JSON and AJAX

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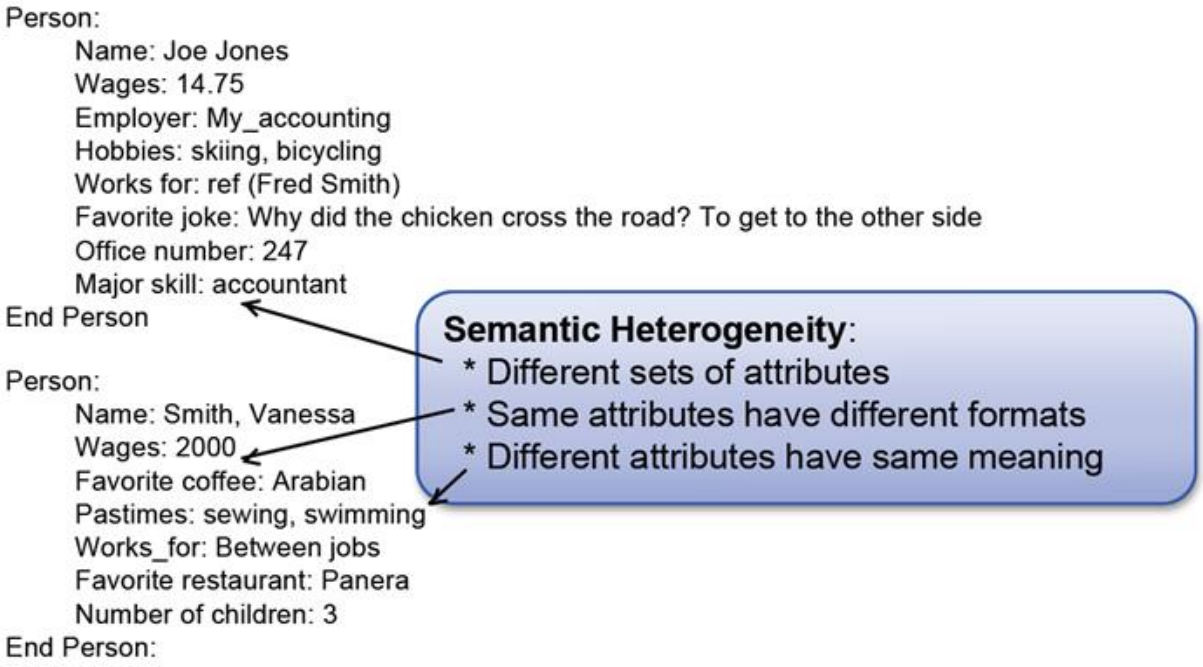
Evolution of DBMS

- Semi-structured era (~2000+)
  - Schema Evolution OR Schema "later": data is self describing



  - A Response to the growth of Web services (AJAX) and XML as a language (same for JSON as Javascript)

Evolution of DBMS

- Semi-structured era (~2000+)
  - Relational DBMS have heavy-weight mechanisms to change schema (ALTER)
  - XML and JSON as a data model:
    - records can be hierarchical
    - records can still reference to other records through paths (i.e., XPath)
    - schema can be defined "later" in DTDs and XMLSchema

Evolution of DBMS

- For machine consumption on the Web, data should have these characteristics:
  - Be *object-like*
  - Be *schemaless* (not guaranteed to conform exactly to any schema, but different objects have some commonality among themselves)
  - Be *self-describing* (some schema-like information, like attribute names, is part of data itself)
- Data with these characteristics are referred to as *semistructured*.

Non-self-describing Data

- Non-self-describing (relational, object-oriented):

Data part:

(#123, [“Students”, {[“John”, s111111111, [123,”Main St”]],
[“Joe”, s222222222, [321, “Pine St”]] }
])

Schema part:

PersonList[*ListName*: String,
Contents: [*Name*: String,
Id: String,
Address: [*Number*: Integer, *Street*: String]]
]

Evolution of DBMS

- *Self-describing*:
  - Attribute names embedded in the data itself, *but are distinguished* from values
  - Doesn't need schema to figure out what is what (but schema might be useful nonetheless)

(#12345,
[*ListName*: "Students",
Contents: { [*Name*: "John Doe",
Id: "s111111111",
Address: [*Number*: 123, *Street*: "Main St."]] ,
[*Name*: "Joe Public",
Id: "s222222222",
Address: [*Number*: 321, *Street*: "Pine St."]] }
])

JSON

- Java Script Object Notation
- Lightweight data interchange
- Used with 'RESTful' APIs and AJAX (Asynchronous Javascript and XML)

JSON – Data Types

- **Number** – Integers and Floating point numbers do not have separate types
- **String** – A sequence of characters
- **Boolean** – true/false
- **Array** – An ordered list
- **Objects** – Sets of name/value pairs
- **Null** – an empty (non-existent) value

JSON - Syntax

- Data in Key/Value pairs : {'key':'value'}
  - Key must be quoted!
  - Value must be one of the described data types
- File extension should be ***.json***
- MIME Types: Application/json

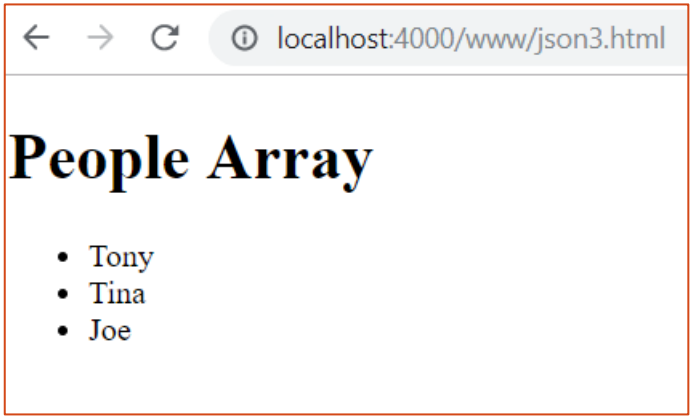
JSON - Syntax

- XMLHttpRequest.readyState
  - https://developer.mozilla.org/en-US/docs/Web/API/XMLHttpRequest/readyState

Value	State	Description
0	UNSENT	Client has been created. open() not called yet.
1	OPENED	open() has been called.
2	HEADERS_RECEIVED	send() has been called, and headers and status are available.
3	LOADING	Downloading; responseText holds partial data.
4	DONE	The operation is complete.

