CS371m - Mobile Computing

Persistence - Web Based Storage

CHECK OUT

https://developer.android.com/training/sync-adapters/index.html

The Cloud ……….

IBMCloud @IBMcloud · Aug 23
Hamsters: Cute, but dangerous. Trust us—you don't want to share your #cloud with a hamster:

38 8

Backend

- No clear definition of backend
- front end - user interface
- backend - data, server, programs the user does not interact with directly
- With 1,000,000s of mobile and web apps …
- rise of Backend as a Service (Baas)
- Sometimes MBaaS, M for mobile

Back End As a Service - May Provide:

- cloud storage of data
- integration with social networks
- push notifications
  - server initiates communication, not the client
- messaging and chat functions
- user management
- user analysis tools
- abstractions for dealing with the backend

Clicker

- How many Mobile Backend as a Service providers exist?

A. 1 or 2

B. about 5

C. about 10

D. about 20

E. 30 or more

https://github.com/relatedcode/ParseAlternatives

MBaaS

Data

Push

Analytics

Social

Cloud Code

Hosting

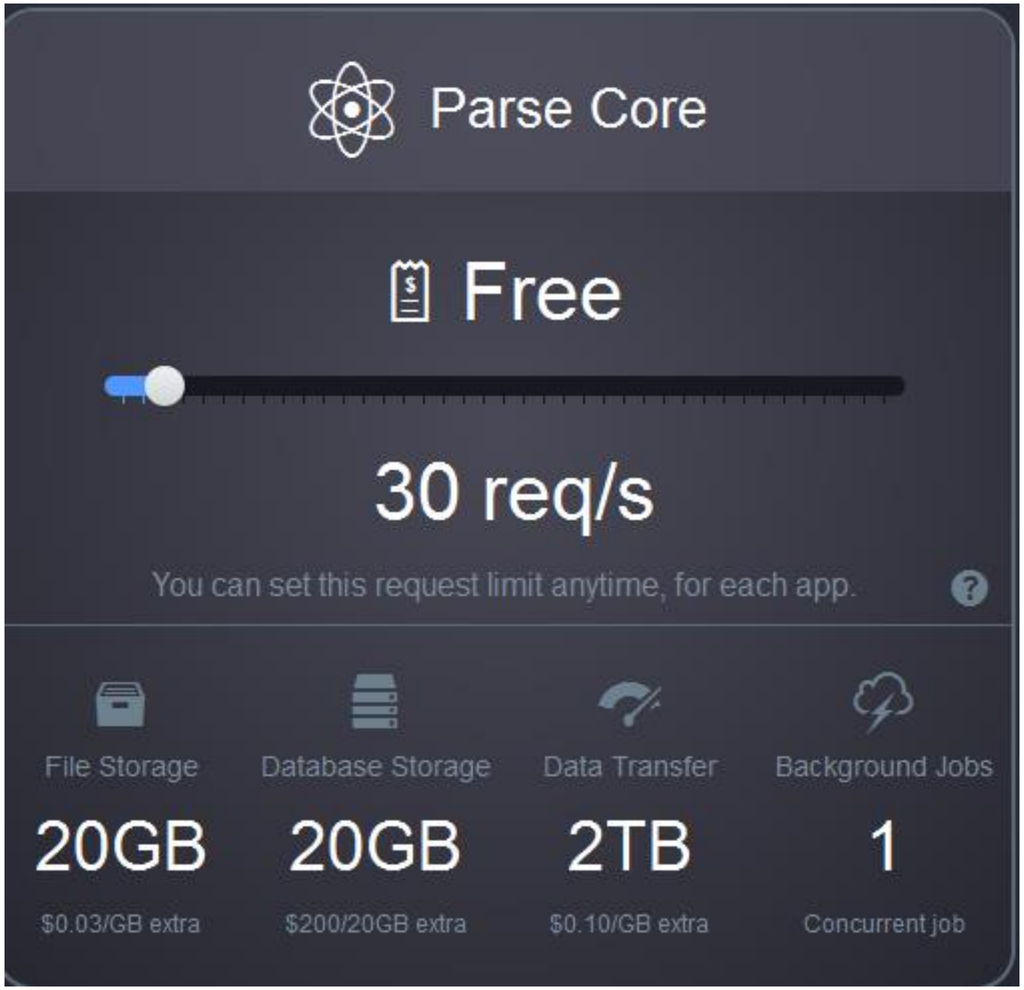
Some Examples of MBaas

- Parse
- Firebase (Google)
- Amazon Web Services
- Google Cloud Platform
- Heroku
- PythonAnywhere
- Rackspace Cloud
- BaasBox (Open Source)
- Usergrid (Open Source)

Parse

Examples of Using a MBaaS

- Parse
- www.parse.com
- various pricing models
- relatively easy to set up and use
- Going away 1/28/2017



Parse Core

Free

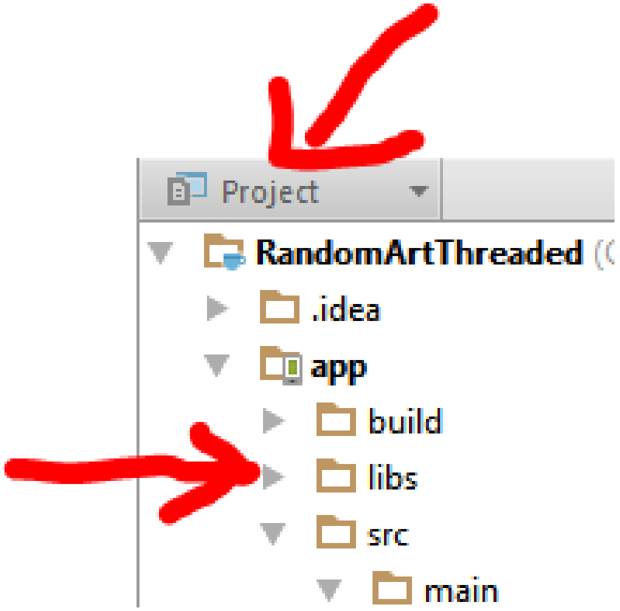
30 req/s

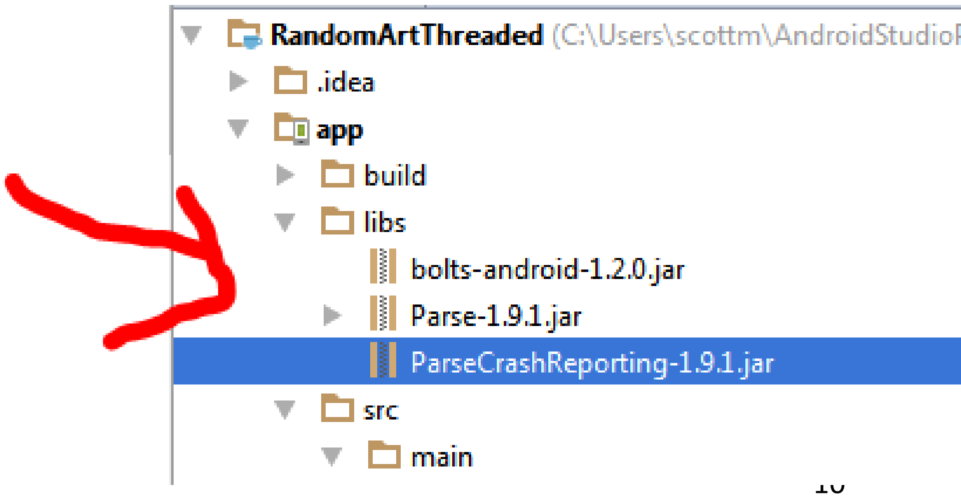
You can set this request limit anytime, for each app.

File Storage	Database Storage	Data Transfer	Background Jobs
20GB	20GB	2TB	1
$0.03/GB extra	$200/20GB extra	$0.10/GB extra	Concurrent job

Parse Set Up in AndroidStudio

1. request api key
2. Download Parse SDK
3. Unzip files
4. Create libs directory in app directory (select Project view)
5. Drag jar files to libs directory

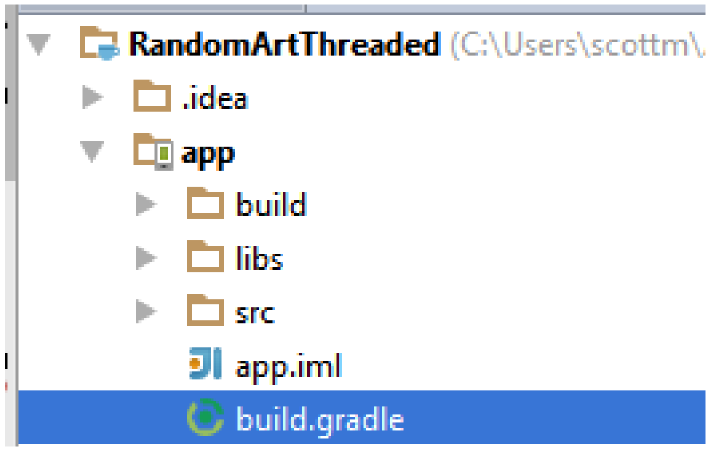




RandomArtThreaded (C:\Users\scottm\AndroidStudio
.idea
app
build
libs
bolts-android-1.2.0.jar
Parse-1.9.1.jar
ParseCrashReporting-1.9.1.jar
src
main

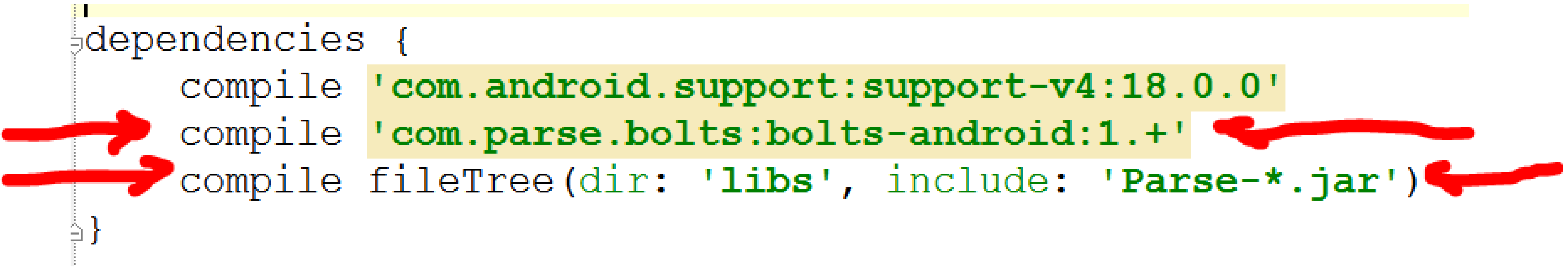
Parse Set Up in AndroidStudio

6. add dependencies to gradle build file under app



RandomArtThreaded (C:\Users\scottm\
.idea
app
build
libs
src
app.iml
build.gradle

like so:

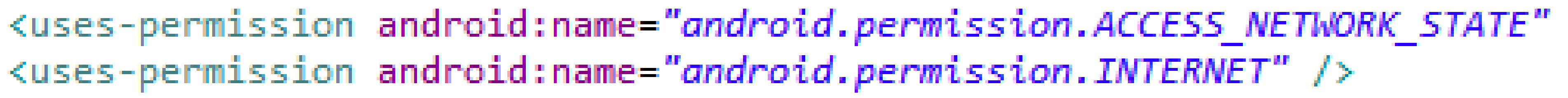


```
dependencies {
    compile 'com.android.support:support-v4:18.0.0'
    compile 'com.parse.bolts:bolts-android:1.+'
    compile fileTree(dir: 'libs', include: 'Parse-*.jar')
}
```

https://www.parse.com/apps/quickstart#parse_data/mobile/android/native/new

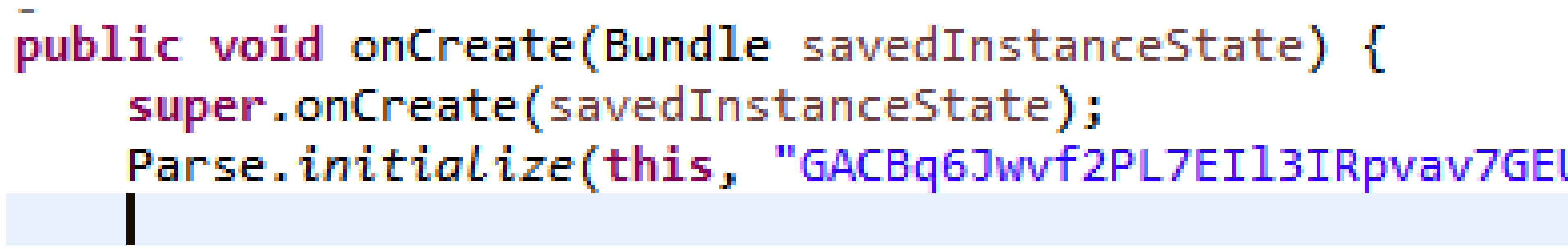
Testing Parse

- Add permissions to manifest to access network state and use internet



```
<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"
<uses-permission android:name="android.permission.INTERNET" />
```

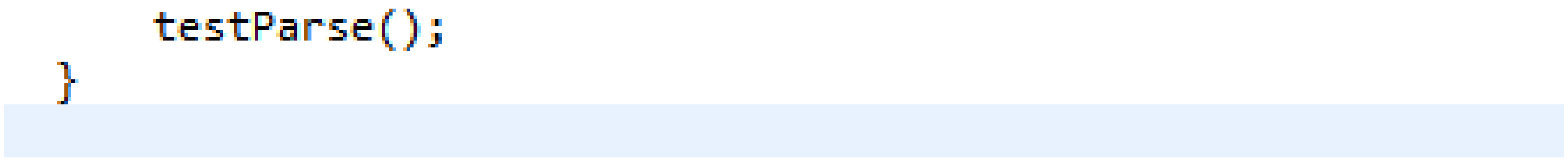
- initialize Parse in onCreate method
- keys for account and app



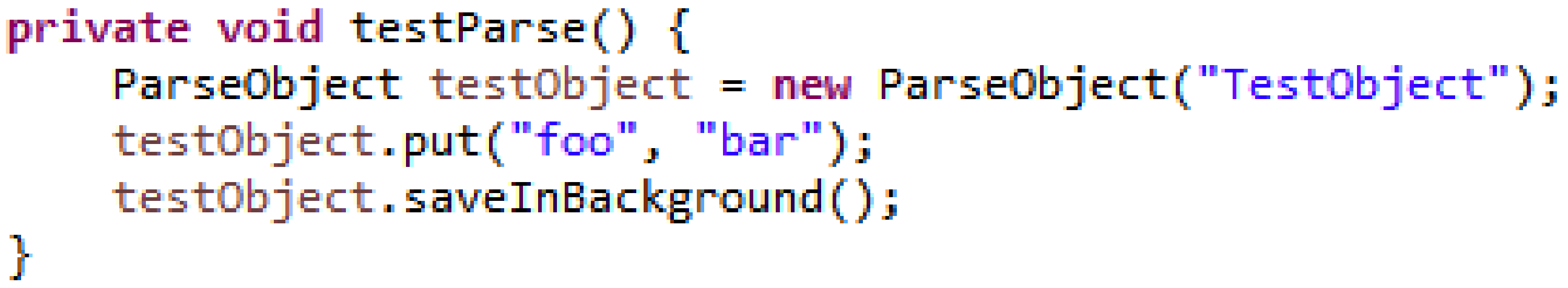
```
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    Parse.initialize(this, "GACBq6Jwvf2PL7EIl3IRpvav7GE
```

