#WWDC19

Advances in Foundation

I-Ting Tina Liu, Foundation

New API Highlights

Combine

Ordered Collection Diffing

Data

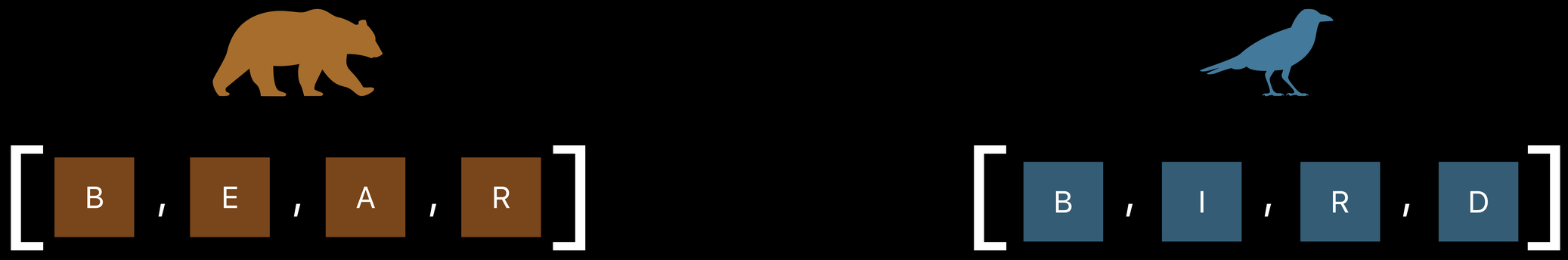
Units and Formatters

OperationQueue

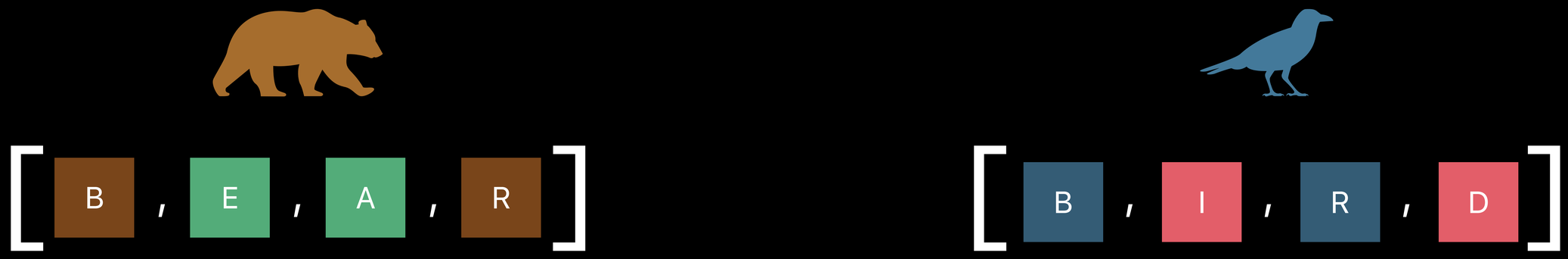
USB and SMB on iOS

Swift Update

Ordered Collection Diffing



Ordered Collection Diffing



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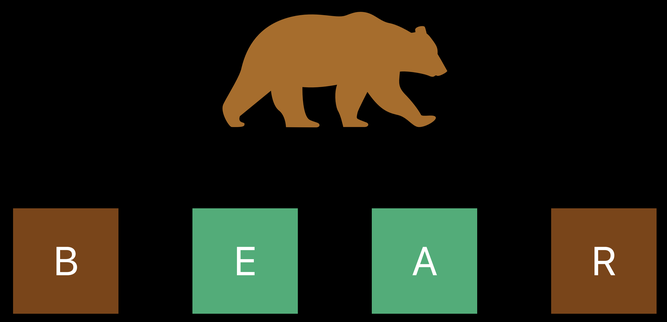

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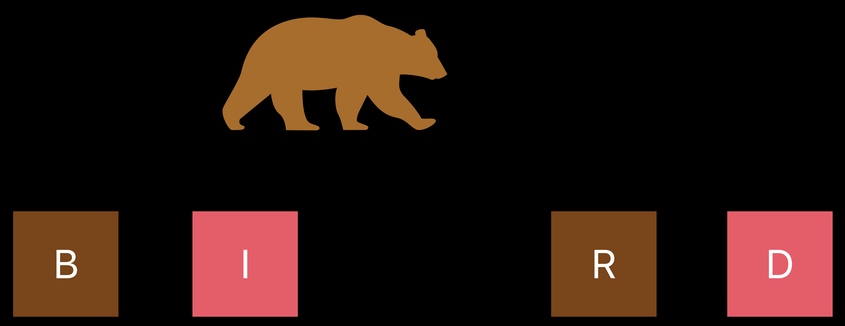

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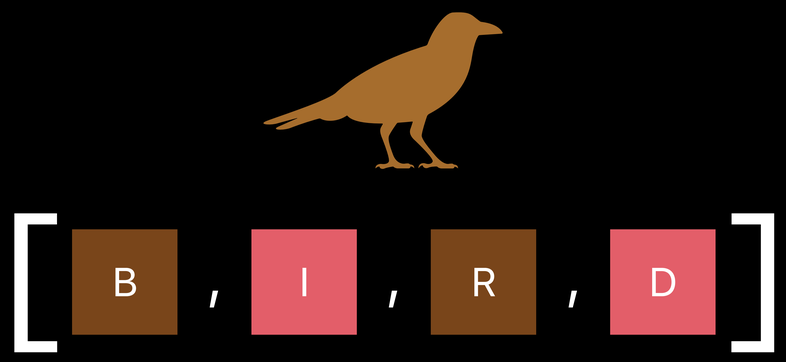

