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THE JAVASCRIPT ANTHOLOGY

101 ESSENTIAL TIPS, TRICKS & HACKS

BY JAMES EDWARDS
& CAMERON ADAMS

THE MOST COMPLETE QUESTION AND ANSWER BOOK ON JAVASCRIPT

The JavaScript Anthology
101 Essential Tips, Tricks & Hacks
(4 Chapter Sample)

Thank you for downloading this four-chapter sample of James Edwards's and Cameron Adams's book, *The JavaScript Anthology: 101 Essential Tips, Tricks & Hacks*, published by SitePoint.

This excerpt includes the Summary of Contents, Information about the Authors, Editors and SitePoint, Table of Contents, Preface, four chapters of the book, and the index.

We hope you find this information useful in evaluating this book.

Summary of Contents of this Excerpt

Summary of Additional Book Contents

The JavaScript Anthology
101 Essential Tips, Tricks & Hacks

by James Edwards

and Cameron Adams

The JavaScript Anthology: 101 Essential Tips, Tricks & Hacks

by James Edwards and Cameron Adams

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For Kizzy—I missed @media for all the right reasons.

—James

This is for Mum, Dad, Darren, and Davina, who gave me their love and support throughout the writing of this book, even though I had to explain it all using plasticine dinosaurs.

—Cameron

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Preface

To many people, the word "JavaScript" conjures up memories of annoying popups, irritating mouse-trails, and frustrating no-right-click scripts. If you've ever been on the receiving end of such a script, you'll know how tedious they can be. Yet JavaScript is a mature, professional scripting language that's used on the majority of modern web sites, and is a key component in almost all web-based applications. Hang on! Are we talking about the same technology here?

As with so many histories, both perceptions are reasonably accurate: JavaScript does have a dubious reputation, which it earned mainly in the first dot com boom when it was used for little else than opening popups, shielding code from casual scrutiny, and adding pointless whizz-bang effects. And in recent years, as both the web development community and the world at large have become more aware of accessibility issues, JavaScript has been singled out as a cause of many problems, though in reality, it's not the technology itself that's at fault—it's the poorly planned and careless use that has given JavaScript this reputation.

Yet with the increasing popularity of remote scripting techniques (popularly referred to as "AJAX"), JavaScript is enjoying something of a renaissance. Designers, developers, and programmers from many different disciplines are becoming interested in—and impressed by—what was once the domain of specialists. Browser vendors and other technology companies are taking another look at the potential of this powerful language, as the line between the Web and the desktop becomes increasingly blurred.

JavaScript is a key component in the development of a raft of new applications, and there's never been a better time to take an interest in it.

Who Should Read this Book?

Anyone who's involved or interested in building web sites or web applications should read this book.

If you're a webmaster looking for copy-and-paste solutions to everyday needs, we have those solutions for you. If you're already an experienced JavaScript programmer, you'll find in this book scripts and discussions that sit on the bleeding edge of current practice. If you're a designer with an interest in the coding side of things, or a student who's just beginning to get into it, you'll find many rich and beautiful examples to give you insight and ideas.

Whatever your current JavaScript knowledge, we hope you'll find this book a useful and inspirational resource for modern, best practice scripting.

What's in this Book?

Chapter 1: ***Getting Started With JavaScript***
This chapter, which is slightly more theoretical than the rest, provides an overview of JavaScript's capabilities and limitations, and introduces some core best practices that we'll be using through the rest of the book. It's not a beginners' tutorial, nor a ground-up summary of the language, but it focuses on finding the best ways to perform basic tasks, including practical solutions for the problems that are encountered as we try to make scripts work together.

Chapter 2: ***Working with Numbers***
This chapter looks at techniques for using and processing numbers in JavaScript. It covers basic computation, number rounding, the generation and constraint of random numbers, and the use of currency values, ordinals, and other formatted numbers.

Chapter 3: ***Working with Strings***
Text is the meat and drink of the Web, and processing text is one of the most common tasks in web scripting. This chapter looks at ways of manipulating strings to find information, store data, and prepare text for output, and includes a thorough introduction to regular expressions in JavaScript.

Chapter 4: ***Working with Arrays***
This chapter introduces one the most powerful data-storage structures in JavaScript: the array. We'll talk about reading and writing data from an array, sorting and processing arrays, and using multidimensional arrays. We'll also discuss a similar data structure: the object literal.

Chapter 5: ***Navigating the Document Object Model***
The DOM is an interface for manipulating individual parts of a document. This chapter introduces and explores the DOM, and looks at how to create and read the data from elements, attributes, and text.

Chapter 6: ***Processing and Validating Forms***
In this chapter, we look at reading and writing data from different kinds of form widget, address the tasks of validating and processing form data, and discuss techniques for improving the usability of form-based interfaces.

Chapter 7: ***Working with Windows and Frames***

This chapter takes a cautious look at manipulating windows and scripting across frames. These are the most controversial parts of the language, as they have the potential to create serious usability and accessibility barriers, so this chapter is centered firmly on techniques that try to avoid or alleviate these problems.

Chapter 8: ***Working with Cookies***

Cookies are the simplest and most reliable method for maintaining state-persistence in JavaScript—they allow pages and applications to "remember" who you are and what you're doing. In this chapter, we introduce cookies and show you how to use them effectively.

Chapter 9: ***Working with Dates and Times***

It won't win any prizes for glamour, but this chapter shows you how to get the date and time in JavaScript, how to compare and process dates and times, and how to output the final data in different formats and conventions.

Chapter 10: ***Working with Images***

Images are an important part of most web designs, and this chapter explores the basic techniques involved in scripting for them. We move from simple tasks like preloading, randomly selecting, swapping, and cross-fading images, to more complex slide show, progress indicator, and image-based clock scripts.

Chapter 11: ***Detecting Browser Differences***

This short chapter outlines techniques for dealing with different browsers and rendering modes. In it, we explain when and where it's appropriate to use browser detection and object detection, and how you can combine these techniques to get the most robust information.

Chapter 12: ***Using JavaScript with CSS***

In this chapter, we look at how to read and write the styles from a single element or group of elements, how to read and write CSS rules to an existing or created style sheet, and how to build a style sheet switcher.

Chapter 13: ***Basic Dynamic HTML***

DHTML uses HTML, the DOM, and CSS to bring static content to life, and although the term DHTML is disparaged in some quarters, we still believe it's a useful and relevant way of describing this kind of scripting. In this chapter, we cover event-handling in all its flavors, detecting the position and size of an object, tracking the mouse, and making elements appear and dis-

appear. We'll also begin to look at rearranging the DOM dynamically with a neat table-sorting script.

Chapter 14: ***Time and Motion***
This chapter advances the ideas from Chapter 13 into more complex forms of scripting that use motion and animation. We'll look at timers in JavaScript, and learn how to use them for both simple and more sophisticated animations. We'll also cover drag-and-drop functionality, and put it to use selecting and sorting information, as well as creating scrollers, sliders, and transition effects.

Chapter 15: ***DHTML Menus and Navigation***
This chapter enters the complex arena of DHTML menus with two major scripts—a drop-down or fly-out menu, and a folder tree or expanding menu. For each menu, we'll create a core navigation structure using clean, semantic code. Then, we'll improve on each script with usability and accessibility enhancements, including submenu indicator arrows, open and close timers, and automatic repositioning (so that a menu never runs off the page's edge). This chapter also includes solutions for the problem of menus overlapping select elements in Windows IE 5 and IE 6.

Chapter 16: ***JavaScript and Accessibility***
This chapter provides an overview of the current state of play regarding JavaScript and accessibility. It's focused on ideas and techniques for making scripts accessible to the keyboard, and also touches on how scripting may impact on people with learning or cognitive disabilities. We'll also examine a range of different scripts, including AJAX applications, to see how they behave with screen readers.

Chapter 17: ***Using JavaScript with Flash***
In this chapter, we look at the narrow alliance between these two technologies, learning to detect whether a user has the Flash plugin, and mastering communication between JavaScript and Flash.

Chapter 18: ***Building Web Applications with JavaScript***
This chapter delves into the exciting area of online application design, including data retrieval using `XMLHttpRequest`, as well as the older technique of using `iframe`s. We'll also talk about creating custom dialogs, building editable elements like rich-text entry fields, and controlling and creating text selections to generate an auto-complete search field.

Chapter 19: *Object Orientation in JavaScript*
Object oriented programming is generally considered the best approach to large-scale programming projects, and in this chapter we introduce OOP, exploring its core concepts and benefits. We'll cover the practical techniques involved in creating an object oriented or object based script, and we'll talk about scope, inheritance, and object namespacing.

Chapter 20: *Keeping up the Pace*
The final chapter looks at everyday techniques for writing faster, more efficient code that's shorter and uses less memory. We'll also cover more brutal techniques for optimizing and obfuscating production code, but with the warning that some optimizations are more trouble than they're worth!

The Book's Web Site

Located at http://www.sitepoint.com/books/jsant1, the web site supporting this book will give you access to the following facilities.

The Code Archive

As you progress through the text, you'll note a number of references to the code archive. This is a downloadable ZIP archive that contains complete code for all the examples presented in this book. You can grab it on the book's web site at http://www.sitepoint.com/books/jsant1/code.php.

Updates and Errata

The Errata page on the book's web site will always have the latest information about known typographical and code errors, and necessary updates for changes to technologies. Visit it at http://www.sitepoint.com/books/jsant1/errata.php.

The SitePoint Forums

While we've made every attempt to anticipate any questions you may have, and answer them in this book, there's no way that *any* book could teach you everything you'll ever need to know about using JavaScript in your web development projects. If you have a question about anything in this book, the best place to go for a quick answer is http://www.sitepoint.com/forums/—SitePoint's vibrant and knowledgeable community.

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Acknowledgements

I'd like to thank all those who helped and supported me while writing this book, particularly to Eddie and Debi, Jon and Kim, who provided as much encouragement as they did practical support. I'd also like to thank Dave Evans, a significant influence from my early days as a developer.

—James Edwards

1 Getting Started with JavaScript

As we hope to demonstrate in many practical solutions throughout this book, JavaScript is an amazingly useful language that offers many unique benefits. With a little consideration for how scripted functionality degrades, you can use JavaScript to bring a whole range of functional, design and usability improvements to your web sites.

Let's begin with an introduction to JavaScript, exploring what it's for, and how we can use it.

JavaScript Defined

JavaScript is a scripting language that's used to add interactivity and dynamic behaviors to web pages and applications. JavaScript can interact with other components of a web page, such as HTML and CSS, to make them change in real time, or respond to user events.

You'll undoubtedly have seen JavaScript in the source code of web pages. It might have been inline code in an HTML element, like this:

```
<a href="page.html" onclick="open('page.html'); return false;">
```

It might have appeared as a `script` element linking to another file:

```
<script type="text/javascript" src="myscript.js"></script>
```

Or it may have had code directly inside it:

```
<script type="text/javascript">
function saySomething(message)
{
  alert(message);
}
saySomething('Hello world!');
</script>
```

Don't worry about the differences between these snippets yet. There are quite a few ways—both good and bad—in which we can add JavaScript to a web page. We'll look at these approaches in detail later in this chapter.

JavaScript was developed by Netscape and implemented in Netscape 2, although it was originally called LiveScript. The growing popularity of another language, Java, prompted Netscape to change the name in an attempt to cash in on the connection, as JavaScript provided the ability to communicate between the browser and a Java applet.

But as the language was developed both by Netscape, in its original form, and by Microsoft, in the similar-but-different JScript implementation, it became clear that web scripting was too important to be left to the wolves of vendor competition. So, in 1996, development was handed over to an international standards body called ECMA, and JavaScript became ECMAScript or ECMA-262.

Most people still refer to it as JavaScript, and this can be a cause of confusion: apart from the name and similarities in syntax, Java and JavaScript are nothing alike.

JavaScript's Limitations

JavaScript is most commonly used as a **client-side language**, and in this case the "client" refers to the end-user's web browser, in which JavaScript is interpreted and run. This distinguishes it from **server-side** languages like PHP and ASP, which run on the server and send static data to the client.

Since JavaScript does not have access to the server environment, there are many tasks that, while trivial when executed in PHP, simply cannot be achieved with JavaScript: reading and writing to a database, for example, or creating text files. But since JavaScript *does* have access to the client environment, it can make de-

cisions based on data that server-side languages simply don't have, such as the position of the mouse, or the rendered size of an element.

What About ActiveX?

If you're already quite familiar with Microsoft's JScript, you might be thinking "but JavaScript *can* do some of these things using ActiveX," and that's true—but ActiveX is not part of ECMAScript. ActiveX is a Windows-specific mechanism for allowing Internet Explorer to access COM (the Component Object Model at the heart of Windows scripting technology) and generally only runs in trusted environments, such as an intranet. There are some specific exceptions we'll come across—examples of ActiveX controls that run without special security in IE (such as the Flash plugin, and `XMLHttpRequest`)—but for the most part, scripting using ActiveX is outside the scope of this book.

Usually, the computer on which a client is run will not be as powerful as a server, so JavaScript is not the best tool for doing large amounts of data processing. But the immediacy of data processing on the client makes this option attractive for small amounts of processing, as a response can be received straight away; form validation, for instance, makes a good candidate for client-side processing.

But to compare server-side and client-side languages with a view to which is "better" is misguided. Neither is better—they're tools for different jobs, and the functional crossover between them is small. However, increased interactions *between* client-side and server-side scripting are giving rise to a new generation of web scripting, which uses technologies such as `XMLHttpRequest` to make requests for server data, run server-side scripts, and then manage the results on the client side. We'll be looking into these technologies in depth in Chapter 18.

Security Restrictions

As JavaScript operates within the realm of highly sensitive data and programs, its capabilities have been restricted to ensure that it can't be used maliciously. As such, there are many things that JavaScript simply is not allowed to do. For example, it cannot read most system settings from your computer, interact directly with your hardware, or cause programs to run.

Also, some specific interactions that would normally be allowed for a particular element are not permitted within JavaScript, because of that element's properties. For example, changing the value of a form `<input>` is usually no problem, but if it's a file input field (e.g., `<input type="file">`), writing to it is not allowed at

all—a restriction that prevents malicious scripts from making users upload a file they didn't choose.

There are quite a few examples of similar security restrictions, which we'll expand on as they arise in the applications we'll cover in this book. But to summarize, here's a list of JavaScript's major limitations and security restrictions, including those we've already seen. JavaScript cannot:

- open and read files directly (except under specific circumstances, as detailed in Chapter 18).
- create or edit files on the user's computer (except cookies, which are discussed in Chapter 8).
- read HTTP `POST` data.
- read system settings, or any other data from the user's computer that is not made available through language or host objects.[1]
- modify the value of a file `input` field.
- alter a the display of a document that was loaded from a different domain.
- close or modify the toolbars and other elements of a window that was not opened by script (i.e., the main browser window).

Ultimately, JavaScript might not be supported at all.

It's also worth bearing in mind that many browsers include options that allow greater precision than simply enabling or disabling JavaScript. For example, Opera includes options to disallow scripts from closing windows, moving windows, writing to the status bar, receiving right-clicks … the list goes on. There's little you can do to work around this, but mostly, you won't need to—such options have evolved to suppress "annoying" scripts (status bar scrollers, no-right-click scripts, etc.) so if you stay away from those kinds of scripts, the issue will come up only rarely.

[1] Host objects are things like `window` and `screen`, which are provided by the environment rather than the language itself.

JavaScript Best Practices

JavaScript best practices place a strong emphasis on the question of what you should do for people whose browsers don't support scripting, who have scripting turned off, or who are unable to interact with the script for another reason (e.g., the user makes use of an assistive technology that does not support scripting).

That final issue is the most difficult to address, and we'll be focusing on solutions to this problem in Chapter 16. In this section, I'd like to look at three core principles of good JavaScript:

progressive enhancement	providing for users who don't have JavaScript
unobtrusive scripting	separating content from behavior
consistent coding practice	using braces and semicolon terminators

The first principle ensures that we're thinking about the bigger picture whenever we use a script on our site. The second point makes for easier maintenance on our end, and better usability and **graceful degradation**[2] for the user. The third principle makes code easier to read and maintain.

Providing for Users who Don't Have JavaScript (Progressive Enhancement)

There are several reasons why users might not have JavaScript:

- They're using a device that doesn't support scripting at all, or supports it in a limited way.
- They're behind a proxy server or firewall that filters out JavaScript.
- They have JavaScript switched off deliberately.

The first point covers a surprisingly large and ever-growing range of devices, including small-screen devices like PDAs, mid-screen devices including WebTV

[2]Graceful degradation means that if JavaScript is not supported, the browser can naturally fall back on, or "degrade" to, non-scripted functionality.

and the Sony PSP, as well as legacy JavaScript browsers such as Opera 5 and Netscape 4.

The last point in the list above is arguably the least likely (apart from other developers playing devil's advocate!), but the reasons aren't all that important: some users simply don't have JavaScript, and we should accommodate them. There's no way to quantify the numbers of users who fall into this category, because detecting JavaScript support from the server is notoriously unreliable, but the figures I've seen put the proportion of users who have JavaScript switched off between 5% and 20%, depending on whether you describe search engine robots as "users."

Solution

The long-standing approach to this issue is to use the HTML `noscript` element, the contents of which are rendered by browsers that don't support the `script` element at all, and browsers that support it but have scripting turned off.

Although it's a sound idea, in practice this solution has become less useful over time, because `noscript` *cannot differentiate by capability*. A browser that offers limited JavaScript support is not going to be able to run a complicated script, but such devices *are* script-capable browsers, so they won't parse the `noscript` element either. These browsers would end up with nothing.

A better approach to this issue is to begin with static HTML, then use scripting to modify or add dynamic behaviors within that static content.

Let's look at a simple example. The preferred technique for making DHTML menus uses an unordered list as the main menu structure. We'll be devoting the whole of Chapter 15 to this subject, but this short example illustrates the point:

```
<ul id="menu">
  <li><a href="/">Home</a></li>
  <li><a href="/about/">About</a></li>
  <li><a href="/contact/">Contact</a></li>
</ul>

<script type="text/javascript" src="menu.js"></script>
```

The list of links is plain HTML, so it exists for all users, whether or not they have scripting enabled. If scripting *is* supported, our `menu.js` script can apply dynamic behaviors, but if scripting isn't supported, the content still appears. We haven't differentiated between devices explicitly—we've just provided content that's dynamic if the browser can handle it, and static if not.

Discussion

The "traditional" approach to this scenario would be to generate a separate, dynamic menu in pure JavaScript, and to have fallback static content inside a `noscript` element:

```
<script type="text/javascript" src="menu.js"></script>

<noscript>
  <ul>
    <li><a href="/">Home</a></li>
    <li><a href="/about/">About</a></li>
    <li><a href="/contact/">Contact</a></li>
  </ul>
</noscript>
```

But, as we've already seen, a wide range of devices will fall though this net, because JavaScript support is no longer an all-or-nothing proposition. The above approach provides default content to *all* devices, and applies scripted functionality only if it works.

This scripting approach is popularly referred to as **progressive enhancement**, and it's a methodology we'll be using throughout this book.

Don't Ask!

