CSc 337

LECTURE 13: JSON

NOISE TO SIGNAL
Rob Cottingham

Apparently our open API is giving our customers unprecedented control over their own lives and allowing them to seize control of their destinies. So please shut it down.

The old standard: XML

```xml
<?xml version="1.0" encoding="UTF-8"?>
<note private="true">
  <from>Alice Smith (alice@example.com)</from>
  <to>Robert Jones (roberto@example.com)</to>
  <to>Charles Dodd (cdodd@example.com)</to>
  <subject>Tomorrow's "Birthday Bash" event!</subject>
  <message language="english">
    Hey guys, don't forget to call me this weekend!
  </message>
</note>
```
XML

- fairly simple to read and understand
- can be parsed by JavaScript code using XML DOM
- Is there any other data format that is more natural for JS code to process?

Pros and cons of XML

- pro:
  - standard open format; don't have to "reinvent the wheel" for storing new types of data
  - can represent almost any general kind of data (record, list, tree)
  - easy to read (for humans and computers)
  - lots of tools exist for working with XML in many languages
- con:
  - bulky syntax/structure makes files large; can decrease performance (example)
  - can be hard to "shoehorn" data into a good XML format
  - JavaScript code to navigate the XML DOM is bulky and generally not fun

JavaScript Object Notation (JSON)

JavaScript Object Notation (JSON): Data format that represents data as a set of JavaScript objects

- invented by JS guru Douglas Crockford of Yahoo!
- natively supported by all modern browsers (and libraries to support it in old ones)
- not yet as popular as XML, but steadily rising due to its simplicity and ease of use

Background: Creating a new object

```
var name = {
  fieldName: value,
  ...
  fieldName: value
};                                                                JS
```

```
var pt = {
  x: 4,
  y: 3
};
pt.z = -1;
alert("(" + pt.x + ", " + pt.y + ", " + pt.z + ")");   // (4, 3, -1)
```

- in JavaScript, you can create a new object without creating a class
- you can add properties to any object even after it is created (`z`)

More about JavaScript object syntax

```
var person = {
  name: "Philip J. Fry",                             // string
  age: 23,                                           // number
  "weight": 172.5,                                   // number
  friends: ["Farnsworth", "Hermes", "Zoidberg"],     // array
  getBeloved: function() { return this.name + " loves Leela"; }
};
alert(person.age);                           // 23
alert(person["weight"]);                     // 172.5
alert(person.friends[2]));                   // Zoidberg
alert(person.getBeloved());                  // Philip J. Fry loves Leela
```

- an object can have methods (function properties) that refer to itself as `this`
- can refer to the fields with `.`*fieldName* or `["`*fieldName*`"]` syntax
- field names can optionally be put in quotes (e.g. `weight` above)

Repeated: Example XML data

```xml
<?xml version="1.0" encoding="UTF-8"?>
<note private="true">
  <from>Alice Smith (alice@example.com)</from>
  <to>Robert Jones (roberto@example.com)</to>
  <to>Charles Dodd (cdodd@example.com)</to>
  <subject>Tomorrow's "Birthday Bash" event!</subject>
  <message language="english">
    Hey guys, don't forget to call me this weekend!
  </message>
</note>                                                XML
```

- Could we express this message data as a JavaScript object?
- Each attribute and tag could become a property or sub-object within the overall message object

The equivalant JSON data

```json
{
  "private": "true",
  "from": "Alice Smith (alice@example.com)",
  "to": [
    "Robert Jones (roberto@example.com)",
    "Charles Dodd (cdodd@example.com)"
  ],
  "subject": "Tomorrow's \"Birthday Bash\" event!",
  "message": {
    "language": "english",
    "text": "Hey guys, don't forget to call me this weekend!"
  }
}
```

JSON

Valid JSON

```
~~var student =~~ {                         // no variable assignment
  "first_name": ~~'~~Bart~~'~~,                      // strings must be double-quoted
  ~~'~~last_name~~'~~: "Simpson",                    // property names must be quoted
  "birthdate": ~~new Date("April 1, 1983"),~~   // Date objects not supported
  "enroll": ~~function() {~~                    // Functions not supported
    ~~this.enrolled = true;~~
 ~~}~~
}~~;~~                                                                    JSON
```

