

# Property Wrappers

## or how Swift decided to become Java 😞

I'm Vincent  

# Property Wrappers!

**But first...**

```
// Kotlin

data class MyServiceResponse(/* ... */)

interface MyService {
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They let developers **extend** their code in a very **declarative** way.

# Swift Developers



# WWDC 2019!



```
struct ContentView : View {
    @State var model = Themes.listModel
    var body: some View {
        List(model.items, action: model.selectItem) { item in
            Image(item.image)
                VStack(alignment: .leading) {
                    Text(item.title)
                    Text(item.subtitle).color(.gray)
                }
        }
    }
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```





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# Swift 5.1



# Property Wrappers!

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import SwiftUI

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# Property Wrappers

`@State` is a Property Wrapper.

A property wrapper **decorates** a **property** with a **custom behavior**.

(This sounds very **similar** to **annotations** in Kotlin/  
Java)

# Property Wrappers

To **understand** how they work under the hood, let's take a **look** at their **implementation**!

The **best place to start** is the Swift Evolution proposal ([SE-0258](#)) where they have been **initially pitched**.

# SE-0258

By reading the **introduction**, we can already get some **insight** in what **motivated** their **addition** to the language.

# SE-0258

*There are **property implementation patterns** that come up **repeatedly**.*

*Rather than **hardcode a fixed set of patterns into the compiler** (as we have done for lazy and @NSCopying), we should **provide a general "property wrapper" mechanism** to allow these patterns to be **defined as libraries**.*

**Let's implement some Property Wrappers**   
**(Courtesy of <https://nshipster.com/propertywrapper/>)**

# clamping Numerical values

# Clamping Numerical Values

```
struct Solution {  
    @Clamping(0...14) var pH: Double = 7.0  
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    var value: Value  
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that's it 

# Clamping Numerical Values

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struct Solution {  
    @Clamping(0...14) var pH: Double = 7.0  
}
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var solution = Solution(pH: 7.0)
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solution.pH = -1  
solution.pH // 0
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# Magic?

# Compiler Magic!

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Whenever we write `solution.pH`, the compiler actually **replaces** it by `solution.pH.wrappedValue`.

This is what makes Property Wrapper incredibly **seamless** to use!

And because this happens at **compile time**, they have **no minimum OS requirement** 

# Compiler Magic

The initializer also gets some compiler magic:

```
init(wrappedValue: Value, _ range: ClosedRange<Value>)  
  
@Clamping(0...14) var pH: Double = 7.0
```

By convention, the argument `wrappedValue` will be set to the initial value of the property (here `7.0`).

# Compiler Magic

If you need to **access** the **Wrapper itself**, you can do so by **implementing** the property `projectedValue`.

```
var projectedValue: Clamping<Value> {  
    get { return self }  
}
```

Which you would then **call** like this:

```
solution.$pH // is of type Clamping<Double>
```

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- etc.

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ISO8601DateFormatter().date(from: " 2019-06-24") // nil (!)
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URL(string: " https://nshipster.com") // nil (!)
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ISO8601DateFormatter().date(from: " 2019-06-24") // nil (!)
```

So let's introduce a **Property Wrapper** that will **trim** such characters!

# Trimming Characters

```
@propertyWrapper
struct Trimmed {
    private(set) var value: String = ""

    var wrappedValue: String {
        get { value }
        set { value = newValue.trimmingCharacters(in: .whitespacesAndNewlines) }
    }

    init(wrappedValue: String) {
        self.wrappedValue = wrappedValue
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}
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# Trimming Characters

```
struct Post {  
    @Trimmed var title: String  
    @Trimmed var body: String  
}
```

```
let quine = Post(title: " Swift Property Wrappers ", body: "...")  
quine.title // "Swift Property Wrappers" (no leading or trailing spaces!)
```

```
quine.title = " @propertyWrapper "  
quine.title // "@propertyWrapper" (still no leading or trailing spaces!)
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# Data Versioning

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We can even go further, and **implement** an entire **business requirement** through a Property Wrapper.

Let's implement a Property Wrapper that will manage an **history** of the **values assigned** to a given **variable**.

(Developers working on **server-side** might find it particularly useful!)

