



Azure ML workshop

Vendredi 28 février 2020



Vos interlocuteurs

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Azure AI Overview: Machine Learning options in Azure



54+
Azure regions
worldwide

>90
Compliance
certifications

Machine Learning on Azure

Domain specific pretrained models

To simplify solution development



Vision



Speech



Language



Search

Familiar Data Science tools

To simplify model development



Visual Studio Code



Azure Notebooks



Jupyter



Command line

Popular frameworks

To build advanced deep learning solutions



PyTorch



TensorFlow



Scikit-Learn



ONNX

Productive services

To empower data science and development teams



Azure
Databricks



Azure
Machine
Learning



Machine
Learning VMs

Powerful infrastructure

To accelerate deep learning



CPU



GPU



FPGA



From the Intelligent Cloud to the Intelligent Edge





Azure Cognitive Services

Azure Cognitive Services

Deploy and run as a cloud service or anywhere as a container

5B

transactions a
month



Vision



Speech



Web Search



Language



Decision

Sophisticated pretrained models

Infuse apps with powerful, pre-trained AI models

Customize easily and tailor to your needs



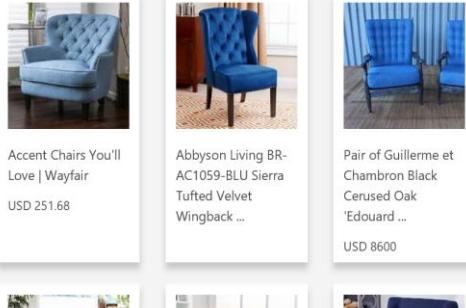
Vision



[Computer Vision](#) | [Video Indexer](#) | [Face](#) | [Content Moderator](#)



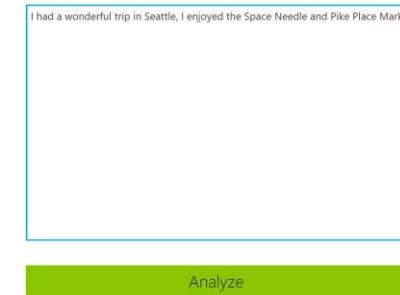
Bing
Search



[Big Web Search](#) | [Video Search](#) | [Image Search](#) | [Visual Search](#) | [Entity Search](#) |
[News Search](#) | [Autosuggest](#)



Language



[Text Analytics](#) | [Spell Check](#) | [Language Understanding](#) | [Text Translation](#) | [QnA Maker](#)

Analyzed text

JSON

Languages:

English (confidence: 100 %)

Key Phrases:

Sentiment:

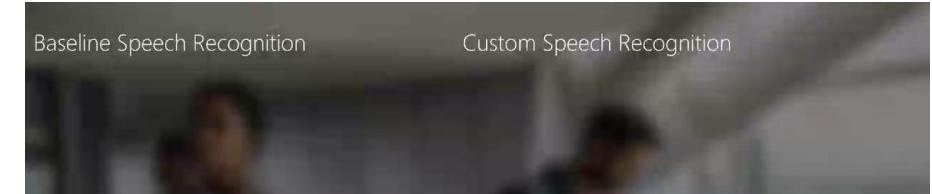
73 %

Linked Entities (Preview):

a



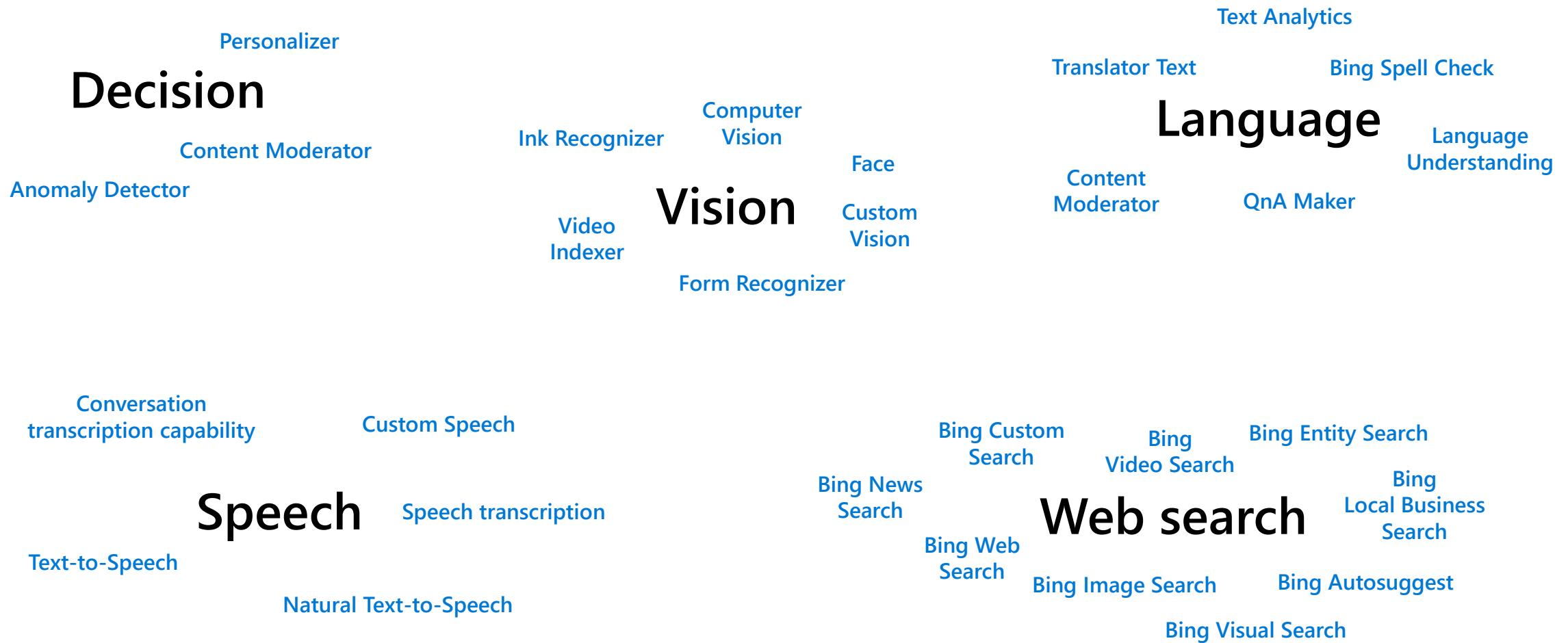
Speech



[Speech to Text](#) | [Text to Speech](#) | [Speech Translation](#) | [Speaker Recognition](#)

Azure Cognitive Services

The most comprehensive pre-trained AI





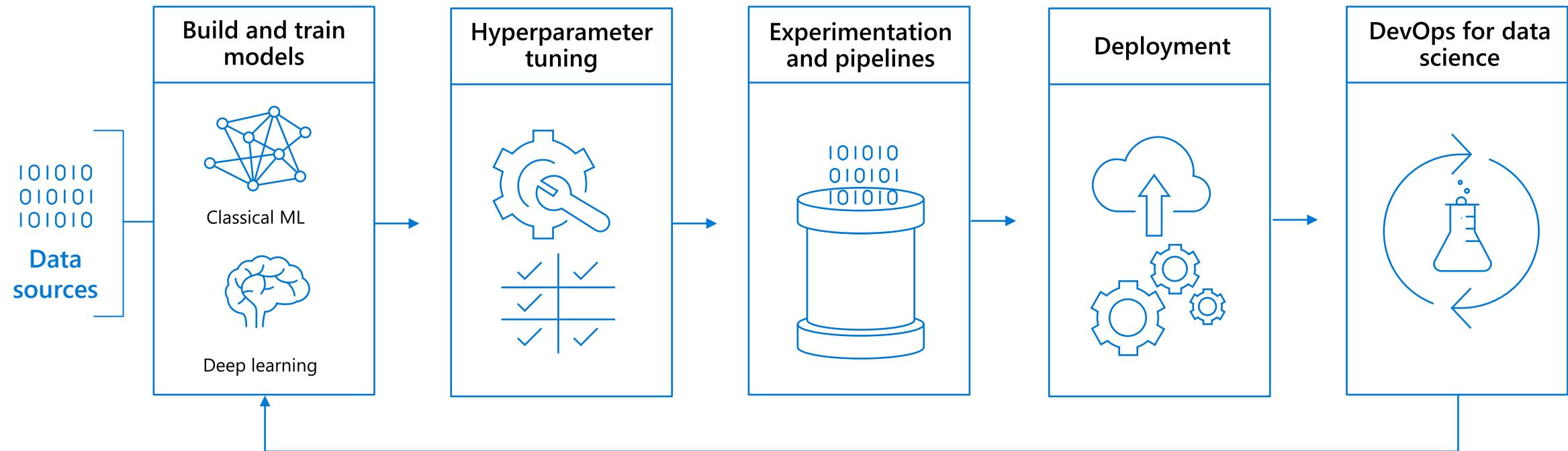
Azure ML Technical Overview



Azure Machine Learning

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

Building blocks for a Data Science Project



Azure Machine Learning

Set of Azure Cloud
Services



Python
SDK & R

That enables you to:

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

Composants Azure ML

Azure Machine Learning components

Experience

SDK, Notebooks, Drag-n-drop, Wizard

MLOps

Reproducible, Automatable, GitHub, CLI, REST

Datasets

Profiling, Drift, Labeling

Training

Experiments, Runs

Model Registry

Models, Images

Inferencing

Batch, Realtime



Compute

Jobs, Clusters, Instances

Azure IoT Edge

Security, Mgmt., Deployment



Cloud

CPU, GPU, FPGA



Edge

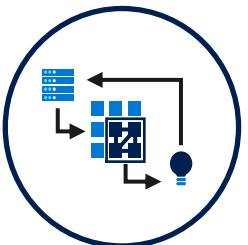
CPU, GPU, NPU



Azure Machine Learning



For all skill levels



Industry leading MLOps



Open & Interoperable

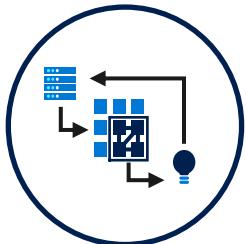


Trusted

Azure Machine Learning



For all skill levels



Industry leading MLOps



Open & Interoperable



Trusted

Access machine learning for all skills and boost productivity.

Rapidly build and deploy machine learning models using tools that meet your needs regardless of skill level. Use the no-code designer to get started with machine learning or use built-in Jupyter notebooks for a code first experience. Accelerate model creation with the automated machine learning UI and access built-in feature engineering, algorithm selection, and hyperparameter sweeping, to develop high accuracy models.

Operationalize at scale with robust MLOps.

MLOps or DevOps for machine learning, streamlines the machine learning lifecycle, from building models to deployment and management. Use ML pipelines to build repeatable workflows and use a rich model registry to track your assets. Manage production workflows at scale using advanced alerts and automation capabilities. Profile, validate and deploy machine learning models anywhere from the cloud to the edge.

Innovate on an open and interoperable platform.

Take advantage of built-in support for popular open-source tools and frameworks for model training and inferencing. Use familiar frameworks like PyTorch, TensorFlow, scikit-learn and more, or the open and interoperable ONNX format. Choose the development tools that best meet your needs, including popular IDEs, Jupyter notebooks and CLIs or languages like Python and R. After you've built and trained your model, use ONNX Runtime to optimize and accelerate inferencing across cloud and edge devices.

Build responsible AI solutions on a secure trusted platform.

Access state-of-the-art technology for fairness and model transparency. Use model interpretability for explanations about predictions, to better understand model behavior. Reduce model bias by applying common fairness metrics, automatically making comparisons and using recommended mitigations. Enterprise-grade security with role-based access control, and virtual network support to protect your assets. Audit trail, quota and cost management capabilities for advanced governance and control.

Azure Machine Learning

For all skill levels
studio web experience

The screenshot shows the Azure Machine Learning studio web interface. The left sidebar has a 'Home' tab selected. The main area displays a welcome message and four quick-start cards: 'Create new' (with a plus icon), 'Notebooks' (with a document icon), 'Automated ML' (with a lightning bolt and gear icon), and 'Designer' (with a 3D cube icon). Below these are sections for 'My recent resources' (Runs table) and 'Compute' (Compute table).

workshop-aml-2020 > Home

Welcome to the studio!

Create new

Notebooks

Code with Python SDK and run sample experiments.

Start now

Automated ML

Automatically train and tune a model using a target metric.

Start now

Designer

Drag-and-drop interface from prepping data to deploying models.

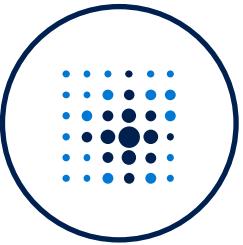
Start now

My recent resources

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

Compute

Name
AKSML



AutoML

Azure Machine Learning accelerates model development

with automated machine learning

Input

Intelligently test multiple models in parallel

101010
010101
101010

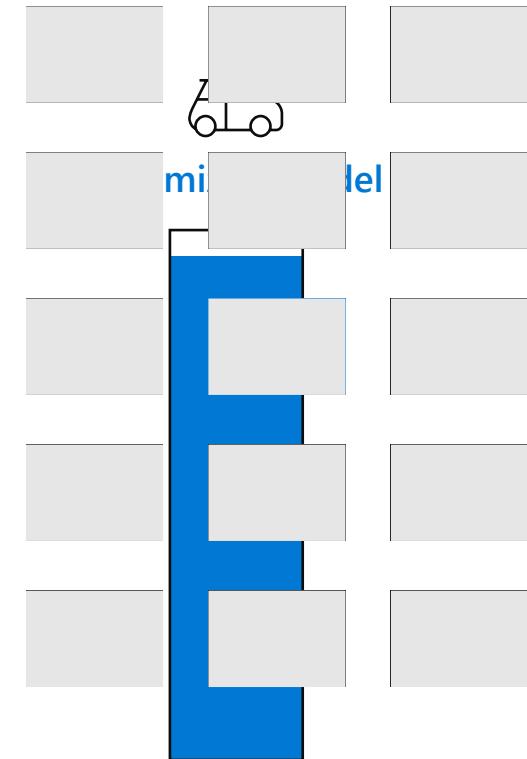
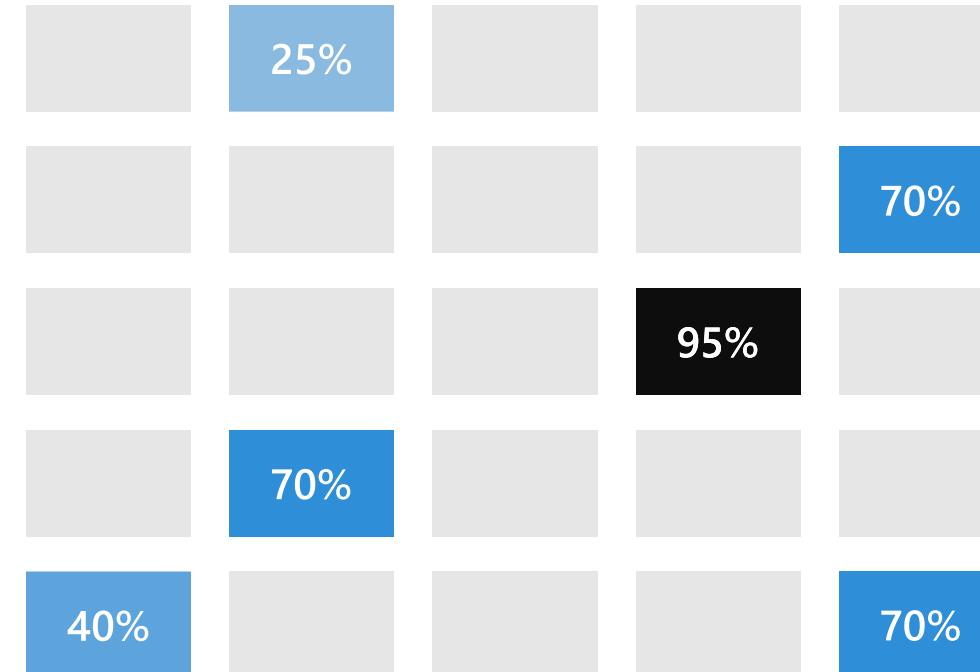
Enter data



