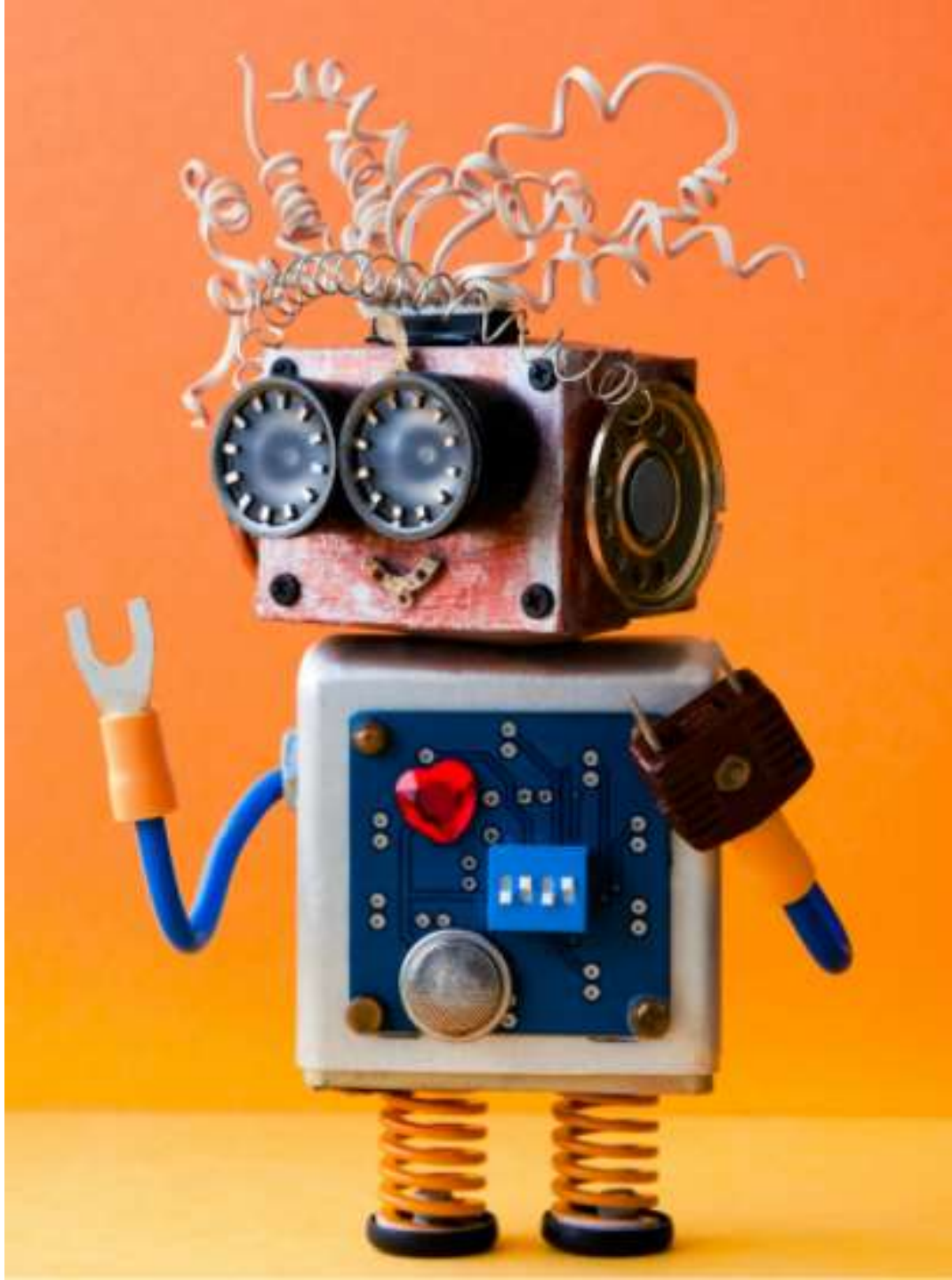
INTRODUCTION & KEY LEARNING OUTCOMES

EASY

ADVANCED



KEY LEARNING OUTCOMES

1. Understand Amazon SageMaker components and overall architecture.
2. Learn how to build and train a simple machine learning model using Amazon SageMaker Canvas.
3. Go over Amazon SageMaker Demo/Walkthrough.
4. Learn how to write your first code in SageMaker notebooks.
5. Learn about Amazon SageMaker Studio key capabilities.
6. Run a demo of a trained model in the AWS SageMaker marketplace.
7. Final Capstone Project

AMAZON SAGEMAKER

- Amazon SageMaker is a fully-managed machine learning workflow platform that provides services on data labeling, model building, training, tuning and deployment.
- SageMaker allows data scientists and developers to build scalable AI/ML models easily and efficiently.
- Models could be deployed in production at a much faster rate and with a fraction of the cost.
- Let's explore SageMaker: https://aws.amazon.com/sagemaker/#

BUILD

- SageMaker offers data labeling service
- Prebuilt available notebooks with state of the art algorithms on AWS marketplace

TRAIN

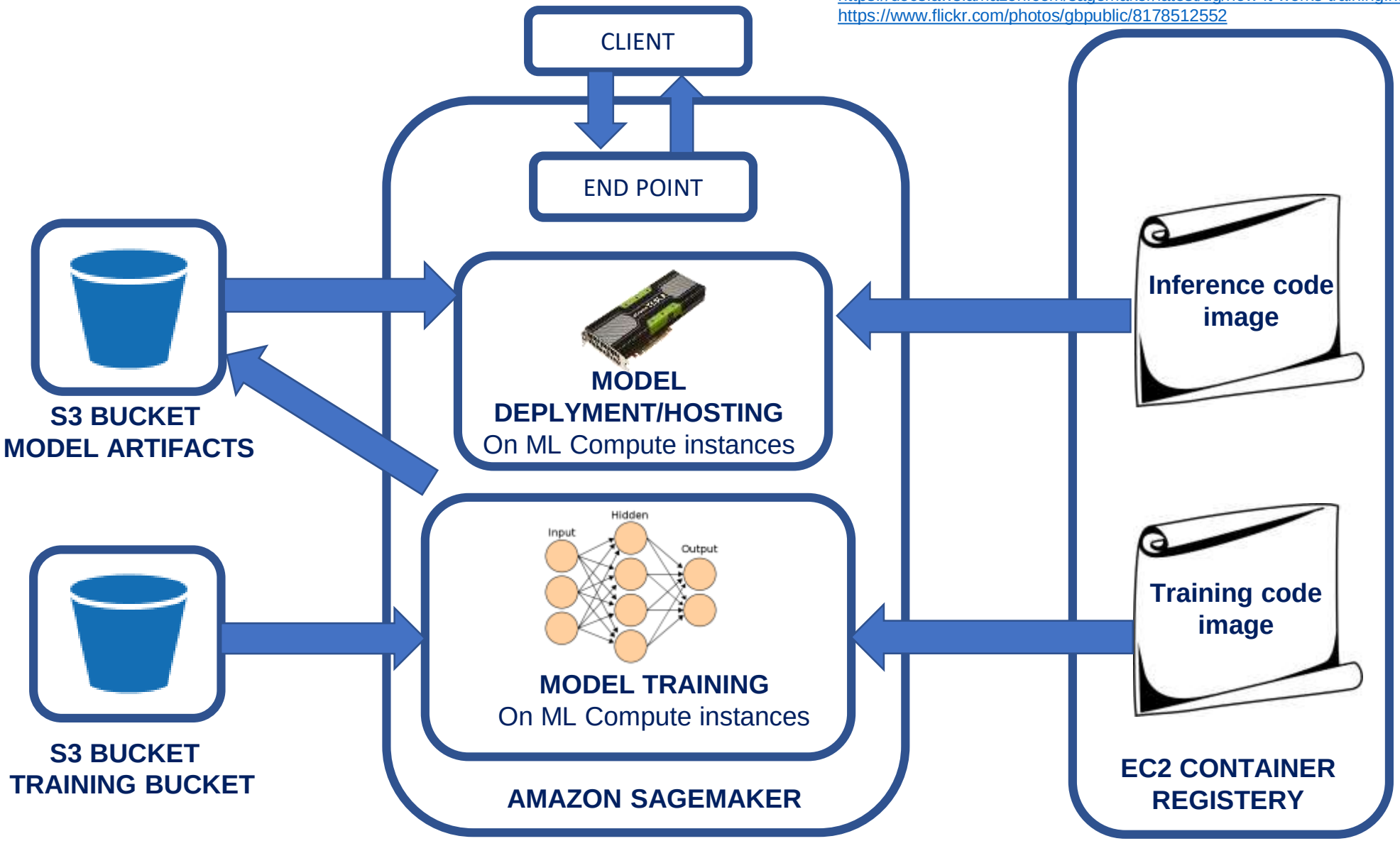
- Train models using EC2 instances (on-demand and spot)
- Manage environments for training
- Hyperparameters optimization for model tuning

DEPLOY

- Easily deploy and scale models
- Autoscaling with 75% savings

AMAZON SAGEMAKER MODEL TRAINING AND DEPLOYMENT OVERVIEW

Source: https://docs.aws.amazon.com/sagemaker/latest/dg/how-it-works-training.html
https://commons.wikimedia.org/wiki/File:Artificial_neural_network.svg
https://commons.wikimedia.org/wiki/File:AWS_Simple_Icons_Storage_Amazon_S3.svg
https://docs.aws.amazon.com/sagemaker/latest/dg/how-it-works-training.html
https://www.flickr.com/photos/gbpublic/8178512552



AMAZON SAGEMAKER COMPONENTS

- Two components are present in Amazon SageMaker:
  - Model training
  - Model deployment
- To start training an AI/ML model using Amazon SageMaker, you will need to create a training job with the following:
  - Amazon S3 bucket URL (training data): where training data is located.
  - Compute resources: Amazon SageMaker will train the model using instances managed by Amazon SageMaker.
  - Amazon S3 bucket URL (Output): this bucket will host the output from the training.
  - Amazon Elastic Container Registry path: where training code is stored.
- Amazon SageMaker uses: (1) training code and (2) training dataset to train the model.
- Amazon SageMaker saves the trained model artifacts in an S3 bucket.

Source: https://docs.aws.amazon.com/sagemaker/latest/dg/how-it-works-training.html

TRAINING OPTIONS OFFERED BY SAGEMAKER

USE AN ALGORITHM PROVIDED BY AMAZON SAGEMAKER

- Amazon SageMaker provides ready, off the shelve training algorithms such as: Linear Learner Algorithm and the XGBoost Algorithm, K Means, Principal Component Analysis, image classification, LDA, Sequence to Sequence Algorithm.

CUSTOM CODE TRAINING USING POPULAR DEEP LEARNING FRAMEWORKS

- Custom python code with TensorFlow or Apache MXNet for model training.

USE YOUR OWN CUSTOM ALGORITHMS

- The code could be placed in a docker container and then registry path of the image could be provided to Amazon SageMaker CreateTrainingJob API call.

AWS MARKETPLACE

- choose an algorithm from Amazon marketplace, https://aws.amazon.com/marketplace/solutions/machine-learning

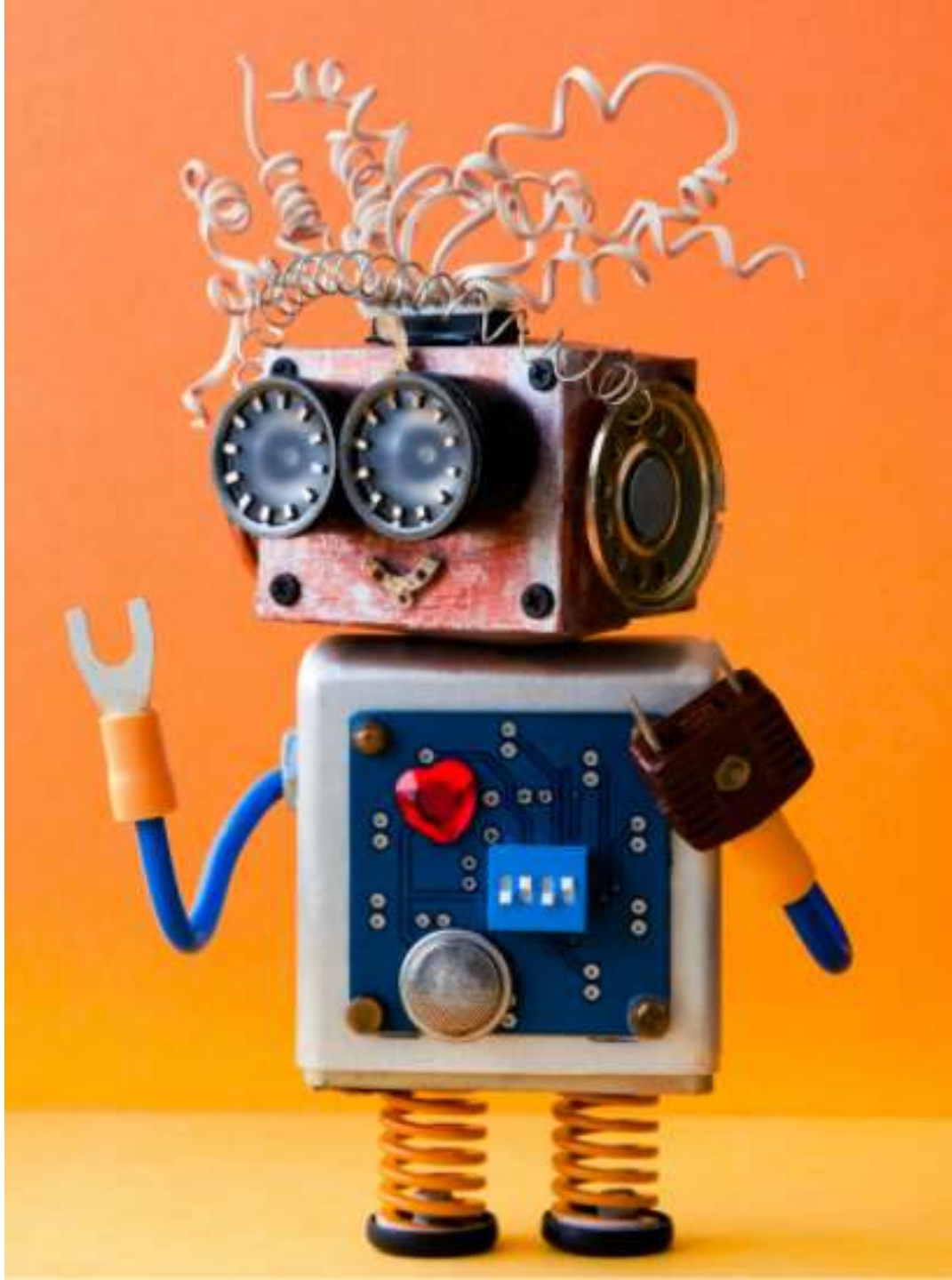
USE APACHE SPARK WITH AMAZON SAGEMAKER

- Apache Spark can be used to train models with Amazon SageMaker.

Source: https://docs.aws.amazon.com/sagemaker/latest/dg/how-it-works-training.html

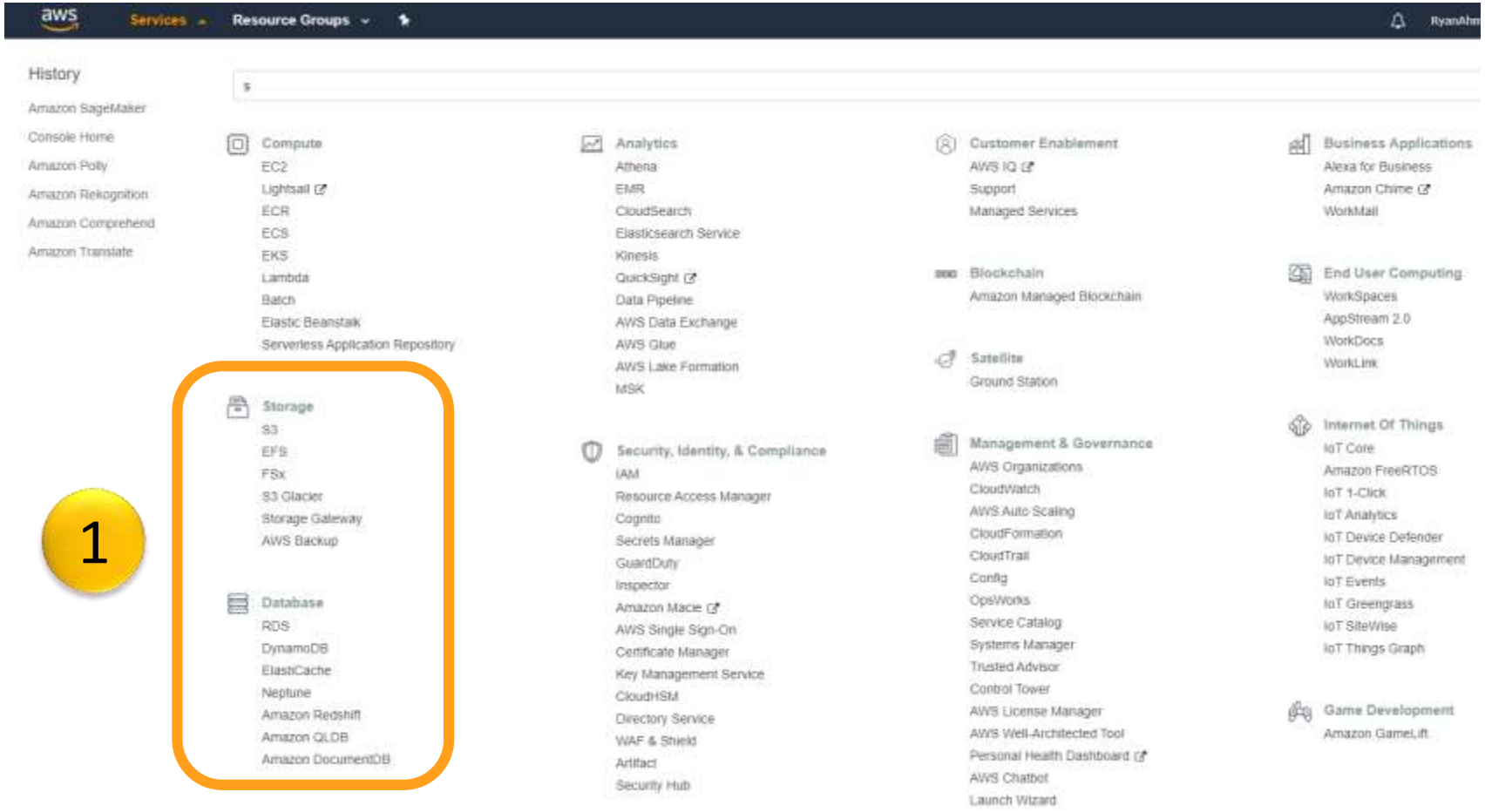
AWS SAGEMAKER DEMO – PART #1 (NOTEBOOK INSTANCE)

EASY ADVANCED



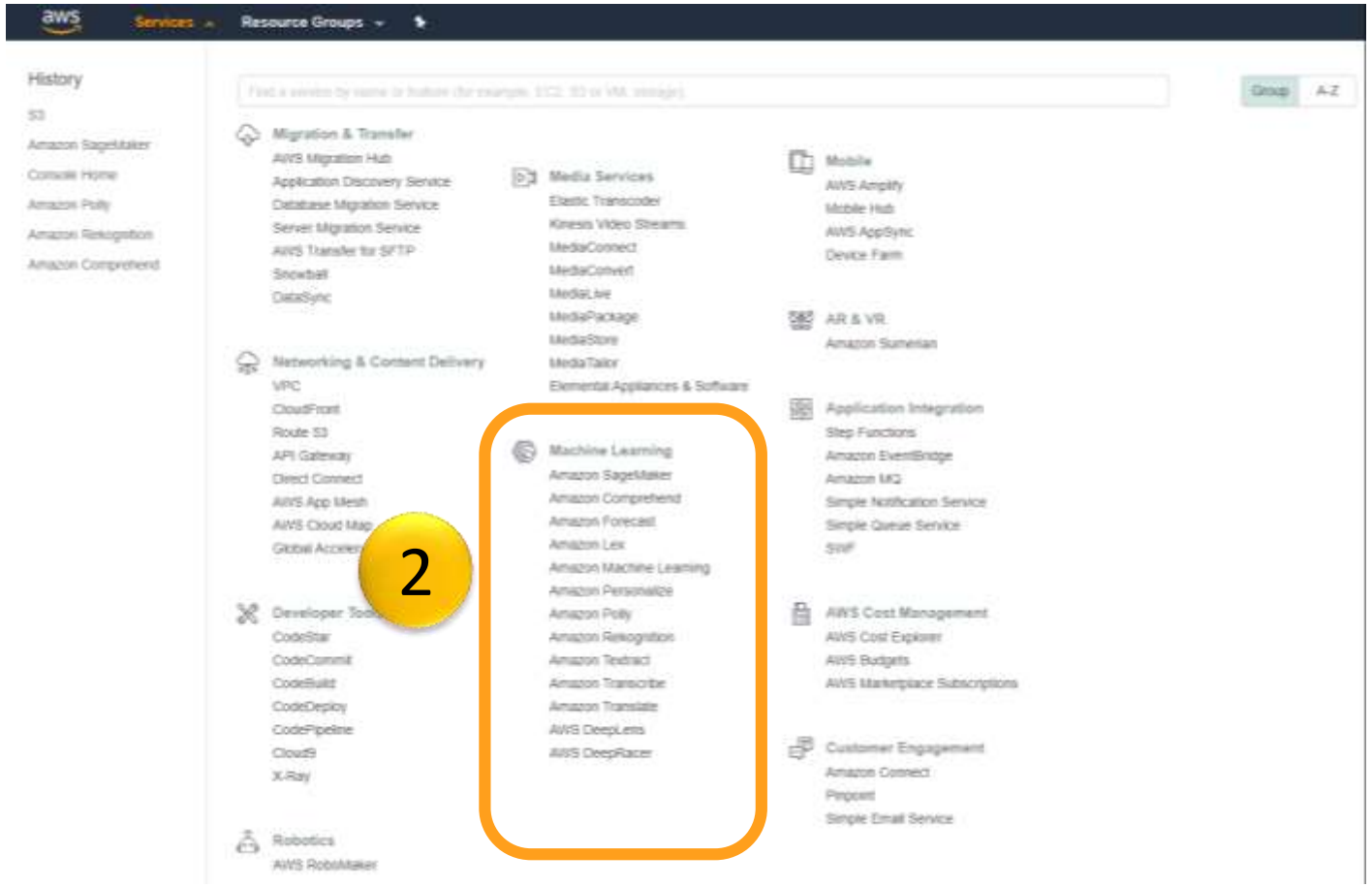
MACHINE LEARNING COMPONENTS IN AWS: 1. DATA

1. DATA + **2. MODEL** + **3. COMPUTE**



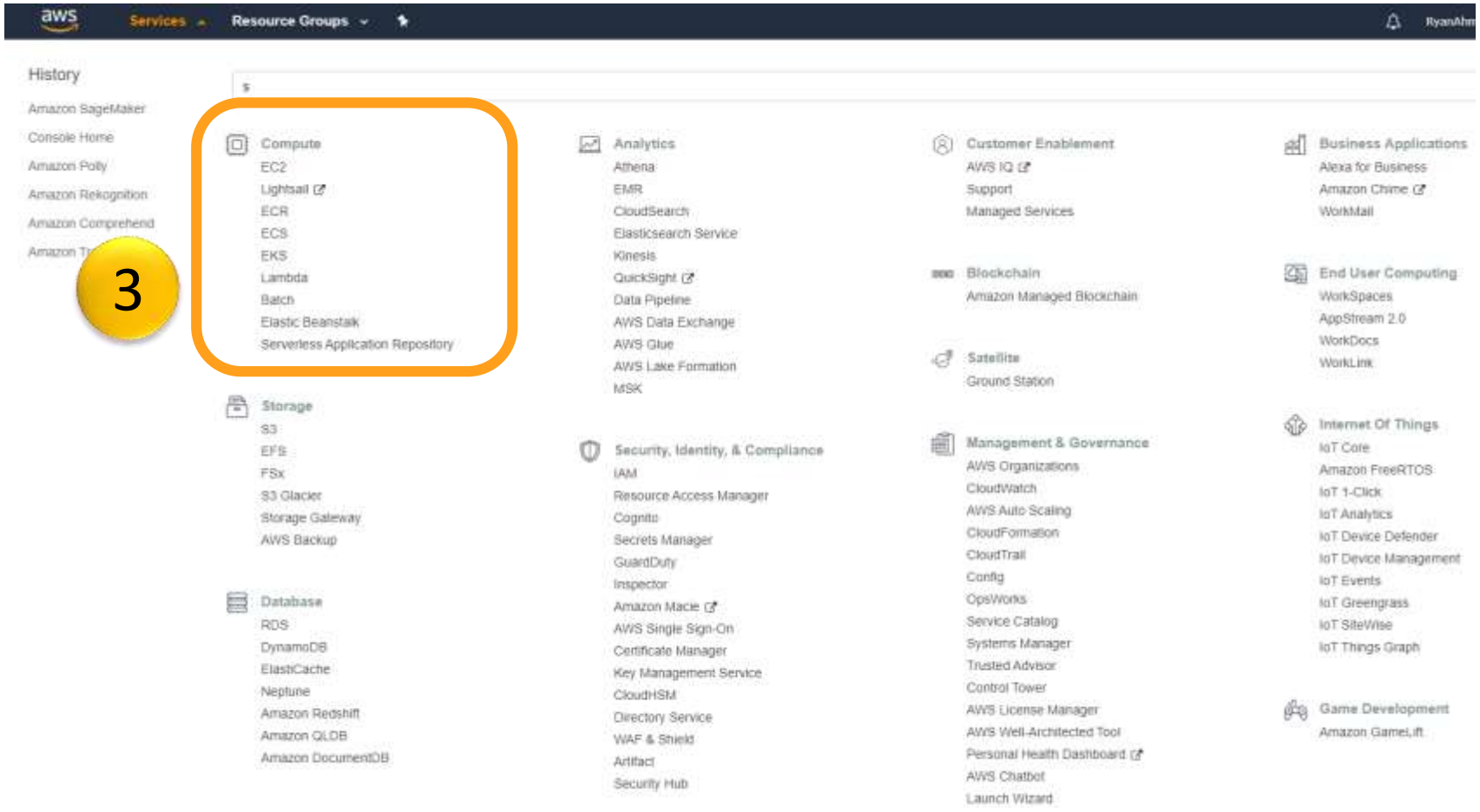
MACHINE LEARNING COMPONENTS IN AWS: 2. MODEL

1. DATA + 2. MODEL + 3. COMPUTE



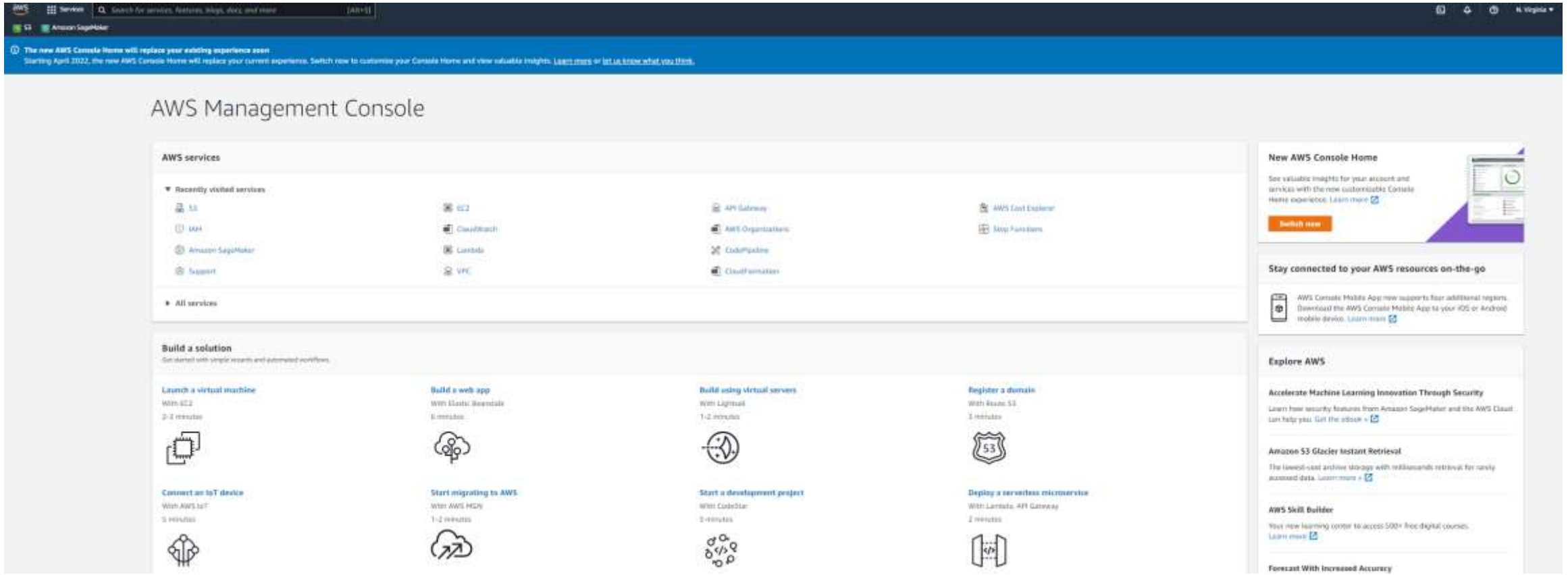
MACHINE LEARNING COMPONENTS IN AWS: 3. COMPUTE

1. DATA + 2. MODEL + 3. COMPUTE



DEMO: AWS SAGEMAKER

NAVIGATE TO AWS MANAMGENT CONSOLE AND SEARCH FOR SAGEMAKER

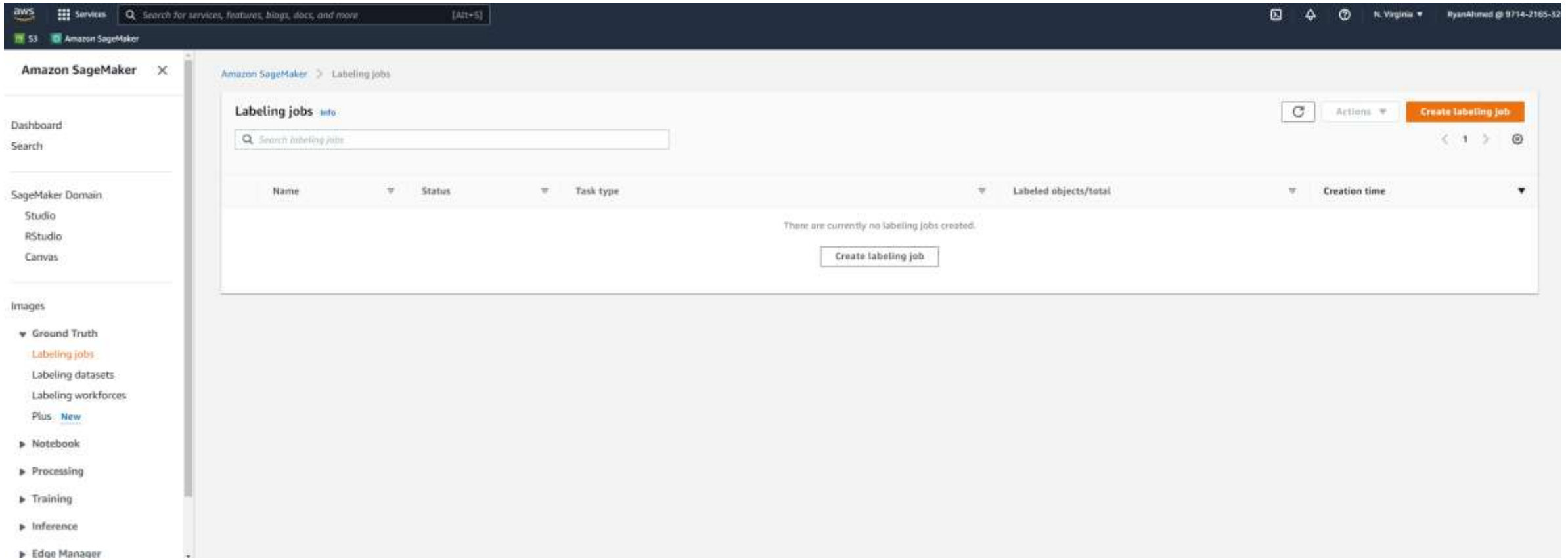


DEMO: AWS SAGEMAKER

YOU CAN LAUNCH A NOTEBOOK INSTANCE FROM THE LEFT PANEL OR YOU CAN LAUNCH SAGEMAKER STUDIO.

