LECTURE 5: JAVASCRIPT FOR MODERN WEB APPS

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Key JavaScript Concepts

- Key JavaScript Concepts
- JavaScript Syntax
- Program Logic
- Advanced JavaScript Syntax

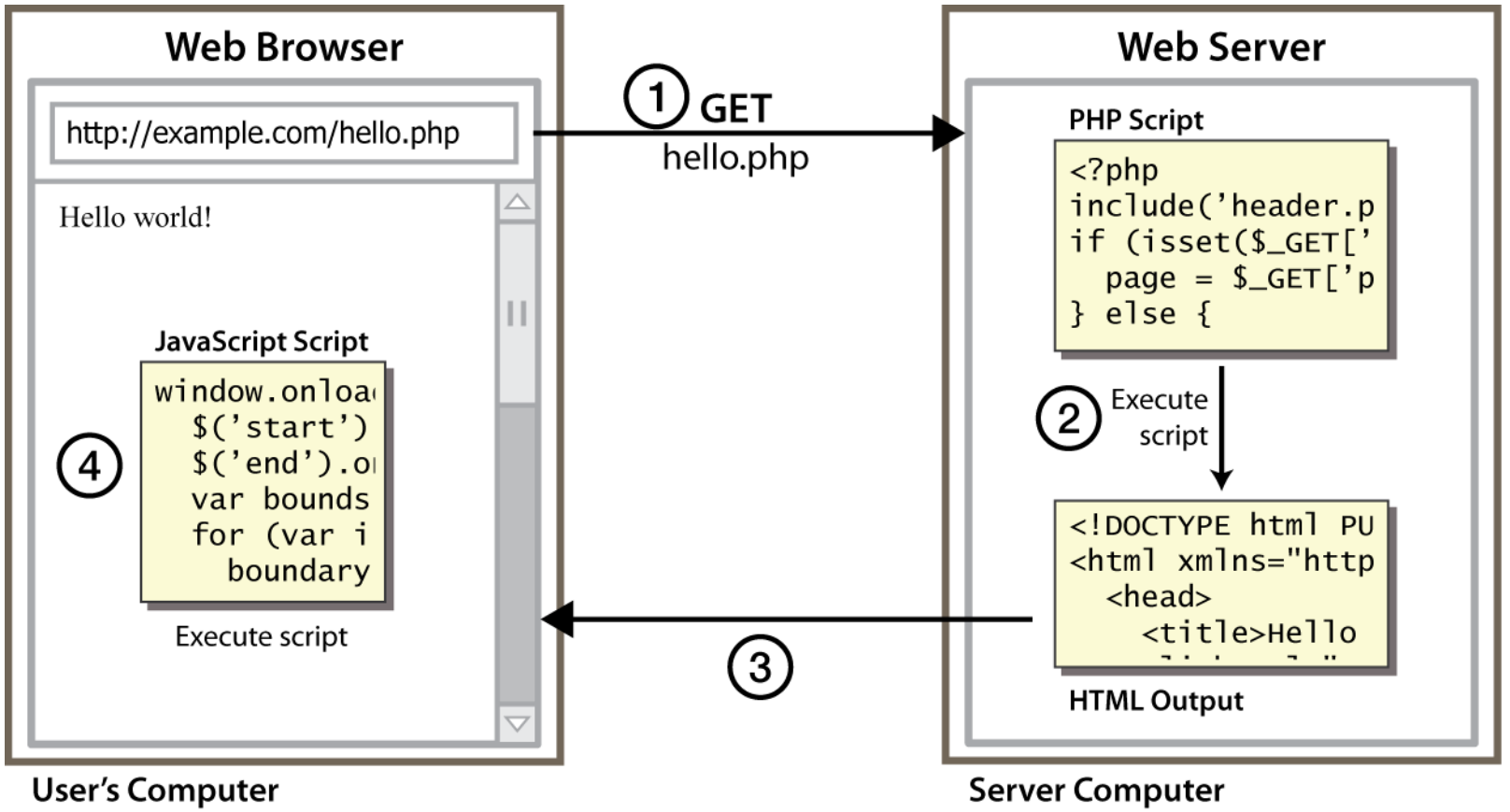
Main Point Preview

JavaScript is a loosely typed language. It has types, but does no compile time type checking. Programmers must be cautious of automatic type conversions, including conversions to Boolean types. It has a flexible and powerful array type as well as distinct types of null and undefined.

Science of Consciousness: To be an effective JavaScript programmer one needs to understand the principles and details of the language. If our awareness is established in the source of all the laws of nature then our actions will spontaneously be in accord with the laws of nature for a particular environment.

