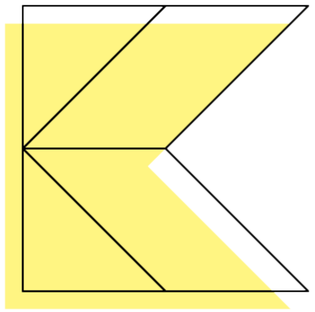
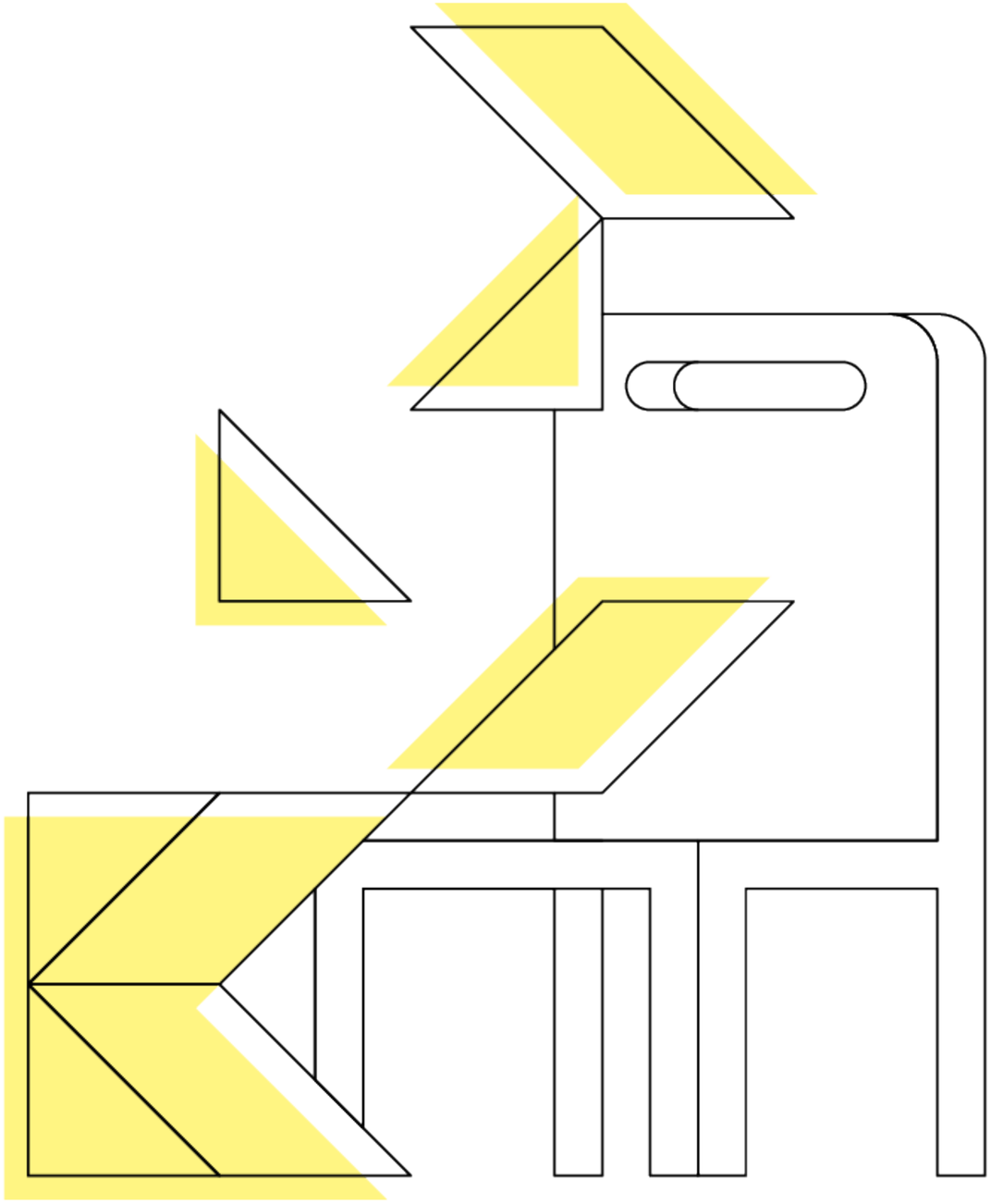


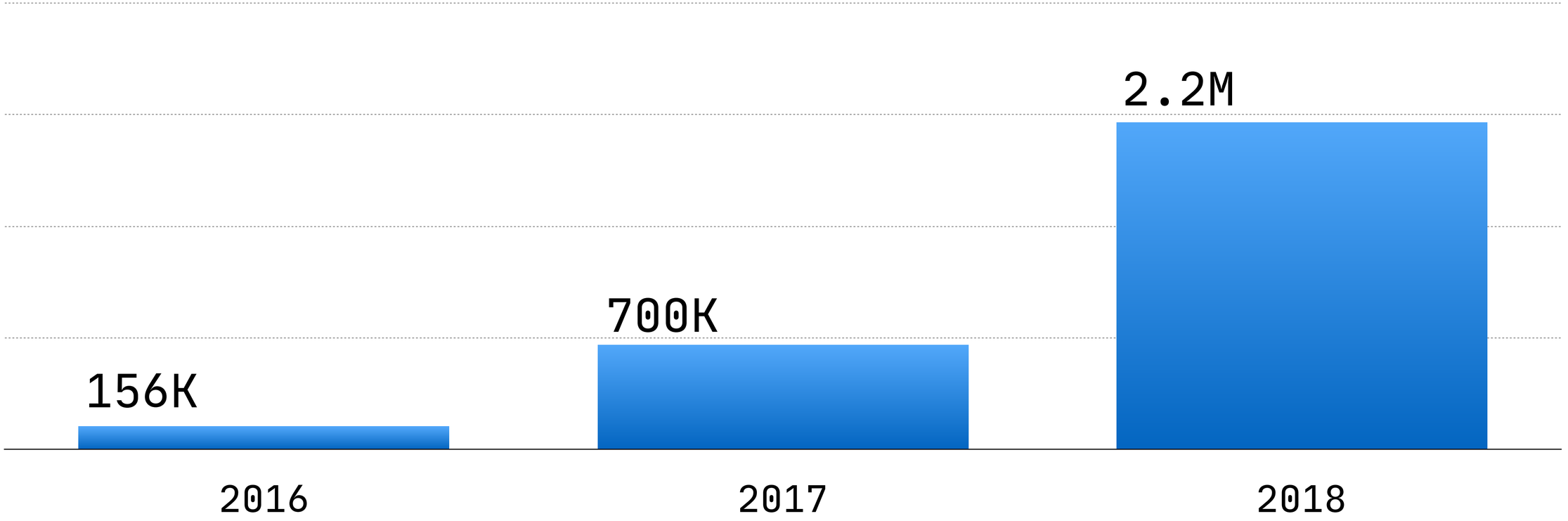
KOTLIN /
Everywhere
Beijing



What’s new in Kotlin?

Svetlana Isakova
@sveta_isakova

Kotlin developers



Timeline

- 2010 Project started

- 2016 Kotlin 1.0
- 2017 Official on Android

- 2018 Kotlin 1.3

Kotlin evolution

Kotlin 1.0	Kotlin gets stable!
Kotlin 1.1	Coroutines (experimental)
Kotlin 1.2	Multi-platform projects (experimental) Kotlin/Native (experimental)
Kotlin 1.3	Coroutines get stable! Multi-platform projects can target Kotlin/Native (experimental)

Agenda

- Kotlin evolution
- “Experimental” features

Agenda: experimental features

- Inline Classes
- Contracts
- Channels
- Flows
- Multiplatform Projects

Principles of Pragmatic Evolution

* The real sculpture made by José Manuel Castro López

```
Language design is cast in stone,
but this stone is reasonably soft,
and with some effort we can reshape
it later.

                        Kotlin Design Team
```

Principles of Pragmatic Evolution

- keeping the language modern
- comfortable updates
- feedback loop

KEEPing the language modern

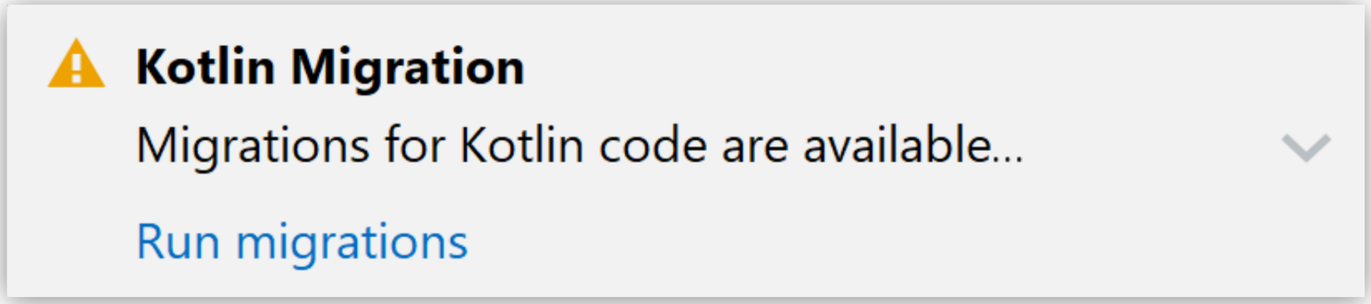
https://github.com/Kotlin/KEEP

KEEP = Kotlin Evolution
and Enhancement Process

contains language proposals
and the corresponding discussions

Comfortable updates

- Deprecation warnings in advance
- Automatic migration



Feedback loop with the community

- Kotlin  the community
- Kotlin team listens to the community
- The community members influence the Kotlin evolution

Contributors from all over the world

KOTLIN BLOG

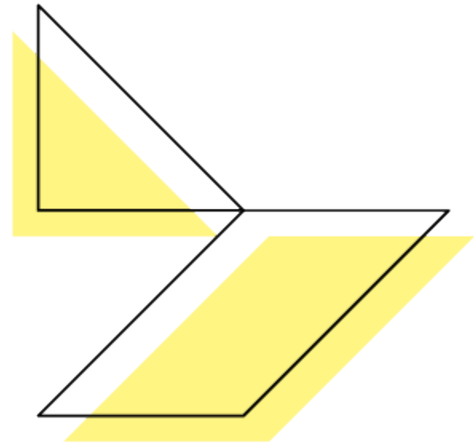
External Contributions

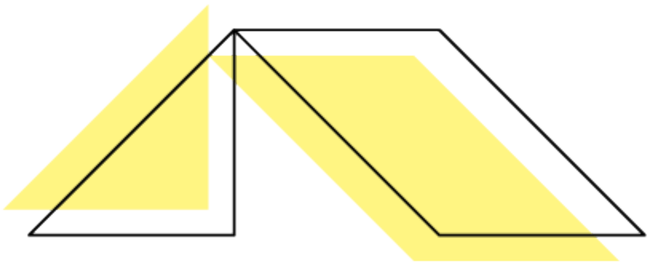
We want to especially thank Toshiaki Kameyama for his ongoing work on providing many useful intentions and inspections for IntelliJ IDEA.