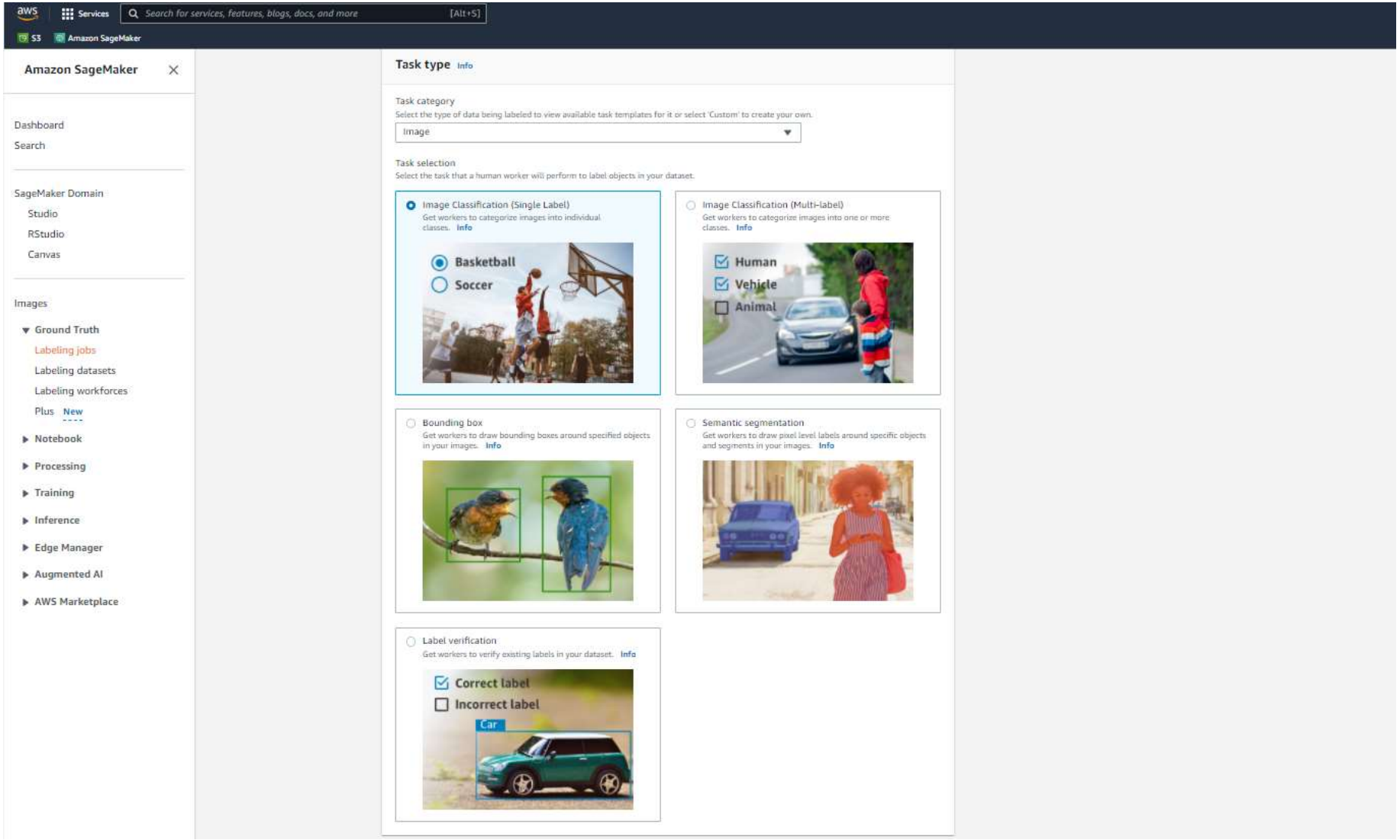
DEMO: AWS SAGEMAKER

YOU CAN CREATE A LABELING JOB BY NAVIGATING TO GROUNDTRUTH ON THE LEFT-HAND SIDE



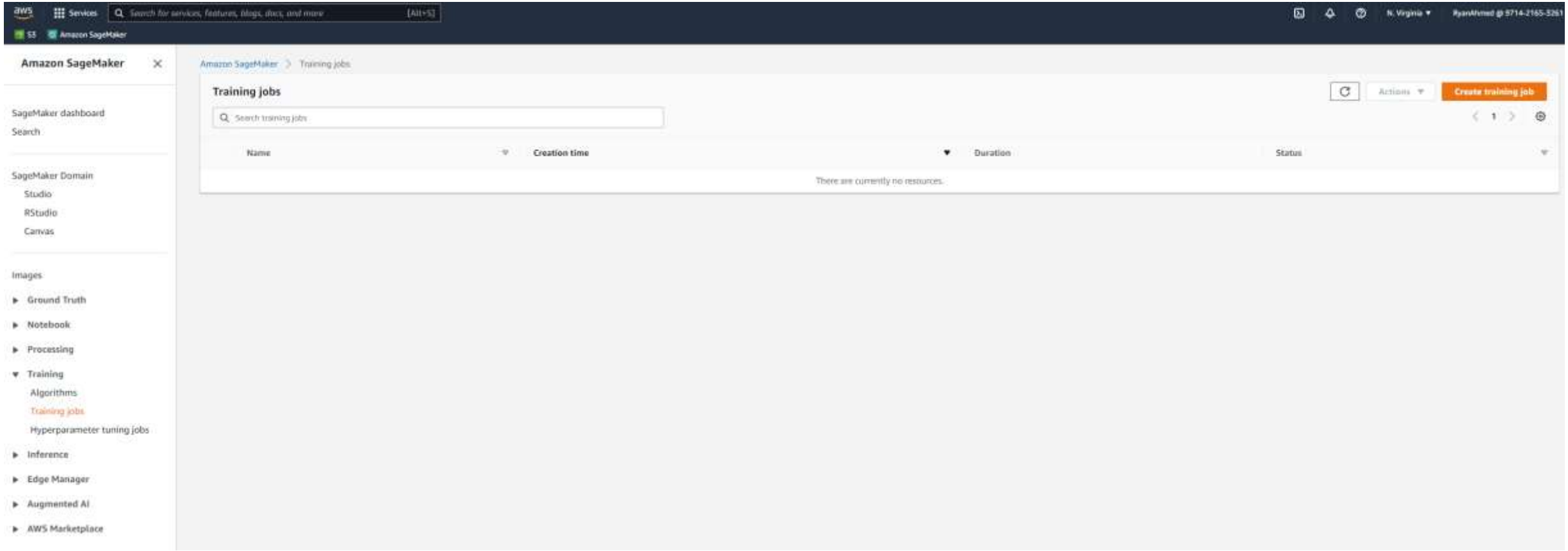
DEMO: AWS SAGEMAKER

YOU CAN CHOOSE WHAT KIND OF LABELING YOU WANT TO PERFORM. WE WILL COVER THIS IN DETAIL IN THE NEXT SECTION.



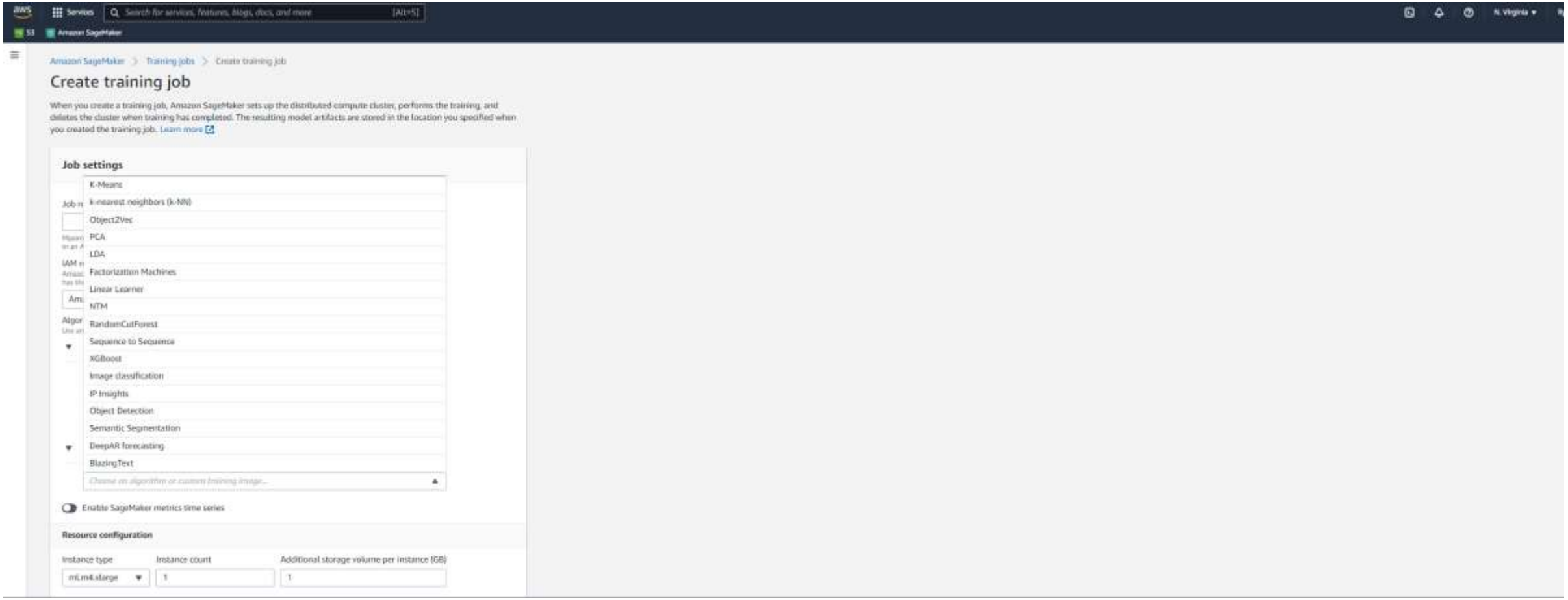
DEMO: AWS SAGEMAKER

CLICK ON TRAINING JOBS AND CLICK ON CREATE TRAINING JOB



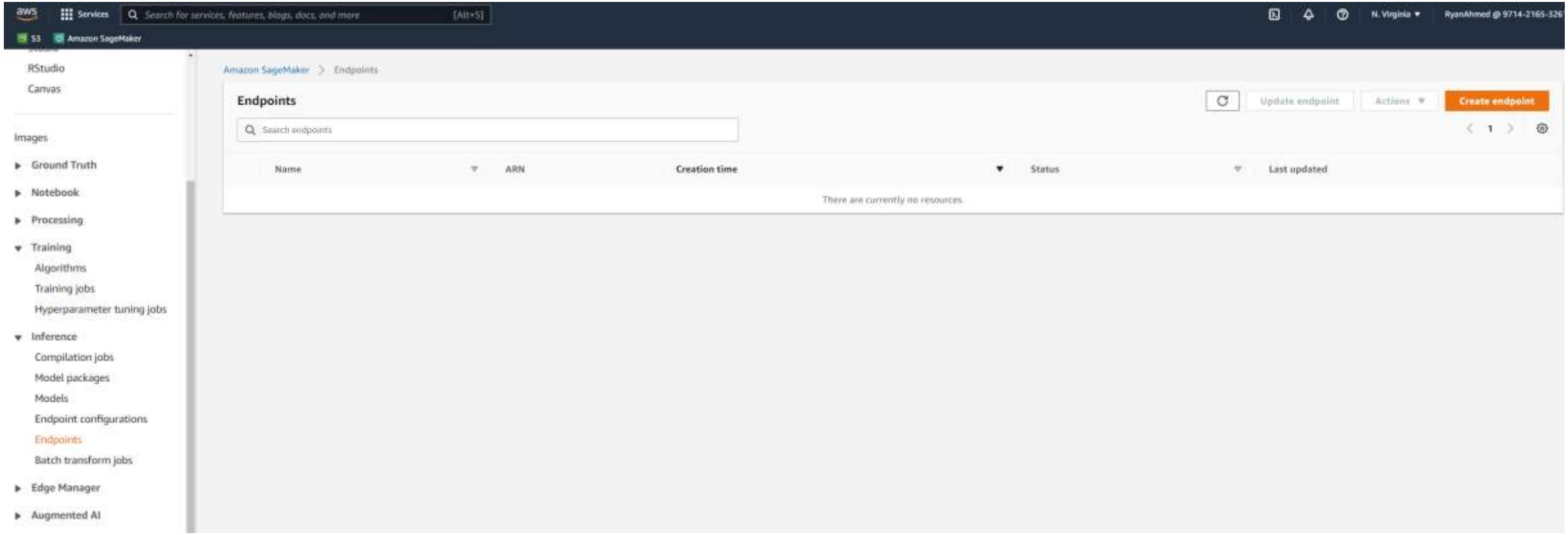
DEMO: AWS SAGEMAKER

YOU CAN CREATE A NEW TRAINING JOB AND SELECT AN ALGORITHM FROM THE LIST. NOTE THAT WE WILL COVER THIS IN GREAT DETAILS IN THE NEXT COUPLE OF DAYS!



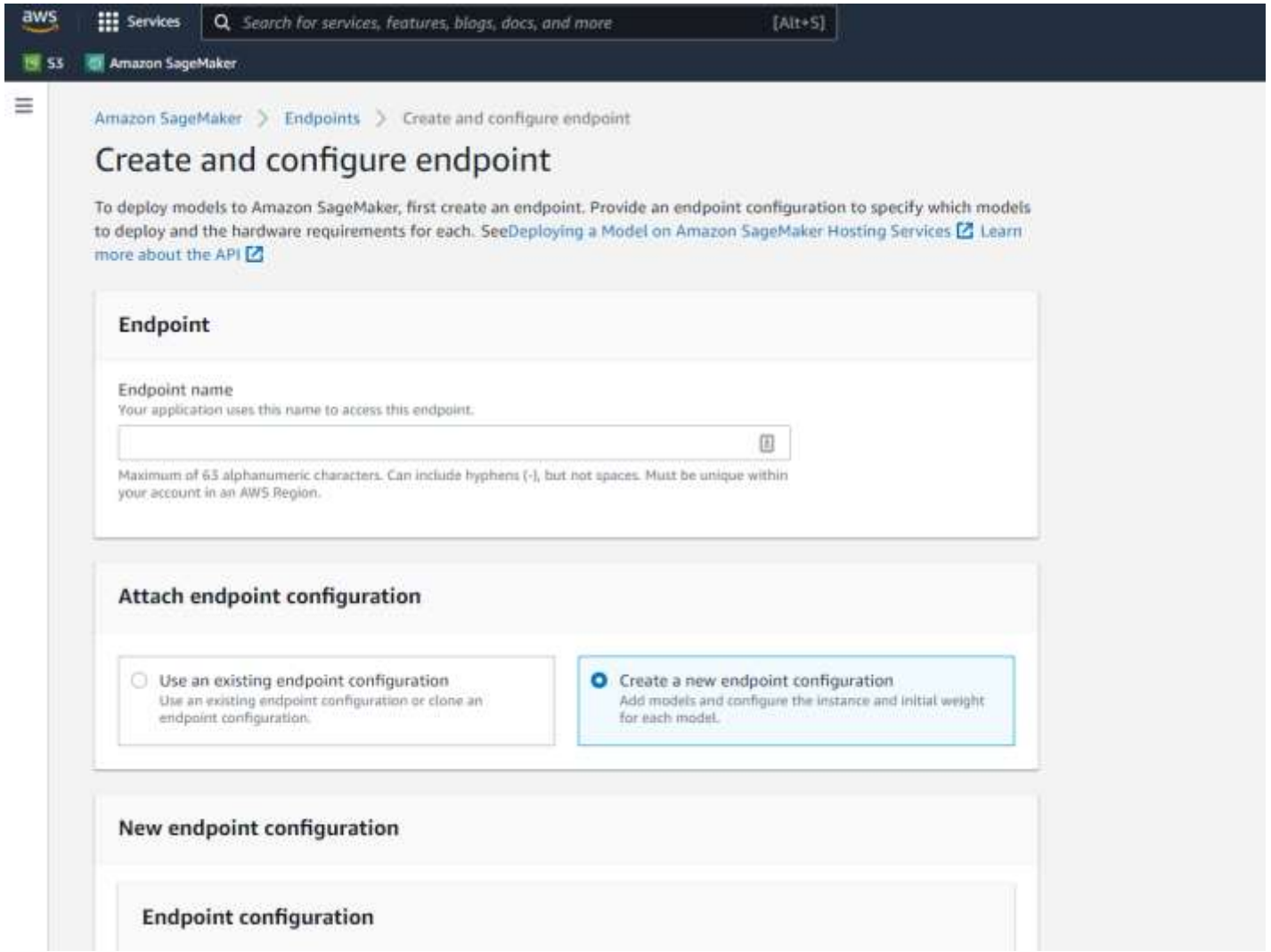
DEMO: AWS SAGEMAKER

AFTER THE MODEL IS TRAINED, YOU WILL NEED TO DEPLOY AN ENDPOINT AND MAKE INFERENCE ON THE DEPLOYED MODEL. YOU CAN CREATE AN ENDPOINT BY CLICKING ON CREATE ENDPOINT FROM THE INFERENCE PANEL.



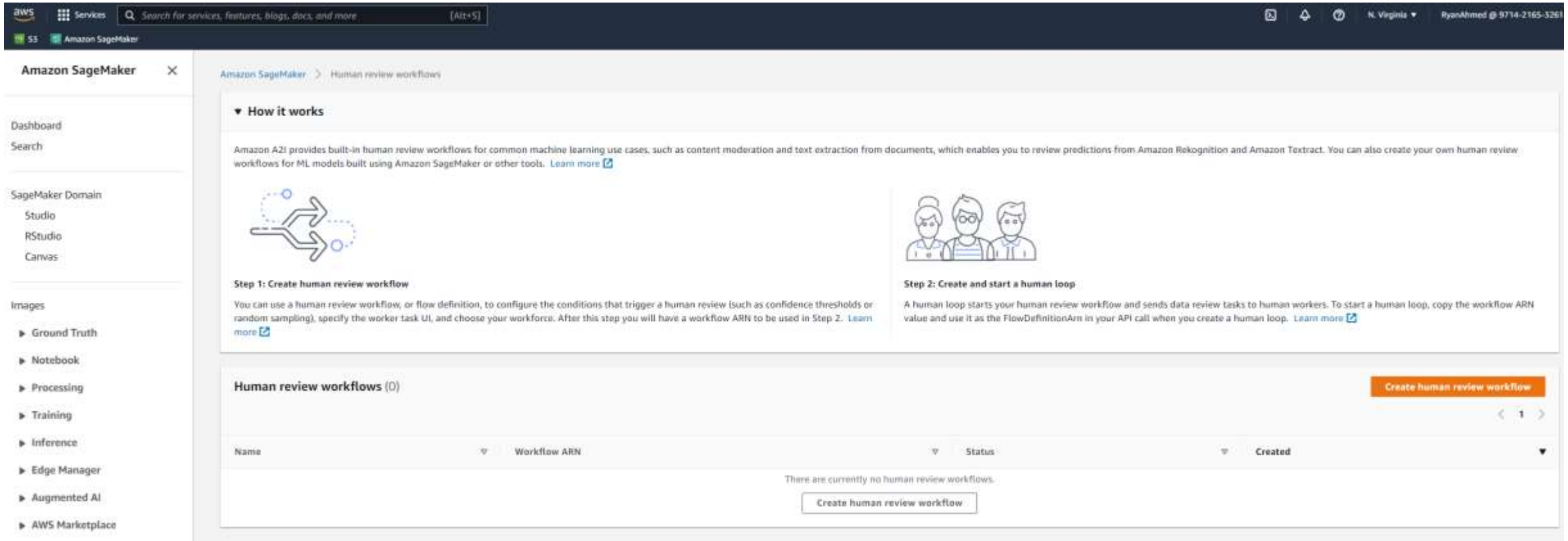
DEMO: AWS SAGEMAKER

AFTER YOU CLICK ON CREATE ENDPOINT, YOU CAN CONFIGURE THE ENDPOINT HERE!



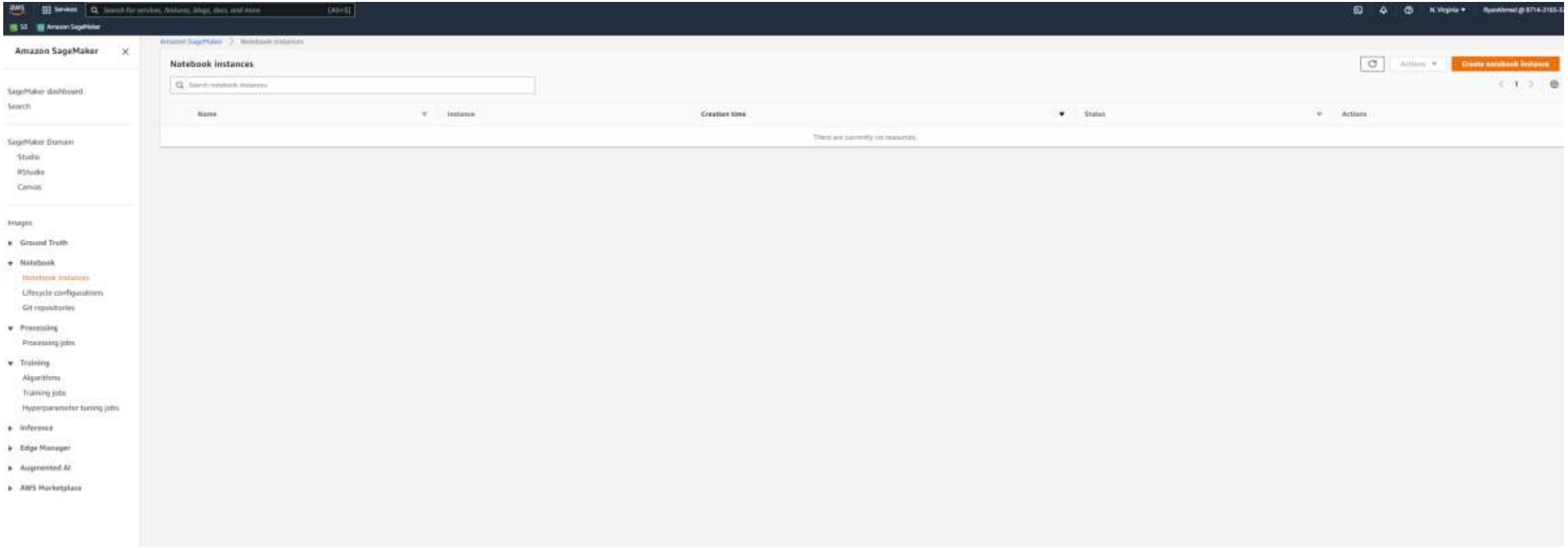
DEMO: AWS SAGEMAKER

CLICK ON AUGEMENTED AI WHICH PROVIDES BUILT-IN HUMAN REVIEWS FOR ML WORKFLOWS.