Client-side Scripting

- client-side script: code runs in browser *after* page is sent back from server
  - often this code manipulates the page or responds to user actions



Why use client-side programming?

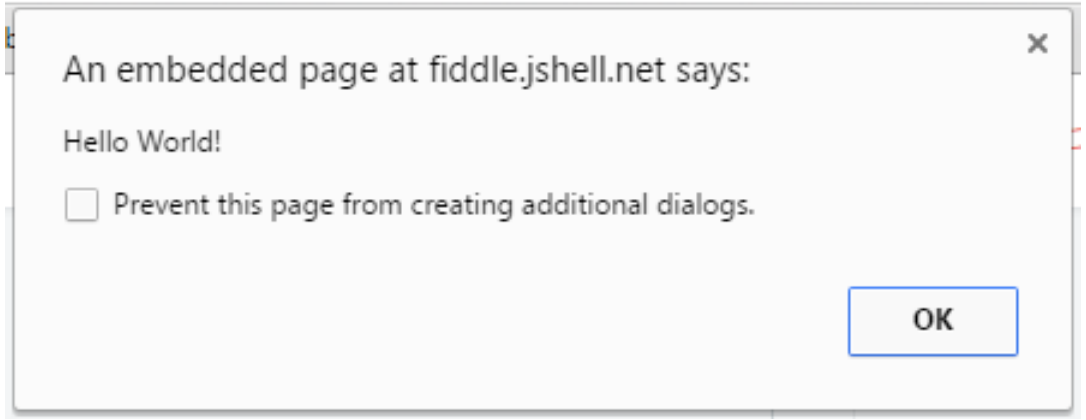
- client-side scripting (JavaScript) benefits:
  - usability: can modify a page without having to post back to the server (faster UI)
  - efficiency: can make small, quick changes to page without waiting for server
  - event-driven: can respond to user actions like clicks and key presses

What is JavaScript?

- a lightweight programming language ("scripting language")
- used to make web pages interactive
  - insert dynamic text into HTML (ex: user name)
  - react to events (ex: page load user click)
  - get information about a user's computer (ex: browser type)
  - perform calculations on user's computer (ex: form validation)
- a web standard (but not supported identically by all browsers)
- NOT related to Java other than by name and some syntactic similarities

A JavaScript statement: alert

```
alert("Hello World!");
```



- A JS command that pops up a dialog box with a message

Variables and types

```
var name = expression;

var age = 32;
var weight = 127.4;
var clientName = "Connie Client";
```

- variables are declared with the var keyword (case sensitive)
  - Replaced by let and const with JS6
- types are not specified, but JS does have types ("loosely typed")
  - Number, Boolean, String, Object (Array , Function) , Null, Undefined
  - can find out a variable's type by calling typeof

Block-scoped variable (ES6)

```
let callbacks = []
for (let i = 0; i <= 2; i++) {
callbacks[i] = function() {
          return i * 2
 }
}
alert(i);
callbacks[0]() === 0
callbacks[1]() === 2
callbacks[2]() === 4
```

Constants (ES6)

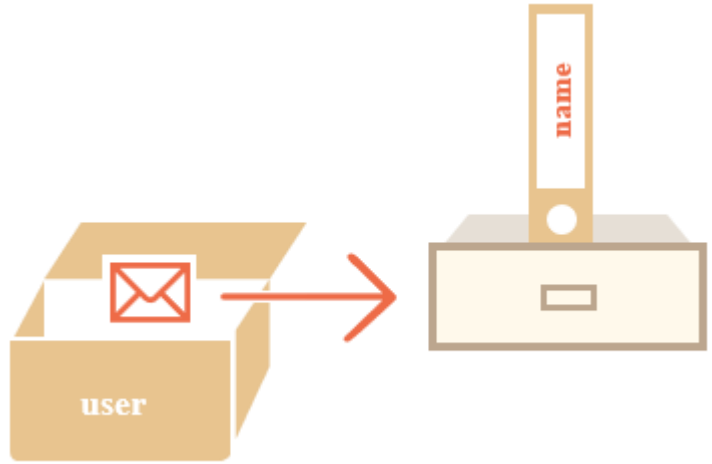
```
const pi = 3.1415926;
pi = 3.14;  //error
const  point = {x:1, y: 10};
point.y = 20;  //ok
```

- always use const or let
  - If any doubt, use const
- also known as "immutable variables",
  - cannot be re-assigned new content.
- only makes the variable itself immutable, not its assigned content
  - object properties can be altered
  - array elements can be altered

