

Week 2: Tab Bar Controllers

Model-View-Controller (MVC) Review

It's important to understand the MVC architecture as it's used in both iOS and Android. It's a modern design pattern that provides a skeleton for organizing all the components of your app.

- **Model:** holds the data and custom types to represent it
 - Should be UI independent
 - Data could be any number of formats including property lists and JSON. Custom types are built to allow the data to be used and manipulated by the Controller.
- **View:** all items for the user interface (objects in Interface Builder)
 - Buttons, labels, inputs
- **Controller:** links the model and the view together. The backbone or brain of the app.
 - Usually subclasses from UI frameworks that will allow the view and the model to interact
 - Controllers are usually paired with a single view, that's where ViewController comes from
 - Controllers link model to view by updating model based on user interaction and updating view based on notifications from the model
- The goal of MVC is to have any object be in only one of these categories.
 - These categories should *never* overlap
 - Ensures reusability and makes changes to the app more isolated

When we have multiple views that depend on one another, they are linked together at the *Controller* level via the use of segues for iOS

Tab Bar Controllers

<https://developer.apple.com/design/human-interface-guidelines/ios/bars/tab-bars/>

The tab bar controller organizes information in a flat hierarchy of different sections of an app in a list of tabs. Provides access to several peer information categories or modes that do not have direct dependencies at once

Tab bars should be used for navigation, not to perform actions (those are toolbars)

The tab bar controller is the root view controller and each tab points to a view with its own view controller. This is largely handled by the SDK behind the scenes.

UITabBarController class <https://developer.apple.com/documentation/uikit/uitabBarController>

Use when you want to present different perspectives of related data (music, clock, phone apps)

Data is not passed between views in a tab bar, it is just a way to organize categories of information.

UITabBarItem class <https://developer.apple.com/documentation/uikit/uitabbaritem>

Rule of thumb is to have 3-5 tabs on an iPhone (5 are shown in horizontal compact), a few more are acceptable on iPad.

- Too few tabs make the interface feel disconnected
- When there are more tabs than can be shown the tab bar controller will automatically display a “More” tab with the rest of the items. This requires additional taps, is a poor use of space, and should be avoided.

Pickers

<https://developer.apple.com/design/human-interface-guidelines/ios/controls/pickers/>

A picker is a scrollable list of distinct values (replaces a select list on the web)

- Slot-machine looking UI element that is used when you have a list of values
- Date picker also available for date and/or time
- Can have multiple components (columns) that are independent or dependent

UIPickerView class <https://developer.apple.com/documentation/uikit/uipickerview>

Use a picker when users are familiar with the entire set of values. Because many of the values are hidden when the wheel is stationary, it's best when users can predict what the values are.

If you need to provide a large set of choices that aren't well known to your users, use a table view.

Pickers don't hold any data themselves. They call methods on their data source and delegate to get the data they need to display.

The UIPickerViewDataSource protocol handles the data or properties of the picker (number of columns/rows) for the picker view and must be adopted

<https://developer.apple.com/documentation/uikit/uipickerviewdatasource>

The UIPickerViewDelegate protocol handles the view content (what the picker displays and actions to take) and must be adopted <https://developer.apple.com/documentation/uikit/uipickerviewdelegate>

Music Demo App

Create a new project called music and *choose the Tabbed App template*.

Look at the files created, the Tabbed Application template did a lot for us.

Main.storyboard already has a tab bar controller set up with three scenes.

Click on the tab bar controller. In the identity inspector you'll see that the class is UITabBarController. In the attributes inspector you'll see that Is Initial View Controller is checked. And in the Connections inspector you'll see that segues are already set up to the other two view controllers.

Click on the first view and look at the identity inspector. It's already set up to use the class FirstViewController and the swift file was created for us.

In the Connections inspector note that a relationship segue has already been set up from the tab bar controller.

You'll also notice that the tab bar item is set up to use an image already in the project called first.png as well as a title (click on the First Scene's tab bar button and go into the attributes inspector). We can change the image later.

Look at the second scene as well. This one uses the SecondViewController class, has a relationship segue, and its tab bar item uses an image called second.png.

Go ahead and *run it* and you'll see that the tab bar is already working and loads both views, so this template does a lot for us.