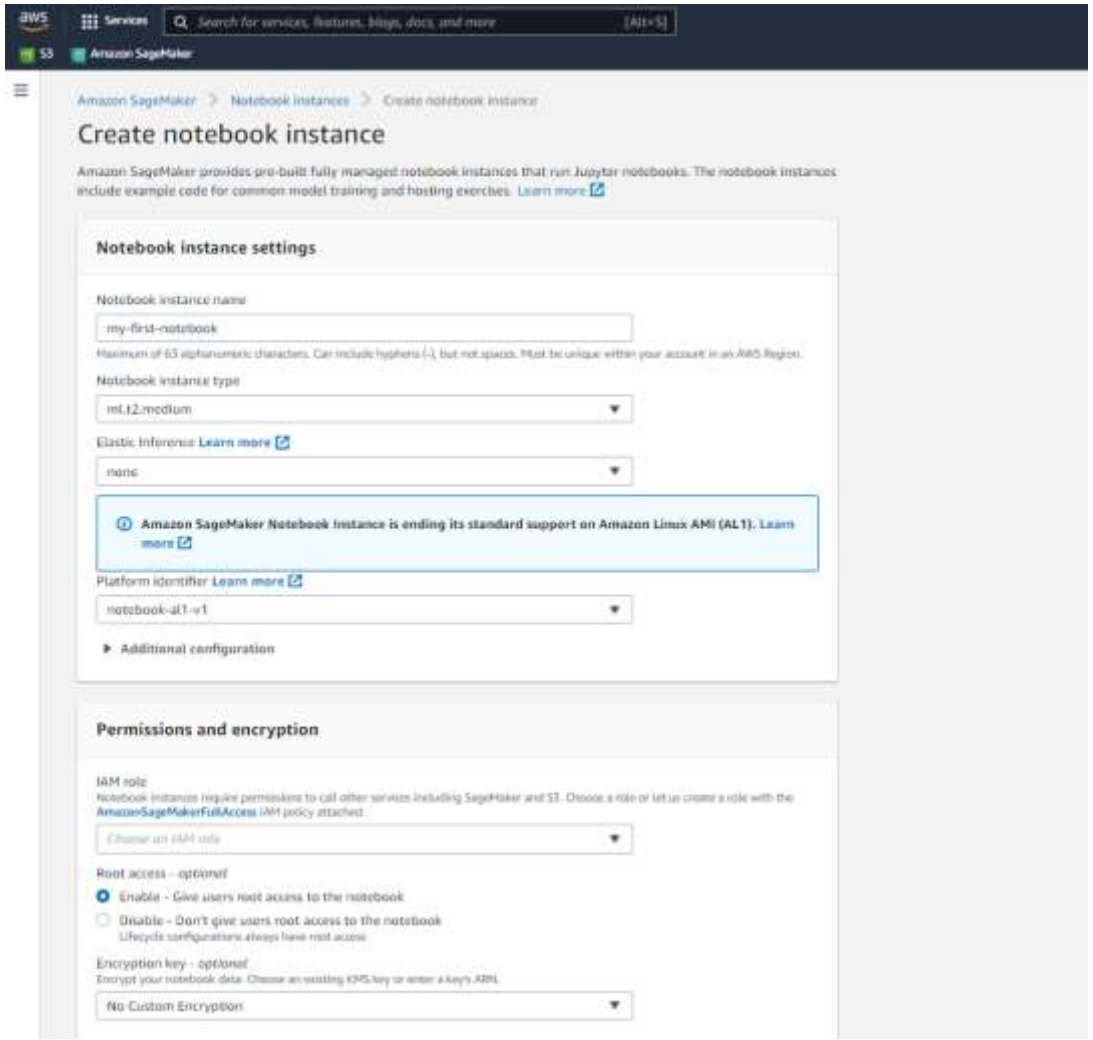
DEMO: AWS SAGEMAKER

CLICK ON NOTEBOOK INSTANCES AND CLICK ON CREATE NOTEBOOK INSTANCE



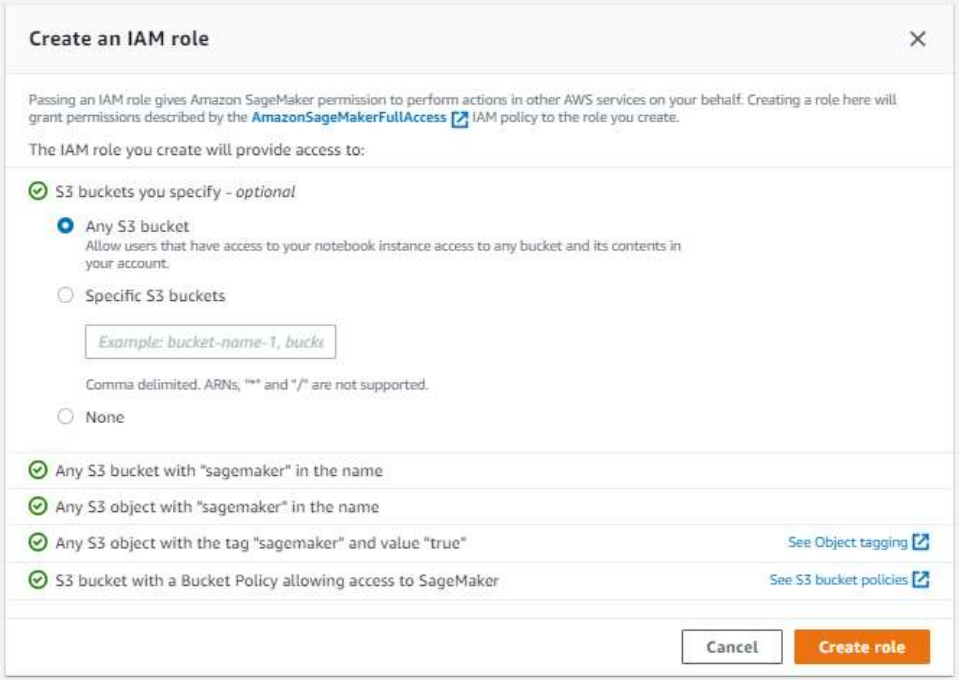
DEMO: AWS SAGEMAKER

PROVIDE A NAME AND SELECT INSTANCE TYPE. NOTE THAT YOU CAN ENABLE ELASTIC INFERENCE. ELASTIC INFERENCE (EI) CAN SPEED UP THE THROUGHPUT AND DECREASE THE LATENCY AT A FRACTION OF THE COST OF USING A DEDICATED GPU INSTANCE.



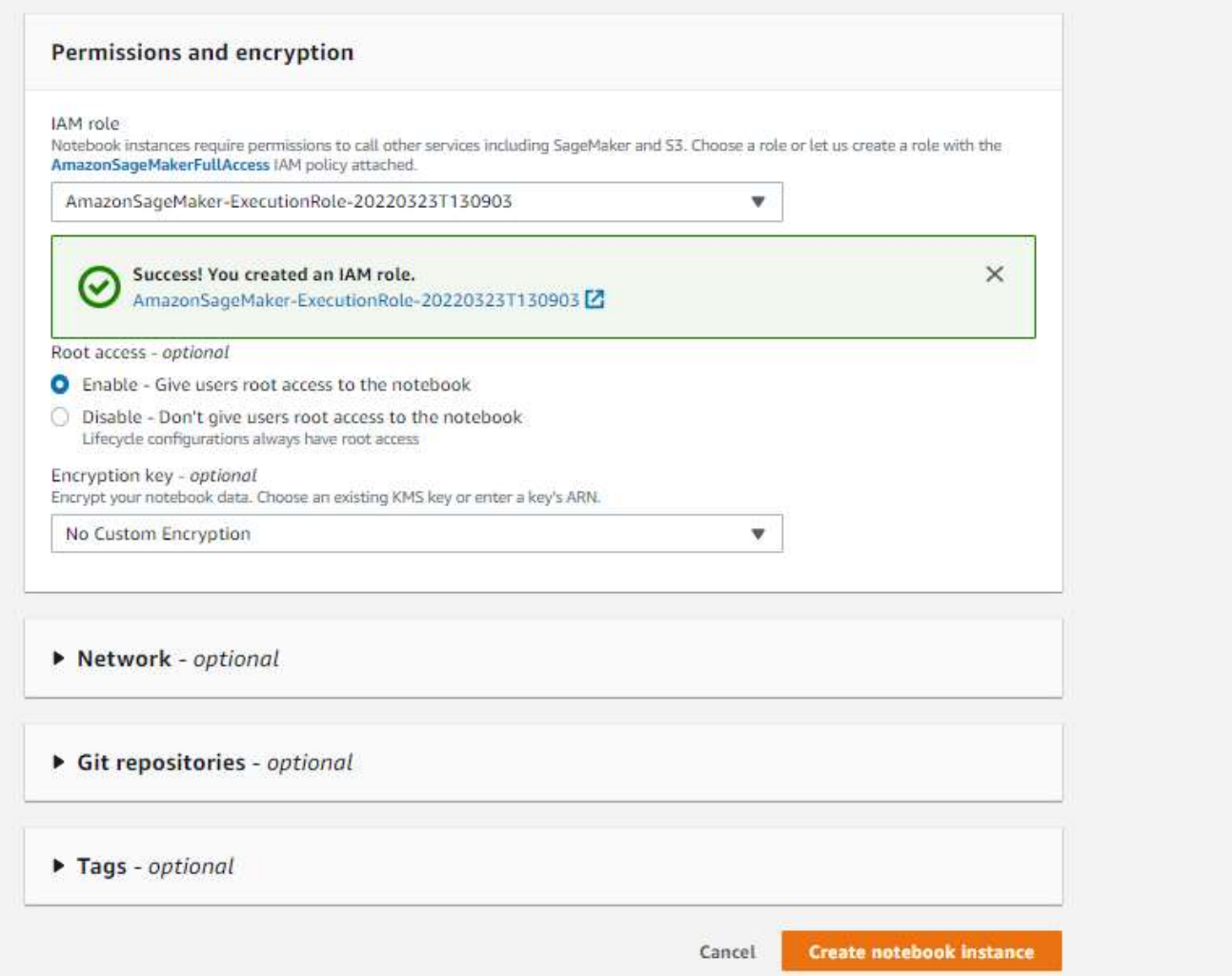
DEMO: AWS SAGEMAKER

CREATE A NEW IAM ROLE THAT CAN ACCESS ANY S3 BUCKET. CLICK ON CREATE ROLE.



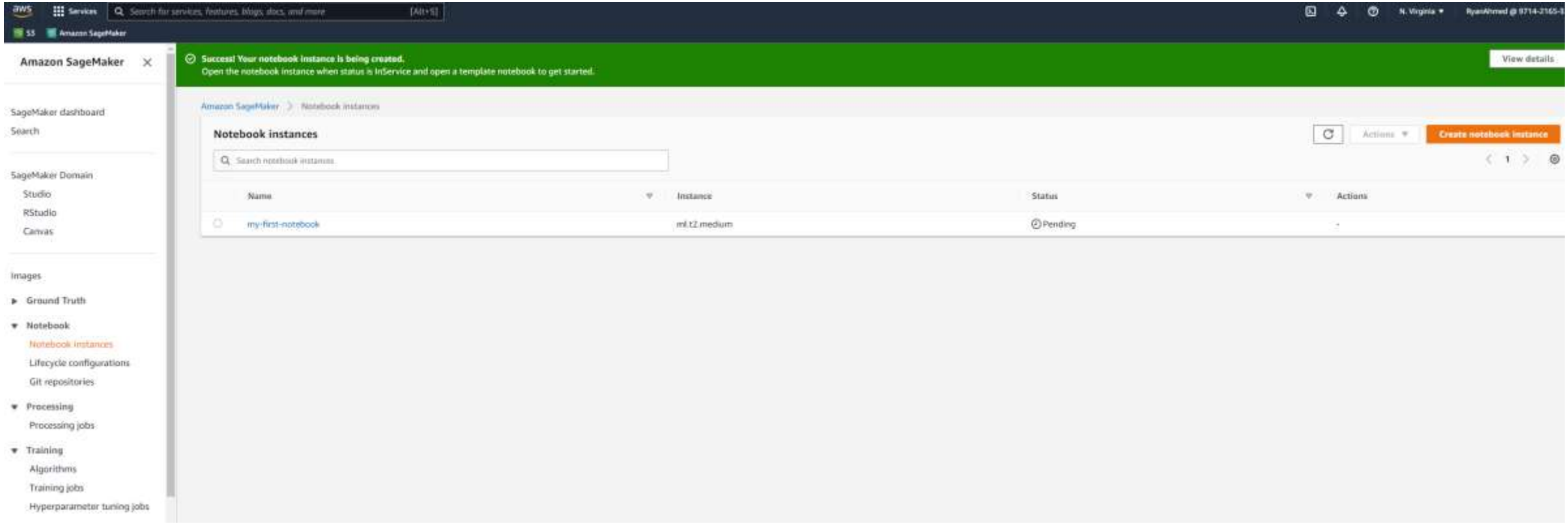
DEMO: AWS SAGEMAKER

NOW THE ROLE IS CREATED! CLICK ON CREATE NOTEBOOK INSTANCE.



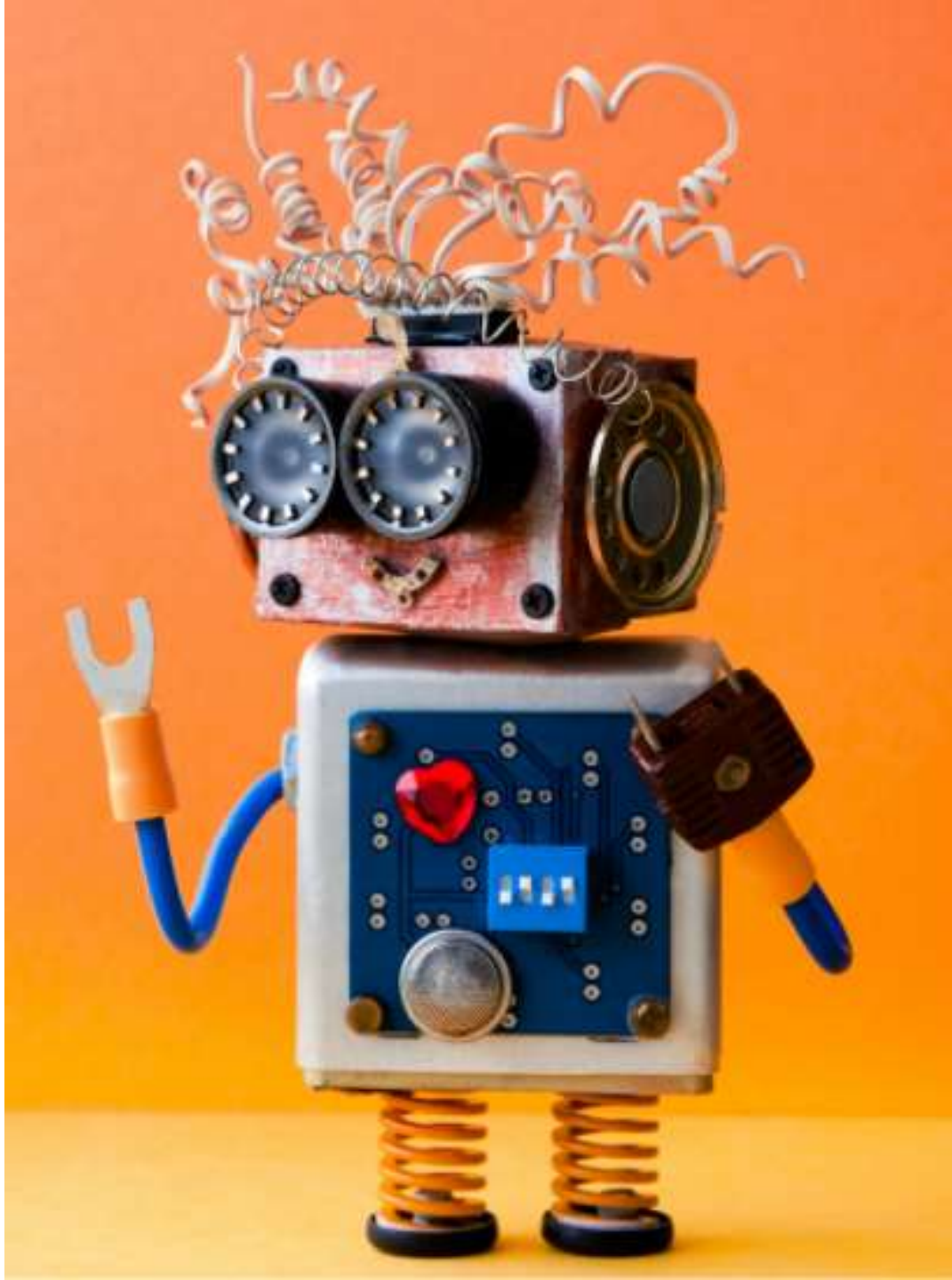
DEMO: AWS SAGEMAKER

THE NOTEBOOK INSTANCE IS NOW BEING CREATED. NOTE THAT YOU MUST TERMINATE THE INSTANCE TO AVOID INCURRING ANY CHARGES IN THE FUTURE.



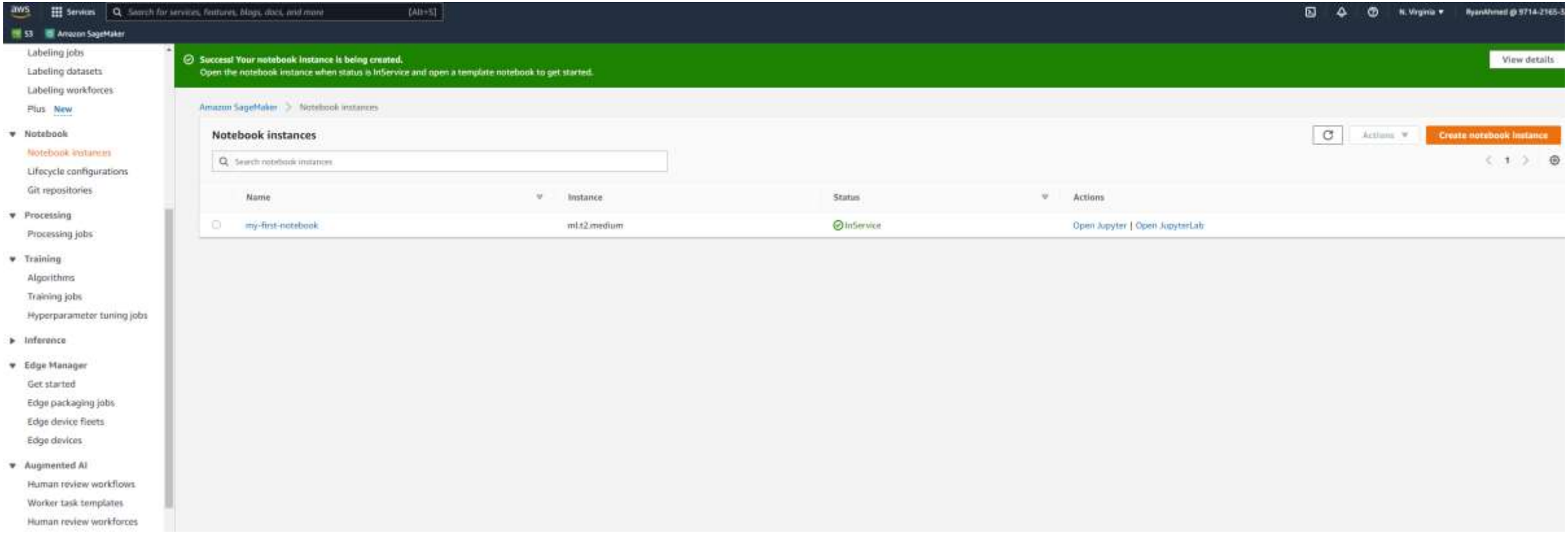
AWS SAGEMAKER DEMO – PART #2 (WRITE YOUR FIRST CODE & TERMINATE INSTANCE)

