

```
<DIV>Q: HOW DO YOU ANNOY A WEB DEVELOPER?</SPAN>
```

# CSE 154

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LECTURE 20: THE DOM TREE

# Setting a timer

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method	description
<code>setTimeout(<i>function</i>, <i>delayMS</i>);</code>	arranges to call given function after given delay in ms
<code>setInterval(<i>function</i>, <i>delayMS</i>);</code>	arranges to call function repeatedly every <i>delayMS</i> ms
<code>clearTimeout(<i>timerID</i>);</code> <code>clearInterval(<i>timerID</i>);</code>	stops the given timer

- both `setTimeout` and `setInterval` return an ID representing the timer
  - this ID can be passed to `clearTimeout/Interval` later to stop the timer



# Passing parameters to timers

```
function delayedMultiply() {  
    // 6 and 7 are passed to multiply when timer goes off  
    setTimeout(multiply, 2000, 6, 7);  
}  
function multiply(a, b) {  
    alert(a * b);  
}
```

JS

Click me!

output

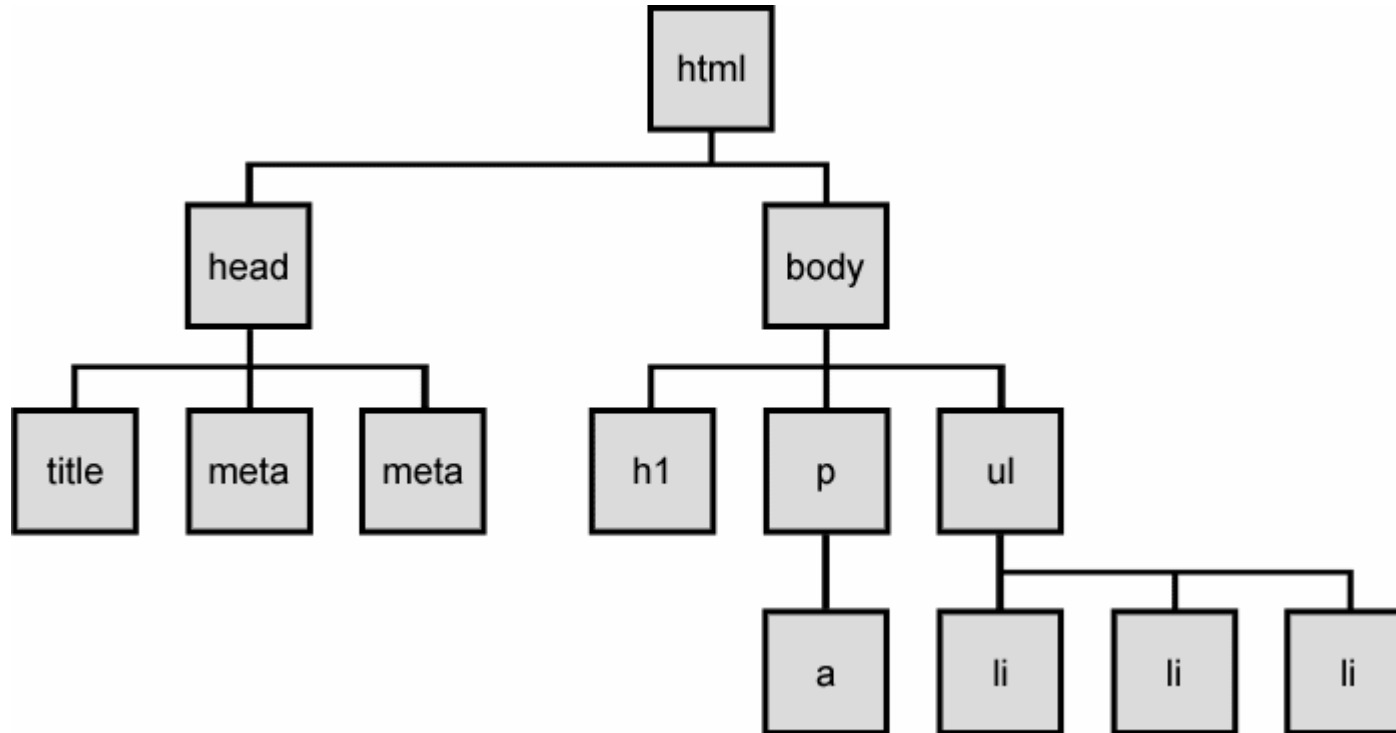
- any parameters after the delay are eventually passed to the timer function
  - doesn't work in IE; must create an intermediate function to pass the parameters
- why not just write this?

```
setTimeout(multiply(6 * 7), 2000);
```

