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# Offline web applications

We will look at Web SQL, IndexedDB, the FileSystem API, and the HTTP cache

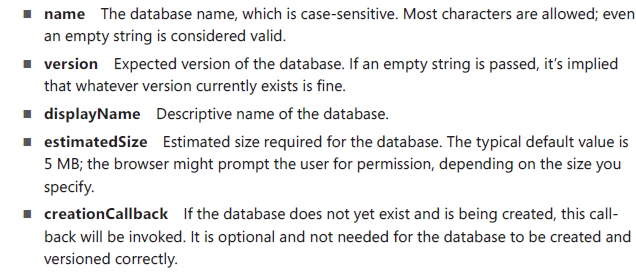
## Lesson 1: Working with Web SQL

**Serious Note**: W3C *no longer supports Web SQL*, but some browsers have continued the support of it. See http://caniuse.com/#feat=sql-storage for a full list of browsers (If you do plan on developing with Web SQL, consider the lack of browser support).

### Creating and opening the database

- Use the *openDatabase* method to start communication with a database (it returns a Database object). Note that if you attempt to open a database that doesn't exist, it will be automatically created for you.

The following are the *openDatabase* parameters:



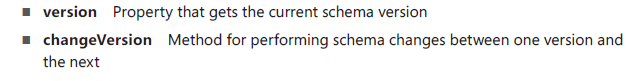
The following example creates a database named 'Library' with an estimated size of 5MB (it returns a Database object that supports transactional operations):

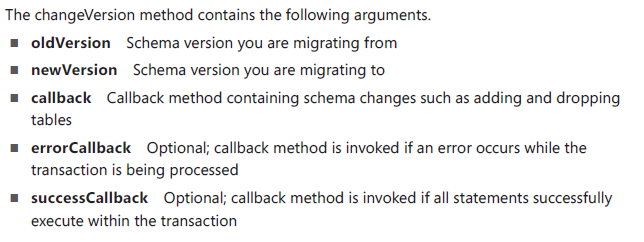
var db = openDatabase('Library', '1.0', 'My Library', 5 \* 1024 \* 1024);

**Closing a connection**: with Web SQL, closing a connection is automatically handled for you

### Performing schema updates

You may need to add new tables, drop existing ones, or even change particular columns. The *Database* object provides the following hooks.



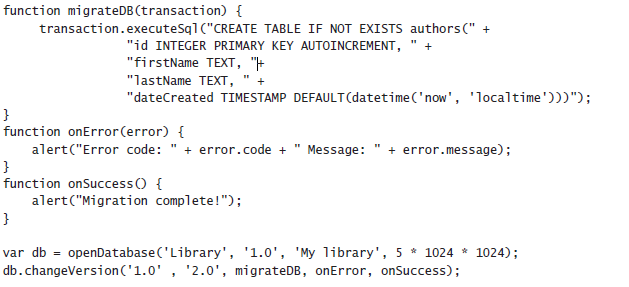


#### Adding a table

To add a table, need a callback method that accepts a *transaction* object, which executes the CREATE TABLE script.

**Note**: The *transaction* object allows multiple actions within it, and it automatically rolls back all changes if any fail.

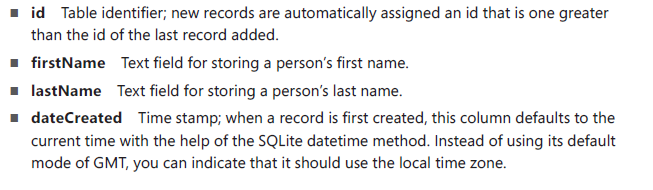
Javascript Example:



JSFiddle: https://jsfiddle.net/bs4r5ooa/ (**The code did not work on JsFiddle, or on my local computer - Forget this garbage**)

**To read the database version:** alert("Current schema: " + db.version);

**After the migration**, the current database has the following fields:



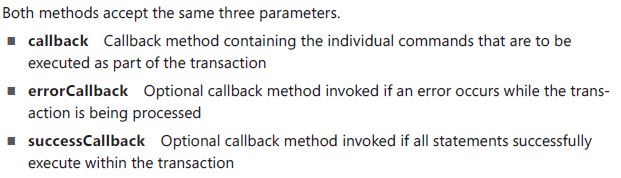
#### Using transactions

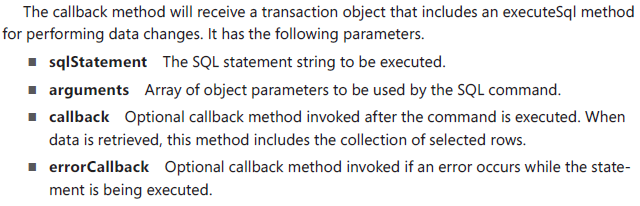
Use transactions to execute SQL statements.

