CMPS 251

Read Chapter 15

Read/Write Files

JSON

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Outline

- Read / Write Text File
- Read / Write JSON File

Read / Write Text File

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Overview

- Data stored in a program variables is lost when the program ends

- To store data between program runs, we use files

- Java has MANY ways to read and write files
  - We will focus on the most commonly used ways

Use Java 8 java.nio.file package

- **Representing file paths**

  Paths.get

- **Reading files**

  Files.lines

- **Writing files**

  Files.write

- **Exploring folders**

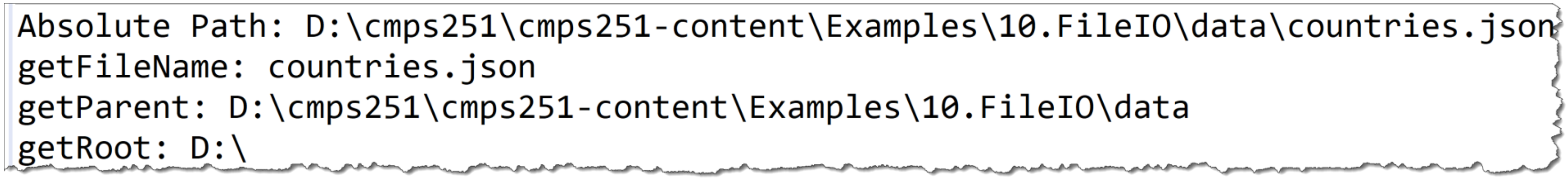
  Files.list, Files.walk, Files.find

Paths

- **Paths** class provides a way to represent a file path and get path info
- **Get Path with Paths.get**
  - `Path p1 = Paths.get("some-file");`
  - `Path p2 = Paths.get("/usr/local/gosling/some-file");`
  - `Path p3 = Paths.get("C:\\Users\\ae\\some-file");`
    - Notice the double backslashes because backslash is used to escape next char in Java strings.
- **Paths have convenient methods**
  - toAbsolutePath, getFileName, getParent, getRoot …

Example

```java
public static void main(String[] args) {
 Path path =
    Paths.get("data/countries.json").toAbsolutePath();
 System.out.printf("Absolute Path: %s%n", path);
 System.out.printf("getFileName: %s%n",
                          path.getFileName());
 System.out.printf("getParent: %s%n",
                          path.getParent());
 System.out.printf("getRoot: %s%n", path.getRoot());
}
```



```
Absolute Path: D:\cmps251\cmps251-content\Examples\10.FileIO\data\countries.json
getFileName: countries.json
getParent: D:\cmps251\cmps251-content\Examples\10.FileIO\data
getRoot: D:\
```

Read File Content

- **You can read all lines into Stream in 1 method call**

  ```
  Stream<String> lines = Files.lines(somePath);
  ```

- **Quick example**
  - Get Middle East countries from countries.txt file and save them to me-countries.txt file

```
String inputFileName = "data/countries.txt";
String outputFileName = "data/me-countries.txt";
List<String> countries =
  Files.lines(Paths.get(inputFileName))
        .filter(c -> c.contains("Middle East"))
        .map(c -> c.split(";")[0])
        .sorted()
        .collect(Collectors.toList());

System.out.println(countries);
Files.write(Paths.get(outputFileName), countries);
```

Benefits of Files.lines

- `Files.lines` **return a Stream**
  - Much faster + memory savings
  - Does not store entire file contents in one huge list, but processes each line as you go along
  - You can stop partway through, and rest of file is never processed (due to lazy evaluation of Streams). E.g., using **.findFirst()**
- Many convenient filtering and transformation methods
  - You can chain these method calls together

Files.write

- **You can write all lines in one method call**
  - `List<String> lines = …;`
  - `Files.write(somePath, lines);`
- **You can write all bytes in one method call**
  - `byte[] fileArray = …;`
  - `Files.write(somePath, fileArray);`
- **OpenOption**
  - Both methods above optionally take an OpenOption to specify whether to create file if it doesn't exist, whether to append.
  - Default behavior is to create file if not there and to overwrite if it exists

