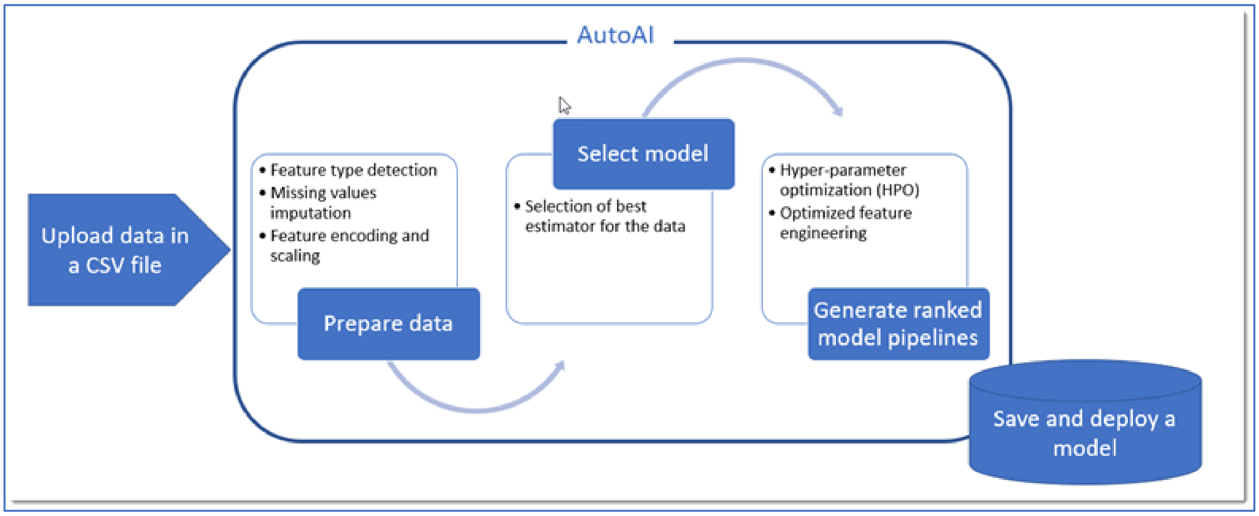
AutoAI + DevOps

Introduction

This lab consists of two parts. The first part will demonstrate the new and exciting AutoAI capability to build and deploy an optimized model based on the Female Human Trafficking datasets. The second part (optional) will deploy an application using the IBM Cloud DevOps toolchain that will invoke the deployed model to predict the trafficking risk.

AutoAI in Watson Studio automatically analyzes your data and generates candidate model pipelines customized for your predictive modeling problem. AutoAI algorithms analyze your dataset to discover data transformations, estimator algorithms, and parameter settings that work best for your problem setting. Results are displayed on a leaderboard, showing the automatically generated model pipelines ranked according to your problem optimization objective.

Using AutoAI, you can build and deploy a machine learning model with sophisticated training features and no coding. The tool does most of the work for you.


AutoAI
Upload data in a CSV file
• Feature type detection
• Missing values imputation
• Feature encoding and scaling
Prepare data
Select model
• Selection of best estimator for the data
• Hyper-parameter optimization (HPO)
• Optimized feature engineering
Generate ranked model pipelines
Save and deploy a model

The AutoAI process follows this sequence to build candidate pipelines:

- Data pre-processing
- Automated model selection
- Automated feature engineering
- Hyperparameter optimization

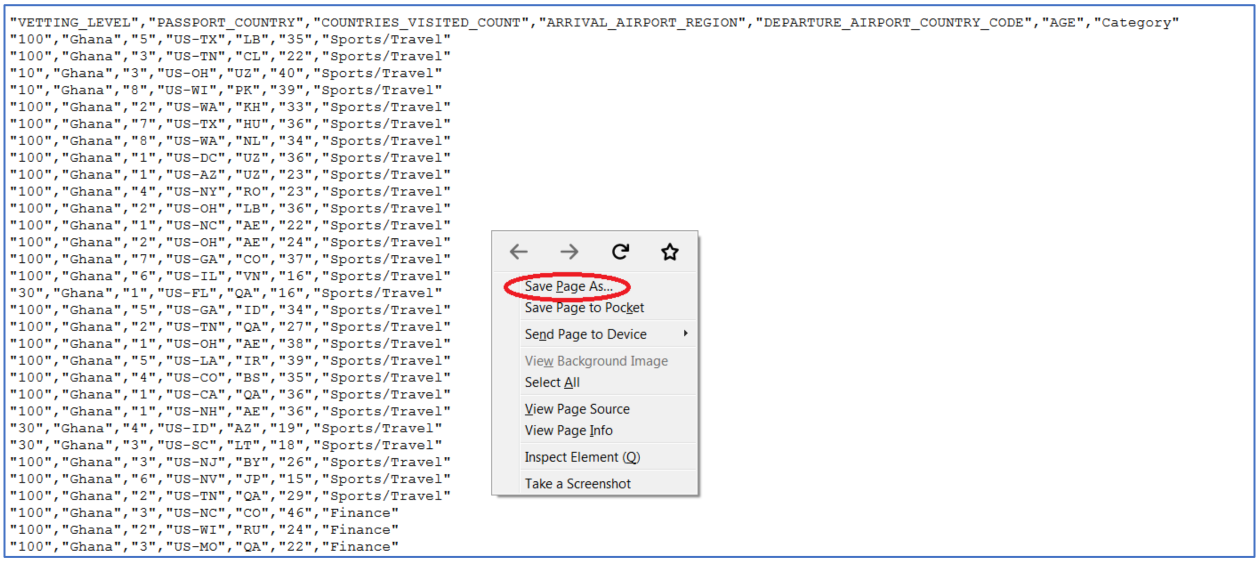
We will perform the following steps in this lab:

1. Download a female human trafficking cleansed dataset from the github repo
2. Add an Auto AI Experiment to create a model to predict the trafficking risk
3. Save and Deploy the model

4. Test the model
5. Deploy a simple web front-end application and connecting it to the deployed model using an IBM Cloud DevOps toolchain.

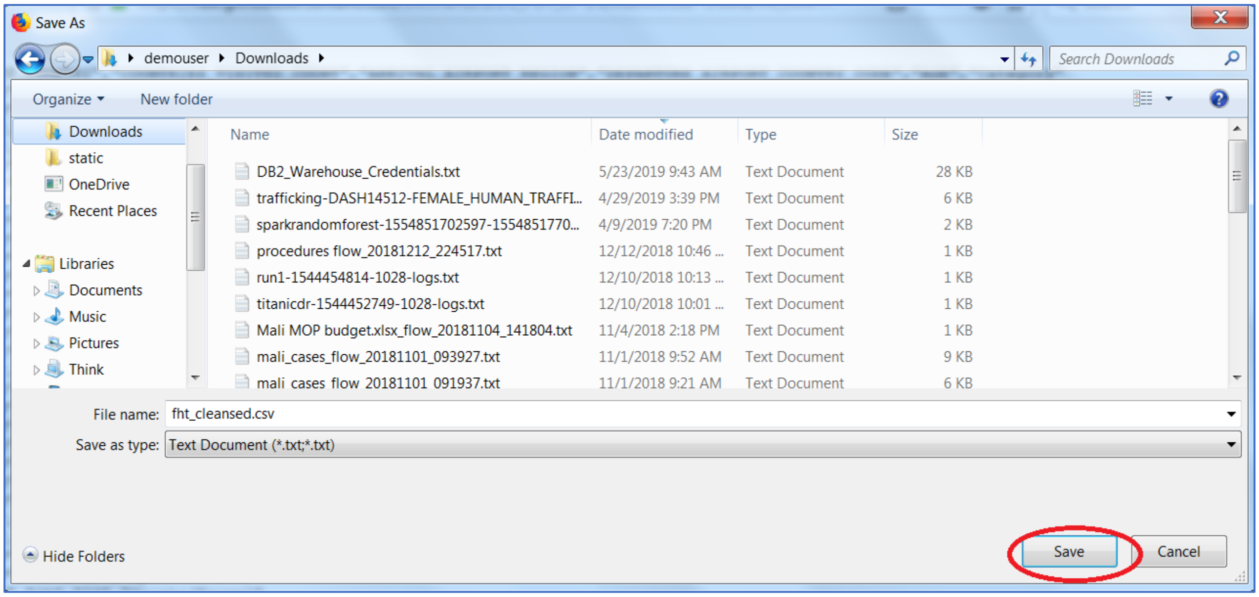
Step 1: Download a female human trafficking cleansed dataset

1. Download the fht_cleansed.csv data file from the following location by clicking here
2. Right-click on the window, and click **Save Page As…**



```
"VETTING_LEVEL","PASSPORT_COUNTRY","COUNTRIES_VISITED_COUNT","ARRIVAL_AIRPORT_REGION","DEPARTURE_AIRPORT_COUNTRY_CODE","AGE","Category"
"100","Ghana","5","US-TX","LB","35","Sports/Travel"
"100","Ghana","3","US-TN","CL","22","Sports/Travel"
"10","Ghana","3","US-OH","UZ","40","Sports/Travel"
"10","Ghana","8","US-WI","PK","39","Sports/Travel"
"100","Ghana","2","US-WA","KH","33","Sports/Travel"
"100","Ghana","7","US-TX","HU","36","Sports/Travel"
"100","Ghana","8","US-WA","NL","34","Sports/Travel"
"100","Ghana","1","US-DC","UZ","36","Sports/Travel"
"100","Ghana","1","US-AZ","UZ","23","Sports/Travel"
"100","Ghana","4","US-NY","RO","23","Sports/Travel"
"100","Ghana","2","US-OH","LB","36","Sports/Travel"
"100","Ghana","1","US-NC","AE","22","Sports/Travel"
"100","Ghana","2","US-OH","AE","24","Sports/Travel"
"100","Ghana","7","US-GA","CO","37","Sports/Travel"
"100","Ghana","6","US-IL","VN","16","Sports/Travel"
"30","Ghana","1","US-FL","QA","16","Sports/Travel"
"100","Ghana","5","US-GA","ID","34","Sports/Travel"
"100","Ghana","2","US-TN","QA","27","Sports/Travel"
"100","Ghana","1","US-OH","AE","38","Sports/Travel"
"100","Ghana","5","US-LA","IR","39","Sports/Travel"
"100","Ghana","4","US-CO","BS","35","Sports/Travel"
"100","Ghana","1","US-CA","QA","36","Sports/Travel"
"100","Ghana","1","US-NH","AE","36","Sports/Travel"
"30","Ghana","4","US-ID","AZ","19","Sports/Travel"
"30","Ghana","3","US-SC","LT","18","Sports/Travel"
"100","Ghana","3","US-NJ","BY","26","Sports/Travel"
"100","Ghana","6","US-NV","JP","15","Sports/Travel"
"100","Ghana","2","US-TN","QA","29","Sports/Travel"
"100","Ghana","3","US-NC","CO","46","Finance"
"100","Ghana","2","US-WI","RU","24","Finance"
"100","Ghana","3","US-MO","QA","22","Finance"
```

3. Click on **Save**.

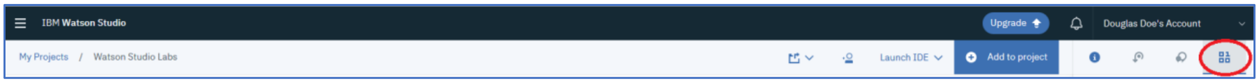


Name	Date modified	Type	Size
DB2_Warehouse_Credentials.txt	5/23/2019 9:43 AM	Text Document	28 KB
trafficking-DASH14512-FEMALE_HUMAN_TRAFFI...	4/29/2019 3:39 PM	Text Document	6 KB
sparkrandomforest-1554851702597-1554851770...	4/9/2019 7:20 PM	Text Document	2 KB
procedures flow_20181212_224517.txt	12/12/2018 10:46 ...	Text Document	1 KB
run1-1544454814-1028-logs.txt	12/10/2018 10:13 ...	Text Document	1 KB
titanicdr-1544452749-1028-logs.txt	12/10/2018 10:01 ...	Text Document	1 KB
Mali MOP budget.xlsx_flow_20181104_141804.txt	11/4/2018 2:18 PM	Text Document	1 KB
mali_cases_flow_20181101_093927.txt	11/1/2018 9:52 AM	Text Document	9 KB
mali_cases_flow_20181101_091937.txt	11/1/2018 9:21 AM	Text Document	6 KB

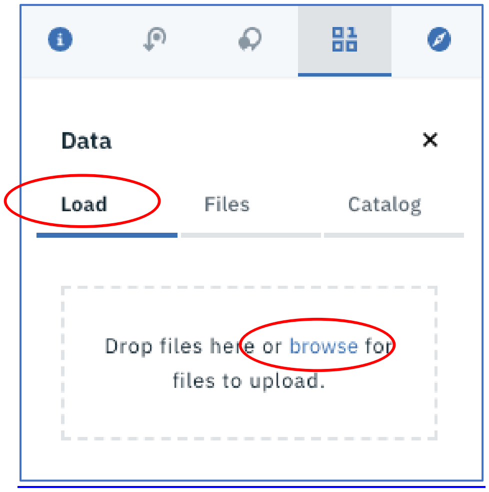
File name: fht_cleansed.csv

Save as type: Text Document (*.txt;*.txt)

4. Go back to your Watson Studio Labs project. Click on the icon.

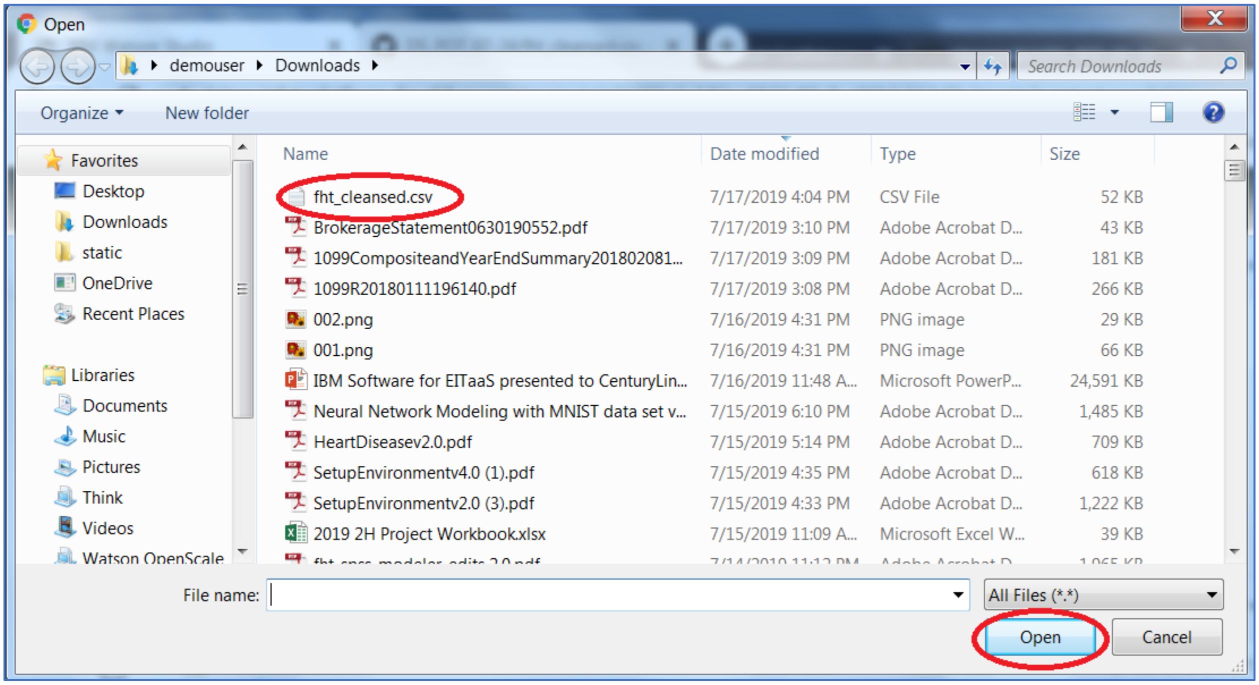


5. Click on the **Load** tab and then click on **browse**. If you don't see the **Load** tab, click on the ⊞ icon again.



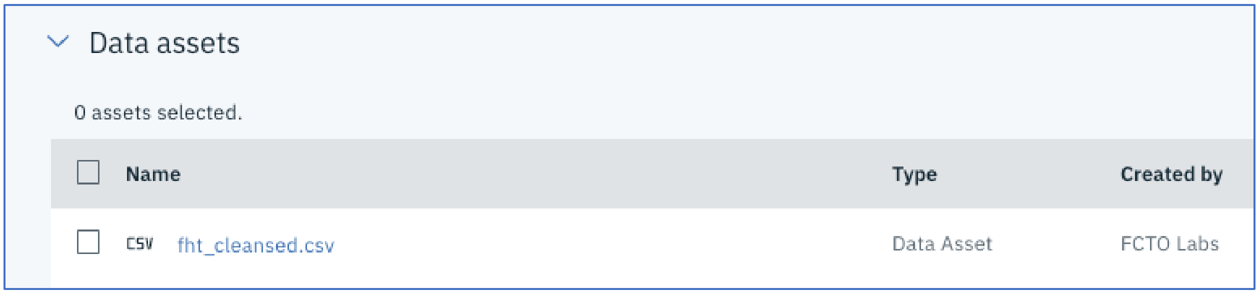
Drop files here or browse for files to upload.