- HTTP 200: https://developer.mozilla.org/en-US/docs/Web/HTTP/Status/200

JSON - Example



people.json

```
{
  "people" : [
    {
      "name":"Tony",
      "age":55
    },
    {
      "name":"Tina",
      "age":35
    },
    {
      "name":"Joe",
      "age":10
    }
  ]
}
```

json3.html

```
<body>
  <h1>People Array</h1>
  <ul id='people'></ul>
  <script>
  var xhttp = new XMLHttpRequest();
  xhttp.onreadystatechange = function() {
     if (this.readyState == 4 && this.status == 200) {
       // Typical actions to be performed when the document is ready:
       console.log(xhttp.responseText);
       var response = JSON.parse(xhttp.responseText);
       var people = response.people;
        var output='';
        for (var i = 0; i < people.length; i++) {
          output += '<li>'+people[i].name+'</li>';
        }
        document.getElementById('people').innerHTML = output;
     }
  };
  xhttp.open('GET', 'people.json', true);
  xhttp.send();
  </script>
</body>
```

JSON – Utility Functions

- **JSON.parse()** – Read a string as a JSON string, parse it, and generate a Javascript object with the contents of the string
- **JSON.stringify()** – Convert data or a Javascript Object into JSON notation

JSON.parse()

- JSON.parse() reads JSON strings and converts them to objects for use by Javascript
- Syntax:

```
JSON.parse(<string>, <reviver>);
```

  - <string> is the string to be parsed and converted to a Javascript object
  - <reviver> is an optional parameter holding a function to convert or modify values

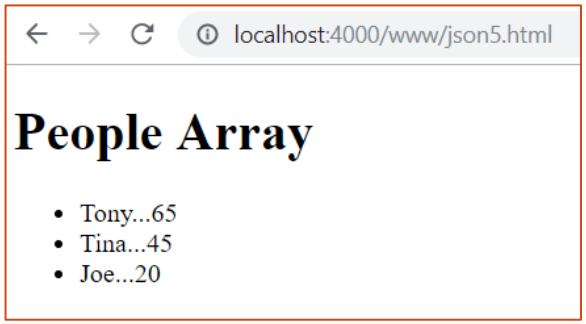
JSON – Example modify data w/parse()

people.json

```
{
   "people" : [
    {
     "name":"Tony",
     "age":55
    },
    {
     "name":"Tina",
     "age":35
    },
    {
     "name":"Joe",
     "age":10
    }
   ]
 }
```

json5.html

```
<body>
  <h1>People Array</h1>
  <ul id='people'></ul>
  <script>
  var xhttp = new XMLHttpRequest();
  xhttp.onreadystatechange = function() {
     if (this.readyState == 4 && this.status == 200) {
       // Typical action to be performed when the document is ready:
        var response = JSON.parse(xhttp.responseText, (key,value) =>
            key === 'age' ? value + 10 : value);
        var people = response.people;
        var output='';
        for (var i = 0; i < people.length; i++) {
          output += '<li>'+people[i].name+'...'+people[i].age+'</li>';
        }
              document.getElementById('people').innerHTML = output;
     }
  };
  xhttp.open('GET', 'people.json', true);
  xhttp.send();
  </script>
</body>
```



JSON.stringify()

- This convert any Javascript data or object into correct JSON syntax
- Syntax:

JSON.stringify(<value>, <replacer>, <space>)

- The second two arguments are optional. The args are:
  - <value> - The data to be converted
  - <replacer> - This can be either:
    - A function that alters the behavior of stringify by selecting properties to include.
    - An array of strings that are used to filter/select which properties stringify() includes
  - <space> - This is either:
    - A number (up to 10) that indicate how many spaces to use between elements
    - A string (up to 10 characters long) used as the space separator

JSON – Example modify data with stringify()

json6.html

```
<body>
  <h1>People Array</h1>
  <ul id='people'></ul>
  <script>
  var xhttp = new XMLHttpRequest();
  xhttp.onreadystatechange = function() {
     var count = 0;
     function replacer(key,value) {
      if (key === 'name') {
        count = count + 1;
        return value+count;
      }
      return value;
     }
     if (this.readyState == 4 && this.status == 200) {
          // Typical action to be performed when the document is ready:
          var response = JSON.parse(xhttp.responseText, (key,value) =>
              key === 'age' ? value + 10 : value);
          console.log(response.people);
          var newpeople = JSON.stringify(response.people, replacer);
          var finalpeople = JSON.parse(newpeople);
          var output='';
          for (var i = 0; i < finalpeople.length; i++) {
             output += '<li>'+finalpeople[i].name+'...'+finalpeople[i].age+'</li>';
          }
          document.getElementById('people').innerHTML = output;
      }
  };
  xhttp.open('GET', 'people.json', true);
  xhttp.send();

  </script>
</body>
```