Integration Workbook

Integration Workbook, Summer '15

@salesforcedocs
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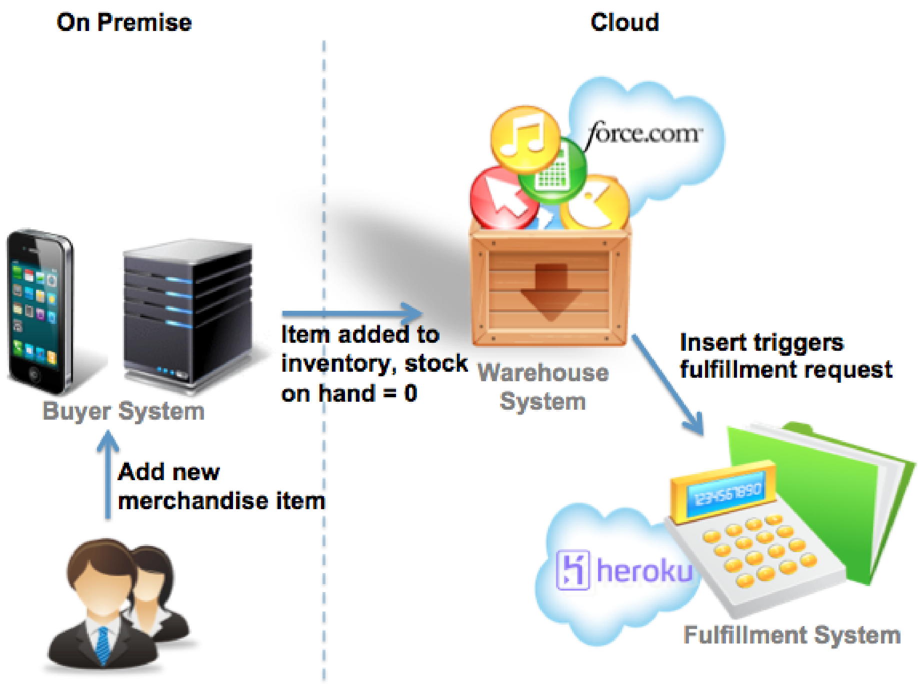
FORCE.COM INTEGRATION WORKBOOK

One of the most frequent tasks Force.com developers undertake is integrating Force.com apps with existing applications. The tutorials within this workbook are designed to introduce the technologies and concepts required to achieve this functionality.

The Force.com Integration Workbook is intended to be the companion to the Force.com Workbook. The series of tutorials provided here extend the Warehouse application by connecting it with a cloud-based fulfillment app.



Intended Audience

This workbook is intended for developers who are new to the Force.com platform but have basic working knowledge in Java.

Tell Me More....

This workbook is designed so that you can go through the steps as quickly as possible. At the end of some steps, there is an optional Tell Me More section with supporting information.

- You can find the latest version of this and other workbooks at `https://developer.salesforce.com/page/Force.com_workbook`.
- To learn more about Force.com and to access a rich set of resources, visit Salesforce Developers at `https://developer.salesforce.com`.

BEFORE YOU BEGIN

Before you begin the tutorials, you'll need to install the Warehouse data model in your organization, create a Heroku developer account, and install the Heroku Toolbelt software on your local workstation.

Step 1: Install the Warehouse Data Model

This workbook uses a set of objects that represent a simple warehouse management system. To install these objects into your developer organization:

1. If you don't have a Developer Edition account, sign up for one at http://sforce.co/1ugNn2R.
2. Navigate to https://login.salesforce.com/packaging/installPackage.apexp?p0=04ti0000000Pi7P in your browser.
3. Log in using your Developer Edition organization username and password.
4. On the Package Installation Details page, click **Continue**.
5. Click **Next**. On the Security Level page, click **Next**. On the following page, click **Install**.
6. You'll also want to add some sample records. Select the Warehouse app from the drop-down app menu in the upper-right corner of your current Salesforce page.
7. Click the Data tab, and then click **Create Data** to add sample records.

Note: After you've gone through this workbook, you can uninstall the Warehouse data model and sample data from your organization by navigating to **Installed Packages** under Setup and deleting the Warehouse package.

Step 2: Create a Heroku Account

Heroku is a cloud application platform separate from Force.com. It provides a powerful Platform as a Service for deploying applications in a multitude of languages, including Java. It also enables you to easily deploy your applications with industry-standard tools, such as Git. If you don't already have a Heroku account you can create a free account as follows:

1. Navigate to http://heroku.com.
2. Click **Sign Up**.
3. Enter your email address.
4. Wait a few minutes for the confirmation email and follow the steps included in the email.

Step 3: Install the Heroku Toolbelt

The Heroku Toolbelt is a free set of software tools that you'll need to work with Heroku. To install the Heroku Toolbelt:

1. Navigate to https://toolbelt.heroku.com.
2. Select your development platform (Mac OS X, Windows, Debian/Ubuntu).
3. Click the download button.
4. After the download finishes, run the downloaded install package on your local workstation and follow the steps to install.

TUTORIAL #1: CREATE A NEW HEROKU APPLICATION

Heroku provides a powerful Platform as a Service for deploying applications in a multitude of languages, including Java. In this tutorial, you create a Web application using the Java Spring MVC framework to mimic handling fulfillment requests from our Warehouse application.

Familiarity with Java is helpful, but not required for this exercise. The tutorial starts with an application template to get you up and running. You then walk through the steps to securely integrate the application with the Force.com platform.

Step 1: Clone the GitHub Project

Git is a distributed source control system with an emphasis on speed and ease of use. Heroku integrates directly into Git, allowing for continuous deployment of your application by pushing changes into a Heroku repository. GitHub is a Web-based hosting service for Git repositories.

You start with a pre-existing Spring MVC-based application stored on GitHub. Then, as you make changes, deploy them into your Heroku account and see your updates available online via Heroku's cloud framework.

1. Open a command line terminal. For Mac OS X users, this can be done by going to the Terminal program, under `Applications/Utilities`. For PC users, this can be done by going to the **Start Menu**, and typing *`cmd`* into the Run dialog.
2. Once in the command line terminal, change to a directory where you want to download the example app. For example, if your directory is "development," type *`cd development`*.
3. Execute the following command:

   ```
   git clone https://github.com/sbob-sfdc/spring-mvc-fulfillment-base
   ```

Git downloads the existing project into a new folder, `spring-mvc-fulfillment-base`.

Step 2: Create a Heroku Project

Now that you have the project locally, you need a place to deploy it that is accessible on the Web. In this step you deploy the app on Heroku.

1. In the command line terminal, change directory to the `spring-mvc-fulfillment-base` folder you created in the last step:

   ```
   cd spring-mvc-fulfillment-base
   ```

2. Execute the following command to log in to Heroku (followed by Heroku login credentials, if necessary):

   ```
   heroku login
   ```

   Heroku uses Git with SSH to deploy code. If you haven't used SSH on this machine, you'll need to create a public key after you provide your Heroku login credentials. On Microsoft Windows, you might need to add your Git directory to your system path before you can create a public key.

