Session 14

Serialization/JSON

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Lecture Objectives

- Understand the need for serialization
- Understand various approaches to serialization
- Understand the use of JSON as a popular approach to serialization
- Understand how to access JSON data from JavaScript and Java

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Reading & Reference

- Reading
  - Tutorial

    www.w3schools.com/js/js_json_intro.asp
- Reference
  - JSON

    en.wikipedia.org/wiki/JSON
  - Serialization

    en.wikipedia.org/wiki/Serialization
    www.tutorialspoint.com/java/java_serialization.htm
  - API

    docs.oracle.com/javaee/7/api/index.html?javax/json/JsonObject.html

Most examples in this set of slides are taken from W3Schools tutorial

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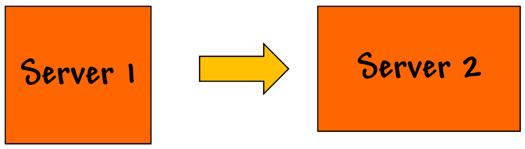
How Do We Transmit Objects Between Servers?

- We previously covered some data transmission approaches
  - Primitives (e.g., form data set name/value pairs)
  - Specific structured data (e.g., JPEG image) as a MIME data type
- But many objects involve structured data that is not logically represented as a stream
- Approaches
  - Java Serialization
  - XML
  - JSON



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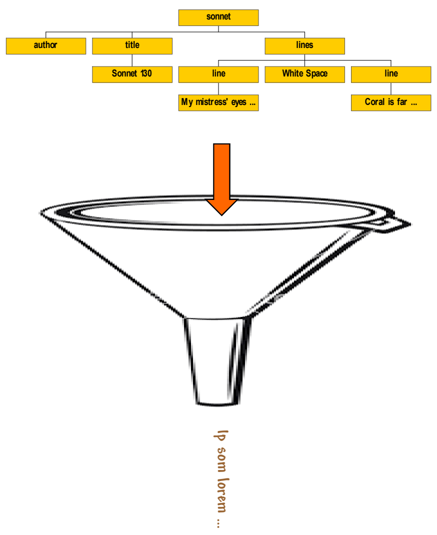
Terminology

- Serialization
  - Process of translating data structures or object state into a format that can be stored and reconstructed later in the same or another computer environment (also called marshalling)
  - A simple way to persist live objects to persistent storage
- Unmarshalling - reverse process



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Java Serialization

- java.io.Serializable interface - must be declared
- Java.io.Externalizable interface
  - writeExternal method
  - readExternal method
- Platform independent (serialized on one platform, reconstructed on another platform)
- No serialization methods declared on the Serializable Interface

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Java Serialization Example ...

```
package lectures;
public class Employee implements java.io.Serializable {
   public String name;
   public String address;
   public transient int SSN;
   public int number;

   public void mailCheck() {
      System.out.println(
      "Mailing a check to " + name + " " + address);
   }
}
```

This example writes an Employee object, then reads it back to reconstruct the object

All fields of a serialized class must be declared Serializable or transient (not serialized)

Example from tutorialspoint.com

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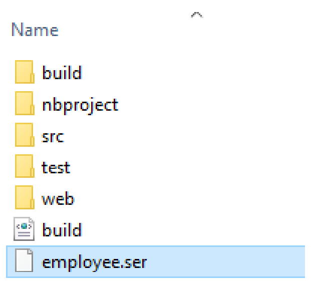
... Java Serialization Example

```
public class SerializeDemo {
   public static void main(String [] args) {
      Employee e = new Employee();
      e.name = "Reyan Ali";
      e.address = "Phokka Kuan, Ambehta Peer";
      e.SSN = 11122333;
      e.number = 101;
      try {
         FileOutputStream fileOut =
         new FileOutputStream("employee.ser");
         ObjectOutputStream out = new ObjectOutputStream(fileOut);
         out.writeObject(e);
         out.close();
         fileOut.close();
         System.out.printf("Serialized data is saved in employee.ser");
      } catch(IOException i) {
         i.printStackTrace();  } } }
```

