CSC 471 / 371 Mobile Application Development for iOS

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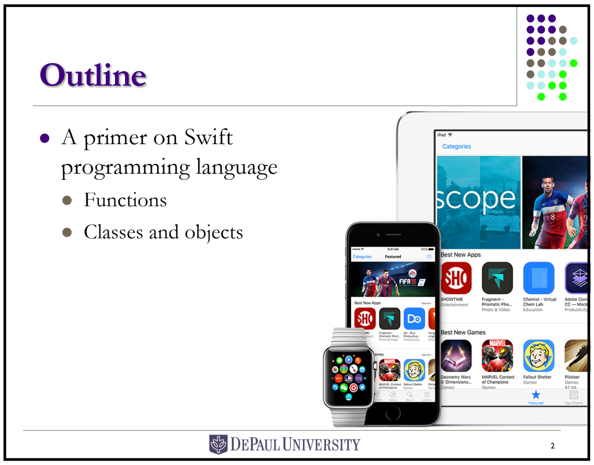

Outline

- A primer on Swift programming language
  - Functions
  - Classes and objects

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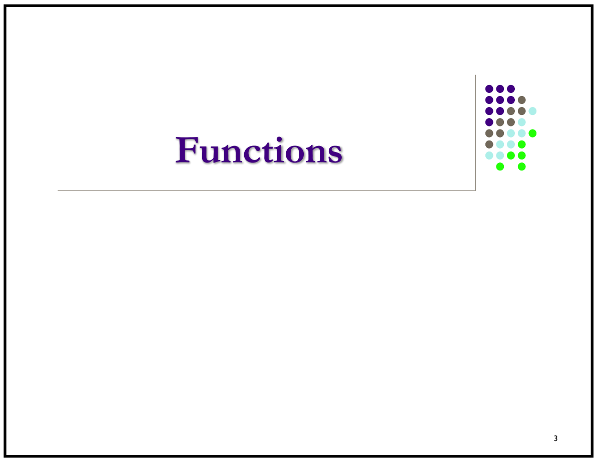

Functions

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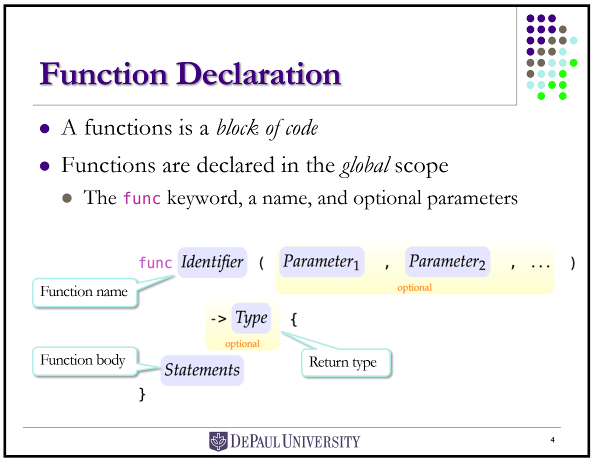

Function Declaration

- A functions is a *block of code*
- Functions are declared in the *global* scope
  - The `func` keyword, a name, and optional parameters

func *Identifier* (*Parameter*$_1$, *Parameter*$_2$, …)
optional
-> *Type* {
optional
Statements
}

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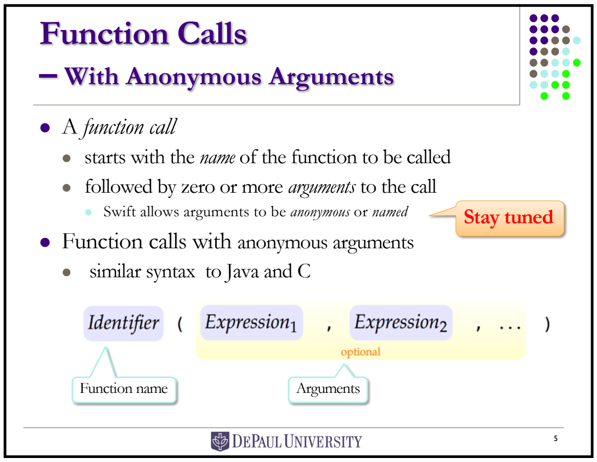

Function Calls – With Anonymous Arguments

- A *function call*
  - starts with the *name* of the function to be called
  - followed by zero or more *arguments* to the call
    - Swift allows arguments to be *anonymous* or *named*
- Function calls with anonymous arguments
  - similar syntax to Java and C

Stay tuned

Identifier (*Expression*$_1$, *Expression*$_2$, …)
optional

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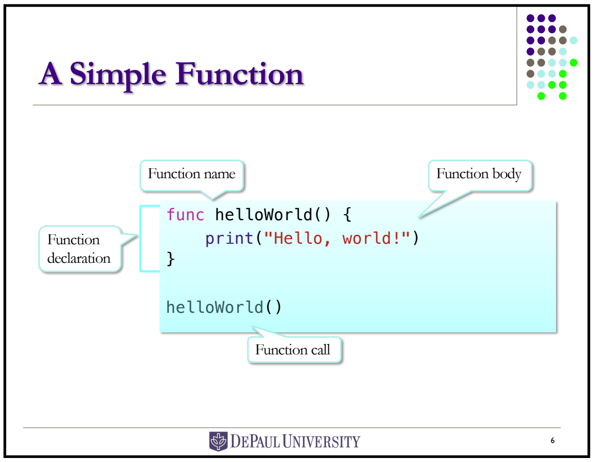

A Simple Function

```
func helloWorld() {
    print("Hello, world!")
}

helloWorld()
```

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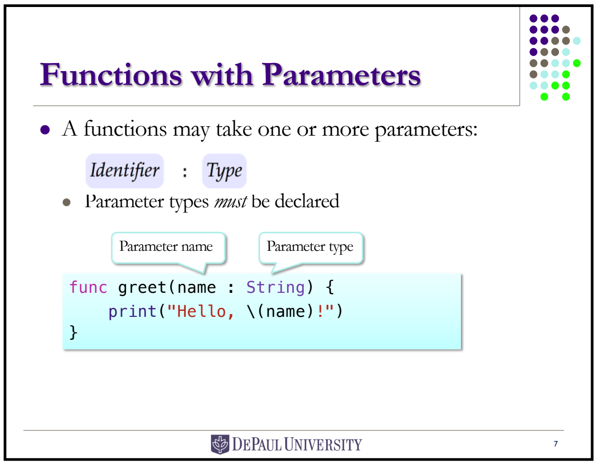

Functions with Parameters

- A functions may take one or more parameters:

  Identifier : *Type*

  - Parameter types *must* be declared

Parameter name

Parameter type

```
func greet(name : String) {
    print("Hello, \(name)!")
}
```

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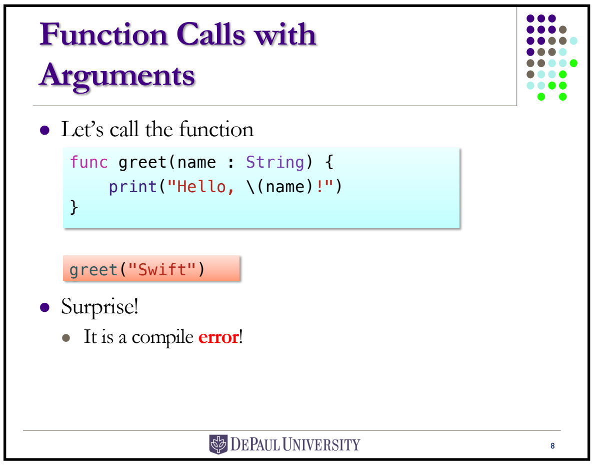

Function Calls with Arguments

- Let's call the function

```
func greet(name : String) {
    print("Hello, \(name)!")
}
```

```
greet("Swift")
```

- Surprise!
  - It is a compile **error**!

