



# Customer

Azure ML workshop

Date





## Microsoft contacts

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- Serge Retkowsky

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# Program overview

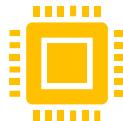
# Workshop Prerequisites



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



Recommended Azure ML  
training on Microsoft  
Learn

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

**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

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



# Workshop 2

## Azure ML fundamentals

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- 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

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- 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

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- 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

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



# Workshop 6

## Azure Databricks

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

# Do you want to be Azure certified?

The image displays a Microsoft certification grid titled "Become Microsoft Certified" last updated in October 2020. The grid is organized into four main categories: Azure, Microsoft 365, Dynamics 365, and Power Platform. Each category has a dark-colored header bar. Below each header bar is a list of certification titles, each associated with a specific exam code. The grid uses color-coding and icons to indicate certification levels and prerequisites.

**Role-based**  
Expand your technical skill set

**Microsoft**

## Become Microsoft Certified

LAST UPDATED OCTOBER 2020

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](https://microsoft.com/certifications)

Full certification title ★ — Expert certification  
This certification has prerequisites 🔒 — Exam requirements

**Azure**

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

**Microsoft 365**

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

**Dynamics 365**

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

**Power Platform**

Power Platform App Maker Associate <b>PL-100</b>	Power Platform Developer Associate <b>PL-400</b>
Power Platform Functional Consultant Associate <b>PL-200</b>	Data Analyst Associate <b>DA-100</b>
Dynamics 365 + Power Platform Solution Architect Expert ★ <b>MB-600</b>	Dynamics 365 Finance and Operations Apps Solution Architect Expert ★ <b>MB-700</b>

# Enterprise Skills Initiative

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

The screenshot shows the Microsoft Enterprise Skills Initiative (ESI) website. At the top, there's a dark header bar with the Microsoft logo, the text "Enterprise Skills Initiative | ESI-Contoso-Demo", and user account options like "Welcome Albus!", "Settings", and "Help". Below the header, the main title "Learning for Data Engineer" is displayed, followed by the subtitle "Learn what you want, when you want.".

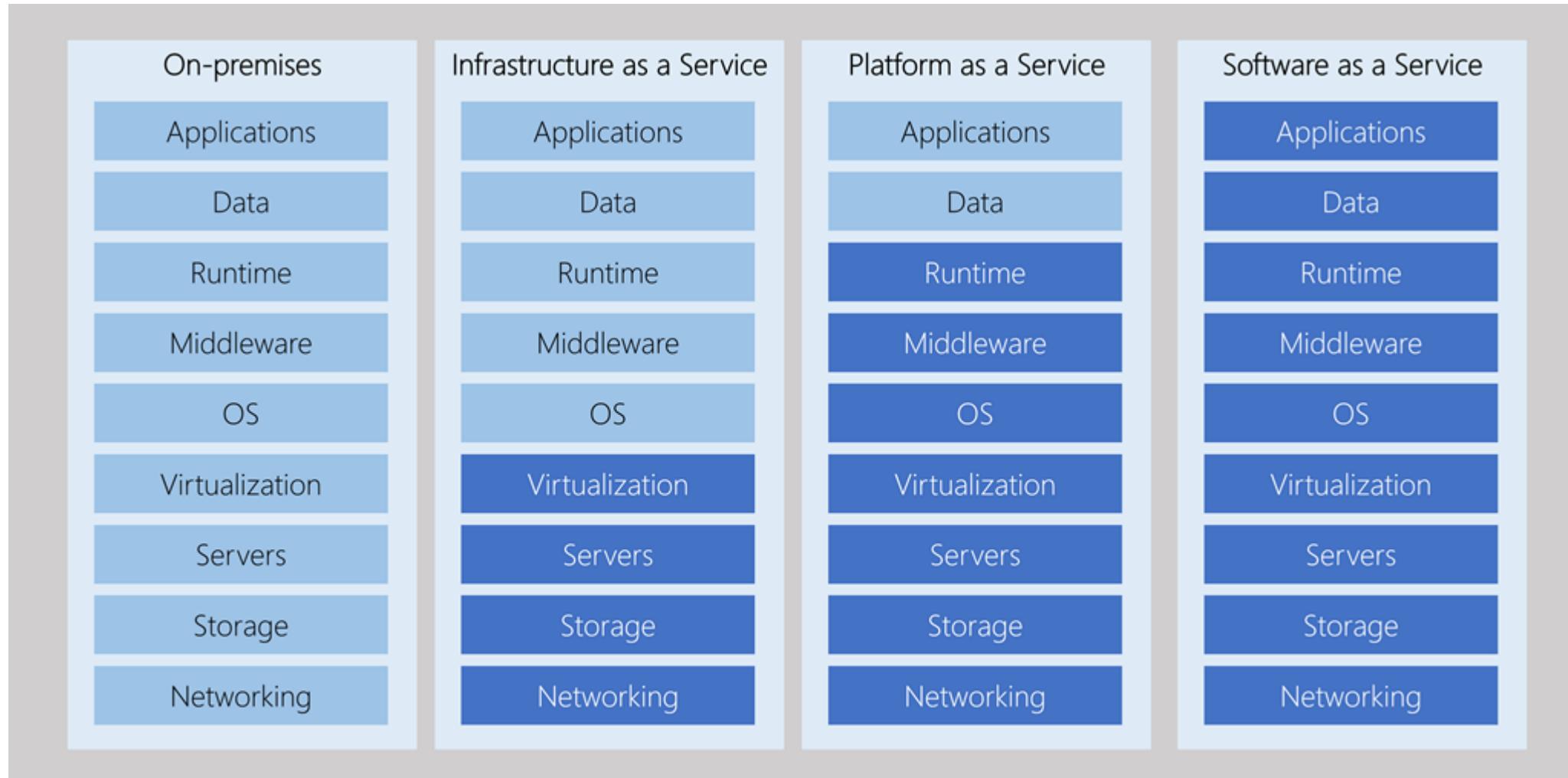
The page features a grid of six cards, each representing a different learning path or service:

- Microsoft Learn**: "LEARN ON YOUR OWN" - Explore a topic in-depth through guided learning paths and interactive, hands-on modules. [Explore](#)
- Microsoft Training Days**: "LEARN THE FUNDAMENTALS" - Sign up for digital events with live moderators supporting attendee questions. [Explore](#)
- Microsoft-Delivered Courses**: "INSTRUCTOR-LED TRAINING" - Enroll in role-based and specialty instructor-led virtual training delivered by Microsoft Certified Trainers. [Explore](#)
- Learning Partner Training**: "INSTRUCTOR-LED TRAINING" - Enroll in discounted instructor-led training, delivered by authorized Microsoft Learning Partners, at a reduced cost. [Register](#)
- Exam Preparation**: "PREPARE FOR AN EXAM" - Exam Prep sessions provide practical details on how best to prepare for your Microsoft Certification exams. [Explore](#)
- Microsoft Certifications**: "GET CERTIFIED" - Advance your career, earn recognition, and validate your technical knowledge through accredited Microsoft Certifications. [Schedule](#)



# Some Azure fundamentals

# Management responsibilities

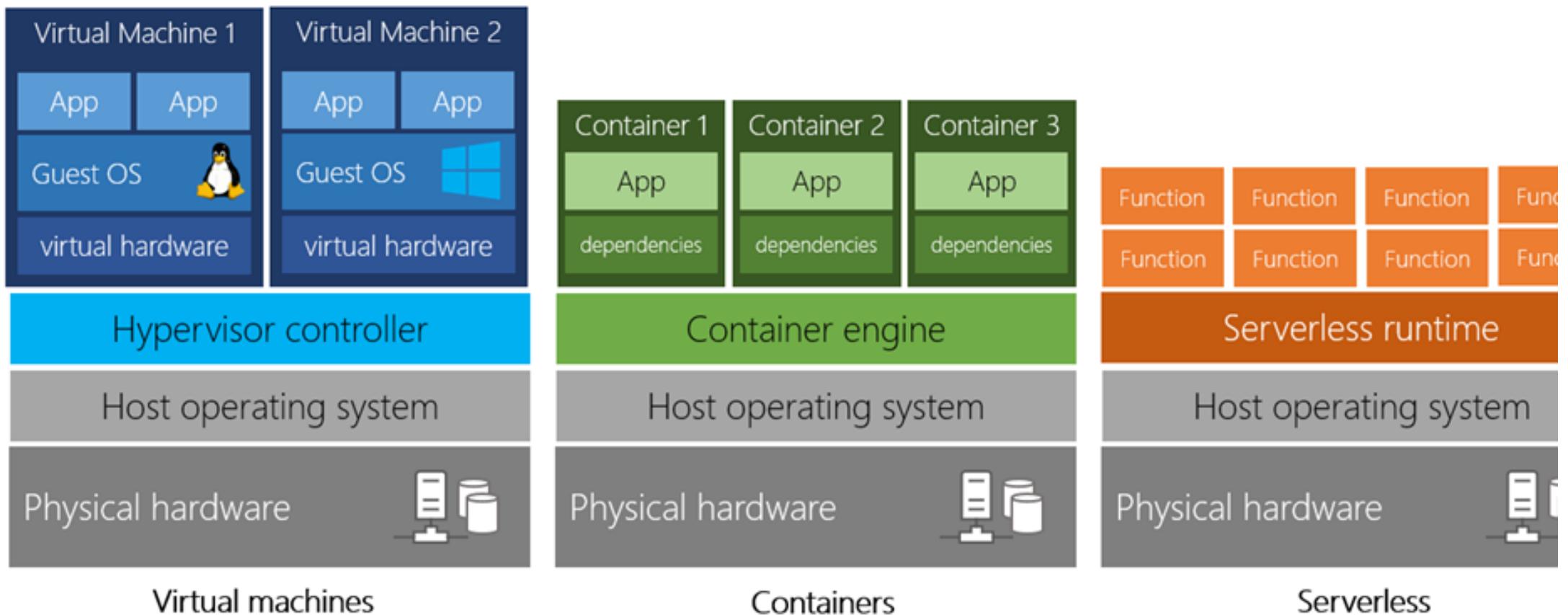


You Manage



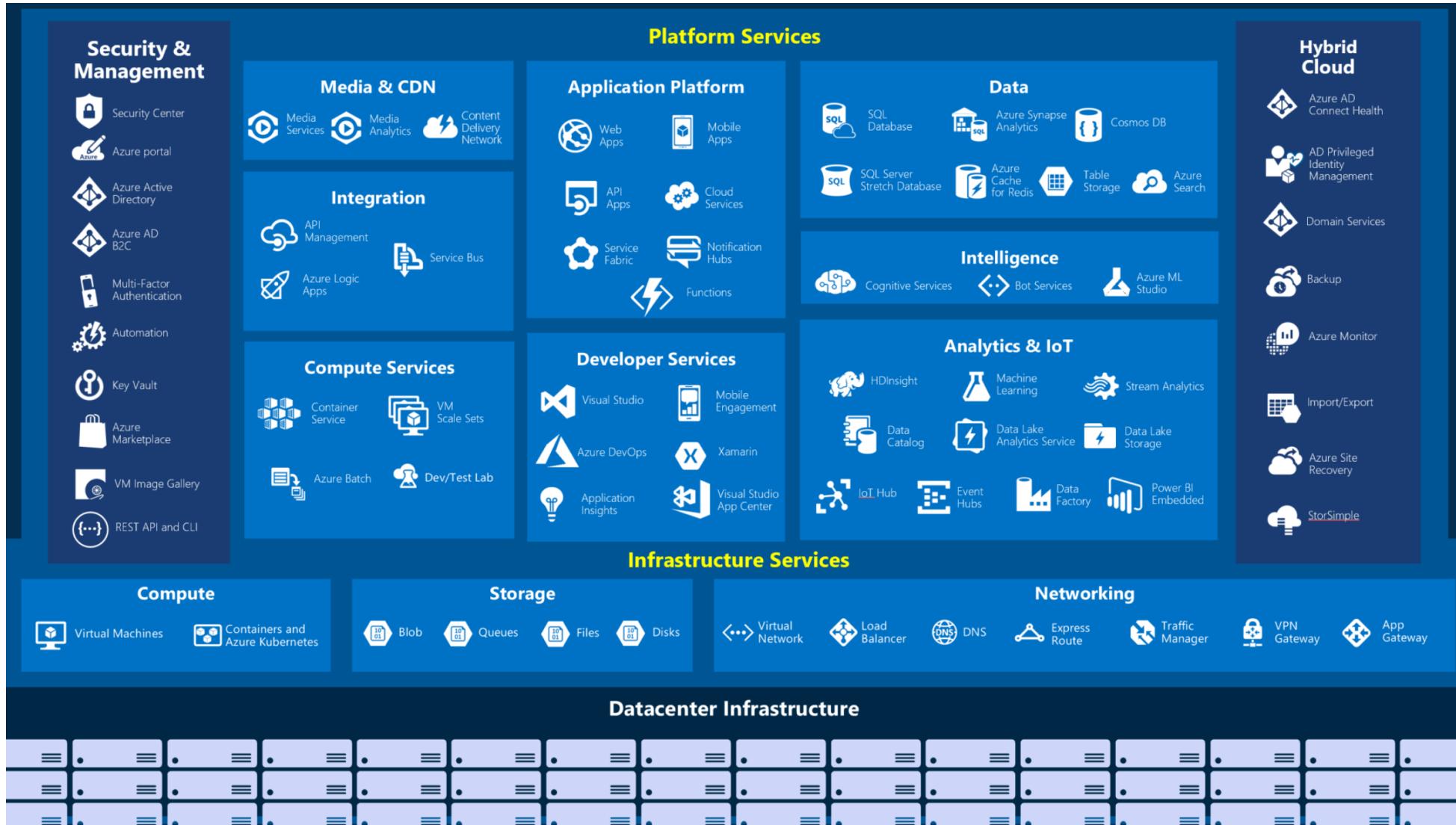
Provider Manages

# 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

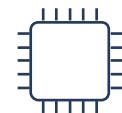


Prepare  
Data

## Experiment



Build model  
(your favorite  
IDE)



Train &  
Test Model



Register and  
Manage  
Model

## Deploy



Build  
Image

Deploy  
Service  
Monitor  
Model



Orchestrate

# Azure Machine Learning



**Set of Azure  
Cloud Services**



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

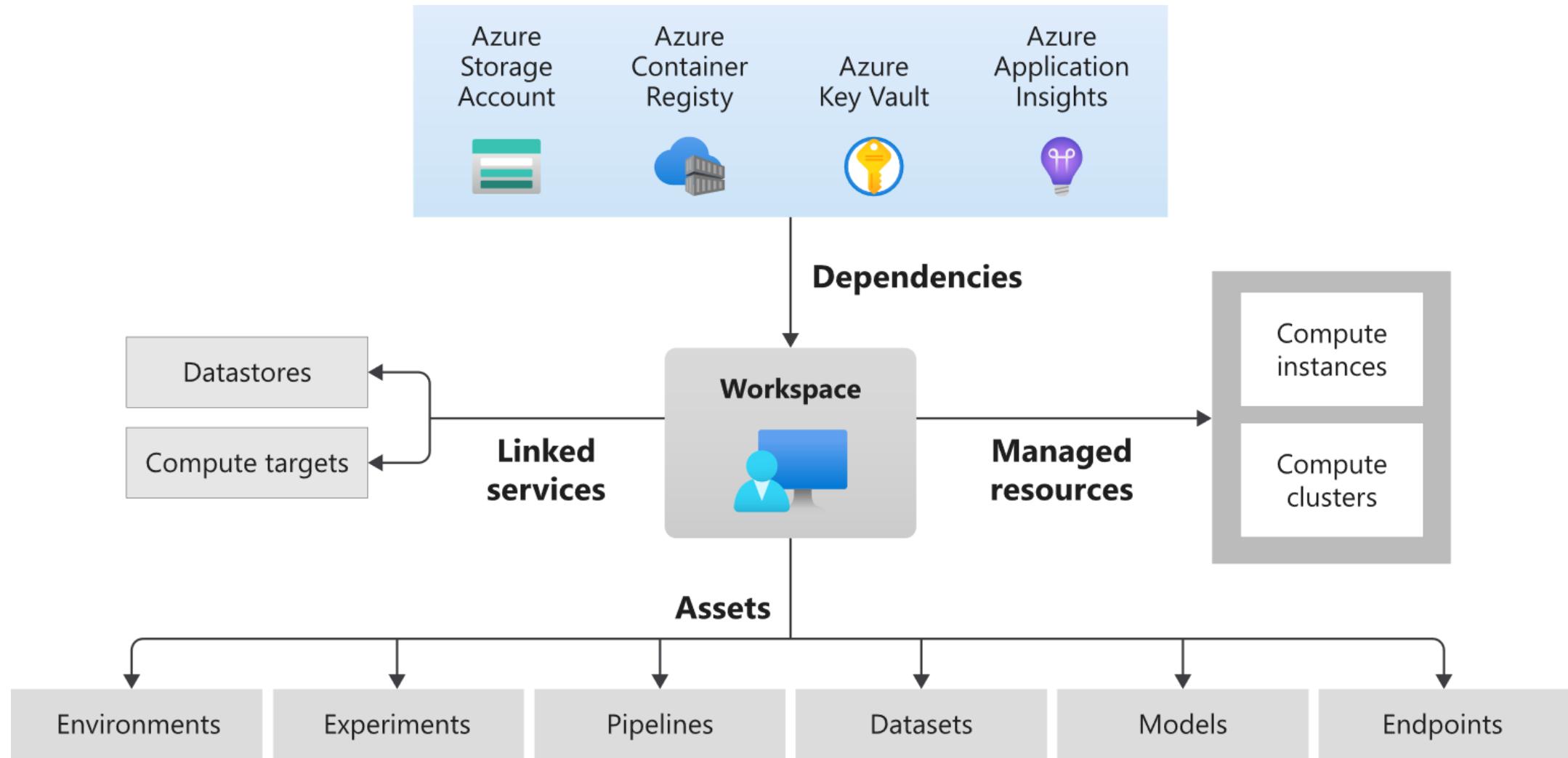
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That enables you to:

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

# Azure ML components

# Azure Machine Learning





Azure Machine Learning

# Azure ML Studio

## For all skill levels studio web experience

The screenshot shows the Azure ML Studio web interface. On the left is a sidebar with a 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 the header is a "Welcome to the studio!" message. There are four main sections with "Start now" buttons:

- Create new** (with a plus sign icon)
- Notebooks** (with a document icon): "Code with Python SDK and run sample experiments."
- Automated ML** (with a lightning bolt and gear icon): "Automatically train and tune a model using a target metric."
- Designer** (with a cube icon): "Drag-and-drop interface from prepping data to deploying models."

