Develop, publish, manage, and secure APIs with IBM API Connect V5.0

Student Exercise Guide

ERC 1.0

Table of Contents

Overview

This IBM API Connect (APIC) Proof of Technology (PoT) provides insight

to a complete solution which helps you:

- Quickly configure your API management solution and rapidly create new APIs.
- Manage your APIs with business-level controls by setting varying levels of consumption/entitlements and the ability to manage an application developer portal.
- Transform and grow your business with insights through detailed analytics with structured filtered searches and navigation capabilities.
- Acquire partners and innovative application developers, both internally and externally; through an attractive developer portal which can be tailored to your brand.
- Use leading standard industry practices to help secure, control, and optimize access to your APIs.
- Reduce resolution time with supplied operational monitoring and debugging capabilities and investments.

Introduction

To be a successful business and provide increased value to clients, employees, citizens, members or patients, one needs to continue to innovate while achieving cost optimization. To innovate while optimizing costs, you have an opportunity to expose key business services to business partners to drive new forms of collaboration, increase revenue opportunities, and provide higher value services to your customers. You can also expose your internal services to your internal developer communities, to drive application development consistency, reduce IT costs, and promote standard use of enterprise-approved services across your organization.

The expansion of the number of mobile devices, such as smart phones and tablets, as well as the growth of social media presents new and additional business opportunities to create new channels with customers and partners. To address these emerging opportunities, you require easy-to-use tools to define, assemble, secure, limit and monitor services, while providing a self-service experience for rapid developer on-boarding.

Business services are exposed with APIs. An API management solution is imperative to the success of externalizing the core services by providing easy assembly of new APIs, enabling security and different levels of service, providing management and insight to developers and business users, and socializing those APIs to developers, through communities and

portals. This enables organizations to participate in the API economy, with rapid, highly secure connections between API providers and API consumers.

This new release of IBM API Connect delivers a complete solution across the Create + Run + Secure + Manage set of capabilities that can be deployed on-premise in an enterprise's data center, or in the cloud. API Connect allows businesses as API providers to integrate the most important features that are necessary to enable the three most significant players in the API economy: application developers, business owners, and IT personnel.

API Connect provides capabilities for creating new applications and APIs, SDLC management, proxying, assembling, securing and scaling the APIs. This solution also provides detailed analytics and operational metrics to the business owner and a customizable developer portal to socialize the APIs and manage applications that can be used by the developers. The developer portal enables self-service registration and provides links to social communities.

Requirements

To complete the labs in this workbook, you'll need the following:

- A network attached workstation with sufficient memory (16GB min).
- VMware Workstation v9 for Windows or VMWare Fusion v8 for OSX to run the supplied student VMware images.
- Access to the API Connect POT Stack – which includes
- IBM DataPower Gateway Appliance (Physical or virtual) with Firmware 7.5.0.0 or greater
- IBM API Management Hypervisor, version 5 or higher.
- Developer Portal, version 5.0.0.0 or higher
- Primary host OS VM for the POT running on Xubuntu Linux

Student workstation username and password

The WU500 lab environment provides the *API Connect POT Stack* as a set of four virtual machines. To complete the lab exercises, open the Xubuntu Linux virtual machine with the following username and password:

- Username: `student`
- Password: `Passw0rd!`

Guidance

The following symbols appear in lab guides at places where additional guidance is available.

Icon	Purpose	Explanation
	Important!	This symbol calls attention to a particular step or command. For example, it might alert you to type a command carefully because it is case sensitive.
	Information	This symbol indicates information that might not be necessary to complete a step, but is helpful or good to know.
	Troubleshooting	This symbol indicates that you can fix a specific problem by completing the associated troubleshooting information.

Proceed to Lab 1 - Introduction to IBM API Connect

Lab 1 - Introduction to IBM API Connect

In this lab, you'll gain a high level understanding of the architecture, features, and development concepts related to the IBM API Connect (APIC) solution. Throughout the lab, you'll get a chance to use the APIC command line interface for creating LoopBack applications, the intuitive Web-based user interface, and explore the various aspects associated with solution's configuration of RESTful based services as well as their operation.

Lab 1 - Objective

In the following lab, you will learn:

- How to create a simple LoopBack application
- How to create a Representational State Transfer (REST) API definition
- How to test a REST API
- How to publish an API to the Developer Portal

Lab 1 - Case Study Used in This Tutorial

In this tutorial, you will create the default Hello World LoopBack application. We will look at the created artifacts to get a better understanding of what is created for you. The hello-world application is a simple RESTful service that holds a set of "notes" in memory. In this lab we may be creating a new RESTful service and API, but in future labs you'll be creating APIs with existing services.

Lab 1 - Before You Begin

For this lab, you will be using a VMWare image running Xubuntu that is pre-installed with the API Connect Developer Toolkit. Ensure the image is up and running before starting. If you have any questions, please consult your lab instructor.

Lab 1 - Student workstation username and

password

To start the lab exercises, open the Xubuntu Linux virtual machine with the following username and password:

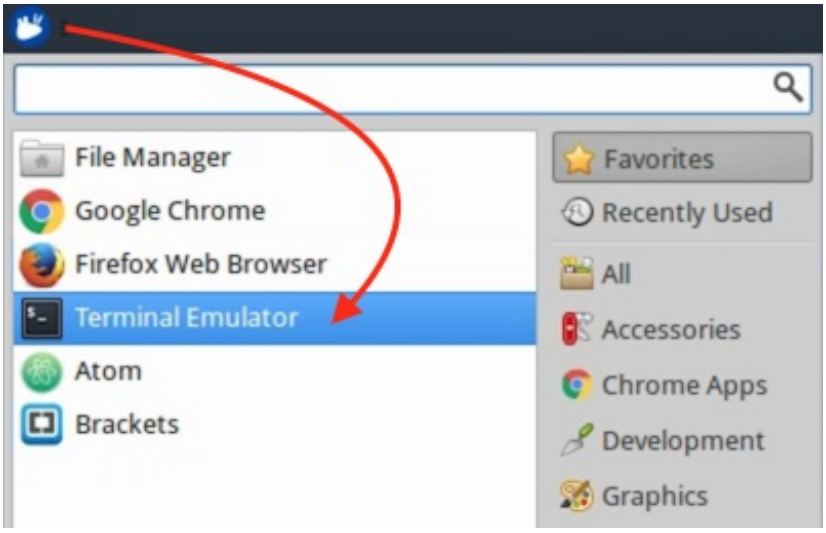
- Username: `student`
- Password: `Passw0rd!`

Lab 1 - Step by Step Lab Instructions

1.1 - Creating a `hello-world` Application

You will use the API Connect Developer Toolkit command line interface to create the initial application and explore the created artifacts.

1. Open the terminal emulator.



2. From the terminal command line type:

```
apic loopback hello-world
```

   This command starts the application generator, Yeoman, to help scaffold the new project. Just press enter for each of the three questions.

```
     _-----_
    |       |    .--------------------------.
    |--(o)--|    |  Let's create a LoopBack |
   `---------´   |       application!       |
    ( _´U`_ )    '--------------------------'
    /___A___\
     |  ~  |
   __'.___.'__
 ´   `  |° ´ Y `

? What's the name of your application? hello-world
? Enter name of the directory to contain the project: hel
lo-world
   create hello-world/
     info change the working directory to hello-world

? What kind of application do you have in mind? hello-wor
ld (A project containing
    a basic working example, including a memory database)
```

This creates an application named "hello-world" in a directory of the same name. The application is a basic Hello World application. You will see a lot of messages printed to the command line window. It is creating a few resources for you and installing the various node modules. Once the node modules are loaded you'll notice that the process creates swagger and product definitions for you. Finally, the process displays some hints about what to do next. Since we've been given such lovely suggestions about what to do next, we may as well follow the first one at least.

3. Change directories to the project directory:

```
cd hello-world
```

4. List the directory:

```
$ ls
client  common  definitions  node_modules  package.json
 server
```

If you're familiar with LoopBack or Node.js applications, some of the

directories may be familiar to you. If not, here is a description of some of what is created.

Directory or file	Description
client	If the application has a front end, this is where the HTML, CSS, JavaScript, etc would be located. For our sample application there is only a stubbed out README.md.
common	Files common to both the server and the client application.
common/models	This sub-directory contains all the model JSON and JavaScript files. By model we're referring to a data model.
common/models/note.js	Custom script for the note data model. This file contains the implementation of the methods defined by the model definition file.
common/models/note.json	The note model definition file. This file contains the definition of the properties and methods for this model.
definitions	This directory contains the definitions for the APIs and the product contained in this application.

definitions/hello-world-product.yaml	YAML file for the the hello-world product. Which includes default plans for testing locally.
definitions/hello-world.yaml	Swagger definition file for the hello-world API. Includes information about the REST paths and operations, schemas for data models, security requirements, etc.
node_modules	Directory containing all the required node modules for the default application.
package.json	Standard Node.js package specification. Most importantly it contains the application package dependencies.
server	This directory contains the Node.js application and configuration files. We'll not look at them all in this tutorial, but here are a few.
server/server.js	The main appication script for this application. **Note:** this is defined in the package.json file.
server/config.json	This file contains the global application settings, such as REST API root, hostname and port.

server/model-config.json	This file binds models to data sources and specifies whether a model is exposed over REST, among other things.
server/datasources.json	This file is the data source configuration file.

> 
>
> `*.md` files, such as that found in the client directory, are markdown files used for internal documentation.

1.2 - Launching the `hello-world` Application

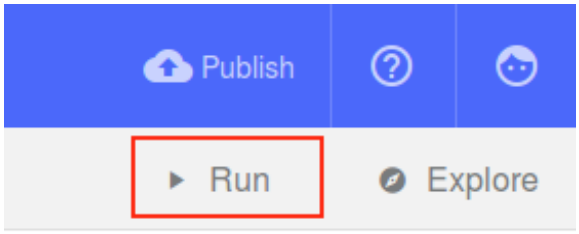
1. Now that we've explored what is created by the application generator, let's move on to the API Designer. From the command line:

   ```
   apic edit
   ```

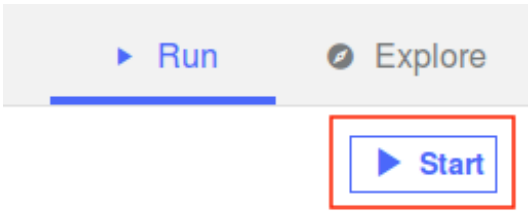
   Alternatively, if you'd rather not login to bluemix:

   ```
   SKIP_LOGIN=true apic edit
   ```

2. To test our hello-world services, click on the `run` button to open the application launcher.

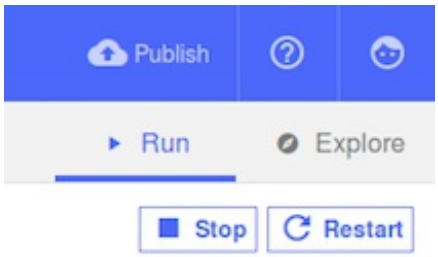
   

3. Next, click on the `start` button to launch the `hello-world` application.



4. Once start completes, you should see a screen similar to this:

5. Notice that once the application is up and running, stop and restart buttons will appear on the right side of the screen:

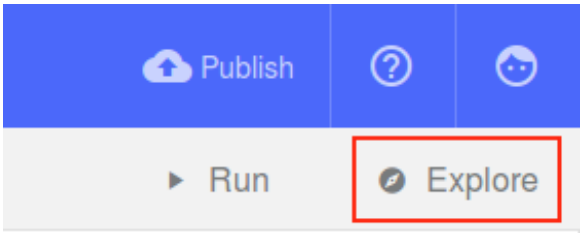


At this point we're ready to Explore and test our services.

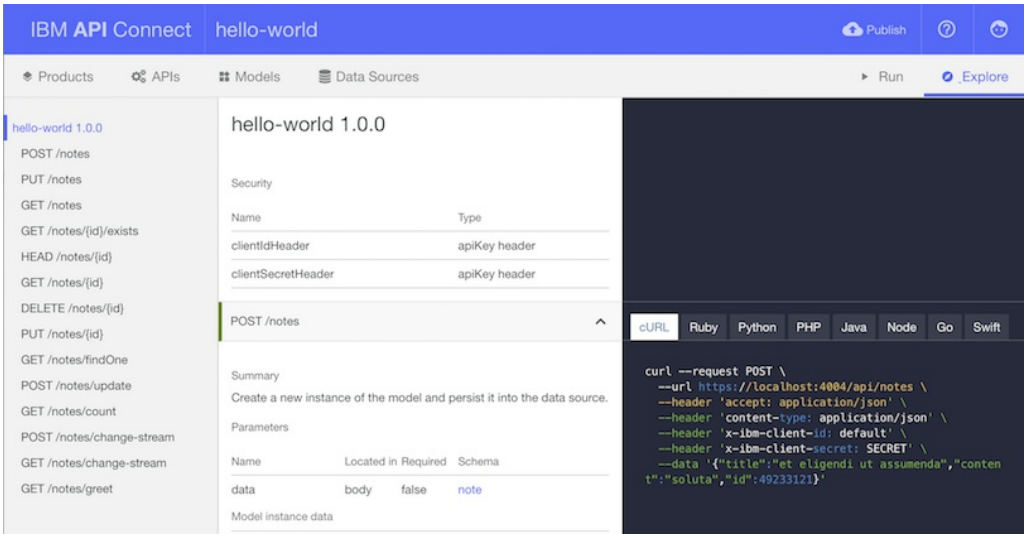
> 
>
> We used the web-based editor to launch the application. There's also a command provided with the API Connect Developer Toolkit that can be utilized from the terminal to launch the application: `apic start`

1.3 - Testing the `hello-world` Application

1. Click the `Explore` button to switch to the API Explorer view.



You will see all the exposed service paths displayed.



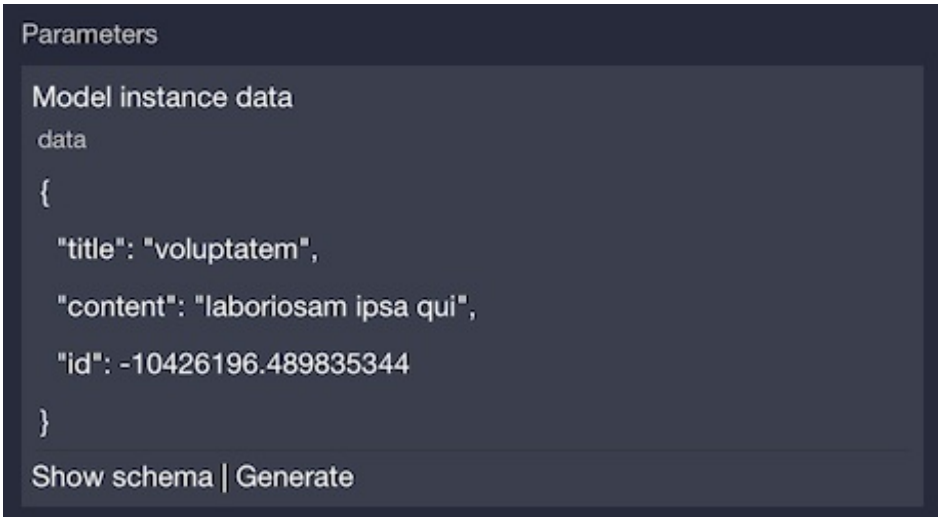
2. Now we're going to test the services using the GUI presented on the explore screen. You'll notice that on the left several REST services are defined for us. In particular, take a look `POST /notes` and `GET /notes`.

   If you're not familiar with GET and POST, they are HTTP methods (sometimes called verbs). The POST method is used for creation calls to the service. The GET method is used to retrieve information from a service. In this case, we see that both methods are used against the `/notes` path. So, POST will create a `note` and GET will retrieve all the `notes` that have been created.

3. Start by creating a couple of notes. Click the `POST /notes` link in the left column. The other columns will scroll so that you're looking at information and controls pertaining to the `POST /notes` service.

4. To test creation of a note, scroll down in the right hand column until the `Call operation` button is visible at the bottom. Just above the `Call operation` button you'll see a `Generate` link. This link will generate dummy data for you to create a test call to this service.

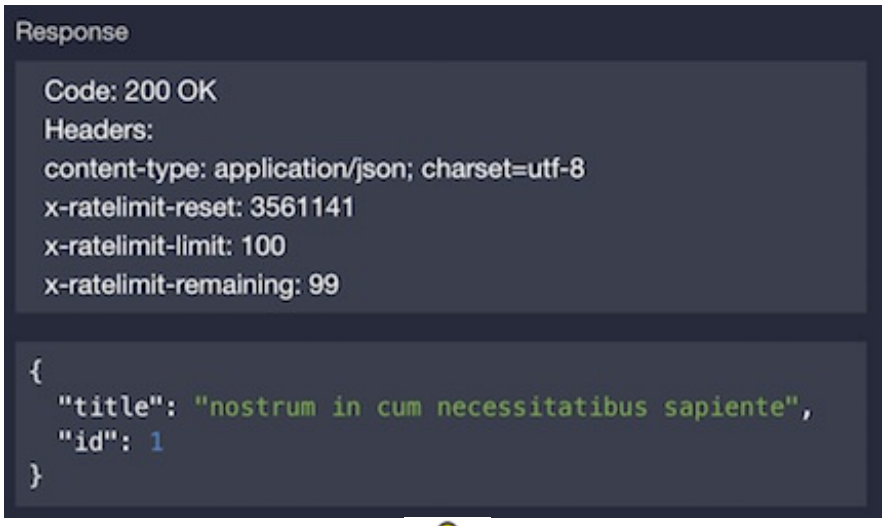
5. Press the `Generate` link to generate some sample data.



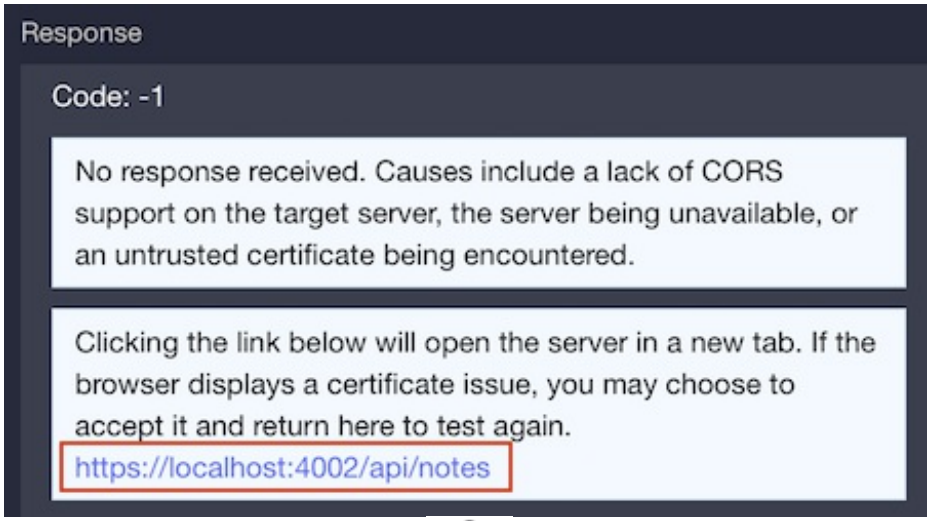
Your data will look different, but you're ready to test the service.

6. Go ahead and press the `Call operation` button and scroll down to the `Response` section to see the results.

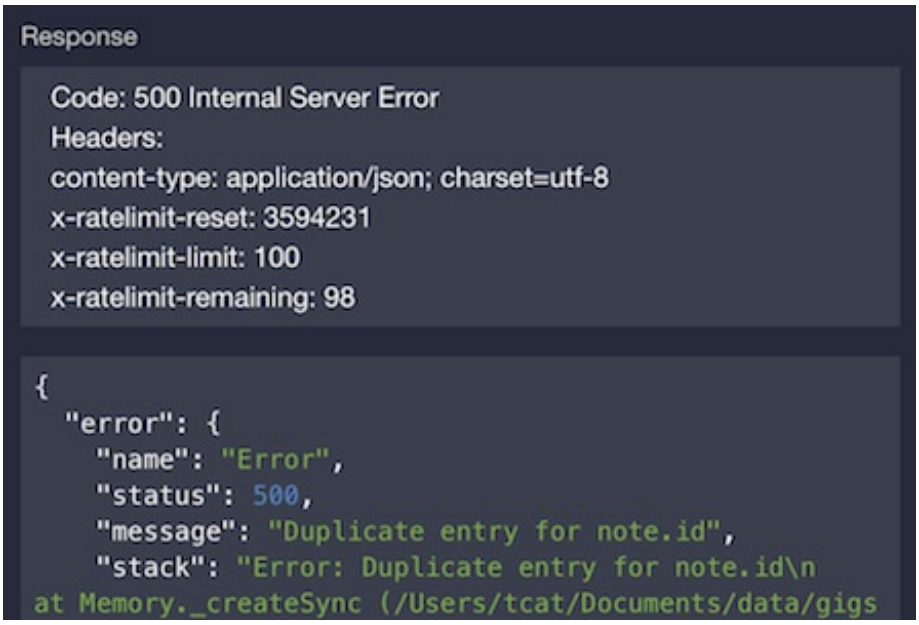
   In the results, you should see a `Code: 200 OK` which indicates that a new `note` was created. If you received a different response, see the troubleshooting steps below.



> You may see an error displayed that mentions a CORS issue. This has to do with certificates in your browser. Go ahead an click the given link to rectify this, accept any certificate, close the opened tab, and press the `Call operation` button again. Additionally, be sure not to skip step 5, as doing a `POST` operation without generating payload will cause an error.



> If you see a 500 error like the one below, make sure you press the `Generate` button before you press the `Call operation` button again. Otherwise, you're trying to create a duplicate note.

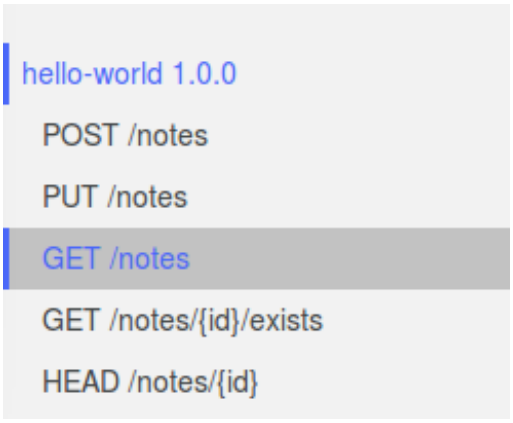


7. Once you have created one note, go ahead and create another one or two.

> It should be noted that you don't need to use the `Generate` link. You can type data directly into the `Parameters`. You can also use `Generate` to create a template for you to use and then change the generated parameters. You may also notice that not all the parameters are always generated. This is because only the `title` parameter is required. Try pressing `Generate` several times to get a feel for how it works.

8. Finally, let's test the `GET /notes` service. We should have two,

three, or more notes created at this point. In the left hand column click the `GET /notes` link.



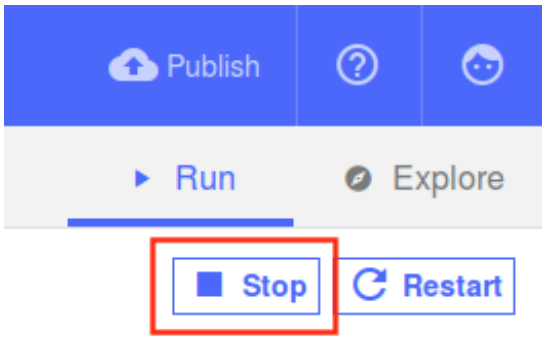
9. Scroll down to the `Call operation` button and press it. Then scroll down to the results.

You should see all the notes that you generated in the result set.

> 
>
> If you see an empty array, `[]`, as your result, then you've not successfully created any notes. This is also true if you stop the application and restart it. With the hello-world example, we're using an in-memory database which means that nothing is persisted to disk. So, it is lost when the server is stopped and restarted. Lab 2 will walk through how to connect to your application to a persistent data source.

10. At this point, we are done testing the app locally. Click on the `Run` button again to return to the application launch screen.

11. Click on the `Stop` button to stop the application.

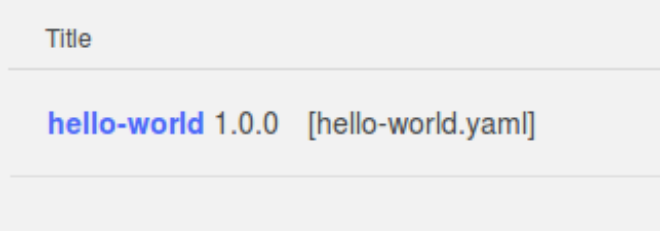


1.4 - Prepare the API for Publishing

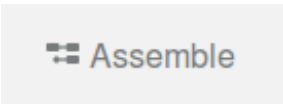
In the previous steps, you started the new application along with a MicroGateway locally on your developer work station. Our API Connect infrastructure uses DataPower as the gateway though, and not the MicroGateway. In order to publish the API definition to the API Connect servers, we'll need to change the Gateway Policies to utilize DataPower.

1. Click on the `APIs` option from the menu bar.

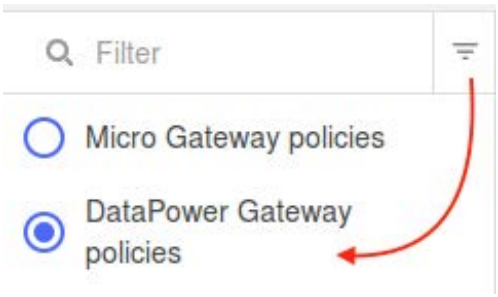
2. Click on the `hello-world` API from the list.



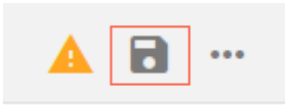
3. Click on the `Assemble` option from the API menu bar.



4. Click on the filter arrow to display the option to select the set of gateway policies and choose the option for `DataPower Gateway Policies`.

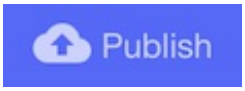


5. Click on the Save icon to save the API.



1.5 - Publishing the API to the Developer Portal

1. Click the `Publish` icon.

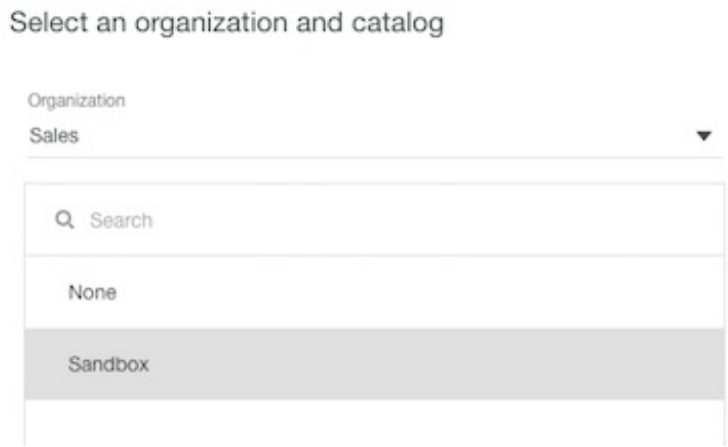


2. Select `Add and Manage Targets` from the menu.
3. Select `Add a different target`.

4. Provide connection information to sign into the IBM API Connect management server, then click the `Sign in` button:

> API Connect host address: `mgr.think.ibm`
>
> Username: `student@think.ibm`
>
> Password: `Passw0rd!`

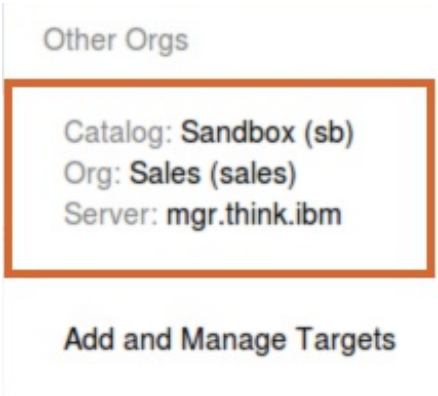
5. On the "Select an organization and catalog" screen, choose the `Sandbox` catalog and click the `Next` button.



6. On the "Select an App" screen, choose `None` application and click the `Save` button.

   Our offline toolkit environment is now configured to speak to the central management server.

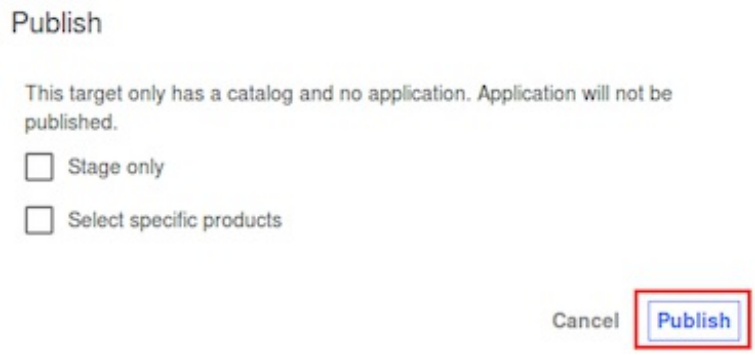
7. Click `Publish` button once more and select our target, indicated by the grey highlighting:



8. Here we have the opportunity to select what gets published. If we were working on multiple API products as part of this project, we could choose specific ones to publish.

Also, the option exists to only Stage the product. A Stage-only action implies that we'll push the configuration to the Management server, but not actually make it available for consumption yet. The reason for doing this may be because your user permissions only allow staging, or that a different group is in charge of publishing Products.

Click the `Publish` button:

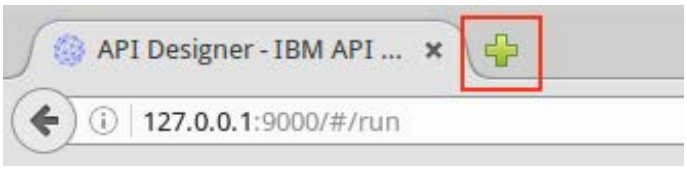


9. Click the `Publish` button to make the API available in the Developer Portal.

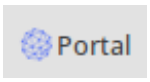
10. Wait a moment while the Product is published, a Success message will appear letting you know the step is complete:

1.6 - Browsing the API in the Developer Portal

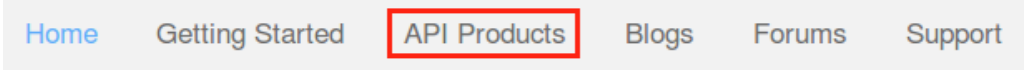
1. Open a new tab in the Firefox web browser by clicking on the new tab `+` button.



2. A bookmark is already saved for the `Portal`, click on the bookmark to open the portal home page.

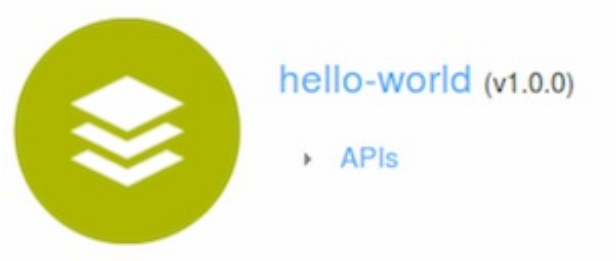


3. Click on the `API Products` link to see the available products published to the portal.



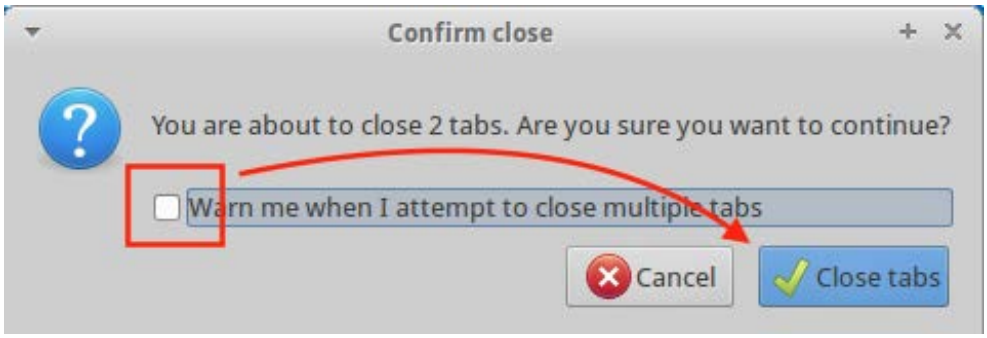
4. You should see the published `hello-world` API in the list of

products.




```
It should be noted that the hello-world application has more
to it than we've shown in this lab. You're encouraged to dig
in and discover the custom method that's implemented. In futu
re labs, we'll be doing more work in the Developer Portal. Fo
r instance we'll be customizing the portal theme, registering
 an application, subscribing to APIs and testing them from a
separate consumer application.
```

1. Close the `Firefox` web browser. If a warning is presented about closing multiple tabs, deselect the option to notify you in the future and click the `Close Tabs` button.



2. In the terminal, use the `control+c` keyboard command to quit the API Designer program.

Lab 1 - Conclusion

Congratulations! You have developed and published your first API!

In this lab you learned:

- How to create a simple LoopBack application
- How to create a Representational State Transfer (REST) API definition
- How to test a REST API
- How to publish an API to the Developer Portal

Proceed to Lab 2 - Create a LoopBack Application

Lab 2 - Create a Loopback Application

In this lab, you'll gain a high level understanding of the architecture, features and development concepts related to the IBM API Connect (APIC) solution. Throughout the lab, you'll get a chance to use the APIC command line interface for creating LoopBack applications, the intuitive web-based user interface, and explore the various aspects associated with the solution's configuration of RESTful based services as well as their operation.

At the end of this lab you will have created an new application which provides access to product inventory via a set of API resource operations.

Lab 2 - Objective

In the following lab, you will learn:

- How to create a multi-model Loopback application
- How to create a Representational State Transfer (REST) API definition using IBM Connect API Designer
- How to create a Representational State Transfer (REST) API definition using IBM Connect Command Line
- How to use the Loopback MySQL Connector
- How to use the Loopback MongodDB Connector
- How to test a REST API
- How to create relationships between models

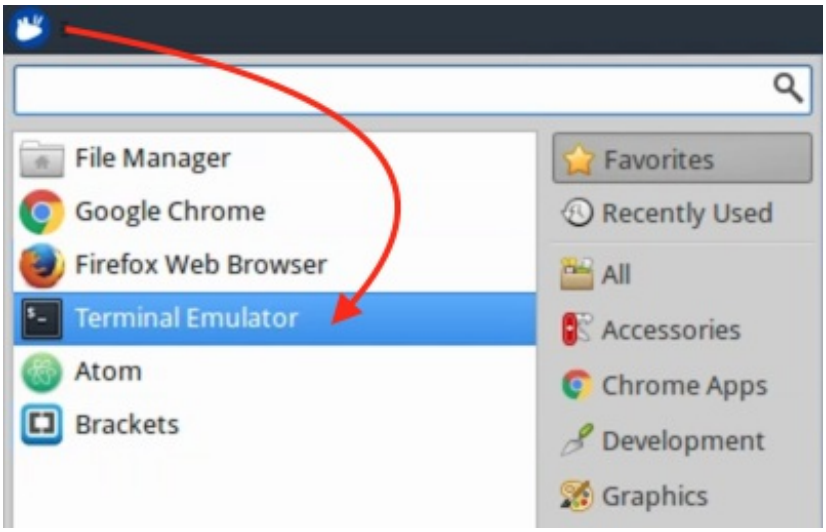
Lab 2 - Case Study Used in this Tutorial

ThinkIBM is a company which sells historical and rare IBM machinery. **ThinkIBM** wants to create easier acess to their inventory database through a collection of APIs. Additionally, the application should also support the ability for buyers to leave reviews. As an application developer, you will create the application that provides access to product inventory.

Lab 2 - Step by Step Lab Instructions

2.1 - Create a Working Directory

1. Return to the `Terminal Emulator` by selecting it from the task bar, or if you closed it previously you can re-launch it from the favorites menu.



