Comp 324/424 - Client-side Web Design

Spring Semester 2019 - Week 13

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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

MongoDB - install and setup

- install on Linux
- install on Mac OS X
  - *again, we can use **Homebrew** to install MongoDB*

```
// update brew packages
brew update
// install MongoDB
brew install mongodb
```

- then follow the above OS X install instructions to set paths...
- install on Windows

Server-side considerations - data storage

MongoDB - a few shell commands

- issue following commands at command line to get started - OS X etc

```
// start MongoDB server - terminal window 1
mongod
// connect to MongoDB - terminal window 2
mongo
```

- switch to, create a new DB (if not available), and drop a current DB as follows

```
// list available databases
show dbs
// switch to specified db
use 424db1
// show current database
db
// drop current database
db.dropDatabase();
```

- DB is not created permanently until data is created and saved
  - *insert a record and save to current DB*
- only permanent DB is the local `test` DB, until new DBs created...

Server-side considerations - data storage

MongoDB - a few shell commands

- add an initial record to a new `424db1` database.

```
// select/create db
use 424db1
// insert data to collection in current db
db.notes.insert({
...   "travelNotes": [{
...   "created": "2015-10-12T00:00:00Z",
...   "note": "Curral das Freiras..."
...   }]
... })
```

- our new DB `424db1` will now be saved in Mongo
- we've created a new collection, `notes`

```
// show databases
show dbs
// show collections
show collections
```

Server-side considerations - data storage

MongoDB - test app

- now create a new test app for use with MongoDB
- create and setup app as before
  - *eg: same setup pattern as Redis test app*
- add **Mongoose** to our app
  - *use to connect to MongoDB*
  - *helps us create a schema for working with DB*
- update our `package.json` file
  - *add dependency for Mongoose*

```
// add mongoose to app and save dependency to package.json
npm install mongoose --save
```

- test server and app as usual from app's working directory

```
node server.js
```

Server-side considerations - data storage

MongoDB - Mongoose schema

- use **Mongoose** as a type of bridge between Node.js and MongoDB
- works as a client for MongoDB from Node.js applications
- serves as a useful data modeling tool
  - *represent our documents as objects in the application*
- a data model
  - *object representation of a document collection within data store*
  - *helps specify required fields for each collection's document*
  - *known as a schema in Mongoose, eg:* `NoteSchema`

```
var NoteSchema = mongoose.Schema({
  "created": Date,
  "note": String
});
```

- using schema, build a model
  - *by convention, use first letter uppercase for name of data model object*

```
var Note = mongoose.model("Note", NoteSchema);
```

- now start creating objects of this model type using JavaScript

```
var funchalNote = new Note({
"created": "2015-10-12T00:00:00Z",
"note": "Curral das Freiras..."
});
```

- then use the Mongoose object to interact with the MongoDB
  - *using functions such as* `save` *and* `find`

Server-side considerations - data storage

MongoDB - test app

- with our new DB setup, our schema created
  - *now start to add notes to our DB, `424db1`, in MongoDB*
- in our `server.js` file
  - *need to connect Mongoose to `424db1` in MongoDB*
  - *define our schema for our notes*
  - *then model a note*
  - *use model to create a note for saving to `424db1`*

```
...
//connect to 424db1 DB in MongoDB
mongoose.connect('mongodb://localhost/424db1');
//define Mongoose schema for notes
var NoteSchema = mongoose.Schema({
  "created": Date,
  "note": String
});
//model note
var Note = mongoose.model("Note", NoteSchema);
...
```

Server-side considerations - data storage

MongoDB - test app

- then update app's `post` route to save note to `424db1`

```
//json post route - update for MongoDB
jsonApp.post("/notes", function(req, res) {
  var newNote = new Note({
    "created":req.body.created,
    "note":req.body.note
  });
  newNote.save(function (error, result) {
    if (error !== null) {
      console.log(error);
      res.send("error reported");
    } else {
      Note.find({}, function (error, result) {
        res.json(result);
      })
    }
  });
});
```

Server-side considerations - data storage

MongoDB - test app

- update our app's `get` route for serving these notes

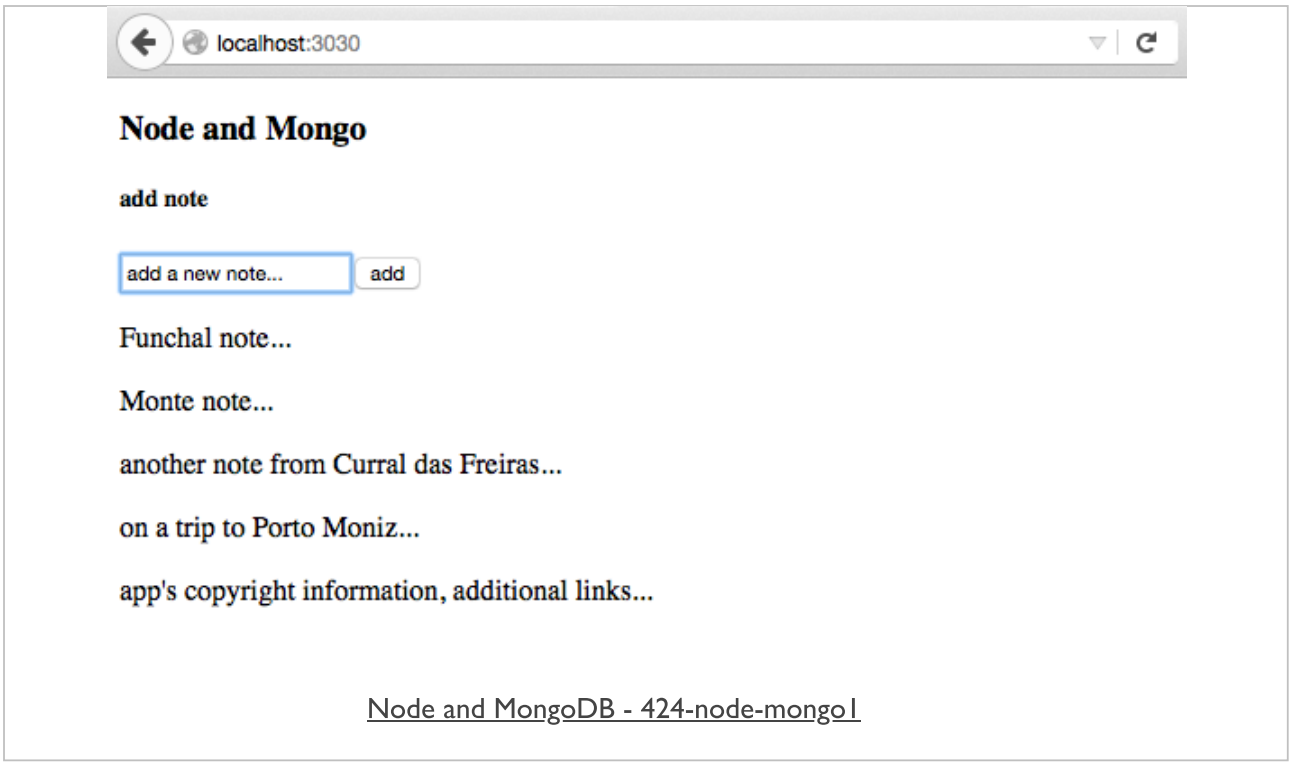
```
//json get route - update for mongo
jsonApp.get("/notes.json", function(req, res) {
  Note.find({}, function (error, notes) {
   //add some error checking...
   res.json(notes);
  });
});
```