6. Go to the folder where the fht_cleansed.csv file is stored. Select the fht_cleansed.csv file and then click **Open**.



Name	Date modified	Type	Size
fht_cleansed.csv	7/17/2019 4:04 PM	CSV File	52 KB
BrokerageStatement0630190552.pdf	7/17/2019 3:10 PM	Adobe Acrobat D...	43 KB
1099CompositeandYearEndSummary201802081...	7/17/2019 3:09 PM	Adobe Acrobat D...	181 KB
1099R20180111196140.pdf	7/17/2019 3:08 PM	Adobe Acrobat D...	266 KB
002.png	7/16/2019 4:31 PM	PNG image	29 KB
001.png	7/16/2019 4:31 PM	PNG image	66 KB
IBM Software for EITaaS presented to CenturyLin...	7/16/2019 11:48 A...	Microsoft PowerP...	24,591 KB
Neural Network Modeling with MNIST data set v...	7/15/2019 6:10 PM	Adobe Acrobat D...	1,485 KB
HeartDiseasev2.0.pdf	7/15/2019 5:14 PM	Adobe Acrobat D...	709 KB
SetupEnvironmentv4.0 (1).pdf	7/15/2019 4:35 PM	Adobe Acrobat D...	618 KB
SetupEnvironmentv2.0 (3).pdf	7/15/2019 4:33 PM	Adobe Acrobat D...	1,222 KB
2019 2H Project Workbook.xlsx	7/15/2019 11:09 A...	Microsoft Excel W...	39 KB
fht_spss_modeler_edits 2.0.pdf	7/14/2019 11:13 PM	Adobe Acrobat D...	1,065 KB

7. The fht_cleansed.csv file is now added as a Data Asset.



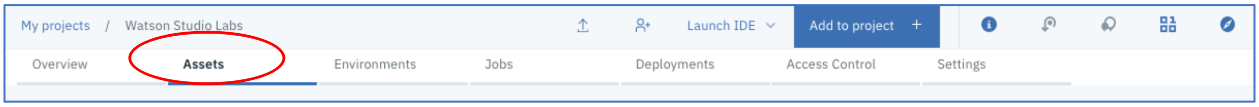
Data assets

0 assets selected.

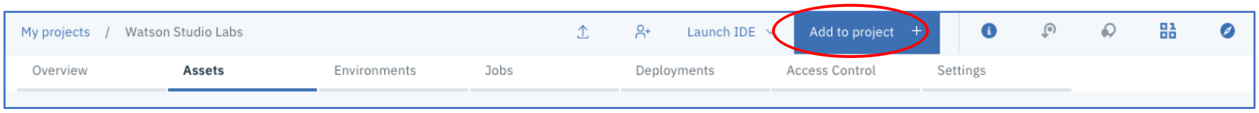
□	Name	Type	Created by
□	CSV fht_cleansed.csv	Data Asset	FCTO Labs

Step 2: Add an AutoAI Experiment.

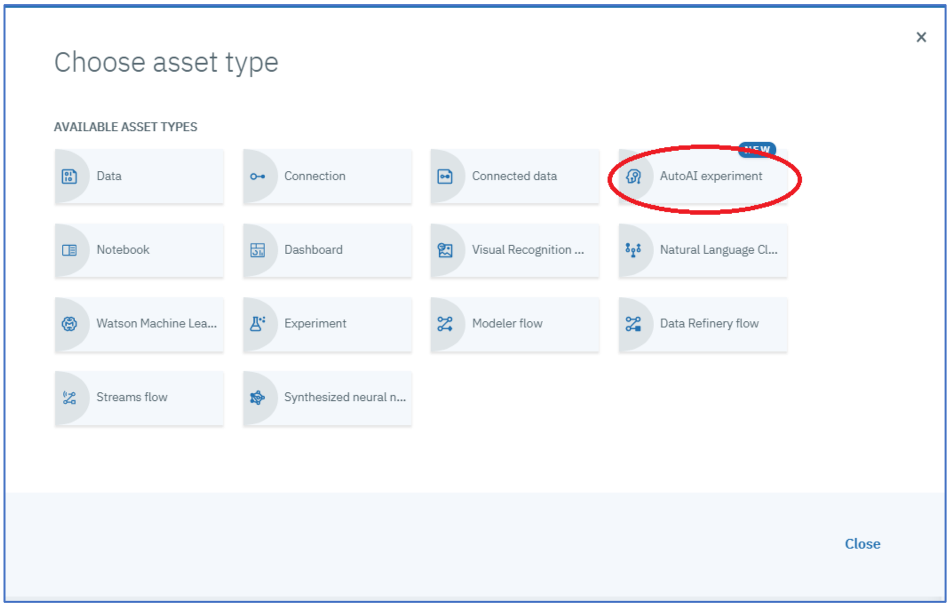
1. If not on the **Assets** page, click on the **Assets** Tab



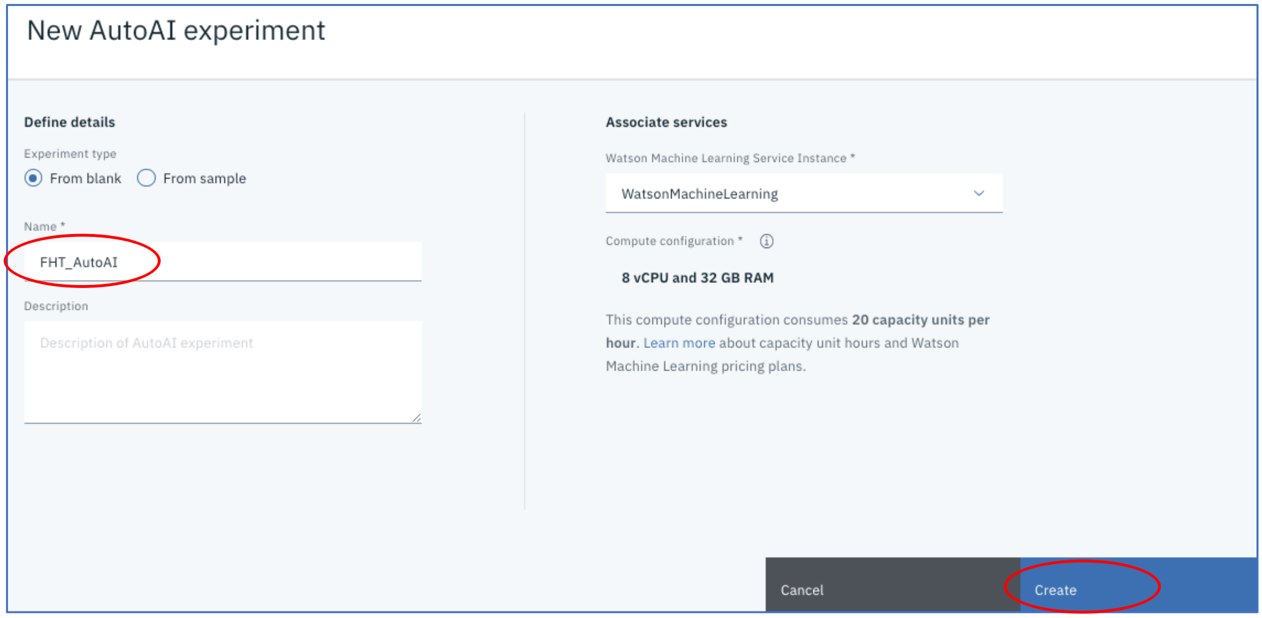
2. Click on **Add to project**.



3. Click on **AutoAI Experiment.**



4. Enter an **Asset name**, leave the defaults for the **Watson Machine Learning** and **Compute configuration** and click on **Create**.



New AutoAI experiment

Define details

Experiment type

● From blank ○ From sample

Name *

FHT_AutoAI

Description

Description of AutoAI experiment

Associate services

Watson Machine Learning Service Instance *

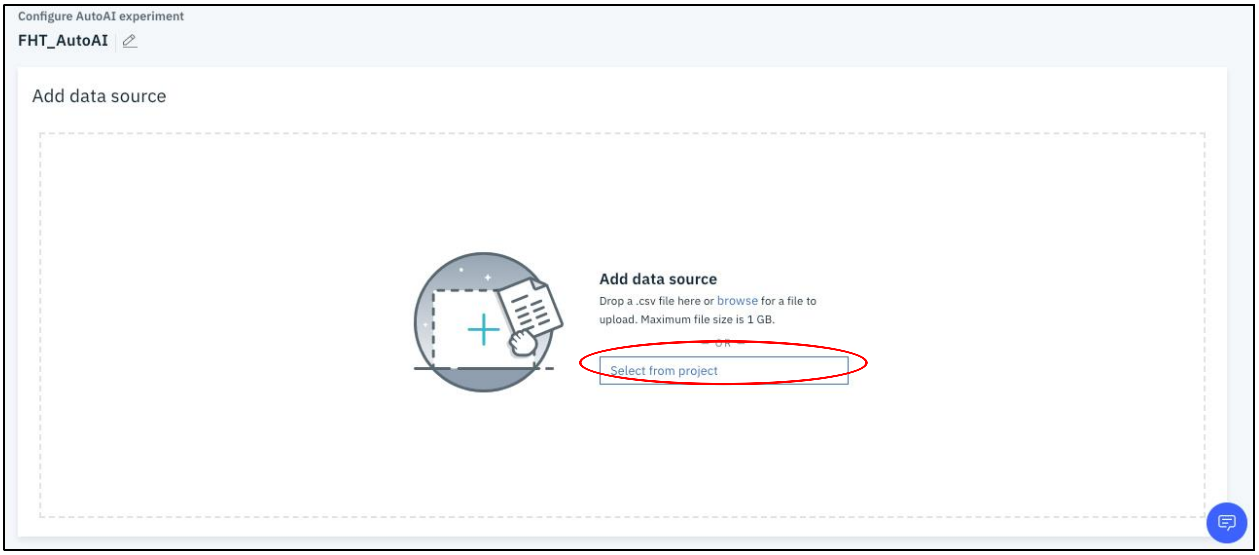
WatsonMachineLearning

Compute configuration *

8 vCPU and 32 GB RAM

This compute configuration consumes **20 capacity units per hour**. Learn more about capacity unit hours and Watson Machine Learning pricing plans.

5. Click on **Select from project**.



Configure AutoAI experiment

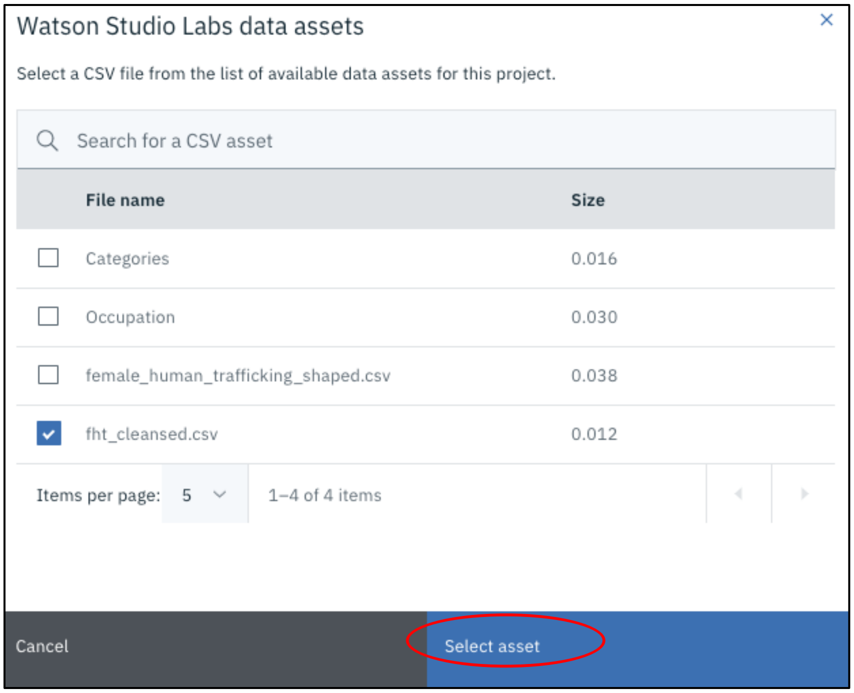
FHT_AutoAI

Add data source

Add data source

Drop a .csv file here or browse for a file to upload. Maximum file size is 1 GB.

6. Select the **fht_cleansed.csv** dataset and click on **Select asset**.



Watson Studio Labs data assets

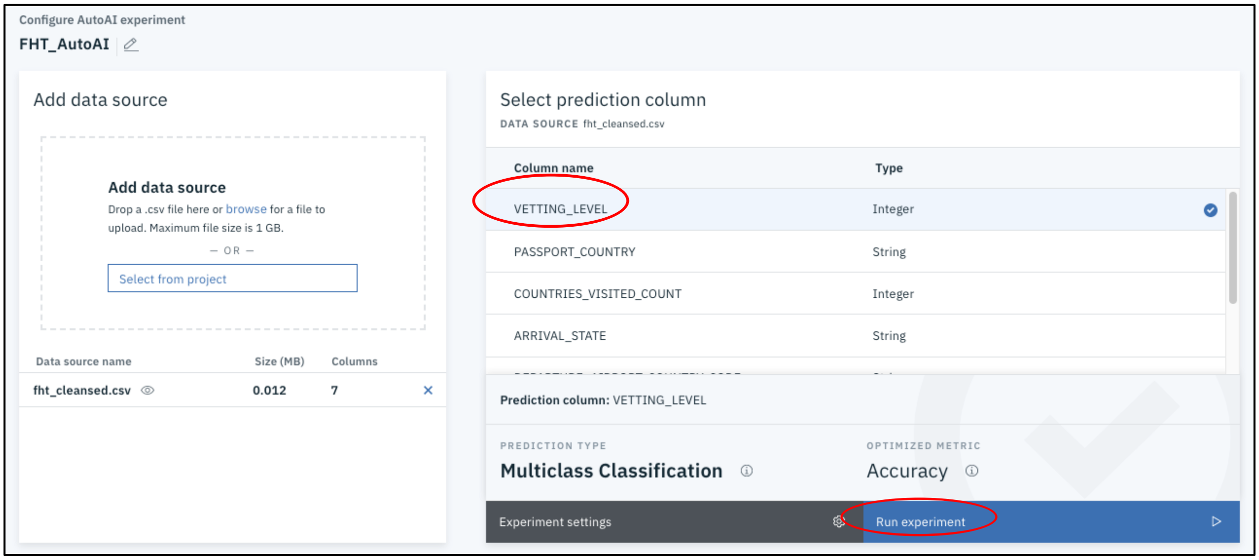
Select a CSV file from the list of available data assets for this project.

Search for a CSV asset

	File name	Size
□	Categories	0.016
□	Occupation	0.030
□	female_human_trafficking_shaped.csv	0.038
☑	fht_cleansed.csv	0.012

Items per page: 5 1–4 of 4 items

7. Select **VETTING_LEVEL** as the column to predict, leave the default for **OPTIMIZED METRIC** and click on **Run Experiment**. Note the system scanned the VETTING_LEVEL values to determine that a **Multiclass Classification** was the **PREDICTION TYPE**.



Configure AutoAI experiment

FHT_AutoAI

Add data source

Add data source

Drop a .csv file here or browse for a file to upload. Maximum file size is 1 GB.