Testing Parse

- at the end of onCreate()
- create and send a test object to Parse



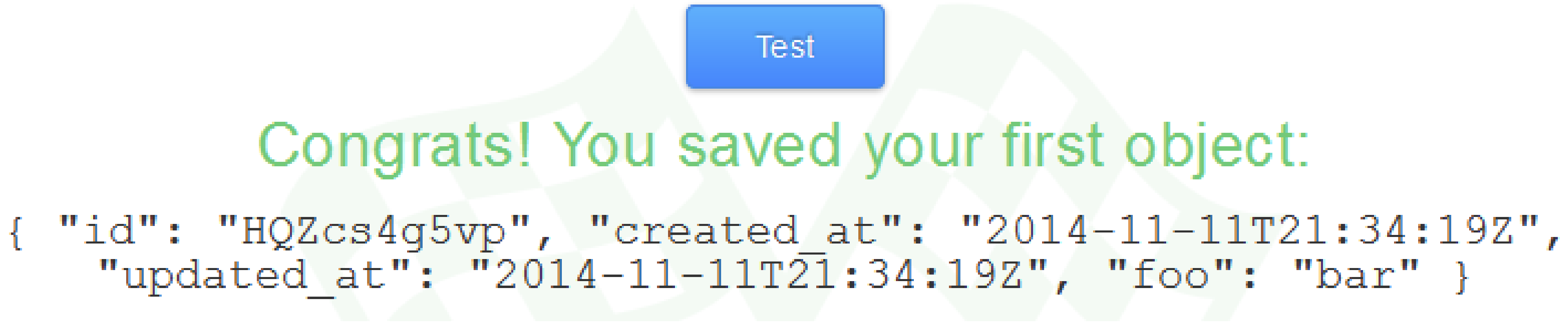
```
    testParse();
}
```



```
private void testParse() {
    ParseObject testObject = new ParseObject("TestObject");
    testObject.put("foo", "bar");
    testObject.saveInBackground();
}
```

- abstraction
  - handles doing this in the background, off the UI thread

Result of Test

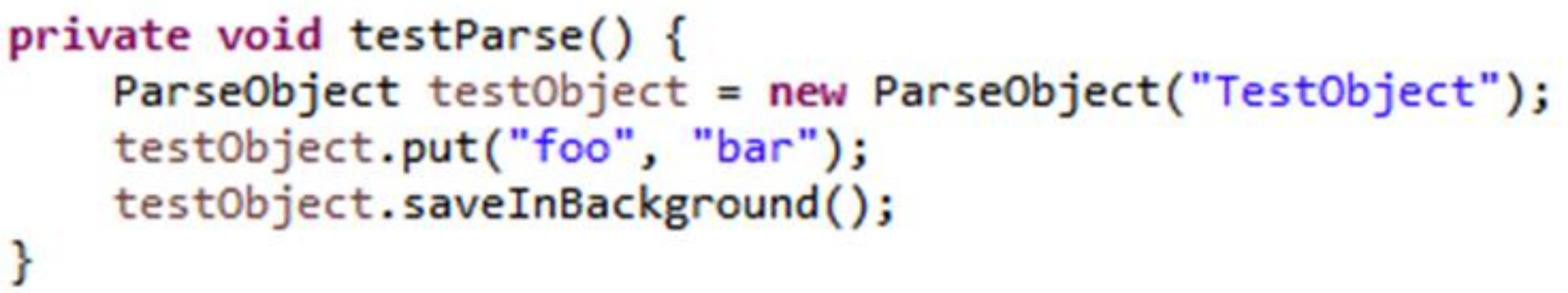


Congrats! You saved your first object:

```
{ "id": "HQZcs4g5vp", "created_at": "2014-11-11T21:34:19Z",
"updated_at": "2014-11-11T21:34:19Z", "foo": "bar" }
```

- JSON
  - JavaScript Object Notation

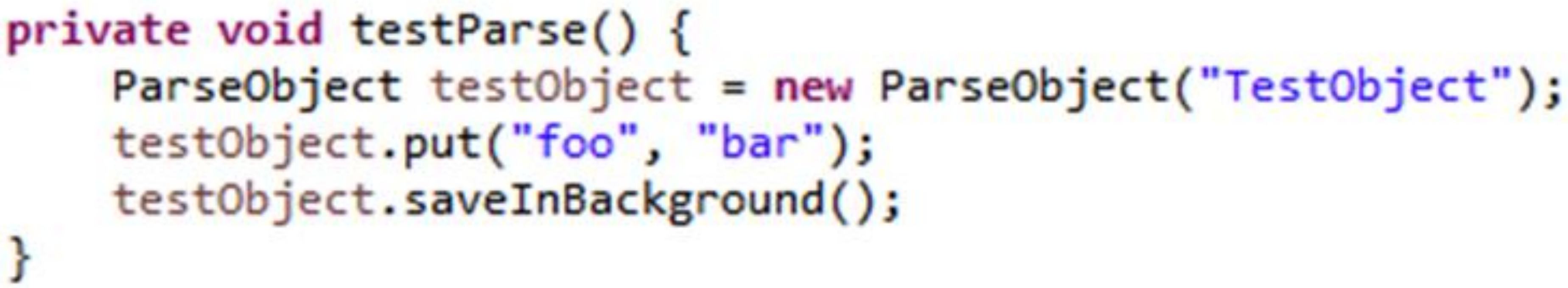
ParseObject



```
private void testParse() {
    ParseObject testObject = new ParseObject("TestObject");
    testObject.put("foo", "bar");
    testObject.saveInBackground();
}
```

- Local representation of data (on the device) that can be saved and retrieved from the Parse
- String in constructor is class name
  - like a table in a data base
- put to add key - value pairs
  - String - Object
  - keys must be alphanumerics
  - like a column in the row

ParseObject

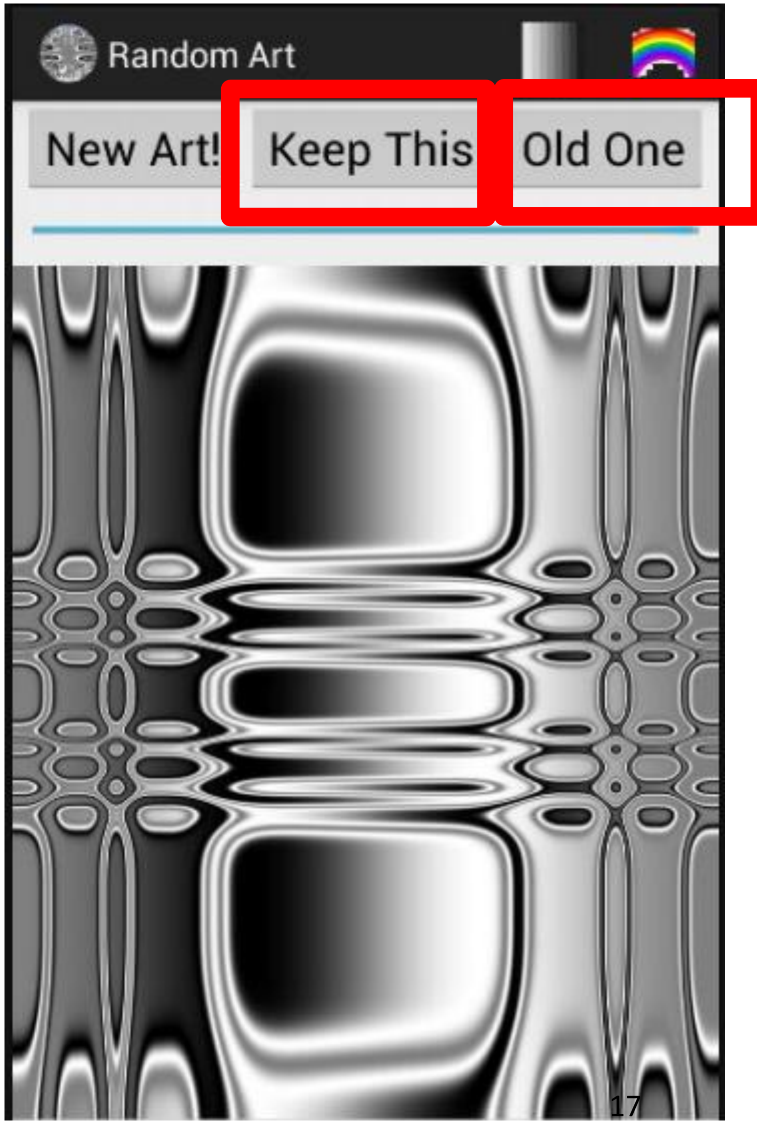


```java
private void testParse() {
    ParseObject testObject = new ParseObject("TestObject");
    testObject.put("foo", "bar");
    testObject.saveInBackground();
}
```

- saveInBackground method saves object to Parse in a background thread
- multiple options for saving
  - saveAll(List)
  - saveEventually() - if server or network not available
  - saveInBackground(SaveCallback)

Parse and RandomArt

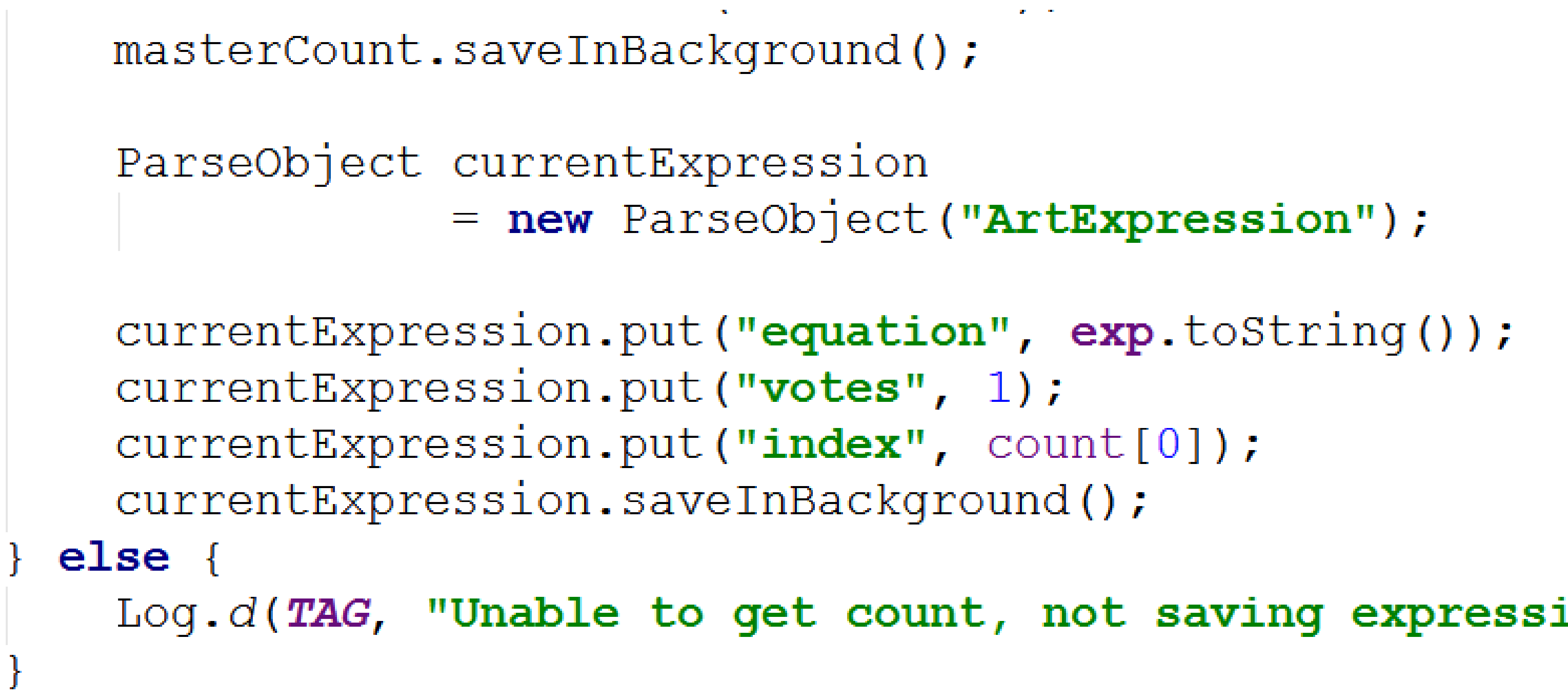
- add ability to save equations
- save to parse database
- allow multiple users to save equations
- functionality to display a random equation others liked
- up and down votes



onClick for Keep This

```
lic void saveEquation(View v) {
 if(exp != null) {
     // should also check to ensure equation not already saved
     final int[] count = {0};

     ParseQuery<ParseObject> countQuery
             = ParseQuery.getQuery("ArtExpressionCount");

     countQuery.getFirstInBackground(new GetCallback<ParseObject>() {
         @Override
         public void done(ParseObject masterCount, ParseException e)
             if(e == null) {
                 count[0] = masterCount.getInt("TheCount");
                 Log.d(TAG, "The Count via the master count object: "
                 masterCount.increment("TheCount");
                 masterCount.saveInBackground();
```

onClick for Save Equation - cont.



```
    masterCount.saveInBackground();

    ParseObject currentExpression
                = new ParseObject("ArtExpression");

    currentExpression.put("equation", exp.toString());
    currentExpression.put("votes", 1);
    currentExpression.put("index", count[0]);
    currentExpression.saveInBackground();
} else {
    Log.d(TAG, "Unable to get count, not saving expressi
}
```

ParseObject allowed addition of any key value pair.

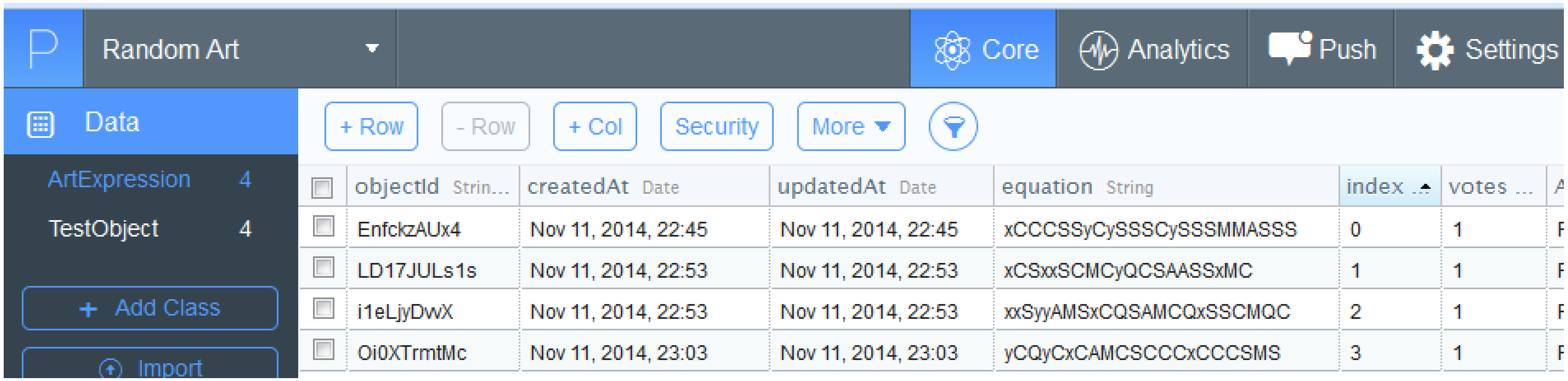
Keys must be Strings.

saveEquation

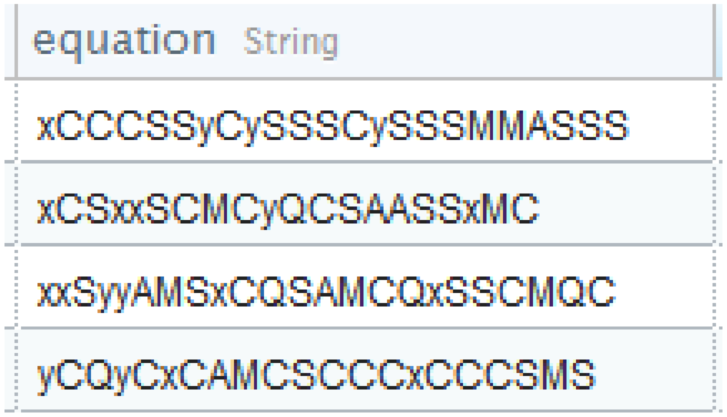
- Makes a query to get the number of rows in the expression table
  - uses another table with one row with one column (GACK, no auto increment function)
- callback method for completed query
- checks the count
- creates new ParseObject
- makes the index for this new expression the count (0 based indexing)
- saves the object and updates count object

