E6156 : Topics in Software Engineering Cloud and Microservice Applications

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  - Composition concept.
  - Activiti example.
  - AWS Workflow, AWS Step Functions

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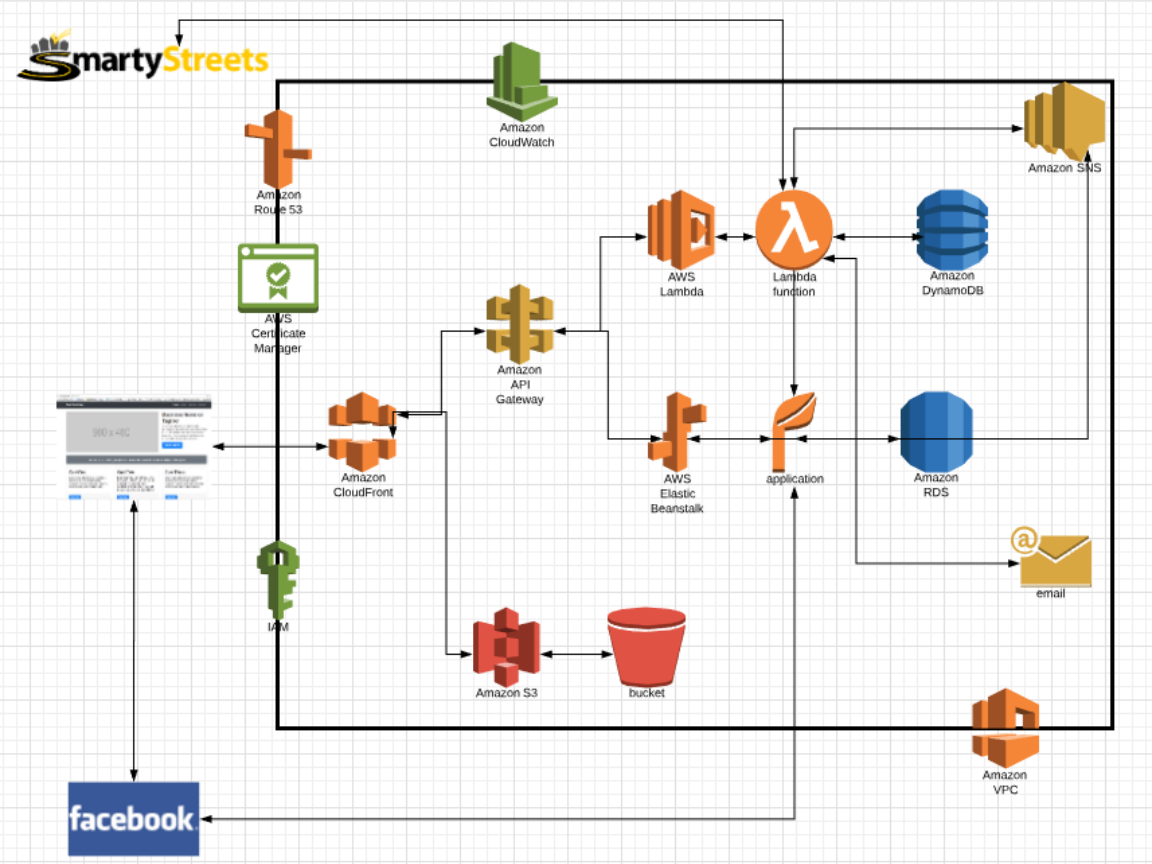
Status

Overall Project Structure



E6156: Solution Structure, OAuth2, Facebook Login, Orchestration
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From Lecture 1 – Objectives

Build a simple multi-tenant cloud application in a small team

- A set of microservices.
- Using elements of cloud computing:
  - PaaS
  - FaaS
  - Logging
  - Serverless
  - Cloud Database(s)
  - Security: Authentication, Authorization and Federation.
  - Message Queues, Events and Event-Driven-Architecture
  - Simple workflow and service orchestration.
  - Call cloud business APIs.
  - Email, Mobile.
  - Other cool stuff.

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Status and Roadmap

- We covered an overview of many concepts, but are behind on applying to a very basic, functioning application.

- Lecture Roadmap:
  - 09-Nov: Email verification, Facebook, Composition/Orchestration Concepts.
  - 16-Nov: Composition/Orchestration, Messaging – Details, Impl.
  - 23-Nov: Thanksgiving.
  - 30-Nov: Graph Database, other cloud databases.
  - 07-Nov: Misc. topics.

- Final project reviews: 10-Dec to 17-Dec.

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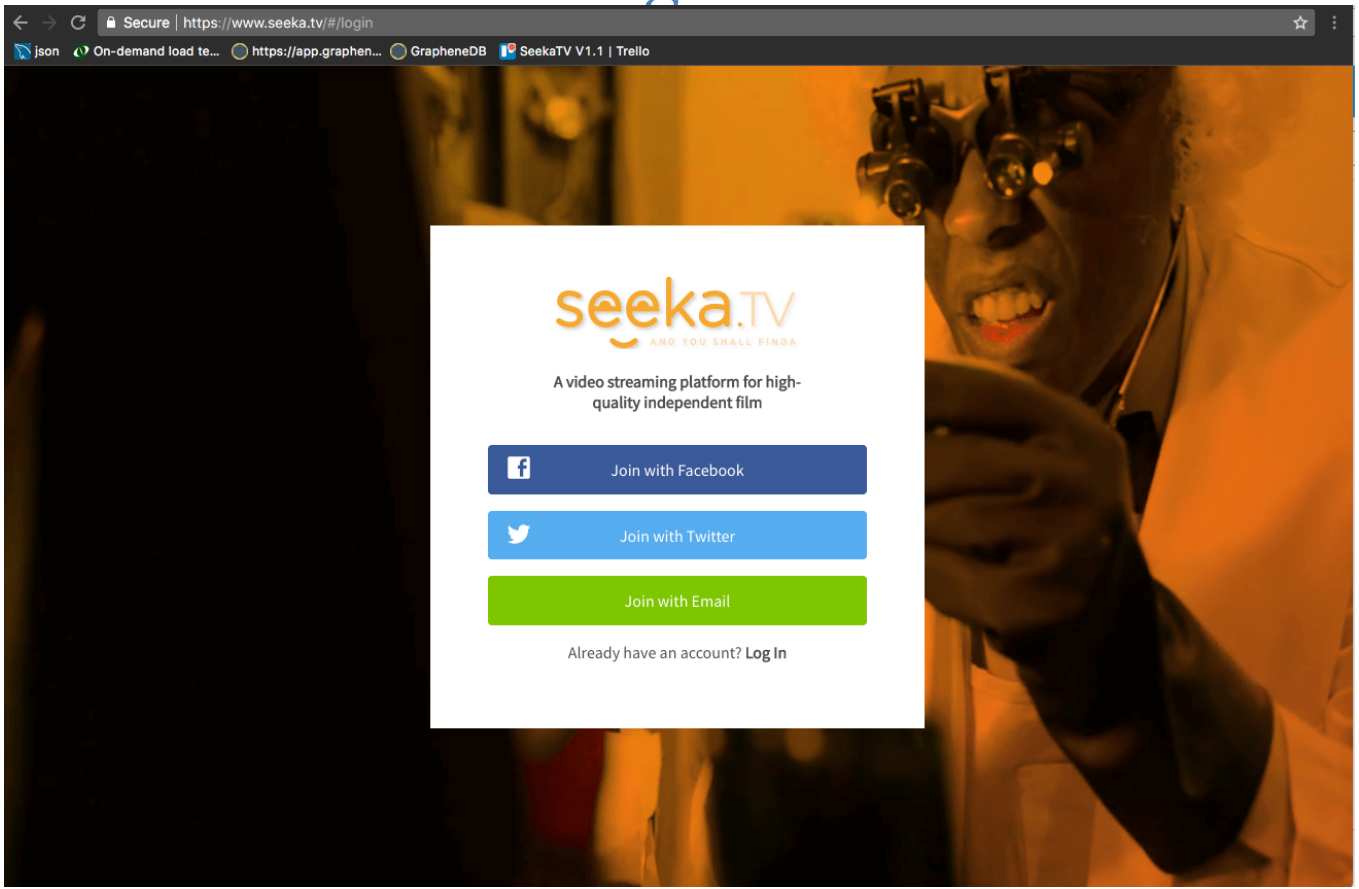
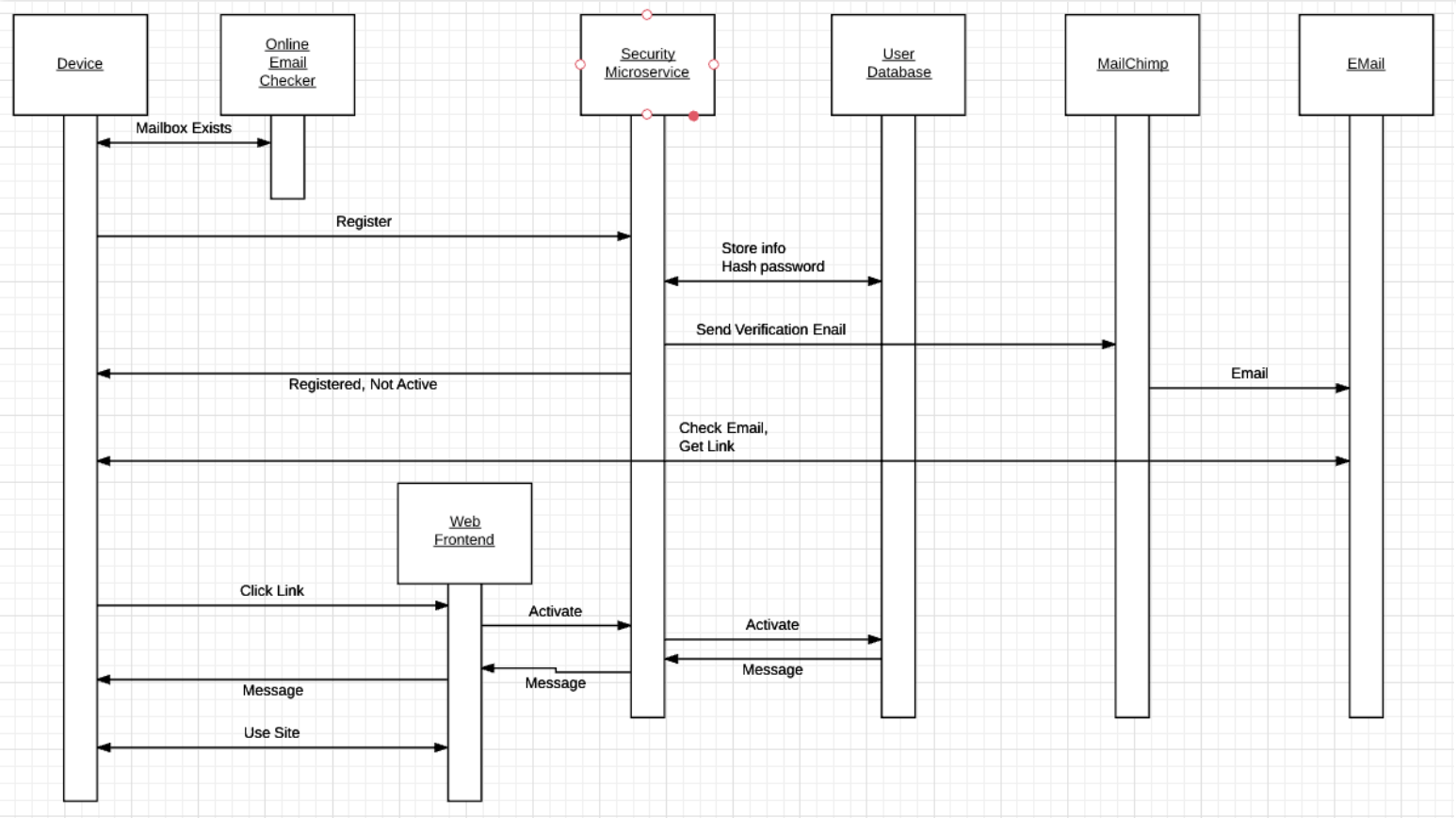
Email Verification

