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Welcome

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#TC18

Embedding Tableau for self-service data science

Blair Hutchinson

Senior Product Consultant

Tableau

Santiago Sanchez

Solutions Consultant

Tableau

“Data Scientist: The Sexiest Job of the 21st Century

Harvard Business Review

Santiago Sanchez

Solutions Consultant

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Blair Hutchinson

Senior Product Consultant

Agenda

1. Current Paradigm
2. A Solution
3. Implementation
4. Q&A

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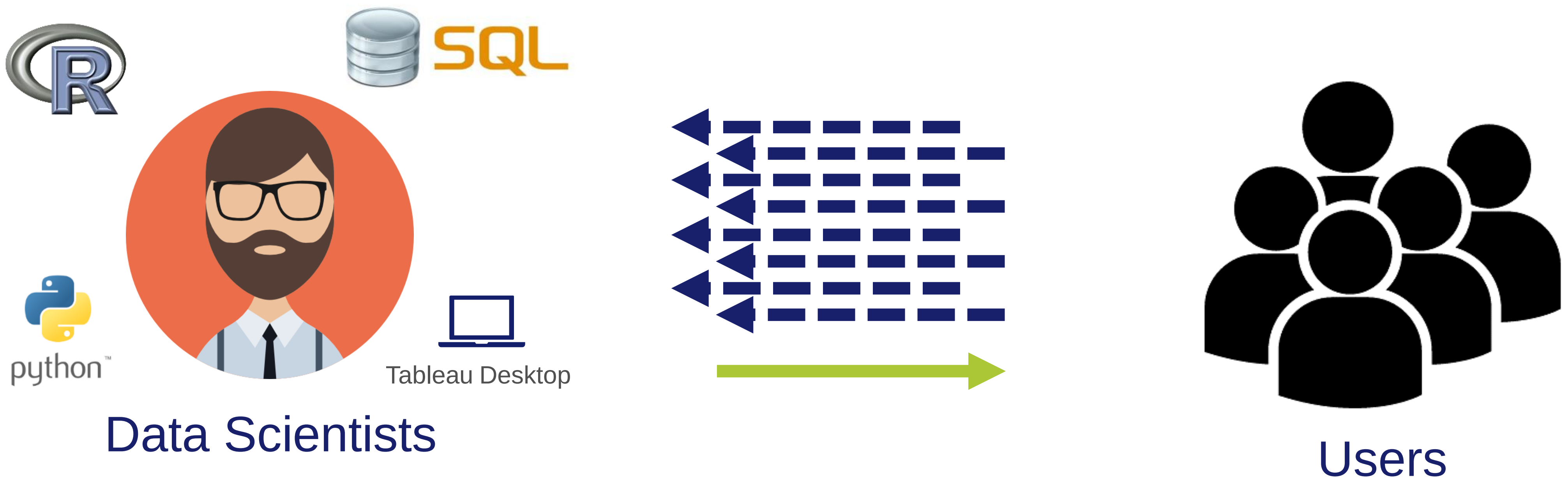
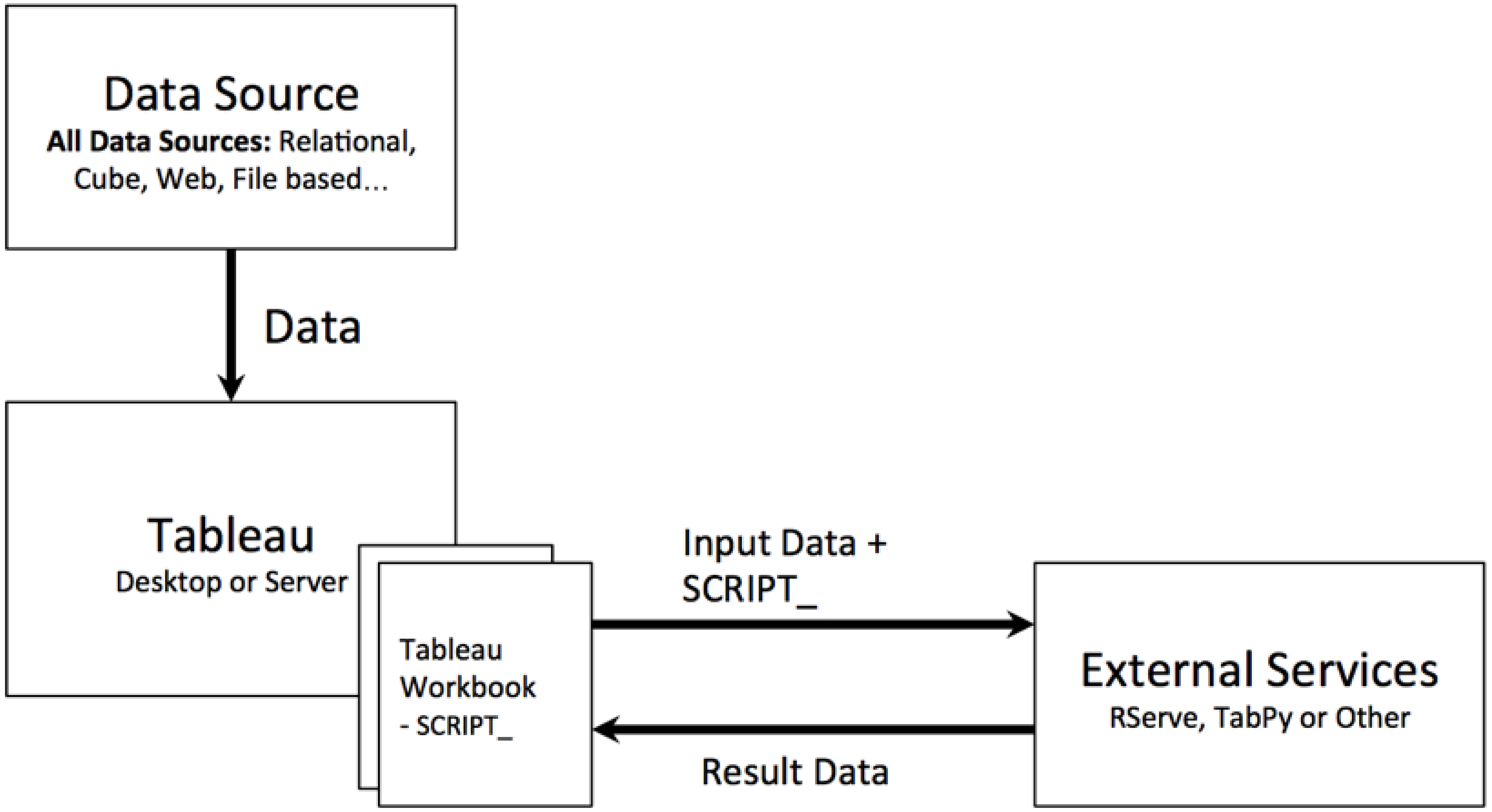
The Problem


SQL
python
Tableau Desktop
Data Scientists
Users

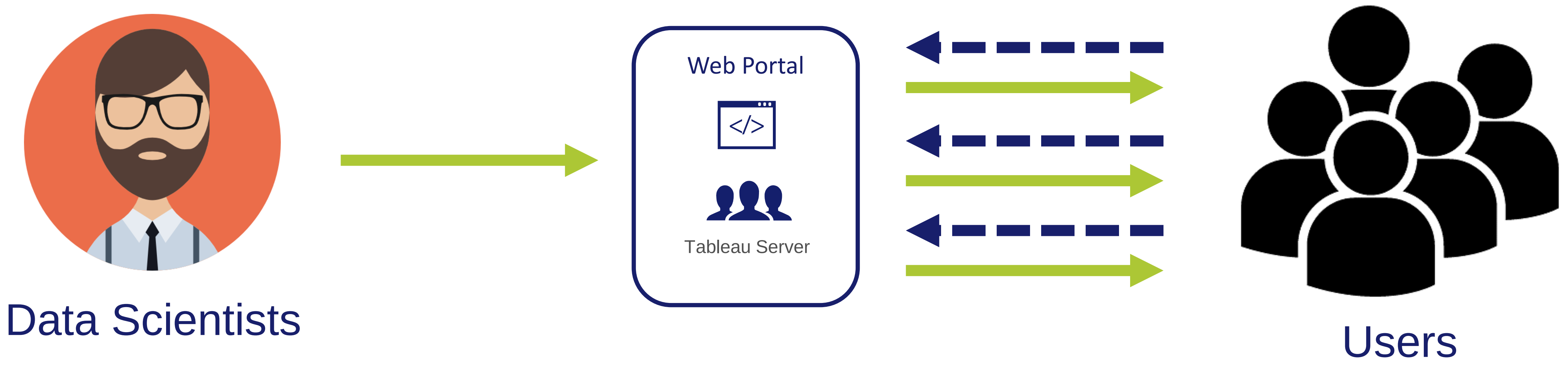
Tableau’s External Services Connection



But what if…

- Adapting your code proves to be difficult/impossible
- Output of the model needs to be persisted
- Time to execute model is above an acceptable threshold
- Model requires different input/output than what a Tableau visualization can send

A Solution!


Data Scientists
Web Portal
</>
Tableau Server
Users

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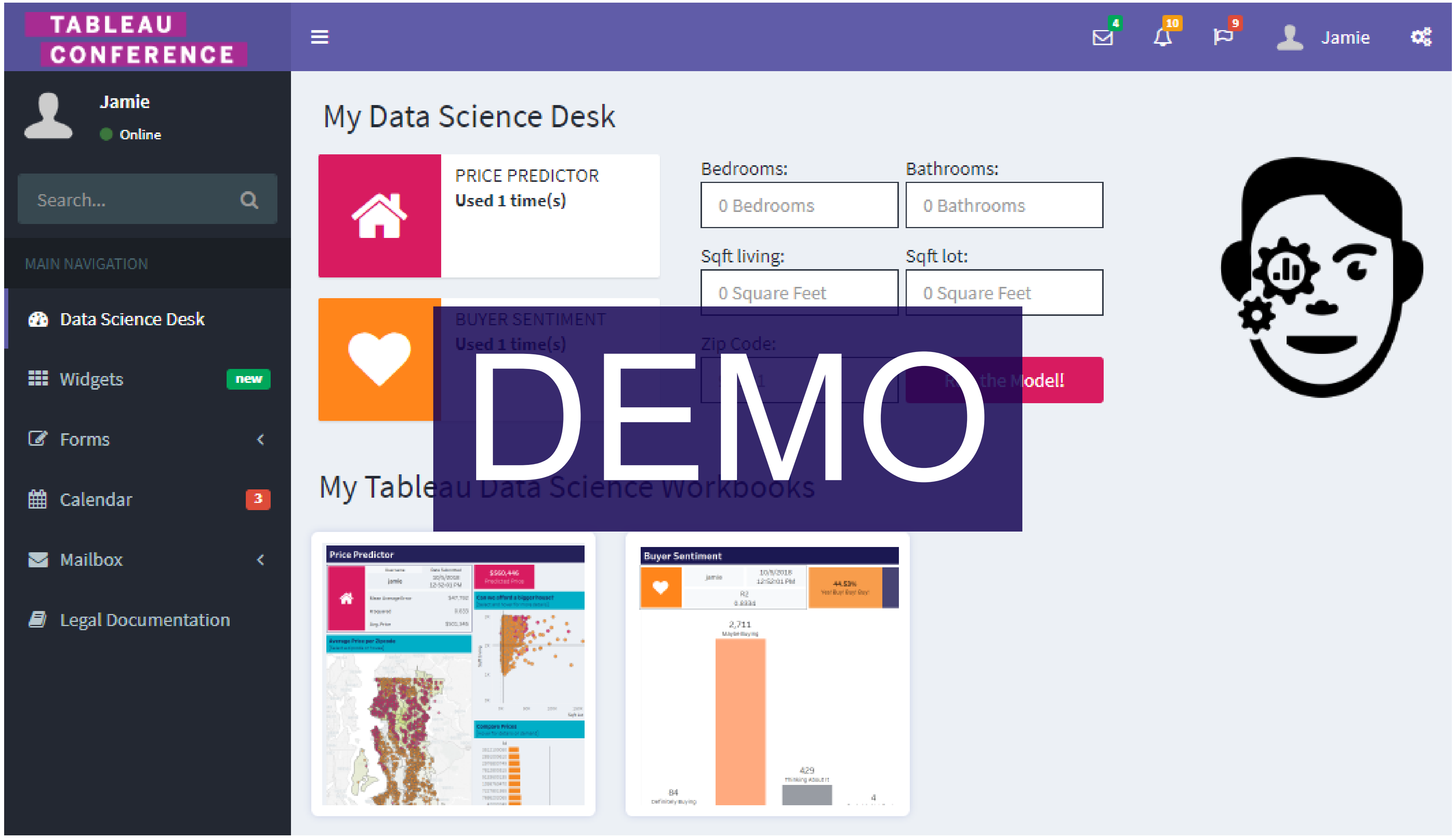
TABLEAU CONFERENCE

4 10 9 Jamie

Jamie
Online

Search...

