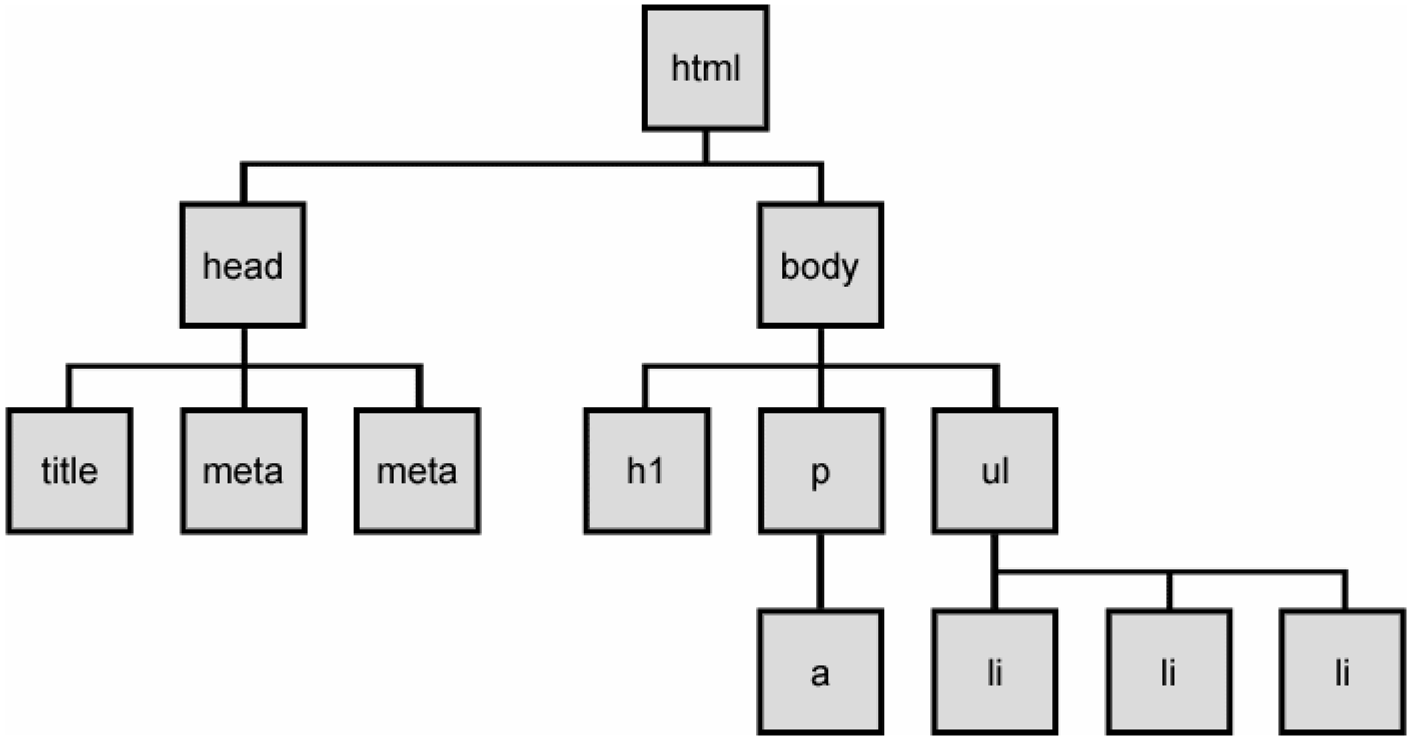
CSE 154

LECTURE 20: THE DOM TREE

The DOM tree



- 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

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
document.createElement("*tag*")	creates and returns a new empty DOM node representing an element of that type
document.createTextNode("*text*")	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

Every DOM element object has these methods:

name	description
appendChild(*node*)	places given node at end of this node's child list
insertBefore(*new*, *old*)	places the given new node in this node's child list just before old child
removeChild(*node*)	removes given node from this node's child list
replaceChild(*new*, *old*)	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