- modify `buildNotes()` function in `json_app.js` to get return correctly

```
...
//get travelNotes
var $travelNotes = response;
...
```

- now able to enter, save, read notes for app
- notes data is stored in the `424db1` database in MongoDB
- notes are loaded from DB on page load
- notes are updated from DB for each new note addition
- DEMO - 424-node-mongo1

Image - Client-side and server-side computing



Node and MongoDB - 424-node-mongo1

Client-side - Data - Node, Express, MongoDB &c.

extra notes

- Heroku
  - *Heroku & Git*
  - *Heroku & MongoDB*
  - *Heroku & Postman*
- Node.js
  - *Node.js outline*
  - *Node.js updating*
- Node.js & Express
  - *Node.js and Express*
  - *Node.js & Express starter*
- Node.js, Express, and MongoDB
  - *Node.js and MongoDB*
- Node.js API
  - *Data stores & APIs - MongoDB and native driver*
  - *Node Todos API*
  - *Testing - Node Todos API*
- Node.js & Web Sockets
  - *Node.js & Socket.io*

Client-side - Data - Firebase

Firebase - intro

- Firebase is hosted platform, acquired by Google
  - *provides options for data starage, authentication, real-time database querying...*
- it provides and API for data access
  - *access and query JavaScript object data stores*
  - *query in real-time*
  - *listeners available for all connected apps and users*
  - *synchronisation in milliseconds for most updates...*
  - *notifications*

Client-side - Data - Firebase

Firebase - authentication

- **authentication** with Firebase provides various backend services and SDKs
  - *help developers manage authentication for an app*
  - *service supports many different providers, including Facebook, Google, Twitter &c.*
  - *using industry standard **OAuth 2.0** and **OpenID Connect** protocols*
- custom solutions also available per app
  - *email*
  - *telephone*
  - *messaging*
  - *...*

Client-side - Data - Firebase

Firebase - cloud storage

- **Cloud Storage** used for uploading, storing, downloading files
  - *accessed by apps for file storage and usage...*
  - *features a useful safety check if and when a user's connection is broken or lost*
  - *files are usually stored in a Google Cloud Storage bucket*
  - *files accessible using either Firebase or Google Cloud*
  - *consider using Google Cloud platform for image filtering, processing, video editing...*
  - *modified files may then become available to Firebase again, and connected apps*
  - *e.g. Google's Cloud Platform*

Client-side - Data - Firebase

Firebase - Real-time database

- **Real-time Database** offers a hosted NoSQL data store
  - *ability to quickly and easily sync data*
  - *data synchronisation is active across multiple devices, in real-time*
  - *available as and when the data is updated in the cloud database*
- other services and tools available with Firebase
  - *analytics*
  - *advertising services such as adwords*
  - *crash reporting*
  - *notifications*
  - *various testing options...*

Client-side - Data - Firebase

Firebase - basic setup

- start using Firebase by creating an account with the service
  - *using a standard Google account*
  - *Firebase*
- login to Firebase
  - *choose either Get Started material or navigate to Firebase console*
- at *Console* page, get started by creating a new project
  - *click on the option to* `Add project`
  - *enter the name of this new project*
  - *and select a region*
- then redirected to the *console dashboard* page for the new project
  - *access project settings, config, maintenance...*
- reference documentation for the Firebase Real-Time database,
  - *https://firebase.google.com/docs/reference/js/firebase.database*