Single Component Picker

In our first view we're going to add a single component picker where you choose a genre of music. Go into the Storyboard and **delete** the two labels there.

Add a picker view (ignore the default data it shows)

Add a label above it that says Music Chooser.

Then **add** another label below the picker that we'll use for output.

Create outlet connections for the picker and the 2nd label called musicPicker and choiceLabel. Make sure you're connecting to FirstViewController.swift.

With the picker selected go into the connections inspector and **connect the dataSource and delegate** to the view controller by clicking in the circle and dragging the connection to View Controller (white square in a yellow circle icon on top of the view). Now this picker knows that FirstViewController is its data source and delegate, and will ask it to supply the data to be displayed. (can also do this programmatically in viewDidLoad)

Go into FirstViewController.swift and add the protocol we're going to implement

```
class FirstViewController: UIViewController, UIPickerViewDelegate,
UIPickerViewDataSource
```

You will have an error until we implement the required methods for UIPickerViewDataSource
Look at the delegate classes.

Define an array that will hold the music genres.

```
let genres = ["Rock", "Country", "Indie", "Hip Hop", "Pop", "House"]
```

Now let's add the methods needed to implement the picker.

```
//picker view methods for data source
//how many "columns" or components do we want?
func numberOfComponents(in pickerView: UIPickerView) -> Int {
    return 1
}

//how many items will be in each "column" or component
func pickerView(_ pickerView: UIPickerView, numberOfRowsInComponent component:
Int) -> Int {
    return genres.count
}
```

The delegate methods are optional, but you need to implement at least one and it's often this one.

```
//Picker delegate methods
//Returns the title for each row
func pickerView(_ pickerView: UIPickerView, titleForRow row: Int, forComponent
component: Int) -> String? {
    return genres[row]
}

//called whenever a new row is selected
func pickerView(_ pickerView: UIPickerView, didSelectRow row: Int, inComponent
component: Int) {
    choiceLabel.text = "You like \(genres[row])"
}
```

Run it in the simulator

Click and drag your mouse in the simulator to move the picker.

Use auto layout so the view looks good in portrait and landscape.

Use autoresizing feature or add constraints (can't use both in a view).

Assistant editor – use the jump bar to access preview mode.

Multi-component picker

Use second tab to create multi-component picker. **Add** picker and labels as in the first tab. Don't forget to create outlets and set the data source and delegate for the picker (same as in the first view)

We're going to add a 2nd component that lists the decade for music.

Genre will be component 0

Decade will be component 1

Add arrays for data to SecondViewController.class

```
let decades = ["1960s", "1970s", "1980s", "1990s", "2000s", "2010s"]
```

Most of the changes will be in the data source methods.

```
//need two columns for this, so return 2
func numberOfComponents(in pickerView: UIPickerView) -> Int {
    return 2
}

//return the correct number of items depending on the component we're working
with
func pickerView(_ pickerView: UIPickerView, numberOfRowsInComponent component:
Int) -> Int {
    if component == 0 {
        return genres.count
    }
}
```

```

    } else if component == 1 {
        return decades.count
    }
    else {
        print("Unknown component: \(component) in numberOfRowsInComponent
method...")
        return -1
    }
}

```

Don't forget the delegate method to draw the title for each row

```

//create the title for each row (once again dependent on the component we're
working with)
func pickerView(_ pickerView: UIPickerView, titleForRow row: Int, forComponent
component: Int) -> String? {
    //genre component
    if component == 0 {
        return genres[row]
    }
    //decade component
    else if component == 1{
        return decades[row]
    }
    //something went horribly wrong...
    else {
        print("Unknown component: \(component) in titleForRow forComponent
method...")
        return "no title"
    }
}

```

Now we have to use both components when printing out our results.

```

//change the label when the selection in either component is changed
func pickerView(_ pickerView: UIPickerView, didSelectRow row: Int, inComponent component: Int) {
    let genre = pickerView.selectedRow(inComponent: 0) //get selected row from genre component
    let decade = pickerView.selectedRow(inComponent: 1) //get selected row from decade component

    choiceLabel.text = "You like \(genres[genre]) from the \(decades[decade])."
}

```

If you hover over code such as an if statement and click the command key the editor will show you the code block. A click then gives you code options.

