SpaceAdventure
Lesson 12

Description

Implement the ability to travel to a random planet, and troubleshoot a runtime error.

```
Welcome to the Solar System.
There are 8 planets to explore.
What is your name?
Jane
Nice to meet you, Jane. My name is Eliza, I'm an old friend of Siri.
Let's go on an adventure!
Shall I randomly choose a planet for you to visit? (Y or N)
Y
Traveling to Neptune...
Arrived at Neptune. A very cold planet, furthest from the sun.
```

Learning Outcomes

- Discover the `arc4random_uniform` C function, and apply the function to obtain a pseudo-random number within a range.
- Discover the Swift data type conversion idiom, and apply initializers to convert a value to another data type.
- Discover the `UInt32` datatype and describe what an unsigned integer is.
- Discuss subtle flaws in a computer program, and paraphrase a problem and solution.

Vocabulary

pseudo-random number	`arc4random_uniform`	unsigned integer
data type conversion	`UInt32`	return value
subscripting	runtime error	

Materials

- **SpaceAdventure Lesson 12** Xcode project

Opening

How can we get the program to select a random planet to travel to?

Agenda

- Discuss how one might select a random integer, use that integer to subscript the `planetarySystem` `planets` array, and pass the value of the retrieved planet's `name` property to the existing `visit:` method.
- Using the Xcode Documentation and API Reference (⇧⌘0), investigate the `arc4random_uniform` function.
- In the `SpaceAdventure` `determineDestination` method, replace the `println` call and `TODO` in the first branch of the `if` statement with a naive implementation.

```
...
if decision == "Y" {
   let upperBound = planetarySystem.planets.count
   let index = Int(arc4random_uniform(UInt32(upperBound)))
   visit(planetarySystem.planets[index].name)
} else if decision == "N" {
...
```

- Explain the use of the C function `arc4random_uniform` to obtain a pseudo-random number between 0 and its argument; the conversion of `upperBound` to a `UInt32` to satisfy the `arc4random_uniform` parameter type; and the conversion of the return value of `arc4random_uniform` to an `Int`, in order to subscript the `planets` array.
- Run the program (⌘R), enter a name, choose `Y`, and observe the results displayed in the console (⇧⌘C).
- Discuss what might happen if the `planets` array is empty.
- In the `SpaceAdventure` initializer, comment out (⌘/) the adding of each `Planet` object to the `planets` array.

```
init() {
   ...
   // planetarySystem.planets.append(mercury)
   ...
   // planetarySystem.planets.append(neptune)
}
```

- Run the program (⌘R), enter a name, choose `Y`, witness the program crash, and observe the "Array index out of range" runtime error displayed in the console (⇧⌘C). Stop the program with a keyboard shortcut (⌘.) or the stop button in the Xcode Toolbar.

Closing

Why is our program crashing with a runtime error? Can you think of a way we can improve the code, to handle cases where the array of planets is empty?

Modifications And Extensions

- Investigate pseudo-random numbers, the `arc4random` function, and different ways of generating random numbers with C and Swift. Explain why random number generation is difficult for a computer, and investigate algorithms that increase the quality of pseudo-random number generation, such as Mersenne Twister.
- Use the Debug Navigator (⌘6) to select different points in the call stack related to the runtime error, and investigate the meaning of the non-Swift code displayed for some of the items.
- Observe how the console displays the `(lldb)` prompt, and investigate the commands you can type to interact with the debugger.

Resources

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

The Swift Programming Language: A Swift Tour https://developer.apple.com/library/prerelease/ios/documentation/Swift/Conceptual/Swift_Programming_Language/GuidedTour.html

The Swift Programming Language: The Basics https://developer.apple.com/library/prerelease/ios/documentation/Swift/Conceptual/Swift_Programming_Language/TheBasics.html
BSD Library Functions Manual: ARC4RANDOM(3) https://developer.apple.com/library/mac/documentation/Darwin/Reference/ManPages/man3/arc4random_uniform.3.html

The Swift Programming Language: Integers https://developer.apple.com/library/ios/documentation/Swift/Conceptual/Swift_Programming_Language/TheBasics.html#//apple_ref/doc/uid/TP40014097-CH5-ID317

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

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

Xcode Overview: Debug Your App https://developer.apple.com/library/ios/documentation/ToolsLanguages/Conceptual/Xcode_Overview/DebugYourApp.html

LLDB Quick Start Guide https://developer.apple.com/library/ios/documentation/IDEs/Conceptual/gdb_to_lldb_transition_guide/document/Introduction.html