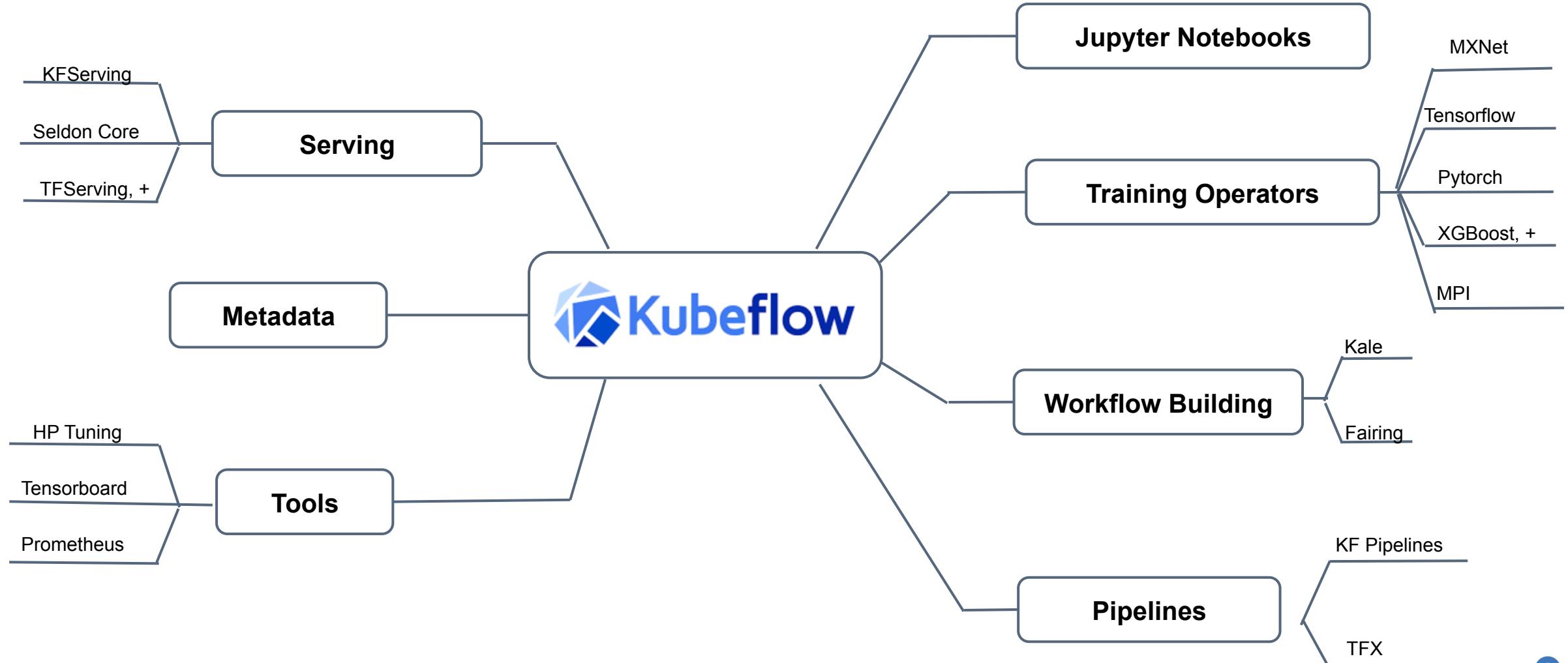




Animesh Singh, Christian Kadner, Tommy Li



# Kubeflow Pipelines



- Containerized implementations of ML Tasks
  - Pre-built components: Just provide params or code snippets (e.g. training code)
  - Create your own components from code or libraries
  - Use any runtime, framework, data types
  - Attach k8s objects - volumes, secrets
- Specification of the sequence of steps
  - Specified via Python DSL
  - Inferred from data dependencies on input/output
- Input Parameters
  - A “Run” = Pipeline invoked w/ specific parameters
  - Can be cloned with different parameters
- Schedules
  - Invoke a single run or create a recurring scheduled pipeline

Pipelines

[Getting Started](#)

**Pipelines** (selected)

[Experiments](#)

[Artifacts](#)

[Executions](#)

[Archive](#)

[Documentation](#)

[Github Repo](#)

[AI Hub Samples](#)

Pipelines

← [Demo] TFX - Taxi Tip Prediction Model Trainer ([Demo] TFX - T...)

+ Create run + Upload version + Create experiment Delete

[Graph](#) [YAML](#)

```

graph TD
    csvexamplegen[csvexamplegen] --> statisticsgen[statisticsgen]
    statisticsgen --> schemagen[schemagen]
    schemagen --> examplevalidator[examplevalidator]
    schemagen --> transform[transform]
    examplevalidator --> trainer[trainer]
    transform --> trainer
    trainer --> evaluator[evaluator]
    trainer --> modelvalidator[modelvalidator]
    evaluator --> pusher[pusher]
    modelvalidator --> pusher
  
```

Pipelines

[Upload pipeline](#) Refresh Delete

Pipeline name	Description	Uploaded on
[Sample] Basic - Condition	A pipeline shows how to use dsl.Condition. For source code, refer to https://github.com/ku...	02/01/2019, 11:24:37
[Sample] Basic - Exit Handler	A pipeline that downloads a message and print it out. Exit Handler will run at the end. For ...	02/01/2019, 11:24:36
[Sample] Basic - Immediate ...	A pipeline with parameter values hard coded. For source code, refer to https://github.com/...	02/01/2019, 11:24:34
[Sample] Basic - Parallel Join	A pipeline that downloads two messages in parallel and print the concatenated result. For ...	02/01/2019, 11:24:33
[Sample] Basic - Sequential	A pipeline with two sequential steps. For source code, refer to https://github.com/kubeflo...	02/01/2019, 11:24:32
[Sample] ML - TFX - Taxi Tip ...	Example pipeline that does classification with model analysis based on a public tax cab Bl...	02/01/2019, 11:24:30
[Sample] ML - XGBoost - Trai...	A trainer that does end-to-end distributed training for XGBoost models. For source code, re...	02/01/2019, 11:24:29

Pipelines

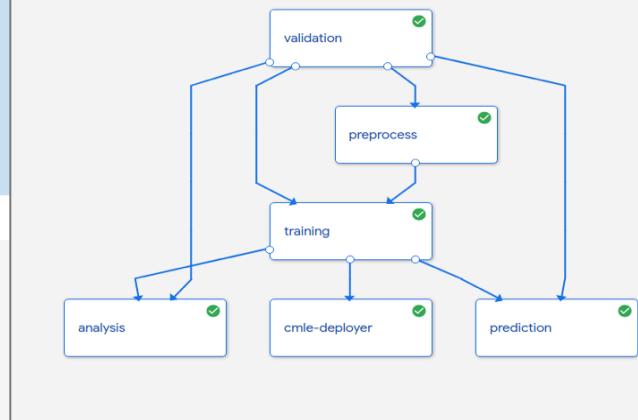
[Upload pipeline](#) Refresh Delete

Pipeline name	Description	Uploaded on
[Sample] Basic - Condition	A pipeline shows how to use dsl.Condition. For source code, refer to https://github.com/ku...	02/01/2019, 11:24:37
[Sample] Basic - Exit Handler	A pipeline that downloads a message and print it out. Exit Handler will run at the end. For ...	02/01/2019, 11:24:36
[Sample] Basic - Immediate ...	A pipeline with parameter values hard coded. For source code, refer to https://github.com/...	02/01/2019, 11:24:34
[Sample] Basic - Parallel Join	A pipeline that downloads two messages in parallel and print the concatenated result. For ...	02/01/2019, 11:24:33
[Sample] Basic - Sequential	A pipeline with two sequential steps. For source code, refer to https://github.com/kubeflo...	02/01/2019, 11:24:32
[Sample] ML - TFX - Taxi Tip ...	Example pipeline that does classification with model analysis based on a public tax cab Bl...	02/01/2019, 11:24:30
[Sample] ML - XGBoost - Trai...	A trainer that does end-to-end distributed training for XGBoost models. For source code, re...	02/01/2019, 11:24:29

# Define Pipeline with Python SDK

```
@dsl.pipeline(name='Taxi Cab Classification Pipeline Example')
def taxi_cab_classification(
    output_dir,
    project,
    Train_data      = 'gs://bucket/train.csv',
    Evaluation_data = 'gs://bucket/eval.csv',
    Target          = 'tips',
    Learning_rate   = 0.1, hidden_layer_size = '100,50', steps=3000):

    tfdv           = TfdvOp(train_data, evaluation_data, project, output_dir)
    preprocess     = PreprocessOp(train_data, evaluation_data, tfdv.output["schema"], project, output_dir)
    training       = DnnTrainerOp(preprocess.output, tfdv.schema, learning_rate, hidden_layer_size, steps,
                                target, output_dir)
    tfma           = TfmaOp(training.output, evaluation_data, tfdv.schema, project, output_dir)
    deploy         = TfServingDeployerOp(training.output)
```



## Compile and Submit Pipeline Run

```
dsl.compile(taxi_cab_classification, 'tfx.tar.gz')
run = client.run_pipeline(
    'tfx_run', 'tfx.tar.gz', params={'output': 'gs://dpa22', 'project': 'my-project-33'})
```





# Visualize the state of various components

IBM Data Science Experience interface showing a runtime execution graph and component details.

