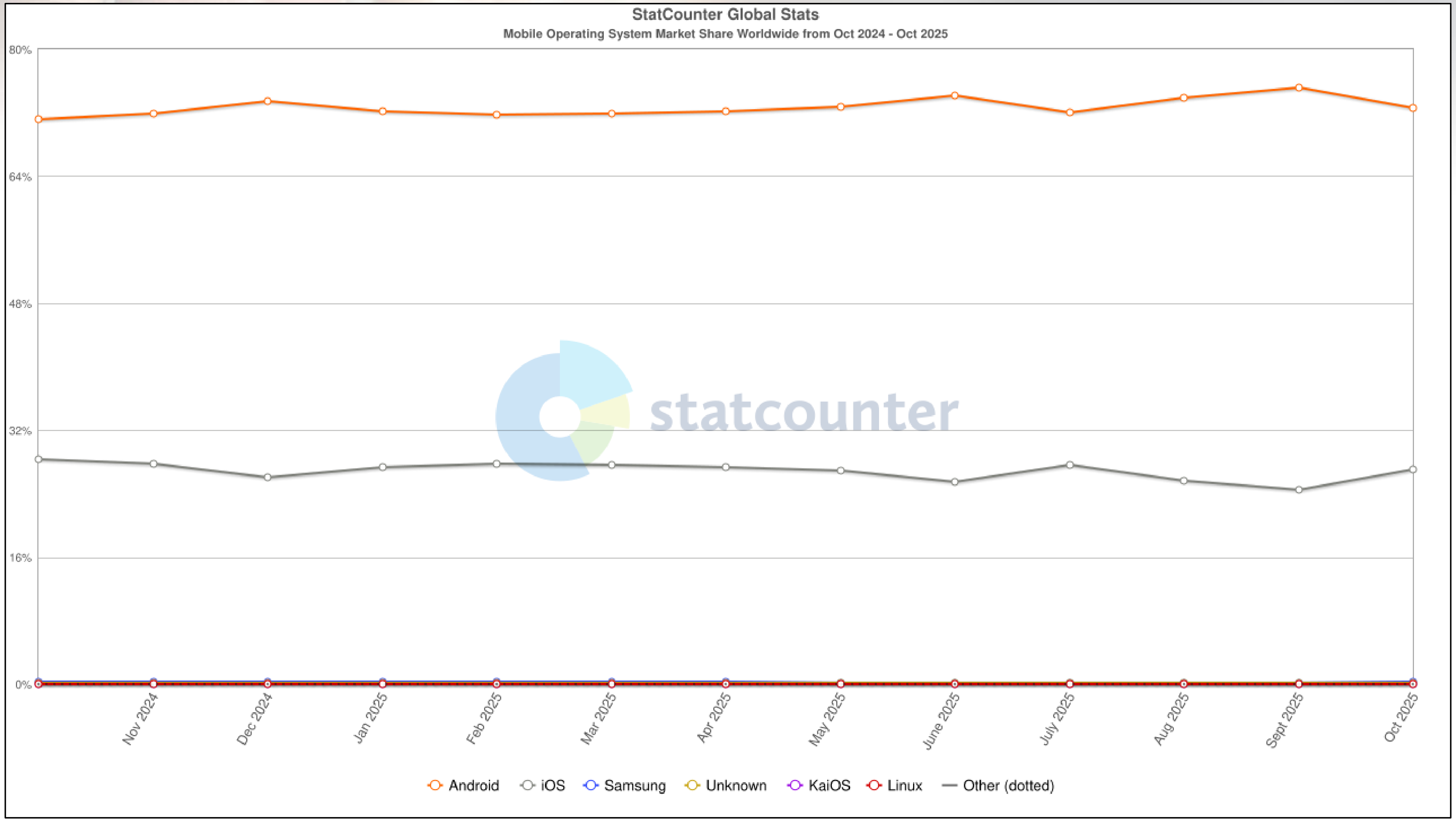
- iOS (iPhone OS): Apple Inc.

iOS

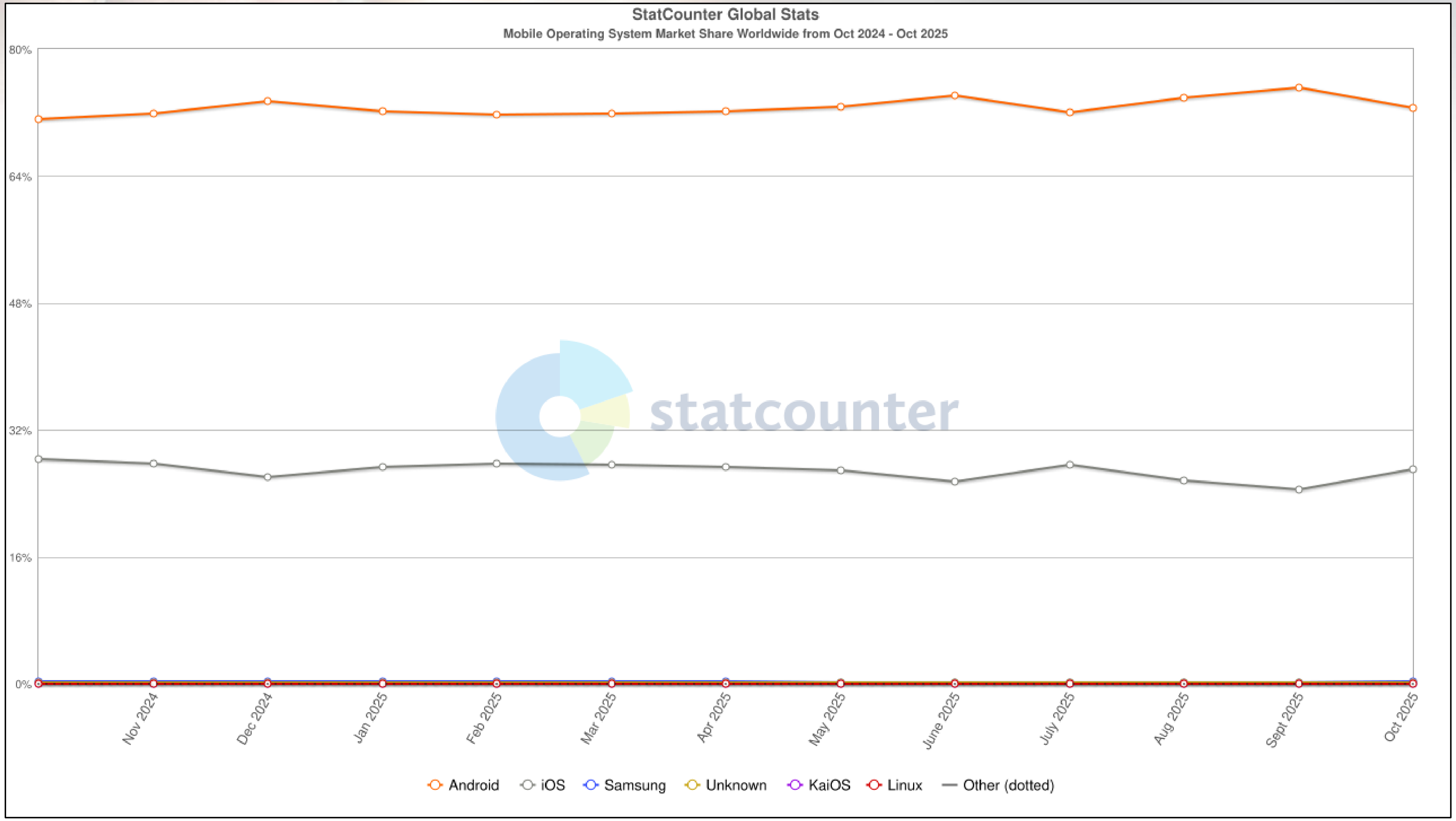
- Android: Google (Open Handset Alliance(OHA))

