JavaScript Basic Syntax – Part 2

Originals of Slides and Source Code for Examples:
http://courses.coreservlets.com/Course-Materials/ajax.html

For additional materials, please see http://www.coreservlets.com/. The JavaScript tutorial section contains complete source code for all examples in the entire tutorial series, plus exercises and exercise solutions for each topic.

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Marty is also available for consulting and development support

Taught by lead author of *Core Servlets & JSP*, co-author of *Core JSF* (4th Ed), and this tutorial.

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Topics in This Section

- Array basics
- Strings
- Regular expressions
- Array methods

Array Basics

Array Basics

- **One-step array allocation**

```
var primes = [2, 3, 5, 7, 11, 13];
var names = ["Joe", "Jane", "John", "Juan"];
```

  - No trailing comma after last element

- **Accessing array elements**

```
primes[0] → 2
primes[5] → 13
names[0] → "Joe";
names[3] → "Juan";
names[3] = "Jill";  // Replace entry at index 3
names[3] → "Jill";
```

- **The length property**

```
var names = ["Joe", "Jane", "John", "Juan"];
names.length → 4
```

  - Notice that if the length is 4, the index of the last entry is 3
  - This is true in general: array indexes run from 0 to length-1

Looping Down Arrays

- **Traditional-style for loop**
  – Roughly same as in Java and other languages. Don't forget the "var" before the i.

```
for(var i=0; i<someArray.length; i++) {
  var value = someArray[i];
  doSomethingWith(value);
}
```

- **JavaScript-specific for loop ("the Lindsay loop")**
  – Relies on fact that a nonexistent array index results in a value of undefined (not an exception) and that undefined means "false" in a test.

```
for(var i=0, value; value=someArray[i]; i++) {
  doSomethingWith(value);
}
```

Looping Down Arrays

- **for-in loop**

```
for(var i in array) {
  doSomethingWith(i);
}
```

- **Usually reserved for objects (covered later)**
  - *Not* recommended for looping down normal arrays
    - The values of i above are the indexes, not the array values
    - JavaScript has "array-like objects" that you normally treat as arrays, but that can have extra properties other than the indexes, and these extra properties will show up as values for i above.

Two-Step Array Allocation

- **Idea**
  - First build empty array, then fill in the elements
  - Often used in real life, because you frequently do not know the array elements or even the array size until after doing some calculations, so one-step array allocation will not work
- **Simple example**

```
var names = new Array(4);
names[0] = "Joe";
names[1] = "Jane";
names[2] = "John";
names[3] = "Juan";
```

- **More typical example**

```
var names = new Array(4);
for(var i=0; i<names.length; i++) {
  names[i] = someCalculation();
}
```

More on Arrays

- **Arrays can be sparse**

```
var names = new Array();
names[0] = "Joe";
names[100000] = "Juan";
```

- **Arrays can be resized**
  - Regardless of how arrays is created, you can do:

```
myArray.length = someNewLength;
myArray[anyNumber] = someNewValue;
myArray.push(someNewValue)
```

  - These are legal regardless of which way myArray was made

More on Arrays (Continued)

- **Arrays have methods**
  - push, pop, concat, slice, reverse, sort, forEach, map, filter, reduce
    - See upcoming slides
- **Regular objects can be treated like arrays**
  - You can use numbers (indexes) as object properties
    - More on this when we cover objects

Strings

String Basics

- **You can use double or single quotes**

```
var names = ["Joe", 'Jane', "John", 'Juan'];
```

- **Strings have length property**

```
"foobar".length → 6
```

- **Numbers can be converted to strings**
  – Automatic conversion during concatenations.

```
var val = 3 + "abc" + 5;  // Result is "3abc5"
```

  – Conversion with fixed precision

```
var n = 123.4567;
var val = n.toFixed(2); // Result is 123.46 (not 123.45)
```

String Basics (Continued)

- **Strings can be compared with ==**

```
   "foo" == 'foo'
            // returns true
```

- **Strings can be converted to numbers**

```
var i = parseInt("37 blah");
           // Result is 37 – ignores blah
var d = parseFloat("6.02 blah");
           // Result is 6.02 – ignores blah
```

Core String Methods

- **Simple methods**
  - charAt, indexOf, lastIndexOf, substring, toLowerCase, toUpperCase

```
"hello".charAt(1); → "e“
"hello".indexOf("o"); → 4  // Returns -1 if no match
"hello".substring(1,3); → "el"
"hello".toUpperCase(); → "HELLO"
```

