# Structured Concurrency in Java

## The what and the why

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# Project Loom

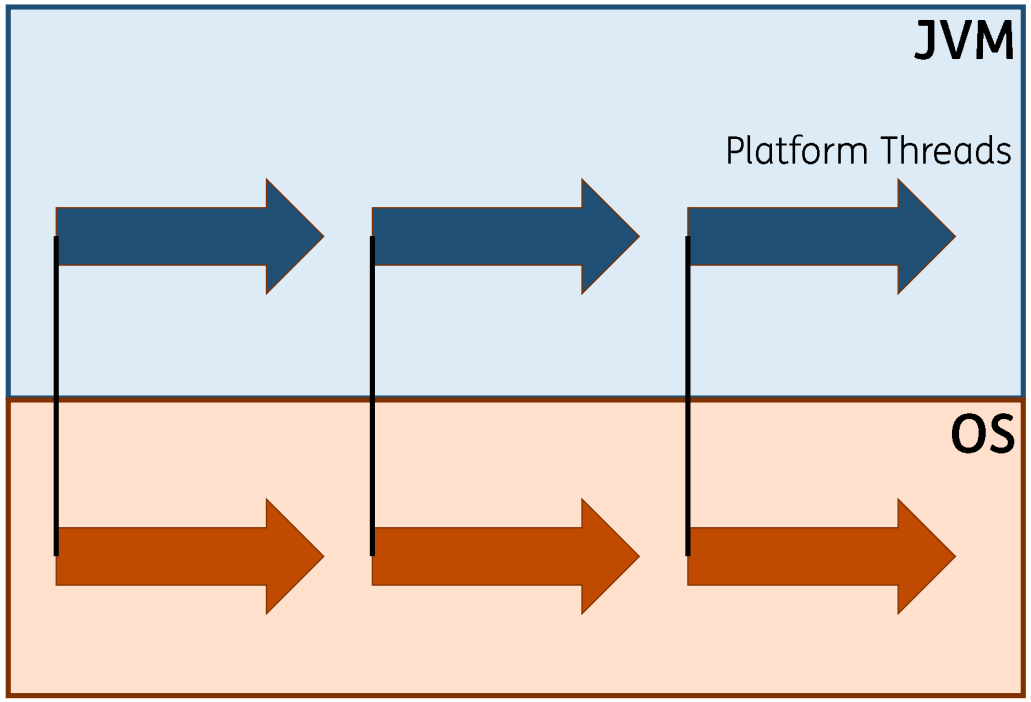
**Purpose:**

- Supporting easy-to-use, high-throughput lightweight concurrency and new programming models for it

**Features:**

- Virtual Threads: It will be finalized in Java 21 JEP - 444
- Structured Concurrency: Preview – JEP - 453
- Scoped Values: Preview – JEP - 446

