

Enemy of the State

(Swift edition!)

**Programming is all about
abstraction**

**We want to be using the
best possible
abstractions for development**

**What even is
state?**

State

Your stored values at any given time

Mutation

The act of updating some state in place

Variables are state

```
var x: Int
```

```
// Store a value into the variable  
a = 5
```

```
// Update (mutate) the variable, by replacing the value  
a = 2
```

```
// Mutate the variable again  
a++
```

State is

e
a
s
y

Easy
and
Simple
are not the same

See Rich Hickey's talk, "Simple Made Easy"

easy

Familiar or approachable

Simple

Fewer concepts and concerns

**State is
familiar
(but complex)**



0 0 0 0 0 0 0 F
0 0 0 0 0 0 0 3

**State is
complex**

Complexity

Mixing (“complecting”) concepts or concerns

**All systems have
essential complexity**

**State also adds
incidental complexity**

See Moseley and Marks' paper, "Out of the Tar Pit"

var visible → 2 states

var enabled → 4 states

var selected → 8 states!

var highlighted → 16 states!!

**State is just a
glorified cache**

*There are only two
hard problems in
Computer Science:
cache invalidation
and naming things.*

– Phil Karlton

EXAMPLE OF INVALIDATING CACHED UI STATE

*See Andy Matuschak's post, "Mutability, aliasing,
and the caches you didn't know you had"*

**State is
unpredictable**

A photograph of a cheetah in mid-stride, chasing a hartebeest across a grassy plain. The cheetah's body is angled towards the right, and its long legs are extended. The hartebeest is also running, slightly behind the cheetah. The background is a soft-focus view of a savanna landscape.

race conditions

[State is] spooky
action at a distance

– **Albert Einstein (*probably*)**

State is unpredictable

```
let x = self.myInt  
println(x)
```

==> 5

```
let y = self.myInt  
println(y)
```

==> 10 (?!?!)

**State is
hard to test**

Tests

verify expected outputs for certain inputs

State

is an *implicit* input that can change unexpectedly

Example: Testing Core Data

```
id managedObject = [OCMockObject mockForClass:[NSManagedObject class]];
id context = [OCMockObject
    mockForClass:[NSManagedObjectContext class]];

[[context expect] deleteObject:managedObject];
[[[context stub] andReturnValue:@YES] save:[OCMArg anyObjectRef]];

id resultsController = [OCMockObject
    mockForClass:[NSFetchedResultsController class]];

[[[resultsController stub] andReturn:context] managedObjectContext];
[[[resultsController stub] andReturn:managedObject]
    objectAtIndexIndexPath:OCMOCK_ANY];

id viewController = partialMockForViewController();
[[[viewController stub] andReturn:resultsController]
    fetchedResultsController];

[viewController deleteObjectAtIndexPath:nil];
[context verify];
```

from Ash Furrow's C-41 project (sorry, Ash!)

Hey, state happens

- Preferences
- Open documents
- Documents saved to disk
- In-memory or on-disk caches
- UI appearance and content

**Minimize state
Minimize complexity**

**values
Purity
Isolation**

values

Purity

Isolation

structs

enums

**copied
(not shared)**

**Value types are
immutable
in Swift**

But I can set the properties of a struct in Swift! This guy doesn't know what he's talking about.

– You, the audience

“Mutating” a struct in Swift

```
struct Point {  
    var x = 0.0  
    var y = 0.0  
  
    mutating func scale(factor: Double) {  
        self.x *= factor  
        self.y *= factor  
    }  
}
```

“Mutating” a struct in Swift

```
var p = Point(x: 5, y: 10)
```

“Mutating” a struct in Swift

```
var p = Point(x: 5, y: 10)  
p.x = 7 // p = (7, 10)
```

“Mutating” a struct in Swift

```
var p = Point(x: 5, y: 10)
p.x = 7           // p = (7, 10)
p.scale(2)       // p = (14, 20)
```

“Mutating” a struct in Swift

```
var p = Point(x: 5, y: 10)  
let q = p
```

“Mutating” a struct in Swift

```
var p = Point(x: 5, y: 10)
let q = p

p.scale(2)    // p = (10, 20)
              // q = (5, 10)
```

Here's the key:

**Variables mutate
values never change**

“Mutating” a struct in Swift

```
var p = Point(x: 5, y: 10)
let q = p

p.scale(2)    // p = (10, 20)
              // q = (5, 10)
```

“Mutating” a struct in Swift

```
var p = Point(x: 5, y: 10)
```

```
let q = p
```

```
p.scale(2) // p = (10, 20)
```

```
// q = (5, 10)
```

```
q.x = 2
```

```
q.scale(2) // Error!
```

