

Workshop1

Azure ML

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Microsoft contacts

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Credits: Original version of deck by Serge Retkowsky serge.retkowsky@microsoft.com



Program overview

Workshop Prerequisites



Activate and Access an
[Azure Subscription](#)



Create an Azure Machine
Learning Workspace in the
Azure Portal : [LINK HERE](#)



Account for Azure DevOps
: [LINK HERE](#)



Prerequisites by Role

App Developers : VS Code, Python
ML Engineers : No prerequisites
Citizen Data Scientists : Python, Jupiter Notebooks
Business Data Scientists : No prerequisites
Enterprise Architects : Cloud Policies and Security



Recommended Azure ML
training on Microsoft
Learn

ML with Code:
<https://docs.microsoft.com/en-us/learn/patterns/build-ai-solutions-with-azure-ml-service>

ML with No Code / Low Code:
<https://docs.microsoft.com/en-us/learn/patterns/create-no-code-predictive-models-azure-machine-learning>

ML at the Edge for IoT:
<https://docs.microsoft.com/en-us/learn/patterns/ai-edge-engineer>



Workshop 1

Azure ML fundamentals

- Presentation and demo of Azure ML.
- Presentation of Azure documentation resources & certifications path.



Workshop 2

Azure ML fundamentals

- Hands-on labs:
 - Azure ML experimentations
 - AutoML with Azure ML Python SDK
 - Estimators with Azure ML Python SDK
 - Interpretation & Fairness of ML models
 - Hyperparameter tuning with Azure ML
 - Model deployment



Workshop 3

No Code with Azure ML

- Hands-on labs:
 - AutoML graphical user interface
 - Azure ML Designer interface for building no code pipelines
 - Use case: Anomaly detection with Azure ML Designer
 - PowerBI Integration



Workshop 4

Azure Computer Vision

- Introduction to Azure Cognitive Services.
- Deep dive on Azure Computer Vision presentation.
- Hands-on lab:
 - Training of a custom vision model
 - Validation and deployment of a custom vision model



Workshop 5

MLOps

- Introduction to MLOps
- Hands-on lab:
 - Implementing CI/CD pipeline using GitHub Action & Azure DevOps

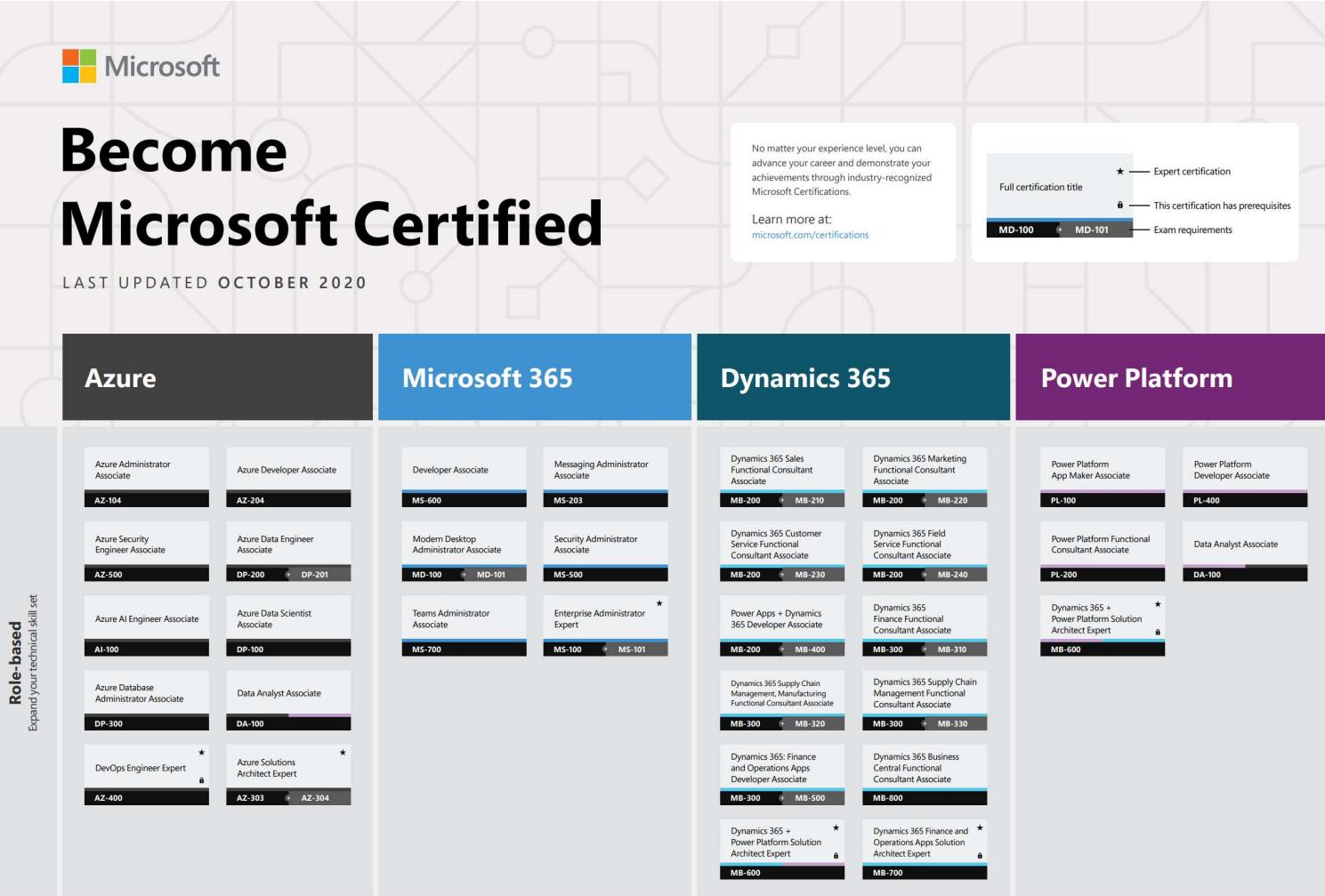


Workshop 6

Azure Databricks

- Azure Databricks presentation
- Hands-on lab:
 - Data preparation
 - ML
 - Model deployment
 - Azure ML integration

Do you want to be Azure certified?



The diagram illustrates the Microsoft certification landscape across four main categories: Azure, Microsoft 365, Dynamics 365, and Power Platform. Each category is represented by a colored horizontal bar at the top, followed by a grid of certification titles and their corresponding exam codes.

Legend:

- ★ — Expert certification
- 🔒 — This certification has prerequisites
- MD-100 + MD-101 — Exam requirements

Azure:

Azure Administrator Associate AZ-104	Azure Developer Associate AZ-204
Azure Security Engineer Associate AZ-500	Azure Data Engineer Associate DP-200 + DP-201
Azure AI Engineer Associate AI-100	Azure Data Scientist Associate DP-100
Azure Database Administrator Associate DP-300	Data Analyst Associate DA-100
DevOps Engineer Expert AZ-400	Azure Solutions Architect Expert AZ-303 + AZ-304

Microsoft 365:

Developer Associate MS-600	Messaging Administrator Associate MS-203
Modern Desktop Administrator Associate MD-100 + MD-101	Security Administrator Associate MS-500
Teams Administrator Associate MS-700	Enterprise Administrator Expert MS-100 + MS-101

Dynamics 365:

Dynamics 365 Sales Functional Consultant Associate MB-200 + MB-210	Dynamics 365 Marketing Functional Consultant Associate MB-200 + MB-220
Dynamics 365 Customer Service Functional Consultant Associate MB-200 + MB-230	Dynamics 365 Field Service Functional Consultant Associate MB-200 + MB-240
Power Apps + Dynamics 365 Developer Associate MB-200 + MB-400	Dynamics 365 Finance Functional Consultant Associate MB-300 + MB-310
Dynamics 365 Supply Chain Management Functional Consultant Associate MB-300 + MB-320	Dynamics 365 Supply Chain Management Functional Consultant Associate MB-300 + MB-330
Dynamics 365: Finance and Operations Apps Developer Associate MB-300 + MB-500	Dynamics 365 Business Central Functional Consultant Associate MB-800
Dynamics 365 + Power Platform Solution Architect Expert MB-600	Dynamics 365 Finance and Operations Apps Solution Architect Expert MB-700

Power Platform:

Power Platform App Maker Associate PL-100	Power Platform Developer Associate PL-400
Power Platform Functional Consultant Associate PL-200	Data Analyst Associate DA-100
Dynamics 365 + Power Platform Solution Architect Expert MB-600	Dynamics 365 + Power Platform Solution Architect Expert MB-700

Role-based
Expand your technical skill set

LAST UPDATED OCTOBER 2020

Microsoft

Become Microsoft Certified

No matter your experience level, you can advance your career and demonstrate your achievements through industry-recognized Microsoft Certifications.

Learn more at: microsoft.com/certifications

Enterprise Skills Initiative

<https://esi.microsoft.com/>

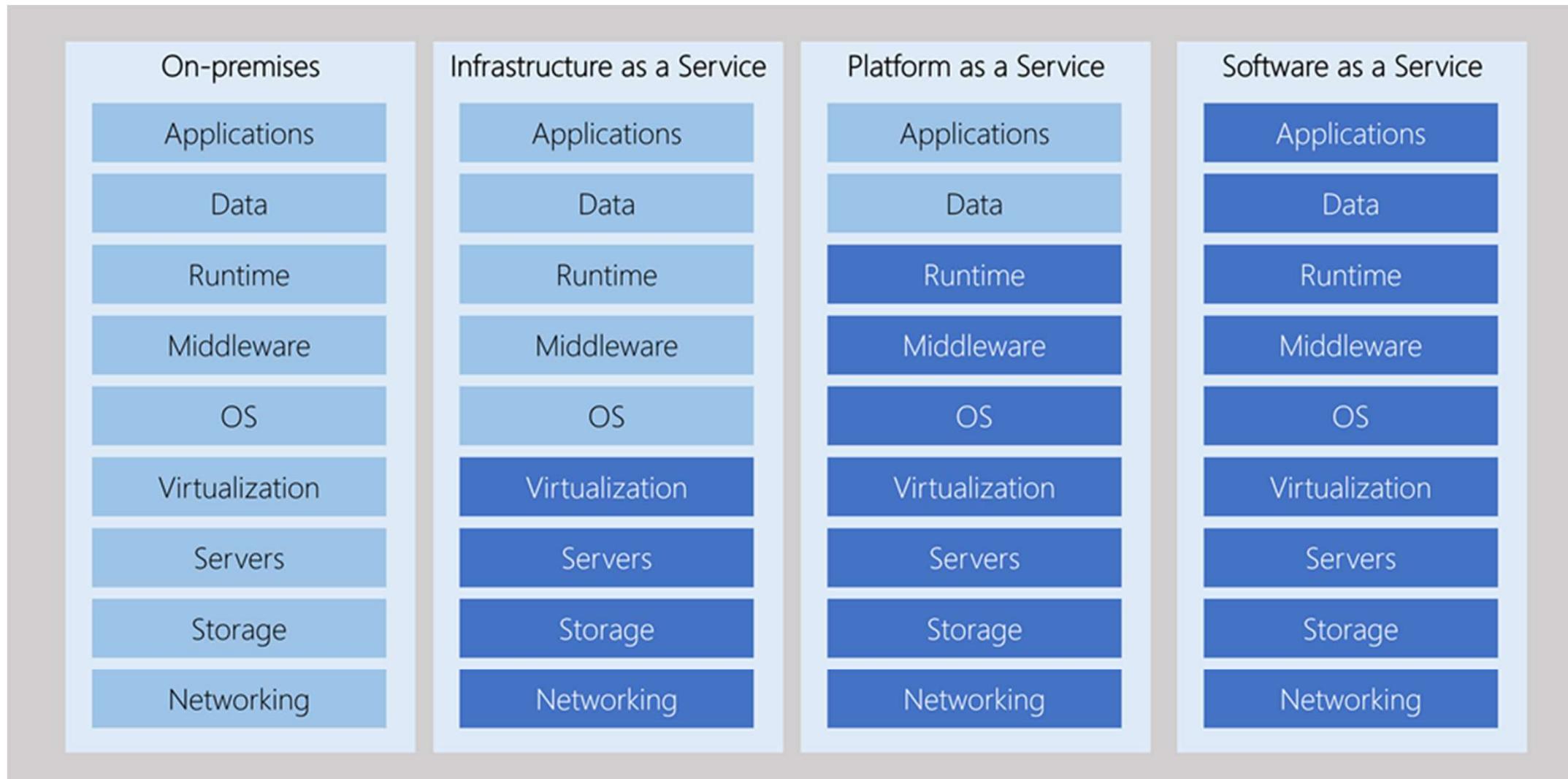
The screenshot shows the Microsoft Enterprise Skills Initiative (ESI) website. At the top, there's a dark blue header bar with the Microsoft logo, the text "Enterprise Skills Initiative | ESI-Contoso-Demo", and user account information ("Welcome Albus!", "Settings", "Help"). Below the header is a large, light blue banner with the text "Learning for Data Engineer". Underneath the banner, a sub-header says "Learn what you want, when you want." followed by a horizontal line. The main content area features six cards arranged in two rows of three. Each card has a small icon, a title, a brief description, and a call-to-action button.

 LEARN ON YOUR OWN Microsoft Learn Explore	 LEARN THE FUNDAMENTALS Microsoft Training Days Explore	 INSTRUCTOR-LED TRAINING Microsoft-Delivered Courses Explore
 INSTRUCTOR-LED TRAINING Learning Partner Training Register	 PREPARE FOR AN EXAM Exam Preparation Explore	 GET CERTIFIED Microsoft Certifications Schedule



Some Azure fundamentals

Management responsibilities

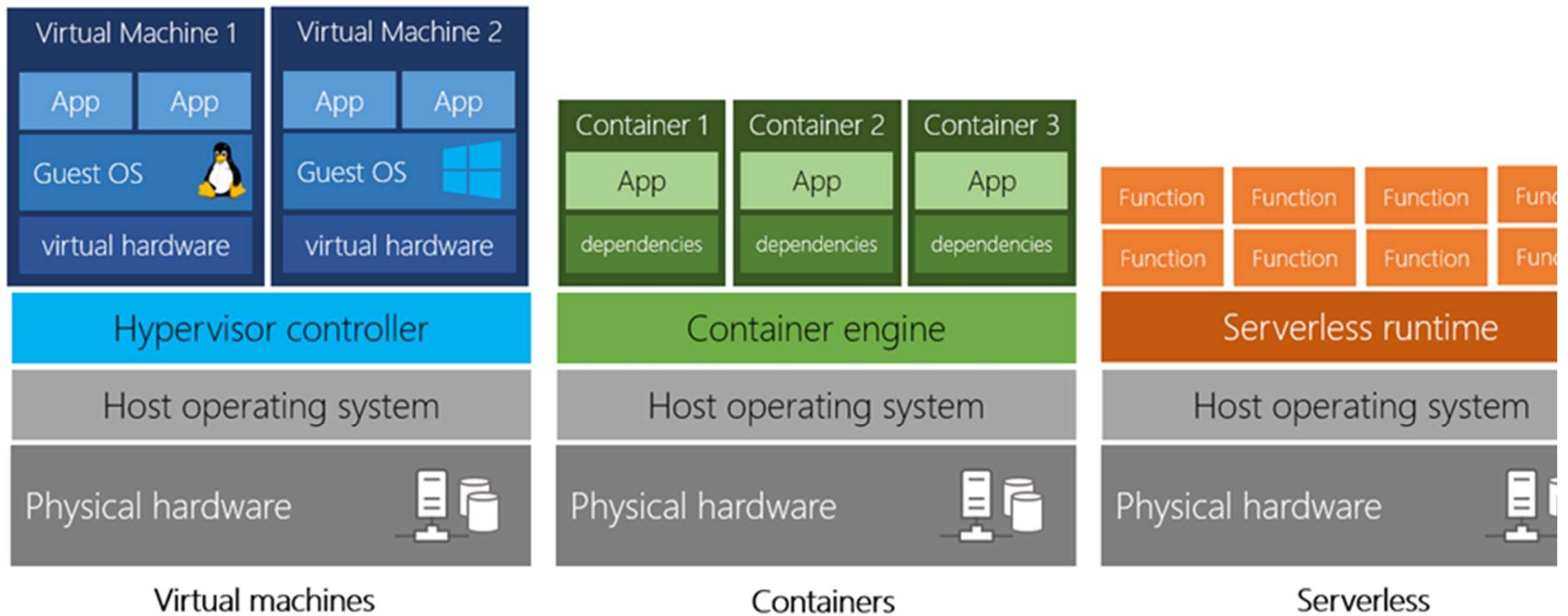


You Manage



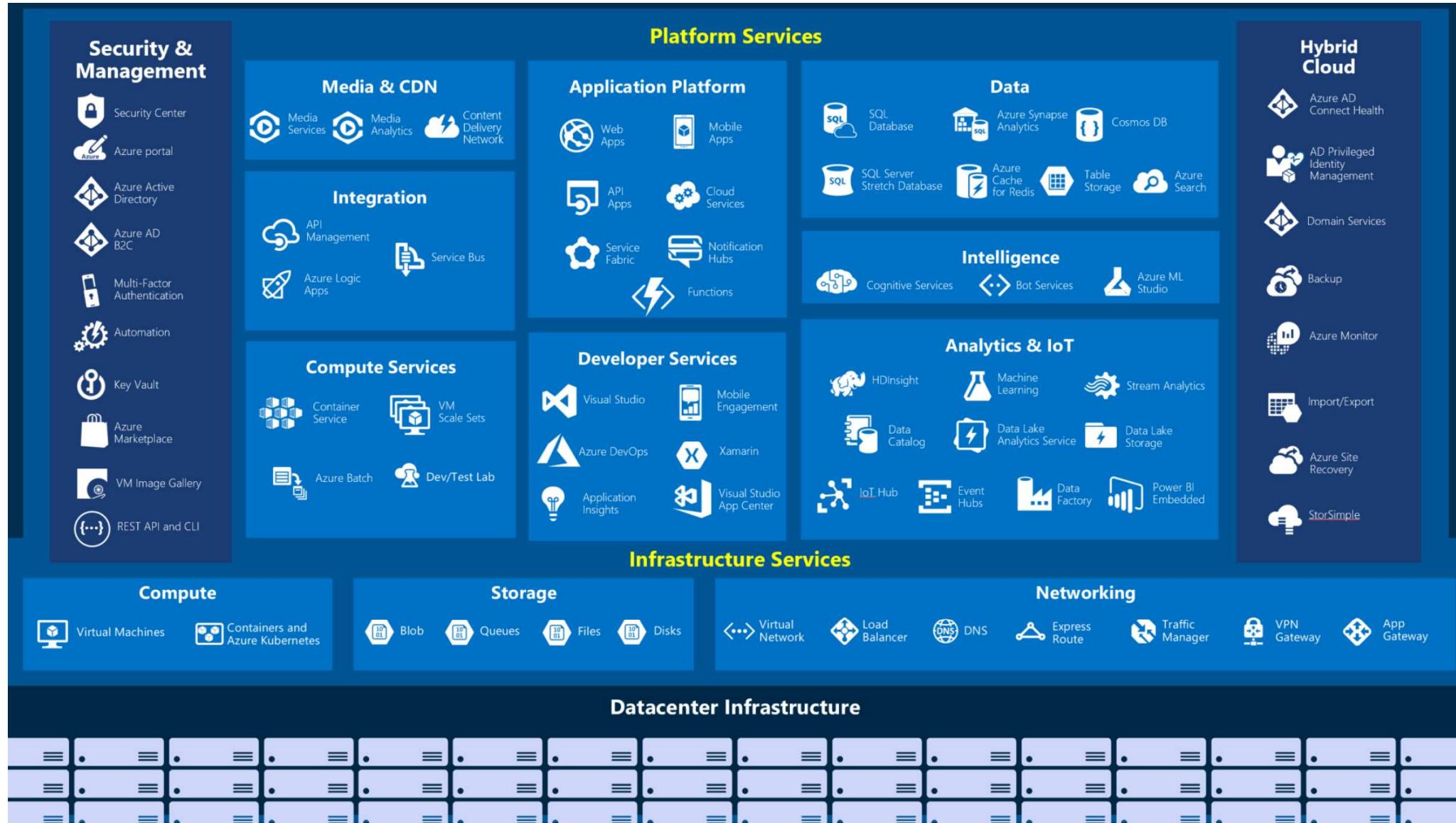
Provider Manages

What is serverless computing ?



Azure services

<https://azure.microsoft.com/en-us/services/>





Azure Machine Learning – what is it?

