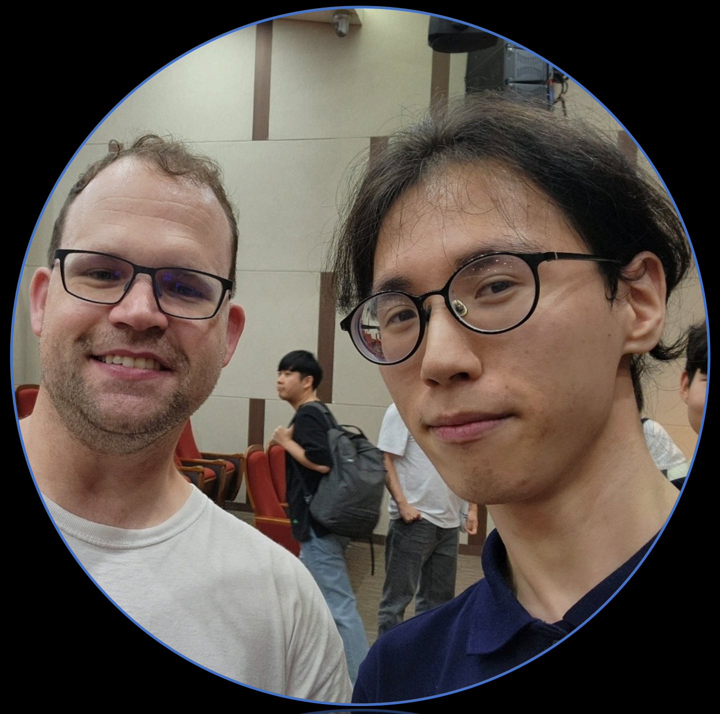
Kotlin User Groups Seoul

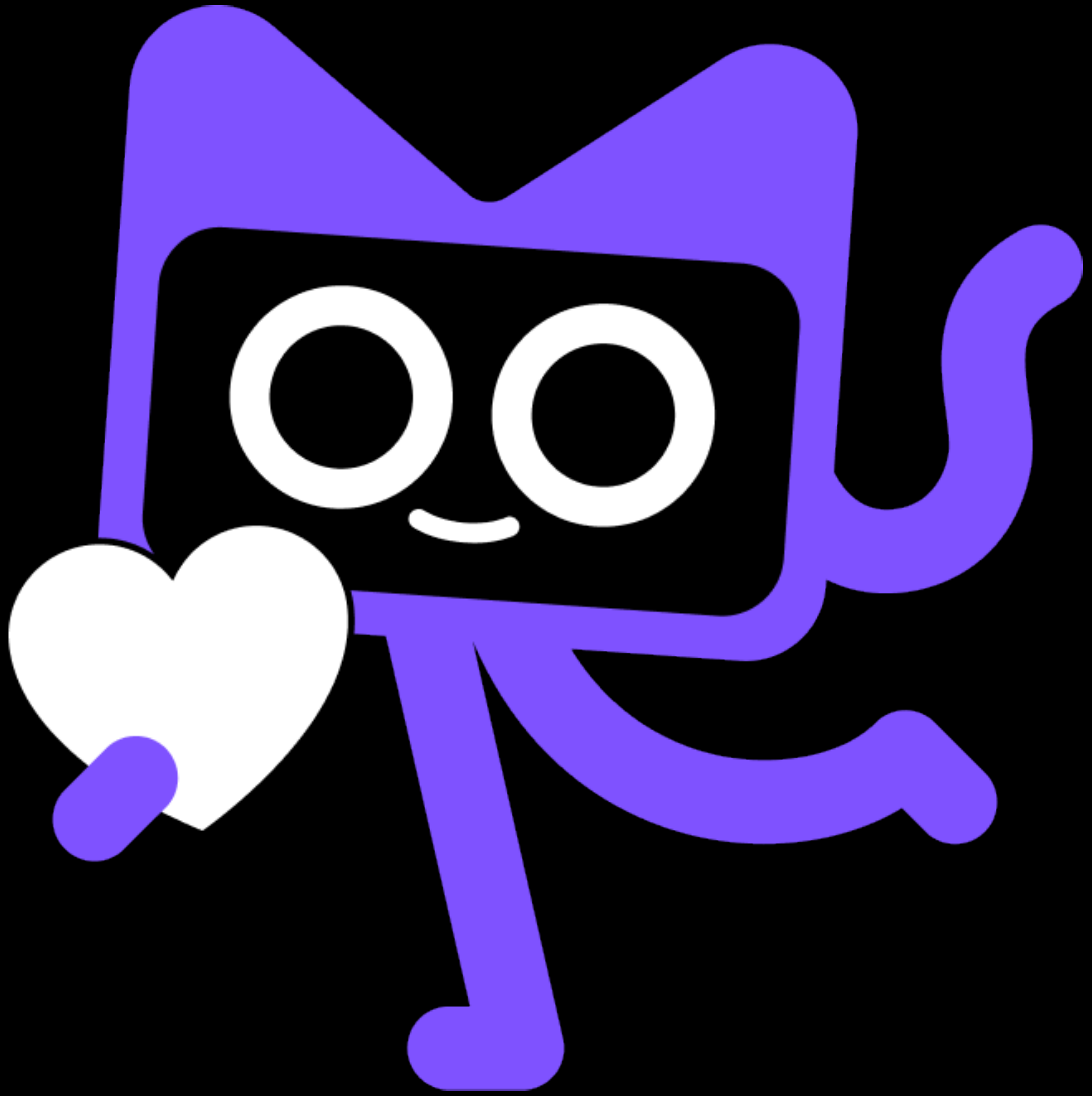
Kotlin Backend Meetup

Coroutine

코루틴 컴파일 과정 파헤치기



김찬우



섹션

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3. State Machine
4. Coroutine Passing Style
5. Local Variables
6. Suspend Function

Coroutine

Coroutine

Kotlin 코루틴은 **비동기 프로그래밍**을 쉽게 구현할 수 있도록 도와주는 도구

Coroutine

Kotlin 코루틴은 **비동기 프로그래밍**을 쉽게 구현할 수 있도록 도와주는 도구

1. 경량 스레드
2. 직관적인 비동기 프로그래밍
3. 중단 가능한 함수

```kotlin
fun doSomething(): Unit
```

```kotlin
suspend fun doSomething(): Unit
```

Coroutine(Suspend) Lambda

```kotlin
suspend fun suspendIt(): Unit { }

suspend fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }
    lambda()
}
```

```kotlin
suspend fun suspendIt(): Unit { }

suspend fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }
    lambda()
}
```

```
1
2

Process finished with exit
code 0
```

```kotlin
suspend fun suspendIt(): Unit { }
```

```kotlin
var continuation: Continuation<Unit>? = null

suspend fun suspendIt(): Unit {
    return suspendCoroutine<Unit>{ c ->
            println(“Suspended”)
            continuation = c
        }
}
```

```kotlin
suspend fun suspendIt(): Unit {
    return suspendCoroutine<Unit>{ c ->
            println(“Suspended”)
            continuation = c
        }
}

suspend fun main() {
    val lambda: suspend () -> Unit = {
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        println(1)
        suspendIt()
        println(2)
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}
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```kotlin
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    return suspendCoroutine<Unit>{ c ->
            println("Suspended")
            continuation = c
        }
}

suspend fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }
    lambda()
}
```
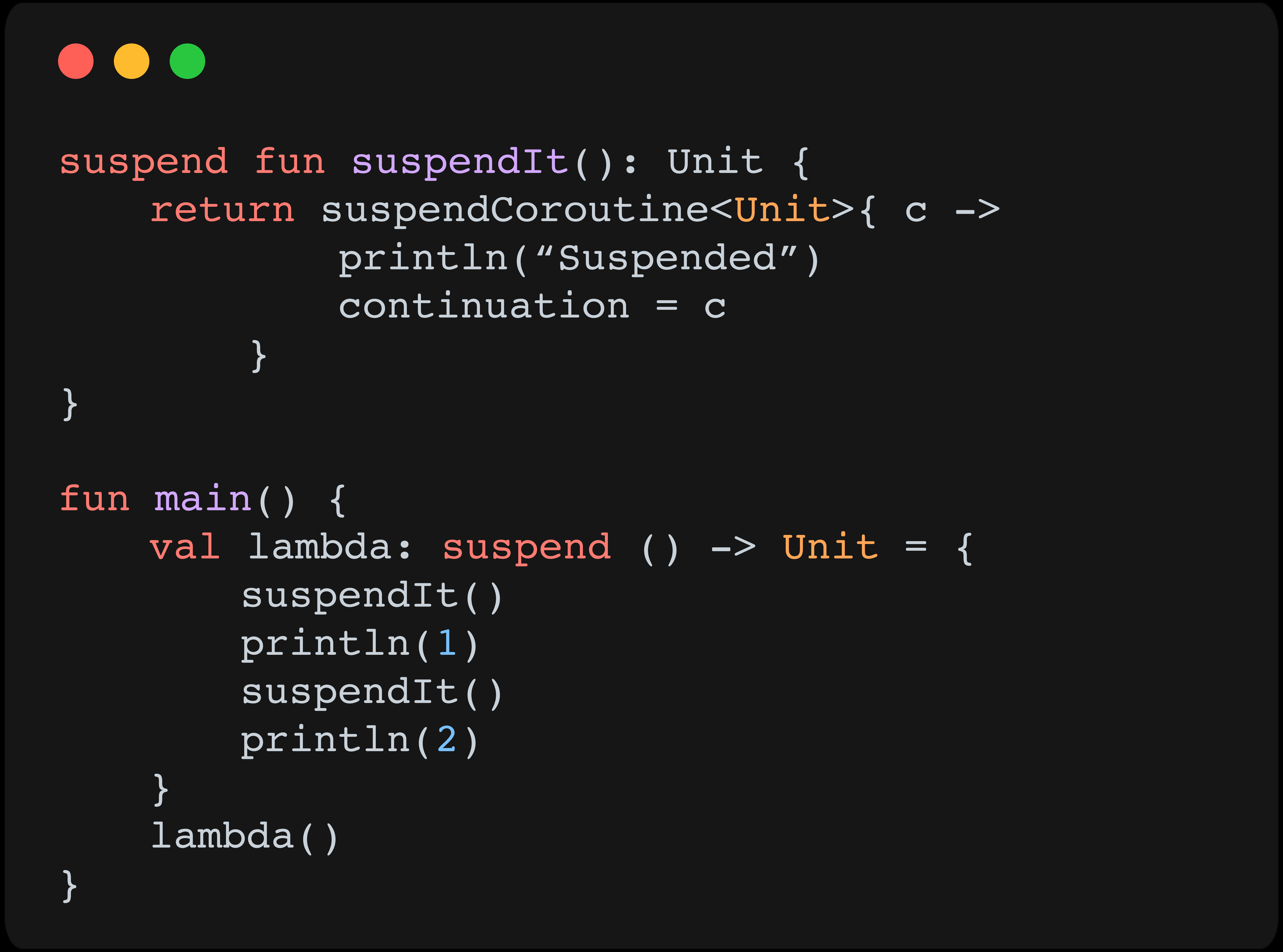
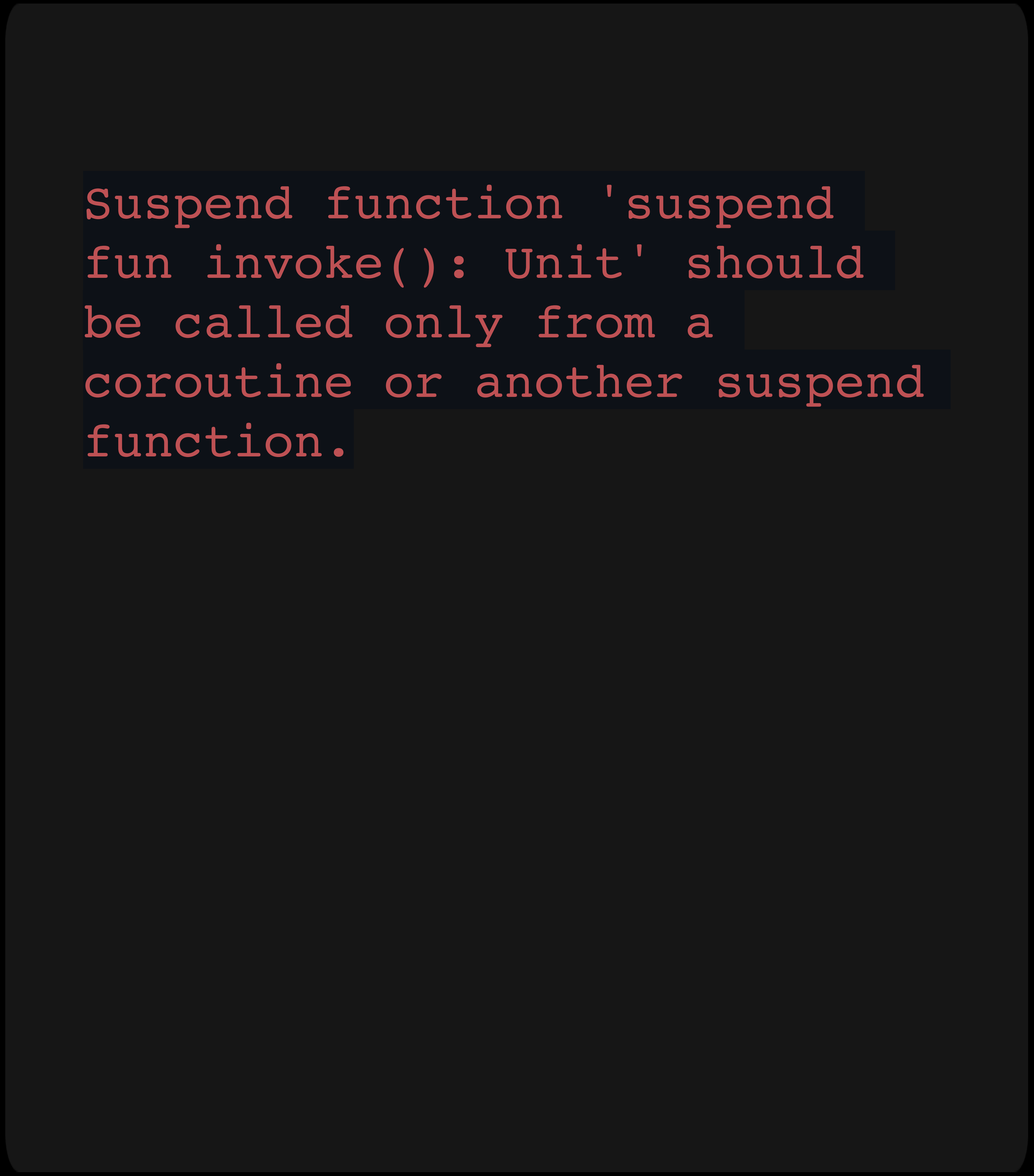

```
Suspended
```

```kotlin
suspend fun suspendIt(): Unit {
    return suspendCoroutine<Unit>{ c ->
            println(“Suspended”)
            continuation = c
        }
}

fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }
    lambda()
}
```