Registration



Email Registration – Seeka/Sparq Model



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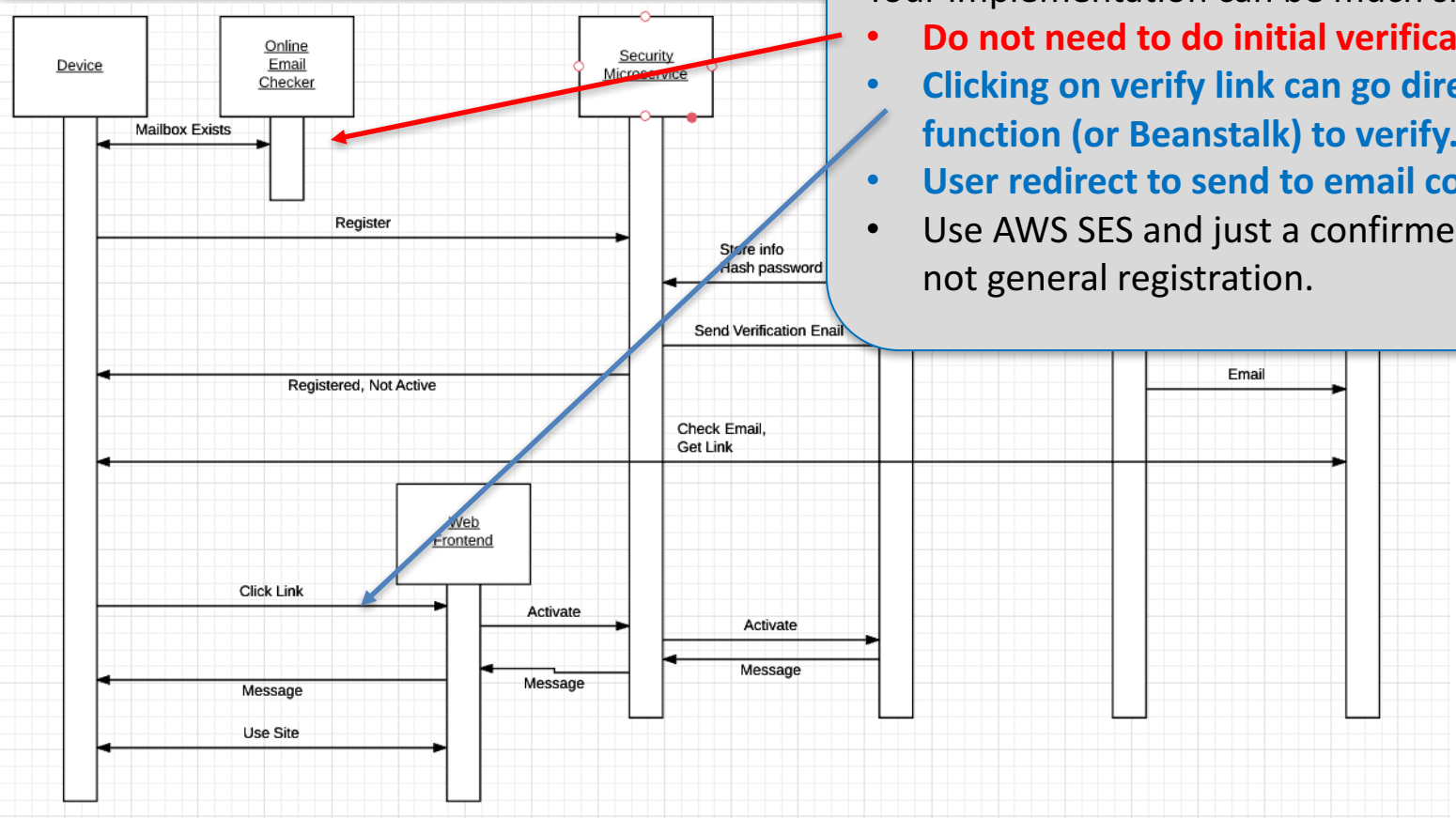
Email Registration – S



Your implementation can be much simpler

- **Do not need to do initial verification.**
- **Clicking on verify link can go directly to Lambda function (or Beanstalk) to verify.**
- **User redirect to send to email confirmed page.**
- Use AWS SES and just a confirmed email account, not general registration.

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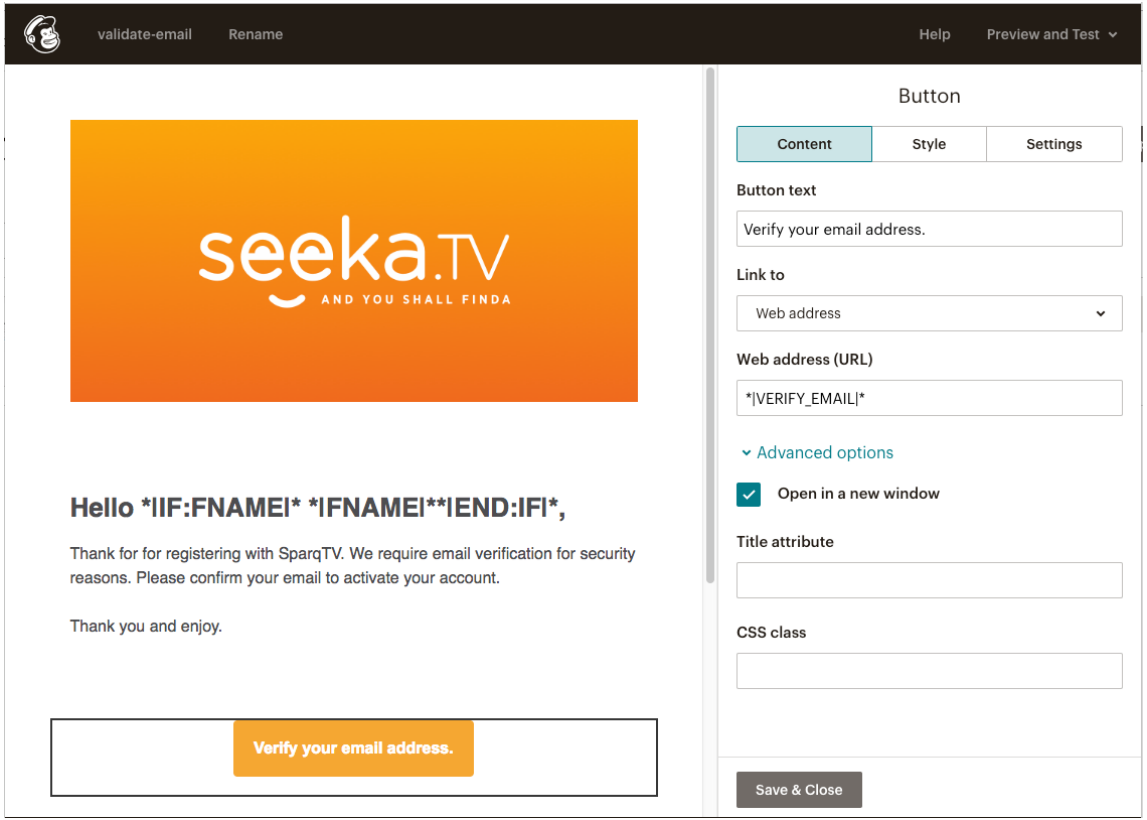
Email Ownership Verification – Seeka



- The email is a template.
- The template
  - Is HTML
  - Has defined ”merge tags” embedded in the document.
- Send email API:
  - Parameters for To:, Cc:, …
  - Values to merge into email, e.g.
    - Name
    - Custom message
    - Verify URL for button
  - Verify email URL gets bound to the href for the button.