Variables as values versus references

- fundamental differences of objects vs primitives is that they are stored and copied “by reference”
- Primitive values: strings, numbers, booleans – are assigned/copied “as a whole value”.

```
let message = "Hello!";
let phrase = message;
```

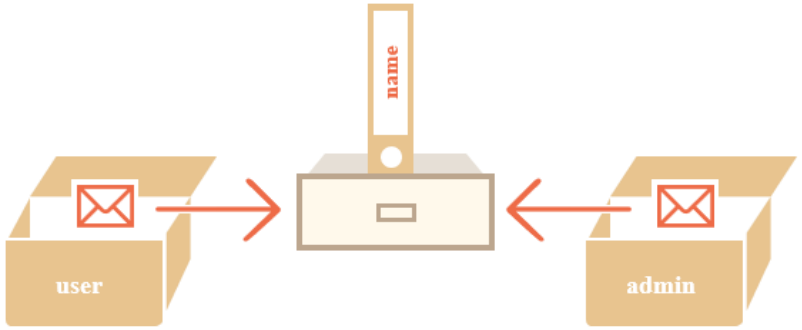


- A variable stores not the object itself, but its “address in memory”, in other words “a reference” to it.

```
let user = {
  name: "John"
};
```

- When an object variable is copied – the reference is copied, the object is not duplicated.

```
let user = { name: "John" };
let admin = user; // copy the reference
```



Number Type

```
let enrollment = 99;
let medianGrade = 2.8;
let credits = 5 + 4 + (2 * 3);
```

- integers and real numbers are the same type (no int vs. double)
- same operators: + - * / % ++ -- = += -= *= /= %=
- similar precedence to Java
- many operators auto-convert types: "2" * 3 is 6
  - What is “2” + 3 ?

Logical Operators

- >, <, >=, <=, &&, ||, ! ==, !=, ===, *!==*
- most logical operators automatically convert types:
  - 5 < "7" is true
  - 42 == 42.0 is true
  - "5.0" == 5 is true
- === and !== are *strict equality* tests
  - checks both type and value
  - "5.0" === 5 is false
- Always use *strict* equality

Comments (same as Java)

```
// single-line comment
/* multi-line comment */
```

- identical to Java's comment syntax
- recall: 4 comment syntaxes
  - HTML: <!-- *comment* -->
  - CSS/JS/PHP/Java: /* *comment* */
  - Java/JS/PHP: // *comment*
  - Python: # *comment*

String Type

```
const s = "Connie Client";
let fName = s.substring(0, s.indexOf(" ")); // "Connie"
let len = s.length; // 13
let s2 = 'Melvin Merchant'; // can use "" or ' '
```

- methods: charAt, charCodeAt, fromCharCode, indexOf, lastIndexOf, replace, split, substring, toLowerCase, toUpperCase
  - charAt returns a one-letter String (there is no char type)
- length property (not a method as in Java)
- concatenation with + : 1 + 1 is 2, but "1" + 1 is "11"

More about String

- escape sequences behave as in Java: \' \" \& \n \t \\
- to convert between numbers and Strings:

```
let count = 10;
let s1 = "" + count; // "10"
let s2 = count + " bananas, ah ah ah!"; // "10 bananas, ah ah ah!"
const n1 = parseInt("42 is the answer"); // 42
const n2 = parseFloat("booyah"); // NaN
```

- to access characters of a String, use [*index*] or charAt:

```
const firstLetter = s[0];
let firstLetter = s.charAt(0);
let lastLetter = s.charAt(s.length - 1);
```

Boolean Type

```
const iLikeWebApps = true;
const ieIsGood = "IE6" > 0; // false
if ("web dev is great") { /* true */ }
if (0) { /* false */ }
```

- any value can be used as a Boolean
  - "falsey" values: false, 0, 0.0, NaN, empty String(""), null, and undefined
  - "truthy" values: anything else, include objects
- !! Idiom – gives boolean value of any variable
  - const x=5;
  - console.log(!x);
  - console.log(x);
  - console.log(!!x);

Special values: null and undefined

```
let ned = null;
const benson = 9;
let caroline;
// at this point in the code,
// ned is null
// benson's 9
// caroline is undefined
```

- undefined : has been declared, but no value assigned
  - e.g., caroline variable above
  - vars that are "hoisted" to beginning of a function
- null : exists, and was specifically assigned a value of null
- reference error when try to evaluate a variable that has not been declared
  - reference error different from undefined
    - E.g., const y = x;
    - Uncaught ReferenceError: x is not defined //if x has never been declared
  - undefined means declared, but no value assigned

if/else statement (same as Java)

```
if (condition) {
  statements;
} else if (condition) {
  statements;
} else {
  statements;
}
```