The Database Object provides the ff two methods:



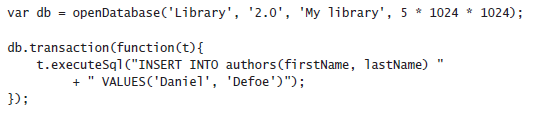




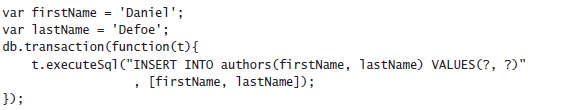


#### Inserting a new record

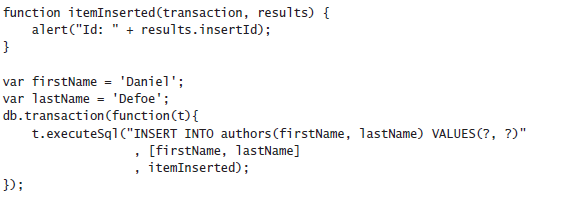
**Without using SQL parameters:**



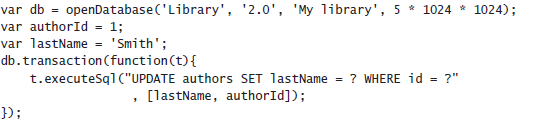
**Using SQL parameters:**

****

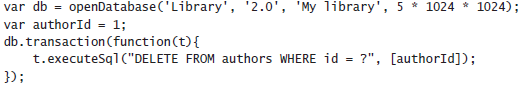
**Add a callback function to the executeSql method, which allows us capture the Id of the newly created row:**

****

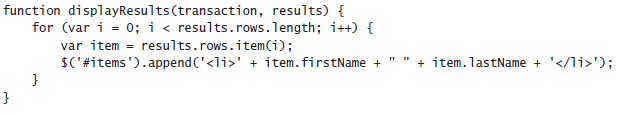
#### Updating an existing record

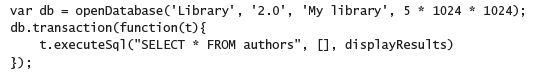


#### Deleting a record



#### Reading values from the database

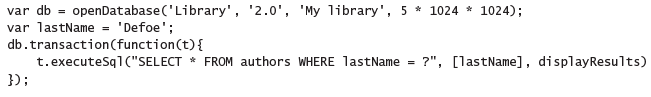




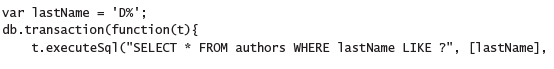
NOTE: Because you are only retrieving data, you just as easily could have used the *readTransaction* method instead of the transaction method



#### Filtering results (using WHERE)

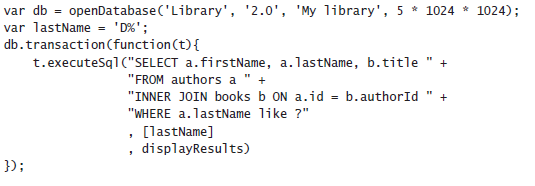


**Using Wildcard symbol** (%)

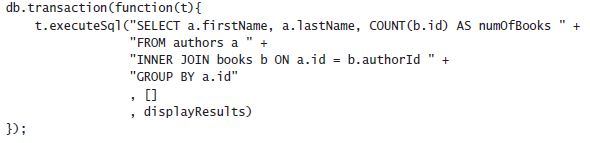




#### Using JOIN commands



#### using Aggregating functions



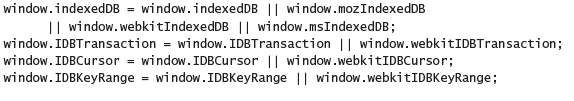
## Lesson 2: Working with IndexedDB

**What is IndexedDB**: A key/value database in which values can range from simple strings to complex object structures

### Using browser-specific code

IndexedDB is still under development hence we need to use browser-specific prefixes.

