
AWS
re:Invent

OPN206

Building end-to-end ML workflows with Kubeflow Pipelines

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AWS

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Agenda

Why machine learning with containers / on Kubernetes

Kubeflow and Kubeflow Pipelines

Demo: Creating a Kubeflow Pipeline

Scaling machine learning on Kubernetes with Amazon SageMaker

Demo: Amazon SageMaker components for Kubeflow Pipelines



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Why machine learning with containers / on Kubernetes



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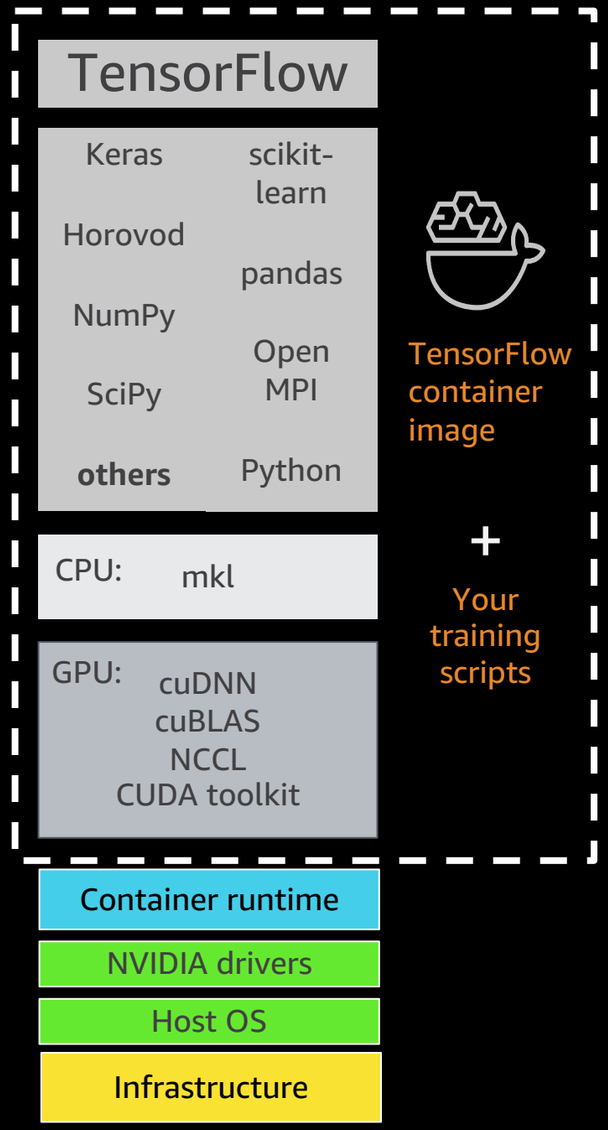
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Why machine learning with containers



Why machine learning with containers





Packages
- Training code
- Dependencies
- Configurations

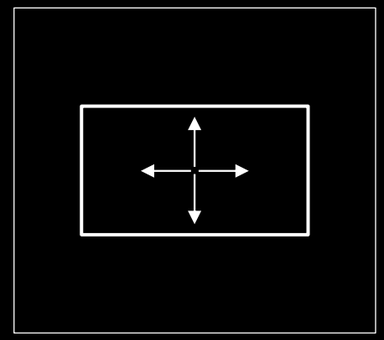
ML environments that are
- Lightweight
- Portable
- Scalable
- Consistent