“Mutating” functions

```
func pointByScaling(factor: Double) -> Point {  
    return Point(self.x * factor, self.y * factor)  
}
```

```
mutating func scale(factor: Double) {  
    self.x *= factor  
    self.y *= factor  
}
```

“Mutating” functions

```
func pointByScaling(self: Point, factor: Double) -> Point {  
    return Point(self.x * factor, self.y * factor)  
}
```

```
mutating func scale(self: Point, factor: Double) {  
    self.x *= factor  
    self.y *= factor  
}
```

“Mutating” functions

```
func pointByScaling(self: Point, factor: Double) -> Point {  
    return Point(self.x * factor, self.y * factor)  
}
```

```
mutating func scale(inout self: Point, factor: Double) {  
    self.x *= factor  
    self.y *= factor  
}
```

**Variables mutate
values never change**

so what?

**Values are automatically
thread-safe**

**Values are automatically
predictable**

Values are predictable

```
let value = self.myData
```

```
let x = value.someInt  
println(x)
```

==> 5

```
let y = value.someInt  
println(y)
```

==> still 5!

Values

Purity

Isolation

Pure functions

Same inputs always yield the same result

Must not have *observable* side effects

```
// Pure: concatenates two input strings and
// returns the result.
func +(lhs: String, rhs: String) -> String
```

```
protocol GeneratorType {
    // Impure: advances to the next element
    // and returns it.
    mutating func next() -> Element?
}
```

```
struct Array {
    // Pure(?)
    var count: Int { get }
}
```

**Impure functions are
surprising**

Insanity is doing the
same thing over and
over again but
expecting **different**
results.

**EXAMPLE OF
MANAGED
OBJECT
VALUEFORKEY**

MAKING CORE DATA PURE?

**EXAMPLE OF
MANAGED
OBJECT
VALUEFORKEY**

**Pure functions are
easily tested**

**EXAMPLE OF
TESTING
MANAGED
OBJECTS BEFORE**

**EXAMPLE OF
TESTING
MANAGED
OBJECTS AFTER**

Values

Purity

Isolation

**Objects should have
only one
reason to change**

**Isolate
unrelated
pieces of state**

Isolation Done Wrong™

```
class MyViewController: UIViewController {  
    // When logging in  
    var username: String?  
    var password: String?  
  
    // After logging in  
    var loggedInUser: User?  
}
```

Isolation Done Right™

```
// For logging in
class LoginViewModel {
    var username: String?
    var password: String?

    func logIn() -> UserViewModel?
}
```

```
// After logging in
class UserViewModel {
    var loggedInUser: User?
}
```

Stateless core, stateful shell

- Keep core **domain logic** in completely immutable value types
- Add **stateful shell objects** with mutable references to the immutable data

See Gary Bernhardt's talk, "Boundaries"

Model-View-ViewModel

IMAGE HERE

Model-View-ViewModel

```
struct User { ... }

class UserViewModel {
    var loggedInUser: User?

    func logOut() {
        loggedInUser = nil
    }
}
```

**Globals:
Just Say No**

**Globals get mixed in to
every part
of your program**

**Isolation reduces complexity
 Globals compound it**

**Singletons
are global state**

Let's just pass
instances
around instead

Example: Singleton Networking

```
class APIClient {  
    // Access the singleton with APIClient.sharedClient  
    class var sharedClient: APIClient {  
        struct Singleton {  
            static let instance = APIClient()  
        }  
  
        return Singleton.instance  
    }  
  
    // Fetches the top-level list of categories  
    func fetchCategories() -> [Category]  
}
```

Example: Singleton Networking

```
class MyViewController: UIViewController {  
    override func viewDidAppear(animated: Bool) {  
        super.viewDidAppear(animated)  
  
        APIClient.sharedClient.fetchCategories()  
    }  
}
```

Example: Instance Networking

```
class APIClient {  
    // Fetches the top-level list of categories  
    func fetchCategories() -> [Category]  
}
```

Example: Instance Networking

```
class MyViewController: UIViewController {  
    let client: APIClient  
  
    designated init(client: APIClient) {  
        super.init(nibName: nil, bundle: nil)  
    }  
  
    override func viewDidAppear(animated: Bool) {  
        super.viewDidAppear(animated)  
  
        client.fetchCategories()  
    }  
}
```

Easily testable
Explicit dependencies
More flexible

**values
Purity
Isolation**

THE

DR

**Minimize state
Minimize complexity**

Learning More

WWDC 2014

Session 229

"Advanced iOS Application

Architecture and Patterns"

Check out ReactiveCocoa
github.com/ReactiveCocoa/ReactiveCocoa

Haskell

book.realworldhaskell.org

Elm

elm-lang.org

**Presentation available at
github.com/jspahrsummers/enemy-of-the-state**