Ordered Collection Diffing

```
let diff = bird.difference(from: bear)

let newBird = bear.applying(diff)                    // [b, i, r, d]
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Contiguity

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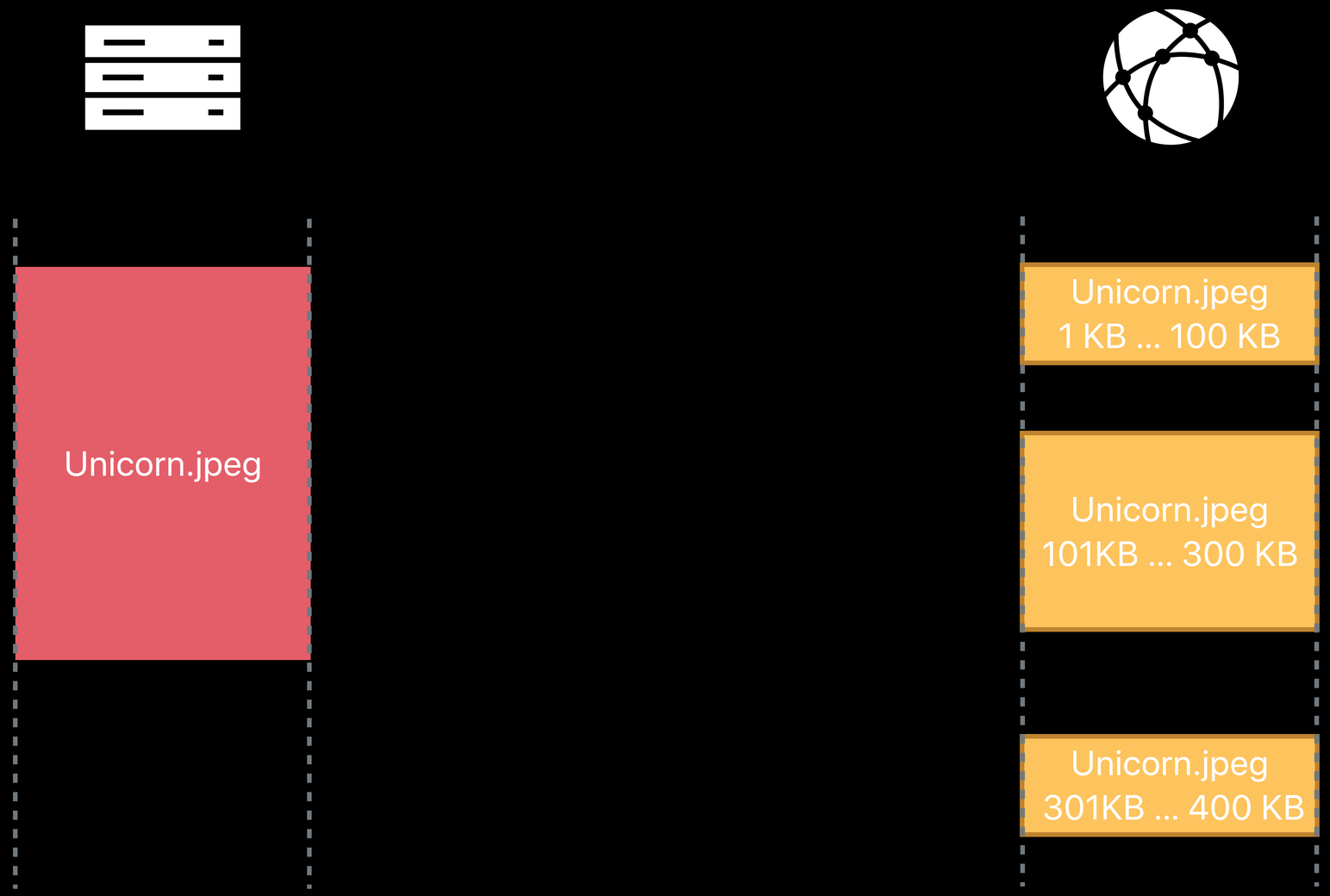