**Left Sidebar:**

- Pipelines
- Experiments
- Artifacts
- Executions
- Archive
- Documentation
- Github Repo
- AI Hub Samples

Cluster name: cluster-4  
Build commit: 743746b  
Report an Issue

**Runtime Execution Graph (Graph Tab):**

```
graph TD; csvexampleger --> statisticsgen; statisticsgen --> schemagen; schemagen --> examplevalidator; examplevalidator --> resolvernode-lates...; resolvernode-lates... --> evaluator; evaluator --> pusher;
```

**Component Details (Artifacts Tab):**

**Static HTML**

Sort by Feature ▾  Reverse order  Feature search (...)

Features:  int(8)  float(7)  string(2)  
 unknown(1)

**Numeric Features (15)**

	count	missing	mean	std dev
dropoff_census_tract	3,618	28.93%	17.0B	333k
dropoff_community_area	4,905	3.65%	21.2	17.85
dropoff_latitude	4,915	3.46%	41.9	0.04
dropoff_longitude	4,915	3.46%	-87.65	0.06



# Pipelines versioning

Pipelines

[+ Upload pipeline](#)[Refresh](#)[Delete](#)

Filter pipelines



<input type="checkbox"/>	Pipeline name	Description	Uploaded on
<input type="checkbox"/>	[Tutorial] DSL - Control structures	<a href="#">source code</a> Shows how to use conditional execution and exit handlers. This pipeline will randomly fail to demonstra...	2/20/2020, 3:28:12 PM
<input type="checkbox"/>	[Tutorial] Data passing in python com...	<a href="#">source code</a> Shows how to pass data between python components.	2/20/2020, 3:28:11 PM
<input type="checkbox"/>	[Demo] TFX - Taxi Tip Prediction Mod...	<a href="#">source code</a> <a href="#">GCP Permission requirements</a> . Example pipeline that does classification with model analysis based on ...	2/20/2020, 3:28:10 PM
<input type="checkbox"/>	Version name		Uploaded on
<input type="checkbox"/>	TFX - Taxi Tip Prediction Model Trainer_version_at_2020-03-03T15:44:30.197Z		3/3/2020, 7:55:03 AM
<input type="checkbox"/>	[Demo] TFX - Taxi Tip Prediction Model Trainer		2/20/2020, 3:28:10 PM
			Rows per page: 10 < >
<input type="checkbox"/>	[Demo] XGBoost - Training with Confu...	<a href="#">source code</a> <a href="#">GCP Permission requirements</a> . A trainer that does end-to-end distributed training for XGBoost models.	2/20/2020, 3:28:09 PM
			Rows per page: 10 < >

Pipelines lets you group and manage multiple versions of a pipeline.





# Artifact Tracking

The screenshot shows the IBM Data Science Experience interface. On the left, a sidebar navigation menu includes: Getting Started, Pipelines, Experiments, Artifacts (selected), Executions, Archive, Documentation, Github Repo, and AI Hub Samples. The main area is titled "Artifacts" and displays a table of artifacts from a pipeline named "taxi\_pipeline\_with\_parameters". The table columns are: Pipeline/Workspace, Name, ID, Type, URI, and Created at. The data is as follows:

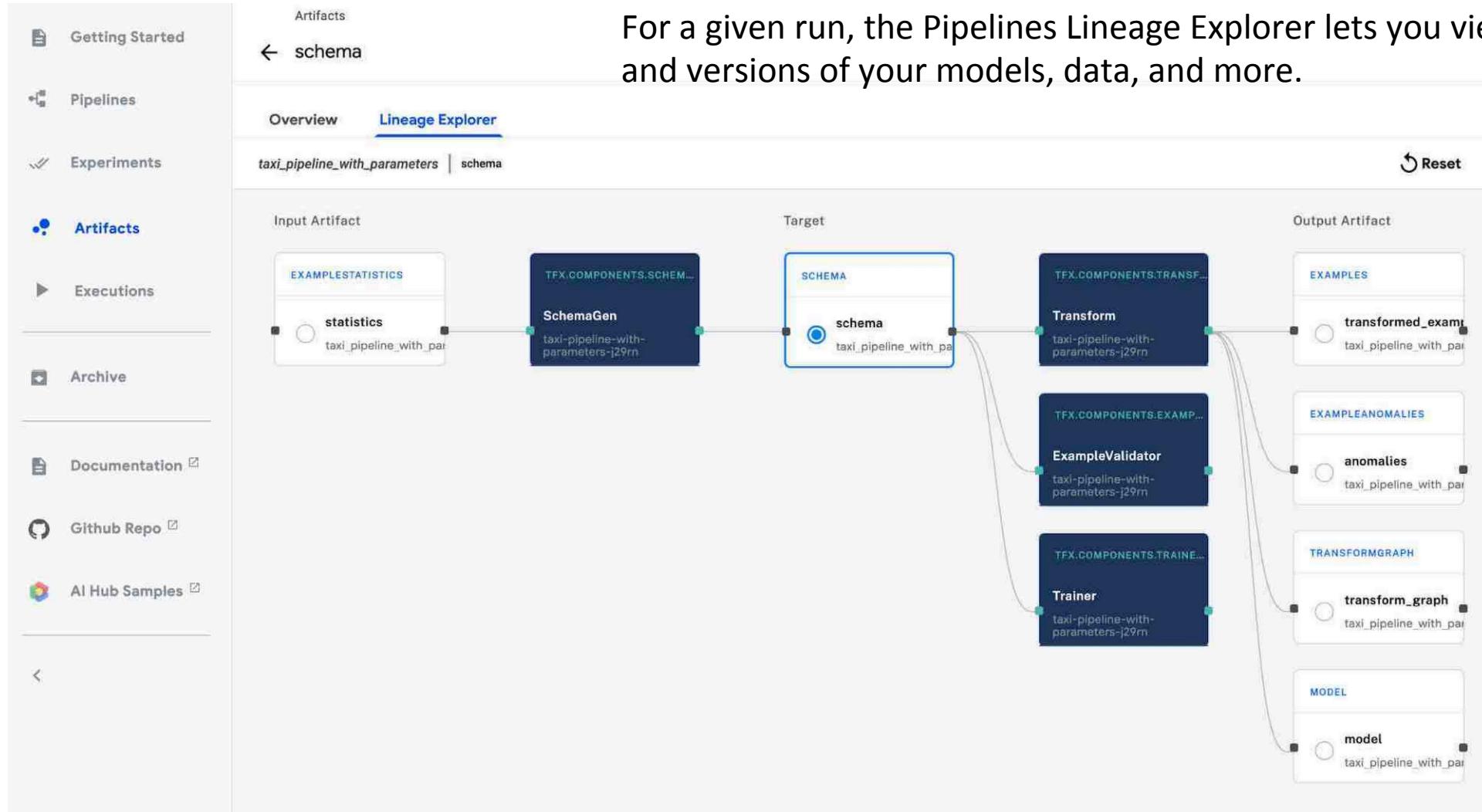
Pipeline/Workspace ↑	Name	ID	Type	URI	Created at
		1	ExternalArtifact	<a href="gs://ml-pipeline-playground/tfx_t...">gs://ml-pipeline-playground/tfx_t...</a>	
taxi_pipeline_with_parameters	examples	2	Examples	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:1...
	statistics	3	ExampleStatistics	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:1...
	schema	4	Schema	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:1...
	anomalies	5	ExampleAnomalies	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:1...
	transform_graph	6	TransformGraph	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:1...
	transformed_e...	7	Examples	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:1...
	model	8	Model	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:2...
	evaluation	9	ModelEvaluation	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:2...
	blessing	10	ModelBlessing	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:2...
	pushed_model	11	PushedModel	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:2...
	evaluation	12	ModelEvaluation	<a href="gs://aju-pipelines/tfx_taxi_simpl...">gs://aju-pipelines/tfx_taxi_simpl...</a>	2/20/2020, 5:4...