EASY ADVANCED



DEMO: AWS SAGEMAKER

NOW THE INSTANCE SHOWS IN-SERVICE,
CLICK ON OPEN JUPYTER

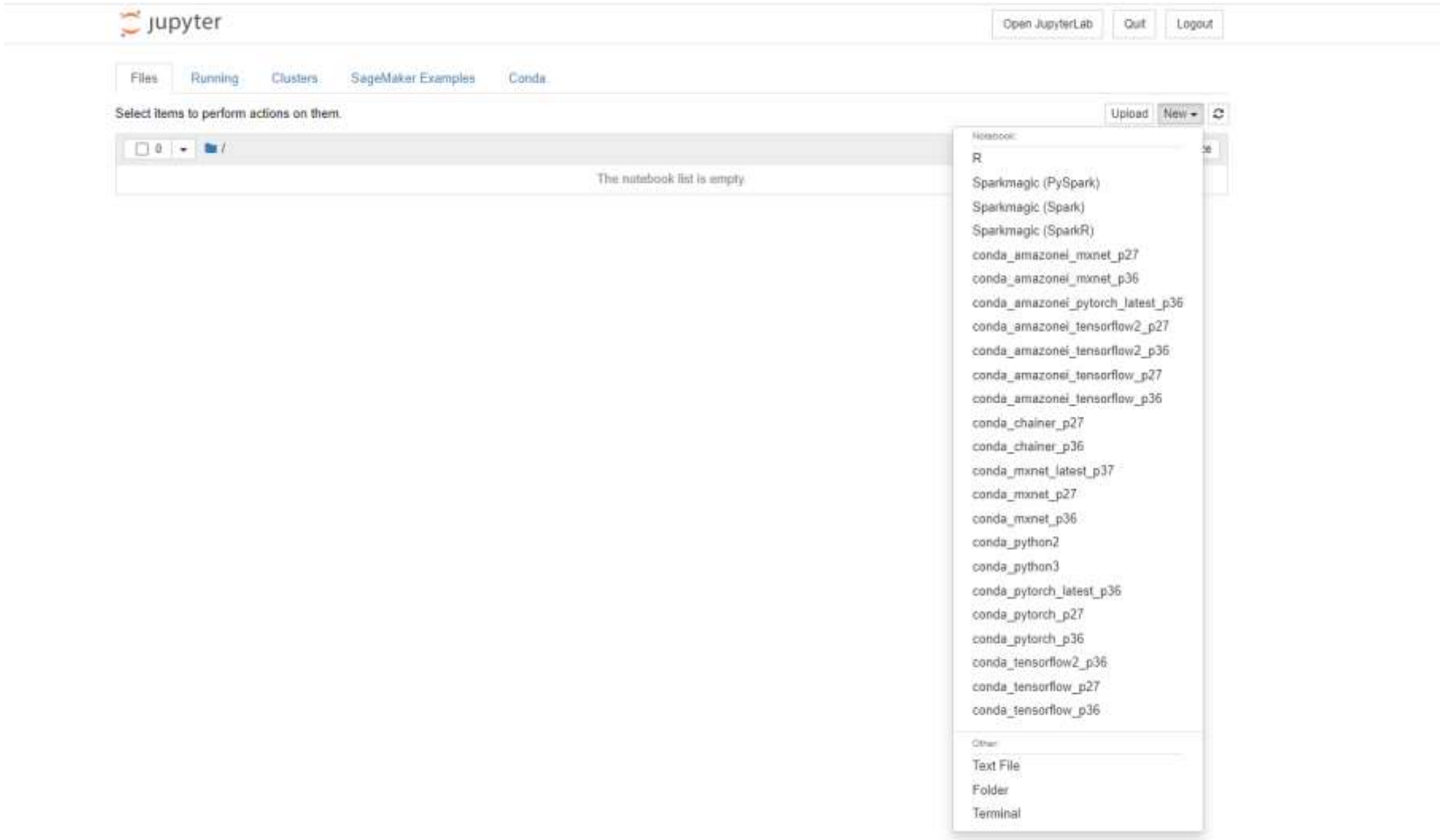


DEMO: AWS SAGEMAKER

NOW YOU CAN CLICK ON NEW TO CREATE A NEW NOTEBOOK

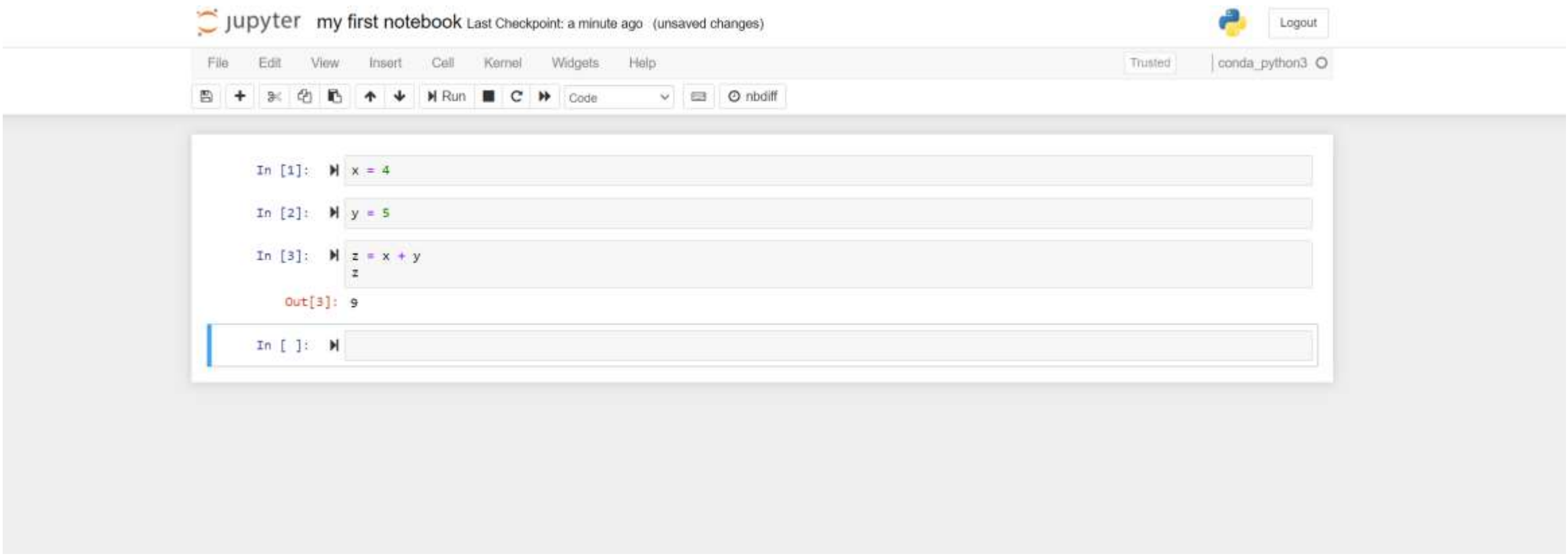
DEMO: AWS SAGEMAKER

SELECT CONDA_PYTHON3



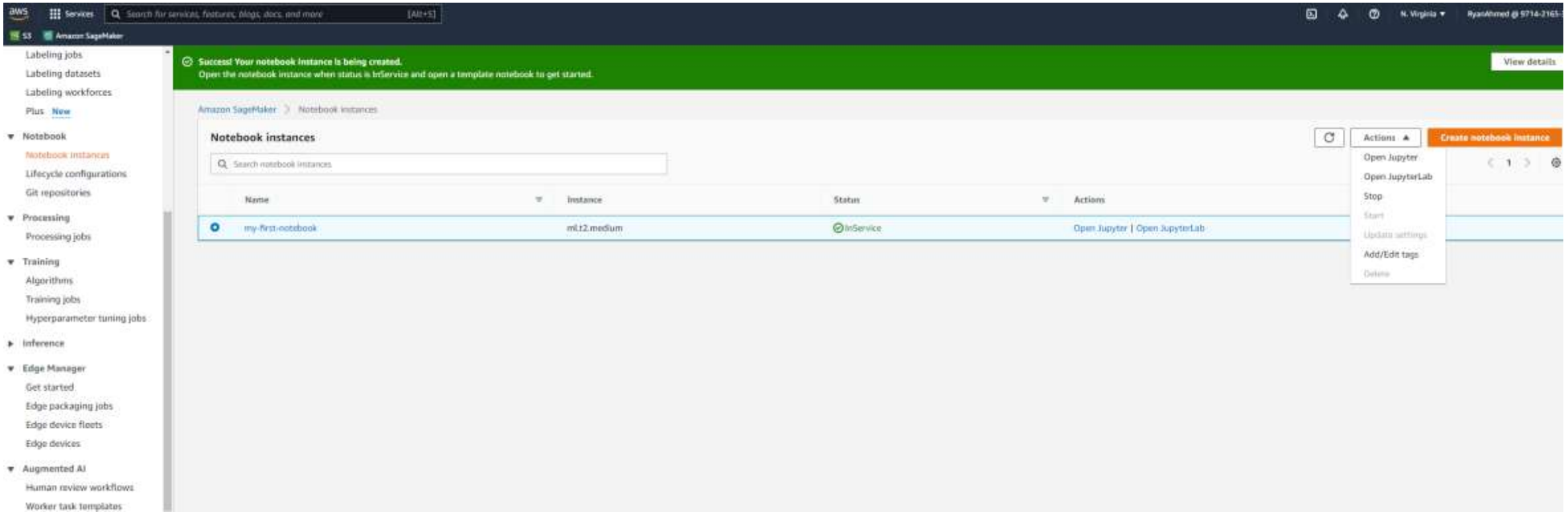
DEMO: AWS SAGEMAKER

WRITE YOUR FIRST CODE



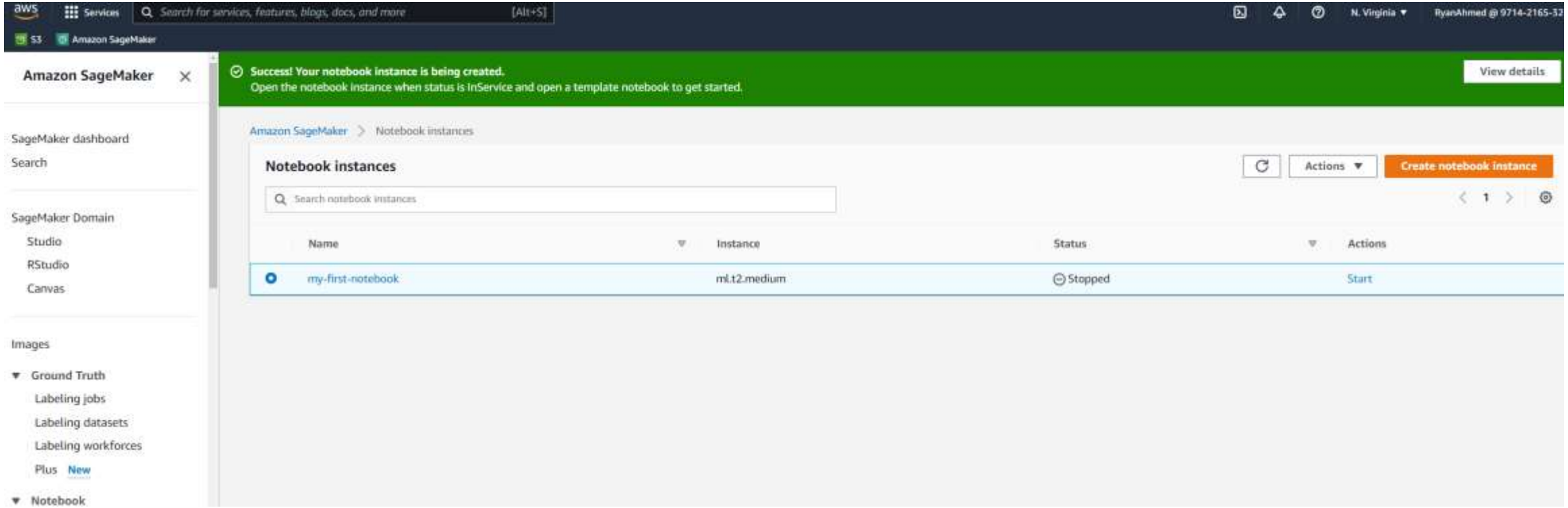
DEMO: AWS SAGEMAKER

TERMINATE THE INSTANCE BY SELECTING
ACTIONS THEN STOP **[IMPORTANT]**

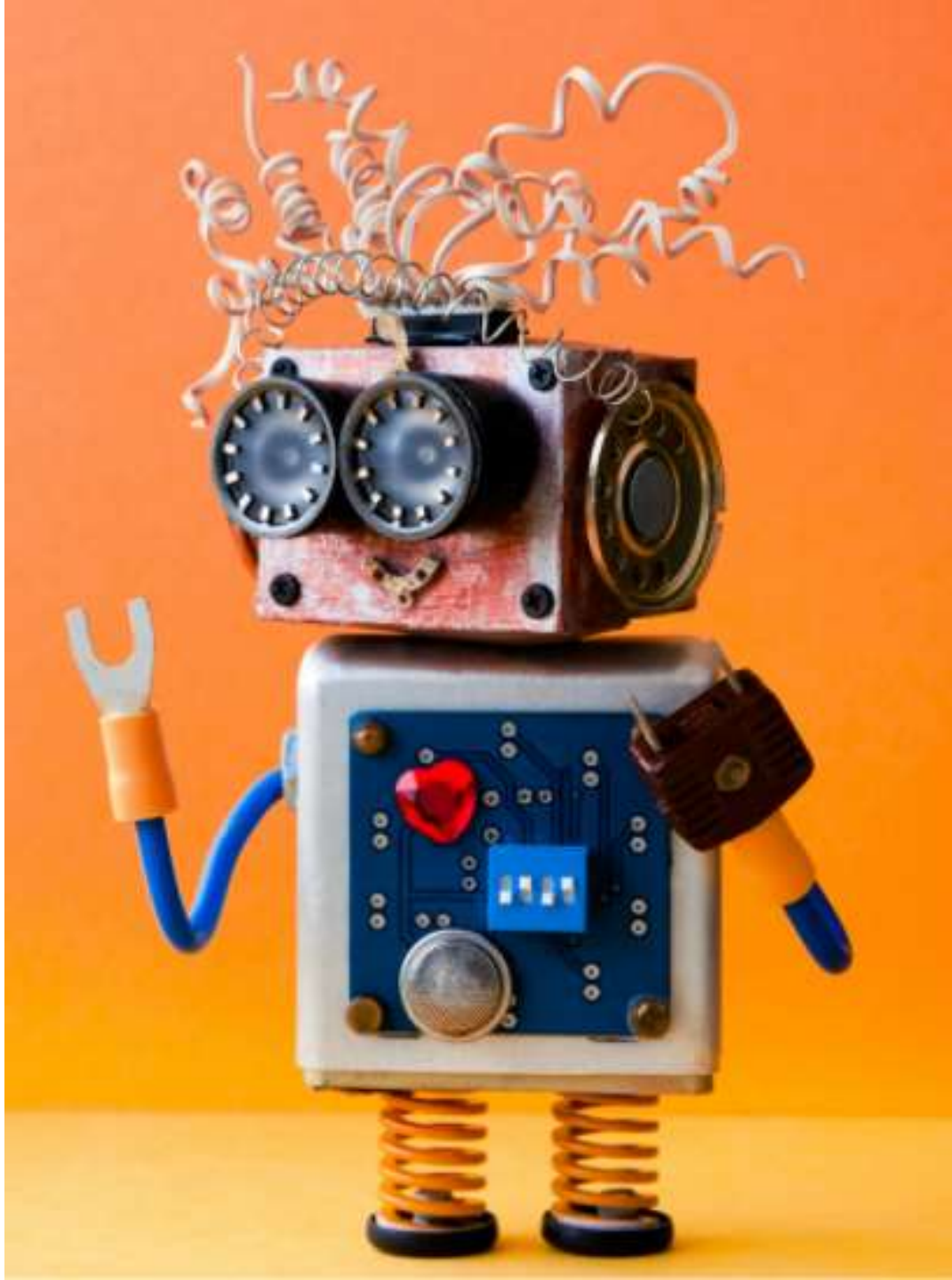


DEMO: AWS SAGEMAKER

NOW IT SHOWS STOPPED. YOU THEN CLICK ON ACTIONS AND DELETE THE INSTANCE.

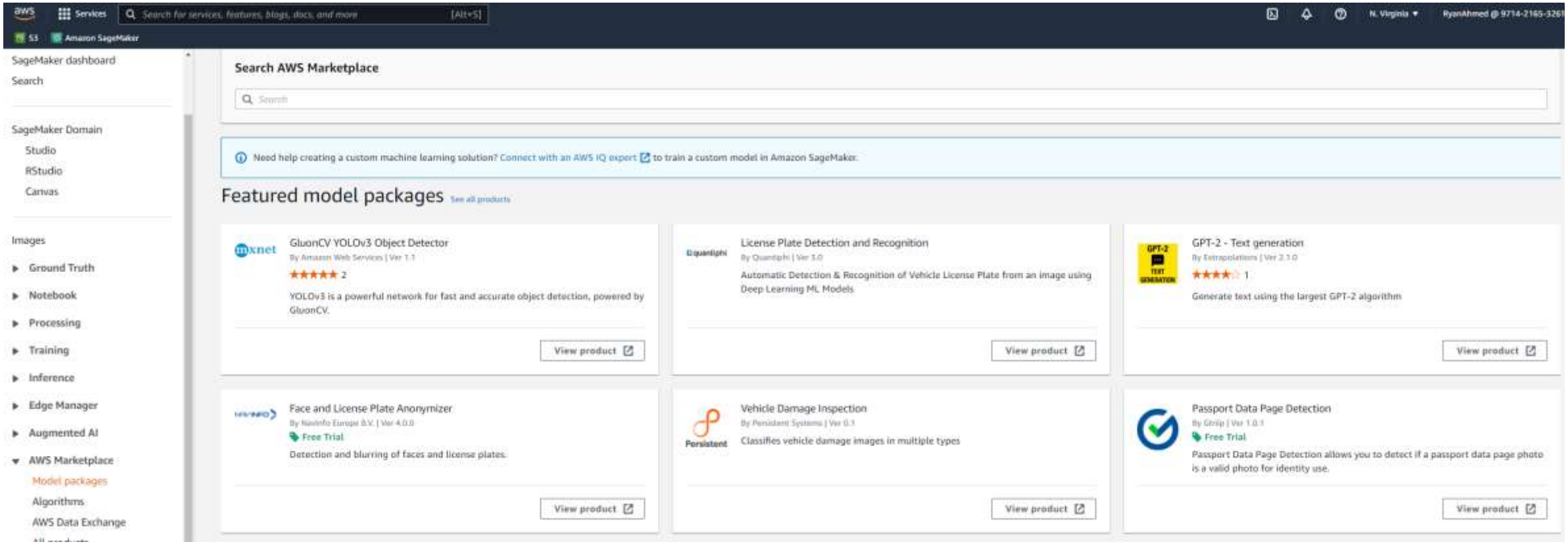


AWS SAGEMAKER DEMO – PART #3 (MARKETPLACE TUTORIAL)



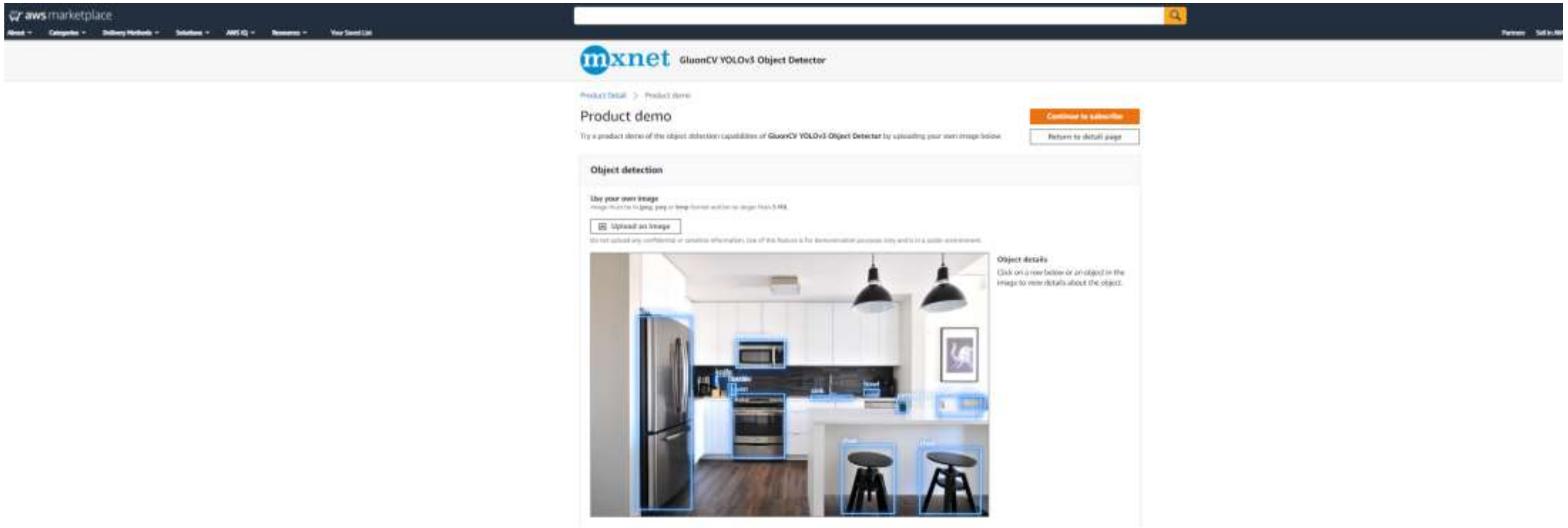
DEMO: AWS SAGEMAKER

NAVIGATE TO AWS MARKETPLACE AND SELECT MODEL PACKAGES.
THESE ARE PRETRAINED MODELS THAT ARE READY TO USE!



DEMO: AWS SAGEMAKER

LET'S TRY A SAMPLE MODEL FROM THE AWS MARKETPLACE

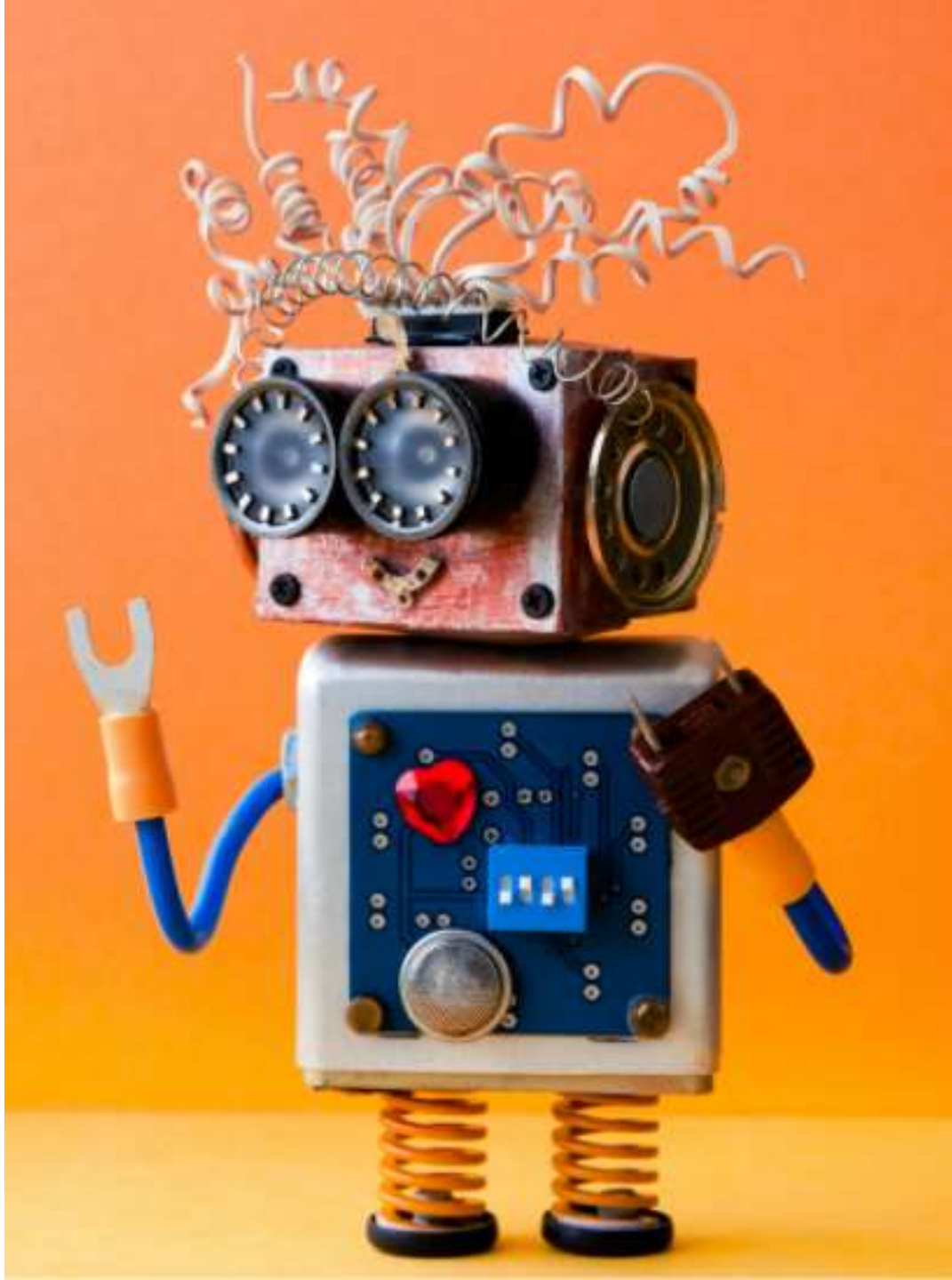


DEMO: AWS SAGEMAKER

LET'S TRY A SAMPLE MODEL FROM THE AWS MARKETPLACE

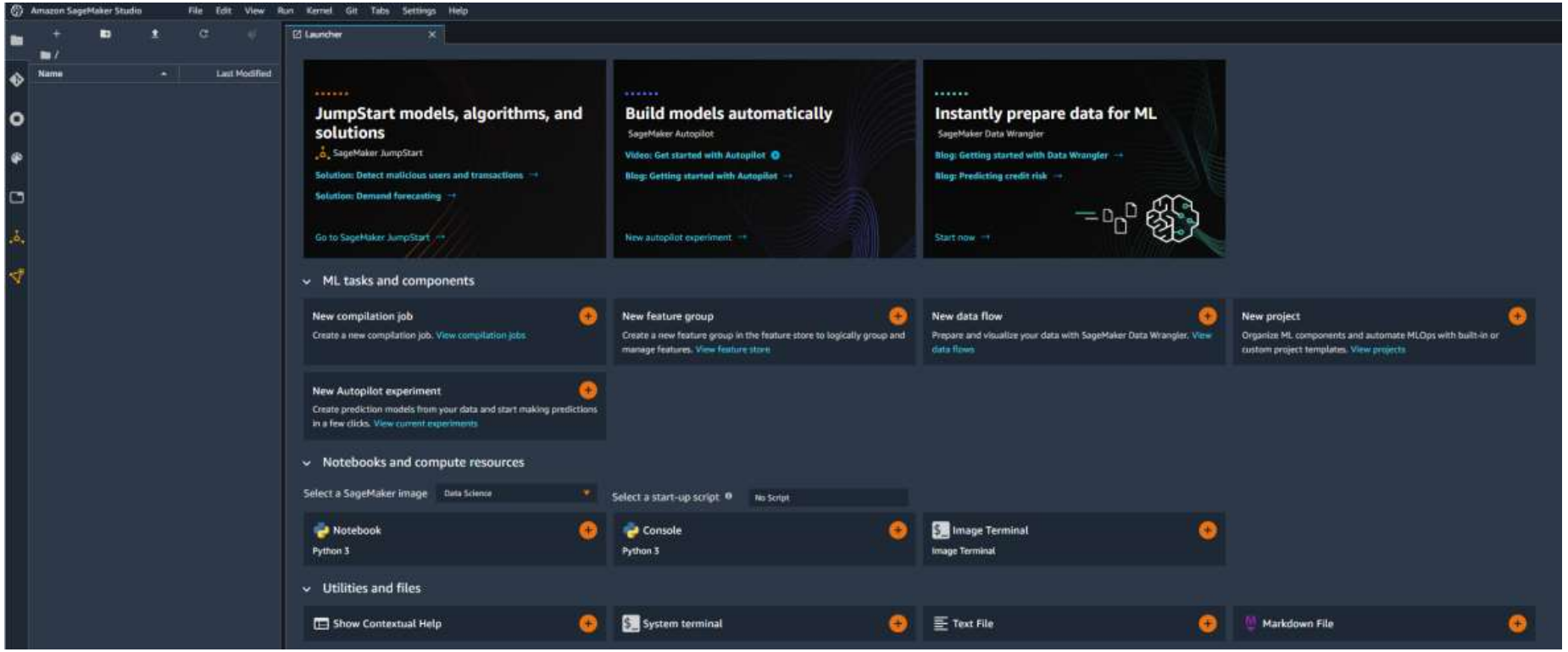
AWS SAGEMAKER DEMO – PART #4 (SAGEMAKER STUDIO)

EASY ADVANCED



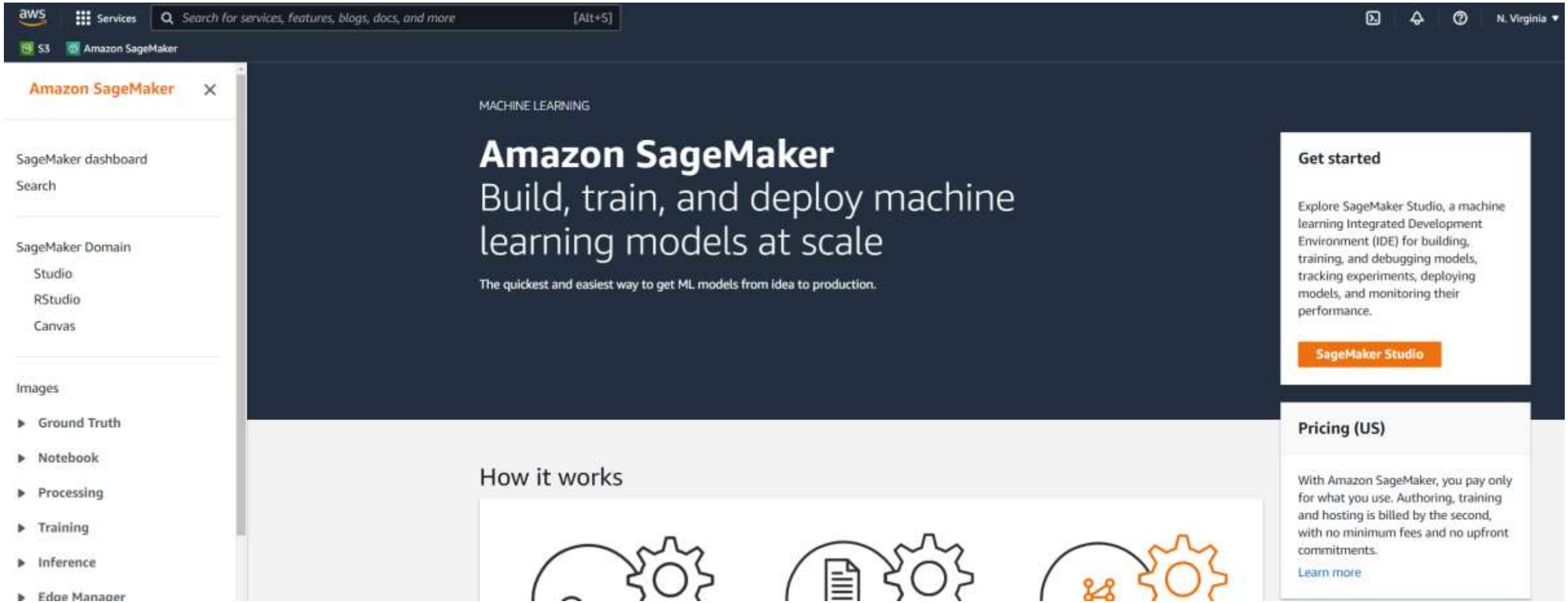
DEMO: AWS SAGEMAKER

- Amazon SageMaker Studio is a web-based visual interface where developers can build, train and deploy AI/ML models in one place!
- SageMaker Studio enhances productivity by 10x since it offers much higher visibility and control compared to regular notebook instances.
- Developers can manage experiments, debug ML models, monitor models for bias and drift in SageMaker Studio.



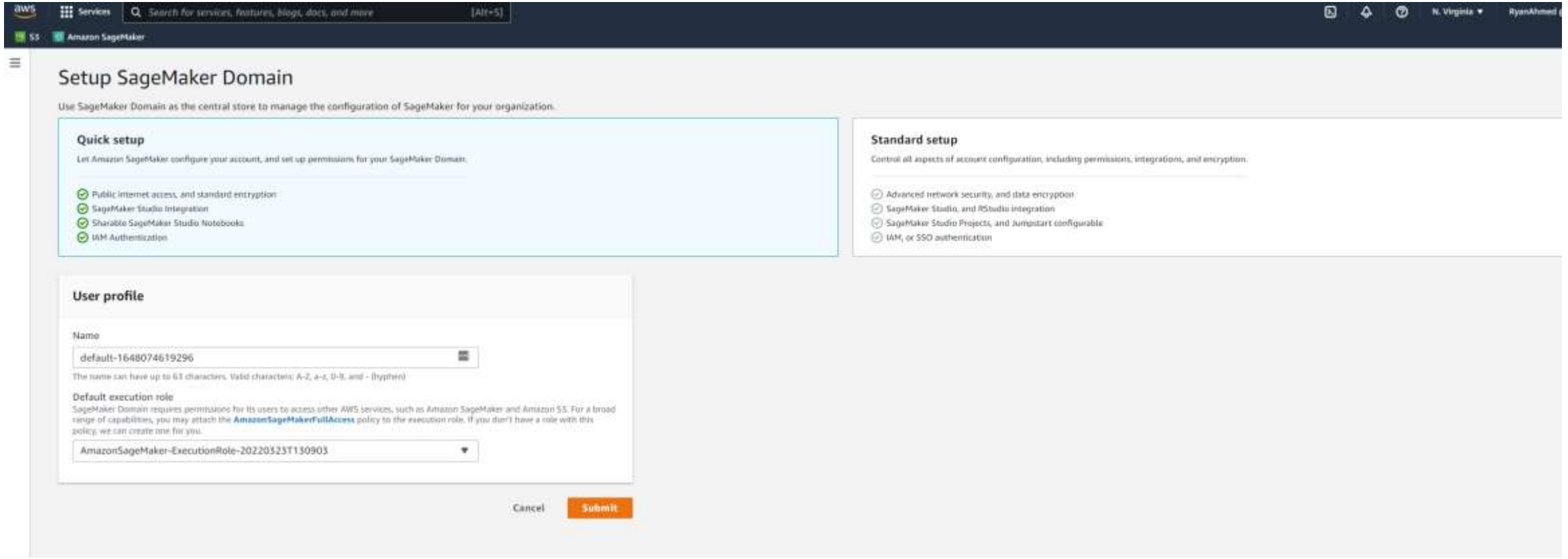
DEMO: AWS SAGEMAKER

CLICK ON SAGEMAKER STUDIO



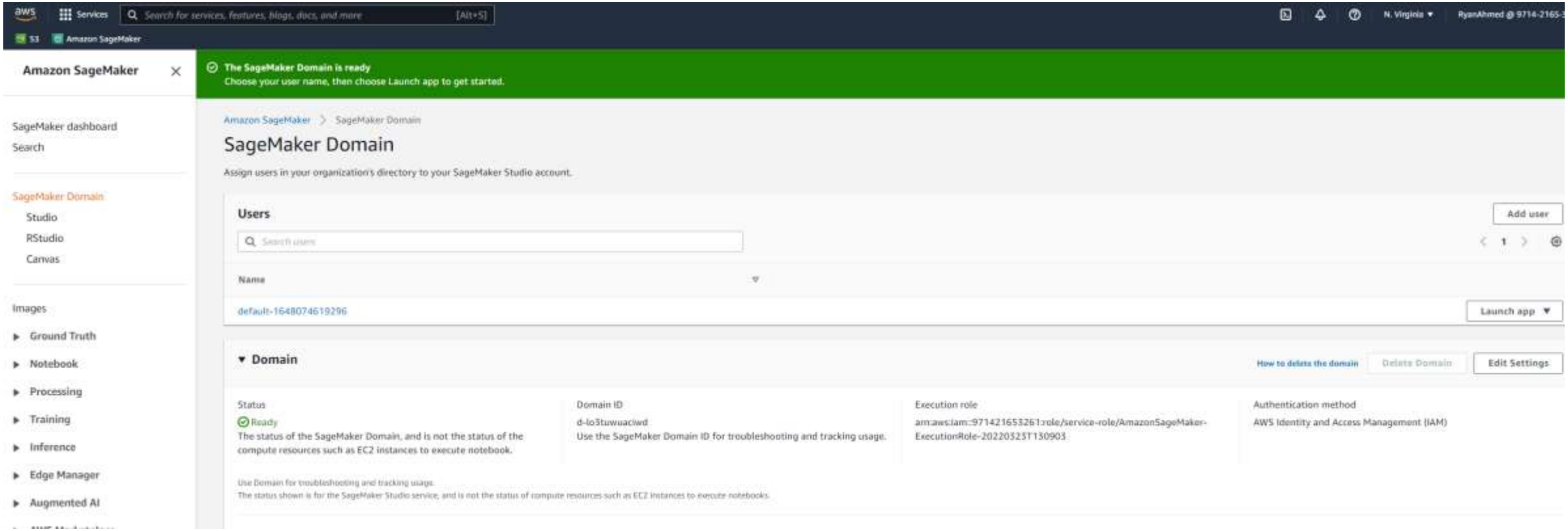
DEMO: AWS SAGEMAKER

YOU WILL NEED TO SETUP A SAGEMAKER DOMAIN. KEEP EVERYTHING AS DEFAULT AND CLICK SUBMIT.



DEMO: AWS SAGEMAKER

SAGEMAKER DOMAIN IS NOW CREATED AND READY. CLICK ON LAUNCH APP AND THEN STUDIO.

