CSI 3140

WWW Structures, Techniques and Standards

Browsers and the DOM

Overview

- The Document Object Model (DOM) is an API that allows programs to interact with HTML (or XML) documents
  - In typical browsers, the JavaScript version of the API is provided via the `document` host object
  - W3C recommendations define standard DOM
- Several other browser host objects are informal, *de facto* standards

  `alert`, `prompt` are examples

DOM Introduction

- Example: “Rollover” effect

Cursor not over image

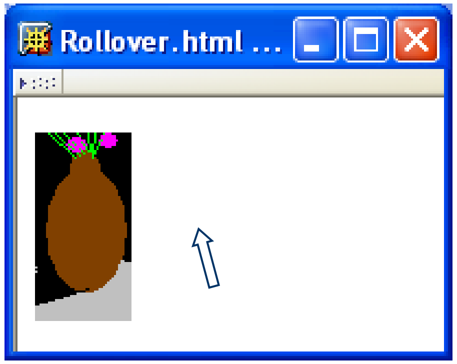
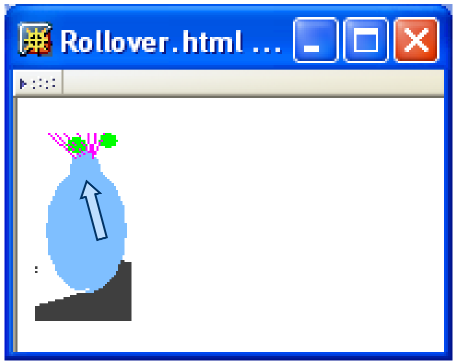


Image changes when cursor moves over



DOM Introduction

```
<!DOCTYPE html
       PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
        "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html>
  <head>
    <title>Rollover.html</title>
    <script type="text/javascript" src="rollover.js">
    </script>
    <meta http-equiv="Content-Script-Type" content="text/javascript" />
  </head>
  <body>
    <p>
      <img id="img1" src="CFP2.png" alt="flower pot"
        height="86" width="44"
        onmouseover="show('img1', 'CFP22.png');"
        onmouseout="show('img1', 'CFP2.png');" />
    </p>
  </body>
</html>
```

DOM Introduction

```
<!DOCTYPE html
       PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
        "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html>
  <head>
    <title>Rollover.html</title>
    <script type="text/javascript" src="rollover.js">
    </script>
    <meta http-equiv="Content-Script-Type" content="text/javascript" />
  </head>
  <body>
    <p>
      <img id="img1" src="CFP2.png" alt="flower pot"
        height="86" width="44"
        onmouseover="show('img1', 'CFP22.png');"
        onmouseout="show('img1', 'CFP2.png');" />
    </p>
  </body>
</html>
```

Import JavaScript code

DOM Introduction

```
<!DOCTYPE html
       PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
        "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html>
  <head>
    <title>Rollover.html</title>
    <script type="text/javascript" src="rollover.js">
    </script>
    <meta http-equiv="Content-Script-Type" content="text/javascript" />
  </head>
  <body>
    <p>
      <img id="img1" src="CFP2.png" alt="flower pot"
        height="86" width="44"
        onmouseover="show('img1', 'CFP22.png');"
        onmouseout="show('img1', 'CFP2.png');" />
    </p>
  </body>
</html>
```

Default language for scripts specified as attribute values

DOM Introduction

```
<!DOCTYPE html
      PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
       "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html>
  <head>
    <title>Rollover.html</title>
    <script type="text/javascript" src="rollover.js">
    </script>
    <meta http-equiv="Content-Script-Type" content="text/javascript" />
  </head>
  <body>
    <p>
      <img id="img1" src="CFP2.png" alt="flower pot"
        height="86" width="44"
        onmouseover="show('img1', 'CFP22.png');"
        onmouseout="show('img1', 'CFP2.png');" />
    </p>
  </body>
</html>
```

Calls to JavaScript `show()` function when mouse moves over/away from image

DOM Introduction

```
<!DOCTYPE html
       PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
        "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html>
  <head>
    <title>Rollover.html</title>
    <script type="text/javascript" src="rollover.js">
    </script>
    <meta http-equiv="Content-Script-Type" content="text/javascript" />
  </head>
  <body>
    <p>
      <img id="img1" src="CFP2.png" alt="flower pot"
        height="86" width="44"
        onmouseover="show('img1', 'CFP22.png');"
        onmouseout="show('img1', 'CFP2.png');" />
    </p>
  </body>
</html>
```

Notice that `id` of image is first argument to `show()`

DOM Introduction

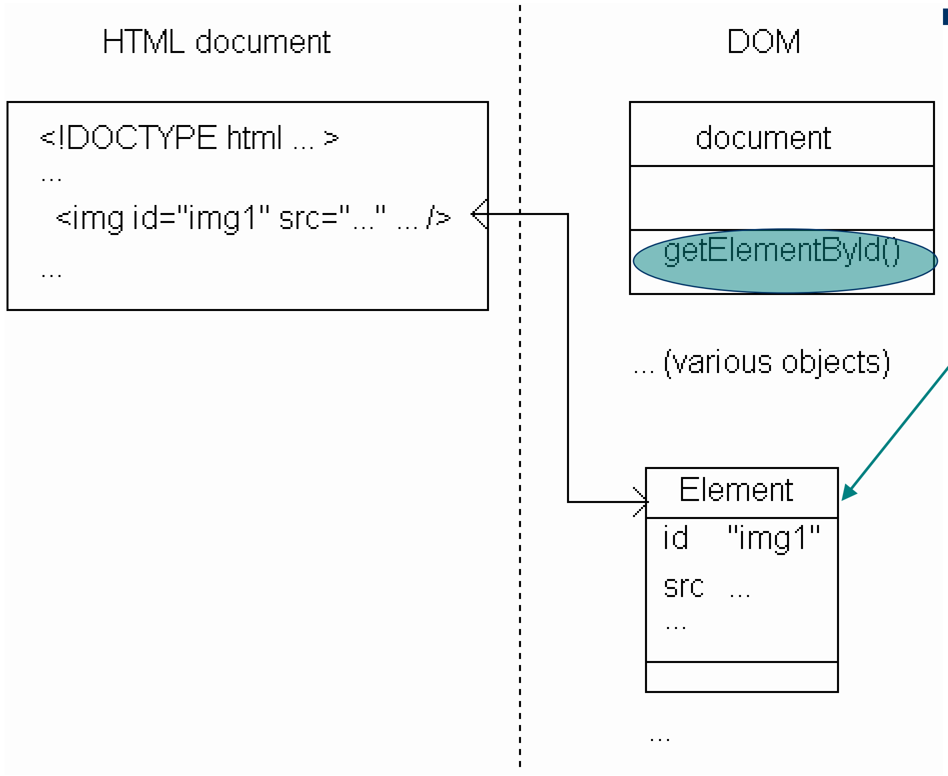
```
// rollover.js

function show(eltId, URL) {
  var elt = window.document.getElementById(eltId);
  elt.setAttribute("src", URL);
  return;
}
```

DOM Introduction

```
// rollover.js

function show(eltId, URL) {
  var elt = window.document.getElementById(eltId);
  elt.setAttribute("src", URL);
  return;
}
```

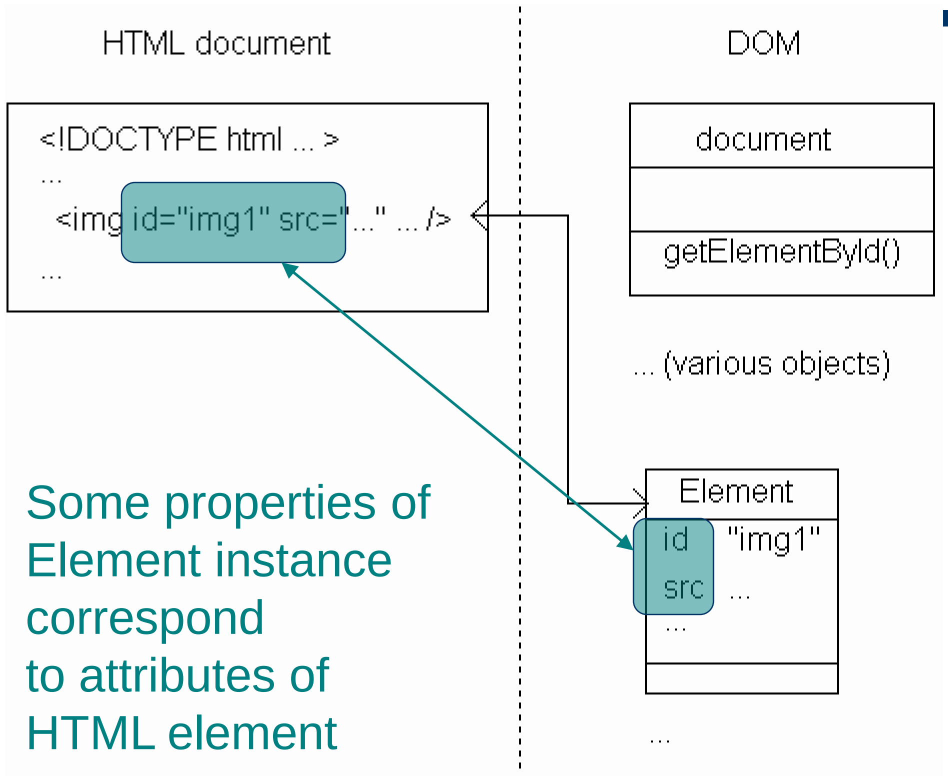
DOM method returning Object

DOM Introduction



Returns instance of `Element` (DOM-defined host object) representing HTML element with given `id`

DOM Introduction



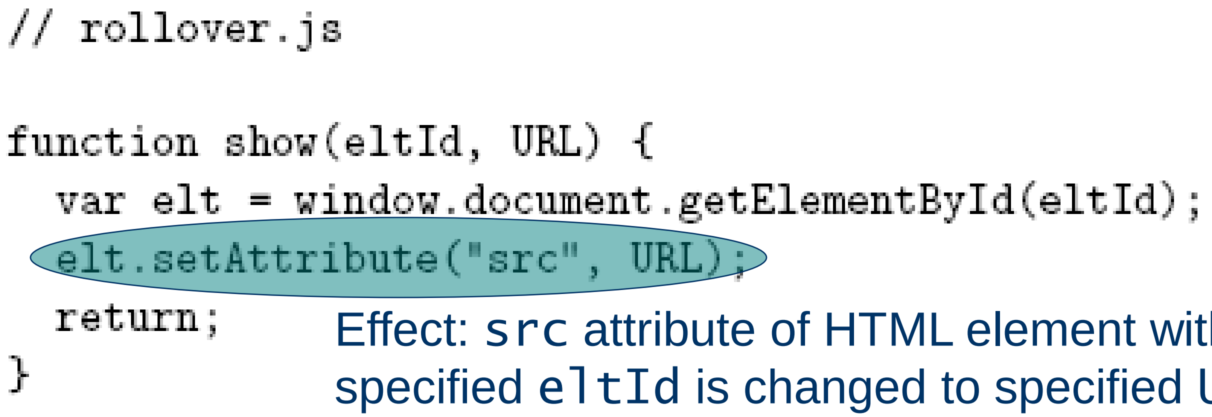
Some properties of Element instance correspond to attributes of HTML element

DOM Introduction

```
// rollover.js

function show(eltId, URL) {
  var elt = window.document.getElementById(eltId);
  elt.setAttribute("src", URL);
  return;
}
```

Method inherited by `Element` instances
for setting value of an attribute

DOM Introduction



```
// rollover.js

function show(eltId, URL) {
  var elt = window.document.getElementById(eltId);
  elt.setAttribute("src", URL);
  return;
}
```

Effect: `src` attribute of HTML element with specified `eltId` is changed to specified `URL`

DOM Introduction

```
<!DOCTYPE html
       PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
        "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html>
  <head>
    <title>Rollover.html</title>
    <script type="text/javascript" src="rollover.js">
    </script>
    <meta http-equiv="Content-Script-Type" content="text/javascript" />
  </head>
  <body>
    <p>
      <img id="img1" src="CFP2.png" alt="flower pot"
        height="86" width="44"
        onmouseover="show('img1', 'CFP22.png');"
        onmouseout="show('img1', 'CFP2.png');" />
    </p>
  </body>
</html>
```

Image `src` changed to `CFP22.png` when mouse is over image, `CFP2.png` when leaves

DOM History and Levels

- Very simple DOM was part of Netscape 2.0
- Starting with Netscape 4.0 and IE 4.0, browser DOM API’s diverged significantly
- W3C responded quickly with DOM Level 1 (Oct 1998) and subsequently DOM Level 2

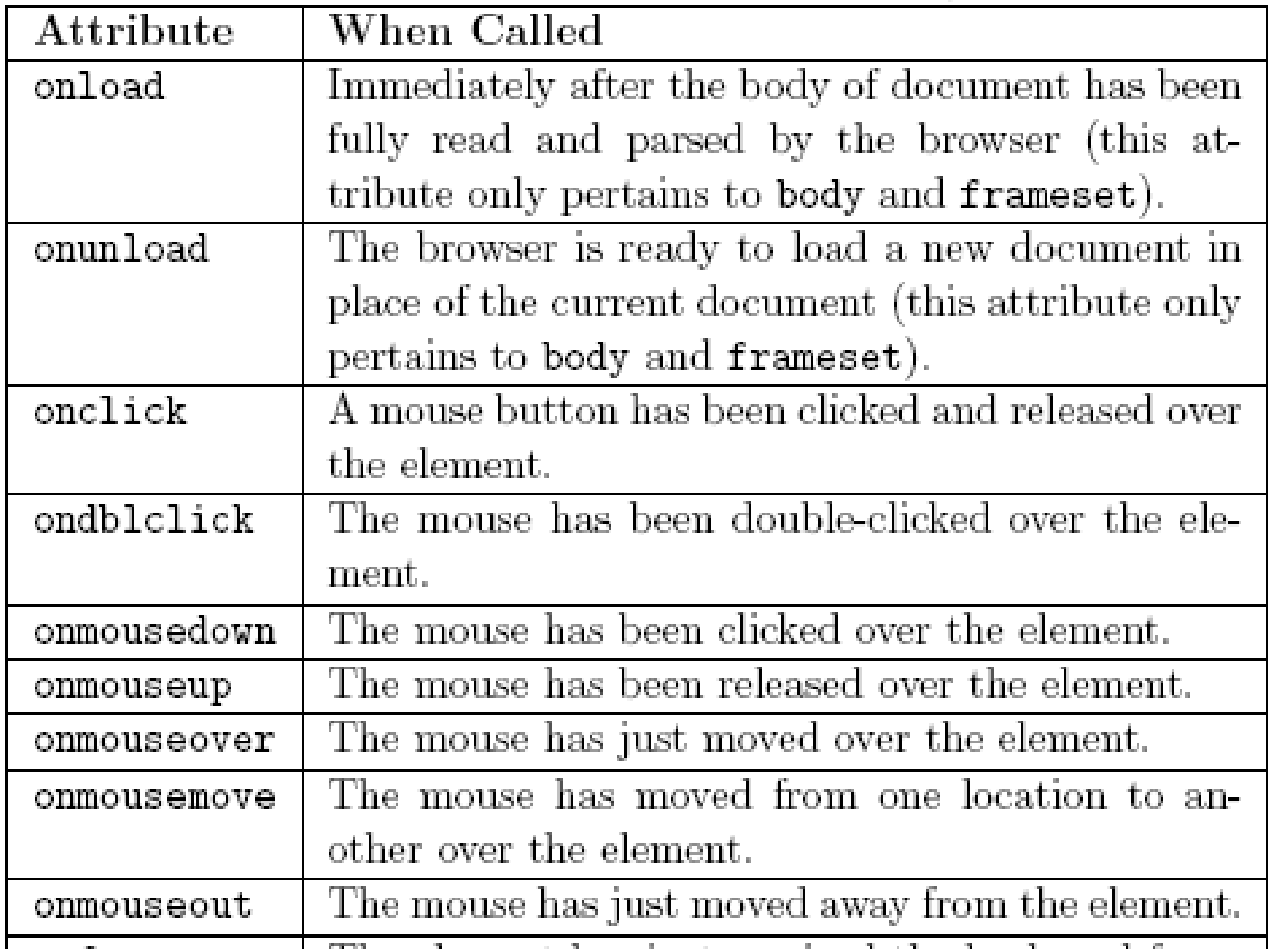
We cover JavaScript API for DOM2 + some coverage of browser specifics

Intrinsic Event Handling

- An event is an occurrence of something potentially interesting to a script:
  - Ex: mouseover and mouseout events
- An HTML intrinsic event attribute is used to specify a script to be called when an event occurs
  - Ex: `onmouseover`
  - Name of attribute is `on` followed by event name

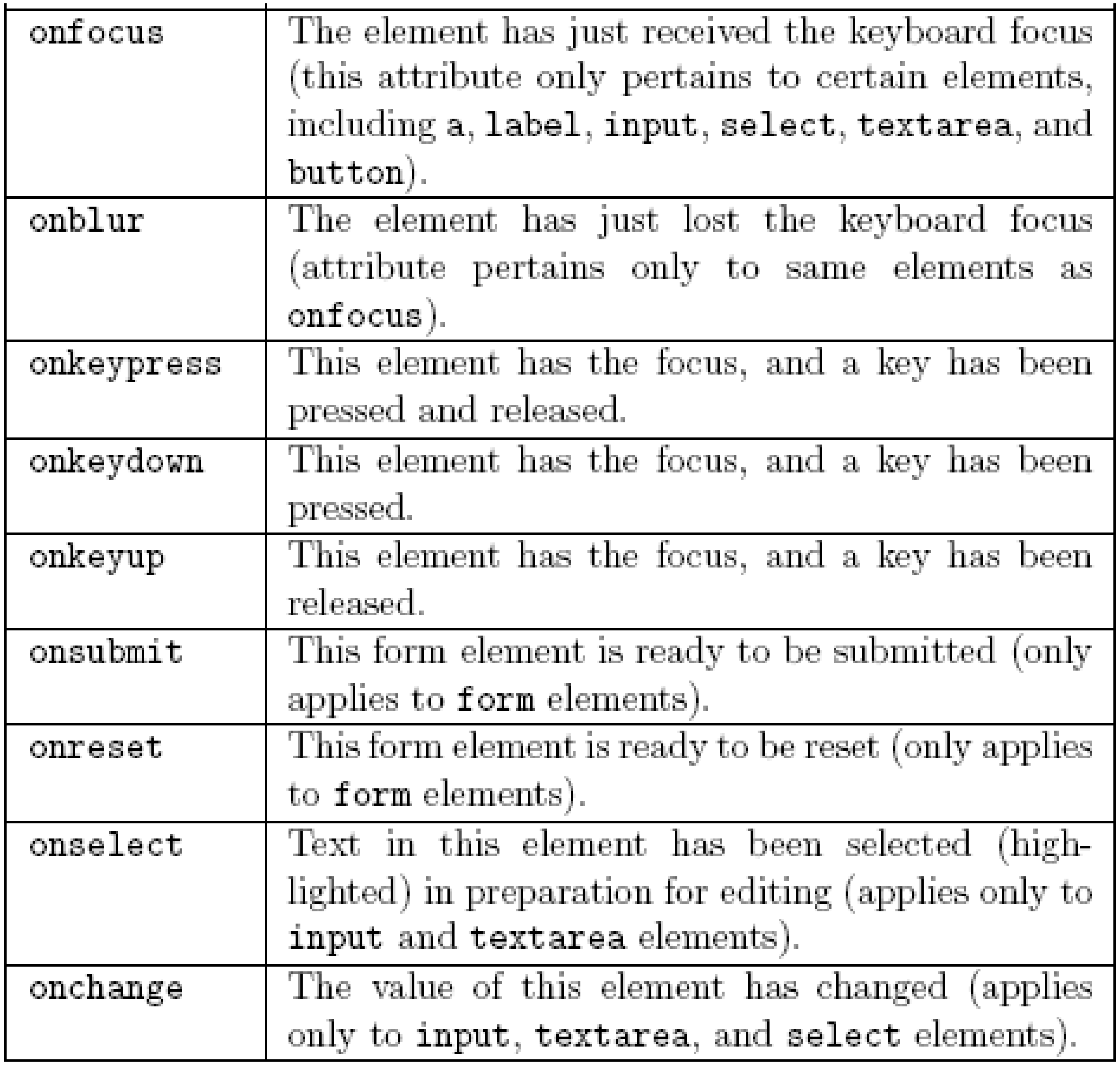
Intrinsic Event Handling

TABLE 5.1: HTML intrinsic event attributes.



Attribute	When Called
`onload`	Immediately after the body of document has been fully read and parsed by the browser (this attribute only pertains to **body** and **`frameset`**).
`onunload`	The browser is ready to load a new document in place of the current document (this attribute only pertains to **body** and **`frameset`**).
`onclick`	A mouse button has been clicked and released over the element.
`ondblclick`	The mouse has been double-clicked over the element.
`onmousedown`	The mouse has been clicked over the element.
`onmouseup`	The mouse has been released over the element.
`onmouseover`	The mouse has just moved over the element.
`onmousemove`	The mouse has moved from one location to another over the element.
`onmouseout`	The mouse has just moved away from the element.
[illegible]	[illegible]

Intrinsic Event Handling



`onfocus`	The element has just received the keyboard focus (this attribute only pertains to certain elements, including `a`, `label`, `input`, `select`, `textarea`, and `button`).
`onblur`	The element has just lost the keyboard focus (attribute pertains only to same elements as `onfocus`).
`onkeypress`	This element has the focus, and a key has been pressed and released.
`onkeydown`	This element has the focus, and a key has been pressed.
`onkeyup`	This element has the focus, and a key has been released.
`onsubmit`	This form element is ready to be submitted (only applies to `form` elements).
`onreset`	This form element is ready to be reset (only applies to `form` elements).
`onselect`	Text in this element has been selected (highlighted) in preparation for editing (applies only to `input` and `textarea` elements).
`onchange`	The value of this element has changed (applies only to `input`, `textarea`, and `select` elements).

Intrinsic Event Handling

```
<body onload="window.alert('Body loaded.');"
      onunload="window.alert('Unloading...');">
  <form action="http://www.example.org"
        onsubmit="window.alert('Submitting...');"
        onreset="window.alert('Resetting...');">
    <p>
      <input type="text" name="someText"
             onkeypress="window.alert('Text field got character.');"
             onselect="window.alert('Text selected.');" />
      <br />
      <input type="button" name="aButton" value="Click Me"
             onclick="window.alert('Button clicked.');" />
      <br />
      <input type="submit" name="aSubmit" value="Submit"
             onfocus="window.alert('Submit button got focus.');" />
      <input type="reset" name="aReset" value="Reset" />
    </p>
  </form>
</body>
```

Intrinsic Event Handling

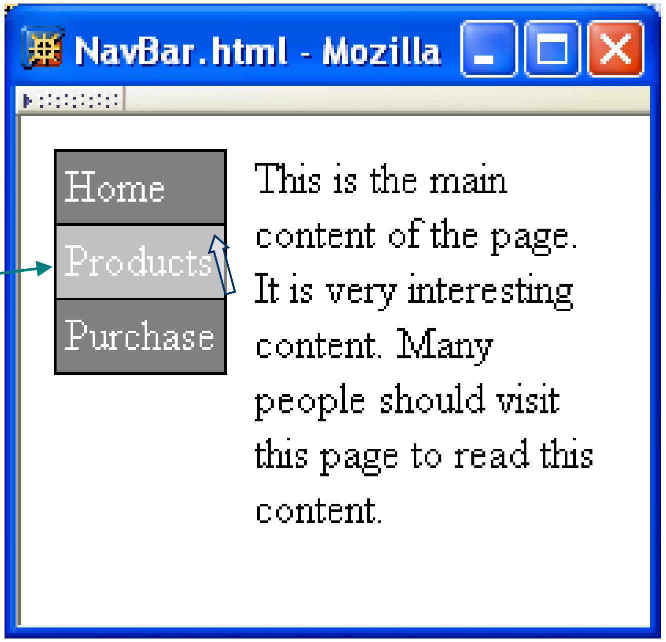
- Intrinsic event attribute value is a script; what language is it written in?
- HTTP Content-Script-Type header field specifies default scripting language
- `meta` element allows document to specify values as if they were header fields

```
<meta http-equiv="Content-Script-Type" content="text/javascript" />
```

Header field name　　　　Header field value

Modifying Element Style

Change background color of element containing cursor



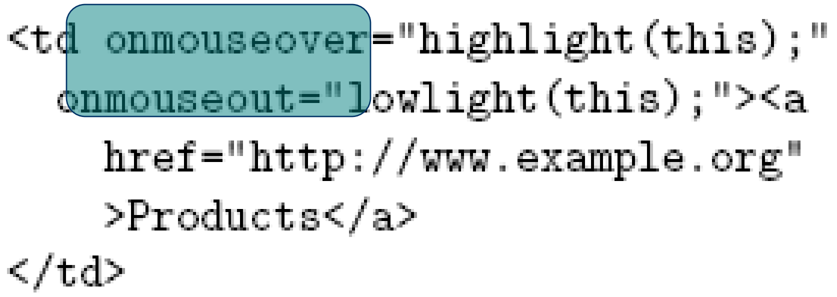
This is the main content of the page. It is very interesting content. Many people should visit this page to read this content.

