Comp 322/422 - Software Development for Wireless and Mobile Devices

Fall Semester 2018 - Week 5

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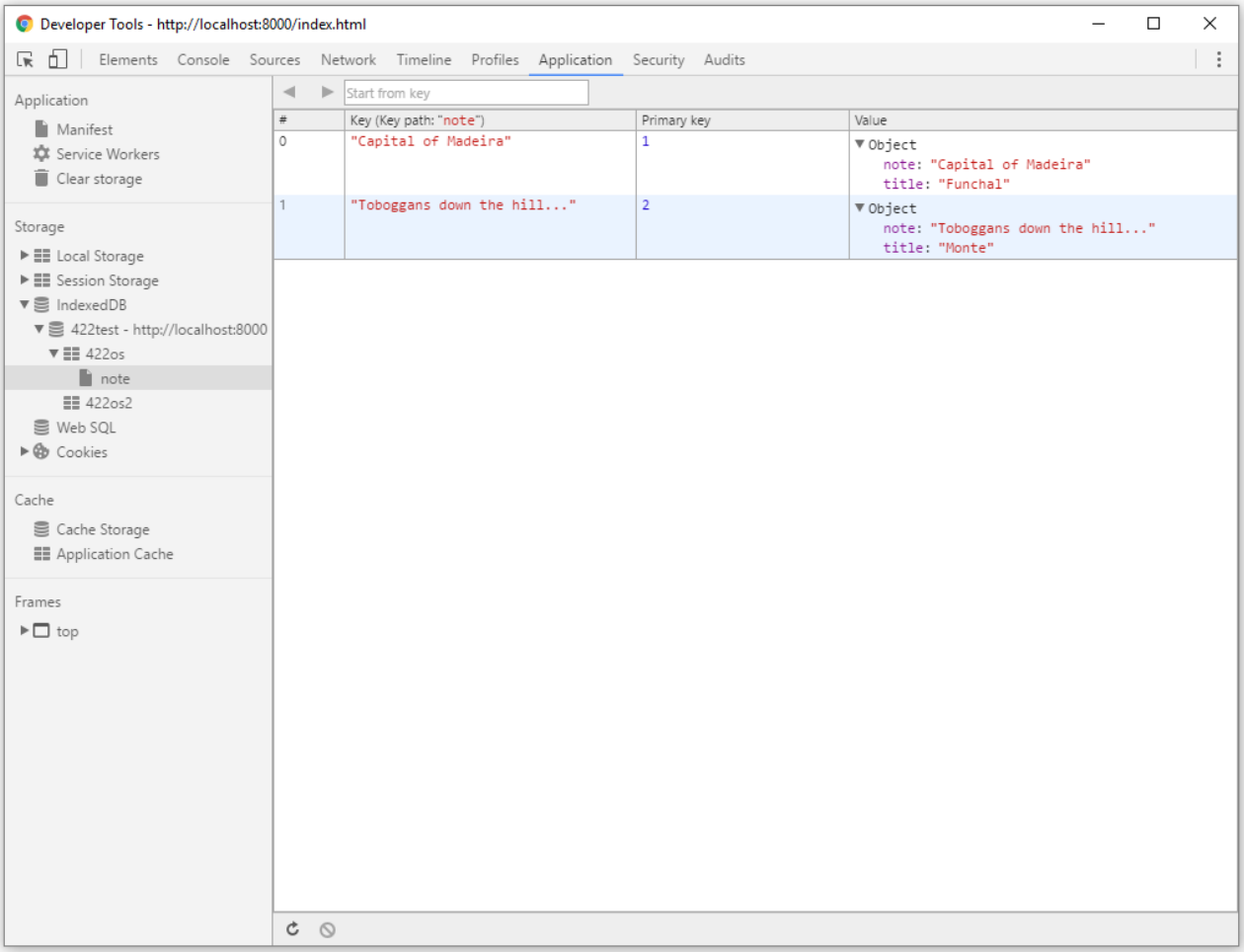
Cordova app - IndexedDB - Recap

Material covered so far:

- general intro
- checked IndexedDB availability as part of `deviceready` event
  - *created reference for later use...*
- general usage
  - *connection &c.*
- event listeners
  - *`success`, `error`, `upgradeneeded`, `blocked`*
- create a new DB
  - *check persistence*
  - *work with success and fail callbacks*
- object stores
- add data
- work with data handlers
- multiple object stores, notes...
- keys
- ...