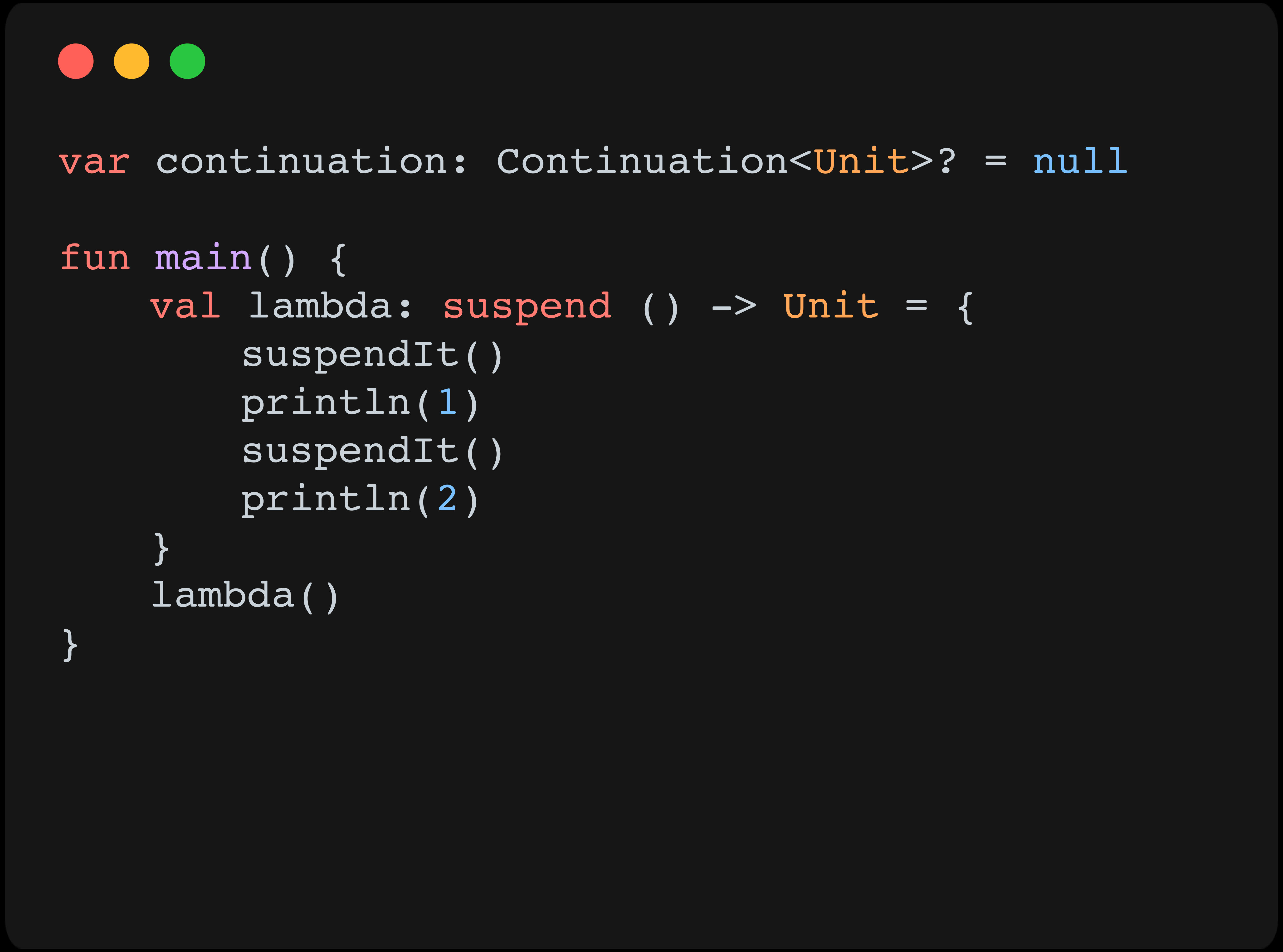
```kotlin
suspend fun suspendIt(): Unit {
    return suspendCoroutine<Unit>{ c ->
            println("Suspended")
            continuation = c
        }
}

fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }
    lambda()
}
```



```
Suspend function 'suspend
fun invoke(): Unit' should
be called only from a
coroutine or another suspend
function.
```

Kotlin User Groups Seoul

```kotlin
val cont = object : Continuation<Unit> {
    override val context = EmptyCoroutineContext
    override fun resumeWith(result: Result<Unit>) {
        result.getOrThrow()
    }
}

fun runBlocking(func: suspend () -> Unit) {
    func.startCoroutine(cont)
}
```



```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }
    lambda()
}
```

```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }

    runBlocking {
        lambda()
    }
}
```

```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }

    runBlocking {
        lambda()
    }
}
```

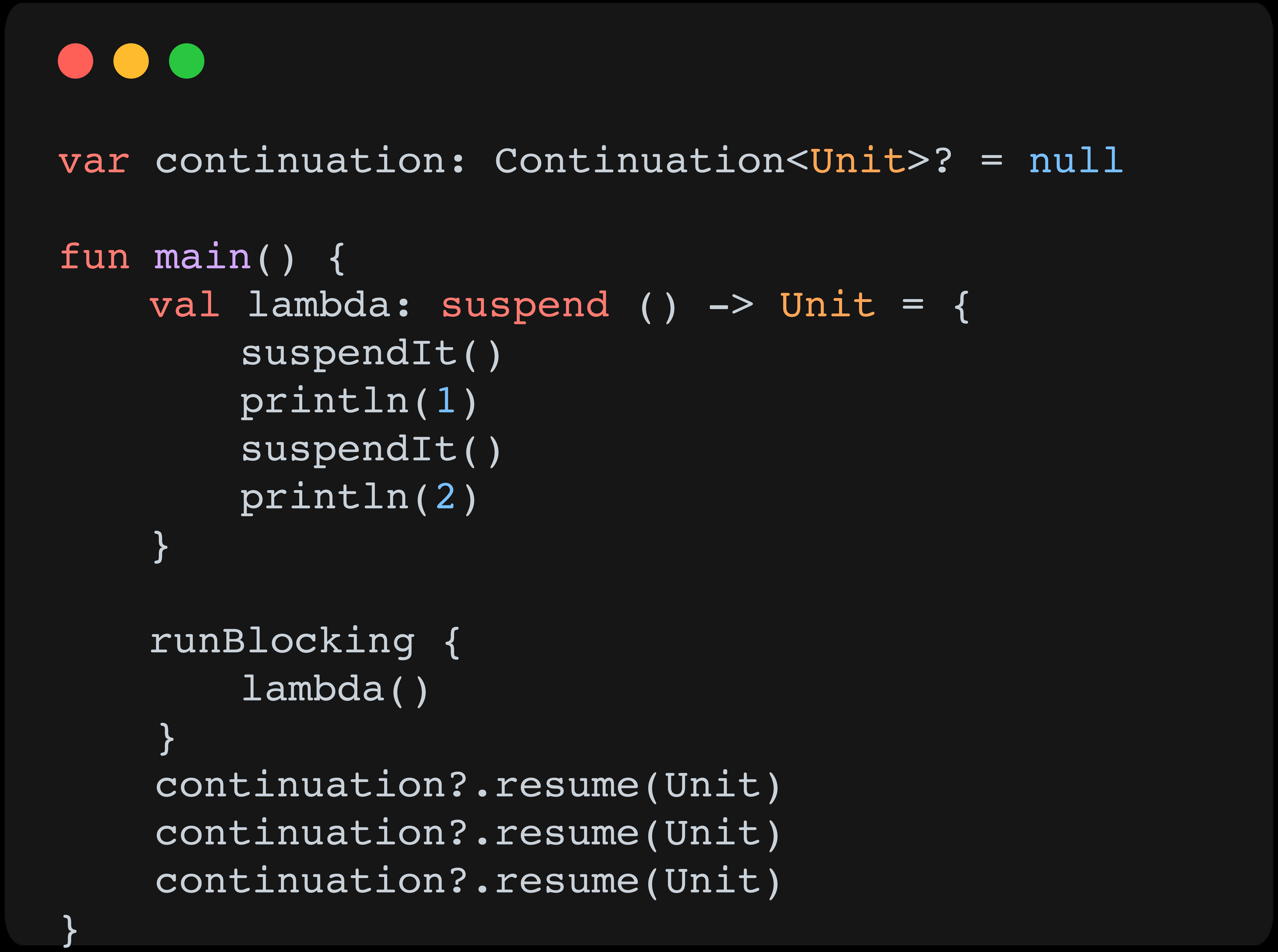
```
Suspended

Process finished with exit
code 0
```

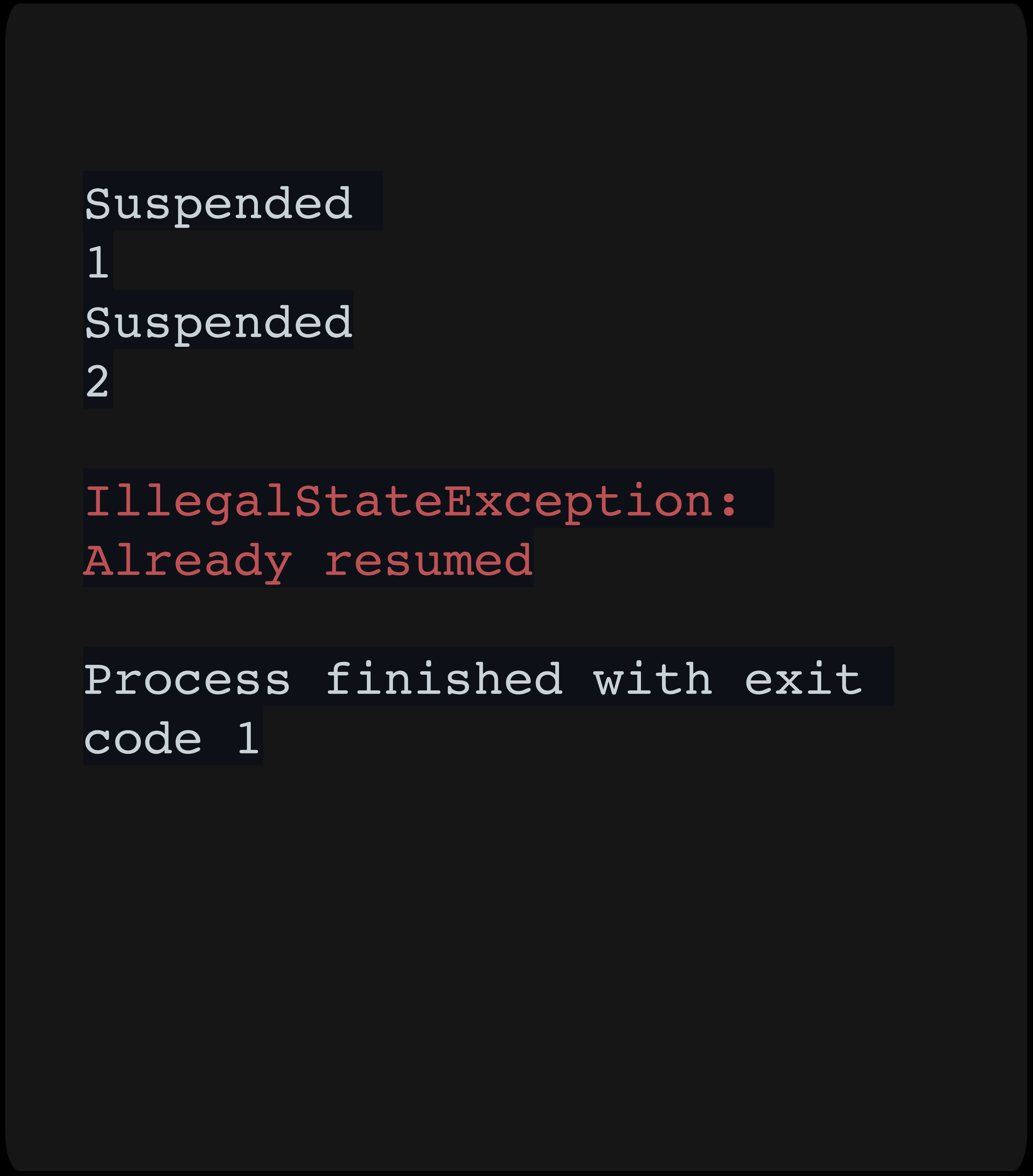
```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }

    runBlocking {
        lambda()
    }
    continuation?.resume(Unit)
}
```

```
Suspended
1
Suspended

Process finished with exit
code 0
```

```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }

    runBlocking {
        lambda()
    }
    continuation?.resume(Unit)
    continuation?.resume(Unit)
}
```

```
Suspended
1
Suspended
2

Process finished with exit
code 0
```


```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }

    runBlocking {
        lambda()
    }
    continuation?.resume(Unit)
    continuation?.resume(Unit)
    continuation?.resume(Unit)
}
```