Neither this technique nor the `noscript` element should be used to add a message that reads, "Please turn on JavaScript to continue." At best, such a message is presumptuous ("Why should I?"); at worst it may be unhelpful ("I can't!") or meaningless ("What's JavaScript?"). Just like those splash pages that say, "Please upgrade your browser," these messages are as useful to the average web user as a road sign that reads, "Please use a different car."

Occasionally, you may be faced with a situation in which equivalent functionality simply *cannot* be provided without JavaScript. In such cases, I think it's okay to have a static message that informs the user of this incompatibility (in nontechnical terms, of course). But, for the most part, try to avoid providing this kind of message unless it's literally the only way.

Separating Content from Behavior (Unobtrusive Scripting)

Separating content from behavior means keeping different aspects of a web page's construction apart. Jeffrey Zeldman famously refers to this as the "three-legged stool" of web development[3]—comprising content (HTML), presentation (CSS), and behavior (JavaScript)—which emphasizes not just the difference in each aspect's functioning, but also the fact that they should be separated from one another.

Good separation makes for sites that are easier to maintain, are more accessible, and degrade well in older or lower-spec browsers.

Solution

At one extreme, which is directly opposed to the ideal of separating content from behavior, we can write inline code directly inside attribute event handlers. This is very messy, and generally should be avoided:

```
<div id="content"
    onmouseover="this.style.borderColor='red'"
    onmouseout="this.style.borderColor='black'">
```

We can improve the situation by taking the code that does the work and abstracting it into a **function**:

```
<div id="content"
    onmouseover="changeBorder('red')"
    onmouseout="changeBorder('black')">
```

Defining a function to do the work for us lets us provide most of our code in a separate JavaScript file:

File: **separate-content-behaviors.js (excerpt)**

```
function changeBorder(element, to)
{
  element.style.borderColor = to;
}
```

[3]Zeldman, J. *Designing with Web Standards*. New Riders, 2003.

But a much better approach is to avoid using inline event handlers completely. Instead, we can make use of the Document Object Model (DOM) to bind the event handlers to elements in the HTML document. The DOM is a standard programming interface by which languages like JavaScript can access the contents of HTML documents, removing the need for any JavaScript code to appear in the HTML document itself. In this example, our HTML code would look like the following:

```
<div id="content">
```

Here's the scripting we'd use:

File: **separate-content-behaviors.js**

```
function changeBorder(element, to)
{
  element.style.borderColor = to;
}

var contentDiv = document.getElementById('content');

contentDiv.onmouseover = function()
{
  changeBorder('red');
};

contentDiv.onmouseout = function()
{
  changeBorder('black');
};
```

This approach allows us to add, remove, or change event handlers without having to edit the HTML, and since the document itself does not rely on or refer to the scripting at all, browsers that don't understand JavaScript will not be affected by it. This solution also provides the benefits of reusability, because we can bind the same functions to other elements as needed, without having to edit the HTML.

This solution hinges on our ability to access elements through the DOM, which we'll cover in depth in Chapter 5.

The Benefits of Separation

By practicing good separation of content and behavior, we gain not only a practical benefit in terms of smoother degradation, but also the advantage of *thinking* in terms of separation. Since we've separated the HTML and

JavaScript, instead of combining them, when we look at the HTML we're less likely to forget that its core function should be to describe the *content* of the page, independent of any scripting.

Andy Clarke refers to the **web standards trifle**,[4] which is a useful analogy, A trifle looks the way a good web site should: when you look at the bowl, you can see all the separate layers that make up the dessert. The opposite of this might be a fruit cake: when you look at the cake, you can't tell what each different ingredient is. All you can see is a mass of cake.

Discussion

It's important to note that when you bind an event handler to an element like this, you can't do it until the element actually exists. If you put the preceding script in the `head` section of a page as it is, it would report errors and fail to work, because the `content div` has not been rendered at the point at which the script is processed.

The most direct solution is to put the code inside a `load` event handler. It will always be safe there because the `load` event doesn't fire until after the document has been fully rendered:

```
window.onload = function()
{
  var contentDiv = document.getElementById('content');

  ⋮
};
```

Or more clearly, with a bit more typing:

```
window.onload = init;

function init()
{
  var contentDiv = document.getElementById('content');

  ⋮
}
```

The problem with the `load` event handler is that only one script on a page can use it; if two or more scripts attempt to install `load` event handlers, each script will override the handler of the one that came before it. The solution to this

[4] http://www.stuffandnonsense.co.uk/archives/web_standards_trifle.html

problem is to respond to the `load` event in a more modern way; we'll look at this shortly, in "Getting Multiple Scripts to Work on the Same Page".

Using Braces and Semicolons (Consistent Coding Practice)

In many JavaScript operations, braces and semicolons are optional, so is there any value to including them when they're not essential?

Solution

Although braces and semicolons are often optional, you should always include them. This makes code easier to read—by others, and by yourself in future—and helps you avoid problems as you reuse and reorganize the code in your scripts (which will often render an optional semicolon essential).

For example, this code is perfectly valid:

File: **semicolons-braces.js (excerpt)**

```
if (something) alert('something')
else alert('nothing')
```

This code is valid thanks to a process in the JavaScript interpreter called **semicolon insertion**. Whenever the interpreter finds two code fragments that are separated by one or more line breaks, and those fragments wouldn't make sense if they were on a single line, the interpreter treats them as though a semicolon existed between them. By a similar mechanism, the braces that normally surround the code to be executed in `if-else` statements may be inferred from the syntax, even though they're not present. Think of this process as the interpreter adding the missing code elements for you.

Even though these code elements are not always necessary, it's easier to remember to use them when they *are* required, and easier to read the resulting code, if you do use them consistently.

Our example above would be better written like this:

File: **semicolons-braces.js (excerpt)**

```
if (something) { alert('something'); }
else { alert('nothing'); }
```

This version represents the ultimate in code readability:

File: **semicolons-braces.js (excerpt)**

```
if (something)
{
  alert('something');
}
else
{
  alert('nothing');
}
```

Using Function Literals

As you become experienced with the intricacies of the JavaScript language, it will become common for you to use **function literals** to create anonymous functions as needed, and assign them to JavaScript variables and object properties. In this context, the function definition should be followed by a semicolon, which terminates the variable assignment:

```
var saySomething = function(message)
{
  ⋮
};
```

Adding a Script to a Page

Before a script can begin doing exciting things, you have to load it into a web page. There are two techniques for doing this, one of which is distinctly better than the other.

Solution

The first and most direct technique is to write code directly inside a `script` element, as we've seen before:

```
<script type="text/javascript">
function saySomething(message)
{
  alert(message);
}
```

```
saySomething('Hello world!');
</script>
```

The problem with this method is that in legacy and text-only browsers—those that don't support the `script` element at all—the contents may be rendered as literal text.

A better alternative, which avoids this problem, is always to put the script in an external JavaScript file. Here's what that looks like:

```
<script type="text/javascript" src="what-is-javascript.js"
    ></script>
```

This loads an external JavaScript file named `what-is-javascript.js`. The file should contain the code that you would otherwise put inside the `script` element, like this:

File: **what-is-javascript.js**

```
function saySomething(message)
{
  alert(message);
}

saySomething('Hello world!');
```

When you use this method, browsers that don't understand the `script` element will ignore it and render no contents (since the element is empty), but browsers that do understand it will load and process the script. This helps to keep scripting and content separate, and is far more easily maintained—you can use the same script on multiple pages without having to maintain copies of the code in multiple documents.

Discussion

You may question the recommendation of not using code directly inside the `script` element. "No problem," you might say. "I'll just put HTML comments around it." Well, I'd have to disagree with that: using HTML comments to "hide" code is a very bad habit that we should avoid falling into.

Putting HTML Comments Around Code

A validating parser is not required to read comments, much less to process them. The fact that commented JavaScript works at all is an anachronism—a throwback

to an old, outdated practice that makes an assumption about the document that might not be true: it assumes that the page is served to a non-validating parser.

All the examples in this book are provided in HTML (as opposed to XHTML), so this assumption is reasonable, but if you're working with XHTML (correctly served with a MIME type of `application/xhtml+xml`), the comments in your code may be discarded by a validating XML parser before the document is processed by the browser, in which case commented scripts will no longer work *at all*. For the sake of ensuring forwards compatibility (and the associated benefits to your own coding habits as much as to individual projects), I strongly recommend that you avoid putting comments around code in this way. Your JavaScript should *always* be housed in external JavaScript files.

The `language` Attribute

The `language` attribute is no longer necessary. In the days when Netscape 4 and its contemporaries were the dominant browsers, the `<script>` tag's `language` attribute had the role of sniffing for up-level support (for example, by specifying `javascript1.3`), and impacted on small aspects of the way the script interpreter worked.

But specifying a version of JavaScript is pretty meaningless now that JavaScript is ECMAScript, and the `language` attribute has been deprecated in favor of the `type` attribute. This attribute specifies the MIME type of included files, such as scripts and style sheets, and is the only one you need to use:

```
<script type="text/javascript">
```

Technically, the value should be `text/ecmascript`, but Internet Explorer doesn't understand that. Personally, I'd be happier if it did, simply because `javascript` is (ironically) a word I have great difficulty typing—I've lost count of the number of times a script failure occurred because I'd typed `type="text/javsacript"`.

Getting Multiple Scripts to Work on the Same Page

When multiple scripts don't work together, it's almost always because the scripts want to assign event handlers for the same event on a given element. Since each element can have only one handler for each event, the scripts override one another's event handlers.

Solution

The usual suspect is the `window` object's `load` event handler, because only one script on a page can use this event; if two or more scripts are using it, the last one will override those that came before it.

We could call multiple functions from inside a single `load` handler, like this:

```
window.onload = function()
{
  firstFunction();
  secondFunction();
}
```

But, if we used this code, we'd be tied to a single piece of code from which we'd have to do everything we needed to at load time. A better solution would provide a means of adding `load` event handlers that *don't conflict with other handlers*.

When the following single function is called, it will allow us to assign *any number* of `load` event handlers, without any of them conflicting:

File: **add-load-listener.js**

```
function addLoadListener(fn)
{
  if (typeof window.addEventListener != 'undefined')
  {
    window.addEventListener('load', fn, false);
  }
  else if (typeof document.addEventListener != 'undefined')
  {
    document.addEventListener('load', fn, false);
  else if (typeof window.attachEvent != 'undefined')
  {
    window.attachEvent('onload', fn);
  }
  else
  {
    var oldfn = window.onload;
    if (typeof window.onload != 'function')
    {
      window.onload = fn;
    }
    else
    {
      window.onload = function()
```

```
      {
        oldfn();
        fn();
      };
    }
  }
}
```

Once this function is in place, we can use it any number of times:

```
addLoadListener(firstFunction);
addLoadListener(secondFunction);
addLoadListener(twentyThirdFunction);
```

You get the idea!

Discussion

JavaScript includes methods for adding (and removing) **event listeners**, which operate much like event handlers, but allow multiple listeners to subscribe to a single event on an element. Unfortunately, the syntax for event listeners is completely different in Internet Explorer than it is in other browsers: where IE uses a proprietary method, others implement the W3C Standard. We'll come across this dichotomy frequently, and we'll discuss it in detail in Chapter 13.

The W3C standard method is called `addEventListener`:

```
window.addEventListener('load', firstFunction, false);
```

The IE method is called `attachEvent`:

```
window.attachEvent('onload', firstFunction);
```

As you can see, the standard construct takes the name of the event (without the "on" prefix), followed by the function that's to be called when the event occurs, and an argument that controls event bubbling (see Chapter 13 for more details on this). The IE method takes the event *handler* name (*including* the "on" prefix), followed by the name of the function.

To put these together, we need to add some tests to check for the existence of each method before we try to use it. We can do this using the JavaScript operator `typeof`, which identifies different types of data (as `"string"`, `"number"`, `"boolean"`, `"object"`, `"array"`, `"function"`, or `"undefined"`). A method that doesn't exist will return `"undefined"`.


```
if (typeof window.addEventListener != 'undefined')
{
  ⋮ window.addEventListener is supported
}
```

There's one additional complication: in Opera, the `load` event that can trigger multiple event listeners comes from the `document` object, not the `window`. But we can't just use `document` because that doesn't work in older Mozilla browsers (such as Netscape 6). To plot a route through these quirks we need to test for `window.addEventListener`, then `document.addEventListener`, then `window.attachEvent`, in that order.

Finally, for browsers that don't support any of those methods (Mac IE 5, in practice), the fallback solution is to **chain** multiple old-style event handlers together so they'll get called in turn when the event occurs. We do this by dynamically constructing a new event handler that calls any existing handler before it calls the newly-assigned handler when the event occurs.[5]

File: **add-load-listener.js (excerpt)**

```
var oldfn = window.onload;
if (typeof window.onload != 'function')
{
  window.onload = fn;
}
else
{
  window.onload = function()
  {
    oldfn();
    fn();
  };
}
```

Don't worry if you don't understand the specifics of how this works—we'll explore the techniques involved in much greater detail in Chapter 13. There, we'll learn that event listeners are useful not just for the `load` event, but for *any* kind of event-driven script.

[5] This technique was pioneered by Simon Willison [http://www.sitepoint.com/blogs/2004/05/26/closures-and-executing-javascript-on-page-load/].

Hiding JavaScript Source Code

If you've ever created something that you're proud of, you'll understand the desire to protect your intellectual property. But JavaScript on the Web is an open-source language by nature; it comes to the browser in its source form, so if the browser can run it, a person can read it.

There are a few applications on the Web that claim to offer source-code encryption, but in reality, there's nothing you can do to encrypt source-code that another coder couldn't decrypt in seconds. In fact, some of these programs actually cause problems: they often reformat code in such a way as to make it slower, less efficient, or just plain broken. My advice? Stay away from them like the plague.

But still, the desire to hide code remains. There is something that you can do to **obfuscate**, if not outright encrypt, the code that your users can see.

Solution

Code that has been stripped of all comments and unnecessary whitespace is very difficult to read, and as you might expect, extracting individual bits of functionality from such code is extremely difficult. The simple technique of compressing your scripts in this way can put-off all but the most determined hacker. For example, take this code:

File: **obfuscate-code.js (excerpt)**

```
var oldfn = window.onload;
if (typeof window.onload != 'function')
{
  window.onload = fn;
}
else
{
  window.onload = function()
  {
    oldfn();
    fn();
  };
}
```

We can compress that code into the following two lines simply by removing unnecessary whitespace:

File: **obfuscate-code.js (excerpt)**

```
var oldfn=window.onload;if(typeof window.onload!='function'){
window.onload=fn;}else{window.onload=function(){oldfn();fn();};}
```

However, remember that important word—unnecessary. Some whitespace is essential, such as the single spaces after `var` and `typeof`.

Discussion

This practice has advantages quite apart from the benefits of obfuscation. Scripts that are stripped of comments and unnecessary whitespace are smaller; therefore, they're faster loading, and may process more quickly.

But please do remember that the code must remain strictly formatted using semicolon line terminators and braces (as we discussed in "Using Braces and Semicolons (Consistent Coding Practice)"); otherwise, the removal of line breaks will make lines of code run together, and ultimately cause errors.

Before you start compression, remember to make a copy of the script. I know it seems obvious, but I've made this mistake plenty of times, and it's all the more galling for being so elementary! What I do these days is write and maintain scripts in their fully spaced and commented form, then run them through a bunch of search/replace expressions just before they're published. Usually, I keep two copies of a script, named `myscript.js` and `myscript-commented.js`, or something similar.

We'll come back to this subject in Chapter 20, where we'll discuss this among a range of techniques for improving the speed and efficiency of scripts, as well as reducing the amount of physical space they require.

Debugging a Script

Debugging is the process of finding and (hopefully) fixing bugs. Most browsers have some kind of bug reporting built in, and a couple of external debuggers are also worth investigating.

Understanding a Browser's Built-in Error Reporting

Opera, Mozilla browsers (such as Firefox), and Internet Explorer all have decent bug reporting functionality built in, but Opera and Mozilla's debugging tools are the most useful.

Opera
: Open the JavaScript console from Tools > Advanced > JavaScript console. You can also set it to open automatically when an error occurs by going to Tools > Preferences > Advanced > Content, then clicking the JavaScript options button to open its dialog, and checking Open JavaScript console on error.

Firefox and other Mozilla browsers
: Open the JavaScript console from Tools > JavaScript console.

Internet Explorer for Windows
: Go to Tools > Internet Options > Advanced and uncheck the option Disable script debugging, then check the option Display a notification about every script error, to make a dialog pop up whenever an error occurs.

Internet Explorer for Mac
: Go to Explorer > Preferences > Web Browser > Web Content and check the Show scripting error alerts option.

Safari doesn't include bug reporting by default, but recent versions have a "secret" Debug menu, including a JavaScript console, which you can enable by entering the following Terminal command:[6]

```
$ defaults write com.apple.safari IncludeDebugMenu -bool true
```

You can also use an extension called Safari Enhancer,[7] which includes an option to dump JavaScript messages to the Mac OS Console; however, these messages are not very helpful.

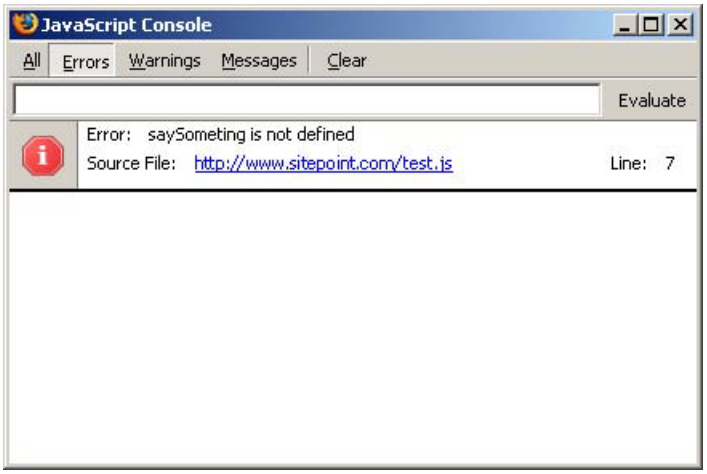
Understanding the various browsers' console messages can take a little practice, because each browser gives such different information. Here's an example of an error—a mistyped function call:

[6] The **$** represents the command prompt, and is not to be typed.
[7] http://www.lordofthecows.com/safari_enhancer.php

```
function saySomething(message)
{
  ⋮
  alert(message);
}
saySometing('Hello world');
```

Firefox gives a concise but very accurate report, which includes the line number at which the error occurred, and a description, as shown in Figure 1.1.

Figure 1.1. The JavaScript errors console in Firefox



As Figure 1.2 illustrates, Opera gives an extremely verbose report, including a backtrace to the event from which the error originated, a notification of the line where it occurred, and a description.

A **backtrace** helps when an error occurs in code that was originally called by other code; for example, where an event-handler calls a function that goes on to call a second function, and it's at this point that the error occurs. Opera's console will trace this process back through each stage to its originating event or call.

Internet Explorer gives the fairly basic kind of report shown in Figure 1.3. It provides the number of the line at which the interpreter encountered the error (this may or may not be close to the true location of the actual problem),[8] plus

[8]Internet Explorer is particularly bad at locating errors in external JavaScript files. Often, the line number it will report as the error location will actually be the number of the line at which the script is loaded in the HTML file.

a summary of the error type, though it doesn't explain the specifics of the error itself.

