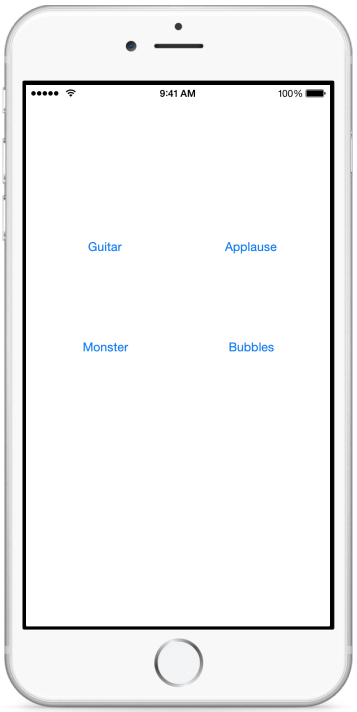
NoiseMaker
Lesson 7

Description

Replace the individual `AVAudioPlayer?` properties with an array of `AVAudioPlayer` objects.



Learning Outcomes

- Analyze repetitive code an infer opportunities to use data structures.
- Describe the difference between mutability and immutability, and relate these concepts to arrays.
- Practice literal array initialization, and accessing array objects with numeric indices.
- Practice using a `for-in` loop to iterate over an array.
- Describe the use of the `map` function to transform arrays.

Vocabulary

array	array literal	mutability
immutable	mutable	`for-in` loop
transformation	`map`	closure
type annotation	trailing closure	

Materials

- **NoiseMaker Lesson 7** Xcode project

Opening

How many `AVAudioPlayer` objects do we have in our model, and what are we doing to create each one?

Agenda

- Discuss the code smell of repetitive variables with number suffixes (e.g. `url2`), and the numerous similar `AVAudioPlayer` objects as motivation for using a data structure.
- Add a new `[String]` property to the `NoiseMaker` model to store the audio file names.

```
class NoiseMaker {

let audioFileNames = ["guitar", "applause", "monster", "bubbles"]
...
```

- Discuss the array literal syntax used to provide a default value for the `audioFileNames` property, and how `let` indicates that the array is immutable.
- Replace the four individual `AVAudioPlayer?` properties with a single `[AVAudioPlayer?]` property to store the `AVAudioPlayer` objects.

```
var players = [AVAudioPlayer?]()
```

- Discuss how using `var` indicates that the array is mutable.
- Within the `NoiseMaker` initializer, delete the existing repetitive `NSURL` and `AVAudioPlayer` instantiations.
- Complete the implementation of `init`, using the `audioFileNames` array and a `for-in` loop to create new `AVAudioPlayer` objects.

```
init() {
   for filename in audioFileNames {
      if let url = NSBundle.mainBundle().URLForResource(filename,
         withExtension: "wav") {
         players.append(try? AVAudioPlayer(contentsOfURL: url))
      }
   }
}
```

- Explain how a Swift `for-in` loop retrieves each `String` in the `audioFileNames` array successively, assigning each `String` to the implicit `filename` constant during each iteration of the loop.

- Discuss the body of the `for-in` loop, and how, for each `filename` retrieved from the `audioFileNames` array, an `NSURL` is created, and a new `AVAudioPlayer` object is appended to the `players` array.
- Refactor each of the "play" methods to use the `players` array instead of specific, named `AVAudioPlayer?` properties.

```
func playGuitarSound() {
   players[0]?.play()
}
...
func playBubblesSound() {
   players[3]?.play()
}
```

- Run the app (⌘R), and verify that the sounds still play.
- Discuss the reduction of repetitive code in the model, and the decrease in the number of lines of code.
- Discuss how the `NoiseMaker` initializer uses an array of audio filenames to generate an array of `AVAudioPlayer` objects.
- Present the concept of the Swift `map` function.
- Change the `players` property to a constant with a type annotation and no default value.

```
let players: [AVAudioPlayer?]
```

- Explain how the initializer will be updated to create and assign an `[AVAudioPlayer?]` to the `players` property.
- Replace the `for-in` loop in the initializer with a verbose call to `map`.

```
init() {
   players = audioFileNames.map( { (filename: String) -> AVAudioPlayer?
in
      if let url = NSBundle.mainBundle().URLForResource(filename,
         withExtension: "wav") {
         return try? AVAudioPlayer(contentsOfURL: url)
      } else {
         return nil
      }
   })
}
```

- Explain how the initializer transforms the array of `String` values into an array of `AVAudioPlayer?` objects, by calling `map`.

- Explain how `map` receives a closure and invokes it, passing each `String` in the `audioFileNames` array as the `filename` argument; and how it builds an array with each `AVAudioPlayer` object returned by the closure.
- Discuss how Swift trailing closure syntax and inferred data types can increase the brevity of the code.
- Update the call of `map` by using a trailing closure and by omitting the type annotations.

```
players = audioFileNames.map { filename in
   if let url = NSBundle.mainBundle().URLForResource(filename,
      withExtension: "wav") {
      return try? AVAudioPlayer(contentsOfURL: url)
   } else {
      return nil
   }
}
```

- Explain how Swift infers the type of the `filename` parameter based on the `[String]` type of `audioFileNames` array; and infers the return type of the closure based on the `[AVAudioPlayer?]` type of the `players` array.
- Discuss how the `NoiseMaker` class no longer relies on a mutable array, and how the initializer is more expressive.
- Run (⌘**R**) the app, and verify that the sounds still play as expected.

Closing

We still see repetitive code across both the model and controller "play" methods. Is the repetition related? Can you think of a way we might improve this code even further?

Modifications and Extensions

- Investigate the concepts of designated and convenience initializers, and create a designated initializer called `initWithFileNames:`. Remove the `audioFileNames` property from the `NoiseMaker` model, and update the `ViewController` to pass a `[String]` of audio file names to the designated initializer.
- Store a collection of audio file names in an external property list file, and load the file names from the property list file instead of using a hard-coded array of explicit file names.

Resources

The Swift Programming Language: Properties https://developer.apple.com/library/ios/documentation/Swift/Conceptual/Swift_Programming_Language/Properties.html

The Swift Programming Language: Collection Types https://developer.apple.com/library/ios/documentation/Swift/Conceptual/Swift_Programming_Language/CollectionTypes.html

The Swift Programming Language: Initialization https://developer.apple.com/library/ios/documentation/Swift/Conceptual/Swift_Programming_Language/Initialization.html

The Swift Programming Language: Control Flow https://developer.apple.com/library/ios/documentation/Swift/Conceptual/Swift_Programming_Language/ControlFlow.html

Swift Standard Library Reference: Array https://developer.apple.com/library/ios/documentation/General/Reference/SwiftStandardLibraryReference/Array.html

The Swift Programming Language: Closures https://developer.apple.com/library/ios/documentation/Swift/Conceptual/Swift_Programming_Language/Closures.html