Example

- Write a list of Strings to a file

```
Path path = Paths.get("data/testFile.txt");
List<String> lines =
  List.of("Line One", "Line Two", "Final Line");
Files.write(path, lines);
```

Get files of a folder

- **Get all files in a folder:** `Files.list`

```
Files.list(Paths.get(folder))
  .forEach(System.out::println);
```

Writing Formatted Text to a File

- Class `PrintWriter` (from package `java.io`) defines methods to create and write to a text file
  - To open the file Declare a *variable* using `PrintWriter` constructor, pass file path as argument
  - Wrap in a `try` and `catch` blocks to handle any IOException such as a new file cannot be created
- Use `println / printf` method to write to the file
- Close the file when done

Writing Formatted Text to a File: Example

```
PrintWriter out = new
PrintWriter("data/MyFormattedFile.txt");
out.println("This is being written to a file.");

for (int i = 0; i < 10; i++) {
      out.printf("%d%n", i);
}

out.close();
```

Read / Write JSON File

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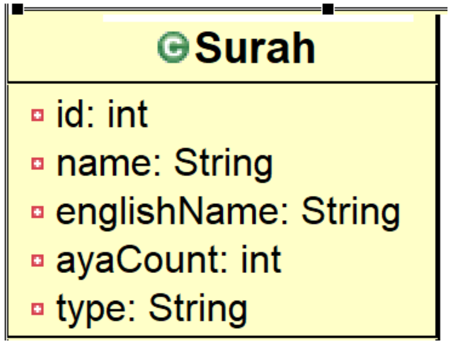
JSON Data Format

- **JSON** (JavaScript Object Notation) is a very popular lightweight data format to transform an object to a **text** form to ease storing and transporting data
- **Jackson ObjectMapper** library could be used to transform an object to json or transform a json string to an object

Transform an instance of Surah class to a JSON string:



```
ObjectMapper jsonMapper = new ObjectMapper();
Surah surah = new Surah(1, "الفاتحة", "Al-Fatiha", 7, "Meccan");
String surahJSON = jsonMapper.writeValueAsString(surah);
```

```
{
     "id": 1,
     "name": "الفاتحة"
     "englishName": "Al-Fatiha",
     "ayaCount": 7,
     "type": "Meccan"
 }
```

Read JSON file

```java
ObjectMapper jsonMapper = new ObjectMapper();
String filePath = "data/surahs.json";
try {
  Surah[] surahsArray = jsonMapper.readValue(
      new File(filePath), Surah[].class);
  List<Surah> surahs = Arrays.asList(surahsArray);
} catch (Exception e) {
  System.out.println(e.getMessage());
}
```

Quick Tips!