Below these sections is a "My recent resources" section. It shows a table titled "Runs" with one entry:

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

On the right side of the main content area, there are two more sections: "Compute" (with a table showing one entry: Name AKSML) and "Datastores" (with a table showing one entry: Name AKSML).

# Azure ML Studio



Azure Machine Learning

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

Max(Accuracy)

Run number

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

The background of the image is a dark red color with a subtle bokeh effect. Numerous small, glowing red and yellow circular particles are scattered across the surface, creating a sense of depth and light. The particles are more concentrated in the lower right quadrant and become more sparse towards the top left.

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 Azure Machine Learning Compute Instances blade. On the left, there's a table with columns: Name, Status, Application URI, and Virtual Machine size. It lists one instance: standardd13v2, which is Running. To the right of the table is a sidebar for creating a new compute instance. The sidebar includes fields for Compute name (mandatory), Region (set to westeurope), Virtual Machine size (set to Standard\_D3\_v2), and a toggle for Enable SSH access. Below these are sections for Advanced settings, Configure virtual network, Resource group, and Virtual network, each with dropdown menus for selection.

# Notebooks



Azure Machine Learning

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.



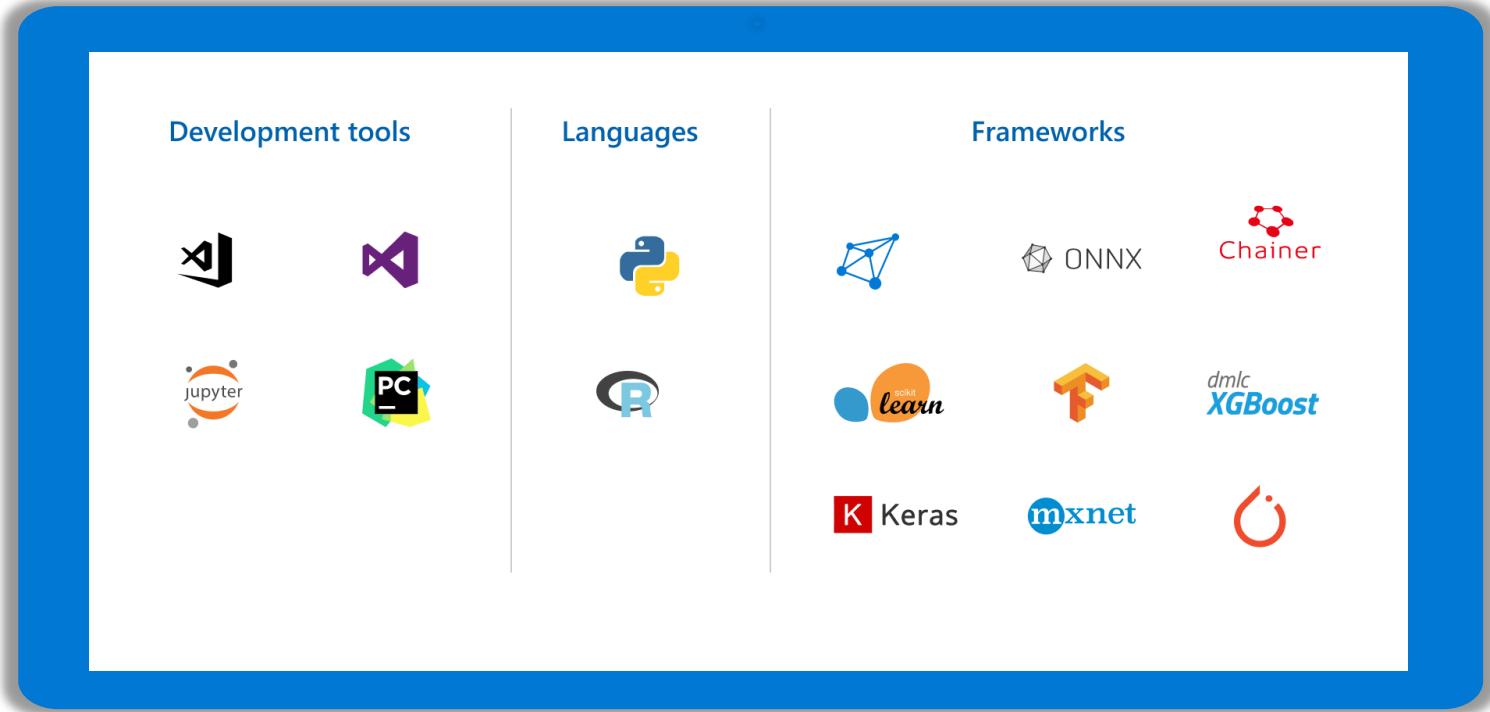
Data Science platform



Azure Machine Learning

# Azure Machine Learning

Open and interoperable platform

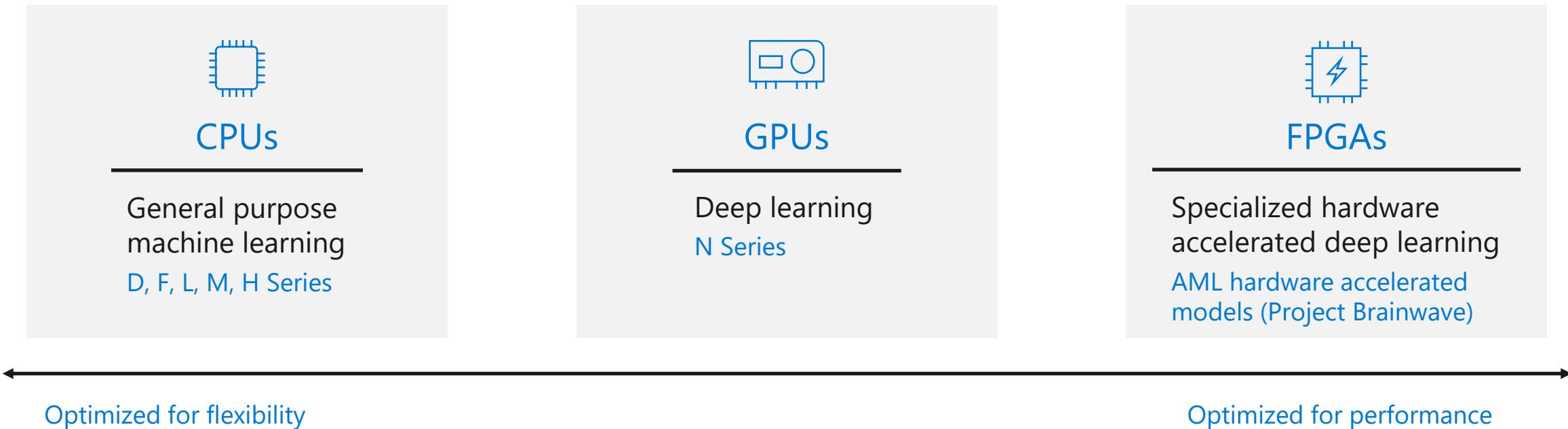


# Powerful infrastructure



Azure Machine Learning

# Accelerate deep 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 \* ⓘ

Region \* ⓘ

Virtual machine type \*

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



Azure Machine Learning

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>

# ONNX support



Azure Machine Learning

## Create

### Frameworks



Caffe2



Chainer



Cognitive Toolkit



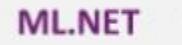
mxnet



PyTorch



PaddlePaddle



ML.NET



MathWorks



XGBoost



ML



learn



T



K

### Services



Azure Custom  
Vision Service



ONNX Model

Native support

Converters

Native support

## Deploy

### Azure

Azure Machine Learning services

Ubuntu VM

Windows Server 2019 VM

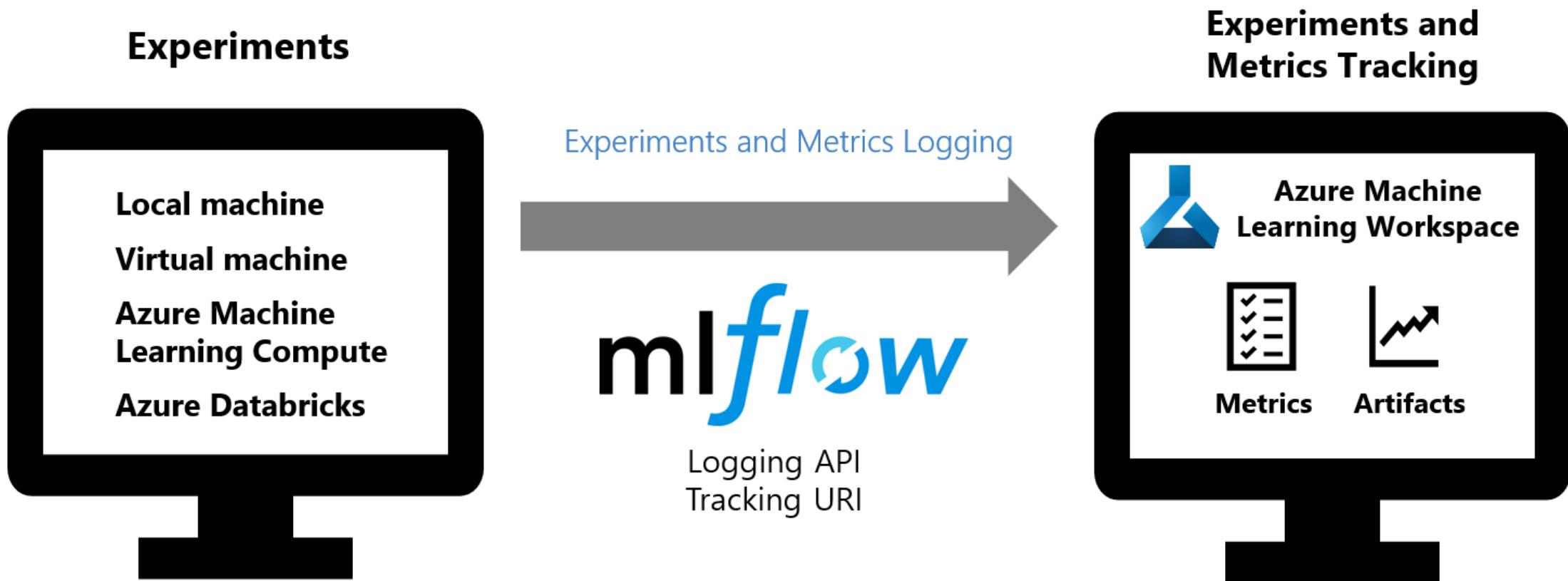
Windows Devices

Native support

Converters

Other Devices  
(iOS, etc)

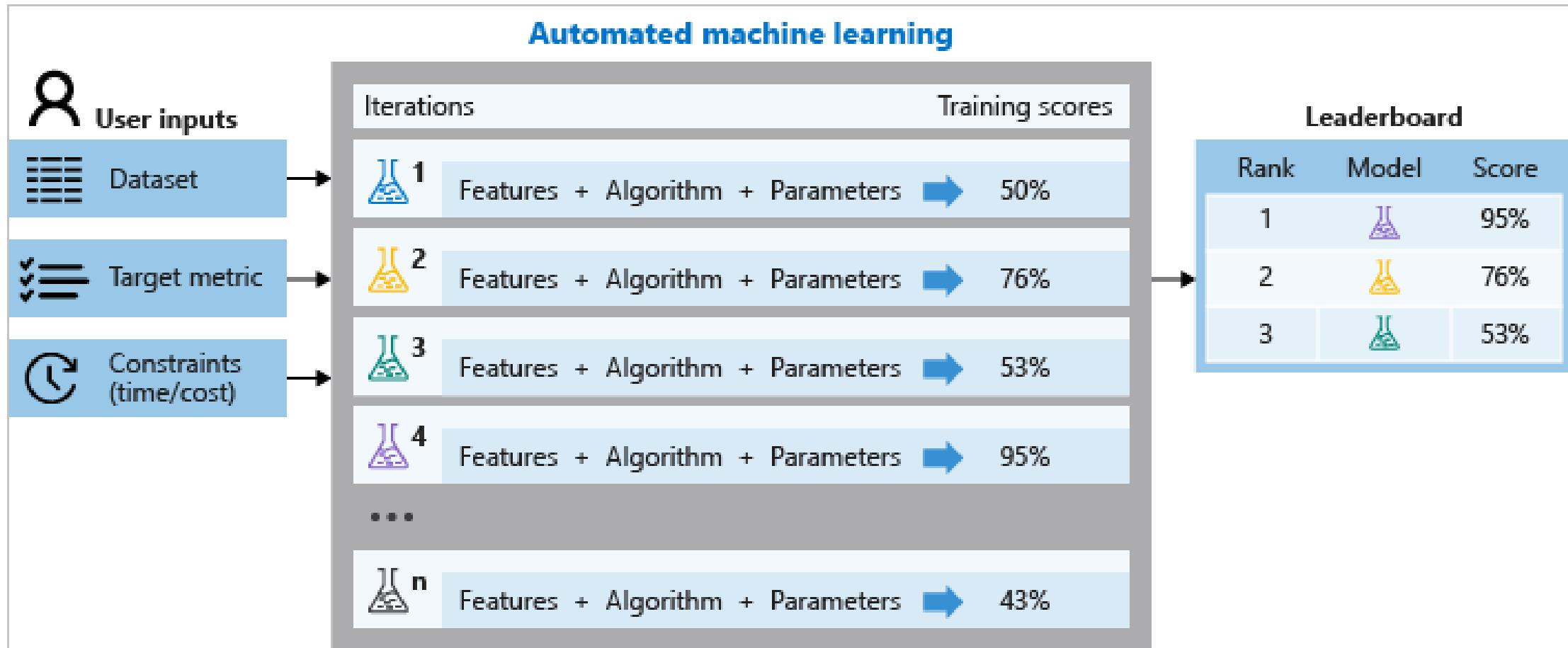
# MLFlow with Azure ML experimentation



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

AutoML

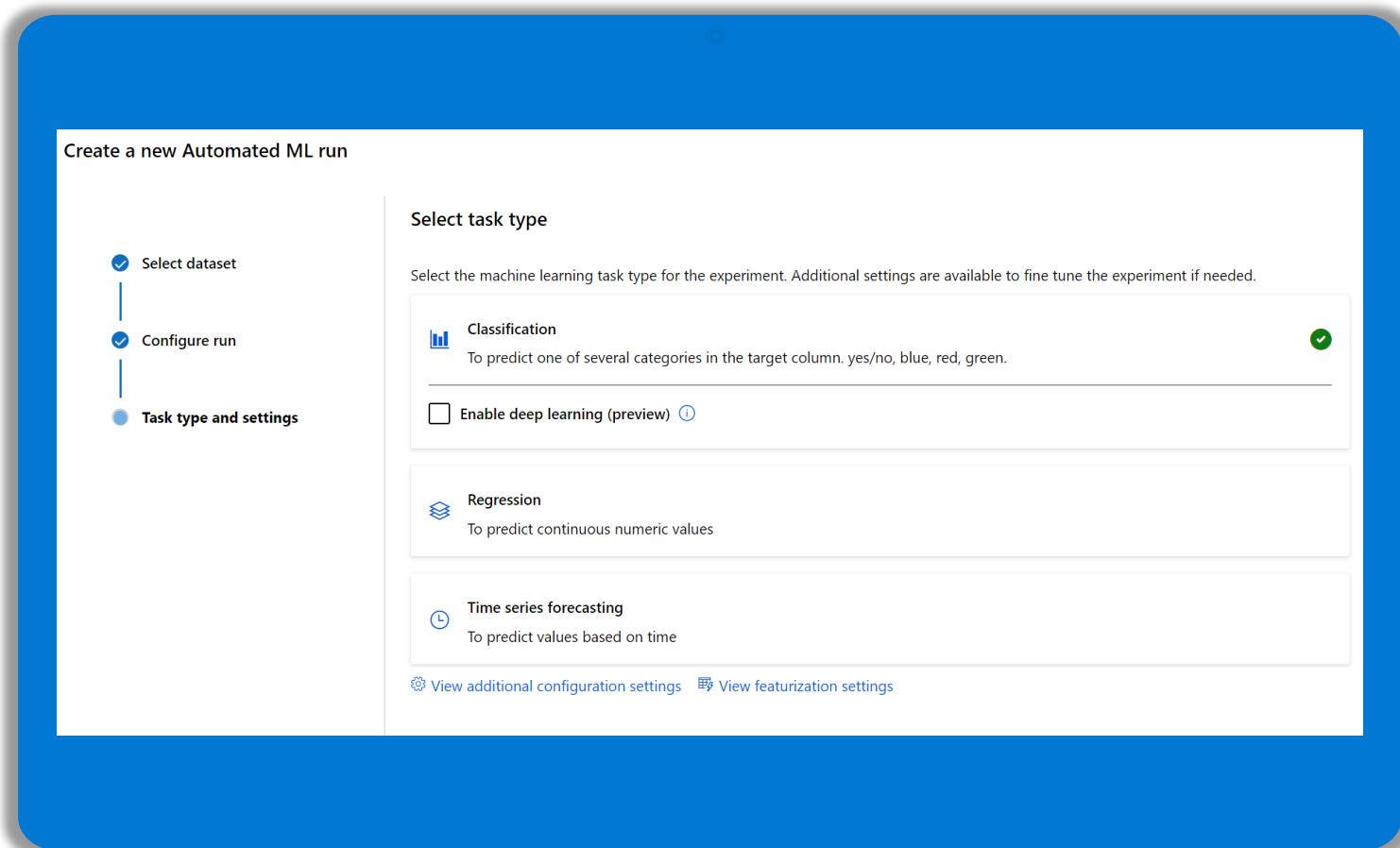
# Automated ML



# Automated ML



- 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.