3. Execute the following command to create a new application on Heroku:

   ```
   heroku create
   ```

Heroku creates a local Git repository as well as a new repository on its hosting framework, where you can push applications, and adds the definition for that remote deployment for your local Git repository to understand. This makes it easy to leverage Git for source control, make local edits, and deploy your application to the Heroku cloud.

All application names on Heroku must be unique, so you'll see messages like the following when Heroku creates a new app:

```
Creating quiet-planet-3215... done
```

Important: The output above shows that the new application name is `quiet-planet-3215`. You might want to copy and paste the generated name into a text file or otherwise make a note of it. Throughout this workbook, there are references to the application name that look like *{appname}* that should be replaced with your application name. So, if your application name is `quiet-planet-3215`, when a tutorial step prompts you to enter a URL with the format `https://{appname}.herokuapp.com/_auth`, use: `https://quiet-planet-3215.herokuapp.com/_auth`.

4. To deploy the local code to Heroku, execute the following command:

```
git push heroku master
```

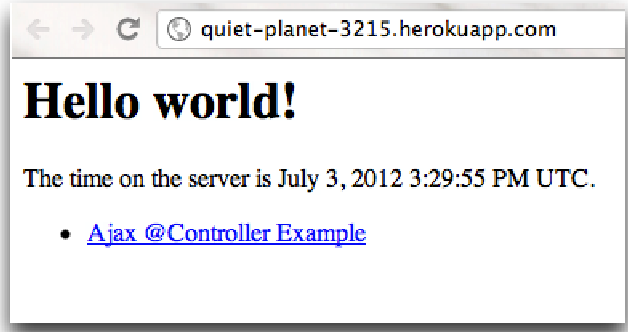
If prompted, select Yes to verify the authenticity of `heroku.com`. The deployment process will take a while as it copies files, grabs any required dependencies, compiles, and then deploys your application.

5. Once the process is complete, you can preview the existing application by executing:

```
heroku open
```

You can also simply open `https://{appname}.herokuapp.com` in a browser.

You now have a new Heroku application in the cloud. The first page should look like this:



Tell Me More...

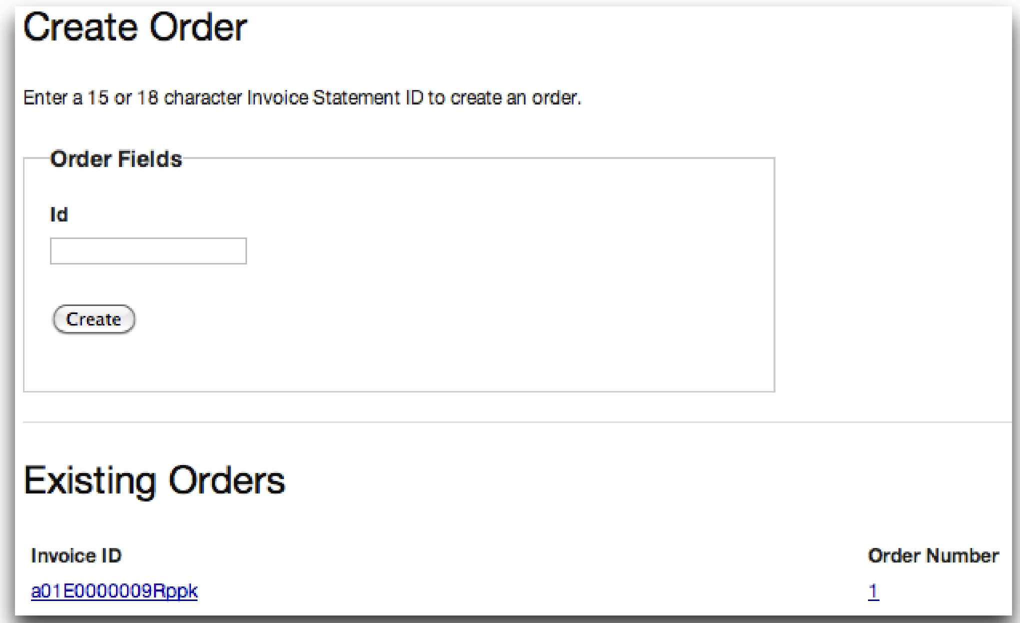
Scroll back through the terminal log to the `git push` command, and you'll see some magic. Early on, Heroku detects that the push is a Spring MVC app, so it installs Maven, builds the app, and then gets it running for you, all with just a single command.

Step 3: Test the Application

This step shows you how to take your application for a quick test run to verify it's working.

1. In a browser tab or window, navigate to `https://{appname}.herokuapp.com`.
2. Click **Ajax @Controller Example**.

3. In another browser tab or window, open the Warehouse application on your Force.com instance.
4. Click **Invoices** and then select an existing invoice or create a new one if necessary.
5. In the browser URL bar, select the invoice record ID, which is everything after `salesforce.com` in the URL. It should look something like `a01E0000000diKc`. Copy the ID to your clipboard.
6. Return to the browser window or tab showing your Heroku application.
7. Paste the invoice record ID into the field under **Id**.
8. Click **Create**. An order is created with the Invoice ID. Note that this order is distinct from a Salesforce order record.
9. Click **OK**. Your page looks something like:



Summary

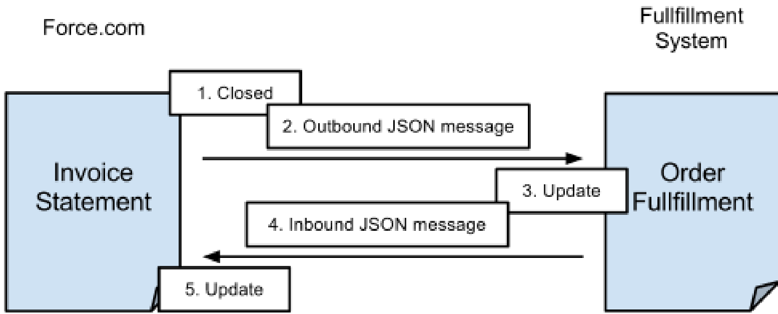
Heroku's polyglot design lets you easily deploy your applications with industry-standard tools, such as Git. Typically, teams use local development environments, like Eclipse, and in fact Heroku has released an Eclipse plug-in for seamless integration with Eclipse. You can also interact with Heroku on the command line and directly access logs and performance tools for your applications.

TUTORIAL #2: CONNECT THE WAREHOUSE APP WITH AN EXTERNAL SERVICE

Force.com offers several ways to integrate with external systems. For example, without writing any code, you can declare workflow rules that send outbound messages. You can implement more complex scenarios programmatically with Apex code.

