Swift: Classes, Structures, Enumerations

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Optionals

Schrödinger’s Cat in terms of Values
• used for situations where the value of a property, the return value of a function etc. may be absent (nil)
• an Optional states
  • that there is value that equals $x$ OR
  • that there is no value at all
Optionals

• var surveyAnswer: String?
  • set to nil automatically
  • if that would be a property, it would not have been
    explicitly given a value during initialization

• static func toInt(string: String) -> Int?
  • returns either nil or the integer representation of the
    string
Accessing Optional Values

- **1st If: forced unwrapping**
  - Exclamation mark added to optional explicitly unwraps the optional
  - Causes runtime error if the optional’s value is nil

- **2nd If: optional binding**
  - Bind the optional’s value to a temporary variable to work with, if the optional’s value is not nil
Implicitly Unwrapped Optionals

Exclamation mark required to explicitly unwrap the optional value

```swift
let optionalInteger : Int? = 1234
let forcedInteger : Int = optionalInteger!
```

```swift
let implicitInteger : Int! = 1234
let integer = implicitInteger
```

no exclamation mark required, because it is already implicitly unwrapped
Implicitly Unwrapped Optionals

- behave like Optionals, but do not need to be explicitly unwrapped when the underlying value is read

- used when the Optional can never be `nil` anytime again during runtime based on the program structure (according to Apple’s documentation [1])

- a runtime error will be raised, when an implicitly unwrapped Optional will be read when the value is `nil`
• used for querying or calling properties, methods or subscripts of an optional that might be \texttt{nil}
• if the optional is \texttt{nil} the property, method or subscript returns \texttt{nil}
• multiple queries or calls can be chained and the chain fails gracefully (without application crash) if one link returns \texttt{nil}

```swift
var optionalNumber = Int("2016")
optionalNumber?.distance(to: 2015)
```
Properties

values for classes, structures, or enumerations
Stored Properties

- variable stored properties (var keyword)
- constant stored properties (let keyword)
- set a default value for either of them as part of the definition
- modification of initial value during initialization
  → this is also true for constant stored properties
- value types assigned to a constant stored property are completely immutable
  - it is not possible to change the properties of the assigned value type
Lazy Stored Properties

• value not calculated until it is used for the first time
• must not be declared as constant
  • a constant property’s value must always be known before initialization completes
• a lazy stored properties might not be evaluated when initialization finishes
• useful when complex computation is required to evaluate the property or when value depends on outside factors that might not be known during initialization
Lazy Stored Properties

- lazily stored property lazy gets evaluated first, when it is accessed
Computed Properties

- do not store a certain value
- used to set and get other properties indirectly
- must not be declared as constants because their value is inherently not fixed
Computed Properties

```swift
struct ComputedStruct {
    var storedProperty: Int
    var calculatedProperty: Int {
        get {
            return storedProperty * 2
        }
        set(newValue) {
            self.storedProperty = newValue + 2
        }
    }
}

var computedStruct = ComputedStruct(storedProperty: 5)
computedStruct.calculatedProperty
computedStruct.calculatedProperty = 3
computedStruct.storedProperty
```
Type Properties

Previously, only instance properties were shown
- their values are always associated with a single instance of a type
- type properties belong to the type instead of the instance
- at runtime, there will be only one copy of that property independent of the number of created instances

- value types allow for stored and computed type properties
- reference types allow for computed type properties only
Type Properties

```swift
struct ExampleStruct {
    let storedProperty : Int
    static let storedStaticImmutableProperty : Int = 1
    static var storedStaticMutableProperty : Int = 0
    static var computedProperty : Int {
        get {
            return self.storedStaticImmutableProperty + 3
        }
        set(newValue) {
            self.storedStaticMutableProperty = newValue
        }
    }
}
```

```swift
class ExampleClass {
    let storedProperty = 0
    class var computedProperty : Int {
        get {
            return 42
        }
    }
}
```
Instance Initialization
• Initializers are used to create new instance of a particular type
• Initializers do not have a return value
• When initialization is completed, all stored properties of a type must be initialized with a sound value
• Initializers are automatically generated, based on the manifestation of the stored properties

```swift
init() {
    // Initialization Task performed here
}
```
**Initializers**

```swift
struct GeometriePoint {
    var x = 0, y = 0, z = 0
}
```