- JSON has a few rules that differ from regular JS:
  - Strings must be quoted (in JS, single- or double-quoted are allowed)
  - All property/field names must be quoted
  - Unsupported types: `Function`, `Date`, `RegExp`, `Error`
  - All others supported: `Number`, `String`, `Boolean`, `Array`, `Object`, `null`
- Numerous validators/formatters available: JSONLint, JSON Formatter & Validator, Free Formatter, JSON Validator

Browser JSON methods

method	**description**
JSON.parse(*string*)	converts the given string of JSON data into an equivalent JavaScript object and returns it
JSON.stringify(*object*)	converts the given object into a string of JSON data (the opposite of JSON.parse)

- you can use Ajax to fetch data that is in JSON format
- then call `JSON.parse` on it to convert it into an object
- then interact with that object as you would with any other JavaScript object

JSON expressions exercise

Given the JSON data at right, what expressions would produce:

- The window's title? *(use the Console)*
- The image's third coordinate?
- The number of messages?
- The y-offset of the last message?

```
var data = JSON.parse(this.responseText);
```

```
{
  "window": {
    "title": "Sample Widget",
    "width": 500,
    "height": 500
  },
  "image": {
    "src": "images/logo.png",
    "coords": [250, 150, 350, 400],
    "alignment": "center"
  },
  "messages": [
    {"text": "Save", "offset": [10, 20]},
    {"text": "Help", "offset": [ 0, 50]},
    {"text": "Quit", "offset": [30, 15]}
  ],
  "debug": "true"
}
```

JSON

```
var title = data.window.title;
var coord = data.image.coords[2];
var len = data.messages.length;
var y = data.messages[len - 1].offset[1];
```

JSON example: Books

Suppose we have a service books_json.php about library books.

- If no query parameters are passed, it outputs a list of book categories:

```
{ "categories": ["computers", "cooking", "finance", ...] }        JSON
```

- Supply a `category` query parameter to see all books in one category:
  http://allisonobourn.com/examples/books_json.php?category=cooking

```
{
  "books": [
    {"category": "cooking", "year": 2009, "price": 22.00,
     "title": "Breakfast for Dinner", "author": "Amanda Camp"},
    {"category": "cooking", "year": 2010, "price": 75.00,
     "title": "21 Burgers for the 21st Century", "author": "Stuart Reges"},
    ...
  ]
}                                                                  JSON
```

Parameters

Values you pass to a web service to specify what you want it to give back

- Parameters have names and values

Syntax:

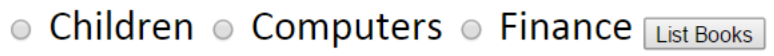
<url>?**<name>**=**<value>**&**<name>**=**<value>** …

Example:

www.allisonobourn.com/examples/books_json.php?category=cooking

JSON exercise

Write a page that processes this JSON book data.

- Initially the page lets the user choose a category, created from the JSON data.
  - 

- After choosing a category, the list of books in it appears:

Books in category "Cooking":

- Breakfast for Dinner, by Amanda Camp (2009)
- 21 Burgers for the 21st Century, by Stuart Reges (2010)
- The Four Food Groups of Chocolate, by Victoria Kirst (2005)

Working with JSON book data - solution

```
function showBooks() {
  // add all books from the JSON data to the page's bulleted list
  var data = JSON.parse(this.responseText);
  for (var i = 0; i < data.books.length; i++) {
    var li = document.createElement("li");
    li.innerHTML = data.books[i].title + ", by " +
        data.books[i].author + " (" + data.books[i].year + ")";
    document.getElementById("books").appendChild(li);
  }
}                                                              JS
```

Bad style: the eval function

```
// var data = JSON.parse(this.responseText);
var data = eval(this.responseText);   // don't do this!
...                                                                  JS
```

- JavaScript includes an `eval` keyword that takes a string and runs it as code
- this is essentially the same as what `JSON.parse` does,
- but `JSON.parse` filters out potentially dangerous code; `eval` doesn't
- `eval` is evil and should not be used!