Figure 1.2. The JavaScript console in Opera

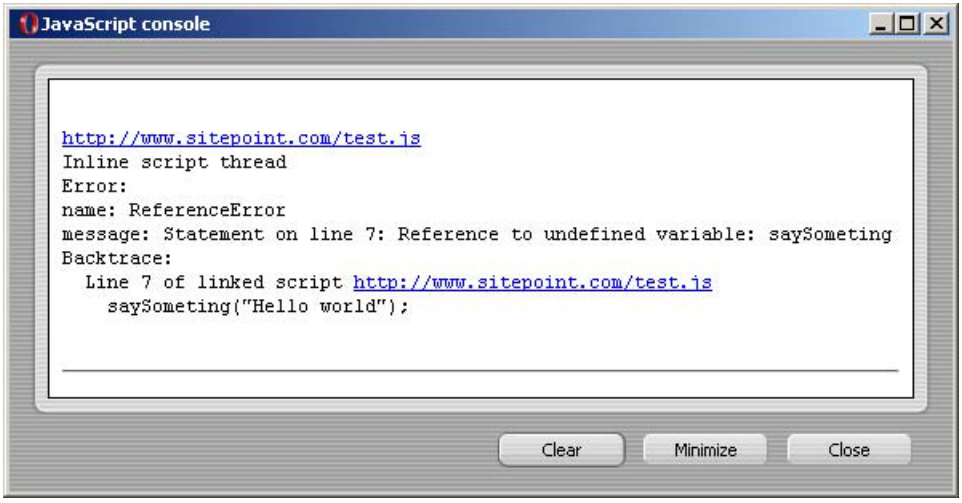
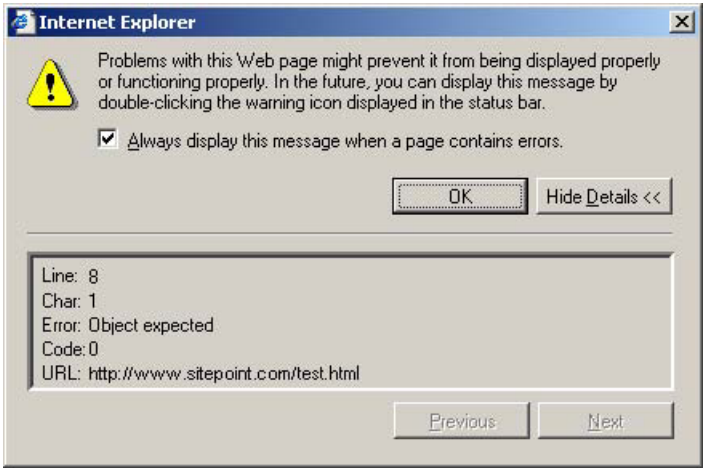


Figure 1.3. The JavaScript console in Windows IE



As you probably gathered, I'm not overly impressed by Internet Explorer's error reporting, but it is vastly better than nothing: at least you know that an error has occurred.

Using `alert`

The `alert` function is a very useful means of analyzing errors—you can use it at any point in a script to probe objects and variables to see if they contain the data you expect. For example, if you have a function that has several conditional branches, you can add an `alert` within each condition to find out which is being executed:

File: **debugging-dialogs.js**

```
function checkAge(years)
{
  if (years < 13)
  {
    alert('less than 13');

    ⋮ other scripting
  }
  else if (years >= 13 && years <= 21)
  {
    alert('13 to 21');

    ⋮ other scripting
  }
  else
  {
    alert('older');

    ⋮ other scripting
  }
}
```

Maybe the value for *years* is not coming back as a number, like it should. You could add to the start of your script an `alert` that tests the variable to see what type it is:

```
function checkAge(years)
{
  alert(typeof years);
  ⋮
```

In theory, you can put any amount of information in an `alert` dialog, although a very long string of data could create such a wide dialog that some of the information would be clipped or outside the window. You can avoid this by formatting the output with escape characters, such as `\n` for a line break.

Using `try-catch`

The `try-catch` construct is an incredibly useful way to get a script just to "try something," leaving you to handle any errors that may result. The basic construct looks like this:

File: **debugging-trycatch.js (excerpt)**

```
try
{
  ⋮ some code
}
catch (err)
{
  ⋮ this gets run if the try{} block results in an error
}
```

If you're not sure where an error's coming from, you can wrap a `try-catch` around a very large block of code to trap the general failure, then tighten it around progressively smaller chunks of code within that block. For example, you could wrap a `try` brace around the first half of a function (at a convenient point in the code), then around the second half, to see where the error occurs; you could then divide the suspect half again, at a convenient point, and keep going until you've isolated the problematic line.

`catch` has a single argument (I've called it *`err`* in this case), which receives the **error object**; we can query properties of that object, such as `name` and `message`, to get details about the error.

Often, I use a `for-in` iterator to run through the entire object and find out what it says:

File: **debugging-trycatch.js (excerpt)**

```
for (var i in err)
{
  alert(i + ': ' + err[i]);
}
```

Writing to the Page or Window

If you're examining a great deal of data while debugging, or you're dealing with data that's formatted in a complicated way, it's often better to write that data directly to a page or popup window than to try to deal with lots of `alert` dialogs. If you're examining data in a loop, in particular, you could end up generating hundreds of dialogs, each of which you'll have to dismiss manually—a very tedious process.

In these kinds of situations, we can use an element's `innerHTML` property to write the data to the page. Here's an example in which we build a list using the contents of an array (`data`), then write it into a test `div`:

File: **debugging-writing.js (excerpt)**

```
var test = document.getElementById('testdiv');

test.innerHTML += '<ul>';
for (var i = 0; i < data.length; i++)
{
  test.innerHTML += '<li>' + i + '=' + data[i] + '</li>';
}
test.innerHTML += '</ul>';
```

We can also write the data into a popup, which is useful if there's no convenient place to put it on the page:

File: **debugging-writing.js (excerpt)**

```
var win = window.open('', win, 'width=320,height=240');

win.document.open();
win.document.write('<ul>');
for (var i = 0; i < data.length; i++)
{
  win.document.write('<li>' + i + '=' + data[i] + '</li>')
}
win.document.write('</ul>');
win.document.close();
```

You can format the output however you like, and use it to structure data in any way that makes it easier for you to find the error.

When you're working with smaller amounts of data, you can gain a similar advantage by writing the data to the main `title` element:

File: **debugging-writing.js (excerpt)**

```
document.title = 'O = ' + data[0];
```

This final approach is most useful when tracking data that changes continually or rapidly, such as a value being processed by a `setInterval` function (an asynchronous timer we'll meet properly in Chapter 14).

Using an External Debugger

I can recommend two debuggers:

- **Venkman**[9] for Mozilla and Firefox
- **Microsoft Script Debugger**[10] for Windows Internet Explorer

External debuggers are a far more detailed way to analyze your scripts, and have much greater capabilities than their in-browser counterparts. External debuggers can do things like stopping the execution of the script at specific points, or watching particular properties so that you're informed of any change to them, however it may be caused. They also include features that allow you "step through" code line by line, in order help find errors that may occur only briefly, or are otherwise difficult to isolate.

External debuggers are complex pieces of software, and it can take time for developers to learn how to use them properly. They can be very useful for highlighting logical errors, and valuable as learning tools in their own right, but they're limited in their ability to help with browser incompatibilities: they're only useful there if the bug you're looking for is in the browser that the debugger supports!

Strict Warnings

If you open the JavaScript console in Firefox you'll see that it includes options to show Errors and Warnings. Warnings notify you of code that, though it is not erroneous per se, does rely on automatic error handling, uses deprecated syntax, or is in some other way untrue to the ECMAScript specification.[11]

For example, the variable `fruit` is defined twice in the code below:

[9] http://www.mozilla.org/projects/venkman/
[10] http://msdn.microsoft.com/scripting/
[11] To see these warnings, it may be necessary to enable strict reporting by typing in the address about:config and setting javascript.options.strict to `true`.

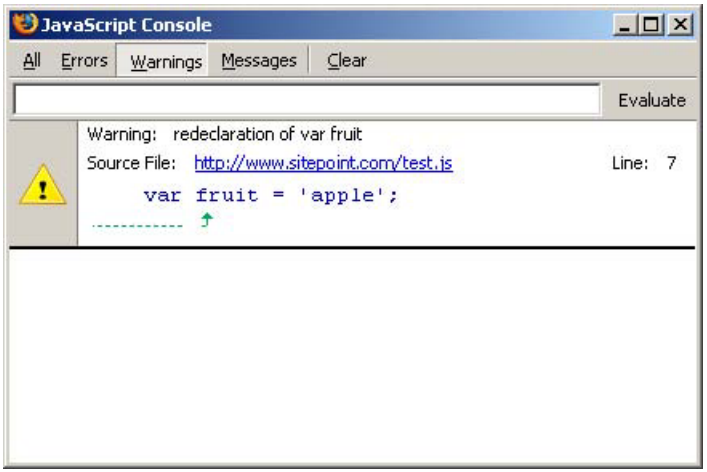
File: **strict-warnings.js (excerpt)**

```
var fruit = 'mango';

if (basket.indexOf('apple') != -1)
{
  var fruit = 'apple';
}
```

We should have omitted the second `var`, because `var` is used to declare a variable for the *first time*, which we've already done. Figure 1.4 shows how the JavaScript console will highlight our error as a warning.

Figure 1.4. The JavaScript warnings console in Firefox



There are several coding missteps that can cause warnings like this. For example:

re-declaring a variable
: This produces the warning, "redeclaration of var *`name`*," as we just saw.

failing to declare a variable in the first place
: This oversight produces the warning, "assignment to undeclared variable *`name`*."

  This might arise, for example, if the first line of our code read simply `fruit = 'mango';`

assuming the existence of an object

This assumption produces the warning "reference to undefined property *name*."

For example, a test condition like `if (document.getElementById)` assumes the existence of the `getElementById` method, and banks on the fact that JavaScript's automatic error-handling capabilities will convert a nonexistent method to `false` in browsers in which this method doesn't exist. To achieve the same end without seeing a warning, we would be more specific, using `if(typeof document.getElementById != 'undefined')`.

There are also some function-related warnings, and a range of other miscellaneous warnings that includes my personal favorite, "useless expression," which is produced by a statement within a function that does nothing:

File: **strict-warnings.js (excerpt)**

```
function getBasket()
{
  var fruit = 'pomegranate';
  fruit;
}
```

For a thorough rundown on the topic, I recommend Alex Vincent's article *Tackling JavaScript strict warnings*.[12]

Warnings don't *matter* in the sense that they don't prevent our scripts from working, but working to avoid warnings helps us to adopt better coding practice, which ultimately creates efficiency benefits. For instance, scripts run faster in Mozilla if there are no strict warnings, a subject we'll look at again in Chapter 20.

Type Conversion Testing

Although we shouldn't rely on type conversion to test a value that might be undefined, it's perfectly fine to do so for a value that might be `null`, because the ECMAScript specification requires that `null` evaluates to `false`. So, for example, having already established the existence of `getElementById` using the `typeof` operator as shown above, it's perfectly safe from then on to test for individual elements as shown below, because `getElementById` returns `null` for nonexistent elements in the DOM:

```
if (document.getElementById('something'))
{
```

[12] http://javascriptkit.com/javatutors/serror.shtml

```
  ⋮ the element exists
}
```

Summary

In this chapter, we've talked about best-practice approaches to scripting that will make our code easier to read and manage, and will allow it to degrade gracefully in unsupported devices. We've also begun to introduce some of the techniques we'll need to build useful scripts, including the ubiquitous `load` event listener that we'll use for almost every solution in this book!

We've covered some pretty advanced stuff already, so don't worry if some of it was difficult to take in. We'll be coming back to all the concepts and techniques we've introduced here as we progress through the remaining chapters.

5 Navigating the Document Object Model

Browsers give JavaScript programs access to the elements on a web page via the Document Object Model (DOM)—an internal representation of the headings, paragraphs, lists, styles, IDs, classes, and all the other data to be found in the HTML on your page.

The DOM can be thought of as a tree consisting of interconnected **nodes**. Each tag in an HTML document is represented by a node; any tags that are nested inside that tag are nodes that are connected to it as children, or branches in the tree. Each of these nodes is called an **element node**.[1] There are several other types of nodes; the most useful are the **document node**, **text node**, and **attribute node**. The document node represents the document itself, and is the root of the DOM tree. Text nodes represent the text contained between an element's tags. Attribute nodes represent the attributes specified inside an element's opening tag. Consider this basic HTML page structure:

```
<html>
  <head>
    <title>Stairway to the stars</title>
  </head>
  <body>
    <h1 id="top">Stairway to the stars</h1>
```

[1] Strictly speaking, each element node represents a *pair* of tags—the start and end tags of an element (e.g., `<p>` and `</p>`)—or a single self-closing tag (e.g., `<br>`, or `<br/>` in XHTML).

```
    <p class="introduction">For centuries, the stars have been
      more to humankind than just burning balls of gas …</p>
  </body>
</html>
```

The DOM for this page could be visualized as Figure 5.1.

Every page has a document node, but its descendents are derived from the content of the document itself. Through the use of element nodes, text nodes, and attribute nodes, every piece of information on a page is accessible via JavaScript.

The DOM isn't just restricted to HTML and JavaScript, though. Here's how the W3C DOM specification site[2] explains the matter:

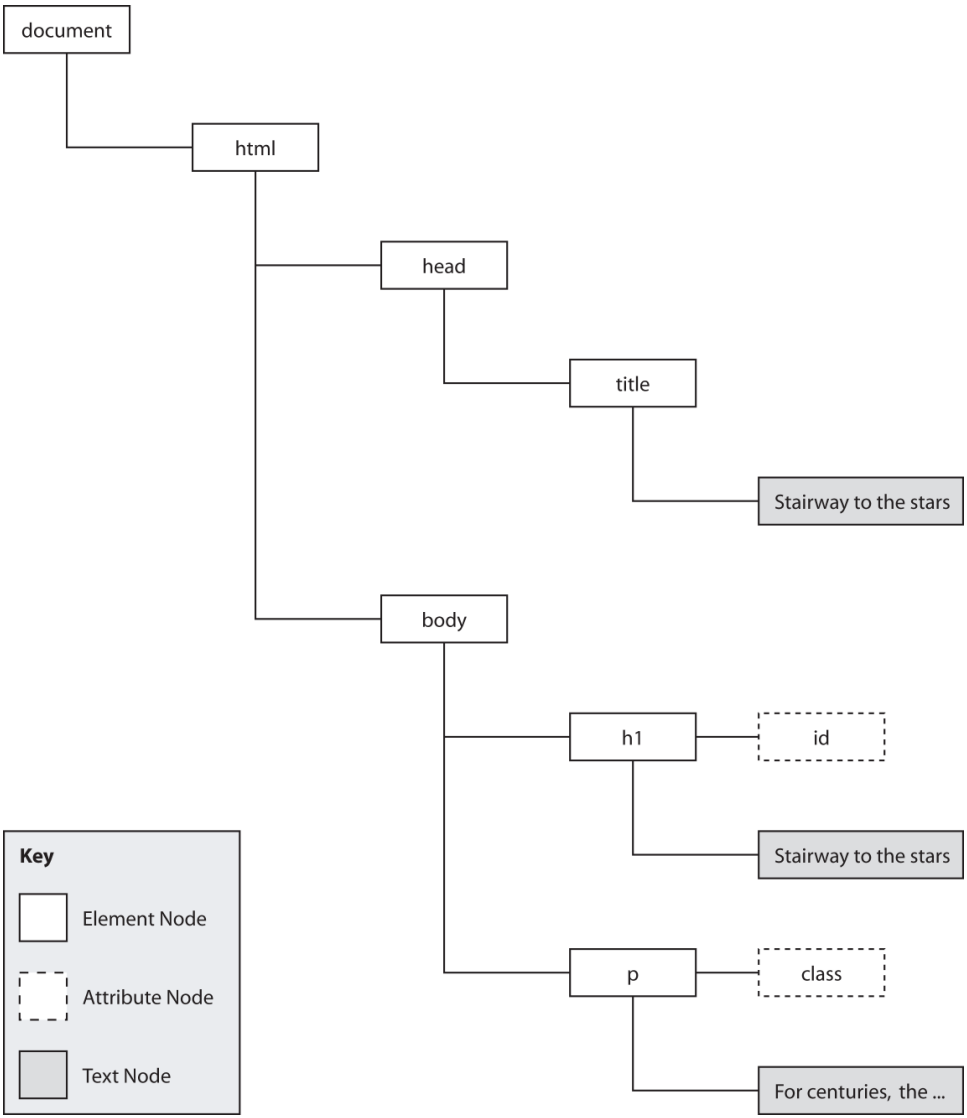
> The Document Object Model is a platform- and language-neutral interface that will allow programs and scripts to dynamically access and update the content, structure and style of documents.

So, even though the mixture of JavaScript and HTML is the most common combination of technologies in which the DOM is utilized, the knowledge you gain from this chapter can be applied to a number of different programming languages and document types.

In order to make you a "master of your DOMain," this chapter will explain how to find any element you're looking for on a web page, then change it, rearrange it, or erase it completely.

[2] http://www.w3.org/DOM/

Figure 5.1. The DOM structure of a simple HTML page, visualized as a tree hierarchy



Accessing Elements

Access provides control, control is power, and you're a power programmer, right? So you need access to everything that's on a web page. Fortunately, JavaScript gives you access to any element on a page using just a few methods and properties.

Solution

Although it's possible to navigate an HTML document like a road map—starting from home and working your way towards your destination one node at a time—this is usually an inefficient way of finding an element because it requires a lot of code, and any changes in the structure of the document will usually mean that you have to rewrite your scripts. If you want to find something quickly and easily, the method that you should tattoo onto the back of your hand is `document.getElementById`.

Assuming that you have the correct markup in place, `getElementById` will allow you immediately to access any element by its unique `id` attribute value. For instance, imagine your web page contains this code:

File: **access_element.html (excerpt)**

```
<p>
  <a id="sirius" href="sirius.html">Journey to the stars</a>
</p>
```

You can use the `a` element's `id` attribute to get direct access to the element itself:

File: **access_element.js (excerpt)**

```
var elementRef = document.getElementById("sirius");
```

The value of the variable `elementRef` will now be referenced to the `a` element—any operations that you perform on `elementRef` will affect that exact hyperlink.

`getElementById` is good for working with a specific element; however, sometimes you'll want to work with a *group* of elements. In order to retrieve a group of elements on the basis of their tag names, you can use the method `getElementsByTagName`.