- identical structure to Java's if/else statement
- JavaScript allows almost anything as a *condition*
  - *JS idioms*
  - //initialize a variable if not set yet
    - if (!a) { a = 10;}
  - //only use a variable if it has a value
    - if (b) { console.log(b); }

for loop (same as Java)

```
for (initialization; condition; update){
 statements;
}

let sum = 0;
for (let i = 0; i < 100; i++) {
 sum = sum + i;
}

const s1 = "hello";
let s2 = "";
for (let i = 0; i < s.length; i++) {
 s2 += s1[i] + s1[i];
} // s2 stores "hheellllloo"
```

while loops (same as Java)

```
while (condition) {
statements;
}

do {
statements;
} while (condition);
```

- break and continue keywords also behave as in Java

Arrays

```
let name = []; // empty array
let name = [value, value, ..., value]; // pre-filled
name[index] = value; // store element

const ducks = ["Huey", "Dewey", "Louie"];
let stooges = []; // stooges.length is 0
stooges[0] = "Larry"; // stooges.length is 1
stooges[1] = "Moe"; // stooges.length is 2
stooges[4] = "Curly"; // stooges.length is 5
stooges[4] = "Shemp"; // stooges.length is 5
```

- two ways to initialize an array
- length *property* (grows as needed when elements are added)

Array methods

```
let a = ["Stef", "Jason"]; // Stef, Jason
a.push("Brian"); // Stef, Jason, Brian
a.unshift("Kelly"); // Kelly, Stef, Jason, Brian
a.pop(); // Kelly, Stef, Jason
a.shift(); // Stef, Jason
a.sort(); // Jason, Stef
```

- array serves as many data structures: list, queue, stack, ...
- methods: concat, join, pop, push, reverse, shift, slice, sort, splice, toString, unshift
  - push and pop add/remove from back
  - unshift and shift add/remove from front
  - shift and pop return the element that is removed

Array methods: map, filter, reduce

```
//functional programming:  map, filter, reduce can replace many
  loops

const a = [1,3,5,3,3];

//return new array with ll elements translated/mapped to another set of values
const b = a.map(function(elem, i, array) {
  return elem + 3;})// [4,6,8,6,6]

//return new array containing select elements based on a condition
const c = a.filter(function(elem, i, array){
  return elem !== 3;});//[1,5]

//find first element or index of first element satisfying condition
const d = a.find(function(elem) {return elem > 1;}); //3
const e = a.findIndex(function(elem) {return elem > 1;}); //1

//accumulate a single value based on elements across the array
const f = a.reduce(function(prevVal, elem, i, array){
  return prevVal + elem;}); //15
```

Function Declaration

```
function name() {
 statement ;
 statement ;
 ...
 statement ;
}

function square(number) {
 return number*number;
}
```

- declarations are "hoisted" (vs function expressions) – see Lecture07
  - They can be declared anywhere in a file, and used before the declaration.

Function Expressions

- Can be Anonymous function
  - Widely used in JS with event handlers

```
const square = function(number) { return number * number };
let x = square(4) // x gets the value 16
```

Can also have a name to be used inside the function to refer to itself //NFE (Named Function Expression)

```
const factorial = function fac(n)
      { return n < 2 ? 1 : n * fac(n - 1) };

console.log(factorial(3));
```

- Basically, a function expression is same syntax as a declaration, just used where an expression is expected (‘lhs’ vs ‘rhs’)

Function Declaration or Function Expression?

- Function declarations have two advantages over function expressions:
  - They are hoisted, so you can call them before they appear in the source code. (some consider this poor style)
  - They have a name. - the name of a function is useful for debugging; especially anonymous function. (ES6 infers name for function expressions)
- Conclusion
  - Neither of the above are significant
  - Can use functions declarations if desired, but can always use function expressions to accomplish same thing (except hoisting)
  - Expression if want anonymous function for event handler, etc
  - declaration if want a reusable function

Functions are objects and are created with a name property

- `function f1(){} f1.name // 'f1'`
- `const f2 = function(){}; f2.name //'` or ‘f2’ in ES6
- `const f3 = function f3(){}; f3.name //’f3’`
  - Named Function Expression (NFE)

Anonymous functions

- JavaScript allows you to declare anonymous functions
- Can be stored as a variable, attached as an event handler, etc.
- Keeping unnecessary names out of namespace for performance and safety

```
window.onload = function(){
  alert("Hello World!");
}
```

- Function declaration or expression?