Image - IndexedDB Support



DataTest2 - test IndexedDB - unique keys 2

Cordova app - IndexedDB - data test 2

database - part 16 - read data

- now able to save our notes to the IndexedDB
- need to read this data, and then load it into our application
- use the same underlying pattern for read and write
  - *use a transaction, and the request will be asynchronous*
  - *modify our transaction for* `readonly`

```
// create transaction
var dbTransaction2 = db.transaction(["422os"],"readonly");
```

- then use our new transaction get the required object store,

```
// define data object store
var dataStore2 = dbTransaction.objectStore("422os");
```

- then request our value from the database,

```
// request value - key &c.
var object1 = dataStore2.get(key);
```

- then use returned value for rendering...

Cordova app - IndexedDB - data test 2

database - part 17 - read data

- update our HTML with a button to load and test our data from IndexedDB,

```
...
<input type="button" id="loadNote" data-icon="refresh" value="Load Note"
...
```

- add our event handler for the button
  - *allows us to call the `loadNoteData()` function for querying the IndexedDB*

```
// handler for load note button
$("#loadNote").on("tap", function(e) {
  e.preventDefault();
  // get requested data for specified key
  loadNoteData(1);
});
```

Cordova app - IndexedDB - data test 2

database - part 18 - read data

- need to add our new function to load the data from the object store

```
function loadNoteData(key) {
 var dbTransaction = db.transaction(["422os"],"readonly");
 // define data object store
 var dataStore2 = dbTransaction.objectStore("422os");
 // request value - use defined key
 var object1 = dataStore2.get(key);
 // do something with return
 object1.onsuccess = function(e) {
   var result = e.target.result;
   //output to console for testing
   console.dir(result);
   console.log("found value...");
 }
}
```

- use transaction to create connection to specified object store in IndexedDB
- able to request a defined value using a specified key
  - *in this example `key 1` for the object store `422os`*
- process return value for use in application

Image - IndexedDB Support

Cordova app - IndexedDB - data test 2

database - part 19 - read more data

- retrieving a single, specific value for a given key is obviously useful
  - *may become limited in practical application usage*
- IndexedDB provides an option to retrieve multiple data values
- uses an option called a `cursor`
  - *helps us iterate through specified data within our IndexedDB*
- use these cursors to create iterators with optional filters
  - *using range within a specified dataset*
  - *also add a required direction*
- creating and working with a cursor requires
  - *a transaction*
  - *performs an asynchronous request*

Cordova app - IndexedDB - data test 2

database - part 19 - read more data

- create our transaction,

```
var dbTransaction = db.transaction(["422os"],"readonly");
```

- retrieve our object store containing the required data

```
// define data object store
var dataStore3 = dbTransaction.objectStore("422os");
```

- now create our `cursor` for use with the required object store,

```
var cursor = dataStore3.openCursor();
```

- with this connection to the required object store in our specified IndexedDB
  - *now process the return values for our request*

Cordova app - IndexedDB - data test 2

database - part 20 - read more data

- use cursor to iterate through return results
  - *work with specified object store within our standard `success` handler*

```
cursor.onsuccess = function(e) {
  var result = e.target.result;
  if (result) {
    console.dir("notes", result.value);
    console.log("notes", result.key);
    result.continue();
 }
}
```

- new success handler is working with a passed object for the result from our IndexedDB
- object, `402result`, contains
  - *required keys, data, and a method to iterate through the returned data*
- `continue()` method is the iterator for this cursor
  - *allows us to iterate through our specified object store*