Why machine learning on Kubernetes









Composability

Portability

Scalability



Amazon EKS: Run Kubernetes in cloud



Managed Kubernetes control plane, attach data plane

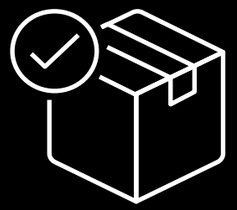
Native upstream Kubernetes experience

Platform for enterprises to run production-grade workloads

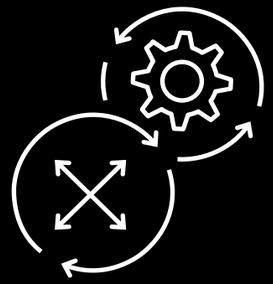
Integrates with additional AWS services

AWS Deep Learning Containers

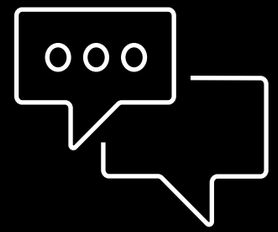
OPTIMIZED AND CUSTOMIZABLE CONTAINERS FOR DEEP LEARNING ENVIRONMENTS



Pre-packaged Docker container images fully configured and validated



Best performance and scalability without tuning



Works with Amazon SageMaker, Amazon EKS, Amazon ECS, and Amazon EC2

KEY FEATURES

Customizable container images

Support for

TensorFlow PyTorch mxnet

Single and multi-node training and inference

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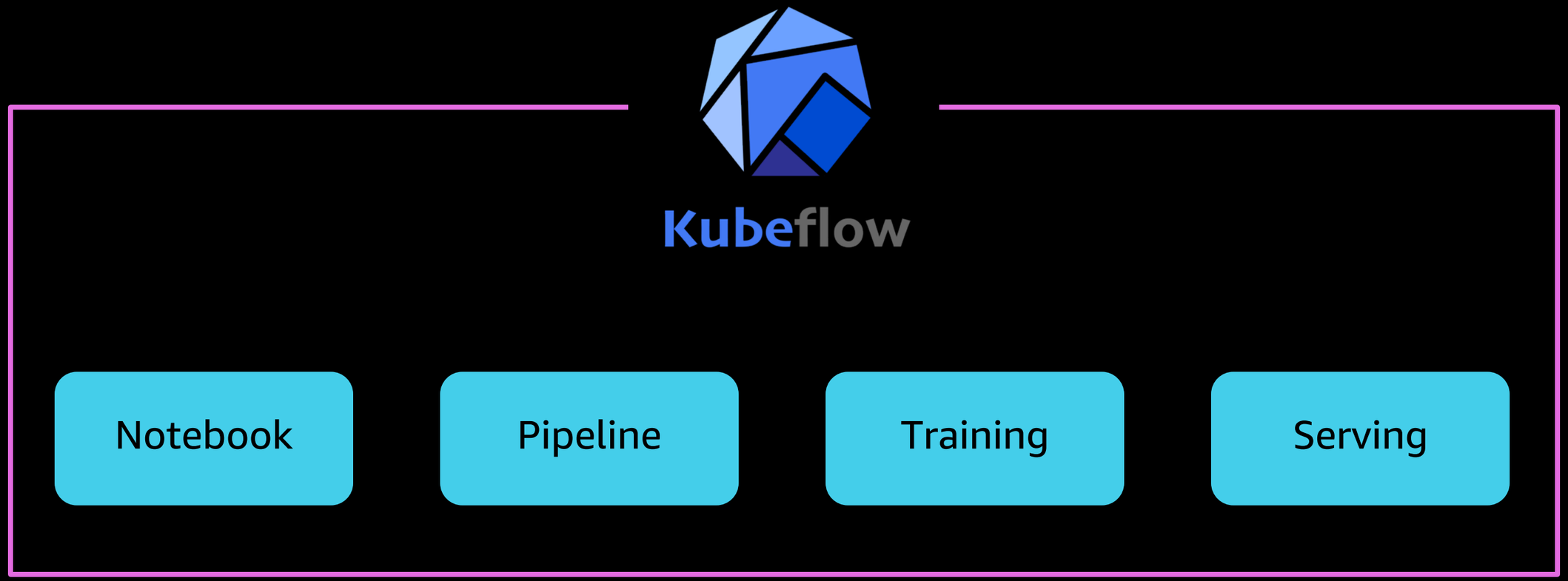
Kubeflow and Kubeflow Pipelines



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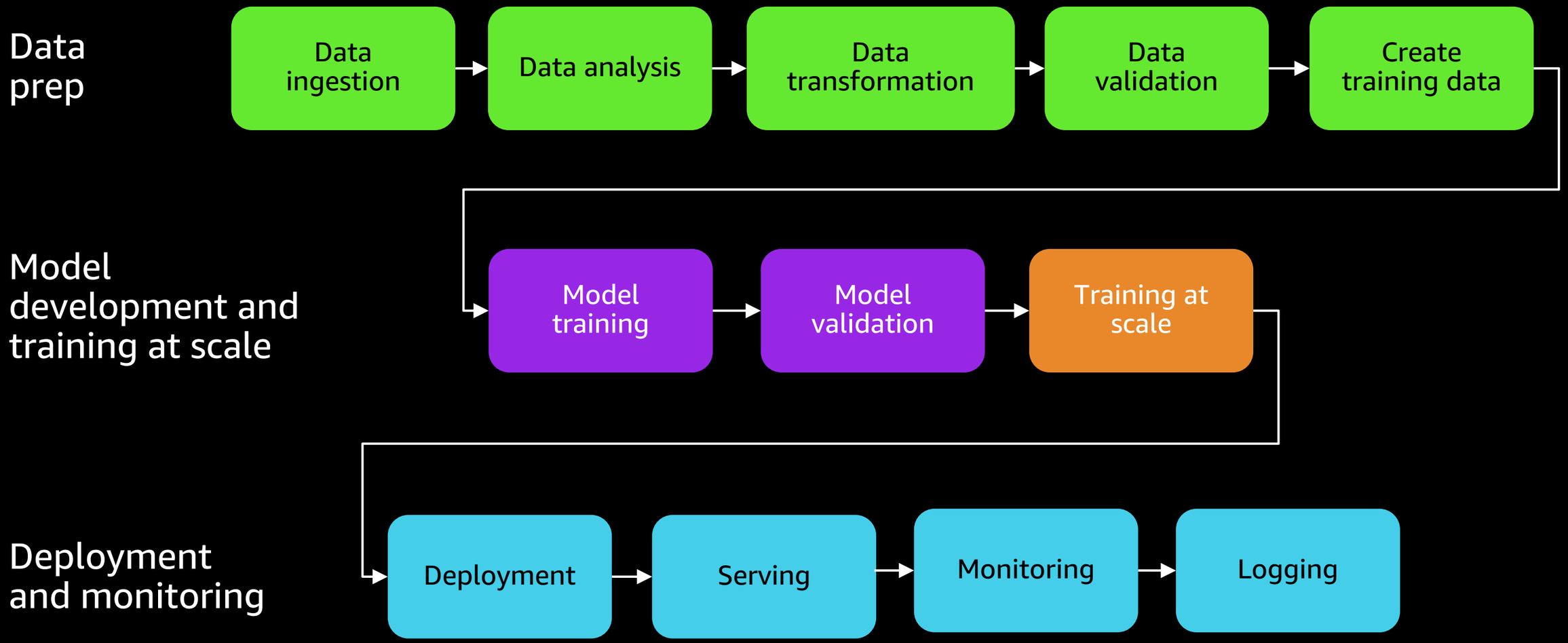
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Introducing Kubeflow