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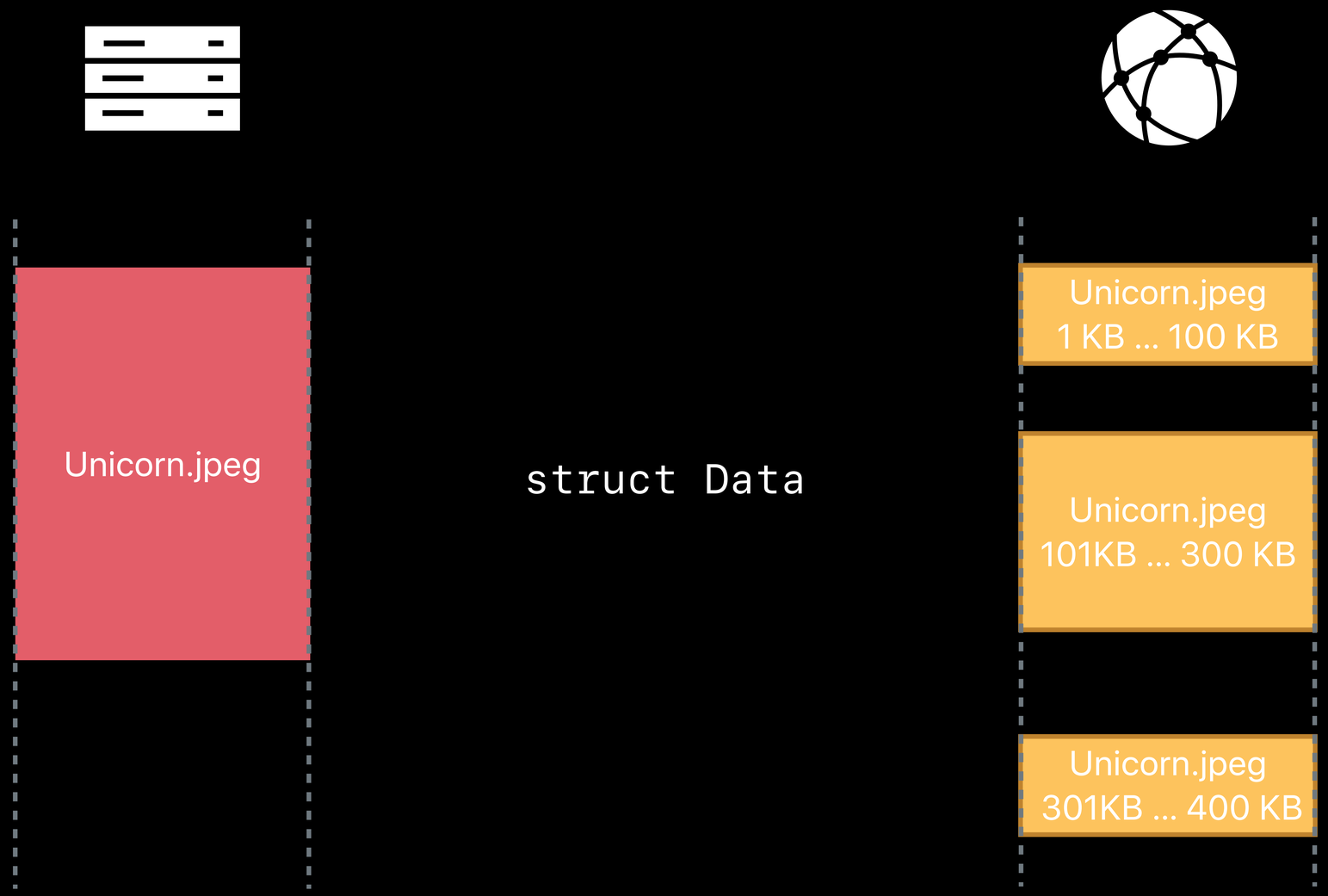

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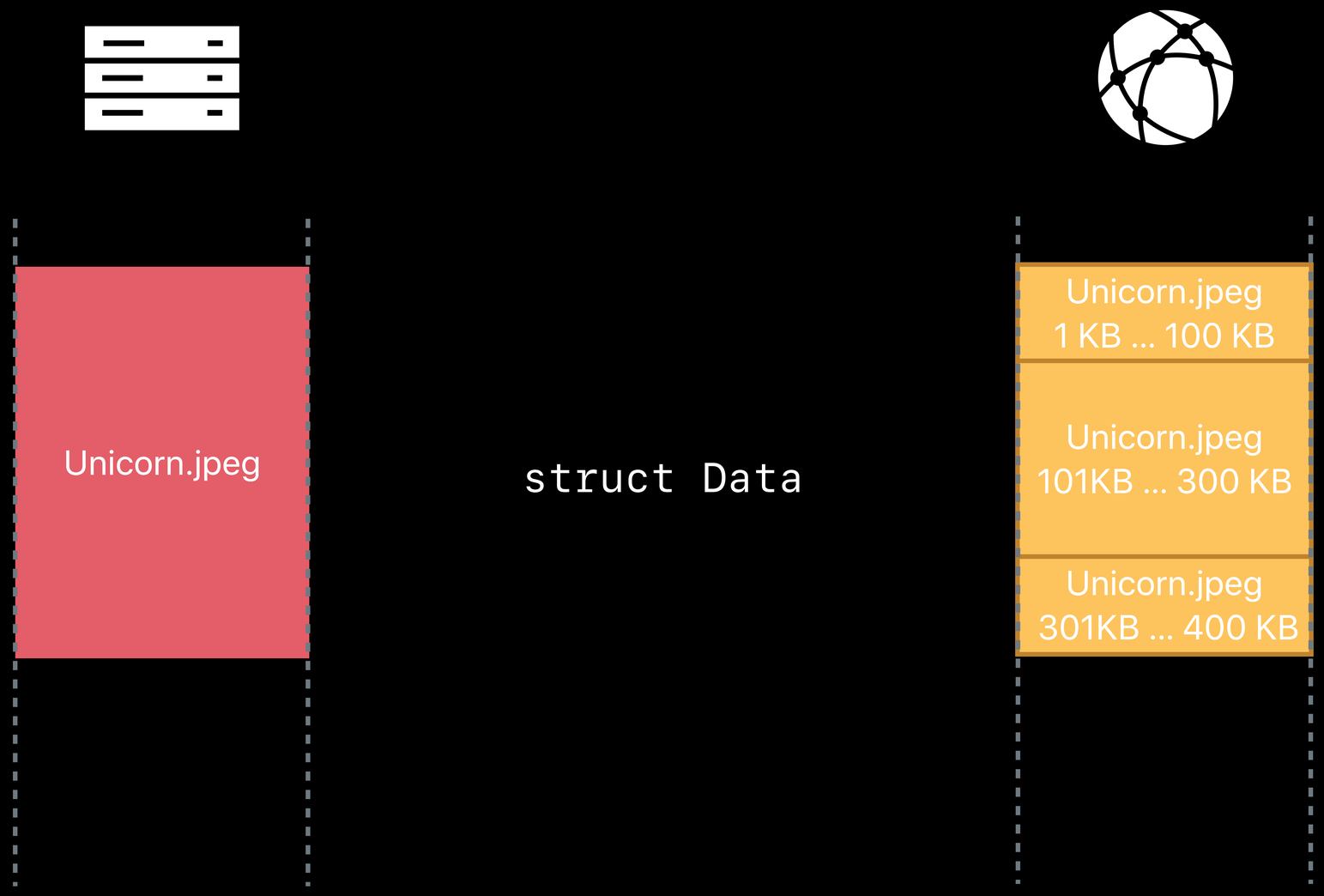

Data

NEW

`Data` is contiguous

Data

NEW

`Data` is contiguous

