
Host by
STUDY4
.NET Conf 2019
探索 .NET 新世界
.NET
dotnet new

誰說 AI 人員不能和維運團隊合作！？

MLOps 深入淺出

Jennie Lin

你可能會問？

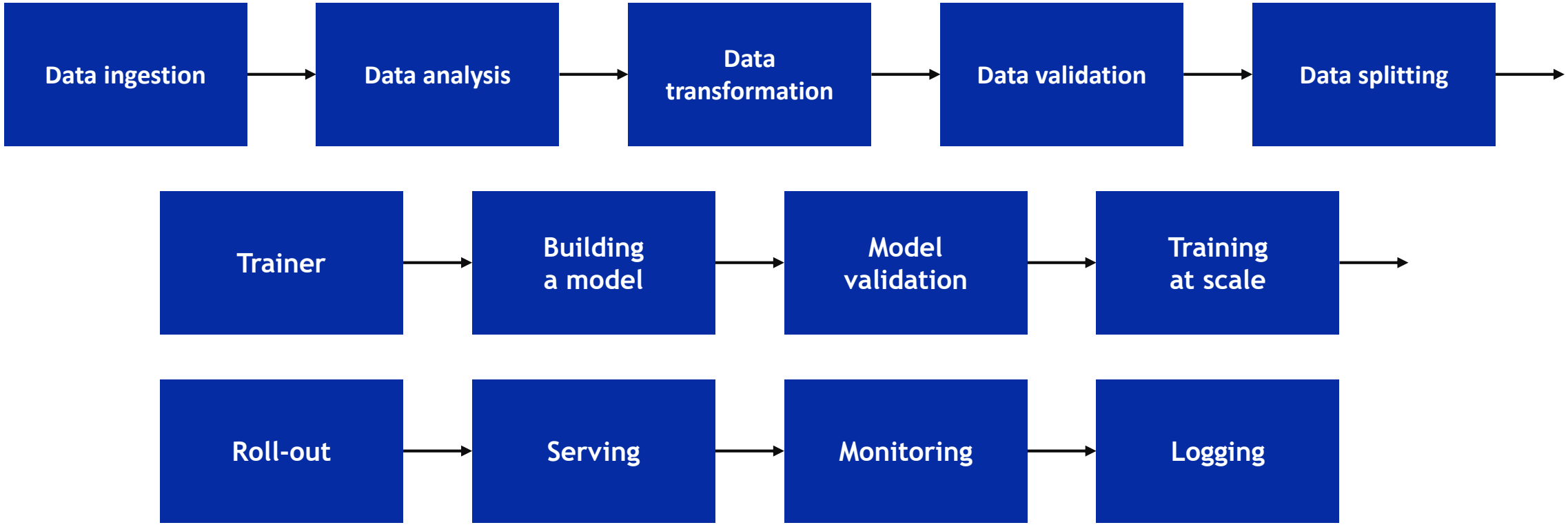
1. 為什麼有MLOps?
2. Azure 為 MLOps 投資什麼?
3. 我如何利用MLOps 功能?

為什麼有 MLOps?

典型數據科學的過程

Building a model

典型數據科學的過程


Data ingestion
Data analysis
Data transformation
Data validation
Data splitting
Trainer
Building a model
Model validation
Training at scale
Roll-out
Serving
Monitoring
Logging

成功實施ML的障礙

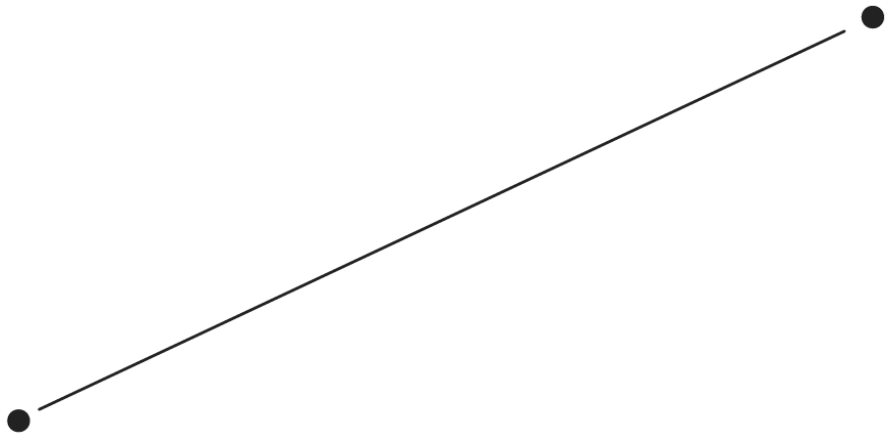
96%

的公司AI計劃都在努力超越測試階段

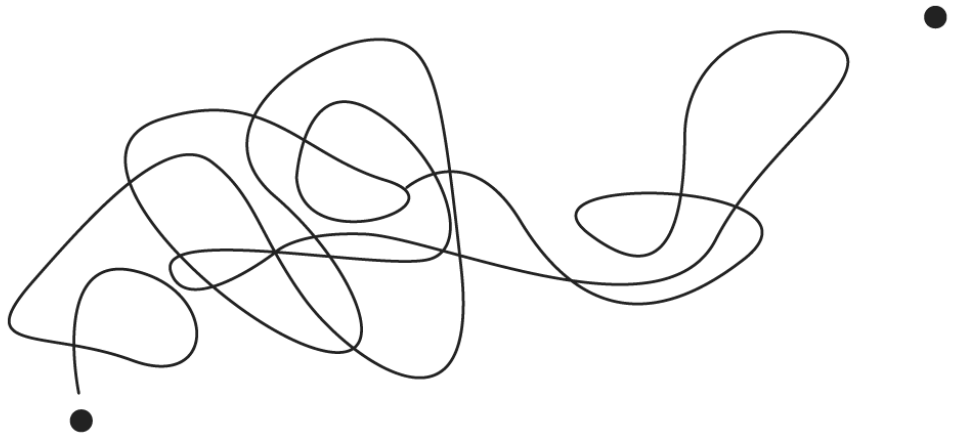
的公司成功地充分利用機器學習模型

5%

成功實施ML的障礙

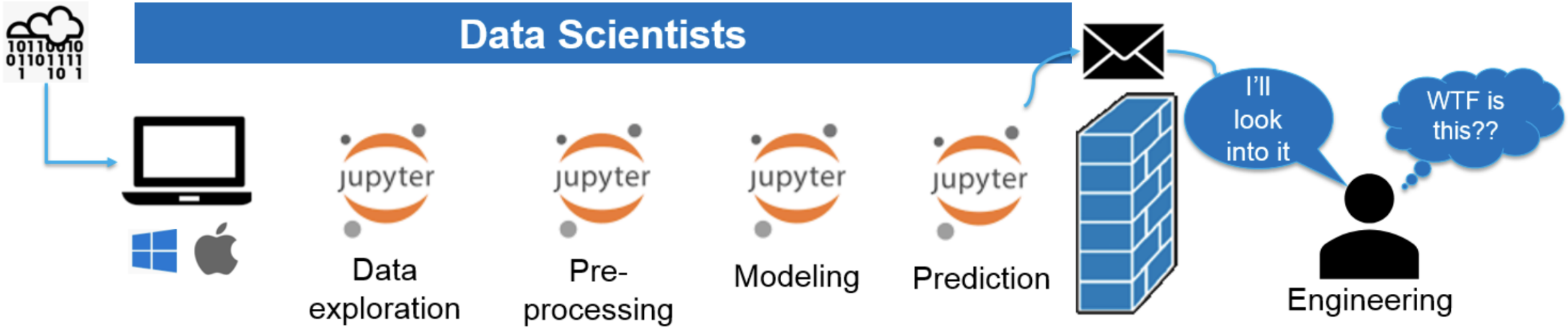


理想



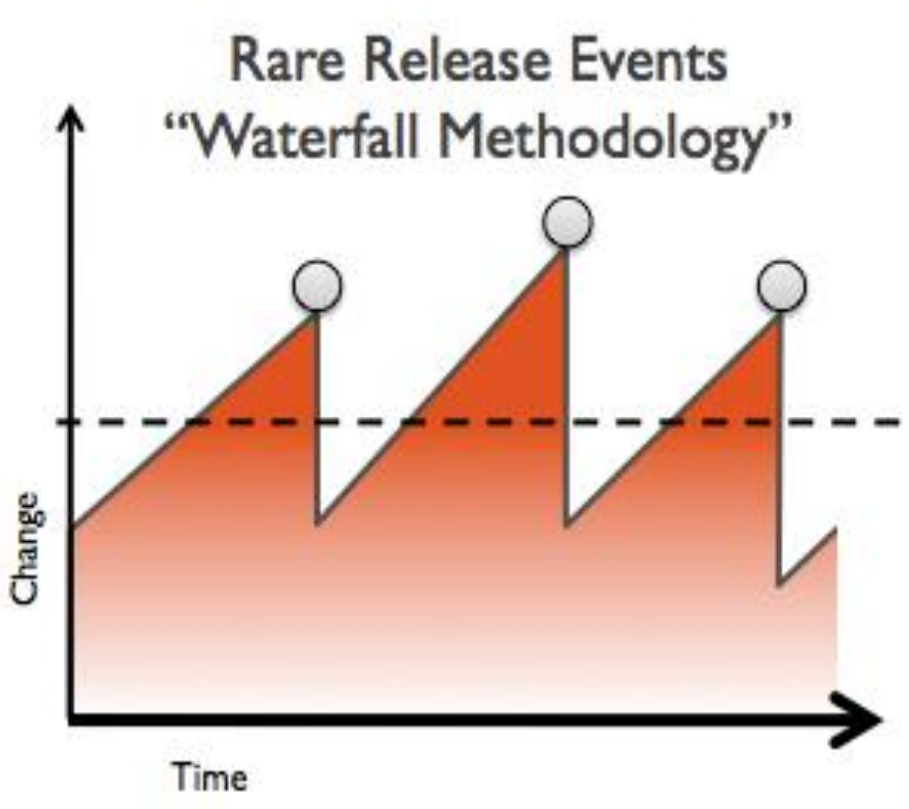
現實

成功實施ML的障礙


Data Scientists
jupyter
jupyter
jupyter
jupyter
Data exploration
Pre-processing
Modeling
Prediction
I'll look into it
WTF is this??
Engineering

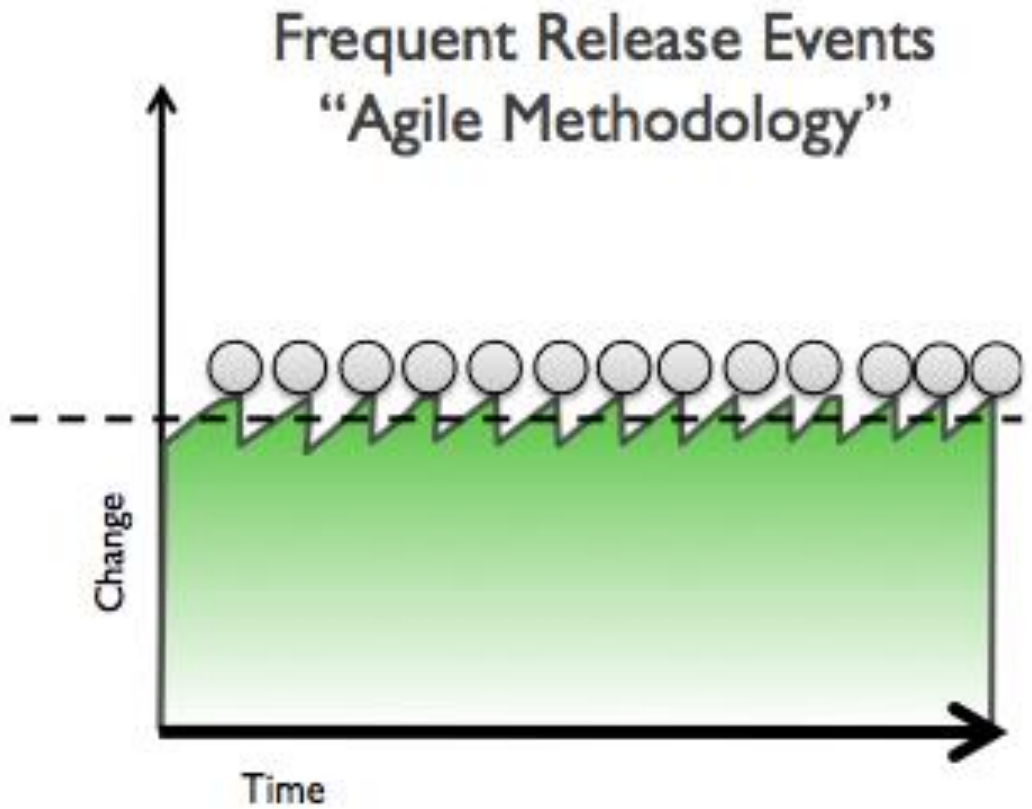

LIFE IS SO HARD

我們不希望.....



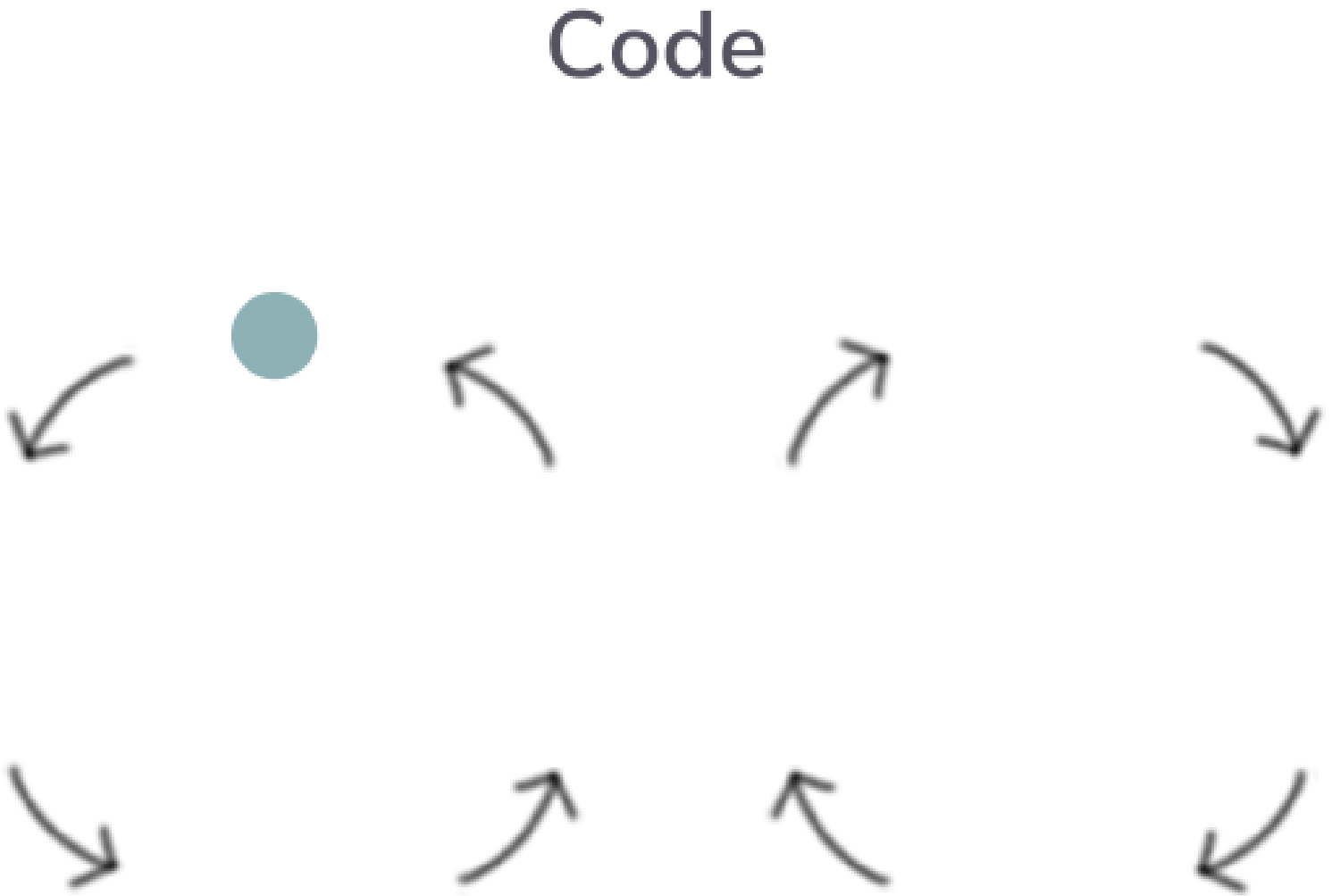
Effort Peaks
High Risk

我們希望.....