— OR —

Data source name	Size (MB)	Columns
fht_cleansed.csv	0.012	7

Select prediction column

DATA SOURCE fht_cleansed.csv

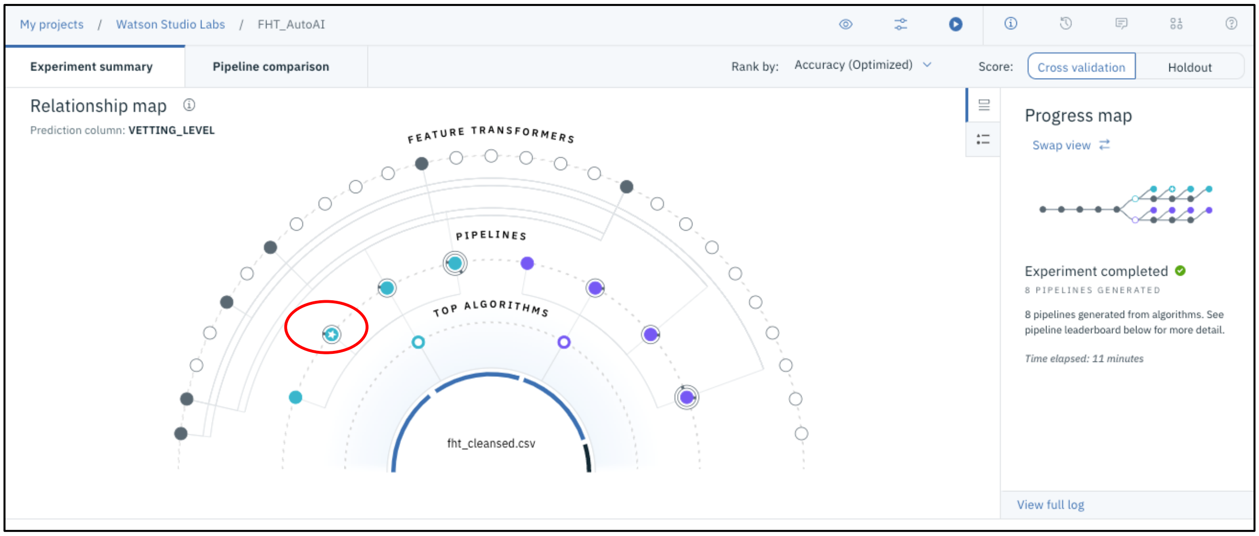
Column name	Type
VETTING_LEVEL	Integer
PASSPORT_COUNTRY	String
COUNTRIES_VISITED_COUNT	Integer
ARRIVAL_STATE	String

Prediction column: VETTING_LEVEL

PREDICTION TYPE Multiclass Classification

OPTIMIZED METRIC Accuracy

8. It will take several minutes for the eight alternative pipelines to be analyzed. The first pipeline picks the best algorithm. In this case, it is Random Forest. The second pipeline performs a hyperparameter optimization to see if tuning the algorithm parameters will improve the performance metric. The third pipeline will derive new features (i.e. feature engineering) to try to improve the performance metric. The fourth pipeline will do another hyperparameter optimization including the newly derived features. The next 4 pipelines do the same thing for the second best algorithm. Note, you can move ahead at any point after the first pipeline has been created. We are going to proceed as if Pipeline 2 is the best ranked pipeline. Yours could be different.



Prediction column: VETTING_LEVEL

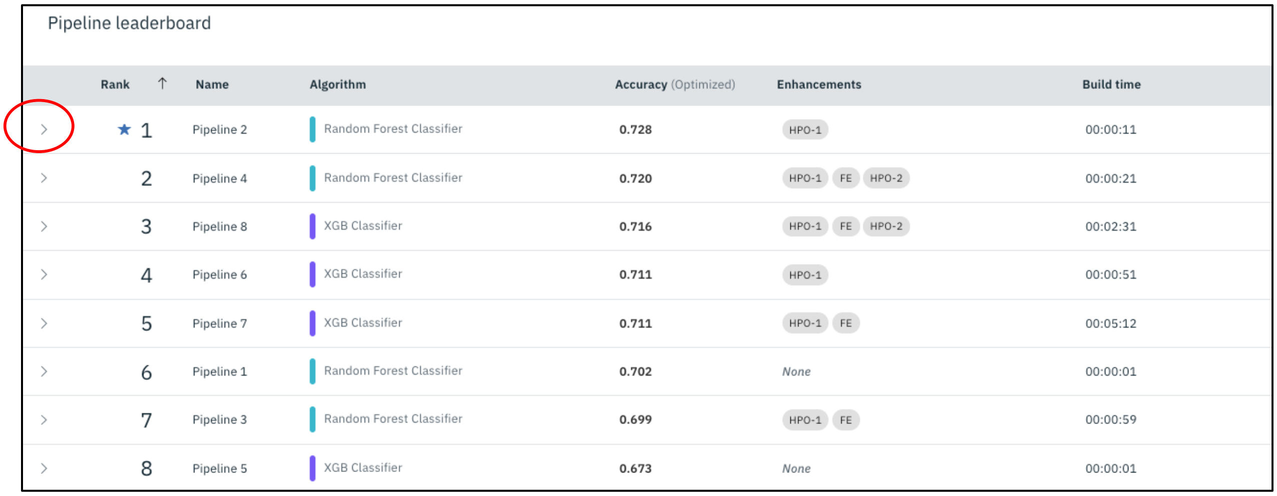
Experiment completed

8 PIPELINES GENERATED

8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

Time elapsed: 11 minutes

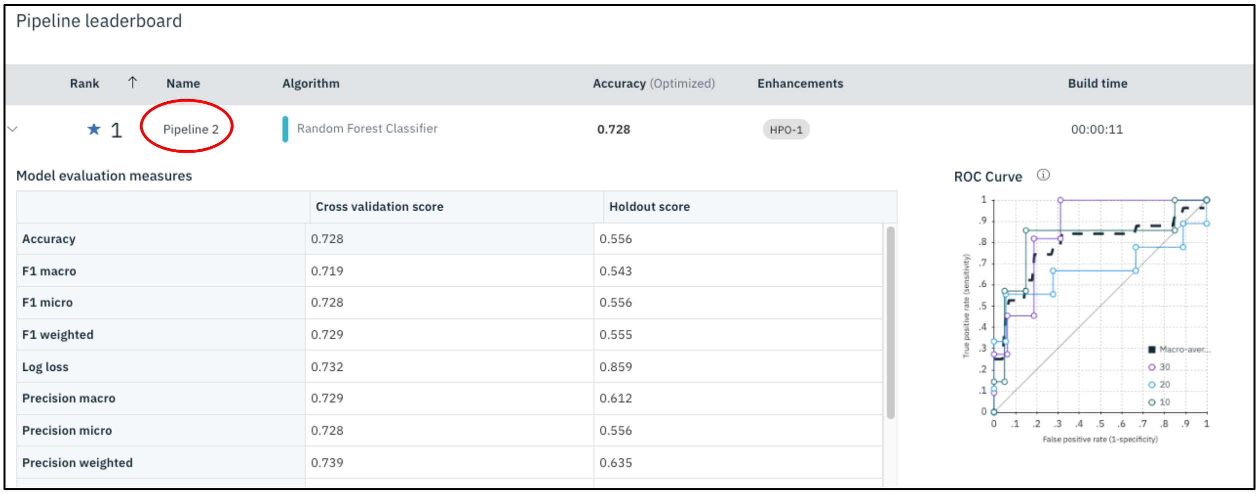
9. Scroll down to view the Pipeline leaderboard. Click on the right caret next to Pipeline 2.



Pipeline leaderboard

	Rank ↑	Name	Algorithm	Accuracy (Optimized)	Enhancements	Build time
>	★ 1	Pipeline 2	Random Forest Classifier	0.728	HPO-1	00:00:11
>	2	Pipeline 4	Random Forest Classifier	0.720	HPO-1 FE HPO-2	00:00:21
>	3	Pipeline 8	XGB Classifier	0.716	HPO-1 FE HPO-2	00:02:31
>	4	Pipeline 6	XGB Classifier	0.711	HPO-1	00:00:51
>	5	Pipeline 7	XGB Classifier	0.711	HPO-1 FE	00:05:12
>	6	Pipeline 1	Random Forest Classifier	0.702	*None*	00:00:01
>	7	Pipeline 3	Random Forest Classifier	0.699	HPO-1 FE	00:00:59
>	8	Pipeline 5	XGB Classifier	0.673	*None*	00:00:01

10. Scores are displayed for different metrics for both the training sample and the holdout sample. The holdout sample is 10%. Click on **Pipeline 2.**



Pipeline leaderboard

Rank	Name	Algorithm	Accuracy (Optimized)	Enhancements	Build time
★ 1	Pipeline 2	Random Forest Classifier	0.728	HPO-1	00:00:11

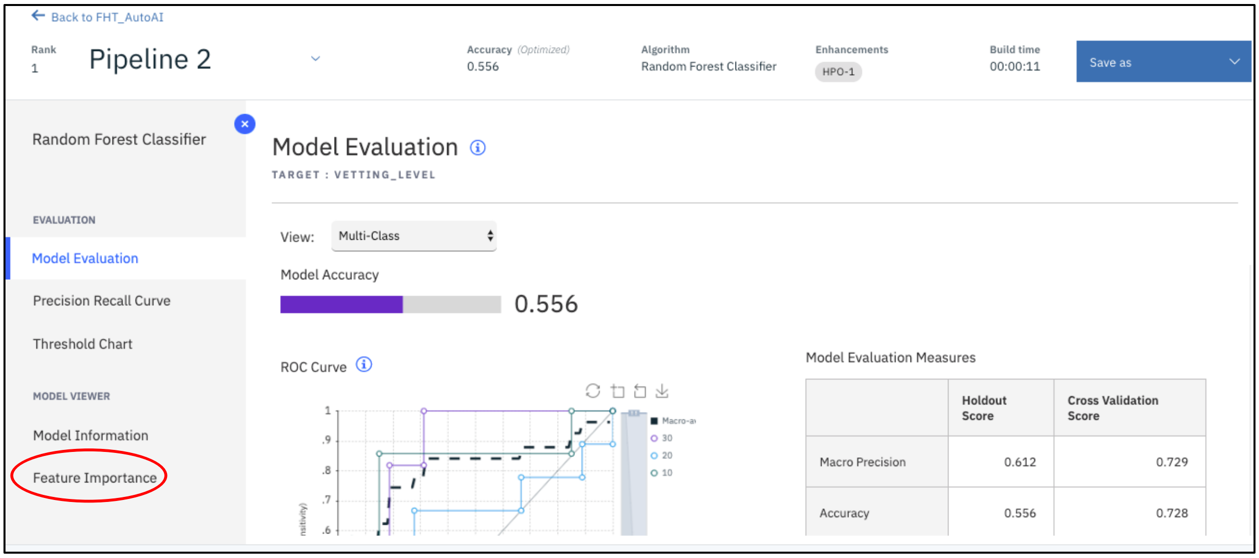
Model evaluation measures

	Cross validation score	Holdout score
Accuracy	0.728	0.556
F1 macro	0.719	0.543
F1 micro	0.728	0.556
F1 weighted	0.729	0.555
Log loss	0.732	0.859
Precision macro	0.729	0.612
Precision micro	0.728	0.556
Precision weighted	0.739	0.635

ROC Curve

1
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
True positive rate (sensitivity)
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
False positive rate (1-specificity)
Macro-aver...
30
20
10

11. The model evaluation metric for the holdout sample is displayed. On the left are options for additional information. Click on **Feature Importance**.



Back to FHT_AutoAI

Rank 1 Pipeline 2

Accuracy (Optimized) 0.556

Algorithm Random Forest Classifier

Enhancements HPO-1

Build time 00:00:11

Save as

Random Forest Classifier

EVALUATION

Model Evaluation

Precision Recall Curve

Threshold Chart

MODEL VIEWER

Model Information

Feature Importance

Model Evaluation

TARGET : VETTING_LEVEL

View: Multi-Class

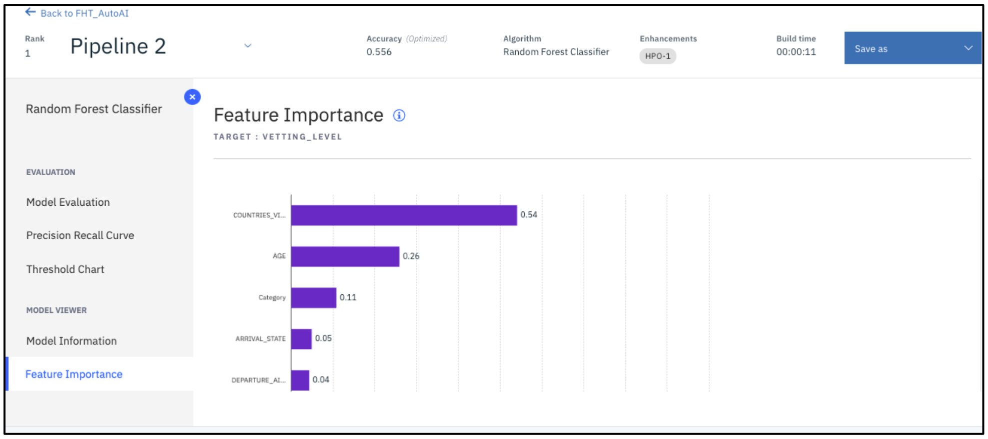
Model Accuracy 0.556

ROC Curve

Model Evaluation Measures

	Holdout Score	Cross Validation Score
Macro Precision	0.612	0.729
Accuracy	0.556	0.728

12. According to the **Feature Importance**, the **COUNTRIES_VISITED_COUNT** feature is the most important, followed by the **Age** feature and the **Category** feature.



Back to FHT_AutoAI

Rank 1 Pipeline 2

Accuracy (Optimized) 0.556

Algorithm Random Forest Classifier

Enhancements HPO-1

Build time 00:00:11

Save as

Random Forest Classifier

EVALUATION

Model Evaluation

Precision Recall Curve

Threshold Chart

MODEL VIEWER

Model Information

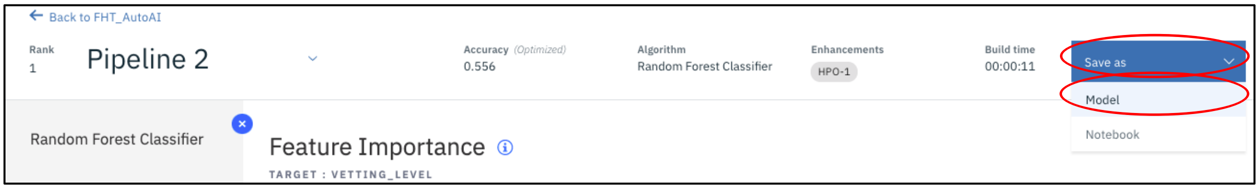
Feature Importance

Feature Importance

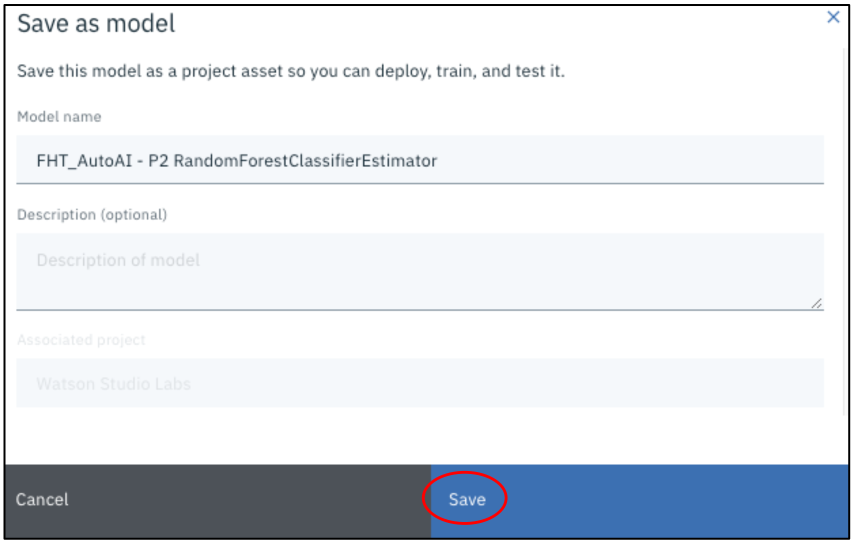
TARGET : VETTING_LEVEL

Step 3: Save and Deploy the Model

1. **Click on Save as.** AutoAI can generate both a machine learning model as well as a script in the form of a Jupyter Notebook to build the model. Feel free to explore the Notebook. When ready, **click on Model.**



2. Optionally change the default name and click **Save**.


Save as model

Save this model as a project asset so you can deploy, train, and test it.