```
public protocol ContiguousBytes {
    func withUnsafeBytes<R>(_ body: (UnsafeRawBufferPointer) throws -> R) rethrows -> R
}
```

Data

NEW

Work with potentially discontiguous types

```
public protocol DataProtocol: RandomAccessCollection where Element == UInt8, … { }

public protocol MutableDataProtocol : DataProtocol,
    MutableCollection, RangeReplaceableCollection { }
```

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Data

NEW

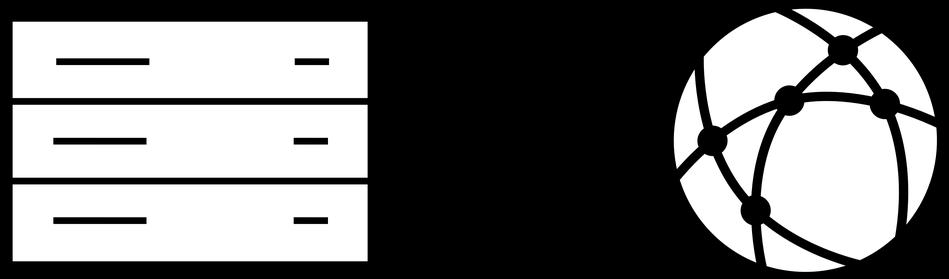
Protocols adopted by

- Foundation: `Data`
- Swift Standard Library: `[UInt8]`
- Dispatch: `DispatchData`

Consider using `DataProtocol` as a generic constraint

Data

Compression



Data

Compression

```
let compressed = try data.compressed(using: .lzfse)

public enum CompressionAlgorithm : Int {
    case lzfse
    case lz4
    case lzma
    case zlib
}
```

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Units

`UnitDuration`

- Added `milliseconds, microseconds, nanoseconds,` and `picoseconds`

`UnitFrequency`

- Added `framesPerSecond`

Units

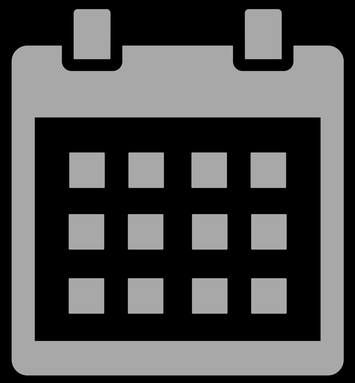
NEW

`UnitInformationStorage`

- `bits, bytes, nibbles` for common usage
- SI- and binary-prefixed units `(kilo, kibi, ... yotta, yobi)`
- Format with `MeasurementFormatter` and `ByteCountFormatter`

Displaying a Date or Time

" Read: 1 hour ago "



" Payment due: Tomorrow "

Relative Date Time Formatter

```
let formatter = RelativeDateTimeFormatter()
let dateString = formatter.localizedString(for: aDate, relativeTo: now)

// en_US:      "2 weeks ago"
// es_ES:      "hace 2 semanas"
// zh_TW:      "2 週前"
```

List Formatter

```
let string = ListFormatter.localizedString(byJoining: ["🐶", "🐷", "🦄"])

// en_US:    "🐶, 🐷, and 🦄"
// es_ES:    "🐶, 🐷 y 🦄"
// zh_TW:    "🐶、🐷和🦄"
```

List Formatter

8/15/2019 9/13/2019 2/1/2020

“8/15/19, 9/13/19, and 2/1/20”

“Aug 15, 2019, Sep 13, 2019, and Feb 1, 2020”

List Formatter

[8/15/2019 , 9/13/2019 , 2/1/2020]

“8/15/19, 9/13/19, and 2/1/20”

“Aug 15, 2019, Sep 13, 2019, and Feb 1, 2020”

“15/8/19, 13/9/19 y 1/2/20”

“15 ago 2019, 13 sept 2019 y 1 feb 2020”

List Formatter

```
let listFormatter = ListFormatter()
let dateFormatter = DateFormatter()


listFormatter.itemFormatter = dateFormatter
let string = listFormatter.string(from: dates)

// en_US:    "8/15/19, 9/13/19, and 2/1/20"
// es_ES:    "15/8/19, 13/9/19 y 1/2/20”
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List Formatter

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let listFormatter = ListFormatter()
let dateFormatter = DateFormatter()
dateFormatter.dateStyle = .medium

listFormatter.itemFormatter = dateFormatter
let string = listFormatter.string(from: dates)

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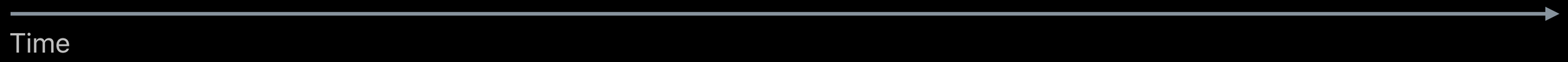
Operation Queue