Below the table, a detailed view of the "model" artifact is shown. The "Overview" tab is selected, displaying the artifact's type (Model), URI ([gs://aju-pipelines/tfx\\_taxi\\_simple/85265540-6a06-4969-a49e-1f65741878be/Trainer/model/](gs://aju-pipelines/tfx_taxi_simple/85265540-6a06-4969-a49e-1f65741878be/Trainer/model/)), properties, and custom properties.

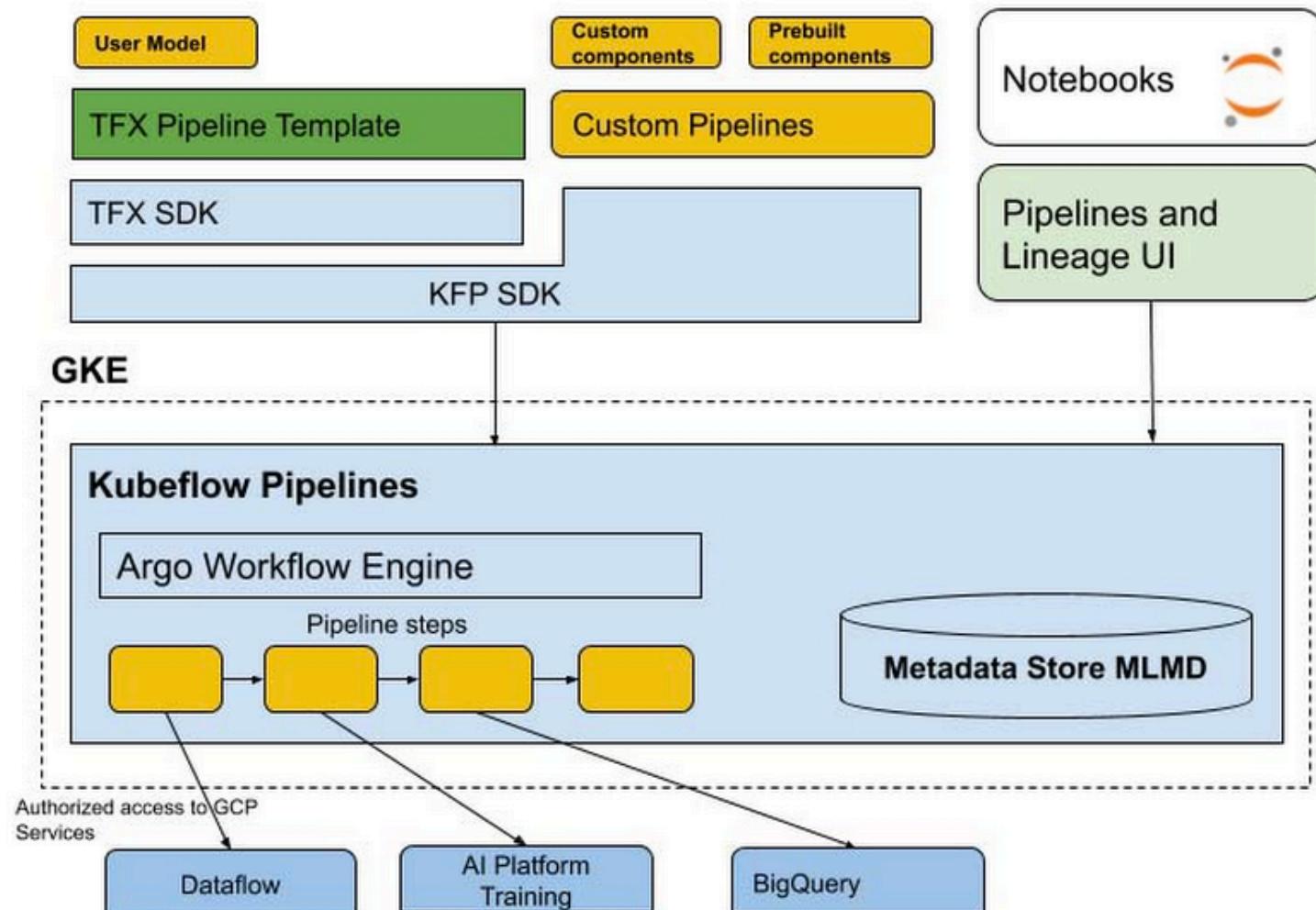
Artifacts for a run of the “TFX Taxi Trip” example pipeline. For each artifact, you can view details and get the artifact URL—in this case, for the model.