Code convention for serialized filename



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… Java Serialization Example

```
public class DeSerializeDemo {
  public static void main(String [] args) {
      Employee e = null;
      try {
         FileInputStream fileIn = new FileInputStream("employee.ser");
         ObjectInputStream in = new ObjectInputStream(fileIn);
         e = (Employee) in.readObject();
         in.close();
         fileIn.close();
      } catch(IOException i) {
         i.printStackTrace();
         return;
      } catch(ClassNotFoundException c) {
         System.out.println("Employee class not found");
         c.printStackTrace();
         return; }
...
```

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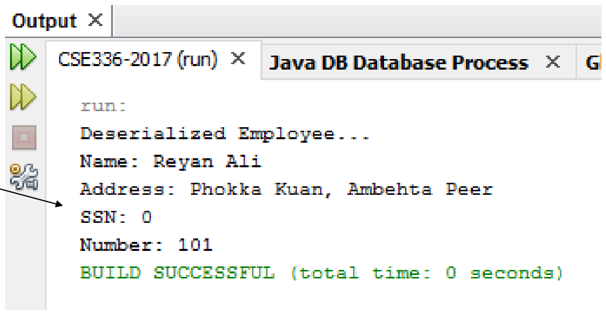
… Java Serialization Example

```
...
       System.out.println("Deserialized Employee...");
       System.out.println("Name: " + e.name);
       System.out.println("Address: " + e.address);
       System.out.println("SSN: " + e.SSN);
       System.out.println("Number: " + e.number);
    }
}
```



```
run:
Deserialized Employee...
Name: Reyan Ali
Address: Phokka Kuan, Ambehta Peer
SSN: 0
Number: 101
BUILD SUCCESSFUL (total time: 0 seconds)
```

SSN was declared transient. When the object is recreated the default value for a transient int is 0

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Uses of Java Serialization

- Persisting objects to be reused in the same or similar environment
- Not useful for sharing objects with non-Java environments
- Alternatives
  - XML
  - JSON

What is JSON?

- JavaScript Object Notation
- Data serialization format
- Open standard format for the interchange of name/value pair objects
- Alternative to XML
- Language independent format, although originally derived from JavaScript

How Do You Pronounce JSON?

- It doesn't matter (according to the inventor)
- The way your colleagues pronounce it
  - Just like the name (Jason) or
  - Jay-Sahn

Background

- The JSON format is syntactically identical to the code for creating JavaScript objects
- Unlike XML, you don't need an external parser
- JavaScript function available to convert JSON data into a native JavaScript object
- Very useful in sharing data with a browser client

Revisit JavaScript

- Objects
  - Unordered collection of properties
  - Each property has a name and a value
  - Property names are strings
- Examples
  - {} - empty
  - { x:0, y:0}
  - {"main title": "JavaScript",
    'sub-title': "Definitive Guide",
    author: {
      firstname: "David",
      surname: "Flanagan" }
    }

Remember, JavaScript functions are objects

Note the use of quotes in a JavaScript literal when the name includes spaces

Easy to define a new object

```
var position = {x:0, y:0};
```

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Arrays

- Arrays
  - Order collection of values
  - Untyped
  - Array elements may be objects or other arrays

