

DOM and Events - Part 2



Building Modern Web Applications - VSP2024

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Recap from Lecture 1

1. **Recap from Lecture 1**
2. DOM APIs
3. DOM Traversal
4. DOM Manipulation



Why study DOM interactions?

- Needed for JS code to have any effect on webpage (without reloading the page)
- Uniform API/interface to access DOM from JS
- Does not depend on specific browser platform

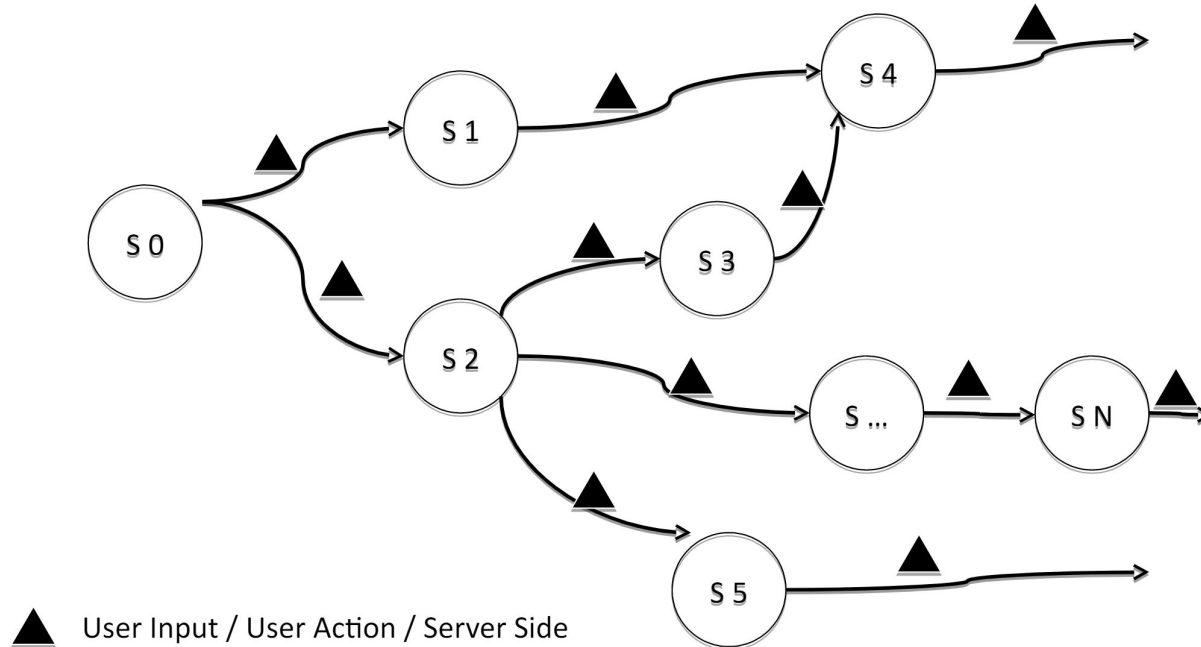


NOTE

- We'll be using the native DOM APIs for many of the tasks in this lecture
- Though many of these can be simplified using frameworks such as jQuery, it is important to know what's "under the hood"
- We assume a standards compliant browser!

DOM: an evolving entity

DOM is highly dynamic!



DOM APIs

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Selecting HTML Elements

- You can access the DOM from the object `window.document` and traverse it to any node
- However, this is slow – often you only need to manipulate specific nodes in the DOM
- Further, navigating to nodes this way can be error prone and fragile
 - Will no longer work if DOM structure changes
 - DOM structure changes from one browser to another



Selecting HTML Elements

- With a specified `id`
- With a specified tag name
- With a specified `class`
- With generalized CSS selector



Method 1: `getElementById`

- Used to retrieve a single element from DOM
 - IDs are unique in the DOM (or at least must be)
 - Returns `null` if no such element is found



```
1 var id = document.getElementById("Section1");  
2 if (id === null) throw new Error("No element found");
```


Method 2: `getElementsByTagName`

- Retrieves multiple elements matching a given tag name ('type') in the DOM
- Returns a read-only array-like object (empty if no such elements exist in the document)



```
1 var images = document.getElementsByTagName("img");
2 for (var i = 0; i < images.length; i++){
3     images[i].style.display = "none";
4 }
```

Method 3: `getElementsByClassName`

- Can also retrieve elements that belong to a specific CSS class
 - More than one element can belong to a CSS class



```
1 var warnings = document.getElementsByClassName("warning");
2 if (warnings.length > 0){
3     console.log("Found " + warnings.length + " elements");
4 }
```

Important point: Live Lists

- Both `getElementsByClassName` and `getElementsByTagName` return **live lists**
 - List can change after it is returned by the function if new elements are added to the document
 - List cannot be changed by JavaScript code adding to it or removing from it directly though
- Make a copy if you're iterating through the lists



Selecting Elements by CSS selector

- Can also select elements using generalized CSS selectors using `querySelectorAll()` method
 - Specify a selector query as argument
 - Query results are not “live” (unlike earlier)
 - Can subsume all the other methods
- `querySelector()` returns the first element matching the CSS query string, `null` otherwise



CSS selector examples

```
1 "#nav"           // Any element with id="nav"
2
3 "div"            // Any <div> element
4
5 ".warning"       // Any element with "warning" class
6
7 "#log span"      // Any <span> descendant of id="log"
8
9 "#log > span"    // Any <span> child element of id="log"
10
11 "body > h1:first-child" // first <h1> child of <body>
12
13 "div, #log"      // All <div> elements and element with id="log"
14
```