Model name

FHT_AutoAI - P2 RandomForestClassifierEstimator

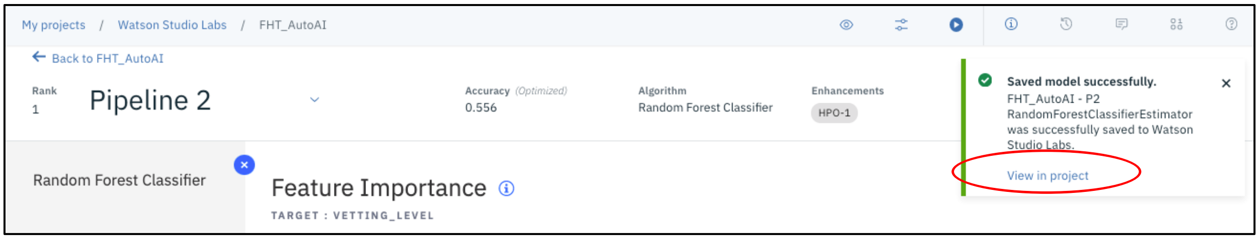
Description (optional)

Description of model

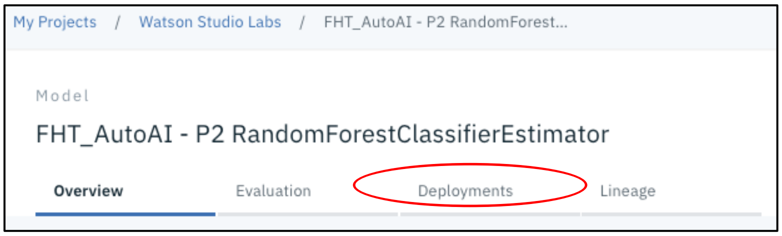
Associated project

Watson Studio Labs

3. A message is displayed showing the model was successfully saved. Click on **View in project.**

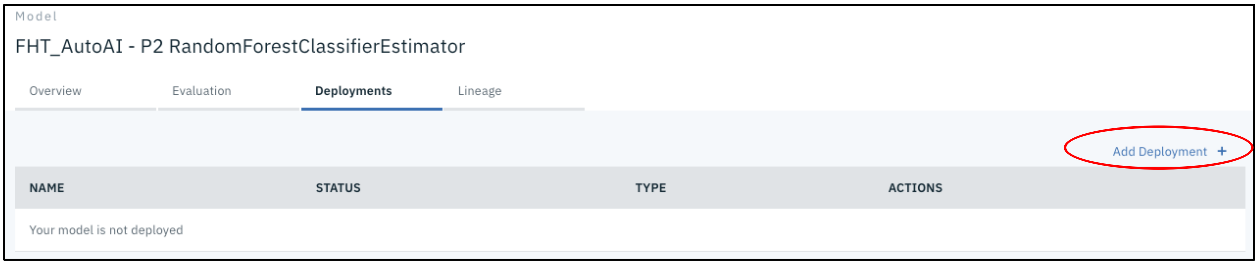

Saved model successfully.
FHT_AutoAI - P2 RandomForestClassifierEstimator was successfully saved to Watson Studio Labs.

4. Click on **Deployments**.



My Projects / Watson Studio Labs / FHT_AutoAI - P2 RandomForest...
Model
FHT_AutoAI - P2 RandomForestClassifierEstimator
Overview
Evaluation
Deployments
Lineage

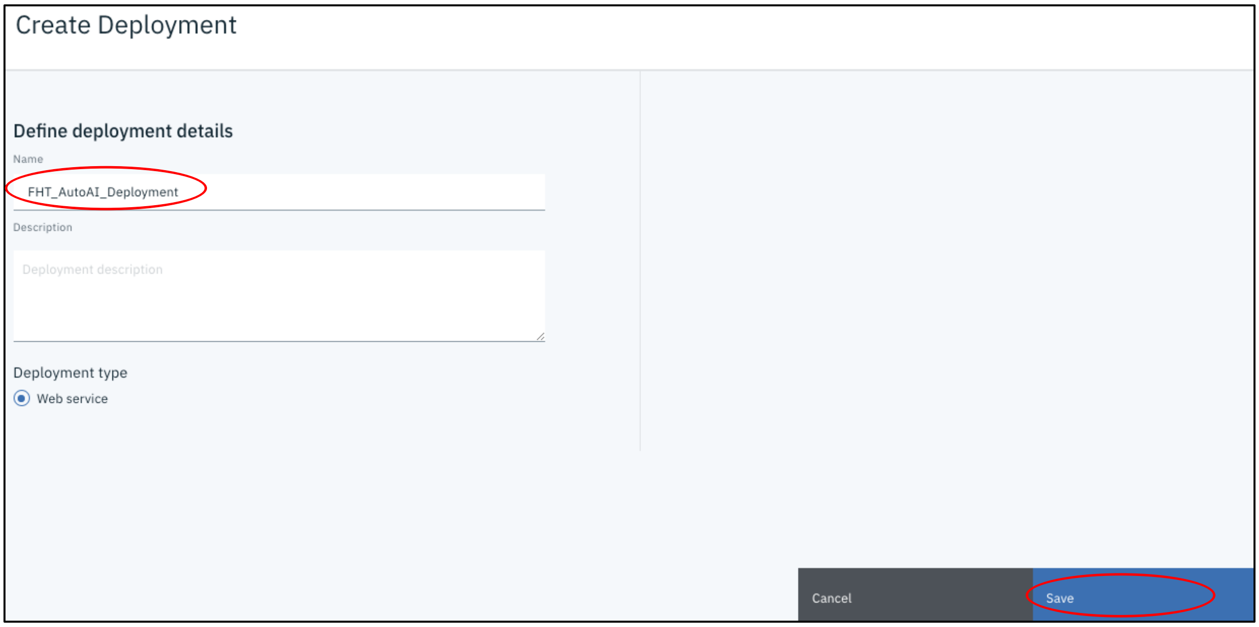
5. Click on **Add Deployment**



FHT_AutoAI - P2 RandomForestClassifierEstimator

NAME	STATUS	TYPE	ACTIONS
Your model is not deployed			

6. Enter a **Name**, optionally a **Description** and click **Save**.



Create Deployment

Define deployment details

Name

FHT_AutoAI_Deployment

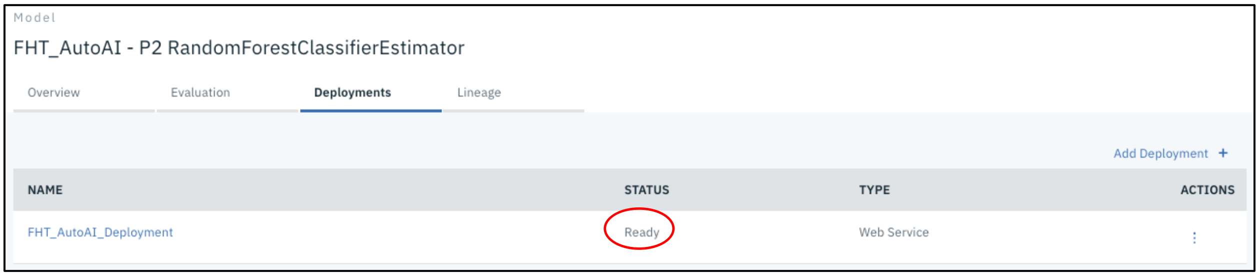
Description

Deployment description

Deployment type

● Web service

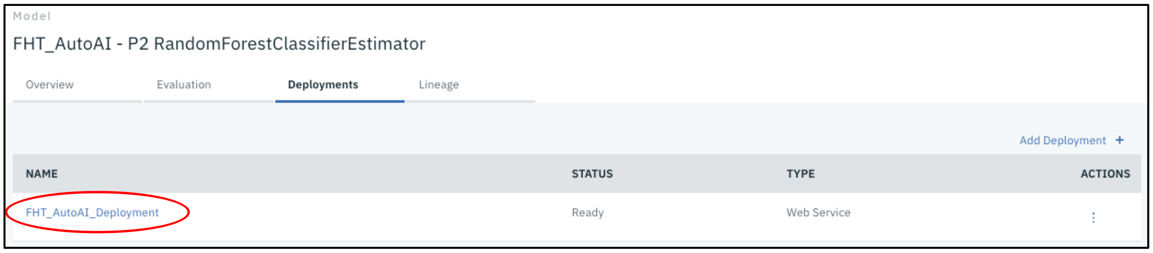
7. The model is successfully deployed in the IBM Cloud.



FHT_AutoAI - P2 RandomForestClassifierEstimator

NAME	STATUS	TYPE	ACTIONS
FHT_AutoAI_Deployment	Ready	Web Service	⋮

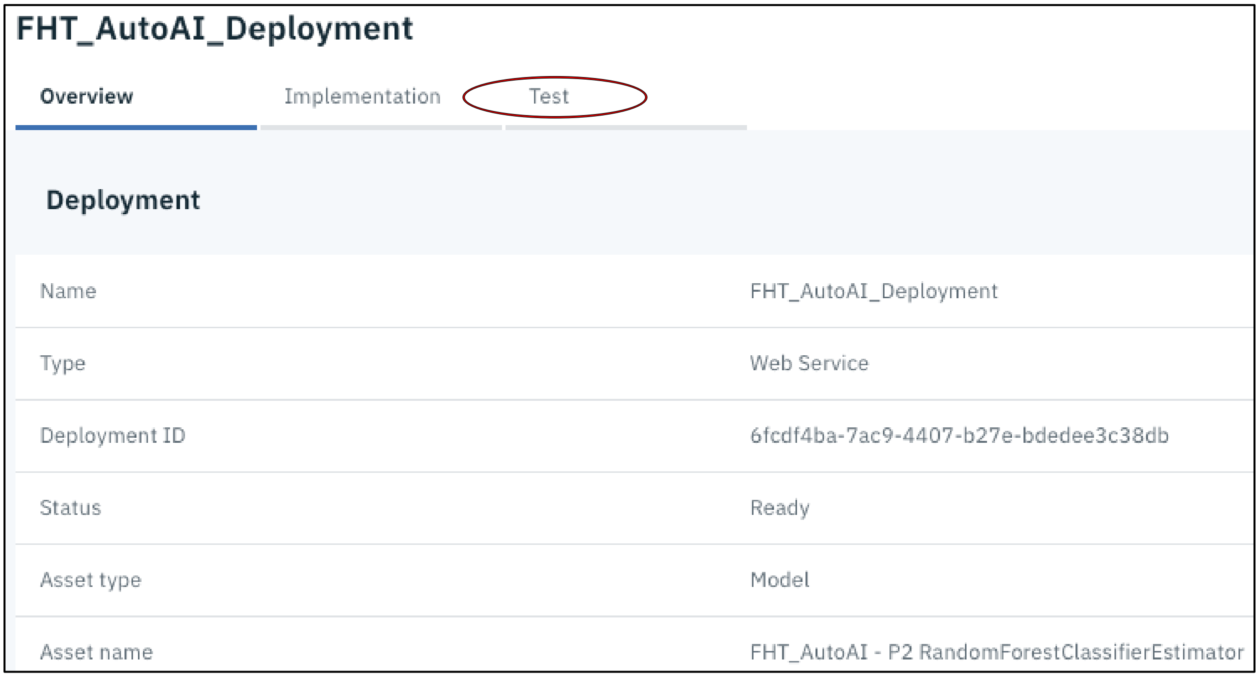
8. Click on **FHT_AutoAI_Deployed**.



FHT_AutoAI - P2 RandomForestClassifierEstimator

NAME	STATUS	TYPE	ACTIONS
FHT_AutoAI_Deployment	Ready	Web Service	⋮

9. Click on **Test.**



FHT_AutoAI_Deployment

Deployment

Name	FHT_AutoAI_Deployment
Type	Web Service
Deployment ID	6fcdf4ba-7ac9-4407-b27e-bdedee3c38db
Status	Ready
Asset type	Model
Asset name	FHT_AutoAI - P2 RandomForestClassifierEstimator

10. Enter the following values:

PASSPORT_COUNTRY **– Ghana**

COUNTRIES_VISITED_COUNT – **3**

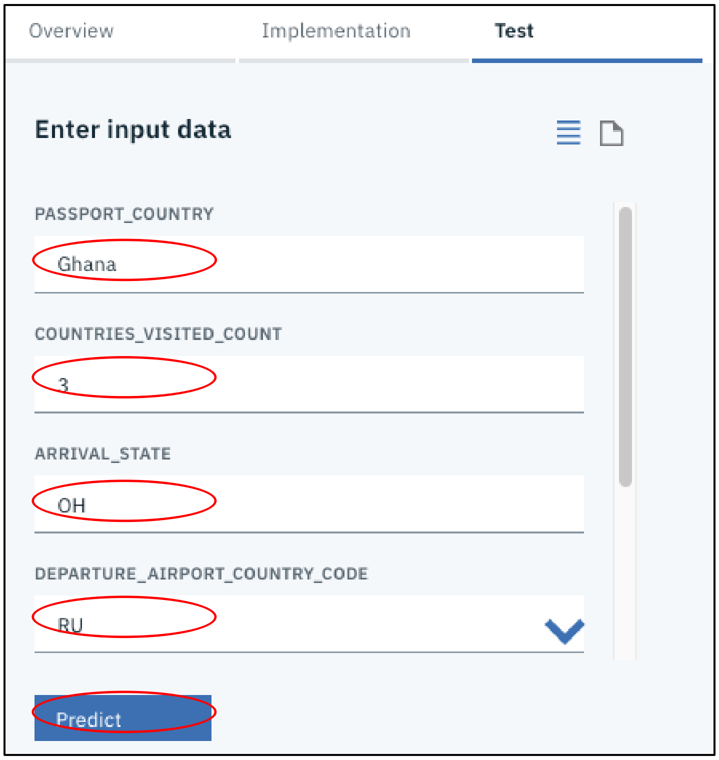
ARRIVAL_STATE – **OH**

DEPARTURE_AIRPORT_COUNTRY_CODE – **RU**

AGE – **20**

Category – **Sports/Travel**

Click **Predict**.



Enter input data

PASSPORT_COUNTRY

Ghana

COUNTRIES_VISITED_COUNT

3

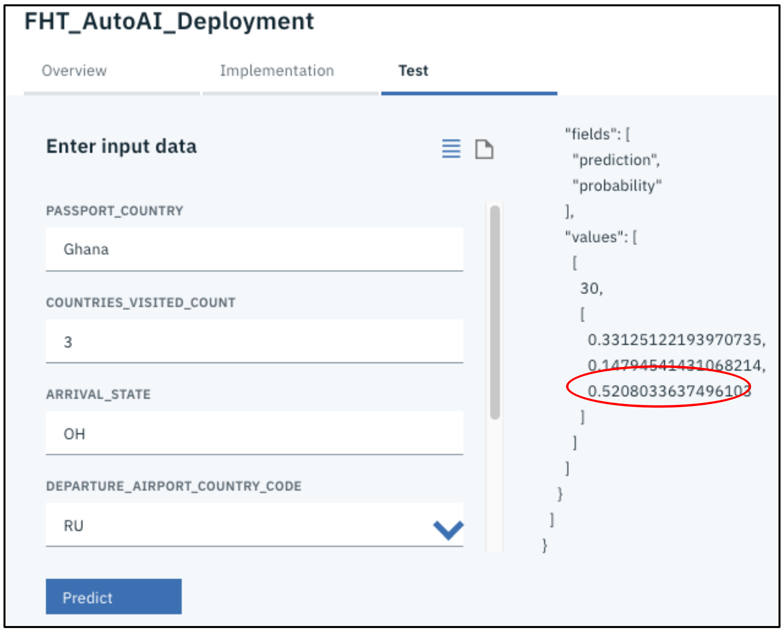
ARRIVAL_STATE

OH

DEPARTURE_AIRPORT_COUNTRY_CODE

RU

11. The prediction is **30** (low risk) of trafficking with 52% confidence.


FHT_AutoAI_Deployment

Enter input data

PASSPORT_COUNTRY

Ghana

COUNTRIES_VISITED_COUNT

3

ARRIVAL_STATE

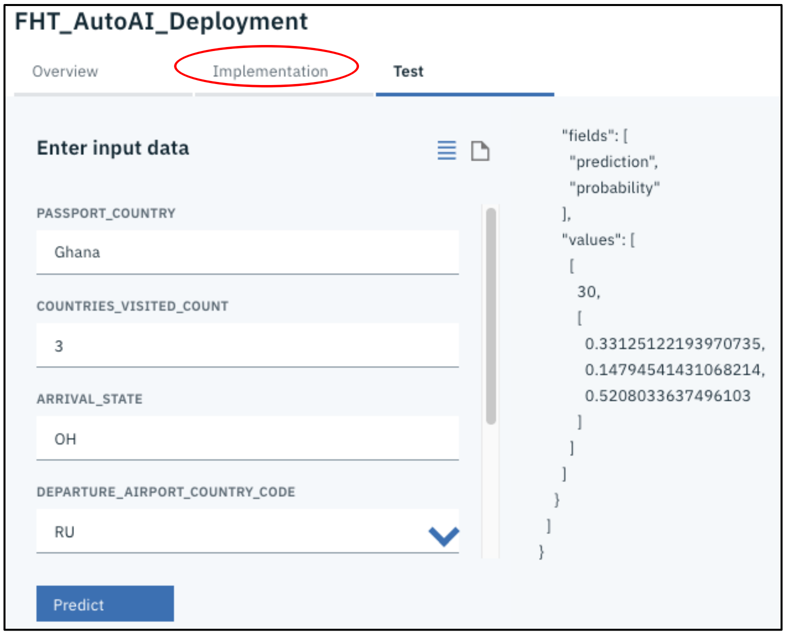
OH

DEPARTURE_AIRPORT_COUNTRY_CODE

RU

```
"fields": [
  "prediction",
  "probability"
],
"values": [
  [
    30,
    [
      0.33125122193970735,
      0.14794541431068214,
      0.5208033637496103
    ]
  ]
]
}
]
}
```