Smoother Effort
Less Risk

持續交付不停歇的產生價值



MLOps = ML + DEV + OPS

MLOps

Develop
模型+ 測試
持續整合
持續部署

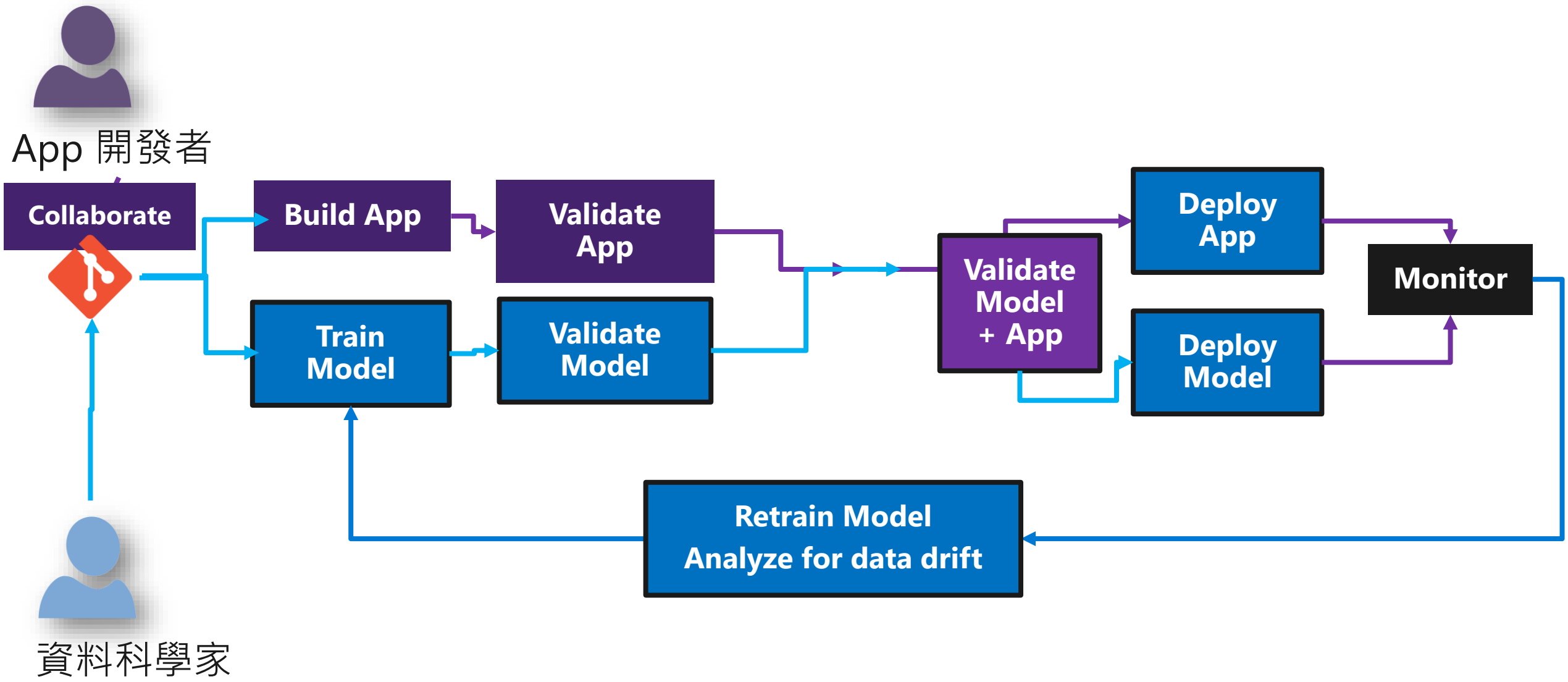
Operate
持續交付
資料品質回饋
系統與模型監控

Experiment
獲取資料
理解業務
模型初始設計

綠字: 機器學習 ， 藍字: DevOps

MLOps 工作流程

MLOps 的工作流程？


App 開發者
Collaborate
Build App
Validate App
Train Model
Validate Model
Validate Model + App
Deploy App
Deploy Model
Monitor
Retrain Model
Analyze for data drift
資料科學家

DevOps vs MLOps

DevOps


Code保存與使用


Code 測試


應用程式部署

MLOps


模型保存與使用


模型驗證


模型部署


模型再訓練

MLOps的工具

ML Experimentation

Training Services


Script Execution

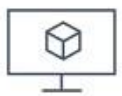

AutoML


HyperDrive

Run History

Compute


ML Compute


ML VMs


Databricks

Storage

Blob Store


Files


Data Lake

ML Ops

Asset Management


Environments **


Code **


Datasets **


Models

Orchestration Services


ML Pipelines


Model Packaging


Model Validation **


Model Deployment **


ML Audit Trail **


Azure DevOps ML Extension **

ML Inference

Real-Time
Azure Kubernetes Service

Batch
Azure ML Compute

Edge
Azure IoT Hub

Monitoring

Experimentation Monitoring

Inference Monitoring

ML Data Drift **

Azure上的ML

Machine Learning on Azure

特定領域的預訓練模型
簡化解決方案開發


Vision


Speech


Language


Web search


Decision

熟悉的數據科學工具
簡化模型開發


Visual Studio Code


Azure Notebooks

Jupyter


Command line

主流的框架
建置進階的深度學習解決方案


PyTorch


TensorFlow

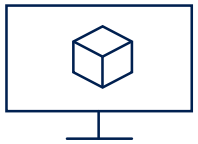
Scikit-Learn


ONNX

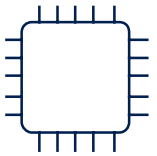
富有成效的服務
增強數據科學和開發團隊的能力

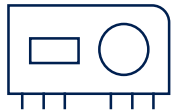

Azure Machine Learning

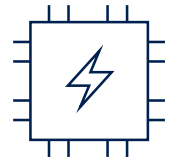

Azure Databricks


Machine Learning VMs

強大的基礎架構
加速深度學習


CPU

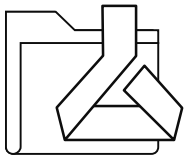

GPU


FPGA

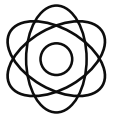

From the Intelligent Cloud to the Intelligent Edge 

Azure Machine Learning

Azure Machine Learning Service

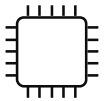


Workspace

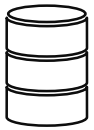


實驗

管線

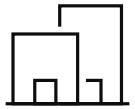


計算



Data Stores

模型

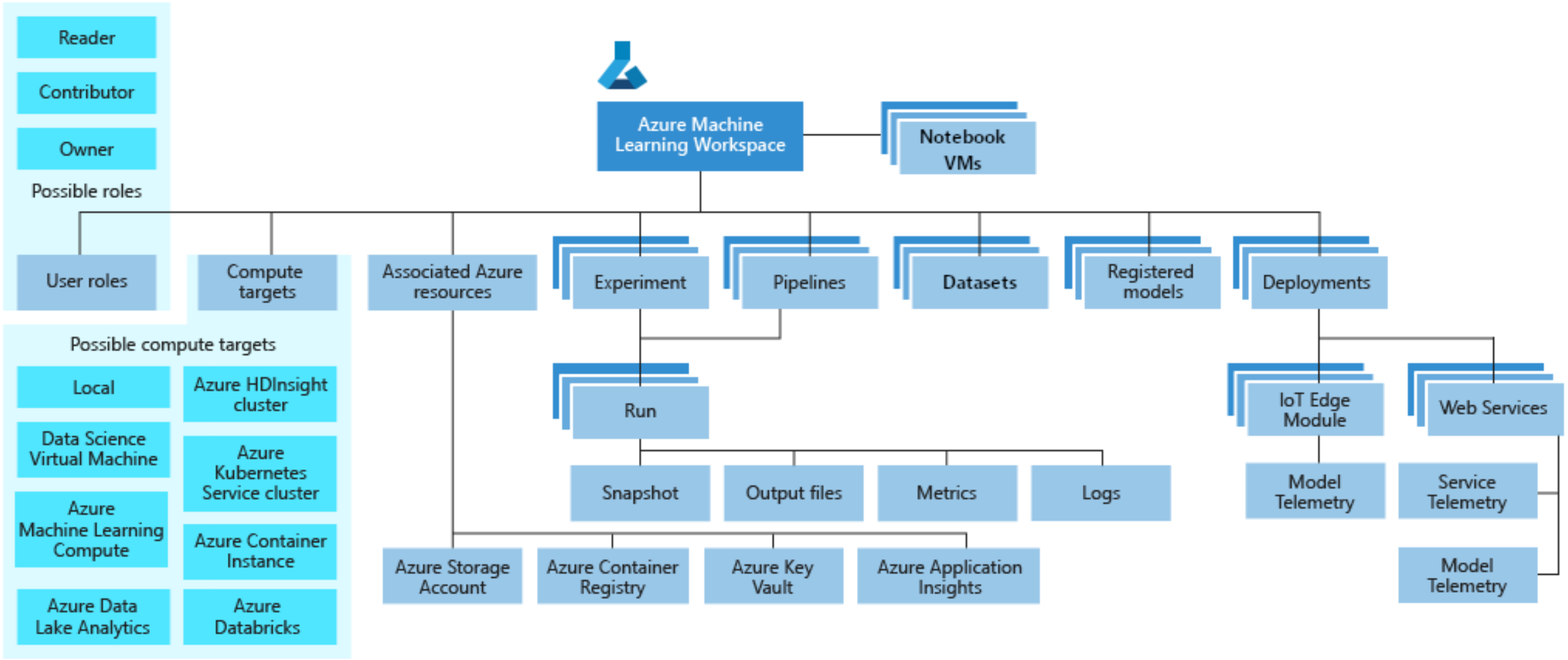


影像

部署

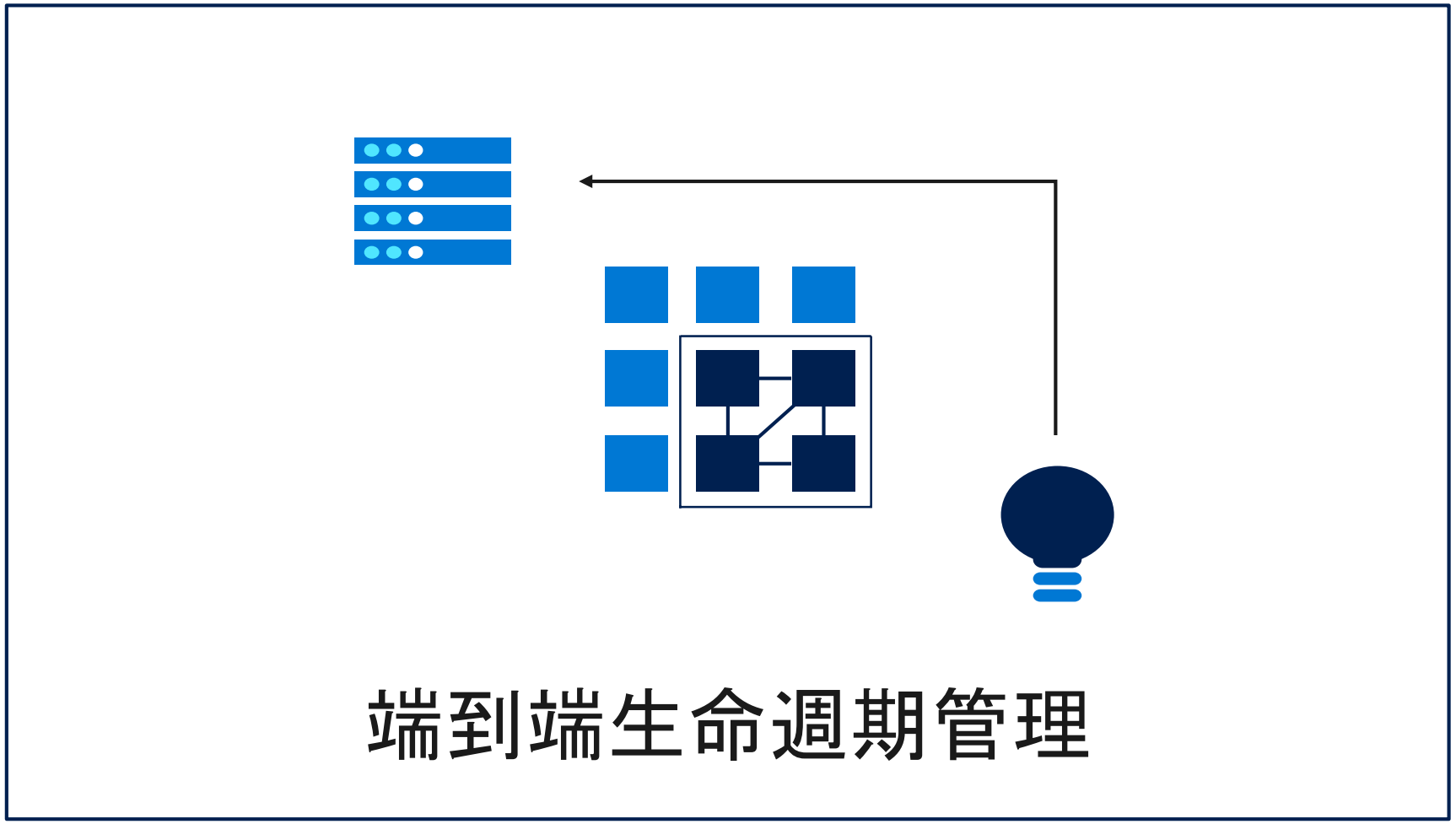
- 使用任何工具和語言
- 共享計算資源
- 註冊版本化模型
- 容器化部署
- 監控效果