android

Mobile Operating System Market Share Worldwide



Mobile Operating System Market Share Thailand



Mobile Development Language

- **Native development**

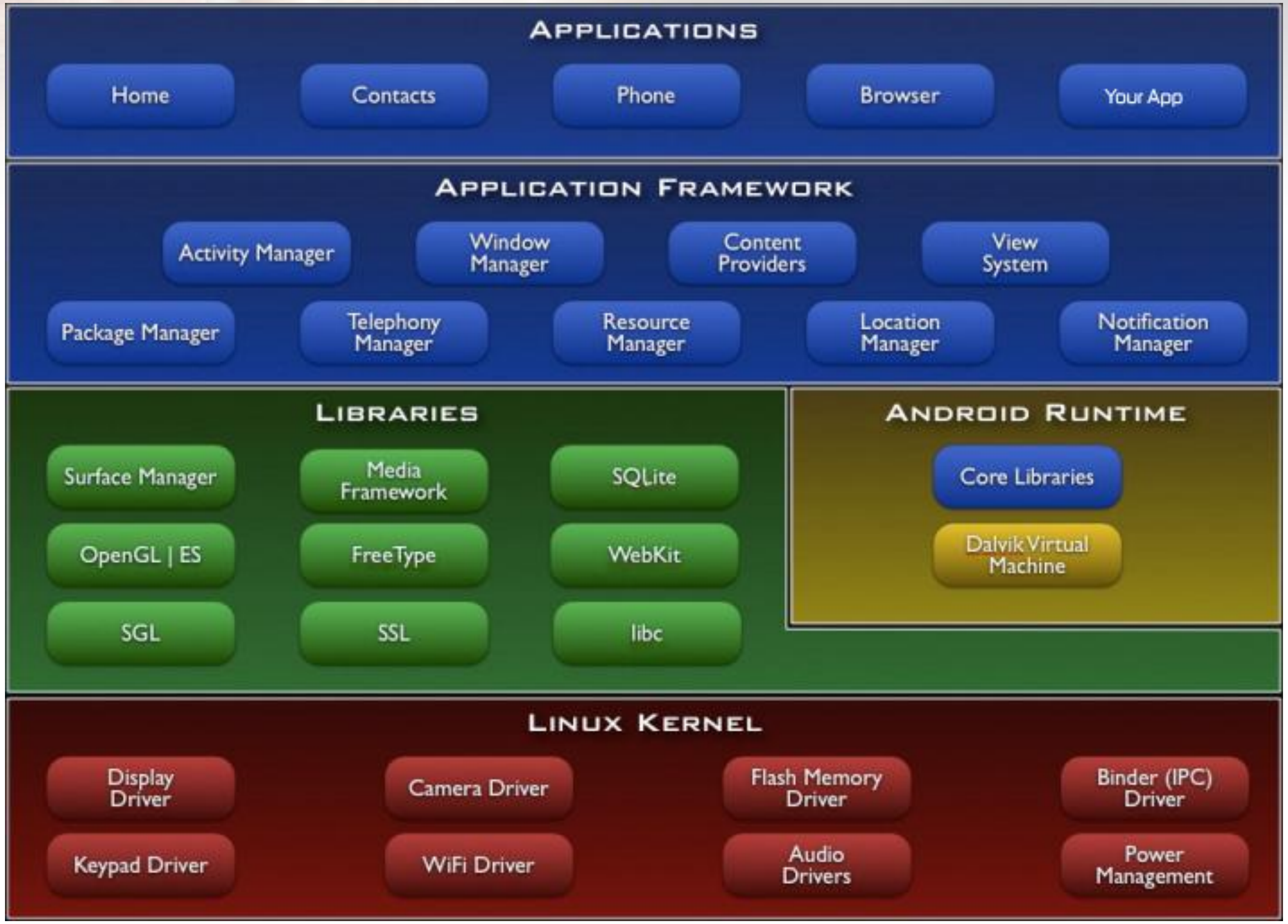
  - Android development: JAVA, Kotlin

  - iOS app development: Objective-C, Swift

- **Cross-platform development**

  React Native (JavaScript), Flutter (Google), Ionic, Xamarin (Microsoft)

Android Architecture



Application Framework

- Activity Manager android.activity

  - Manages the activity life cycle of applications
- Content Providers android.provider

  - Manage the data sharing between applications
- Telephony Manager android.telephony