This tutorial teaches you how to create a Web service callout to integrate the Warehouse app with the fulfillment application you deployed in Tutorial 1. This fulfillment system, written in Java, is hosted on Heroku, but it could be any application with a Web service interface.

The following diagram illustrates the example scenario requirements: when an invoice's status changes to Closed in your Force.com system, the system sends a JSON-formatted message to the order fulfillment service running on Heroku, which then returns an order ID to the Force.com system. The order ID is then added to the invoice.



Step 1: Create an External ID Field on Invoice

To start, create a custom field in the invoice custom object that can store the order ID returned by the Java app running on Heroku. The field is an index into an external system, so it makes sense to make it an External ID.

1. Log in to your Salesforce organization.
2. Go to the Invoice Statement custom object from Setup by clicking **Create** > **Objects** > **Invoice**.
3. Scroll down to **Custom Fields & Relationships**, and then click **New**.
4. Select the **Text** field type, and then click **Next**.
5. Enter *OrderId* as the field label, and then enter *6* as the field length. Accept the default field name *OrderId*.
6. Select the **External ID** checkbox, and then click **Next**.
7. Click **Next** to accept the defaults, and then click **Save**.

Step 2: Create a Remote Site Record

The Force.com platform implements very conservative security controls. By default, Force.com prohibits callouts to external sites. This step teaches you how to register the Heroku Java site in the Remote Site Settings page.

1. From Setup, click **Security Controls** > **Remote Site Settings**.
2. Click **New Remote Site**.

3. In the Remote Site Name field, enter *FulfillmentWebService* (no spaces).
4. In the Remote Site URL field, enter *https://{appname}.herokuapp.com*.
5. Click **Save** to accept the remaining default values.

Now any Apex code in your app can call the fulfillment Web service that you deployed in Tutorial 1.

Tell Me More...

Just for fun, you can delete this remote site record and create and test the callout in Step 3 and Step 4 below to observe the error message that is generated when an app attempts to call a URL without permission. Don't forget to come back and add the remote site record again, though!

Step 3: Create an Integration Apex Class

Now that your app can access an external URL, it's time to implement the callout. Apex triggers are not permitted to make synchronous Web service calls. This restriction ensures that a long-running Web service doesn't hold a lock on a record within your Force.com app.

The steps in this tutorial teach you how to build out the correct approach, which is to create an Apex class with an asynchronous method that uses the `@future` annotation, and then build a trigger to call the method as necessary. When the trigger calls the asynchronous method, Force.com queues the call, executes the trigger, and then releases any record locks. Eventually, when the asynchronous call reaches the top of the queue, Force.com executes the call and posts the invoice to the order fulfillment Web service running on Heroku.

Start by adding the code for the asynchronous method in a new Apex class.

1. From Setup, click **Develop** > **Apex Classes**.
2. Click **New** and paste in the following code:

```
public class Integration {

    // The ExternalOrder class holds a string and integer
    // received from the external fulfillment system.

    public class ExternalOrder {
        public String id {get; set;}
        public Integer order_number {get; set;}
    }

    // The postOrder method integrates the local Force.com invoicing system
    // with a remote fulfillment system; specifically, by posting data about
    // closed orders to the remote system. Functionally, the method 1) prepares
    // JSON-formatted data to send to the remote service, 2) makes an HTTP call
    // to send the prepared data to the remote service, and then 3) processes
    // any JSON-formatted data returned by the remote service to update the
    // local Invoices with the corresponding external IDs in the remote system.

    @future (callout=true) // indicates that this is an asynchronous call
    public static void postOrder(List<Id> invoiceIds) {

        // 1) see above

        // Create a JSON generator object
        JSONGenerator gen = JSON.createGenerator(true);
```

```
// open the JSON generator
gen.writeStartArray();
// interate through the list of invoices passed in to the call
// writing each invoice ID to the array
for (Id invoiceId : invoiceIds) {
    gen.writeStartObject();
    gen.writeStringField('id', invoiceId);
    gen.writeEndObject();
}
// close the JSON generator
gen.writeEndArray();
// create a string from the JSON generator
String jsonOrders = gen.getAsString();
// debugging call, which you can check in debug logs
System.debug('jsonOrders: ' + jsonOrders);

// 2) see above

// create an HTTPrequest object
HttpRequest req = new HttpRequest();
// set up the HTTP request with a method, endpoint, header, and body
req.setMethod('POST');
// DON'T FORGET TO UPDATE THE FOLLOWING LINE WITH YOUR APP NAME
req.setEndpoint('https://{appname}.herokuapp.com/order');
req.setHeader('Content-Type', 'application/json');
req.setBody(jsonOrders);
// create a new HTTP object
Http http = new Http();
// create a new HTTP response for receiving the remote response
// then use it to send the configured HTTPrequest
HTTPResponse res = http.send(req);
// debugging call, which you can check in debug logs
System.debug('Fulfillment service returned '+ res.getBody());

// 3) see above

// Examine the status code from the HTTPResponse
// If status code != 200, write debugging information, done
if (res.getStatusCode() != 200) {
    System.debug('Error from ' + req.getEndpoint() + ' : ' +
      res.getStatusCode() + ' ' + res.getStatus());
}
// If status code = 200, update each Invoice
// with the external ID returned by the fulfillment service.
else {
    // Retrieve all of the Invoice records
    // originally passed into the method call to prep for update.
    List<Invoice__c> invoices =
      [SELECT Id FROM Invoice__c WHERE Id IN :invoiceIds];
    // Create a list of external orders by deserializing the
    // JSON data returned by the fulfillment service.
    List<ExternalOrder> orders =
      (List<ExternalOrder>)JSON.deserialize(res.getBody(),
        List<ExternalOrder>.class);
```

```
      // Create a map of Invoice IDs from the retrieved
      // invoices list.
      Map<Id, Invoice__c> invoiceMap =
        new Map<Id, Invoice__c>(invoices);
      // Update the order numbers in the invoices
      for ( ExternalOrder order : orders ) {
        Invoice__c invoice = invoiceMap.get(order.id);
        invoice.OrderId__c = String.valueOf(order.order_number);
      }
      // Update all invoices in the database with a bulk update
      update invoices;
    }
  }
}
```

Don't forget to replace `{appname}` with your Heroku application name.

3. Click **Save**.

This code collects the necessary data for the remote service, makes the remote service HTTP call, and processes any data returned by the remote service to update local invoices with the corresponding external IDs. See the embedded comments in the code for details.