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Send Email Lambda – Seeka Example

```
'use strict';
console.log('Loading function');

var mandrill = require('mandrill-api/mandrill');
var mandrill_client = new mandrill.Mandrill('L5FjEL8ItFib4wIdQOmlcw');

var theHandler = function(event, context, callback) {
    console.log('Received event:', JSON.stringify(event, null, 2));

    console.log("Calling sendTemplate");
    sendTemplate(event.template_name, event.toEmail, event.subject, event.fname, event.url);
    console.log("After sendTemplate");
    callback(null, "Email Sent!.");
};

exports.handler = theHandler;
```


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Send Email Lambda

```
var template_content = [];
var template_message = {
    "subject": "Welcome, and Verify Email",
    "from_email": "info@seeka.tv",
    "from_name": "SeekaTV",
    "to": [

    ],
    "headers": {
        "Reply-To": "info@seeka.tv"
    },
    "important": false,
    "track_opens": null,
    "track_clicks": null,
    "auto_text": null,
    "auto_html": null,
    "inline_css": null,
    "url_strip_qs": null,
    "preserve_recipients": null,
    "view_content_link": null,
    "bcc_address": "george.reese@seeka.tv",
    "tracking_domain": null,
    "signing_domain": null,
    "return_path_domain": null,
    "merge": true,
    "merge_language": "mailchimp",
    "global_merge_vars": [{
        "name": "merge1",
        "content": "merge1 content"
    }],
```


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Send Email Lambda

```
    }],
    "merge_vars": [{
        "rcpt": "donff2@aol.com",
        "vars": [{
            "name": "FNAME",
            "content": "Donald"
        }, {
            "name": "VERIFY_EMAIL",
            "content": "http://preview.seeka.tv"
        }, {
            "name": "PREFERENCES_LINK",
            "content": "http://preview.seeka.tv"
        }, {
            "name": "EMAIL_ADDRESS",
            "content": "info@seeka.tv"
        }]
    }],
    "tags": [
        "email-verification"
    ],
    "async": false,
    "ip_pool": "Main Pool",
    "send_at": "2016:09:03 00:00:00"
;
```

- This is a simple test/example.
- The URL for the button href would be the value of the “VERIFY_EMAIL” variable.
- The obvious question is, ”What is the URL?”

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Send Email Lambda

```
var sendTemplate = function(t_name, toEmail, subject, fname, url) {
    var async = false;
    var ip_pool = "Main Pool";
    var send_at = "2016:09:03 00:00:00";

    console.log("In sendTemplate.");
    console.log("")


    template_message.subject = subject;
    template_message.to = [{
        "email": toEmail,
        "type": "to",
        "subject": subject
    }];
    template_message.merge_vars[0].rcpt = toEmail;
    template_message.merge_vars[0].vars[0].content = fname;
    template_message.merge_vars[0].vars[1].content = url;
    var template_name = t_name;

    console.log("Message = " + JSON.stringify(template_message));

    mandrill_client.messages.sendTemplate({
            "template_name": template_name,
            "template_content": template_content,
            "message": template_message,
            "async": async,
            "ip_pool": ip_pool,
            "send_at": send_at
        },
        function(result) {
            console.log("Mandrill result: " + JSON.stringify(result));
        },
        function(error) {
            console.log("Mandrill returned an error " + JSON.stringify(error));
        }
    );

    console.log("Exiting.");
};
```


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Verification Email

```
let jwt = require('jsonwebtoken');

// DO NOT EVER PUT SECRETS IN CODE.
let secret = "secret";

let generate_verify_email_url = function(info) {

    let result = jwt.sign(info, secret);
    result = "http://www.dff-cu.org/api/verify_email?m=" + result
    return result;
};

let info = {
    "nameLast": "Ferguson",
    "nameFirst": "Donald",
    "created": new Date(),
    "email": "someemail@some.org"
};

let verify_url =  generate_verify_email_url(info)
console.log("URL = " + verify_url)
```

```
/usr/local/bin/node /Users/donaldferguson/Dropbox/ColumbiaCourse/Courses/Fall2018/E6156/Projects/CustomerV2/lib/general_mail_url.js
URL = http://www.dff-cu.org/api/verify_email?m=eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJuYW1lTGFzdCI6IkZlcmd1c29uIiwibmFtZUZpcnN0IjoiRG9uYWxkIiwiY3JlYXRlZCI6IjIwMTgtMTEtMD

Process finished with exit code 0
```


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Email Verification

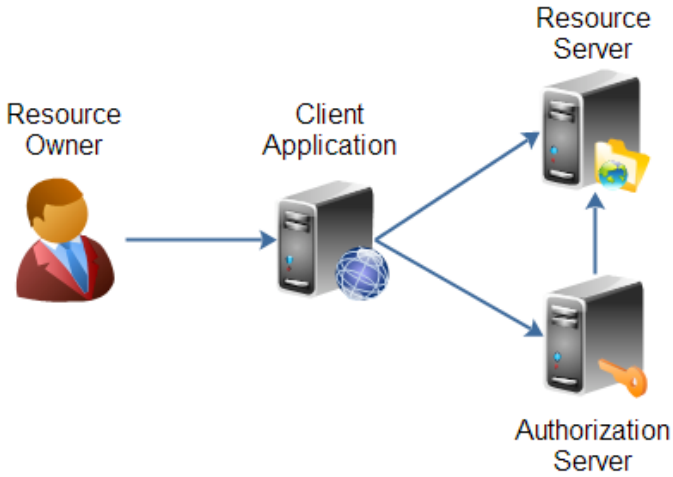
Overview (http://tutorials.jenkov.com/oauth2/index.html)

- Resource Owner
  - Controls *access* to the "data."
  - Facebook **user**, LinkedIn **user**, …
- Resource Server
  - The website that holds/manages info.
  - Facebook, LinkedIn, ...
  - And provides access API.
- Client Application
  - "The product you implemented."
  - Wants to read/update
    - "On your behalf"
    - The data the data that the Resource Server maintains, e.g. posts, status, tweets, ...
- Authorization Server
  - Grants/rejects authorization
  - Based on Resource Owner decisions.
  - Usually (logically) the same as Resource Server.

OAuth 2.0 defines the following roles of users and applications:

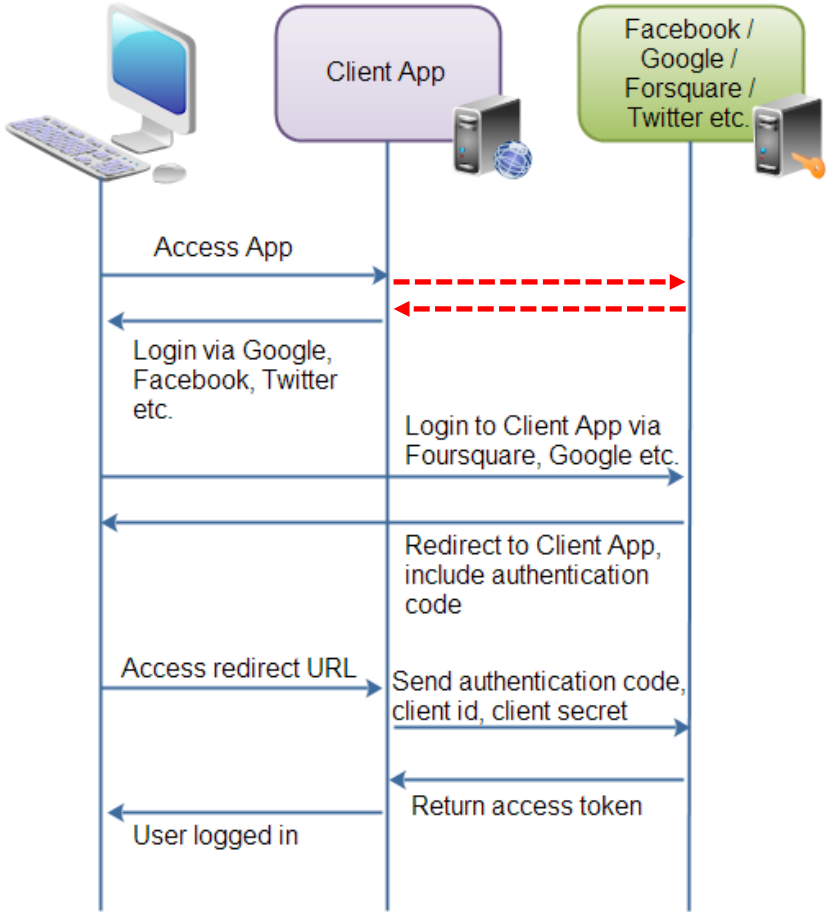
- Resource Owner
- Resource Server
- Client Application
- Authorization Server