Define goals



Apply constraints



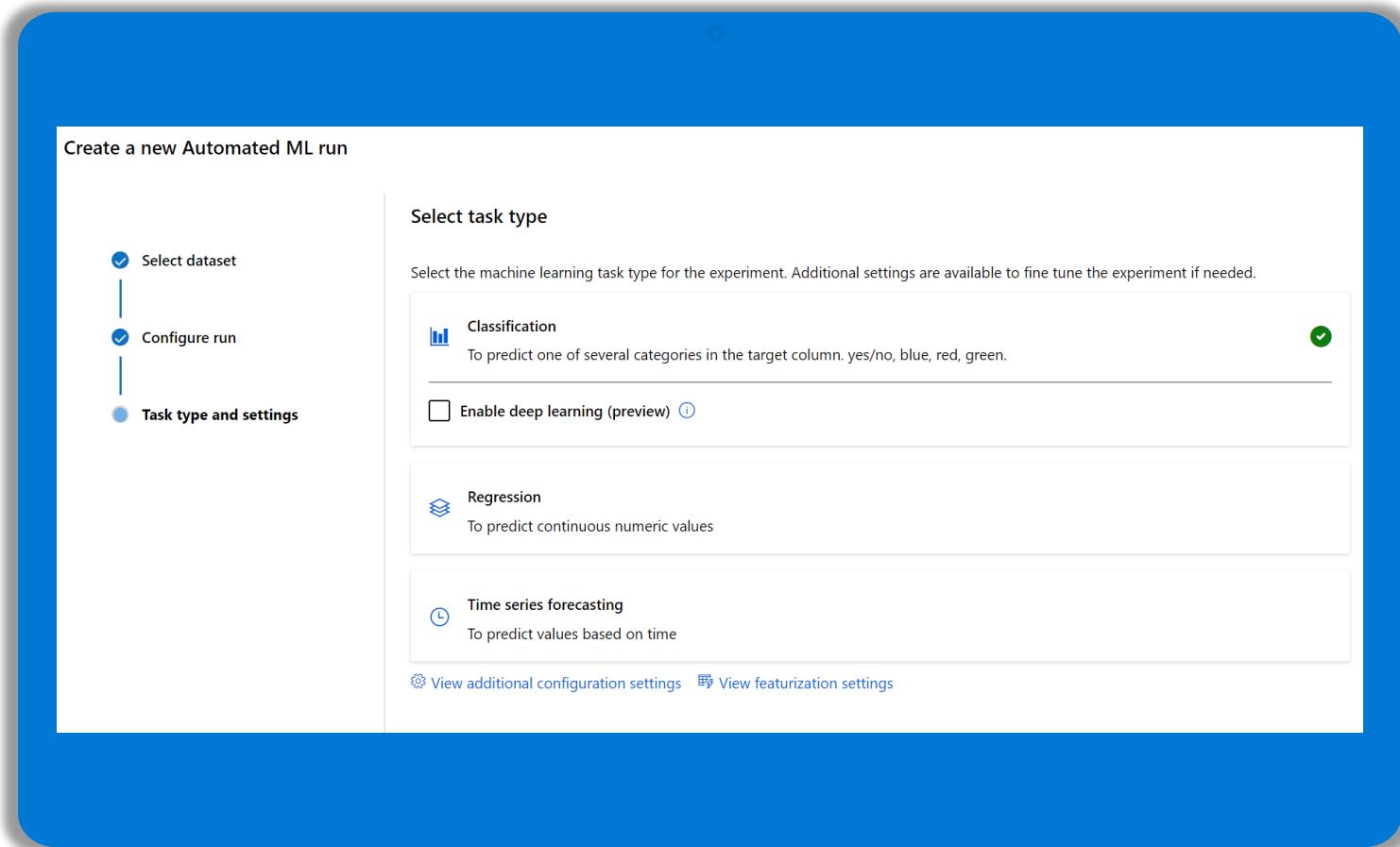
Automated ML

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.



Automated Machine Learning

What's new

Automated ML UI

New look & feel

Datasets integration: more data sources supported

Featurizer customization

Out-of-the-box model explainability

Automated ML SDK

Deep learning

Text Classification with BERT (GPU) & BiLSTM (CPU)

Time series forecasting with ForecastTCN & HyperDrive

Automatic feature engineering

Customizable featurization

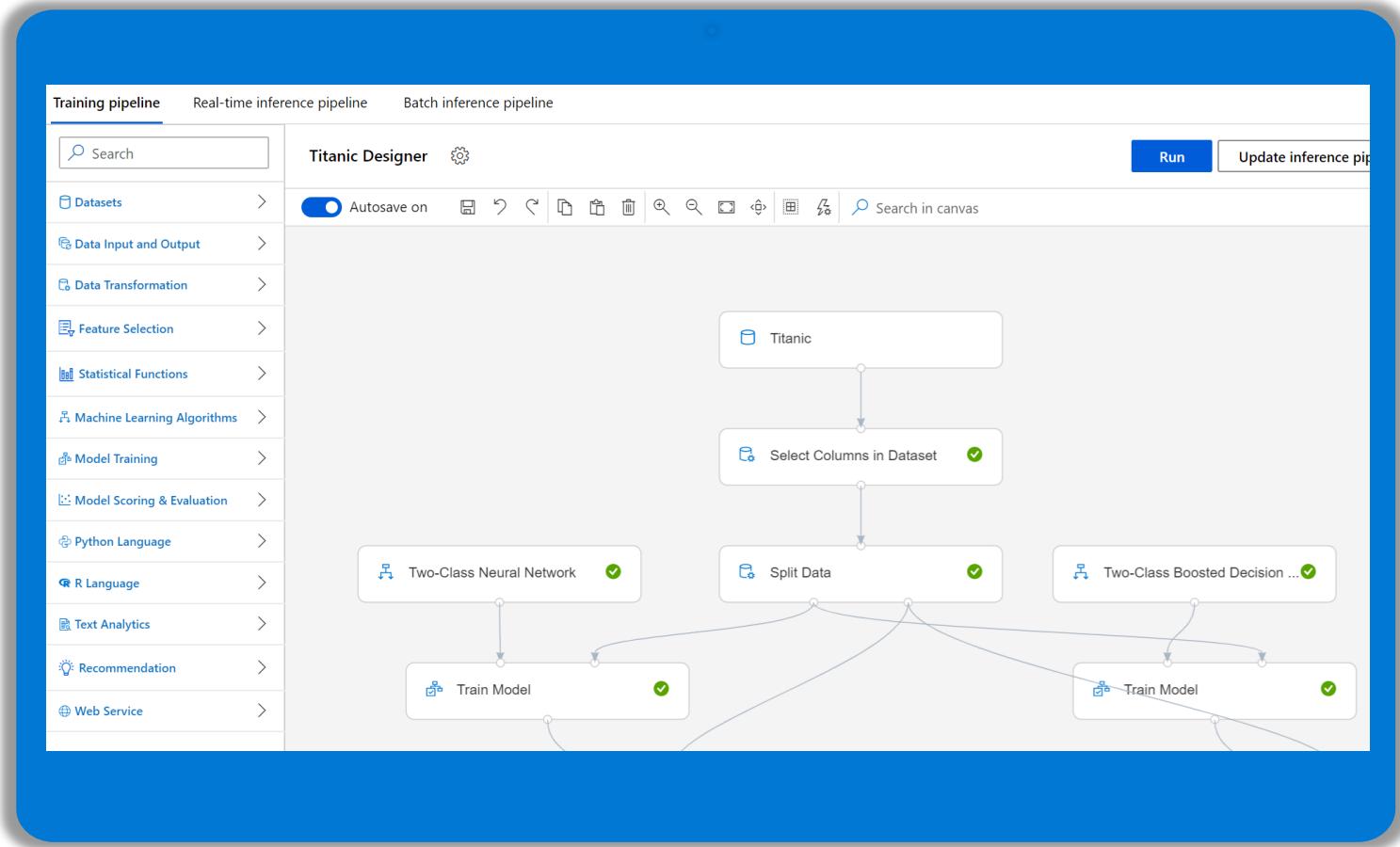
Feature transparency: retrieve generated features

Algorithm name	Accuracy ↓	Created	Duration	Status	Model
VotingEnsemble	0.8327340823970036	Feb 14, 2020 11:02 AM	00:02:32	Completed	Download
StandardScalerWrapper, LightGBM	0.8271285892634207	Feb 14, 2020 10:49 AM	00:01:42	Completed	Download
StackEnsemble	0.8249188514357053	Feb 14, 2020 11:02 AM	00:02:48	Completed	Download
StandardScalerWrapper, LightGBM	0.8237702871410736	Feb 14, 2020 10:59 AM	00:01:45	Completed	Download
MaxAbsScaler, LightGBM	0.8215355805243446	Feb 14, 2020 10:48 AM	00:01:39	Completed	Download
MaxAbsScaler, LightGBM	0.819250936329588	Feb 14, 2020 10:55 AM	00:01:42	Completed	Download
MaxAbsScaler, LightGBM	0.8181523096129837	Feb 14, 2020 10:57 AM	00:01:51	Completed	Download
StandardScalerWrapper, LightGBM	0.8148439450686642	Feb 14, 2020 10:45 AM	00:01:37	Completed	Download
MaxAbsScaler, LightGBM	0.8148064918851435	Feb 14, 2020 10:50 AM	00:01:40	Completed	Download
MaxAbsScaler, LightGBM	0.8147815230961297	Feb 14, 2020 10:59 AM	00:01:44	Completed	Download

Designer

Designer

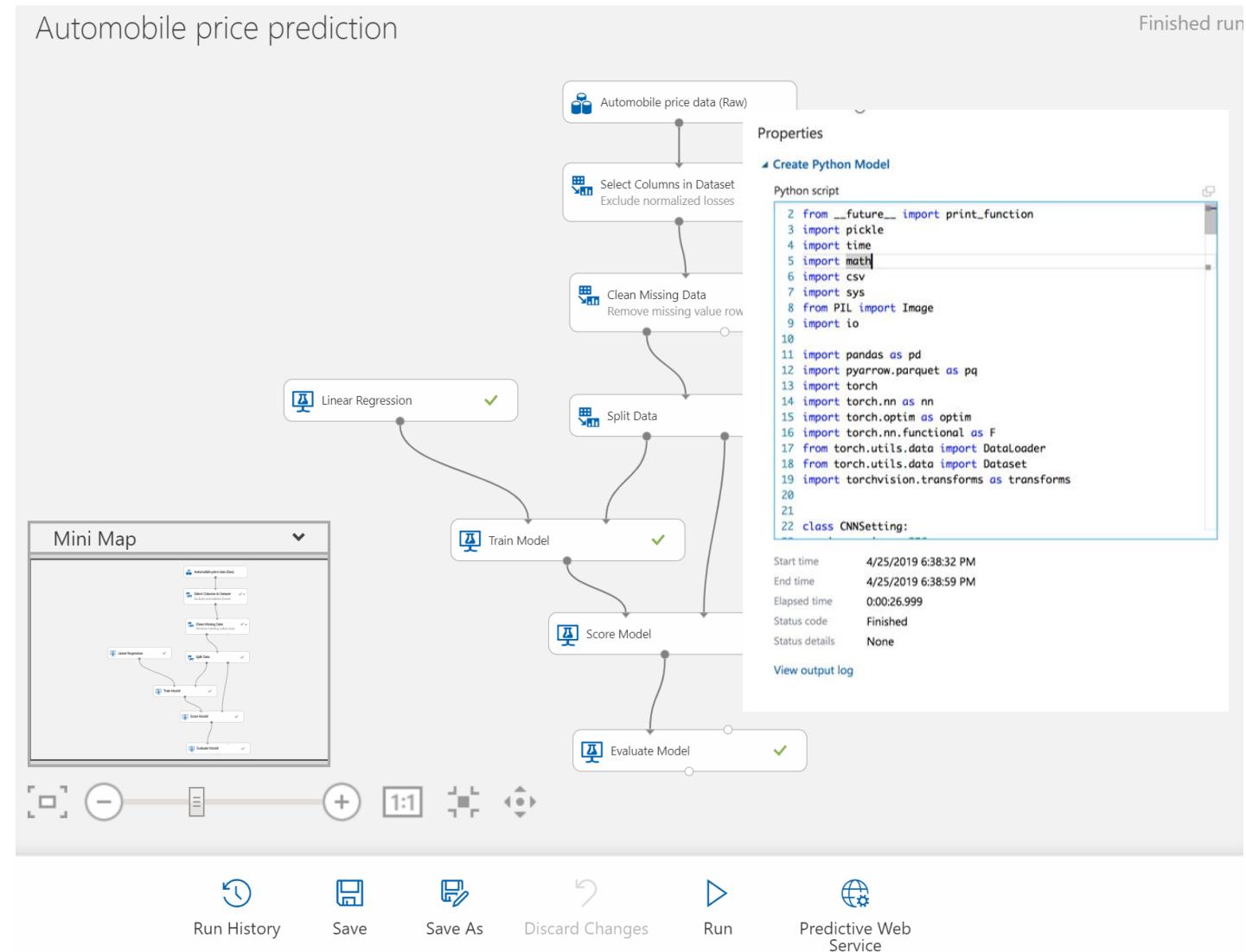
- drag-n-drop workflow capability
- simplify the process of building, testing, and operating machine learning models
- Create new pipelines



Drag and drop modeling with Azure Machine Learning

Designer

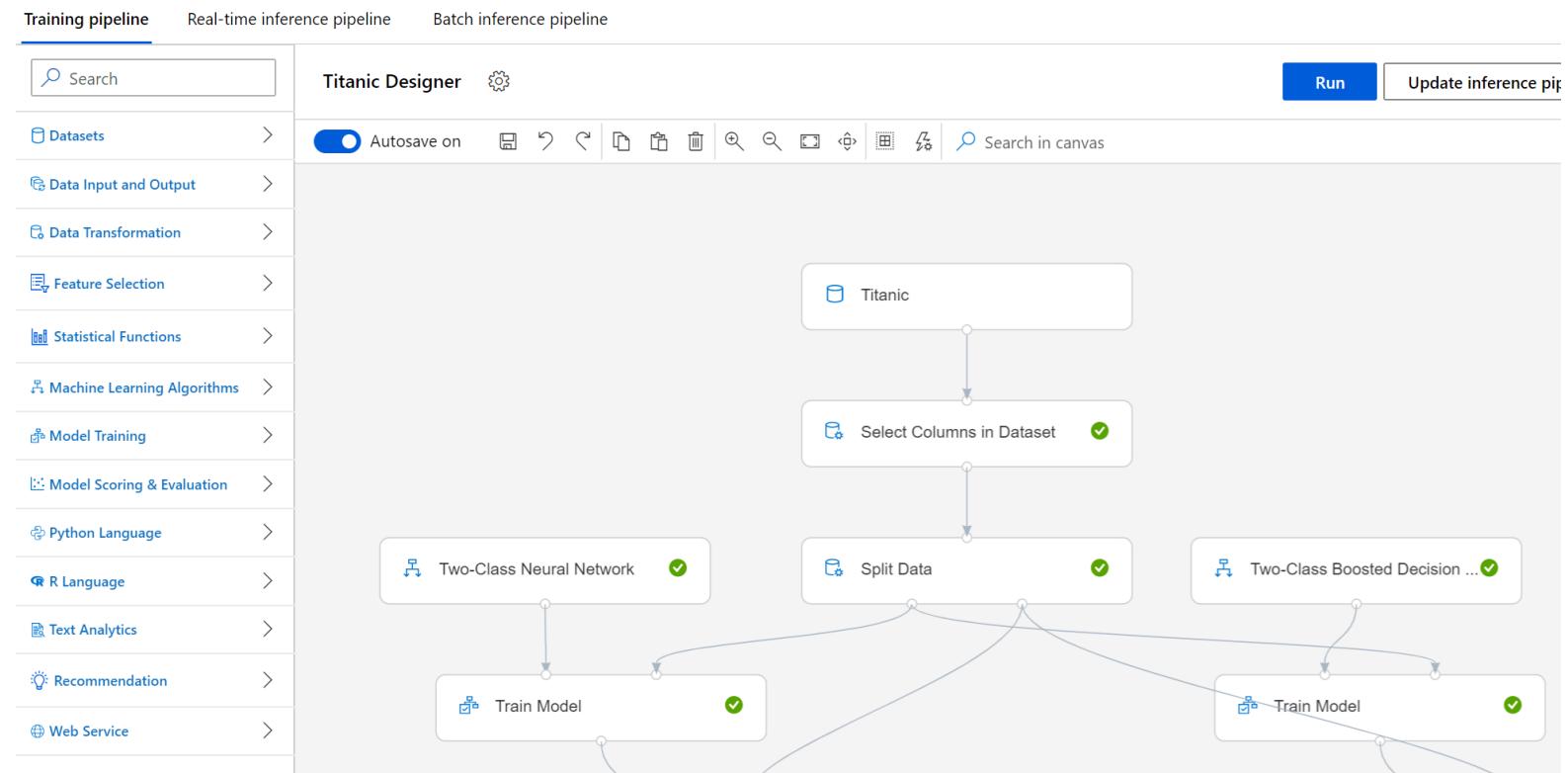
- User built in modules, data visualization, model evaluation
- Automatically generate scoring files, register models and build images using AKS for scale
- Custom code to run Python and R