12. Click on Implementation



PASSPORT_COUNTRY: Ghana

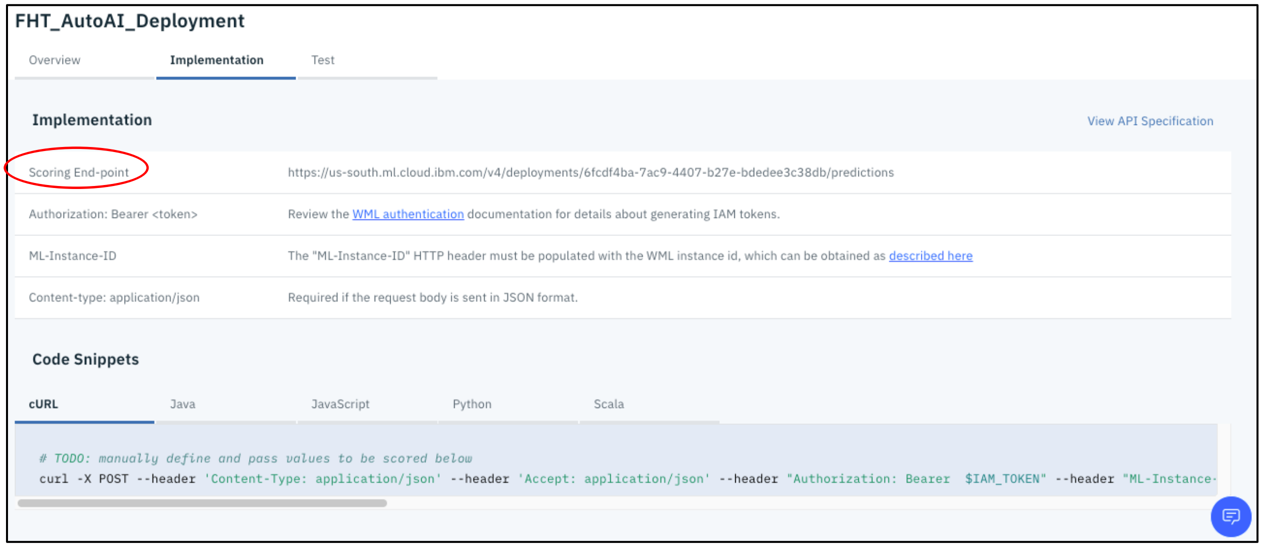
COUNTRIES_VISITED_COUNT: 3

ARRIVAL_STATE: OH

DEPARTURE_AIRPORT_COUNTRY_CODE: RU

```
"fields": [
  "prediction",
  "probability"
],
"values": [
  [
    30,
    [
      0.33125122193970735,
      0.14794541431068214,
      0.5208033637496103
    ]
  ]
]
}
]
}
```

13. The Implementation panel provides information for the application developers to invoke the deployed model. It includes sample code in various programming languages and the scoring endpoint to be used when invoking the web service. Open Windows Notepad to copy and paste the scoring endpoint, or just leave this panel available to cut and paste the scoring endpoint. We will need the scoring endpoint in the next section.



Implementation

Scoring End-point	https://us-south.ml.cloud.ibm.com/v4/deployments/6fcdf4ba-7ac9-4407-b27e-bdedee3c38db/predictions
Authorization: Bearer <token>	Review the WML authentication documentation for details about generating IAM tokens.
ML-Instance-ID	The "ML-Instance-ID" HTTP header must be populated with the WML instance id, which can be obtained as described here
Content-type: application/json	Required if the request body is sent in JSON format.

Code Snippets

```
# TODO: manually define and pass values to be scored below
curl -X POST --header 'Content-Type: application/json' --header 'Accept: application/json' --header "Authorization: Bearer  $IAM_TOKEN" --header "ML-Instance-
```

Step 4: Deploy a simple web front-end to invoke the Watson Machine Learning service (Optional)

This section provides an example of a simple Python Flask web front-end application that invokes the Female Human Trafficking risk prediction deployed model, demonstrating embedding machine learning in a web app. You will click on a link below that will deploy the sample Python web application into your IBM Cloud account. A toolchain will be set up for continuous delivery of the application. The application code will be cloned from a public Git repository into a private Git repo in your account that will be set up as part of the toolchain. Each time you commit changes to the repo, the app will be built and deployed.

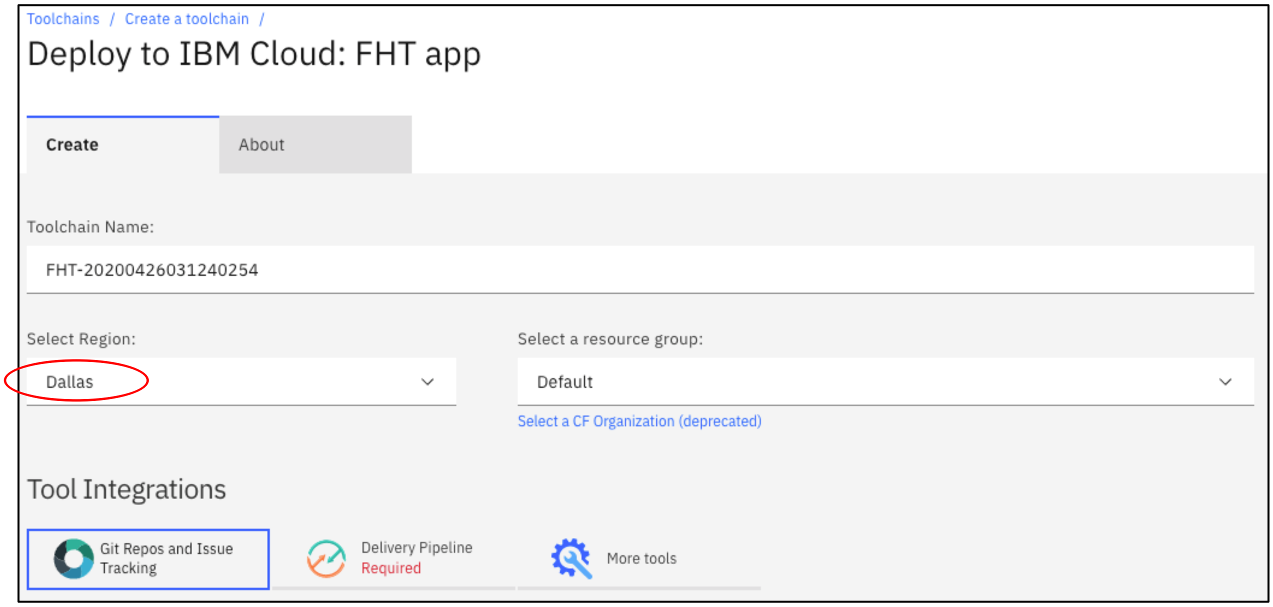
The toolchain uses tools that are part of the Continuous Delivery service. If an instance of that service isn't already in your account, when you click **Deploy**, it is automatically added with the free Lite plan selected.

The steps below guide you in configuring the application to connect to your Watson Machine Learning service, and to update the application with the deployed model's scoring endpoint.

1. Click on the **Deploy to IBM Cloud** link below to deploy a sample Python Flash web application into your IBM Cloud account. Note you may get this message – "*An IBM Cloud account is required. To get started, click Log In or Sign Up at the top of this page*". If you get this message, click on **Log In.**

   Deploy to IBM Cloud

2. In the **Select Region**, make sure that the region is Dallas. If not, change it to Dallas, and wait for the screen to refresh.



Toolchains / Create a toolchain /

Deploy to IBM Cloud: FHT app

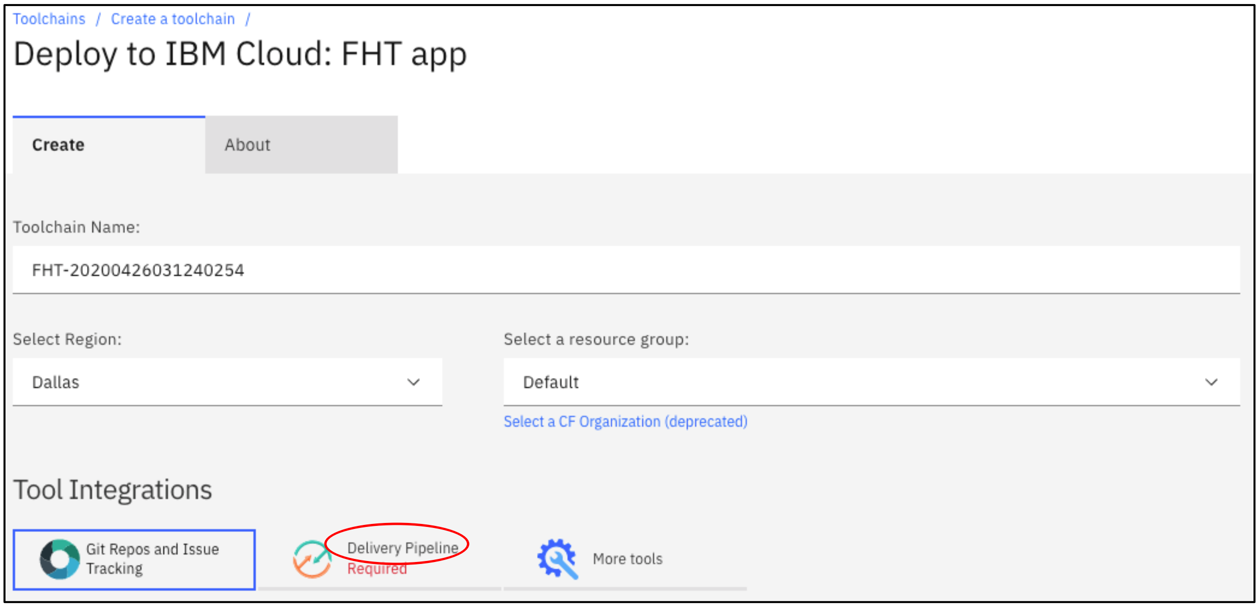
Toolchain Name: FHT-20200426031240254

Select Region: Dallas

Select a resource group: Default

Select a CF Organization (deprecated)
Tool Integrations
Git Repos and Issue Tracking
Delivery Pipeline
Required
More tools

3. Click on **Delivery Pipeline**.



Toolchains / Create a toolchain /

Deploy to IBM Cloud: FHT app

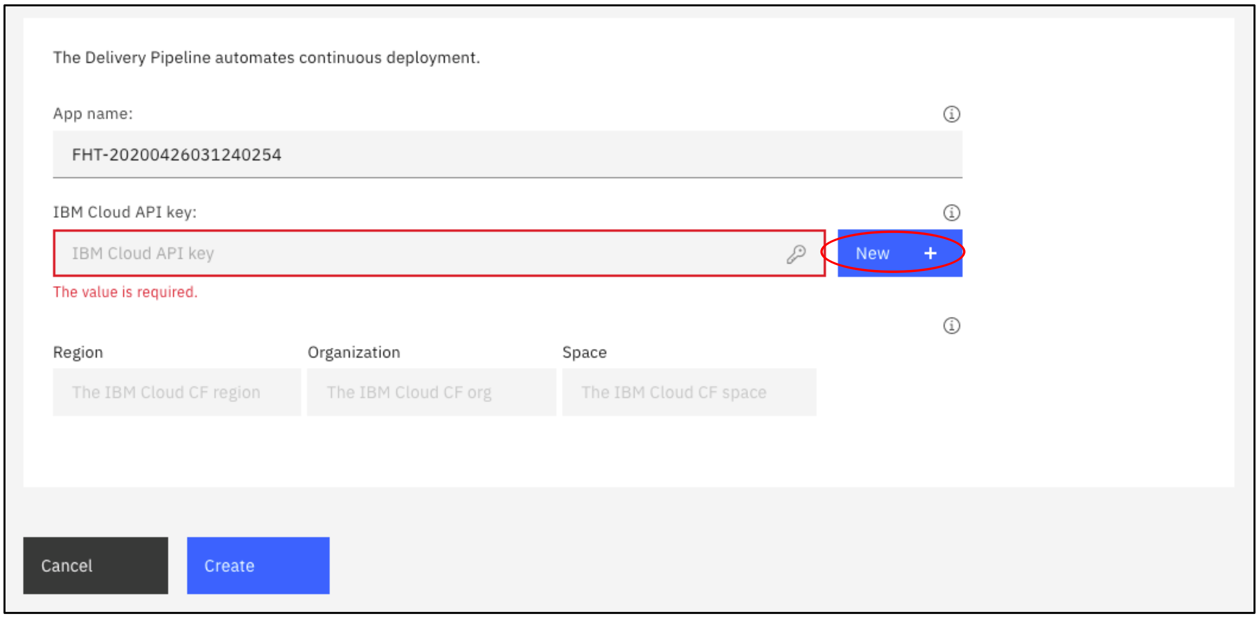
Toolchain Name: FHT-20200426031240254

Select Region: Dallas

Select a resource group: Default

Create
About
Select a CF Organization (deprecated)
Tool Integrations
Git Repos and Issue Tracking
Delivery Pipeline
Required
More tools

4. Scroll down and click **New+** to create an API key.



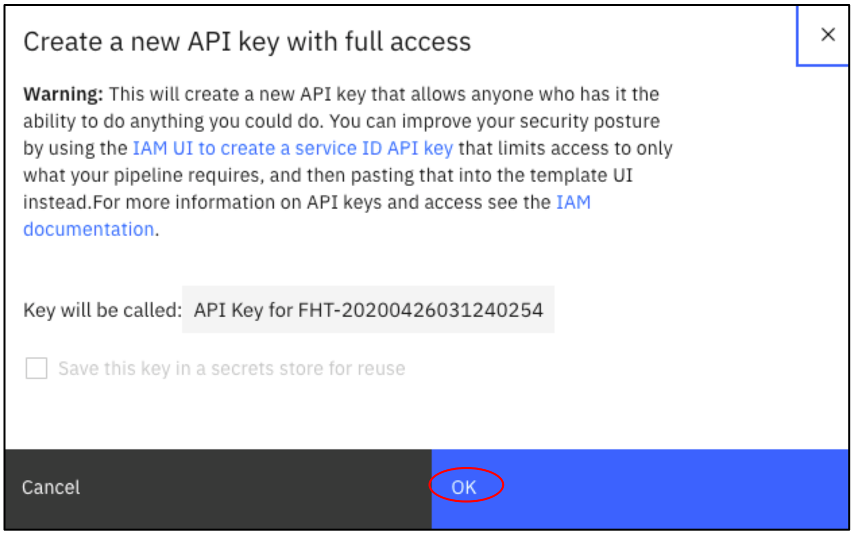
The Delivery Pipeline automates continuous deployment.

App name: FHT-20200426031240254

IBM Cloud API key:

The value is required.

5. Click **OK**.



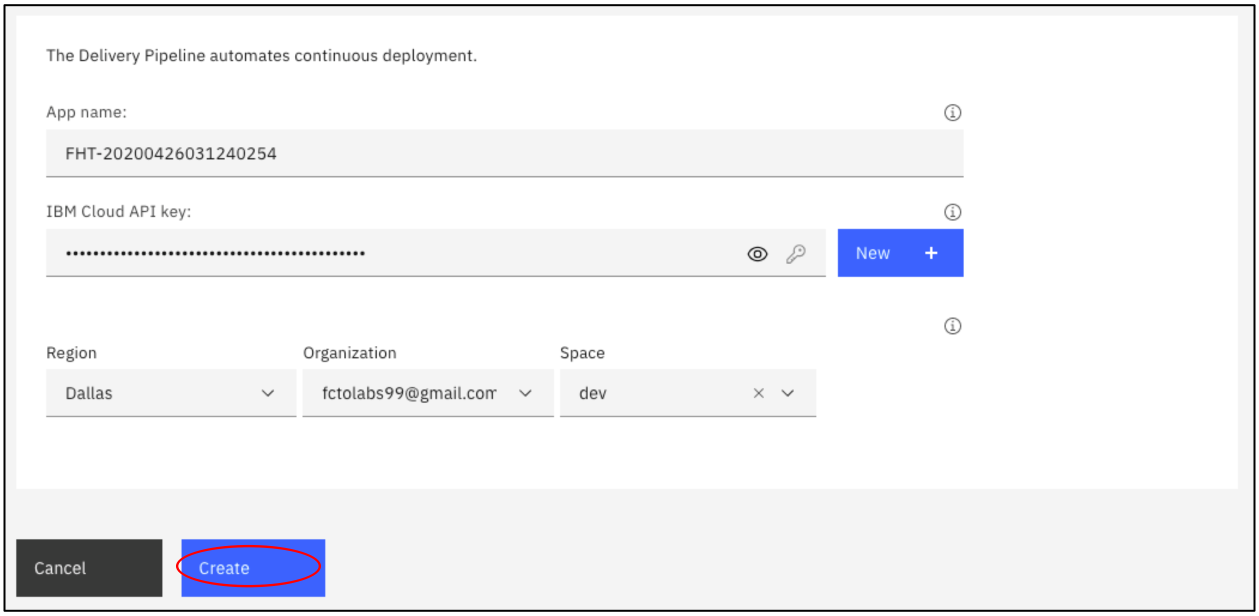
Create a new API key with full access

Warning: This will create a new API key that allows anyone who has it the ability to do anything you could do. You can improve your security posture by using the IAM UI to create a service ID API key that limits access to only what your pipeline requires, and then pasting that into the template UI instead.For more information on API keys and access see the IAM documentation.