Azure Machine Learning workspace

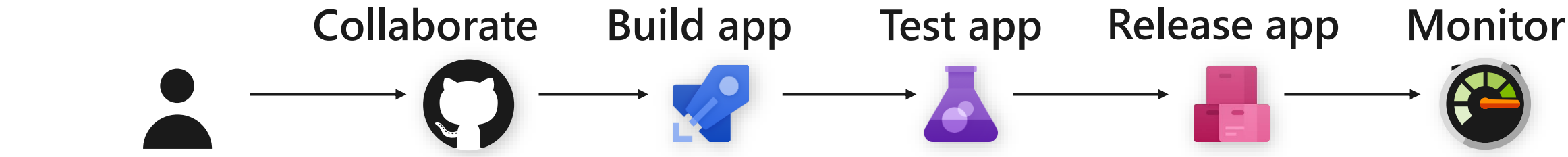


端到端(E2E) ML生命週期

Azure Machine Learning Service



MLOps 工作流程

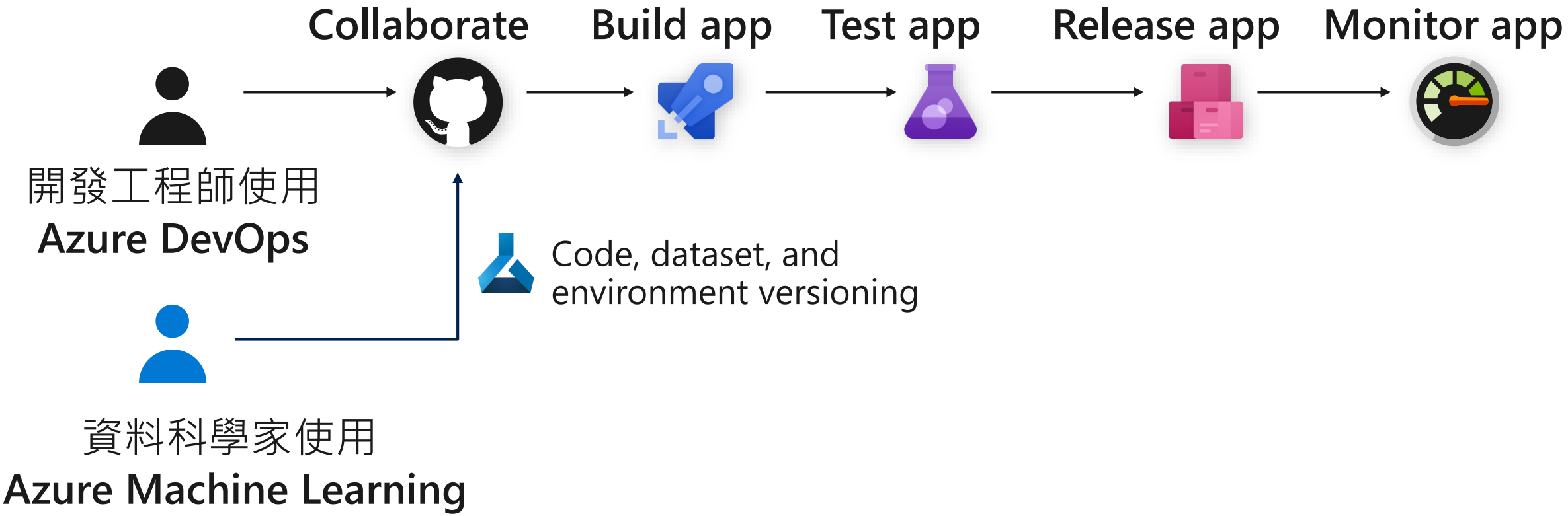


開發工程師
使用 **Azure DevOps**

資料科學家使用
Azure Machine Learning

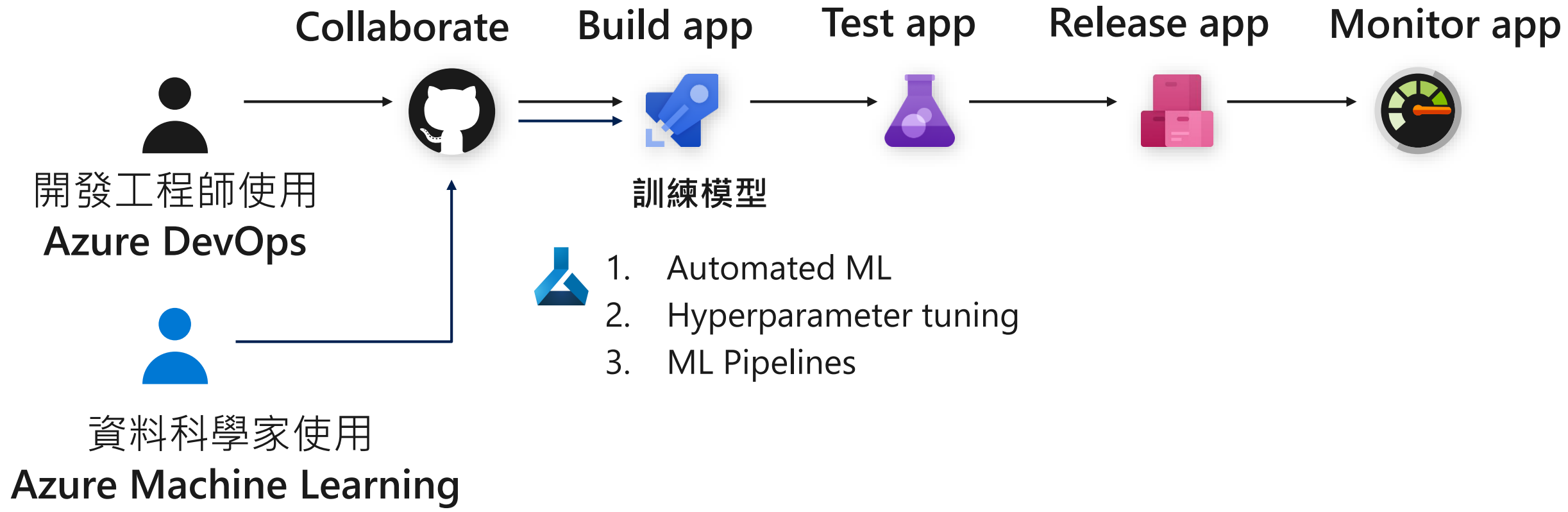
- ✕ 模型重現性
- ✕ 模型驗證
- ✕ 模型部屬
- ✕ 模型再訓練

MLOps 工作流程



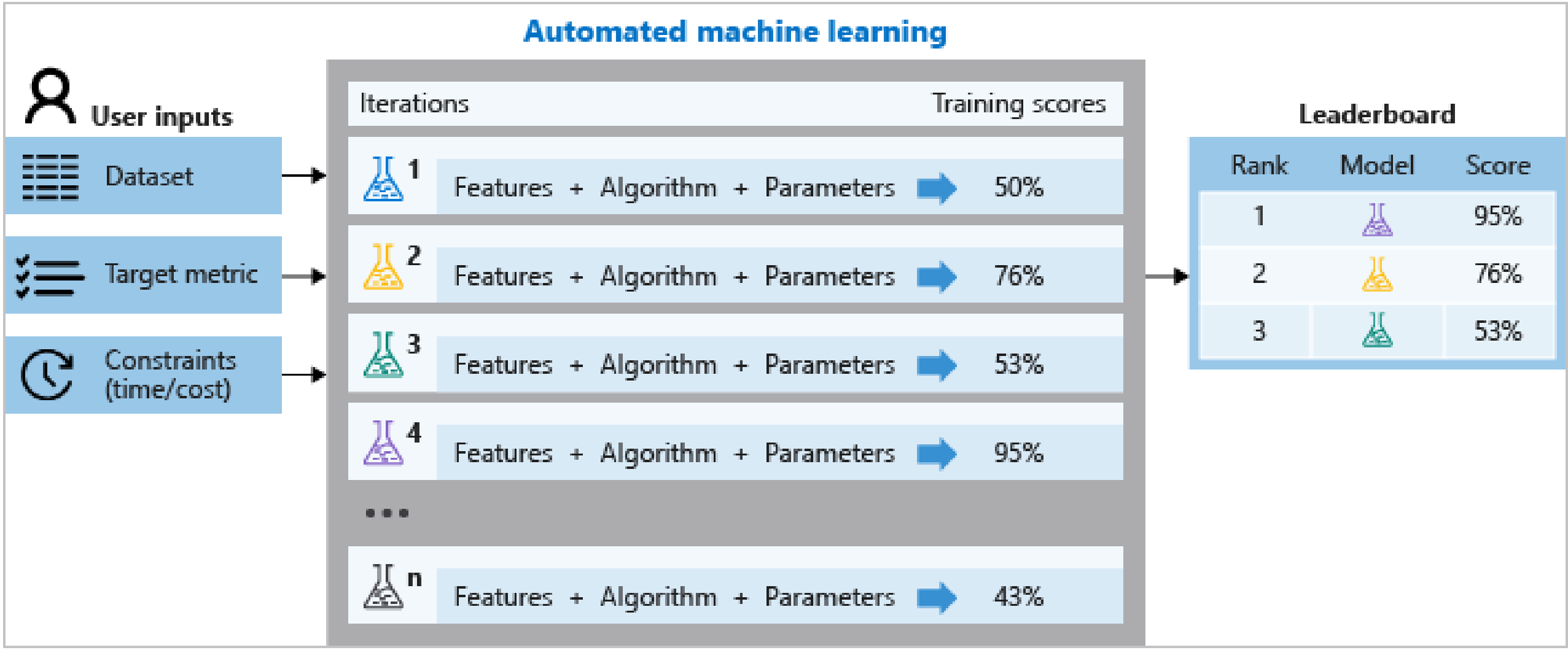
✓ 模型重現性　✗ 模型驗證　✗ 模型部屬　✗ 模型再訓練

MLOps 工作流程



✓ 模型重現性 ✗ 模型驗證 ✗ 模型部屬 ✗ 模型再訓練

自動化 ML 的運作方式


Automated machine learning
User inputs
Dataset
Target metric
Constraints (time/cost)
Iterations
Training scores
1 Features + Algorithm + Parameters 50%
2 Features + Algorithm + Parameters 76%
3 Features + Algorithm + Parameters 53%
4 Features + Algorithm + Parameters 95%
n Features + Algorithm + Parameters 43%
Leaderboard
Rank Model Score
1 95%
2 76%
3 53%

自己動手做**AutoML-**
使用**Python SDK**

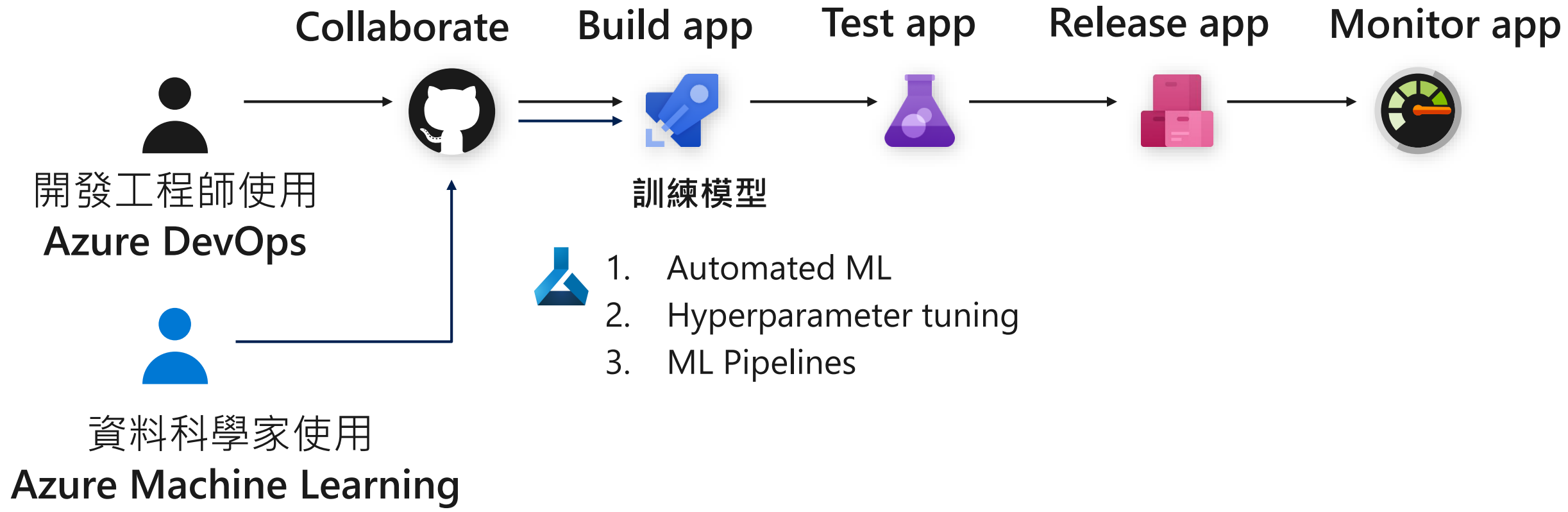
https://is.gd/PMUvgF

自動化 ML的分類計量

計量	說明	計算	額外的參數
AUC_Macro	AUC 是「接收者作業特性曲線」下方的面積。 Macro 是每個類別 AUC 的算術平均值。	計算	average="macro"
AUC_Micro	AUC 是「接收者作業特性曲線」下方的面積。 微的計算方式是將每個類別的真肯定和假陽性結合在一起。	計算	average="micro"
AUC_Weighted	AUC 是「接收者作業特性曲線」下方的面積。 加權是每個類別的分數算術平均值，以每個類別中 true 實例的數目加權。	計算	average="weighted"
精確度	精確度是完全符合 true 標籤的預測標籤百分比。	計算	None

https://docs.microsoft.com/zh-tw/azure/machine-learning/service/how-to-understand-automated-ml