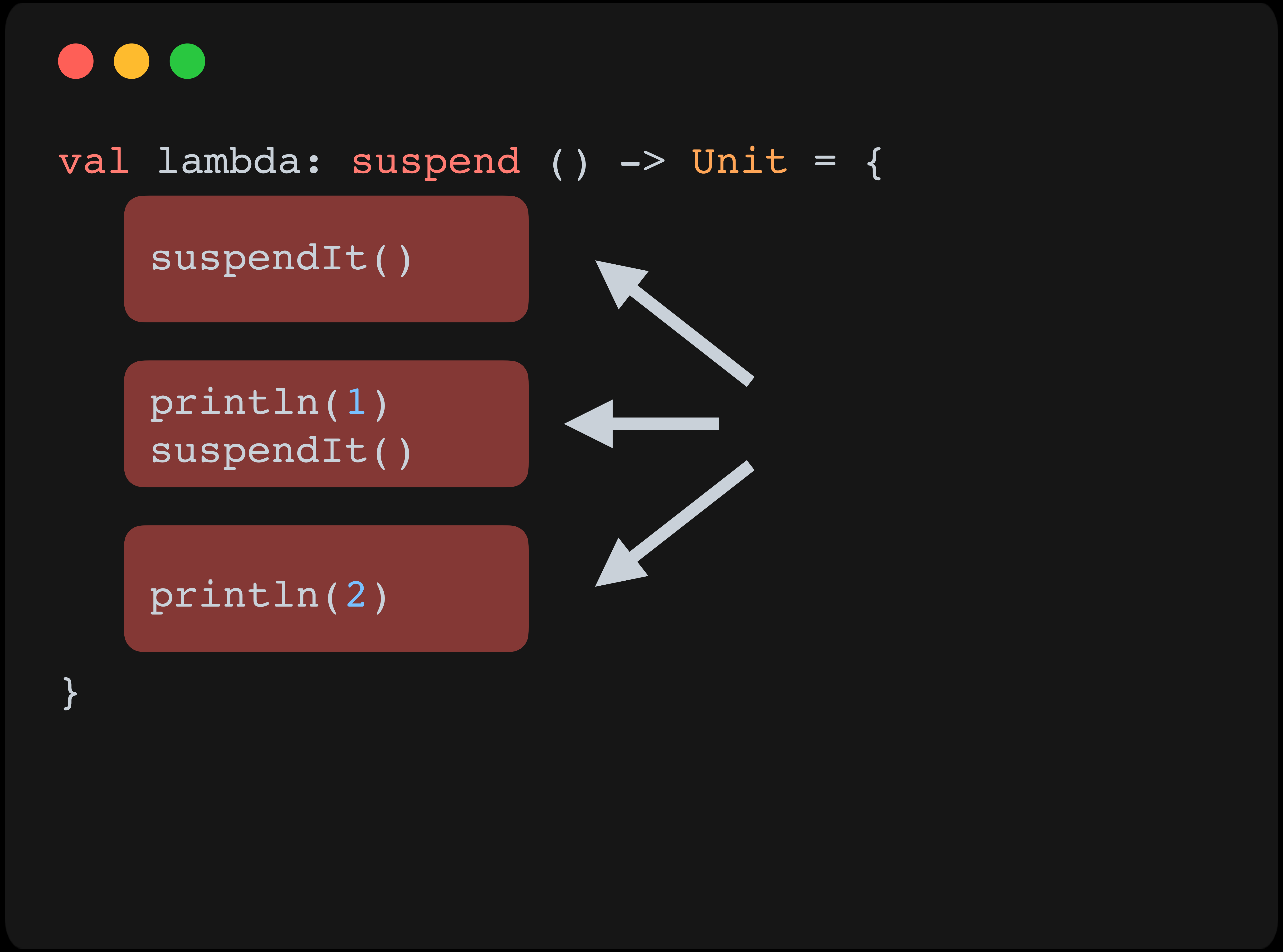

```
Suspended
1
Suspended
2

IllegalStateException:
Already resumed

Process finished with exit
code 1
```

State Machine

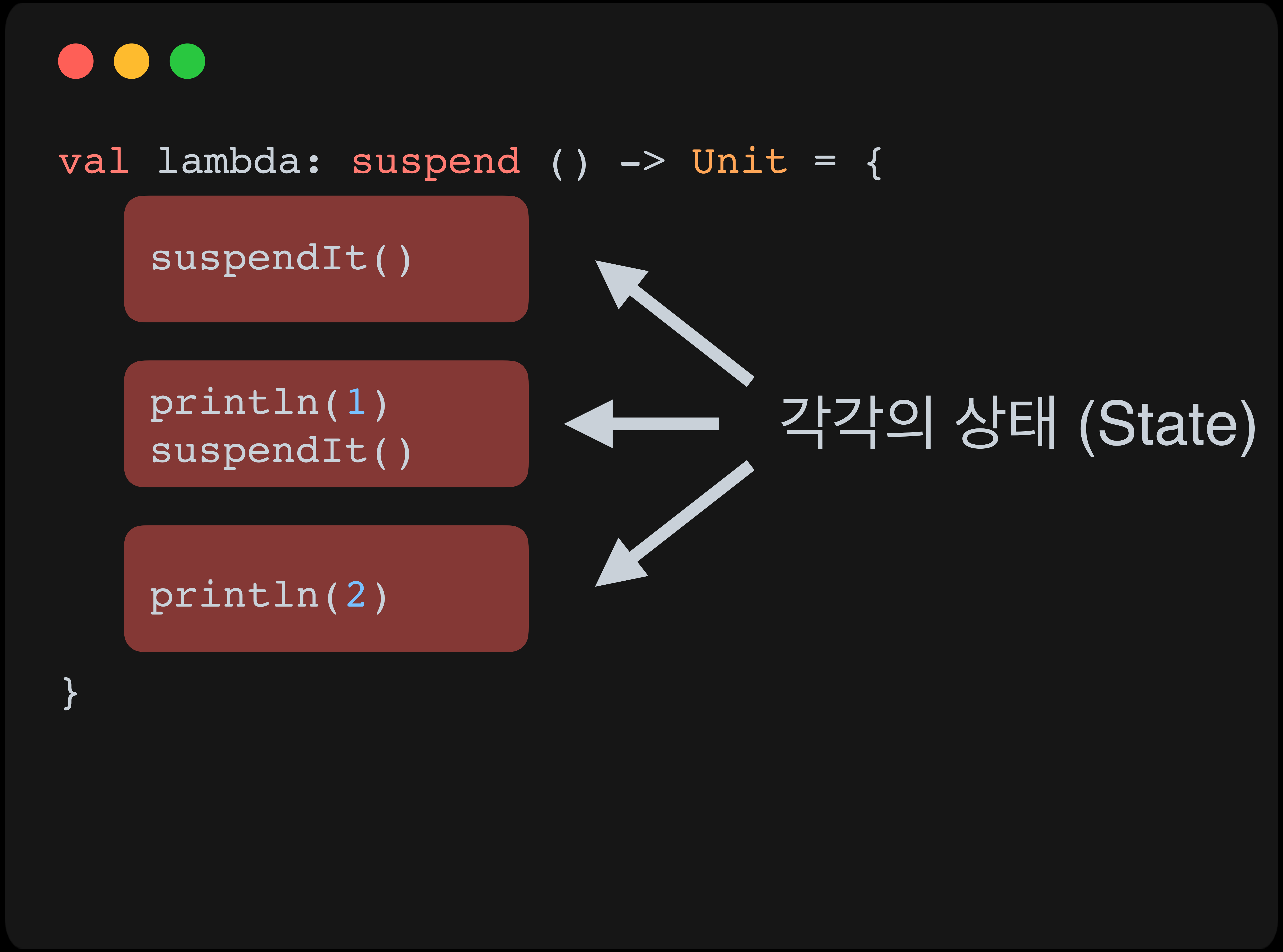
```kotlin
fun main() {
    val lambda: suspend () -> Unit = {
        suspendIt()
        println(1)
        suspendIt()
        println(2)
    }

    runBlocking {
        lambda()
    }
    continuation?.resume(Unit)
    continuation?.resume(Unit)
}
```

```kotlin
val lambda: suspend () -> Unit = {
    suspendIt()
    println(1)
    suspendIt()
    println(2)
}
```

```kotlin
val lambda: suspend () -> Unit = {
    suspendIt()

    println(1)
    suspendIt()

    println(2)
}
```



```kotlin
val lambda: suspend () -> Unit = {
    suspendIt()

    println(1)
    suspendIt()

    println(2)
}
```

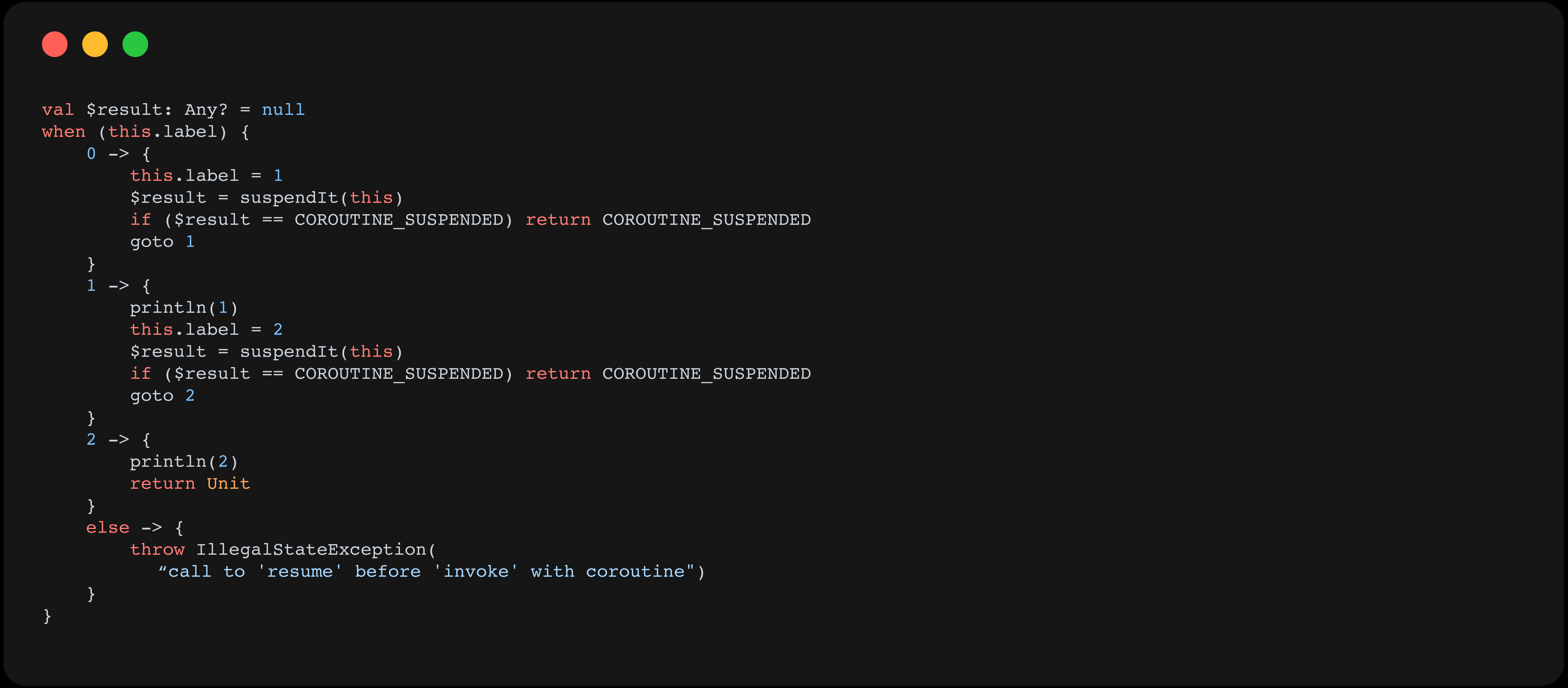


```kotlin
val lambda: suspend () -> Unit = {
    suspendIt()

    println(1)
    suspendIt()

    println(2)
}
```

```kotlin
val lambda: suspend () -> Unit = {
    suspendIt()

    println(1)
    suspendIt()

    println(2)
}
```

invokeSuspend 내부

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
    2 -> {
        println(2)
        return Unit
    }
    else -> {
        throw IllegalStateException(
           “call to 'resume' before 'invoke' with coroutine")
    }
}
```



```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
    2 -> {
        println(2)
        return Unit
    }
    else -> {
        throw IllegalStateException(
          “call to 'resume' before 'invoke' with coroutine")
    }
}
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Not Suspended
```