Azure No-Code AutoML

# Automated ML



- 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](#)

Details    **Models**    Data guardrails    Properties

Search to filter items...

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

Azure No-Code AutoML

# AutoML Power BI integration



Choose model

Select data

Customize inputs

Name + train

Choose a model type

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.

New to machine learning models?

Next

## MODEL PERFORMANCE

### 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%

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

See top predictors

	Predicted Malignant	Predicted Benign
Actual Malignant	43.00	0.00
Actual Benign	8.00	62.00

84%

Precision

100%

Recall

Probability Threshold

Increase Recall

0.00 0.03

Increase Precision

of records predicted as Malignant are likely to actually be Malignant

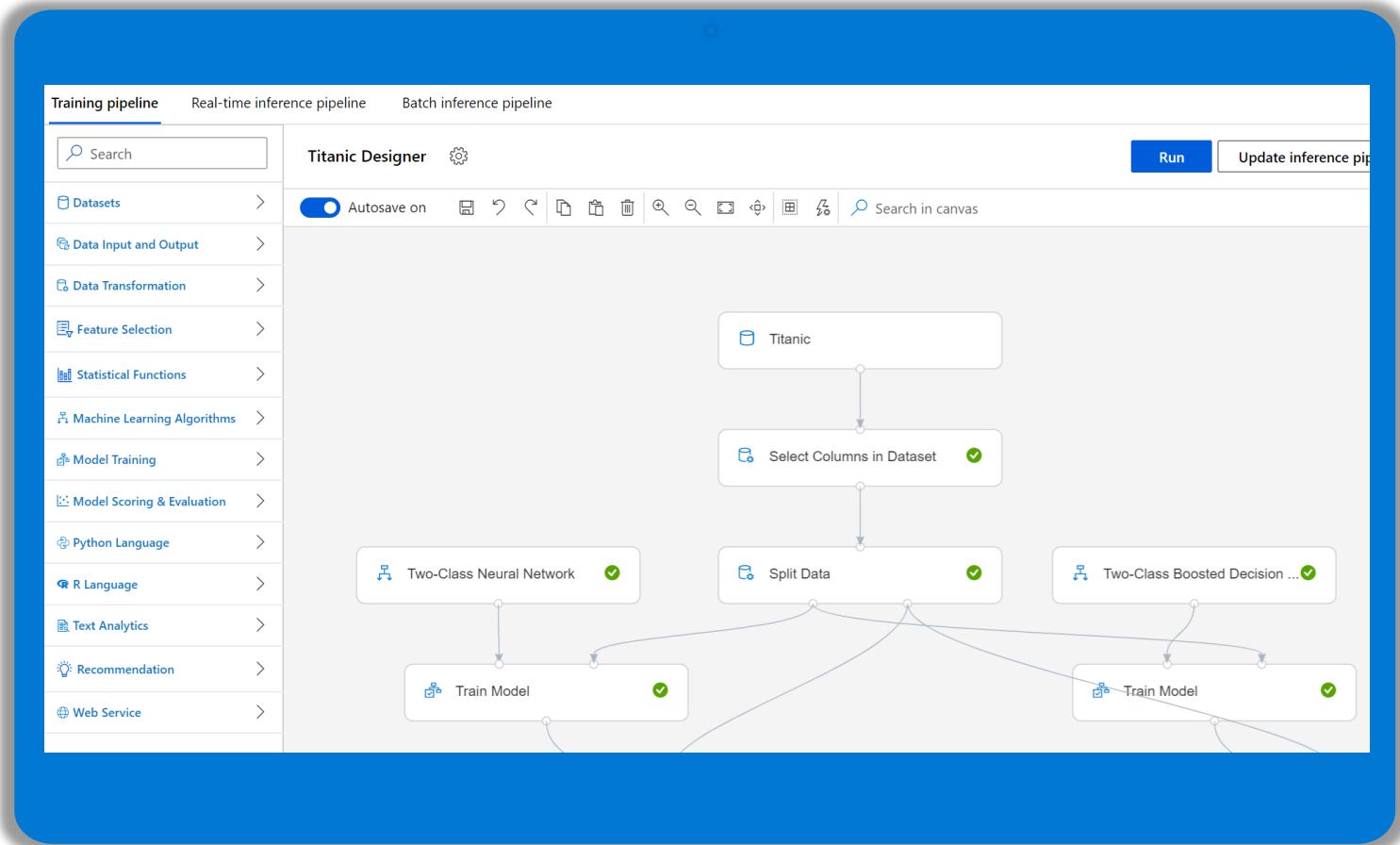
of records that are actually Malignant are likely to be predicted as Malignant

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

New

Home

Author

Notebooks

Automated ML

Designer

Assets

Datasets

Experiments

Pipelines

Models

Endpoints

Datasets

Data Input and Output

Data Transformation

- Add Columns
- Add Rows
- Apply Math Operation
- Apply SQL Transformation
- Clean Missing Data
- Clip Values
- Convert to CSV
- Convert to Dataset
- Edit Metadata

Flight Delays

Autosave on

Flight Delays Data

Normalize Data

```
graph TD; A[Flight Delays Data] --> B[Normalize Data]
```

# Azure ML Designer



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

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

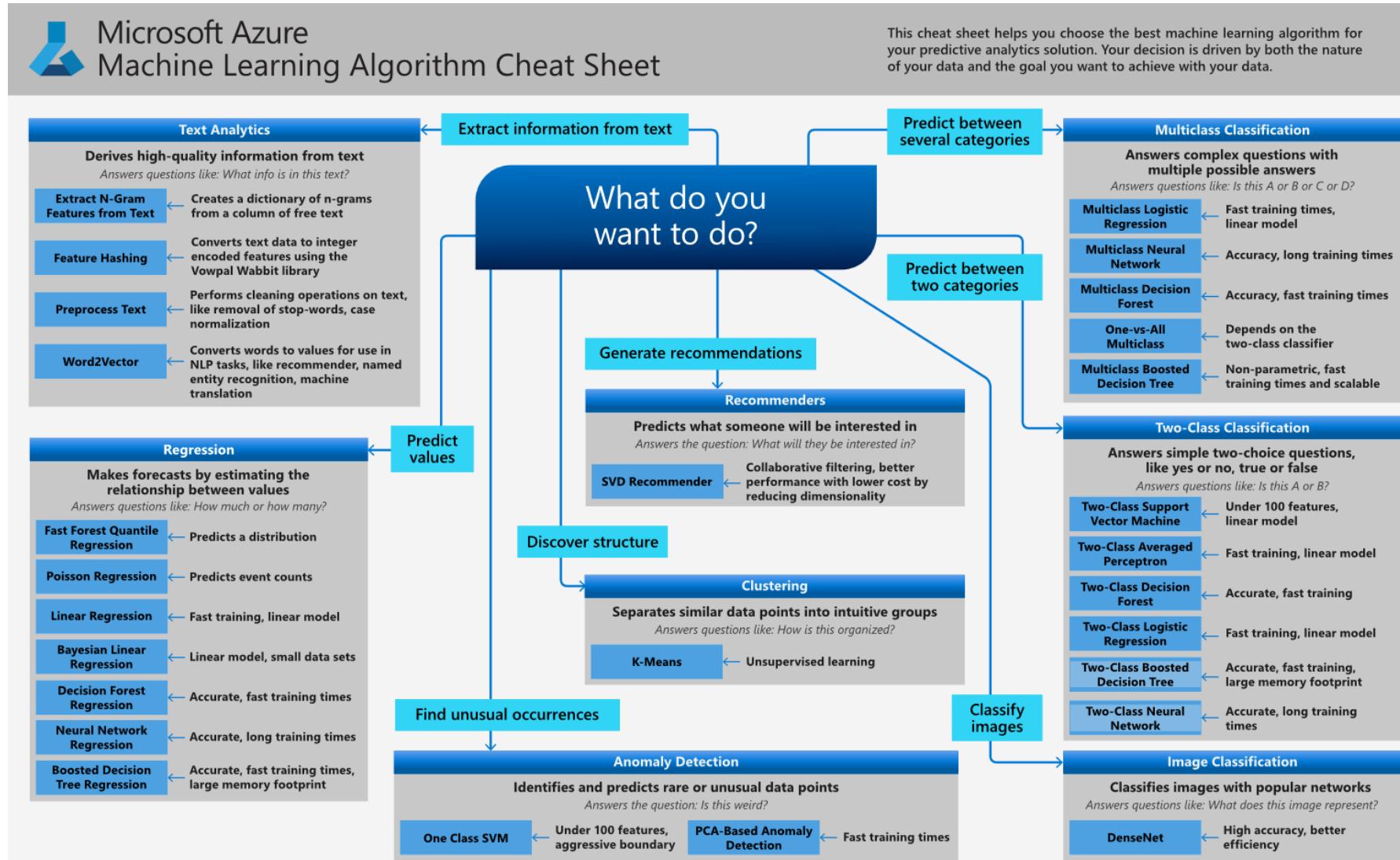
Navigator

# Azure ML Designer



Azure Machine Learning

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





Azure ML Pipelines

# Pipelines

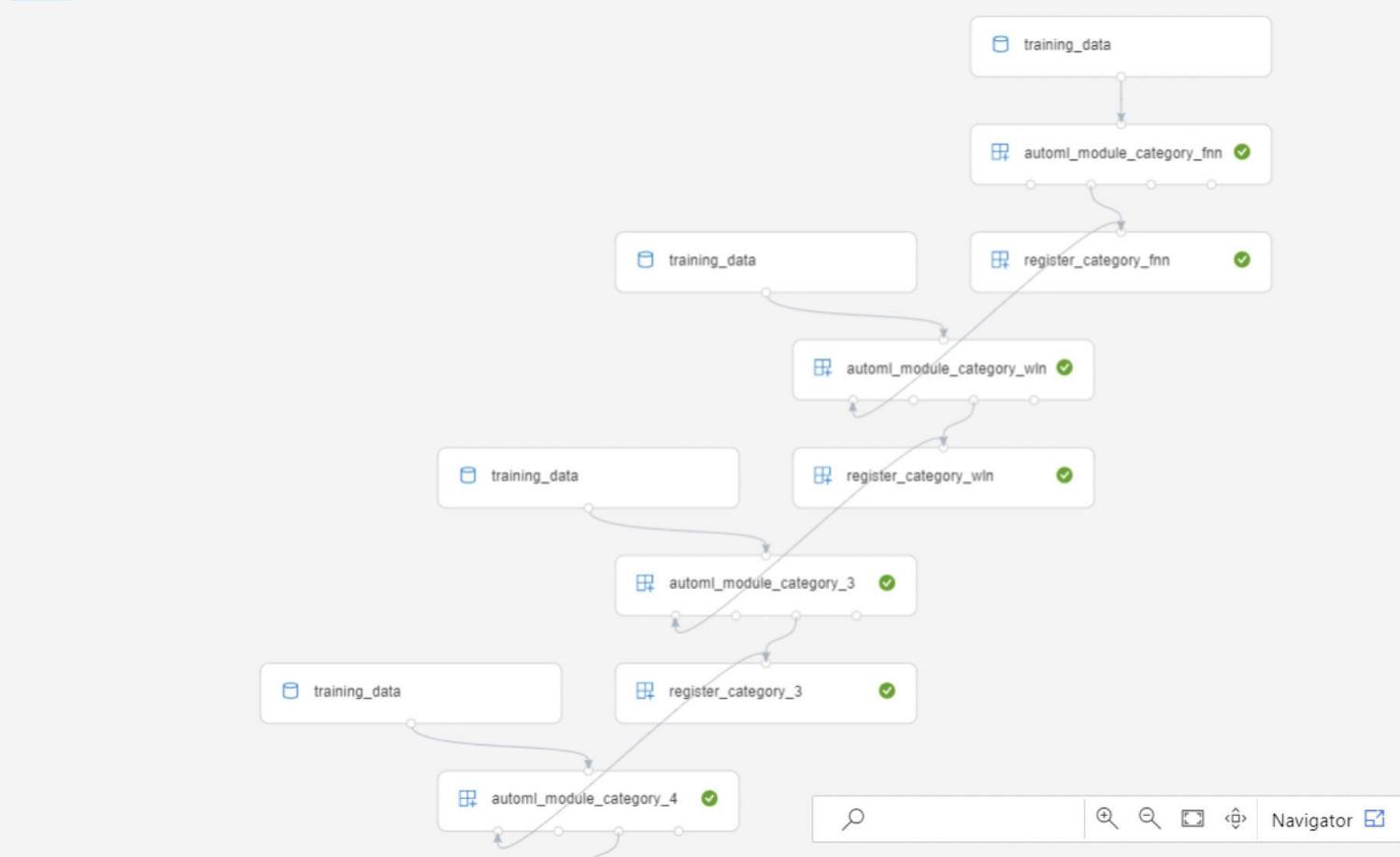


Azure Machine Learning

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

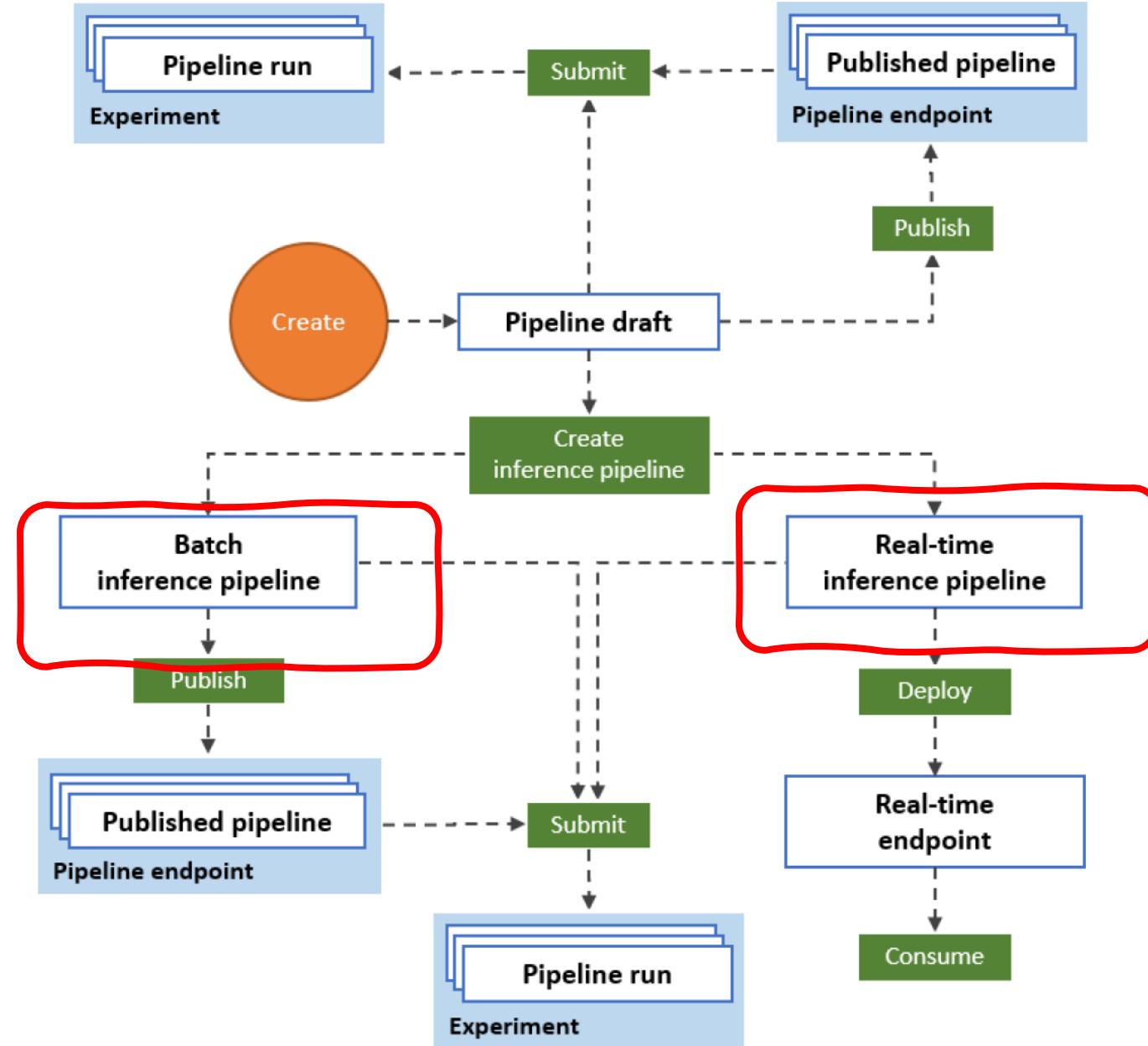
End time  
10/09/2019, 12:40:13 AM

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](#)