Step 4: Test the `@future` Method

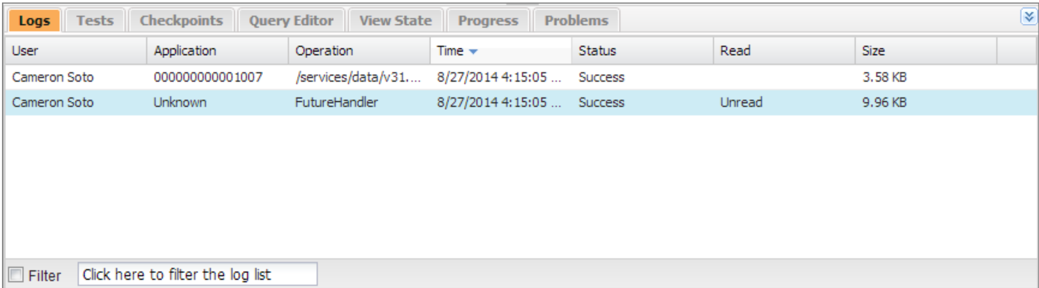
Before creating a trigger that calls an `@future` method, it's best practice to interactively test the method by itself and validate that the remote site settings are correctly configured. To test the method interactively, you can use the Developer Console.

1. Go to the Developer Console by clicking ***Your Name*** > **Developer Console**.
2. Click **Debug** > **Open Execute Anonymous Window**, and then enter the following code.

```
// Get an Invoice__c for testing
Invoice__c invoice = [SELECT ID FROM Invoice__c LIMIT 1];
// Call the postOrder method to test the asynchronous call
Integration.postOrder(new List<Id>{invoice.id});
```

This small snippet of Apex code retrieves the ID for a single invoice and calls your `@future` method using this ID.

3. Select the **Open Log** checkbox.
4. Click **Execute**. You should see two entries in the logs at the bottom of the page. Double click the second line — it should have `Future Handler` as its operation and a status of `Success`.



5. Select the **Filter** checkbox under the Execution Log, above the Logs list, and then type *DEBUG* as the filter text. Scroll down and double click the last line of the execution log. You should see a popup window with the response from the fulfillment Web service that looks something like:

```
08:08:42:962 USER_DEBUG [58]|DEBUG|Fulfillment service returned
[{"order_number":2,"id":"a01E0000009RpppIAC"}]
```

Now that you have a functional `@future` method that can call the fulfillment Web service, it's time to tie things together with a trigger.

Step 5: Create a Trigger to Call the @future Method

To create a trigger on the invoice object that calls the `Integration.postOrder` method that was created in Step 3, complete the following steps:

1. Go to the invoice custom object from Setup by clicking **Create** > **Objects** > **Invoice**.
2. Scroll down to **Triggers**, click **New**, and then paste the following code in place of the trigger skeleton:

```
trigger HandleOrderUpdate on Invoice__c (after update) {

    // Create a map of IDs to all of the *old* versions of records
    // updated by the call that fires the trigger.
    Map<ID, Invoice__c> oldMap =    new Map<ID,
    Invoice__c>(Trigger.old);

    // Create an empty list of IDs
    List<Id> invoiceIds = new List<Id>();

    // Iterate through all of the *new* versions of Invoice__c
    // records updated by the call that fires the trigger, adding
    // corresponding IDs to the invoiceIds list, but *only* when an
    // invoice's status changed from a non-"Closed" value to "Closed".
    for (Invoice__c invoice: Trigger.new) {
        if (invoice.status__c == 'Closed' &&  oldMap.get(invoice.Id).status__c !=
'Closed'){
            invoiceIds.add(invoice.Id);
        }
    }
    // If the list of IDs is not empty, call Integration.postOrder
    // supplying the list of IDs for fulfillment.
    if (invoiceIds.size() > 0) {
        Integration.postOrder(invoiceIds);
    }
 }
```

3. Click **Save**.

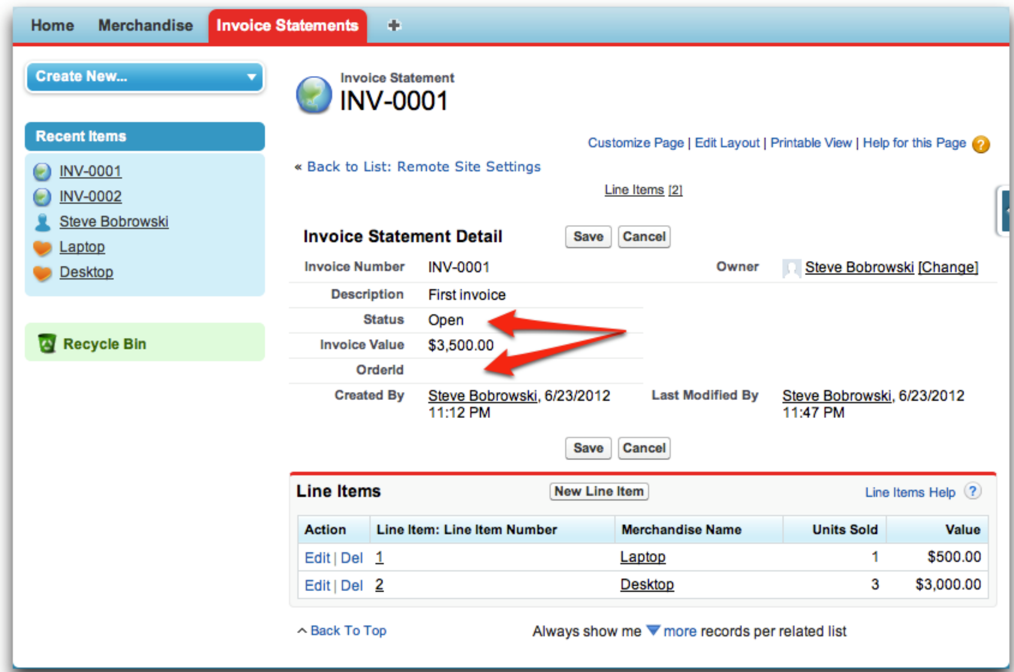
The comments in the code explain what the code does. In particular, understand that Force.com triggers must be able to handle both single-row and bulk updates because of the varying types of calls that can fire them (single-row or bulk update calls). The trigger creates a list of invoice IDs that have been closed in this update, and then calls the `@future` method once, passing the list of IDs.

