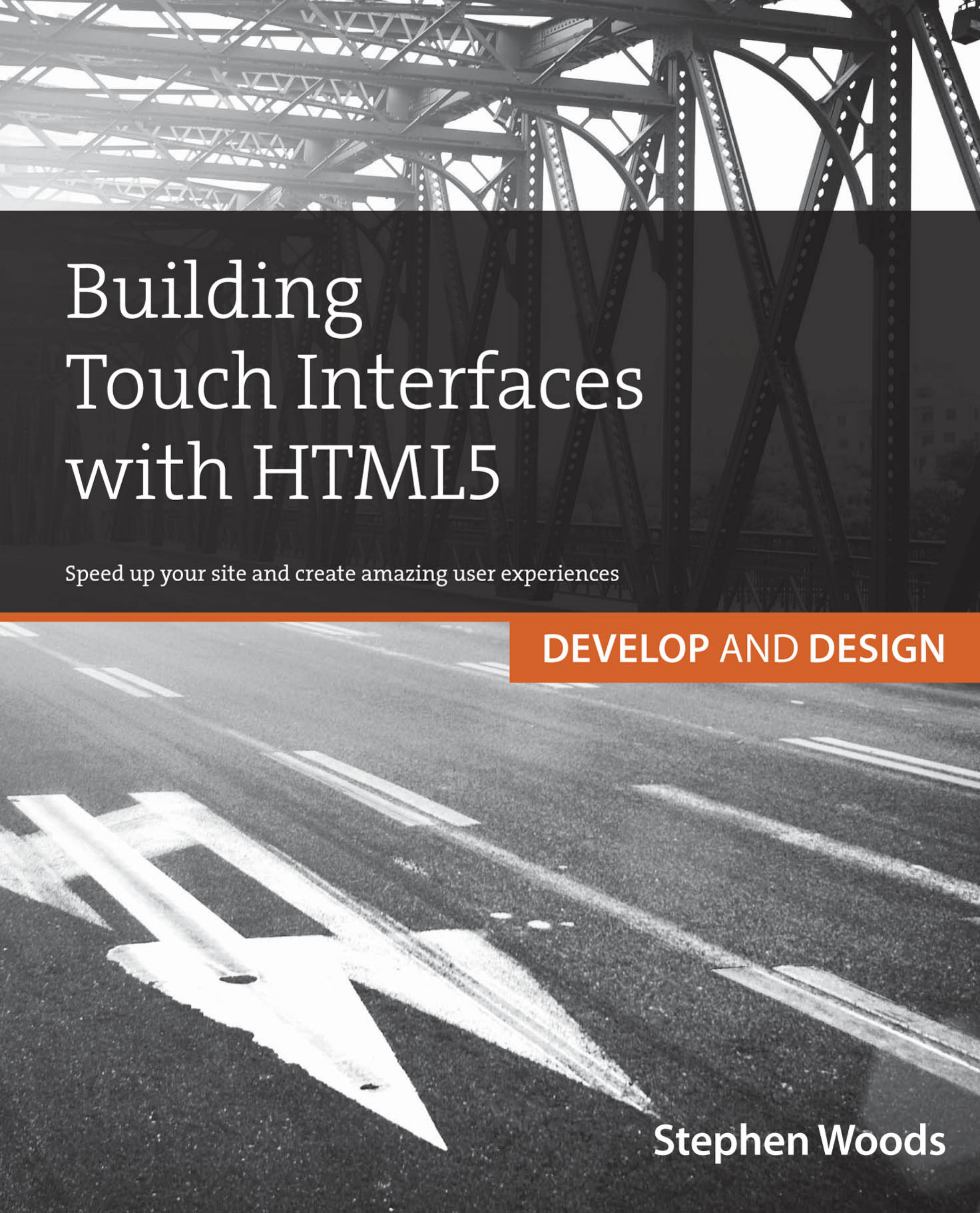
Building Touch Interfaces with HTML5

Speed up your site and create amazing user experiences

DEVELOP AND **DESIGN**



Stephen Woods

Building Touch Interfaces with HTML5

Speed up your site and create amazing user experiences

DEVELOP AND **DESIGN**

Stephen Woods

PEACHPIT PRESS
WWW.PEACHPIT.COM

Building Touch Interfaces with HTML5: Develop and Design
Stephen Woods

Peachpit Press
www.peachpit.com

To report errors, please send a note to errata@peachpit.com.
Peachpit Press is a division of Pearson Education.

Project Editor: Nancy Peterson
Production Editor: Rebecca Chapman-Winter
Development Editor: Jeff Riley
Compositor: Danielle Foster
Technical Editor: Nicholas C. Zakas
Copyeditor: Gretchen Dykstra
Proofer: Darren Meiss
Indexer: Jack Lewis
Cover Design: Aren Straiger
Interior Design: Mimi Heft

ISBN 13: 978-0-321-88765-8
ISBN 10: 0-321-88765-4

Printed and bound in the United States of America

9 8 7 6 5 4 3 2 1

To Sashimi, the best cat ever.