MAIN NAVIGATION

- Data Science Desk
- Widgets new
- Forms
- Calendar 3
- Mailbox
- Legal Documentation

My Data Science Desk

PRICE PREDICTOR
Used 1 time(s)

BUYER SENTIMENT
Used 1 time(s)

Bedrooms: 0 Bedrooms
Bathrooms: 0 Bathrooms
Sqft living: 0 Square Feet
Sqft lot: 0 Square Feet
Zip Code:

the Model!

DEMO

My Tableau Data Science Workbooks

Price Predictor

Buyer Sentiment

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How do we get there?

Your Options

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Buy it

Tableau Partners

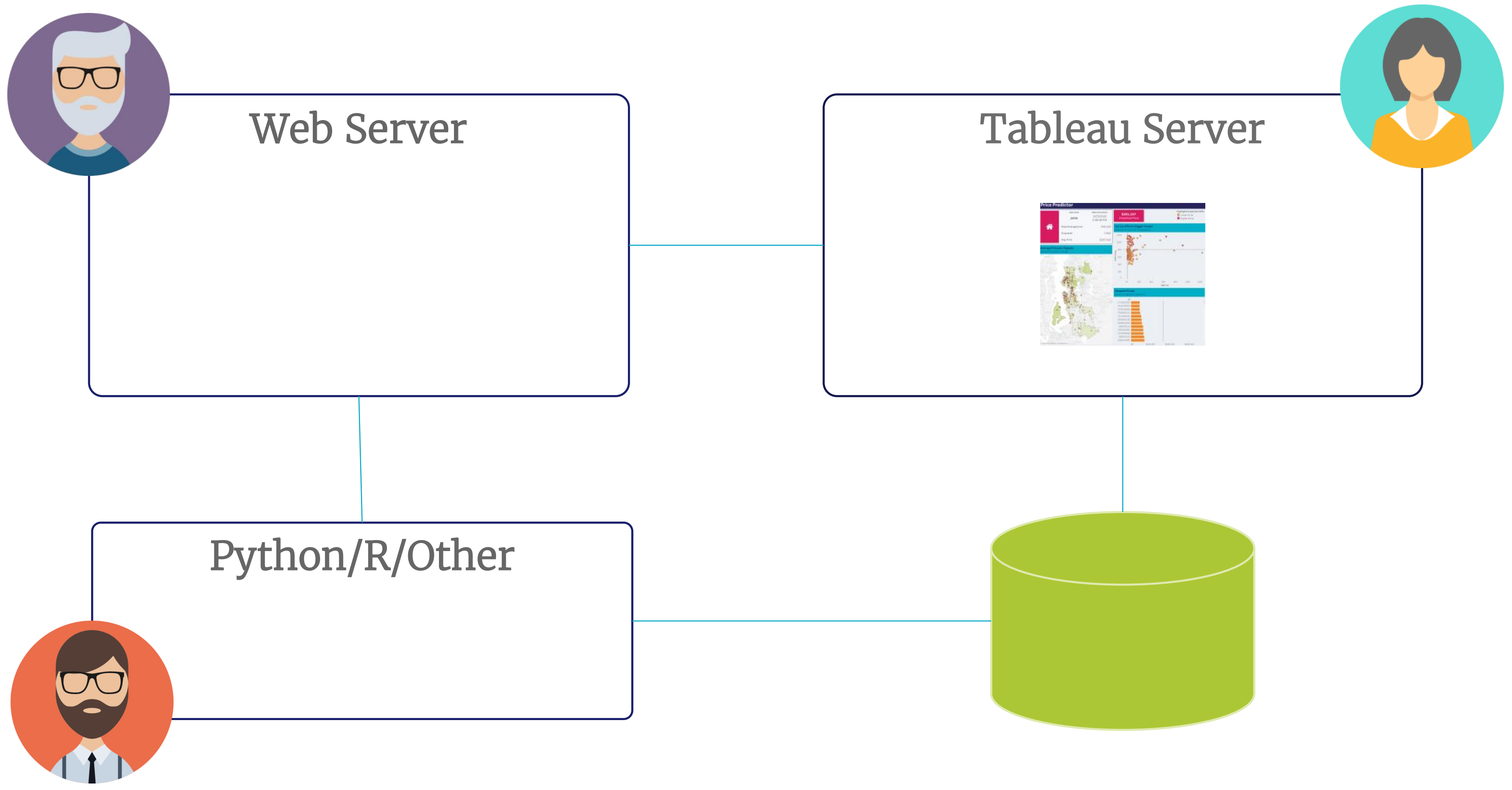
Build it

Data Scientist(s)

Tableau Server Admin

Web Developer(s)

Building Components



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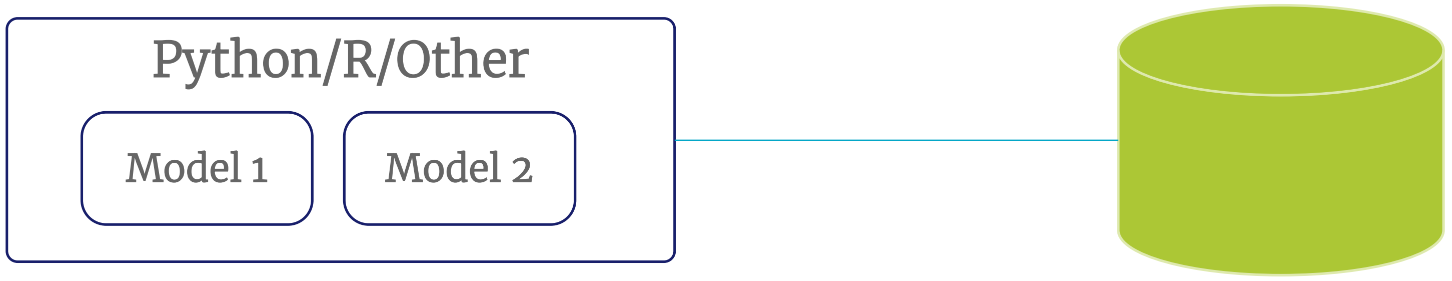
Implementation

Building Components



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Step 1

Build the Model

- Create and train your predictive model.
- Exposed relevant **variables** to the end user.
- Create and save your script (.py file) to **a server**.

Step 1 - Python Code & Data Structure

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Input variables

Load & filter data

Predict housing prices

Add username & timestamp columns

Export data to a database

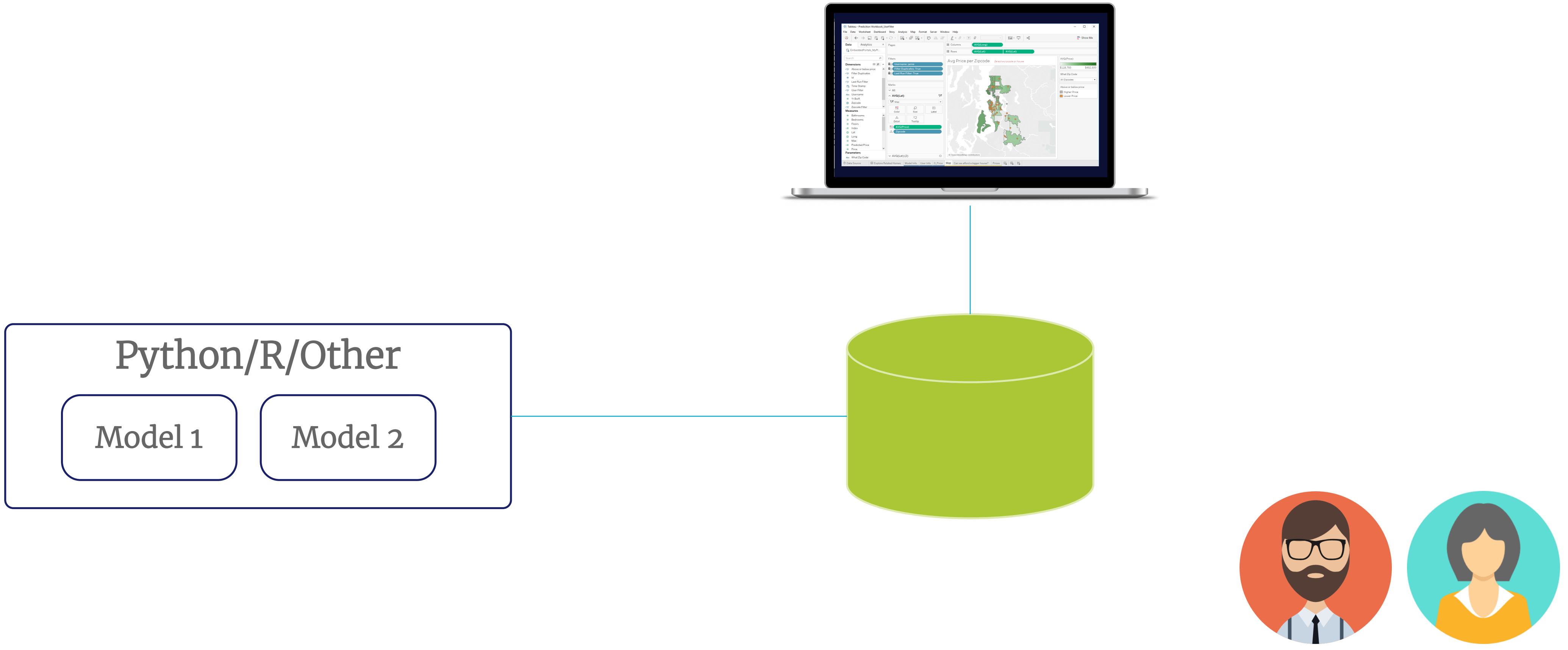
```
def predict_home(bedrooms, bathrooms, sqft_living, sqft_lot, zipcode, username, time):

    #load in housing data
    housing_df = pd.read_csv("kc_house_data_v2.csv")
    #filter to similar homes
    similar_df = housing_df[(housing_df.bedrooms == bedrooms)
                            & (housing_df.bathrooms <= (bathrooms + .5))
                            & (housing_df.bathrooms >= (bathrooms - .5))
                            & (housing_df.sqft_living <= (sqft_living * 1.5))
                            & (housing_df.sqft_living >= (sqft_living * .5))]
    #score similar homes
    model = joblib.load('BlairModel.pkl')
    prediction = model.predict(similar_df)

    #add username column
    pred_df['username'] = pd.Series(username, index=pred_df.index)
    #add timestamp column
    pred_df['time_stamp'] = pd.Series(time, index=pred_df.index)

    #append data to PricingPredictions table
    params = urllib.quote_plus("DRIVER={ODBC Driver 17 for SQL Server};SERVER=demo-dbs…
    engine = create_engine("mssql+pyodbc:///?odbc_connect=%s" % params)
    pred_df.to_sql('PricingPredictions', con=engine, if_exists='append', index=False)
```