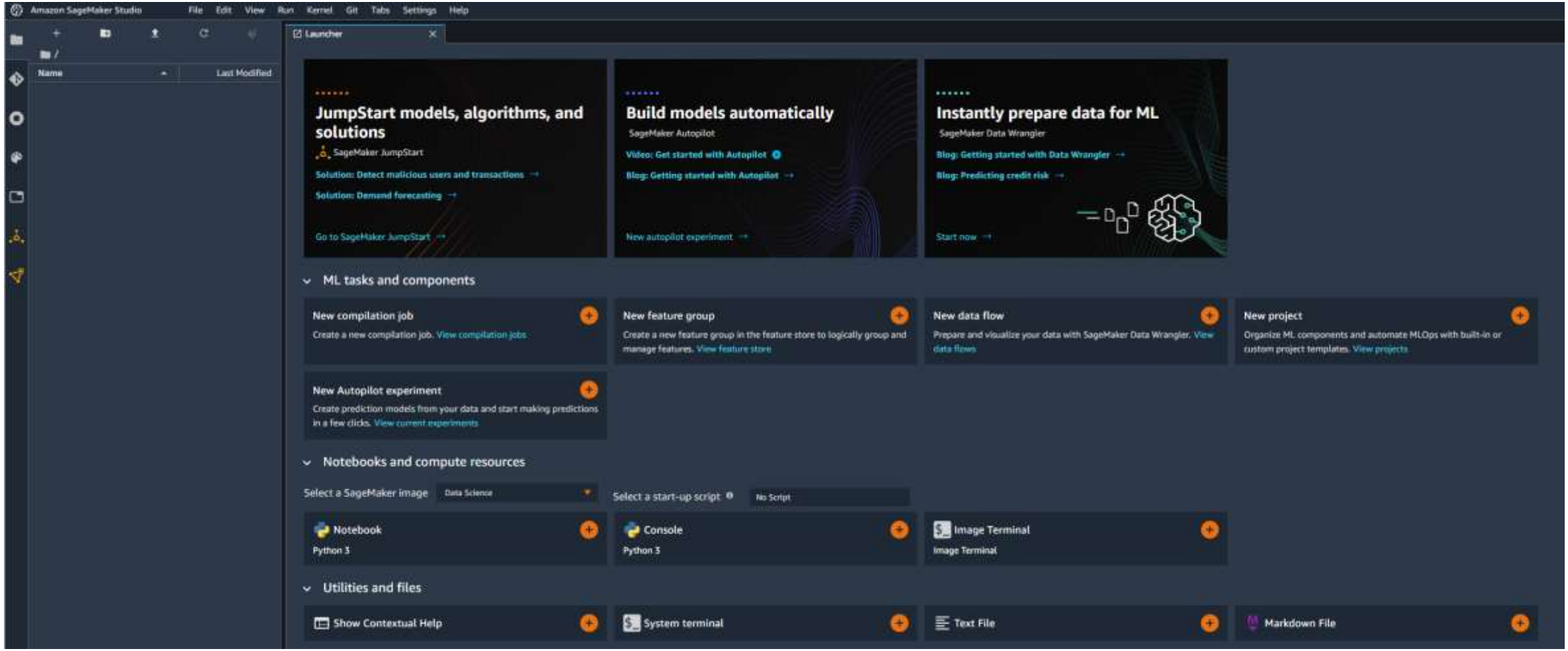


DEMO: AWS SAGEMAKER

YOU SHOULD SEE THE SAGEMAKER STUDIO
JUPYTER SERVER STARTING UP

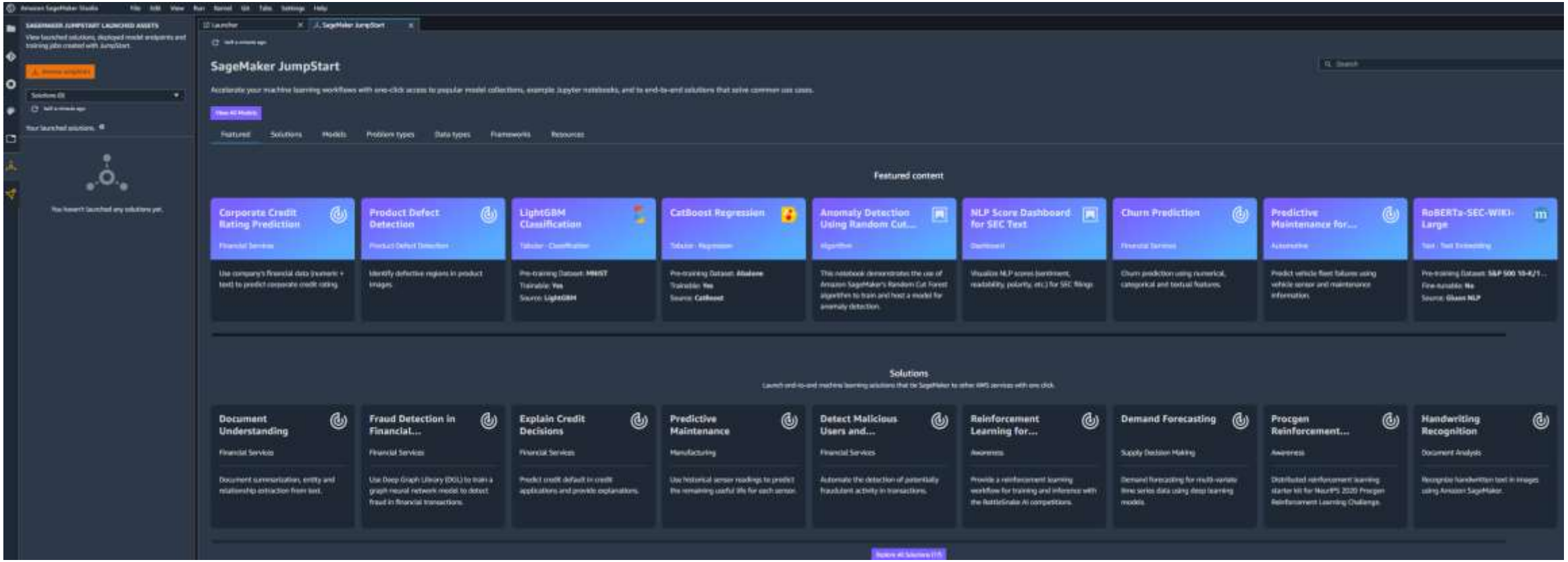
DEMO: AWS SAGEMAKER

WELCOME TO SAGEMAKER STUDIO



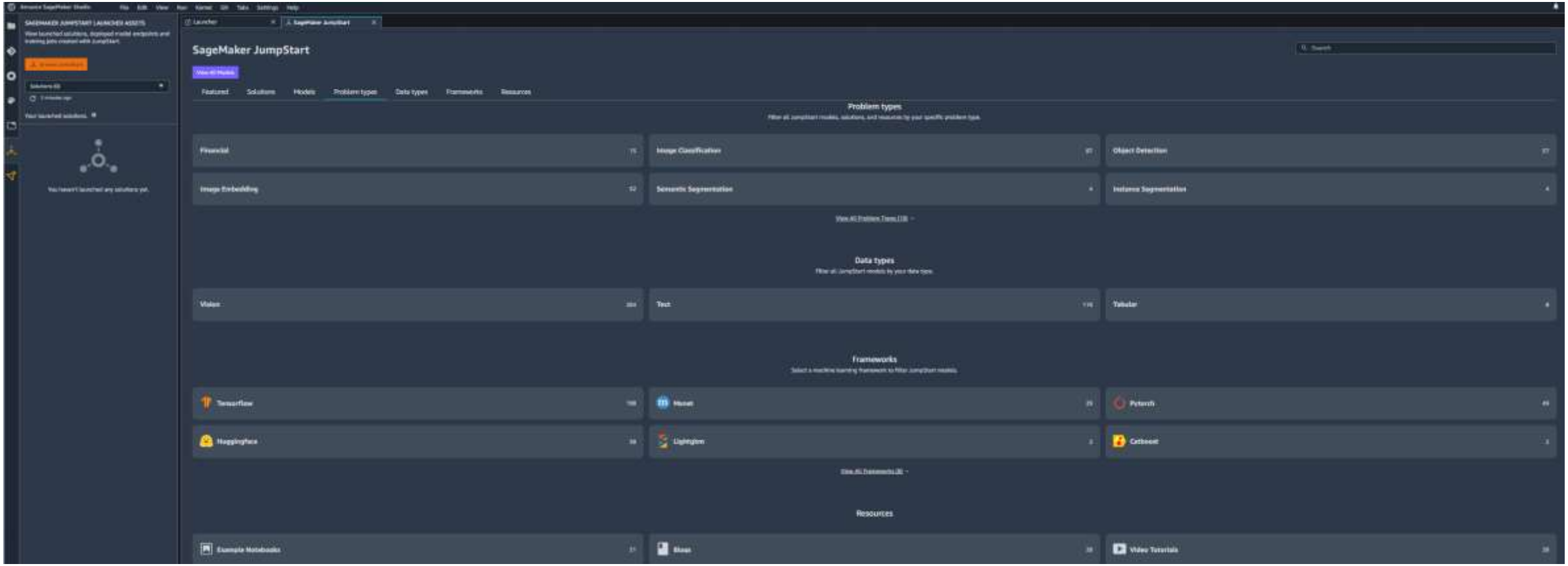
DEMO: AWS SAGEMAKER

CLICK ON JUMSTART



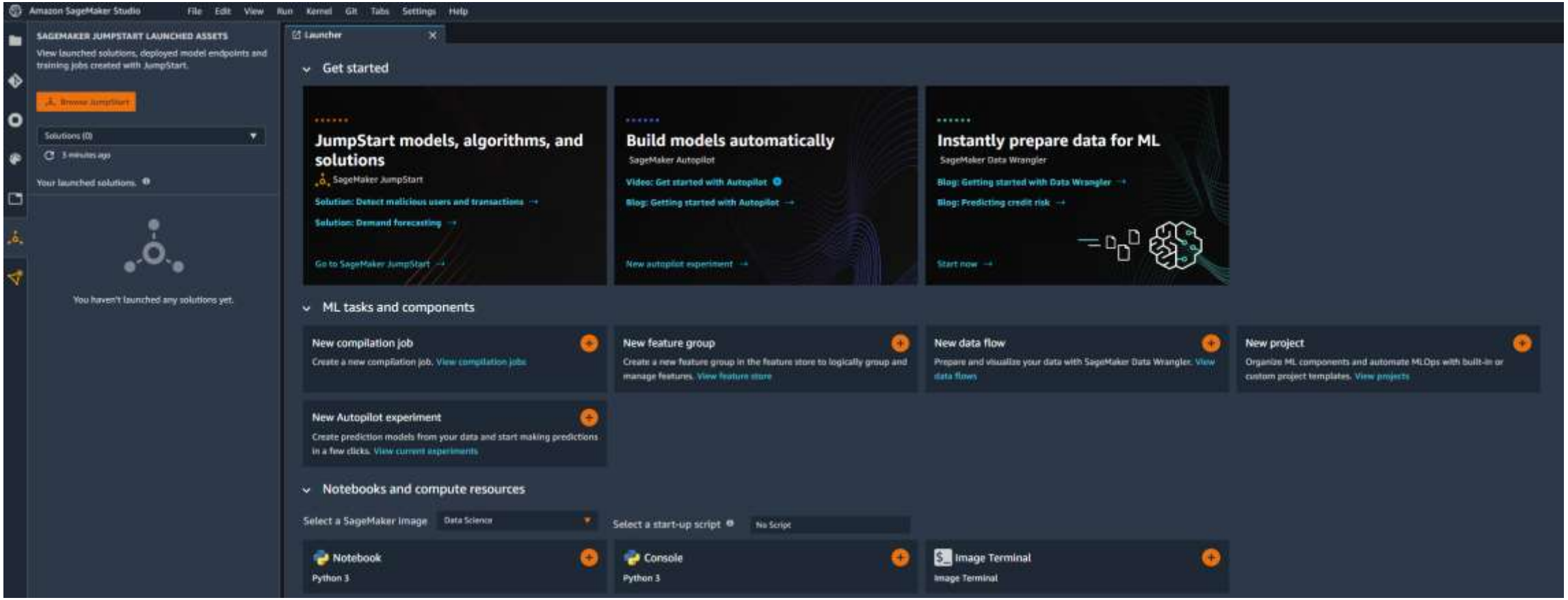
DEMO: AWS SAGEMAKER

YOU WILL FIND MANY MODELS GROUPED BASED ON DATA TYPES, PROBLEM TYPES, AND FRAMEWORKS



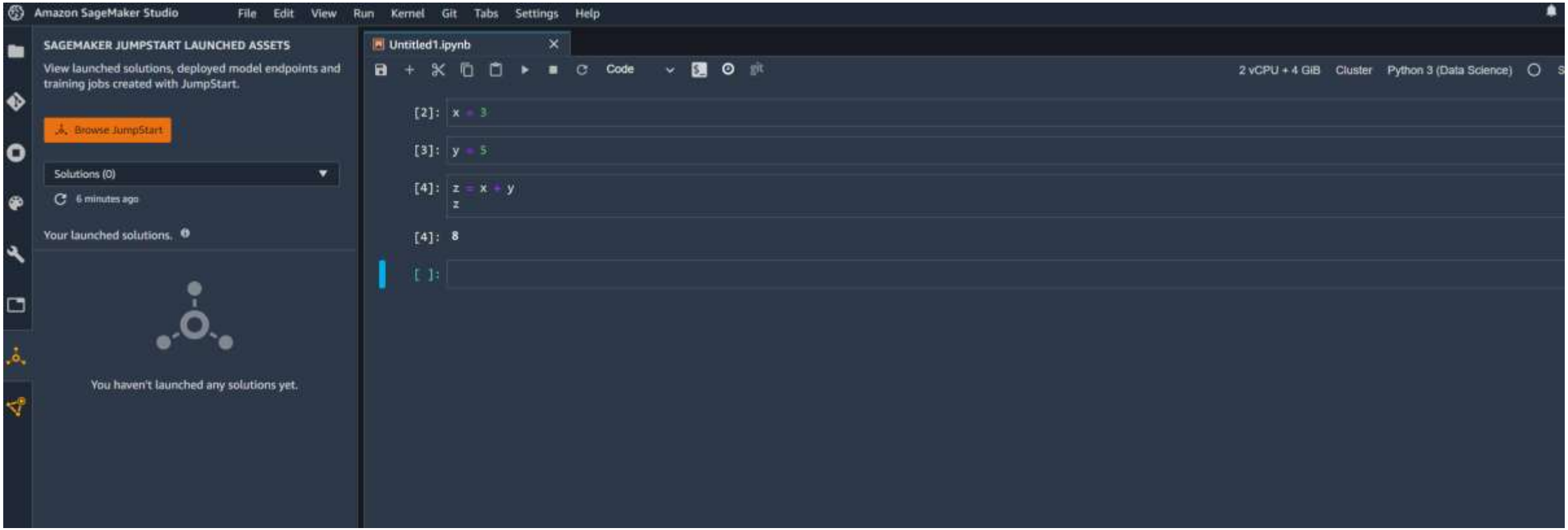
DEMO: AWS SAGEMAKER

CLICK ON NOTEBOOK TO LAUNCH A JUPYTER NOTEBOOK



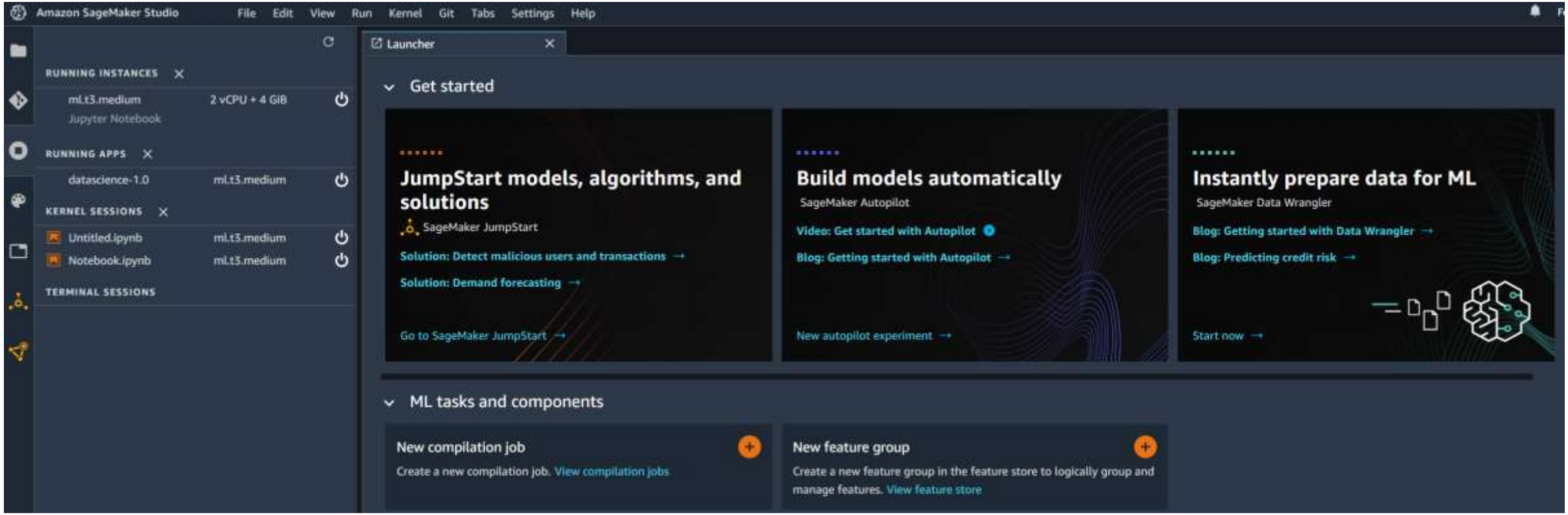
DEMO: AWS SAGEMAKER

RUN YOUR FIRST CODE IN SAGEMAKER STUDIO



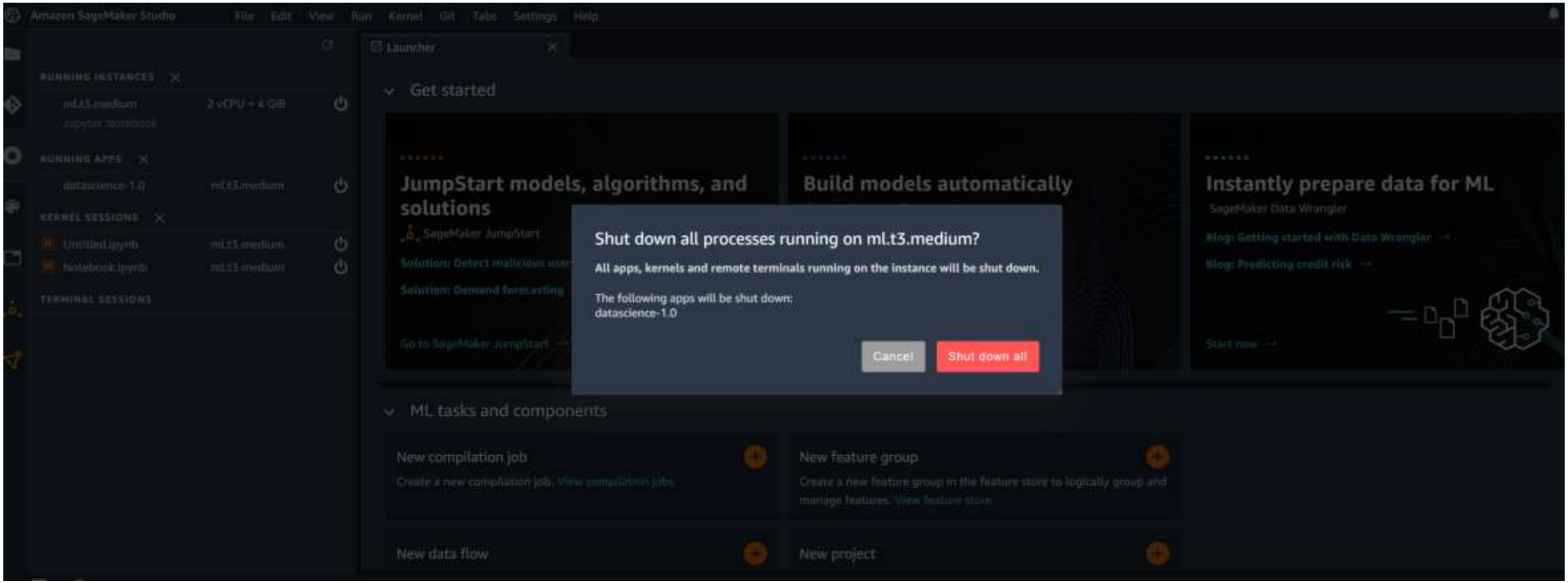
DEMO: AWS SAGEMAKER

TERMINATATION OF SAGEMAKER STUDIO IS DIFFERENT COMPARED TO A REGULAR SAGEMAKER INSTANCE. YOU WILL NEED TO CLIK ON POWER OFF BUTTON **[IMPORTANT]**.



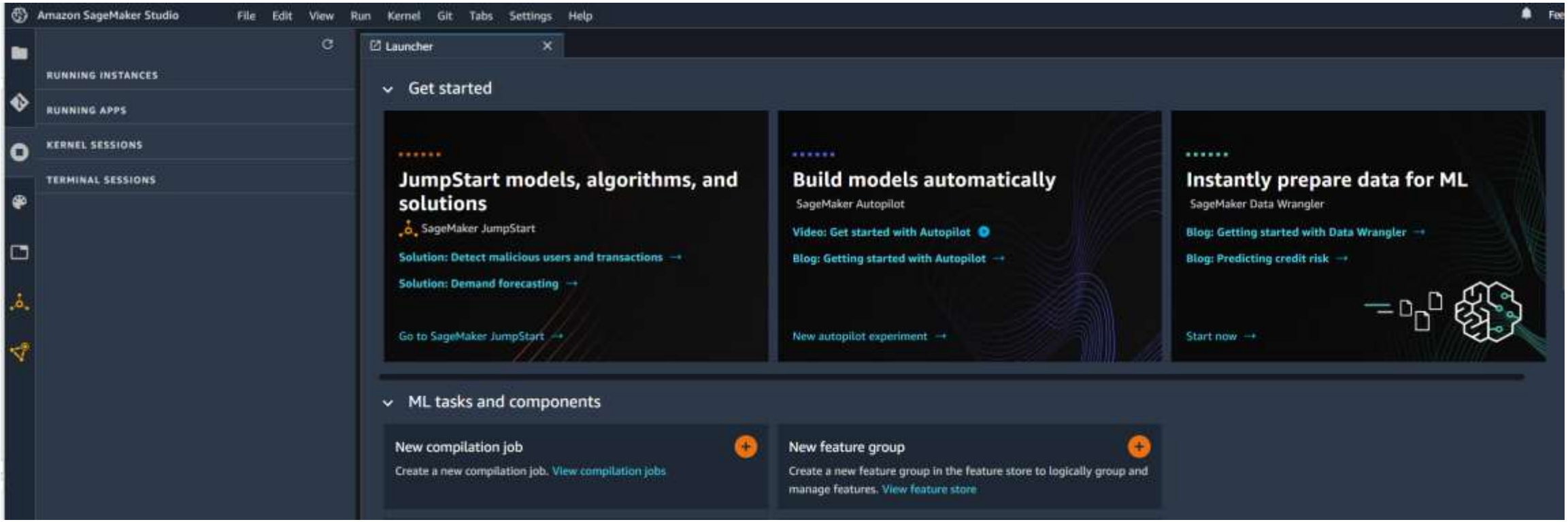
DEMO: AWS SAGEMAKER

CLICK ON SHUTDOWN ALL

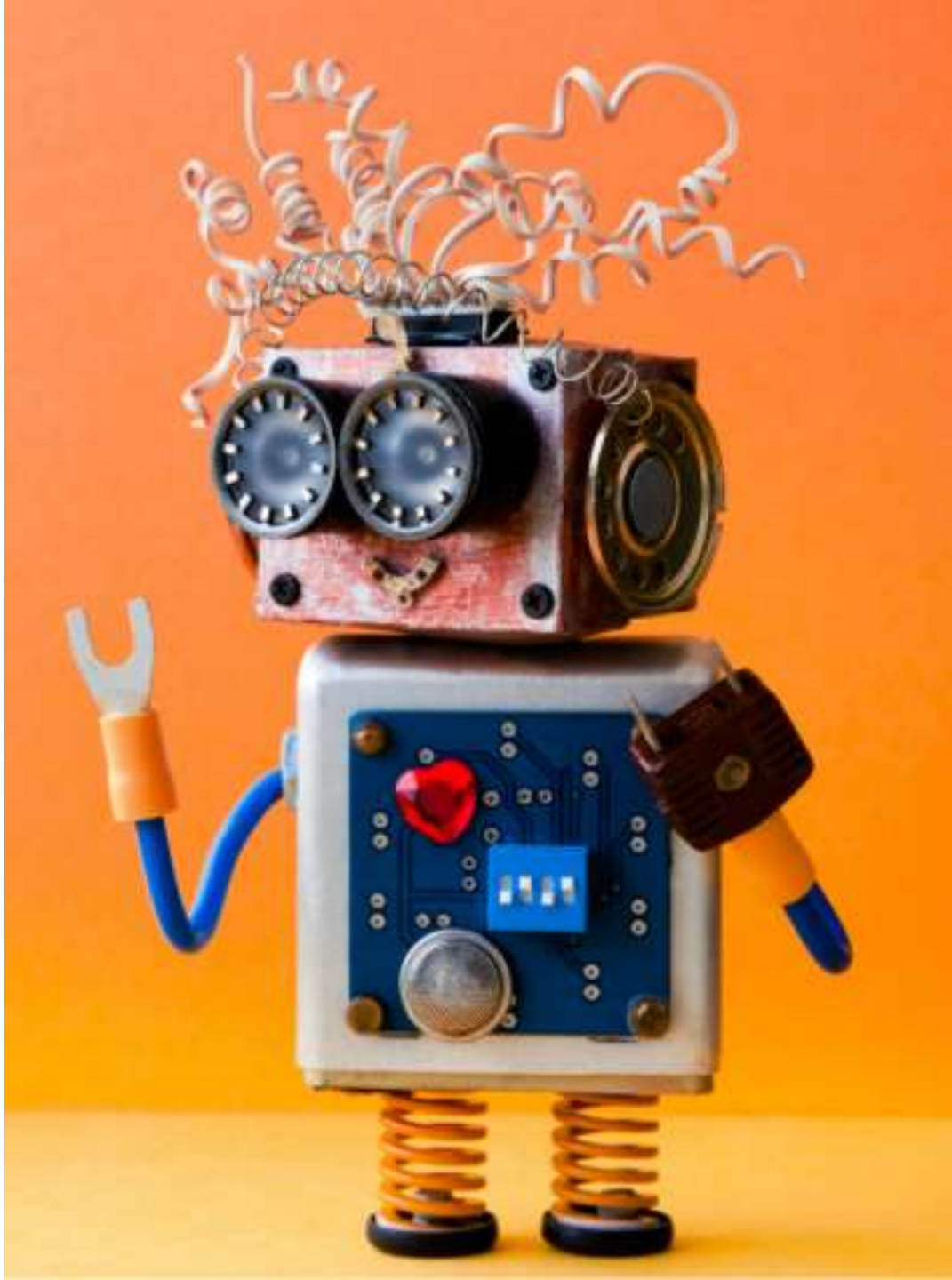


DEMO: AWS SAGEMAKER

NOW YOU'RE GOOD TO GO! NO ADDITIONAL CHARGES WILL BE INCURRED!



AWS SAGEMAKER DEMO – PART #5 (SAGEMAKER CANVAS OVERVIEW)



WHAT IS AWS SAGEMAKER CANVAS?