Semicolon ;

- Semicolons are (technically) ‘optional’
  - JS implicitly adds them to our code if parser is expecting
  - “semicolon insertion”
  - “bad part” of JavaScript
  - ‘seemed like a good idea at the time’ …
  - in certain cases that can cause problems
    - return, var, break, throw, …
  - Best practice to explicitly include them
  - Include brackets at the end of line versus new line
    - K&R (Kernighan and Ritchie) versus OTBS (one true brace style)

Semicolon ;

```
function a() {//K&R style
   return {
            a: 1 ;
      }
}
function b()
{  //OTBS not good practice (Crockford, …)
 return  //semicolon gets inserted here
      {
   a: 1 ;
   }
}
console.log(a()); //object
console.log(b());  //undefined  -- oops
```

Main Point

JavaScript is a loosely typed language. It has types but does no compile time type checking. Programmers must be cautious of automatic type conversions, including conversions to Boolean types. It has a flexible and powerful array type as well as distinct types of null and undefined.

Science of Consciousness: To be an effective JavaScript programmer one needs to understand the principles and details of the language. If our awareness is established in the source of all the laws of nature, then our actions will spontaneously be in accord with the laws of nature for a particular environment.

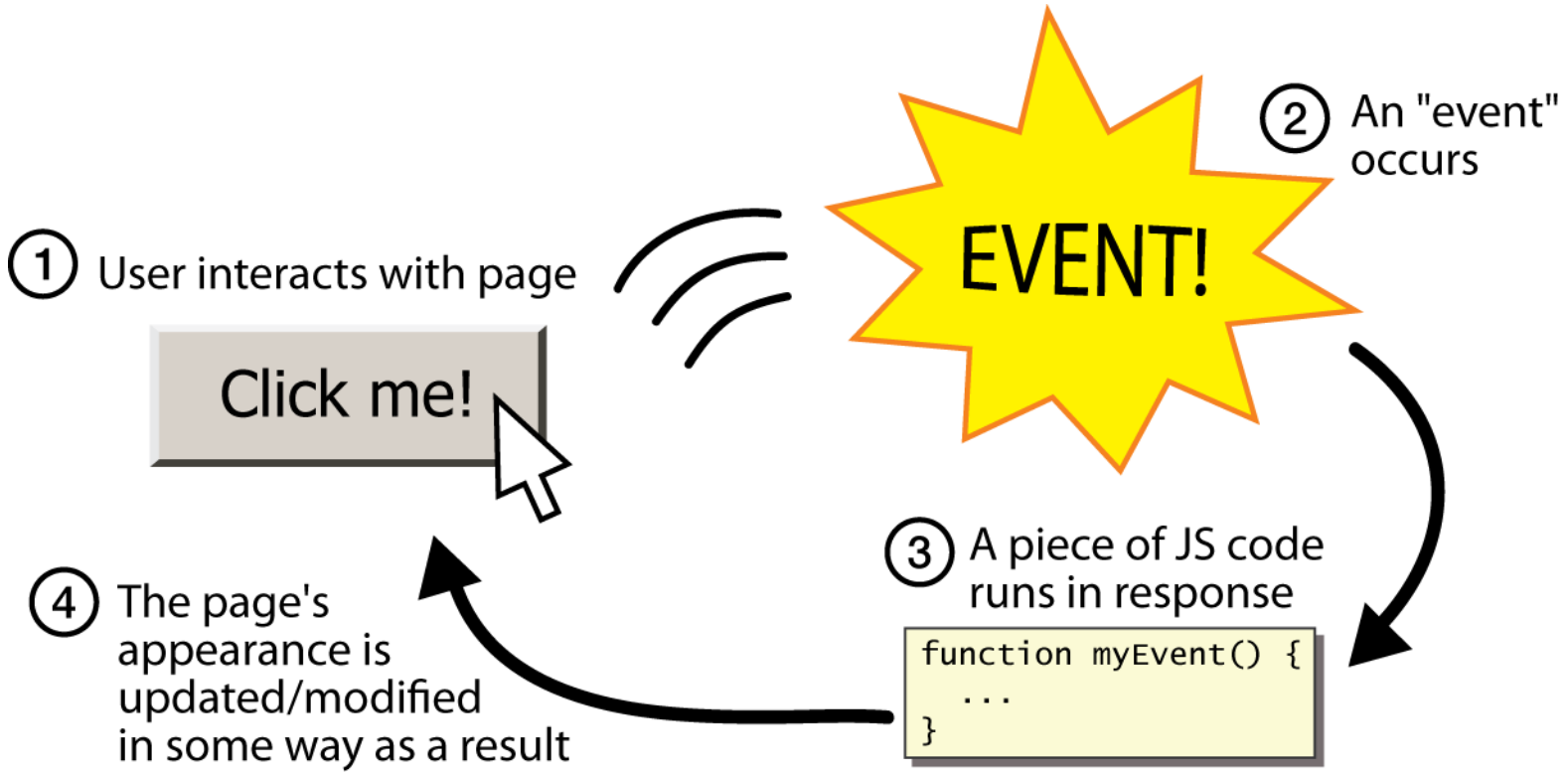
Main Point Preview

JavaScript programs have no main. They respond to user actions called events.