Step 6: Test the Complete Integration Path

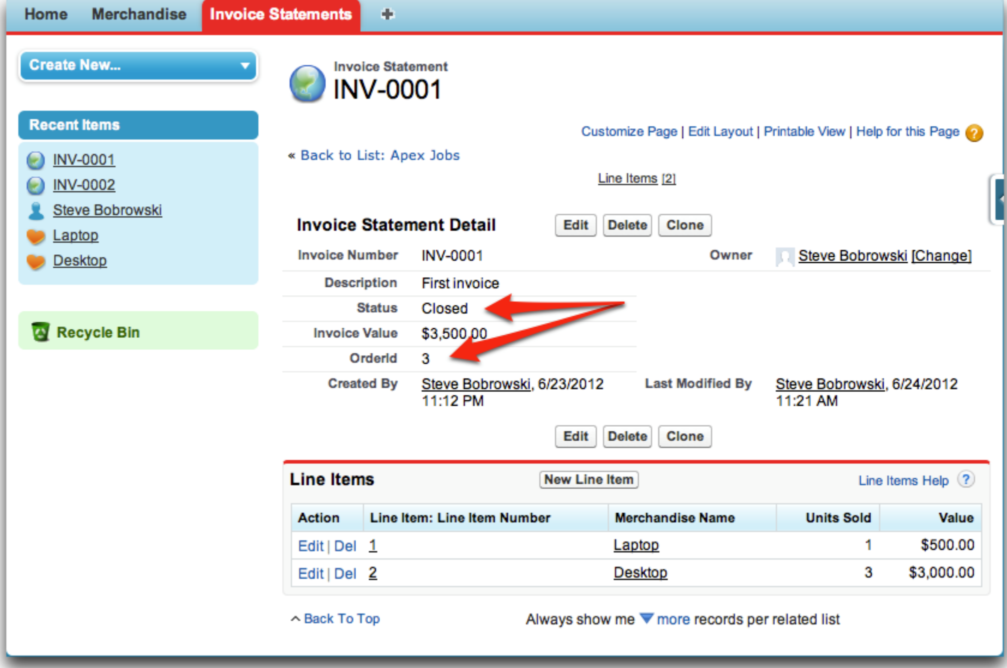
With the trigger in place, test the integration by firing the trigger.

1. Select the Warehouse app.
2. Click the **Invoices** tab.
3. Click one of the recent invoices and notice that there is no OrderId for the invoice.
4. If the Status is already Closed, double-click the word **Closed**, change it to **Open** and click **Save**.
5. Double-click the **Status** value, change it to **Closed** and click **Save**. This triggers the asynchronous callout.
6. Wait a few seconds and refresh the page in the browser.
7. You should see an external order ID appear in the `OrderId` field.

The following screen shows the Invoices tab before any changes have been made:



The following screen shows the Invoices tab after the asynchronous call has returned the new order ID:



Summary

Congratulations! Your app is sending invoices for fulfillment. You have successfully created an asynchronous Apex class that posted invoice details to your fulfillment app hosted on Heroku. Of course, your external application could reside anywhere as long as you have access via Web services. Your class uses open standards including JSON and REST to transmit data, and a trigger on invoices to execute the process.

TUTORIAL #3: UPDATE THE HEROKU APP

You now have two sides of an integration in place: one running a Java endpoint on Heroku, and another in Force.com which communicates with the endpoint when the appropriate changes take place. Now that you've got the connection in place, update the Heroku application to retrieve the pertinent information and display it to the user.

Step 1: Configure Your Connected App

Before moving on, let's go back to your Salesforce organization so that we can configure your connected app. At a high level, we will:

- Add your app to the available connected apps in your organization.
- Enable OAuth. External applications must authenticate remotely before they can access data. Force.com supports OAuth 2.0 (hereafter referred to as OAuth) as an authentication mechanism.

Let's go ahead and begin.

1. From Setup, click **Create** > **Apps**.
2. In the Connected Apps section, click **New**.
3. For `Connected App Name`, enter your app name.
4. Enter the `API Name`, used when referring to your app from a program. It defaults to a version of the name without spaces.
5. Provide your `Contact Email`.
6. Under API (Enable OAuth Settings) select `Enable OAuth Settings`.
7. For Callback URL, enter *`https://{appname}.herokuapp.com/_auth`*.

   Note: Be sure to replace *`{appname}`* with your actual Heroku app name.

8. In the `Selected OAuth Scopes` field, select `Full access (full)` and `Perform requests on your behalf at any time (refresh_token, offline_access)`, and then add them to the selected OAuth scopes.
9. Click **Save**.

Step 2: Update Your Application with a New Branch

While you were creating a new Apex trigger on your Force.com instance, other developers added new functionality to the original project and placed it into a specific branch on GitHub. Using this branch you can test out new features, specifically, your Heroku application's ability to directly access your Salesforce records. It's easy to add this branch, called "full," to your codebase:

1. Return to the command line, and make sure you're in the `spring-mvc-fulfillment-base` folder.
2. Enter the following command to fetch the "full" branch and merge it with your master branch, all in one step:

   ```
   git pull origin full
   ```

   a. Before continuing, go back to your org.

   b. From Setup, click **Create** > **Apps**.

   c. In the Connected App Settings section, click your app name.

   d. Next to Consumer Secret, click **Click to reveal**.
   e. Use your keyboard controls to copy the number that appears.

3. You need to set your Access keys to your Heroku application. Enter:

```
heroku config:add OAUTH_CLIENT_KEY=PUBLICKEY OAUTH_CLIENT_SECRET=PRIVATEKEY
```

   Replace `PUBLICKEY` with the `Consumer Key`. Similarly, replace `PRIVATEKEY` with the `Consumer Secret`. It may be helpful to do this in a text editor before putting it on the command line.

4. Execute the following command to push the local changes to Heroku:

```
git push heroku master
```

5. In a browser tab or window, navigate to `https://{appname}.herokuapp.com` to see the changes (refresh your browser if needed).

By adding an OAuth flow to your app, your app can request a user's permission to work with session information without requiring the third-party server to handle the user's credentials. With this functionality added to the project, the fulfillment application can use the Force.com REST API to access information directly from the user's instance.

Tell Me More...

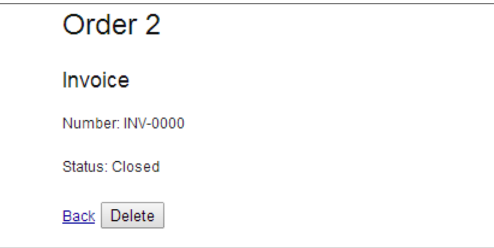
You can review all of the changes brought in by this branch on GitHub at: `https://github.com/sbob-sfdc/spring-mvc-fulfillment-base/compare/master...full`. Notice that the changes use the Force.com REST API to manipulate invoice records. Look at `InvoiceServiceImpl.java` in particular to see how it creates, queries, retrieves and deletes invoices. This tutorial uses the `findOrder()` method only. The other methods are included for your reference.

Step 3: View the Invoice Information

In the previous steps you added brand new functionality by merging a branch into your local code. The application now understands how to use OAuth and how to access data from the Force.com platform. Now let's view the invoice fields in your fulfillment app.

1. Navigate to your fulfillment app in the browser, and then refresh the page.
2. Click an order.

Notice that, given an ID, this code retrieves the corresponding invoice record. Because there might be mock ID's in the database that are not in Force.com, the app handles the corresponding exception by showing default data. Adding the invoice to the model makes it available to view. Now when you test the fulfillment application, it will show the invoice information currently in your Force.com instance by grabbing the information via the REST API using the record ID. Your order detail page might look something like:



Tell Me More...