2. Create a project directory in the student's home folder called ThinkIBM. In the terminal, type:

```
mkdir ~/ThinkIBM
```

3. Change to the new `ThinkIBM` directory by typing:

```
cd ~/ThinkIBM
```

2.2 - Create the Inventory App

To create your Inventory Application you will use LoopBack technology that comes with the API Connect Developer Toolkit. LoopBack enables you to quickly compose scalable APIs, runs on top of the Express web framework and conforms to the Swagger 2.0 specification. LoopBack is a highly-extensible, open-source Node.js framework that enables you to:

- Create dynamic end-to-end REST APIs with little or no coding.
- Access data from Relational and NoSQL Databases, SOAP and other REST APIs.

- Incorporates model relationships and access controls for complex APIs.

LoopBack consists of:

- A library of Node.js modules.
- Yeoman generators for scaffolding applications.

1. From the command line terminal, type the following command to create the `inventory` application:

   ```
   apic loopback inventory
   ```

2. You will be asked to name your application.

   ```
        _-----_
       |       |    .--------------------------.
       |--(o)--|    |  Let's create a LoopBack |
      `---------´   |       application!       |
       ( _´U`_ )    '--------------------------'
       /___A___\
        |  ~  |
      __'.___.'__
    ´   `  |° ´ Y `

   ? What's the name of your application? (inventory)
   ```

   Since you already supplied the name of the application as part of the previous step you can keep the default by pressing the `Enter` or `Return` key.

3. Next you will be asked to supply the name of the directory where the application will be created.

LoopBack will default the project directory name to the name of the application.

Press the `Enter` or `Return` key to accept the default value of `inventory`.

1. Next you will be asked to select the type of application.

   Use the arrow keys to select the `empty-server` option and press the `Enter` or `Return` key.

```
> empty-server (An empty LoopBack API, without any confi
gured models or datasources)
```

2. At this point, the project builder will install the core dependencies for our Node.js application.

Please wait until you see the `Next steps:` section.

1. Change to the newly created `inventory` directory:

```
cd inventory
```

2.3 - Create a Data Source Connector to MySQL

The datasource is what allows the API to communicate with the backend data repository. In this case we will be using MySQL to store the inventory item information.

There are two parts to this. First is the definition of how to connect to the backend system. They second is downloading the actual loopback connector for MySQL. The connector is akin to an ODBC or JDBC connector.

1. In your terminal ensure that you are in the `~/ThinkIBM/inventory` directory. You prompt should be `student@xubuntu-vm:~/ThinkIBM/inventory`.

   Optionally, you can type `pwd` in your terminal and it should return `/home/student/ThinkIBM/inventory`.

2. In your terminal, type:

```
apic create --type datasource
```

   The terminal will bring up the configuration wizard for our new datasource. The configuration wizard will prompt you with a series of questions. Some questions require text input, others offer a selectable menu of pre-defined choices.

Answer the questions with the following data:

```
? Enter the data-source name:  mysql-connection
? Select the connector for mysql-connection:
    > MySQL (supported by StrongLoop)
? host:  mysql.think.ibm
? port:  3306
? user:  student
? password:  Passw0rd!
? database:  think
? Install loopback-connector-mysql@^2.2 (Y/n)  Y
```

By typing Y (Yes) to the question `Install loopback-connector-mysql@^2.2`, the MySQL Connector will be downloaded and saved to your project automatically. This will create a connection profile in the `~/ThinkIBM/inventory/server/datasources.json` file. It is effectively the same as running the following to install the connector:

`npm install loopback-connector-mysql --save`

For more information on the LoopBack Connector for MySQL, see:

https://www.npmjs.com/package/loopback-connector-mysql

2.4 - Launch the API Connect Designer

1. Ensure you're in the `~/ThinkIBM/inventory` directory, then type the following command:

```
apic edit
```

The Firefox web browser will launch and automatically load the designer screen.

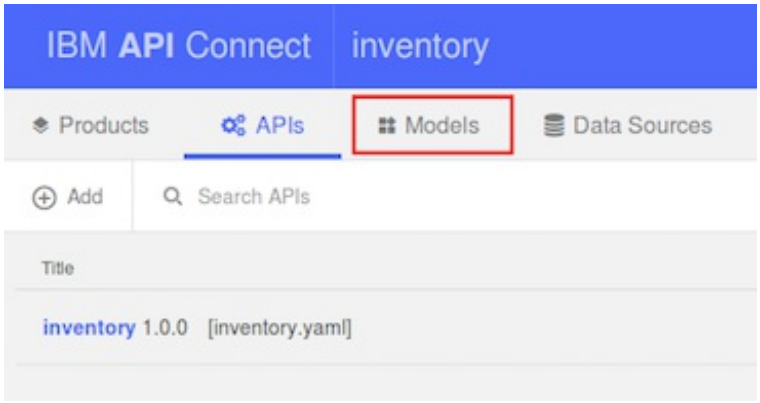
2. Now that the API Designer is running, you should see the start page with your `inventory` API.

> This API was created as a result of the generation of our LoopBack application.

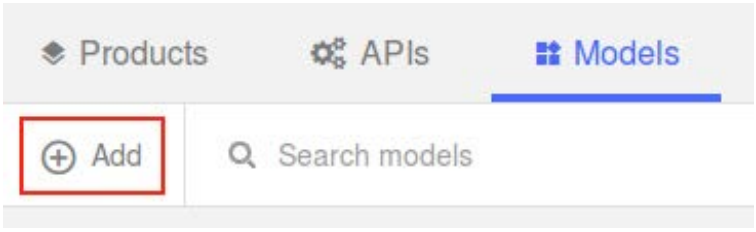
2.5 - Create a Model for the Inventory Items

In this section, you will define the `item` data model for our `inventory` API and attach it to the MySQL data source. LoopBack is a data model driven framework. The properties of the data model will become the JSON elements of the API request and response payloads.

1. Click the `Models` tab.

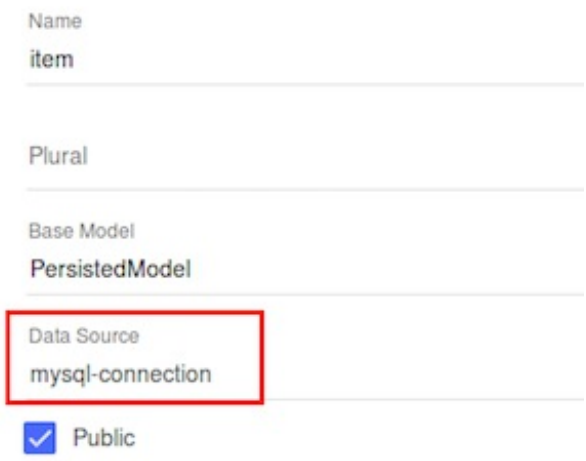


2. Click the `+ Add` button.



3. In the New LoopBack Model dialog, enter `item` as the model name, then click the `New` button.

4. When the Model edit page for the item model displays, select the `my sql-connection` Data Source:



2.6 - Create Properties for the `item` Model

The item table in the MySQL database has 6 columns that will need to mapped as well. To start creating properties for the item model:

1. Click the `+` button in the **Properties** section.
2. The `item` data model consists of six properties. Use the data below to add each of the properties:

   > Required: `yes`
   >
   > Property Name: `name`
   >
   > Type: `string`
   >
   > Description: `item name`

   > Required: `yes`
   >
   > Property Name: `description`
   >
   > Type: `string`
   >
   > Description: `item description`

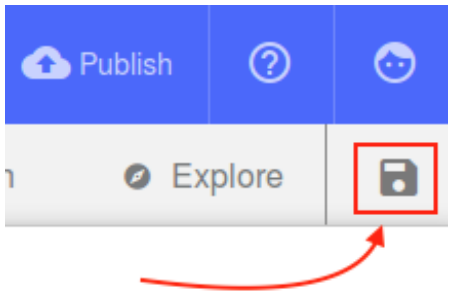
   > Required: `yes`
   >
   > Property Name: `img`
   >
   > Type: `string`
   >
   > Description: `location of item image`

> Required: `yes`
>
> Property Name: `img_alt`
>
> Type: `string`
>
> Description: `item image title`

> Required: `yes`
>
> Property Name: `price`
>
> Type: `number`
>
> Description: `item price`

> Required: `no`
>
> Property Name: `rating`
>
> Type: `number`
>
> Description: `item rating`

3. Scroll to the top of the page and click the `Save` button to save the data model.

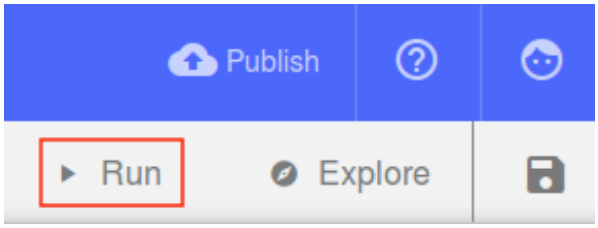


4. Click the `All Models` link to return to the main API Designer page.

2.7 - Verify API

To confirm that the API has been correctly mapped and can interface with the MySQL datasource, you will run the server and test the API.

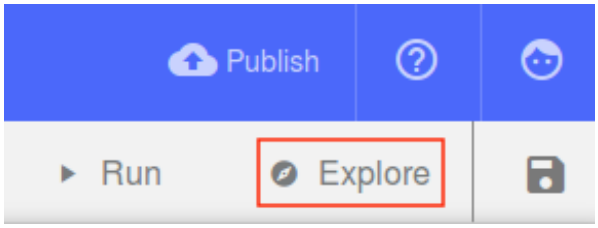
1. Click the `Run` button to open the Run page.



2. Click the `Start` button to start the `inventory` LoopBack application. In addition to the application, a MicroGateway will also be started.

3. Wait a moment while the servers are started. Proceed to the next step when you see the following:

4. Click the `Explore` button to review your APIs.



5. On the left side of the page, notice the list of paths for the `inventory` API. These are the paths and operations that were automatically created for you by the LoopBack framework simply by adding the `item` data model. The operations allow users the ability to create, update, delete and query the data model from the connected (MySQL) data source.

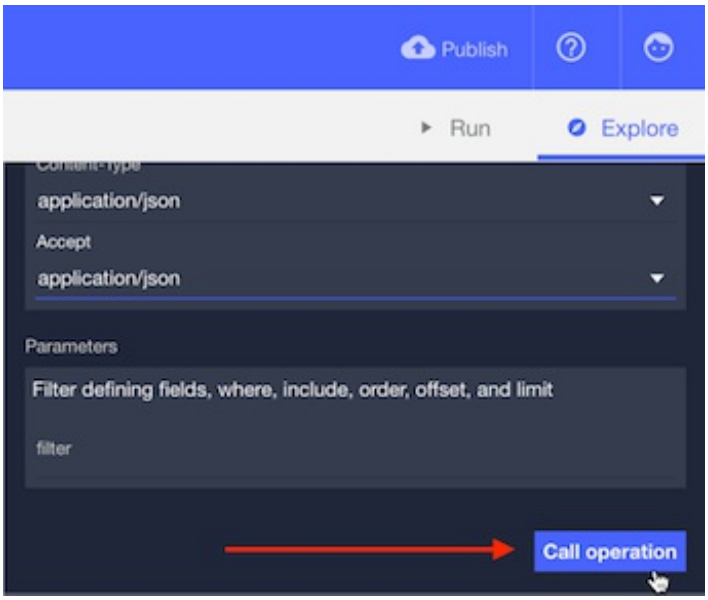
6. Click the `GET /items` operation.

7. By clicking the `GET /items` operation, your screen will auto-focus to the correct location in the window. In the center pane you will see a summary of the operation, as well as optional parameters and responses.

On the right side you will see sample code for executing the API in various programming languages and tools such as cURL, Ruby, Python, PHP, Java, Node, Go, and Swift.

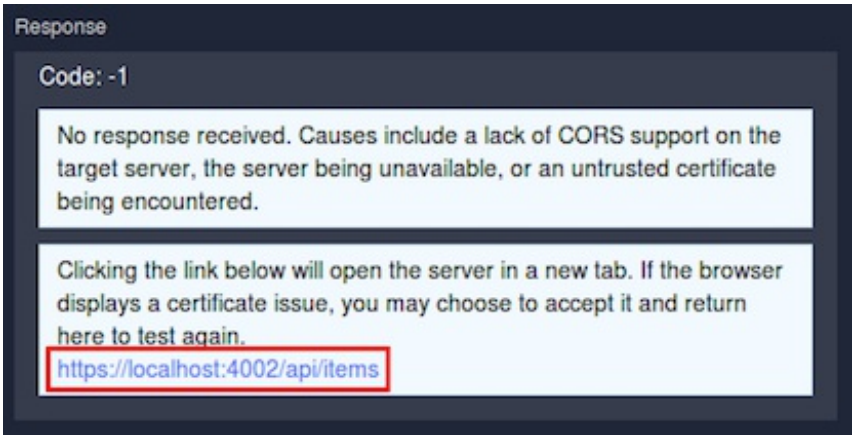
In addition to the sample code, if you look further down the page you will see an example response, URL, API identification information, and API parameters.

8. Scroll down slowly to locate the `Call operation` button.



9. Click the `Call operation` button to invoke the API.

> 
>
> The first time you invoke the API, you may receive an error. The error occurs because the browser does not trust the self-signed certificate from the MicroGateway. To resolve the error, click on the link in the response window and accept the certificate warning.



10. Once complete, return to the API explorer and click on the `Call ope`

`ration` button again.

11. Scroll down to see the `Request` and `Response` headers.

```
Request
GET https://localhost:4002/inventory/items
APIm-Debug: true
Content-Type: application/json
Accept: application/json
X-IBM-Client-Id: default
X-IBM-Client-Secret: SECRET
```

```
Response
Code: 200 OK
Headers:
content-type: application/json; charset=utf-8
x-ratelimit-limit: 100
x-ratelimit-remaining: 99
x-ratelimit-reset: 3599999
```

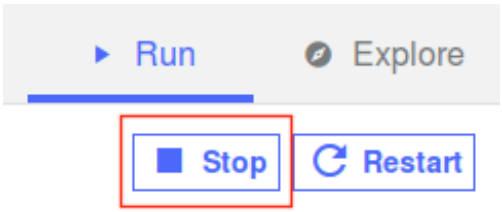
12. Scroll further and the payload returned from the GET request is displayed.


```
[
    {
        "name": "Dayton Meat Chopper",
        "description": "Punched-card tabulating machines
 and time clocks...",
        "img": "images/items/meat-chopper.jpg",
        "img_alt": "Dayton Meat Chopper",
        "price": 4599.99,
        "rating": 0,
        "id": 5
    },
    ...
]
```


13. Test the `GET /items/count` operation by following the same process above. You should receive a count of 12 inventory items.

```
{
  "count": 12
}
```

14. Return to the `Run` screen and click the `Stop` button to stop the Inventory application and MicroGateway.



2.8 - Create a MongoDB Data Source

So far, we have created a LoopBack application which provides APIs around our inventory items stored in a MySQL database.

In the next section, you will create the data model for item reviews which will use MongoDB to store the review data.

First you must create a data source entry for the MongoDB.

1. Click the `x` button on the Firefox tab or window to close the browser.

2. Select the `Terminal Emulator` from the taskbar to open the command line.

3. Even though we closed the browser, the API Designer application itself is still running.

   Hold the `control` key and press the `c` key to end the API Designer session:

   ```
   control+c
   ```

   This will return you to the command line prompt.

4. Type the following command to create a data source for MongoDB:

```
apic create --type datasource
```

5. The terminal will bring up the configuration wizard for our new datasource. The configuration wizard will prompt you with a series of questions. Some questions require text input, others offer a selectable menu of pre-defined choices.

   Answer the questions with the following data:

```
? Enter the data-source name:  mongodb-connection
? Select the connector for mongodb-connection:
    > MongoDB (supported by StrongLoop)
? host: mongo.think.ibm
? port: 27017
? user:
? password:
? database: think
? Install loopback-connector-mongodb@^1.4 (Y/n) Y
```

By typing Y (Yes) to the question Install loopback-connector-mongo@^1.4, the MongoDB Connector will be downloaded and saved to your project automatically. This will create a connection profile in the `~/ThinkIBM/inventory/server/datasources.json` file.

It is effectively the same as running the following to install the connector

`npm install loopback-connector-mongodb --save`

For more information on the LoopBack Connector for MongoDB, see:

https://www.npmjs.com/package/loopback-connector-mongodb

2.9 - Create Model for Reviews

The `review` data model will be used to store item reviews left by buyers. The reviews will be stored in a MongoDB.

In the earlier steps, you used the API Designer User Experience to create

a data model. This time you will use the command line to create the `review` model.

1. Type the following command to create the `review` data model:

```
apic create --type model
```

2. Enter the properties for the `review` model:

> 
>
> You will **not** expose the review mode as a REST API. This is because you create a relationship between item and review later that will create the REST APIs you will use.

```
? Enter the model name:  review
? Select the data-source to attach review to:
    > mongodb-connecton (mongodb)
? Select models base class:
    > PersistedModel
? Expose review via the REST API? (Y/n):  N
? Custom plural form (used to build REST URL):
? Common model or server only?
    > common
```

3. Continue using the wizard to add properties for the `review` model:

4. The first property is the `date` property:

```
Enter an empty property name when done.
? Property name: date
? Property type:
    > date
?Required? Y
?Default value [leave blank for none]: <leave blank>
```

5. Next add the `reviewer_name` property:

```
Let's add another review property.
Enter an empty property name when done.
? Property name: reviewer_name
? Property type:
    > string
? Required? N
? Default value [leave blank for none]: <leave blank>
```

6. Next add the `reviewer_email` property:

```
Let's add another review property.
Enter an empty property name when done.
? Property name: reviewer_email
? Property type:
    > string
? Required? N
? Default value [leave blank for none]: <leave blank>
```

7. Next add the `comment` property:

```
Let's add another review property.
Enter an empty property name when done.
? Property name: comment
? Property type:
    > string
? Required? N
? Default value [leave blank for none]: <leave blank>
```

8. Finally add a property for the item `rating`:

```
Let's add another review property.
Enter an empty property name when done.
? Property name: rating
? Property type:
    > number
? Required? Y
? Default value [leave blank for none]: <leave blank>
```

9. To close the wizard, the next time it asks you to add another review proporty, just press `Enter` or `Return` to exit.

2.10 - Create a Relationship Between the `item` and `review` Data Models

The next step in this lab is to create a relationship between the `item` model and the `review` model. Even though the models reference entities in entirely different databases, API Connect provides a way to create a logical relationship between them. This logical relationship is then exposed as additional operations for the item model.

1. In the terminal session, type the following command:

```
apic loopback:relation
```

2. Enter the details for the relationship as follows:

```
? Select the model to create the relationship from:
    > item
? Relation type:
    > has many
? Choose a model to create a relationship with:
    > review
? Enter the property name for the relation:  reviews
? Optionally enter a custom foreign key: <leave blank>
? Require a through model? No
```

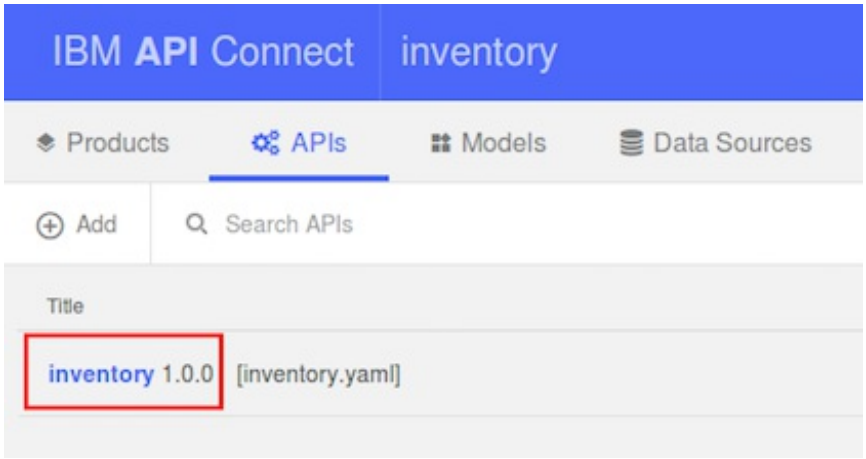
2.11 - Verify the Relationship

To verify that the relationship has been created, you will open the API Connect Designer and view the operations on the Explore page.

1. In the terminal session, type the following command to launch the API Connect Designer window:

```
apic edit
```

2. Click on the `inventory` link from the APIs tab.



3. Scroll down to the `Paths` section of the API definition.

   Notice how three new API paths have been created which allow access to item revew data:

4. Click the `x` button on the Firefox tab or window to close the browser.

5. Select the `Terminal Emulator` from the taskbar to open the command line.

6. Even though we closed the browser, the API Designer application itself is still running.

   Hold the `control` key and press the `c` key to end the API Designer session:

   ```
   control+c
   ```

   This will return you to the command line prompt.

Lab 2 - Validation

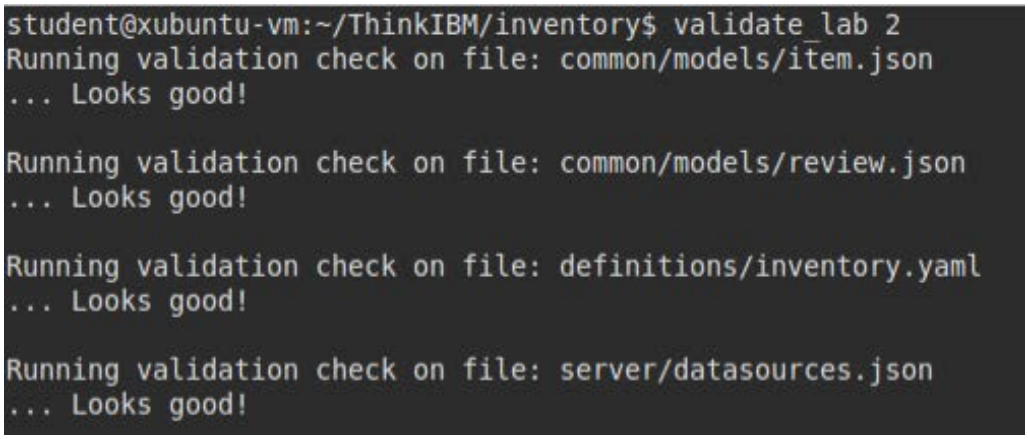
Using both the CLI and the API Designer, a lot of files have been created

and updated. Before moving on to the next lab, a simple script has been provided for you which will validate your source files against those of a completed lab. These next steps will help ensure that easily made typing errors do not cause problems down the line.

1. From the `Terminal Emulator`, type:

```
validate_lab 2
```

2. The script will execute a series `diff` commands against specific files in your project folder (`~/ThinkIBM/inventory`)



3. If your output looks the same as the image above, then everything matches up and you may continue to lab 3. However, if a discrepency was found with one of the files, we can look a little close to see if it is something that will cause a problem.

4. In the example below, an issue was found in the `server/datasources.json` file.

```
Running validation check on file: server/datasources.jso
n
12c12
<     "host": "mongo.thinkibm",
---
>     "host": "mongo.think.ibm",
```

5. The first line specifies the line numbers of the two files where the differences occur. In this example that comes out to line 12 of both files.

6. Next, you will notice a block that specifies what the differences were.

   Any lines that begin with a `<` sign belong to your source files.

   And, any lines that begin with a `>` sign belong to files from our correct sources.

7. In the example provided, the host for the MongoDB server was mistyped. This will cause a problem later when your application attempts to connect to the incorrect host address.

8. For this lab, there are four key files that need validation.

   - common/models/item.json **and** review.json
     - Key elements in these file are the element names and data types.
   - definitions/inventory.yaml
     - Discrepencies in the item.json or review.json files will show up here in the data model definitions.
   - server/datasources.json
     - Most elements in this file must be accurate.

9. If you have differences in one or more of your files, the good news is they are easy to fix. Run the following command to merge the corrected changes into your source files:

   ```
   merge_lab 2
   ```

Lab 2 - Conclusion

Congratulations! In this lab you learned:

- How to create a multi-model LoopBack application
- How to create a Representational State Transfer (REST) API definition using IBM Connect API Designer
- How to create a Representational State Transfer (REST) API definition using IBM Connect Command Line
- How to use the LoopBack MySQL Connector
- How to use the LoopBack MongodDB Connector
- How to test a REST API
- How to create relationships between models

Lab 3 will build on what you have already created to enable processing hooks and publish the APIs to the API Manager.

Proceed to Lab 3 - Customize and Deploy an Application

Lab 3 - Customize and Deploy the Inventory Application

In this lab, you will add capabilities into the LoopBack application which was created in Lab 2. You will add custom javascript code which will alter the default behavior of the application. Once your edits are complete, you will package the application and publish it to a WebSphere Liberty runtime collective where it will be managed and enforced by the API Connect solution.

Lab 3 - Objective

In the following lab, you will learn:

- About LoopBack remote hooks
- How to create a remote hook
- How to publish a LoopBack application to a Liberty runtime collective

Lab 3 - Case Study Used in this Tutorial

At this point, you have: created a basic application template, added an `item` data model backed by a MySQL datasource, added a `review` data model backed by a MongoDB data source, added a relationship between the `item` and `review` models.

In this tutorial you will extend the `inventory` application by adding a remote hook. Remote hooks allow you to provide pre- and post-processing to an API call, such as adding additional header information to a remote service or calculating a value, which is what you will do in this lab.

Then, you will publish your LoopBack Inventory application to the Liberty Collective. Making it generally available for consumption.

For more information on Liberty Collectives see here:

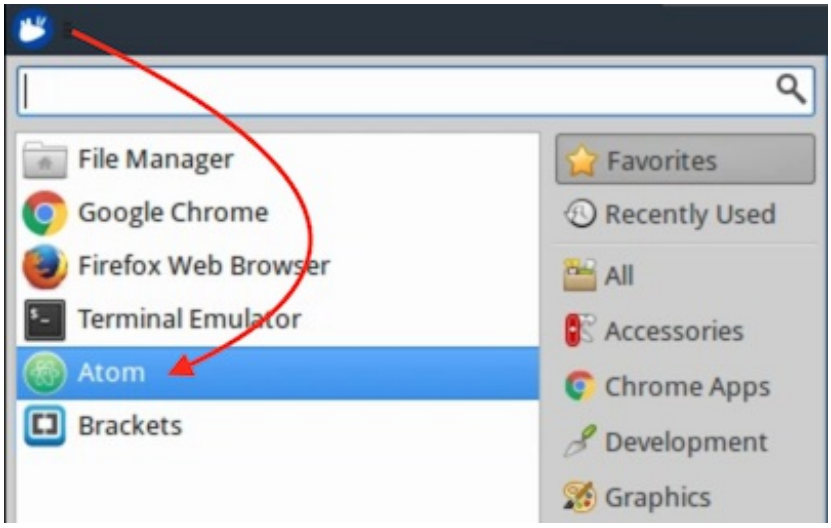
https://www.ibm.com/support/knowledgecenter/SSD28V_8.5.5/com.ibm.websphere.wlp.nd.doc/ae/cwlp_collective_arch.html

Lab 3 - Step by Step Lab Instructions

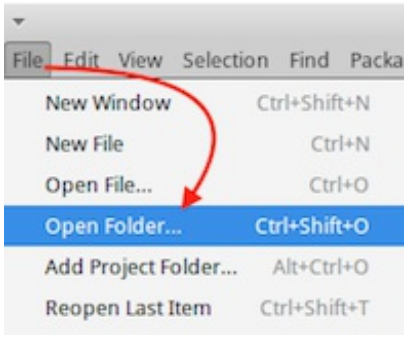
Lab 3.1 - Edit the Application Configuration

Before publishing the API for our application, the configuration file that was generated for you needs to be edited. By default, the generated application uses a base path of `/api`. In the next few steps, you will modify the base path to listen on `/inventory`.

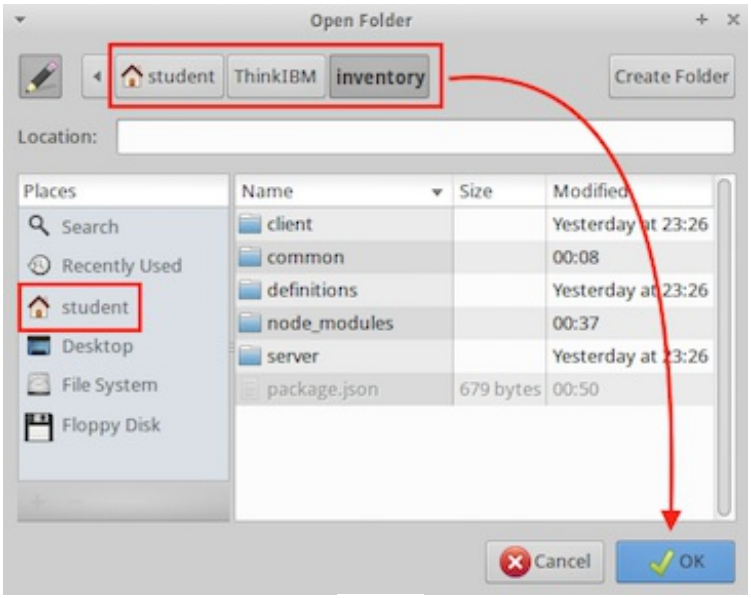
1. Click on the application favorites menu and open the `Atom` text editor.



2. From the `Atom` menu, click on `File > Open Folder`.

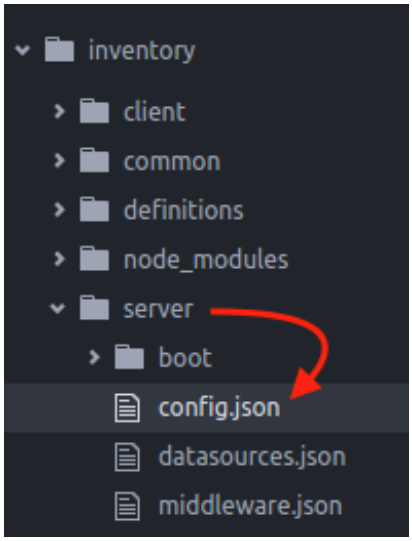


3. Click on the `student` location from the Places menu, then navigate to the `ThinkIBM > inventory` folder and click the `OK` button.



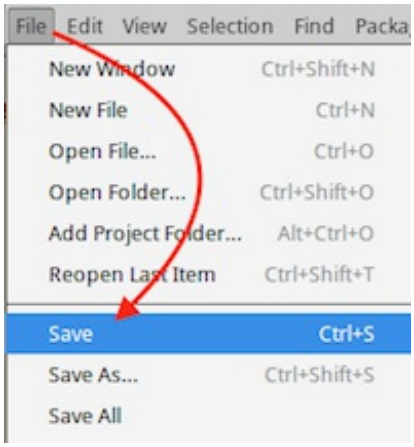
> LoopBack applications use a series of configuration files which drive the application runtime. For more information about these files, review the table in Lab 1.

4. From the folder tree menu, expand the `server` folder and click on the `config.json` file to view the source.



5. Edit line 2 of the `config.json` file. Change `/api` to `/inventory`.

6. Use the `Atom` file menu to save the changes.



Lab 3.2 - Create a Remote Hook

Remote hooks are custom javascript code that execute before or after calling an operation on a LoopBack application.

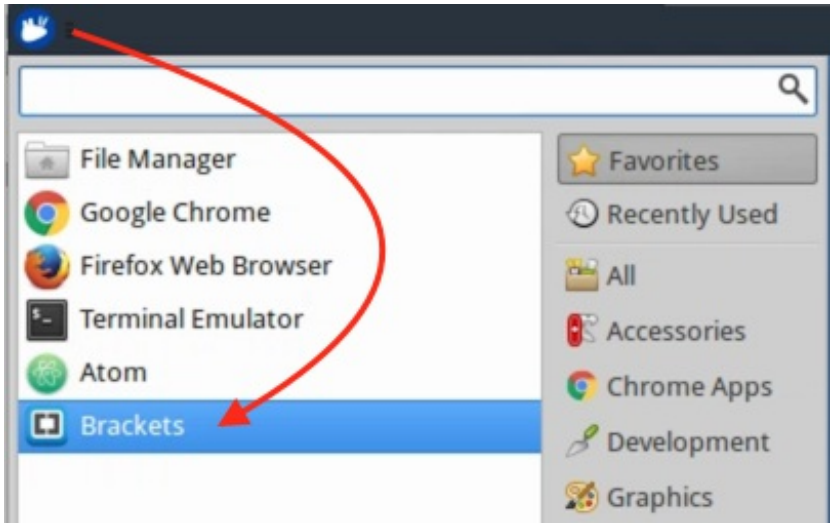
For more information on Remote Hooks please see:

https://docs.strongloop.com/display/public/LB/Remote+hooks

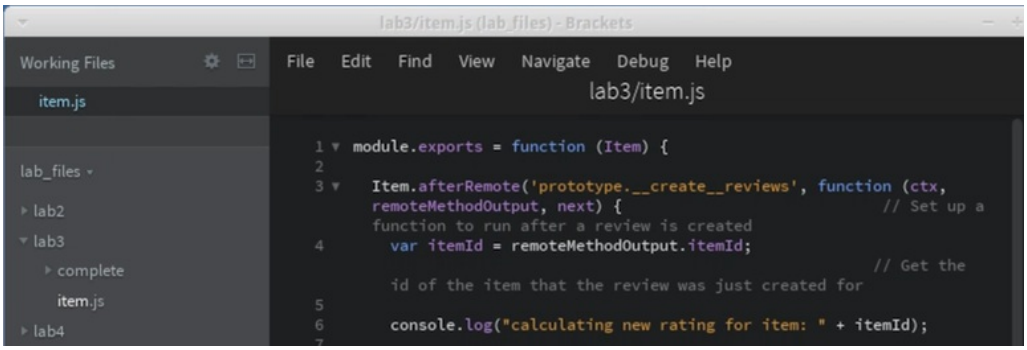
1. In the `Atom` editor, expand the directory structure for the `common/models` location and select the `item.js` file.

2. You are going to update this file to include a new remote hook function which will run *after* a new review is submitted for an item. The function will take an average of all reviews for that item, then update the item rating in the MySQL data source.

3. To avoid potential for typing errors, a sample file is available for you to copy. Use the favorites menu to open the `Brackets` application.



4. Expand the `lab_files/lab3` folder and select the example `item.js` file.



5. Use the menu option for `Selection > Select All` to highlight all of the text.

6. Use the menu option for `Edit > Copy` to copy the file contents your clipboard.

7. Return to the `Atom` application. **Remove** everything in the `item.js` file. Then paste (`control+v` or `Edit > Paste`) the contents of your clipboard to update the file.

item.js

```
module.exports = function (Item) {

  Item.afterRemote('prototype.__create__reviews', function (ctx, remoteMethodOutput, next) {
    var itemId = remoteMethodOutput.itemId;

    console.log("calculating new rating for item: " + itemId);

    var searchQuery = {include: {relation: 'reviews'}};

    Item.findById(itemId, searchQuery, function findItemReviewRatings(err, findResult) {
      var reviewArray = findResult.reviews();
      var reviewCount = reviewArray.length;
      var ratingSum = 0;

      for (var i = 0; i < reviewCount; i++) {
        ratingSum += reviewArray[i].rating;
      }

      var updatedRating = Math.round((ratingSum / reviewCount) * 100) / 100;

      console.log("new calculated rating: " + updatedRating);

      findResult.updateAttribute("rating", updatedRating, function (err) {
        if (!err) {
          console.log("item rating successfully updated");
        } else {
          console.log("error updating rating for item: " + err);
        }
      });

      next();
    });

  });
```

```
module.exports = function (Item) {
  Item.afterRemote('prototype.__create__reviews', funct
ion (ctx, remoteMethodOutput, next) {
    var itemId = remoteMethodOutput.itemId;

    console.log("calculating new rating for item: " + i
temId);

    var searchQuery = {include: {relation: 'reviews'}};

    Item.findById(itemId, searchQuery, function findIte
mReviewRatings(err, findResult) {
      var reviewArray = findResult.reviews();
      var reviewCount = reviewArray.length;
      var ratingSum = 0;

      for (var i = 0; i < reviewCount; i++) {
        ratingSum += reviewArray[i].rating;
      }

      var updatedRating = Math.round((ratingSum / revie
wCount) * 100) / 100;

      console.log("new calculated rating: " + updatedRa
ting);

      findResult.updateAttribute("rating", updatedRating
, function (err) {
        if (!err) {
          console.log("item rating successfully updated"
);
        } else {
          console.log("error updating rating for item: "
 + err);
        }
      });
      next();
    });
  });
};
```

You can scroll to the right within the `Atom` text editor to view the code comments describing what each line is doing.