We'd like to thank all our external contributors whose pull requests were included in this release:

* Steven Schäfer
* pyos
* Ivan Gavrilovic
* Mads Ager
* Ting-Yuan Huang
...

Experimental features





Experimental features

The goal: to let new features be tried by early adopters as soon as possible

Experimental Language Features

- can be changed in the future
- you need to explicitly opt in at the call site to use experimental features

```
compileTestKotlin {
    kotlinOptions {
        freeCompilerArgs += "-Xinline-classes"
    }
}
```

Experimental API for Libraries

- can be publicly released as a part of the library
- may break at any moment

Experimental API

You can mark your new class or function as experimental

```
@Experimental
annotation class ShinyNewAPI


@ShinyNewAPI
class Foo {
    ...
}
```

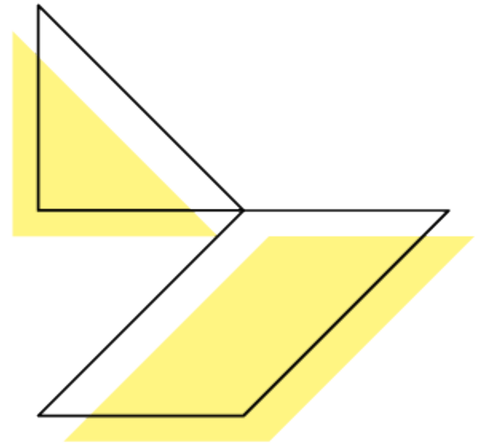
Using experimental API

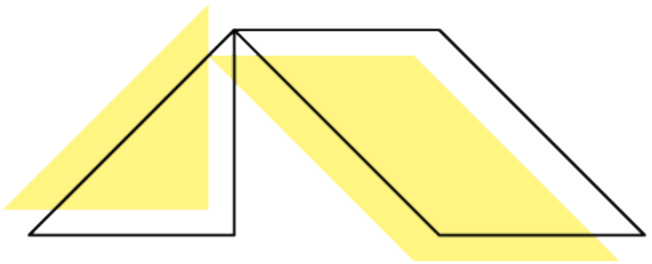
```
@UseExperimental(ShinyNewAPI::class)
fun doSomethingImportant() {
    val foo = Foo()
    ...
}
```

Experimental: Summary

- feedback loop for new features and API

Inline classes





Inline classes

- can wrap values without additional overhead
- currently an experimental feature

Duration API

- KEEP: Duration and Time Measurement API
- status: experimental in Kotlin 1.3.50
- uses inline classes

Refining API: trying primitive args

```
fun greetAfterTimeout(millis: Long)


greetAfterTimeout(2) // meaning 2 seconds?
```

Refining API: trying primitive args

```
fun greetAfterTimeout(millis: Long)
```

```
greetAfterTimeout(2) // meaning 2 seconds?
```

Too easy to make a mistake

Refining API: trying overloads

```
fun greetAfterTimeoutMillis(millis: Long)

fun greetAfterTimeoutSeconds(seconds: Long)

greetAfterTimeoutSeconds(2)
```

Refining API: trying overloads

```
fun greetAfterTimeoutMillis(millis: Long)

fun greetAfterTimeoutSeconds(seconds: Long)

greetAfterTimeoutSeconds(2)
```

Too verbose

Refining API: trying class

```
class Duration(val millis: Long)

fun greetAfterTimeout(duration: Duration)

greetAfterTimeout(Duration(millis = 2000))
```

Refining API: trying class

```
class Duration(val millis: Long)

fun greetAfterTimeout(duration: Duration)

greetAfterTimeout(Duration(millis = 2000))
```

Extra object is allocated

Inline classes to the rescue

```
inline class Duration(val value: Long)
```

```
fun greetAfterTimeout(duration: Duration)
```

Under the hood:

```
fun greetAfterTimeout_(duration: Long)
```

Inline classes to the rescue

```
inline class Duration(val value: Long)
```

```
fun greetAfterTimeout(duration: Duration)
```

Under the hood:

```
fun greetAfterTimeout_(duration: Long)
```

No extra object is allocated! ✓

Inline classes constraints

`inline` class can define only one `val` property

```
inline class Duration(val value: Long)
```

```
fun greetAfterTimeout(duration: Duration)
```

Creating Duration

```
val Int.seconds
  get() = toDuration(DurationUnit.SECONDS)

fun greetAfterTimeout(duration: Duration)

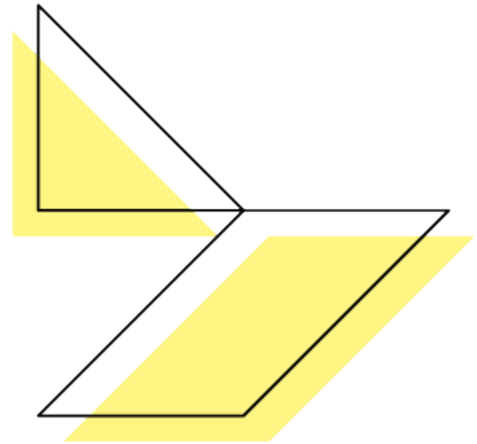
greetAfterTimeout(2.seconds)
```

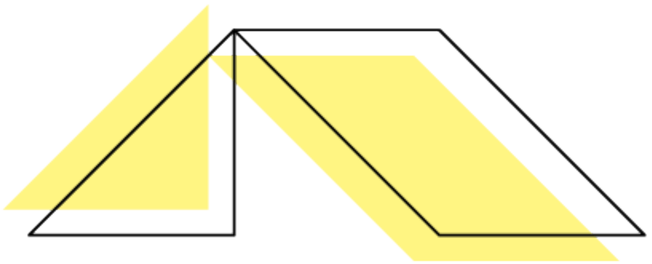
Explicit units in the code ✓

Inline classes: summary

- KEEP: inline classes
- help to improve API and avoid extra allocations
- you can go and try it out

Contracts





Changes in standard library

```
fun String?.isNullOrEmpty(): Boolean {
    return this == null || this.length == 0
}
```

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fun String?.isNullOrEmpty(): Boolean {
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```

```
fun String?.isNullOrEmpty(): Boolean {
    contract {
        returns(false) implies (this@isNullOrEmpty != null)
    }

    return this == null || this.length == 0
}
```

Changes in standard library

```
fun String?.isNullOrEmpty(): Boolean {
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```

```
fun String?.isNullOrEmpty(): Boolean {
    contract {
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    }
    return this == null || this.length == 0
}
```

We know something about `isNullOrEmpty`, which the compiler doesn't

```
val s: String? = ""
if (!s.isNullOrEmpty()) {
    s.first()
}
```

We know something about `isNullOrEmpty`, which the compiler doesn't

```
val s: String? = ""
if (!s.isNullOrEmpty()) {
    s.first()
}
```

```
Compiler error:
Only safe (?.) or non-null asserted (!!.) calls
are allowed on a nullable receiver of type String?
```

We know something about `isNullOrEmpty`, which the compiler doesn't

```
val s: String? = ""
if (!s.isNullOrEmpty()) {
    s.first()
}
```

```
Compiler error:
Only safe (?.) or non-null asserted (!!.) calls
are allowed on a nullable receiver of type String?
```

```
if (s != null && s.isNotEmpty()) {
    s.first()
}
```

✓

We know something about run, that the compiler doesn't

```
val answer: Int
run {
    answer = 42
}

println(answer)
```

We know something about run, that the compiler doesn't

```
val answer: Int
run {
    answer = 42
}   Compiler error:
    Captured values initialization is forbidden
    due to possible reassignment

println(answer)
```

Kotlin Contracts

…allow to share extra information
about code semantics with the compiler

Contract: if the function returns `false`, the receiver is not-null

```
fun String?.isNullOrEmpty(): Boolean {
    contract {
        returns(false) implies (this@isNullOrEmpty != null)
    }

    return this == null || this.length == 0
}
```

Contract: if the function returns `false`, the receiver is not-null

```
fun String?.isNullOrEmpty(): Boolean {
    contract {
        returns(false) implies (this@isNullOrEmpty != null)
    }
    return this == null || this.length == 0
}
```

```
val s: String? = ""
if (!s.isNullOrEmpty()) {
    s.first()
}
```

✓

Contract: `block` lambda will be always called once

```
inline fun <R> run(block: () -> R): R {
    contract {
        callsInPlace(block, InvocationKind.EXACTLY_ONCE)
    }
    return block()
}
```

Contract: `block` lambda will be always called once

```
inline fun <R> run(block: () -> R): R {
    contract {
        callsInPlace(block, InvocationKind.EXACTLY_ONCE)
    }
    return block()
}
```