Machine Learning designer

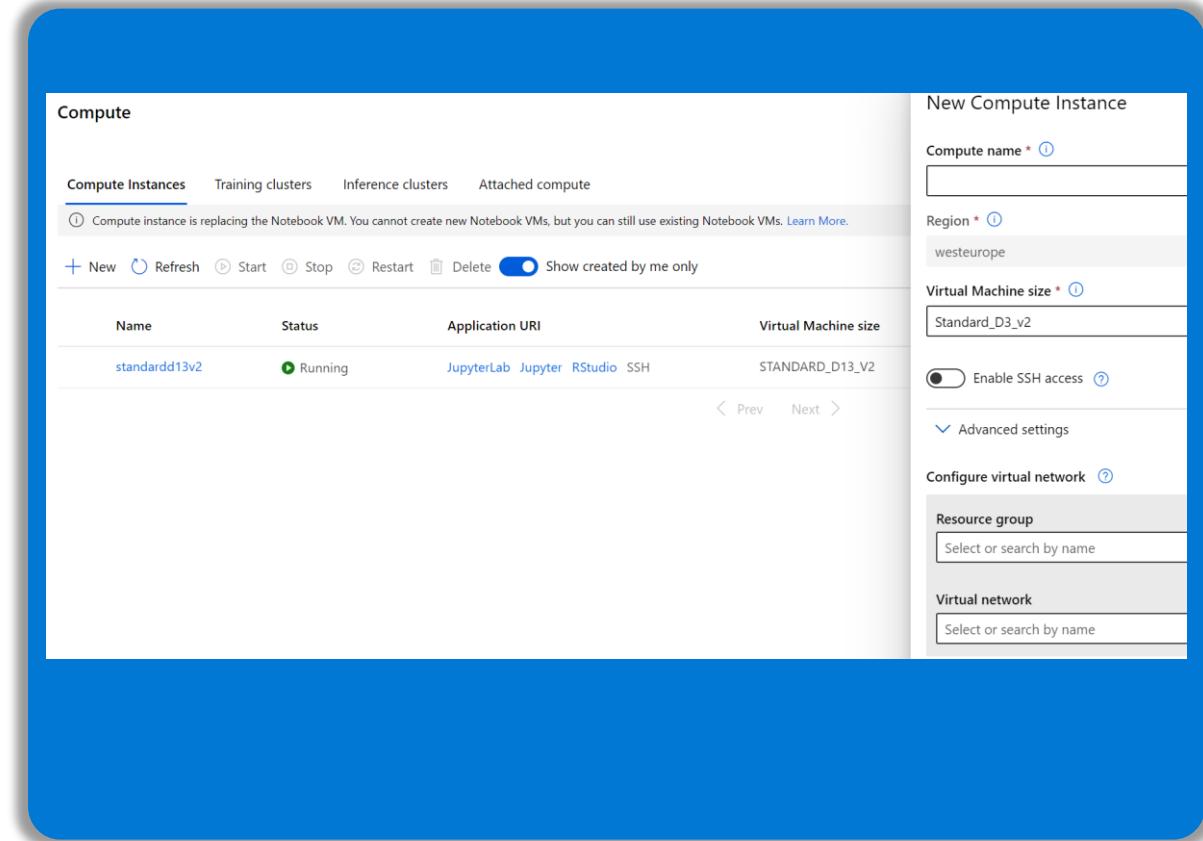
What's new

brings drag-n-drop workflow capability
simplify the process of building,
testing, and operating machine
learning models
Create new pipelines



Machine Learning notebooks

- 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.



Machine Learning Notebooks

What's new in compute instance

Productive

Build and deploy models easily using integrated notebooks and popular tools. Collaboratively debug models and share notebooks within the boundaries of workspace.

Managed and secure

Managed VM form-factor ensures compliance with enterprise security requirements.

Preconfigured for ML

Pre-configured and up-to-date ML packages, GPU drivers and everything Data Scientist needs to save time on setup tasks.

Fully customizable

Broad support for Azure VM types and persisted low-level customization makes advanced scenarios a breeze.

New Compute Instance

Compute name *

Virtual Machine size *

Enable SSH access (Optional)

Administrator account username *

SSH public key *

Advanced settings

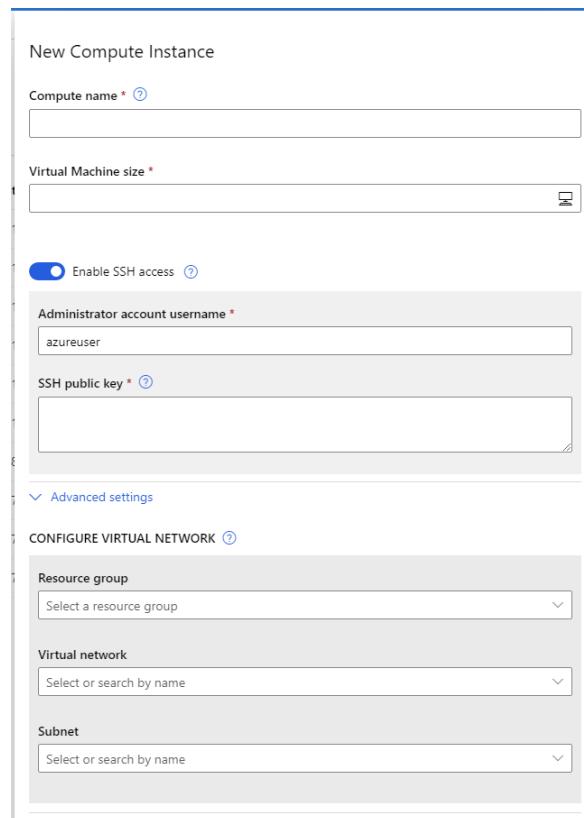
CONFIGURE VIRTUAL NETWORK (Optional)

Resource group

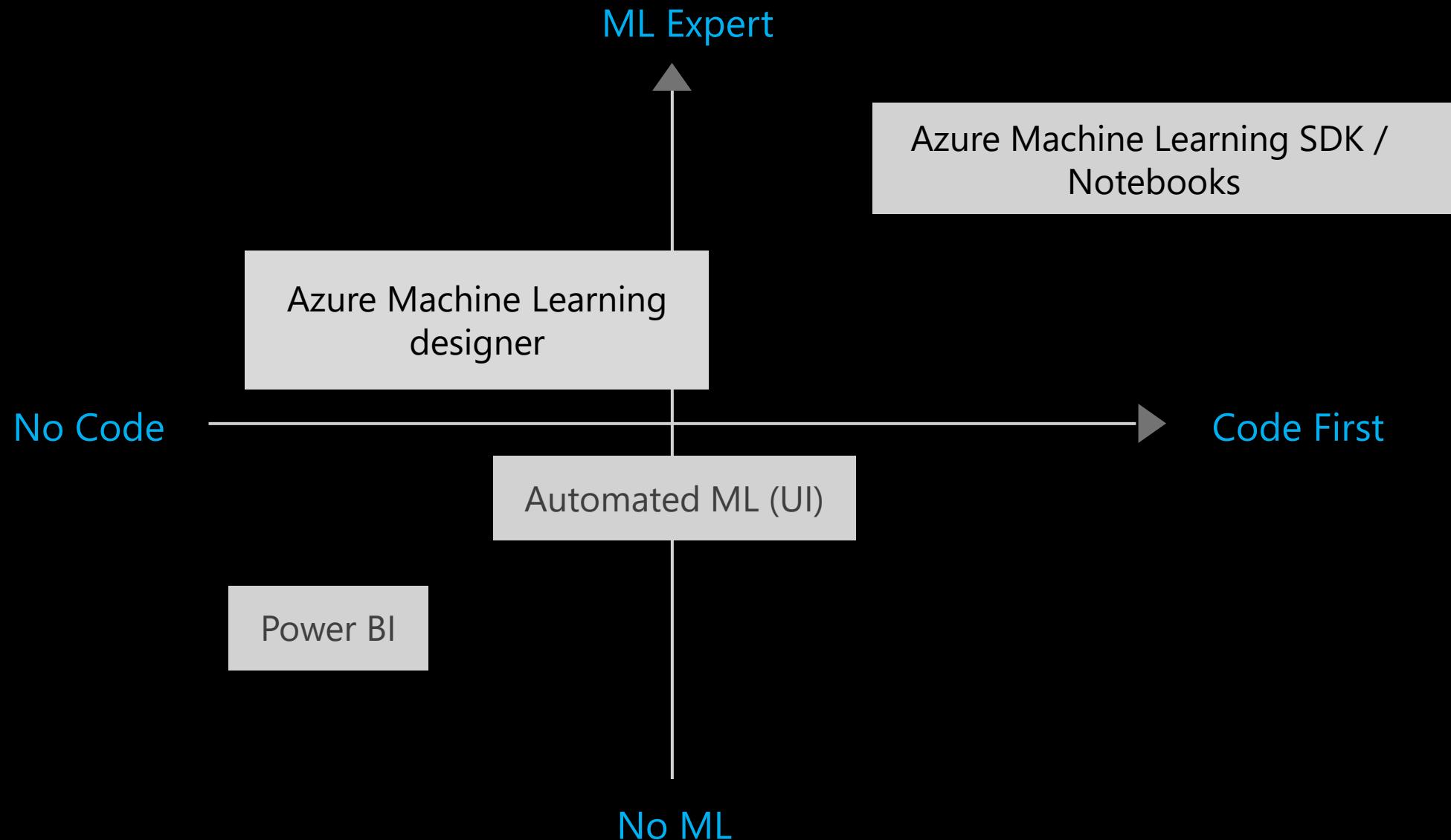
Virtual network

Subnet

Create Cancel

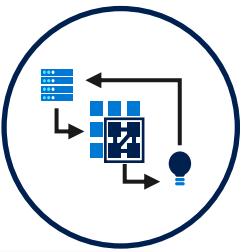
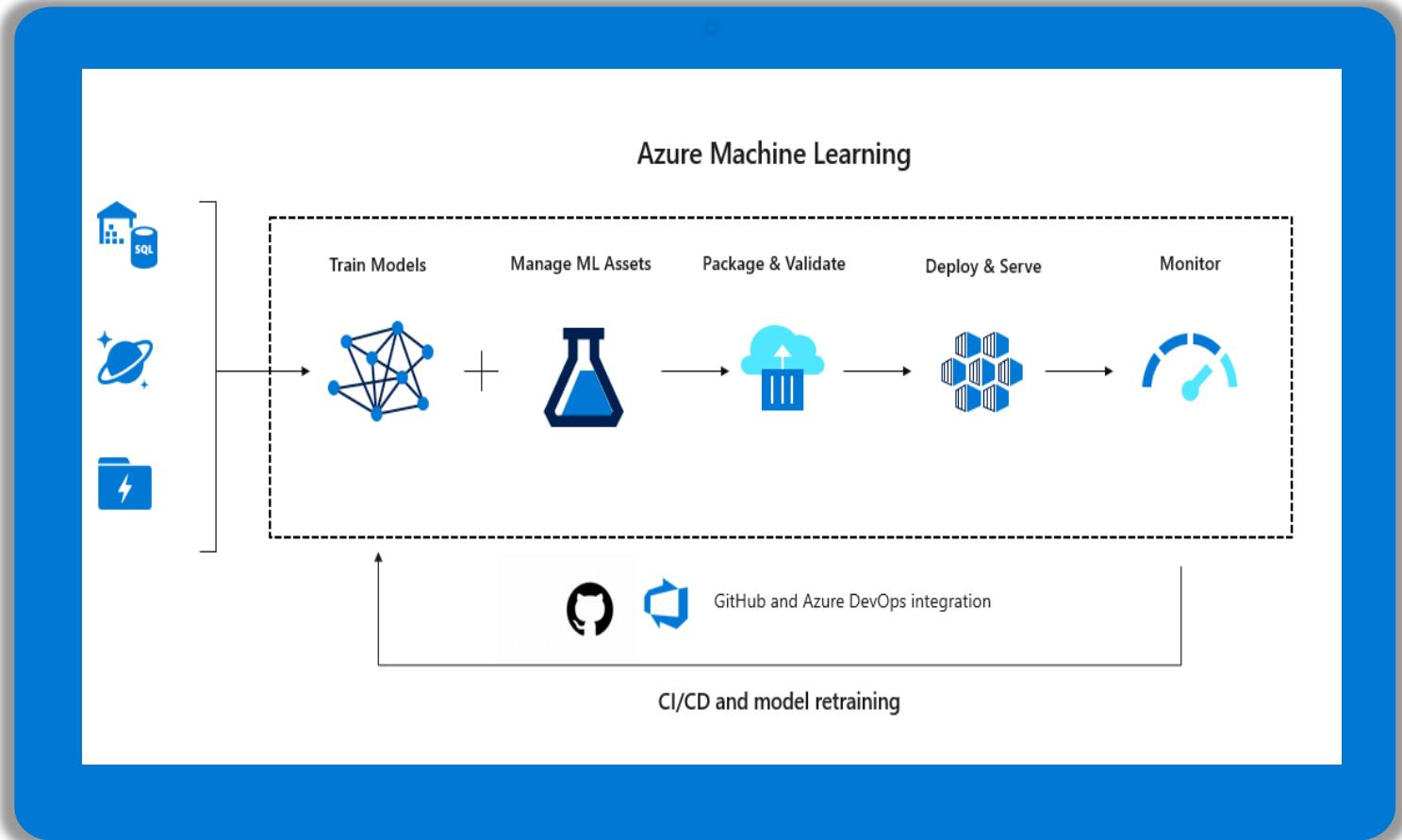