MLOps 工作流程



✓ 模型重現性 ✗ 模型驗證 ✗ 模型部屬 ✗ 模型再訓練

自己動手做
Hyperparameter tuning
使用Python SDK

https://is.gd/z7jhyA

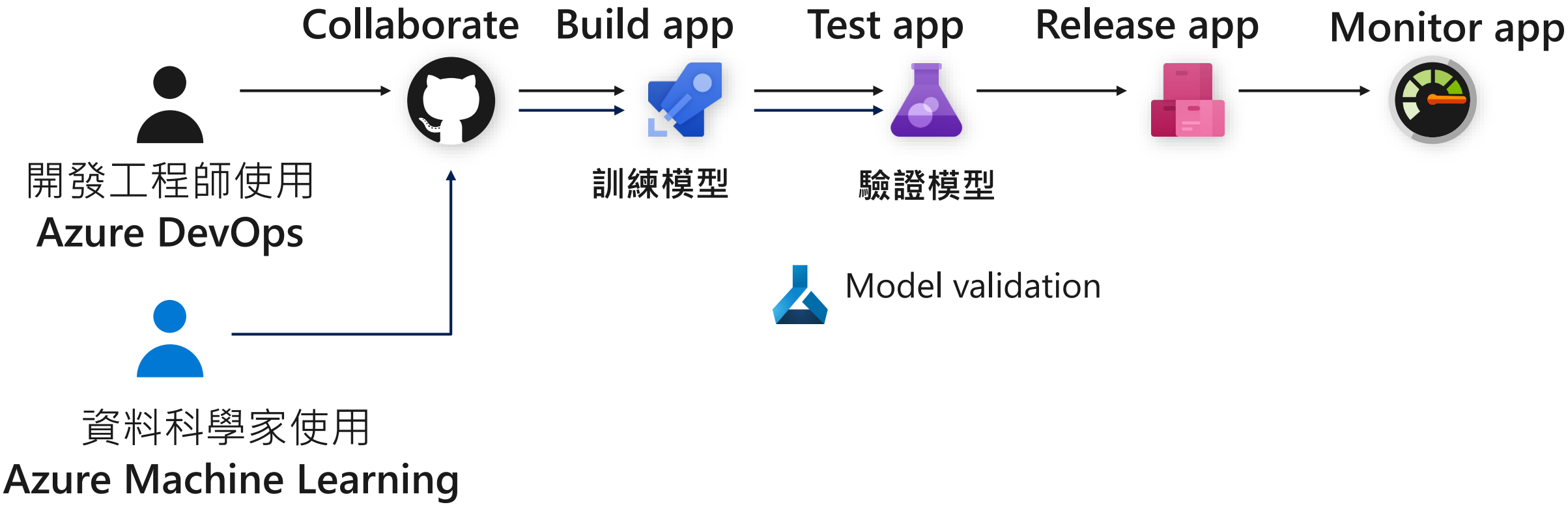
自己動手做

schedule-for-a-published-pipeline

使用Python SDK

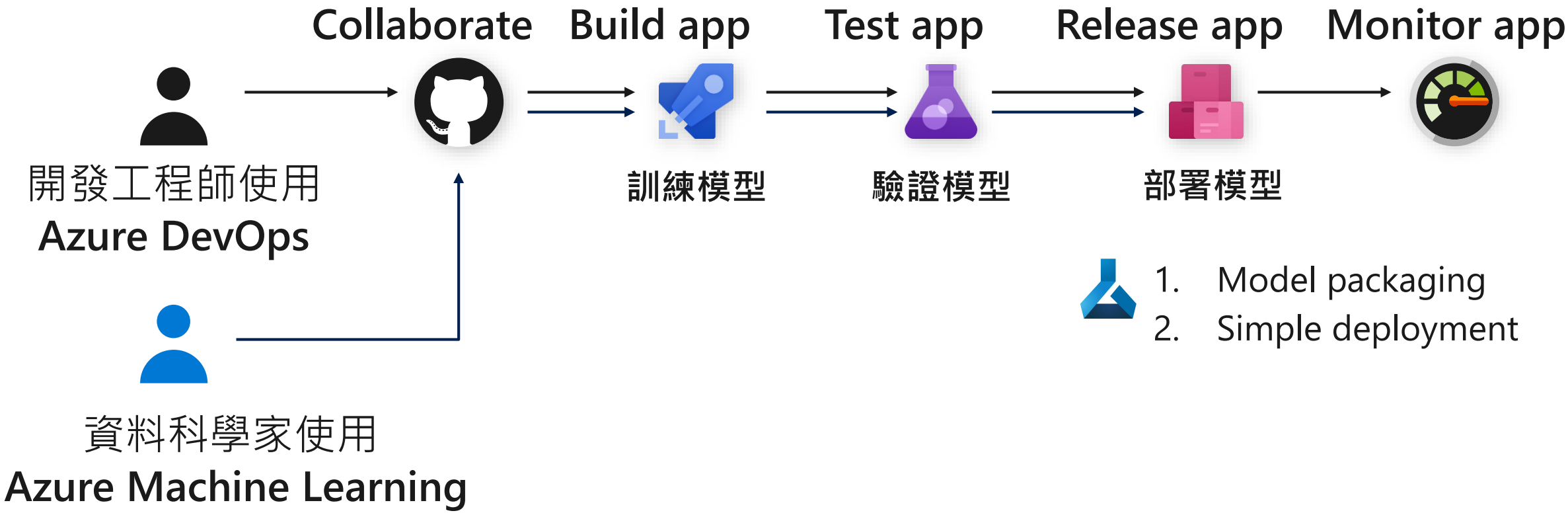
https://is.gd/393S1F

MLOps 工作流程



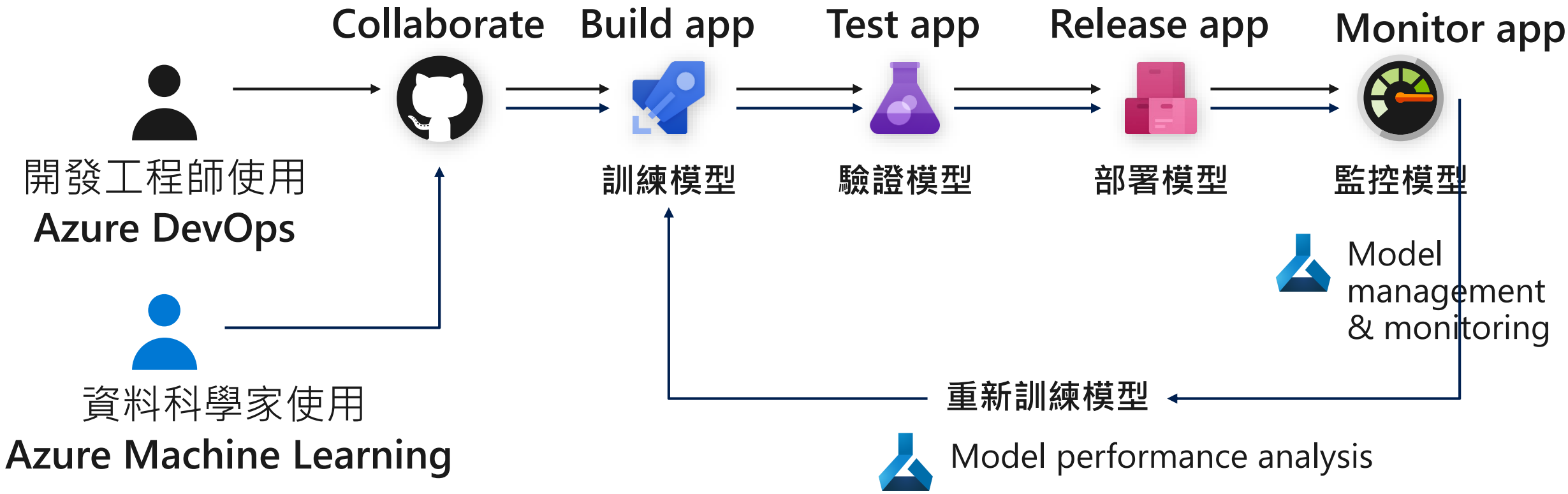
✓ 模型重現性　✓ 模型驗證　✗ 模型部屬　✗ 模型再訓練

MLOps 工作流程



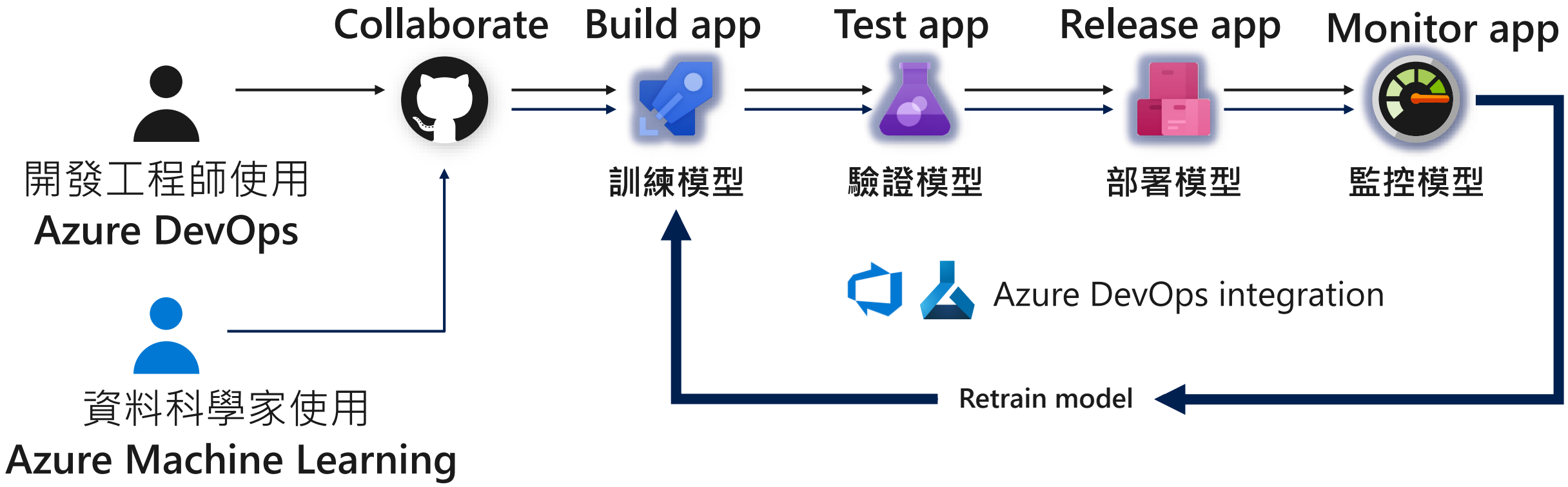
✓ 模型重現性　✓ 模型驗證　✓ 模型部屬　✗ 模型再訓練

MLOps with Azure Machine Learning



✓ 模型重現性 ✓ 模型驗證 ✓ 模型部屬 ✓ 模型再訓練

MLOps with Azure Machine Learning



✓ 模型重現性 ✓ 模型驗證 ✓ 模型部屬 ✓ 模型再訓練


Code creation
Code testing
Model creation
Model validation
Packaging
Deployment
Quality assurance
Production

Demo

Sample code

https://is.gd/8Bld2A

Three Pipelines

Azure DevOps :

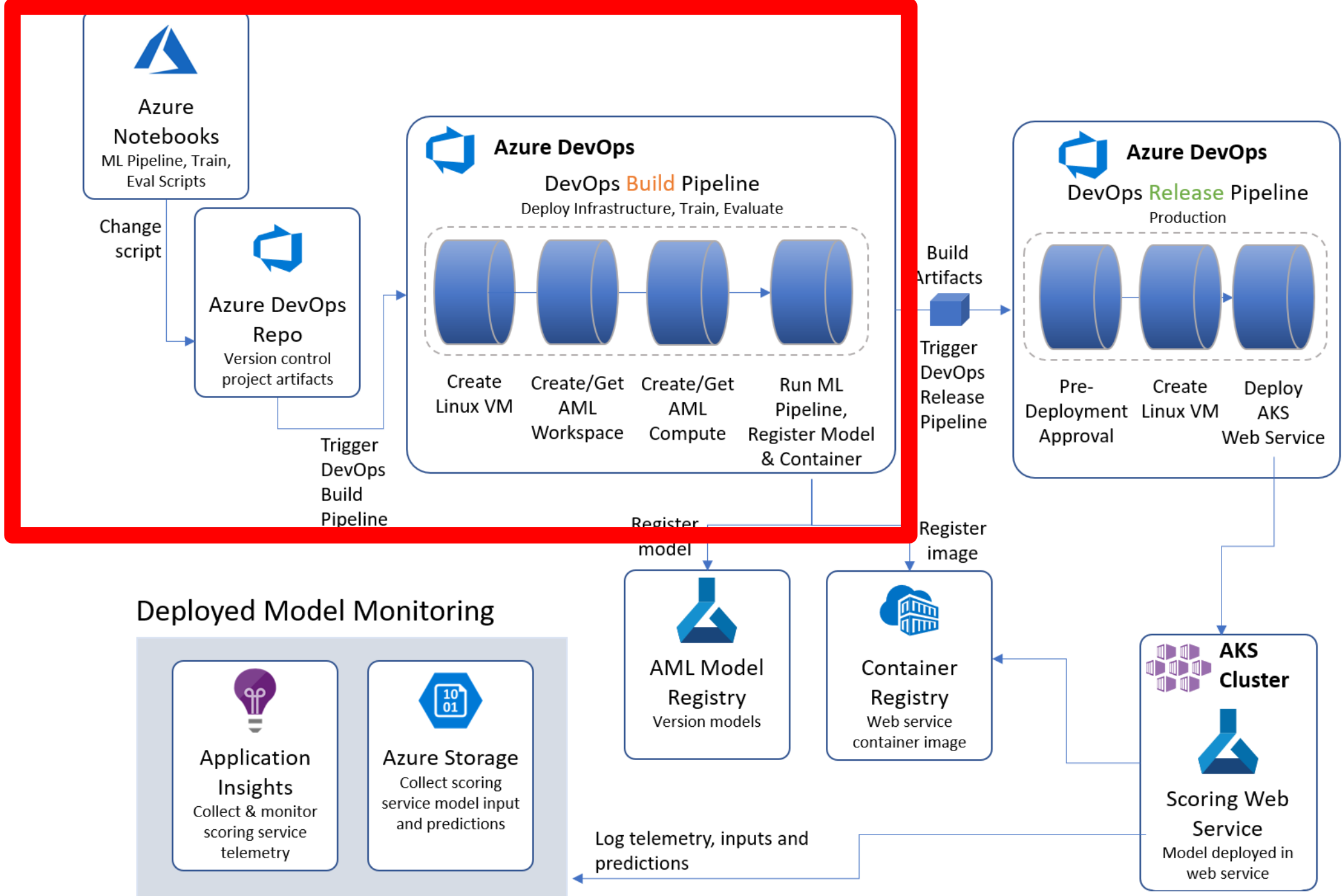
- Azure DevOps **Build** Pipeline
- Azure DevOps **Release** Pipeline

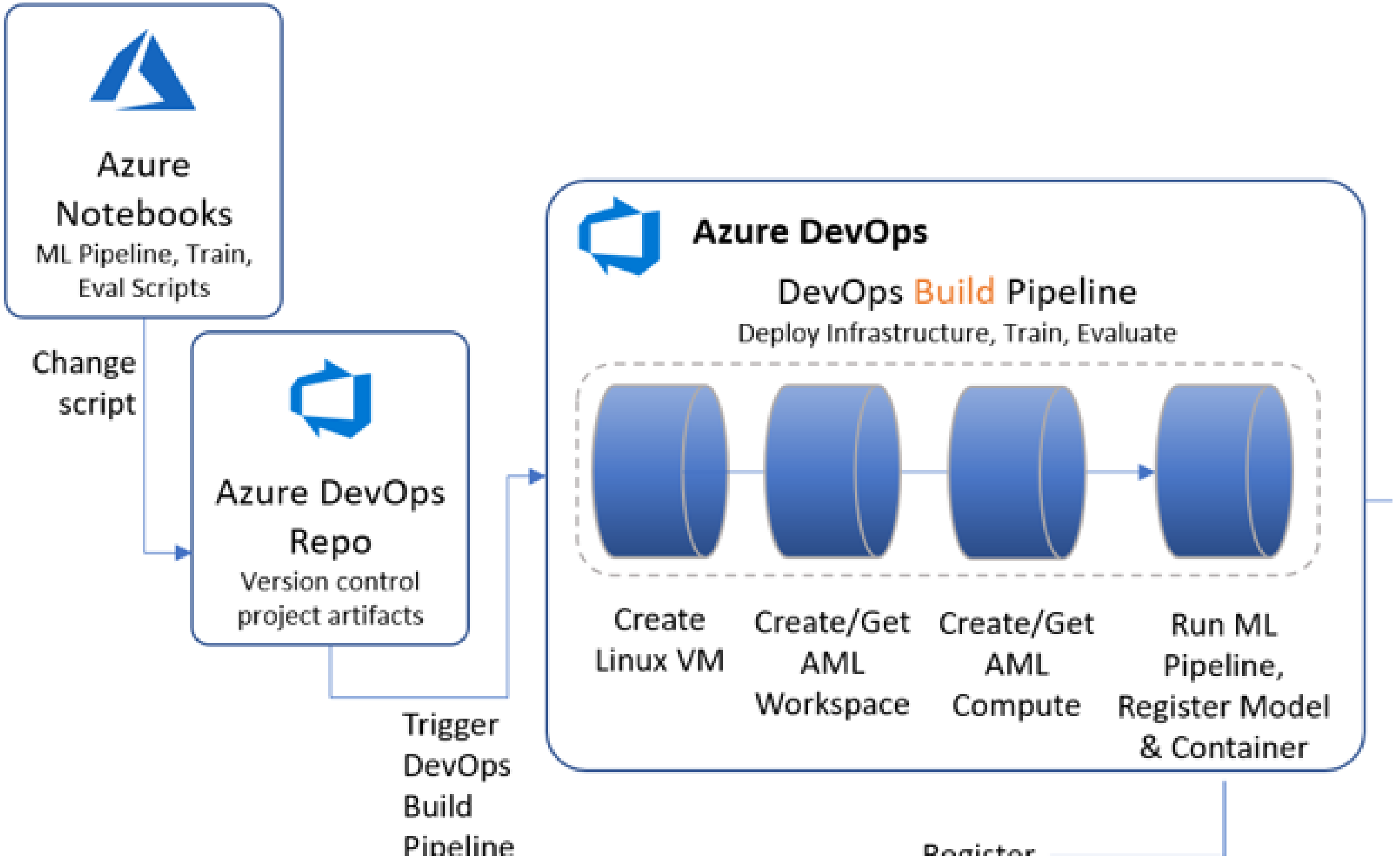
Azure Machine Learning Service :