Property Lists

Few applications use arrays with data hard coded so this time we're going to use the data stored in a property list which is a simple data file in XML.

- Use the Bundle(Previously NSBundle) class to access the plist
 - A Bundle object represents a location in the file system that groups code and resources that can be used in a program
 - We can use a bundle to get access to the files in our app
- Property lists can be created using the Property List Editor application (/Developer/Applications/Utilities/Property List Editor.app) or directly in Xcode
 - You can use the new PropertyListDecoder class to decode data from a plist and assign the data to an array or a dictionary (depending on plist structure).

Dependent multi-component picker

Now let's add a third tab to our tab bar. In this tab we're going to have a 2 component picker but this time the components are going to be dependent on each other.

Let's also look at how you add more tabs.

Go back into Main.Storyboard and drag a View Controller from the object library onto the canvas.

Make the connection from the tab bar controller to the new view controller by ctrl-click and drag from the tab bar controller to the new view controller and choose Relationship segue view controllers. This will add a third tab bar button that is hooked up to the new view controller.

Now we need a new class to control this view.

File -> New -> File

iOS Source -> Cocoa Touch class

Call it ThirdViewController and make sure it's a subclass of UIViewController.

Uncheck Also create xib file and make sure the language is Swift.

Make sure it's being saved into your project folder and the music target is checked

This should create ThirdViewController.swift

In the Storyboard click on the third ViewController and in the identity inspector change its class to ThirdViewController.

Go into the Storyboard and create a similar interface as before - a picker and two labels (one that says Artist Picker and another label that's empty that we'll use for output). Same constraints will work.

Create outlet connections for the 2nd label and the picker called choiceLabel and artistPicker. Don't forget the data source and delegate!

With the picker selected go into the connections inspector and connect the dataSource and delegate to the View Controller icon.

Grab the artist-albums plist from my GitHub repo and drag it into your project.

Make sure you choose Copy items if needed and that the project target is checked.
Look at the plist. Note that it's an array of dictionaries, with:

- key name, value string
- key albums, value array of strings.

Now let's add a model struct to represent this data and a class to load it

File -> New -> File -> Swift File

ArtistAlbums

Make sure the music target is checked.

We'll create a struct to represent this data model.

Classes and structures in Swift have many things in common. Both can:

- Define properties to store values
- Define methods to provide functionality
- Define subscripts to provide access to their values using subscript syntax
- Define initializers to set up their initial state
- Be extended to expand their functionality beyond a default implementation
- Conform to protocols to provide standard functionality of a certain kind

Classes have additional capabilities that structures do not:

- Inheritance enables one class to inherit the characteristics of another.
- Type casting enables you to check and interpret the type of a class instance at runtime.
- Deinitializers enable an instance of a class to free up any resources it has assigned.
- Reference counting allows more than one reference to a class instance.

Classes are pass by reference whereas structs are pass-by-value

```
struct ArtistAlbums: Decodable {  
    let name: String  
    let albums: [String]  
}
```

Starting in Swift 4.1 the ability to encode and decode custom types became much easier through the Encodable and Decodable protocols (and the Codable type alias for both). By adopting these protocols for your custom types you can implement the Encoder and Decoder protocols which will encode or decode your data to and from an external representation such as JSON or property list -- will come up later as we look at different types of data persistence

The property names in your custom type MUST match the property names in your data. In the case of a plist the names of the keys must be the same as the names of the properties in your struct for the decoding to work automatically. (you can use codingkeys if the names don't match).

It's best practice to keep anything that is not directly related to controlling the view out of the view controller so we're going to create a class that will handle loading the data from the plist. This also

decouples the data from the view controller, which is good practice. We could change this class so it's loading JSON data and it wouldn't change the view controller code at all. It also makes it easier to test.

File -> New -> File -> Swift File
ArtistAlbumsController

Make sure the music target is checked.