ACKNOWLEDGEMENTS

Thanks to Jeff Riley, Nancy Peterson, Michael Nolan, and the staff at Peachpit for making the book possible and my words less incoherent. Thanks to Nicholas Zakas for his exceptionally detailed and thoughtful criticism about this book and for his mentorship at Yahoo!

Thanks as well to Stoyan Stefanov for his last-minute review and invaluable experience in the world of technical writing. Thanks also to Guy Podjarny for his time and research.

This book wouldn't have been possible without the support of my manager, Ross Harmes, as well as the rest of the front-end team at Flickr.

Thanks to Benjamin for showing me the many uses for mobile devices.

Finally, thank you to Elise for putting up with me while I spent hours every evening staring at my computer and a pile of cell phones.

ABOUT THE AUTHOR

Stephen Woods is a Senior Front-end Engineer at Flickr. He has been developing user interfaces for the web since the end of the last century. He has worked at Yahoo! since 2006. Before Flickr, he developed JavaScript platforms that supported the Yahoo! home page and worked on the UI team at Yahoo! Personals. He's an expert with the full web stack, but his primary interest is making responsive user interfaces with web technologies. Stephen has spoken at SXSW and HTML5DevConf about touch interfaces and he has been published in *.net* magazine.

CONTENTS

Bonus chapters mentioned in this eBook are available after the index.

INTRODUCTION

As of this writing, 11.42 percent of web visits are via a mobile device (according to StatCounter.com). One year ago that was 7 percent. Three years ago it was 1.77 percent. Desktops will be with us for a while, but the future of the web will be on mobile devices.

For web developers, supporting mobile devices is the biggest change since the web standards revolution of the early 2000s. Mobile devices all have HTML5-capable, thoroughly modern browsers. They have limited memory and slow CPUs. They often connect via high-latency connections. Most importantly, they all have touch interfaces.

Developing for mobile is developing for touch. Many of the skills you use for desktop web development carry over to the mobile web, but some things are quite different—and getting those things right can be difficult. I wrote this book to help you get the new things right.

WHO THIS BOOK IS FOR

This book was written for two types of readers:

- Experienced web developers who have never developed for mobile or touch interfaces and want to learn how.
- Developers who've been working in mobile but have struggled to make their mobile websites feel right.

This book is not for absolute beginners. You'll need to have a working knowledge of the web front-end: HTML, CSS, and JavaScript. Prior experience with the new APIs and features of HTML5 and CSS3 won't hurt either.

Most importantly, this book is for people who aren't content with a mobile site that's just good enough. If you want to build a site that feels fast and smooth, this book is for you.

WHAT YOU WILL LEARN

This book is focused on making touch interfaces that feel fast. It's structured in roughly the same way I approach optimizing a website. The first half covers what I consider the basics—concepts that make any website faster, but mobile sites in particular. Chapters 2 and 3 show you how to build a simple site and make it load faster. Chapter 4 helps you speed up users' next visit to the site with caching. Chapter 5 is all about removing page loads all together and structuring applications to maximize real and perceived performance.

The second half of the book is specifically about touch interfaces, in particular making them feel as smooth and fast as possible. The book gets more complex as it goes on. If you feel like the later chapters are over your head, try applying what you've learned so far in your work and then coming back to some of the ideas I'll present toward the end. A website doesn't need pinch to zoom to be useful.

WHAT YOU'LL NEED

To get the most out of this book you'll need at least one touch-enabled device in addition to your computer. If you're only going to have one, I recommend an iOS 6 or Android 4 device. Having both is ideal if you can afford it.

When developing for the mobile web, try to get as many devices as possible. iOS and Android simulators are no substitute for real devices. When writing this book, I used a Samsung Galaxy S III with Android 4.0.4 (Ice Cream Sandwich), an iPhone 4, an iPhone 5, an iPad 1, and an HTC 8X (Windows 8). I supplemented these devices with the simulators.

At Flickr we have a similar set but we also have several Android tablets and a Kindle Fire.

FRAMEWORKS

This book doesn't use jQuery or any other JavaScript framework. You'll learn about a few specialized libraries, but we'll focus as much as possible on native DOM APIs. That's not to say you should avoid frameworks—far from it! But I want to make sure you understand how things really work. When you decide to build a site with jQuery mobile, Backbone.js, Zepto.js, or any other framework, you'll be much more comfortable understanding what's really going on.

The other huge benefit to understanding the native DOM APIs is that when you find a bug or a problem in a library you can patch it yourself and make a pull request with your fixes, benefiting the entire community. Appendix A lists some handy debugging tools.