  - Manages all voice calls.
- Location Manager android.location

  - Location management, using GPS or cell tower
- Resource Manager

  - Manage the various types of resources we use in our App

Libraries

- OpenGL ES android.opengl

  The OpenGL ES is a 3D graphics library.
- SQLite android.database.sqlite

  Contains the SQLite database management classes
- Media Framework

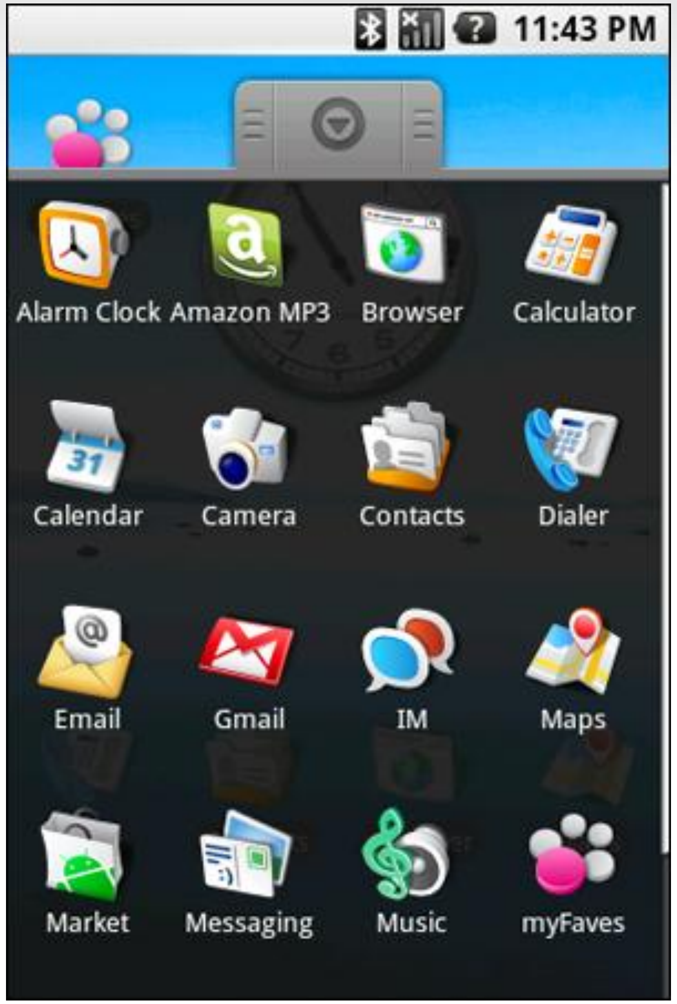
  The media framework contains all of the codecs that are required for multimedia experience.
- FreeType: used to render the fonts
- SSL: used for internet security
- WebKit: open source browser engine

Linux Kernel

- Based on Linux 2.6 kernel but Android is not Linux.
- Does not include the full set of standard Linux utilities
- No native windowing system
- Performs important power management activities
- Open Source: provide libraries to modify hardware drivers

First version of android

- Initial release: Oct. 2008
- NO on-screen keyboard
- NO multitouch capability
- NO paid apps
- The pull-down notification window
- Deep, rich Gmail integration
- Home screen widgets



Early versions of Android

- Version 1.5 cupcake and Version 1.6 Donut
  - An on-screen keyboard
  - Extensible widgets
  - Video capture and playback
- Version 2.1 – Version 2.3
  - multitouch capability
  - Support for front-facing cameras
  - Screen PIN protection
- Version 3.x
  - Targeted exclusively at tablets
  - No physical buttons
  - Improved multitasking

Recent versions of android

- Version 4.0 Ice Cream Sandwich
  - NFC support
  - Face unlock
  - Data usage analysis
- Version 4.1 to 4.3
  - Support panoramic image
  - Predictive text
  - support OpenGL ES 3.0
- Version 4.4 KitKat (SDK 19)
  - Full screen apps
  - Google Cloud Print
  - Improved Quickoffice app

Recent versions of Android

- Version 5.0 – 5.1 Lollipop (SDK 22)

- Version 6.0 Marshmallow (SDK 23)

- Version 7.0 Nougat (SDK 24)

http://socialcompare.com/en/comparison/android-versions-comparison

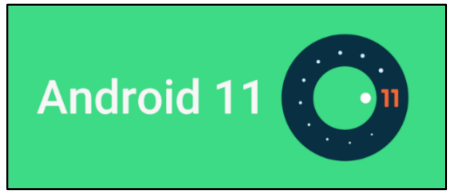
Current versions of Android

- Version 8.0 Oreo (API 26)

- Version 9 Pie (API 28)

- Version 10 Android Q (API 29)

- Version 11 (API 30) (2020)



http://socialcompare.com/en/comparison/android-versions-comparison

Current versions of Android

- Version 12 (API 31) (2021)
- Version 13 (2022)
- Android 14 (2023)
- Android 15 (2024)
- Android 16 (2025)