JS

# The DOM tree

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- The elements of a page are nested into a tree-like structure of objects the DOM has properties and methods for traversing this tree

# DOM versus innerHTML hacking

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Why not just code the previous example this way?

```
function slideClick() {  
    document.getElementById("main").innerHTML += "<p>A paragraph!</p>";  
}
```

JS

- Imagine that the new node is more complex:
  - ugly: bad style on many levels (e.g. JS code embedded within HTML)
  - error-prone: must carefully distinguish " and '
  - can only add at beginning or end, not in middle of child list

```
function slideClick() {  
    document.getElementById("main").innerHTML += "<p style='color: red; " +  
        "margin-left: 50px;' " + "onclick='myOnClick();'>" +  
        "A paragraph!</p>";  
}
```

JS

# Creating new nodes

name	description
<code>document.createElement("tag")</code>	creates and returns a new empty DOM node representing an element of that type
<code>document.createTextNode("text")</code>	creates and returns a text node containing given text

```
// create a new <h2> node
var newHeading = document.createElement("h2");
newHeading.innerHTML = "This is a heading";
newHeading.style.color = "green";
```

JS

- merely creating a element does not add it to the page
- you must add the new element as a child of an existing element on the page...

# Modifying the DOM tree

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Every DOM element object has these methods:

name	description
<u><a href="#">appendChild</a></u> ( <i>node</i> )	places given node at end of this node's child list
<u><a href="#">insertBefore</a></u> ( <i>new, old</i> )	places the given new node in this node's child list just before old child
<u><a href="#">removeChild</a></u> ( <i>node</i> )	removes given node from this node's child list
<u><a href="#">replaceChild</a></u> ( <i>new, old</i> )	replaces given child with new node

```
var p = document.createElement("p");  
p.innerHTML = "A paragraph!";  
document.getElementById("main").appendChild(p);
```

JS

A paragraph!

# Complex DOM manipulation problems

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How would we do each of the following in JavaScript code? Each involves modifying each one of a group of elements ...

- When the Go button is clicked, reposition all the divs of class puzzle to random x/y locations.
- When the user hovers over the maze boundary, turn all maze walls red.
- Change every other item in the ul list with id of TAs to have a gray background.



# Selecting groups of DOM objects

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- methods in document and other DOM objects (\* = HTML5):

name	description
<a href="#"><u>getElementsByTagName</u></a>	returns array of descendents with the given tag, such as "div"
<a href="#"><u>getElementsByName</u></a>	returns array of descendents with the given name attribute (mostly useful for accessing form controls)
<a href="#"><u>querySelector</u></a> *	returns the first element that would be matched by the given CSS selector string
<a href="#"><u>querySelectorAll</u></a> *	returns an array of all elements that would be matched by the given CSS selector string

# Getting all elements of a certain type

---

highlight all paragraphs in the document:

```
var allParas = document.querySelectorAll("p");
for (var i = 0; i < allParas.length; i++) {
  allParas[i].style.backgroundColor = "yellow";
}
```

JS

```
<body>
  <p>This is the first paragraph</p>
  <p>This is the second paragraph</p>
  <p>You get the idea...</p>
</body>
```

HTML

# Complex selectors

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highlight all paragraphs inside of the section with ID "address":

```
// document.getElementById("address").getElementsByTagName("p")
var addrParas = document.querySelectorAll("#address p");
for (var i = 0; i < addrParas.length; i++) {
    addrParas[i].style.backgroundColor = "yellow";
}
```

JS

```
<p>This won't be returned!</p>
<div id="address">
    <p>1234 Street</p>
    <p>Atlanta, GA</p>
</div>
```