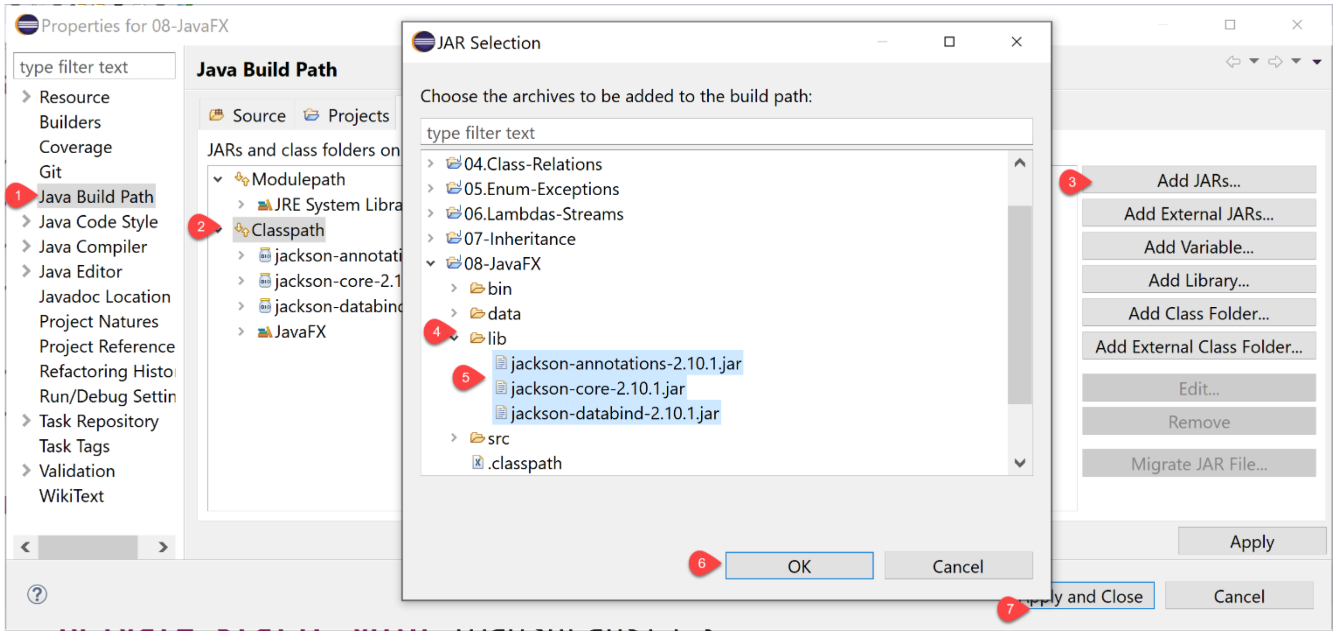
You may use https://codebeautify.org/json-to-java-converter to generate a Java class from a json string!

Write object to a JSON file

```java
public static void saveStudents(Student[] students) {
  ObjectMapper jsonMapper = new ObjectMapper();
  String filePath = "data/students.json";
  // Write students array to a json file
  try {
    jsonMapper.writeValue(new File(filePath), students);
  } catch (IOException e) {
    e.printStackTrace();
  }
}
```

Steps to use Jackson ObjectMapper

- Create a subfolder named **lib** under your project folder
- Download the followings library into **lib** subfolder
  - https://repo1.maven.org/maven2/com/fasterxml/jackson/core/jackson-databind/2.10.1/jackson-databind-2.10.1.jar
  - https://repo1.maven.org/maven2/com/fasterxml/jackson/core/jackson-annotations/2.10.1/jackson-annotations-2.10.1.jar
  - https://repo1.maven.org/maven2/com/fasterxml/jackson/core/jackson-core/2.10.1/jackson-core-2.10.1.jar
- Right-click your project and select `Configure Build Path…`
- Click ***`Classpath`*** then click ***`Add JARS…`*** select the jars from your project **lib** subfolder (see image below)



Jackson ObjectMapper vs. Gson

- ObjectMapper supports reading and writing JSON files for Class with JavaFX properties
- ObjectMapper supports inheritance hierarchy. E.g.,

```
@JsonTypeInfo(use=JsonTypeInfo.Id.NAME,
    include=JsonTypeInfo.As.PROPERTY, property="@type")
@JsonSubTypes({
    @Type(value = Student.class, name = "Student"),
    @Type(value = Faculty.class, name = "Faculty")
})

public abstract class Member {
  ...
}
```

Summary

- **Use Path to refer to file location**

```
Path somePath = Paths.get("/path/to/file.txt");
```

- **Read all lines into a Stream**

```
Stream<String> lines = Files.lines(somePath);
```

  - Can now use filter, map, distinct, sorted, findFirst, etc.
  - You get benefits of lazy evaluation
  - Can output as List with `collect(Collectors.toList())`

- **Write List into a file**

```
Files.write(somePath, someList);
```

- **Use PrintWriter for more flexible output**
- **Use Gson library for reading/writing json files**