Appendix B lists a few of the more common mobile-focused frameworks. When you build a new site, I recommend carefully evaluating your needs, including as little library code as you can, and adding only what you need.

The appendices are not printed in the book. They can be found at the book's companion website: touch-interfaces.com

THE WEBSITE

All the code samples in this book as well as late-breaking changes can be found at the companion website: touch-interfaces.com. The code samples are also mirrored on GitHub, where you can file issues with the samples and submit pull requests: https://github.com/saw/touch-interfaces.

WELCOME TO THE MOBILE WEB

Websites are built with HTML, CSS, and JavaScript. Mobile websites are no different. All you really need to get started is a web browser and a text editor, but to be really productive I recommend a few more tools.

THE TOOLCHAIN

The easiest process is to develop with a text editor and a desktop browser, then keep a touch device around for testing.

A TEXT EDITOR & A WEBKIT BROWSER

I use TextMate 2 (github.com/textmate/textmate) for MacOS X, but any editor will do.

Because the vast majority of mobile devices run a WebKit browser, you will find that Chrome or Safari is a an essential tool to being productive. It isn't the same as testing on the real device but it's a lot easier and essential.

A WEB SERVER

In order to test your site on an actual device you will need to serve pages on your local wireless network. On the Mac I find MAMP (www.mamp.info) to be a very convenient tool for this, but using the built-in Apache web server will work as well.

A TOUCH DEVICE

There is no substitute for a physical device. If you can afford it, I recommend having at least a recent Android phone and an iOS device. If you can only afford one phone it's helpful to find people who will let you borrow their phones for a moment to test on.

TESTING ACROSS DEVICES

You can't assume that all WebKit browsers are created equal. You should test your app in iOS 5, iOS 6, Android 2.3, Android 4.0, Android 4.1 (Chrome), and IE 10. Here is a guide to how to test on these devices, even if you don't have access to the device itself.

IOS SAFARI

Apple provides a quite capable simulator with XCode. The simulator can run as iOS 5 or 6 and as a tablet or phone. It also supports remote debugging with Safari. It really is a great tool and assuming you have a Mac this is a critical part of your toolset. XCode is available for free from the Mac App store.

ANDROID

Google provides emulators for just about every version of Android. These are available with the Android SDK (developer.android.com/sdk). Once you have the Android SDK, images for various Android versions are separate downloads. Keep in mind these are the official builds from Google; Android versions on actual devices can vary quite a bit.

WINDOWS 8

Microsoft does provide an emulator for Windows Phone 8; it's available with the SDK (dev.windowsphone.com/en-us/downloadsdk). The emulator runs only on Windows. IE 10 for the desktop is the same browser, so most debugging can be down with the desktop browser rather than the emulator.

DEBUGGING

Debugging websites on phones can be a chore, but there are a lot of tools available to make it easier. I've provided a list of several on the website in Appendix A.

CHAPTER 4

Speeding Up the Next Visit

So much about computing performance depends on caching. Fundamentally, caching is putting data somewhere after you get it the first time so you can access it much more quickly the next time. On the web, we want to take advantage of caching as often as possible to speed up users' subsequent visits to the site, keeping in mind that their next visit is quite frequently within seconds of their first, when they ask for another page.

On mobile, as much as anywhere, we want to make the best possible use of caching. The main tools we have for caching on touch devices are the normal browser cache, localStorage, and the application cache. In this chapter we'll look at normal browser cache, which isn't as good as it should be; LocalStorage, a newish API for persistent storage that's an incredibly powerful tool for manual caching; and the application cache.

CACHING IN HTTP

HTTP was designed with caching in mind. The cache we're most familiar with is the browser cache, but additional caching *proxies* often exist as well, and they follow the same rules defined in the specification. There are three ways to control HTTP caches:

- Freshness
- Validation
- Invalidation

FRESHNESS

Freshness, sometimes called the TTL (Time To Live), is the simplest. Using headers, caching agents are told how long to hold on to a cached resource before it should be considered stale and refetched. The simplest way this is handled is with the Expires header. You might remember that YSlow and PageSpeed recommend setting far-future Expires headers for static content.

The goal here is that so-called static assets (like CSS and JavaScript) are never fetched again, if possible. YSlow advises that you set an expiration some time in the distant future:

```
Expires: Thu, 15 Apr 2025 20:00:00 GMT
```

The intent is that the browser (or a caching proxy) will keep this file around until it runs out of room in cache.

VALIDATION

Validation provides a way for a caching agent to determine if a stale cache is actually still good, without requesting the full resource. The browser can make a request with an If-Modified-Since header. The server then can send a `304 Not Modified` response and the browser uses the file already in the cache, rather than refetching from the server.

Another validation feature is the ETag. ETags are unique identifiers, usually hashes, which allow cache validation without dates by comparing a short string. The requesting agent makes a conditional request as well, but this time with an If-None-Match header containing the ETag. If the current content matches the client's ETag, then the server can again return a 304 response.