Machine Learning

Typical E2E Process



Prepare

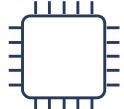


Prepare Data



Build model
(your favorite
IDE)

Experiment



Train &
Test Model



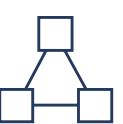
Register and
Manage Model

Deploy



Deploy
Service
Monitor
Model

Orchestrate



Azure Machine Learning



Azure Machine Learning

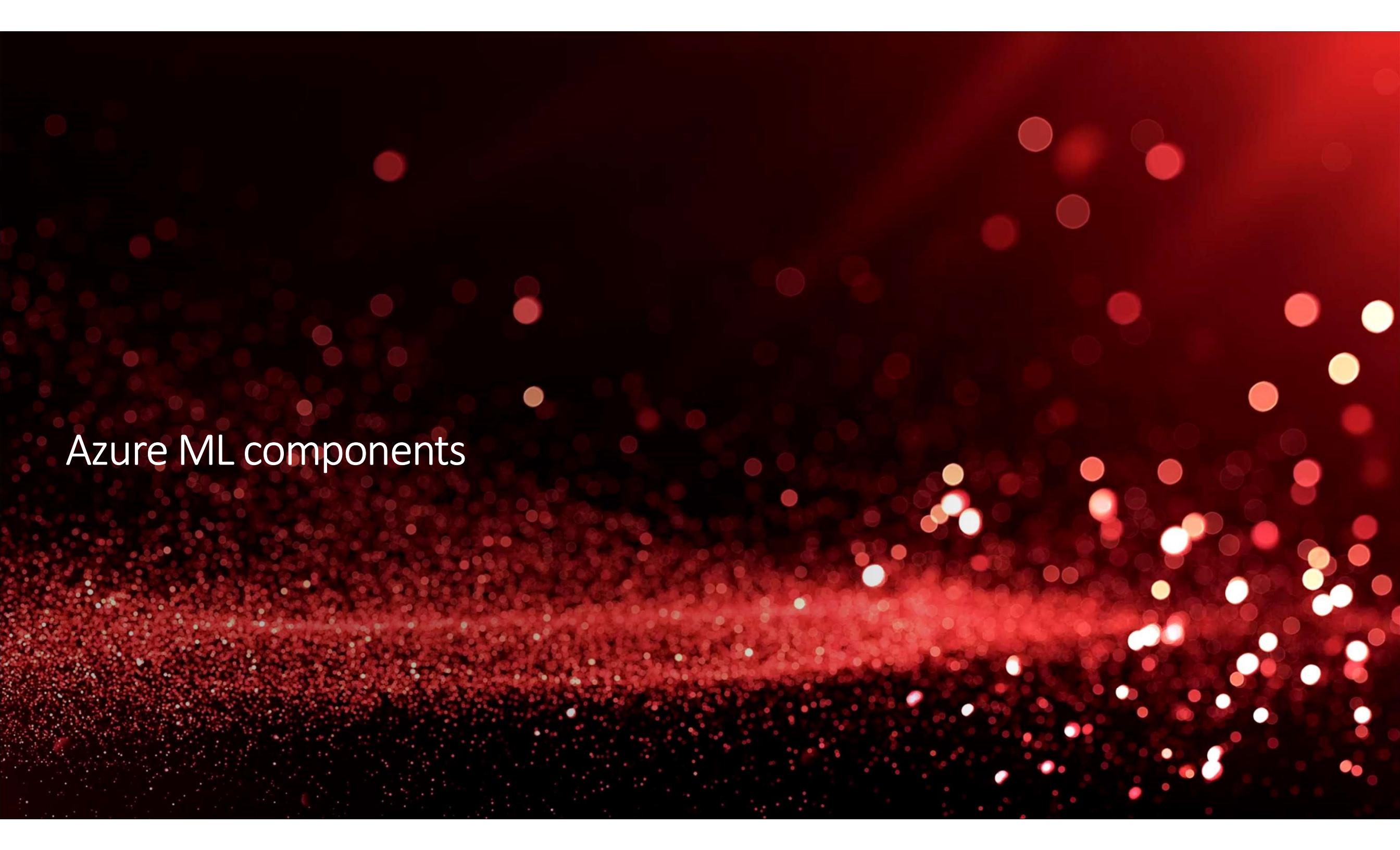
**Set of Azure
Cloud Services**



**Python & R SDK,
Visual Interface,
CLI**

That enables you to:

- ✓ Prepare Data
- ✓ Build Models
- ✓ Train Models
- ✓ Manage Models
- ✓ Track Experiments
- ✓ Deploy Models

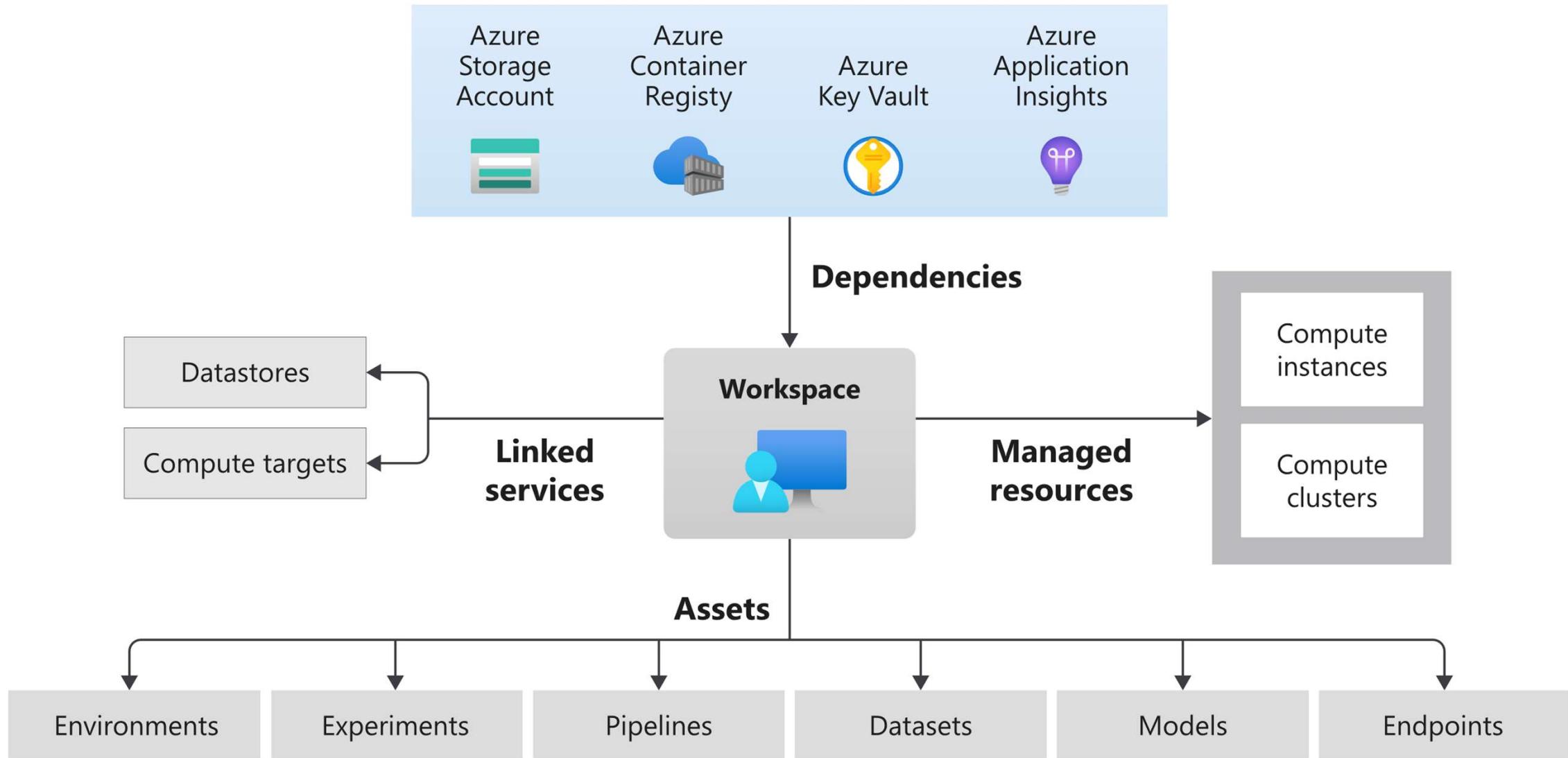


Azure ML components

Azure Machine Learning



Azure Machine Learning





Azure Machine Learning

Azure ML Studio

For all skill levels studio web experience

The screenshot shows the Azure ML Studio home page. On the left is a vertical navigation menu:

- New
- Home** (selected)
- Author
 - Notebooks
 - Automated ML
 - Designer
- Assets
 - Datasets
 - Experiments
 - Pipelines
 - Models
 - Endpoints
- Manage
 - Compute
 - Datastores
 - Data Labeling

The main content area has a blue header bar with the text "workshop-aml-2020 > Home". Below it is a "Welcome to the studio!" message. There are four main cards:

- Create new** (with a plus icon) - Description: "Code with Python SDK and run sample experiments." - Button: "Start now"
- Notebooks** (with a notebook icon) - Description: "Code with Python SDK and run sample experiments." - Button: "Start now"
- Automated ML** (with a lightning bolt icon) - Description: "Automatically train and tune a model using a target metric." - Button: "Start now"
- Designer** (with a three-dot grid icon) - Description: "Drag-and-drop interface from prepping data to deploying models." - Button: "Start now"

Below these cards is a section titled "My recent resources" with a "Runs" table:

Run number	Experiment	Updated time	Status
2	workshop5-amlcompute	Feb 18, 2020 2:56 PM	Completed

On the right side, there is a "Compute" section with a table:

Name
AKSML



Azure ML Studio

shwinneworkshop > Experiments > keras-mnist

keras-mnist

Switch to old experience ?

Edit table Refresh Reset to default view Add chart Include child runs

Customizations to this page will be preserved for you in this browser and they will not affect how other people experience the same page.

+ Add filter

Run status

Status	Count
Running	0
Completed	20
Failed	0
Other	5

Accuracy

Min(Loss)

Loss

Accuracy

Min(Loss)

Show only selected rows (25 selected)

Page Size: 25

Run	Status	Duration	Compute target	Run type	Min(Loss)	Max(Accuracy)
Run 25	Completed	2m 40s	gpu-cluster	Script	0.00637676913137492	0.9986000011364619
Run 24	Completed	2m 50s	gpu-cluster	Script	0.0062801566226492545	0.9987500011424224
Run 23	Completed	2m 33s	gpu-cluster	Script	0.28901339417672905	0.9698499940832456



Notebooks

Machine Learning notebooks



Azure Machine Learning

- Fully managed cloud-based solution for data scientists to get started with ML machine learning.
- Deeply integrated with Azure ML workspaces and datastores.
- First-class experience for model authoring through integrated notebooks using Azure ML Python and R SDK.
- Management and enterprise readiness capabilities for IT administrators.

The screenshot shows the 'Compute' blade in the Azure portal. On the left, there's a navigation bar with 'Compute Instances', 'Training clusters', 'Inference clusters', and 'Attached compute'. Below it is a message: 'Compute instance is replacing the Notebook VM. You cannot create new Notebook VMs, but you can still use existing Notebook VMs. [Learn More.](#)' A toolbar below the message includes 'New', 'Refresh', 'Start', 'Stop', 'Restart', 'Delete', and a toggle for 'Show created by me only'. A table lists a single compute instance: 'standardd13v2' (Status: Running, Application URI: JupyterLab, Virtual Machine size: STANDARD_D13_V2). To the right, a 'New Compute Instance' form is open, showing fields for 'Compute name' (with placeholder 'my-new-compute'), 'Region' (set to 'westeurope'), 'Virtual Machine size' (set to 'Standard_D3_v2'), and 'Enable SSH access' (checked). Below these are sections for 'Advanced settings', 'Configure virtual network', 'Resource group' (with placeholder 'Select or search by name'), and 'Virtual network' (with placeholder 'Select or search by name').



Notebooks

Preview Microsoft Azure Machine Learning

workshopAML2020 > Notebooks

Notebooks

My files Samples

User files

- seretkow
- create-first-ml-experiment
- imgs
- tutorial-1st-experiment-sdk-train.ipynb**
- tutorial-1st-experiment-sdk-train.yml
- .config

Jupyter Compute: instance - Running Python 3.6 - AzureML Python 3.6.9 | Send Feedback

instance • Jupyter Kernel Idle

Copyright (c) Microsoft Corporation. All rights reserved.

```
[1] import sys  
sys.version  
'3.6.9 |Anaconda, Inc.| (default, Jul 30 2019, 19:07:31) \n[GCC 7.3.0]'
```

Tutorial: Train your first model

This tutorial is **part two of a two-part tutorial series**. In the previous tutorial, you created a workspace and chose a development environment. In this tutorial, you learn the foundational design patterns in Azure Machine Learning service, and train a simple scikit-learn model based on the diabetes data set. After completing this tutorial, you will have the practical knowledge of the SDK to scale up to developing more-complex experiments and workflows.

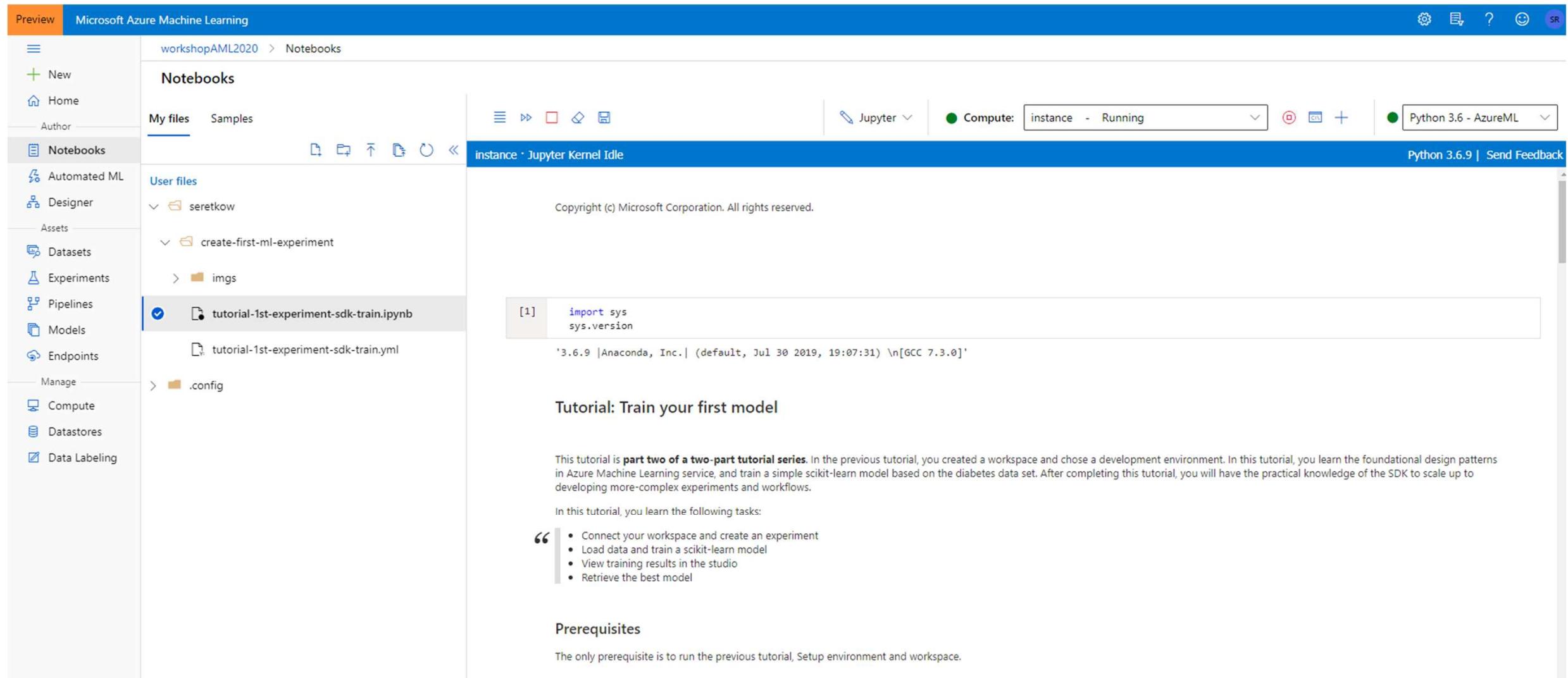
In this tutorial, you learn the following tasks:

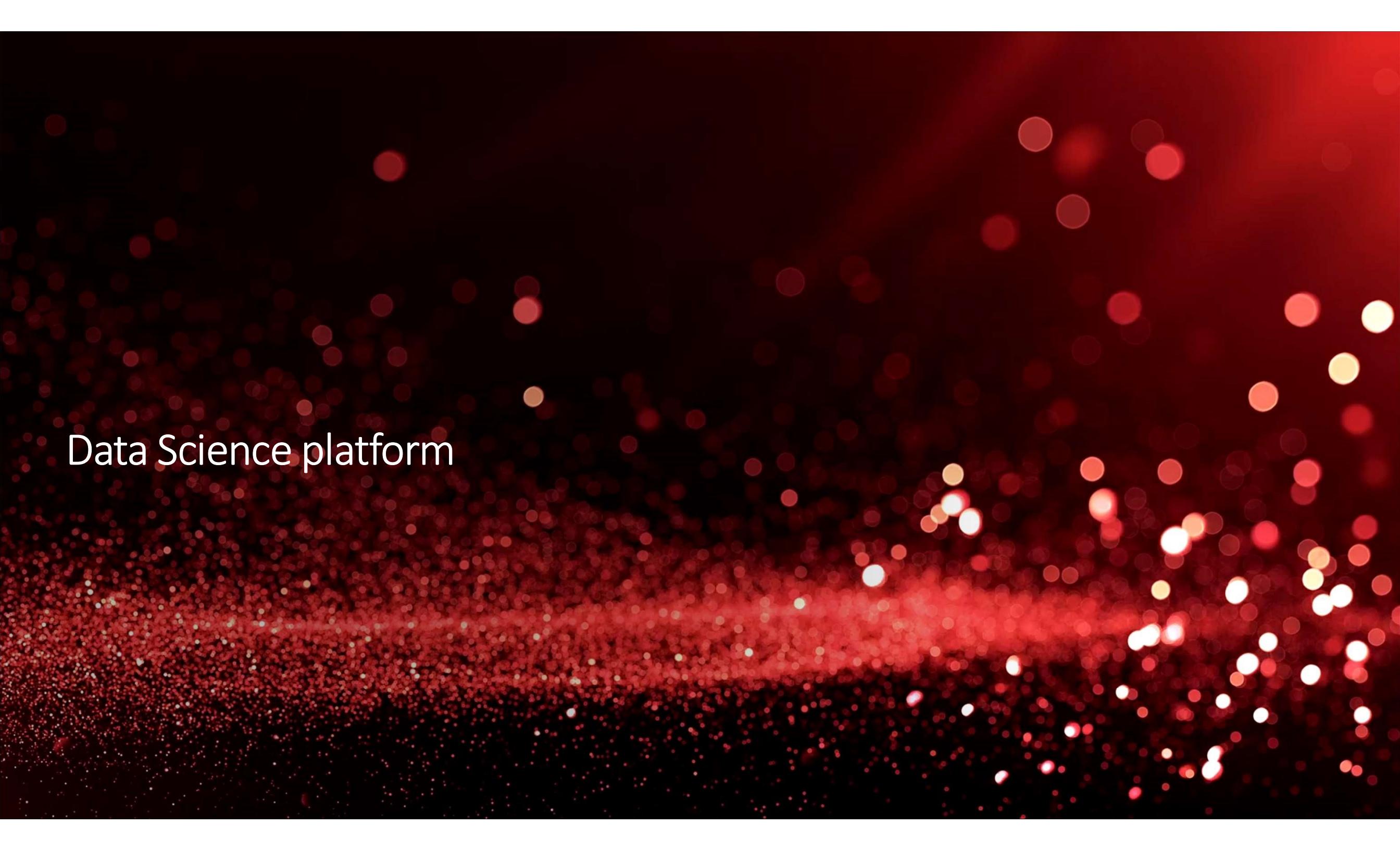
“

- Connect your workspace and create an experiment
- Load data and train a scikit-learn model
- View training results in the studio
- Retrieve the best model

Prerequisites

The only prerequisite is to run the previous tutorial, Setup environment and workspace.





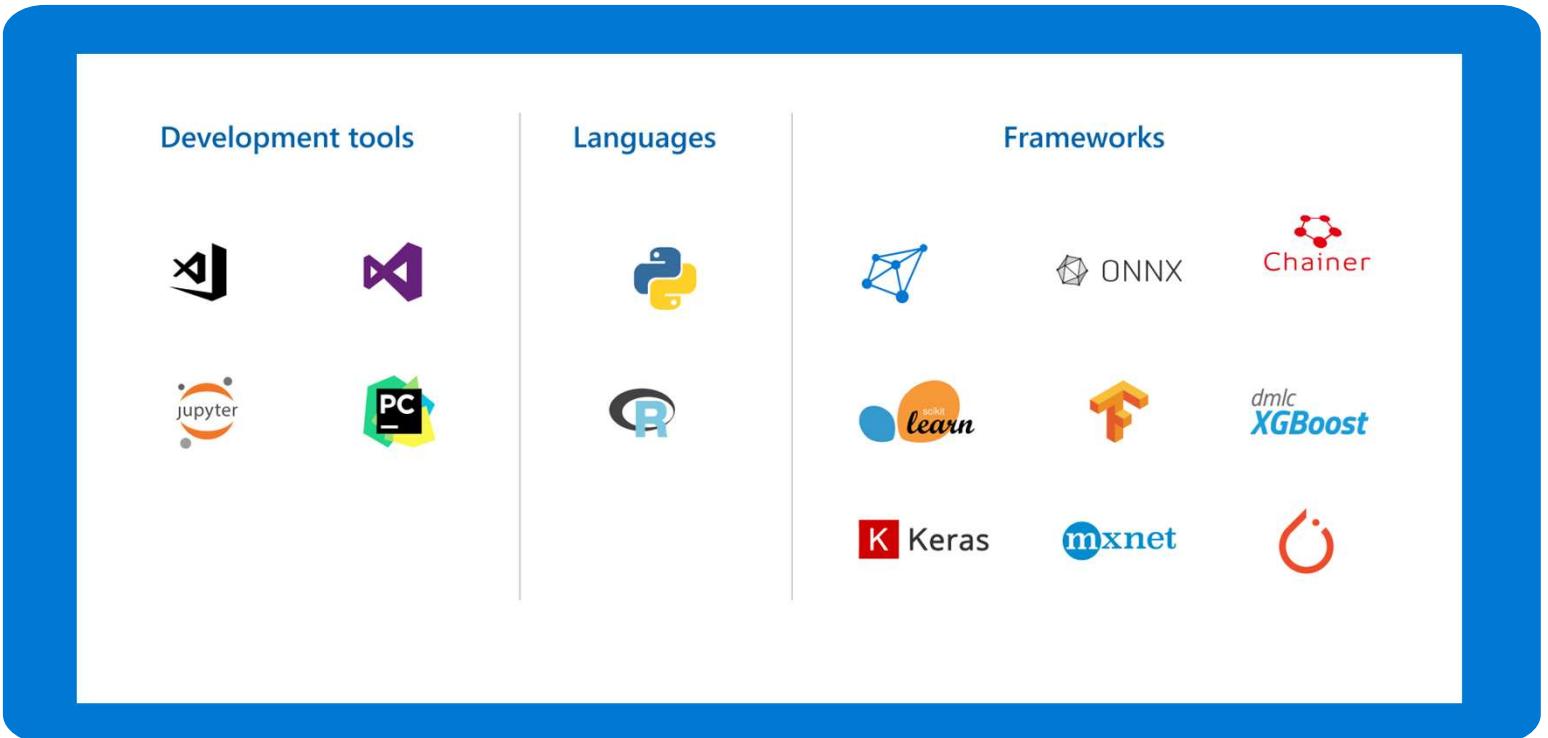
Data Science platform



Azure Machine Learning

Azure Machine Learning

Open and interoperable platform

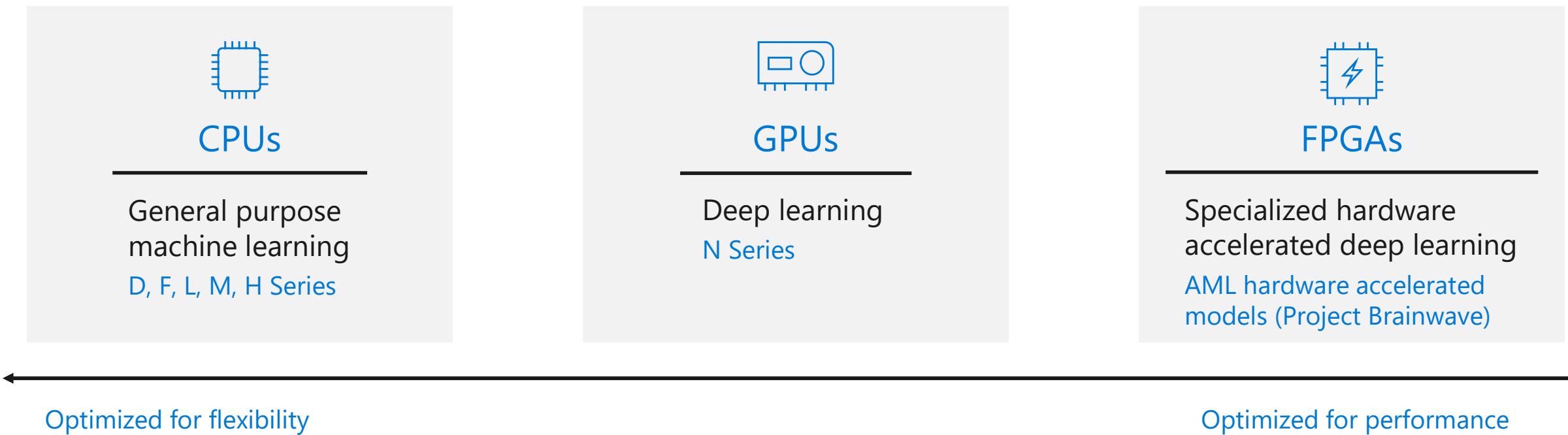


Powerful infrastructure

Accelerate deep learning



Azure Machine Learning





Azure Machine Learning

Compute Cluster

CPU, GPU

- Azure Machine Learning compute cluster is a CPU or GPU **managed-compute infrastructure** that allows you to easily create a single or multi-node compute.
- The compute is created within your workspace region as a **resource that can be shared** with other users in your workspace.
- The compute **scales up automatically** when a job is submitted and can be put in an Azure Virtual Network.
- The compute executes in a **containerized environment and packages your model dependencies** in a [Docker container](#).

Compute name * ⓘ
instance

Region * ⓘ
westeurope

Virtual machine type * ⓘ
CPU (Central Processing Unit)

Virtual machine priority * ⓘ
Dedicated Low priority

Virtual machine size * ⓘ
Standard_DS3_v2 4 Cores, 14 GB (RAM), 28 GB (Disk)
+ Add filter Search by VM name...