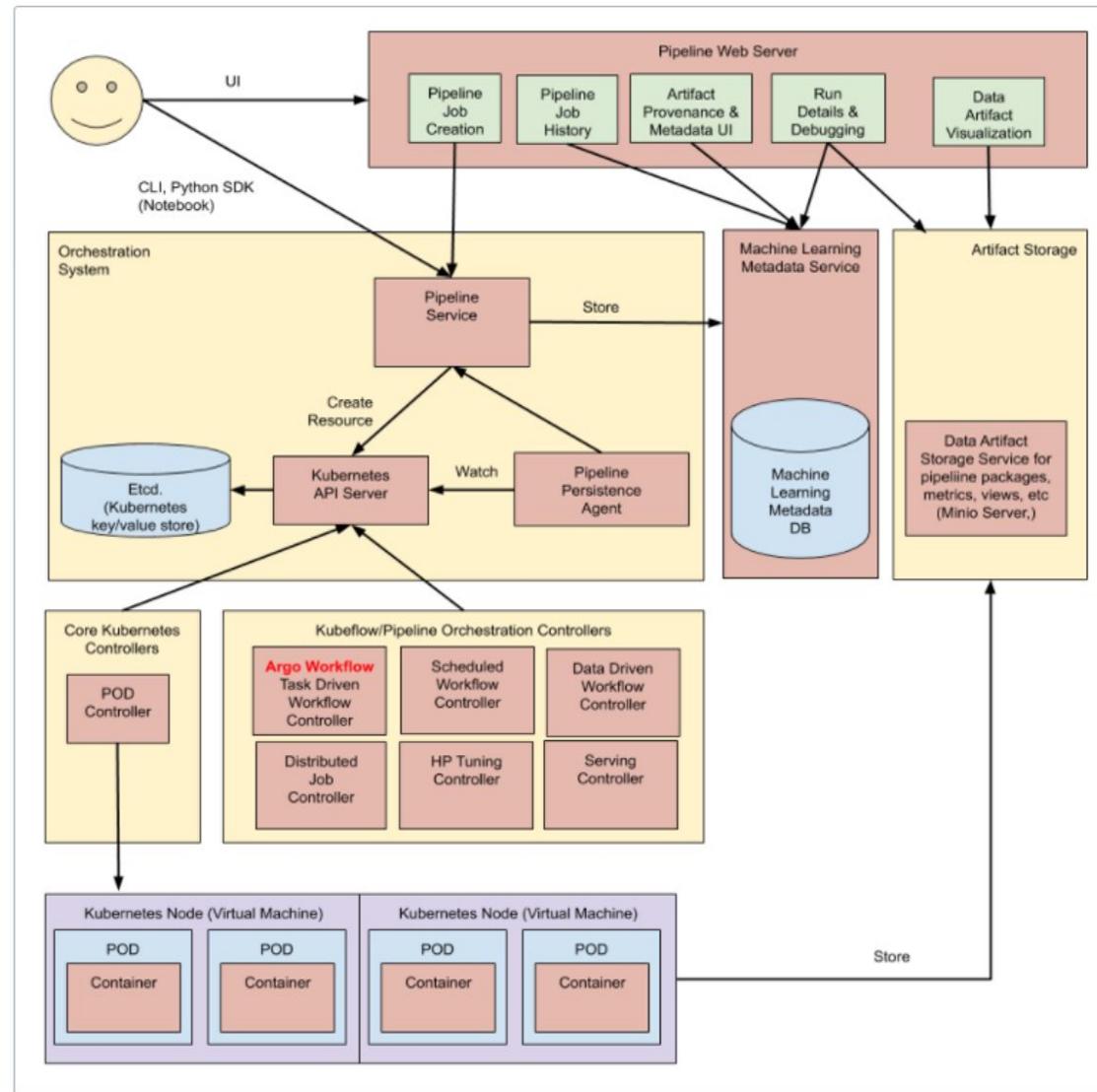
# Lineage Tracking



# Kubeflow Pipeline Architecture



# Kubeflow Pipeline Architecture





# Goals

- Demonstrate that Watson can be used for end-end AI lifecycle data prep/model training/model risk validation/model deployment/monitoring/updating models
- Demonstrate that the full lifecycle can be operated programmatically, and have **Tekton** as a backend instead of Argo

Kubeflow Select namespace ▾

Pipelines Experiments Artifacts Executions Archive Documentation GitHub Repo AI Hub Samples

Experiments > GCR-AutoAI-Experiment-1 ← Run of Train the model and monitor with OpenScale (a28a6)

Graph Run output Config

create-secret-wit... download-data-a... data-refinery dart-toolkit biased-data-split upload-data-asses... auto-ai-op deploy-model-to... mrm-check-in-openscale mrm-check-in-op...

train-the-model-and-monitor-with-openscale-pjpr-2081484978

Artifacts Input/Output Volumes Manifest Logs

```

19 Requirement already satisfied: numpy in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (1.1.3)
20 Requirement already satisfied: joblib<0.11 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (0.10.1)
21 Requirement already satisfied: python-dateutil<2.2 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (2.1.3)
22 Requirement already satisfied: six<1.16 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (1.12.0)
23 Requirement already satisfied: tensorflow<1.16 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (1.1.3)
24 Requirement already satisfied: pytz in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (2018.7)
25 Requirement already satisfied: cycler<0.10 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (0.10.0)
26 Requirement already satisfied: numpy<1.16 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (1.15.4)
27 Requirement already satisfied: networkx<2.0 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (1.11)
28 Requirement already satisfied: pillow<4.3.0 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (3.1.1)
29 Requirement already satisfied: imageio<2.3.0 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (2.3.0)
30 Requirement already satisfied: decorator<4.3.0 in /opt/app-root/lib/python3.6/site-packages (from tensorflow==1.1.3) (4.2.8)
31 drifitng...
32 enablement finished.
33 running mrm...
34 triggered mrm [data_mart_id: 00000000-0000-0000-0000-000000000000]
35 MRM monitor instance: 40451cc6-5df4-2af4-9226-833333333333
36 Triggering MRM computation with https://rcc-cod...
37 Done triggering MRM computation with mrm_monitor...
38 10:48:05 upload_in_progress
39 10:48:19 upload_in_progress
40 10:48:31 upload_in_progress
41 10:48:31 upload_in_progress

42 running upload and evaluate for validation_test
43 10:48:36 upload_in_progress
44 10:48:41 running
45 10:48:44 running
46 10:48:55 finished
47 running upload and evaluate for validation_test
48 10:49:01 upload_in_progress
49 10:49:04 upload_in_progress
50 10:49:28 running
51 10:49:44 running
52 10:49:58 running
53 10:49:59 finished
54 running upload and evaluate for validation_test
55 10:49:59 upload_in_progress
56 10:49:59 upload_in_progress
57 10:49:59 upload_in_progress
58 10:49:59 upload_in_progress
59 10:49:59 upload_in_progress
60 10:49:59 upload_in_progress
61 10:49:59 upload_in_progress
62 10:49:59 upload_in_progress
63 10:49:59 upload_in_progress
64 10:49:59 running
65 10:49:59 running
66 10:49:59 upload_in_progress
67 10:49:59 upload_in_progress
68 10:49:59 upload_in_progress
69 10:49:59 upload_in_progress
70 10:49:59 upload_in_progress
71 10:49:59 upload_in_progress
72 10:49:59 upload_in_progress
73 10:49:59 running
74 10:49:59 running
75 10:49:59 finished
76

```

Relationship map Prediction column: Risk

FEATURE TRANSFORMERS PIPELINES TOP ALGORITHMS german\_credit\_dat...

Experiment completed 8 PIPELINES GENERATED 8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

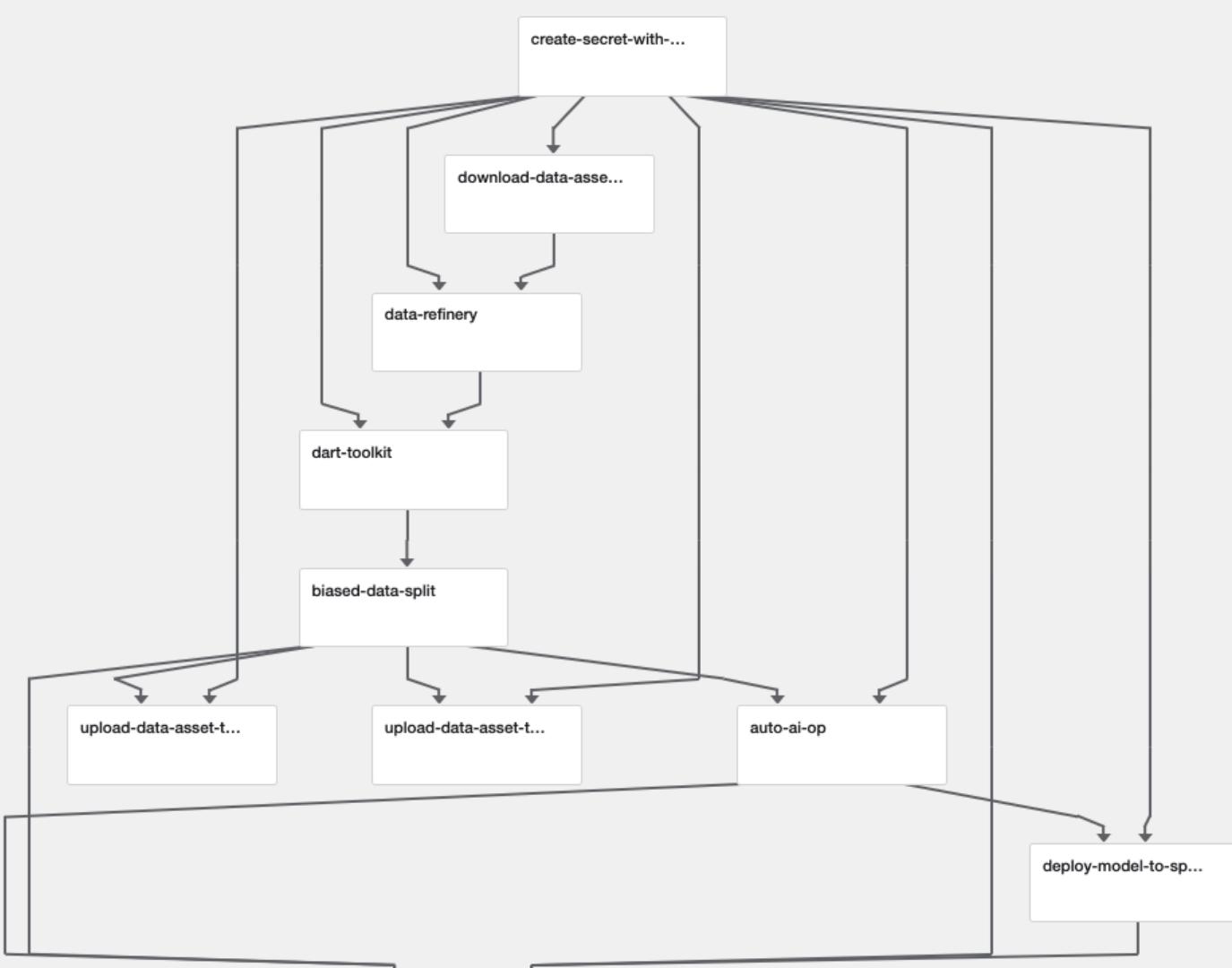
Time elapsed: 15 minutes

View full log

Pipeline leaderboard

Rank	Name	Algorithm	Accuracy (Optimized)	Enhancements	Build time
> 1	Pipeline 4	Gradient Boosting Classifier	0.807	HPO-1 FE HPO-2	00:01:48
> 2	Pipeline 3	Gradient Boosting Classifier	0.804	HPO-1 FE	00:04:19
> 3	Pipeline 2	Gradient Boosting Classifier	0.804	HPO-1	00:00:38
> 4	Pipeline 1	Gradient Boosting Classifier	0.802	None	00:00:07