- Azure Machine Learning Service Pipeline

Input Data

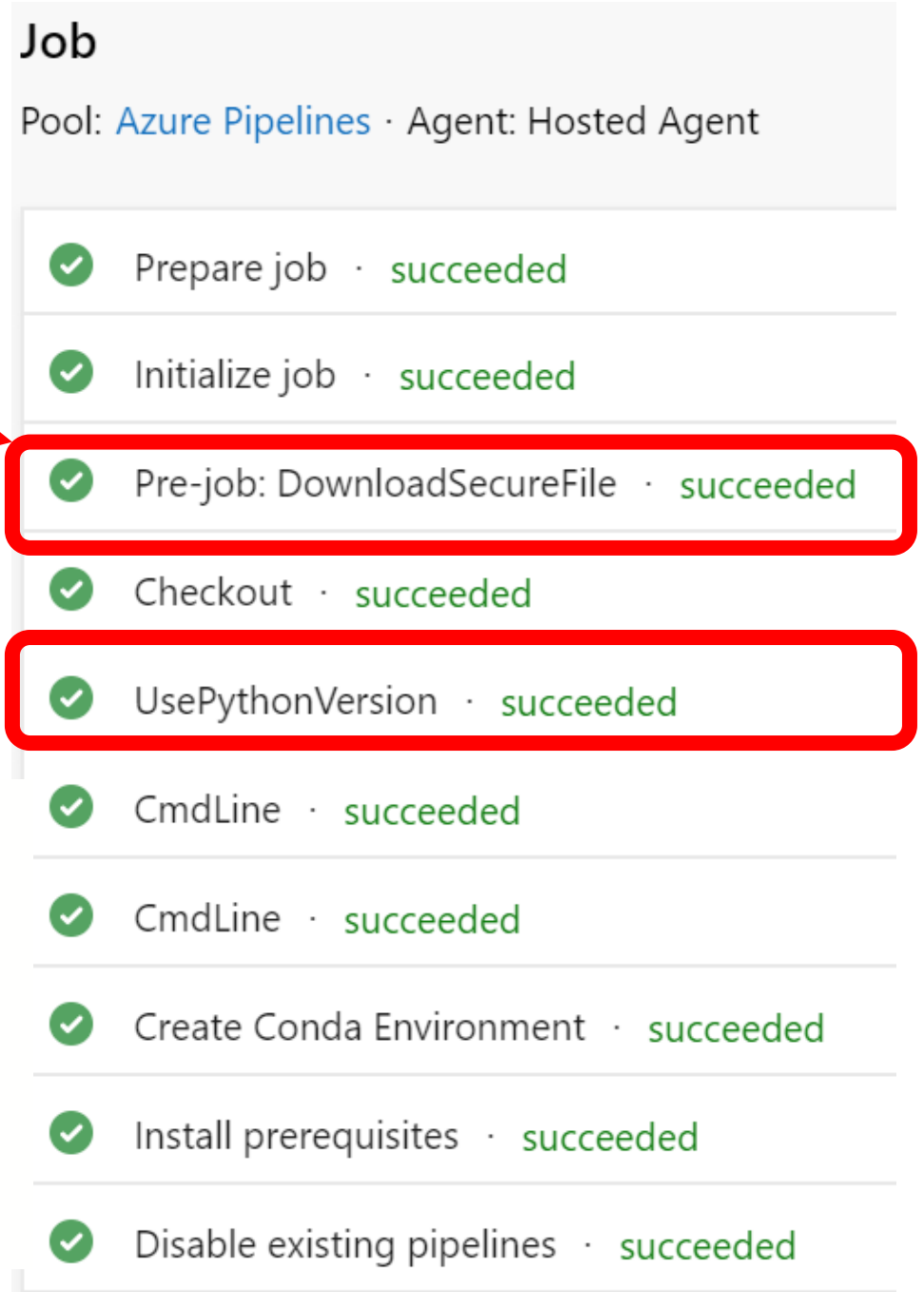
	A	B	C	D
1	text	label		
2	good condition carbon fiber component manufactured in 201	0		
3	good condition carbon fiber component manufactured in 199	1		
4	manufactured in 2018 made of carbon fiber in good conditio	0		
5	manufactured in 2018 made of carbon fiber in poor conditio	1		
6	manufactured in 1996 made of steel in good condition	0		
7	manufactured in 1971 made of steel in good condition	1		
8	carbon fiber component manufactured in 2011 in good condi	0		
9	carbon fiber component manufactured in 1986 in good condi	1		
10	good condition steel component manufactured in 2002	0		
11	poor condition steel component manufactured in 2002	1		
12	manufactured in 2019 made of carbon fiber in new conditior	0		
13	manufactured in 2019 made of carbon fiber in fair condition	1		
14	manufactured in 2003 made of steel in new condition	0		
15	manufactured in 1978 made of steel in new condition	1		
16	new condition carbon fiber component manufactured in 199	0		


Azure Notebooks
ML Pipeline, Train, Eval Scripts
Change script
Azure DevOps Repo
Version control project artifacts
Trigger DevOps Build Pipeline
Azure DevOps
DevOps Build Pipeline
Deploy Infrastructure, Train, Evaluate
Create Linux VM
Create/Get AML Workspace
Create/Get AML Compute
Run ML Pipeline, Register Model & Container
Build Artifacts
Trigger DevOps Release Pipeline
Azure DevOps
DevOps Release Pipeline
Production
Pre-Deployment Approval
Create Linux VM
Deploy AKS Web Service
Register model
Register image
AML Model Registry
Version models
Container Registry
Web service container image
AKS Cluster
Scoring Web Service
Model deployed in web service
Deployed Model Monitoring
Application Insights
Collect & monitor scoring service telemetry
Azure Storage
Collect scoring service model input and predictions
Log telemetry, inputs and predictions

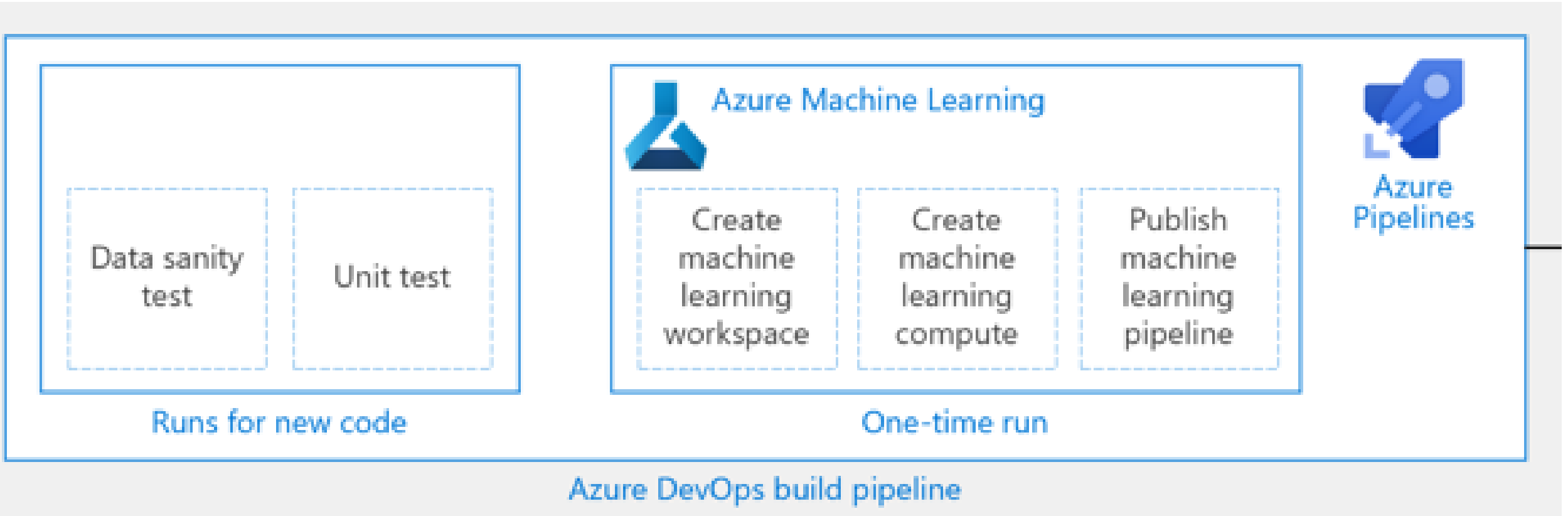

Azure
Notebooks
ML Pipeline, Train,
Eval Scripts
Change
script
Azure DevOps
Repo
Version control
project artifacts
Trigger
DevOps
Build
Pipeline
Azure DevOps
DevOps Build Pipeline
Deploy Infrastructure, Train, Evaluate
Create
Linux VM
Create/Get
AML
Workspace
Create/Get
AML
Compute
Run ML
Pipeline,
Register Model
& Container

Azure Devops 建置管線 - yml

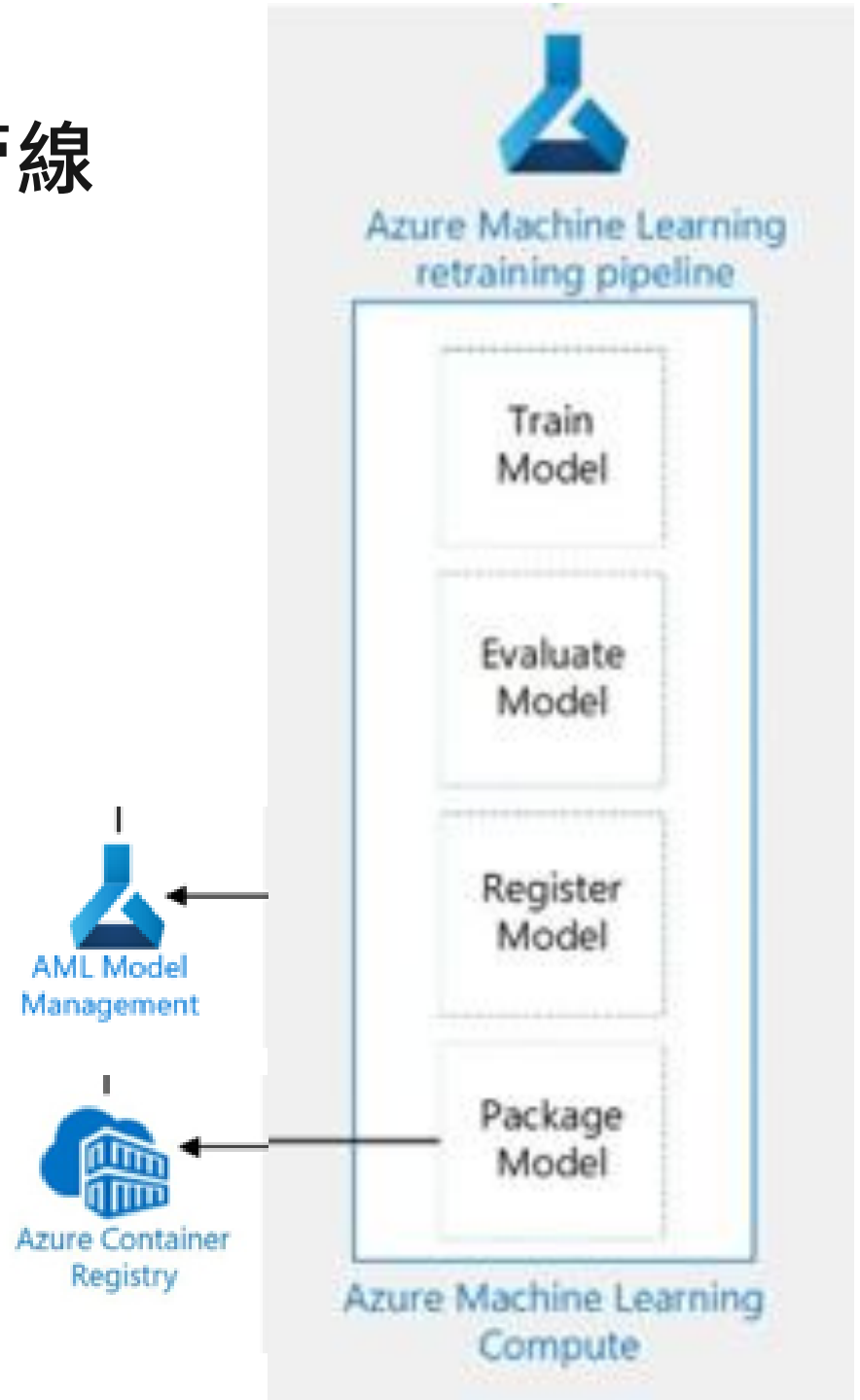
```yaml
steps:
- task: DownloadSecureFile@1
  inputs:
    name: configFile
    secureFile: jennie_config.json


- task: UsePythonVersion@0
  inputs:
    versionSpec: 3.6
    architecture: 'x64'
```

