cloudera

Modern Platform for Machine Learning and Analytics

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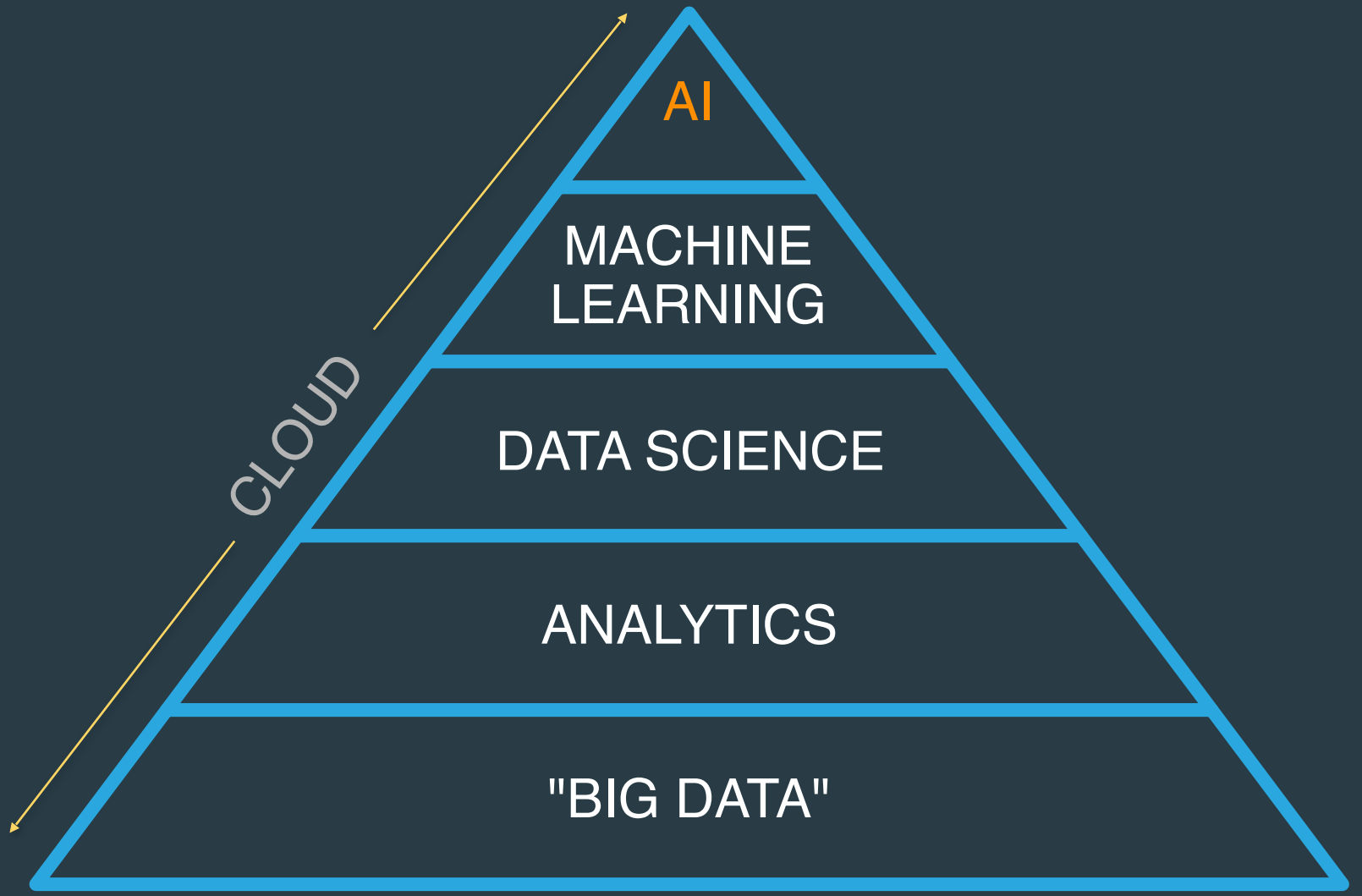
SEB CDSW Workshop 20190529

Agenda

Cloudera Data Science Workbench (CDSW) Demo

- Introduction
- Introduction to CDSW
- CDSW Workshop
- Questions
- Next steps

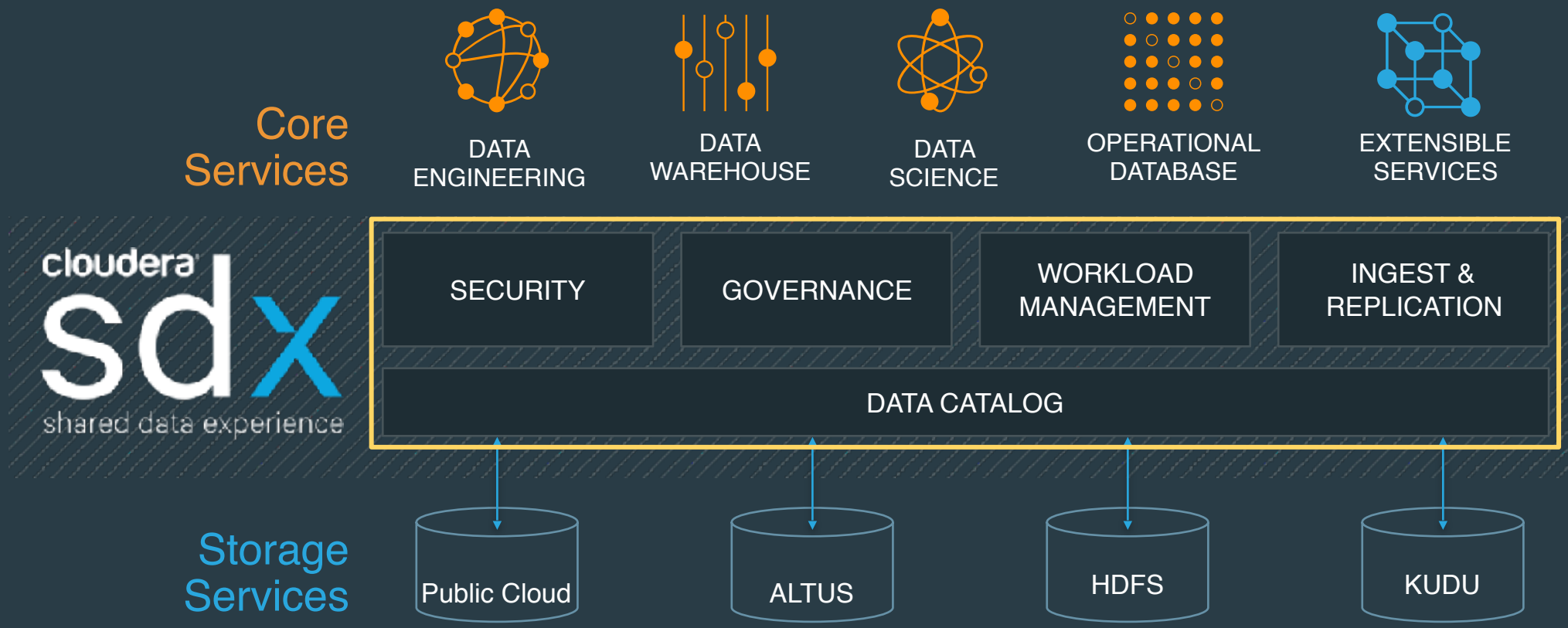


Cloudera Data Science Workbench

cloudera

Modern Platform for Machine Learning and Analytics

Integrated data, workflows, metadata, security, governance, ...



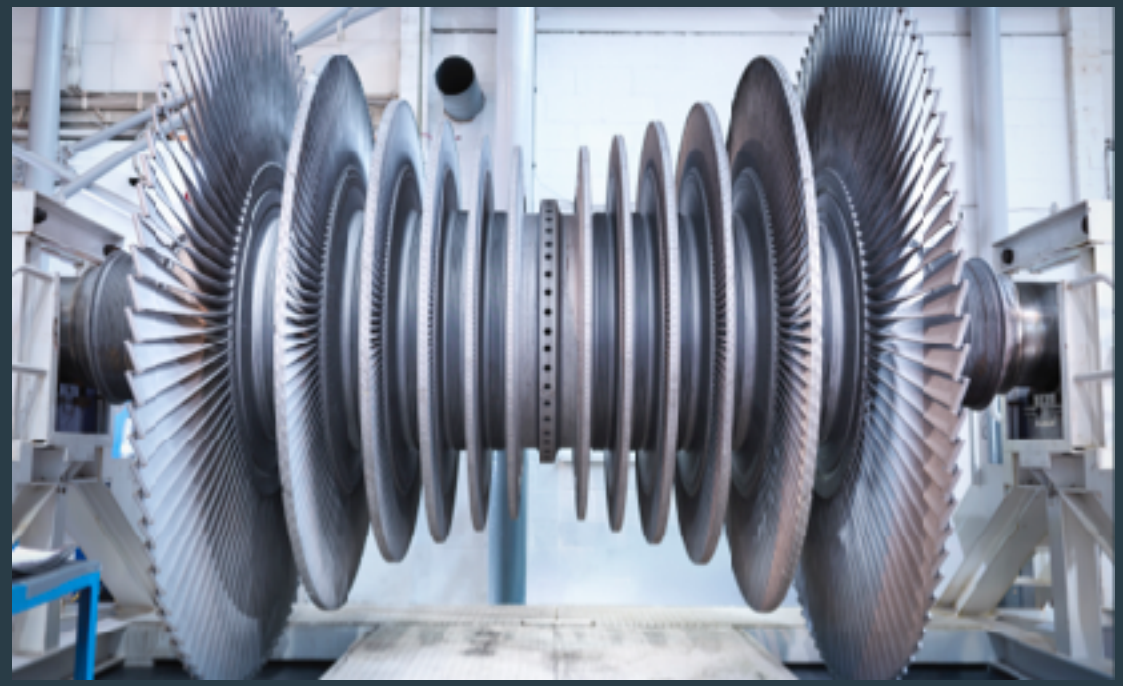
MACHINE LEARNING AT CLOUDERA

Our philosophy

We empower our customers to run their business on data with an open platform:

- Your data
- Open algorithms
- Running anywhere

We accelerate enterprise data science.