Showing 72 VM sizes Total available quota: 164 cores ⓘ

Name ⓘ	Category	Cores ⓘ	Available ... ⓘ	RAM	Storage	Cost ⓘ
Standard_D2_v3	General purpose	2	100 cores	8 GB	50 GB	\$0.12/hr
Standard_D2s_v3	General purpose	2	100 cores	8 GB	16 GB	--
Standard_D3	General purpose	4	24 cores	14 GB	200 GB	\$0.34/hr
Standard_D32_v3	General purpose	32	100 cores	128 GB	800 GB	\$1.92/hr
Standard_D32s_v3	General purpose	32	100 cores	128 GB	256 GB	--
Standard_D3_v2 ⓘ	General purpose	4	120 cores	14 GB	200 GB	\$0.27/hr
Standard_D4	General purpose	8	24 cores	28 GB	400 GB	\$0.67/hr



Compute Cluster

Type	Sizes	Description
General purpose	B, Dsv3, Dv3, Dasv4, Dav4, DSv2, Dv2, Av2, DC, DCv2, Dv4, Dsv4, Ddv4, Ddsv4	Balanced CPU-to-memory ratio. Ideal for testing and development, small to medium databases, and low to medium traffic web servers.
Compute optimized	F, Fs, Fsv2	High CPU-to-memory ratio. Good for medium traffic web servers, network appliances, batch processes, and application servers.
Memory optimized	Esv3, Ev3, Easv4, Eav4, Ev4, Esv4, Edv4, Edsv4, Mv2, M, DSv2, Dv2	High memory-to-CPU ratio. Great for relational database servers, medium to large caches, and in-memory analytics.
Storage optimized	Lsv2	High disk throughput and IO ideal for Big Data, SQL, NoSQL databases, data warehousing and large transactional databases.
GPU	NC, NCv2, NCv3, NCasT4_v3 (Preview), ND, NDv2 (Preview), NV, NVv3, NVv4	Specialized virtual machines targeted for heavy graphic rendering and video editing, as well as model training and inferencing (ND) with deep learning. Available with single or multiple GPUs.
High performance compute	HB, HBv2, HC, H	Our fastest and most powerful CPU virtual machines with optional high-throughput network interfaces (RDMA).

<https://docs.microsoft.com/en-us/azure/virtual-machines/sizes>



Azure Machine Learning

ONNX support

Create

Frameworks

Caffe2 Chainer Cognitive Toolkit

mxnet PyTorch PaddlePaddle

ML.NET MathWorks XGBoost

ML learn F K

Services

Azure Custom Vision Service

ONNX Model

Deploy

Azure

Azure Machine Learning services

Ubuntu VM

Windows Server 2019 VM

Windows Devices

Other Devices (iOS, etc)

Native support

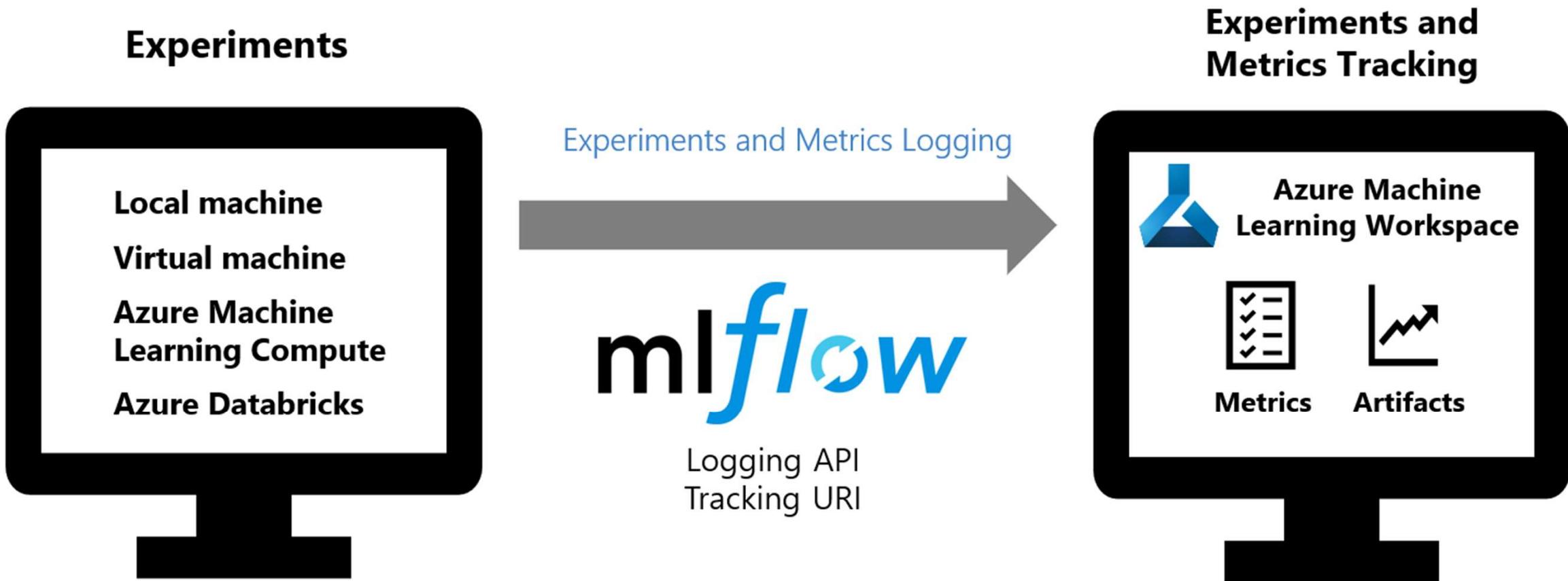
Converters

Native support

Native support

Converters

MLFlow with Azure ML experimentation



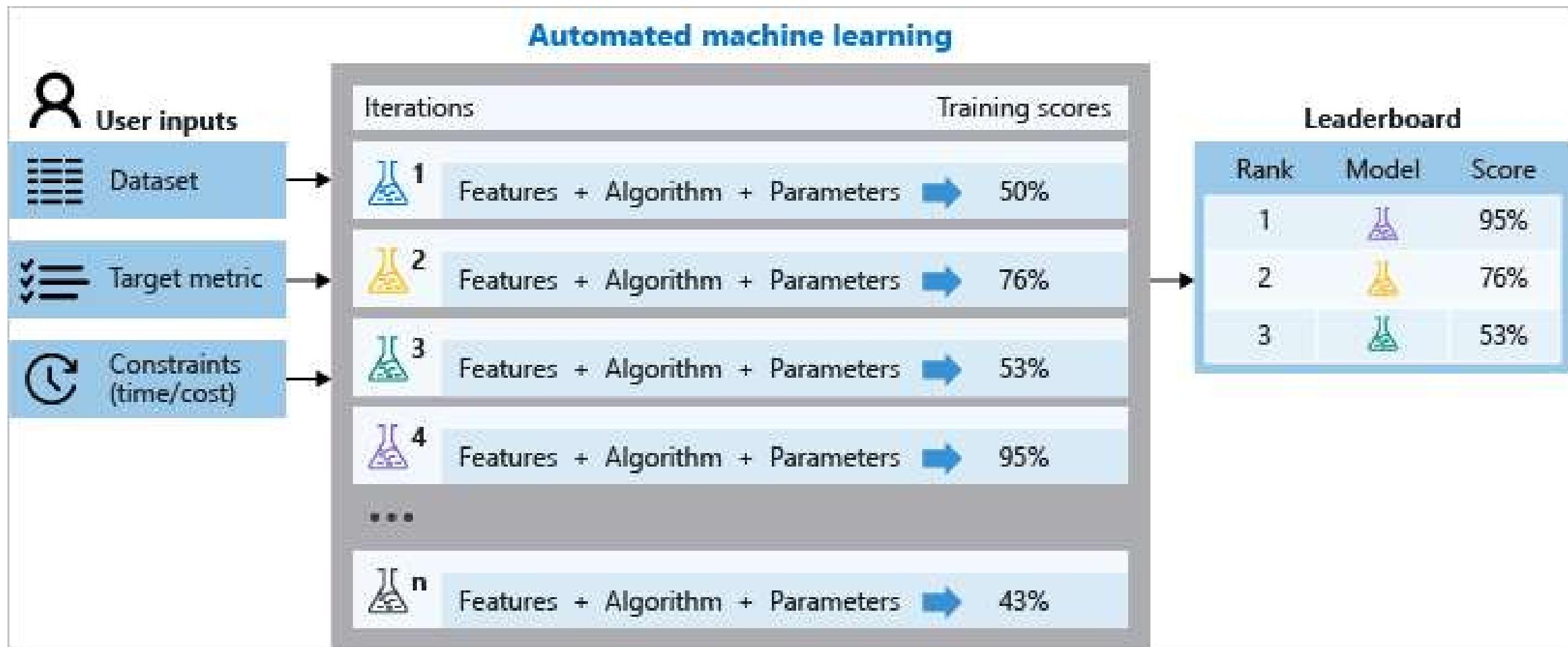
<https://docs.microsoft.com/en-us/azure/machine-learning/how-to-use-mlflow>

AutoML

Automated ML



Azure Machine Learning



Automated ML



Azure Machine Learning

- Automatically build and deploy predictive models using the no-code UI or through a code-first notebooks experience.
- Increase productivity with easy data exploration and profiling and with intelligent feature engineering.
- Easily create accurate models customized to your data and refined by a wide array of algorithms and hyperparameters.
- Build responsible AI solutions with model interpretability and fine-tune your models to improve accuracy.

The screenshot shows the 'Create a new Automated ML run' interface. On the left, a vertical navigation bar lists three steps: 'Select dataset' (checked), 'Configure run' (checked), and 'Task type and settings' (unchecked). The main area is titled 'Select task type' and contains four options: 'Classification' (checked with a green checkmark), 'Regression' (unchecked), 'Time series forecasting' (unchecked), and 'Enable deep learning (preview)' (unchecked). At the bottom of the task type section are two links: 'View additional configuration settings' and 'View featurization settings'.

Azure No-Code AutoML

Automated ML



Azure Machine Learning

Select dataset

Configure Run

Task type and settings

Select task type

Select the machine learning task type for the experiment. Additional settings needed.

Classification
To predict one of several categories in the target column. Yes/No, blue, red, green.

Regression
To predict continuous numeric values

Time series forecasting
To predict values based on time

[View additional configuration settings](#) [View featurization settings](#)

Algorithm name	spearman_corr...	Created	Duration	Status	Model
MaxAbsScaler, DecisionTree	0.9874938192482...	10/31/2019, 9:38:57 PM	00:01:05	Completed	Download
MaxAbsScaler, ExtremeRandomTrees	0.9844198790461...	10/31/2019, 9:35:48 PM	00:04:58	Completed	Download
MaxAbsScaler, RandomForest	0.9834759850616...	10/31/2019, 9:33:12 PM	00:01:04	Completed	Download
StandardScalerWrapper, ExtremeRandomTrees	0.9818152059586...	10/31/2019, 9:37:30 PM	00:01:06	Completed	Download
StandardScalerWrapper, ExtremeRandomTrees	0.9793813451703...	10/31/2019, 9:33:12 PM	00:04:51	Completed	Download
MaxAbsScaler, ExtremeRandomTrees	0.978520141200337	10/31/2019, 9:40:22 PM	00:01:02	Completed	Download
StandardScalerWrapper, LightGBM	0.9779188281892...	10/31/2019, 9:33:12 PM	00:01:39	Completed	Download
StandardScalerWrapper, RandomForest	0.9037608207911...	10/31/2019, 9:41:28 PM	00:01:02	Completed	Download
StandardScalerWrapper, RandomForest	0.8697731140904...	10/31/2019, 9:33:12 PM	00:01:05	Completed	Download
StandardScalerWrapper, RandomForest	0.8679320338984...	10/31/2019, 9:34:35 PM	00:04:34	Completed	Download

Azure No-Code AutoML

AutoML Power BI integration



Azure Machine Learning

The screenshot illustrates the process of creating a machine learning model using AutoML within a Power BI environment. The interface is divided into several sections:

- Top Navigation:** A horizontal bar with four steps: "Choose model" (highlighted with a yellow circle), "Select data", "Customize inputs", and "Name + train".
- Left Sidebar:** A list of datasets: Account, Contact, Date, Event, Lead, Message, Opportunity, Owner, and Product.
- Model Selection:** A section titled "Choose a model type" featuring three options:
 - Classification:** Identify the category or class an entity belongs to.
 - Forecast:** Estimate values and trends based on historical data.
 - Binary Prediction:** Determine the likelihood of a specific outcome being achieved. This option is highlighted with a yellow border.
- Model Performance:** A central section titled "MODEL PERFORMANCE" containing the following information:
 - How the model was evaluated:** The model predicted diagnosis_boolean probabilities for a test set of 113 records and compared the predicted outcomes (based on the selected threshold) to the historical outcomes.
 - Model performance:** The Area under the curve (AUC) observed on the test set is 100%.
 - See top predictors:** A button to view the features influencing the predictions.
- Confusion Matrix:** A 2x2 matrix showing the distribution of actual vs predicted classes:

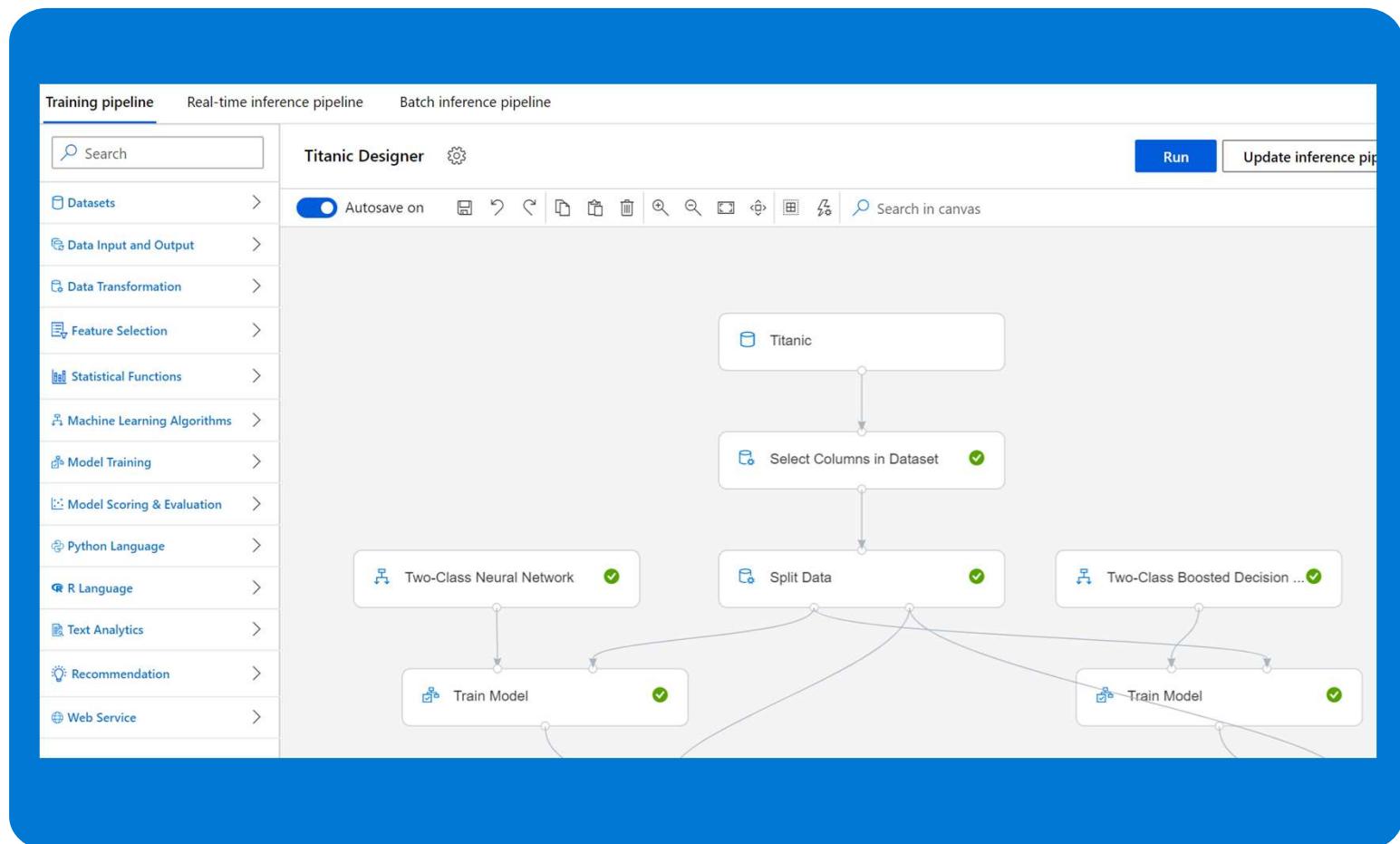
	Predicted Malignant	Predicted Benign
Actual Malignant	43.00	0.00
Actual Benign	8.00	62.00
- Performance Metrics:** A summary of precision and recall:
 - Precision:** 84% of records predicted as Malignant are likely to actually be Malignant.
 - Recall:** 100% of records that are actually Malignant are likely to be predicted as Malignant.
- Probability Threshold:** A slider to adjust the threshold for predictions, with markers at 0.00 and 0.03.

Azure ML Designer interface – ML with no code

Azure ML Designer



- Drag-n-drop workflow capability.
- Simplify the process of building, testing, and operating machine learning models.
- Drag-and-drop datasets and modules onto the canvas.
- Connect the modules together to create a pipeline draft.
- Submit a pipeline run using the compute resources in your Azure Machine Learning workspace.
- Convert your training pipelines to inference pipelines.
- Publish your pipelines to a REST pipeline endpoint to submit new pipeline runs with different parameters and datasets.
- Deploy a real-time inference pipeline to a real-time endpoint to make predictions on new data in real time.



Azure ML Designer



Azure Machine Learning

The screenshot shows the Azure ML Designer interface. On the left, there's a navigation sidebar with options like New, Home, Notebooks, Automated ML, Designer (which is selected and highlighted in grey), Datasets, Experiments, Pipelines, Models, and Endpoints. Below the main menu is a search bar and a list of datasets, data input/output, and various data transformation operations such as Add Columns, Add Rows, Apply Math Operation, Apply SQL Transformation, Clean Missing Data, Clip Values, Convert to CSV, Convert to Dataset, and Edit Metadata. The main workspace is titled "Flight Delays" and contains a "Flight Delays Data" dataset node connected by a vertical line to a "Normalize Data" node.

```
graph TD; FlightDelaysData[Flight Delays Data] --- NormalizeData[Normalize Data]
```

Azure ML Designer



Azure Machine Learning

Microsoft Azure Machine Learning

AlinaDay > Designer > Authoring

Training pipeline Real-time inference pipeline Batch inference pipeline

Search by name, tags and description

99 assets in total

Datasets (5) Sample datasets (16) Data Input and Output (3) Data Transformation (19) Feature Selection (2) Statistical Functions (1) Machine Learning Algorithms (18) Model Training (4) Model Scoring & Evaluation (6) Python Language (2) R Language (1) Text Analytics (7) Computer Vision (6) Recommendation (5) Anomaly Detection (2) Web Service (2)

Pipelinevisual

Submit Update inference pipeline Publish ...

Run finished View run overview

GermanCredit

Two-Class Neural Network Completed

Split Data Completed

Train Model Completed

Score Model Completed

Evaluate Model

Navigator

Settings

Default compute target Designer Select compute target

Pipeline parameters No parameters selected

Default output settings Select default datastore

Draft details

Draft name Pipelinevisual

Draft description (optional) Pipeline created on 20201030

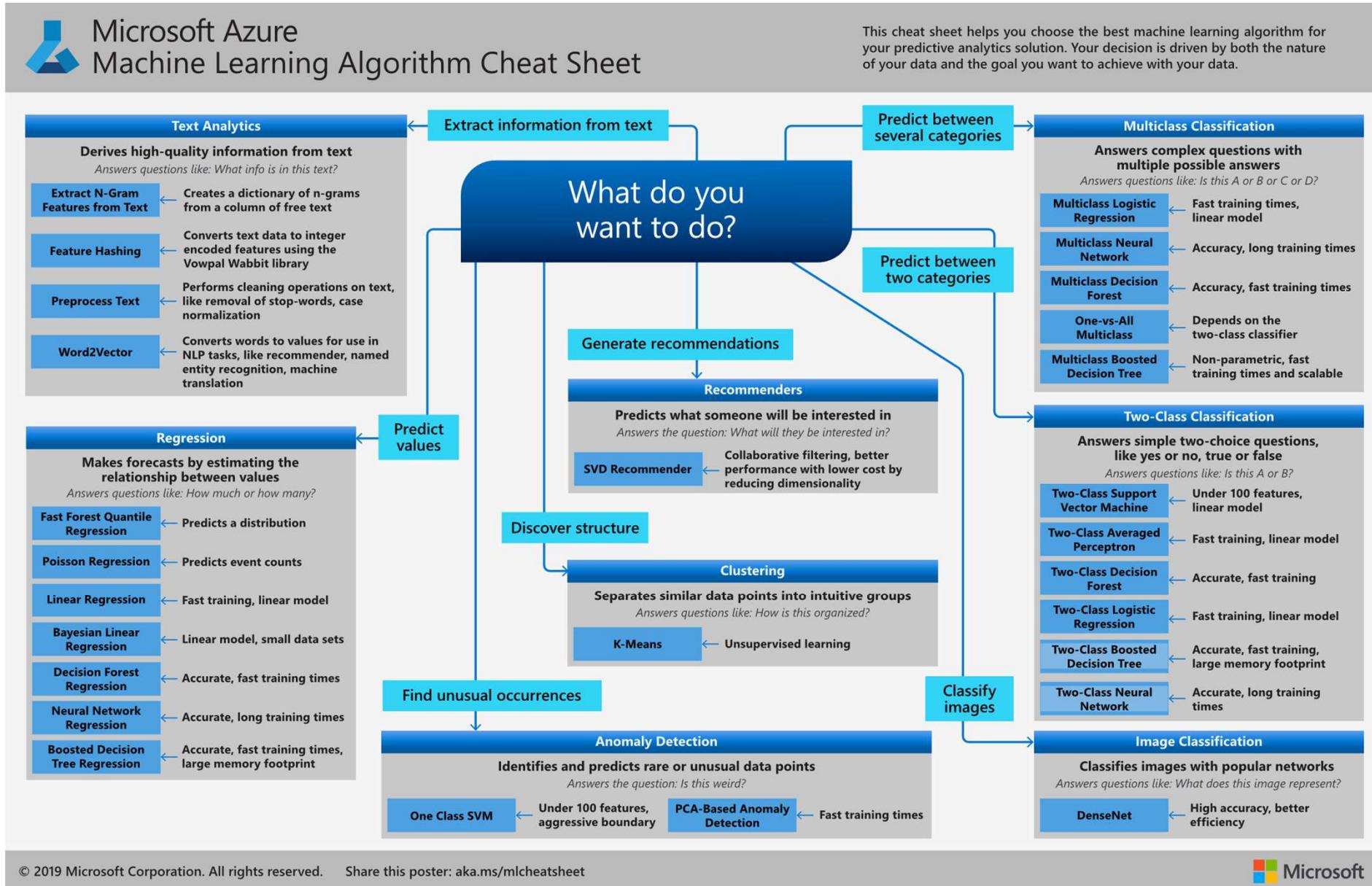
Created on October 30, 2020 9:34 AM

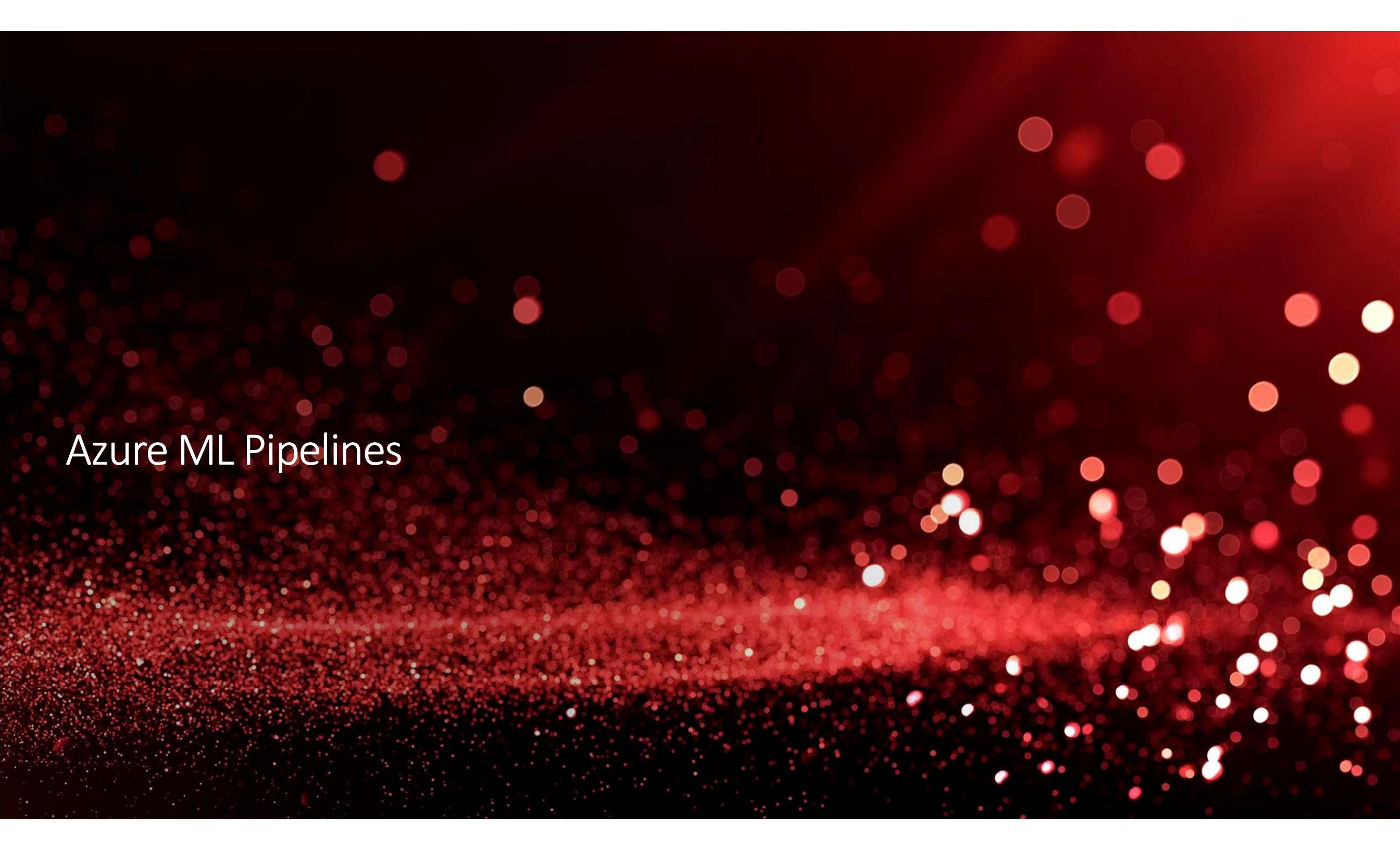
Created by



Azure ML Designer

<https://docs.microsoft.com/fr-fr/azure/machine-learning/algorithm-cheat-sheet#download-machine-learning-algorithm-cheat-sheet>