- AWS SageMaker Canvas empowers anyone to build, train and test a machine learning model without writing a single line of code!
- With AWS Canvas, anyone can:
  - Import data from S3 or any other source
  - Build an AI/ML model
  - Assess model performance
  - Perform inference and generate predictions
  - Export model to SageMaker Studio

- AWS SageMaker Canvas Documentation: https://aws.amazon.com/sagemaker/canvas/

PROJECT OVERVIEW: CONVERT °C TO °F

- In this project, we will train a simple machine learning model to convert temperatures from Celsius to Fahrenheit using Amazon SageMaker Canvas.
- SageMaker Canvas allows anyone to build powerful ML models without writing any code or having any prior knowledge with AI/ML.
- The equation is as follows:

$$T(°F) = T(°C) \times 9/5 + 32$$

- For Example, let's convert 0°C Celsius temperature to Fahrenheit:

$$T(°F) = (0°C \times 9/5) + 32 = 32°F$$

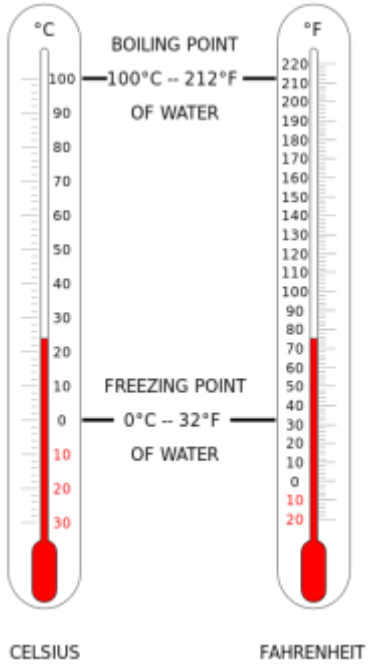
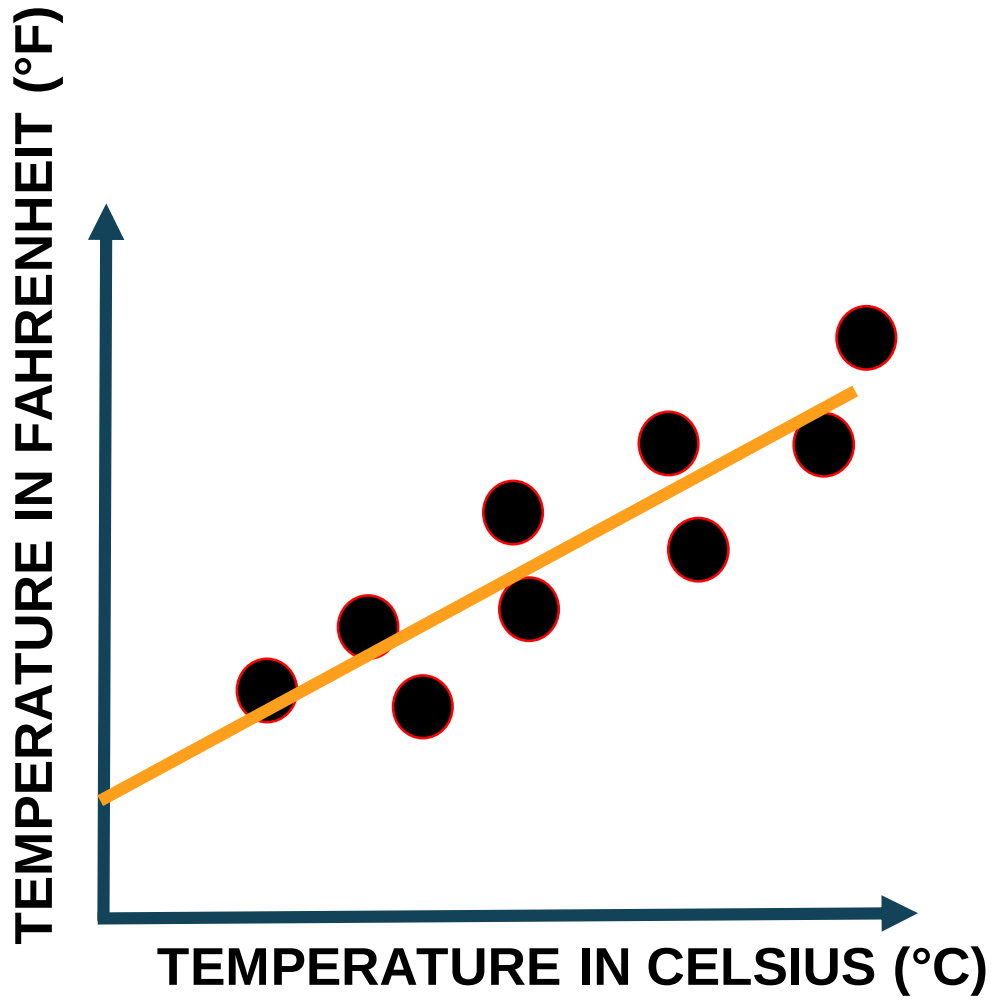


Image Source: https://commons.wikimedia.org/wiki/File:Thermometer_CF.svg

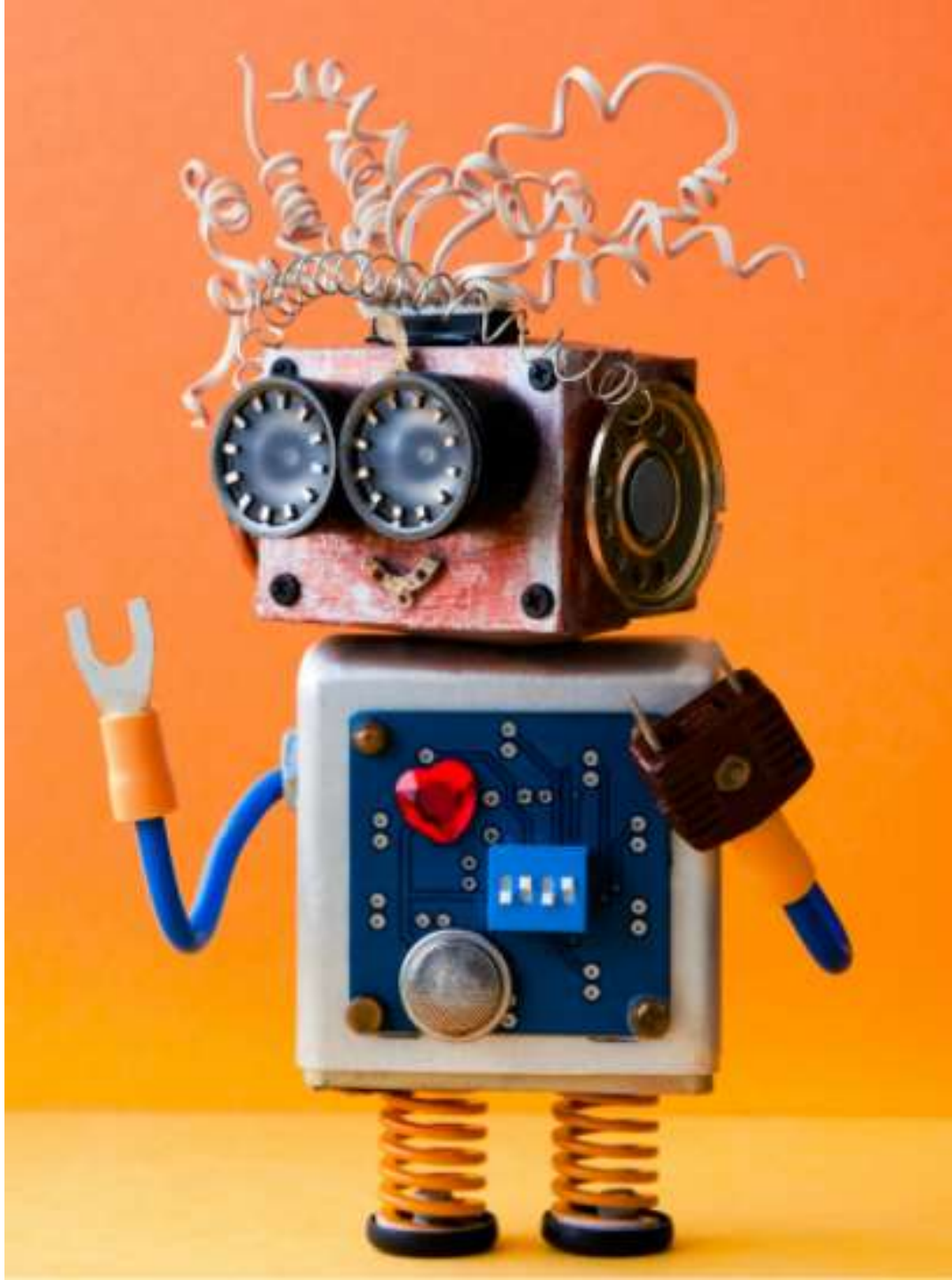
PROJECT OVERVIEW: CONVERT °C TO °F

- The objective is to predict the value of one variable Y based on another variable X.
- X is called the independent variable and Y is called the dependant variable.
- This is called “Regression” and it will be covered in much more detail in later sections of the course.



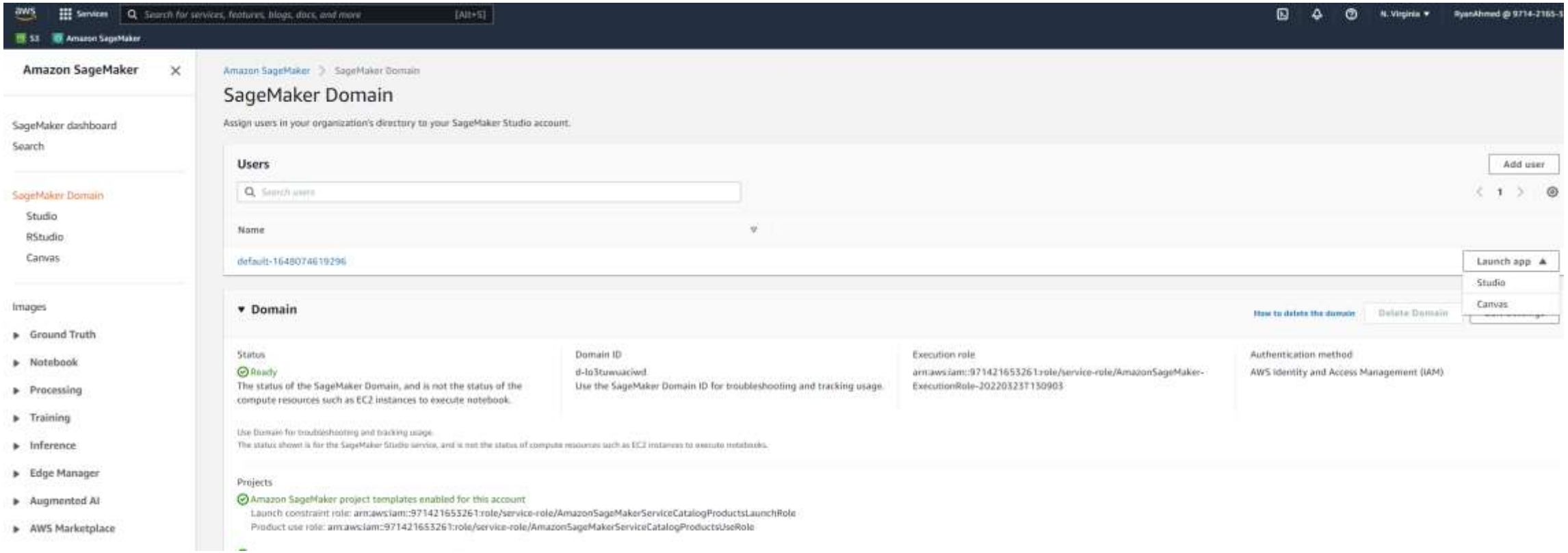
AWS SAGEMAKER DEMO – PART #6 (SAGEMAKER CANVAS DATA UPLOAD)

EASY ADVANCED



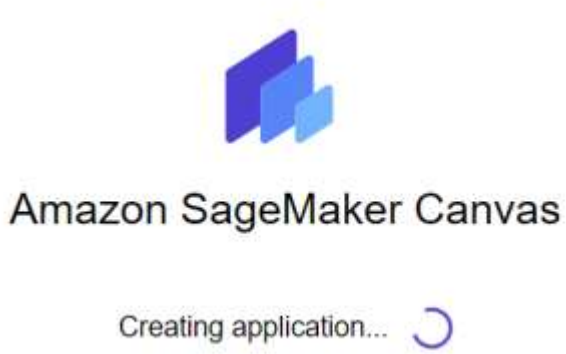
DEMO: AWS SAGEMAKER

OPEN SAGEMAKER AND CLICK ON LAUNCH APP AND THEN CANVAS



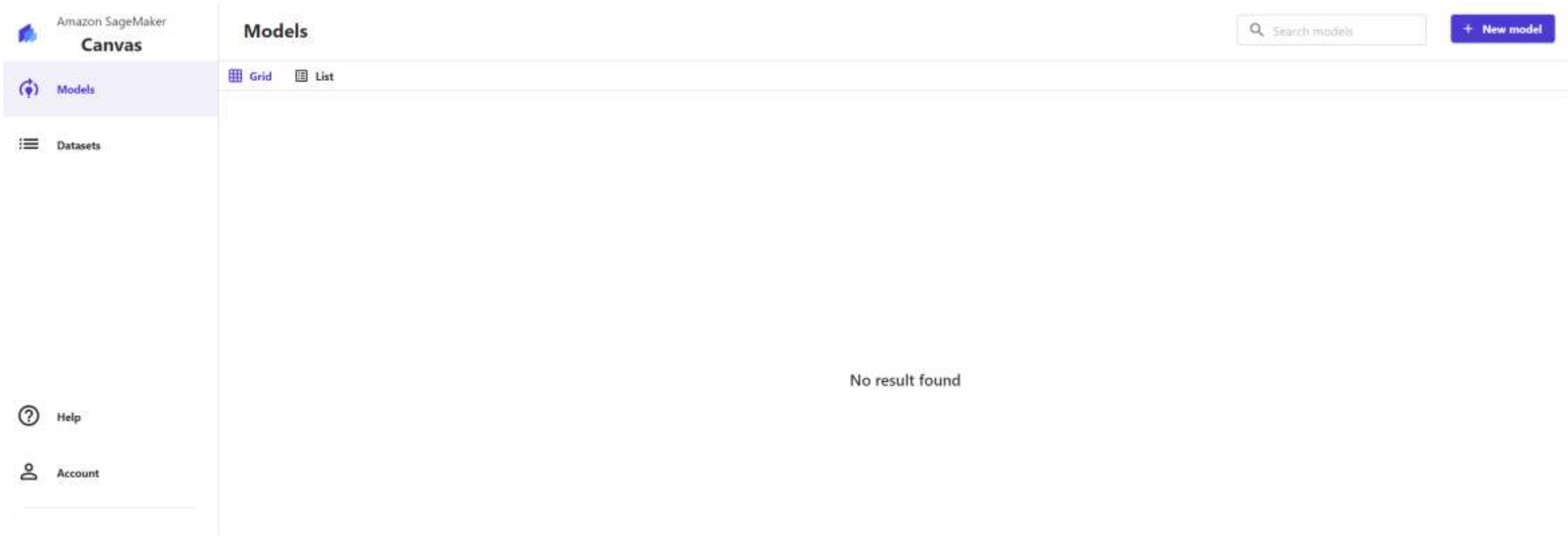
DEMO: AWS SAGEMAKER

IT MIGHT TAKE COUPLE OF MINUTES FOR SAGEMAKER CANVAS TO START. BE PATIENT IT'S WORTH IT!



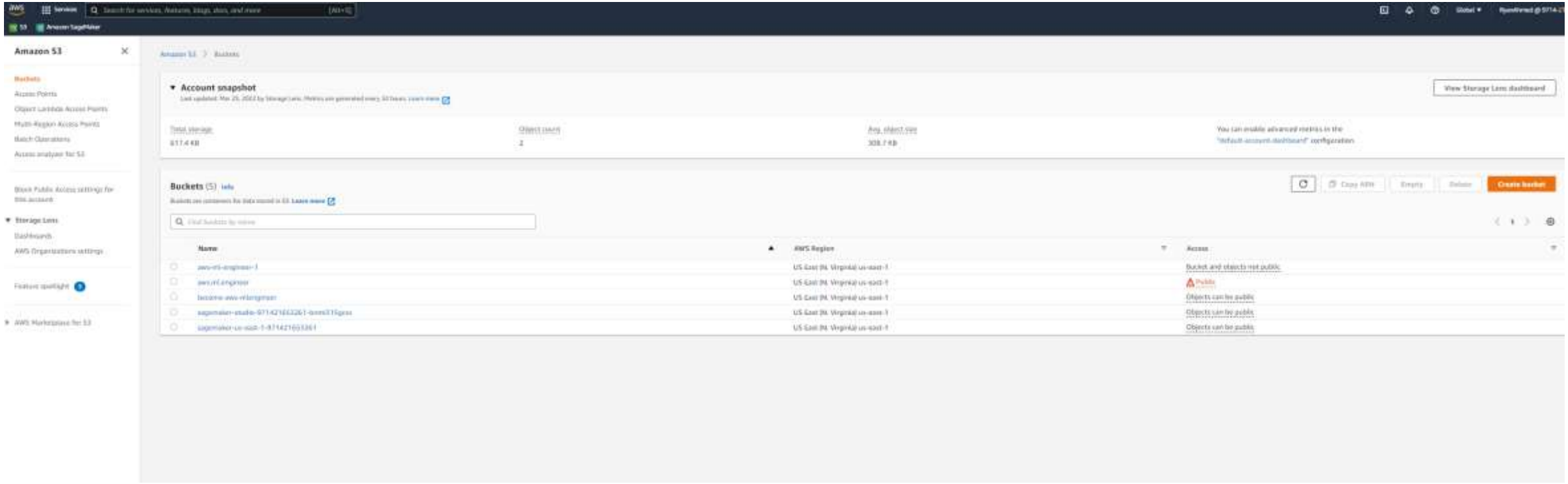
DEMO: AWS SAGEMAKER

HERE'S AMAZON SAGEMAKER CANVAS HOMEPAGE! LET'S UPLOAD THE DATA INTO S3 FIRST.



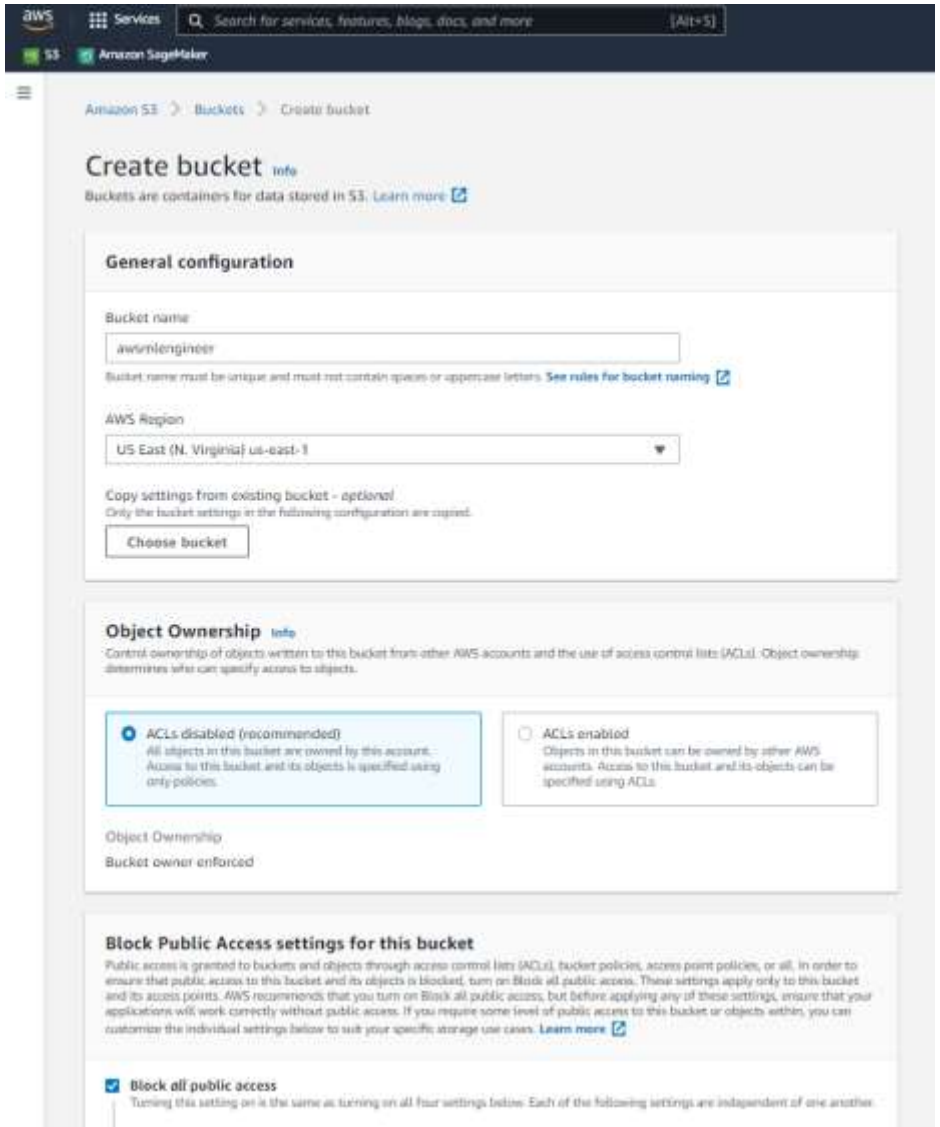
DEMO: AWS SAGEMAKER

GO TO S3 AND CLICK ON CREATE BUCKET



DEMO: AWS SAGEMAKER

PROVIDE A NAME TO THE BUCKET AND CLICK ON CREATE BUCKET



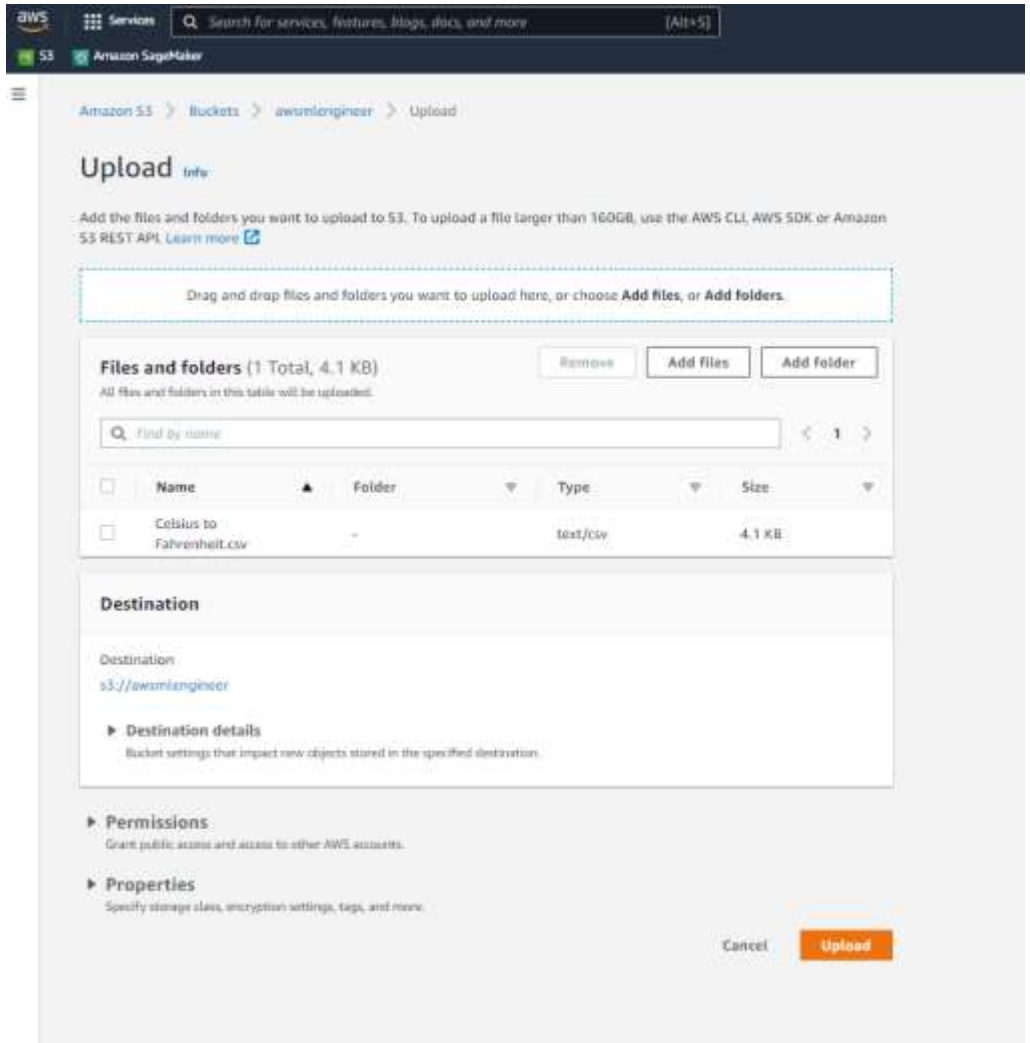
DEMO: AWS SAGEMAKER

LET'S UPLOAD THIS DATA TO S3. THE FILE "*CELCIUS TO FAHRENHEIT.CSV*" IS INCLUDED IN THE COUTSE PACKAGE

Celsius	Fahrenheit
-50	-58
-40	-40
-30	-22
-20	-4
-10	14
-9	15.8
-8	17.6
-7	19.4
-6	21.2
-5	23
-4	24.8
-3	26.6
-2	28.4
-1	30.2
0	32
1	33.8
2	35.6
3	37.4
4	39.2

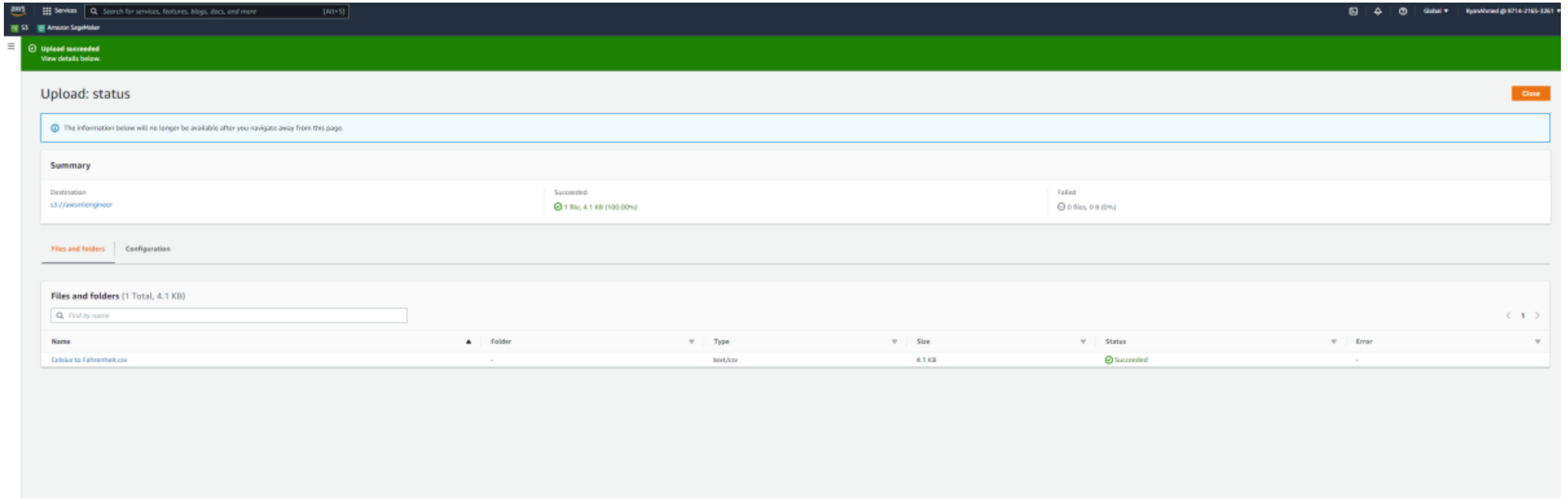
DEMO: AWS SAGEMAKER

DRAG AND DROP THE FILE AND CLICK UPLOAD



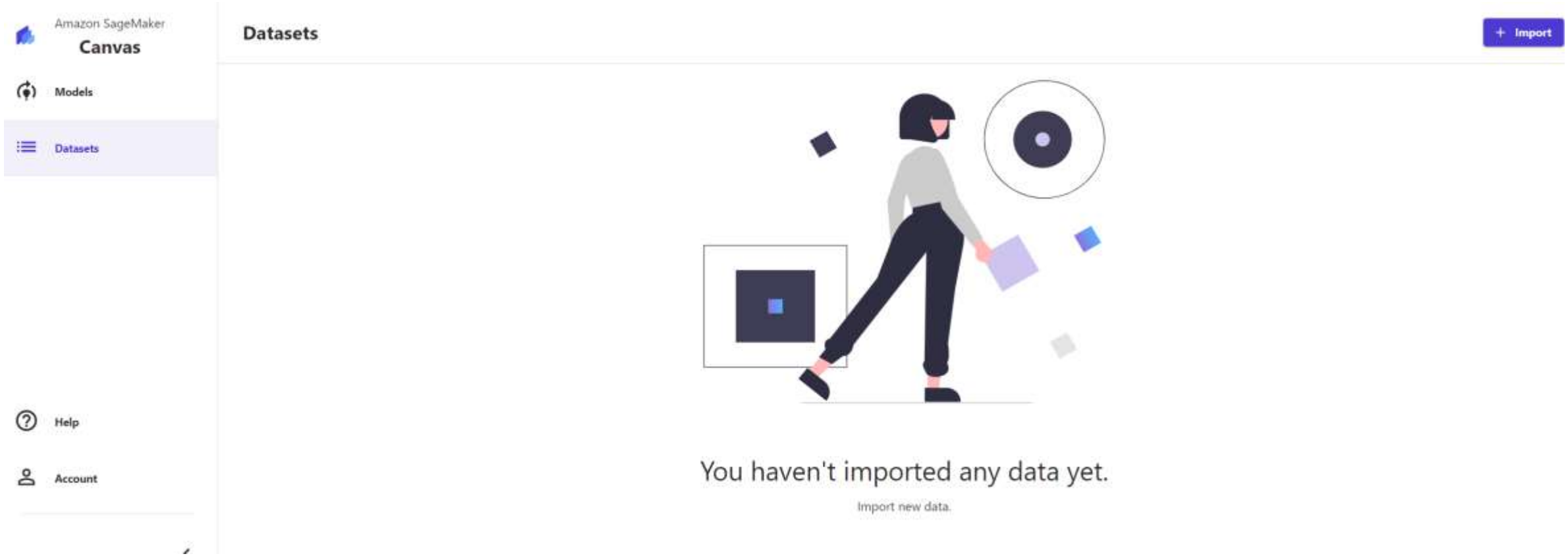
DEMO: AWS SAGEMAKER

NOW THE DATA IS UPLOADED TO S3. YOU SHOULD BE ABLE TO SEE IT IN CANVAS NOW.



