Firebase: REST and Web API

INF 551

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Firebase

- A cloud-based platform to support web and mobile app development

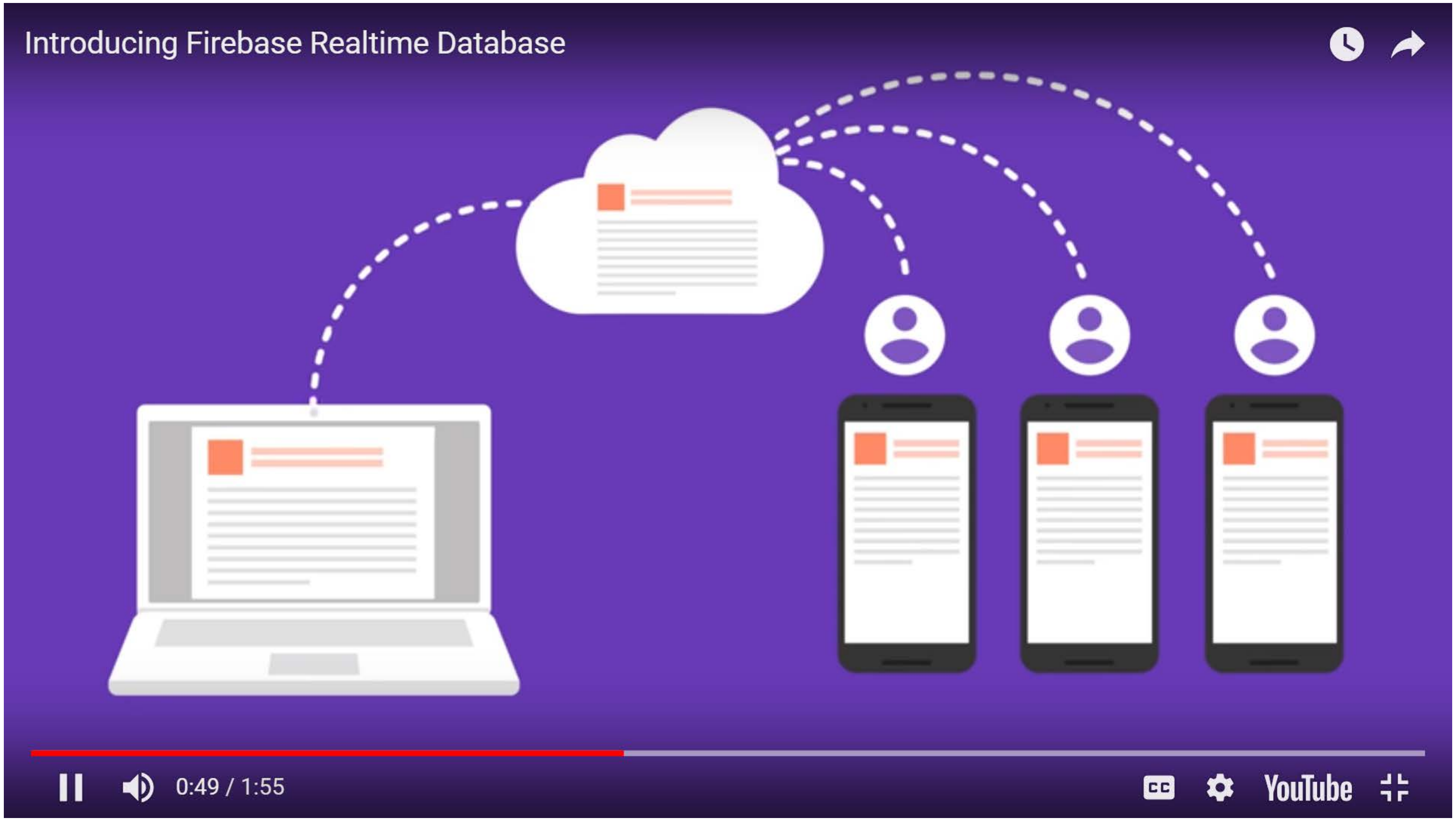
- Used to be Envolve, a startup founded in 2011
  - For adding online chat functions into websites

- Later expanded into Firebase which was then acquired by Google in 2015

Products

- Firebase (realtime) database
  - Manage JSON documents
  - Real-time syncing data between users and devices
- Firebase (cloud) storage
  - Store images, photos, videos
- Firebase (user) authentication
  - Support signin using Google, Facebook

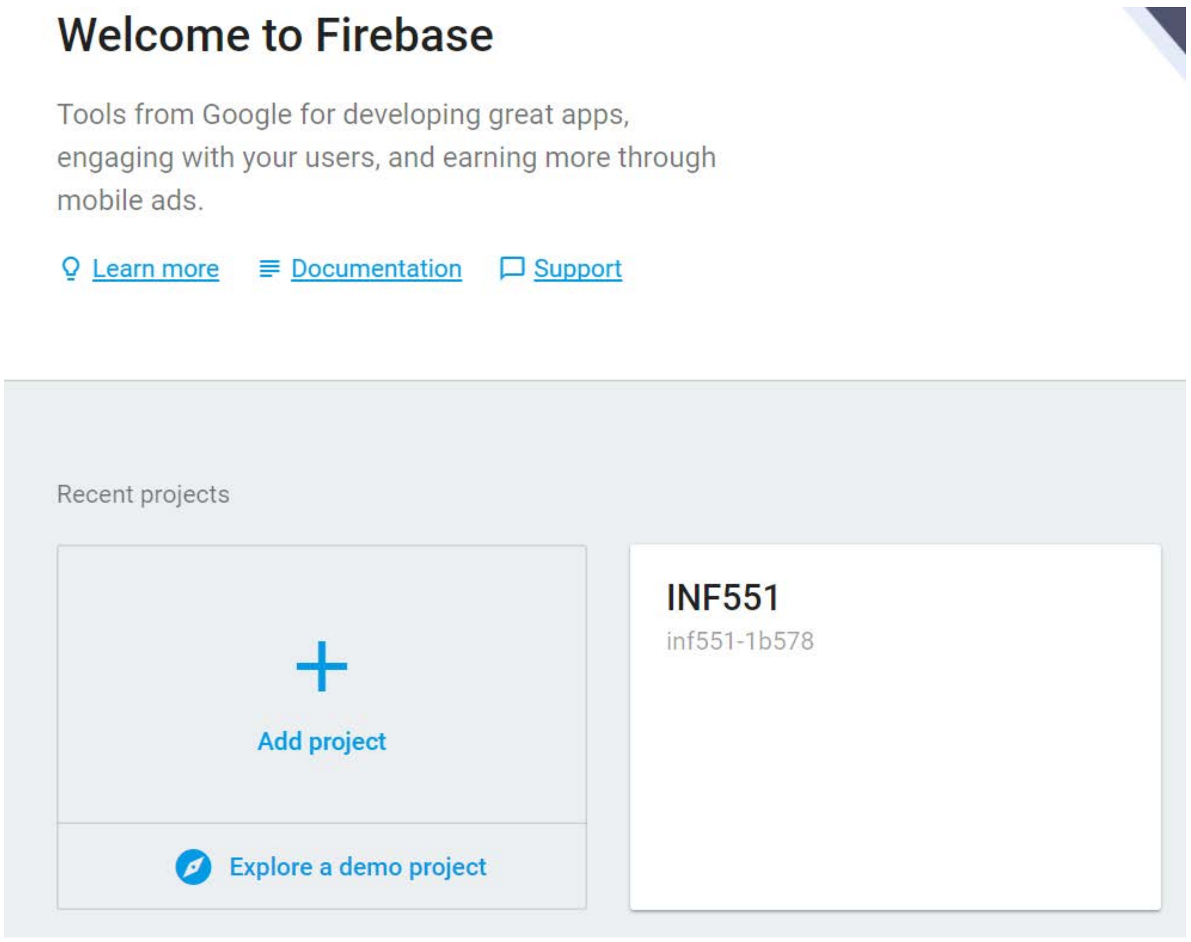
Firebase realtime database



Create a Firebase account

- You may use your Google account
- Go to Firebase console:
  - https://console.firebase.google.com/