8. Use the `File > Save` menu option to save the changes.

3.2.1 - Verify the inventory application

Before you publish the API provider application, verify that the inventory application starts correctly.

1. Return to your `Terminal Emulator` session, or open a new one if you had closed it previously.
2. Switch to the `~/ThinkIBM/inventory` directory.

   ```
   cd ~/ThinkIBM/inventory
   ```

3. Start the Node application with the `npm start` command.

   ```
   npm start
   ```

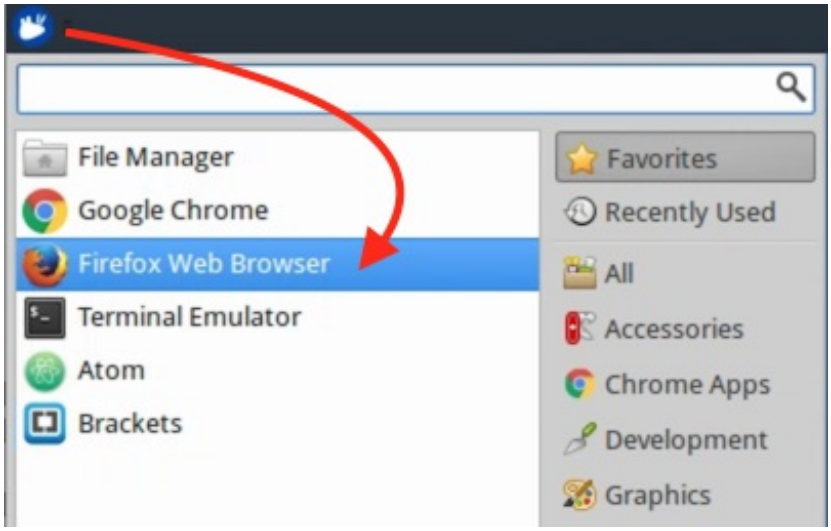
4. Open a web browser to http://localhost:3000/inventory/items.
5. Make sure that the API operation call returns a list of items in a JSON object.
6. In the terminal window, press `Ctrl+c` to stop the Node application.

Lab 3.3 - Publish App to a Liberty Collective

In this section, you will publish the `inventory` application to a Liberty runtime collective for general consumption.

3.3.1 - Register the App with API Connect and Liberty

1. Use the favorites menu to launch the `Firefox Web Browser`:



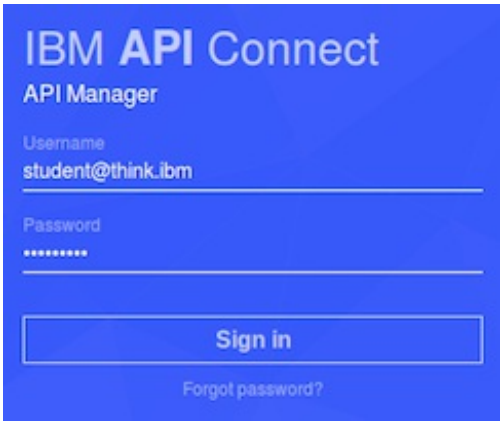
2. Click on the `API Manager` bookmark:

3. Enter the following credentials and then click the the `Sign in` button:

   Username: `student@think.ibm`

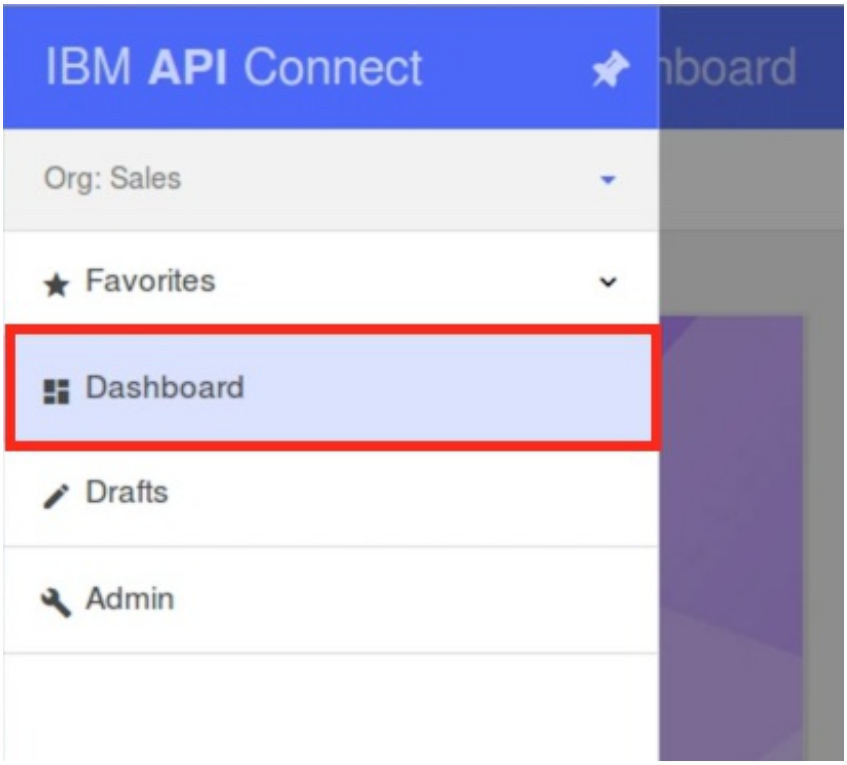
   Password: `Passw0rd!`

> Username and Password may already be saved for you by the browser, you can re-use these saved credentials.

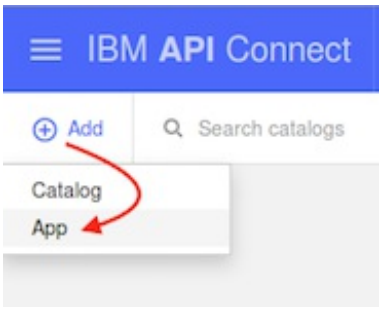


4. Select the menu button from the top left corner of the page.

5. Open the `Dashboard` view.



1. Now that the API Manager Dashboard is open, click the `+ Add` button and select `App` from the list:

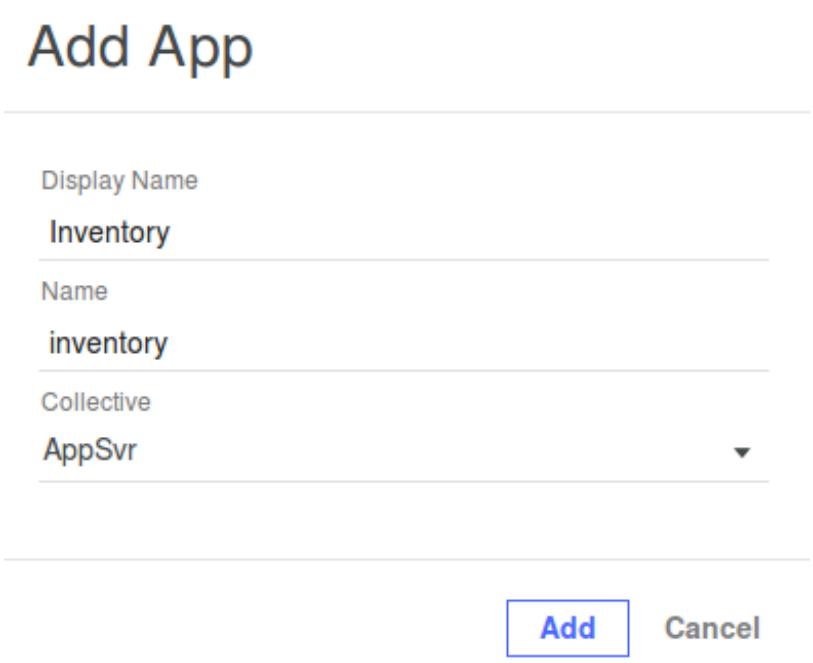


2. Fill out the `Add App` form with the following details:

> Display Name: `inventory`

> Name: `inventory`

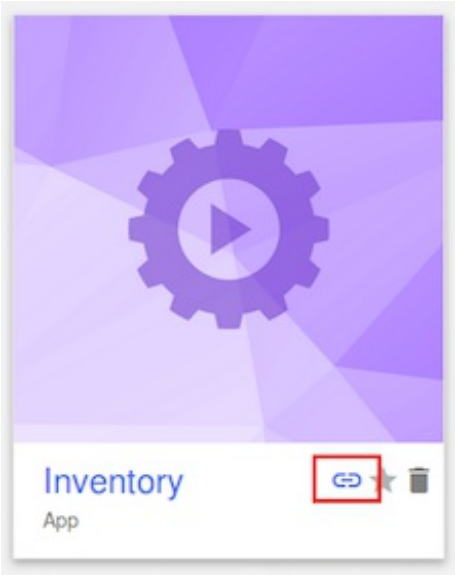
> Collective: `AppSvr`



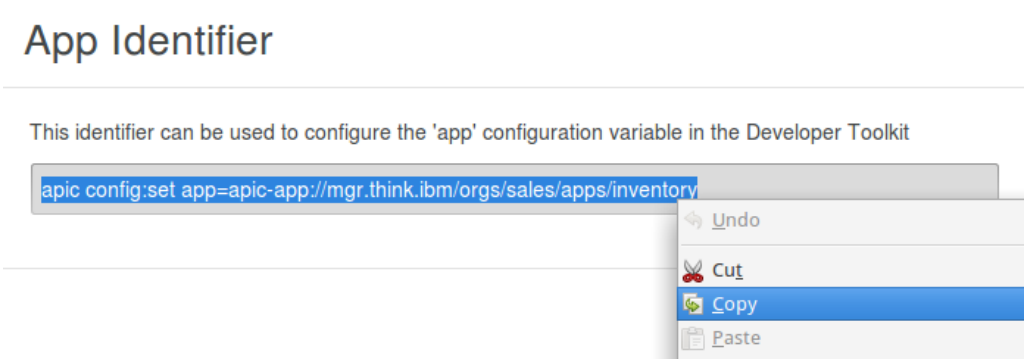
3. Click the `Add` button to link the application between our API Connect server and the Liberty Collective server. This step creates a registration that allows app management from API Connect once the application is published.

3.3.2 - Configure the Developer Toolkit to Communicate with API Connect

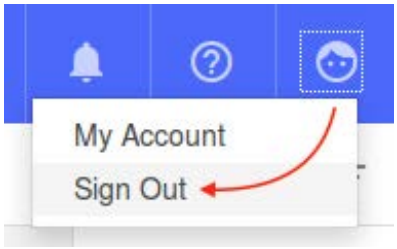
1. Click on the `hyperlink` icon inside of the `Inventory` app tile.



2. Copy the contents of the popup to your system clipboard.



3. Click on the user profile icon and select `Log Out`.



4. Close the Firefox browser by clicking the `x` on the tab or browser window.

5. Return to your `Terminal Emulator` session, or open a new one if you had closed it previously.

6. Ensure you are in the `~/ThinkIBM/inventory` project folder by typing the following command:

```
cd ~/ThinkIBM/inventory
```

7. Use the terminal menu bar to select `Edit > Paste` to paste the contents of your clipbard. If you did not copy the command earlier, you can type it here:

```
apic config:set app=apic-app://mgr.think.ibm/orgs/sales/a
pps/inventory
```

8. Continue setting up the development environment by logging into the API Connect management server:

```
apic login --type app
```

9. Use the following credentials when prompted:

9. Use the following credentials when prompted:

> Server: `mgr.think.ibm`
>
> Username: `student@think.ibm`
>
> Password: `Passw0rd!`

3.3.3 - Publish the Application

1. Ensure the Liberty Collective server is up and running by typing:

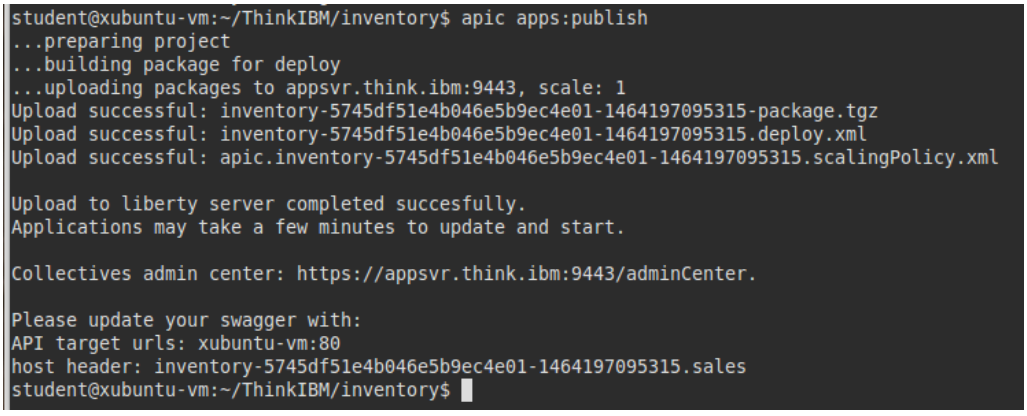
```
wlpn-controller start
```

2. Type the following command to package the `inventory` application and publish it to the collective server:

```
apic apps:publish
```

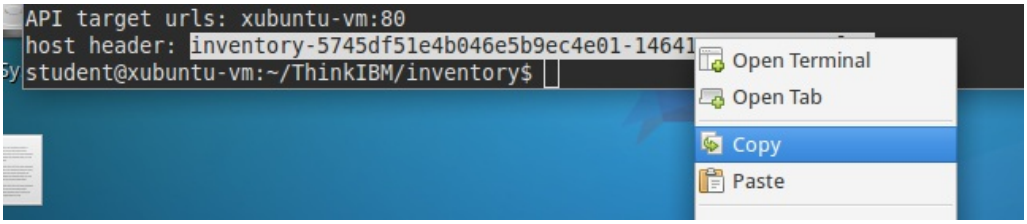
> 
>
> We used the command line in the previous few steps to publish the application. However, we could have also used the API Designer web experience to accomplish the same task.

3. The terminal will prompt you when the publication is complete:

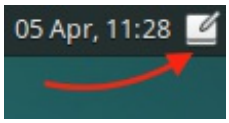


4. You will need the `host` header that is returned in the next lab.

   Highlight the `host header:` value and then **right-mouse-click** to show the menu and select `Copy`.



5. Open the `Notes` application by clicking on the notepad icon in the task bar:



6. Paste (use the `control+v` keyboard command) the host header into the `Notes` window. Add a label so that you know what the value is:

Lab 3 - Validation

Using both the CLI and the API Designer, a lot of files have been created and updated. Before moving on to the next lab, a simple script has been provided for you which will validate your source files against those of a completed lab. These next steps will help ensure that easily made typing errors do not cause problems down the line.

1. From the `Terminal Emulator`, type:

```
validate_lab 3
```

2. The script will execute a series `diff` commands against specific files in your project folder (`~/ThinkIBM/inventory`)

3. If the output of the `validate_lab` script includes discrepancies, you may merge the corrected changes into your source files by typing:

```
merge_lab 3
```

Lab 3 - Conclusion

In this lab you learned:

- How to create a remote hook
- How to test the remote hook
- Publish App to Liberty Collective

Proceed to Lab 4 - Configure and Secure an API

Lab 4 - Configure and Secure an API

In this lab, you will learn how to configure and secure the `inventory` API created during loopback application generation. Using the graphical design tools in API Designer, you will create an OAuth 2.0 provider API called `oauth` and then update the `inventory` API to use this provider. You will use the API Editor assembly view to specify the API's runtime behavior.

Lab 4 - Objective

In the following lab, you will learn:

- How to create an OAuth 2.0 Provider, specifically using the Resource Owner Password grant type.
- How to secure an existing API using the newly created OAuth 2.0 Provider.
- How to add catalog-specific properties to an API.
- How to assemble an API implementation using the activity-log, set-variable and invoke policies

Lab 4 - Case Study Used in this Tutorial

In this tutorial, you will secure the Inventory API to protect the resources exposed by **ThinkIBM**. Consumers of your API will be required to obtain & provide a valid OAuth token before they can invoke the Inventory API.

Lab 4 - Step by Step Lab Instructions

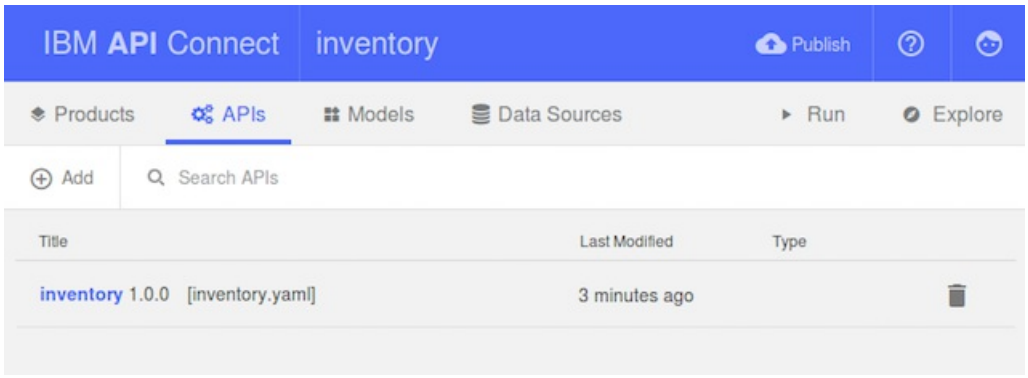
4.1 - Working with the Inventory API in API Designer

1. First, launch API Designer by typing the following commands from your project directory:

```
cd ~/ThinkIBM/inventory/
apic edit
```

API Designer will open in your browser. You may see an informational message about Draft APIs. (This message appears the very first time you launch the API Designer.) If so, click the `Got it!` button, when you are ready to proceed to creating an API.

You should see the APIs view, and a single API listed. The `inventory` API was automatically created during loopback app generation. We will edit this API at a later step.



alt text

4.2 - Adding a New OAuth 2.0 Provider API

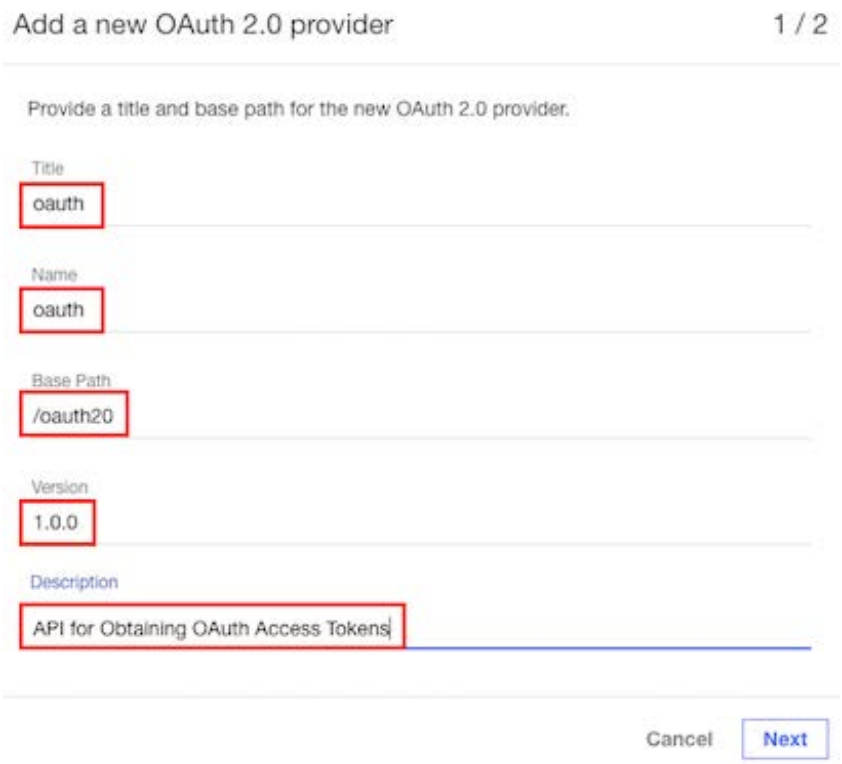
1. Click the `+ Add` button and select `OAuth 2.0 Provider API` from the menu.
2. Specify the following properties and click the `Next` button to continue.

> Title: `oauth`

> Name: `oauth`

> Base Path: `/oauth20`

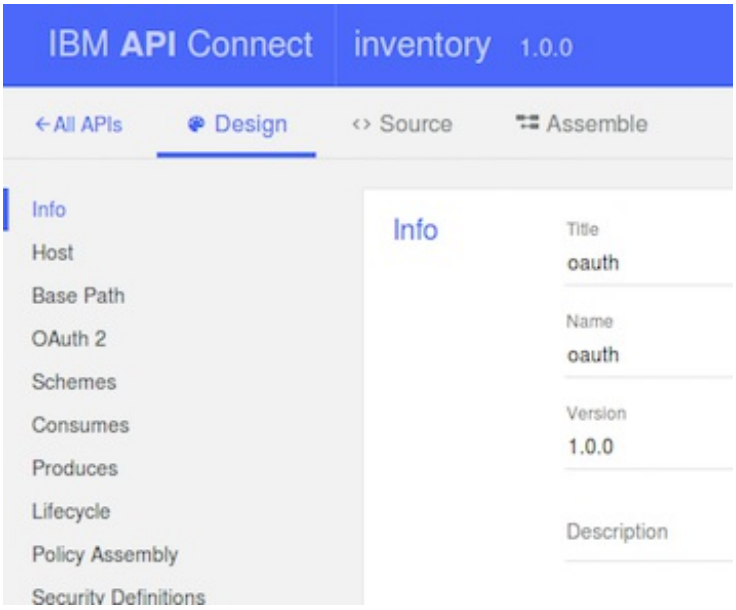
> Description: `API for Obtaining Access Tokens`



3. Accept the default radio button selection labeled `Don't add to a product` and click the `Add` button.

   The API Editor will launch. If this is your first time using the API Editor, you will see an informational message. When you are ready to proceed, click the `Got it!` button to dismiss the message.

   The API Editor opens to the newly created `oauth` API. The left hand side of the view provides shortcuts to various elements within the API definition: Info, Host, Base Path, etc. By default, the API Editor opens to the `Design` view, which provides a user-friendly way to view and edit your APIs. You may notice additional tabs labeled `Source` and `Assemble`. We will work with these views as well.



4. Navigate to the `Host` section of the API. Remove `$(catalog.host)` from the Host field, as we want to keep this blank.

5. Navigate to the `OAuth 2` section.

   Over the next several steps, we will set up OAuth-specific options, such as client type (public vs confidential), valid access token scopes, supported authorization grant types, etc. The OAuth 2.0 Specification has detailed descriptions of each of the properties we are configuring here.

6. For the Client type field, click the drop down twisty and select `Confidential`.

7. Three scopes were generated for you when the OAuth API Provider was generated: `scope1`, `scope2`, `scope3`.

8. Modify the values for `scope1`, set the following fields:

   > Name: `inventory`

   > Description: `Access to Inventory API`

9. Delete `scope2` and `scope3` by clicking the trashcan icons to the right of the scope definitions.

10. We want to configure this provider to*only* support the Resource Owner Password Credentials grant type. Deselect the `Implicit`, `Application` and `Access Code` Grants, but leave `Password` checked.

11. Set the remaining OAuth 2 settings as follows:

    > Collect credentials using: `basic`

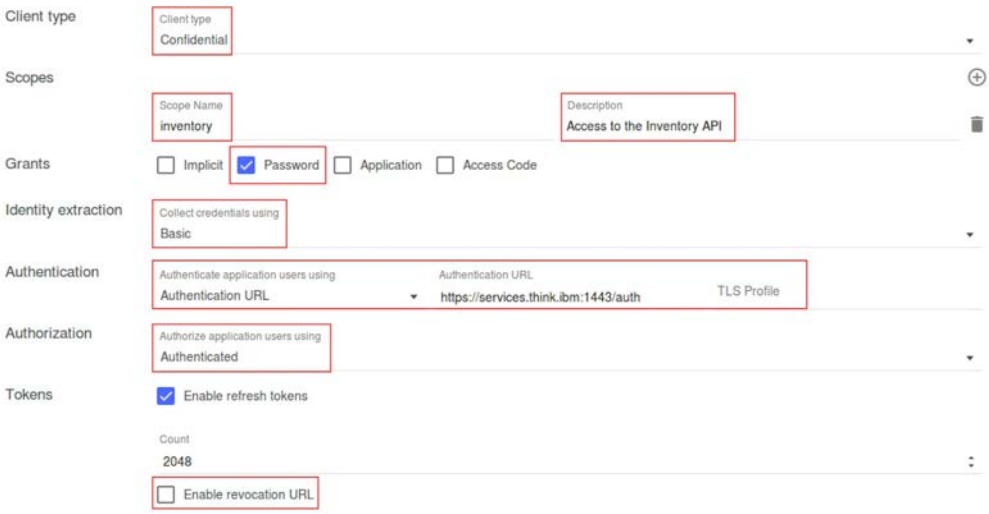
    > Authenticate application users using: `Authentication URL`

    > Authentication URL: `https://services.think.ibm:1443/auth`

    > TLS Profile: **remove** `tls-profile-4` and leave blank

> Deselect the `Enable revocation URL` option

When complete, your settings should look like this:

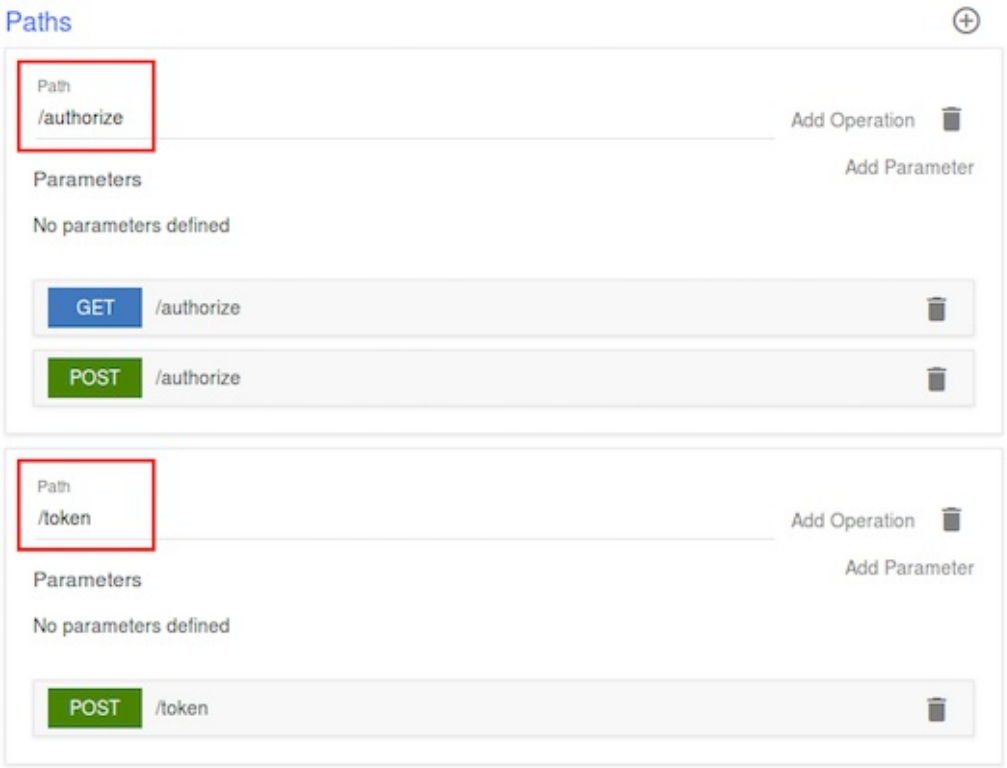


> The scope defined here must be identical to the scope that we define later when telling the `inventory` API to use this OAuth config. A common mistake is around case sensitivity. To avoid running into an error later, make sure that your scope is set to all **lowercase**.

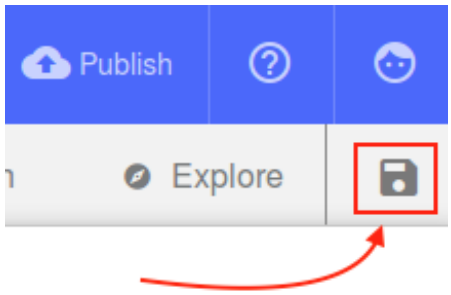
12. Navigate to the `Paths` section. Notice that the generated paths begin with `/oauth2`. However, since we have configured our base path to be `/oauth20`, we will shorten the authorization and token paths.

13. Change the `/oauth2/authorize` path to `/authorize`

14. Change the `/oauth2/token` path to `/token`



15. Click the `Save` icon in the top right corner of the editor to save your changes.



4.3 - Configuring and Securing the Inventory API

1. Click the `All APIs` link at the top left of the API Editor to return to list of APIs.

2. Click the `inventory` link.

   The inventory API will open in the API Editor, where we can make the necessary configuration changes. Over the next several steps you will set this API up to use the OAuth provider you just created.

3. Click on the `trashcan` icon for the `x-any` Definition to remove it. Confirm the removal by clicking the `OK` button in the prompt.

4. Navigate to the `Base Path` section.

Change the base path from `/api` to `/inventory`.

5. Navigate to the `Host` section of the API. **Remove** the `$(catalog.host)` value.

   As with the OAuth API Provider we just created, we want this value to remain empty.

6. Navigate to the `Security Definitions` section.

   Click the `+` icon in the **Security Definitions** section and select `OAuth` from the menu.

   A new security definition is created for you, called `oauth-1 (OAuth)`.

7. Scroll down slightly to edit the newly created security definition.

   Set it to have the following properties:

   > Name: `oauth`

   > Description: `Resource Owner Password Grant Type`

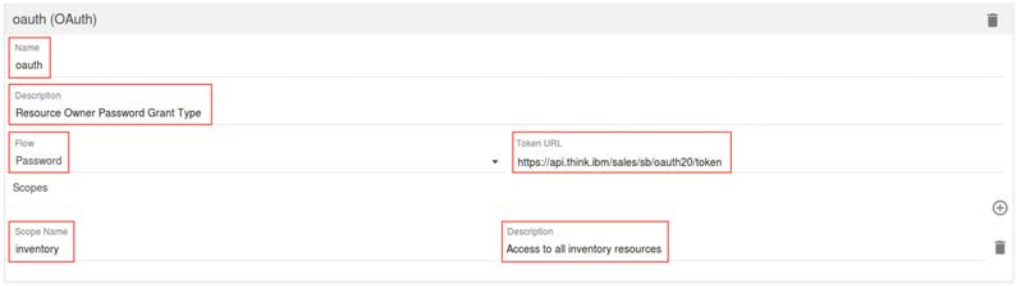
   > Flow: `Password`

   > Token URL:
   > `https://api.think.ibm/sales/sb/oauth20/token`

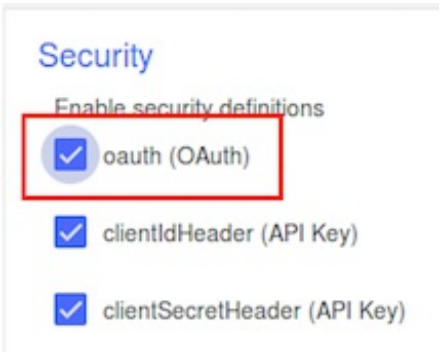
8. Click the `+` icon in the **Scopes** section to create a new scope. Set the following properties:

   > Scope Name: `inventory`

   > Description: `Access to all inventory resources`



9. Navigate to the `Security` section and check the `oauth (OAuth)` checkbox.



Now that the API is secured using our OAuth provider, we can define how the API should behave when called. In the next two sections, we will configure the `inventory` API to call our inventory application which was published at the end of Lab 3.

4.4 - Adding API Properties

Before we add and configure the `inventory` API processing policies, we need to set up a couple of API properties. These are used to hold parameters needed by the API, whose values vary based on which Catalog the API is running in.

For example, we will configure the `inventory` API to invoke a backend service. We want to be able to call different instances of that service based on which Catalog the API is deployed to.

1. Navigate to the `Properties` section and click the `+ Add` icon to create a new property. Give it the following attributes:

   > Name: `app-server`

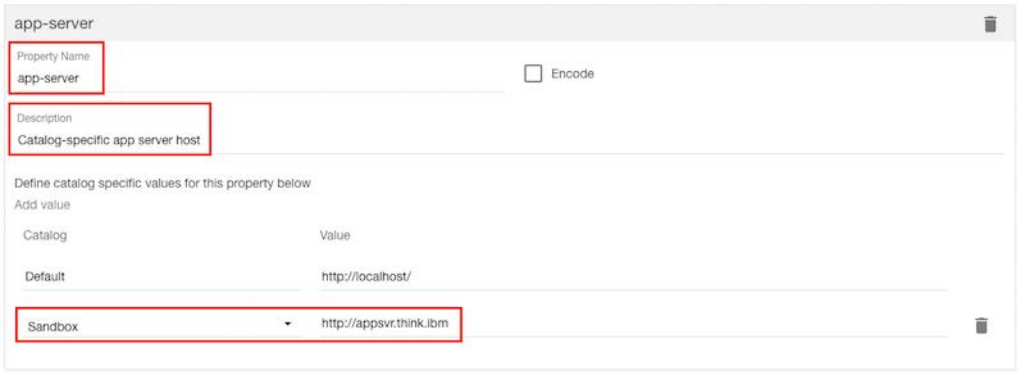
   > Description: `Catalog-specific app server URL`

   > Default Value: `http://localhost/`

2. Add additional catalog-specific values by clicking the `Add value` link. Specify the following catalog name and value:

> Catalog: `Sandbox`

> Value: `http://appsvr.think.ibm`



> 
>
> The Catalog and Value fields are strict. They are case-sensitive and must be typed exactly as shown. You will note that the catalog drop down list will have a default entry there for `sb`. It is important that you type in the `Sandbox` name in the Catalog as indicated above, otherwise you will encounter issues.