**Note**: To **make your IndexedDB code cross-browser-friendly**, include the following code at the top of your page

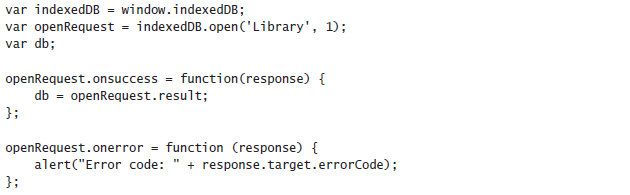


### Creating and opening the database

**To access the browser's indexedDB object,** use:

var indexedDB = window.indexedDB;

**To open an indexedDB object store**, use



**Live code**: Run "index.html". Look at the "testIndexedDBOpen.js" file to see working code.

**Note about using the 'open' indexedDB method**: This method returns an *IDBRequest* object and begins an *asynchronous process* of opening a connection. Hence we have to listen to the 'onsuccess' and 'onerror' methods to determine when the database has been opened or when an error occurs.

### Using object stores

IndexedDB uses 'Object stores', which are key/value storage areas.

#### Understanding versioning

Before creating a new 'object store', you need to understand how IndexedDB handles versioning.

E.g. Consider the code below



In the code, a **version number is passed as the second parameter**. The *'request object'* returned contains an *'onupgradeneeded'* event that will be **triggered if the version requested doesn't match the current version of the existing database (or if the database does not yet exist)**.

**Note**: the ' *onupgradeneeded'* event will be fired BEFORE the *'onsuccess'* event

**How to allocate a new storage area**

Within the *onupgradeneeded* event handler, use the *createObjectStore* method to allocate a new storage area.

This method requires an *object store name* and an *object* containing any extra parameters to use in configuring the store.

#### Using the keypath property

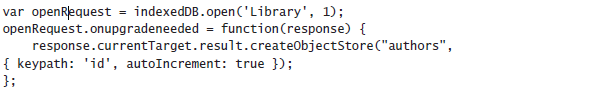
Used to specify which property on the *value* object should be used as the key.

(The key is used as the primary index for stored object instances)

**NOTE**: If the property specified by the keypath does not exist on the value object, you must use a key generator such as autoIncrement, which creates auto incrementing numeric keys

e.g.

**JS**:



**Live Code**: open 'keypathTest.html' in a browser. See 'testIndexedDBKeypath.js' for the code

**To use an existing field in the value object as the *key*** (e.g. using the 'email' property as a key)*,* use:

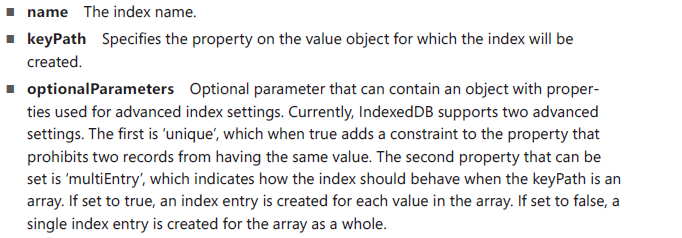
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#### Adding indexes

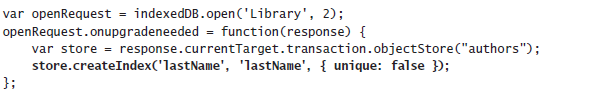
Although the key will be the primary index for object stores, you can specify other indexes.

**Use This When**: properties other than the key might be commonly used in sorting or filtering.

**To create an index**, use the 'createIndex' method on the object store, which has the following parameters:



e.g. using the *createIndex* method on the object store to create a new, non-unique index for the lastName property

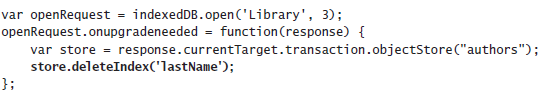


Note: The *createIndex* method is called during a database migration, within the *onupgradeneeded* event handler, to ensure that the index is created when the version is updated.

#### Removing indexes

Remove an index by creating a database migration that uses the object store's *deleteIndex*() method

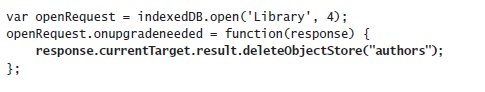
e.g.



#### Removing object stores

use *deleteObjectStore()* method in the *onupgradeneeded* event

e.g.



### Using transactions

**objectStoreNames**: use a single string when creating a transaction for one objectStore, and an array when creating a transaction for multiple objectStores

e.g. opening a transaction for a single object store

*var trans = db.transaction('authors');*

Here is an example of opening a transaction for multiple object stores.

*var trans = db.transaction(['authors', 'books']);*

**mode**: Optional parameter. Possible values are *readonly* and *readwrite*. Default value is *readonly.*

e.g. a transaction being opened in *readonly* mode.