Build across skill levels with Azure Machine Learning



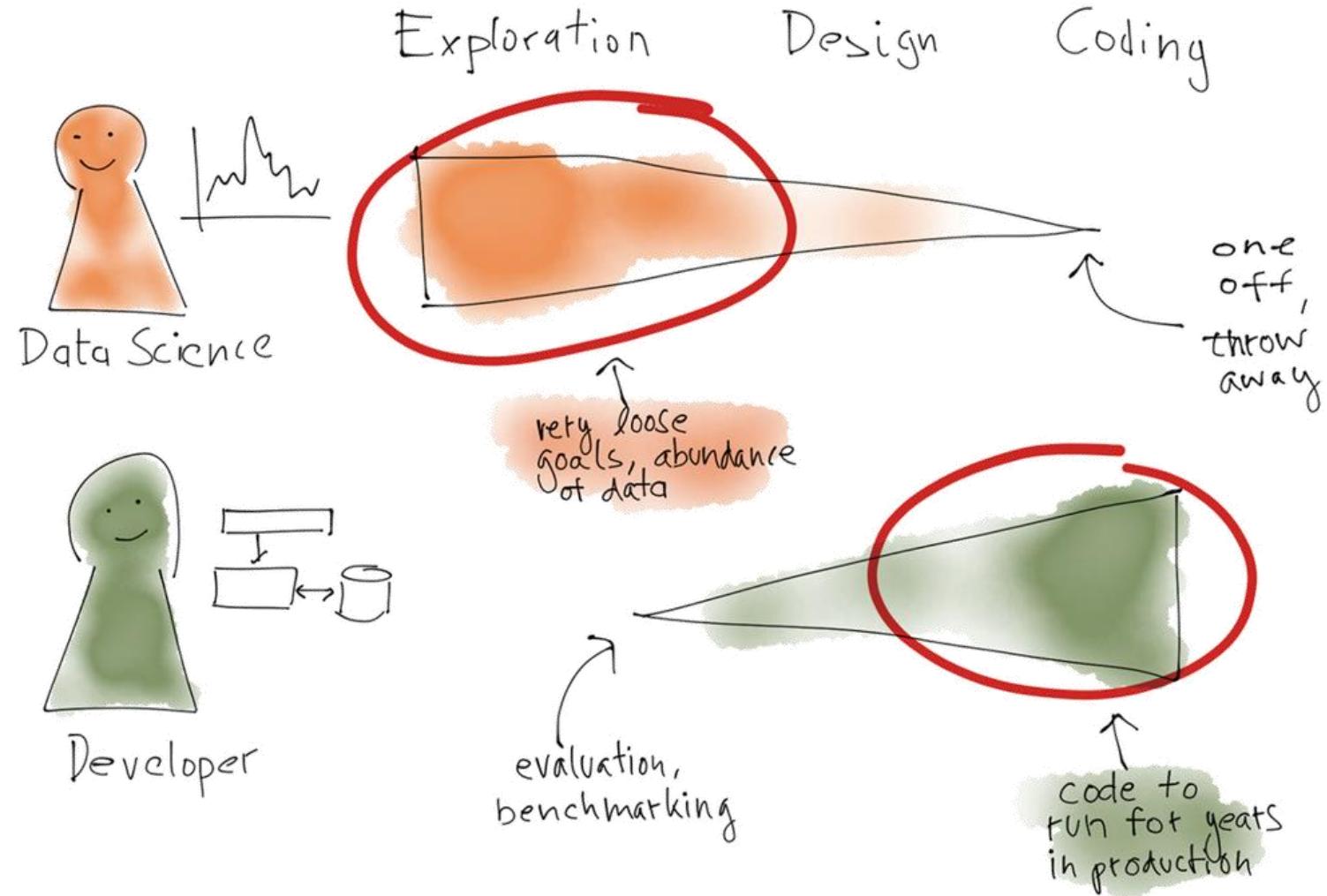
Azure Machine Learning

Industry leading MLOps

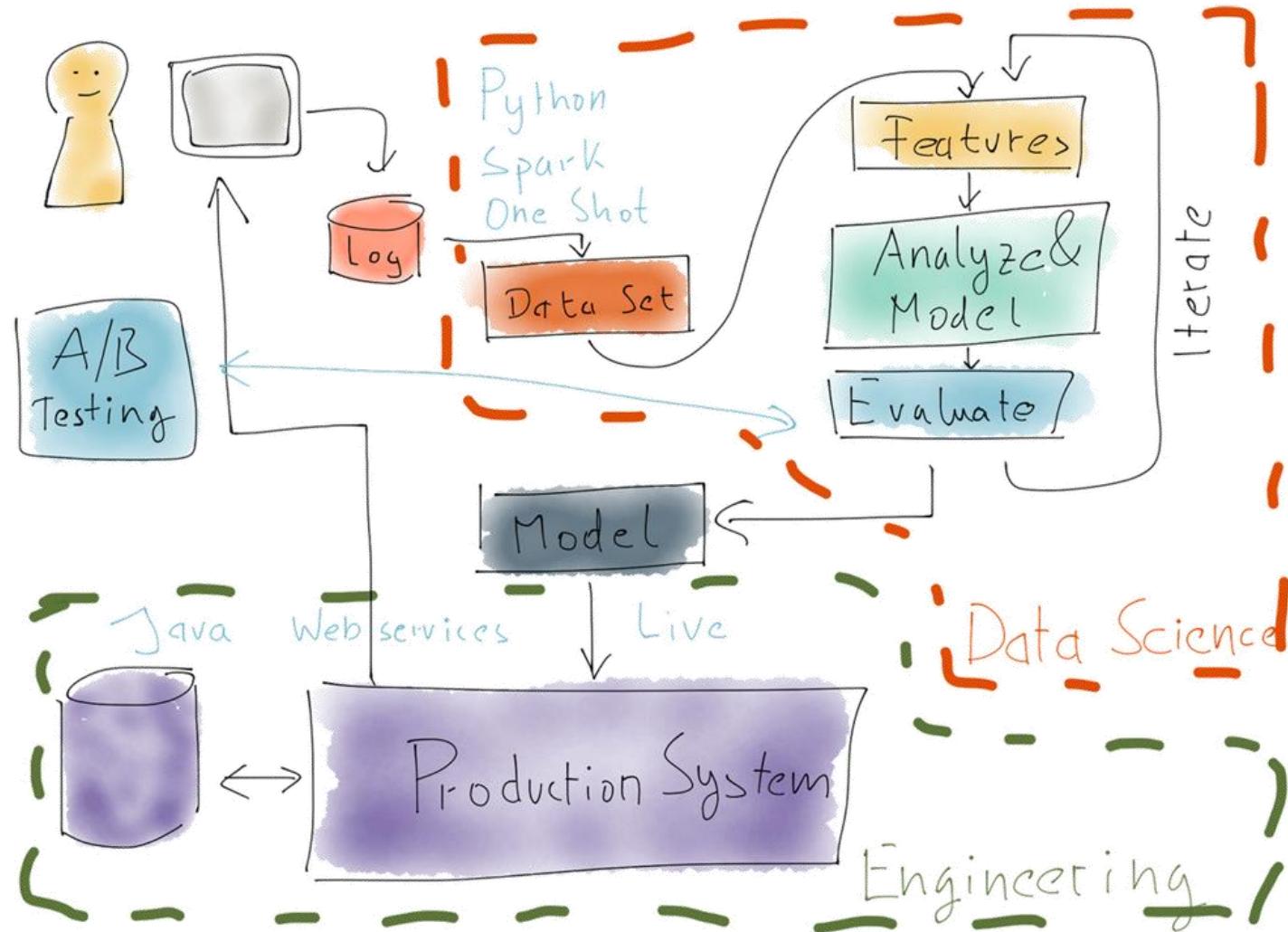


MLOps

Current situation



How to manage?