Azure ML Pipelines

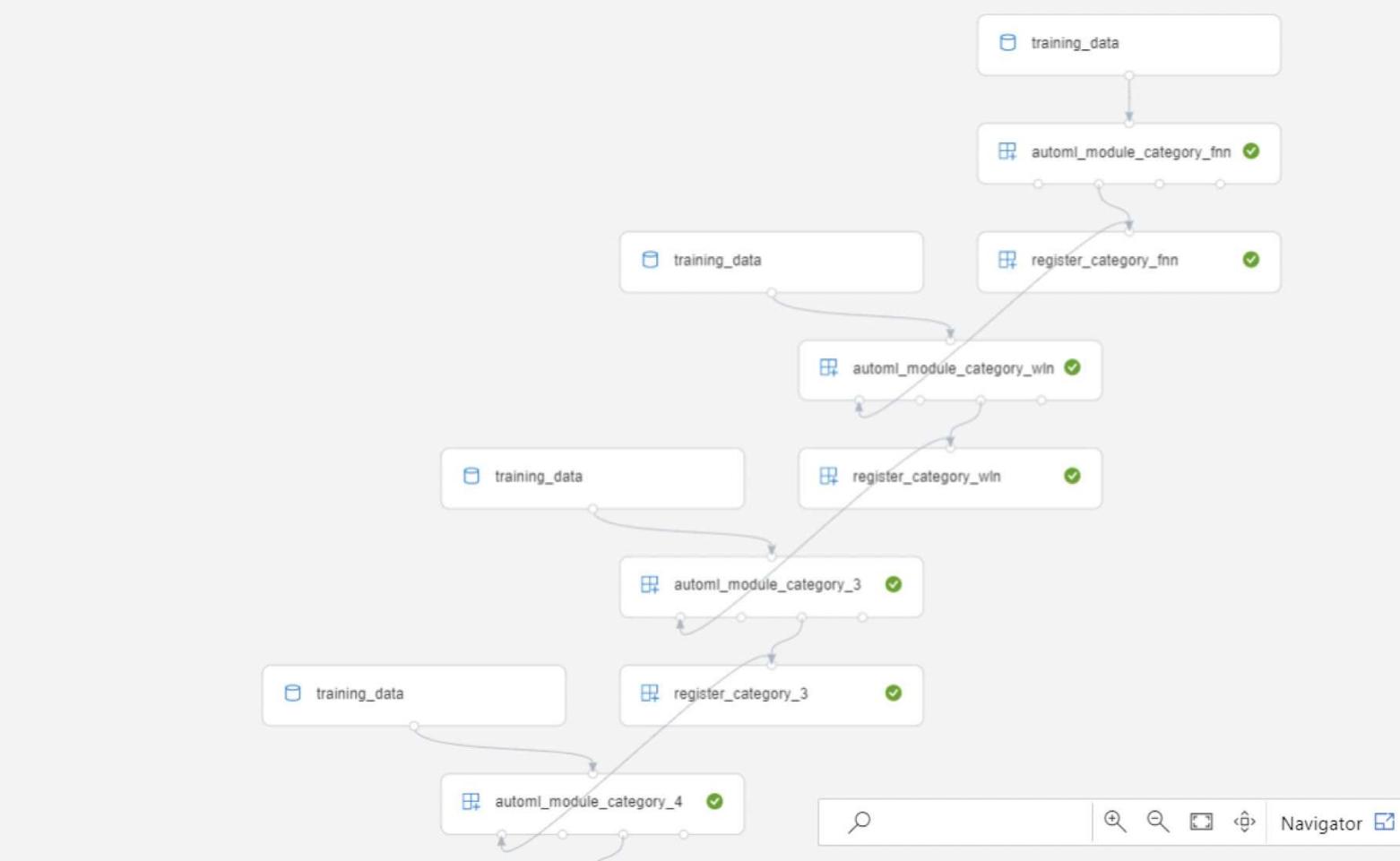
Pipelines



Azure Machine Learning

Run 1 ✓ Completed
[Refresh](#) [Clone](#) [Publish](#) [Cancel](#)

Details Logs



Pipeline run overview

Attributes Pipeline parameters

Status
Finished

Submitted by

Total steps
20

Run ID
b626f56c-bc72-40e5-b401-3505271e206e

Description
category-based-propensity-pipeline

Run source
SDK

Run type
SDK

Published pipeline
[View detail](#)

Experiment
[category-based-propensity-pipeline](#)

Submit time
10/08/2019, 9:47:15 PM

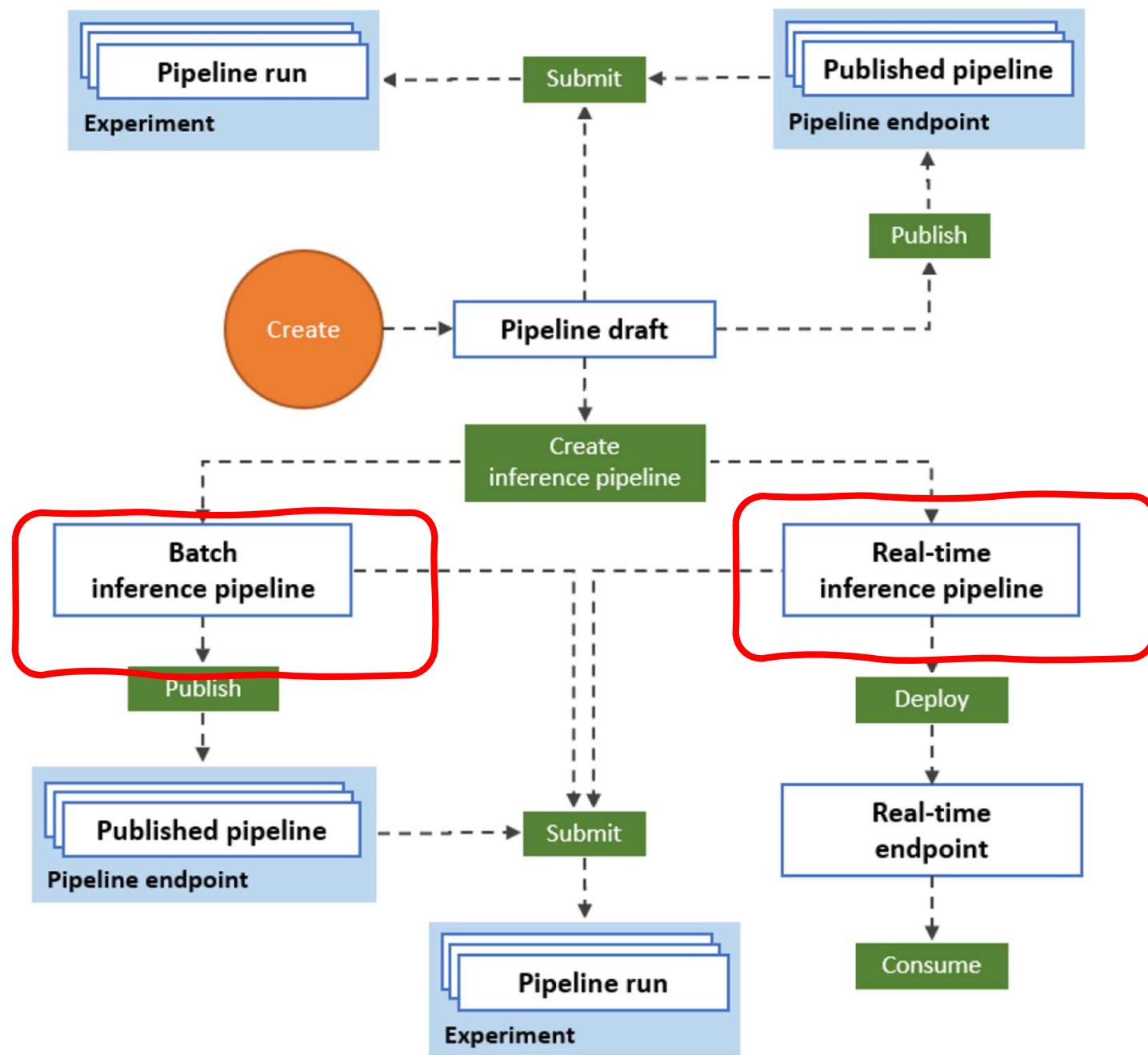
End time
10/09/2019, 12:40:13 AM

Duration
02:52:58

Pipelines



Azure Machine Learning



Interpret & explain ML models

Think fairness. Build for everyone.

A toolkit to assess and improve the fairness of machine learning models.

[Assess](#) [Mitigate](#)

Use common fairness metrics and an interactive dashboard to assess which groups of people may be negatively impacted.



[Get Started](#)

[API Docs](#)

Microsoft Fairlearn
<https://fairlearn.github.io/>

Understand Models. Build Responsibly.

A toolkit to help understand models and enable responsible machine learning

[Get Started](#)[Learn More](#)

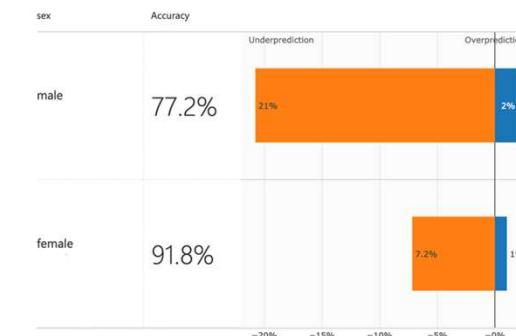
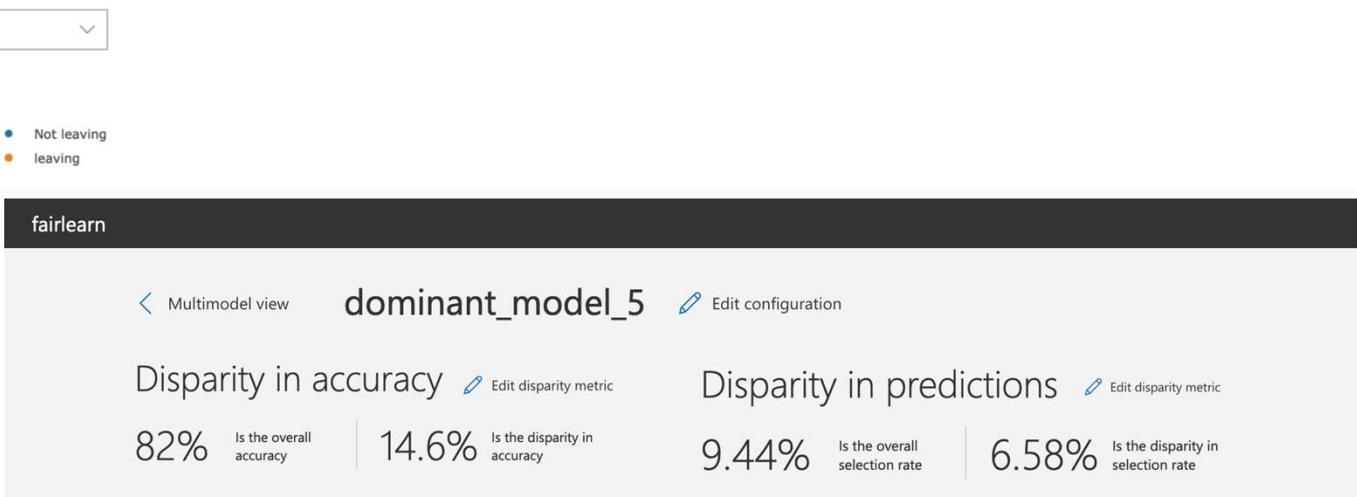
Microsoft InterpretML
<https://interpret.ml/>



Examples



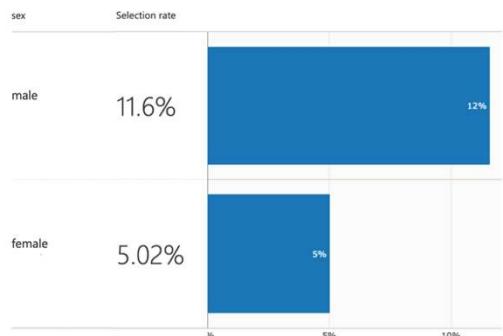
Azure Machine Learning



Hide explanation

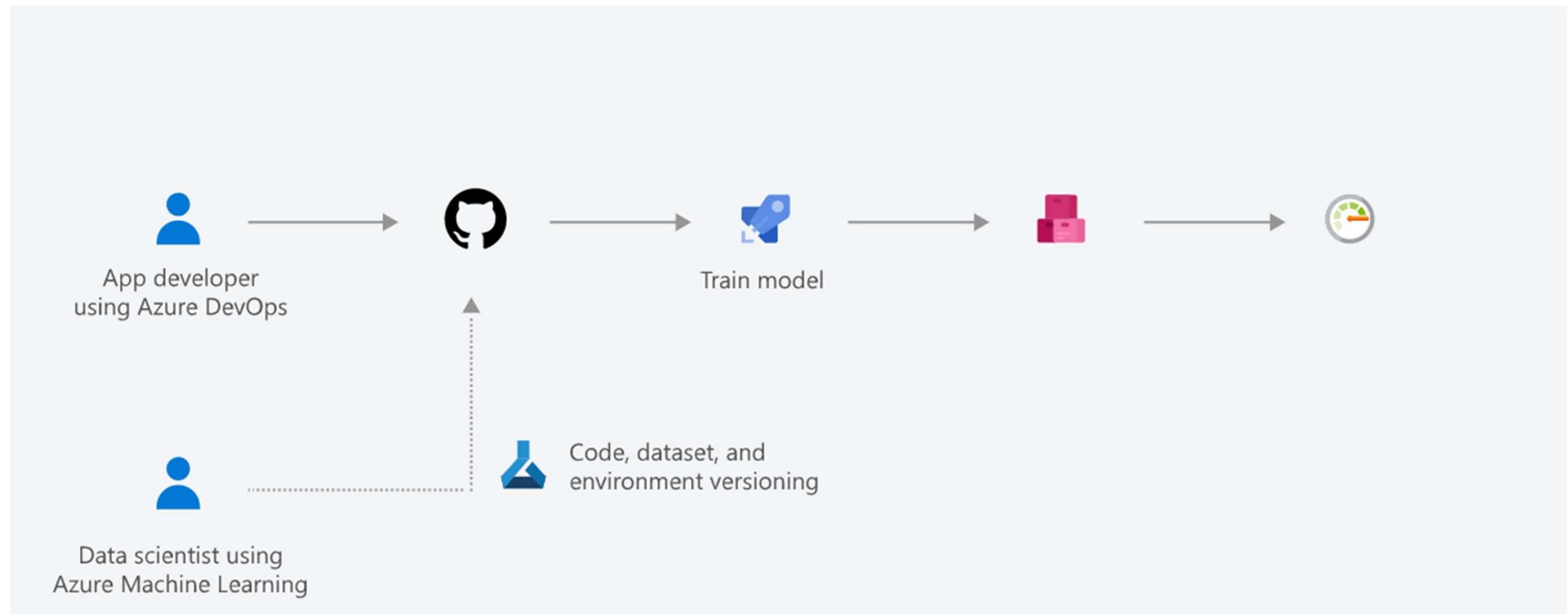
The bar chart shows the distribution of errors in each group.

Errors are split into overprediction errors (predicting 1 when the true label is 0), and underprediction errors (predicting 0 when the true label is 1).