As can be seen from its name, `getElementsByTagName` takes a tag name and returns all elements of that type. Assume that we have this HTML code:

File: **access_element2.html (excerpt)**

```
<ul>
  <li>
    <a href="sirius.html">Sirius</a>
  </li>
  <li>
    <a href="canopus.html">Canopus</a>
  </li>
  <li>
    <a href="arcturus.html">Arcturus</a>
  </li>
  <li>
    <a href="vega.html">Vega</a>
  </li>
</ul>
```

We can retrieve a collection that contains each of the hyperlinks like so:

File: **access_element2.js (excerpt)**

```
var anchors = document.getElementsByTagName("a");
```

The value of the variable `anchors` will now be a **collection** of `a` elements. Collections are similar to arrays in that each of the items in a collection is referenced using square bracket notation, and the items are indexed numerically starting at zero. The collection returned by `getElementsByTagName` sorts the elements by their source order, so we can reference each of the links thus:

`anchorArray[0]` the `a` element for "Sirius"

`anchorArray[1]` the `a` element for "Canopus"

`anchorArray[2]` the `a` element for "Arcturus"

`anchorArray[3]` the `a` element for "Vega"

Using this collection you can iterate through the elements and perform an operation on them, such as assigning a class using the element nodes' `className` property:

File: **access_element2.js (excerpt)**

```
var anchors = document.getElementsByTagName("a");

for (var i = 0; i < anchors.length; i++)
{
```

```
  anchors[i].className = "starLink";
}
```

Unlike `getElementById`, which may be called on the document node only, the `getElementsByTagName` method is available from every single element node. You can limit the scope of the `getElementsByTagName` method by executing it on a particular element. `getElementsByTagName` will only return elements that are descendents of the element on which the method was called.

If we have two lists, but want to assign a new class to the links in one list only, we can target those `a` elements exclusively by calling `getElementsByTagName` on their parent list:

File: **access_element3.html (excerpt)**

```
<ul id="planets">
  <li>
    <a href="mercury.html">Mercury</a>
  </li>
  <li>
    <a href="venus.html">Venus</a>
  </li>
  <li>
    <a href="earth.html">Earth</a>
  </li>
  <li>
    <a href="mars.html">Mars</a>
  </li>
</ul>
<ul id="stars">
  <li>
    <a href="sirius.html">Sirius</a>
  </li>
  <li>
    <a href="canopus.html">Canopus</a>
  </li>
  <li>
    <a href="arcturus.html">Arcturus</a>
  </li>
  <li>
    <a href="vega.html">Vega</a>
  </li>
</ul>
```

To target the list of stars, we need to obtain a reference to the parent `ul` element, then call `getElementsByTagName` on it directly:

File: **access_element3.js (excerpt)**

```
var starsList = document.getElementById("stars");
var starsAnchors = starsList.getElementsByTagName("a");
```

The value of the variable `starsAnchors` will be a collection of the `a` elements inside the `stars` unordered list, instead of a collection of *all* `a` elements on the page.

DOM 0 Collections

Many "special" elements in an HTML document can be accessed by even more direct means. The `body` element of the document can be accessed as `document.body`. A collection of all the forms in a document may be found in `document.forms`. All of the images in a document may be found in `document.images`.

In fact, most of these collections have been around since before the DOM was standardized by the W3C, and are commonly referred to as **DOM 0 properties**.

Because the initial implementations of these features were not standardized, these collections have occasionally proven unreliable in browsers that are moving towards standards compliance. Early versions of some Mozilla browsers (e.g., Firefox), for example, did not support these collections on XHTML documents.

Today's browsers generally do a good job of supporting these collections; however, if you *do* run into problems, it's worth trying the more verbose `getElementsByTagName` method of accessing the relevant elements. Instead of `document.body`, for example, you could use:

```
var body = document.getElementsByTagName("body")[0];
```

Discussion

If you really need to step through the DOM hierarchy element by element, each node has several properties that enable you to access related nodes:

***node*.childNodes**	a collection that contains source-order references to each of the children of the specified node, including both elements and text nodes
***node*.firstChild**	the first child node of the specified node

***node*.lastchild**	the last child node of the specific node
***node*.parentNode**	a reference to the parent element of the specified node
***node*.nextSibling**	the next node in the document that has the same parent as the specified node
***node*.previousSibling**	the previous element that's on the same level as the specified node

If any of these properties do not exist for a specific node (e.g., the last node of a parent will not have a next sibling), they will have a value of `null`.

Take a look at this simple page:

File: **access_element4.html (excerpt)**

```
<div id="outerGalaxy">
  <ul id="starList">
    <li id="star1">
      Rigel
    </li>
    <li id="star2">
      Altair
    </li>
    <li id="star3">
      Betelgeuse
    </li>
  </ul>
</div>
```

The list item with ID `star2` could be referenced using any of these expressions:

```
document.getElementById("star1").nextSibling;
document.getElementById("star3").previousSibling;
document.getElementById("starList").childNodes[1];
document.getElementById("star1").parentNode.childNodes[1];
```

Whitespace Nodes

Some browsers will create **whitespace nodes** between the element nodes in any DOM structure that was interpreted from a text string (e.g., an HTML file). Whitespace nodes are text nodes that contain only whitespace (tabs, spaces, new lines) to help format the code in the way it was written in the source file.

When you're traversing the DOM node by node using the above properties, you should always allow for these whitespace nodes. Usually, this means checking that the node you've retrieved is an element node, not just a whitespace node that's separating elements.

There are two easy ways to check whether a node is an element node or a text node. The `nodeName` property of a text node will always be `"#text"`, whereas the `nodeName` of an element node will identify the element type. However, in distinguishing text nodes from element nodes, it's easier to check the `nodeType` property. Element nodes have a `nodeType` of `1`, whereas text nodes have a `nodeType` of `3`. You can use this knowledge as a test when retrieving elements:

File: **access_element4.js (excerpt)**

```
var star2 = document.getElementById("star1").nextSibling;

while (star2.nodeType == "3")
{
  star2 = star2.nextSibling;
}
```

Using these DOM properties, it's possible to start your journey at the root `html` element, and end up buried in the `legend` of some deeply-nested `fieldset`—it's all just a matter of following the nodes.

Creating Elements and Text Nodes

JavaScript doesn't just have the ability to modify existing elements in the DOM; it can also create new elements and place them anywhere within a page's structure.

Solution

`createElement` is the aptly named method that allows you to create new elements. It only takes one argument—the type (as a string) of the element you wish to create—and returns a reference to the newly-created element:

File: **create_elements.js (excerpt)**

```
var newAnchor = document.createElement("a");
```

The variable `newAnchor` will be a new `a` element, ready to be inserted into the page.

Specifying Namespaces in Documents with an XML MIME Type

If you're coding JavaScript for use in documents with a MIME type of `application/xhtml+xml` (or some other XML MIME type), you should use the method `createElementNS`, instead of `createElement`, to specify the namespace for which you're creating the element:

```
var newAnchor = document.createElementNS(
    "http://www.w3.org/1999/xhtml", "a");
```

This distinction applies to a number of DOM methods, such as `removeElement`/`removeElementNS` and `getAttribute`/`getAttributeNS`; however, we won't use the namespace-enhanced versions of these methods in this book.

Simon Willison provides a brief explanation of working with JavaScript and different MIME types[3] on his web site.

The text that goes inside an element is actually a child text node of the element, so it must be created separately. Text nodes are different from element nodes, so they have their own creation method, `createTextNode`:

File: **create_elements.js (excerpt)**

```
var anchorText = document.createTextNode("monoceros");
```

If you're modifying an existing text node, you can access the text it contains via the `nodeValue` property. This allows you to get and set the text inside a text node:

```
var textNode = document.createTextNode("monoceros");
var oldText = textNode.nodeValue;
textNode.nodeValue = "pyxis";
```

The value of the variable `oldText` is now `"monoceros"`, and the text inside `textNode` is now `"pyxis"`.

You can insert either an element node or a text node as the last child of an existing element using its `appendChild` method. This method will place the new node after all of the element's existing children.

Consider this fragment of HTML:

[3] http://simon.incutio.com/archive/2003/06/15/javascriptWithXML

File: **create_elements.html (excerpt)**

```
<p id="starLinks">
  <a href="sirius.html">Sirius</a>
</p>
```

We can use DOM methods to create and insert another link at the end of the paragraph:

File: **create_elements.js (excerpt)**

```
var anchorText = document.createTextNode("monoceros");

var newAnchor = document.createElement("a");
newAnchor.appendChild(anchorText);

var parent = document.getElementById("starLinks");
var newChild = parent.appendChild(newAnchor);
```

The value of the variable `newChild` will be a reference to the newly inserted element.

If we were to translate the state of the DOM after this code had executed into HTML code, it would look like this:

```
<p id="starLinks">
  <a href="sirius.htm">Sirius</a><a>monoceros</a>
</p>
```

We didn't specify any attributes for the new element, so it doesn't link anywhere at the moment. The process for specifying attributes is explained shortly in "Reading and Writing the Attributes of an Element".

Discussion

There are three basic ways by which a new element or text node can be inserted into a web page. The approach you use will depend upon the point at which you want the new node to be inserted: as the last child of an element, before another node, or as the replacement for a node. The process of appending an element as the last child was explained above. You can insert the node before an existing node using the `insertBefore` method of its parent element, and you can replace a node using the `replaceChild` method of its parent element.

In order to use `insertBefore`, you need to have references to the node you're going to insert, and to the node before which you wish to insert it. Consider this HTML code:

File: **create_elements2.html (excerpt)**

```
<p id="starLinks">
  <a id="sirius" href="sirius.html">Sirius</a>
</p>
```

We can insert a new link before the existing one by calling `insertBefore` from its parent element (the paragraph):

File: **create_elements2.js (excerpt)**

```
var anchorText = document.createTextNode("monoceros");

var newAnchor = document.createElement("a");
newAnchor.appendChild(anchorText);

var existingAnchor = document.getElementById("sirius");
var parent = existingAnchor.parentNode;
var newChild = parent.insertBefore(newAnchor, existingAnchor);
```

The value of the variable `newChild` will be a reference to the newly inserted element.

If we were to translate into HTML the state of the DOM after this operation, it would look like this:

```
<p id="starLinks">
  <a>monoceros</a><a id="sirius" href="sirius.htm">Sirius</a>
</p>
```

Instead, we could replace the existing link entirely using `replaceChild`:

File: **create_elements3.js (excerpt)**

```
var anchorText = document.createTextNode("monoceros");

var newAnchor = document.createElement("a");
newAnchor.appendChild(anchorText);

var existingAnchor = document.getElementById("sirius");
var parent = existingAnchor.parentNode;
var newChild = parent.replaceChild(newAnchor, existingAnchor);
```

The DOM would then look like this:

```
<p id="starLinks">
  <a>monoceros</a>
</p>
```

Changing the Type of an Element

Are your ordered lists feeling a bit unordered? Do your headings have paragraph envy? Using a little JavaScript knowledge, it's possible to change the type of an element entirely, while preserving the structure of its children.

Solution

There's no straightforward, simple way to change the type of an element. In order to achieve this feat you'll have to perform a bit of a juggling act.

Let's assume that we want to change this paragraph into a `div`:

File: **change_type_of_element.js (excerpt)**

```
<p id="starLinks">
  <a href="sirius.html">Sirius</a>
  <a href="achanar.html">Achanar</a>
  <a href="hadar.html">Hadar</a>
</p>
```

We need to create a new `div`, move each of the paragraph's children into it, then swap the new element for the old:

File: **change_type_of_element.js (excerpt)**

```
var div = document.createElement("div");
var paragraph = document.getElementById("starLinks");

for (var i = 0; i < paragraph.childNodes.length; i++)
{
  var clone = paragraph.childNodes[i].cloneNode(true);

  div.appendChild(clone);
}

paragraph.parentNode.replaceChild(div, paragraph);
```

The only unfamiliar line here should be the point at which a **clone** is created for each of the paragraph's children. The `cloneNode` method produces an identical copy of the node from which it's called. By passing this method the argument

`true`, we indicate that we want all of that element's children to be copied along with the element itself. Using `cloneNode`, we can mirror the original element's children under the new `div`, then remove the paragraph once we're finished copying.

While cloning nodes is useful in some circumstances, it turns out that there's a cleaner way to approach this specific problem. We can simply move the child nodes of the existing paragraph into the new `div`. DOM nodes can belong only to one parent element at a time, so adding the nodes to the `div` also removes them from the paragraph:

File: **change_type_of_element2.js (excerpt)**

```
var div = document.createElement("div");
var paragraph = document.getElementById("starLinks");

while (paragraphNode.childNodes.length > 0){
  div.appendChild(paragraphNode.firstChild);
}

paragraph.parentNode.replaceChild(div, paragraph);
```

Take Care Changing the Node Structure of the DOM

The elements in a collection are updated automatically whenever a change occurs in the DOM—even if you copy that collection into a variable before the change occurs. So, if you remove from the DOM an element that was contained in a collection with which you had been working, the element reference will also be removed from the collection. This will change the length of the collection as well as the indexes of any elements that appear after the removed element.

When performing operations that affect the node structure of the DOM—such as moving a node to a new parent element—you have to be careful about iterative processes. The code above uses a `while` loop that only accesses the first child of the paragraph, because each time a child is relocated, the length of the `childNodes` collection will decrease by one, and all the elements in the collection will shift along. A `for` loop with a counter variable would not handle all the children correctly because it would assume that the contents of the collection would remain the same throughout the loop.

Discussion

There's no easy way to copy the attributes of an element to its replacement.[4] If you want the new element to have the same `id`, `class`, `href`, and so on, you'll have to copy the values over manually:

File: **change_type_of_element.js (excerpt)**

```
div.id = paragraph.getAttribute("id");
div.className = paragraph.className;
```

Removing an Element or Text Node

Once an element has outlived its usefulness, it's time to give it the chop. You can use JavaScript to remove any element cleanly from the DOM.

Solution

The `removeChild` method removes any child node from its parent, and returns a reference to the removed object.

Let's start off with this HTML:

File: **remove_element.html (excerpt)**

```
<p>
  <a id="sirius" href="sirius.html">Sirius</a>
</p>
```

We could use `removeChild` to remove the hyperlink from its parent paragraph like so:

File: **remove_element.js (excerpt)**

```
var anchor = document.getElementById("sirius");
var parent = anchor.parentNode;
var removedChild = parent.removeChild(anchor);
```

The variable `removedChild` will be a reference to the `a` element, but that element will not be located anywhere in the DOM: it will simply be available in memory, much as if we had just created it using `createElement`. This allows us to relocate it to another position on the page, it we wish, or we can simply let the variable

[4] If you look at the DOM specification, it *looks* like there is. Unfortunately, Internet Explorer's support for the relevant properties and methods is just not up to the task.

disappear at the end of the script, and the reference will be lost altogether—effectively deleting it. Following the above code, the DOM will end up like this:

```
<p>
</p>
```

Of course, you don't need to assign the return value from `removeChild` to a variable. You can just execute it and forget about the element altogether:

```
var anchor = document.getElementById("sirius");
var parent = anchor.parentNode;
parent.removeChild(anchor);
```

Discussion

If the element that you're deleting has children that you wish to preserve (i.e., you just want to "unwrap" them by removing their parent), you must rescue those children to make sure they stay in the document when their parent is removed. You can achieve this using the already-mentioned `insertBefore` method, which, when used on elements that are already contained in the DOM, first removes them, then inserts them at the appropriate point.

The paragraph in the following HTML contains multiple children:

File: **remove_element2.html (excerpt)**

```
<div id="starContainer">
  <p id="starLinks">
    <a href="aldebaran.html">Aldebaran</a>
    <a href="castor.html">Castor</a>
    <a href="pollux.html">Pollux</a>
  </p>
</div>
```

We can loop through the paragraph's `childNodes` collection, and relocate each of its children individually before removing the element itself:

File: **remove_element2.js (excerpt)**

```
var parent = document.getElementById("starLinks");
var container = document.getElementById("starContainer");

while (parent.childNodes.length > 0)
{
  container.insertBefore(parent.childNodes[0], parent);
}
```

```
container.removeChild(parent);
```

The page's DOM will now look like this:

```
<div id="starContainer">
  <a href="aldebaran.htm">Aldebaran</a>
  <a href="castor.htm">Castor</a>
  <a href="pollux.htm">Pollux</a>
</div>
```

Reading and Writing the Attributes of an Element

The most frequently used parts of an HTML element are its attributes—its `id`, `class`, `href`, `title`, or any of a hundred other pieces of information that can be included in an HTML tag. JavaScript is able not only to read these values, but write them as well.

Solution

Two methods exist for reading and writing an element's attributes. `getAttribute` allows you to read the value of an attribute, while `setAttribute` allows you to write it.

Consider this HTML:

File: **read_write_attributes.html (excerpt)**

```
<a id="antares" href="antares.html" title="A far away place">
  Antares</a>
```

We would be able to read the attributes of the element like so:

File: **read_write_attributes.js (excerpt)**

```
var anchor = document.getElementById("antares");
var anchorId = anchor.getAttribute("id");
var anchorTitle = anchor.getAttribute("title");
```

The value of the variable `anchorId` will be `"antares"`, and the value of the variable `anchorTitle` will be `"A far away place"`.

To change the attributes of the hyperlink, we use `setAttribute`, passing it the name of the attribute to be changed, and the value we want to change it to:

File: **read_write_attributes2.js (excerpt)**

```
var anchor = document.getElementById("antares");

anchor.setAttribute("title", "Not that far away");

var newTitle = anchor.getAttribute("title");
```

The value of the variable `newTitle` will now be `"Not that far away"`.

Discussion

In its journey from the free-roaming Netscape wilderness to the more tightly defined, standards-based terrain of the modern age, the DOM standard has picked up a fair amount of extra syntax for dealing with HTML. One of the most pervasive of these extras is the mapping between DOM properties and HTML attributes.

When a document is parsed into its DOM form, special attribute nodes are created for an element's attributes. These nodes are not accessible as "children" of that element: they are accessible only via the two methods mentioned above. However, as a throwback to the original DOM implementations (called DOM 0, where the zero suggests these features came prior to standards), current DOM specs contain additional functionality that's specific to HTML. In particular, attributes are accessible directly as properties of an element. So, the `href` attribute of a hyperlink is accessible through *`link`*`.getAttribute("href")` as well as through *`link`*`.href`.

This shortcut syntax is not only cleaner and more readable: in some situations it is also *necessary*. Internet Explorer 6 and versions below will not propagate changes made via `setAttribute` to the visual display of an element. So any changes that are made to the `class`, `id`, or `style` of an element using `setAttribute` will not affect the way it's displayed. In order for those changes to take effect, they must be made via the element node's attribute-specific properties.

To further confuse matters, the values that are returned when an attribute-specific property is read vary between browsers, the most notable variations occurring in Konqueror. If an attribute doesn't exist, Konqueror will return `null` as the value of an attribute-specific property, while all other browsers will return an empty string. In a more specific case, some browsers will return *`link`*`.getAttribute("href")` as an absolute URL (e.g., `"http://www.example.com/ant-`

ares.html"), while others return the actual attribute value (e.g., "antares.html"). In this case, it's safer to use the dot property, as it consistently returns the absolute URL across browsers.

So, what's the general solution to these problems?

The basic rule is this: if you are certain that an attribute has been assigned a value, it's safe to use the dot property method to access it. If you're unsure whether or not an attribute has been set, you should first use one of the DOM methods to ensure that it has a value, then use the dot property to obtain its value.

For *reading* an unverified attribute, use the following:

```
var anchor = document.getElementById("sirius");

if (anchor.getAttribute("title") &&
    anchor.title == "Not the satellite radio")
{
  ⋮
}
```

This makes sure that the attribute exists, and is not `null`, before fetching its value.

For *writing to* an unverified attribute, use the following code:

```
var anchor = document.getElementById("sirius");

anchor.setAttribute("title", "");
anchor.title = "Yes, the satellite radio";
```

This code makes sure that the attribute is created correctly first, and is then set in such a way that Internet Explorer will not have problems if the attribute affects the visual display of the element.