Validating the cache does require a full round-trip to the server. That is better than redownloading a file, but avoiding a round trip altogether is preferable. That's the reason for the far-future expiration date. If the cached item hasn't expired, then the browser won't attempt to validate it.

INVALIDATION

Browsers invalidate cached items after some actions, the most common being any non-GET request to the same URL.

WHAT IS NORMAL CACHE BEHAVIOR?

So what is the normal behavior of the browser cache, if you don't mess with the headers or do anything else? Most browsers have a maximum cache size. When that size is reached they begin removing items from the cache that were *least recently used.* So a cached item that hasn't been used in a long time will be purged, keeping items used more frequently.

The result of this algorithm is that what is purged is completely based on user behavior and there's no reliable way to predict how it will work. It's safe to assume that if you don't think about cache headers, then some browser will cache something you don't want cached and won't cache something you do.

OPTIMIZING FOR MOBILE

The browser cache is very important on a desktop computer, but not so much on touch devices.

In iOS 5, the browser cache is limited to 100 MB and *does not* persist between app launches. That means that if the phone restarts or the browser is killed or crashes, the entire cache is emptied when the browser starts again. Android 2.x's stock browser (still the most widely installed version by far) has a cache limit of just 5.7 MB, and that isn't per domain—that's total (**Table 4.1**).

TABLE 4.1 Persistent Cache Size by Browser

OS	BROWSER	MAX PERSISTENT SIZE
iOS 4.3	Mobile Safari	0
iOS 5.1.1	Mobile Safari	0
iOS 5.1.1	Chrome for iOS	200 MB +
Android 2.2	Android Browser	4 MB
Android 2.3	Android Browser	4 MB
Android 3.0	Android Browser	20 MB
Android 4.0–4.1	Chrome for Android	85 MB
Android 4.0–4.1	Android Browser	85 MB
Android 4.1	Firefox Beta	75 MB
BlackBerry OS 6	Browser	25 MB
BlackBerry OS 7	Browser	85 MB

* Adapted from research by Guy Podjarny (www.guypo.com)

It's very important to optimize the cacheability of your site. But the very limited size of the browser caches means that users will very often come to your site with an empty cache, so optimizing for that state should not be neglected.

A good header for a static resource looks something like this:

```
HTTP/1.1 200 OK
Content-Type: image/png
Last-Modified: Thu, 29 Mar 2012 23:53:57 GMT
Date: Tue, 11 Sep 2012 21:36:44 GMT
Expires: Wed, 11 Sep 2013 21:36:44 GMT
Cache-Control: public, max-age=31536000
```

`Cache-Control: public` makes sure that SSL resources can be cached by proxies. The max-age is one year (in seconds). The Expires date is also a year in the future.

In practice, it's a good idea to read up on how to configure your particular server so that the headers are correct. If you're working with separate back-end developers, gently remind them how important these values are.

For the actual content many major sites use `cache-control: private` to prevent any caching by proxies. For the Birds of California site, the content won't change that much, so on the server we can set up the cache headers to expire in one hour. We're using Nginx, so we can do that with the expires directive:

```
location / {
  expires 1h;
}
```

This results in a header that looks like this, assuming the site was accessed at 05:16:45 PST:

```
Last-Modified: Thu, 05 Jul 2012 17:15:35 PST
Connection: keep-alive
Vary: Accept-Encoding
Expires: Wed, 14 Nov 2012 06:16:46 PST
Cache-Control: max-age=3600
```

This prevents mobile users from refetching content too much during a browsing session, but ensures that the content is fresh, even for desktop users.

Another important thing to consider is web accelerators like Amazon Silk. Silk is the browser for the Kindle Fire tablets. Unlike a normal browser, Amazon Silk is a browser that lives both on the Kindle Fire and on Amazon servers. According to Amazon, much of the acceleration comes from pipelining and "predictive push," which means sending static resources to the browser before the browser even requests the resource. In this case Silk acts as a transparent HTTP proxy. A proxy may cache just like the browser, and it follows the same rules. So by sending the correct headers you're also improving performance for Kindle users.

USING WEB STORAGE

Browser makers, and Apple in particular, have left us with a less than ideal situation when it comes to the browser cache. But they and the W3C have given us something else that almost makes up for it: the web storage API. Web storage provides a persistent data store for the browser, in addition to cookies. Unlike cookies, 5 MB is available per domain in a simple key-value store. On iOS, WebStorage stores the text as a UTF-16 string, which means that each character takes twice as many bytes. So on iOS the total is actually 2.5 MB.

USING THE WEB STORAGE API

Web storage is accessed from two global variables: localStorage and sessionStorage. sessionStorage is a nonpersistent store; it's cleared between browsing sessions. It also isn't shared between tabs, so it's better suited to temporary storage of application data rather than caching. Other than that, localStorage and sessionStorage are the same.