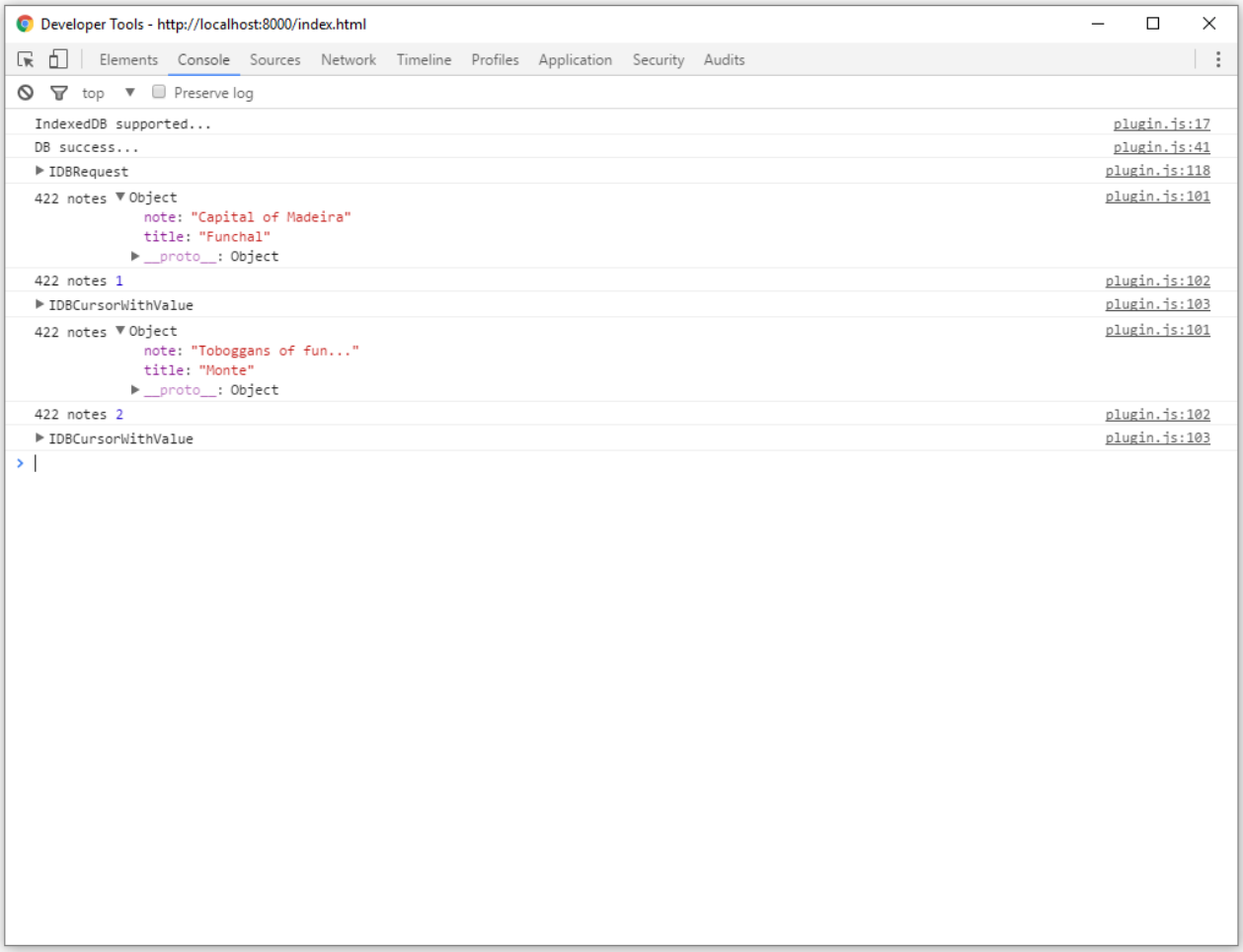
Cordova app - IndexedDB - data test 2

database - part 21 - read more data

- add an option to view all of the notes within our IndexedDB
- using the following new function, `loadNotes()`

```
function loadNotes() {
  // create transaction
  var dbTransaction = db.transaction(["422os"],"readonly");
  // define data object store
  var dataStore3 = dbTransaction.objectStore("422os");
  var cursor = dataStore3.openCursor();
  // do something with return...
  cursor.onsuccess = function(e) {
    var result = e.target.result;
    if (result) {
      console.log("422 notes", result.value);
      console.log("422 notes", result.key);
      console.dir(result);
      result.continue();
    }
  }
}
```