Key will be called: API Key for FHT-20200426031240254

□ Save this key in a secrets store for reuse

6. Please wait until the Region, Organization, and Space are filled in. **Note that these must match the corresponding Region (Dallas), Organization, and Space where the FHT_WML_Model_Deployed is deployed.** If this is not the case, try a different **Region**. Click on **Create.**



The Delivery Pipeline automates continuous deployment.

App name: FHT-20200426031240254

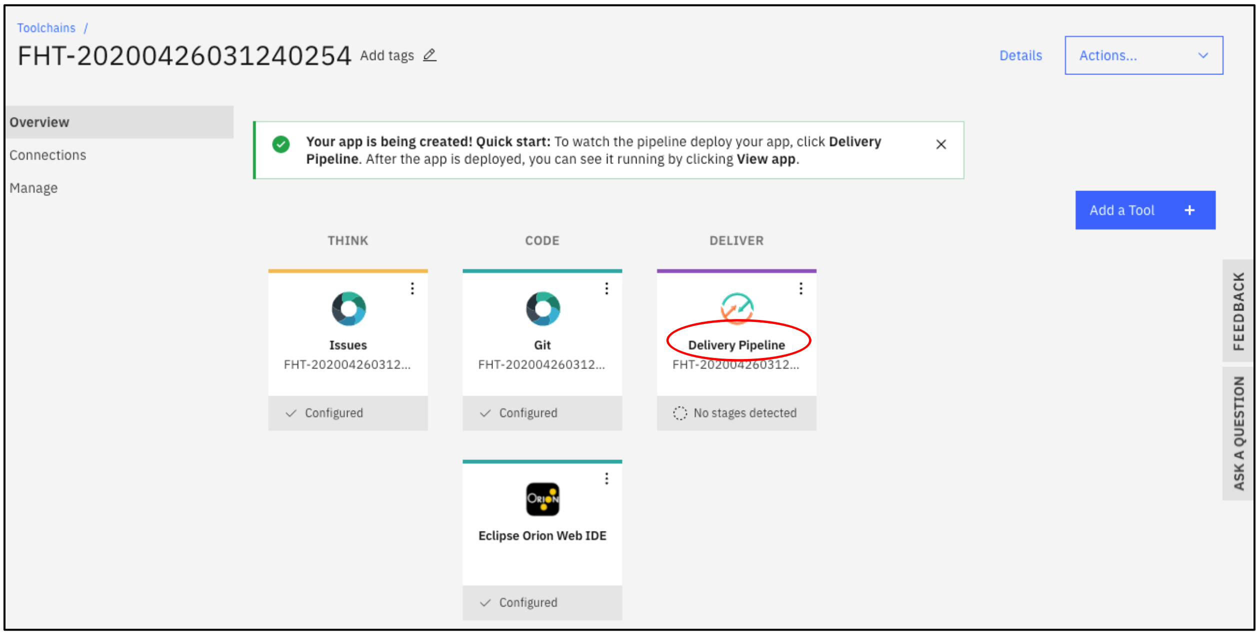
IBM Cloud API key: ••

Region: Dallas

Organization: fctolabs99@gmail.com

Space: dev

7. Your app is being created! To watch the pipeline deploy your app, click **Delivery Pipeline**.

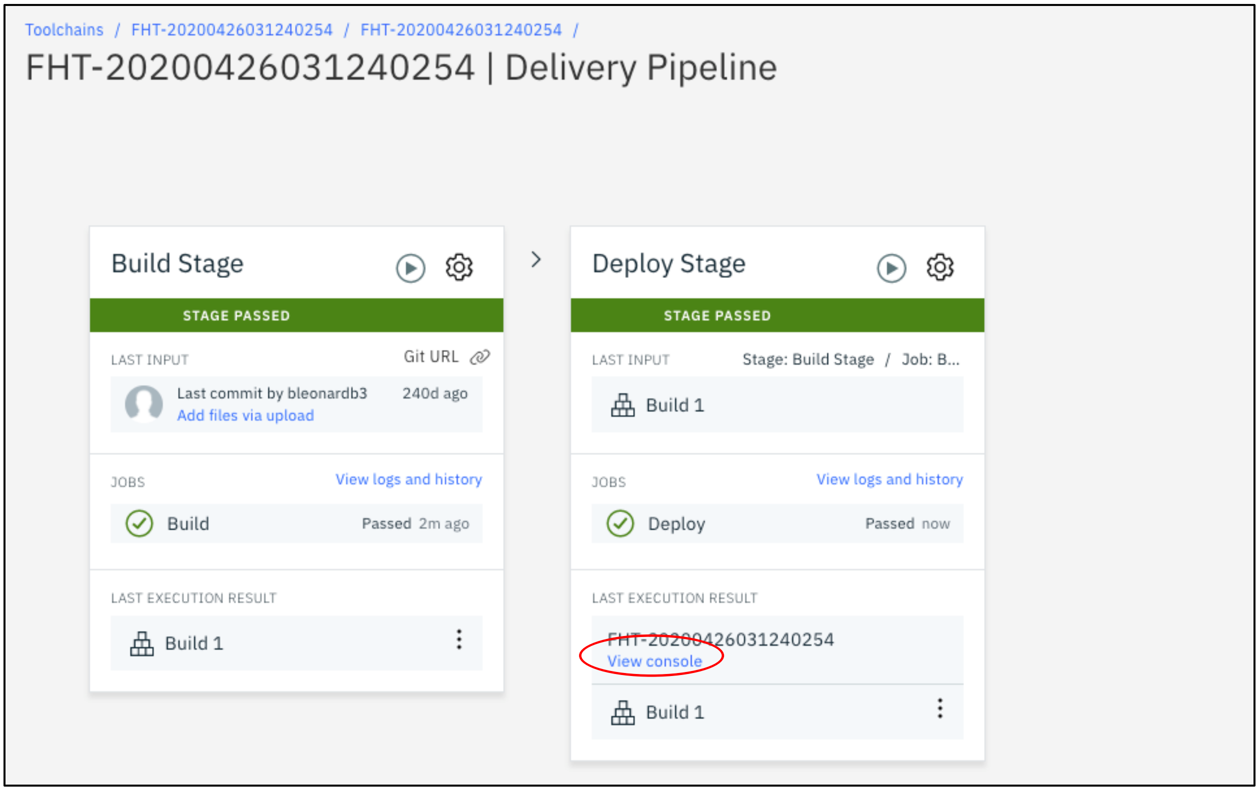


Toolchains /

FHT-20200426031240254

Your app is being created! Quick start: To watch the pipeline deploy your app, click **Delivery Pipeline**. After the app is deployed, you can see it running by clicking **View app**.

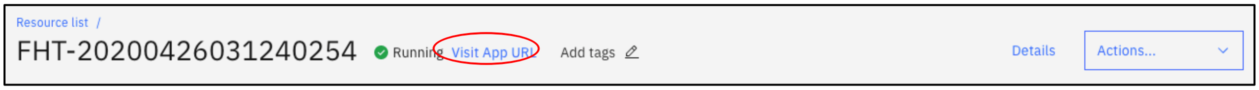
8. It may take a moment for this section to finish setting up. After the app is deployed successfully (should say Deploy Passed in the Deploy stage-may take about 2 minutes), view the running app by clicking on **View Console**



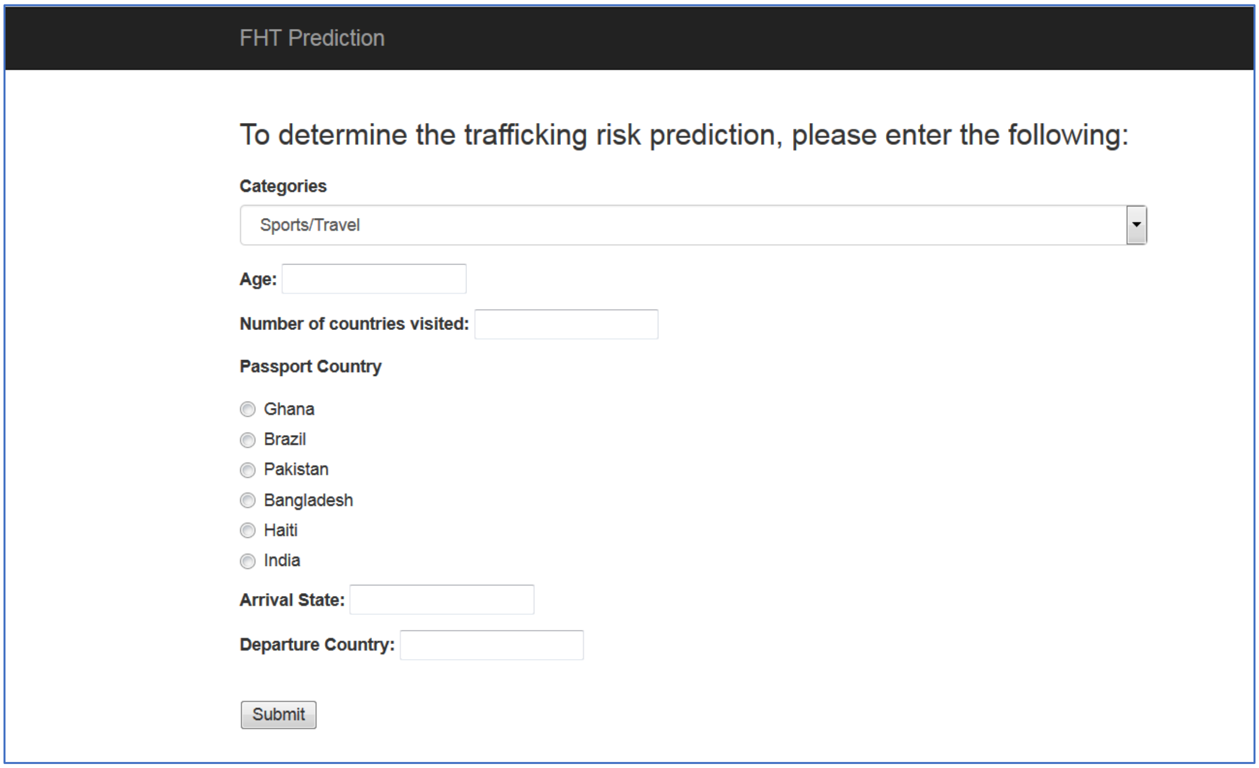
Toolchains / FHT-20200426031240254 / FHT-20200426031240254 /

FHT-20200426031240254 | Delivery Pipeline

9. Click on **Visit App URL**



10. The web form collecting the FHT data should appear. Note that the application is not functional until we connect it to the Watson Machine Learning service so if you Submit you will get an error! Close the FHT Prediction browser tab.



To determine the trafficking risk prediction, please enter the following:

Categories

Sports/Travel

Age:

Number of countries visited:

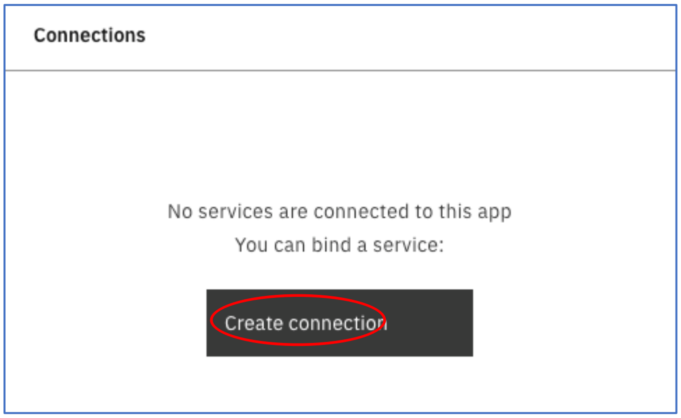
Passport Country

○ Ghana
○ Brazil
○ Pakistan
○ Bangladesh
○ Haiti
○ India

Arrival State:

Departure Country:

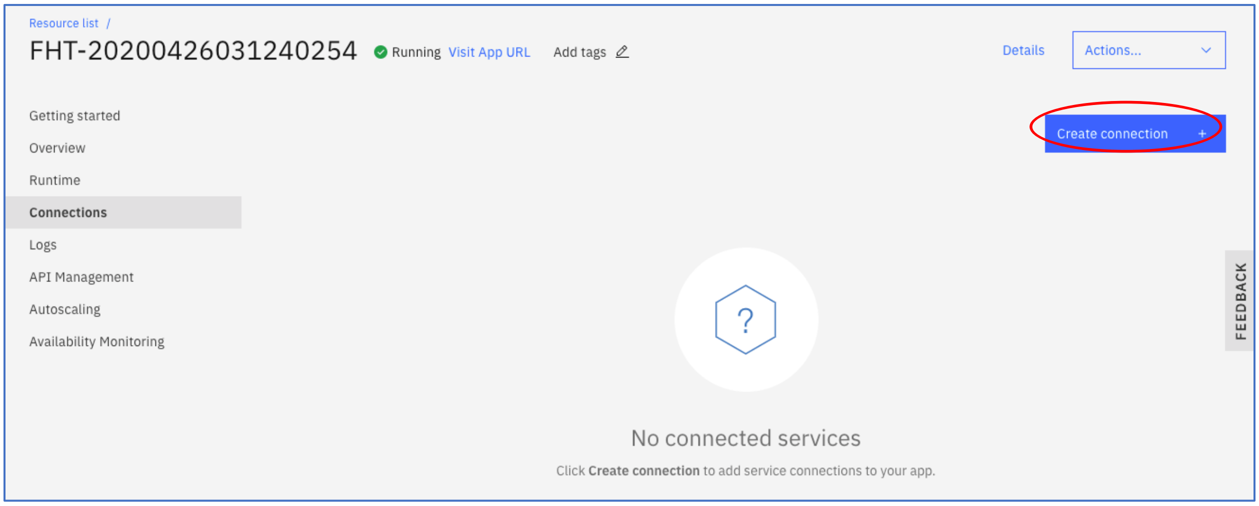
11. We are now going to connect the application to the Watson Machine Learning service that was created earlier. Scroll down until you see the Connections panel. Click on **Create Connection**.



No services are connected to this app

You can bind a service:

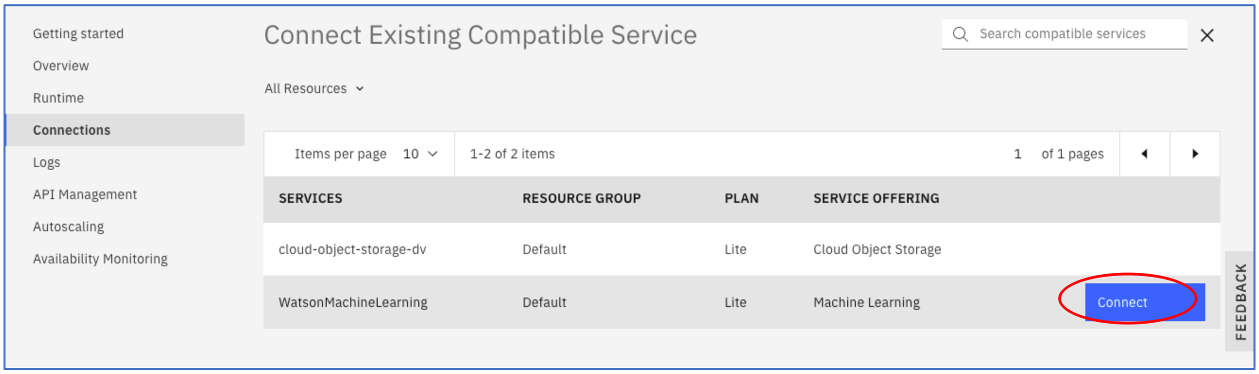
12. You should see at least 2 services listed, a Cloud Object Storage service, and a Watson Machine Learning service. Point the cursor on the **Machine Learning** service for your application, and then click on **Connect**.



No connected services

Click **Create connection** to add service connections to your app.