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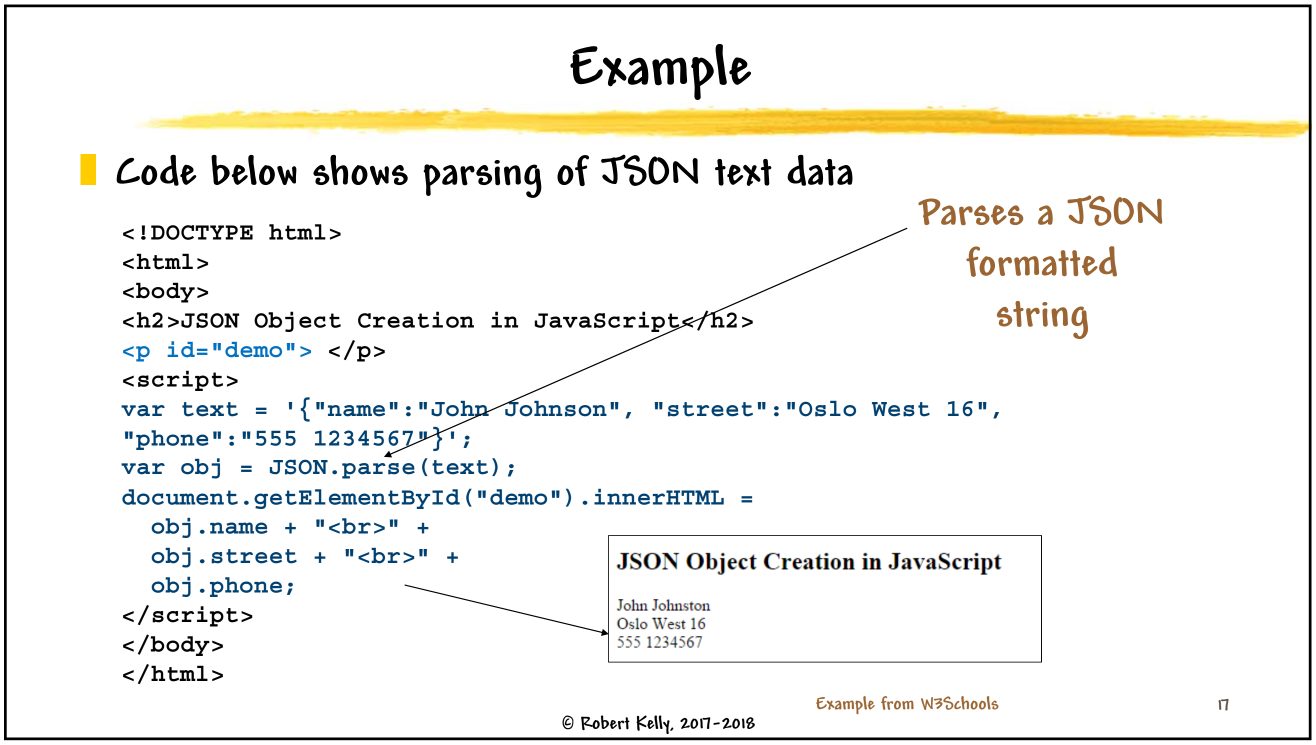

Example

- Code below shows parsing of JSON text data

```
<!DOCTYPE html>
<html>
<body>
<h2>JSON Object Creation in JavaScript</h2>
<p id="demo"> </p>
<script>
var text = '{"name":"John Johnson", "street":"Oslo West 16",
"phone":"555 1234567"}';
var obj = JSON.parse(text);
document.getElementById("demo").innerHTML =
  obj.name + "<br>" +
  obj.street + "<br>" +
  obj.phone;
</script>
</body>
</html>
```

Parses a JSON formatted string

```
JSON Object Creation in JavaScript

John Johnston
Oslo West 16
555 1234567
```