This rule has a few exceptions for attributes whose existence you can guarantee. The most notable of these "must-have" attributes are `style` and `class`, which will always be valid for any given element; thus, you can immediately reference them as dot properties (*`element`*`.style` and *`element`*`.className` respectively).

`class` is one of two attributes that get a little tricky, because `class` is a reserved word in JavaScript. As a property, it is written *`element`*`.className`, but using

`getAttribute`/`setAttribute`, we write *`element`*`.getAttribute("class")`, *except in Internet Explorer*, where we still use *`element`*`.getAttribute("className")`.

The other attribute that we have to watch out for is the `for` attribute of a `label`. It follows the same rules as `class`, but its property form is `htmlFor`. Using `getAttribute`/`setAttribute`, we write *`element`*`.getAttribute("for")`, but in Internet Explorer it's *`element`*`.getAttribute("htmlFor")`.

Getting all Elements with a Particular Attribute Value

The ability to find all the elements that have a particular attribute can be pretty handy when you need to modify all elements that have the same `class` or `title`, for example.

Solution

In order to find elements with a particular attribute value, we need to check every element on the page for that attribute. This is a very calculation-intensive operation, so it shouldn't be undertaken lightly. If you wanted to find all `input` elements with `type="checkbox"`, you're better off limiting your search to `input` elements first:

```
var inputs = document.getElementsByTagName("input");

for (var i = 0; i < inputs.length; i++)
{
  if (inputs.getAttribute("type") == "checkbox")
  {
    ⋮
  }
}
```

This will require less calculation than iterating through *every* element on the page and checking its `type`. However, the function presented in this solution—`getElementsByAttribute`—is ideal when you need to find a number of elements of *different* types that have the same attribute value.

The easiest way to check every element on a page is to loop through the collection returned by `getElementsByTagName("*")`. The only problem with this method is that Internet Explorer 5.0 and 5.5 do not support the asterisk wildcard for tag

selection. Luckily, these browsers support the `document.all` property, which is an array containing all the elements on the page. `getElementsByAttribute` handles this issue with a simple code branch, then proceeds to check the elements for a given attribute value, adding matches to an array to be returned:

File: **get_elements_by_attribute.js (excerpt)**

```
function getElementsByAttribute(attribute, attributeValue)
{
  var elementArray = new Array();
  var matchedArray = new Array();

  if (document.all)
  {
    elementArray = document.all;
  }
  else
  {
    elementArray = document.getElementsByTagName("*");
  }

  for (var i = 0; i < elementArray.length; i++)
  {
    if (attribute == "class")
    {
      var pattern = new RegExp("(^| )" +
          attributeValue + "( |$)");

      if (pattern.test(elementArray[i].className))
      {
        matchedArray[matchedArray.length] = elementArray[i];
      }
    }
    else if (attribute == "for")
    {
      if (elementArray[i].getAttribute("htmlFor") ||
          elementArray[i].getAttribute("for"))
      {
        if (elementArray[i].htmlFor == attributeValue)
        {
          matchedArray[matchedArray.length] = elementArray[i];
        }
      }
    }
    else if (elementArray[i].getAttribute(attribute) ==
        attributeValue)
    {
```

```
      matchedArray[matchedArray.length] = elementArray[i];
    }
  }

  return matchedArray;
}
```

A lot of the code in `getElementsByAttribute` deals with the browser differences in attribute handling that were mentioned earlier in this chapter, in "Reading and Writing the Attributes of an Element". The necessary techniques are used if the required attribute is `class` or `for`. As an added bonus when checking for a match on the `class` attribute, if an element has been assigned multiple classes, the function automatically checks each of these to see whether it matches the required value.

Adding and Removing Multiple Classes to/from an Element

Combining multiple classes is a very useful CSS technique. It provides a very primitive means of inheritance by allowing a number of different styles to be combined on the one element, allowing you to mix and match different effects throughout a site. They're particularly useful in situations like highlighting elements: a class can be added that highlights an element without disturbing any of the other visual properties that may have been applied to the element by other classes. However, if you are assigning classes in JavaScript you have to be careful that you don't inadvertently overwrite previously assigned classes.

Solution

The class for any element is accessible via its `className` property. This property allows you both to read and write the classes that are currently applied to that element. Because it's just one string, the most difficult part of working with `className` is that you need to deal with the syntax it uses to represent multiple classes.

The class names in an element's `className` property are separated by spaces. The first class name is not preceded by anything, and the last class name is not followed by anything. This makes it easy to add a class to the class list naively: just concatenate a space and the new class name to the end of `className`. However, you'll want to avoid adding a class name that already exists in the list, as

this will make removing the class harder. You'll also want to avoid using a space at the beginning of the `className` value, because this will cause errors in Opera 7:

File: **add_remove_classes.js (excerpt)**

```
function addClass(target, classValue)
{
  var pattern = new RegExp("(^| )" + classValue + "( |$)");

  if (!pattern.test(target.className))
  {
    if (target.className == "")
    {
      target.className = classValue;
    }
    else
    {
      target.className += " " + classValue;
    }
  }

  return true;
}
```

First, `addClass` creates a regular expression pattern containing the class to be added. It then uses this pattern to test the current `className` value. If the class name doesn't already exist, we check for an empty `className` value (in which case the class name is assigned to the property verbatim), or we append to the existing value a space and the new class name.

Separating Classes

Some regular expression examples for finding classes use the word boundary special character (`\b`) to separate classes. However, this will not work with all valid class names, such as those containing hyphens.

The process for removing a class uses a regular expression pattern that's identical to the one we use to add a class, but we don't need to perform as many checks:

File: **add_remove_classes.js (excerpt)**

```
function removeClass(target, classValue)
{
  var removedClass = target.className;
  var pattern = new RegExp("(^| )" + classValue + "( |$)");
```

```
  removedClass = removedClass.replace(pattern, "$1");
  removedClass = removedClass.replace(/ $/, "");

  target.className = removedClass;

  return true;
}
```

After `removeClass` has executed the replacement regular expression on a copy of the `className` property's value, it cleans up the resulting value by removing any trailing space (which is created when we remove the last class in a multiple class `className`), then assigns it back to the target's `className`.

Summary

This chapter introduced the basic but powerful tools that you'll need in order to manipulate the Document Object Model. It's important that you understand the DOM—the skeleton beneath everything you see in a browser—as you manipulate any web page. Knowing how to create, edit, and delete parts of the DOM is crucial to understanding the remainder of this book. Once you've mastered these techniques, you'll be well on your way to becoming a proficient JavaScript programmer.

7 Working with Windows and Frames

This chapter is about simple window and frame manipulation, including tasks like opening popups, communicating between frames,[1] and finding out the page's scrolling position.

Plenty of people feel that window manipulation is akin to the Dark Side. They believe that a window is part of the user's GUI, not the document, and since JavaScript is a document scripting language, it has no business manipulating windows.

I'm generally inclined to agree, yet I know that opinion is sometimes a luxury. If your clients ask for something specific, you can't necessarily change their minds, or have the freedom to turn down work on the basis of such a principle. In this chapter, we'll cover a range of practical window and frame manipulation tasks while remaining sensitive to the usability and accessibility issues that can arise from their use.

Note, though, that there are limits, and some varieties of window scripting are particularly unfriendly. We won't be dealing with aggressive tactics like closing or modifying the user's *primary* window, moving windows around the screen, or opening full-screen or "chromeless" windows. These are exactly the kinds of abuses that have given JavaScript a bad name.

[1]The techniques involved in reading data from an `iframe` will be covered in Chapter 18.

Through most of this chapter we'll be looking closely at the properties and methods of the `window` object. These are implemented by different browsers in a variety of ways, most of which have been in use since the days before JavaScript was standardized.

We'll have quite a few code branches to deal with, but we'll avoid the dreaded browser sniffing by careful use of **object detection**, the process of detecting an object or feature to test for compatibility, rather than detecting specific browsers.

Using Popup Windows

Should you use popup windows? The most considered answer I have is this: *not if you can help it*. Popup windows have gained a bad reputation from marketers' aggressive use of them, but even *requested* popups can be barriers to good usability.

I won't say that popups are *never* appropriate, but I will say that they're *seldom* so. Nevertheless, there are situations where popping open a new window is arguably the most appropriate solution: an online survey might be one example, as the format may make the content more approachable; DHTML games are another, as the viewport may need to be of a known size.

I'll qualify my opinion by discussing the problems that popups create, then providing a pragmatic method for using them that mitigates these problems as much as possible.

What's Wrong with Popups?

The main problem with most popup window scripts is that they don't consider the needs of the user—they address only the needs of the designer. The results? We've all seen them:

- popups that are generated from links, though those links do nothing when scripting is not available
- popup windows that don't have a status bar, so you can't necessarily tell whether the document has loaded or stalled, is still loading, etc.
- popups that don't give users the ability to resize the window, and popups that fail to generate scrollbars for content that might scale outside the window
- windows that are "chromeless," or open to the full size of the user's screen

These issues are not just questions of usability, but of accessibility as well. For example, screen-reader users may not be notified by their devices that a new window has opened. This could obviously cause confusion if they then attempted to go back in the browser history (they can't). The same thing might happen for a sighted user if a window opens at full-size: you and I may be familiar with using the taskbar to monitor open windows, but not all computer users are—they may not even realize that a new window has popped up.

If you're going to use popups, looking out for issues like these, and being generally sensitive to their impacts, will make your popups friendlier to users, and less of a strain on your conscience.

Also, bear in mind that, from a *developer's* perspective, popup windows are not guaranteed to work: most browsers now include options to suppress popup windows, and in some cases, suppression occurs even if the popup is generated in response to a user event.

You may be able to allow for this as you would for situations in which scripting was not supported: by ensuring that the underlying trigger for the popup still does something useful if the popup fails. Or you might have your code open a window and then check its own `closed` property, to see if it's actually displayed (we'll look at this technique in the next solution).

But neither of these approaches is guaranteed to work with every browser and popup blocker out there, so for this as much as the usability reasons, it's simpler and better to avoid using popups whenever you can.

How Do I Minimize the Problems?

What we need to do is establish some golden rules for the ethical use of popups:

- Make sure any triggering link degrades properly when scripting is not available.
- Always include the status bar.
- Always include a mechanism to overflow the content: either allow window resizing, or allow scrollbars to appear, or both.
- Don't open windows that are larger than 640x480 pixels.

By limiting the size of popups, you ensure that they're smaller than users' primary windows on the vast majority of monitors. This increases the likelihood that the user will realize that the popup is a new window.

Solution

Here's a generic popup function that's based on the guidelines above:

File: **make-popup.js (excerpt)**

```
function makePopup(url, width, height, overflow)
{
  if (width > 640) { width = 640; }
  if (height > 480) { height = 480; }

  if (overflow == '' || !/^(scroll|resize|both)$/.test(overflow))
  {
    overflow = 'both';
  }

  var win = window.open(url, '',
      'width=' + width + ',height=' + height
      + ',scrollbars=' + (/^(scroll|both)$/.test(overflow) ?
      'yes' : 'no')
      + ',resizable=' + (/^(resize|both)$/.test(overflow) ?
      'yes' : 'no')
      + ',status=yes,toolbar=no,menubar=no,location=no'
  );

  return win;
}
```

As well as limiting the window size, this script refuses to create a popup that doesn't have an overflow, so if you don't specify `"scroll"`, `"resize"`, or `"both"` for the *`overflow`* argument, the default setting of `"both"` will be used.

The Ternary Operator

This script uses a shortcut expression called a **ternary operator** to evaluate each of the overflow options. The ternary operator uses `?` and `:` characters to divide the two possible outcomes of an evaluation, and is equivalent to a single pair of `if..else` conditions. Consider this code:

```
if (outlook == 'optimistic') { glass = 'half-full'; }
else { glass = 'half-empty'; }
```

That code is equivalent to the markup below:

```
glass = (outlook == 'optimistic' ? 'half-full' :
    'half-empty');
```

The parentheses are not required, but you may find they make the expression easier to read.

For more about this and other useful shortcuts, see Chapter 20.

Once you have the popup function in place, you can call it in a variety of ways. For example, you could use a regular link:

File: **make-popup.html (excerpt)**

```
<a href="survey.html" id="survey_link">Online survey</a>
```

If scripting is not available, this will work just like any other link, but if scripting *is* available, the script can trigger a `click` event handler that passes its `href` to the `makePopup` function, along with the other settings. The return value of the handler depends on whether or not the window is actually opened; browsers that block the popup will follow the link as normal:

File: **make-popup.js (excerpt)**

```
document.getElementById('survey_link').onclick = function()
{
  var survey = makePopup(this.href, 640, 480, 'scroll');

  return survey.closed;
};
```

In general, if you have a script that requires that a window be generated, you can call the `makePopup` function directly with a URL:

```
var cpanel = makePopup('cpanel.html', 480, 240, 'resize');
```

If you need to close that window later in your script, you can do so by using the `close` method on the stored window reference:

```
cpanel.close();
```

Discussion

The `window.open` method can take a number of arguments—in addition to the URL and window name—which specify whether the window should have particular **decorations**, such as the menu bar, tool bar, or address (location) bar. These

arguments are passed as a comma-delimited string to the *third* argument of `window.open`:

```
var win = window.open('page.html', 'winName',
    'width=640,height=480,'
    + 'scrollbars=yes,resizable=yes,status=yes,'
    + 'toolbar=no,menubar=no,location=no');
```

In our `makePopup` function, the `menubar`, `toolbar`, and `location` arguments are all preset to `no` because these elements are rarely useful for popup windows—they're navigational tools, after all. Popups are mostly used for one-page interfaces, or those in which history navigation is discouraged, such as our survey example, or the logon procedure for a bank's web site.

You can change those arguments if you need to, but the `status` argument should *always* be set to `yes`, because turning it off undermines good usability. (I know—I've mentioned it already, but I'm saying it again because it's important!)

The `resizable` argument may not have any effect—in some browsers, either by design or as a result of user preferences, it's not possible to create non-resizable windows, even if you set this value to `no`. In fact, in Opera 8 for Mac OS X, it's not possible to create custom-sized windows *at all*—a created window will appear as a new tab in the current window. That specific exception might not be significant in itself, but it serves to illustrate the general point that control over the properties of a created window is not absolutely guaranteed.

Once a new window is open, you can bring it into focus using the object's `focus` method. This isn't usually necessary—generally, it happens by default—but the technique may be useful when you're scripting with multiple windows:

```
var cpanel = makePopup('cpanel.html', 480, 240, 'resize');
cpanel.focus();
```

Alternatively, you may want to open a popup but keep the focus in the *primary* window (thereby creating a so-called "popunder"). You can take the focus away from a window using its `blur` method:

```
var cpanel = makePopup('cpanel.html', 480, 240, 'resize');
cpanel.blur();
```

However, in that case you can't predict where the focus will go to next, so it's more reliable to refocus the primary window:

```
var cpanel = makePopup('cpanel.html', 480, 240, 'resize');
self.focus();
```

Opening Off-site Links in a New Window

In the strict versions of HTML 4 and XHTML 1, the `target` attribute for links no longer exists. One interpretation of this is that web pages simply shouldn't open links in new windows; another is that targeting doesn't have universal semantics and therefore shouldn't be defined in HTML.[2]

There are other interpretations, and the arguments are long (and sometimes tedious), but suffice it to say that you may find yourself needing a solution to this problem. Whatever your personal views may be, it's a common request of web development clients.

Solution

This script identifies links by the `rel` attribute value `external`. The `rel` attribute is a way of describing the relationship between a link and its target,[3] so its use for identifying links that point to another site is semantically non-dubious:

File: **offsite-links.html (excerpt)**

```
<a href="http://www.google.com/" rel="external">Google
  (offsite)</a>
```

If each external link is identified like that, a single `document.onclick` event handler can process clicks on all such links:

File: **offsite-links.js**

```
document.onclick = function(e)
{
  var target = e ? e.target : window.event.srcElement;

  while (target && !/^(a|body)$/i.test(target.nodeName))
  {
    target = target.parentNode;
```

[2]The CSS 3 working draft includes a set of target properties for link presentation [http://www.w3.org/TR/2004/WD-css3-hyperlinks-20040224/], which could eventually see this mechanism handed to CSS instead. Personally, I hope this never gets past the draft stage, because it's nothing to do with CSS: interface control is no more appropriate in a design language than it is in a semantic markup language!

[3] http://www.w3.org/TR/REC-html40/struct/links.html#h-12.1.2

```
  }

  if (target && target.getAttribute('rel')
      && target.rel == 'external')
  {
    var external = window.open(target.href);

    return external.closed;
  }
}
```

Discussion

Using a single, document-wide event handler is the most efficient approach—it's much better than iterating through all the links and binding a handler to each one individually. We can find out which element was actually clicked by referencing the **event target** property. For more about events and event properties, see Chapter 13, but here's a brief summary of the situation.

Two completely different event models are employed by current browsers. The script establishes which one should be used by looking for `e`—the event argument that's used by Mozilla browsers, and has been adopted by most other browsers—as opposed to the `window.event` object used by Internet Explorer. It then saves the object property that's appropriate to the model in use: either `target` for Mozilla and like browsers, or `srcElement` for IE.

The target object (if it's not `null`) can be one of three things: a link element node, an element or text node inside a link, or some other node. We want the *first two* cases to be handled by our script, but clicks arising from the last situation may be safely ignored. What we do is follow the trail of parent nodes from the event target until we either find a link, or get to the `body` element.

Once we have a unified target link, we need simply to check for a `rel` attribute with the correct value; if it exists, we can open a window with the link's `href`, and if all of *that* is successful (as judged by the new window object's `closed` property), the handler will return false, preventing the original link from being followed.

Passing a link to `window.open` without defining arguments will create a window with default decorations—as will a link with `target="_blank"`.

The First Test

We use `getAttribute` as the first test for `rel` because attribute-specific properties are only reliable *if* you know for certain that the attribute in question has been assigned a value. We can't go straight to testing `target.rel` against a string, because it might be `null` or `undefined`. This was discussed in more detail in "Reading and Writing the Attributes of an Element" in Chapter 5.

Communicating Between Frames

If you're working in a framed environment, it may be necessary to have scripts communicate between frames, either reading or writing properties, or calling functions in different documents.

If you have a choice about whether or not to use frames, I'd strongly advise *against* doing so, because they have many serious usability and accessibility problems, quite apart from the fact that they're conceptually broken (they create within the browser states that cannot be addressed[4]). But as with your use of popups, in some cases you may not have a choice about your use of frames. So if you really must use them, here's what you'll need to do.