```
val answer: Int
run {
    answer = 42
}
```

✓

Why can’t compiler just implicitly infer such information?

Why can’t compiler just implicitly infer such information?

Because then such implicitly inferred information:

- can be implicitly changed
- can accidentally break code depending on it

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Why can’t compiler just implicitly infer such information?

Because then such implicitly inferred information:

- can be implicitly changed
- can accidentally break code depending on it

Contract = explicit statement about function behaviour

Kotlin Contract

experimental

extra information by developer
&
compiler uses this information for code analysis

Kotlin Contract

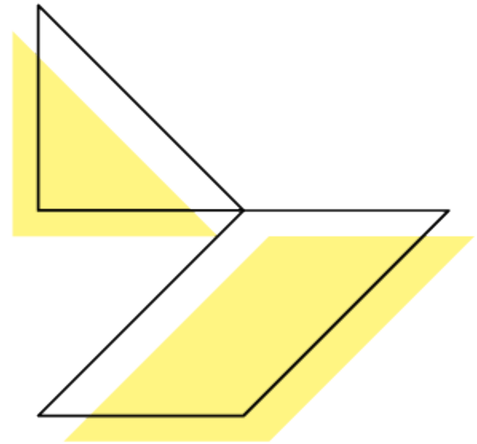
extra information by developer
&
compiler uses this information for code analysis
&
checking that the information is correct
at compile time or runtime

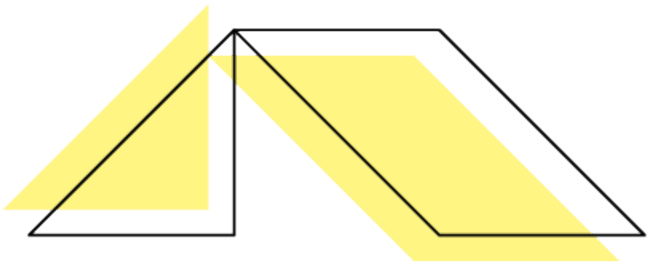
to be supported

Contracts: Summary

- handy functions (`run`, `isEmptyOrNull`) are even more useful
- contract DSL will change
- more use-cases in the future
- you can define contracts for your own functions

Channels





Channels

used for ~~synchronization~~
communication
between coroutines

“Share by communicating”

Shared
Mutable State

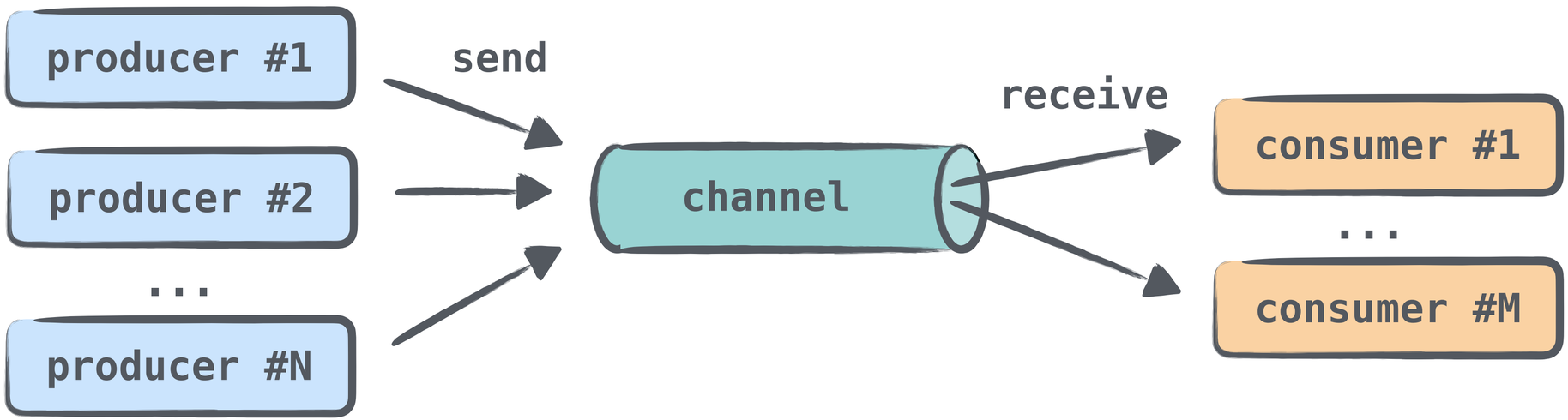
Share by
Communicating

Synchronization
Primitives

Communication
Primitives

Channel

Producer-consumer problem



Send & Receive “views” for the same channel

```
interface SendChannel<in E> {
    suspend fun send(element: E)
    fun close()
}

interface ReceiveChannel<out E> {
    suspend fun receive(): E
}

interface Channel<E> : SendChannel<E>, ReceiveChannel<E>
```

Send & Receive “views” for the same channel

```
interface SendChannel<in E> {
    suspend fun send(element: E)
    fun close()
}

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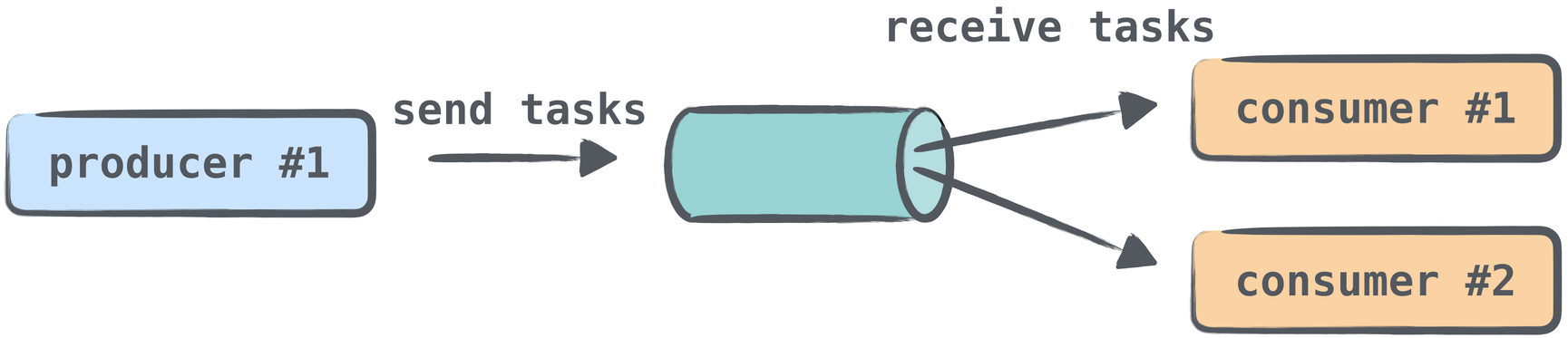
    suspend fun receive(): E
}

interface Channel<E> : SendChannel<E>, ReceiveChannel<E>
```

Producer-consumer problem



Producer-consumer solution: producer

```
val channel = Channel<Task>()
async {
    channel.send(Task("task1"))
    channel.send(Task("task2"))
    channel.close()
}
```

producer

Producer-consumer solution: consumers

```
val channel = Channel<Task>()
...
async { worker(channel) }
async { worker(channel) }
```

consumer #1

consumer #2

```
suspend fun worker(channel: Channel<Task>) {
    val task = channel.receive()
    processTask(task)
}
```

Producer-consumer solution

```
val channel = Channel<Task>()
```

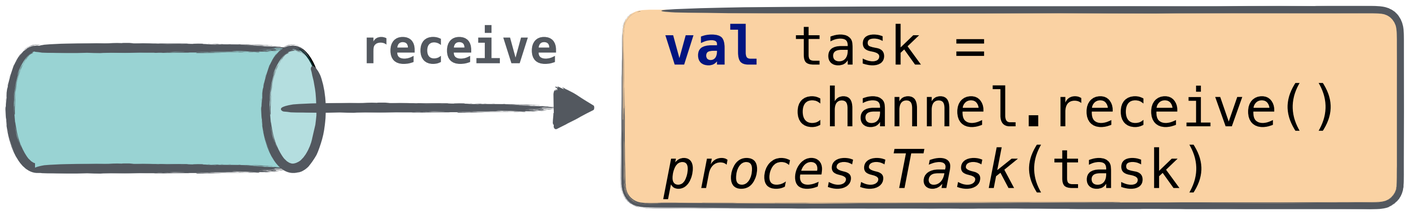
Producer-consumer solution

```
val channel = Channel<Task>()
```

```
val task =
    channel.receive()
processTask(task)
```

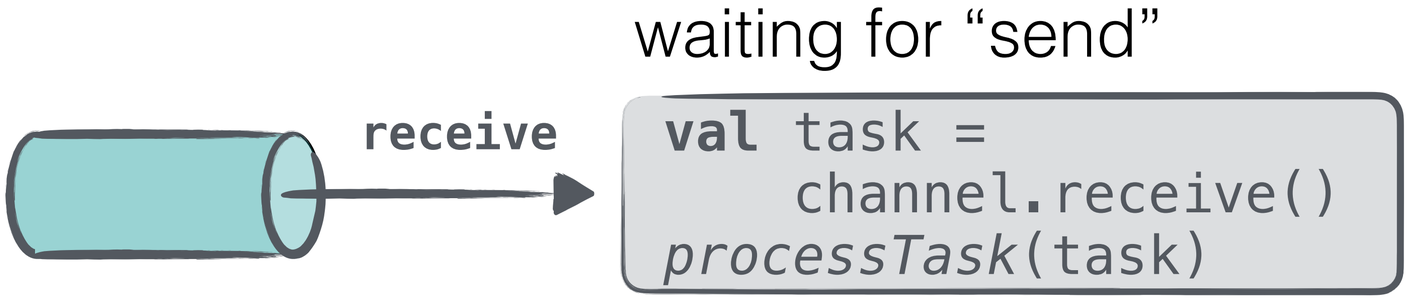
Producer-consumer solution

```
val channel = Channel<Task>()
```



Producer-consumer solution

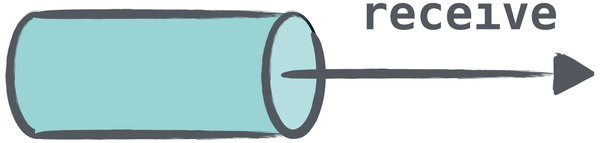
```
val channel = Channel<Task>()
```



Producer-consumer solution

```
val channel = Channel<Task>()
```

```
channel.send(task1)
channel.send(task2)
channel.close()
```

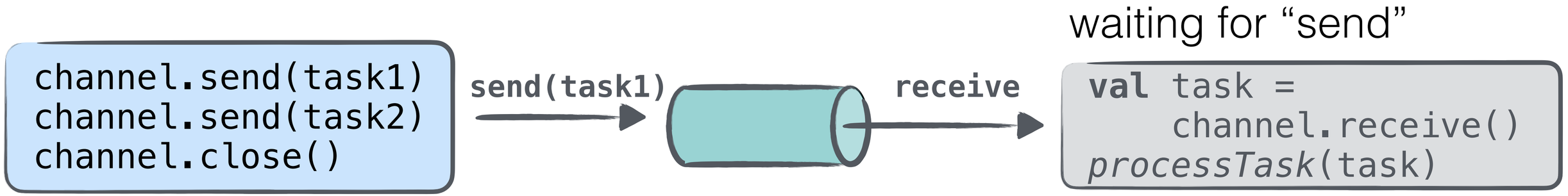


waiting for “send”