Parse Dashboard

- Examine data uploaded from apps

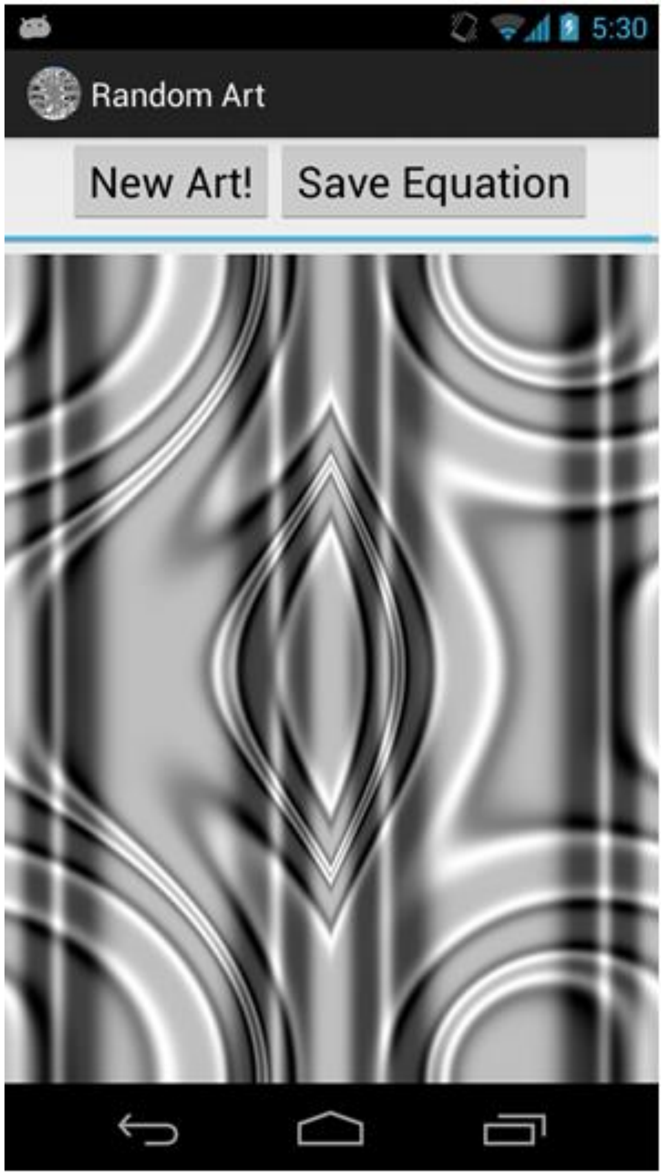


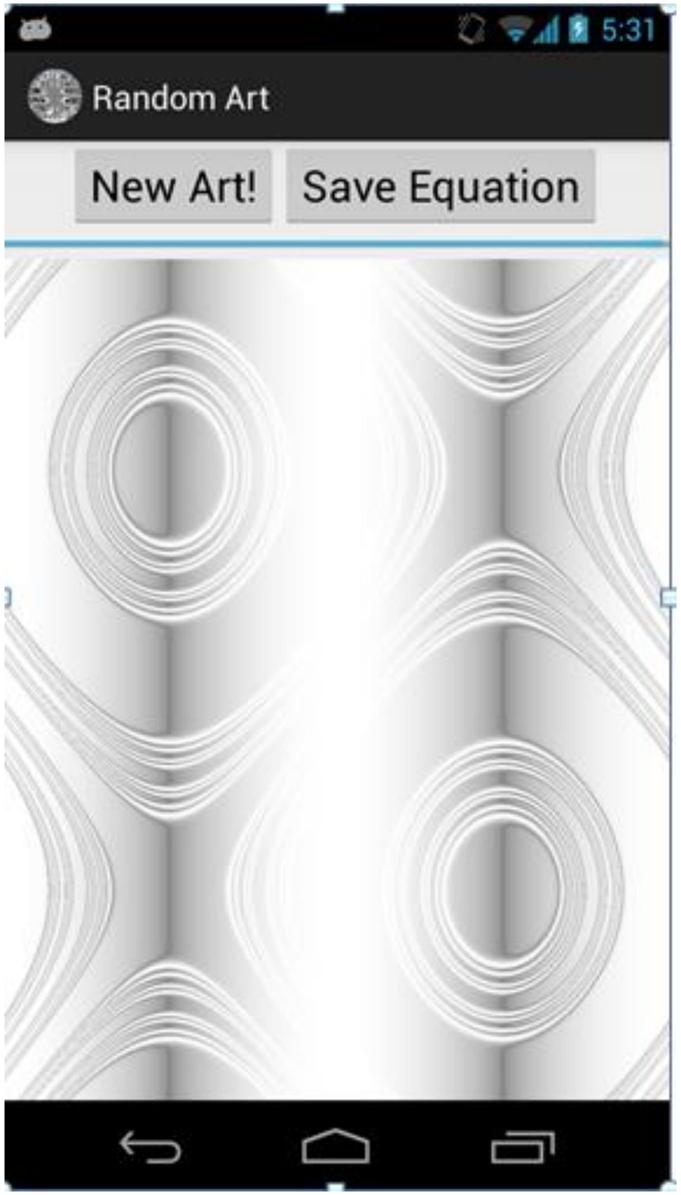
objectId String	createdAt Date	updatedAt Date	equation String	index	votes
EnfckzAUx4	Nov 11, 2014, 22:45	Nov 11, 2014, 22:45	xCCCSSyCySSSCySSSMMASSS	0	1
LD17JULs1s	Nov 11, 2014, 22:53	Nov 11, 2014, 22:53	xCSxxSCMCyQCSAASSxMC	1	1
i1eLjyDwX	Nov 11, 2014, 22:53	Nov 11, 2014, 22:53	xxSyyAMSxCQSAMCQxSSCMQC	2	1
Oi0XTrmtMc	Nov 11, 2014, 23:03	Nov 11, 2014, 23:03	yCQyCxCAMCSCCCxCCCSMS	3	1



equation String
xCCCSSyCySSSCySSSMMASSS
xCSxxSCMCyQCSAASSxMC
xxSyyAMSxCQSAMCQxSSCMQC
yCQyCxCAMCSCCCxCCCSMS

demo Saving an Equation

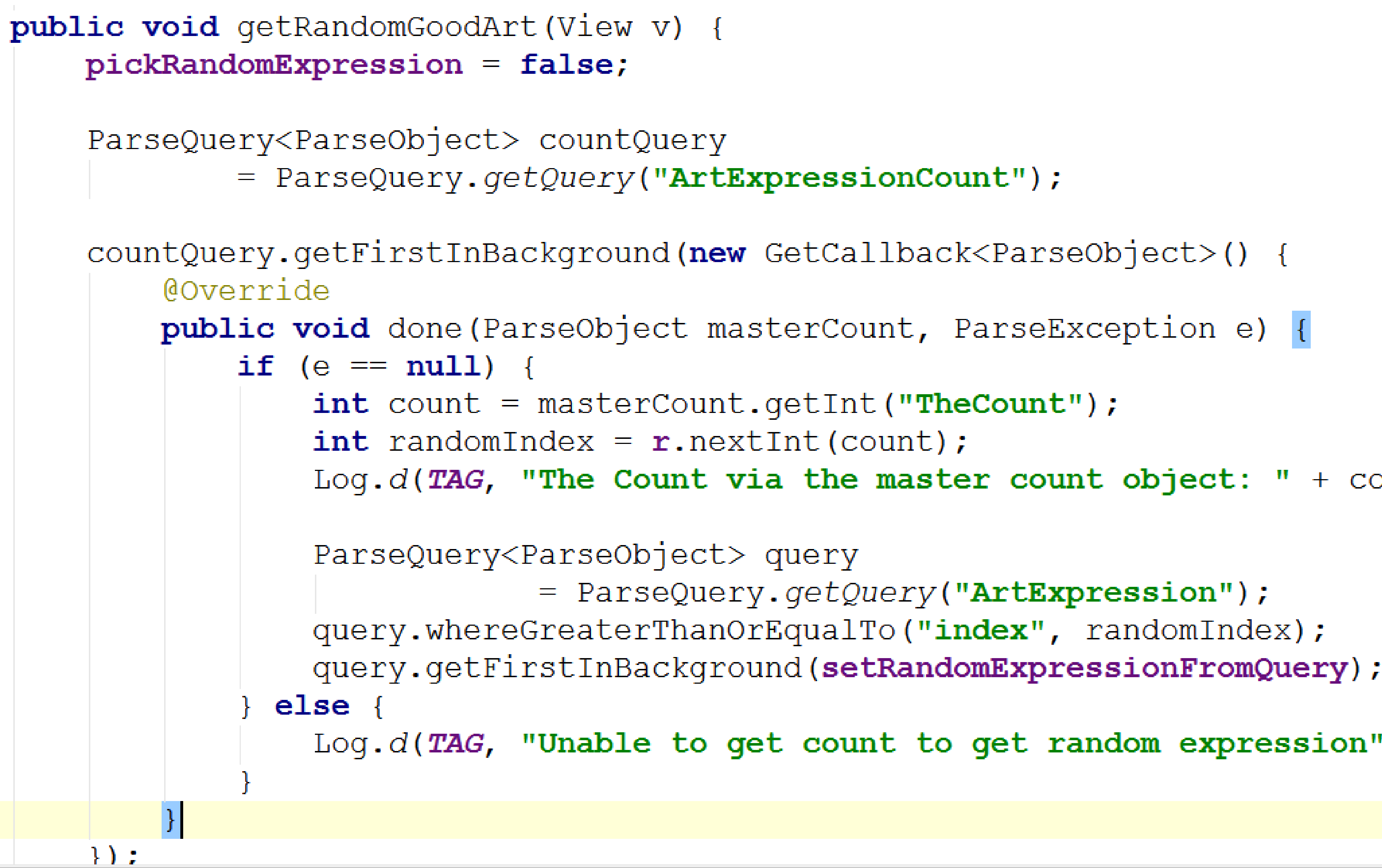




Get Random Saved Art

- When user presses button pick a random saved expression and render that image
- We just save the expression so we must recreate image
  - time vs. space trade off
- check count of values and pick random index

getRandomGoodArt



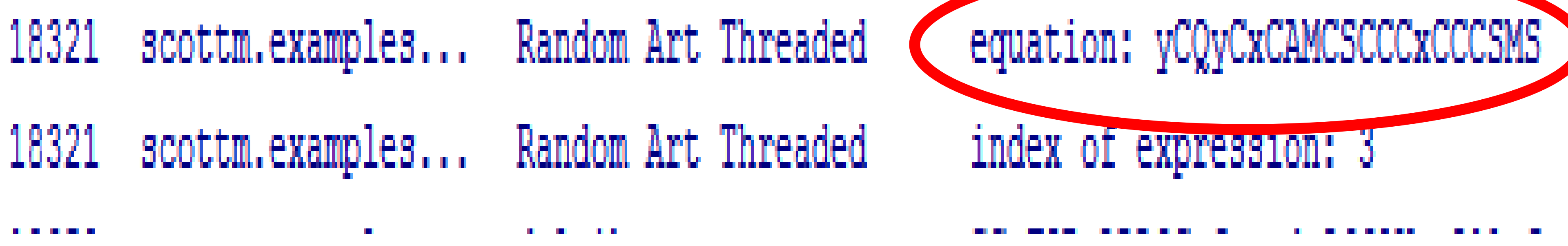
```
public void getRandomGoodArt(View v) {
    pickRandomExpression = false;

    ParseQuery<ParseObject> countQuery
            = ParseQuery.getQuery("ArtExpressionCount");

    countQuery.getFirstInBackground(new GetCallback<ParseObject>() {
        @Override
        public void done(ParseObject masterCount, ParseException e) {
            if (e == null) {
                int count = masterCount.getInt("TheCount");
                int randomIndex = r.nextInt(count);
                Log.d(TAG, "The Count via the master count object: " + co

                ParseQuery<ParseObject> query
                        = ParseQuery.getQuery("ArtExpression");
                query.whereGreaterThanOrEqualTo("index", randomIndex);
                query.getFirstInBackground(setRandomExpressionFromQuery);
            } else {
                Log.d(TAG, "Unable to get count to get random expression"
            }
        }
    });
```

callback object

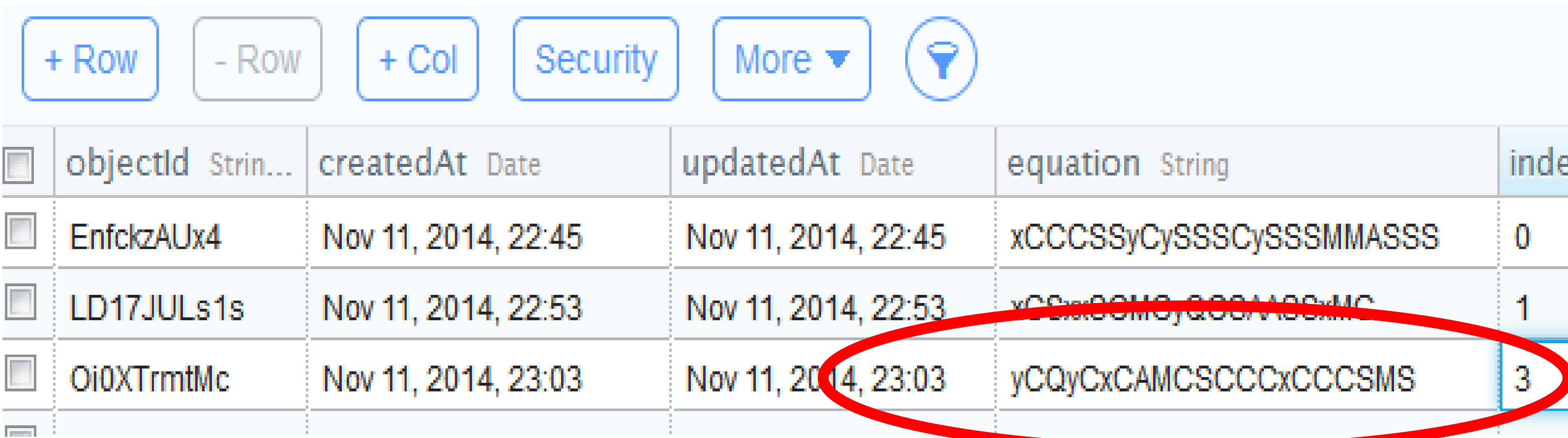
- pull out the String from the returned object and build expression based on equation

```java
private GetCallback<ParseObject> setRandomExpressionFromQuery
                                            = new GetCallback<ParseObject>() {
    public void done(ParseObject object, ParseException e) {
        if (e == null) {
            String equation = object.getString("equation");
            exp = new RandomExpression(equation);
            // now draw it
            Log.d(TAG, "equation: " + equation);
            Log.d(TAG, "index of expression: " + object.getInt("index"));
            new ArtTaskInner().execute(artImage.getWidth(), artImage.getHeight());
        } else {
            Log.d(TAG, "Unable to get the given random expression");
        }
    }
};
```

good one logcat



```
18321  scottm.examples...  Random Art Threaded   equation: yCQyCxCAMCSCCCxCCCSMS
18321  scottm.examples...  Random Art Threaded   index of expression: 3
```



	objectId String	createdAt Date	updatedAt Date	equation String	inde
	EnfckzAUx4	Nov 11, 2014, 22:45	Nov 11, 2014, 22:45	xCCCSSyCySSSCySSSMMASSS	0
	LD17JULs1s	Nov 11, 2014, 22:53	Nov 11, 2014, 22:53	xCSxxCCMCyQCCAACCxMC	1
	Oi0XTrmtMc	Nov 11, 2014, 23:03	Nov 11, 2014, 23:03	yCQyCxCAMCSCCCxCCCSMS	3

More Parse

- Includes capability to do local data store
  - save objects on device, save to cloud later
  - abstracts away a lot of the details
  - Kyle Norton from Pariveda: "Assume you WON'T be connected to the network."
- Parse objects meant to be "small"
  - less than 128 kb
  - not for images
  - Parse files for large pieces of data
- Past semesters many groups used Parse successfully

