Firebase: REST and Web API

DSCI 551

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CRUD in REST

- CRUD
  - C – create PUT/POST (verbs in HTTP)
  - R – retrieve/read GET
  - U – update PATCH
  - D – delete DELETE

- ordering and filtering
  - orderBy="$key"
  - orderBy="$value"
  - orderBy="name"
  - startAt=25, endAt=25, equalTo=25, equalTo="john"
  - limitToFirst=1, limitToLast=1

Firebase

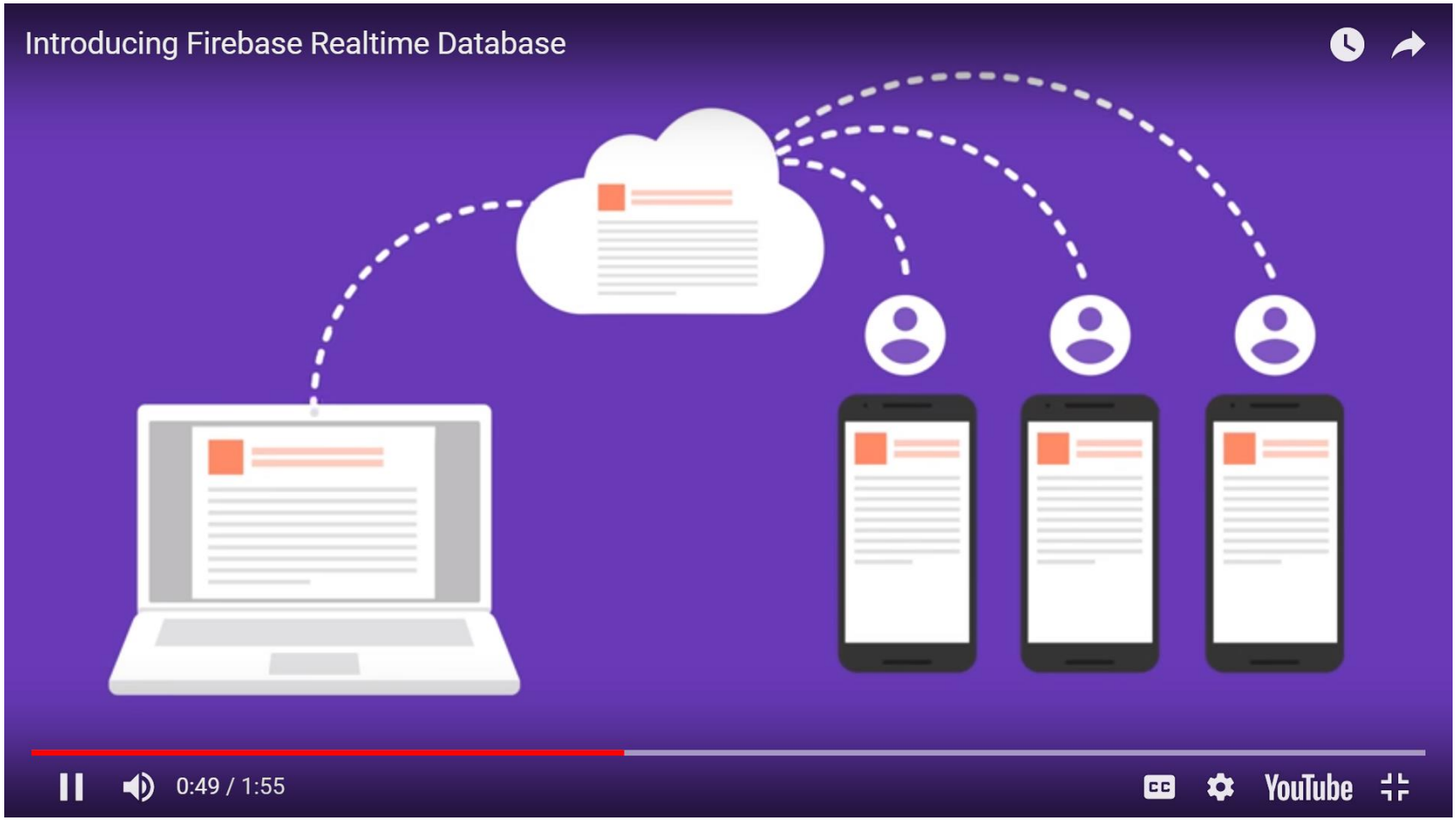
- A cloud-based platform to support web and mobile app development
- Used to be Envolve, a startup founded in 2011
  - For adding online chat functions into websites
- Later expanded into Firebase which was then acquired by Google in 2015