Modifying Element Style

```
<td onmouseover="highlight(this);"
  onmouseout="lowlight(this);"><a
    href="http://www.example.org"
    >Products</a>
</td>
```

Modifying Element Style

Like rollover, style needs to be modified both when entering and exiting the element.



```
<td onmouseover="highlight(this);"
  onmouseout="lowlight(this);"><a
    href="http://www.example.org"
    >Products</a>
</td>
```

Modifying Element Style

Reference to `Element` instance representing the `td` element

```
<td onmouseover="highlight(this);"
  onmouseout="lowlight(this);"><a
    href="http://www.example.org"
    >Products</a>
</td>
```

Modifying Element Style

```
function highlight(element) {
  element.style.backgroundColor = "silver";
  return;
}
```

Modifying Element Style

Reference to `Element` instance

```
function highlight(element) {
  element.style.backgroundColor = "silver";
  return;
}
```

Modifying Element Style

```
function highlight(element) {
  element.style.backgroundColor = "silver";
  return;
}
```

All `Element` instances have a `style` property with an Object value

Modifying Element Style

```
function highlight(element) {
  element.style.backgroundColor = "silver";
  return;
}
```

Properties of `style` object correspond to CSS style properties of the corresponding HTML element.

Modifying Element Style

- Rules for forming `style` property names from names of CSS style properties:
  - If the CSS property name contains no hyphens, then the `style` object's property name is the same
    - Ex: `color` $\longrightarrow$ `color`
  - Otherwise, all hyphens are removed and the letters that immediately followed hyphens are capitalized
    - Ex: `background-color` $\longrightarrow$ `backgroundColor`

Modifying Element Style

```
function highlight(element) {
  element.style.backgroundColor = "silver";
  return;
}
```

Net effect: "`silver`" becomes the specified value for CSS `background-color` property of `td` element; browser immediately modifies the window.

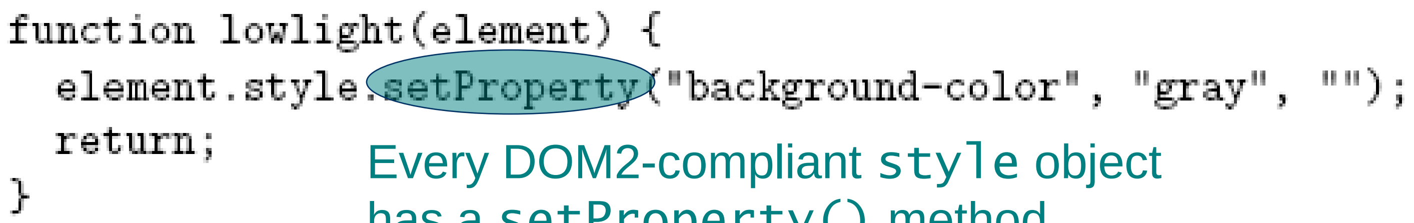
Modifying Element Style

- Alternative syntax (not supported in IE6/7/8):

```
function lowlight(element) {
  element.style.setProperty("background-color", "gray", "");
  return;
}
```

Modifying Element Style

- Alternate syntax (not supported in IE6/7/8):



```
function lowlight(element) {
  element.style.setProperty("background-color", "gray", "");
  return;
}
```

Every DOM2-compliant `style` object has a `setProperty()` method

Modifying Element Style

- Alternate syntax (not supported in IE6/7/8):

CSS property value

```
function lowlight(element) {
  element.style.setProperty("background-color", "gray", "");
  return;
}
```

CSS property name (unmodified)

Empty string or “`important`”

Modifying Element Style

- Advantages of `setProperty()` syntax:
  - Makes it clear that a CSS property is being set rather than merely a property of the `style` object
  - Allows CSS property names to be used as-is rather than requiring modification (which can potentially cause confusion)
- BUT lack of IE support makes it difficult to use (works with FF & Chrome)

Modifying Element Style

- Obtaining *specified* CSS property value:

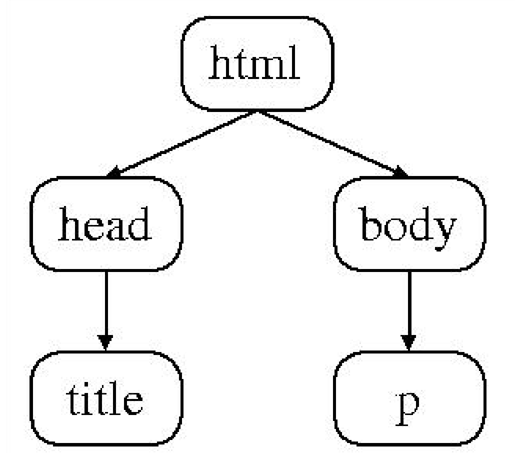
```
if (element.style.backgroundColor == "gray") {
```

- Alternate DOM2 syntax (not supported by IE6/7/8):

```
if (element.style.getPropertyValue("background-color") == "gray") {
```

Document Tree

- Recall that HTML document elements form a tree structure, *e.g.*,



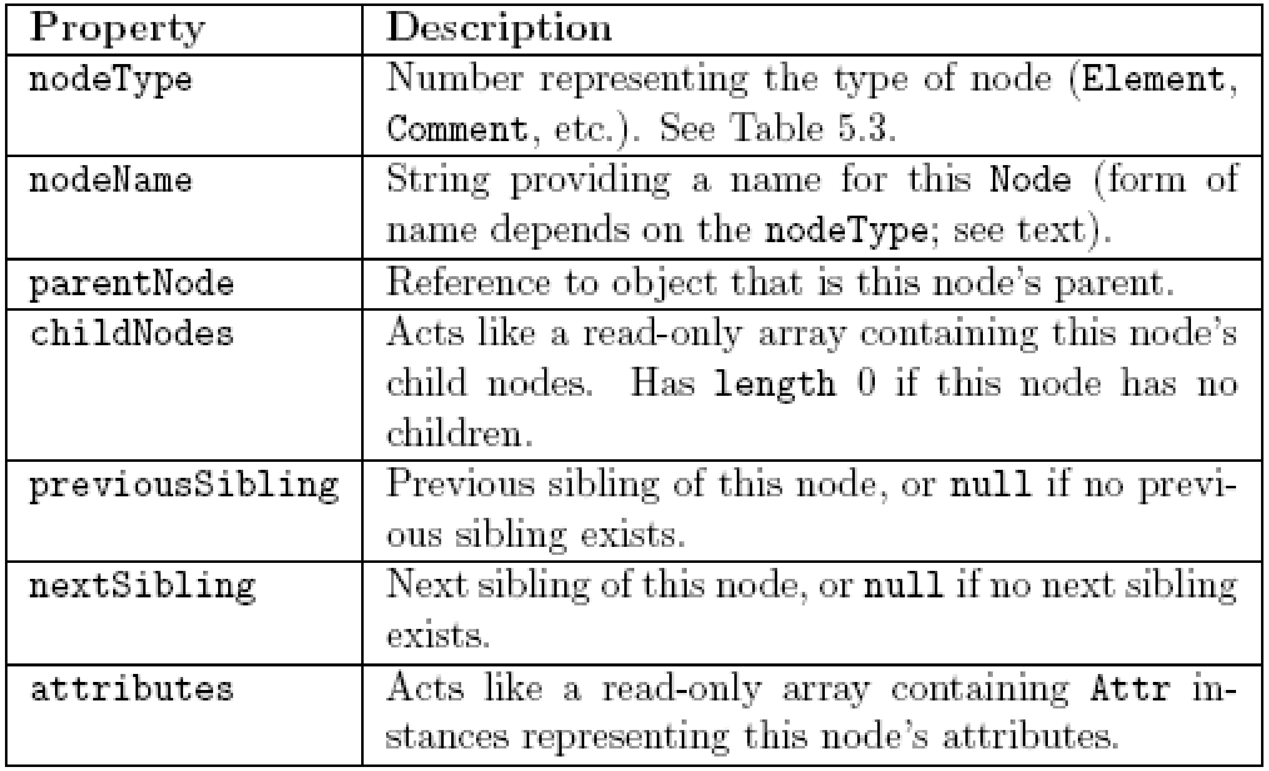
- DOM allows scripts to access and modify the document tree

Document Tree: Node

- There are many types of nodes in the DOM document tree, representing elements, text, comments, the document type declaration, etc.
- Every Object in the DOM document tree has properties and methods defined by the Node host object

Document Tree: Node

TABLE 5.2: Non-method properties of `Node` instances.



Property	Description
`nodeType`	Number representing the type of node (`Element`, `Comment`, etc.). See Table 5.3.
`nodeName`	String providing a name for this `Node` (form of name depends on the `nodeType`; see text).
`parentNode`	Reference to object that is this node's parent.
`childNodes`	Acts like a read-only array containing this node's child nodes. Has `length` 0 if this node has no children.
`previousSibling`	Previous sibling of this node, or `null` if no previous sibling exists.
`nextSibling`	Next sibling of this node, or `null` if no next sibling exists.
`attributes`	Acts like a read-only array containing `Attr` instances representing this node's attributes.

Document Tree: Node

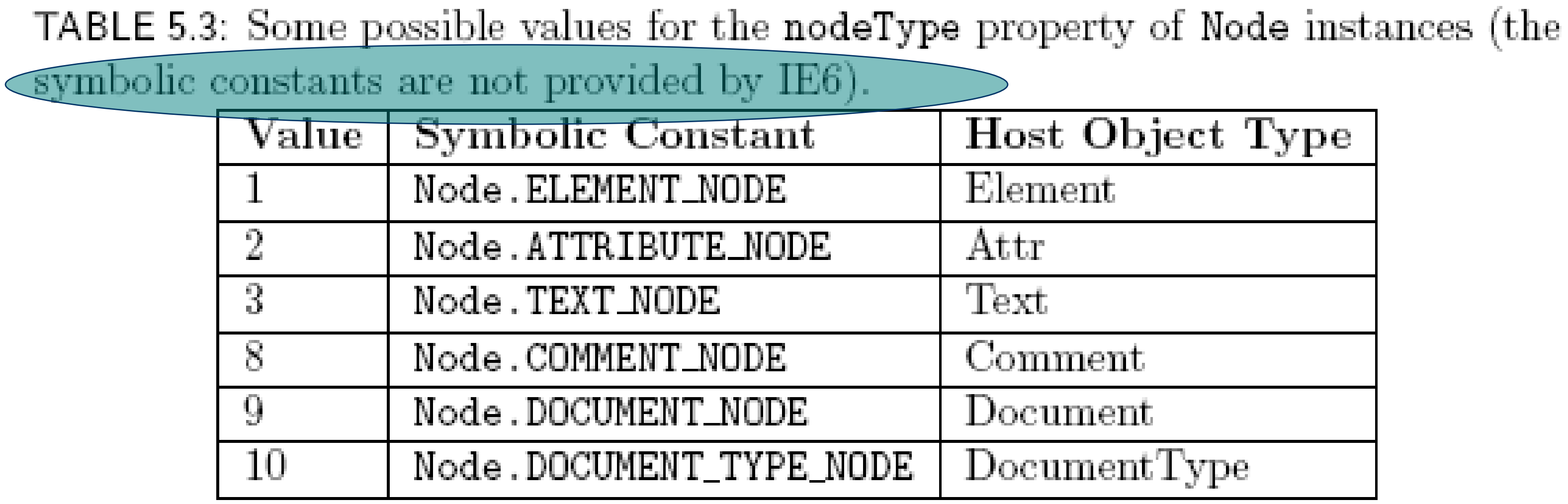


TABLE 5.3: Some possible values for the nodeType property of Node instances (the symbolic constants are not provided by IE6).

Value	Symbolic Constant	Host Object Type
1	Node.ELEMENT_NODE	Element
2	Node.ATTRIBUTE_NODE	Attr
3	Node.TEXT_NODE	Text
8	Node.COMMENT_NODE	Comment
9	Node.DOCUMENT_NODE	Document
10	Node.DOCUMENT_TYPE_NODE	DocumentType

(still doesn’t work with IE8, apparently.
Chrome OK)

Document Tree: Node

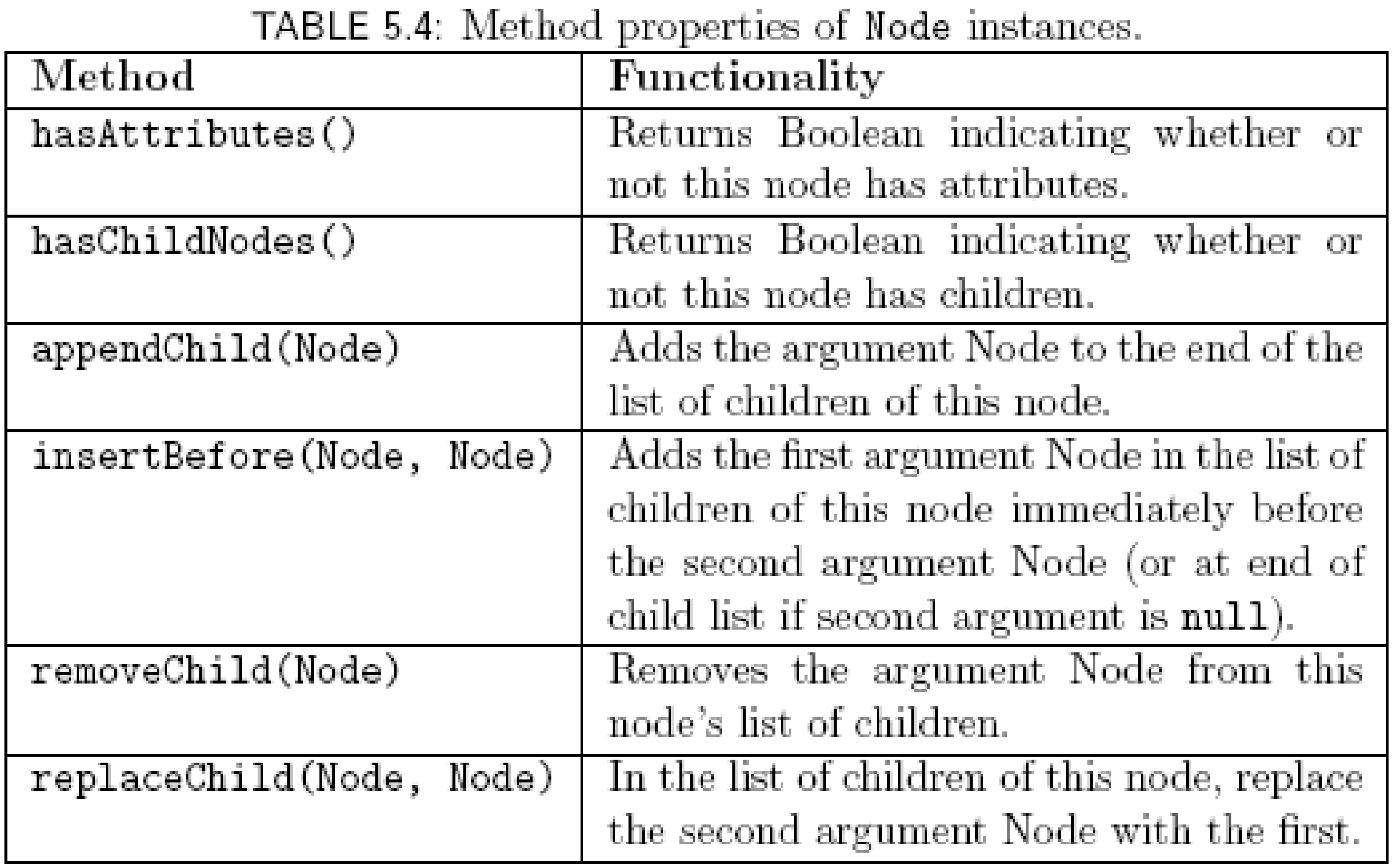


TABLE 5.4: Method properties of Node instances.

Method	Functionality
`hasAttributes()`	Returns Boolean indicating whether or not this node has attributes.
`hasChildNodes()`	Returns Boolean indicating whether or not this node has children.
`appendChild(Node)`	Adds the argument Node to the end of the list of children of this node.
`insertBefore(Node, Node)`	Adds the first argument Node in the list of children of this node immediately before the second argument Node (or at end of child list if second argument is `null`).
`removeChild(Node)`	Removes the argument Node from this node's list of children.
`replaceChild(Node, Node)`	In the list of children of this node, replace the second argument Node with the first.

Document Tree: Node

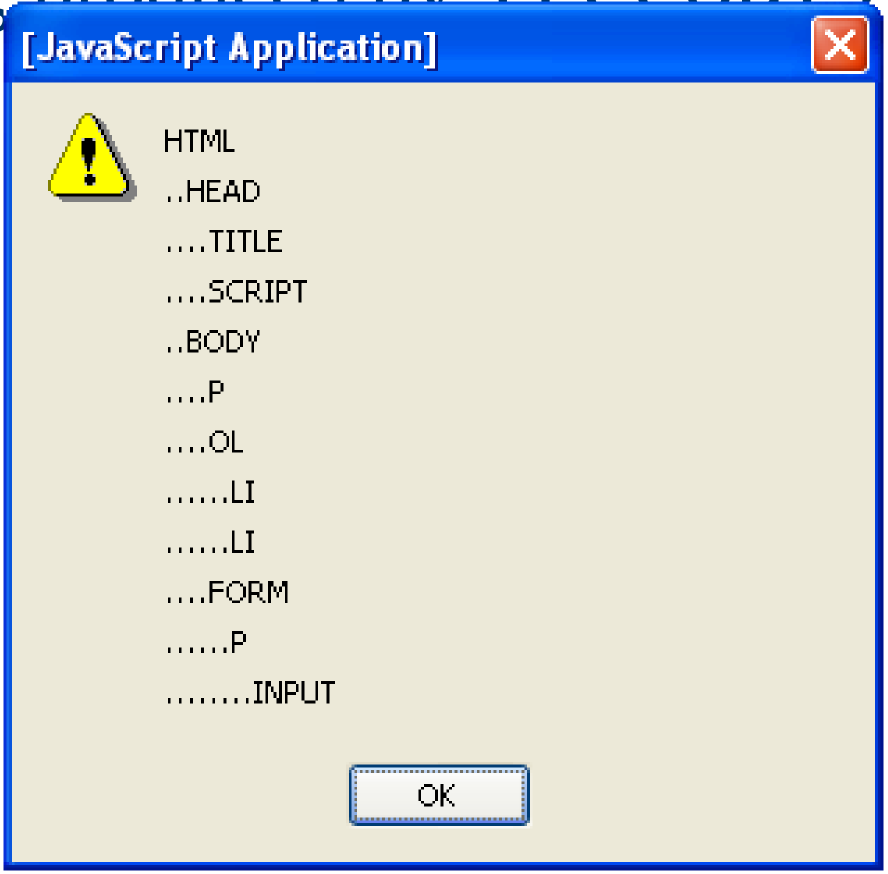
Example HTML document

```
<body>
  <p>
    Text within a "p" element.
  </p>
  <ol>
    <li>First element of ordered list.</li>
    <li>Second element.</li>
  </ol>
  <!-- Call function producing an outline of this document's
       element tree -->
  <form action="">
    <p><input type="button" name="button" value="Click to see outline"
                onclick="window.alert(treeOutline());" /></p>
  </form>
</body>
```

Function we will write that will use Node methods and properties to produce string representing `Element` tree

Document Tree: Node

- String produced by `TreeOutline()`:



```
HTML
..HEAD
....TITLE
....SCRIPT
..BODY
....P
....OL
......LI
......LI
....FORM
......P
........INPUT
```

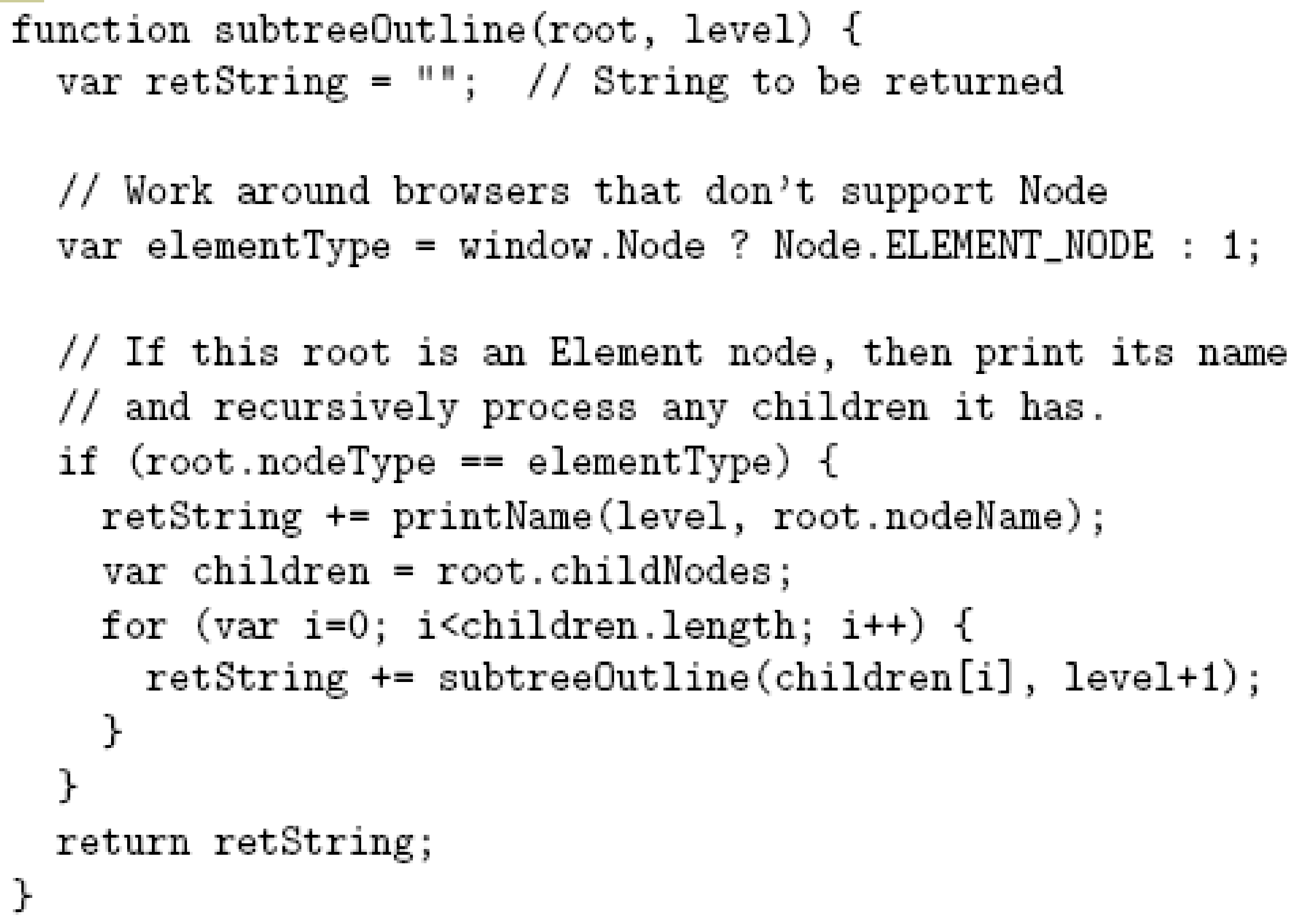
Document Tree: Node

- Example: "walking" the tree of an HTML document
  - Reference to `html` element is contained in `documentElement` property of `document` object
  - Use `Node`-defined methods to recursively create an outline of `nodeName`'s:

Depth in tree

```
function treeOutline() {
  return subtreeOutline(document.documentElement, 0);
}
```

Document Tree: Node



```
function subtreeOutline(root, level) {
  var retString = "";  // String to be returned

  // Work around browsers that don't support Node
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;

  // If this root is an Element node, then print its name
  // and recursively process any children it has.
  if (root.nodeType == elementType) {
    retString += printName(level, root.nodeName);
    var children = root.childNodes;
    for (var i=0; i<children.length; i++) {
      retString += subtreeOutline(children[i], level+1);
    }
  }
  return retString;
}
```

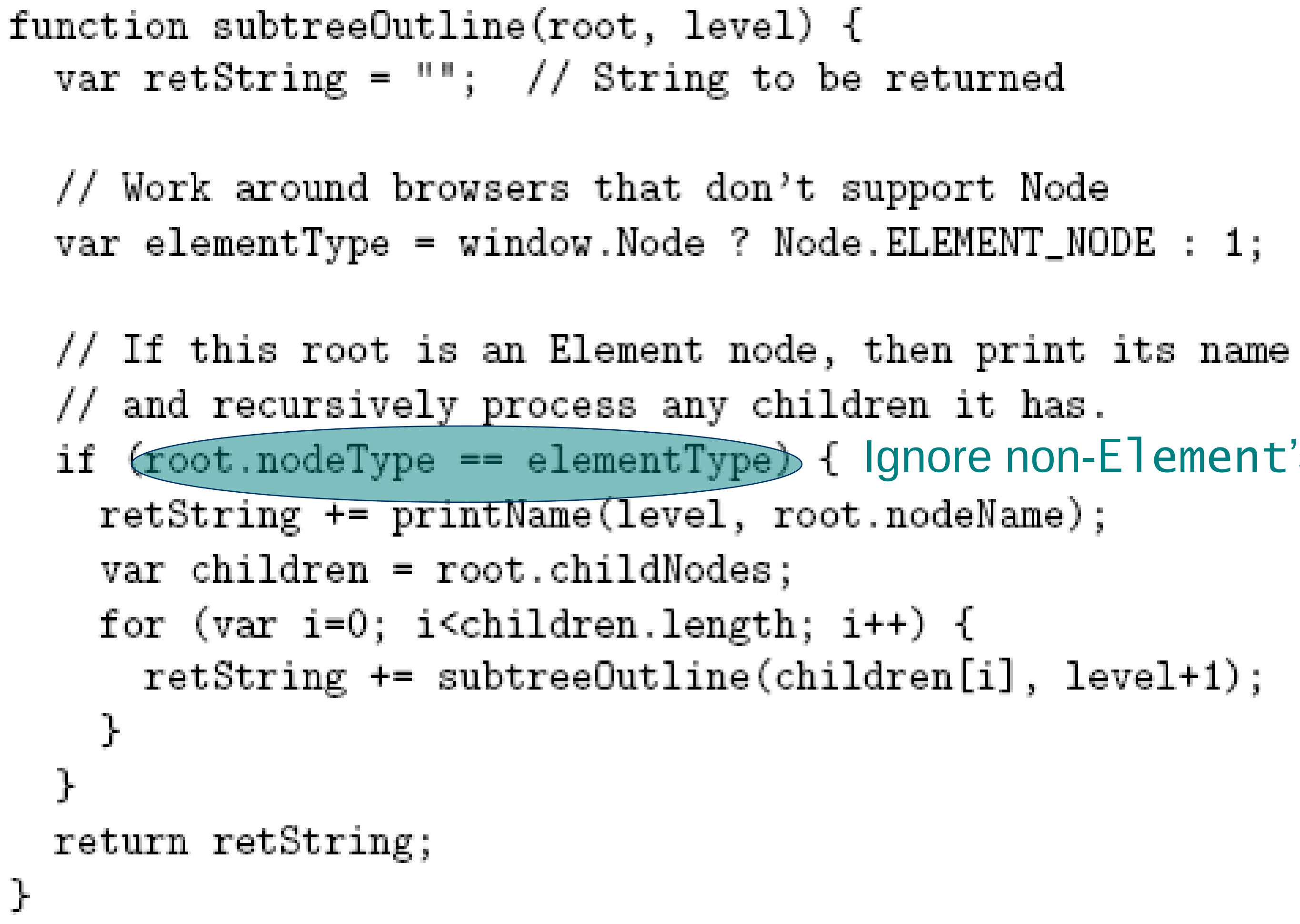
Document Tree: Node

```
function subtreeOutline(root, level) {
  var retString = "";  // String to be returned

  // Work around browsers that don't support Node
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;
```

Contains nodeType value representing `Element`

```
  // If this root is an Element node, then print its name
  // and recursively process any children it has.
  if (root.nodeType == elementType) {
    retString += printName(level, root.nodeName);
    var children = root.childNodes;
    for (var i=0; i<children.length; i++) {
      retString += subtreeOutline(children[i], level+1);
    }
  }
  return retString;
}
```

Document Tree: Node



```
function subtreeOutline(root, level) {
  var retString = "";  // String to be returned

  // Work around browsers that don't support Node
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;

  // If this root is an Element node, then print its name
  // and recursively process any children it has.
  if (root.nodeType == elementType) {
    retString += printName(level, root.nodeName);
    var children = root.childNodes;
    for (var i=0; i<children.length; i++) {
      retString += subtreeOutline(children[i], level+1);
    }
  }
  return retString;
}
```

Ignore non-Element's

Document Tree: Node

```
function subtreeOutline(root, level) {
  var retString = "";  // String to be returned

  // Work around browsers that don't support Node
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;

  // If this root is an Element node, then print its name
  // and recursively process any children it has.
  if (root.nodeType == elementType) {
    retString += printName(level, root.nodeName);
    var children = root.childNodes;
    for (var i=0; i<children.length; i++) {
      retString += subtreeOutline(children[i], level+1);
    }
  }
  return retString;
}
```

Add nodeName to string

Document Tree: Node

```
function subtreeOutline(root, level) {
  var retString = "";  // String to be returned

  // Work around browsers that don't support Node
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;

  // If this root is an Element node, then print its name
  // and recursively process any children it has.
  if (root.nodeType == elementType) {
    retString += printName(level, root.nodeName);
    var children = root.childNodes;
    for (var i=0; i<children.length; i++) {
      retString += subtreeOutline(children[i], level+1);
    }
  }
  return retString;
}
```

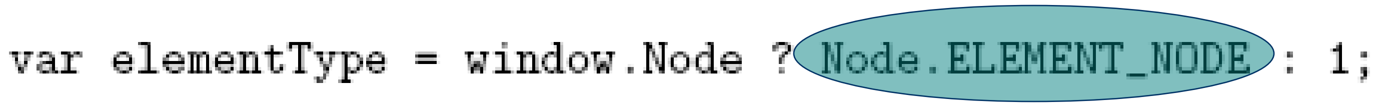
Recurse on child nodes

Document Tree: `Node`

- For `Element`'s, `nodeName` is type of the element (`p`, `img`, etc.)
- Case: Name will be lower case if browser recognizes document as XHTML, upper case otherwise
  - Can guarantee case by using `String` instance `toLowerCase()` / `toUpperCase()` methods

Document Tree: Node

- Convention: write code as if browser is DOM-compliant, work around non-compliance as needed



```
var elementType = window.Node ? Node.ELEMENT_NODE : 1;
```

In a DOM-compliant browser, we would use
this symbolic constant rather than the constant 1.
Problem: IE6 does not define `ELEMENT_NODE`
property (or Node object).
Solution: Use symbolic constant if available,
fall back to numeric constant if necessary.

Document Tree: Node

- Convention: write code as if browser is DOM-compliant, work around non-compliance as needed

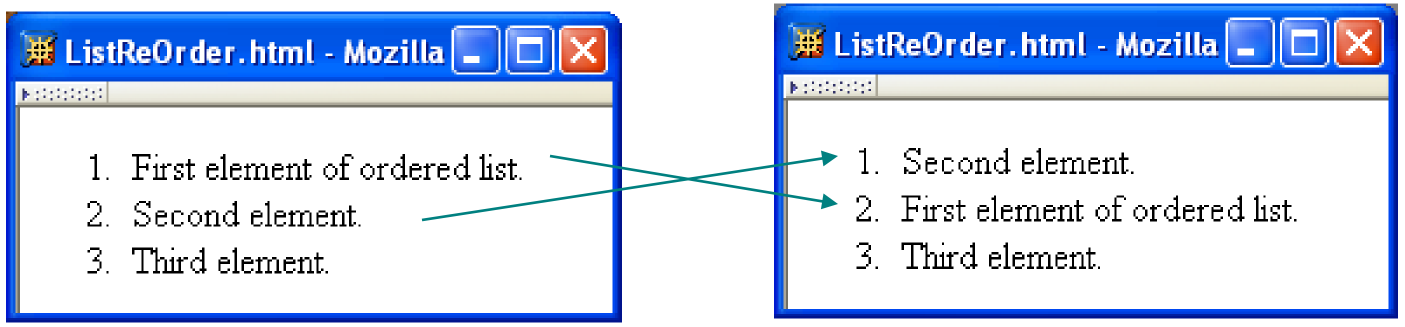
```
var elementType = window.Node ? Node.ELEMENT_NODE : 1;
```

This expression is automatically cast to Boolean.
IE6: no Node global, so evaluates to `false`
DOM-compliant: Node is an Object, so evaluates to `true`

Document Tree: Modification

Initial rendering

After user clicks first list item



1. First element of ordered list.
2. Second element.
3. Third element.

1. Second element.
2. First element of ordered list.
3. Third element.

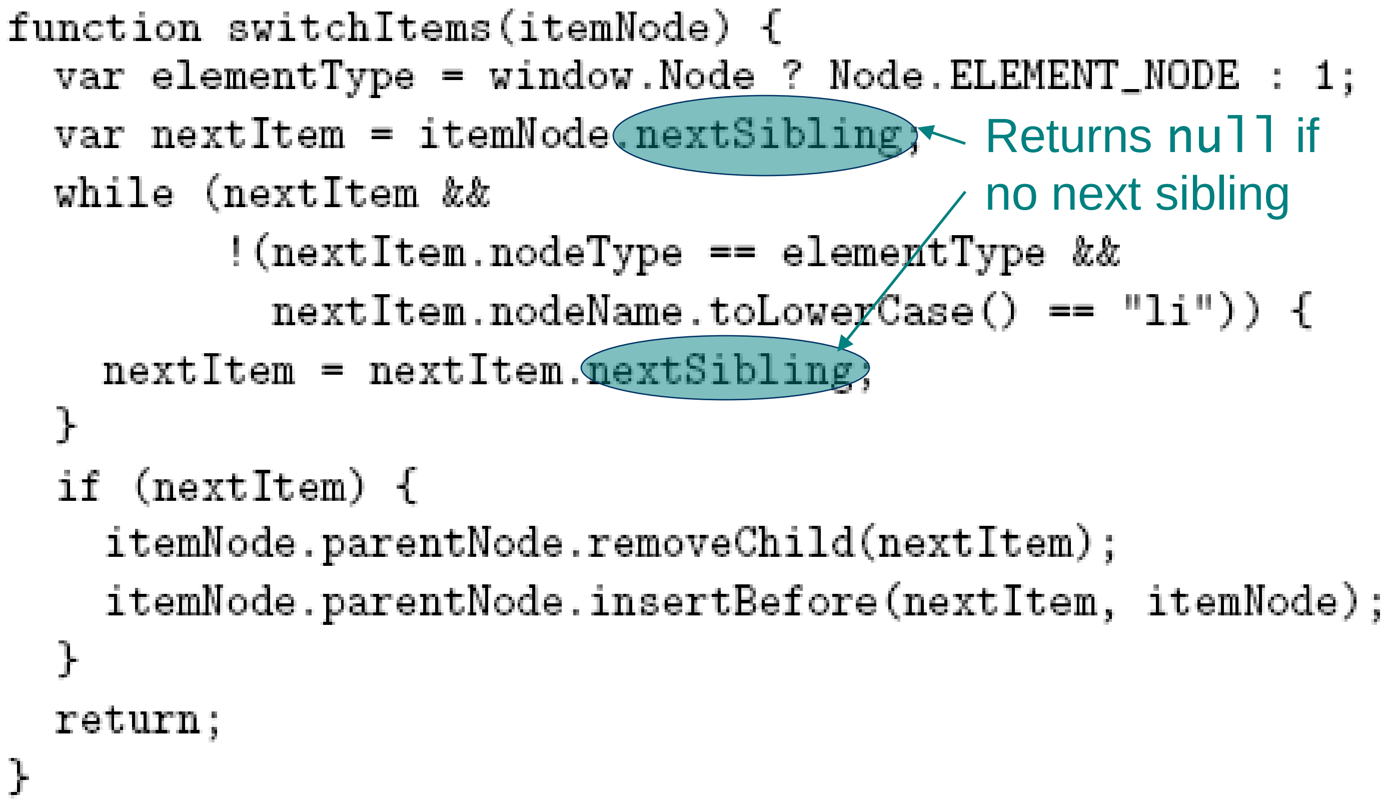
```
<ol>
  <li onclick="switchItems(this);">First element of ordered list.</li>
  <li onclick="switchItems(this);">Second element.</li>
  <li onclick="switchItems(this);">Third element.</li>
</ol>
```

Document Tree: Modification

Find the `li` Element following the selected one (if it exists)

```
function switchItems(itemNode) {
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;
  var nextItem = itemNode.nextSibling;
  while (nextItem &&
         !(nextItem.nodeType == elementType &&
           nextItem.nodeName.toLowerCase() == "li")) {
    nextItem = nextItem.nextSibling;
  }
  if (nextItem) {
    itemNode.parentNode.removeChild(nextItem);
    itemNode.parentNode.insertBefore(nextItem, itemNode);
  }
  return;
}
```

Document Tree: Modification



```
function switchItems(itemNode) {
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;
  var nextItem = itemNode.nextSibling;
  while (nextItem &&
          !(nextItem.nodeType == elementType &&
            nextItem.nodeName.toLowerCase() == "li")) {
    nextItem = nextItem.nextSibling;
  }
  if (nextItem) {
    itemNode.parentNode.removeChild(nextItem);
    itemNode.parentNode.insertBefore(nextItem, itemNode);
  }
  return;
}
```

Returns `null` if no next sibling

Document Tree: Modification

```
function switchItems(itemNode) {
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;
  var nextItem = itemNode.nextSibling;
  while (nextItem &&
         !(nextItem.nodeType == elementType &&
           nextItem.nodeName.toLowerCase() == "li")) {
    nextItem = nextItem.nextSibling;
  }
  if (nextItem) {
    itemNode.parentNode.removeChild(nextItem);
    itemNode.parentNode.insertBefore(nextItem, itemNode);
  }
  return;
}
```

Converting `null` to Boolean produces `false`

Document Tree: Modification

Swap nodes if an `li` element follows

```
function switchItems(itemNode) {
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;
  var nextItem = itemNode.nextSibling;
  while (nextItem &&
         !(nextItem.nodeType == elementType &&
           nextItem.nodeName.toLowerCase() == "li")) {
    nextItem = nextItem.nextSibling;
  }
  if (nextItem) {
    itemNode.parentNode.removeChild(nextItem);
    itemNode.parentNode.insertBefore(nextItem, itemNode);
  }
  return;
}
```

Document Tree: Modification

```
function switchItems(itemNode) {
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;
  var nextItem = itemNode.nextSibling;
  while (nextItem &&
           !(nextItem.nodeType == elementType &&
             nextItem.nodeName.toLowerCase() == "li")) {
    nextItem = nextItem.nextSibling;
  }
  if (nextItem) {
    itemNode.parentNode.removeChild(nextItem);
    itemNode.parentNode.insertBefore(nextItem, itemNode);
  }
  return;
}
```

Operate on a node by calling methods on its parent

Document Tree: Modification

```
function switchItems(itemNode) {
  var elementType = window.Node ? Node.ELEMENT_NODE : 1;
  var nextItem = itemNode.nextSibling;
  while (nextItem &&
         !(nextItem.nodeType == elementType &&
           nextItem.nodeName.toLowerCase() == "li")) {
    nextItem = nextItem.nextSibling;
  }
  if (nextItem) {
    itemNode.parentNode.removeChild(nextItem);
    itemNode.parentNode.insertBefore(nextItem, itemNode);
  }
  return;
}
```

Remove following element from tree

Re-insert element earlier in tree

Document Tree: `document`

- The `document` object is also considered a `Node` object
- Technically, `document` is the root `Node` of the DOM tree
  - `html` Element object is a child of `document`
  - Other children may also include document type declaration, comments, text elements (white space)

Document Tree: document

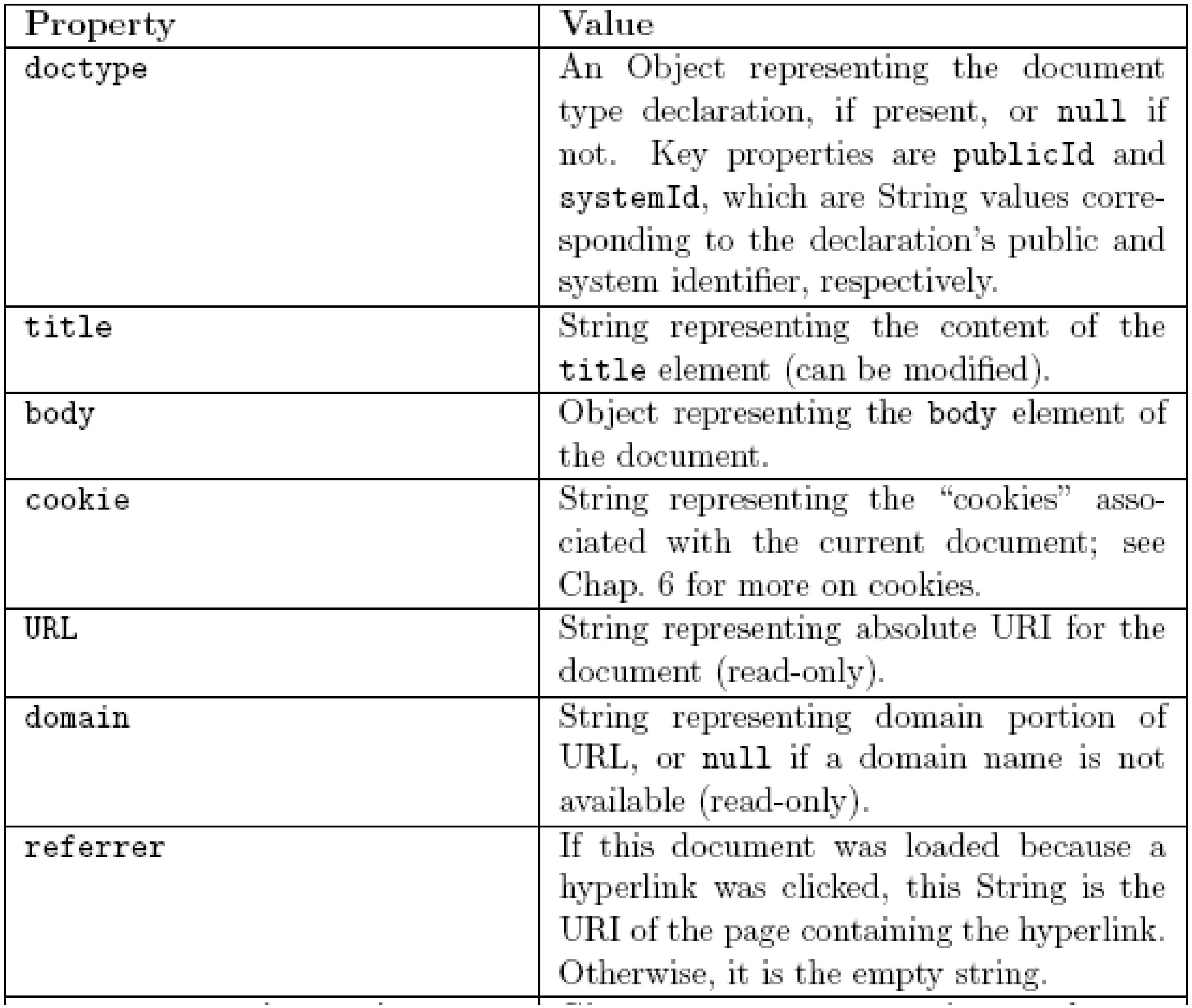
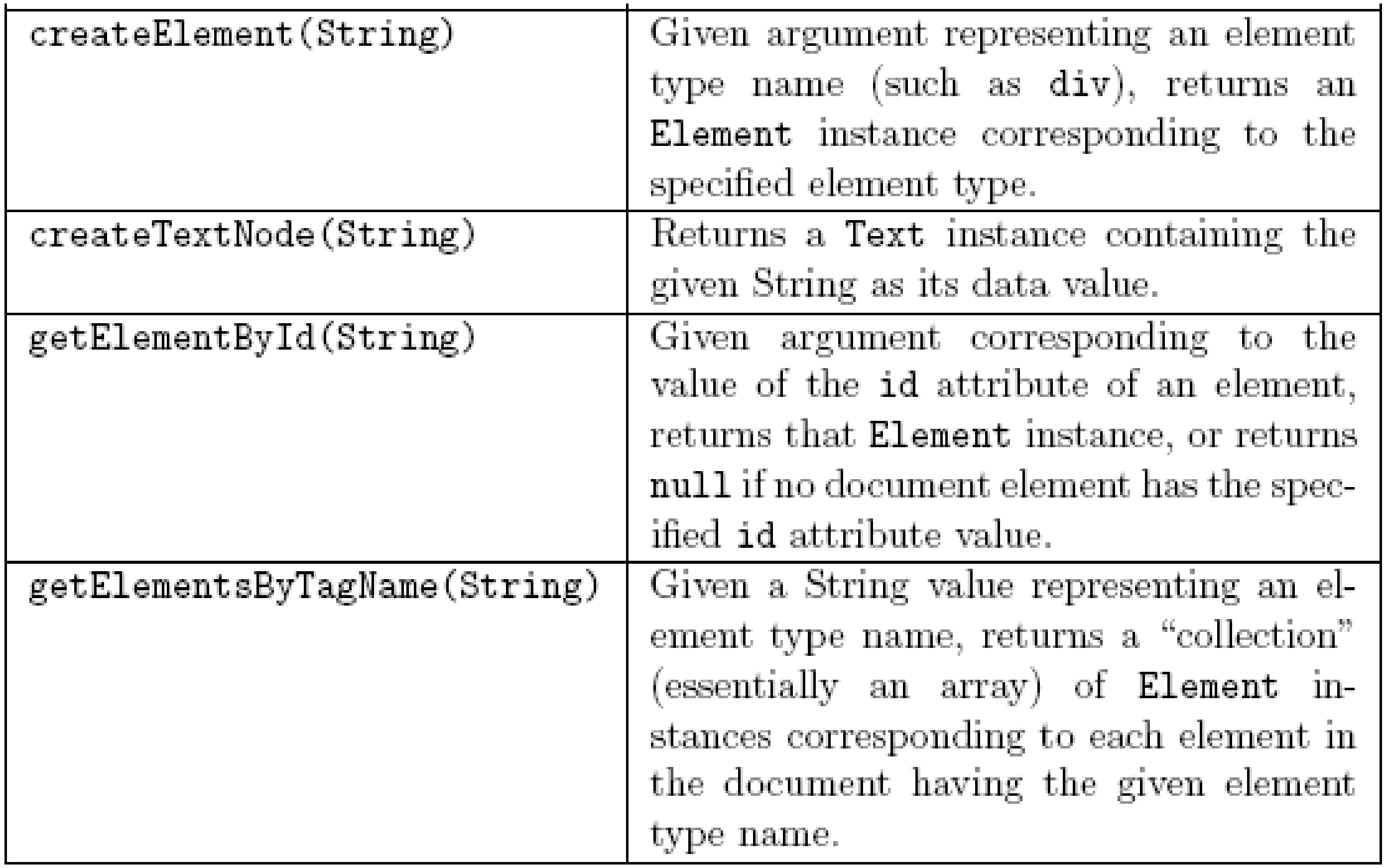


TABLE 5.5: Some properties of the document object.