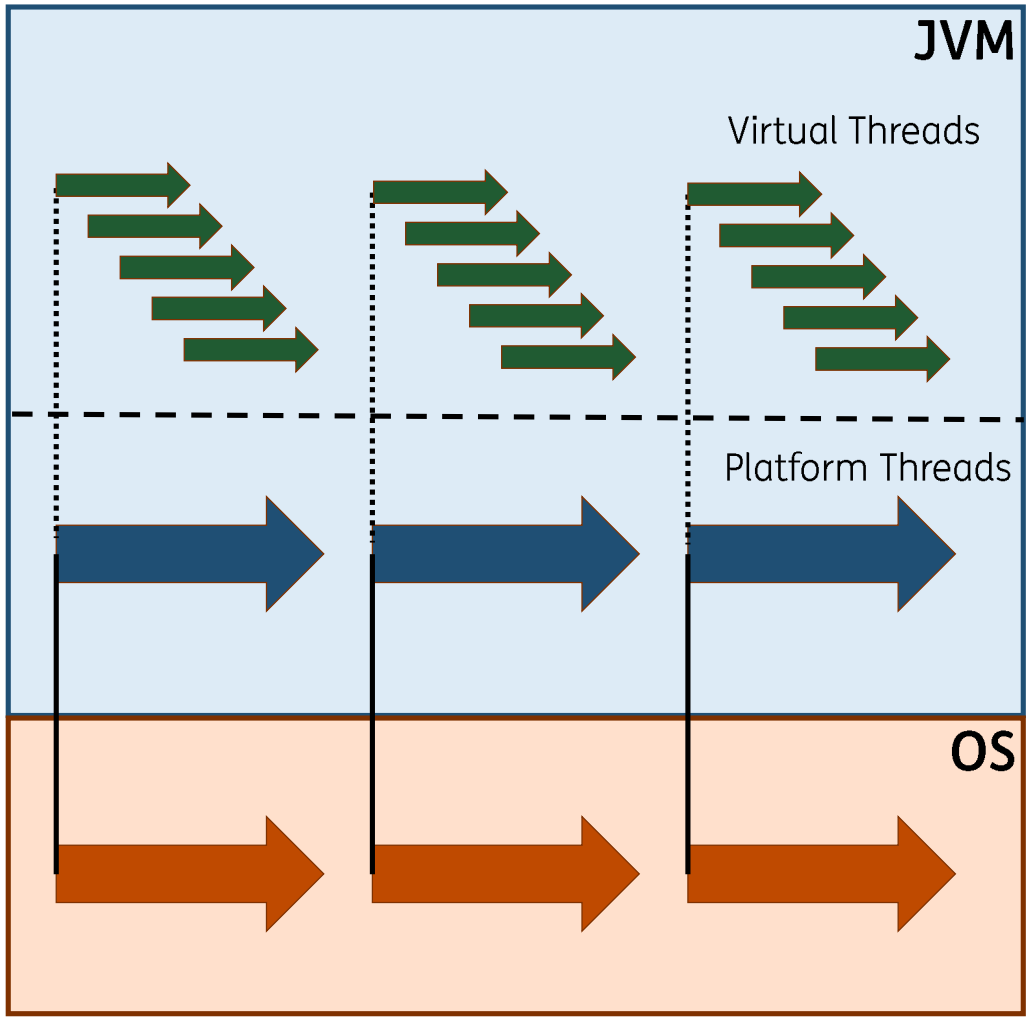
# (Platform) Threads




**Platform Threads:**

- Abstraction over OS threads
- Limited scalability (when using thread-per-request model)
- Need for pooling