```
val task =
    channel.receive()
processTask(task)
```

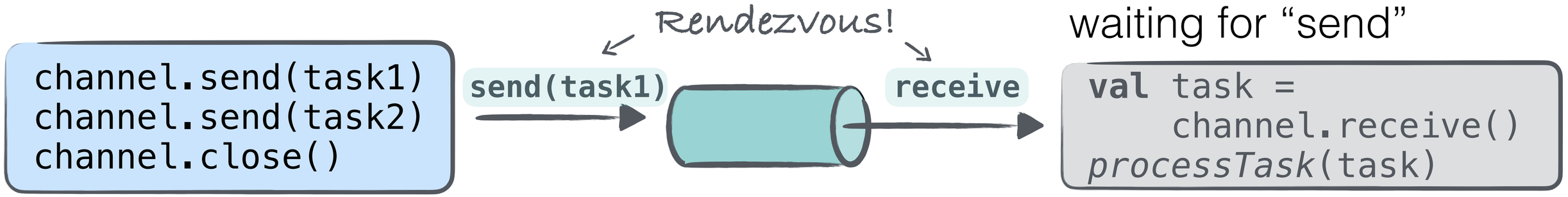
Producer-consumer solution

```
val channel = Channel<Task>()
```



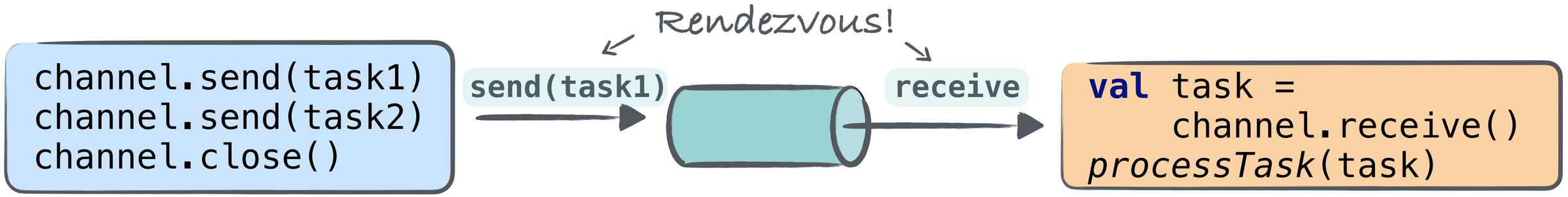
Producer-consumer solution

```
val channel = Channel<Task>()
```



Producer-consumer solution

```
val channel = Channel<Task>()
```



Producer-consumer solution

```
val channel = Channel<Task>()
```

```
channel.send(task1)
channel.send(task2)
channel.close()
```

processing task1

```
val task =
    channel.receive()
processTask(task)
```

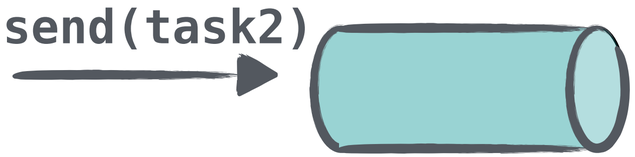
Producer-consumer solution

```
val channel = Channel<Task>()
```

processing task1

```
val task =
    channel.receive()
processTask(task)
```

```
channel.send(task1)
channel.send(task2)
channel.close()
```

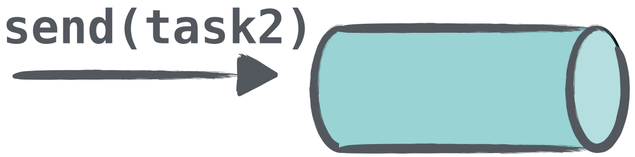


Producer-consumer solution

```
val channel = Channel<Task>()
```

waiting for “receive”

```
channel.send(task1)
channel.send(task2)
channel.close()
```

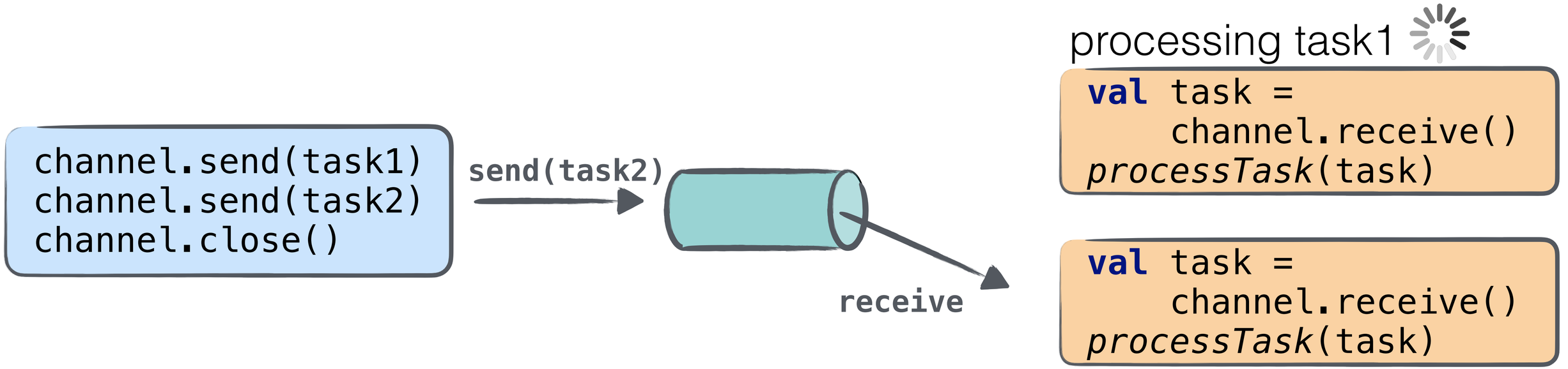


processing task1

```
val task =
    channel.receive()
processTask(task)
```

Producer-consumer solution

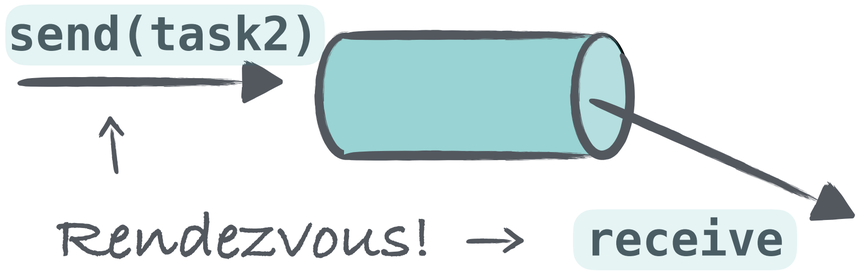
```
val channel = Channel<Task>()
```



Producer-consumer solution

```
val channel = Channel<Task>()
```

```
channel.send(task1)
channel.send(task2)
channel.close()
```



processing task1

```
val task =
    channel.receive()
processTask(task)
```

```
val task =
    channel.receive()
processTask(task)
```

Producer-consumer solution

```
val channel = Channel<Task>()
```

```
channel.send(task1)
channel.send(task2)
channel.close()
```

processing task1

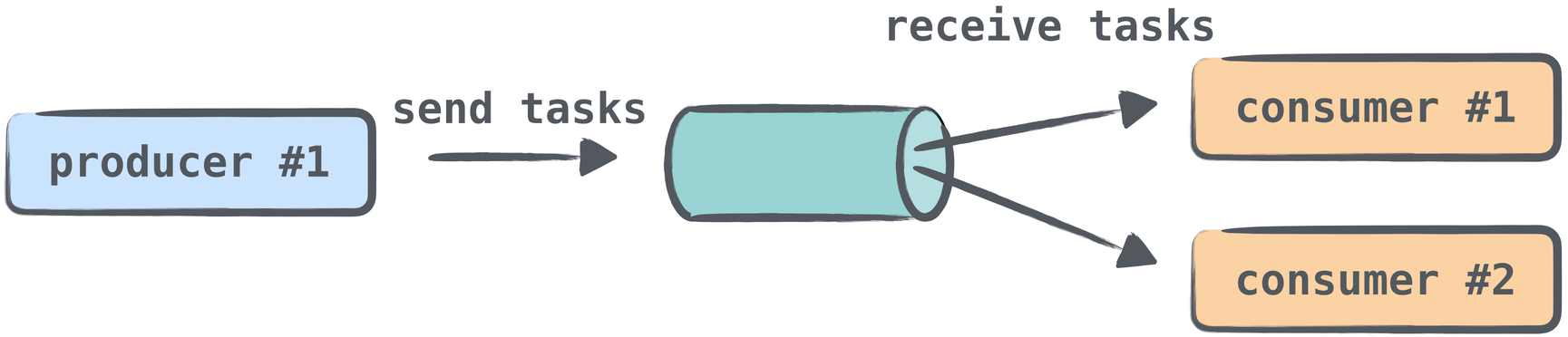
```
val task =
    channel.receive()
processTask(task)
```

processing task2

```
val task =
    channel.receive()
processTask(task)
```

Producer-consumer solution: many tasks