Building Components

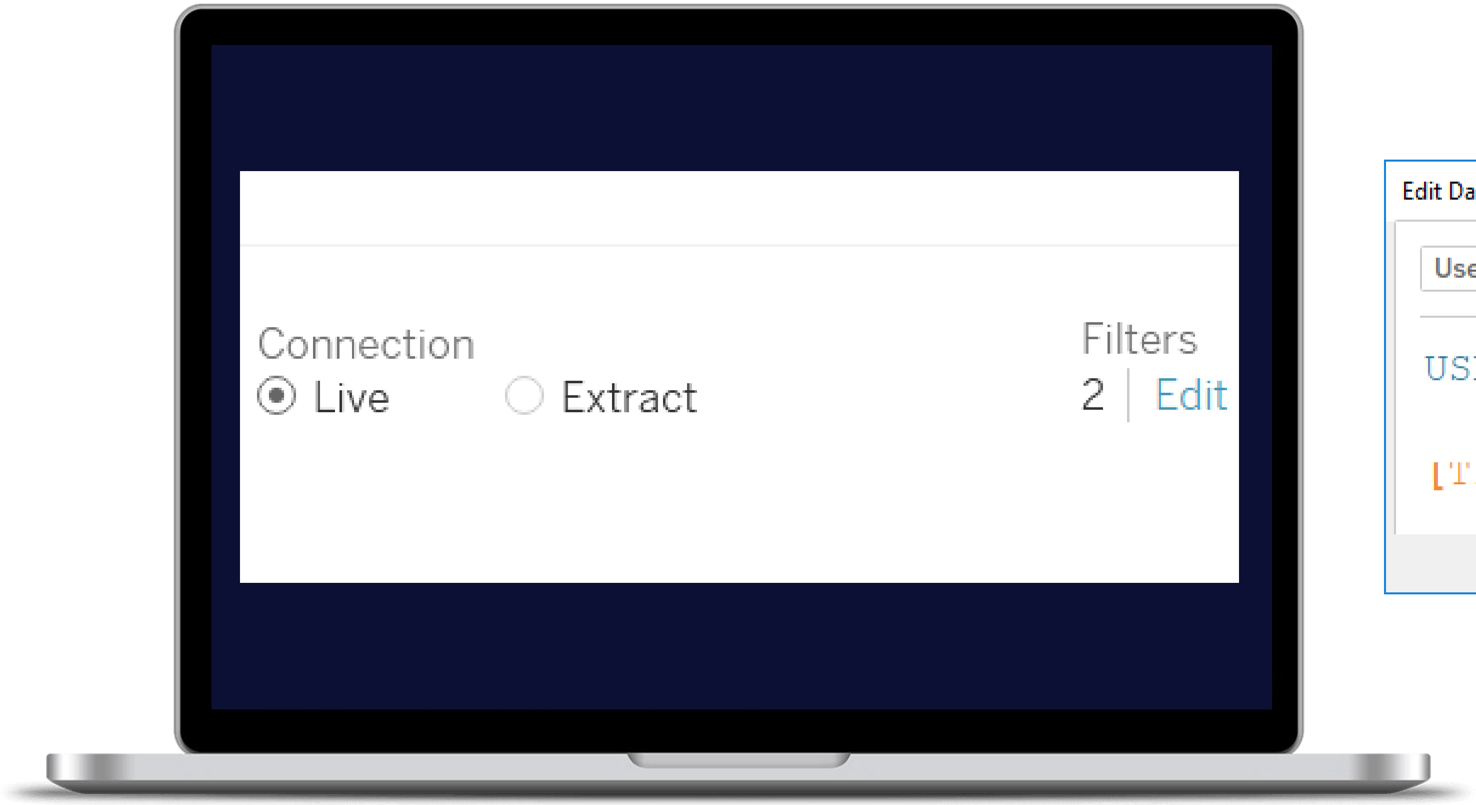


Step 2

Tableau Desktop

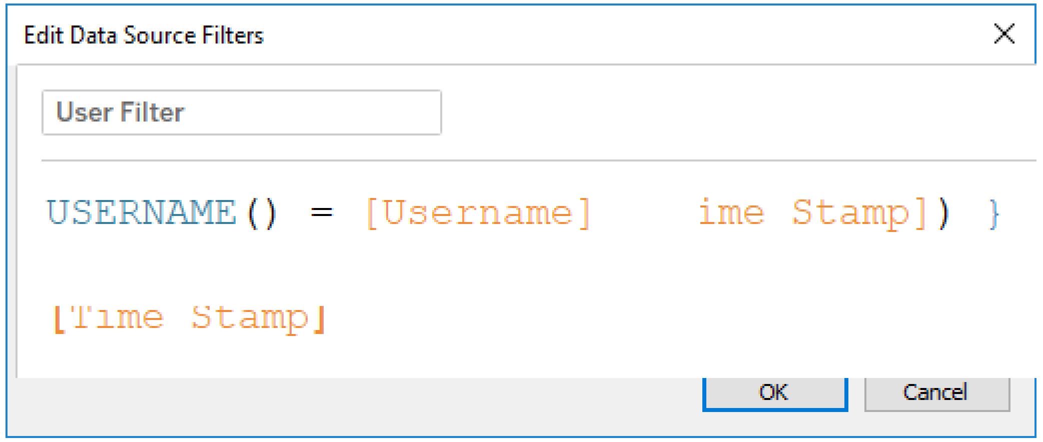
- Connect to your output table and visualize the result
- **Filter** the data
  - Most recent run
  - Row level security

Step 2 - Tableau Workbook



Connection
(● Live) ○ Extract

Filters
2 | Edit



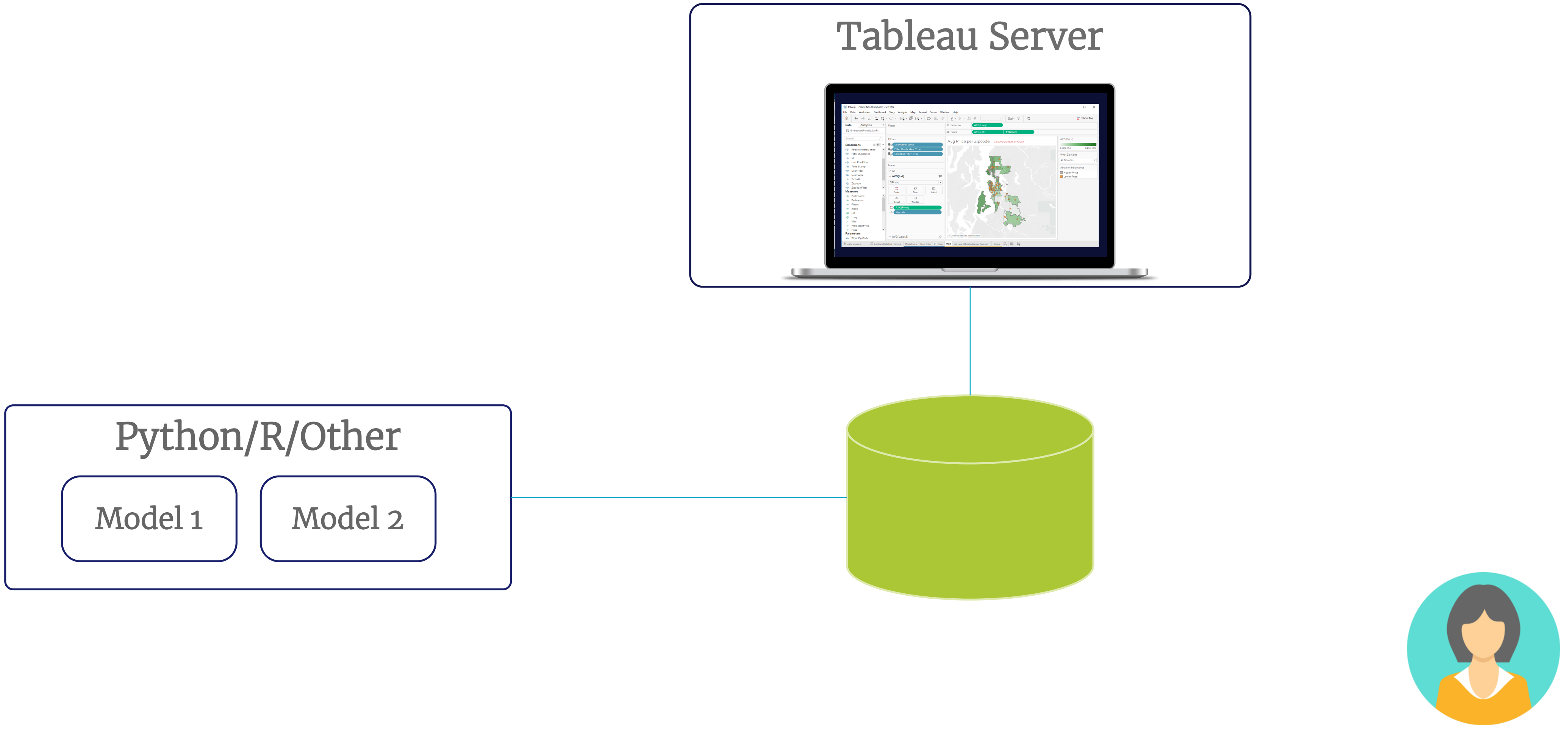
Edit Data Source Filters

User Filter

```
USERNAME() = [Username]     ime Stamp]) }

[Time Stamp]
```

Building Components



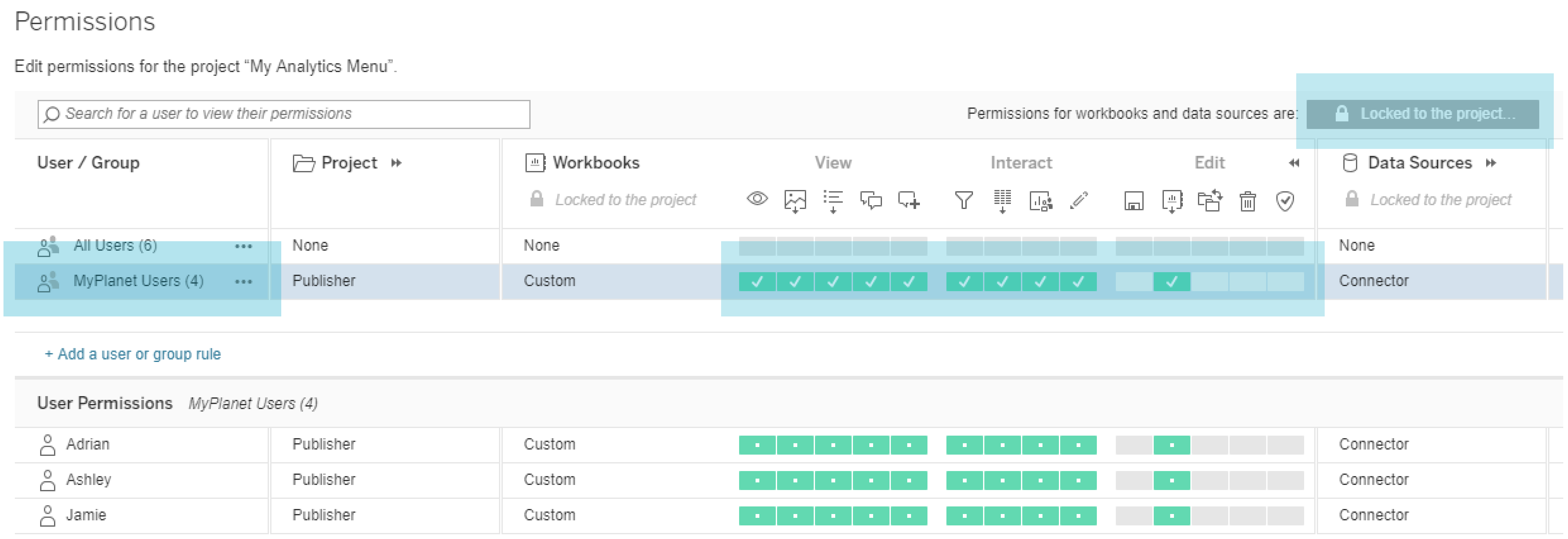
Step 3

Publish the Workbook

- Create a project in Tableau Server and **configure permissions**
- Publish the workbook to the project in Tableau Server