HTML

# Common querySelectorAll issues

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- many students forget to write `.` or `#` in front of a class or id

```
// get all buttons with a class of "control"  
var gameButtons = document.querySelectorAll("control");  
var gameButtons = document.querySelectorAll(".control");
```

JS

- `querySelectorAll` returns an array, not a single element; must loop over the results (`document.querySelector` returns just the first element that matches, if that's what you want)

```
// set all buttons with a class of "control" to have red text  
document.querySelectorAll(".gamebutton").style.color = "red";  
var gameButtons = document.querySelector(".gamebutton");  
for (var i = 0; i < gameButtons.length; i++) {  
    gameButtons[i].style.color = "red";  
}
```

Q: Can I still select a group of elements using `querySelectorAll` even if my CSS file doesn't have any style rule for that same group? (A: Yes!)

# Removing a node from the page

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```
function slideClick() {  
  var bullet = document.getElementById("removeme");  
  bullet.parentNode.removeChild(bullet);  
}
```

JS

- odd idiom: *obj*.parentNode.remove(*obj*);

# The keyword this

---

```
this.fieldName           // access field  
this.fieldName = value;  // modify field  
this.methodName(parameters); // call method
```

JS

- all JavaScript code actually runs inside of an object
- by default, code runs in the global window object (so this === window)
  - all global variables and functions you declare become part of window
- the this keyword refers to the current object

# Event handler binding

```
window.onload = function() {  
  document.getElementById("textbox").onmouseout = booyah;  
  document.getElementById("submit").onclick = booyah;  
}; // bound to submit button here  
  
function booyah() { // booyah knows what object it was called on  
  this.value = "booyah";  
}
```

JS

output

- event handlers attached unobtrusively are bound to the element
- inside the handler, that element becomes this

# Problems with reading/changing styles

<code>&lt;button id="clickme"&gt;Click Me&lt;/button&gt;</code>	HTML
<pre>window.onload = function() {   document.getElementById("clickme").onclick = biggerFont; }; function biggerFont() {   var button = document.getElementById("clickme");   var size = parseInt(button.style.fontSize);   button.style.fontSize = (size + 4) + "pt"; }</pre>	JS
<code>Click Me</code>	output

- style property lets you set any CSS style for an element
- problem: you cannot read existing styles with it  
(you can read ones you set using the DOM `.style`, but not ones that are set in the CSS file)



# Accessing elements' existing styles

```
window.getComputedStyle(element).propertyName
```

JS

```
function biggerFont() {  
    // turn text yellow and make it bigger  
    var clickMe = document.getElementById("clickme");  
    var size = parseInt(window.getComputedStyle(clickMe).fontSize);  
    clickMe.style.fontSize = (size + 4) + "pt";  
}
```

JS

Click Me

output

- `getComputedStyle` method of global window object accesses existing styles

# Common bug: incorrect usage of existing styles

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

```
var main = document.getElementById("main");  
main.style.top = window.getComputedStyle(main).top + 100 + "px";  
    // bad! JS
```

- a corrected version:

```
main.style.top = parseInt(window.getComputedStyle(main).top) +  
    100 + "px"; // correct JS
```

# Getting/setting CSS classes

---

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

JS

- JS DOM's className property corresponds to HTML class attribute
- somewhat clunky when dealing with multiple space-separated classes as one big string

# Getting/setting CSS classes with classList

---