# Virtual Threads



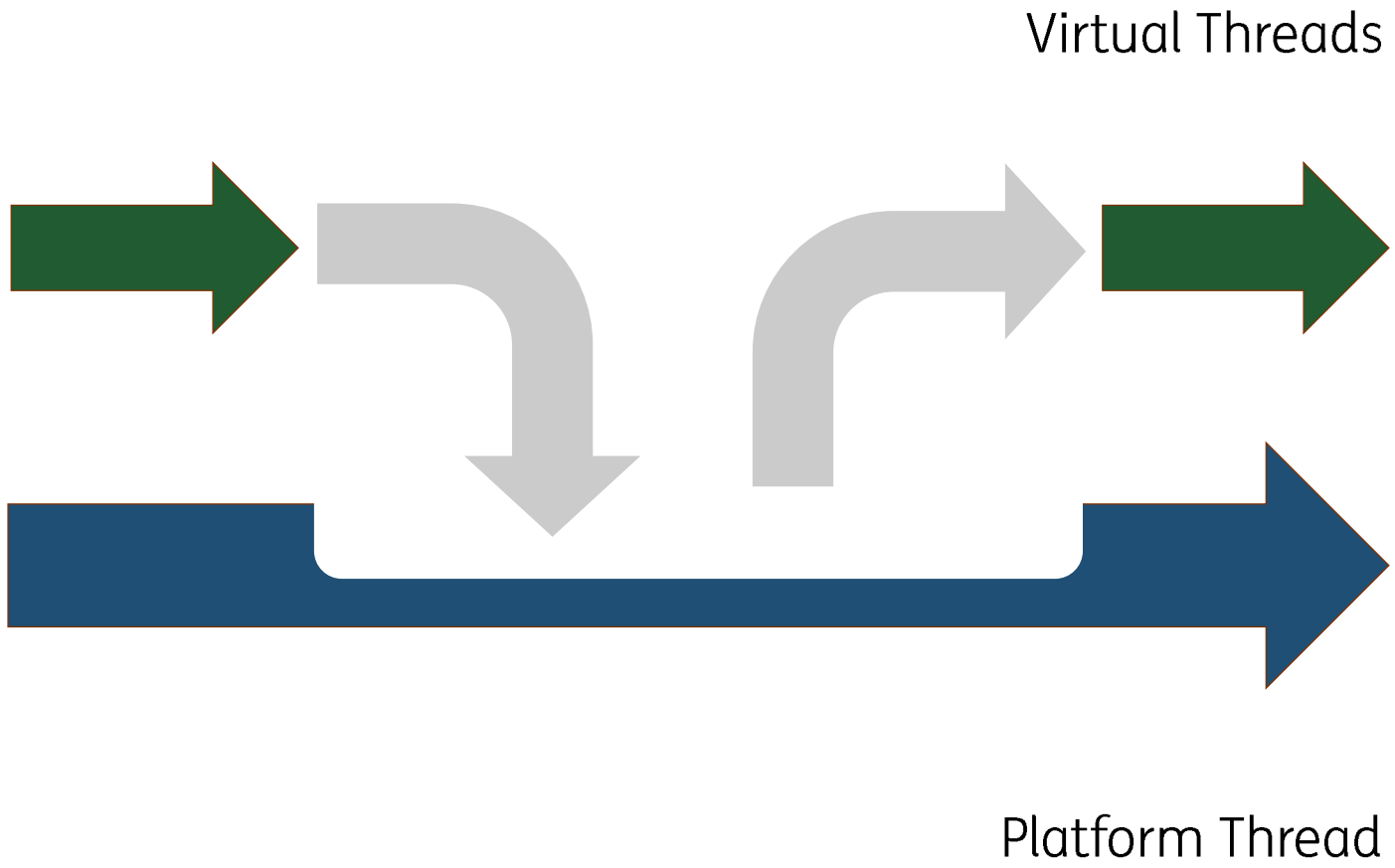

**Virtual Threads:**

- Lightweight user threads
- Highly scalable
- No need for pooling

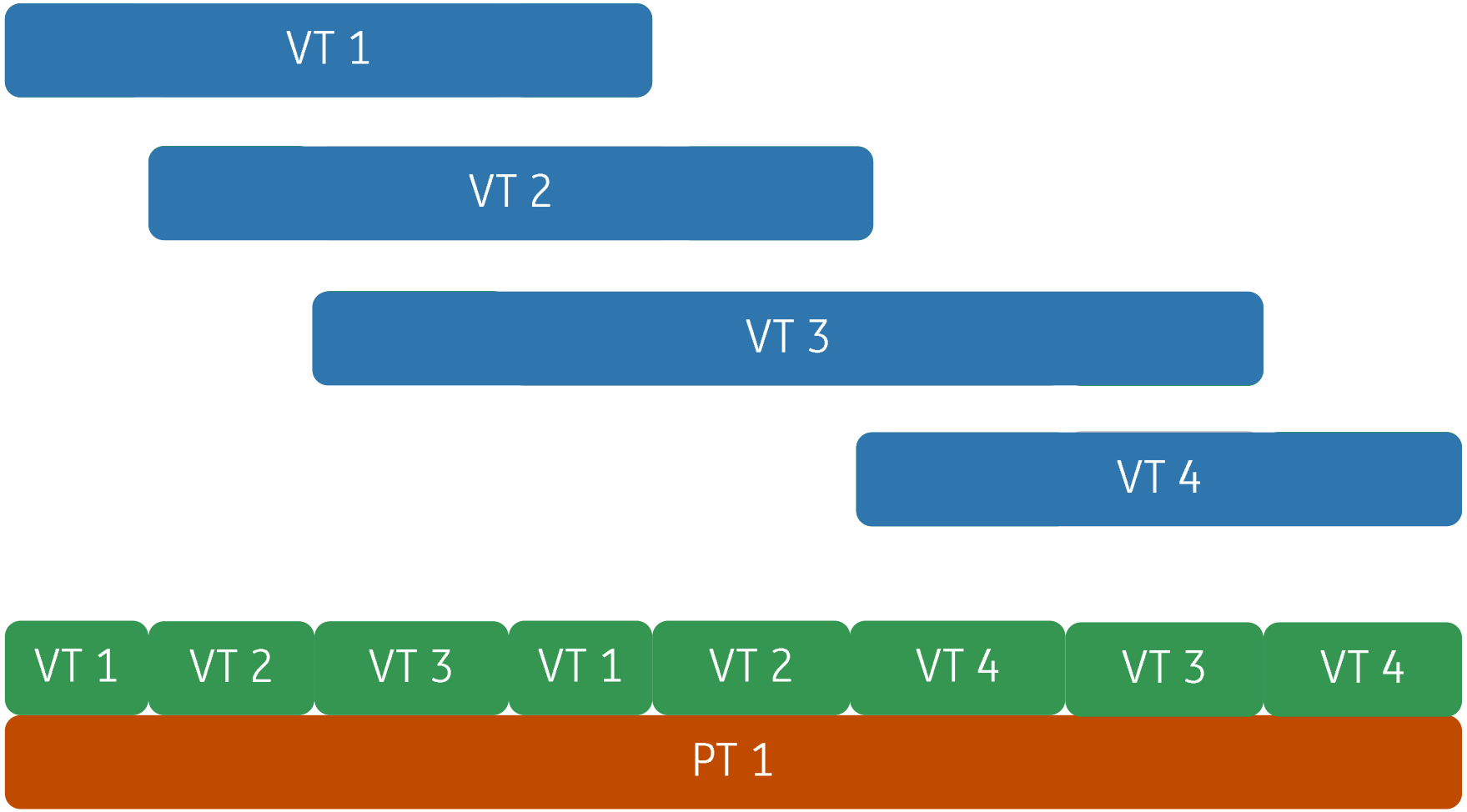
# Demo

# How to create virtual threads?

# Virtual Thread Scheduler



# Virtual Threads continued...



Use virtual threads to model (business) tasks.