- **Methods that use regular expressions**
  - match, replace, search, split
- **HTML methods**
  - anchor, big, bold, fixed, fontcolor, fontsize, italics, link, small, strike, sub, sup

```
"test".bold().italics().fontcolor("red")
→ '<font color="red"><i><b>test</b></i></font>'
```

  - These are technically nonstandard methods, but supported in all major browsers
    - But I prefer to construct HTML strings explicitly anyhow

Regular Expressions

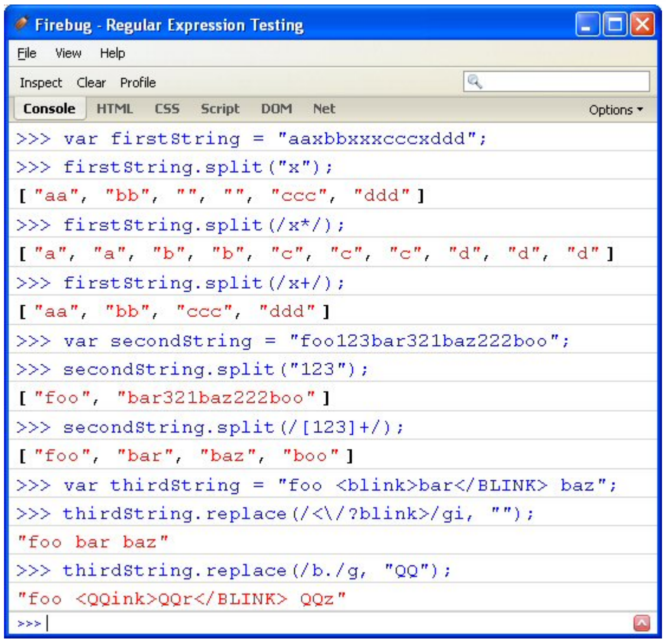
Regular Expressions: Overview

- **You specify a regexp with /pattern/**
  - *Not* with a String as in Java and many other languages
- **Most special characters same as in Java/Unix/Perl**
  - ^, $, . – beginning, end of string, any one char
  - \ – escape what would otherwise be a special character
  - *, +, ? – 0 or more, 1 or more, 0 or 1 occurrences
  - {n}, {n,} – exactly n, n or more occurrences
  - [] – grouping
  - \s, \S – whitespace, non-whitespace
  - \w, \W – word char (letter or number), non-word char
- **Modifiers**
  - /pattern/g – do global matching (find all matches, not just first one)
  - /pattern/i – do case-insensitive matching
  - /pattern/m – do multiline matching

String Methods that Use Regular Expressions

- **replace**
  - Replaces all places that match the regular expression with a replacement string
    `"axbxxcxxxd".replace(/x+/g, "q") → "aqbqcqd"`
- **match**
  - Returns array of parts of the String that *match* the regular expression
    `"axbxxcxxxd".match(/x+/g) → ["x", "xx", "xxx"]`
- **split**
  - Returns array of all parts of the String that *are in between* the regular expressions
    `"axbxxcxxxd".split(/x+/) → ["a", "b", "c", "d"]`
- **search**
  - Returns the position of the first place that matches the regular expression
    `"axbxxcxxxd".search(/x+/) → 1`

Regular Expression: Examples


Firebug - Regular Expression Testing
File View Help
Inspect Clear Profile
Console HTML CSS Script DOM Net
Options

```
>>> var firstString = "aaxbbxxxcccxddd";
>>> firstString.split("x");
[ "aa", "bb", "", "", "ccc", "ddd" ]
>>> firstString.split(/x*/);
[ "a", "a", "b", "b", "c", "c", "c", "d", "d", "d" ]
>>> firstString.split(/x+/);
[ "aa", "bb", "ccc", "ddd" ]
>>> var secondString = "foo123bar321baz222boo";
>>> secondString.split("123");
[ "foo", "bar321baz222boo" ]
>>> secondString.split(/[123]+/);
[ "foo", "bar", "baz", "boo" ]
>>> var thirdString = "foo <blink>bar</BLINK> baz";
>>> thirdString.replace(/<\/?blink>/gi, "");
"foo bar baz"
>>> thirdString.replace(/b./g, "QQ");
"foo <QQink>QQr</BLINK> QQz"
>>>
```

