JavaScript

Introduction

JavaScript

- background history and origins
  - strengths and weaknesses
  - alternatives to JavaScript
  - JavaScript in the browser
  - JavaScript platforms
- JavaScript and HTML
- syntax
  - data types
- statements
  - if/then
  - iteration
- Date objects
- Array
- functions
- regular expressions

JavaScript origins

- Netscape and Sun Microsystems developed a scripting language named JavaScript in 1995 to add new functionality within web pages
- originally designed for the Netscape Navigator browser
- Brendan Eich, now CTO of Mozilla, developed JavaScript
  - originally named Mocha, then LiveScript
  - Netscape changed its name to JavaScript purely for marketing due to growing Java popularity

JavaScript origins

- JavaScript is not Java, a complex programming language designed for diverse computing purposes
  - Java uses static binding not dynamic binding
- all major browsers support JavaScript, now one of the most popular web languages
- JavaScript was originally designed with a simpler Java-like syntax just for browsers
- many language syntax similarities with Java and C
- JavaScript is an implementation of the ECMAScript language standard (ECMA International organization – European Computer Manufacturers Association)

JavaScript origins

- prior to JavaScript, web pages used server-side programs (CGI[1]) to handle user interaction with forms, buttons, and menus -- an internet connection to web server must be maintained
- with client-side JavaScript the actions of the user are handled by the browser not the web server – means more information in the web page to download from server but overall faster user experience

JavaScript origins

- browsers equipped with a JavaScript engine interpret then execute the JavaScript code as required
- early JavaScript uses include handling user events like mouse click, hover over a button, and verify data entry in a form
- JavaScript is officially managed by Mozilla Foundation
- "JavaScript" is a trademark of Oracle Corporation

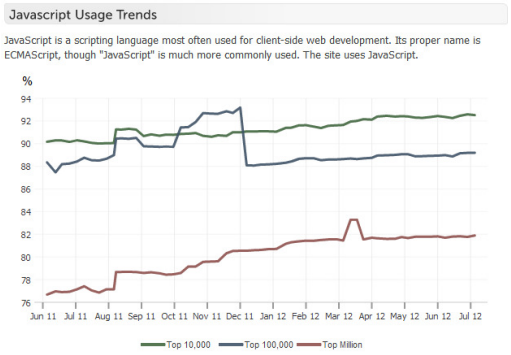
JavaScript - strengths

- quick development
  - no special creation software required
  - fast test and modify cycle
  - many free resources and frameworks available
- easy to learn
  - doesn't share the more complex syntax of Java
  - object oriented structure
- platform independence – all operating systems support it
- interfaces well with the DOM (Document Object Model)
- the most popular web development language
  - basis for JSON, jQuery, and AJAX technologies
- small overhead for browser resources
  - fast download of HTML and JavaScript script, even faster if they are in separate files
- JavaScript code files can be easily shared

JavaScript - weaknesses

- parts of the language can be difficult to master
  - concept of closures, anonymous methods in JavaScript
  - not as well suited for team development as other languages
- rendering varies by browser
  - browsers employ different JavaScript engines resulting in inconsistent functionality and interface
- no JavaScript code hiding
  - JavaScript visible within the HTML page
  - consensus has become JavaScript scripts are essentially 'freeware'
  - JavaScript executing within browser could potentially have malicious code exploits on the user's system
- users have option to disable JavaScript in browser
  - prevent storage of cookies, pop-ups, and other functionality
- search engines may ignore HTML pages containing a lot of JavaScript code
  - Web developers can isolate all the JavaScript code into a separate .js file
- JavaScript always stops running at the first sign of an error
  - Even if you have multiple errors in the JavaScript, only the first one is flagged

JavaScript - trends

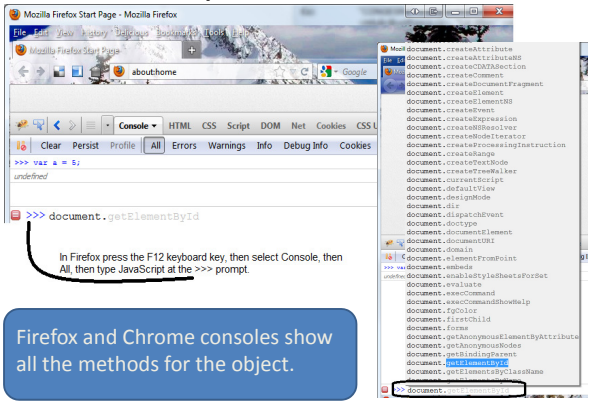


http://trends.builtwith.com/docinfo/Javascript

Alternatives to JavaScript

- Google Dart
  - http://www.dartlang.org/docs/spec/latest/dart-language-specification.html
  - supported only by Google Chrome (as of May 2012)
  - syntax similar to C
- CoffeeScript
  - http://www.coffeescript.org
  - transcompiles to JavaScript
  - language adds syntactic sugar from Ruby, Python, and Haskell
- Haxe
  - http://haxe.org
  - compiles to Adobe Flash, PHP, or JavaScript
- Opa
  - http://opalang.org
  - Can be used for client-side and server-side scripting
  - Influenced by Ocaml and Erlang programming languages
- Google Web Toolkit, RubyJS, Pyjamas
  - Use Java language to manage web front end applications
  - RubyJS is the Ruby language implementation, Pyjamas is the python language implementation

JavaScript – browser console



Firefox and Chrome consoles show all the methods for the object.

JavaScript – cool stuff

- Google Chrome's open source JavaScript engine V8
  - https://developers.google.com/v8/intro
- platform for building network applications
  - http://nodejs.org/
- application framework built on jQuery
  - http://www.claypooljs.com

JavaScript and HTML

- HTML tags <script> </script> contain the JavaScript portion within the HTML file
- attribute "type" identifies the MIME type of the script (usually `text/javascript`)
- as of HTML 5, the "type" is optional and will default to `text/javascript` if not provided
- attribute language="JavaScript1.8" is deprecated

```
<script type="text/javascript">

   JavaScript source script appears in here

</script>
```


JavaScript and HTML

- hiding scripts from older browsers (pre-IE 6 vintage) which do not support JavaScript, use the HTML comment element – now obsolete <!-- -->

```
<script type="text/javascript">
<!-- Hide the script from some browsers

JavaScript program code …

// Stop hiding from other browsers -->
</script>
```

single line comments in JavaScript use // notation

JavaScript and HTML

- where to place the JavaScript code within the HTML document?
- JavaScript programs can be included anywhere in the header or body of the HTML
- if there is JavaScript to execute prior to the HTML page rendering, then place it in the HTML header
- JavaScript can be defined anywhere within the HTML body if JavaScript functionality is appropriate for that part of the HTML
  - form validation of user entered data , mouse hover, or DHTML (dynamic HTML)

JavaScript and HTML

- longer or complex scripts can be placed in a separate text file which must have a `.js` file extension
- usually the scripts that affect page layout are defined within the head element and external scripts (Google analytics, e.g.) at the bottom of the body element (just before `</body>`) to improve the page rendering rendering time
- JavaScript code in the `.js` file cannot have the <script> element

```
<script type="text/javascript"
    src="http://www.you.com/myScript.js">
</script>
<script type="text/javascript"
    src="js/myJSLib.js">
</script>
```

JavaScript - sample 1

- following page shows HTML having an embedded JavaScript script in the body element using DHTML to write some text (Have a nice day!) to the browser window.
- JavaScript is updating the HTML page content via the DOM object document