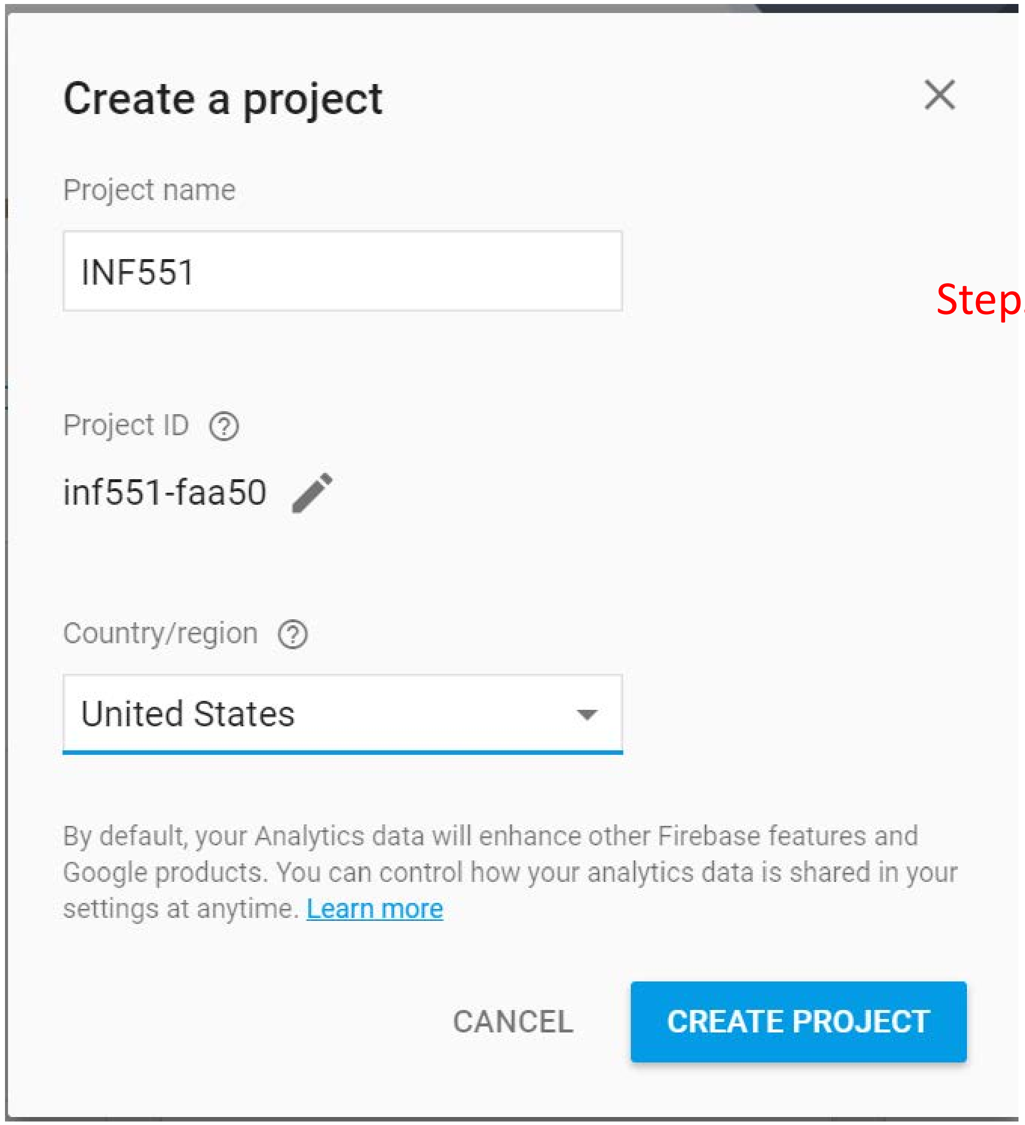
Click on "Add project"



Welcome to Firebase

Tools from Google for developing great apps, engaging with your users, and earning more through mobile ads.

Create a Firebase project



Create a project

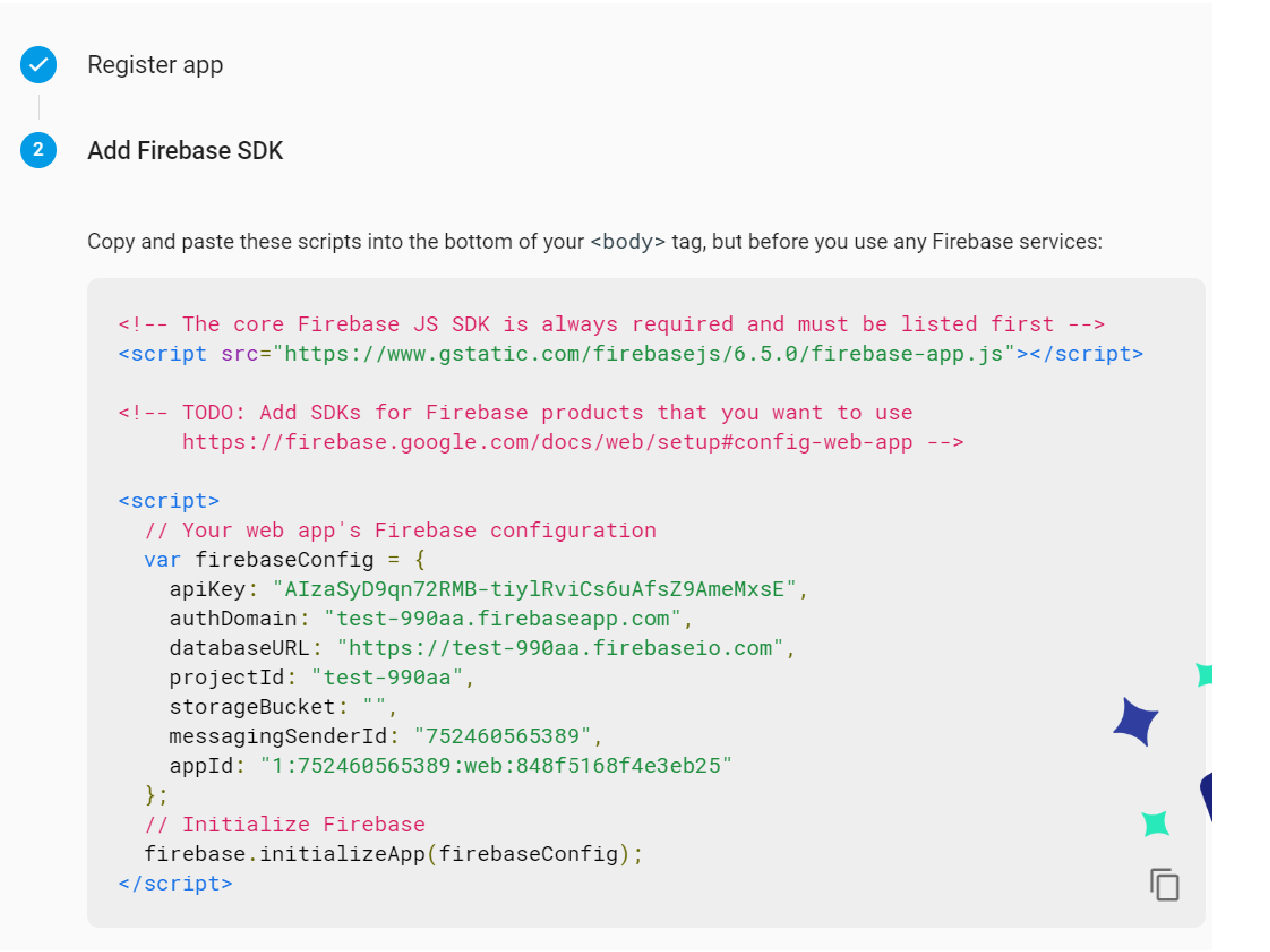
Project name: INF551

Project ID: inf551-faa50

Country/region: United States

By default, your Analytics data will enhance other Firebase features and Google products. You can control how your analytics data is shared in your settings at anytime. Learn more

Steps may vary now



Register app

2 Add Firebase SDK

Copy and paste these scripts into the bottom of your <body> tag, but before you use any Firebase services:

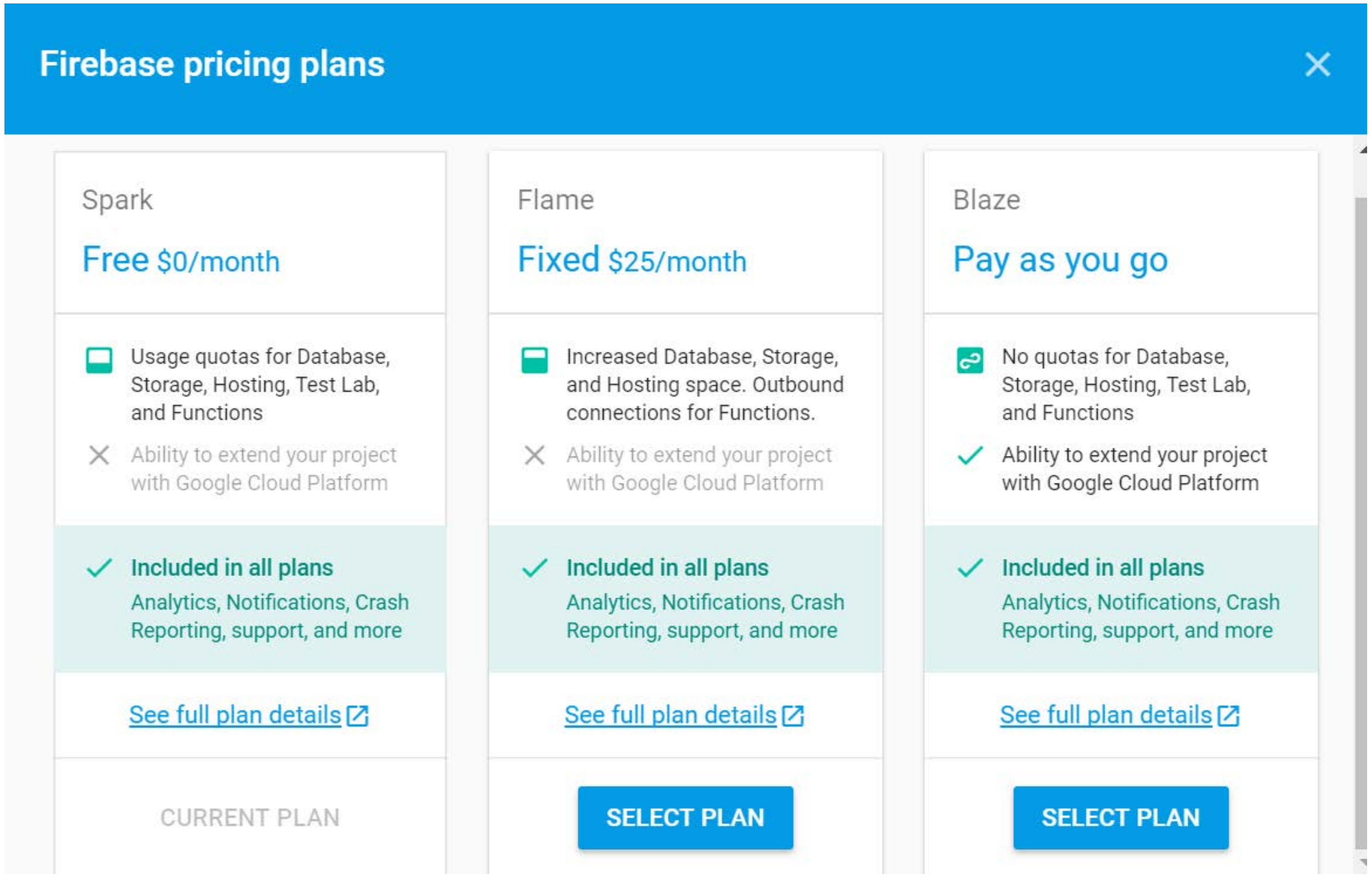
```
<!-- The core Firebase JS SDK is always required and must be listed first -->
<script src="https://www.gstatic.com/firebasejs/6.5.0/firebase-app.js"></script>

<!-- TODO: Add SDKs for Firebase products that you want to use
     https://firebase.google.com/docs/web/setup#config-web-app -->

<script>
  // Your web app's Firebase configuration
  var firebaseConfig = {
    apiKey: "AIzaSyD9qn72RMB-tiylRviCs6uAfsZ9AmeMxsE",
    authDomain: "test-990aa.firebaseapp.com",
    databaseURL: "https://test-990aa.firebaseio.com",
    projectId: "test-990aa",
    storageBucket: "",
    messagingSenderId: "752460565389",
    appId: "1:752460565389:web:848f5168f4e3eb25"
  };
  // Initialize Firebase
  firebase.initializeApp(firebaseConfig);
</script>
```

Pricing plan

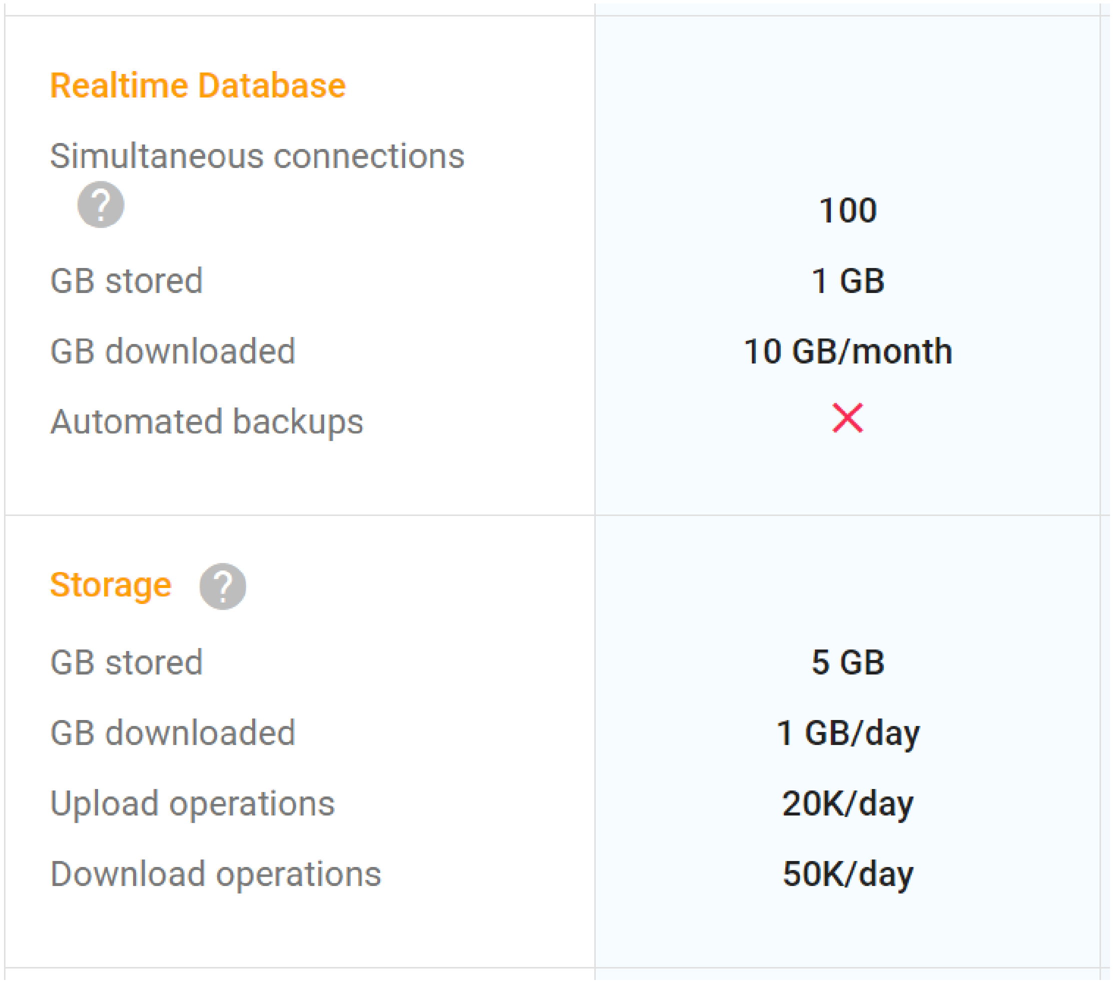
- Free Spark plan is sufficient for coursework



