JSON

JSON - Reminder

- JSON is [mostly] used to communicate between programming languages
- Consists of 6 types
  - String
  - Number
  - Boolean
  - Array
  - Object
  - Null

JSON - Reminder

- In Python
  - json.dumps to convert from Python types to JSON string
  - json.loads to convert from JSON string to Python types
- In JavaScript
  - JSON.stringify to convert from JavaScript types to JSON string
  - JSON.parse to convert from JSON string to JavaScript types

JSON

- What about Scala?

{"timestamp":1550774961,"message":"success","iss_position":
{"latitude":"-36.5017","longitude":"-2.8015"}}

- This is valid JSON

- What Scala type do we use to store this data?

JSON

- What about Scala?

{"timestamp":1550774961,"message":"success","iss_position":
{"latitude":"-36.5017","longitude":"-2.8015"}}

- This is valid JSON

- What Scala type do we use to store this data?
  - Map[String, String]?
  - Map[String, Long]?
  - Map[String, Map[String, String]]?
  - Map[String, Any]?? <- This is the only one that can work, but it's very restrictive since we can only use the Any methods

JSON

- What about Scala?

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- This is valid JSON

- What Scala type do we use to store this data?
  - We can't mix types in our Scala data structures
  - .. at least, not without polymorphism

JSON - Library

- We'll install a library to help us work with JSON in Scala
  - The Play JSON library
- Library defines these Scala types
  - JsString
  - JsNumber
  - JsBoolean
  - JsArray
  - JsObject
  - JsNull
- **All these types extend JsValue**

JSON - Library

- What about Scala?

{"timestamp":1550774961,"message":"success","iss_position":
{"latitude":"-36.5017","longitude":"-2.8015"}}

- This is valid JSON

- What Scala type do we use to store this data?
  - **Map[String, JsValue]**

JSON - Library

- The library parses JSON strings and converts all values into one of the Js_ types
- We store them in variables of the JsValue base class
- Convert values to the Scala types as needed

Reading JSON

JSON - Library

response = {"timestamp":1550774961,"message":"success","iss_position": {"latitude":"-36.5017","longitude":"-2.8015"}}

```
import play.api.libs.json.{JsValue, Json}

...

val parsed: JsValue = Json.parse(response)

// unused values, but this is how we would extract message and timestamp
val message: String = (parsed \ "message").as[String]
val timestamp: Long = (parsed \ "timestamp").as[Long]
val issLocation: Map[String, String] = (parsed \ "iss_position").as[Map[String, String]]
```

- Use the library to extract specific values

JSON - Library

response = {"timestamp":1550774961,"message":"success","iss_position": {"latitude":"-36.5017","longitude":"-2.8015"}}

```
import play.api.libs.json.{JsValue, Json}

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val parsed: JsValue = Json.parse(response)

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val message: String = (parsed \ "message").as[String]
val timestamp: Long = (parsed \ "timestamp").as[Long]
val issLocation: Map[String, String] = (parsed \ "iss_position").as[Map[String, String]]
```

- Import the classes/objects we'll need from the library

JSON - Library

response = {"timestamp":1550774961,"message":"success","iss_position": {"latitude":"-36.5017","longitude":"-2.8015"}}

```
import play.api.libs.json.{JsValue, Json}

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val parsed: JsValue = Json.parse(response)

// unused values, but this is how we would extract message and timestamp
val message: String = (parsed \ "message").as[String]
val timestamp: Long = (parsed \ "timestamp").as[Long]
val issLocation: Map[String, String] = (parsed \ "iss_position").as[Map[String, String]]
```

- Call Json.parse
- Parses the JSON string and converts it to a JsValue

JSON - Library

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```
import play.api.libs.json.{JsValue, Json}

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val parsed: JsValue = Json.parse(response)

// unused values, but this is how we would extract message and timestamp
val message: String = (parsed \ "message").as[String]
val timestamp: Long = (parsed \ "timestamp").as[Long]

val issLocation: Map[String, String] = (parsed \ "iss_position").as[Map[String, String]]
```

- Extract values at specific keys
- Use \ to get the value at a key as a JsValue
- Use as[type] to convert the value to the type you expect
  - Cannot use your custom types without defying how to parse your type

Writing JSON

JSON - Library

response = {"timestamp":1550774961,"message":"success","iss_position": {"latitude":"-36.5017","longitude":"-2.8015"}}