*var trans = db.transaction('authors', 'readonly');*

Example of a transaction being opened in *readwrite* mode.

*var trans = db.transaction('authors', 'readwrite');*

#### Inserting a new record

After creating a transaction, we can use it to add a new record.

Steps to adding a new record using a transaction:

1. find the object store to which we want to add the record

2. Call the *add* method of the object store, which will insert the record asynchronously. (**Note**: the *add* method returns a request instance in which you can subscribe to an *onsuccess* event that provides notification when the operation is completed)

3. Use the *request.result* property to obtain the auto-generated id for the new record

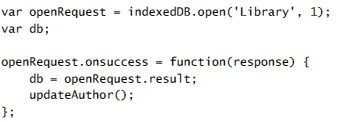
4. You can also subscribe to the *onerror* event if the operation fails

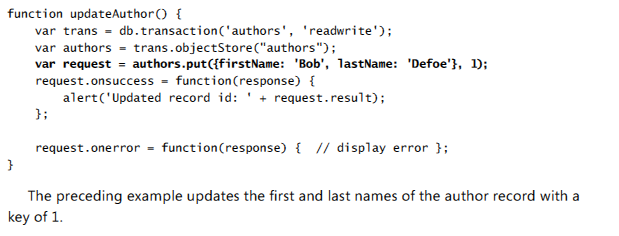
**Note**: An exception is thrown if the add method is called using a key that already exists  
e.g.  


#### Updating an existing record

Just like adding a new record except we use the *put* method of the object store.

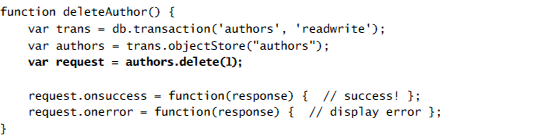
**Note**: We can use the *put()* method for both adding and updating records, However the *add()* method can only be used for adding new records.

e.g.  




#### Deleting a record

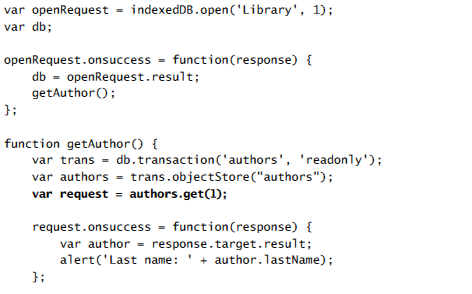
To remove a stored object, you need to pass its key value to the delete method of the object store

e.g.  


#### Retrieving a record

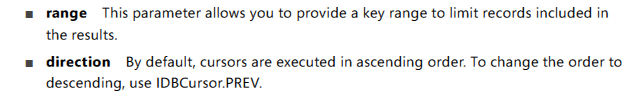
If you need to find a specific record use the *get()* method of the object store

**Note**: Like other operations, this needs to be done within a transaction

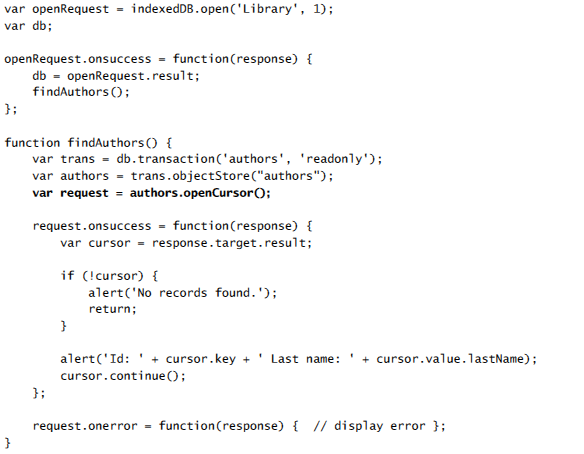
e.g.  
  


### Understanding cursors

Cursors are another way to find records.