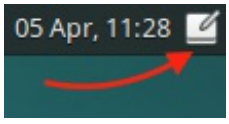
3. Create another property by clicking on the `+` icon, named `app-id`:

> Name: `app-id`

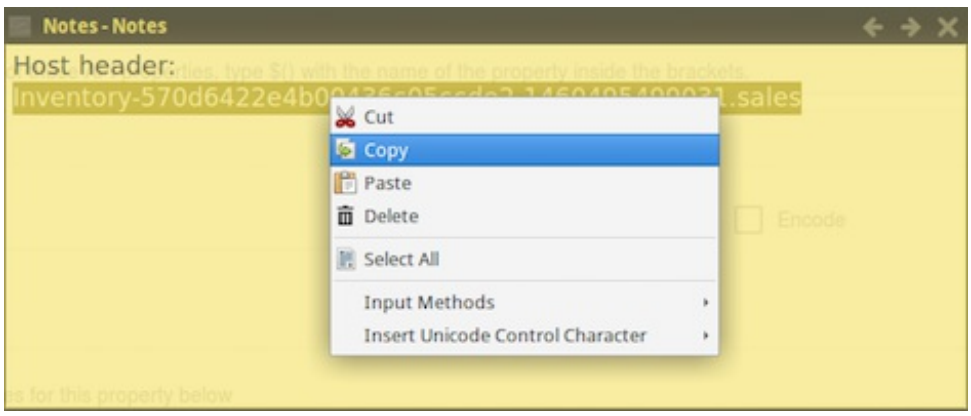
> Description: `Inventory application id`

> Default Value: `null`

4. Click on the Notepad icon in the top-righthand corner of the OS task bar.



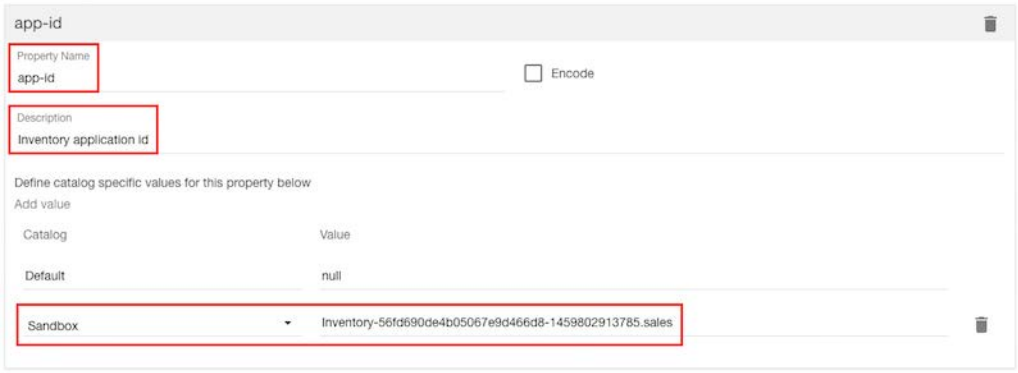
5. Copy the `Host header` from the notepad.



6. Add a new value to the `app-id` property:

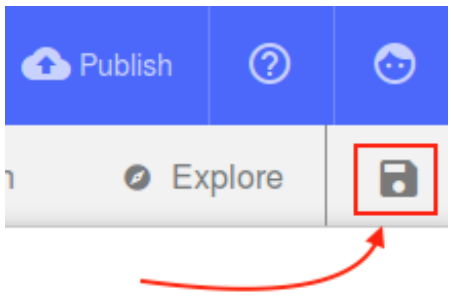
   > Catalog: `Sandbox`

   > Value: paste the value of the `app-id` here



> 
>
> The UI may inadvertently add another value after you paste in the app-id. If this occurs, click the trashcan icon to remove the unwanted entry.

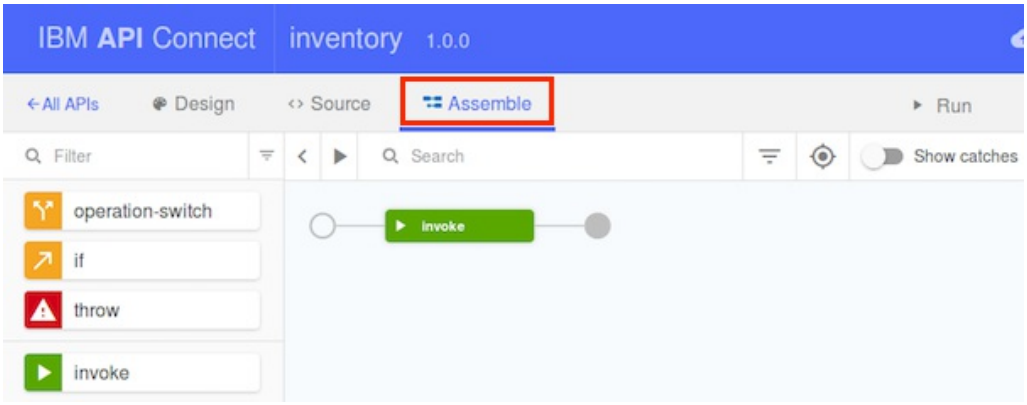
7. Save your changes.



4.5 - Defining API Processing Behavior

An API Assembly provides collection of policies which are enforced and executed on the API Gateway. Policies include actions like modifying the logging behavior and altering the message content or headers. Additionally, if the out of the box policies do not meet your specific needs, you may opt to create your own policy and have it available for API designers through the API Connect UI.

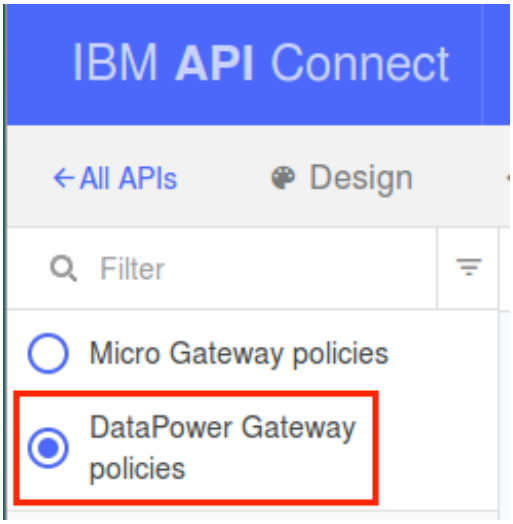
1. Switch to the `Assemble` tab. A simple assembly has been created for you.



2. Modify your assembly to use DataPower Gateway policies.

   Expand the `Filter` menu by clicking the menu icon (to the right of the `Filter` label).

   Select the `DataPower Gateway policies` radio button.

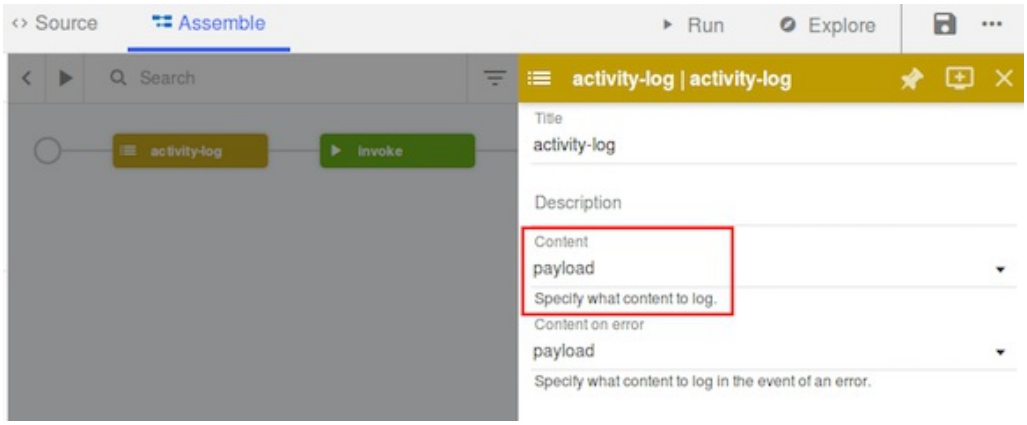


3. Add an `activity-log` policy to the assembly and configure it to log API payload.

   Drag the `activity-log` policy from the list of available policies to the left of the `invoke` policy already created in your assembly.

4. Select the newly added `activity-log` step. A properties menu will open on the right of your screen.

   Under `Content` select `payload` from the drop-down list.



5. Click on the `X` to close the activity-log editor menu.

6. Add a `set-variable` policy to the assembly, to the right of the activity-log step.

7. Click on the `set-variable` policy to access the editor and set the `Host` header for our request. The `Host` header is used by the liberty runtime to properly route the request to our Inventory application.

8. Click the `+ Action` button.

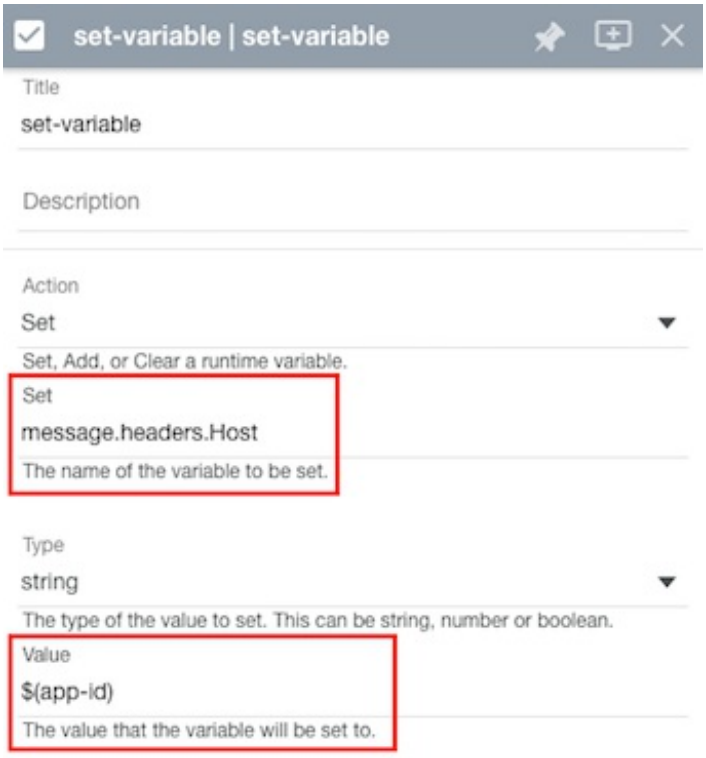
   Edit the action properties to set the header value:

   > Action: `Set`

   > Set: `message.headers.Host`

   > Type: `string`

   > Value: `$(app-id)`

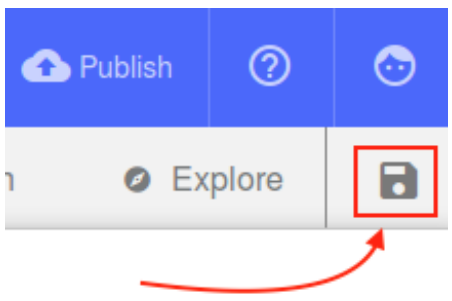


9. Click on the `X` to close the set-variable editor menu.
10. Click on the `invoke` policy to bring up the editor.
11. Replace the default `Invoke URL` path.

    Update the URL to be: `$(app-server)$(request.path)`

> The `$(request.path)` variable will automatically remove the organization and catalog components of the full API Connect request path. Additionally, the leading slash `/` is already included in the variable value.

12. Click on the `X` to close the invoke policy editor menu.
13. Save your changes.



14. Close the Firefox browser by clicking the `x` on the tab or browser window.

15. Return to your `Terminal Emulator` session.

16. Even though we closed the browser, the API Designer application itself is still running.

    Hold the `control` key and press the `c` key to end the API Designer session:

    ```
    control+c
    ```

    This will return you to the command line prompt.

Lab 4 - Validation

Using both the CLI and the API Designer, a lot of files have been created and updated. Before moving on to the next lab, a simple script has been provided for you which will validate your source files against those of a completed lab. These next steps will help ensure that easily made typing errors do not cause problems down the line.

1. From the `Terminal Emulator`, type:

    ```
    validate_lab 4
    ```

2. The script will execute a series `diff` commands against specific files in your project folder (`~/ThinkIBM/inventory`)

3. If the output of the `validate_lab` script includes discrepencies, you may merge the corrected changes into your source files by typing:

    ```
    merge_lab 4
    ```

Lab 4 - Conclusion

Congratulations! You have successfully configured and secured the

inventory API. You will consume this API in a later step.

Proceed to Lab 5 - Advanced API Assembly

Lab 5 - Advanced API Assembly

In this lab, you will learn how to create advanced API assemblies. Using the graphical design tools and source editor, you will create a new API called `financing` which will expose an existing SOAP service as a RESTful API. Additionally, you will create another API called `logistics` which connects to existing public services and uses the assembly tools to map responses into a desired format.

Lab 5 - Objective

In the following lab, you will learn:

- How to create a new API, including object definitions and paths
- How to configure an API to access an existing SOAP service
- How the source editor can be used to import an existing API definition
- How to map data retrieved from multiple API calls into an aggregate response
- How to use gatewayscript directly within an API assembly

Lab 5 - Case Study Used in this Tutorial

In this tutorial, you will expand the product offerings for**ThinkIBM**. In addition to the Inventory API, **ThinkIBM** wishes to provide API's that offer financing and shipping logistics to consumer applications. Your goal is to utilize existing enterprise and public assets to create these API offerings.

Lab 5 - Step by Step Lab Instructions

5.1 - Create the Financing API (REST to SOAP)

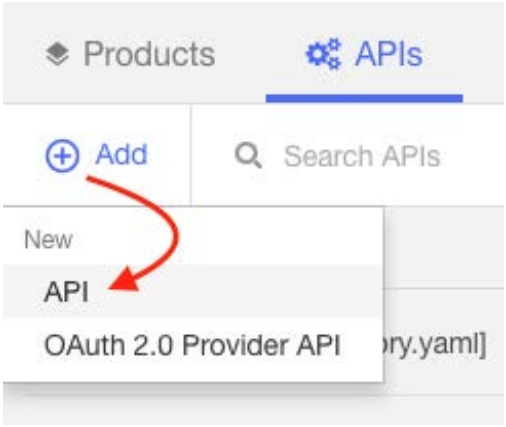
1. If the API Designer screen has not already been launched, open a terminal and start the designer by issuing the following commands:

```
cd ~/ThinkIBM/inventory
apic edit
```

2. Otherwise, click the `All APIs` link to return to the main Designer screen.

5.1.1 - Create the API Definition

1. Click on the `+ Add` button and select `API`.



2. Fill in the form values for the API, then click the `Next` button to continue.

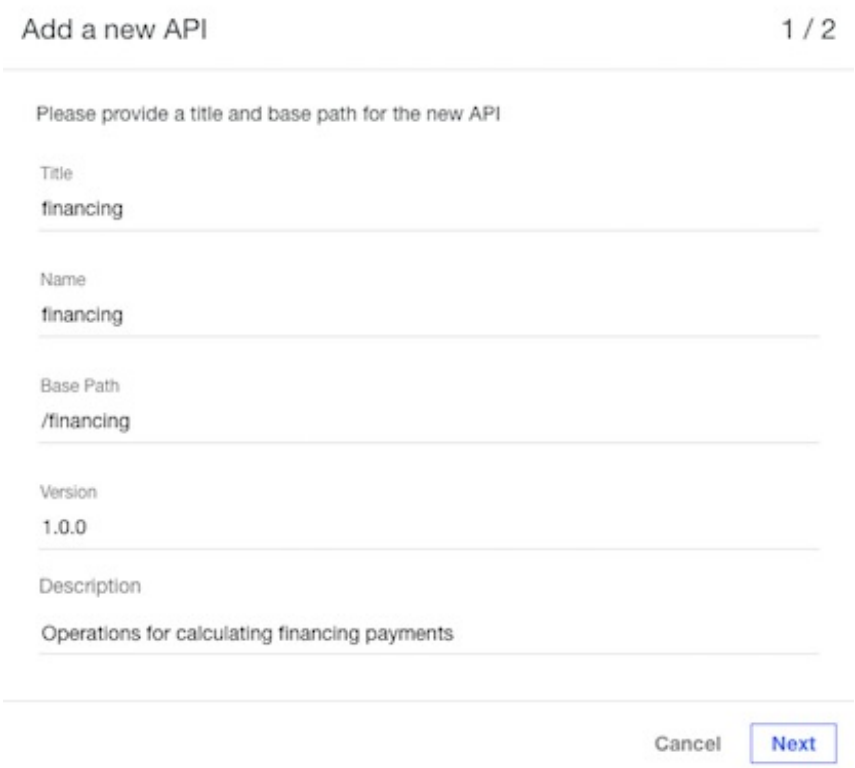
> Title: `financing`

> Name: `financing`

> Base Path: `/financing`

> Version: `1.0.0`

> Description:
> `Operations for calculating financing payments`



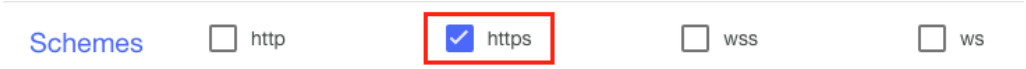
3. Keep the selected default to `Don't add to a product` and click the `Add` button.

4. API Connect will generate a new swagger definition file for the `financing` API and automatically load the API editor screen. Notice that the API does not contain any paths or data definitions. We will be adding these in the following steps.

5. Click on `Host` from the API editor menu. Remove `$(catalog.host)` from the Host field. We will keep this blank.

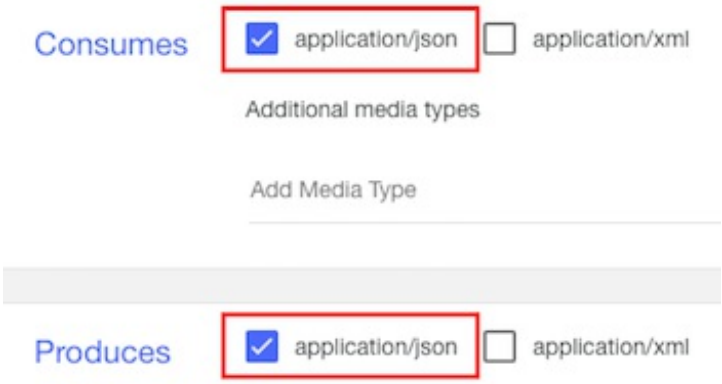
> 
>
> The host field will show a red line indicating that the field is required. You may ignore this message.

6. Scroll down to the `Schemes` section, or select it from the API editor menu. Enable the `https` scheme.



7. Below the Schemes section are the `Consumes` and `Produces`

sections. For each of these, choose `application/json`.



8. Next, we need to create the model definition for our new API. These definitions are used in a few places. Their primary role is to serve as documentation in the developer portal on expected input and output parameters; however, they can also be used for data mapping actions. Click on `Definitions` from the API Designer menu.

9. Click the `+` icon in the **Definitions** section to create a new definition. Then, click on `new-definitions-1` to edit the new definition.

10. Edit the `Name` of the definition, set it to `paymentAmount`.

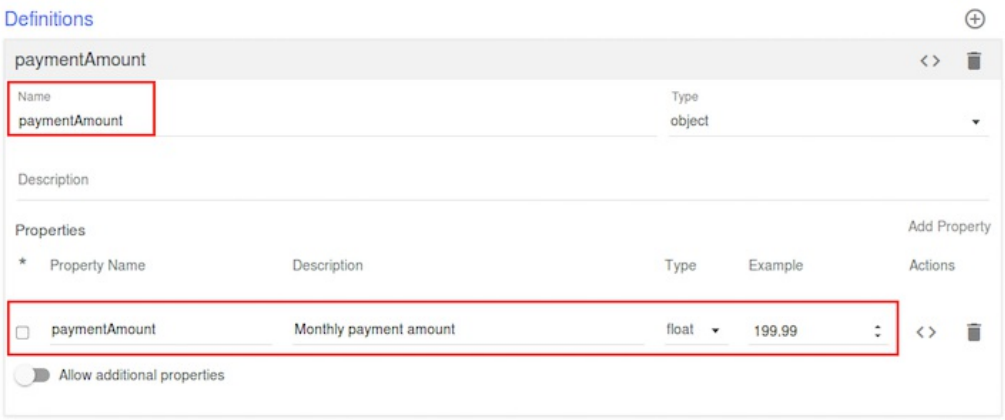
11. The new definition already adds in a sample property called `new-property-1`. Edit the property values:

    > Property Name: `paymentAmount`

    > Description: `Monthly payment amount`

    > Type: `float`

    > Example: `199.99`



12. Now that we have a definition, we'll create a path. Click on `Paths`

from the API Designer menu.

13. Click on the `+` button to create a new path. The template will generate the path and a GET resource under the path. This is sufficient for our needs, but we could also add other resources and REST verbs to our path if needed.

14. Edit the default path location to be `/calculate`.

    - Recall that our Base Path for this API is `/financing`. This new path will be appended to the base, creating a final path of `/financing/calculate`.

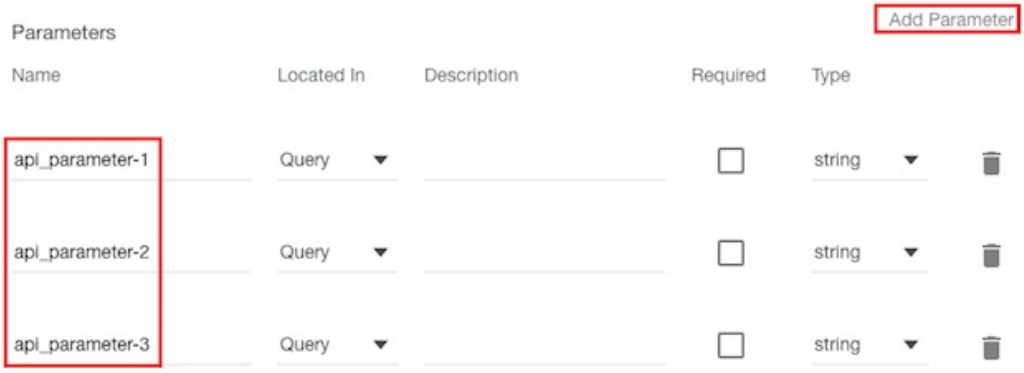
15. Click on the `GET` operation to expand the configuration options for the resource.

16. Each operation needs an Operation ID. Set the Operation ID to: `get.financingAmount`

17. Next, we have the option of adding request parameters to the operation. This defines the input to the API request. Since this is a GET request, we'll add the required request parameters to the query component of the URI.

    Click on the `Add Parameter` link to create a new query parameter. Then, select `Add new parameter` from the sub-menu.

18. We're actually going to need three total parameters for this operation, so go ahead and click on the `Add Parameter` link two more times to add the parameter templates.



19. Edit the parameters to set the values:

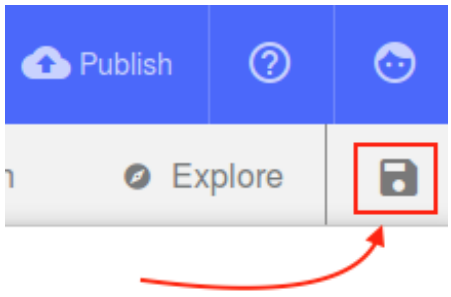
> Name: `amount`
>
> Located In: `Query`
>
> Description: `amount to finance`
>
> Required: *selected*
>
> Type: `float`

> Name: `duration`
>
> Located In: `Query`
>
> Description: `length of term in months`
>
> Required: *selected*
>
> Type: `integer`

> Name: `rate`
>
> Located In: `Query`
>
> Description: `interest rate`
>
> Required: *selected*
>
> Type: `float`

20. Next we'll set the schema for the response. Since we already defined the `paymentAmount` definition, we will select it from the drop down list. You will find the `paymentAmount` definition at the top of the list.

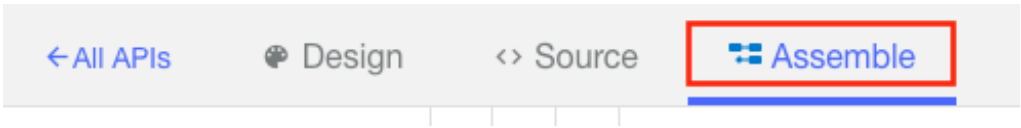
21. Save the API definition.



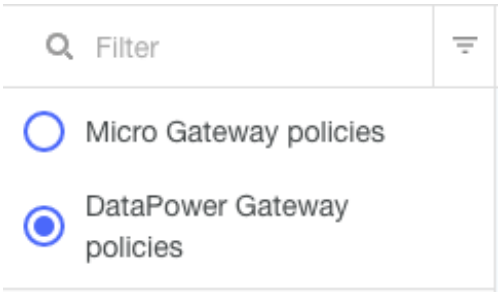
22. You have completed the creation of the new API definition. The path and model data will be presented to our consumers on the developer portal once it's published.

5.1.2 - Build the Financing API Assembly

1. Click on the `Assemble` tab to access the assembly editor.



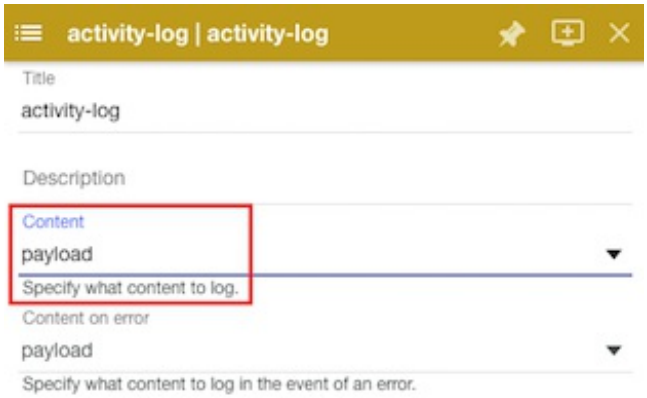
2. Select the `DataPower Gateway policies` filter.



3. In the policy list, click and drag the `activity-log` policy to the front of the processing pipeline.

4. Click on the `activity-log` action resting on the pipeline to open the configuration options for the policy.

5. Change the selected item for the Content field from `activity` to `payload`.



6. Click the `X` to close the policy editor window to return to the assembly processing pipeline.

7. Now we are going to add the remaining policies required for mapping our REST API into SOAP.

8. Between the `activity-log` and `invoke` policies, add a `map` policy.

9. After the `invoke` policy, add a `gatewayscript` policy and then a `xml-to-json` policy.

10. In order to consume a SOAP-based service from our REST-based API, we need to map the query parameter inputs that we defined as part of the `GET /calculate` operation to a SOAP payload. To do so, click on the `map` policy on our pipeline to open the map editor.

11. Click on the `+` icon to make the editor window fill the screen.

12. On the **Input** column, click on the `pencil` icon to bring up the input editor.

13. Recall that our GET operation has three required query parameters: `amount`, `duration` and `rate`. Click on the `+ input` button three times to add the entries to the input table.

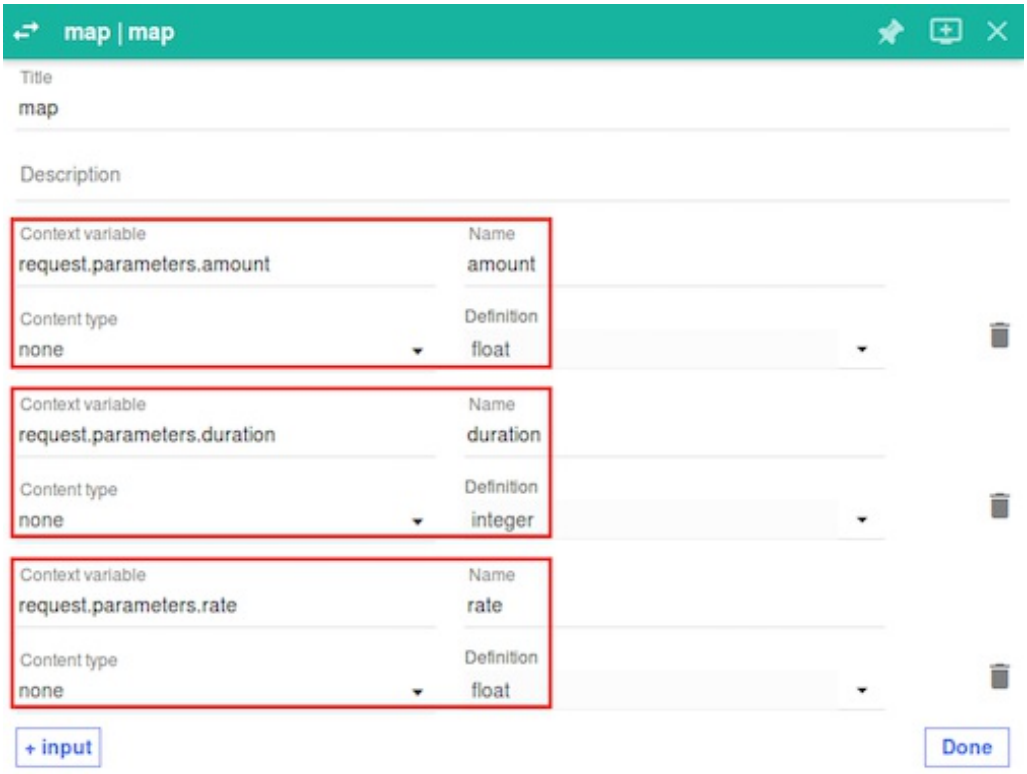
14. Fill in the values for each of the input parameters:

> Context variable: `request.parameters.amount`

> Name: `amount`
>
> Content type: `none`
>
> Definition: `float`

> Context variable: `request.parameters.duration`
>
> Name: `duration`
>
> Content type: `none`
>
> Definition: `integer`

> Context variable: `request.parameters.rate`
>
> Name: `rate`
>
> Content type: `none`
>
> Definition: `float`



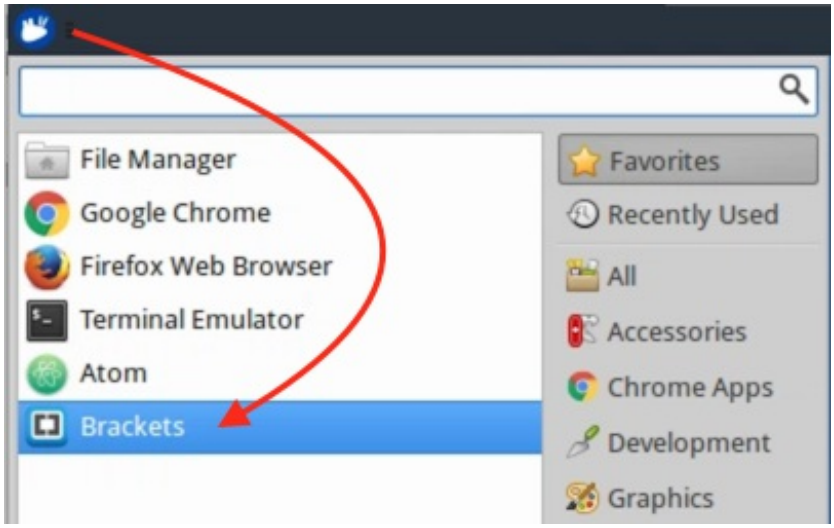
15. Click on the `Done` button to return to the map editor.
16. Next, in the **Output** column, click on the `pencil` icon to add an output definition.
17. Click on `+ output`.

18. Set the `Content type` to `application/xml`.

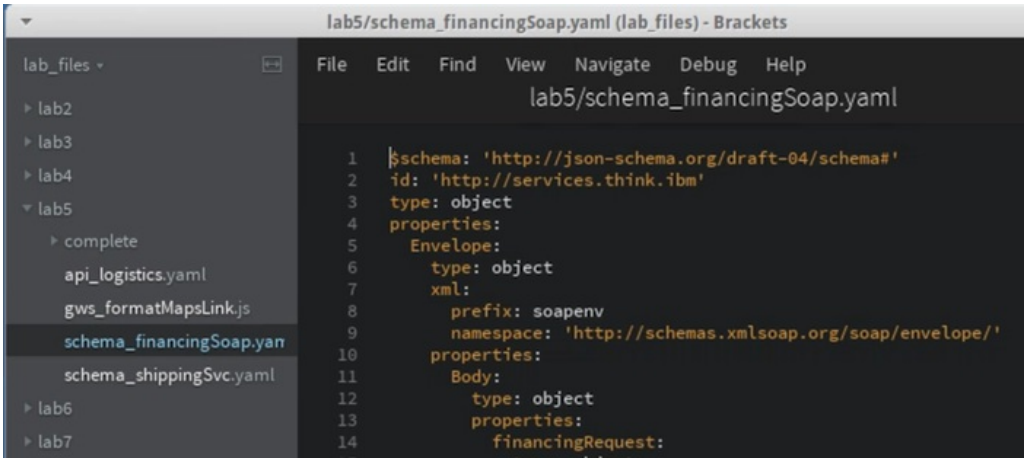
19. For the `Definition` field, click on the drop down menu and scroll to the bottom to select `Inline schema`.

20. In the interest of time, and to avoid typing errors, a sample schema file has been provided for you.

    Open the `Brackets` application from the system task bar, or using the favorites menu.



1. Use the file tree menu to open the `lab5/schema_financingSoap.yaml` file:

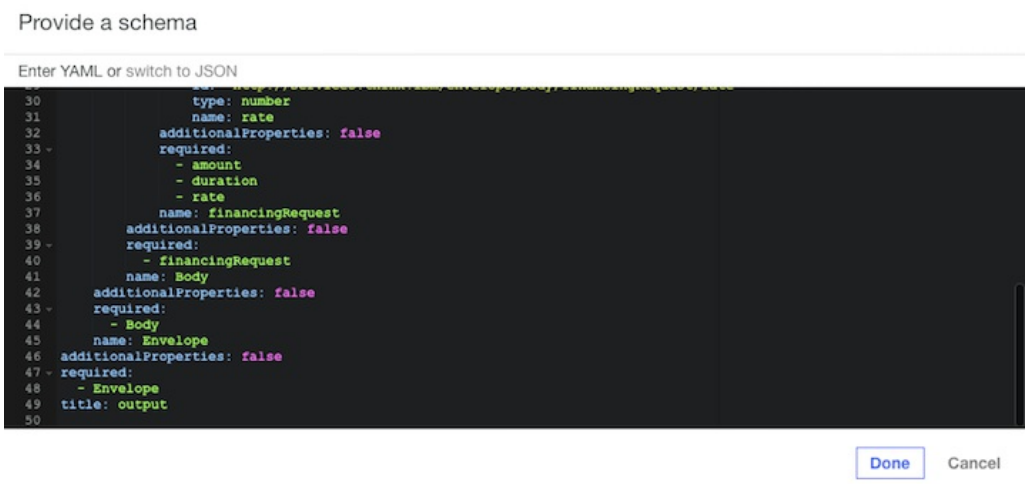


2. Copy the contents of the `schema_financingSoap.yaml` file to the system clipboard.

```
$schema: 'http://json-schema.org/draft-04/schema#'
id: 'http://services.think.ibm'
type: object
properties:
  Envelope:
    type: object
```

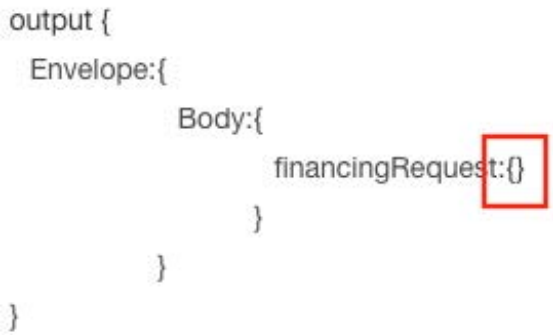
```
    type: object
    xml:
      prefix: soapenv
      namespace: 'http://schemas.xmlsoap.org/soap/envelope/'
    properties:
      Body:
        type: object
        properties:
          financingRequest:
            type: object
            xml:
              prefix: ser
              namespace: 'http://services.think.ibm'
            properties:
              amount:
                id: 'http://services.think.ibm/Envelope/Body/financingRequest/amount'
                type: number
                name: amount
              duration:
                id: 'http://services.think.ibm/envelope/body/financingRequest/duration'
                type: integer
                name: duration
              rate:
                id: 'http://services.think.ibm/envelope/body/financingRequest/rate'
                type: number
                name: rate
            additionalProperties: false
            required:
              - amount
              - duration
              - rate
            name: financingRequest
        additionalProperties: false
        required:
          - financingRequest
        name: Body
    additionalProperties: false
    required:
      - Body
    name: Envelope
additionalProperties: false
required:
  - Envelope
title: output
```

3. Switch back to the `Firefox` browser and paste (`control+v`) the SOAP schema definition into the schema editor window, then click the `Done` button.