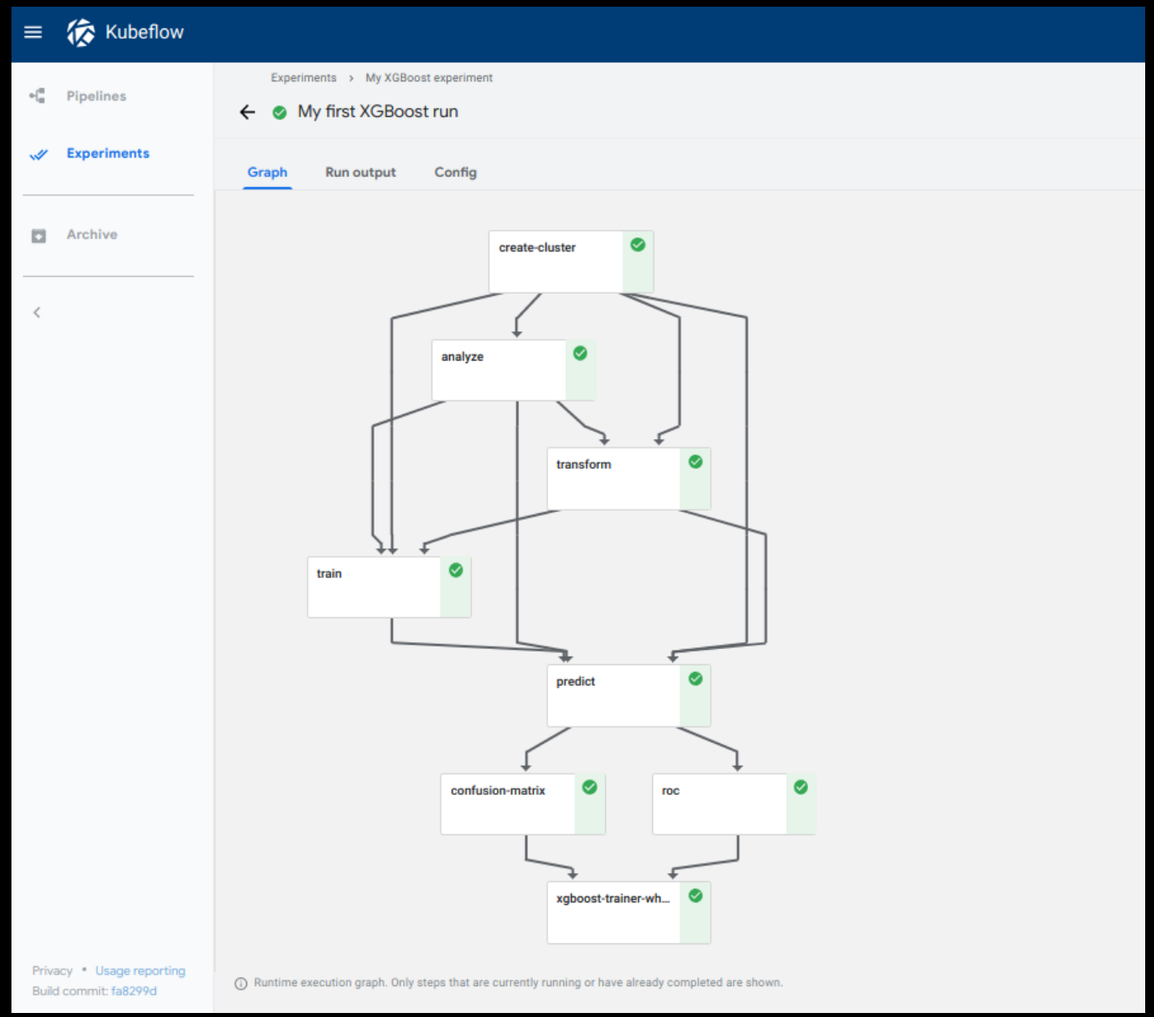
Kubeflow is the machine learning (ML) toolkit for Kubernetes