`document.writeln`


```
<html>
<head>
<title>JavaScript Sample 1</title>
</head>

<body>
   This is sample DHTML JavaScript:
    <script type="text/javascript">

      // Display a greeting message.
     document.writeln("Have a nice day!<br />");

    </script>
</body> </html>
```


JavaScript syntax

- basic unit is one-line statement or expression followed by a semicolon (not mandatory but strongly recommended)
- `document.writeln("...");`
  - JavaScript command invokes the DOM's document object method `writeln( )`
- in JavaScript, as in Java, everything is *case-sensitive*
  - *use document NOT Document or DOCUMENT*
  - *use writeln NOT WRITELN or WriteLN*

JavaScript syntax

- Terms:
  - method
    - name of a function associated with an object
    - e.g. write and writeln are methods of object document
  - parameter
    - In the definition of the method or function, the placeholder values passed into the method or function
    - e.g function add(n) { return n+1; } // n is parameter
  - argument
    - The actual values used in the invocation of the method or function
    - e.g. document.write("Hello "); // "Hello" is argument
  - when more than one is used, parameters and arguments are separated by commas

JavaScript syntax

- JavaScript layout is free-format
  - it does not matter how you format your JavaScript with white spaces (tabs, new lines)
  - multiple statements on one line separated by ;
  - readability is key if you are maintaining the JavaScript code for development
  - many third party JavaScript libraries are provided in *minimized* form to speed up download (all newlines and unnecessary spaces stripped out) and may obfuscate the JavaScript code (hinder reverse engineering)
  - there are JavaScript code formatters which make JavaScript more easily readable to humans
  - http://javascript.crockford.com/code.html


```
<script type="text/javascript">

document.writeln ( "This ") ;
   document.writeln(
              "  is  "
    );
document.writeln( "       a   "  )
 ;
     document.writeln(    "line  \
                                .  \
                               " )  ;

</script>
```

Free-format demo – do not write JavaScript like this!

If text spans more than one line, use the backslash \ to continue.

JavaScript tools

- JSLint is a JavaScript program that checks for problems in your JavaScript programs (improves code quality)
  - jslint.com
- YUI Compressor minimizes JavaScript and CSS
  - developer.yahoo.com/yui/compressor
- Dojo Toolkit allows you to use and build custom web page widgets for many platforms
  - dojotoolkit.org

JavaScript comments

- use comments in JavaScript to explain the code purpose and make it human readable.
- use // for one line comment and /* */ for multiline

```
// Use the numeric sort function.
function s(a,b) {
   return (a-b);
}
/*
  This code will write to a heading.
*/
document.getElementById("theHeading").innerHTML
= "This is the beginning.";
```

JavaScript methods

- `document.writeln("Hello<br />");`
  - outputs the text `Hello<br />` to the browser, which interprets it as HTML information
  - `writeln` is one of many *methods* associated with the object `document`
- all methods are functions in JavaScript
- in JavaScript, methods are called by combining the object name with the method
  - objectname.methodname
- if the object name is omitted, the *window* object is assumed (e.g. `alert` is `window.alert`)

JavaScript methods

- data that the method needs to perform is provided as an argument within the parenthesis:

```
document.write( "Welcome !" );
document.writeln( "Have a great day!");
```

- script container does not affect the HTML structures where it occurs, so any format tags or elements in the HTML file will affect the text produced by `write()` and `writeln()` methods


```
<html>
<head>
<title>JavaScript Sample 2</title>
</head>

<body>
Here is a sample JavaScript <b>
<script type="text/javascript">

// Display a message
document.writeln("This text appears as bold. ");
document.writeln(" </b>");

</script> </body> </html>
```


JavaScript - prompt

- JavaScript can interact directly with the user
- simplest way is with the JavaScript `prompt()` method
- prompt displays its first argument as the prompt text
- optional second argument is displayed as the default value within the dialog box
- empty string is returned if user clicks OK without providing any text

```
<script type="text/javascript">

var name = prompt("Enter your name:",
                                    "visitor"));

document.write("Welcome " + name );

var sign = prompt("What is your zodiac sign?");

document.write("<br />");

document.write("Your sign is " + sign + ".");
</script>
```


JavaScript - prompt

- the `prompt` method doesn't need to be prefixed by `document.` because it is a method of the `window` object
- if the object name is missing, then `window` object is assumed
  - e.g. JavaScript functions `parseInt`, `parseFloat`, `isNaN` do not require to be prefixed by `window`.

JavaScript - alert

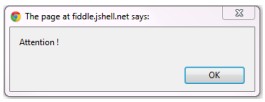
- `alert` dialog box
- useful to show some information in a dialog box
- `alert("Click OK to continue.");`
- useful to point out
  - incorrect information in a form
  - invalid result from a calculation
  - other immediate messages


```
<script type="text/javascript">

document.write('<img src="welcome.gif">');

alert("Attention !");

</script>
```



JavaScript - variables

- variable names are case sensitive and must start with a letter, dollar sign, or underscore; subsequent characters can be digits 0-9; no reserved JavaScript keywords* allowed
- best practice: variable name starts with a-z
- valid JavaScript variable names:
  a rangeRow x1 p_input salary2012
- invalid JavaScript variable names:
  a# @tag 4H X factor true
- * https://developer.mozilla.org/en/JavaScript/Reference/Reserved_Words

JavaScript - variables

- keyword `var` declares variables
- subsequent use of `var` for the same variable within the same script block is unnecessary

```
var a;
var selection;
var b, c, d;
```


JavaScript - constants

- a read-only named constant is created with the `const` keyword
- same name rules as for variables
- constants cannot change value or be re-declared
- cannot use same name as an existing function or variable

```
const g = 10.5;
```


JavaScript - assignment

- the single equals sign = is the assignment operator e.g. *variable* = *expression*;
  - expression on the right is evaluated and the variable name on the left represents that value

```
var a = 0;   // declare variable a having value 0
a  = 100+1;    // variable a now has value 101
a = "cat";     // variable a now has value "cat"
var b = 0, c = true, d = "atom";  // 3 variables
a = b;          // variable a now has value zero
```

JavaScript – scope rules

- in general, always preface the declaration of new variables with the `var` keyword
- if you declare a new variable without the `var` keyword *(implicit declaration),* you may be accidentally changing the value of the same variable name found in a higher scope…but you are permitted to use `delete` statement on it … not so if you use the var keyword
- more about this later in the scoping section in functions

JavaScript - block

- a block statement is used to group one or more statements within braces { }
- commonly used with control flow as in loops

```
{
   statement_1;
   statement_2;
    …
   statement_n;
}
```


JavaScript - block

- JavaScript does **not** have block scope. Variables declared within a block are scoped to the containing function or script, and any assignment of values to them continue beyond the block itself. (v1.7 JavaScript introduces a `let` keyword which changes this – to be discussed later)

```
var a = 1;
{
   var a = 5;
}
 // variable a is 5
```


JavaScript - variables

- multiple variables may be declared with one var statement – each separated by a comma

```
var a = 0, b, c = 100, d = "blue sky", e = a;
```

- this practice is slightly more execution efficient than declaring each variable with a separate `var` but not as maintainable
  - potentially, an error will occur if you remove a declared variable and the comma separator
  - e.g `var a = 0 , b d = "blue sky", e = a;`

JavaScript – data types

- JavaScript provides five primitive data types
  - numeric as in 0, -21, and 32.62
  - strings as in "Hello" and 'There'
  - Boolean (logical) either `true` or `false`
  - `null` special keyword for a nothing value; null is primitive and case-sensitive (not NULL or Null)
  - `undefined` for something not yet assigned a value or an unknown variable; also primitive