Step 3 - Project Permissions

Create a group - Set permissions - Lock to project



Permissions

Edit permissions for the project "My Analytics Menu".

Search for a user to view their permissions

Permissions for workbooks and data sources are: Locked to the project...

User / Group	Project	Workbooks	View					Interact				Edit					Data Sources
		Locked to the project															Locked to the project
All Users (6)	None	None															None
MyPlanet Users (4)	Publisher	Custom	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓				Connector

+ Add a user or group rule

User Permissions *MyPlanet Users (4)*

User	Project	Workbooks	View					Interact				Edit					Data Sources
Adrian	Publisher	Custom	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩		🟩				Connector
Ashley	Publisher	Custom	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩		🟩				Connector
Jamie	Publisher	Custom	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩		🟩				Connector

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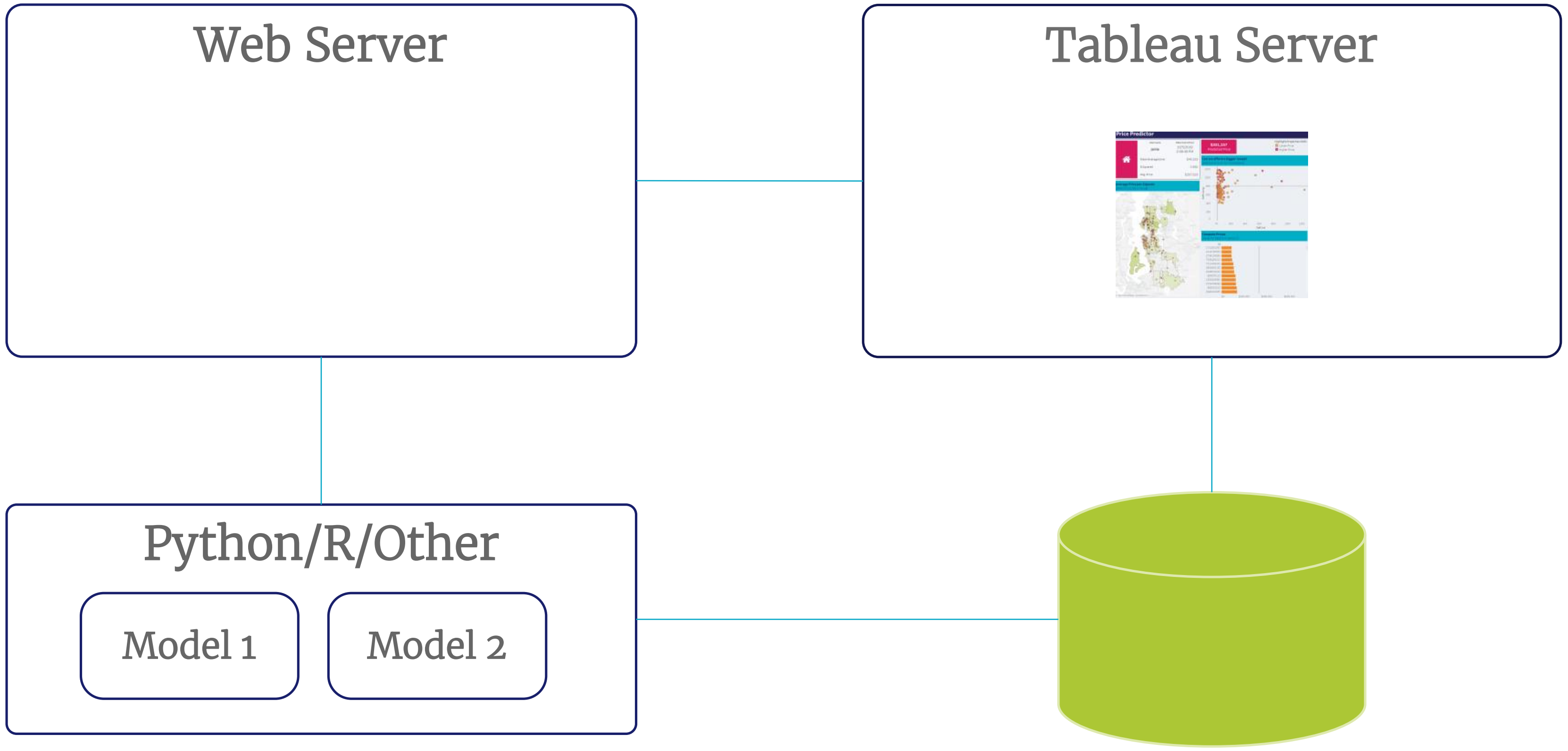
Building Components



Step 4

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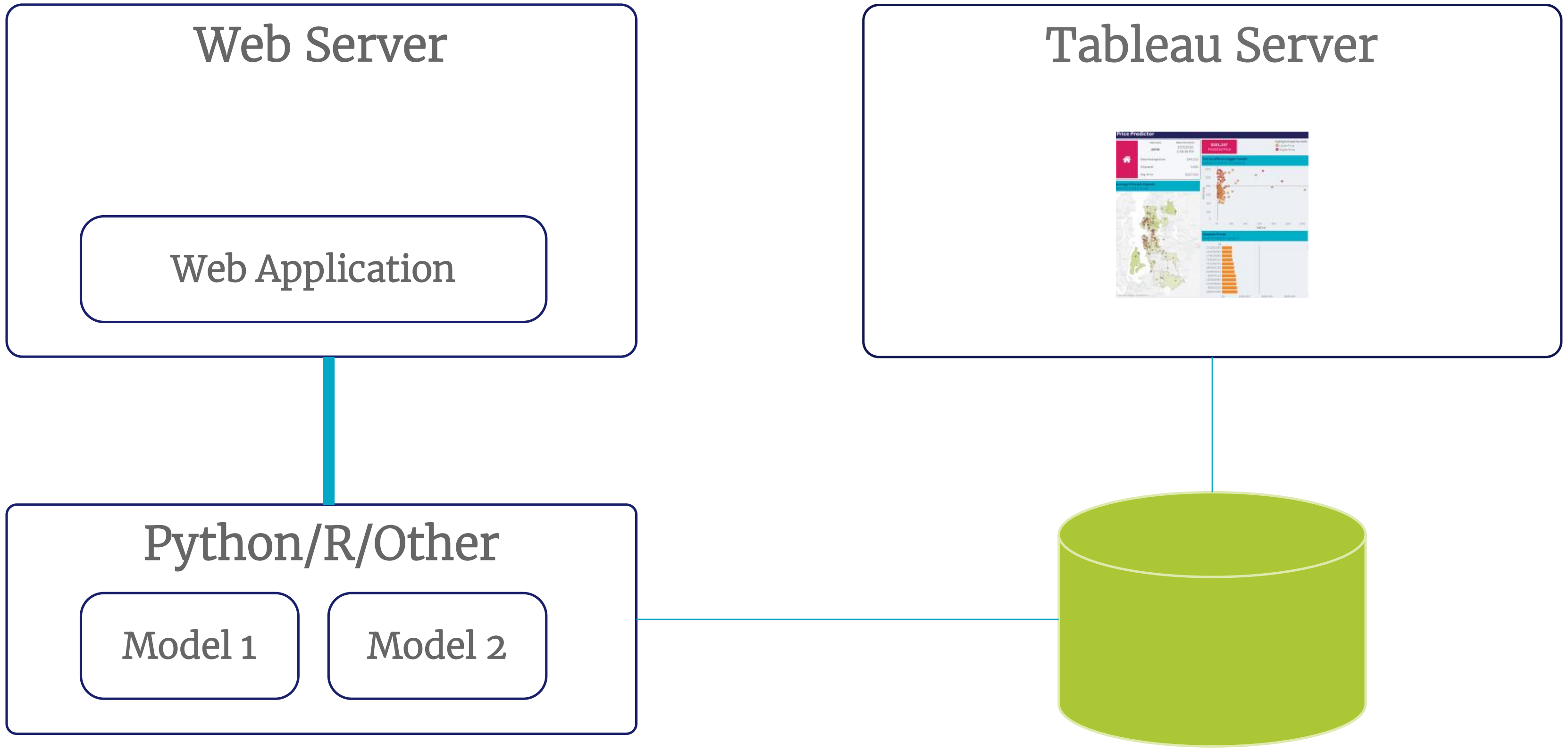
Build the Web Application

1. Receive parameters from the end user to feed into model
2. Single Sign On into Tableau Server
3. Embed a Tableau Workbook on the web application