FIREBASE

Firebase

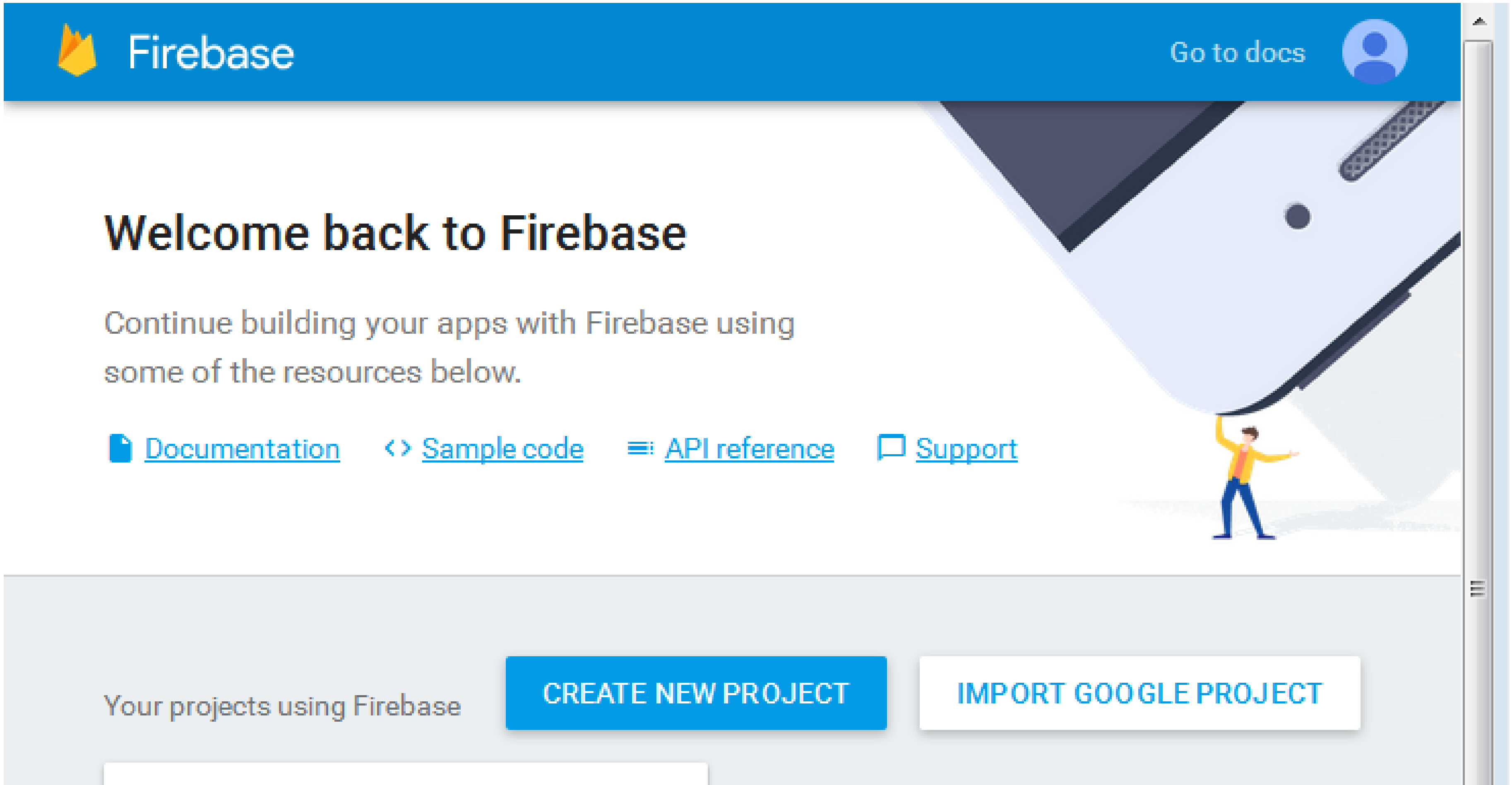
- Yet another Backend as a Service (Baas)
- Designed for web and mobile
- Founded in 2011
- Initial product was backend so websites could easily host chat as part of site
- discovered developers were sending non chat data (such as game state) via the tool

Firebase for Android

- Devices with Android 4.0 (ice cream sandwich) or higher
- Google play services SDK
  - same as fused location
- Android Studio 1.5 or higher
- Your Android studio project and package name
- Firebase Assistant in Android Studio 2.2 or higher
  - Tools -> Firebase

Firebase Project Set up

- Create Firebase project in console
- Just needs name and country



Firebase

Go to docs

Welcome back to Firebase

Continue building your apps with Firebase using some of the resources below.

Documentation Sample code API reference Support

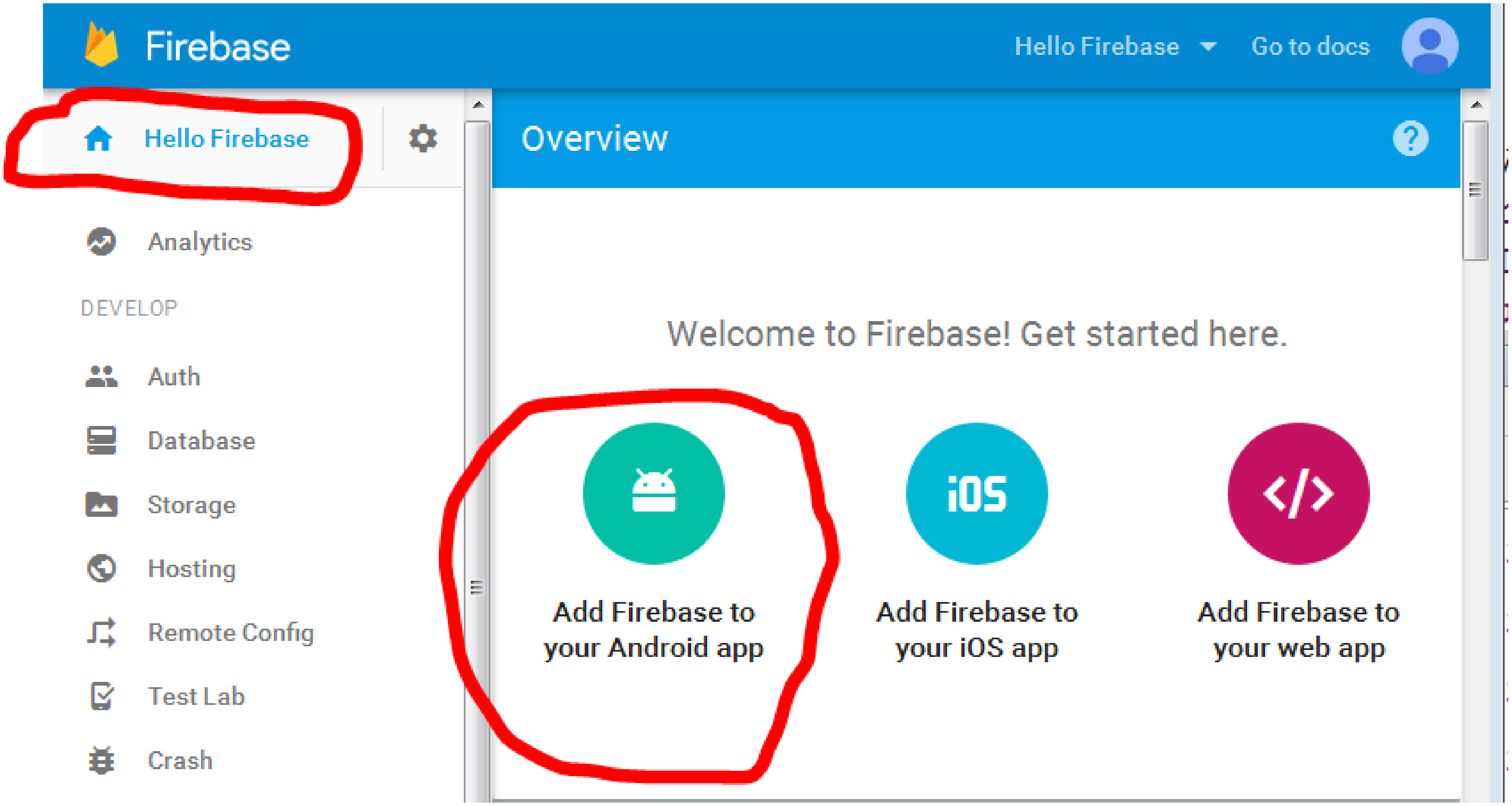
Your projects using Firebase

CREATE NEW PROJECT

IMPORT GOOGLE PROJECT

Firebase Project Console

- After creating project, overview page:



Welcome to Firebase! Get started here.

Add Firebase to your Android app

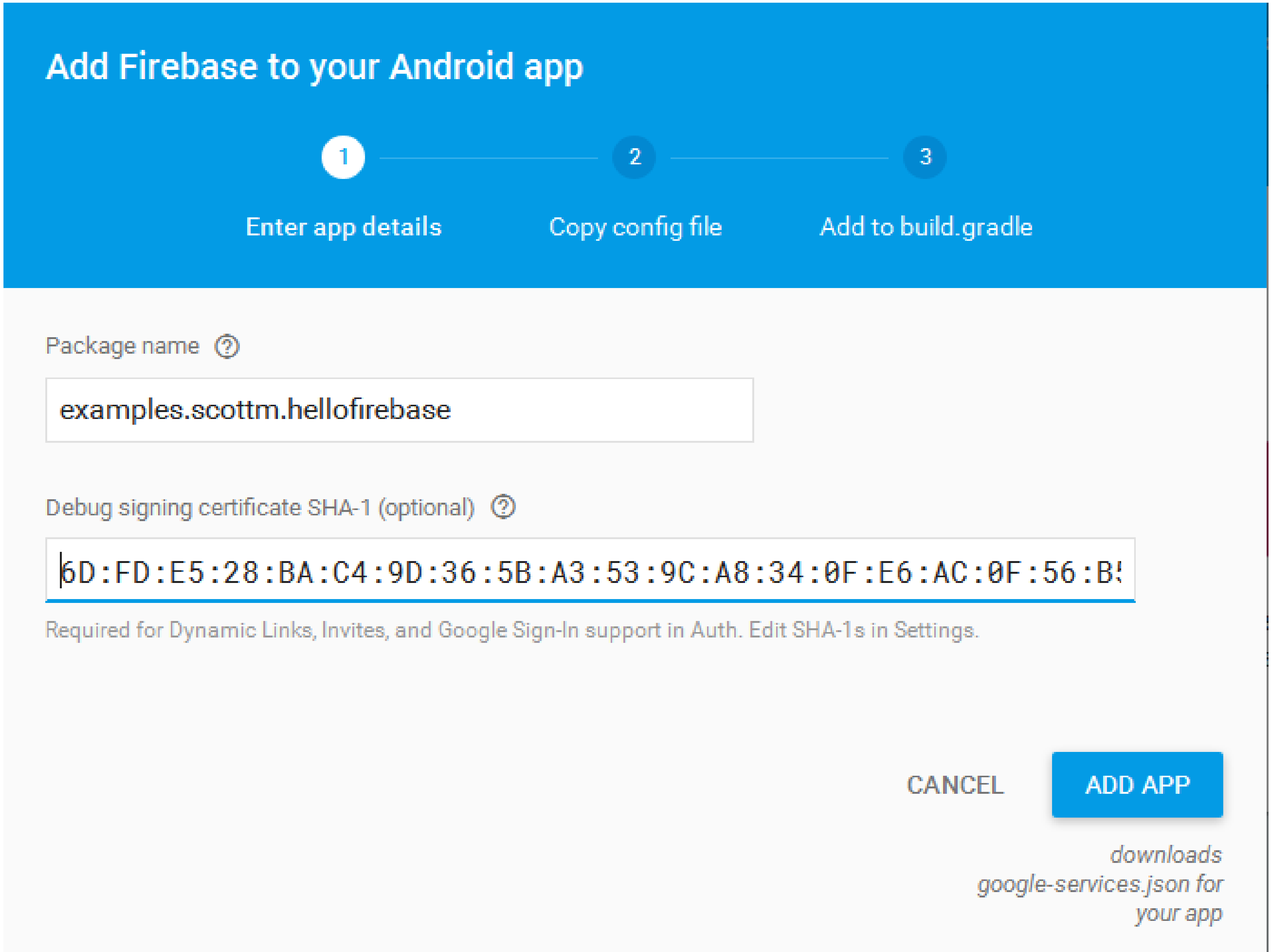
Add Firebase to your iOS app

Add Firebase to your web app

Firebase for Android Project

- Adding Firebase to Android app
- Need package name (easy)
- Debug signing certificate SHA-1 hash (for use of some Firebase features)
- Uses the keytool program included with Java
  - "Manages a keystore (database) of cryptographic keys, X.509 certificate chains, and trusted certificates. "

Adding Firebase to Android App



Add Firebase to your Android app

Package name

examples.scottm.hellofirebase

Debug signing certificate SHA-1 (optional)

6D:FD:E5:28:BA:C4:9D:36:5B:A3:53:9C:A8:34:0F:E6:AC:0F:56:B

Required for Dynamic Links, Invites, and Google Sign-In support in Auth. Edit SHA-1s in Settings.

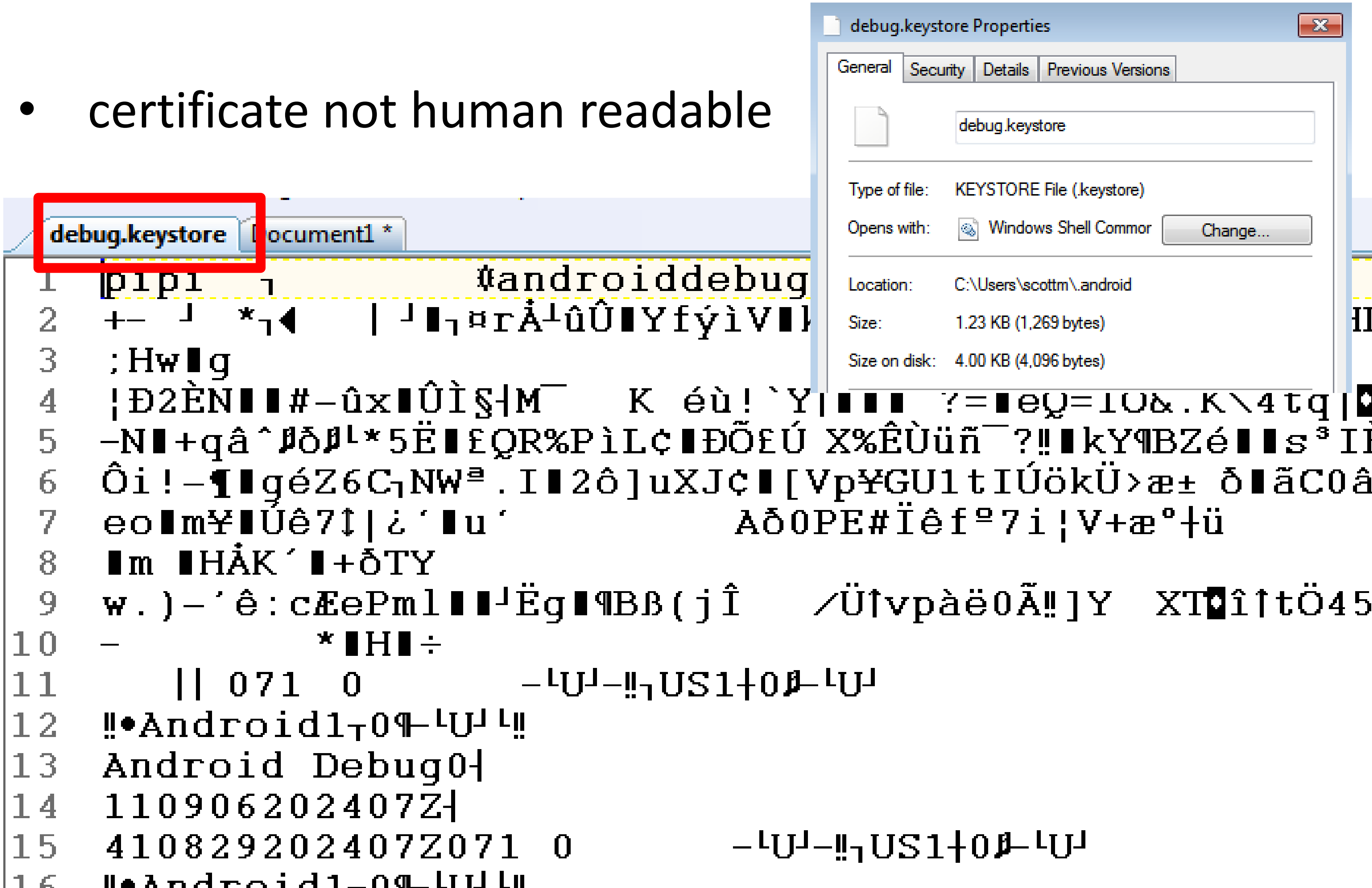
downloads google-services.json for your app

Using keytool

- Varies from system to system
- need location of debug signing certificate
  - created automatically when Android Studio installed
- typically, <USER>/.android/debugkeystore

Debug Signing Certificate

- certificate not human readable



debug.keystore | Document1 *

```
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410829202407Z071 0        ─└U┘─‼┐US1┼0╛─└U┘
‼•Android1┬0¶─└U┘└‼
```

debug.keystore Properties

General | Security | Details | Previous Versions

debug.keystore

Type of file: KEYSTORE File (.keystore)

Opens with: Windows Shell Common — Change...