Property	Value
doctype	An Object representing the document type declaration, if present, or null if not. Key properties are publicId and systemId, which are String values corresponding to the declaration's public and system identifier, respectively.
title	String representing the content of the title element (can be modified).
body	Object representing the body element of the document.
cookie	String representing the "cookies" associated with the current document; see Chap. 6 for more on cookies.
URL	String representing absolute URI for the document (read-only).
domain	String representing domain portion of URL, or null if a domain name is not available (read-only).
referrer	If this document was loaded because a hyperlink was clicked, this String is the URI of the page containing the hyperlink. Otherwise, it is the empty string.

Document Tree: document

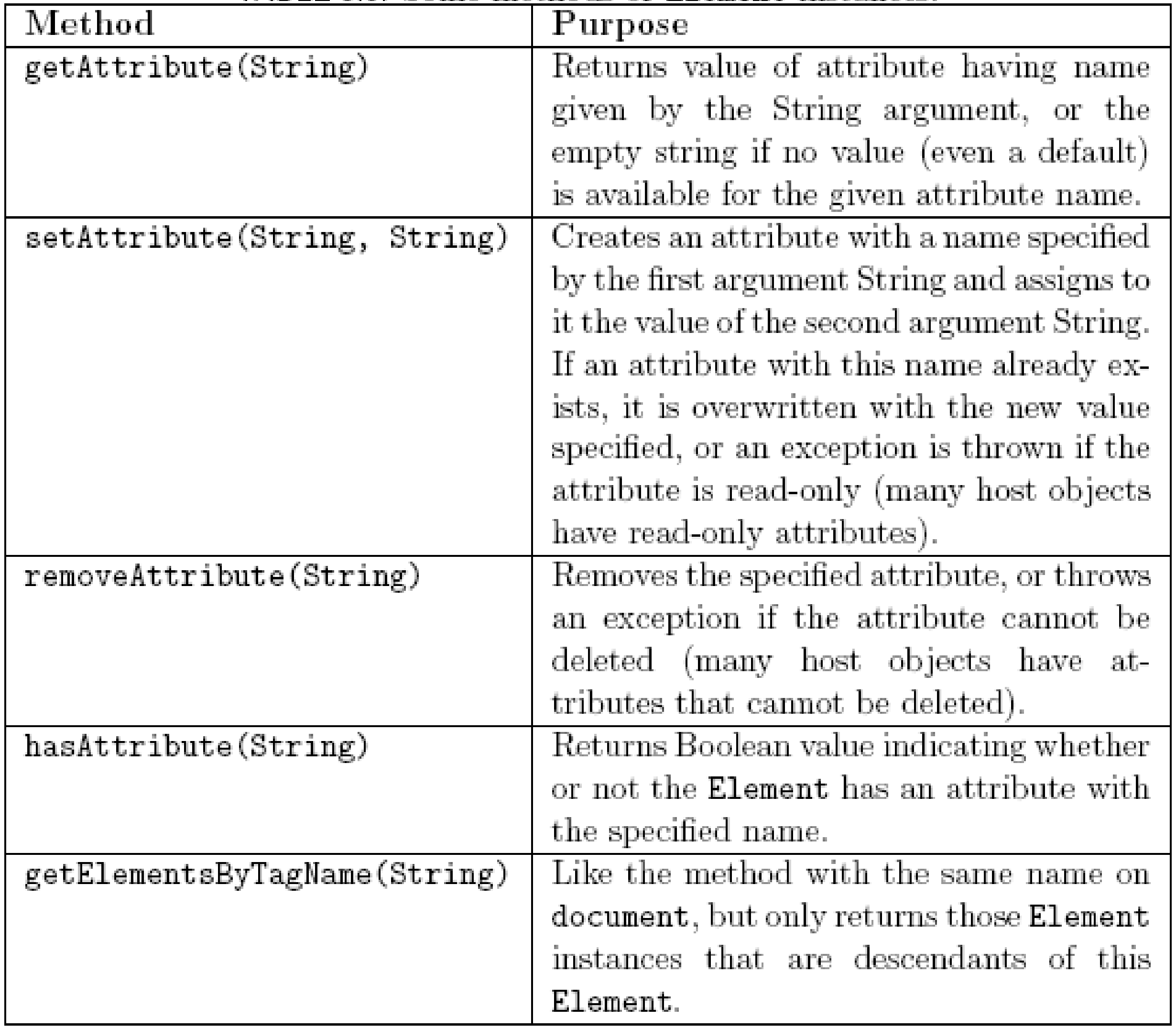
TABLE 5.5: Some properties of the **document** object.



`createElement(String)`	Given argument representing an element type name (such as `div`), returns an `Element` instance corresponding to the specified element type.
`createTextNode(String)`	Returns a `Text` instance containing the given String as its data value.
`getElementById(String)`	Given argument corresponding to the value of the `id` attribute of an element, returns that `Element` instance, or returns `null` if no document element has the specified `id` attribute value.
`getElementsByTagName(String)`	Given a String value representing an element type name, returns a "collection" (essentially an array) of `Element` instances corresponding to each element in the document having the given element type name.

Document Tree: `Element` Nodes

TABLE 5.6: Some methods of `Element` instances.



Method	Purpose
`getAttribute(String)`	Returns value of attribute having name given by the String argument, or the empty string if no value (even a default) is available for the given attribute name.
`setAttribute(String, String)`	Creates an attribute with a name specified by the first argument String and assigns to it the value of the second argument String. If an attribute with this name already exists, it is overwritten with the new value specified, or an exception is thrown if the attribute is read-only (many host objects have read-only attributes).
`removeAttribute(String)`	Removes the specified attribute, or throws an exception if the attribute cannot be deleted (many host objects have attributes that cannot be deleted).
`hasAttribute(String)`	Returns Boolean value indicating whether or not the `Element` has an attribute with the specified name.
`getElementsByTagName(String)`	Like the method with the same name on `document`, but only returns those `Element` instances that are descendants of this `Element`.

Document Tree: `Text` Nodes

- `data` property represents character data of a `Text` node
  - Modifying the property modifies the corresponding text in the browser
- By default, the DOM tree may contain sibling `Text` nodes
  - Example: `&copy; 2007` might be split into two `Text` nodes, one with copyright character
  - Call `normalize()` method on an ancestor node to prevent this

Document Tree: Adding Nodes

```
<body onload="makeCollapsible('collapse1');">
   <ol id="collapse1">
     <li>First element of ordered list.</li>
     <li>Second element.</li>
     <li>Third element.</li>
   </ol>
   <p>
     Paragraph following the list (does not collapse).
   </p>
 </body>
```

Body of original HTML document:

Document Tree: Adding Nodes

```
<body onload="makeCollapsible('collapse1');">
```

Added to DOM tree:

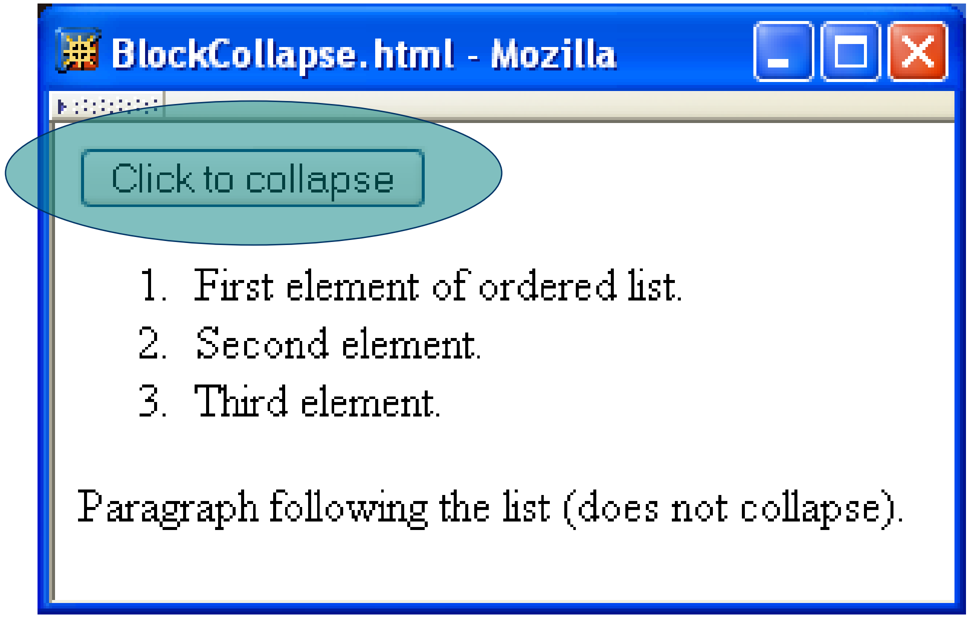
```
<div>
  <button type="button"
          onclick="toggleVisibility(this,'collapse1')">
    Click to collapse
  </button>
</div>
```

```
  <ol id="collapse1">
    <li>First element of ordered list.</li>
    <li>Second element.</li>
    <li>Third element.</li>
  </ol>
  <p>
    Paragraph following the list (does not collapse).
  </p>
</body>
```

Effect of executing makeCollapsible():

Document Tree: Adding Nodes

Added element is displayed as if it was part of the HTML source document



1. First element of ordered list.
2. Second element.
3. Third element.

Paragraph following the list (does not collapse).

Document Tree: Adding Nodes

```
function makeCollapsible(elementId) {
  var element = window.document.getElementById(elementId);
  if (element) {
    var div = window.document.createElement("div");
    element.parentNode.insertBefore(div, element);
    var button = window.document.createElement("button");
    div.appendChild(button);
    button.setAttribute("type", "button");
    var buttonText = window.document.createTextNode("Click to collapse");
    button.appendChild(buttonText);
    button.setAttribute("onclick",
                        "toggleVisibility(this,'" + elementId + "');");
  }
  return;
}
```

Document Tree: Adding Nodes

```
function makeCollapsible(elementId) {
  var element = window.document.getElementById(elementId);
  if (element) {
    var div = window.document.createElement("div");
    element.parentNode.insertBefore(div, element);
    var button = window.document.createElement("button");
    div.appendChild(button);
    button.setAttribute("type", "button");
    var buttonText = window.document.createTextNode("Click to collapse");
    button.appendChild(buttonText);
    button.setAttribute("onclick",
                         "toggleVisibility(this,'" + elementId + "');");
  }
  return;
}
```

Node creation

Document Tree: Adding Nodes

```
function makeCollapsible(elementId) {
  var element = window.document.getElementById(elementId);
  if (element) {
    var div = window.document.createElement("div");
    element.parentNode.insertBefore(div, element);
    var button = window.document.createElement("button");
    div.appendChild(button);
    button.setAttribute("type", "button");
    var buttonText = window.document.createTextNode("Click to collapse");
    button.appendChild(buttonText);
    button.setAttribute("onclick",
                        "toggleVisibility(this,'" + elementId + "');");
  }
  return;
}
```

Node addition to DOM tree (rec. doing this immediately after creation).

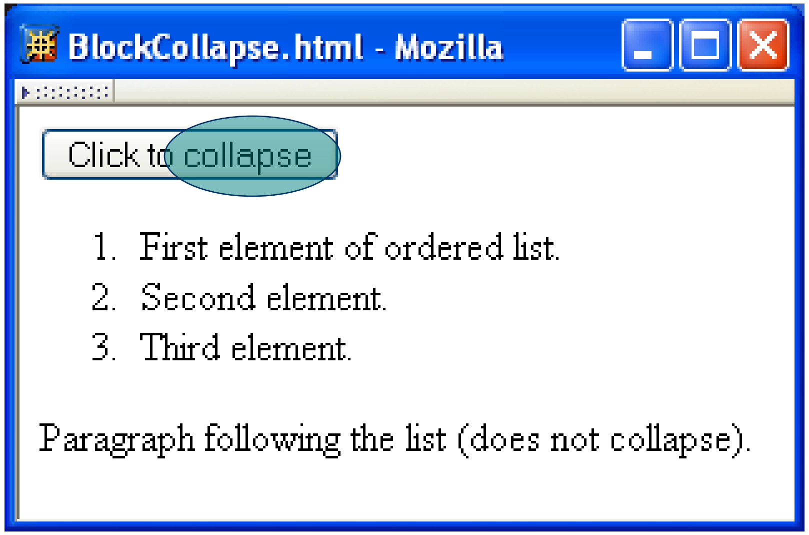
Document Tree: Adding Nodes

```
function makeCollapsible(elementId) {
  var element = window.document.getElementById(elementId);
  if (element) {
    var div = window.document.createElement("div");
    element.parentNode.insertBefore(div, element);
    var button = window.document.createElement("button");
    div.appendChild(button);
    button.setAttribute("type", "button");
    var buttonText = window.document.createTextNode("Click to collapse");
    button.appendChild(buttonText);
    button.setAttribute("onclick",
                        "toggleVisibility(this,'" + elementId + "');");
  }
  return;
}
```

Attribute addition

Document Tree: Adding Nodes

Before clicking button:

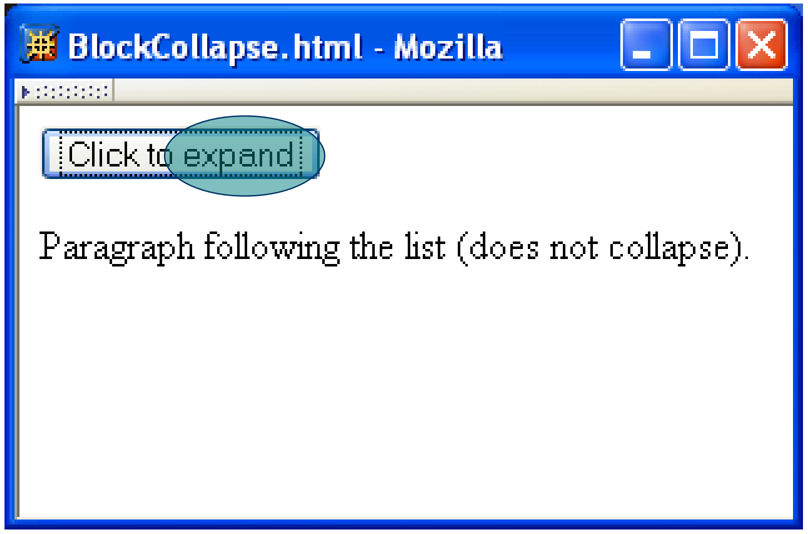

BlockCollapse.html - Mozilla

Click to collapse

1. First element of ordered list.
2. Second element.
3. Third element.

Paragraph following the list (does not collapse).

After clicking button:


BlockCollapse.html - Mozilla

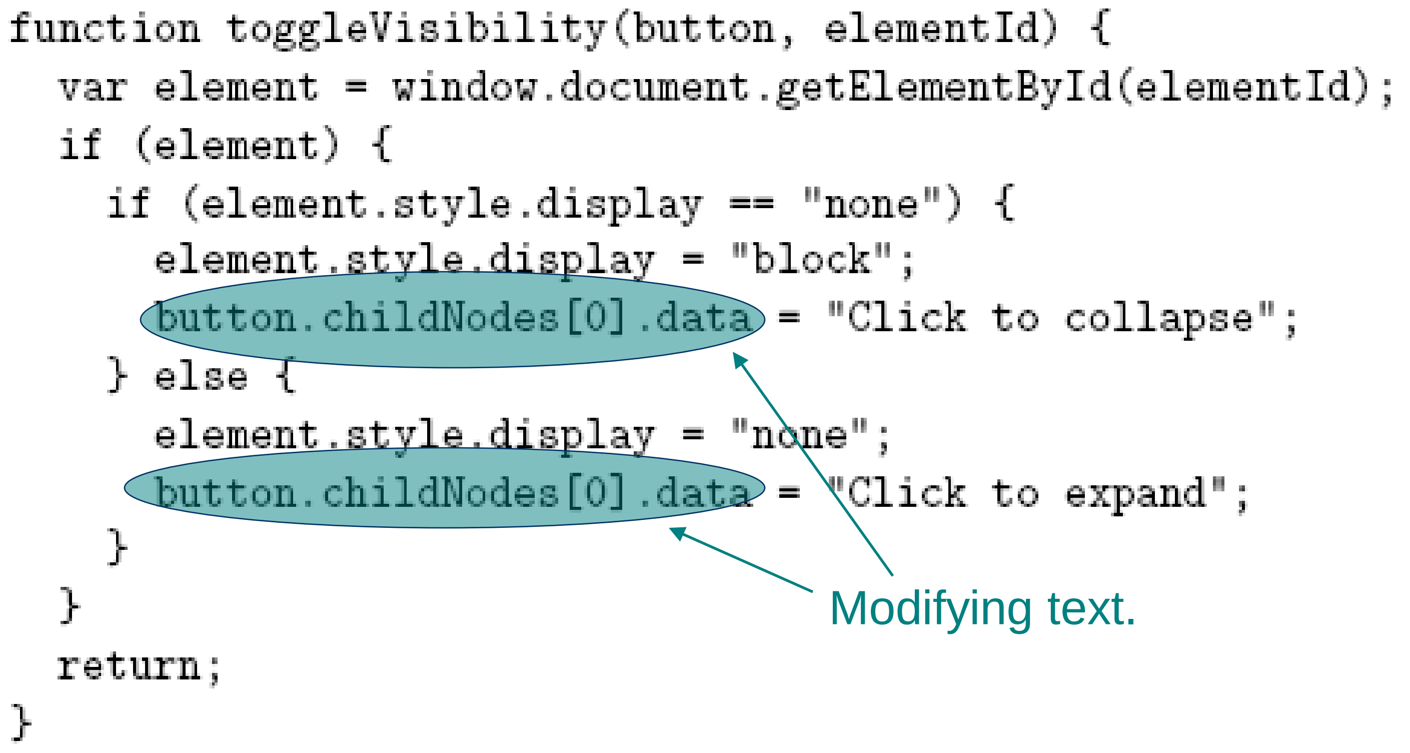
Click to expand

Paragraph following the list (does not collapse).

Document Tree: Adding Nodes

```
function toggleVisibility(button, elementId) {
  var element = window.document.getElementById(elementId);
  if (element) {
    if (element.style.display == "none") {
      element.style.display = "block";
      button.childNodes[0].data = "Click to collapse";
    } else {
      element.style.display = "none";
      button.childNodes[0].data = "Click to expand";
    }
  }
  return;
}
```

Document Tree: Adding Nodes



```
function toggleVisibility(button, elementId) {
  var element = window.document.getElementById(elementId);
  if (element) {
    if (element.style.display == "none") {
      element.style.display = "block";
      button.childNodes[0].data = "Click to collapse";
    } else {
      element.style.display = "none";
      button.childNodes[0].data = "Click to expand";
    }
  }
  return;
}
```

Modifying text.

Document Tree: Adding Nodes

Note that the previous example doesn't work with IE6/7, for at least two reasons:

1. "SetAttribute" doesn't work, and should be replaced by a direct assignment
2. Even if

```
button.setAttribute("onclick",
"toggleVisibility(this,'" + elementId +"');");
```

Was replaced with the IE friendly

```
button.onclick = toggleVisibility;
```

This seems to have been fixed in IE8

Document Tree: Adding Nodes

- Adding Text nodes is often tedious, with the mandatory creation of a new node via "createTextNode" and insertion of the newly created node in the DOM.
- A **NON STANDARD** alternative is to use innerHtml, which lets you just write blocks of html. It is faster (to write and to run), but error prone, and non standard so future support is unknown

Document Tree: HTML Properties

- Attribute values can be set two ways:

```
element.setAttribute("id", "element3");
element.id = "element3";
```

- As with CSS properties, former has some advantages:
  - Makes clear that setting an HTML attribute, not merely a property of an object
  - Avoids certain special cases, e.g.

```
element.setAttribute("class", "warning");
//DOM
element.className = "warning"; //req'd in IE6
```

class is reserved word in JavaScript

DOM Event Handling

- **Note**: IE6/7 has a different event model
- `Event` instance created for each event
- `Event` instance properties:
  - `type`: name of event (click, mouseover, *etc*.)
  - `target`: Node corresponding to document element that generated the event (*e.g.*, `button` element for click, `img` for mouseover). This is the event target.

DOM Event Handling

- JavaScript event listener: function that is called with `Event` instance when a certain event occurs
- An event listener is associated with a target element by calling `addEventListener()` on the element (still doesn’t work with IE8, it seems)

DOM Event Handling

```
var button = window.document.getElementById("msgButton");
button.addEventListener("click", sayHello, false);

function sayHello(event) {
  window.alert(
    "Hello World!\n\n" +
    "Event type: " + event.type + "\n" +
    "Event target element type: " + event.target.nodeName);
  return;
}
```

DOM Event Handling

Event target

```
var button = window.document.getElementById("msgButton");
button.addEventListener("click", sayHello, false);

function sayHello(event) {
  window.alert(
    "Hello World!\n\n" +
    "Event type: " + event.type + "\n" +
    "Event target element type: " + event.target.nodeName);
  return;
}
```

DOM Event Handling

```
var button = window.document.getElementById("msgButton");
button.addEventListener("click", sayHello, false);
```

Event type

```
function sayHello(event) {
  window.alert(
    "Hello World!\n\n" +
    "Event type: " + event.type + "\n" +
    "Event target element type: " + event.target.nodeName);
  return;
}
```

DOM Event Handling

- DOM event types:
  - All HTML intrinsic events except keypress, keydown, keyup, and dblclick
  - Also has some others that are typically targeted at the `window` object:

Event	Cause
`error`	An error (problem loading an image, script error, etc.) has occurred.
`resize`	View (window or frame) of document is resized.
`scroll`	View (window or frame) of document is scrolled.

DOM Event Handling

```
var button = window.document.getElementById("msgButton");
button.addEventListener("click", sayHello, false);

function sayHello(event) {
  window.alert(
    "Hello World!\n\n" +
    "Event type: " + event.type + "\n" +
    "Event target element type: " + event.target.nodeName);
  return;
}
```

Event handler

Definition of event handler

DOM Event Handling

```
var button = window.document.getElementById("msgButton");
button.addEventListener("click", sayHello, false);
```

Event instance

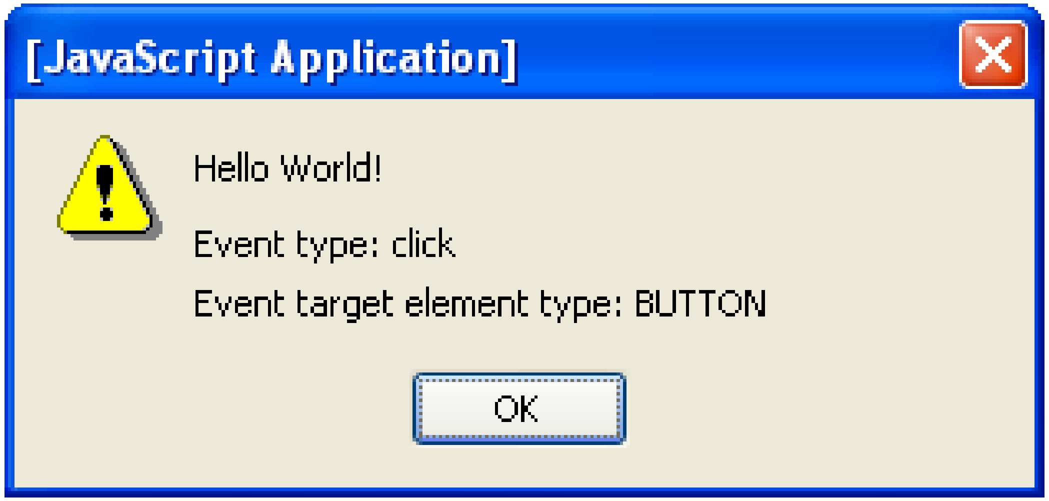
```
function sayHello(event) {
  window.alert(
    "Hello World!\n\n" +
    "Event type: " + event.type + "\n" +
    "Event target element type: " + event.target.nodeName);
  return;
}
```

DOM Event Handling

```
var button = window.document.getElementById("msgButton");
button.addEventListener("click", sayHello, false);

function sayHello(event) {
  window.alert(
    "Hello World!\n\n" +
    "Event type: " + event.type + "\n" +
    "Event target element type: " + event.target.nodeName);
  return;
}
```

Normally false
(more later)

DOM Event Handling


[JavaScript Application]

Hello World!