A cursor can be opened by calling the *openCursor()* method on the object store, which returns a request object and accepts the following parameters:  


e.g. The following is a simple example that iterates through all records held in the authors object store



**Notes on using cursors**:

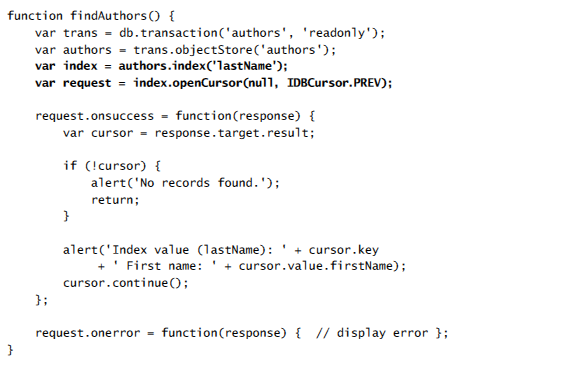
* The **cursor itself is on the result property** of the response of the *onsuccess* event handler.
* If records are found, the **cursor’s value property will contain the current record**.
* **To continue iterating, invoke the cursor’s continue method**, which will trigger the *onsuccess* eventhandler again, this time with the next record in the results. **When it reaches the end of the collection, the *onsuccess* event will have a null cursor**.

#### Indexing cursors

Cursors can also be created by using an index of an object store.

The cursor opened in the previous example using the *openCursor()* method will return the entire object associated to the index value.

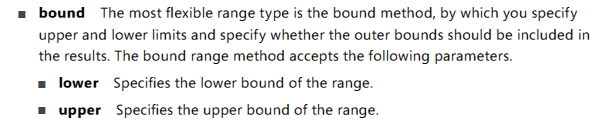
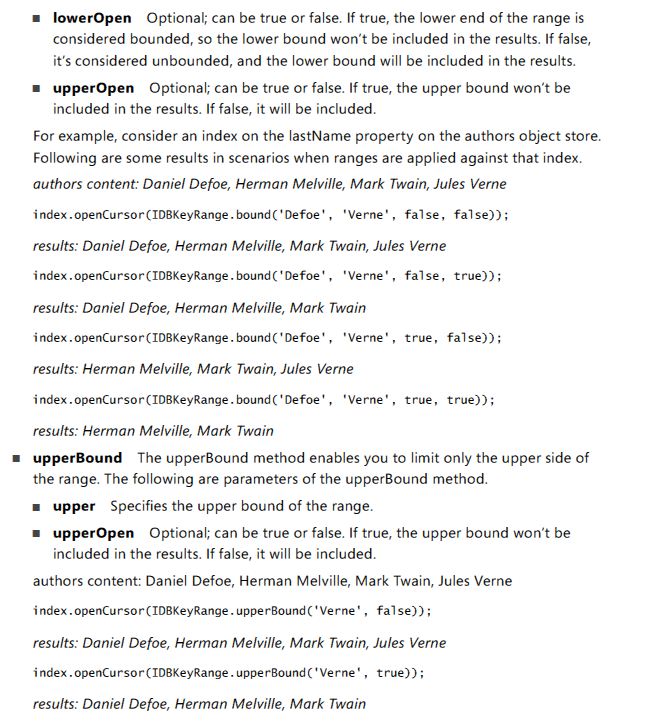
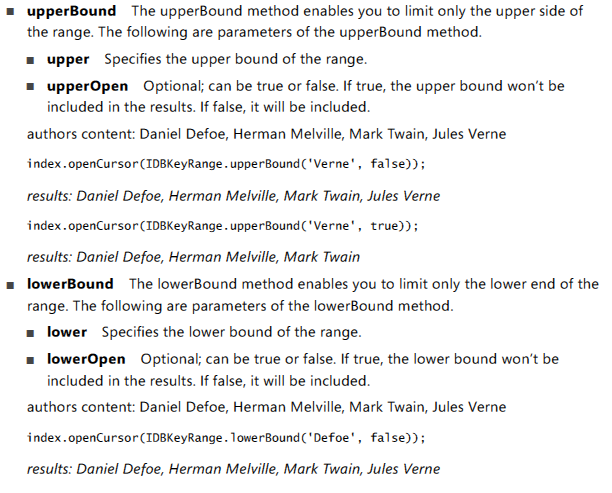
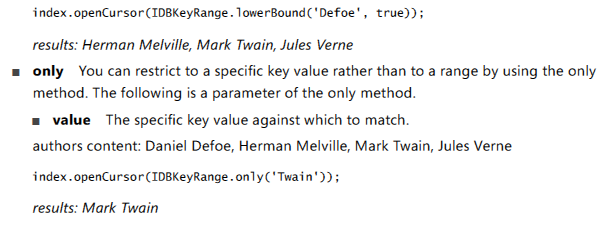
If you **only need the object keys** and not the full object, use the *openKeyCursor()* method

e.g. the example below is a modified version of the *findAuthors()* method, which creates the cursor against the lastName index instead of going directly against the object store.  