Image - IndexedDB Support



DataTest2 - test IndexedDB - read more data

Cordova app - IndexedDB - data test 2

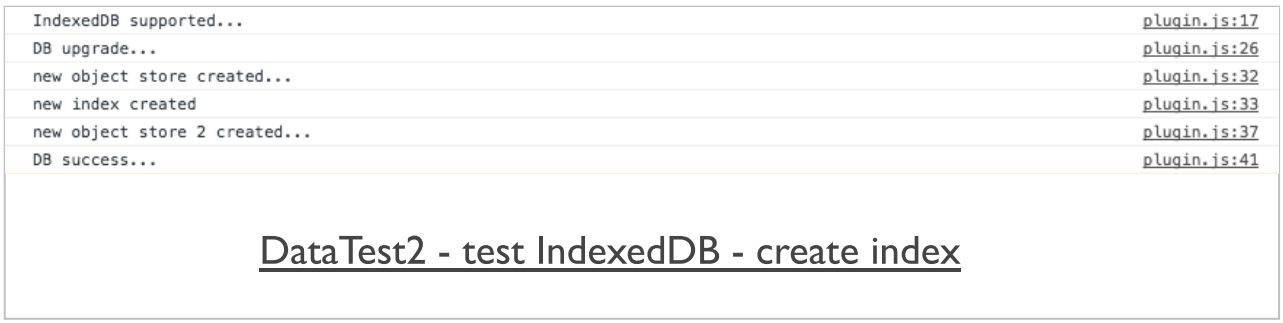
database - part 22 - index

- a primary benefit of using IndexedDB
  - *its support for indexes*
  - *retrieve data from these object stores using the data value itself*
  - *in addition to the standard key search*
- start by adding this option to our object stores
- create an index by using our pattern for an `upgrade` event
  - *creating the index at the same time as the object store*

```
var dataStore = db.createObjectStore("422os", { autoIncrement:true});
// set name of index
dataStore.createIndex("note","note", {unique:false});
```

- creating our object store, `422os`
  - *then using object store result to create and index using `createIndex()`*
  - *first argument for this method is the name for our index*
  - *second is the actual property we want indexing within the object store*
  - *add a set of options, eg: unique or not*
- IndexedDB will then create an index for this object store

Image - IndexedDB Support



Cordova app - IndexedDB - data test 2

database - part 22 - index

- new index now created
  - *start to add options for querying the database's values*
- need to specify a required index from the applicable object store
- use a transaction to retrieve a given object store
  - *then able to specify required index from that object store*

```
// create transaction
var dbTransaction = db.transaction(["422os"],"readonly");
// define data object store
var dataStore = dbTransaction.objectStore("422os");
// define index
var dataIndex = dataStore.index("note");
```

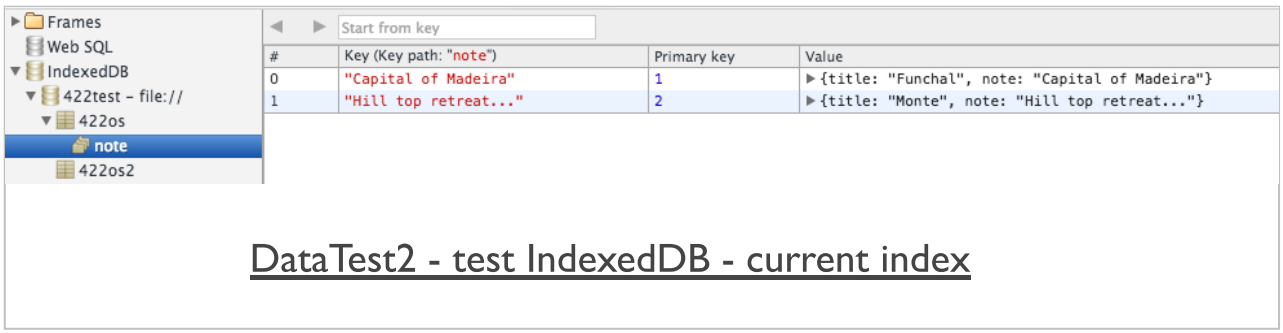
- we can then request some values using a standard `get` method with this index

```
var note = "Capital of Madeira";
var getRequest = dataIndex.get(note);
```

Image - IndexedDB Support

DataTest2 - test IndexedDB - query index

Image - IndexedDB Support



DataTest2 - test IndexedDB - current index

Cordova app - IndexedDB - data test 2

database - part 23 - index

- we will need to consider queries against an index in much broader terms
- we need to consider the use and application of ranges relative to our index
- use of ranges returns a limited set of data from our object store
- IndexedDB helps us create few different options for ranges
  - ***everything above..., everything below..., something between..., exact***
  - *set ranges either inclusive or exclusive*
  - *request ascending and descending ranges for our results*
- an example range might be limiting a query to a specific word, title, or other key value...

```
// Only match "Madeira"
var singleRange = IDBKeyRange.only("Madeira");
```

- by default, IndexedDB supports the following types of queries
  - `IDBKeyRange.only()` - *Exact match*
  - `IDBKeyRange.upperBound()` – *objects = property below certain value*
  - `IDBKeyRange.lowerBound()` – *objects = property above certain value*
  - `IDBKeyRange.bound()` – *objects = property between certain values*