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

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

name	description
getElementsByTagName	returns array of descendents with the given tag, such as "div"
getElementsByName	returns array of descendents with the given name attribute (mostly useful for accessing form controls)
querySelector *	returns the first element that would be matched by the given CSS selector string
querySelectorAll *	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

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

- 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

```
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
```

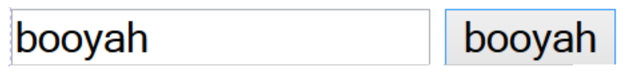
- all JavaScript code actually runs inside of an object
- by default, code runs in the global window object (so this === window)
    - all global variables and functions you declare become part of window
- the this keyword refers to the current object

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



booyah

output

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

Problems with reading/changing styles

```
<button id="clickme">Click Me</button>
```

HTML

```
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";
}
```

JS

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

- 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

```js
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

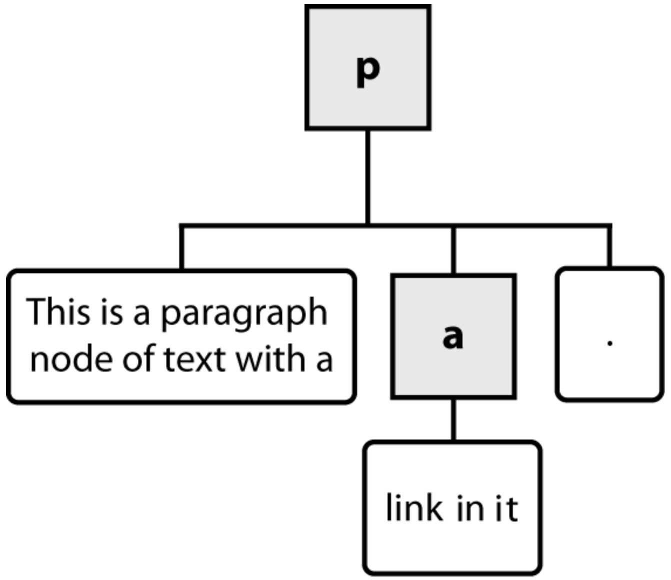
```
function highlightField() {
  // turn text yellow and make it bigger
  var text = document.getElementById("text");
  if (!text.classList.contains("invalid")) {
    text.classList.add("highlight");
  }
}                                                         JS
```

- 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

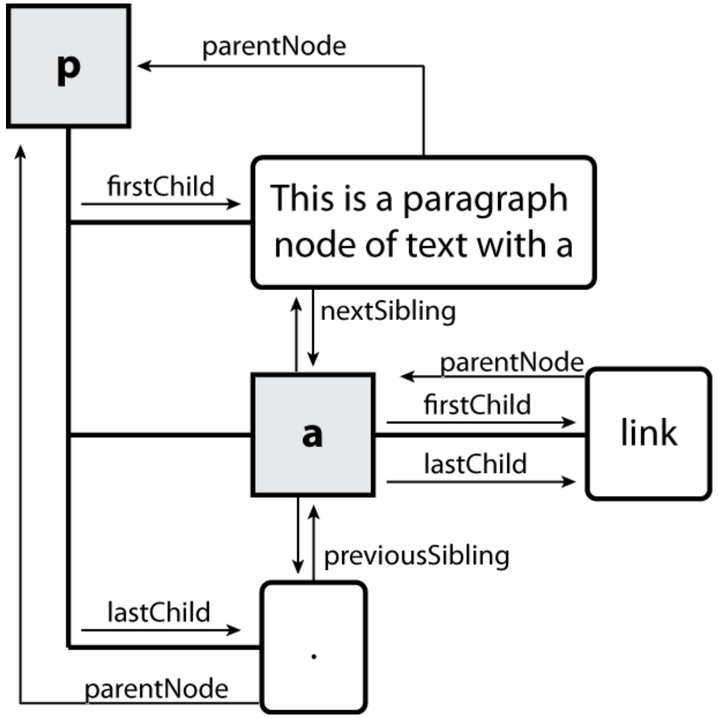
every node's DOM object has the following properties:

name(s)	**description**
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 incompatiblity 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

```html
<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?