Solution

Let's begin with a simple frameset document:

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Frameset//EN"
    "http://www.w3.org/TR/html4/frameset.dtd">
<html>
  <head>
    <title>A frameset document</title>
  </head>
  <frameset cols="200, *">
    <frame src="navigation.html" name="navigationFrame">
    <frame src="content.html" name="contentFrame">
    <noframes>
      <p>This frameset document contains:</p>
      <ul>
        <li><a href="navigation.html">Site navigation</a></li>
        <li><a href="contents.html">Main content</a></li>
      </ul>
```

[4] http://www.456bereastreet.com/archive/200411/who_framed_the_web_frames_and_usability/

```
    </noframes>
  </frameset>
</html>
```

We can use *four* references for cross-frame scripting:

- `window` or `self` refers to the current framed page.
- `parent` refers to the page that contains the frame that contains the current page.
- `top` refers to the page at the very top of the hierarchy of frames, which will be the same as `parent` if there's only one frameset in the hierarchy.
- The `frames` collection is an associative array of all the frames in the current page.

Let's say we have a script in `contentFrame` that wants to communicate the page in `navigationFrame`. Both pages are contained in a single frameset—the only one in the hierarchy—so we could successfully make any of the following references from within `contentFrame`:

- `parent.frames[0]`
- `top.frames[0]`
- `parent.frames['navigationFrame']`
- `top.frames['navigationFrame']`

The `frames` collection is an associative array (like the `forms` collection we saw in Chapter 6), so each element can be accessed by either index or name. It's generally best to use the name (unless you have a good reason not to) so that you won't have to edit your code later if the frame order changes. By the same token, `parent` references in a complex nested frameset can change if the hierarchy changes, so I generally recommend that developers always start referencing from `top`. Of the above options, the reference I prefer, then, is `top.frames['navigationFrame']`.

Now that we have a reference to the frame, we can call a function in the other framed page:

File: **frames-navigation.js (excerpt)**

```
var navframe = top.frames['navigationFrame'];
navframe.callMyFunction();
```

Alternatively, we can get a reference to the other framed document, and work with the DOM from there:

File: **frames-navigation.js (excerpt)**

```
var navdoc = navframe.document;
var menu = navdoc.getElementById('menulist');
```

Discussion

Communication between frames is only allowed for documents *in the same domain*—for security reasons, it's not possible to work with a document that was loaded from a different domain than the script. It wouldn't do, for example, for a malicious site owner to load a site that you visit regularly into a frame, and steal the personal data you enter there.

In fact, some browsers let users disallow *all* scripts from communicating between frames, just to eradicate any possibility of a cross-site scripting vulnerability, and there's no way to work around this preference if your script finds itself running in a browser so configured.

If you do have users who are complaining of problems (and they can't or won't change their settings to allow cross-frame scripting), the safest thing to do is simply to avoid cross-frame scripting altogether.

Alternative methods of passing data between pages are discussed in Chapter 6 and Chapter 8.

Getting the Scrolling Position

Page scrolling is one of the least-standardized properties in JavaScript: *three* variations are now in use by different versions of different browsers. But with a few careful object tests, we can reliably get a consistent value.

Solution

There are three ways of getting this information. We'll use object tests on each approach, to determine the level of support available:

File: **get-scrolling-position.js (excerpt)**

```
function getScrollingPosition()
{
  var position = [0, 0];

  if (typeof window.pageYOffset != 'undefined')
  {
    position = [
        window.pageXOffset,
        window.pageYOffset
    ];
  }

  else if (typeof document.documentElement.scrollTop
      != 'undefined' && document.documentElement.scrollTop > 0)
  {
    position = [
        document.documentElement.scrollLeft,
        document.documentElement.scrollTop
    ];
  }

  else if (typeof document.body.scrollTop != 'undefined')
  {
    position = [
        document.body.scrollLeft,
        document.body.scrollTop
    ];
  }

  return position;
}
```

The function can now be called as required. Here's a simple demonstration, using a `window.onscroll` event handler, that gets the figures and writes them to the title bar:

File: **get-scrolling-position.js (excerpt)**

```
window.onscroll = function()
{
  var scrollpos = getScrollingPosition();
  document.title = 'left=' + scrollpos[0] + ' top=' +
      scrollpos[1];
};
```

The Problem with `scroll`

`scroll` is not the most reliable of events: it may not fire at all in Konqueror or Safari 1.0, or when the user navigates with a mouse wheel in Firefox. And if it does fire, it may do so continually and rapidly (as it does in Internet Explorer), which can be slow and inefficient if the scripting you set to respond to the event is very complex.

If you have difficulties of this kind, you may find it better to use the `setInterval` function instead of an `onscroll` event handler. `setInterval` will allow you to call the function at a predictable interval, rather than in response to an event. You can find out more about this kind of scripting in Chapter 14, but here's a comparable example:

```
window.setInterval(function()
{
  var scrollpos = getScrollingPosition();
  document.title = 'left=' + scrollpos[0] + ' top=' +
      scrollpos[1];
}, 250);
```

Discussion

The only real complication here is that IE 5 actually *does* recognize the `documentElement.scrollTop` property, but its value is always zero, so we have to check the value as well as looking for the existence of the property.

Otherwise, it doesn't really matter to us which browser is using which property; all that matters is that our script gets through one of the compatibility tests and returns a useful value. However, the properties used by each browser are shown here for reference:

- `window.pageYOffset` is used by Firefox and other Mozilla browsers, Safari, Konqueror, and Opera.
- `document.documentElement.scrollTop` is used by IE 6 in standards-compliant mode.
- `document.body.scrollTop` is used by IE 5, and IE 6 in "Quirks" mode.

This list doesn't tell the complete story, but it's intended primarily to describe the ordering of the tests. More recent Mozilla browsers (such as Firefox) also support `documentElement.scrollTop` and `body.scrollTop`, by the same render-

ing mode rules as IE 6. Safari and Konqueror support `body.scrollTop` in either mode. Opera supports all three properties in any mode!

But none of this is important for you to know—browser vendors add these multiple properties to allow for scripts that are unaware of one property or another, not to provide arbitrary choices for the sake of it. From our perspective, the important point is to settle on a set of compatibility tests that ensures our script will work as widely as possible.

Rendering Modes

"Standards" mode and "Quirks" mode are the two main **rendering modes** in use by current browsers. These modes affect various aspects of the output document, including which element is the canvas (`<body>` or `<html>`), and how CSS box sizes are calculated. For more on rendering modes, see Chapter 11.

Making the Page Scroll to a Particular Position

All current browsers implement the same (nonstandard) methods for scrolling a page. At least something here is simple!

Solution

There are two methods that can be used to scroll the page (or rather, the window or frame), either by a particular amount (`window.scrollBy`), or to a particular point (`window.scrollTo`):

File: **scroll-page.js (excerpt)**

```
//scroll down 200 pixels
window.scrollBy(0, 200);
```

File: **scroll-page.js (excerpt)**

```
//scroll across 200 pixels
window.scrollBy(200, 0);
```

File: **scroll-page.js (excerpt)**

```
//scroll to 300 from the edge and 100 from the top
window.scrollTo(300, 100);
```

File: **scroll-page.js (excerpt)**

```
//scroll to the beginning
window.scrollTo(0, 0);
```

These examples say: scroll down by 200 pixels, then across by 200 pixels, then to a point that's 300 pixels from the left and 100 pixels from the top, then back to the top corner.

Getting the Viewport Size (the Available Space inside the Window)

The details of the viewport size are needed for many kinds of scripting, wherever available space is a factor in the script's logic. This solution provides a utility function for getting the viewport size We'll be seeing the function again quite a few times throughout this book!

Solution

The properties we need are implemented in three different ways, like the properties we saw for page scrolling in the previous section ("Making the Page Scroll to a Particular Position"). As was the case in that example, we can use object testing to determine which implementation is relevant, including the test for a zero-value that we need in IE 5 (this test is required for the same reason: because, though the property exists, it isn't what we want):

File: **get-viewport-size.js (excerpt)**

```
function getViewportSize()
{
  var size = [0, 0];

  if (typeof window.innerWidth != 'undefined')
  {
    size = [
        window.innerWidth,
        window.innerHeight
    ];
  }
  else if (typeof document.documentElement != 'undefined'
      && typeof document.documentElement.clientWidth !=
      'undefined' && document.documentElement.clientWidth != 0)
  {
```

```
    size = [
        document.documentElement.clientWidth,
        document.documentElement.clientHeight
    ];
  }
  else
  {
    size = [
        document.getElementsByTagName('body')[0].clientWidth,
        document.getElementsByTagName('body')[0].clientHeight
    ];
  }

  return size;
}
```

The function returns an array of the width and height, so we can call it whenever we need that data:

File: **get-viewport-size.js (excerpt)**

```
window.onresize = function()
{
  var size = getViewportSize();
  alert('Viewport size: [' + size[0] + ', ' + size[1] + ']');
};
```

Summary

We've covered the basics of window and frame manipulation from a pragmatist's point of view in this chapter. We've also talked about principles and techniques that we can use to ensure that scripts like this are as user-friendly and as accessible as we can make them. Doubtless, this kind of work will remain controversial, and clearly we do need *some kind* of targeting mechanism, because even though the use of frames is slowly dying out, the advent of ever more sophisticated interfaces keeps these issues alive.

I rather like the XLink standard's `show` attribute, which has values like `new` and `replace`.[5] These *suggest* a target process (open a new window, and replace the contents of the current window, respectively) but they don't actually *define* specific behaviors. They leave it up to the user agent to control what actually happens, so, for example, `new` could be used to open tabs instead of windows.

[5] http://www.w3.org/TR/xlink/#show-att

13 Basic Dynamic HTML

Dynamic HTML isn't a single piece of technology that you can point to and say, "This is DHTML." The term is a descriptor that encompasses all of the technologies that combine to make a web page dynamic: the technologies that let you create new elements without refreshing the page, change the color of those elements, and make them expand, contract, and zoom around the screen.

DHTML uses HTML, the DOM, and CSS in combination with a client-side scripting language—JavaScript—to bring life to what was traditionally a static medium. In previous chapters, we learned that we can use JavaScript to manipulate parts of a page to achieve some very handy results. DHTML provides solutions to much more complex problems by assembling these parts into a coherent whole—one that satisfies real-world needs, rather than programming puzzles.

This chapter explores a few of the tools we need in order to create effective user interfaces with DHTML. It then discusses a couple of simple widgets in preparation for the more complex modules we'll consider throughout the rest of this book.

Handling Events

Any interaction that users have with a web page—whether they're moving the mouse or tapping the keyboard—will cause the browser to generate an event.

Sometimes, we want our code to respond to this interaction, so we listen for these events, which let us know when we should execute our code.

Solution

There are two ways to handle events: the short way, and the W3C way. Each has its pros and cons, but both allow you to execute a specified function when an event occurs on a particular element.

The Short Way: Using Event Handlers

The shorter way of handling an event is to use the DOM 0 event handlers that are assigned as shortcut properties of every element. Much as we saw in Chapter 5 when we discussed DOM 0 attribute shortcuts, these event handlers are not future-proof. However, they do offer some advantages over standard W3C event listeners:

- Every browser that's currently in operation supports DOM 0 event handlers without the need for code branching.
- Each function executed by a DOM 0 event handler has access to the exact element to which the event handler was assigned. (As you'll see later, this is not always available in W3C event listeners.)

The main problem with utilizing DOM 0 event handlers is that they are not designed to work with multiple scripts. Every time you assign a DOM 0 event handler, you overwrite any previously assigned handler for that event. This can interfere with the operation of multiple scripts that require event handling on the same element. With W3C event listeners, you can apply any number of event listeners on the same element, and enjoy the ability to remove any of them at any time.

If you can be certain that your code will not interfere with someone else's event handling (e.g., you're placing events on elements that are created dynamically in your own script), it will be safe to use DOM 0 event handlers. But—all things being equal—it is safer to use the W3C event listeners wherever practical, as we do in this book.

A number of DOM 0 event handlers are available via the browser; Table 13.1 lists the most commonly used handlers.

Table 13.1. DOM 0 event handlers

DOM 0 Event Handler	W3C DOM Event	Indicated Action
`onblur`	`blur`	Remove focus from an element by clicking outside or tabbing away from it.
`onfocus`	`focus`	Focus the cursor on an element.
`onchange`	`change`	Remove focus from an element after changing its content.
`onmouseover`	`mouseover`	Move the mouse pointer over an element.
`onmouseout`	`mouseout`	Move the mouse pointer out of an element.
`onmousemove`	`mousemove`	Move the mouse pointer while it is over an element.
`onmousedown`	`mousedown`	Press a mouse button while the pointer is over an element.
`onmouseup`	`mouseup`	Release a mouse button while the pointer is over an element.
`onclick`	`click`	Press and release the main mouse button or keyboard equivalent (**Enter** key) while the pointer is over an element.
`ondblclick`	`dblclick`	Double-click the main mouse button while the pointer is over an element.
`onkeydown`	`keydown`	Press a keyboard key while an element has focus.
`onkeyup`	`keyup`	Release a keyboard key while an element has focus.
`onkeypress`	`keypress`	Press and release a keyboard key while an element has focus.
`onsubmit`	`submit`	Request that a form be submitted.
`onload`	`load`	Finish loading a page and all associated assets (e.g., images).
`onunload`	`unload`	Request a new page to replace the currently-displayed page, or close the window.

In using DOM 0 event handlers, once you have a reference to the element whose events you want to handle, it's a simple matter of assigning a handling function to the appropriate property:

File: **handle_events.js (excerpt)**

```
var mylink = document.getElementById("mylink");

mylink.onclick = engage;
⋮
function engage()
{
  alert("Engage!");

  return false;
}
```

You'll note that, in the function assignment (`button.onclick = engage;`), parentheses do not follow the function name. Their inclusion would execute the function immediately, and assign the *return value* as the event handler. By omitting the parentheses, you can assign the function *itself* to the handler. This also means that you cannot supply arguments directly to the handling function: the function must obtain its information through other means.

Anonymous Functions

Instead of supplying a reference to a named function, you can supply an anonymous function for an event handler:

```
var mylink = document.getElementById("mylink");

mylink.onclick = function()
{
  alert("Engage!");

  return false;
}
```

Depending on whether you need to reuse the handling function (and your own coding preferences), this can be an easier way of writing event handling code.

The return value of the handling function determines whether the default action for that event occurs. So, in the preceding code, if `mybutton` were a hyperlink, its default action when clicked would be to navigate to its `href` location. By returning `false`, the `engage` function does not allow the default action to occur, and the hyperlink navigation will not take place. If the return value were `true`, the default action *would* occur after the event handling function's code had executed.

When an event occurs, detailed information about the how, why, and where of that event is written to an **event object**. In Internet Explorer, this takes the form of a global `window.event` object, but in other browsers the object is passed as an argument to the event-handling function. This difference is fairly easy to address within the handling function:

File: **handle_events2.js (excerpt)**

```
function engage(event)
{
  if (typeof event == "undefined")
  {
    event = window.event;
  }

  alert("The screen co-ordinates of your click were: " +
      event.screenX + ", " + event.screenY);

  return false;
}
```

The event object allows you to find out a range of details, such as which element was clicked, whether any keys were pressed, the coordinates of the event (e.g., where the cursor was located when the mouse button was clicked), and the type of event that triggered the function. Quite a few of the event property names are consistent across browsers, but a few differ. The Mozilla event properties can be viewed at the Gecko DOM Reference,[1] while the Internet Explorer event properties can be seen at MSDN.[2] For properties whose names vary between browsers, the potential for associated problems can normally be rectified with a little object detection; we'll discuss this in detail later in this chapter.

The W3C Way (Event Listeners)

Although the DOM 0 event handlers are quick and easy, they do have limitations (aside from the fact that eventually they will become deprecated). The main advantage of the W3C event listeners is that they natively support the addition and removal of multiple handling functions for the same event on a single element. Event listeners also have the capability to respond to events in several phases (though most browsers don't yet support this capability).

[1] http://www.mozilla.org/docs/dom/domref/dom_event_ref.html
[2] http://msdn.microsoft.com/workshop/author/dhtml/reference/objects/obj_event.asp

In the W3C specification, an event can be added to an element using the element's `addEventListener` method, but Internet Explorer for Windows chooses to use a method called `attachEvent`, which has a slightly different syntax.[3]

To add an event listener in every browser except Internet Explorer, you would write code similar to this:

```
var mylink = document.getElementById("mylink");

mylink.addEventListener("click", engage, false);
```

To support Internet Explorer, you'd need this code:

```
var mylink = document.getElementById("mylink");

mylink.attachEvent("onclick", engage);
```

As well as the differing function names, it's important to note that Internet Explorer uses the DOM 0 handler name for the event—`"onclick"`—rather than the true event name: `"click"`. The extra argument that's supplied to `addEventListener` specifies whether the listener is applied during the capture (`true`) or bubble (`false`) event propagation phase. Event propagation is explained in more detail in the discussion below, but bubble is really the most useful choice, and ensures the same behavior in standards-compliant browsers as in Internet Explorer.

The differences between these two approaches are fairly easy to work around using an abstracting function. We can also provide a fallback for browsers that don't support W3C event listeners at the same time:

File: **handle_events3.js (excerpt)**

```
function attachEventListener(target, eventType, functionRef,
    capture)
{
  if (typeof target.addEventListener != "undefined")
  {
    target.addEventListener(eventType, functionRef, capture);
  }
  else if (typeof target.attachEvent != "undefined")
  {
    target.attachEvent("on" + eventType, functionRef);
  }
```

[3]Internet Explorer for Mac doesn't support either of these event models, so we have to rely on the DOM 0 handlers to work with events in this browser.