Server-side considerations - data storage

SQL or NoSQL

- common database usage and storage
  - *often thought solely in terms of SQL, or structured query language*
- SQL used to query data in a relational format
- relational databases, for example MySQL or PostgreSQL, store their data in tables
  - *provides a semblance of structure through rows and cells*
  - *easily cross-reference, or relate, rows across tables*
- a relational structure to map authors to books, players to teams...
  - *thereby dramatically reducing redundancy, required storage space...*
- improvement in storage capacities, access...
  - *led to shift in thinking, and database design in general*
- started to see introduction of non-relational databases
  - *often referred to simply as* ***NoSQL***
- with NoSQL DBs
  - *redundant data may be stored*
  - *such designs often provide increased ease of use for developers*
- some NoSQL examples for specific use cases
  - *eg: fast reading of data more efficient than writing*
  - *specialised DB designs*

Server-side considerations - data storage

Redis - intro

- Redis provides an excellent example of NoSQL based data storage
- designed for fast access to frequently requested data
- improvement in performance often due to a reduction in perceived reliability
  - *due to in-memory storage instead of writing to a disk*
- able to flush data to disk
  - *performs this task at given points during uptime*
  - *for majority of cases considered an in-memory data store*
- stores this data in a **key-value** format
  - *similar in nature to standard object properties in JavaScript*
- Redis often a natural extension of conventional data structures
- Redis is a good option for quick access to data
  - *optionally caching temporary data for frequent access*

Server-side considerations - data storage

MongoDB - intro

- MongoDB is another example of a NoSQL based data store
  - *a database that enables us to store our data on disk*
- unlike MySQL, for example, it is not in a relational format
- MongoDB is best characterised as a **document-oriented** database
- conceptually may be considered as storing objects in collections
- stores its data using the BSON format
  - *consider similar to JSON*
  - *use JavaScript for working with MongoDB*

Server-side considerations - data storage

MongoDB - document oriented

- SQL database, data is stored in tables and rows
- MongoDB, by contrast, uses **collections** and **documents**
- comparison often made between a collection and a table
- **NB:** a document is quite different from a table
- a document can contain a lot more data than a table
- a noted concern with this document approach is duplication of data
- one of the trade-offs between NoSQL (MongoDB) and SQL
- SQL - goal of data structuring is to normalise as much as possible
- thereby avoiding duplicated information
- NoSQL (MongoDB) - provision a data store, as easy as possible for the application to use

Server-side considerations - data storage

MongoDB - BSON

- BSON is the format used by MongoDB to store its data
- effectively, JSON stored as binary with a few notable differences
  - *eg: `ObjectId` values - data type used in MongoDB to uniquely identify documents*
  - *created automatically on each document in the database*
  - *often considered as analogous to a primary key in a SQL database*
- `ObjectId` is a large pseudo-random number
- for nearly all practical occurrences, assume number will be unique
- might cease to be unique if server can't keep pace with number generation...
- other interesting aspect of `ObjectId`
  - *they are partially based on a timestamp*
  - *helps us determine when they were created*

Server-side considerations - data storage

MongoDB - general hierarchy of data

- in general, MongoDB has a three tiered data hierarchy

1. database
   - *normally one database per app*
   - *possible to have multiple per server*
   - *same basic role as DB in SQL*
2. collection
   - *a grouping of similar pieces of data*
   - *documents in a collection*
   - *name is usually a noun*
   - *resembles in concept a table in SQL*
   - *documents do not require the same schema*
3. document
   - *a single item in the database*
   - *data structure of field and value pairs*
   - *similar to objects in JSON*
   - *eg: an individual user record*

Server-side considerations - data storage

Firebase - mobile platform - what is it?

- other data store and management options now available to us as developers
- depending upon app requirements consider
  - *Firebase*
  - *RethinkDB*
- as a data store, Firebase offers a hosted NoSQL database
  - *data store is JSON-based*
  - *offering quick, easy development from webview to data store*
- syncs an app's data across multiple connected devices in milliseconds
  - *available for offline usage as well*
- provides an API for accessing these JSON data stores
  - *real-time for all connected users*
- Firebase as a hosted option more than just data stores and real-time API access
- Firebase has grown a lot over the last year
  - *many new features announced at Google I/O conference in May 2016*
  - *analytics, cloud-based messaging, app authentication*
  - *file storage, test options for Android*
  - *notifications, adverts...*

References

- GitHub
  - *cordova-plugin-indexeddb*
- MDN
  - *IndexedDB*