These roles are illustrated in this diagram:



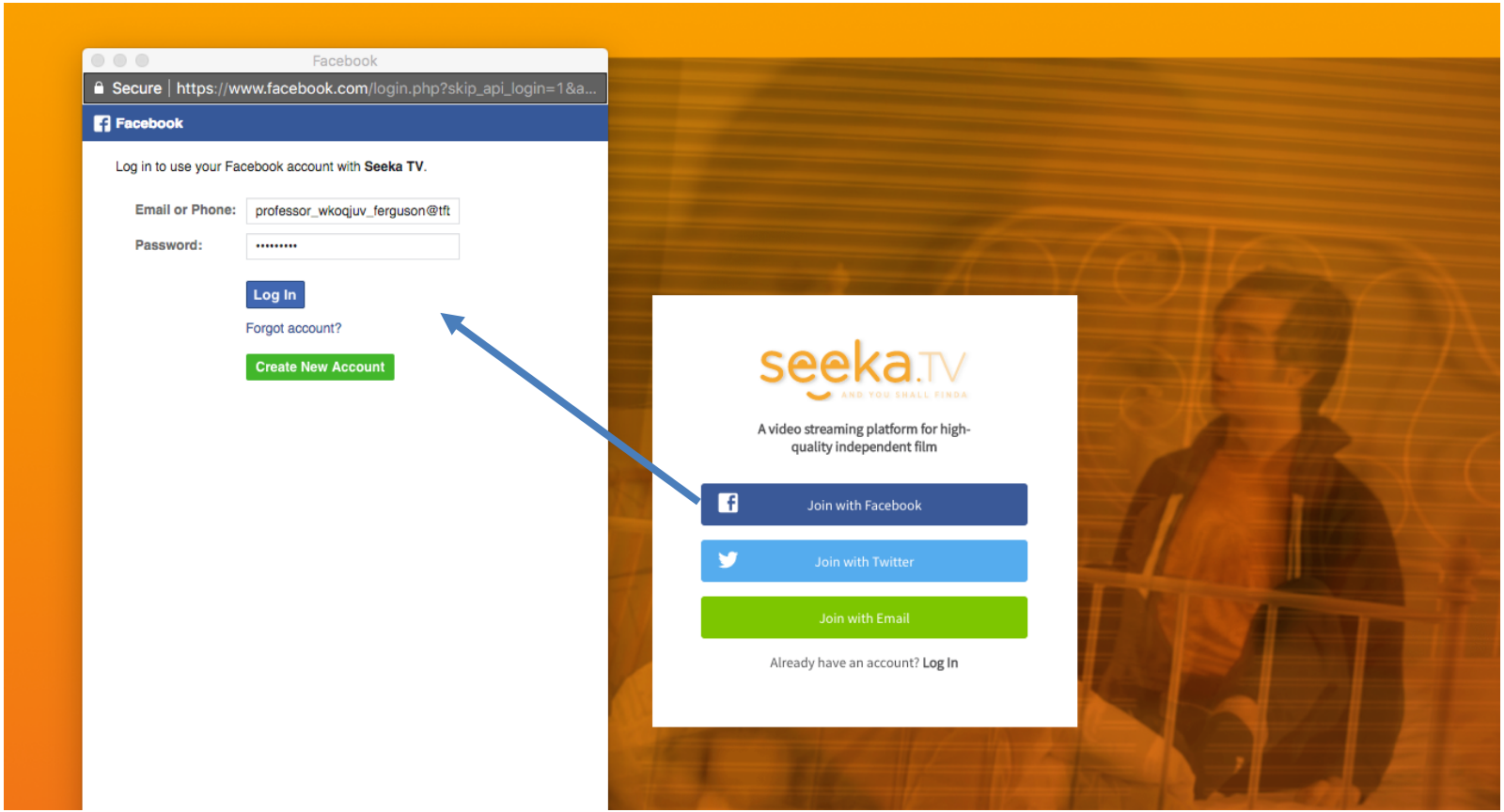
Rol

- User Clicks “Logon with XXX”
  - Redirect user to XXX
  - With Client App application ID.
  - And permissions app requests.
  - Code MAY have to call Resource Server to get a token to include in redirect URL.
- Browser redirected to XXX
  - Logon on to XXX prompt.
  - Followed by “do you grant permission to …”
  - Clicking button drives a redirect back to Client App. URL contains a temporary token.
- User/Browser
  - Redirected to Client App URL with token.
  - Client App calls XXX API
  - Obtains access token.
  - Returns to User.
- Client App can use access token on API calls.