Key use case: ML pipelines

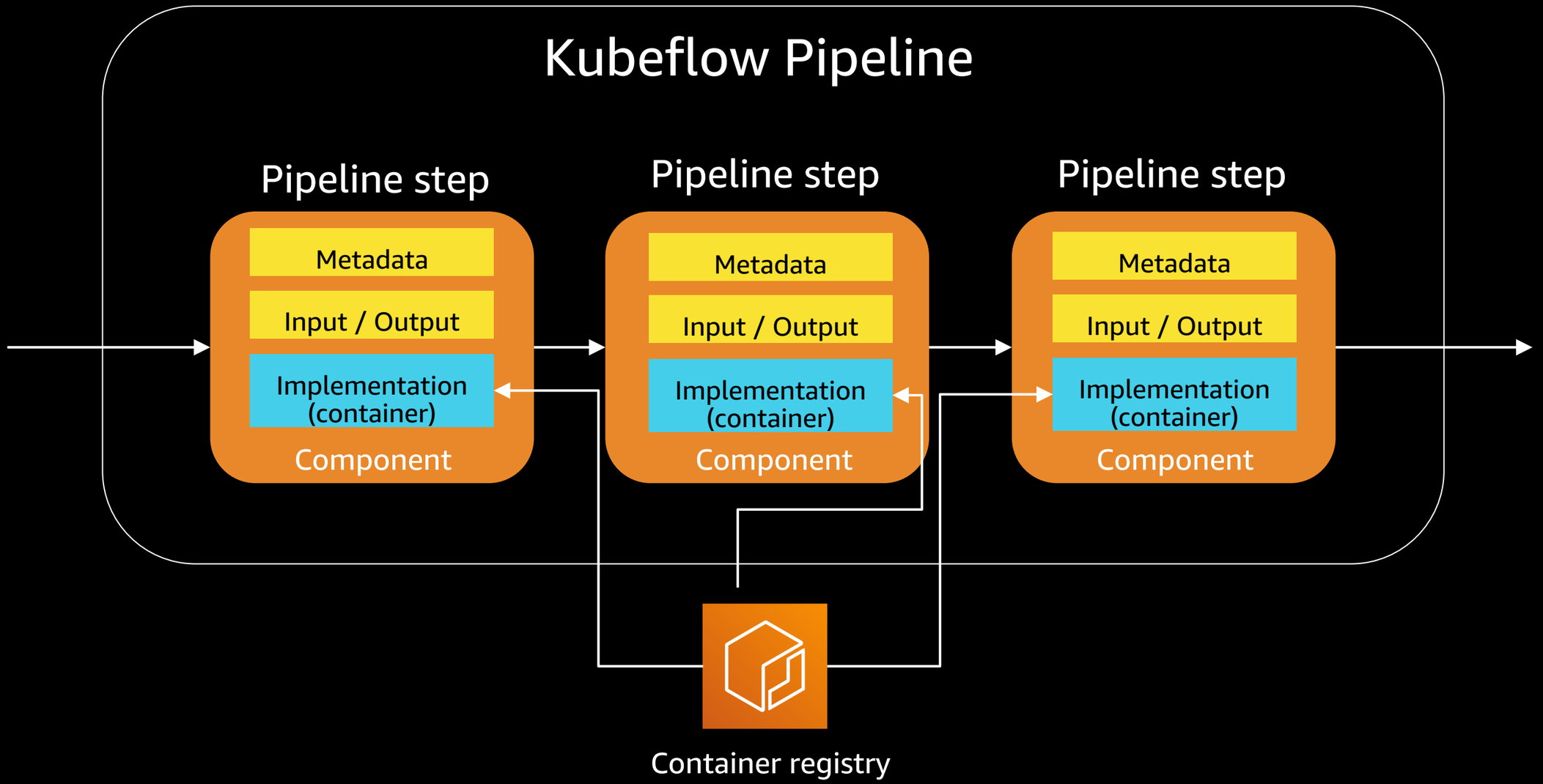


Kubeflow Pipelines

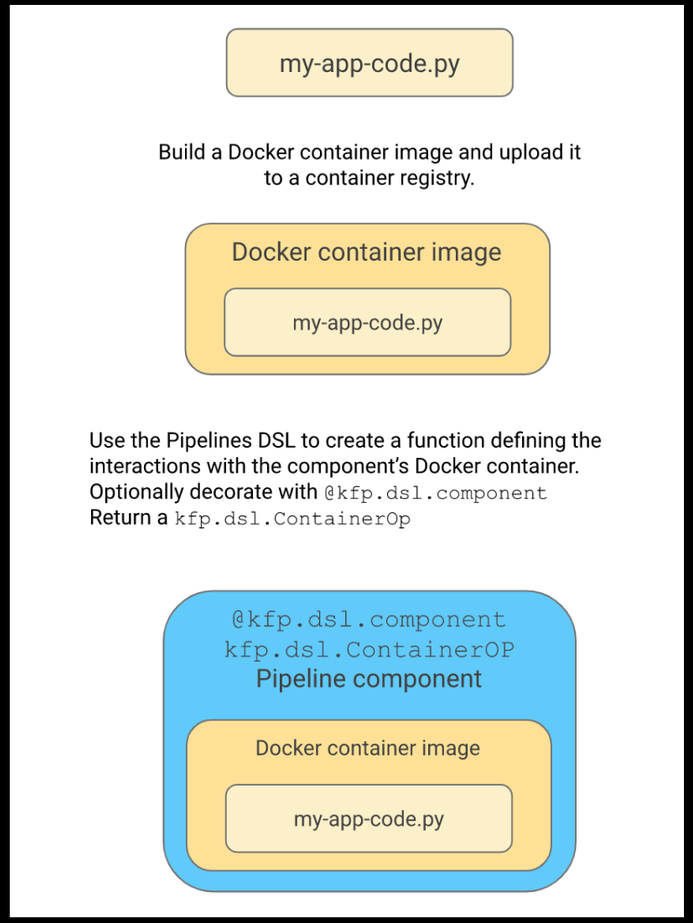
- A user interface (UI) for managing and tracking experiments, jobs, and runs
- An engine for scheduling multi-step ML workflows
- A software development kit (SDK) for defining and manipulating pipelines and components