More Information on Regular Expressions

- **Online API references given earlier (See RegExp class)**
  - http://www.w3schools.com/jsref/jsref_obj_regexp.asp
  - http://www.devguru.com/technologies/ecmascript/QuickRef/regexp.html
- **JavaScript Regular Expression Tutorials**
  - http://www.evolt.org/article/Regular_Expressions_in_JavaScript/17/36435/
  - http://www.javascriptkit.com/javatutors/re.shtml

WHENEVER I LEARN A NEW SKILL I CONCOCT ELABORATE FANTASY SCENARIOS WHERE IT LETS ME SAVE THE DAY.
OH NO! THE KILLER MUST HAVE FOLLOWED HER ON VACATION!
BUT TO FIND THEM WE'D HAVE TO SEARCH THROUGH 200 MB OF EMAILS LOOKING FOR SOMETHING FORMATTED LIKE AN ADDRESS!
IT'S HOPELESS!
EVERYBODY STAND BACK.
I KNOW REGULAR EXPRESSIONS.
PERL!
From Randall Munroe and xkcd.com

Array Methods

Big Idea

- **In JavaScript, arrays can have methods**
  - Not functions to which you *pass* arrays, but methods *of* arrays

```
var nums = [1,2,3];
nums.reverse(); → [3,2,1]

[1,2,3].reverse(); → [3,2,1]
```

- **Most important methods**
  - push, pop
  - sort
  - forEach
  - map
  - filter
  - reduce

Many more details at
https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Array

push, pop, join

- **push**

```
var nums = [1,2,3];
nums.push(4);
nums; → [1,2,3,4]
```

- **pop**

```
var val = nums.pop();
val;  → 4
nums;  → [1,2,3]
```

- **concat**

```
var nums2 = nums.concat([4,5,6]);
nums2;  → [1,2,3,4,5,6]
nums;  → [1,2,3]
```

sort

- **With no arguments (default comparisons)**
  - Note the odd behavior with numbers: they are sorted lexicographically, not numerically

```
["hi","bye","hola","adios"].sort();
  → ["adios","bye","hi","hola"]
[1,-1,-2,10,11,12,9,8].sort();
  → [-1,-2,1,10,11,12,8,9]
```

sort (Continued)

- **With function as argument**
  - Function returns negative if first of two compared items should go first, positive if second should go first, zero if they are tied. More on functions in upcoming lecture.

```
var nums = [1,-1,-2,10,11,12,9,8];
function difference(n1,n2) { return(n1-n2); }
function reverseDifference(n1,n2) { return(n2-n1); }
nums.sort(difference);
  → [-2, -1, 1, 8, 9, 10, 11, 12]
nums.sort(reverseDifference);
  → [12, 11, 10, 9, 8, 1, -1, -2]
```

Sorting: Java 8 vs. JavaScript

- **Java 8**

```
String[] testStrings = {"one", "two", "three", "four"};
Arrays.sort(testStrings,
            (s1, s2) -> s1.length() - s2.length());
Arrays.sort(testStrings,
            (s1, s2) -> s1.charAt(s1.length() - 1) –
                        s2.charAt(s2.length() - 1));
```

First variation of each sorts by length, second variation sorts by last character.

- **JavaScript**

```
var testStrings = ["one", "two", "three", "four"];
testStrings.sort(function(s1, s2) {
                   return(s1.length - s2.length);});
testStrings.sort(function(s1, s2) {
                 return(s1.charCodeAt(s1.length - 1) -
                        s2.charCodeAt(s2.length - 1));
                 });
```

forEach

- **Big idea**
  - Calls function on each element of array. Cannot break “loop” partway through
    - Lacks option to run in parallel that Java 8 has
- **Examples**

```
[1,2,3].forEach(function(n) { alert(n); });
```

  - Pops up alert box in page 3 times showing each number

```
[1,2,3].forEach(alert);
```

  - Same as above. Explained in later section on functions.