# Virtual threads enable Structured Concurrency

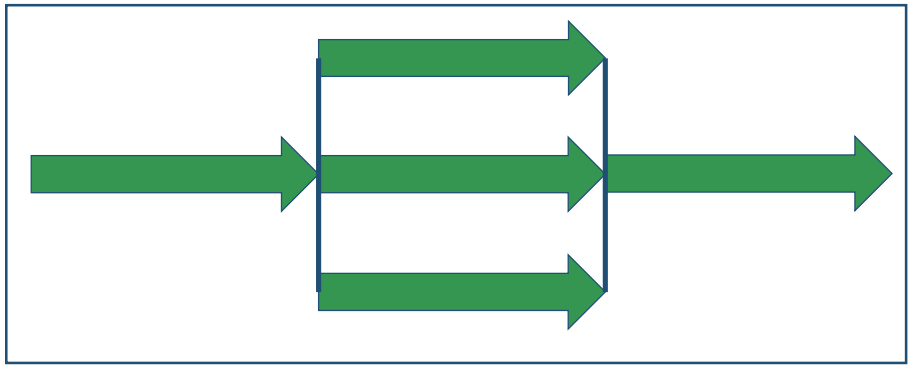
Programs → Structured Programming

Concurrent programs → Structured Concurrency

# Structured Concurrency: Continued

**Principle:**

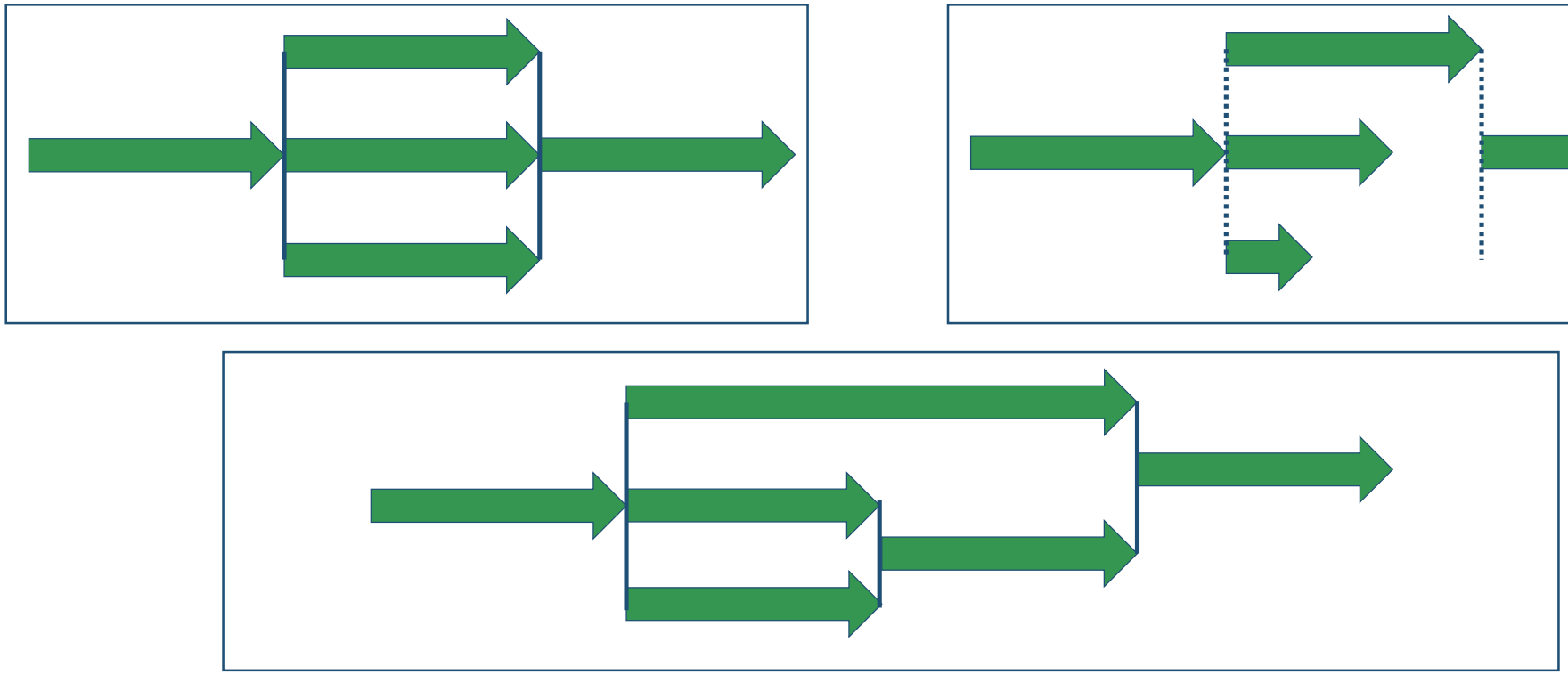
- When flow of execution splits into multiple concurrent flows, they rejoin in the same code block



**Benefits:**

- Error handling with short-circuiting
- Cancellation propagation
- Clarity
- Observability

# Structured Concurrency: Examples



All these can be modelled using StructuredTaskScope.