We'll create a class with an array of ArtistAlbums to load our .plist data into and a constant with our file name.

```
class ArtistAlbumsController {  
    //class properties  
    var artistAlbumData: [ArtistAlbums]?  
    let filename = "artist-albums"  
}
```

This class will also have a method to load the data into our array. We'll throw a custom error type if anything goes wrong in the process.

```
//load all the data from our plist and throw appropriate errors if we run into  
issues  
func loadData() throws {  
    print("Loading data...")  
    //get our file based on the file path  
    if let pathURL = Bundle.main.url(forResource: filename, withExtension:  
"plist") {  
        //we  
        let decoder = PropertyListDecoder()  
        do {  
            //get file contents  
            let data = try Data(contentsOf: pathURL)  
            //decode them using our struct as the type to decode to  
            artistAlbumData = try decoder.decode([ArtistAlbums].self, from: data)  
            print("Data loaded")  
        } catch {  
            throw DataError.CouldNotDecodeData  
        }  
    }  
    //error fetching data file  
    else {  
        throw DataError.BadFilePath  
    }  
}
```

Add this enum above the class declaration for the errors that we'll be throwing:

```
//define our error types
```



```
enum DataError: Error {
    case BadFilePath
    case CouldNotDecodeData
    case NoData
}
```

We'll also want to be able to ask for all the artists for the first picker component and for all the albums for a given artist. So we'll create two methods that return this data or throw an error if there's an issue.

```
//grab all the artist and return them in an array of strings or throw error
```

```
func getAllArtists() throws -> [String] {
    var artists = [String]()
    //make sure we got data
    if let data = artistAlbumData {
        for artist in data {
            artists.append(artist.name)
        }

        return artists
    }
    else {
        //we don't have data!
        throw DataError.NoData
    }
}
```

```
//get the albums for any of the artists or throw an error
```

```
func getAlbums(idx: Int) throws -> [String] {
    if let data = artistAlbumData {
        return data[idx].albums
    }
    else {
        //we don't have data!
        throw DataError.NoData
    }
}
```

Go into ThirdViewController.swift and add the protocols for the picker like last time.

```
class ThirdViewController: UIViewController, UIPickerViewDataSource,
    UIPickerViewDelegate
```

Let's define 2 constants for the component numbers since we'll be using them a lot.

```
let artistComponent = 0
let albumComponent = 1
```

Now we're going to define an instance of ArtistAlbumsController that we'll use to access our data and 2 arrays to hold the artists names and album names.

```
var artistAlbums = ArtistAlbumsController()
var artists = [String]()
var albums = [String]()
```

In viewDidLoad we'll use our instance of ArtistAlbumsController to load the data, get the array of artists, and get the first artists list of albums (also handles any potential errors).

```
override func viewDidLoad() {
    super.viewDidLoad()
    //load the data using our data class
    do {
        try artistAlbums.loadData()
        artists = try artistAlbums.getAllArtists()
        //use first index on load since that is what the artist component will be
        set to
        albums = try artistAlbums.getAlbums(idx: 0)
    } catch {
        print(error)
    }
}
```

The next 3 methods haven't changed much, we're just using the constants we defined.

```
//need two components again
func numberOfComponents(in pickerView: UIPickerView) -> Int {
    return 2
}

//return the right number of rows based on the size of each data array
func pickerView(_ pickerView: UIPickerView, numberOfRowsInComponent component:
Int) -> Int {
    if component == artistComponent {
        return artists.count
    } else if component == albumComponent {
        return albums.count
    } else {
        print("Unknown component")
        return -1
    }
}
```

```

}

//get the titles for each row from the data arrays
func pickerView(_ pickerView: UIPickerView, titleForRow row: Int, forComponent
component: Int) -> String? {
    if component == artistComponent {
        return artists[row]
    } else if component == albumComponent {
        return albums[row]
    } else {
        print("Unkown component")
        return "Unknown component"
    }
}
}

```

We need to change this method so when the artist is changed the list of albums changes as well.

```

//change the albums component when the user selects a new artist -- also
update the choice label
func pickerView(_ pickerView: UIPickerView, didSelectRow row: Int,
inComponent component: Int) {
    //need to update albums if user selects a new artists
    if component == artistComponent {
        //get the new list of albums
        do {
            albums = try artistAlbums.getAlbums(idx: row)
        }
        catch {
            print(error)
        }
        //update the album component
        artistAlbumPicker.reloadComponent(albumComponent)
        artistAlbumPicker.selectRow(0, inComponent: albumComponent, animated:
true)
    }

    let artist = pickerView.selectedRow(inComponent: artistComponent)
    let album = pickerView.selectedRow(inComponent: albumComponent)

    choiceLabel.text = "You like \(albums[album]) by \(artists[artist])"
}

```

If you find your text being cut off in the label, set the attribute Autoshrink to Minimum font scale or size so it will automatically adjust.