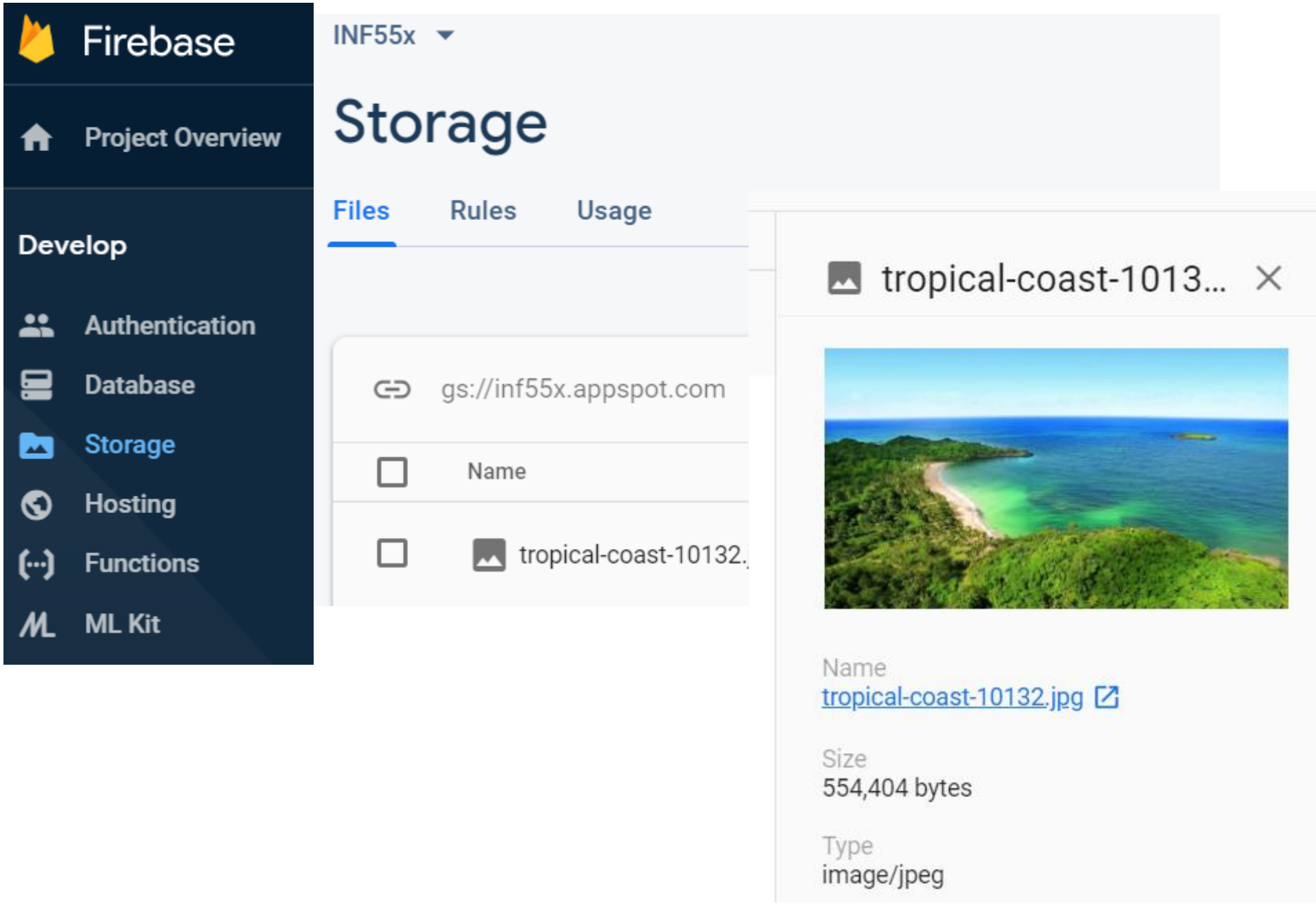
Products

Also has Cloud Firestore in Beta

- 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




Firebase
INF55x
Project Overview
Storage
Develop
Files
Rules
Usage
Authentication
Database
gs://inf55x.appspot.com
Storage
Name
Hosting
tropical-coast-10132.
tropical-coast-1013...
Functions
ML Kit
Name
tropical-coast-10132.jpg
Size
554,404 bytes
Type
image/jpeg

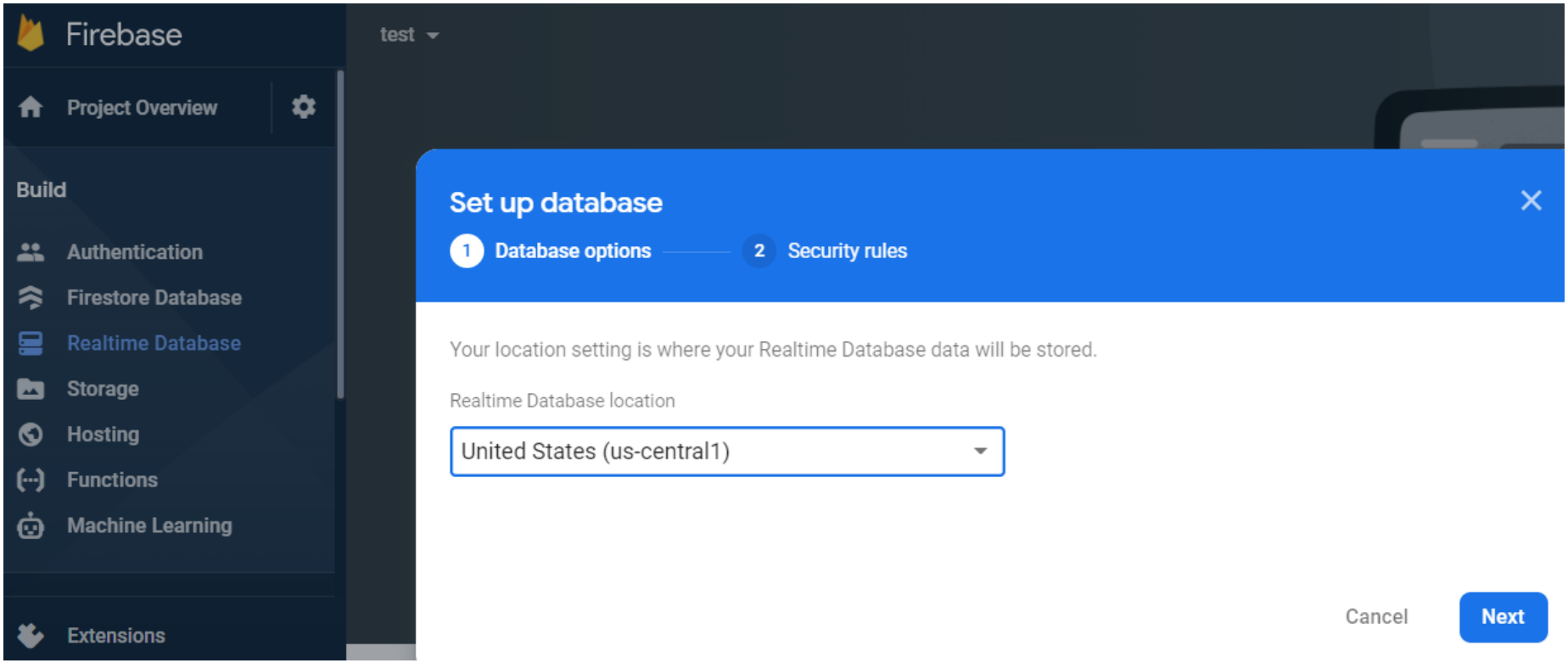
Create a Firebase account

- You may use your Google account

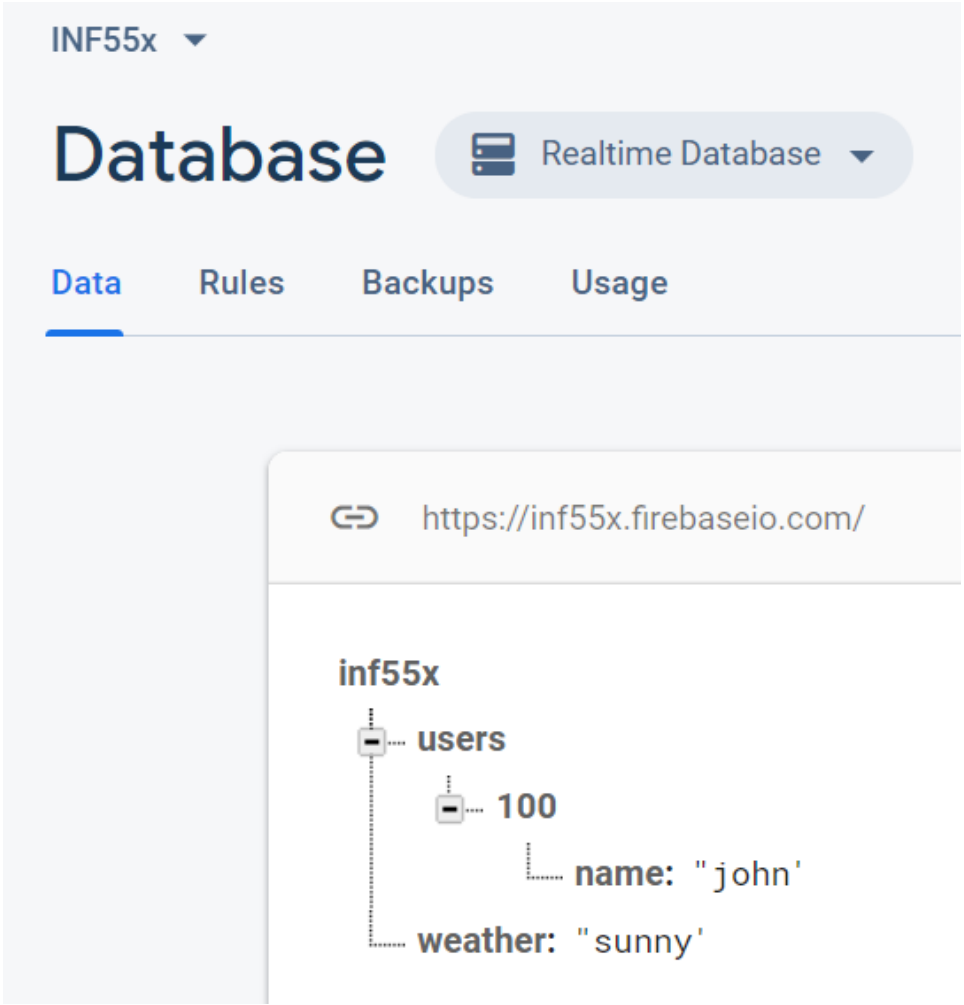
- Go to Firebase console:
  - https://console.firebase.google.com/