```
val channel = Channel<Task>()
```



Producer-consumer solution: many tasks

```
val channel = Channel<Task>()
async {
    for (i in 1..N) {
        channel.send(Task("task$i"))
    }
    channel.close()
}
```

producer

Producer-consumer solution: many tasks

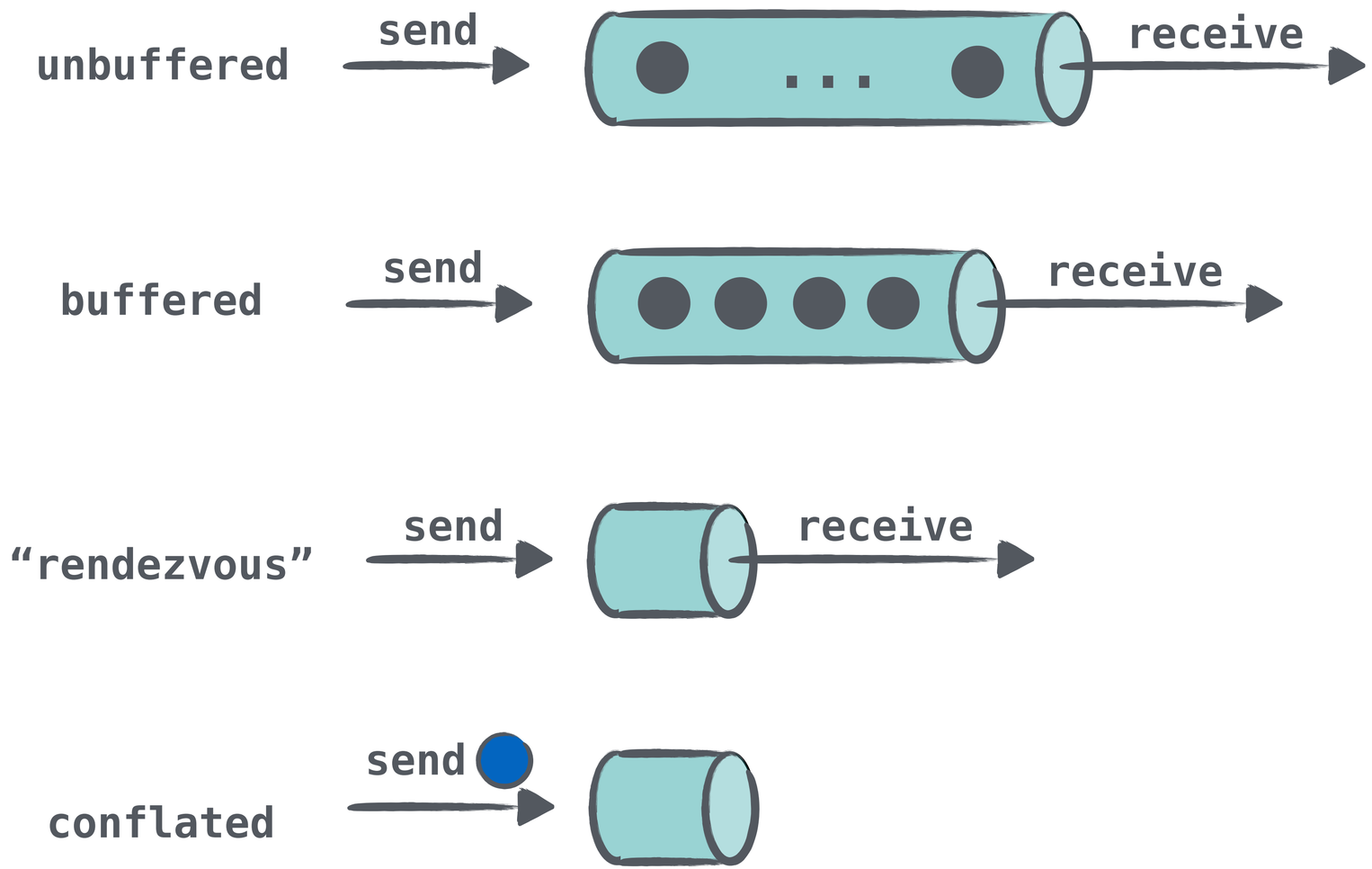
```
val channel = Channel<Task>()
...
async { worker(channel) }          consumer #1