Runtime execution graph. Only steps that are currently running or have already completed are shown.



## Run details

Pipeline\*

Train the model and monitor with OpenScale

[Choose](#)

Pipeline Version\*

Train the model and monitor with OpenScale

[Choose](#)

Run name\*

Run of Train the model and monitor with OpenScale (a28a6)

Description (optional)

This run will be associated with the following experiment

Experiment\*

GCR-AutoAI-Experiment-1

[Choose](#)

## Run Type

 One-off Recurring

## Run parameters

Specify parameters required by the pipeline

github\_token

6fd86cff0394892e772cd84d43a9e2d7546b1576

ai\_config\_url

https://raw.githubusercontent.com/IBM-Lifecycle-Poland/kubeflow-pipelines-credentials/master/config\_cpd

catalog\_name

DataCatalog

asset\_id

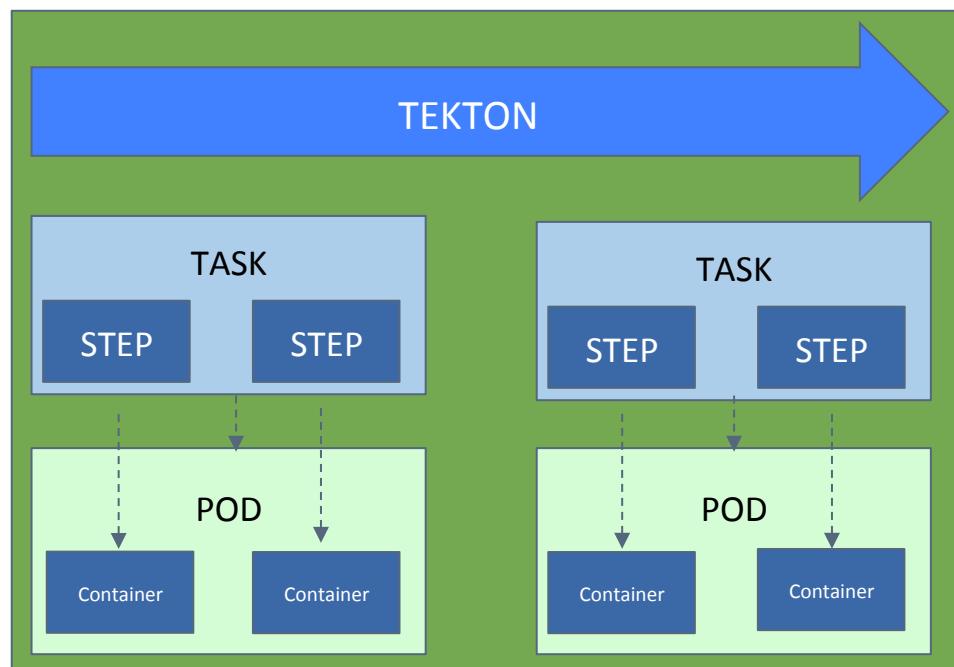
2737bafc-3f78-4e2d-850a-e7f352b3d6b8

pre\_production\_space\_uid

1dd2aaec-781a-4712-a7ff-ae1862cf7a84

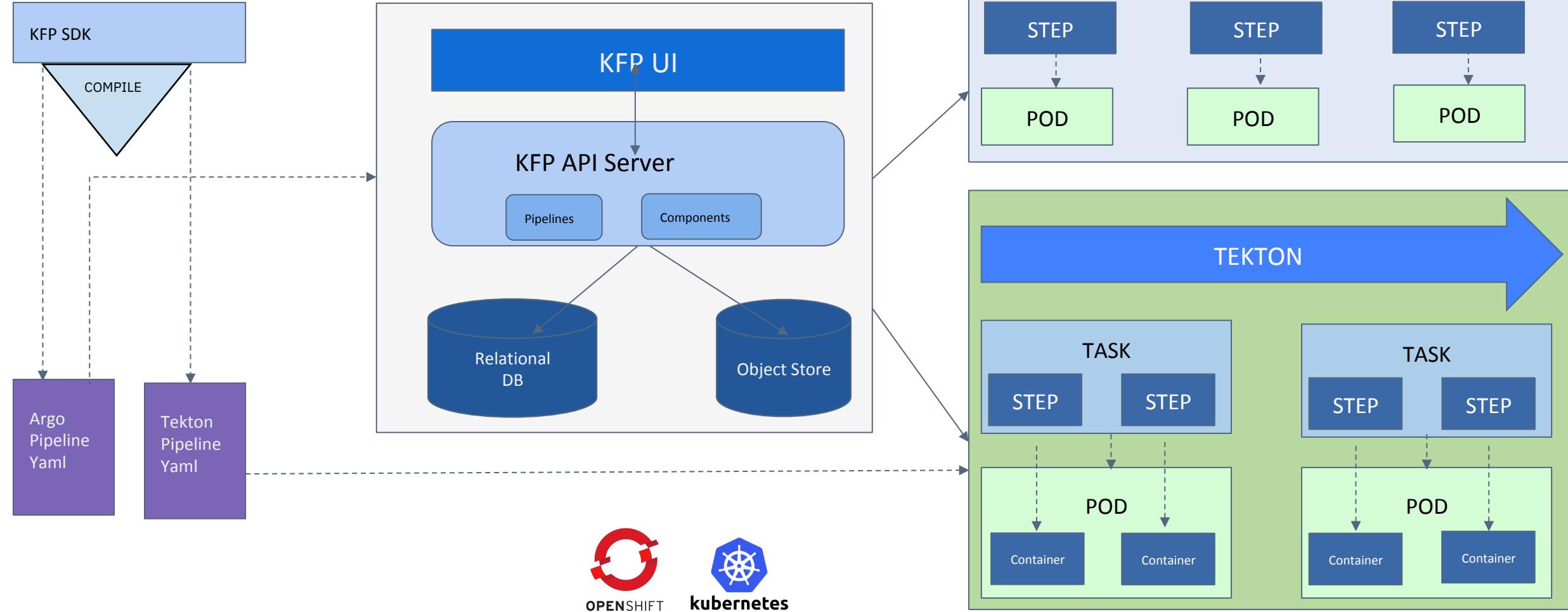
# Tekton

- The Tekton Pipelines project provides Kubernetes-style resources for declaring CI/CD-style pipelines.
- Tekton introduces several new CRDs including Task, Pipeline, TaskRun, and PipelineRun.
- A PipelineRun represents a single running instance of a Pipeline and is responsible for creating a Pod for each of its Tasks and as many containers within each Pod as it has Steps.



- A **PipelineResource** defines an object that is an input (such as a git repository) or an output (such as a docker image) of the pipeline.
- A **PipelineRun** defines an execution of a pipeline. It references the Pipeline to run and the PipelineResources to use as inputs and outputs.
- A **Pipeline** defines the set of Tasks that compose a pipeline.
- A **Task** defines a set of build Steps such as compiling code, running tests, and building and deploying images.