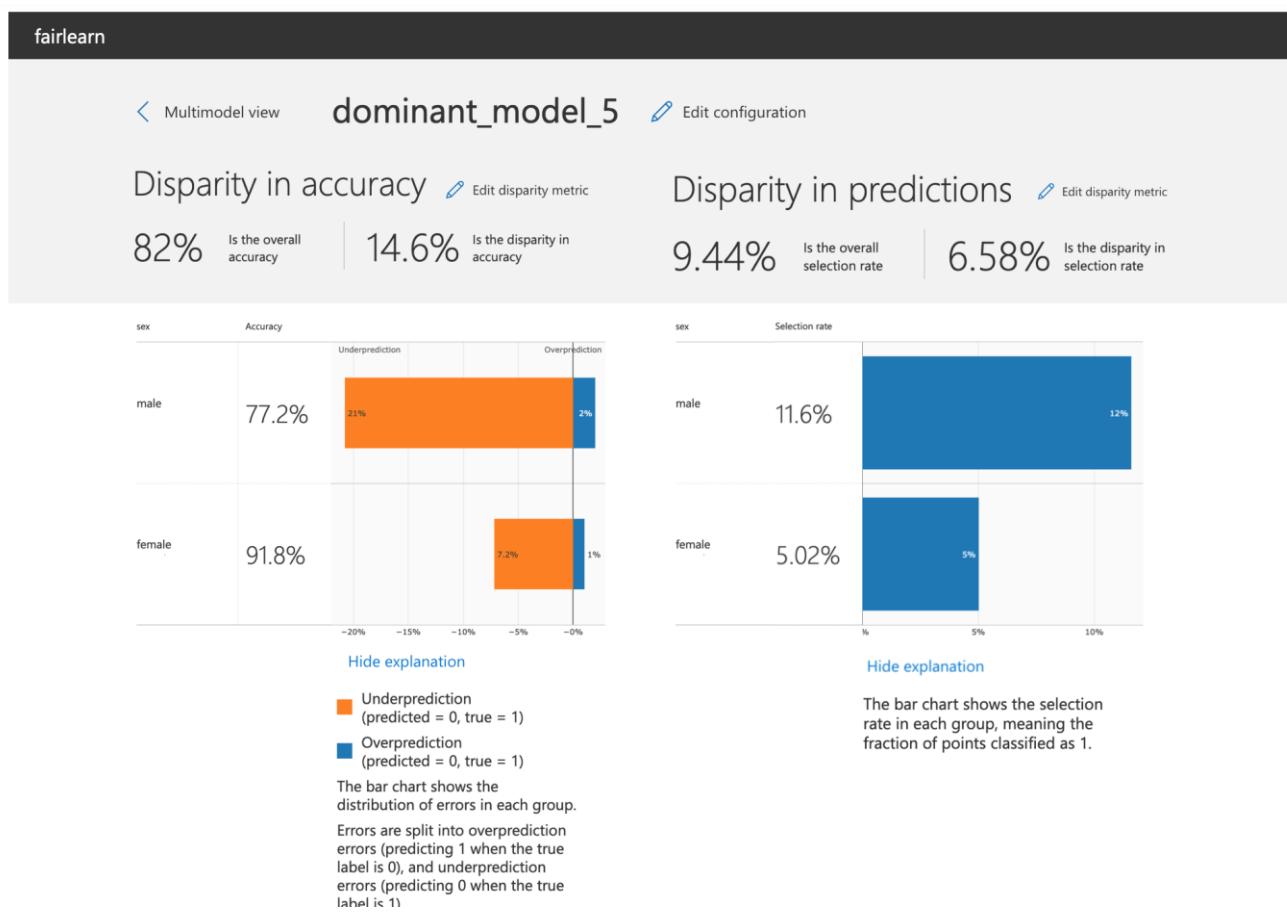
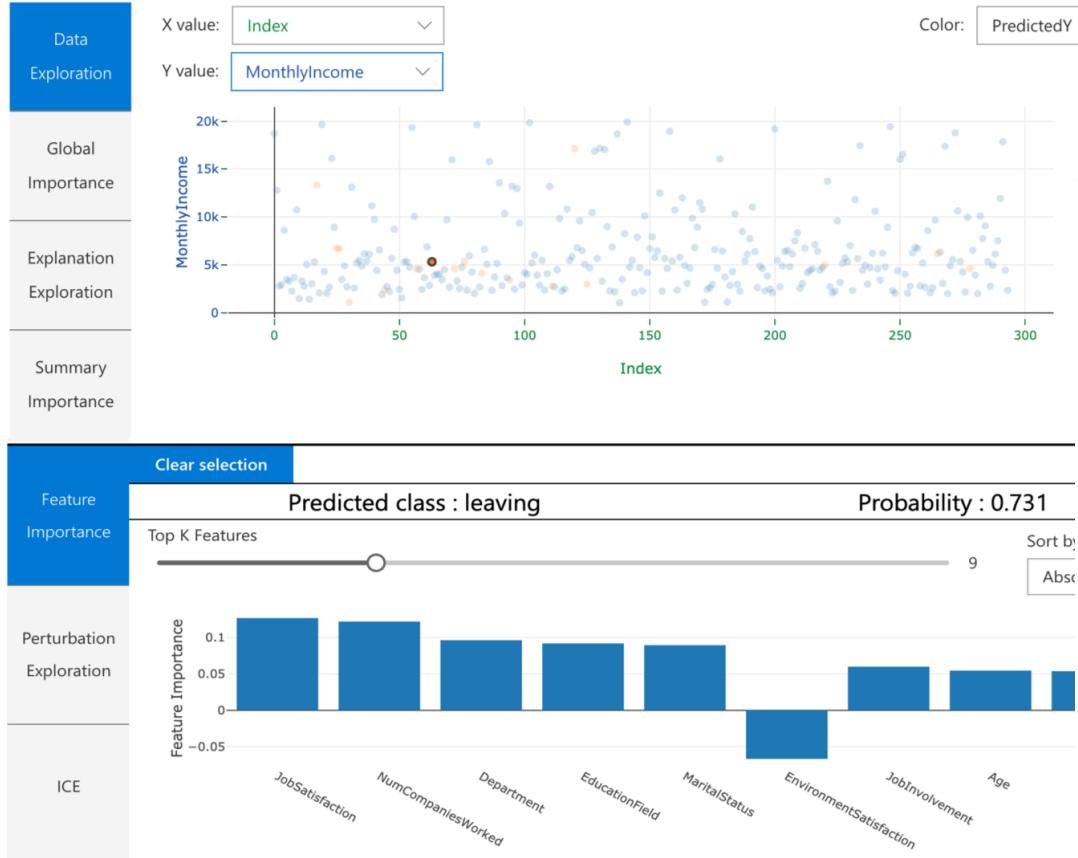
Microsoft InterpretML  
<https://interpret.ml/>