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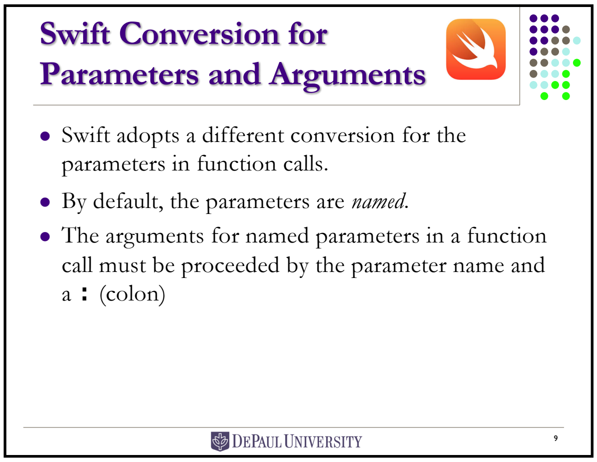

Swift Conversion for Parameters and Arguments

- Swift adopts a different conversion for the parameters in function calls.
- By default, the parameters are *named.*
- The arguments for named parameters in a function call must be proceeded by the parameter name and a **:** (colon)

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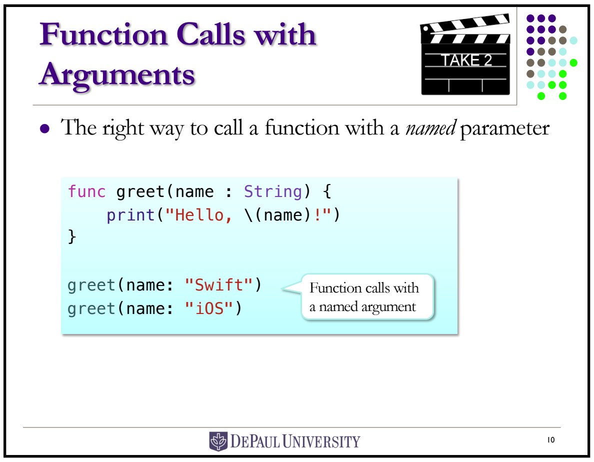

Function Calls with Arguments

TAKE 2

- The right way to call a function with a *named* parameter

```
func greet(name : String) {
    print("Hello, \(name)!")
}

greet(name: "Swift")
greet(name: "iOS")
```

Function calls with a named argument

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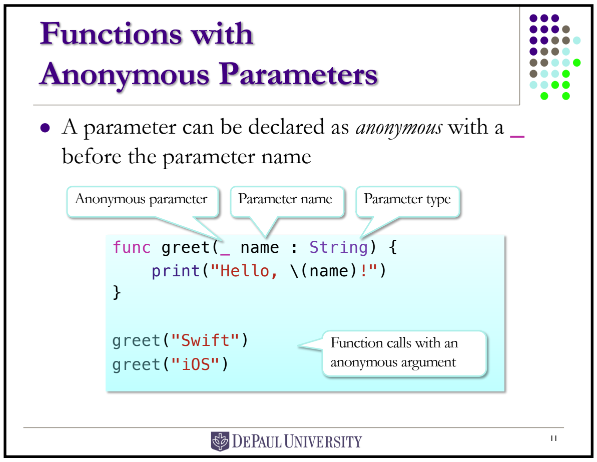

Functions with Anonymous Parameters

- A parameter can be declared as *anonymous* with a _ before the parameter name

Anonymous parameter

Parameter name

Parameter type

```
func greet(_ name : String) {
    print("Hello, \(name)!")
}

greet("Swift")
greet("iOS")
```

Function calls with an anonymous argument

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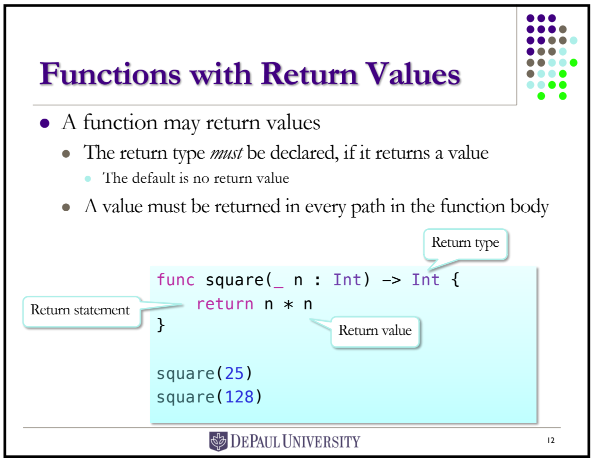

Functions with Return Values

- A function may return values
  - The return type *must* be declared, if it returns a value
    - The default is no return value
  - A value must be returned in every path in the function body

Return type

Return statement

```
func square(_ n : Int) -> Int {
    return n * n
}

square(25)
square(128)
```

Return value

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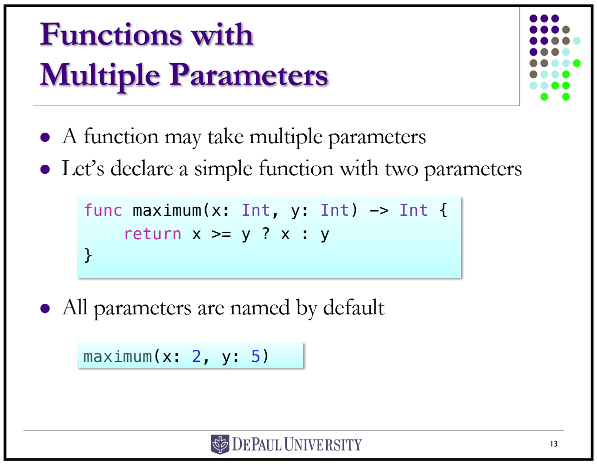

Functions with Multiple Parameters

- A function may take multiple parameters
- Let's declare a simple function with two parameters

```
func maximum(x: Int, y: Int) -> Int {
    return x >= y ? x : y
}
```

- All parameters are named by default

```
maximum(x: 2, y: 5)
```

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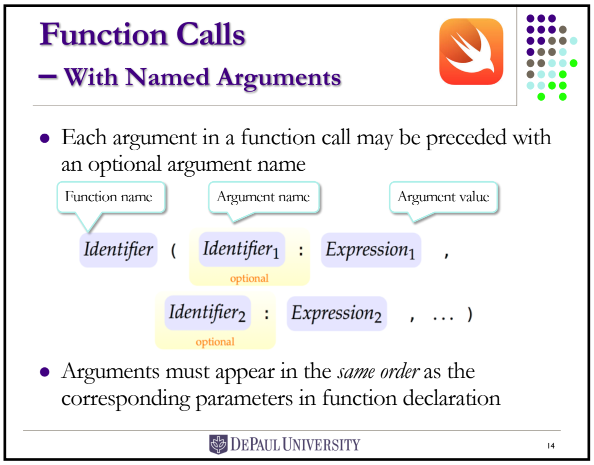