# KFP – Tekton Phase One

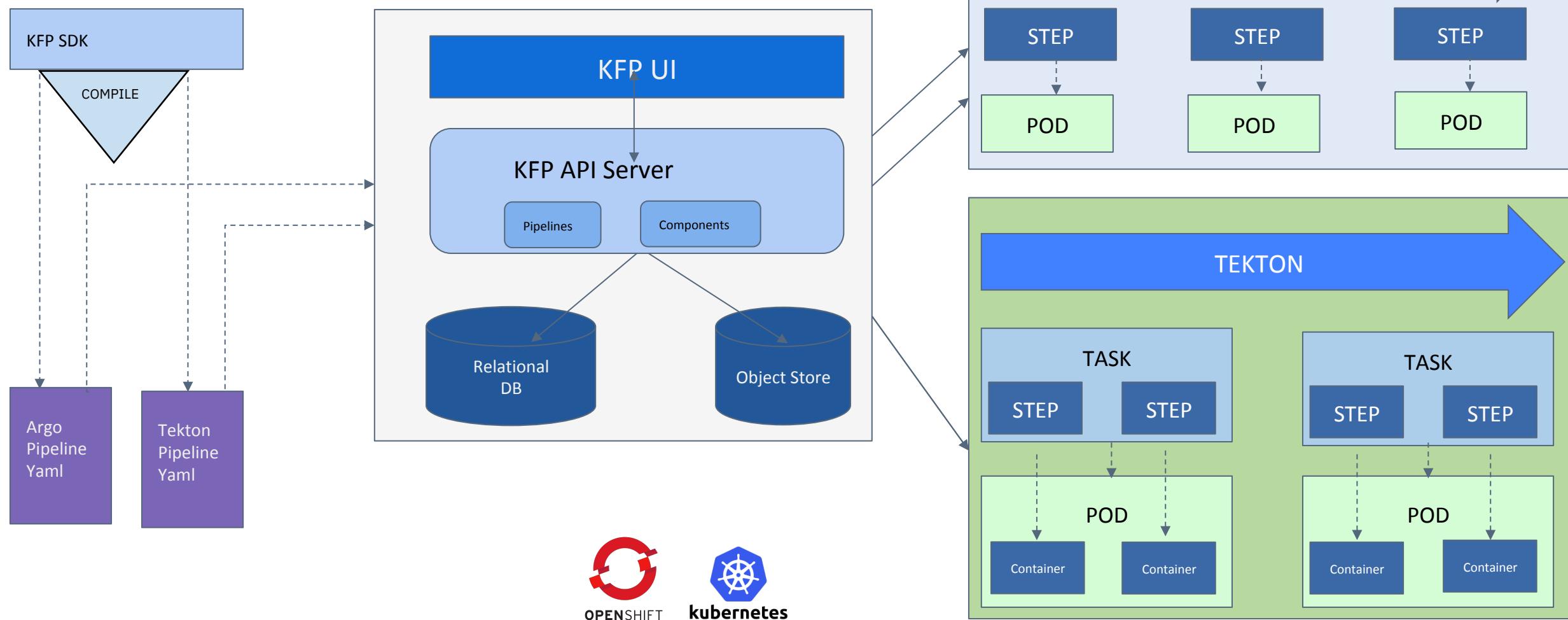


Pluggable Components

- Spark
- Watson Studio
- WML
- Open Scale
- Kubeflow Training
- Seldon
- AIF360
- ART
- KATIB
- KFSERVING
- ...



# KFP – Tekton Phase Two



OPENSHIFT



kubernetes

Pluggable Components



Spark

Watson Studio

WML

Open Scale

Kubeflow Training

Seldon

AIF360

ART

KATIB

KFSERVING

...



# DSL features implemented

- Pipeline DSL features with native Tekton implementation
  - pod\_annotations and pod\_labels
  - Retries
  - Volumes
  - Timeout for Tasks and Pipelines
  - RunAfter
  - Input Parameters
  - ContainerOp
  - Affinity, Node Selector, and Tolerations
- Pipeline DSL features with custom Tekton implementation
  - Features with same behavior as Argo
    - InitContainers
    - Conditions
    - ResourceOp, VolumeOp, and VolumeSnapshotOp
    - Output Parameters
    - Input Artifacts
    - Output Artifacts
  - Features with limitations
    - ParallelFor - Tracking issue
    - Variable Substitutions - Tracking issue
    - ImagePullSecrets - Tracking issue
  - Features with different behavior than Argo
    - Sidecars - Tracking issue
- Pipeline features that are unavailable on Tekton
  - Exit Handler - Tracking PR



# Pipeline samples we are running

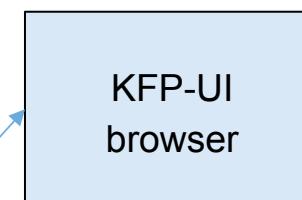
- MNIST End to End example with Kubeflow components
- Hyperparameter tuning using Katib
- Trusted AI Pipeline with AI Fairness 360 and Adversarial Robustness 360 components
- Training and Serving Models with Watson Machine Learning
- Lightweight python components example
- The flip-coin pipeline
- Nested pipeline example

[https://github.com/kubeflow/kfp-tekton/blob/master/samples/  
README.md](https://github.com/kubeflow/kfp-tekton/blob/master/samples/README.md)

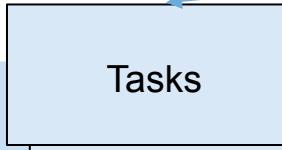
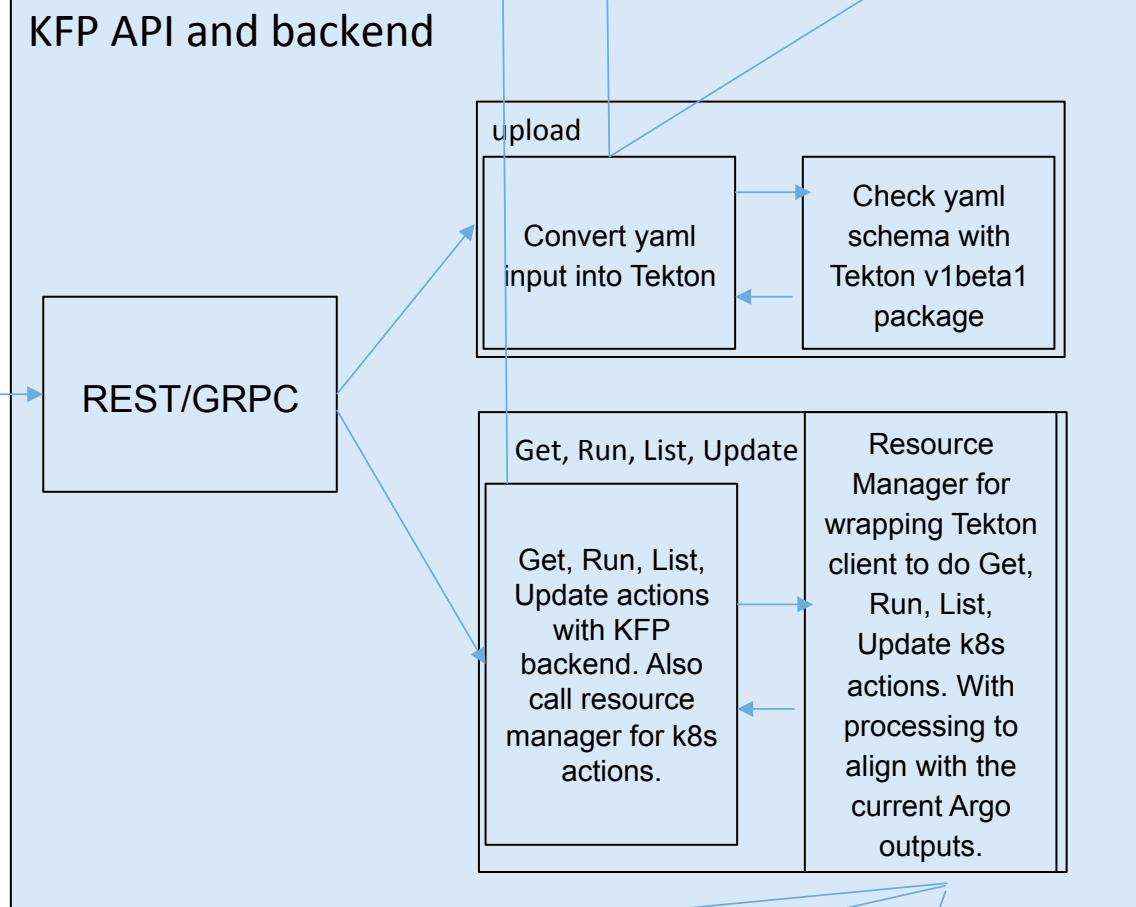
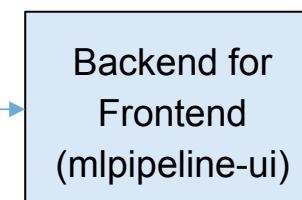