DevOps



Code reproducibility



Code testing



App deployment

MLOps



Model reproducibility



Model validation

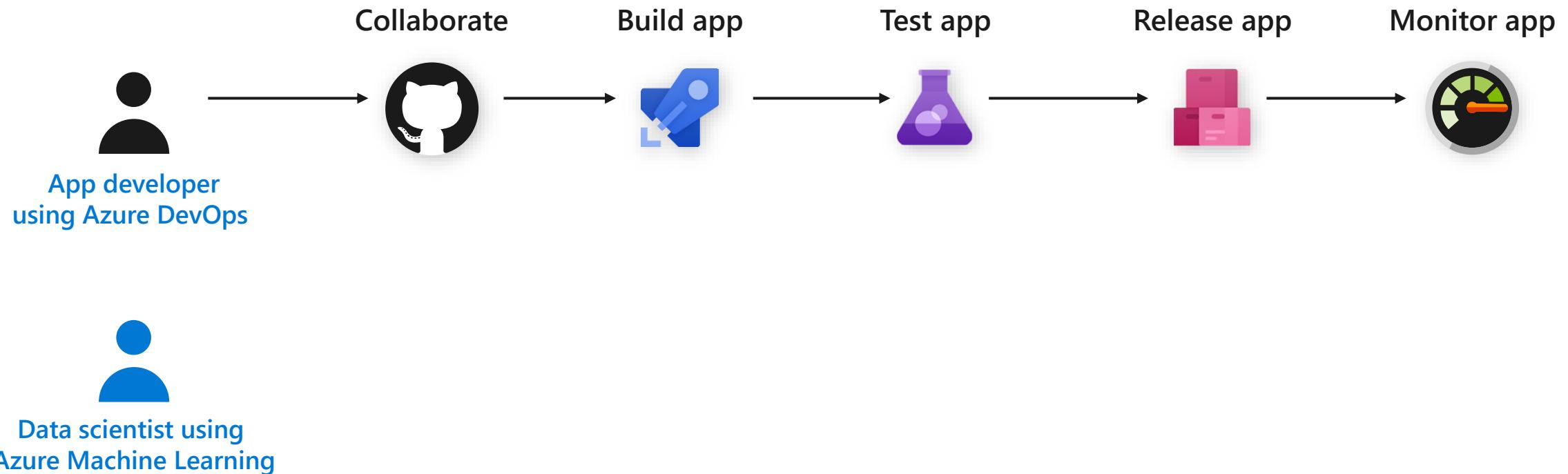


Model deployment



Model retraining

MLOps with Azure Machine Learning



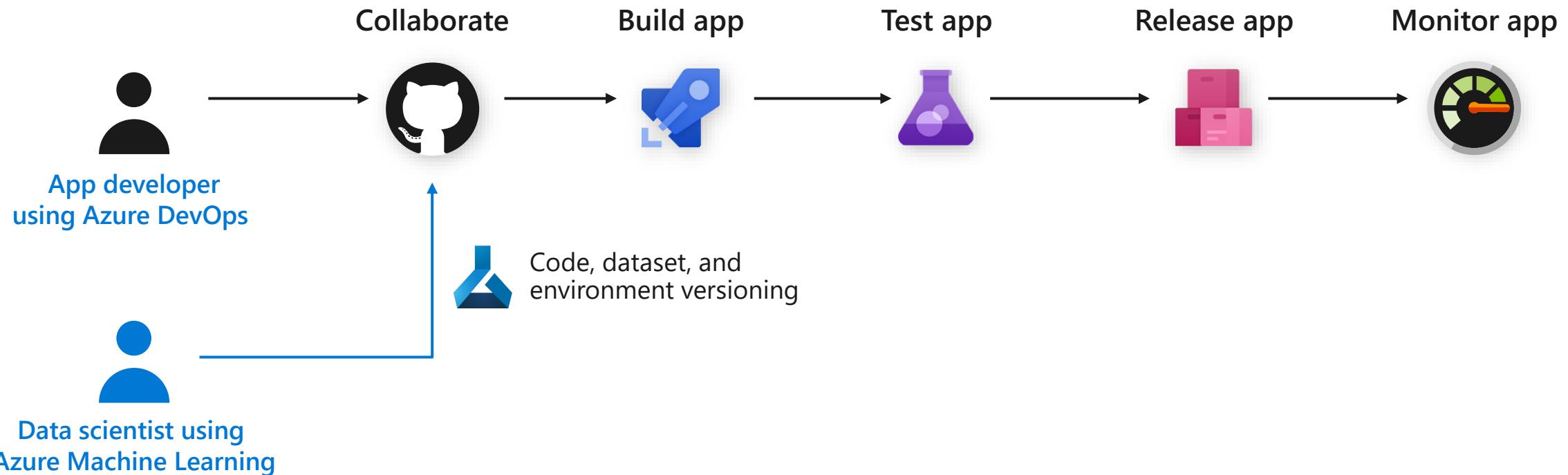
Model reproducibility

Model validation

Model deployment

Model retraining

MLOps with Azure Machine Learning



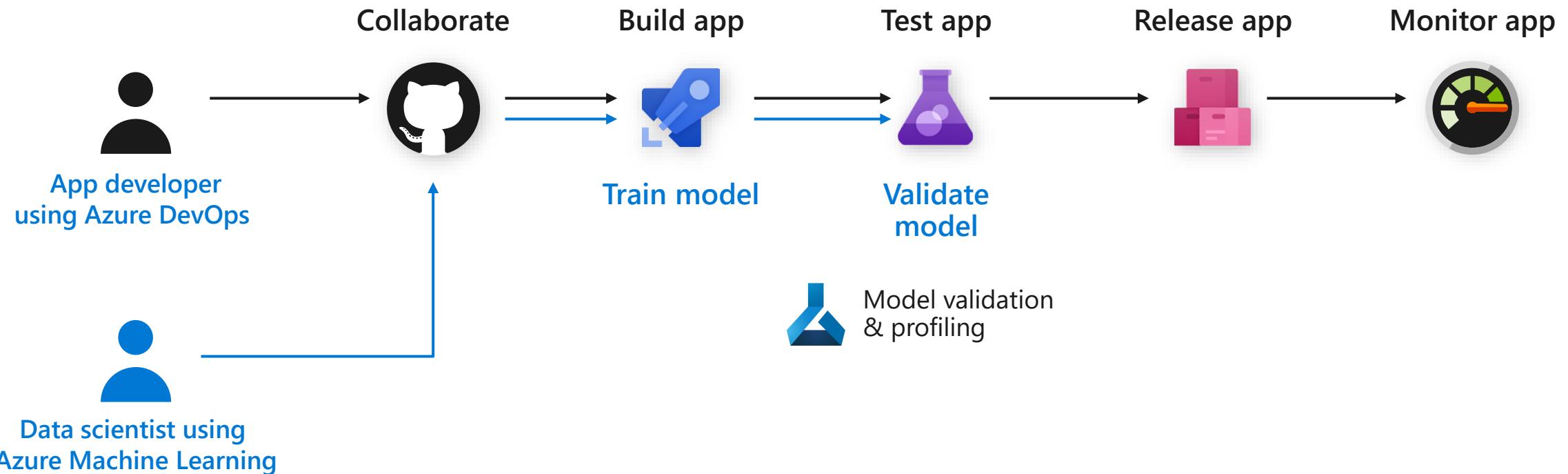
Model reproducibility

Model validation

Model deployment

Model retraining

MLOps with Azure Machine Learning



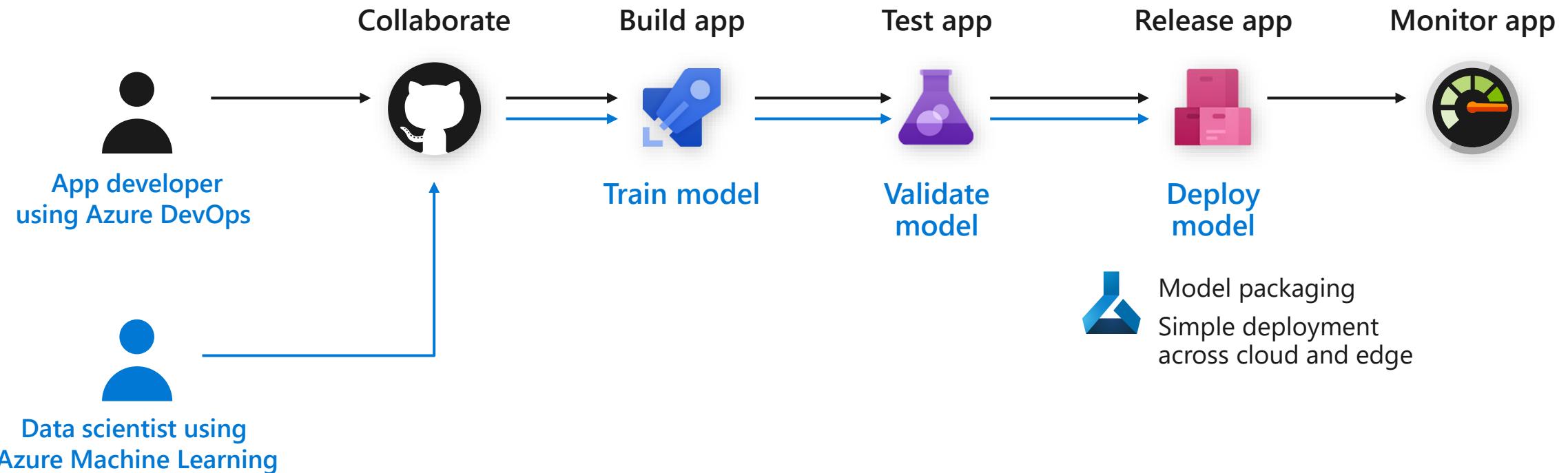
Model reproducibility

Model validation

Model deployment

Model retraining

MLOps with Azure Machine Learning



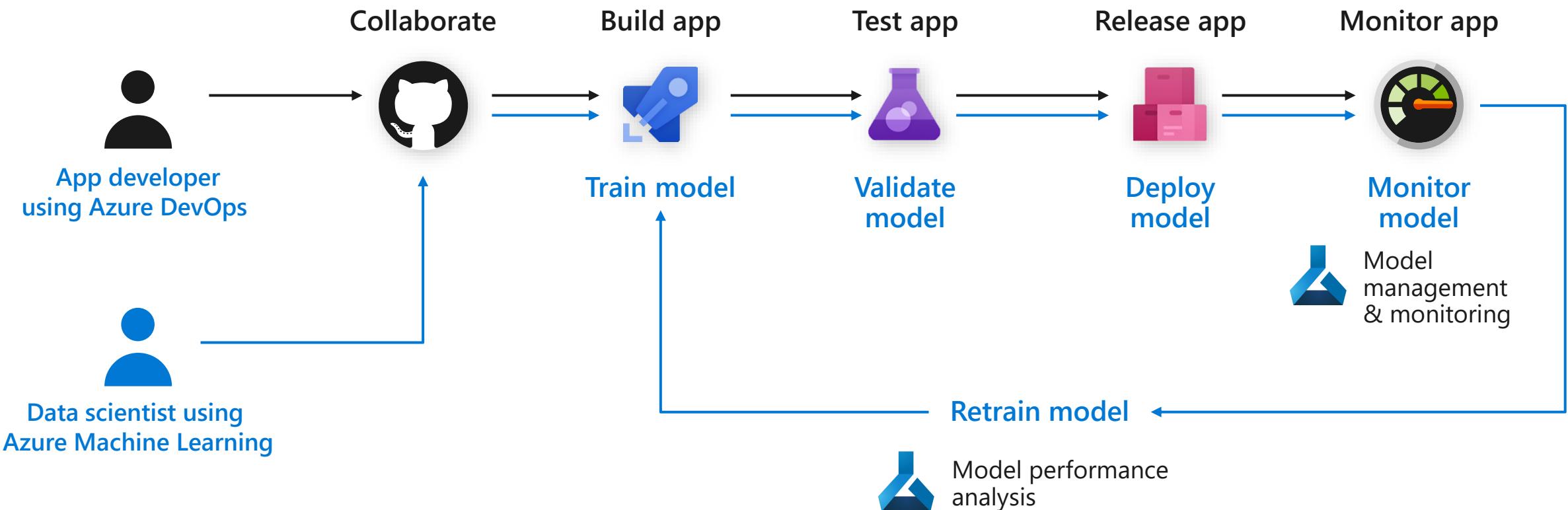
Model reproducibility

Model validation

Model deployment

Model retraining

MLOps with Azure Machine Learning



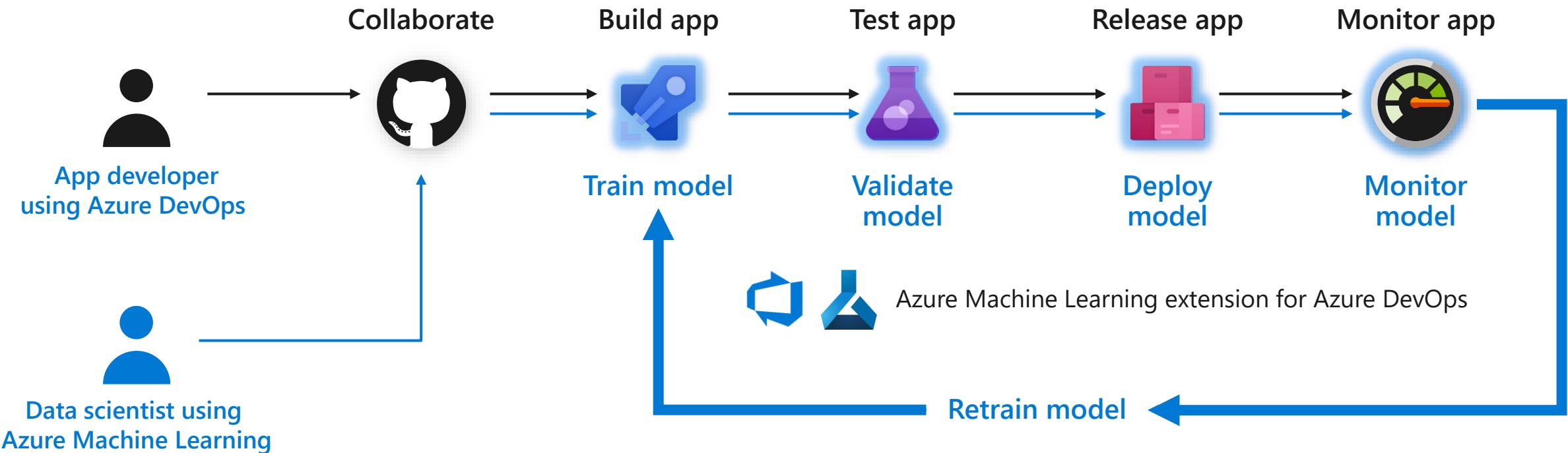
Model reproducibility

Model validation

Model deployment

Model retraining

MLOps with Azure Machine Learning



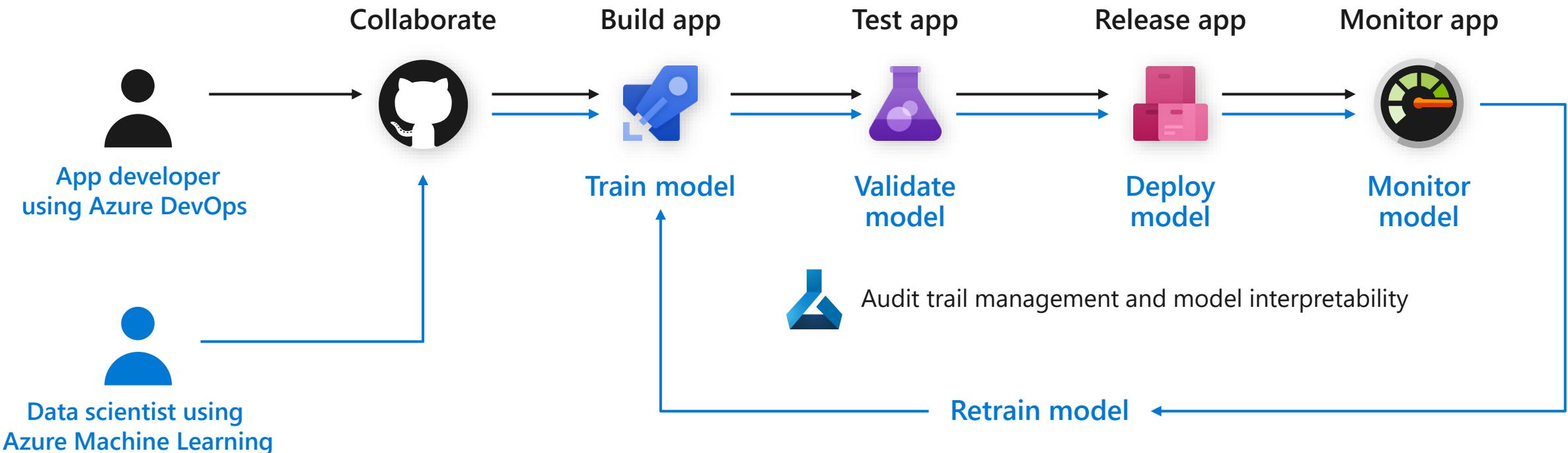
Model reproducibility

Model validation

Model deployment

Model retraining

MLOps with Azure Machine Learning

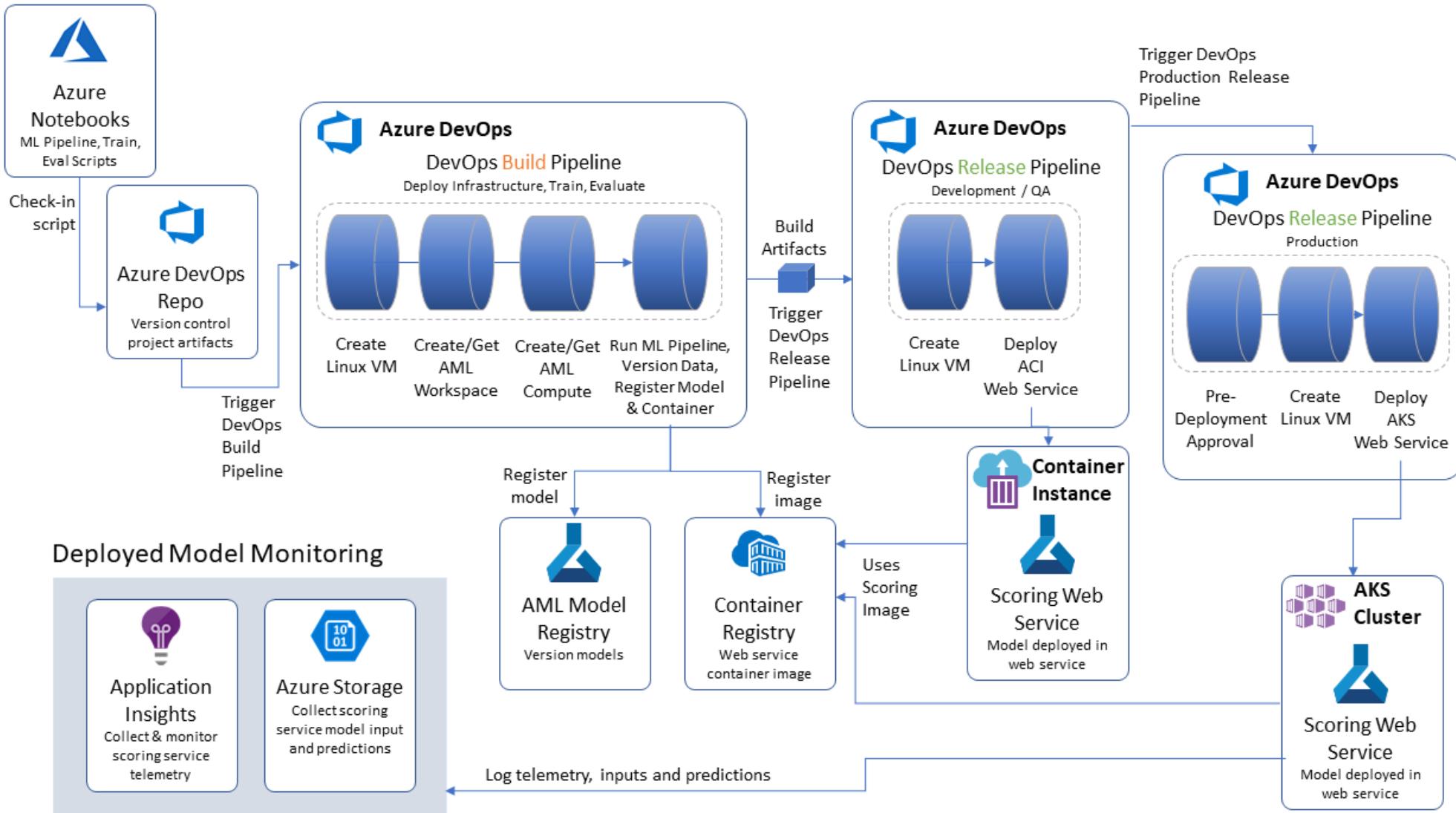


Model reproducibility

Model validation

Model deployment

Model retraining



Model reproducibility

Model validation

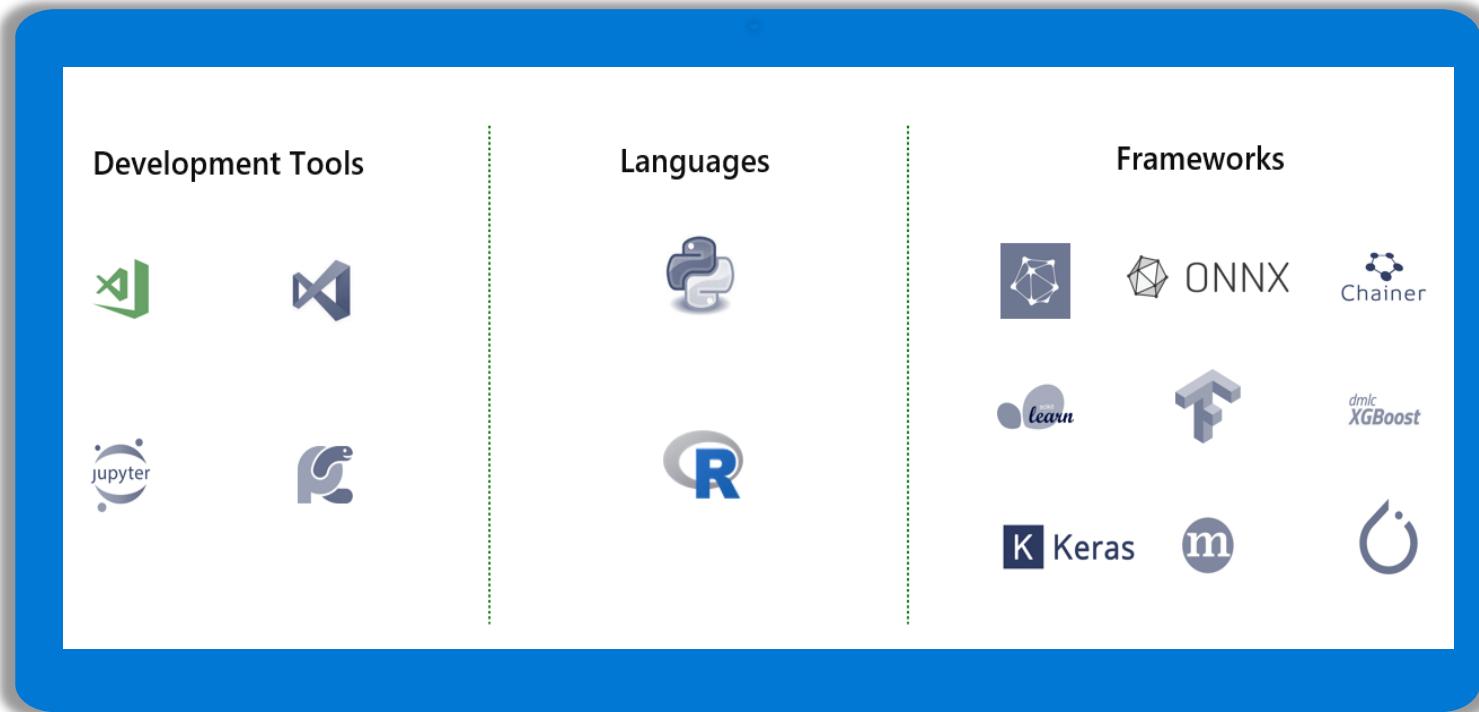
Model deployment

Model retraining

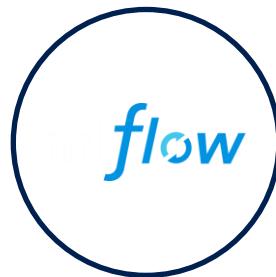


Azure Machine Learning

Open and interoperable platform



Open platform



Native MLflow support



ONNX Runtime updates



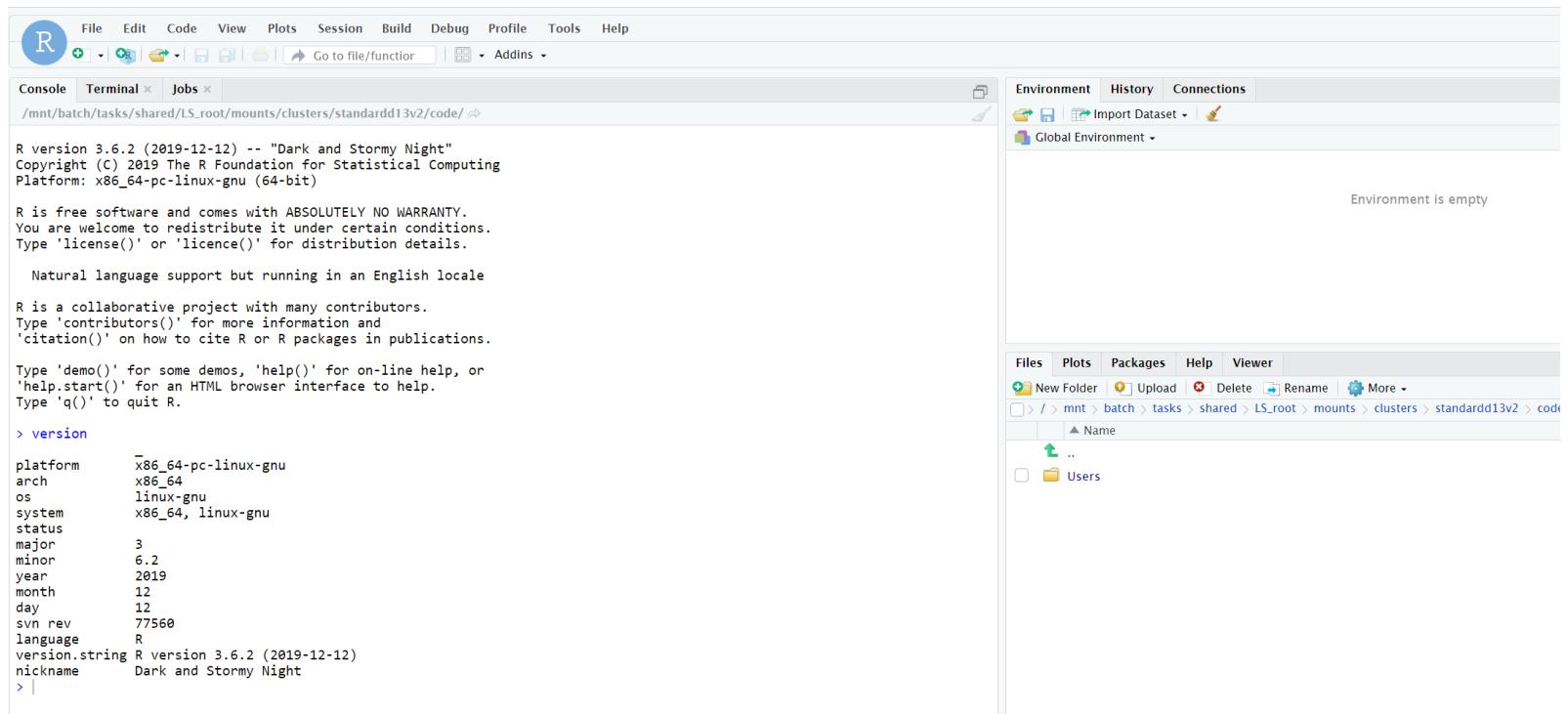
Azure Open Datasets

R support

What's new

R capabilities

- enable data scientists to scale out their R-based machine learning workloads on Azure.



The screenshot shows the RStudio interface with the following components:

- Console Tab:** Displays the R startup message and the output of the `version` command.
- Environment Tab:** Shows the "Environment is empty" message.
- Files Tab:** Shows a file tree with a single folder named "Users".

```
R version 3.6.2 (2019-12-12) -- "Dark and Stormy Night"
Copyright (C) 2019 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> version
platform      x86_64-pc-linux-gnu
arch        x86_64
os          linux-gnu
system      x86_64, linux-gnu
status
major       3
minor       6.2
year        2019
month       12
day         12
svn rev    77560
language     R
version.string R version 3.6.2 (2019-12-12)
nickname   Dark and Stormy Night
> |
```

Machine Learning on Azure

Domain specific pretrained models

To simplify solution development

Familiar Data Science tools

To simplify model development

Popular frameworks

To build advanced deep learning solutions

Productive services

To empower data science and development teams

Powerful infrastructure

To accelerate deep learning



Vision



Speech



Language



Search



Visual Studio Code



Azure Notebooks



Jupyter



Command line



PyTorch



TensorFlow



Scikit-Learn



ONNX



Azure
Databricks



Azure Machine
Learning



Machine
Learning VMs



CPU



GPU



FPGA



From the Intelligent Cloud to the Intelligent Edge



Powerful infrastructure

Accelerate deep learning



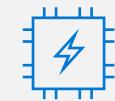
CPUs

General purpose
machine learning
D, F, L, M, H Series



GPUs

Deep learning
N Series



FPGAs

Specialized hardware
accelerated deep learning
AML hardware accelerated