async { worker(channel) }          consumer #2
```

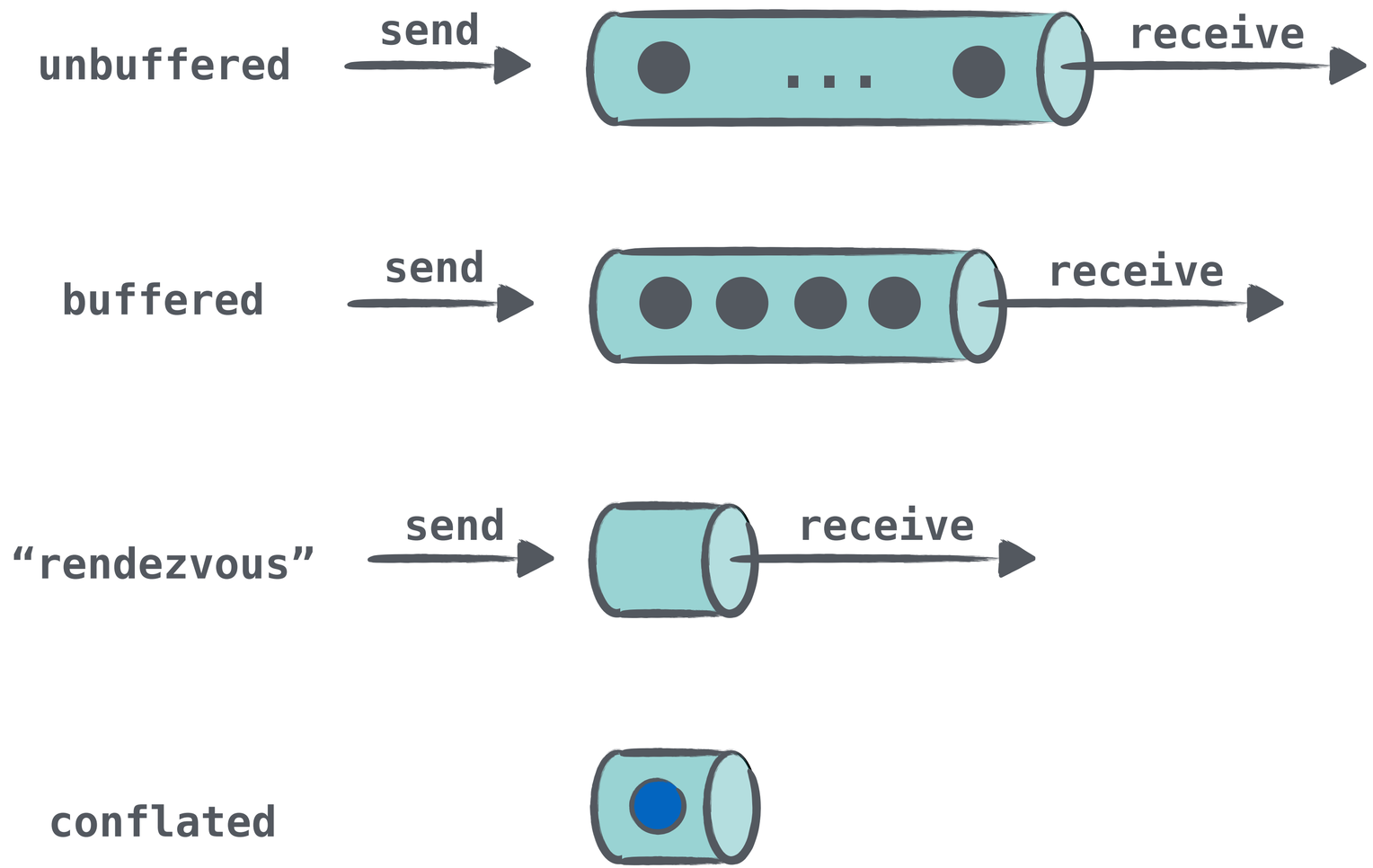
```
suspend fun worker(channel: Channel<Task>) {
    for (task in channel) {
        processTask(task)
    }
}
```

calls `receive` while iterating

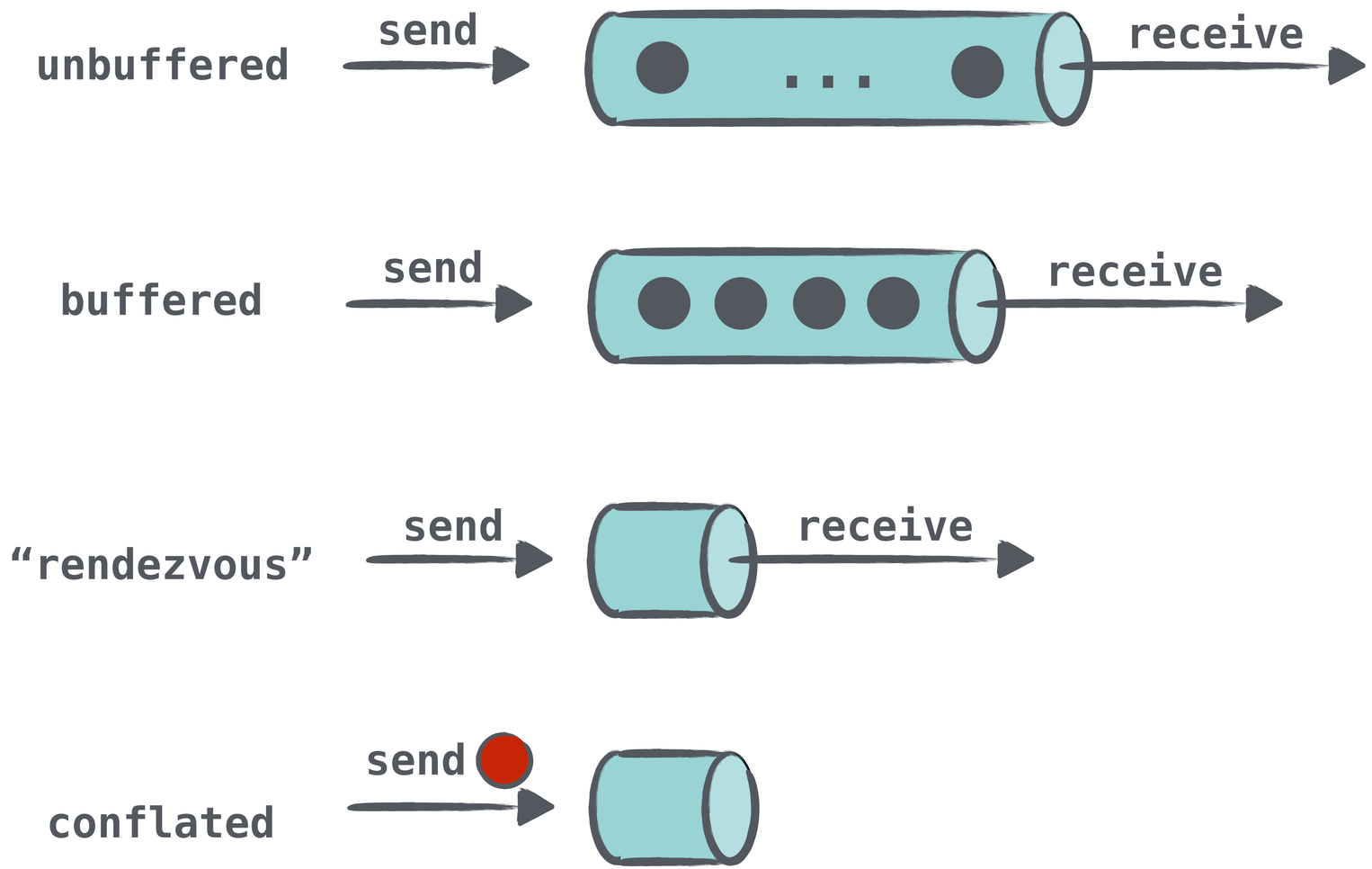
Types of Channels



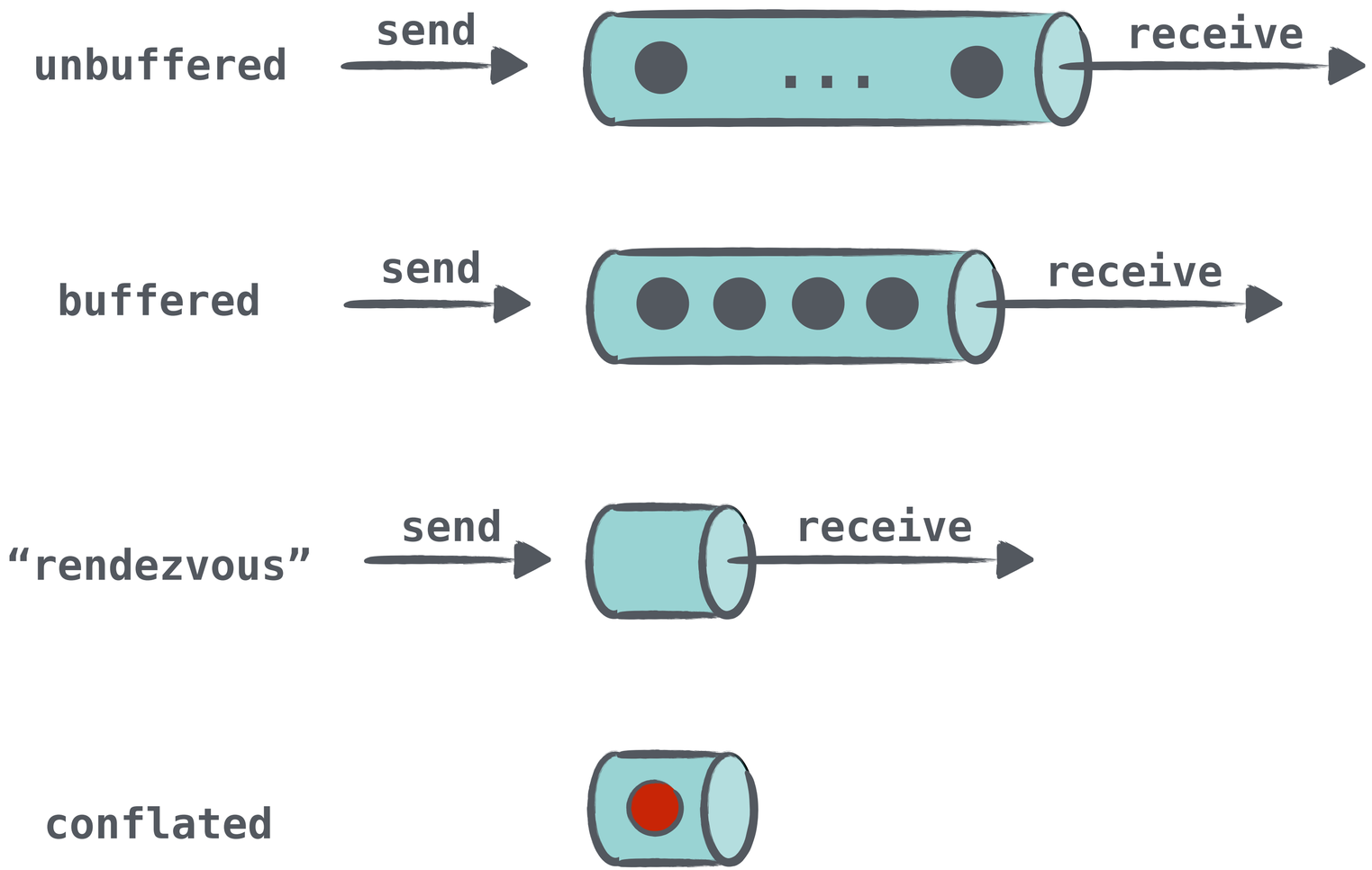
Types of Channels



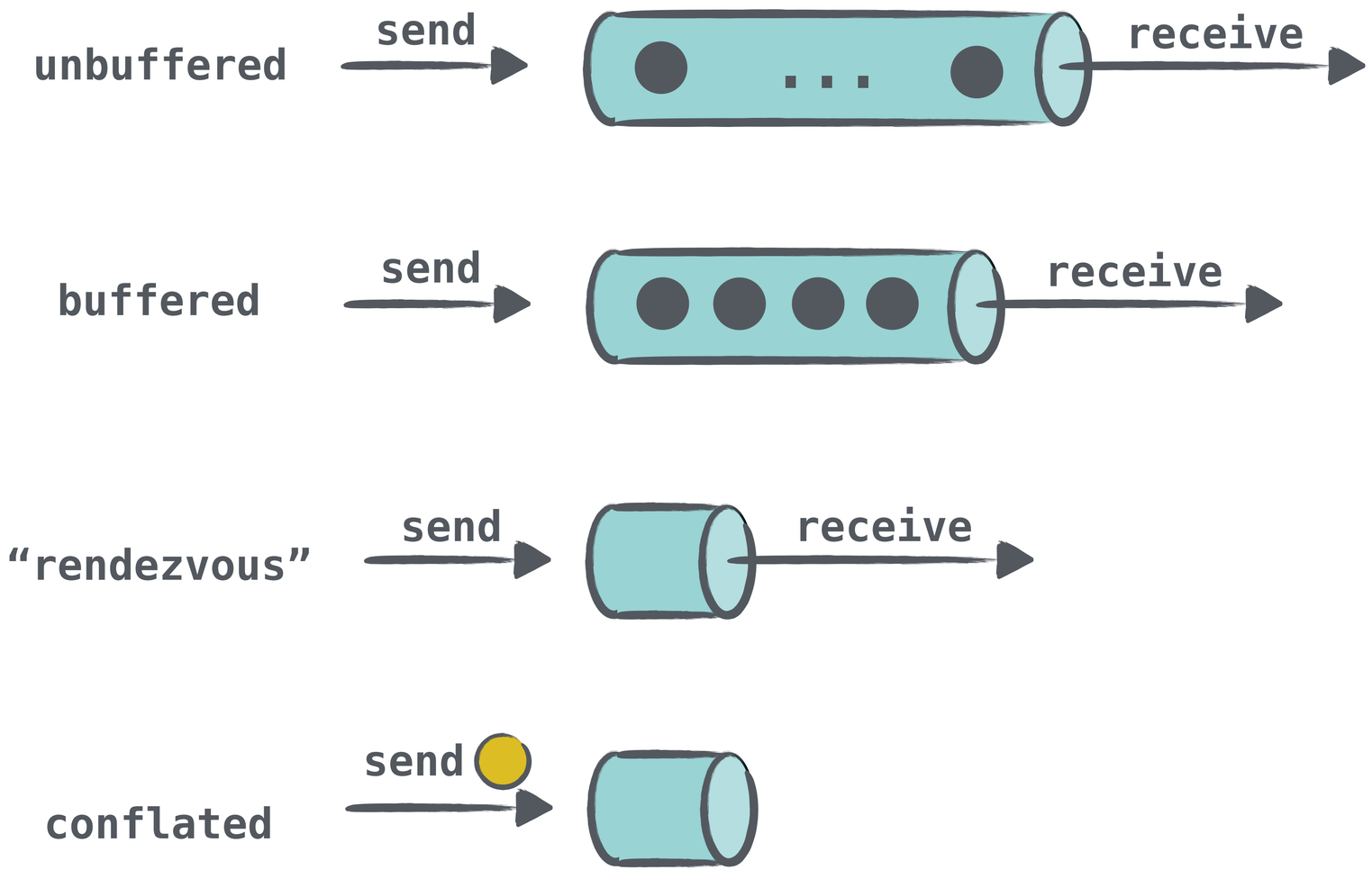
Types of Channels



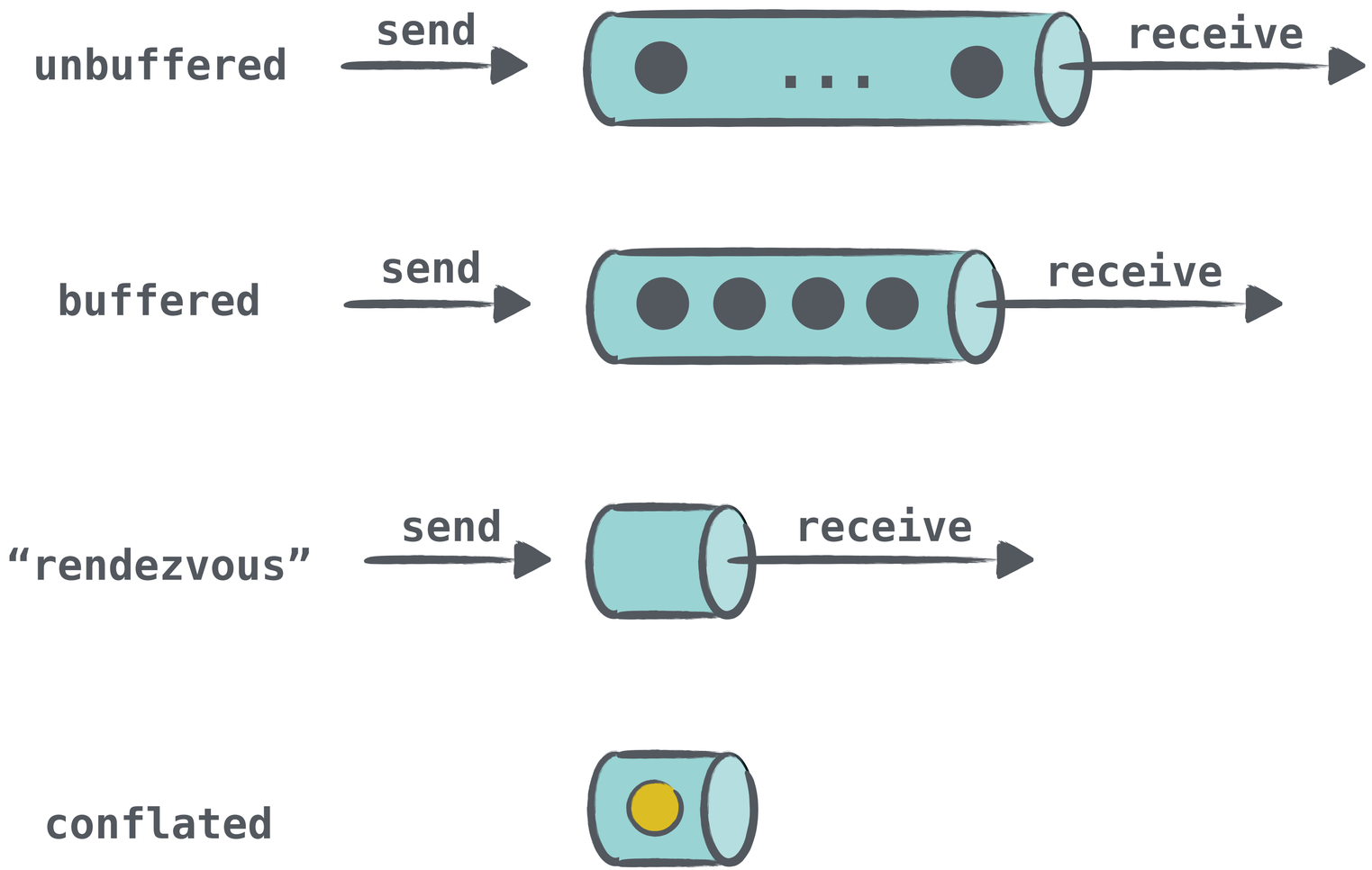
Types of Channels



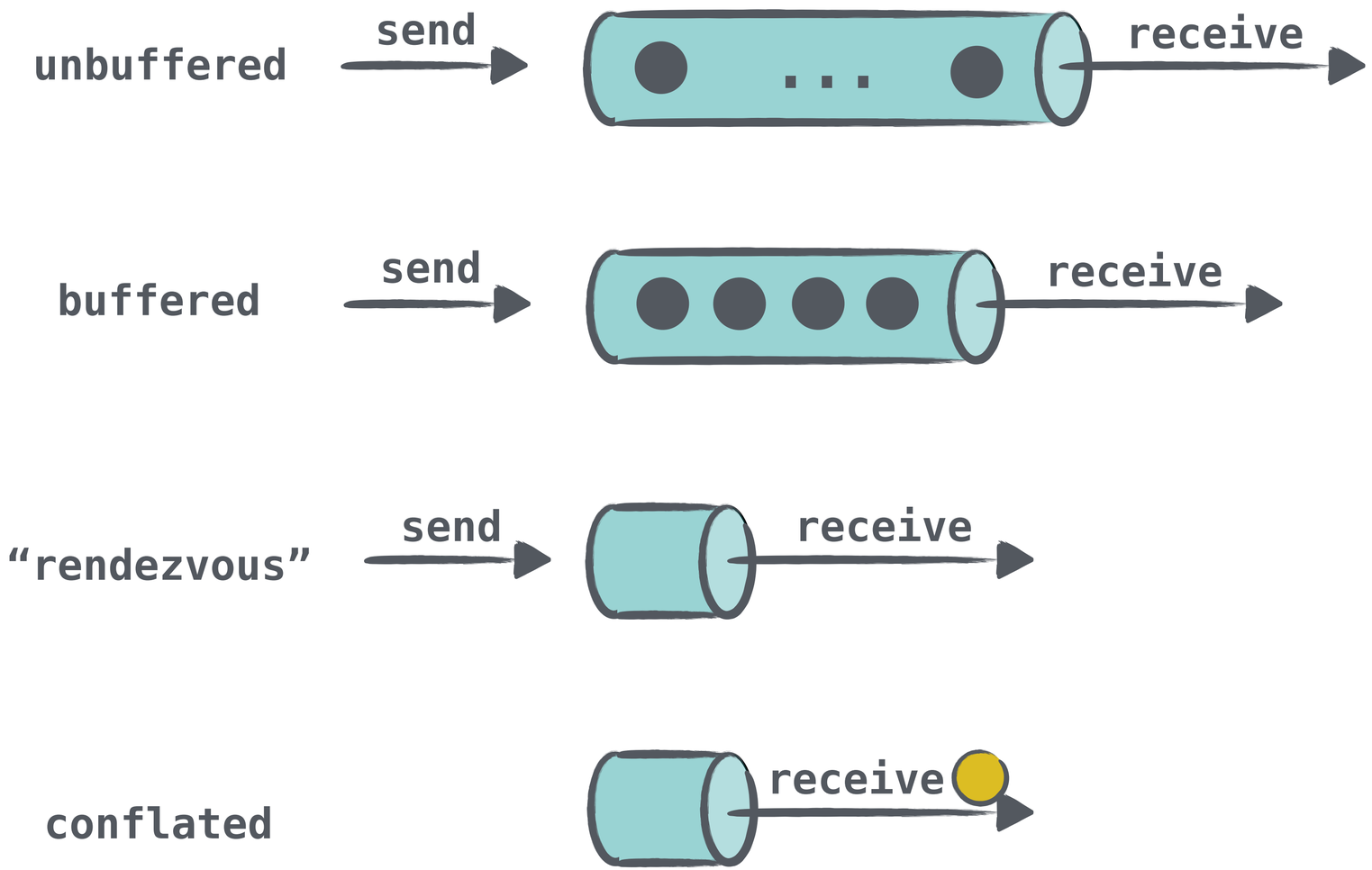
Types of Channels



Types of Channels



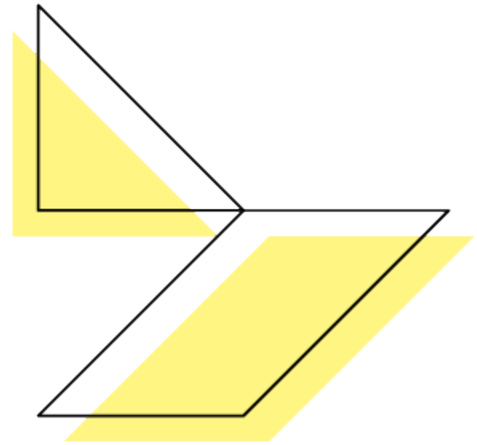
Types of Channels

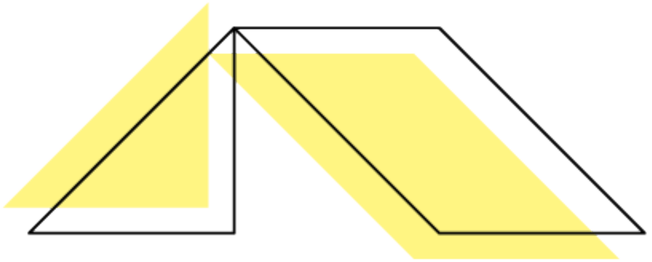


Channels: summary

- used for communication between different coroutines
- stable part of the `kotlinx.coroutines` library

Flows





Flow

- `suspend`-based reactive stream