Science of Consciousness: JavaScript was designed as a language that could effectively respond to browser and DOM events. We respond most effectively to events in our environment if our awareness is settled and alert.

Event-driven programming

- JS programs have no main; they respond to user actions called **events**
- **event-driven programming**: writing programs driven by user events



Button: <button>

```
<button>Click me!</button>
```

- To make a responsive button or other UI control:
  - choose the control (e.g. button) and event (e.g. mouse click) of interest
  - write a JavaScript function to run when the event occurs
  - attach the function to the event on the control

Event handlers

```
<element attributes onclick="function();">...

<button onclick="myFunction();">Click me!</button>
```

- JavaScript functions can be set as **event handlers**
  - when you interact with the element, the function will execute
- onclick is just one of many event HTML attributes we'll use

- but popping up an alert window is disruptive and annoying
  - A better user experience would be to have the message appear on the page...

Main Point

JavaScript programs have no main. They respond to user actions called events.

Science of Consciousness: JavaScript was designed as a language that could effectively respond to browser and DOM events. We respond most effectively to events in our environment if our awareness is settled and alert.

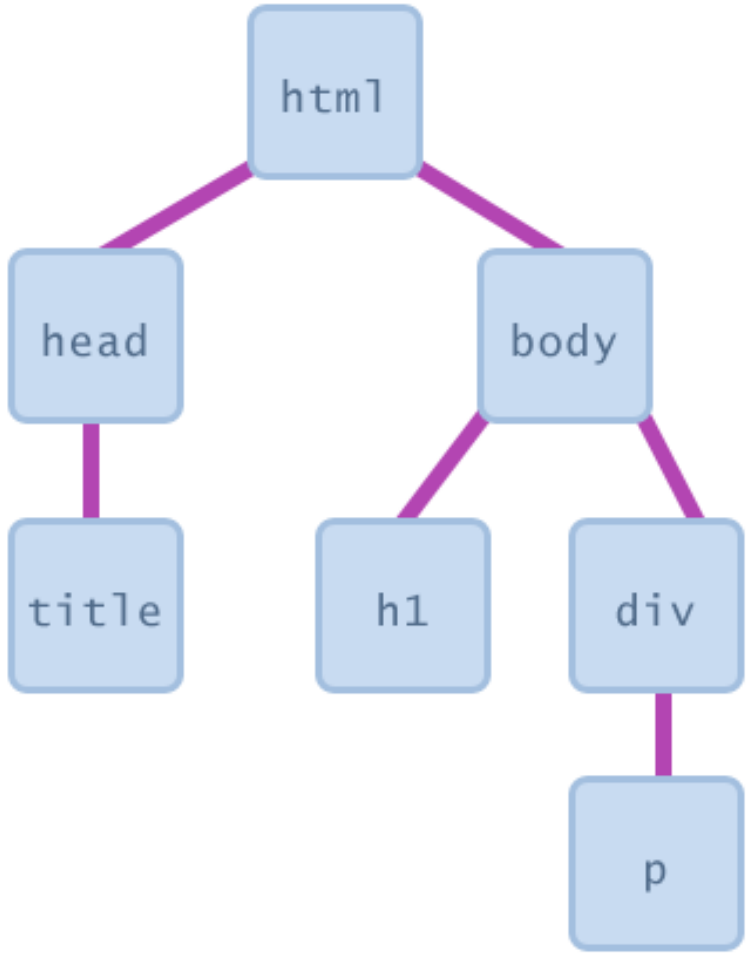
Main Point Preview

The DOM is an API so the JavaScript programmer can conveniently access and manipulate the HTML elements in code.

Science of Consciousness: The TM and TM-Sidhi programs are techniques that allow anyone to conveniently contact and act at the level of the Unified Field.