Click on "Add project"

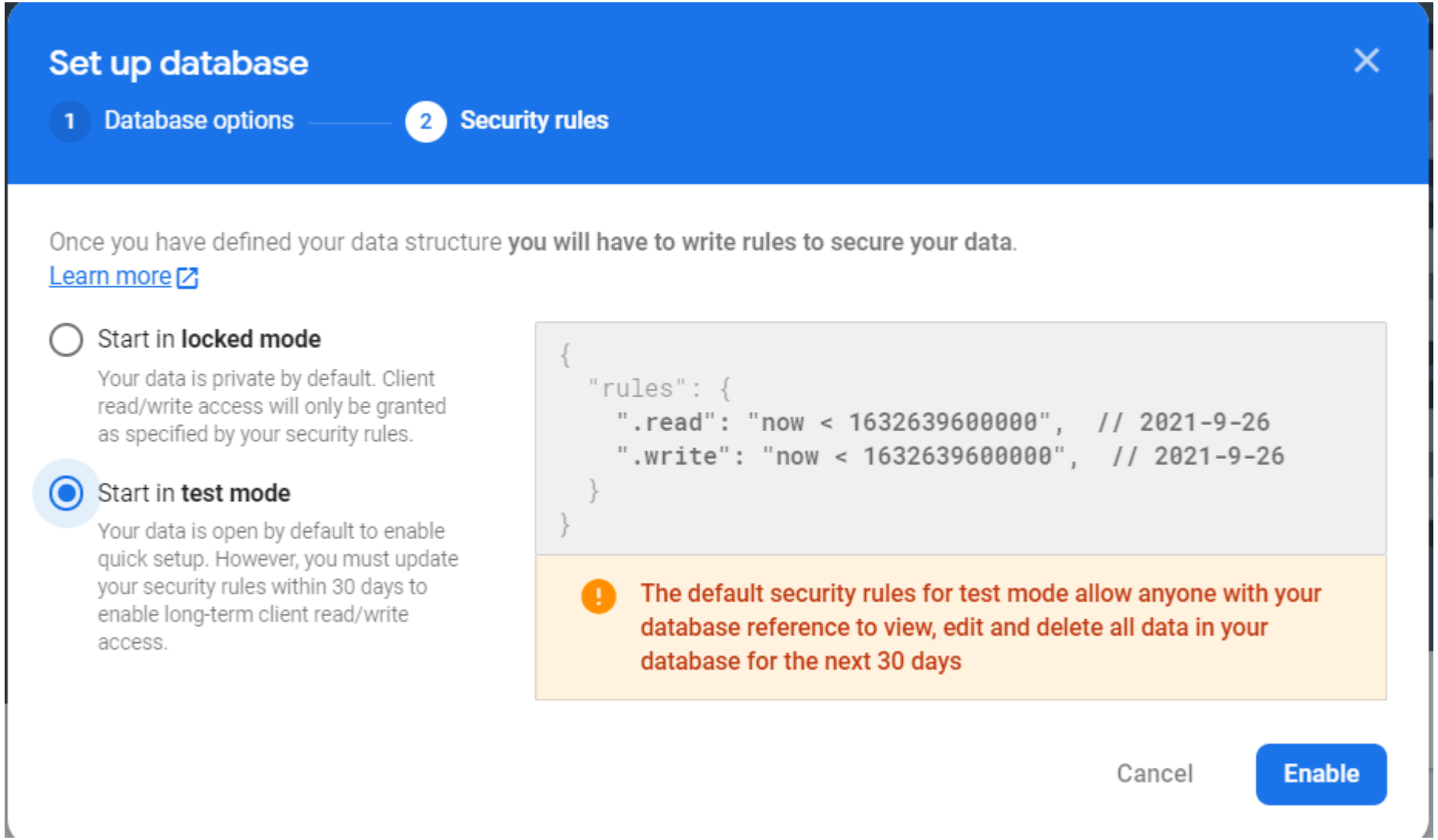
Create a firebase realtime db



Realtime database



Choose test mode



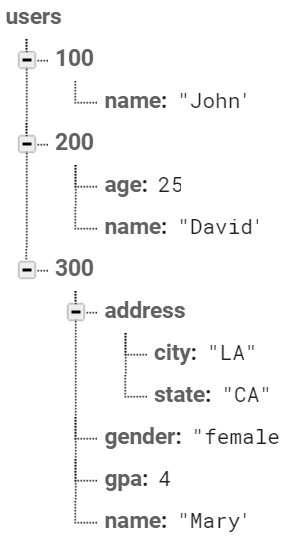
Open to access forever

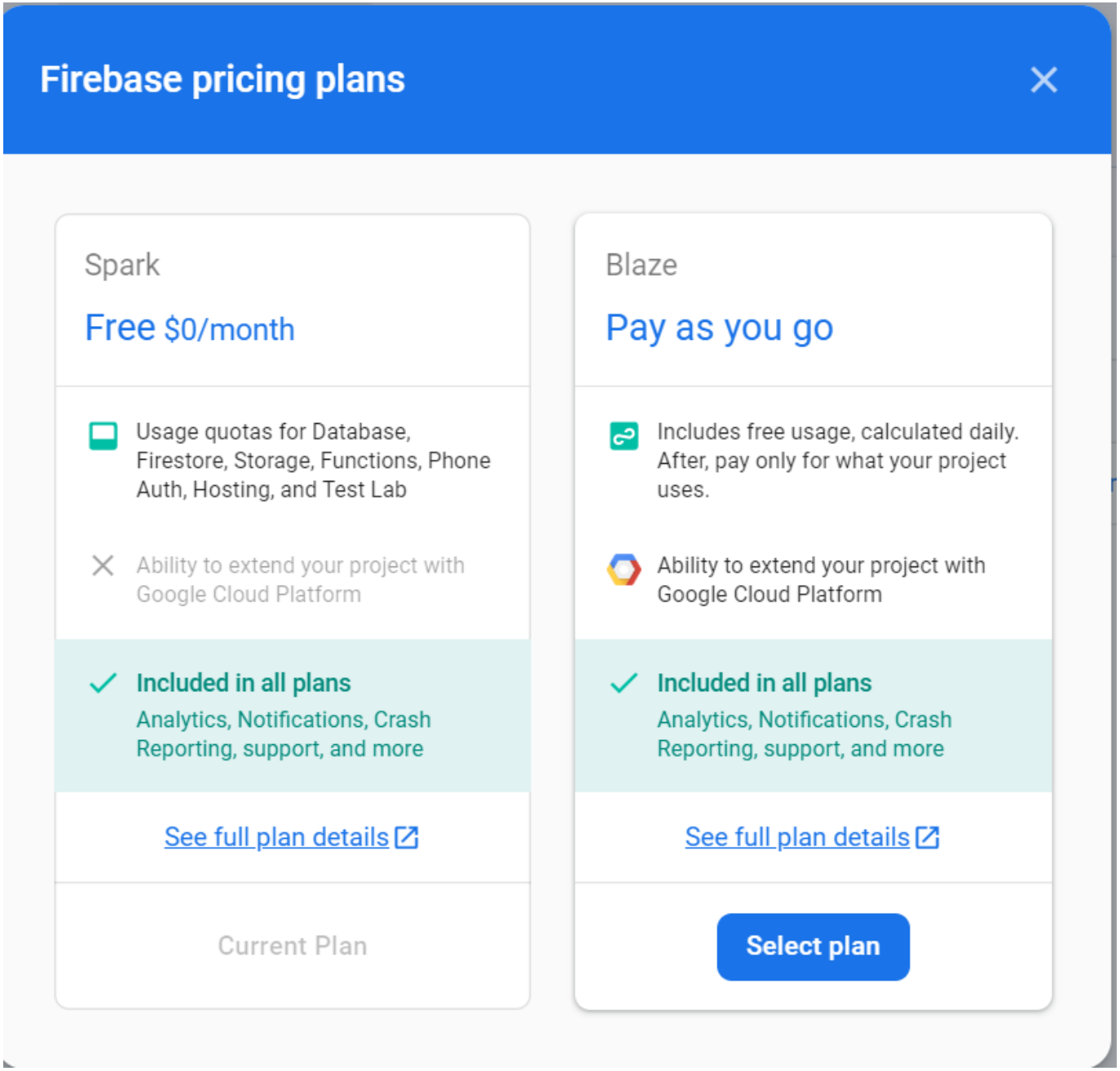
- note .read and .write have a value of true

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

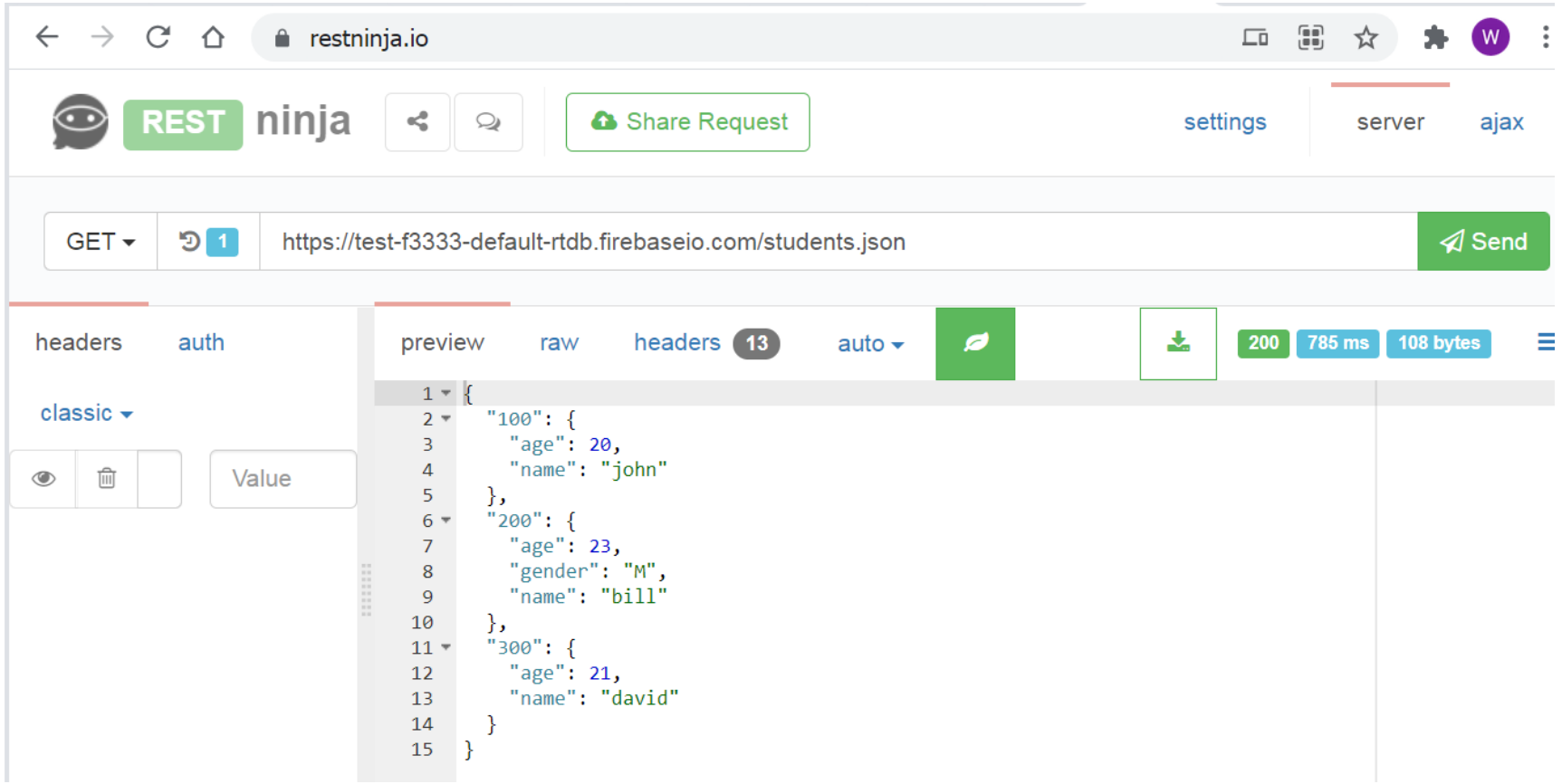
db-URL/users.json?orderBy="name"

this index supports this orderBy




Firebase pricing plans
Spark
Free $0/month
Usage quotas for Database, Firestore, Storage, Functions, Phone Auth, Hosting, and Test Lab
Ability to extend your project with Google Cloud Platform
Included in all plans
Analytics, Notifications, Crash Reporting, support, and more
See full plan details
Current Plan
Blaze
Pay as you go
Includes free usage, calculated daily. After, pay only for what your project uses.
Ability to extend your project with Google Cloud Platform
Included in all plans
Analytics, Notifications, Crash Reporting, support, and more
See full plan details
Select plan

May use this (but we expect you to know the curl way)



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

These are actual values

- value =
  string|number|object|array|**true**|**false**|**null**

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

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

Valid JSON or not?