Example from W3Schools

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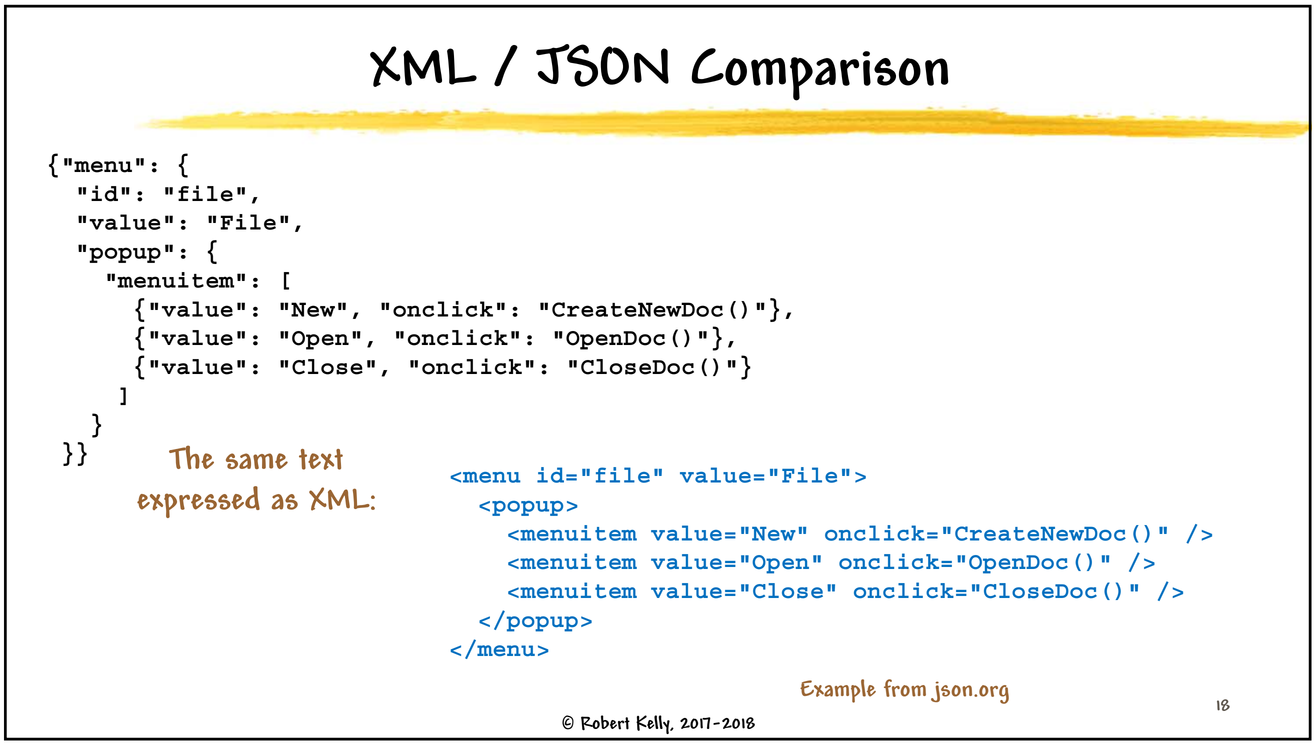

XML / JSON Comparison

```
{"menu": {
  "id": "file",
  "value": "File",
  "popup": {
    "menuitem": [
      {"value": "New", "onclick": "CreateNewDoc()"},
      {"value": "Open", "onclick": "OpenDoc()"},
      {"value": "Close", "onclick": "CloseDoc()"}
    ]
  }
 }}
```

The same text expressed as XML:

```
<menu id="file" value="File">
  <popup>
    <menuitem value="New" onclick="CreateNewDoc()" />
    <menuitem value="Open" onclick="OpenDoc()" />
    <menuitem value="Close" onclick="CloseDoc()" />
  </popup>
</menu>
```

Example from json.org

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XML / JSON Comparison

- Both XML and JSON are
  - Self describing
  - Hierarchal
  - Can be fetched with an XMLHttpRequest
- parse is a JavaScript function
- XML requires clumsier access
  - external parser
  - temporary variables for the parsed results
  - Tree traversal

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JSON Syntax

- Data is in name/value pairs
- Data is separated by commas
- Curly braces hold objects
- Square brackets hold arrays
- JSON names require double quotes

JSON syntax and JavaScript literal syntax are closely related, but not exactly the same

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JSON Values

- JSON values can be:
  - A number (integer or floating point)
  - A string (in double quotes)
  - A Boolean (true or false)
  - An array (in square brackets)
  - An object (in curly braces)
  - null

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Accessing JavaScript Object Data

- For

```
var employees = [
    {"firstName":"John", "lastName":"Doe"},
    {"firstName":"Anna", "lastName":"Smith"},
    {"firstName":"Peter","lastName": "Jones"}
];
// returns John Doe
employees[0].firstName + " " + employees[0].lastName;
```

Employees is an array of objects and firstName is a property of an element of the array

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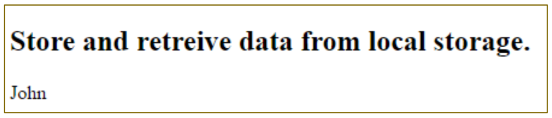
Storing and Retrieving from localstorage

localstorage is a property of the window object. Browsers write text to localstorage

```
<!DOCTYPE html>
<html>
<body>
<h2>Store and retrieve data from local storage.</h2>
<p id="demo"></p>
<script>
var myObj, myJSON, text, obj;
myObj = { "name":"John", "age":31, "city":"New York" };
myJSON = JSON.stringify(myObj);
localStorage.setItem("testJSON", myJSON);
text = localStorage.getItem("testJSON");
obj = JSON.parse(text);
document.getElementById("demo").innerHTML = obj.name;
</script>
</body>
</html>
```

The stringify and parse methods perform marshalling and unmarshalling of JavaScript objects



Store and retreive data from local storage.