models (Project Brainwave)

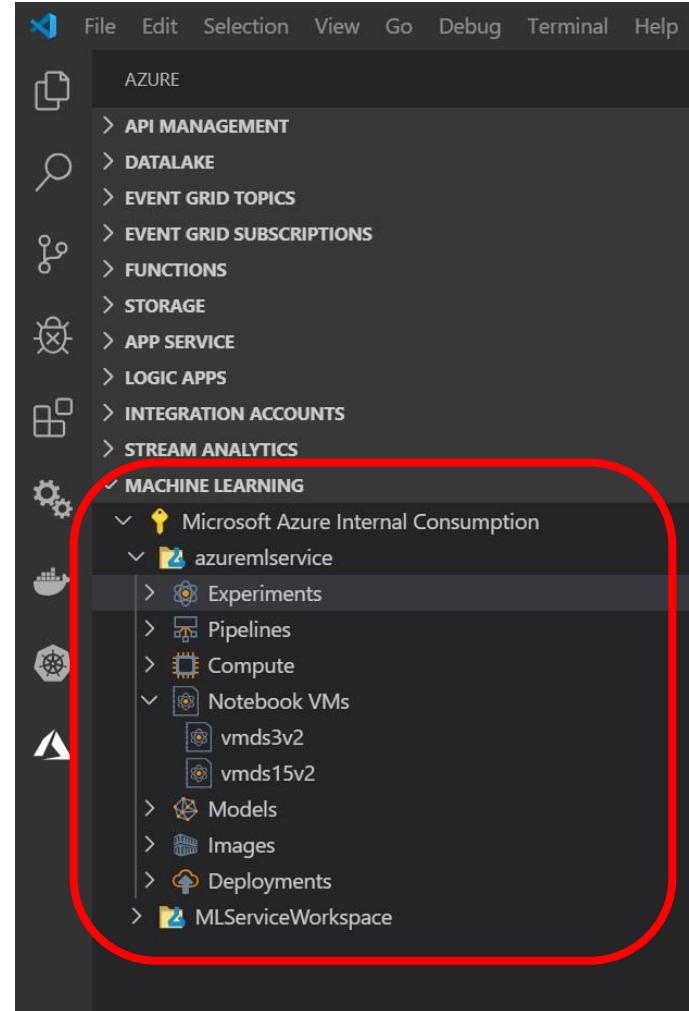


Optimized for flexibility

Optimized for performance

Integration with VS Code

Integration with Visual Studio



The screenshot shows the Azure ML Service integration in Visual Studio Code. On the left, the Explorer sidebar has a section for 'AZURE' which includes icons for API Management, DataLake, Event Grid Topics, Event Grid Subscriptions, Functions, Storage, App Service, Logic Apps, Integration Accounts, Stream Analytics, and Machine Learning. The 'Machine Learning' section is expanded, showing 'Microsoft Azure Internal Consumption' and 'azuremlservice'. Under 'azuremlservice', there are sub-folders for Experiments, Pipelines, Compute, Notebook VMs (containing vmds3v2 and vmds15v2), Models, Images, Deployments, and MLServiceWorkspace. A red oval highlights the 'Machine Learning' section. The top right shows the 'Welcome' and 'Release Notes: 1.39.2 X' tabs, and the main area displays the 'September 2019 (version 1.39)' release notes.

Release Notes: 1.39.2 - AzureMLService - Visual Studio Code

Welcome Release Notes: 1.39.2 X

September 2019 (version 1.39)

Update 1.39.1: The update addresses these [issues](#), including a fix for a security vulnerability.

Update 1.39.2: The update addresses these [issues](#).

Welcome to the September 2019 release of Visual Studio Code. There are a number of updates in this version:

- [Text selections displayed in minimap](#) - See selection regions in the minimap overview.
- [Toggle region folding keyboard shortcut](#) - Quickly expand and collapse regions with Toggle Fold.
- [Source Control tree view](#) - Display pending changes in either a list or new tree view.
- [Open terminal in custom working directory](#) - Add keyboard shortcuts for specific folders.
- [HTML ARIA attribute reference links](#) - Links to ARIA documentation directly from IntelliSense.
- [CSS property completions include semicolons](#) - Semicolons added as you enter CSS properties.
- [CSS color variables preview](#) - Color variable completions display color swatch.
- [Improved column breakpoint UI](#) - View possible inline breakpoints directly in your source code.
- [Inline debug actions in CALL STACK view](#) - Stay in context with debug actions on hover.
- [Remote Explorer updates](#) - Explorer now displays WSL distros and repository containers.

If you'd like to read these release notes online, go to [Updates on code.visualstudio.com](#).

Insiders: Want to see new features as soon as possible? You can download the nightly [Insiders](#) build and try it out! Follow us on Twitter @code!

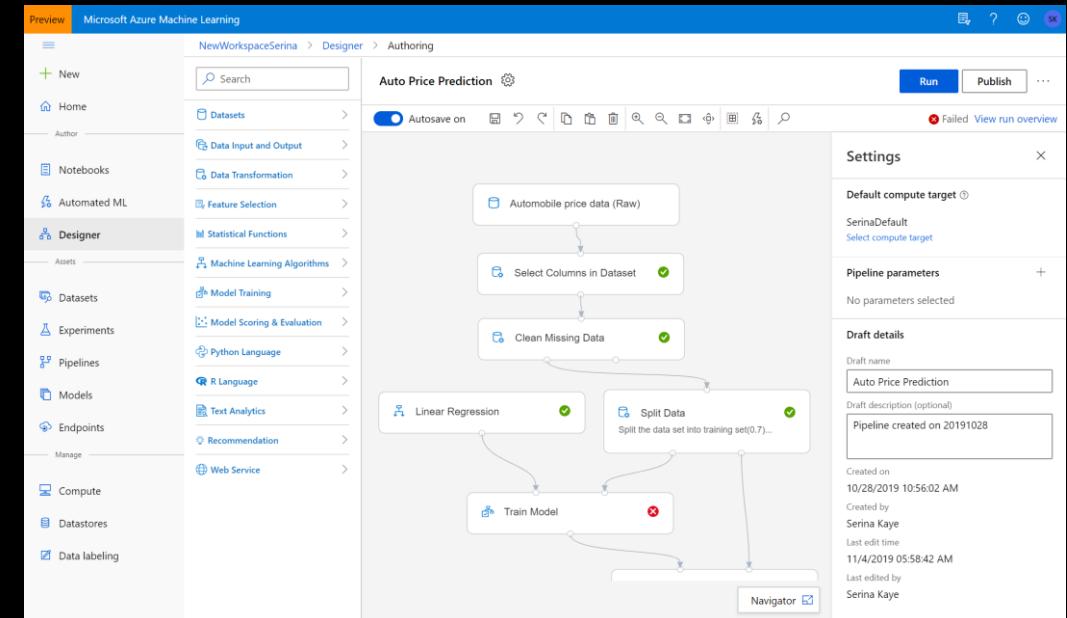
Azure ML Editions

Azure Machine Learning Enterprise Edition

- **Enterprise Edition**

At Ignite, we announced the new Azure Machine Learning Enterprise and Basic editions. The Enterprise edition contains our no-code ML capabilities (AutoML and designer) as well as cutting edge AutoML features such as DNNs, enterprise grade ML Ops capabilities such as data drift monitoring, and cross-workspace compute management

- The Enterprise edition is currently in preview. While in preview, customers with Enterprise workspaces will pay only for Azure resources consumed.
- All capabilities of AzureML that were in general availability before Ignite are now available in the "Basic" edition, now in GA. Basic workspaces will incur costs only for consumed Azure resources.