Event type: click

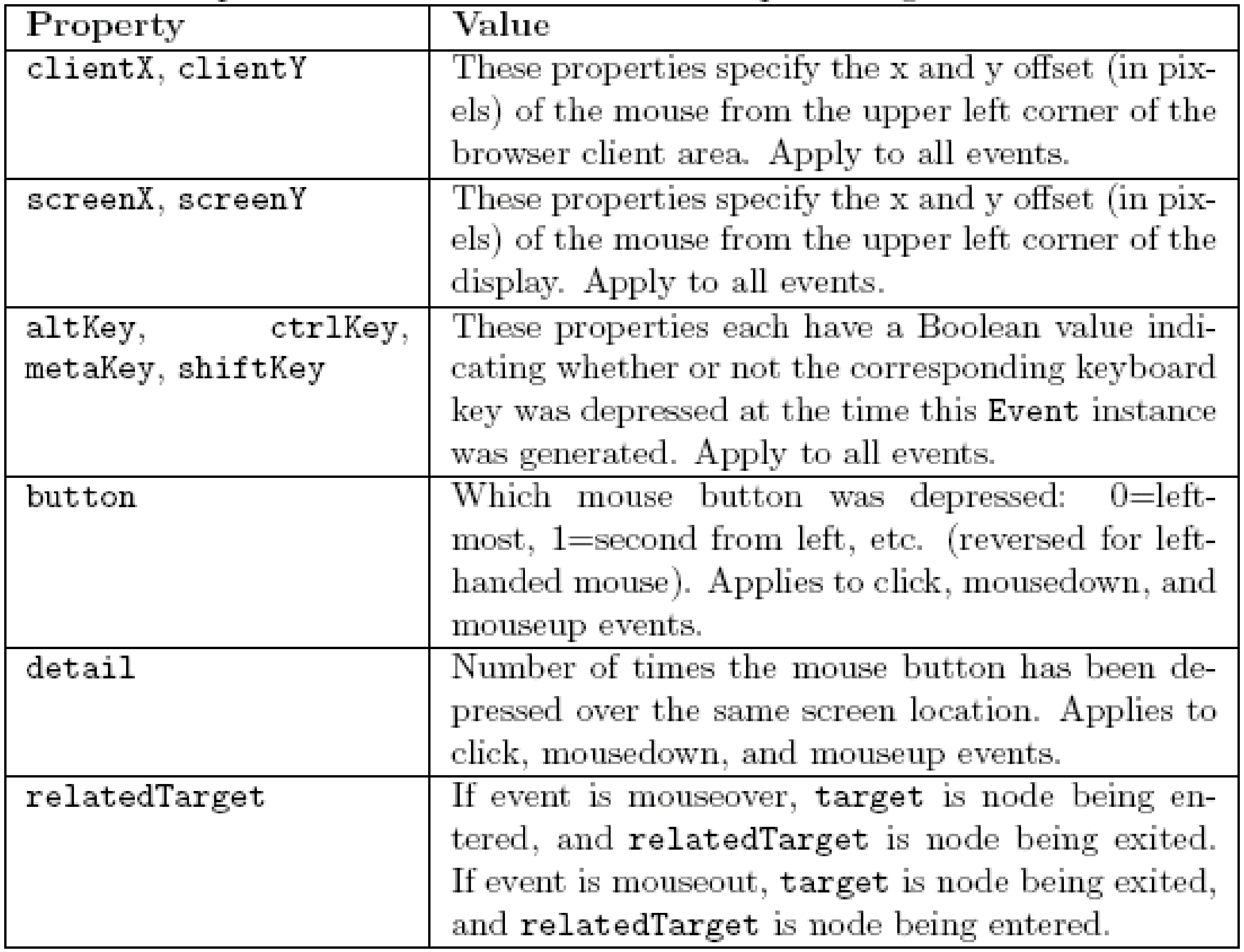
Event target element type: BUTTON

DOM Event Handling: Mouse Events

- DOM2 mouse events
  - click
  - mousedown
  - mouseup
  - mousemove
  - mouseover
  - mouseout
- `Event` instances have additional properties for mouse events

DOM Event Handling: Mouse Events

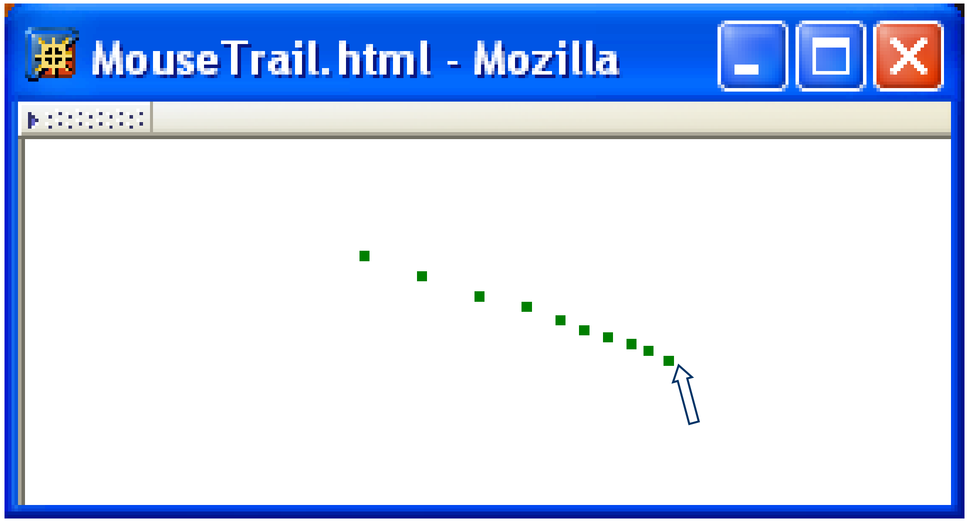
TABLE 5.7: Properties added to Event instances representing DOM2 mouse events.



Property	Value
`clientX`, `clientY`	These properties specify the x and y offset (in pixels) of the mouse from the upper left corner of the browser client area. Apply to all events.
`screenX`, `screenY`	These properties specify the x and y offset (in pixels) of the mouse from the upper left corner of the display. Apply to all events.
`altKey`, `ctrlKey`, `metaKey`, `shiftKey`	These properties each have a Boolean value indicating whether or not the corresponding keyboard key was depressed at the time this `Event` instance was generated. Apply to all events.
`button`	Which mouse button was depressed: 0=leftmost, 1=second from left, etc. (reversed for left-handed mouse). Applies to click, mousedown, and mouseup events.
`detail`	Number of times the mouse button has been depressed over the same screen location. Applies to click, mousedown, and mouseup events.
`relatedTarget`	If event is mouseover, `target` is node being entered, and `relatedTarget` is node being exited. If event is mouseout, `target` is node being exited, and `relatedTarget` is node being entered.

DOM Event Handling: Mouse Events

- Example: mouse “trail”



DOM Event Handling: Mouse Events

- HTML document:

```
<body onload="init();">
```

- JavaScript `init()` function:

```
function init() {
    for (var i=0; i<NUM_BLIPS; i++) {
      var aDiv = window.document.createElement("div");
      window.document.body.appendChild(aDiv);
      aDiv.setAttribute("id", DIV_ID_PREFIX + i);
      aDiv.setAttribute("class", CSS_CLASS);
    }
   window.document.addEventListener("mousemove", updateDivs, false);
   return;
 }
```

Create "blips"

String uniquely identifying this div

Add event listener

DOM Event Handling: Mouse Events

- Style sheet for “blips”:

```
.mouseTrailClass {
   background-color:green;
   height:3px; width:3px;
   position:absolute;
   left:0; top:0;
   display:none }
```

Initially, not displayed

DOM Event Handling: Mouse Events

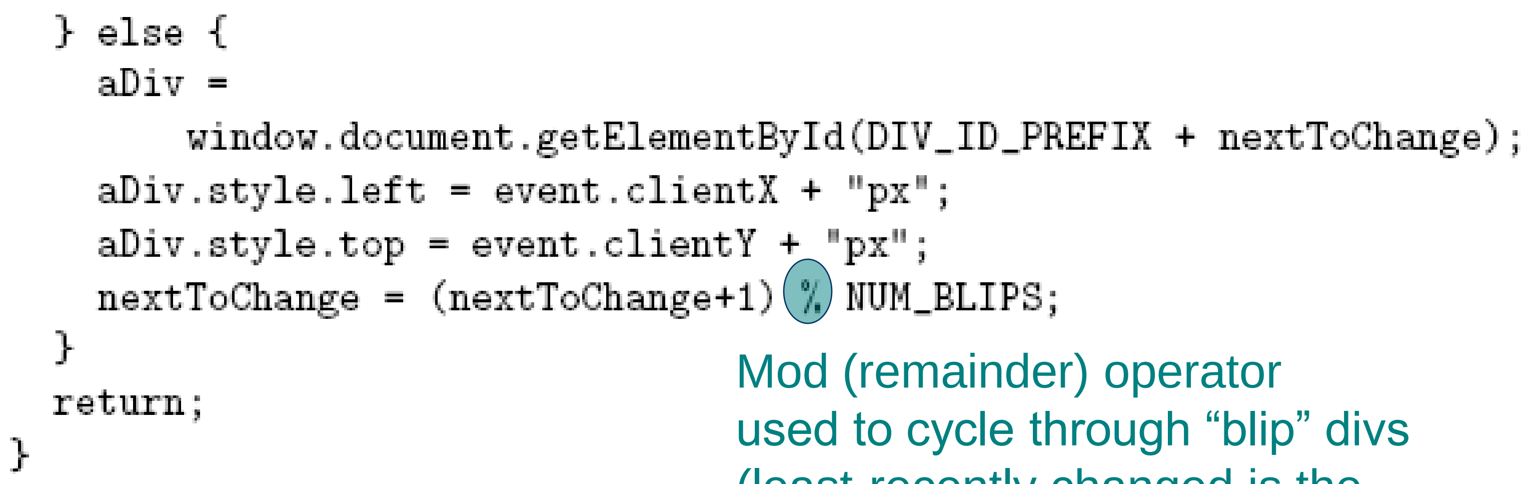
- Event handler `updateDivs()`:

```
function updateDivs(event) {
  var aDiv; // object corresponding to a blip div element
  if (!moved) {
    moved = true;
    for (var i=0; i<NUM_BLIPS; i++) {
      aDiv =
        window.document.getElementById(DIV_ID_PREFIX + i);
      aDiv.style.left = event.clientX + "px";
      aDiv.style.top = event.clientY + "px";
      aDiv.style.display = "block";
    }
```

Convert mouse location from Number to String and append units

DOM Event Handling: Mouse Events

- Event handler `updateDivs()`:



```
  } else {
    aDiv =
        window.document.getElementById(DIV_ID_PREFIX + nextToChange);
    aDiv.style.left = event.clientX + "px";
    aDiv.style.top = event.clientY + "px";
    nextToChange = (nextToChange+1) % NUM_BLIPS;
  }
  return;
}
```

Mod (remainder) operator used to cycle through “blip” divs (least-recently changed is the next div moved)

DOM Event Propagation

- Target of event is lowest-level element associated with event
  - Ex: target is the `a` element if the link is clicked:

```
<td><a href=…>click</a></td>
```

- However, event listeners associated with ancestors of the target may also be called

DOM Event Propagation

- Three types of event listeners:

```
<p id="p1">
  <a id="a1" href="somewhere">Over the rainbow</a>
</p>


var target = document.getElementById("a1");
var ancestor = document.getElementById("p1");
ancestor.addEventListener("click", listener1, true);
target.addEventListener("click", listener2, false);
ancestor.addEventListener("click", listener3, false);
```

DOM Event Propagation

- Three types of event listeners:

```
<p id="p1">
  <a id="a1" href="somewhere">Over the rainbow</a>
</p>
```

Capturing: Listener on ancestor created with `true` as third arg.

```
var target = document.getElementById("a1");
var ancestor = document.getElementById("p1");
ancestor.addEventListener("click", listener1, true);
target.addEventListener("click", listener2, false);
ancestor.addEventListener("click", listener3, false);
```

DOM Event Propagation

- Three types of event listeners:

```
<p id="p1">
  <a id="a1" href="somewhere">Over the rainbow</a>
</p>
```

Target: Listener on target element

```
var target = document.getElementById("a1");
var ancestor = document.getElementById("p1");
ancestor.addEventListener("click", listener1, true);
target.addEventListener("click", listener2, false);
ancestor.addEventListener("click", listener3, false);
```

DOM Event Propagation

- Three types of event listeners:

```
<p id="p1">
  <a id="a1" href="somewhere">Over the rainbow</a>
</p>
```

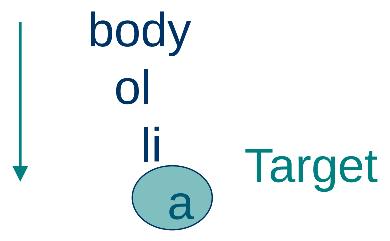
Bubbling: Listener on ancestor created with `false` as third arg.

```
var target = document.getElementById("a1");
var ancestor = document.getElementById("p1");
ancestor.addEventListener("click", listener1, true);
target.addEventListener("click", listener2, false);
ancestor.addEventListener("click", listener3, false);
```

DOM Event Propagation

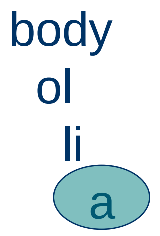
- Priority of event handlers:

1. Capturing event handlers; ancestors closest to root have highest priority



DOM Event Propagation

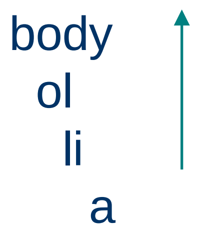
- Priority of event handlers:



2. Target event handlers

DOM Event Propagation

- Priority of event handlers:



3. Bubbling event handlers; ancestors closest to target have priority.

DOM Event Propagation

- Certain events do not bubble, *e.g.*,
  - load
  - unload
  - focus
  - blur

DOM Event Propagation

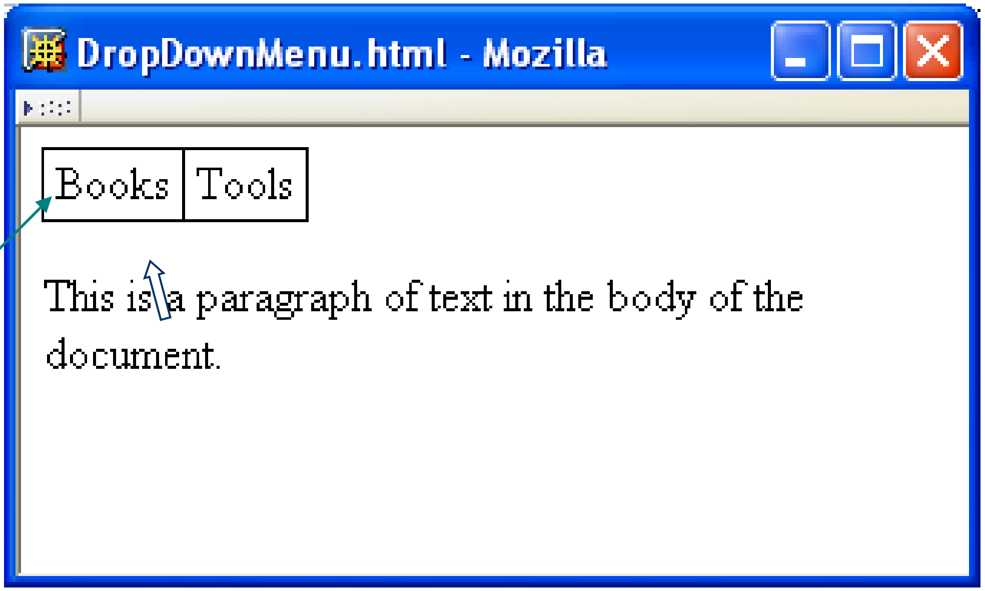
- Propagation-related properties of `Event` instances:
  - `eventPhase`: represents event processing phase:
    - 1: capturing
    - 2: target
    - 3: bubbling
  - `currentTarget`: object (ancestor or target) associated with this event handler

DOM Event Propagation

- Propagation-related method of `Event` instances:
  - `stopPropagation()`: lower priority event handlers will not be called
- Typical design:
  - Use bubbling event handlers to provide default processing (may be stopped)
  - Use capturing event handlers to provide required processing (*e.g.*, cursor trail)

Example: Drop-down Menus

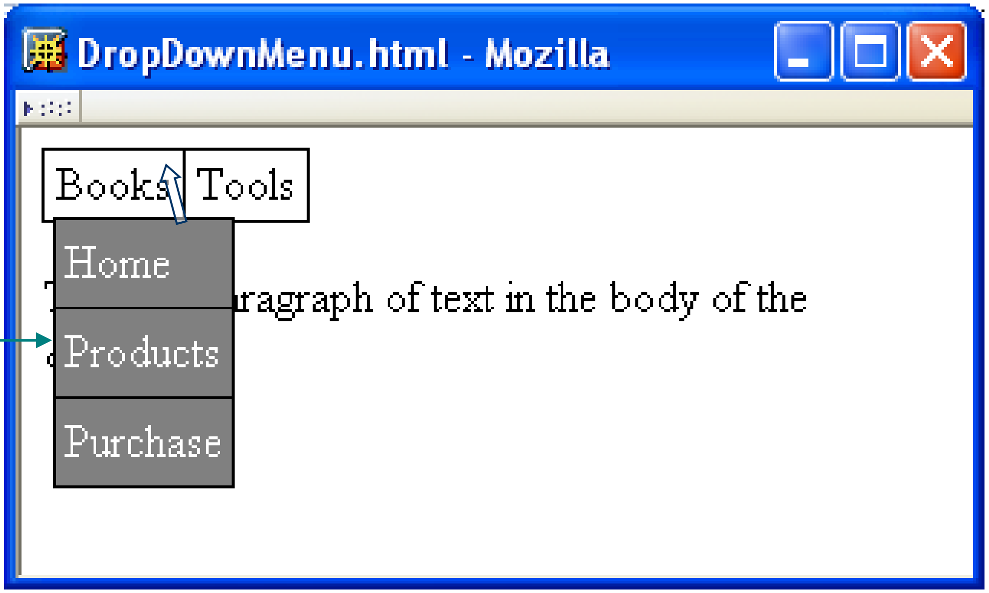
When cursor moves over upper menu …



This is a paragraph of text in the body of the document.

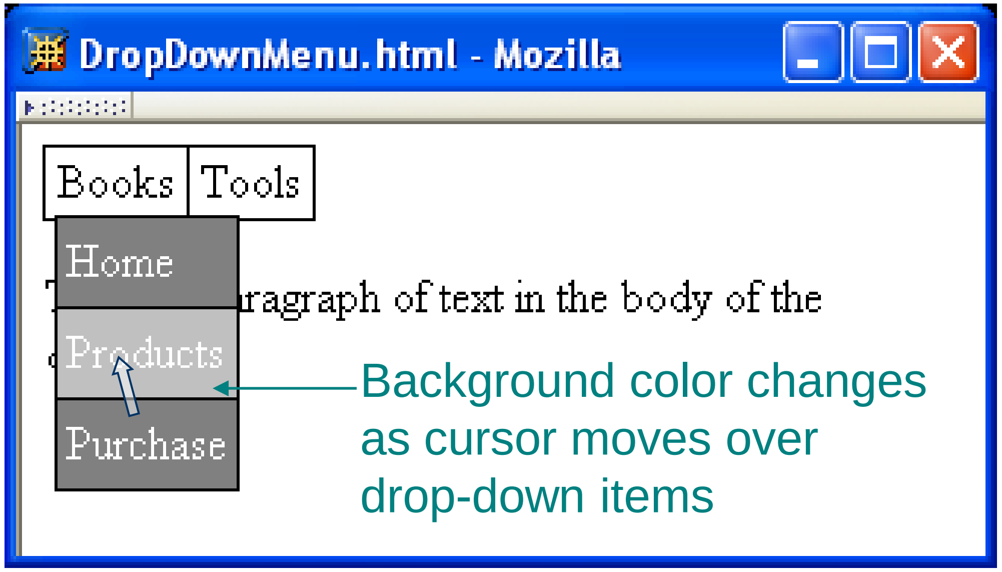
Example: Drop-down Menus

…
a drop-down appears

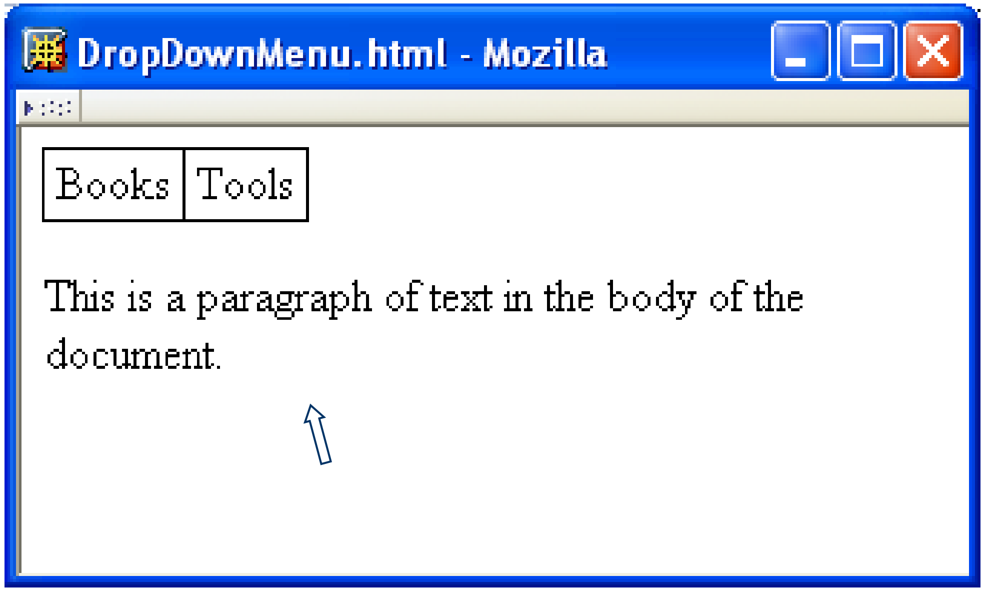

DropDownMenu.html - Mozilla

T…ragraph of text in the body of the

Example: Drop-down Menus


DropDownMenu.html - Mozilla
Books
Tools
Home
Products
Purchase
T ragraph of text in the body of the
Background color changes as cursor moves over drop-down items

Example: Drop-down Menus


DropDownMenu.html - Mozilla

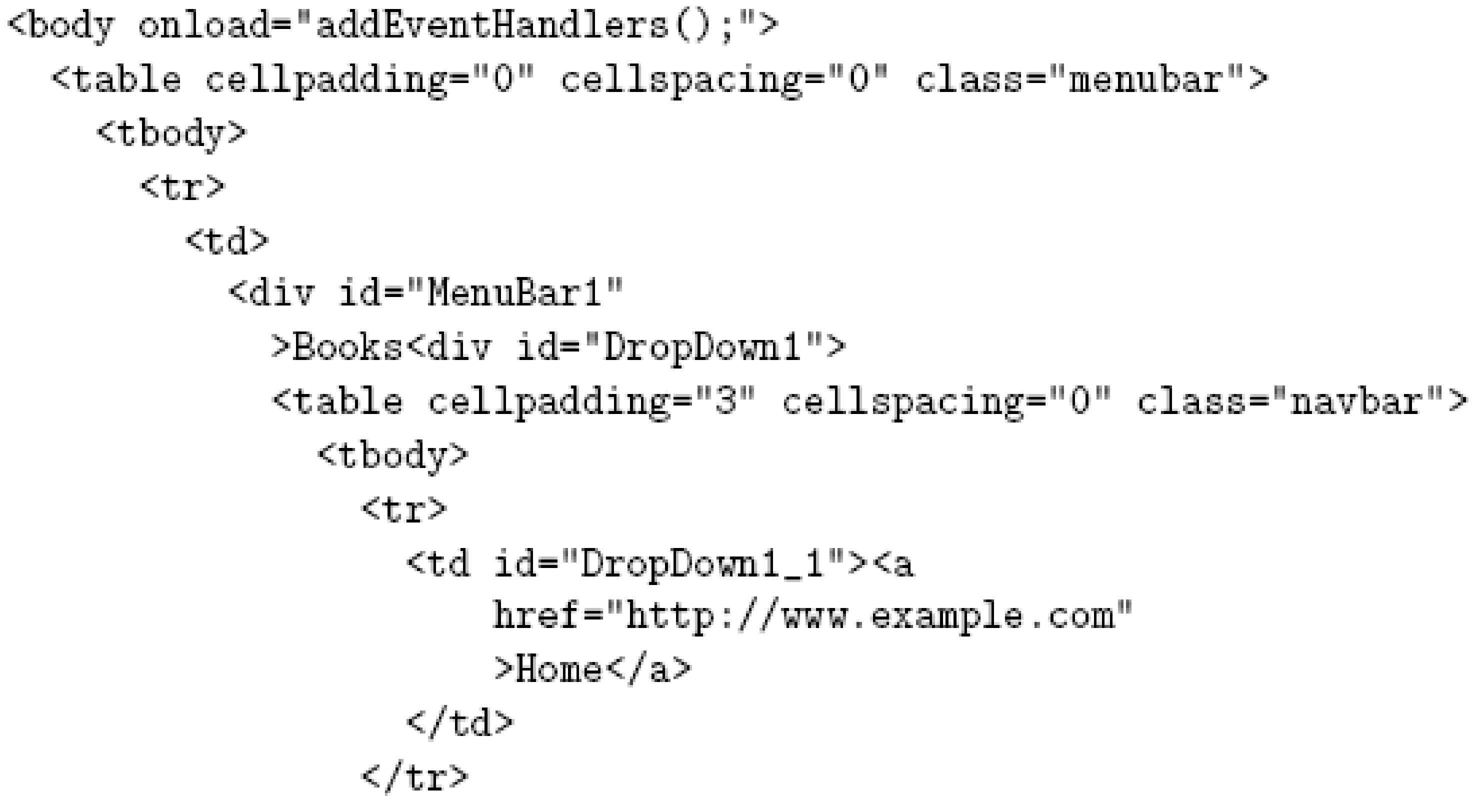
Books | Tools

This is a paragraph of text in the body of the document.