# Examples

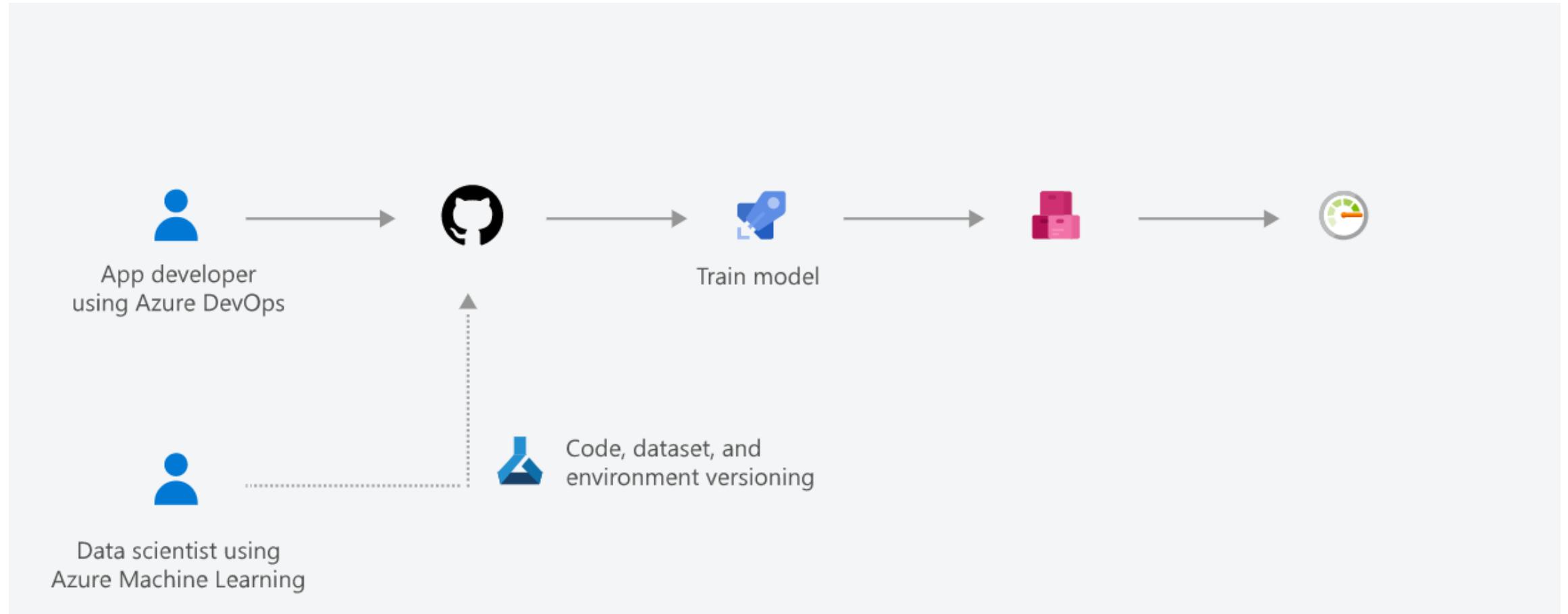


Azure Machine Learning



MLOps = DevOps for Data Science

# MLOps workflow



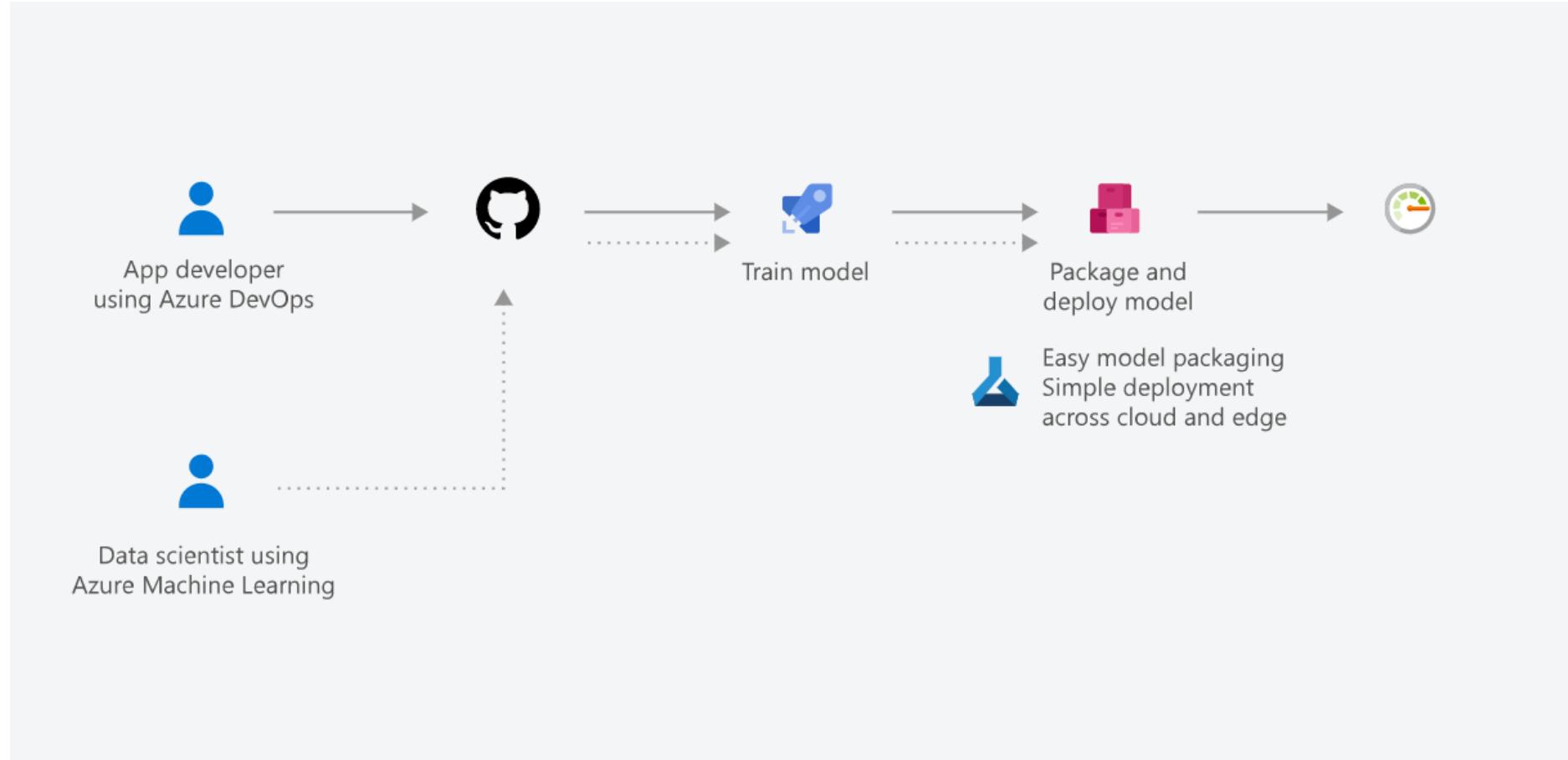
Model reproducibility

Model validation

Model deployment

Model retraining

# MLOps workflow



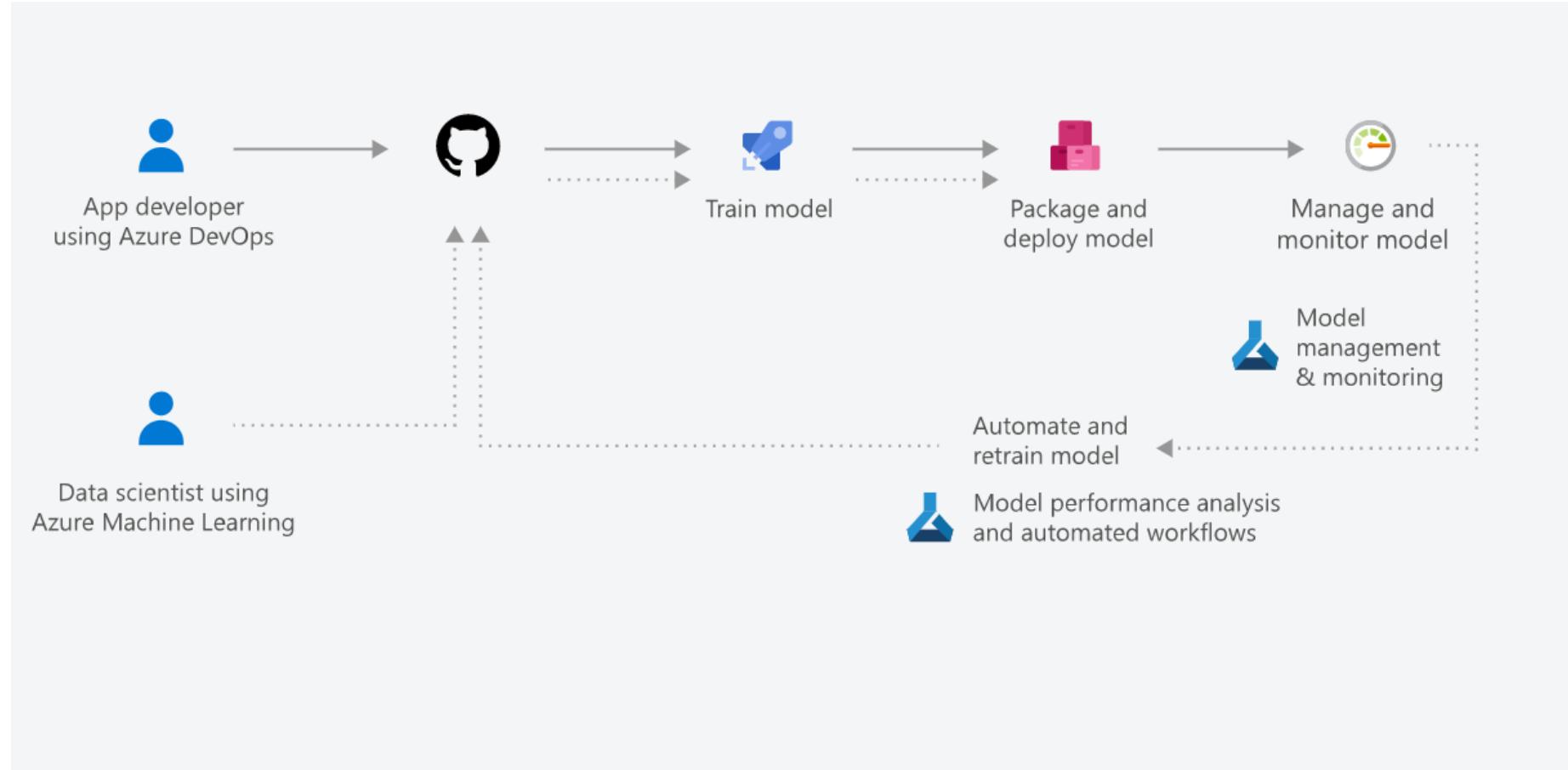
Model reproducibility

Model validation

Model deployment

Model retraining

# MLOps workflow



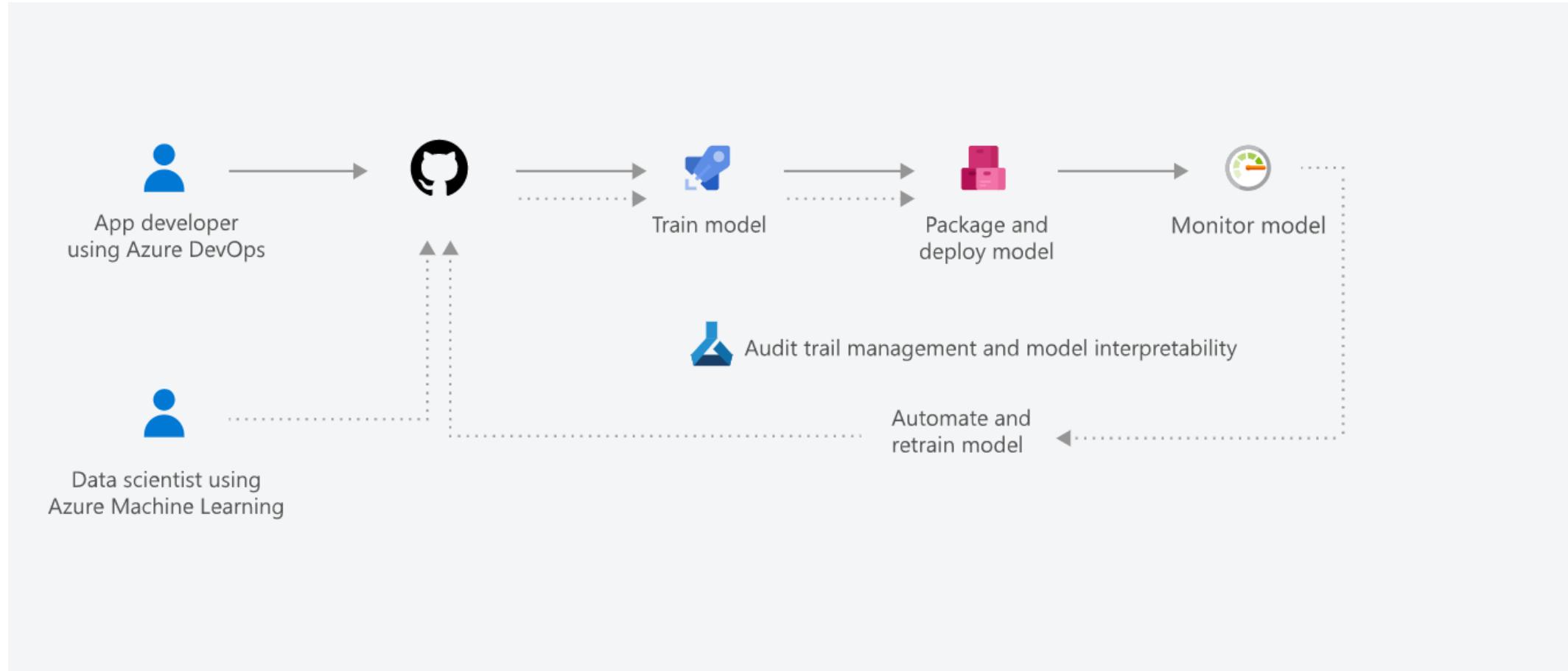
Model reproducibility

Model validation

Model deployment

Model retraining

# MLOps workflow



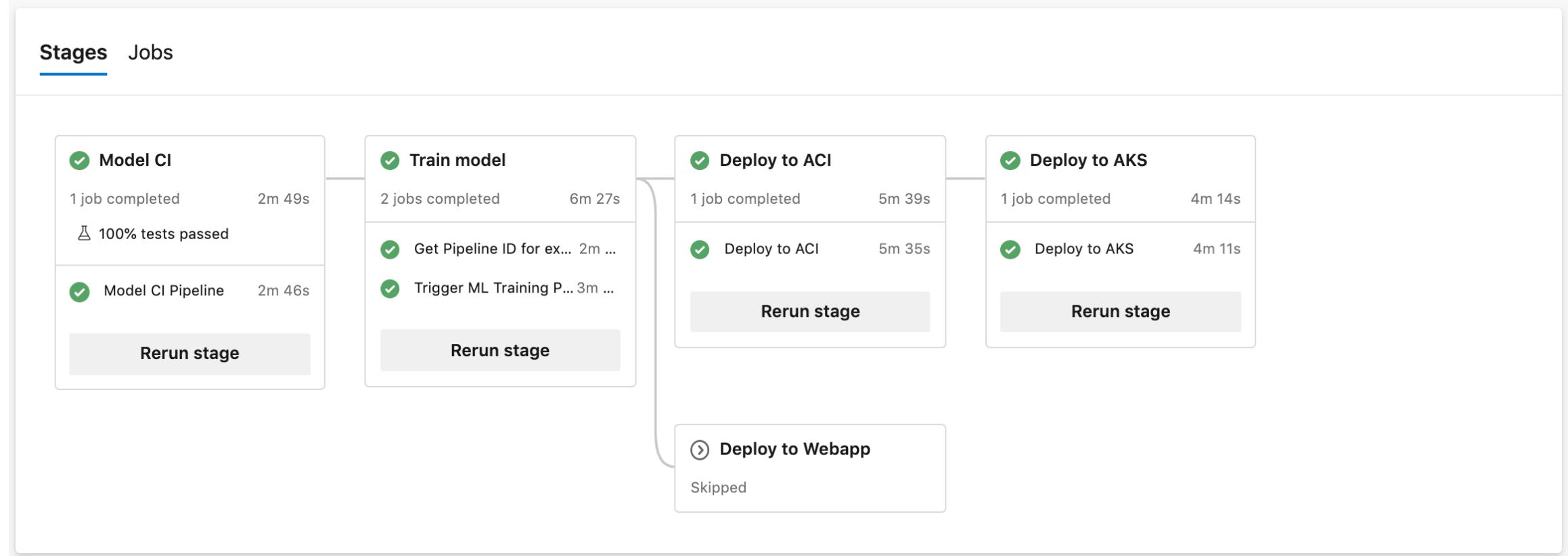
Model reproducibility

Model validation

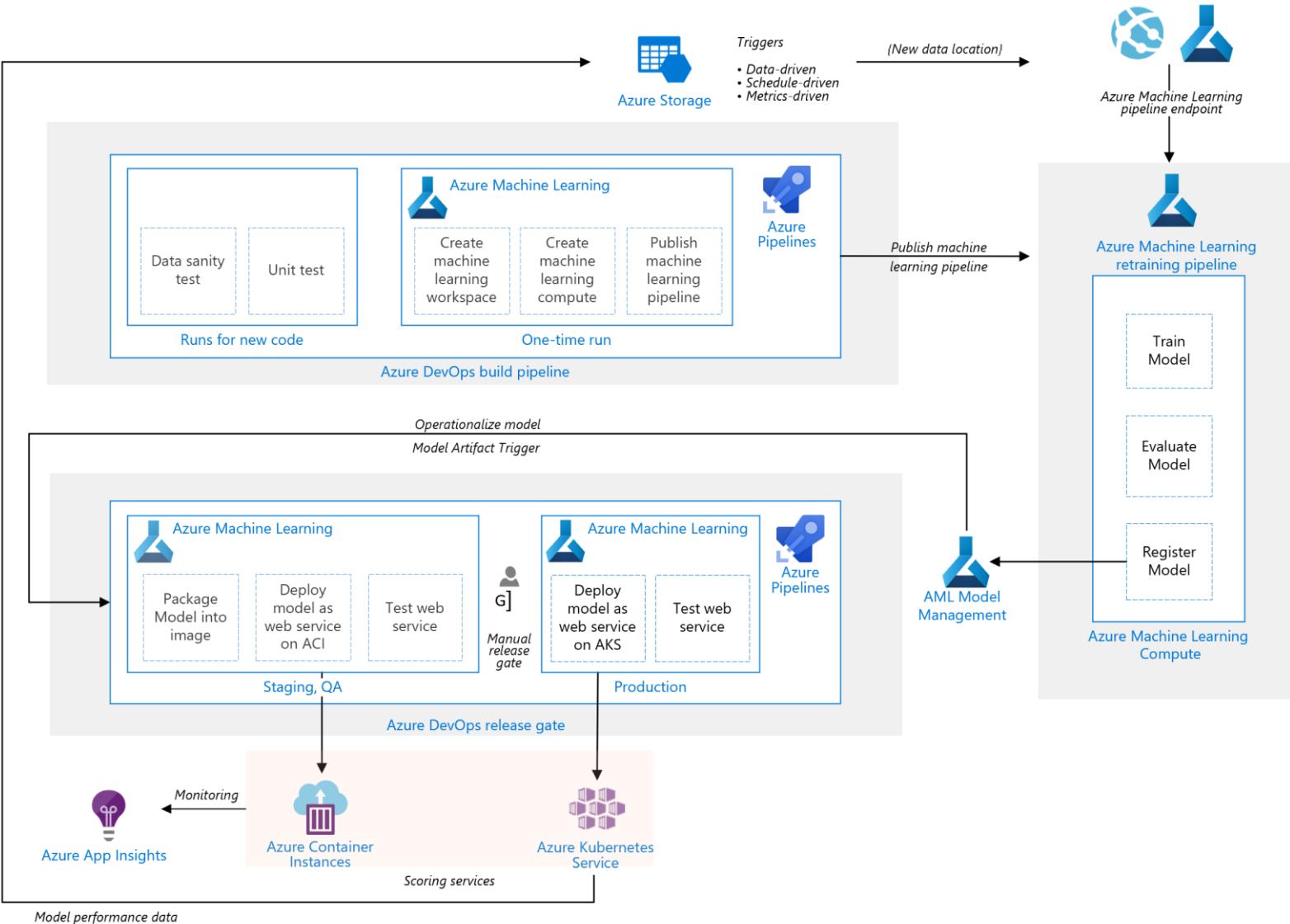
Model deployment

Model retraining

# An example

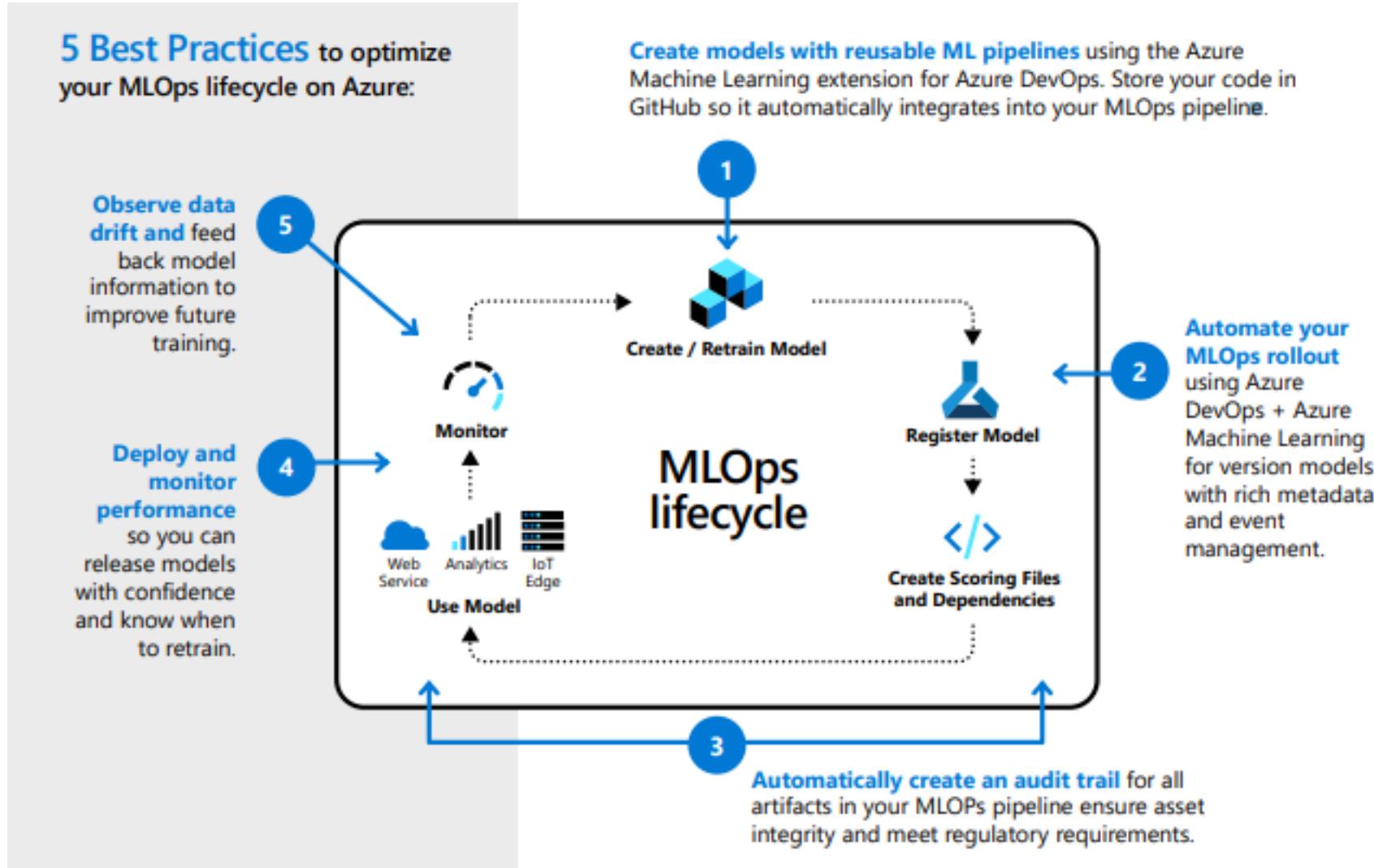


# Architecture



# 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 interface in AI Preview mode. The main navigation bar includes 'Microsoft' logo, 'Power BI', 'Power BI AI Prev...', 'Titanicdataset', 'New look on' toggle, 'Search' bar, and a notification bell.

The left sidebar lists navigation items: Home, Favorites, Recent, Apps, Shared with me, Deployment pipelines, Learn, Workspaces, and 'Power BI AI Prev...' which is currently selected.

The central workspace displays the 'Power Query - Edit queries' interface. The 'Home' tab is selected. The 'Queries' pane on the left shows a list of queries, with 'titanicmodel que...' and 'Titanicdataset' highlighted. The main area shows an 'AI insights' card for the query 'AzureML.titanic-real-time-inference'. The card details the model's purpose ('Appel modèle ML Titanic'), creation date ('Created On : 6/1/2020 9:39 AM'), and last modification date ('Last modified On : 6/1/2020 11:47 AM'). Below the card is a form for real-time inference, with fields for Passenger ID, Survived status, Class, Name, Sex, Age, Siblings or Spouses, Parents or children, and Ticket number. The 'Apply' and 'Cancel' buttons are at the bottom right of the form.