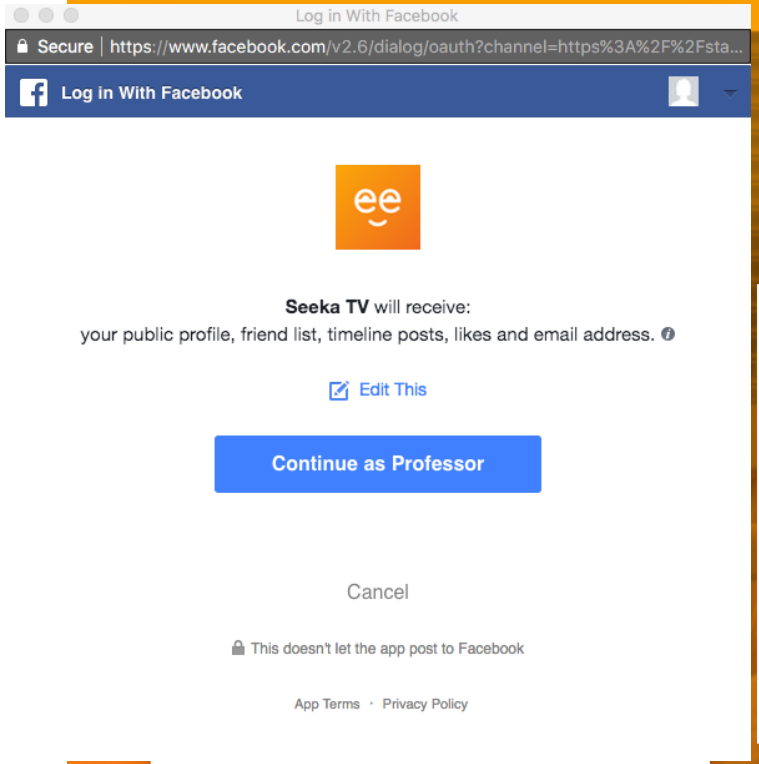


Registration

Registration



Registration



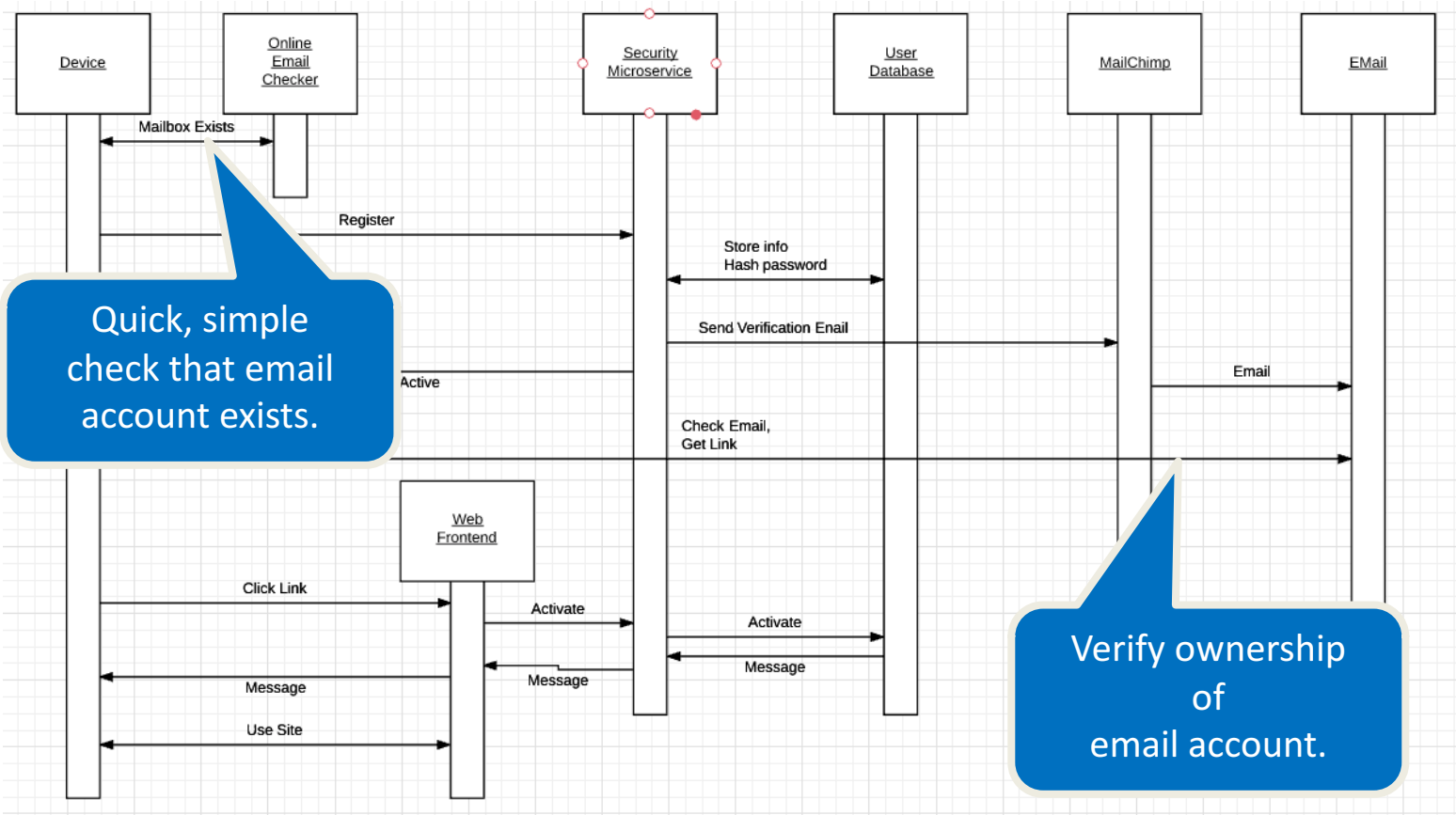
Pros and Cons of Social Media Logon

(https://econsultancy.com/blog/61911-the-pros-and-cons-of-a-facebook-login-on-ecommerce-sites)

- Pros
  - One password for many services: Some people hate making up passwords
  - Familiarity: People trust Facebook and may not want to give you info.
  - Added convenience drives business: "Forced registration is a major cause of checkout abandonment, with a quarter (26%) of respondents in a recent Econsultancy survey stating that being forced to register would cause them to abandon a purchase."
  - Sharing: Simplifies customers sharing their use of your site → drives awareness.
  - Access to profile data: Do not require users to enter a new profile.
  - Your site does not have to have code for password reset, locked account, etc.
- Cons
  - Some users don't want everything to be connected.
  - Some people don't use Facebook.
  - Muddying your brand image.

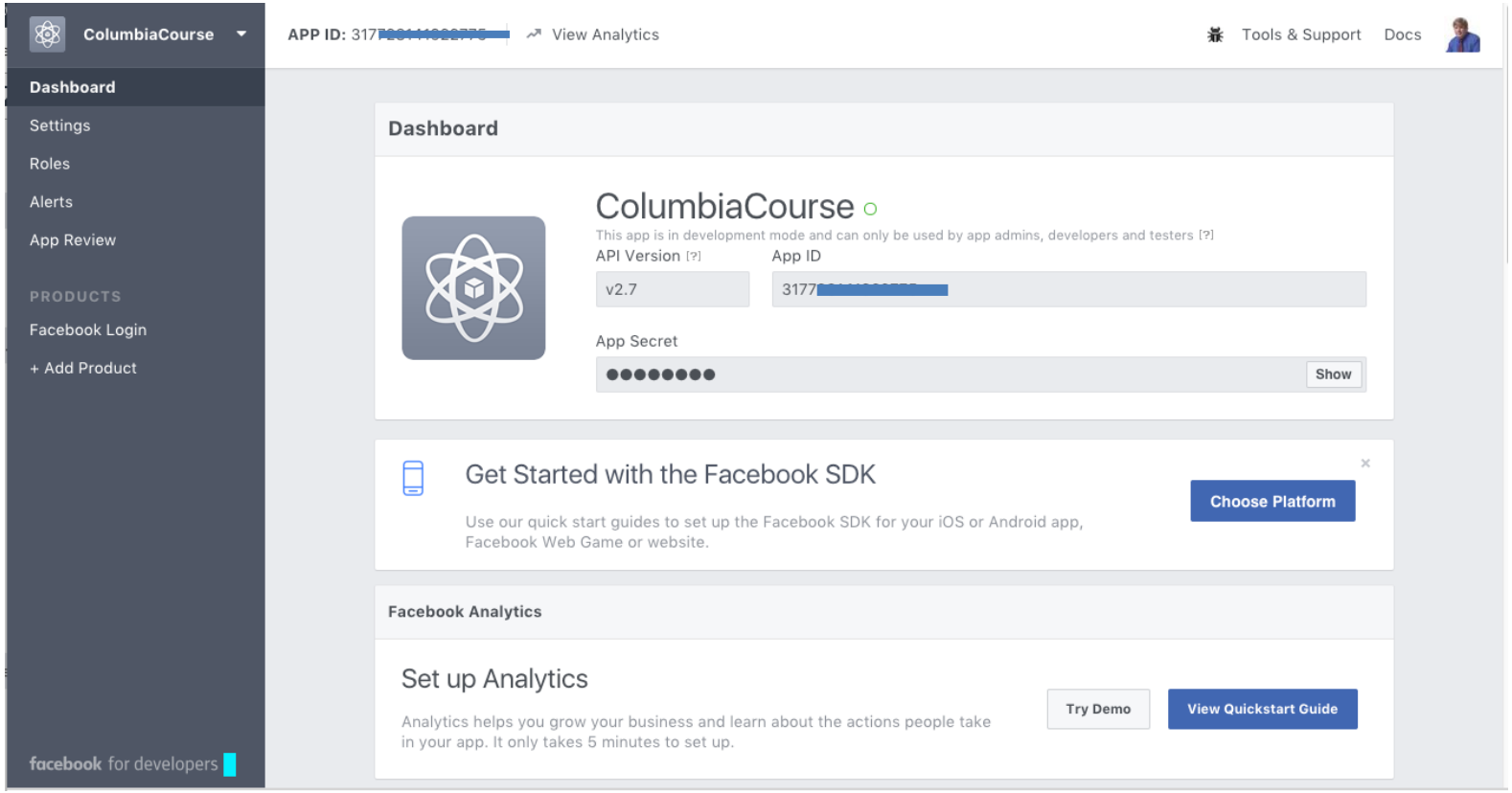
Email

Email Registration

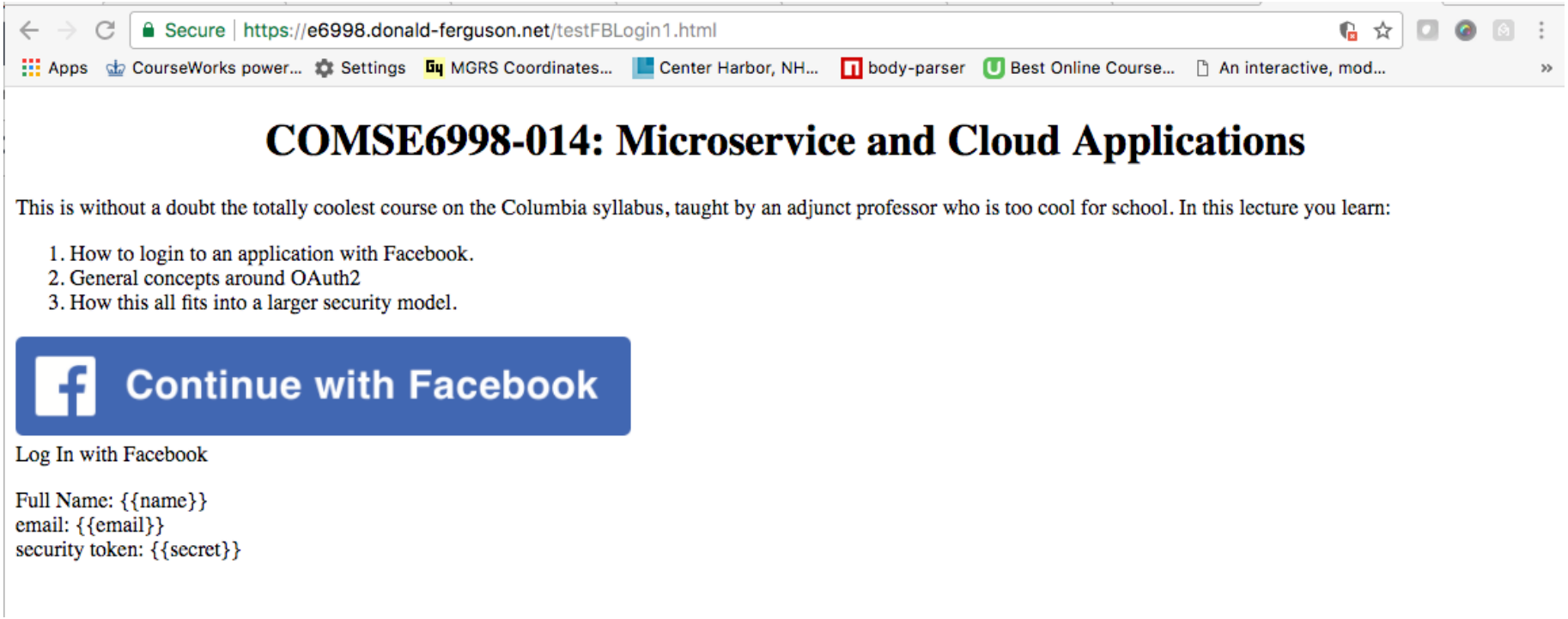


Social Media Registration (Facebook)