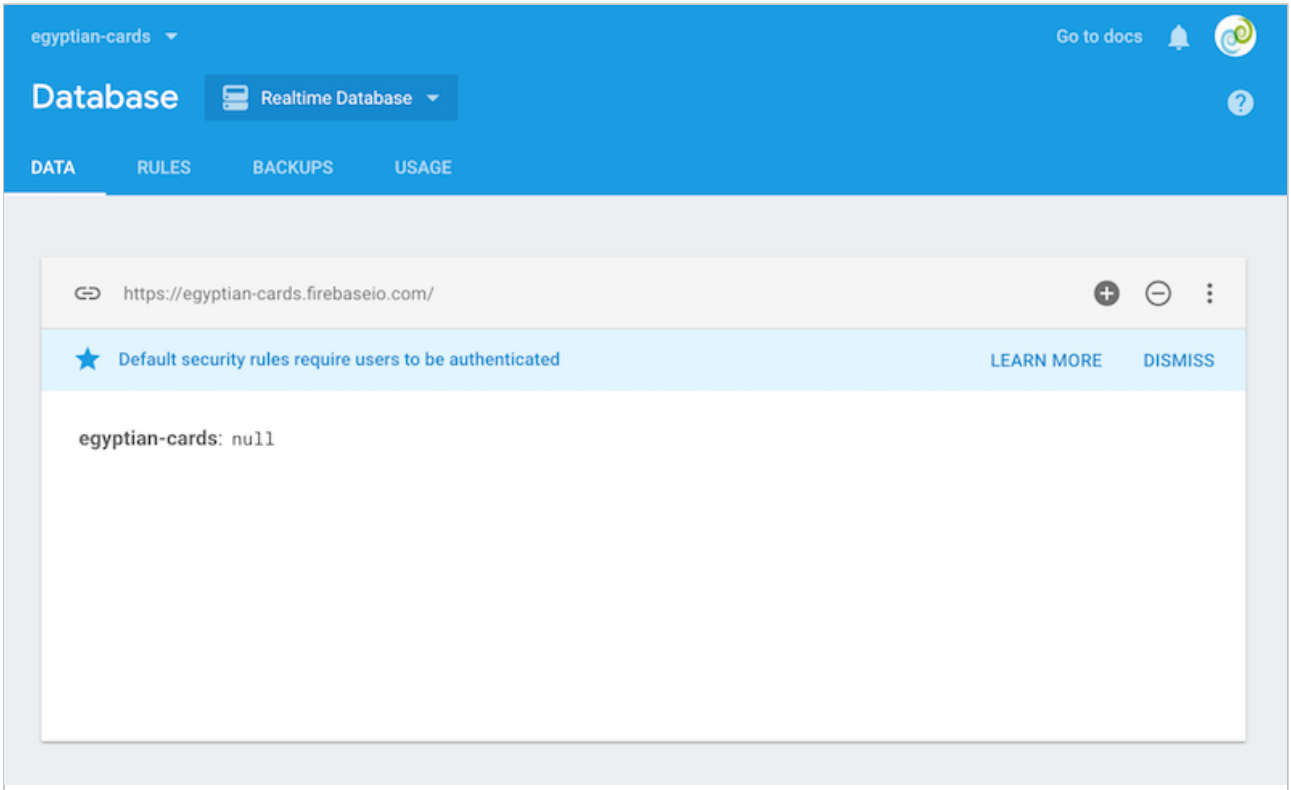
Client-side - Data - Firebase

Firebase - create real-time database

- now setup a database with Firebase for a test app
- start by selecting *Database* option from left sidebar on the Console Dashboard
  - *available under the DEVELOP option*
- then select *Get Started* for the real-time database
- presents an empty database with an appropriate name to match current project
- data will be stored in a JSON format in the real-time database
- working with Firebase is usually simple and straightforward for most apps
- get started quickly direct from the Firebase console
  - *or import some existing JSON...*