JavaScript - numeric

- an integer number is a sequence of digits
  - range is -2^{53} to 2^{53} (-9007199254740992 to 9007199254740992 inclusive)
  - base 10 integers (decimal) do not start with a zero
  - base 8 integers (octal) start with a zero (deprecated)
  - base 16 integers (hexadecimal) start with 0x

```
var a = 0100;  // a is 64
var b = 100;   // b is 100
var c = 0x010; // c is 16

var d = 0x3a - 0200;  // d is -70
var e = -073 - 0x0b;  // e is -68
```


JavaScript - numeric

- floating point literals
  - floating-point literals must have at least one digit and either a decimal point or "e" (or "E")
  - range is 5e-324 to 1.797e308
  - JavaScript keyword: Infinity or –Infinity
  - `Number.POSITIVE_INFINITY, Number.NEGATIVE_INFINITY and Number.MAX_VALUE, Number.MIN_VALUE`

```
var a = 10.010101;
var b = -0.99;
var c = 1.45E10;
var d = 2e-2;
var bigNum = 2/0;  // bigNum is Infinity
```


JavaScript - string

- strings store a piece of text
- JavaScript has two kinds of strings: primitives and objects
- primitives: can use JavaScript String() or assignment

```
var txt = String("Hello");
var txt = "Hello";
```

- objects: use new String()

```
var txt = new String("Hello");
```

- use primitive form unless object form is required.

JavaScript - string

- JavaScript literal strings are *immutable*
  - cannot modify them after they are declared
  - the characters within them may not be changed
  - there is no JavaScript method or property that allows you to change the characters in a literal string (e.g. "ice cream" cannot be modified to be "ice cream sandwich")

```
var s1 = "abcd";
var s2 = "abc" + "d";
if (s1 == s1) alert("string compared by
                          value");
```


JavaScript - string

- string length displayed using `length` method

```
var txt_len = "hello".length;    // txt_len is 5
```

- empty string "" has a length of zero
- special characters such as " ' \ and backspace, newline, tab, carriage return can be defined within a string this way: "\b" "\"", '\'', "\\", "\n", "\t", "\r" respectively

```
var t = "He said, \"Welcome\".";
```


JavaScript - string

- concatenation operators are **+** and **+=**

`"Welcome to " + "my house"` makes the string `"Welcome to my house"`

`welcome += " Thank-you."` adds the string "Thank-you." to the end of the string variable named `welcome`

also, *string1*.`concat`(*string2*) method

```
var n = "abc";
var t = n.concat("xyz");
                  // t is "abcxyz"; n is "abc"
```


JavaScript - string

- access an individual character within a string in two ways, using the `charAt` method or as an array (first character is index zero)
  - `"mouse".charAt(1)` is "o"
  - `"mouse"[1]` is "o"

```
var pet = "mouse";
var c = pet.charAt(1);  // c is "o"
c = pet[1];             // c is "o"
```

JavaScript - string

- `substr` method returns a portion of a string
  - *string*`.substr(` *start_index*, *length* `)` length is optional but if not provided, extract characters until end of string

```
var answer = "quick";

var n1 = answer.substr(1, 2); // ui

var n2 = answer.substr(2);    // ick

var n3 = answer.substr(-1);   // k
```

https://developer.mozilla.org/en/JavaScript/Reference/Global_Objects/String#Properties_2

JavaScript - string

- `replace` method substitutes one substring with another
  - *string*`.replace(` *search_string*, *new_string*`)`

```
var t = "white car with white seat";

var n = t.replace("white", "blue");
var p = t.replace(/white/g, "red");
    // n is "blue car with white seat"
    // p is "red car with red seat"
    // t is "white car with white seat"
```


JavaScript - string

- `toLowerCase` and `toUpperCase` convert the string's case
  - these two methods require no arguments

```
var city = "Victoria, BC";

var n1 = city.toLowerCase(); // victoria, bc

var n2 = city.toUpperCase(); // VICTORIA, BC
                             // city is still
                             // Victoria, BC
```


JavaScript - string

- string "null" is not the same as null
- string "undefined" is not the same as undefined
- string "" is not the same as null or undefined

JavaScript - boolean

- boolean values are either true or false
- double equals operator == tests if two operands represent the same value (but not the same *type*)
- triple equals operator === tests if two operands represent the same value **and** the same type
- non-zero numeric values evaluate to `true`
- null, undefined, NaN, and `""` evaluate to `false`

```
var a = true;
var b = false;
var c = (1 == 1);      // c is true
var d = (a = 2);       // d is true, a is 2
var e = (1 == "1");    // e is true
var f = (1 === "1");   // f is false
```


JavaScript - typing

- JavaScript is a *dynamically typed* programming language
  - variables are not defined by data type at declaration but by their values (or 'literals')
- the type of a literal is defined based on context (run-time)
- when combining literals of different types, the first type is used
- Java and C are *statically typed* – the type of the variable is set at compile time permanently

JavaScript - typeof

- the `typeof` operator is unary – use of () optional
  - e.g. `typeof( "pumpkin" )`, `typeof( 563 )`, `typeof( true)`, `typeof( null )`, or `typeof "squash"`
  - returns **type** of the operand: `"number"`, `"string"`, `"boolean"`, `"object"`, `"function"`, `"undefined"`, `"xml"`

```
var a = "cherry";
var a_type = typeof(a);  // a_type is "string"
var b = 3.14;
var b_type = typeof(b);  // b_type is "number"
var c;
var c_type = typeof c;   // c_type is "undefined"
var d = null;
var d_type = typeof d;   // d_type is "object"
```


JavaScript – dynamic typing

- Recall in JavaScript the + is overloaded

```
var a = 99;
var b = "Ninety nine";
var c = 100 + 100;   // c is 200
var d = ( a < 100 );  // d is true
var e = d && (c > 100); // e is true
a = e;     // a is true
var f = "100" + 10; // f is "10010"
var g = "100" - 10; // g is 90
```

JavaScript – weak typing

- JavaScript is also **weakly typed**
  - no restrictions on use of operators (such as the plus sign) involving values of different data types
- JavaScript rule: when you use + with a number and a string in any order you get a string result

```
var a = 100;
var b = "+100";
var sum = a + b;    // sum is "100+100" not 200
sum = parseInt(a) + parseInt(b);   // sum is 200
```


JavaScript - casting

- JavaScript data type examples
  - `"Count to " + 10` is `"Count to 10"`
  - and `2.5 + "10"` is `"2.510"`
- `parseInt()` and `parseFloat()` JavaScript functions cast values to a new type :
  - `parseInt( "12" )` returns the integer 12
  - `parseFloat( "33.23" )` returns 33.23
  - `parseInt( "23.66")` returns 23
  - `parseInt( undefined )` and `parseInt(null)` returns NaN (not a number)
  - optional second argument is the radix (10 is default, 16, or 8 but that is deprecated) `parseInt("0xaa", 16)` is 170 decimal.
- see http://jsfiddle.net/Stevelang/vpenh/


```
<script type="text/javascript">

var answer = 99;

answer = "Ninety nine ";

var question = "What is 9 times 11? " + answer;

document.write(question + "<br />");

question = answer + " is 9 times what number?";

document.write(question);
</script>
```


JavaScript - expressions

- expressions in JavaScript come in four types
  - assignment which assigns a value to a variable
  - arithmetic evaluates to a number
  - string evaluates to a string
  - logical evaluates to a boolean value (true or false)
- use the keyword `var` to declare a variable and optionally assign it an initial value
- a variable declared using `var` with no initial value has the value `undefined`
- it's possible to drop the `var` keyword but that makes the variable global scope -- not recommended

