Persistence, drag'n'drop

Introduction

This week, we will talk about HTML5 persistence, and about offline web applications, yes, applications you can use even when your internet connexion is down! You certainly think about mobile web applications, when connectivity cannot be as trusted as when browsing from home or from the office. However, even for desktop applications, for games, for web based email clients, for a contact database, an HTML5 based presentation, etc. users expect them to keep on working even when the connection goes down.

There are of course applications for which that is simply not possible: if you are creating a chat application, there is no way in which you can usefully maintain a chat session when your users are not connected — but that is fine, users typically understand that magic is not possible.

But even in the case of an application that can store data on a remote service, it is much preferable for users to be able to manipulate their data locally and only synchronise remotely when there is a viable connection. This requires the ability to persistently store data locally.

Thankfully, our HTML5 toolkit contains not one but several solutions to this problem:

A File API for dealing with... files on the client side!
A new Cache API that gives more control over what is being cached, from JavaScript code,
Web Storage, sort of super cookies for storing string based value-pairs locally on the browser side,
The more complex (but more powerful) approach, IndexedDB, is a real indexed JavaScript obejct store, that supports transactions and comes with a large API. Three long subchapters are dedicated to its study.
The WebSQL database, implemented by all major browsers but not part of the HTML5 standard (there is only a single implementation and W3C requieres at least two different implementations for validating a standard, also it seems a bit overweighted for manipulating structured data client side, not adapted to JavaScript objects, etc). We will present it briefly for this reason.

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Table of contents

1 Introduction

2 HTML5 cache / Offline applications

3 TheWeb Storage API (LocalStorage, SessionStorage)

4 The File API

5 Drag'n'drop API part 1, principles

6 Drag'n'drop API part 2: files!

7 Several examples of form submission using Xhr2/Ajax, files and also PHP code for the server side.

8 The Filesystem and FileWriter APIs

9 The WebSQL API (deprecated)

10 [ADVANCED] IndexedDB: introduction and current support

11 [ADVANCED] IndexedDB: basic concepts

12 [ADVANCED] Using IndexedDB

13 [ADVANCED] High level libraries for using IndexedDB, other useful ressources

14 Conclusion about client-side persistence

1 Introduction

Introduction

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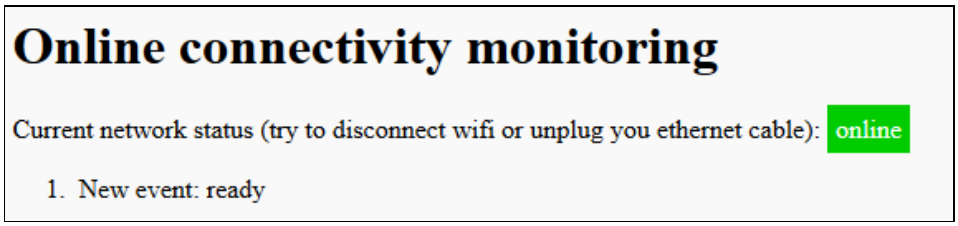
A "Web Storage" API, sort of super cookies for storing string based value-pairs locally on the browser side,
A real JavaScript object store: IndexedDB. This is a more complex (but more powerful) approach, that supports transactions and comes with a large API. Three long subchapters are dedicated to its study.
A WebSQL database, implemented by all major browsers but not part of the HTML5 standard (there is only a single implementation, and the W3C requires at least two different implementations to validate a standard). Furthermore it seems a bit overweighted for manipulating structured data on the client side, and not adapted to JavaScript objects, etc., and some vendors have no plans to support it (i.e. Microsoft). For this reason, we will not study it here.

Checking that the browser is online/offline

The new HTML5 persistence APIs are very often used with the `navigator.onLine` property, part of the DOM API. This feature is available on all browsers. The property `onLine` property returns `true` or `false` depending on whether or not the app has network connectivity:

Online example: http://jsbin.com/ebotog/4/edit




```


<!DOCTYPE html>
<html lang="en">
<head>
<meta charset=utf-8>
<meta name="viewport" content="width=620">
<title>HTML5 Demo: Online connectivity monitoring</title>
<body>
    <header>
      <h1>Online connectivity monitoring</h1>
      <style>
        #status {
          color: #FFFFFF;
          padding: 5px;
        }
        .online {
          background: none repeat scroll 0 0 #00CC00;
        }
        .offline {
          background: none repeat scroll 0 0 #FF0000;
        }
      </style>
    </header>

<article>
  <p>Current network status (try to disconnect wifi or unplug you ethernet cable):
            <span id="status">checking...</span></p>
```

```
  <ol id="state"></ol>
</article>
<script>
var statusElem  = document.getElementById('status'),
    state       = document.getElementById('state');

function online(event) {
  statusElem.className = navigator.onLine ? 'online' : 'offline';
  statusElem.innerHTML = navigator.onLine ? 'online' : 'offline';
  state.innerHTML += '<li>New event: ' + event.type + '</li>';
}

window.addEventListener('online', online);
window.addEventListener('offline', online);
// just to call the online function so that it refreshed display
online({ type: 'ready' });
</script>
</html>
```

Usually, one checks if the application is running in online or offline mode (in this last case, data may be retrieved from the client side, using one of the various methods presented in this week's course):

```
window.addEventListener('online', function(e) {
  // Re-sync data with server.
}, false);

window.addEventListener('offline', function(e) {
  // Queue up events for server.
}, false);
```

Special note about FireFox and FireFox OS / virtual lan VMs etc.

With FireFox the above example does not work except if you manually use the "switch to offline mode menu. As stated here the browsers handle the navigator.onLine property differently: https://developer.mozilla.org/en-US/docs/Web/API/window.navigator.onLine

In particular : "In Firefox and Internet Explorer, switching the browser to offline mode sends a `false` value. **All other conditions return a `true` value."**

There are also issues when the connectivity is lost by your router instead of the client machine. It takes time before the client machine says it is offline even if from a user point of view internet access does not work. There are timeouts in that case.

There are also problems in case you installed some "virtual LAN adapters on your machine", on computers with VirtualBox installed, all the virtual adapters have to be turned off otherwise the navigator.onLine property is always true, with all browsers.

Interesting article here about how we can detect if we are online or offline in a more reliable way, it includes testing navigator.online but also making ajax calls... http://www.html5rocks.com/en/mobile/workingoffthegrid/

People from FireFox OS are also investigating the way the online/offline status could be checked and what is the proper user interface to display. If you are curious about that read: https://bugzilla.mozilla.org/show_bug.cgi?id=882186

2 HTML5 cache / Offline applications

Introduction

All browsers have a native way of caching files, however the implementations and heuristics differ from one browser to another, and there is no easy way to control at the application layer which parts will be cached.

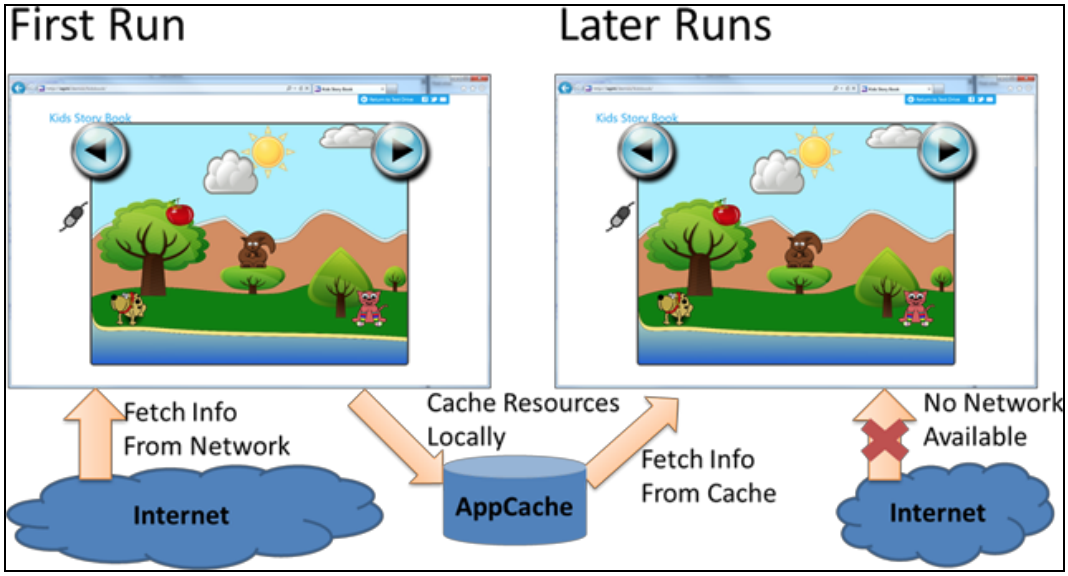
HTML5 in its "offline applications" specification", brings a new way to handle caching. By "offline applications", this means 1) that a web site can be browsed while no internet connexion is available, but it also says that 2) the web page may be an "application", not just a static page.

It may be a video game that usually retrieves data from a web server, saves high scores, etc. It may be a mail application (like gmail) that shows the most recent emails, checks for new ones, and has features for composing and sending new emails.

In these cases, having a controllable "cache API", we can implement things like: "when offline, you can read and compose mails, but you cannot get new emails or send new ones". Or, in a static web site, everything can be retrieved from the cache, so that a user can read the web site offline, but the login page will not be available... Instead, a disclaimer page will be displayed, etc.

The HTML5 cache will try to address all these needs, and is pretty useful for mobile web applications, where connections are not always available/reliable. "Unfortunately, a web app cannot run offline" is often emphased by native mobile applications fanatics. This is a false statement.

Using the HTML5 cache is not useful only for mobile applications, or only for web application developers. Any web site (even made 100% of static pages/images/videos etc.) can benefit from being intelligently cached, as the HTML5 cache can seriously decrease the load time for any given site, especially if the same browser/person visits the web site regularly, as illustrated by these pictures (borrowed from a MSDN blog post about offline applications that is worth reading):



External resources:

- The W3C specification about Offline Web Applications / cache.
- Article from html5rocks.com about the cache API
- Article from webdirections.com about the cache API.
- Appcache facts: good resume of the cache API + best practices.
- Tools
  - Cache manifest validator tool,
  - ManifestR bookmarklet, a tool for automatically generating a cache manifest file.

Current support

Support as of March 2013 is pretty good:

Offline web applications - Working Draft

Method of defining web page files to be cached using a cache manifest file, allowing them to work offline on subsequent visits to the page

*Usage stats:	Global
Support:	69.89%
Partial support:	0.1%
Total:	69.99%

Show all versions	IE	Firefox	Chrome	Safari	Opera	iOS Safari	Opera Mini	Android Browser	Blackberry Browser
								2.1	
								2.2	
						3.2		2.3	
						4.0-4.1		3.0	
	8.0		24.0			4.2-4.3		4.0	
	9.0	19.0	25.0	5.1		5.0-5.1		4.1	7.0
Current	10.0	20.0	26.0	6.0	12.1	6.0	5.0-7.0	4.2	10.0
Near future		21.0	27.0						
Farther future		22.0	28.0						

Notes | Known issues (1) | Resources (4) | Feedback | Edit on GitHub

No notes

Up-to-date version of this table: http://caniuse.com/#feat=offline-apps

Principles: HTML5 introduced a cache manifest file

HTML5 introduced a "manifest file" as an attribute to the `<html>` element. This file will tell the browser what to cache, what not to cache, and some other goodies we will see together in this section.

Example of the inclusion of a manifest file (it is best practice/recommandation to use the `.appcache` suffix)

```
<html manifest="myCache.appcache">
  ...
</html>
```

You must include the `manifest` attribute on every page for which you want to cache resources (images included in the page, JavaScript files, CSS files).

The manifest file will contain lines that will tell which image/js/css needs to be cached, which ones must never be cached, etc.

The page with the manifest is de facto included in the files that will be cached. This means that any page the user navigates to that include a `manifest` will be implicitly added to the application cache.

The browser does not cache a page if it does not contain the `manifest` attribute. The default cache behavior, prior to HTML5 will be used (it depends on browser versions).

The `manifest` attribute value is a relative path (relative to the page URL), but an absolute URL can be used (not recommended), if it respects the same origin policy.

The manifest file must be served with the correct MIME Type

The HTTP server that serves your files must be configured so that `.appcache` files are served with the MIME type `text/cache-manifest`. For example, with the Apache server, this line must be added in the `HTTP.conf` configuration file (or in `.htaccess` files):

```
AddType text/cache-manifest .appcache
```

What do we put in the manifest file?

First example (taken from the W3C specification, you can try the online example here: http://www.whatwg.org/demos/offline/clock/live-demo/clock.html):

```
CACHE MANIFEST
clock.html
clock.css
clock.js
```

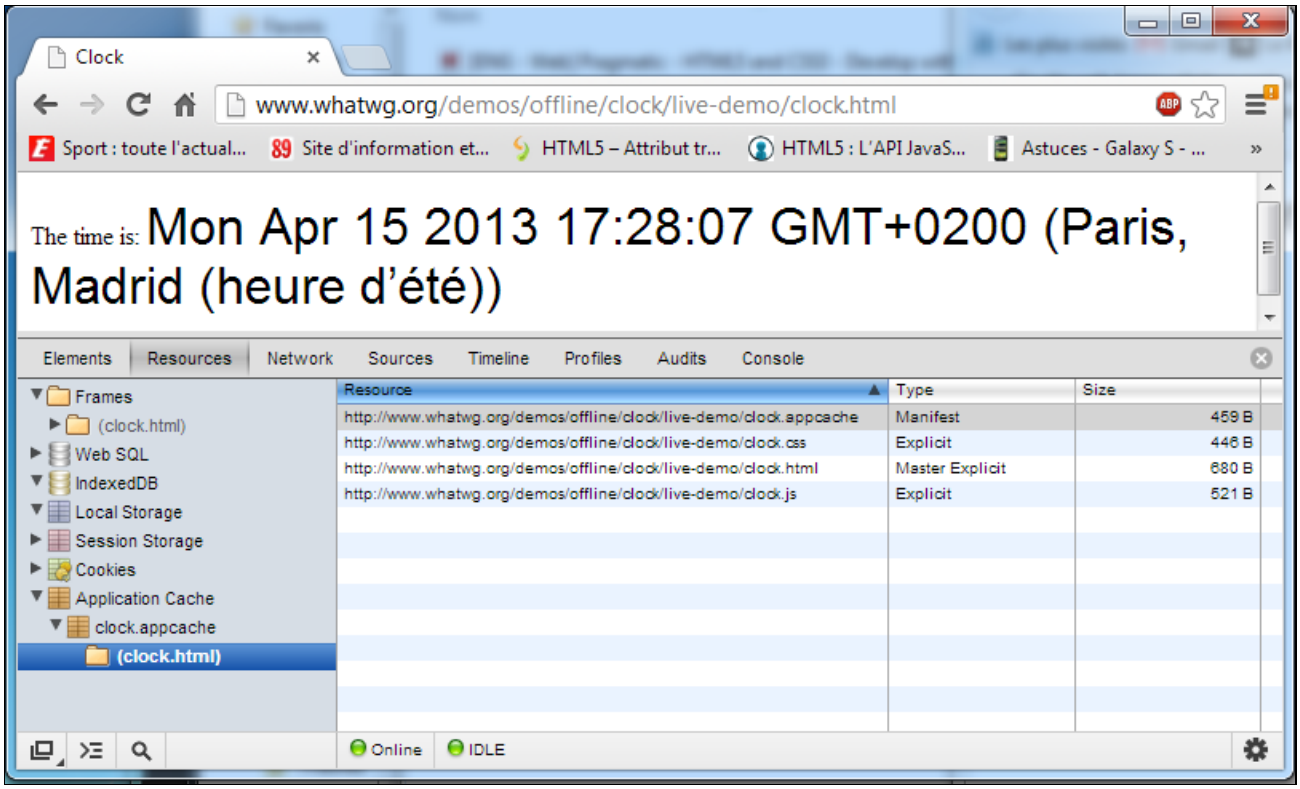
This example displays the current time and caches three files: the html page that includes the cache (it is cached by default but the specifications recommend adding it to the manifest as good practice), a CSS file and a JavaScript file.

Note that the first line (CACHE MANIFEST) is mandatory.

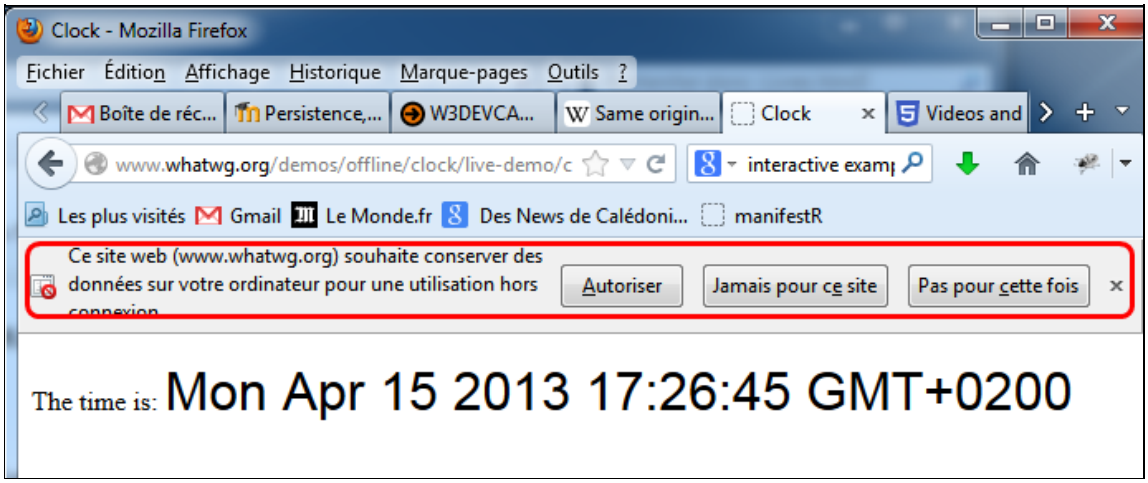
TRAP: When a file is available in the cache and on the remote HTTP server, it will **always be retrieved from the cache**! We will see in the section "updating the cache" further on, how to control this and update the files in the cache.

SECOND TRAP: If one file cannot be retrieved and cached, **zero files will be updated in the cache**. There is not "partial update" possible. Good practice is to always validate you manifest file using one of the tools listed at the end of this chapter.

The first time you run this in Chrome, you may see the cache content with the dev tools (F12):



With the same example, Firefox asks if you agree to cache some data (the sentence is in French here but it says: "this web site would like to save data on your computer for offline use, authorize, never, just for this time"):



Let's have a look at another example of `manifest.appcache` (this one comes from: http://www.webdirections.org/blog/get-offline/), that does a little more:

```
CACHE MANIFEST

CACHE:

#images
/images/image1.png
/images/image2.png

#pages
/pages/page1.html
/pages/page2.html

#CSS
/style/style.css

#scripts
```

```
17 /js/script.js
18
19 FALLBACK:
20 / /offline.html
21
22 NETWORK:
23 login.html
```

This time we notice a few additional things:

We can add comments starting with #,
There are three different sections in capital letters: CACHE, FALLBACK and NETWORK.

These three sections are optional, we did not have them in the first example. But as soon as you indicate one of them, you must indicate the others. (CACHE was defaulted in the first example as we had no explicit section declarations).

The CACHE section specifies the URLs of the resources that must be cached (generally relative to the page, but they can also be absolute and external, for example for caching jQuery from a google repository, etc.). these resources will be 1) cached when online, and 2) available from the cache when offline.

The NETWORK section is the contrary of the CACHE section: it is useful for specifying resources that should NOT be cached. These resources 1) will not be cached when online, and consequently 2) will not be available when the user is offline. EVEN IF THE BROWSER HAS CACHED THEM IN ITS OWN "PRE HTML5" cache! In the previous example, at line 23, the login.html file (the one with the login/password form...) is never cached. Indeed, entering login/password and pressing a "login/connect/signup" button is useless if you are offline.

Using a wildcard * in that section is also common practice, this means "do not cache all files that are not in the CACHE or FALLBACK section":

```
1 NETWORK:
2 *
```

Partial URLs may also be used in that section, like "`/images`" that means, all URLs that ends with images/*... should not be cached. Notice that wildcards and partial URLs are not allowed in the CACHE section, where all individual files must be explicitly specified.

The FALLBACK section specifies resources that will be displayed when a resource that is not available when offline is requested. For example, a login.html file must not be cached nor be available when offline. In that case, accessing to `http://.../login.html` will cause offline.html to be displayed (and this file will be cached, this is forced by being in the FALLBACK section). The "/ /offline.html" in the FALLBACK section of the example says that for any resource that is not available in the cache ("/" means here "any resource"), show the offline.html page.

Partial URLs can be used too. For example:

```
1 /images/ /images/missing.png
```

... tells us that all images in the subdirectory "images" relative to the web page that includes the manifest, if unavailable in the cache when offline, will be replaced by an image named "missing.png".

Cache size limitations?

There are size limitations, but they may vary from one browser to another. For example, with Chrome, there is no maximum size for cached data, but there is a 5Mbytes limitation for all shared data located on the client side, by domain. However, if you write HTML5 web apps that you will publish in the Chrome store, this size is unlimited. Usually there is a limit around 5Mbytes, some browsers like Opera allow some user configuration in the browser's preferences, etc.

Updating the cache

When a resource is in the cache, it will ALWAYS be retrieved from the cache, even if you are online, and even if a more recent version is available on your web server.

Updating the manifest file server side will update the files cached by browsers: the easiest way to make the browser update the cache is to update the manifest file itself. Good practice is to add a comment with the last modification date of your web site in the manifest file. If you update any file on your site, also update this comment. Your manifest last modified date will be changed, and the browser will check all files in the CACHE section of the manifest for modification, and update the cached version if necessary.

Clearing the cache using the browser dev tools/options will also regenerate the cache at the next connection.

The cache can be updated programmatically using the HTML5 cache JavaScript API:

There is a JavaScript API that is accesible through the `window.applicationCache` interface. This interface provides a `status` property, two methods `update()` and `swapCache()`, and a set of events. The `update()` method updates the cache in a temporary location, and `swapCache()` replaces the current cache with the new updated one.

```
interface ApplicationCache {

  // update status
  const unsigned short UNCACHED = 0;
  const unsigned short IDLE = 1;
  const unsigned short CHECKING = 2;
  const unsigned short DOWNLOADING = 3;
  const unsigned short UPDATEREADY = 4;
  const unsigned short OBSOLETE = 5;
  readonly attribute unsigned short status;

  // updates
  void update();
  void swapCache();

  // events
           attribute Function onchecking;
           attribute Function onerror;
           attribute Function onnoupdate;
           attribute Function ondownloading;
           attribute Function onprogress;
           attribute Function onupdateready;
           attribute Function oncached;
           attribute Function onobsolete;
};
ApplicationCache implements EventTarget;
```

Here is a piece of code that forces programmatically an update of the cache:

```
var appCache = window.applicationCache;

appCache.update(); // Attempt to update the user's cache.

...

if (appCache.status == window.applicationCache.UPDATEREADY) {
  appCache.swapCache();  // The fetch was successful, swap in the new cache.
}
```

Notify the user that the cache will be updated

The following piece of JavaScript code checks if the web site has updated its manifest, and requests the browser to update the cache. In that case the user is prompted for confirmation (code from: http://www.html5rocks.com/en/tutorials/appcache/beginner/)

```
// Check if a new cache is available on page load.
window.addEventListener('load', function(e) {

  window.applicationCache.addEventListener('updateready', function(e) {
    if (window.applicationCache.status == window.applicationCache.UPDATEREADY) {
      // Browser downloaded a new app cache.
      // Swap it in and reload the page to get the new hotness.
      window.applicationCache.swapCache();
      if (confirm('A new version of this site is available. Load it?')) {
        window.location.reload();
      }
    } else {
      // Manifest didn't changed. Nothing new to server.
    }
  }, false);

}, false);
```

Do you need to cache resources included by your CSS/JavaScript files, etc.?

If your CSS files use `@import` or include some external pictures, you need to explicitly add them one by one to the manifest file. The same with your JavaScript files, if they include other files, and you want them to be added to the cache, you must add them one by one to the manifest file. This can be tricky, so fortunately there are several tools to help you generate a manifest file. More on these at the end of this chapter.

What about cross domain/external domain files? Can we cache them too?

Normally yes, you can. Imagine a web site that uses jQuery or any other common JS/CSS addons, it will not run offline.

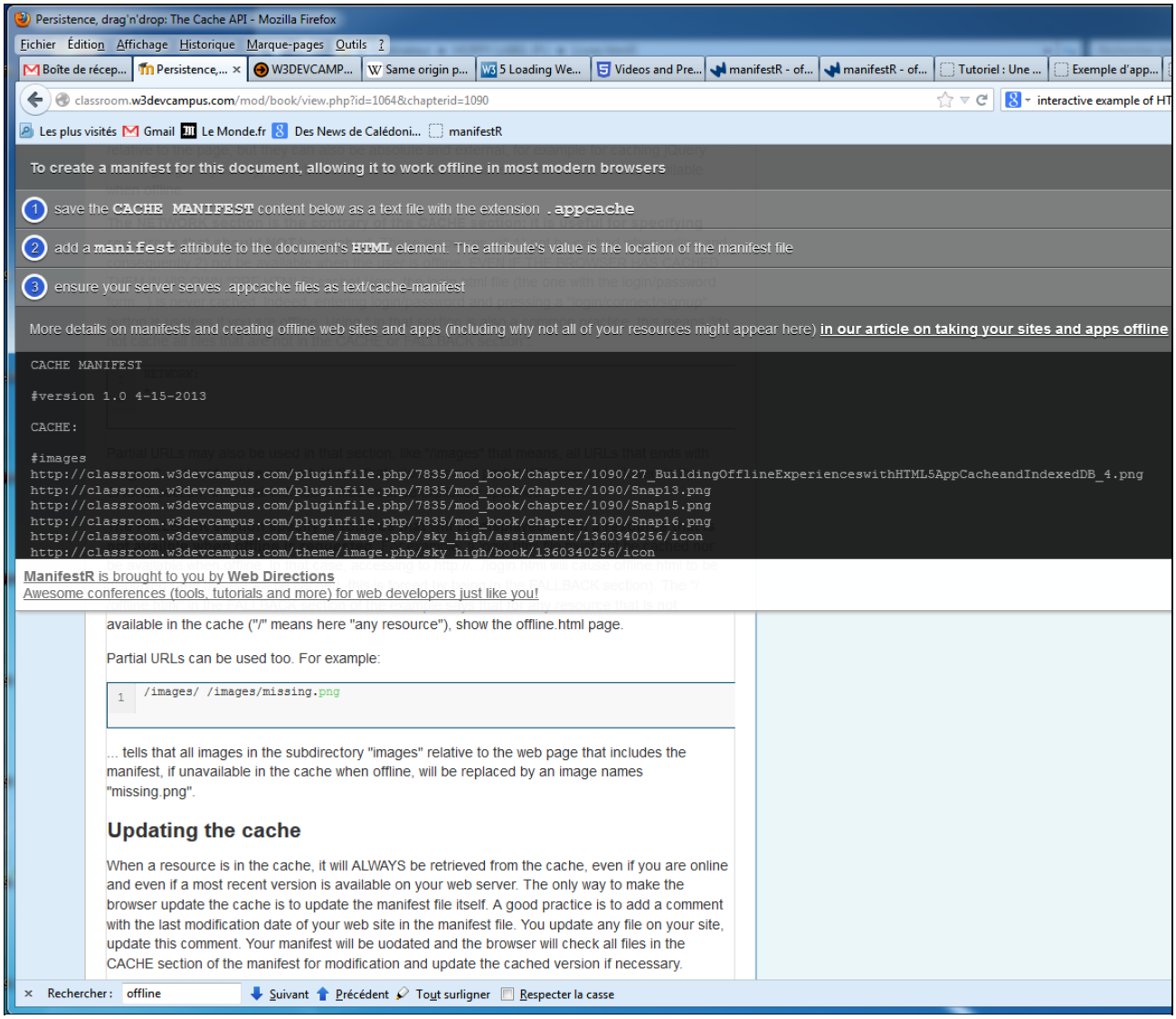
The specification, however, says that for web sites accessible only through `https://` secure connexions, the same origin

policy should apply. Chrome in fact does not adhere to this part of the specification, and it has been argued that the single origin policy for https is too restrictive in the real world for app caching to be of genuine value. I haven't checked about each browser's vendor position on this. Firefox follows the specification.

Useful tools

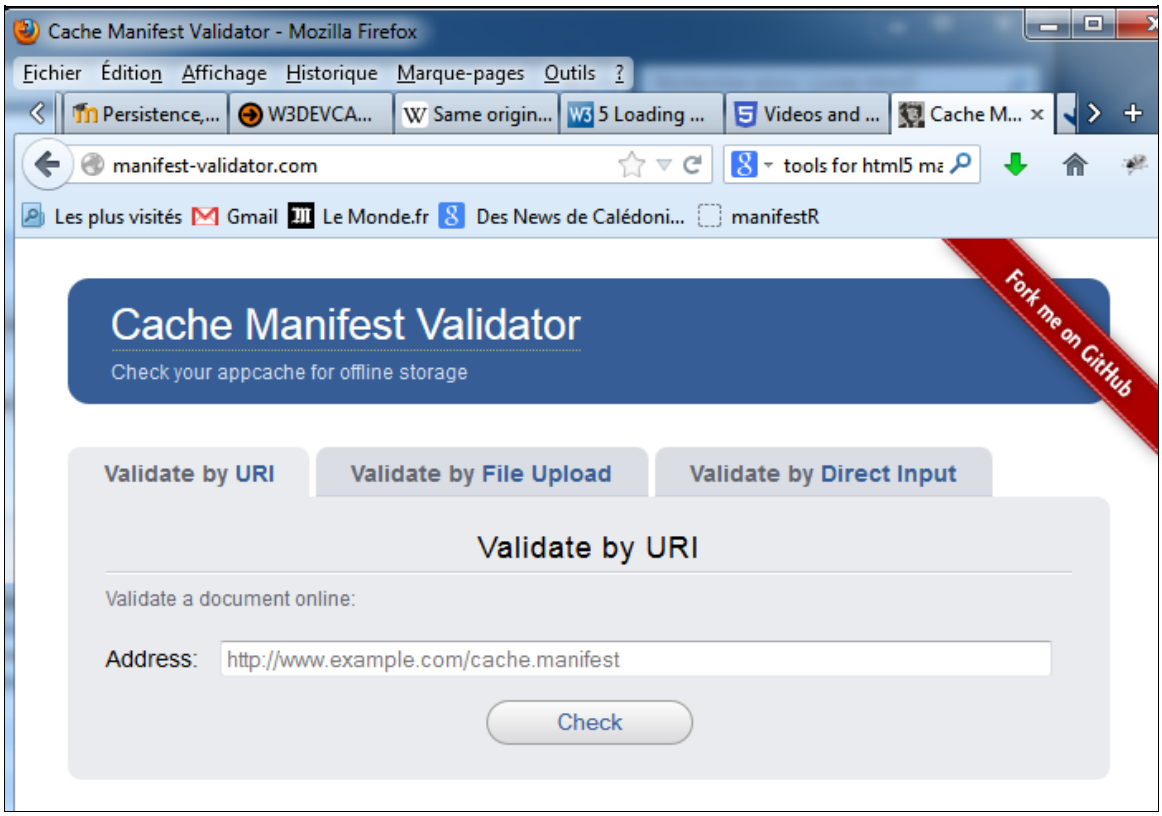
Check the following tools that can help bootstrapping a cache manifest file:

manifestR: http://westciv.com/tools/manifestR/



Manifest validator: http://manifest-validator.com/

This web site accepts URLs of manifest files, or directly pasting content. It will validate the file. It also proposes a Chrome extension and a TextMate addon.