Notice that the Web service call from Force.com to create orders is not secured. Securing the call goes beyond the scope of this workbook, but a simple solution would be to set up a shared secret between the Force.com app and the fulfillment app. The Force.com app would create an HMAC signature from the parameters in the request, using the secret, and the fulfillment app would verify the signature.

Summary

Congratulations! Your fulfillment app now retrieves invoice information via the Force.com REST API and displays it to the user. You configured your app in Salesforce to use OAuth for authentication, and you added OAuth credentials to your app hosted on Heroku. You can further modify your app to manipulate invoice information however you want.

TUTORIAL #4: ADD YOUR APP TO SALESFORCE USING FORCE.COM CANVAS

You've done a lot already. Let's go one step further and make your app accessible for your users right from within Salesforce. Force.com Canvas enables you to easily integrate a third-party application in Salesforce. Force.com Canvas is a set of tools and JavaScript APIs that you can use to expose an application as a canvas app. This means you can take your new or existing applications and make them available to your users as part of their Salesforce experience.

Step 1: Update your Application with a New Branch

Earlier, we added a branch to the codebase named "full." Now we'll add one named "canvas."

1. Return to the command line, and make sure you're in the `spring-mvc-fulfillment-base` folder.
2. Enter the following command to fetch the canvas branch and merge it with your master branch, all in one step:

```
git pull origin canvas
```

3. Execute the following command to push the local changes to Heroku:

```
git push heroku master
```

4. In a browser tab or window, navigate to `https://{appname}.herokuapp.com` to see the changes (refresh your browser if needed).

Tell Me More...

You can review all of the changes brought in by this branch on GitHub at https://github.com/sbob-sfdc/spring-mvc-fulfillment-base/compare/full...canvas.

Notice that the new branch uses the signed request from the Force.com Canvas API and not the Heroku-initiated OAuth from Tutorial 3, Step 2. The new branch also uses the Force.com REST API to manipulate invoice records. Look at `CanvasUiController.java` in particular to see how it retrieves, parses, and sets the signed request for use by the app. Also, `order.jsp` has changed to present an easier-to-use screen on the invoice page layout. This tutorial has only set the signed request for use on the `canvasui` page and the orders page in the app.

Step 2: Edit the Connected App Details and Enable the App for Force.com Canvas

We've already configured your connected app. Now we need to enable and configure it for Force.com Canvas.

1. From Setup, click **Create** > **Apps**.
2. In the Connected App Settings section, select your application and click **Edit**.
3. In the Canvas App Settings section, select the `Force.com Canvas` checkbox.
4. In the `Canvas App URL` field, enter `https://{appname}.herokuapp.com/canvasui`.
5. In the `Access Method` field, select Signed Request (Post).
6. In the `Locations` field, select Chatter Tab and Visualforce Page, and then add them to the selected locations.

7. Click **Save**.

If you look at `CanvasUiController.java`, you'll see something like the following, which shows Heroku obtaining a signed request and validating it. We're leveraging the `OAUTH_CLIENT_SECRET` Heroku key set in Tutorial 3, Step 2 to validate the signed request.

```
@Controller
@RequestMapping(value="/canvasui")
public class CanvasUIController {

    private static final String SIGNED_REQUEST = "signedRequestJson";
    private CanvasContext cc = new CanvasContext();

    @Autowired
    private OrderService orderService;

    @Autowired
    private InvoiceService invoiceService;

    private Validator validator;

    @Autowired
    public CanvasUIController(Validator validator) {
        this.validator = validator;
    }

    @RequestMapping(method= RequestMethod.POST)
    public String postSignedRequest(Model model,
   @RequestParam(value="signed_request")String signedRequest, HttpServletRequest request){

        String srJson = SignedRequest.verifyAndDecodeAsJson
        (signedRequest, getConsumerSecret());
      CanvasRequest cr = SignedRequest.verifyAndDecode(signedRequest, getConsumerSecret());

        HttpSession session = request.getSession(true);
        model.addAttribute(SIGNED_REQUEST, srJson);
        cc = cr.getContext();
        CanvasEnvironmentContext ce = cc.getEnvironmentContext();
        Map<String, Object> params = ce.getParameters();
        if (params.containsKey("orderId")) {
            invoiceService.setSignedRequest(cr);
            Integer orderId = Integer.parseInt(params.get("orderId").toString());
            if(orderId != null) {
                Order order = orderService.findOrder(orderId);
                if (order == null) {
                    throw new ResourceNotFoundException(orderId);
                }
                model.addAttribute("order", order);

                Invoice invoice;
                try {
                    invoice = invoiceService.findInvoice(order.getId());
                } catch (ApiException ae) {
                    // No match
                    invoice = new Invoice();
```

```
                }
                model.addAttribute("invoice", invoice);

                return "order";
            }
        }
        return getOrdersPage(model);
    }

    @RequestMapping(method=RequestMethod.GET)
    public String getOrdersPage(Model model) {
        model.addAttribute("order", new Order());
        model.addAttribute("orders", orderService.listOrders());

        return "orders";
    }

    private static final String getConsumerSecret(){
        String secret = System.getenv("OAUTH_CLIENT_SECRET");
        if (null == secret){
            throw new IllegalStateException("Client secret not found in environment.
            You must define the OAUTH_CLIENT_SECRET environment variable.");
        }
        return secret;
    }
}
```