```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

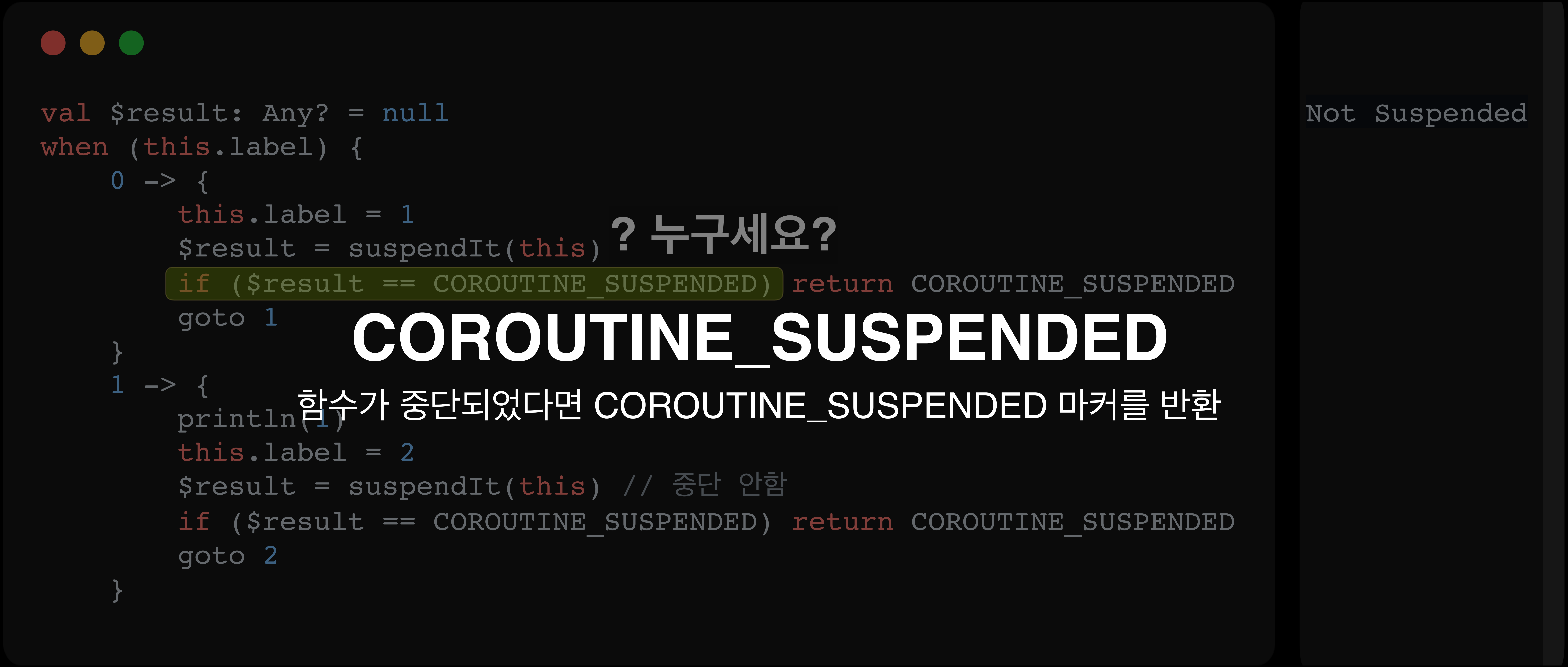
```
Not Suspended
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) ?/ 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Not Suspended
```

```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) ? 누구세요?
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Not Suspended
```



```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

Not Suspended

? 누구세요?

COROUTINE_SUSPENDED

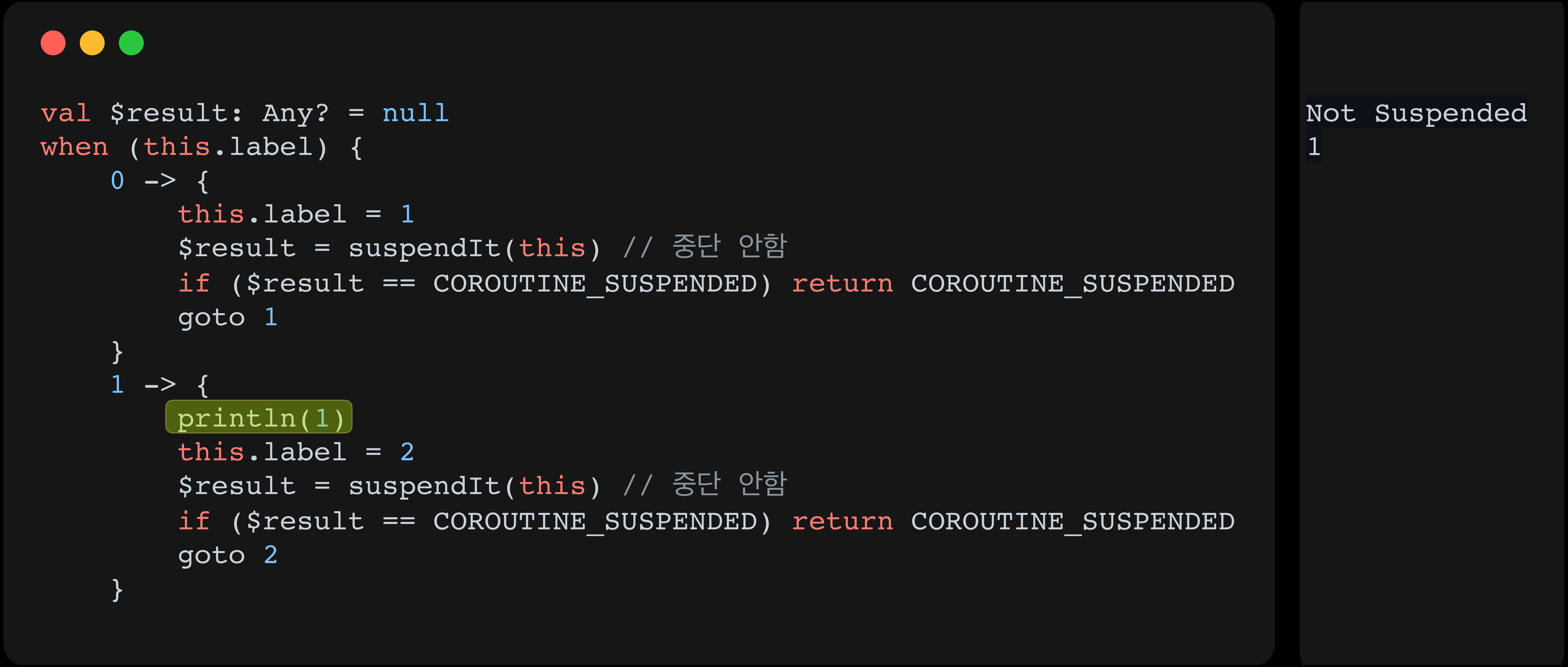
함수가 중단되었다면 COROUTINE_SUSPENDED 마커를 반환

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Not Suspended
```

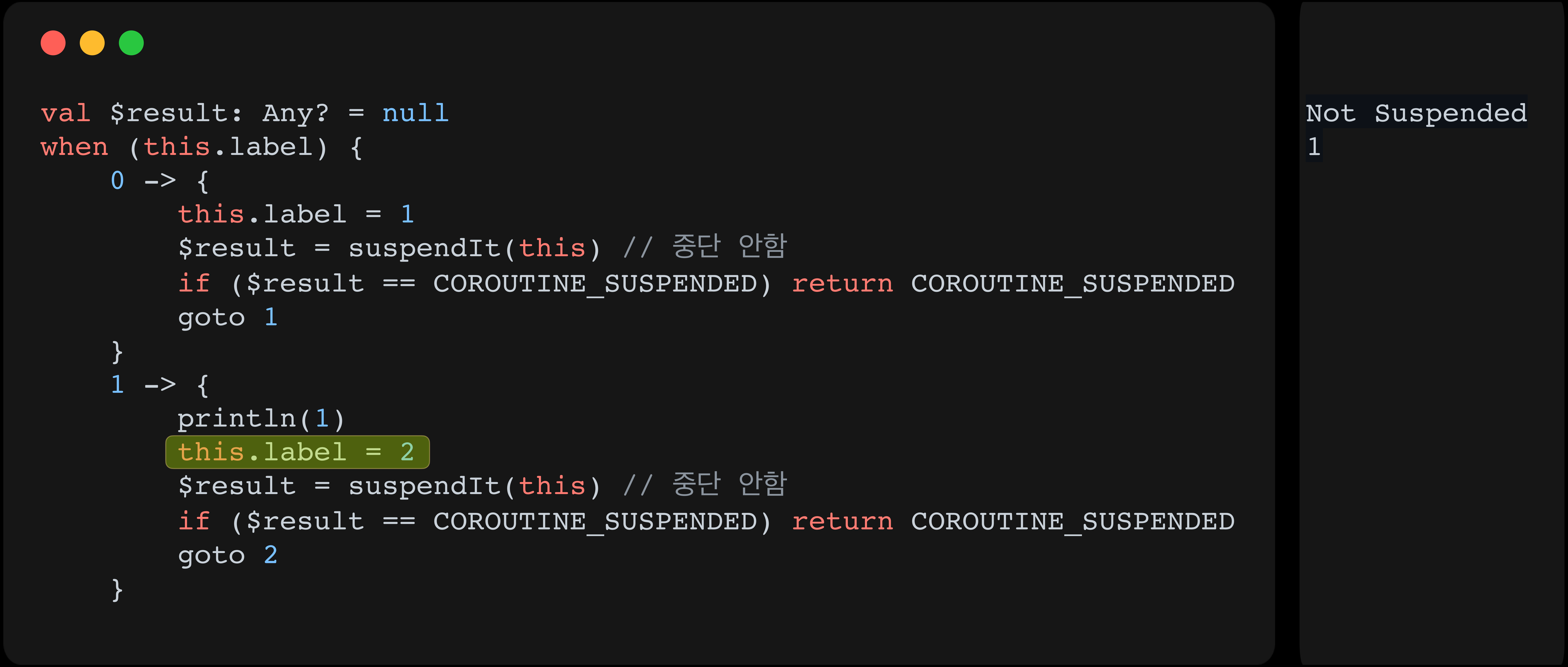
```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Not Suspended
```



```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Not Suspended
1
```

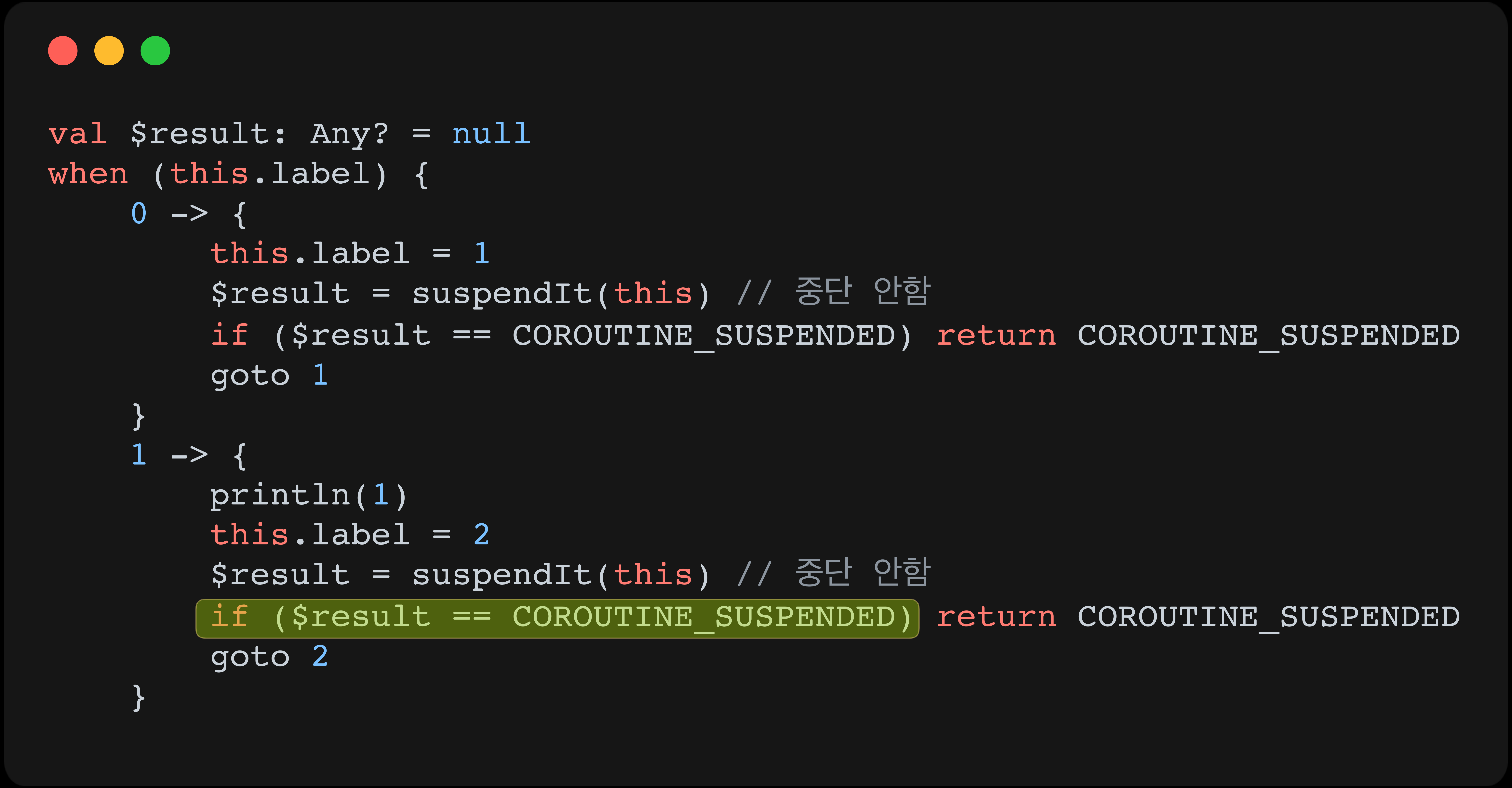


```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Not Suspended
1
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Not Suspended
1
Not Suspended
```



```
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when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```
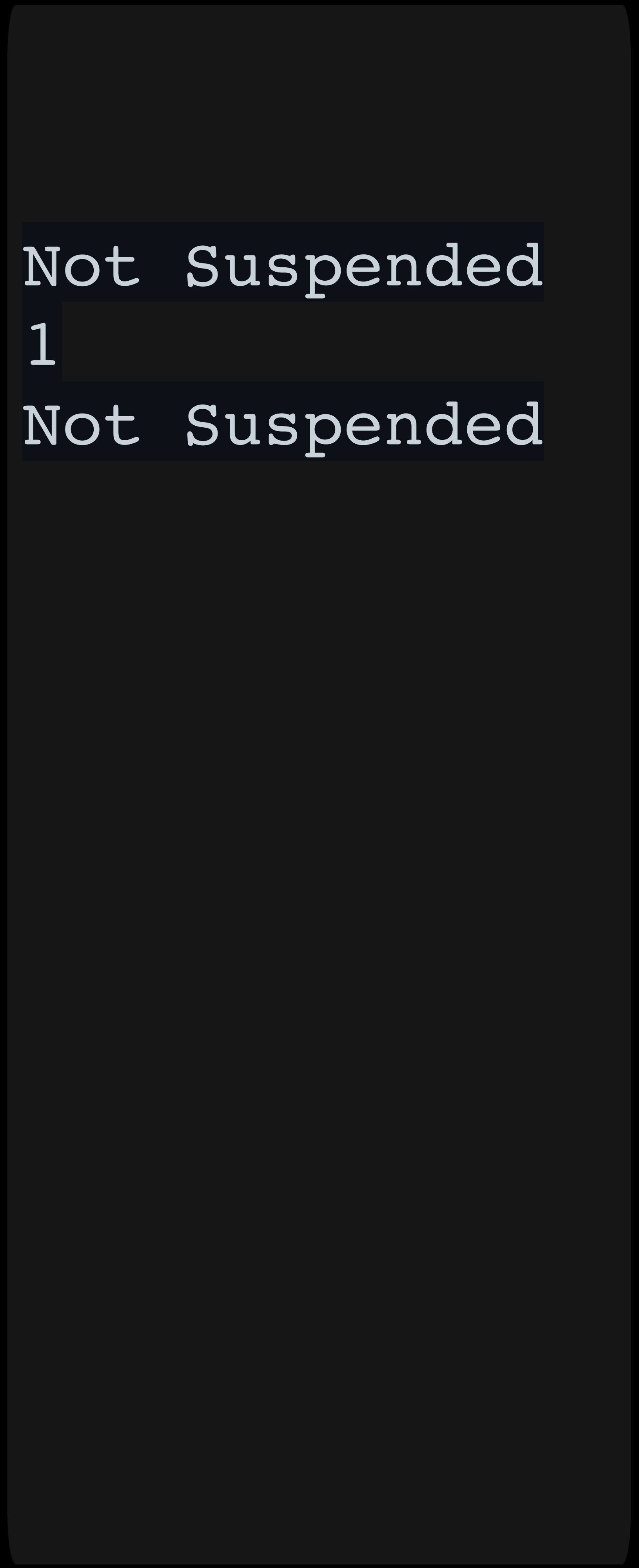



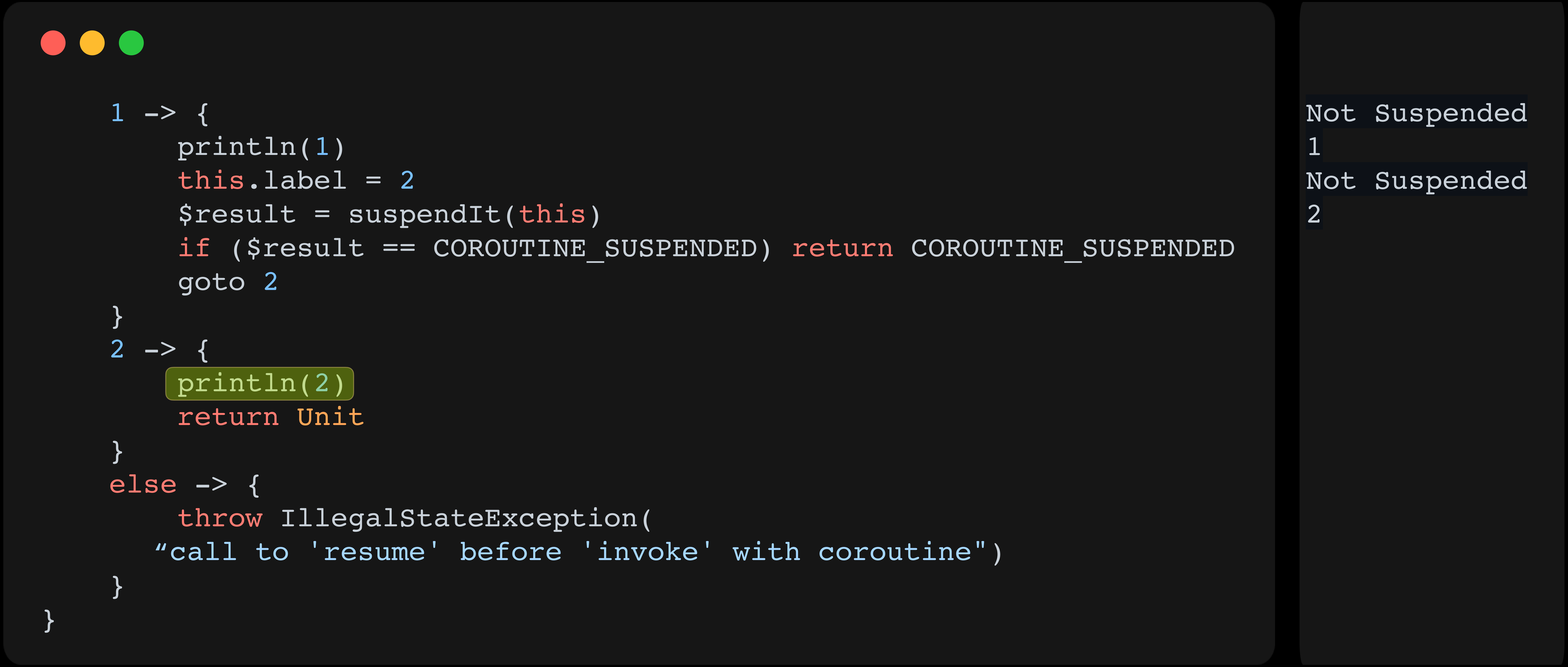
```
Not Suspended
1
Not Suspended
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단 안함
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Not Suspended
1
Not Suspended
```