```
flow { emit(value) }
    .map { transform(it) }
    .filter { condition(it) }
    .catch { exception → log(exception) }
    .collect { process(it) }
```

Integration with RxJava

Use extension functions:

- `flow.asPublisher()`
- `publisher.asFlow()`

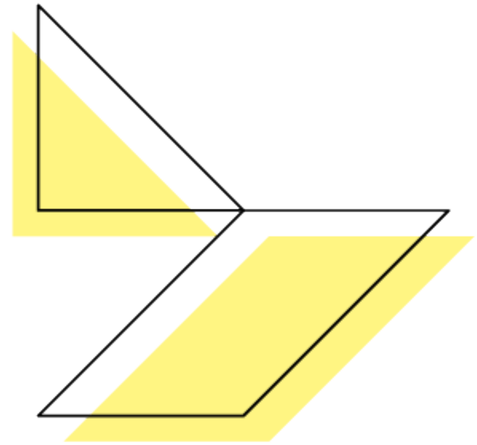
Backpressure

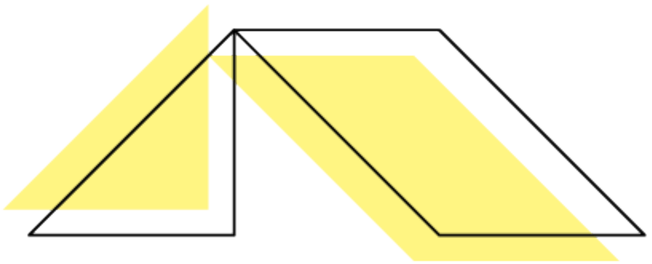
- Backpressure happens automatically thanks to suspension mechanism

Flows: summary

- bring reactive streams to coroutines library
- currently in an experimental state
- will get stable soon

Multi-platform Projects





`expect` / `actual` in standard library

Before:

```
fun Char.isUpperCase(): Boolean =
    java.lang.Character.isUpperCase(this)
```

`expect` / `actual` in standard library

Before:

```
fun Char.isUpperCase(): Boolean =
    java.lang.Character.isUpperCase(this)
```

Now:

```
expect fun Char.isUpperCase(): Boolean

public actual fun Char.isUpperCase(): Boolean =
    java.lang.Character.isUpperCase(this)
```

`expect` / `actual` in standard library

Before:

```
fun Char.isUpperCase(): Boolean =
    java.lang.Character.isUpperCase(this)
```

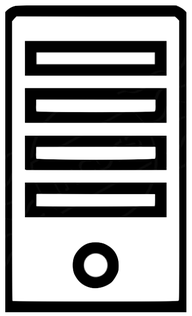
Now:

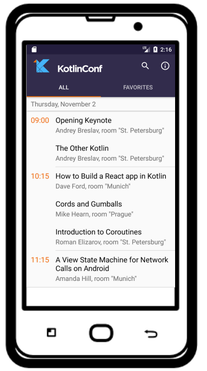
```
expect fun Char.isUpperCase(): Boolean

public actual fun Char.isUpperCase(): Boolean =
    java.lang.Character.isUpperCase(this)
```

Multi-platform projects

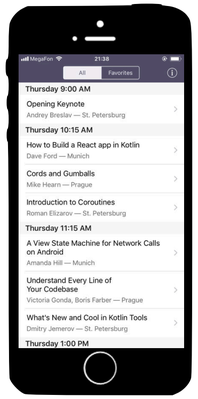
Server
Kotlin/JVM





Android
Kotlin/JVM

common
code



iOS
Kotlin/Native

Browser
Kotlin/JS

Sharing common code

- Sharing business logic
- Keeping UI platform-dependent
- The shared part might vary

Common code

- you define `expect` declarations in the common code and use them
- you provide different `actual` implementations for different platforms

Time measurement example

Expected platform-specific API:

```
expect fun measureTime(action: () → Unit): Duration
```

Expected API can be used in the common code:

```
measureTime {
    // operation
}
```

Platform-specific Implementations

```
expect fun measureTime(action: () → Unit): Duration
```

Kotlin/JVM

```
actual fun measureTime(action: () → Unit): Duration {
    // implementation using System.nanoTime()
}
```

Kotlin/Native

