

# Stopwatch

## Lesson 7



### Description

Refactor the elapsed time formatting into a model property, and make the frequently changing elapsed time label accommodate assistive devices.

### Learning Outcomes

- Recognize user diversity and the concept of accessibility, and describe accessibility features of iOS.
- Recognize the principle of "separation of concerns" between controllers and models, and apply refactoring to properly abstract model concerns.
- Assess a working application and formulate additional features related to usability and accessibility.



### Vocabulary

user experience	accessibility	assistive device
Identity Inspector	separation of concerns	refactor
computed property		

### Materials

- **Stopwatch Lesson 8** Xcode project
- **Apple Accessibility** web resources

## Opening

Without enhancing its functionality, what subtle improvements might we make to our app?

## Agenda

- Present the concepts of user diversity, user experience, and accessibility with the Apple Accessibility web resources.
- Explain how assistive devices notify the user of changes in the view. Consider how frequently the view is changing while the `Stopwatch` is running, and how this might cause an excessive number of notifications to assistive devices.
- Using Interface Builder, select the elapsed time label and use the Identity Inspector (⌘3) to check the *Accessibility > Updates Frequently* trait, and uncheck the *User Interaction Enabled* trait.
- Discuss the numerous `println` calls in the code, and how using customized breakpoints is a better approach.
- Delete the remaining `println` calls in the `ViewController` implementation.
- Discuss how the creation of individual time components in the `ViewController` `updateElapsedTimeLabel:` method sounds more like a concern of the `Stopwatch` model.
- Extract the formatted `String` generation and time component code from the `ViewController` `updateElapsedTimeLabel:` method into a new computed property in the `Stopwatch` class.

```
var elapsedTimeAsString: String {  
    return String(format: "%02d:%02d.%d", Int(elapsedTime / 60),  
                  Int(elapsedTime % 60), Int(elapsedTime * 10 % 10))  
}
```

- Discuss the computed property syntax.
- Update the `ViewController` `updateElapsedTimeLabel:` method to use the new `elapsedTimeAsString` property.

```
func updateElapsedTimeLabel(timer: NSTimer) {  
    if stopwatch.isRunning {  
        elapsedTimeLabel.text = stopwatch.elapsedTimeAsString  
    } else {  
        timer.invalidate()  
    }  
}
```

- Discuss how the `updateElapsedTimeLabel:` method now relies on the `Stopwatch.elapsedTimeAsString` property, rather than formatting the elapsed time itself.
- Run the app (⌘R), and observe that the functionality has not changed.
- Discuss the read-only nature of the `Stopwatch` model's computed `isRunning` property, and how it is impossible to explicitly set `isRunning` to `false` after starting a `Stopwatch`.
- Discuss how the `private` access modifier of the `startTime` property is important, preventing the ability to directly access or modify the `Stopwatch` `startTime` property.
- Discuss the lack of a Reset button, but how the Start button restarts the elapsed time.
- Discuss how the Start, Stop and reset functionalities exist, and discuss if the user experience is good enough or not.
- Discuss how usability, user experience and accessibility might further improve.

## Closing

What other features could we add to our Stopwatch app?

## Modifications and Extensions

- Enhance the user interface by changing the colors of the buttons depending on the model state.
- Investigate key-value-observing and how the model might notify the controller to update the elapsed time label instead of using an `NSTimer`.
- Design additional features to enhance the usability, accessibility and value of the app.

## Resources

Accessibility for iOS Developers <https://developer.apple.com/accessibility/ios/>

Accessibility Programming Guide for iOS: Making Your App Accessible [https://developer.apple.com/library/ios/documentation/UserExperience/Conceptual/iPhoneAccessibility/Making\\_Application\\_Accessible/Making\\_Application\\_Accessible.html](https://developer.apple.com/library/ios/documentation/UserExperience/Conceptual/iPhoneAccessibility/Making_Application_Accessible/Making_Application_Accessible.html)

Cocoa Core Competencies: Accessibility <https://developer.apple.com/library/ios/documentation/General/Conceptual/DevPedia-CocoaCore/>

Cocoa Core Competencies: Model Object <https://developer.apple.com/library/ios/documentation/General/Conceptual/DevPedia-CocoaCore/ModelObject.html>

The Swift Programming Language: Computed Properties [https://  
developer.apple.com/library/ios/documentation/Swift/Conceptual/  
Swift\\_Programming\\_Language/Properties.html#//apple\\_ref/doc/uid/TP40014097-  
CH14-ID259](https://developer.apple.com/library/ios/documentation/Swift/Conceptual/Swift_Programming_Language/Properties.html#//apple_ref/doc/uid/TP40014097-CH14-ID259)