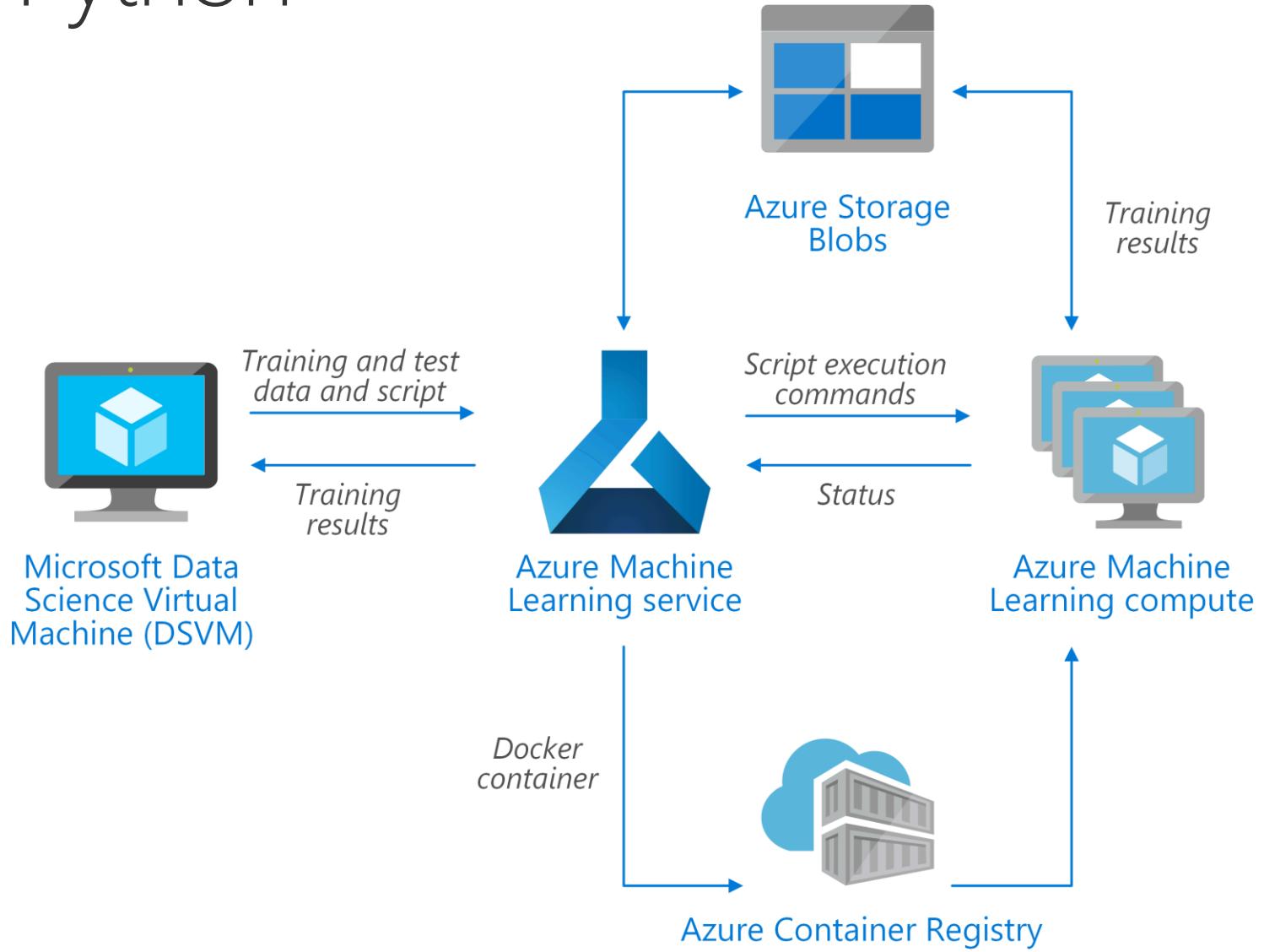
Enterprise and Basic: Summary

- Azure Machine Learning offers two editions: Enterprise and Basic
- Basic edition is available in GA / Enterprise edition currently in preview
- More detail on our pricing page: <https://azure.microsoft.com/en-us/pricing/details/machine-learning/>

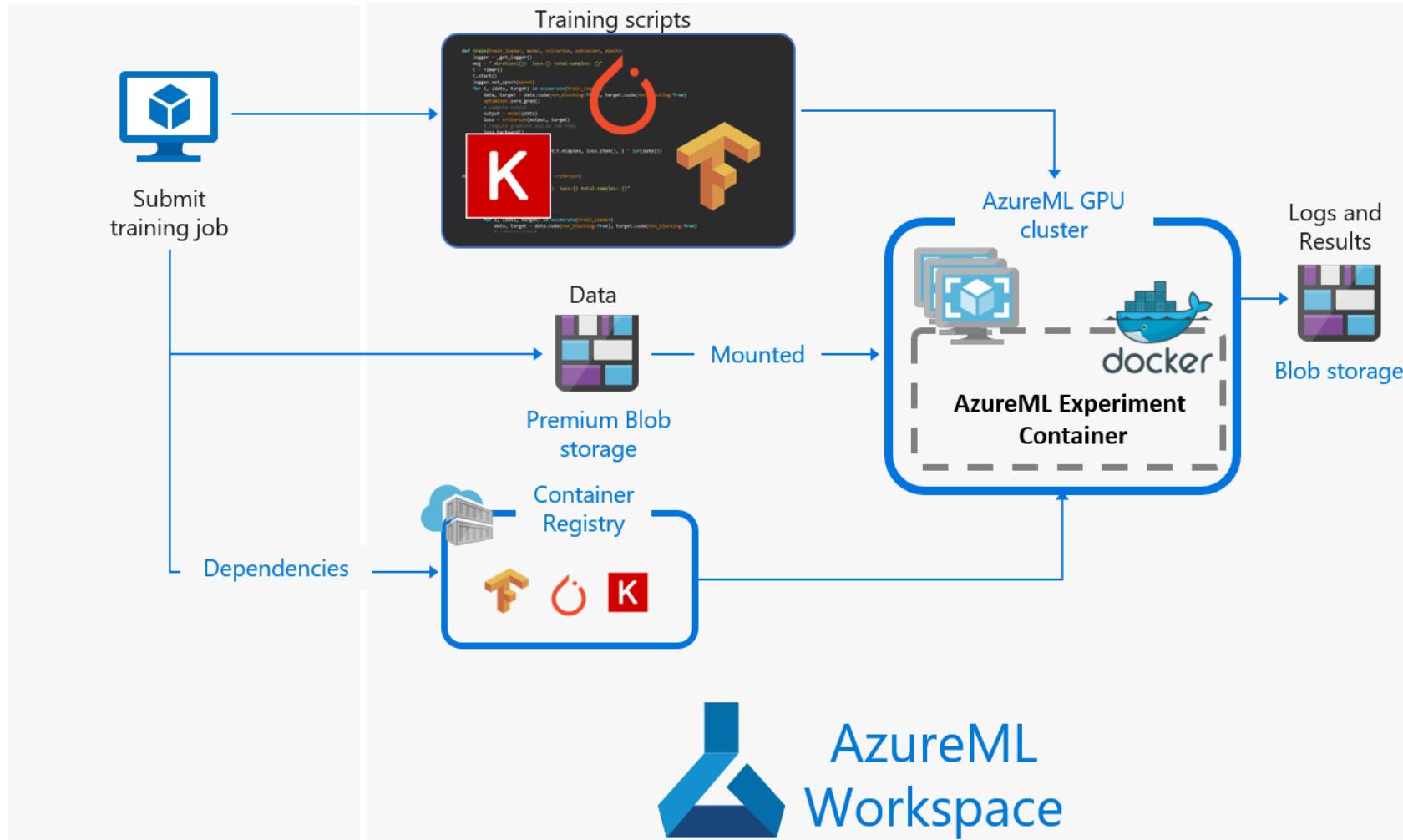
	Basic	Enterprise
Pricing structure	<ul style="list-style-type: none">• Pay only for Azure resources consumed• No charge for AzureML	<ul style="list-style-type: none">• No up-front cost – scale as you need, pay for what you consume• Compute surcharge for ML activities: data prep, training, inferencing
Audience	<ul style="list-style-type: none">• Experienced data scientists who like a code-first environment• Single data scientists or small data science teams who don't need enterprise price controls, or large-scale ML Ops	<ul style="list-style-type: none">• Large enterprises with mixed data science, data engineering and analyst teams who would benefit from both code-forward and drag-and-drop ML• Large data science teams that need to share compute across workspaces, or access other enterprise features
Messages	<ul style="list-style-type: none">• The best place for open source ML• Use your existing tools and IDE when scaling to the cloud• Best in class code-first experience	Basic level + <ul style="list-style-type: none">• Best in class ML for all skill levels including no-code ML• Enterprise-grade security, governance and cost control• Comprehensive ML lifecycle management
[Roadmap features]	<ul style="list-style-type: none">• Responsible AI toolkit• Reinforcement learning• Batch inferencing• Manual data labelling	<ul style="list-style-type: none">• Data drift capabilities• Automated ML ensemble models and deep learning• Automated model retraining• Managed inferencing• ML assisted labelling