  - Summing an array (but reduce can also be used)

```
var nums = [1,2,3];
var sum = 0;
nums.forEach(function(n) { sum += n; });
sum; → 6
```

map

- **Big idea**
  - Calls function on each element, then accumulates result array of each of the outputs. Returns new array; does not modify original array.
    - Like the Java 8 “map” method, but not as powerful since the JavaScript version does not support lazy evaluation or parallel operations.
- **Examples**

```
function square(n) { return(n * n); }
[1,2,3].map(square);
  → [1, 4, 9]
```

filter

- **Big idea**
  - Calls function on each element, keeps only the results that “pass” (return true for) the test. Returns new array; does not modify original array.
    - Like the Java 8 “filter” method, but not as powerful since the JavaScript version does not support lazy evaluation or parallel operations.
- **Examples**

```
function isEven(n) { return(n % 2 == 0); }
[1,2,3,4].filter(isEven);
  → [2, 4]
```

Notes on map and filter

- **Cheaper if you combine mapping operations**

```
var singleCost = someArray.map(combinedFunction);
var doubleCost = someArray.map(funct1).map(funct2);
```

- **Cheaper if you combine filtering tests**

```
var singleCost = someArray.filter(combinedTest);
var doubleCost = someArray.filter(test1).filter(test2);
```

- **Wasteful on large arrays if you need only one result**

```
var firstResult = largeArray.filter(test).map(funct)[0];
```

- **Points seem obvious, but none are true in Java 8**
  - Two calls to map vs. one call with a combined function: same cost
  - Two calls to filter vs. one call with a combined test: same cost
  - Finding first element of result of series of mapping and filtering operations: cost depends only on location of first match, not on size of original array
    - For more detail, see Java 8 tutorial at coreservlets.com

reduce

- **Big idea**
  - Takes function and starter value. Each time, passes accumulated result and next array element through function, until a single value is left.
    - Like the Java 8 “reduce” method, but not as powerful since the JavaScript version does not support lazy evaluation or parallel operations.
- **Examples**

```
function add(n1,n2) { return(n1 + n2); }
function multiply(n1,n2) { return(n1 * n2); }
function bigger(n1,n2) { return(n1> n2 ? n1 : n2); }
var nums = [1,2,3,4];
var sum = nums.reduce(add, 0);   // 10
var product = nums.reduce(multiply, 1);  // 24
var max = nums.reduce(bigger, -Number.MAX_VALUE); // 4
```

Notes on reduce

- **Backward args from Java 8 and some other languages**
  - In Java 8, reduce takes starter value (identity) first, combiner function second
  - JavaScript takes combiner function first, starter value second
- **There is one-arg version**
  - Both the JavaScript and Java 8 versions of reduce let you omit the starter value, but then you have to worry about what to do if there are no values in the array
- **reduceRight method**
  - Goes in opposite order: from highest index to lowest
- **Other names**
  - Some other languages call this “fold” or “inject” instead of “reduce”

More Array Methods

- **concat**
  - Concatenates arrays
```
[1,2,3].concat([4,5,6]); → [1,2,3,4,5,6]
```
- **slice**
  - Returns sub-array
```
[9,10,11,12].slice(0, 2); → [9,10]
[1,2,3].slice(0); → [1,2,3] // Makes copy of array
```
- **reverse**
  - Reverses array (returns it, but also changes original)
```
[1,2,3].reverse(); → [3,2,1]
```
- **indexOf**
  - Finds index of matching element
```
[9,10,11].indexOf(10); → 1
[9,10,11].indexOf(12); → -1
```

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Wrap-up

Summary

- **JavaScript arrays**
  - One step allocation
    ```
    var nums = [1, 2, 3];
    ```
  - Looping down arrays
    ```
    for(var i=0; i<nums.length; i++) { doSomethingWith(nums[i]); }
    ```
  - Two-step allocation
    ```
    var nums = new Array(12);
    for(var i=0; i<nums.length; i++) { nums[i] = someCalculation(); }
    ```
  - There are useful array methods, especially push, pop, sort, map, filter, and reduce
- **Strings**
  - Either single or double quotes are legal. There are some useful String methods
- **Regular expressions**
  - Used for comparing to patterns

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Questions?

More info:

http://www.coreservlets.com/javascript-jquery-tutorial/ -- Tutorial on JavaScript, jQuery, and jQuery UI
http://courses.coreservlets.com/Course-Materials/java.html – General Java programming tutorial
http://www.coreservlets.com/java-8-tutorial/ – Java 8 tutorial
http://courses.coreservlets.com/java-training.html – Customized Java training courses, at public venues or onsite at *your* organization
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