# 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**

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

Select a predictor on the left to see its breakdown

**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, choose the algorithm 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**

Model Quality

Maximum Model Quality: 0.87

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

workshopmlRG - Insights (preview)  
Resource group

X

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)
- 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
workshopmlRG	1 (-)	—	—	<span style="color: blue;">💡</span> <span style="color: blue;">💡</span>	...
Compute	1 (-)	—	—	<span style="color: blue;">💡</span>	...
Virtual machine	1 (-)	—	—	<span style="color: blue;">💡</span>	...
standardd2v224d142833d	—	—	—	<span style="color: blue;">💡</span>	...
standardds13v244d198275	1 (-)	—	—	<span style="color: blue;">💡</span>	...
Container registry	—	—	—		
Application	—	—	—	<span style="color: blue;">💡</span>	...
Networking	—	—	—		
Other	—	—	—		
Storage and Databases	—	—	—		



Azure Machine Learning

# Monitoring Azure ML with Azure Monitor

Show data for last:

1 hour

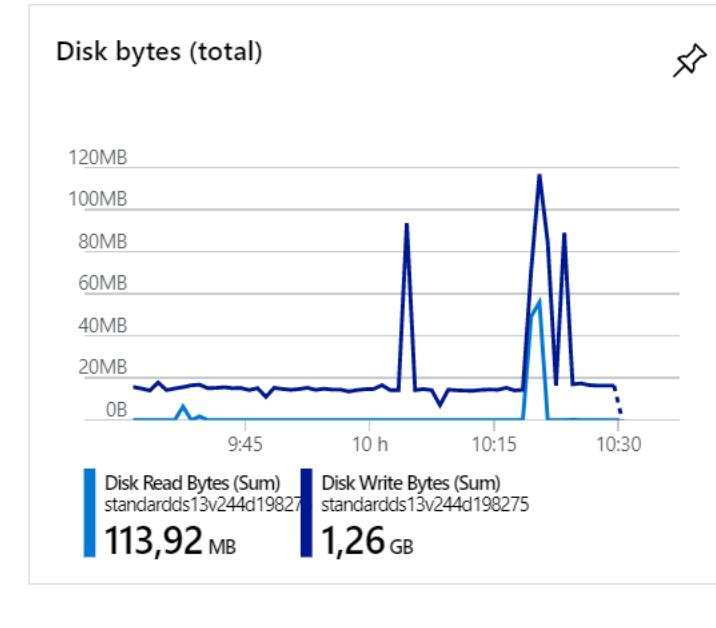
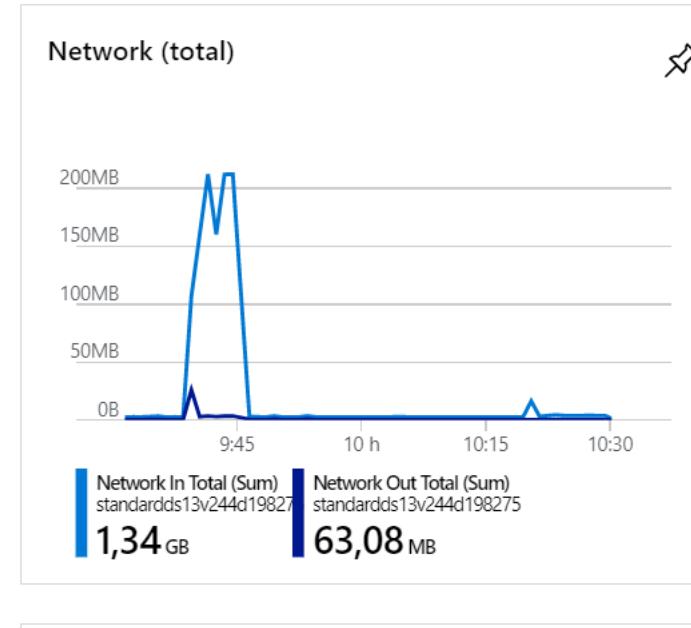
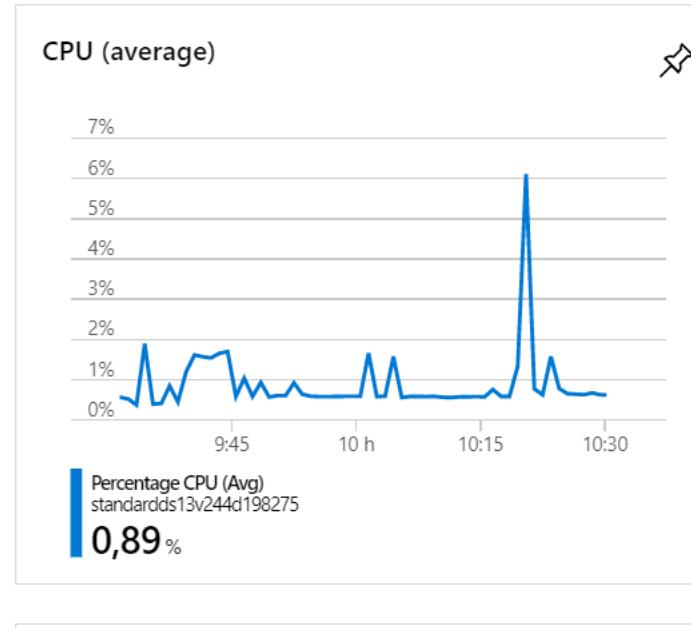
6 hours

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 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

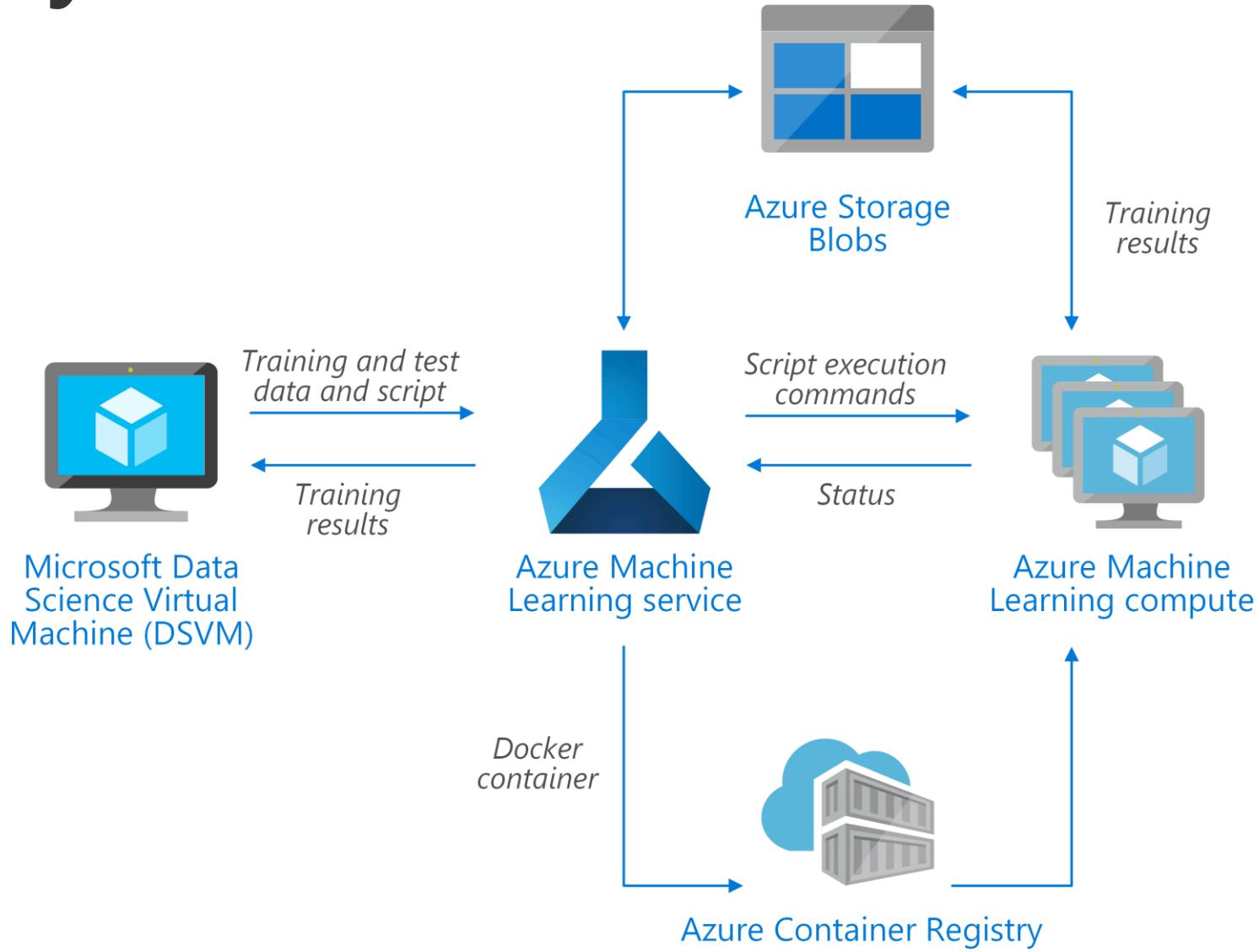
- Properties
- Locks
- Export template

Monitoring

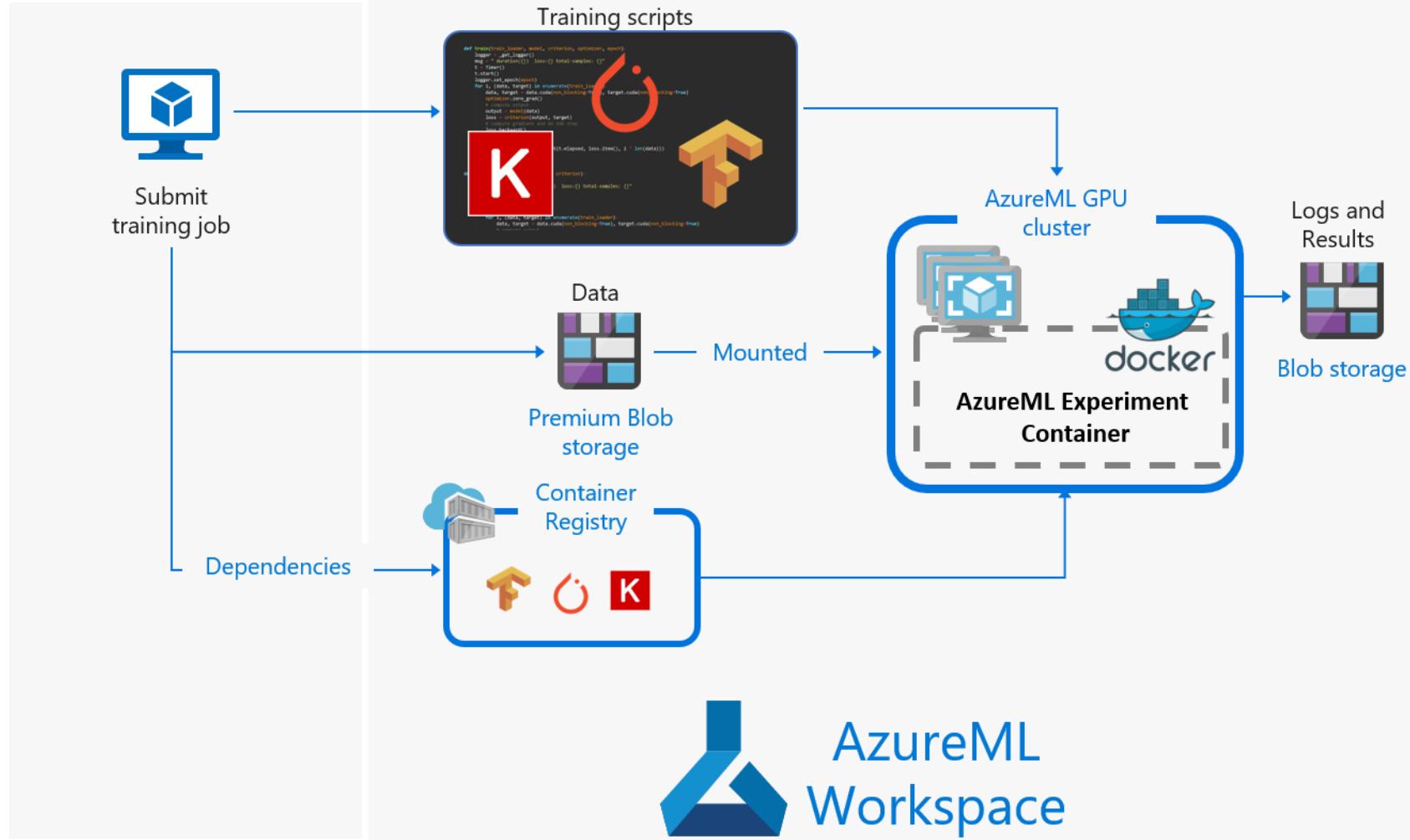
- Alerts
- Metrics
- Diagnostic settings
- Logs

