CSCI 1720

JavaScript – Part 2

JavaScript Operators

JS Operators

JavaScript operators are identical to Java's

+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Modulus
++	Increment
--	Decrement

JS Assignment Operators

JavaScript operators are identical to Java's

Operator	Example	Same as
=	x = y	x = y
+=	x += y	x = x + y
-=	x -= y	x = x - y
*=	x *= y	x = x * y
/=	x /= y	x = x / y
%=	x %= y	x = x % y

JS String Operators

The += assignment operator can also be used to add (concatenate) strings

```
<p>The assignment operator += can concatenate strings.</p>

<p id="demo"></p>

<script>
txt1 = "One ring to rule them all, ";
txt1 += "One ring to find them";
document.getElementById("demo").innerHTML = txt1;
</script>
```

The assignment operator += can concatenate strings.

One ring to rule them all, One ring to find them

JS Adding Strings and Numbers

Adding two numbers, will return the sum, but adding a number and a string will return a string

```
<p>Adding a number and a string, returns a string.</p>

<p id="demo"></p>

<script>
var x = 5 + 5;
var y = "5" + 5;
var z = "Hello" + 5;
document.getElementById("demo").innerHTML =
x + "<br>" + y + "<br>" + z;
</script>
```

Adding a number and a string, returns a string.

10
55
Hello5

JS Comparison Operators

JavaScript operators are identical to Java's, with a couple of additional ones

Operator	Description
==	equal to
===	equal value & equal type
!=	not equal
!==	not equal value or type
>	greater than
<	less than
>=	greater than or equal to
<=	less than or equal to

JS Logical Operators

JavaScript operators are identical to Java's, with a couple of additional ones

Operator	Description
&&	logical and
||	logical or
!	Logical not

JavaScript Data Types

JS Data Types

JavaScript variables can hold many data types: numbers, strings, objects and more (Remember, **`var`** is deprecated. Use **`let`** instead)

```
let length = 16;                               // Number
let lastName = "Johnson";                      // String
let x = { firstName:"John",lastName:"Dokes"};  // Object
```

In programming, data types is an important concept

To be able to operate on variables, it is important to know something about the type

Without data types, a computer cannot safely solve this

```
let x = 16 + "Volvo";
```


JS Data Types

JavaScript has dynamic types

This means that the same variable can be used to hold different data types

```
let x;         // x is undefined
x = 5;         // Now x is a number
x = "John";    // Now x is a string
```

JS Data Types

JavaScript has only one type of numbers

Numbers can be written with, or without decimals

```
let x1 = 34.00;     // With decimals,
let x2 = 34;        // Without
```

Extra large or extra small numbers can be written with scientific (exponential) notation

```
let y = 123e5,      // 12300000
    z = 123e-5;     // 0.00123
```


JS Data Types

Booleans can only have two values: true or false

```
let y = true,
    z = false;     // Notice, no quotes
```


JS Data Types

JavaScript arrays are written with square brackets

Array items are separated by commas

The following code declares (creates) an array called cars, containing three items (car names)

```
let cars = ["Saab", "Volvo", "BMW"];
```

JS Data Types

JavaScript objects are written with braces

Object properties are written as name:value pairs, separated by commas

```
<p id="demo"></p>

<script>
    let person = {
        firstName : "Joe",
        lastName  : "Dokes",
        age       : 50,
        eyeColor  : "blue"
    };

    document.getElementById("demo").innerHTML =
    person.firstName + " is " + person.age +
    " years old.";
</script>
```

Joe is 50 years old.

JS Data Types – typeof Operator

You can use the JavaScript typeof operator to find the type of a JavaScript variable

The `typeof` operator returns the type of a variable or an expression

```
typeof "";          // Returns "string"
typeof "Joe";       // Returns "string"
typeof "Joe Dokes"; // Returns "string"
typeof 0;           // Returns "number"
typeof 314;         // Returns "number"
typeof 3.14;        // Returns "number"
typeof (3);         // Returns "number"
typeof (3 + 4);     // Returns "number"
```


JS Data Types – Primitive Data

A primitive data value is a single simple data value with no additional properties and methods

The typeof operator can return one of these primitive types:

- string
- number
- Boolean
- null
- undefined

```
typeof "Joe Dokes"; // Returns "string"
typeof 0;           // Returns "number"
typeof true;        // Returns "boolean"
typeof false;       // Returns "boolean"
```

JS Data Types

The typeof operator can return one of two complex types:

function
object

```
typeof [1,2,3,4];                 // Returns "object"
typeof {name: "John", age: 34};   // Returns "object"
typeof function myFunc(){}        // Returns "function"
```

The typeof operator returns object for arrays because in JavaScript arrays are objects

JS Data Types

In JavaScript, a variable without a value, has the value undefined

The `typeof` is also undefined

```
let person;     // Value is undefined, type is undef
```


JS Data Types

In JavaScript, a variable without a value, has the value undefined

The `typeof` is also undefined

```
let person;     // Value is undefined, type is undef
typeof person;  // Also undefined
console.log(person, typeof(person));
```

```
undefined 'undefined'                    lecture.js.html:24
```

An empty value has nothing to do with undefined

An empty string variable has both a value and a type

```
let car = "";
console.log(car, typeof(car));
```

```
string                                   lecture.js.html:26
```

JS Data Types

In JavaScript null is "nothing"

It is supposed to be something that doesn't exist

Unfortunately, in JavaScript, the data type of null is an object

You can consider it a bug in JavaScript that typeof null is an object. It should be null

You can empty an object by setting it to null

```
var person = null;        // Value is null, but type is still an object
```

You can also empty an object by setting it to undefined

JS Data Types

Difference Between Undefined and Null

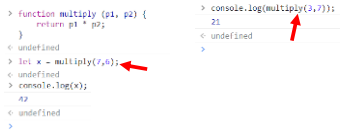
```
> typeof undefined
'undefined'
> typeof null   //object
'object'
> null === undefined
false
> null == undefined
true
```


JavaScript Functions

JS Functions

A JavaScript function is a block of code designed to perform a particular task

A JavaScript function is executed when something invokes it (calls it)



JS Function Syntax

A JavaScript function is defined with the function keyword, followed by a name, followed by parentheses ()

Function names can contain letters, digits, underscores, and dollar signs (same rules as variables)

The parentheses may include parameter names separated by commas (parameter1, parameter2, ...)

The code to be executed, by the function, is placed inside brackets: {}

```
function name(parameter1, parameter2, parameter3) {
    code to be executed
}
```


JS Function Syntax

Function parameters are the names listed in the function definition

Function arguments are the real values received by the function when it is invoked

Inside the function, the arguments (the parameters) behave as local variables

A Function is much the same as a Procedure or a Subroutine, in other programming languages

JS Function Invocation

The code inside the function will execute when "something" invokes (calls) the function:

- When an event occurs (when a user clicks a button)
- When it is invoked (called) from JavaScript code
- Automatically (self invoked)

JS Function Return

JavaScript reaches a return statement, the function will stop executing

If the function was invoked from a statement, JavaScript will "return" to execute the code after the invoking statement

Functions often compute a return value. The return value is returned back to the caller

JS Function Example

```
<p>
    This example calls a function<br>
    which performs a calculation<br>
    and returns the result:
</p>

<p id="demo"></p>

<script>
    function multiply(a, b) {
        return a * b;
    }
    document.getElementById("demo").innerHTML =
        multiply(6, 7);
</script>
```

DEFINE

CALL

This example calls a function
which performs a calculation
and returns the result:

42

JS – Why Functions?

You can reuse code: Define the code once, and use it many times

You can use the same code many times with different arguments, to produce different results

Functions can be used the same way as you use variables, in all types of formulas, assignments, and calculations

```
let temp = toCelsius(77),
    text = "Seventy-seven degrees is " + x + " Celsius";
```


JavaScript Scope

JS Scope

Scope is the set of variables you have access to

In JavaScript, objects and functions are also variables

In JavaScript, scope is the set of variables, objects, and functions you have access to