Just like cookies, web storage access is limited by the same origin policy (a web page can only access web storage values set from the same domain) and if users reset their browsers all the data will be lost. One other small issue is that in iOS 5, web views in apps stored their web storage data in the same small space used for the browser cache, so they were hardly persistent. This has been fixed in iOS 6.

> **NOTE** LocalStorage should not be treated as secure. Like everything, the user can read and modify what is in localStorage.

The web storage API is very simple. The primary methods are `localStorage.getItem('key')`; `localStorage.setItem('key', 'value')`. `key` and `value` are stored as strings. If you try to set the value of a key to a non-string value it will use the JavaScript default `toString` method, so an object will just be replaced with `[object object]`.

Additionally you can treat localStorage as a regular object and use square bracket notation:

```
var bird = localStorage['birdname'];

localStorage['birdname'] = 'Gull';
```

Removing items is as simple as calling `localStorage.removeItem('key')`. If the key you specify doesn't exist, `removeItem` will conveniently do nothing.

In addition to storing specific information, localStorage is a great tool for caching. In this next section, we'll use the Flickr API to fetch a random photo for Birds of California, and use localStorage as a transparent caching layer to greatly improve the performance of the random image picker on future page loads.

USING WEB STORAGE AS A CACHING LAYER

For the Birds of California site, we can make things a little more exciting for users by incorporating a random image from Flickr, rather than a predefined image. This will sacrifice some of the gains we made in the last chapter in trimming images down to size, in exchange for developer convenience.

We'll use the Flickr search API to find Creative Commons–licensed photos of birds. **Listing 4.1** is a simple JavaScript Flickr API module that uses JSONP to fetch data. For the sake of brevity the code is not included here, but it's available for download from the website. Let's use this module to grab some images related to the California Gull.

LISTING 4.1 Fetching the Flickr data

```
//a couple of convenience functions
var $ = function(selector) {
  return document.querySelector(selector);
};

var getEl = function(id) {
  return document.getElementById(id);
};


var flickr = new Flickr(apikey);
var photoList;

flickr.makeRequest(
  'flickr.photos.search',

  {
    text:'Larus californicus',
    extras:'url_z,owner_name',
    license:5,
    per_page:50
  },

  function(data) {
    photoList = data.photos.photo;
    updatePhoto();
  }
);
```

As you can see, the API takes a method (flickr.photos.search) and some parameters. This will hopefully give us back as many as 50 photos of *Larus Californicus*.

In **Listing 4.2**, the `updatePhoto` function takes the list, grabs a random photo from the list, and updates the image, the links, and the attribution.

LISTING 4.2 Updating the photo

```
function updatePhoto() {
    var heroImg = document.querySelector('.hero-img');

    //shorthand for "random member of this array"
    var thisPhoto = photoList[Math.floor(Math.random() * photoList.length)];
    $('.hero-img').style.backgroundImage
            = 'url('+ thisPhoto.url_z + ')';

    //update the link
    getEl('imglink').href =
        'http://www.flickr.com/photos/' +
        thisPhoto.owner +
        '/'+ thisPhoto.id;

    //update attribution
    var attr = getEl('attribution');
    attr.href = 'http://www.flickr.com/photos/'
         + thisPhoto.owner;

    attr.innerHTML = thisPhoto.ownername;

}
```

Add this script (with the Flickr API module) to the Birds of California page with a valid Flickr API key and the bird hero image will dynamically update to a random option from the search results list. With no changes to the HTML and CSS from before, however, the user will see the original gull photo, and then a moment later it will be replaced with the result from the API. On one hand, this provides a fallback in case of JavaScript failure for the image. But on the other hand, it doesn't look very nice, and we'll go ahead and say the image is an enhancement to the main content, which is the text.

With that in mind, let's create a null or "loading" state for the links and caption, as shown in **Listing 4.3**.

LISTING 4.3 Hero image null state

```
<div class="hero-shot">
   <a id="imglink" href="#">
   <span class="hero-img"></span></a>
   <p class="caption">
      Photo By <a id="attribution" href="#">...</a>
   </p>
</div>
```

While the data is loading the user needs some indication that something's happening, just so she knows things aren't broken. Normally a spinner of some kind is called for, but in this case let's just add the text "loading" and make the image background gray until it's ready:

```
//show the user we are loading something....
var heroImgElement = $('.hero-img');
heroImgElement.style.background = '#ccc';
heroImgElement.innerHTML = '<p>Loading...</p>';

//Then inside updatePhoto I'll remove the loading state:
heroImgElement.innerHTML = '';
```

So, now we have a pretty nice random image, with a loading state (**Figure 4.1**). However, we're making users wait every time they visit for a random image from a list that probably doesn't change that much. Not only that, but having a very up-to-date list of photos isn't all that important because we just want to add variety, not give up-to-the-minute accurate search results. This is a prime candidate for caching.