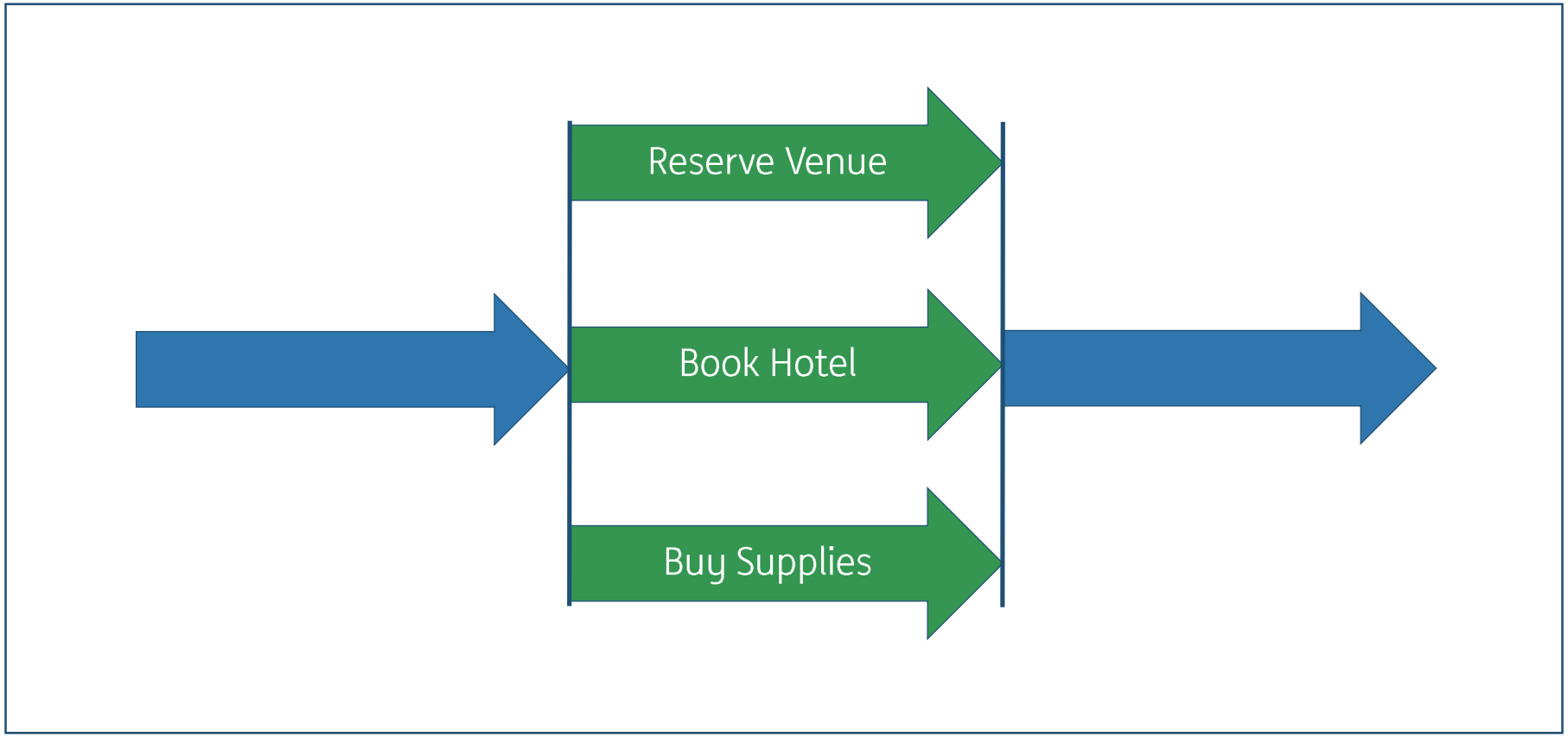
# CompletableFuture

- Provides API for asynchronous processing
- Chain multiple stages to create pipeline
- Callbacks