Firebase pricing plans

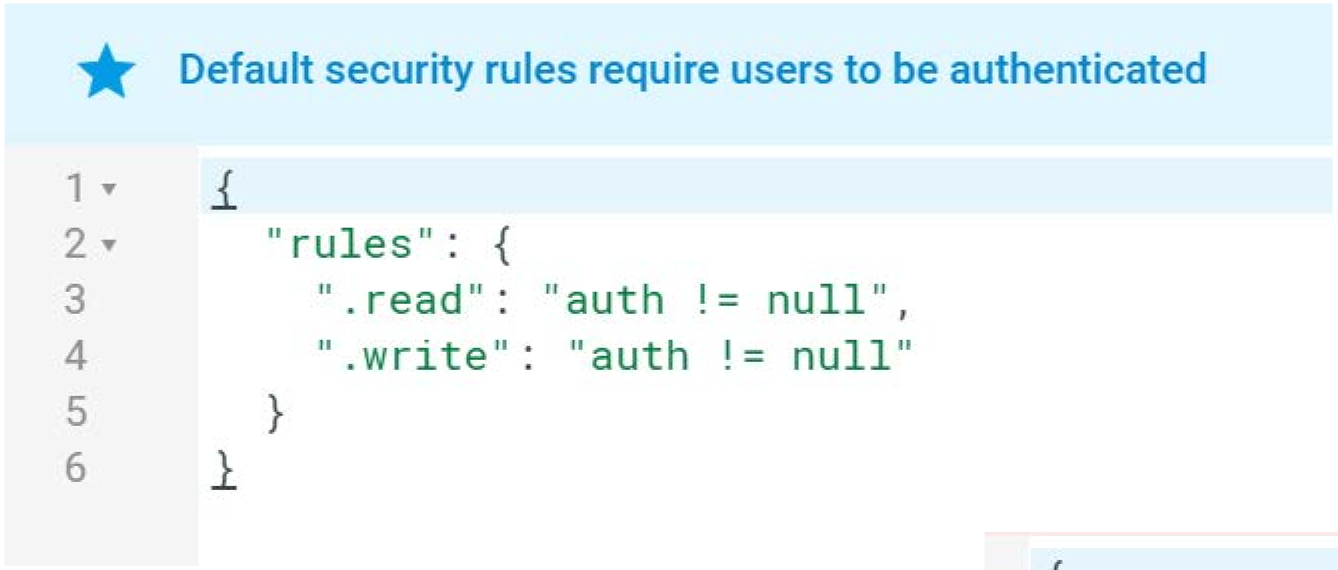
Spark	Flame	Blaze
Free $0/month	Fixed $25/month	Pay as you go
Usage quotas for Database, Storage, Hosting, Test Lab, and Functions	Increased Database, Storage, and Hosting space. Outbound connections for Functions.	No quotas for Database, Storage, Hosting, Test Lab, and Functions
✗ Ability to extend your project with Google Cloud Platform	✗ Ability to extend your project with Google Cloud Platform	✓ Ability to extend your project with Google Cloud Platform
✓ Included in all plans: Analytics, Notifications, Crash Reporting, support, and more	✓ Included in all plans: Analytics, Notifications, Crash Reporting, support, and more	✓ Included in all plans: Analytics, Notifications, Crash Reporting, support, and more
See full plan details	See full plan details	See full plan details
CURRENT PLAN	SELECT PLAN	SELECT PLAN

Spark plan



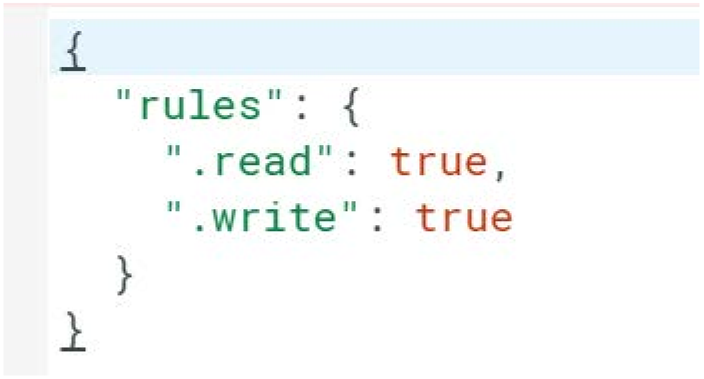
Realtime Database	
Simultaneous connections	100
GB stored	1 GB
GB downloaded	10 GB/month
Automated backups	✗
Storage	
GB stored	5 GB
GB downloaded	1 GB/day
Upload operations	20K/day
Download operations	50K/day

Change authentication rule



Default security rules require users to be authenticated

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



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

Open to public (for testing only)

JSON (Javascript Object Notation)

- Light-weight data exchange format
  - Much simpler than XML
  - Language-independent
  - Inspired by syntax of JavaScript object literals

- Some differences from JavaScript objects, e.g.,
  - String in JSON must be double-quoted
  - Ok to single-quote in JavaScript (& Python)

Syntax of JSON

- value = string|number|object|array$\overbrace{|\textbf{true}|\textbf{false}|\textbf{null}}^{\text{These are actual values}}$

- object = {} | { members }
  - members = pair | pair, members
  - pair = string : value

- array = [] | [elements]
  - elements = value | value, elements

Valid JSON or not?

- []
- {}
- {[]}
- [{}]
- {"name": john}
- {name: "john"}
- {"name": 25}
- "name"
- 25
- {25}
- [25]

JSON is case-sensitive

- Valid or not?
  - True
  - true
  - TRUE
  - Null
  - false

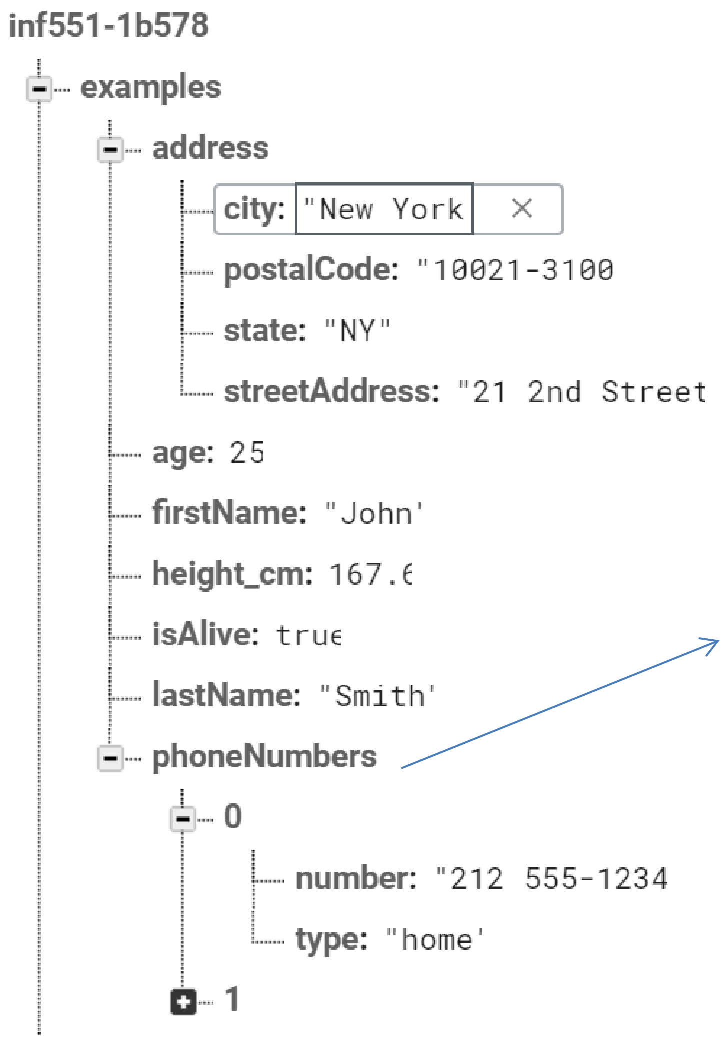
Example JSON

```
{
  "firstName": "John",
  "lastName": "Smith",
  "isAlive": true,
  "age": 25,
  "address": {
    "streetAddress": "21 2nd Street",
    "city": "New York",
    "state": "NY",
    "postalCode": "10021-3100"
  },
  "phoneNumbers": [
    {
      "type": "home",
      "number": "212 555-1234"
    },
    {
      "type": "office",
      "number": "646 555-4567"
    }
  ],
  "children": [],
  "spouse": null
}
```

Value is an object

Value is an array

Stored in Firebase



```
inf551-1b578
  examples
    address
      city: "New York
      postalCode: "10021-3100
      state: "NY"
      streetAddress: "21 2nd Street
    age: 25
    firstName: "John'
    height_cm: 167.6
    isAlive: true
    lastName: "Smith'
    phoneNumbers
      0
        number: "212 555-1234
        type: "home'
      1
```