Some suggest further modularization and separating out the datasource and delegate methods since those handle the data and don't control the view but for simplicity I left them in the view controller.

Icons

You can customize the text and image for each tab

You can use a standard image or add a custom one

- About 25x25 pixels for 1x (max 48x32)
- png format
- Colors are ignored, alpha values from 0 (completely invisible) to 1 (completely visible) are used.
- Different versions for unselected and selected(filled in)

Let's set the tab bar name and image. Drag the png files into Assets.xcassets that you want to use.

Then in the Storyboard click on the tab bar item for the first scene and in the attributes inspector you can change its title and image, or remove the title if you just want an image. (65-note,

120-headphones, 194-note-2, 31-ipod, 66-microphone) (you can download glyphish icons to use)

For app icons you need 120x120 for the 2x and 180x180 for 3x.

You should also set up a launch screen and its constraints.

App access

Now let's add a fourth tab to our tab bar. In this tab we're going to access other apps.

Add a new view controller into your storyboard and connect the tab bar controller with a relationship segue.

Add a new Cocoa Touch class, subclass UIViewController and call it FourthViewController.

Make this the class for your new view controller.

Add a new class to control this view and call it FourthViewController and make sure it's a subclass of UIViewController.

This should create FourthViewController.swift

In the Storyboard click on the fourth ViewController and in the identity inspector change its class to FourthViewController.

(these steps are the same as what we did when we added the third view controller)

Now let's get our fourth view setup.

Let's make this a view where a button will take the user to Spotify, the iTunes music library or if that's not on their device(simulator) then it opens itunes in Safari.

Add a button that says Listen and connect it as an action to a method called gotomusic.

Since this is the fourth scene we must connect to FourthViewController.swift.

Add Missing Constraints for all views in the fourth view controller and fix as needed.

Change the tab bar button image(ipod)

Now let's go into FourthViewController.swift and implement goToMusic(). We'll write functions for checking if we can open a url and actually opening the url

```

//constants for the url schemes that we'll need to check/use
let spotifyScheme = "spotify://"
let appleMusicScheme = "music://"
let itunesScheme = "http://www.apple.com/music"

//open an app that we have access to
func openApp(scheme: String) {
    if let url = URL(string: scheme) {
        UIApplication.shared.open(url, options: [:], completionHandler: {
            (success) in
                print("Open \(scheme): \(success)")
        })
    }
}

//func for checking if we have access to a given url scheme
func schemeAvailable(scheme: String) -> Bool {
    if let url = URL(string: scheme) {
        return UIApplication.shared.canOpenURL(url)
    }
    return false
}

//open spotify if installed, apple music if installed, or navigate to iTunes on
safari as last resort
@IBAction func gotToMusic(_ sender: Any) {

    //check for access
    let spotifyInstalled = schemeAvailable(scheme: spotifyScheme)
    let appleMusicInstalled = schemeAvailable(scheme: appleMusicScheme)

    if spotifyInstalled {
        //we have spotify access :)
        openApp(scheme: spotifyScheme)
    } else if appleMusicInstalled {
        //we don't have spotify :( give apple music a try
        openApp(scheme: appleMusicScheme)
    } else {
        //don't even have apple music :( just open iTunes in safari
        openApp(scheme: itunesScheme)
    }
}

```

For a Swift app, iOS creates a `UIApplication` object to set up the app's runtime environment: its use of the display, its ability to handle touches and rotation events, etc. This object is also how we can interact with the rest of the iOS system. We're using the `shared.canOpenURL(_:)` method to see if there's an app available to handle that string (returns a `Boolean`).

`UIApplication` also has the method `shared.open(_: options: completionHandler:)`, which will launch other applications and have them deal with the URL.