Image - Firebase

create a database



Firebase - create a database

Client-side - Data - Firebase

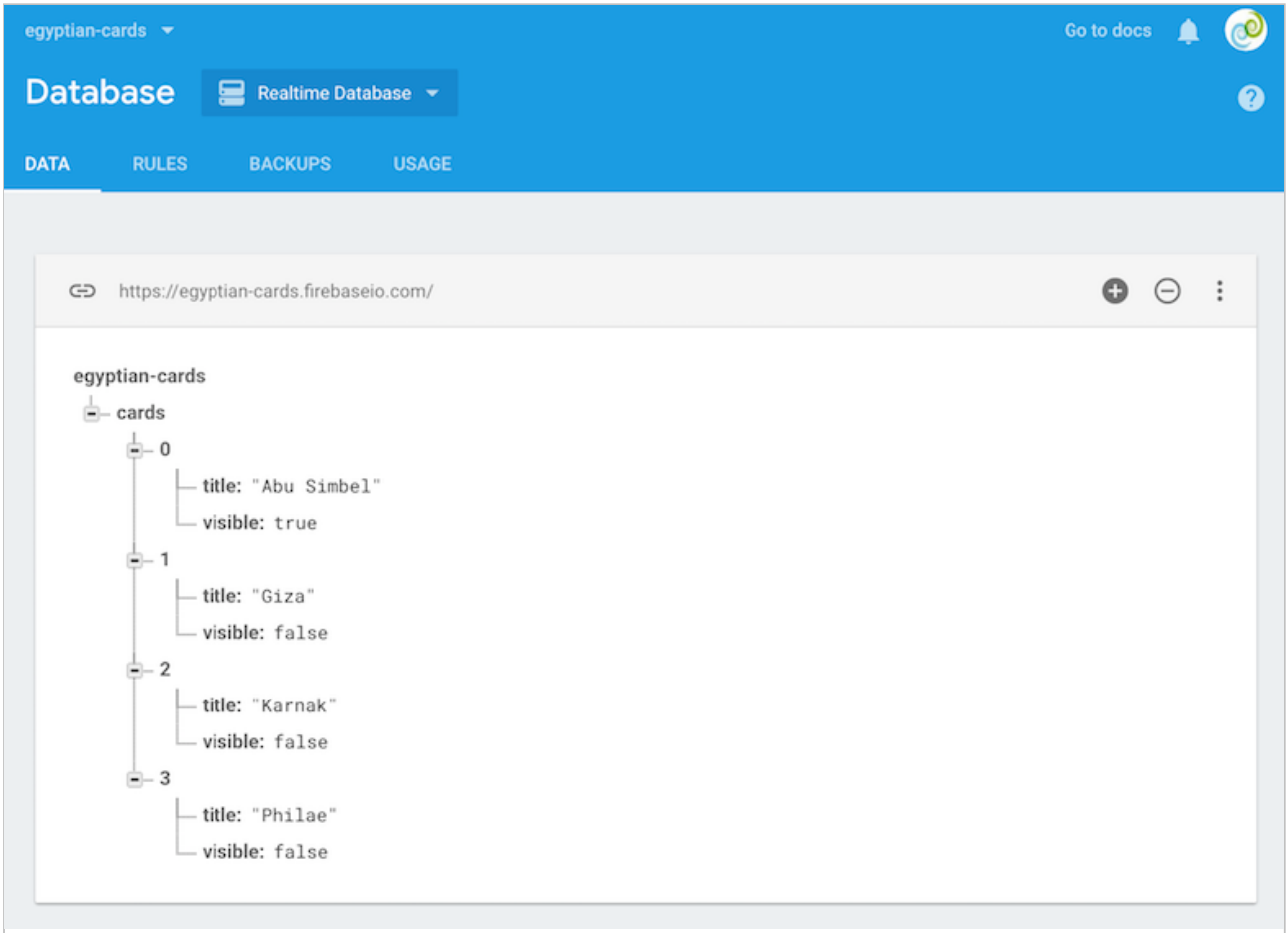
Firebase - import JSON data

- we might start with some simple data to help test Firebase
- import JSON into our test database
  - *then query the data &c. from the app*

```
{
  "cards": [
    {
      "visible": true,
      "title": "Abu Simbel",
      "card": "temple complex built by Ramesses II"
    },
    {
      "visible": false,
      "title": "Amarna",
      "card": "capital city built by Akhenaten"
    },
    {
      "visible": false,
      "title": "Giza",
      "card": "Khufu's pyramid on the Giza plateau outside Cairo"
    },
    {
      "visible": false,
      "title": "Philae",
      "card": "temple complex built during the Ptolemaic period"
    }
  ]
}
```

Image - Firebase

JSON import



Firebase - import JSON file

Client-side - Data - Firebase

Firebase - permissions

- initial notification in Firebase console after creating a new database
  - *Default security rules require users to be authenticated*
- permissions with Firebase database
  - *select RULES tab for current database*
- lots of options for database rules
  - *Firebase - database rules*
- e.g. for testing initial app we might remove authentication rules
- change rules as follows

from

```
{
  "rules": {
    ".read": "auth != null",
    ".write": "auth != null"
  }
}
```

to

```
{
  "rules": {
    ".read": "true",
    ".write": "true"
  }
}
```

Client-side - Data - Firebase

add data with plain JS objects

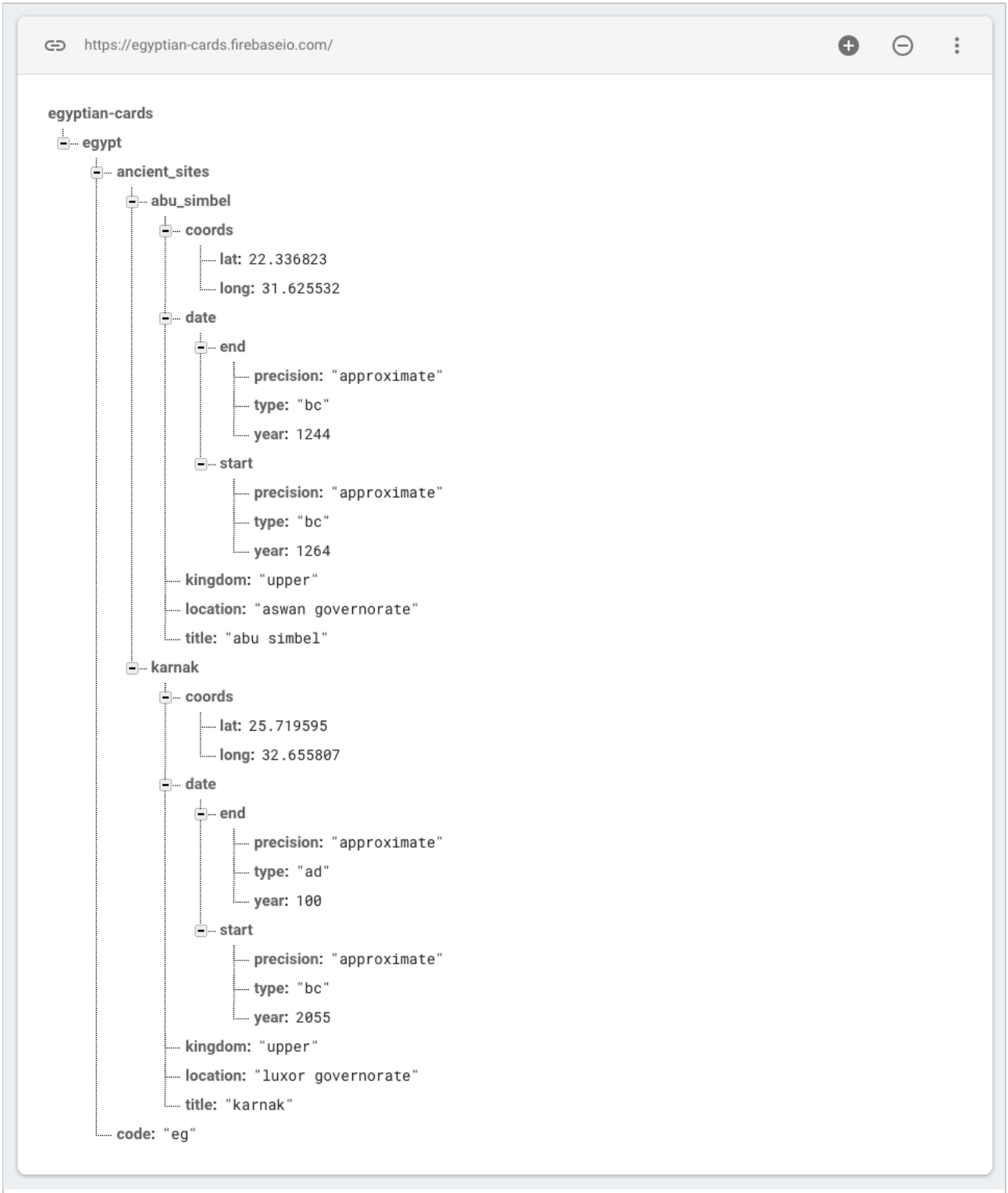
- plain objects as standard Firebase storage
  - *helps with data updating*
  - *helps with auto-increment pushes of data...*


```
{
  "egypt": {
    "code": "eg",
    "ancient_sites": {
      "abu_simbel": {
        "title": "abu simbel",
        "kingdom": "upper",
        "location": "aswan governorate",
        "coords": {
          "lat": 22.336823,
          "long": 31.625532
        },
        "date": {
          "start": {
            "type": "bc",
            "precision": "approximate",
            "year": 1264
          },
          "end": {
            "type": "bc",
            "precision": "approximate",
            "year": 1244
          }
        }
      },
      "karnak": {
        "title": "karnak",
        "kingdom": "upper",
        "location": "luxor governorate",
        "coords": {
          "lat": 25.719595,
          "long": 32.655807
        },
        "date": {
          "start": {
            "type": "bc",
            "precision": "approximate",
            "year": 2055
          },
          "end": {
            "type": "ad",
            "precision": "approximate",
            "year": 100
          }
        }
      }
    }
```

```
    }
}
```