```kotlin
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
    2 -> {
        println(2)
        return Unit
    }
    else -> {
        throw IllegalStateException(
      “call to 'resume' before 'invoke' with coroutine")
    }
}
```

```
Not Suspended
1
Not Suspended
```



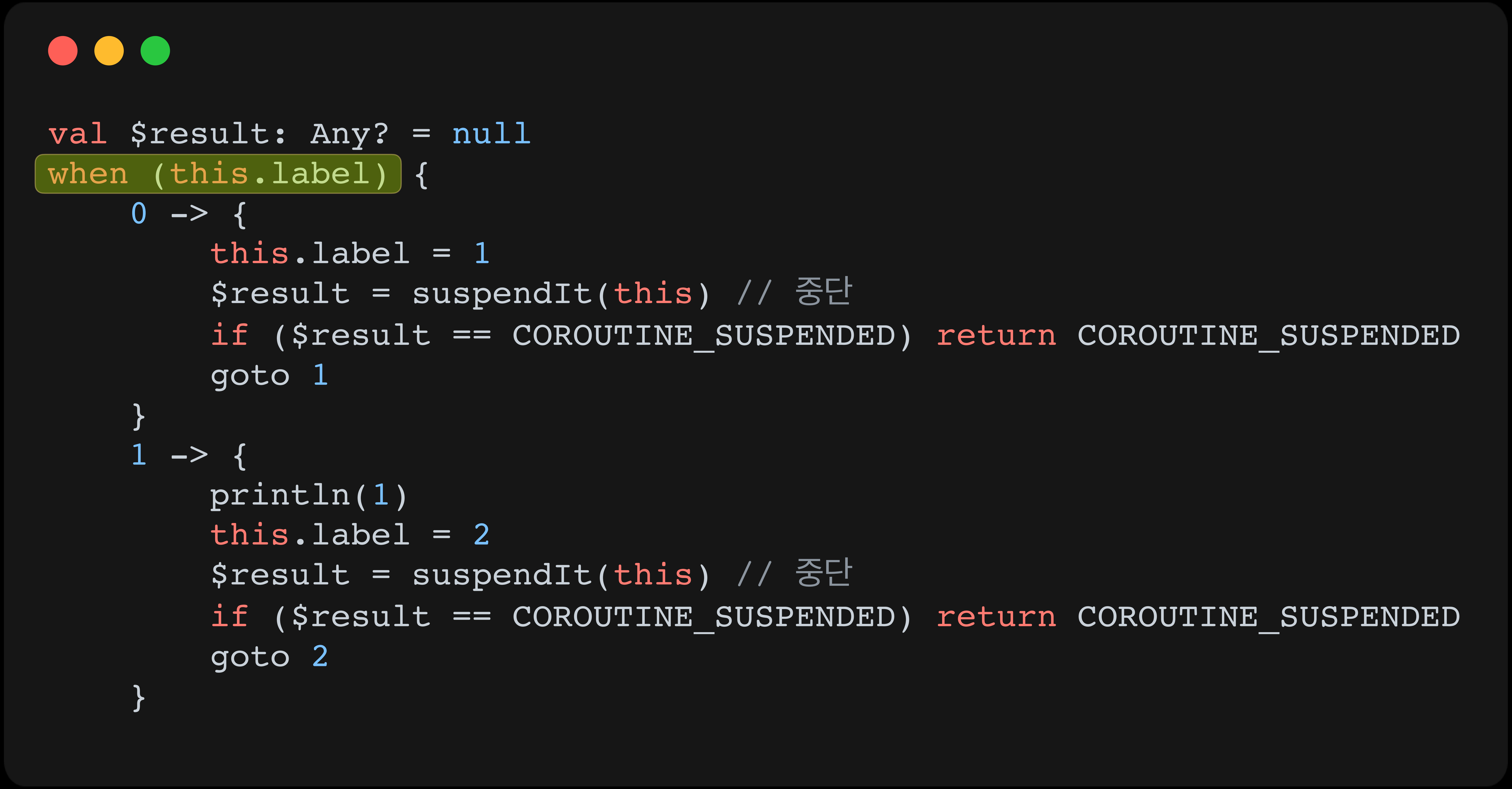
```
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
    2 -> {
        println(2)
        return Unit
    }
    else -> {
        throw IllegalStateException(
       “call to 'resume' before 'invoke' with coroutine")
    }
}
```

```
Not Suspended
1
Not Suspended
2
```

```
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
    2 -> {
        println(2)
        return Unit
    }
    else -> {
        throw IllegalStateException(
      “call to 'resume' before 'invoke' with coroutine")
    }
}
```

```
Not Suspended
1
Not Suspended
2

exit code 0
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```


```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

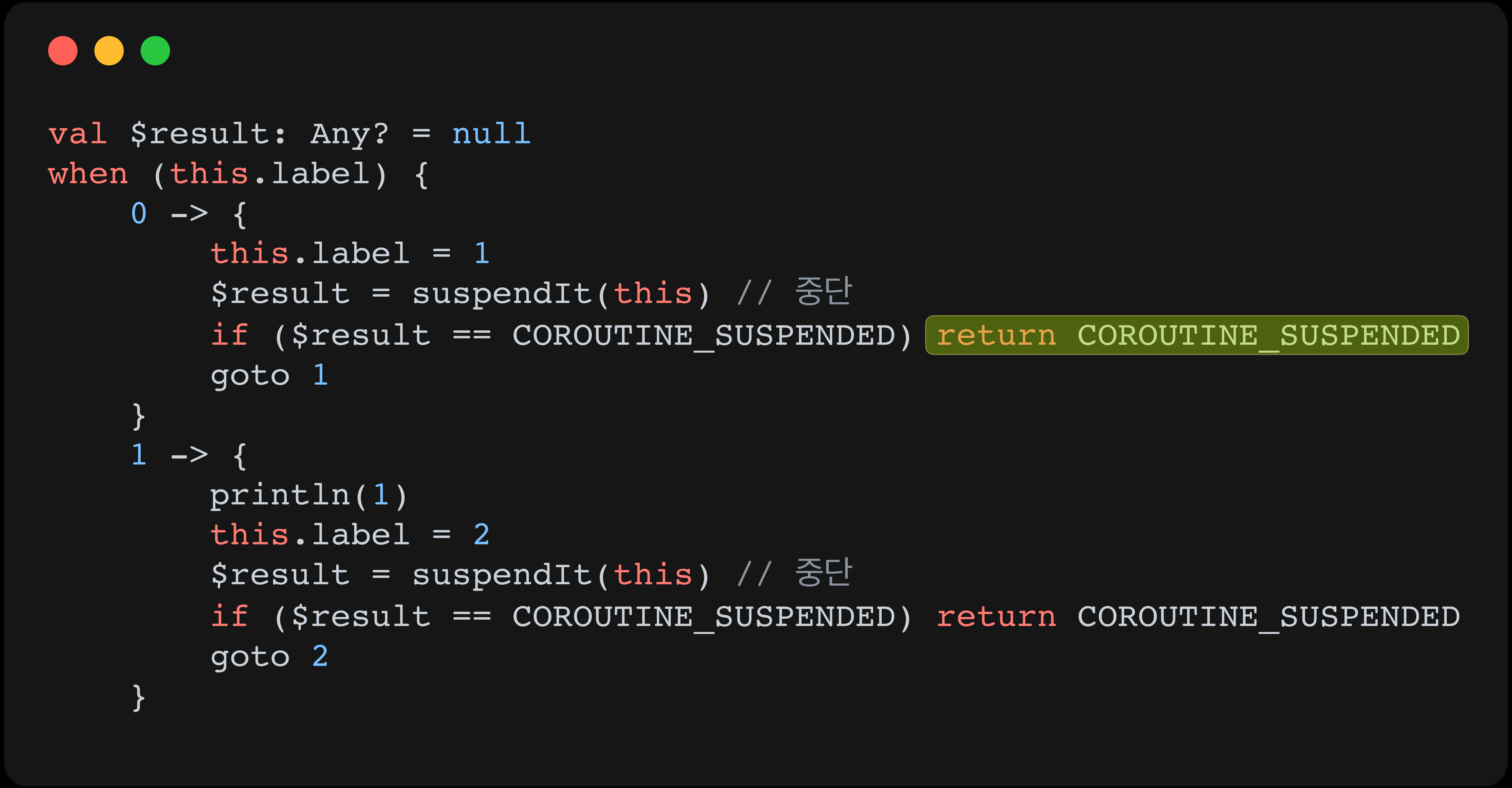
```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Suspended
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Suspended
```

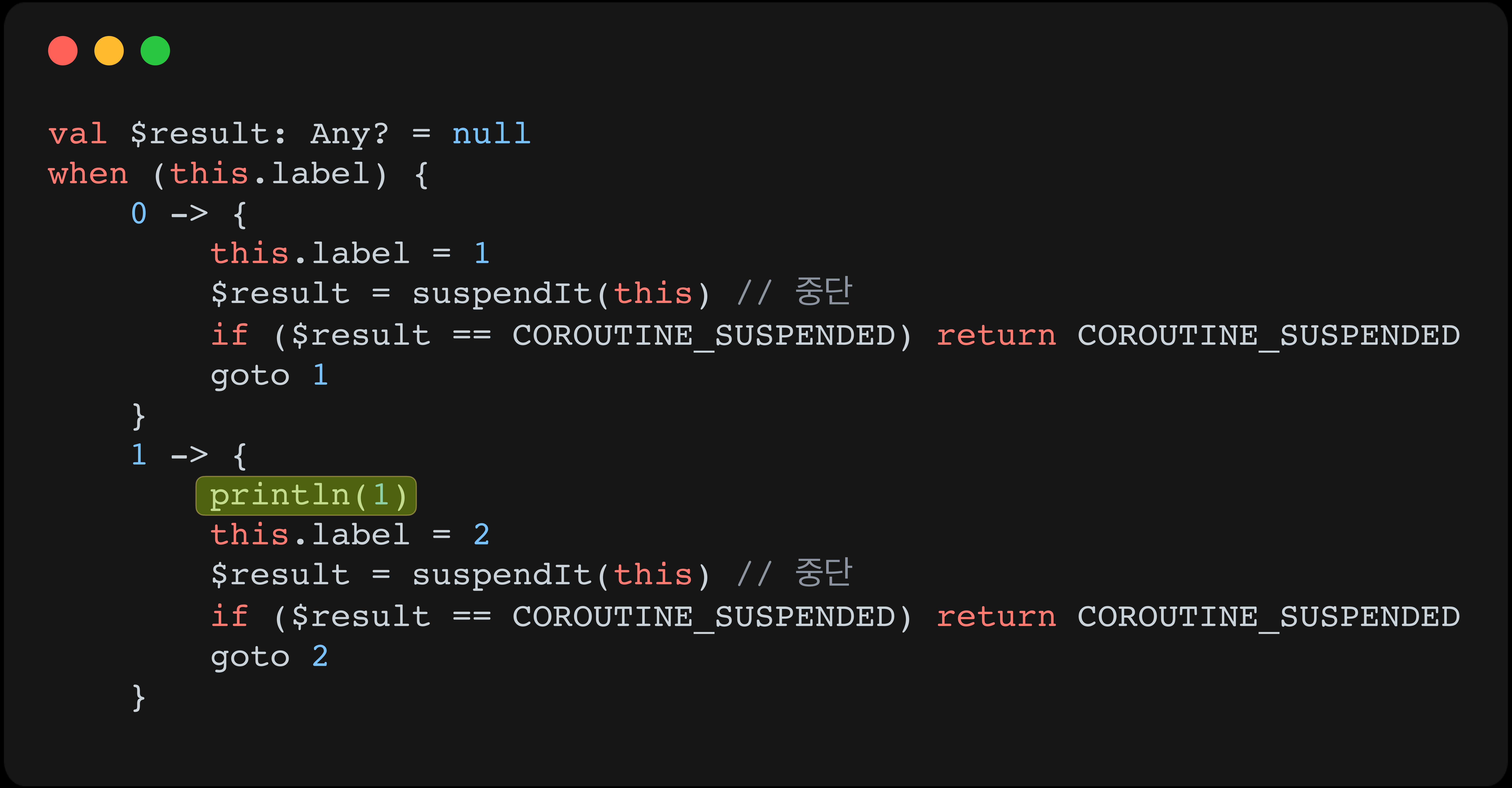