Local Machine



Server Machine





```
In [12]: kfp.Client(host="169.62.93.163").run_pipeline(experiment_id="74f7f363-96f8-487e-8632-4980b0971c7a",
                                                    job_name="sample-job",
                                                    pipeline_id="e684bc9e-cb30-4a3e-88f7-5c768202e6b7")
```

Run link [here](#)

```
Out[12]: {'created_at': datetime.datetime(2020, 5, 22, 0, 7, 46, tzinfo=tzutc()),
           'description': None,
           'error': None,
           'finished_at': datetime.datetime(1970, 1, 1, 0, 0, tzinfo=tzutc()),
           'id': '752ed34b-4ade-4654-b7d7-829618edd530',
           'metrics': None,
           'name': 'sample-job',
           'pipeline_spec': {'parameters': None,
                             'pipeline_id': 'e684bc9e-cb30-4a3e-88f7-5c768202e6b7',
                             'pipeline_manifest': None,
                             'pipeline_name': 'tekton-parameters',
                             'workflow_manifest': '{"kind": "PipelineRun", "apiVersion": "tekton.dev/v1beta1", "metadata": {"name": "pipelinerun-with-taskspec-to-echo-message", "creationTimestamp": null}, "spec": {"pipelineSpec": {"tasks": [{"name": "echo-message", "taskSpec": {"params": [{"name": "MESSAGE", "type": "string", "default": "Hello World!"}]}], "steps": [{"name": "echo", "image": "ubuntu", "resources": {}, "script": "echo $MESSAGE"}]}}}'}}
```

## Experiments

[+ Create run](#)[+ Create experiment](#)[Compare runs](#)[Clone run](#)[Archive](#)[Refresh](#)[All experiments](#)[All runs](#)

Filter experiments

**Experiment name****Description****Last 5 runs****Default**

All runs created without specifying an experiment will be grouped here.

 **Run name****Status****Duration****Pipeline Version****Recurring Run****Start time** sample-job

-

tekton-parameters

-

5/21/2020, 5:07:46 PM



Pipelines

Experiments

Artifacts

Executions

Archive

Documentation

Github Repo

AI Hub Samples

## Pipelines

← watson-ml-pipeline (watson-ml-pipeline)

[+ Create run](#)[+ Upload version](#)[+ Create experiment](#)

Delete

[Graph](#)[YAML](#)

X

deploy-model-watson-machine-learning

### Input parameters

model\_name  
scoring\_payload  
store-model-watson-machine-learning-model\_uid

### Output parameters

scoring-endpoint /tmp/outputs/scoring\_endpoint/data  
model-uid /tmp/outputs/model\_uid/data

### Arguments

```
-u /app/wml-deploy.py
--model-uid
$(inputs.params.store-model-watson-machine-learning-model_uid)
--model-name
$(inputs.params.model_name)
--scoring-payload
$(inputs.params.scoring_payload)
--deployment-name
--output-scoring-endpoint-path
$(results.scoring-endpoint.path)
--output-model-uid-path
$(results.model-uid.path)
```

### Command

```
python
```

### Image

```
docker.io/aiipeline/wml-deploy:latest
```

### Volume Mounts

## Summary

[Hide](#)

ID  
c377cb85-0120-443c-972f-04ae642d452a  
Version  
[watson-ml-pipeline](#) ▾

Version source

Uploaded on  
5/26/2020, 4:42:19 PM

Description



Pipelines

Experiments

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Executions

Archive

Documentation

Github Repo

AI Hub Samples

&lt;

Build commit: unknown

Report an Issue

Pipelines

## ← watson-ml-pipeline (watson-ml-pipeline)

+ Create run

+ Upload version

+ Create experiment

Delete

Graph

YAML

```
1 apiVersion: tekton.dev/v1beta1
2 kind: PipelineRun
3 metadata:
4   name: kfp-on-wml-training-run
5 spec:
6   params:
7     - name: GITHUB_TOKEN
8       value: ''
9     - name: CONFIG_FILE_URL
10    value: https://raw.githubusercontent.com/user/repository/branch/creds.ini
11    - name: train_code
12      value: tf-model.zip
13    - name: execution_command
14      value: '''python3 convolutional_network.py --trainImagesFile ${DATA_DIR}/train-images-idx3-ubyte.gz
15        --trainLabelsFile ${DATA_DIR}/train-labels-idx1-ubyte.gz --testImagesFile ${DATA_DIR}/t10k-images-idx3-ubyte.gz
16        --testLabelsFile ${DATA_DIR}/t10k-labels-idx1-ubyte.gz --learningRate 0.001
17        --trainingIters 20000'''
18    - name: framework
19      value: tensorflow
20    - name: framework_version
21      value: '1.15'
22    - name: runtime
23      value: python
24    - name: runtime_version
25      value: '3.6'
26    - name: run_definition
27      value: wml-tensorflow-definition
28    - name: run_name
29      value: wml-tensorflow-run
30    - name: model_name
31      value: wml-tensorflow-mnist
32    - name: scoring_payload
33      value: tf-mnist-test-payload.json
34    - name: compute_name
35      value: k80
36    - name: compute_nodes
37      value: '1'
38 pipelineSpec:
39   params:
40     - default: ''
41     - name: GITHUB_TOKEN
42       default: https://raw.githubusercontent.com/user/repository/branch/creds.ini
43     - name: CONFIG_FILE_URL
44     - default: tf-model.zip
45     - name: train_code
46     - default: '''python3 convolutional_network.py --trainImagesFile ${DATA_DIR}/train-images-idx3-ubyte.gz
47        --trainLabelsFile ${DATA_DIR}/train-labels-idx1-ubyte.gz --testImagesFile ${DATA_DIR}/t10k-images-idx3-ubyte.gz
48        --testLabelsFile ${DATA_DIR}/t10k-labels-idx1-ubyte.gz --learningRate 0.001
49        --trainingIters 20000'''
50     - name: execution_command
51     - default: tensorflow
```



Pipelines

Experiments

Artifacts

Executions

Archive

Documentation

Github Repo

AI Hub Samples

## Run of watson-ml-pipeline (444a2)

Retry   [Clone run](#)   [Terminate](#)   [Archive](#)

Graph   Run output   Config



kfp-on-wml-training-run-c2934-deploy-model-watson-machine-8v52x							
Artifacts	Input/Output	ML Metadata	Volumes	Manifest	Logs	Pod	Events
1 -----							
2 GUID							
3 702d4b5c-075c-4114-b119-96a23a674e35	wml-tensorflow-mnist	NAME		STATE ready	CREATED 2020-03-19T20:42:52.406Z		ARTIFACT_TYPE model
4 4f635147-da34-4f38-ac39-18116288c6cd	wml-tensorflow-mnist			ready	2020-03-19T19:56:39.104Z		
5 8381bf0c-776a-4c21-af1f-2c7a21334ee1	wml-tensorflow-mnist			ready	2020-03-19T19:55:44.681Z		
6 8bb3f49c-2b2a-4e2d-88cd-045e139e78c6	wml-tensorflow-mnist			ready	2020-03-19T19:39:52.485Z		
7 2e854faf-b091-49f3-858d-0f1d996cbda3	wml-tensorflow-mnist			ready	2020-03-19T01:25:13.537Z		
8 -----							
9							
10 #####							
11 #####							
12 #####							
13 Synchronous deployment creation for uid: 'bb170958-a27b-4001-b5d3-6fda6d4265a9' started							
14 #####							
15 #####							
16 #####							
17 #####							
18 initializing							
19 ready							
20							
21							
22 -----							
23 Successfully finished deployment creation, deployment_uid='170be98d-1135-4ff9-b8e4-a9833fc7f524'							
24 -----							
25							
26							
27 deployment_uid: 170be98d-1135-4ff9-b8e4-a9833fc7f524							
28 Scoring result:							
29 {'predictions': [['values': [5, 4]]]}}							
30							