Document Object Model (DOM)

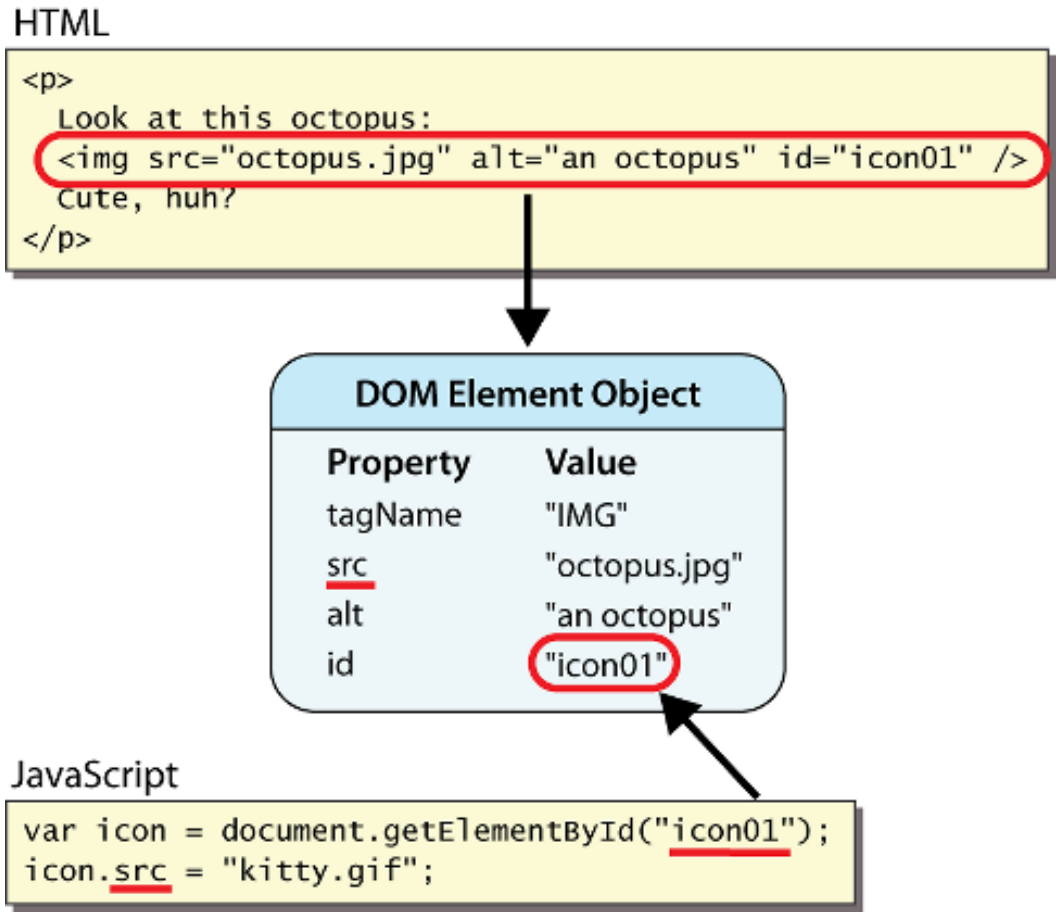
- most JS code manipulates elements on an HTML page
- we can examine elements' state
  - e.g. see whether a box is checked
- we can change state
  - e.g. insert some new text into a div
- we can change styles
  - e.g. make a paragraph red



DOM element objects

- every element on the page has a corresponding DOM object

- access/modify the attributes of the DOM object
  with *objectName*.*attributeName*



Accessing elements: document.getElementById

```
const name = document.getElementById(“someId");

<button onclick="changeText();">Click me!</button>
<input id="output" type="text" value="replace me" />

function changeText() {
 const textbox = document.getElementById("output");
 textbox.value = "Hello, world!";
}
```

- document.getElementById returns the DOM object for an element with a given id
- can change the text in most *form controls* by setting the value property
- Browser automatically updates the screen when any DOM object is changed

More advanced example

```
<button onclick="swapText();">Click me!</button>
<span id="output2">Hello</span>
<input id="textbox2" type="text" value="Goodbye" />

function swapText() {
 var span = document.getElementById("output2");
 var textBox = document.getElementById("textbox2");
 var temp = span.innerHTML;
 span.innerHTML = textBox.value;
 textBox.value = temp;
}
```

can change the text inside most elements by setting the innerHTML property
See examples: See example: lecture05_examples/click2.html
lecture05_examples/click1.html

DOM object properties

```
<div id="main" class="foo bar">
 <p>Hello, <em>very</em> happy to see you!</p>
 <img id="icon" src="greatwall.jpg" alt="GREAT WALL" />
</div>
const mainDiv = document.getElementById("main");
const icon = document.getElementById("icon");
```