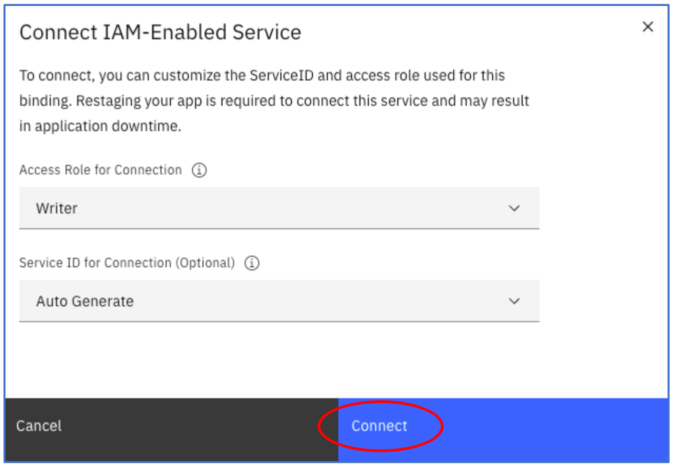
13. You should see at least 2 services listed, a Cloud Object Storage service, and a Watson Machine Learning service. Point the cursor on the **Machine Learning** service for your application for the “Connect” button to appear, and then click on **Connect**.



Connect Existing Compatible Service

SERVICES	RESOURCE GROUP	PLAN	SERVICE OFFERING	
cloud-object-storage-dv	Default	Lite	Cloud Object Storage	
WatsonMachineLearning	Default	Lite	Machine Learning	Connect

14. A **Connect IAM-enabled service** pop up will appear. Click **Connect**.



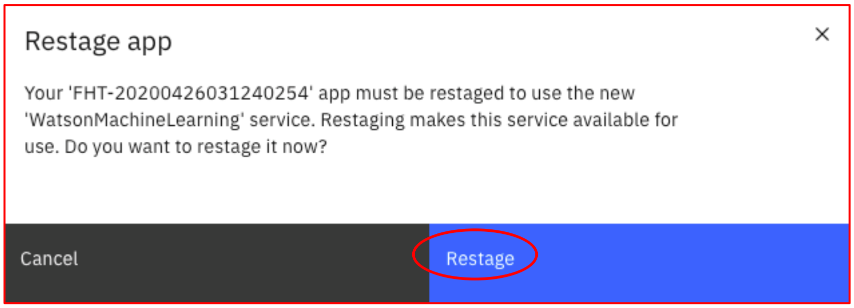
Connect IAM-Enabled Service

To connect, you can customize the ServiceID and access role used for this binding. Restaging your app is required to connect this service and may result in application downtime.

Access Role for Connection: Writer

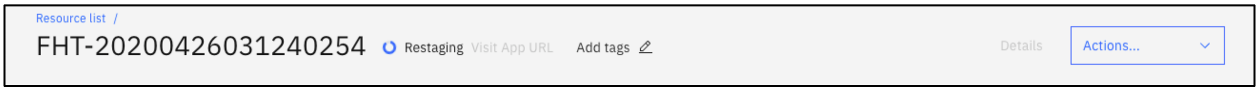
Service ID for Connection (Optional): Auto Generate

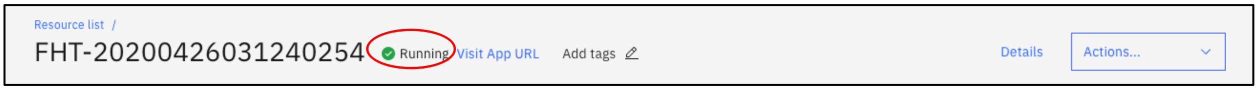
15. A **Restage app** pop up will appear. Click on **Restage**.


Restage app

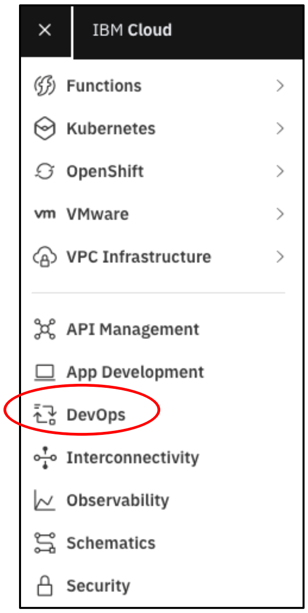
Your 'FHT-20200426031240254' app must be restaged to use the new 'WatsonMachineLearning' service. Restaging makes this service available for use. Do you want to restage it now?

16. Wait for the application status to change from **Restaging** to ● Running , or something similar.

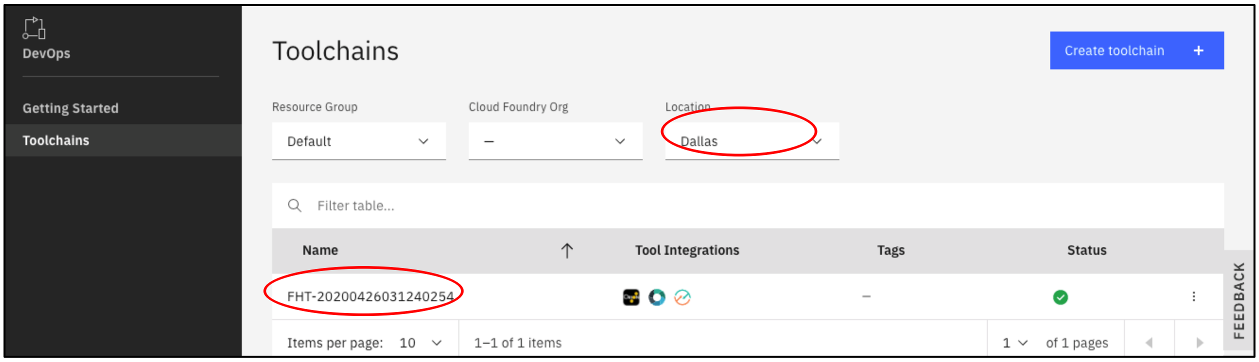




17. We now have tied the web application to the Watson Machine Learning service. Note that the Watson Machine Learning service could have more than one deployed model available to select and then embed in the web application. We now need to copy the scoring endpoint, which we previously copied and pasted into Notepad, and paste it in the web application code. Click on the ☰ icon and click on DevOps in the pulldown to navigate to the Toolchain.



18. We are now going to paste the scoring endpoint into the application code. Click on the Toolchain (FHT-2019xxxxx below). If no toolchain appears, switch the location to Dallas.



Toolchains

Resource Group: Default

Cloud Foundry Org: –

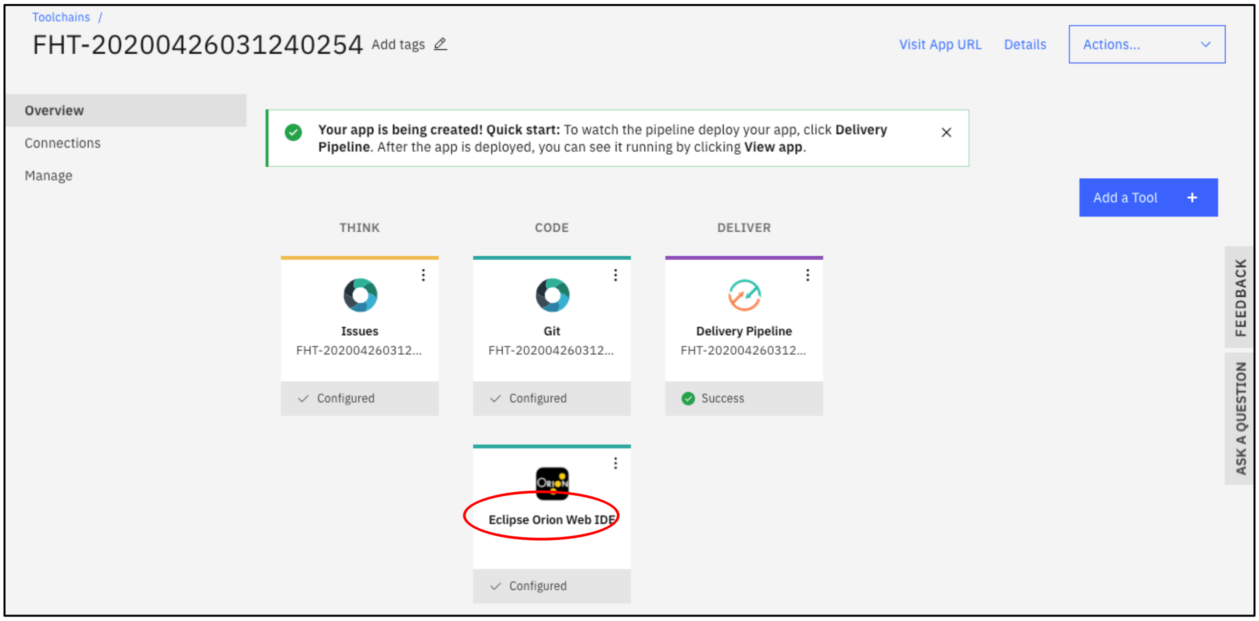
Location: Dallas

Filter table...

Name	Tool Integrations	Tags	Status
FHT-20200426031240254		–	✓

Items per page: 10 1–1 of 1 items 1 of 1 pages

19. Click on the Eclipse Orion Web IDE. The IDE will enable the editing of the source code to update the scoring endpoint url.

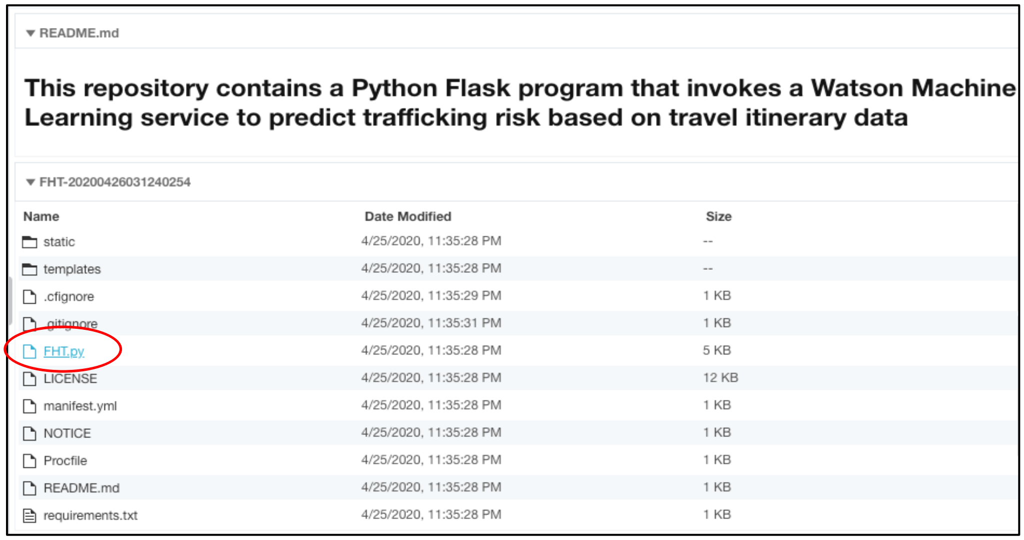


FHT-20200426031240254

Your app is being created! Quick start: To watch the pipeline deploy your app, click **Delivery Pipeline**. After the app is deployed, you can see it running by clicking **View app**.

THINK	CODE	DELIVER
Issues FHT-202004260312... ✓ Configured	Git FHT-202004260312... ✓ Configured	Delivery Pipeline FHT-202004260312... ✓ Success
	Eclipse Orion Web IDE ✓ Configured	

20. Click on the FHT.py file. This is a python source file.



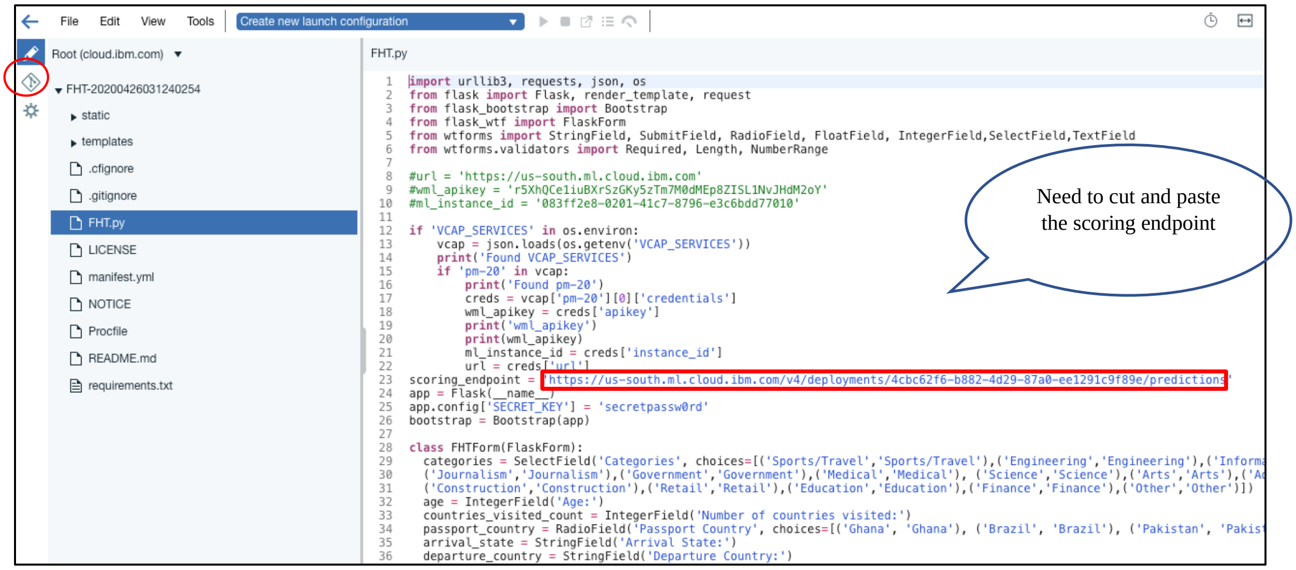
▾ README.md

This repository contains a Python Flask program that invokes a Watson Machine Learning service to predict trafficking risk based on travel itinerary data

▾ FHT-20200426031240254

Name	Date Modified	Size
static	4/25/2020, 11:35:28 PM	--
templates	4/25/2020, 11:35:28 PM	--
.cfignore	4/25/2020, 11:35:29 PM	1 KB
.gitignore	4/25/2020, 11:35:31 PM	1 KB
FHT.py	4/25/2020, 11:35:28 PM	5 KB
LICENSE	4/25/2020, 11:35:28 PM	12 KB
manifest.yml	4/25/2020, 11:35:28 PM	1 KB
NOTICE	4/25/2020, 11:35:28 PM	1 KB
Procfile	4/25/2020, 11:35:28 PM	1 KB
README.md	4/25/2020, 11:35:28 PM	1 KB
requirements.txt	4/25/2020, 11:35:28 PM	1 KB

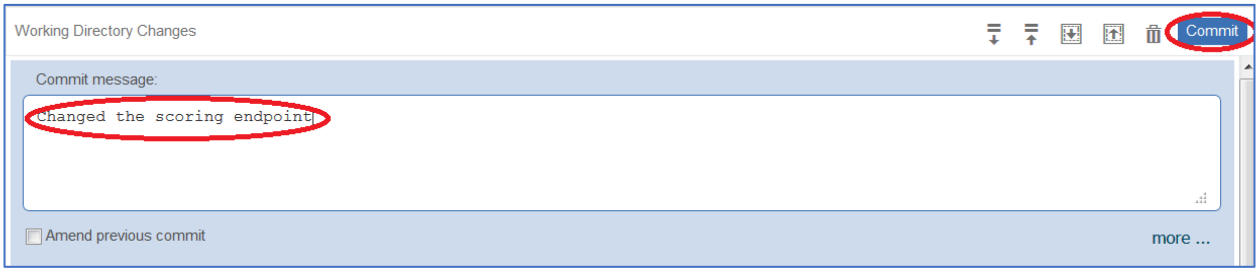
21. Go back to the Notepad file and copy the scoring endpoint to the clipboard. Look around line 20 in the FHT.py file for the “scoring endpoint =”. Select the scoring endpoint value in line 20 (starting with https:// may want to use Shift-End to get to the end of the line, and then back up one space to not select the endpoint quote – if you do just make sure to put it back in). Enter Ctrl-V to paste the new scoring endpoint from your Notepad file. Enter Ctrl-S or File > Save to save the file. Then click on the ◈ icon on the top left.



```
 1 import urllib3, requests, json, os
 2 from flask import Flask, render_template, request
 3 from flask_bootstrap import Bootstrap
 4 from flask_wtf import FlaskForm
 5 from wtforms import StringField, SubmitField, RadioField, FloatField, IntegerField,SelectField,TextField
 6 from wtforms.validators import Required, Length, NumberRange
 7
 8 #url = 'https://us-south.ml.cloud.ibm.com'
 9 #wml_apikey = 'r5XhQCe1iuBXrSzGKy5zTm7M0dMEp8ZISL1NvJHdM2oY'
10 #ml_instance_id = '083ff2e8-0201-41c7-8796-e3c6bdd77010'
11
12 if 'VCAP_SERVICES' in os.environ:
13     vcap = json.loads(os.getenv('VCAP_SERVICES'))
14     print('Found VCAP_SERVICES')
15     if 'pm-20' in vcap:
16         print('Found pm-20')
17         creds = vcap['pm-20'][0]['credentials']
18         wml_apikey = creds['apikey']
19         print('wml_apikey')
20         print(wml_apikey)
21         ml_instance_id = creds['instance_id']
22         url = creds['url']
23 scoring_endpoint = 'https://us-south.ml.cloud.ibm.com/v4/deployments/4cbc62f6-b882-4d29-87a0-ee1291c9f89e/predictions'
24 app = Flask(__name__)
25 app.config['SECRET_KEY'] = 'secretpassw0rd'
26 bootstrap = Bootstrap(app)
27
28 class FHTForm(FlaskForm):
29   categories = SelectField('Categories', choices=[('Sports/Travel','Sports/Travel'),('Engineering','Engineering'),('Informa
30   ('Journalism','Journalism'),('Government','Government'),('Medical','Medical'), ('Science','Science'),('Arts','Arts'),('Ac
31   ('Construction','Construction'),('Retail','Retail'),('Education','Education'),('Finance','Finance'),('Other','Other')])
32   age = IntegerField('Age:')
33   countries_visited_count = IntegerField('Number of countries visited:')
34   passport_country = RadioField('Passport Country', choices=[('Ghana', 'Ghana'), ('Brazil', 'Brazil'), ('Pakistan', 'Pakis
35   arrival_state = StringField('Arrival State:')
36   departure_country = StringField('Departure Country:')
```

Need to cut and paste the scoring endpoint

22. The next step is to commit the change to the git repository. Enter “Changed the Scoring Endpoint” in the Enter Commit Message field, and then click on **Commit**.