Cache Manifest Validator - Mozilla Firefox
Fichier Édition Affichage Historique Marque-pages Outils ?
Persistence,... W3DEVCA... Same origin... 5 Loading ... Videos and ... Cache M...
manifest-validator.com
tools for html5 ma
Les plus visités Gmail Le Monde.fr Des News de Calédoni... manifestR
Fork me on GitHub
Cache Manifest Validator
Check your appcache for offline storage
Validate by URI
Validate by File Upload
Validate by Direct Input
Validate by URI
Validate a document online:
Address:
http://www.example.com/cache.manifest
Check

3 TheWeb Storage API (LocalStorage, SessionStorage)

Web Storage

External resources:

> [The W3C specification of the WebStorage API](),
> [Interesting article on html5rocks that compares the different ways of doing client side persistence with HTML5, including Web Storage]().

This [W3C specification of this API]() introduces *"two related mechanisms, similar to HTTP session cookies, for storing structured data on the client side"*.

Web Storage indeed provides two interfaces called sessionStorage and localStorage, whose main difference is data longevity. With localStorage the data will remain until it is deleted, whereas with sessionStorage the data is erased when the tab/browser is closed.

For convenience, we will mainly illustrate the examples with the localStorage object. Just change "local" by "session" and it should work (this time with a session lifetime).

localStorage is a simple key-value store, in which the keys and values are strings. There is only one store *per origin*. This functionality is exposed through the globally available `localStorage` object. The same applies to sessionStorage.

Example:

```
// Using localStorage

// store data
localStorage.lastName = "Buffa";
localStorage.firstName = "Michel";

// retrieve data
var lastName = localStorage.lastName;
var firstName = localStorage.firstName;


```

This data is located in a store attached to the origin of the page.

Cookies are also a popular way to store key-value pairs. Web Storage however, is a technique more powerful than cookies, which are limited in size (a few Kbytes for cookies, compared to several MBytes for Web Storage) and which generate HTTP traffic for each additional request (whether to request a web page, an image, a stylesheet, a JavaScript file, etc.). Objects managed by Web Storage are no longer carried on the network and HTTP, and are easily accessible (read, change and delete) from JavaScript, using the Web Storage API.

For security reasons (more on that later), pages loaded with a file:// type of URL cannot use localStorage or sessionStorage. You must use http:// or https:// URLs and a web server.

Current support: excellent!

As of January 2013, support is excellent, including mobile browsers.

Web Storage - name/value pairs - Working Draft

Method of storing data locally like cookies, but for larger amounts of data (sessionStorage and localStorage, used to fall under HTML5).

*Usage stats:	Global
Support:	92.46%
Partial support:	0.14%
Total:	92.6%

Show all versions	IE	Firefox	Chrome	Safari	Opera	iOS Safari	Opera Mini	Android Browser	Blackberry Browser
								2.1	
								2.2	
						3.2		2.3	
						4.0-4.1		3.0	
	8.0		24.0			4.2-4.3		4.0	
	9.0	19.0	25.0	5.1		5.0-5.1		4.1	7.0
Current	10.0	20.0	26.0	6.0	12.1	6.0	5.0-7.0	4.2	10.0
Near future		21.0	27.0						
Farther future		22.0	28.0						

To see an up-to-date version of this table: [http://caniuse.com/#feat=namevalue-storage]()

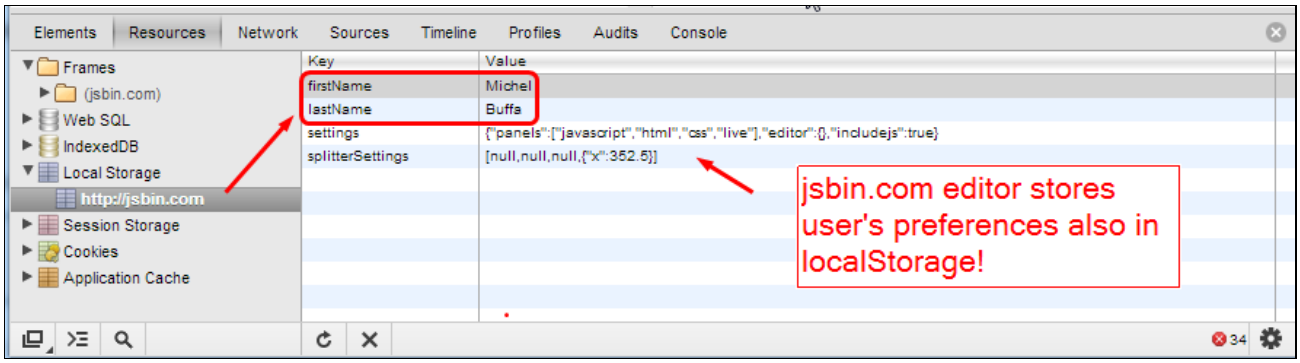
First example that uses localStorage

Online code: http://jsbin.com/oyafiv/3/edit

Code from this example:

```
<!DOCTYPE html>
<html>
<head>
<meta charset=utf-8 />
<title>JS Bin</title>
  <script>
    // Using localStorage

    // store data
    localStorage.lastName = "Buffa";
    localStorage.firstName = "Michel";

    function getData() {
       // retrieve data
       document.querySelector("#lastName").innerHTML = localStorage.lastName;
       document.querySelector("#firstName").innerHTML = localStorage.firstName;
    }
  </script>
</head>
<body onload="getData()">
  <h1>Data retrieved from localStorage</h1>
  <ul>
    <li>Last name : <span id="lastName"></span></li>
    <li>First name : <span id="firstName"></span></li>
  </ul>
</body>
</html>
```

And if you run this example and look at the dev tools with Chrome (F12), you can see the local store tied to the jsbin.com origin:



Differences between localStorage and sessionStorage

Here is the list of differences:

> data stored using the sessionStorage interface has the same lifetime as the browsing session, and its scope is limited to the active window or tab. When the tab or the active window is closed, the data is erased. Unlike cookies, there is no interference. Each session storage is limited to a domain.
> data stored using localStorage has unlimited lifetime. Unlike sessionStorage, data is not deleted when closing a tab or the window/browser. The scope of localStorage is de facto wider: it is possible to work with the same data across multiple tabs opened at the same time on the same domain/subdomain, in the same browser.

Different browsers cannot share data. The Web Storage is unique per browser.

More methods from localStorage/sessionStorage

This time we will look at another example that uses new methods from the API: localStorage.setItem(...), localStorage.getItem(...), localStorage.removeItem(...), localStorage.clear().

If you want to keep a simple counter of the number of times a given user has loaded your application, you can use the following code (just to show setItem/removeItem):

```
var counter = localStorage.getItem("count") || 0;
counter++;
localStorage.setItem("count", counter);
```

As you can easily guess from the above, we use `getItem()` to retrieve a key's value and `setItem()` to set it.

Deleting a key completely can be performed through `removeItem()`, and if you wish to reset the entire store, simply call `localStorage.clear()`.

Note that it may be quite rare that you will want the entire store to be cleared by the user in production software (since that effectively deletes their entire data), but it is a rather common operation needed during development, since bugs may store faulty data the persistence of which can break your application, since the way you store data may evolve over time, or simply because you also need to test the experience of the user when first using the application. One way of handling that is to add a user interface button that calls `clear()` when clicked, but you then have to be sure not to forget to remove it when you ship! The approach recommended to use (when possible) is to simply open the console and type `localStorage.clear()` there — it's safer and works just as well.

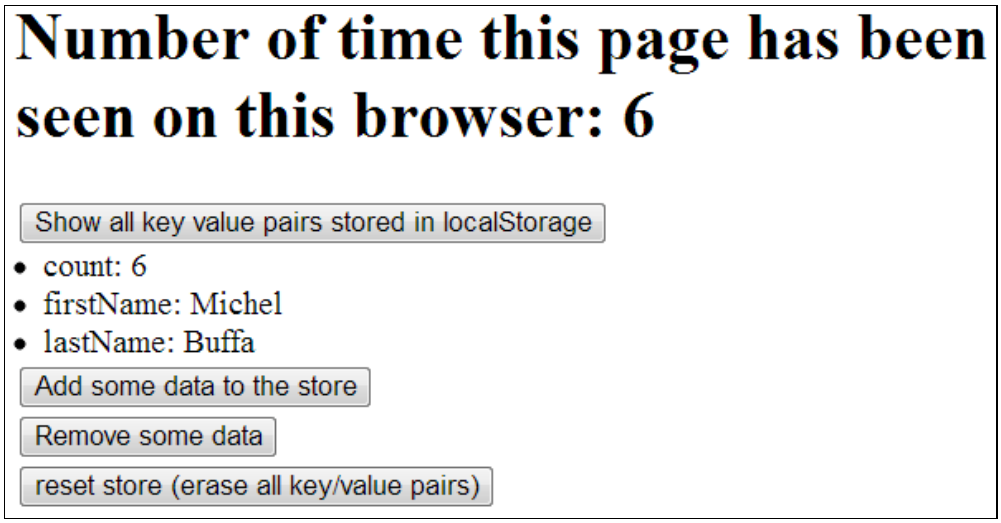
Local stores can also be iterated through in order to list all the content that they contain. The order is not guaranteed, but this can be useful at times (if only for debugging purposes!). The following code lists everything in the current store:

```
for (var i = 0, n = localStorage.length; i < n; i++) {
    var k = localStorage.key(i);
    console.log(k + ": " + localStorage[k]);
}
```

Astute students will note something off in the example above: instead of calling `localStorage.getItem(k)` we simply access `localStorage[k]`. Why? Because keys in the local store can also be accessed as if the store were a simple JavaScript object. So instead of `localStorage.getItem("foo")` and `localStorage.setItem("foo", "bar")` one can write `localStorage.foo` and `localStorage.foo = "bar"`. Of course there are limitations to this mapping: any string can serve as a key, so that `localStorage.getItem("one two three")` works, whereas that string would not be a valid identifier after the dot (but it could still work as `localStorage["one two three"]`).

An example that shows all these things: http://jsbin.com/esexib/3/edit

Run it, then click on the first button to show all key/values in the localStorage. Open the URL in another tab, and see that the data is shared between tabs. Then click on the second button to add some data in the store, click on the third to remove some data. FInally, the last one clears the whole data store.



Code from this example:

```
<!DOCTYPE html>
<html>
<head>
<meta charset=utf-8 />
<title>JS Bin</title>
  <script>
    // Using localStorage

    var counter = localStorage.getItem("count") || 0;
    counter++;
    localStorage.setItem("count", counter);
```

```

    function getCountValue() {
       // retrieve data
       document.querySelector("#counter").innerHTML = localStorage.count;
    }

    function seeAllKeyValuePairsStored() {
      // clear list first
      document.querySelector('#list').innerHTML="";

      for (var i = 0, n = localStorage.length; i < n; i++) {
        var key = localStorage.key(i);
        var value = localStorage[key];
        console.log(key + ": " + value);

        var li = document.createElement('li');
          li.innerHTML = key + ": " + value;
          document.querySelector('#list').insertBefore(li, null);
      }
    }

    function resetStore() {
      // erase all key values from store
      localStorage.clear();
      // reset displayed list too
      document.querySelector('#list').innerHTML="";
    }
    function addSomeData() {
      // store data
      localStorage.lastName = "Buffa";
      localStorage.firstName = "Michel";
      // refresh display
      seeAllKeyValuePairsStored();
    }
     function removeSomeData() {
      // store data
      localStorage.removeItem("lastName");
       localStorage.removeItem("firstName");
      // refresh display
      seeAllKeyValuePairsStored();
    }
  </script>
</head>
<body onload="getCountValue()">
  <h1>Number of time this page has been seen on this browser: <span id="counter"></span></h1>

  <button onclick="seeAllKeyValuePairsStored()">Show all key value pairs stored in localStorage</button><br/>
  <output id="list"></output>

  <button onclick="addSomeData()">Add some data to the store</button><br/>
  <button onclick="removeSomeData()">Remove some data</button><br/>
   <button onclick="resetStore()">reset store (erase all key/value pairs)</button>
</body>
</html>

```

We tried to use some HTML5 goodies as well as the Web Storage API. We used the new document.querySelector() method that has been added to the DOM API by HTML5 (the additions to this API were studied in the Week 5 course), and we used an <output> element (Week 2 course) to display the keys/values retrieved from the data store. You can check in the Chrome dev tools user interface that the content of the localStorage changes as you click on the buttons.

Another useful example: store form content as you type, in session storage

I bet that at least once you have lost everything you typed in a long form, because you pressed backspace or clicked on a link by mistake. You went back to the URL of the form and bing! Everything you typed was lost! Cry baby cry...

In this example, we will be listening to every key you type in an input field, storing the field's content in a sessionStorage. Try the example, change to another page or reload. You will get the form back in the state you left it!

Online example: http://jsbin.com/utuyiv/2/edit

Pre filled form using session storage

This forms will store the content of the input field as you type...using an onchange JavaScript event... If you reload this page any time, or press by mistake the Backspace key, and come back to this page, you will find the form in the exact state you left it.

Message

Hello

Code from this example:

```
<!DOCTYPE html>
<html>

<head>
  <meta charset="utf-8">
  <title>HTML5 : Web Storage</title>
</head>

<body>

<h1>Pre filled form using session storage</h1>

    <p>This forms will store the content of the input field as you type...using an onchange JavaScript event...

    <p><label for="message">Message</label></p>
    <p><textarea id="message" name="message" onchange="sessionStorage.message=this.value"></textarea></p>

<script>
  if(typeof sessionStorage!='undefined') {
    if('message' in sessionStorage) {
        alert("Message restored from sessionStorage");
        document.getElementById('message').value = sessionStorage.getItem('message');
    }
} else {
    alert("sessionStorage is not supported by Your browser");
}
</script>

</body>
</html>
```

Size limitation, security, localStorage or sessionStorage?

The specification states that:

> *User agents should limit the total amount of space allowed for storage areas.*
> *User agents should guard against sites storing data under the origins other affiliated sites, e.g. storing up to the limit in a1.example.com, a2.example.com, a3.example.com, etc, circumventing the main example.com storage limit.*
> *User agents may prompt the user when quotas are reached, allowing the user to grant a site more space. This enables sites to store many user-created documents on the user's computer, for instance.*
> *User agents should allow users to see how much space each domain is using.*
> *A mostly arbitrary limit of five megabytes per origin is recommended. Implementation feedback is welcome and will be used to update this suggestion in the future.*

Indeed, the five megabytes limit is the one implemented in Chrome and Firefox, we haven't checked all the browsers' documentation, but we guess they all do the same.

In many cases, local storage is all that your application will need, but be careful with several aspects. One is that the user may decline to provide your application with that storage, so be sure to write your application in such a way that it can survive not being granted storage rights (or if that is impossible, make it clear to your users why it is needed).

Additionally, there will be a limit on the amount of data that you can store there. Browsers enforce quotas that will prevent you from cluttering your users' drives excessively. Those quotas can vary from platform to platform, but are usually reasonably generous for simple cases (around 5MB), so if you are careful not to store anything huge there, you should be fine. Finally, keep in mind that this storage is not necessarily permanent. Browsers are inconsistent in how they allow for it to be wiped, but in several cases it gets deleted with cookies — which is logical when you think of how it can be used for tracking in a similar

fashion. It is therefore important to ensure that you synchronize data that is there with the server on a regular basis, in order to avoid data loss (and in general, because users enjoy using the same service from multiple devices at once).

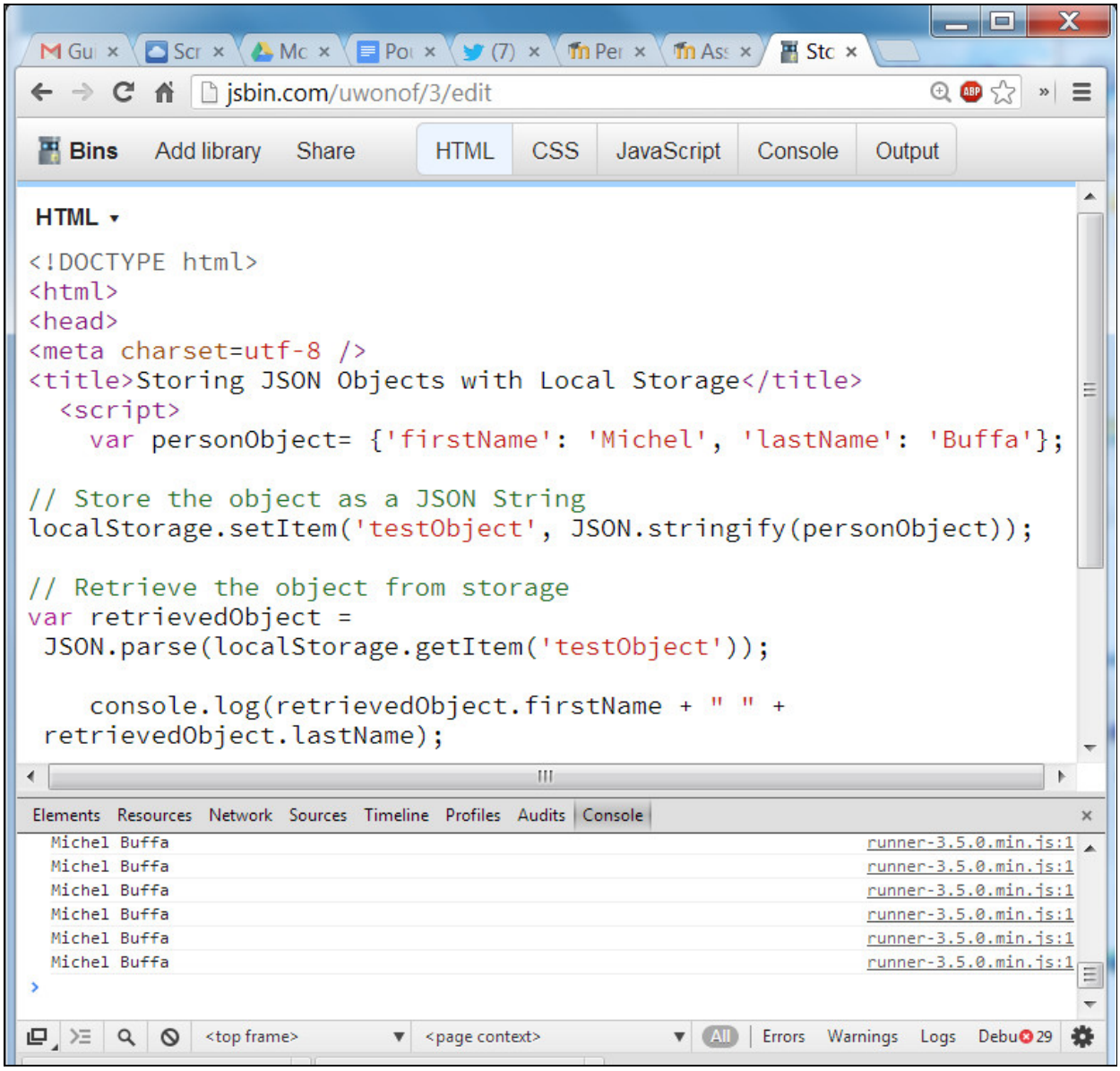
Note that if all you need is to store session-based data in a manner that is more powerful than cookies, you can use the `sessionStorage` object which works in the exact same way as `localStorage`, but the lifetime of which is limited to a single browser session. Also note that in addition to being more convenient and capable of storing more data than cookies, it also has the advantage of being scoped to a given browser tab (or similar execution context). If a user has two tabs open to the same site, they will share the same cookies. Which is to say that if you are storing information about a given operation using cookies in one tab, that information will leak to the other side — something that can be confusing if the user is performing different tasks in each. Using `sessionStorage`, the data you store will be scoped and therefore not leak across tabs.

Storing more than strings? Use JSON!

Storing strings is all nice and well, but quickly limiting: it is not rare to need to store more complex data with at least a modicum of structure. There are some simple approaches to this, such as creating your own minimal record format (e.g. a string with fields separated with a given character, using `join()` on store and `split()` upon retrieval) or using multiple keys (e.g.`post_17_title`, `post_17_content`, `post_17_author`, etc.) but these are really hacks. Thankfully, there's a better way, JSON stringify() and parse() methods.

JSON provides a great way of encoding and decoding data that is a really good match for JavaScript. You have to be careful not to use circular data structures or non-serialisable objects, but in the vast majority of cases plugging JSON support into your local store is straightforward. The following example is one way of doing so:

Online example: http://jsbin.com/uwonof/3/edit

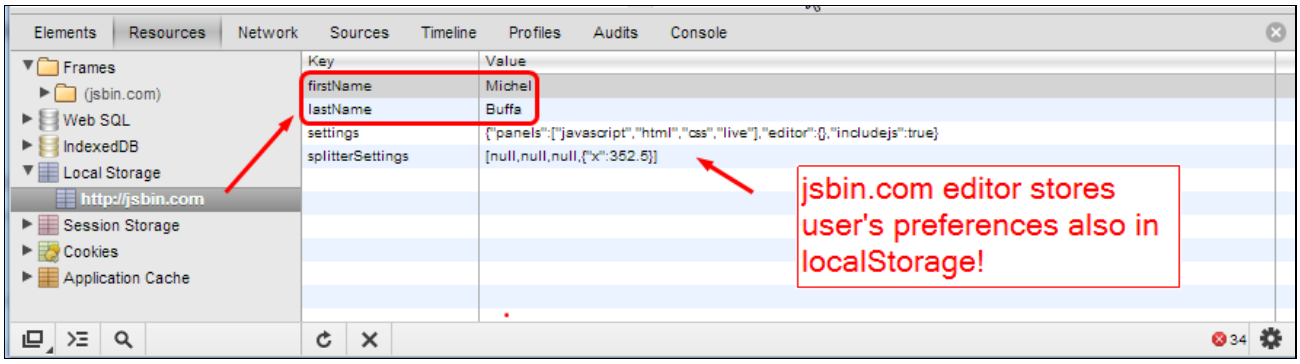


Source code from the example:

```
<!DOCTYPE html>
<html>
<head>
```

```
<meta charset=utf-8 />
<title>Storing JSON Objects with Local Storage</title>
  <script>
    var personObject= {'firstName': 'Michel', 'lastName': 'Buffa'};

// Store the object as a JSON String
localStorage.setItem('testObject', JSON.stringify(personObject));

// Retrieve the object from storage
var retrievedObject = JSON.parse(localStorage.getItem('testObject'));

console.log(retrievedObject.firstName + " " + retrievedObject.lastName);

// then you can use retrievedObject.firstName, retrievedObject.lastName...
  </script>
</head>
<body>
</body>
</html>
```

Notice that this is how jsbin.com stores the user's preferences (the last two lines of data):



Conclusion about Web Storage

Advantages:

Simple to use,
We may store objects/images using JSON/dataURLs,
Simple to use,
Simple to use :-)

Disadvantages:

Not accessible from Web Workers,
Synchronous access (may take time if you work with big objects or images, may freeze the UI)
If you need to store big objects, have performance concerns, need access from multiple tabs, from Web Workers, then use IndexedDB.

4 The File API

Introduction

Previously, HTML5 file management was limited to multiparts forms and Ajax. Possible actions were not very interesting, neither for the developer or user. However, HTML5 is now providing an API called "File" (and two others "Filesystem and FileWriter APIs" that only have experimental implementation in Chrome and will not be addressed in this course, not yet stable enough...), that provides features for accessing information about files (name, size, type) and read their content. Furthermore, some improvements on XMLHttpRequest, together with the file API make uploading/downloading files much easier.

In the next chapters, we will look at the drag'n'drop API that can also work with files and the File API.

The objective of this chapter is to provide an overview of the File API.

External resources

- The W3C specification about the File API
- Article on html5rocks.com about the file API (and drag'n'drop)
- Article from developer.mozilla.org about the file API

Getting details about a file

Imagine you have an input field like this:

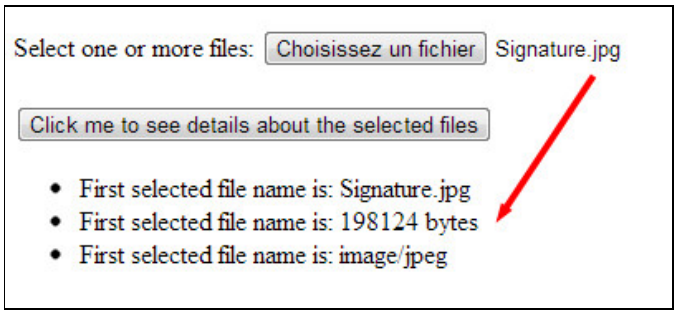
```
Select one or more files: <input type="file" id="input"/>
```

This will render as a "select files" or "browse files" button. If you select one file in the file choser dialog that has popped up, you can get details about the first file selected. Look at the the code below: it uses the file API, in particular, this API defines a `files` property on the DOM node corresponding to the `<input type="file"...>` input field.

```
var selectedFile = document.getElementById('input').files[0];

// do something with selectedFile.name, selectedFile.size, selectedFile.type
...
```

Example 1

Here is a complete online example that uses the `files` property to get details about the first selected file: http://jsbin.com/axuyin/4/edit



Code from the example:

```
<!DOCTYPE html>
<html>
<head>
<meta charset=utf-8 />
<title>JS Bin</title>

  <script>
    function displayFirstSelectedFile() {
      var selectedFile = document.getElementById('input').files[0];
      document.querySelector("#singleName").innerHTML = selectedFile.name;
      document.querySelector("#singleSize").innerHTML = selectedFile.size + "  bytes";
      document.querySelector("#singleType").innerHTML = selectedFile.type;
    }
  </script>
</head>
<body>
  Select one or more files: <input type="file" id="input">
  <br/>
  <button onclick="displayFirstSelectedFile()">Click me to see details about the selected files</button>
```

```
  <ul>
    <li>First selected file name is: <span id="singleName"></span></li>
    <li>First selected file name is: <span id="singleSize"></span></li>
    <li>First selected file name is: <span id="singleType"></span></li>
  </ul>

</body>
</html>
```

Example 2

You can also do something just after the files have been selected, using the "change" event on the input field. This example is a bit more complicated, as it will display details about all files selected (not only the first) and allows only images to be selected, using the `accept` attribute of the input field: `<input type="file" accept="image/*"...>`.

It also shows the use of the `lastModifiedDate` property on a File object (aka a file descriptor)

Online example: http://jsbin.com/ofelet/14/edit

Select several images: Sélect. fichiers 4 fichiers

Name	Bytes	MIME Type	Last modified date
IMG_20130308_122305.jpg	14152	image/jpeg	Fri Mar 08 2013 20:59:58 GMT+0100 (Paris, Madrid)
prime numbers.jpg	29898	image/jpeg	Thu Apr 11 2013 10:18:30 GMT+0200 (Paris, Madrid (heure d'été))
raytracer.jpg	83278	image/jpeg	Thu Apr 11 2013 20:46:55 GMT+0200 (Paris, Madrid (heure d'été))
SharedWebWorkersSupport.jpg	112402	image/jpeg	Thu Apr 11 2013 09:49:21 GMT+0200 (Paris, Madrid (heure d'été))

Code from the example:

```
1  Select several images: <input type="file" accept="image/*" multiple onchange="filesProcess(this.files)" name="s
2  <br/>
3  <br/>
4  <div id="result">...</div>
5  <script>
6    function filesProcess(files) {
7      selection = "<table><tr><th>Name</th><th></th><th>Bytes</th><th></th><th>MIME Type</th><th>Last modified da
8
9      for(i=0; i<files.length ;i++){
10       file = files[i];
11         selection += "<tr><td>"+file.name+"</td><td> | </td><td style=\"text-align:right\">"
12             +file.size+"</td><td> | </td><td>"
13             +file.type+"</td><td> | "+file.lastModifiedDate+"</td></tr>";
14     }
15      selection += "</table>";
16
17      document.getElementById("result").innerHTML = selection;
18    }
19 </script>
20
```

Line 1 shows how we added an `onchange` handler to the input field: `onchange="filesProcess(this.files)"`. Here, `this.files` corresponds to the collection of files that have been selected. The `accept="image/*"` is a filter that makes only selection possible on images.

The event handler function (line 6-18) iterates on the file collection and for each file, displays in a table row its details (using `file.name`, `file.size`, etc. see lines 11-13).

Blob and File, what is that?

The HTML5 File API specification introduces several new Interfaces, like the `FileList` interface (we met it, the files property is a `FileList`), the `File` interface (the `file` variable in the last example is of that type) that is useful for getting details about a file, the `Blob` interface that is for read only binary data that can be accessed slice by slice (as chunks of data, each one is a "Blob"), and a `FileReader` interface for reading file content. We will not use all of them, but let's explain a little the difference between `Blob` and `File`, as most of the methods exposed by the `FireReader` interface take indifferently a `Blob` or a `File` as parameter.

The Blob object

An object of type `Blob` is a structure that represents binary data available as read-only. Most of the time, you will encounter these objects only when you handle files.

`Blob` objects have two properties named `size` and `type` which respectively retrieve the size in bytes of the data handled by

the `Blob` and their MIME type. There is also a method called `slice ()`, but this is a subject too advanced for this course, and is not used in common applications. If you are curious, check the "slicing a file" section of this article: http://www.html5rocks.com/en/tutorials/file/dndfiles/

The File object

`File` objects are useful for manipulating... files! They inherit the properties and methods of Blob objects, and have two additional properties that are `name` for the file name and `lastModifiedDate` to get the date of the last modification of the file (in the form of a JavaScript `Date` object, obviously) .

Most of the time, we will work with `File` objects. Blob objects will have real interest when the Filesystem API is widely available (at the moment there is only an experimental version in Chrome).

Reading a file

The file API proposes several methods for reading a file content, each proposed by the `FileReader` interface. Here is how you create a `FileReader object`:

```
var reader = new FileReader();
```

From http://www.html5rocks.com/en/tutorials/file/dndfiles/:

"Once you create an instance of `FileReader`, you can call one of these asynchronous methods:

> `FileReader.readAsText(Blob|File, opt_encoding)` - The `result` property will contain the file/blob's data as a text string. By default the string is decoded as 'UTF-8'. Use an optional encoding parameter to specify a different encoding.
>
> `FileReader.readAsDataURL(Blob|File)` - The `result` property will contain the file/blob's data encoded as a data URL.
>
> `FileReader.readAsArrayBuffer(Blob|File)` - The `result` property will contain the file/blob's data as an ArrayBuffer object.