```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

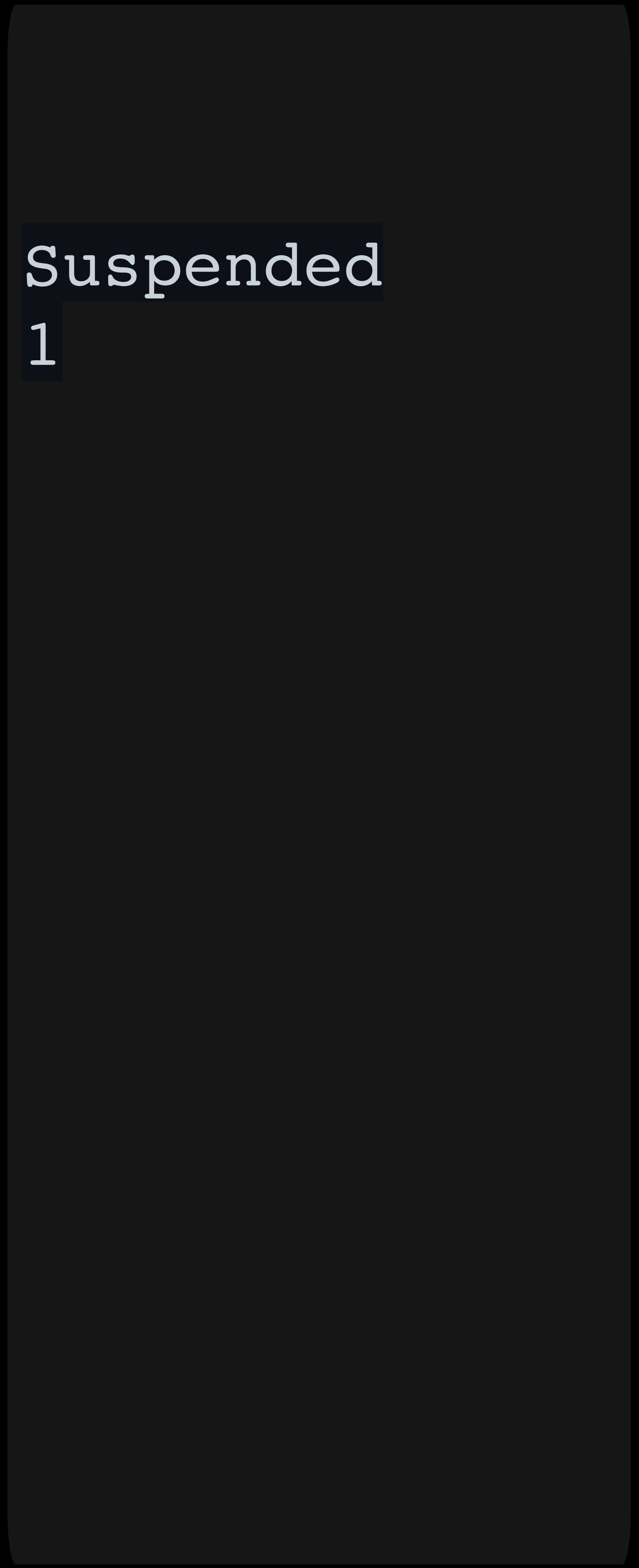
```
Suspended
```

```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Suspended
```



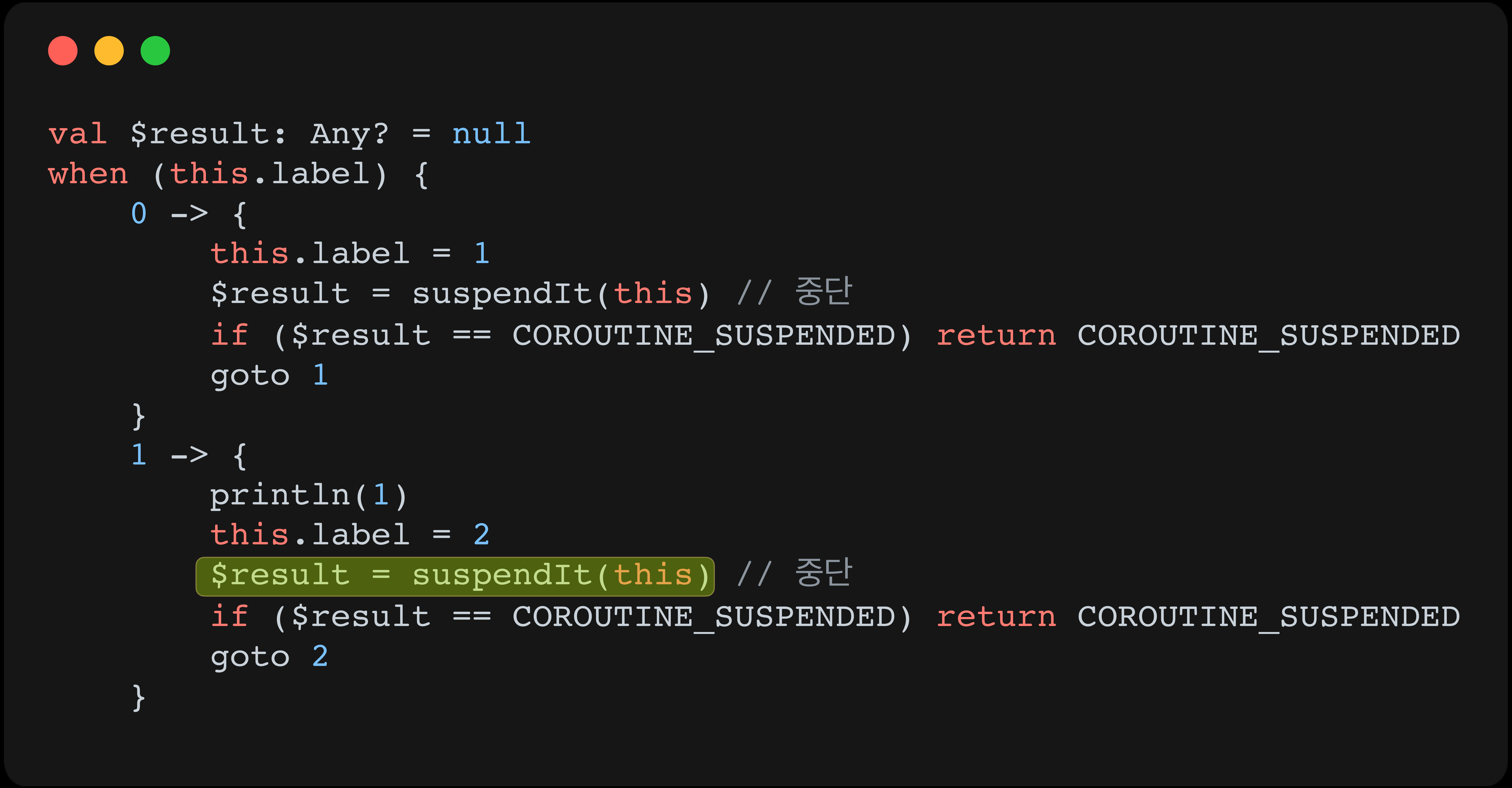
```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```



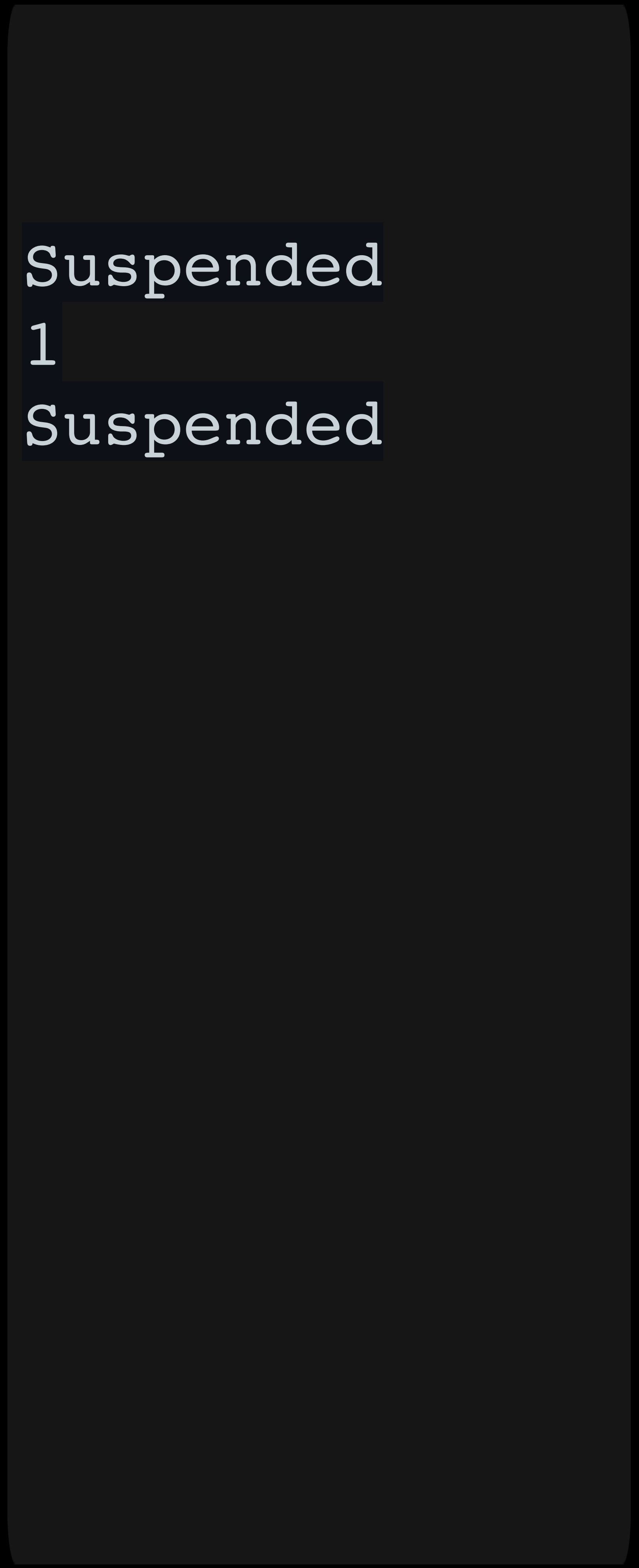
```
Suspended
1
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Suspended
1
```

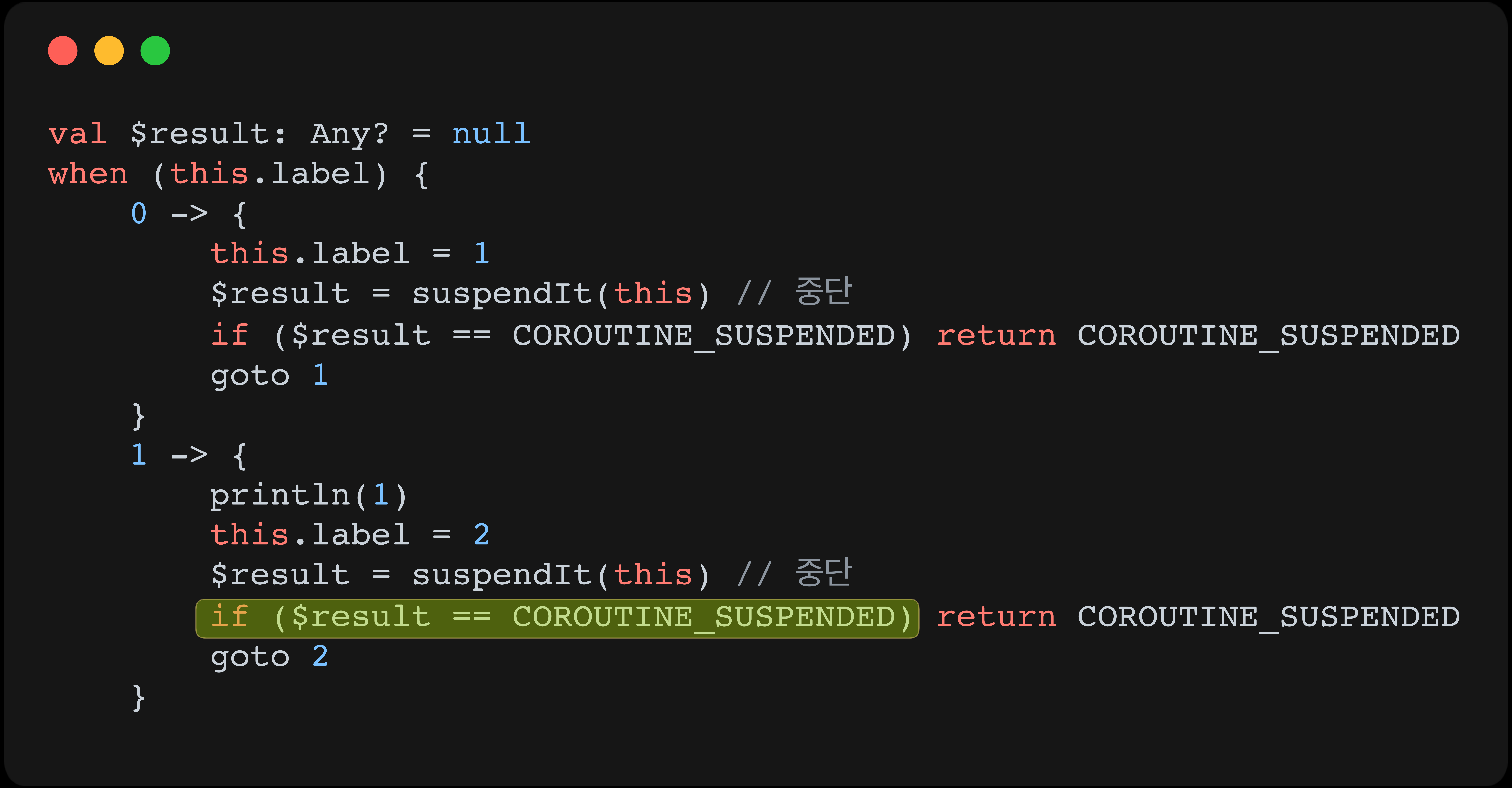