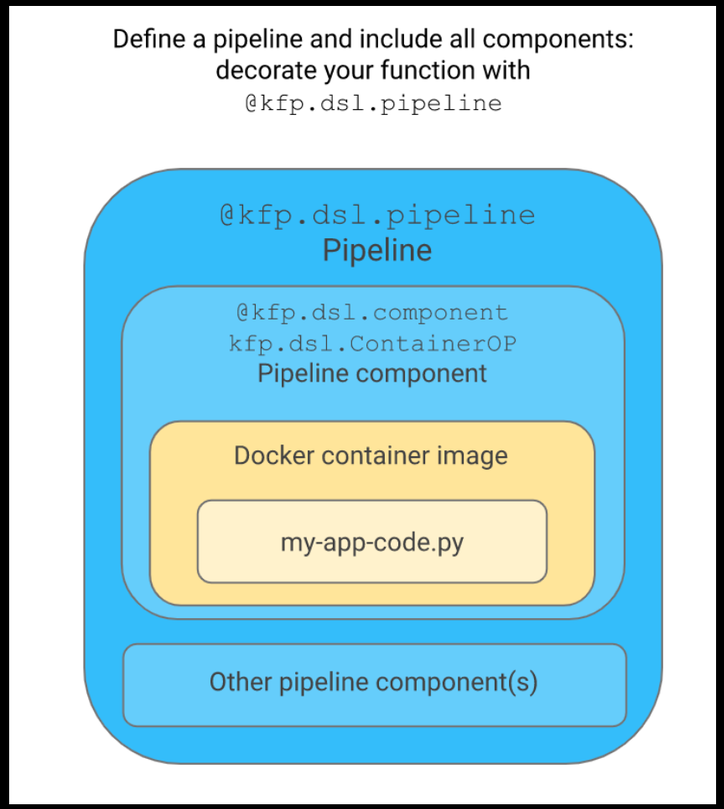


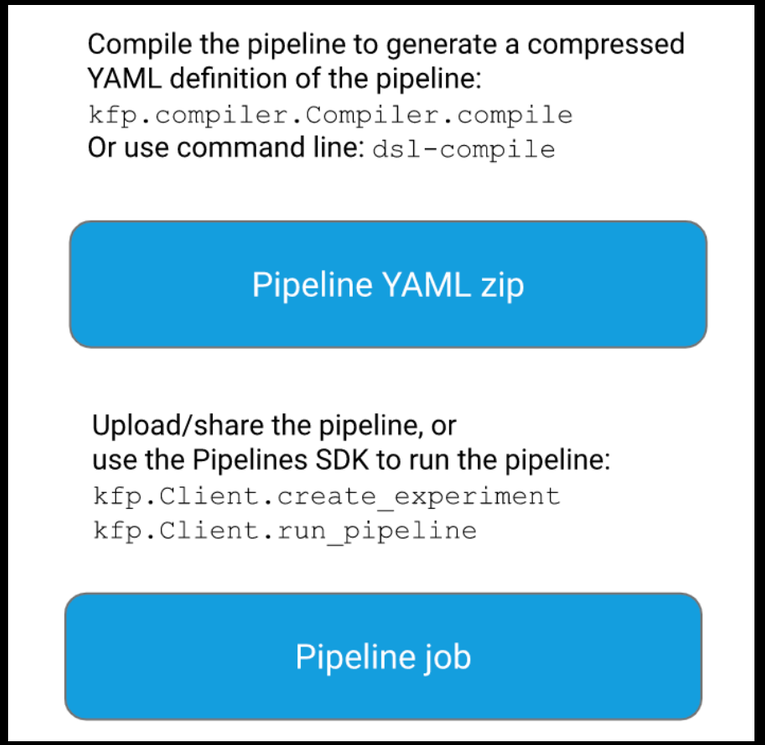
Pipeline component



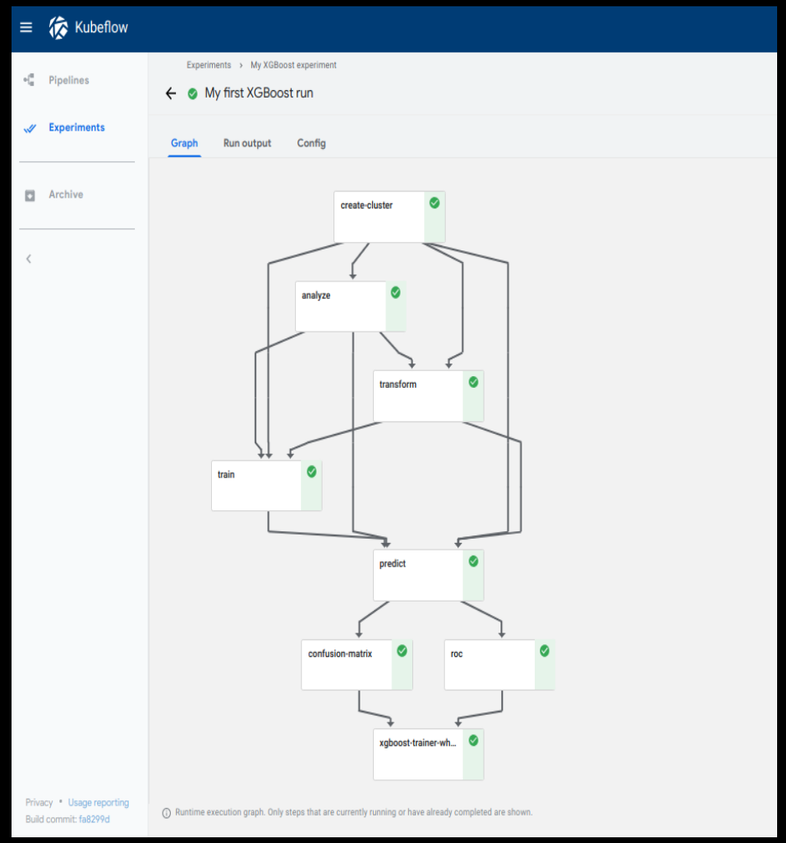
Creating a pipeline (1)







Creating a pipeline (2)



Pipeline decorator

Pipeline function

Pipeline component

```
@dsl.pipeline(
  name='Sample Trainer',
  description=''
)

def sample_train_pipeline(... ):

    create_cluster_op = CreateClusterOp('create-cluster', ...)

    analyze_op = AnalyzeOp('analyze', ...)

    transform_op = TransformOp('transform', ...)

    train_op = TrainerOp('train', ...)

    predict_op = PredictOp('predict', ...)

    confusion_matrix_op = ConfusionMatrixOp('confusion-matrix', ...)

    roc_op = RocOp('roc', ...)

kfp.compiler.Compiler().compile(sample_train_pipeline , 'my-pipeline.zip')
```

Compile pipeline

Amazon Container Services

Amazon ECS
Clusters
Task definitions

Amazon EKS
Clusters

Amazon ECR
Repositories

Containers

Elastic Kubernetes Service (Amazon EKS)

Fully managed Kubernetes control plane

Amazon EKS is a managed service that makes it easy for you to use Kubernetes on AWS without needing to install and operate your own Kubernetes control plane.

Create EKS cluster

Cluster name

Next step

Pricing

EKS Control Plane	EKS Pricing