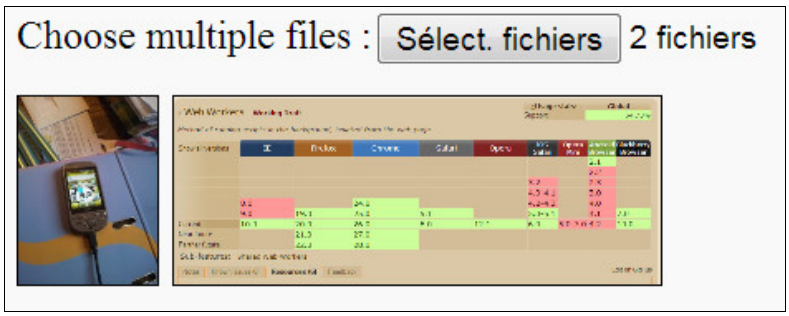
Once one of these read methods is called on your `FileReader` object,
the `onloadstart`, `onprogress`, `onload`, `onabort`, `onerror`, and `onloadend` events can be used to track its progress"

We will see examples that use each of these methods...

Example 3: read file content with readAsDataURL()

This example is just a modified version of example 2, except that this tilme, instead of displaying file details, we display the selected files as image thumbnails...

Online example: http://jsbin.com/erepek/3/edit



Code from this example:

```
<style>
  .thumb {
    height: 75px;
    border: 1px solid #000;
    margin: 10px 5px 0 0;
  }
</style>

Choose multiple files :<input type="file" id="files" multiple /><br/>

<output id="list"></output>

<script>

```

```
15    function readFilesAndDisplayPreview(files) {
16      // Loop through the FileList and render image files as thumbnails.
17      for (var i = 0, f; f = files[i]; i++) {
18
19        // Only process image files.
20        if (!f.type.match('image.*')) {
21          continue;
22        }
23
24        var reader = new FileReader();
25
26        //capture the file information.
27        reader.onload = function(e) {
28            // Render thumbnail.
29            var span = document.createElement('span');
30            span.innerHTML = "<img class='thumb' src='" + e.target.result + "'/>";
31            document.getElementById('list').insertBefore(span, null);
32          };
33
34
35        // Read in the image file as a data URL.
36        reader.readAsDataURL(f);
37      }
38    }
39
40    function handleFileSelect(evt) {
41      var files = evt.target.files; // FileList object
42      readFilesAndDisplayPreview(files);
43    }
44
45    document.getElementById('files').addEventListener('change', handleFileSelect, false);
46
47  </script>
```

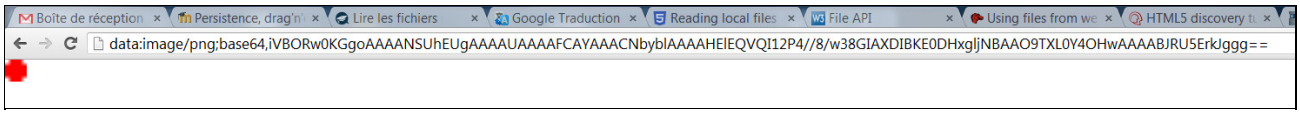
And the interesting part is in the function `readFilesAndDisplayPreview(files)`, located lines 15-38.

> We loop on the collection of selected files, line 17. The loop variable that corresponds to the current file in the collection is named `f`,
> We instanciate a file Reader (line 24),
> We read the content of file `f` (line 36), this can take some time. When the file is completely loaded in memory, as a data URL, the asynchronous method `reader.onload()` is called (located line 27-32).
> The `onload` callback takes a DOM event as a unique parameter, and `e.target.result` is the content of the file that has been read, as a data URL.

A data URL is a URL that includes type and content at the same time. It is useful, for example, for inlining images or video in the HTML of a web page. Here is an example of a red square, as a data URL. Copy and paste it in the address bar of your browser, you should see the red square:

```

```

This data URL in a browser address bar:



If we set the `src` attribute of an image element with the data URL of an image, it will work. Exactly as if you use a url that starts with `http://`

Example with the same picture:

```
<img src="
AAAFCAYAAACNbyblAAAAHElEQVQI12P4//8/w38GIAXDIBKE0DHxgljNBAAO
9TXL0Y4OHwAAAABJRU5ErkJggg==" alt="Red square" />
```

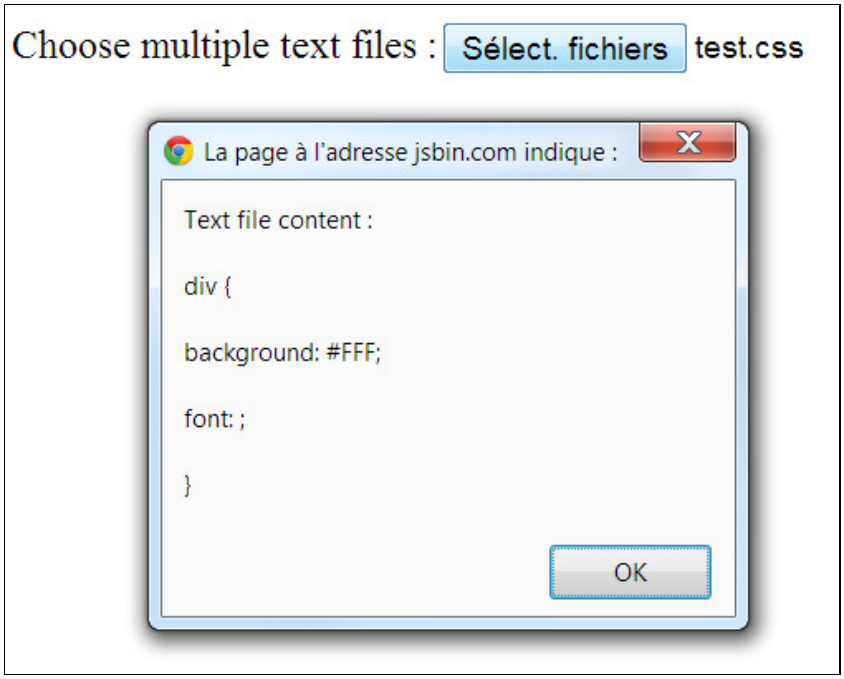
This dataURL format enables storing a file content in a base64 format (as a string), and adds the MIME type specification of the content. The dataURL can therefore store a file as a URL readable with modern browsers. Its use is becoming more common on the Web, especially for mobile applications, as inlining images reduces the number of HTTP requests and makes web page load faster.

So, in our example at line 29 we create an empty `<span>` element, at line 30 we add an `<img>` element in the span, with the `src` attribute that has its value set to `e.target.result` (the dataURL of the image that has been read by the `FileReader`) and at line 31 we add this span+img to the `<output>` element of id "list". Simple and powerful!

Example 4: use readAsText() to read a file content

In this example we show how to read text files content:

Online example: http://jsbin.com/idevur/3/edit



Code of this example:

```
Choose multiple text files :<input type="file" id="files" multiple /><br/>

<output id="list"></output>

<script>
  function readFilesAndDisplayAsText(files) {
    console.log("dans read files");
    // Loop through the FileList and render image files as thumbnails.
    for (var i = 0, f; f = files[i]; i++) {

      var reader = new FileReader();

      //read the file content.
      reader.onload = function(e) {
        alert('Text file content :\n\n' + e.target.result);
      };


      // Read in the tfile as text
      console.log("reading" + f.name);
      reader.readAsText(f);
    }
  }

  function handleFileSelect(evt) {
    var files = evt.target.files; // FileList object
    readFilesAndDisplayAsText(files);
  }

  document.getElementById('files').addEventListener('change', handleFileSelect, false);
</script>
```

Note that you can optionally indicate the encoding of the file you are going to read (default is UTF-8):

```
reader.readAsText(file, 'UTF-8');
reader.readAsText(file, 'ISO-8859-1');
...
```

Example 5: using readAsArrayBuffer() to read binary file content

This time we will look at an example that uses the `readAsArrayBuffer()` method. This method reads and stores data in an object of type `ArrayBuffer`. This method and type were designed to allow the reading and writing of binary data directly in its native form. They are mostly used in demanding fields such as the WebGL API or the WebAudio API.

We will look now at a more complicated example that runs only in Chrome, as it uses the WebAudio API, that is for the moment only implemented by this browser. We talked rapidlly about this API at the end of the Week 3 course (HTML5 multimedia), but did not see any details. Among its features is the option to load a sound sample in memory, and play it without any latency due to streaming. Possible uses are video games and musical applications.

The example displays a web page, asks the user for a sound file, and loads it in the memory before playing it (detailed explanations are availble here, written by the author of the example: http://ericbidelman.tumblr.com/post/13471195250/web-audio-api-how-to-playing-audio-based-on-user). We adapted this code.

Online example: http://jsbin.com/aluyix/3/edit

Example of using the Web Audio API to load a sound file and start playing on user-click.

Choisissez un fichier MeAndYo...red.wav Start Stop

Code from this example:

```
1  <!DOCTYPE html>
2  <!-- Author: Eric Bidelman (ericbidelman@chromium.org) -->
3  <html>
4  <head>
5    <meta charset="utf-8" />
6    <meta http-equiv="X-UA-Compatible" content="chrome=1" />
7    <title>Web Audio API: Simple load + play</title>
8  </head>
9  <body>
10   <p>Example of using the Web Audio API to load a sound file
11   and start playing on user-click.</p>
12   <input type="file" accept="audio/*">
13   <button onclick="playSound()" disabled>Start</button>
14   <button onclick="stopSound()" disabled>Stop</button>
15 <script>
16 var context = new window.webkitAudioContext();
17 var source = null;
18 var audioBuffer = null;
19
20 function stopSound() {
21   if (source) {
22     source.noteOff(0);
23   }
24 }
25
26 function playSound() {
27   // source is global so we can call .noteOff() later.
28   source = context.createBufferSource();
29   source.buffer = audioBuffer;
30   source.loop = false;
31   source.connect(context.destination);
32   source.noteOn(0); // Play immediately.
33 }
34
35 function initSound(arrayBuffer) {
36   context.decodeAudioData(arrayBuffer, function(buffer) {
37     // audioBuffer is global to reuse the decoded audio later.
38     audioBuffer = buffer;
39     var buttons = document.querySelectorAll('button');
40     buttons[0].disabled = false;
41     buttons[1].disabled = false;
42   }, function(e) {
43     console.log('Error decoding file', e);
44   });
45 }
46
47 // User selects file, read it as an ArrayBuffer and pass to the API.
48 var fileInput = document.querySelector('input[type="file"]');
49
50 fileInput.addEventListener('change', function(e) {
51   var reader = new FileReader();
52
53   reader.onload = function(e) {
54     initSound(this.result);
55   };
56   // THIS IS THE INTERESTING PART!
57   reader.readAsArrayBuffer(this.files[0]);
58 }, false);
59
60
61 </script>
62 </body>
63 </html>
64
```

The interesting parts are at line 57 (start the reading of the sound file), and in lines 53-55 where the result is processed. The file content, located in the variable `this.result` in this example, is sent to a function as an `ArrayBuffer` object (indeed,initSound() takes an `ArrayBuffer` object as input). `ArrayBuffer` is not a string, nor a base64 encoded data, it is pure binary, native format.

Reading ArrayBuffer objects using Ajax and XMLHttpRequest level 2

If you are uncomfortable with Ajax programming, you can avoid this part of the course.

HTML5 added some novelties to the XMLHttpRequest for AjaxApplications (see: http://www.w3.org/TR/XMLHttpRequest2/). We won't go too much into detail here, but recent browsers (> 2012) usually support XMLHttpRequest level 2, that adds the option to exchange directly binary data of type `ArrayBuffer`. HTTP is a text based protocol, and when you upload/download images, videos or any binary file, it is text encoded, then decoded on the fly by browsers or JavaScript libs. This improvement on the low level of the XMLHttpRequest enables easier control of binary exchange from the JavaScript code.

Here is a function that loads a sound sample using XMLHttpRequest level 2, and that works with the previous example:

```
// Load file from a URL as an ArrayBuffer.
// Example: loading via xhr2: loadSoundFile('sounds/test.mp3');
function loadSoundFile(url) {
  var xhr = new XMLHttpRequest();
  xhr.open('GET', url, true);
  xhr.responseType = 'arraybuffer'; // THIS IS NEW WITH HTML5!
  xhr.onload = function(e) {
    initSound(this.response); // this.response is an ArrayBuffer.
  };
  xhr.send();
}
```

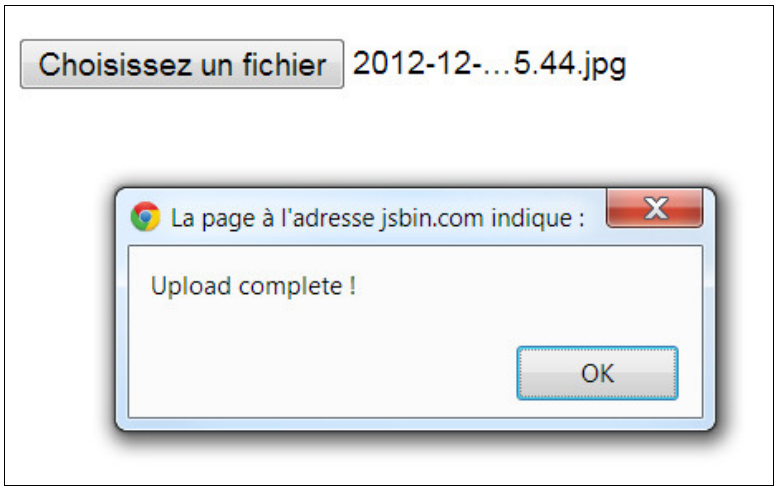
There is a very interesting article about XMLHttpRequest level 2 on html5rocks.com: http://www.html5rocks.com/en/tutorials/file/xhr2/

We will see in the next section how to use a variant of this method for uploading files using Ajax (the above code is for downloading a file).

XMLHttpRequest level 2 and HTML5 file API: upload text/binary files and monitor progress

Here is an example that uses a FormData object for uploading one or more files to an HTTP server. Notice that the URL of the server is fake, so the request normally fails here. However, sending a file to a fake server takes time, and it is interesting to see how it works. For real working code with server side PHP source, see for example http://wabism.com/html5-file-api-how-to-upload-files-dynamically-using-ajax/, or Google for examples in Java, C#/.net etc.

Online example: http://jsbin.com/akomuy/3/edit, try it with a big file (a few megabytes long). The next two exampels have been inspired by this article on a French web site:



Source code of the example:

```

<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8" />
    <title>File upload with XMLHttpRequest and HTML5</title>
  </head>

  <body>
    <input id="file" type="file" />

    <script>
      var fileInput = document.querySelector('#file');
```

```
      fileInput.onchange = function() {

        var xhr = new XMLHttpRequest();
        xhr.open('POST', 'upload.html'); // With FormData, POST is mandatory

        xhr.onload = function() {
            alert('Upload complete!');
        };

        var form = new FormData();
        form.append('file', fileInput.files[0]);
      // send the request
        xhr.send(form);
    };
    </script>
  </body>
</html>

```

This is the same example, but this time we monitor the progress of the upload. We bind an event handler to the progress event an XMLHttpRequest can trigger. The event has two properties: `loaded` and `total` that corresponds to the number of byte that have been uploaded, and the total number of bytes we need to upload.

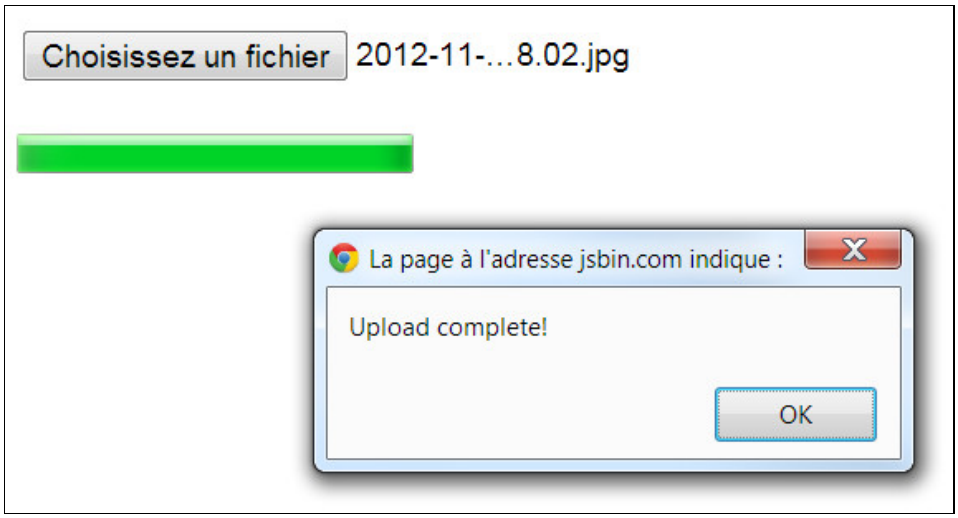
Here is the code of such an event listener:

```
xhr.upload.onprogress = function(e) {
    e.loaded; // number of bytes uploaded
    e.total;  // number total of bytes in the file that is being uploaded
};
```

We will also use a `<progress>` element to display the percentage of the file that is being uploaded:

```
<progress id="progress"></progress>
```

Here is the complete online example: http://jsbin.com/ahasoz/2/edit



Code from this example:

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8" />
    <title>HTML5 file upload with monitoring</title>
  </head>

  <body>
    <input id="file" type="file" />
    <br/><br />
    <progress id="progress"></progress>

    <script>
    var fileInput = document.querySelector('#file'),
        progress = document.querySelector('#progress');

    fileInput.onchange = function() {
        var xhr = new XMLHttpRequest();
        xhr.open('POST', 'upload.html');

        xhr.upload.onprogress = function(e) {
            progress.value = e.loaded;
            progress.max = e.total;
```

```
24          };
25
26          xhr.onload = function() {
27              alert('Upload complete!');
28          };
29
30          var form = new FormData();
31          form.append('file', fileInput.files[0]);
32
33          xhr.send(form);
34      };
35      </script>
36    </body>
37  </html>
```

The interesting part is at lines 22 and 23, in only 2 lines we update the progression bar. The `loaded` and `total` properties have been designed for setting the `value` and `max` attributes of a `<progress>` element!

5 Drag'n'drop API part 1, principles

Introduction

From the W3C specification: *"the drag'n'drop API defines an event-based drag-and-drop mechanism, it does not define exactly what a drag-and-drop operation actually is"*.

We decided to present this API in a book more dedicated to the HTML5 client-side persistence, as it is very often used for dragging and dropping files.

In this chapter, we present the API itself, and we will focus on the particular case of drag'n'dropping files in the next chapter.

External resources

W3C specification about drag'n'drop
Article from opera dev channel, lots of demos included,
Article about drag'n'drop in HTML5 at html5rocks.com
Nice shopping cart demo: http://nettutsplus.s3.amazonaws.com/64_html5dragdrop/demo/index.html

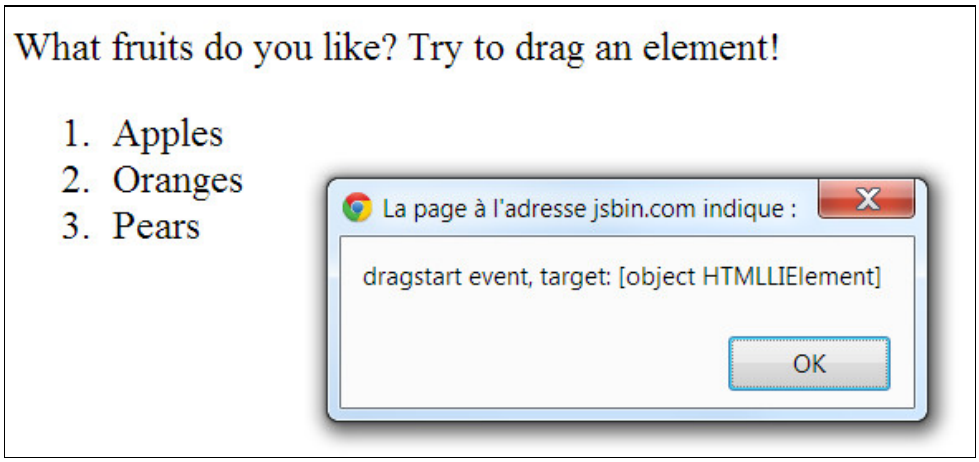
Detect a drag

This is a very simple example that allows some HTML elements to be dragged. In order to make an element draggable, just add an attribute `draggable="true"` to any visible HTML5 element. Notice that some elements are draggable by default, like `<IMG>` elements. In order to detect a drag, add an event listener for the `dragstart` event:

```
<ol ondragstart="dragStartHandler(event)">
    <li draggable="true" data-value="fruit-apple">Apples</li>
    <li draggable="true" data-value="fruit-orange">Oranges</li>
    <li draggable="true" data-value="fruit-pear">Pears</li>
 </ol>
```

In the above code, we made all `<LI>` elements draggable, and we detect the `dragstart` event on the whole list: `<OL` **`ondragstart="dragStarthandler(event)"`**`>`

Here is the complete example: http://jsbin.com/uvuvew/4/edit



Code from this example:

```
<!DOCTYPE html>
<html>
  <head>
    <script>
      function dragStartHandler(event) {
        alert('dragstart event, target: ' + event.target);
      }
    </script>
  </head>
<body>
   <p>What fruits do you like? Try to drag an element!</p>
   <ol ondragstart="dragStartHandler(event)">
     <li draggable="true" data-value="fruit-apple">Apples</li>
     <li draggable="true" data-value="fruit-orange">Oranges</li>
     <li draggable="true" data-value="fruit-pear">Pears</li>
   </ol>
```

```
17  <body>
18  <html>
```

In this code, the event handler just displays an alert with the target element that lauched the event. If you look at what is displayed, you will see that it's a JavaScript object, with a type equal to `HTMLLIElement` ("HTML <LI> element", in plain English).

How to detect a drop and do something with the dragged elements

In this example, that is the continuation of the previous example, we show how to drag an element and detect a drop, getting back some value corresponding to the dragged element, and modifiy the page content.

Steps 1: in the dragstart handler, copy a value in the drag'n'drop clipboard, for later use

In the `dragstart` handler, when a draggable `<LI>` element has been dragged, get the value of its `data-value` attribute (you remember the data* attributes from Week 1, don't you?), and copy it in the "drag'n'drop clipboard, for later use. When a value is copied in this clipboard, a key/name must be given. Data copied in the clipboard is associated with this name. The variable `event.target` at line 5 below is the `<LI>` element that has been dragged, and `event.target.dataset.value` is the value of its `data-value` attribute (in our case Apples, Oranges or Pears):

```
1  function dragStartHandler(event) {
2      console.log('dragstart event, target: ' + event.target);
3
4      // Copy in the drag'n'drop clipboard the value of the data* attribute of the target, with a type "Fruit".
5      event.dataTransfer.setData("Fruit", event.target.dataset.value);
6  }
```

Step 2: define a "drop zone"

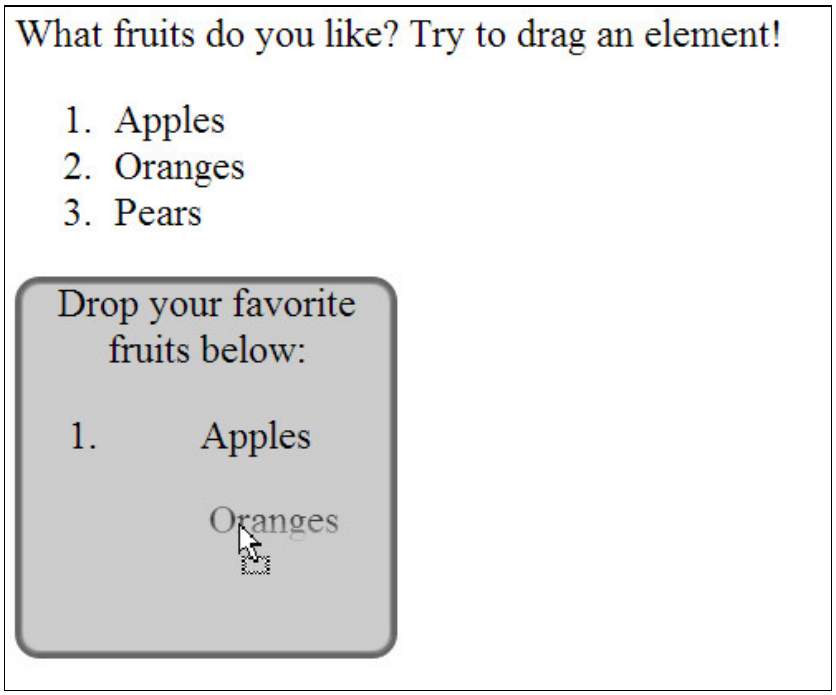
Any visible HTML element may become a "drop zone", just add an event listener for the `drop` event. Notice that most of the time, as events may be propagated, we will also listen to `ondragover` or `dragend` events and stop the propagation. More on this later...

```
1  <div ondragover="return false" ondrop="dropHandler(event);">
2      Drop your favorite fruits below:
3      <ol id="droppedFruits"></ol>
4  </div>
```

Step 3: write a drop handler, get content from the clipboard, do something with it

```
1  function dropHandler(event) {
2      console.log('drop event, target: ' + event.target);
3
4      ...
5
6      // get the data from the drag'n'drop clipboard, with a type="Fruit"
7      var data = event.dataTransfer.getData("Fruit");
8
9      // do something with the data
10     ...
11 }
```

Complete online example: http://jsbin.com/uvuvew/7/edit



Code from this example:

```
1  <!DOCTYPE html>
2  <html>
3    <head>
4      <script>
5        function dragStartHandler(event) {
6          console.log('dragstart event, target: ' + event.target);
7          // Copy in the drag'n'drop clipboard the value of the data* attribute of the target, with a type "Fruit
8          event.dataTransfer.setData("Fruit", event.target.dataset.value);
9        }
10
11       function dropHandler(event) {
12         console.log('drop event, target: ' + event.target);
13         var li = document.createElement('li');
14         // get the data from the drag'n'drop clipboard, with a type="Fruit"
15         var data = event.dataTransfer.getData("Fruit");
16
17         if (data == 'fruit-apple') {
18           li.textContent = 'Apples';
19         } else if (data == 'fruit-orange') {
20           li.textContent = 'Oranges';
21         } else if (data == 'fruit-pear') {
22           li.textContent = 'Pears';
23         } else {
24           li.textContent = 'Unknown Fruit';
25         }
26         // add the dropped data as a child of the list.
27         document.querySelector("#droppedFruits").appendChild(li);
28     }
29     </script>
30   </head>
31 <body>
32     <p>What fruits do you like? Try to drag an element!</p>
33     <ol ondragstart="dragStartHandler(event)">
34       <li draggable="true" data-value="fruit-apple">Apples</li>
35       <li draggable="true" data-value="fruit-orange">Oranges</li>
36       <li draggable="true" data-value="fruit-pear">Pears</li>
37     </ol>
38
39
40   <div ondragover="return false" ondrop="dropHandler(event);">
41     Drop your favorite fruits below:
42     <ol id="droppedFruits"></ol>
43   </div>
    <body>
    <html>
```

In the above code, notice:

Line 40 we define the zone where we can drop (`ondrop=...`) and when a drag enters the zone, we stop the event propagation (`ondragover="return false"`)
When we enter the dragstart listener (line 5), we copy the content of the `data-value` attribute of the object that is

being dragged, in the drag'n'drop clipboard, with a name/key equal to "Fruit" (line 8),
When a drop occurs in the "drop zone" (the `<div>` at line 40), the `dropHandler(event)` function is called, it always occurs after a call to the `dragstart` handler. In other words, when we enter the `drop` handler, there is always something in the clipboard. We do a `event.dataTransfer.setData(...)` in the `dragstart` handler, and a `event.dataTransfer.getData(...)` in the `drop` handler.
The `dropHandler` function is called (line 11), we get the object (line 15) that is in the clipboard, the one with a name/key equal to "Fruit" , we create a `<LI>` element (line 13) and we set its value depending on the value read in the clipboard (lines 17-25),
Finally we add the `<LI>` element to the `<OL>` list that is in the <DIV>

Notice that we use some CSS to make the drop zone nicer (not presented in the source code above, but available in the online example):

```
1
2       div {
3         height: 150px;
4         width: 150px;
5         float: left;
6         border: 2px solid #666666;
7         background-color: #ccc;
8         margin-right: 5px;
9         -webkit-border-radius: 10px;
10        -ms-border-radius: 10px;
11        -moz-border-radius: 10px;
12        border-radius: 10px;
13        -webkit-box-shadow: inset 0 0 3px #000;
14        -ms-box-shadow: inset 0 0 3px #000;
15        box-shadow: inset 0 0 3px #000;
16        text-align: center;
17        cursor: move;
18      }
19
```

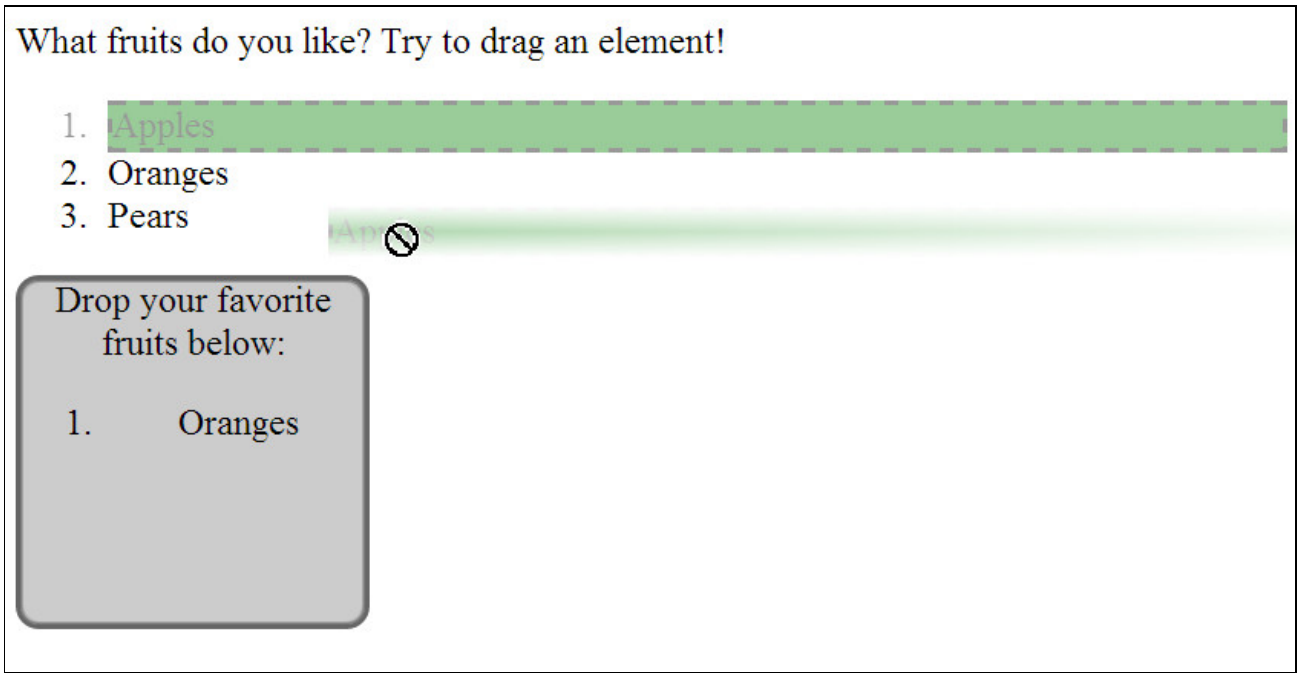
Add visual feedback when you enter a drop zone, when you drag something, etc.

We can associate some CSS styling to the lifecycle of a drag'n'drop. This is easy to do as the drag'n'drop API provides many events we can listen to, and that can be used on the draggable elements as well as the drop zones:

`dragstart`: already seen, this event is usually used on draggable elements. We used it for getting some value from the element dragged + copy it onto the clipboard. It's a nice place to add some visual feedback, for example by adding a CSS class to the draggable object.

`dragend`: this event is launched when the drag has ended (on a drop or if the user released the mouse button while not in a droppable zone). In both cases, one good practice is to reset the style of the draggable object to default.

The next example shows how to add some style (green backgriound + dashed border) when a drag is started, and to reset the style of the dragged object to default when the drag is ended. The full runnable online example is a bit further (it includes visual feedback on the drop zone):



Code from this example:

```
...
<style>
  .dragged {
      border: 2px dashed #000;
      background-color: green;
  }
</style>
<script>
  function dragStartHandler(event) {
    // Change css class for visual feedback
    event.target.style.opacity = '0.4';
    event.target.classList.add('dragged');

    console.log('dragstart event, target: ' + event.target);
    // Copy in the drag'n'drop clipboard the value of the data* attribute of the target, with a type "Fruits".
    event.dataTransfer.setData("Fruit", event.target.dataset.value);
  }

  function dragEndHandler(event) {
    console.log("drag end");
    // Set draggable object to default style
    event.target.style.opacity = '1';
    event.target.classList.remove('dragged');
  }
</script>
...
 <ol ondragstart="dragStartHandler(event)"  ondragend="dragEndHandler(event)" >
     <li draggable="true" data-value="fruit-apple">Apples</li>
     <li draggable="true" data-value="fruit-orange">Oranges</li>
     <li draggable="true" data-value="fruit-pear">Pears</li>
 </ol>
```

`dragenter`: usually we bind this event to the drop zone. The event occurs when a dragged object enters a drop zone. It's a good place for changing the look of the droppable zone.

`dragleave`: this event is also used on the drop zone. When a dragged element leaves the drop zone (maybe the user changed his mind?), we must set the look of the droppable zone back to normal.

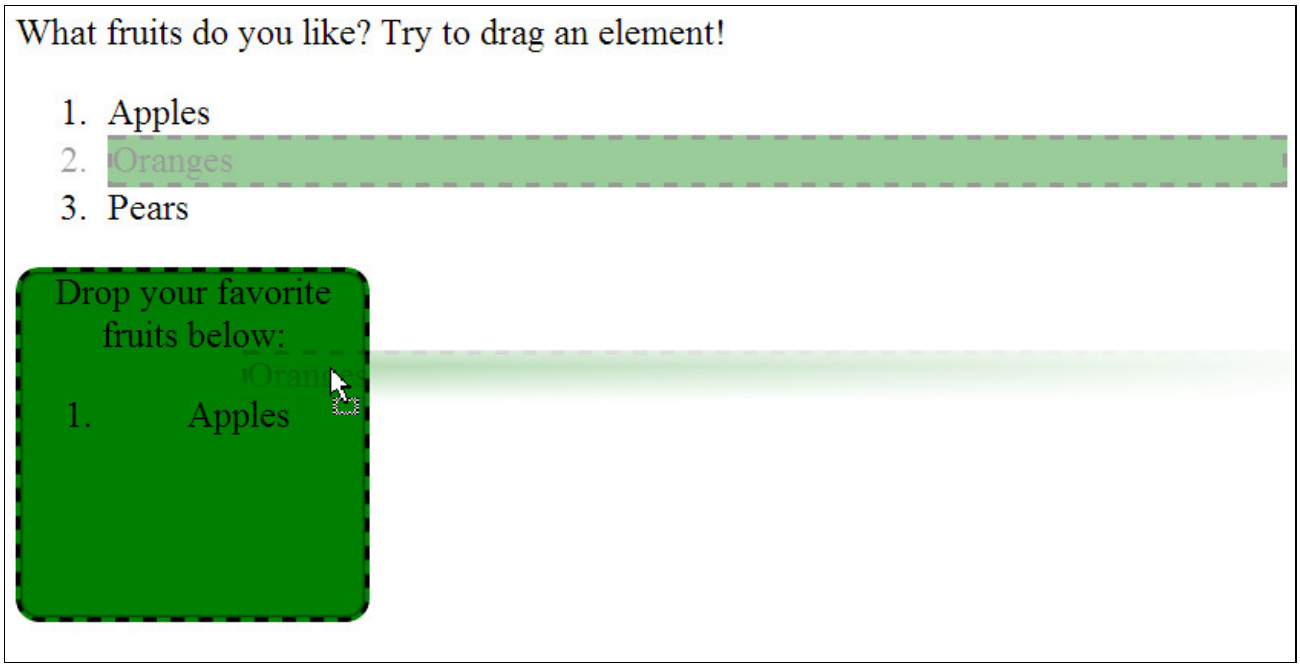
`dragover`: this event is also generally binded to elements that correspond to a drop zone. Good practice is to prevent the propagation of the event, and also to prevent the defaut behavior of the browser (i.e. if we drop an image, the default behaviour is to display its full size in a new page, etc.)

`drop`: also on the drop zone. This is where we really process the drop (get the value from the clipboard, etc). It's also necessary to reset the look of the drop zone to default.

Complete example with visual feedback on draggable objects and on the drop zone

The next example shows how to use these events on the droppable zone. We used a real handler this time for the `dragover` event, in order to prevent the browser default behavior.

Online example with drag and drop visual feedbacks: http://jsbin.com/uvuvew/10/edit



Code from this example:

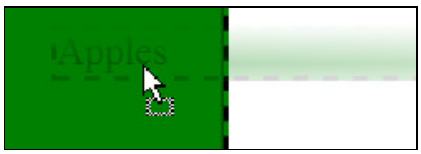
```
<!DOCTYPE html>
<html>
  <head>
    <style>
      div {
        height: 150px;
        width: 150px;
        float: left;
        border: 2px solid #666666;
        background-color: #ccc;
        margin-right: 5px;
        -webkit-border-radius: 10px;
        -ms-border-radius: 10px;
        -moz-border-radius: 10px;
        border-radius: 10px;
        -webkit-box-shadow: inset 0 0 3px #000;
        -ms-box-shadow: inset 0 0 3px #000;
        box-shadow: inset 0 0 3px #000;
        text-align: center;
        cursor: move;
      }

      .dragged {
        border: 2px dashed #000;
        background-color: green;
      }

      .draggedOver {
         border: 2px dashed #000;
         background-color: green;
      }
    </style>
    <script>
      function dragStartHandler(event) {
        // Change css class for visual feedback
        event.target.style.opacity = '0.4';
        event.target.classList.add('dragged');

        console.log('dragstart event, target: ' + event.target);
        // Copy in the drag'n'drop clipboard the value of the data* attribute of the target, with a type "Frui
        event.dataTransfer.setData("Fruit", event.target.dataset.value);
      }

       function dragEndHandler(event) {
         console.log("drag end");
         event.target.style.opacity = '1';
         event.target.classList.remove('dragged');
       }

       function dragLeaveHandler(event) {
```

```
          console.log("drag leave");
          event.target.classList.remove('draggedOver');
        }

        function dragEnterHandler(event) {
          console.log("Drag enter");
          event.target.classList.add('draggedOver');
        }

        function dragOverHandler(event) {
          //console.log("Drag over a droppable zone");
          event.preventDefault(); // Necessary. Allows us to drop.
        }

        function dropHandler(event) {
          console.log('drop event, target: ' + event.target);
          // reset the visual look of the drop zone to default
          event.target.classList.remove('draggedOver');

          var li = document.createElement('li');
          // get the data from the drag'n'drop clipboard, with a type="Fruit"
          var data = event.dataTransfer.getData("Fruit");

          if (data == 'fruit-apple') {
           li.textContent = 'Apples';
          } else if (data == 'fruit-orange') {
           li.textContent = 'Oranges';
          } else if (data == 'fruit-pear') {
           li.textContent = 'Pears';
          } else {
           li.textContent = 'Unknown Fruit';
          }
          // add the dropped data as a child of the list.
          document.querySelector("#droppedFruits").appendChild(li);
      }
     </script>
   </head>
 <body>
    <p>What fruits do you like? Try to drag an element!</p>
    <ol ondragstart="dragStartHandler(event)"  ondragend="dragEndHandler(event)" >
      <li draggable="true" data-value="fruit-apple">Apples</li>
      <li draggable="true" data-value="fruit-orange">Oranges</li>
      <li draggable="true" data-value="fruit-pear">Pears</li>
    </ol>
   <div id="droppableZone" ondragenter="dragEnterHandler(event)" ondrop="dropHandler(event)"
                    ondragover="dragOverHandler(event)" ondragleave="dragLeaveHandler(event)">
     Drop your favorite fruits below:
     <ol id="droppedFruits"></ol>
 </div>
  <body>
  <html>
```

More feedback using the `dropEffect` property: change the cursor shape

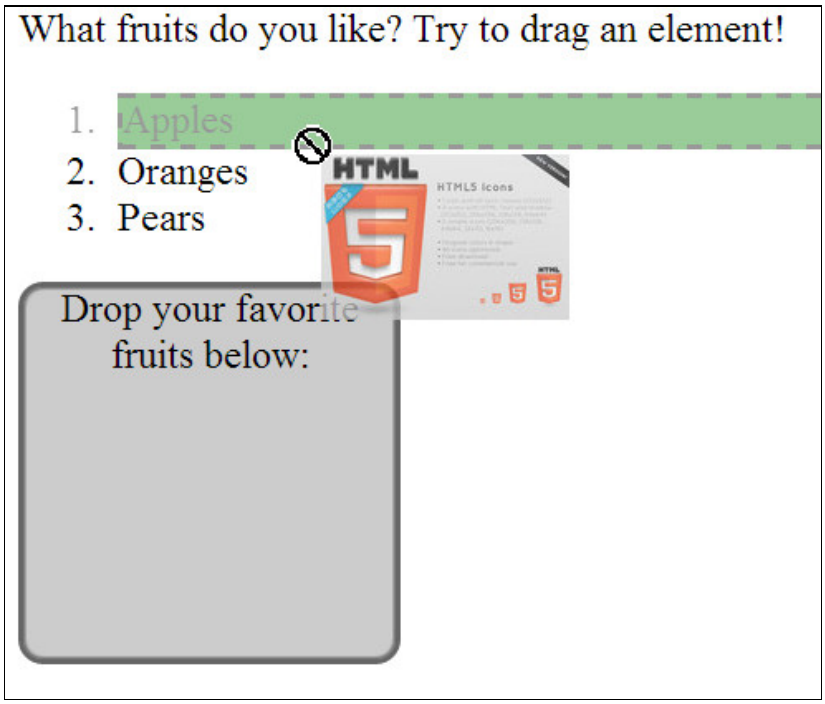
It is possible to change the cursor shape during the drag process. The cursor will turn into a "copy", "move", "link" icon, depending on the semantic of your drag'n'drop, when you enter a drop zone during a drag. For example, if you "copy" a fruit into the drop zone, like in the previous example, you would like to have a "copy" cursor like this:

If you are "moving" objects, it's more a cursor like this that you would like:



And if you are making a "link" or e "shortcut", it is more a cursor like this:

You can also use any image/icon you like:



For giving this visual feedback, we use the `effectAllowed` and `dropEffect` property of the `dataTransfert` object. For setting one of the possible predefined cursors, we allow an effect in the `dragstart` handler, and we set the effect (to "move", "copy", etc.) in the `dragEnter` or `dragOver` handler.

Here is an extract of the code we can add to the example we saw earlier:

```
function dragStartHandler(event) {
   // Allow a "copy" cursor effect
   event.dataTransfer.effectAllowed = 'copy';
   ...
}
```

And here is where we can set the cursor to an allowed value:

```
function dragEnterHandler(event) {
    // change the cursor shape to a "+"
    event.dataTransfer.dropEffect = 'copy';
    ...
}
```

For setting a custom image, we also do this in the `dragstart` handler:

```
function dragStartHandler(event) {
     // allowed cursor effects
     event.dataTransfer.effectAllowed = 'copy';

    // Load and create an image
    var dragIcon = document.createElement('img');
    dragIcon.src = 'anImage.png';
    dragIcon.width = 100;

    // set the cursor to this image, with an offset in X, Y
    event.dataTransfer.setDragImage(dragIcon, -10, -10);

    ...


}
```

Complete online example:

Here is the previous example (with Apples, Oranges, etc) that sets a "copy" cursor and a custom image: http://jsbin.com/uvuvew/12/edit

Here are the various possible values for the cursor effects (not all may be supported by your browser, we noticed that copyMove, etc. had no effects with Chrome, for example. Value of "move", "copy", "link" are widely supported.

All possible values for `dropEffect` and `effectAllowed`:

`dataTransfer.effectAllowed:` can be set to the following

values: `none`, `copy`, `copyLink`, `copyMove`, `link`,`linkMove`, `move`, `all`, and `uninitialized`.

`dataTransfer.dropEffect:` can take on one of the following values: `none`, `copy`, `link`, `move`.

Other examples that drag and drop images, HTML sub trees, text selection, etc

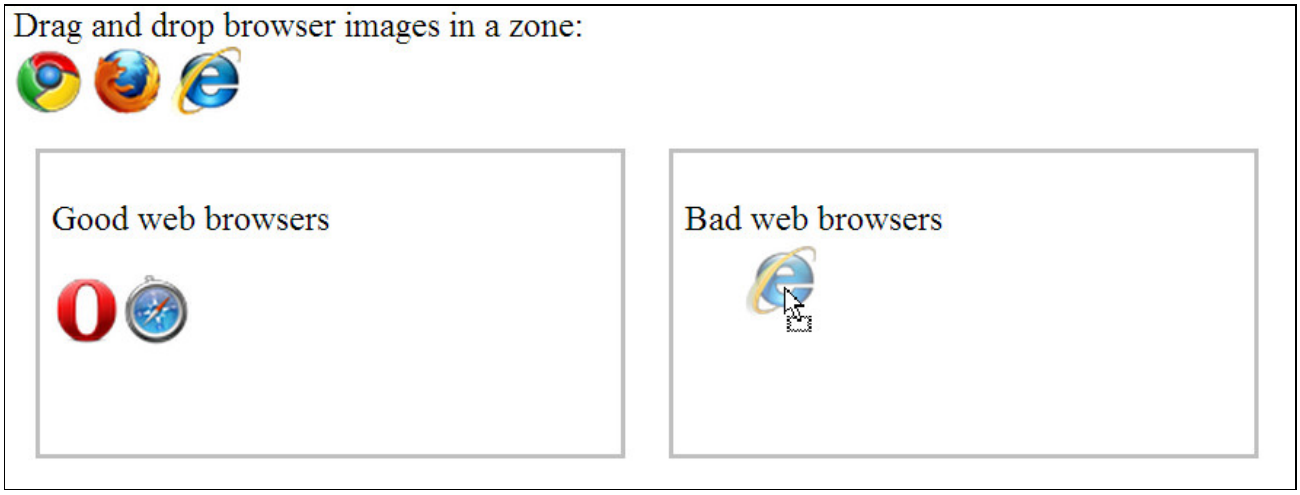
We saw the main principles in the previous sections. There are other interesting uses, that differs on how we copy and paste things to/from the clipboard. The clipboard is accessed through the `dataTransfer` property of the different events.

```
event.dataTransfer.setData("Fruit", event.target.dataset.value);
...
var data = event.dataTransfer.getData("Fruit");
```

Example: drag and drop images or any HTML element

Adapted from: http://html5demo.braincracking.org/demo/dragNDrop.php

Online example: http://jsbin.com/ezobiv/3/edit



Code from the example:

```
<html>
<head>
  <style>
    .box {
      border: silver solid;
      width: 256px;
      height: 128px;
      margin: 10px;
      padding: 5px;
      float: left;
    }
  </style>
  <script>
    function drag(target, evt) {
        evt.dataTransfer.setData("Text", target.id);
    }
    function drop(target, evt) {
        var id = evt.dataTransfer.getData("Text");
        target.appendChild(document.getElementById(id));
      // prevent default behavior
      evt.preventDefault();
    }
  </script>
</head>
<body>
  Drag and drop browser images in a zone:<br/>
  <img src="http://html5demo.braincracking.org/img/logos/chrome1.png"  id="cr" ondragstart="drag(this, event)"
  <img src="http://html5demo.braincracking.org//img/logos/firefox1.png" id="ff" ondragstart="drag(this, event)"
  <img src="http://html5demo.braincracking.org//img/logos/ie1.png"      id="ie" ondragstart="drag(this, event)"
  <img src="http://html5demo.braincracking.org//img/logos/opera1.png"   id="op" ondragstart="drag(this, event)"
  <img src="http://html5demo.braincracking.org//img/logos/safari1.png"  id="sf" ondragstart="drag(this, event)"

  <div class="box" ondragover="return false" ondrop="drop(this, event)">
    <p>Good web browsers</p>
  </div>
  <div class="box" ondragover="return false" ondrop="drop(this, event)">
    <p>Bad web browsers</p>
  </div>
```

```
39 </body>
40 </html>
```

The trick here is only to work on the DOM directly. We used a variant of the event handler proposed by the DOM API. This time, we used handlers with two parameters (the first parameter, `target`, is the element that triggered the event, and the second parameter is the event itself). In the `dragstart` handler we copy just the `id` of the element in the DOM (line 15).

In the `drop` handler, we just move the element from one part of the DOM to another part (under the `<div>` defined at line 36, that is the drop zone). This occurs at line 18 (get back the `id` from the clipboard), and line 19 (make it a child of the div. Consequence: it is no longer a child of the `<body>` and indeed, we "moved" one `<img>` from its previous location to another one in the page).

Drag and drop a text selection

There is no need to add a `dragstart` handler on an element that contains text. Any text that is selected is added automatically to the clipboard with a name/key equals to `"text/plain"`. Just add a `drop` event handler on the drop zone and get the data from the clipboard using `"text/plain"` as the access key:

```
function drop(target, event) {
    event.preventDefault();
    target.innerHTML = event.dataTransfer.getData('text/plain');
};
```

Complete online example: http://jsbin.com/ezobiv/6/edit

Drag and drop a text selection from this paragraph. Drag and drop any part of this text in the drop zone. Notice in the code: there is no need for a dragstart handler in case of text selection: the text is added to the clipboard when dragged with a key/name equals to "text/plain". Just write a drop handler that will do a event.dataTransfert.getData("text/plain") and you are done!

This paragraphe is not selectable however. Look at the CSS in the source code.

Drop some text selection here.

Code from the example:

```
1  <html>
2  <head>
3    <style>
4      .box {
5        border: silver solid;
6        width: 256px;
7        height: 128px;
8        margin: 10px;
9        padding: 5px;
10       float: left;
11     }
12
13     .notDraggable {
14       -moz-user-select: none;
15       -khtml-user-select: none;
16       -webkit-user-select: none;
17       user-select: none;
18     }
19   </style>
20   <script>
21     function drop(target, event) {
22       event.preventDefault();
23       target.innerHTML = event.dataTransfer.getData('text/plain');
24     };
25   </script>
26 </head>
27 <body>
28   <p id="text"><b>Drag and drop a text selection from this paragraph</b>. Drag and drop any part of this text i
29    the drop zone. Notice in the code: there is no need for a dragstart handler in case of text selection:
30    the text is added to the clipboard when dragged with a key/name equals to "text/plain". Just write a
31    drop handler that will do a event.dataTransfert.getData("text/plain") and you are done!</p>
32
33   <p class="notDraggable">This paragraphe is not selectable however. Look at the CSS in the source code.</p>
34
35   <div class="box" ondragover="return false" ondrop="drop(this, event)">
36     <p>Drop some text selection here.</p>
```

```
    </div>
  </body>
  </html>
```

Here we used a CSS trick to make the second paragraph non-selectable, by setting the `user-selected` property to none.

In the next chapter we will see how we can drag'n'drop files!

6 Drag'n'drop API part 2: files!

Introduction

Here we will look at how we can drag'n'drop files between the browser and the desktop.

External resources

Article from HTML5 rocks about drag'n'drop, cover files
Article from theCSSninjas.com about dragging files from browser to desktop

Drag and drop files from the desktop to the browser

The principle is the same as in the examples from the last chapter, except that we do not need to worry about a `dragstart` handler. Files will be dragged from the desktop, so the browser will do the job of copying their content to the clipboard and make it available in our JavaScript code.

Indeed, the main work will be done in the drop handler, where we will use the `files` property from the dataTransfer/clipboard objects. This is where the browser will copy the files that have been dragged from the desktop. In the `files` property of the dataTransfer object (aka the clipboard).

This `files` object is the same one we saw in the chapter about the File API: it is a collection, each member being a `file` object. From each `file` object we will be able to get the name of the file, its type, size, last modification date, read it, etc. like in the examples from the File API chapter.

Example of a drop handler that works on files that have been dragged and dropped:

```
1  function dropHandler(event) {
2      // Do not propagate the event
3      event.stopPropagation();
4      // Prevent default behavior, in particular when we drop images or links
5      event.preventDefault();
6
7      // get the files from the clipboard
8      var files = event.dataTransfer.files;
9
10     var filenames = "";
11
12     // do something with the files...here we iterate on them and log the filenames
13     for(var i = 0 ; i < filesLen ; i++) {
14        filenames += '\n' + files[i].name;
15     }
16
17     console.log(files.length + ' file(s) have been dropped:\n' + filenames);
18 }
```

At lines 7-8, we get the files that have been dropped. Lines 12-15 iterate on the collection and build a string that contains the list of file names. Line 17 displays this string on the debugging console.

When dragging and dropping images or links, we need to prevent the browser's default behavior

The previous piece of code shows at the beginning of the `drop` handler two lines of code that stop the propagation of the `drop` event, and prevent the default behavior of the browser. Try to drop on a web page an image or an HTTP link: the browser will display the image or the web page pointed by the link into a new tab/window. This is not what we would like in an application that controls the drag'n'drop process. These two lines are necessary to prevent the default behavior of the browser:

```
// Do not propagate the event
event.stopPropagation();
// Prevent default behavior, in particular when we drop images or links
event.preventDefault();
```

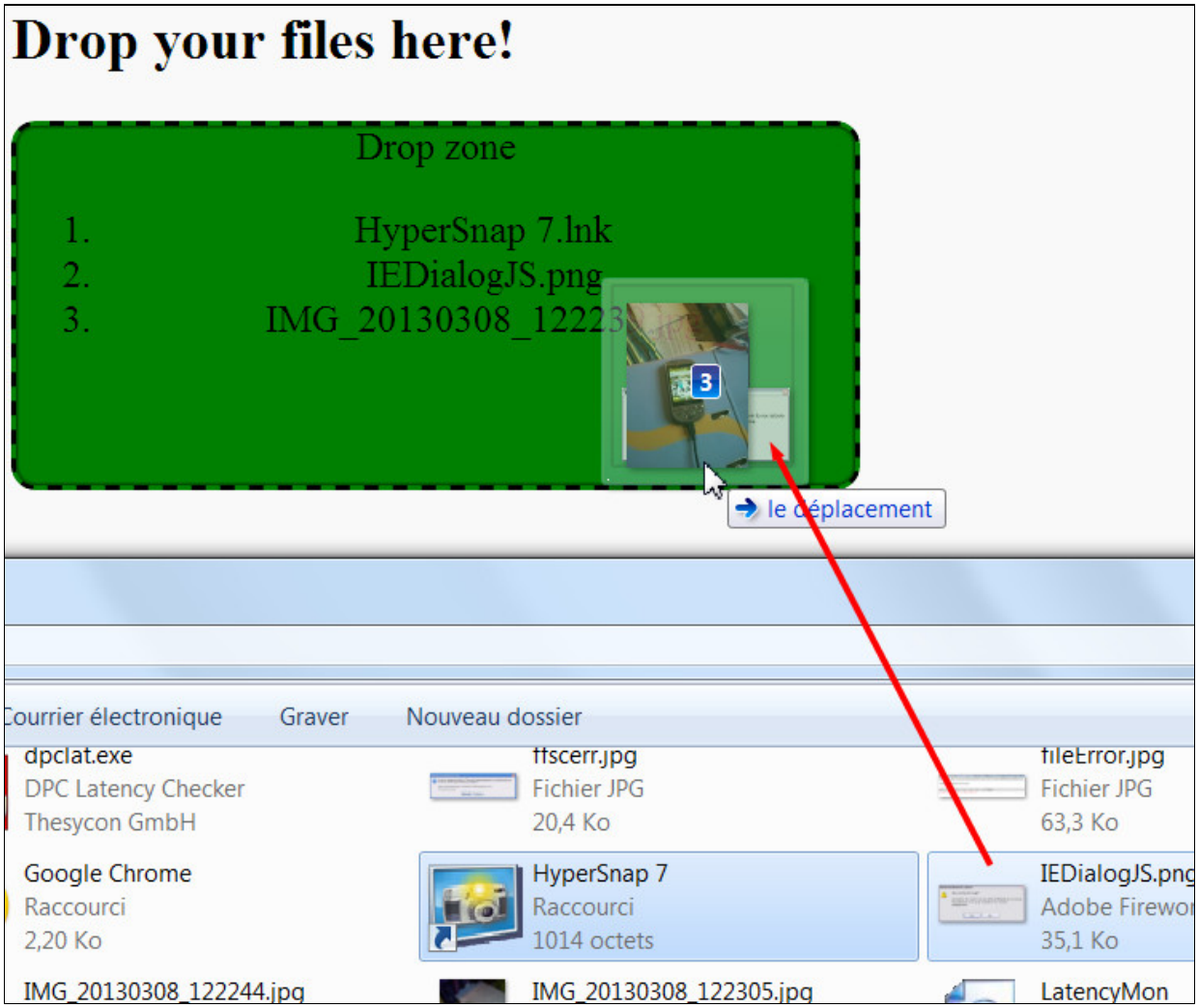
Good practice: add these lines to the `drop` handler and to the `dragOver` handler attached to the drop zone:

```
function dragOverHandler(event) {
   // Do not propagate the event
   event.stopPropagation();

   // Prevent default behavior, in particular when we drop images or links
   event.preventDefault();
   ...
}

function dropHandler(event) {
```

```
    // Do not propagate the event
    event.stopPropagation();

    // Prevent default behavior, in particular when we drop images or links
    event.preventDefault();
    ...
}
```

First example: drag and drop files to a drop zone, display file details in a list

Online example: http://jsbin.com/itiriv/2/edit



Code from the example:

```
<!DOCTYPE html>
<html>
  <head>
    <style>
      div {
        height: 150px;
        width: 350px;
        float: left;
        border: 2px solid #666666;
        background-color: #ccc;
        margin-right: 5px;
        -webkit-border-radius: 10px;
        -ms-border-radius: 10px;
        -moz-border-radius: 10px;
        border-radius: 10px;
        -webkit-box-shadow: inset 0 0 3px #000;
        -ms-box-shadow: inset 0 0 3px #000;
        box-shadow: inset 0 0 3px #000;
        text-align: center;
        cursor: move;
      }

      .dragged {
        border: 2px dashed #000;
        background-color: green;
      }

```

```
28        .draggedOver {
29           border: 2px dashed #000;
30           background-color: green;
31        }
32      </style>
33      <script>
34        function dragLeaveHandler(event) {
35           console.log("drag leave");
36          // Set style of drop zone to default
37           event.target.classList.remove('draggedOver');
38        }
39
40        function dragEnterHandler(event) {
41          console.log("Drag enter");
42          // Show some visual feedback
43          event.target.classList.add('draggedOver');
44        }
45
46         function dragOverHandler(event) {
47           //console.log("Drag over a droppable zone");
48           // Do not propagate the event
49           event.stopPropagation();
50           // Prevent default behavior, in particular when we drop images or links
51            event.preventDefault();
52        }
53
54        function dropHandler(event) {
55            console.log('drop event');
56
57           // Do not propagate the event
58           event.stopPropagation();
59           // Prevent default behavior, in particular when we drop images or links
60            event.preventDefault();
61
62           // reset the visual look of the drop zone to default
63           event.target.classList.remove('draggedOver');
64
65           // get the files from the clipboard
66           var files = event.dataTransfer.files;
67           var filesLen = files.length;
68           var filenames = "";
69
70           // iterate on the files, get details using the file API
71           // Display file names in a list.
72           for(var i = 0 ; i < filesLen ; i++) {
73             filenames += '\n' + files[i].name;
74             // Create a li, set its value to a file name, add it to the ol
75             var li =     document.createElement('li');
76             li.textContent = files[i].name;
77             document.querySelector("#droppedFiles").appendChild(li);
78           }
79
80           console.log(files.length + ' file(s) have been dropped:\n' + filenames);
81        }
82      </script>
83    </head>
84  <body>
85    <h2>Drop your files here!</h2>
86    <div id="droppableZone" ondragenter="dragEnterHandler(event)" ondrop="dropHandler(event)" ondragover="dragOve
87      Drop zone
88      <ol id="droppedFiles"></ol>
89    </div>
90  <body>
91  <html>
```

Note that:

> We prevented the browser default behavior in the drop and dragOver handlers,
> Lines 75-77 create a `<LI>` element, its value is initalized with the file name of the current file in the collection, and added to the `<OL>` list.

This example in its principle is very similar to the ones we saw in the previous chapter, with Apples, Oranges, etc. Except that this time we work with files. And when we work with files, it is important to prevent the browser's default behavior.

Drag'n'drop images with thumbnail previews

This time we will reuse the `readFIlesAndDisplayPreview()` method we saw in example 3 of the File API chapter, available online at: http://jsbin.com/erepek/3/edit. You can take a look again at this section of the course, as detailed explanations about how we read and display the file content as images are given.

Code from this method:

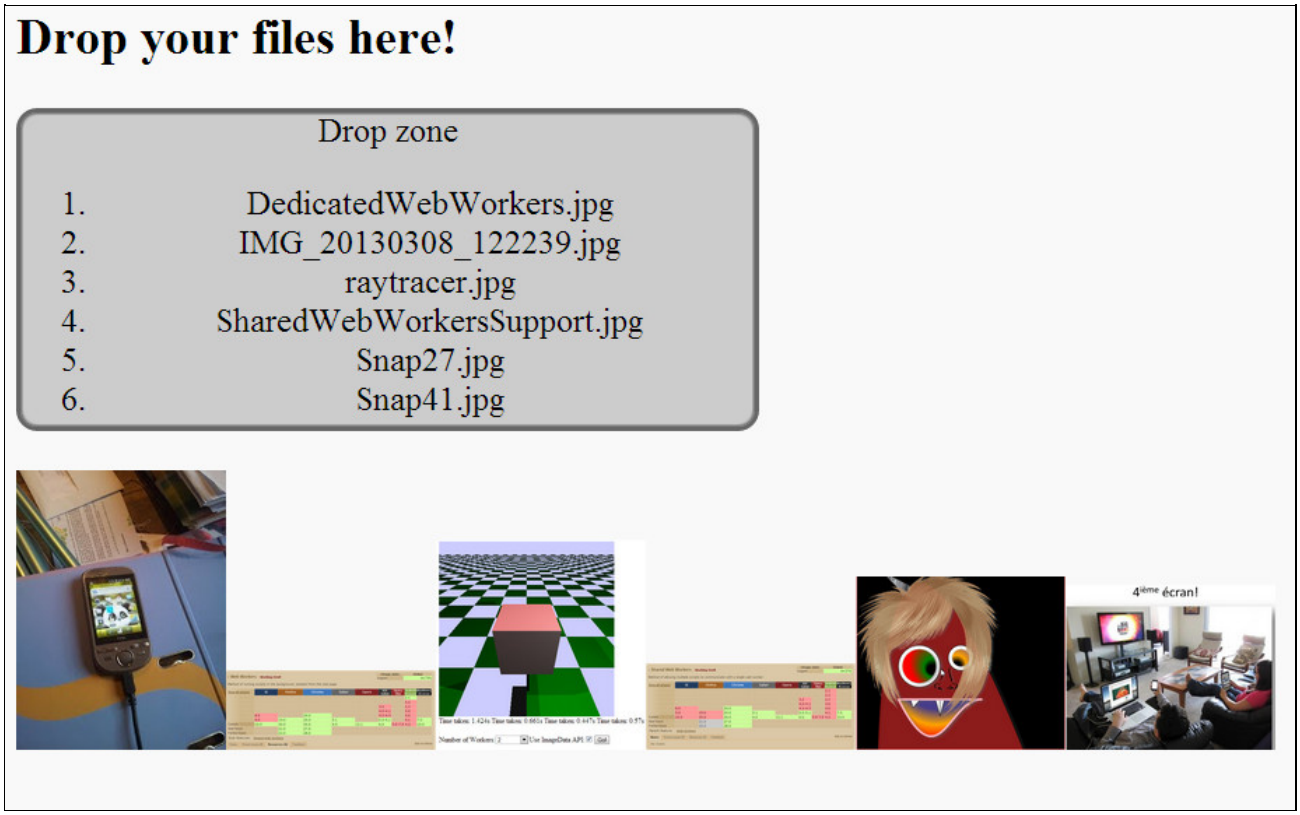
```
1  function readFilesAndDisplayPreview(files) {
2      // Loop through the FileList and render image files as thumbnails.
```