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

JSON is case-sensitive

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

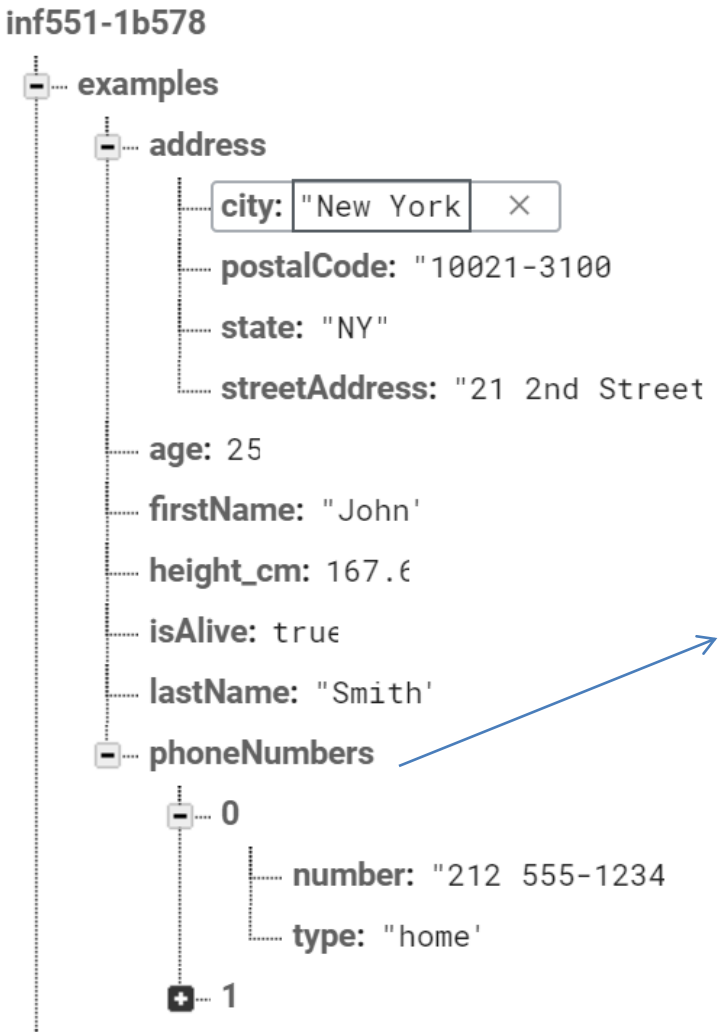
Example JSON

```
{
  "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



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

Check syntax of JSON

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

Roadmap

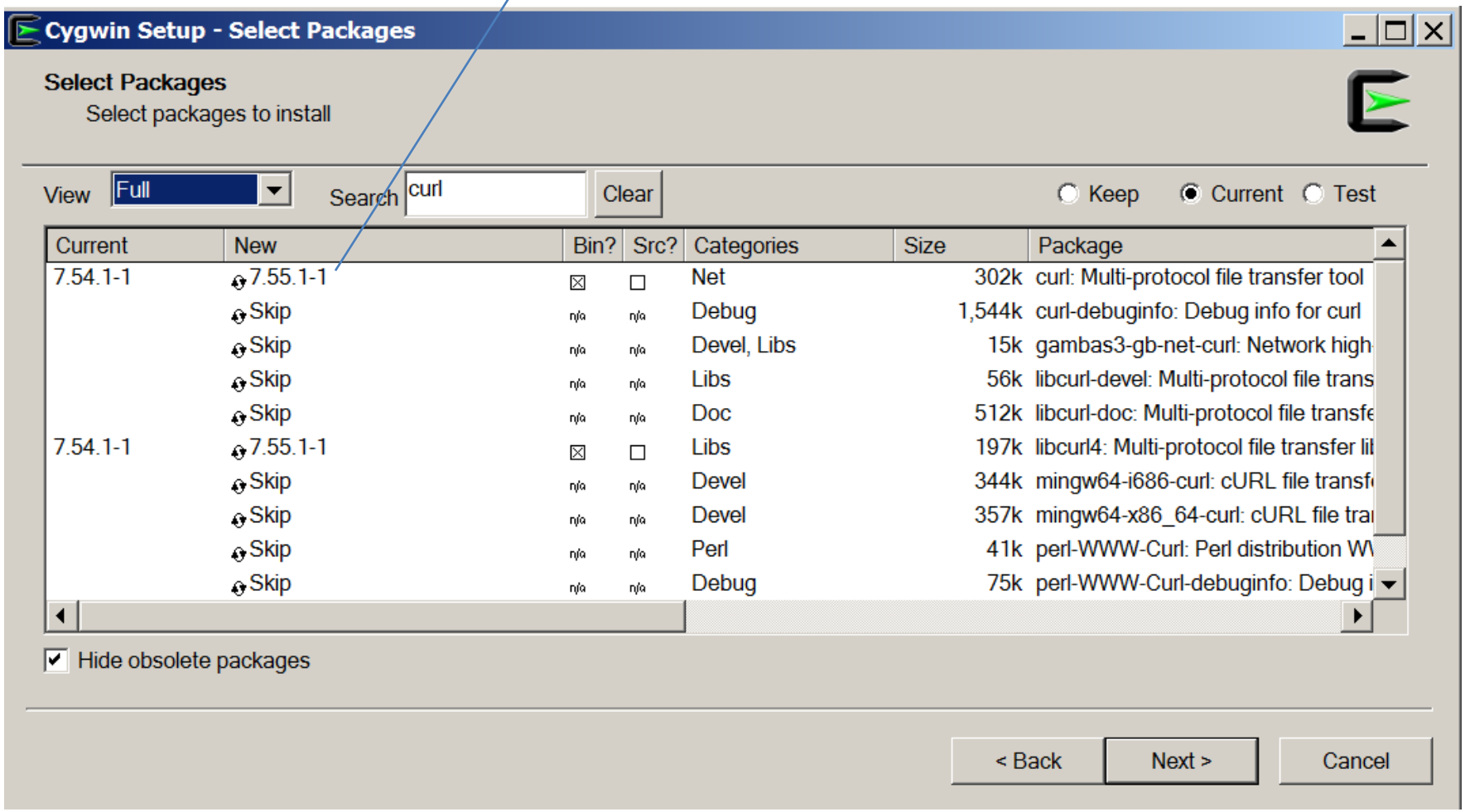
- Firebase REST API 
- Firebase Javascript API
  - Useful for your project

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)
- You may also use curl on EC2 pre-installed…

Install curl in Cygwin

Select to install this one



Firebase REST API

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

All request commands
are case sensitive (all uppercases)

GET

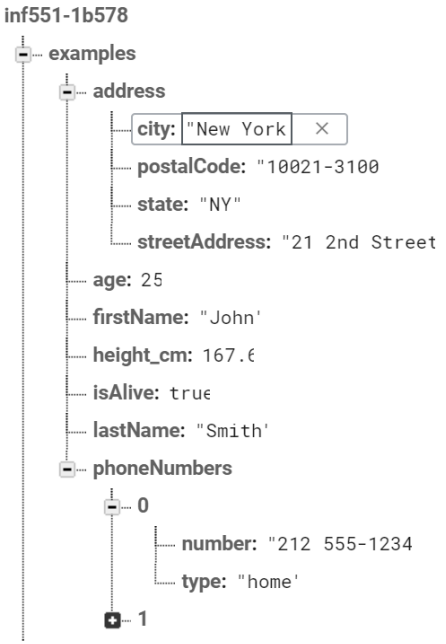
- curl 'https://inf551-1b578.firebaseio.com/weather.json'

- 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



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 stores the value for the new key
  - In contrast, PUT will simply overwrite the value

PATCH

NOTE: patch expects an JSON object in the value

- 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)
  - So... 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"'

Must be a string. Why?

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

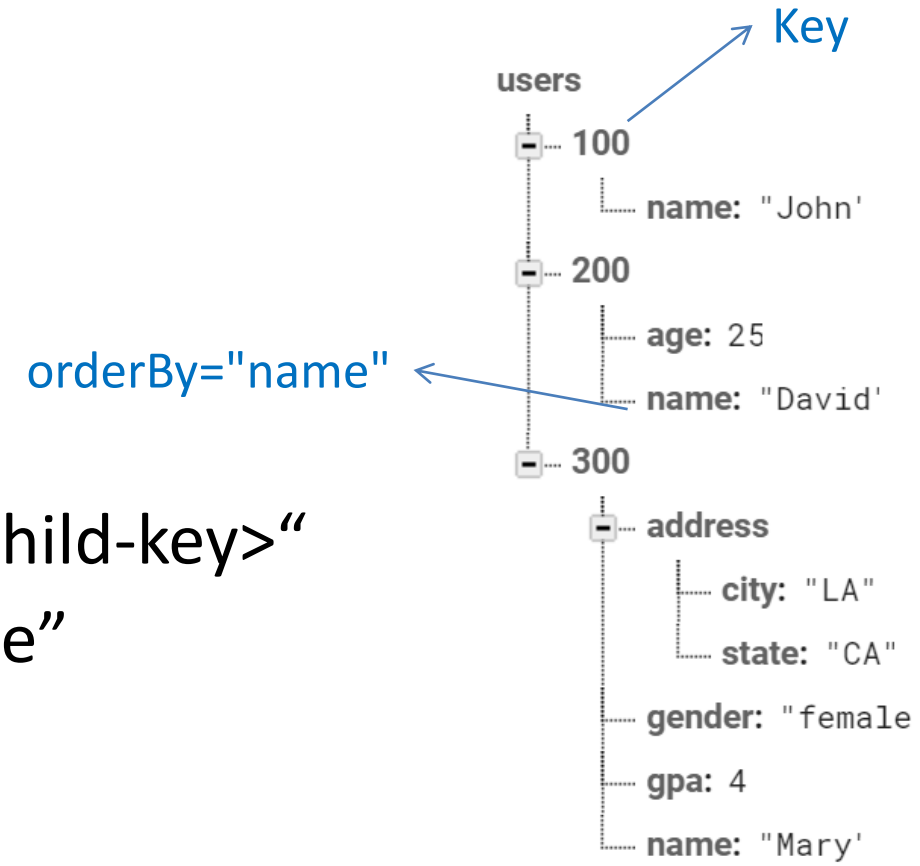
Another example

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

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

Ways of filtering data

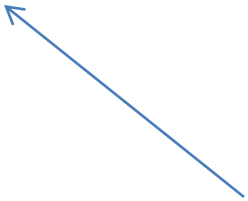
- By key:
  - orderBy="$key"
- By child key:
  - orderBy="<path-to-child-key>“
  - E.g., orderBy = “name”
- By value:
  - orderBy="$value"



Parameters

- startAt
- endAt
- equalTo
- limitToFirst
- limitToLast

Example: filtering by child key



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

- What will this return?

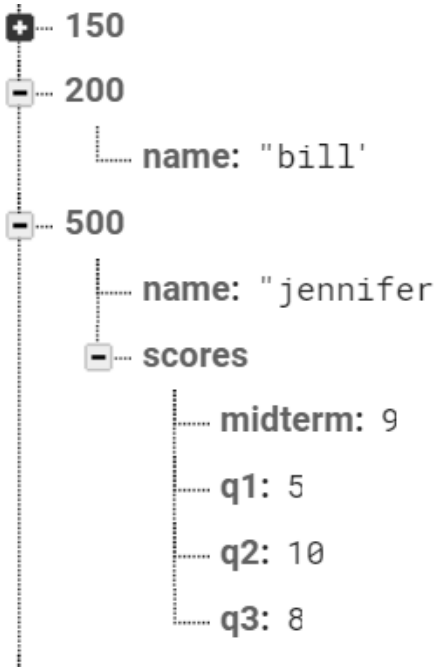
Example for orderBy="$value"

- 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?



Creating index for value/child key

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

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