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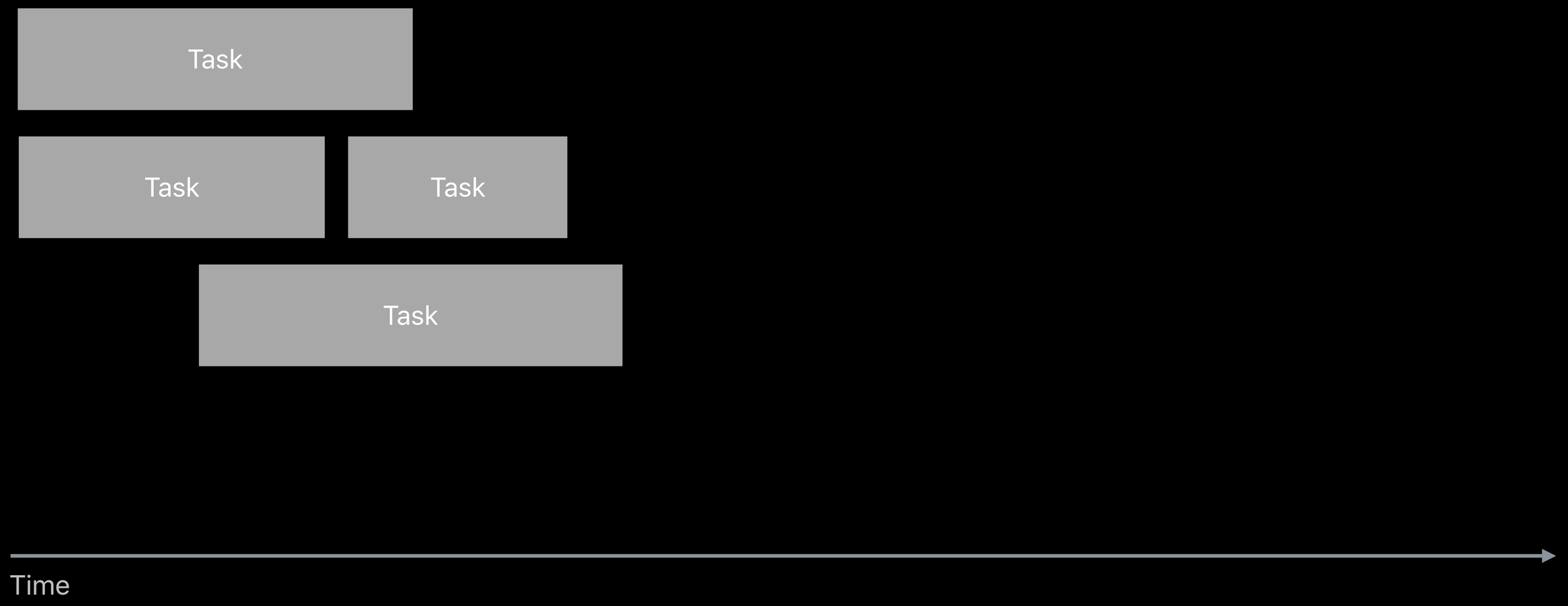

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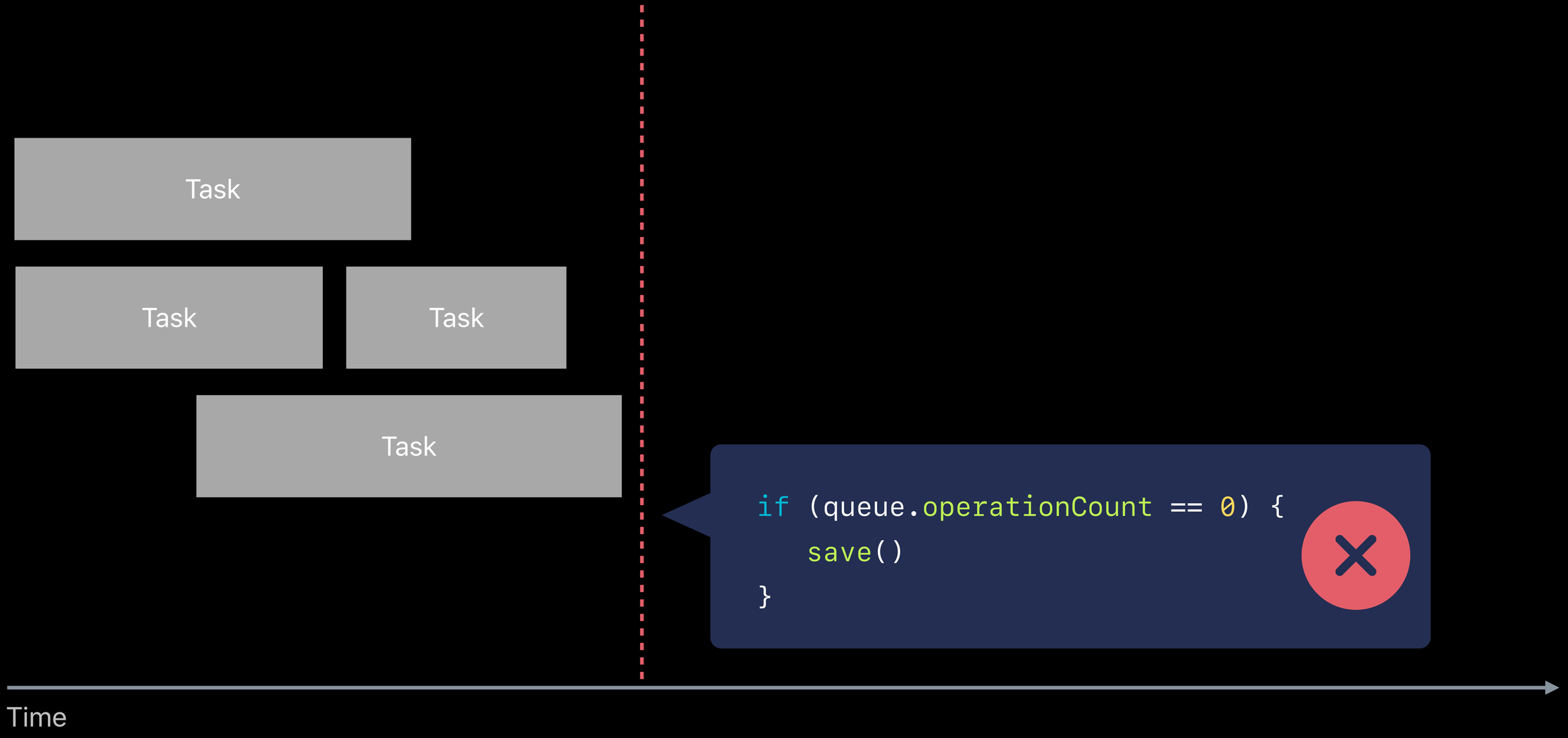