http://socialcompare.com/en/comparison/android-versions-comparison

Introduction to Kotlin Programming

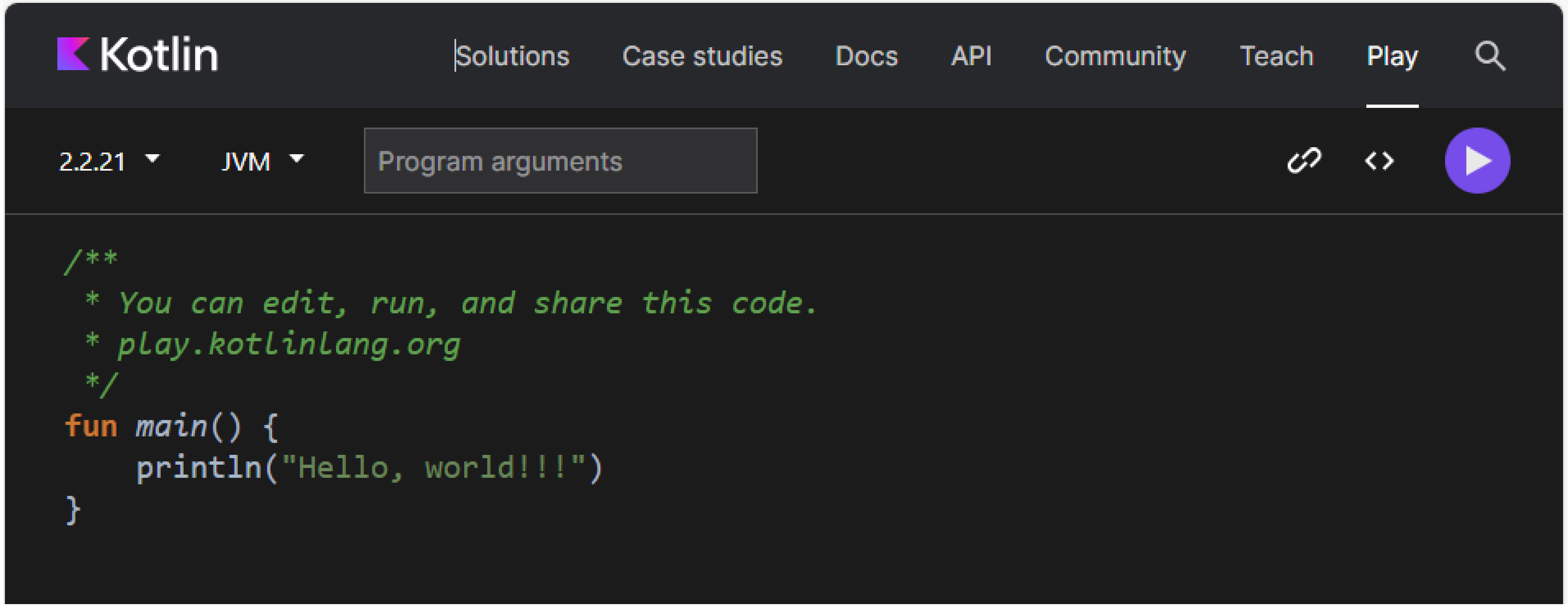
Kotlin

Kotlin

- Kotlin is a programming language introduced by JetBrains, the official designer of the most intelligent Java IDE, named IntelliJ IDEA.
- This is a strongly statically typed language that runs on JVM.
- In 2017, Google announced Kotlin is an official language for android development.
- Kotlin is an open source programming language that combines object-oriented programming and functional features into a unique platform.

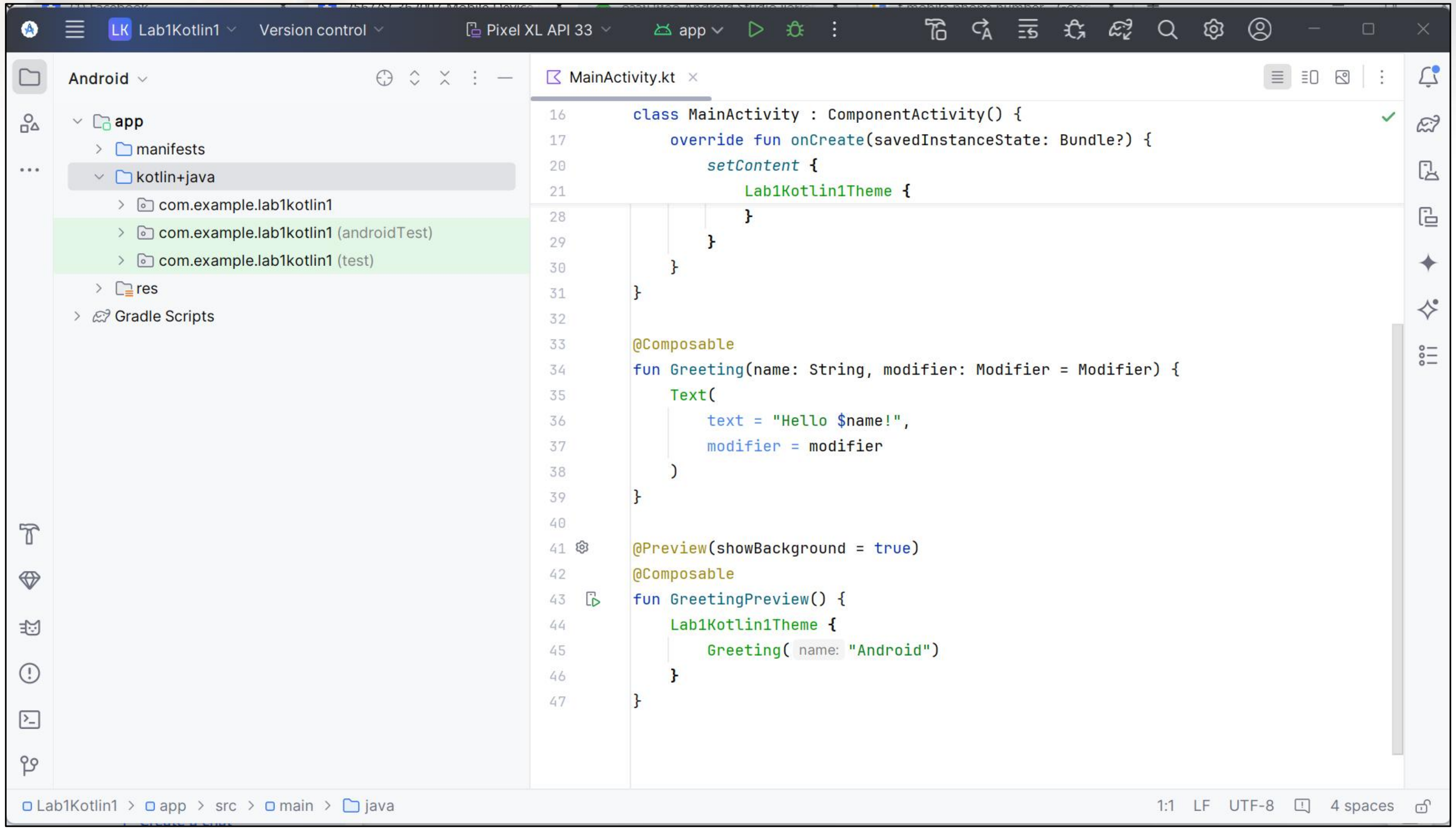
Try Kotlin Programming

https://play.kotlinlang.org

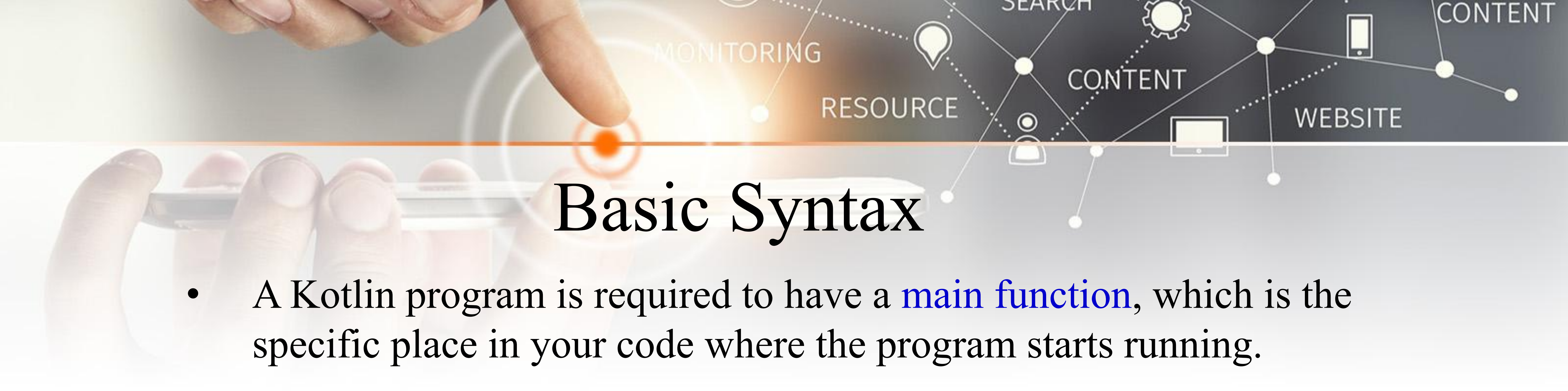


```kotlin
/**
 * You can edit, run, and share this code.
 * play.kotlinlang.org
 */
fun main() {
    println("Hello, world!!!")
}
```