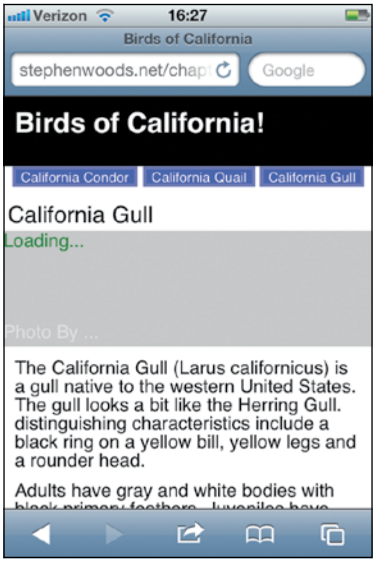


FIGURE 4.1 The loading state.

If something is cacheable, it's generally best to abstract away the caching, otherwise the main logic of the application will be cluttered with references to the cache, validation checks, and other logic not relevant to the task at hand. For this call we'll create a new object to serve as a data access layer, so that rather than calling the Flickr API object directly, we'll call the data layer, like so:

```
birdData.fetchPhotos('Larus californicus', function(photos) {
  photoList = photos;
  updatePhoto();
});
```

Because all we ever want to do is search for photos and get back a list, we can hide the Flickr-specific stuff inside this new API. Not only that, but by creating a clean API we can, in theory, change the data source later. If we decide that a different API produces better photo results, we can change the data layer without making changes to any consumers. In this case the key feature is caching. We want to cache API results locally for one day, so that the next time the user visits she'll still get a random photo, but she won't have to wait for a response from the Flickr API.

CREATING THE CACHING LAYER

The fetchPhotos method will first check if this search is cached, and whether the cached data is still valid. If the cache is available and valid, it will return the cached data, otherwise it will make a request to the API and then populate the cache after firing the callback.

First, we'll set up a few variables, as shown in **Listing 4.4**.

LISTING 4.4 A caching layer

```
window.birdData = {};

var memoryCache = {};

var CACHE_TTL = 86400000; //one day in seconds
var CACHE_PREFIX = 'ti';
```

The `memoryCache` object is a place to cache things fetched from localStorage, so if those items are requested again in the same session they can be returned even faster; fetching data from localStorage is much slower than simply getting data from memory, without including the added cost of decoding a JSON string (remember, localStorage can only store strings). We'll talk more about `CACHE_PREFIX` and `CACHE_TTL` shortly.

The first thing we need is a method to write values into cache. We'll cache the response from the Flickr search, but wrap the cached value inside a different object so we can store a timestamp for a cache so that it can be expired.

```
function setCache(mykey, data) {

   var stamp, obj;

   stamp = Date.now();

   obj = {
      date: stamp,
      data: data
   };

   localStorage.setItem(CACHE_PREFIX + mykey, JSON.stringify(obj));
   memoryCache[mykey] = obj;
}
```

We're using `CACHE_PREFIX` for each of the keys to eliminate the already small chance of collisions. It's possible that another developer on the Birds of California site might decide to use localStorage, so just to be on the safe side we'll prefix our keys. The date value contains a timestamp in seconds, which we can use later to check if the cache has expired. We'll also add the value to the memory cache for quicker access to it if it's fetched again during the same session. We'll use the "setItem" notation for localStorage; this is much clearer than bracket notation—another developer will see right away what is happening, rather than thinking that this is a regular object.

The next function is getCached, which returns the cached data if it's available and valid, or false if the cache is not present or expired (the caller really doesn't need to know which):

```
//fetch cached date if available,
//returns false if not (stale date is treated as unavailable)
function getCached(mykey) {

   var key, obj;

   //prefixed keys to prevent
   //collisions in localStorage, not likely, but
   //a good practice
   key = CACHE_PREFIX + mykey;

   if(memoryCache[key]) {

      if(memoryCache[key].date - Date.now() > CACHE_TTL) {
         return false;
      }
```

```
      return memoryCache[key].data;
    }

    obj = localStorage.getItem(key);

    if(obj) {
      obj = JSON.parse(obj);

      if (Date.now() - obj.date > CACHE_TTL) {
        //cache is expired! let us purge that item
        localStorage.removeItem(key);
        delete(memoryCache[key]);
        return false;
      }
      memoryCache[key] = obj;
      return obj.data;
    }
  }
```

This function checks the cache in layers. It starts with the memory cache, because this is the fastest. Then it falls back to localStorage. If it finds the value in localStorage, then it makes sure to also put that value into the memoryCache before returning the data. If no cached value is found, or one of the cached values has expired, then the function returns false.