JavaScript has function scope: The scope changes inside functions

JS Scope

Variables declared within a JavaScript function, are LOCAL to the function

Local variables have local scope: They can only be accessed within the function

```
<p>
    The local variable carName cannot<br>
    be accessed from code outside the <br>
    function:
</p>

<p id="demo"></p>

<script>
    printCarName();
    document.getElementById("demo").innerHTML =
    "The type of carName is " + typeof carName;

    function printCarName() {
        let carName = "Volvo";
    }
</script>
```

The local variable carName cannot be accessed from code outside the function:

The type of carName is undefined

JS Scope

A variable declared outside a function, becomes GLOBAL

A global variable has global scope: All scripts and functions on a web page can access it

```
<p>
    A GLOBAL variable can be<br>
    accessed from any script or<br>
    function:
</p>

<p id="demo"></p>

<script>
    let carName = "Volvo";
    printCarName();

    function printCarName() {
        document.getElementById("demo").innerHTML =
        "I can display " + carName;
    }
</script>
```

A GLOBAL variable can be accessed from any script or function:

I can display Volvo

JS Scope

Do NOT create global variables unless you intend to

Global variables, in any programming language, are generally a bad idea

JS Scope

With JavaScript, the global scope is the complete JavaScript environment

In HTML, the global scope is the window object; all global variables belong to it

```
<p>
In HTML, all global variables<br>
will become window variables.
</p>

<p id="demo"></p>

<script>
    let carName = "Volvo";
    printCarName();

    function printCarName() {
        document.getElementById("demo").innerHTML =
        "I can display " + window.carName;
    }
</script>
```

In HTML, all global variables
will become window variables.

I can display Volvo

JS Scope

Your global variables (or functions) can overwrite window variables (or functions)

Any function, including the window object, can overwrite your global variables and functions

The lifetime of a JavaScript variable starts when it is declared

Local variables are deleted when the function is completed

In a web browser, global variables are deleted when you close the browser window (or tab), but remains available to new pages loaded into the same window

JavaScript Conditions

JS Conditions

Very often when you write code, you want to perform different actions for different decisions

You can use conditional statements in your code to do this

JS Conditions

In JavaScript we have the following conditional statements:

- Use if to specify a block of code to be executed, if a specified condition is true
- Use else to specify a block of code to be executed, if the same condition is false
- Use else if to specify a new condition to test, if the first condition is false
- Use switch to specify many alternative blocks of code to be executed

JS Conditions -- if

Use the if statement to specify a block of JavaScript code to be executed if a condition is true

Note that if is in lowercase letters. Uppercase letters (If or IF) will generate a JavaScript error

```
<script>
    if (condition) {
        // code to execute if true;
    }
</script>
```

JS Conditions -- if

```
<p>
    Display 'Good day' if the<br>
    hour is less that 18:00
</p>

<p id="demo">Good Evening!</p>

<script>
    if (new Date().getHours() < 18) {
        document.getElementById("demo").innerHTML =
        "Good Day!";
    }
</script>
```

Display 'Good day' if the hour is less that 18:00

Good Day!

JS Conditions – if - else

Use the else statement to specify a block of code to be executed if the condition is false

```
<script>
    if (condition) {
        // code to execute if true;
    } else {
        // code to execute if false;
    }
</script>
```


JS Conditions – if - else

```
<p>
    Click the button to display<br>
    a time-based greeting:
</p>
<button onclick="dayEveningGreet()">
    Try it
</button>

<p id="demo"></p>

<script>
    function dayEveningGreet() {
        let hour = new Date().getHours(),
            greeting;
        if (hour < 18) {
            greeting = "Good day!";
        } else {
            greeting = "Good evening!";
        }
        document.getElementById("demo").
        innerHTML = greeting;
    }
</script>
```

Click the button to display a time-based greeting:

Try it

Click the button to display a time-based greeting:

Try it

Good day!

JS Conditions – else if

Use the else if statement to specify a new condition if the first condition is false

```
if (condition1) {
    // code to execute;
} else if (condition2) {
    // code to execute;
} else {
    // code to execute if both
    // condition1 and condition2
    // are false;
}
```


JS Conditions – else if

```
<script>
    function dayEveningGreet() {
        let hour = new Date().getHours(),
            greeting;
        if (hour < 10) {
            greeting = "Good morning!";
        } else if (hour < 20) {
            greeting = "Good day!";
        } else {
            greeting = "Good evening!";
        }
        document.getElementById("demo").
        innerHTML = greeting;
    }
</script>
```

Click the button to display a time-based greeting:

Try it

Click the button to display a time-based greeting:

Try it

Good day!