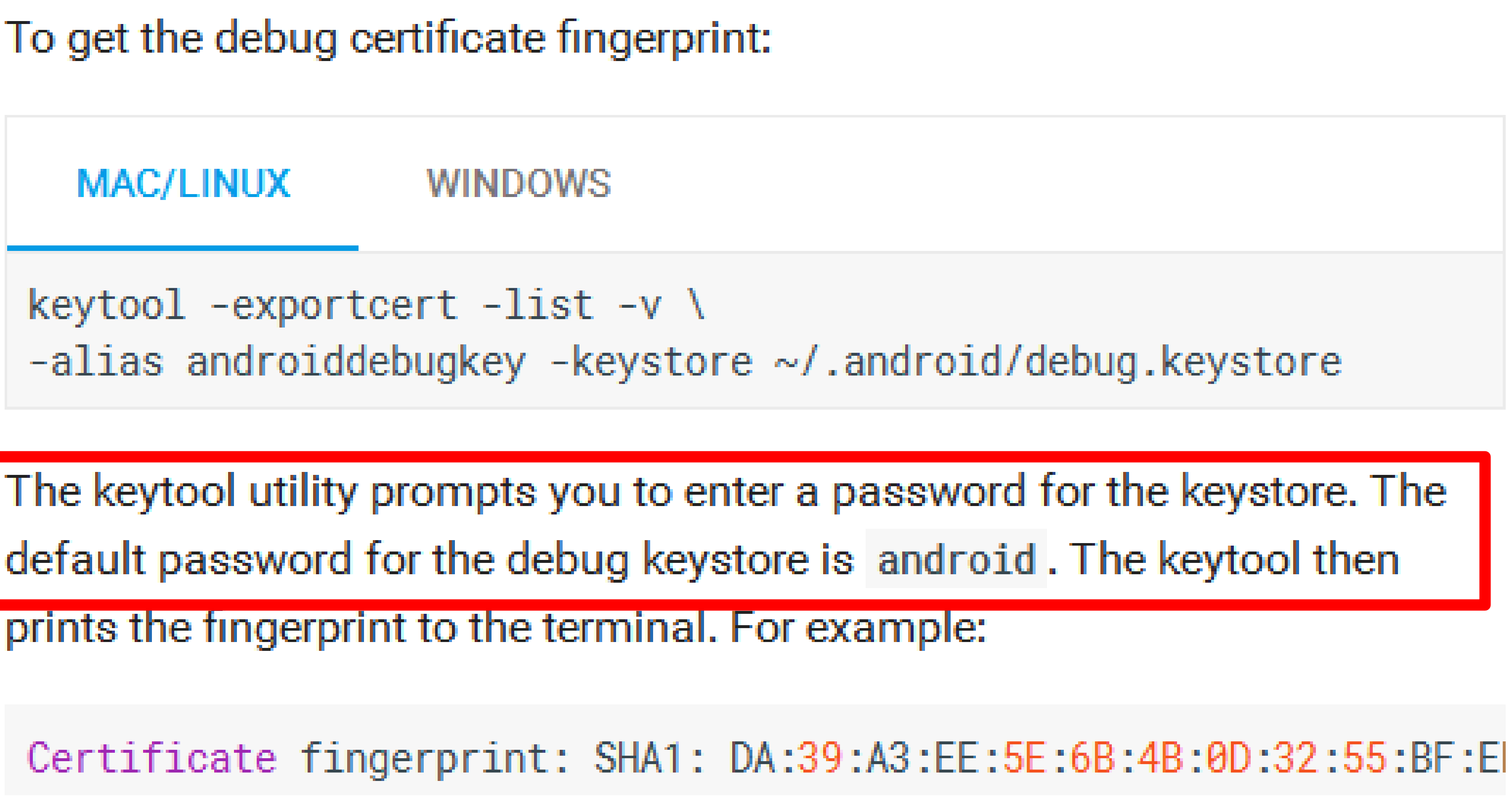
Location: C:\Users\scottm\.android

Size: 1.23 KB (1,269 bytes)

Size on disk: 4.00 KB (4,096 bytes)

Running keytool

- Specifics vary from system to system



To get the debug certificate fingerprint:

```
keytool -exportcert -list -v \
-alias androiddebugkey -keystore ~/.android/debug.keystore
```

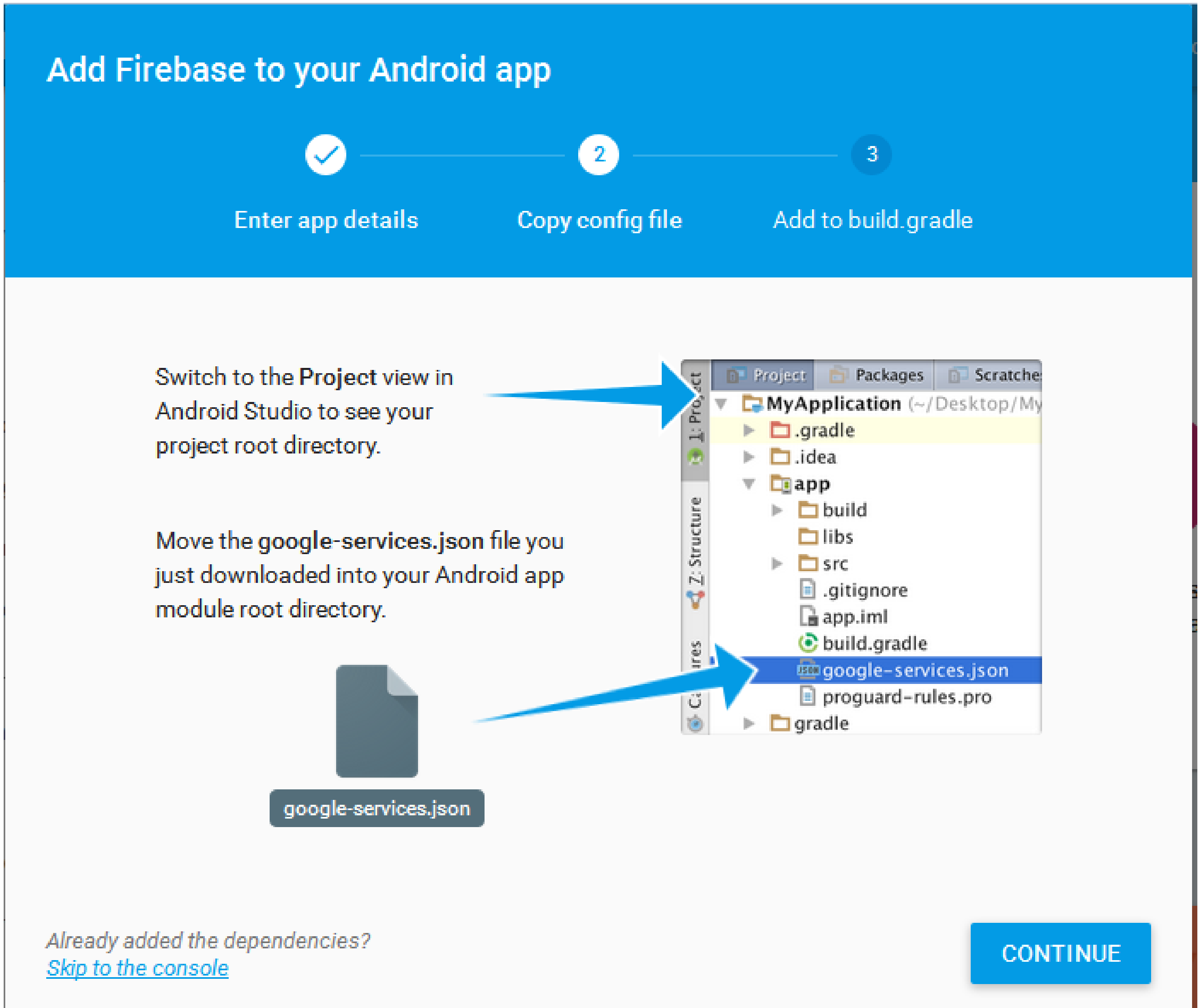
The keytool utility prompts you to enter a password for the keystore. The default password for the debug keystore is `android`. The keytool then prints the fingerprint to the terminal. For example:

```
Certificate fingerprint: SHA1: DA:39:A3:EE:5E:6B:4B:0D:32:55:BF:E
```

Firebase Config File for App

- After providing package name and SHA-1 fingerprint ...
- Firebase generates a JSON file named google-services.json specific for this project
  - multiple projects / apps -> repeat steps
- Download and add file to project

Firebase Config File for App



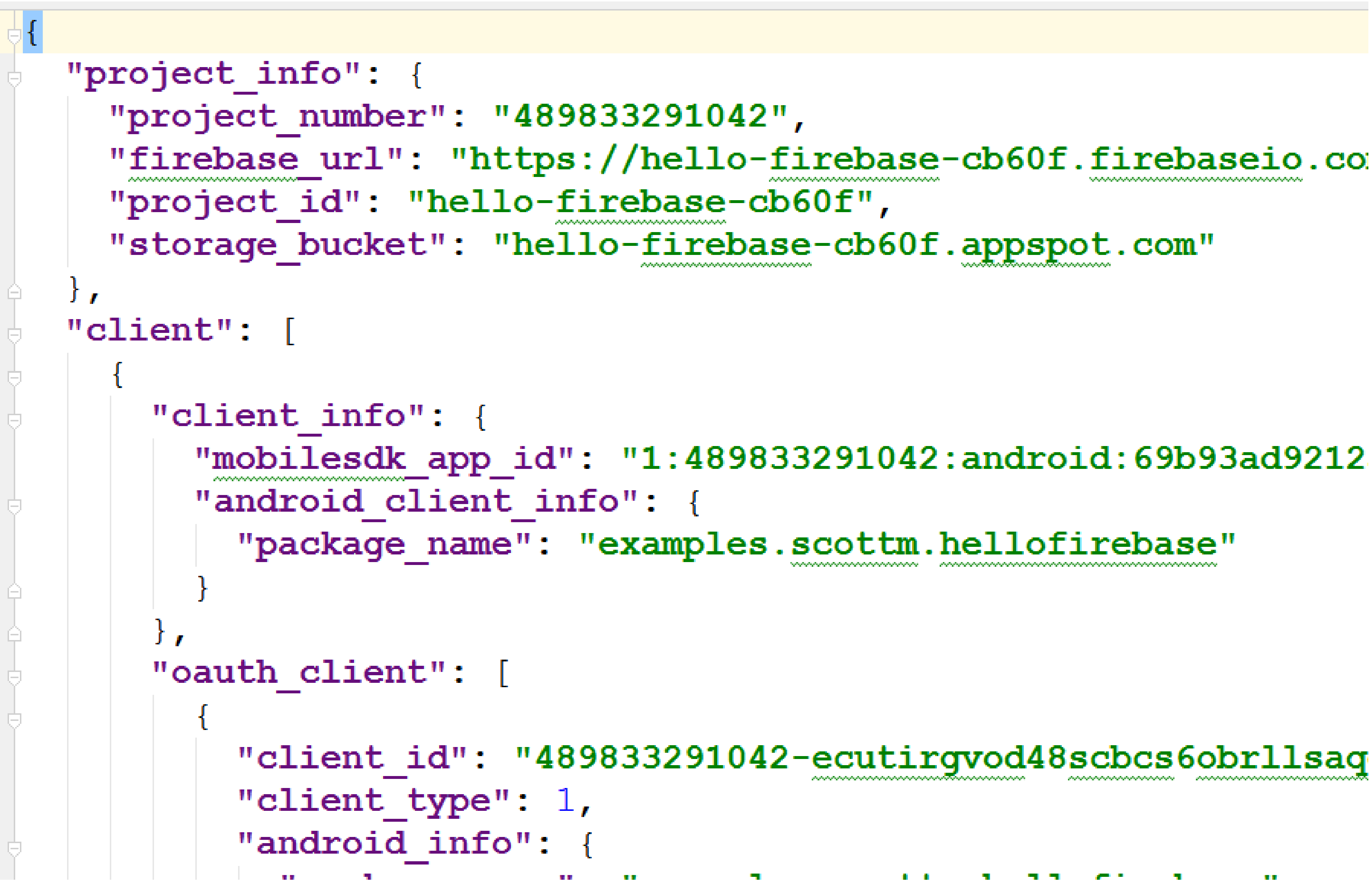
Add Firebase to your Android app

Switch to the **Project** view in Android Studio to see your project root directory.

Move the **google-services.json** file you just downloaded into your Android app module root directory.

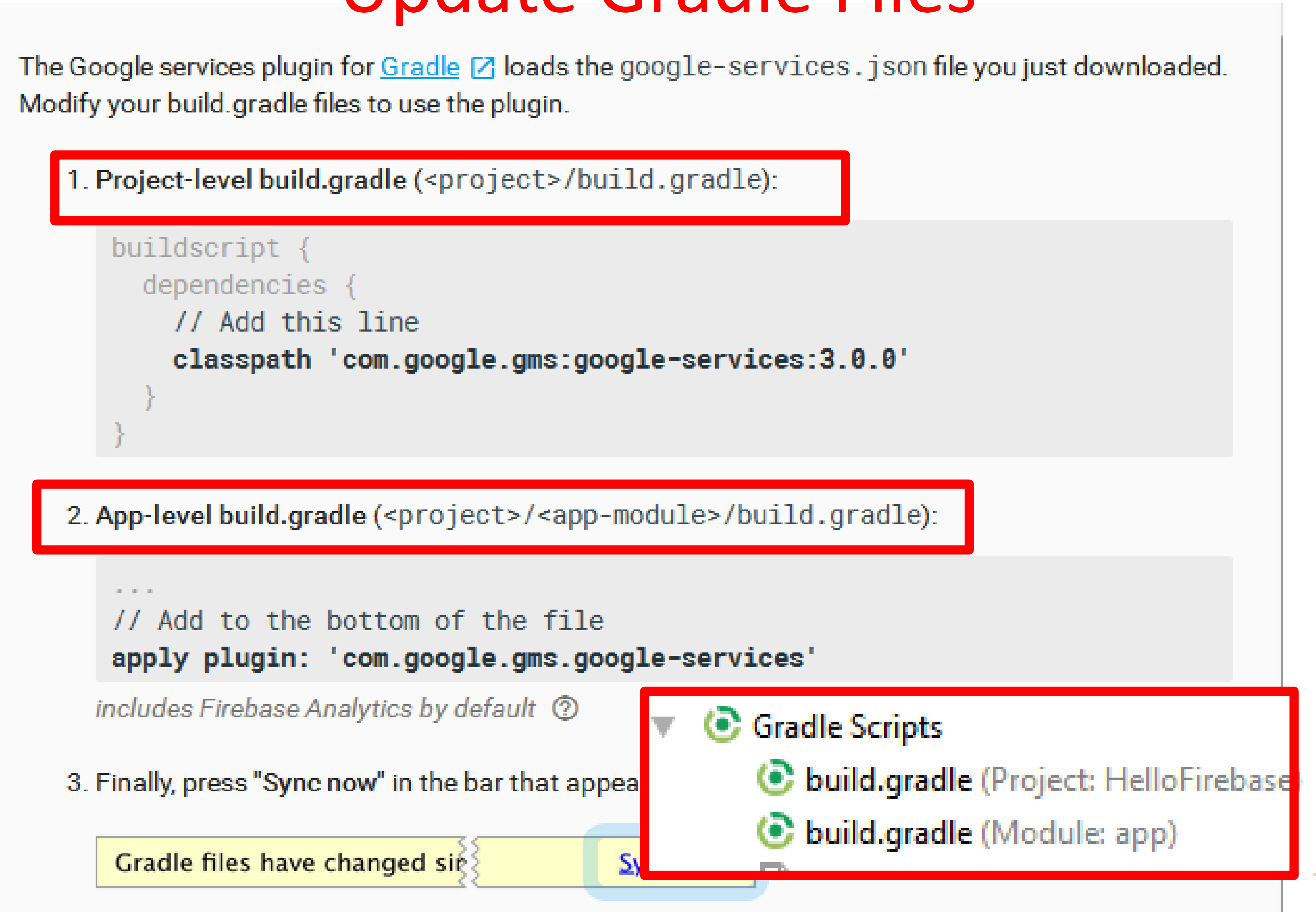
Already added the dependencies?
Skip to the console

google-services.json



```
{
  "project_info": {
    "project_number": "489833291042",
    "firebase_url": "https://hello-firebase-cb60f.firebaseio.co
    "project_id": "hello-firebase-cb60f",
    "storage_bucket": "hello-firebase-cb60f.appspot.com"
  },
  "client": [
    {
      "client_info": {
        "mobilesdk_app_id": "1:489833291042:android:69b93ad9212
        "android_client_info": {
          "package_name": "examples.scottm.hellofirebase"
        }
      },
      "oauth_client": [
        {
          "client_id": "489833291042-ecutirgvod48scbcs6obrllsaq
          "client_type": 1,
          "android_info": {
```

Update Gradle Files



The Google services plugin for Gradle loads the google-services.json file you just downloaded. Modify your build.gradle files to use the plugin.