See example: lecture06_examples/objectproperties.html

Property	Description	Example
tagName	element's HTML tag	mainDiv.tagName is "DIV"
className	CSS classes of element	mainDiv.className is "foo bar"
innerHTML	Content in element	mainDiv.innerHTML is "\n <p>Hello…
src	URL target of an image	icon.src is "greatwall.jpg"

DOM properties for form controls

```
<input id="sid" type="text" size="7" maxlength="7" />
<input id="frosh" type="checkbox" checked="checked" /> Freshman?
const sid = document.getElementById("sid");
const frosh = document.getElementById("frosh");
```

Property	Description	Example
value	the text/value chosen by the user	sid.value could be "1234567"
checked	whether a box is checked	frosh.checked is true
disabled	whether a control is disabled (boolean)	frosh.disabled is false
readOnly	whether a text box is read-only	sid.readOnly is false

Abuse of innerHTML

```
// bad style!
var paragraph = document.getElementById("welcome");
paragraph.innerHTML = "<p>text and <a
 href="page.html">link</a>";
```

- innerHTML is the content between the HTML tags of an element
- innerHTML can inject arbitrary HTML content into the page
- however, this is prone to bugs and errors and is considered poor style
  - innerHTML not part of DOM standard
  - issues involving DOM rebuilding tree and maintaining node and event handler references
- Best practice: inject plain text only
  - Do not use innerHTML to inject HTML tags;

DOM elements style property

```
<button id="clickme">Color Me</button>
window.onload = function() {
 document.getElementById("clickme").onclick = changeColor;
};
function changeColor() {
 const clickMe = document.getElementById("clickme");
 clickMe.style.color = "red";
}
```

Property	Description
style	lets you set any CSS style property for an element

- contains same properties as in CSS, but with camelCasedNames
  - examples: backgroundColor, borderLeftWidth, fontFamily

Common DOM styling errors

- many students forget to write .style when setting styles

```
var clickMe = document.getElementById("clickme");
clickMe.color = "red";
clickMe.style.color = "red";
```

- style properties are capitalized likeThis, not like-this

```
clickMe.style.font-size = "14pt";
clickMe.style.fontSize = "14pt";
```

- style properties *must* be set as strings, often with units at the end

```
clickMe.style.width = 200;
clickMe.style.width = "200px";
clickMe.style.padding = "0.5em";
```

  - write exactly the value you would have written in the CSS, but in quotes

Unobtrusive styling

```
function okayClick() {
  this.style.color = "red";
  this.className = "highlighted";
}
.highlighted { color: red; }
```

- well-written JavaScript code should contain as little CSS as possible
- use JS to set CSS classes/IDs on elements
- define the styles of those classes/IDs in your CSS file
- Remember cssZenGarden?

Getting/Setting CSS classes

```
function highlightField() {
 // turn text yellow and make it bigger
 if (!document.getElementById("text").className) {
 document.getElementById("text").className = "highlight";
 } else if (document.getElementById("text").className.indexOf("invalid")
 < 0) {
  document.getElementById("text").className += " highlight";
 }
}
```

- JS DOM's className property corresponds to HTML class attribute
- somewhat clunky with multiple space-separated classes
  - which is what getElementById(..).className returns

Common bug: incorrect usage of existing styles

```
document.getElementById("main").style.top  =
document.getElementById("main").style.top + 100 + "px"; //
  bad
```

- the above example computes e.g. "200px" + 100 + "px" , which would evaluate to "200px100px"

- a corrected version:

```
document.getElementById("main").style.top =
 parseInt(document.getElementById("main").style.top)
 + 100 + "px"; // correct
```

Main Point

The DOM is an API so the JavaScript programmer can conveniently access and manipulate the HTML elements in code.

Science of Consciousness: The TM and TM-Sidhi programs are techniques that allow anyone to conveniently contact and act at the level of the Unified Field.

CONNECTING THE PARTS OF KNOWLEDGE WITH THE WHOLENESS OF KNOWLEDGE

JavaScript for Modern Web Apps: Spontaneous Right Action

1. JavaScript code comes with an HTML page and is executed on the browser.

2. JavaScript reacts to browser events and manipulates the web page using the HTML DOM API.

---

3. **Transcendental consciousness** is the source of thought and the home of all the laws of nature.

4. **Impulses within the transcendental field:** Actions arising from this level will spontaneously be in accord with all the laws of nature.

5. **Wholeness moving within itself:** In unity consciousness, all of one's perceptions and actions are grounded in the experience of pure consciousness.