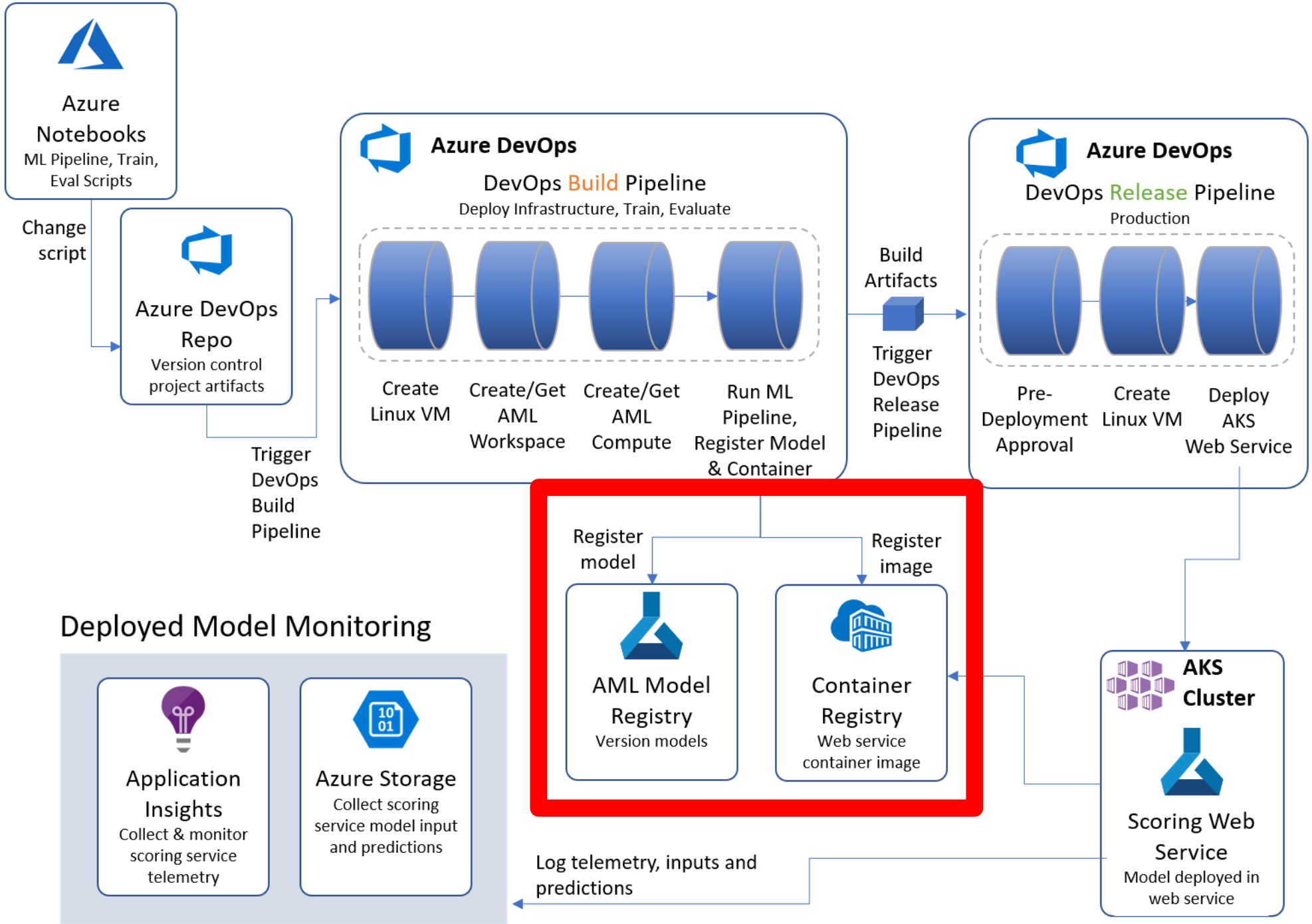


Build 管線


Azure Machine Learning
Data sanity test
Unit test
Create machine learning workspace
Create machine learning compute
Publish machine learning pipeline
Azure Pipelines
Runs for new code
One-time run
Azure DevOps build pipeline

Azure Mmachine Learning 管線




Azure Notebooks
ML Pipeline, Train, Eval Scripts
Change script
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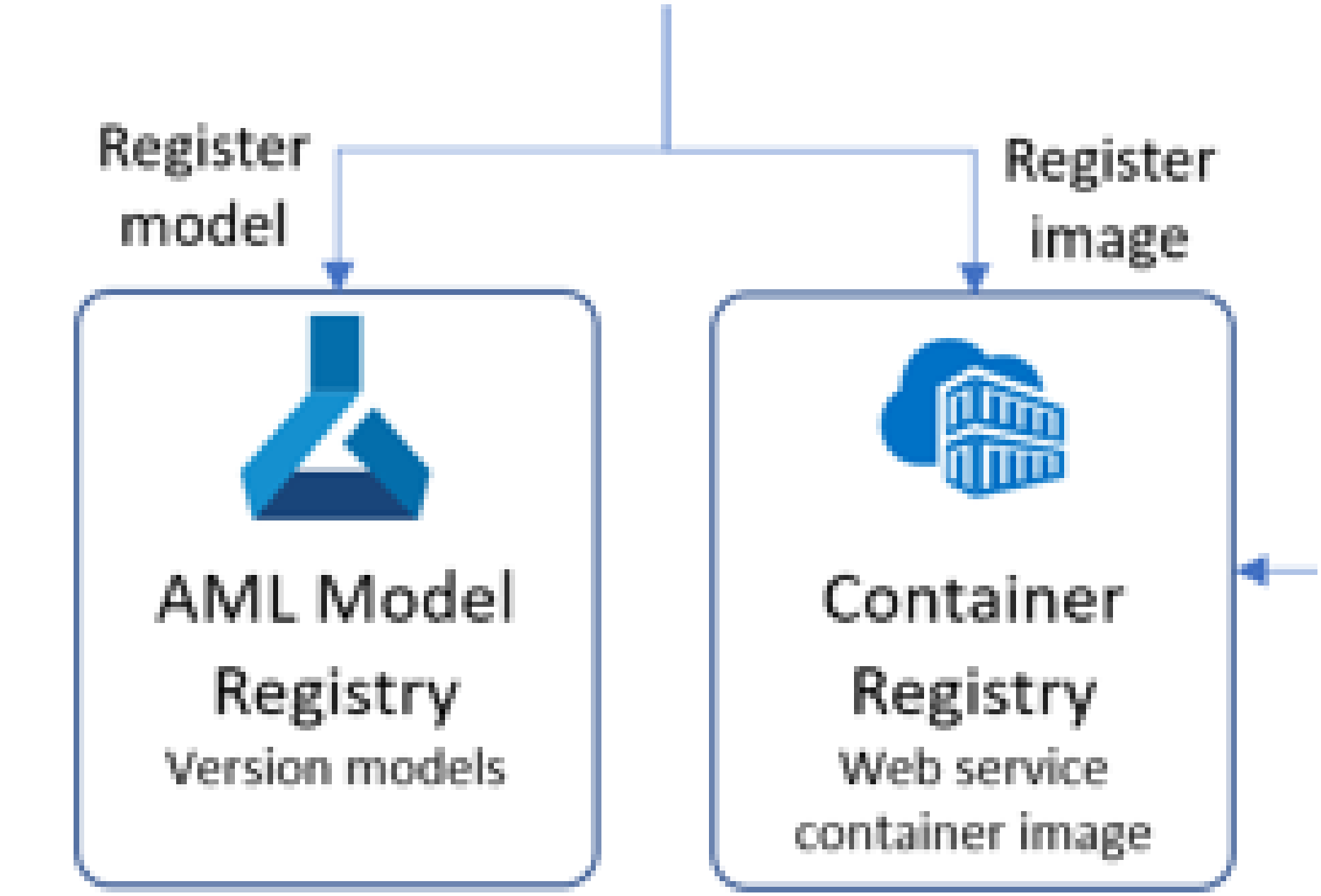
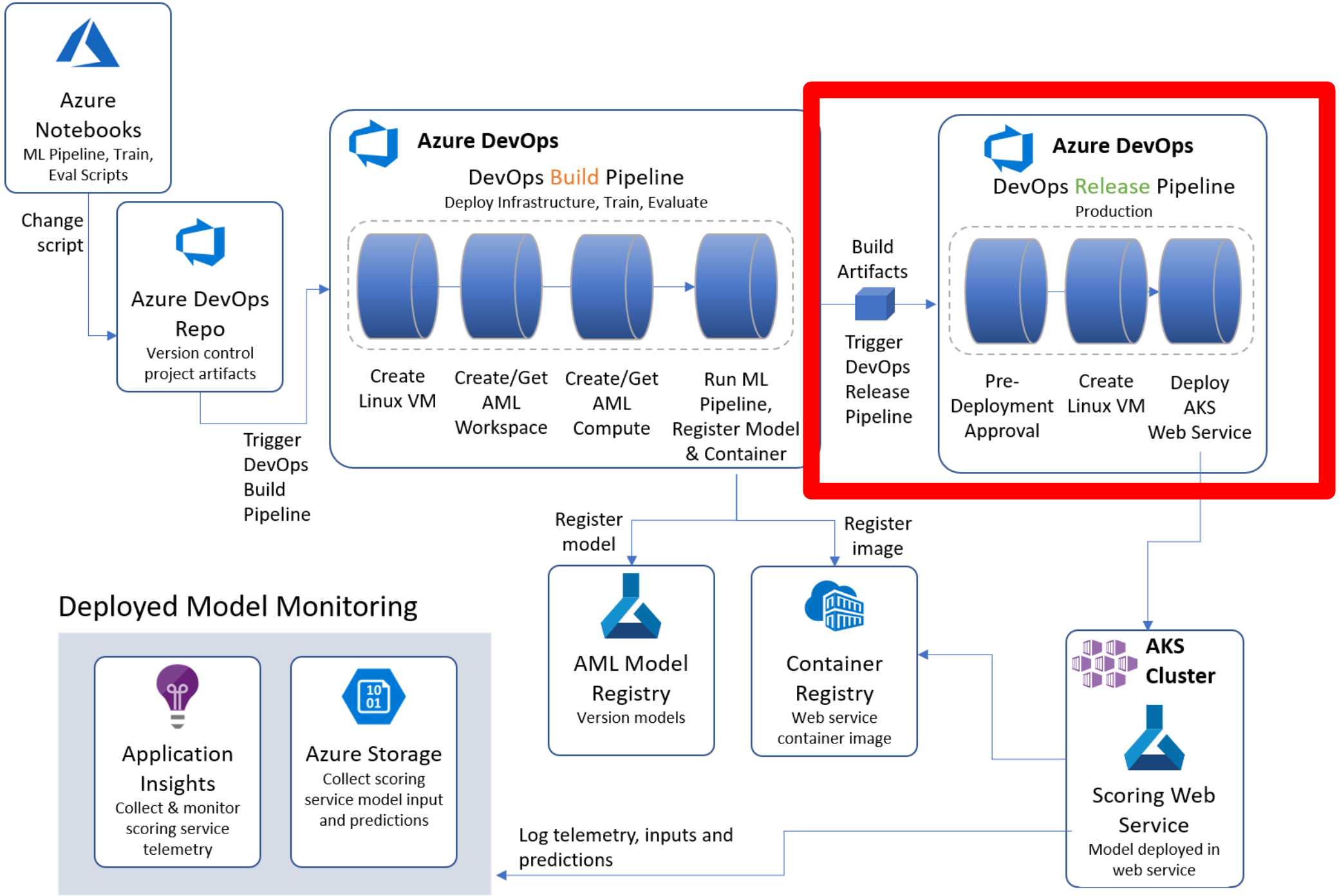
Trigger DevOps Build Pipeline
Azure DevOps
DevOps Build Pipeline
Deploy Infrastructure, Train, Evaluate
Create Linux VM
Create/Get AML Workspace
Create/Get AML Compute
Run ML Pipeline, Register Model & Container
Build Artifacts
Trigger DevOps Release Pipeline
Azure DevOps
DevOps Release Pipeline
Production
Pre-Deployment Approval
Create Linux VM
Deploy AKS Web Service
Register model
Register image
AML Model Registry
Version models
Container Registry
Web service container image
AKS Cluster
Scoring Web Service
Model deployed in web service
Deployed Model Monitoring
Application Insights
Collect & monitor scoring service telemetry
Azure Storage
Collect scoring service model input and predictions
Log telemetry, inputs and predictions


Register model
Register image
AML Model Registry
Version models
Container Registry
Web service container image