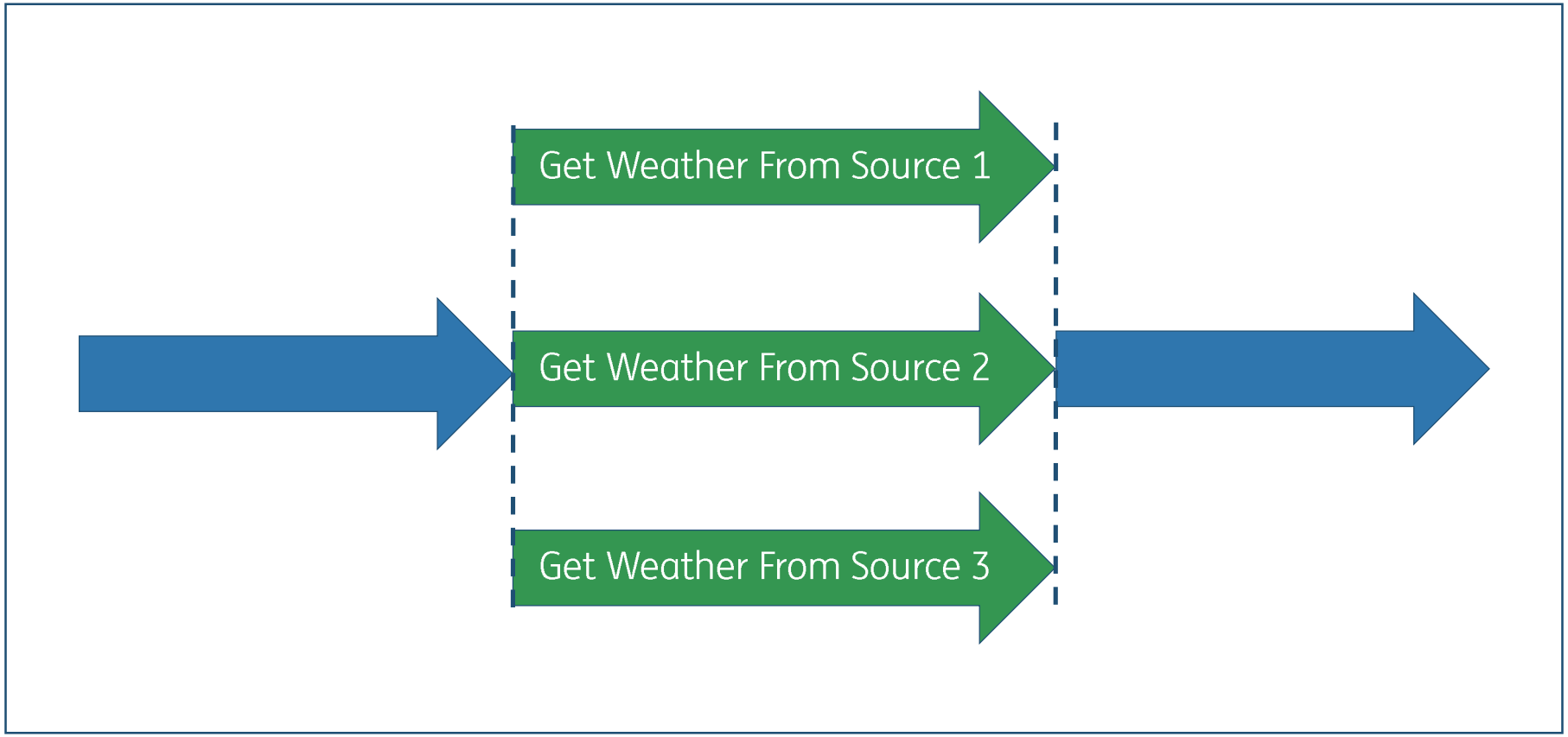
# Demo

# CompletableFuture API vs Structured Concurrency API

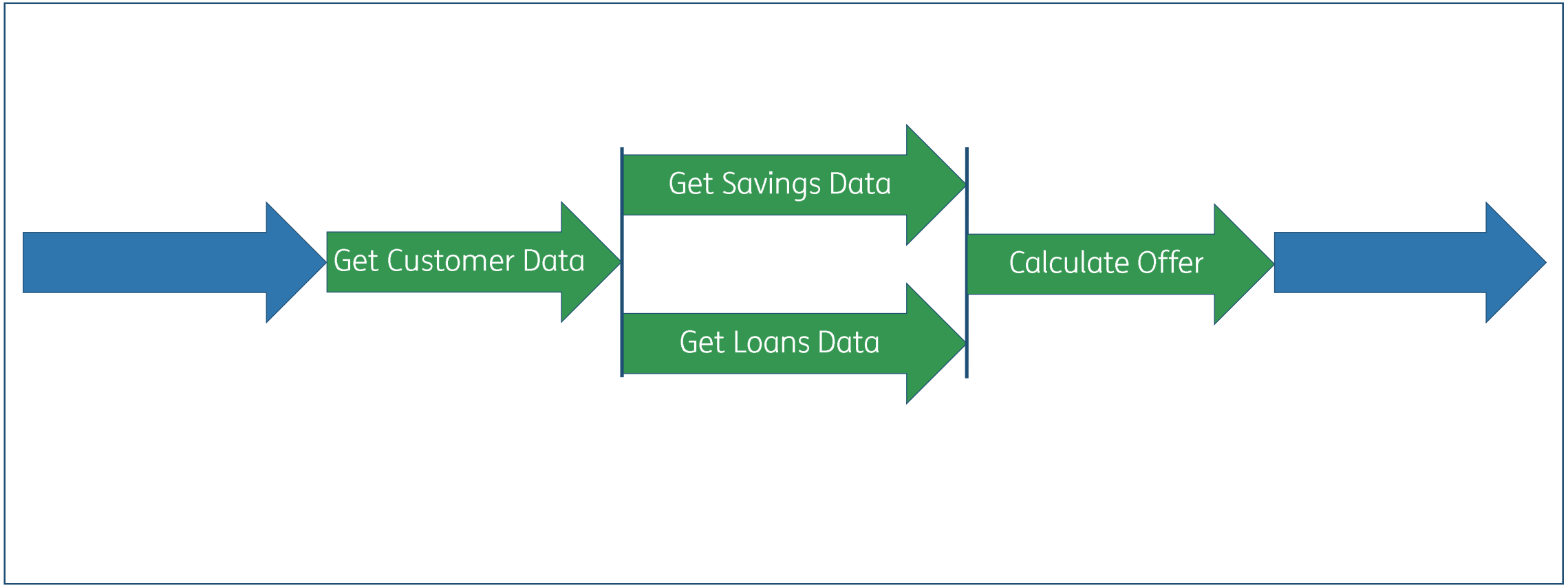
# Use case 1: Event Management



# Use case 2: Weather Service



# Use case 3: Banking Portal



# Shutdown policies

- ShutdownOnFailure
  - Stops when one of the tasks “fail”
  - Cancels other tasks
  - Useful when you want that all tasks must complete successfully
- ShutdownOnSuccess
  - Stops when one of the tasks “succeed”
  - Cancels other tasks
  - Useful when you want any one of the tasks to complete successfully
- Custom
  - Extend StructuredTaskScope
  - Override handleComplete()
  - Useful when you want custom logic/ some tasks to complete successfully

# Be aware of Pinning!

- When virtual thread is executing a synchronized code-block or method, it gets pinned
- Problem if you're doing long-running/ blocking operations inside synchronized
- Identify cases with JFR (JDK Flight Recorder)
- Use re-entrant lock

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# Questions and Feedback

**Contact points:**

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