Note: array stored as an object
Key = index of element in array

Check syntax of JSON

- JSON validator
  - http://jsonlint.com/

Roadmap

- Firebase REST API ⬅
- Firebase Javascript API
  - Useful for your project

curl

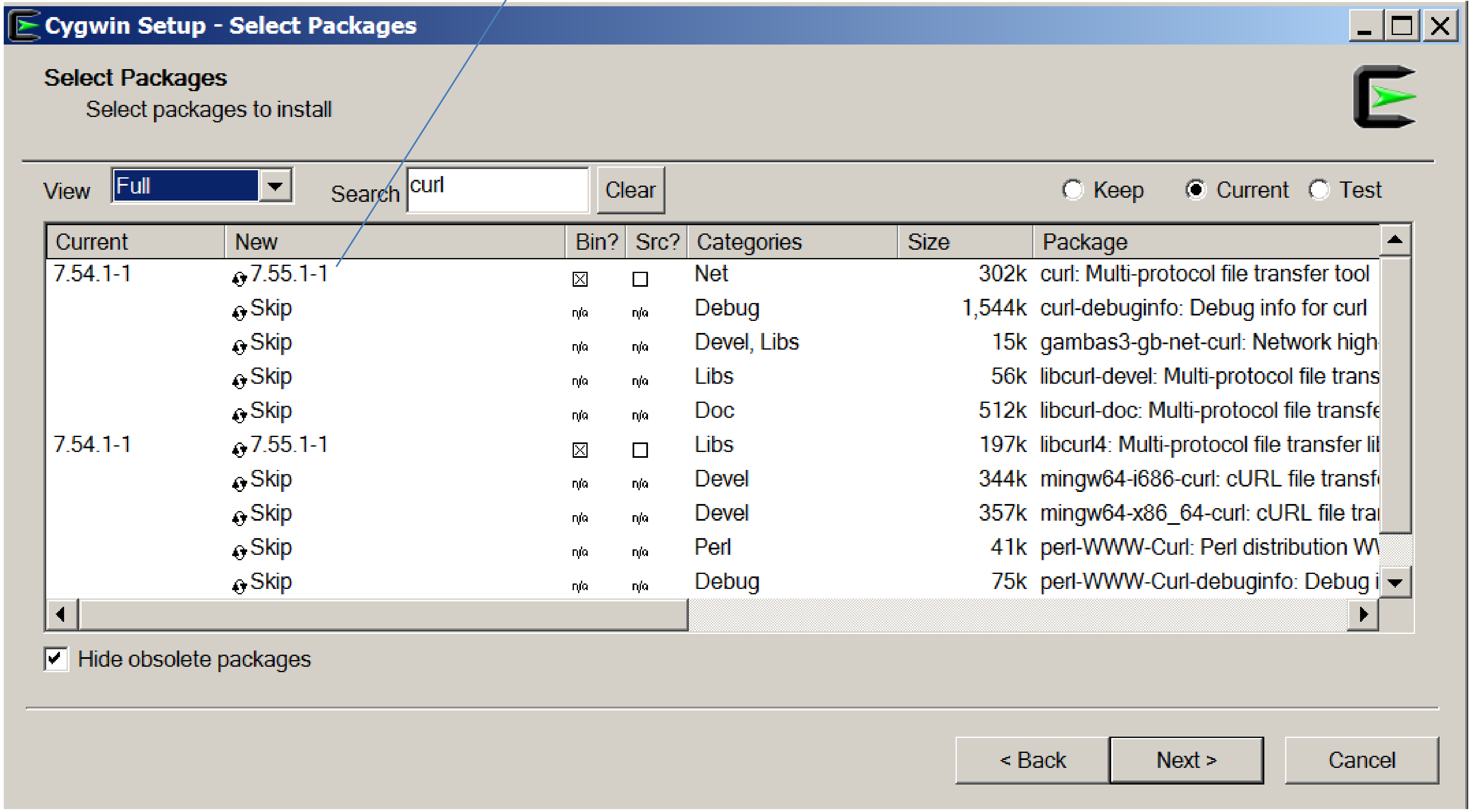
- Command line tool for data transfer

- Download from here (has Windows & Mac OS versions):
  - https://curl.haxx.se/download.html

- You may easily grab a copy of curl in Cygwin (see next slide)

Install curl in Cygwin

Select to install this one



Select Packages

Select packages to install

View: Full Search: curl Clear ( ) Keep [✓ Current] ( ) Test

Current	New	Bin?	Src?	Categories	Size	Package
7.54.1-1	7.55.1-1	☒	☐	Net	302k	curl: Multi-protocol file transfer tool
	Skip	n/a	n/a	Debug	1,544k	curl-debuginfo: Debug info for curl
	Skip	n/a	n/a	Devel, Libs	15k	gambas3-gb-net-curl: Network high
	Skip	n/a	n/a	Libs	56k	libcurl-devel: Multi-protocol file trans
	Skip	n/a	n/a	Doc	512k	libcurl-doc: Multi-protocol file transfe
7.54.1-1	7.55.1-1	☒	☐	Libs	197k	libcurl4: Multi-protocol file transfer lil
	Skip	n/a	n/a	Devel	344k	mingw64-i686-curl: cURL file transfe
	Skip	n/a	n/a	Devel	357k	mingw64-x86_64-curl: cURL file trai
	Skip	n/a	n/a	Perl	41k	perl-WWW-Curl: Perl distribution W
	Skip	n/a	n/a	Debug	75k	perl-WWW-Curl-debuginfo: Debug i

☑ Hide obsolete packages

Firebase REST API

- PUT & POST (C in CRUD)
- GET (R)
- PATCH (U)
- DELETE (D)

All request commands
are case sensitive (all uppercases)

GET

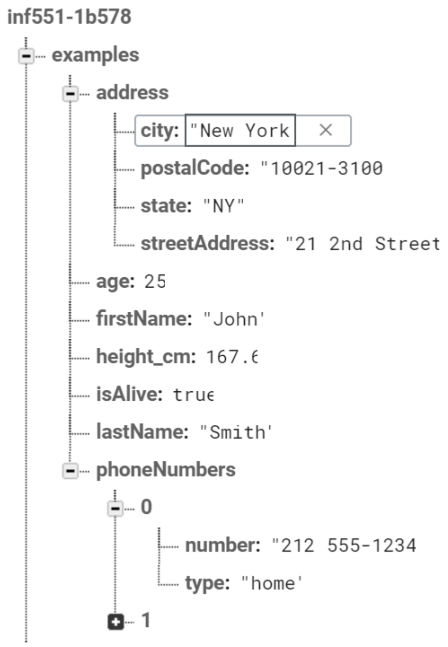
- curl 'https://inf551-1b578.firebaseio.com/weather.json'

- Or
  - curl -X GET 'https://inf551-1b578.firebaseio.com/weather.json'

Another example

- curl -X GET 'https://inf551-1b578.firebaseio.com/examples/phoneNumbers/0.json'
  - {"number":"212 555-1234","type":"home"}

Note: refer to array element by index



```
inf551-1b578
 examples
   address
     city: "New York
     postalCode: "10021-3100
     state: "NY"
     streetAddress: "21 2nd Street
   age: 25
   firstName: "John'
   height_cm: 167.6
   isAlive: true
   lastName: "Smith'
   phoneNumbers
     0
       number: "212 555-1234
       type: "home'
     1
```

PUT

- curl -X PUT 'https://inf551-1b578.firebaseio.com/weather.json' -d '"hot"'
  - "hot"

- PUT: write a given value (e.g., "hot") to the specify node (e.g., "weather")
  - Overwrite if node already has value

PUT

- curl -X PUT 'https://inf551-1b578.firebaseio.com/users/100.json' -d '{"name": "john"}'

- This will add a new node "users" (assuming it does not exist yet) and a child of this node with key "100" and content: {"name": "john"}

Example

- Is the previous command the same as this?
  - curl -X PUT -d '{"100": {"name": "John"}}' 'https://inf551-1b578.firebaseio.com/users.json'

Note we now write to the "users" node

- Can you think of a situation where two commands give different results?