# Data Versioning

```
@propertyWrapper
struct Versioned<Value> {
    private var value: Value
    private(set) var timestampedValues: [(Date, Value)] = []

    var wrappedValue: Value {
        get { value }
        set {
            value = newValue
            timestampedValues.append((Date(), value))
        }
    }

    init(wrappedValue: Value) {
        self.wrappedValue = wrappedValue
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        get { value }
        set {
            value = newValue
            timestampedValues.append((Date(), value))
        }
    }

    init(wrappedValue: Value) {
        self.wrappedValue = wrappedValue
    }
}
```

# Data Versioning

```
@propertyWrapper
struct Versioned<Value> {
    private var value: Value
    private(set) var timestampedValues: [(Date, Value)] = []

    var wrappedValue: Value {
        get { value }
        set {
            value = newValue
            timestampedValues.append((Date(), value))
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    }

    init(wrappedValue: Value) {
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            value = newValue
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        }
    }

    init(wrappedValue: Value) {
        self.wrappedValue = wrappedValue
    }
}
```

# Data Versioning

```
class ExpenseReport {  
    enum State { case submitted, received, approved, denied }  
  
    @Versioned var state: State = .submitted  
}
```

# Data Versioning

A real world back-end application could go even further.

We could implement another wrapper `@Audited`, that would **track which user read or wrote** a given variable.

# Data Versioning

However there are still some **limitations**: Property Wrapper **cannot throw errors**, which makes some interesting use cases **out of reach**.

# Data Versioning

However there are still some **limitations**: Property Wrapper **cannot throw errors**, which makes some interesting use cases **out of reach**.

If it **were possible**, we could write some **pretty cool things**, like extending `@Versioned` to **implement a workflow mechanism** 😍

**We've used Property Wrappers  
to implement standalone features...**

**...Now, let's try to  
interact with existing APIs**

# Let's look at UserDefaults 😐

(Example from <https://www.avanderlee.com/swift/property-wrappers/>)

# UserDefaults

```
extension UserDefaults {  
  
    public enum Keys {  
        static let hasSeenAppIntroduction = "has_seen_app_introduction"  
    }  
  
    /// Indicates whether or not the user has seen the on-boarding.  
    var hasSeenAppIntroduction: Bool {  
        set {  
            set(newValue, forKey: Keys.hasSeenAppIntroduction)  
        }  
        get {  
            return bool(forKey: Keys.hasSeenAppIntroduction)  
        }  
    }  
}
```

# UserDefaults

```
UserDefaults.standard.hasSeenAppIntroduction = true  
  
guard !UserDefaults.standard.hasSeenAppIntroduction else { return }  
showAppIntroduction()
```

# UserDefaults

Very clean call sites 

Requires boilerplate 

# Perfect Use Case for a Property Wrapper

```
@propertyWrapper
struct UserDefault<T> {
    let key: String
    let defaultValue: T

    init(_ key: String, defaultValue: T) {
        self.key = key
        self.defaultValue = defaultValue
    }

    var wrappedValue: T {
        get {
            return UserDefaults.standard.object(forKey: key) as? T ?? defaultValue
        }
        set {
            UserDefaults.standard.set(newValue, forKey: key)
        }
    }
}
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```

# UserDefaults

```
struct UserDefaultsConfig {  
    @UserDefaults("has_seen_app_introduction", defaultValue: false)  
    static var hasSeenAppIntroduction: Bool  
}
```

```
UserDefaultsConfig.hasSeenAppIntroduction = false  
print(UserDefaultsConfig.hasSeenAppIntroduction) // Prints: false  
UserDefaultsConfig.hasSeenAppIntroduction = true  
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# UserDefaults & More

This example focused on **smoothing out interactions** with UserDefaults.

# UserDefaults & More

This example focused on **smoothing out interactions** with UserDefaults.

But it's an **approach** that could be **applied** to **any data store**.