Function Calls – With Named Arguments

- Each argument in a function call may be preceded with an optional argument name

Function name
Argument name
Argument value

Identifier (*Identifier*$_1$: *Expression*$_1$,
optional

Identifier$_2$: *Expression*$_2$, …)
optional

- Arguments must appear in the *same order* as the corresponding parameters in function declaration

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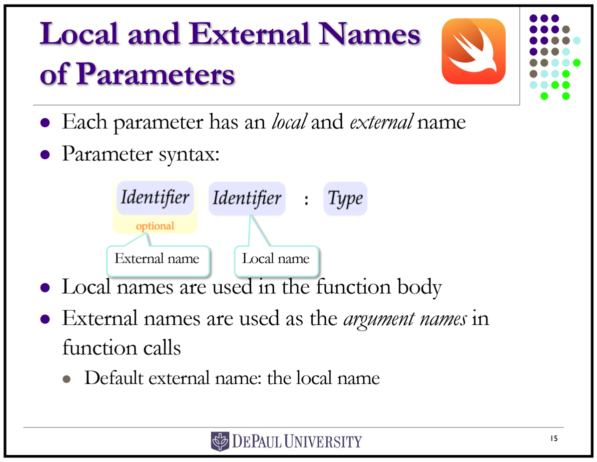

Local and External Names of Parameters

- Each parameter has an *local* and *external* name
- Parameter syntax:

Identifier *Identifier* : *Type*
optional

External name
Local name

- Local names are used in the function body
- External names are used as the *argument names* in function calls
  - Default external name: the local name

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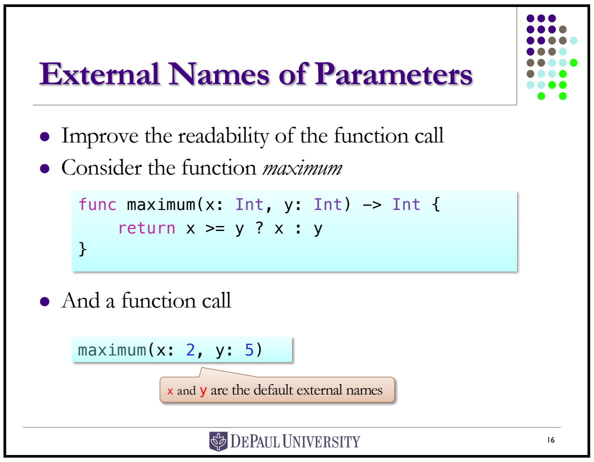

External Names of Parameters

- Improve the readability of the function call
- Consider the function *maximum*

```
func maximum(x: Int, y: Int) -> Int {
    return x >= y ? x : y
}
```

- And a function call

```
maximum(x: 2, y: 5)
```

x and y are the default external names

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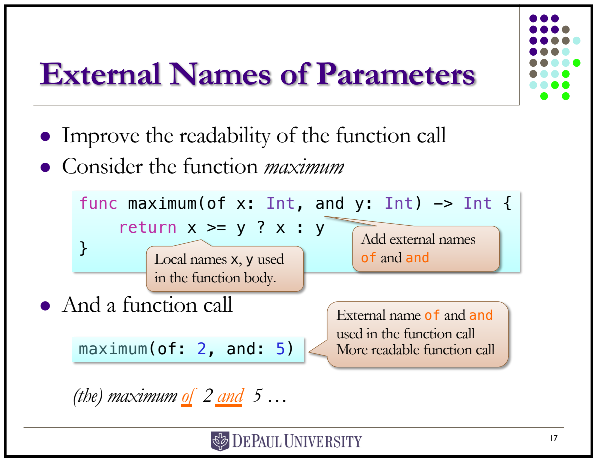

External Names of Parameters

- Improve the readability of the function call
- Consider the function *maximum*

```
func maximum(of x: Int, and y: Int) -> Int {
    return x >= y ? x : y
}
```

Local names x, y used in the function body.

Add external names of and and

- And a function call

```
maximum(of: 2, and: 5)
```

External name of and and used in the function call More readable function call

(the) maximum of 2 and 5 …

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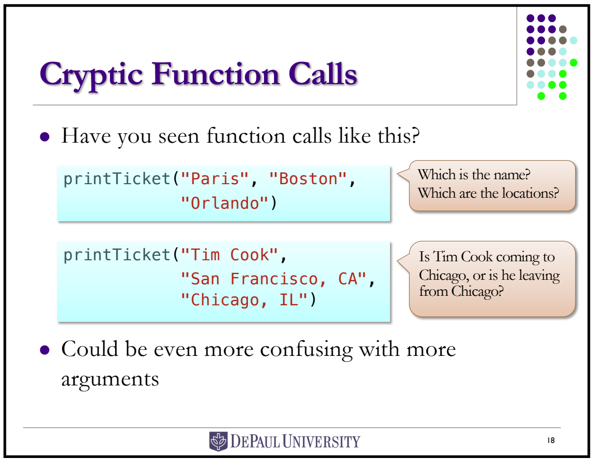

Cryptic Function Calls

- Have you seen function calls like this?

```
printTicket("Paris", "Boston",
            "Orlando")
```

Which is the name? Which are the locations?

```
printTicket("Tim Cook",
            "San Francisco, CA",
            "Chicago, IL")
```

Is Tim Cook coming to Chicago, or is he leaving from Chicago?

- Could be even more confusing with more arguments

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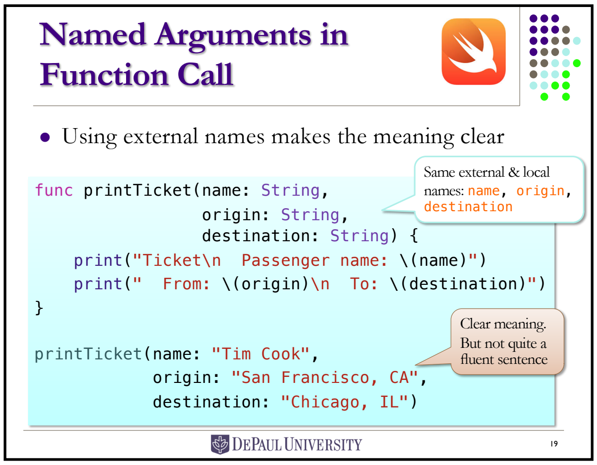

Named Arguments in Function Call

- Using external names makes the meaning clear

```
func printTicket(name: String,
                 origin: String,
                 destination: String) {
    print("Ticket\n  Passenger name: \(name)")
    print("  From: \(origin)\n  To: \(destination)")
}

printTicket(name: "Tim Cook",
            origin: "San Francisco, CA",
            destination: "Chicago, IL")
```

Same external & local names: name, origin, destination

Clear meaning. But not quite a fluent sentence

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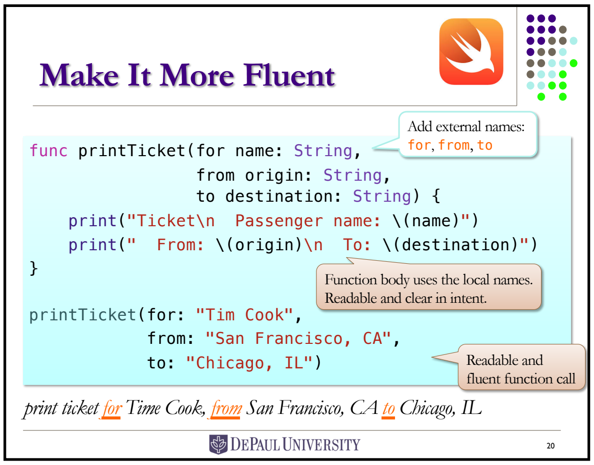

Make It More Fluent

```
func printTicket(for name: String,
                 from origin: String,
                 to destination: String) {
    print("Ticket\n  Passenger name: \(name)")
    print("  From: \(origin)\n  To: \(destination)")
}

printTicket(for: "Tim Cook",
            from: "San Francisco, CA",
            to: "Chicago, IL")
```

Add external names: for, from, to

Function body uses the local names. Readable and clear in intent.