TABLEAU CONFERENCE

Building Components



Step 4.1

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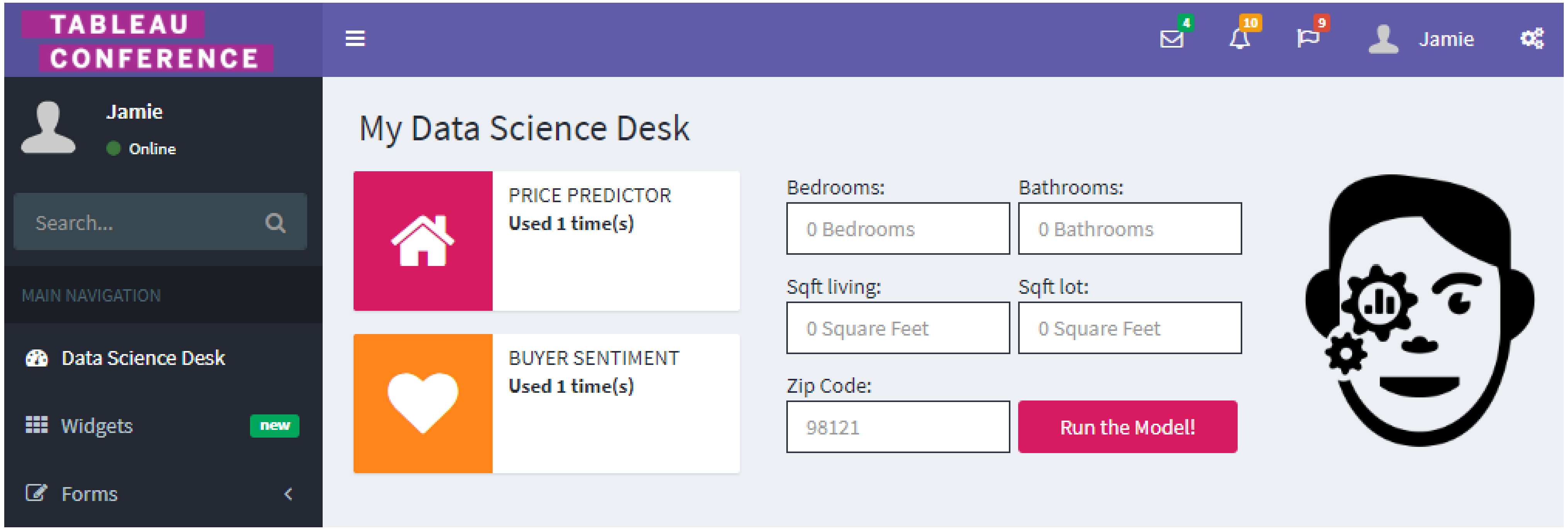
Receive parameters from the end user to feed into model:

a. Create a web page with input fields
b. Make a server-side call from the web application to the model

Step 4.1 - Web App Receiving Parameters



My Data Science Desk

PRICE PREDICTOR
Used 1 time(s)

BUYER SENTIMENT
Used 1 time(s)

Bedrooms: 0 Bedrooms
Bathrooms: 0 Bathrooms
Sqft living: 0 Square Feet
Sqft lot: 0 Square Feet
Zip Code: 98121

Run the Model!

Step 4.1 - Gather user input

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Parse JSON object & create a string with all variables

Add user & time

Execute the model

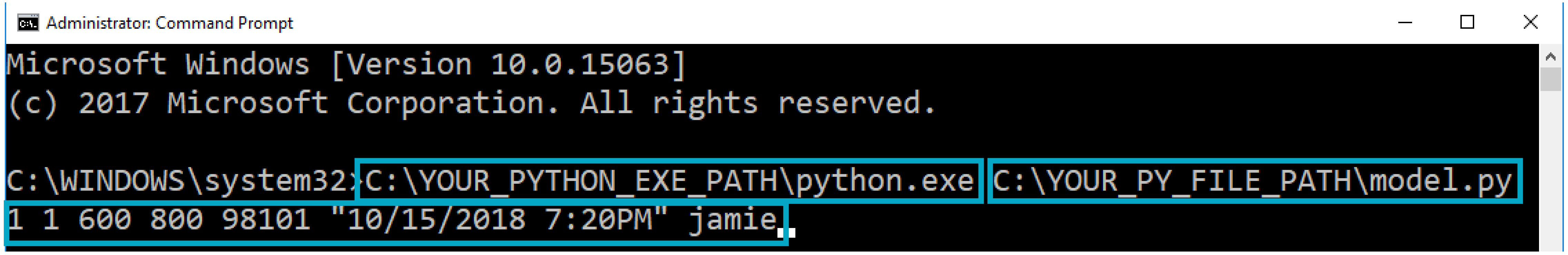
```
public JsonResult RunDataScienceModel(string inputArray)
{
    try
    {
        var inputDataModel = JsonConvert.DeserializeObject<Models.InputModel>(inputArray);
        string userVariables = "\"" + inputDataModel.Items.Find(x => x.ItemName == "bedrooms").Quantity +
            "\" \"" + inputDataModel.Items.Find(x => x.ItemName == "bathrooms").Quantity +
            "\" \"" + inputDataModel.Items.Find(x => x.ItemName == "sqftLiving").Quantity +
            "\" \"" + inputDataModel.Items.Find(x => x.ItemName == "sqftLot").Quantity +
            "\" \"" + inputDataModel.Items.Find(x => x.ItemName == "zipCode").Quantity;

        userVariables += "\" \"" + DateTime.Now.ToString() + "\" \""
            + User.Identity.GetUserEmail().Split('@')[0] + "\"";

        RunPythonCommandLine(ConfigurationManager.AppSettings["YOUR_PY_FILE_PATH"], userVariables);

        return Json("");
    }
    catch (Exception e)
    {
        return Json("This is not an elegant way to handle an error...");
    }
}
```

How do we execute the model?


Administrator: Command Prompt

```
Microsoft Windows [Version 10.0.15063]
(c) 2017 Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>C:\YOUR_PYTHON_EXE_PATH\python.exe C:\YOUR_PY_FILE_PATH\model.py
1 1 600 800 98101 "10/15/2018 7:20PM" jamie
```

1. Specify Python.exe location
2. Find the model file (.py)
3. Pass user variables

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Step 4.1 - Run the model

```
public string RunPythonCommandLine(string cmd, string args)
{
```

Setup python.exe location

```
    ProcessStartInfo start = new ProcessStartInfo();
    start.FileName = ConfigurationManager.AppSettings["YOUR_PYTHON_EXE_PATH"];
```

Specify model file and variables

```
    start.Arguments = string.Format("\"{0}\" {1}", cmd, args);
```

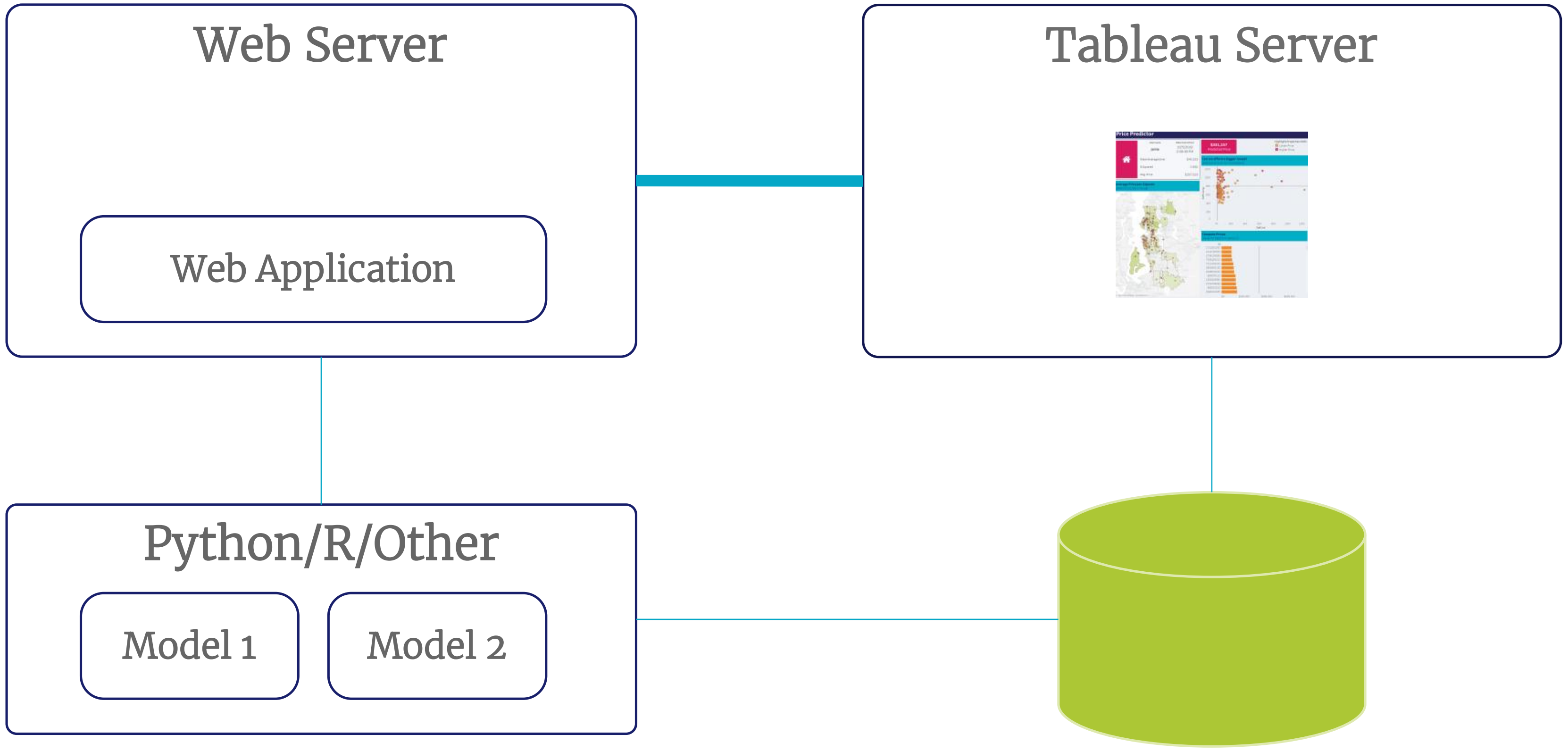
Configure command line to open in the background

```
    start.UseShellExecute = false;
    start.CreateNoWindow = true;
    start.RedirectStandardOutput = true;
    start.RedirectStandardError = true;
```

Execute the model and return the results (if any…)

```
    using (Process process = Process.Start(start))
    {
        using (StreamReader reader = process.StandardOutput)
        {
            string stderr = process.StandardError.ReadToEnd();
            string result = reader.ReadToEnd();
            return result;
        }
    }
}
```