Android Studio



```kotlin
class MainActivity : ComponentActivity() {
    override fun onCreate(savedInstanceState: Bundle?) {
        setContent {
            Lab1Kotlin1Theme {
                }
            }
        }
}

@Composable
fun Greeting(name: String, modifier: Modifier = Modifier) {
    Text(
        text = "Hello $name!",
        modifier = modifier
    )
}

@Preview(showBackground = true)
@Composable
fun GreetingPreview() {
    Lab1Kotlin1Theme {
        Greeting( name: "Android")
    }
}
```



Basic Syntax

- A Kotlin program is required to have a main function, which is the specific place in your code where the program starts running.

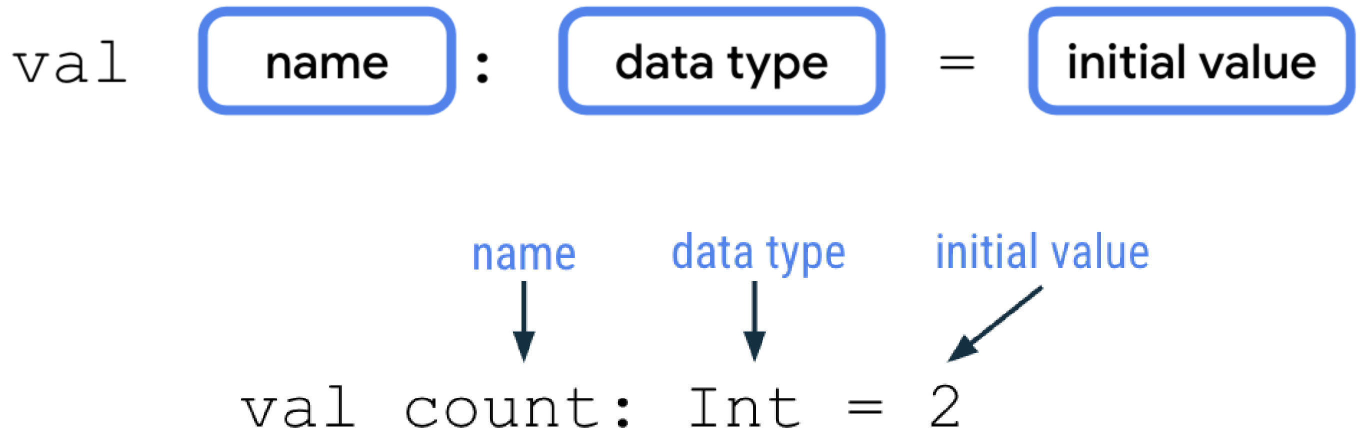
```
fun main() {

    println("Hello, world!!!")

}
```

Basic Syntax

- Defining packages

```
package my.demo

import java.util.*
```

- Defining variables



```
val name : data type = initial value

val count: Int = 2
```

Basic Syntax

- Defining variables

1. Assign-once (read-only) local variable (value)

```
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
val myNull : Int? = null     //null values
```

2. Mutable variable:

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

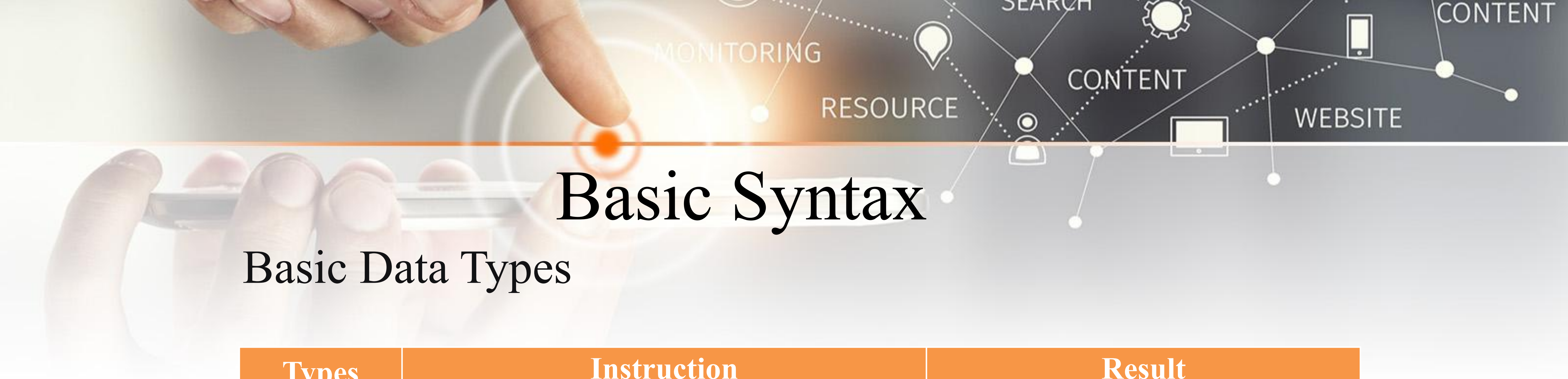
Basic Syntax

- Defining variables

Difference between val and var

- **val** (Immutable variable): We cannot change the value of variable which is declared using **val** keyword.

- **var** (Mutable variable): We can change the value of variable declared using **var** keyword later in the program.