JavaScript - assignment

```
var x = 10;
var y = 5;

x += y;  // x is now 15 (10 + 5)

x *= y;  // x is now 75 (15 * 5)

x /= y;  // x is now 15 (75 / 5)

x %= y;  // x is now 0  (15 / 5 leaves 0
         //              remainder )
```


JavaScript - assignment

```
var x = 10;
var y = 5;
var z;

x++;  // increment operator; x is now 11

y--;  // decrement operator; y is now 4

z = ++y;  // z is 5 and y is now 5 (avoid this)

z = x--;  // z is 11 and x is now 10 (avoid too)
```


JavaScript - comparison

- use double equals sign (no space) == to test if two expressions are equivalent in value

  `1 == 1` `"1" == 1` `"100" == 99 + 1`
- use "bang equals" != for not-equal test

  `"a" != "A"` `100 != 99.9` `null != undefined`
- comparison operators `<` `>` `<=` `>=` test for less than, greater than, less than or equal, greater than or equal – these 3 are true:

  `100 < 111` `"12" < "2"` `"apple" > "Apple"`

JavaScript - comparison

- triple equals sign === tests if two expressions are equivalent in **value** and the same ***type***

  1 === 1 "cat" === "cat" 1 === "1" (false)
- the !== tests if two expressions are not equivalent and the same type

  `1 !== "1"` (but `1 == "1"` is `true`)
- null === undefined is false but

  null == undefined is true

JavaScript - logical

- logical AND operator is two ampersands: &&
- logical OR operator is two vertical pipes: ||
- logical NOT operator is a single bang: !

```
var x = 10;
var y = 5;

var a = ( x < y ) && ( x == 5 );  // false
var b = ( x > y ) || ( x < 5 );   // true

var c = !b;  // c is false
```


JavaScript - conditional

- ternary operator as in C, C++

  (expression) ? *value1* : *value2*;

  – if (*expression*) evaluates true, then value1 is returned; otherwise, value2 is returned

```
var a = ( 3 == 4 ) ? "y" : "n";    // a is "n"
```

- can lead to cryptic programming code if overused

Bit Manipulation operators

- JavaScript operators shift bit representations

Operator	Name	Description
&	Bitwise AND	Performs an AND on each bit position
|	Bitwise OR	Performs an OR on each bit position
^	Bitwise XOR	Set result bit to 1 only if either not both bits is 1
~	Bitwise NOT	Inverts the bits of the operand
<<	Bitwise left shift	Shift all the bits to the left, leftmost bit dropped
>>	Bitwise right shift	Shift all the bits to the right, keep the sign
>>>	Bitwise zero-fill right shift	Shifts all the bits to the right

Bit Manipulation examples

Expression	Result	Binary Description
15 & 9	9	1111 & 1001 = 1001
15 | 9	15	1111 | 1001 = 1111
15 ^ 9	6	1111 ^ 1001 = 0110
~15	0	~1111 = 0000
9 << 2	36	1001 shifted 2 bits left = 100100
9 >> 2	2	1001 shifted 2 bits right = 10
19 >>> 2	4	10011 shifted 2 bits right = 100

Order of Precedence

Precedence	Operator
1	. (dot operator) [ ] new
2	Function call ( )
3	++ --
4	! (logical not) ~ (bitwise not) + (unary) - (unary) typeof void delete
5	* / %
6	+ (addition) - (subtraction)
7	<< >> >>>
8	< <= > >= in instanceof
9	== != === !==
10	& (bitwise and)
11	^ (bitwise xor)
12	| (bitwise or)
13	&& (logical and)
14	|| (logical or)
15	? :
16	yield
17	= += -= *= /= %= <<= >>= >>>= &= ^= |=
18	, (comma operator)

JavaScript – if block

- test a condition is met with an `if else` block

`if` (*expression*) {
    block of statement(s) to execute provided *expression* true
} // do not forget the matching closing brace }

```
var diff = 3-2;
if (diff == 1) {
    document.writeln("diff is 1");
}
```


JavaScript – if block

if-else statement version:

`if` (*expression*) {
    block of statements if *expression* true
} `else` {
    block of statements if *expression* false
}

```
var diff = 3-2;
if (diff == 1) {
    document.writeln("diff is 1");
} else {
    document.writeln("diff is NOT 1");
}
```


JavaScript - if block

```
var day = "Sunday";

if ( day == "Saturday" ) {
  document.writeln("It's the weekend!");
  the_weekend = true;
} else {
  document.writeln("Back to work.");
  the_weekend = false;
}
```

JavaScript – if block

- multiple tests combined into one if statement

```
var day = "Sunday";
var message;
if ( day == "Saturday" ) {
   message = "It's the weekend!";
} else if ( day == "Monday" ) {
   message = " Back to work. ";
} else if ( day == "Friday" ) {
   message = " TGIF ! ";
} else {
   message = " Just another day. ";
}
```


JavaScript – if block

- when statement blocks are just one statement, the { } braces are optional

```
var day = "Sunday";
var message;
if ( day == "Saturday" )
   message = "It's the weekend!";
else if ( day == "Monday" )
   message = " Back to work. ";
else if ( day == "Friday" )
   message = " TGIF ! ";
else
   message = " Just another day. ";
```


Nested if blocks

- it is possible to nest if statements within another if statement

```
var x = (2-3);
if (x < 0)
   sign = -1;
else {
  if (x == 0)
   sign = 0;
  else
   sign = 1;
}
// acceptable form
```

```
var x = (2-3);
if (x < 0)
   sign = -1;
if (x == 0)
   sign = 0;
if (x > 0)
   sign = 1;

// not recommended form
```


JavaScript - switch

- JavaScript `switch` statement tests an expression against a list of values

```
switch ( expression ) {
   case value1 :
        statement(s)
        break;
   case value2 :
        statement(s)
        break;
   ....
   default :
        statement(s)
}
```

if *expression* matches *value1*, then do these statements only.

if *expression* does not find a match, then default applies.

JavaScript - switch

- JavaScript `switch` is similar to if-else statement

```
if (expression == value1) {
     statement(s) for value1
 } else if (expression == value2) {
     statement(s) for value2
 } else {
     statement(s) for the default
 }
```


JavaScript - switch

- JavaScript `switch` statement tests an expression against a list of literal or expression values

```
var day = "Sunday";
switch ( day ) {
  case "Saturday" :
     document.write("Weekend started.");
     break;
  case "Monday" :
     document.write("Back to work.");
     break;
  default :
     document.write("Another day.");
     break;
}
```

String literals


```
<script type="text/javascript">
var name = prompt("Enter your name:",
                                  "visitor"));
document.write("Welcome " + name );
var sign = prompt("What is your zodiac sign?");

switch(sign.toLowerCase() ) {
   case "aries" :
   case "taurus":
   case "gemini":
     document.write("You are witty and smart.");
     break;
   case "virgo":
   case "capricorn":
   case "libra":
     document.write("You are cool and hip.");
     break;
   default:
     document.write("You are fun and adventurous.");
     break;
}

</script>
```


JavaScript - confirm

- `confirm` method allows the user to select an OK button or a Cancel button
- `confirm` returns true if OK clicked, false if Cancel clicked

```
if (confirm("Press OK to retry."))
  response = prompt("What is 2+2 ?", "3");
```

JavaScript - sample 2

- mathtest.html demonstrates the JavaScript `confirm` method in action

1 of 3

```
<script type="text/javascript">

  // define variables

  var question = "What is 10 + 10?";
  var answer = 20;
  var correct = '<img src="correct.gif">';
  var incorrect ='<img src="incorrect.gif">';
```