4. Click the `Done` button in the output editor window to return to the map editor.

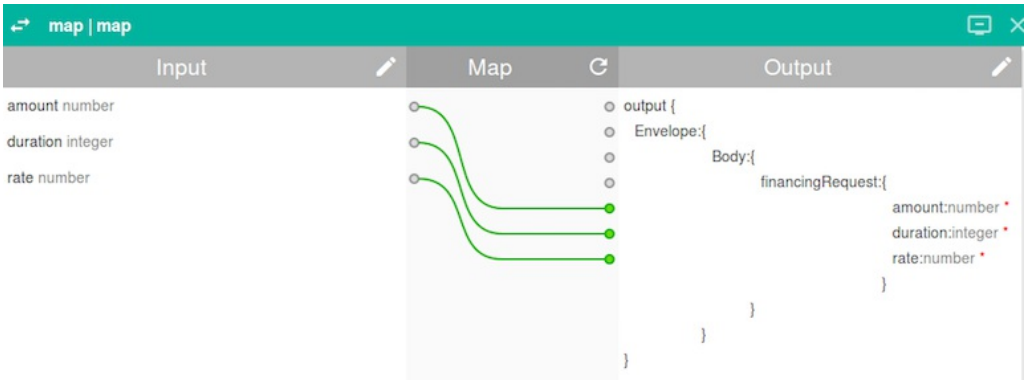
5. Click on the curly braces `{}` for the `financingRequest: {}` element to expand the view and see the SOAP input elements.



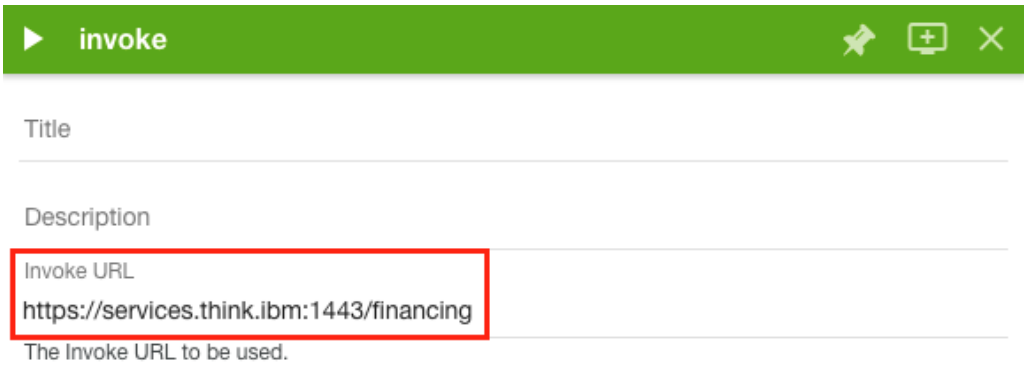
6. Click the '+' icon in menu bar on the the map properties window to maximize the properties, or you might not see the output variables to be mapped.

7. For each of the `Input` query parameters, map them to their respective SOAP `Output` elements.

   To map from an input field to an output field, click the circle next to the *source* element once, then click the circle next to the*target* element. A line will be drawn between the two, indicating a mapping from the source to the target.



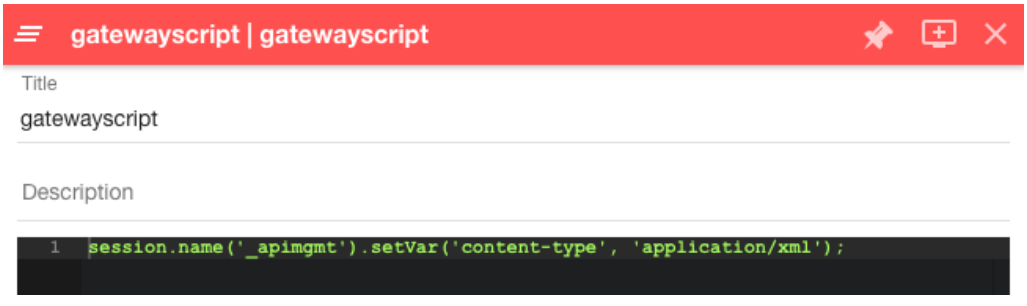
8. Click the `X` button in the map editor to return to the policy pipeline.
9. Click the `invoke` policy to open its editor.
10. Set the `Invoke URL` to: `https://services.think.ibm:1443/financing`.



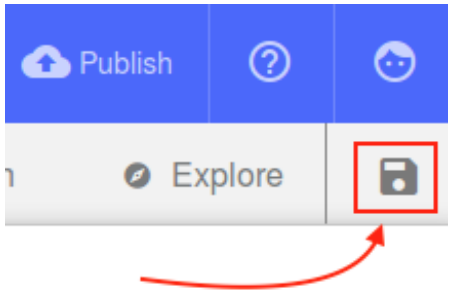
11. Scroll down and set the `HTTP Method` to `POST`.

12. Click the `X` button to return to the policy pipeline.
13. Click on the `gatewayscript` policy to open the editor. Add the following line:

```
session.name('_apimgmt').setVar('content-type', 'application/xml');
```



14. You are now finished with the assembly for the `financing` API. The assembly takes the following actions:
    - Logs requests.
    - Maps the REST query parameters into a SOAP body.
    - Sets the SOAPAction header.
    - Invokes the SOAP service.
    - Transforms the SOAP service's response into JSON.
15. Save the API definition.



5.2 - Add Logistics API (Advanced Assembly)

In this lab section, we will be adding a new API called `logistics` which will provide helper services around calculating shipping rates and locating nearby stores.

Rather than require you to build the entire API from scratch again, you will see how you can use the source editor to paste in an API definition that has already been started for you.

5.2.1 - Import Predefined API Definition

1. Click on the `All APIs` link to return to the main API Designer screen.
2. Click on the `+ Add` button to add a new API. Specify the following values:

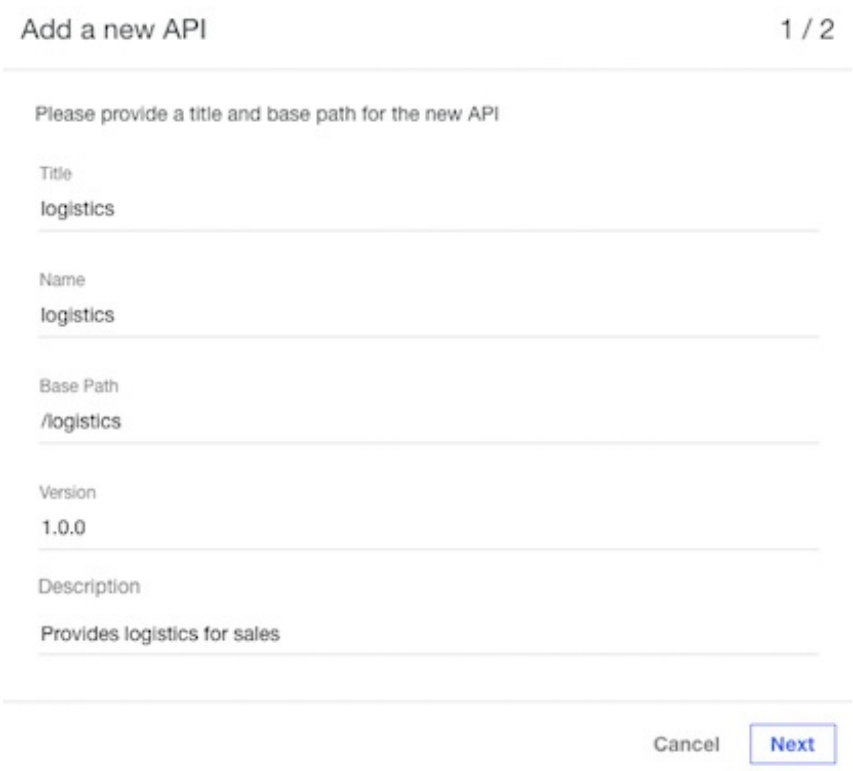
    > Title: `logistics`

    > Name: `logistics`

    > Base Path: `/logistics`

    > Version: `1.0.0`

    > Description: `Provides logistics for sales`



3. Keep the default `Don't add to a product` option selected and click the `Add` button.

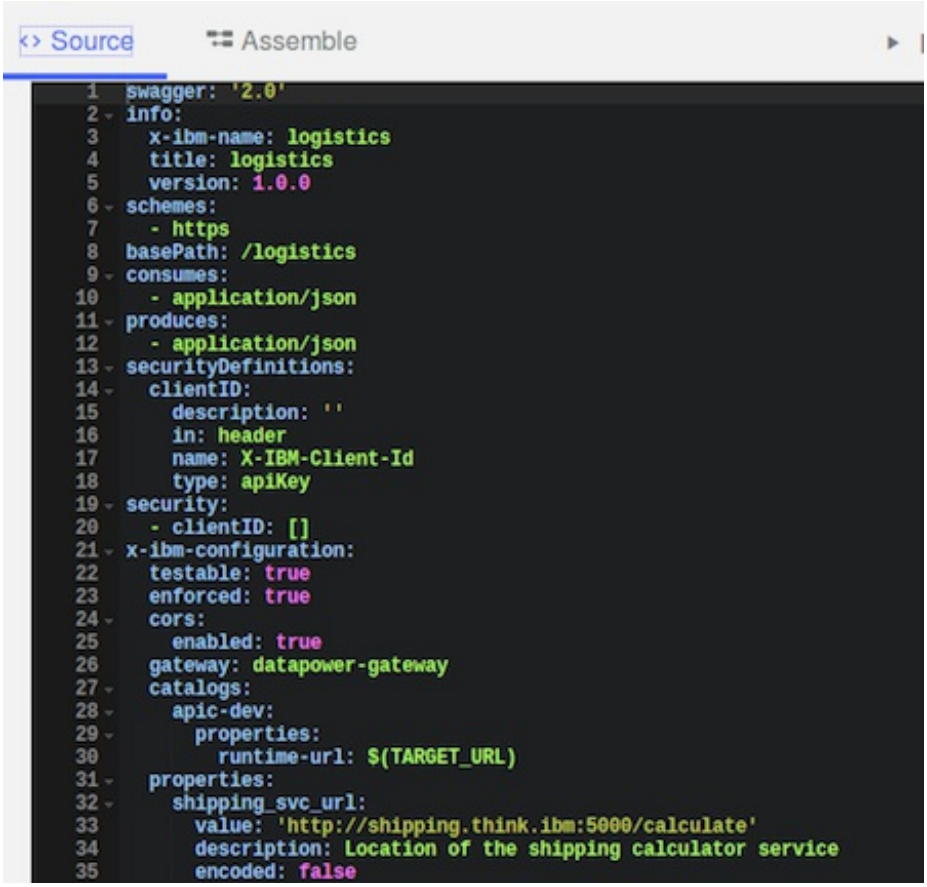
4. Switch to the `Source` tab and look at the API Definition. Any edits you make directly to the source will be immediately visible on the `Design` tab.

5. From the `Brackets` editor, open the `lab5/api_logistics.yaml` file.

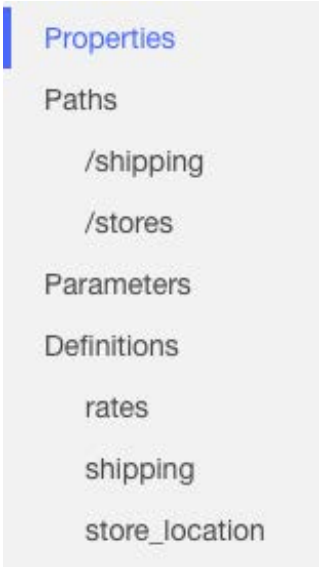
   Select the full contents of the file and **copy** the contents to the clipboard.

6. Return to the browser, select the contents of the `Source` tab and delete the contents.

7. Paste the contents of your clipboard to update the API Definition.



8. Switch back to the `Design` view and note the changes that have been imported, in particular:
    - Properties
    - Paths
    - Definitions



5.2.2 - Create the Logistics API Assembly

1. Switch to the `Assemble` tab and click the `Create assembly` button.

2. Add an `activity-log` policy to the assembly pipeline.

3. Click the `activity-log` policy to open editor, configure it to log the `payload` for the **Content** field.

4. Add an `operation-switch` policy to the right of the activity-log step.

5. Click on the `operation-switch` policy to launch the editor. A single case `case 0` is created by default.

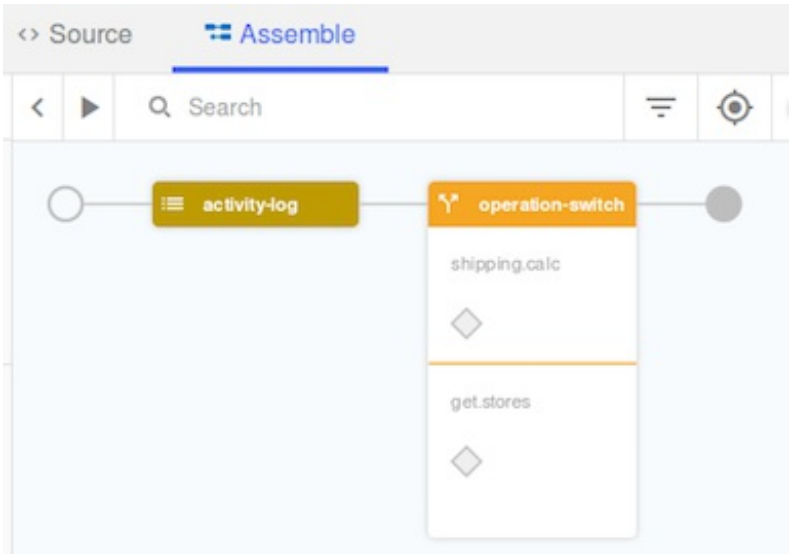
6. Click `search operations...` to bring up the drop-down list of available operations.

7. Select the `shipping.calc` operation.

8. Click the `+ Case` button to add a second case for the `get.stores` operation.

9. Click the `X` to close the operation switch configuration editor.

   You should see two new processing pipelines created on your `operation-switch` step - one for each case:



5.2.2.1 - Configure the `shipping.calc` Case:

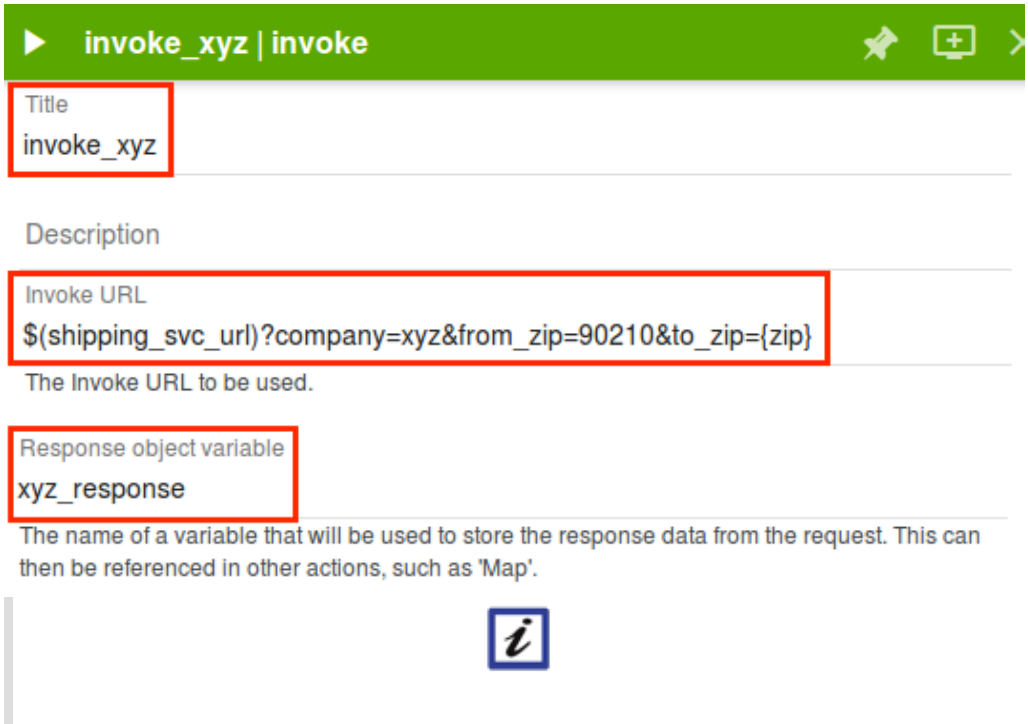
This operation will end up invoking two separate back-end services to acquire shipping rates for the respective companies, then utilize a map action to combine the two separate responses back into a single, consolidated message for our consumers.

1. Add an invoke policy to the `shipping.calc` case with the following properties:

   > Title: `invoke_xyz`

   > Invoke URL: `$(shipping_svc_url)?company=xyz&from_zip=90210&to_zip={zip}`

   > Response object variable (scroll to the bottom): `xyz_response`



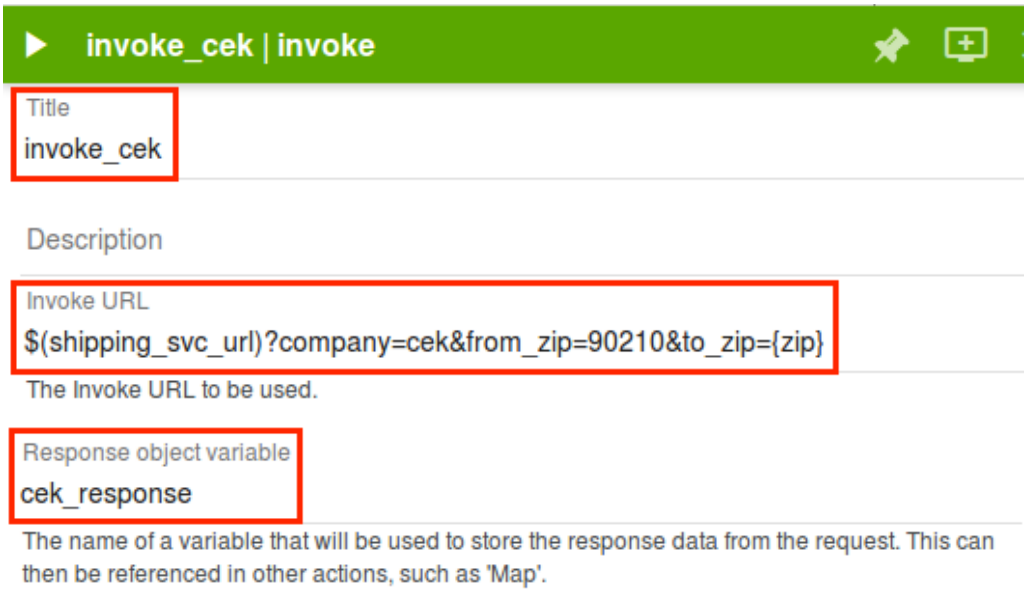
> The `{zip}` parameter provided here is a reference to the `zip` parameter defined as input to the operation. The `{zip}` portion of the URL will get replaced by the actual zip code provided by then API consumers.

2. Add a second invoke policy to the `shipping.calc` case with the following properties:

   > Title: `invoke_cek`

   > Invoke URL: `$(shipping_svc_url)?company=cek&from_zip=90210&to_zip={zip}`

   > Response object variable: `cek_response`

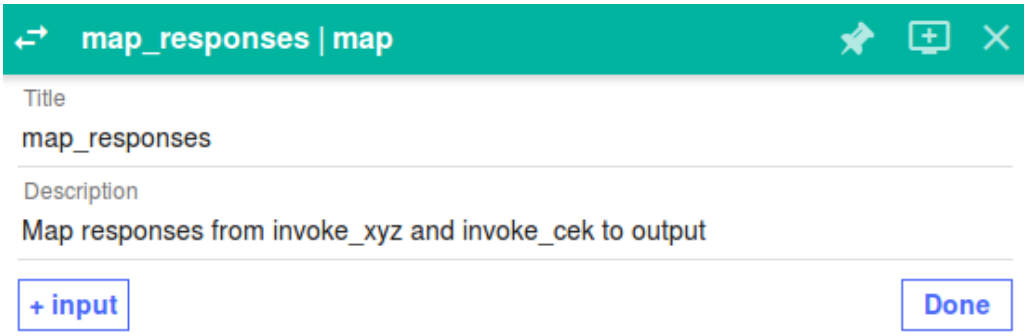


3. Add a `map` policy after the last invoke, then click it to open the editor.

4. Click the `pencil` icon next to `Input` and specify the following map properties:

   > Title: `map_responses`

   > Description: `Map responses from invoke_xyz and invoke_cek to output`



5. Click the `+ input` button to add an input. Specify the following input configuration:

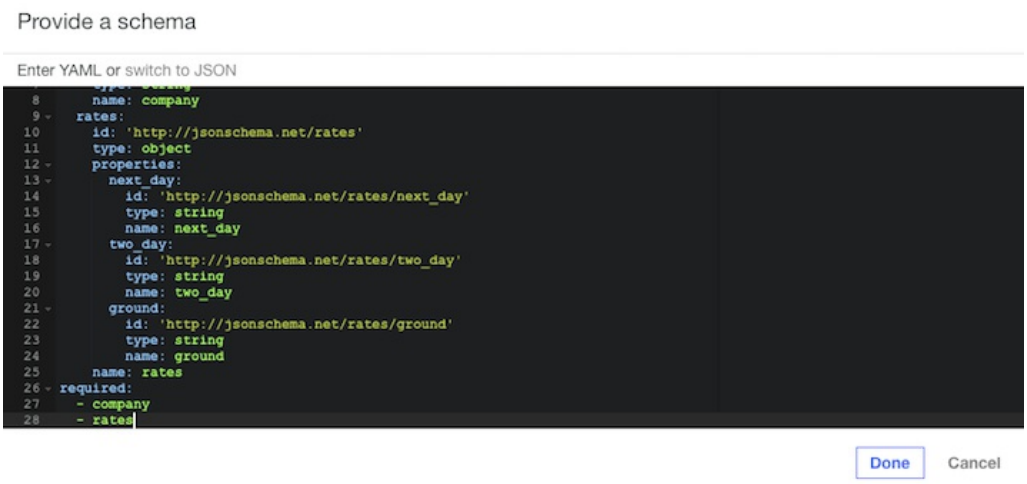
   > Context variable: `xyz_response.body`
   >
   > Name: `xyz`
   >
   > Content type: `application/json`
   >
   > Definition: `Inline schema`

6. After you select `Inline schema`, you will be prompted to "Provide a schema".

   Use the `Brackets` text editor to open the `lab5/schema_shippingSvc.yaml` file.

   Copy the contents to your clipboard and paste them into the schema editor window.

7. Click `Done` to close the Schema window



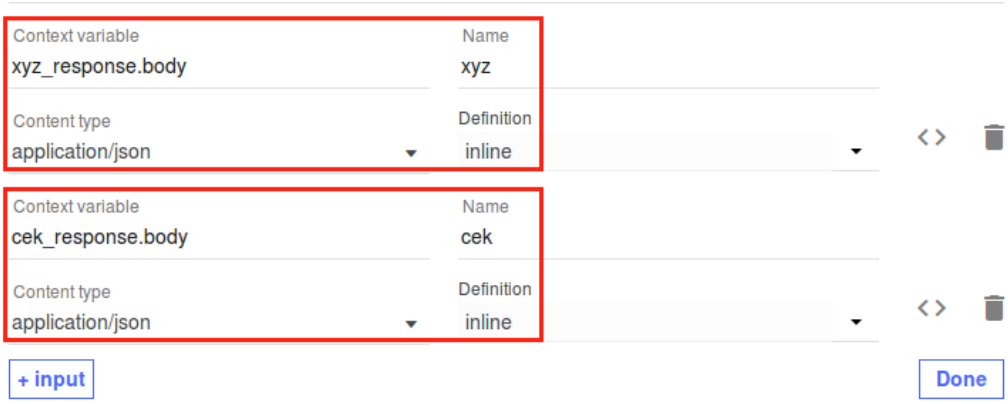
8. Click the `+input` button again to add another input. Specify the following input configuration:

   > Context variable: `cek_response.body`

> Name: `cek`
>
> Content type: `application/json`
>
> Definition: `Inline schema`

9. Paste the same schema definition that was used for the previous input (for our lab purposes, the responses from the shipping service are in the same format, thus using the same schema)

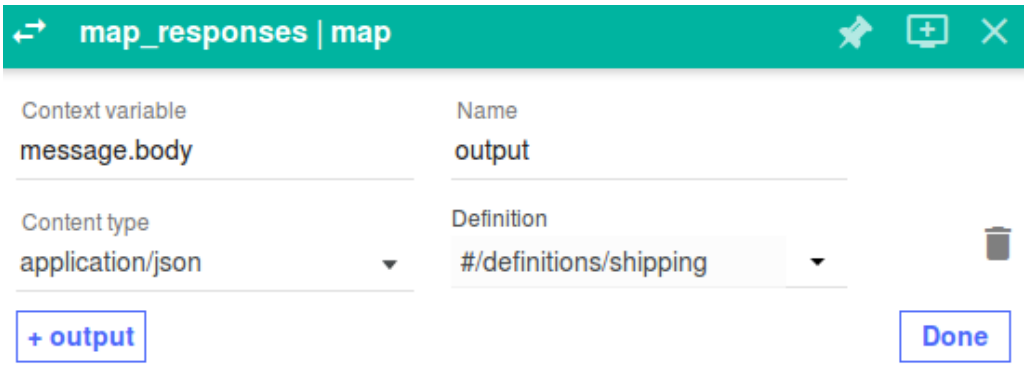
10. You now have two inputs assigned to the `map` policy:



11. Click the `Done` button to return to the editor.

12. Click the `pencil` icon next to `Output`, then click the `+ output` button to add an output field with the following properties:

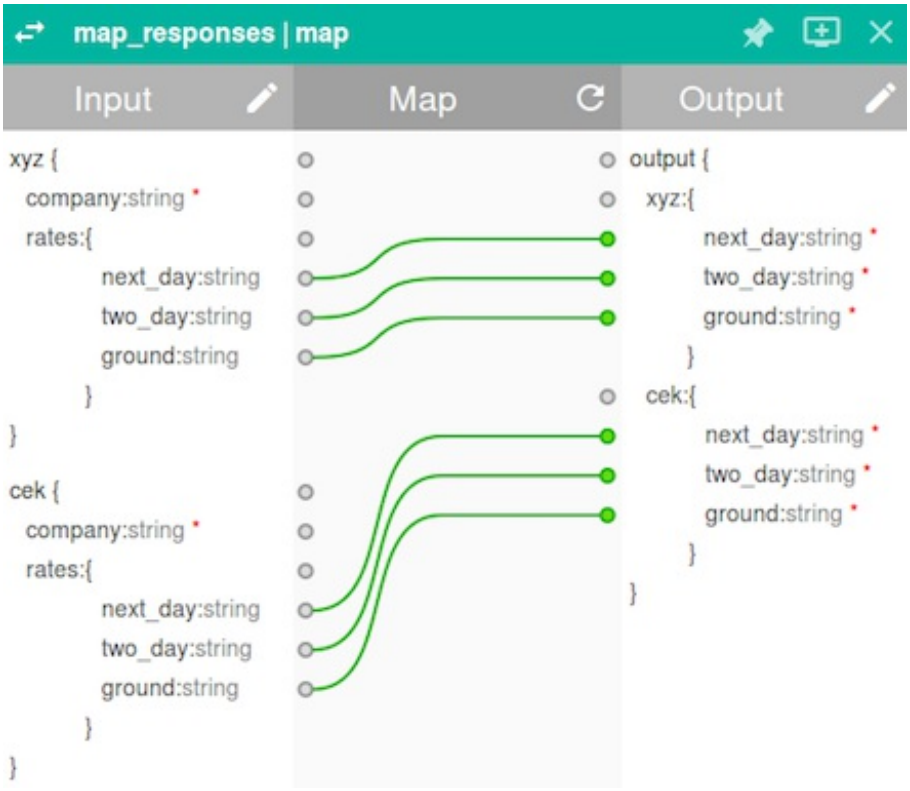
> Context variable: `message.body`
>
> Name: `output`
>
> Content type: `application/json`
>
> Definition: `#/definitions/shipping`



13. Click the `Done` button to return to the editor.

14. Complete the mapping. To map from an input field to an output field,

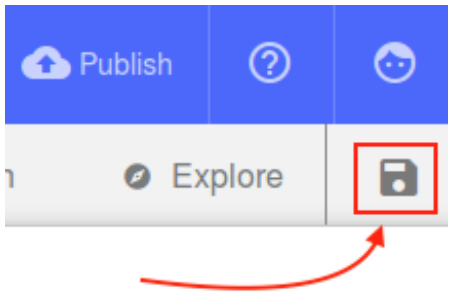
click the circle next to the *source* element once, then click the circle next to the *target* element. A line will be drawn between the two, indicating a mapping from the source to the target.



15. Click the `X` to close the map editor.

    Your assembly policy for the `shipping.calc` operation is now complete.

16. Save your changes.



5.2.2.2 - Configure the `get.stores` Case:

This operation will call out to the Google Geocode API to obtain location information about the provided zip code, then utilize a simple gatewayscript to modify the response and provide a formatted Google

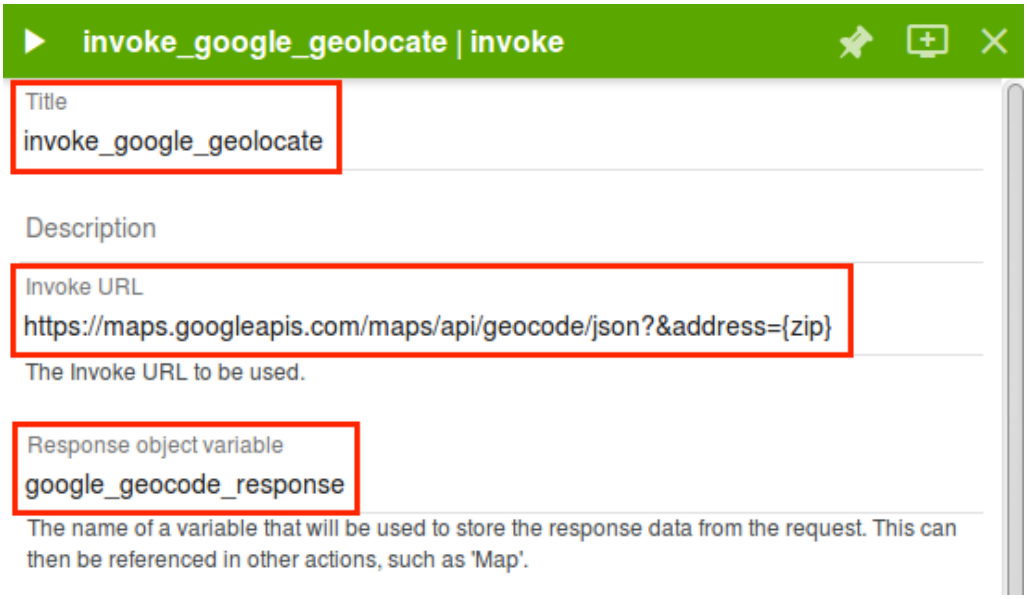
Maps link.

1. Add an invoke policy to the `get.stores` case with the following properties:

   > Title: `invoke_google_geolocate`

   > Invoke URL: `https://maps.googleapis.com/maps/api/geocode/json?&address={zip}`

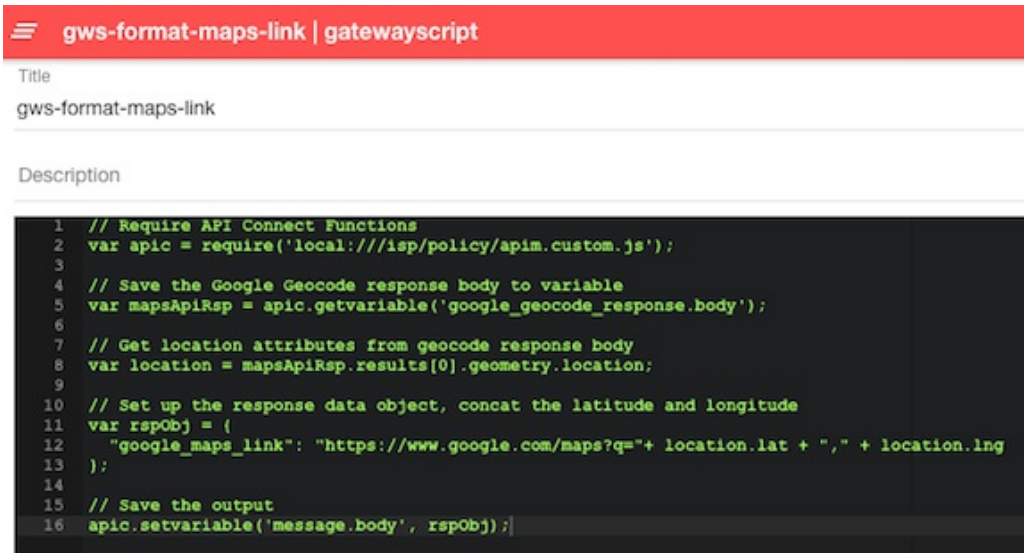
   > Response object variable (scroll to the bottom): `google_geocode_response`



2. Add a `gatewayscript` policy with the following properties:

   > Title: `gws-format-maps-link`

   > Paste the contents of `lab5/gws_formatMapsLink.js` into the code section of the policy.

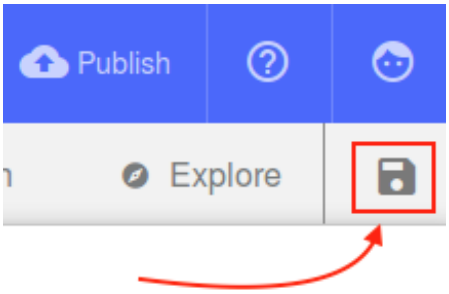


> 
>
> Take a quick look at line 5. Notice how our gateway script file is reading the body portion of the `google_geocode_response` variable which was assigned to the output of the `invoke` action.

3. Click the `X` to close the gatewayscript editor.

4. Your assembly for the `logistics` API will now include two separate operation policies:

5. Save your changes.



6. Close the Firefox browser by clicking the `x` on the tab or browser window.

7. Return to your `Terminal Emulator` session.

8. Even though we closed the browser, the API Designer application itself is still running.

   Hold the `control` key and press the `c` key to end the API Designer session:

```
control+c
```

   This will return you to the command line prompt.

Lab 5 - Validation

Using both the CLI and the API Designer, a lot of files have been created and updated. Before moving on to the next lab, a simple script has been provided for you which will validate your source files against those of a completed lab. These next steps will help ensure that easily made typing errors do not cause problems down the line.

1. From the `Terminal Emulator`, type:

   ```
   validate_lab 5
   ```

2. The script will execute a series `diff` commands against specific files in your project folder (`~/ThinkIBM/inventory`)

3. If the output of the `validate_lab` script includes discrepencies, you may merge the corrected changes into your source files by typing:

   ```
   merge_lab 5
   ```

Lab 5 - Conclusion

Congratulations! You have successfully configured two new API's with advanced assemblies. In the next lab, you will bundle the API's into a Product and publish it to the consumer portal.

Proceed to Lab 6 - Working with API Products

Lab 6 - Working with API Products

API's published by API Connect are bundled into an object called a **Product**. The Product combines one or more API's with one or more Plans.

A **Plan** is effectively a contract between the API Provider and API Consumer which specifies the allowed rate of API calls over a given period of time.

Lab 6 - Objective

In the following lab, you will learn:

- How to create a Product
- How to attach APIs to a Product
- How to create a Plan
- How to publish a Product

Lab 6 - Case Study Used in this Tutorial

Your work as an Application Developer / API Designer is now complete. It's time to switch roles and become an API Product Manager. The role of the API Product Manager is to take the developed assets and bundle them together using a go-to-market strategy.

In the case of **ThinkIBM**, you will publish all of our API's together as a single product offering to API Consumers. Additionally, you will create two plans which have different levels of access to your APIs.

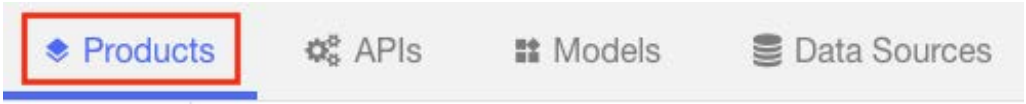
Lab 6 - Step by Step Lab Instructions

6.1 - Creating an API Product

1. If the API Designer screen has not already been launched, open a terminal and start the designer by issuing the following commands:

```
cd ~/ThinkIBM/inventory
apic edit
```

2. Switch to the `Products` tab



3. Click the link for the `inventory` product.

> 
>
> This product was automatically created during creation of the Inventory LoopBack application.