Building Components

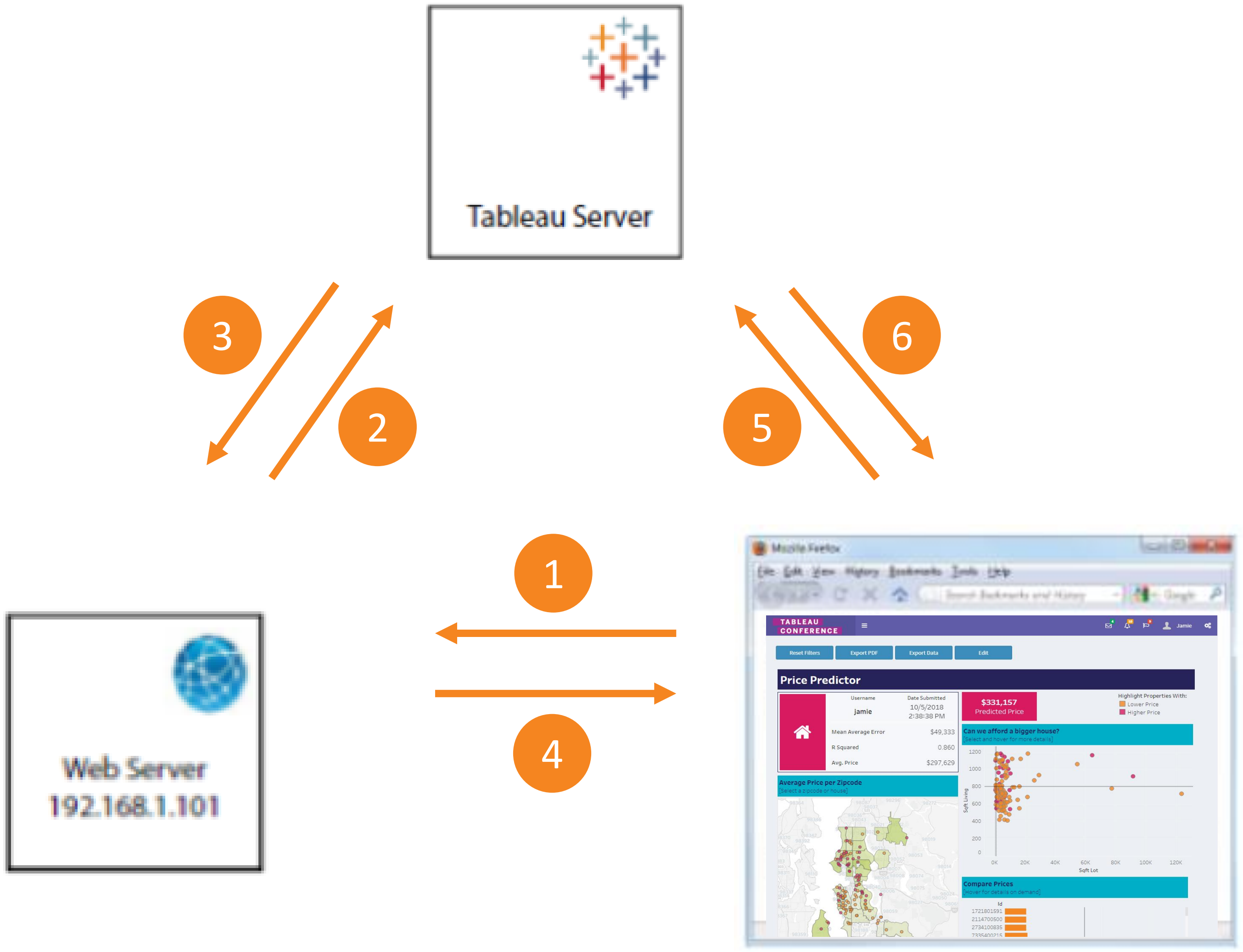


Step 4.2

Single Sign On into Tableau Server. Choose between:

a. Trusted Authentication
b. Windows Authentication
c. SAML
d. Others

Step 4.2 - Trusted Authentication



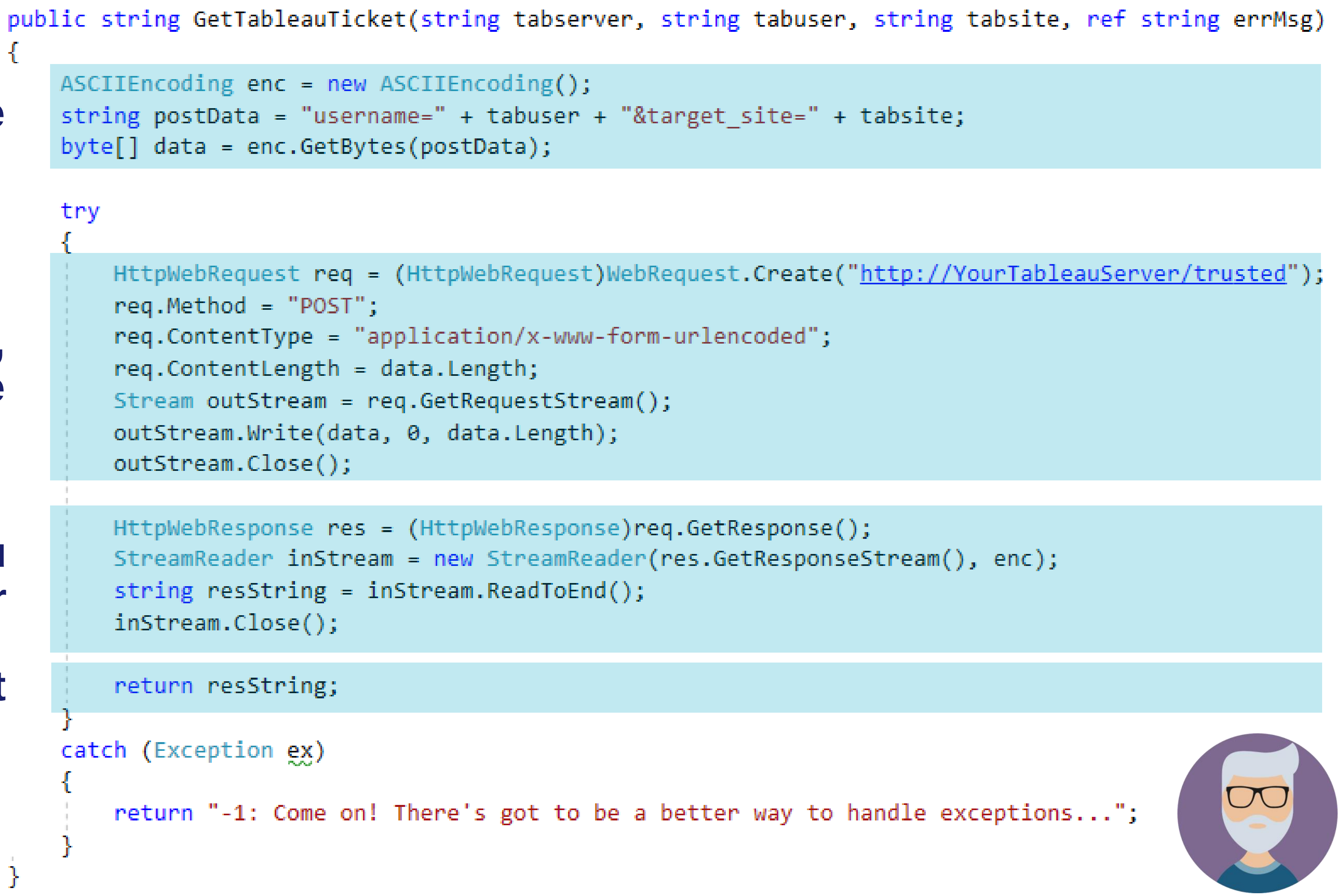
Step 4.2 - Trusted Authentication

Specify the username & site

Form a POST web request, include: URL, username & site

Send the request to Tableau Server

Get the ticket



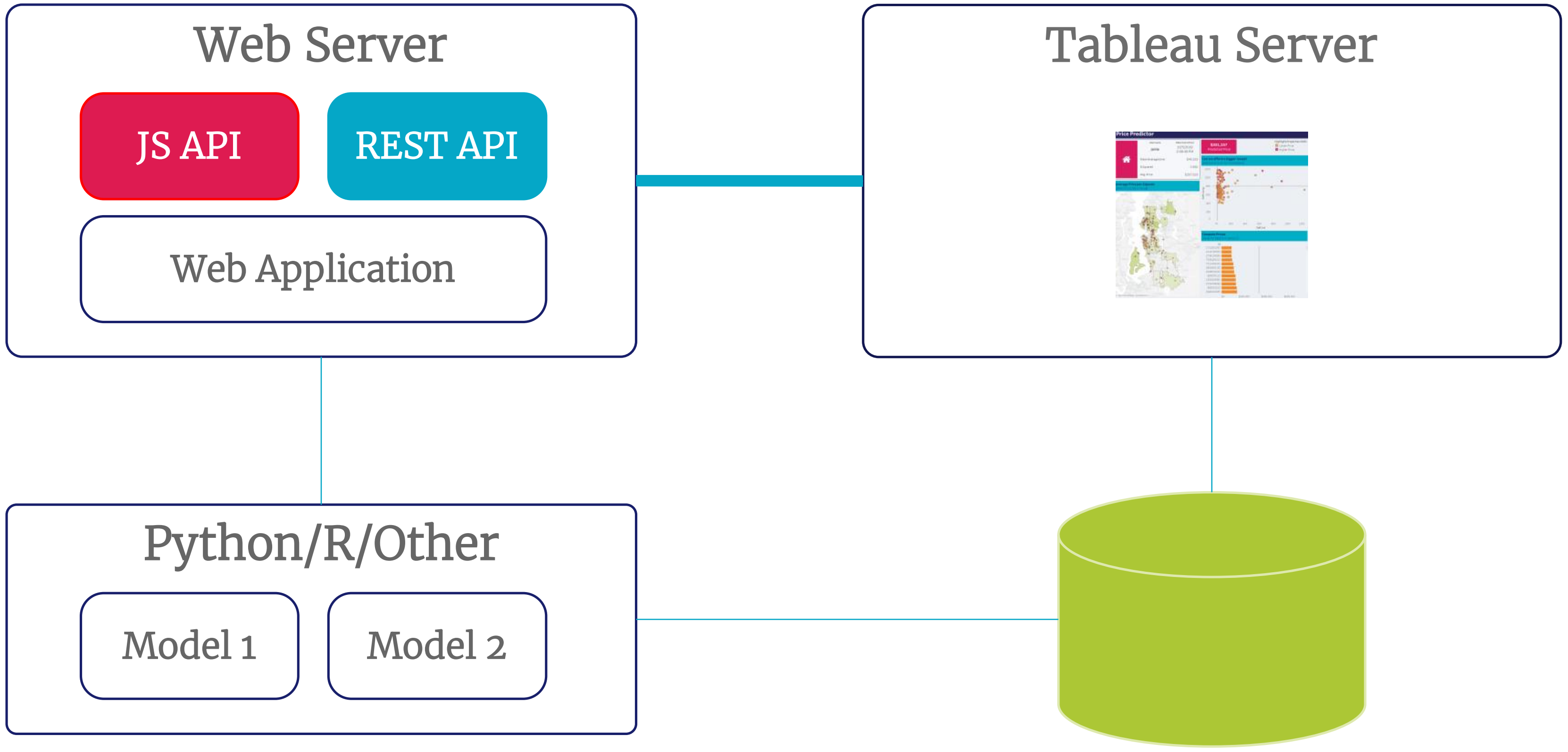
```
public string GetTableauTicket(string tabserver, string tabuser, string tabsite, ref string errMsg)
{
    ASCIIEncoding enc = new ASCIIEncoding();
    string postData = "username=" + tabuser + "&target_site=" + tabsite;
    byte[] data = enc.GetBytes(postData);

    try
    {
        HttpWebRequest req = (HttpWebRequest)WebRequest.Create("http://YourTableauServer/trusted");
        req.Method = "POST";
        req.ContentType = "application/x-www-form-urlencoded";
        req.ContentLength = data.Length;
        Stream outStream = req.GetRequestStream();
        outStream.Write(data, 0, data.Length);
        outStream.Close();

        HttpWebResponse res = (HttpWebResponse)req.GetResponse();
        StreamReader inStream = new StreamReader(res.GetResponseStream(), enc);
        string resString = inStream.ReadToEnd();
        inStream.Close();

        return resString;
    }
    catch (Exception ex)
    {
        return "-1: Come on! There's got to be a better way to handle exceptions...";
    }
}
```

What does a ticket look like?