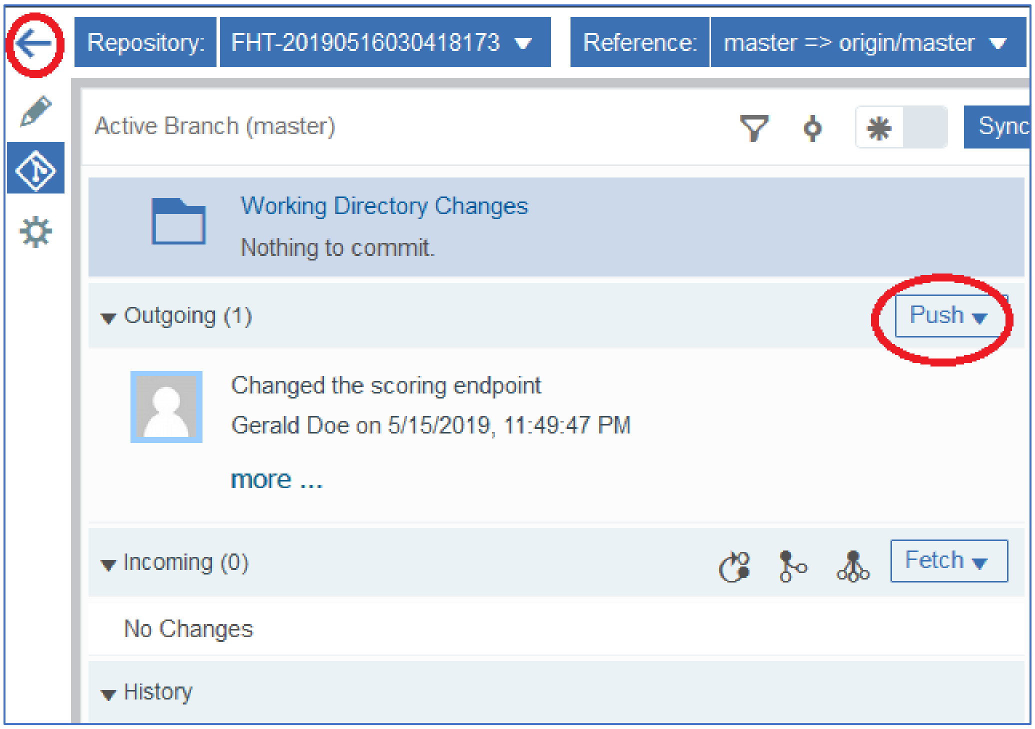


Commit message:

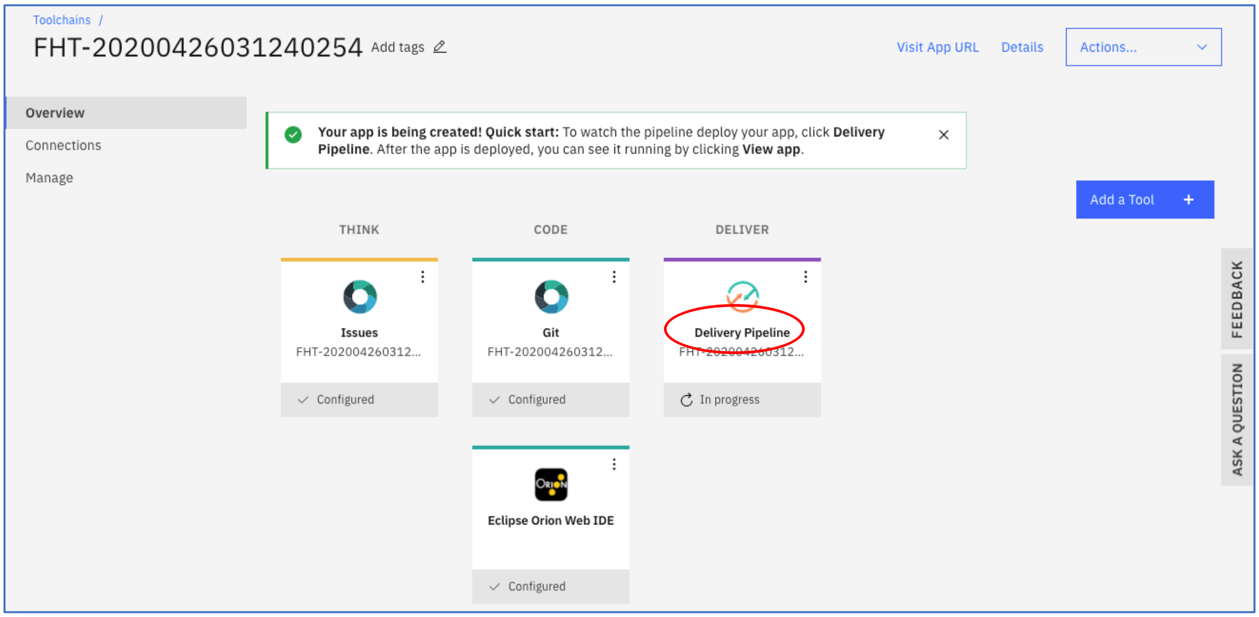
Changed the scoring endpoint

☐ Amend previous commit

23. Then click on **Push** to push the changes to the central Git repo which will start the build and deploy of the application. Click on the left arrow to return to the Toolchain.

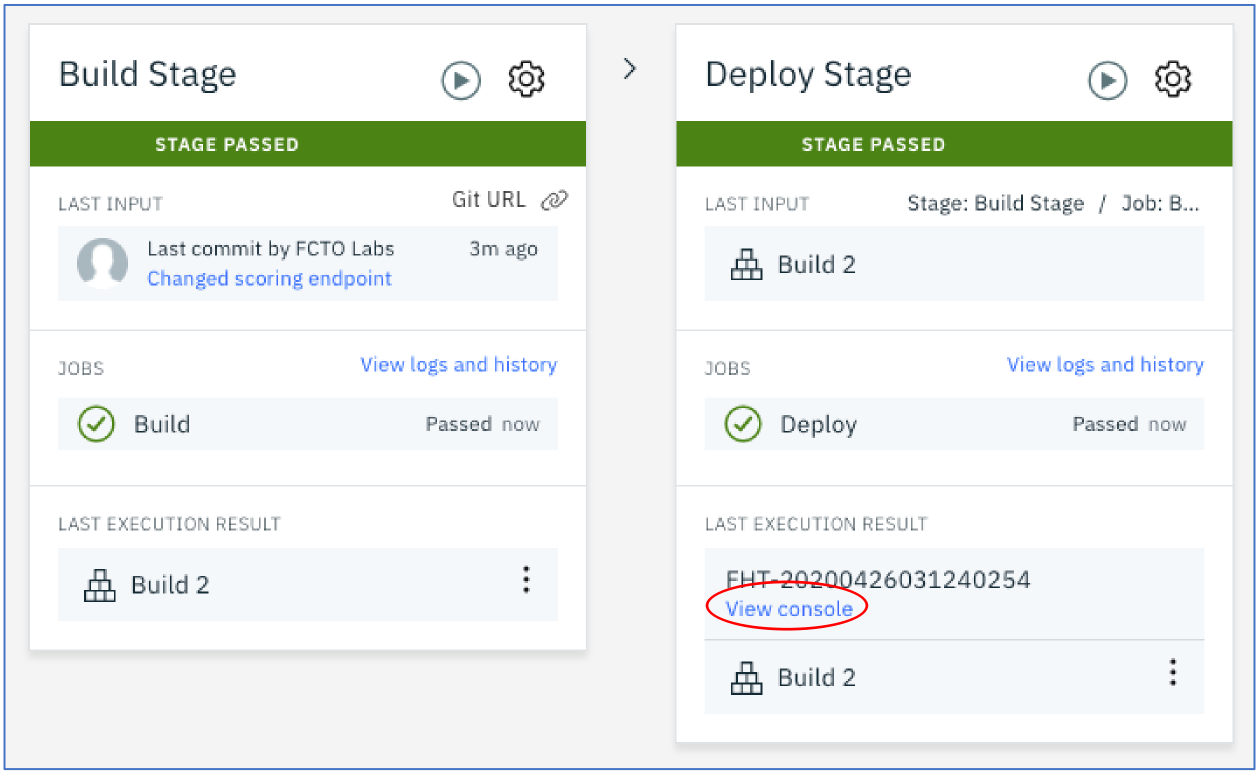


24. Click on the **Delivery Pipeline** to view status of the deployment as before. Refresh the screen if the stage status doesn't change.



Your app is being created! Quick start: To watch the pipeline deploy your app, click **Delivery Pipeline**. After the app is deployed, you can see it running by clicking **View app**.

25. Once the Deployment status shows **Deploy passed now** it shouldn't take longer than 2 minutes (reload the browser in case the UI didn't update after 2 minutes). Click on **View Console.**



Build Stage

STAGE PASSED

LAST INPUT Git URL

Last commit by FCTO Labs 3m ago
Changed scoring endpoint

JOBS View logs and history

Build Passed now

LAST EXECUTION RESULT

Build 2

Deploy Stage

STAGE PASSED

LAST INPUT Stage: Build Stage / Job: B...

Build 2

JOBS View logs and history

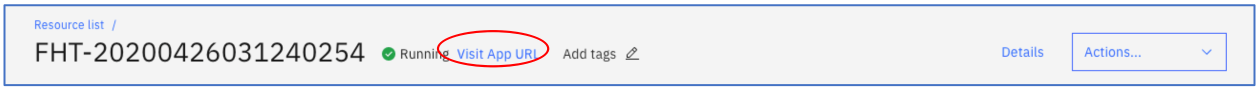
Deploy Passed now

LAST EXECUTION RESULT

FHT-20200426031240254
View console

Build 2

26. Click on **Visit App URL**.



Resource list /

FHT-20200426031240254 Running Visit App URL Add tags Details Actions...

27. The web form should appear. Enter data in all the fields and click on the **Submit** button.

Categories: Sports/Travel

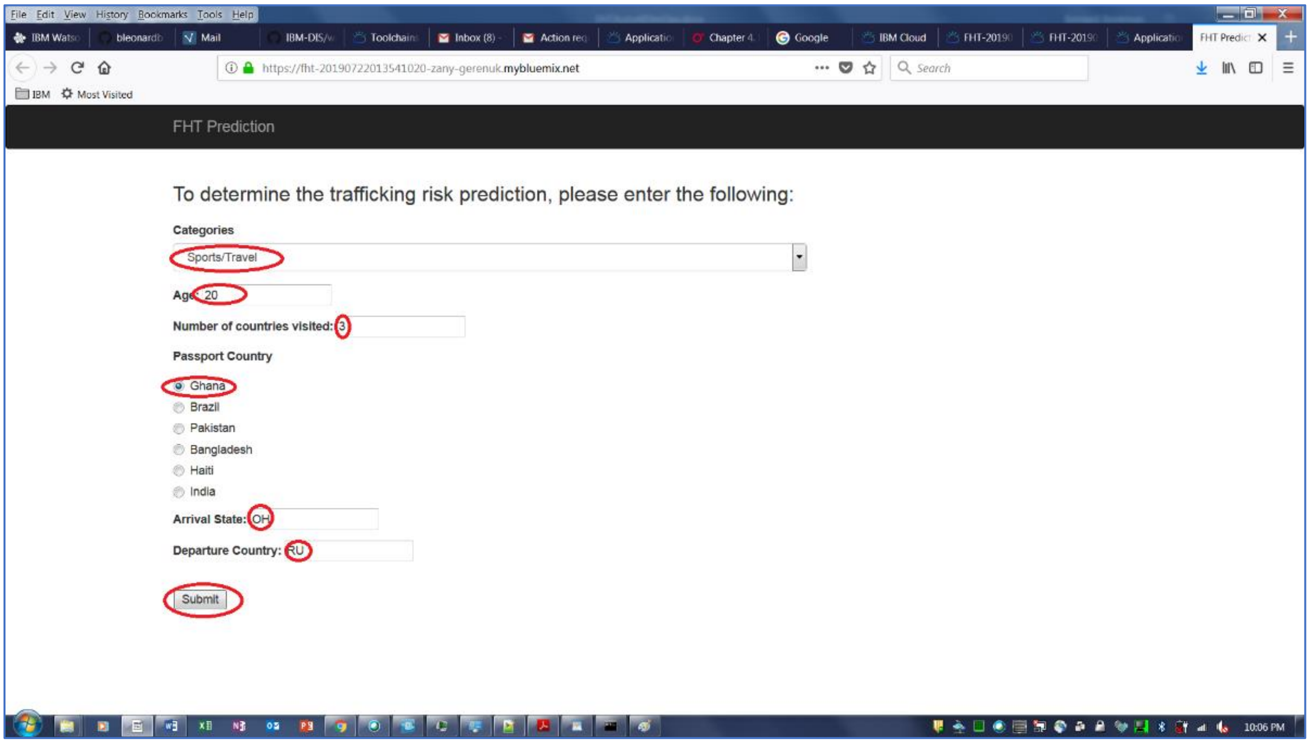
Age: 20

Number of countries visisted: 3

Passport Country: Ghana

Arrival State: OH

Departure Country: RU



FHT Prediction

To determine the trafficking risk prediction, please enter the following:

Categories

Sports/Travel

Age 20

Number of countries visited: 3

Passport Country

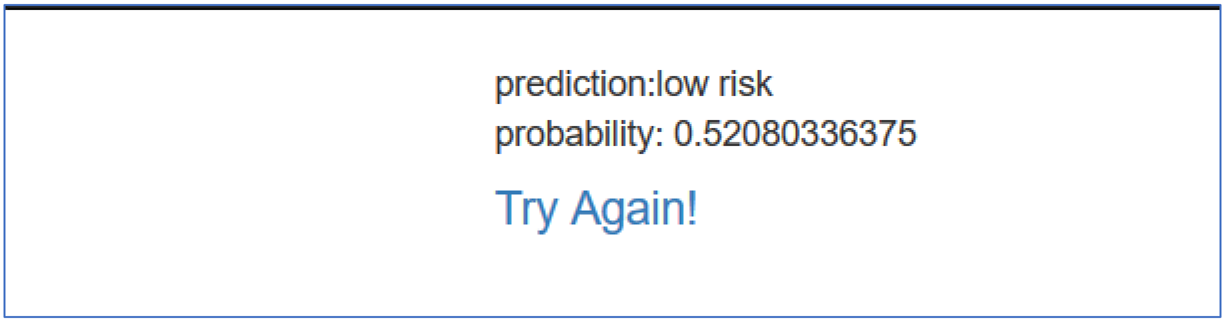
● Ghana
○ Brazil
○ Pakistan
○ Bangladesh
○ Haiti
○ India

Arrival State: OH

Departure Country: RU

Submit

28. You should see something similar to the following depending on the values of the input fields that you entered. Click on the **Try Again!**, if you want to experiment with different inputs.



prediction:low risk
probability: 0.52080336375

Try Again!

You have successfully completed the Lab!!!

- ✓ Downloaded a female human trafficking cleansed dataset from the github repo
- ✓ Added an Auto AI Experiment to create a model to predict the trafficking risk
- ✓ Saved and Deployed the model
- ✓ Tested the model
- ✓ Deployed a simple web front-end application and connected it to the deployed model using an IBM Cloud DevOps toolchain.