After the validation, the signed request is passed to `order.jsp`, where the browser can access it.

```
<%@ page session="false" %>
<%@ taglib uri="http://java.sun.com/jsp/jstl/core" prefix="c" %>
<%@ taglib uri="http://java.sun.com/jsp/jstl/fmt" prefix="fmt" %>
<%@ taglib prefix="form" uri="http://www.springframework.org/tags/form" %>

<html>
 <head>
  <title>Order</title>
  <link rel="stylesheet" href="<c:url value="/resources/blueprint/screen.css" />"
  type="text/css" media="screen, projection">
  <link rel="stylesheet" href="<c:url value="/resources/blueprint/print.css" />"
type="text/css" media="print">
  <!--[if lt IE 8]>
   <link rel="stylesheet" href="<c:url value="/resources/blueprint/ie.css" />"
  type="text/css" media="screen, projection">
  <![endif]-->
  <script type="text/javascript" src="<c:url value="/resources/jquery-1.4.min.js" /> ">
  </script>
  <script type="text/javascript" src="<c:url value="/resources/json.min.js" /> ">
  </script>
        <script type="text/javascript" src="<c:url value="/resources/canvas-all.js" /> ">

    </script>
        <script>
            // Get the Signed Request from the CanvasUIController
           var sr =  JSON.parse('${not empty signedRequestJson?signedRequestJson:"{}"}');
```

```
            // Set handlers for the various buttons on the page
            Sfdc.canvas(function() {
                $('#finalizeButton').click(finalizeHandler);
                $('#deleteButton').click(deleteHandler);
            });

            // This function will be called when the "Finalize" button is clicked.
            // This shows using the Canvas Cross Domain API to hit the REST API
            // for the invoice that the user is viewing.  The call updates the
            // Status__c field to "Shipped".  If successful, the page is refreshed,
            // and if there is an error it will alert the user.
            function finalizeHandler(){
                var invoiceUri=sr.context.links.sobjectUrl + "Invoice__c/${order.id}";
                var body = {"Status__c":"Shipped"};
                Sfdc.canvas.client.ajax(invoiceUri,{
                    client : sr.client,
                    method: 'PATCH',
                    contentType: "application/json",
                    data: JSON.stringify(body),
                    success : function() {
                        window.top.location.href = getRoot() + "/${order.id}";
                    },
                    error: function(){
                        alert("Error occurred updating local status.");
                    }
                });
            }

            // This function will be called when the "Delete Order" button is clicked.
            // It will delete the record from the Heroku database.
            function deleteHandler(){
                $.deleteJSON("/order/${order.orderId}", function(data) {
                    alert("Deleted order ${order.orderId}");
                    location.href = "/orderui";
                }, function(data) {
                    alert("Error deleting order ${order.orderId}");
                });
                return false;
            }

            // This function gets the instance the user is on for a page referesh
            function getRoot() {
                return sr.client.instanceUrl;
            }
        </script>

</head>
<body>
        <div id="bodyDiv" style="width:inherit;">
            <div id="myPageBlockTable">
                <h2 id="OrderTitle">
                    Order Number: <c:out value="${order.orderId}"/>
```

```
                </h2>
                <table id="myTable" width="100%">
                    <col width="20%">
                    <tr><td class="myCol">Invoice Id:</td><td class="valueCol">
                    <c:out value="${invoice.id}"/></td></tr>
                    <tr><td class="myCol">Invoice Number:</td><td class="valueCol">
                    <c:out value="${invoice.number}"/></td></tr>
                  <tr><td class="myCol">Status:</td><td class="valueCol" valign="center">

                    <c:out value="${invoice.status}"/>
                        <!-- Display a green check if the order is Shipped, or a red x if
 not shipped -->
                        <c:choose>
                            <c:when test="${invoice.status == 'Shipped'}">
                                <img src="/resources/images/shipped.png" />
                            </c:when>
                            <c:otherwise>
                                <img src="/resources/images/pending.png" />
                            </c:otherwise>
                        </c:choose>
                    </td></tr>
                </table>
                <!-- Display the Back and Delete Order Button if viewed outside
                of salesforce (no signed request). -->
                <!-- Display the Finalize Button if viewed inside of salesforce and
                the Status is not Shipped. -->
                <c:choose>
                    <c:when test="${empty signedRequestJson}">
                        <button onclick="location.href='/orderui'">Back</button>
                        <button id="deleteButton">Delete Order</button>
                    </c:when>
                    <c:otherwise>
                        <c:if test="${invoice.status ne 'Shipped'}">
                            <button id="finalizeButton">Finalize</button>
                        </c:if>
                    </c:otherwise>
                </c:choose>
            </div>
        </div>
 </body>
</html>
```

Step 3: Configure Access to Your Force.com Canvas App

Because this app is designed for use by a specific audience, let’s give access only to the users who need it.

1. In Salesforce, from Setup, click **Manage Apps** > **Connected Apps**.
2. Click your app, and then click **Edit**.
3. In the `Permitted Users` field, select **Admin approved users are pre-authorized**. Click **OK** on the popup message that appears.
4. Click **Save**.

Now you'll use profiles and permission sets to define who can see your canvas app. In this example, we'll allow anyone with the System Administrator profile to access the app.

5. In the Connected App Detail page's Profiles related list, click **Manage Profiles**.
6. Select the `System Administrator` profile, and then click **Save**.

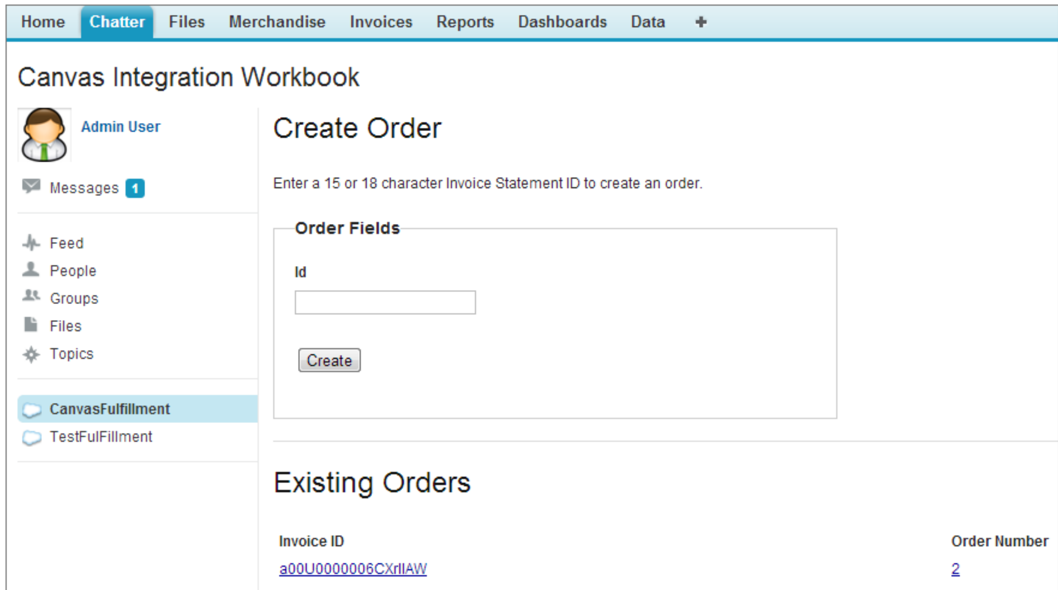
Your app is now available to anyone with the `System Administrator` profile.

Step 4: Make Your Force.com Canvas App Available from the Chatter Tab

The values you selected in the `Locations` field when creating the connected app in Step 2: Edit the Connected App Details and Enable the App for Force.com Canvas on page 16 determine where an installed canvas app appears. When an app is made available to the Chatter tab, there's nothing we need to do for this step. If you log into your Salesforce org and select the Chatter tab, you'll see that your canvas app appears in the app navigation list.

Note: When displaying the list of orders on the Chatter Tab, remember that `orders.jsp` has been set up to handle the signed request POST. However, if you click into a record from this page, you are redirected to `orderui`, which uses OAuth. If the Heroku OAuth flow is inactive, you may receive an error when viewing the individual order.

Click your app's name. It should look something like this:



Step 5: Use Visualforce to Display the Canvas App on a Record

While you can certainly use the app based on the work completed so far, let's take one more step and use Visualforce to display information from your canvas app on the invoice record.