- Only required
  for REST API
- No need to index key
  - Done automatically by Firebase

Ordering

orderBy

When using `orderBy` with the name of a child key, data that contains the specified child key will be ordered as follows:

1. Children with a `null` value for the specified child key come first.
2. Children with a value of `false` for the specified child key come next. If multiple children have a value of `false`, they are sorted lexicographically by key.
3. Children with a value of `true` for the specified child key come next. If multiple children have a value of `true`, they are sorted lexicographically by key.
4. Children with a numeric value come next, sorted in ascending order. If multiple children have the same numerical value for the specified child node, they are sorted by key.
5. Strings come after numbers, and are sorted lexicographically in ascending order. If multiple children have the same value for the specified child node, they are ordered lexicographically by key.
6. Objects come last, and sorted lexicographically by key in ascending order.

The filtered results are returned unordered. If the order of your data is important you should sort the results in your application after they are returned from Firebase.

Ordering

orderBy="$key"

When using the `orderBy="$key"` parameter to sort your data, data will be returned in ascending order by key as follows. Keep in mind that keys can only be strings.

1. Children with a key that can be parsed as a 32-bit integer come first, sorted in ascending order.
2. Children with a string value as their key come next, sorted lexicographically in ascending order.

orderBy="$value"

When using the `orderBy="$value"` parameter to sort your data, children will be ordered by their value. The ordering criteria is the same as data ordered by a child key, except the value of the node is used instead of the value of a specified child key.

Watch out…

- https://firebase.google.com/docs/database/rest/retrieve-data

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)
- response.text
- response.json()

Update, delete & post

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