MLOps = DevOps for Data Science

MLOps workflow



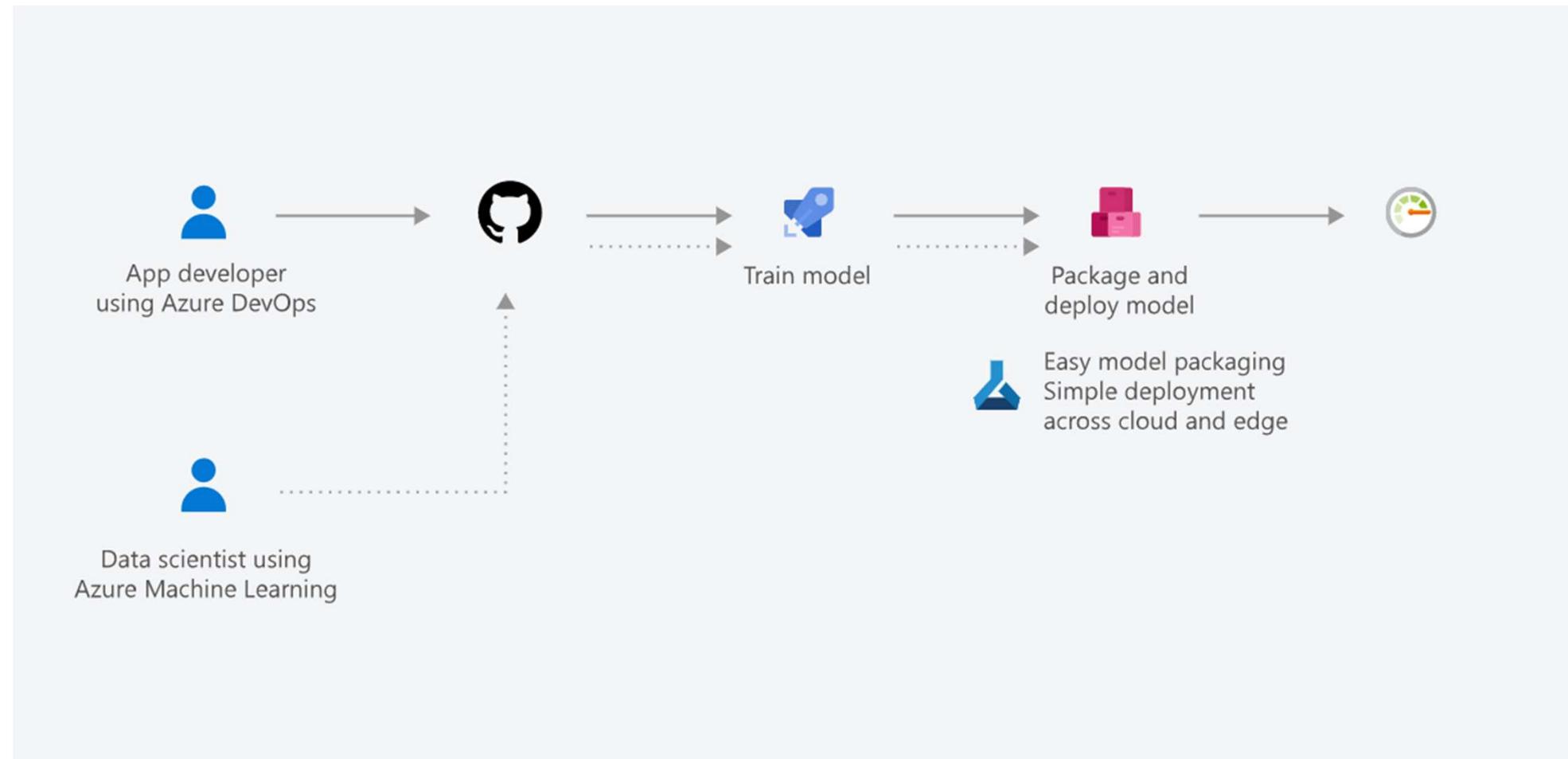
Model reproducibility

Model validation

Model deployment

Model retraining

MLOps workflow



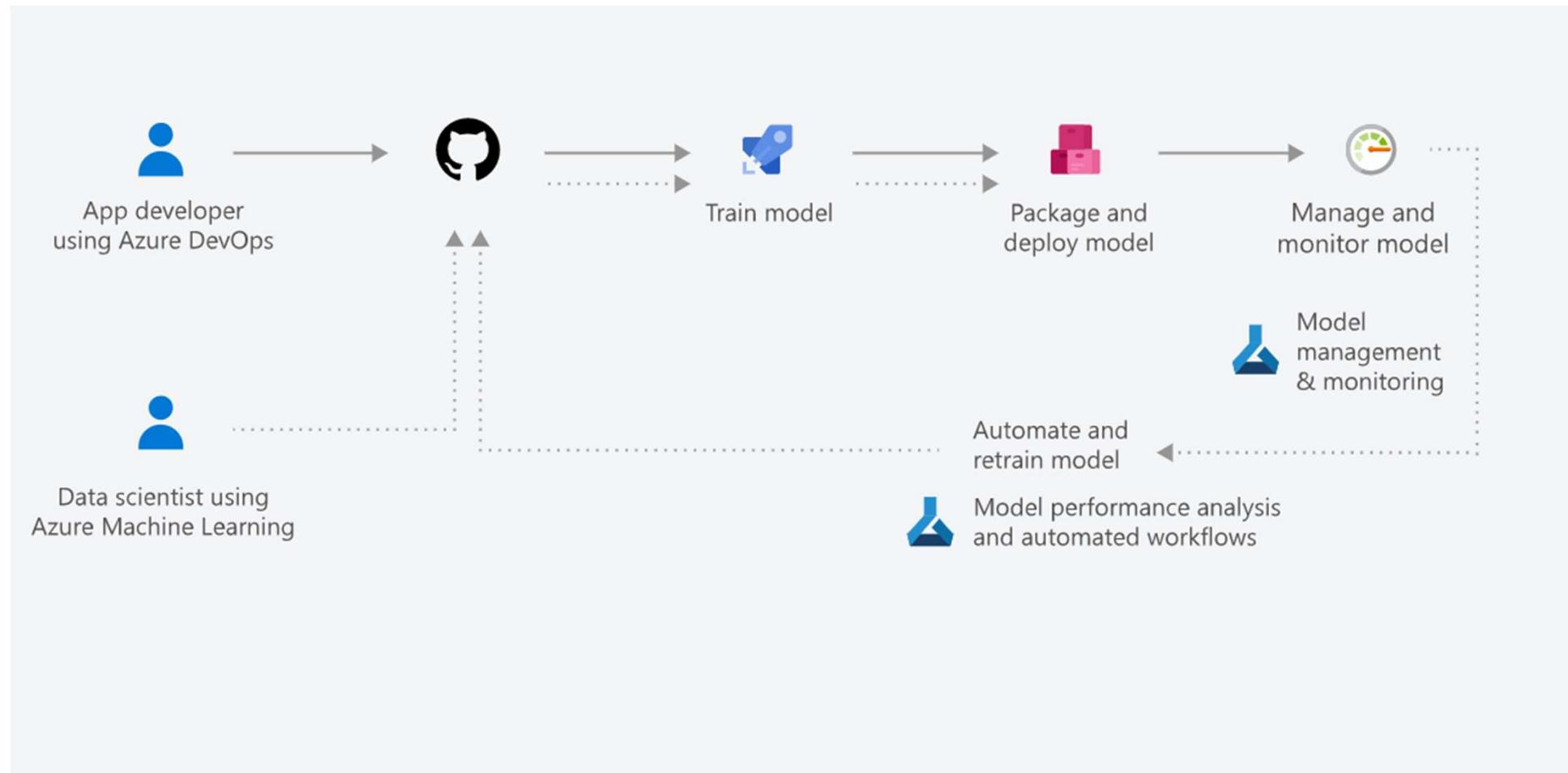
Model reproducibility

Model validation

Model deployment

Model retraining

MLOps workflow



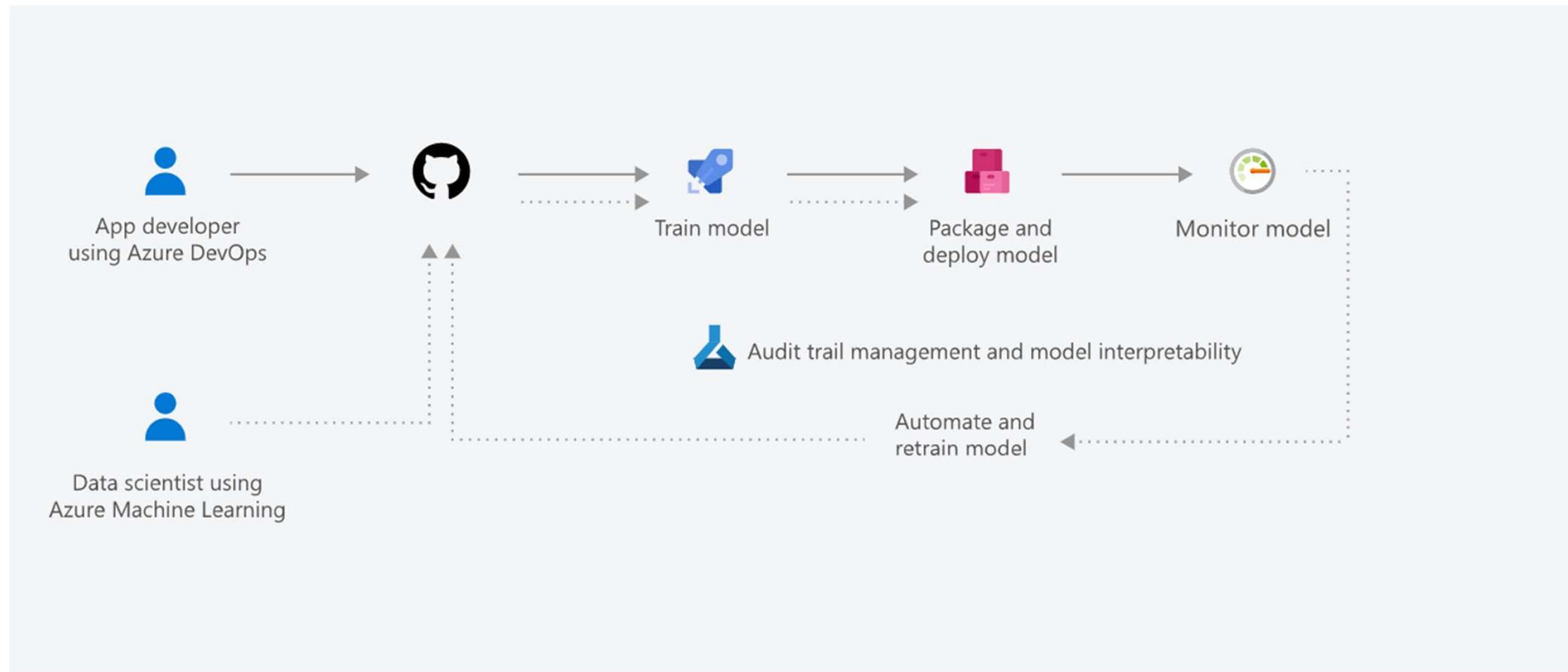
Model reproducibility

Model validation

Model deployment

Model retraining

MLOps workflow



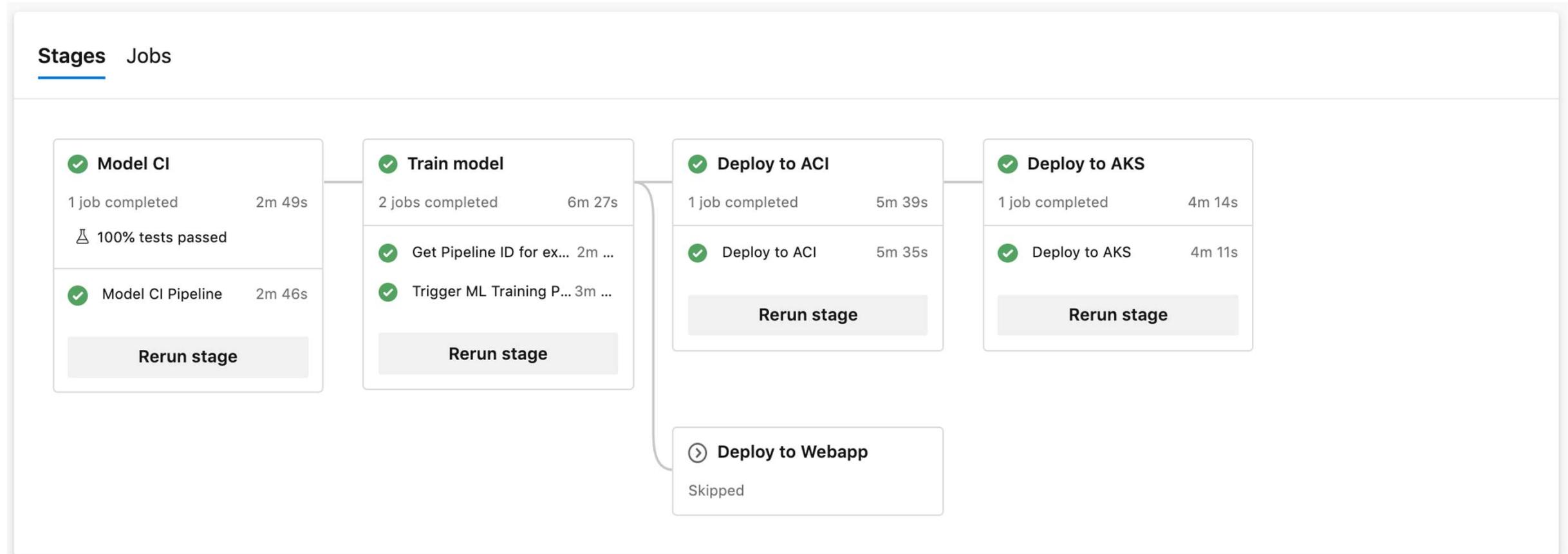
Model reproducibility

Model validation

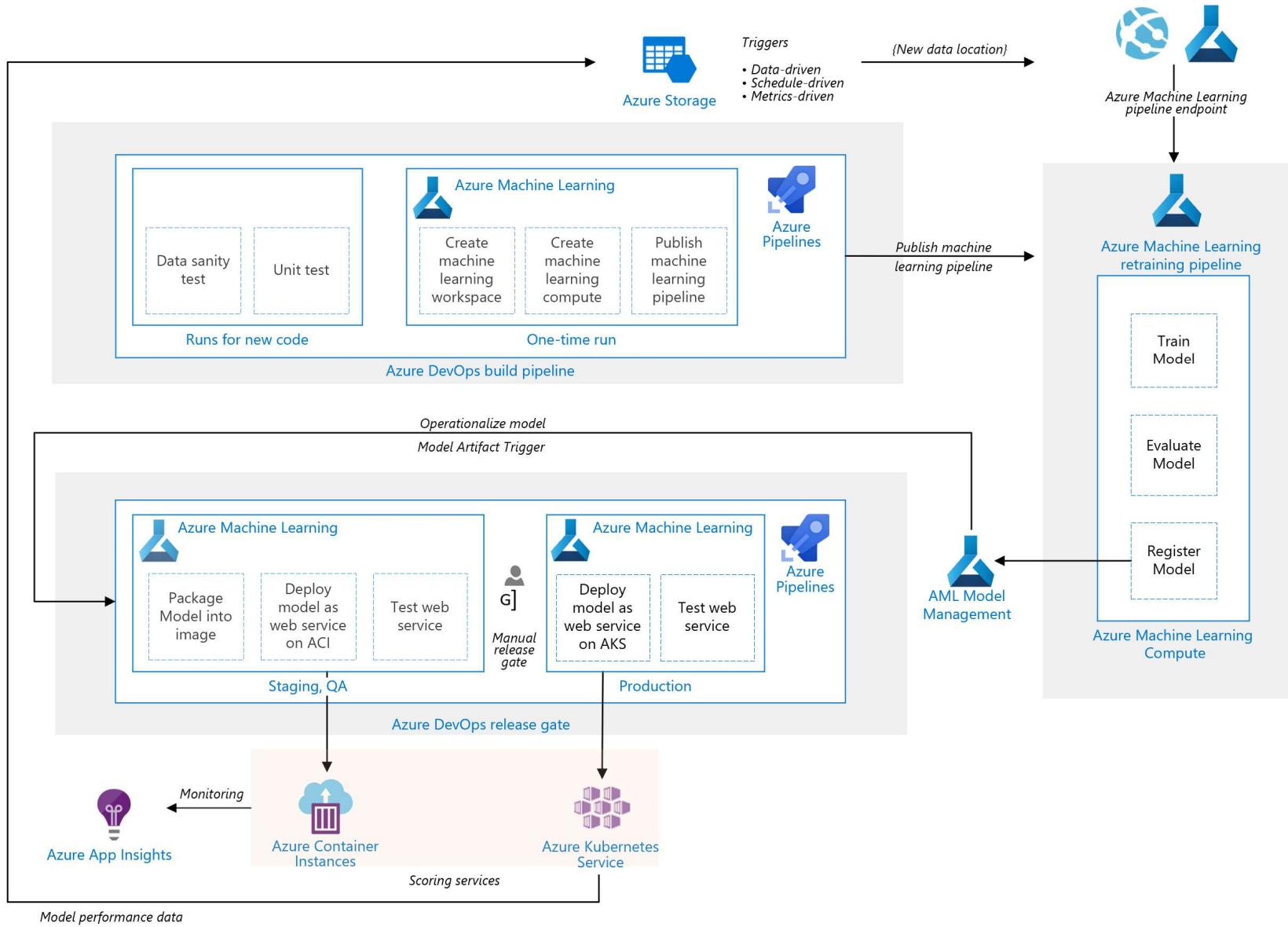
Model deployment

Model retraining

An example

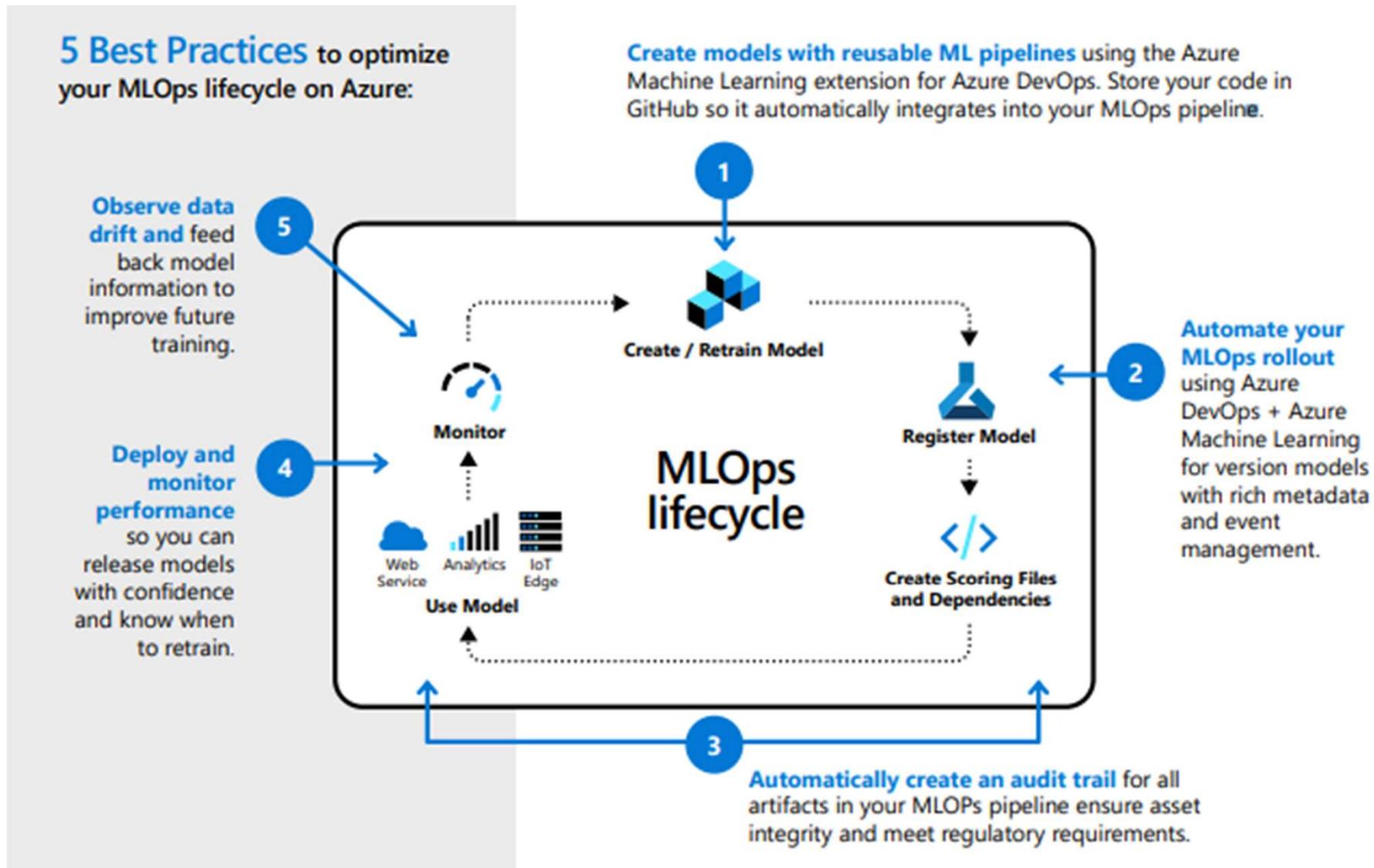


Architecture



MLOps resources – White paper

<https://azure.microsoft.com/en-us/services/machine-learning/mlops/#resources>



Power BI integration

Power BI integration

The screenshot shows the Microsoft Power BI AI Preview interface. The top navigation bar includes the Microsoft logo, 'Power BI', 'Power BI AI Prev...', and 'Titanicdataset'. On the far right are 'New look on' (yellow button), 'Search' (magnifying glass icon), and a user profile icon.

The left sidebar contains navigation links: Home, Favorites, Recent, Apps, Shared with me, Deployment pipelines, Learn, Workspaces, and 'Power BI AI Prev...' (selected).

The main area has a ribbon with tabs: Home (selected), Transform, Add column, View, and a Properties panel. Below the ribbon is a toolbar with icons for Get data, Enter data, Options, Manage parameters, and Ref.

A central 'Power Query - Edit queries' window displays the 'AI insights' dialog for the 'AzureML.titanic-real-time-inference' model. The dialog includes a search bar, a tree view of Azure Machine Learning Models and Cognitive Services, and a summary section with creation and modification dates.

The main data grid shows the 'Titanicdataset' with 31 rows and columns for PassengerId, Survived, Pclass, Name, Sex, Age, SibSp, Parch, and Ticket. A row for 'Uruchurtu, Don. Manuel E' is selected.

The 'AI insights' dialog contains input fields for PassengerId (PassengerId), Survived (True), Class (Pclass), Name (Name), Sex (Sex), Age (Age), Siblings or Spouses (SibSp), Parents or children (Parch), and Ticket. Buttons for 'Show' (dropdown), 'Apply', and 'Cancel' are at the bottom.

AutoML Power BI integration

Microsoft | Power BI Power BI AI Prev... > Titanicdataset

New look on Search

titanicmodel model training report

This report summarizes the model performance and training details and enables you find an optimal threshold for defining your business outcome.

MODEL PERFORMANCE

How the model was evaluated

The model predicted Survived probabilities for a test set of 178 records and compared the predicted outcomes (based on the selected threshold) to the historical outcomes.

Model performance

The Area under the curve (AUC) observed on the test set is :

84%

Different features have varying influence on the predicted outcome. Click below for details.

See top predictors

Top predictors by influence

Select a predictor on the left to see its breakdown

Percentage of target outcome records

Predictor	Percentage of target outcome records
Sex is male	10
pclass is 3	8
Age	7
pclass is 1	6
Fare	5
SibSp is 1	2
SibSp is 0	1
pclass is 2	1

Training Details

How the model was trained

Power BI used the automated ML capability in Azure Machine Learning to train your model. Automated ML was used to find the best way to prepare your data, determine the algorithms used and select the algorithm parameters likely to yield the best accuracy. These steps were used in the machine learning pipeline which generated your machine learning model.