- **Default Initializer**
  ```swift
  init() {} 
  ```

- **Memberwise Initializer**
  ```swift
  init(x: Int, y: Int, z: Int)
  {
      self.x = x; self.y = y; self.z = z
  }
  ```

- **Custom Initializer**
  ```swift
  init(withPlanePoint: Point)
  {
      x = point.x; y = point.y
  }
  ```
## Generation Rules

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<tr>
<th>Given</th>
<th>Default Initializer</th>
<th>Memberwise Initializer</th>
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<tr>
<td>mutable Stored Properties</td>
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<td>with default value</td>
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</table>
Generated Initializers

• Default Initializers
  • generated for structures or classes that do not provide any initializers themselves
  • does nothing but set properties to their default values
• Memberwise Initializers for Structure Types
  • generated when structures do not provide any initializers themselves
  • also holds, if properties do not have any default values assigned within the declaration
class ToDoItem
{
    var name = "New Item"
    var due = NSDate.date()
    var done = false
}

var item = ToDoItem()
Memberwise Initializer

```swift
struct Point {
    var x = 0
    var y = 0
}

var point = Point(x: 5, y: 7)

init(x: Int, y: Int) {
    self.x = x
    self.y = y
}
```

Default Initializer is generated as well, but omitted for simplicity reasons.
• have other initializers to perform initialization tasks to avoid code duplication
• because value types do not support inheritance, structures and enumerations can only call initializers they provide themselves
• use `self.<initializer>` to delegate the initialization task
• remember, that delegation to default or memberwise initializer is not possible from custom initializer
Instance Initialization

A closer look on Classes
• stored properties must be assigned an initial value during initialization
  • that includes inherited properties, too

• own properties must be initialized before inherited properties

• designated and convenience initializers available
Designated Initializers

- primary initializers of a class
- fully initialize the properties provided by the class
  - forwards initialization of inherited properties to one of the superclass’ designated initializer
- each class must have at least one designated initializer
  - inherit the designated initializers from the superclass
    might be sufficient

```cpp
init(/*parameters*/) {
    // Initialization
}
```
Convenience Initializers

- secondary, supporting initializers
- can only forward initialization to designated initializers of the same class as the convenience initializer
- used to provide shortcut or use-case specific initialization processes of a class

```cpp
convenience init(/*parameters*/) {
    // Initialization
}
```
Designated / Convenience

• 3 rules apply:
  • designated initializers must call designated initializers from their immediate superclass
  • convenience initializers must call another initializer from the same class
  • convenience initializers must ultimately call a designated initializer
Phase 1:
- stored properties are assigned initial values by the class that introduces it

Phase 2:
- commences as soon as all properties are in their default configuration
- each class can modify the default values of their stored properties
• Swift’s compiler performs sanity checks to ensure two-phase initialization performs without error
• Check 1:
  • all introduced properties of a class must be initialized before initialization is delegated to the superclass’ initializer

• Check 2:
  • designated initializer must forward to the superclass’ designated initializer before values of inherited properties can be changed
• Check 3:
  • convenience initializers must delegate the process to designated initializers before values of any properties (inherited or self) can be modified

• Check 4:
  • initializers cannot call instance methods, read values of instance properties or refer to self as a value until the first phase of the Two-Phase Initialization is completed
Two Phase Initialization: Overview

**Phase 1**

- **Root Class**
  - Memory Uninitialized
  - ... → Memory Initialized
  - self now usable → Properties Customized

- **Immediate Superclass**
  - Memory Uninitialized
  - ... → Memory Initialized
  - designated initializer hands off to superclass

- **Class**
  - Memory Allocated
  - designated initializer confirms that all stored properties have a value
  - Class
  - initializer called

**Phase 2**

- Properties Customized
- modify properties

- Properties Customized
- modify properties

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- Properties Customized
- modify properties

- Instance
- ready for usage
Automatic Initializer Inheritance

- Initializers are not bequeathed to subclasses by default
- inheriting initializers is still possible under certain conditions:
  1. if subclass defines no own designated initializers, all the superclass’ initializers are inherited
  2. if subclass provides all designated initializers of the superclass, it inherits all convenience initializers of the superclass
- can be achieved through 1 or by providing a custom implementation according to definition of the initializer