Next up is the actual fetchPhotos function that encapsulates the caching. All it has to do now is fetch the cached value for the query. If that value is false, then it executes the API method and caches the response. If it is true, then the callback function is called immediately with the cached value.

```
  // function to fetch CC flickr photos,
  // given a search query. Results are cached for
  // one day
  function fetchPhotos(query, callback) {
    var flickr, cached;

    cached = getCached(query);

    if(cached) {
      callback(cached.photos.photo);
    } else {

      flickr = new Flickr(API_KEY);
```

```
        flickr.makeRequest(
          'flickr.photos.search',

          {text:query,
           extras:'url_z,owner_name',
           license:5,
           per_page:50},

          function(data) {
            callback(data.photos.photo);

            //set the cache after the
            //callback, so that it happens after
              //any UI updates that may be needed
            setCache(query, data);
          }
        );
      }

    }

    window.birdData.fetchPhotos = fetchPhotos;
```

Now the data call is fully cacheable, with a simple API.

MANAGING LOCALSTORAGE

This is just the beginning for `localStorage`. Unlike the browser cache, `localStorage` gives you full manual control. You can decide what to put in, when to take it out, and when to expire it. Some websites (like Google) have actually used `localStorage` to cache JavaScript and CSS explicitly. It's a powerful tool, so powerful that 5 MB starts to feel a little small sometimes. What do you do when the cache is full? How do you know if the cache is full?

First of all, we can treat `localStorage` as a normal JavaScript object, so `JSON.stringify (localStorage)` will return a JSON representation of localStorage. Then we can apply an old trick to figure out how many bytes that uses, including UTF-8 multi-byte characters: `unescape(encodeURIcomponent('string')).length`, which gives us the size of string in bytes. We know that 5 MB is 1024 * 1024 * 5 bytes, so the available space can be found with this:

```
1024 * 1024 * 5 - unescape(encodeURIComponent(JSON.stringify(localStorage))).
→ length
```

If you want to know if you've run out of space, WebKit browsers, Opera mobile and Internet Explorer 10 for Windows Phone 8 will throw an exception if you've exceeded the available storage space; if you're worried, you can wrap your setItem call in a try/catch block. When you've run out of storage you can either clear all the values your app has written with localStorage.clear, or keep a separate list in localStorage of all the data you cache and intelligently clear out old values.

THE APPLICATION CACHE

The traditional browser cache, as mentioned previously in this chapter, isn't particularly reliable on mobile. On the other hand, the HTML5 application cache is very reliable on mobile—maybe even too reliable.

WHAT IS THE APPLICATION CACHE?

With features like `localStorage`, you can easily see how a web application could continue to be useful even when not connected to the network. The application cache is designed for that use case.

The idea is to provide a list of all the resources your app needs to function up front, so that the browser can download and cache them. This list is called the manifest. The manifest is identified with a parameter to the <html> tag:

```
<!DOCTYPE html>
<html manifest="birds.appcache">
<head>
```

This file *must* be served with the mime-type `text/cache-manifest`. If it's not, it will be ignored. If you can't configure a custom mime type on your server, you can't use the application cache.

The manifest contains four types of entries:

- MASTER
- CACHE
- NETWORK
- FALLBACK

MASTER

MASTER entries are the files that reference the manifest in their HTML. By including a manifest, these files are implicitly adding themselves to the list. The rest of the entries are included in the manifest file.

CACHE

The CACHE entries define what to cache. Anything in this list *will be* downloaded the first time a visitor comes to the page. The entries will then be cached forever, or until the manifest (not the resource in question) changes.

NETWORK

Because the application cache is designed for offline use, network access actually has to be whitelisted. That means that if a network resource is not listed under network it will be blocked, even if the user is online. For example, if the site includes a Facebook "like" widget inside an iframe, if http://www.facebook.com is not listed in the NETWORK entry, *that iframe will not load.* To allow all network requests you can use the '*' wildcard character.

FALLBACK

These entries allow you to specify fallback content if the user is not online. Entries here are listed as pairs of URLs: the first is the resource requested, the second is the fallback. You have to use relative paths, and everything listed here has to be on the same domain. For example, if you serve images from a CDN on a separate domain you can't define a fallback for that.

CREATING THE CACHE MANIFEST

Here's a manifest for the Birds of California site from the previous chapter:

```
CACHE MANIFEST

# Timestamp:
# 2013-03-15r1

CACHE:
jquery-1.8.0.min.js
gull-360x112.jpg
gull-640x360.jpg
gull-720x225.jpg

FALLBACK:

NETWORK:
*
```

Notice that there are entries for all the different images. Because these are explicit, the browser will download and cache all of them on the first visit to the page, but will never again need to fetch them.

PITFALLS OF THE APPLICATION CACHE

The application cache is the nuclear option. That's because the files in here will *never* expire until the manifest file itself changes, the user clears the cache, or the cache is updated via JavaScript (more on that later). That's why we included a timestamp in the manifest so we can easily force a change to the file if we want to invalidate cached versions in the wild.