2 of 3

```
// ask the question

   var response = prompt(question,"0");

   // check the answer

   if (response != answer) {

     // wrong answer; retry once more.

     if (confirm("Wrong!  \
           Press OK for a second chance."))

       response = prompt(question, "0");
   }
```


3 of 3

```
// Check the answer.

  var output =
      (response == answer) ? correct : incorrect;

  // output will be one of these two strings:
       '<img src="correct.gif">'
       '<img src="incorrect.gif">'
</script>
   </head>

   <body>
   <script type="text/javascript">

   document.write(output);

   </script>
```


JavaScript – object literal

- a JavaScript object literal is delimited by { } which contains the object's *properties* as name:value pairs, separated by commas.

```
var student = { name: "Smith, John",
                id: 103923,
                program: "CSC",
                dob: new Date(1990, 3, 20) };

document.write( student.name ); // Smith, John
document.write( student["program"]); //  CSC
```

JavaScript - eval

- `eval()` method
  - evaluates a string parameter to its numeric value
    - e.g. eval("4 + 5") returns a value of 9
  - avoid using eval if possible – there are potential side effects, especially if the string parameter contains malicious code
- http://javascriptweblog.wordpress.com/2010/04/19/how-evil-is-eval/

JavaScript - iteration

- iteration is the process of repeating the execution of one or more statements until some end condition is reached
  - each time the iteration body is executed is a *cycle*
- example 1 : continually prompt user until right answer is entered
- example 2 : display the month names (January, February, etc) of the entire year
- example 3 : calculate and show the values of a multiplication table up to 12 x 12

JavaScript - iteration

- the while statement indicates iteration
- conceptually:
  while (condition is true)
    perform these statement(s) within
      body of iteration in order continually
- in practice:

```
while ( expression ) {
    one or more statements;
}
```


JavaScript - iteration

- the expression must evaluate true for the statements in the iteration body to be executed
- implies it is possible for the iteration body to be not executed at all if the expression is false initially

JavaScript - iteration

```
var a = 0;
var sum = 0;
while (a <= 10) {
    sum += a;
    a++;
}
document.writeln("sum of 1 to 10 = " + sum);

var answer = 0;
while (answer != 10) {
   answer = prompt("What is 5 + 5?", "0");
}
```

This iteration body will cycle 11 times.

JavaScript - iteration

- some gotcha's using while
  - no semi-colon allowed between the condition and iteration body – this leads to a never-ending loop (aka infinite loop)

```
while ( a < 10 ) ; {   // oops, an infinite loop !
    a++;
}
```

  - condition must at some point become false
  - braces may be omitted if iteration body is one statement

```
while ( a < 10 )  a++;
```


JavaScript - iteration

- some gotcha's using while
  - sometimes while condition is always true but within the iteration body there is a break to end the loop

```
while (true) {
   … if ( some condition ) break;
}
```

  - condition expression can be an assignment statement by mistake -- watch the equals sign!

```
while ( a = 0 ) vs while ( a == 0 )   // first is false
while ( a = 1 ) vs while ( a == 1 )   // first is true
```


JavaScript - iteration

- Some gotcha's using while
  - forgetting to increment the counter if it is used in the condition

```
var n = 0;
var sum = 0;
while ( n < 10 ) {
    sum += n;    // oops, n is always zero
}
```

JavaScript - iteration

- another form of iteration: for
- useful when number of iterations is known
- conceptually:
  for (each step in loop counter)
    execute statement(s)
- in practice:
  for (optional initial statement(s);
    condition;
    optional end body statement(s))
    execute statement(s)

JavaScript - iteration

```
var sum = 0;
for (var n = 0; n <= 10; n++)  {
    sum += n;
}
document.writeln("sum of 1 to 10 = " + sum);


var pets = new Array( "cat", "dog", "fish" );
for (var i=0, len=pets.length; i < len; i++) {
    document.write("I have a "
                   + pets[i]
                   + ". <br />");
}
```


JavaScript - iteration

- if only one statement in body, braces may be omitted

```
for (var n = 0; n < 10; n++)  sum += n;
```

- the initial statement and end statement (usually an increment) are optional

```
var n = 0;
for (  ;  n < 10 ; )  {
    … n++;
  }
```

- same as a while loop

JavaScript - iteration

- if the condition is false initially, the iteration body will not be executed at all and execution will proceed with the next statement after the end of the iteration body

```
var sum = 0;
for (var n = 0; n > 1; n-- ) {   // oops, 0 should be 10
  sum += n;        // never executed
}
document.write( "sum is " + sum );  // sum is 0
```

JavaScript - iteration

- the do while iteration is similar to while but the condition is after the iteration body
- guarantees the iteration body is executed at least once

```
var  n = 0;
do  {
      n++;
       document.write("n has value "
                        + n );
}  while ( n < 10 ) ;
```


JavaScript - iteration

- an iteration body may include an iteration
- "outer loop" contains an "inner loop"

```
var a = 0;
while ( a < 10) {
    var b = 0;
    while ( b < 10) {
         document.writeln( a * b );
         b++;
     }
     document.writeln( "< /br>" );
     a++;
}
```


JavaScript - iteration

```
for (var a = 0;  a < 10; a++ ) {
  for ( var b = 0; b < 10; b++ )
     document.writeln( a * b );
   document.writeln("<br />");
}
```


JavaScript - iteration

- labels are used to assign a unique identifier to a location within the JavaScript code
  - usage is label_name followed by a colon at the start of a line (after any white space is removed)
- label names cannot be JavaScript reserved words, case-sensitive rule applies!

```
label_one :
          var a = 0;
          while ( a < 10 ) { …
```

JavaScript - iteration

- the break statement terminates the innermost while, do while, for, or switch immediately and transfers control to the following statement
- the break *label* form terminates the specified enclosing label statement

```
var n;
for (n = 0; n < 10; n++ ) {
  if ( n == 5 )
      break;     // immediately exit for loop
}   // n is 5
```


JavaScript - iteration

- another example of the break in an iteration

```
while (true) {
    … continuously process some steps
    … if ( a condition becomes true )
            break;
}
```


JavaScript - iteration

- the continue statement immediately causes the iteration body to start at the next cycle
  - subsequent statements in the iteration body are not executed in the current cycle
  - execution begins at the start of the iteration body (while loop) or with the counter increment (for loop)
  - continue may be used only within the for or while loop

JavaScript - iteration

```
// Sum up the odd integers from 0 to 20.
var sum = 0;

for ( var a=0; a <= 20; a++) {

    if ( a % 2 == 0 ) {
        continue;
    }
    sum += a;
}
```

JavaScript - iteration

- break and continue may indicate an optional label, e.g.

```
break calculateSum;
continue releaseMemory;
```

- break *label* means stop executing the statement at label (likely a loop of some kind)
- continue *label* means transfer execution to the statement at label

JavaScript - iteration

```
Outer:
 for ( var a=1; a <= 10; a++ ) {

Inner:
   for ( var b=1; b <= 10; b++ ) {

     document.write( (a*b) + "   " );
     if ( a > 5 ) {
        break Inner;
     }
   }
   document.write( "<br />");
}
```

1 2 3 4 5 6 7 8 9 10
2 4 6 8 10 12 14 16 18 20
3 6 9 12 15 18 21 24 27 30
4 8 12 16 20 24 28 32 36 40
5 10 15 20 25 30 35 40 45 50
6
7
8
9
10