Image - Firebase

JSON import



Firebase - import JSON file

Client-side - Data - Firebase

add to app's `index.html`

- start testing setup with default config in app's `index.html` file
  - *e.g.*

```
<!-- JS - Firebase app -->
<script src="https://www.gstatic.com/firebasejs/5.5.8/firebase.js"></script>
<script>
  // Initialise Firebase
  var config = {
    apiKey: "YOUR_API_KEY",
    authDomain: "422cards.firebaseapp.com",
    databaseURL: "https://422cards.firebaseio.com",
    projectId: "422cards",
    storageBucket: "422cards.appspot.com",
    messagingSenderId: "282356174766"
  };
  firebase.initializeApp(config);
</script>
```

- example includes initialisation information so the SDK has access to
  - *Authentication*
  - *Cloud storage*
- Realtime Database
- Cloud Firestore

n.b. don't forget to modify the above values to match your own account and database...

Client-side - Data - Firebase

customise API usage

- possible to customise required components per app
- allows us to include only features required for each app
  - *e.g. the only **required** component is*
- `firebase-app` - core Firebase client (required component)

```
<!-- Firebase App is always required and must be first -->
<script src="https://www.gstatic.com/firebasejs/5.5.8/firebase-app.js"></script>
```

- we may add a mix of the following optional components,
- `firebase-auth` - various authentication options
- `firebase-database` - realtime database
- `firebase-firestore` - cloud Firestore
- `firebase-functions` - cloud based function for Firebase
- `firebase-storage` - cloud storage
- `firebase-messaging` - Firebase cloud messaging

Client-side - Data - Firebase

modify JS in app's `index.html`

```
<!-- Add additional services that you want to use -->
<script src="https://www.gstatic.com/firebasejs/5.5.3/firebase-auth.js"></script>
<script src="https://www.gstatic.com/firebasejs/5.5.3/firebase-database.js"></script>
<script src="https://www.gstatic.com/firebasejs/5.5.3/firebase-firestore.js"></script>
<script src="https://www.gstatic.com/firebasejs/5.5.3/firebase-messaging.js"></script>
<script src="https://www.gstatic.com/firebasejs/5.5.3/firebase-storage.js"></script>

<script src="https://www.gstatic.com/firebasejs/5.5.3/firebase-functions.js"></script>
```

- then define an object for the `config` of the required services and options,

```
var config = {
  // add API key, services &c.
};
firebase.initializeApp(config);
```

Client-side - Data - Firebase

initial app usage - DB connection

- after defining required config and initialisation
  - *start to add required listeners and calls to app's JS*

define DB connection

- we can establish a connection to our Firebase DB as follows,

```
const db = firebase.database();
```

- then use this reference to connect and query our database

Client-side - Data - Firebase

initial app usage - `ref()` method

- with the connection to the database
  - *we may then call the `ref()`, or reference, method*
  - *use this method to read, write &c. data in the database*
- by default, if we call `ref()` with no arguments
  - *our query will be relative to the root of the database*
  - *e.g. reading, writing &c. relative to the whole database*
- we may also request a specific reference in the database
  - *pass a location path, e.g.*

```
db.ref('egypt/ancient_sites/abu_simbel/title').set('Abydos');
```

- allows us to create multiple parts of the Firebase database
- such parts might include,
  - *multiple objects, properties, and values &c.*
- a quick and easy option for organising and distributing data

Client-side - Data - Firebase

write data - intro

- also write data to the connected database
  - *again from a JavaScript based application*
- Firebase supports many different JavaScript datatypes, including
  - *strings*
  - *numbers*
  - *booleans*
  - *objects*
  - *arrays*
  - ...
- i.e. any values and data types we add to JSON
  - *n.b. Firebase may not maintain the native structure upon import*
  - *e.g. arrays will be converted to plain JavaScript objects in Firebase*

Client-side - Data - Firebase

write data - set all data

- `set` data for the whole database by calling the `ref()` method at the *root*
  - *e.g.*

```
db.ref().set({
  site: 'abu-simbel',
  title: 'Abu Simbel',
  date: 'c.1264 B.C.',
  visible: true,
  location: {
    country: 'Egypt',
    code: 'EG',
    address: 'aswan'
  }
  coords: {
    lat: '22.336823',
    long: '31.625532'
  }
});
```

Client-side - Data - Firebase

write data - set data for a specific data location

- also write data to a specific location in the database
- add an argument to the `ref()` method
  - *specifying required location in the database*
  - *e.g.*

```
db.ref('egypt/ancient_sites/abu_simbel/location').set('near aswan');
```

- `ref()` may be called relative to any depth in the database from the *root*
- allows us to update anything from whole DB to single property value

Client-side - Data - Firebase

Promises with Firebase

- Firebase includes native support for Promises and associated chains
  - *we do not need to create our own custom Promises*
- we may work with a return Promise object from Firebase
  - *using a standard chain, methods...*
- e.g. when we call the `set()` method
  - *Firebase will return a Promise object for the method execution*
- `set()` method will not explicitly return anything except for success or error
  - *we can simply check the return promise as follows,*

```
db.ref('egypt/ancient_sites/abu_simbel/title')
  .set('Abu Simbel')
  .then(() => {
    // log data set success to console
    console.log('data set...');
  })
  .catch((e) => {
    // catch error from Firebase - error logged to console
    console.log('error returned', e);
  });
```

Client-side - Data - Firebase

remove data - intro

- we may also delete and remove data from the connected database
- various options for removing such data, including
  - *specific location*
  - *all data*
  - *`set()` with `null`*
  - *by updating data*
  - ...