1. **Project-level build.gradle** (`<project>/build.gradle`):

```
buildscript {
  dependencies {
    // Add this line
    classpath 'com.google.gms:google-services:3.0.0'
  }
}
```

2. **App-level build.gradle** (`<project>/<app-module>/build.gradle`):

```
...
// Add to the bottom of the file
apply plugin: 'com.google.gms.google-services'
```

includes Firebase Analytics by default

3. Finally, press "Sync now" in the bar that appea

Gradle files have changed sir

Sy

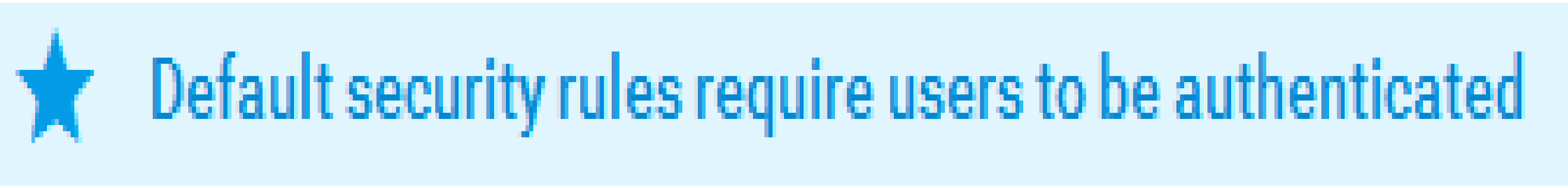
Gradle Scripts
build.gradle (Project: HelloFirebase
build.gradle (Module: app)

Firebase Capabilities

- Firebase has a host of capabilities
- User authorization
- database storage
- storage for larger files
- cloud messaging
- push notifications
- analytics
- hosting of web content

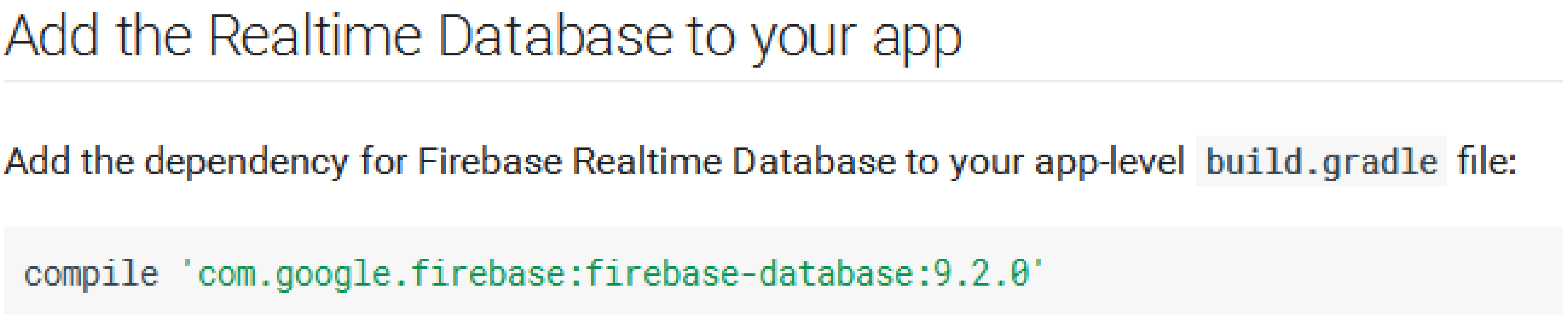
Firebase Database

- With Parse offline, migrated Random Art database to Firebase
- The roots of the chat room are somewhat apparent
  - lots of chat examples
  - realtime updates
  - emphasis on authorized users


Default security rules require users to be authenticated

One More Setup Step

- To use Firebase databases in app, after previous setup steps:



Add the Realtime Database to your app

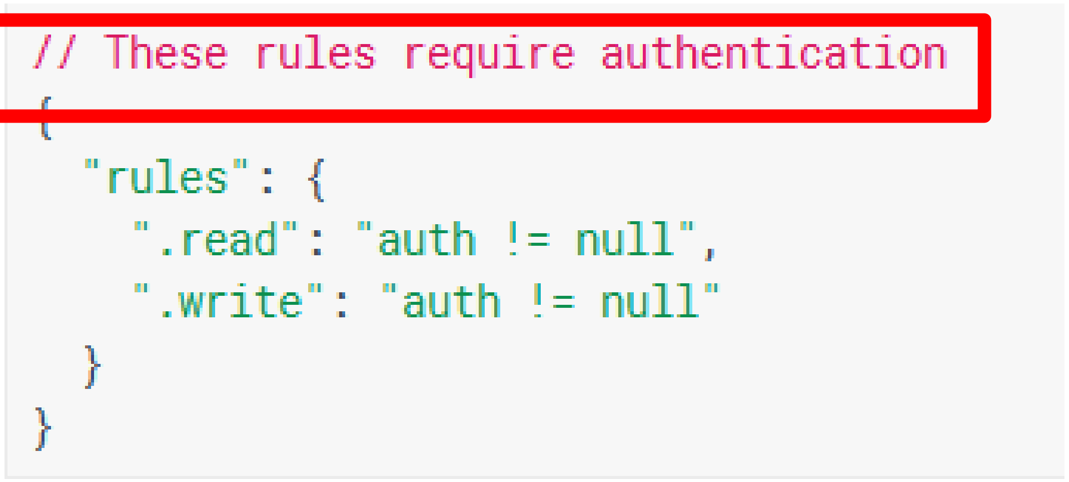
Add the dependency for Firebase Realtime Database to your app-level `build.gradle` file:

```
compile 'com.google.firebase:firebase-database:9.2.0'
```

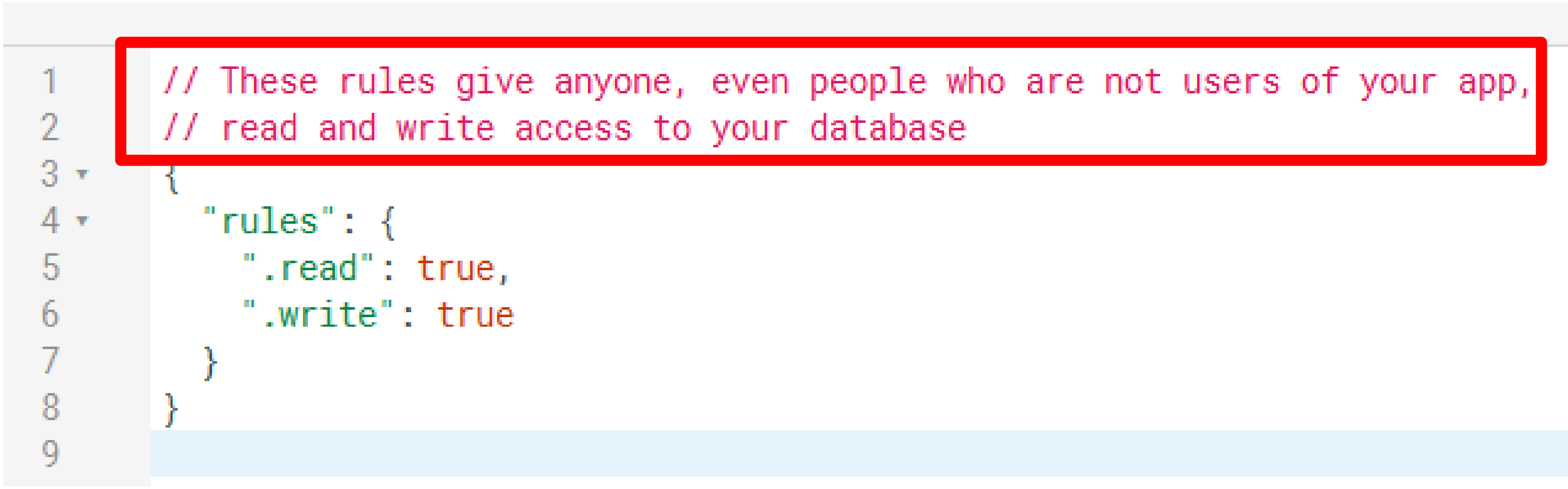
Firebase Database Rules

- Firebase database rules
- Defines:
- How data should be structured
- How data should be indexed
- When data can be read or written
- Who can read and write data

Firebase Database Rules



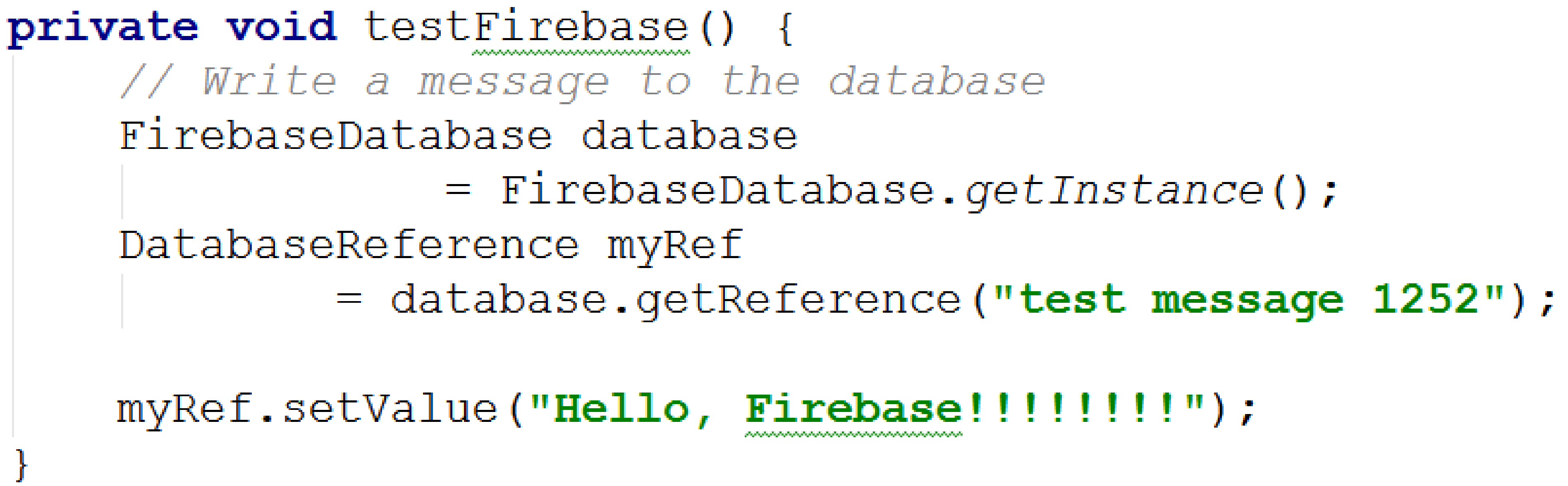
```
// These rules require authentication
{
  "rules": {
    ".read": "auth != null",
    ".write": "auth != null"
  }
}
```



```
// These rules give anyone, even people who are not users of your app,
// read and write access to your database
{
  "rules": {
    ".read": true,
    ".write": true
  }
}
```

Hello Firebase

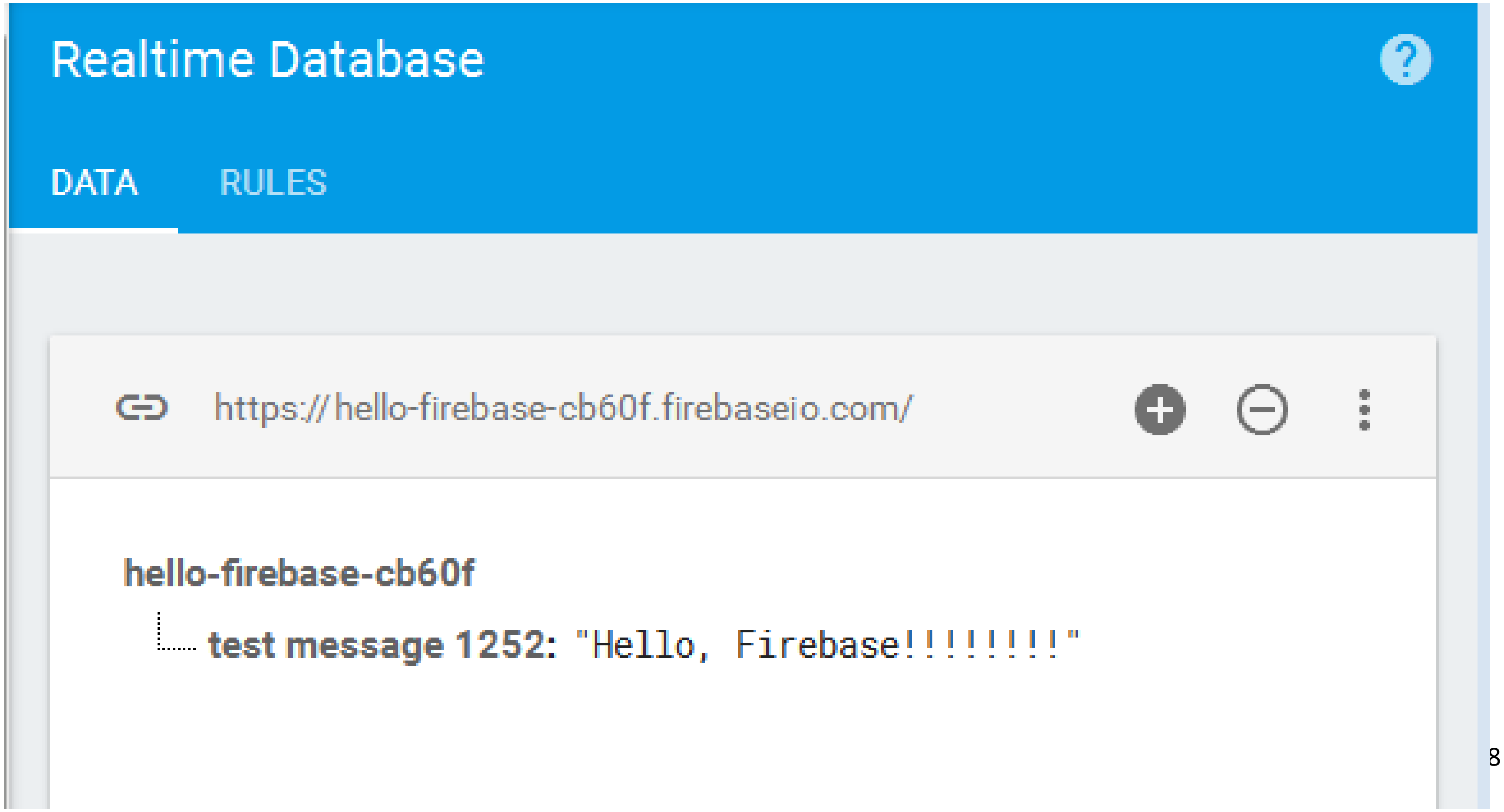
- In app, called from onCreate of Activity



```
private void testFirebase() {
    // Write a message to the database
    FirebaseDatabase database
            = FirebaseDatabase.getInstance();
    DatabaseReference myRef
            = database.getReference("test message 1252");

    myRef.setValue("Hello, Firebase!!!!!!!!");
}
```