Readable and fluent function call

print ticket for Time Cook, from San Francisco, CA to Chicago, IL

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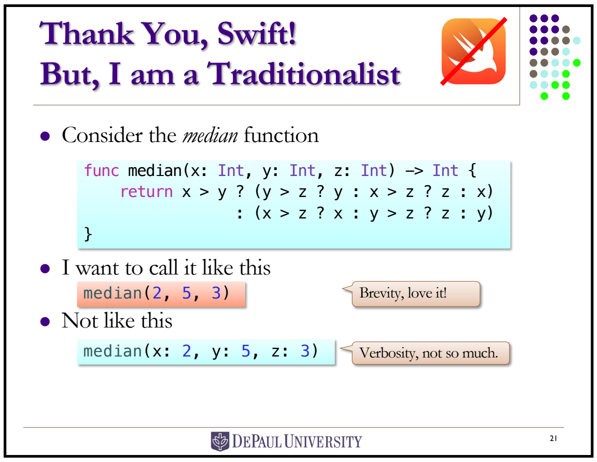

Thank You, Swift! But, I am a Traditionalist

- Consider the *median* function

```
func median(x: Int, y: Int, z: Int) -> Int {
    return x > y ? (y > z ? y : x > z ? z : x)
                 : (x > z ? x : y > z ? z : y)
}
```

- I want to call it like this

```
median(2, 5, 3)
```

Brevity, love it!

- Not like this

```
median(x: 2, y: 5, z: 3)
```

Verbosity, not so much.

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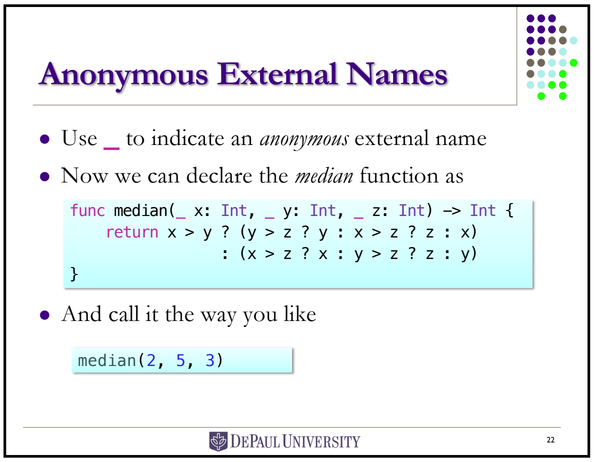

Anonymous External Names

- Use _ to indicate an *anonymous* external name
- Now we can declare the *median* function as

```
func median(_ x: Int, _ y: Int, _ z: Int) -> Int {
    return x > y ? (y > z ? y : x > z ? z : x)
                 : (x > z ? x : y > z ? z : y)
}
```

- And call it the way you like

```
median(2, 5, 3)
```

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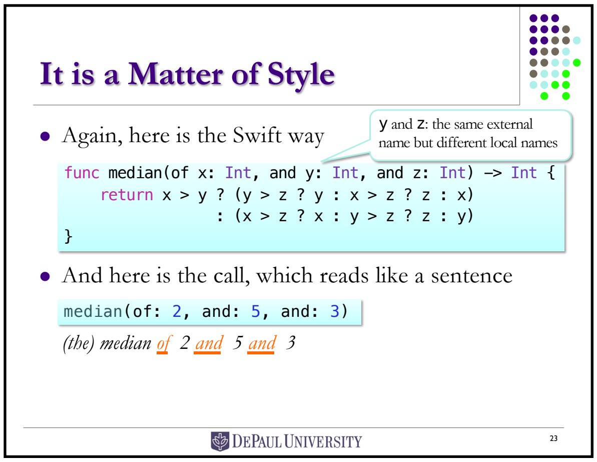

It is a Matter of Style

- Again, here is the Swift way

y and z: the same external name but different local names

```
func median(of x: Int, and y: Int, and z: Int) -> Int {
    return x > y ? (y > z ? y : x > z ? z : x)
                 : (x > z ? x : y > z ? z : y)
}
```

- And here is the call, which reads like a sentence

```
median(of: 2, and: 5, and: 3)
```

(the) median of 2 and 5 and 3

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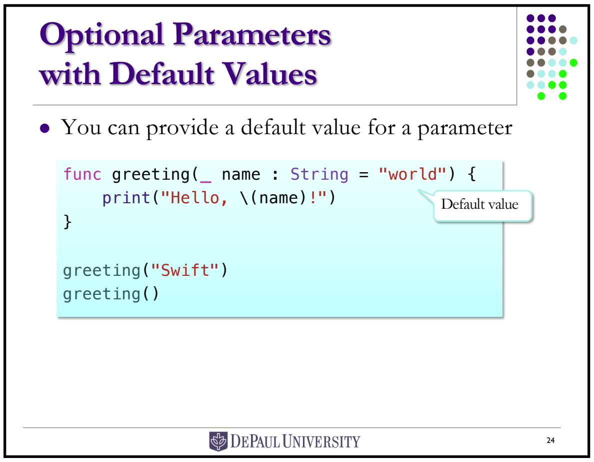

Optional Parameters with Default Values

- You can provide a default value for a parameter

```
func greeting(_ name : String = "world") {
    print("Hello, \(name)!")
}

greeting("Swift")
greeting()
```

Default value

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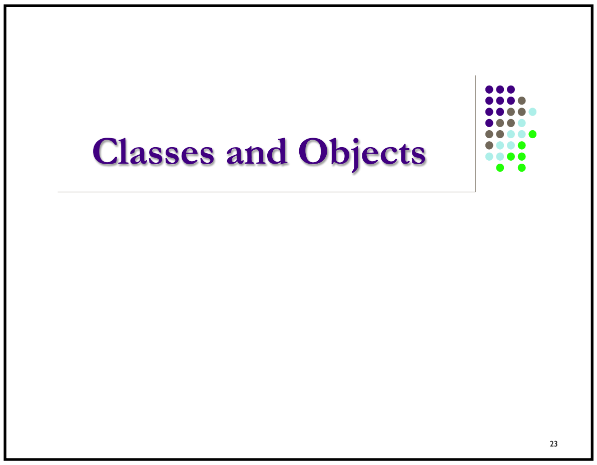