```
3       for (var i = 0, f; f = files[i]; i++) {
4
5         // Only process image files.
6         if (!f.type.match('image.*')) {
7           continue;
8         }
9
10        var reader = new FileReader();
11
12        //capture the file information.
13        reader.onload = function(e) {
14            // Render thumbnail.
15            var span = document.createElement('span');
16            span.innerHTML = "<img class='thumb' src='" + e.target.result + "'/>";
17            document.getElementById('list').insertBefore(span, null);
18          };
19
20        // Read in the image file as a data URL.
21        reader.readAsDataURL(f);
22      }
23    }
```

At line 17, we insert the `<IMG>` element that has been created and initalized with the `dataURL` of the image file, to a list of `id` "list". So, let's add this method to our previous example, and add to the HTML of the page an `<output id="list"></output>`.

Complete example of drag'n'drop + thumbnails of images

Online example: http://jsbin.com/iwuleq/9/edit



Code from the example:

```
1  <!DOCTYPE html>
2  <html>
3    <head>
4      <style>
5        div {
6          height: 150px;
7          width: 350px;
8          border: 2px solid #666666;
9          background-color: #ccc;
10         margin-right: 5px;
11         -webkit-border-radius: 10px;
12         -ms-border-radius: 10px;
13         -moz-border-radius: 10px;
14         border-radius: 10px;
15         -webkit-box-shadow: inset 0 0 3px #000;
16         -ms-box-shadow: inset 0 0 3px #000;
17         box-shadow: inset 0 0 3px #000;
18         text-align: center;
```

```
19          cursor: move;
20        }
21
22        .dragged {
23          border: 2px dashed #000;
24          background-color: green;
25        }
26
27        .draggedOver {
28           border: 2px dashed #000;
29           background-color: green;
30        }
31
32      </style>
33      <script>
34        function dragLeaveHandler(event) {
35           console.log("drag leave");
36          // Set style of drop zone to default
37           event.target.classList.remove('draggedOver');
38        }
39
40        function dragEnterHandler(event) {
41          console.log("Drag enter");
42          // Show some visual feedback
43          event.target.classList.add('draggedOver');
44        }
45
46         function dragOverHandler(event) {
47           //console.log("Drag over a droppable zone");
48           // Do not propagate the event
49           event.stopPropagation();
50           // Prevent default behavior, in particular when we drop images or links
51            event.preventDefault();
52        }
53
54        function dropHandler(event) {
55            console.log('drop event');
56
57            // Do not propagate the event
58            event.stopPropagation();
59            // Prevent default behavior, in particular when we drop images or links
60            event.preventDefault();
61
62            // reset the visual look of the drop zone to default
63            event.target.classList.remove('draggedOver');
64
65
66            // get the files from the clipboard
67            var files = event.dataTransfer.files;
68            var filesLen = files.length;
69            var filenames = "";
70
71            // iterate on the files, get details using the file API
72            // Display file names in a list.
73            for(var i = 0 ; i < filesLen ; i++) {
74              filenames += '\n' + files[i].name;
75              // Create a li, set its value to a file name, add it to the ol
76              var li = document.createElement('li');
77              li.textContent = files[i].name;
78              document.querySelector("#droppedFiles").appendChild(li);
79            }
80            console.log(files.length + ' file(s) have been dropped:\n' + filenames);
81
82            readFilesAndDisplayPreview(files);
83      }
84
85      function readFilesAndDisplayPreview(files) {
86        // Loop through the FileList and render image files as thumbnails.
87        for (var i = 0, f; f = files[i]; i++) {
88
89        // Only process image files.
90        if (!f.type.match('image.*')) {
91          continue;
92        }
93
94        var reader = new FileReader();
95
96        //capture the file information.
97        reader.onload = function(e) {
98            // Render thumbnail.
99            var span = document.createElement('span');
100           span.innerHTML = "<img class='thumb' width='100' src='" + e.target.result + "'/>";
101           document.getElementById('list').insertBefore(span, null);
102       };
103
104       // Read in the image file as a data URL.
105       reader.readAsDataURL(f);
106     }
107   }
108 </script>
```

```
109 </head>
110 <body>
111   <h2>Drop your files here!</h2>
112   <div id="droppableZone" ondragenter="dragEnterHandler(event)" ondrop="dropHandler(event)" ondragover="dragOv
113     Drop zone
114     <ol id="droppedFiles"></ol>
115   </div>
116   <br/>
117   <output id="list"></output>
118  <body>
119  <html>
120
121
```

We just added the `readFilesAndDisplayPreview()` method we saw in example 3 of the File API chapter. We called it at the end of the drop handler (line 82), and we just added the `<output>` element that will contain the `<img>` elements corresponding to the thumbnails (line 117).

Let's go further and also add an `<input type="file">`

If you look (again) at example 3 from the File API chapter, you will notice that the event handler we used to track the files selected using `<input type="file"/>` looks like this:

```
1  <script>
2    function handleFileSelect(evt) {
3      var files = evt.target.files; // FileList object
4      // do something with files... why not call readFilesAndDisplayPreview!
5      readFilesAndDisplayPreview(files);
6    }
7
8    document.getElementById('files').addEventListener('change', handleFileSelect, false);
9  </script>
10 ...
11 <body>
12     Choose multiple files :<input type="file" id="files" multiple /><br/>
13 </body>
```

It calls `readFilesAndDisplayPreview()` too! We can then add to our drag'n'drop example an `<input type="file">` element, and this handler. Like that, we will be able to indifferently select files with drag'n'drop, or by using a file selector.

Just for fun, we also added an experimental "directory choser" that is implemented by Chrome (notice, `<input type="file" webkitdirectory=""/>` is not in the HTML5 specification, we added it here just for fun. The drag'n'drop and file choser will work with any modern browser, only this feature will work only with Chrome).

Online example: http://jsbin.com/iwuleq/11/edit

In this screenshot, we selected some files using the first button, that is an `<input type="file" multiple.../>`, then we used the second button , that is a `<input type="file" webkitdirectory="".../>` selected a directory that contained 11 files, then we dragged and dropped some other images to the drop zone. Every time, thumbnails were displayed.

Use one of these input fields for selecting files

Beware, the directory choser works only in Chrome and may overload your browser memory if there are too many big images in the directory you choose.

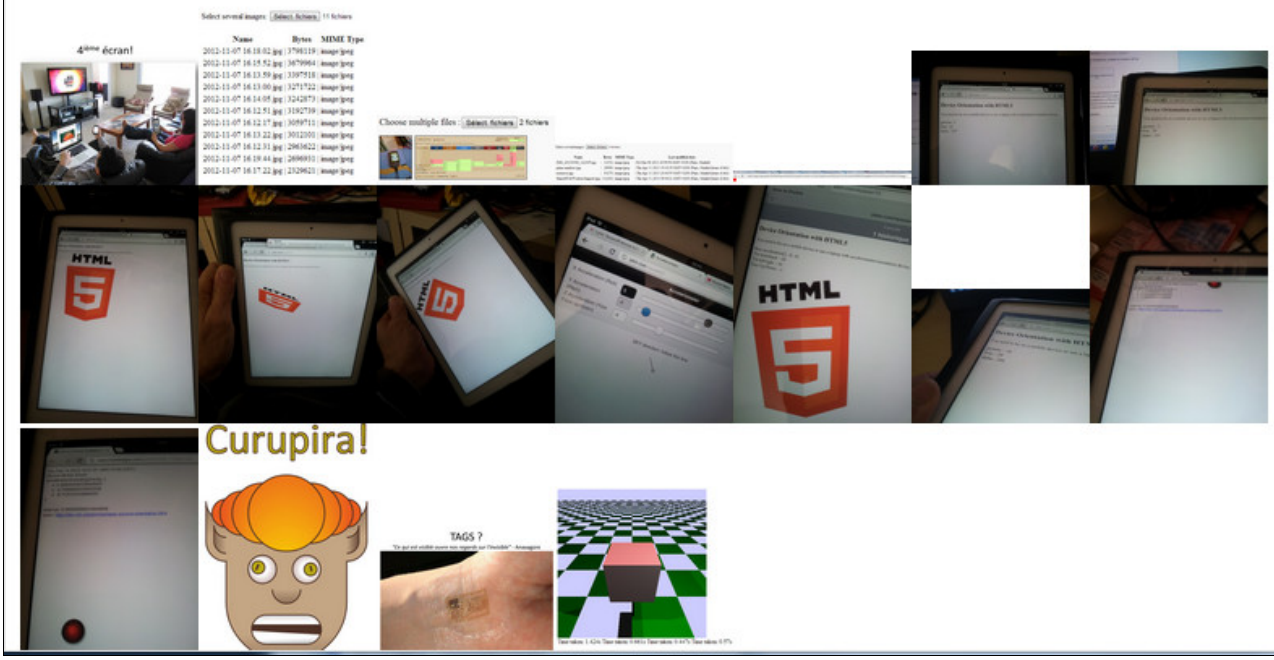
Choose multiple files : Sélect. fichiers 4 fichiers

Choose a directory (Chrome only): Choisissez un fichier 11 fichiers

Drop your files here!

Drop zone

1. Snap28.jpg
2. Snap40.jpg
3. raytracer.jpg



Code from this example:

```
<!DOCTYPE html>
<html>
  <head>
    <style>
      div {
        height: 150px;
        width: 350px;
        border: 2px solid #666666;
        background-color: #ccc;
        margin-right: 5px;
        -webkit-border-radius: 10px;
        -ms-border-radius: 10px;
        -moz-border-radius: 10px;
        border-radius: 10px;
        -webkit-box-shadow: inset 0 0 3px #000;
        -ms-box-shadow: inset 0 0 3px #000;
        box-shadow: inset 0 0 3px #000;
        text-align: center;
        cursor: move;
      }

      .dragged {
        border: 2px dashed #000;
        background-color: green;
      }

      .draggedOver {
```

```
28          border: 2px dashed #000;
29          background-color: green;
30        }
31
32      </style>
33      <script>
34        function dragLeaveHandler(event) {
35           console.log("drag leave");
36         // Set style of drop zone to default
37          event.target.classList.remove('draggedOver');
38        }
39
40        function dragEnterHandler(event) {
41          console.log("Drag enter");
42          // Show some visual feedback
43          event.target.classList.add('draggedOver');
44        }
45
46         function dragOverHandler(event) {
47           //console.log("Drag over a droppable zone");
48           // Do not propagate the event
49           event.stopPropagation();
50           // Prevent default behavior, in particular when we drop images or links
51            event.preventDefault();
52        }
53
54        function dropHandler(event) {
55            console.log('drop event');
56
57           // Do not propagate the event
58           event.stopPropagation();
59           // Prevent default behavior, in particular when we drop images or links
60            event.preventDefault();
61
62
63         // reset the visual look of the drop zone to default
64         event.target.classList.remove('draggedOver');
65
66
67         // get the files from the clipboard
68         var files = event.dataTransfer.files;
69         var filesLen = files.length;
70         var filenames = "";
71
72         // iterate on the files, get details using the file API
73         // Display file names in a list.
74      for(var i = 0 ; i < filesLen ; i++) {
75         filenames += '\n' + files[i].name;
76         // Create a li, set its value to a file name, add it to the ol
77         var li =     document.createElement('li');
78         li.textContent = files[i].name;    document.querySelector("#droppedFiles").appendChild(li);
79      }
80       console.log(files.length + ' file(s) have been dropped:\n' + filenames);
81
82         readFilesAndDisplayPreview(files);
83      }
84
85        function readFilesAndDisplayPreview(files) {
86      // Loop through the FileList and render image files as thumbnails.
87      for (var i = 0, f; f = files[i]; i++) {
88
89        // Only process image files.
90        if (!f.type.match('image.*')) {
91          continue;
92        }
93
94        var reader = new FileReader();
95
96        //capture the file information.
97        reader.onload = function(e) {
98            // Render thumbnail.
99            var span = document.createElement('span');
100           span.innerHTML = "<img class='thumb' width='100' src='" + e.target.result + "'/>";
101           document.getElementById('list').insertBefore(span, null);
102         };
103
104
105       // Read in the image file as a data URL.
106       reader.readAsDataURL(f);
107     }
108   }
109
110   function handleFileSelect(evt) {
111     var files = evt.target.files; // FileList object
112     // do something with files... why not call readFilesAndDisplayPreview!
113     readFilesAndDisplayPreview(files);
114   }
115     </script>
116   </head>
117 <body>
```

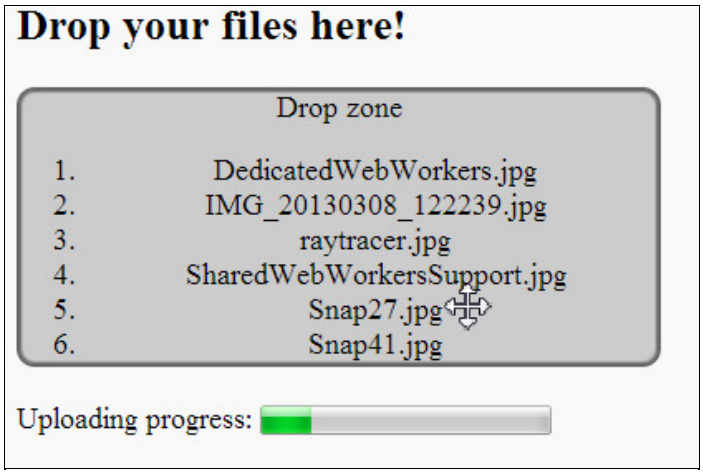
```
  <h2>Use one of these input fields for selecting files</h2>
  Beware, the directory choser works only in Chrome and may overload your browser memory if there are too many
  big images in the directory you choose.

  <p>Choose multiple files :<input type="file" id="files" multiple  onchange="handleFileSelect(event)"/></p>
  <p>Choose a directory (Chrome only): <input  type="file" id="dir" webkitdirectory=""
         onchange="handleFileSelect(event)"/></p>

  <h2>Drop your files here!</h2>
  <div id="droppableZone" ondragenter="dragEnterHandler(event)" ondrop="dropHandler(event)"
          ondragover="dragOverHandler(event)" ondragleave="dragLeaveHandler(event)">
    Drop zone
    <ol id="droppedFiles"></ol>
</div>
  <br/>
  <output id="list"></output>
 <body>
 <html>
```

The added parts have been highlighted. As you can see, all the methods share the same code for previewing the images.

Uploading files using XMLHttpRequest level 2

This time we will mix the last example of the File API chapter, with one of the examples from this page that used drag'n'drop. We just copied and pasted some code in a method called `uploadAllFilesUsingAjax()` and added a `<progress>` element.

Online example: http://jsbin.com/amebem/3/edit



Code from this example:

```
<!DOCTYPE html>
<html>
  <head>
    <style>
      div {
        height: 150px;
        width: 350px;
        border: 2px solid #666666;
        background-color: #ccc;
        margin-right: 5px;
        -webkit-border-radius: 10px;
        -ms-border-radius: 10px;
        -moz-border-radius: 10px;
        border-radius: 10px;
        -webkit-box-shadow: inset 0 0 3px #000;
        -ms-box-shadow: inset 0 0 3px #000;
        box-shadow: inset 0 0 3px #000;
        text-align: center;
        cursor: move;
      }

      .dragged {
        border: 2px dashed #000;
        background-color: green;
      }

      .draggedOver {
         border: 2px dashed #000;
         background-color: green;
      }

    </style>
    <script>
```

```
      function dragLeaveHandler(event) {
         console.log("drag leave");
        // Set style of drop zone to default
         event.target.classList.remove('draggedOver');
      }

      function dragEnterHandler(event) {
        console.log("Drag enter");
        // Show some visual feedback
        event.target.classList.add('draggedOver');
      }

      function dragOverHandler(event) {
         //console.log("Drag over a droppable zone");
         // Do not propagate the event
         event.stopPropagation();
         // Prevent default behavior, in particular when we drop images or links
         event.preventDefault();
      }

      function dropHandler(event) {
        console.log('drop event');

        // Do not propagate the event
        event.stopPropagation();
        // Prevent default behavior, in particular when we drop images or links
        event.preventDefault();

        // reset the visual look of the drop zone to default
        event.target.classList.remove('draggedOver');


        // get the files from the clipboard
        var files = event.dataTransfer.files;
        var filesLen = files.length;
        var filenames = "";

        // iterate on the files, get details using the file API
        // Display file names in a list.
        for(var i = 0 ; i < filesLen ; i++) {
           filenames += '\n' + files[i].name;
           // Create a li, set its value to a file name, add it to the ol
           var li = document.createElement('li');
           li.textContent = files[i].name;
           document.querySelector("#droppedFiles").appendChild(li);
        }
        console.log(files.length + ' file(s) have been dropped:\n' + filenames);

        uploadAllFilesUsingAjax(files);
      }

      function uploadAllFilesUsingAjax(files) {
         var xhr = new XMLHttpRequest();
         xhr.open('POST', 'upload.html');

        xhr.upload.onprogress = function(e) {
            progress.value = e.loaded;
            progress.max = e.total;
        };

        xhr.onload = function() {
            alert('Upload complete!');
        };

        var form = new FormData();
        for(var i = 0 ; i < files.length ; i++) {
           form.append('file', files[i]);
        }

        // Send the Ajax request
        xhr.send(form);
      }
    </script>
  </head>
<body>
  <h2>Drop your files here!</h2>
  <div id="droppableZone" ondragenter="dragEnterHandler(event)" ondrop="dropHandler(event)"
        ondragover="dragOverHandler(event)" ondragleave="dragLeaveHandler(event)">
    Drop zone
    <ol id="droppedFiles"></ol>
  </div>
  <br/>
  Uploading progress: <progress id="progress"></progress>
 <body>
 <html>
```

We highlighted the interesting parts. In this example we build an object of type `FormData` (this comes from the standard

JavaScript DOM API level 2), we fill this object with the file contents (line 100), then we send the Ajax request and monitor the upload progress.

It could be interesting to upload one file at a time with a visual feedback like this; "uploading file MichaelJackson.jpg....." etc. instead of uploading all files at once. We leave this to you, as an exercise.

Dragging files "out" from the browser to the desktop

Dragging out files from the browser to the desktop is supported by most desktop browsers, except Internet Explorer (even version 10). Notice that you can drag and drop not only from browser to desktop, but also from browser to browser.

There is nothing about dragging files out of the browser in the W3C specification about drag'n'drop. **The W3C specification defines a drag'n'drop model based on events, but does not define the way the data that is drag'n'dropped will be handled.**

Browser vendors defined a *de facto* standard for dragging files out of the browser.

To be more specific, they defined:

> A standard way to copy a file to the clipboard during a drag, if we want this file to be draggable out of the browser.
> They implemented the download code for copying the content of the clipboard in the case of a drop on the desktop.

For step 1, the file copied to the clipboard must have a key/name equal to `DownloadURL`, and the data itself should follow a format like that:

```
MIME type:filename:URL of source file
```

Where the filename is the name of the file downloaded on the desktop, once the download is complete.

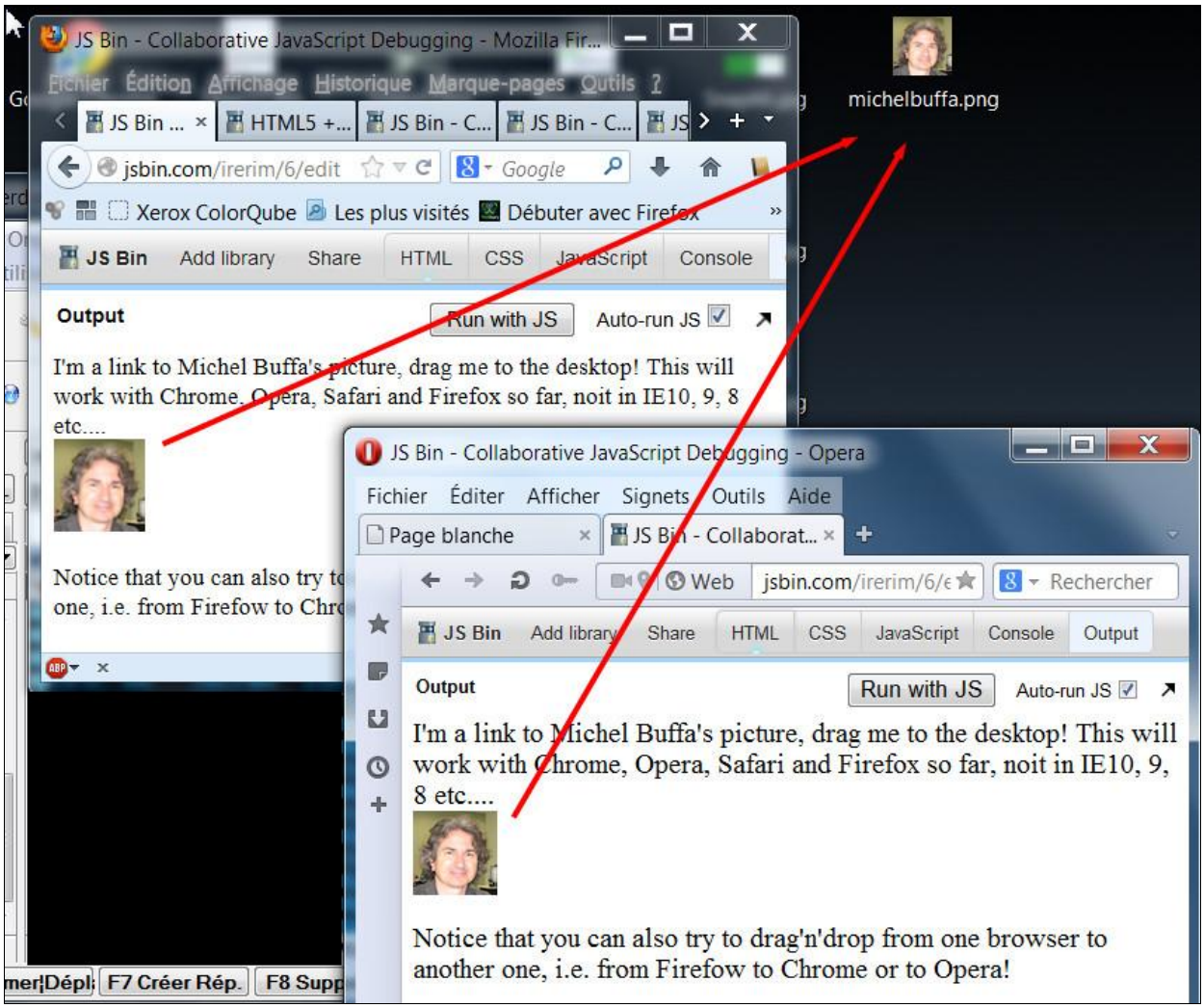
Example of a dragStartHandler that copies a PNG image in the clipboard:

```
ondragstart="event.dataTransfer.setData('DownloadURL', 'image/png:logo.png:http://www.w3devcampus.com/logo.png')
```

Complete example: drag an <img> to the Desktop

Tested with Chrome, Firefox and Opera. Does not work with Internet Explorer, even version 10.

Online example: http://jsbin.com/irerim/6/edit



Code from the example:

```
1  <!DOCTYPE html>
2  <html>
3  <head>
4  <meta charset=utf-8 />
5  <title>JS Bin</title>
6  </head>
7  <body>
8    I'm a link to Michel Buffa's picture, drag me to the desktop! This will work with Chrome, Opera,
9    Safari and Firefox so far, noit in IE10, 9, 8 etc....<br/>
10   <a href="http://www.w3devcampus.com/wp-content/uploads/2013/01/michelbuffa.png"
11     draggable="true"
12     ondragstart="event.dataTransfer.setData('DownloadURL',
13     'image/png:michelbuffa.png:http://www.w3devcampus.com/wp-content/uploads/2013/01/michelbuffa.png');"
14     onclick="return false"
15 >
16   <img src="http://www.w3devcampus.com/wp-content/uploads/2013/01/michelbuffa.png" alt="Michel Buffa"/>
17 </a>
18   <p>Notice that you can also try to drag'n'drop from one browser to another one, i.e. from Firefox to
19   Chrome or to Opera!</p>
   </body>
   </html>
```

In this example, there is no javascript, we wrote the dragstart handler instructions directly in the `ondragstart` attribute (line 12)
The `<IMG>` element is wrapped by an `<A HREF>...</A>` element that is draggable (line 11) and not clickable (prevent defaut behavior, line 14).
When dragged, this element calls the `dragstart` handler that just adds to the clipboard an object with key="`DownloadURL`", and value equal to `image/png:michelbuffa.png:url of the file`

You need to indicate the MIME type of the file, followed by ":", followed by the filename of the files that will be copied to the desktop, followed by the URL of the file.

Example: drag out a canvas image

This example draws in one canvas, builds one `<IMG>` element from the canvas content, and allows indifferently the canvas or

the image to be dragged out from the browser to the desktop : http://jsbin.com/oboyiw/5/edit

Drag out a canvas or an image to the desktop

Demo adapted by M.Buffa from: : http://jsfiddle.net/bgrins/xgdSC/ (courtesy of TheCssNinja & Brian Grinstead)

Drag out the image or the canvas. Notice that the filenames will be different on desktop. This example is interesting as it works with canvas data, img (in the form of a data URL or classic internal/external URL).

The Canvas:

The Image

Code from the example:

```
<html>
  <head>
<script src="http://ajax.googleapis.com/ajax/libs/jquery/1/jquery.min.js"></script>
    <script>
        function dragStartHandler(e) {
          console.log("drag start");
          var element = e.target;
          var src;

          if (element.tagName === "IMG" && element.src.indexOf("data:") === 0) {
            src = element.src;
          }

          if (element.tagName === "CANVAS") {
            try {
                src = element.toDataURL();
            }
            catch(e) { }
          }

          if (src) {

            var name = element.getAttribute("alt") || "download";
            var mime = src.split(";")[0].split("data:")[1];
            var ext = mime.split("/")[1] || "png";
            var download = mime + ":" + name + "." + ext + ":" + src;