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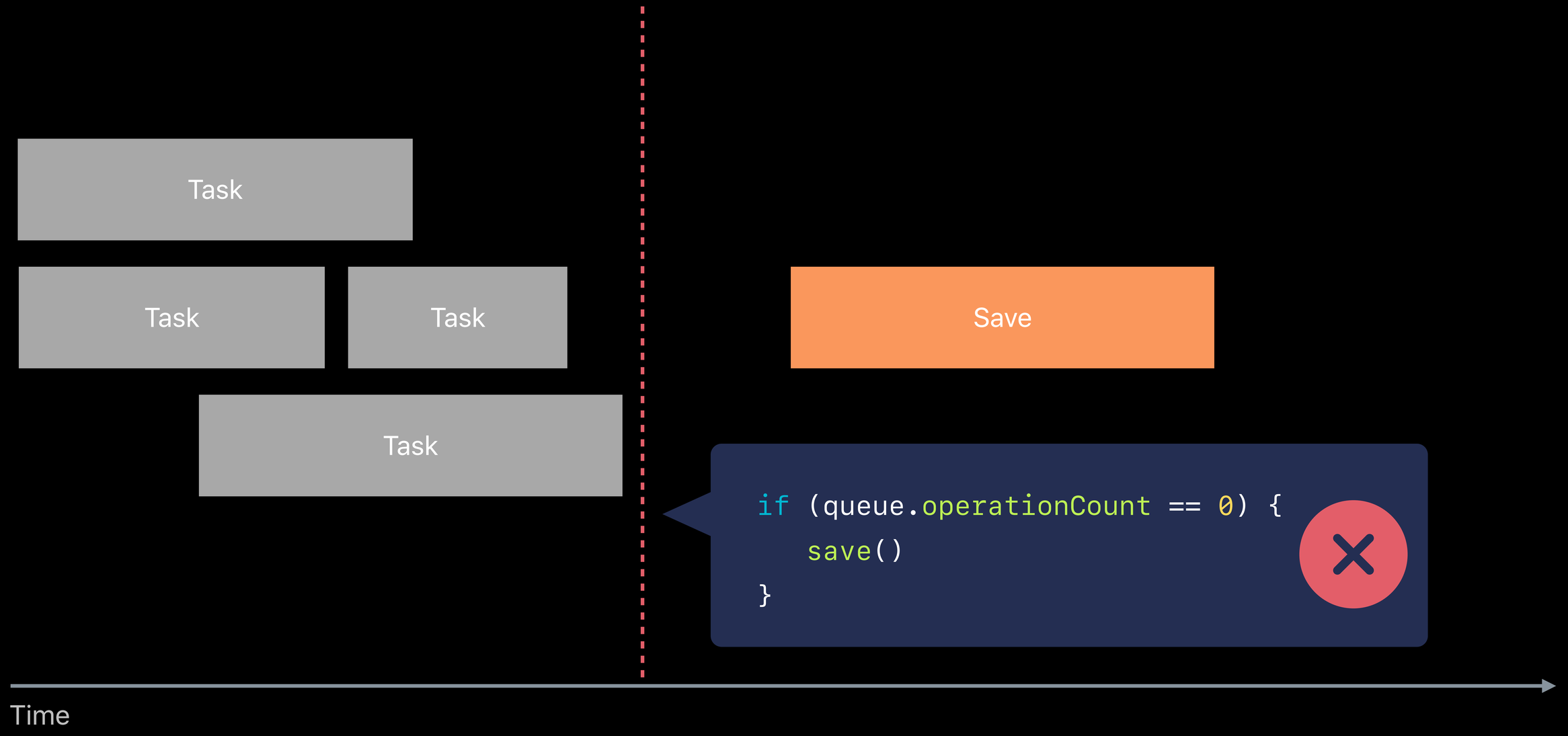