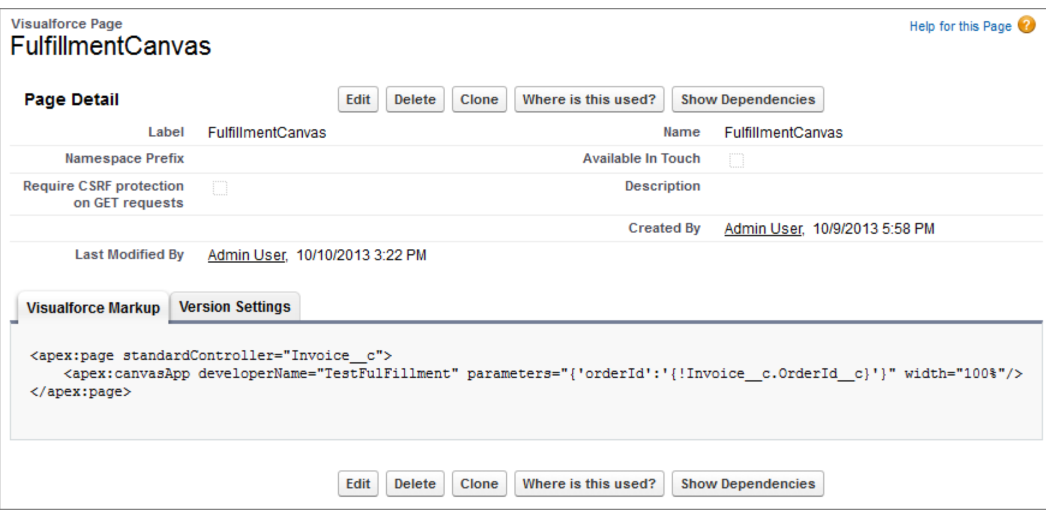
1. From Setup, click **Develop** > **Pages**.
2. Click **New**.

3. In `Label`, enter *`FulfillmentCanvas`*. You use this label to identify the page in Setup tools when performing actions such as defining custom tabs or overriding standard buttons.
4. In `Name`, accept the default name *`FulfillmentCanvas`*.
5. Add the following markup to the Visualforce Markup box, making sure to replace *`{appname}`* with your Heroku application name, and then click **Save**.

```
    <apex:page standardController="Invoice__c">
        <apex:canvasApp developerName="{appname}"
parameters="{'orderId':'{!Invoice__c.OrderId__c}'}" width="100%"/>
    </apex:page>
```

Notice how the parameters tag in the `apex:canvasApp` component is set to `"{'orderId':'{!Invoice__c.OrderId__c}'}"`. This code sends a JSON object as part of the signed request to the Heroku app when the page is loaded. In the signed request, the parameters object will look something like `parameters : {'orderId':'5'}`, where '5' is the OrderId from the invoice record. Remember that this value is an external ID field that connects the record in the Heroku database to the Salesforce invoice record. By delivering the OrderId to the Heroku app with the signed request, the Heroku app can display the correct record on the invoice page layout.

Your page should look something like this:



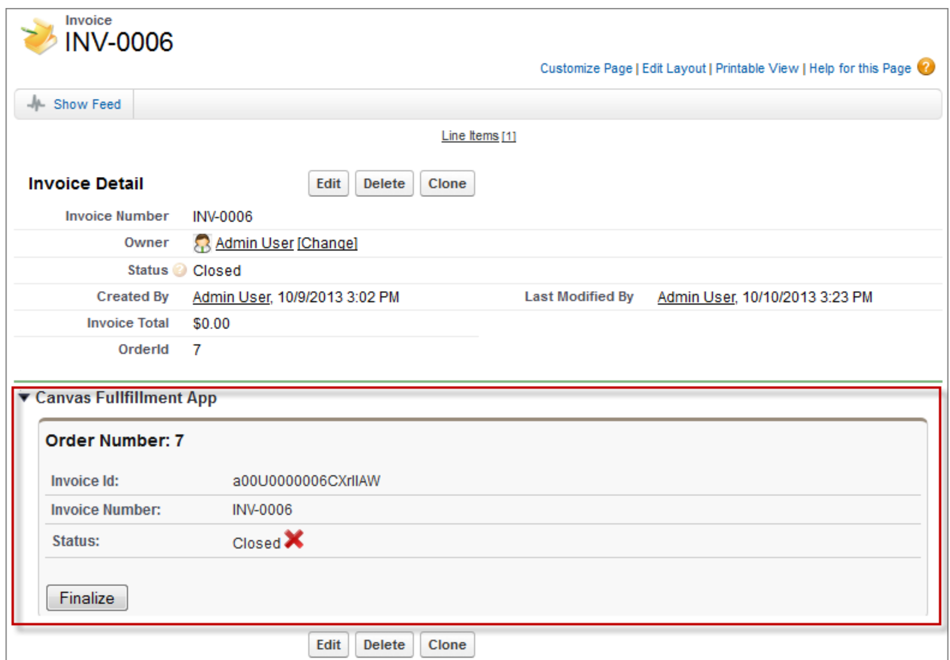
Now let's add your Visualforce page to the page layout.

6. From the Invoices tab, select a record.
7. Click **Edit Layout** and then **Visualforce Pages**.
8. Drag a section down to your page and name it Canvas Fulfillment.
   a. Make sure to deselect `Edit Page`.
   b. Select `1-Column` for the layout.
9. Drag your `FulfillmentCanvas` page onto the new section.
10. Click the wrench to update your page properties. The width should be set to 100% and height set to 165 pixels.
11. Ensure that both `Show scrollbars` and `Show label` are deselected and click **Save**.
12. From Setup, click **Create** > **Objects**, and then click `Invoice`.

13. In the Custom Fields & Relationships section, click `Status`.

14. Add another picklist item named Shipped.

Now when users go to an invoice record, they'll see the canvas app right on the record detail page:



Notice the **Finalize** button in the canvas app. If the invoice isn't in 'Shipped' status, the red "X" and **Finalize** will show in the app. If you click **Finalize**, Heroku uses the Force.com Canvas API to call the REST API and update the invoice Status field. Once the status is set to 'Shipped', the red "X" is replaced and **Finalize** is hidden.

Summary

Congratulations! With a combination of OAuth authentication, Force.com REST API, Apex triggers, `@future` callouts, the polyglot framework of the Heroku platform, Force.com Canvas, and Visualforce, you created and deployed a bi-directional integration between two clouds.

This workbook covers just one example of the many ways to integrate your applications with Salesforce. One integration technology that we didn't mention is the Streaming API that lets your application receive notifications from Force.com whenever a user changes Salesforce data. You can use this in the fulfillment application to monitor when changes are made to invoices and to automatically update the application pages accordingly. Visit `https://developer.salesforce.com` to learn more about all the ways you can integrate your application with Salesforce.