JavaScript - iteration

```
Outer:
 for ( var a=1; a <= 5; a++ ) {

Inner:
   for ( var b=1; b <= 5; b++ ) {
     if ( a > 5 ) {
        continue Inner;
     }
     document.write( (a*b) + "   " );
   }
   document.write( "<br />");
}
```

1 2 3 4 5
2 4 6 8 10
3 6 9 12 15

JavaScript - iteration

- use the while iteration when you do not know in advance the number of iterations
- use the for iteration when you do know in advance the number of iterations
- avoid use of break and continue if possible
  - misuse or overuse can lead to 'code spaghetti'

JavaScript - function

- the function definition statement consists of the function keyword, followed by:
  - the name of the function
  - a list of arguments enclosed in parenthesis and separated by commas
  - the JavaScript statements that define the function, enclosed by braces { }

JavaScript - function

- the `function` declaration defines a set of statements which performs a task

```
function function_name(parameter(s)) {
   statement block
}
```

e.g.

```
function printName( myname ) {
 document.write("Your name is <b>");
 document.write( myname );
 document.write("</b>");
}
printName( "Clark Kent" );  // Your name is <b>Clark Kent</b>
```


JavaScript - function

- JavaScript functions are usually defined in the header element in the HTML or in separate file
- this ensures that all functions have been parsed before it is possible for user events to invoke a function
- function name rules same as for variables
  - if you accidentally name a variable having the same function name, the variable overrides the function
- parameter names are separated by commas
- no type checking is performed on arguments

JavaScript - function

- a function may return a value

```
function calculateArea(height, width) {
  return height * width; // returns a number
}

var h = 100;
var w = 25;
var area1 = calculateArea(h, w);  // area1 is 2500
var area2 = calculateArea(h, 33); // area2 is 3300
```

JavaScript - function

- a function may return a string

```
function encode(message) {

  var coded = "";
  for (var i=0,len=message.length; i<len; i++) {
     var ch = message[i];
     if ( /[a-z]/i.test(ch) ) { // is the character a-z ?
        coded +=
                String.fromCharCode( ch.charCodeAt(0) + 1);
     } else {
        coded += ch;
     }
   }
   return coded;
}
var m = "April is a happy month!";
var x = encode(m);  // x is "Bqsjm jt b ibqqz npoui!"
```


JavaScript - function

- **primitive** parameters (strings, numbers) are **passed by value**, meaning if the function changes the parameter values, the change is **lost** when the function returns or ends

```
function calculateArea(height, width) {
  height += 10;
  return height * width;
}

var h = 100;
var w = 25;
var area1 = calculateArea(h, w);  // area1 is 2750
document.write( h );   // h is 100
```


JavaScript - function

- **non-primitive** parameters (arrays, objects) are **passed by reference**, meaning if the function changes the parameter properties, the change is **kept** when the function returns or ends

```
function foo(a, obj) {
  a[2] += 10;
  obj.name = "parsnip";
  obj = { name: "carrot"; } // assign new object works only within function
}

var arr = [1, 2, 3];
var w = { name: "turnip" };
foo(arr, w);
document.write( arr + "" + w.name );// arr is [1,2,13], w.name is parsnip
```


JavaScript functions

- in JavaScript functions are first-class objects
  - can be manipulated and treated like objects
- keyword `Function` defines a function object dynamically created at run-time
  - `new Function(` *optional param1, param2, …, body of function as a string* `);`

```
var fun = new Function(a, "return a");
var g = fun();
```

- sample HTML file testing.html

```
<script type="text/javascript">                    1 of 3

 // define function testQuestion()

function testQuestion(question) {

    // define local variables

  var ftmp = new Function(' return ' + question);

  var answer = ftmp();  // answer is 9
  var output = "What is " + question + "?";
  var correct = '<img src="correct.gif">';
  var incorrect ='<img src= "incorrect.gif">';
```



```
// ask the question                                2 of 3

   var response = prompt(output, "0");

// check the result

   return (response == answer) ?
                       correct :
                       incorrect;
   }

   </script>
   </head>
```



```
                                                   3 of 3
<body>

   <script type="text/javascript">

   var result = testQuestion("4 + 5");

   document.write(result);

   </script>
```


JavaScript functions

- functions may be defined inside within a function
  - inner function is private to outer function
  - inner function can be accessed only from the outer function
  - inner function can use arguments and variables of outer function but outer cannot use inner's arguments or variables

JavaScript - functions

```
function foo(c) {
   var x = 100;

   function bar(arg1, arg2) {
     if (x > 99) arg1++;   // x access allowed in inner function
     return (arg1 + arg2);
   }
   return bar(x, c);  // returns 101 + 10
}

var n = 10;
var p = foo(n); // p is 111 (101 + 10)
document.write(p);
document.write( bar(10,10) );  // not allowed - out of scope
```

outer function is foo

inner function is bar

JavaScript – recursive function

- functions may be recursive; a function may call itself inside the function declaration

```
function factorial(n) {
  if ((n == 0) || (n == 1))
    return 1;
  else
    return (n * factorial(n - 1));
}

var a = factorial(4); // a gets value 24
```


JavaScript – function arguments

- arguments of a function are kept in an array-like object named `arguments`

```
function sumup(n) {
  var sum = 0;
  for (var i = 0; i < arguments.length; i++) {
    sum += arguments[i];
  }
  return sum;
}

var a = sumup(3,4,5); // a gets value 12
var b = sumup(1,-3,1,3,4); // b gets value 6
```


JavaScript – Number and String

- JavaScript has built-in functions Number and String to convert an object to that type

```
var today = new Date;
var x = String( today );
   // x is "Mon Aug 20 04:37:33 GMT-0700 2012"

var str = "123";
var n = Number( str );  // n is 123
```

JavaScript – exception

- handling potential errors during run time is important
- the `throw` statement provides error handling
- in JavaScript any object can be thrown, though it is usually a number or a string

Examples:

```
throw "Error 100";
throw 1033;
throw false;
throw ReferenceError();
```


JavaScript – try catch

- the `try…catch` marks a block of statements to try, and if there is an error (or 'exception'), the catch block controls the process neatly
- An exception 'thrown' within a `try` block is managed in the 'catch' block

```
var a = 0;
try {
      if (a == 0) throw "a is zero";
    }
    document.write("a not zero"); // never executed because exception is thrown.
} catch (e) {                     // e is the exception parameter.
                                  // a is found to be zero
     if (e == "a is zero")
        document.write("error - a is zero");
}
```


JavaScript – finally

- with the `try…catch` blocks is an optional `finally` block
- code within the `finally` block will execute after the try and catch blocks execute but before the statements following the try…catch
- `finally` block executes whether or not an exception is thrown
- use `finally` block to release a resource your code is using (such as an open file)

JavaScript – finally

```
try {
   openMyFile();
   writeSomeData(theData); // May cause error.
} catch (e) {
   handleError(e);  // If error, handle it.
} finally {
   closeTheFile();  // Always close file.
}
```

JavaScript – Error object

- the Error object in JavaScript allows you to create your own error message object and throw it
- IE browser supports an optional number
- Firefox browser supports a message, filename,line#
- Opera, Chrome, Safari support only message

```
var a = 0;
try {
      if (a == 0) throw new Error("a is zero");
    }
    document.write("a not zero"); // never executed because exception is thrown.
} catch (e) {                     // e is the exception parameter.
                                  // a is found to be zero
     if (e.message == "a is zero")
        document.write("error - a is zero");
}
```

message

JavaScript – variable scope

- when you declare a variable outside of any function, it is called a *global* variable because it is visible to any other JavaScript code in the current document
- if you declare a variable inside a function, it is *local* to that function only and not visible to JavaScript outside that function
- if the function declares a new local variable having the same name as a global, the function uses the local variable