What is Cloudera Data Science Workbench (CDSW)

Supports your workloads in an enterprise secure way

Accelerate data science from exploration to production using R, Python, Spark and more

For data scientists

Open data science, your way.

Use R, Python, or Scala with your favorite libraries and frameworks

No need to sample.

Directly access data in secure Hadoop clusters through Apache Spark and Apache Impala

Reproducible, collaborative research.

Share insights with your whole team

For IT professionals

Bring analysis to the data.

Give your data science team the freedom to work how they want, when they want

Secure by default.

Stay compliant with out-of-the-box support for full Hadoop security

Flexible deployment.

Run on-premises or in the cloud

THE CHALLENGE

Balance these needs

DATA SCIENCIST

- Access to granular data
- Flexibility
  - Preferred open source tools
- Elastic provisioning
  - Compute
  - Storage
- Reproducible research
- Path to production

VS.

DevOps/IT

- Security
- Governance
- Standards
- Low maintenance
- Low cost
- Self-service access

THE TYPICAL SOLUTION

"If I can't use my favorite tools, I'll…"

- Copy data to my laptop
- Copy data to a data science appliance
- Copy data to a cloud service

Why this is a problem:

- Complicates security
- Breaks data governance
- Adds latency to process
- Makes collaboration more difficult
- Complicates model management and deployment
- Creates infrastructure silos

CLOUDERA DATA SCIENCE WORKBENCH

Accelerate Machine Learning from Research to Production

For data scientists

- **Experiment faster**
  Use R, Python, or Scala with on-demand compute and secure CDH data access
- **Work together**
  Share reproducible research with your whole team
- **Deploy with confidence**
  Get to production repeatably and without recoding

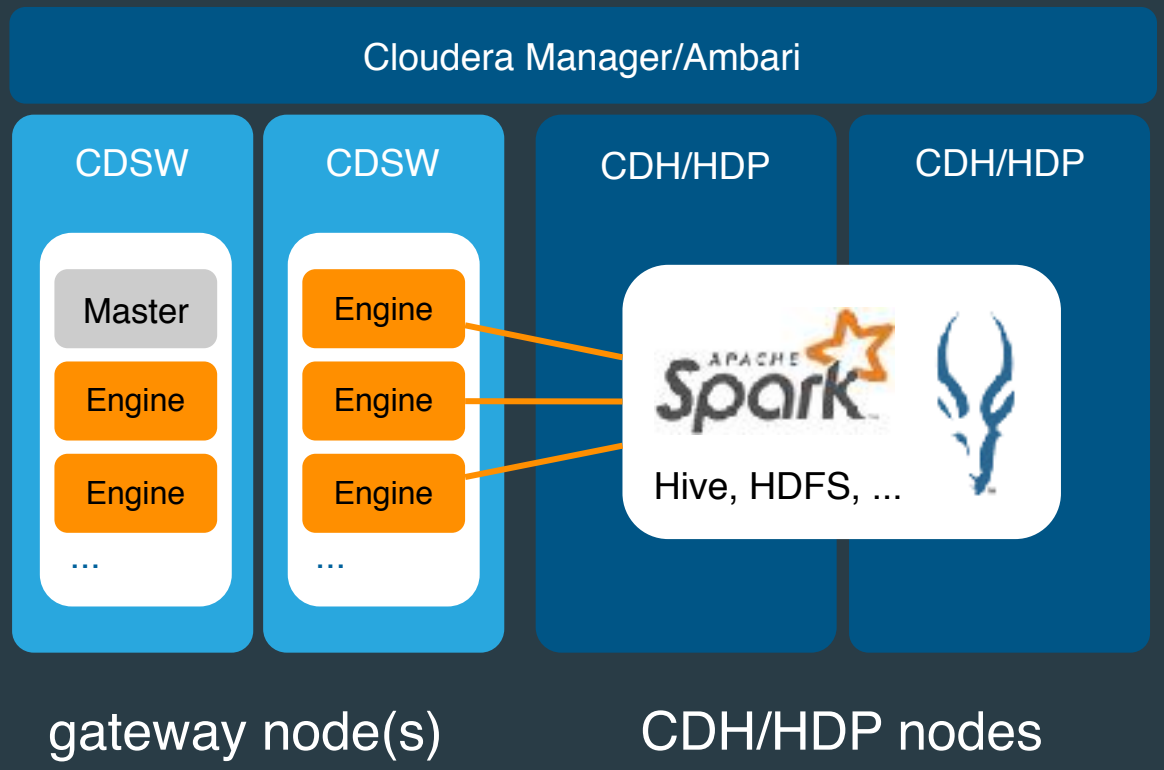
For IT professionals

- **Bring data science to the data**
  Give your data science team more freedom while reducing the risk and cost of silos
- **Secure by default**
  Leverage common security and governance across workloads
- **Run anywhere**
  On-premises or in the cloud

A MODERN DATA SCIENCE ARCHITECTURE

Containerized environments with scalable, on-demand compute

- Built with Docker and Kubernetes
  - Isolated, reproducible user environments
- Supports both big and small data
  - Local Python, R, Scala runtimes
  - Schedule & share GPU resources
  - Run Spark, Impala, and other CDH services
- Secure and governed by default
  - Easy, audited access to Kerberized clusters
  - Leverages SDX platform services
- Deployed with Cloudera Manager/Ambari

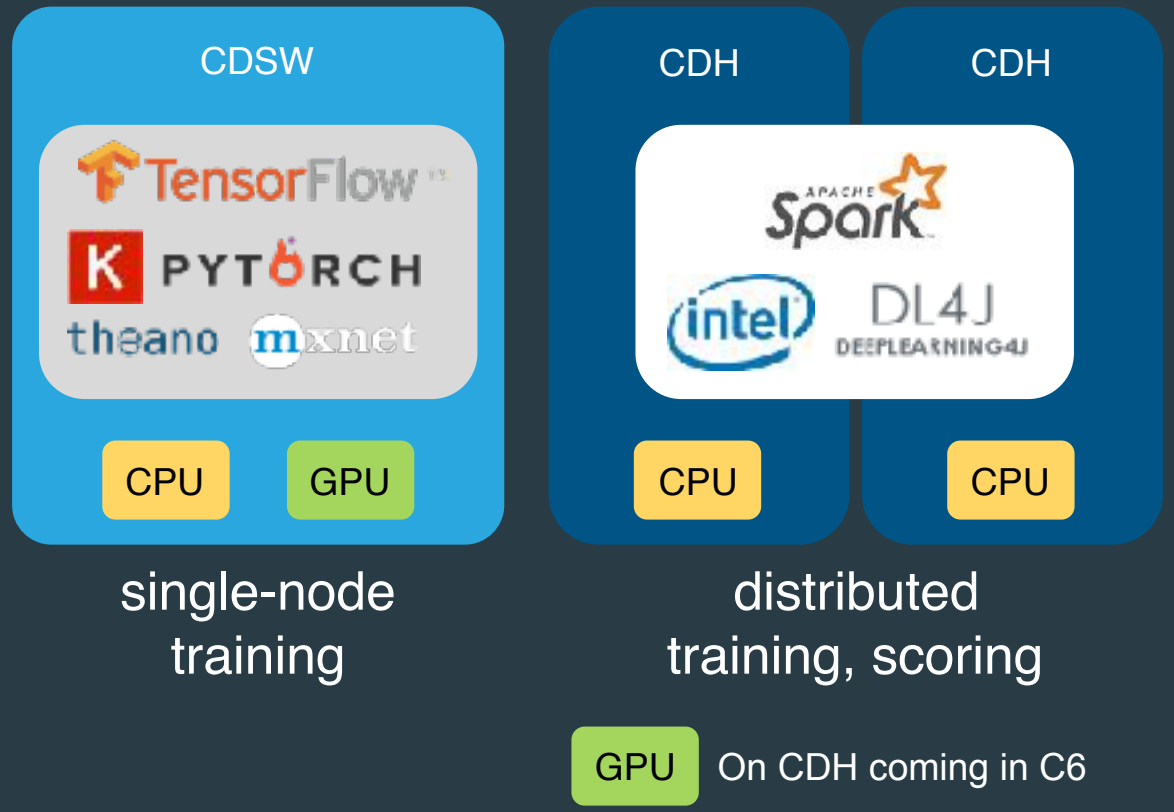


ACCELERATED DEEP LEARNING WITH GPUS

Multi-tenant GPU support on-premises or cloud

"Our data scientists want GPUs, but we need multi-tenancy. If they go to the cloud on their own, it's expensive and we lose governance."