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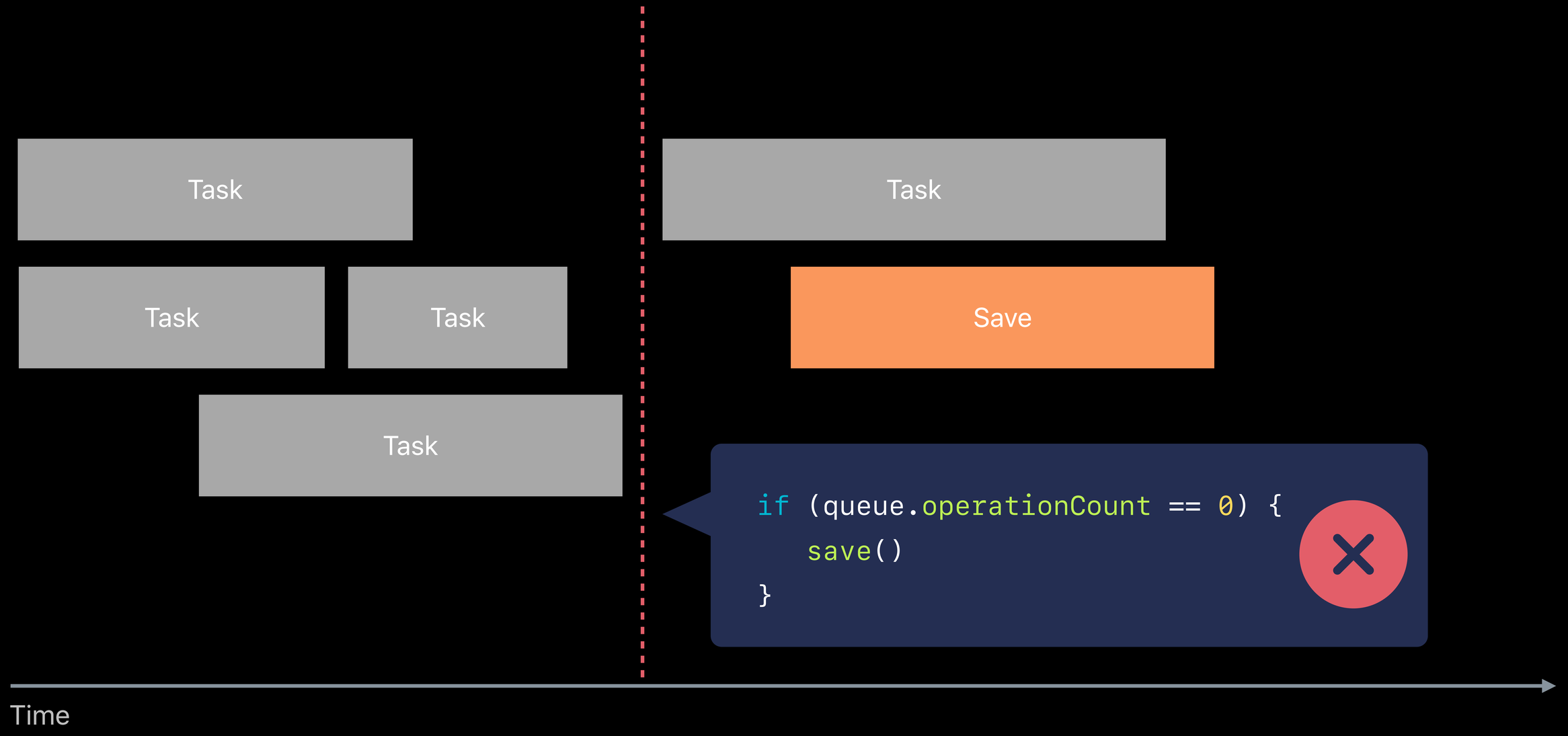

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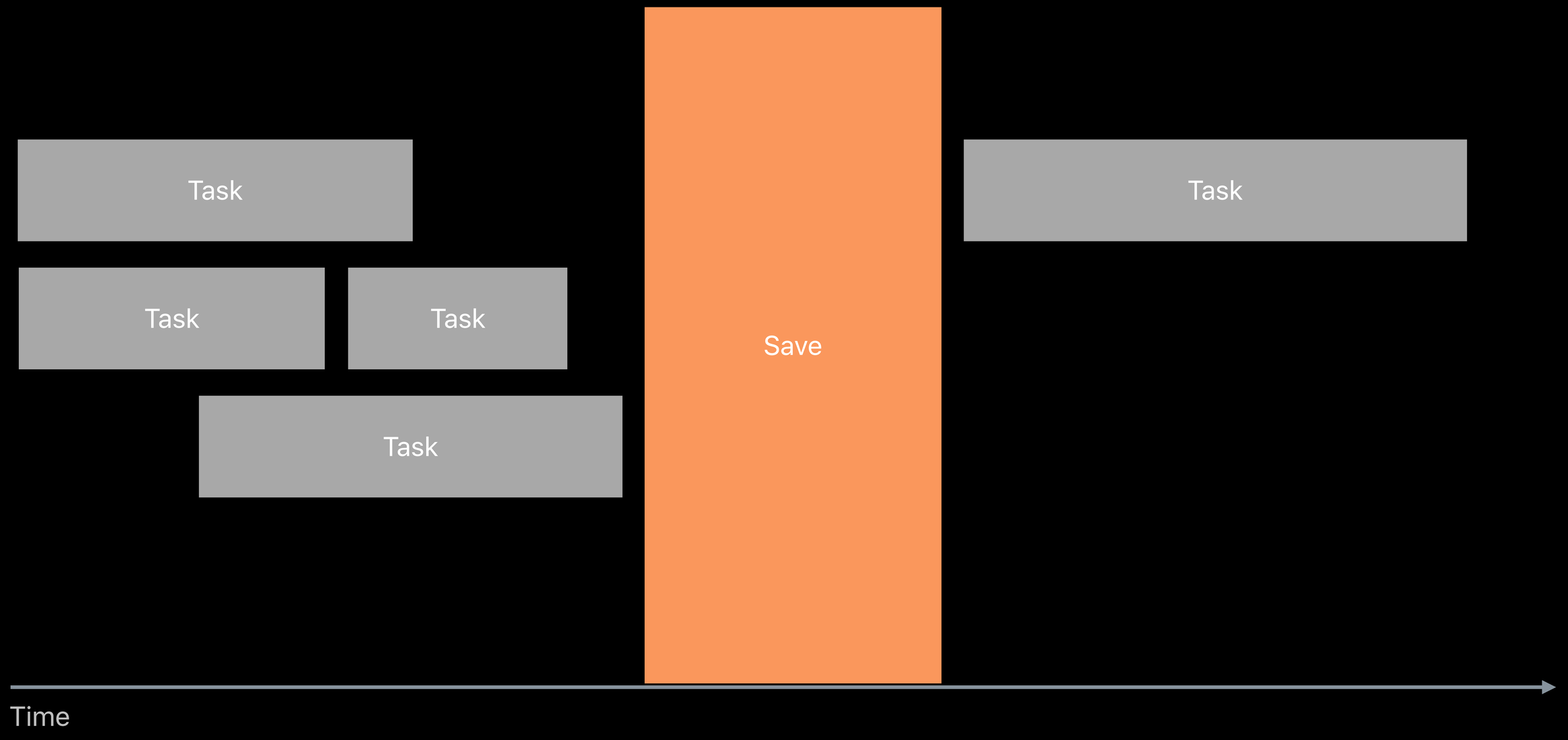