4. Edit the Product Info & Contact details:

> Title: `think`

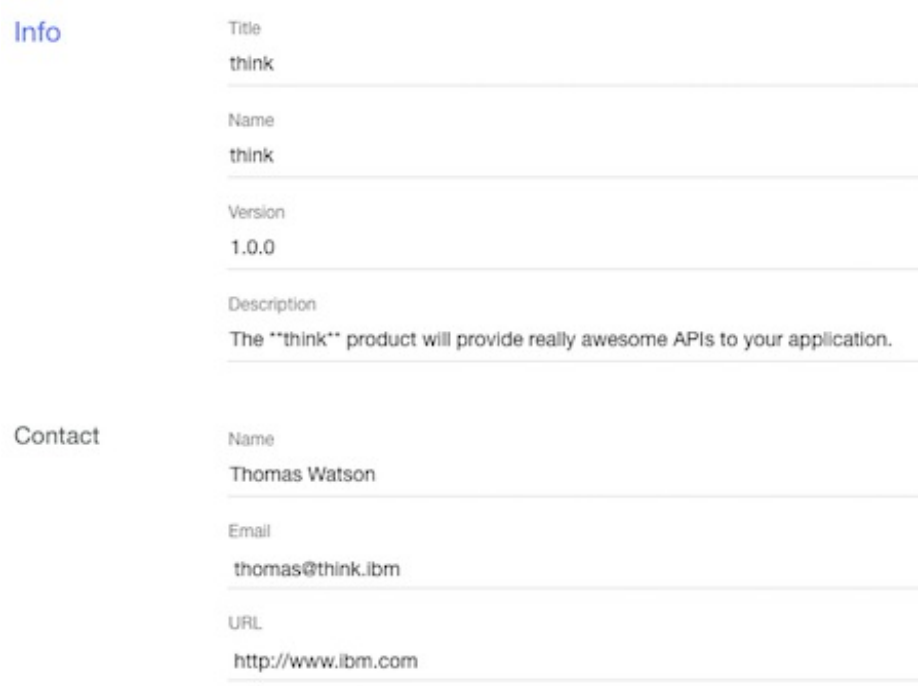
> Name: `think`

> Description:
> `The **think** product will provide really awesome APIs to your application.`

> Contact Name: `Thomas Watson`

> Contact Email: `thomas@think.ibm`

> Contact URL: `http://www.ibm.com`

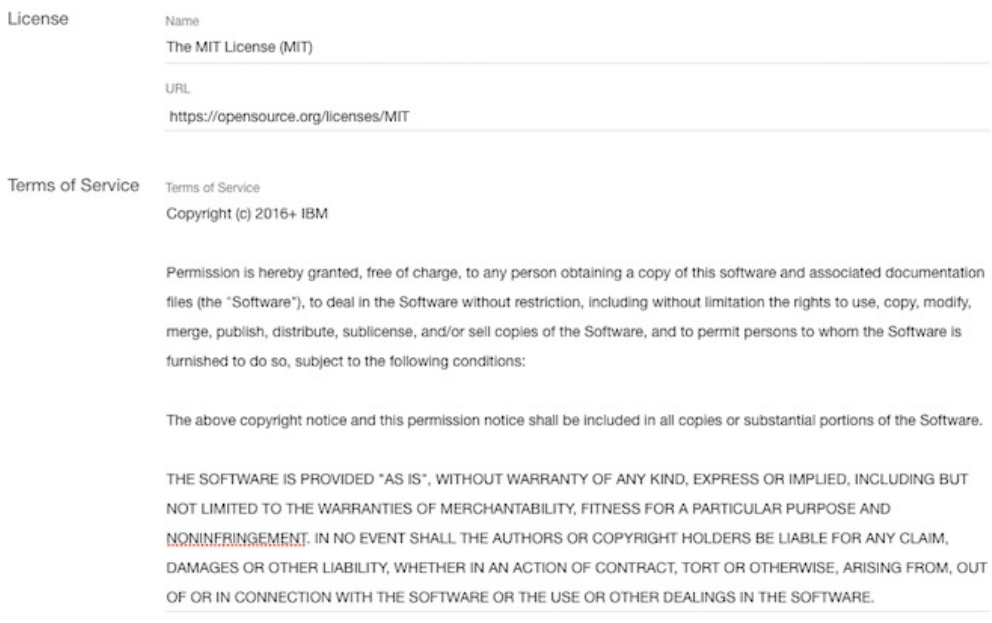


5. Specify a License and Terms of Service:

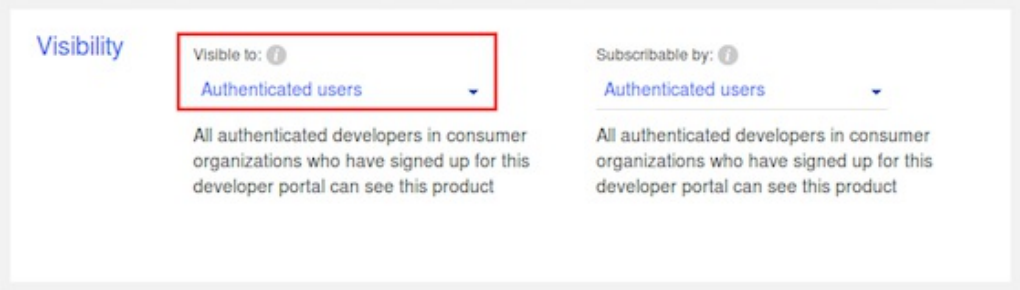
   > License Name: `The MIT License (MIT)`

   > License URL: `https://opensource.org/licenses/MIT`

   > Terms of Service: paste the contents of the `lab6/license.txt` file

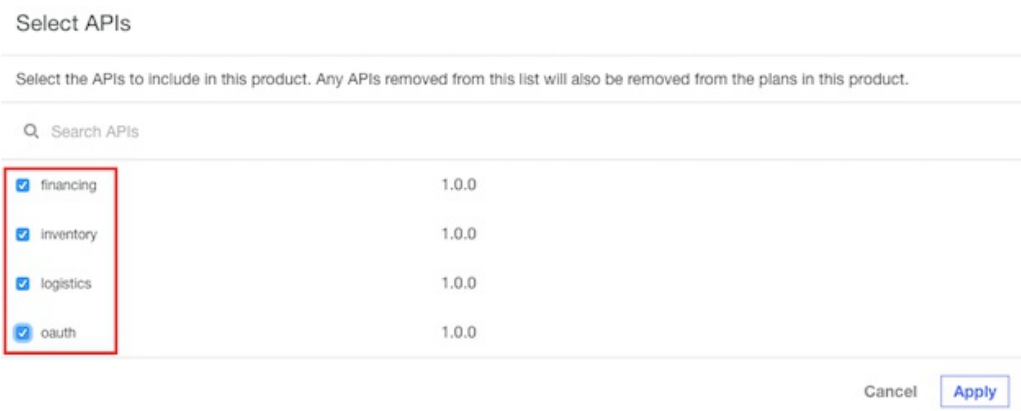


6. Modify the Visibility so that the `think` product is only visible to `Authenticated users`:



7. Navigate to the APIs section. Click the `+` button to add all of our new APIs to this product.

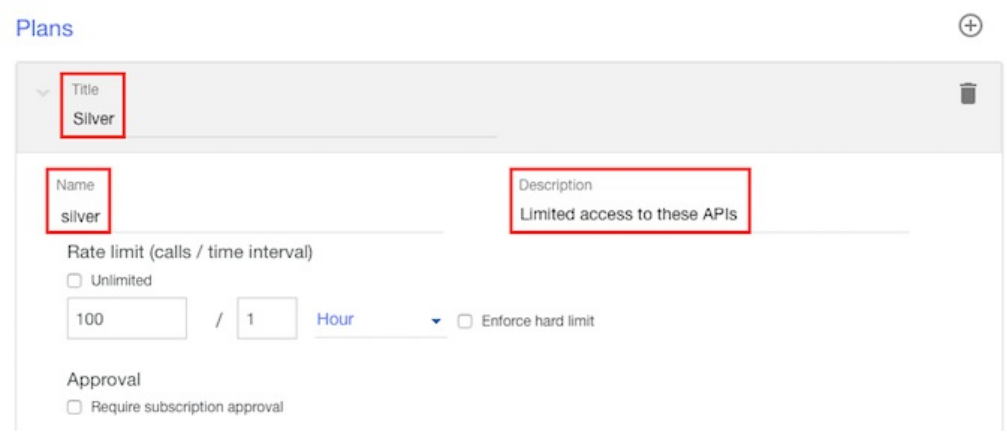
8. Check the checkboxes next to `financing`, `logistics` and `oauth`, ensuring that `inventory` is left selected.



9. Click the `Apply` button.

10. Navigate to the Plans section. Modify the default plan by selecting it and specifying the following properties:

    > Title: `Silver`
    >
    > Name: `silver`
    >
    > Description: `Limited access to these APIs`



11. Click the `+` button to create a new plan. Give it the following properties:

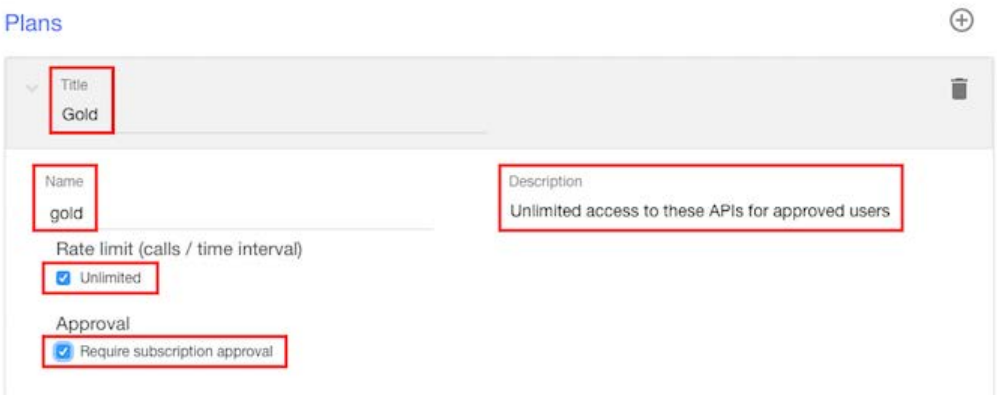
> Title: `Gold`

> Name: `gold`

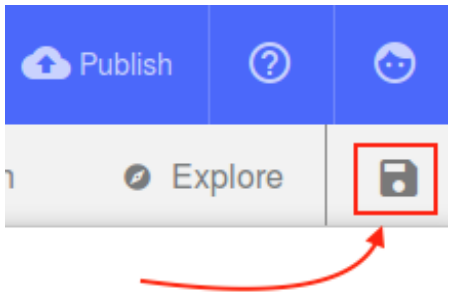
> Description:
> `Unlimited access to these APIs for approved users`

> Rate limit: `Unlimited`

> Approval: check `Require subscription approval`

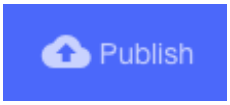


12. Save your changes.



6.2 - Publishing the API Product

1. Click the `Publish` icon.

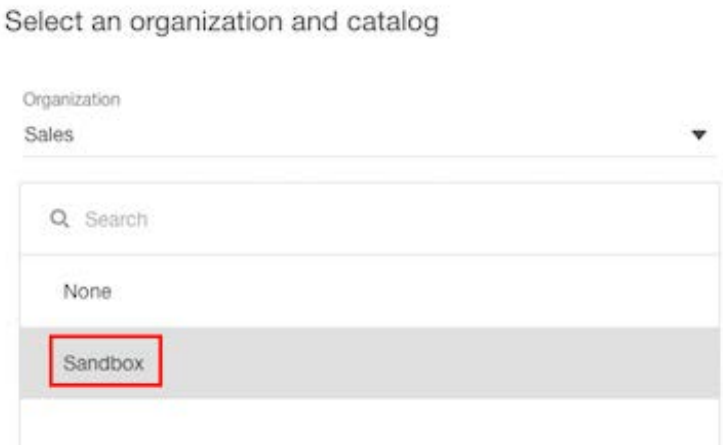


2. Select `Add and Manage Targets` from the menu.
3. Select `Add a different target`.

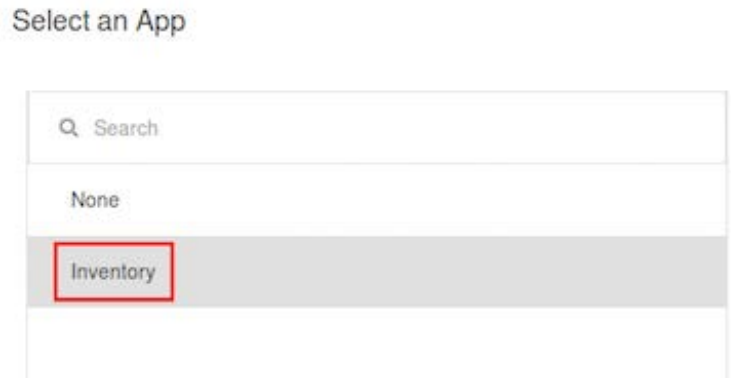
4. Provide connection information to sign into the IBM API Connect management server, then click the `Sign in` button:

   > API Connect host address: `mgr.think.ibm`
   >
   > Username: `student@think.ibm`
   >
   > Password: `Passw0rd!`

5. On the **Select an organization and catalog** screen, choose the `Sandbox` catalog and click the `Next` button.

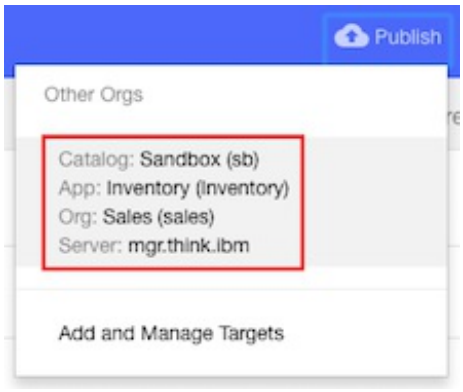


6. On the **Select an App** screen, choose the `Inventory` application and click the `Save` button.

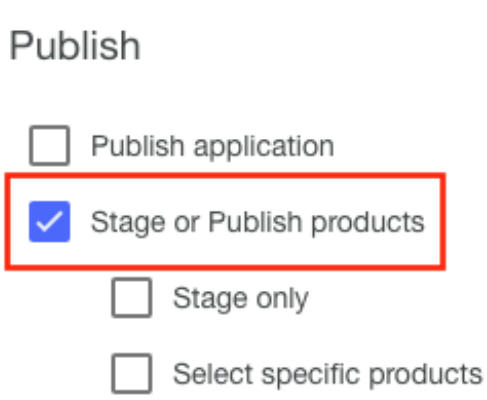


> Our offline toolkit environment is now configured to speak to the central management server.
>
> Since we already published the Inventory app in Lab 3, now all we need to do is publish the associated Product containing the APIs.

7. Click `Publish` button once more and select our target:



8. Check the box to `Stage or Publish products`:



> Here we have the opportunity to select what gets published. If we were working on multiple API products as part of this project, we could chose specific ones to publish.

> Also, the option exists to only Stage the product. A Stage-only action implies that we'll push the configuration to the Management server, but not actually make it available for consumption yet. The reason for doing this may be because your user permissions only allow staging, or that a different group is in charge of publishing Products.

9. Click the `Publish` button to make the API available in the Developer Portal and enforced on our API Gateway.

10. Wait a moment while the Product is published, a `Success` message will appear letting you know the step is complete:

11. Close the Firefox web browser.

12. In the `Terminal Emulator`, use the `control+c` keyboard command to quit the API Designer process.

Lab 6 - Validation

Using both the CLI and the API Designer, a lot of files have been created and updated. Before moving on to the next lab, a simple script has been provided for you which will validate your source files against those of a completed lab. These next steps will help ensure that easily made typing errors do not cause problems down the line.

1. From the `Terminal Emulator`, type:

```
validate_lab 6
```

2. The script will execute a series `diff` commands against specific files in your project folder (`~/ThinkIBM/inventory`)

3. If the output of the `validate_lab` script includes discrepencies, you may merge the corrected changes into your source files by typing:

```
merge_lab 6
```

4. If a merge was necessary, you will also need to re-publish the API Product in order to update the API Connect server with the latest changes.

5. Run the `apic edit` command to launch the API Designer, then repeat the steps from a moment ago to re-publish the product.

Lab 6 - Conclusion

Congratulations! You have completed Lab 6.

In this lab, you learned:

- About API Products
- How to publish an API Product

Proceed to Lab 7 - Consumer Experience

Lab 7 - Consumer Experience

In this lab, you will learn the consumer experience for APIs that have been exposed to your developer organization.

Using the developer portal, you will first login in as the admin user to load a Think IBM custom theme. You will then login as a developer to register your application and then subscribe to an API and test that API.

Lab 7 - Objective

In the this lab, you will learn:

- How to add a custom theme to change the overall look and feel of the developer portal.
- How to register an application with the developer portal.
- How to subscribe to a plan in order to consume an API.
- How to test an API from the developer portal.
- How to consume an API from a sample test application.

Lab 7 - Case Study Used in this Tutorial

In this tutorial, **ThinkIBM** wishes to brand their developer portal to their own look and feel. They also want to provide a self-service experience to application developers who are potential consumers of their APIs.

Lab 7 - Step by Step Lab Instructions

7.1 - Customize the Developer Portal

In this section, you will leverage a custom prebuilt theme. A theme file is packaged as a zip file that contains a set of predefined files. The theme zip file is what is loaded into the developer portal. The best method for creating a custom theme is to obtain an existing custom theme, rename it and change the files as explained in the table below to meet your customization needs.

Filename	Description

`overrides.css`	This style sheet overrides the fonts, colors and other defaults from the inherited base IBM API Connect theme. The name of this css file is specified in the theme.info file.
`screenshot.png`	The file contains a screenshot of the home page for the custom theme and is used in the appearance settings so you can easily find the theme you want to enable and set as the default theme. When you are finishing completing the edits to the overrides.css and have set up the welcome banner to your satisfaction, you should take a screen shot of the developer portal home page and capture it with Snagit or some other screen capture tool and place the file in the top level directory of the theme file. The name of this screenshot file is specified in the theme.info file.
`templete.php`	The template.php file contains your sub-theme's functions to manipulate Drupal's default markup. It is one of the most useful files when creating or modifying Drupal themes. With this file you can modify any theme hooks variables or add your own variables, using preprocess or process functions. Override any theme function: that is, replace a module's default theme function with one you write.

	Call hook alter functions, which allow you to alter various parts of Drupal's internals, including the render elements in forms. See http://api.drupal.org for more information about these functions.
`thinkibm_connect_theme.info`	The .info file is a static text file for defining and configuring a theme. Each line in the.info file is a key-value pair with the key on the left and the value on the right, with an "equals sign" between them (e.g. name = my_theme). The info file naming conventions needs to have the theme name specified as part of the filename. The project key in the .info file contains the name of the theme.
`theme-settings.php`	Drupal themes get a number of configurable settings options for free. For example, most provide toggle switches for the search box, site slogans, user pictures, and so on. Similarly, most provide file uploading widgets to add a custom logo or favicon. These settings are easy: Drupal will add them to the theme's configuration page by default, so it takes no extra work. We want to create our own custom setting, however; one that adds a hidden field that contains the current release

	information to the Theme configuration form. To do that, we'll need to add a new file to the theme: `theme-settings.php`. The function name specified within this file needs to be prefixed with the theme name: `thinkibm_connect_theme`.
`thinkibm_welcome_banner.png`	This file provides the image that shows up in the welcome banner. Although the welcome banner does not need to be part of the theme zip file contents, it is useful to place the welcome banner with other theme files.
`favicon.ico`	In web development, you can provide a small logo for your site that appears near the address bar and in the bookmarks folder in a visitor's browser. This logo is called the favicon. Drupal provides a default one, which is the recognizable water drop logo. Using the Drupal logo as the favicon is fine but if you really want to make your site stand out, you should provide your own. Favicon files are in the .ico format and are extremely small in dimensions. The default Drupal favicon is 32 pixels high by 32 pixels wide, many browsers use a 16 x 16 pixel version that can be included in the same file. This is because the favicon is only an icon that shows up in the

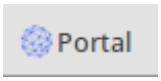
	address bar and favorites (bookmarks) list and typically there is not a lot of room there. Any favicon that you create should be just as small.
`logo.png`	The default logo that appears at the top left-hand side of the developer portal page.

7.1.1 - Install and Configure a Custom Theme

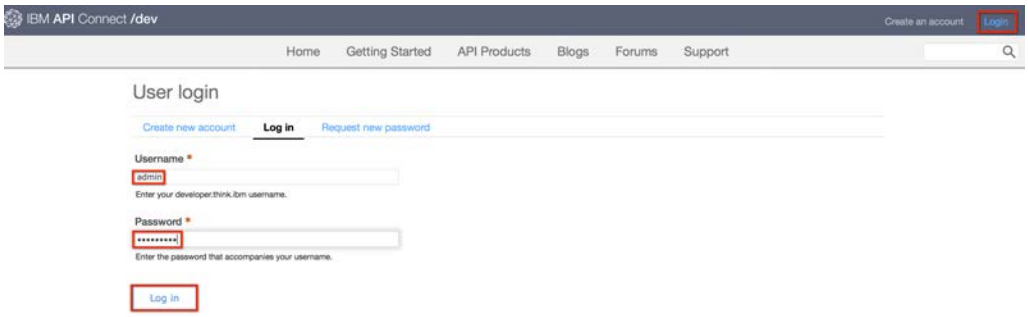
Now that we have explained the contents of a custom theme file, it is time to load the custom theme.

Note:* If this section is already complete in your lab environment, follow the steps and review the options.

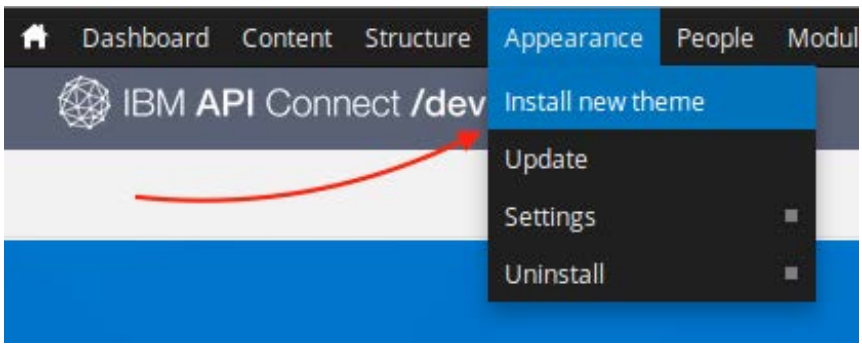
1. From the Firefox browser, click the `Portal` bookmark on the toolbar to lauch the developer portal.



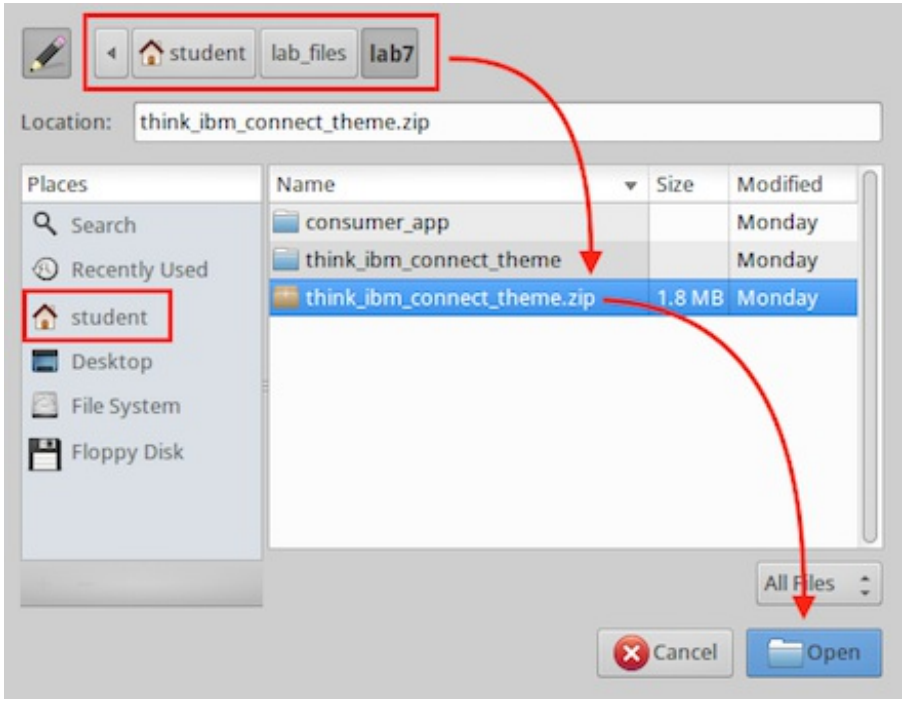
2. Login into the developer portal as an administrator using a username of `admin` and a password of `Passw0rd!`.



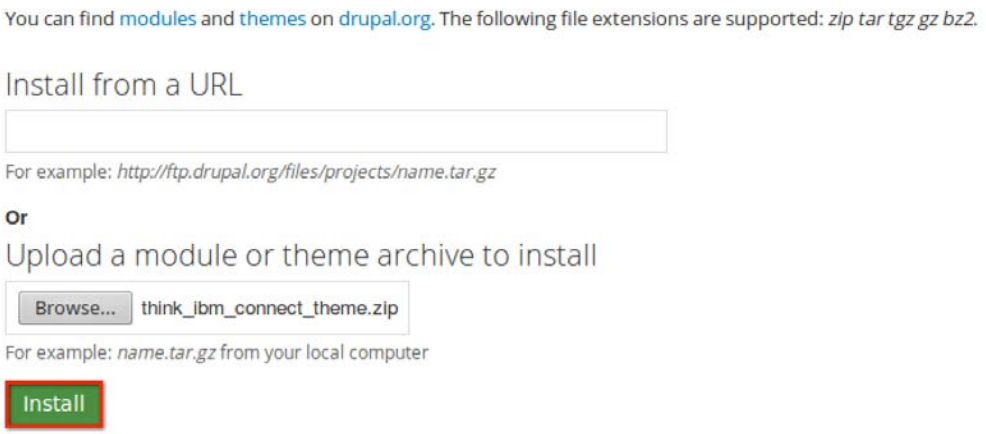
3. From the Administrator menu, select `Appearance` and then `Install new theme`.



4. Click the `Browse` button and navigate to the `/home/student/lab_files/lab7/` directory and select the `think_ibm_connect_theme.zip file`, then click the `Open` button.

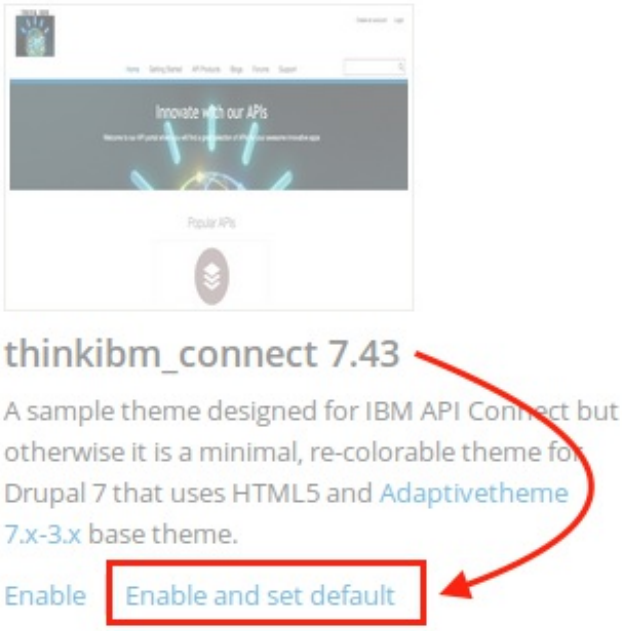


5. Click the `Install` button to install the **ThinkIBM** custom theme.

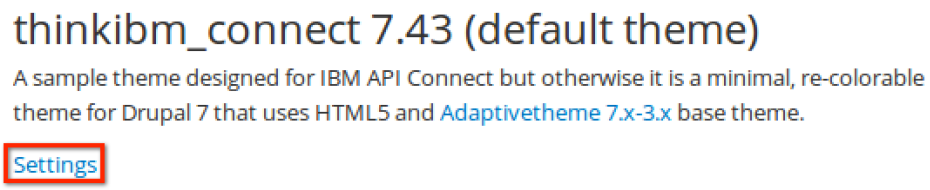


6. The installation of the custom theme completes. Click the `Enable newly added themes` link.

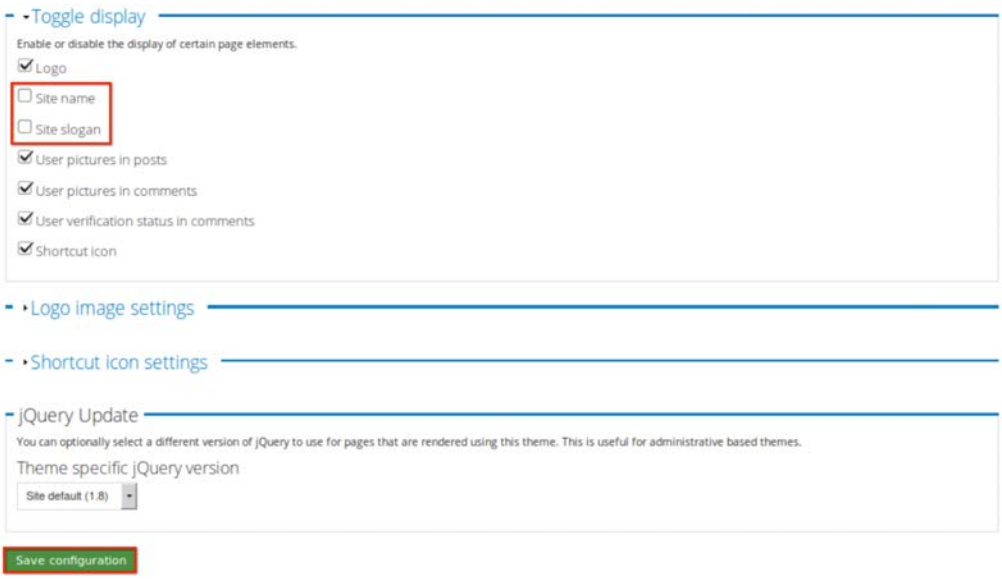
7. Scroll down the list of themes to find the `thinkibm_connect 7.43` theme. Click the `Enable and set default link` link.



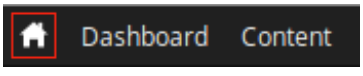
8. We need to go into settings for the theme and save the configuration. Click the `Settings` link under the theme.



9. Scroll down to the bottom of the settings page to find the **Toggle Display** section. Expand the **Toggle click the** `Save Configuration` button at the bottom of the screen:



10. Click the `Home` icon to return to the home page.

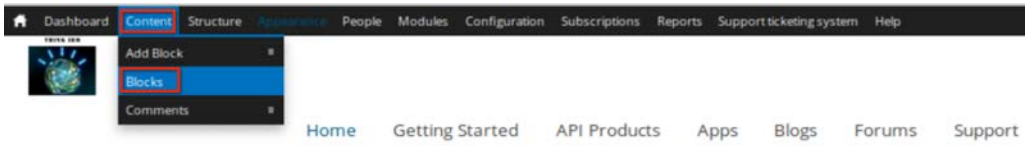


7.1.2 - Customize the Welcome Banner

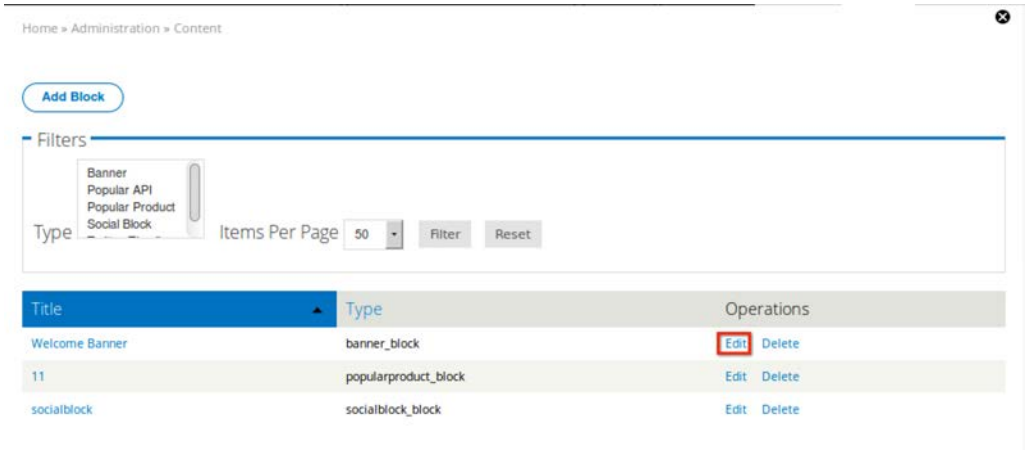
Note:* If this section is already complete in your lab environment, follow the steps and review the options.

Now we want to change the default Welcome banner to use our custom Welcome banner image.

1. Navigate to the blocks content page by selecting `Content > Blocks` from the admin menu.

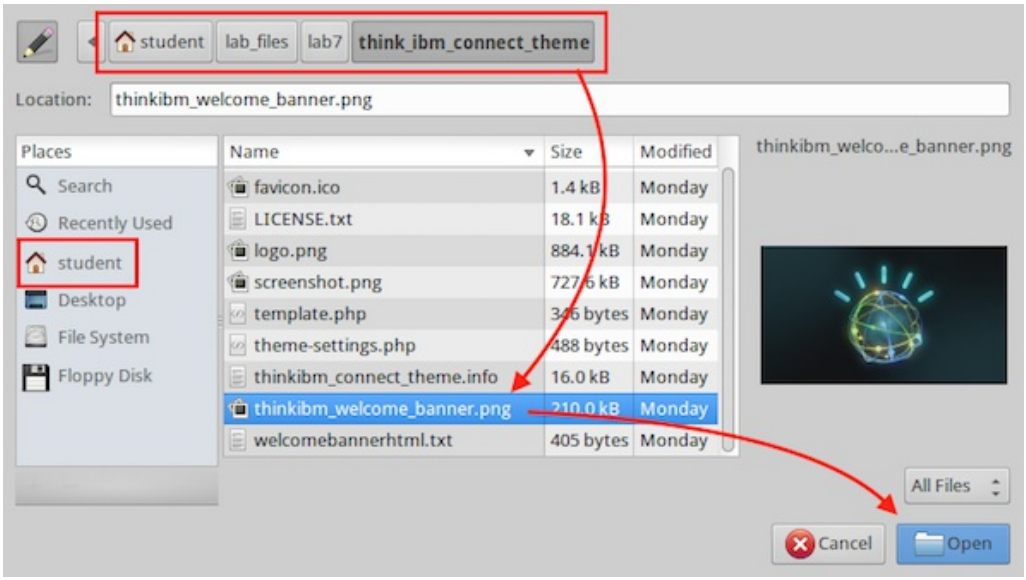


2. Underneath operations select `Edit` to the right of the Welcome banner block.



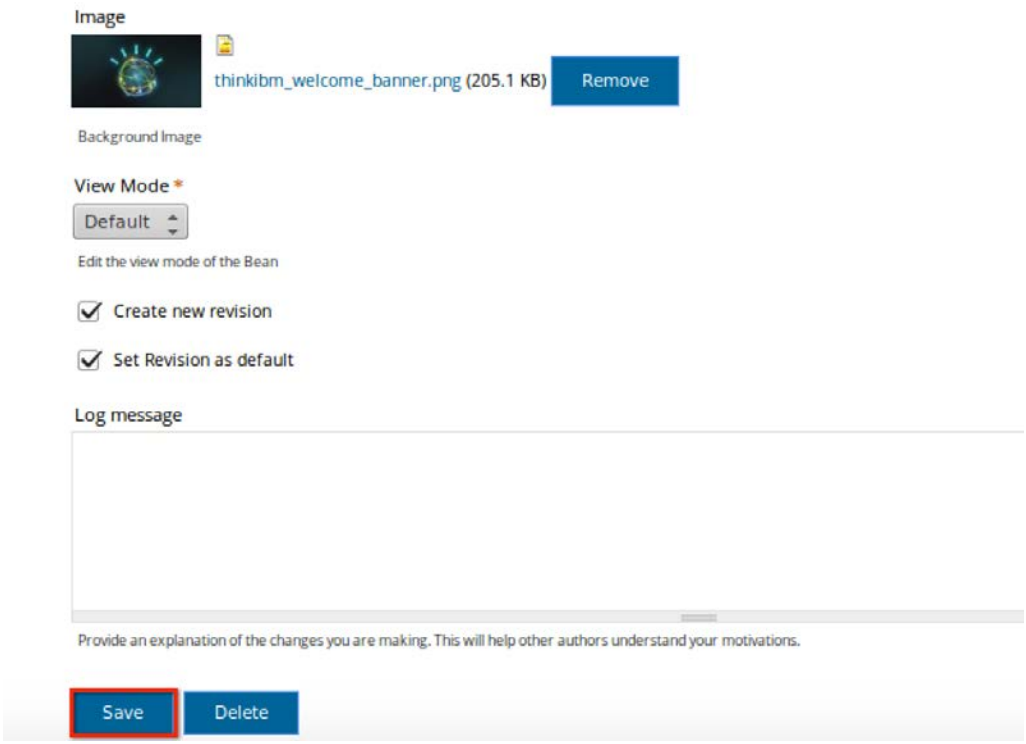
3. Scroll down the banner edit page, click the `Browse` button underneath **Image** to launch the file explorer.