Define Application



Web Page

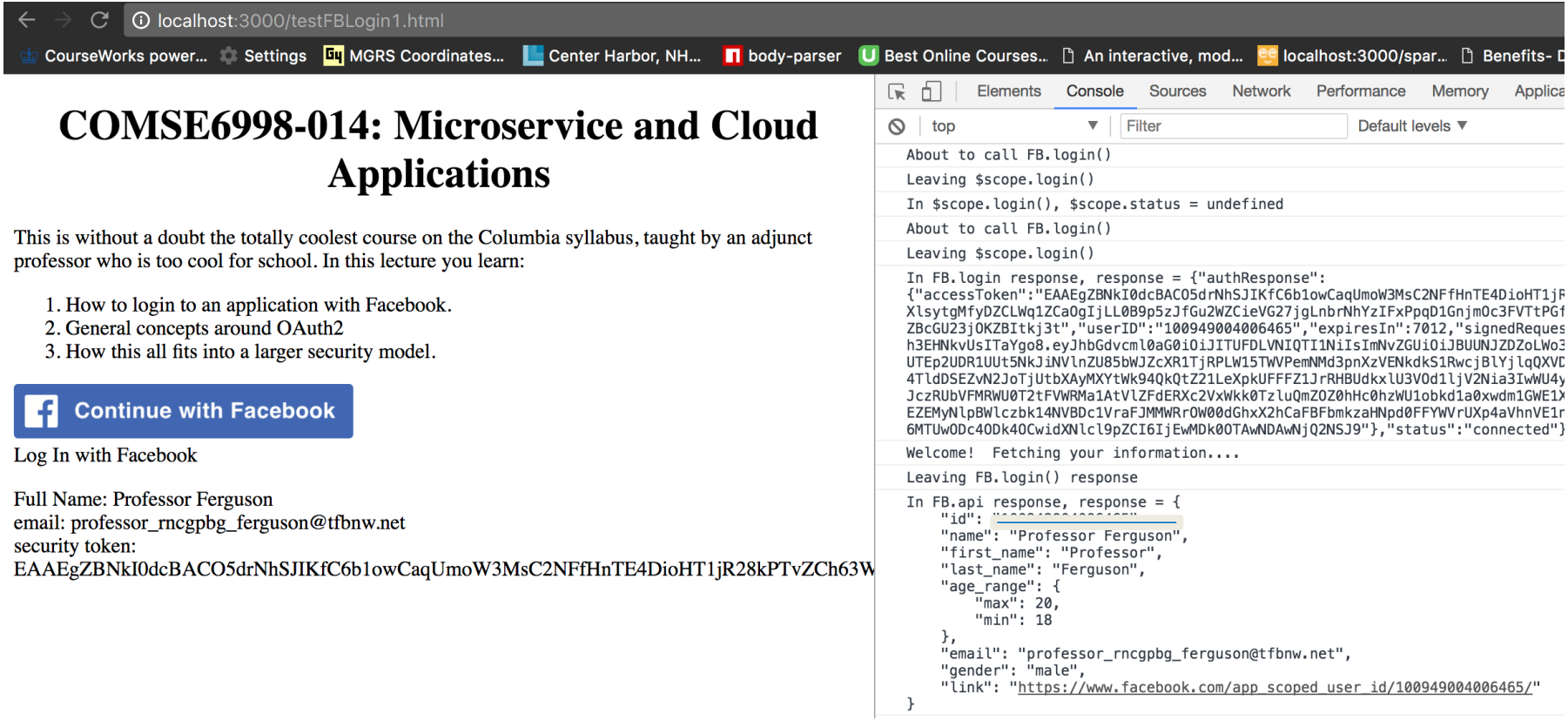

Secure | https://e6998.donald-ferguson.net/testFBLogin1.html
Apps
CourseWorks power...
Settings
MGRS Coordinates...
Center Harbor, NH...
body-parser
Best Online Course...
An interactive, mod...
COMSE6998-014: Microservice and Cloud Applications
This is without a doubt the totally coolest course on the Columbia syllabus, taught by an adjunct professor who is too cool for school. In this lecture you learn:
1. How to login to an application with Facebook.
2. General concepts around OAuth2
3. How this all fits into a larger security model.
Continue with Facebook
Log In with Facebook
Full Name: {{name}}
email: {{email}}
security token: {{secret}}

```
<div ng-app="apiController" ng-controller="myCtrl">
    <script src="http://ajax.googleapis.com/ajax/libs/angularjs/1.4.8/angular.min.js"></script>
    <script src="/apiController.js"></script>
    <script>


        // This function is called when someone finishes with the Login
        // Button.  See the onlogin handler attached to it in the sample
        // code below.
        function checkLoginState() {
            FB.getLoginStatus(function(response) {
                statusChangeCallback(response);
            });
        }

        window.fbAsyncInit = function() {
            FB.init({
                appId      : '3177[redacted]',
                cookie     : true,  // enable cookies to allow the server to access
                                    // the session
                xfbml      : true,  // parse social plugins on this page
                version    : 'v2.5' // use graph api version 2.5
            });

            // Now that we've initialized the JavaScript SDK, we call
            // FB.getLoginStatus().  This function gets the state of the
            // person visiting this page and can return one of three states to
            // the callback you provide.  They can be:
            //
            // 1. Logged into your app ('connected')
            // 2. Logged into Facebook, but not your app ('not_authorized')
            // 3. Not logged into Facebook and can't tell if they are logged into
            //    your app or not.
            //
            // These three cases are handled in the callback function.

            FB.getLoginStatus(function(response) {
                statusChangeCallback(response);
            });

        };

        // Load the SDK asynchronously
        (function(d, s, id) {
            var js, fjs = d.getElementsByTagName(s)[0];
            if (d.getElementById(id)) return;
            js = d.createElement(s); js.id = id;
            js.src = "//connect.facebook.net/en_US/sdk.js";
            fjs.parentNode.insertBefore(js, fjs);
        }(document, 'script', 'facebook-jssdk'));
```

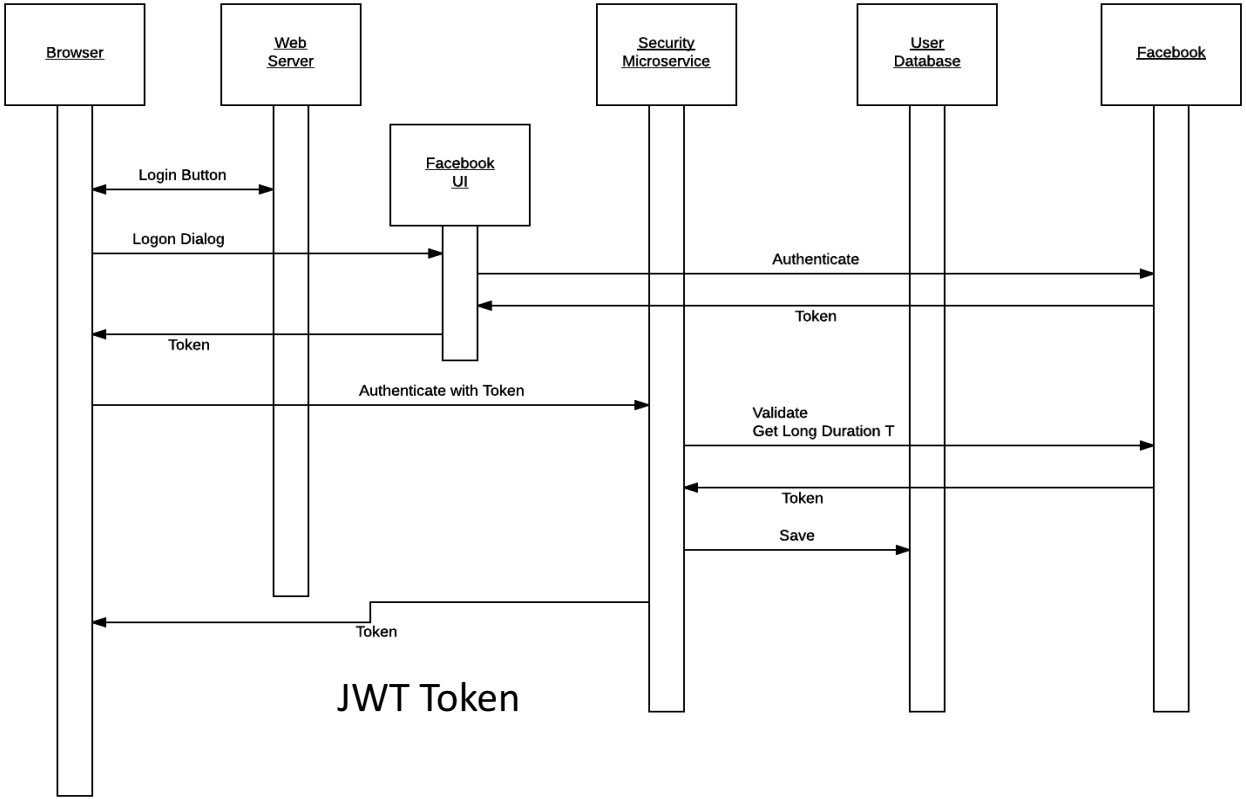
Code (II)

```
    <h1 style="text-align: center;">COMSE6998-014: Microservice and Cloud Applications</h1>
<p>
    This is without a doubt the totally coolest course on the Columbia syllabus, taught by an adjunct professor who is too cool for school. In this lecture you
    learn:
    <ol>
        <li>How to login to an application with Facebook.
        <li>General concepts around OAuth2
        <li>How this all fits into a larger security model.
    </ol>
<p>

<!--
<fb:login-button scope="public_profile,email" onlogin="checkLoginState();">
</fb:login-button>
-->
<div ng-click="login()">
    <img src="./facebook_login.png" style="width:40%;"><br>
    <span>Log In with Facebook</span>
</div>

<div>
    <p>
    Full Name: {{name}}<br>
    email: {{email}}<br>
    security token: {{secret}}<br>
    </p>

</div>
</div>
</body>
</html>
```