Classes and Objects

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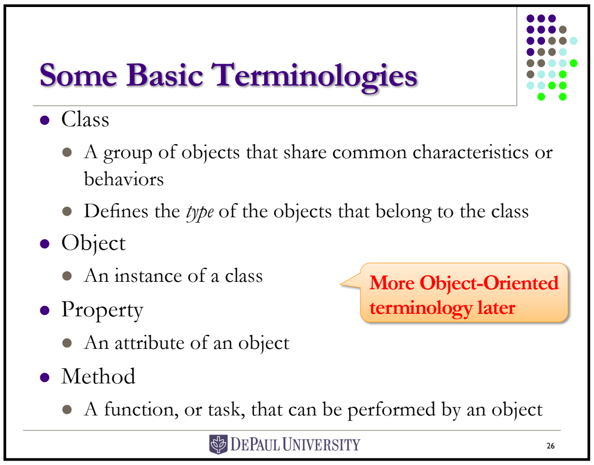

Some Basic Terminologies

- Class
  - A group of objects that share common characteristics or behaviors
  - Defines the *type* of the objects that belong to the class
- Object
  - An instance of a class
- Property
  - An attribute of an object
- Method
  - A function, or task, that can be performed by an object

More Object-Oriented terminology later

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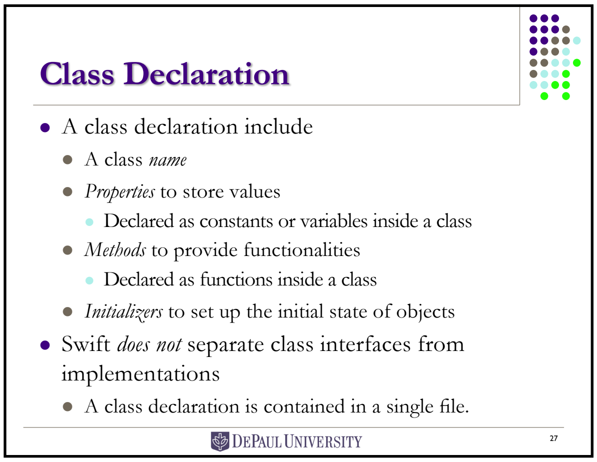

Class Declaration

- A class declaration include
  - A class *name*
  - *Properties* to store values
    - Declared as constants or variables inside a class
  - *Methods* to provide functionalities
    - Declared as functions inside a class
  - *Initializers* to set up the initial state of objects
- Swift *does not* separate class interfaces from implementations
  - A class declaration is contained in a single file.

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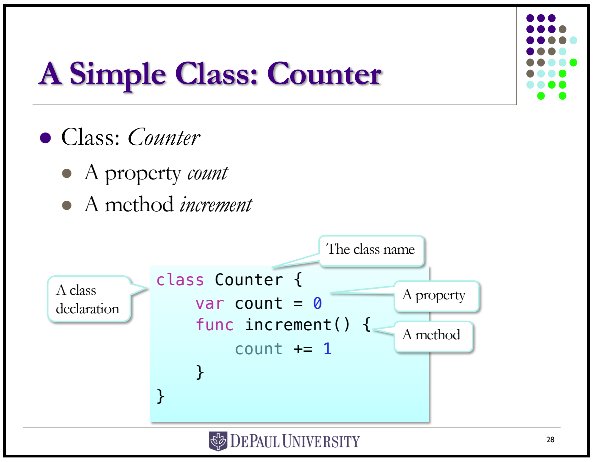

A Simple Class: Counter

- Class: *Counter*
  - A property *count*
  - A method *increment*

The class name

A class declaration

A property

A method

```
class Counter {
    var count = 0
    func increment() {
        count += 1
    }
}
```

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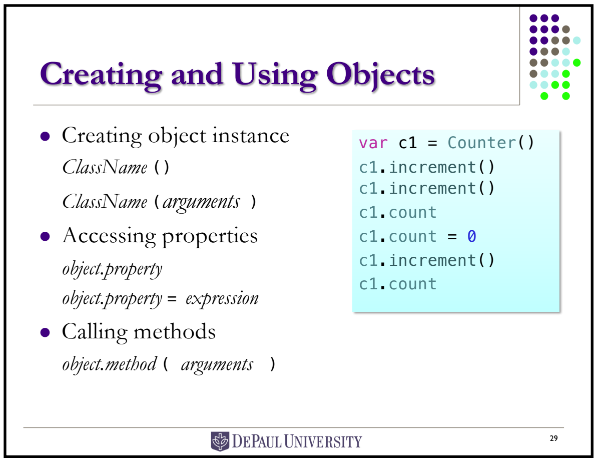

Creating and Using Objects

- Creating object instance

  ClassName ( )

  ClassName (*arguments*)
- Accessing properties

  object.property

  object.property = *expression*
- Calling methods

  object.method (*arguments*)

```
var c1 = Counter()
c1.increment()
c1.increment()
c1.count
c1.count = 0
c1.increment()
c1.count
```

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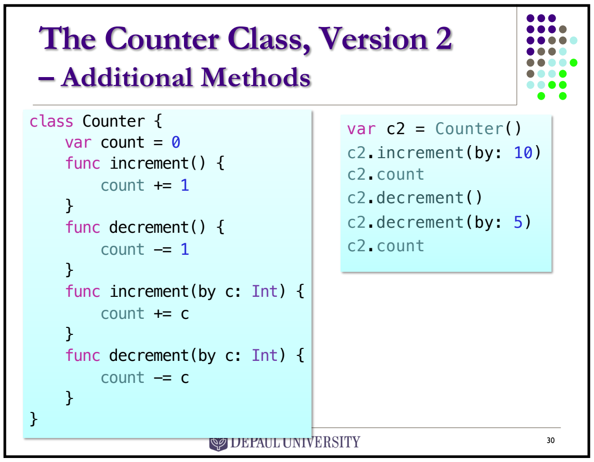

The Counter Class, Version 2 – Additional Methods

```
class Counter {
    var count = 0
    func increment() {
        count += 1
    }
    func decrement() {
        count -= 1
    }
    func increment(by c: Int) {
        count += c
    }
    func decrement(by c: Int) {
        count -= c
    }
}
```

```
var c2 = Counter()
c2.increment(by: 10)
c2.count
c2.decrement()
c2.decrement(by: 5)
c2.count
```

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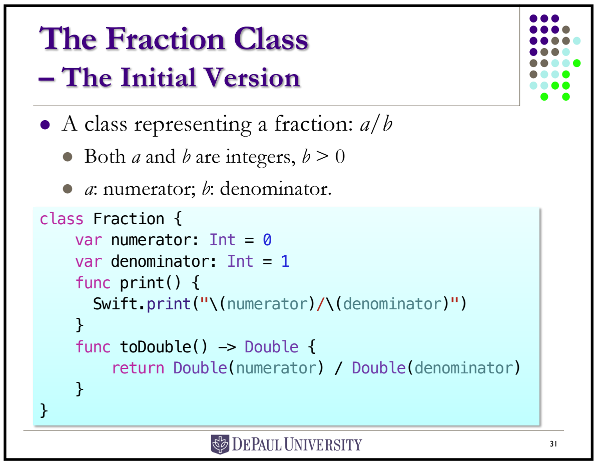

The Fraction Class – The Initial Version

- A class representing a fraction: *a*/*b*
  - Both *a* and *b* are integers, *b* > 0
  - *a*: numerator; *b*: denominator.