```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```



```
Suspended
1
Suspended
```

Kotlin User Groups Seoul



```
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

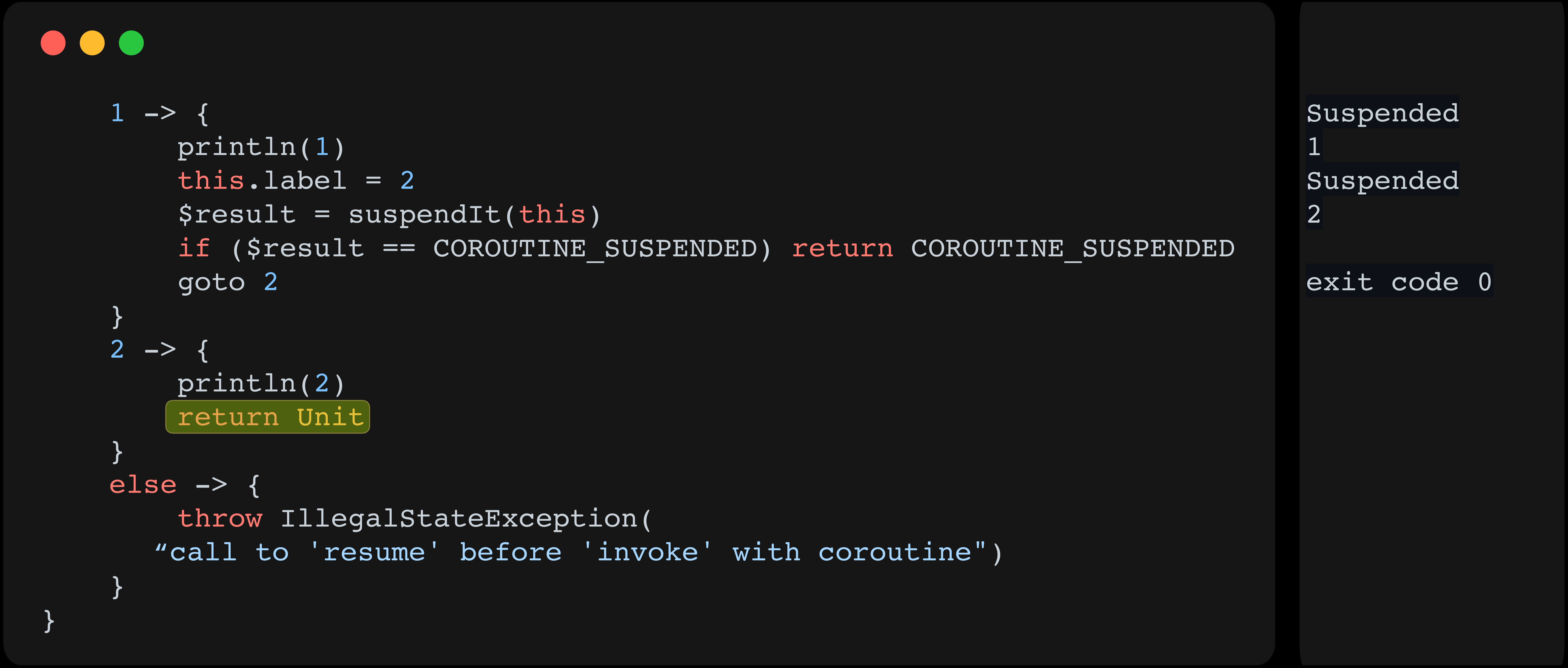
```
Suspended
1
Suspended
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this) // 중단
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

```
Suspended
1
Suspended
```

```
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
    2 -> {
        println(2)
        return Unit
    }
    else -> {
        throw IllegalStateException(
      “call to 'resume' before 'invoke' with coroutine")
    }
}
```

```
Suspended
1
Suspended
2
```



```
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
    2 -> {
        println(2)
        return Unit
    }
    else -> {
        throw IllegalStateException(
      "call to 'resume' before 'invoke' with coroutine")
    }
}
```

```
Suspended
1
Suspended
2

exit code 0
```

의문점

COROUTINE_SUSPENDED와 **returnType** 둘 중 하나를
반환 해야한다

의문점

COROUTINE_SUSPENDED와 returnType 둘 중 하나를 반환 해야한다

How?

의문점

COROUTINE_SUSPENDED와 returnType 둘 중 하나를
반환 해야한다

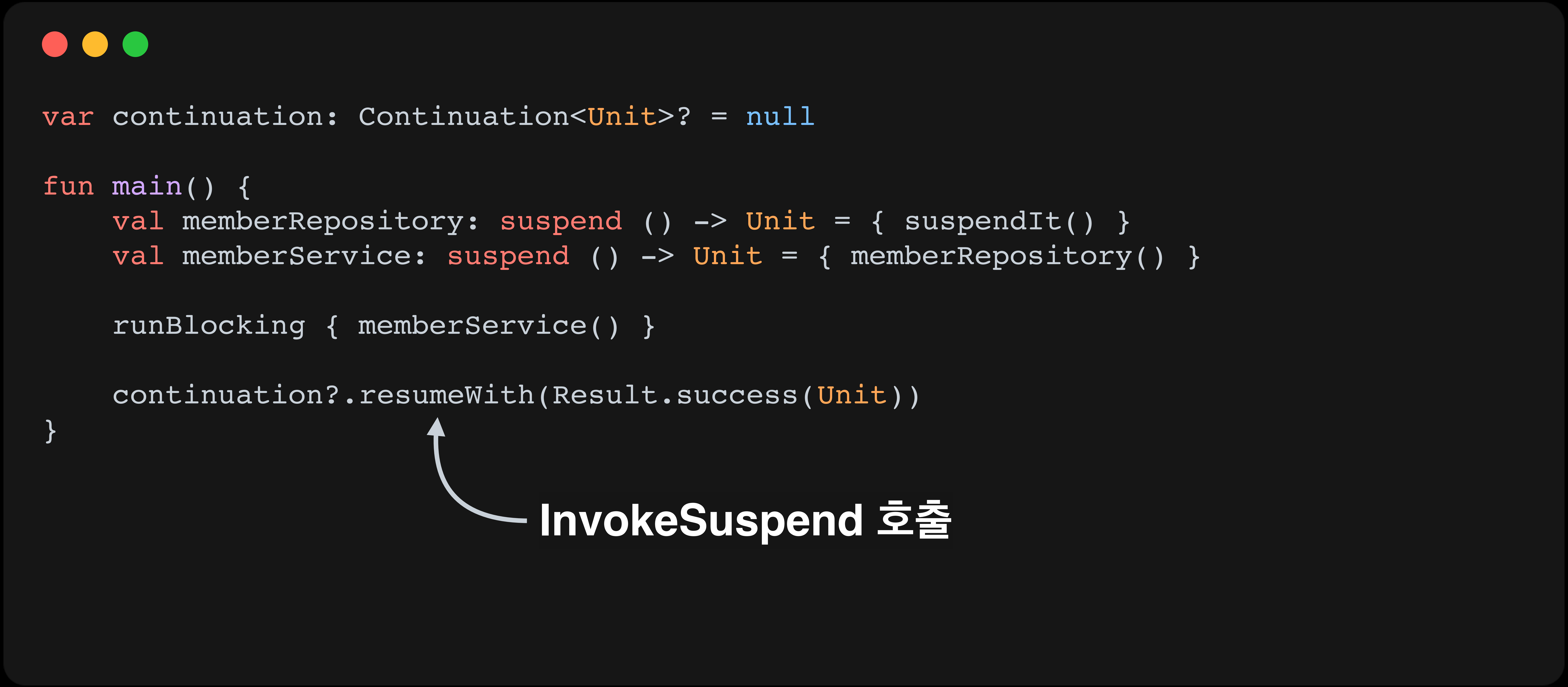
How?

`Any?` 를 반환

Continuation Passing Style

```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val memberRepository: suspend () -> Unit = { suspendIt() }
    val memberService: suspend () -> Unit = { memberRepository() }

    runBlocking { memberService() }

    continuation?.resume(Unit)
}
```

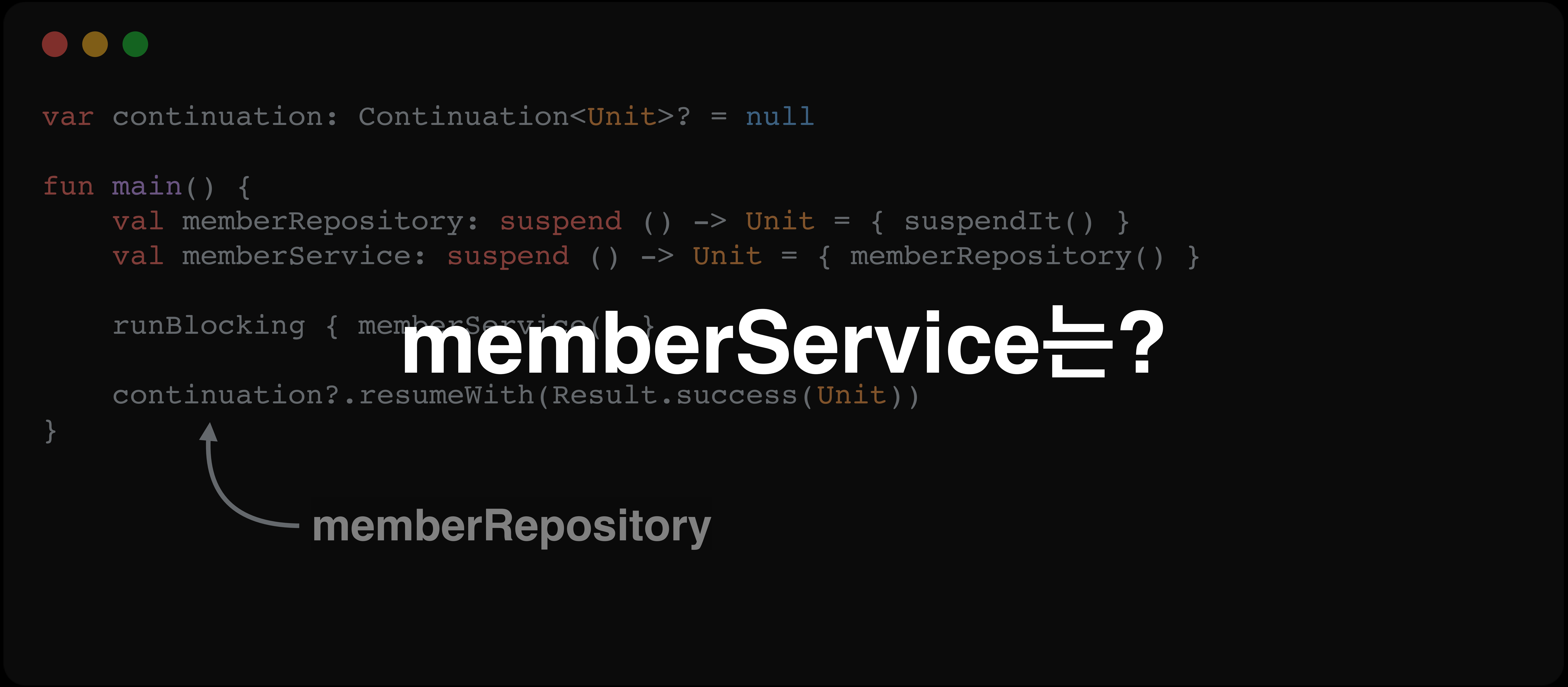
```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val memberRepository: suspend () -> Unit = { suspendIt() }
    val memberService: suspend () -> Unit = { memberRepository() }

    runBlocking { memberService() }

    continuation?.resumeWith(Result.success(Unit))
}
```



```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val memberRepository: suspend () -> Unit = { suspendIt() }
    val memberService: suspend () -> Unit = { memberRepository() }

    runBlocking { memberService() }

    continuation?.resumeWith(Result.success(Unit))
}
```

```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val memberRepository: suspend () -> Unit = { suspendIt() }
    val memberService: suspend () -> Unit = { memberRepository() }

    runBlocking { memberService() }

    continuation?.resumeWith(Result.success(Unit))
}
```

memberRepository



```kotlin
var continuation: Continuation<Unit>? = null

fun main() {
    val memberRepository: suspend () -> Unit = { suspendIt() }
    val memberService: suspend () -> Unit = { memberRepository() }

    runBlocking { memberService() }

    continuation?.resumeWith(Result.success(Unit))
}
```

memberService는?

memberService는 어떻게 실행할까?