`mailto:`, `facetime:`, and `tel:` open the Mail, FaceTime, and Phone apps, respectively.

`UIApplication` also has a `UIApplicationDelegate` object, which is informed of major life-cycle events that affect the app. This is the `AppDelegate` class that Xcode gave us to start with. When all the app setup is done, the `application(_: didFinishLaunchingWithOptions:)` method gets called. From our point of view, this is where the app "starts," although a bunch of stuff has already been done for us by this point.

Starting in iOS9 you have to declare any URL schemes of non-Apple apps you want your app to be able to call `canOpenURL(_:)`. This does not affect `open(_: options: completionHandler:)`.

Go into `Info.plist` and add `LSApplicationQueriesSchemes` as an Array. Click on the arrow to the left of `LSApplicationQueriesSchemes` to open it and then hit the + to add an item to the array called "spotify" and one for "music".

Audio

The iOS SDK has multiple multimedia frameworks to access iOS's audio capabilities.

Frameworks for audio from easiest to use to harder:

- System Sound Services - plays user-interface sound effects, or to invoke vibration
 - supports .caf, .aif, or .wav formats and must be less than 30 secs.
- Media Player framework - plays songs, audio books, or audio podcasts from a user's iPod library.
- AVFoundation framework - plays and records audio
 - We'll be using this to record and playback sounds in our app
- Audio Toolbox framework - plays audio with synchronization capabilities, access packets of incoming audio, parse audio streams, convert audio formats, and record audio with access to individual packets.
- Audio Unit Framework - connect to and use audio processing plug-ins
- OpenAL framework - provides positional audio playback and lets you mix sounds
 - Best choice for games
 - OpenAL gives you more control of audio but is more complicated.

The AVFoundation framework

The **AVAudioSession** class acts as an intermediary between your app and the system's media services <https://developer.apple.com/documentation/avfoundation/avaudiosession>

- Configure your audio session
- Configure audio settings such as sample rate, I/O buffer duration, and number of channels
- Handle audio route changes

- Events such as a phone call
- Audio use by another app
- Audio session category
- How your audio session interacts with others

The **AVAudioPlayer** class provides playback of audio data from a file or memory

<https://developer.apple.com/documentation/avfoundation/avaudioplayer>

- Play sounds of any duration from files or memory
- Configure and control playback
- Manage audio level metering

The AVAudioPlayerDelegate protocol has optional methods that are called when the audio file finishes playing, if there are interruptions or if there's an error.

<https://developer.apple.com/documentation/avfoundation/avaudioplayerdelegate>

The **AVAudioRecorder** class provides recording of audio data

<https://developer.apple.com/documentation/avfoundation/avaudiorecorder>

- Record until the user stops the recording
- Record for a specified duration
- Pause and resume a recording
- Obtain input audio-level data for level metering
- In iOS, the audio being recorded comes from the device connected by the user such as the built-in microphone or a headset microphone.
- Configurable settings include bit depth, bit rate, and sample rate conversion quality

<https://developer.apple.com/documentation/avfoundation/avaudioplayer/1389359-settings>

The AVAudioRecorderDelegate protocol has optional methods that are called when the recording completes, if there are interruptions or if there's an error

<https://developer.apple.com/documentation/avfoundation/avaudiorecorderdelegate>

Add a fifth tab as before, along with a FifthViewController class for the new view controller and set the class for the new view in Interface Builder.

(same steps as before)

Click on the Target and go into the Build Phases tab.

Open Link Binary with Libraries and click the + to add the AVFoundation framework under iOS 11.2.

In the storyboard add 3 buttons for Record, Play, and Stop. (add needed constraints)

Connect these as outlets called recordButton, playButton, and stopButton. We need these so we can enable and disable these buttons as needed.

Also connect these as actions called recordAudio, playAudio, and stopAudio.

You must request permission before your app can access the microphone.

In info.plist you must add the entry "Privacy - Microphone Usage Description" and give it a value that will be used in the permission request to the user.