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    func print() {
      Swift.print("\(numerator)/\(denominator)")
    }
    func toDouble() -> Double {
        return Double(numerator) / Double(denominator)
    }
}
```

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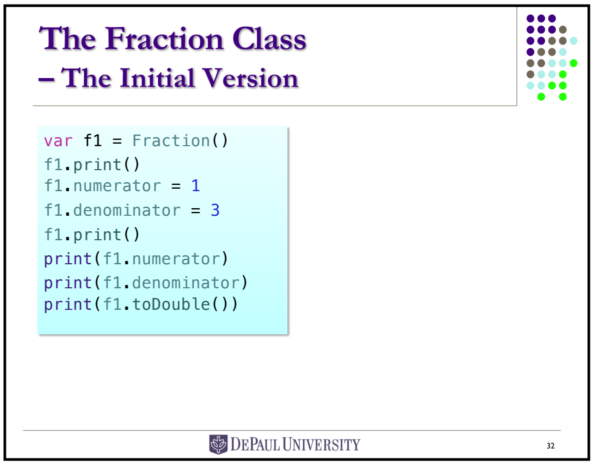

The Fraction Class – The Initial Version

```
var f1 = Fraction()
f1.print()
f1.numerator = 1
f1.denominator = 3
f1.print()
print(f1.numerator)
print(f1.denominator)
print(f1.toDouble())
```

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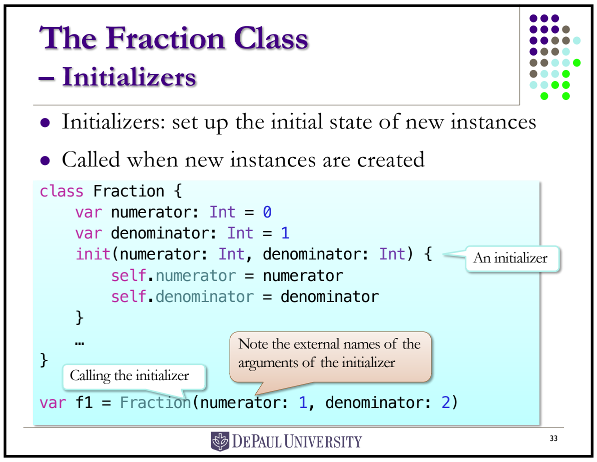

The Fraction Class – Initializers

- Initializers: set up the initial state of new instances
- Called when new instances are created

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    init(numerator: Int, denominator: Int) {
        self.numerator = numerator
        self.denominator = denominator
    }
    …
}
var f1 = Fraction(numerator: 1, denominator: 2)
```

An initializer

Note the external names of the arguments of the initializer

Calling the initializer

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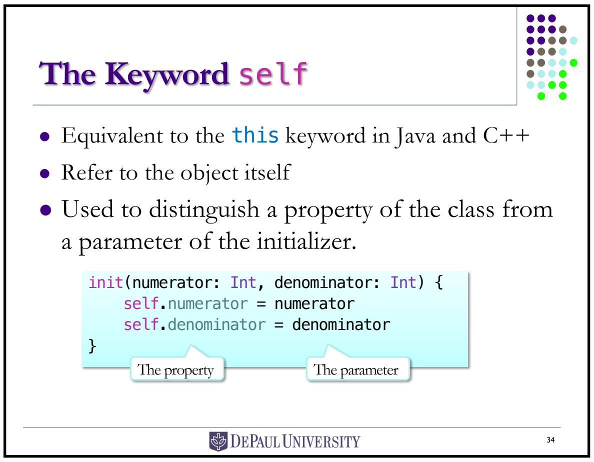

The Keyword `self`

- Equivalent to the `this` keyword in Java and C++
- Refer to the object itself
- Used to distinguish a property of the class from a parameter of the initializer.

```
init(numerator: Int, denominator: Int) {
    self.numerator = numerator
    self.denominator = denominator
}
```

The property

The parameter

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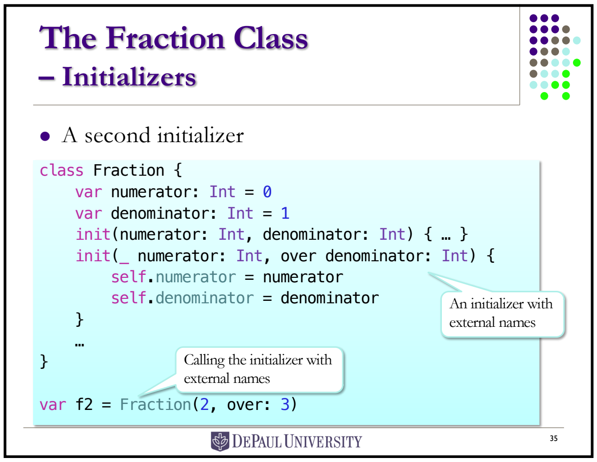

The Fraction Class – Initializers

- A second initializer

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    init(numerator: Int, denominator: Int) { … }
    init(_ numerator: Int, over denominator: Int) {
        self.numerator = numerator
        self.denominator = denominator
    }
    …
}
var f2 = Fraction(2, over: 3)
```

An initializer with external names

Calling the initializer with external names

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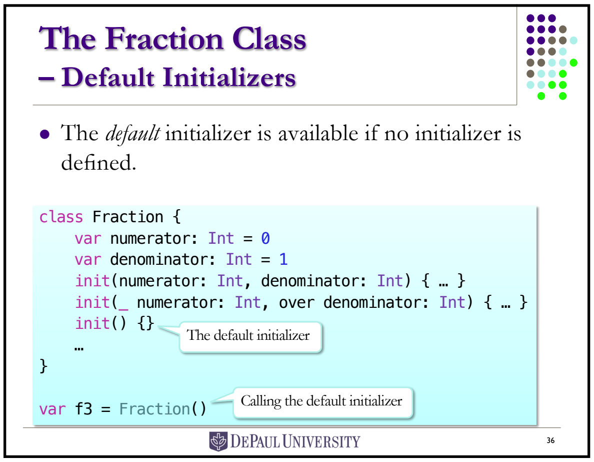

The Fraction Class – Default Initializers

- The *default* initializer is available if no initializer is defined.

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    init(numerator: Int, denominator: Int) { … }
    init(_ numerator: Int, over denominator: Int) { … }
    init() {}
    …
}
var f3 = Fraction()
```

The default initializer

Calling the default initializer

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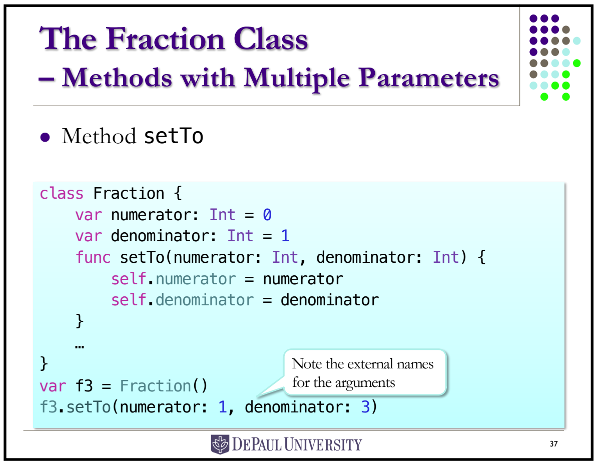