9D1C

ɔ6mlJ5

Building Components



Step 4.3

Embed a Tableau Workbook on the web application

a. Use the Tableau JavaScript API to embed the workbook
b. Use the Tableau REST API to check which workbooks a user can see

Step 4.3 - Tableau APIs

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JS API

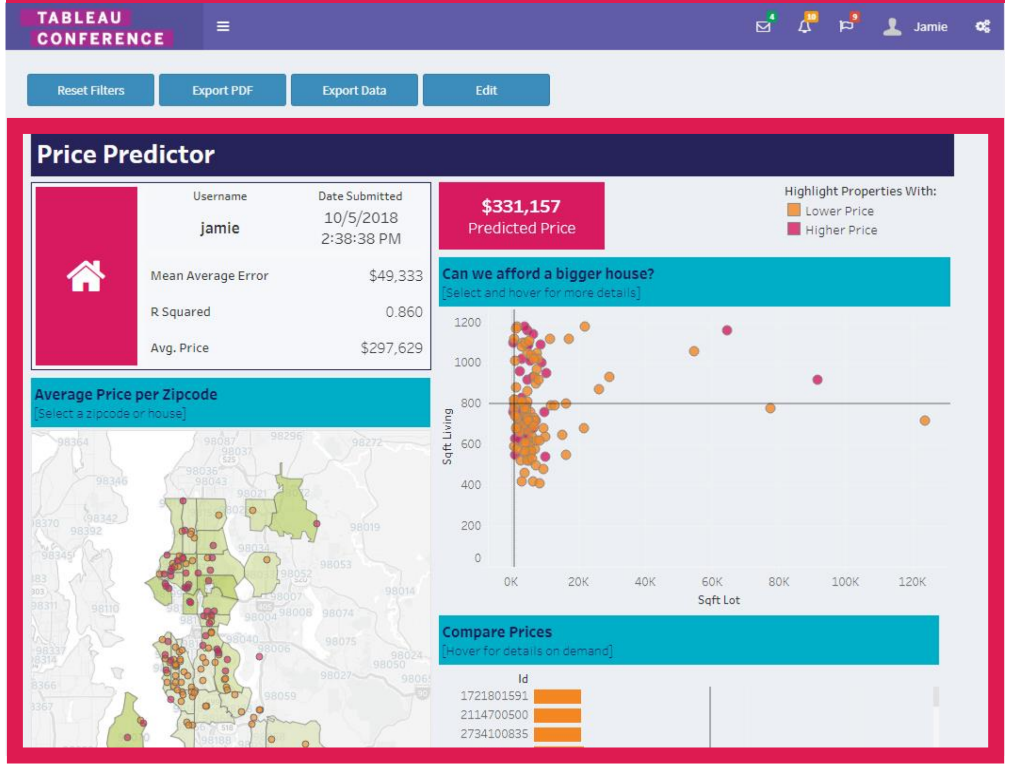


TABLEAU CONFERENCE
Jamie
Reset Filters
Export PDF
Export Data
Edit
Average Price per Zipcode
[Select a zipcode or house]
Can we afford a bigger house?
[Select and hover for more details]
Sqft Living
Sqft Lot
Compare Prices
[Hover for details on demand]
Id

Price Predictor

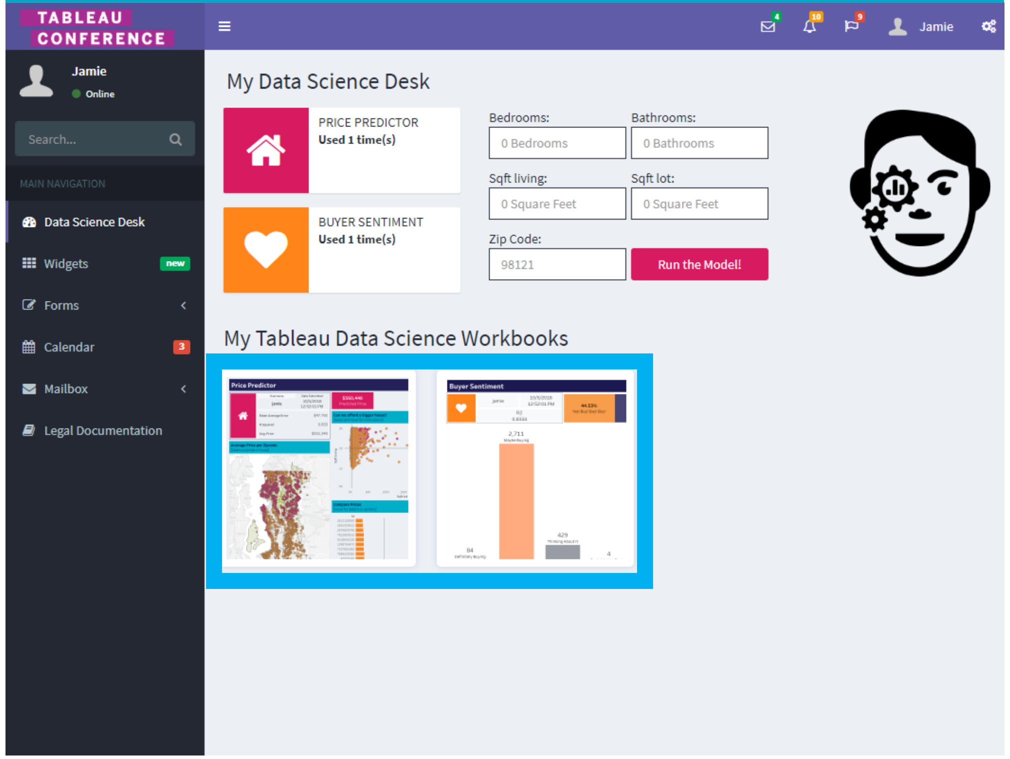
Username	Date Submitted
jamie	10/5/2018 2:38:38 PM

Mean Average Error	$49,333
R Squared	0.860
Avg. Price	$297,629

$331,157
Predicted Price

Highlight Properties With:
🟧 Lower Price
🟥 Higher Price

REST API



My Data Science Desk

PRICE PREDICTOR
Used 1 time(s)

BUYER SENTIMENT
Used 1 time(s)

Bedrooms: 0 Bedrooms	Bathrooms: 0 Bathrooms
Sqft living: 0 Square Feet	Sqft lot: 0 Square Feet
Zip Code: 98121	

My Tableau Data Science Workbooks

Step 4.3 - Tableau JavaScript API

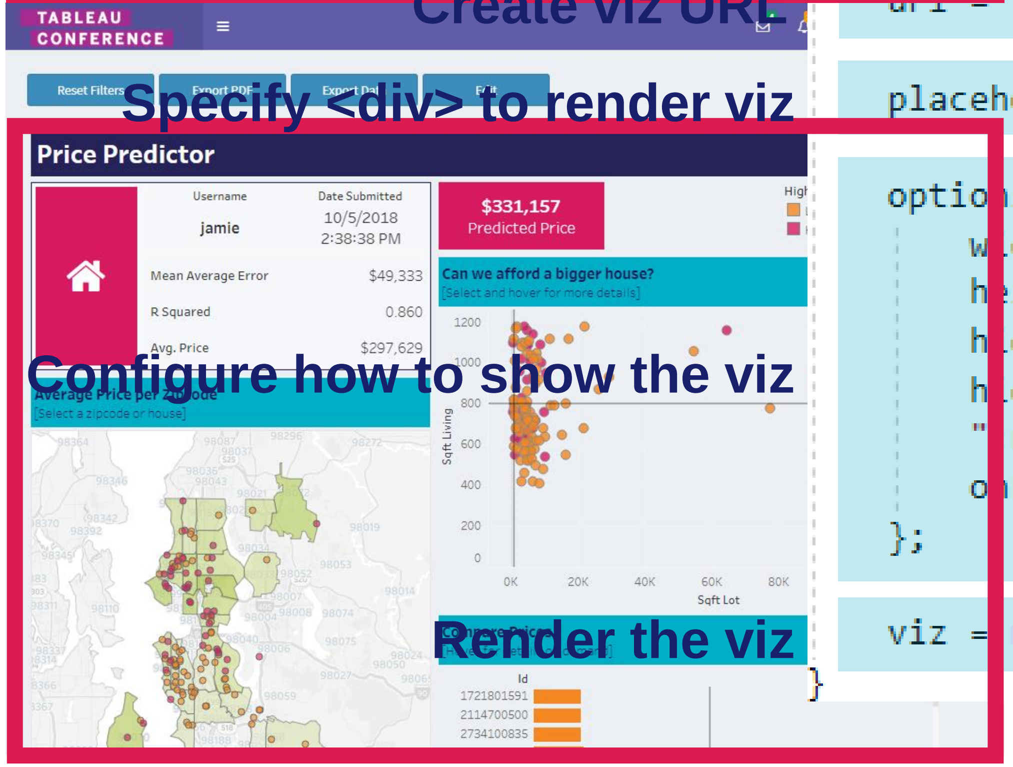
JS API

Create viz URL

Specify <div> to render viz

Configure how to show the viz

Render the viz



```
initializeViz() {
    url = tableauServer + '/trusted/' + ticket + "/t" + tableauSite + vizPath;

    placeholderDiv = document.getElementById("tableauViz");

    options = {
        width: placeholderDiv.offsetWidth,
        height: placeholderDiv.offsetHeight,
        hideTabs: true,
        hideToolbar: true,
        "refresh": "yes",
        onFirstInteractive: completeLoad
    };

    viz = new tableau.Viz(placeholderDiv, url, options);
}
```

Step 4.3 - Tableau JavaScript API

Create viz URL

```
url = tableauServer + '/trusted/' + ticket + "/t" + tableauSite + vizPath;
```

http://tabserver/trusted/9D1ObyqDQmSIOyQpKdy4Sw==:dg62gCsSE0QRArXNTOp6mIJ5/t/mySite/views/aWorkbook/aView

Tableau JavaScript API

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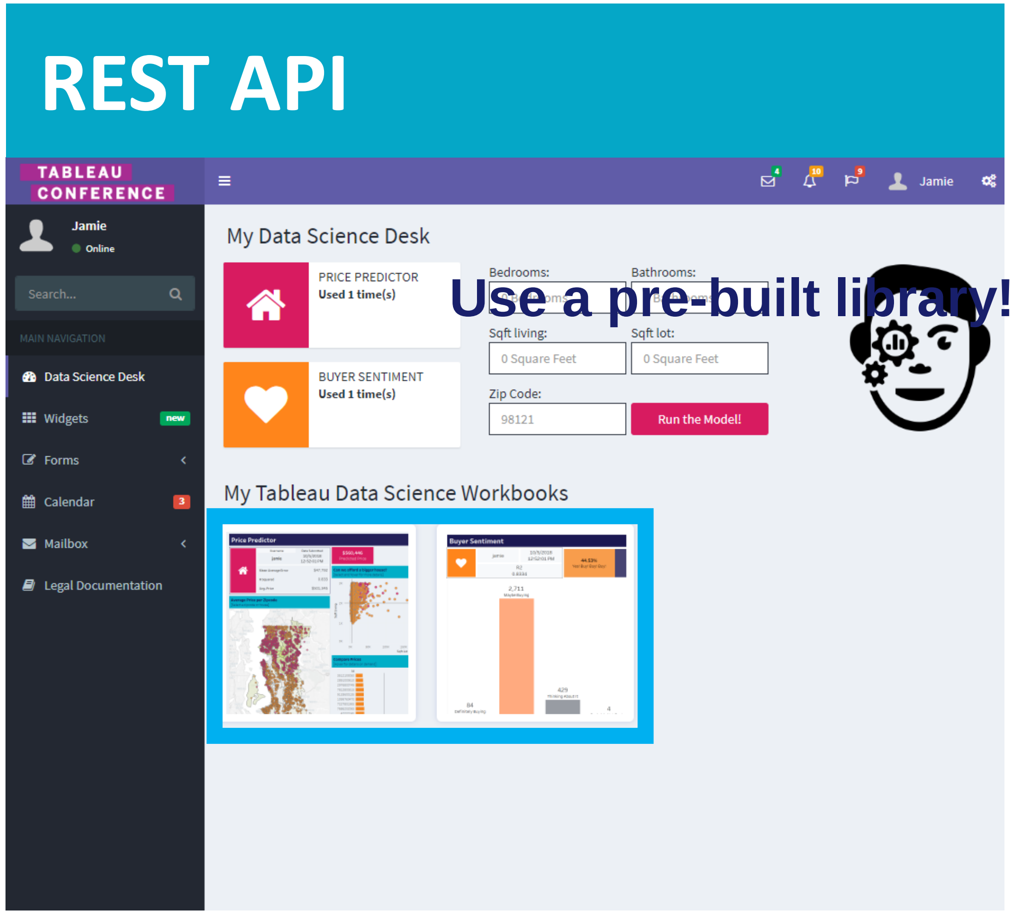
Hey! I want to learn more…

a. Intro Video to the JavaScript API:
https://www.tableau.com/learn/tutorials/on-demand/javascript-api-intro-and-embed

b. Tableau JavaScript API Tutorial:
https://onlinehelp.tableau.com/samples/en-us/js_api/tutorial.htm

c. Tableau JavaScript API Reference:
https://onlinehelp.tableau.com/current/api/js_api/en-us/JavaScriptAPI/js_api_ref.htm

Step 4.3 - Tableau REST API



REST API

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Jamie

Online

Search...