Client-side - Data - Firebase

remove data - specify location

- we may also delete data at a specific location in the connected database
  - *e.g.*

```
db.ref('egypt/ancient_sites/abu_simbel/kingdom')
  .remove()
  .then(() => {
    // log data removed success to console
    console.log('data removed...');
  })
  .catch((e) => {
    // catch error from Firebase - error logged to console
    console.log('error returned', e);
  });
```

Client-side - Data - Firebase

remove data - all data

- also remove all of the data in the connected database
  - *e.g.*

```
db.ref()
  .remove()
  .then(() => {
    // log data removed success to console
    console.log('data removed...');
  })
  .catch((e) => {
    // catch error from Firebase - error logged to console
    console.log('error returned', e);
  });
```

remove data - `set()` with null

- another option specified in the Firebase docs for deleting data
  - *by using `set()` method with a `null` value*
  - *e.g.*

```
db.ref('egypt/ancient_sites/abu_simbel/kingdom')
  .set(null)
  .then(() => {
    // log data removed success to console
    console.log('data set to null...');
  })
  .catch((e) => {
    // catch error from Firebase - error logged to console
    console.log('error returned', e);
  });
```

Client-side - Data - Firebase

update data - intro

- also combine setting and removing data in a single pattern
  - *using the `update()` method call to the defined database reference*
- meant to be used to update multiple items in database in a single call
- we must pass an object as the argument to the `update()` method

Client-side - Data - Firebase

update data - existing properties

- to update multiple existing properties
  - *e.g.*

```
db.ref('egypt/ancient_sites/abu_simbel/').update({
  title: 'The temple of Abu Simbel',
  visible: false
});
```

Client-side - Data - Firebase

update data - add new properties

- also add a new property to a specific location in the database

```
db.ref('egypt/ancient_sites/abu_simbel/').update({
  title: 'The temple of Abu Simbel',
  visible: false,
  date: 'c.1264 B.C.'
});
```

- still set new values for the two existing properties
  - `title` and `visible`
- add a new property and value for `data`
- `update()` method will only update the specific properties
  - *does not override everything at the reference location*
  - *compare with the `set()` method...*

Client-side - Data - Firebase

update data - remove properties

- also combine these updates with option to remove an existing property
  - *e.g.*

```
db.ref('egypt/ancient_sites/abu_simbel/').update({
  card: null,
  title: 'The temple of Abu Simbel',
  visible: false,
  date: 'c.1264 B.C.',
});
```

- `null` used to delete specific property from reference location in DB
- at the reference loaction in the DB, we're able to combine
  - *creating new property*
  - *updating a property*
  - *deleting existing properties*

Client-side - Data - Firebase

update data - multiple properties at different locations

- also combine updating data in multiple objects at different locations
  - *locations relative to initial passed reference location*
  - *e.g.*

```
db.ref().update({
  'egypt/ancient_sites/abu_simbel/visible': true,
  'egypt/ancient_sites/karnak/visible': false
});
```

- relative to the root of the dabatase
  - *now updated multiple `title` properties in different objects*
- *n.b.* update is only for child objects relative to specified ref location
  - *due to character restrictions on the property name*
  - *e.g. the name may not begin with `.`, `/` &c.*

Client-side - Data - Firebase

update data - Promise chain

- `update()` method will also return a Promise object
  - *allows us to chain the standard methods*
  - *e.g.*

```
db.ref().update({
  'egypt/ancient_sites/abu_simbel/visible': true,
  'egypt/ancient_sites/karnak/visible': false
}).then(() => {
  console.log('update success...');
}).catch((e) => {
  console.log('error = ', e);
});
```

- as with `set()` and `remove()`
  - *Promise object itself will return success or error for method call*

Client-side - Data - Firebase

read data - intro

- fetch data from the connected database in many different ways, e.g.
  - *all of the data*
  - *or a single specific part of the data*
- also connect and retrieve data once
- another option is to setup a listener
  - *used for polling the database for live updates...*

Client-side - Data - Firebase

read data - all data, once

- retrieve all data from the database a single time

```
// ALL DATA ONCE - request all data ONCE
// - returns Promise value
db.ref().once('value')
  .then((snapshot) => {
    // snapshot of the data - request the return value for the data at the time of query...
    const data = snapshot.val();
    console.log('data = ', data);
  })
  .catch((e) => {
    console.log('error returned - ', e);
  });
```

Client-side - Data - Firebase

read data - single data, once

- we may query the database once for a single specific value
  - *e.g.*

```
// SINGLE DATA - ONCE
db.ref('egypt/ancient_sites/abu_simbel/').once('value')
  .then((snapshot) => {
    // snapshot of the data - request the return value for the data at the time of query...
    const data = snapshot.val();
    console.log('single data = ', data);
  })
  .catch((e) => {
    console.log('error returned - ', e);
  });
```

- returns value for object at the specified location
  - *egypt/ancient_sites/abu_simbel/*

Client-side - Data - Firebase

read data - listener for changes - subscribe

- also setup listeners for changes to the connected database
  - *then continue to poll the DB for any subsequent changes*
  - *e.g.*

```
// LISTENER - poll DB for data changes
// - any changes in the data
db.ref().on('value', (snapshot) => {
  console.log('listener update = ', snapshot.val());
});
```

- `on()` method polls the DB for any changes in `value`
- then get the current snapshot value for the data stored
- any change in data in the online database
  - *listener will automatically execute defined success callback function*

Client-side - Data - Firebase

read data - listener for changes - subscribe - error handling

- also add some initial error handling for subscription callback
  - e.g.

```
// LISTENER - SUBSCRIBE
// - poll DB for data changes
// - any changes in the data
db.ref().on('value', (snapshot) => {
  console.log('listener update = ', snapshot.val());
}, (e) => {
  console.log('error reading db', e);
});
```

Client-side - Data - Firebase

read data - listener - why not use a Promise?