Basic Syntax

Basic Data Types

Types	Instruction	Result

Numbers	val a: Int = 10000
	val d: Double = 100.00
	val f: Float = 100.00f
	val l: Long = 1000000004
	
	println("Your Int Value is "+a)
	println("Your Double Value is "+d)
	println("Your Float Value is "+f)
	println("Your Long Value is "+l)
		Your Int Value is 10000
		Your Double Value is 100.0
		Your Float Value is 100.0
		Your Long Value is 1000000004

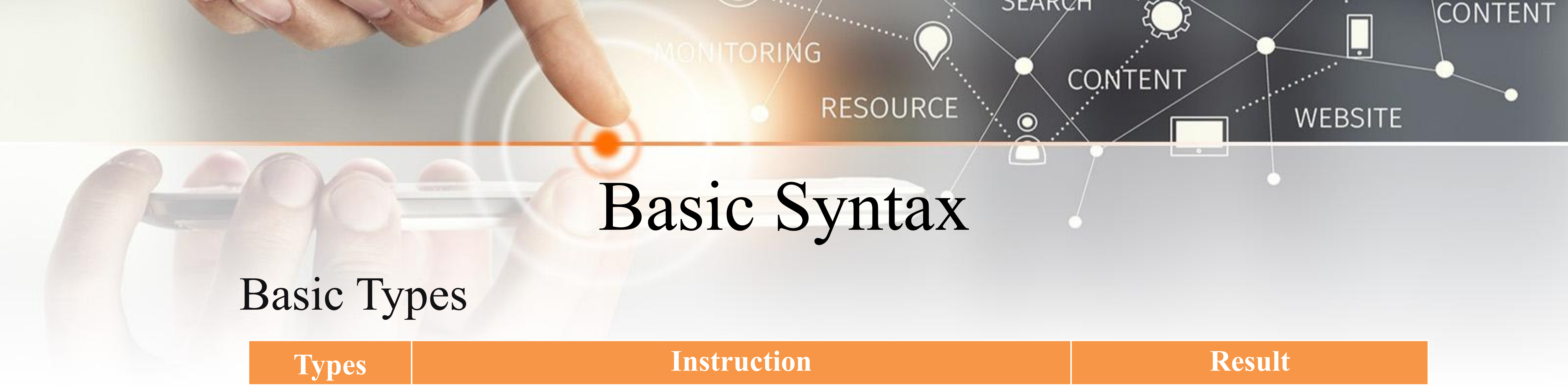
Basic Syntax

Basic Data Types

Types	Instruction	Result

Boolean	val letter: Boolean // defining a variable
	letter = true // assinging a value to it
	
	println(“Character is "+"$letter")
		Character is true

Strings	var rawString :String = "I am Raw String!"
	val escapedString : String = "I am escaped String!\n"
	
	println("Hello!"+ escapedString)
	
	println("Hey!! $rawString")
		Hello!I am escaped String!
		
		Hey!!I am Raw String!



Basic Syntax

Basic Types

Types	Instruction	Result
Arrays	val anyThing = arrayOf(1, "A", 23.99) println("I am array example "+ anyThing[2]) val numbers= intArrayOf(1, 2, 3, 4, 5) println("I am int array example "+ numbers[2])	I am array example 23.99 I am int array example 3

List	val listIn= listOf ("A", "B", "C", "D")
	println(listIn)
	val listChange= mutableListOf ("A", "B", "C", "D")
	listChange.remove("D")
	println(listChange)
	println("I am list example " + listChange[2])
		[A, B, C, D]
		[A, B, C]
		I am list example C

Basic Syntax

Arrays

- Array 1 dimensional

```
fun main() {
    val rows : Int  = 3
    val array1 = arrayOf(1234, "Hello", true)
    for (i in 0..rows - 1) {
          print( " " + array1[i] + " ")
        }
}
```

Result

```
1234  Hello  true
```

```
fun main() {
    val array2 = arrayOf<Int>(1234, 444, 636)
    for (i in 0 .. array2.size-1 ) {
          print( " " + array2[i] + " ")
        }
}
```

Result

```
1234  444  636
```

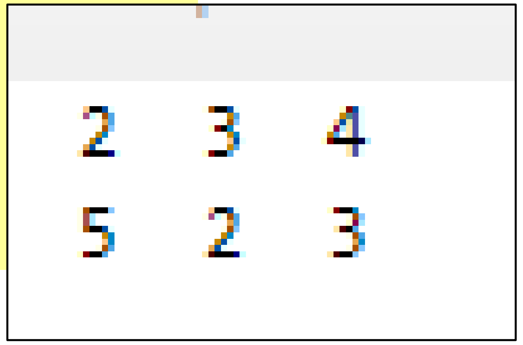
Basic Syntax

Arrays

- Array 2 dimensional

```
fun main() {
    val rows : Int  = 2
    val columns : Int = 3
    val firstMatrix = arrayOf(intArrayOf(2, 3, 4), intArrayOf(5, 2, 3))
    for (i in 0..rows - 1) {
         for (j in 0..columns - 1) {
              print( " " + firstMatrix[i][j] + " ")
         }
        println(" ")
    }
}
```

Result



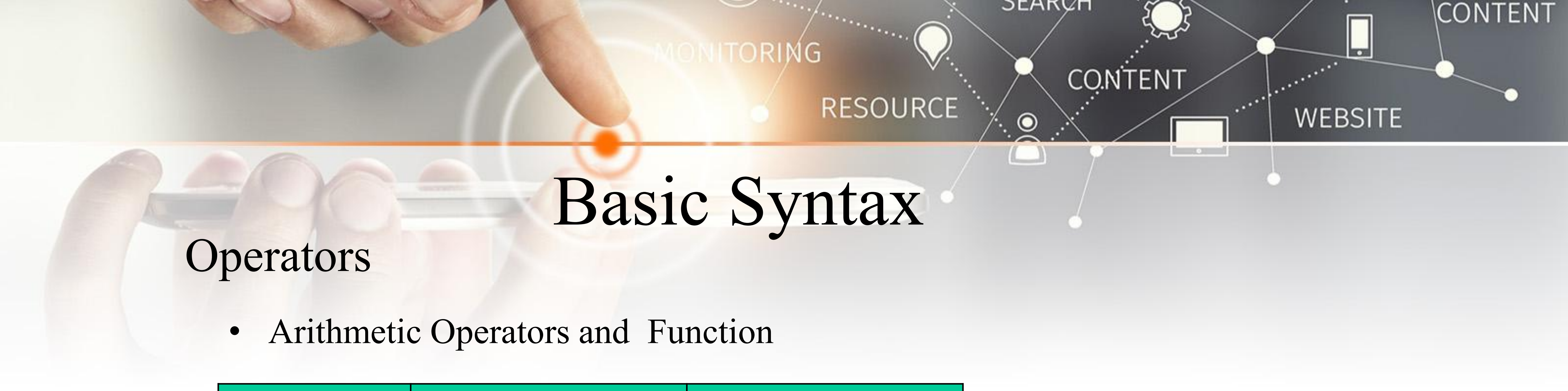
```
 2  3  4
 5  2  3
```

Basic Syntax

Operators

- Arithmetic Operators

Operator	Meaning
+	Addition (also used for string concatenation)
-	Subtraction Operator
*	Multiplication Operator
/	Division Operator
%	Modulus Operator