```
  else
  {
    eventType = "on" + eventType;

    if (typeof target[eventType] == "function")
    {
      var oldListener = target[eventType];

      target[eventType] = function()
      {
        oldListener();

        return functionRef();
      };
    }
    else
    {
      target[eventType] = functionRef;
    }
  }
}
```

The first two `if` statements deal with the standards-based and Internet Explorer methods respectively, but the catch-all `else` deals with older browsers that don't support either of these methods, particularly Internet Explorer 5 for Mac. In this last case, a DOM 0 event handler is used, but to ensure that multiple functions can be used to handle a single event for a particular element, a closure is used to execute any existing functions that are attached to the event.

Closures are an advanced feature of JavaScript that relates to scoping (which you can read about in Chapter 19). Closures allow an inner function to reference the variables of the containing function even after the containing function has finished running. Simon Willison has explained their usage in relation to event handlers in some detail.[4] Suffice it to say that closures allow us to stack multiple event handlers in browsers that don't support W3C event listeners.

The cross-browser code for assigning an event listener is as follows:

File: **handle_events3.js (excerpt)**

```
var mylink = document.getElementById("mylink");

attachEventListener(mylink, "click", engage, false);
```

[4] http://www.sitepoint.com/blogs/2004/05/26/closures-and-executing-javascript-on-page-load/

Not (quite) the Genuine Article

Although the DOM 0 event handler fallback mimics the ability to add multiple event listeners for one event type on an element, it does not provide exact replication of the W3C event model, because specific handlers cannot be *removed* from an element.

Whereas DOM 0 handlers allowed the cancellation of an element's default action by returning `false`, W3C event listeners achieve this goal slightly differently. To cancel a default action in this model, we need to modify the event object. Internet Explorer requires you to set its `returnValue` property to `false`; standards-based implementations offer the `preventDefault` method to do the same thing. We can create a small function that figures out the difference for us:

File: **handle_events4.js (excerpt)**

```
function stopDefaultAction(event)
{
  event.returnValue = false;

  if (typeof event.preventDefault != "undefined")
  {
    event.preventDefault();
  }
}
```

We can call this function whenever we want to cancel the default action:

File: **handle_events4.js (excerpt)**

```
function engage(event)
{
  if (typeof event == "undefined")
  {
    event = window.event;
  }

  alert("Engage!");

  stopDefaultAction(event);

  return false;
}
```

You still need to return `false` after executing `stopDefaultAction` in order to ensure that browsers that don't support the W3C event model will also prevent the default action.

Safari and W3C Event Listeners

Due to a bug in Safari, it's impossible to cancel the default action of clicking a hyperlink in that browser when using W3C event listeners. To achieve the cancellation, you'll have to use DOM 0 event handlers with a return value of `false`.

Checking for `attachEvent`

Internet Explorer for Windows actually passes an event object to the event-handling function when `attachEvent` is used to attach an event listener. However, we still need to check for the existence of this object for any browsers that use the old event model.

One of the advantages of using W3C event listeners is that you can remove an individual listener from an element without disturbing any other listeners on the same event. This is not possible using the DOM 0 handlers.

Internet Explorer uses the `detachEvent` method, while the standards-compliant browsers instead specify a method called `removeEventListener`. Each of these methods operates fairly similarly to its listener-adding counterpart: an event type must be supplied along with the function that was assigned to handle that event type. The standard method also demands to know whether the event handler was registered to respond during the capture or bubble phase.

Here's a function that supports this approach across browsers:

File: **handle_events5.js (excerpt)**

```
function detachEventListener(target, eventType, functionRef,
    capture)
{
  if (typeof target.removeEventListener != "undefined")
  {
    target.removeEventListener(eventType, functionRef, capture);
  }
  else if (typeof target.detachEvent != "undefined")
  {
    target.detachEvent("on" + eventType, functionRef);
  }
  else
  {
    target["on" + eventType] = null;
  }
}
```

The W3C Event Model and Anonymous Functions

The W3C event model doesn't allow for the removal of anonymous functions, so if you need to remove an event listener, hang onto a reference to the function in question.

In browsers that don't support W3C event listeners, this function removes all event handlers on the given event: it's not possible to remove just one of them and leave the others.

Discussion

Referencing the Target Element

Quite often, you'll want to use the object that was the target of an event inside the event handler itself. With DOM 0 event handlers, the use of the special variable `this` inside a handling function will refer to the event target object. Consider this code:

File: **handle_events6.js (excerpt)**

```
var mylink = document.getElementById("mylink");

mylink.onclick = engage;
⋮
function engage()
{
  var href = this.getAttribute("href");

  alert("Engage: " + href);

  return false;
}
```

Here, `this` refers to the link with ID `mylink`. We can use it to get the link's `href` attribute.

However, if you use W3C event listeners, the target of the event is stored as part of the event object, under different properties in different browsers. Internet Explorer stores the target as `srcElement`, while the standards model stores it as `target`. But the element to which these properties point isn't necessarily the element to which the event listener was assigned. It is, in fact, the deepest element in the hierarchy affected by the event. Take a look at the following HTML.

File: **handle_events6.html (excerpt)**

```
<p>
  These are the voyages of the <a id="mylink"
      href="enterprise.html">starship Enterprise</a>.
</p>
```

If a `click` event listener were placed on the paragraph and a user clicked on the link, the paragraph's `click` event handler would be executed, but the event target that was accessible through the above-mentioned properties would be the hyperlink. Some browsers (most notably, Safari) even go so far as to count the text node *inside* the link as the target node.

We can write a function that returns the event target irrespective of which property has been implemented, but this does not solve the problem of finding the element to which we originally applied the event listener.[5] Often, the best resolution to this quandary is to iterate upwards from the event target provided by the browser until we find an element that's *likely* to be the element to which we attached an event listener. To do this, we can perform checks against the element's tag name, class, and other attributes.

The abstracting event target function would look like this:

File: **handle_events7.js (excerpt)**

```
function getEventTarget(event)
{
  var targetElement = null;

  if (typeof event.target != "undefined")
  {
    targetElement = event.target;
  }
  else
  {
    targetElement = event.srcElement;
  }

  while (targetElement.nodeType == 3 &&
      targetElement.parentNode != null)
  {
    targetElement = targetElement.parentNode;
```

[5]The W3C Standard specifies another property called `currentTarget`, which lets you get the element to which the listener was assigned, but there is no Internet Explorer equivalent. Browsers that support `currentTarget` also set up the event handler-style `this` variable with the same value, but again, without Internet Explorer support, this isn't particularly useful.

```
  }

  return targetElement;
}
```

The `if-else` retrieves the event target across browsers; the `while` loop then finds the first non-text-node parent if the target reported by the browser happens to be a text node.

If we want to retrieve the element that was clicked upon, we then make a call to `getEventTarget`:

File: **handle_events7.js (excerpt)**

```
var mylink = document.getElementById("mylink");

attachEventListener(mylink, "click", engage, false);
⋮
function engage(event)
{
  if (typeof event == "undefined")
  {
    event = window.event;
  }

  var target = getEventTarget(event);

  while(target.nodeName.toLowerCase() != "a")
  {
    target = target.parentNode;
  }

  var href = target.getAttribute("href");

  alert("Engage: " + href);

  return true;
}
```

Because we know, in this case, that the event-handling function will be attached only to links (`<a>` tags), we can iterate upwards from the event target, checking for a node name of `"a"`. The first one we find will be the link to which the handler was assigned; this ensures that we aren't working with some element inside the link (such as a `strong` or a `span`).

Obviously, this method of target finding is not ideal, and cannot be 100% accurate unless you have knowledge of the exact HTML you'll be working with. Recently, much effort has gone into resolving this problem, and quite a few of the proposed solutions offer the same `this` variable as is available under DOM 0 event handlers, and in browsers that support the W3C Standard for event listeners (not Internet Explorer).

One such solution is to make the event listening function a method of the target object in Internet Explorer. Then, when the method is called, `this` will naturally point to the object for which the method was called. This requires both the `attachEventListener` and `detachEventListener` to be modified:

File: **handle_events8.js (excerpt)**

```
function attachEventListener(target, eventType, functionRef,
    capture)
{
  if (typeof target.addEventListener != "undefined")
  {
    target.addEventListener(eventType, functionRef, capture);
  }
  else if (typeof target.attachEvent != "undefined")
  {
    var functionString = eventType + functionRef;
    target["e" + functionString] = functionRef;

    target[functionString] = function(event)
    {
      if (typeof event == "undefined")
      {
        event = window.event;
      }
      target["e" + functionString](event);
    };

    target.attachEvent("on" + eventType, target[functionString]);
  }
  else
  {
    eventType = "on" + eventType;

    if (typeof target[eventType] == "function")
    {
      var oldListener = target[eventType];

      target[eventType] = function()
```

```
      {
        oldListener();

        return functionRef();
      }
    }
    else
    {
      target[eventType] = functionRef;
    }
  }
}

function detachEventListener(target, eventType, functionRef,
    capture)
{
  if (typeof target.removeEventListener != "undefined")
  {
    target.removeEventListener(eventType, functionRef, capture)
  }
  else if (typeof target.detachEvent != "undefined")
  {
    var functionString = eventType + functionRef;

    target.detachEvent("on" + eventType, target[functionString]);

    target["e" + functionString] = null;
    target[functionString] = null;
  }
  else
  {
    target["on" + eventType] = null;
  }
}
```

This line of thinking was well represented in entries to Peter Paul Koch's improved addEvent competition.[6]

Another solution by Dean Edwards totally eschews the W3C event model in favor of implementing DOM 0 event handlers with independent add and remove abilities.[7]

[6] http://www.quirksmode.org/blog/archives/2005/10/_and_the_winner_1.html
[7] http://dean.edwards.name/weblog/2005/10/add-event/

Although both of these solutions may prove to be well written and robust, they're largely untested as of this writing, so we'll stick with the approach whose flaws we know and can handle: the one presented in the main solution. Besides, in practice, the process of iterating to find an event's target isn't as unreliable as it may appear to be.

What is Event Bubbling, and How do I Control it?

You may have noticed that we needed to supply a third argument to the W3C Standard `addEventListener` method, and that a *`capture`* argument was included in our `attachEventListener` function to cater for this. This argument determines the phase of the event cycle in which the listener operates.

Suppose you have two elements, one nested inside the other:

```
<p>
  <a href="untimely_death.html">Nameless Ensign</a>
</p>
```

When a user clicks on the link, click events will be registered on both the paragraph and the hyperlink. The question is, which one receives the event first?

The event cycle contains two phases, and each answers this question in a different way. In the **capture** phase, events work from the outside in, so the paragraph would receive the click first, then the hyperlink. In the **bubble** phase, events work from the inside out, so the anchor would receive the click before the paragraph.

Internet Explorer and Opera only support bubbling, which is why `attachEvent` doesn't require a third argument. For browsers that support `addEventListener`, if the third argument is `true`, the event will be caught during the capture phase; if it is `false`, the event will be caught during the bubble phase.

In browsers that support both phases, the capture phase occurs first and is always followed by the bubble phase. It's possible for an event to be handled on the same element in both the capture and bubbling phases, provided you set up listeners for each phase.

These phases also highlight the fact that nested elements are affected by the same event. If you no longer want an event to continue propagating up or down the hierarchy (depending upon the phase) after an event listener has been triggered, you can stop it. In Internet Explorer, this involves setting the `cancelBubble`

property of the event object to `true`; in the W3C model, you must instead call its `stopPropagation` method:

File: **handle_events9.js (excerpt)**

```
function stopEvent(event)
{
  if (typeof event.stopPropagation != "undefined")
  {
    event.stopPropagation();
  }
  else
  {
    event.cancelBubble = true;
  }
}
```

If we didn't want an event to propagate further than our event handler, we'd use this code:

File: **handle_events9.js (excerpt)**

```
var mylink = document.getElementById("mylink");

attachEventListener(mylink, "click", engage, false);

var paragraph = document.getElementsByTagName("p")[0];

attachEventListener(paragraph, "click", engage, false);

function engage(event)
{
  if (typeof event == "undefined")
  {
    event = window.event;
  }

  alert("She canna take no more cap'n!");

  stopEvent(event);

  return true;
}
```

Although we have assigned the `engage` function to listen for the `click` event on both the link and the paragraph that contains it, the function will only be called

once per click, as the event's propagation is stopped by the listener the first time it is called.

Finding the Size of an Element

There are so many variables that affect the size of an element—content length, CSS rules, font family, font size, line height, text zooming … the list goes on. Add to this the fact that browsers interpret CSS dimensions and font sizes inconsistently, and you can never predict the dimensions at which an element will be rendered. The only consistent way to determine an element's size is to measure it once it's been rendered by the browser.

Solution

You can tell straight away that it's going to be useful to know exactly how big an element is. Well, the W3C can't help: there's no standardized way to determine the size of an element. Thankfully, the browser-makers have more or less settled on some DOM properties that let us figure it out.

Although box model differences mean that Internet Explorer includes padding and borders inconsistently as part of an element's CSS dimensions, the `offsetWidth` and `offsetHeight` properties will consistently return an element's width—including padding and borders—across all browsers.

Let's imagine that an element's dimensions were specified in CSS like this:

File: **find_size_element.css**

```
#enterprise
{
  width: 350px;
  height: 150px;
  margin: 25px;
  border: 25px solid #000000;
  padding: 25px;
}
```

We can determine that element's exact pixel width in JavaScript by checking the corresponding `offsetWidth` and `offsetHeight` properties:

File: **find_size_element.js (excerpt)**

```
var starShip = document.getElementById("enterprise");
var pixelWidth = starShip.offsetWidth;
var pixelHeight = starShip.offsetHeight;
```

In Internet Explorer 6, Opera, Mozilla, and Safari, the variable `pixelWidth` will now be set to `450`, and the variable `pixelHeight` will be set to `250`. In Internet Explorer 5/5.5, `pixelWidth` will be `350` and `pixelHeight` `150`, because those are the dimensions at which the broken box model approach used in those browsers will render the element. The values are different across browsers, but only because the actual rendered size differs as well. The offset dimensions consistently calculate the exact pixel dimensions of the element.

If we did not specify the dimensions of the element, and instead left its display up to the default block rendering (thus avoiding the box model bugs), the values would be comparable between browsers (allowing for scrollbar width differences, fonts, etc.).

Attaining the Correct Dimensions

In order to correctly determine the dimensions of an element you must wait until the browser has finished rendering that element, otherwise the dimensions may be different from those the user ends up seeing. There's no guaranteed way to ensure that a browser has finished rendering an element, but it's normally safe to assume that once a window's `load` event has fired, all elements have been rendered.

Discussion

It is possible to retrieve the dimensions of an element minus its borders, but including its padding. These values are accessed using the `clientWidth` and `clientHeight` properties, and for the example element used above their values would be `300` and `100` in Internet Explorer 5/5.5, and `400` and `200` in all other browsers.

There is no property that will allow you to retrieve an element's width without borders *or* padding.

Finding the Position of an Element

Knowing the exact position of an element is very helpful when you wish to position other elements relative to it. However, because of different browser sizes,

font sizes, and content lengths, it's often impossible to hard-code the position of an element *before* you load a page. JavaScript offers a method to ascertain any element's position *after* the page has been rendered, so you can know exactly where your elements are located.

Solution

The `offsetTop` and `offsetLeft` properties tell you the distance between the top of an element and the top of its `offsetParent`. But what is `offsetParent`? Well, it varies widely for different elements and different browsers. Sometimes it's the immediate containing element; other times it's the `html` element; at other times it's nonexistent.

Thankfully, the solution is to follow the trail of `offsetParent`s and add up their offset positions—a method that will give you the element's accurate absolute position on the page in every browser.

If the element in question has no `offsetParent`, then the offset position of the element itself is enough; otherwise, we add the offsets of the element to those of its `offsetParent`, then repeat the process for *its* `offsetParent` (if any):

File: **find_position_of_element.js (excerpt)**

```
function getPosition(theElement)
{
  var positionX = 0;
  var positionY = 0;

  while (theElement != null)
  {
    positionX += theElement.offsetLeft;
    positionY += theElement.offsetTop;
    theElement = theElement.offsetParent;
  }

  return [positionX, positionY];
}
```

IE 5 for Mac Bug

Internet Explorer 5 for Mac doesn't take the `body`'s margin or padding into account when calculating the offset dimensions, so if you desire accurate measurements in this browser, you should have zero margins and padding on the `body`.

Discussion

The method above works for simple and complex layouts; however, you may run into problems when one or more of an element's ancestors has its CSS `position` property set to something other than `static` (the default).

There are so many possible combinations of nested positioning and browser differences that it's almost impossible to write a script that takes them all into account. If you are working with an interface that uses a lot of relative or absolute positioning, it's probably easiest to experiment with specific cases and write special functions to deal with them. Here are just a few of the differences that you might encounter:

- In Internet Explorer for Windows and Mozilla/Firefox, any element whose parent is relatively positioned will not include the parent's border in its own offset; however, the parent's offset will only measure to the edge of its border. Therefore, the sum of these values will not include the border distance.
- In Opera and Safari, any absolutely or relatively positioned element whose `offsetParent` is the `body` will include the `body`'s margin in its own offset. The `body`'s offset will include its own margin as well.
- In Internet Explorer for Windows, any absolutely positioned element inside a relatively positioned element will include the relatively positioned element's margin in its offset. The relatively positioned element will include its margin as well.

Detecting the Position of the Mouse Cursor

When working with mouse events, such as `mouseover` or `mousemove`, you will often want to use the coordinates of the mouse cursor as part of your operation (e.g., to position an element near the mouse). The solution explained below is actually a more reliable method of location detection than the element position detection method we discussed in "Finding the Position of an Element", so if it's possible to use the following solution instead of the previous one, go for it!

Solution

The event object contains everything you need to know to work with the position of the cursor, although a little bit of object detection is required to ensure you get equivalent values across all browsers.

The standard method of obtaining the cursor's position relative to the entire page is via the `pageX` and `pageY` properties of the event object. Internet Explorer doesn't support these properties, but it *does* include some properties that are *almost* the ones we want. `clientX` and `clientY` are available in Internet Explorer, though they measure the distance from the mouse cursor to the edges of the browser window. In order to find the position of the cursor relative to the entire page, we need to add the current scroll position to these dimensions. This technique was covered in Chapter 7; let's use the `getScrollingPosition` function from that solution to retrieve the required dimensions:

File: **detect_mouse_cursor.js (excerpt)**

```
function displayCursorPosition(event)
{
  if (typeof event == "undefined")
  {
    event = window.event;
  }

  var scrollingPosition = getScrollingPosition();
  var cursorPosition = [0, 0];

  if (typeof event.pageX != "undefined" &&
      typeof event.x != "undefined")
  {
    cursorPosition[0] = event.pageX;
    cursorPosition[1] = event.pageY;
  }
  else
  {
    cursorPosition[0] = event.clientX + scrollingPosition[0];
    cursorPosition[1] = event.clientY + scrollingPosition[1];
  }

  var paragraph = document.getElementsByTagName("p")[0];

  paragraph.replaceChild(document.createTextNode(
      "Your mouse is currently located at: " + cursorPosition[0] +
      "," + cursorPosition[1]), paragraph.firstChild);
```

```
  return true;
}
```

`clientX`/`clientY` are valid W3C DOM event properties that exist in most browsers, so we can't rely on their existence as an indication that we need to use them. Instead, within our event handler, we test for the existence of `pageX`. Internet Explorer for Mac does have `pageX`, but it's an incorrect value, so we must also check for `x`. `x` is actually a nonstandard property, but most browsers support it (the exceptions being Opera 8+ and Internet Explorer). It's okay that Opera 8+ doesn't support `x`, because the `else` statement is actually a cross-browser method for calculating the mouse cursor position *except* in Safari, which incorrectly gives `clientX` the same value as `pageX`. That's why we still need to use both methods of calculating the cursor position.

Displaying a Tooltip when you Mouse Over an Element

Tooltips are a helpful feature in most browsers, but they can be a bit restrictive if you plan to use them as parts of your interface. If you'd like to use layers that appear when you want them to, aren't truncated, and can contain more than plain text, why not make your own enhanced tooltips?

Solution

For this example, we'll apply a `class`, `hastooltip`, on all the elements for which we'd like tooltips to appear. We'll get the information that's going to appear in the tooltip from each element's `title` attribute:

File: **`tooltips.html` (excerpt)**

```
<p>
  These are the voyages of the <a class="hastooltip"
      href="enterprise.html" title="USS Enterprise (NCC-1701) …">
    starship Enterprise</a>.
</p>
```

From our exploration of browser events earlier in this chapter, you'll probably already have realized that we need to set up some event listeners to let us know when the layer should appear and disappear.

Tooltips classically appear in a fixed location when you mouse over an element, and disappear when you mouse out. Some implementations of JavaScript tooltips also move the tooltip as the mouse moves over the element, but I personally find this annoying. In this solution, we'll focus on the `mouseover` and `mouseout` events:

File: **tooltips.js (excerpt)**

```
addLoadListener(initTooltips);

function initTooltips()
{
  var tips = getElementsByAttribute("class", "hastooltip");

  for (var i = 0; i < tips.length; i++)
  {
    attachEventListener(tips[i], "mouseover", showTip, false);
    attachEventListener(tips[i], "mouseout", hideTip, false);
  }

  return true;
}
```

We've already coded quite a few of the functions in this script, including `addLoadListener` from Chapter 1, `getElementsByAttribute` from Chapter 5, and the `attachEventListener` function that we created earlier in this chapter, so the bulk of the code is in the event listener functions:

File: **tooltips.js (excerpt)**