#### Applying key range limits

To limit the results of a cursor to a subset of the data store, pass an IDBKeyRange value as the first parameter to the openCursor method.

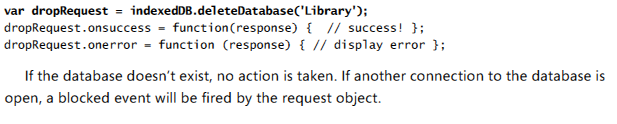
The IDBKeyRange object can accept the following range methods:

### Dropping a database

The IDBFactory object that is referenced by the indexedDB object contains a *deleteDatabase()* method that removes an existing database.

**deleteDatabase()** : takes a name parameter and returns a request object immediately while asynchronously attempting to drop the database

e.g.  


## Lesson 3: Working with the FileSystem API

Using the FileSystem API, we can create directories in a sandboxed location on the user’s system where we can store images, text files, and other large bits of data

Lesson objectives

* Describe the use of the FileSystem API
* Implement the FileSystem API

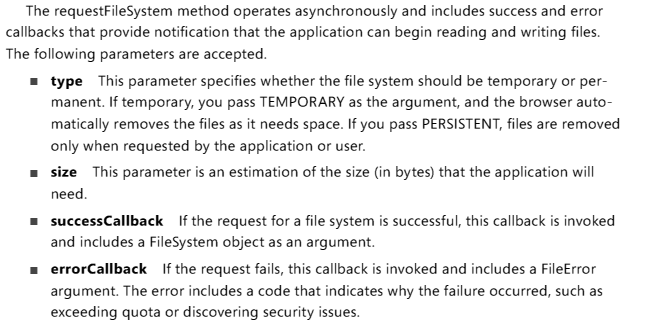
### Assessing browser support

The only major browser that supports the FileSystem API is Chrome, therefore the FileSystem API is most commonly used in creating Chrome extensions.

### Opening the file system

Use the following code to open the FileSystem:

window.requestFileSystem = window.requestFileSystem || window.webkitRequestFileSystem;

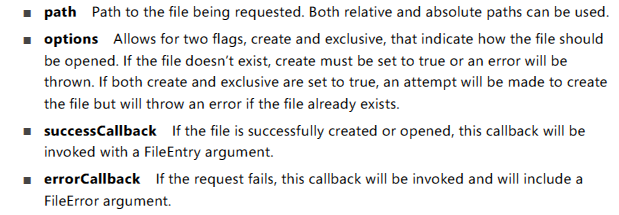


### Creating and opening a file

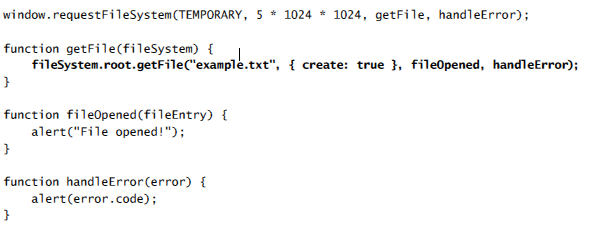
To create a file we need to have a DirectoryEntry object so we have an allocated place to put the file.

The FileSystem argument passed to the *successCallback()* method includes a special DirectoryEntry as a property named root, which points to the root of the file system reserved for the application.

A DirectoryEntry object has a getFile() method that can both create new files and read those that already exist.

The following are the parameters of the getFile() method:  
  


e.g. The example below shows us how to create a new file in the root directory of the DirectoryEntry



### Writing to a file

When you have access to a *FileEntry* object, you can create a *FileWriter*, which persists data to the opened file.

The *fileOpened* method in the previous example is modified to create a new *FileWriter* and write a line of text to the opened document. **Writing to a file is done using the FileWriter's write method, which accepts a binary large object (BLOB) data parameter**.

**Note**: in the *writeToFile* method below, you must assign the *onwriteend* and *onerror* callbacks before performing the write action

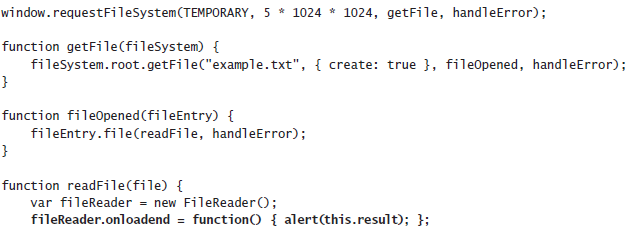
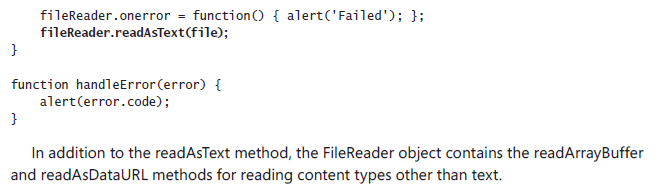
e.g.   