4. Navigate to the `/home/student/lab_files/lab7/think_ibm_connect_theme` directory and select the `thinkibm_welcome_banner.png` file. Then, click the `Open` button.

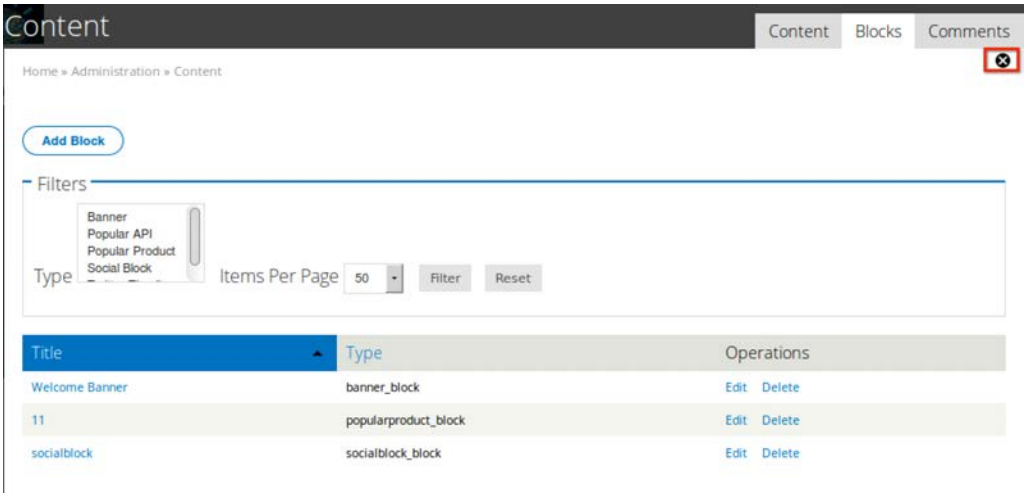


5. Click the `Upload` button to upload the new welcome banner image.

6. Scroll to the bottom of the page and click the `Save` button.



7. Close the content block settings.

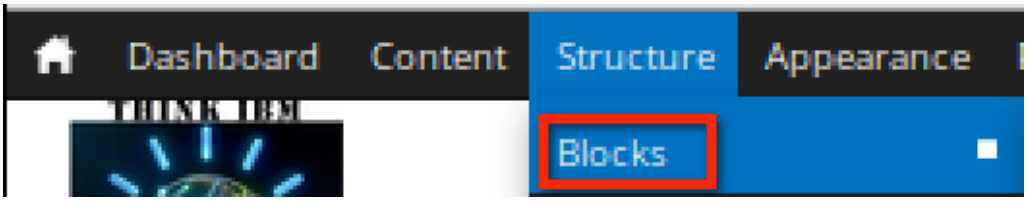


7.1.3 - Change the Region Settings for the Content Blocks

Note:* If this section is already complete in your lab environment, follow the steps and review the options.

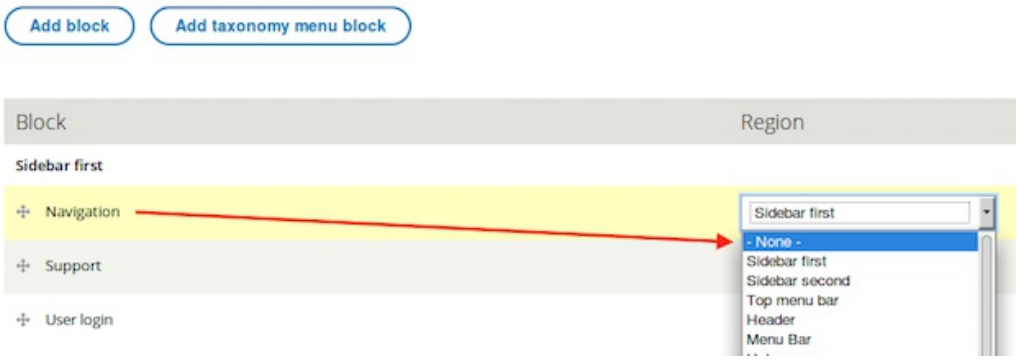
The region settings for some of the content blocks have been reset, so we will set these back.

1. Navigate to the region settings for block content page by selecting `Structure > Blocks` from the admin menu.



2. Locate the **Sidebar first** block. You will see entries for `Navigation`, `Support` and `User login`.

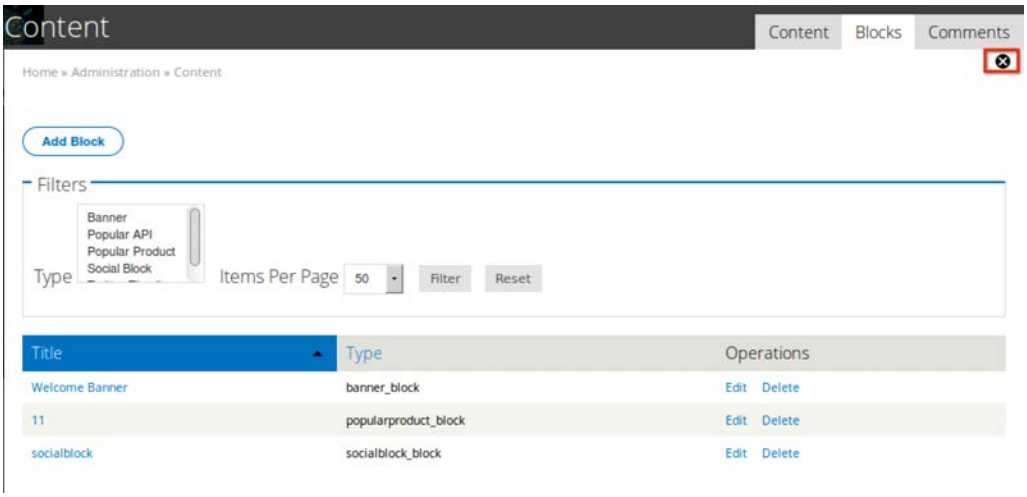
3. For **both** the `Navigation` and `User Login` entries, select `– None –` from the drop down menu.



4. The only entry left in the section should be `Support`.

5. Scroll down to the bottom of the screen anc click the `Save Blocks` button.

6. Click close on the block region settings.

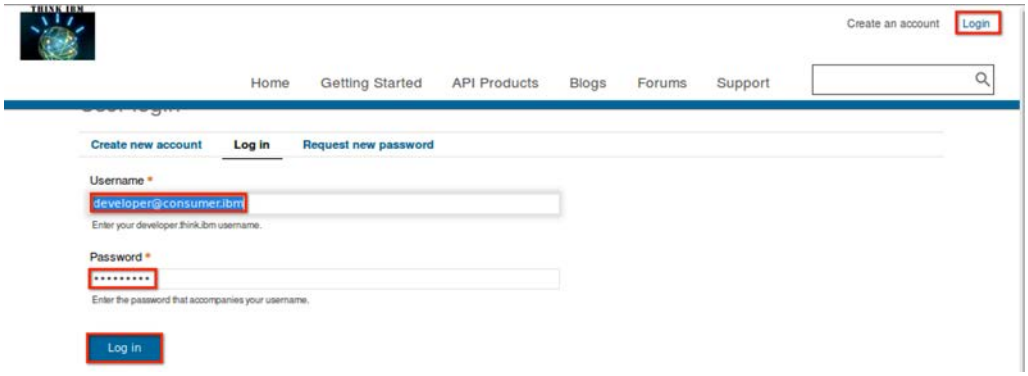


7. You are finished with customizing the developer portal. There is a lot more that can be customized than what we have time for in this lab. Log out of the developer portal.

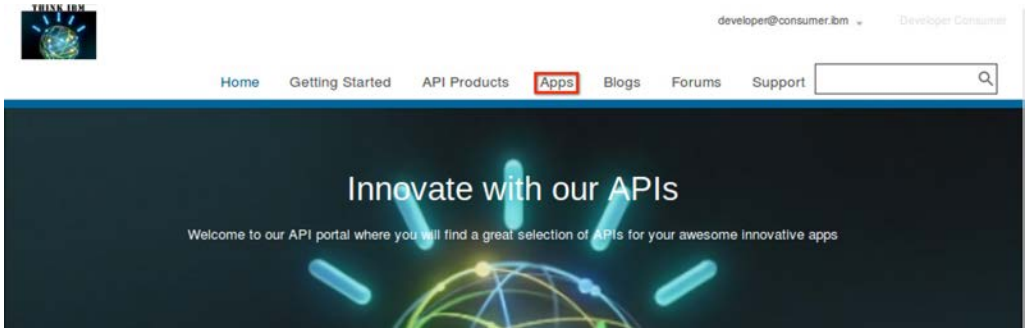
7.2 - Register an Application as a Developer

In this section, you will log into the portal as a user in the application developer role, then register an application that will be used to consume APIs.

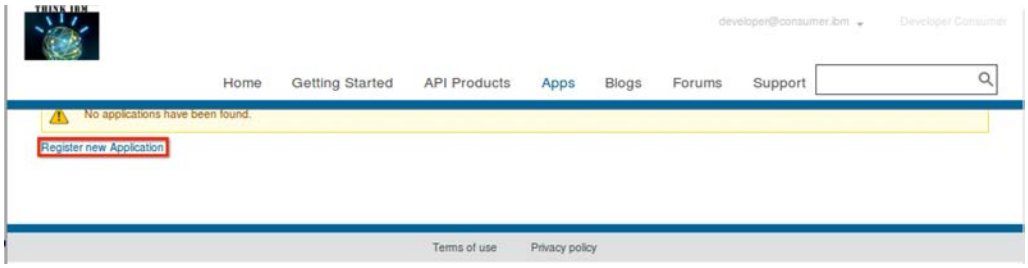
1. Login into the developer portal as an application developer using a username of `developer@consumer.ibm` and a password of `Passw0rd!`.



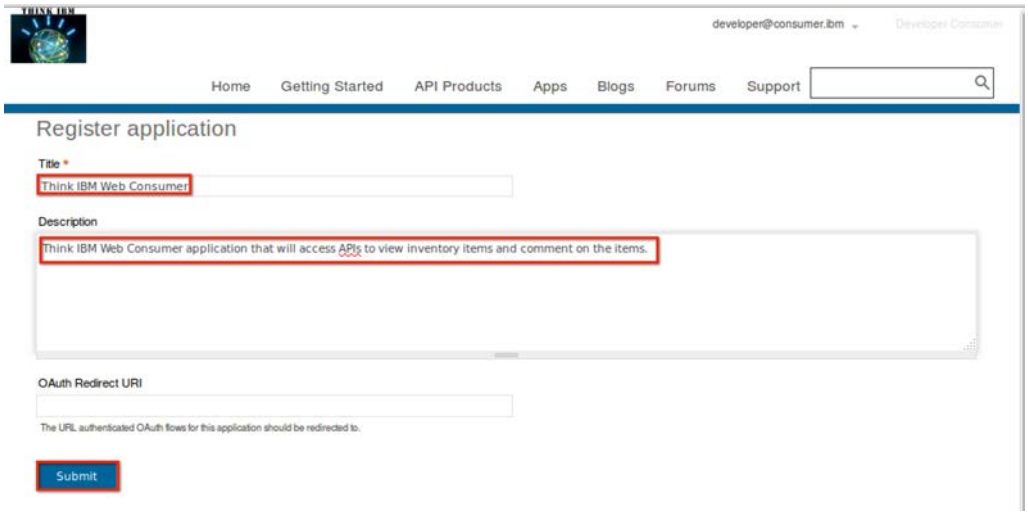
2. Click the `Apps` link.



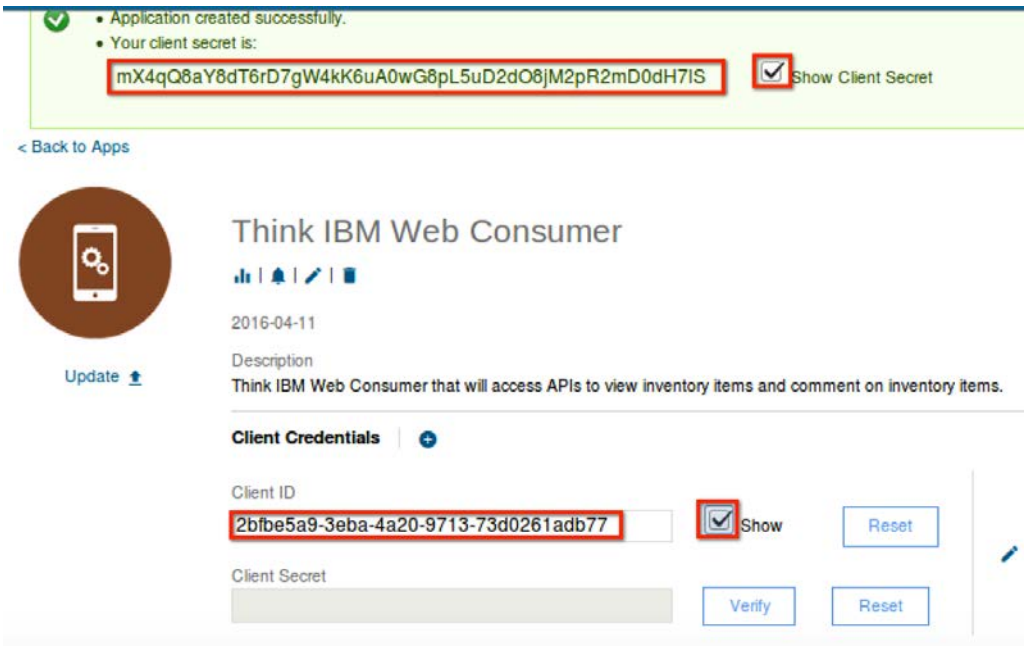
3. Click the `Register new Application` link.



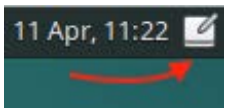
4. Enter a title and description for the application as shown below and click the `Submit` button.



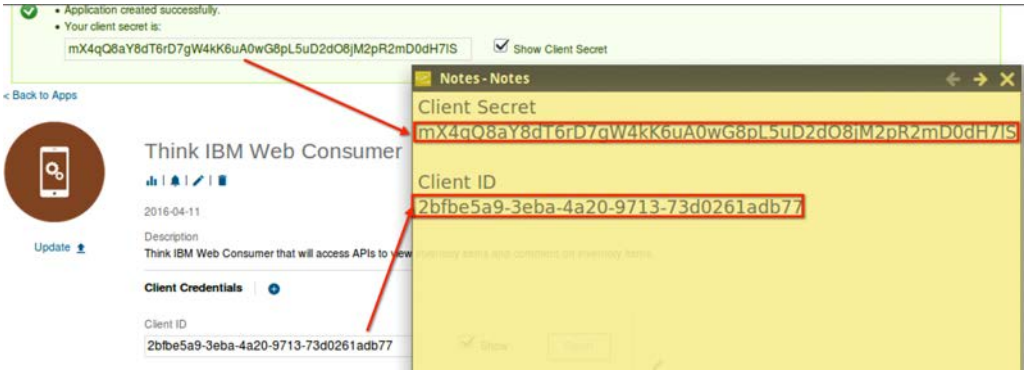
5. We need to capture the Client Secret and Client ID in a text editor for later use by our web application. Select the `Show Client Secret` checkbox next to Client Secret at the top of the page and the `Show` checkbox next to Client ID.



6. Launch the `Notes` application as shown below.



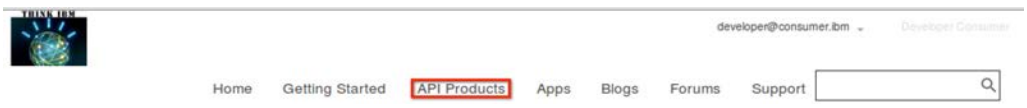
7. Navigate back to the browser and copy/paste both the Client ID and Client Secret into the Notes application window as shown below. Add a notation above each item so you know which value is the Client ID and which is the Client Secret. Do not exit the Notes application as we will need these values later in this lab.



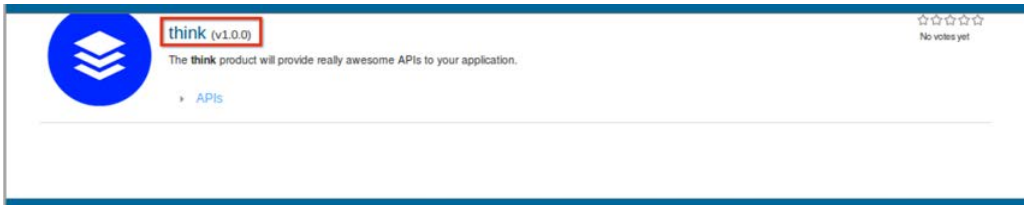
7.3 - Subscribe to a Plan for the ThinkIBM APIs

In this section, we will subscribe to a plan for the ThinkIBM APIs using the Think IBM Web Consumer application.

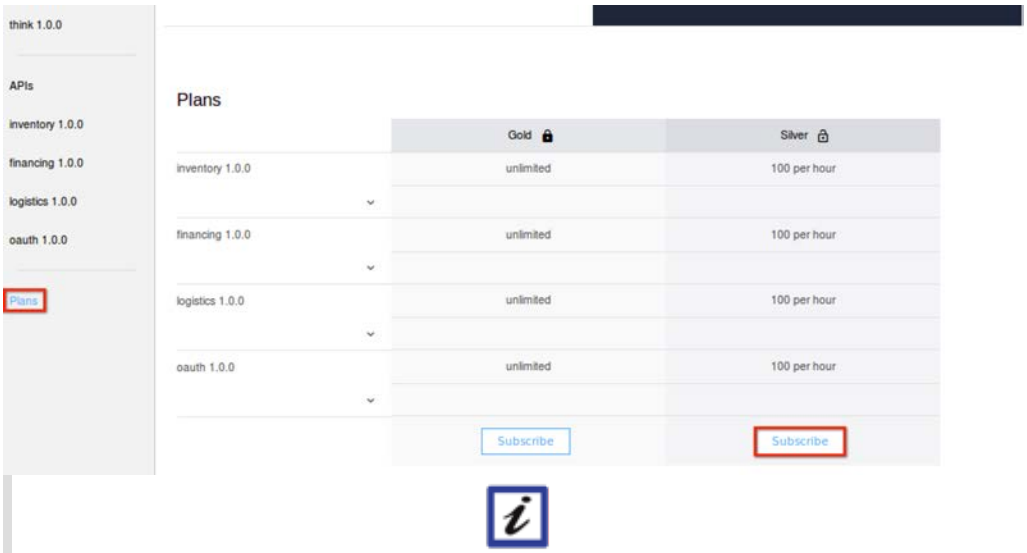
1. Click the `API Products` link.



2. Click the `think (v1.0.0)` API product link.



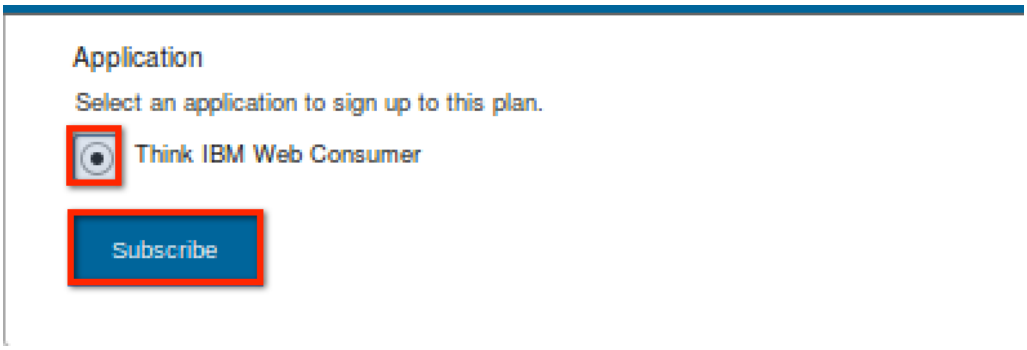
3. Click the `Plans` link on the left-hand navigation menu and then click the `Subscribe` button under the **Silver** plan as shown below.



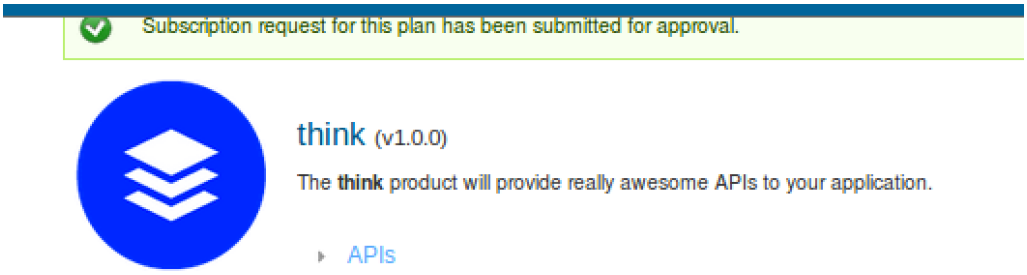
Alt text

The Gold plan requires approval by the API provider for any subscription requests and allows unlimited requests for a given time period. The Silver plan is limited to 100 requests per hour and does not require approval by the API provider for subscription requests.

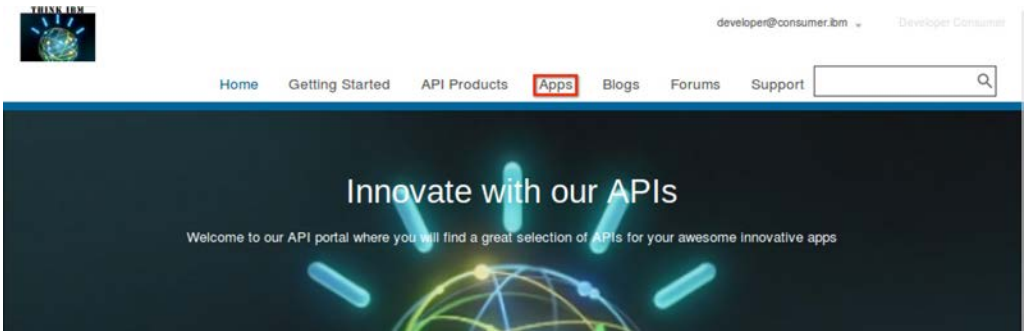
4. Select the `Think IBM Web Consumer` toggle and click the `Subscribe` button.



5. The `Think IBM Web Consumer` Web application is now subscribed to the Silver plan for the `think` API product.

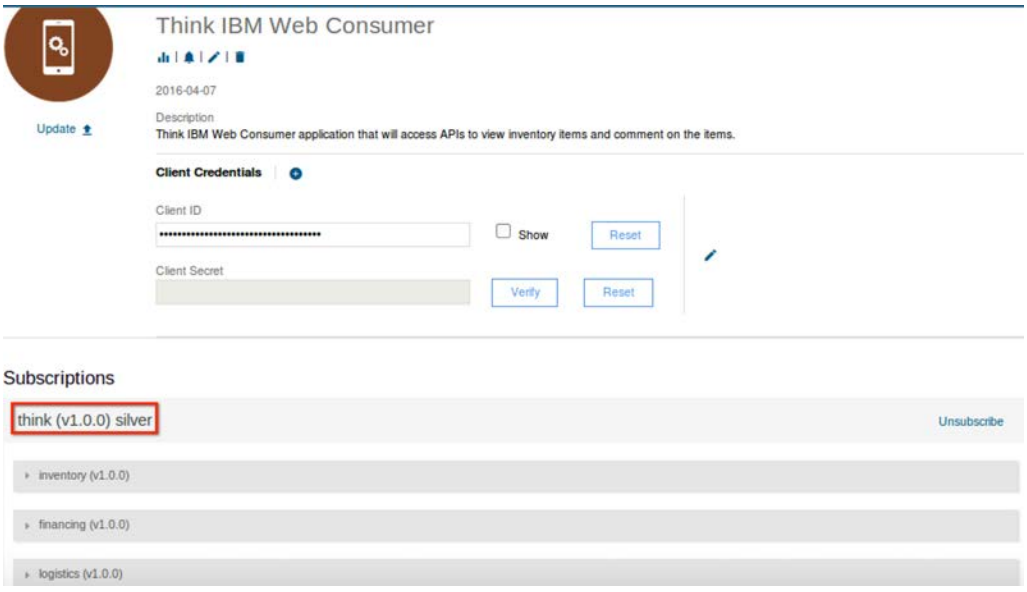


6. Let's validate that we subscribed to the Silver plan for the `think v1.0.0` API product. Click the `Apps` link.



7. Click the `Think IBM Web Consumer` application link.

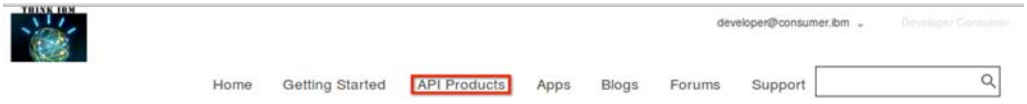
8. The `Think IBM Web Consumer` application is subscribed to the Silver plan for the `think` product as shown below.



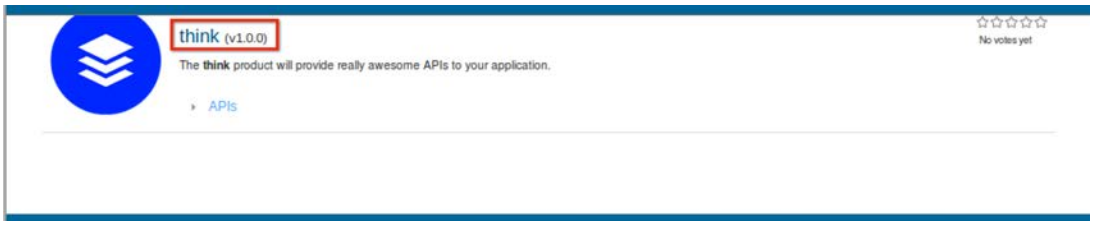
7.4 - Test `think` Product APIs from the Developer Portal

In this section, we will use the developer portal to test one of the think product APIs. This is useful for application developers to ***try out*** the APIs before their application is fully developed or to simply see the expected response based on inputs they provide the API. Later in this lab, you will run an actual application that is already developed and uses these same APIs. We will test the `logistics` API from the developer portal.

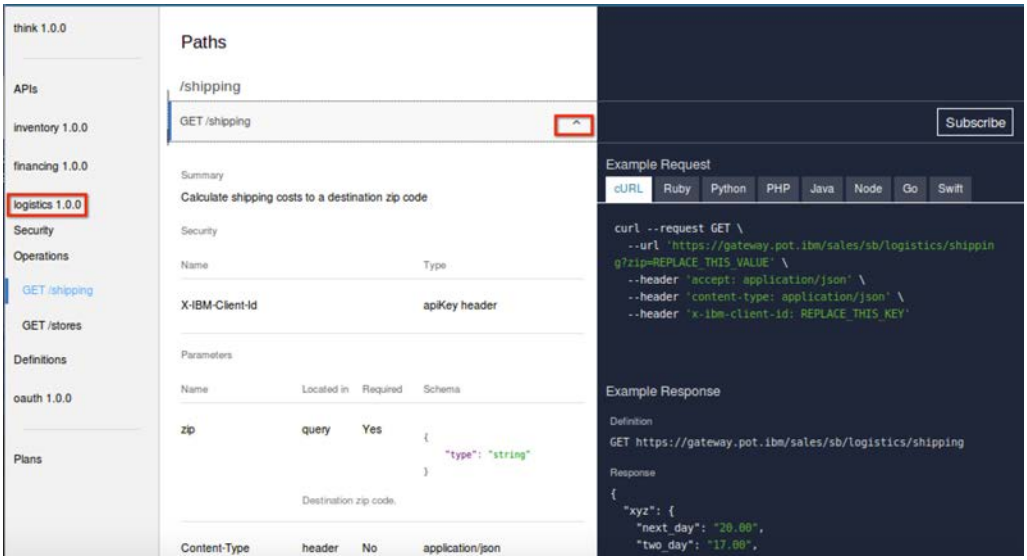
1. Click the `API Products` link.



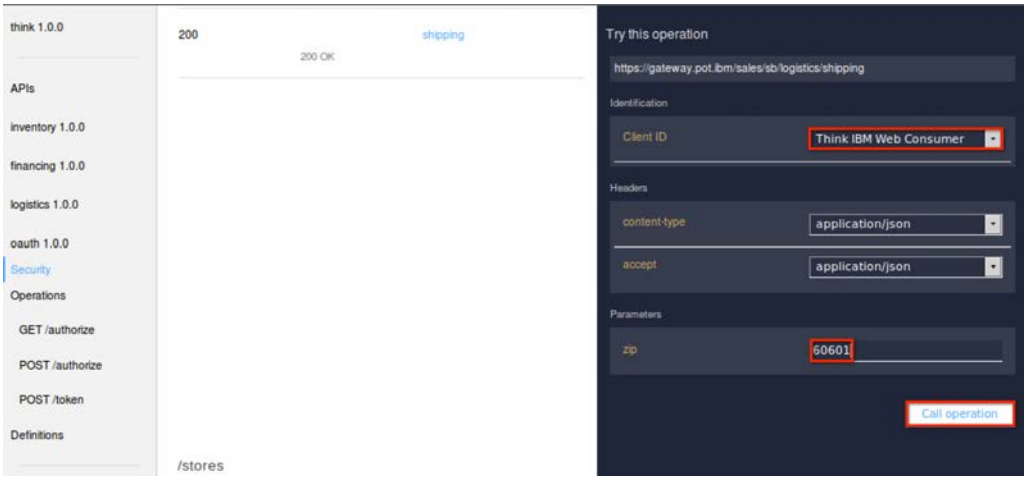
2. Click the `think (v1.0.0)` API product link.



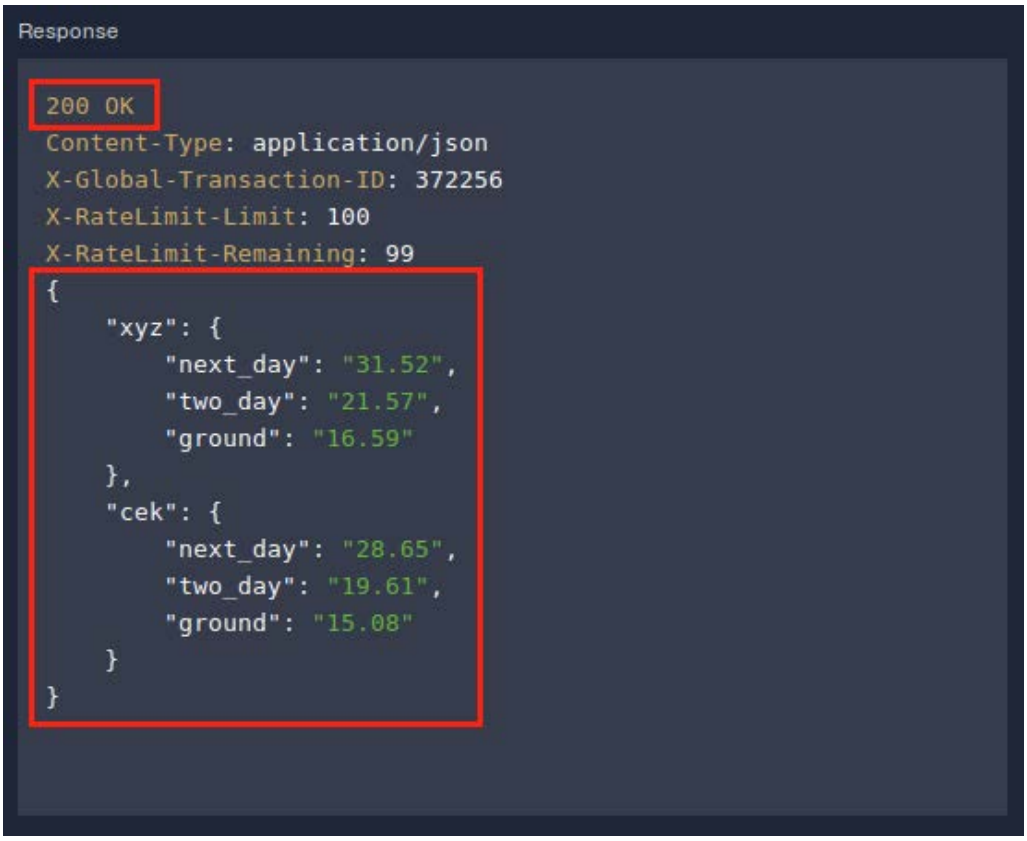
1. Click the `logistics 1.0.0` link on the left-hand navigation menu and then expand the `GET /shipping` path by clicking on the twisty next to the path.



2. Scroll down to the **Try this operation** section for the `GET /shipping` path. Enter any zip code and click the `Call Operation` button.