Input Artifact	Target		Output Artifact	Output Artifact
<b>NOTYPE</b> secret_name kfp-on-wml-training-run-486da	<b>COMPONENTS.TRAIN-MOD...</b> <b>train-model-watson-mach</b> kfp-on-wml-training-run-486da	<b>NOTYPE</b> run_uid kfp-on-wml-training-run-486da	<b>COMPONENTS.STORE-MOD...</b> <b>store-model-watson-machi</b> kfp-on-wml-training-run-486da	<b>NOTYPE</b> model_uid kfp-on-wml-training-run-486da
kfp-on-wml-training-run-486da	secret_name	11	NoType	<a href="#">minio://mlpipeline/artifacts/kfp...</a>
	run_uid	12	NoType	<a href="#">minio://mlpipeline/artifacts/kfp...</a>
	training_uid	13	NoType	<a href="#">minio://mlpipeline/artifacts/kfp...</a>
	model_uid	14	NoType	<a href="#">minio://mlpipeline/artifacts/kfp...</a>
	model_uid	15	NoType	<a href="#">minio://mlpipeline/artifacts/kfp...</a>
	scoring_endp...	16	NoType	<a href="#">minio://mlpipeline/artifacts/kfp...</a>
				6/14/2020, 7:1...
				6/14/2020, 7:1...
				6/14/2020, 7:1...
				6/14/2020, 7:1...
				6/14/2020, 7:2...
				6/14/2020, 7:2...





# Compiled Pipelines on Tekton



Tekton

Tekton resources ^

Pipelines

PipelineRuns

PipelineResources

Tasks

ClusterTasks

TaskRuns

Namespace

All Namespaces X ▾

About

Import Tekton resources

Secrets

ServiceAccounts

## PipelineRuns

 Input a label filter of the format labelKey:labelValueCreate +

Status	Name	Pipeline	Namespace	Created	Duration	
✓	<a href="#">kfp-on-wml-training-run...</a>	<a href="#">kfp-on-wml-training</a>	default	20 hours ago	6 minutes 23 seconds	:
✓	<a href="#">launch-trusted-ai-pipelin...</a>	<a href="#">launch-trusted-ai-pipeline</a>	anonymous	2 days ago	9 minutes 3 seconds	:
✓	<a href="#">conditional-execution-pip...</a>	<a href="#">conditional-execution-pip...</a>	default	2 days ago	52 seconds	:
✓	<a href="#">end-to-end-pipeline-run</a>	<a href="#">end-to-end-pipeline</a>	anonymous	2 days ago	14 minutes 41 seconds	:





# Running Pipelines on Tekton

Tekton

Tekton resources ^

- Pipelines
- PipelineRuns**
- PipelineResources
- Tasks
- ClusterTasks
- TaskRuns

Namespace

default X ▾

About

Import Tekton resources

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kfp-on-wml-training-run-p7n6f 20 hours ago

Succeeded Tasks Completed: 4, Skipped: 0 □

Rerun ↻

Task	Status
create-secret-kubernetes	Completed
train-model-watson-machine-learning	Completed
train-mode... Completed	Completed
store-model-watson-ma...	Completed
deploy-model-watson-m...	Completed

Logs Status Details

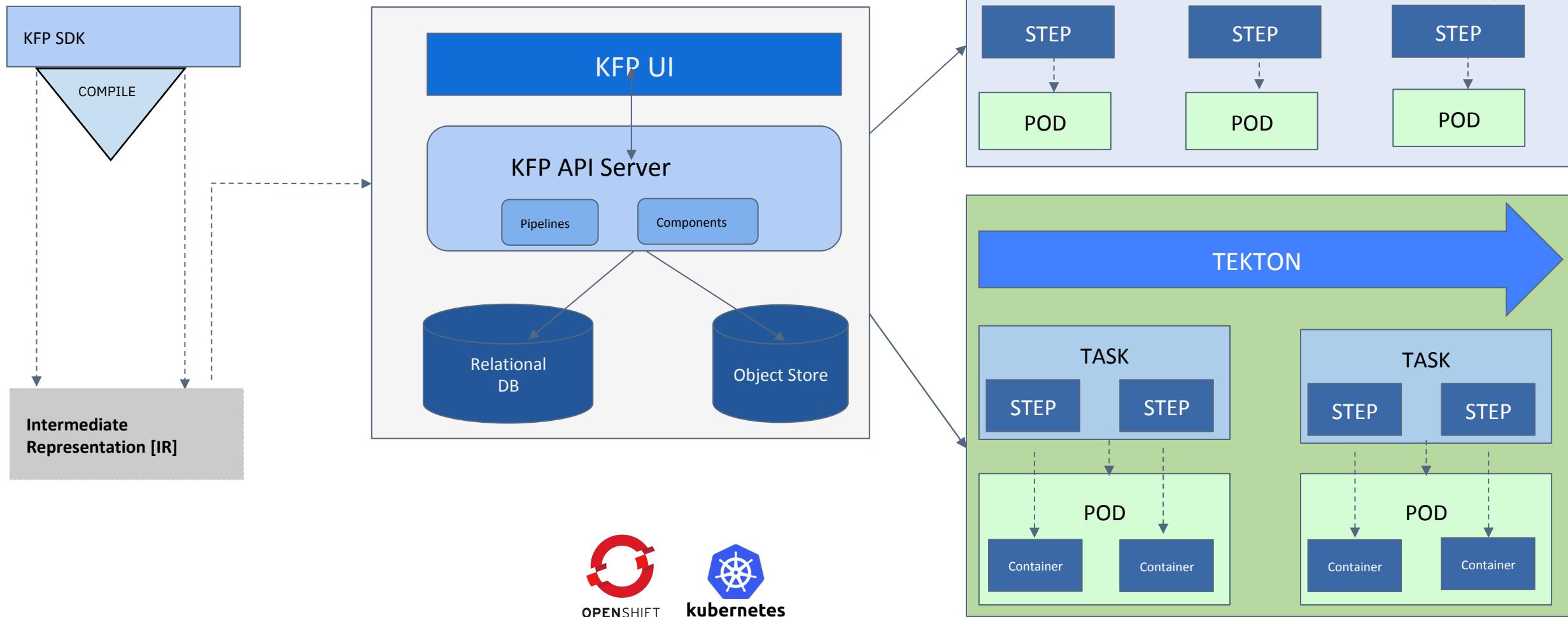
```
training_id {'metadata': {'created_at': '2020-05-07T23:57:46.868Z', 'guid': 'b200eef4-3dde-4b4e-a521-fe751735932c'}, 'state': 'running'}
```

```
#####
Log monitor started for training run: b200eef4-3dde-4b4e-a521-fe751735932c
#####
-----
```

Log monitor done.

```
#####
Metric monitor started for training run: b200eef4-3dde-4b4e-a521-fe751735932c
```

# Future: KFP – Tekton Phase Three



Pluggable Components

- Spark
- Watson Studio
- WML
- Open Scale
- Kubeflow Training
- Seldon
- AIF360
- ART
- KATIB
- KFSERVING
- ...



# Useful Links

Main Open Source Github Repository:

<https://github.com/kubeflow/kfp-tekton>

IBM internal Slack channels

#kfp-tekton

#kubeflow

The Kubeflow external Slack workspace is

[kubeflow.slack.com](https://kubeflow.slack.com)

To join, click here

[https://join.slack.com/t/kubeflow/shared\\_invite/zt-cpr020z4-PfcAue\\_2nw67~iIDy7maAQ](https://join.slack.com/t/kubeflow/shared_invite/zt-cpr020z4-PfcAue_2nw67~iIDy7maAQ)