Sampled rows: 708 Final model used: Pre-fitted Soft Voting Classifier

Training rows: 530 Iterations run: 32

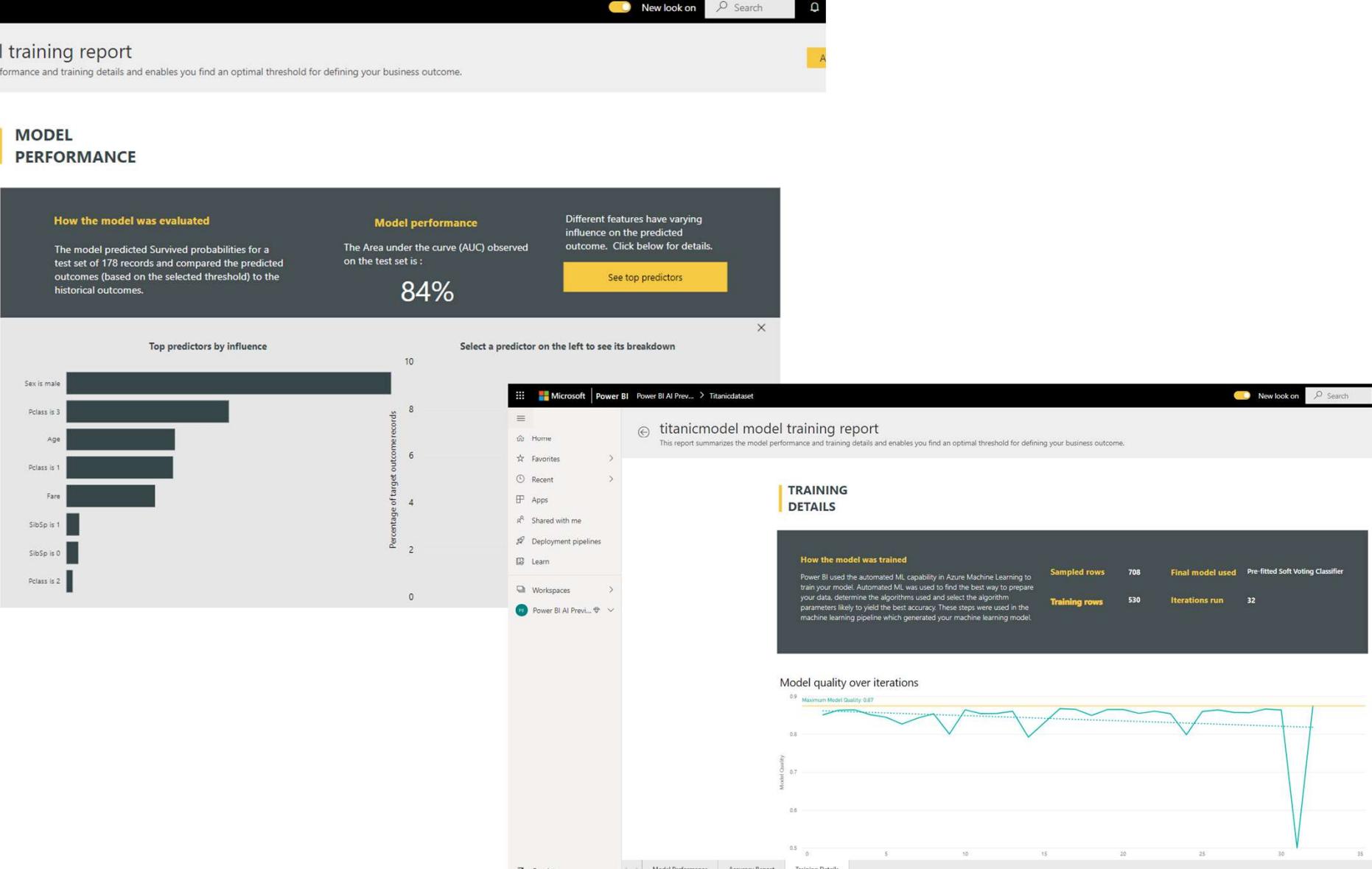
Model quality over iterations

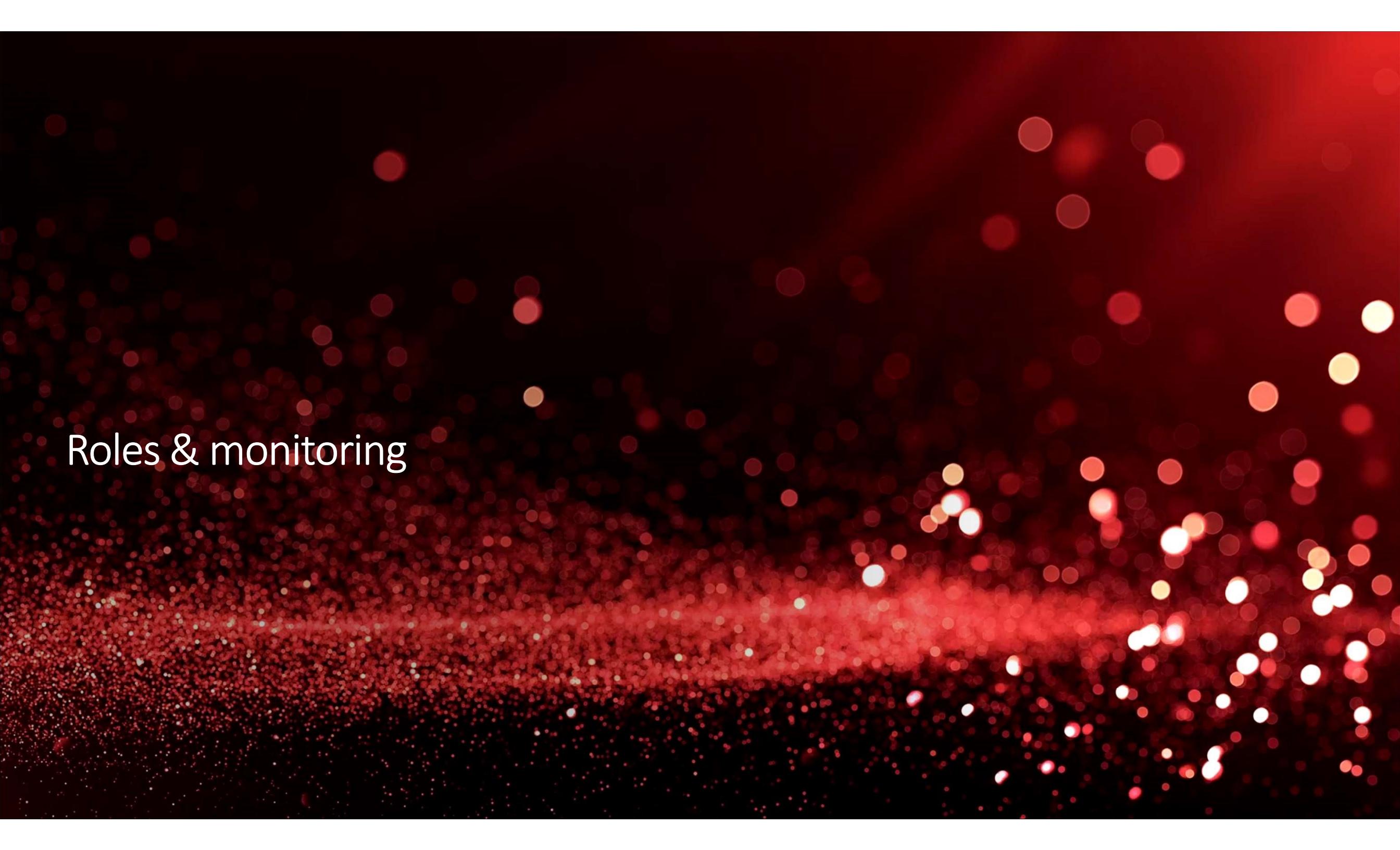
Maximum Model Quality: 0.87

Model Quality

Iterations

Get data Model Performance Accuracy Report Training Details





Roles & monitoring



Roles

- Standard roles
- Custom roles

Azure Machine Learning operation	Owner	Contributor	Reader
Create workspace	✓	✓	
Share workspace	✓		
Upgrade workspace to Enterprise edition	✓		
Create compute target	✓	✓	
Attach compute target	✓	✓	
Attach data stores	✓	✓	
Run experiment	✓	✓	
View runs/metrics	✓	✓	✓
Register model	✓	✓	
Create image	✓	✓	
Deploy web service	✓	✓	
View models/images	✓	✓	✓
Call web service	✓	✓	✓



Roles

```
{  
  "Name": "Data Scientist Demo",  
  "Description": "Can create experiments, submit runs, deploy models to test environments; Cannot create compute or register datastores",  
  "Actions": [  
    "Microsoft.MachineLearningServices/workspaces/*/read",  
    "Microsoft.MachineLearningServices/workspaces/*/action"  
,  
  "NotActions": [  
    "Microsoft.MachineLearningServices/workspaces/computes/listKeys/action",  
    "Microsoft.MachineLearningServices/workspaces/listKeys/action"  
,  
  "DataActions": [  
    "Microsoft.MachineLearningServices/workspaces/*/read",  
    "Microsoft.MachineLearningServices/workspaces/*/write",  
    "Microsoft.MachineLearningServices/workspaces/*/delete",  
    "Microsoft.MachineLearningServices/workspaces/*/action"  
,  
  "NotDataActions": [  
    "Microsoft.MachineLearningServices/workspaces/services/aks/prod/write",  
    "Microsoft.MachineLearningServices/workspaces/services/aks/prod/delete",  
    "Microsoft.MachineLearningServices/workspaces/endpoints/pipelines/write",  
    "Microsoft.MachineLearningServices/workspaces/endpoints/pipelines/delete",  
    "Microsoft.MachineLearningServices/workspaces/datastores/write"  
,  
  "AssignableScopes": [  
    "/subscriptions/e9b2ec51-5c94-4fa8-809a-dc1e695e4896"  
  ]  
}
```

<https://docs.microsoft.com/en-us/azure/machine-learning/service/how-to-assign-roles>



Monitoring Azure ML with Azure Monitor

workshopmIRG - Insights (preview) X

Resource group

Search (Ctrl+/) Refresh Collapse all Feedback Help

Total resources Active alerts 19 1 ! Application map

Deployments Policies Properties Locks Export template

Cost Management

- Cost analysis
- Cost alerts
- Budgets
- Advisor recommendations

Monitoring

- Insights (preview) selected
- Alerts
- Metrics
- Diagnostic settings
- Logs

Filter by name... Local : Last 24 hours Group by app layer and resource type Alerts Severity

NAME	TOTAL ALERTS	SEV 0 ALERTS	SEV 1 ALERTS	INSIGHTS	ACTIONS
workshopmIRG	1 (-)	—	—		
Compute	1 (-)	—	—		
Virtual machine	1 (-)	—	—		
standardd2v224d142833d	—	—	—		...
standardds13v244d198275	1 (-)	—	—		...
Container registry	—	—	—		
Application	—	—	—		
Networking	—	—	—		
Other	—	—	—		
Storage and Databases	—	—	—		



Azure Machine Learning

Monitoring Azure ML with Azure Monitor

Show data for last:

1 hour

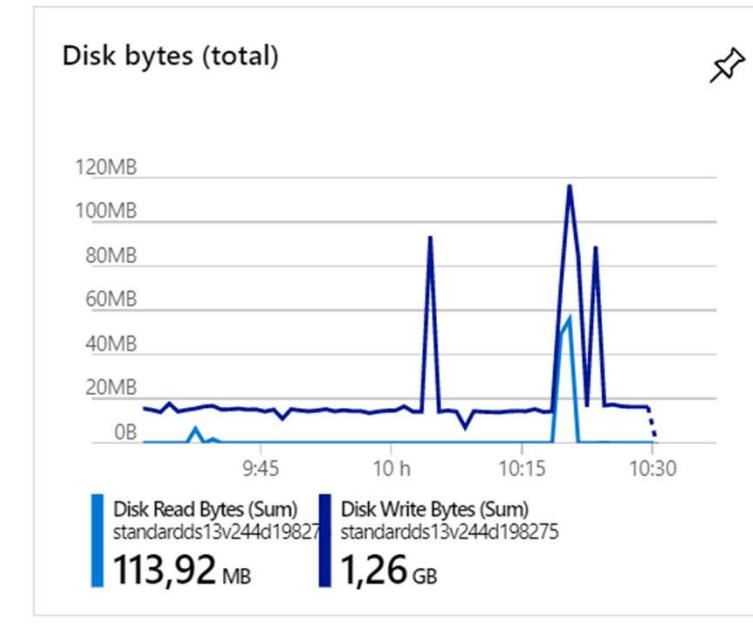
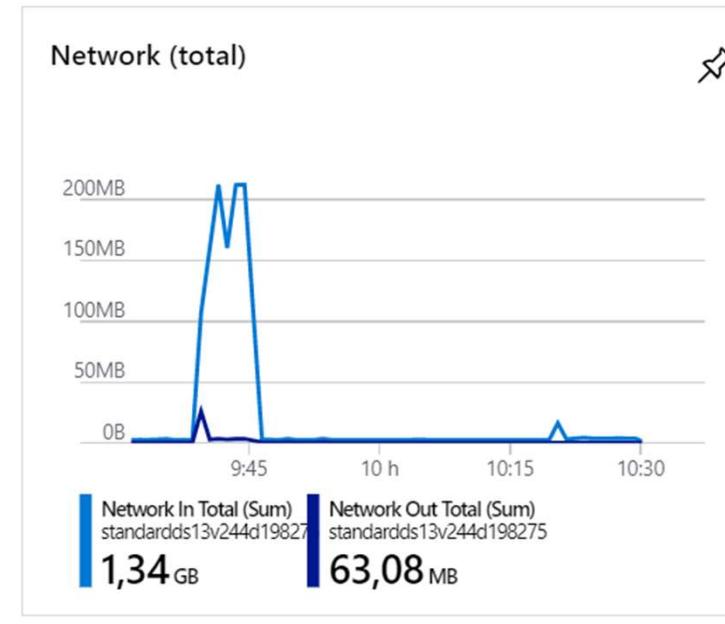
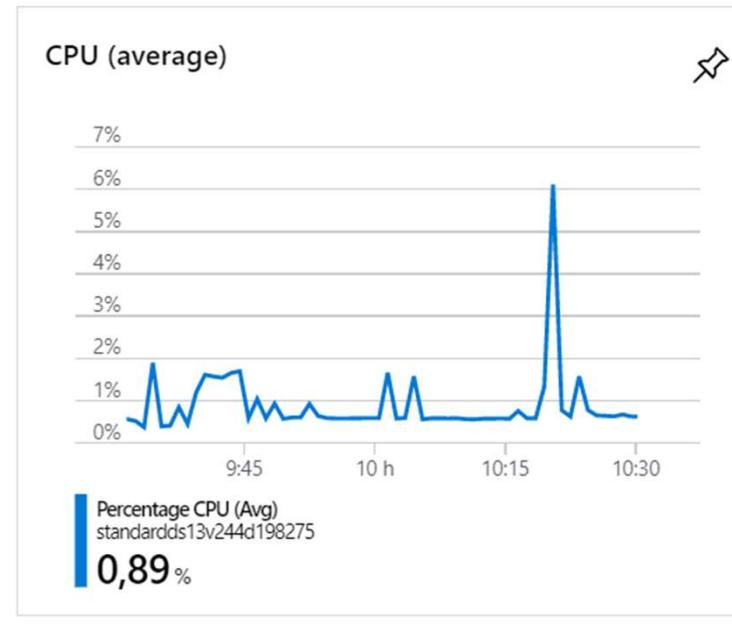
6 hours

12 hours

1 day

7 days

30 days





Monitoring Azure ML models

AMLServiceWS - Metrics

Machine Learning

Search (Ctrl+ /)

New chart Refresh Share Feedback

Chart Title

Add metric Add filter Apply splitting Line chart New alert rule

SCOPE: AMLServiceWS METRIC NAMESPACE: Machine Learning S...

METRIC AGGREGATION

Select metric Select aggregation

MODEL

- Model Deploy Failed
- Model Deploy Started
- Model Deploy Succeeded
- Model Register Failed
- Model Register Succeeded

QUOTA

- Active Cores

Select a metric above to see data appear on this chart or learn more below:

- Filter + Split: Apply filters and splits to identify outlying segments
- Plot multiple metrics: Create charts with multiple metrics and resources
- Build custom dashboards: Pin charts to your dashboards

Assets

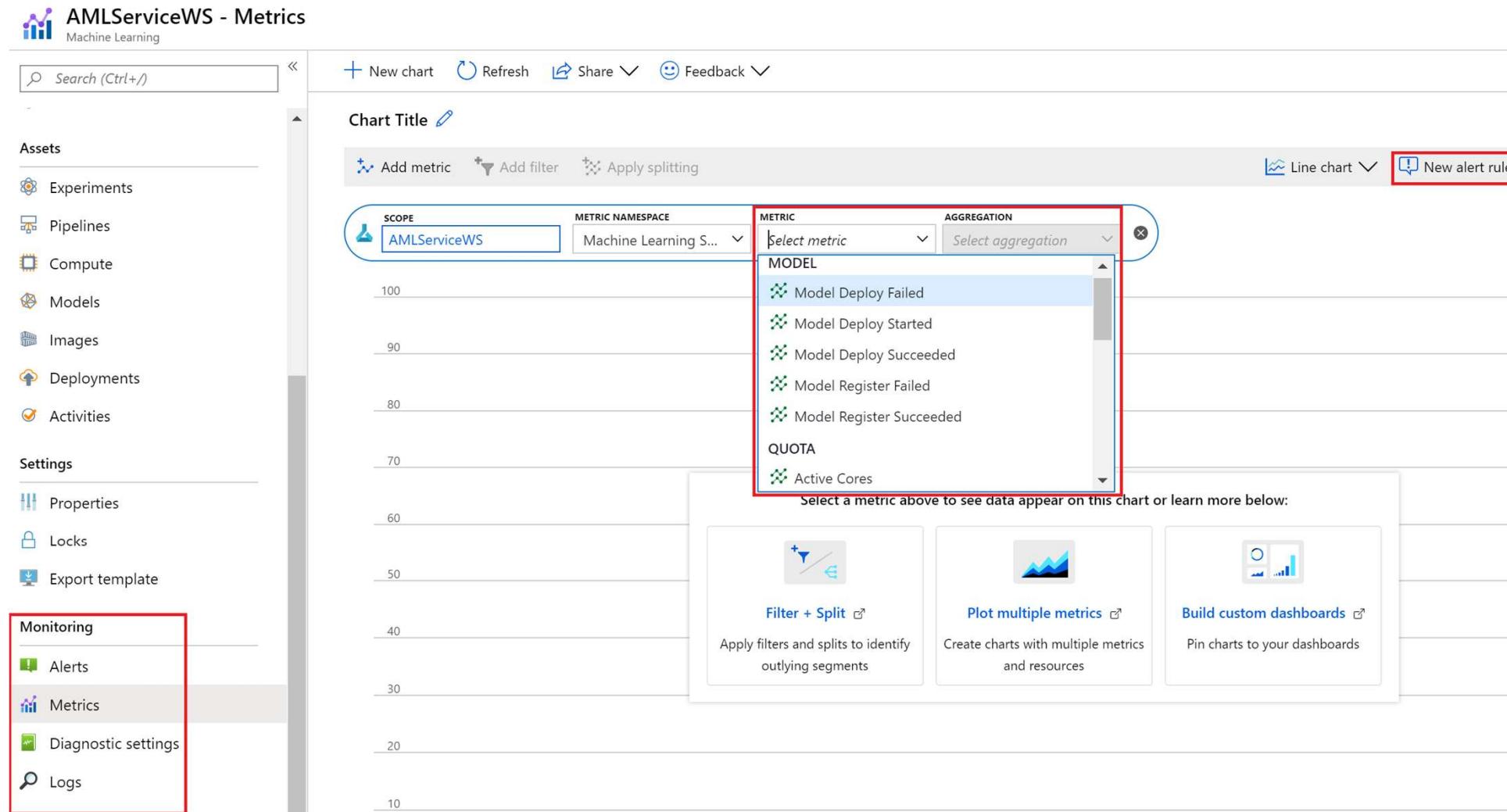
- Experiments
- Pipelines
- Compute
- Models
- Images
- Deployments
- Activities