### Reading a file

The *FileEntry* object also has a *file* method, which makes it return a File object.

Read from a *File* object using the *FileReader* object.

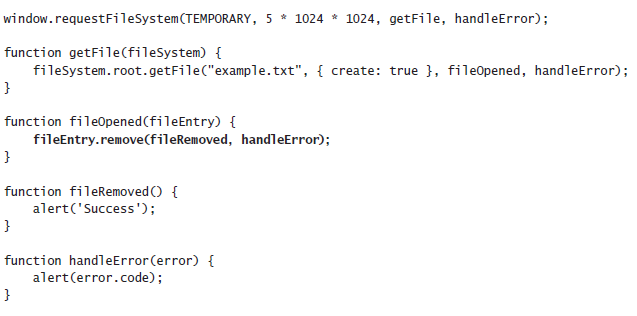
**Note**: Similar to the *FileWriter*, we must set the *onloadend* and *onerror* callbacks before making the read attempt

e.g. The example below uses the *readAsText* method to read the contents of the file and store it in a string that can be accessed in the *this.result* value within the *onloadend* callback  
  


### Deleting a file

Also requires a *FileEntry* object. The *FileEntry* object has a *remove* method to remove itself from the file system.

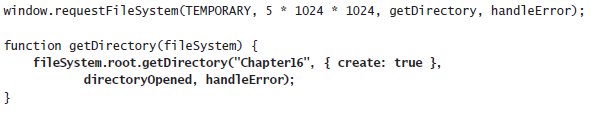
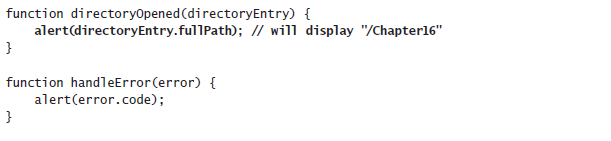
The FileEntry's *remove* method accepts both a *successCallback* call and an *onError* callback, as shown in the code below

e.g.  


### Creating and opening a directory

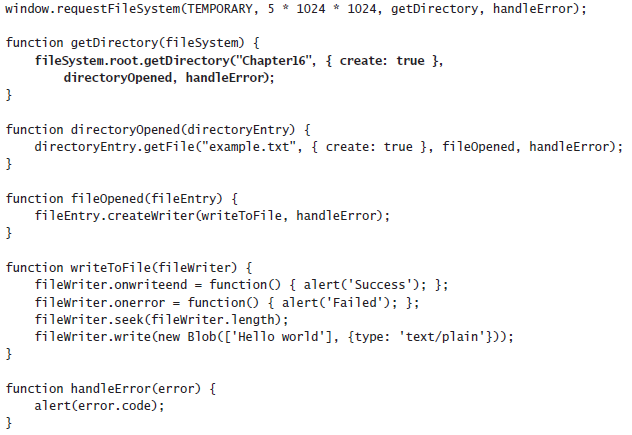
Similar to working with files.

Use *getDirectory* to open or create a new directory.

e.g.  
  


### Writing a file to a directory

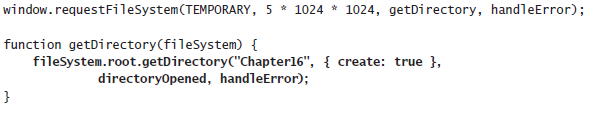
e.g. The example below shows us how to write a file to a new subdirectory outside of the root directory



### Deleting a directory

The *DirectoryEntry* object also inherits from the Entry object, which provides a remove method.

**Note**: The *remove* method is only used for empty directories. An error will be thrown if the directory contains other subdirectories or files.

e.g.  
  


## Lesson 4: Working with the offline application HTTP cache

Current automatic caching of web resources is not reliable, so HTML5 offers the application cache, which introduces the ability to configure how files are cached by including a manifest file.

The manifest file contains a list of resources to include and exclude from cache, and alternate file designations to serve in some cases.

**Key**: the application cache works behind the scenes to keep the local cache up to date as the manifest file is updated. Once the internet connection is lost, the cache switches over to serve local files.