Azure Notebooks
ML Pipeline, Train, Eval Scripts
Change script
Azure DevOps Repo
Version control project artifacts
Trigger DevOps Build Pipeline
Azure DevOps
DevOps Build Pipeline
Deploy Infrastructure, Train, Evaluate
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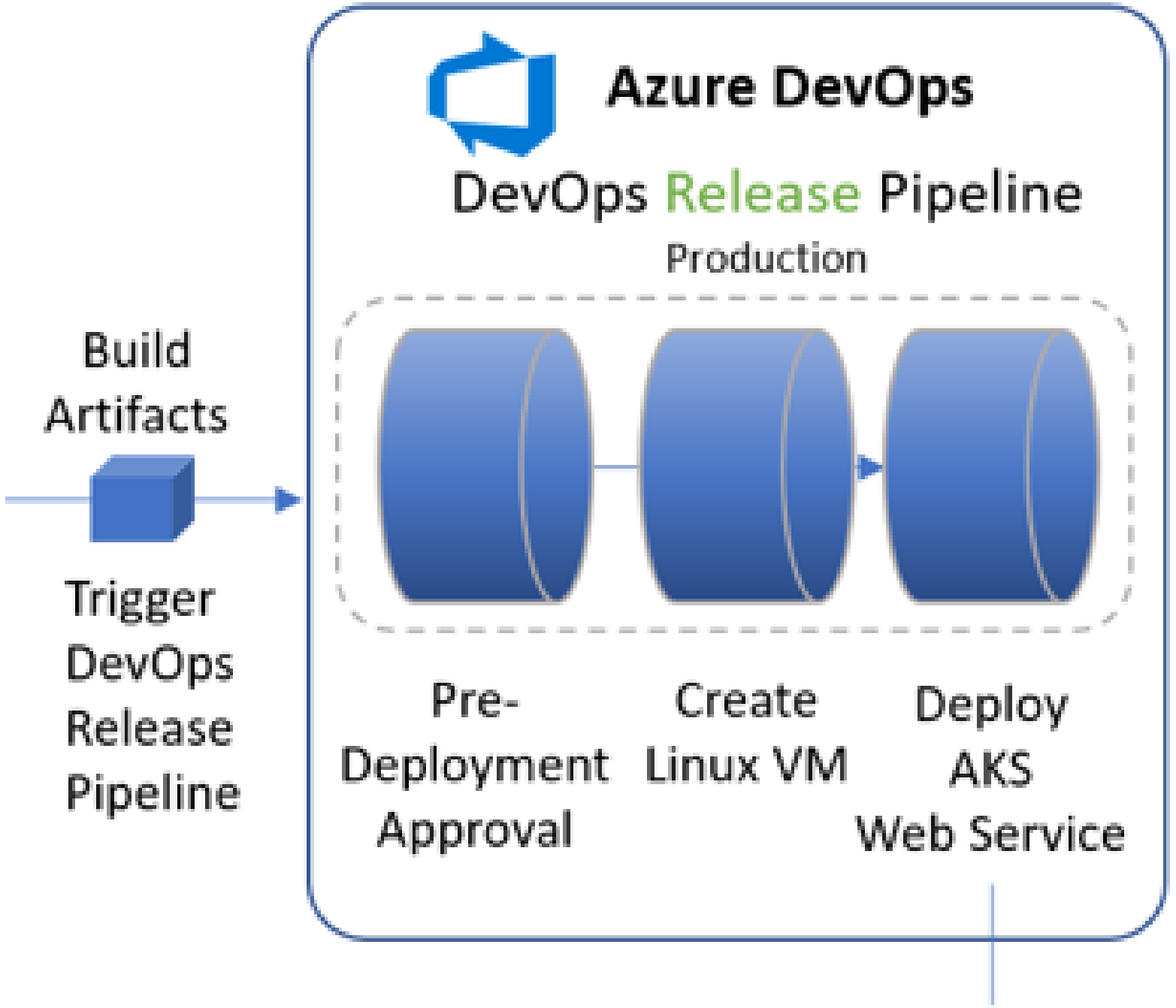
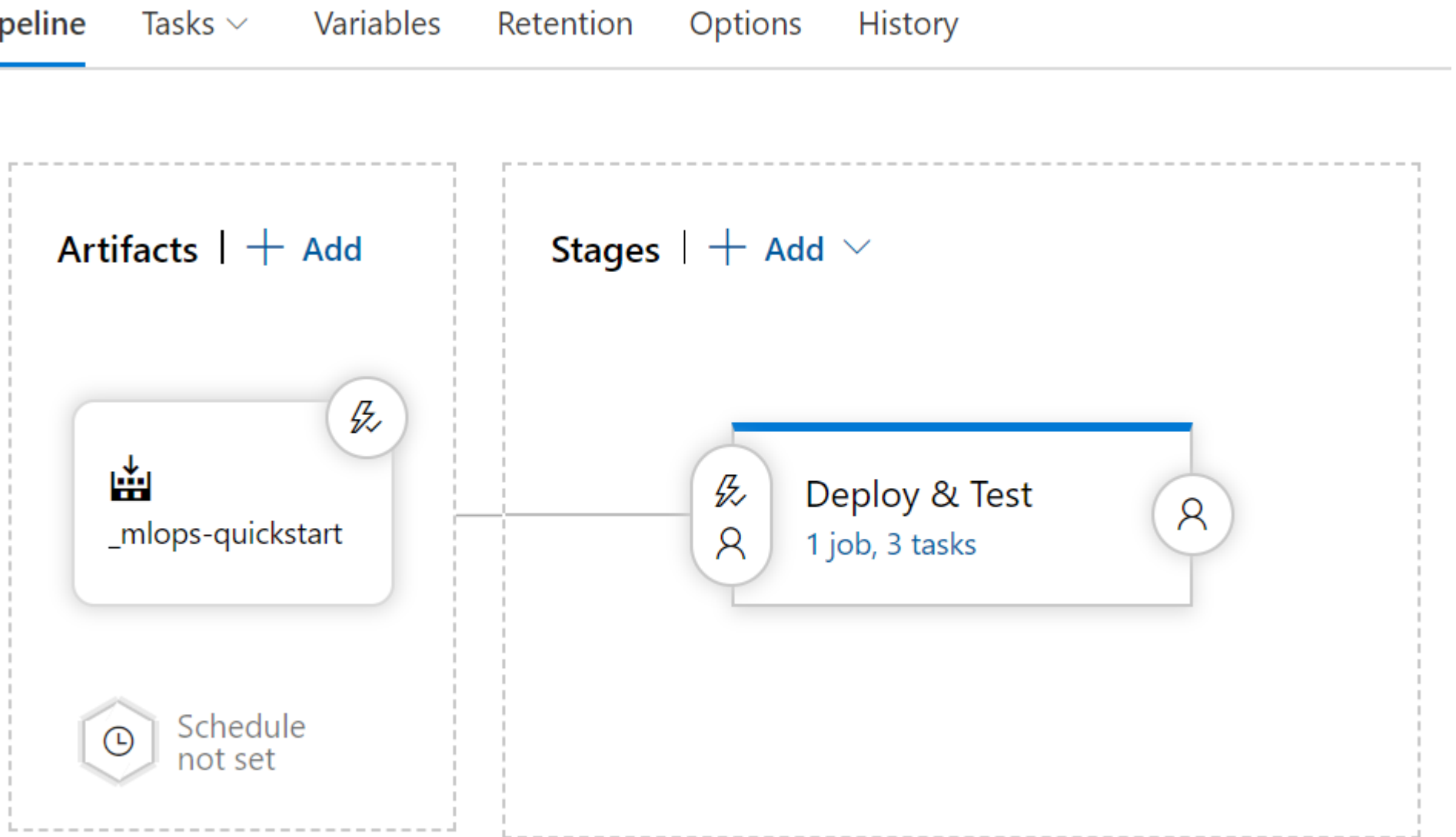
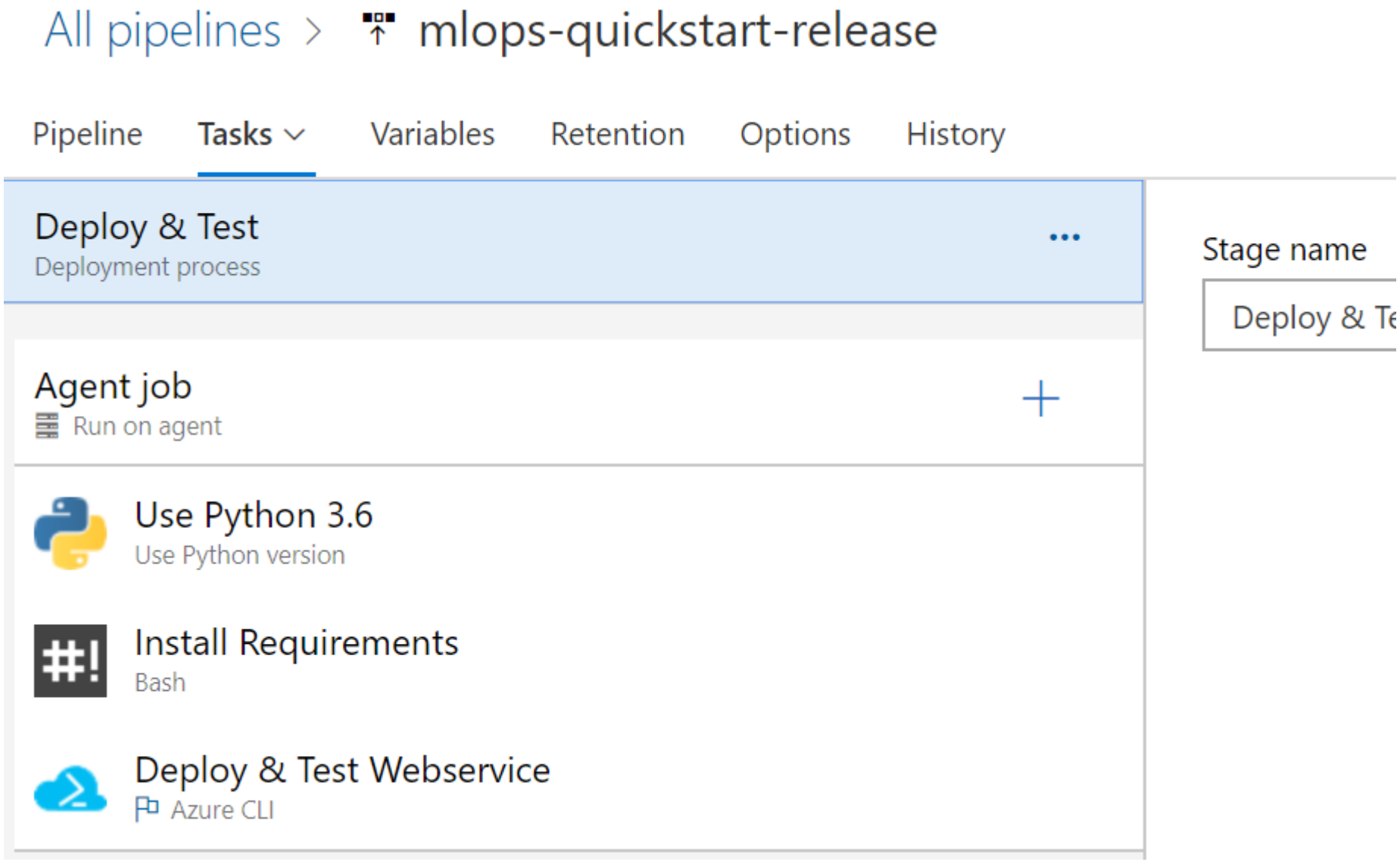

Azure DevOps
DevOps Release Pipeline
Production
Build
Artifacts
Trigger
DevOps
Release
Pipeline
Pre-
Deployment
Approval
Create
Linux VM
Deploy
AKS
Web Service

Release 管線


Pipeline
Tasks
Variables
Retention
Options
History
Artifacts | Add
_mlops-quickstart
Schedule
not set
Stages | Add
Deploy & Test
1 job, 3 tasks

Release 管線 裡面的Job & Task



Pipeline | Tasks | Variables | Retention | Options | History

Deploy & Test
Deployment process

Agent job
Run on agent

- **Use Python 3.6**
  Use Python version
- **Install Requirements**
  Bash
- **Deploy & Test Webservice**
  Azure CLI

Use Python version

Task version: 0.*

Display name *: Use Python 3.6

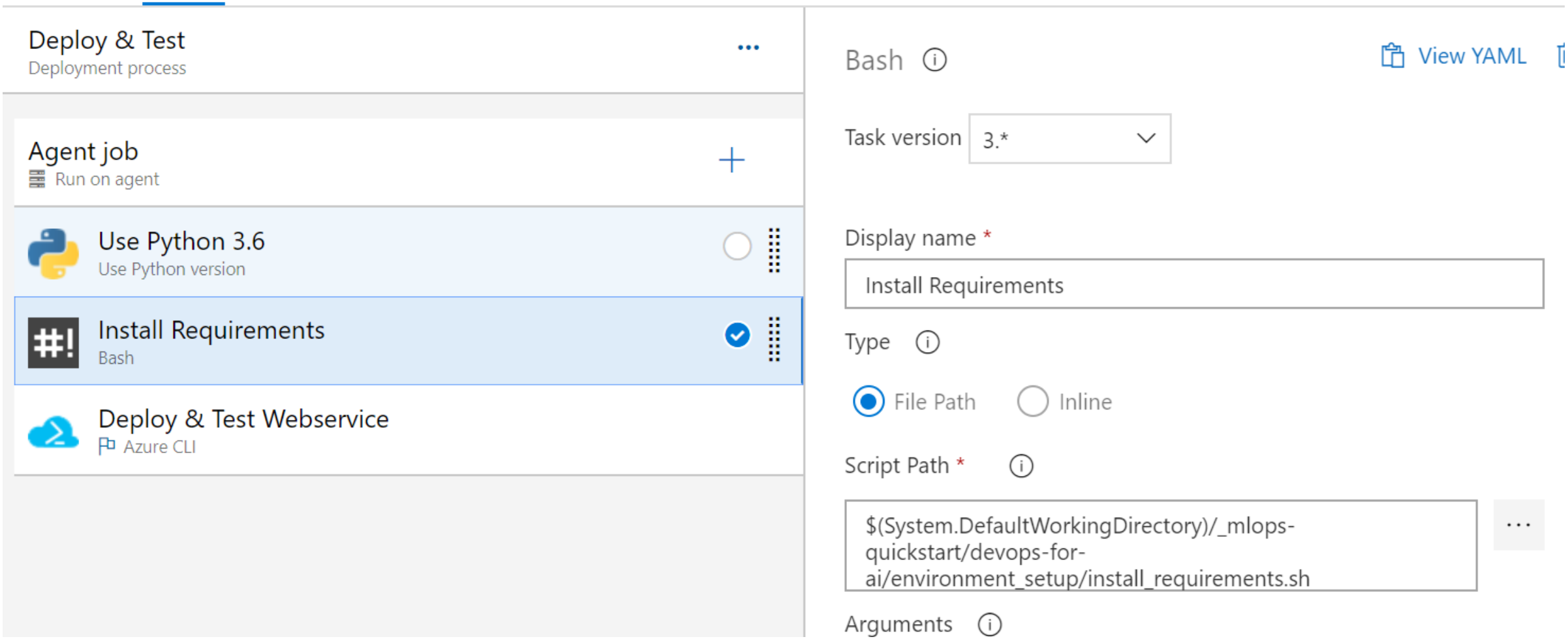
Version spec *: 3.6

Add to PATH

Advanced

Control Options

Output Variables


Deploy & Test
Deployment process
Agent job
Run on agent
Use Python 3.6
Use Python version
Install Requirements
Bash
Deploy & Test Webservice
Azure CLI
Bash
View YAML
Task version
3.*
Display name *
Install Requirements
Type
File Path
Inline
Script Path *
$(System.DefaultWorkingDirectory)/_mlops-quickstart/devops-for-ai/environment_setup/install_requirements.sh
Arguments

Pipeline | Tasks | Variables | Retention | Options | History

Deploy & Test
Deployment process

Agent job
Run on agent

Use Python 3.6
Use Python version

Install Requirements
Bash

Deploy & Test Webservice
Azure CLI

Display name *
Deploy & Test Webservice

Azure subscription * | Manage

quick-starts-sc

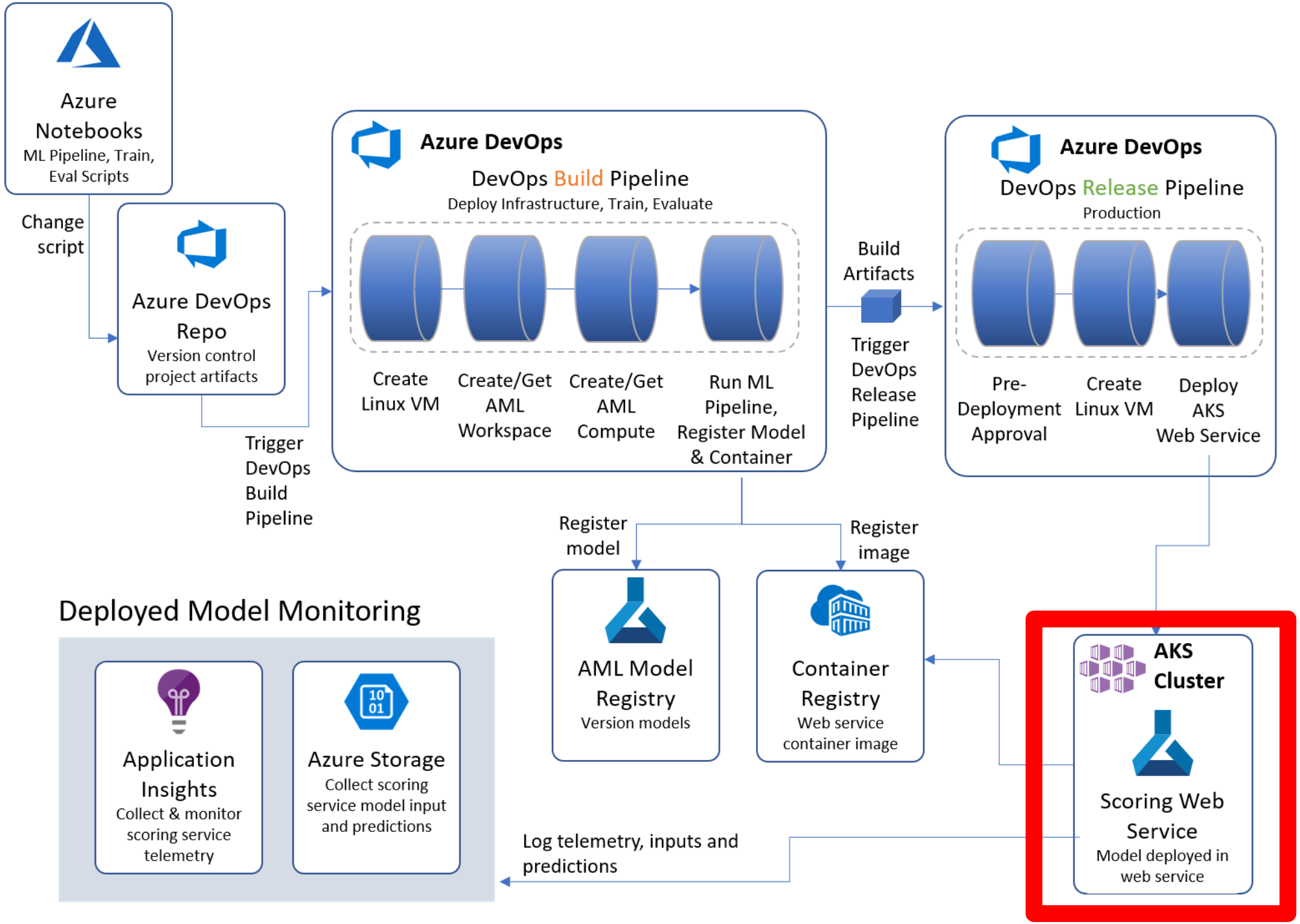
Scoped to resource group 'test20191105'