- Extend CDSW to deep learning
- Schedule & share GPU resources
- Train on GPUs, deploy on CPUs
- Works on-premises or cloud



WHAT DATA SCIENCE TEAMS DO

PREPARE DATA

Ingest data at scale.

Store and secure data.

Clean and transform data for analysis.

BUILD MODELS

Explore data and build predictive models, offline.

Evaluate and tune models.

Develop and deliver a modeling pipeline.

DEPLOY MODELS

Test, verify, and approve model for deployment.

Create and maintain batch/ stream pipelines, embedded models, APIs.

Update models in production.

CLOUDERA DATA SCIENCE WORKBENCH

Accelerate and simplify machine learning from research to production

ANALYZE DATA

- Explore data securely and share insights with the team

TRAIN MODELS

- Run, track, and compare reproducible experiments

DEPLOY APIs

- Deploy and monitor models as APIs to serve predictions

MANAGE SHARED RESOURCES

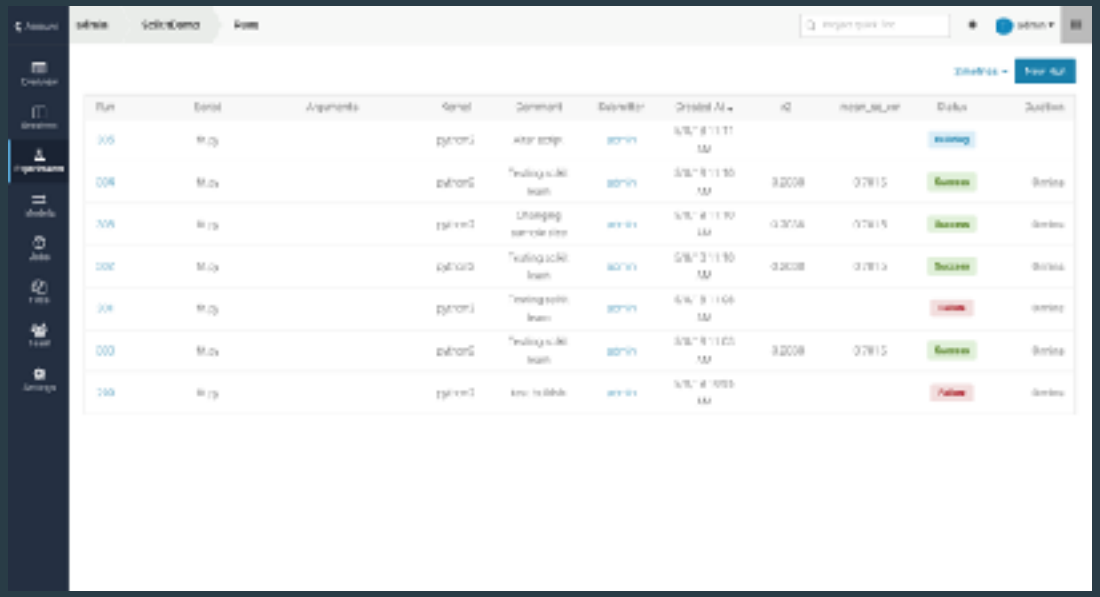
- Provide a secure, collaborative, self-service platform for your data science teams

INTRODUCING EXPERIMENTS

Versioned model training runs for evaluation and reproducibility

Data scientists can now...

- Create a snapshot of model code, dependencies, and configuration necessary to train the model
- Build and execute the training run in an isolated container
- Track specified model metrics, performance, and model artifacts
- Inspect, compare, or deploy prior models



INTRODUCING MODELS

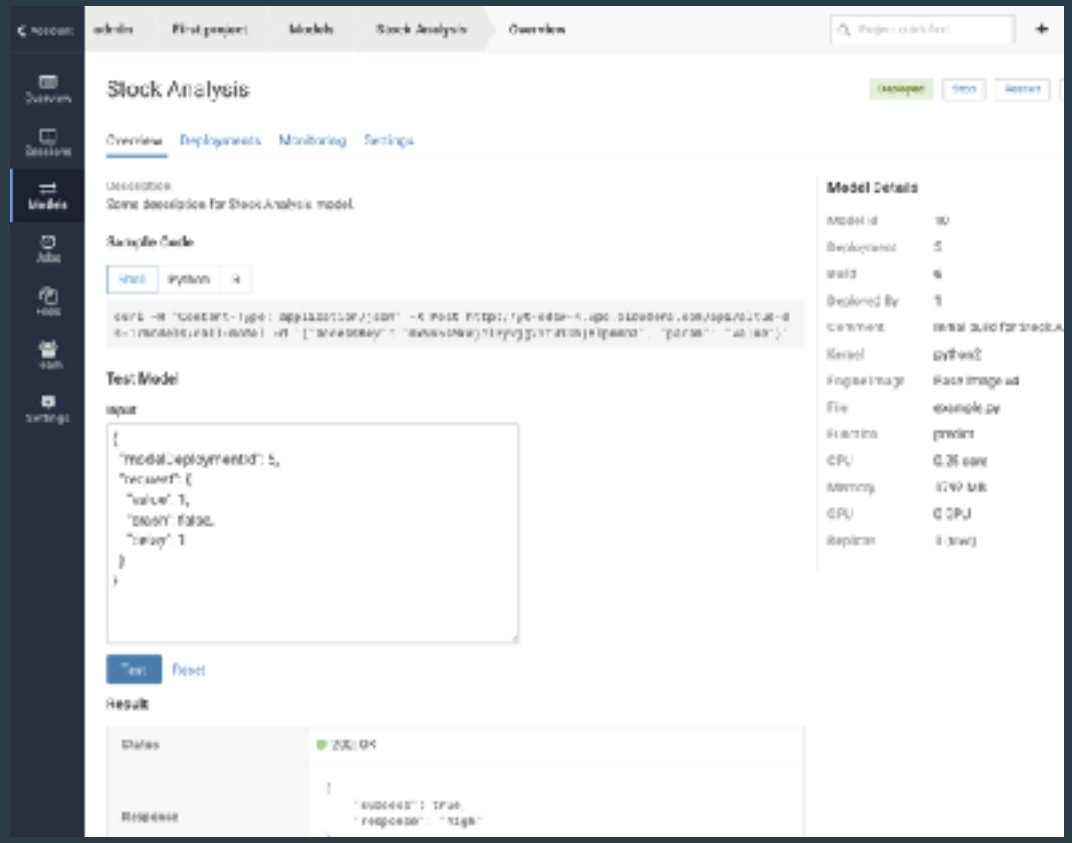
Machine learning models as one-click microservices (REST APIs)

1. Choose file, e.g. `score.py`
2. Choose function, e.g. `forecast`

```
f = open('model.pk', 'rb')
model = pickle.load(f)
def forecast(data):
    return model.predict(data)
```

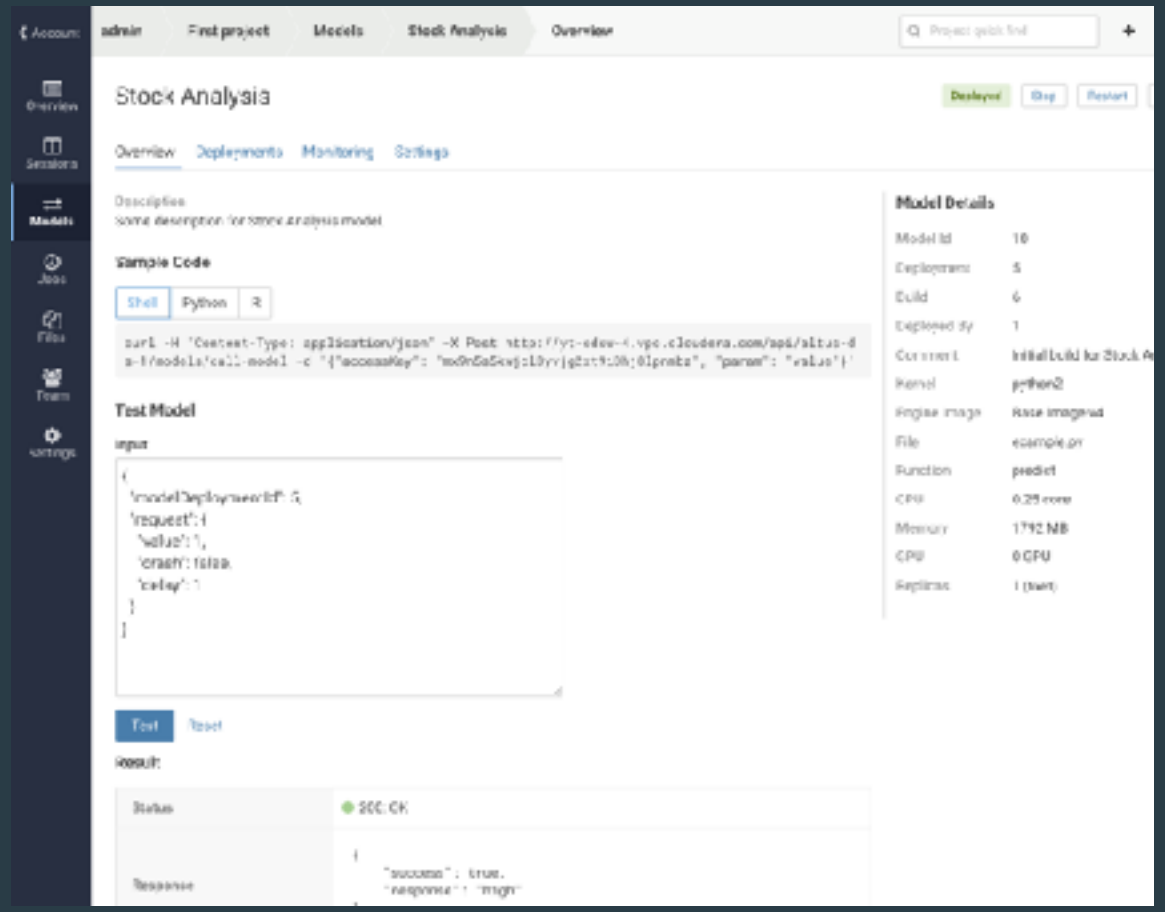
3. Choose resources
4. Deploy!