Worker nodes	EC2 Pricing
Fargate pods	Fargate Pricing

How it works



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Leverage AWS innovations through Kubeflow



Do-it-yourself + Managed service



Blog Post

Enterprise-ready Kubeflow: Securing and scaling AI and ML

https://aws.amazon.com/blogs/opensource/enterprise-ready-kubeflow-securing-and-scaling-ai-and-machine-learning-pipelines-with-aws/

The AWS ML stack

AI services

Vision	Speech		Text			Search	Chatbots	Personalization	Forecasting	Fraud	Development	Contact centers
Amazon Rekognition	Amazon Polly	Amazon Transcribe *+Medical*	Amazon Comprehend *+Medical*	Amazon Translate	Amazon Textract	Amazon Kendra	Amazon Lex	Amazon Personalize	Amazon Forecast	Amazon Fraud Detector	Amazon CodeGuru	Contact Lens *For Amazon Connect*

ML services

Amazon SageMaker

Ground Truth

AWS Marketplace for ML

SageMaker Studio IDE

Built-in algorithms | Notebooks | Experiments | Processing | Model training & tuning | Debugger | Autopilot | Model hosting | Model monitor

Neo

Augmented AI

ML frameworks and infrastructure

TensorFlow

mxnet

PyTorch

GLUON

Scikit learn

HOROVOD

Keras

DeepGraphLibrary

Deep Learning AMIs & containers | GPUs & CPUs | Elastic inference | Inferentia | FPGA