            // Prepare file content to be draggable to the desktop
            e.dataTransfer.setData("DownloadURL", download);
          }
    }

  function drawCanvas(){
    var canvas = document.getElementById('mycanvas');
    var ctx = canvas.getContext('2d');

    var lingrad = ctx.createLinearGradient(0,0,0,150);
    lingrad.addColorStop(0, '#000');
    lingrad.addColorStop(0.5, '#669');
    lingrad.addColorStop(1, '#fff');

    ctx.fillStyle = lingrad;
```

```
43
44      ctx.fillRect(0, 0, canvas.width, canvas.height);
45
46      // Create an image from the canvas
47      var img = new Image();
48      img.src = canvas.toDataURL("image/png");
49      img.alt = 'downloaded-from-image';
50      //img.draggable='true' is not necessary, images are draggable by default
51      img.addEventListener('dragstart', dragStartHandler, false);
52
53      // Add the image to the document
54      document.querySelector("body").appendChild(img);
55
56    }
57      </script>
58    </head>
59    <body onload="drawCanvas()">
60      <h2>Drag out a canvas or an image to the desktop</h2>
61      <p>Demo adapted by M.Buffa from: : <a href="http://jsfiddle.net/bgrins/xgdSC/"/>http://jsfiddle.net/bgrins/
62      Drag out the image or the canvas. Notice that the filenames will be different on desktop. This example is i
63     <br/>
64      <br/>The Canvas:<br/>
65     <canvas id='mycanvas' alt='downloaded-from-canvas' draggable='true' ondragstart="dragStartHandler(event)"></
66     <br/>
67     <br/>
68      The Image<br/>
69    </body>
70  </html>
71
```

Notice the way we build the data corresponding to the canvas or image (lines 23-29).

7 Several examples of form submission using Xhr2/Ajax, files and also PHP code for the server side.

Introduction

Hi all, I've got many questions about how to submit a form with regular input fields AND files AND a progress bar. This part of the course will cover an example and we will propose different implementations. I asked two of my student (thanks a lot Loïse and Cedrik who work at W3C now!) to help me writing these examples. We included PHP server side code.

Imagine that we have a regular HTML5 form, but aside input fields for entering name, address, age, etc. we want also to select multiple files (that can be images). And we want to get all the data on the server side.

To begin with, there are two different approaches we can use :

> Upload the files "automatically" as soon as they are drag'n'dropped or selected (using a <input type="file".../>), with Ajax/Xhr2 + progress bars as we saw in the examples from the File API. This first approach is similar to what Gmail does when you write a new email and upload files/pictures to your message. The attachments are uploaded as soon as they are selected, and the message is sent when you press the "send" button. The interesting part here is that the "regular" part of the form will benefit from the HTML5 validation system built in the browser. A empty field with a "required" attribute, if left empty, will pop up some nice error messages in a bubble and the form will not be submitted. Nice! However, on the server side, we need a way to "join" the files that have been asynchronously uploaded with the rest of the form values. It's easier to do than it sounds. Look at the provided PHP code further in this message.
> We can also send all the form content (regular input fields values + the files selected) at once, using a single Ajax request (we will have only one progress bar), or we may use more than one Ajax requests, and we start them only after the submit button has been clicked. If we use a single request, we will have only one progress bar for the whole content we are sending. Of course we are still using Ajax/Xhr2 in order to will monitor the progress of the upload with multiple progress bars. The difference with the first approach is that we are sending everything using Ajax/JavaScript, including the regular input field content. We cannot benefit from the HTML5 form validation system. This approach is less convenient, needs more work client side (for validating by hand all the fields' contents) but the server side code may be simpler. PHP code is also provided. We also have played with some form validation API functions like document.getElementById("MyForm").checkValidity() to see if they could trigger the built in validation system implemented in the browser. Apparently not :-(I asked some friends at W3C if this is possible with current implementations, apparently not yet...

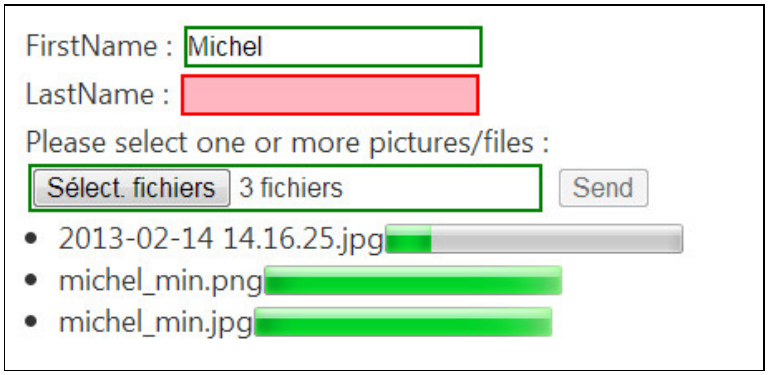
So, we also made two versions of each of these approach (one that uses only a file selector and one that uses drag'n'drop). We could have merged file selector + drag'n'drop like we did in the examples in the course but the code would have been longer and more difficult to follow. So let's start with the first approach, the one that auto loads the files as soon as they are selected.

Auto-loading of the files, regular form submission, benefit from the HTML5 form validation system

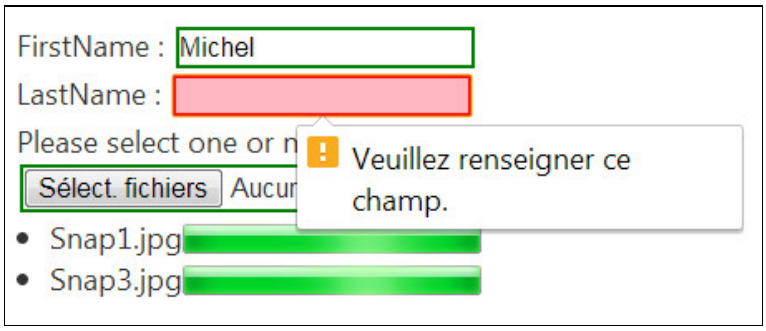
Here is the online example (this one does not have the PHP code running, but works anyway even if the files are not uploaded). Just change the "upload.html" URL to "upload.php", install our php code in an apache server somewhere and it will be 100% working) : http://jsbin.com/eCInIH/4/edit

Full working example (that calls PHP code listed further on) : http://88.191.177.121/Buffa/autoUpload/indexInput.html

In this example the "send" button is disabled and becomes enabled as soon as all the files have been uploaded completely.



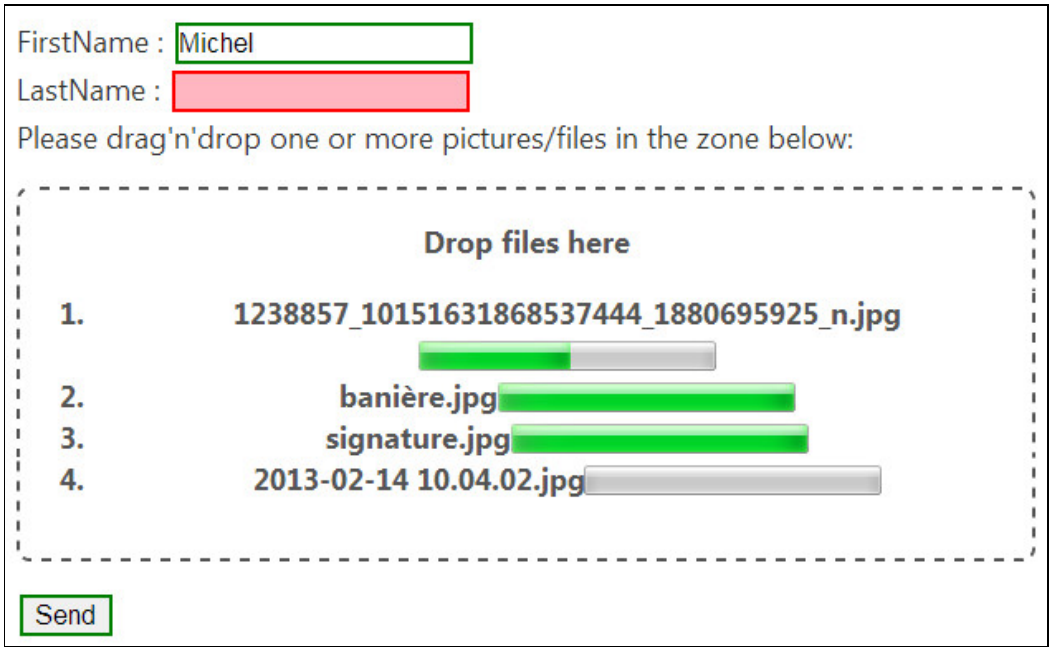
Example of submission after file transfer completed and an invalid input field:



Look at the jsbin example for the code + explanations in the comments.

Here is the same version but this time it uses drag'n'drop for the files, except a file input field : http://jsbin.com/UJEtilA/2/edit

Full working example (that calls PHP code listed further on)
: http://http://88.191.177.121/Buffa/autoUpload/indexDragDrop.html



And here is the PHP code for the server side part of these examples :

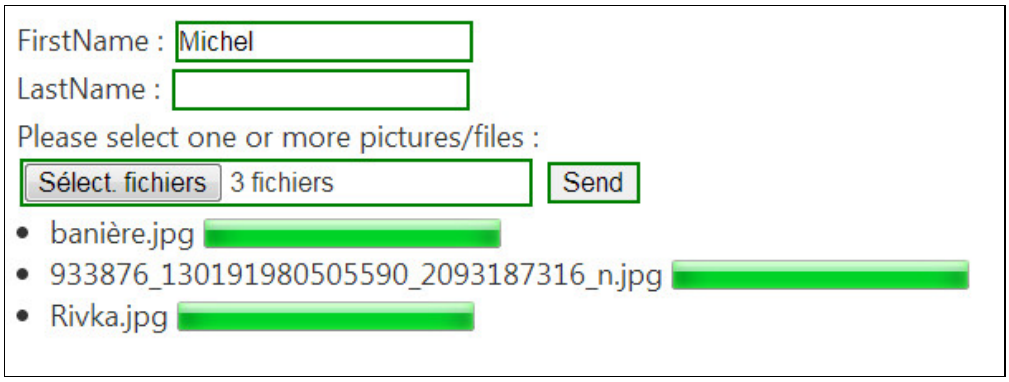
```php
<?php

if (isset($_POST['firstname']) && isset($_POST['lastname'])) {
    echo $_POST['firstname'] . ' ' . $_POST['lastname'] . ' uploaded file(s).<br />';
}

if (isset($_POST['namesAllFiles']) && $_POST['namesAllFiles'] != "") {
    $folderName = date("m.d.Y");
    if (!is_dir('upload/$folderName')) {
        mkdir("upload/$folderName");
    }

    $filesName = explode("::", $_POST['namesAllFiles']);
    for ($i=0; $i < count($filesName); $i++) {
        copy('upload/RecycleBin/' . $filesName[$i], 'upload/' . $folderName . '/' . $filesName[$i]);
        unlink('upload/RecycleBin/' . $filesName[$i]);
        echo "$filesName[$i] uploaded<br />";
    }
}

$fn = (isset($_SERVER['HTTP_X_FILENAME']) ? $_SERVER['HTTP_X_FILENAME'] : false);

if ($fn) {
    if (!is_dir('upload/RecycleBin')) {
        mkdir('upload/RecycleBin');
    }
    file_put_contents('upload/RecycleBin/' . $fn, file_get_contents('php://input'));
    exit();
}

?>
```

Second approach : upload everything at once !

This time, we add the files to the HTML5 FormData object before sending Xhr2 Ajax requests to the server (one for each file + one for the rest of the form, we could have send only one single request with everything in it, example to come). There is no built-in HTML5 form validation.

First example that does not use drag'n'drop: http://jsbin.com/ObeGipO/2/edit

Full working example (that calls PHP code listed further on)
: http://88.191.177.121/Buffa/autoUpload/indexInput.htmlBuffa/sendUpload/indexInput.html



And version with drag'n'drop here: http://jsbin.com/OtItIpO/2/edit

Full working example (that calls PHP code listed further on) : http://37.187.52.167/Buffa/sendUpload/indexDragDrop.html

PHP code for this approach (with and without drag'n'drop, the PHP code is the same):

```php
<?php

$fn = (isset($_SERVER['HTTP_X_FILENAME']) ? $_SERVER['HTTP_X_FILENAME'] : false);

if (isset($_POST['firstname']) && isset($_POST['lastname'])) {
    echo $_POST['firstname'] . ' ' . $_POST['lastname'] . ' try to upload file(s).';
}

$folderName = date("m.d.Y");
if (!is_dir('upload/$folderName')) {
    mkdir("upload/$folderName");
}

if ($fn)
{
    file_put_contents('upload/' . $folderName . '/' . $fn, file_get_contents('php://input'));
    echo "$fn uploaded";
    exit();
}
else {
    if (isset($_FILES) && is_array($_FILES)) {
        $number_files_send = count($_FILES['formFiles']['name']);
        $dir = realpath('.') . '/upload/' . $folderName . '/';

        if ($number_files_send > 0) {
            for ($i = 0; $i < $number_files_send; $i++) {
                echo '<br/>Reception of : ' . $_FILES['formFiles']['name'][$i];
                $copy = move_uploaded_file($_FILES['formFiles']['tmp_name'][$i], $dir . $_FILES['formFiles']['n
                if ($copy) {
                    echo '<br />File ' . $_FILES['formFiles']['name'][$i] . ' copy';
                }
                else {
                    echo '<br />No file to upload';
                }
            }
        }
    }
}

?>
```

Variant of the last approach : use a single Xhr2 request, pack everything into one big FormData object

Online example : http://jsbin.com/exePiY/5/edit

Source code of this example

```
<!DOCTYPE html>
<html lang="en">
    <head>
        <meta charset="UTF-8" />
        <title>HTML5 File</title>
        <link rel="stylesheet" type="text/css" media="all" href="styles.css" />
        <script type="text/javascript">


            // object that hold form values
            var formValues = new Object;

            // function that iterates through the form and dynamically assigns properties/values to form values
            storeValues = function () {
                var formElements = document.formUpload.elements;

                for (i = 0; i < formElements.length; i++) {
                    var formElement = formElements[i];

                    if (formElement.localName == "input") {
                        var name = formElements[i].name;
                        var value = formElements[i].value;
                        formValues[name] = value;
                    }
                }
                // Store the object as a JSON String
                sessionStorage.setItem('formUploadSave', JSON.stringify(formValues));
            }

            // on loading, retrieve any form values previously stored this session.
            // called by body onLoad

            // function that retrieves form values from sessionStorage, iterates through form and restores prop
            retrieveValues = function () {
                var formElements = document.formUpload.elements;

                // Retrieve the object from storage
                var retrievedValues = JSON.parse(sessionStorage.getItem("formUploadSave"));

                // If found, populate form
                for (i = 0; i < formElements.length; i++) {
                    var formElement = formElements[i];

                    if (formElement.localName == "input") {
                      // Assign onchange event listener
                      formElement.addEventListener("change", storeValues, false);

                       var formElementName = formElement.name;

                       if (retrievedValues) {// != null
                            formElement.value = retrievedValues[formElementName];
                       }
                    }
                }
            }

            function uploadFileWithoutParameters() {
              // creates a FormData object that contains all the different fields values.
                var fd = new FormData(document.getElementById("formUpload");
             // add the files
                var inputFiles = document.getElementById('formFiles');
                var memFiles = inputFiles.files;

                for(i=0; i<memFiles.length; i++) {
                    fd.append(inputFiles.name, memFiles[i]);
                }

              // prepare the request
                var xhr = new XMLHttpRequest();
                xhr.open("POST", formUpload.getAttribute("action"), true);

              // Define the callbacks

                xhr.upload.onprogress = function(e) {
                    progress.value = e.loaded;
                    progress.max = e.total;
                };

                xhr.onload = function() {
                    //alert("Upload termine");
                };


              // send the request
                xhr.send(fd);
            }

    </script>
    </head>
    <body onload="retrieveValues();">
```

```
        <form id="formUpload" name="formUpload" method="post" action="upload.php" enctype="multipart/form-data"
            FirstName : <input type="text" name="firstname" required/><br />
            LastName : <input type="text" name="lastname" required/><br />
            <input type="file" multiple name="formFiles[]" id="formFiles" onchange="uploadFileWithoutParameters
            <input type="submit" value="Send">
        </form>
        <progress id="progress" value="0" max="100"></progress>
    </body>
</html>
```

And here is the PHP code :

```
<?php


if (isset($_POST['firstname']) && isset($_POST['lastname'])) {
    echo $_POST['firstname'] . ' ' . $_POST['lastname'] . ' try to upload file(s).';
}


    if (isset($_FILES) && is_array($_FILES)) {
        $number_files_send = count($_FILES['formFiles']['name']);
        $dir = realpath('.') . '/upload/';

        if ($number_files_send > 0) {
            for ($i = 0; $i < $number_files_send; $i++) {
                echo '<br/>Reception of : ' . $_FILES['formFiles']['name'][$i];
                $copy = move_uploaded_file($_FILES['formFiles']['tmp_name'][$i], $dir . $_FILES['formFiles']['n
                if ($copy) {
                    echo '<br />File ' . $_FILES['formFiles']['name'][$i] . ' copy';
                }
                else {
                    echo '<br />No receive file';
                }
            }
        }
    }

?>
```

8 The Filesystem and FileWriter APIs

Introduction

Manage a client-side, sandboxed, filesystem from your web application? Yes it is possible... but only in Chrome for the moment...

The Filesystem and Filewriter APIs will not be studied in the course this year, as they are only partially implemented as an experimental build in Google Chrome, and are not available on any other browser. Furthermore, the specification is still subject to change. However, if you are curious have a look at the following links:

> The W3C specification of the Filesystem and FileWriter APIs
> Article on html5rocks.com about the Chrome implementation of these APIs
> Tutorial about how to use the first implementation: http://net.tutsplus.com/tutorials/html-css-techniques/toying-with-the-html5-filesystem-api/

This API will be complemetary to the cache API for offline applications, giving lot more flexibility. It will also allow JavaScript code from applications to create files and directory client side!

Current support

As of April 2013, an experimental implementation (prefixed by "webkit") is available in Chrome:

Filesystem & FileWriter API - Working Draft

Method of reading and writing files to a sandboxed file system.

*Usage stats:	Global
Support:	32.17%
Partial support:	0.38%
Total:	32.55%

Show all versions	IE	Firefox	Chrome	Safari	Opera	iOS Safari	Opera Mini	Android Browser	Blackberry Browser
								2.1	
								2.2	
						3.2		2.3	
						4.0-4.1		3.0	
	8.0		24.0 webkit			4.2-4.3		4.0	
	9.0	19.0	25.0 webkit	5.1		5.0-5.1		4.1	7.0
Current	10.0	20.0	26.0 webkit	6.0	12.1	6.0	5.0-7.0	4.2	10.0 webkit
Near future		21.0	27.0 webkit						
Farther future		22.0	28.0 webkit						

Notes | Known issues (0) | Resources (2) | Feedback | Edit on GitHub

No notes

Up-to-date version of this table:http://caniuse.com/#feat=filesystem

9 The WebSQL API (deprecated)

Introduction

This API has been abandonned. See the disclaimer at the top of the last version of the specification (http://www.w3.org/TR/webdatabase/).

Beware. This specification is no longer in active maintenance, and the Web Applications Working Group does not intend to maintain it further.

This API proposed a standard way to use a SQL database embedded in web browsers. The main problem was that there was only one single implementation based on the SQLite database, and there needs to be at least two different implementations to validate a specification. Another problem was that some vendors (Microsoft, Mozilla) had no plans to have a working implementation.

If you are interested, google "WebSQL" API, but beware, this is a dead end.

10 [ADVANCED] IndexedDB: introduction and current support

Introduction

IndexedDB is presented as an alternative to the WebSQL Database, which the W3C deprecated on November 18, 2010 (while still being implemented by all major browsers, it is no longer in the HTML5 specification). Both are solutions for storage, but they do not offer the same functionalities. WebSQL Database is a relational database access system, whereas **IndexedDB is an indexed table system**.

From the W3C specification about IndexedDB: "*User agents (apps running in browsers) may need to store large numbers of objects locally in order to satisfy **off-line data requirements of Web applications**. Where WebStorage (as seen in the previous chapter) is useful for storing pairs of keys and their corresponding values, IndexedDB provides in-order retrieval of keys, efficient searching of values, and the storage of duplicate values for a key.*

The W3C specification provides a concrete API to perform advanced key-value data management that is at the heart of most sophisticated query processors. It does so by using transactional databases to store keys and their corresponding values (one or more per key), and providing a means of traversing keys in a deterministic order. This is often implemented through the use of persistent B-tree data structures that are considered efficient for insertion and deletion, as well as in-order traversal of very large numbers of data records."

So, in other words, **IndexedDB is a transactional Object Store in which you will be able to store JavaScript objects, and put indexes on some properties of these objects for faster retrievial and search. Applications that use IndexedDB can work both online and offline.**

Examples of applications where IndexedDB should be considered:

a catalog of DVDs in a lending library,
mail clients, to-do lists, notepads,
data for games: hi scores, level definitions, etc.

External resources:

A lot of this chapter is an adaptation / built on the content of the following articles posted on the Mozilla Developer Network site (articles are: IndexedDB, Basic Concepts of IndexedDB and Using IndexedDB).

W3C specification about IndexedDB,
Mozilla developer's page about IndexedDB,
Getting started with IndexedDB article from codeproject.com,
Example that runs using the new version of the specification:
https://files.myopera.com/RAJUDASA/web/IndexedDB/iDB_Test.html, explanations
on http://rajudasa.blogspot.in/2012/12/indexeddbjs-updated.html

Current Support

IndexedDB is supported mainly on Desktop browsers and on recent versions only (IE 10, FF recent, Chrome canary 24+). Support on mobile is not available yet. Notice that the "synchronous API", which was designed specifically for use from WebWorkers, has a good chance of being removed from the specification as implementers have encountered numerous difficulties.

Support as in March 2013:

IndexedDB - Working Draft

Method of storing data client-side, allows indexed database queries. Previously known as WebSimpleDB API.

*Usage stats:	Global
Support:	49.43%
Partial support:	2.14%
Total:	51.57%

Show all versions	IE	Firefox	Chrome	Safari	Opera	iOS Safari	Opera Mini	Android Browser	Blackberry Browser
								2.1	
								2.2	
						3.2		2.3	
						4.0-4.1		3.0	
	8.0		24.0			4.2-4.3		4.0	
	9.0	19.0	25.0	5.1		5.0-5.1		4.1	7.0
Current	10.0	20.0	26.0	6.0	12.1	6.0	5.0-7.0	4.2	10.0 webkit
Near future		21.0	27.0						
Farther future		22.0	28.0						

Up-to-date version of this table: http://caniuse.com/#feat=indexeddb

11 [ADVANCED] IndexedDB: basic concepts

Important notice: A lot of this chapter'c content is adapted from the W3C specification about IndexedDB and from the following articles posted on the Mozilla Developer Network site (articles are: IndexedDB, Basic Concepts of IndexedDB and Using IndexedDB).

IndexedDB is very different from SQL databases. Don't be afraid if you've only used SQL database, IndexedDB might seem complex at first sight, but it really isn't.

Let's quickly look at the main concepts of IndexedDB, we will go into detail later on:

> IndexedDB stores and retrieves objects which are indexed by a "key",
> Changes to the database happen within transactions.
> IndexedDB follows a same-origin policy. So while you can access stored data within a domain, you cannot access data across different domains.
> The API includes both an asynchronous API and a synchronous API. The asynchronous API can be used in most cases, including WebWorkers, while the synchronous API was intended for use only with WebWorkers. Currently, no browser supports the synchronous API and there is a good chance that this API will be removed from the W3C specification, as stated in one paragraph : "The following features are at risk, and may be removed, due to the potential lack of implementations: 3.3 Synchronous APIs"

"Using the asynchronous API" means that most processing will be done in callback functions, and here we mean in LOTS of callback functions!

Detailed overview

IndexedDB databases store key-value pairs. The values can be complex structured objects (hint: imagine JSON objects), and keys can be properties of those objects. You can create indexes that use any property of the objects for quick searching, as well as sorted enumeration.

Example of data (from: https://developer.mozilla.org/en-US/docs/IndexedDB/Using_IndexedDB)

```
// This is what our customer data looks like.
const customerData = [
{ ssn: "444-44-4444", name: "Bill", age: 35, email: "bill@company.com" },
{ ssn: "555-55-5555", name: "Donna", age: 32, email: "donna@home.org" }
];
```

IndexedDB is built on a transactional database model. Everything you do in IndexedDB always happens in the context of a transaction. The IndexedDB API provides lots of objects that represent indexes, tables, cursors, and so on, but each is tied to a particular transaction. Thus, you cannot execute commands or open cursors outside a transaction.

Example of a transaction:

```
// Open a transaction in for reading and writing on the DB "customer"
var transaction = db.transaction(["customers"], "readwrite");

// Do something when all the data is added to the database.
transaction.oncomplete = function(event) {
 alert("All done!");
};

transaction.onerror = function(event) {
 // Don't forget to handle errors!
};

// Use the transaction to add data...
var objectStore = transaction.objectStore("customers");

 for (var i in customerData) {
   var request = objectStore.add(customerData[i]);
   request.onsuccess = function(event) {
   // event.target.result == customerData[i].ssn
 };
}
```

Transactions have a well-defined lifetime, so attempting to use a transaction after it has completed throws exceptions.

Transactions also auto-commit and cannot be committed manually.

This transaction model is really useful when you consider what might happen if a user opened two instances of your web app in two different tabs simultaneously. Without transactional operations, the two instances could stomp all over each other's modifications.

The IndexedDB API is mostly asynchronous. The API doesn't give you data by returning values; instead, you have to pass a callback function. You don't "store" a value into the database, or "retrieve" a value out of the database through synchronous means. Instead, you "request" that a database operation happens. You get notified by a DOM event when the operation finishes, and the type of event you get lets you know if the operation succeeded or failed. This sounds a little complicated at first, but there are some sanity measures baked in. After all, you are a JavaScript programmer aren't you ;-)

So look at previous extracts of code: `transaction.oncomplete`, `transaction.onerror`, `request.onsuccess`, etc...

IndexedDB uses requests all over the place. Requests are objects that receive the success or failure DOM events that were mentioned previously. They have `onsuccess` and `onerror` properties, and you can call `addEventListener()` and `removeEventListener()` on them. They also have `readyState`, `result`, and `errorCode` properties that tell you the status of the request.

The `result` property is particularly magical, as it can be many different things, depending on how the request was generated (for example, an `IDBCursor` instance, or the key for a value that you just inserted into the database). We will see this in detail in the next chapter "Using IndexedDB".

IndexedDB uses DOM events to notify you when results are available. DOM events always have a `type` property (in IndexedDB, it is most commonly set to `"success"` or `"error"`). DOM events also have a `target` property that shows where the event is headed. In most cases, the `target` of an event is the `IDBRequest` object that was generated as a result of doing some database operation. Success events don't bubble up and they can't be cancelled. Error events, on the other hand, do bubble, and can be cancelled. This is quite important, as error events abort whatever transactions they're running in, unless they are cancelled.

IndexedDB is object-oriented. IndexedDB is not a relational database, which has tables with collections of rows and columns. This important and fundamental difference affects the way you design and build your applications, it is an Object Store!

In a traditional relational data store, you would have a table that stores a collection of rows of data and columns of named types of data. IndexedDB, on the other hand, requires you to create an object store for a type of data and simply persist JavaScript objects to that store. Each object store can have a collection of indexes (corresponding to the properties of the JavaScript object you store in the store) that makes it efficient to query and iterate across.

IndexedDB does not use Structured Query Language (SQL). It uses queries on an index that produces a cursor, which you use to iterate across the result set. If you are not familiar with NoSQL systems, read the Wikipedia article on NoSQL.

IndexedDB adheres to a same-origin policy. An origin is the domain, application layer protocol, and port of a URL of the document where the script is being executed. Each origin has its own associated set of databases. Every database has a name that identifies it within an origin. Think of it as "an application, a Database". What defines "same origin" does not include the port or the protocol. For example, an app in a page with this URL `http://www.example.com/app/` and an app in a page with this URL `http://www.example.com/dir/` both can access the same IndexedDB database because they have the same origin (example.com), `http://www.example.com:8080/dir/` (different port) or `https://www.example.com/dir/` (different protocol), cannot be considered of the same origin (port and protocol are different from `http://www.example.com`)

Definitions

These definitions come from the W3C specification, they are just commented on to clarify when needed...

Database

> Each origin (you may consider as "each application") has an associated set of databases. A *database* comprises one or more object stores which hold the data stored in the database.
> Every database has a *name* which identifies it within a specific origin. The name can be any string value, including the empty string, and stays constant for the lifetime of the database.

Each database also has a current *version*. When a database is first created, its version is 0, if not specified otherwise. Each database can only have one version at any given time. A database can't exist in multiple versions at once.
The act of opening a database creates a *connection*. There *may* be multiple connections to a given database at any given time.

Object store

A object sotre is the mechanism by which data are stored in the database.
Every object store has a *name*. The name is unique within the database to which it belongs.
The object store persistently holds records (JavaScript objects), which are key-value pairs. One of these keys is a kind of "primary key" in the SQL database sense... This "key" is a property which every object in the datastore *must* contain.
Values in the object store are structured, but this structure may vary (i.e if we store persons in a database, and use the email as "the key all objects must define", some may have first name and last name in addition, others may have an adress or no address at all, etc.)
Records within an object store are sorted according to the *keys* in ascending order.

Every object store also optionally has a key generator and an optional *key path*. If the object store has a key path, it is said to use *in-line keys*. Otherwise it is said to use *out-of-line* keys.

The object store can derive the key from one of three sources:

A key generator. A key generator generates a monotonically increasing numbers every time a key is needed. This is a bit similar to auto-incremented primary keys in a SQL database.
Keys can be derived via a key path.
Keys can also be explicitly specified when a value is stored in the object store.

More details will be given in the next chapter "Using IndexedDB".

Version

Important notice: as of January 2013 many examples presented in IndexedDB articles or tutorials available on the web use a deprecated API, regarding the version management of IndexedDB databases, in particular the popular A simple TODO list using HTML5 IndexedDB tutorial from the html5rocks.com web site uses the deprecated `setVersion()` method and given examples do not run on recent browsers.

When a database is first created, its version is the integer 0. Each database has one version at a time; a database can't exist in multiple versions at once.
The only way to change the version is by opening it with a higher version than the current one. This will start a `versionchange` *transaction* and fire an `upgradeneeded` event. The only place where the schema of the database can be updated is inside the handler of that event.

This definition describes the most recent specification, which is only implemented in up-to-date browsers. Old browsers implemented the now deprecated and removed `IDBDatabase.setVersion()` method.

Transaction

From the specification: "A *transaction* is used to interact with the data in a database. Whenever data is read or written to the database, this is done by using a transaction.

All transactions are created through a connection, which is the transaction's *connection*. The transaction has a mode (`read`, `readwrite` or `versionchange`) that determines which types of interactions can be performed upon that transaction. The mode is set when the transaction is created and remains fixed for the life of the transaction. The transaction also has a *scope* that determines the object stores with which the transaction may interact."

A transaction in IndexedDB is similar to a transaction in SQL database. It defines: "An atomic and durable set of data-access and data-modification operations". Either all operations succeed or fail.

A database connection can have several active transactions associated with it at a time, but these write transactions cannot have overlapping *scopes (they cannot work on the same data at the same time)*. The scope of transactions, which is defined at creation time, determines which object that stores the transaction can interact with, and remains constant for the lifetime of the transaction. So, for example, if a database connection already has a writing transaction with a scope that just covers the `flyingMonkey` object store, you can start a second transaction with a scope of the `unicornCentaur` and `unicornPegasus` object stores. As for reading transactions, you can have several - even overlapping ones. A `"versionchange"` transaction never runs concurrently with other transactions (reminder: usually we use such

transactions when we create the object store or when we modify the schema).

Generally speaking, the above requirements mean that `"readwrite"` transactions which have overlapping scopes always run in the order they were created, and never run in parallel. A `"versionchange"` transaction is automatically created when a database version number is provided that is greater than the current database version. This transaction will be active inside the `onupgradeneeded` event handler, allowing the creation of new object stores and indexes.

Request

The operation by which reading and writing on a database is done. Every request represents one read or one write operation. Requests are always run within a transaction. The example below adds a customer into the object store named "customers".

