Introduction to Web Programming

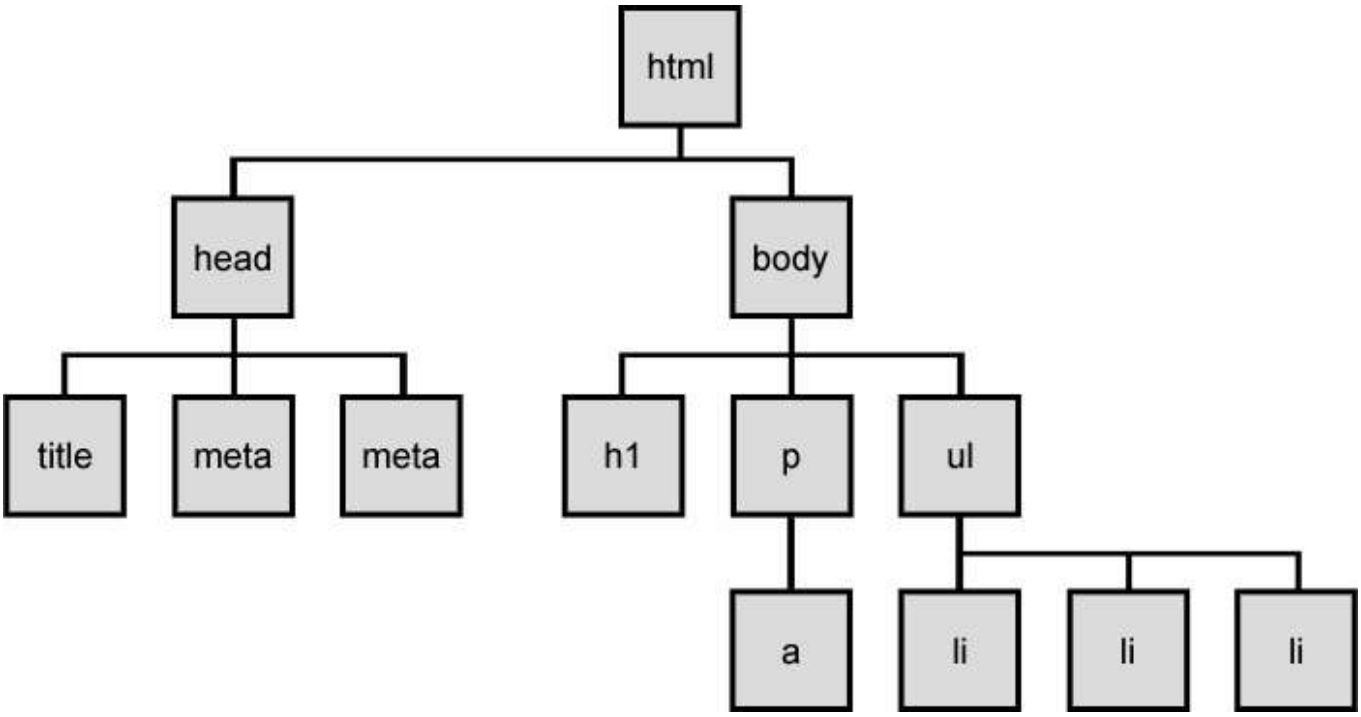
Lecture 18: The DOM Tree

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.

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

Selecting groups of DOM objects

- methods in `document` and other DOM objects:

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";
}
```

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

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";
}
```

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

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");
```

- 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!)

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";
```

- 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);
```

DOM versus innerHTML hacking

Why not just code the previous example this way?

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

- 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>";
}
```

Removing a node from the page

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

- each DOM object has a `removeChild` method to remove its children from the page
- odd idiom: *obj*.`parentNode.remove(`*obj*`);`

The keyword `this`

```
this.fieldName                  // access field
this.fieldName = value;          // modify field

this.methodName(parameters);     // call method
```

- 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";
}
```

Save

- 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>
```

```
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";
}
```

Click Me

- `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
```

```
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";
}
```

Click Me

- `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!
```

- a corrected version:

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

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 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`

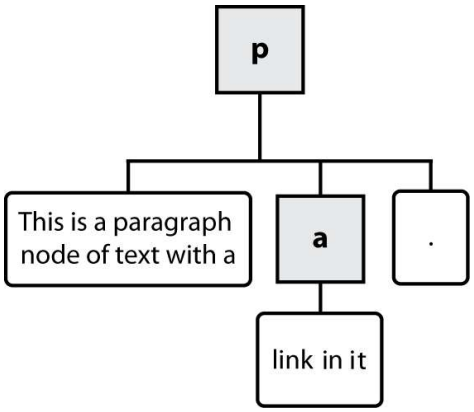
```
function highlightField() {
  // turn text yellow and make it bigger
  var text = document.getElementById("text");
  if (!text.classList.contains("invalid")) {
    text.classList.add("highlight");
  }
}
```

- `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>
```

- **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

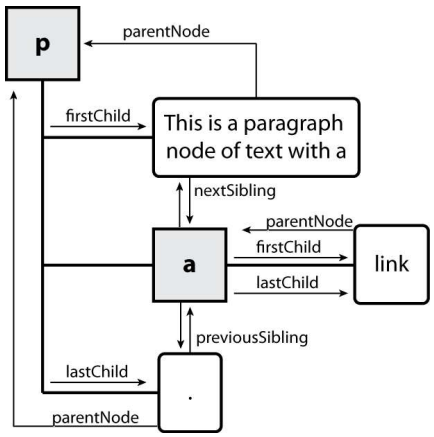
every node's DOM object has the following properties:

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>
```



Element vs. text nodes

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

- 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?