```
def createJSON(message: String, timestamp: Long, location: Location): String = {
  val jsonTimestamp: JsValue = Json.toJson(timestamp)
  val jsonMessage: JsValue = Json.toJson(message)

  val locationMap: Map[String, String] = Map(
    "latitude" -> location.latitude.toString,
    "longitude" -> location.longitude.toString
  )

  val jsonLocation: JsValue = Json.toJson(locationMap)

  val jsonMap: Map[String, JsValue] = Map(
    "timestamp" -> jsonTimestamp,
    "message" -> jsonMessage,
    "iss_position" -> jsonLocation
  )

  Json.stringify(Json.toJson(jsonMap))
}
```

- Convert Scala types to JsValue with Json.toJson
  - Cannot use your custom types without defying how to convert your type

JSON - Library

response = {"timestamp":1550774961,"message":"success","iss_position": {"latitude":"-36.5017","longitude":"-2.8015"}}

```
def createJSON(message: String, timestamp: Long, location: Location): String = {
  val jsonTimestamp: JsValue = Json.toJson(timestamp)
  val jsonMessage: JsValue = Json.toJson(message)

  val locationMap: Map[String, String] = Map(
    "latitude" -> location.latitude.toString,
    "longitude" -> location.longitude.toString
  )

  val jsonLocation: JsValue = Json.toJson(locationMap)

  val jsonMap: Map[String, JsValue] = Map(
    "timestamp" -> jsonTimestamp,
    "message" -> jsonMessage,
    "iss_position" -> jsonLocation
  )

  Json.stringify(Json.toJson(jsonMap))
}
```

- Call Json.stringify to convert a type to a JSON string
  - Can be any types known to the library (Most of the common Scala types)

Data From the Internet

HTTP Requests

- Use another library
  - scalaj-http library

- Simplifies HTTP requests

```scala
val url: String = "http://api.open-notify.org/iss-now.json"

val response: String = Http(url).asString.body
```

Maven

- We're using 2 new libraries
- Must download them before use
- Add them to our Maven file

Maven

```xml
<project xmlns="http://maven.apache.org/POM/4.0.0">
    <groupId>com.mycompany.app</groupId>
    <artifactId>test1</artifactId>
    <modelVersion>4.0.0</modelVersion>
    <url>http://maven.apache.org</url>
    <version>0.0.1</version>

    <dependencies>

        <!-- https://mvnrepository.com/artifact/org.scalatest/scalatest -->
        <dependency>
            <groupId>org.scalatest</groupId>
            <artifactId>scalatest_2.12</artifactId>
            <version>3.0.5</version>
        </dependency>

    </dependencies>

</project>
```

- This is our current Maven file that we used to download scalatest
- We can add more dependancies to this file
    - Open the Maven sidebar, refresh, then download the new libraries

Maven

```xml
<project xmlns="http://maven.apache.org/POM/4.0.0">
    <groupId>com.mycompany.app</groupId>
    <artifactId>test1</artifactId>
    <modelVersion>4.0.0</modelVersion>
    <url>http://maven.apache.org</url>
    <version>0.0.1</version>

    <dependencies>

        <!-- https://mvnrepository.com/artifact/org.scalatest/scalatest -->
        <dependency>
            <groupId>org.scalatest</groupId>
            <artifactId>scalatest_2.12</artifactId>
            <version>3.0.5</version>
        </dependency>

    </dependencies>

</project>
```

- Find new libraries at https://mvnrepository.com
    - An enormous wealth of shared libraries
    - Search for the new libraries, paste the dependency into you pom.xml file

Lecture Question

Objective: Practice working with JSON strings in a stron

Question: [Scala] In a package named "json" create and complete the "Store" class which is stared below

toJSON returns a JSON string representing an object with keys "cashInRegister" and "inventory" mapping to value from the two state variables with the same names

fromJSON takes a JSON string in the same format returned from toJSON and sets the state variables to the values from the JSON string

```
package json

class Store(var cashInRegister: Double, var inventory: List[String]) {

  def toJSON(): String = {
    ""
  }

  def fromJSON(jsonString: String): Unit = {

  }

}
```

* This question will be open until midnight

Lecture Question

```
package tests

import json.Store
import org.scalatest.FunSuite

class TestStore extends FunSuite {

  val EPSILON: Double = 0.000001

  def equalDoubles(d1: Double, d2: Double): Boolean = {
    (d1 - d2).abs < EPSILON
  }

  test("test the store JSON") {
    val store: Store = new Store(550.21, List("eggs", "milk", "waffles"))
    val storeJSON: String = store.toJSON()

    val store2: Store = new Store(0.0, List())
    store2.fromJSON(storeJSON)

    assert(equalDoubles(store2.cashInRegister, 550.21))
    val actualList: List[String] = store2.inventory.sorted
    val expectedList: List[String] = List("eggs", "milk", "waffles").sorted

    assert(actualList == expectedList)
  }
}
```