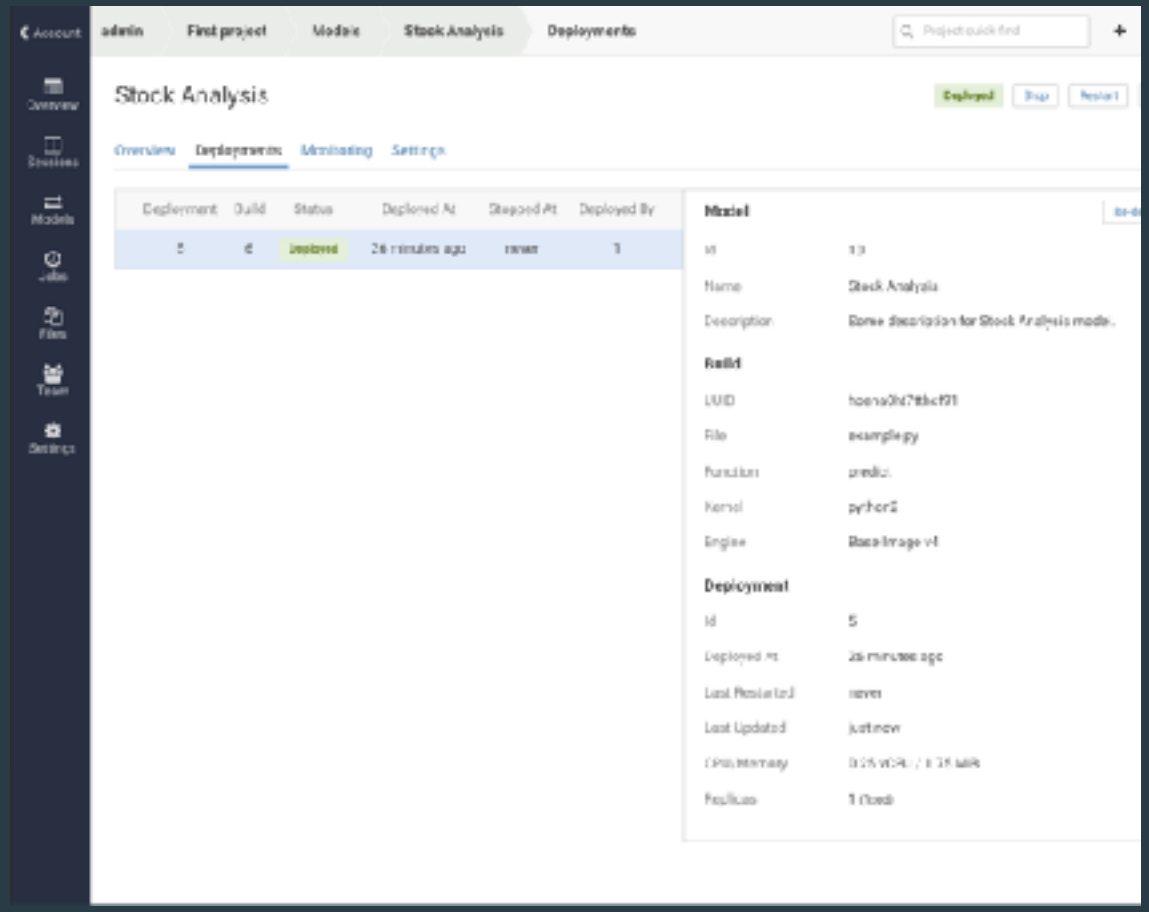
Running model containers also have access to CDH for data lookups.