Basic Syntax

Operators

- Arithmetic Operators and Function

Expression	Function name	Translates to
a + b	plus	a.plus(b)
a - b	minus	a.minus(b)
a * b	times	a.times(b)
a / b	div	a.div(b)
a % b	mod	a.mod(b)

```
fun main() {
    var a : Int = 5
    var b : Int = 3
    println("a+b = "+  a.plus(b))
}
```

Basic Syntax

Operators

- Assignment Operators

Expression	Equivalent to	Translates to
a +=b	a = a + b	a.plusAssign(b)
a -= b	a = a - b	a.minusAssign(b)
a *= b	a = a * b	a.timesAssign(b)
a /= b	a = a / b	a.divAssign(b)
a %= b	a = a % b	a.modAssign(b)

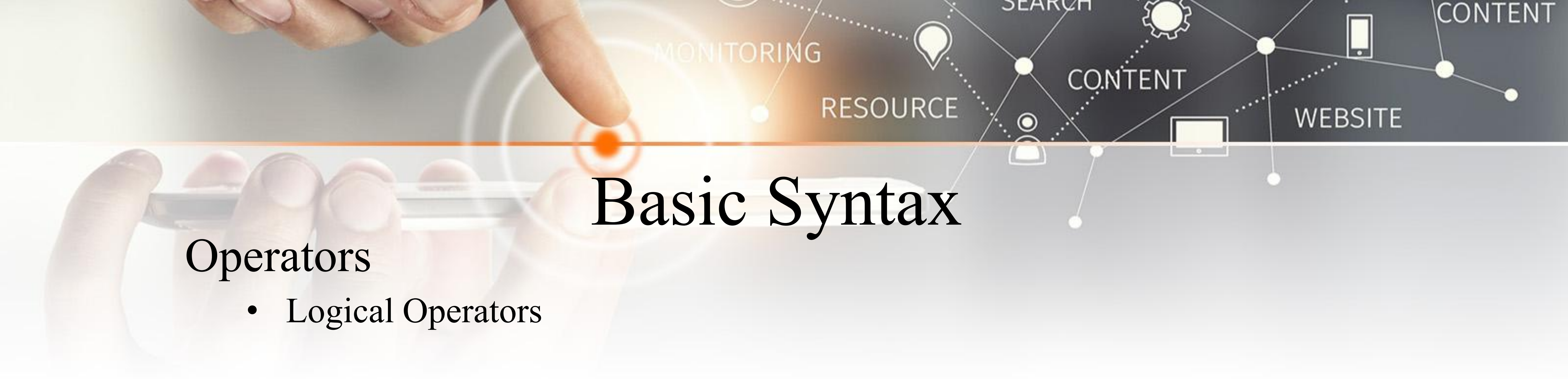
```
fun main() {
      var a  =5
     a += 3
    println("a = " + a)
}
```

Basic Syntax

Operators

- Comparison and Equality Operators

Operator	Meaning	Expression
>	greater than	a > b
<	less than	a < b
>=	greater than or equals to	a >= b
<=	less than or equals to	a < = b
==	is equal to	a == b
!=	not equal to	a != b



Basic Syntax

Operators

- Logical Operators

Operator	Description	Expression	Corresponding Function
||	true if either of the Boolean expression is true	(a>b)||(a<c)	(a>b)or(a<c)
&&	true if all Boolean expressions are true	(a>b)&&(a<c)	(a>b)and(a<c)

Basic Syntax

Type Conversion

A numeric value of one type is not automatically converted to another type

- toByte()
- toShort()
- toInt()
- toLong()
- toFloat()
- toDouble()
- toChar()
- toString()

Basic Syntax

Type Conversion

Example

```
fun main() {
      val number1: Double = 77545.33
      val number2: Int = number1.toInt()
       println("number1 = "+ number1)
       println("number2 = "+ number2)

    val str : String = "35"
    val intV : Int = str.toInt()/6
    val doubleV : Double = str.toDouble()/6
      println( "intV =" + intV )
      println( "doubleV =" +doubleV)              }
```

Result

Basic Syntax

Comments

Just like Java and JavaScript, Kotlin supports end-of-line and block comments.

```
// This is an end-of-line comment

/* This is a block comment
   on multiple lines. */
```

Basic Syntax

- Nullable Variable to solve NullPointerException or NPE

  - Use var and ?

```
var nullV   : Int    = null // Error
var nullV2 : Int?  =  null
```

  - !! Operator

This operator is used to explicitly tell the compiler that the property is not null and if it's null, please throw a null pointer exception (NPE).

```
val s: String? = “”
val lowerS = s!!.toLowerCase()
```

Basic Syntax

?: (Elvis Operator)

```
val result = value1 ?: value2
```

If *value1* is NOT NULL, result is assigned its value.
But, if *value1* is NULL, result is assigned *value2*'s value.

Elvis Operator

Basic Syntax

- If - Else

```
fun main() {
    val number : Int = -5
    if (number > 0) {
        print("Positive number")   }
    else { print("Negative number")  }
}
```

```
fun main() {
   val number : Int = -5
   val result = if (number > 0) {
        "Positive number“     }
     else { "Negative number“     }
    println(result)
}
```

Result

Basic Syntax

- if...else...if

```
fun main() {
    val number : Int = 0
    val result :String = if (number > 0)
        "positive number"
    else if (number < 0)
        "negative number"
    else
        "zero"

    println("number is $result")
}
```

Result

Basic Syntax

- Use of When

```
fun main() {
   val x : Int = 5
   when (x) {
      1 -> print("x = 1")
      2 -> print("x =  2")
      else -> {
          print("x is neither 1 nor 2")
      }
   }
}
```

Result

Basic Syntax

- For Loop

```
fun main() {
    val items = listOf(1, 2, 3, 4)
    for (i in items)
        println("values of the list = "+ i )
}
```

Result

Basic Syntax

- For Loop

```
fun main() {
  val items = listOf(1, 22, 83, 4)

  for ((index, value) in items.withIndex()) {
    println("the element at $index is $value")
  }
}
```

Result

Basic Syntax

- For Loop : Range expressions

Result

```
fun main() {
   for (i in 1..4)
         println(i)
}
```

Arbitrary step :