Settings

- Properties
- Locks
- Export template

Monitoring

- Alerts
- Metrics
- Diagnostic settings
- Logs



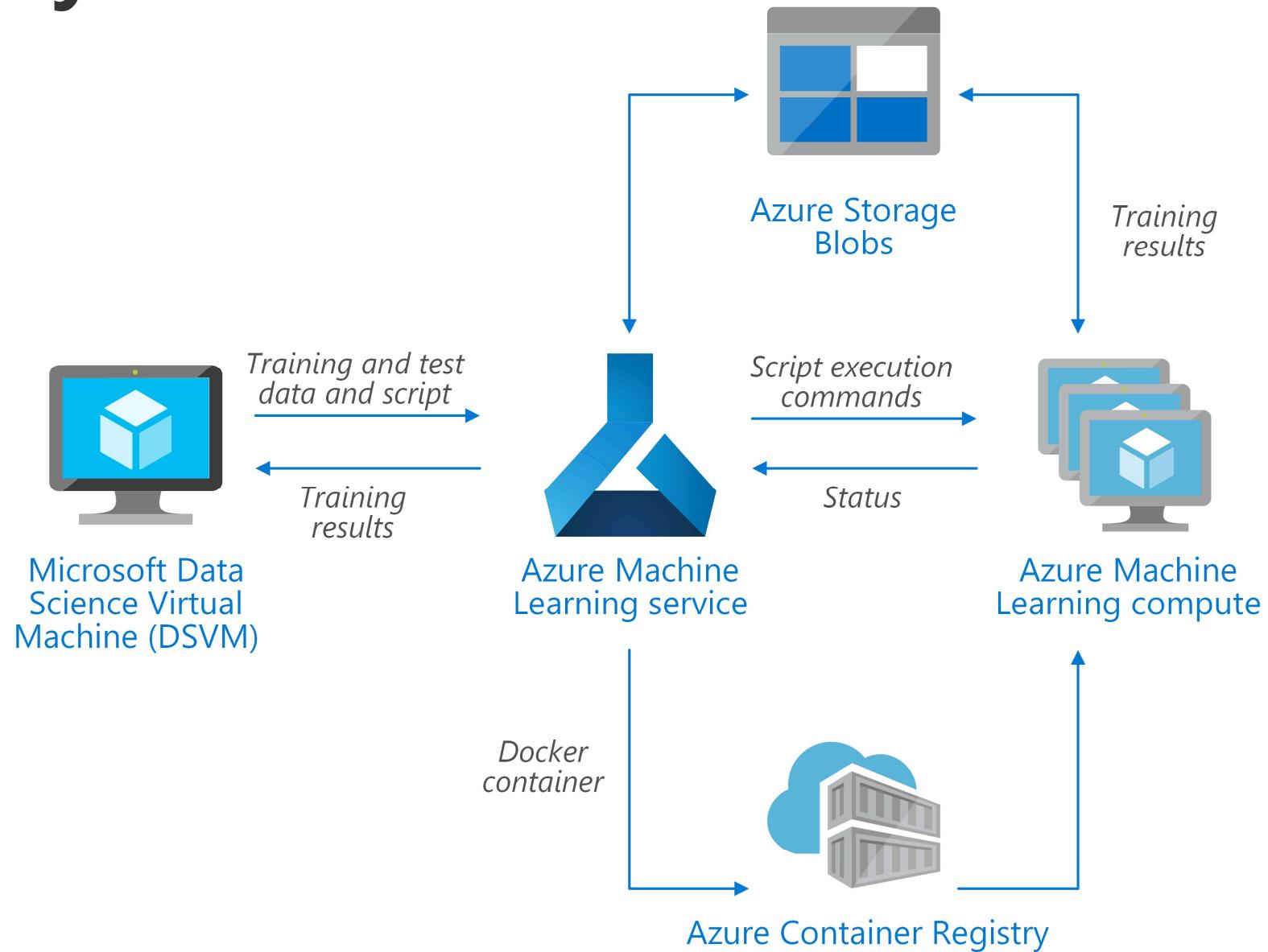


Architecture

Training Python



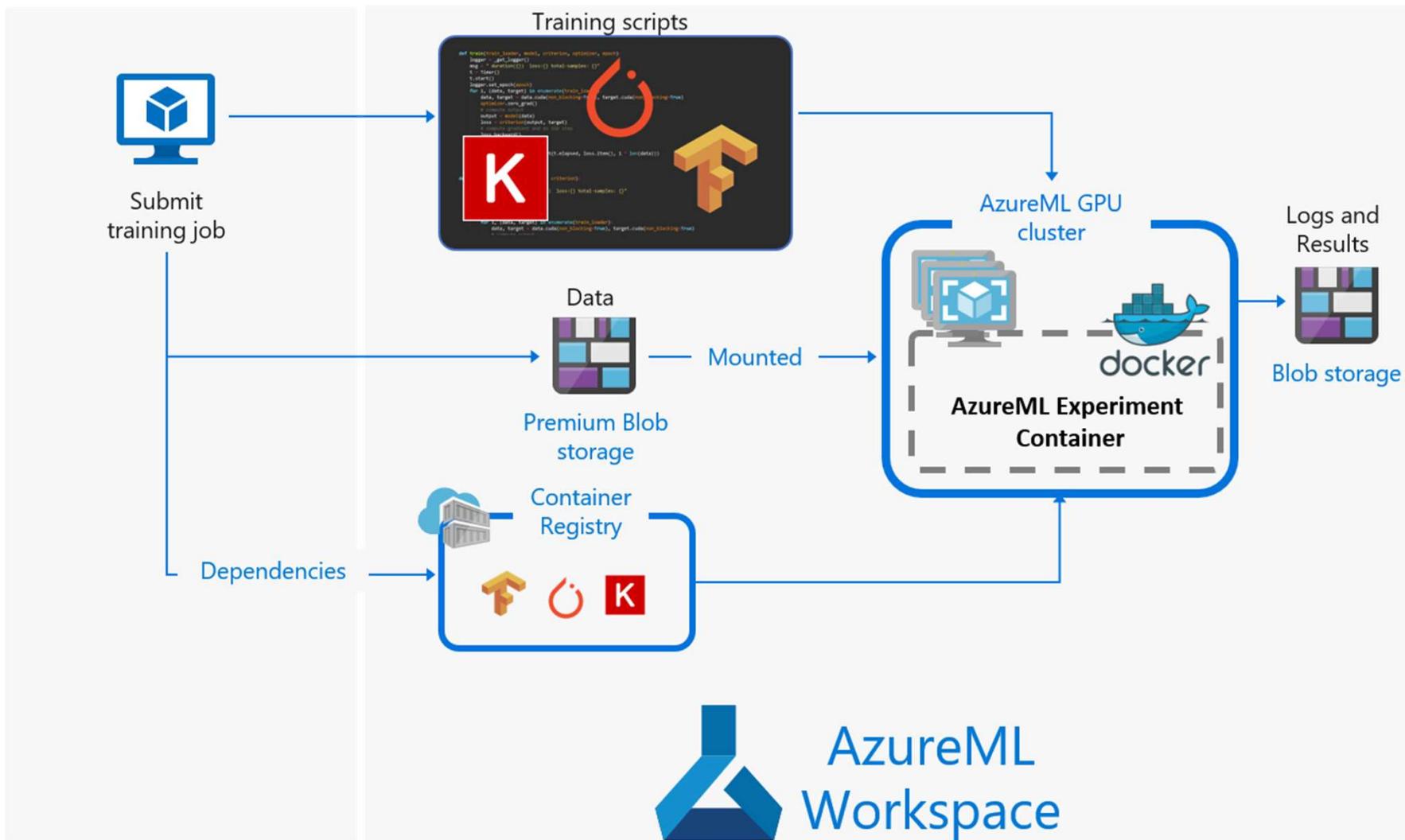
Azure Machine Learning



Deep Learning



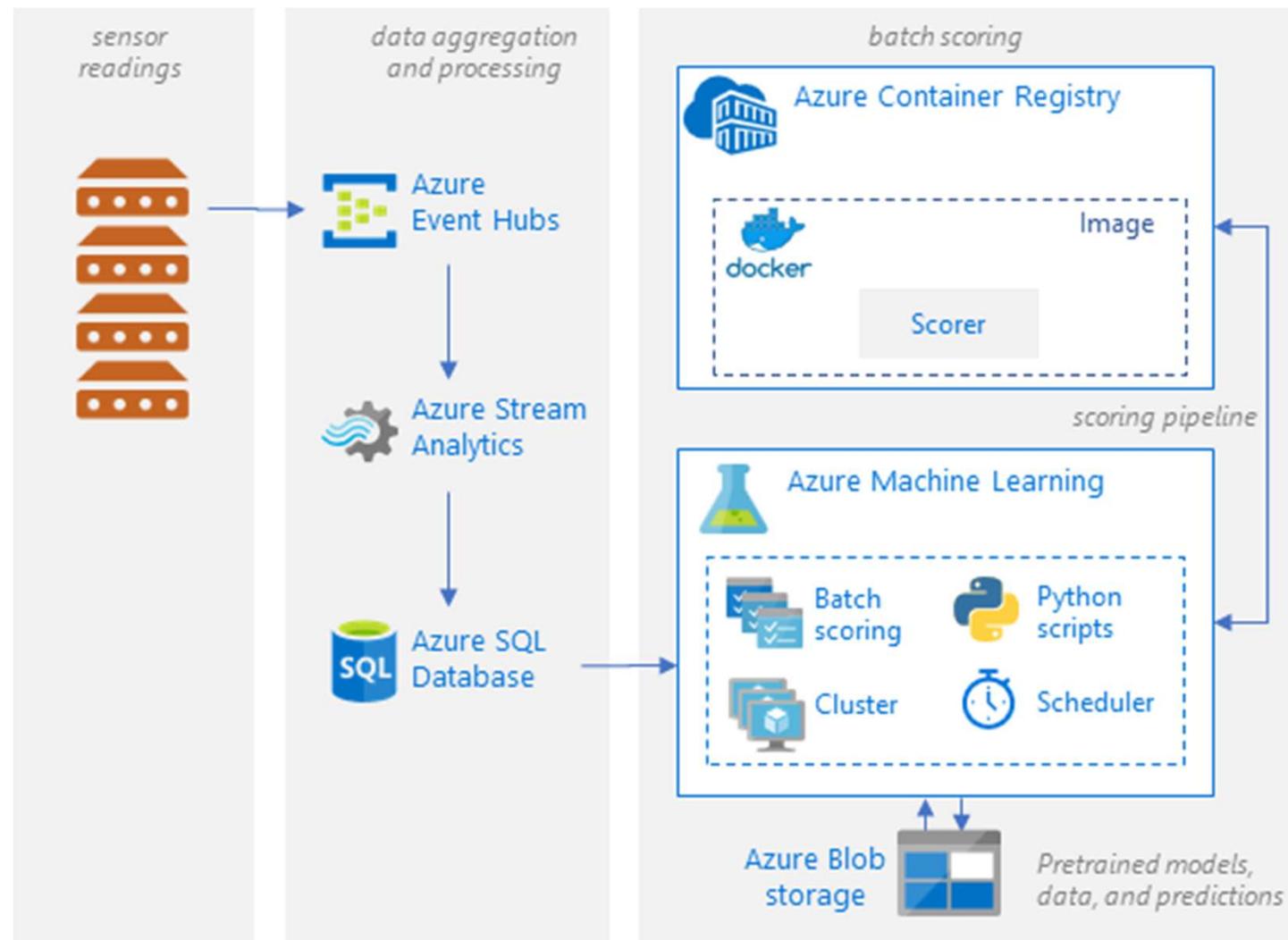
Azure Machine Learning



Batch scoring of Python models



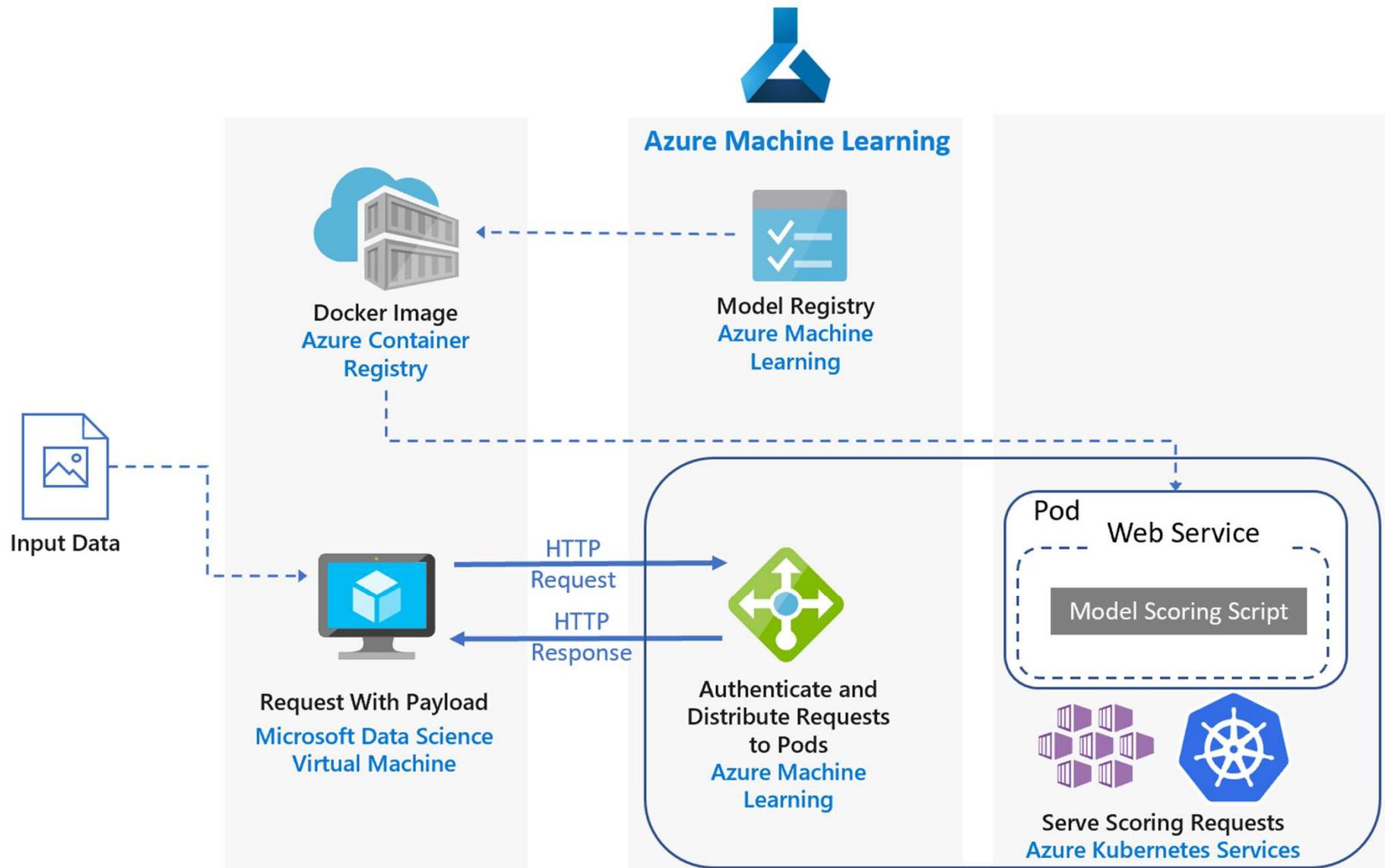
Azure Machine Learning



Real time scoring



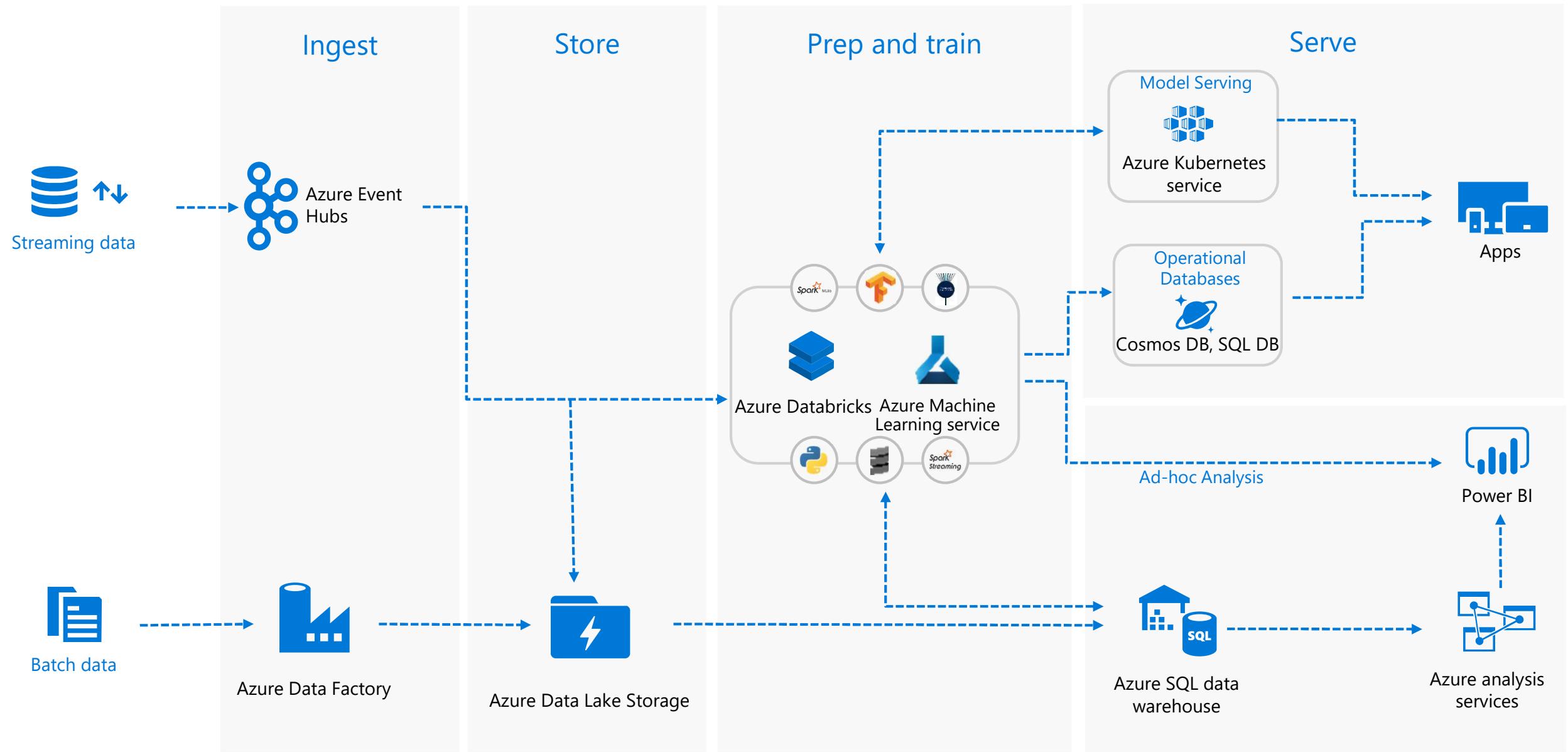
Azure Machine Learning



Azure Databricks + Azure ML



Azure Machine Learning



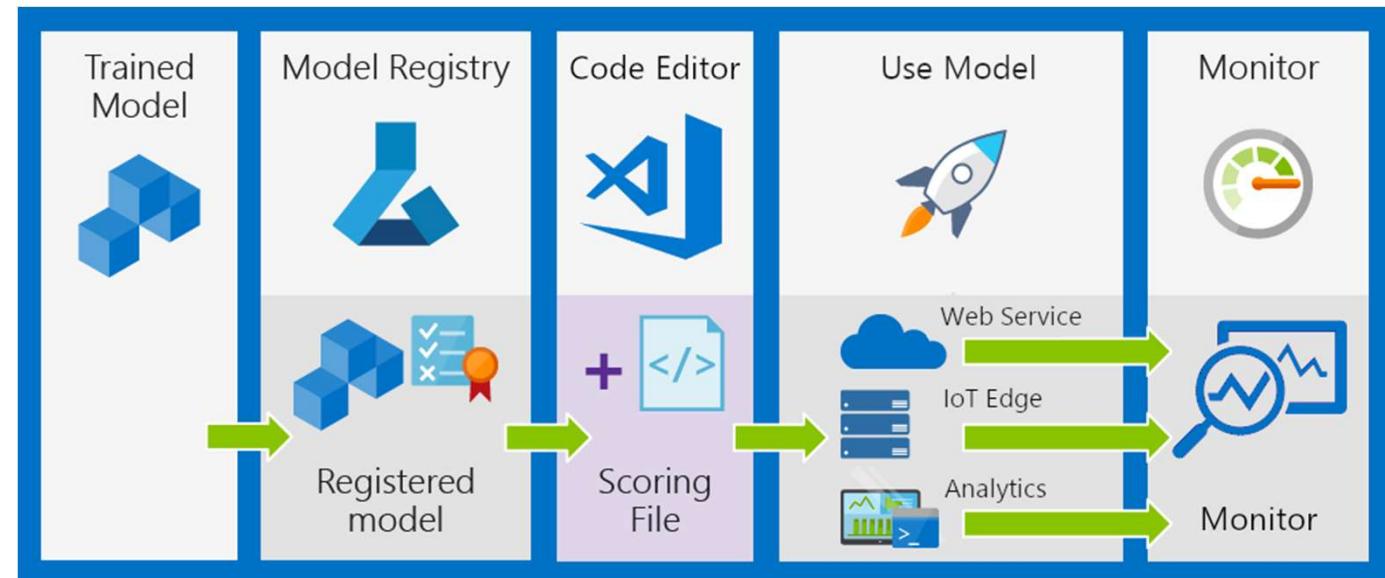
Deployment scenarios



Deployment scenarios

You can deploy your machine learning model as a web service in the Azure cloud or to Azure IoT Edge devices.

- Azure ML Compute instances
- Azure Kubernetes Service (AKS)
- Azure Container Instance (ACI)
- GPU inference
- Azure App Service
- Azure Cognitive Search
- Azure IoT Edge devices
- Field-Programmable Gate Arrays (FPGA)
- Custom docker images



<https://docs.microsoft.com/en-us/azure/machine-learning/how-to-deploy-and-where>

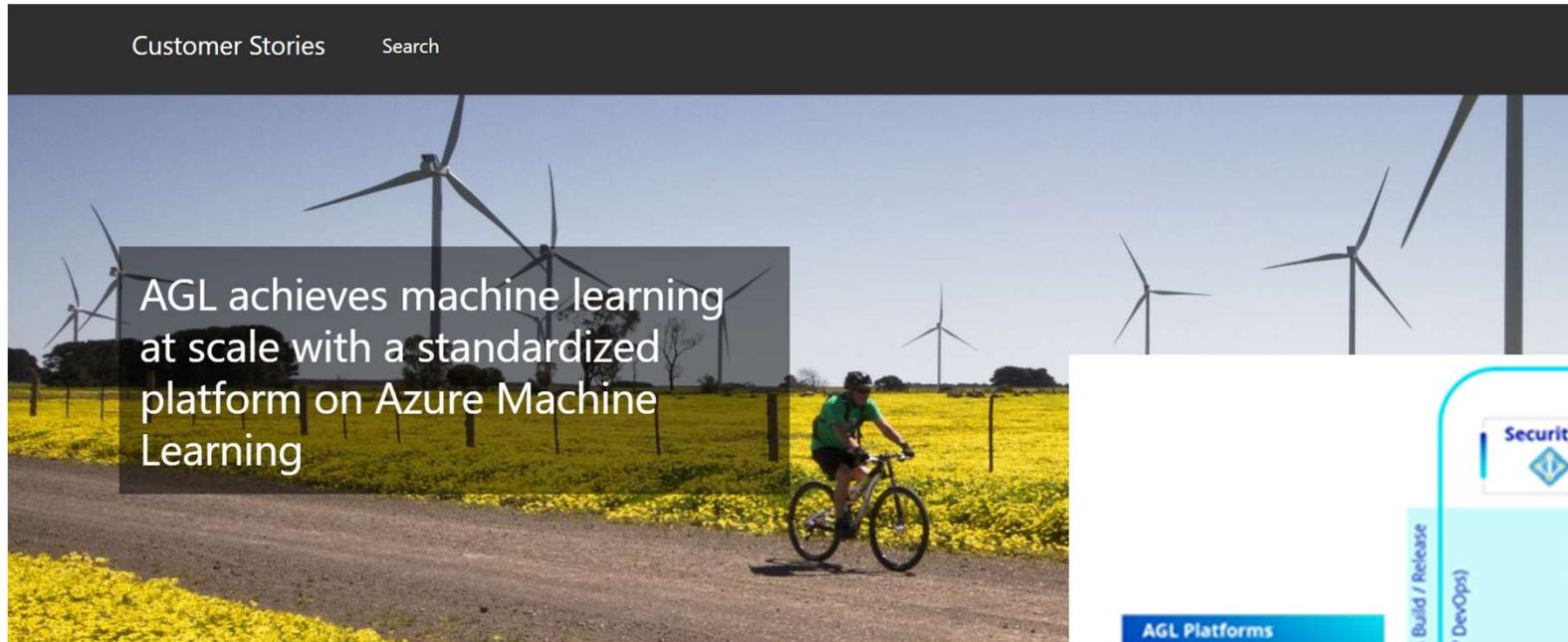
Some references



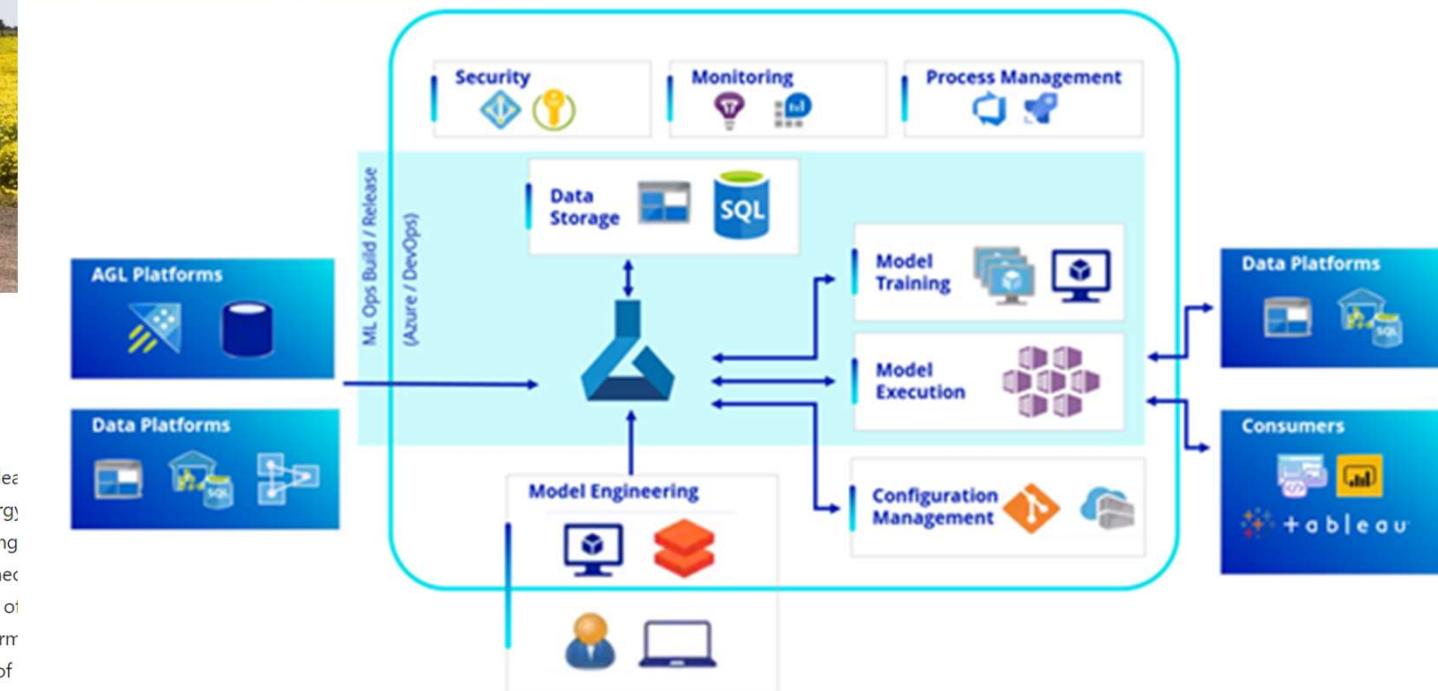
Azure Machine Learning

AGL

<https://customers.microsoft.com/en-us/story/844796-agl-energy-azure>



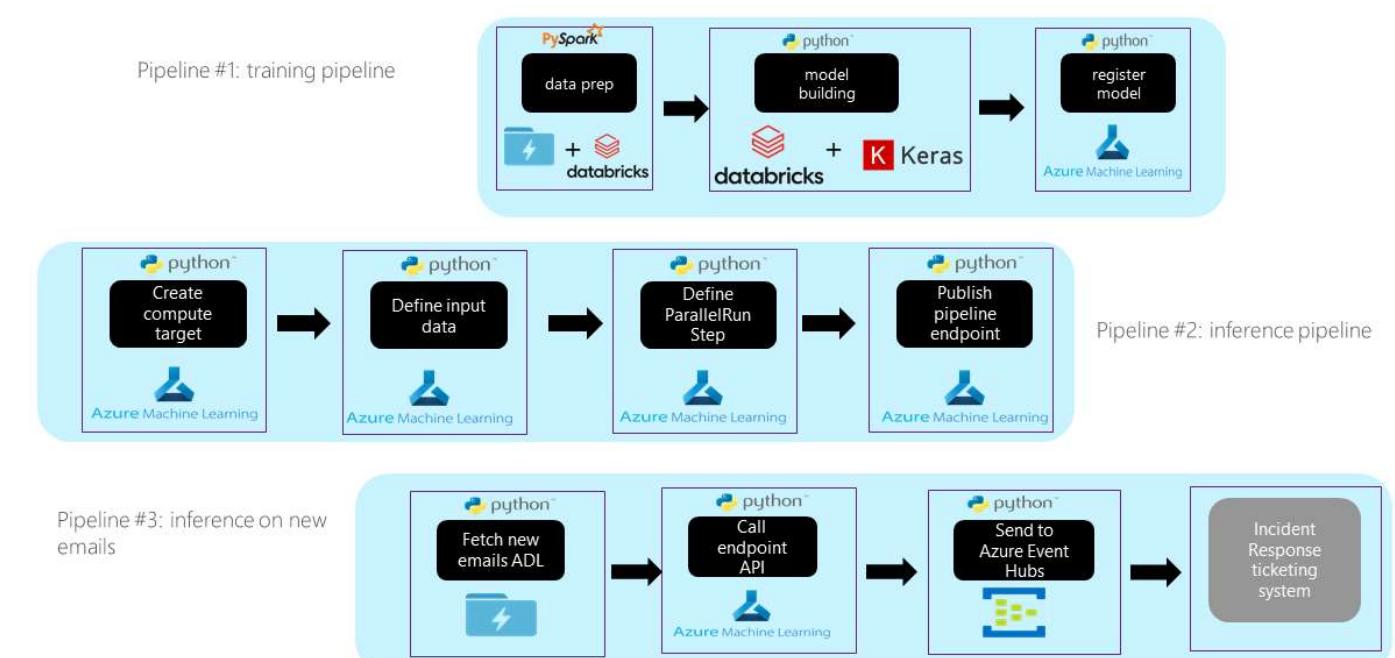
For more than 180 years, AGL has been a leading private investors in renewable energy technologies. But when its machine learning thousands of customized models simultaneously. Learning, AGL's Data and Analytics Center of Databricks to create a standardized platform and lifecycle management for thousands of