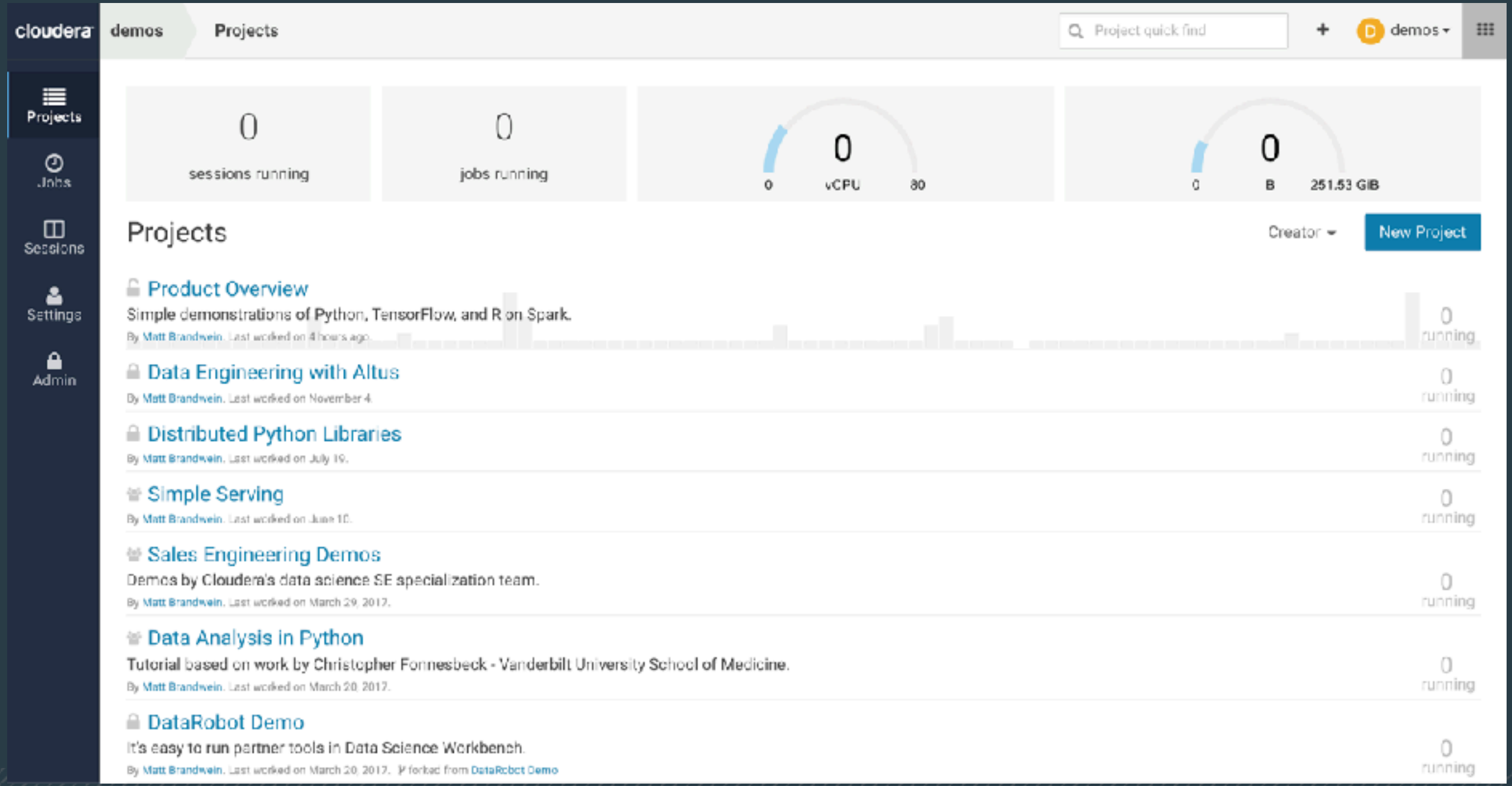


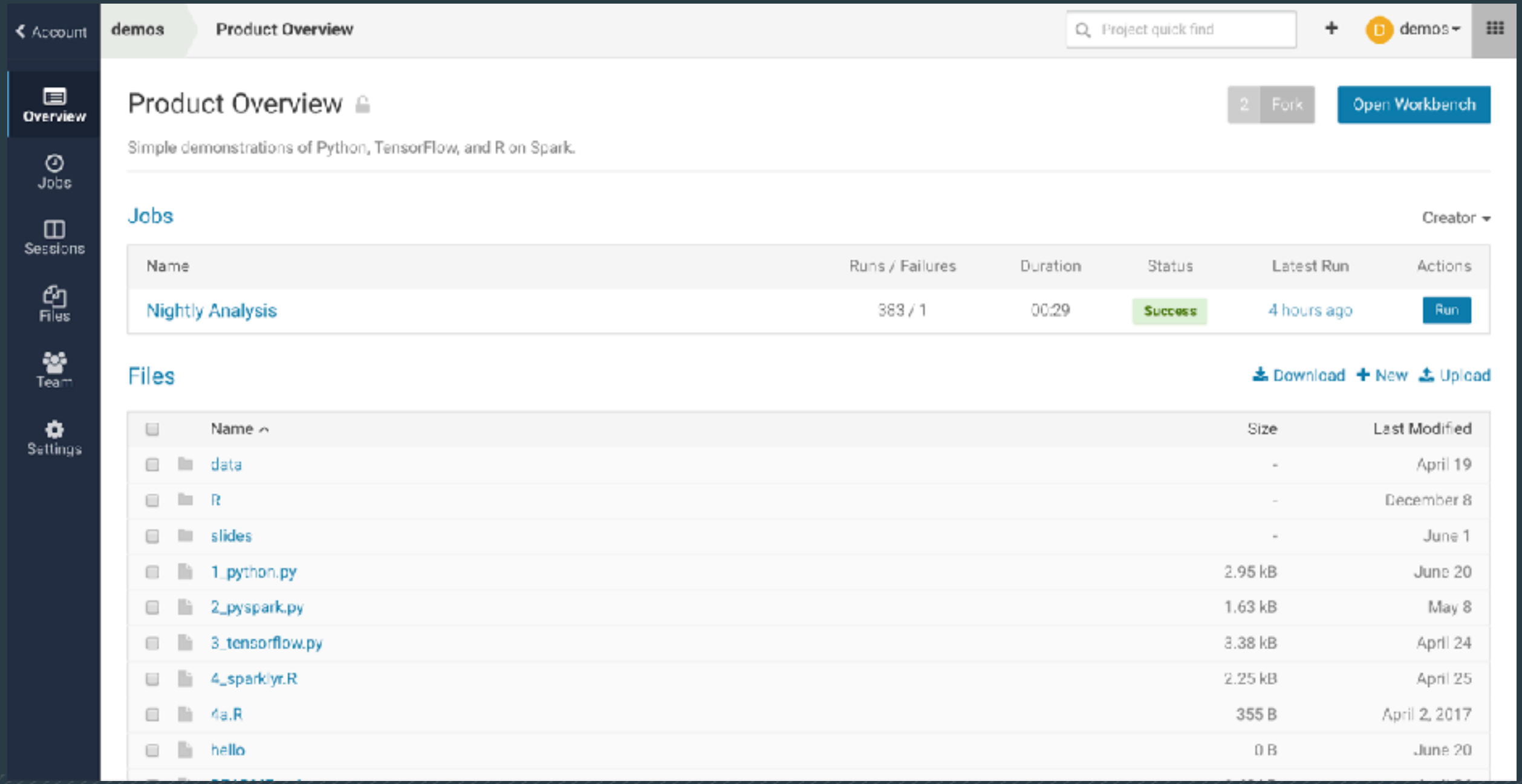
MODEL MANAGEMENT

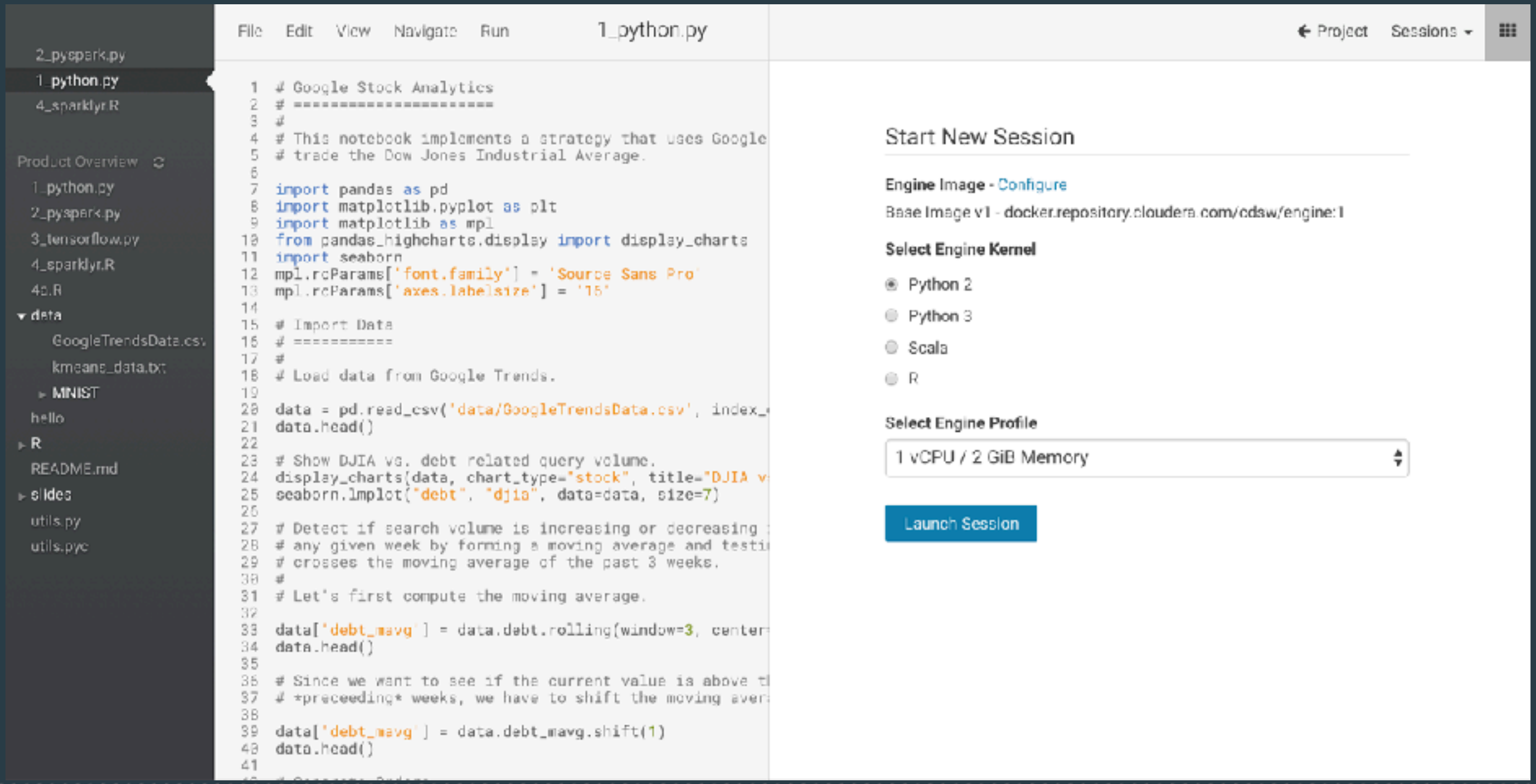
View, test, monitor, and update models by team or project