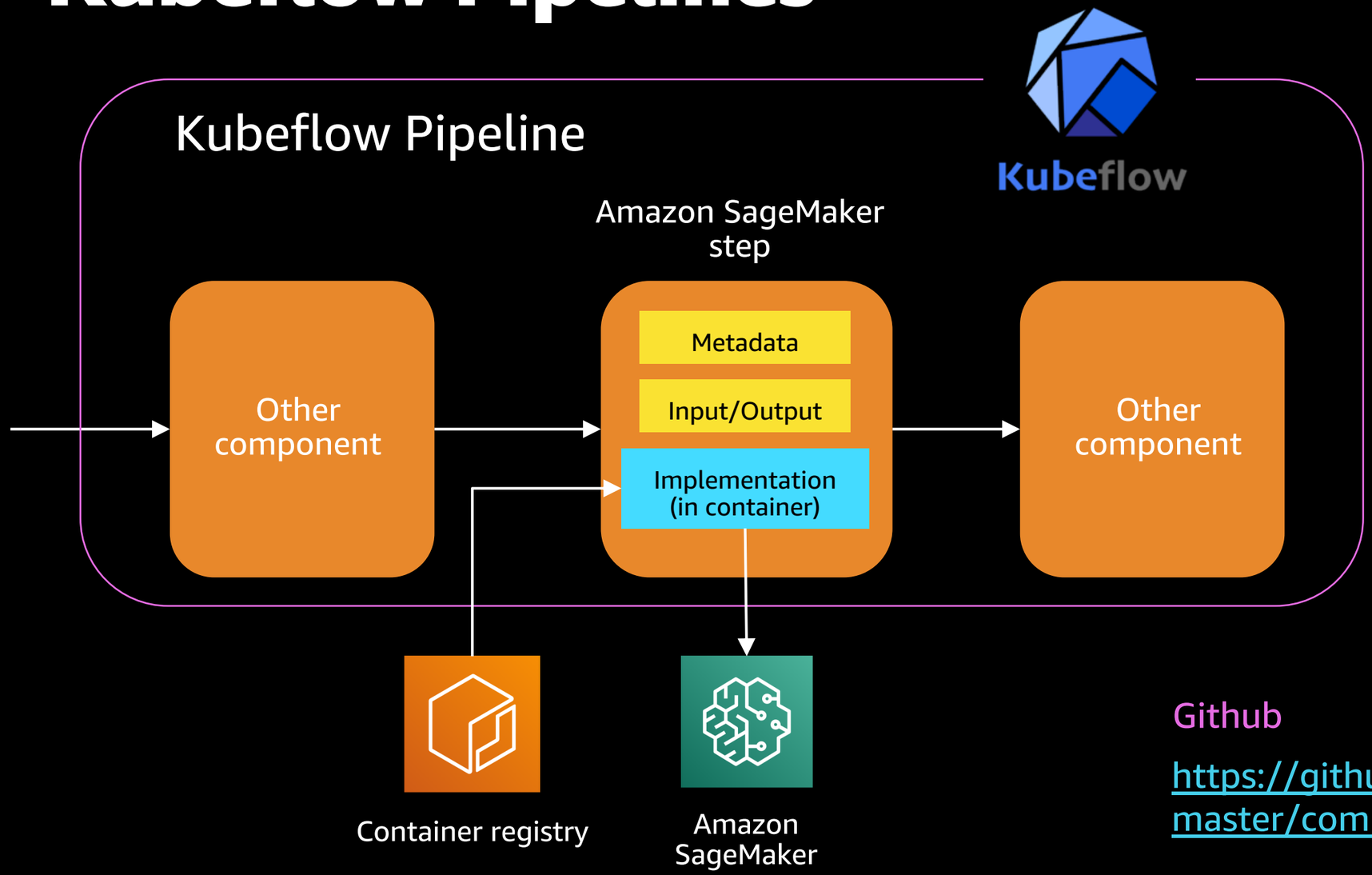
Scaling machine learning on Kubernetes with Amazon SageMaker



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Amazon SageMaker components for Kubeflow Pipelines