**Property Wrappers  
operate on properties**

thank you,  
Captain Obvious



**Wouldn't it be cool to have  
the same mechanism for functions?**

**Swift** ❤️  
**Functional**

# Functional Programming in Swift

Functions are first-class citizens

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var increment: (Int) -> Int = { $0 + 1 }
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# Functional Programming in Swift

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var increment: (Int) -> Int = { $0 + 1 }

[1, 2, 3].map({ $0 * $0 })

func buildIncrementor() -> (Int) -> Int {
    return { $0 + 1 }
}
```



**We can store a function in a property...**

**...so Property Wrappers can work with functions** 

# **Let's start with a simple use case**

# Caching Pure Functions

# Caching Pure Functions

```
@propertyWrapper
struct Cached<Input: Hashable, Output> {

    private var functionWithCache: (Input) -> Output

    init(wrappedValue: @escaping (Input) -> Output) {
        self.functionWithCache = Cached.addCachingLogic(to: wrappedValue)
    }

    var wrappedValue: (Input) -> Output {
        get { return self.functionWithCache }
        set { self.functionWithCache = Cached.addCachingLogic(to: newValue) }
    }

    private static func addCachingLogic(to function: @escaping (Input) -> Output) -> (Input) -> Output {
        var cache: [Input: Output] = [:]

        return { input in
            if let cachedOutput = cache[input] {
                return cachedOutput
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                cache[input] = output
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        }
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}
```



# Caching Pure Functions

```
struct Trigo {  
    @Cached static var cachedCos = { (x: Double) in cos(x) }  
}
```

```
Trigo.cachedCos(.pi * 2) // takes 48.85 µs
```

```
// value of cos for 2π is now cached
```

```
Trigo.cachedCos(.pi * 2) // takes 0.13 µs
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But we could devise **many others**:

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- `@Delayed(delay: 0.3)` and `@Debounced(delay: 0.3)`, to deal with timing
- `@ThreadSafe`, to wrap a piece of code around a Lock
- etc.

Last one

```
// Kotlin

data class MyServiceResponse(/* ... */)

interface MyService {
    @FormUrlEncoded
    @POST("/myservice/endpoint")
    fun call(@Header("Authorization") authorizationHeader: String,
            @Field("first_argument") firstArgument: String,
            @Field("second_argument") secondArgument: Int
    ): Observable<MyServiceResponse>
}
```

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# **Property Wrappers can't be composed (yet)...**

**...so we're going to implement GET instead**

```
typealias Service<Response> = (_ completionHandler: @escaping (Result<Response, Error>) -> Void) -> ()

@propertyWrapper
struct GET {
    private var url: URL

    init(url: String) {
        self.url = URL(string: url)!
    }

    var wrappedValue: Service<String> {
        get {
            return { completionHandler in
                let task = URLSession.shared.dataTask(with: self.url) { (data, response, error) in
                    guard error == nil else { completionHandler(.failure(error!)); return }
                    let string = String(data: data!, encoding: .utf8)!

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        self.url = URL(string: url)!
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    var wrappedValue: Service<String> {
        get {
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                let task = URLSession.shared.dataTask(with: self.url) { (data, response, error) in
                    guard error == nil else { completionHandler(.failure(error!)); return }

                    let string = String(data: data!, encoding: .utf8)!

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                task.resume()
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typealias Service<Response> = (_ completionHandler: @escaping (Result<Response, Error>) -> Void) -> ()

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struct API {
    @GET(url: "https://samples.openweathermap.org/data/2.5/weather?id=2172797&appid=b6907d289e10d714a6e88b30761fae22")
        static var getCurrentWeather: Service<String>
}

API.getCurrentWeather { result in
    print(result)
}

success("{\"coord\":{\"lon\":145.77,\"lat\":-16.92},\"weather\":[{\\"id\\":802,\\"main\\\":\"Clouds\",\\\"description\\\":\"scattered clouds\",
\\\"icon\\\":\\\"03n\\\"}],\"base\":\"stations\",\\\"main\\\":{\\\"temp\\\":300.15,\\\"pressure\\\":1007,\\\"humidity\\\":74,\\\"temp_min\\\":300.15,\\\"temp_max\\\":300.15},
\\\"visibility\\\":10000,\\\"wind\\\":{\\\"speed\\\":3.6,\\\"deg\\\":160},\\\"clouds\\\":{\\\"all\\\":40},\\\"dt\\\":1485790200,\\\"sys\\\":{\\\"type\\\":1,\\\"id\\\":8166,
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Time to Recap 💪

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- They will **probably lead** to **new and exciting frameworks** 



# Property Wrappers

## or how Swift decided to become Java 😊

Vincent Pradeilles [@v\\_pradeilles](https://twitter.com/v_pradeilles) – Worldline 