Drop-down disappears when cursor leaves both drop-down and menu

Example: Drop-down Menus

- Document structure:



```
<body onload="addEventHandlers();">
  <table cellpadding="0" cellspacing="0" class="menubar">
    <tbody>
      <tr>
        <td>
          <div id="MenuBar1"
            >Books<div id="DropDown1">
            <table cellpadding="3" cellspacing="0" class="navbar">
              <tbody>
                <tr>
                  <td id="DropDown1_1"><a
                      href="http://www.example.com"
                      >Home</a>
                  </td>
                </tr>
```

Example: Drop-down Menus

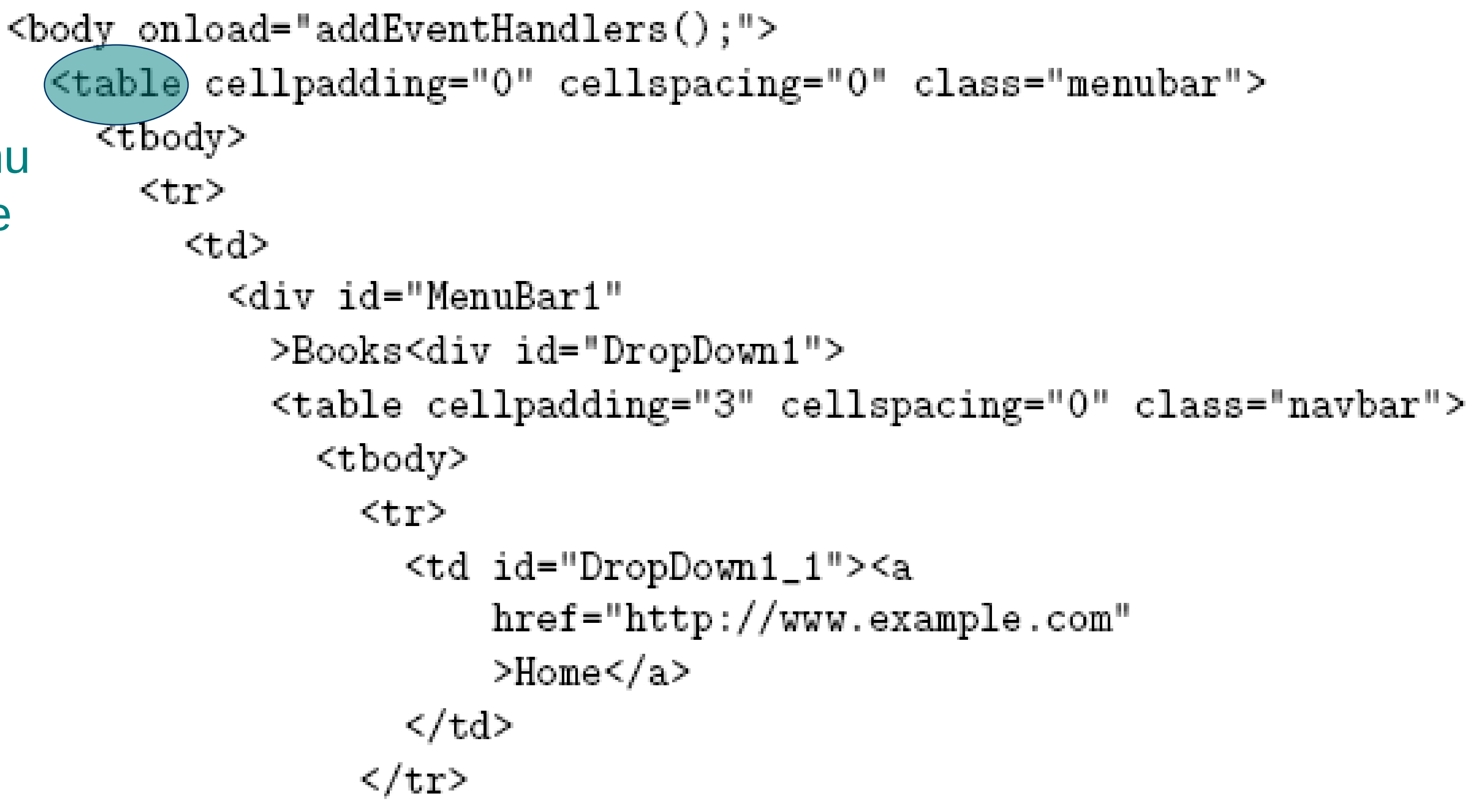
- Document structure:

Event handlers will be added by JavaScript code

```
<body onload="addEventHandlers();">
  <table cellpadding="0" cellspacing="0" class="menubar">
    <tbody>
      <tr>
        <td>
          <div id="MenuBar1"
            >Books<div id="DropDown1">
            <table cellpadding="3" cellspacing="0" class="navbar">
              <tbody>
                <tr>
                  <td id="DropDown1_1"><a
                      href="http://www.example.com"
                      >Home</a>
                  </td>
                </tr>
```

Example: Drop-down Menus

- Document structure:

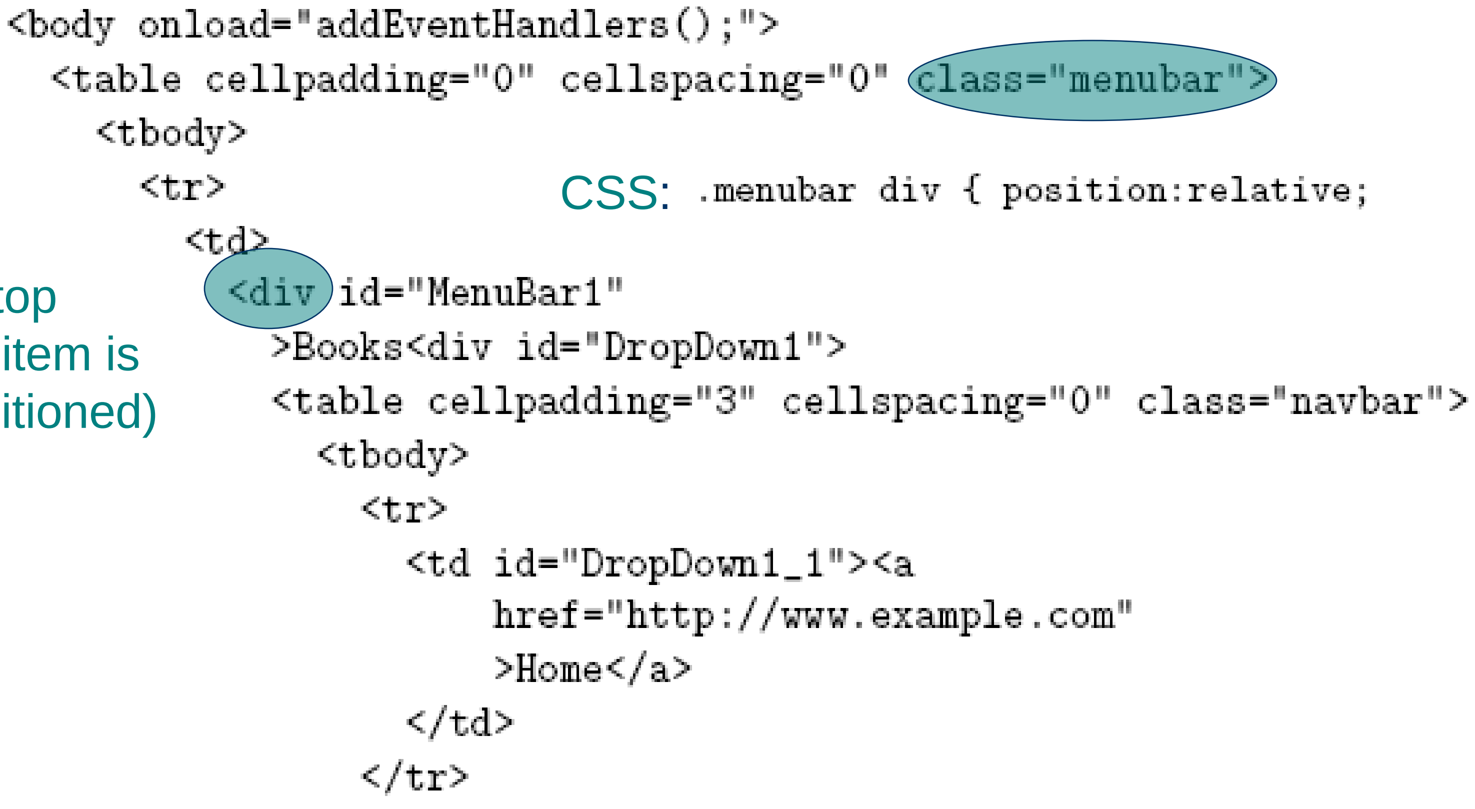


```
<body onload="addEventHandlers();">
  <table cellpadding="0" cellspacing="0" class="menubar">
    <tbody>
      <tr>
        <td>
          <div id="MenuBar1"
            >Books<div id="DropDown1">
            <table cellpadding="3" cellspacing="0" class="navbar">
              <tbody>
                <tr>
                  <td id="DropDown1_1"><a
                      href="http://www.example.com"
                      >Home</a>
                  </td>
                </tr>
```

Top menu
is a table

Example: Drop-down Menus

- Document structure:



```
<body onload="addEventHandlers();">
  <table cellpadding="0" cellspacing="0" class="menubar">
    <tbody>
      <tr>
        <td>
          <div id="MenuBar1"
            >Books<div id="DropDown1">
            <table cellpadding="3" cellspacing="0" class="navbar">
              <tbody>
                <tr>
                  <td id="DropDown1_1"><a
                      href="http://www.example.com"
                      >Home</a>
                  </td>
                </tr>
```

CSS: `.menubar div { position:relative;`

Each top menu item is a (positioned) div

Example: Drop-down Menus

- Document structure:

```
<body onload="addEventHandlers();">
  <table cellpadding="0" cellspacing="0" class="menubar">
    <tbody>
      <tr>
        <td>
          <div id="MenuBar1"
            >Books<div id="DropDown1">
            <table cellpadding="3" cellspacing="0" class="navbar">
              <tbody>
                <tr>
                  <td id="DropDown1_1"><a
                      href="http://www.example.com"
                      >Home</a>
                  </td>
                </tr>
```

CSS:
```
.menubar div div { position:absolute;
                   display:none
```

Associated drop-down is in a div that is out of the normal flow and initially invisible

Example: Drop-down Menus

- Document structure:

```
<body onload="addEventHandlers();">
  <table cellpadding="0" cellspacing="0" class="menubar">
    <tbody>
      <tr>
        <td>
          <div id="MenuBar1"
            >Books<div id="DropDown1">
            <table cellpadding="3" cellspacing="0" class="navbar">
              <tbody>
                <tr>
                  <td id="DropDown1_1"><a
                      href="http://www.example.com"
                      >Home</a>
                  </td>
                </tr>
```

Associated drop-down is a table

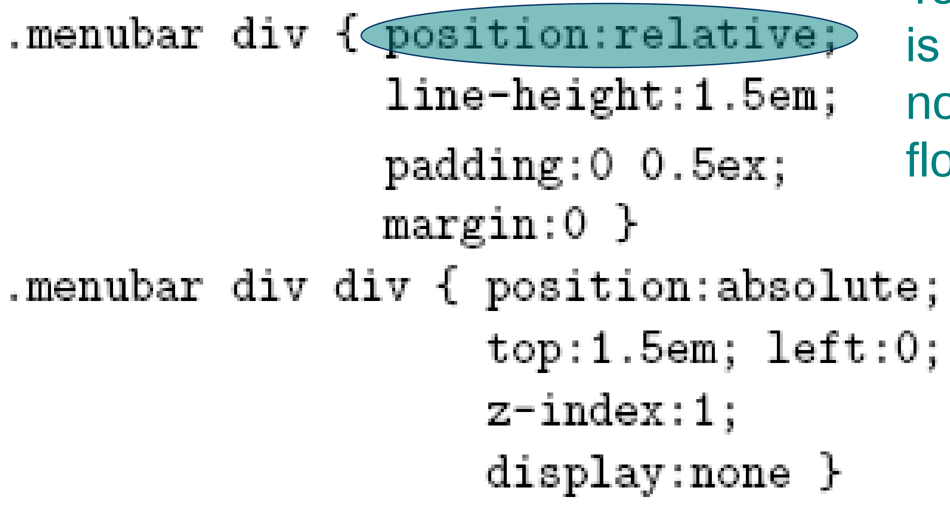
Example: Drop-down Menus

- Full style rules:

```
.menubar div { position:relative;
               line-height:1.5em;
               padding:0 0.5ex;
               margin:0 }
.menubar div div { position:absolute;
                   top:1.5em; left:0;
                   z-index:1;
                   display:none }
```

Example: Drop-down Menus

- Full style rules:

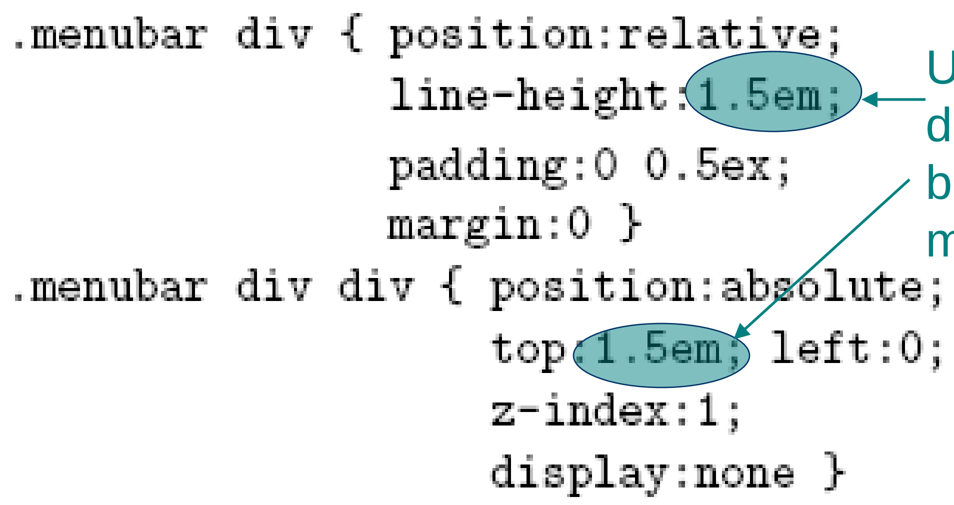


```
.menubar div { position:relative;
               line-height:1.5em;
               padding:0 0.5ex;
               margin:0 }
.menubar div div { position:absolute;
                   top:1.5em; left:0;
                   z-index:1;
                   display:none }
```

Top menu item div is “positioned” but not moved from normal flow location

Example: Drop-down Menus

- Full style rules:



```
.menubar div { position:relative;
               line-height:1.5em;
               padding:0 0.5ex;
               margin:0 }
.menubar div div { position:absolute;
                   top:1.5em; left:0;
                   z-index:1;
                   display:none }
```

Upper left corner of drop-down div overlaps bottom border of top menu

Example: Drop-down Menus

- Full style rules:

```
.menubar div { position:relative;
               line-height:1.5em;
               padding:0 0.5ex;
               margin:0 }
.menubar div div { position:absolute;
                   top:1.5em; left:0;
                   z-index:1;
                   display:none }
```

Drop-down drawn over lower z-index elements

Example: Drop-down Menus

- Adding event handlers to top menu:
  - Document:

```
<div id="MenuBar1"
  >Books<div id="DropDown1">
```

  - JavaScript `addEventHandlers()`:

Target event handlers

```
var menuBar1 = window.document.getElementById("MenuBar1");
menuBar1.addEventListener("mouseover", showDropDown, false);
menuBar1.addEventListener("mouseout", hideDropDown, false);
menuBar1.dropDown = window.document.getElementById("DropDown1");
```

Example: Drop-down Menus

- Adding event handlers to top menu:
  - Document:

```
<div id="MenuBar1"
  >Books<div id="DropDown1">
```

  - JavaScript `addEventListener()`:

```
var menuBar1 = window.document.getElementById("MenuBar1");
menuBar1.addEventListener("mouseover", showDropDown, false);
menuBar1.addEventListener("mouseout", hideDropDown, false);
menuBar1.dropDown = window.document.getElementById("DropDown1");
```

`menuBar1` will be target of events; adding reference to the drop-down div makes it easy for event handler to access the drop-down

Example: Drop-down Menus

```
function showDropDown(event) {
  if (event.target == event.currentTarget) {
    var dropDown = event.currentTarget.dropDown;
    dropDown.style.display = "block";
  }
  return;
}
function hideDropDown(event) {
  if (!ancestorOf(event.currentTarget, event.relatedTarget)) {
    var dropDown = event.currentTarget.dropDown;
    dropDown.style.display = "none";
  }
  return;
}
```

Example: Drop-down Menus

```
function showDropDown(event) {
  if (event.target == event.currentTarget) {
    var dropDown = event.currentTarget.dropDown;
    dropDown.style.display = "block";
  }
  return;
}
function hideDropDown(event) {
  if (!ancestorOf(event.currentTarget, event.relatedTarget)) {
    var dropDown = event.currentTarget.dropDown;
    dropDown.style.display = "none";
  }
  return;
}
```

Basic processing: change visibility of drop-down

Example: Drop-down Menus

Ignore bubbling mouseover events from drop-down

```
function showDropDown(event) {
  if (event.target == event.currentTarget) {
    var dropDown = event.currentTarget.dropDown;
    dropDown.style.display = "block";
  }
  return;
}
function hideDropDown(event) {
   if (!ancestorOf(event.currentTarget, event.relatedTarget)) {
     var dropDown = event.currentTarget.dropDown;
     dropDown.style.display = "none";
   }
   return;
}
```

Example: Drop-down Menus

```
function showDropDown(event) {
  if (event.target == event.currentTarget) {
    var dropDown = event.currentTarget.dropDown;
    dropDown.style.display = "block";
  }
  return;
}
function hideDropDown(event) {
  if (!ancestorOf(event.currentTarget, event.relatedTarget)) {
    var dropDown = event.currentTarget.dropDown;
    dropDown.style.display = "none";
  }
  return;
}
```

Ignore mouseout event if cursor is remaining over menu item or drop-down (self or descendant)

Example: Drop-down Menus

```
function ancestorOf(ancestorElt, descendElt) {
  var found;

  // Base cases: descendElt is null or same as ancestorElt
  if (!descendElt) {
    found = false;
  } else if (descendElt == ancestorElt) {
    found = true;

  // Recursive case: check descendElt's parent
  } else {
    found = ancestorOf(ancestorElt, descendElt.parentNode);
  }
  return found;
}
```

Example: Drop-down Menus

- Adding event handlers to drop-down:
  - Document:

```
<td id="DropDown1_1"><a
    href="http://www.example.com"
    >Home</a>
</td>
```

  - JavaScript `addEventListener()`:

```
var dropDown1_1 = window.document.getElementById("DropDown1_1");

dropDown1_1.addEventListener("mouseover", highlight, false);
dropDown1_1.addEventListener("mouseout", lowlight, false);
```

Example: Drop-down Menus

```
function highlight(event) {
  if (event.currentTarget.style.backgroundColor != "silver") {
    event.currentTarget.style.backgroundColor = "silver";
  }

  event.stopPropagation();
  return;
}

function lowlight(event) {
  if (!ancestorOf(event.currentTarget, event.relatedTarget)) {
    event.currentTarget.style.backgroundColor = "gray";
  }
  return;
}
```

Example: Drop-down Menus

Don't bother changing style if this event bubbled from a descendant. →

```
function highlight(event) {
  if (event.currentTarget.style.backgroundColor != "silver") {
    event.currentTarget.style.backgroundColor = "silver";
  }

  event.stopPropagation();
  return;
}

function lowlight(event) {
   if (!ancestorOf(event.currentTarget, event.relatedTarget)) {
     event.currentTarget.style.backgroundColor = "gray";
   }
   return;
 }
```

Example: Drop-down Menus

```
function highlight(event) {
  if (event.currentTarget.style.backgroundColor != "silver") {
    event.currentTarget.style.backgroundColor = "silver";
  }

  event.stopPropagation();
  return;
}
```

Don’t bubble up to showDropDown since the drop-down must be visible

```
function lowlight(event) {
   if (!ancestorOf(event.currentTarget, event.relatedTarget)) {
     event.currentTarget.style.backgroundColor = "gray";
   }
   return;
}
```

Example: Drop-down Menus

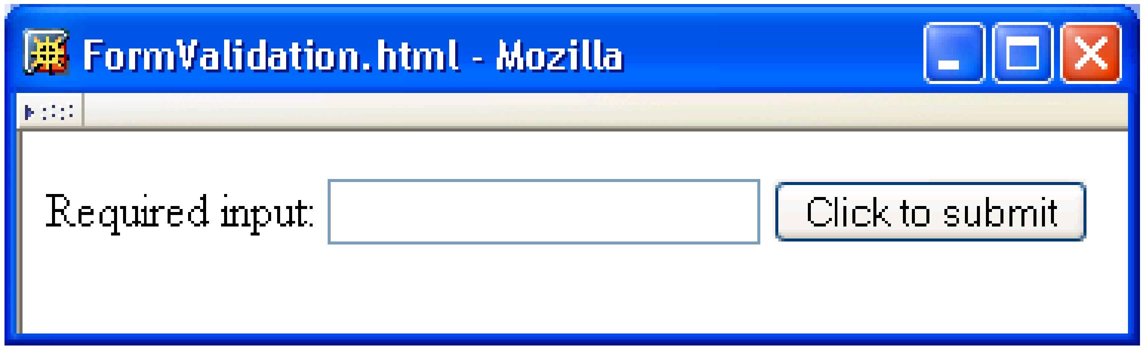
```
function highlight(event) {
  if (event.currentTarget.style.backgroundColor != "silver") {
    event.currentTarget.style.backgroundColor = "silver";
  }
  event.stopPropagation();
  return;
}

function lowlight(event) {
  if (!ancestorOf(event.currentTarget, event.relatedTarget)) {
    event.currentTarget.style.backgroundColor = "gray";
  }
  return;
}
```

Ignore mouseout to a descendant →

DOM Event Cancellation

- Browser provides default event listener for certain elements and events
  - Ex: click on hyperlink
  - Ex: click on submit button
- Default listeners are called *after* all user-specified listeners
- `stopPropagation()` does not affect default listeners
- Instead, call `preventDefault()` on Event instance to cancel default event handling

DOM Form Validation



DOM Form Validation

```
<body onload="addListeners();">
  <form id="validatedForm" action="http://www.example.com">
  <p>
    <label>Required input:
      <input type="text"
             name="requiredField" id="requiredField" />
    </label>
    <input type="submit"
           name="submit" value="Click to submit" />
  </p>
  </form>
</body>
```

