

Algorithms & Programming

(p.6 – Arrays & Lists)



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Arrays

- Arrays in Kotlin are represented by the `Array` class, that has `get` and `set` functions (that turn into `[]` by operator overloading conventions), and `size` property, along with a few other useful member functions
- To create an array, we can use a library function `arrayOf()` and pass the item values to it, so that `arrayOf(1, 2, 3)` creates an array `[1, 2, 3]`

Arrays

- Another option is to use the Array constructor that takes the array size and the function that can return the initial value of each array element given its index:

```
// Creates an Array<String> with values  
// ["0", "1", "4", "9", "16"]  
val asc = Array(5) { i -> (i * i).toString() }  
asc.forEach { println(it) }
```

Primitive type arrays

- Kotlin also has specialized classes to represent arrays of primitive types without boxing overhead: `ByteArray`, `ShortArray`, `IntArray` and so on.
- These classes have no inheritance relation to the `Array` class, but they have the same set of methods and properties.
- Each of them also has a corresponding factory function

Primitive type arrays

```
val x: IntArray = intArrayOf(1, 2, 3)
x[0] = x[1] + x[2]
```

```
// Array of int of size 5 with values [0,0,0,0,0]
val arr = IntArray(5)
```

```
// initialise the values in the array with a constant
// Array of int of size 5 with values [42,42,42,42,42]
val arr = IntArray(5) { 42 }
```

```
// initialise the values in the array using a lambda
// Array of int of size 5 with values [0, 1, 2, 3, 4]
// (values initialised to their index value)
var arr = IntArray(5) { it }
```

List

- `List<T>` stores elements in a specified order and provides indexed access to them. Indices start from zero – the index of the first element – and go to `lastIndex` which is the `(list.size - 1)`.

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

List

- List elements (including nulls) can duplicate: a list can contain any number of equal objects or occurrences of a single object.
- Two lists are considered equal if they have the same sizes and structurally equal elements at the same positions.

```
val bob = Person("Bob", 31)
val people = listOf(Person("Adam", 20), bob, bob)
val people2 = listOf(
    Person("Adam", 20), Person("Bob", 31), bob)
println(people == people2)
bob.age = 32
println(people == people2)
```

MutableList

- `MutableList<T>` is a `List` with list-specific write operations, for example, to add or remove an element at a specific position.

```
val numbers = mutableListOf(1, 2, 3, 4)
numbers.add(5)
numbers.removeAt(1)
numbers[0] = 0
numbers.shuffle()
println(numbers)
```

- *In some aspects lists are very similar to arrays.*
- *One important difference: an array's size is defined upon initialization and is never changed;*
- *List doesn't have a predefined size; a list's size can be changed as a result of write operations: adding, updating, or removing elements.*

Task 1:

Linear search in an array

- Traverse the **array** using a for loop.
- In every iteration, compare the target value with the current value of the **array**. If the values match, return the current index of the **array**. If the values do not match, move on to the next **array** element.
- If no match is found, return -1 .

Task 1:

Linear search in an array

```
fun linearSearch(x:Int, a:IntArray): Int {  
    for (i in 0..a.size-1) {  
        if (a[i] == x) return i  
    }  
    return -1  
}
```

```
fun linearSearch1(x: Int, a: IntArray): Int {  
    for (i in a.indices) {  
        if (a[i] == x) return i  
    }  
    return -1  
}
```

```
fun search(x: Int, a: IntArray): Int = a.indexOf(key)
```

Task 2:

Find Max / Min in an array

- Assume that it's present at the beginning of the **array** and stores that value in a variable.
- Then we compare it with the other **array** elements one by one,
 - if any element is greater than our assumed **maximum**,
 - then the **maximum** value and the index at which it occurs are updated.
- Same approach for **minimum**

Task 2:

Find Max / Min in an array

```
fun findMax(a: IntArray): Int {  
    var result = a[0]  
    for (i in 1..a.size-1) {  
        if (result < a[i]) result = a[i]  
    }  
    return result  
}
```

```
fun findMaxOrNull(a: IntArray): Int? {  
    if (a.isEmpty()) return null  
    return findMax(a)  
}
```

Task 2:

Find Max / Min in an array

```
fun findMin(a: IntArray): Int {  
    var result = a[0]  
    for (i in 1..a.size-1) {  
        if (result > a[i]) result = a[i]  
    }  
    return result  
}
```

```
fun findMinOrNull(a: IntArray): Int? {  
    if (a.isEmpty()) return null  
    return findMin(a)  
}
```

```
val min = a.min()
```

```
val min = a.minOrNull()
```

Task 3: Calculate number of elements with condition

- Given an array of integers. The task is to calculate the count of a number of elements which are divisible by a given number k
- For example, calculate the count of even elements (divisible by 2)

Task 3: Calculate number of elements with condition

```
fun calculateDivisible(a: IntArray, k: Int): Int {  
    var count = 0  
    for (x in a) {  
        if (x % k == 0) count++  
    }  
    return count  
}
```

```
fun calculateDivisible(a: IntArray, k: Int): Int = a.count { it % k == 0 }
```