Architecture

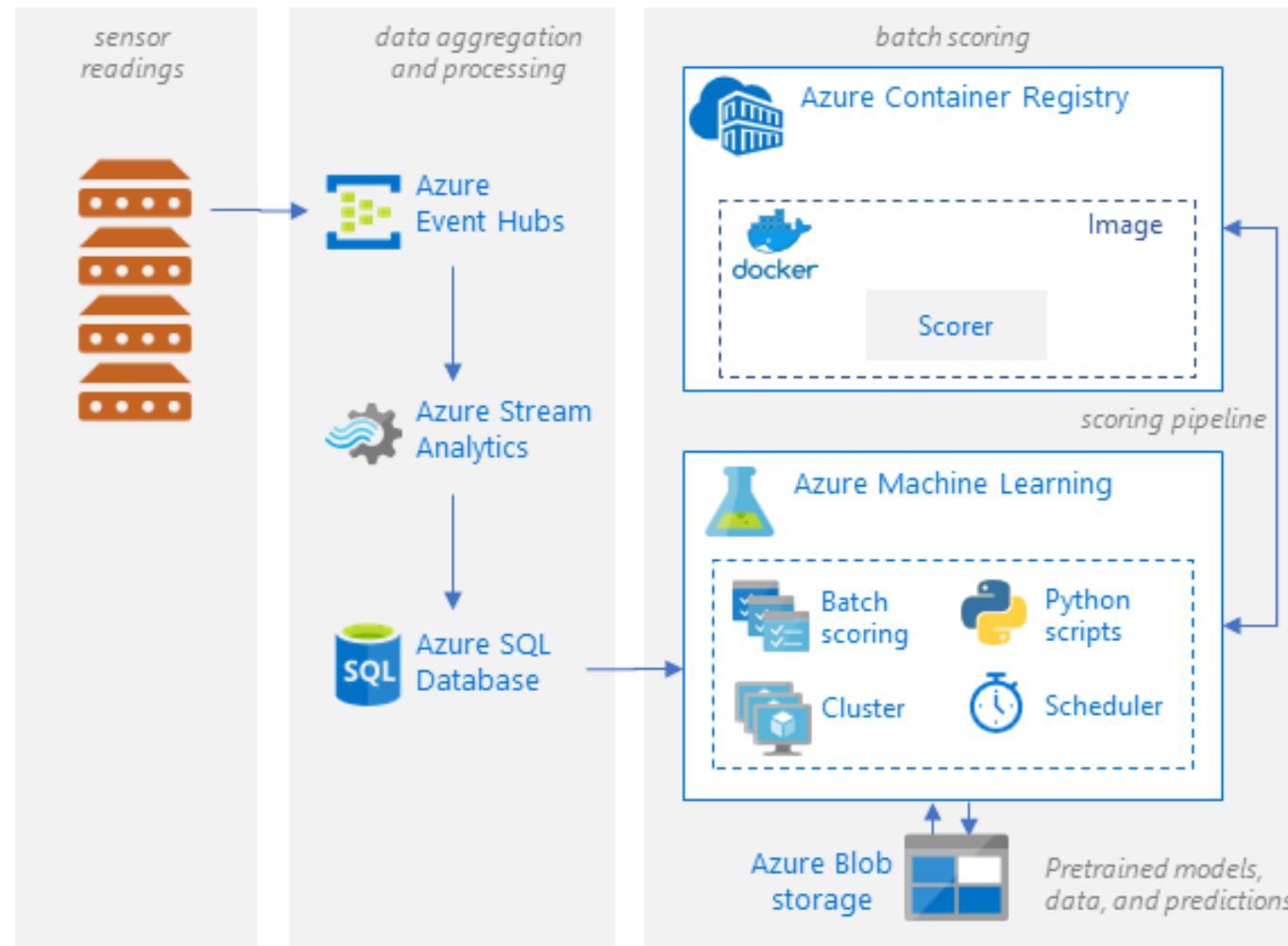
# Training Python



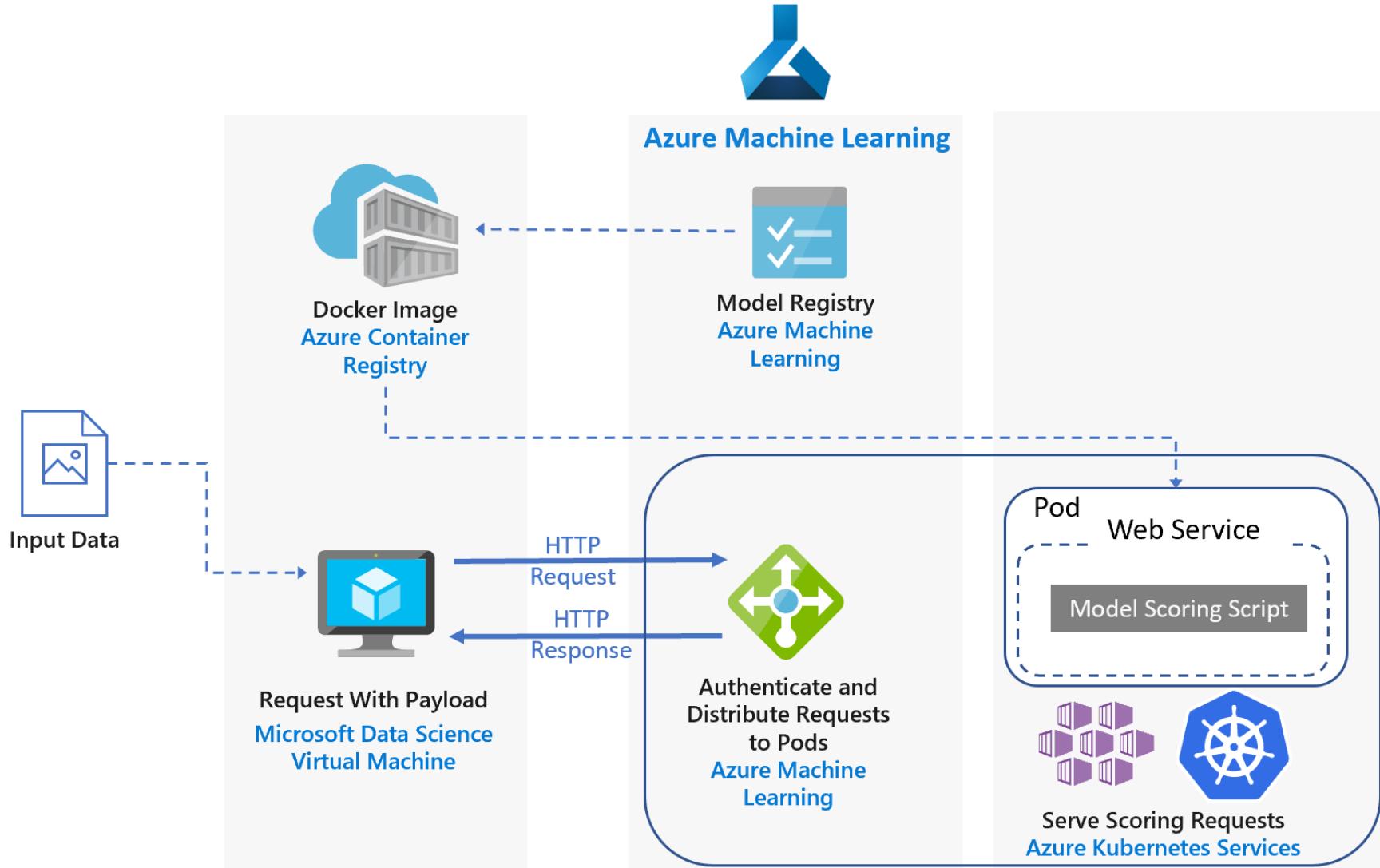
# Deep Learning



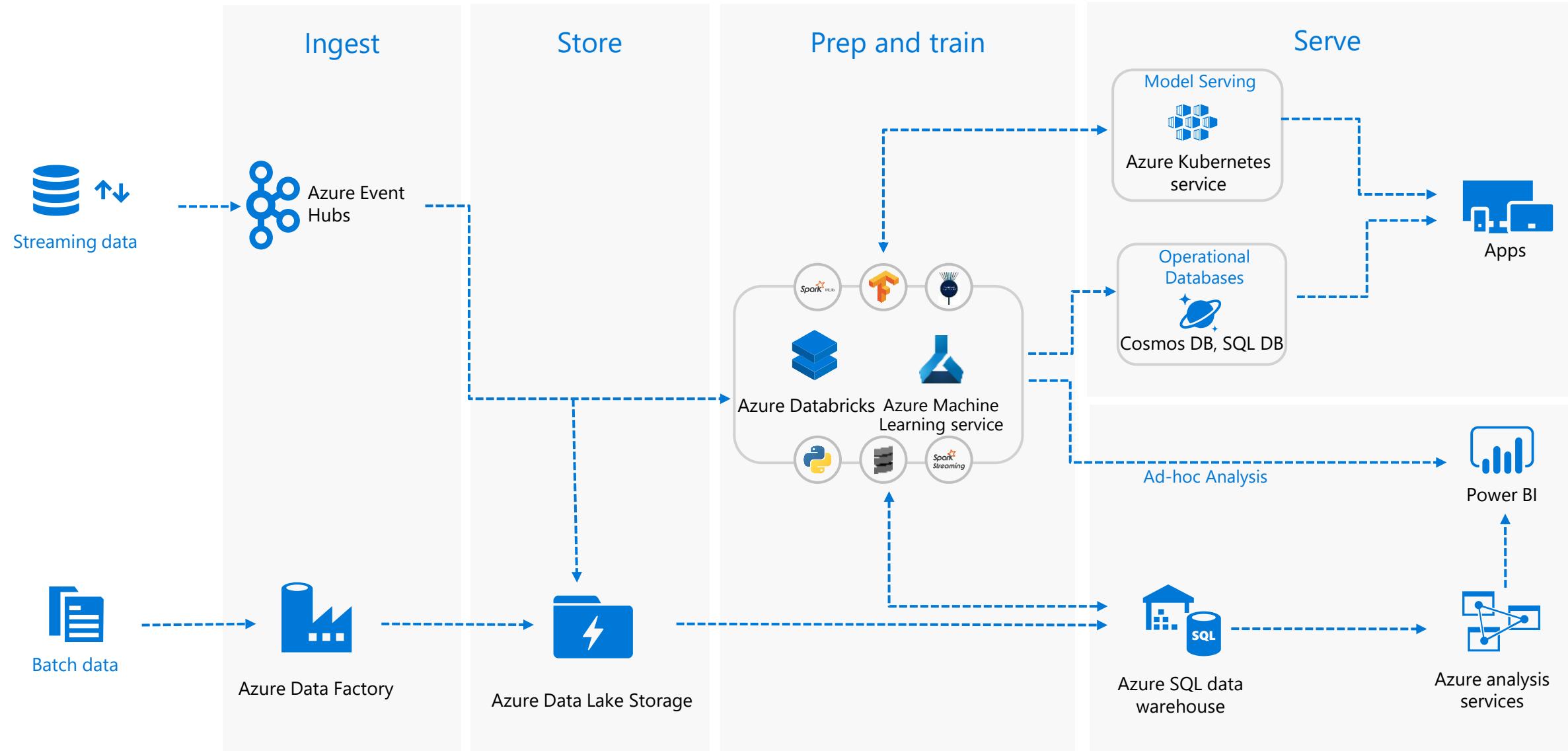
# Batch scoring of Python models



# Real time scoring



# Azure Databricks + Azure ML



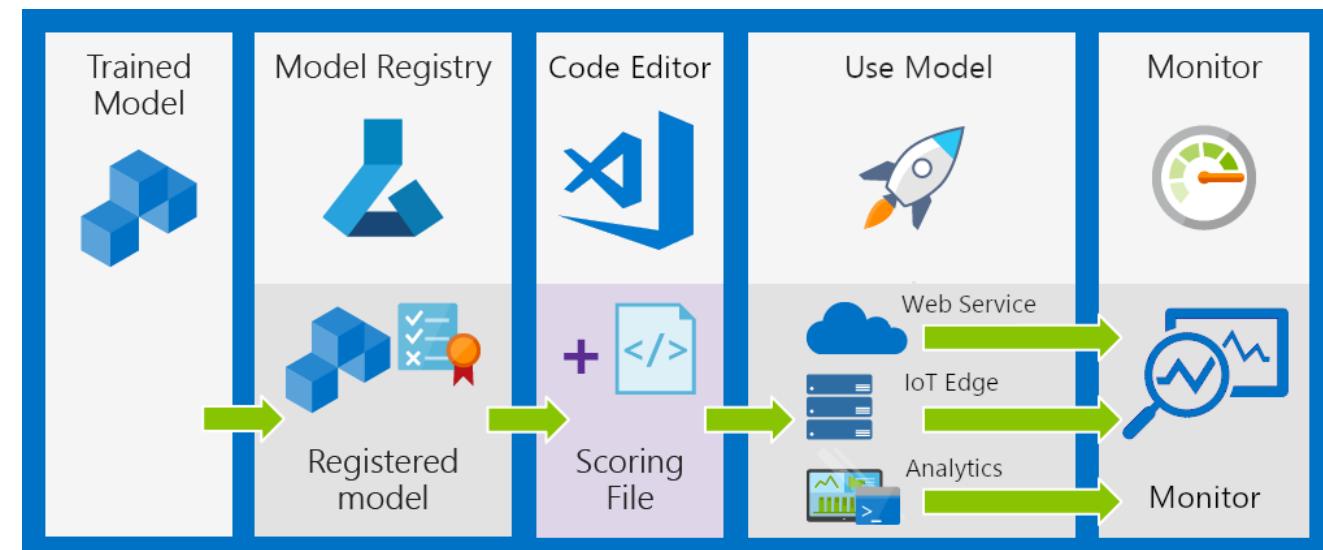
## Deployment scenarios



# 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>

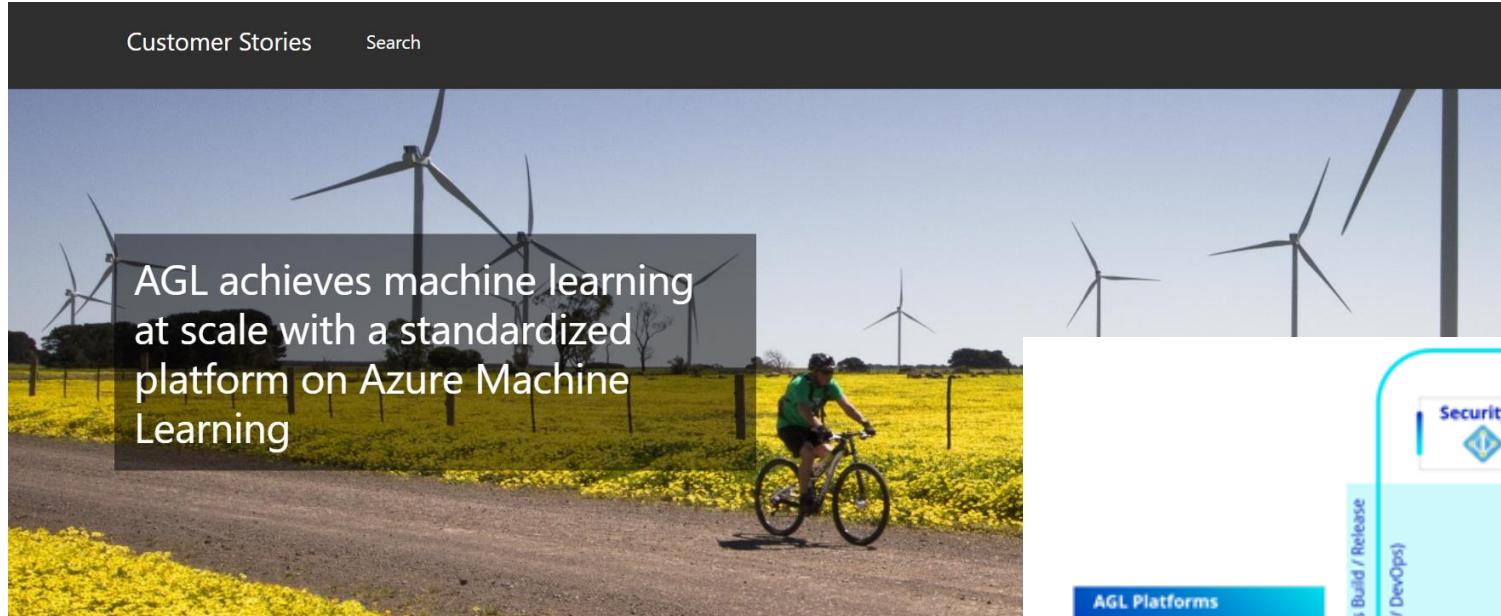
Some references



Azure Machine Learning

# AGL

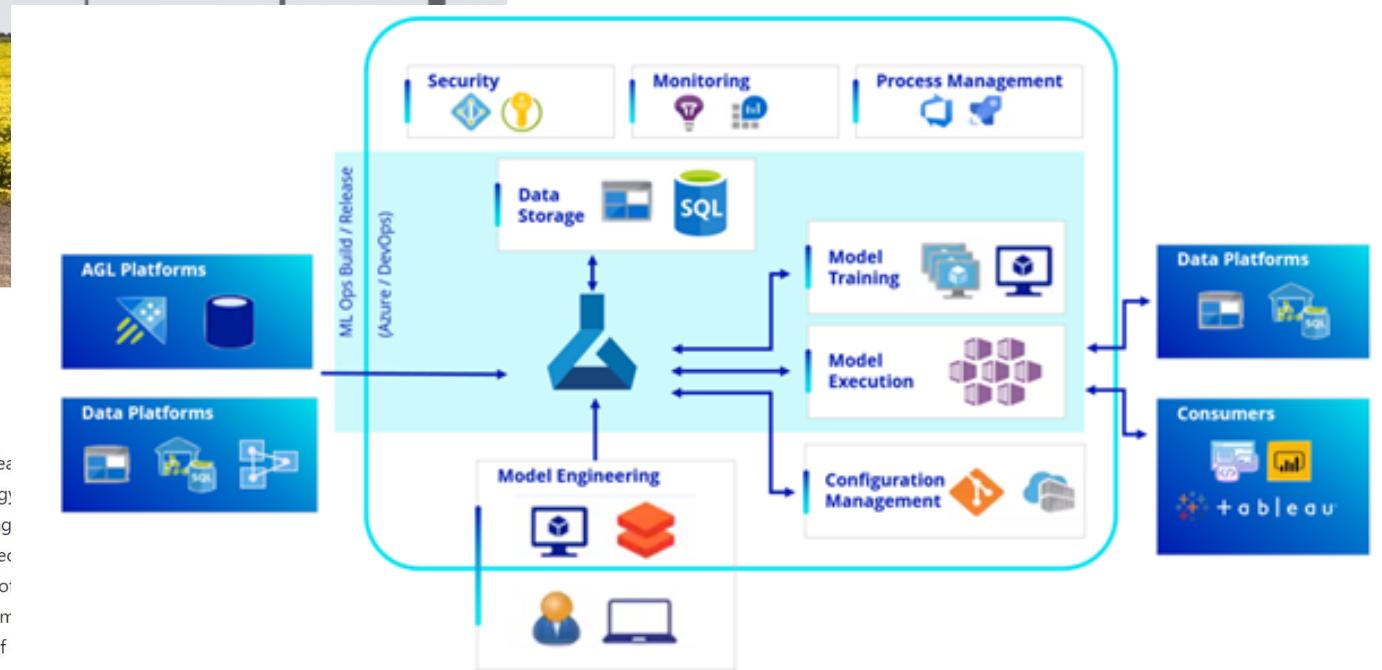
<https://customers.microsoft.com/en-us/story/844796-agl-energy-azure>



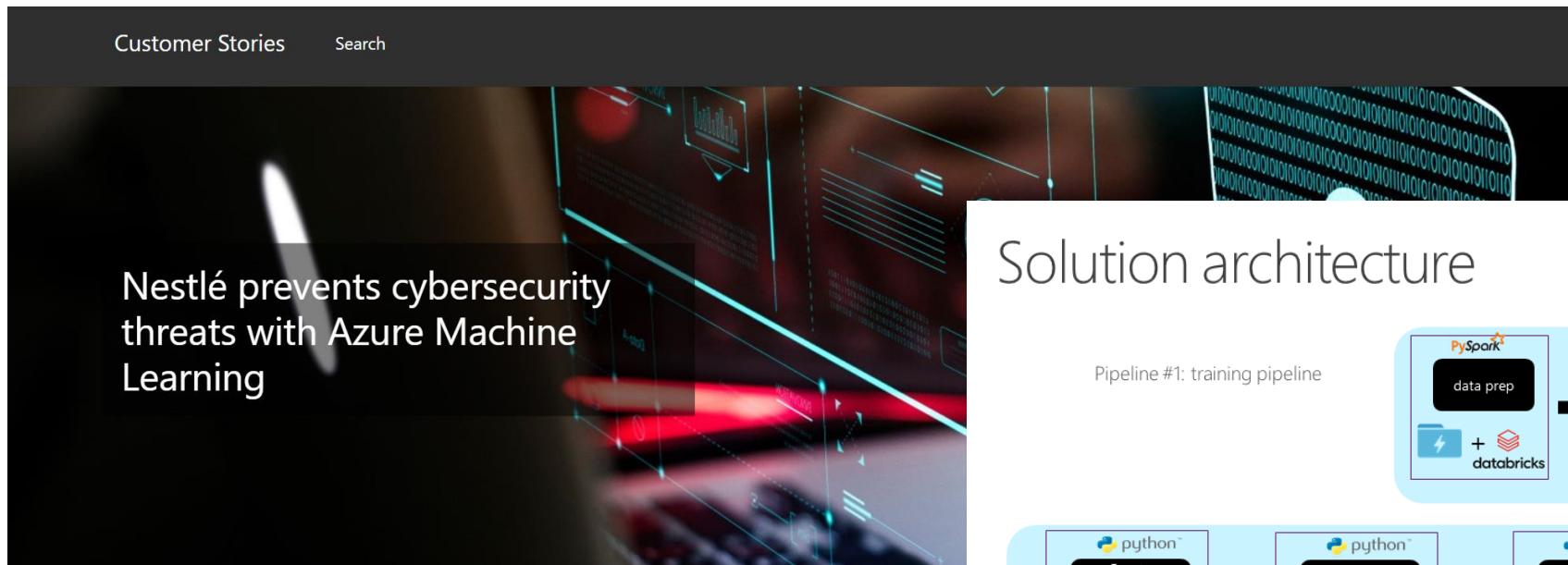
AGL achieves machine learning at scale with a standardized platform on Azure Machine Learning

September 22, 2020

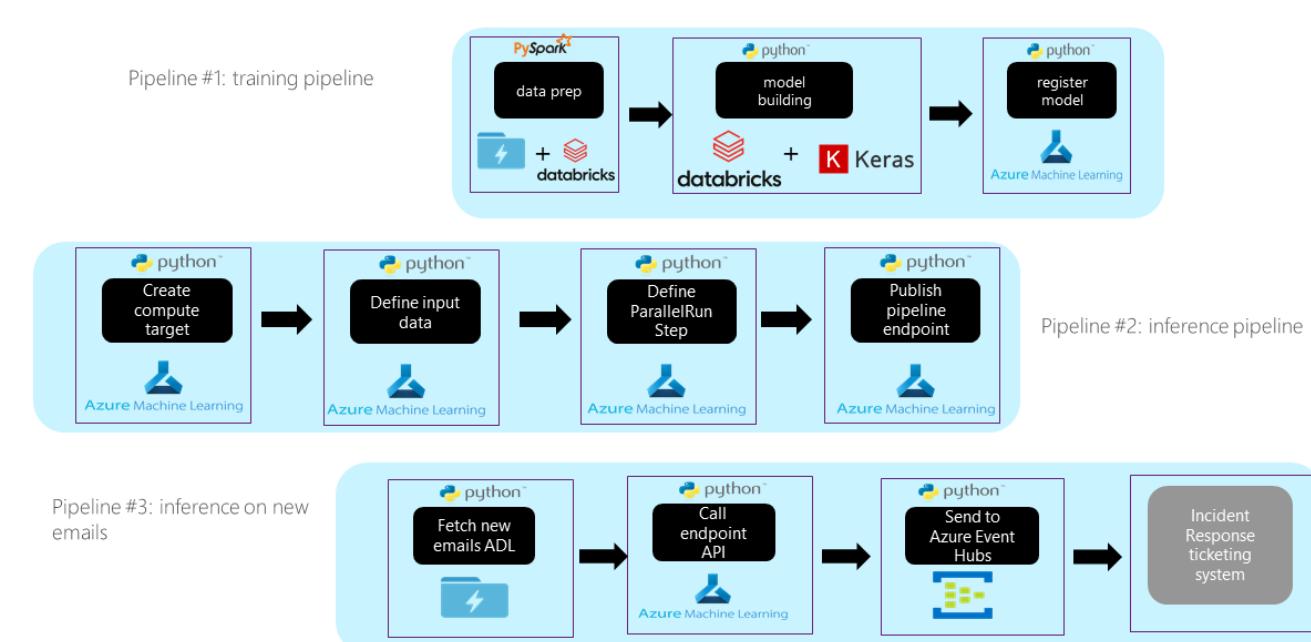
For more than 180 years, AGL has been a leading private investors in renewable energy technologies. But when its machine learning thousands of customized models simultaneously. Learning. AGL's Data and Analytics Center of Databricks to create a standardized platform and lifecycle management for thousands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