The application cache is also completely separate from the browser cache. For example, it is possible to create an application cache that will never revalidate. If you set a far-future Expires header on the manifest file, the browser will cache that file forever. When the application cache checks whether it has changed, it will get the version in the browser cache, see that it is unchanged, and then hold on to the cached files forever (or until the user explicitly clears her cache).

Once the page is cached, it's possible to visit Birds of California without network connectivity. On iOS, offline is guaranteed to work only if the user has bookmarked the page on her home screen. In iOS Safari the contents of the application cache may be evicted if the browser needs to reclaim the space for the browser cache. The cache will still be used.

One of the other pitfalls of the application cache is that once it expires it won't be updated until the next time the user visits. So if a user comes to your site with a stale cache, she'll still see the cached version, even though it's been updated. To make sure users get the latest and greatest bird info, we'll take advantage of the application cache JavaScript API to programmatically check for a stale cache.

AVOIDING A STALE CACHE WITH JAVASCRIPT

The API for the cache hangs off the `window.applicationCache` object. The most important property there is "status." As shown in **Table 4.2**, it has an integer value that represents the current state of the application cache.

TABLE 4.2 Application Cache Status Codes

CODE	NAME	DESCRIPTION
0	UNCACHED	The cache isn't being used.
1	IDLE	The application cache is not currently being updated.
3	CHECKING	The manifest is being downloaded and updates are being made, if available.
4	UPDATEREADY	The new cache is downloaded and ready to use.
5	OBSOLETE	The current cache is stale and cannot be used.

Thankfully, you don't have to remember these numbers; there are constants on the applicationCache object that keep track of the association:

```
> console.log(window.applicationCache.CHECKING)
  2
```

On the Birds of California site, we'll add a short script to check the cache every time the page loads:

```
//alias for convenience
var appCache = window.applicationCache;

appCache.update();
```

This goes at the bottom of page and doesn't need to be ready for the window onload event to do its stuff. At this point we could start polling `appCache.status` to see if a new version is loaded. When it's calling the swapCache method, it will force the browser to update the changed files in the cache (it will not change what the user is seeing; a reload is still required). It's simpler to use the built-in events that the applicationCache object provides. We can add an event handler to automatically reload the page when the cache is refreshed:

```
var appCache = window.applicationCache;

appCache.addEventListener('updateready', function(e) {

  //let's be defensive and double check the status
  if (appCache.status == appCache.UPDATEREADY) {

    //swap in the new cache!
    appCache.swapCache();

    //Reload the page
    window.location.reload();

  }

});

appCache.update();
```

In addition to the extremely useful "updateready" event, there's a bigger set of events available on the applicationCache object, one for each state we already saw in the status property.

Having the page automatically reload, particularly when the user is in the middle of looking at the site, is a terrible user experience. There are several ways to handle this. Using a confirm dialog box or whisper tip to ask the user to reload to fetch new content is better, but still not great. In the next chapter we'll explore a much better way to handle this, and other cases, by dynamically updating the content with AJAX.

THE 404 PROBLEM

If any of the resources in the CACHE entry can't be retrieved when the browser attempts to fetch them, the browser ignores the cache manifest. This means that if a user visits your site and for some reason one of the requests fails, it will be as if she were a completely new visitor the next time she visits—the cache will be useless. That means the cache is quite brittle: unless all the requests are successful, there's no caching at all—it's all or nothing.

THE APPLICATION CACHE: WORTH THE PAIN?

The application cache is obviously fraught with difficulties, not the least of which is how difficult it is to invalidate. It gives you a lot of power, but at the cost of flexibility and maintainability. Users love an app that launches instantly, but everyone hates strange errors. The stickiness of the application cache leads necessarily to strange bugs that are hard to chase down. When you use it, you'll eventually end up with a file that you just can't seem to get out of cache. It isn't that the application cache is buggy; it's that it's completely unforgiving. If you deploy a bad cache, it can be a real problem to undo the error.

Optimizing for browser cache and using the much more flexible web storage API is usually a better choice, but when you want the fastest possible launch time, and you're willing to accept the difficulties, the application cache is an incredible tool.

WRAPPING UP

Caching is one of the most powerful tools for optimizing performance. It's one of the basics that you really want to get right before you move on to more complex optimizations. In this chapter we covered the fundamentals of the browser cache and some simple optimization strategies. We discussed web storage and using it for caching data. Finally we talked about the application cache, which is powerful, if a bit finicky.

In the next chapter we'll look at how to work around the overhead of page loads entirely with PJAX.

FURTHER READING

The complete APIs for web storage and the application cache are well covered on the Mozilla Developer Network:

- https://developer.mozilla.org/en-US/docs/DOM/Storage
- https://developer.mozilla.org/en-US/docs/HTML/Using_the_application_cache

INDEX

R

S

T

U

V

W

Y

Z