POST

- curl -X POST -d '{"name": "John"}' 'https://inf551-1b578.firebaseio.com/users.json'
- Note post automatically generates a new key & then store the value for the new key
  - In contrast, PUT will simply overwrite the value

PATCH

- curl -X PATCH -d '{"name": "John Smith", "age": 25}' 'https://inf551-1b578.firebaseio.com/users/100.json'
- PATCH performs the update if value already exists (e.g., name) ; otherwise, it inserts the new value (e.g., age)
  - … an upsert

DELETE

- curl -X DELETE 'https://inf551-1b578.firebaseio.com/users/100.json'

- What does this do?
  - curl -X DELETE 'https://inf551-1b578.firebaseio.com/users.json'

Query: filtering by key

- curl 'https://inf551-1b578.firebaseio.com/users.json?orderBy="$key"&equalTo="200"'

$\longrightarrow$ Must be a string. Why?

- This returns:
  - {"200":{"age":25,"name":"David"}}

Another example

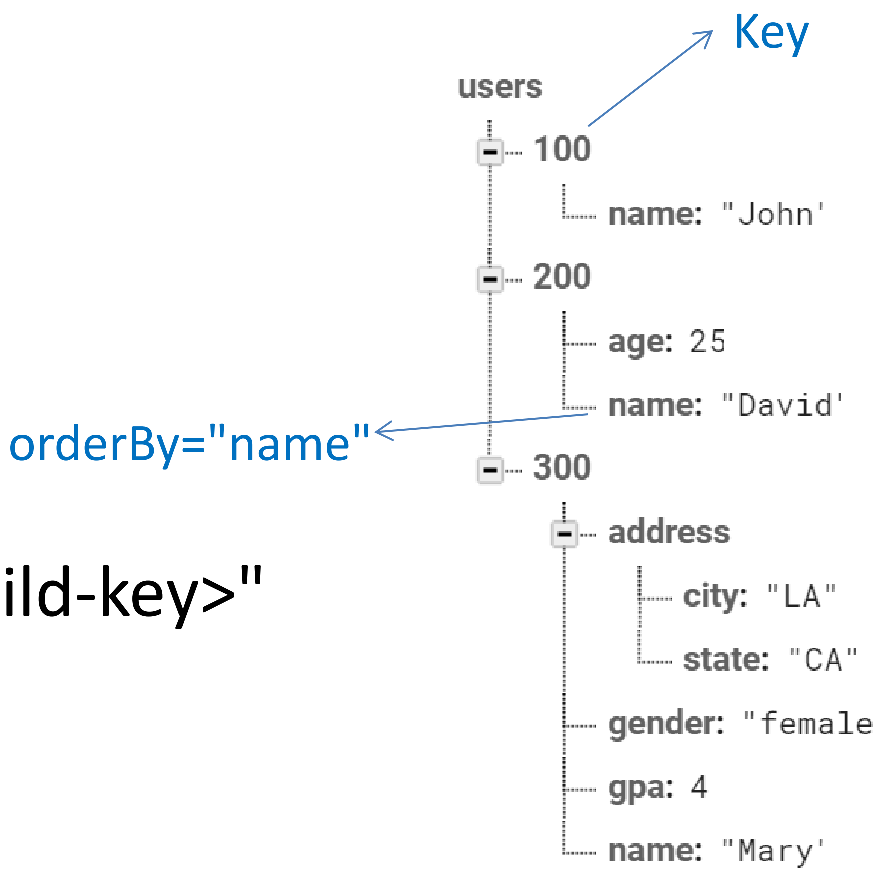
- curl 'https://inf551-1b578.firebaseio.com/users.json?orderBy="$key"&startAt="200"'

Users with keys >= "200"

- This returns:
  - {"200":{"age":25,"name":"David"},"300":{"gender":"female","gpa":4.0,"name":"Mary"}}

Ways of filtering data

- By key:
  - orderBy="$key"
- By child key:
  - orderBy="<path-to-child-key>"
- By value:
  - orderBy="$value"



```
users
├── 100
│   └── name: "John'
├── 200
│   ├── age: 25
│   └── name: "David'
└── 300
    ├── address
    │   ├── city: "LA"
    │   └── state: "CA"
    ├── gender: "female
    ├── gpa: 4
    └── name: "Mary'
```

Parameters

- startAt
- endAt
- equalTo
- limitToFirst
- limitToLast

Example: filtering by child key

- curl 'https://inf551-1b578.firebaseio.com/users.json?orderBy="name"&limitToFirst=1&print=pretty'

- What will this return?

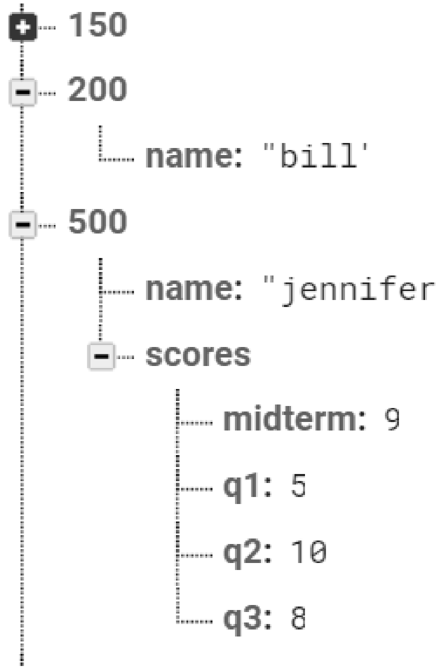
Example for orderBy="$value"

- curl -X PUT 'https://inf551-1b578.firebaseio.com/users/500.json' -d '{"name": "jennifer", "scores": {"q1": 5, "q2": 10, "q3": 8, "midterm": 9}}'

Example: filtering by value

- curl 'https://inf551-1b578.firebaseio.com/users/500/scores.json?orderBy="$value"&limitToFirst=1&print=pretty'

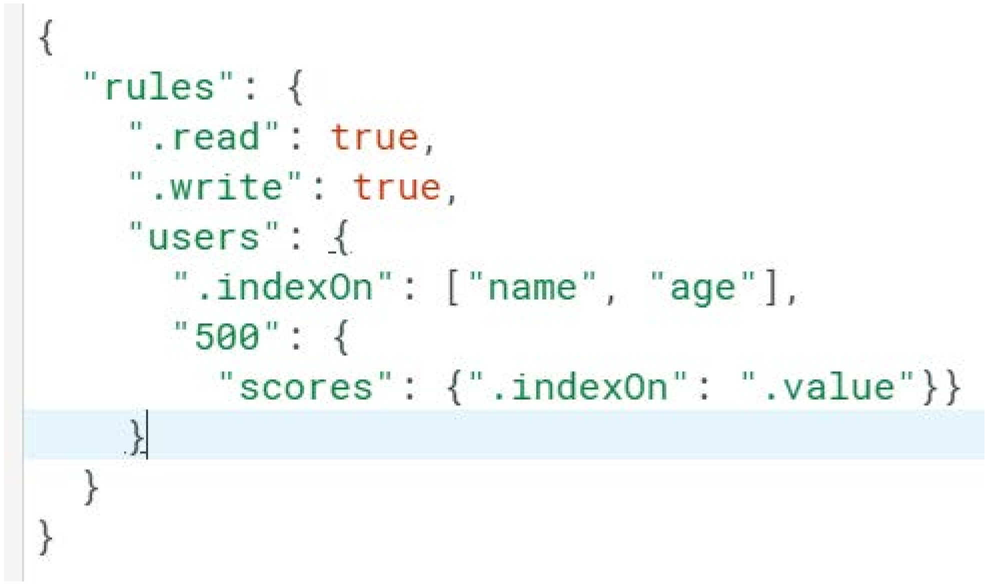
- What will this return?


```
150
200
  name: "bill'
500
  name: "jennifer
  scores
    midterm: 9
    q1: 5
    q2: 10
    q3: 8
```

Creating index for value/child key

- Specified in database rules:
  - https://firebase.google.com/docs/database/security/indexing-data

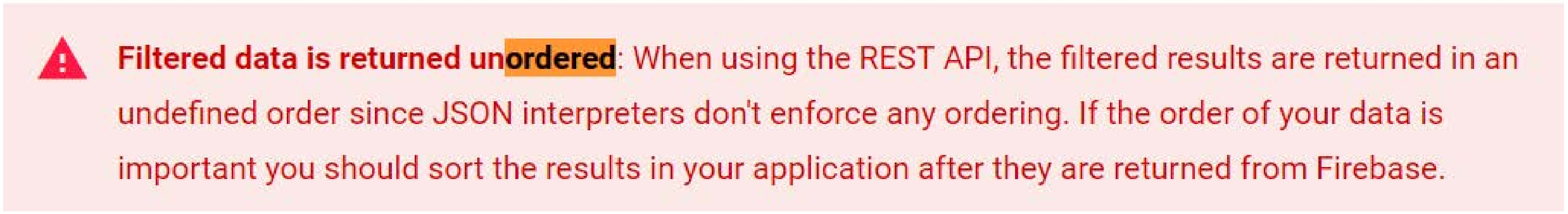
- Only required for REST API



```
{
  "rules": {
    ".read": true,
    ".write": true,
    "users": {
      ".indexOn": ["name", "age"],
      "500": {
        "scores": {".indexOn": ".value"}}
    }
  }
}
```

Watch out…

- https://firebase.google.com/docs/database/rest/retrieve-data#filtering-by-a-specified-child-key



Filtered data is returned unordered: When using the REST API, the filtered results are returned in an undefined order since JSON interpreters don't enforce any ordering. If the order of your data is important you should sort the results in your application after they are returned from Firebase.