Requests API

- Requests for Python
  - https://requests.readthedocs.io/en/latest/

Pretty printing

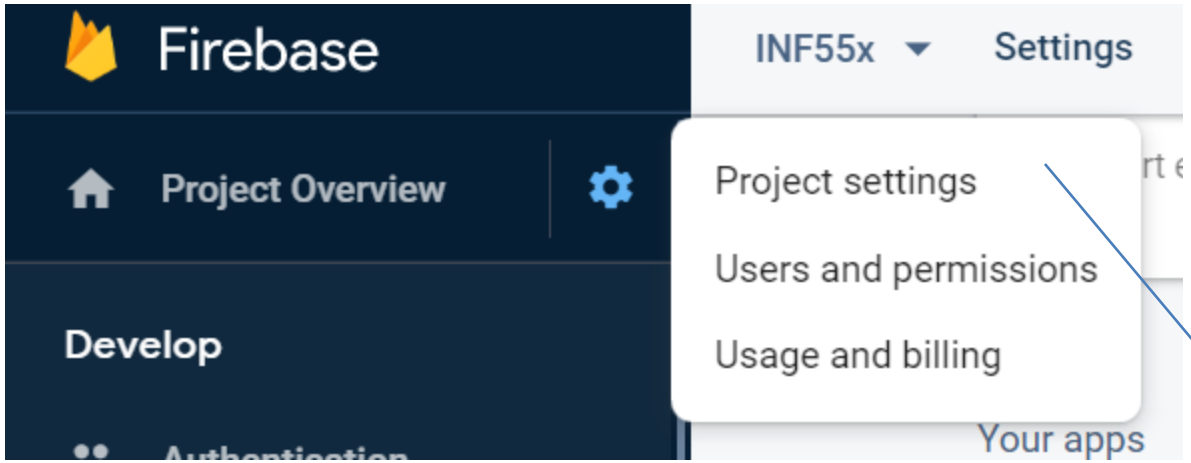
- import json

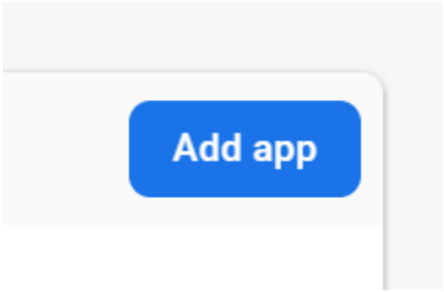
- print json.dumps(response.json(), indent=4)

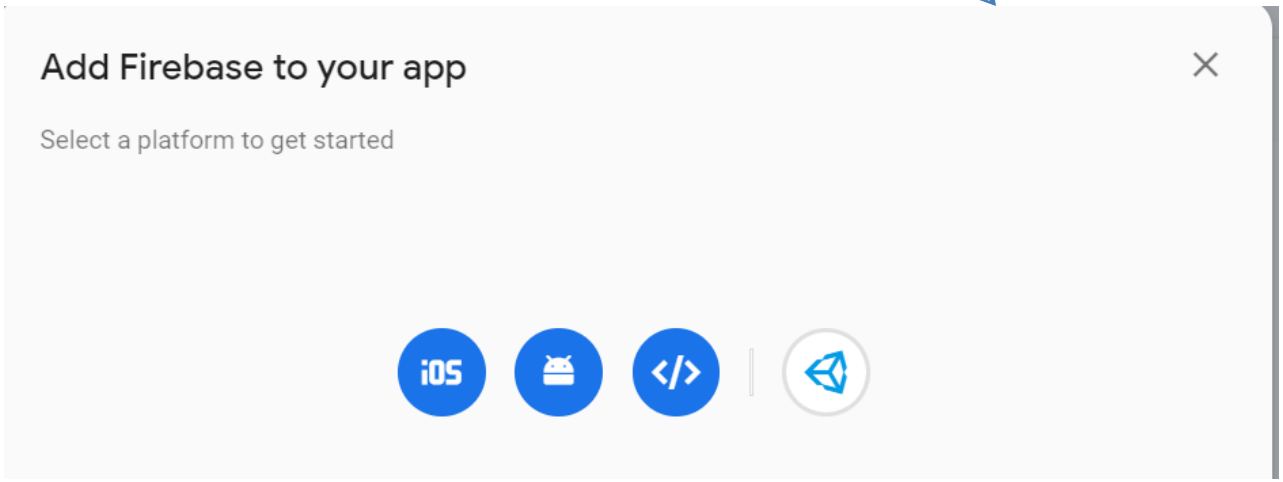
```
{
    "200": {
        "age": 25,
        "name": "David"
    },
...
```

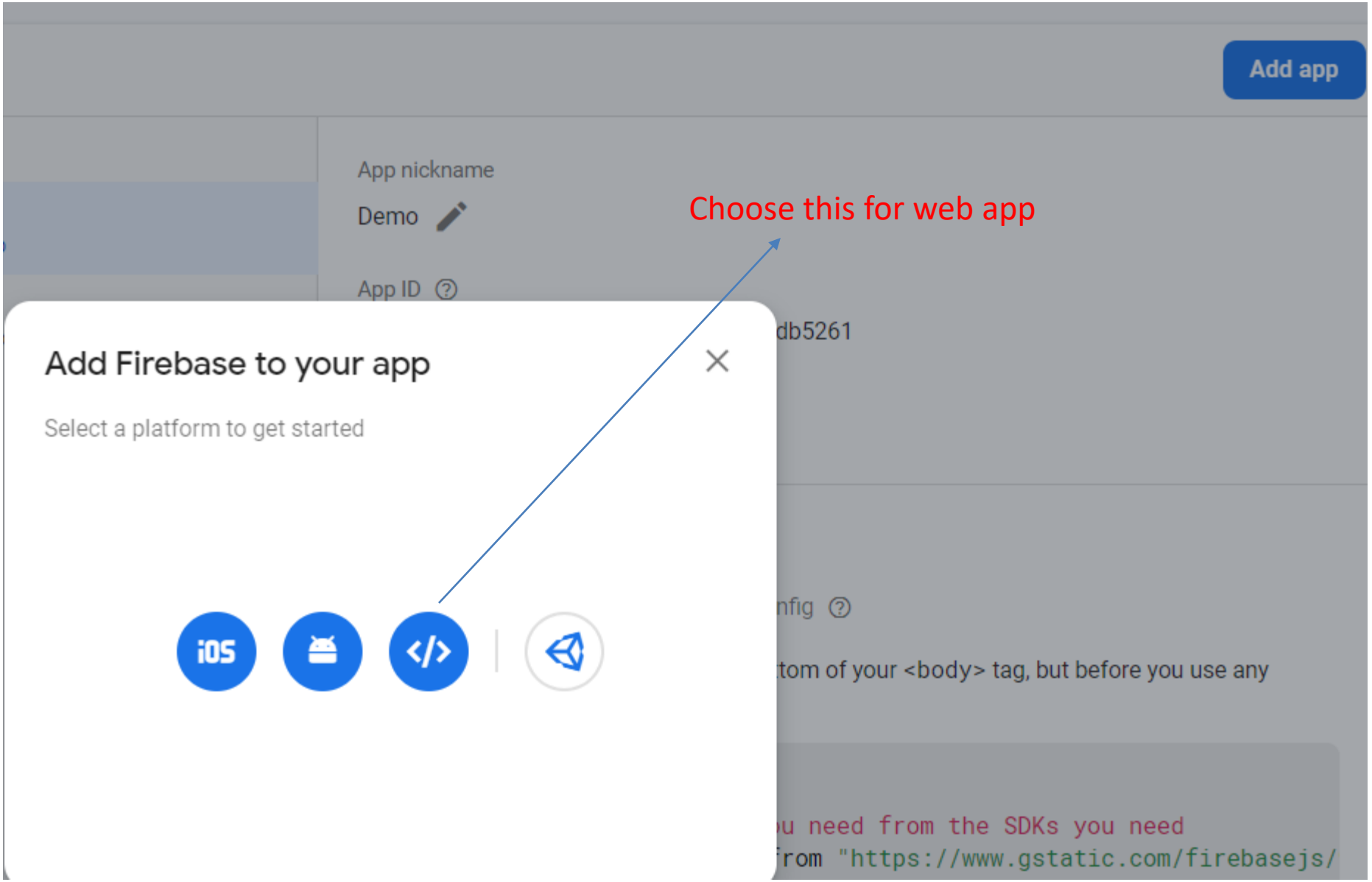
Roadmap

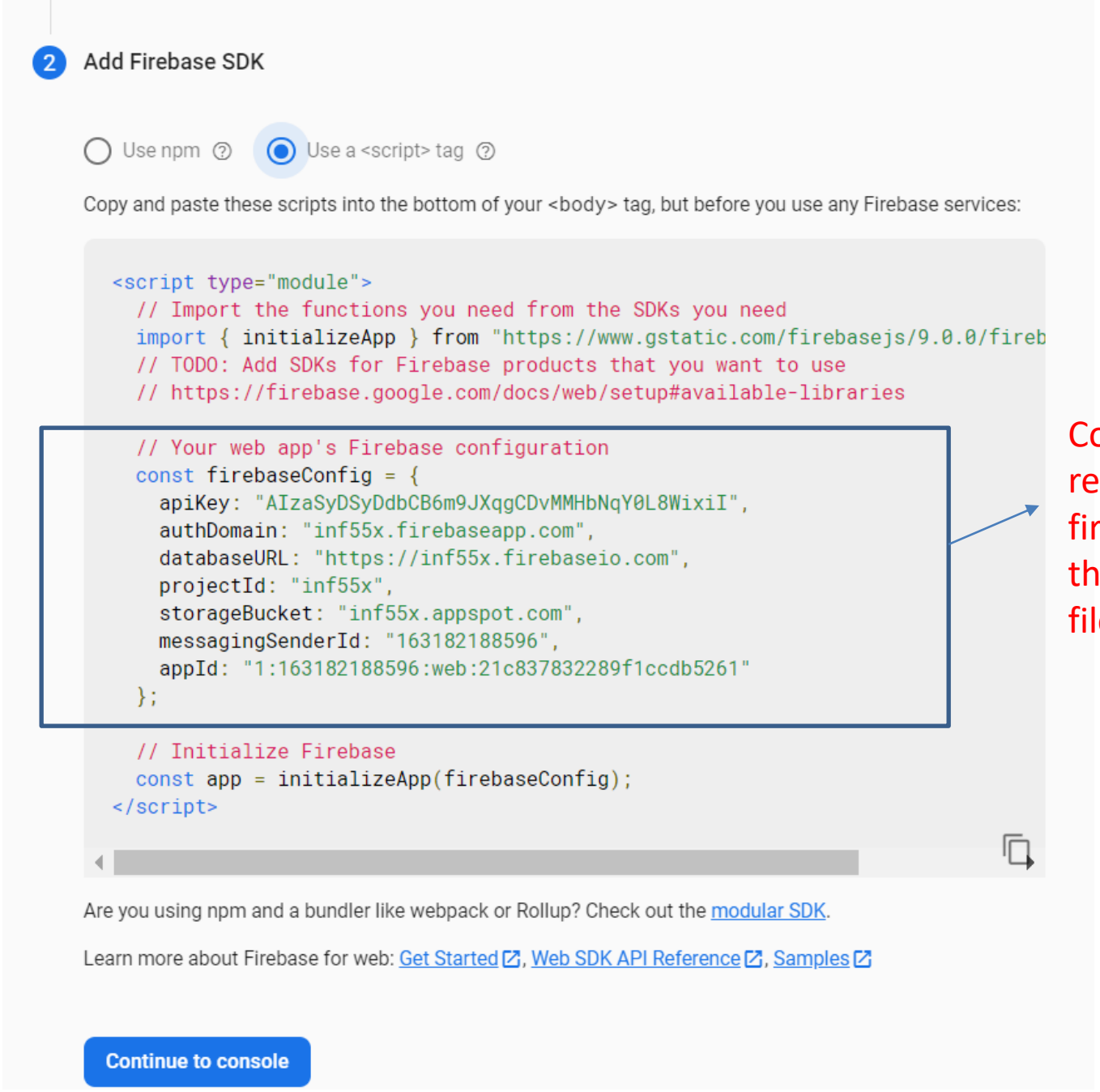
- Firebase REST API
- Firebase Javascript/Web API 
  - Useful for your project


Firebase
INF55x
Settings
Project Overview
Project settings
Users and permissions
Usage and billing
Develop
Your apps


Add app


Add Firebase to your app
Select a platform to get started
iOS


Add app
App nickname
Demo
App ID
Choose this for web app
Add Firebase to your app
Select a platform to get started
iOS
db5261
nfig
tom of your <body> tag, but before you use any
u need from the SDKs you need
rom "https://www.gstatic.com/firebasejs/



Copy this & replace the firebaseConfig in the sample html file

Demo html page

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

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

<!-- The core Firebase JS SDK is always required and must be listed first -->
<script src="https://www.gstatic.com/firebasejs/7.7.0/firebase-app.js"></script>
<script src="https://www.gstatic.com/firebasejs/7.7.0/firebase-database.js"></script>

<script>
  // Your web app's Firebase configuration
  var firebaseConfig = {
    apiKey: "AIzaSyDSyDdbCB6m9JXqgCDvMMHbNqY0L8WixiI",
    authDomain: "inf55x.firebaseapp.com",
    databaseURL: "https://inf55x.firebaseio.com",
    projectId: "inf55x",
    storageBucket: "inf55x.appspot.com",
    messagingSenderId: "163182188596",
    appId: "1:163182188596:web:ca7ccfc2221ef4f4db5261"
  };
  // Initialize Firebase
  firebase.initializeApp(firebaseConfig);

  var value = document.getElementById("value");
  var dbRef = firebase.database().ref().child("weather");

  // query example: a single value
  dbRef.on('value', function(snapshot) {
     console.log("weather value" + ": " + JSON.stringify(snapshot.val()));
     value.innerText = snapshot.val()
  });
```