JS Conditions – switch

Use the switch statement to select one of many blocks of code to be executed

Notice that all the cases – except the last one – have break statements. Why?

```
switch (expression) {
    case n:
        //code to execute if n;
        break;  // exit the statement
    case n:
        //code to execute if n;
        break;  // exit the statement
    case n:
        //code to execute if n;
        break;  // exit the statement
    case n:
        //code to execute if n;
        break;  // exit the statement
    case n:
        //code to execute if n;
}
```

JS Conditions – the break Keyword

When JavaScript reaches a break keyword, it breaks out of the switch block

This will stop the execution of more code and case testing inside the block

When a match is found, and the job is done, it's time for a break. There is no need for more testing

A break can save a lot of execution time because it "ignores" the execution of all the rest of the code in the switch block

It is not necessary to break the last case in a switch block. The block breaks (ends) there anyway

JS Conditions – switch

```
<script>
    let day;
    switch (new Date().getDay()) {
        case 1:
            day = "Monday";
            break;
        case 2:
            day = "Tuesday";
            break;
        case 3:
            day = "Wednesday";
            break;
        case 4:
            day = "Thursday";
            break;
        case 5:
            day = "Friday";
            break;
        case 6:
        case 0:
            day = "Weekend";
    }
    document.getElementById("demo").
      innerHTML = "Today is " + day;
</script>
```

Today is Monday

What's going on here?

JS Conditions – switch default Case

```
<script>
    let text;
    switch (new Date().getDay()) {
        case 5:
            text = "It's Friday!";
            break;
        case 6:
        case 0:
            text = "Weekend";
        default:
            text = "Ugh!";
    }
    document.getElementById("demo").
      innerHTML = text;
</script>
```

Ugh!

The default case does not have to be the last case in a switch block

JavaScript Loops

JS Loops

Loops can execute a block of code a number of times

Loops are handy, if you want to run the same code over and over again, each time with a different value

JavaScript supports different kinds of loops:

- for - loops through a block of code a number of times
- for/in - loops through the properties of an object
- while - loops through a block of code while a specified condition is true
- do/while - also loops through a block of code while a specified condition is true

JS Loops – for

The for loop is often the tool you will use when you want to create a loop

The for loop has the following syntax:

```
for (statement1; statement2; statement3) {
    // code to be executed;
}
```

Statement 1 is executed before the loop (the code block) starts

Statement 2 defines the condition for running the loop (the code block)

Statement 3 is executed each time after the loop (the code block) has been executed

JS Loops – for

```
for (i = 0; i < 5; i++) {
    console.log(i);
}
```

```
0   lecture.js.html:32
1   lecture.js.html:32
2   lecture.js.html:32
3   lecture.js.html:32
4   lecture.js.html:32
```


JS Loops – for/in

The JavaScript for/in statement loops through the properties of an object

```
<p>
    The for/in statement loops through<br>
    the properties of an object.
</p>
<p id="demo"></p>

<script>
    let txt = "",
        person = {fName:"Joe", lName: "Dokes", age: 25},
        p;
    for (p in person) {
        txt += person[p] + " ";
    }
    document.getElementById("demo").innerHTML = txt;
</script>
```

The for/in statement loops through the properties of an object.

Joe Dokes 25

JS Loops – while

Loops can execute a block of code as long as a specified condition is true

The while loop loops through a block of code as long as a specified condition is true

```
while (condition) {
    // code to execute
    // incrememnt condition
}
```

If you forget to increase the variable used in the condition, the loop will never end. This will crash your browser

JS Loops – while

The JavaScript for/in statement loops through the properties of an object

```
<p id="demo"></p>

<script>
    let txt = "",
        i = 0;

    while (i < 10) {
        txt += "<br>The number is " + i;
        i++;
    }
    document.getElementById("demo").innerHTML = txt;
</script>
```

The number is 0
The number is 1
The number is 2
The number is 3
The number is 4
The number is 5
The number is 6
The number is 7
The number is 8
The number is 9