```
actual fun measureTime(action: () → Unit): Duration {
    // implementation using std::chrono::high_resolution_clock
}
```

Kotlin/JS

```
actual fun measureTime(action: () → Unit): Duration {
    // implementation using window.performance.now()
}
```

Common code

- can use the standard library
- can define `expect` declarations and use them
- can use other multi-platform libraries

Multi-platform libraries

- Standard library
- Ktor HTTP client
- kotlinx.serialization
- kotlinx.coroutines
- … and more

Many apps **already** in production

KOTLINCONF
COPENHAGEN 4—6 DEC

ANA REDMOND

Founder & CTO, infinut, http://infinut.com

Going Native: How I used Kotlin Native to Port 6 years of Android Game Code to iOS in 6 months

ALEC STRONG

Android on @CashApp

Shipping a Mobile Multiplatform Project on iOS & Android

AHMED EL-HELW

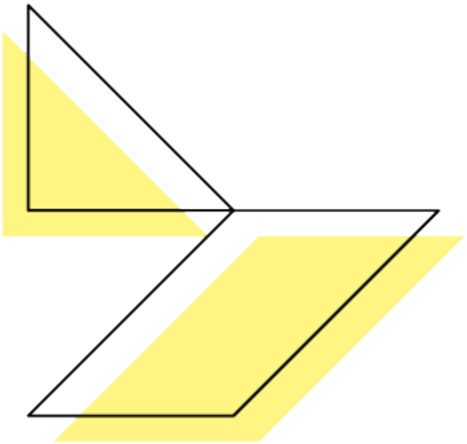
Android Lead at Careem

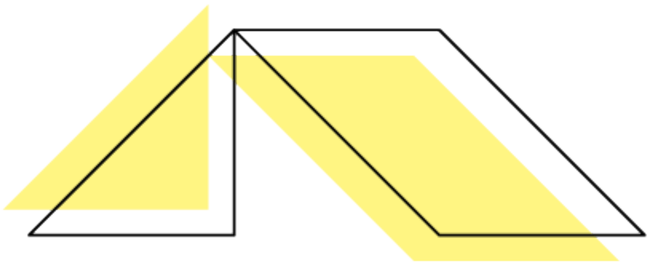
Your Multiplatform Kaptain has Arrived: iOS release is powered by Kotlin Multiplatform

Multi-platform projects: summary

- a modern approach to multi-platform development
- you can easily tune what parts you want to be shared
- you can go and try it out

More about Kotlin





Kotlin IN ACTION

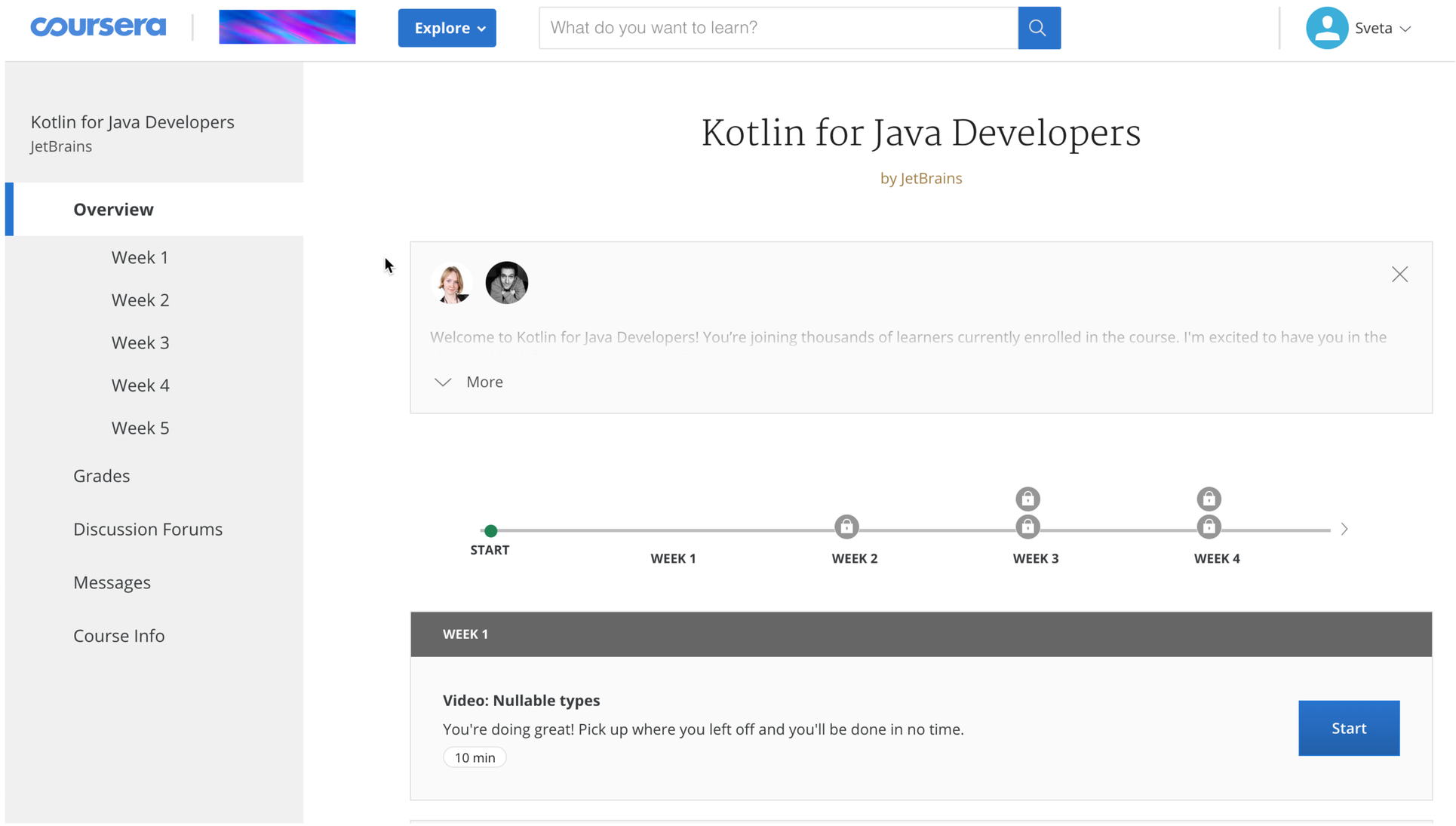
Dmitry Jemerov
Svetlana Isakova
FOREWORD BY Andrey Breslav

MANNING

ATOMIC KOTLIN

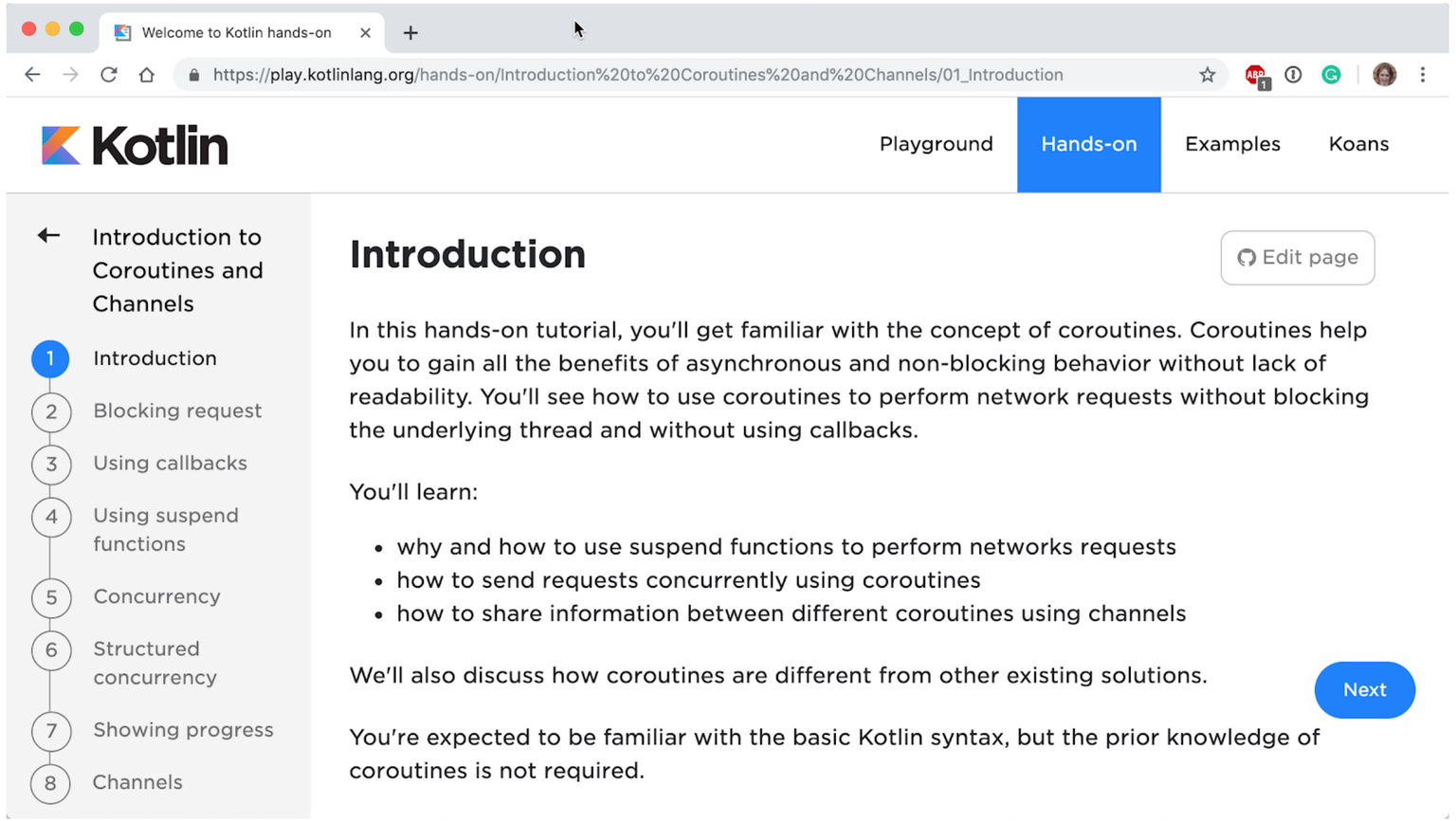
Bruce Eckel
Svetlana Isakova

Kotlin course at Coursera



Hands-on lab “Intro to coroutines & channels”

http://kotl.in/hands-on



Have a nice Kotlin!