Result When App Run

- Immediately writes to database if network connections exists:



hello-firebase-cb60f

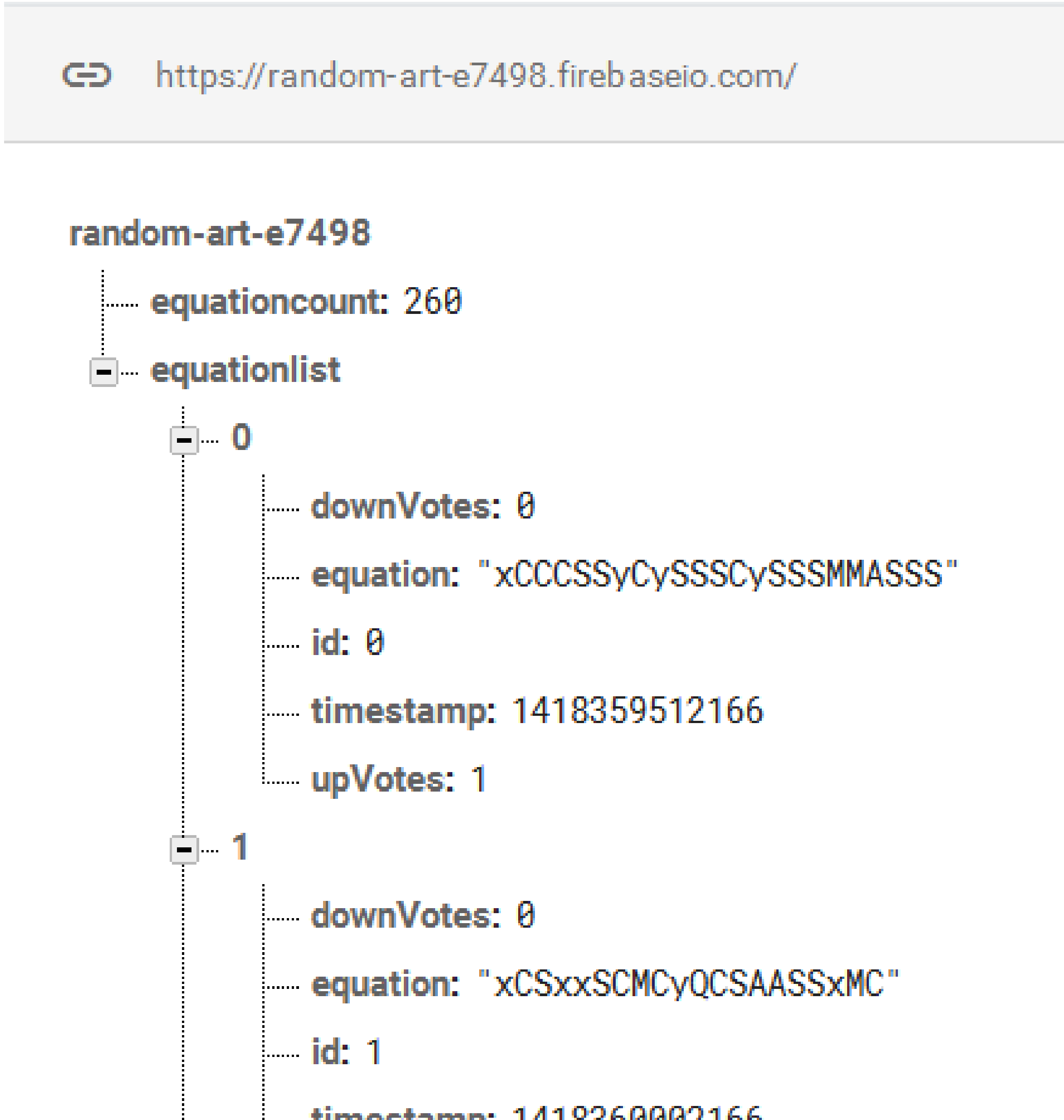
test message 1252: "Hello, Firebase!!!!!!!!"

Firebase database

- Not traditional tables
- "Everything is a JSON! tree"
- Children of main tree are like "tables" in traditional database
- Children of children are typically (but not always) like rows in a traditional table

Random Art Data on Firebase

- equation count child to assign ids and pick random equation
- equation list with children for each equation



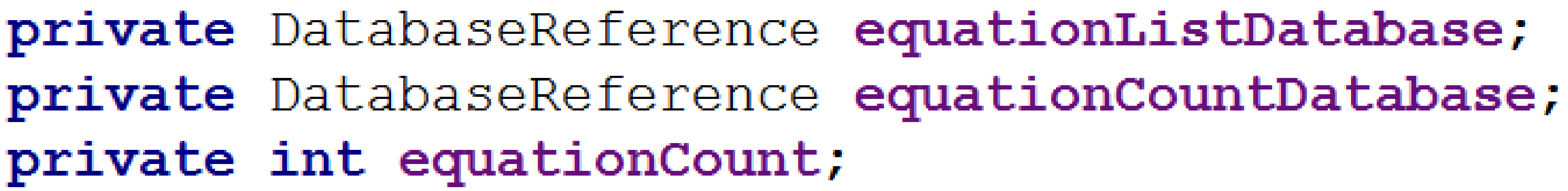
```
https://random-art-e7498.firebaseio.com/

random-art-e7498
  equationcount: 260
  equationlist
    0
      downVotes: 0
      equation: "xCCCSSyCySSSCySSSMMASSS"
      id: 0
      timestamp: 1418359512166
      upVotes: 1
    1
      downVotes: 0
      equation: "xCSxxSCMCyQCSAASSxMC"
      id: 1
      timestamp: 1418360002166
```

Random Art

- App keeps track of current equation count
- First value from database and listener so whenever count changes, local copy is updated

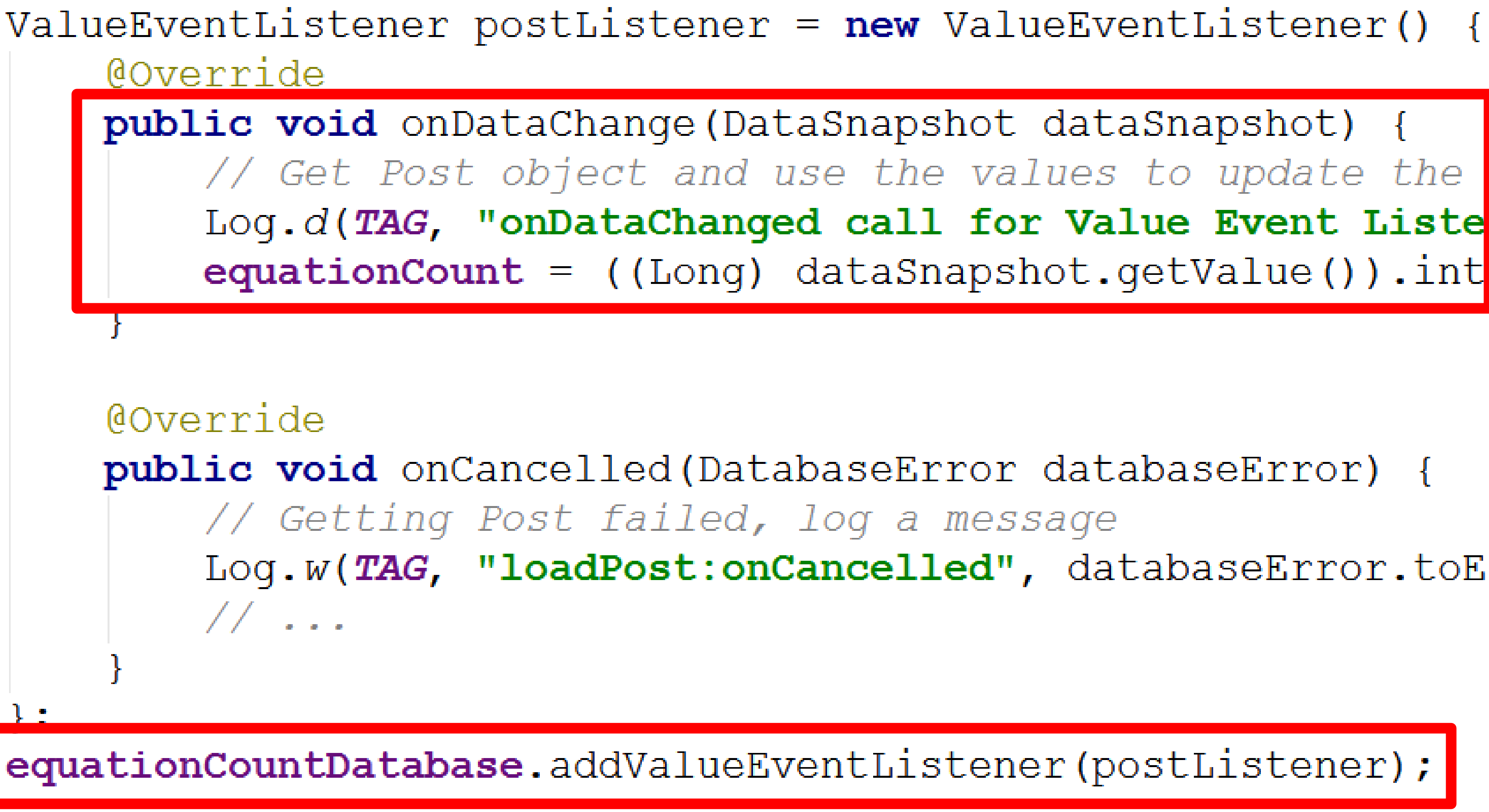
Random Art

- Keep references to parts of JSON tree
- Update values (equation count)
- add children (new, good equations)
- pull random children (old, good equations)
- In main Random Art Activity



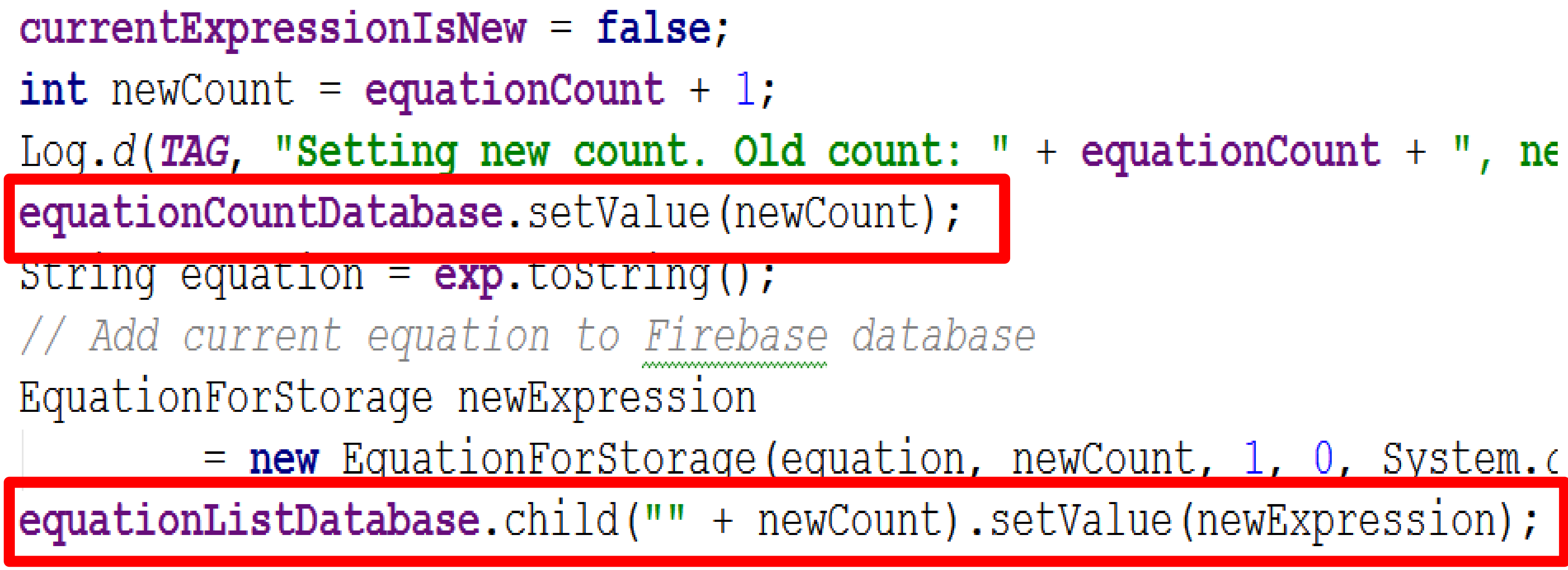
```
private DatabaseReference equationListDatabase;
private DatabaseReference equationCountDatabase;
private int equationCount;
```

Random Art - Count Listener



```
ValueEventListener postListener = new ValueEventListener() {
    @Override
    public void onDataChange(DataSnapshot dataSnapshot) {
        // Get Post object and use the values to update the
        Log.d(TAG, "onDataChanged call for Value Event Liste
        equationCount = ((Long) dataSnapshot.getValue()).int
    }

    @Override
    public void onCancelled(DatabaseError databaseError) {
        // Getting Post failed, log a message
        Log.w(TAG, "loadPost:onCancelled", databaseError.toE
        // ...
    }
};
equationCountDatabase.addValueEventListener(postListener);
```

Random Art - Save Equation

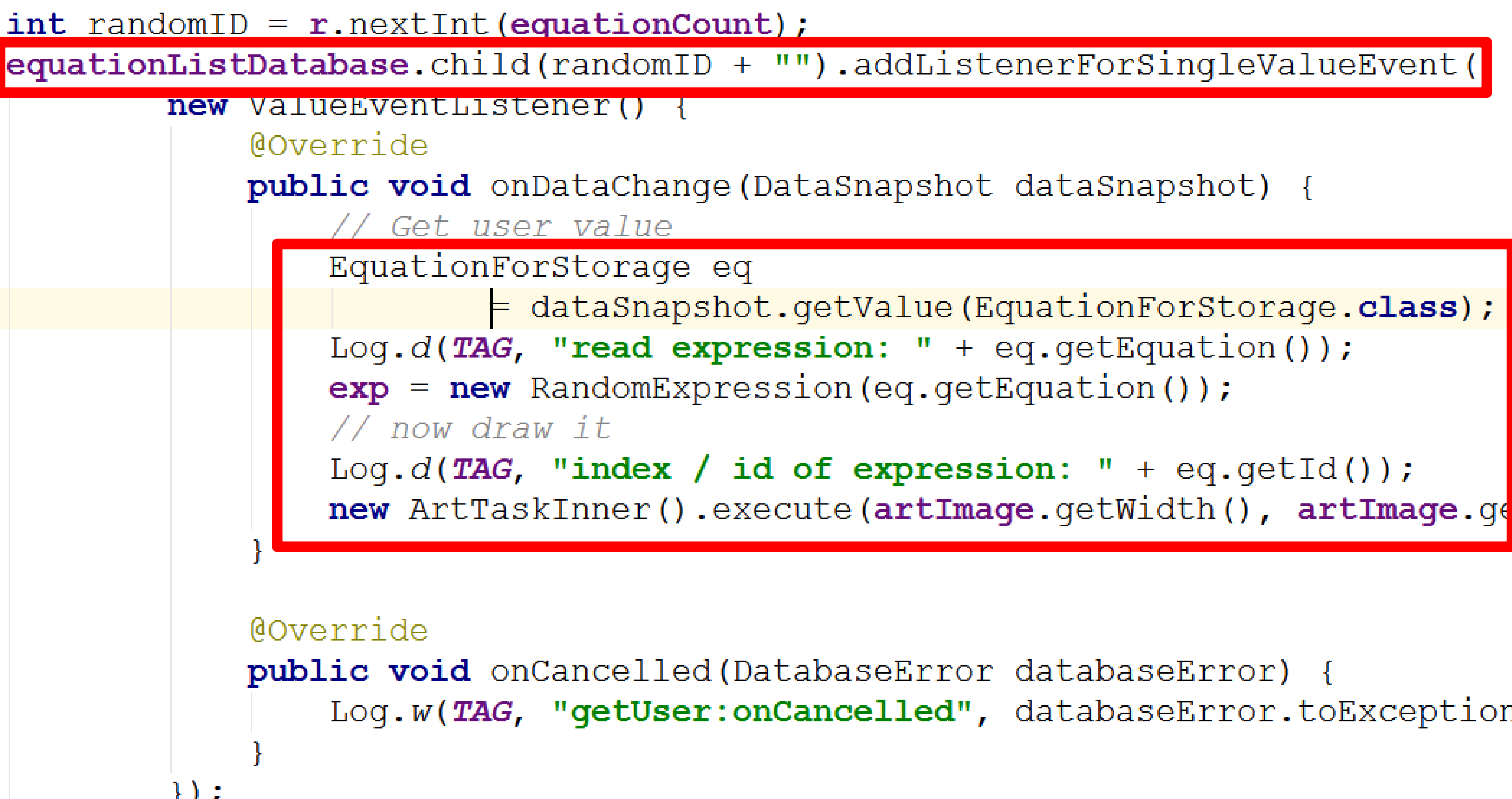


```
currentExpressionIsNew = false;
int newCount = equationCount + 1;
Log.d(TAG, "Setting new count. Old count: " + equationCount + ", ne
equationCountDatabase.setValue(newCount);
String equation = exp.toString();
// Add current equation to Firebase database
EquationForStorage newExpression
        = new EquationForStorage(equation, newCount, 1, 0, System.c
equationListDatabase.child("" + newCount).setValue(newExpression);
```