Architecture

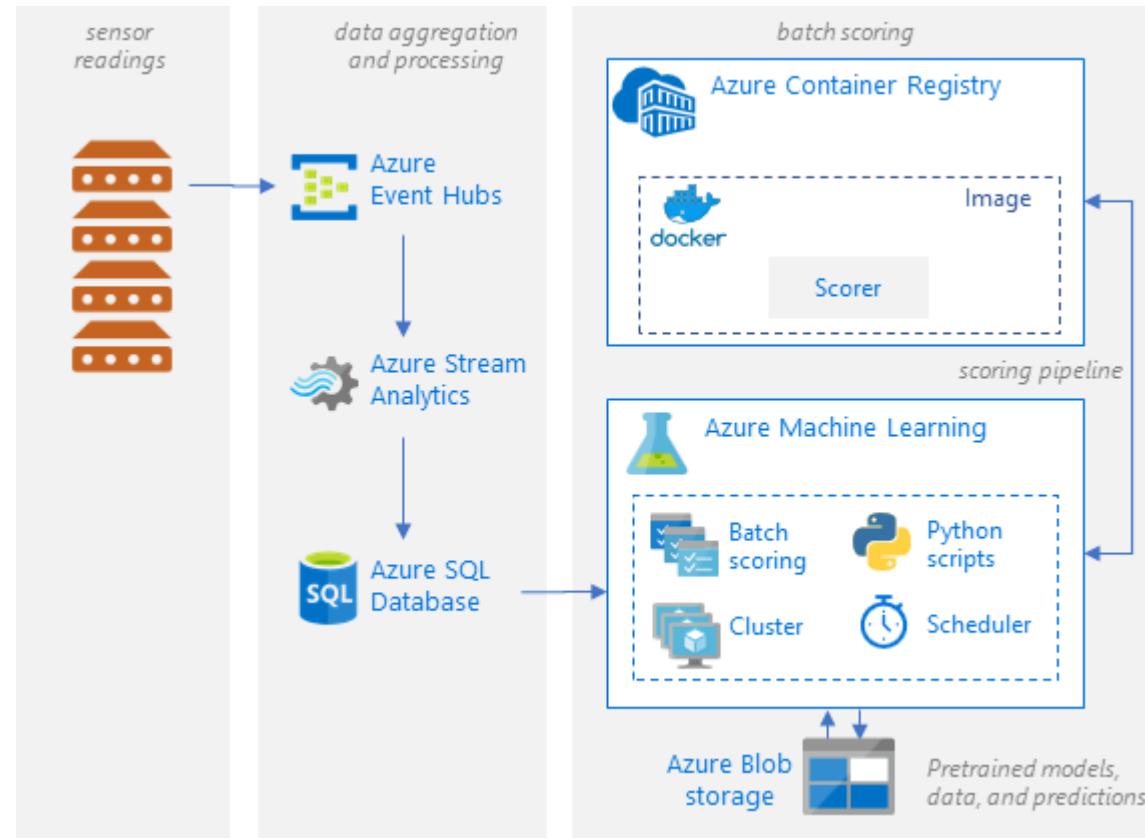
Training Python



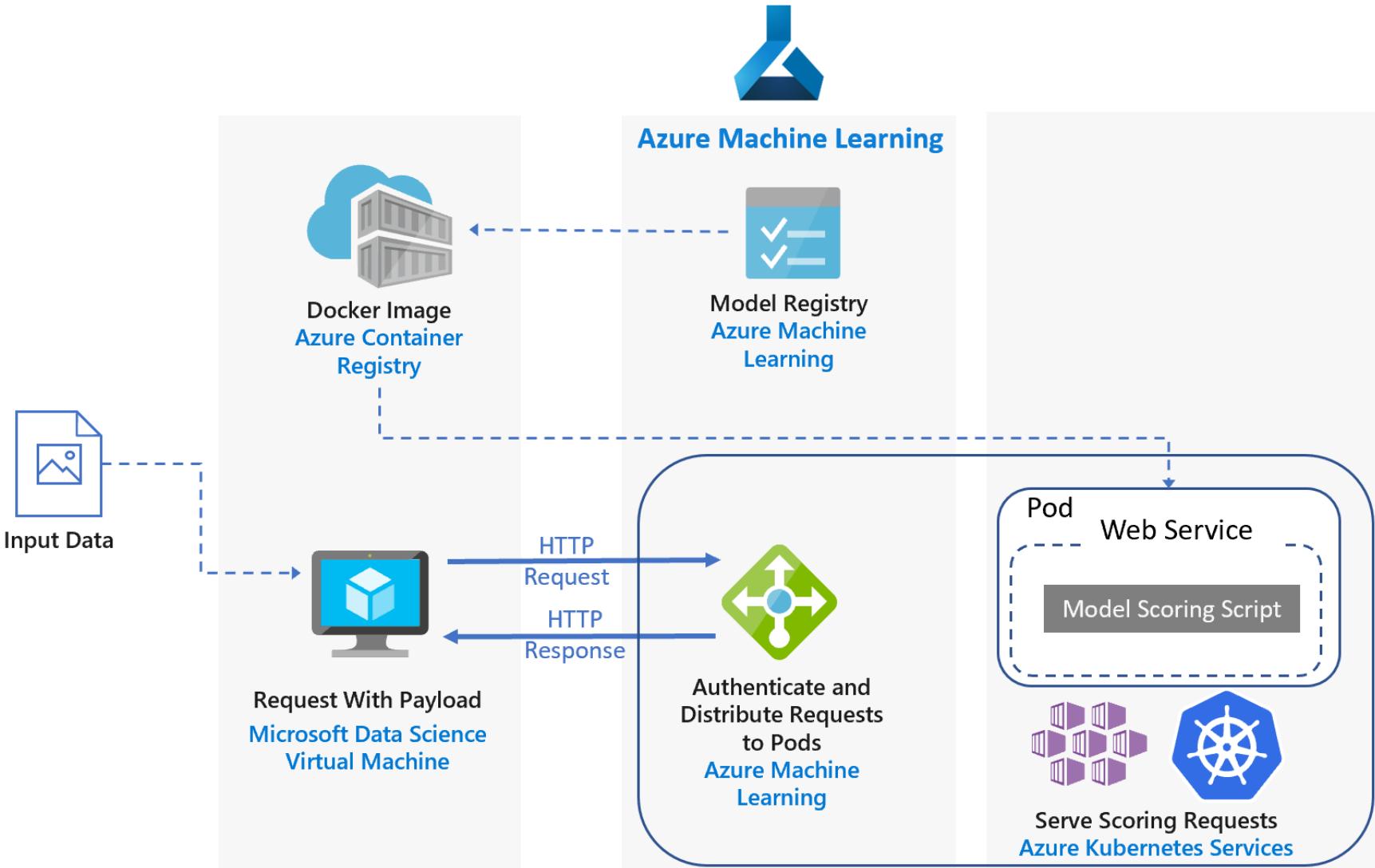
Deep Learning



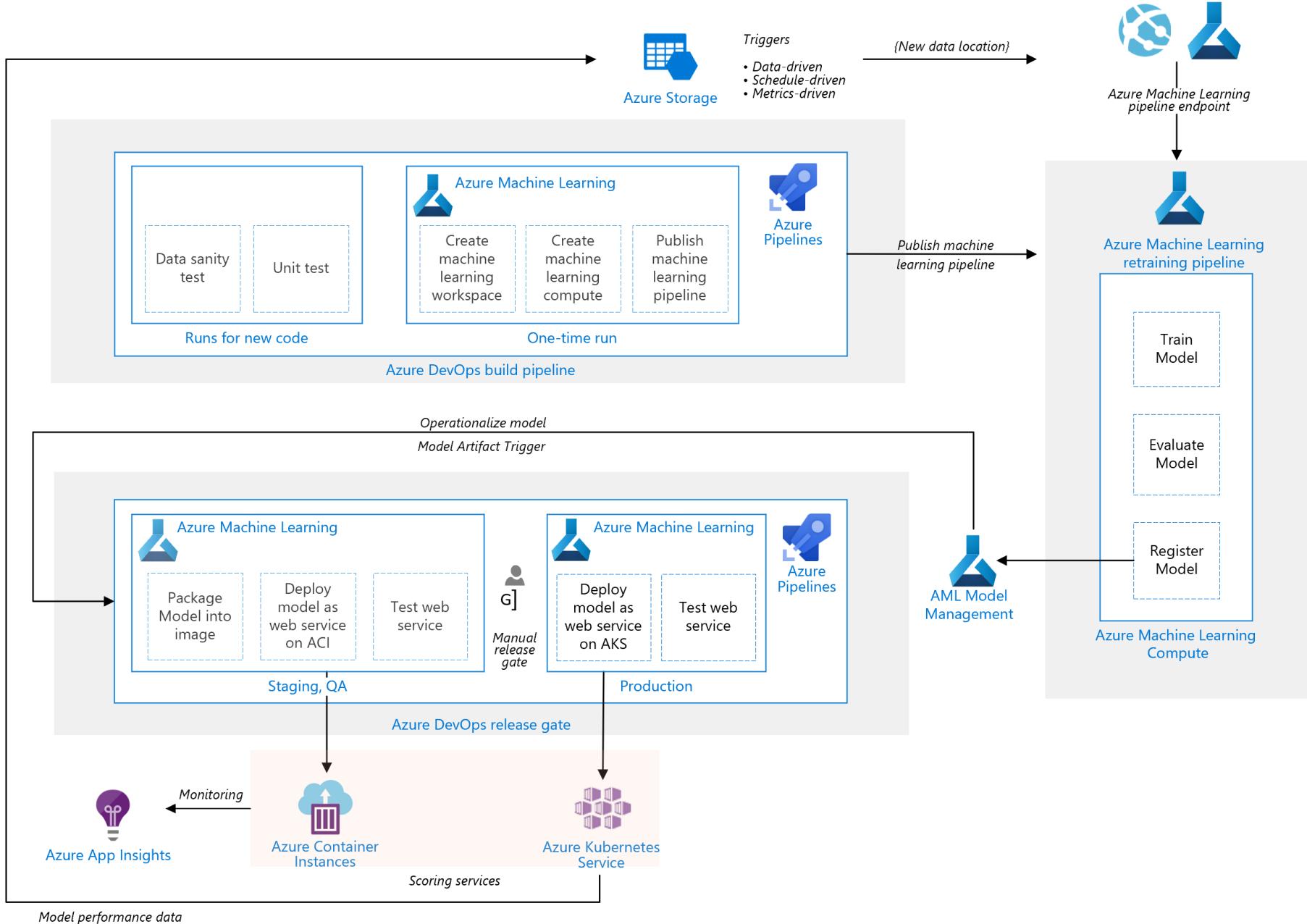
Batch scoring of Python models



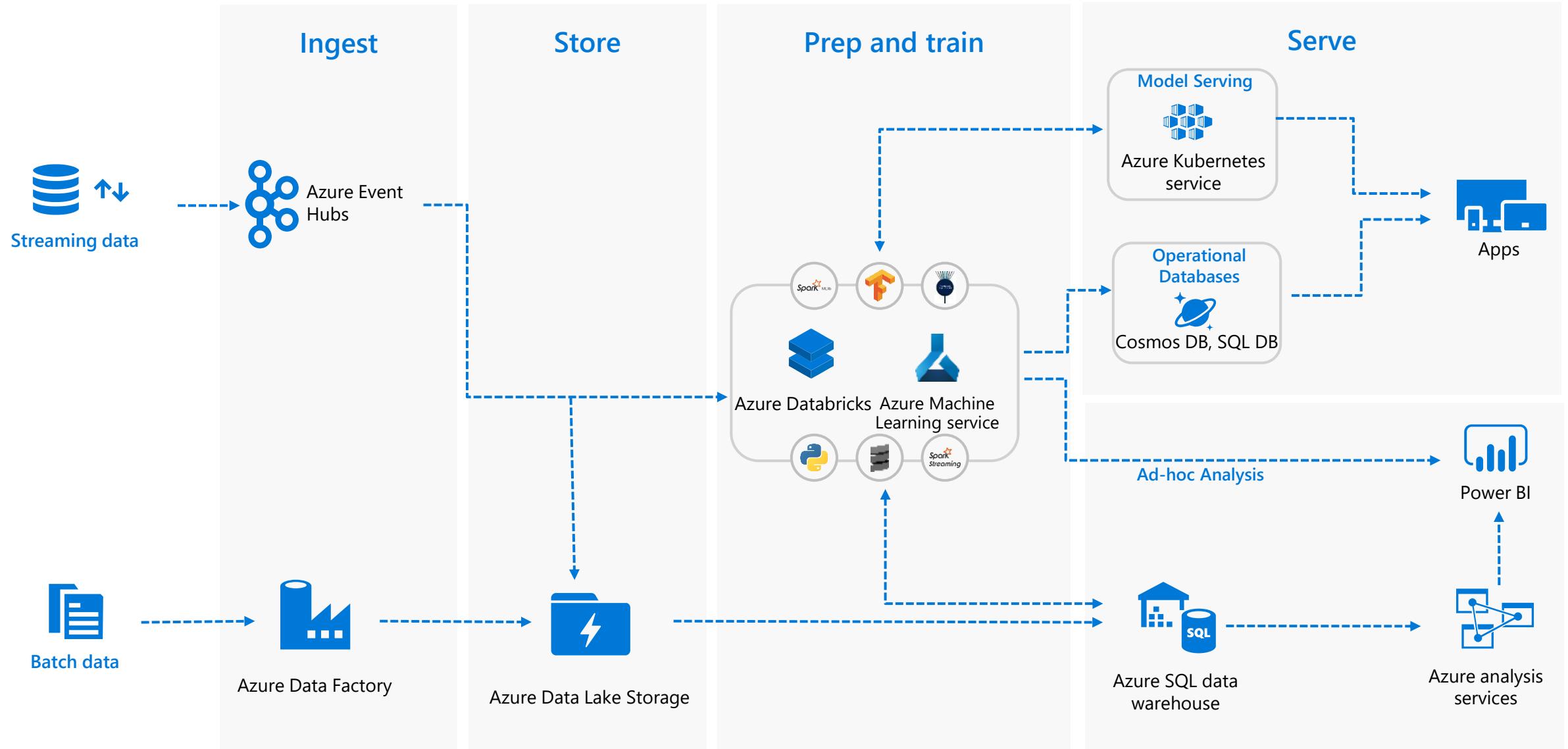
Real time scoring



MLOps



Azure Databricks + Azure ML



Roles

End user roles

- Standard roles
- Custom roles

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

Monitoring Azure ML

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 (-)	—	—	💡	...
Compute	1 (-)	—	—	💡	...
Virtual machine	1 (-)	—	—	💡	...
standardd2v224d142833d	—	—	—	💡	...
standardds13v244d198275	1 (-)	—	—	💡	...
Container registry	—	—	—	💡	...
Application	—	—	—	💡	...
Networking	—	—	—	💡	...
Other	—	—	—	💡	...
Storage and Databases	—	—	—	💡	...

Monitoring Azure ML with Azure Monitor

Show data for last:

1 hour

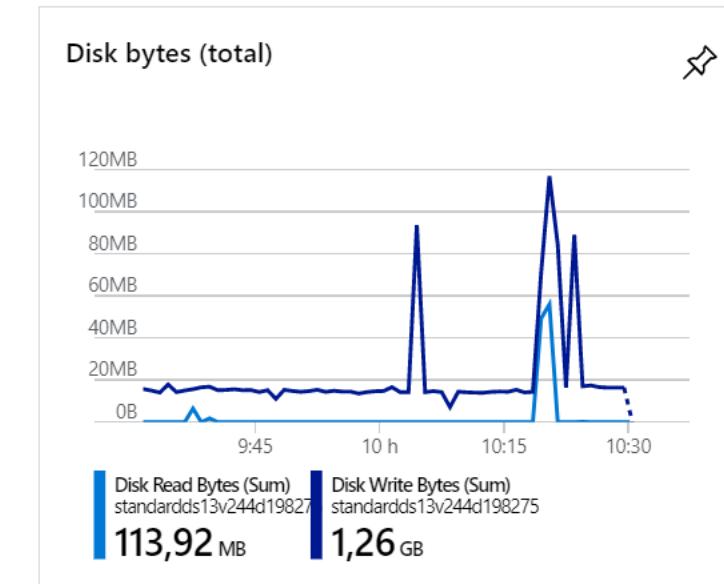
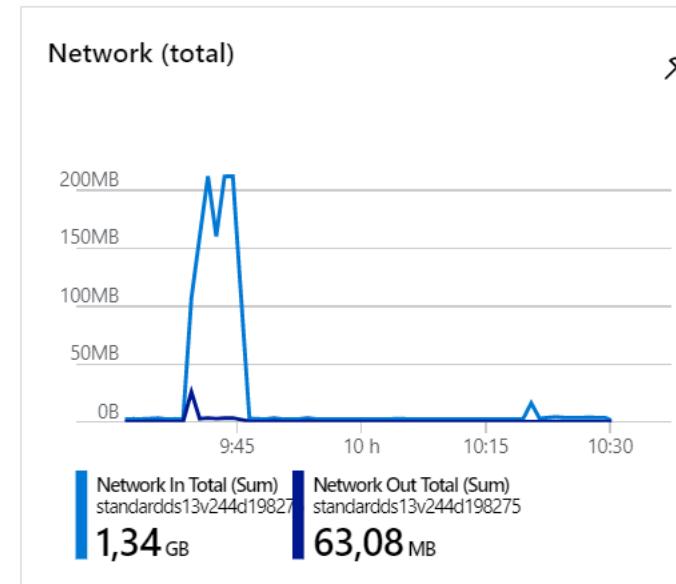
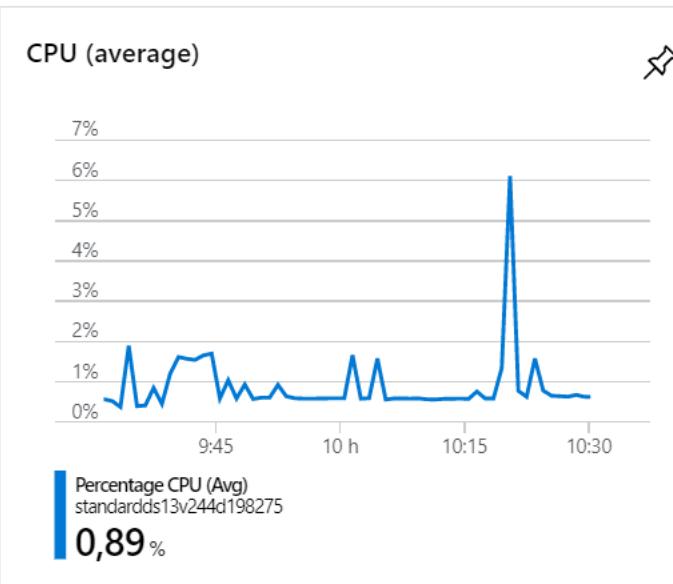
6 hours

12 hours

1 day

7 days

30 days



Monitoring Azure ML with Azure Monitor

Performance Map Health (preview)

Time range: Last hour

View Workbooks ▾

Properties

Log Events

Alerts

Logical Disk Performance

DISK	CURRE...	CURRE...	P95 I...	P95 I...	P95 I...	P95 M...	P95 M...	P95 M...
/	61.51	42%	0	34	34	0	0.32	0.32
/boot/efi	0.1	4%	0	0	0	0	0	0
/mnt	109.94	5%	0	0	0	0	0	0
Total	173.11	19%	0	34	34	0	0.32	0.32

CPU Utilization % ⓘ

Avg Min 50th 90th 95th Max ⚙

100%
80%
60%
40%
20%
0%
09:45 10 AM 10:15 10:30

0% 20% 40% 60% 80% 100%

■ Average ■ Q5th ■ 10th

Available Memory ⓘ

Avg Max 50th 10th 5th Min ⚙

55.9GB
46.6GB
37.3GB
27.9GB
18.6GB
9.3GB
0B
09:45 10 AM 10:15 10:30

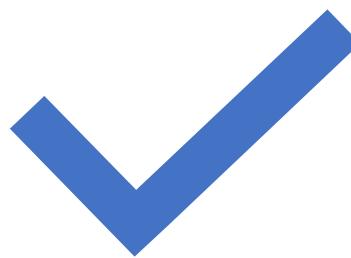
0B 9.3GB 18.6GB 27.9GB 37.3GB 46.6GB 55.9GB

■ Average ■ 5th ■ 10th



Documentation & ressources

Documentation Azure ML



Lien général :

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

Pricing :

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

Documentation :

<https://docs.microsoft.com/en-us/azure/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 Intégration

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

AutoML with Azure ML References

Schneider Electric :

<https://customers.microsoft.com/en-us/story/schneider-electric-power-utilities-azure>

BP:

<https://news.microsoft.com/transform/bp-ai-drilling-data-fueling-smarter-decisions/>

Boots:

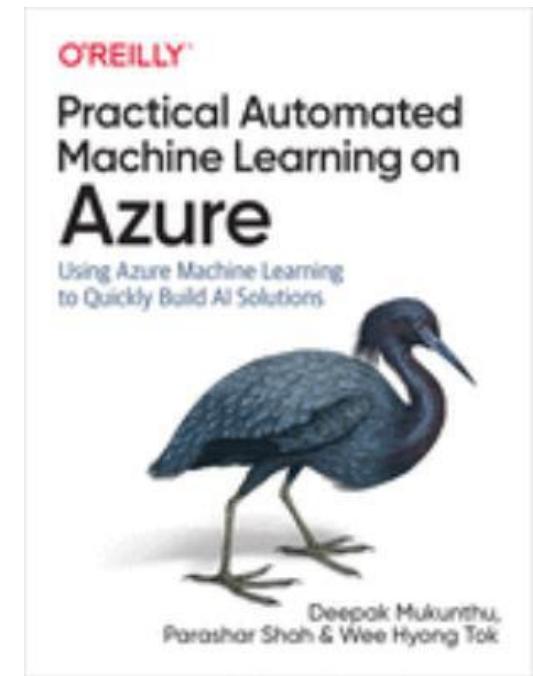
<https://customers.microsoft.com/en-us/story/733091-walgreens-boots-alliance-pharmaceuticals-azure>

AutoML integration with PowerBI:

<https://customers.microsoft.com/en-us/story/724164-macaw-partner-professional-services-power-bi>

Blog : <https://azure.microsoft.com/blog/announcing-automated-ml-capability-in-azure-machine-learning/>

Book: https://www.amazon.com/Practical-Automated-Machine-Learning-Azure-ebook/dp/B07Y8X2HH4/ref=sr_1_1?keywords=automl+azure&qid=1573050215&s=digital-text&sr=1-1

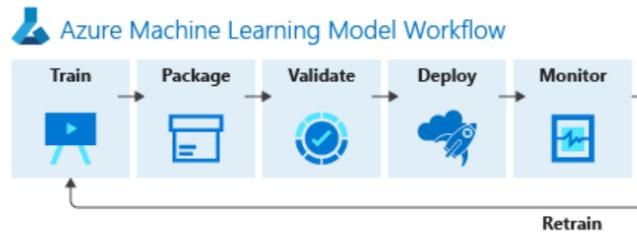


Azure ML Git

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

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.



Get Started Guide for Azure Developers



Azure Application Architecture Guide



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Networking Overview

Content Delivery Network

ExpressRoute

Azure DNS

Virtual Network

Storage

Storage

StorSimple

Data Lake Storage Gen2

Data Lake Storage Gen1

Blob Storage

Web

App Service - Web Apps

API Management

Content Delivery Network

Notification Hubs

Azure Search

Documentation Microsoft

<https://docs.microsoft.com/en-us/azure/#pivot=products>

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Azure Reference Architectures

Our reference architectures are arranged by scenario. Each architecture includes recommended practices, along with considerations for scalability, availability, manageability, and security. Most also include a deployable solution or reference implementation.

Jump to: [AI](#) | [Big data](#) | [IoT](#) | [Microservices](#) | [Serverless](#) | [Virtual networks](#) | [VM workloads](#) | [SAP](#) | [Active Directory](#) | [Web apps](#)

AI and machine learning



Training of Python scikit-learn models

Recommended practices for tuning the hyperparameters of a scikit-learn Python model.



Distributed training of deep learning models

Run distributed training of deep learning models across clusters of GPU-enabled VMs.



Batch scoring of Python models

Batch score many Python models in parallel on a schedule using Azure Machine Learning.



Batch scoring for deep learning models



Real-time scoring of Python and deep learning models



MLOps for Python models using Azure Machine Learning

Architectures Microsoft
<https://docs.microsoft.com/en-us/azure/architecture/>

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<https://docs.microsoft.com/en-us/learn/>



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