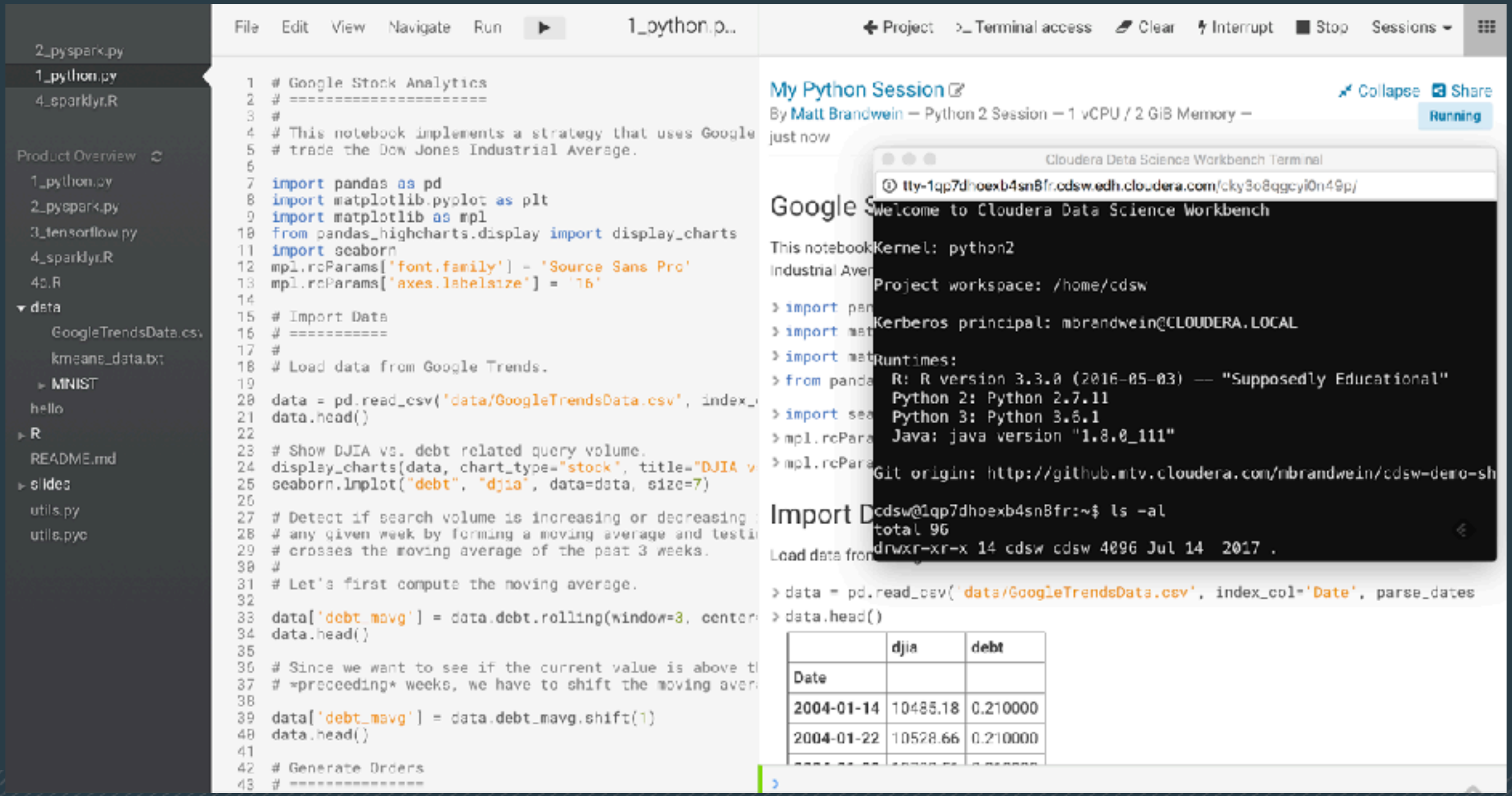








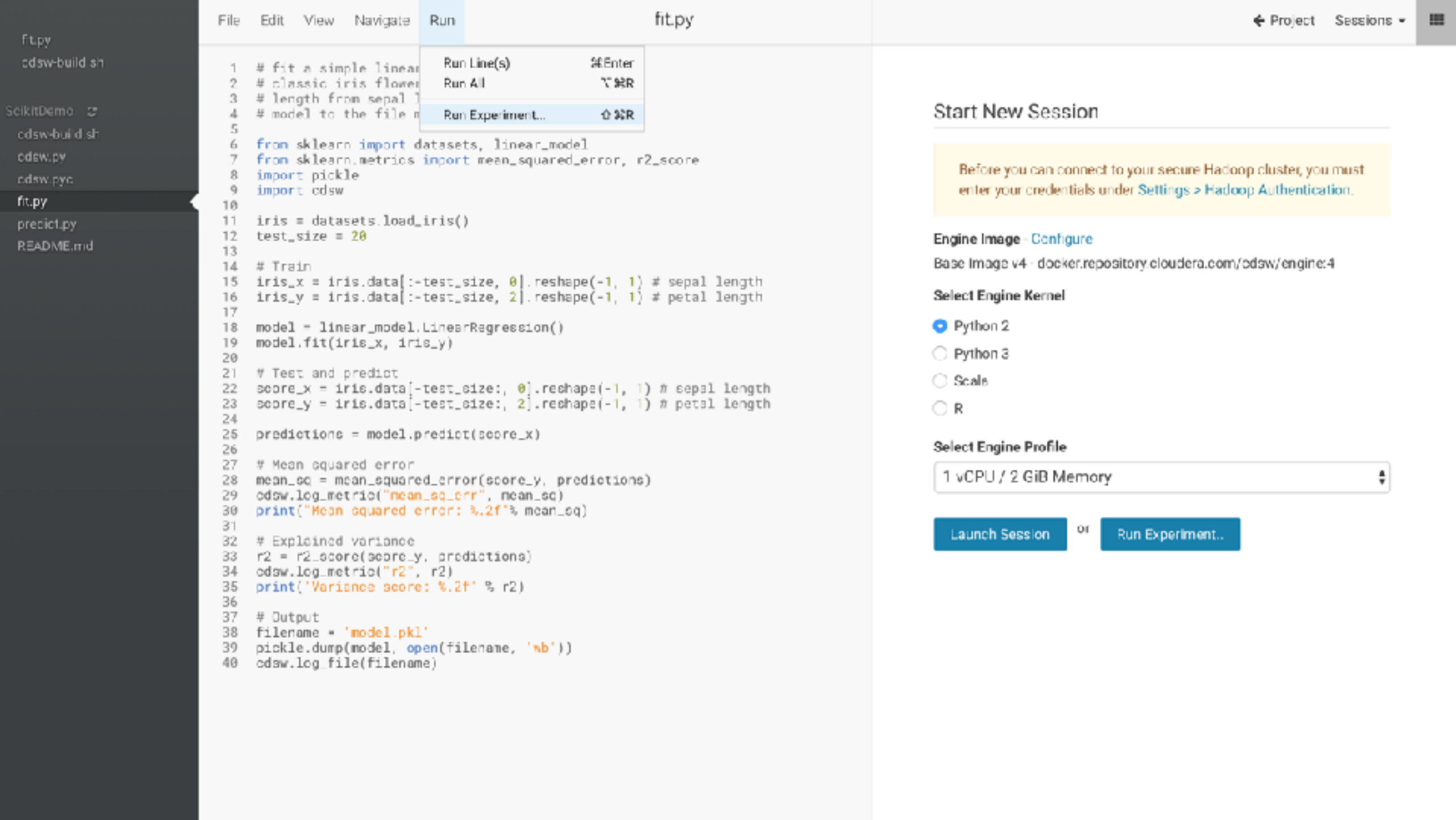


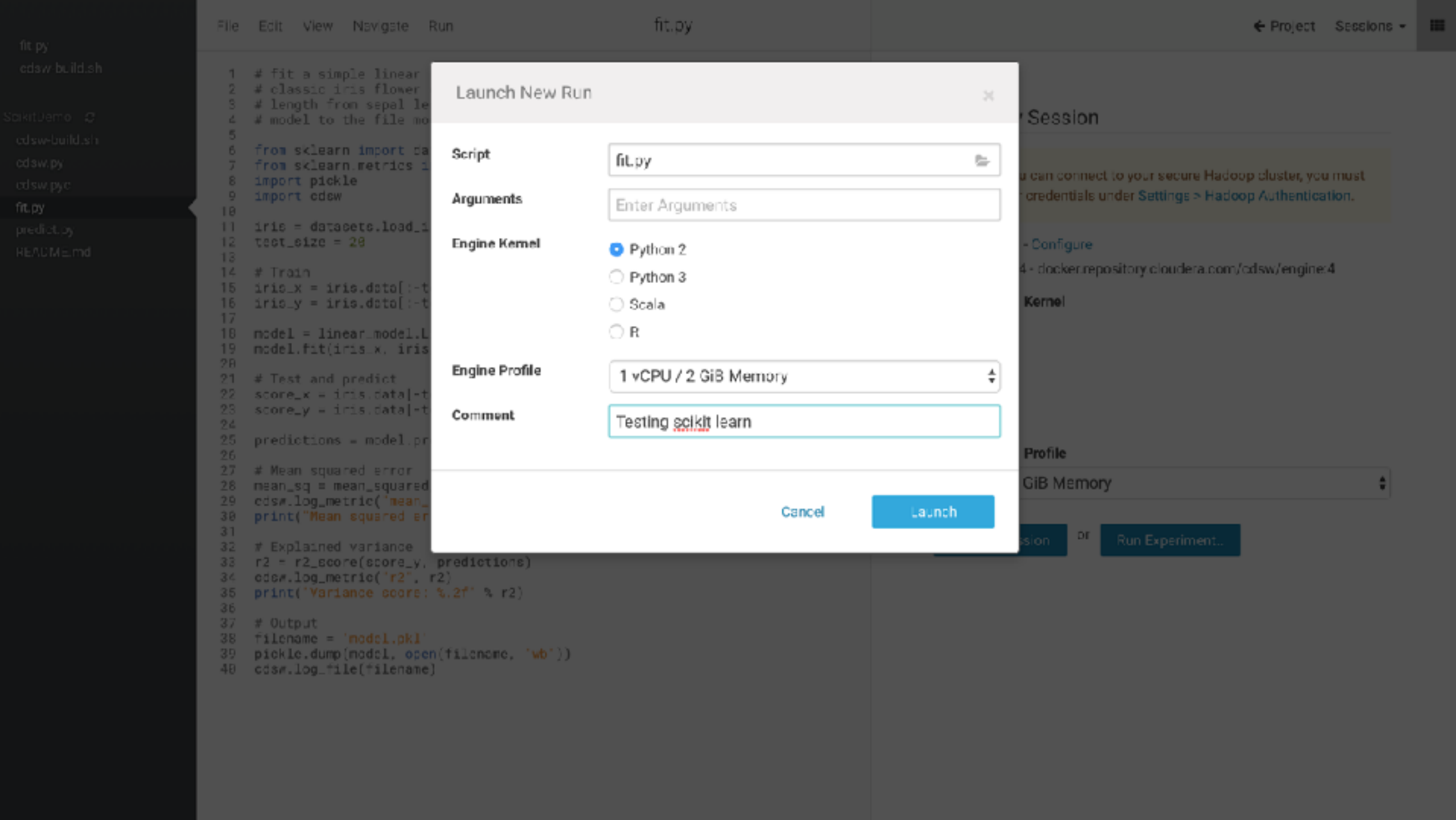


CDSW
DEMO

THANK YOU

cloudera


fit.py
cdsw-build.sh
ScikitDemo
cdsw-build.sh
cdsw.py
cdsw.pyc
fit.py
predict.py
README.md
File
Edit
View
Navigate
Run
fit.py
Project
Sessions
Run Line(s) ⌘Enter
Run All ⌥⌘R
Run Experiment... ⇧⌘R
# fit a simple linear
# classic iris flower
# length from sepal l
# model to the file m
from sklearn import datasets, linear_model
from sklearn.metrics import mean_squared_error, r2_score
import pickle
import cdsw
iris = datasets.load_iris()
test_size = 20
# Train
iris_x = iris.data[:-test_size, 0].reshape(-1, 1) # sepal length
iris_y = iris.data[:-test_size, 2].reshape(-1, 1) # petal length
model = linear_model.LinearRegression()
model.fit(iris_x, iris_y)
# Test and predict
score_x = iris.data[-test_size:, 0].reshape(-1, 1) # sepal length
score_y = iris.data[-test_size:, 2].reshape(-1, 1) # petal length
predictions = model.predict(score_x)
# Mean squared error
mean_sq = mean_squared_error(score_y, predictions)
cdsw.log_metric("mean_sq_err", mean_sq)
print("Mean squared error: %.2f"% mean_sq)
# Explained variance
r2 = r2_score(score_y, predictions)
cdsw.log_metric("r2", r2)
print('Variance score: %.2f' % r2)
# Output
filename = 'model.pkl'
pickle.dump(model, open(filename, 'wb'))
cdsw.log_file(filename)
Start New Session
Before you can connect to your secure Hadoop cluster, you must enter your credentials under Settings > Hadoop Authentication.
Engine Image · Configure
Base Image v4 · docker.repository.cloudera.com/cdsw/engine:4
Select Engine Kernel
Python 2
Python 3
Scala
R
Select Engine Profile
1 vCPU / 2 GiB Memory
Launch Session
or
Run Experiment...


File Edit View Navigate Run
fit.py
Project Sessions
fit.py
cdsw_build.sh
SciKitDemo
cdsw-build.sh
cdsw.py
cdsw.pyc
fit.py
predict.py
README.md
# fit a simple linear
# classic iris flower
# length from sepal le
# model to the file mo
from sklearn import da
from sklearn.metrics i
import pickle
import cdsw
iris = datasets.load_i
test_size = 20
# Train
iris_x = iris.data[:-t
iris_y = iris.data[:-t
model = linear_model.L
model.fit(iris_x, iris
# Test and predict
score_x = iris.data[-t
score_y = iris.data[-t
predictions = model.pr
# Mean squared error
mean_sq = mean_squared
cdsw.log_metric("mean_
print("Mean squared er
# Explained variance
r2 = r2_score(score_y, predictions)
cdsw.log_metric("r2", r2)
print('Variance score: %.2f' % r2)
# Output
filename = 'model.pkl'
pickle.dump(model, open(filename, 'wb'))
cdsw.log_file(filename)
Launch New Run
Script
fit.py
Arguments
Enter Arguments
Engine Kernel
Python 2
Python 3
Scala
R
Engine Profile
1 vCPU / 2 GiB Memory
Comment
Testing scikit learn
Cancel
Launch
Session
u can connect to your secure Hadoop cluster, you must
credentials under Settings > Hadoop Authentication.
- Configure
4 - docker.repository.cloudera.com/cdsw/engine:4
Kernel
Profile
GiB Memory
or
Run Experiment...

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2 metrics
New Run

Run	Script	Arguments	Kernel	Comment	Submitter	Created At	r2	mean_sq_err	Status	Duration
305	fit.py		python2	Alter script	admin	5/8/18 11:11 AM			Building	
304	fit.py		python2	Testing scikit learn	admin	5/8/18 11:10 AM	-3.2038	0.7015	Success	0 mins
303	fit.py		python2	Changing sample size	admin	5/8/18 11:10 AM	-3.2038	0.7015	Success	0 mins
302	fit.py		python2	Testing scikit learn	admin	5/8/18 11:10 AM	-3.2038	0.7015	Success	0 mins
301	fit.py		python3	Testing scikit learn	admin	5/8/18 11:08 AM			Failure	0 mins
300	fit.py		python2	Testing scikit learn	admin	5/8/18 11:03 AM	-3.2038	0.7015	Success	0 mins
299	fit.py		python2	test buildsh	admin	5/8/18 10:55 AM			Failure	0 mins

Run-306

Re-run

Building

Build Id: **589e8234-c39d-4e7d-99f6-62dc2f3b7d56**

```
Sending build context to Docker daemon 1.352 MB

Step 1/6 : FROM docker.repository.cloudera.com/cdsw/engine:4