JavaScript – scope ex 1

```
var a = 100;     // global

function myfun() {
   var b = 200;     // local to myfun only
   a++;             // variable a is global
   var c = b + a;   // variable c is local
   document.write( c );
}

myfun();   // call function myfun, displays 301
document.write( a );   // displays 101
if ( typeof c != undefined)
  document.write( c );   // nothing displayed
```


JavaScript – scope ex 2

```
var a = 100;  // global

function myfun() {
   var b = 200;     // local to myfun only
   var a = 10;      // local - not the global
   a++;             // this variable a is local
   var c = b + a;   // variable c is local
   document.write( c );
}

myfun();   // call function myfun, displays 211
document.write( a );   // displays 100
if ( typeof c != undefined)
  document.write( c );   // nothing displayed
```

JavaScript – scope ex 3

```
var a = 100;  // global

function myfun() {
   var b = 200;     // local to myfun only
   var a = 10;      // local – not the global
   window.a++;      // this variable a is global
   var c = b + window.a;  // variable c is local
   document.write( c );
}

myfun();  // call function myfun, displays 301
document.write( a );  // displays 101
if ( typeof c != undefined)
  document.write( c );  // nothing displayed
```


JavaScript - scope

- JavaScript uses *hoisting* to move the declaration of any declared variables within a function to the *top* of the function

```
function myfun1() {
  document.write( a + b );
  var a = 10;
  var b = 20;
}
function myfun2() {
  var a, b;
  document.write( a + b );
  a = 10, b = 20;
}
```

Identical functions

JavaScript - object

- objects in JavaScripts are similar to objects in real life with properties, type, and behaviour
- A car object has properties:
  - colour, make, model, year, VIN, transmission, manufacturer
- A car object has type:
  - car is a type of a vehicle
- A car object has behaviour:
  - accelerate, decelerate, turn left, turn right, stop

JavaScript Date object

- a `Date` object in JavaScript represents a single date
- three different usages:

  `variable = new Date( parameters );`

  where the `parameters` indicate year, month, day, hour, minute, second, milliseconds in order
  - if no parameters, current date assumed; otherwise year, month and day must be provided
  - if hour and minute not provided, then midnight assumed (0 hour, 0 minute)
  - if year < 100, then 1900 + year is assumed

JavaScript Date object

```
variable = new Date("date string" );
```

where the date string represents a text form of the date as in
"October 7, 1995"
"October 7, 1995 12:43"

```
variable = new Date(milliseconds);
```

where milliseconds is an integer value representing the number of milliseconds since 1 January 1970 00:00:00 UTC (Unix Epoch)

new Date(1343053807040);

JavaScript Date object

- UTC (Universal Time coordinated) is a timezone-independent method of storing time values, based on milliseconds since midnight, January 1, 1970 in the Greenwich Mean Time zone
- all dates and times are stored internally in JavaScript using UTC format
- Date objects have both UTC and non-UTC methods to get and set date and time values
- https://developer.mozilla.org/en-US/docs/JavaScript/Reference/Global_Objects/Date

JavaScript Date object

```
var today = new Date();
var birthday = new Date( 1962, 7, 24); // Aug 24, 1962
var party = new Date( 96, 3, 23, 8, 0, 0);
                      //  Apr 23, 1996, 8:00AM
var d1 = new Date(2012, 4, 12); // May 12, 2012

var d2 = new Date("November 3, 2011");
var d3 = new Date("May 1, 2011 9:00 PST");

var d4 = new Date(1343053807040);
    // July 23, 2012 3:33 PM PST
```


JavaScript Date object

- if the Date cannot be determined to be valid, the Date is set to be "Invalid Date"
- if the new keyword is not used to create the Date object, then the date value is returned as a string object rather than a Date object
- Date objects can be subtracted from each other to obtain the amount of separation time in milliseconds

JavaScript Date object

```
var today = new Date();   // current date and time

var yesterday = new Date(2012, 7, 23);

var elapsed = today - yesterday;
     // number of millisecs since start of Aug 23, 2012 (00:00)

elapsed = elapsed / (60 * 60 * 24 * 1000);
     // number of hours since start of Aug 23, 2012 (00:00)
```


JavaScript Date object

- Date object methods:
  getDate() returns the day of the month (1-31)
  getFullYear() returns the year in four digits
  getMonth() returns the month (0 – 11)
  getTime() returns milliseconds since midnight Jan 1, 1970
  plus many more methods … check link
  https://developer.mozilla.org/en/JavaScript/Reference/Global_Objects/Date/

JavaScript Date object

```
var today = new Date("May 2, 2012 5:15 PM");
var yr    = today.getFullYear();
var month = today.getMonth();
var day   = today.getDate();
var hr    = today.getHours();
var min   = today.getMinutes();
document.write( "Today is "
              + yr + " "
              + month + " "
              + day + " "
              + hr + " "
              + min );

//  displays:  Today is 2012 4 2 17 15
```


JavaScript Date object

- third party JavaScript libraries available for parsing, manipulating, and formatting dates
  - Date.js
    http://www.datejs.com/
  - Moment.js
    http://momentjs.com/
  - dateFormat.js
    http://blog.stevenlevithan.com/archives/date-time-format
  - Date Extensions
    http://depressedpress.com/javascript-extensions/dp_dateextensions/

JavaScript - array

- an array literal is a list of zero or more expressions, each an array element, enclosed by square brackets **[ ]**
- the length of the array literal is the number of elements it contains
- array elements are referenced by [*index*]

```
var pets = [ "cat", "dog", "fish" ]; // array pets
document.write (pets.length);  // displays 3
document.write( pets[0] );    // displays cat
document.write( pets[5] );   // displays undefined
```


JavaScript - array

```
var pets = [ "cat", "dog", "fish" ];

for (var i=0, len=pets.length; i < len; i++) {

    document.write("I have a pet "
                   + pets[i]
                   + ".<br />");
}
```

// use a for loop to iterate over the values of an array

JavaScript - array

- array elements need not be all the same primitive data type

```
var myList = [ "cat", 1000, false, (1==2-1) ];
```

- array elements may contain variables

```
var a = -333.33;
var myList2 = [ "dog", a, 100 ];
```

- array elements may be literal arrays as well

```
var myList3 = [  [1,2],  ["cat", "mouse"], 0.01 ];
var myList4 = [ "fish", myList ];
```

but the array element counts as a single

JavaScript – array literal

- in JavaScript you can omit specifying all the elements in an array literal

```
var zoo = [ "tiger",    , "bear", , "lion" ];
```

has 5 array elements – the second and fourth elements are `undefined`

- declaring an array with no initial elements

```
var  emptyList = [];
```

JavaScript – array object

- array objects are the same as array literals only defined differently using the Array keyword
- no difference but literal format is shorter

```
var a_obj = new Array( 1, 2, 3 );
var b_obj = Array(300, 301, 302);
```


JavaScript – array - adding

- adding new elements to an array is a simple matter of assigning them based on a new index

```
var a = [];      // array a is empty
a[1] = "cat";
             // index 0 element is undefined
a[3] = "dog";
      // array a is length 4 but elements at
      //  index 0 and 2 are undefined.
```


JavaScript – array - index

- adding new elements to an array using a non-integer index causes a new property for the array, instead of an array element

```
var a = [];       // array a is empty
a[1.5] = "clip"; // legal, but no element
if ( a.hasOwnProperty[1.5] ) {
   document.write("property is set");
}
```