Facebook Login



Facebook Login



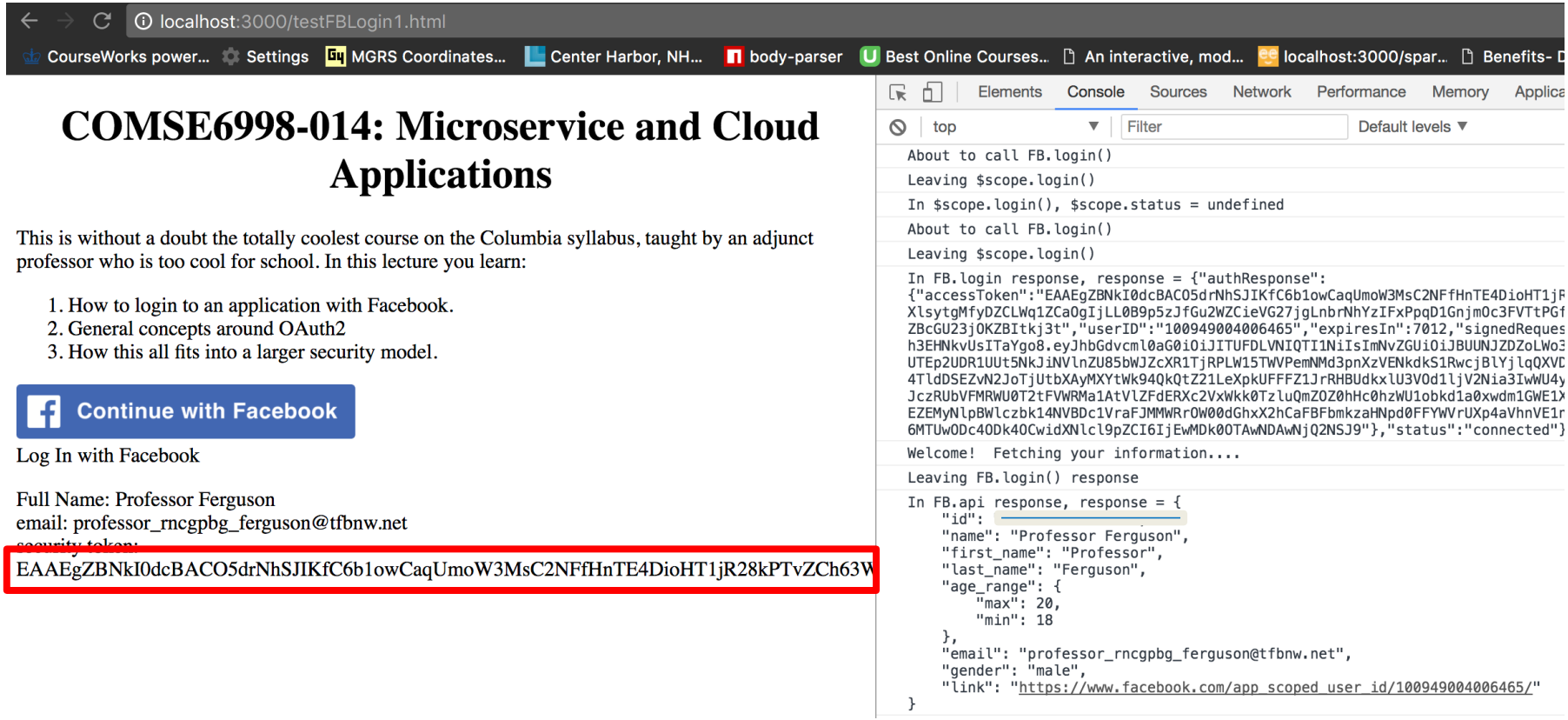
Validate Token

```
public class FBConnector {

    private static final Version FACEBOOK_APP_VERSION = Version.VERSION_2_6;

    private static final org.slf4j.Logger logger = LoggerFactory.getLogger(FBConnector.class);

    public static Gson prettyGson = new GsonBuilder().setPrettyPrinting().create();

    public static boolean validateUIDAndToken(String accessToken, String uid) {
        boolean authenticated = false;
        User theUser = null;

        try {
            theUser = FBConnector.fetchUserObjectAsJsonObject(accessToken, uid);

            if (theUser != null) {
                authenticated = true;
            }
        } catch (Exception e) {
            System.out.println("Error = " + e.toString());
            e.printStackTrace();
        }

        return authenticated;

    }
```

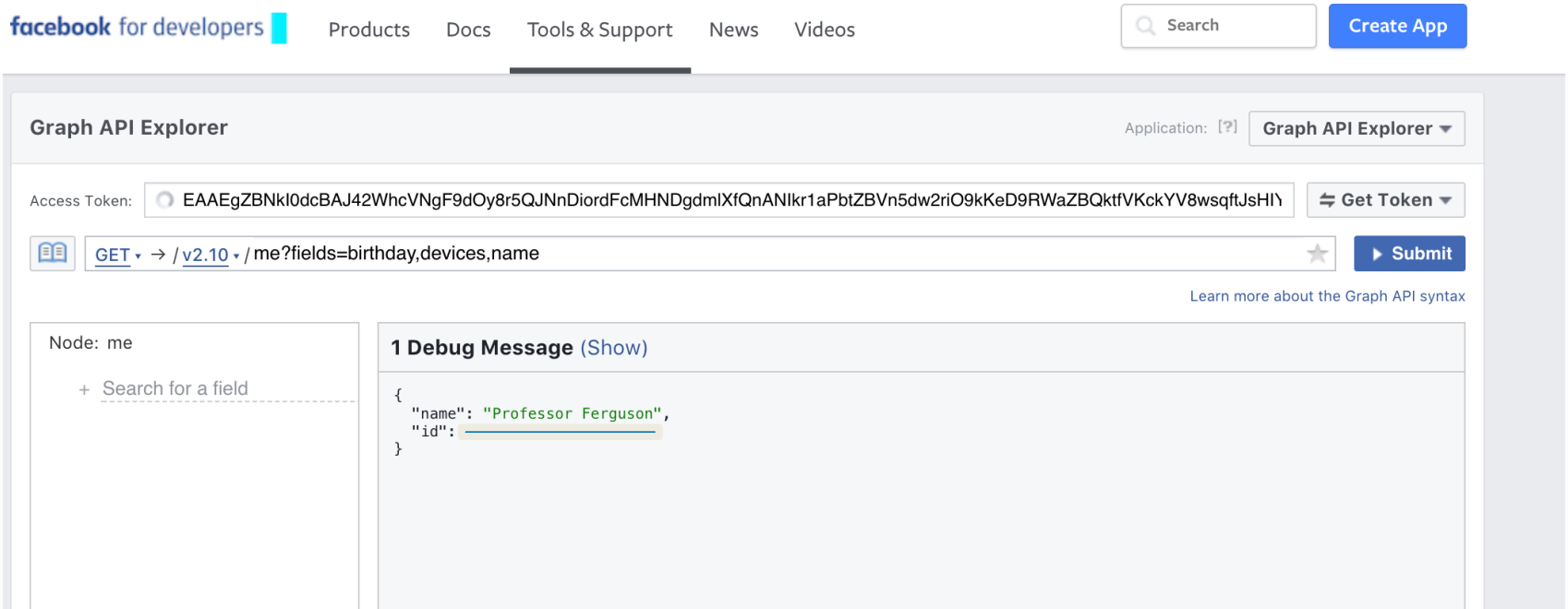
Validate Token

```
public static User fetchUserObjectAsJsonObject(String accessToken, String uid) {
    User theUser = null;

    try {
        logger.debug("In FB Connector.");

        DefaultFacebookClient facebookClient23 = new DefaultFacebookClient(accessToken, FACEBOOK_APP_VERSION);

        logger.debug("Got Facebook client");
        logger.debug("Calling FB for ID = " + uid);

        // Make the API call
        theUser = facebookClient23.fetchObject(uid, User.class);

        // logger.debug("Back from FB call, result = " +
        // prettyGson.toJson(theUser));
        logger.debug("Last name = " + theUser.getLastName());

        // Based on the FB App ID and access token, we sometimes get the
        // last_name and first_name,
        // and sometimes just the full name, e.g. "Hermione Grainger."
        if ((theUser.getLastName() == null) || (theUser.getFirstName() == null)) {
            theUser = updateNames(theUser);
        }
    } catch (Exception e) {
        System.out.println("Error = " + e.toString());
        e.printStackTrace();
        theUser =   null;
    }

    return theUser;

}
```