The Fraction Class – Methods with Multiple Parameters

- Method `setTo`

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    func setTo(numerator: Int, denominator: Int) {
        self.numerator = numerator
        self.denominator = denominator
    }
    …
}
var f3 = Fraction()
f3.setTo(numerator: 1, denominator: 3)
```

Note the external names for the arguments

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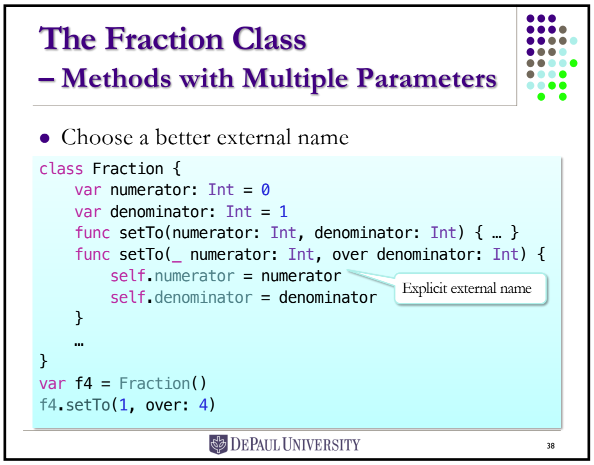

The Fraction Class – Methods with Multiple Parameters

- Choose a better external name

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    func setTo(numerator: Int, denominator: Int) { … }
    func setTo(_ numerator: Int, over denominator: Int) {
        self.numerator = numerator
        self.denominator = denominator
    }
    …
}
var f4 = Fraction()
f4.setTo(1, over: 4)
```

Explicit external name

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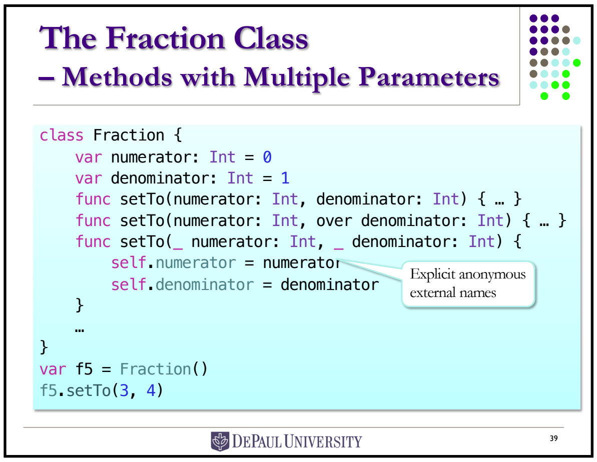

The Fraction Class – Methods with Multiple Parameters

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    func setTo(numerator: Int, denominator: Int) { … }
    func setTo(numerator: Int, over denominator: Int) { … }
    func setTo(_ numerator: Int, _ denominator: Int) {
        self.numerator = numerator
        self.denominator = denominator
    }
    …
}
var f5 = Fraction()
f5.setTo(3, 4)
```

Explicit anonymous external names

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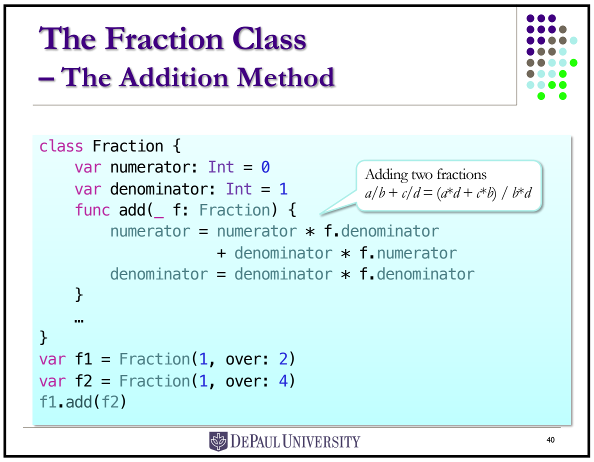

The Fraction Class – The Addition Method

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    func add(_ f: Fraction) {
        numerator = numerator * f.denominator
                  + denominator * f.numerator
        denominator = denominator * f.denominator
    }
    …
}
var f1 = Fraction(1, over: 2)
var f2 = Fraction(1, over: 4)
f1.add(f2)
```

Adding two fractions
$a/b + c/d = (a*d + c*b) / b*d$

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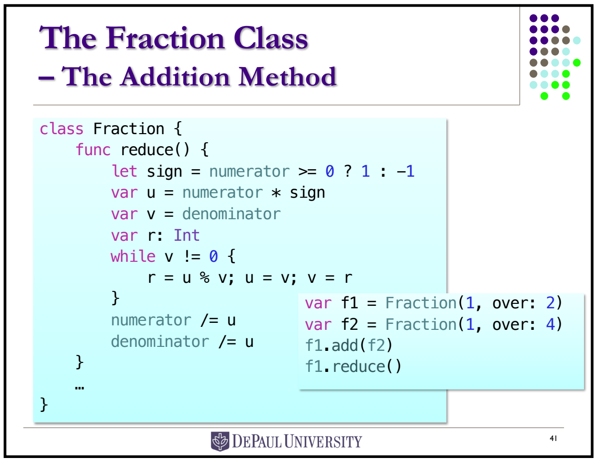

The Fraction Class – The Addition Method

```
class Fraction {
    func reduce() {
        let sign = numerator >= 0 ? 1 : -1
        var u = numerator * sign
        var v = denominator
        var r: Int
        while v != 0 {
            r = u % v; u = v; v = r
        }
        numerator /= u
        denominator /= u
    }
    …
}
```

```
var f1 = Fraction(1, over: 2)
var f2 = Fraction(1, over: 4)
f1.add(f2)
f1.reduce()
```

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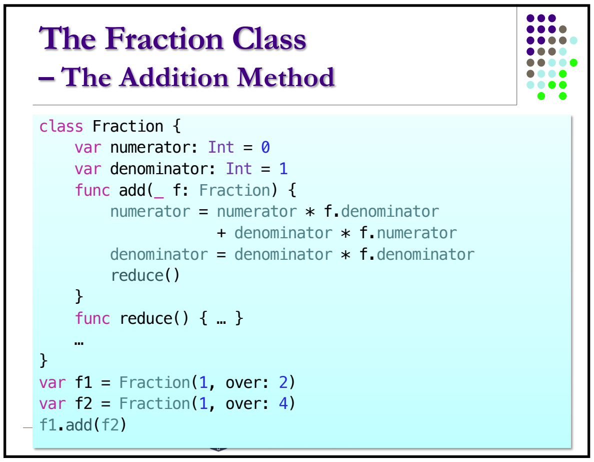

The Fraction Class – The Addition Method

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    func add(_ f: Fraction) {
        numerator = numerator * f.denominator
                  + denominator * f.numerator
        denominator = denominator * f.denominator
        reduce()
    }
    func reduce() { … }
    …
}
var f1 = Fraction(1, over: 2)
var f2 = Fraction(1, over: 4)
f1.add(f2)
```

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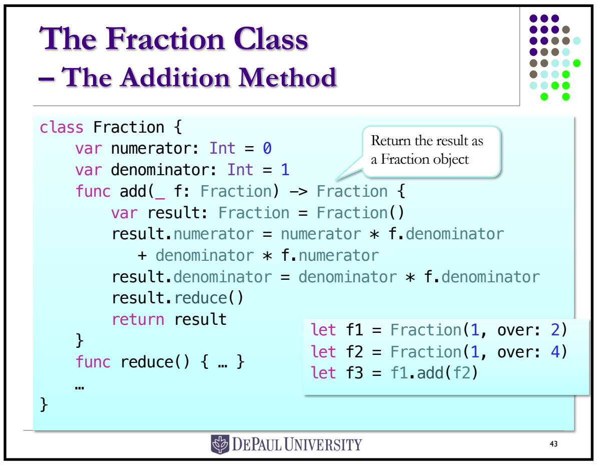

The Fraction Class – The Addition Method

