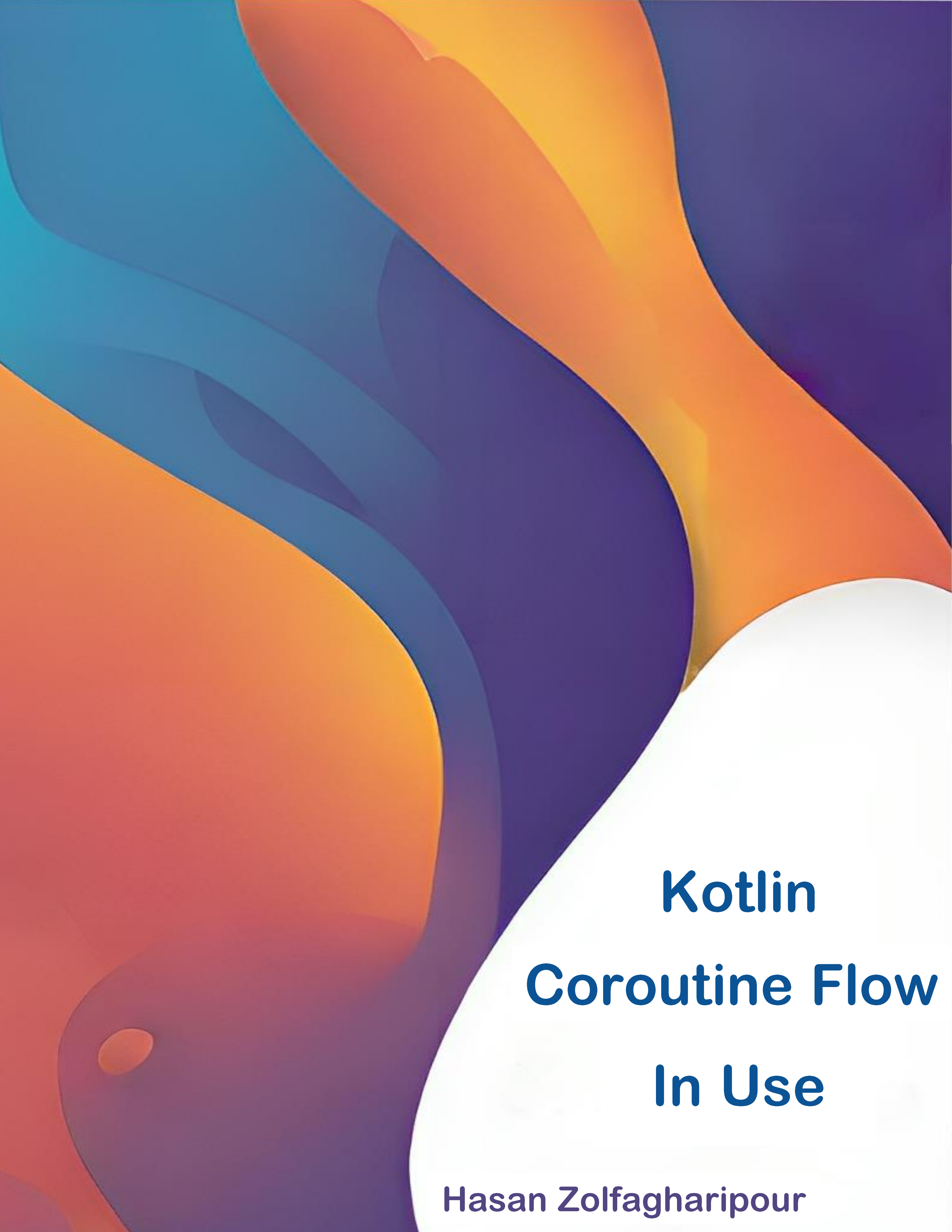

Kotlin Coroutine Flow In Use

Hasan Zolfagharipour

About this book

This is a comprehensive guide that takes you on an immersive journey into the world of Android development and Kotlin programming. With over 350 pages of carefully crafted content, this book is your ultimate companion for mastering the art of asynchronous programming using Coroutine and Flow. Building responsive and efficient applications is paramount in today's fast-paced mobile app development.

This book equips you with the knowledge and practical skills required to harness the power of Kotlin Coroutine and Flow to create smooth, responsive, and resource-efficient Android applications. Drawing from a wealth of authoritative sources, including articles, official documents, and expert-authored books, 'Coroutine-Flow In Use' distills the most essential concepts into a single, accessible resource. The book combines theoretical insights with real-world examples, providing a holistic understanding of using Coroutines and Flow effectively. Whether you're a new programmer or an experienced developer seeking to refine your skills, this book accommodates all proficiency levels. You'll explore foundational concepts, advanced techniques, and discover best practices. 'Coroutine-Flow In Use' is your gateway to building Android applications that are not just functional, but also highly responsive and user-friendly.

Join us on this journey and unlock the full potential of Kotlin Coroutines and Flow for your Android development projects. At the end of the book, we invite you to provide feedback, helping us improve future editions. Your insights are invaluable in our mission to deliver the most relevant and helpful content.

About Author

Hasan Zolfagharipour is an Android developer with 3+ years of experience developing cutting-edge Android applications. In his free time, Hasan likes to do volunteer work, read a book, be in nature, or go to the gym.