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



## Solution architecture

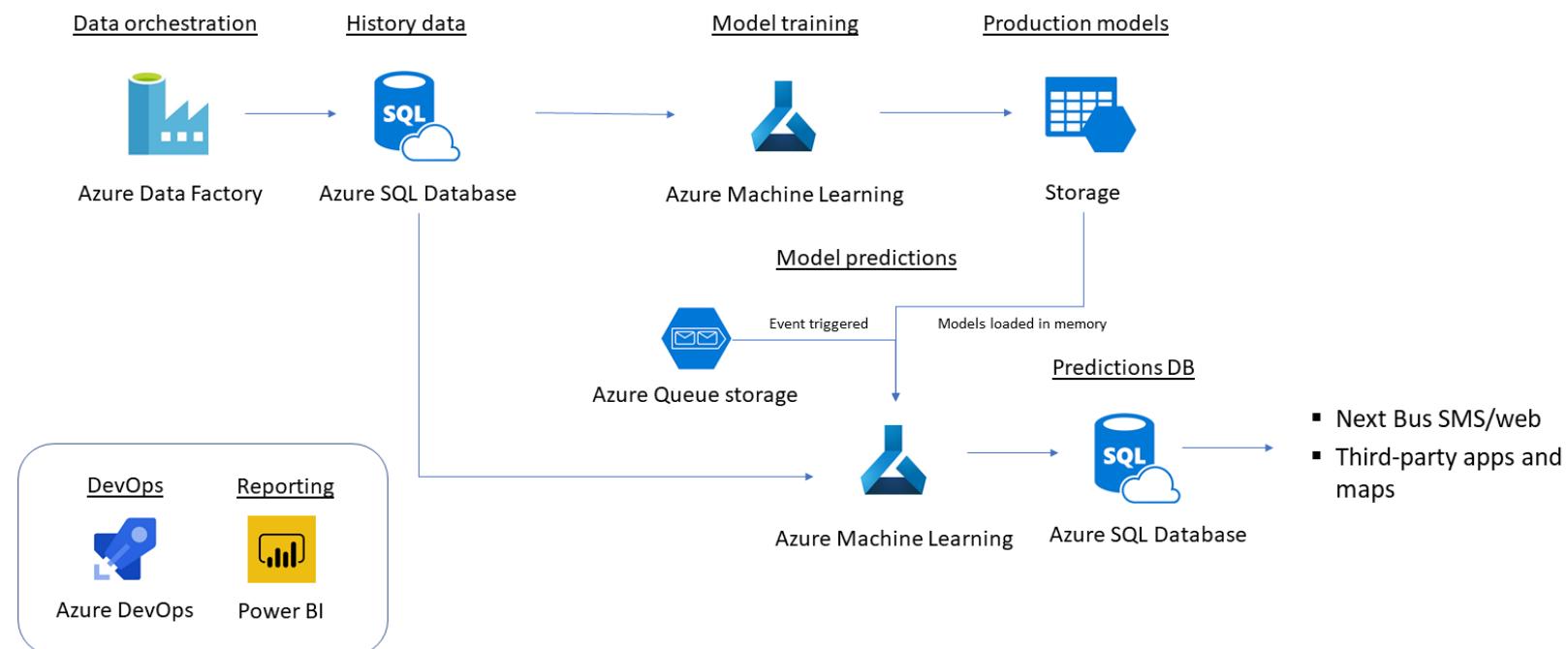




Azure Machine Learning

# 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>



Documentation



Azure Machine Learning

# Microsoft Learn

# Azure ML training



10800 XP

## 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

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

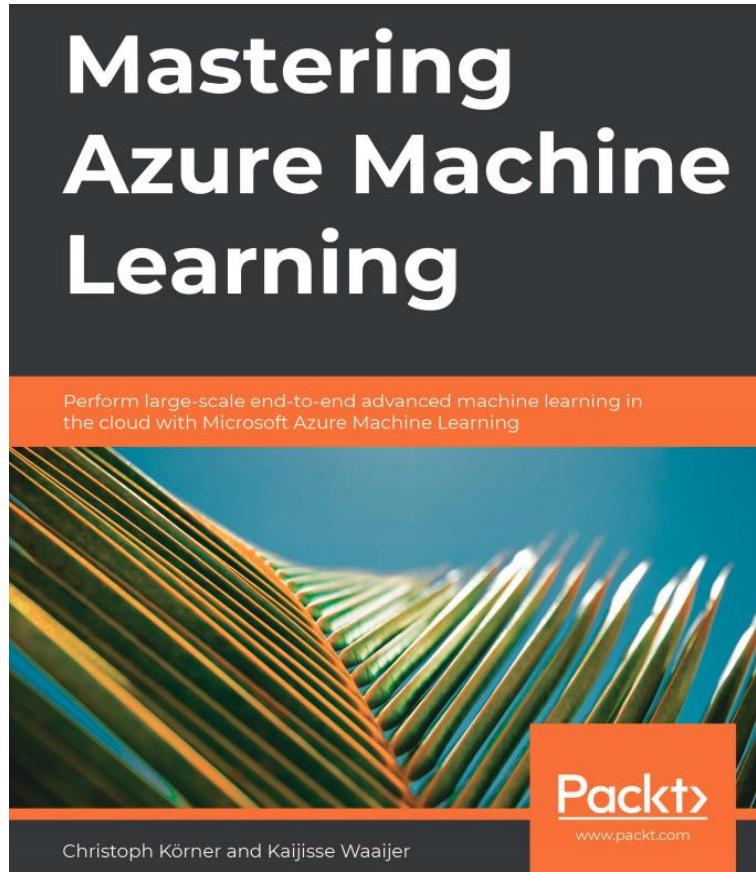
<https://docs.microsoft.com/en-us/learn/patterns/build-ai-solutions-with-azure-ml-service/>



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:

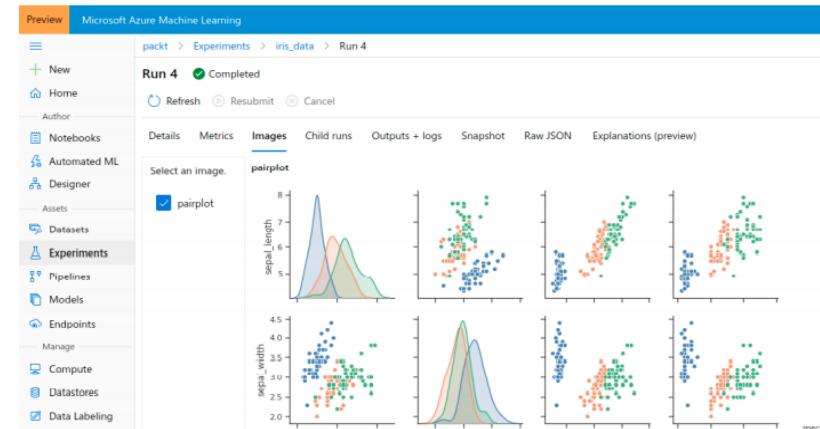


Figure 3.11: The Images tab, showing a pairplot in the Azure Machine Learning workspace

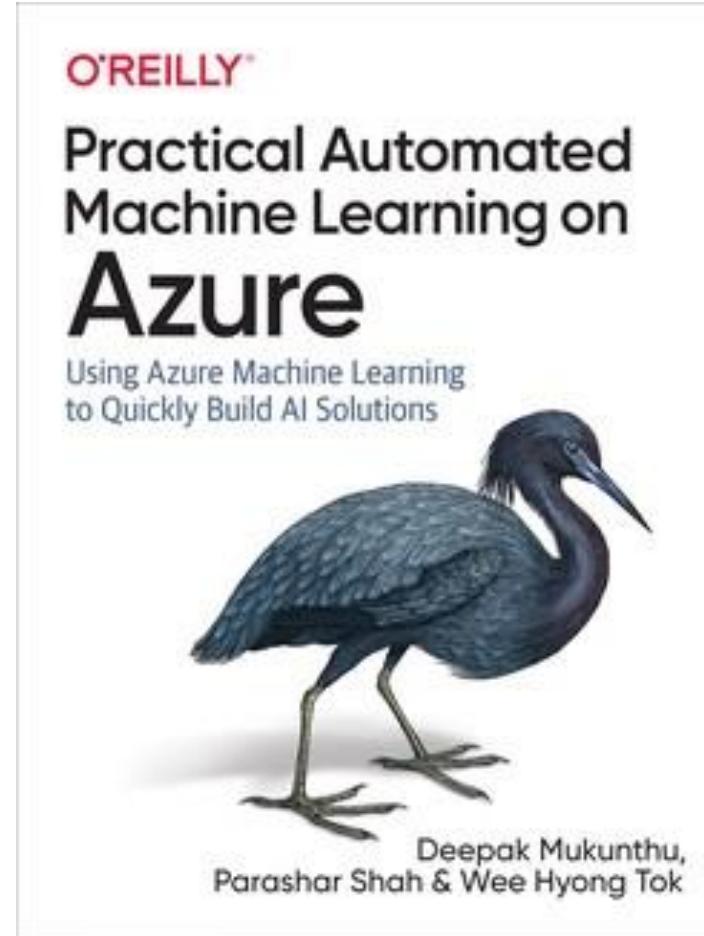
Code: <https://github.com/PacktPublishing/Mastering-Azure-Machine-Learning>



Azure Machine Learning

# AutoML with Azure Book

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



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

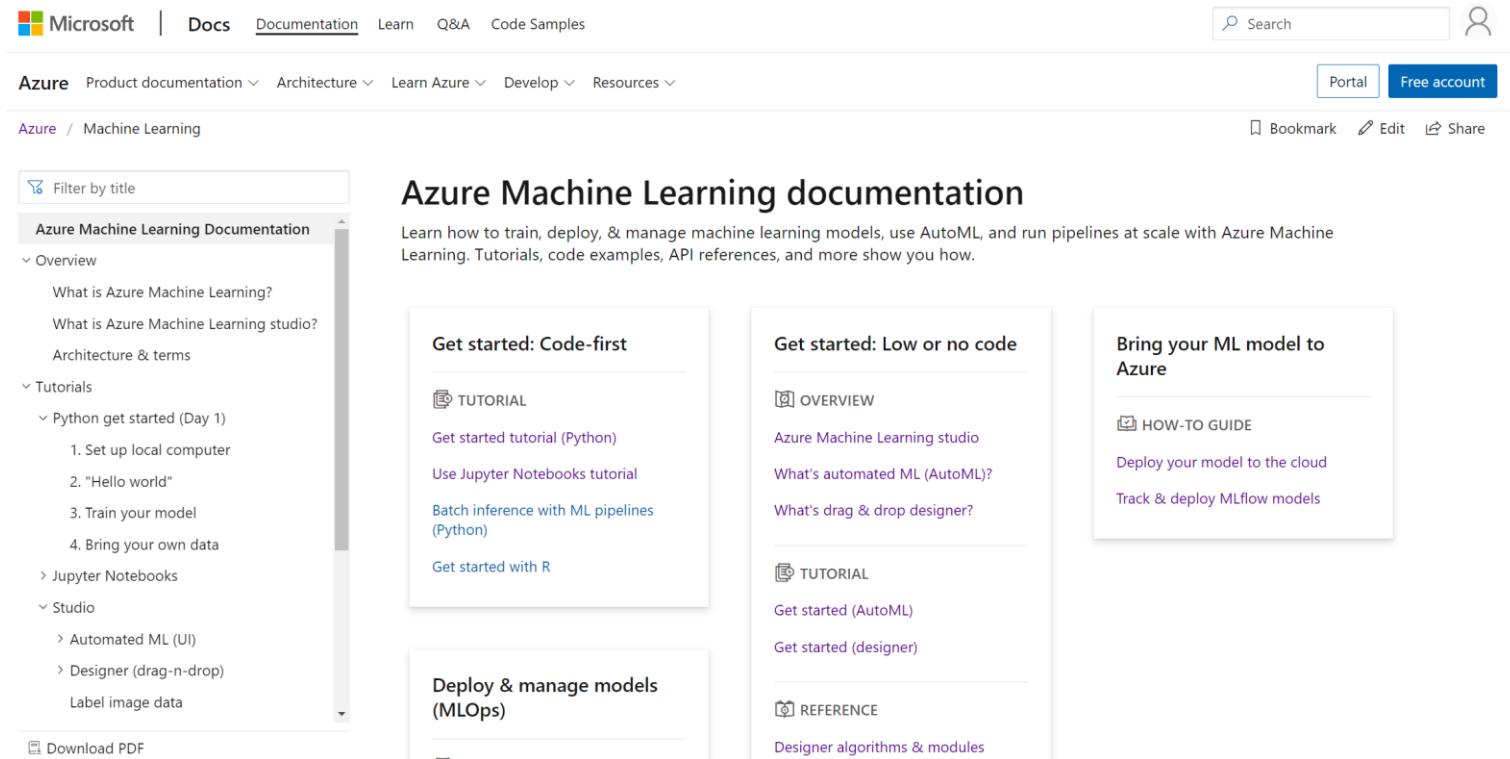
# Azure ML documentation



Azure Machine Learning

## Documentation

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



The screenshot shows the Microsoft Docs website for Azure Machine Learning. The top navigation bar includes links for Microsoft, Docs, Documentation (which is underlined), Learn, Q&A, and Code Samples. A search bar and account options (Portal, Free account) are also present. The main content area has a breadcrumb trail: Azure / Machine Learning. On the left, there's a sidebar with a 'Filter by title' dropdown and a list of topics under 'Azure Machine Learning Documentation'. The main content area features several cards: 'Get started: Code-first' (with TUTORIAL, Get started tutorial (Python), Use Jupyter Notebooks tutorial, Batch inference with ML pipelines (Python), and Get started with R), 'Get started: Low or no code' (with OVERVIEW, Azure Machine Learning studio, What's automated ML (AutoML), and What's drag & drop designer?), 'Deploy & manage models (MLOps)' (with TUTORIAL, Get started (AutoML), Get started (designer), and REFERENCE, Designer algorithms & modules), and a 'Bring your ML model to Azure' section (with HOW-TO GUIDE, Deploy your model to the cloud, and Track & deploy MLflow models).

Microsoft | Docs Documentation Learn Q&A Code Samples

Search

Azure Product documentation ▾ Architecture ▾ Learn Azure ▾ Develop ▾ Resources ▾

Portal Free account

Azure / Machine Learning

Filter by title

Azure Machine Learning Documentation

Overview

- What is Azure Machine Learning?
- What is Azure Machine Learning studio?
- Architecture & terms

Tutorials

- Python get started (Day 1)
  - Set up local computer
  - "Hello world"
  - Train your model
  - Bring your own data
- Jupyter Notebooks
- Studio
  - Automated ML (UI)
  - Designer (drag-n-drop)
  - Label image data

Download PDF

## Azure Machine Learning documentation

Learn how to train, deploy, & manage machine learning models, use AutoML, and run pipelines at scale with Azure Machine Learning. Tutorials, code examples, API references, and more show you how.

### Get started: Code-first

- TUTORIAL  
Get started tutorial (Python)
- Use Jupyter Notebooks tutorial
- Batch inference with ML pipelines (Python)
- Get started with R

### Get started: Low or no code

- OVERVIEW  
Azure Machine Learning studio
- What's automated ML (AutoML)?
- What's drag & drop designer?

### Deploy & manage models (MLOps)

- TUTORIAL  
Get started (AutoML)
- Get started (designer)

### Bring your ML model to Azure

- HOW-TO GUIDE  
Deploy your model to the cloud
- Track & deploy MLflow models

Bookmark Edit Share



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...)

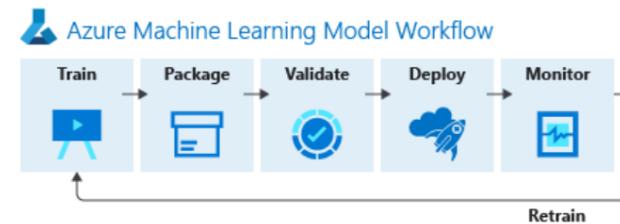
<https://github.com/Azure/MachineLearningNotebooks/>



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 ML demos Materials





**Serge Retkowsky**

[retkowsky](#)

Global Black Belt Data & AI - Microsoft  
France

[Edit profile](#)

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 Microsoft

 Paris France

 serge.retkowsky@microsoft.com

 <https://www.linkedin.com/in/serger/>

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 [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 ▾](#)

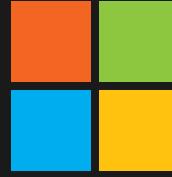
<https://github.com/retkowsky>



# Azure ML Demo



**Q&A**



# Microsoft Azure

---

Be future  
ready

Build on  
your terms

Operate hybrid  
seamlessly

Trust  
your cloud