```
function showTip(event)
{
  if (typeof event == "undefined")
  {
    event = window.event;
  }

  var target = getEventTarget(event);

  while (target.className == null ||
      !/(^| )hastooltip( |$)/.test(target.className))
  {
    target = target.parentNode;
  }

  var tip = document.createElement("div");
  var content = target.getAttribute("title");
```

```
  target.tooltip = tip;
  target.setAttribute("title", "");

  if (target.getAttribute("id") != "")
  {
    tip.setAttribute("id", target.getAttribute("id") + "tooltip");
  }

  tip.className = "tooltip";
  tip.appendChild(document.createTextNode(content));

  var scrollingPosition = getScrollingPosition();
  var cursorPosition = [0, 0];

  if (typeof event.pageX != "undefined" &&
      typeof event.x != "undefined")
  {
    cursorPosition[0] = event.pageX;
    cursorPosition[1] = event.pageY;
  }
  else
  {
    cursorPosition[0] = event.clientX + scrollingPosition[0];
    cursorPosition[1] = event.clientY + scrollingPosition[1];
  }

  tip.style.position = "absolute";
  tip.style.left = cursorPosition[0] + 10 + "px";
  tip.style.top = cursorPosition[1] + 10 + "px";
  document.getElementsByTagName("body")[0].appendChild(tip);

  return true;
}
```

After getting a cross-browser event object, and iterating from the base event target element to one with a `class` of `hastooltip`, `showtip` goes about creating the tooltip (a `div`). The content for the tooltip is taken from the `title` attribute of the target element, and placed into a text node inside the tooltip.

To ensure that the browser doesn't display a tooltip of its own on top of our enhanced tooltip, the `title` of the target element is then cleared—now, there's nothing for the browser to display as a tooltip, so it can't interfere with the one we've just created. Don't worry about the potential accessibility issues caused by removing the `title`: we'll put it back later.

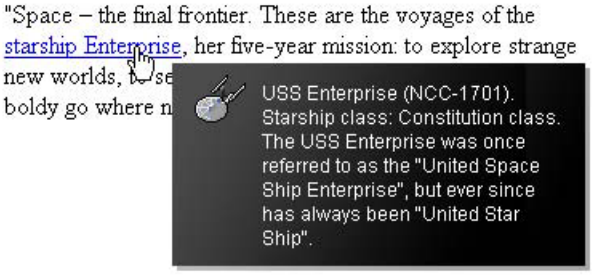
Controlling Tooltip Display in Opera

Opera still displays the original `title` even after we set it to an empty string. If you wish to avoid tooltips appearing in this browser, you'll have to stop the default action of the mouseover using the `stopDefaultAction` function from "Handling Events", the first section of this chapter. Be aware that this will also affect other mouseover behavior, such as the status bar address display for hyperlinks.

To provide hooks for the styling of our tooltip, we assign the tooltip element an ID that's based on the target element's ID (*`targetID`*`tooltip`), and set a `class` of `tooltip`. Although this approach allows for styles to be applied through CSS, we are unable to calculate the tooltip's position ahead of time, so we must use the coordinates of the mouse cursor, as calculated when the event is triggered, to position the tooltip (with a few extra pixels to give it some space).

All that remains is to append the tooltip element to the `body`, so it will magically appear when we mouse over the link! With a little bit of CSS, it could look like Figure 13.1.

Figure 13.1. A dynamically generated layer that appears on mouseover



When the mouse is moved off the element, we delete the tooltip from the document, and it will disappear:

File: **`tooltips.js` (excerpt)**

```
function hideTip(event)
{
  if (typeof event == "undefined")
  {
```

```
    event = window.event;
  }

  var target = getEventTarget(event);

  while (target.className == null ||
      !/(^| )hastooltip( |$)/.test(target.className))
  {
    target = target.parentNode;
  }

  if (target.tooltip != null)
  {
    target.setAttribute("title",
        target.tooltip.childNodes[0].nodeValue);
    target.tooltip.parentNode.removeChild(target.tooltip);
  }

  return false;
}
```

Earlier, in `showTip`, we created a reference to the tooltip element as a property of the target element. Having done that, we can remove it here without needing to search through the entire DOM. Before we remove the tooltip, we retrieve its content and insert it into the `title` of the target element, so we can use it again later.

Do those Objects Exist?

You should check that objects created in other event listeners actually exist before attempting to manipulate them, because events can often misfire, and you can't guarantee that they will occur in a set order.

Discussion

One problem with the code above is that if the target element is close to the right or bottom edge of the browser window, the tooltip will be cut off. To avoid this, we need to make sure there's enough space for the tooltip, and position it accordingly.

By checking, in each dimension, whether the mouse position is less than the browser window size minus the tooltip size, we can tell how far to move the layer in order to get it onto the screen:

File: **tooltips2.js (excerpt)**

```
function showTip(event)
{
  if (typeof event == "undefined")
  {
    event = window.event;
  }

  var target = getEventTarget(event);

  while (target.className == null ||
      !/(^| )hastooltip( |$)/.test(target.className))
  {
    target = target.parentNode;
  }

  var tip = document.createElement("div");
  var content = target.getAttribute("title");

  target.tooltip = tip;
  target.setAttribute("title", "");

  if (target.getAttribute("id") != "")
  {
    tip.setAttribute("id", target.getAttribute("id") + "tooltip");
  }

  tip.className = "tooltip";
  tip.appendChild(document.createTextNode(content));

  var scrollingPosition = getScrollingPosition();
  var cursorPosition = [0, 0];

  if (typeof event.pageX != "undefined" &&
      typeof event.x != "undefined")
  {
    cursorPosition[0] = event.pageX;
    cursorPosition[1] = event.pageY;
  }
  else
  {
    cursorPosition[0] = event.clientX + scrollingPosition[0];
    cursorPosition[1] = event.clientY + scrollingPosition[1];
  }

  tip.style.position = "absolute";
```

```
  tip.style.left = cursorPosition[0] + 10 + "px";
  tip.style.top = cursorPosition[1] + 10 + "px";
  tip.style.visibility = "hidden";

  document.getElementsByTagName("body")[0].appendChild(tip);

  var viewportSize = getViewportSize();

  if (cursorPosition[0] - scrollingPosition[0] + 10 +
      tip.offsetWidth > viewportSize[0] - 25)
  {
    tip.style.left = scrollingPosition[0] + viewportSize[0] - 25 -
        tip.offsetWidth + "px";
  }
  else
  {
    tip.style.left = cursorPosition[0] + 10 + "px";
  }

  if (cursorPosition[1] - scrollingPosition[1] + 10 +
      tip.offsetHeight > viewportSize[1] - 25)
  {
    if (event.clientX > (viewportSize[0] - 25 - tip.offsetWidth))
    {
      tip.style.top = cursorPosition[1] - tip.offsetHeight - 10 +
          "px";
    }
    else
    {
      tip.style.top = scrollingPosition[1] + viewportSize[1] -
          25 - tip.offsetHeight + "px";
    }
  }
  else
  {
    tip.style.top = cursorPosition[1] + 10 + "px";
  }

  tip.style.visibility = "visible";

  return true;
}
```

This function is identical to the previous version until we get to the insertion of the tooltip element. Just prior to inserting the element, we set its `visibility` to `"hidden"`. This means that when it's placed on the page, the layer will occupy

the same space it would take up if it were visible, but the user won't see it on the page. This allows us to measure the tooltip's dimensions, then reposition it without the user seeing it flash up in its original position.

In order to detect whether the layer displays outside of the viewport, we use the position of the cursor relative to the viewport. This could theoretically be obtained by using `clientX`/`clientY`, but remember: Safari gives an incorrect value for this property. Instead, we use our cross-browser values inside `cursorPosition` and subtract the scrolling position (which is the equivalent of `clientX`/`clientY`). The size of the viewport is obtained using the `getViewportSize` function we created in Chapter 7, then, for each dimension, we check whether the cursor position plus the size of the layer is greater than the viewport size (minus an allowance for scrollbars).

If part of the layer is going to appear outside the viewport, we position it by subtracting its dimensions from the viewport size; otherwise, it's positioned normally, using the cursor position.

The only other exception to note is that if the layer would normally appear outside the viewport in both dimensions, when we are positioning it vertically, it is automatically positioned above the cursor. This prevents the layer from appearing directly on top of the cursor and triggering a `mouseout` event. It also prevents the target element from being totally obscured by the tooltip, which would prevent the user from clicking on it.

Measuring Visible Tooltip Dimensions

In order for the dimensions of the tooltip to be measured it must first be appended to the document. This will automatically make it appear on the page, so to prevent the user seeing it display in the wrong position, we need to hide it. We do so by setting its `visibility` to `"hidden"` until we have finalized the tooltip's position.

We can't use the more familiar `display` property here, because objects with `display` set to `"none"` are not rendered at all, so they have no dimensions to measure.

Sorting Tables by Column

Tables can be a mine of information, but only if you can understand them properly. Having the ability to sort a table by its different columns allows users

to view the data in a way that makes sense to them, and ultimately provides the opportunity for greater understanding.

Solution

To start off, we'll use a semantically meaningful HTML `table`. This will provide us with the structure we need to insert event listeners, inject extra elements, and sort our data:

File: **`sort_tables_by_columns.html` (excerpt)**

```
<table class="sortableTable" cellspacing="0"
    summary="Statistics on Star Ships">
  <thead>
    <tr>
      <th class="c1" scope="col">
        Star Ship Class
      </th>
      <th class="c2" scope="col">
        Power Output (Terawatts)
      </th>
      <th class="c3" scope="col">
        Maximum Warp Speed
      </th>
      <th class="c4" scope="col">
        Captain's Seat Comfort Factor
      </th>
    </tr>
  </thead>
  <tbody>
    <tr>
      <td class="c1">
        USS Enterprise NCC-1701-A
      </td>
      <td class="c2">
        5000
      </td>
      <td class="c3">
        6.0
      </td>
      <td class="c4">
        4/10
      </td>
    </tr>
```

First, we need to set up event listeners on each of our table heading cells. These will listen for clicks to our columns, and trigger a sort on the column that was clicked:

File: **sort_tables_by_columns.js (excerpt)**

```
function initSortableTables()
{
  if (identifyBrowser() != "ie5mac")
  {
    var tables = getElementsByAttribute("class", "sortableTable");

    for (var i = 0; i < tables.length; i++)
    {
      var ths = tables[i].getElementsByTagName("th");

      for (var k = 0; k < ths.length; k++)
      {
        var newA = document.createElement("a");
        newA.setAttribute("href", "#");
        newA.setAttribute("title",
            "Sort by this column in descending order");

        for (var m = 0; m < ths[k].childNodes.length; m++)
        {
          newA.appendChild(ths[k].childNodes[m]);
        }

        ths[k].appendChild(newA);

        attachEventListener(newA, "click", sortColumn, false);
      }
    }
  }

  return true;
}
```

Internet Explorer 5 for Mac has trouble dealing with dynamically generated table content, so we have to specifically exclude it from making any of the tables sortable.

Only tables with the `class sortableTable` will be turned into sortable tables, so `initSortableTable` navigates the DOM to find the table heading cells in these tables. Once they're found, the contents of each heading cell are wrapped in a hyperlink—this allows keyboard users to select a column to sort the table

by—and an event listener is set on these links to monitor `click` events, and execute `sortColumn` in response. The `title` attribute of each link is also set, providing the user with information on what will happen when the link is clicked.

The `sortColumn` function is fairly lengthy, owing to the fact that it must navigate and rearrange the entire table structure each time a heading cell is clicked:

File: **`sort_tables_by_columns.js` (excerpt)**

```
function sortColumn(event)
{
  if (typeof event == "undefined")
  {
    event = window.event;
  }

  var targetA = getEventTarget(event);

  while (targetA.nodeName.toLowerCase() != "a")
  {
  targetA = targetA.parentNode;
  }

  var targetTh = targetA.parentNode;
  var targetTr = targetTh.parentNode;
  var targetTrChildren = targetTr.getElementsByTagName("th");
  var targetTable = targetTr.parentNode.parentNode;
  var targetTbody = targetTable.getElementsByTagName("tbody")[0];
  var targetTrs = targetTbody.getElementsByTagName("tr");
  var targetColumn = 0;

  for (var i = 0; i < targetTrChildren.length; i++)
  {
    targetTrChildren[i].className = targetTrChildren[i].className.
        replace(/(^| )sortedDescending( |$)/, "$1");
    targetTrChildren[i].className = targetTrChildren[i].className.
        replace(/(^| )sortedAscending( |$)/, "$1");

    if (targetTrChildren[i] == targetTh)
    {
      targetColumn = i;

      if (targetTrChildren[i].sortOrder == "descending" &&
          targetTrChildren[i].clicked)
      {
        targetTrChildren[i].sortOrder = "ascending";
        targetTrChildren[i].className += " sortedAscending";
```

```
      targetA.setAttribute("title",
          "Sort by this column in descending order");
    }
    else
    {
      if (targetTrChildren[i].sortOrder == "ascending" &&
          !targetTrChildren[i].clicked)
      {
        targetTrChildren[i].className += " sortedAscending";
      }

      else
      {
        targetTrChildren[i].sortOrder = "descending";
        targetTrChildren[i].className += " sortedDescending";
        targetA.setAttribute("title",
            "Sort by this column in ascending order");
      }
    }

    targetTrChildren[i].clicked = true;
  }
  else
  {
    targetTrChildren[i].clicked = false;

    if (targetTrChildren[i].sortOrder == "ascending")
    {
      targetTrChildren[i].firstChild.setAttribute("title",
          "Sort by this column in ascending order");
    }
    else
    {
      targetTrChildren[i].firstChild.setAttribute("title",
          "Sort by this column in descending order");
    }
  }
}

var newTbody = targetTbody.cloneNode(false);

for (var i = 0; i < targetTrs.length; i++)
{
  var newTrs = newTbody.childNodes;
  var targetValue = getInternalText(
      targetTrs[i].getElementsByTagName("td")[targetColumn]);
```

```
  for (var j = 0; j < newTrs.length; j++)
  {
    var newValue = getInternalText(
        newTrs[j].getElementsByTagName("td")[targetColumn]);

    if (targetValue == parseInt(targetValue, 10) &&
        newValue == parseInt(newValue, 10))
    {
      targetValue = parseInt(targetValue, 10);
      newValue = parseInt(newValue, 10);
    }
    else if (targetValue == parseFloat(targetValue) &&
        newValue == parseFloat(newValue))
    {
      targetValue = parseFloat(targetValue, 10);
      newValue = parseFloat(newValue, 10);
    }

    if (targetTrChildren[targetColumn].sortOrder ==
        "descending")
    {
      if (targetValue >= newValue)
      {
        break;
      }
    }
    else
    {
      if (targetValue <= newValue)
      {
        break;
      }
    }
  }

  if (j >= newTrs.length)
  {
    newTbody.appendChild(targetTrs[i].cloneNode(true));
  }
  else
  {
    newTbody.insertBefore(targetTrs[i].cloneNode(true),
        newTrs[j]);
  }
}
```

```
  targetTable.replaceChild(newTbody, targetTbody);

  stopDefaultAction(event);

  return false;
}
```

The first `for` loop that occurs after all the structural variables have been defined sets the respective states for each of the table heading cells when one of them is clicked. Not only are classes maintained to identify the heading cell on which the table is currently sorted, but a special `sortOrder` property is maintained on each cell to determine the order in which that column is sorted. Initially, a column will be sorted in descending order, but if a heading cell is clicked twice consecutively, the sort order will be changed to reflect an ascending sequence. Each heading cell remembers the sort order state it exhibited most recently, and the column is returned to that state when its heading cell is re-selected. The `title` of the hyperlink for a clicked heading cell is also rewritten depending upon the current sort order, and what the sort order would be if the user clicked on it again.

The second `for` loop sorts each of the rows that's contained in the body of the table. A copy of the original `tbody` is created to store the reordered table rows, and initially this copy is empty. As each row in the original `tbody` is scanned, the contents of the table cell in the column on which we're sorting is compared with the rows already in the copy.

In order to find the contents of the table cell, we use the function `getInternalText`:

File: **sort_tables_by_columns.js (excerpt)**

```
function getInternalText(target)
{
  var elementChildren = target.childNodes;
  var internalText = "";

  for (var i = 0; i < elementChildren.length; i++)
  {
    if (elementChildren[i].nodeType == 3)
    {
      if (!/^\s*$/.test(elementChildren[i].nodeValue))
      {
        internalText += elementChildren[i].nodeValue;
      }
    }
```

```
    else
    {
      internalText += getInternalText(elementChildren[i]);
    }
  }

  return internalText;
}
```

`getInternalText` extracts all of the text inside an element—including all of its descendant elements—by recursively calling itself for each child element and concatenating the resultant values together. This allows us to access the text inside a table cell, irrespective of whether it's wrapped in elements such as `span`s, `strong`s, or `em`s. Any text nodes that are purely whitespace (spaces, tabs, or new lines) are ignored via a regular expression check.

When `sortColumn` finds a row in the copy whose sorted table cell value is "less" than the one we're scanning, we insert a copy of the scanned row into the copied `tbody`. For a column in ascending order, we simply reverse this comparison: the value of the row in the copy must be "greater" than that of the scanned row.

However, before a comparison is made, we check whether the contents of the sorted table cell can be interpreted as an integer or a float; if so, the comparison values are converted. This makes sure that columns that contain numbers are sorted properly; string comparisons will produce different results than number comparisons.

Once all of our original rows have been copied into the new `tbody`, that element is used to replace the old one, and we have our sorted table!

Using the `sortableDescending` and `sortableAscending` classes, which are assigned to the currently sorted table heading cells, we can use CSS to inform the user which column the table is sorted on, and how it is sorted, as shown in Figure 13.2 and Figure 13.3.

Figure 13.2. A sortable table sorted in descending order on the fourth column

Star Ship Class	Power Output (Terra Watts)	Maximum Warp Speed	Captain's Seat Comfort Factor ▼
Ferengi Trading Vessel	500	4.0	8/10
USS Enterprise NCC-1701-D	6500	8.5	5/10
USS Enterprise NCC-1701-A	5000	6.0	4/10
Klingon Bird of Prey	3000	6.5	1/10
Class E Geo-stationary Satellite	2	0.1	0/10

Figure 13.3. A sortable table sorted in ascending order on the second column

Star Ship Class	Power Output (Terra Watts) ▲	Maximum Warp Speed	Captain's Seat Comfort Factor
Class E Geo-stationary Satellite	2	0.1	0/10
Ferengi Trading Vessel	500	4.0	8/10
Klingon Bird of Prey	3000	6.5	1/10
USS Enterprise NCC-1701-A	5000	6.0	4/10
USS Enterprise NCC-1701-D	6500	8.5	5/10

Summary

The two main pillars of DHTML are the capturing of events, and the reorganization and creation of page elements via the DOM. Using these principles, it's possible to capture many of the different ways that users interact with a page and make the interface respond accordingly.

As can be seen by the number and quality of JavaScript-enhanced web applications that are now available, the features DHTML can bring to new interfaces represents one of the biggest growth areas for innovative JavaScript. The foundations and basic examples shown in this chapter give you a sense of the power that it can deliver inside a user's browser. We'll expand upon this further in the following chapters as we build some really interesting interfaces.

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