Using REST in Python

- import requests
  - May need to "pip install requests" first

- url = 'https://inf551-1b578.firebaseio.com/users.json'
- response = requests.get(url)
- response.json()
  - {u'200': {u'age': 25, u'name': u'David'},…

Writing

- url1 = 'https://inf551-1b578.firebaseio.com/users/888.json'
- data = '{"name": "jimmy", "gender": "male"}'
- response = requests.put(url1, data)

Updating & deleting

- Updating
  - requests.patch(url, data)
- Deleting
  - requests.delete(url)

Pretty printing

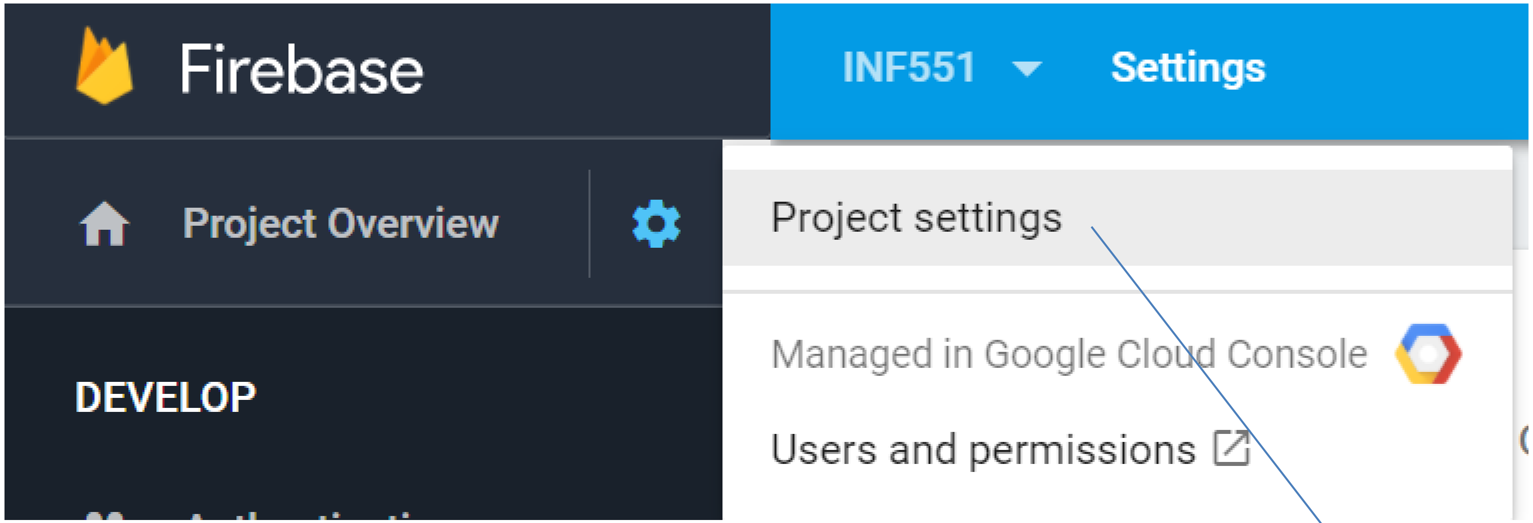
- import json
- print json.dumps(response.json(), indent=4)