JavaScript – array - splice

- removing an element from an array requires the `splice` function

  array_name.splice(*index*, *number of elements*)

```
var a = [ "cat", "and", "dog" ];
a.splice( 1, 1 );   // a is [ "cat", "dog" ]
```

JavaScript – array - delete

- the `delete` keyword can be used to swap an array element value with `undefined`
- using `delete` in this way does not remove the element itself or shorten the array

```
var a = ["sun", "moon", "earth"];
delete a[1];
       // a is "sun",,"earth"
       // length of a is still 3
```


JavaScript – array - push

- another way to add new elements to an array in JavaScript is to use the array's `push` function
- elements are always added to the end

```
var a = ["cat", "and"];
a.push("the");
a.push("dog", "story");
         // array a now has 5 elements
```


JavaScript – array - pop

- `pop` removes the last element in an array and returns it – if the array is empty, `undefined` is returned.

```
var a = ["cat", "and", "dog"];
var b = a.pop();
      // array a is ["cat", "and"]
      //  b is "dog"
```


JavaScript – array - reverse

- the `reverse` method moves all the elements in the array into reverse order

```
var batman = ["West", "Keaton", "Kilmer",
              "Clooney", "Bale"];
batman.reverse();
document.write( batman[0] );  // Bale
```

JavaScript – array - foreach

- the `foreach` method defines a call back function to be applied to each element in the array
- array element values cannot be changed this way

```
var sum = 0;
 function sumthis(value) {
       sum += value;
 }
 var a = [ 111, 22.2 ];
  a.forEach( sumthis );   // sum is 133.2
```


JavaScript – array - sort

- the `sort` method moves all the elements in the array into alphabetic order ("30" appears before "2") – use a function for numeric sort

```
var villain = ["Joker", "Catwoman", "Two-Face",
               "Bane", "Riddler"];
villain.sort();
document.write( villain[0] );  // Bane

var s = [ 23, 15, 8, 42, 16, 4 ];
s.sort( function(a,b) {return a-b});
  // array score is now 4,8,15,16,23,42
```


JavaScript – array - join

- the `join` method causes all the array elements to be merged into a single string with a delimiter (comma is the default

```
var dessert = ["pie", "cake", "sundae"];
var s = dessert.join();
     // s is "pie,cake,sundae"

var t = dessert.join(" / ");
     // t is pie / cake / sundae
```


JavaScript – Regular Expression

- a regular expression describes a string pattern
  - e.g. apply the pattern /at/ to the string "Cat in the Hat" matches "Cat in the Hat"
  - patterns /AT/, /ta/, and /cat/ will find no matches
- metacharacters such as * + and ? are called qualifiers and are used in the pattern after a character
  - * denotes zero or more matches
  - + denotes 1 or more matches
  - ? denotes either 0 or 1 match

JavaScript – Regular Expression

- /fe*/ matches "fee" in "two feet" and "f" in "left arm" but nothing in "my head"
- /to+/ matches "to" in "nine toes" and "too" in "me too" but nothing in "my tasks"
- /h?ea?/ matches "hea" in "my head" and "e" in "left foot" and "ea" in "my ear"

JavaScript – Regular Expression

- metacharacter . (decimal point) matches any single character except the newline
  - /r.t/ matches "rat","rut","r t" but not "art"
- \ is used to match metacharacters
  - /a*/ matches "a*" but not "apple"
- ^ matches beginning of input
  - /^A/ matches "A story" but not "the ABCs"
- $ matches end of input
  - /x$/ matches "the ox" but not "my axe"

JavaScript – Regular Expression

- | (pipe) matches text on either side
  - /a|b|c/ matches either the first "a","b",or "c", and /apple|pear/ matches either "apple" or "pear"
- {n} where n is a positive integer, matches n occurrences of the preceding character
  - /e{2}/ matches the "ee" in "feed" and the first "ee" in "feeeed", but not "fed"
- {n,m} where n and m are positive integers, matches at least n and at most m occurrences of the preceding character
  - /r{1,3}/ matches the "r" in "art", the "rr" in "array", and the first "rrr" in "arrrgh!"

JavaScript – Regular Expression

- [abc] defines a range of any characters to match. Shorthand range form can use a hyphen [a-c] = [abc]
  - /[a-m]/ matches the "e" in "A pear" and /[a-z]+/ matches "anana" in "Banana"
  - /[0-9]/ matches the "4" in "robin4nest"
- negation of the range uses the ^
  - /^[a-m]/ matches the "p" in "pear"
  - /^a-z/ is same as /^[a-z]/

JavaScript – Regular Expression

- Special characters used in regex
- \d matches a single digit – same as [0-9]
- \n matches a new line
- \s matches a single white space, tab, form feed, new line
- \t matches a tab
- \w matches any alphanumeric including the underscore – same as [A-Za-z0-9_]
- \xHH matches the character with the hex code HH e.g. /x20/ = /\s/

JavaScript – Regular Expression

- \D matches any non-digit, same as [^0-9]
- \S matches any non white space
- \W matches any non alphanumeric, same as [^A-Za-z0-9_]
- \b matches a word boundary - \W\w or \w\W
  - /\bspo/ matches the "spo" in "my spoon" and no match in "dispose"
  - /\ba\b/ matches the second "a" in "at a mall"
- \B matches a non-word boundary
  - /\B../ matches the "ec" in "pecan" but not " a"

JavaScript – Regular Expression

- (tree) matches "tree" and remembers the match using the resulting array's elements [1],…,[n]
  - `/([A-Za-z]+)\s(\w+)/` matches "John Smith" in "100 John Smith 203-300" and remembers "John" and "Smith" in the resulting arrays [1] and [2]

    `([A-Za-z]+)` means look for one or more alphabetic characters (any case) and remember them … e.g. "John"

    `\s` matches a single white space

    `(\w+)` is the same as `([A-Za-z0-9_]+)`

JavaScript – Regular Expression

- pattern flags – regular expressions have four optional flags, used singly or combined in any order
  - g – indicates global search
    - /\w\s/g returns "e", "i", "o" in "fee fi fo fum"
    - /\w\s/ returns "e"
  - i – indicates case insensitive (ignore case)
    - /abc/i is the same as [A-Ca-c]
  - m – indicates multi-line search
    - makes the ^ $ characters match the start and end of any input line, as opposed to the entire input text
  - y – "sticky" search – match starting at current position in the target string – non-standard

JavaScript – Regular Expression

- the qualifiers * + ? { } are by default, "greedy"
  - matches will take as much as it can find
  - /a+b+/ matches "aaaabbbb" in "aaaabbbbabc"
- "lazy" matches will stop as soon as minimum found
  - the ? qualifier appended to * + ? { } makes the match lazy not greedy
  - /a+?b+?/ matches "aaaab" in "aaaabbbbabc"

Mozilla-specific - let

- JavaScript version 1.7 supports the `let` keyword for Firefox browers – not yet an ECMA standard (in draft)
- useful when you want to use an existing variable name within a separate code block
- need to specify that you wish to use JavaScript 1.7

<script type="application/javascript;**version=1.7**"></script>

```
var x = 10, y = 2;
let (x=5) {
      y = x;  // y is now 5
}
document.write(x + " " + y);  // 10 5
```


Course Note References

- http://www.ecma-international.org/publications/standards/Ecma-262.htm
- http://www.reddit.com/r/javascript/comments/fqht8/references_for_javascript_mastery/
- http://www.w3.org/community/webed/wiki/Main_Page
- http://code.google.com/edu/submissions/html-css-javascript/
- http://reference.sitepoint.com/css
- https://developer.mozilla.org/en-US/docs