### Browser support

The application cache is now **supported by all major browsers** and most mobile browsers (for Internet explorer, it starts from IE10).

### The cache manifest file

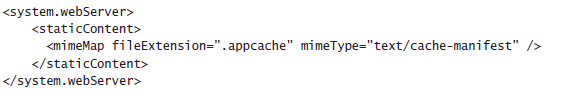
The manifest file must exist in order for the application cache to work.

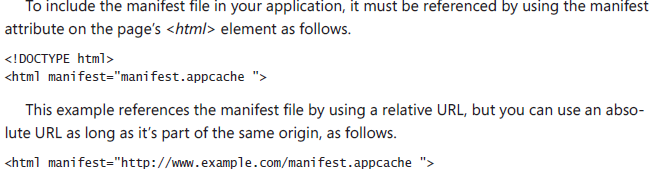
Serving the manifest file:

- To serve the manifest file correctly, use the *text/cache-manifest* content type in the HTTP response.

- The file itself can reside anywhere on your web server such as /home/manifest or /manifest.appcache.

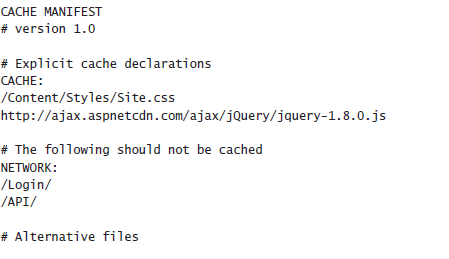
- if you choose to use a static file reference, you might need to configure the MIME type in Internet Information Server (IIS) first, or add a mimeMap element to your application's web.config file.

e.g. Adding a mimeMap type to web.config  




### Understanding structure

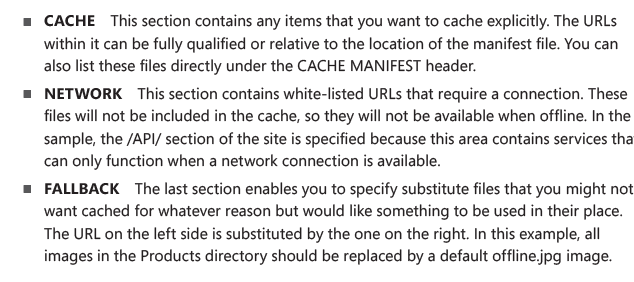
e.g. The example below shows what a sample manifest file looks like


Important notes about the structure of a manifest file:

- The top line of the file MUST always be the *CACHE MANIFEST* statement  
- Comment lines begin with a # symbol and will be ignored by the browser (Empty lines are also ignored)

The example file shown above has the following 3 sections within it



### Updating the cache

After changing the manifest file, the browser asynchronously downloads and caches all the files listed in the manifest file.

All cached resources listed in the manifest file are held until either:

- The manifest file is updated  
- The user manually clears the cache  
- The cache is updated through a developer-created script

Problem: A change to a resource itself doesn't trigger a cache update, so the cache can easily become stale

Solution: include a version number with each deployment of the web application

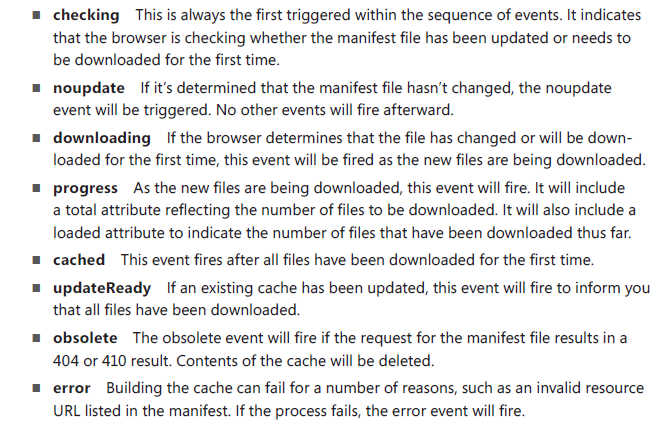
e.g.



### Understanding events

Normally the application cache process occurs silently. That said, using the *window.applicationCache* object, we can inject custom functionality into that workflow.

As the browser executes each step in the cache process, it fires a series of events on the applicationCache object. The events are listed below:



#### Updating the cache programmatically from code

use *window.applicationCache.update();*

#### Swapping the newly updated cache for the old cache

After the new cache has been downloaded and the updateReady event has fired, you can call the swapCache method to replace the old cache with the new

e.g.  