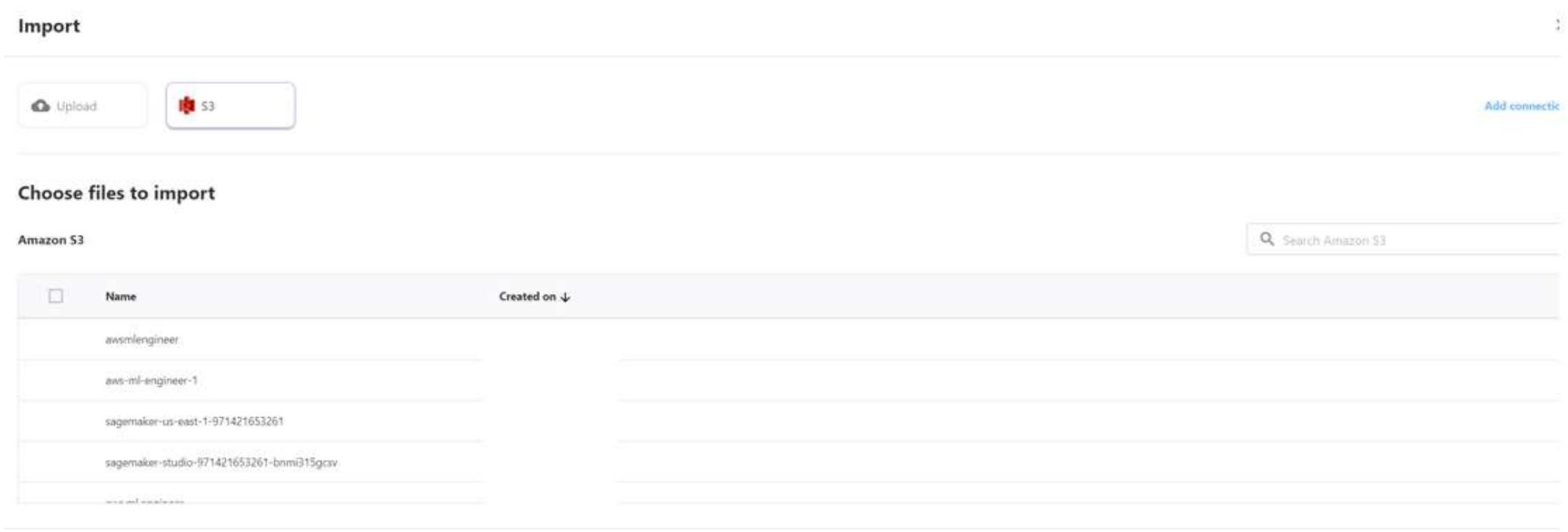
DEMO: AWS SAGEMAKER

CLICK ON IMPORT



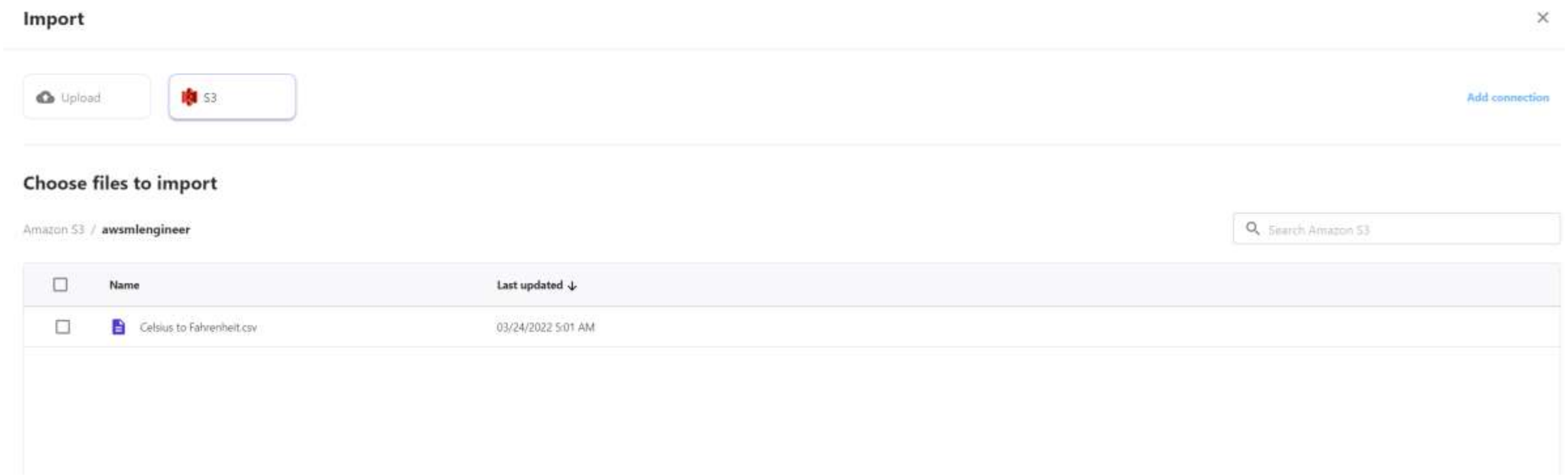
DEMO: AWS SAGEMAKER

SELECT THE BUCKET

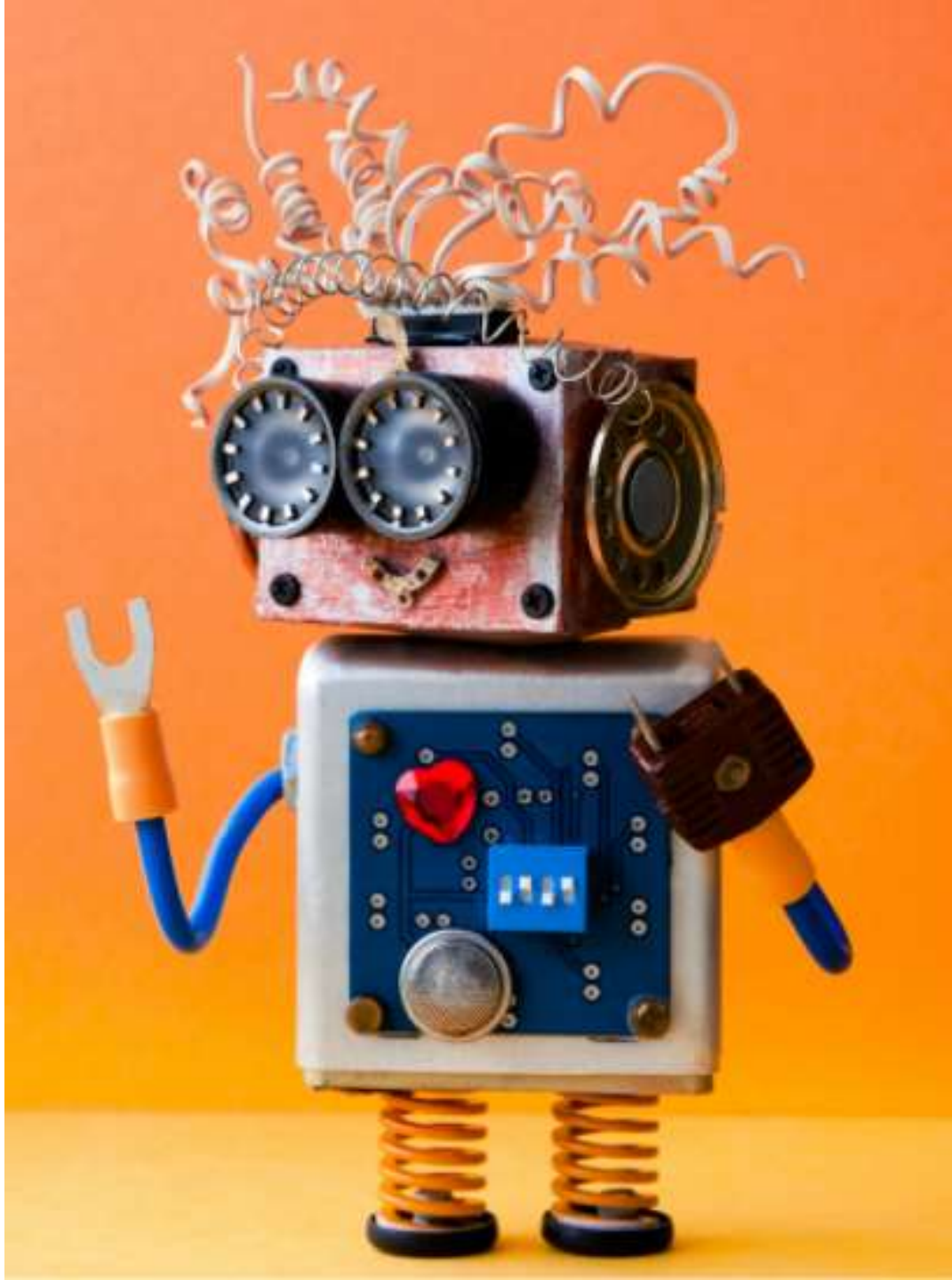


DEMO: AWS SAGEMAKER

SELECT THE FILE AND CLICK IMPORT

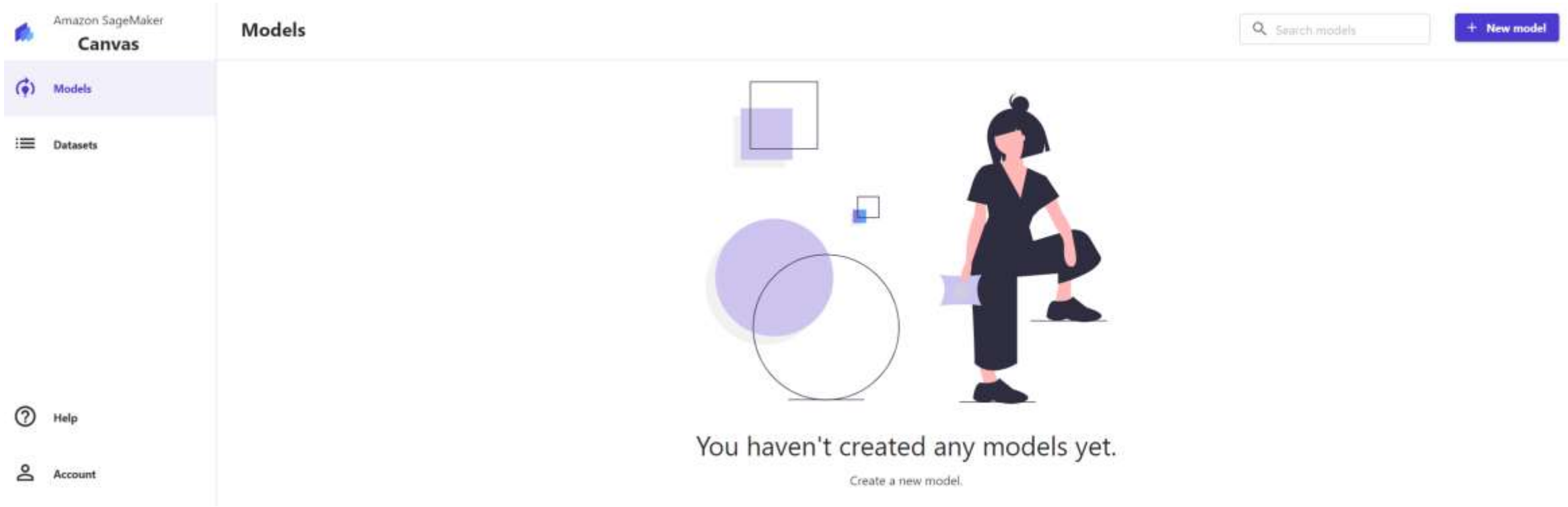


AWS SAGEMAKER DEMO – PART #7 (SAGEMAKER CANVAS MODEL TRAINING/EVAL)



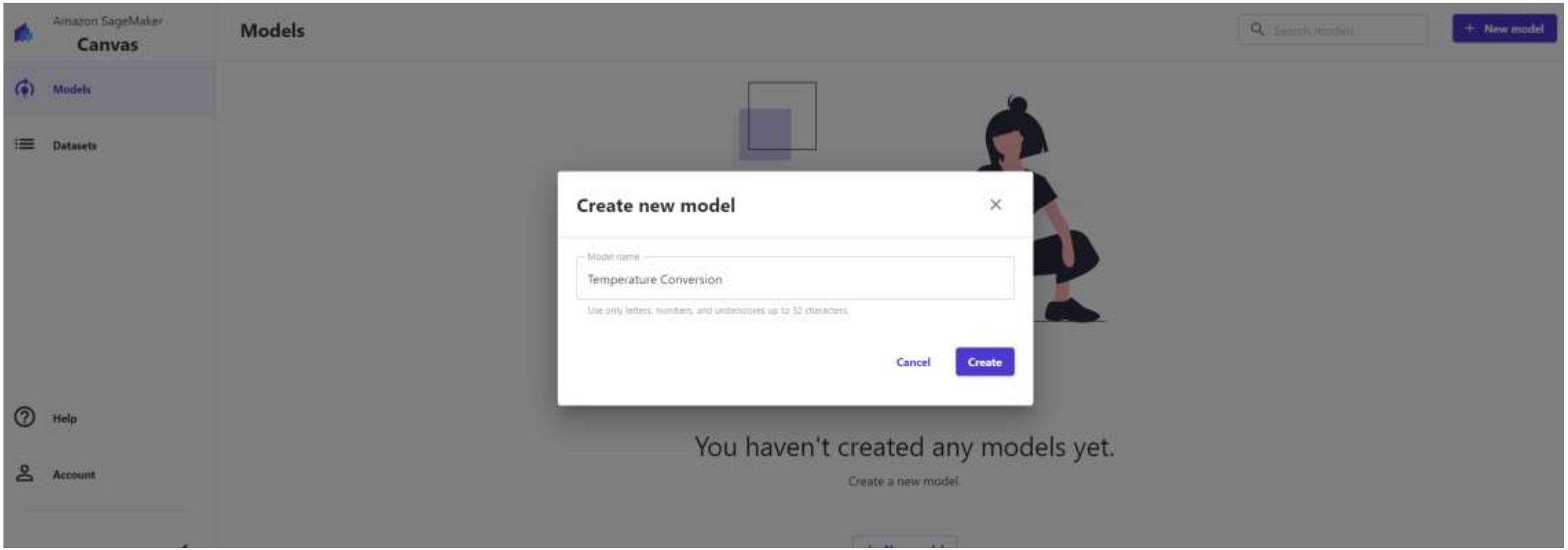
DEMO: AWS SAGEMAKER

CLICK ON MODELS AND CLICK ON CREATE NEW MODEL



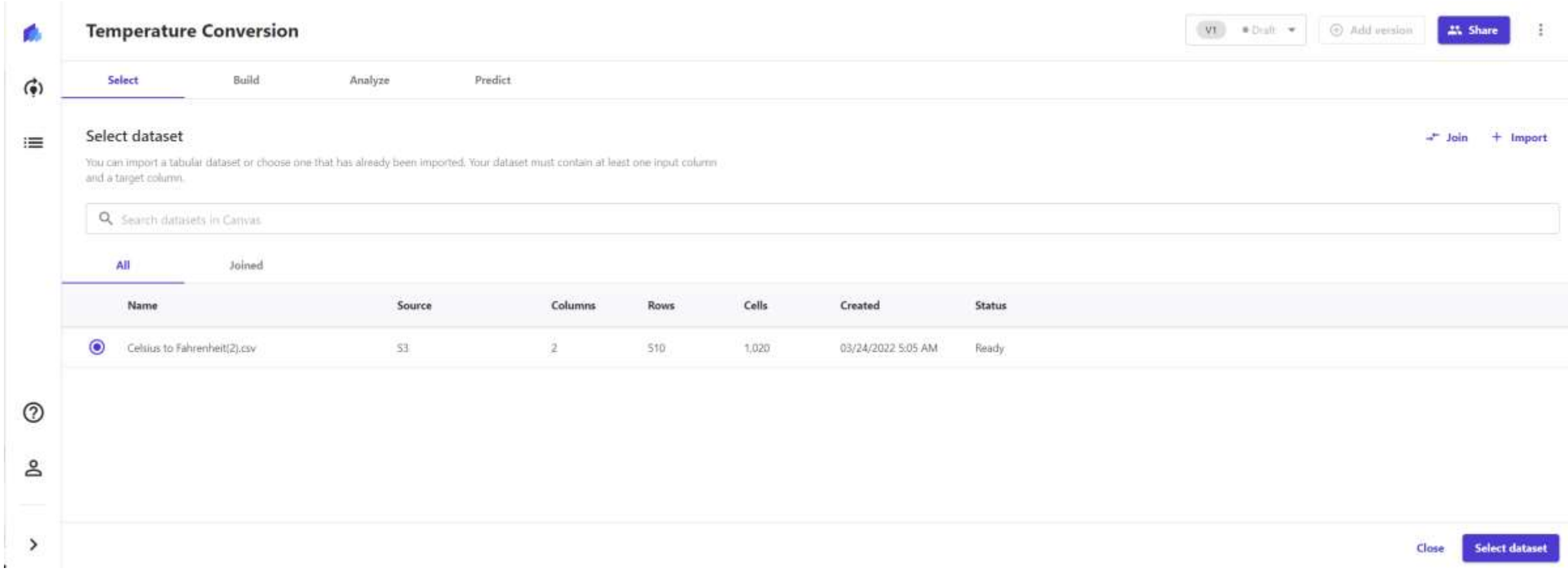
DEMO: AWS SAGEMAKER

PROVIDE A NAME TO THE MODEL AND CLICK CREATE



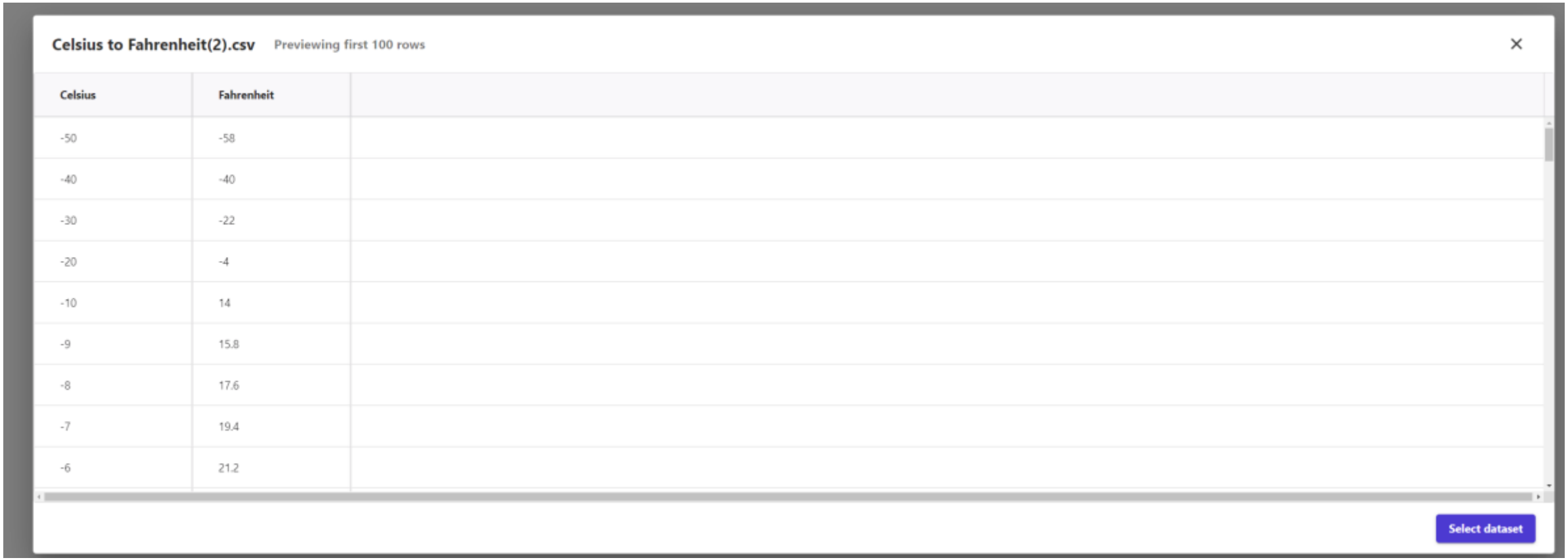
DEMO: AWS SAGEMAKER

SELECT THE DATASET



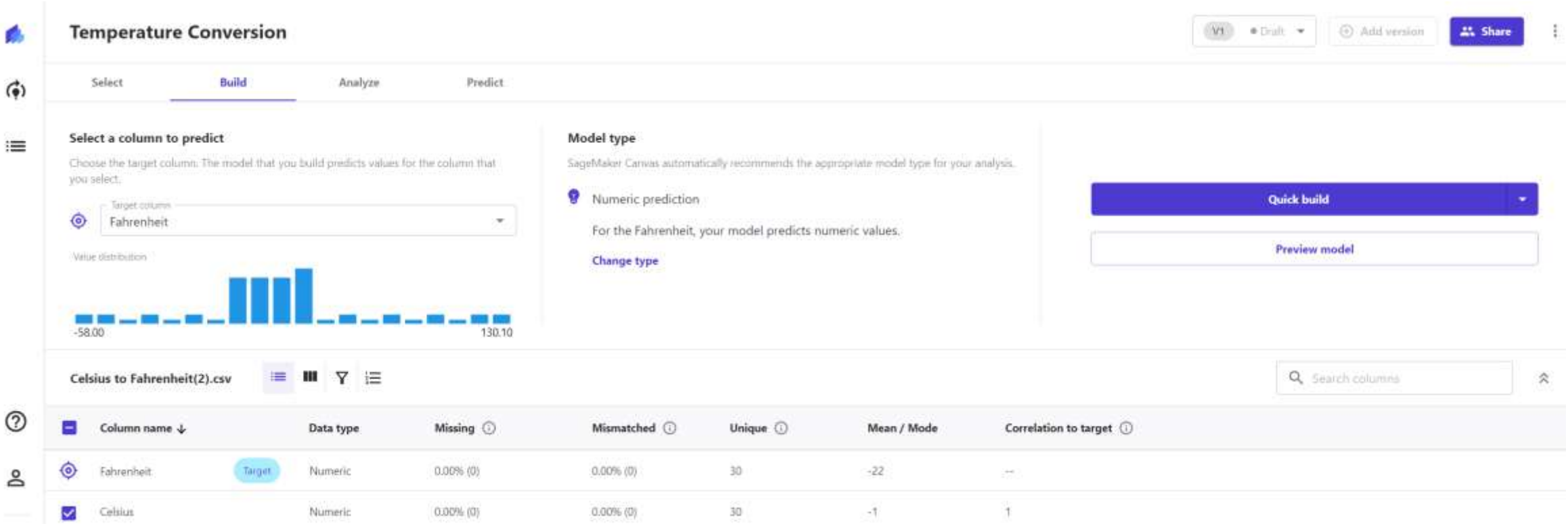
DEMO: AWS SAGEMAKER

YOU CAN VIEW THE FIRST 100 ROWS



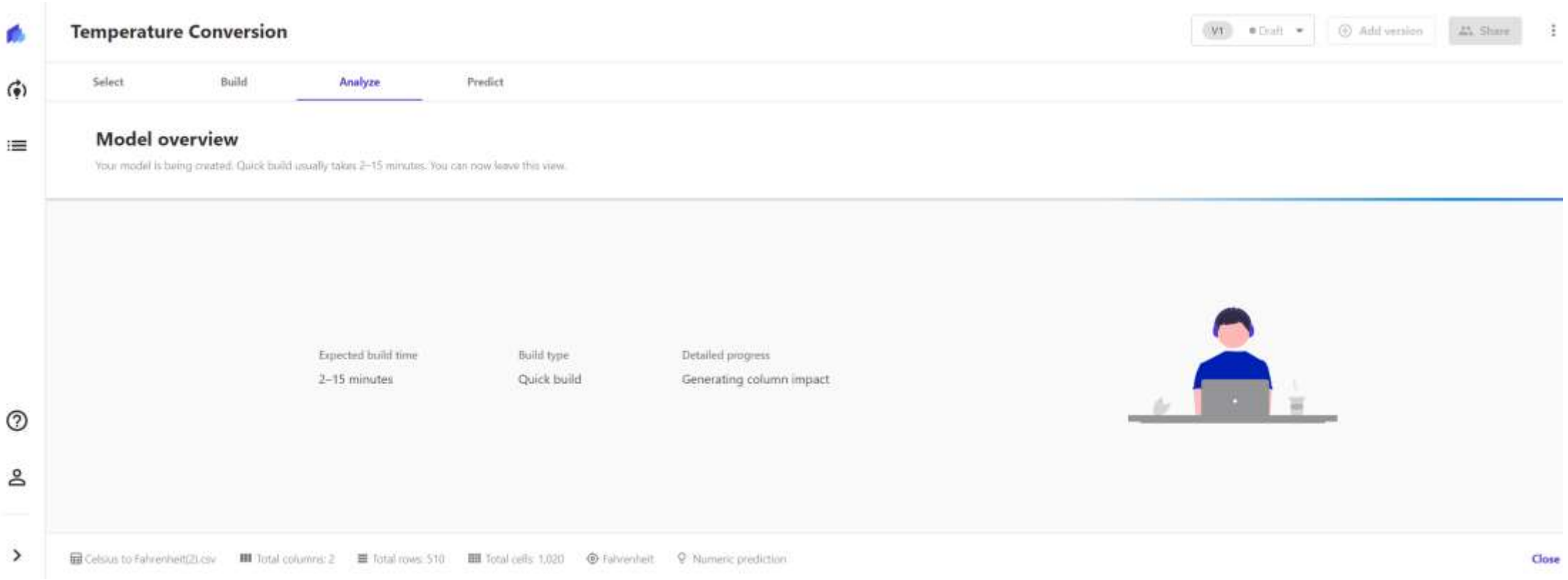
DEMO: AWS SAGEMAKER

I WANT TO CONVERT FROM CELCIUS TO FAHRENHEIT SO SELECT FAHRENHEIT AS THE TARGET. CLICK ON QUICK BUILD.



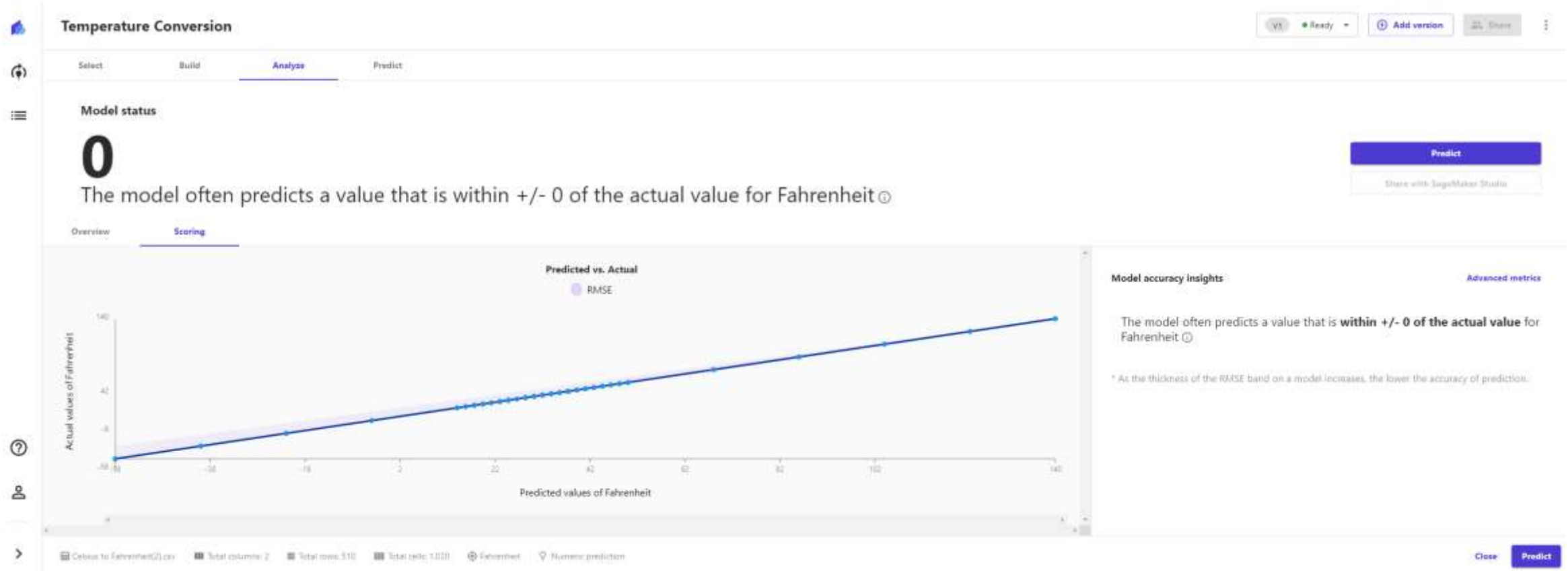
DEMO: AWS SAGEMAKER

MODEL IS NOW BEING BUILT!