Invocation on DOM subtrees

- All of the above methods can also be invoked on DOM elements not just the document
 - Search is confined to subtree rooted at element
- Example: Assume element with id="log" exists



```
1 var log = document.getElementById("log");
2 var error = log.getElementsByTagName("error");
3 if (error.length === 0){ ... }
4
```

Class Activity



lectures/lecture-5/changeImage.html
lectures/lecture-5/changeImage.js



- Assume the page contains a `<div>` element with ID `id`, which contains a series of images (`` nodes)
- Write a function that takes two arguments, `id` and `offset`. At each `offset`, the images must be “rotated”, i.e., `image0` will become `image1`, `image1` will become `image2`, etc.

```
1 function changeImages(id, offset){  
2  
3 }
```

- To repeat the execution of a given function `f` at a specific interval (e.g. 1000 ms): `setInterval(1000, f);`

DOM Traversal

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Traversing the DOM

- Since the DOM is just a tree, you can walk it the way you'd do with any other tree
 - Typically using recursion
- Every browser has minor variations in implementing the DOM, so should not be sensitive to such changes
 - Traversing DOM this way can be fragile



Before accessing or manipulating the DOM...

Problem

- When your JS code executes, the page might not have finished loading
 - The DOM tree might not be fully instantiated / might change!



window.onload

- Event that gets fired when the DOM is fully loaded (we'll get back to events later...)
- You can give a callback function to execute upon proper loading of the DOM.
- Your DOM manipulation code should go inside that function

```
1 // Using DOM Level 1 API -- not recommended
2 window.onload = function(){ /* Access the DOM here */ }
```

Properties for DOM Traversal

- `parentNode`: Parent node of this one, or `null`
- `childNodes`: A read only array-like object containing all the (live) child nodes of this one
- `firstChild`, `lastChild`: The first and last child of a node, or `null` if it has no children
- `nextSibling`, `previousSibling`: The next and previous siblings of a node (in the order in which they appear in the document)



Other node properties

- **nodeType**: 'kind of node'
 - Element node: 1
 - Text node: 3
 - Comment node: 8
 - Document node: 9
- **nodeValue**: Textual content of Text or comment node
- **nodeName**: Tag name of a node, converted to upper-case



Exercise: Find a Text Node

- We want to find the DOM node that has a certain piece of text, say “text”
- Return `true` if text is found, false otherwise
- We need to recursively walk the DOM looking for the text in all text nodes



```
1 function search(node, text){  
2     /* ... */  
3 };  
4 var result = search(window.document, "Hello world!");
```

Exercise: Find a Text Node

Solution:

```
1 function search(node, text){
2     if (node.nodeType === 3 && node.nodeValue === text){
3         return true;
4     }
5     else if (node.childNodes){
6         for (var i = 0; i < node.childNodes.length; i++){
7             var found = search(node.childNodes[i], text);
8             if (found) return found;
9         }
10    }
11    return false;
12 };
13 var result = search(window.document, "Hello world!");
```



Class Activity



lectures/lecture-5/domcollect.html
lectures/lecture-5/domcollect.js

- Write a function that will traverse the DOM tree rooted at a node with a specific **id**, and **checks if** any of its **sibling nodes** and **itself** in the document **is a text node**, and if so, concatenates their text content and returns it.
- Can you generalize it so that it works for the entire subtree rooted at the sibling nodes?



DOM Manipulation

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Adding and removing nodes

- DOM elements are also JavaScript Objects (in most browsers) and consequently can have their properties read and written to
 - Can extend DOM elements by modifying their prototype objects
 - Can add fields to the elements for keeping track of state (e.g., visited node during traversals)
 - Can modify HTML attributes of the node such as width etc. – changes reflected in browser display



Creating New and Copying Existing DOM Nodes



- Creating New DOM Nodes

- Using either `document.createElement("element")` OR `document.createTextNode("text content")`

```
1 var newNode = document.createTextNode("hello");  
2 var elNode = document.createElement("h1");
```

- Copying Existing DOM Nodes: use `cloneNode`

- Single argument can be true or false
 - True: deep copy (recursively copy all descendants)
- new node can be inserted into a different document

```
1 var existingNode = document.getElementById("my");  
2 var newNode = existingNode.cloneNode(true);
```

Inserting Nodes

- `appendChild`: Adds a new node as a child of the node it is invoked on. node becomes `lastChild`
- `insertBefore`: Similar, except that it inserts the node before the one that is specified as the second argument (`lastChild` if it's `null`)



```
1 var s = document.getElementById("my");  
2 s.appendChild(newNode);  
3 s.insertBefore(newNode, s.firstChild);
```

Removing and replacing nodes

- Removing a node *n*: `removeChild`

```
1 n.parentNode.removeChild(n);
```

- Replacing a node *n* with a new node: `replaceChild`

```
1 var edit = document.createTextNode("[redacted]");  
2 n.parentNode.replaceChild(edit, n);
```



Class Activity



lectures/lecture-5/domadd.html

lectures/lecture-5/domadd.js

- Write a function `newdiv` that takes two parameters: a node `n` and a string `id`. The function should replace node `n` by making it a child of a new `<div>` element with `id = id`.



```
1  /* function to replace a node n by making it a child of a new
2    <div> element with id = "id" */
3  function newdiv(n, id){
4    /* ... */
5  };
```

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