<https://customers.microsoft.com/en-us/story/844797-nestle-consumer-goods-azure>



Solution architecture

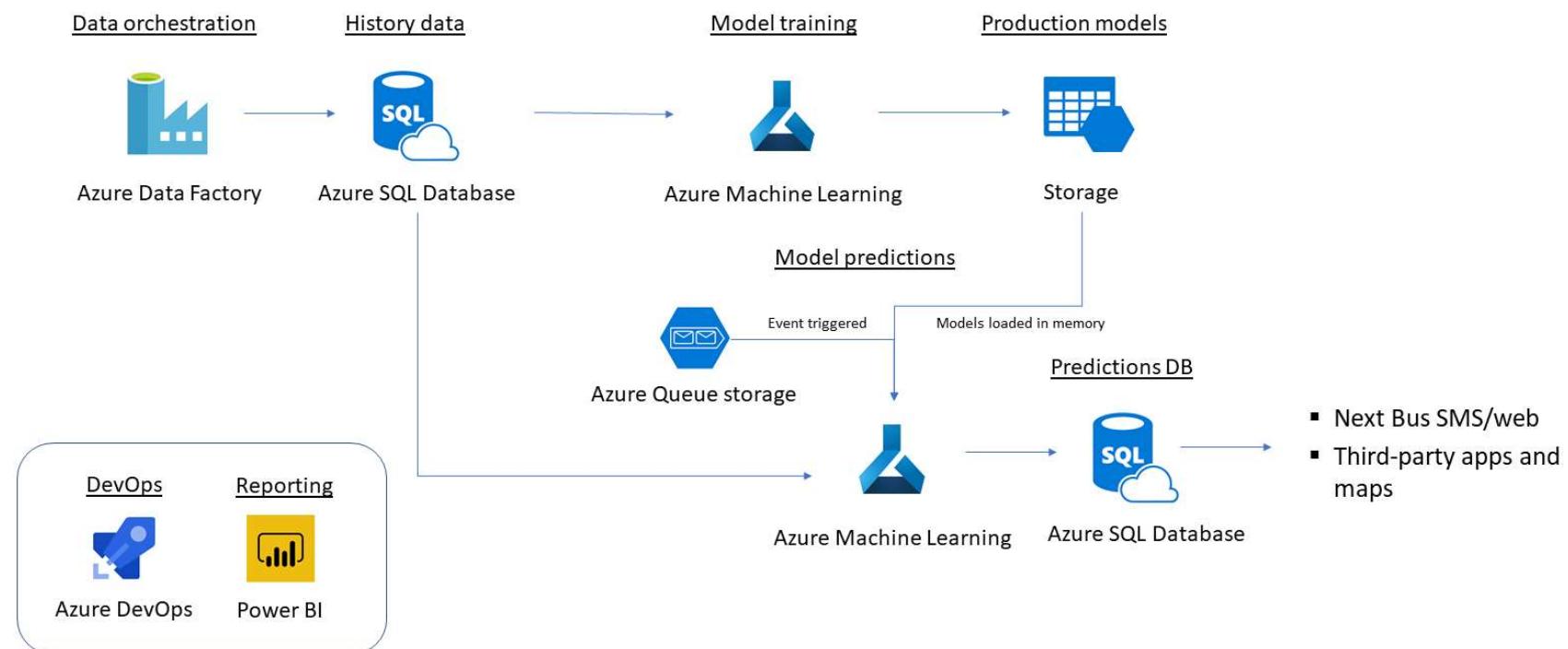


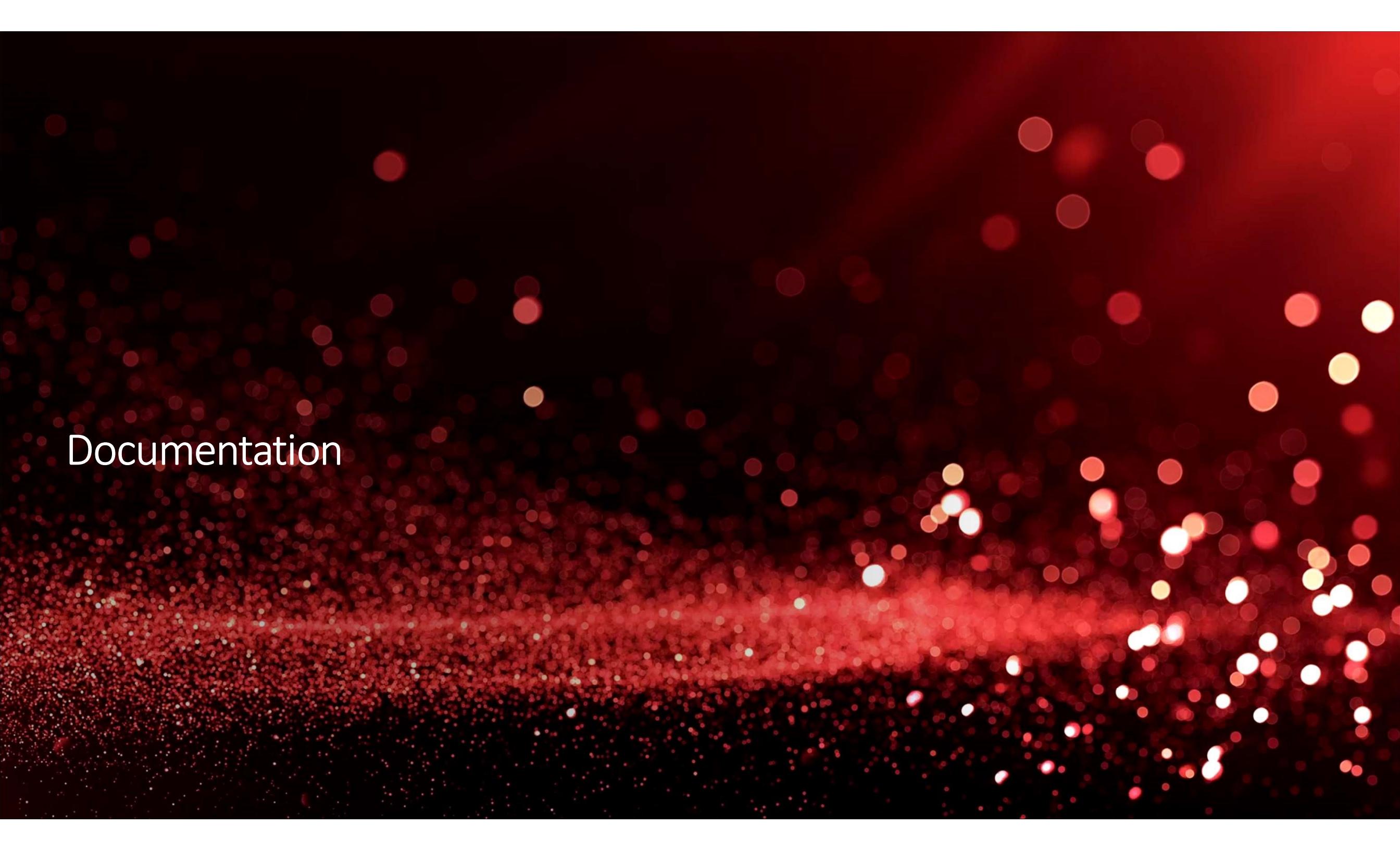


Azure Machine Learning

Metro Vancouver transportation authority improves bus departure estimates by 74 percent with Azure Machine Learning

<https://customers.microsoft.com/en-us/story/768972-translink-travel-and-transportation-azure>





Documentation



Azure Machine Learning

Microsoft Learn Azure ML training



Build AI solutions with Azure Machine Learning

8 hr 26 min remaining • Learning Path • 4 of 13 modules completed

Intermediate

Data Scientist

Student

Azure

Machine Learning

Azure Portal

10800 XP

Azure Machine Learning is a cloud platform for training, deploying, managing, and monitoring machine learning models. Learn how to use the Azure Machine Learning Python SDK to create enterprise-ready AI solutions.

Prerequisites

This learning path assumes that you have experience of training machine learning models with Python and open-source frameworks like Scikit-Learn, PyTorch, and Tensorflow. If not, you should complete the [Create machine learning models](#) learning path before starting this one.

Start >

Bookmark

Add to collection

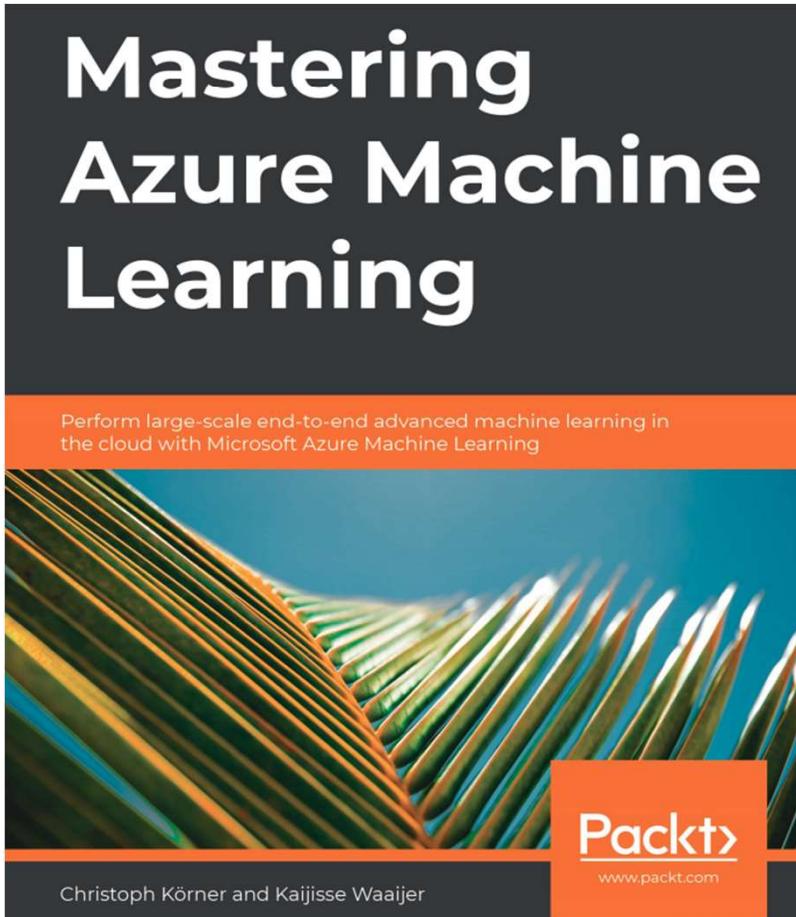
<https://docs.microsoft.com/en-us/learn/patterns/build-ai-solutions-with-azure-ml-service/>



Azure Machine Learning

Mastering Azure Machine Learning

<https://www.packtpub.com/product/mastering-azure-machine-learning/9781789807554>



What is more interesting is how we can automatically embed code like the preceding in our data experimentation and preparation script, and later, in the training and optimization pipelines. With a few lines of code, we can track all Matplotlib figures and attach them to our experimentation run. To do so, we only have to pass the Matplotlib reference to the `run.log_image()` method and give it an appropriate name. The following snippet shows how this would look in an experiment:

```
with exp.start_logging() as run:  
    fig = sns.pairplot(df, hue="species")  
    run.log_image("pairplot", plot=fig)
```

Now, this is the amazing part. By calling the function with the Matplotlib reference, Azure Machine Learning will render the figure, save it, and attach it to the experiment run. Figure 3.11 shows the Azure Machine Learning UI with the **Images** tab clicked. You can see the `pairplot` image that we just created and registered attached to the run:

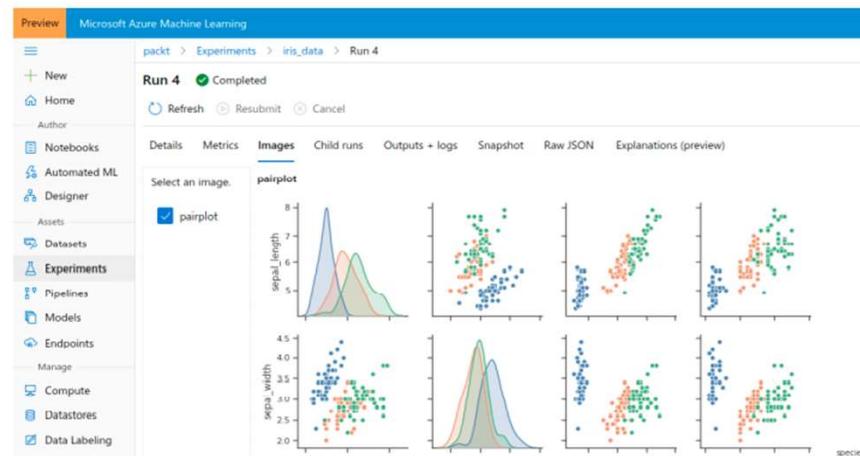


Figure 3.11: The Images tab, showing a pairplot in the Azure Machine Learning workspace

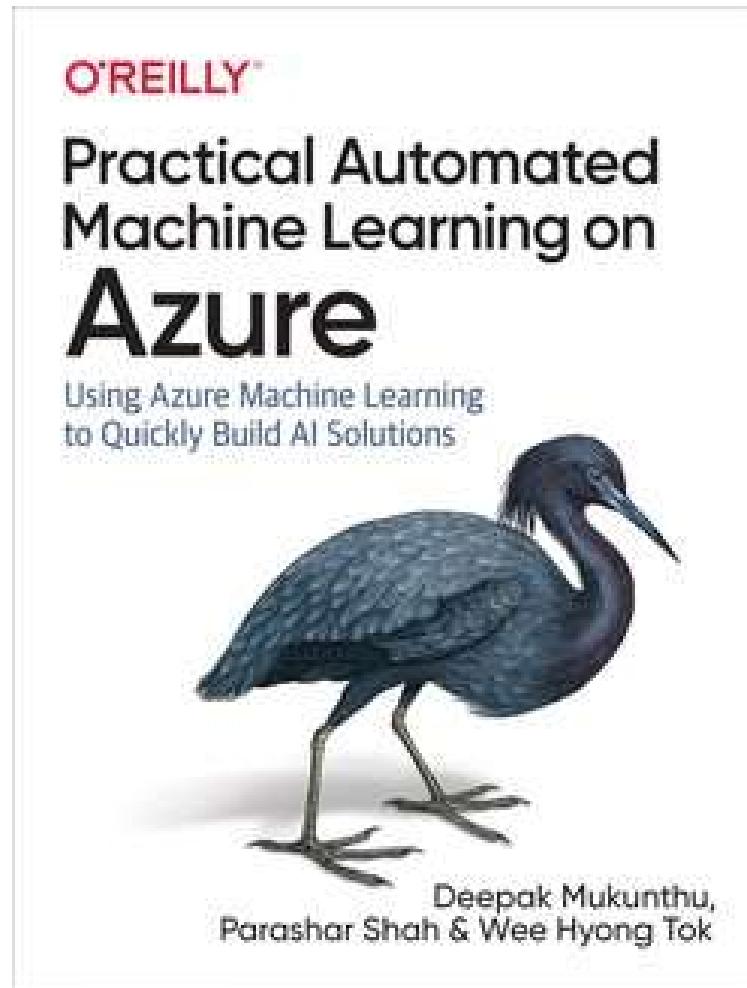
Code: <https://github.com/PacktPublishing/Mastering-Azure-Machine-Learning>



Azure Machine Learning

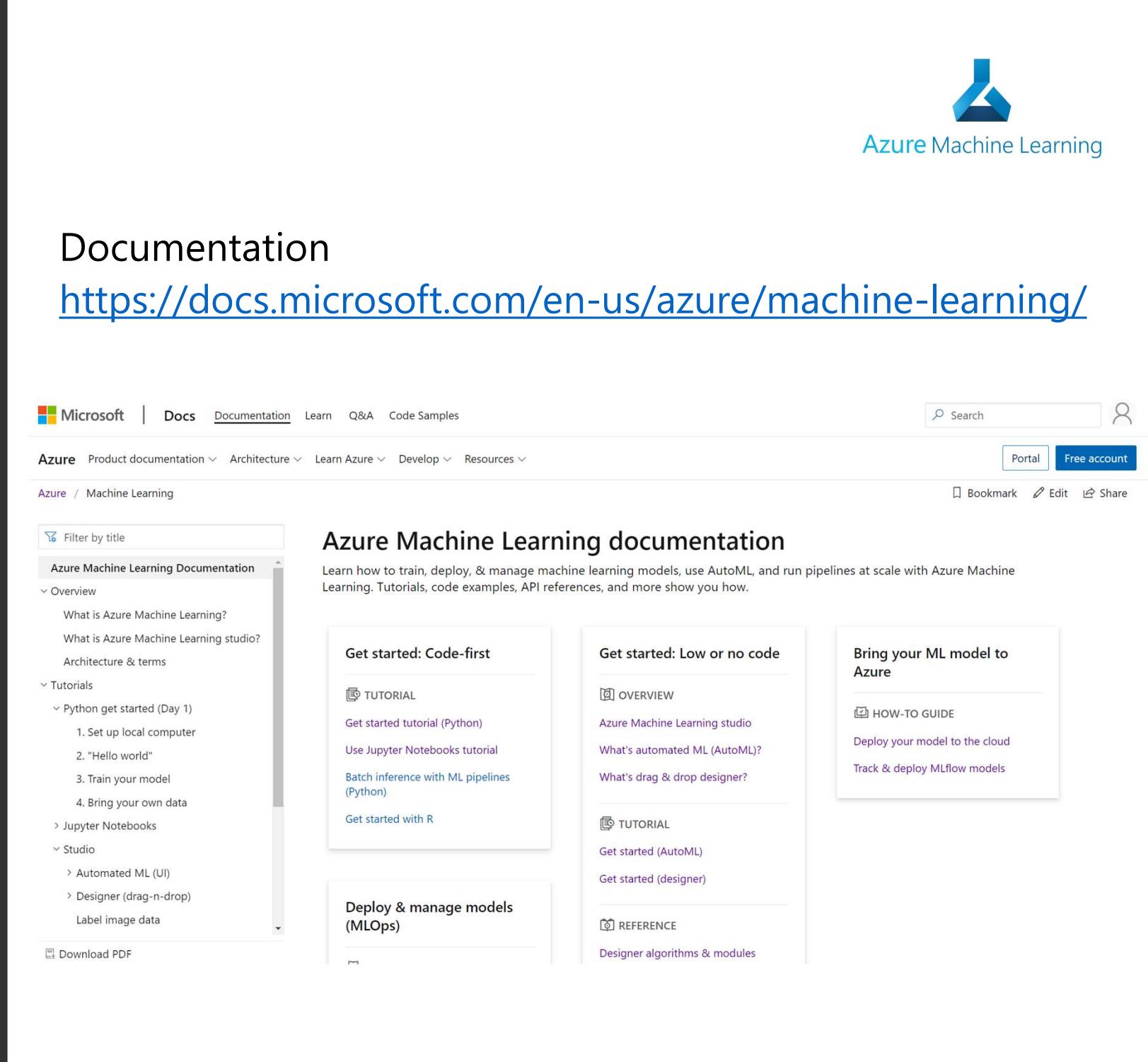
AutoML with Azure Book

<https://www.oreilly.com/library/view/practical-automated-machine/9781492055587/>



Code: <https://github.com/PracticalAutomatedMachineLearning/Azure>

Azure ML documentation



The screenshot shows the Microsoft Azure Machine Learning documentation page. At the top right is the Azure Machine Learning logo, which consists of three blue overlapping shapes. Below the logo is the text "Azure Machine Learning". The main content area has a dark header bar with the Microsoft logo, "Docs", "Documentation" (which is underlined), and other navigation links like "Learn", "Q&A", and "Code Samples". To the right of the header is a search bar and user account options. The main content area is titled "Azure Machine Learning documentation". It features several sections: "Get started: Code-first", "Get started: Low or no code", and "Deploy & manage models (MLOps)". Each section contains links to various tutorials and guides. On the left side, there is a sidebar with a "Filter by title" input field and a list of topics under "Azure Machine Learning Documentation", including "Overview", "Tutorials", "Jupyter Notebooks", "Studio", and "Label image data". At the bottom of the sidebar is a "Download PDF" button.

Documentation

<https://docs.microsoft.com/en-us/azure/machine-learning/>



Azure Machine Learning

<https://azure.microsoft.com/en-us/services/machine-learning-service/>

Pricing

<https://azure.microsoft.com/en-us/pricing/details/machine-learning-service/>

Concepts

<https://docs.microsoft.com/en-us/azure/machine-learning/service/concept-azure-machine-learning-architecture>

Forum

<https://social.msdn.microsoft.com/Forums/en-US/home?forum=AzureMachineLearningService>

Addin Visual Studio

<https://marketplace.visualstudio.com/items?itemName=ms-toolsai.vscode-ai#overview>

Power BI integration

<https://docs.microsoft.com/en-us/power-bi/service-machine-learning-automated>

Misc

Azure ML Git (samples, demos...)

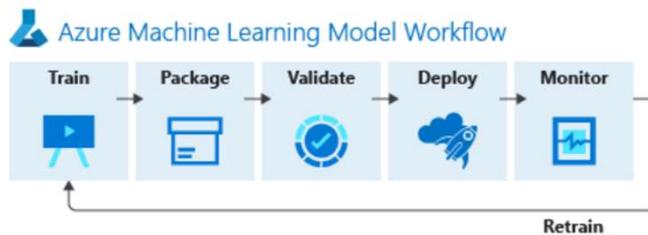
<https://github.com/Azure/MachineLearningNotebooks/>



Azure Machine Learning

Azure Machine Learning service example notebooks

This repository contains example notebooks demonstrating the [Azure Machine Learning Python SDK](#) which allows you to build, train, deploy and manage machine learning solutions using Azure. The AML SDK allows you the choice of using local or cloud compute resources, while managing and maintaining the complete data science workflow from the cloud.



Quick installation

```
pip install azureml-sdk
```

Read more detailed instructions on [how to set up your environment](#) using Azure Notebook service, your own Jupyter notebook server, or Docker.

How to navigate and use the example notebooks?

If you are using an Azure Machine Learning Notebook VM, you are all set. Otherwise, you should always run the [Configuration](#) notebook first when setting up a notebook library on a new machine or in a new environment. It configures your notebook library to connect to an Azure Machine Learning workspace, and sets up your workspace and compute to be used by many of the other examples.



Azure Machine Learning

Azure ML demos Materials



Serge Retkowsky
retkowsky

Global Black Belt Data & AI - Microsoft
France

[Edit profile](#)

19 followers · 3 following · 21

Microsoft
 Paris France
 serge.retkowsky@microsoft.com
 <https://www.linkedin.com/in/serger/>

Overview Repositories 78 Projects Packages

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Customize your pins

[MachineLearningNotebooks](#)
Forked from Azure/MachineLearningNotebooks
Python notebooks with ML and deep learning examples with Azure Machine Learning | Microsoft
Jupyter Notebook ⭐ 1 ⚡ 1

[WorkshopAML2020](#)
Cloud workshop Azure ML 2020
Jupyter Notebook ⭐ 12 ⚡ 13

[WorkshopAzureMLInterfacesgraphiques](#)
Workshop interfaces graphiques Azure ML
⭐ 5 ⚡ 3

[WorkshopMLOps](#)
Workshop MLOps Azure
Jupyter Notebook ⭐ 3 ⚡ 2

[Titanic](#)
Exemple AutoML avec Azure ML service SDK
Jupyter Notebook ⭐ 2 ⚡ 1

[Azure-Databricks-Workshop](#)
Azure Databricks workshop
Jupyter Notebook ⭐ 3 ⚡ 3

Single sign-on to see contributions for organizations within the Microsoft Open Source enterprise.

555 contributions in the last year Contribution settings ▾

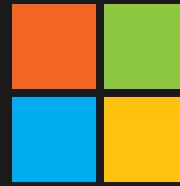
<https://github.com/retkowsky>



Azure ML Demo



Q&A



Microsoft Azure

Be future
ready

Build on
your terms

Operate hybrid
seamlessly

Trust
your cloud