MAIN NAVIGATION

- Data Science Desk
- Widgets new
- Forms
- Calendar 3
- Mailbox
- Legal Documentation

My Data Science Desk

PRICE PREDICTOR
Used 1 time(s)

BUYER SENTIMENT
Used 1 time(s)

Bedrooms:

Bathrooms:

Sqft living: 0 Square Feet

Sqft lot: 0 Square Feet

Zip Code: 98121

Run the Model!

My Tableau Data Science Workbooks

Use a pre-built library!

```
public Image getWorkbookImage(string workbookId)
{
    string tableau_restAPI_ticket = "";
    string tableau_site = "";
    ArrayList authentication = new ArrayList(3);

    try
    {
        authentication = TableauAPIController.tsLogin();
    }
    catch (Exception e)
    {
        Console.Write(e.Message + " " + e.StackTrace);
    }

    // Get the Authentication Information
    tableau_restAPI_ticket = authentication[0].ToString();
    tableau_site = authentication[1].ToString();

    // Send the new header request
    string url = ConfigurationManager.AppSettings["TableauServer"] + "/api/2.0/sites/"
        + tableau_site + "/workbooks/" + workbookId + "/previewImage";

    WebClient client = new WebClient();
    client.Headers.Add("Content-Type", "text/xml");
    client.Headers.Add("X-Tableau-Auth", tableau_restAPI_ticket);

    return new Bitmap(new MemoryStream(client.DownloadData(url)));
}
```

Tableau REST API

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Hey! I want to learn more about this too…

a. Intro Video to the Tableau REST API:
   https://www.tableau.com/learn/tutorials/on-demand/rest-api

a. Tableau REST API Reference:
   https://onlinehelp.tableau.com/current/api/rest_api/en-us/help.htm

b. Tableau REST API Libraries worth checking:
   - Tableau Server Client (Python): https://github.com/tableau/server-client-python
   - tableau_tools (Python): https://github.com/bryantbhowell/tableau_tools
   - DataPainters (.NET/JAVA): http://datapainters.com/products/tableau_rest_library.php

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Let’s Summarize

The full picture

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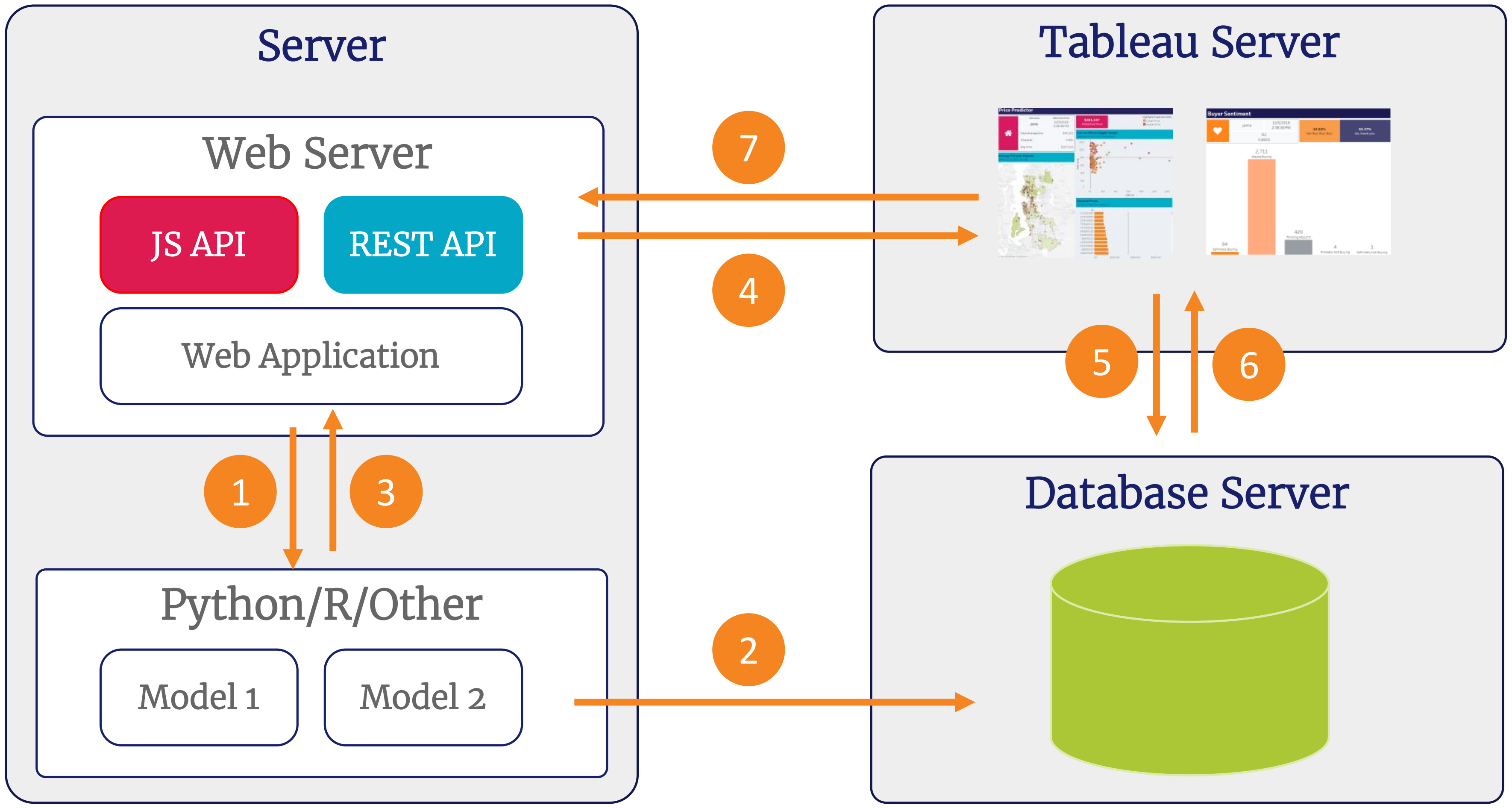
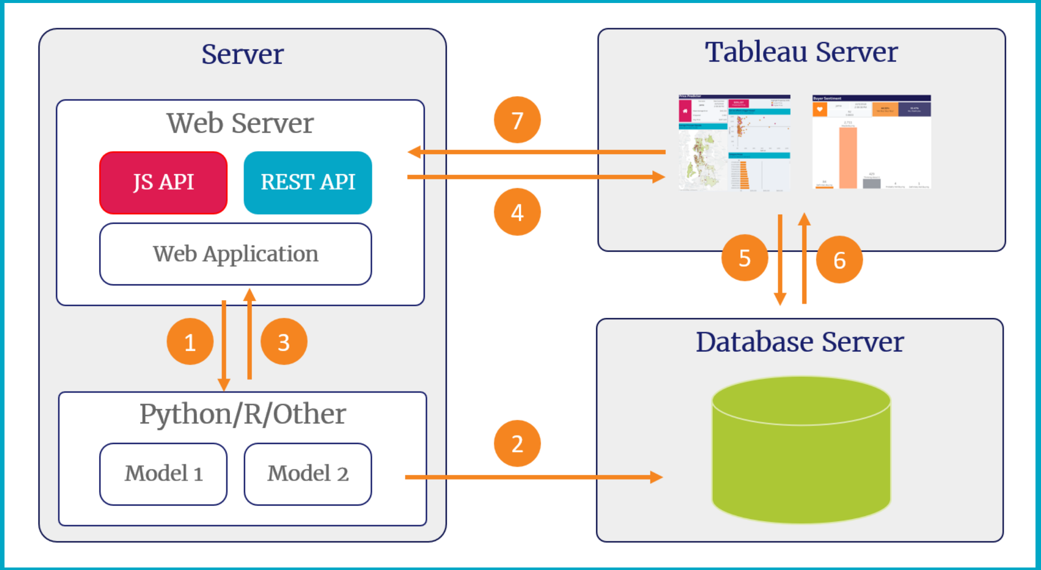
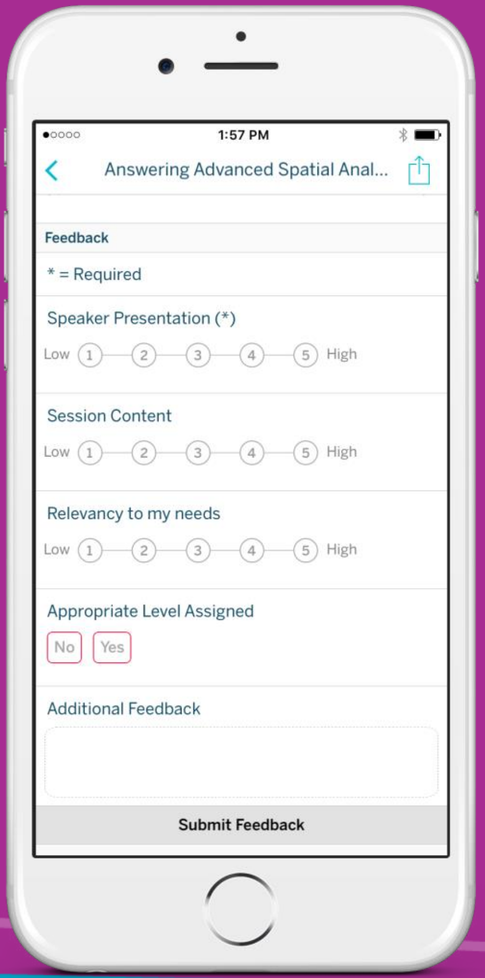


What Next?


Server
Web Server
JS API
REST API
Web Application
Python/R/Other
Model 1
Model 2
Tableau Server
Database Server
1
2
3
4
5
6
7



1:57 PM

Answering Advanced Spatial Anal...

Feedback

* = Required

Speaker Presentation (*)

Low 1 2 3 4 5 High

Session Content

Low 1 2 3 4 5 High

Relevancy to my needs

Low 1 2 3 4 5 High

Appropriate Level Assigned

No Yes

Additional Feedback

Submit Feedback

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Please complete the session survey from the Session Details screen in your TC18 app

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SESSION REPEATS

Embedding Tableau for Self-Service Data Science

Thursday | 2:15PM – 3:15PM | Location

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RELATED SESSIONS

Data Science Applications with TabPy/R

Wednesday | 12:00PM – 1:00PM | New Orleans Theater B

Advanced Analytics at Scale

Wednesday | 3:30PM – 4:30PM | New Orleans Theater C

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Questions?

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Thank you!

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