Task 4: filter elements with condition

- Given an array of integers. The task is to select elements which are divisible by a given number k and copy them into another array



Task 4: filter elements with condition

```
fun filterDivisible(a: IntArray, k: Int): IntArray {  
    val list = mutableListOf<Int>()  
    for (x in a) {  
        if (x % k == 0) list.add(x)  
    }  
    return list.toIntArray()  
}
```

```
val b = a.filter { it % k == 0 }.toIntArray()
```

Task 5:

Binary search in an array

- Binary search works on sorted arrays.
- Binary search begins by comparing an element in the middle of the array with the target value.
- If the target value matches the element, its position in the array is returned.
- If the target value is less than the element, the search continues in the lower half of the array. If the target value is greater than the element, the search continues in the upper half of the array.
- By doing this, the algorithm eliminates the half in which the target value cannot lie in each iteration

Task 5:

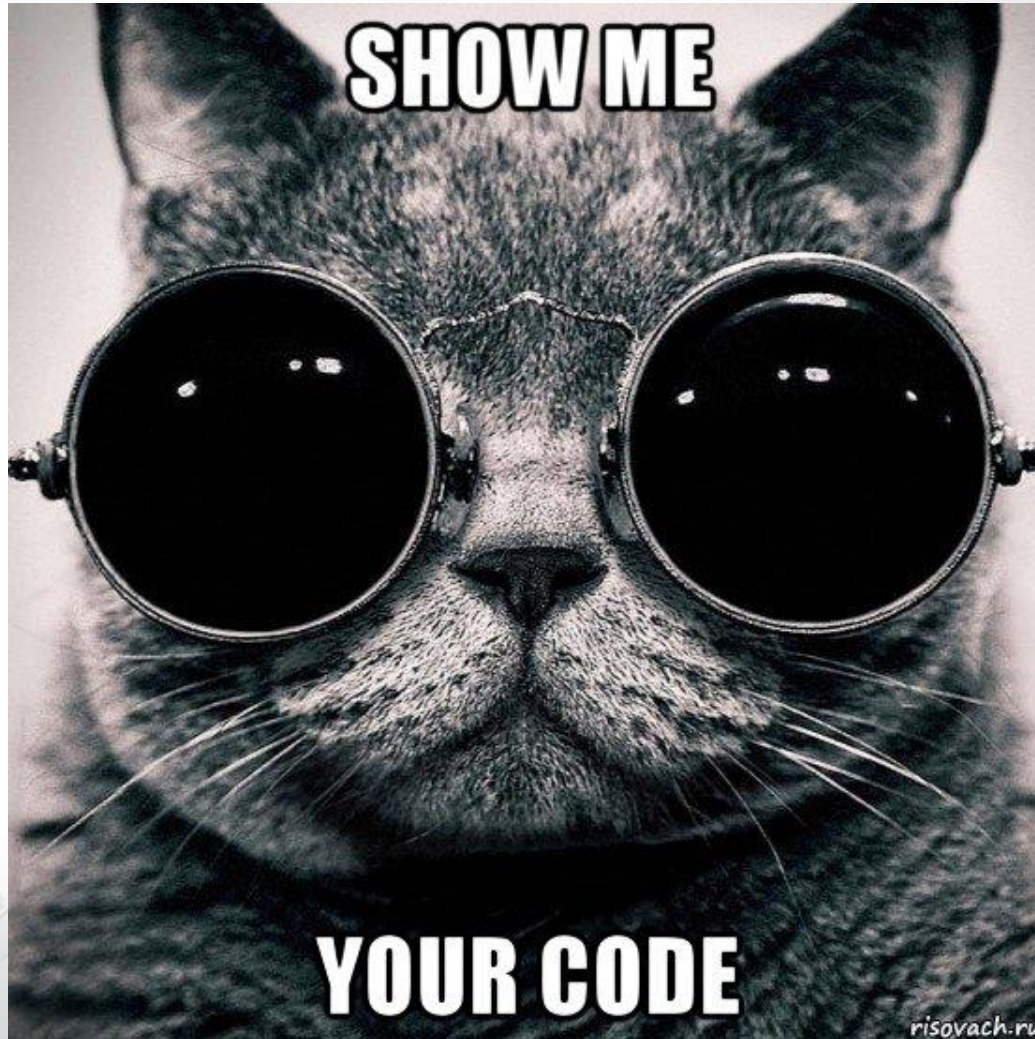
Binary search in an array

```
fun binarySearch(x: Int, a: IntArray): Int {  
    var firstIndex = 0  
    var lastIndex = a.size-1  
    if (lastIndex == -1) return -1  
    while (firstIndex <= lastIndex) {  
        val avgIndex = (lastIndex + firstIndex) / 2  
        if (x < a[avgIndex])  
            lastIndex = avgIndex-1  
        else if (x > a[avgIndex])  
            firstIndex = avgIndex + 1  
        else return avgIndex  
    }  
    return -(firstIndex+1)  
}
```



НАЦІОНАЛЬНИЙ
УНІВЕРСИТЕТ
КОРАБЛЕБУДУВАННЯ
ІМЕНІ АДМІРАЛА МАКАРОВА

Let's code!



Questions?



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