JS Loops – do/while

The do/while loop is a variant of the while loop

This loop will execute the code block once, before checking if the condition is true, then it will repeat the loop as long as the condition is true

```
do {
    // code to execute;
    // don't forget to increment
    // the condition
} while (condition);
```

If you forget to increase the variable used in the condition, the loop will never end. This will crash your browser

JS Loops – while

The JavaScript for/in statement loops through the properties of an object

```
<p id="demo"></p>

<script>
    let txt = "",
        i = 0;
    do {
        txt += "<br> The number is " + i++;
    } while (i < 10);
    document.getElementById("demo").innerHTML = txt;
</script>
```

The number is 0
The number is 1
The number is 2
The number is 3
The number is 4
The number is 5
The number is 6
The number is 7
The number is 8
The number is 9

JavaScript Events

JS Events

HTML events are things that happen to HTML elements

When JavaScript is used in HTML pages, JavaScript can react on these events

An HTML event can be something the browser does, or something a user does

Here are some examples of HTML events:

An HTML web page has finished loading
An HTML input field was changed
An HTML button was clicked

JS Events

Often, when events happen, you want to do something

JavaScript lets you execute code when events are detected

HTML allows event handler attributes, with JavaScript code, to be added to HTML elements

With single quotes:

```
<element event='some JavaScript'>
```

With double quotes:

```
<element event="some JavaScript">
```

JS Events

```
<button onclick="document.getElementById('demo').
  innerHTML=Date()">The time is?</button>

<p id="demo"></p>
```

The time is?

Mon Aug 07 2017 10:21:38 GMT-0400 (Eastern Daylight Time)

JS Events

Code changes the content of its own element (using **this**.innerHTML)

```
<button onclick="this.innerHTML=Date()">
  The time is?
</button>
```

The time is?

Mon Aug 07 2017 10:26:14 GMT-0400 (Eastern Daylight Time)

JS Events

JavaScript code is often several lines long

It is more common to see event attributes calling functions

```
<p>
  Click the button to display the date.
</p>

<button onclick="displayDate()">
  The time is?
</button>

<script>
function displayDate() {
    document.getElementById("demo").
      innerHTML = Date();
}
</script>
```

Click the button to display the date.

The time is?

Click the button to display the date.

The time is?

Mon Aug 07 2017 10:40:22 GMT-0400 (Eastern Daylight Time)

JS Events

Here is a list of some common HTML events

Event	Description
onchange	An HTML element has been changed
onclick	The user clicks an HTML element
onmouseover	The user moves the mouse over an HTML element
onmouseout	The user moves the mouse away from an HTML element
onkeydown	The user pushes a keyboard key
onload	The browser has finished loading the page

JS – What Can JavaScript Do?

Event handlers can be used to handle, and verify, user input, user actions, and browser actions:

- Things that should be done every time a page loads
- Things that should be done when the page is closed
- Action that should be performed when a user clicks a button
- Content that should be verified when a user inputs data

JS – What Can JavaScript Do?

Many different methods can be used to let JavaScript work with events:

- HTML event attributes can execute JavaScript code directly
- HTML event attributes can call JavaScript functions
- You can assign your own event handler functions to HTML elements
- You can prevent events from being sent or being handled

JavaScript Event Listeners

JS Event Listeners

- A more elegant way to react to events on a web site by creating event listeners
- Removes the 'trigger' from the HTML and puts it in the JS
- Similar to the ones we've seen, with some differences

JS Event Listeners

```
document.getElementById('btn1').addEventListener('click', function() {
    //code goes here
});
```

- This appears in your JavaScript code, not the HTML

JS Event Listeners

```
<body>
    <div class='container'>
        <p id='demo'>&lt;&lt; Click here &gt;&gt;</p>
        <p id='demo2'></p>
        <span id='btn1' class='btn'>Click</span>
    </div>

    <script src='handlers.js'></script>
</body>
```


JS Event Listeners

```
document.getElementById('demo').style.cursor = 'pointer';

document.getElementById('demo').addEventListener('click', function() {
    let p = document.getElementById('demo');
    p.innerHTML =   "It is so shocking to find out how many<br>" +
                    "people do not believe that they can learn,<br>" +
                    "and how many more believe learning to be<br>" +
                    "difficult.<br>" +
                    "  - Frank Herbert, Dune";
});
```


