From Editor to Output

Learn what happens behind the scenes when you Run a Kotlin program.

How does a program work? From our perspective, we write some code, run it, and then something (usually) appears in the output terminal; however, that isn't the full story. In this article, we're going to break down all of the work and processes that happen between running our Kotlin code and seeing its output.

Behind the Scenes

When we run a program, a series of processes work together to evaluate and format the code as needed. This process varies by language, but in Kotlin it looks like this:

First, the compiler evaluates our entire program and ensures that it does not contain any errors. It then translates our source code to Java bytecode in the form of `.class` files. These files then get passed on to the JVM.

JVM stands for Java Virtual Machine and is the software responsible for executing Java bytecode given to it from a compiler. The JVM doesn't understand programming languages like Kotlin; instead, it speaks to and analyzes bytecode. The JVM then executes these instructions in the order they were given. Once the JVM completes the final instruction, it terminates - meaning our program has been fully executed.

What happens when there's an error?

Since Kotlin is a statically compiled language, its code gets translated and its types are checked before run time, specifically during compilation. Any errors in our code get caught during this phase. If the compiler recognizes an error, it displays an error message in the output terminal and terminates the rest of the processes as shown below:

The bytecode is never generated, the JVM is never reached, and finally, our code's output is not displayed. Assuming we have an error such as this one:

```
Error.kt:2:25: error: expecting ')'
  println("Hello, World"
                        ^
```

Until we resolve this error by adding a `)` and rerunning our code, we will not be able to see any output.

No Kotlin supported IDE? No problem!

In the case that we're off the Codecademy platform and writing our Kotlin code locally in an IDE without a built-in converter between Kotlin and Java code, we can rely on the bash terminal.

The bash terminal is a command language interpreter that has the ability to execute a series of commands contained in a script or program. With Kotlin installed, we can run a series of commands which will manually compile our code, execute it, and display its output. Take a look at how it's done manually.

Assume we have the following program in a **HelloWorld.kt** file:

```
fun main() {
  println("Hello, World!")
}
```

In the bash terminal, we can enter the first command to compile our code and save it in a `.jar` file:

```
$ kotlinc HelloWorld.kt -include-runtime -d HelloWorld.jar
```

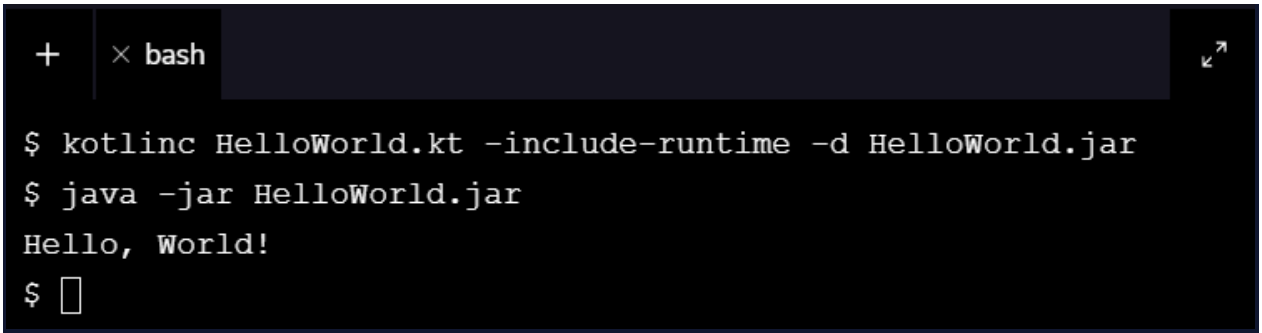
- `kotlinc` represents the compiler.
- `HelloWorld.kt` represents the source code file that we need to compile into Java bytecode.
- The `-include-runtime` option results in the `.jar` file being runnable by including the Kotlin runtime library within it.
- The `.jar` extension represents a file format that indicates many Java files zipped into one. When executed, Java can extract and use its information.
- The `-d` flag specifies the output path for the newly generated class files.

After we've hit enter, we can then run our program with the following command:

```
java -jar HelloWorld.jar
```

- The `java` command launches an application written in Java. It does this by starting the JVM, loading the `.class` file, and executing the code within the `main()` function.

- By specifying the `-jar` flag, we are instructing Java to execute a program within a `.jar` file.



Note: If we make changes to our code, we'd need to recompile our program and run the above two commands again.

You've reached the end of the article - great job! We covered a vast majority of information that gives us insight into what happens after we run our Kotlin code.

We now understand that our Kotlin code needs to be compiled into bytecode before it can be passed on to the Java Virtual Machine which executes the code as instructions. IDEs often automatically compile our code, but if we don't have that luxury, we can use a bash terminal to manually compile and execute our program. Next time you're running your code, you'll know what's happening from editor to output. And if you want to learn more about how to use your bash terminal, check out our Bash courses.