↓

```
{
    "200": {
        "age": 25,
        "name": "David"
    },
…
```

Roadmap

- Firebase REST API
- Firebase Javascript/Web API
  - Useful for your project

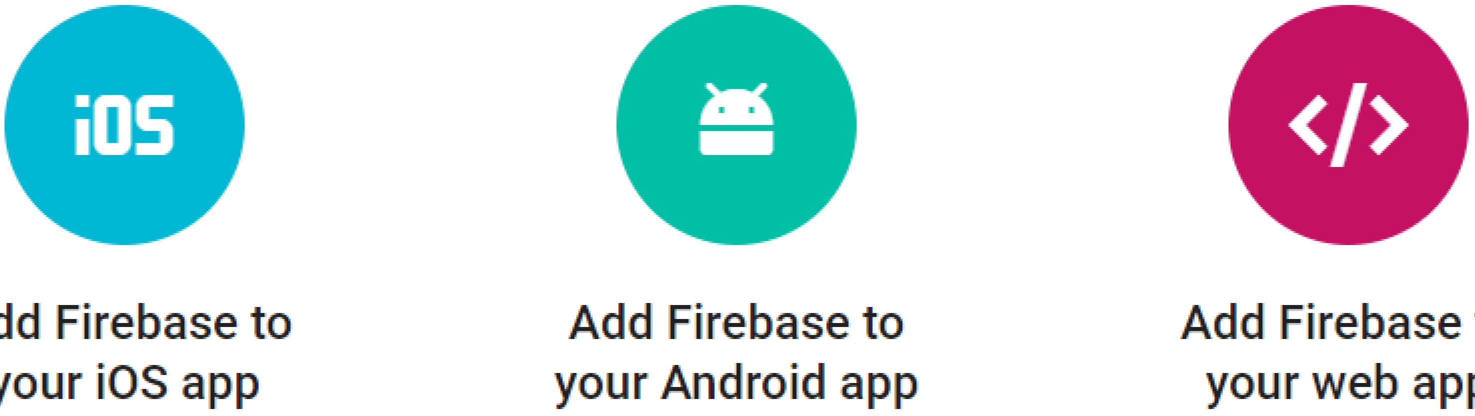


Project settings

Managed in Google Cloud Console

Users and permissions

Select this

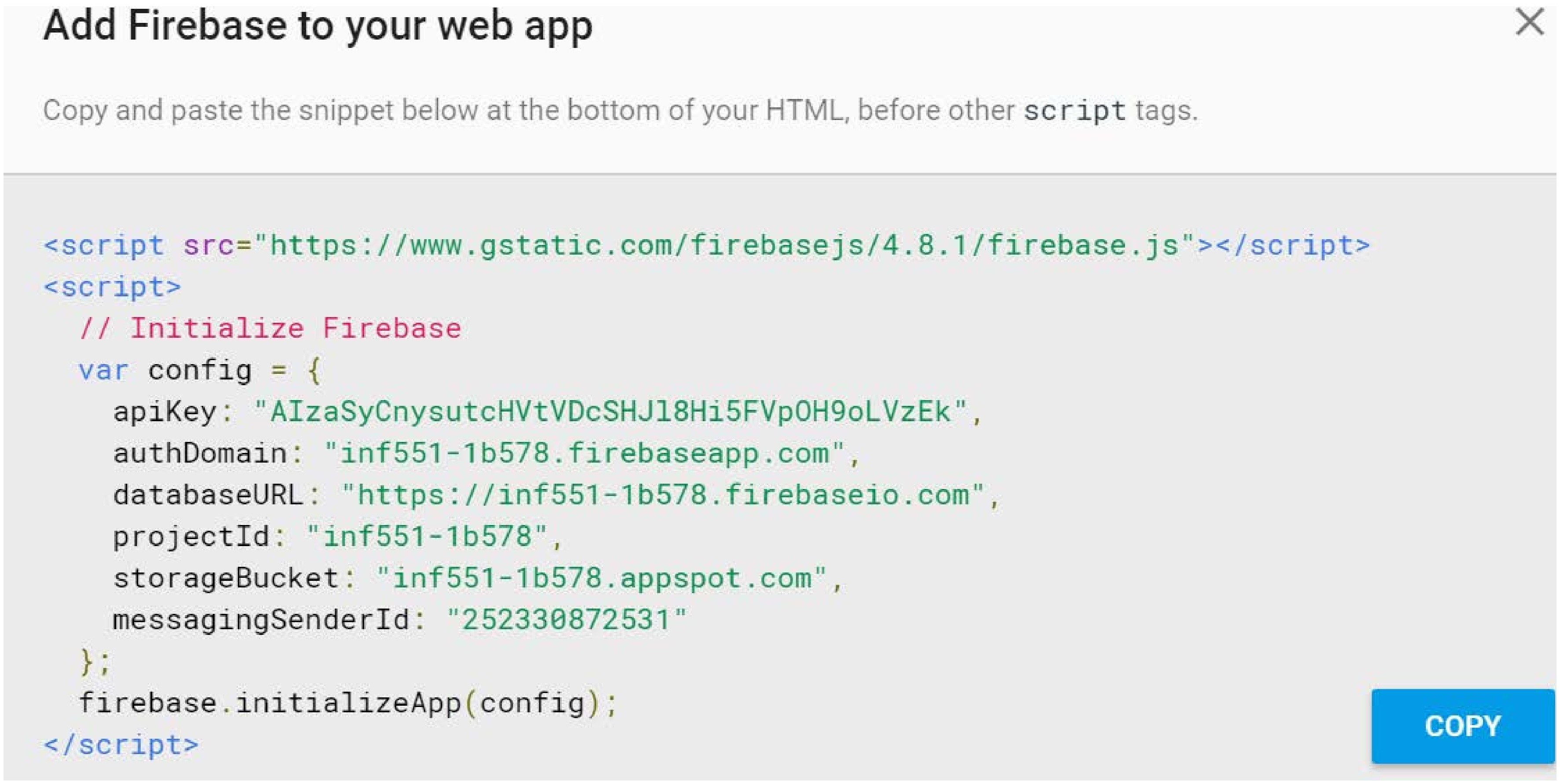


Add Firebase to your iOS app

Add Firebase to your Android app

Add Firebase to your web app

Copy the integration script


Add Firebase to your web app

Copy and paste the snippet below at the bottom of your HTML, before other `script` tags.

```
<script src="https://www.gstatic.com/firebasejs/4.8.1/firebase.js"></script>
<script>
  // Initialize Firebase
  var config = {
    apiKey: "AIzaSyCnysutcHVtVDcSHJ18Hi5FVpOH9oLVzEk",
    authDomain: "inf551-1b578.firebaseapp.com",
    databaseURL: "https://inf551-1b578.firebaseio.com",
    projectId: "inf551-1b578",
    storageBucket: "inf551-1b578.appspot.com",
    messagingSenderId: "252330872531"
  };
  firebase.initializeApp(config);
</script>
```

A html page for testing

```
<html>
<head><title>Test Firebase</title></head>
<body>

It is <span id="value"></span> today!

<script src="https://www.gstatic.com/firebasejs/4.3.0/firebase.js"></script>
<script>
  // Initialize Firebase
  var config = {
    apiKey: "AIzaSyCnysutcHVtVDcSHJl8Hi5FVpOH9oLVzEk",
    authDomain: "inf551-1b578.firebaseapp.com",
    databaseURL: "https://inf551-1b578.firebaseio.com",
    projectId: "inf551-1b578",
    storageBucket: "inf551-1b578.appspot.com",
    messagingSenderId: "252330872531"
  };
  firebase.initializeApp(config);

  var value = document.getElementById("value");
  var dbRef = firebase.database().ref().child("weather");
  dbRef.on('value', snap => value.innerText = snap.val());

</script>
</body>

</html>
```

val() returns a Javascript object representing content of snapshot

Internet explorer does not support "=>" notation
Change it to function(snap) {…}

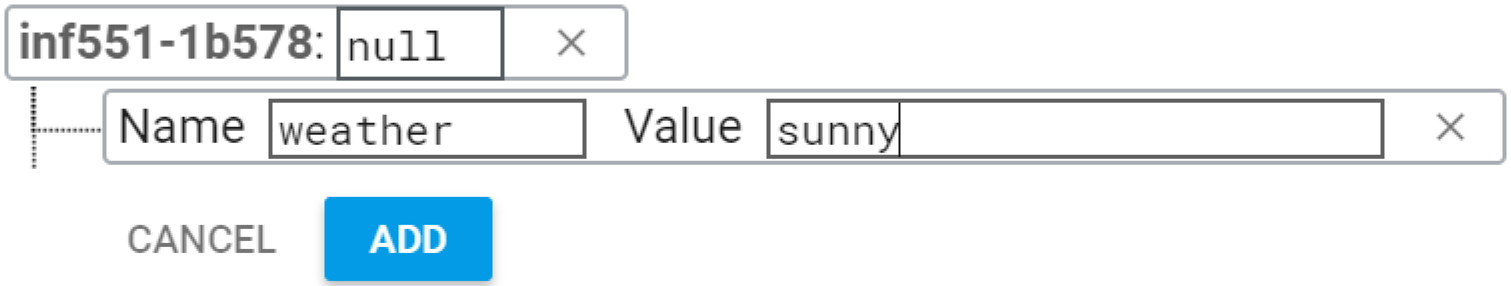
Database reference

- Firebase.database() returns a reference to the firebase database as specified by "config"

- ref(): returns a reference to the root node of the database
- ref("weather") returns a reference to the "weather" child of the root
  - same as ref().child("weather")

Modify the data in database

- Observe the data automatically changed in the browser


inf551-1b578: null

Name weather Value sunny

Write data using set()

-
  ```
  function writeUserData(userId, name, email) {
  firebase.database().ref("users/" + userId).set({
    name: name,
    email: email
  });
  }
  ```

Setting/overwriting the data of user 123

- `writeUserData("123", "John", "john@usc.edu");`

Write data using push() and set()

- firebase.database().ref("users").push().set({name: "John", email: "john@usc.edu"});

- push() will automatically generate a key
  - In this case, id for the new user

- Which REST command is this similar to?

Update data

- function updateUserData(userId, phone) {

  firebase.database().ref("users/"+userId).update({

   phone: phone

  });

 }

Note this does not remove other data of user 123
What if you replace "update" with "set"?

- updateUserData("123", "(626)123-0000");

Retrieve a list of values

- userRef = firebase.database().ref("users");
- userRef.on("value", function(snapshot) {

```
snapshot.forEach(function(child) {
 console.log(child.key + ": " + child.val());
});
});
```

Press Ctrl+Shift+J in Chrome for console window

Listening to child events instead

- userRef.on("value", function(snapshot) {…
  - Will retrieve a list of values in the path specified by userRef
  - Not efficient, since entire list will be retrieved whenever changes occur

- userRef.on("child_added", function(…)) {…
  - Firebase will callback for every existing child and new child added to the path userRef
  - Other events: child_changed, child_removed

Filtering data

- queryRef = firebase.database().ref("users").orderByChild("name").equalTo("David");
- queryRef.on("value", function(snapshot) {

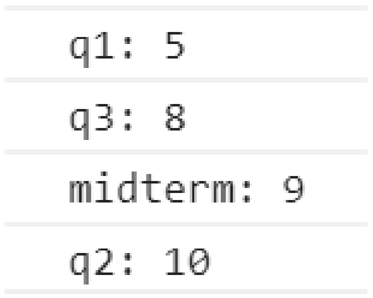
```
snapshot.forEach(function(child) {
   console.log(child.key + ": " + child.val());
  });
});
```

Filtering data

- It also supports:
  - orderByKey()
  - orderByValue()

orderByValue() example

```
queryRef = firebase.database().ref("users/500/scores")
        .orderByValue();
 queryRef.on("value", function(snapshot) {
        snapshot.forEach(function(child) {
                console.log(child.key + ": " + child.val());
  });
 });
```



```
q1: 5
q3: 8
midterm: 9
q2: 10
```

Resources

- Add Firebase to your JavaScript Project
  - https://firebase.google.com/docs/web/setup

- Getting Started with Firebase on the Web
  - https://www.youtube.com/watch?v=k1D0_wFlXgo&feature=youtu.be

- Realtime Database: Installation & Setup in JavaScript, Read & Write Data …
  - https://firebase.google.com/docs/database/web/start

Resources

- Firebase REST API
  - https://firebase.google.com/docs/reference/rest/database/

- Requests for Python
  - http://docs.python-requests.org/en/master/user/quickstart/#make-a-request