val() returns a Javascript object representing content of snapshot

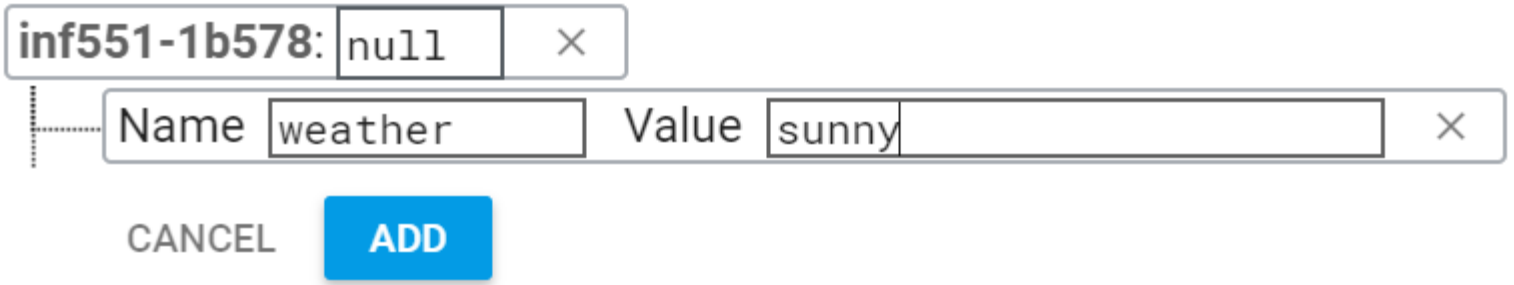
Database reference

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

- 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



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

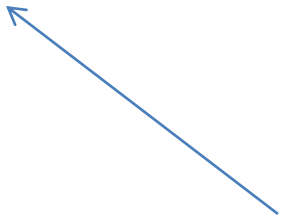
- function updateUserData(userId, phone) {
  firebase.database().ref("users/"+userId).update({
    phone: phone
  });
}

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
  - https://requests.readthedocs.io/en/latest/

Resources

- Firebase Firestore Tutorial
  - https://www.youtube.com/watch?v=4d-gIPGzmK4
  - On how to develop a web app using Firestore