- setValue method to add child
- Firebase data: String, Long, Double, Boolean, Map<String, Object>, List<Object>
- any custom object with 0 argument constructor and public getters for properties

Random Art - Get Equation

- Pick random child based on current number of equations



```
int randomID = r.nextInt(equationCount);
equationListDatabase.child(randomID + "").addListenerForSingleValueEvent(
        new ValueEventListener() {
            @Override
            public void onDataChange(DataSnapshot dataSnapshot) {
                // Get user value
                EquationForStorage eq
                        = dataSnapshot.getValue(EquationForStorage.class);
                Log.d(TAG, "read expression: " + eq.getEquation());
                exp = new RandomExpression(eq.getEquation());
                // now draw it
                Log.d(TAG, "index / id of expression: " + eq.getId());
                new ArtTaskInner().execute(artImage.getWidth(), artImage.ge
            }

            @Override
            public void onCancelled(DatabaseError databaseError) {
                Log.w(TAG, "getUser:onCancelled", databaseError.toExceptio
            }
        });
```

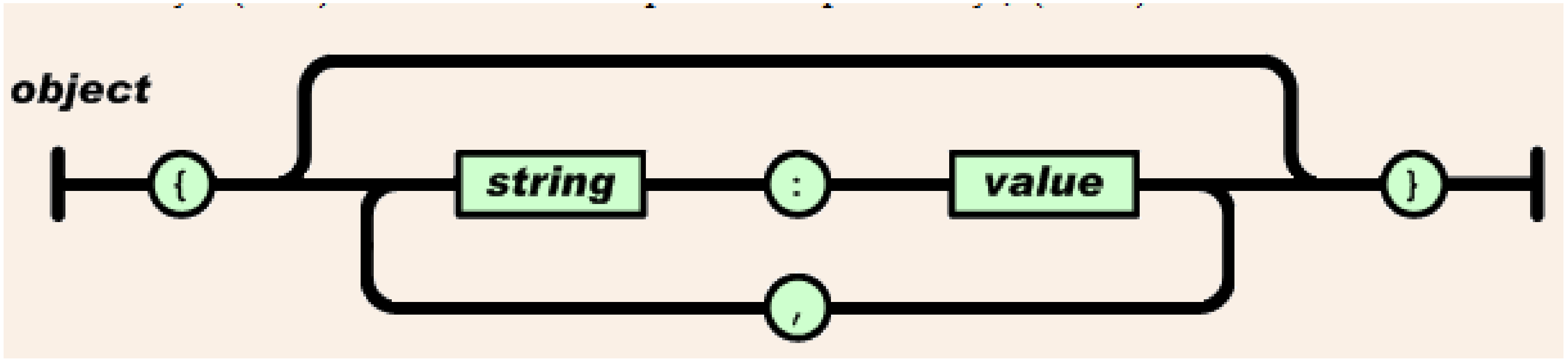
JSON

JSON

- JavaScript Object Notation
- a way to represent JavaScript objects as Strings
- alternative to XML for passing data between servers and clients
- designed for data interchange format that humans can also read and write

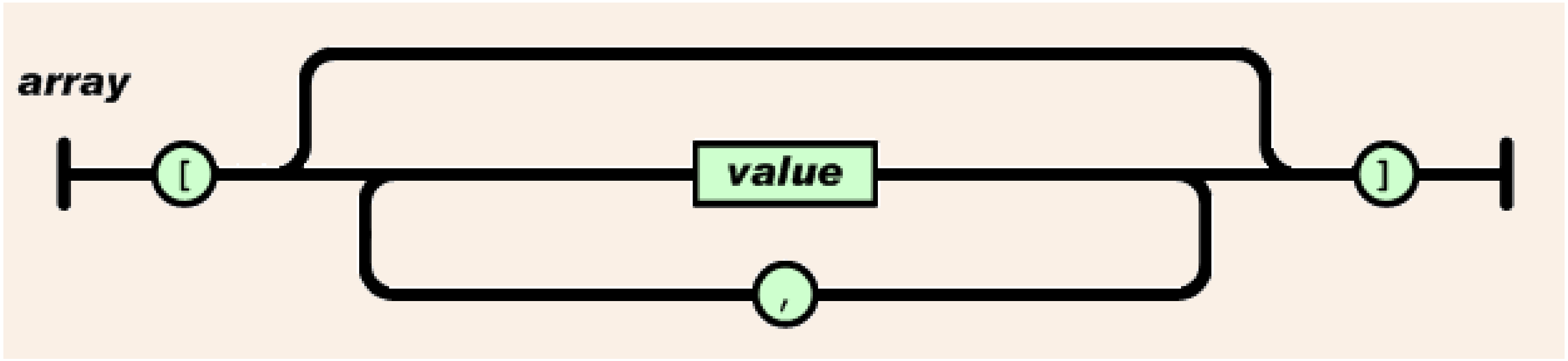
JSON Format

- Built on two structures
  - collection of name-value pairs: a.k.a. objects, records, structs, etc.
  - an ordered list of values: a.k.a. an array
- objects



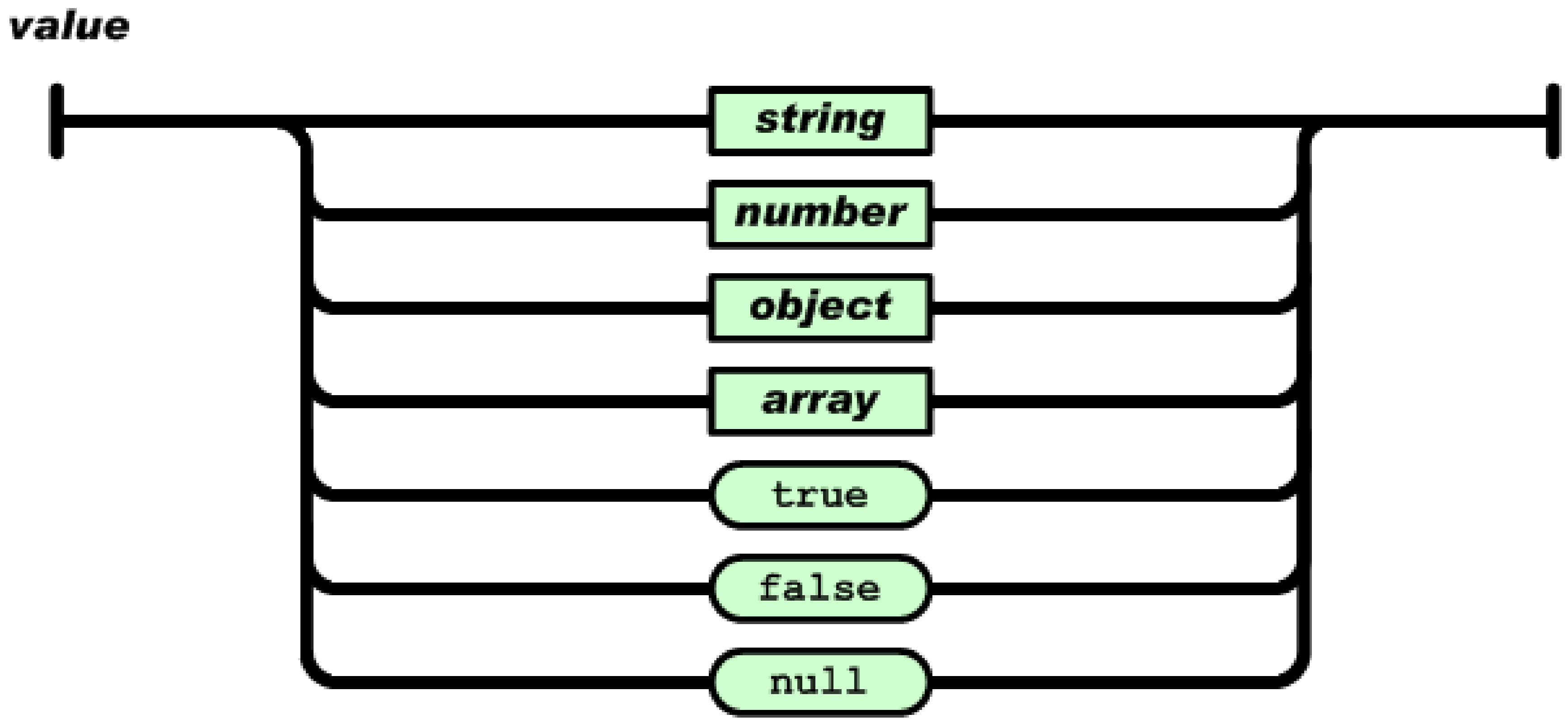
JSON Format

- arrays



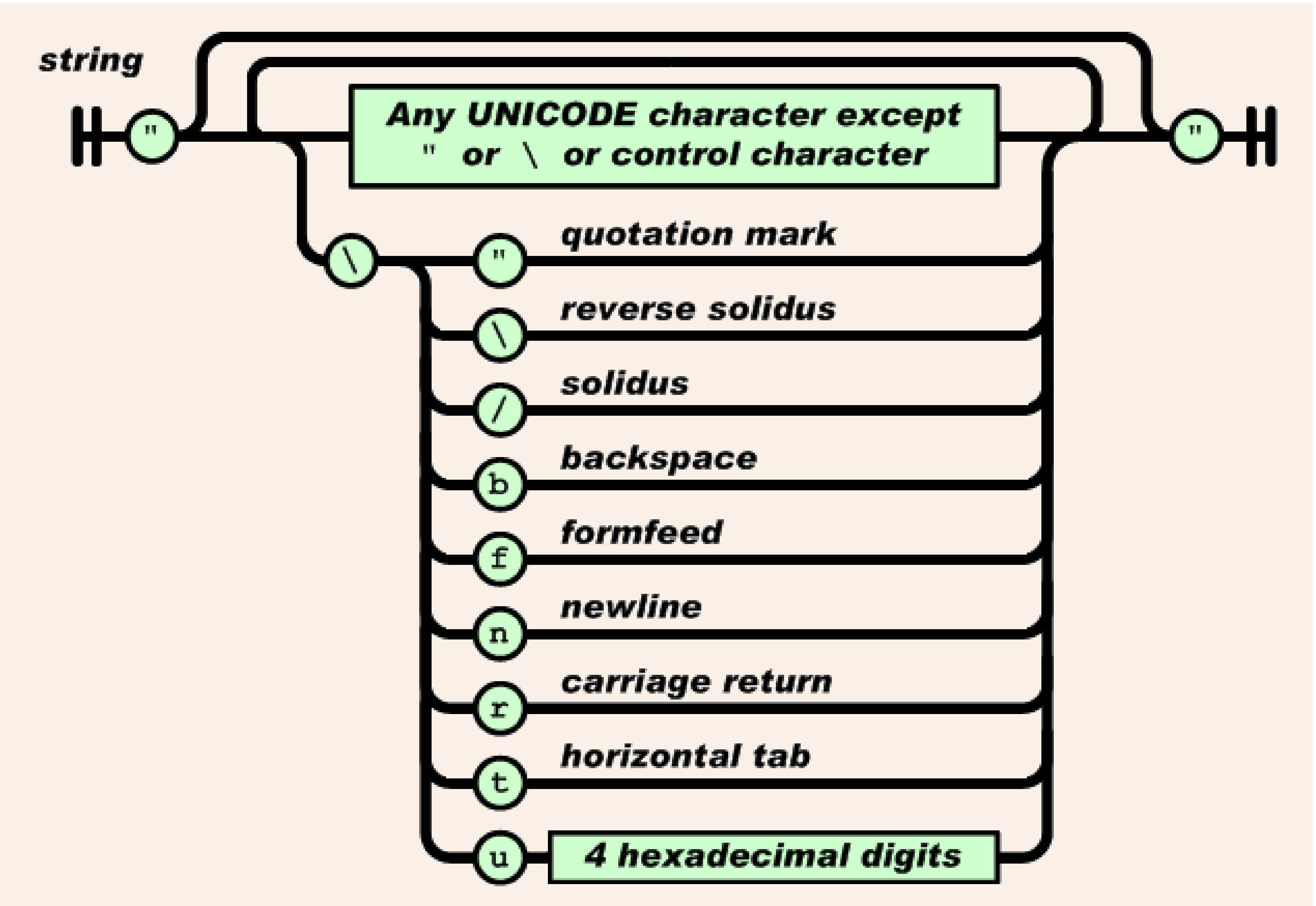
- values
  - string, number, object, array, true, false, null

JSON Values

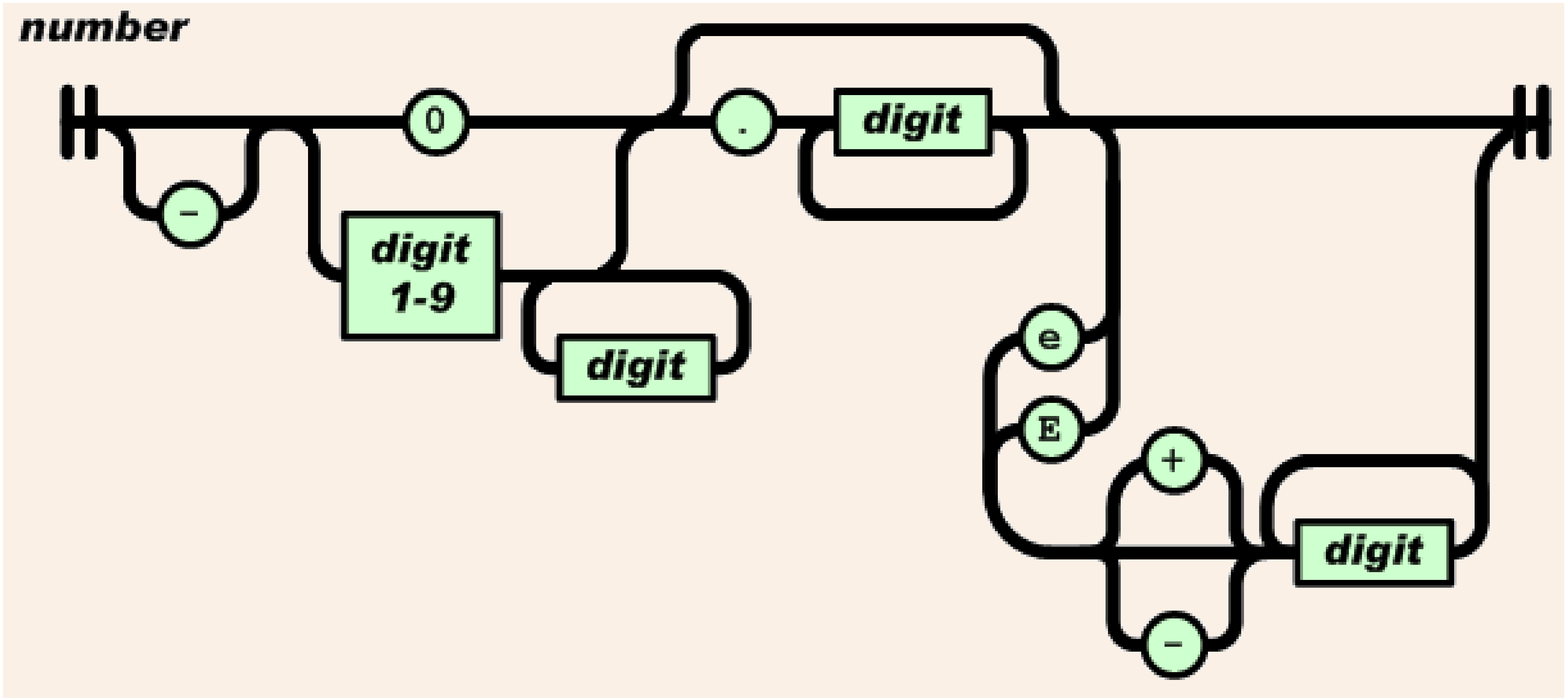


Syntax Diagrams for string and number: http://www.json.org/

JSON Strings



JSON Numbers



JSON Examples

- value (String):
  - "Round Rock"
- array:
  - ["Round Rock", "Dallas", "Houston"]
- object
  - {"height":70,"weight":165}