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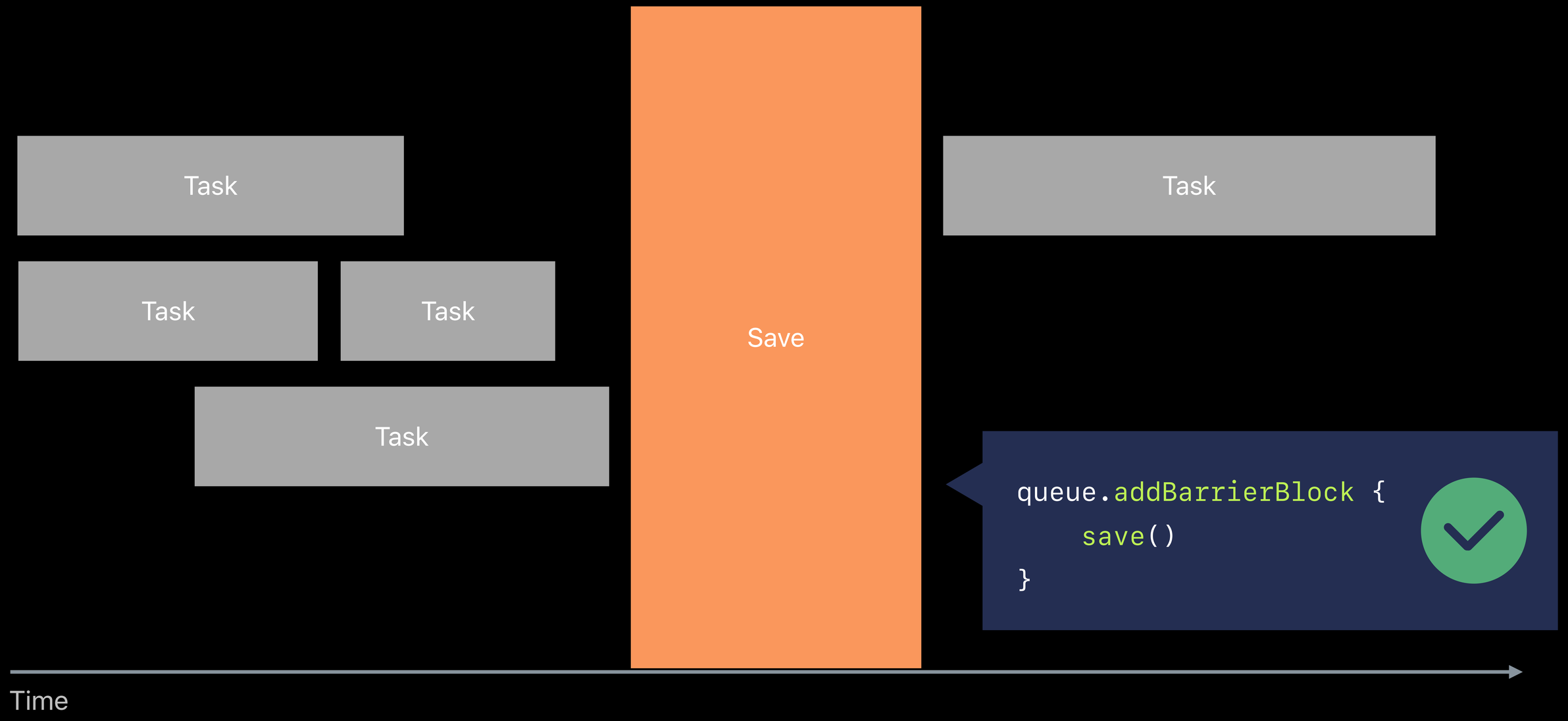

Operation Queue

Progress reporting

```
let queue = OperationQueue()
queue.progress.totalUnitCount = 3

queue.addOperation {
    task1()                                    // Finished task: 1 / 3
}
queue.addOperation {
    task2()                                    // Finished task: 2 / 3
}
queue.addOperation {
    task3()                                    // Finished task: 3 / 3
}
```

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```

Be Prepared for USB and SMB on iOS

Multiple volumes

- Use `FileManager.SearchPathDirectory.itemReplacementDirectory`

Disappearing volumes

- Use `Data.ReadingOptions.mappedIfSafe`

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Be Prepared for USB and SMB on iOS

Slower file system operations

- Defer access to non-main thread

Varying capabilities

- Test capabilities with `URLResourceKey`, e.g. `volumeSupportsFileCloningKey`
- Handle errors

Swift Update

Scanner

```
// Swift 4
var nameNSString: NSString?
if scanner.scanUpToCharacters(from: .newlines, into: &nameNSString) {
   let name = nameNSString! as String
}
```

```
// Swift 5.1
let nameString = scanner.scanUpToCharacters(from: .newlines)
```

Swift Update

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Scanner

```
// Swift 4
var nameNSString: NSString?
if scanner.scanUpToCharacters(from: .newlines, into: &nameNSString) {
   let name = nameNSString! as String
}
```

```
// Swift 5.1
let nameString = scanner.scanUpToCharacters(from: .newlines)
let matchedString = scanner.scanString(string: "hi, 🏠")
```

Swift Update

FileHandle

Error-based API

```
let fileHandle = FileHandle()
let data = try fileHandle.readToEnd()
```

Works with `DataProtocol`

```
extension FileHandle {
    public func write<T: DataProtocol>(contentsOf data: T) throws
}
```

Try It

Use `DataProtocol` instead of `[UInt8]`

Format dates and lists with `Formatter`

Use `OperationQueue`'s barrier and progress reporting

More Information

developer.apple.com/wwdc19/723

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