```
function highlightField() {  
    // turn text yellow and make it bigger  
    var text = document.getElementById("text");  
    if (!text.classList.contains("invalid")) {  
        text.classList.add("highlight");  
    }  
}
```




JS

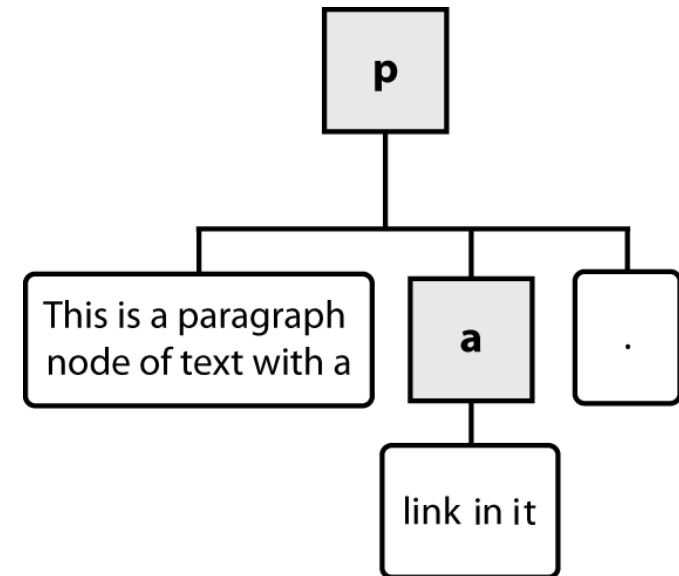
- classList collection has methods add, remove, contains, toggle to manipulate CSS classes
- similar to existing className DOM property, but don't have to manually split by spaces

# Types of DOM nodes

```
<p>  
  This is a paragraph of text with a  
  <a href="/path/page.html">link in it</a>.  
</p>
```

HTML

- **element nodes** (HTML tag) 
  - can have children and/or attributes
- **text nodes** (text in a block element) 
- **attribute nodes** (attribute/value pair) 
  - text/attributes are children in an element node
  - cannot have children or attributes
  - not usually shown when drawing the DOM tree



# Traversing the DOM tree manually

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every node's DOM object has the following properties:

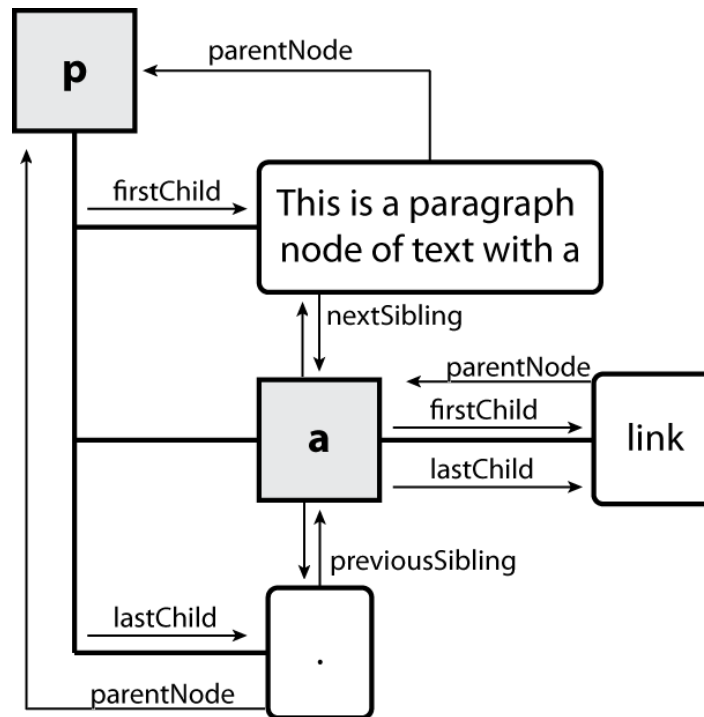
<b>name(s)</b>	<b>description</b>
firstChild, lastChild	start/end of this node's list of children
childNodes	array of all this node's children
nextSibling, previousSibling	neighboring nodes with the same parent
parentNode	the element that contains this node

- [complete list of DOM node properties](#)
- [browser incompatibility information](#) (IE6 sucks)

# DOM tree traversal example

```
<p id="foo">This is a paragraph of text with a  
  <a href="/path/to/another/page.html">link</a>.</p>
```

HTML



# Element vs. text nodes

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```
<div>
  <p>
    This is a paragraph of text with a
    <a href="page.html">link</a>.
  </p>
</div>
```

HTML

- Q: How many children does the div above have?  
A: 3
  - an element node representing the <p>
  - two *text nodes* representing "\n\t" (before/after the paragraph)
- Q: How many children does the paragraph have? The a tag?