JS Event Listeners

<< Click here >>

It is so shocking to find out how many people do not believe that they can learn, and how many more believe learning to be difficult.
- Frank Herbert, Dune

JS Event Listeners

```
<body>
    <div class='container'>
        <p id='demo'>&lt;&lt; Click here &gt;&gt;</p>
        <p id='demo2'></p>
        <span id='btn1' class='btn'>Click</span>
    </div>

    <script src='handlers.js'></script>
</body>
```


JS Event Listeners

```
document.getElementById('btn1').addEventListener('click', function() {
    let p = document.getElementById('demo2');
    p.innerHTML =     "I must not fear. Fear is the mind-killer.<br>" +
                      "Fear is the little-death that brings total<br>" +
                      "obliteration. I will face my fear. I will<br>" +
                      "permit it to pass over me and through me. And<br>" +
                      "when it has gone past I will turn the inner<br>" +
                      "eye to see its path. Where the fear has gone<br>" +
                      "there will be nothing. Only I will remain.<br>" +
                      "  - Frank Herbert, Dune<br>";

});
```


JS Event Listeners

JS Event Listeners - Document

There are a variety of event listeners built in to JavaScript (in addition to 'click')

animationcancel event
animationend event
animationiteration event
animationstart event
copy event
cut event
DOMContentLoaded event
dragend event
dragenter event
dragleave event
dragover event
dragstart event
drag event
drop event
fullscreenchange event
fullscreenerror event
gotpointercapture event
keydown event
keypress event
keyup event
lostpointercapture event
paste event
pointercancel event
pointerdown event
pointerenter event
pointerleave event
pointerlockchange event
pointerlockerror event
pointermove event
pointerout event
pointerover event
pointerup event
readystatechange event
scroll event
selectionchange event
selectstart event
touchcancel event
touchend event
touchmove event
touchstart event
transitioncancel event
transitionend event
transitionrun event
transitionstart event
visibilitychange event
wheel event

JS Event Listeners - Element

There are a variety of event listeners built in to JavaScript (in addition to 'click')

afterscriptexecute event
auxclick event
beforescriptexecute event
blur event
click event
compositionend event
compositionstart event
compositionupdate event
contextmenu event
copy event
cut event
dblclick event
DOMActivate event
DOMMouseScroll event
error event
focusin event
focusout event
focus event
fullscreenchange event
fullscreenerror event
gesturechange event
gestureend event
gesturestart event
keydown event
keypress event
keyup event
mousedown event
mouseenter event
mouseleave event
mousemove event
mouseout event
mouseover event
mouseup event
mousewheel event
msContentZoom event
MSGestureChange event
MSGestureEnd event
MSGestureHold event
MSGestureStart event
MSGestureTap event
MSInertiaStart event
overflow event
paste event
scroll event
select event
show event
touchcancel event
touchend event
touchmove event
touchstart event
underflow event
wheel event

JS Event Listeners - Window

There are a variety of event listeners built in to JavaScript (in addition to 'click')

afterprint event
animationcancel event
animationend event
animationiteration event
animationstart event
appinstalled event
beforeprint event
beforeunload event
blur event
copy event
cut event
devicemotion event
deviceorientation event
DOMContentLoaded event
error event
focus event
gamepadconnected event
gamepaddisconnected event
hashchange event
languagechange event
load event
messageerror event
message event
offline event
online event
orientationchange event
pagehide event
pageshow event
paste event
popstate event
rejectionhandled event
resize event
storage event
transitioncancel event
transitionend event
transitionrun event
transitionstart event
unhandledrejection event
unload event
vrdisplayactivate event
vrdisplayblur event
vrdisplayconnect event
vrdisplaydeactivate event
vrdisplaydisconnect event
vrdisplayfocus event
vrdisplaypointerrestricted event
vrdisplaypresentchange event

JS Event Listeners

This list doesn't include all of the built in events, but should illustrate the variety of things you can do with JavaScript

Questions?

Sources

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