 ---> 62e5f1fa8baa
Step 2/6 : COPY sources /home/cdsw
 ---> ba4dfdf49295
Removing intermediate container f6f360141303
Step 3/6 : WORKDIR /home/cdsw
 ---> 66e5b433a8fc
Removing intermediate container f2ee353ffc55
Step 4/6 : RUN /home/cdsw/cdsw-build.sh
 ---> Running in 03312512a8fc
[91m'import sitecustomize' failed; use -v for traceback
[0mCollecting scikit-image==0.12.3 (from -r requirements.txt (line 1))
  Downloading
https://files.pythonhosted.org/packages/32/b0/d1e2c4a95747542f03338bd65e403a5a2dcbffb782a0d66d8fd73cd6ff82/scikit_image-
0.12.3-1-cp27-cp27mu-manylinux1_x86_64.whl (28.2MB)
Collecting scikit-learn==0.18.1 (from -r requirements.txt (line 2))
  Downloading
https://files.pythonhosted.org/packages/ca/0f/bfadd2f0ef390c6d6d38624823dfa63479b4e63820de94a960d1a14c585d/scikit_learn-
0.18.1-cp27-cp27mu-manylinux1_x86_64.whl (11.6MB)
```

Run-306

Re-run

Success

Fit a simple LR model to the classic iris flower dataset to predict petal length from sepal length, and write the fitted model to the file model.pkl

```
> from sklearn import datasets, linear_model
> from sklearn.metrics import mean_squared_error, r2_score
> import pickle
> import cdsw
> iris = datasets.load_iris()
> test_size = 20
```

Train

```
> iris_x = iris.data[:-test_size, 0].reshape(-1, 1) # sepal length
> iris_y = iris.data[:-test_size, 2].reshape(-1, 1) # petal length
> model = linear_model.LinearRegression()
> model.fit(iris_x, iris_y)
```

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=1, normalize=False)
```

Test and predict

```
> score_x = iris.data[-test_size:, 0].reshape(-1, 1) # sepal length
> score_y = iris.data[-test_size:, 2].reshape(-1, 1) # petal length
> predictions = model.predict(score_x)
```

Mean squared error

```
> mean_sq = mean_squared_error(score_y, predictions)
> cdsw.log_metric("mean_sq_err", mean_sq)
> print("Mean squared error: %.2f"% mean_sq)
```

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Run-306

Rerun

Success

Overview | Console | Build Output

Config

Script	fit.py
Arguments	
Comment	Testing scikit learn
Snapshot	1f5d7069eed6d04ace8945ffbebc241857d1b6b5
Created At	5/8/18 11:12 AM
Submitter	admin

Metrics

mean_sq_err	0.7015130262209633
r2	-3.2038233781031504

Ouput

model.pkl

Save to project

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Success

Overview | Console | Build Output

Config

Script	fit.py
Arguments	
Comment	Testing scikit learn
Snapshot	1f5d7069eed6d04ace5945ffbebc241887d1b6b5
Created At	5/8/18 11:12 AM
Submitter	admin

Metrics

mean_sq_err	0.7015130262209633
r2	-3.2038233781031504

Ouput

- [x] model.pkl

Save to project

ScikitDemo

0 Fork | Open Workbench

Models

This project has no models yet. Create a new model.

Jobs

This project has no jobs yet. Create a new job to document your analytics pipelines.

Files

Delete | Move | Copy | Rename | Download | New | Upload

Name	Size	Last Modified
cdsw-build.sh	32 B	56 minutes ago
cdsw.py	9.19 kB	17 minutes ago
cdsw.pyc	10.28 kB	57 minutes ago
fit.py	1.10 kB	7 minutes ago
model.pkl	739 B	just now
predict.py	442 B	47 minutes ago
README.md	79 B	47 minutes ago
requirements.txt	476 B	24 minutes ago

Show Hidden Files

DEPLOY AND MANAGE MODELS DEMO

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ScikitDemo

1 running

Fork Open Workbench

Models

This project has no models yet. Create a new model.

Jobs

This project has no jobs yet. Create a new job to document your analytics pipelines.

Files

Download + New Upload

Name	Size	Last Modified
cdsw-build.sh	32 B	1 hour ago
cdsw.py	9.19 kB	1 hour ago
cdsw.pyc	10.28 kB	1 hour ago
fit.py	1.10 kB	1 hour ago
model.pkl	799 B	54 minutes ago
predict.py	442 B	1 hour ago
README.md	79 B	1 hour ago
requirements.txt	476 B	1 hour ago

Show Hidden Files

CDSW 1.4 Models Demo

Simple linear regression on iris data with scikit-learn

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Files / predict.py

Download Open in Workbench