Facebook Token



Graph API Explorer Demo



OAuth

Twitter
and
Others

Overview (http://tutorials.jenkov.com/oauth2/index.html)

- Resource Owner
  - Controls *access* to the "data."
  - Facebook **user**, LinkedIn **user**, …
- Resource Server
  - The website that holds/manages info.
  - Facebook, LinkedIn, ...
  - And provides access API.
- Client Application
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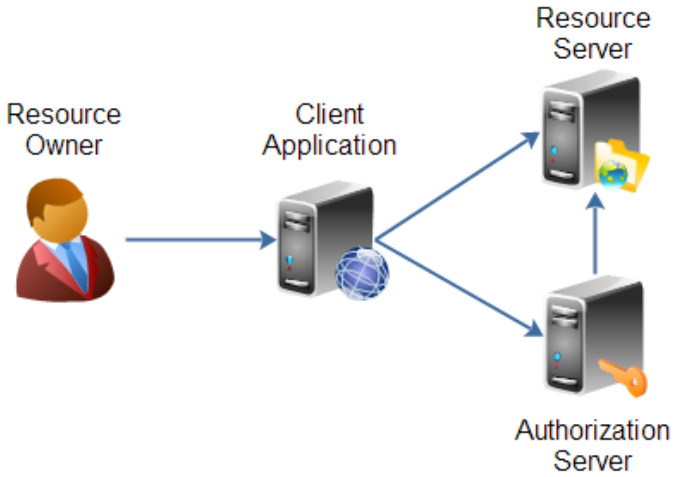

Rol

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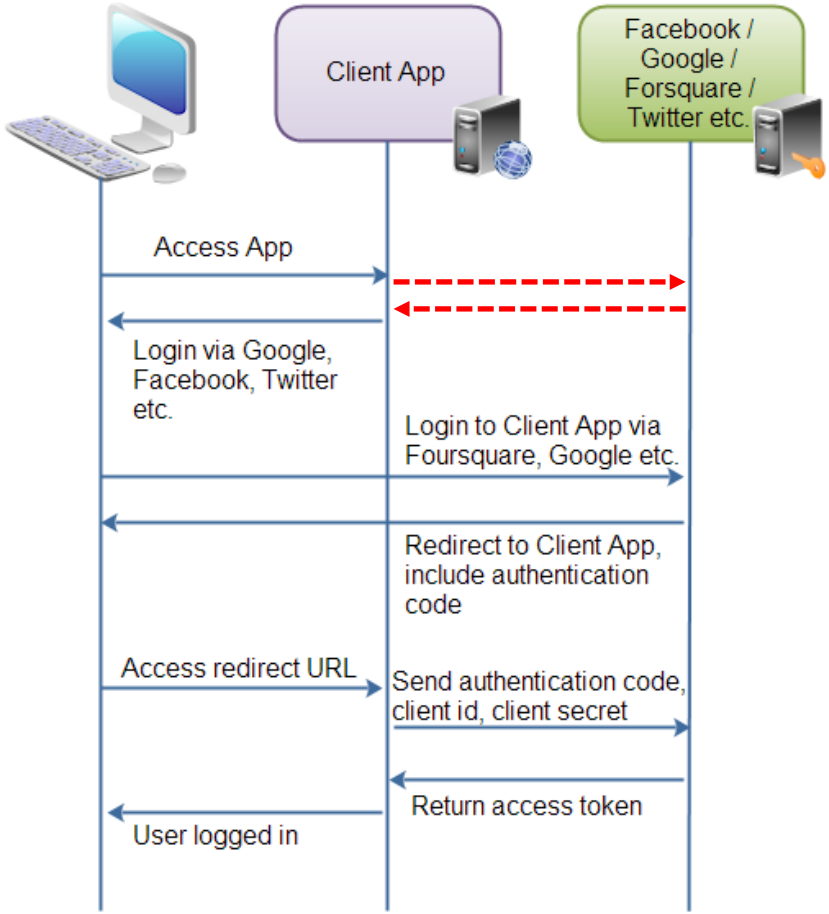
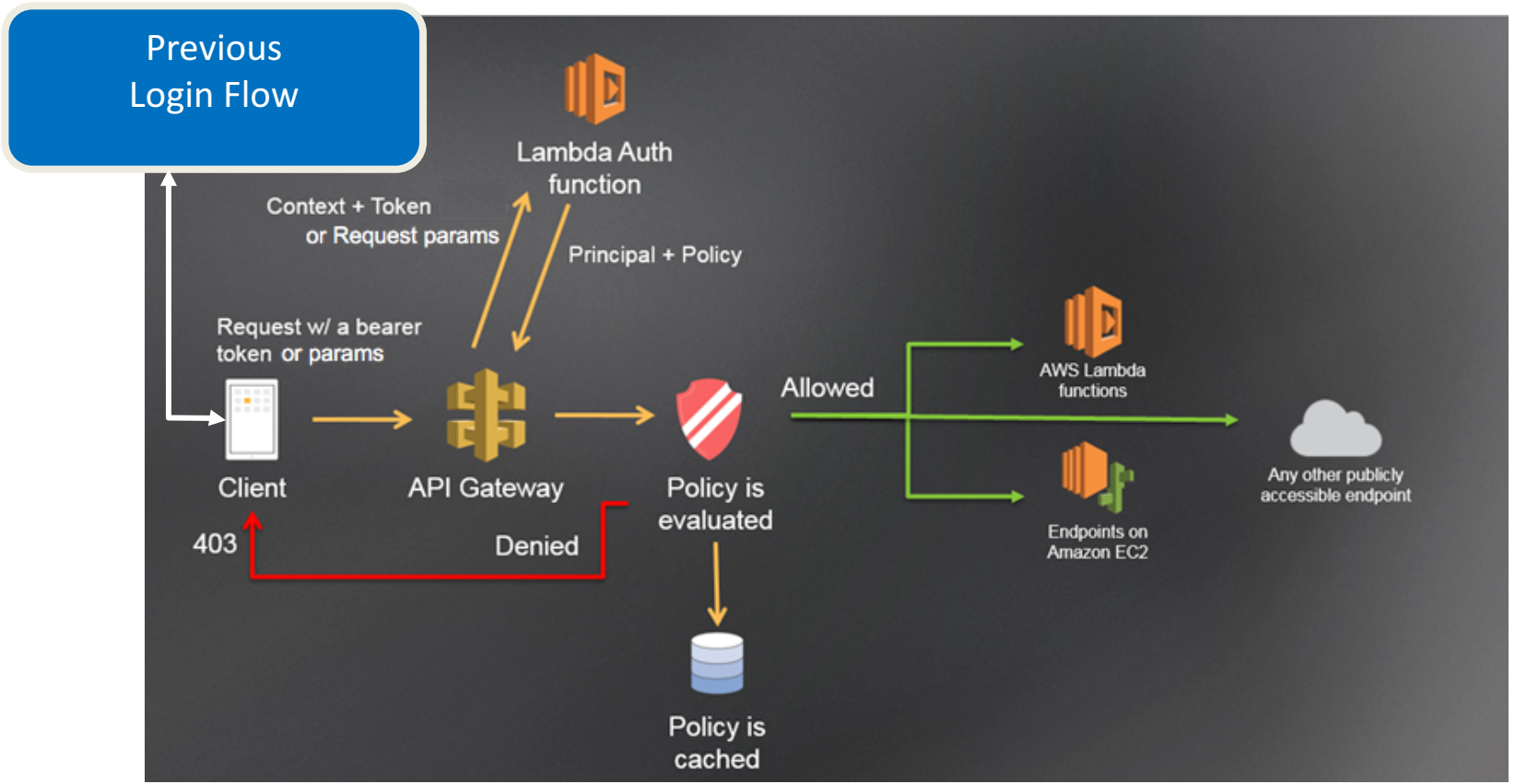
  - Redirect user to XXX
  - With Client App application ID.
  - And permissions app requests.
  - Code MAY have to call Resource Server to get a token to include in redirect URL.
- Browser redirected to XXX
  - Logon on to XXX prompt.
  - Followed by “do you grant permission to …”
  - Clicking button drives a redirect back to Client App. URL contains a temporary token.
- User/Browser
  - Redirected to Client App URL with token.
  - Client App calls XXX API
  - Obtains access token.
  - Returns to User.
- Client App can use access token on API calls.



Authorization

Custom Authorizer



Authorization

- 1st check occurs at perimeter in API GW Authorization
  - Based on (bearer token) JWT token
  - Is this role authorized to invoke this URL?
  - Implementation
    - Lambda function that …
    - Checks an authorization table (role, URL)
    - Or the rights are encoded in the token.
- All down stream microservices
  - Receive the JWT token and perform their own authorization decisions.
  - Run with a set of AWS roles and permissions that determine if AWS allows access, which may include user role.