DOM Form Validation

```
var form = window.document.getElementById("validatedForm");
form.addEventListener("submit", validateForm, false);


function validateForm(event) {
  var textfield = window.document.getElementById("requiredField");
  var fieldValue = textfield.value; // getAttribute doesn't work here!
  if (/^\s*$/.test(fieldValue)) {
    window.alert("Data must be entered in the field\n" +
                 "before submitting the form");
    event.preventDefault();
  }
  return;
}
```

DOM Form Validation

```
var form = window.document.getElementById("validatedForm");
form.addEventListener("submit", validateForm, false);
```

Listen for form to be submitted

```
function validateForm(event) {
  var textfield = window.document.getElementById("requiredField");
  var fieldValue = textfield.value; // getAttribute doesn't work here!
  if (/^\s*$/.test(fieldValue)) {
    window.alert("Data must be entered in the field\n" +
                 "before submitting the form");
    event.preventDefault();
  }
  return;
}
```

DOM Form Validation

```
var form = window.document.getElementById("validatedForm");
form.addEventListener("submit", validateForm, false);

function validateForm(event) {
  var textfield = window.document.getElementById("requiredField");
  var fieldValue = textfield.value; // getAttribute doesn't work here!
  if (/^\s*$/.test(fieldValue)) {
    window.alert("Data must be entered in the field\n" +
                 "before submitting the form");
    event.preventDefault();
  }
  return;
}
```

Must use `value` property to access value entered in text field on form

DOM Form Validation

```
var form = window.document.getElementById("validatedForm");
form.addEventListener("submit", validateForm, false);


function validateForm(event) {
  var textfield = window.document.getElementById("requiredField");
  var fieldValue = textfield.value; // getAttribute doesn't work here!
  if (/^\s*$/.test(fieldValue)) {
    window.alert("Data must be entered in the field\n" +
                 "before submitting the form");
    event.preventDefault();
  }
  return;
}
```

Regular expression literal representing
“set of strings consisting only of white space”

DOM Form Validation

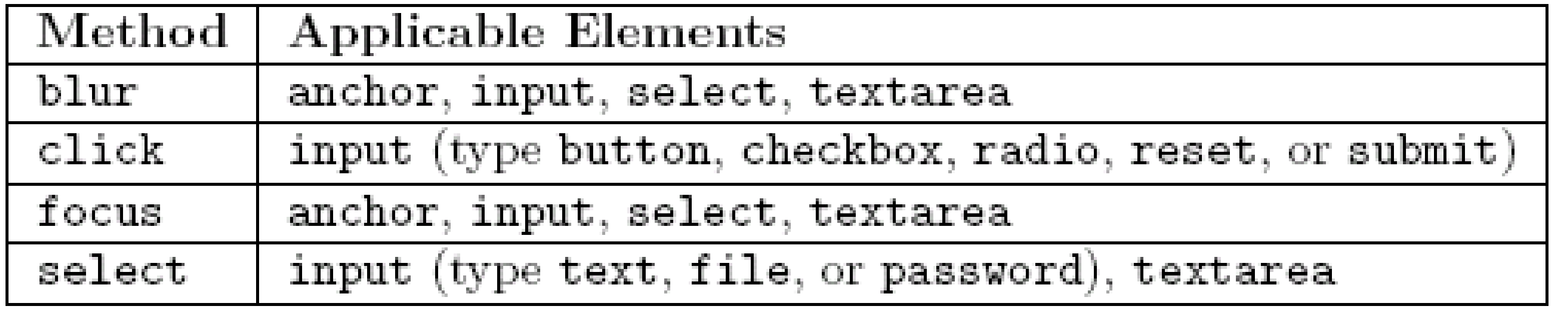
```
var form = window.document.getElementById("validatedForm");
form.addEventListener("submit", validateForm, false);


function validateForm(event) {
  var textfield = window.document.getElementById("requiredField");
  var fieldValue = textfield.value; // getAttribute doesn't work here!
  if (/^\s*$/.test(fieldValue)) {
    window.alert("Data must be entered in the field\n" +
                 "before submitting the form");
    event.preventDefault();
  }
  return;
}
```

Cancel browser's default submit event processing

DOM Event Generation

- Several Element's provide methods for *generating* events
  - Ex: `textfield.select();` causes text in text field to be selected and a select event to occur

TABLE 5.9: DOM2 methods for generating common events.



Method	Applicable Elements
`blur`	`anchor`, `input`, `select`, `textarea`
`click`	`input` (type `button`, `checkbox`, `radio`, `reset`, or `submit`)
`focus`	`anchor`, `input`, `select`, `textarea`
`select`	`input` (type `text`, `file`, or `password`), `textarea`

Detecting Host Objects

- How can a JavaScript program test for the existence of a certain host object?
  - Does the `style` element have a `setProperty()` method?

```
if (element.style.setProperty) {
```

  - If we're also not sure that `element` is defined or that `style` exists:

```
if (element && element.style && element.style.setProperty) {
```

Detecting Host Objects

- Is a browser DOM-compliant?
  - Ex: `document.implementation(“Core”, “2.0”)` returns `true` if browser implements *all* of DOM 2 Core module, `false` otherwise
  - Problem: what does `false` tell you?
- Many scripts attempt to directly determine the browser, but…
  - What about new browsers?
  - Some browsers can “lie” about what they are

IE6 and the DOM

- No `Node` object (and associated constants)
- No `setProperty()` or `getPropertyValue()`
- Must use "`className`" rather than "`class`" in `setAttribute()` and `getAttribute()`
- Empty `div/span` height cannot be made less than character height

IE6 and the DOM

- No `addEventListener()` (so no multiple listeners)
- Cannot use `setAttribute()` to specify intrinsic event attribute

```
button.setAttribute("onclick",
                    "toggleVisibility(this,'" + elementId + "');");
```

- IE6: `button.onclick = toggleVisibility;`

  Value assigned is a function Object (method) rather than a String.

IE6 and the DOM

- Adding listeners to both IE6 and DOM:

String-valued in DOM, initially `null` in IE6

```
if (button.onclick === null) { // e.g., in IE
  button.onclick = toggleVisibility;
} else {
  button.setAttribute("onclick",
                      "toggleVisibility(this,'" + elementId + "');");
}
```

IE6 and the DOM

- Passing arguments to event listeners:
  - DOM:

```
button.setAttribute("onclick",
                    "toggleVisibility(this,'" + elementId + "');");
```

  - IE6:

```
button.onclick = toggleVisibility;
button.elementId = elementId;
```

Listener is called as a method in IE6, so `this` is a reference to `button`

IE6 and the DOM

- Passing arguments to event listeners:

Test that arguments are defined

DOM approach

```
function toggleVisibility(inButton, elementId) {
  var button, element;
  if (inButton && elementId) {
    button = inButton;
    element = window.document.getElementById(elementId);
  }
 else if (window.event) {
   button = this;
   if (button) {
     element = window.document.getElementById(button.elementId);
   }
 }
```

IE6 and the DOM

- Passing arguments to event listeners:

```
function toggleVisibility(inButton, elementId) {
  var button, element;

  if (inButton && elementId) {
    button = inButton;
    element = window.document.getElementById(elementId);
  }
  else if (window.event) {
    button = this;
    if (button) {
      element = window.document.getElementById(button.elementId);
    }
  }
```

Test for host object created by IE6 when event occurs

IE6 approach

Update: window.event test succeed with Chrome!

IE6 and the DOM

- Passing arguments to event listeners:

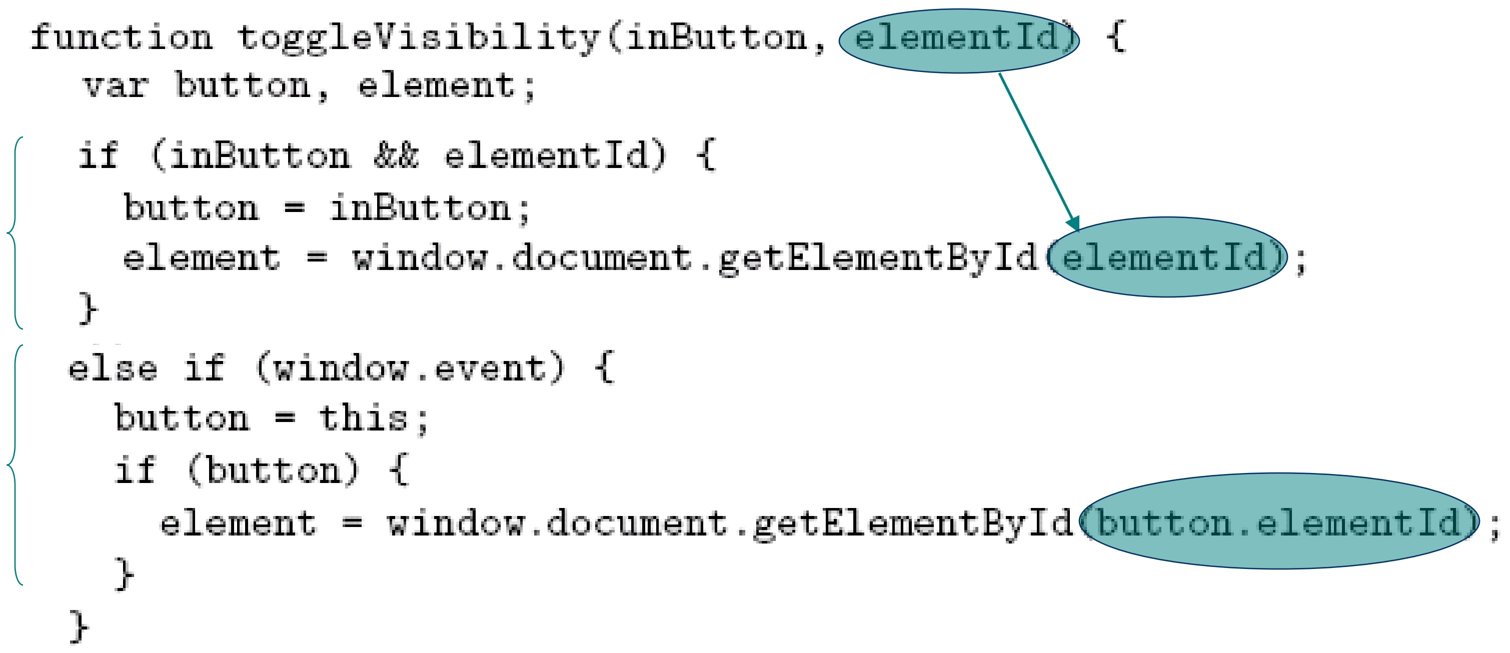
```
function toggleVisibility(inButton, elementId) {
   var button, element;
   if (inButton && elementId) {
     button = inButton;
     element = window.document.getElementById(elementId);
   }
  else if (window.event) {
    button = this;
     if (button) {
       element = window.document.getElementById(button.elementId);
     }
  }
```

DOM approach

IE6 approach

IE6 and the DOM

- Passing arguments to event listeners:



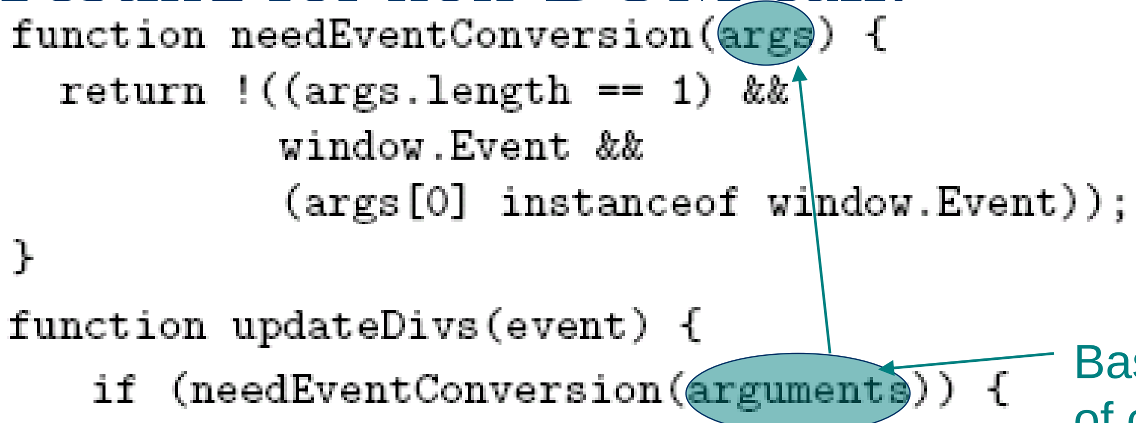
```
function toggleVisibility(inButton, elementId) {
  var button, element;
  if (inButton && elementId) {
    button = inButton;
    element = window.document.getElementById(elementId);
  }
  else if (window.event) {
    button = this;
    if (button) {
      element = window.document.getElementById(button.elementId);
    }
  }
```

DOM approach

IE6 approach

IE6 and the DOM

- IE6 does *not* pass an Event instance to event listeners
- Instead, IE6 creates a global object `event` when an (intrinsic) event occurs
- Testing for non-DOM call:



```
function needEventConversion(args) {
  return !((args.length == 1) &&
           window.Event &&
           (args[0] instanceof window.Event));
}

function updateDivs(event) {
    if (needEventConversion(arguments)) {
```

In a DOM-compliant call to event listener there is one argument that is an Event instance

Basically an Array of call arguments

IE6 and the DOM

- Converting `event` object to `Event`-like:

Undefined if IE6

```
function updateDivs(event) {
    if (needEventConversion(arguments)) {
      event = eventConvert(window.event, this);
    }
```

Global object created by IE6

In IE6, evaluates to Object value of DOM's `Event` `currentTarget` property

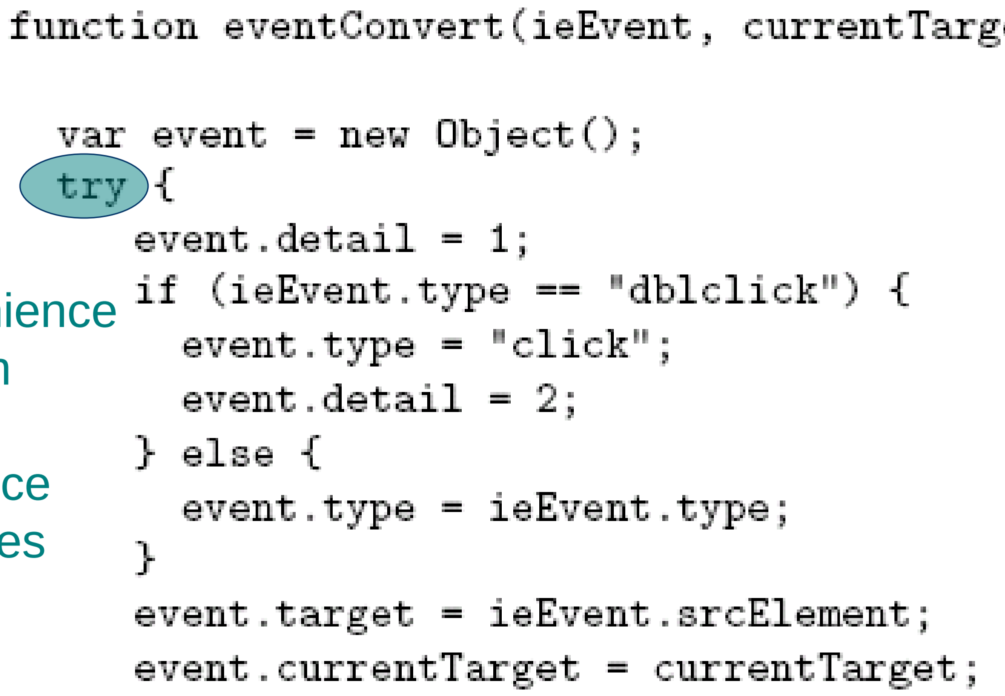
IE6 and the DOM

- Converting **event** object to **Event**-like:

```
function eventConvert(ieEvent, currentTarget) {

  var event = new Object();
  try {
      event.detail = 1;
      if (ieEvent.type == "dblclick") {
        event.type = "click";
        event.detail = 2;
      } else {
        event.type = ieEvent.type;
      }
      event.target = ieEvent.srcElement;
      event.currentTarget = currentTarget;
```

IE6 and the DOM

- Converting `event` object to `Event`-like:



```
function eventConvert(ieEvent, currentTarget) {

  var event = new Object();
  try {
      event.detail = 1;
      if (ieEvent.type == "dblclick") {
        event.type = "click";
        event.detail = 2;
      } else {
        event.type = ieEvent.type;
      }
      event.target = ieEvent.srcElement;
      event.currentTarget = currentTarget;
```

Use exception handling for convenience rather than testing for existence of properties

IE6 and the DOM

- Converting `event` object to `Event`-like:

```
function eventConvert(ieEvent, currentTarget) {

  var event = new Object();
  try {
    event.detail = 1;
    if (ieEvent.type == "dblclick") {
      event.type = "click";
      event.detail = 2;
    } else {
      event.type = ieEvent.type;
    }
    event.target = ieEvent.srcElement;
    event.currentTarget = currentTarget;
```

Most `type` values (except dblclick) are copied without change

IE6 and the DOM

- Converting `event` object to `Event`-like:

```
function eventConvert(ieEvent, currentTarget) {

  var event = new Object();
  try {
    event.detail = 1;
    if (ieEvent.type == "dblclick") {
      event.type = "click";
      event.detail = 2;
    } else {
      event.type = ieEvent.type;
    }
    event.target = ieEvent.srcElement;
    event.currentTarget = currentTarget;
```

IE6 uses a different name for `target` $\longrightarrow$

IE6 and the DOM

- Converting `event` object to `Event`-like:

```
function eventConvert(ieEvent, currentTarget) {

  var event = new Object();
  try {
     event.detail = 1;
     if (ieEvent.type == "dblclick") {
       event.type = "click";
       event.detail = 2;
     } else {
       event.type = ieEvent.type;
     }
     event.target = ieEvent.srcElement;
     event.currentTarget = currentTarget;
```

`currentTarget` passed in from event listener:
within `eventConvert()`, `this` refers to the global object!

IE6 and the DOM

- Converting `event` object to `Event`-like:

```
event.stopPropagation = function () {ieEvent.cancelBubble = true;};
event.preventDefault = function () {ieEvent.returnValue = false;};
event.screenX = ieEvent.screenX;
event.screenY = ieEvent.screenY;
event.clientX = ieEvent.clientX;
event.clientY = ieEvent.clientY;
event.altKey = ieEvent.altKey;
event.ctrlKey = ieEvent.ctrlKey;
// No meta key defined in IE event object
event.shiftKey = ieEvent.shiftKey;
```

IE6 and the DOM

- Converting `event` object to `Event`-like:

Use function expressions to define DOM methods as setting IE properties

```
event.stopPropagation = function () {ieEvent.cancelBubble = true;};
event.preventDefault = function () {ieEvent.returnValue = false;};
event.screenX = ieEvent.screenX;
event.screenY = ieEvent.screenY;
event.clientX = ieEvent.clientX;
event.clientY = ieEvent.clientY;
event.altKey = ieEvent.altKey;
event.ctrlKey = ieEvent.ctrlKey;
// No meta key defined in IE event object
event.shiftKey = ieEvent.shiftKey;
```

IE6 and the DOM

- Converting `event` object to `Event`-like:

```
event.stopPropagation = function () {ieEvent.cancelBubble = true;};
event.preventDefault = function () {ieEvent.returnValue = false;};
event.screenX = ieEvent.screenX;
event.screenY = ieEvent.screenY;
event.clientX = ieEvent.clientX;
event.clientY = ieEvent.clientY;
event.altKey = ieEvent.altKey;
event.ctrlKey = ieEvent.ctrlKey;
// No meta key defined in IE event object
event.shiftKey = ieEvent.shiftKey;
```

Most mouse-event properties are identical

IE6 and the DOM

◆ Converting `event` object to `Event`-like:

```
    switch (ieEvent.button) {
      case 1: event.button = 0; break;
      case 4: event.button = 1; break;
      case 2: event.button = 2; break;
    }
    switch (ieEvent.type) {
      case "mouseover": event.relatedTarget = ieEvent.fromElement; break;
      case "mouseout": event.relatedTarget = ieEvent.toElement; break;
    }
  } catch (e) {
    // Return whatever we have and hope for the best...
  }
  return event;
}
```

Buttons are numbered differently

IE6 and the DOM

- Converting `event` object to `Event`-like:

```
    switch (ieEvent.button) {
      case 1: event.button = 0; break;
      case 4: event.button = 1; break;
      case 2: event.button = 2; break;
    }
    switch (ieEvent.type) {
      case "mouseover": event.relatedTarget = ieEvent.fromElement; break;
      case "mouseout": event.relatedTarget = ieEvent.toElement; break;
    }
  } catch (e) {
    // Return whatever we have and hope for the best...
  }
  return event;
}
```

Different names for relatedTarget

IE6 and the DOM

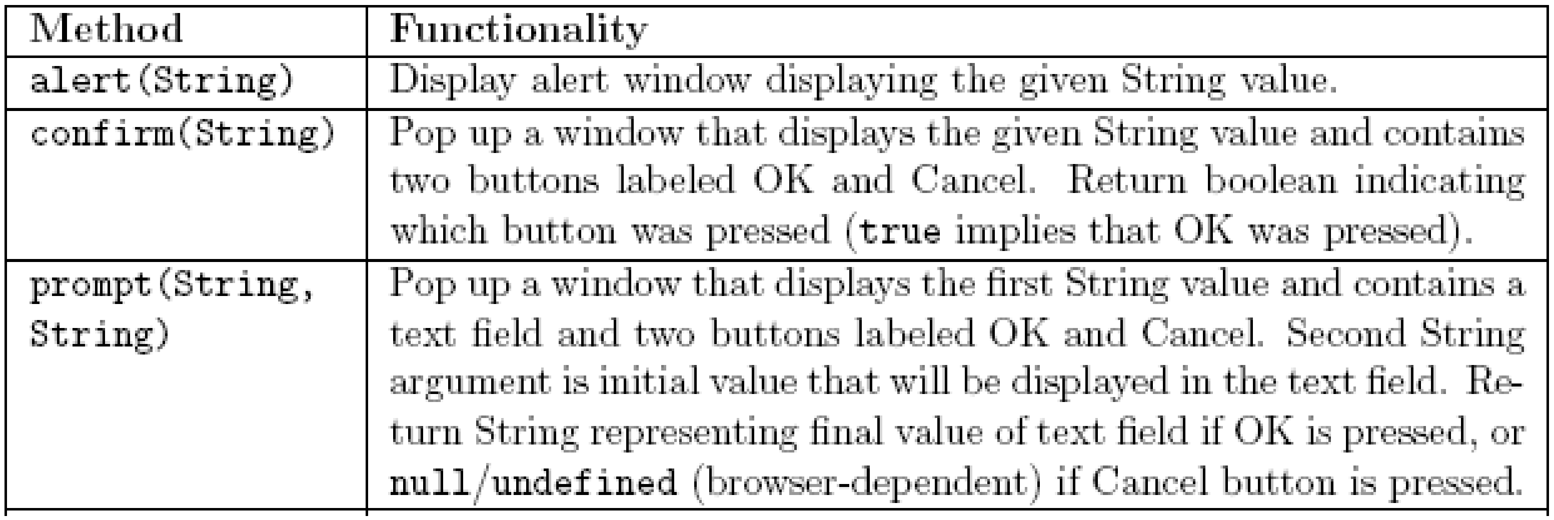
- Converting `event` object to `Event`-like:
  - Capturing listeners behave somewhat differently in IE6 and DOM, so `eventConvert()` did not attempt to simulate the `eventPhase` DOM property

Other Common Host Objects

- Browsers also provide many non-DOM host objects as properties of `window`
- While no formal standard defines these objects, many host objects are very similar in IE6 and Mozilla

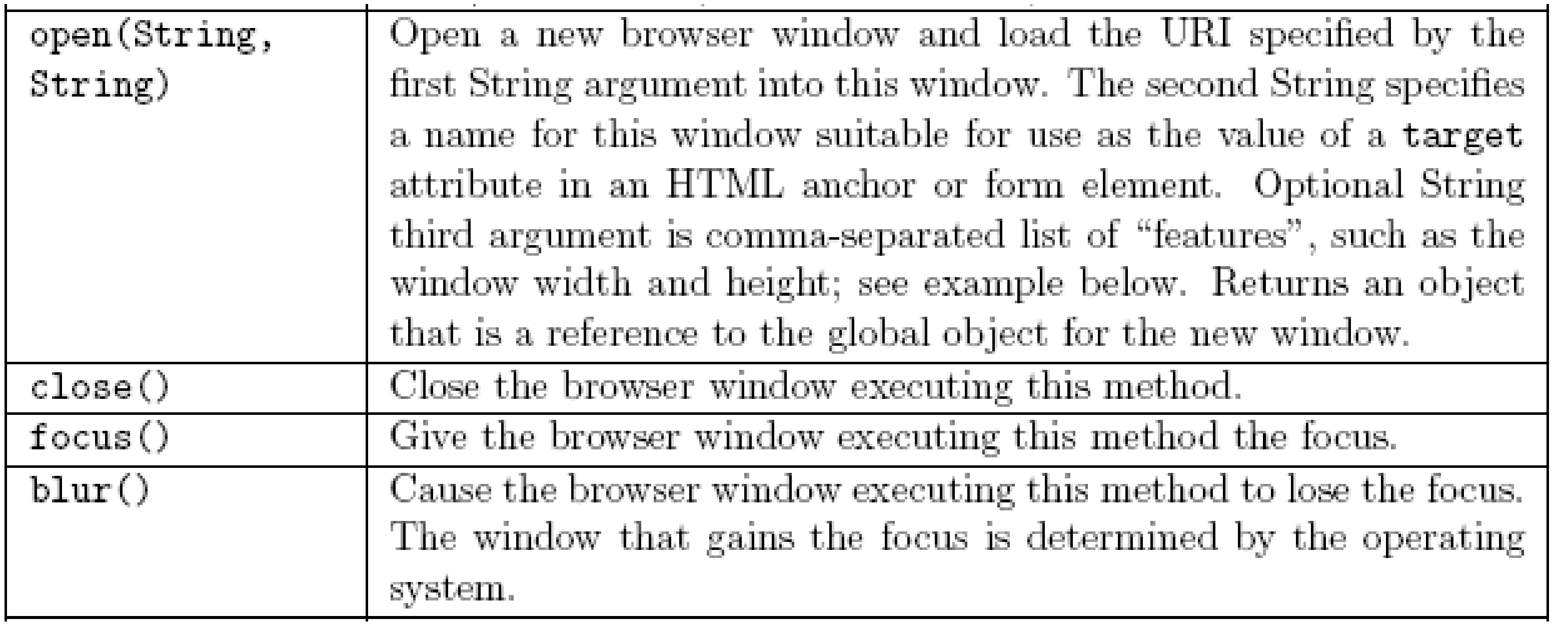
Other Common Host Objects

TABLE 5.10: Some common `window` methods.