In FifthViewController.swift we need to import the AVFoundation framework and adopt the AVAudioPlayerDelegate and AVAudioRecorderDelegate.

```
import UIKit
import AVFoundation

class FifthViewController: UIViewController, AVAudioPlayerDelegate,
AVAudioRecorderDelegate {
```

Create an instance variable for our audio player, audio recorder, and audio session

```
//instance variables
let audioSession = AVAudioSession.sharedInstance()
var audioPlayer: AVAudioPlayer?
var audioRecorder: AVAudioRecorder?
```

Create a constant for the name of the file where the audio will be saved

```
//audio recording filename constant
let filename = "audio.m4a"
```

viewDidLoad is a good place to do our setup and initialization

```
override func viewDidLoad() {
    super.viewDidLoad()

    // enable play and stop since we don't have any audio to work with on load
    playButton.isEnabled = false
    stopButton.isEnabled = false

    //get path for the audio file
    let dirPath = FileManager.default.urls(for: .documentDirectory, in:
.userDomainMask)
    let docDir = dirPath[0]
    let audioFileURL = docDir.appendingPathComponent(filename)
    print(audioFileURL)

    //configure our audioSession
    do {
        try audioSession.setCategory(AVAudioSession.Category.playAndRecord, mode:
.default, options: .init(rawValue: 1))
    } catch {
        print("audio session error: \(error.localizedDescription)")
    }
}
```



```

//declare our settings in a dictionary
let settings = [
    AVFormatIDKey: Int(kAudioFormatMPEG4AAC), // audio codec
    AVSampleRateKey: 1200, //sample rate in hZ
    AVNumberOfChannelsKey: 1, //num of channels
    AVEncoderAudioQualityKey: AVAudioQuality.high.rawValue // audio bit rate
]

do {
    //create our recorder instance
    audioRecorder = try AVAudioRecorder(url: audioFileURL, settings:
settings)
    //get it ready for recording by creating the audio file at the specified
location
    audioRecorder?.prepareToRecord()
    print("Audio recorder ready!")
} catch {
    print("Audio recorder error: \(error.localizedDescription)")
}
}

```

Then we'll implement our methods to record, stop, and play.

```

//button actions
@IBAction func recordAudio(_ sender: Any) {
    //make sure we have an instance
    if let recorder = audioRecorder {
        //check to make sure we aren't already recording
        if recorder.isRecording == false {
            //enable the stop button and start recording
            playButton.isEnabled = false
            stopButton.isEnabled = true
            recorder.delegate = self //allows recorder to respond to errors and
complete the recording
            recorder.record()
        }
    } else {
        print("No audio recorder instance")
    }
}

//either stop the recording or stop the playing, depending on which is currently
happening
@IBAction func stopAudio(_ sender: Any) {

```

```

stopButton.isEnabled = false
playButton.isEnabled = true
recordButton.isEnabled = true

//stop recording if that's the current task
if audioRecorder?.isRecording == true {
    audioRecorder?.stop()
} else { // stop the playback and reset the audio session mode
    audioPlayer?.stop()
    //reset session mode
    do {
        try audioSession.setCategory(AVAudioSession.Category.playAndRecord)
    } catch {
        print(error.localizedDescription)
    }
}
}

@IBAction func playAudio(_ sender: Any) {
    //make sure we aren't recording
    if audioRecorder?.isRecording == false {
        stopButton.isEnabled = true
        recordButton.isEnabled = false

        do {
            try audioPlayer = AVAudioPlayer(contentsOf: (audioRecorder?.url!))
            //set to playback mode for optimal volume
            try audioSession.setCategory(AVAudioSession.Category.playback)
            audioPlayer!.delegate = self
            audioPlayer!.prepareToPlay() // preload audio
            audioPlayer!.play() //plays audio file
        } catch {
            print("audioPlayer error: \(error.localizedDescription)")
        }
    }
}
}

```

Both delegate protocols have optional methods. Since you don't tap a button when the audio playing ends, let's implement that one to change the buttons as needed.

```

//audio player delegate method to change buttons when audio finishes playing
func audioPlayerDidFinishPlaying(_ player: AVAudioPlayer, successfully flag:
Bool) {
    recordButton.isEnabled = true
    stopButton.isEnabled = false
}

```

```
//reset av session mode to optimize recording
do {
    try audioSession.setCategory(AVAudioSession.Category.playAndRecord)
} catch {
    print(error.localizedDescription)
}
}
```