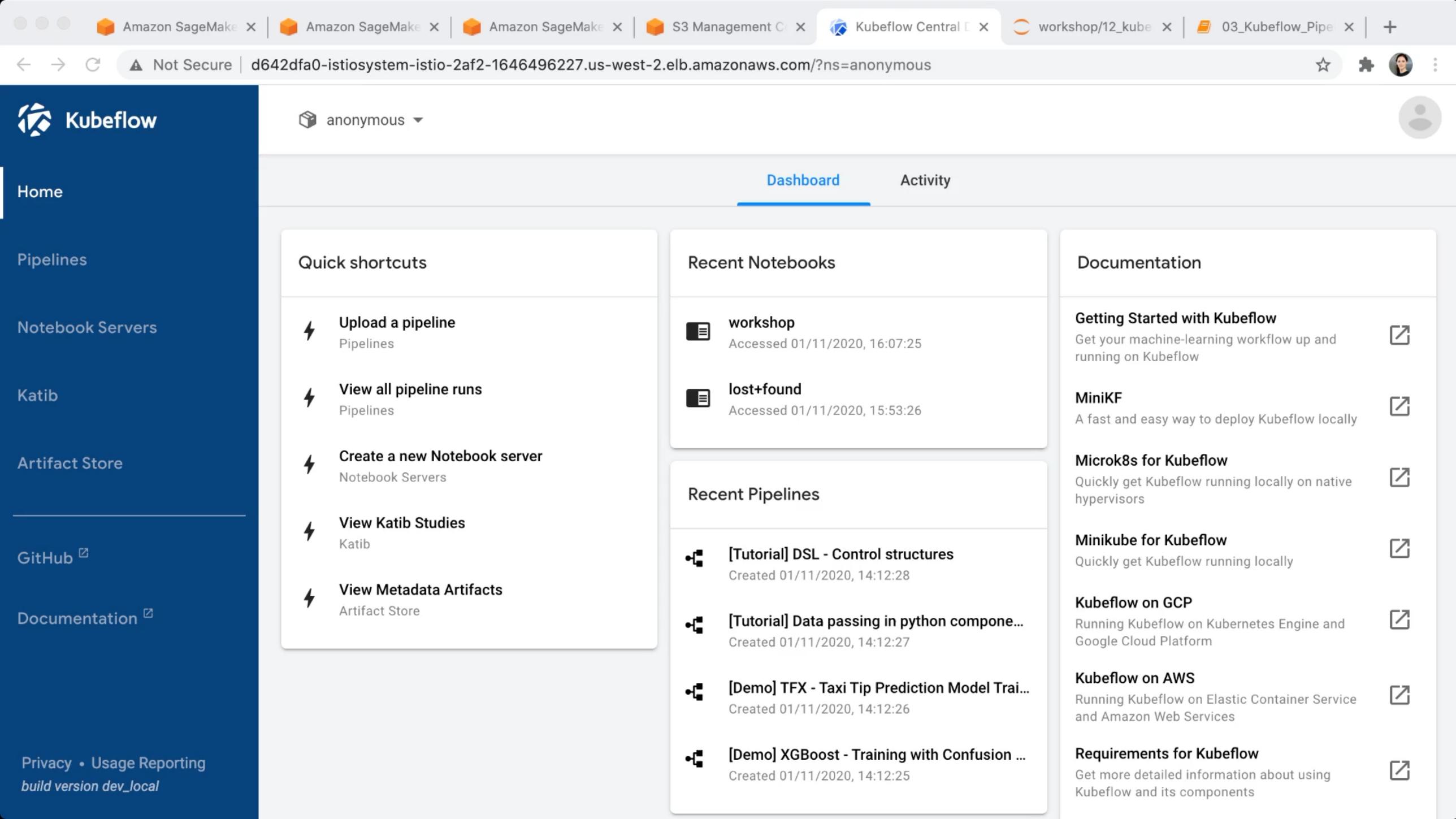


Supported components

- Model training
- Hyperparameter tuning
- Processing
- Model deployment
- Batch transform
- Amazon SageMaker Ground Truth

Github

https://github.com/kubeflow/pipelines/tree/master/components/aws/sagemaker


Amazon SageMake
Amazon SageMake
Amazon SageMake
S3 Management C
Kubeflow Central
workshop/12_kube
03_Kubeflow_Pipe
Not Secure
d642dfa0-istiosystem-istio-2af2-1646496227.us-west-2.elb.amazonaws.com/?ns=anonymous
Kubeflow
anonymous
Home
Pipelines
Notebook Servers
Katib
Artifact Store
GitHub
Documentation
Privacy • Usage Reporting
build version dev_local
Dashboard
Activity
Quick shortcuts
Upload a pipeline
Pipelines
View all pipeline runs
Pipelines
Create a new Notebook server
Notebook Servers
View Katib Studies
Katib
View Metadata Artifacts
Artifact Store
Recent Notebooks
workshop
Accessed 01/11/2020, 16:07:25
lost+found
Accessed 01/11/2020, 15:53:26
Recent Pipelines
[Tutorial] DSL - Control structures
Created 01/11/2020, 14:12:28
[Tutorial] Data passing in python compone...
Created 01/11/2020, 14:12:27
[Demo] TFX - Taxi Tip Prediction Model Trai...
Created 01/11/2020, 14:12:26
[Demo] XGBoost - Training with Confusion ...
Created 01/11/2020, 14:12:25
Documentation
Getting Started with Kubeflow
Get your machine-learning workflow up and running on Kubeflow
MiniKF
A fast and easy way to deploy Kubeflow locally
Microk8s for Kubeflow
Quickly get Kubeflow running locally on native hypervisors
Minikube for Kubeflow
Quickly get Kubeflow running locally
Kubeflow on GCP
Running Kubeflow on Kubernetes Engine and Google Cloud Platform
Kubeflow on AWS
Running Kubeflow on Elastic Container Service and Amazon Web Services
Requirements for Kubeflow
Get more detailed information about using Kubeflow and its components

Kubeflow + Amazon SageMaker delivers value

Kubeflow

- Portability
- Composability
- Scalability
- Shared infrastructure
- Repeatable pipelines
- Automation
- CI / CD
- Open source



Amazon SageMaker

- Fully-managed infrastructure
- Ground truth labeling
- Automatic model tuning
- Built-in optimized algorithms
- Managed Spot Training
- Scalable inference endpoints
- Model monitoring

Get started

Demo code
https://github.com/data-science-on-aws/workshop

Blog post – Enterprise-ready Kubeflow
https://aws.amazon.com/blogs/opensource/enterprise-ready-kubeflow-securing-and-scaling-ai-and-machine-learning-pipelines-with-aws/

Kubeflow on AWS
https://www.kubeflow.org/docs/aws/

SageMaker components for Kubeflow Pipelines
http://github.com/kubeflow/pipelines/tree/master/components/aws/sagemaker

Online workshop
https://www.eksworkshop.com/advanced/420_kubeflow/pipelines/

Thank you!

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