```
// Use the transaction to add data...
var objectStore = transaction.objectStore("customers");
 for (var i in customerData) {
 var request = objectStore.add(customerData[i]);
 request.onsuccess = function(event) {
 // event.target.result == customerData[i].ssn
 };
}
```

Index

It is sometimes useful to retrieve records in an object store through other means than their key. An *index* allows looking up records in an object store using the properties of the values in the object stores records. Indexes are a common concept in databases. Indexes can speed up object retrieval and allow multi-criteria searches. For example, if you store persons in your object store, and add an index on the "email" property of each person, then looking for some person by email will be much faster.

An index is a specialized persistent key-value storage and has a *referenced* object store. For example, you have your "persons" object store that is the referenced data store, and this reference store can have an index storage associated with it that contains indexes that map email values to key values in the reference store.

The index has a *list of records* which hold the data stored in the index. The records in an index are automatically populated whenever records in the referenced object store are inserted, updated or deleted. There can be several indexes referencing the same object store, in which changes to the object store cause all such indexes to get updated.

An index contains a *unique* flag. When this flag is set to true, the index enforces that no two records in the index has the same key. If a record in the index's referenced object store is attempted to be inserted or modified, such that evaluating the index's key path on the records new value yields a result which already exists in the index, then the attempted modification to the object store fails.

Key and values

key

A data value by which stored values are organized and retrieved in the object store. The object store can derive the key from one of three sources: a *key generator*, a *key path*, and an explicitly specified value.

The key must be of a data type that has a number that is greater than the one before. Each record in an object store must have a key that is unique within the same store, so you cannot have multiple records with the same key in a given object store.

A key can be one of the following type: string, date, float, and array. For arrays, the key can range from an empty value to infinity. And you can include an array within an array.

Alternatively, you can also look up records in an object store using the *index*.

key generator

A mechanism for producing new keys in an ordered sequence. If an object store does not have a key generator, then the application must provide keys for records being stored. Similar to auto-generated primary keys in SQL databases.

in-line key

A key that is stored as part of the stored value. Example: the email of a person or a student number in an object representingt a student in a student store. It is found using a *key path*. An in-line key can be generated using a generator.

After the key has been generated, it can then be stored in the value using the key path, or it can also be used as a key.

out-of-line key

A key that is stored separately from the value being stored. Ex: an auto-incremented id that is not part of the object. Example: you store persons {name:Buffa, firstName:Michel} and {name:Gandon, firstName: Fabien}, each will have a key (think of it as a primary key, an id...) that can be auto-generated or specified, but that is not part of the objects stored.

key path

Defines where the browser should extract the key from a value in the object store or index. **A valid key path can include one of the following: an empty string, a JavaScript identifier, or multiple JavaScript identifiers separated by periods.** It cannot include spaces.

value

Each record has a value, which could include anything that can be expressed in JavaScript, including: boolean, number, string, date, object, array, regexp, undefined, and null.

When an object or an array is stored, the properties and values in that object or array can also be anything that is a valid value.

Blobs and files can be stored, (support anly in FF >= 11 and Chrome > 24 or Chrome canary > 24). The example in the next chapter stores images using blobs.

Range and scope

scope

The set of object stores and indexes to which a transaction applies. The scopes of read-only transactions can overlap and execute at the same time. On the other hand, the scopes of writing transactions cannot overlap. You can still start several transactions with the same scope at the same time, but they just queue up and execute one after another.

cursor

A mechanism for iterating over multiple records with a *key range*. The cursor has a source that indicates which index or object store it is iterating. It has a position within the range, and moves in a direction that is increasing or decreasing in the order of record keys. For the reference documentation on cursors, see IDBCursor.

key range

A continuous interval over some data type used for keys. Records can be retrieved from object stores and indexes using keys or a range of keys. You can limit or filter the range using lower and upper bounds. For example, you can iterate over all values of a key between x and y.

For the reference documentation on key range, see IDBKeyRange.

12 [ADVANCED] Using IndexedDB

Introduction

This page details simple examples for creating, adding, removing, updating, and searching data in an IndexedDB database. It explains the basic steps to perform such common operations, while explaining the programmation principles behind IndexedDB.

External resources:

- Using IndexedDB from the Firefox Developer's site. This chapter is an adaptation of this web page.
- Storing images and files in IndexedDB,
- Storing and retrieving videos with IndexedDB,
- How to see IndexedDB content in other browsers than Chrome: the linq2indexedDB tool.
- How to view IndexedDB content in Firefox,

In this page you will learn:

- Creating and populating a database
- Working with data
  - Transactions,
  - Inserting, deleting, updating and getting data

Creating and populating a database

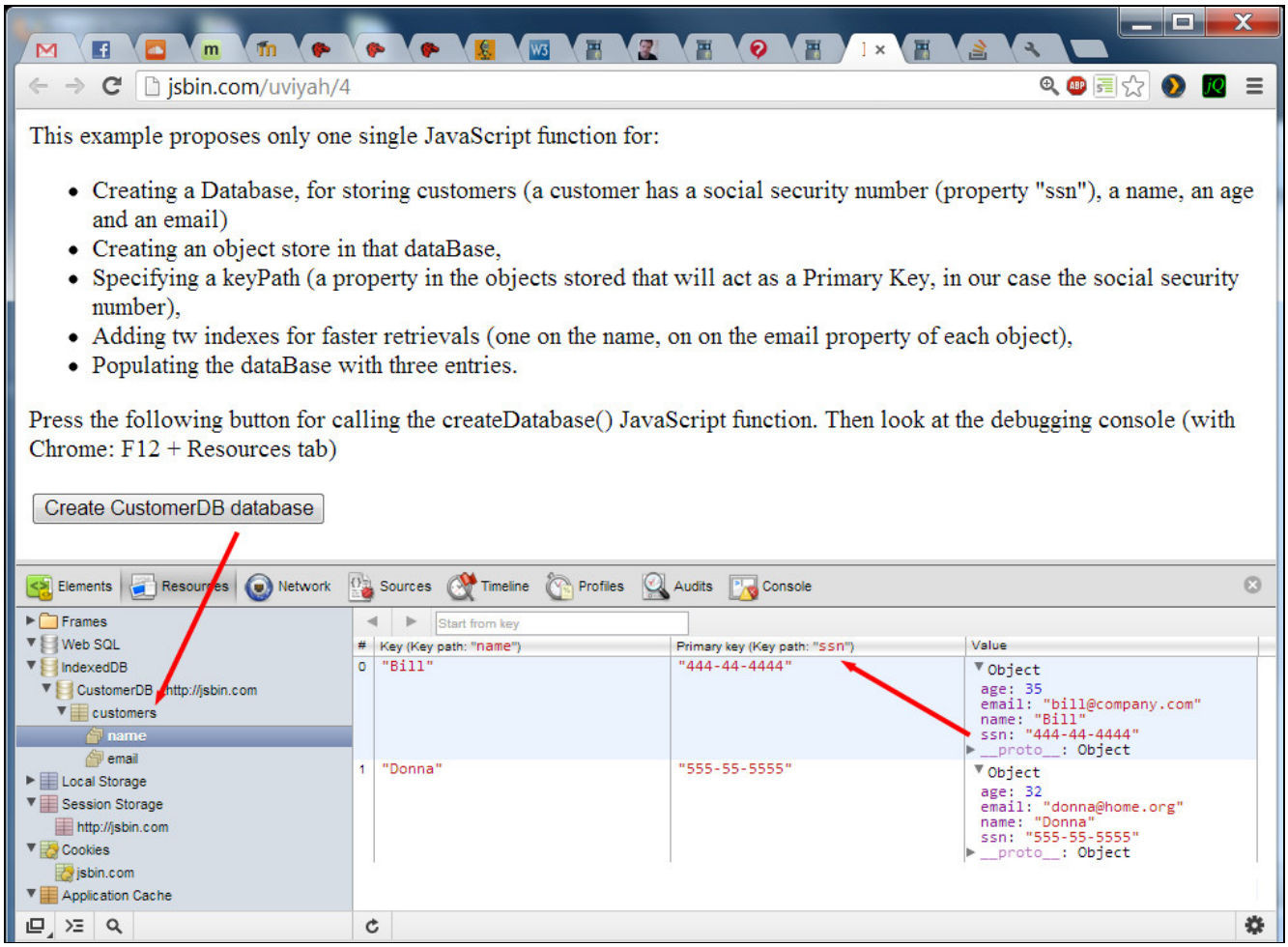
Online example here: http://jsbin.com/uviyah/11/edit

This example shows how to create / open a database using IndexedDB. We tried this example on Chrome version 23 and Firefox version 19.

With Chrome, open the Developper tool console (F12) and press the "Create CustomerDB" button, it will call the createDB() JavaScript function that creates a new IndexedDB database, a datastore in it ("customers") and inserts two javascript objects (see them on the right in the console). Note that the social security number is the "Primary key", called a Key path in the IndexedDB vocabulary (red arrow on the right).

Notice that with Firefox or other browsers it is not as easy to see the IndexedDB databases, object stores and data. We recommend using a JavaScript library called linq2indexedDB. Note also that Firefox implements the indexedDB API using SQlite, and the database can be "explored" using the Firefox extension sqlite manager. See this discussion if you are interested...

Chrome DevTools (F12) shows the IndexedDB databases, object stores and data:



Normally, when you create the database for the first time, the console should show this message:

This message comes from the JavaScript request.`onupgradeneeded` callback. Indeed, the first time we open the database we ask for a specific version (in this example: version 2) with:

```
var request = indexedDB.open(dbName, 2);
```

..and if there is no version "2" of the database, then we enter the `onupgradeneeded` callback where we really create the database.

You can try to click again on the button "CreateCustomerDatabase", if database version "2" exists, this time the `request.onsuccess` callback will be called. This is where we will add/remove/search data (you should see a message on the console).

Notice that the version number cannot be a float: "1.2" and "1.4" will automatically be rounded to "1".

JavaScript code from the example:

```
var db; // the database connexion we need to initialize

function createDatabase() {

   if(!window.indexedDB) {
     window.alert("Your browser does not support a stable version of IndexedDB");
   }

   // This is what our customer data looks like.
   var customerData = [
     { ssn: "444-44-4444", name: "Bill", age: 35, email: "bill@company.com" },
     { ssn: "555-55-5555", name: "Donna", age: 32, email: "donna@home.org" }
   ];
   var dbName = "CustomerDB";

```

```
    // version must be an integer, not 1.1, 1.2 etc...
    var request = indexedDB.open(dbName, 2);

    request.onerror = function(event) {
     // Handle errors.
     console.log("request.onerror" + event.target.errorCode);
    };
    request.onupgradeneeded = function(event) {
      console.log("request.onupgradeneeded, we are creating a new version of the dataBase");

      db = event.target.result;

      // Create an objectStore to hold information about our customers. We're
      // going to use "ssn" as our key path because it's guaranteed to be
      // unique.
      var objectStore = db.createObjectStore("customers", { keyPath: "ssn" });

      // Create an index to search customers by name. We may have duplicates
      // so we can't use a unique index.
      objectStore.createIndex("name", "name", { unique: false });

      // Create an index to search customers by email. We want to ensure that
      // no two customers have the same email, so use a unique index.
      objectStore.createIndex("email", "email", { unique: true });

      // Store values in the newly created objectStore.
      for (var i in customerData) {
        objectStore.add(customerData[i]);
      }
    }; // end of request.onupgradeneeded

    request.onsuccess = function(event) {
      // Handle errors.
      console.log("request.onsuccess, database opened, now we can add / remove / look for data in it!");

      // The result is the database itself
      db = event.target.result;
    };
} // end of function createDatabase
```

Explanations:

All the "creation" process is done in the `onupgradeneeded` callback:

> Get the database created in the result of the dom event: `db = event.target.result;`
> Create an object store named "customers" with the primary key being the social security number ("ssn" property of the JavaScript objects we want to store in the object store): `var objectStore = db.createObjectStore("customers", {keyPath: "ssn"});`
> Create indexes on the "name" and "email" properties of JavaScript objects: `objectStore.createIndex("name", "name", {unique: false});`
> Populate the database: `objectStore.add(...)`.

Note that we did not create any transaction, as the `onupgradeneeded` callback on a create database request is always in a default transaction that cannot overlap with another transation at the same time.
If we try to open a database version that exists, then the request.onsuccess callback is called. This is where we are going to work with data. The DOM event result attribute is the database itself, so it is wise to store it in a variable for later use: `db = event.target.result;`

Working with data

Explicit use of a transaction is necessary

All operations in the dabase should occur within a transaction. While the creation of the database occured in a transaction that was run "under the hood" with no explicit "transaction" keyword used, for adding/removing/updating/retrieving data, explicit use of a transaction is required.

You need to get a transaction from the database object and indicate on which object store the transaction will be associated. Transactions, when created, must have a mode set that is either `read`, `readwrite` or `versionchange` (this last mode is only for creating a new database or for modifying its schemas: i.e. change the primary key or the indexes). When you can, use the transaction in `read` mode as multiple read transactions can run concurrently in this mode.

```
var transaction = db.transaction(["customers"], "readwrite"); // or "read"...

// Note: Older experimental implementations use the deprecated constant
// IDBTransaction.READ_WRITE instead of "readwrite".
// In case you want to support such an implementation, you can
// just write:
```

```
// var transaction = db.transaction(["customers"],
// IDBTransaction.READ_WRITE);
```

Inserting data in an objectStore

Example1: basic steps

Online example:

> http://jsbin.com/ocaxeh/11/edit. Execute this example and look at the IndexedDB object store content from the Chrome dev tools (F12). One more customer should have been added.

Be sure to click on the "create database" button before clicking the "insert new customer" button.

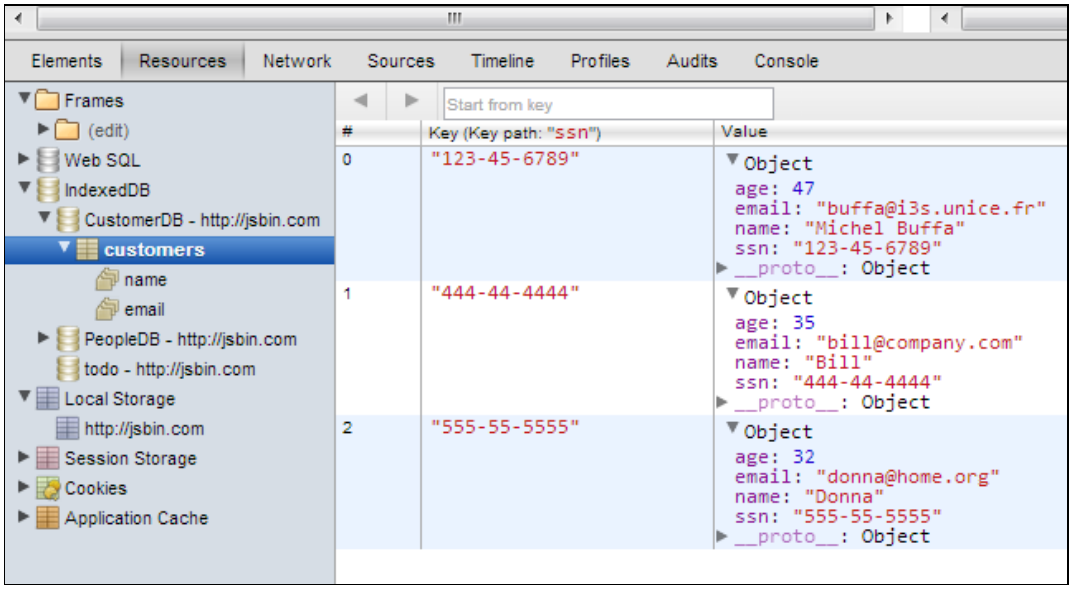
This example proposes only one single JavaScript function for:

- Creating a Database, for storing customers (a customer has a social security number (property "ssn"), a name, an age and an email)
- Creating an object store in that dataBase,
- Specifying a keyPath (a property in the objects stored that will act as a Primary Key, in our case the social security number),
- Adding two indexes for faster retrievals (one on the name, on on the email property of each object),
- Populating the dataBase with three entries.

Press the following button for calling the createDatabase() JavaScript function. Then look at the debugging console (with Chrome: F12 + Resources tab)

Create CustomerDB database | Add a new Customer

The indexedDB store in Chrome dev tools, after pressing the left button, the right button adds a customer named Michel Buffa in the database (press F12/ressources/IndexedDB):



Code from the example, explanations:

We just added one single function into the example from the previous section, the function `AddACustomer()` that adds one single object:

```
{ ssn: "123-45-6789", name: "Michel Buffa", age: 47, email: "buffa@i3s.unice.fr" }
```

Here is the complete source code of the `addACustomer` function:

```
function addACustomer() {
   // 1 - get a transaction on the "customers" object store
   // in readwrite, as we are going to insert a new object
   var transaction = db.transaction(["customers"], "readwrite");
```

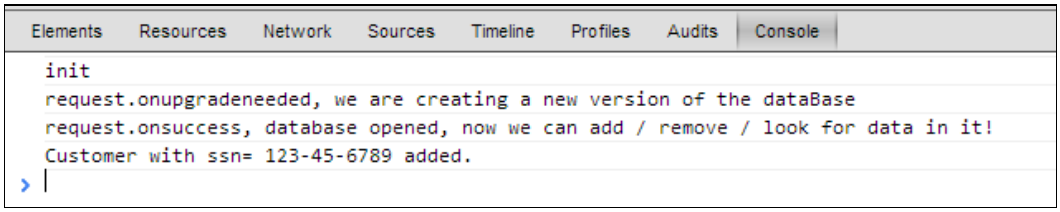
```
5
6     // Do something when all the data is added to the database.
7     // This callback is called after transaction has been completely executed (comitted)
8     transaction.oncomplete = function(event) {
9       alert("All done!");
10    };
11
12    // This callback is called in case of error (rollback)
13    transaction.onerror = function(event) {
14      console.log("transaction.onerror" + event.target.errorCode);
15    };
16
17    // 2 - Init the transaction on the objectStore
18    var objectStore = transaction.objectStore("customers");
19
20    // 3 - Get a request from the transaction for adding a new object
21    var request = objectStore.add({ ssn: "123-45-6789", name: "Michel Buffa", age: 47, email: "buffa@i3s.unice.f
22
23    // The insertion was ok
24    request.onsuccess = function(event) {
25      console.log("Customer with ssn= " + event.target.result + " added.");
26    };
27
28    // the insertion led to an error (object already in the store, for example)
29    request.onerror = function(event) {
30      console.log("request.onerror, could not insert customer, errcode = " + event.target.errorCode);
31    };
32  }
33
```

Explanations:

In the code above, in lines 4, 18 and 21 are the main calls you have to perform in order to add a new object in the store: 1) create a transaction, 2) map the transaction on the object store, 3) create an "add" request that will take part in the transaction.

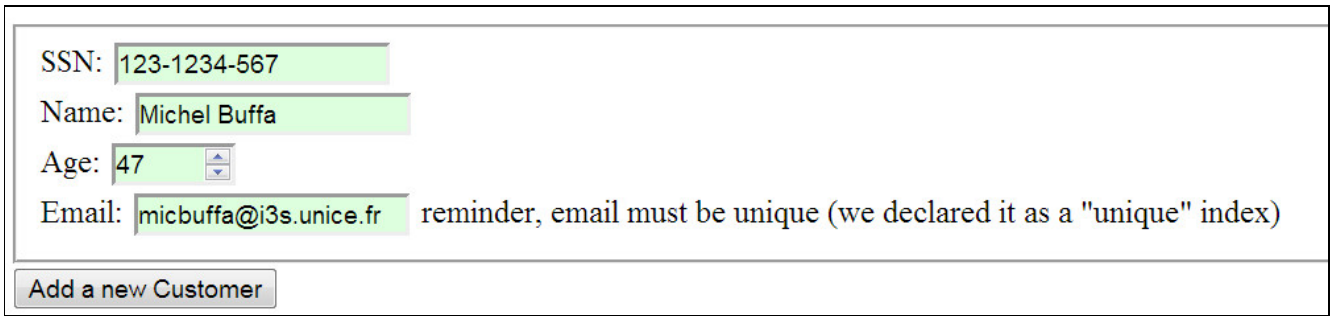
The different callbacks are in lines 8 and 13 for the transaction, and in lines 24 and 29 for the request. You may have several requests for the same transaction. Once all requests have finished, the `transaction.oncomplete` callback is called. In any other case the `transaction.onerror` callback is called, and the datastore remains unchanged.

Here is the trace from the dev tools console:



Example2: adding a form and validating inputs

Online example available here: http://jsbin.com/ocaxeh/21/edit



You can try this example. Press first on the "Create database" button, then enter a new customer in the form, then press F12 to use the Chrome dev tools and check for the indexedDB store content. Sometimes it is necessary to refresh the view (right click on indexedDB/refresh), and sometimes it is necessary to close/open the dev tools to have a view that shows the changes (press F12 twice). Chrome dev tools are a bit strange from time to time.

This time we added some tests for checking that the database is opened before trying to insert an element + we added a small form for entering a new customer.

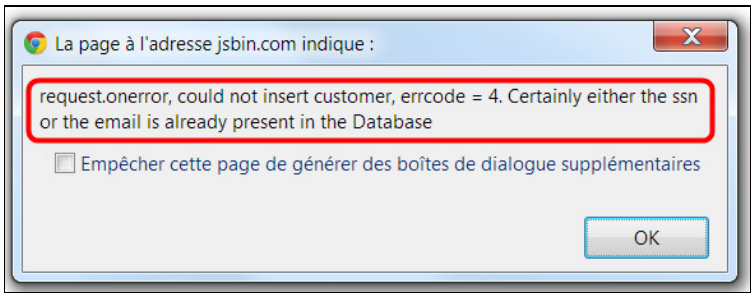
Notice that the insert will fail and display an alert with an error message if:

> The ssn is already present in the database. This property has been declared as the `keyPath` (sort of primary key) in the object store schema, and it should be unique: `db.createObjectStore("customers", { keyPath:`

```
"ssn" });
```

The email is already present in the object store, remember that in our schema, the email property is an index that we declared unique: `objectStore.createIndex("email", "email", { unique: true });`

Try to insert twice the same customer, or different customers with the same ssn. An alert like this should pop up:



Here is the updated version of the HTML code of this example:

```html
<fieldset>
   SSN: <input type="text" id="ssn" placeholder="444-44-4444" required/><br>
   Name: <input type="text" id="name"/><br>
   Age: <input type="number" id="age" min="1" max="100"/><br>
   Email:<input type="email" id="email"/> reminder, email must be unique (we declared it as a "unique" index)<br
</fieldset>

<button onclick="addACustomer();">Add a new Customer</button>
```

And here is the new version of the addACustomer() JavaScript function:

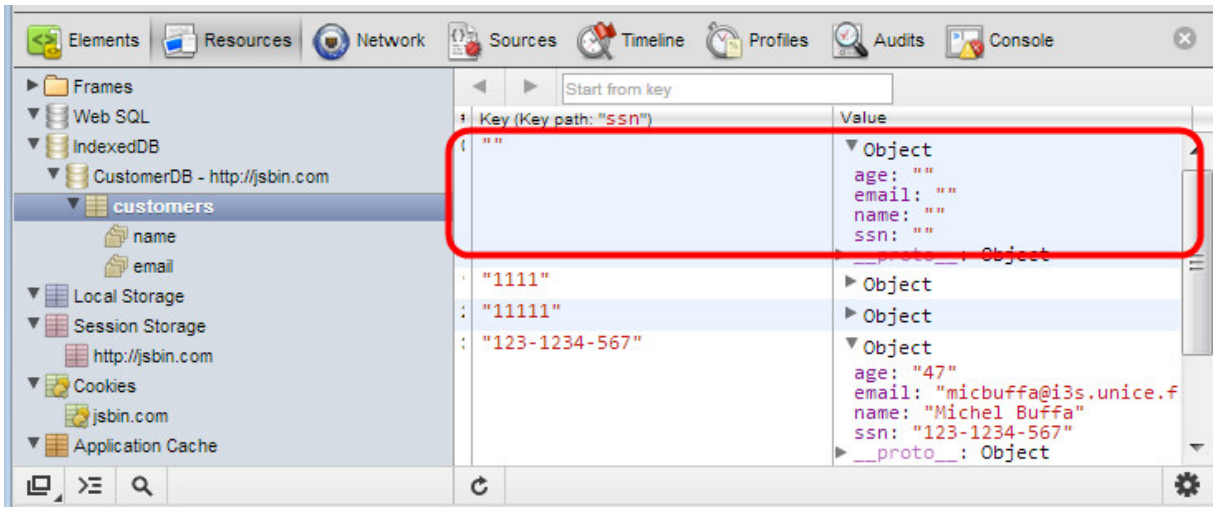
```javascript
function addACustomer() {
   if(db === null) {
     alert('Database must be opened, please click the Create CustomerDB Database first');
     return;
   }

   var transaction = db.transaction(["customers"], "readwrite");

   // Do something when all the data is added to the database.
   transaction.oncomplete = function(event) {
     console.log("All done!");
   };

   transaction.onerror = function(event) {
     console.log("transaction.onerror" + event.target.errorCode);
   };

  var objectStore = transaction.objectStore("customers");

  // adds the customer data
  var newCustomer={};
  newCustomer.ssn = document.querySelector("#ssn").value;
  newCustomer.name = document.querySelector("#name").value;
  newCustomer.age = document.querySelector("#age").value;
  newCustomer.email = document.querySelector("#email").value;
  alert('adding customer ssn=' + newCustomer.ssn);

  var request = objectStore.add(newCustomer);

  request.onsuccess = function(event) {
    console.log("Customer with ssn= " + event.target.result + " added.");
  };

  request.onerror = function(event) {
    alert("request.onerror, could not insert customer, errcode = " + event.target.errorCode +
          ". Certainly either the ssn or the email is already present in the Database");
  };
}
```

It is also possible to shorten the code of the above function by chaining the different operations using the "." operator (getting a transaction from the db, opening the store, adding a new customer, etc.). Here is the short version:

```javascript
var request = db.transaction(["customers"], "readwrite")
 .objectStore("customers")
 .add(newCustomer);
```

The above code does not perform all the tests, but you may encounter such a way of coding (!).

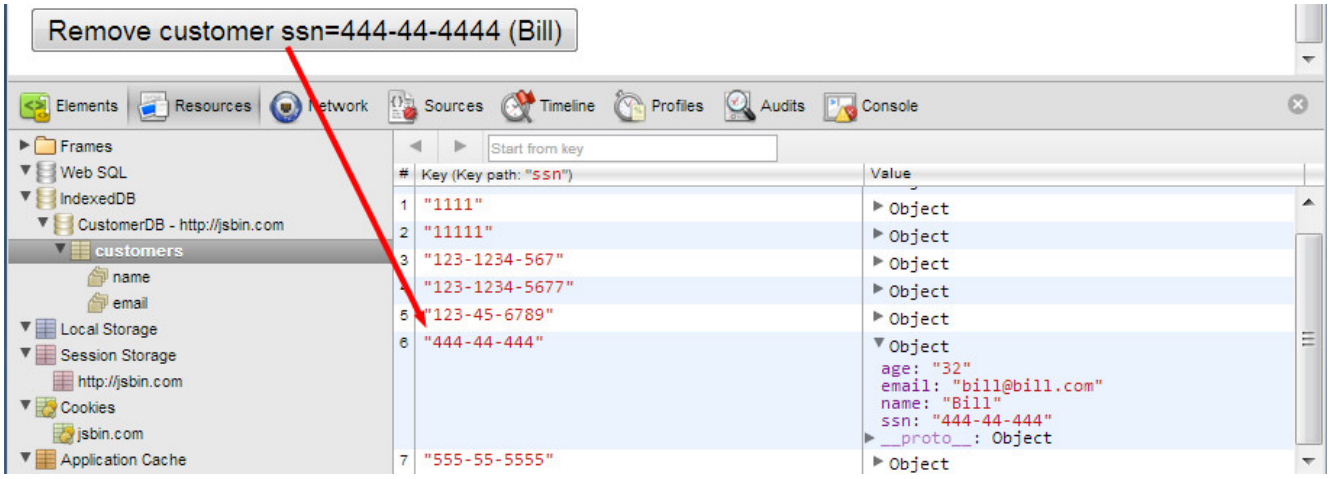
Note also that if you try to insert some empty data it works:



Indeed, entering an empty value for the `keyPath` or for indexes is a valid value (in the indexedDB sense). In order to avoid this, you should add more JavaScript code. We will let you do this as an exercise...

Removing data from an object store

Online example: http://jsbin.com/ocaxeh/25/edit



See the changes in Chrome dev tools: refresh the view (right click/refresh) or press F12 twice. There is a bug in the refresh feature with Chrome 23+.

Be sure to click the create database button to open the existing database. Then check with Chrome dev tools that the customer with ssn=444-44-444 exists. In case, just insert into the database. Right click on indexDB in the Chrome dev tools and refresh the display of the IndexedDB's content if necessary. Then click on the "Remove Customer ssn=444-44-4444(Bill)" button. Refresh the display of the database. Normally, Bill should have disappeared!

Code added in this example:

```
function removeACustomer() {
  if(db === null) {
    alert('Database must be opened first, please click the Create CustomerDB Database first');
    return;
 }

 var transaction = db.transaction(["customers"], "readwrite");

 // Do something when all the data is added to the database.
 transaction.oncomplete = function(event) {
   console.log("All done!");
 };

 transaction.onerror = function(event) {
   console.log("transaction.onerror" + event.target.errorCode);
 };

 var objectStore = transaction.objectStore("customers");

 alert('removing customer ssn=444-44-4444');
 var request = objectStore.delete("444-44-4444");

 request.onsuccess = function(event) {
   console.log("Customer removed.");
```

```
25   };
26
27   request.onerror = function(event) {
28     alert("request.onerror, could not remove customer, errcode = " + event.target.errorCode + ". The ssn does no
29   };
30 }
31
32
```

Notice that after the deletion of the Customer (line 22), the `request.onsuccess` callback is called. And if you try to print the value `event.target.result`, it is "undefined". Even if you try to remove a customer with a non existing ssn, the same callback `request.onsuccess` is called, and the value of `event.target.result` is also undefined. This is strange (tested on Chrome 23), and looks like an incomplete implementation or a bug.

Short way of doing the delete:

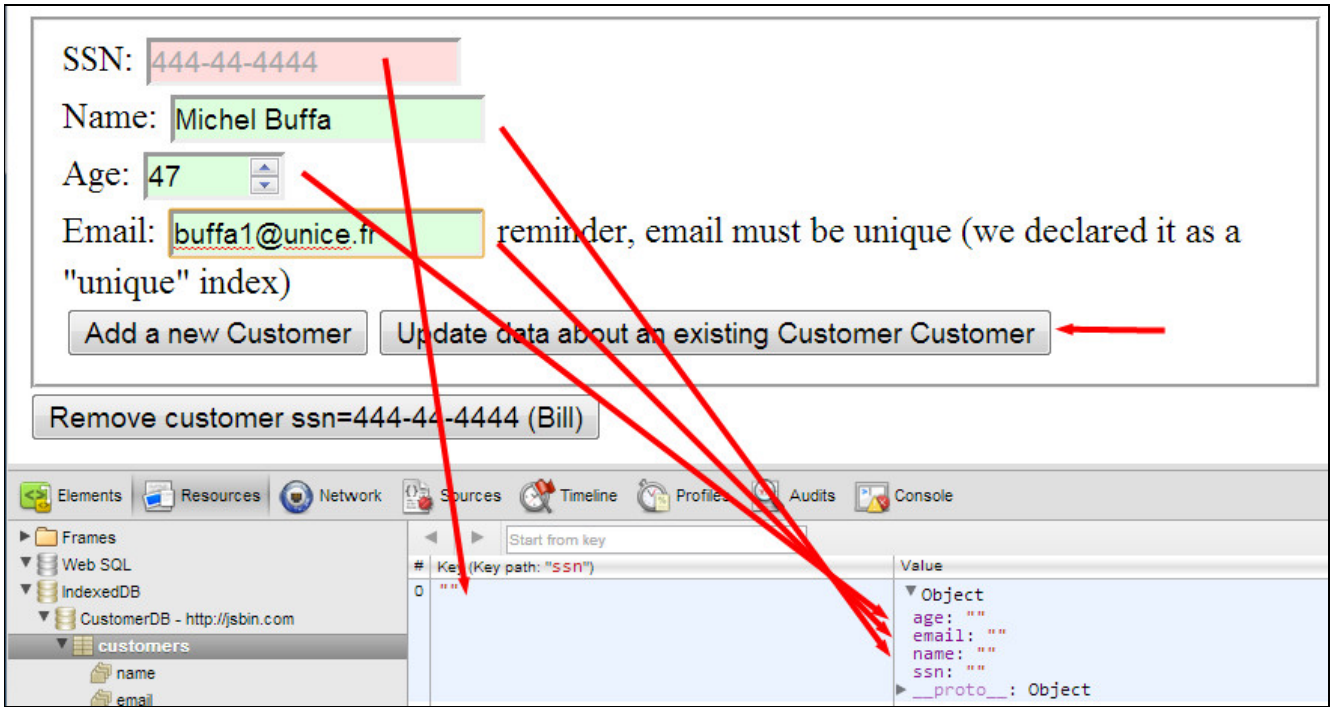
It is also possible to shorten the code of the above function a lot by concatenating the different operations (getting the store from the db, getting the request, calling delete, etc.). Here is the short version:

```
1 var request = db.transaction(["customers"], "readwrite")
2  .objectStore("customers")
3  .delete("444-44-4444");
```

Modifying data from an object store

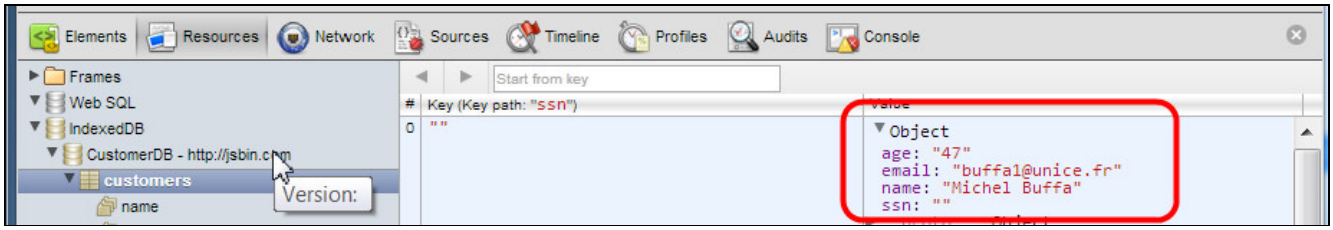
We used `request.add(object)` to add a new customer, `request.delete(keypath)` to remove a customer, then we will use `request.put(keypath)` to put a customer!

Online example: http://jsbin.com/ocaxeh/28/edit



The above screenshot shows how we added an empty customer with ssn="", (we just clicked on the open database button, then on the "add a new customer button" with an emtpy form.

Then we just filled the name, age and email input fields for updating the object with ssn="" and clicked on the "update data about an existing customer". This updates the data in the object store, as shown in this screenshot:



Here is the code added to this example:

```
1 function updateACustomer() {
```

```
2    if(db === null) {
3      alert('Database must be opened first, please click the Create CustomerDB Database first');
4      return;
5    }
6
7    var transaction = db.transaction(["customers"], "readwrite");
8
9    // Do something when all the data is added to the database.
10   transaction.oncomplete = function(event) {
11     console.log("All done!");
12   };
13
14   transaction.onerror = function(event) {
15     console.log("transaction.onerror" + event.target.errorCode);
16   };
17
18   var objectStore = transaction.objectStore("customers");
19
20   var customerToUpdate={};
21   customerToUpdate.ssn = document.querySelector("#ssn").value;
22   customerToUpdate.name = document.querySelector("#name").value;
23   customerToUpdate.age = document.querySelector("#age").value;
24   customerToUpdate.email = document.querySelector("#email").value;
25
26   alert('updating customer ssn=' + customerToUpdate.ssn);
27   var request = objectStore.put(customerToUpdate);
28
29   request.onsuccess = function(event) {
30     console.log("Customer updated.");
31   };
32
33   request.onerror = function(event) {
34     alert("request.onerror, could not update customer, errcode = " +
35          event.target.errorCode + ". The ssn is not in the Database");
36   };
37 }
```

The update occurs at line 27.

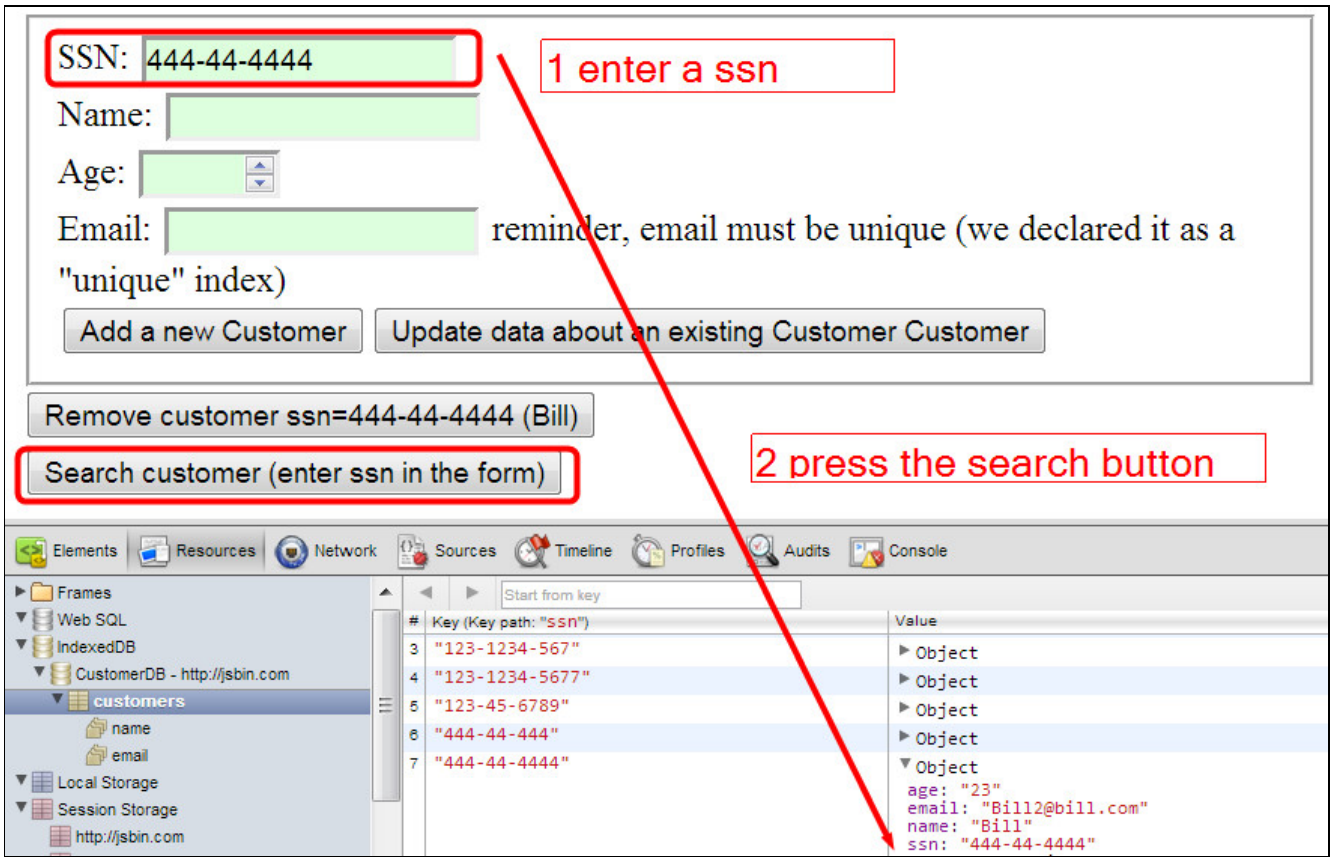
Getting data from a data store

There are several way to retrieve data from a data store.

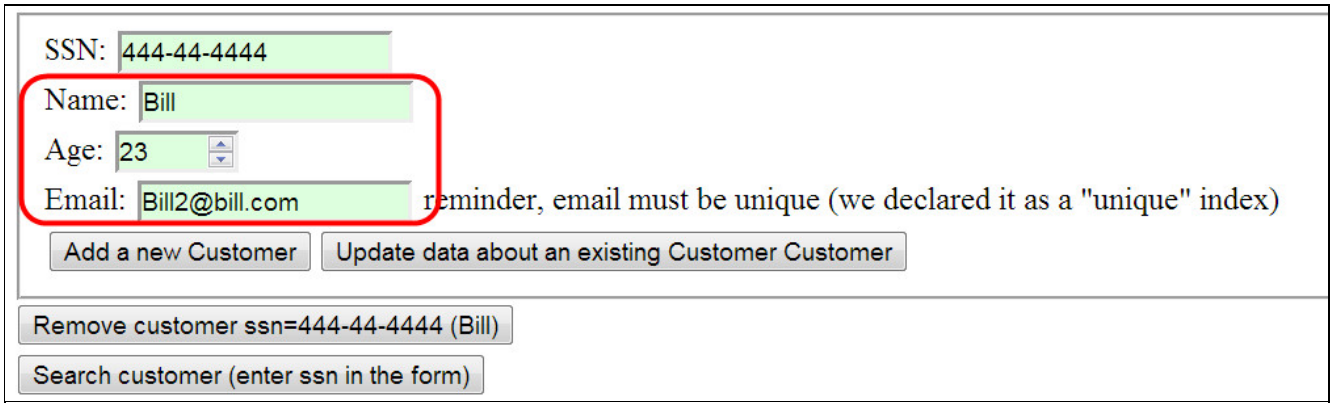
Getting data when we know its key

The simplest function from the API is the `request.get(key)` function. It retrieves an object when we know its key/keypath.

Online example: http://jsbin.com/ocaxeh/36/edit



If the ssn exists in the object store, then the results are displayed in the form itself (the code that gets the results and updates the form is in the `request.onsuccess` callback)



Here is the code we added to that example:

```
function searchACustomer() {
  if(db === null) {
    alert('Database must be opened first, please click the Create CustomerDB Database first');
    return;
  }

  var transaction = db.transaction(["customers"], "readwrite");

  // Do something when all the data is added to the database.
  transaction.oncomplete = function(event) {
    console.log("All done!");
  };

  transaction.onerror = function(event) {
    console.log("transaction.onerror" + event.target.errorCode);
  };

  var objectStore = transaction.objectStore("customers");

  // Init a customer object with just the ssn property initialized from the form
  var customerToSearch={};
  customerToSearch.ssn = document.querySelector("#ssn").value;

  alert('Looking for customer ssn=' + customerToSearch.ssn);

  // Look for the customer corresponding to the ssn in the object store
  var request = objectStore.get(customerToSearch.ssn);
```

```
28
29    request.onsuccess = function(event) {
30      console.log("Customer found" + event.target.result.name);
31      document.querySelector("#name").value = event.target.result.name;
32      document.querySelector("#age").value = event.target.result.age;
33      document.querySelector("#email").value = event.target.result.email;
34    };
35
36    request.onerror = function(event) {
37      alert("request.onerror, could not find customer, errcode = " + event.target.errorCode + ".
38             The ssn is not in the Database");
39    };
  }
```

The search is done on line 27, and the callback in the case of success is `request.onsuccess`, lines 29-34. `event.target.result` is the resulting object.

Well, this is a lot of code isn't it? We can do a mush shorter version of this function, while admitting that we won't take care of all possible errors... Here is the shortened version:

```
1 function searchACustomerShort() {
2    db.transaction("customers").objectStore("customers")
3     .get(document.querySelector("#ssn").value).onsuccess = function(event) {
4    document.querySelector("#name").value = event.target.result.name;
5    document.querySelector("#age").value = event.target.result.age;
6    document.querySelector("#email").value = event.target.result.email;
7  };
8 }
```

You can [try this version of the online example that uses this shortened version](#) (the function is at the end of the JavaScript code):

```
1  function searchACustomerShort() {
2      if(db === null) {
3        alert('Database must be opened first, please click the Create CustomerDB Database first');
4        return;
5      }
6
7        db.transaction("customers").objectStore("customers")
8           .get(document.querySelector("#ssn").value).onsuccess = function(event) {
9             document.querySelector("#name").value = event.target.result.name;
10            document.querySelector("#age").value = event.target.result.age;
11            document.querySelector("#email").value = event.target.result.email;
12          };
13 }
```

What's happening here:

> Since there's only one object store, you can avoid passing a list of object stores you need in your transaction and just pass the name as a string (line 7),
> We are only reading from the database, so we don't need a "readwrite" transaction. Calling transaction() with no mode specified gives a "readonly" transaction (line 7),
> We don't actually save the request object to a variable. Since the DOM event has the request as its target we can use the event to get to the result property (line 8).

Using a cursor

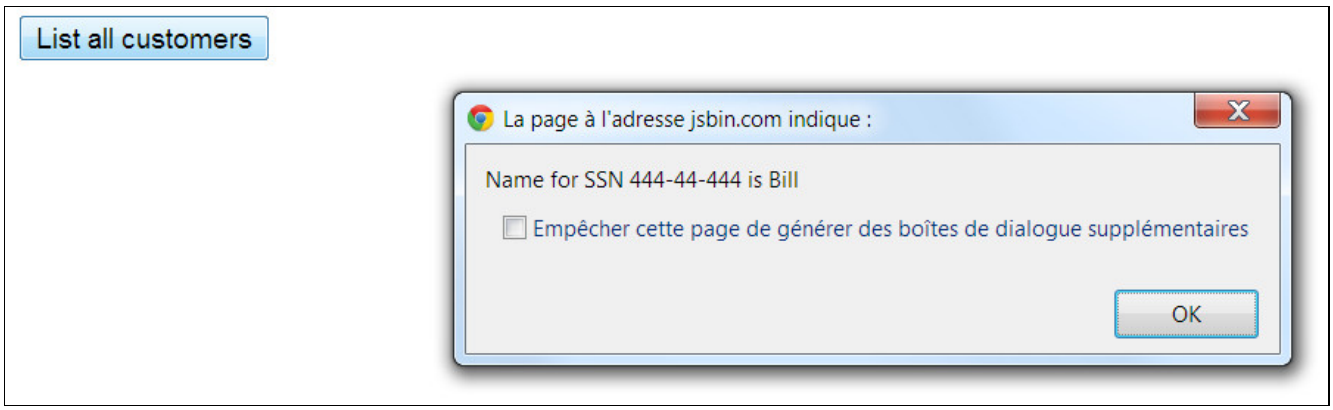
Using `get()` requires that you know which key you want to retrieve. If you want to step through all the values in your object store, or just between a certain range, then you can use *a cursor*.

Here's what it looks like:

```
function listAllCustomers() {
  var objectStore = db.transaction("customers").objectStore("customers");

  objectStore.openCursor().onsuccess = function(event) {
    // we enter this callback for each object in the store

    // The result is the cursor itself
    var cursor = event.target.result;

    if (cursor) {
      alert("Name for SSN " + cursor.key + " is " + cursor.value.name);
      // Calling continue on the cursor will make this callback to be called
      // again if there are other objects in the store
      cursor.continue();
    } else {
      alert("No more entries!");
    }
 }; // end of onsuccess...
} // end of listAllCustomers()

```

You can try this example online: http://jsbin.com/ocaxeh/39/edit

It adds a button to our application, clicking on it will display a set of alerts, each showing details of an object in the object store:



The `openCursor()` function takes several arguments.

First, you can limit the range of items that are retrieved by using a key range object that we'll get to in a minute.
Second, you can specify the direction that you want to iterate.

In the above example, we're iterating over all objects in ascending order. The `success` callback for cursors is a little special. The cursor object itself is the `result` of the request (above we're using the shorthand, so it's `event.target.result`). Then the actual key and value can be found on the `key` and `value` properties of the cursor object. If you want to keep going, then you have to call `continue()` on the cursor.

When you've reached the end of the data (or if there were no entries that matched your `openCursor()` request) you still get a success callback, but the `result` property is `undefined`.

One common pattern with cursors is to retrieve all objects in an object store and add them to an array, like this:

```
function listAllCustomersArray() {
  var objectStore = db.transaction("customers").objectStore("customers");

  var customers = []; // the array of customers that will hold results

  objectStore.openCursor().onsuccess = function(event) {
    var cursor = event.target.result;

    if (cursor) {
      customers.push(cursor.value); // add a customer in the array
      cursor.continue();
    } else {
      alert("Got all customers: " + customers);
    }
 }; // end of onsucess
} // end of listAllCustomersArray()
```

You can try this version online: http://jsbin.com/ocaxeh/40/edit

Using an index

Storing customer data using the ssn as a key is logical since the ssn uniquely identifies an individual. If you need to look up a customer by name, however, you'll need to iterate over every ssn in the database until you find the right one. Searching in this fashion would be very slow, so instead you can use an index.

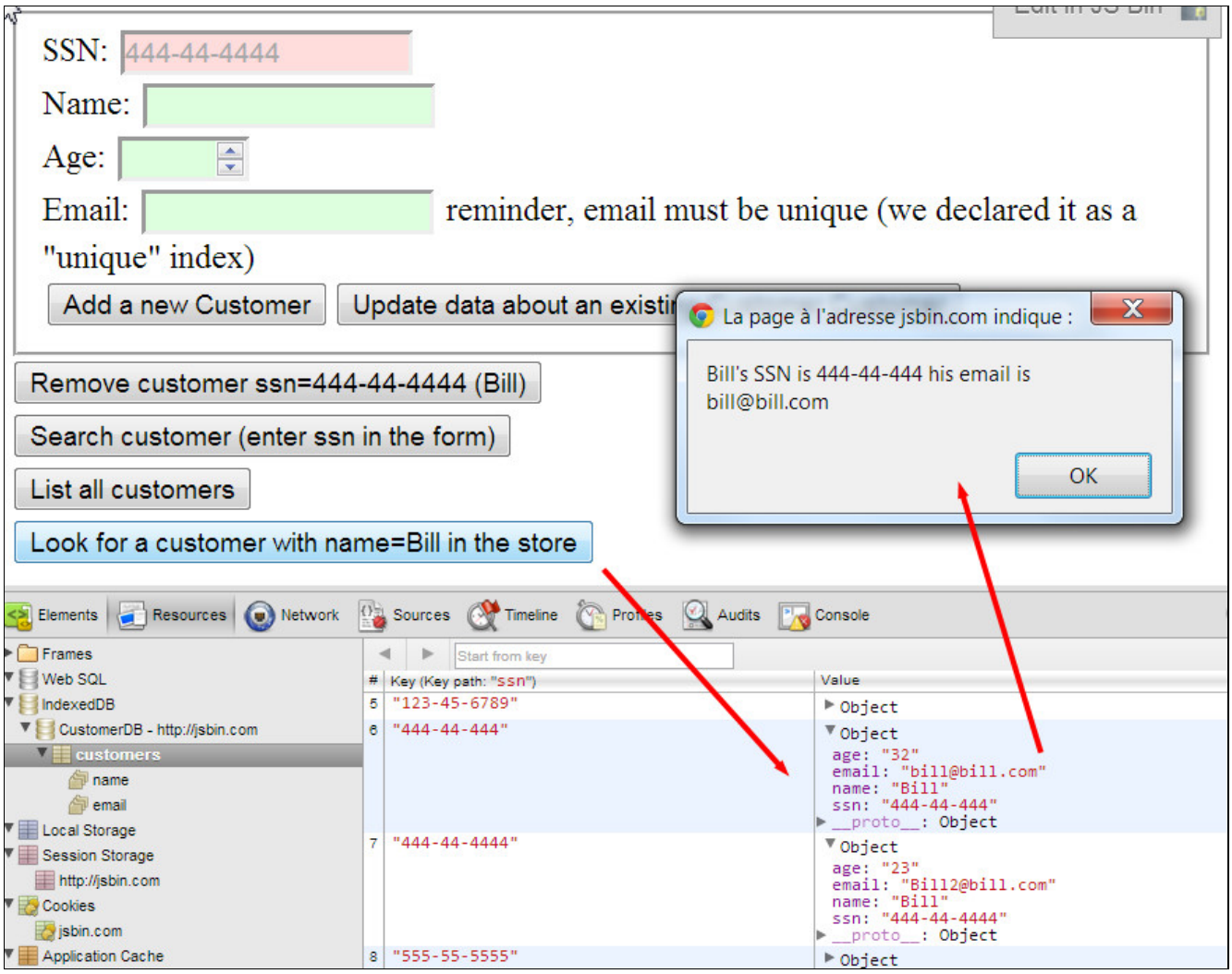
Remember that we added two indexes in our data store: one on the `name` and one on the `email` properties.

Here is a function that lists by name the objects in the object store and returns the first one it finds with a name equal to "Bill":

```
function getCustomerByName() {
  if(db === null) {
    alert('Database must be opened first, please click the Create CustomerDB Database first');
    return;
  }

  var objectStore = db.transaction("customers").objectStore("customers");

  var index = objectStore.index("name");

  index.get("Bill").onsuccess = function(event) {
    alert("Bill's SSN is " + event.target.result.ssn +
          " his email is " + event.target.result.email);
  };
}
```

The search by index occurs lone 9 and 11. Line 9 gets back an "index" object that corresponds to the index on the "name" property. Line 11 ucalls the `get()` method on this object to retrieve all objects that have a name equal to "Bill" in the dataStore.

And here is the online example you can try: http://jsbin.com/ocaxeh/45/edit



The above example retrieves only the first object that has an name/index with the value="Bill". Notice that there are two "Bill"s in the object store.

Getting more than one result

In order to get all the "Bill"s, we have to use again a cursor. When we work with indexes, we can open two different types of cursors on indexes:

A normal cursor that maps the index property to the object in the object store, or,
A key cursor that maps the index property to the key used to store the object in the object store.

The differences are illustrated here:

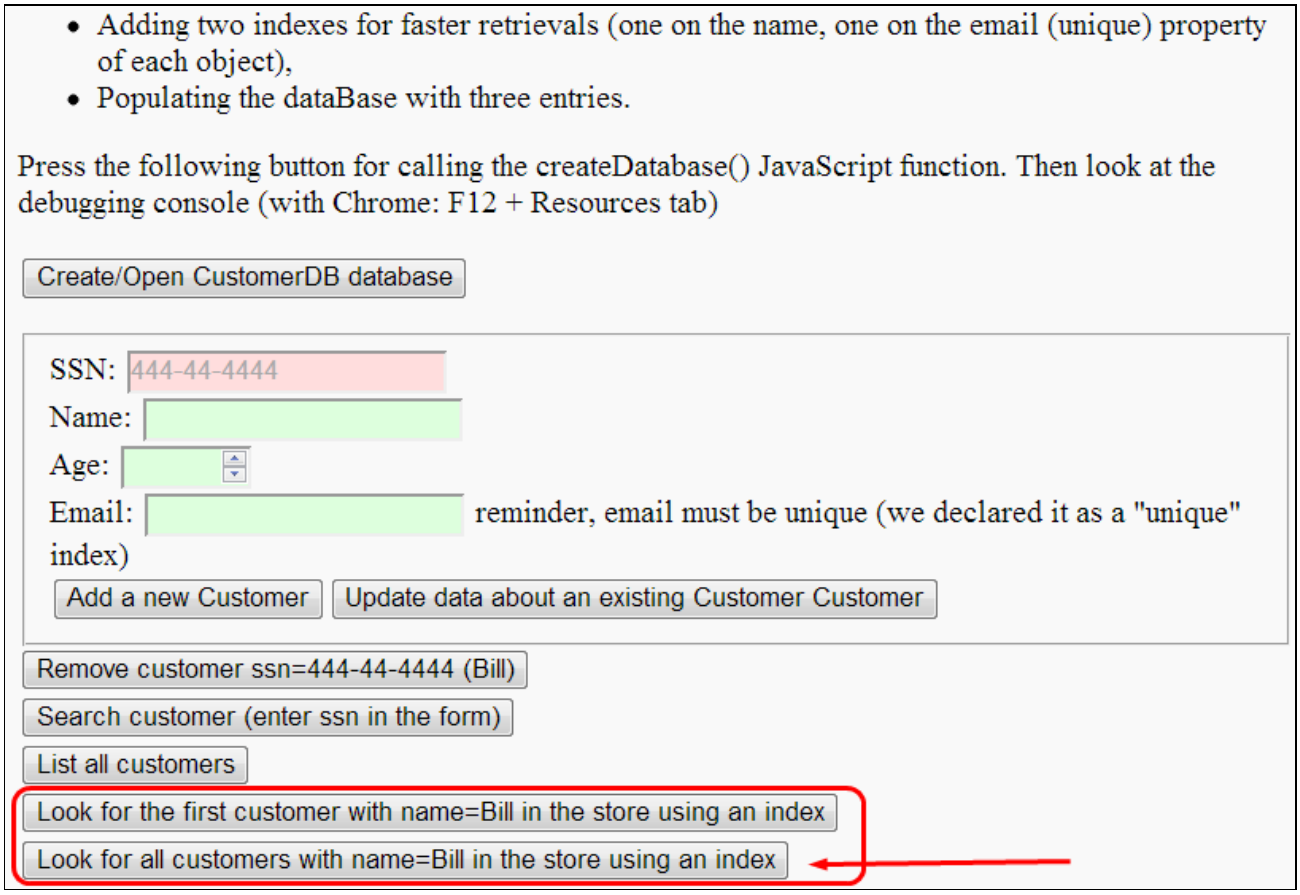
```
index.openCursor().onsuccess = function(event) {
  var cursor = event.target.result;
    if (cursor) {
      // cursor.key is a name, like "Bill", and cursor.value is the whole object.
     alert("Name: " + cursor.key + ", SSN: " + cursor.value.ssn + ", email: " + cursor.value.email);
     cursor.continue();
   }
};
```

and

```
index.openKeyCursor().onsuccess = function(event) {
  var cursor = event.target.result;
   if (cursor) {
     // cursor.key is a name, like "Bill", and cursor.value is the SSN (the key).
     // No way to directly get the rest of the stored object.
     alert("Name: " + cursor.key + ", "SSN: " + cursor.value);
     cursor.continue();
   }
```

```
};
```

Online example: http://jsbin.com/ocaxeh/51/edit



Press the create/Open CustomerDB database, then you may add some customers, then press the last button. This will iterate all the customers with name equals to "Bill" in the object store. There should be two "Bills", if this is not the case, add two customers with a name equal to "Bill", then press the last Button.

Code from the example:

```
function getAllCustomersByName() {
  if(db === null) {
      alert('Database must be opened first, please click the Create CustomerDB Database first');
      return;
    }

  var objectStore = db.transaction("customers").objectStore("customers");

  var index = objectStore.index("name");

  // Only match "Bill"
  var singleKeyRange = IDBKeyRange.only("Bill");

  index.openCursor(singleKeyRange).onsuccess = function(event) {

    var cursor = event.target.result;

    if (cursor) {
      // cursor.key is a name, like "Bill", and cursor.value is the whole object.
      alert("Name: " + cursor.key + ", SSN: " + cursor.value.ssn + ", email: " +   cursor.value.email);
      cursor.continue();
    }
  };
}
```

13 [ADVANCED] High level libraries for using IndexedDB, other useful ressources

Introduction

The learning curve of indexedDB is steep, furthermore, it requires a lot of callbacks/spaghetti code to use it properly. On the other hand, IndexedDB provides really cool stuff:

It is asynchronous!
It's versioned!
It's transactional! useful when used by several instances of the same webapp in different tabs, useful when used with WebWorkers, useful when used on Windows 8 desktop apps, Windows/Chrome stores, Firefox OS apps.
Support indexes for faster searches!
Works with objects, no need to work with JSON!
Offers bigger space (5 to 50 MB) and can be surpassed if user agree (especially for non "web" apps, for apps in stores or web os like Firefox OS).

This section will just proposes links to high-level libraries that are being developed. We haven't tested them so far, and prefer to wait until one these libs emerges as "the one you need to know"..

External libraries/tools for IndexedDB

DB.js : http://aaronpowell.github.io/db.js/
JQuery : https://github.com/axemclion/jquery-indexeddb
IDBWrapper: https://github.com/jensarps/IDBWrapper
PouchDB : http://pouchdb.com/

Even the guys from Firefox OS created their own utility: https://github.com/mozilla-b2g/gaia/blob/master/shared/js/async_storage.js

14 Conclusion about client-side persistence

Conclusion

Hmmm... this week we have studied a lot, and it may be that you have trouble identifying which of the different techniques we presented best suits your needs.

I copied here (source: http://www.html5rocks.com/en/tutorials/offline/storage/, follow this link for details) some tables that summarize the advantages and disadvantages of the different approaches.

To sum up:

> If you need to work with transactions (in the database sense: protect data against concurrent access, etc), or do some searches on a large amount of data, if you need indexes, etc. then use IndexedDB,
>
> If you need a way to simply store strings, or JSON objects, use localStorage/sessionStorage. Example: store HTML form content as you type, store a game hi-scores, preferences of an application, etc.
>
> if you need to cache files for faster access: today, use the cache API, tomorrow you will have the choice to create directories and files in a sandbow filesystem, using the Filesystem and Filewriter APIs.
>
> If you need an SQL database, ~~just use WebSQL~~. oops, no, forget this idea, please...

Web Storage

Strengths of Web Storage	Weakness of Web Storage
1. Supported on all modern browsers, as well as on iOS and Android, for several years (IE since version 8). 2. Simple API signature. 3. Simple call flow, being a synchronous API. 4. Semantic events available to keep other tabs/windows in sync.	1. Poor performance for large/complex data, when using the synchronous API (which is the most widely supported mode). 2. Poor performance when searching large/complex data, due to lack of indexing. (Search operations have to manually iterate through all items.) 3. Poor performance when storing and retrieving large/complex data structures, because it's necessary to manually serialize and de-serialize to/from string values. The major browser implementations only support string values (even though the spec says otherwise). 4. Need to ensure data consistency and integrity, since data is effectively unstructured.

WebSQL

Beware: not part of the HTML5 standard! May never be implemented by some browsers!

Strengths of Web SQL Database	Weakness of Web SQL Database
1. Supported on major mobile browsers (Android Browser, Mobile Safari, Opera Mobile) as well as several desktop browsers (Chrome, Firefox, Opera). 2. Good performance generally, being an asynchronous API. Database interaction won't lock up the user interface. (Synchronous API is also available for WebWorkers.) 3. Good search performance, since data can be indexed according to search keys. 4. Robust, since it supports a transactional database model. 5. Easier to maintain integrity of data, due to rigid data structure.	1. Deprecated. Will not be supported on IE or Firefox, and will probably be phased out from the other browsers at some stage. 2. Steep learning curve, requiring knowledge of relational databases and SQL. 3. Suffers from object-relational impedence mismatch. 4. Diminishes agility, as database schema must be defined upfront, with all records in a table matching the same structure.

IndexedDB

Strengths of IndexedDB	Weakness of IndexedDB
1. Good performance generally, being an asynchronous API. Database interaction won't lock up the user interface. (Synchronous API is also available for WebWorkers.) 2. Good search performance, since data can be indexed according to search keys. 3. Supports agile development, with no need to flexible data structures. 4. Robust, since it supports a transactional database model. 5. Fairly easy learning curve, due to a simple data model. 6. Decent browser support: Chrome, Firefox, mobile FF, IE10.	1. Somewhat complex API. 2. Need to ensure data consistency and integrity, since data is effectively unstructured. (This is the standard flipside weakness to the typical strengths of NOSQL structures.)

Filesystem API

Strengths of FileSystem API	Weakness of FileSystem API
1. Can store large content and binary files, so it's suitable for images, audio, video, PDFs, etc. 2. Good performance, being an asynchronous API.	1. Very early standard. Only available in Chrome. 2. No transaction support. 3. No built-in search/indexing support.