3. Scroll down below the `Call operation` button. You should see a `200 OK` and a response body as shown below.

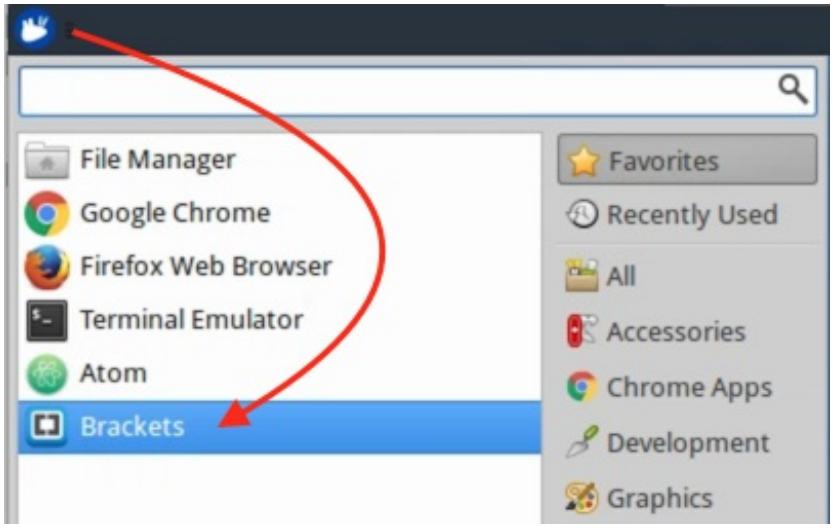


7.5 - Configure and Run a Consumer Application

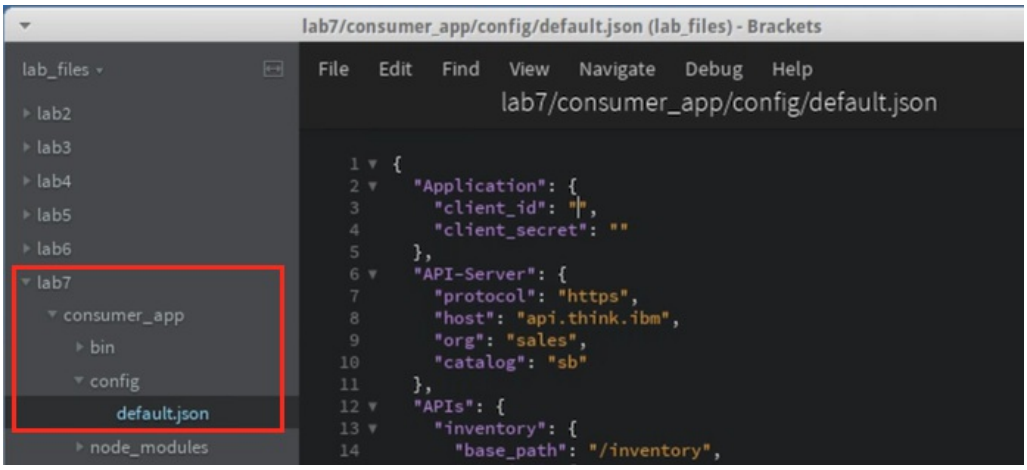
In this section, we will edit a config file for an implementation of the `Think IBM Web Consumer` application. The application is pre-configured to communicate with our API Connect environment and the API's which you just created.

The application will handle the OAuth token exchange on our behalf, as well as provide the Client ID and Client Secret for all API calls so that they will pass entitlement validation.

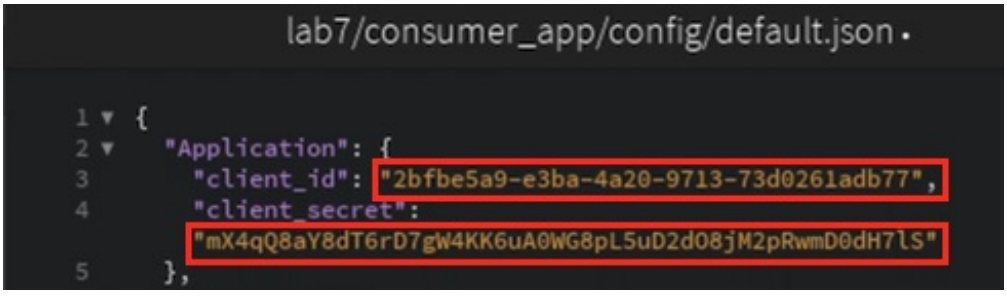
1. Launch the `Brackets` text editor window from the task bar if it is already open, or from the favorites menu as shown below:



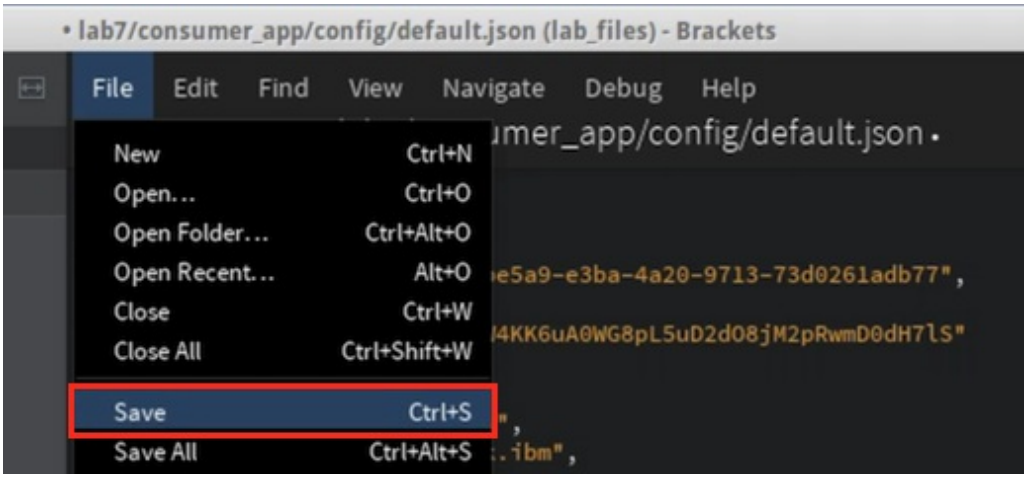
2. In the `Brackets` text editor file tree menu, expand the `lab7 > consumer_app > config` folder and select the `default.json` file to edit the source.



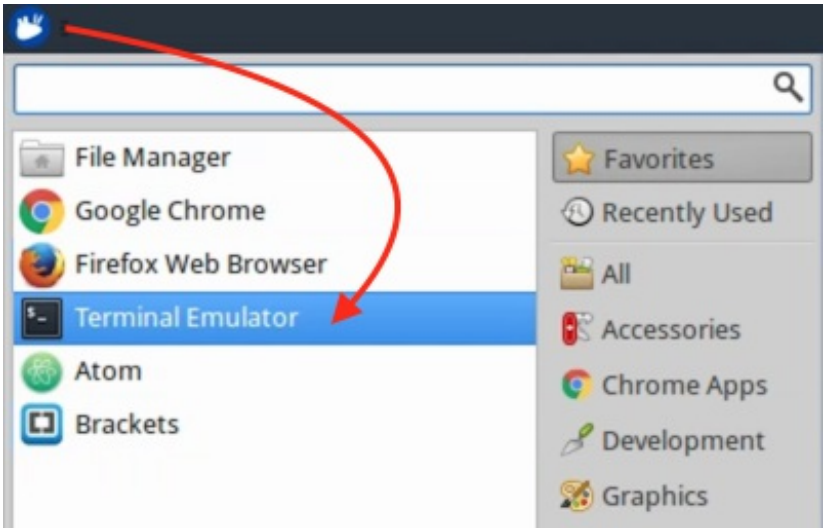
3. Using the Client ID and Client Secret values in the Notes application, copy/paste them into the `"client_id":""` and `"client_secret":""` values between the quotes in the `default.json` file as shown below:



4. With the `default.json` tab in the Brackets text editor window selected, choose `File > Save` from the application menu.



5. Now we will open a fresh Terminal Emulator window so we can start the `Think IBM Web Consumer` application. Click the favorites menu and select `Terminal Emulator` as shown below.



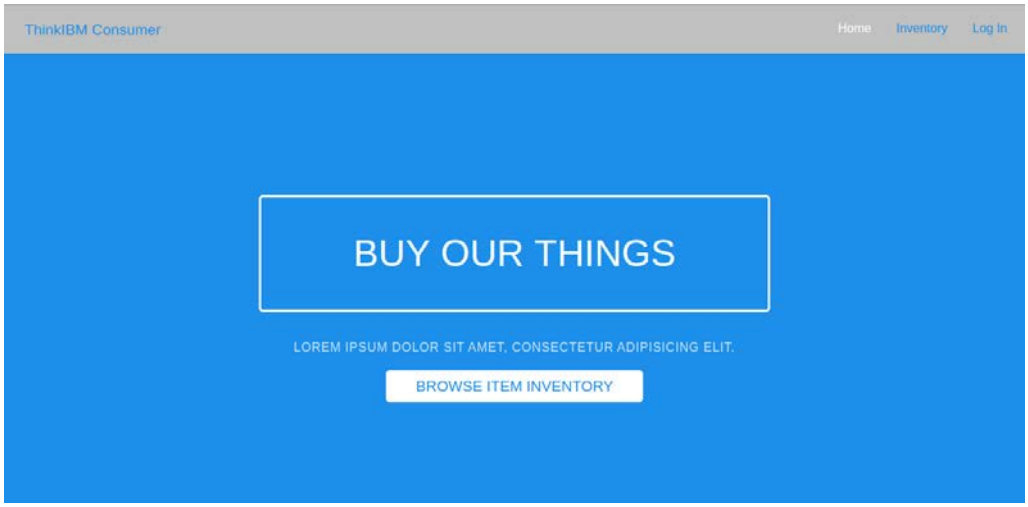
6. Navigate to the `/home/student/lab_files/lab7/consumer_app/` directory by entering the `cd` command as shown below:

```
cd ~/lab_files/lab7/consumer_app/
```

7. Start the `Think IBM Web Consumer` application by entering the `npm start` command as shown below. The application is a **Node.js** application.

```
npm start
```

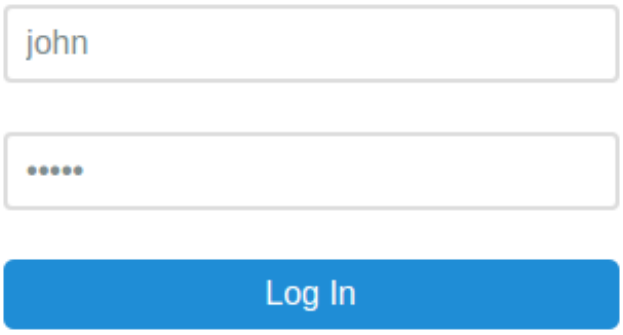
8. The `Think IBM Web Consumer` application launches in a browser window.



7.6 - Test the APIs from the Think IBM Web Consumer Application

1. Recall that in Lab 4 you secured the `inventory` API by requiring OAuth. If you attempt to view the Item Inventory before logging in, you will be challenged for a username and password. Either click on the `Browse Item Inventory` button, or the `Log In` link to open the login prompt.

2. Enter any Username and Password then click the `Log In` button. Our sample authentication service is a dummy repository that will accept any credentials provided.



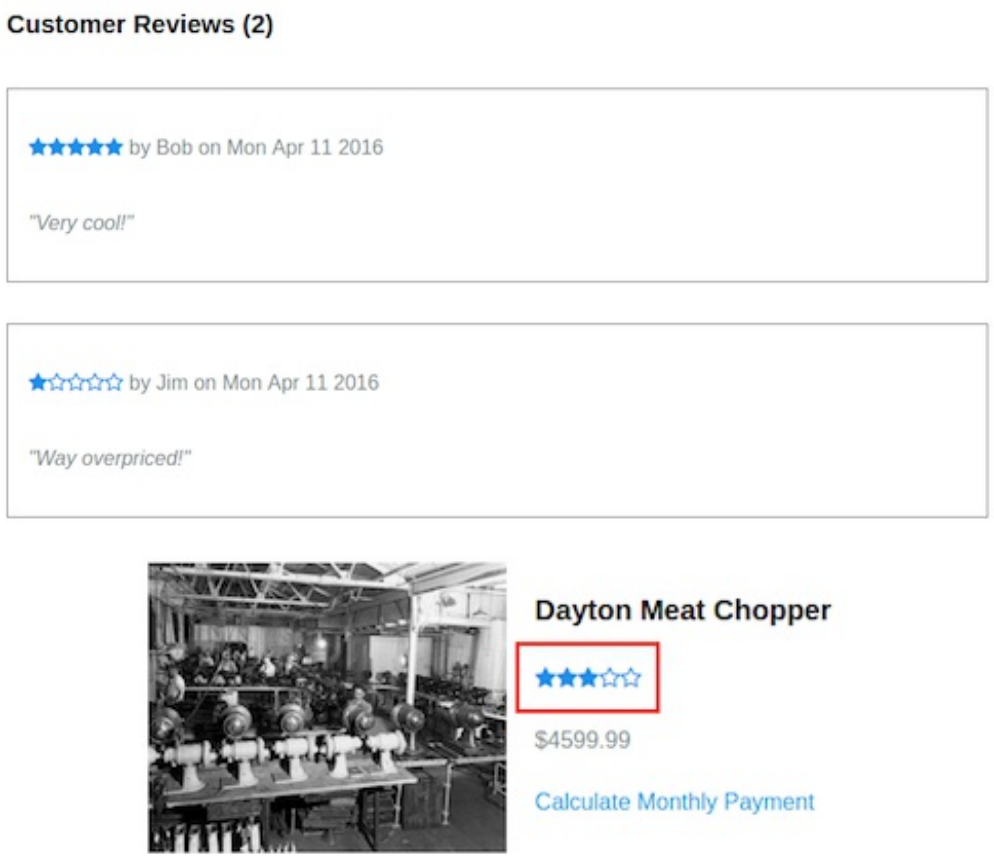
> The consumer app will contact our OAuth Token URL and handle the token exchange using standard OAuth proceedures. If you're interested in seeing the token, you can switch over to the terminal from where you launched the consumer app and view the logs. Look for a line similar to:

```
Using OAuth Token: AAEkZGEwZDgxNDMtMzIxMS00ZDgyLWE3MGYtMTJmY2UyYjk1YmUyxzqSMdEr7wM8XU_edO3dmxGDmC1ZGaqUC9Ibh-rOVNlflzd6blfDq4CGaNsD1qn-KESw6Q6RN_TPA0IfMdIn1nHY4ZpGRYa5N0f7mgY2Jg4Tfhm0IlhCUq5HRvoo7c4SIX7SAS3rL998_BvMVBST_g
```

3. Once you are logged in, the consumer application will redirect you to the item inventory page. The data displayed on the page is being powered by our `inventory` API! The consumer application is calling to our API, which is then being sent to our LoopBack application which handles the connection to the MySQL data source where the inventory data is persisted.

4. Click around the pages. Use the review form to leave new reviews for items. Recall how the item reviews are separate data models stored in MongoDB, yet are related to the items through our LoopBack application.

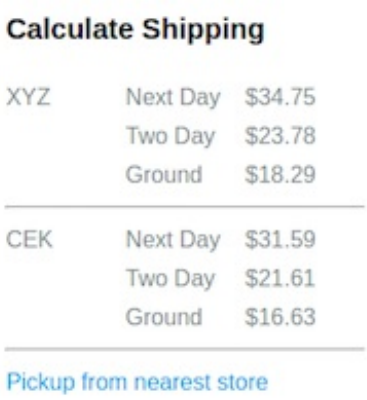
   Notice how the product rating is updated automatically as new reviews are posted. This happens because of the custom code you added to the LoopBack application in Lab 3.



5. Continue testing the features of the consumer application. Try entering your home zip code to obtain shipping data. This feature is

powered by the `logistics` APIs that were built using advanced assembly techniques in Lab 5. Your quotes will vary based on the zip code provided.

The results also provides a link to the nearest store.



6. Finally, try clicking on the `Calculate Monthly Payment` link. This feature is powered by the `financing` API that was created using our REST-to-SOAP assembly in Lab 5.

7. Repeat the steps on a few of products to drive data into the analytics database.

Lab 7 - Completion

Congratulations! You have completed Lab 7!

Appendix A - Troubleshoot the inventory API

In this appendix, you review and apply troubleshooting steps for the case study in the lab exercises.

Apply the steps to verify your copy of the case study, and correct the issues that you identify.

Appendix A - Objective

In the this lab, you will learn:

- How to verify the key components in the exercise case study
- How to troubleshoot and correct common issues with the case study
- How to isolate implementation issues in your own workstation

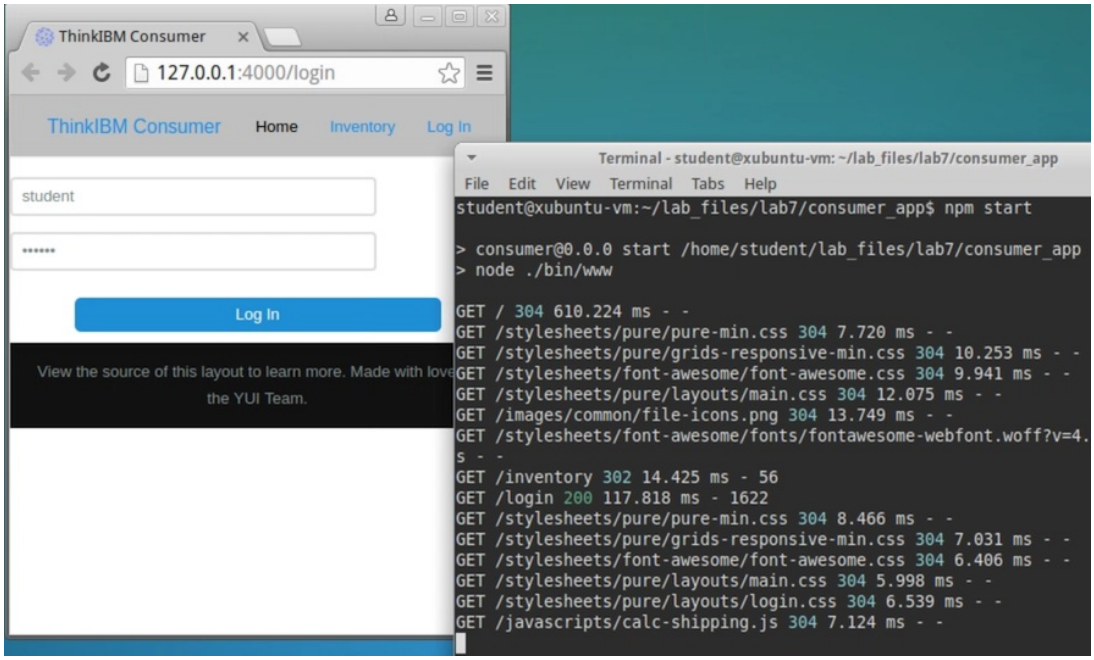
Appendix A - Case Study Used in this Tutorial

After you finished exercise 6, you completed the*ThinkIBM* inventory, logistics, financing, and OAuth API implementations. In this appendix, you verify the API gateway and API implementation in your lab environment. You troubleshoot and correct common issues with the exercises.

Appendix A - Step by Step Troubleshooting Instructions

Appendix A.1 - Review the inventory items API operation

In exercise section 7.3, you test the inventory items API operation that you built from exercise 2 to exercise 6. If your copy of the `consumer_app` returns a runtime error, you must isolate and determine which part of the inventory API caused the issue.



The `consumer_app` in lab 7 makes three API calls when you select `log in` :

- Call #1: Consumer app --> API Gateway `/oauth20/authorize`
- Call #2: Consumer app --> API Gateway `/oauth20/token`
- Call #3: Consumer app --> API Gateway `/inventory/items` --> IBM HTTP Server --> Collective plug-in --> Collective server --> Inventory LoopBack app

In *call #1*, the consumer application calls the OAuth 2.0 provider's `authorize` API operation. The `authorize` operation redirects your web browser to a log in page. You enter any value for the user name and password, and the authorization URL returns HTTP status code 200 to the OAuth 2.0 Provider. In turn, the `authorize` API operation returns an OAuth *authorization bearer token* to the consumer application.

In *call #2*, the consumer application sends the*authorization bearer token* to the `token` API operation, and a request to the `/inventory/items` resource. After the `token` API operation verifies that the bearer token is valid, it returns an OAuth 2.0 *access token* to the consumer application.

In *call #3*, the consumer application calls the `/inventory/items` API operation with the *access token*.

Appendix A.2 - Check whether the OAuth 2.0 /oauth20/authorize API operation call completed successfully

If you see the message `Using OAuth Token: ...` in your terminal console after you submitted your user name and password, your application completed *calls #1* and *#2* successfully.

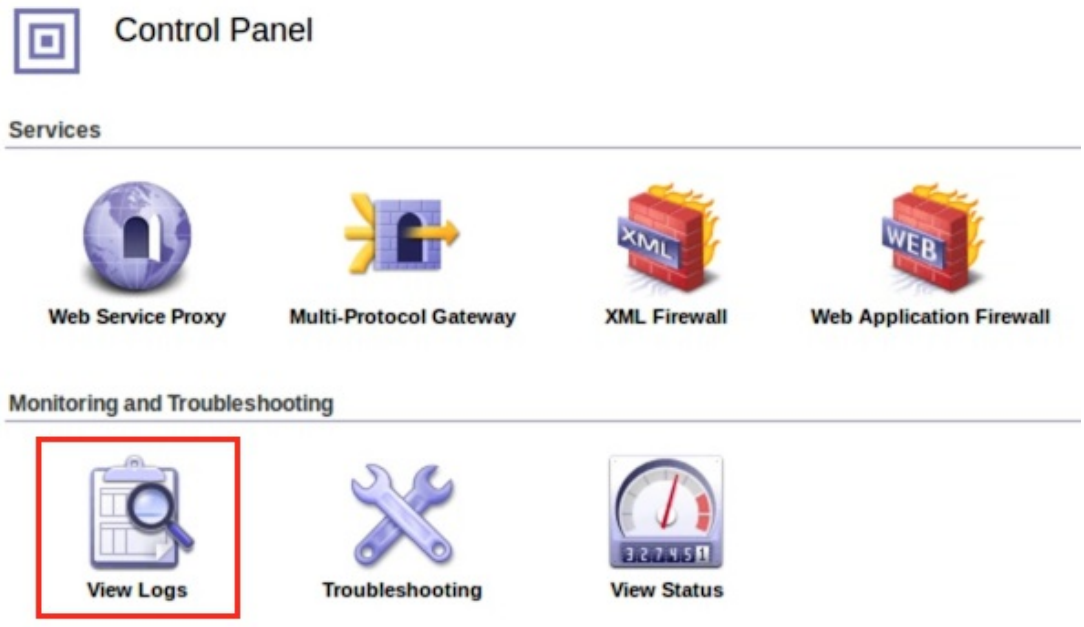
```
Using OAuth Token:
AAEkM2M0MjdiNDAtMThkNS00NzkyLWFhNTUtOTc0NGNjZTAzNTdh-7Z1GFMiO
HTY0FVGbxK_zX0c8Hr5tXd91zmrlTqV6LoaWlawbqwOh4b-PiXYf3Q0-TWtFO
Dyp2cbjgvxT5kJnA
```

If you do not see this message in your terminal console, log into the DataPower web interface. Verify that there are no authorization errors at the Gateway before you continue to section A.3.

1. To open the DataPower web interface, open https://dp.think.ibm:9090/ in a web browser.

2. Log in with the following credentials:
   - User name: `admin`
   - Password: `Passw0rd!`
   - Domain: `default`

3. In the control panel, select `view logs`.



Appendix A.3 - Verify that the consumer application sent an OAuth token in the /inventory/items API call

If *call #3*, the call from the consumer app to the `/inventory/items` API

operation fails, you see this error:

```
Inventory API call failed:
```

Complete these steps to print out the HTTP response message from the `/inventory/items` API call.

1. Examine the console log in your terminal after the sign-in page.
2. Review the HTTP request call to the `/inventory/items` API operation. Confirm that the call includes an `Authorization: Bearer` HTTP header.

```
MY OPTIONS:
{"method":"GET","url":"https://api.think.ibm/sales/sb/invento
ry/items?filter[order]=name%20ASC","strictSSL":false,"headers
":{"X-IBM-Client-Id":"3c427b40-18d5-4792-aa55-9744cce0357a","
X-IBM-Client-Secret":"X4vK7cY6xJ5tC0vR1qV5nD2jS1tL0tS1gU7dP3b
Q7aY2fD4iE2","Authorization":"Bearer AAEkM2M0MjdiNDAtMThkNS00
NzkyLWFhNTUtOTc0NGNjZTAzNTdh-7Z1GFMiOHTY0FVGbxK_zX0c8Hr5tXd91
zmrlTqV6LoaWlawbqwOh4b-PiXYf3Q0-TWtFODyp2cbjgvxT5kJnA"}}
```

3. Review the error message with the text `Inventory API call failed:`. Specifically, examine the **response** section of the message.

```
Inventory API call failed:
{"name":"StatusCodeError","statusCode":404,"request":{"method
":"GET","url":"https://api.think.ibm/sales/sb/inventory/items
?filter[order]=name%20ASC","strictSSL":false,"headers":{"X-IB
M-Client-Id":"3c427b40-18d5-4792-aa55-9744cce0357a","X-IBM-Cl
ient-Secret":"X4vK7cY6xJ5tC0vR1qV5nD2jS1tL0tS1gU7dP3bQ7aY2fD4
iE2","Authorization":"Bearer AAEkM2M0MjdiNDAtMThkNS00NzkyLWFh
NTUtOTc0NGNjZTAzNTdh-7Z1GFMiOHTY0FVGbxK_zX0c8Hr5tXd91zmrlTqV6
LoaWlawbqwOh4b-PiXYf3Q0-TWtFODyp2cbjgvxT5kJnA"}},"response":"
<!DOCTYPE HTML PUBLIC \"-//IETF//DTD HTML 2.0//EN\">\n<html><
head>\n<title>404 Not Found</title>\n</head><body>\n<h1>Not F
ound</h1>\n<p>The requested URL /inventory/items was not foun
d on this server.</p>\n<hr>\n<address>IBM_HTTP_Server at inve
ntory-576d5dc5e4b05a78b037514b-1466785559733.sales Port 80</a
ddress>\n</body></html>\n"}
```

In this specific example, the Collective plug-in cannot invoke the

`/inventory/items` URL. This error occurs while the API gateway attempts to invoke the `inventory` API that you published in exercise 3.

The next step is to determine whether this is an issue with the `app-id` routing, the LoopBack API implementation, the collective member, or the collective plug-in routing paths.

Appendix A.4 - Verify the app-id routing policy in the inventory API definition file.

In exercise section 4.4, you defined the `app-id` application property in the `inventory` API definition. The API gateway invokes the collective member that matches the `app-id` value. In this section, confirm that the `app-id` value matches the identifier for the application that you published at the end of exercise 3.

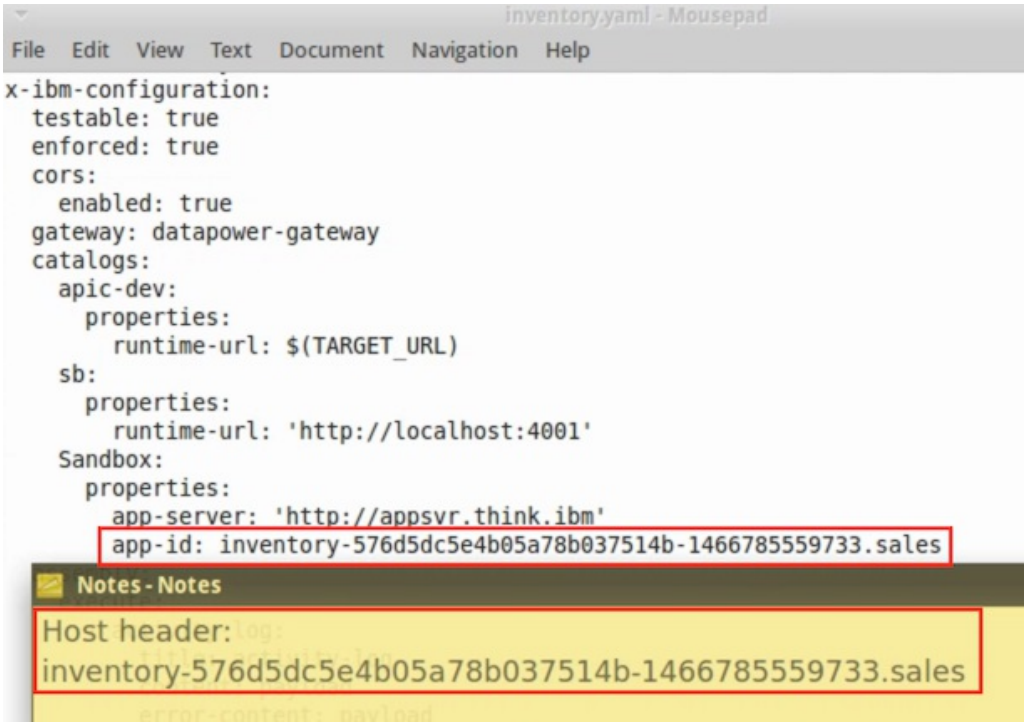
1. Open `~/ThinkIBM/inventory/definitions/inventory.yaml` document in a text editor.

```
cd ~/ThinkIBM/inventory/definitions
mousepad inventory.yaml &
```

2. Locate the `app-id` property in the `x-ibm-configuration` section of the `inventory.yaml` file.

```
Sandbox:
properties:
  app-server: 'http://appsvr.think.ibm'
  app-id: inventory-576d5dc5e4b05a78b037514b-1466785559733.sa
les
```

3. Confirm that the `app-id` value matches the **host header** value that you saved at the end of exercise 3.



If the `app-id` value does not match the host header value, you must correct this issue before you continue to section A.5.

1. Correct the `app-id` value in `inventory.yaml` to match the **host header** value.
2. Save your changes in the text editor.
3. From the terminal, launch the API Designer web application.

```
cd ~/ThinkIBM/inventory/
apic edit
```

4. Complete **Exercise 6.3**, **Publishing the API Product** to publish the changes in the `inventory.yaml` API definition to the API Management server.

Appendix A.5 - Call and verify the /inventory/items API operation directly

The next component to check is whether the Inventory LoopBack app that you published in lab 3 is running.

- Call #3: Consumer app --> API Gateway `/inventory/items` --> IBM HTTP Server --> Collective plug-in --> Collective server --> **Inventory LoopBack app**

The files that represent the collective server is stored in the `~/wlpn/` directory, with the following naming convention: `inventory-xyz-1`, where `xyz` is the same value that you copied for the host header ID. The first member in the cluster has a suffix of `-1`: for example, `inventory-576d5dc5e4b05a78b037514b-1466785559733-1`.

1. Examine the server configuration for the collective member that hosts the inventory application.

```
cd ~/wlpn/
ls
cd ~/wlpn/inventory-576d5dc5e4b05a78b037514b-1466785559733-1
/
cat join.json
```

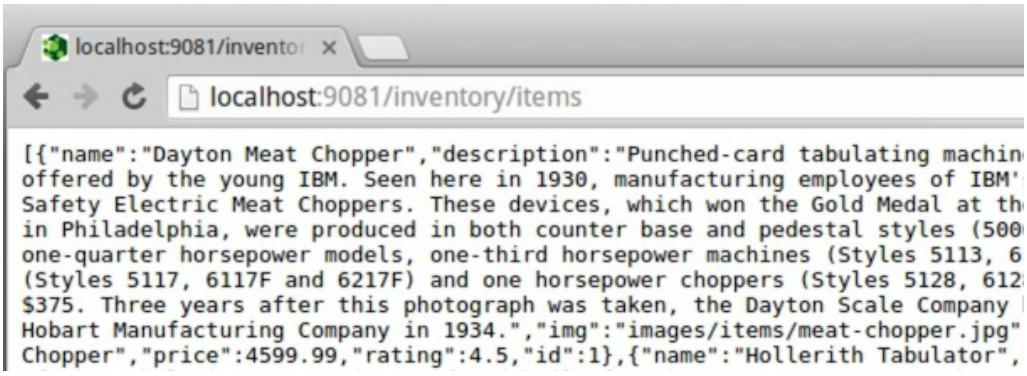
Note: Replace the collective server name with the one in your `~/wlpn` directory.

2. Write down the server port number from the `join.json` configuration file. For example, port `9081`.

```
  "clusterName": "apic.inventory-576d5dc5e4b05a78b037514b-146
6785559733",
  "appPort": "9081",
  "adminPort": "9444"
```

3. Open a web browser to http://localhost:9081/inventory/items

4. Verify that the `/inventory/items` API operation successfully returns a JSON object with item names and descriptions.



Note: If the call to http://localhost:9081/inventory/items fails to return a list of inventory items, you must review the inventory application that you created in the `~/ThinkIBM/inventory` directory. Follow the instructions

in section 3.3.2 to re-publish the inventory application.

Appendix A.6 - Verify that the collective controller and collective member are running

In the previous section, you confirmed that the LoopBack API implementation of the `/inventory/items` operation works correctly.

- Call #3: Consumer app --> API Gateway `/inventory/items` --> IBM HTTP Server --> **Collective plug-in** --> **Collective server** --> Inventory LoopBack app

In this section, you verify whether the collective controller and collective member are working properly.

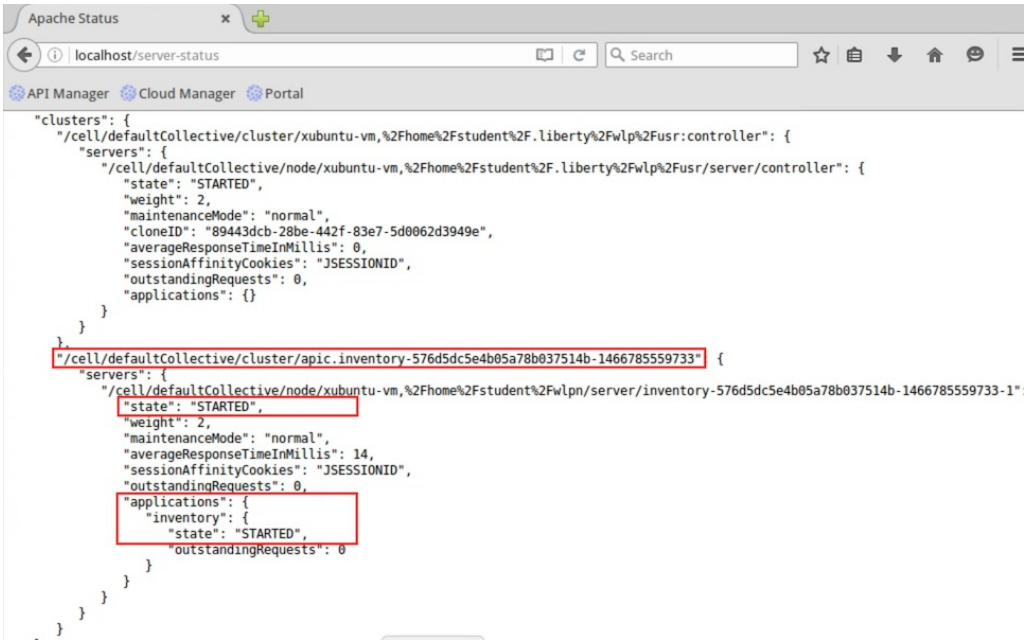
1. Verify that the collective server is running.

```
cd ~/wlpn/
ls
wlpn-server status inventory-576d5dc5e4b05a78b037514b-1466785559733-1
```

Note: Replace the collective server name with the one in your `~/wlpn` directory.

Verify that the Collective plug-in in your HTTP server sees your collective server. That is, your server is part of the collective.

2. Open http://localhost:80/server-status/ Check to see whether there is an entry for the server `inventory-xyz-1`, where *xyz* is the value of your collective member.



Appendix A.7 - Restart the IBM HTTP server, the collective controller, and collective member

At this point, you completed the following verification steps:

- In *section A.2*, you confirmed that the consumer application completes the call to the OAuth `authorize` operation successfully.
- In *section A.3*, you confirmed that the consumer application sent an *OAuth Authorization Bearer* token in the `/inventory/items` API call.
- In *section A.4*, you verified that the product definition added the correct `app-id` value in the HTTP header in exercise 4.
- In *section A.5*, you confirmed that the LoopBack API implementation of `/inventory/items` works properly.
- In *section A.6*, you verified that the collective member is running.

At this point, restart the HTTP server, the collective controller, and the collective member with this script:

1. Open a terminal window.

2. Run the `restart_inventory` script in the `~/bin` directory.

```
cd ~/bin
./restart_inventory
```

Note: The restart script requires the operating system password. Enter `P`

`assw0rd!` when prompted.

3. After the collective controller, collective member restarts, run the `consumer_app` in exercise 7 to test the `/inventory/items` API operation.