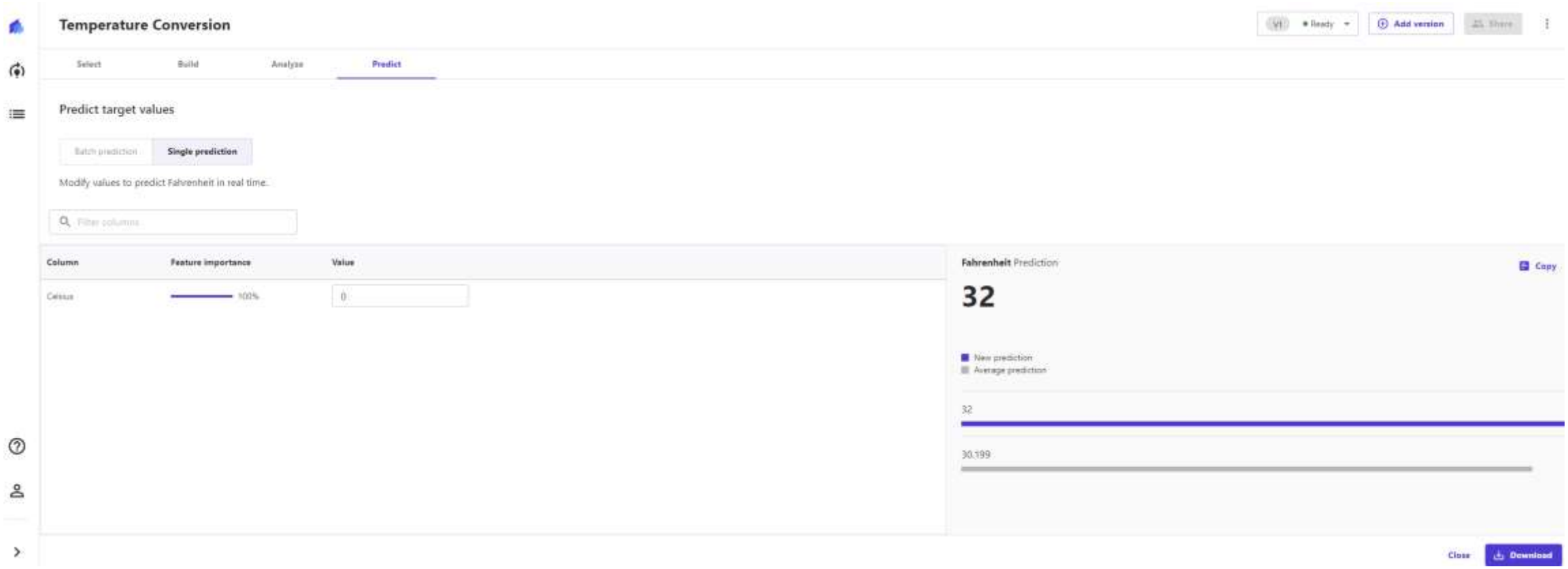
DEMO: AWS SAGEMAKER

PREDICTED VS. ACTUAL! NOTE THAT THIS IS A SIMPLE STARTER MODEL AND WE DIDN'T REALLY NEED TO USE ML HERE! IN THE FUTURE WE WILL BUILD MUCH MORE ADVANCED MODELS!



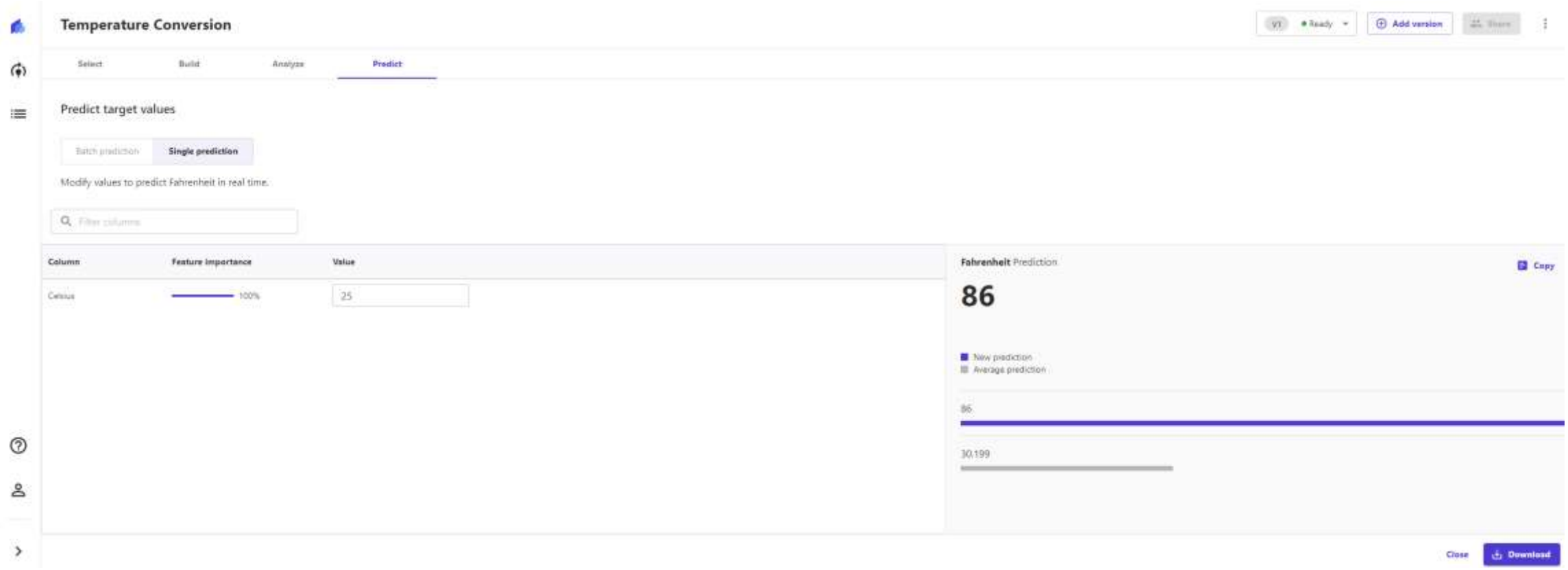
DEMO: AWS SAGEMAKER

SELECT A TEMPERATURE IN CELCIUS AND
CLICK UPDATE TO GENERATE A PREDICTION IN
FAHRENHEIT



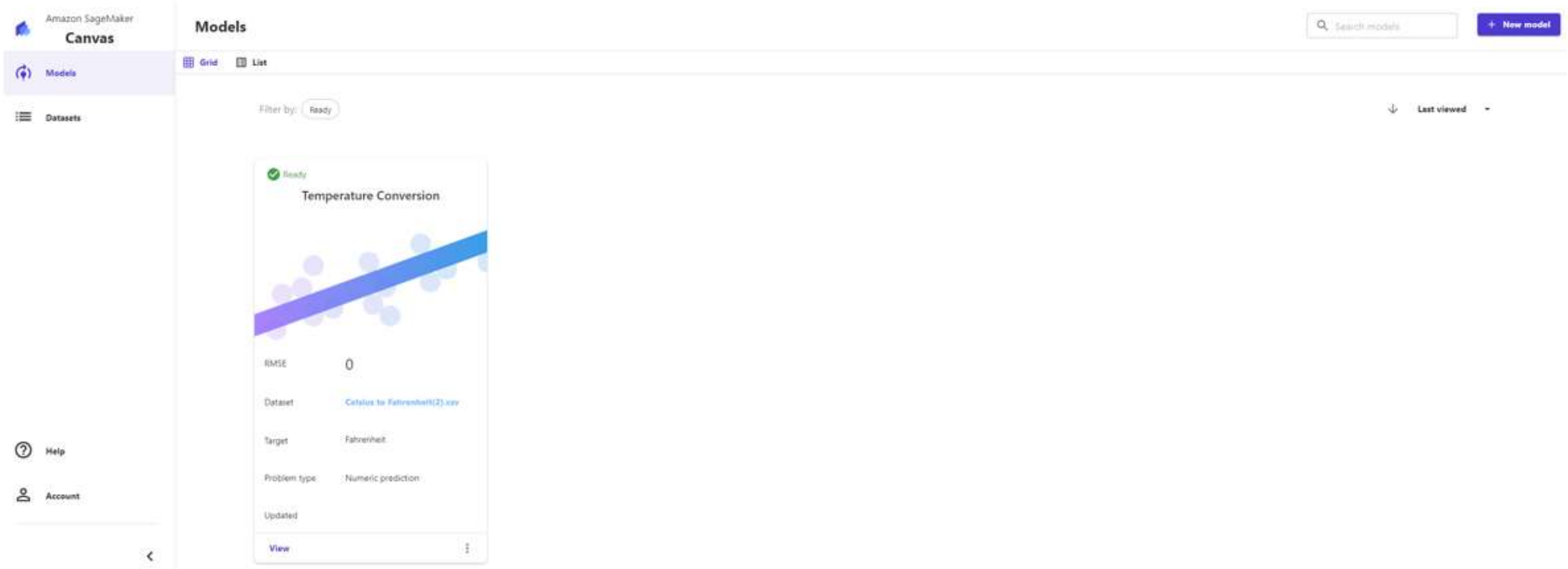
DEMO: AWS SAGEMAKER

SELECT ANOTHER NUMBER AND PERFORM A SANITY CHECK!



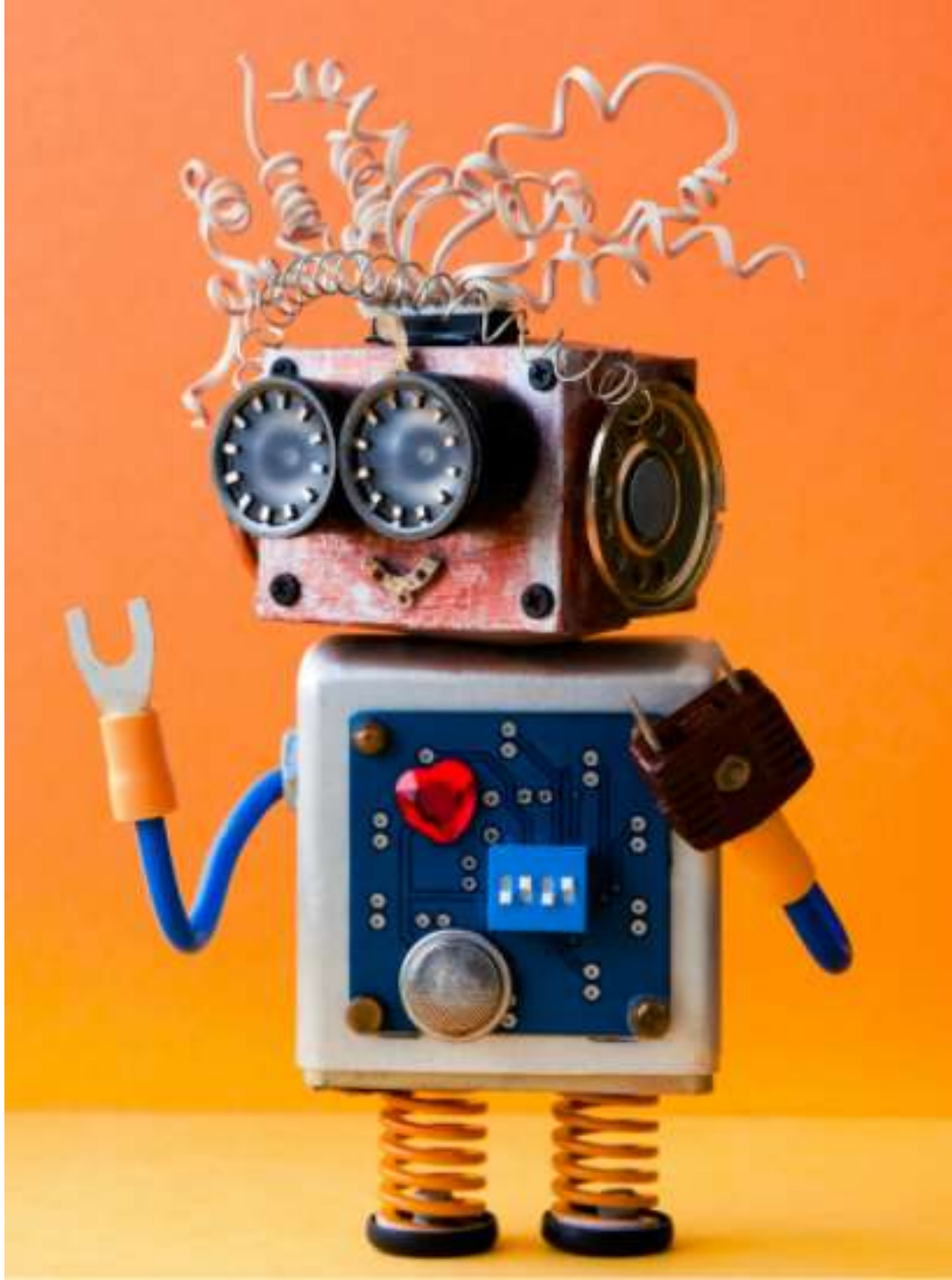
DEMO: AWS SAGEMAKER

NOW YOU CAN SEE THE MODEL



FINAL CAPSTONE PROJECT

EASY ADVANCED



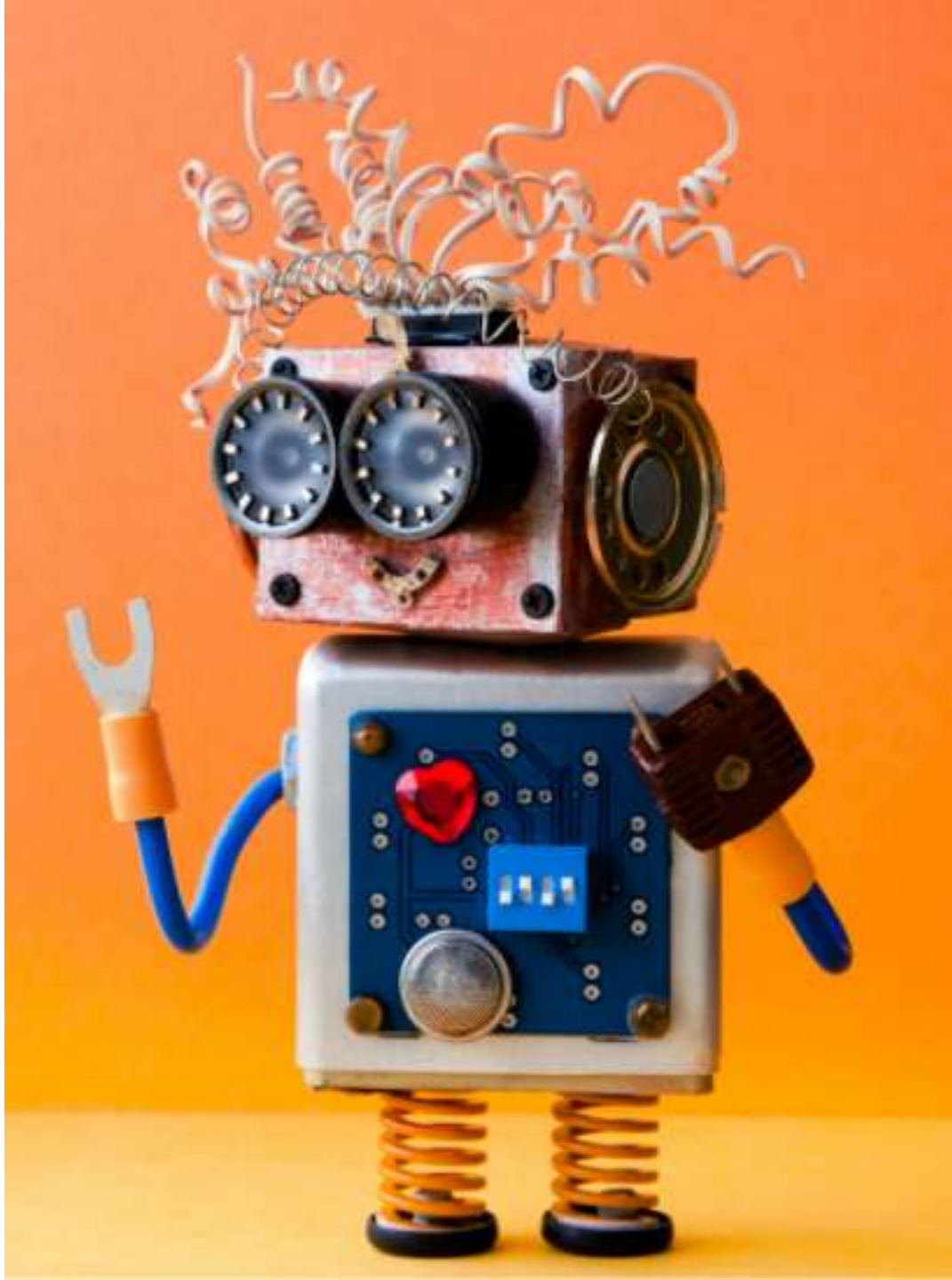
PROJECT OVERVIEW: EMPLOYEE SALARY PREDICTION

- In this project, we will train a simple machine learning model to predict employee salary based on the number of years of experience using Amazon SageMaker Canvas.
- 1. Upload the “salary.csv” data to S3
- 2. Select the target column and plot its distribution
- 3. Build a new Machine Learning model using Amazon SageMaker Canvas
- 4. Analyze the results, what’s the accuracy of the trained model?
- 5. Test the trained model performance using at least 3 sample years of experience.

Years of Experience	Salary
25	106959.8057
26	125038.0243
28	132126.4578
21	97541.39206
12	63248.03888
14	73588.14876
14	61778.90358
31	139343.328
1	11078.06765
32	147560.1648
11	65193.68168
4	14232.0306
19	93489.34132
14	57908.18682
40	181095.5209
18	93981.80664
26	129641.9995

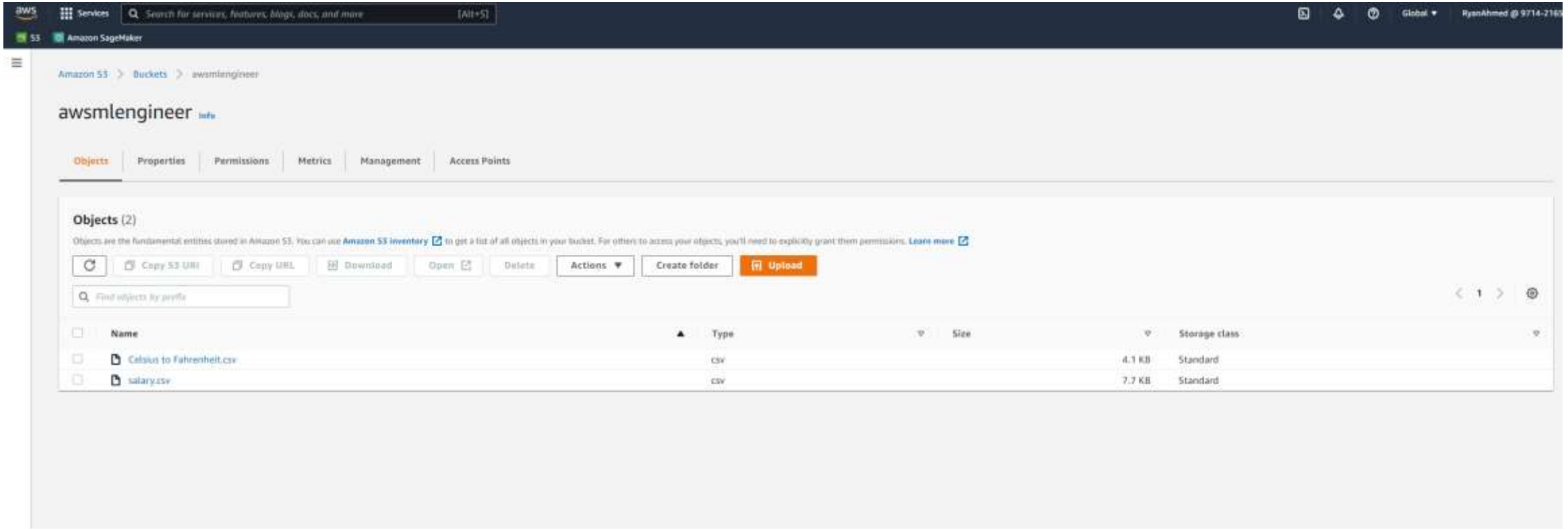
FINAL CAPSTONE PROJECT SOLUTION

EASY ADVANCED



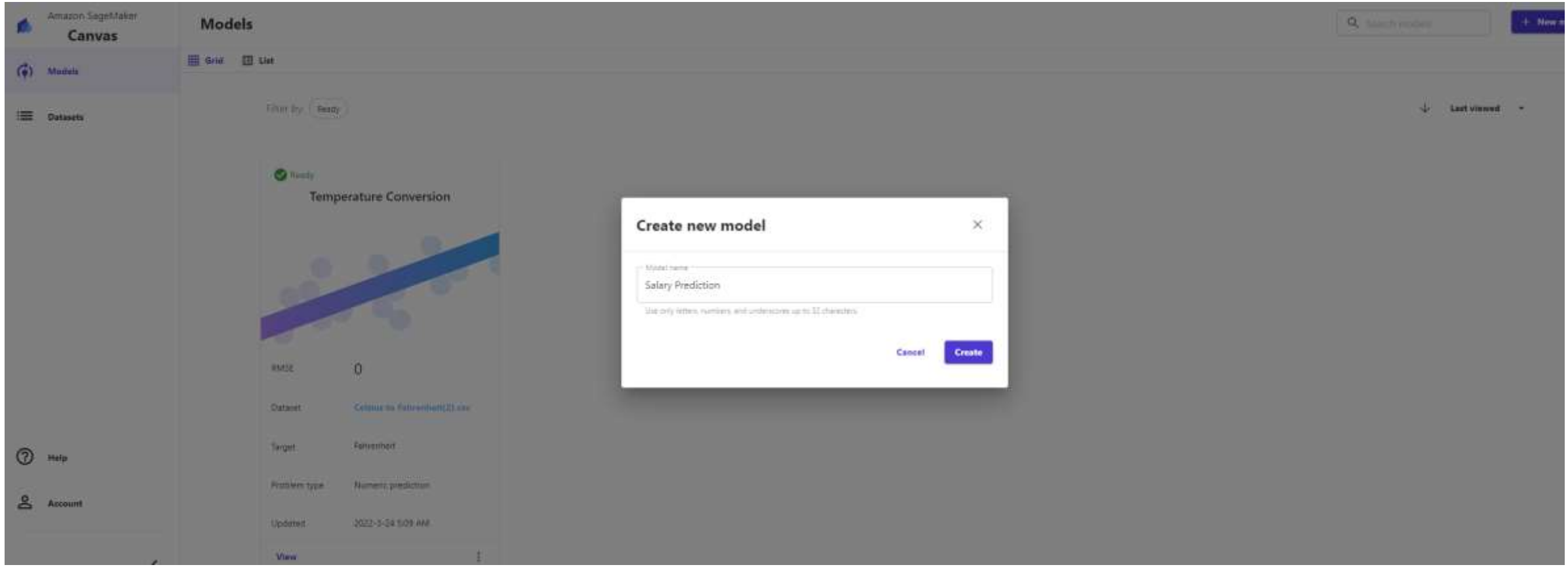
DEMO: AWS SAGEMAKER

UPLOAD THE SALARY.CSV DATA TO S3



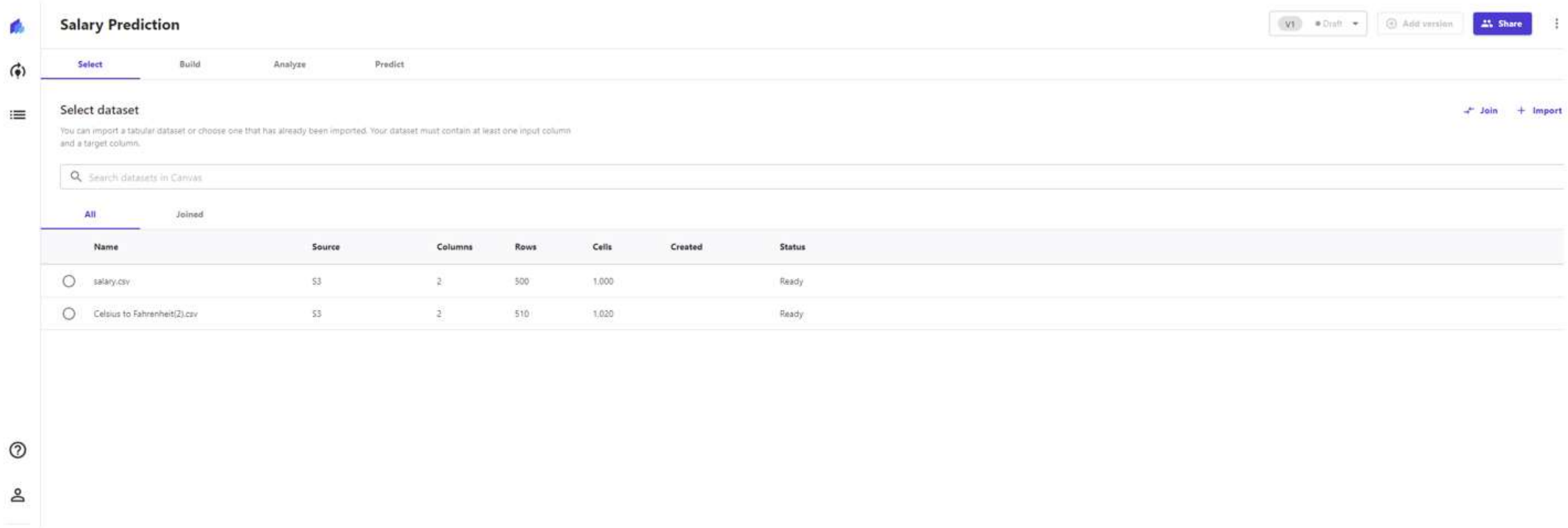
DEMO: AWS SAGEMAKER

CREATE A NEW MODEL AND NAME IT SALARY PREDICTION



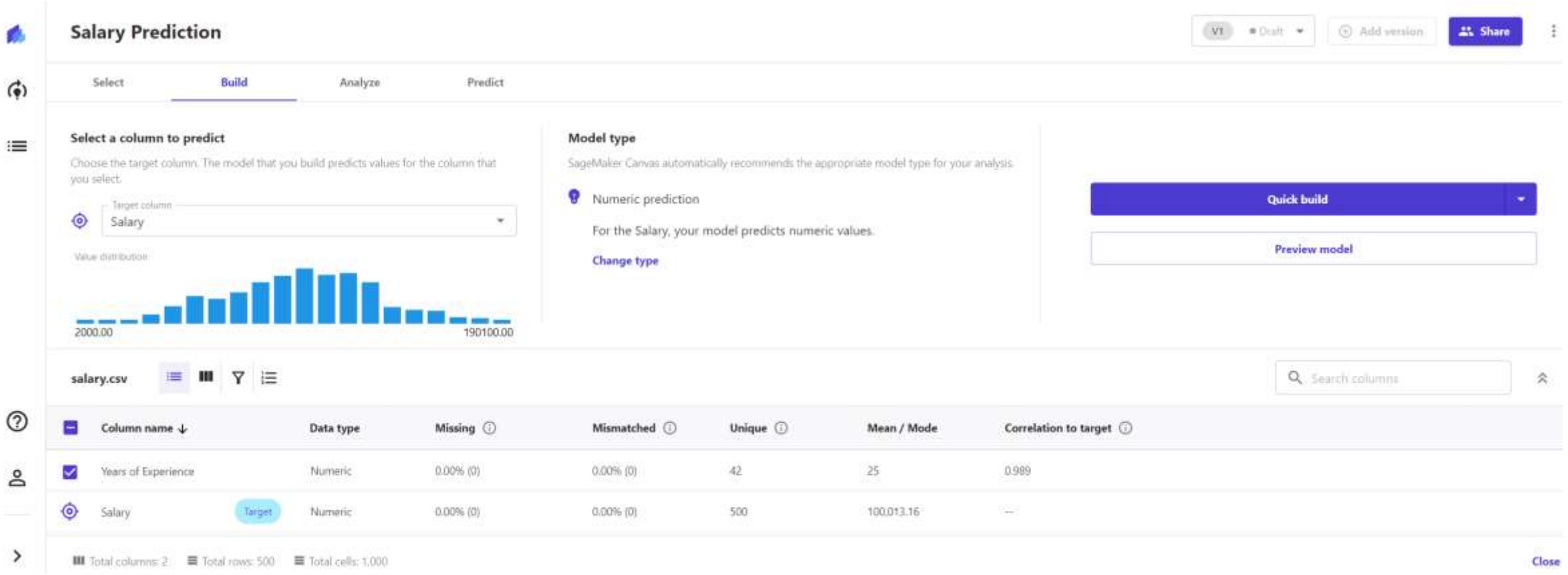
DEMO: AWS SAGEMAKER

IMPORT SALARY DATA



DEMO: AWS SAGEMAKER

SELECT SALARY AS THE TARGET COLUMN AND
CLICK ON QUICK BUILD



DEMO: AWS SAGEMAKER

MODEL PREDICTIONS VS. ACTUAL VALUES

DEMO: AWS SAGEMAKER

CLICK ON ADVANCED METRICS

DEMO: AWS SAGEMAKER

SELECT SINGLE PREDICTION AND CHOOSE A NUMBER OF YEARS OF EXPERIENCE TO PREDICT SALARY