- as listener is notified of updates to the online database
  - *we need the callback function to be executed*
- callback may need to be executed multiple times
  - *e.g. for many updates to the stored data*
- a Promise may only be resolved a single time
  - *with either* `resolve` *or* `reject`
- to use a Promise in this context
  - *we would need to instantiate a new Promise for each update*
  - *would not work as expected*
  - *therefore, we use a standard callback function*
- a callback may be executed as needed
  - *each and every time there is an update to the DB*

Client-side - Data - Firebase

read data - listener for changes - unsubscribe

- need to *unsubscribe* from all or specific changes in online database
  - *e.g.*

```
db.ref().off();
```

- removes *all* current subscriptions to defined DB connection

Client-side - Data - Firebase

read data - listener for changes - unsubscribe

- also *unsubscribe* a specific subscription by passing callback
  - *callback as used for the original subscription*
- abstract the callback function
  - *pass it to both `on()` and `off()` methods for database `ref()` method*
  - *e.g.*

```
// abstract callback
const valChange = (snapshot) => {
  console.log('listener update = ', snapshot.val());
};
```

Client-side - Data - Firebase

read data - listener for changes - unsubscribe

- then pass this variable as callback argument
  - *for both subscribe and unsubscribe events*
  - *e.g.*

```
// subscribe
db.ref().on('value', valChange);
// unsubscribe
db.ref().off(valChange);
```

- allows our app to maintain the DB connection
  - *and unsubscribe a specific subscription*

Client-side - Data - Firebase

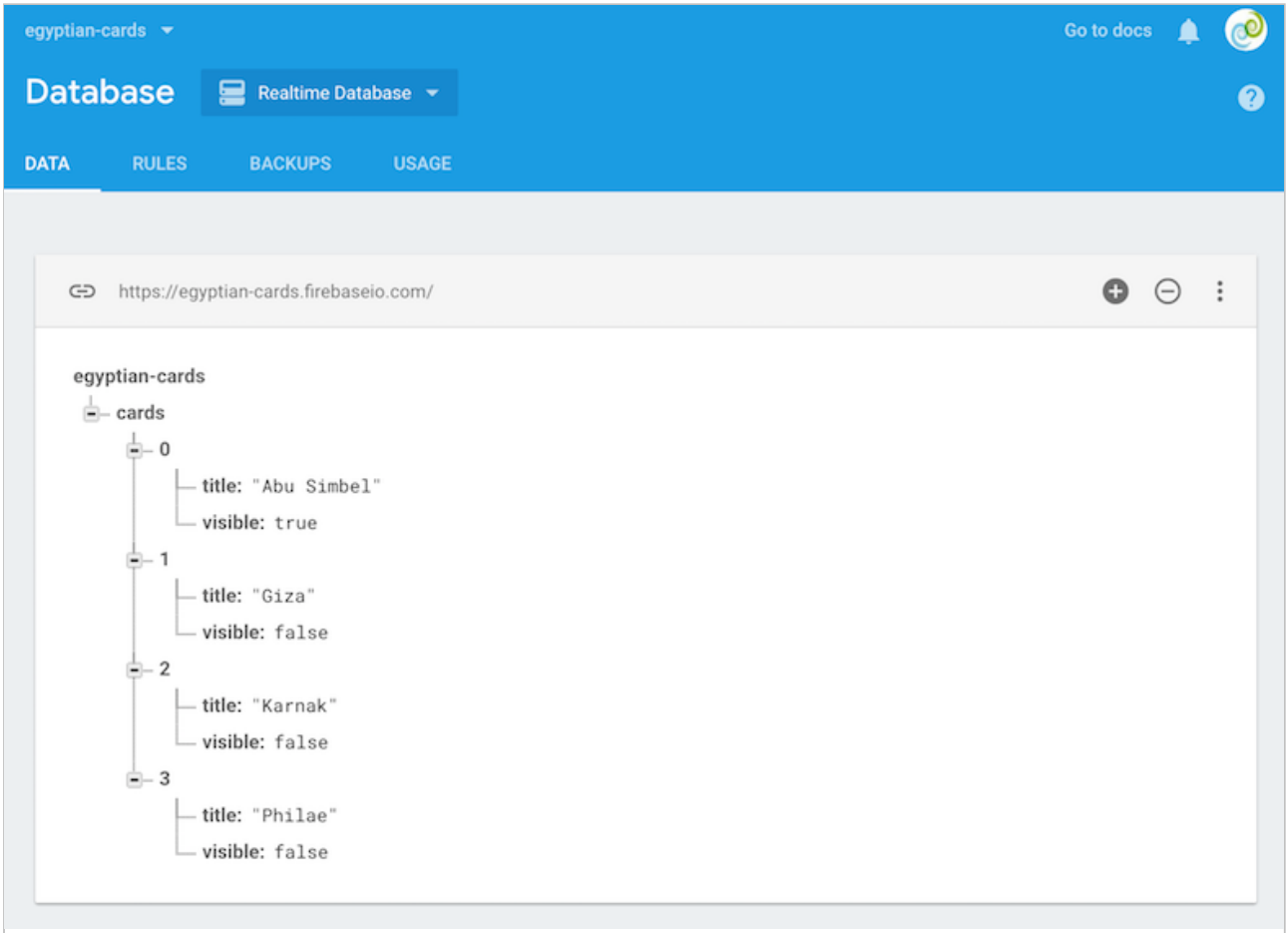
working with arrays

- Firebase does not explicitly support array data structures
  - *converts array objects to plain JavaScript objects*
- e.g. import the following JSON with an array

```
{
  "cards": [
    {
      "visible": true,
      "title": "Abu Simbel",
      "card": "temple complex built by Ramesses II"
    },
    {
      "visible": false,
      "title": "Amarna",
      "card": "capital city built by Akhenaten"
    },
    {
      "visible": false,
      "title": "Giza",
      "card": "Khufu's pyramid on the Giza plateau outside Cairo"
    },
    {
      "visible": false,
      "title": "Philae",
      "card": "temple complex built during the Ptolemaic period"
    }
  ]
}
```