Result

```
fun main() {
   for (i in 1..4 step 2)
        println(i)
}
```

Basic Syntax

- For Loop : Reverse order

Result

```
fun main() {
   for (i in 4 downTo 1)
         println(i)
}
```

Arbitrary step :

Result

```
fun main() {
   for (i in 4 downTo 1 step 2)
         println(i)
}
```

Basic Syntax

- For Loop : until

```
fun main() {
   for (i in 1 until 5) {
      // i in [1, 5), 5 is excluded
        println(i)
    }
}
```

Result

Basic Syntax

- While Loop

Result

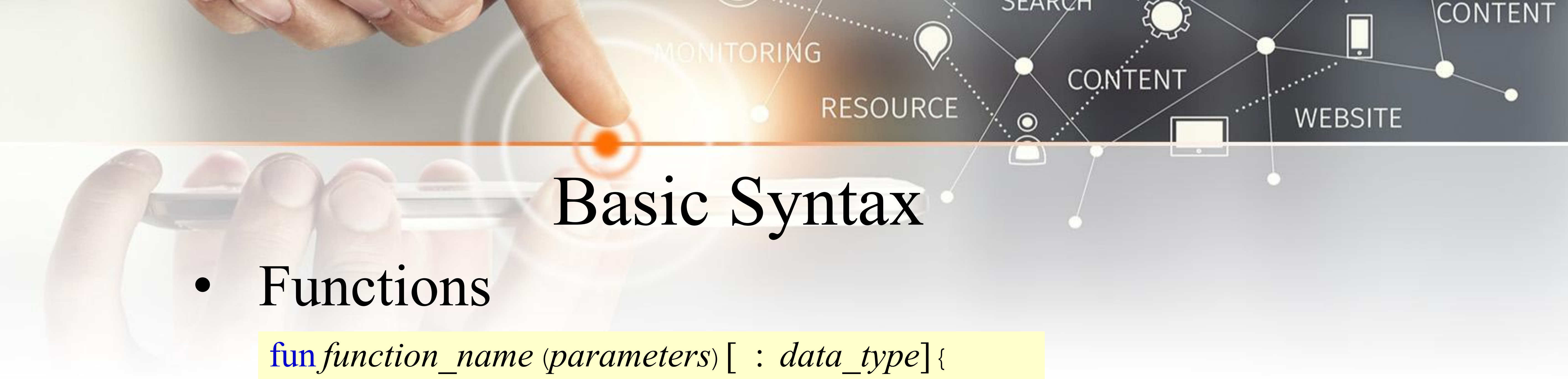
```
fun main() {
   var x:Int = 0

   while(x <= 6) {
      println(x)
      x++
   }
}
```

Basic Syntax

- Do-while loop

```
fun main() {
   var x:Int = 0
   do {
            x = x + 10
            println("I am inside Do block---"+ x)
   } while(x <= 50)
}
```

Result



Basic Syntax

- Functions

```
fun function_name (parameters) [ : data_type] {

    //// statement

}
```

Example

```
fun printSum(a: Int, b: Int) {
   println("sum of $a and $b is ${a + b}")
}
```

Basic Syntax

- Function having two Int parameters with Int return type:

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

- Function with an expression body and inferred return type (Compact Function):

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

Basic Syntax

- Call Functions

```
fun main() {
    printSum(3,4)
    println("sum = " + sum(3,4) )
}

fun printSum(a: Int, b: Int) {
   println("sum of $a and $b is ${a + b}")
}


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

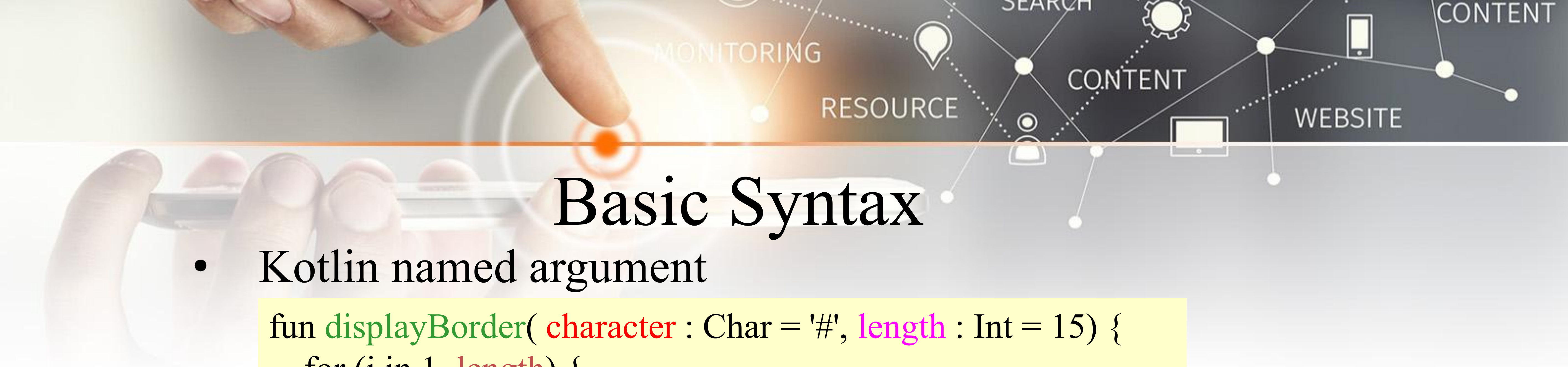
Result

Basic Syntax

- Kotlin Default Argument

```
fun displayBorder( character : Char = '#', length : Int = 15) {
    for (i in 1..length) {
        print(character)
    }
    println()
}
fun main() {
    println("Output when no argument is passed:")
    displayBorder()
    println("Output when first argument is passed:")
    displayBorder('*')
     println("Output when both arguments are passed:")
    displayBorder('*', 5)
}
```

Result



Basic Syntax

- Kotlin named argument

```
fun displayBorder( character : Char = '#', length : Int = 15) {
    for (i in 1..length) {
        print(character)
    }
    println()
}

fun main( ){
    displayBorder(length = 5)
}
```

Result

References

- http://www.cems.uwe.ac.uk/~bk2dean/uwe/digitalmedia/mobiledevelopment/lectures/anatomy_of_a_mobile_device.ppt
- https://en.wikipedia.org/wiki/Windows_Phone#/media/File:Windows_10_Logo.svg
- https://www.cs.cmu.edu/~bam/uicourse/830spring09/BFeiginMobileApplicationDevelopment.pdf
- http://cs.joensuu.fi/~zhao/Courses/Location/Dariusz.ppt