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memberRepository가 memberService에 대한 링크를 지니고 있어야한다

memberService는 어떻게 실행할까?

memberRepository가 memberService에 대한 링크를 지니고 있어야한다

즉, memberService를 memberRepository에 전달해야한다

```
fun invoke(): T
```

```kotlin
fun invoke(c: Continuation<Unit>): Any?
fun invoke(c: Continuation<Unit>): Any?
```

이를 Continuation Passing Style이라고 한다

completion

```kotlin
fun invoke(c: Continuation<Unit>): Any?
```

이를 Continuation Passing Style이라고 한다

completion

```
fun invoke(c: Continuation<Unit>): Any?
```

일반 함수에서 suspend 함수를 호출하지 못하는 이유

이를 Continuation Passing Style이라고 한다

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        this.label = 1
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1
    }
    1 -> {
        println(1)
        this.label = 2
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2
    }
```

Local Variables

Local Variables

코루틴이 일시 중단되면, 해당 지역 변수를 저장해야한다

Local Variables

코루틴이 일시 중단되면, 해당 지역 변수를 저장해야한다

그렇지 않으면 코루틴이 다시 재개될 때 변수의 값이 유실된다

Local Variables

코루틴이 일시 중단되면, 해당 지역 변수를 저장해야한다

그렇지 않으면 코루틴이 다시 재개될 때 변수의 값이 유실된다

따라서 중단이 발생하기 전에 변수를 저장하고
코루틴이 재개되었을 때, 저장한 변수를 복원해야한다

```kotlin
data class Price(val value: Int) {
    operator fun plus(other: Price): Price {
        return Price(value + other.value)
    }
}

fun main() {
    val lambda: suspend() -> Unit = {
        val price1 = Price(1000)
        suspendIt()
        val price2 = Price(2000)
        suspendIt()
        println(price1 + price2)
    }

}
```

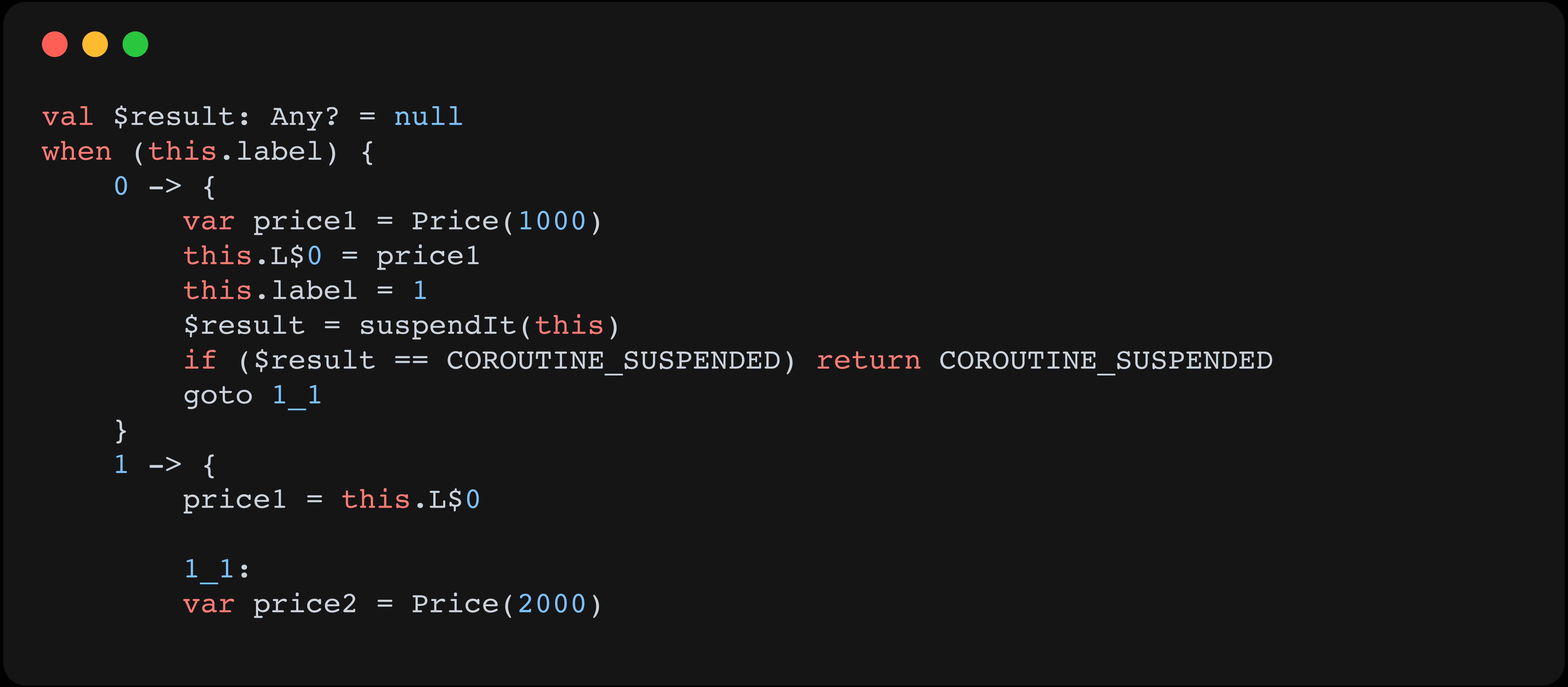
```kotlin
data class Price(val value: Int) {
    operator fun plus(other: Price): Price {
        return Price(value + other.value)
    }
}

fun main() {
    val lambda: suspend() -> Unit = {
        val price1 = Price(1000)
        suspendIt()
        val price2 = Price(2000)
        suspendIt()
        println(price1 + price2)
    }

}
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        var price1 = Price(1000)
        this.L$0 = price1
        this.label = 1
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1_1
    }
    1 -> {
        price1 = this.L$0

        1_1:
        var price2 = Price(2000)
        this.L$0 = null
        this.label = 2
        $result = plus(price1, price2)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2_1
    }
    2 -> {
        2_1:
        println($result)
        return Unit
    }
    else -> {
        throw IllegalStateException("call to 'resume' before 'invoke'
with coroutine")
    }
}
```

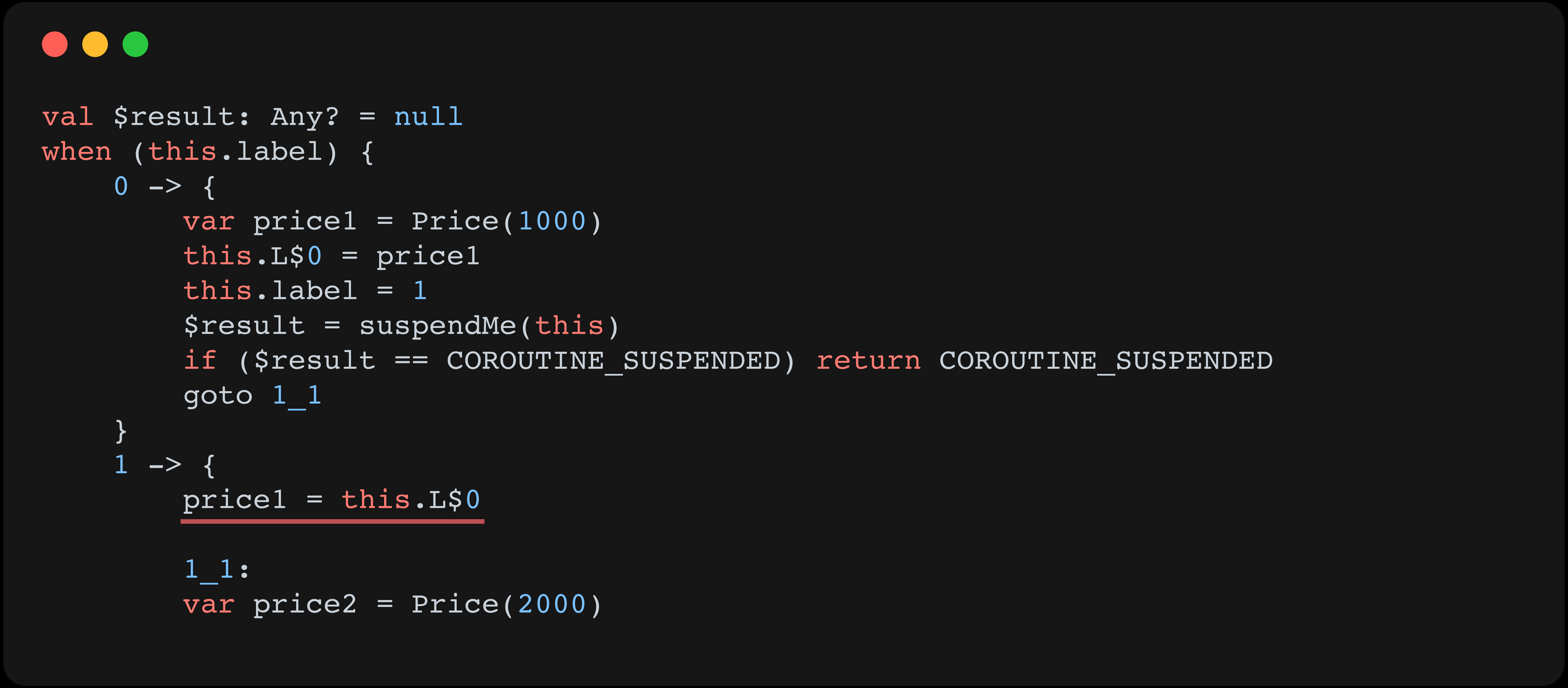


```
val $result: Any? = null
when (this.label) {
    0 -> {
        var price1 = Price(1000)
        this.L$0 = price1
        this.label = 1
        $result = suspendIt(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1_1
    }
    1 -> {
        price1 = this.L$0

        1_1:
        var price2 = Price(2000)
```

```
val $result: Any? = null
when (this.label) {
    0 -> {
        var price1 = Price(1000)
        this.L$0 = price1
        this.label = 1
        $result = suspendMe(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1_1
    }
    1 -> {
        price1 = this.L$0

        1_1:
        var price2 = Price(2000)
```

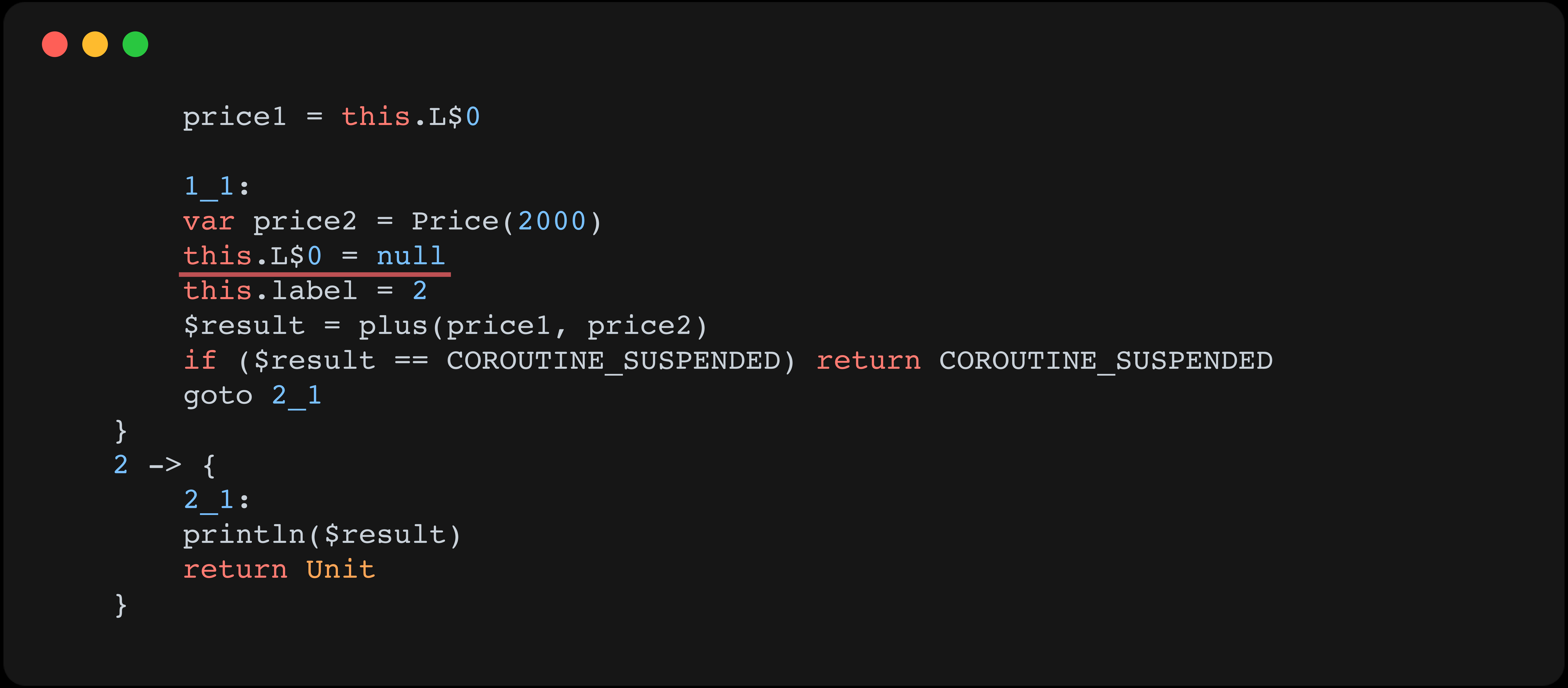


```
val $result: Any? = null
when (this.label) {
    0 -> {
        var price1 = Price(1000)
        this.L$0 = price1
        this.label = 1
        $result = suspendMe(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1_1
    }
    1 -> {
        price1 = this.L$0

        1_1:
        var price2 = Price(2000)
```

```kotlin
val $result: Any? = null
when (this.label) {
    0 -> {
        var price1 = Price(1000)
        this.L$0 = price1
        this.label = 1
        $result = suspendMe(this)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 1_1
    }
    1 -> {
        price1 = this.L$0

        1_1:
        var price2 = Price(2000)
```



```
        price1 = this.L$0

        1_1:
        var price2 = Price(2000)
        this.L$0 = null
        this.label = 2
        $result = plus(price1, price2)
        if ($result == COROUTINE_SUSPENDED) return COROUTINE_SUSPENDED
        goto 2_1
    }
    2 -> {
        2_1:
        println($result)
        return Unit
    }
```

Suspend Function

지금까지 suspend 키워드가 붙은 람다로 진행함

지금까지 suspend 키워드가 붙은 람다로 진행함

Why?

지금까지 suspend 키워드가 붙은 람다로 진행함

Why?

Continuation의 재사용이 불가능함

Suspend Function

Suspend Function

ㄴ 정적 함수일 수 있음

Suspend Function

ㄴ 정적 함수일 수 있음

ㄴ 클래스 내에 여러개 존재 가능

Then?

Then?

모든 함수를 suspend 람다로 변환

JVM은 왜 이 방법을 사용하지 않을까?

JVM은 왜 이 방법을 사용하지 않을까?

스택 트레이스(Stack Trace)의 가독성

함수 본문을 Lambda로 이동한 경우

```
suspendFun1$1.invokeSuspend
suspendFun2$1.invokeSuspend
suspendFun3$1.invokeSuspend
suspendFun4$1.invokeSuspend
suspendFun5$1.invokeSuspend
```

우리가 원하는 형태

```
suspendFun1
suspendFun2
suspendFun3
suspendFun4
suspendFun5
```

How?

Suspend 함수의 본문을 람다로 이동하는 대신, 함수 내부에 그대로 유지하고 상태기계를 그 안에 직접 구축하는 방식을 채택

감사합니다.

QnA

linkedin.com/in/chanwoo040531/