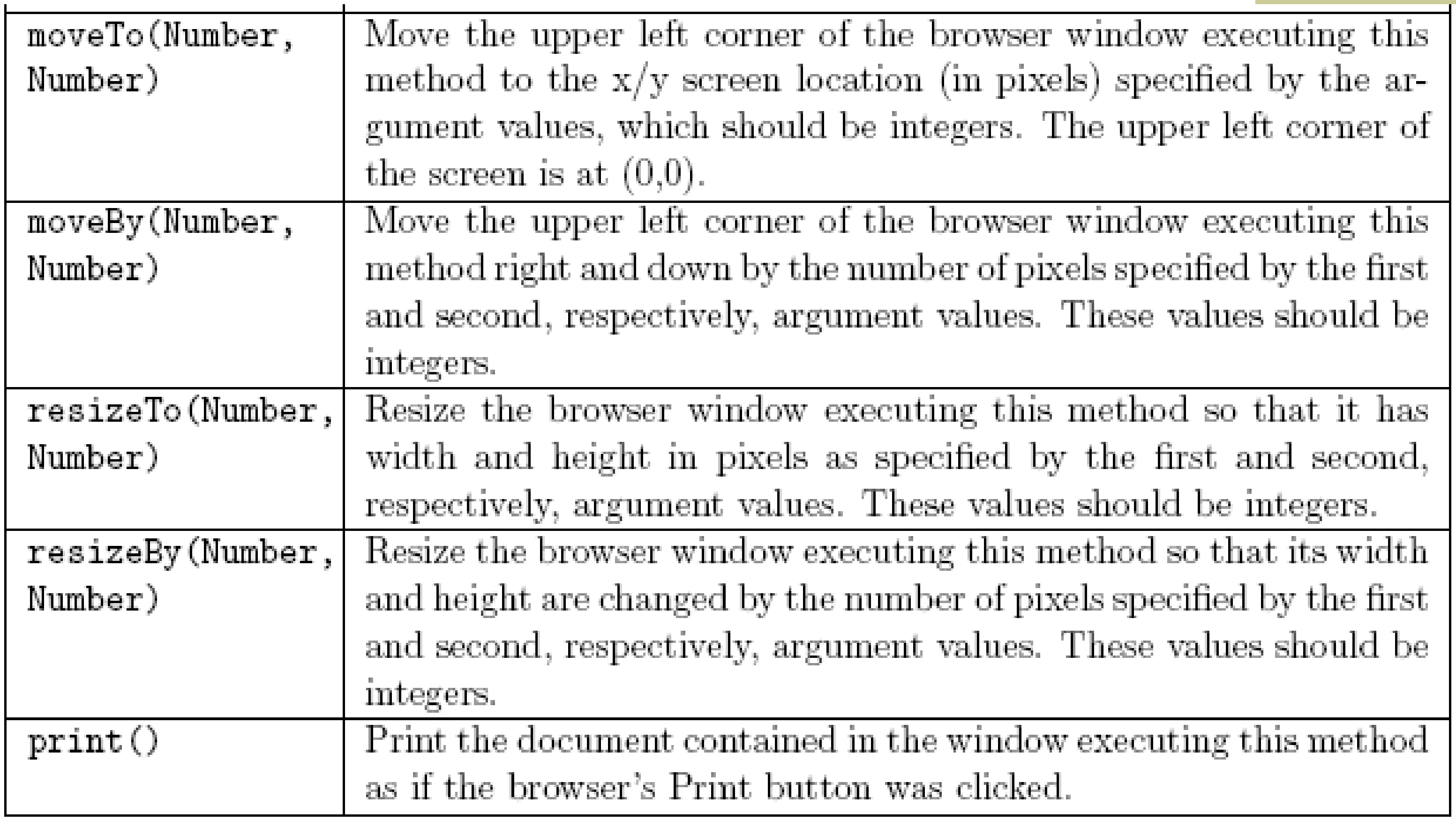
Method	Functionality
`alert(String)`	Display alert window displaying the given String value.
`confirm(String)`	Pop up a window that displays the given String value and contains two buttons labeled OK and Cancel. Return boolean indicating which button was pressed (`true` implies that OK was pressed).
`prompt(String, String)`	Pop up a window that displays the first String value and contains a text field and two buttons labeled OK and Cancel. Second String argument is initial value that will be displayed in the text field. Return String representing final value of text field if OK is pressed, or `null`/`undefined` (browser-dependent) if Cancel button is pressed.

Other Common Host Objects



`open(String, String)`	Open a new browser window and load the URI specified by the first String argument into this window. The second String specifies a name for this window suitable for use as the value of a `target` attribute in an HTML anchor or form element. Optional String third argument is comma-separated list of "features", such as the window width and height; see example below. Returns an object that is a reference to the global object for the new window.
`close()`	Close the browser window executing this method.
`focus()`	Give the browser window executing this method the focus.
`blur()`	Cause the browser window executing this method to lose the focus. The window that gains the focus is determined by the operating system.

Other Common Host Objects



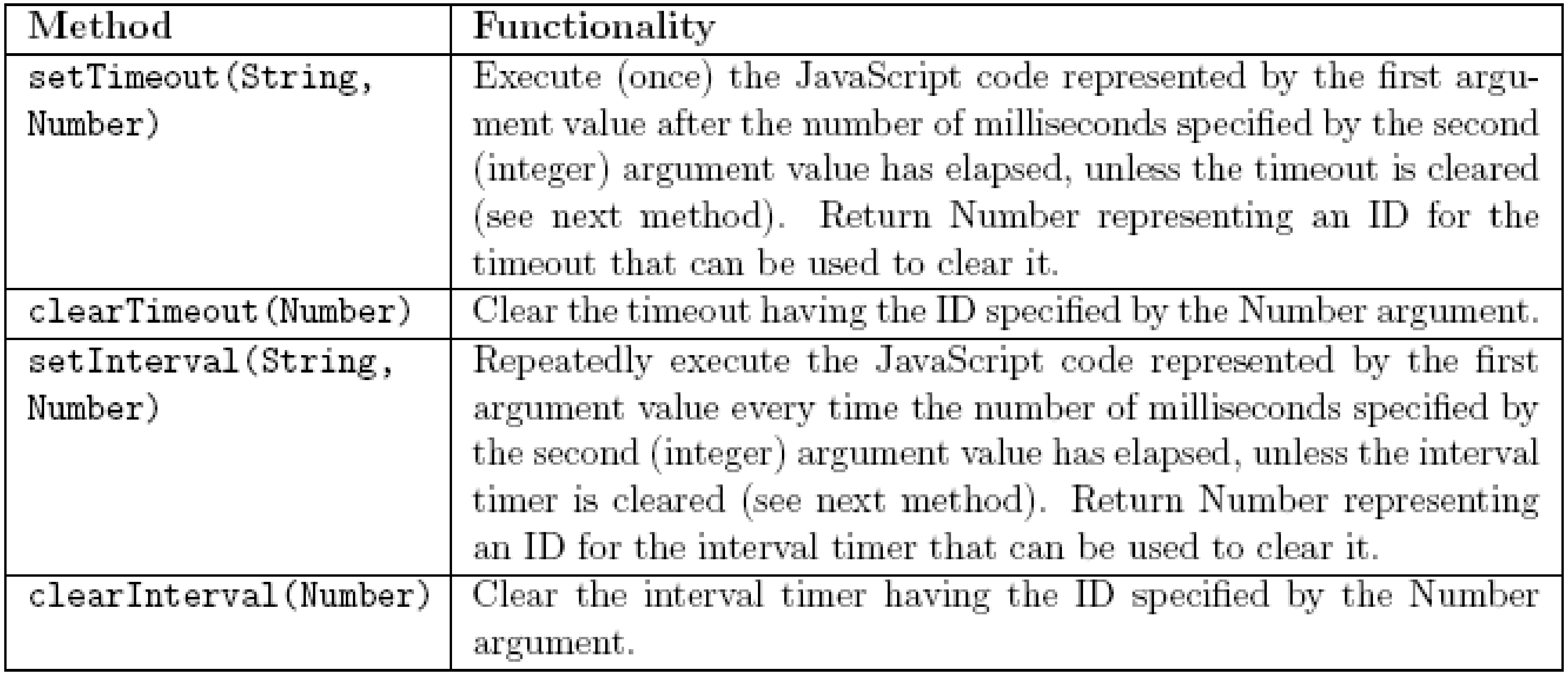
`moveTo(Number, Number)`	Move the upper left corner of the browser window executing this method to the x/y screen location (in pixels) specified by the argument values, which should be integers. The upper left corner of the screen is at (0,0).
`moveBy(Number, Number)`	Move the upper left corner of the browser window executing this method right and down by the number of pixels specified by the first and second, respectively, argument values. These values should be integers.
`resizeTo(Number, Number)`	Resize the browser window executing this method so that it has width and height in pixels as specified by the first and second, respectively, argument values. These values should be integers.
`resizeBy(Number, Number)`	Resize the browser window executing this method so that its width and height are changed by the number of pixels specified by the first and second, respectively, argument values. These values should be integers.
`print()`	Print the document contained in the window executing this method as if the browser's Print button was clicked.

Other Common Host Objects

- `open()` creates a pop-up window
  - Each window has its own global object, host objects, etc.
  - Use pop-ups with care:
    - Pop-ups may be blocked by the browser
    - They can annoy and/or confuse users

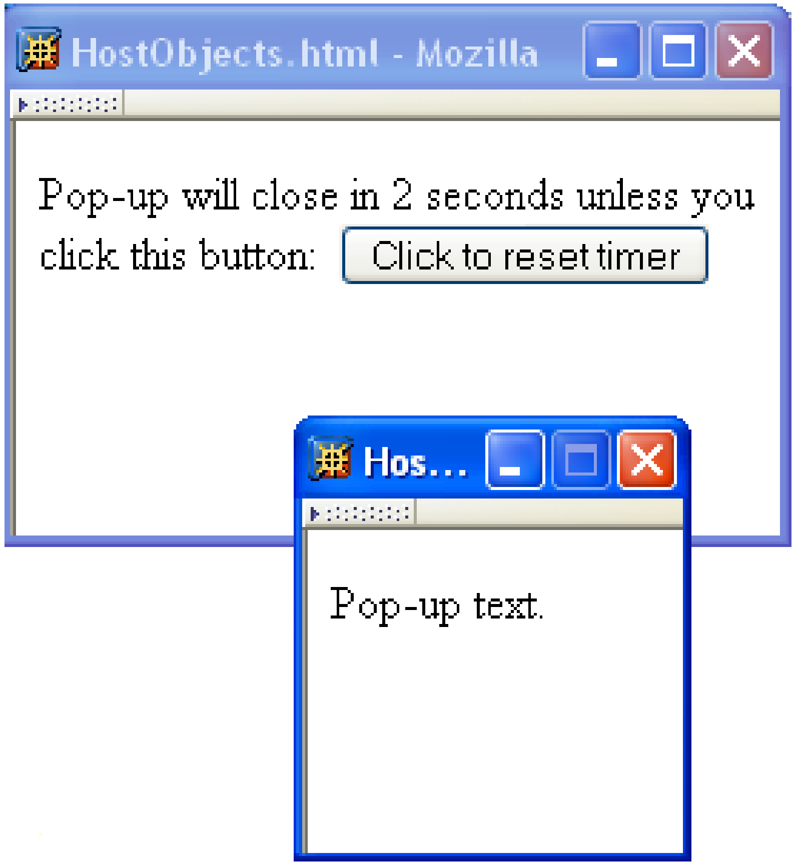
Other Common Host Objects

TABLE 5.11: Common `window` methods related to time.



Method	Functionality
`setTimeout(String, Number)`	Execute (once) the JavaScript code represented by the first argument value after the number of milliseconds specified by the second (integer) argument value has elapsed, unless the timeout is cleared (see next method). Return Number representing an ID for the timeout that can be used to clear it.
`clearTimeout(Number)`	Clear the timeout having the ID specified by the Number argument.
`setInterval(String, Number)`	Repeatedly execute the JavaScript code represented by the first argument value every time the number of milliseconds specified by the second (integer) argument value has elapsed, unless the interval timer is cleared (see next method). Return Number representing an ID for the interval timer that can be used to clear it.
`clearInterval(Number)`	Clear the interval timer having the ID specified by the Number argument.

Other Common Host Objects



Pop-up will close in 2 seconds unless you click this button: Click to reset timer

Pop-up text.

Other Common Host Objects

```
<body onload="init();">
  <p>
    <label>Pop-up will close in <span id="countdown">10</span>
      seconds unless you click this button:&nbsp;
      <button type="button"
              onclick="resetCountdown();">Click to reset timer</button>
    </label>
  </p>
</body>
```

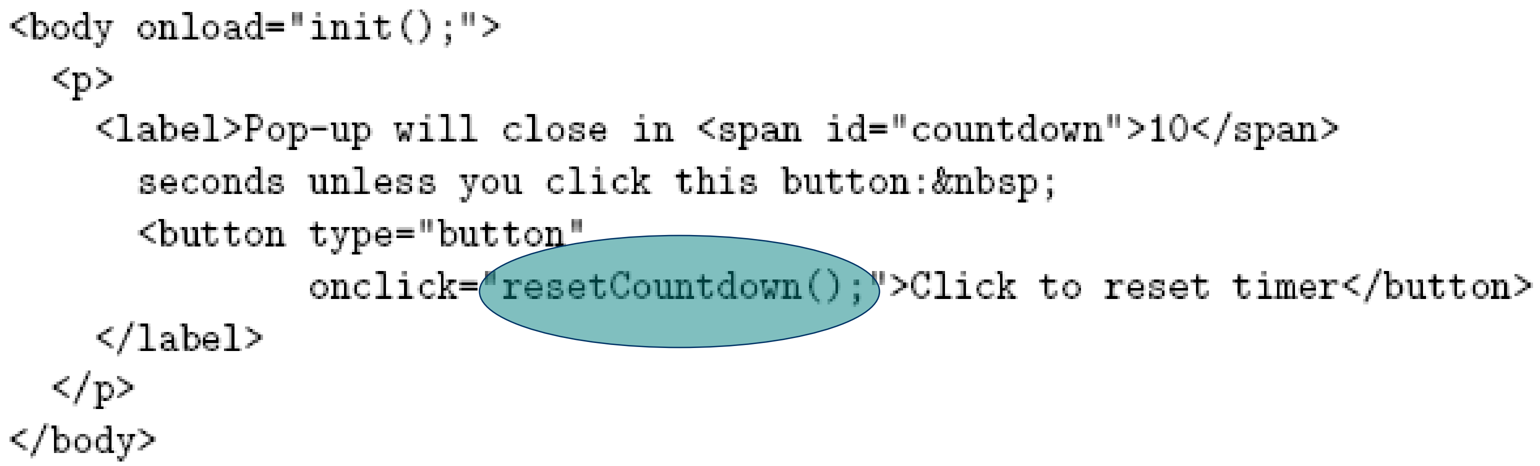
Other Common Host Objects

```
<body onload="init();">
  <p>
    <label>Pop-up will close in <span id="countdown">10</span>
      seconds unless you click this button:&nbsp;
      <button type="button"
              onclick="resetCountdown();">Click to reset timer</button>
    </label>
  </p>
</body>
```

Other Common Host Objects

```
var popup;          // Reference to pop-up window's global object
var intervalID;     // ID of one-second interval timer
var countdownElt;   // span containing number of seconds until pop-up closes

function init() {
  popup = window.open("HostObjectsPopUp.html", "popup",
                      "width=100,height=100");
  intervalID = window.setInterval("messWithPopUp();", 1000);
  countdownElt = window.document.getElementById("countdown");
  return;
}
```

Other Common Host Objects



```
<body onload="init();">
  <p>
    <label>Pop-up will close in <span id="countdown">10</span>
      seconds unless you click this button:&nbsp;
      <button type="button"
              onclick="resetCountdown();">Click to reset timer</button>
    </label>
  </p>
</body>
```

Other Common Host Objects

```
var popup;          // Reference to pop-up window's global object
var intervalID;     // ID of one-second interval timer
var countdownElt;   // span containing number of seconds until pop-up closes

function resetCountdown() {
  countdownElt.childNodes[0].data = "10";
  popup.focus();  // Make sure the pop-up is still visible.
  return;
}
```

Other Common Host Objects

```
var popup;          // Reference to pop-up window's global object
var intervalID;     // ID of one-second interval timer
var countdownElt;   // span containing number of seconds until pop-up closes
```

```
function messWithPopUp() {
  var secondsLeft = countdownElt.childNodes[0].data - 1;
  countdownElt.childNodes[0].data = String(secondsLeft);
  if (secondsLeft == 0) {
    window.clearInterval(intervalID);
    popup.close();
  } else {
    popup.moveBy(10,10);
    popup.resizeBy(2,2);
    popup.focus();
  }
  return;
}
```

Other Common Host Objects

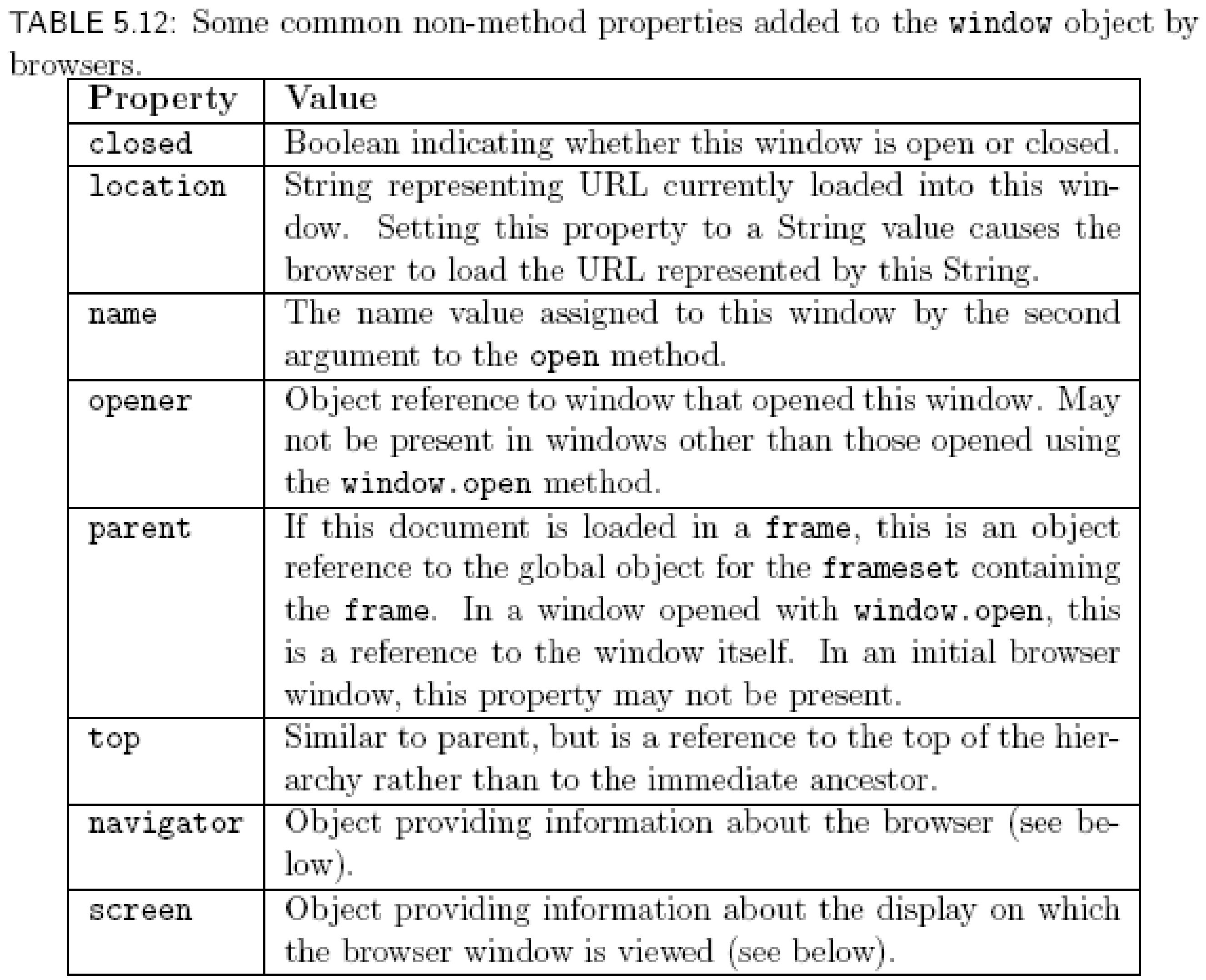


TABLE 5.12: Some common non-method properties added to the `window` object by browsers.

Property	Value
`closed`	Boolean indicating whether this window is open or closed.
`location`	String representing URL currently loaded into this window. Setting this property to a String value causes the browser to load the URL represented by this String.
`name`	The name value assigned to this window by the second argument to the `open` method.
`opener`	Object reference to window that opened this window. May not be present in windows other than those opened using the `window.open` method.
`parent`	If this document is loaded in a `frame`, this is an object reference to the global object for the `frameset` containing the `frame`. In a window opened with `window.open`, this is a reference to the window itself. In an initial browser window, this property may not be present.
`top`	Similar to parent, but is a reference to the top of the hierarchy rather than to the immediate ancestor.
`navigator`	Object providing information about the browser (see below).
`screen`	Object providing information about the display on which the browser window is viewed (see below).

Other Common Host Objects

- `navigator`: (unreliable) information about browser, including String-valued properties:
  - `appName`
  - `appVersion`
  - `userAgent`
- `screen`: information about physical device, including Number properties:
  - `availHeight`, `availWidth`: effective screen size (pixels)
  - `colorDepth`: bits per pixel