```
# read the fitted model from the file model.pkl
# and define a function that uses the model to
# predict petal length from sepal length

# this currently fails beecuse Python cannot find
# the sklearn module, so it cannot reconstitute
# the fitted model object

import pickle

model = pickle.load(open('model.pkl', 'rb'))

def predict(args):
  iris_x = float(args.get('sepal_length'))
  result = model.predict(iris_x)
  return result[0][0]
```

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Create a Model

General

Name *

Iris Petal Predictor

Description *

Predicts the petal length of an iris from its sepal length.

Build

File *

predict.py

Function *

predict

Example Input

```
{
  "sepal_length": 10
}
```

Example Output

11.542927510360638

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Example Output

```
11.542927518366688
```

Kernel

- (•) Python 2
- ( ) Python 3
- ( ) Scala
- ( ) R

Comment

Enter comment for this build

Deployment

Engine Profile

0.25 vCPU / 1.75 GiB Memory

Replicas

2

Set Environmental Variables

Deploy Model | Cancel

Iris Petal Predictor

Building | Stop | Deploy New Build

Build	Status	File	Function	Kernel	Engine Image	Created By	Created At	Comment
1	Building	predict.py	predict	python2	Base Image v4	admin	May 8, 2018, 11:59 AM	Initial revision

Build Id: **0439e419-e44a-48e3-ea4f-0f088f323016**

```
Sending build context to Docker daemon  1.64 MB

Step 1/16 : FROM docker-registry.infra.cloudera.com/cdsw/engine:4
 ---> 62a5f1fa8baa
Step 2/16 : RUN apt-get update && apt-get install -y   curl   wget   build-essential   xz-utils &&   rm -rf
/var/lib/apt/lists/*
 ---> Using cache
 ---> c56b5034fb95
Step 3/16 : RUN wget --quiet https://nodejs.org/dist/v8.9.1/node-v8.9.1-linux-x64.tar.xz &&   tar -C /usr/local --
```

Iris Petal Predictor

Deploying | Stop | Deploy New Build

Build	Status	File	Function	Kernel	Engine Image	Created By	Created At	Comment
1	Built	predict.py	predict	python2	Base Image v4	admin	May 8, 2018, 11:59 AM	Initial revision.

Build Id: **0439e419-e41a-48a3-aa4f-0f888f323016**

```
Sending build context to Docker daemon  1.64 MB

Step 1/16 : FROM docker-registry.infra.cloudera.com/cdsw/engine:4
 ---> 62a5f1fa8baa
Step 2/16 : RUN apt-get update && apt-get install -y   curl   wget   build-essential   xz-utils &&   rm -rf
/var/lib/apt/lists/*
 ---> Using cache
 ---> c56b5834fb95
Step 3/16 : RUN wget --quiet https://nodejs.org/dist/v8.9.1/node-v8.9.1-linux-x64.tar.xz &&   tar -C /usr/local --
```

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Iris Petal Predictor

Deploying | Stop | Deploy New Build

Overview | Deployments | Builds | Monitoring | Settings

Id	Build	Status	Deployed At	Stopped At	Deployed By
152	1	Deploying	Never		admin

Model

Re-deploy This Build

Id	163
Name	Iris Petal Predictor
Description	Predicts the petal length of an iris from its sepal length.

Build

Build Number	1
UUID	0439e419-e44a-48a3-ae4f-0f868f323016
File	predict.py
Function	predict
Kernel	python2
Engine	Base Image v4

Deployment

Id	152
Deployed At	Never
Last Restarted	Never
Last Updated	May 8, 2018, 12:03 PM

Resources

Replicas	0 available of 2 requested

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Iris Petal Predictor

Deployed | Stop | Restart | Deploy New Build

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Id	Build	Status	Deployed At	Stopped At	Deployed By
152	1	Deployed	May 8, 2018, 12:03 PM		admin

Model

Re-deploy This Build

Id	163
Name	Iris Petal Predictor
Description	Predicts the petal length of an iris from its sepal length.

Build

Build Number	1
UUID	0439c419-b44a-48a3-aa4f-0f888f323016
File	predict.py
Function	predict
Kernel	python2
Engine	Base Image v4

Deployment

Id	152
Deployed At	May 8, 2018, 12:03 PM
Last Restarted	Never
Last Updated	May 8, 2018, 12:03 PM

Resources

Replicas	2

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Iris Petal Predictor

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Description: Predicts the petal length of an iris from its sepal length.

Sample Code: Shell | Python | R

```
curl -H 'Content-Type: application/json' -X POST http://cegner-cdsw2-4.vpc.cloudera.com/api/altus-ds-1/models/call-model -d '{"accessKey":"m50d8hrj5wp27gqbmm152y4515oeao4x","request":{"sepal_length":10}}'
```

Sample Response

```
11.542927510360683
```

Test Model

Input

```
{
  "sepal_length": 10
}
```

Test | Reset

Model Details

Model Id	163
Deployment	152
Build	158
Deployed By	admin
Comment	Initial revision.
Kernel	python2
Engine Image	Base Image v4
File	predict.py
Function	predict

Model Resources

Replicas	0 available of 2 requested
CPU Per Replica	0.25 vCPUs
Memory Per Replica	1.75 GiB
Total CPU	0 vCPUs
Total Memory	0 GiB

Sample Code

Shell | Python | R

```
curl -H "Content-Type: application/json" -X POST http://cegner-cdsw2-4.vpc.cloudera.com/api/altus-ds-1/models/call-model -d '{"accessKey":"m50d8hrj5wp27gqbmmi52y4515omac4x","request":{"sepal_length":10}}'
```

Sample Response

```
11.542927510360688
```

Test Model

Input

```
{
  "sepal_length": 10
}
```

Test | Reset

Result

Status	success
Response	11.542927510360688
Replica ID	iris-petal-predictor-163-152-67bf5b5446-422wc

Model Id	163
Deployment	152
Build	158
Deployed By	admin
Comment	Initial revision.
Kernel	python2
Engine Image	Base Image v4
File	predict.py
Function	predict

Model Resources

Replicas	2
CPU Per Replica	0.25 vCPUs
Memory Per Replica	1.75 GiB
Total CPU	0.5 vCPUs
Total Memory	3.5 GiB

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Log Echo

Deployed | Stop | Restart | Deploy New Build

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Replica	Status	Received	Processed	Success	Failure	Error	Busy	Not Ready
log-echo-23-149-7dc47d447-tznw5	Ready	1	1 (100 %)	1 (100 %)	0	0	0	0
log-echo-23-149-7dc47d447-nq782	Ready	4	4 (100 %)	4 (100 %)	0	0	0	0

```
2018-05-08 10:08:09.034 stdout 2018-05-08T17:08:05.208349 hello log files!
2018-05-08 10:08:09.034 stdout 2018-05-08T17:08:05.218472 hello log files!
2018-05-08 10:08:09.034 stdout 2018-05-08T17:08:05.228692 hello log files!
2018-05-08 10:08:09.034 stdout 2018-05-08T17:08:05.238863 hello log files!
2018-05-08 10:08:09.034 stdout 2018-05-08T17:08:05.248996 hello log files!
2018-05-08 10:00:03.748 2018-05-08 17:00:03,747 33      Model.Runtime   Start  Python model runtime in 33
2018-05-08 10:08:05.259 stderr 2018-05-08T17:08:05.259142 hello log files!
2018-05-08 10:08:05.269 stderr 2018-05-08T17:08:05.269343 hello log files!
2018-05-08 10:08:05.279 stderr 2018-05-08T17:08:05.279529 hello log files!
2018-05-08 10:08:05.289 stderr 2018-05-08T17:08:05.289681 hello log files!
2018-05-08 10:08:05.299 stderr 2018-05-08T17:08:05.299867 hello log files!
```

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Iris Petal Predictor

Deployed | Stop | Restart | Deploy New Build

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Name

Iris Petal Predictor

Description

Predicts the petal length of an iris from its sepal length.

Access Key — Regenerate

m50d8hrj5wp27gcbmmi52y4515oaaeo4x

Update

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ScikitDemo

1 running

0 Fork | Open Workbench

Models

Model	Status	Replicas	CPU	Memory	Last Deployed	Actions
Iris Petal Predictor	Deployed	2 / 2	0.5	3.5 GiB	May 8, 2018, 12:03 PM	Stop

Jobs

This project has no jobs yet. Create a new job to document your analytics pipelines.

Files

Download + New Upload

Name	Size	Last Modified
cdsw-build.sh	32 B	1 hour ago
cdsw.py	9.19 kB	1 hour ago
cdsw.pyc	10.28 kB	1 hour ago
fit.py	1.10 kB	1 hour ago
model.pkl	799 B	55 minutes ago
predict.py	442 B	1 hour ago
README.md	79 B	1 hour ago
requirements.txt	476 B	1 hour ago

Show Hidden Files

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Site Administration

Overview Users Activity Models Engines Security License Settings

1	2	0.5	3.5
Active Models	Active Model Replicas	Total Requested CPU	Total Requested Memory (GiB)

Active Models

Model	Project	Status	Replicas	CPU	Memory	Deployed By	Last Deployed	Actions
Iris Petal Predictor	ScikitDemo	Deployed	2 / 2	0.5	3.5 GiB	admin	May 8, 2018, 12:03 PM	Stop