Image - Firebase

JSON import with array



Firebase - import JSON file

Client-side - Data - Firebase

working with arrays - index values

- each index value will now be stored as a plain object
  - *with an auto-increment value for the property*
  - *e.g.*

```
cards: {
  0: {
    card: "temple complex built by Ramesses II",
    title: "Abu Simbel",
    visible: "true"
  }
}
```

Client-side - Data - Firebase

working with arrays - access index values

- we may still access each index value from the original array object
  - *without easy access to pre-defined, known unique references*
- e.g. to access the title value of a given card
  - *need to know its auto-generated property value in Firebase*

```
db.ref('cards/0')
```

- reference will be the path to the required object
  - *then access a given property on the object*
- even if we add a unique reference property to each card
  - *still need to know assigned property value in Firebase*

Client-side - Data - Firebase

working with arrays - `push()` method

- add new content to an existing Firebase datastore
- we may use the `push()` method to add this data
- a unique property value will be auto-generated for pushed data
  - *e.g.*

```
// push new data to specific reference in db
db.ref('egypt/ancient_sites/').push({
  "philae": {
    "kingdom": "upper",
    "visible": false
  }
});
```

- new data created with auto-generated ID for parent object
  - *e.g.*

```
LPcdS31H_u9NOdIn27_
```

- may be useful for dynamic content pushed to a datastore
- e.g. notes, tasks, calendar dates &c.

Client-side - Data - Firebase

working with arrays - Firebase `snapshot` methods

- various data snapshot methods in the Firebase documentation
- commonly used method with `snapshot` is the `val()` method
- many additional methods specified in API documentation for *DataSnapshot*
  - *e.g. `forEach()` - iterator for plain objects from Firebase*
  - *Firebase Docs - DataSnapshot*

Client-side - Data - Firebase

working with arrays - create array from Firebase data

- as we store data as plain objects in Firebase
  - *need to consider how we may work with array-like structures*
  - *i.e. for technologies and patterns that require array data structures*
  - *e.g. Redux*
- need to get data from Firebase, then prepare it for use as an array
- to help us work with Firebase object data and arrays
  - *we may call `forEach()` method on the return `snapshot`*
  - *provides required iterator for plain objects stored in Firebase*
  - *e.g.*

```
// get ref in db once
// call forEach() on return snapshot
// push values to local array
// unique id for each DB parent object is `key` property on snapshot
db.ref('egypt/ancient_sites')
  .once('value')
  .then((snapshot) => {
    const sites = [];
    snapshot.forEach((siteSnapshot) => {
      sites.push({
        id: siteSnapshot.key,
        ...siteSnapshot.val()
      });
    });
    console.log('sites array = ', sites);
  });
```

Image - Firebase

snapshot `forEach()` - creating a local array

Firebase - local array

- we now have a local array from the Firebase object data
  - *use with options such as Redux...*

Client-side - Data - Firebase

add listeners for value changes

- as we modify objects, properties, values &c. in Firebase
  - *set listeners to return notifications for such updates*
  - *e.g. add a single listener for any update relative to full datastore*

```
// LISTENER - SUBSCRIBE - v.2
// - get all data & then push return data to local array...
db.ref('egypt').on('value', (snapshot) => {
  const sites = [];
  snapshot.forEach((siteSnapshot) => {
    sites.push({
      id: siteSnapshot.key,
      ...siteSnapshot.val()
    });
  });
  console.log('sites array after update = ', sites);
});
```

- the on( ) method does not return a Promise object
  - *we need to define a callback for the return data*

Client-side - Data - Firebase

listener events - intro

- for subscriptions and updates
  - *Firebase provides a few different events*
- for the `on()` method, we may initially consult the following documentation
- Firebase docs - `on()` events
- need to test various listeners for datastore updates

Client-side - Data - Firebase

listener events - `child_removed` event

- add a subscription for event updates
  - *as a child object is removed from the data store.*
- `child_removed` event may be added as follows,

```
// - listen for child_removed event relative to current ref path in DB
db.ref('egypt/ancient_sites/').on('child_removed', (snapshot) => {
  console.log('child removed = ', snapshot.key, snapshot.val());
});
```

Client-side - Data - Firebase

listener events - `child_changed` event

- also listen for the `child_changed` event
  - *relative to the current path passed to `ref()`*
  - *e.g.*

```
// - listen for child_changed event relative to current ref path in DB
db.ref('egypt/ancient_sites/').on('child_changed', (snapshot) => {
  console.log('child changed = ', snapshot.key, snapshot.val());
});
```

Client-side - Data - Firebase

listener events - `child_added` event

- another common event is adding a new child to the data store
  - *a user may create and add a new note or to-do item...*
  - *e.g. new child added to specified reference*

```
// - listen for child_added event relative to current ref path in DB
db.ref('egypt/ancient_sites/').on('child_added', (snapshot) => {
  console.log('child added = ', snapshot.key, snapshot.val());
});
```

Client-side - Data - Firebase

extra notes

- Firebase - authentication
- Firebase - setup & usage

Demos

- MongoDB
  - *424-node-mongo I*

Resources

- MongoDB
  - *MongoDB - For Giant Ideas*
  - *MongoDB - Getting Started (Node.js driver edition)*
  - *MongoDB - Getting Started (shell edition)*
- Mongoose
  - *MongooseJS Docs*
- Node.js
  - *Node.js home*
  - *Node.js - download*
  - *ExpressJS*
  - *ExpressJS body-parser*