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1 Coroutine

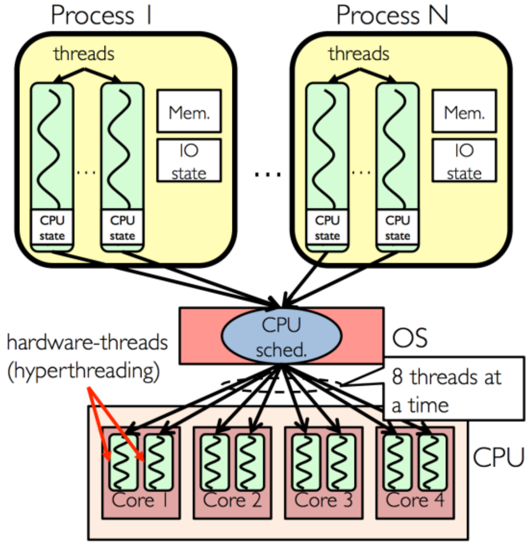
Coroutines are computations that run on top of threads and can be suspended. A coroutine is an instance of suspendable computation. Coroutines is a recommended solution for asynchronous programming on Android. Noteworthy features include the following:

- **Lightweight:** You can run many coroutines on a single thread due to support for suspension, which doesn't block the thread where the coroutine is running.
- **Fewer memory leaks:** Using structured concurrency to run operations within a scope.
- **Built-in cancellation support:** Cancellation is automatically propagated through the coroutine hierarchy.
- **Jetpack integration:** Many Jetpack libraries include extensions that support full coroutines.

Conceptually a Coroutine is like a Thread, it takes a block of code to run that works concurrently with the rest of the code.

1.1 Threads

A Thread is a very lightweight process, or the smallest part, that allows a program to operate more efficiently by running multiple tasks simultaneously.



Considering the above image, all process threads live in the same memory space, whereas processes have separate memory space. So, sharing objects between threads is more accessible, as they share the same memory space. To achieve the same between processes, we must use some IPC (inter-process communication) model, typically provided by the OS. Also, the context switch time between threads is lower than the process context switch. Process context switching requires more overhead from the CPU. So, we have:

- **Single-process:** On a single-core processor, we can only run one thread at a time, but the Operating system achieves multithreading using time-slicing. A core CPU appears to be doing two things simultaneously but is time-slicing between threads (tasks) so quickly; it means a core is still running only one hardware thread, quickly switching between many software threads.
- **Multi-process:** Now, most modern phones have multi-core CPUs. That means you have more than one process (dual-core, quad-core, etc.). So technically, multiprocessing is impossible on a single-core CPU; multitasking is possible.

CPU Core: A CPU core is a hardware component called a CPU's brain. It is like a small CPU within a bigger CPU. The core can process all the computational jobs independently. It receives commands and performs the related operations or calculations.

What is a Thread? It's critical to distinguish between hardware and software threads.

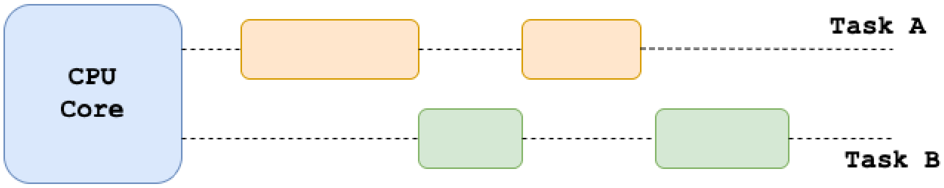
- **Hardware Thread:** A single-core CPU can have up to 2 hardware threads per core. For example, a dual-core CPU will have four threads. Multiple cores allow the CPU to execute code simultaneously.
- **Software Thread:** One hardware thread can run many software threads. We need to be able to divide problems into smaller tasks. So, we can start as many threads as we require, regardless of the number of physical CPU cores. All software threads assigned to the hardware threads and hardware threads assigned to the processing core. The OS tries to map threads to cores if sufficient cores exist. Otherwise, it uses time-slicing

to do its tasks.

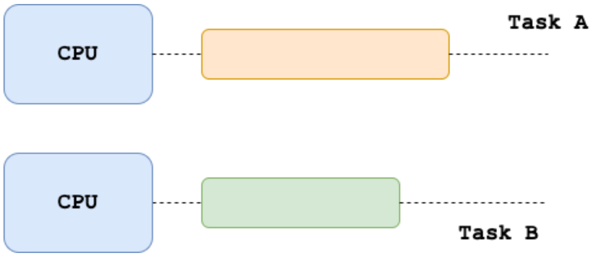
1.1.1 Concurrency & Parallelism

Let's briefly define concurrency and parallelism, and then we'll dive deeper into how to improve it.

- Concurrency: One of the main goals of concurrency is to prevent tasks from blocking each other by switching back and forth when one of the tasks is forced to wait. For example, Task A progresses till a certain point, then the CPU stops working on Task A, switches to Task B, and starts working on it for a while, and so on.



- Parallelism: In parallelism, multiple tasks can run simultaneously (e.g., on a multi-core processor or a machine with multiple CPUs). Therefore, it is not possible to have parallelism on machines with a single processor and a single-core. With parallelism, we can maximize the use of hardware resources.



- Combination of concurrency and parallelism: A system can be concurrent and parallel.

1.1.2 Concurrency is Not Parallelism

This is a nice summary by Rakhim Davletkaliyev of an excellent talk by Rob Pike, "Concurrency is Not Parallelism".

Concurrency is about dealing with a lot of things at once. Parallelism is about doing a lot of things at once. Concurrency is structuring things in a way that might allow parallelism to execute them simultaneously. However, parallelism is not the goal of concurrency. The