John

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JSON Syntax

- JSON format is almost identical to that of JavaScript objects
- Keys must be strings, written with double quotes (JavaScript allows strings, numbers or identifiers
- JSON values must be one of:
  - string
  - number
  - object
  - array
  - boolean
  - null

Note that functions are not valid JSON values

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Example – Code

JSON-Ajax.html Class Web site

```
<div id="id01"></div>
<script>
var xmlhttp = new XMLHttpRequest();
var url = "myTutorials.txt";

xmlhttp.onreadystatechange = function() {
    if (xmlhttp.readyState == 4 && xmlhttp.status == 200) {
        var myArr = JSON.parse(xmlhttp.responseText);
        myFunction(myArr);
    } }
xmlhttp.open("GET", url, true);
xmlhttp.send();

function myFunction(arr) {
    var out = "";
    var i;
    for(i = 0; i < arr.length; i++) {
        out += '<a href="' + arr[i].url + '">' +
        arr[i].display + '</a><br>';
    }
    document.getElementById("id01").innerHTML = out;
} </script>
```

HTML Tutorial
CSS Tutorial
JavaScript Tutorial
jQuery Tutorial
JSON Tutorial
AJAX Tutorial
SQL Tutorial
PHP Tutorial
XML Tutorial

out is used to build the html that is inserted into the div block

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myTutorials.txt – JSON Data

```
[ { "display": "HTML Tutorial",
"url": "http://www.w3schools.com/html/default.asp" },
{ "display": "CSS Tutorial",
"url": "http://www.w3schools.com/css/default.asp" },
{"display": "JavaScript Tutorial",
"url": "http://www.w3schools.com/js/default.asp" },
{"display": "jQuery Tutorial",
"url": "http://www.w3schools.com/jquery/default.asp" },
{"display": "JSON Tutorial",
"url": "http://www.w3schools.com/json/default.asp"  },
{"display": "AJAX Tutorial",
"url": "http://www.w3schools.com/ajax/default.asp" },
{"display": "SQL Tutorial",
"url": "http://www.w3schools.com/sql/default.asp" },
{"display": "PHP Tutorial",
"url": "http://www.w3schools.com/php/default.asp" },
{"display": "XML Tutorial",
"url": "http://www.w3schools.com/xml/default.asp" }]
```

File on CSE336 Web site

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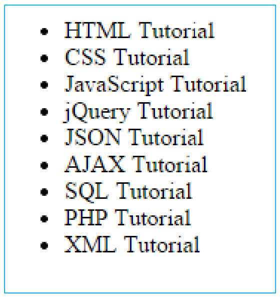
Are We on Track?

- Modify and run the example so that
  - The tutorial names do not contain an anchor tag
  - The names appear in an unordered list
- Steps (to get around the Same Origin Policy)
  - Download the example html
  - Download the myTutorials.txt file
  - Insert both files into your NetBeans project
  - Modify the JavaScript in the html file



- HTML Tutorial
- CSS Tutorial
- JavaScript Tutorial
- jQuery Tutorial
- JSON Tutorial
- AJAX Tutorial
- SQL Tutorial
- PHP Tutorial
- XML Tutorial

Download html from

http://www3.cs.stonybrook.edu/~cse336/JSON-Ajax.html

Download text file from

http://www3.cs.stonybrook.edu/~cse336/myTutorials.txt

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Were We on Track?

```
function myFunction(arr) {
    var out = "<ul>";
    var i;
    for(i = 0; i < arr.length; i++) {
        out += "<li>" + arr[i].display +  '</li>';
    }
    out += "</ul>"
    document.getElementById("id01").innerHTML = out;
}
```

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Read a JSON File in Java

- JSON is also used to access data from a file
- A few libraries are available
- Example uses jsavax.json.*