```
class Fraction {
    var numerator: Int = 0
    var denominator: Int = 1
    func add(_ f: Fraction) -> Fraction {
        var result: Fraction = Fraction()
        result.numerator = numerator * f.denominator
           + denominator * f.numerator
        result.denominator = denominator * f.denominator
        result.reduce()
        return result
    }
    func reduce() { … }
    …
}
```

Return the result as a Fraction object

```
let f1 = Fraction(1, over: 2)
let f2 = Fraction(1, over: 4)
let f3 = f1.add(f2)
```

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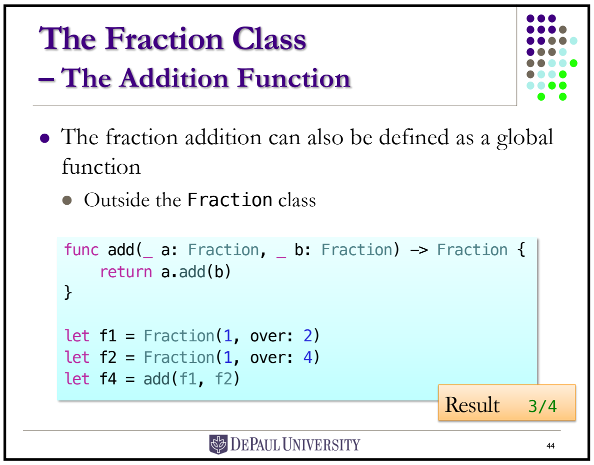

The Fraction Class – The Addition Function

- The fraction addition can also be defined as a global function
  - Outside the `Fraction` class

```
func add(_ a: Fraction, _ b: Fraction) -> Fraction {
    return a.add(b)
}

let f1 = Fraction(1, over: 2)
let f2 = Fraction(1, over: 4)
let f4 = add(f1, f2)
```

Result 3/4

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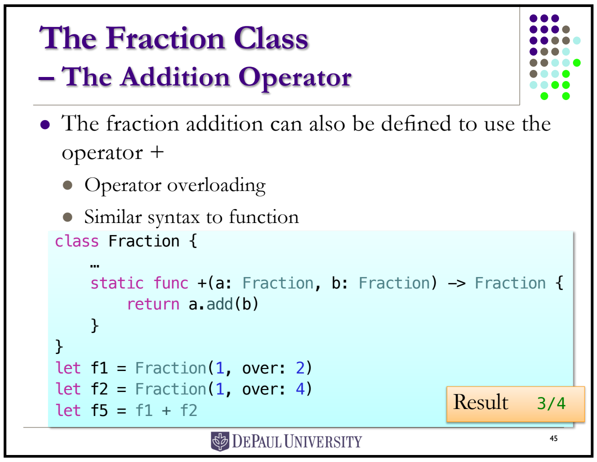

The Fraction Class – The Addition Operator

- The fraction addition can also be defined to use the operator +
  - Operator overloading
  - Similar syntax to function

```
class Fraction {
    …
    static func +(a: Fraction, b: Fraction) -> Fraction {
        return a.add(b)
    }
}
let f1 = Fraction(1, over: 2)
let f2 = Fraction(1, over: 4)
let f5 = f1 + f2
```

Result 3/4

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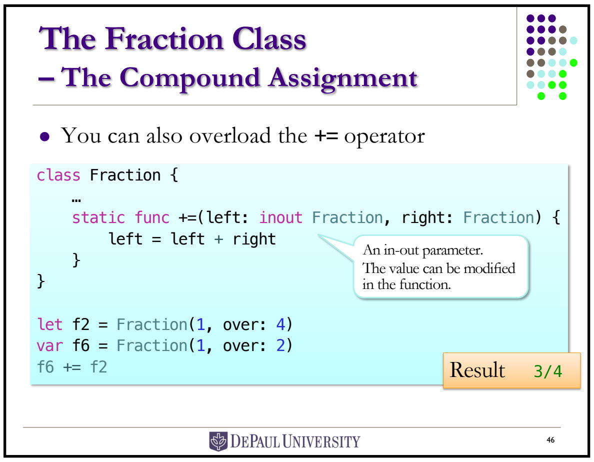

The Fraction Class – The Compound Assignment

- You can also overload the += operator

```
class Fraction {
    …
    static func +=(left: inout Fraction, right: Fraction) {
        left = left + right
    }
}

let f2 = Fraction(1, over: 4)
var f6 = Fraction(1, over: 2)
f6 += f2
```

An in-out parameter. The value can be modified in the function.

Result 3/4

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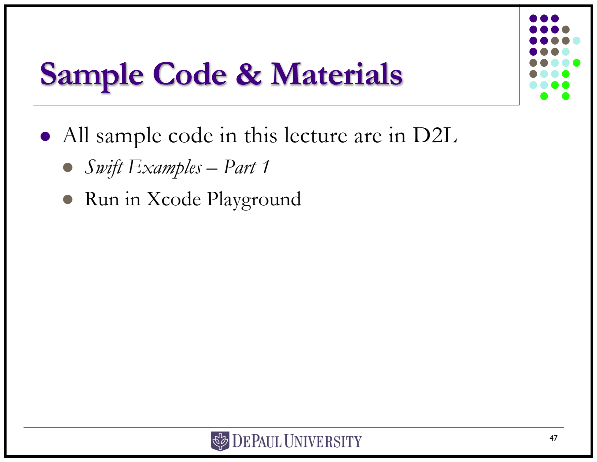

Sample Code & Materials

- All sample code in this lecture are in D2L
  - *Swift Examples – Part 1*
  - Run in Xcode Playground

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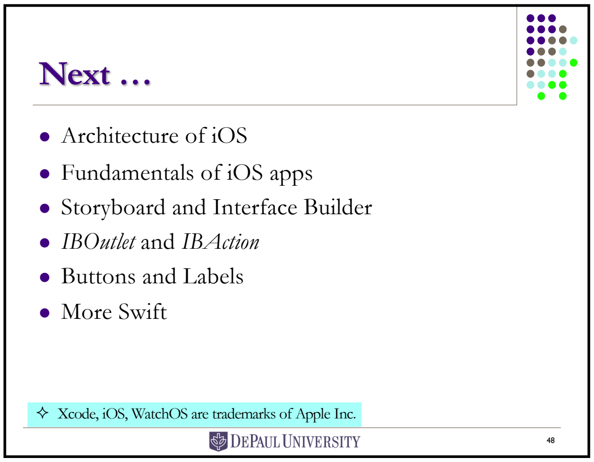

Next …

- Architecture of iOS
- Fundamentals of iOS apps
- Storyboard and Interface Builder
- *IBOutlet* and *IBAction*
- Buttons and Labels
- More Swift

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