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Example

```
public class JsonRead {
    public static void main(String[] args) {
        Employee e = null;
        try {
            FileInputStream fileIn = new FileInputStream("employees.json");
            JsonReader reader = Json.createReader(fileIn);
            JsonArray employees = reader.readArray();
            JsonObject employee = employees.getJsonObject(0);
            JsonObject person = employee.getJsonObject("employee");
            System.out.println(person.getJsonString("firstName"));
            System.out.println(person);
            reader.close();

        } catch (IOException i) {
            i.printStackTrace();
            return;
        }
    }
}
```

Library in javax.json.*

```
[
 {"employee": {
    "firstName": "Lokesh",
    "lastName": "Gupta",
    "website": "howtodoinjava.com" } },
  { "employee": {
     "firstName": "Brian",
     "lastName": "Schultz",
     "website": "example.com" } } ]
```

```
"Lokesh"

{"firstName":"Lokesh","lastName":"Gu
pta","website":"howtodoinjava.com"}
```

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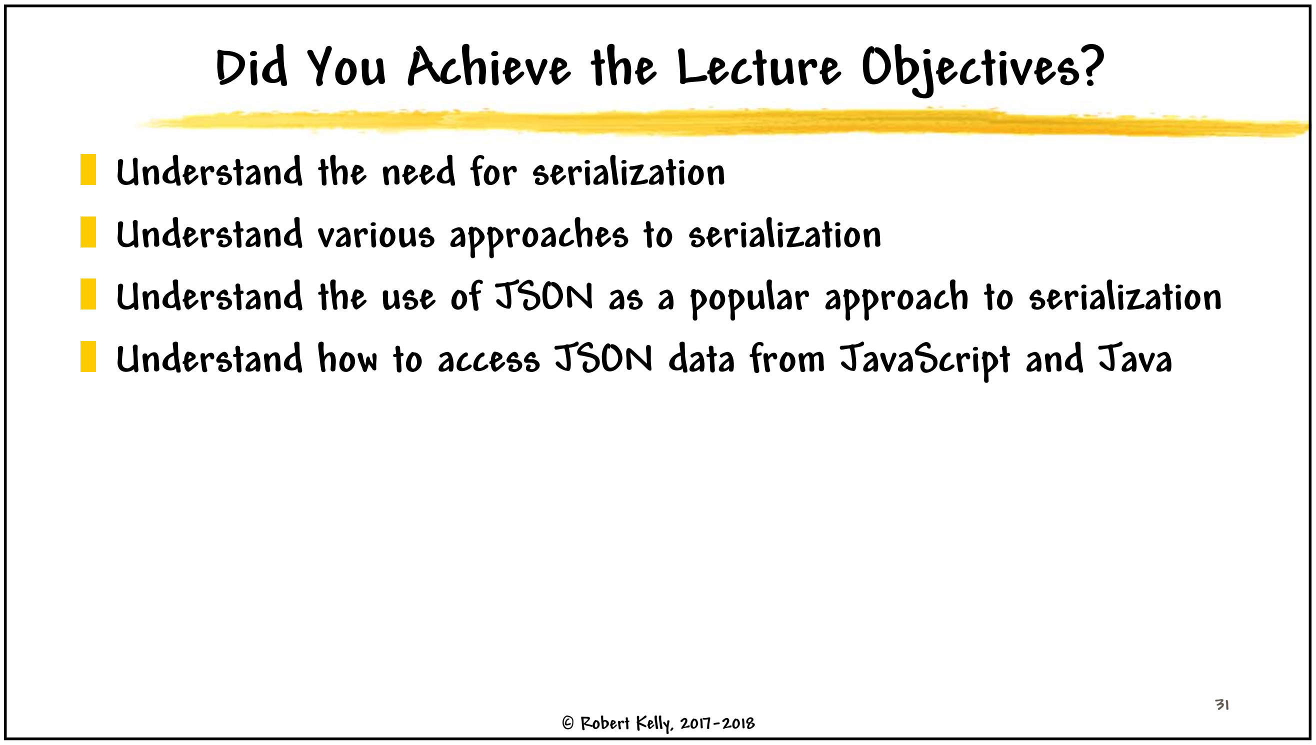

Did You Achieve the Lecture Objectives?

- Understand the need for serialization
- Understand various approaches to serialization
- Understand the use of JSON as a popular approach to serialization
- Understand how to access JSON data from JavaScript and Java