Script Location *

Inline script

Inline Script *

```
python aml_service/deploy.py --service_name $(service_name) --aks_name $(aks_name) --aks_region $(aks_region) --description $(description)
```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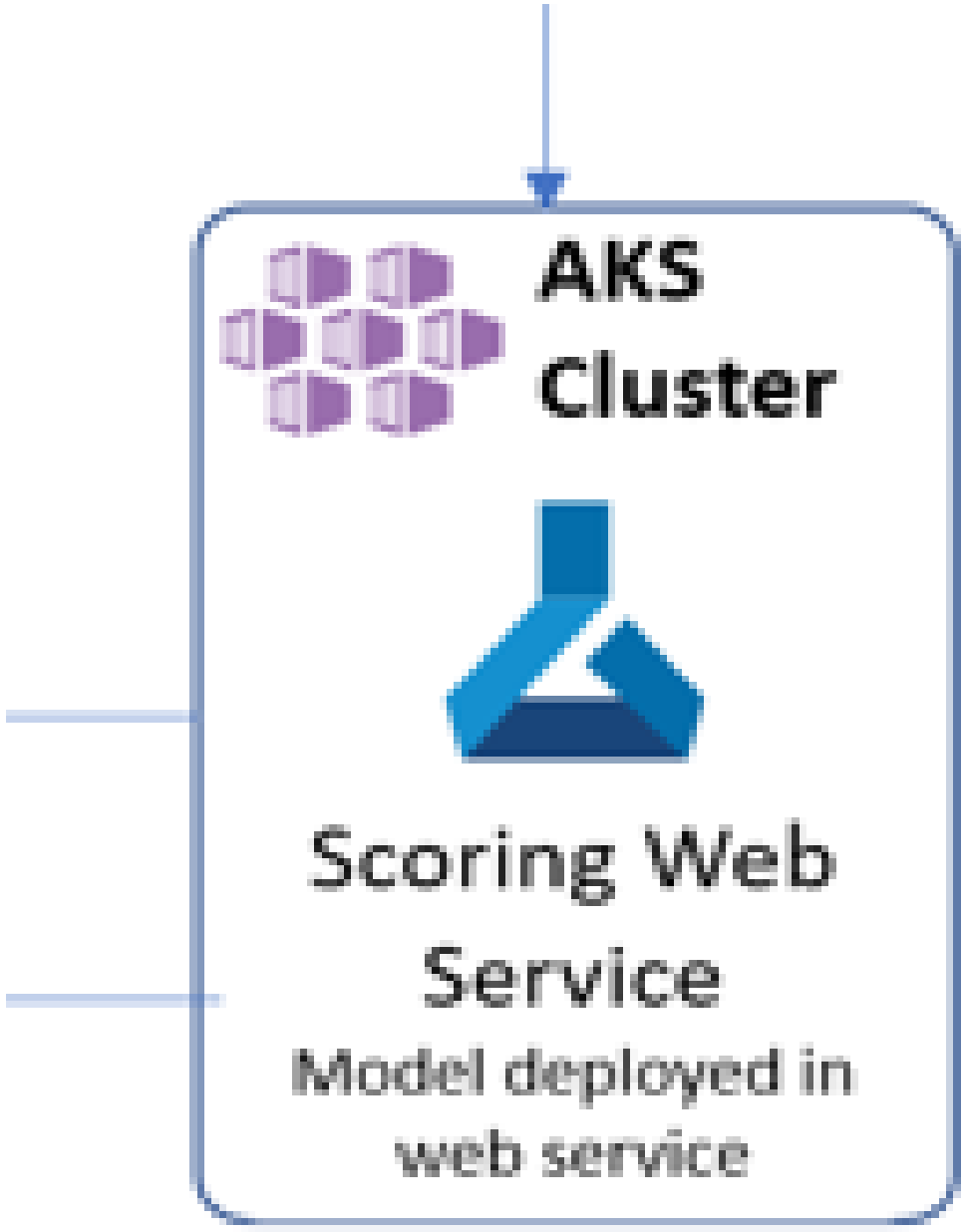
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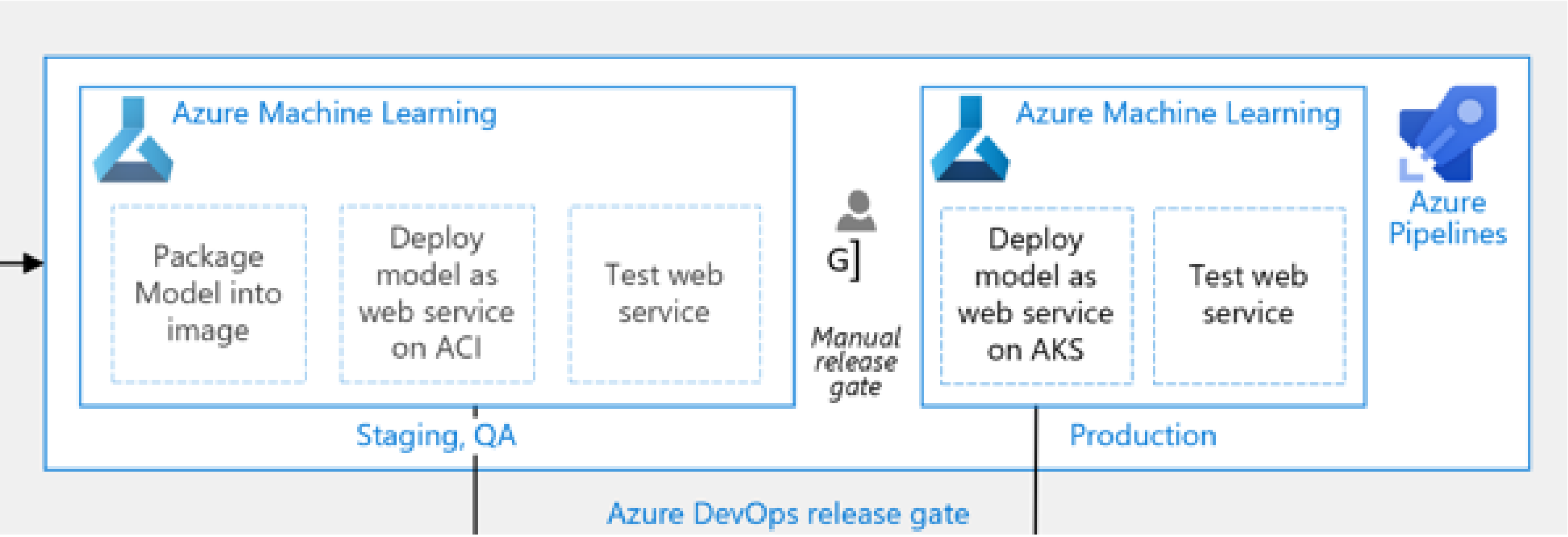
Cluster
Scoring Web
Service
Model deployed in
web service

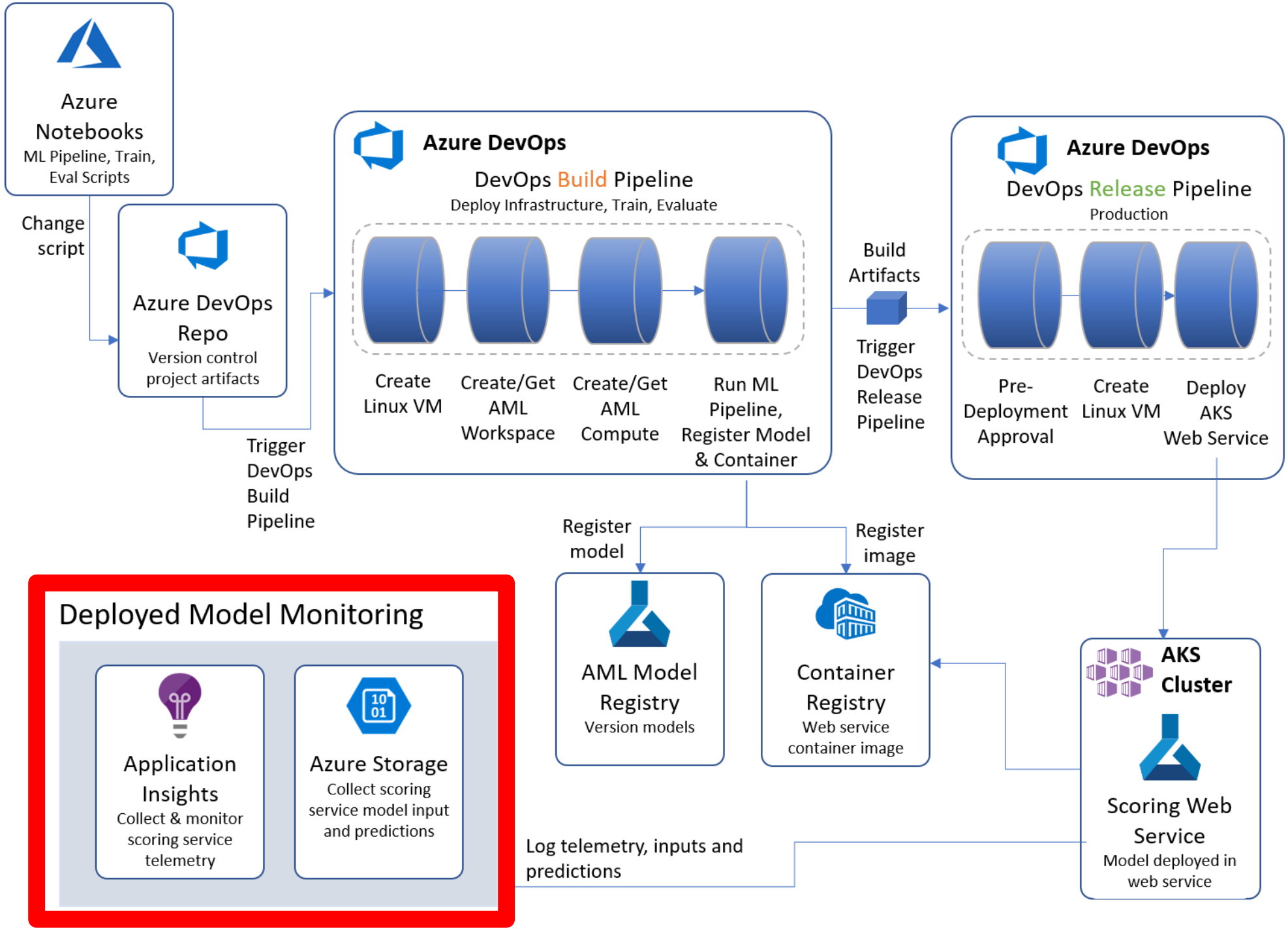

Azure Machine Learning
Package Model into image
Deploy model as web service on ACI
Test web service
Manual release gate
Azure Machine Learning
Deploy model as web service on AKS
Test web service
Azure Pipelines
Staging, QA
Production
Azure DevOps release gate

create docker images

```
image = Image.create(name = image_name,
                     models = [model],
                     image_config = img_config,
                     workspace = ws)
```

Create Webservice

```
service = Webservice.deploy_from_image
            (
               deployment_config = aciconfig,
               image = image,
               name = aci_service_name,
               workspace = ws
            )
```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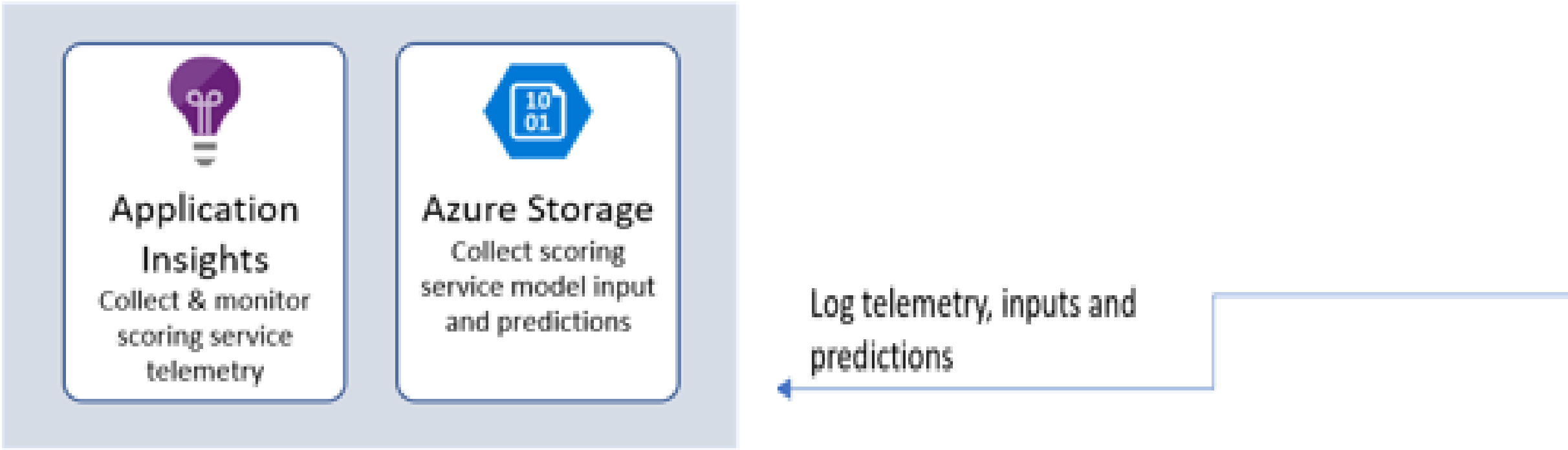
Deployed Model Monitoring



部署模型

其他部署的選擇

Local deployment

Notebook VM web service (dev/test)

Azure Container Instances (dev/test)

Azure Kubernetes Service (dev/test and production)

IoT Edge module (preview)

Azure App Service (preview)

MLOps 的好處

1.減少將模型投入生產的時間和難度

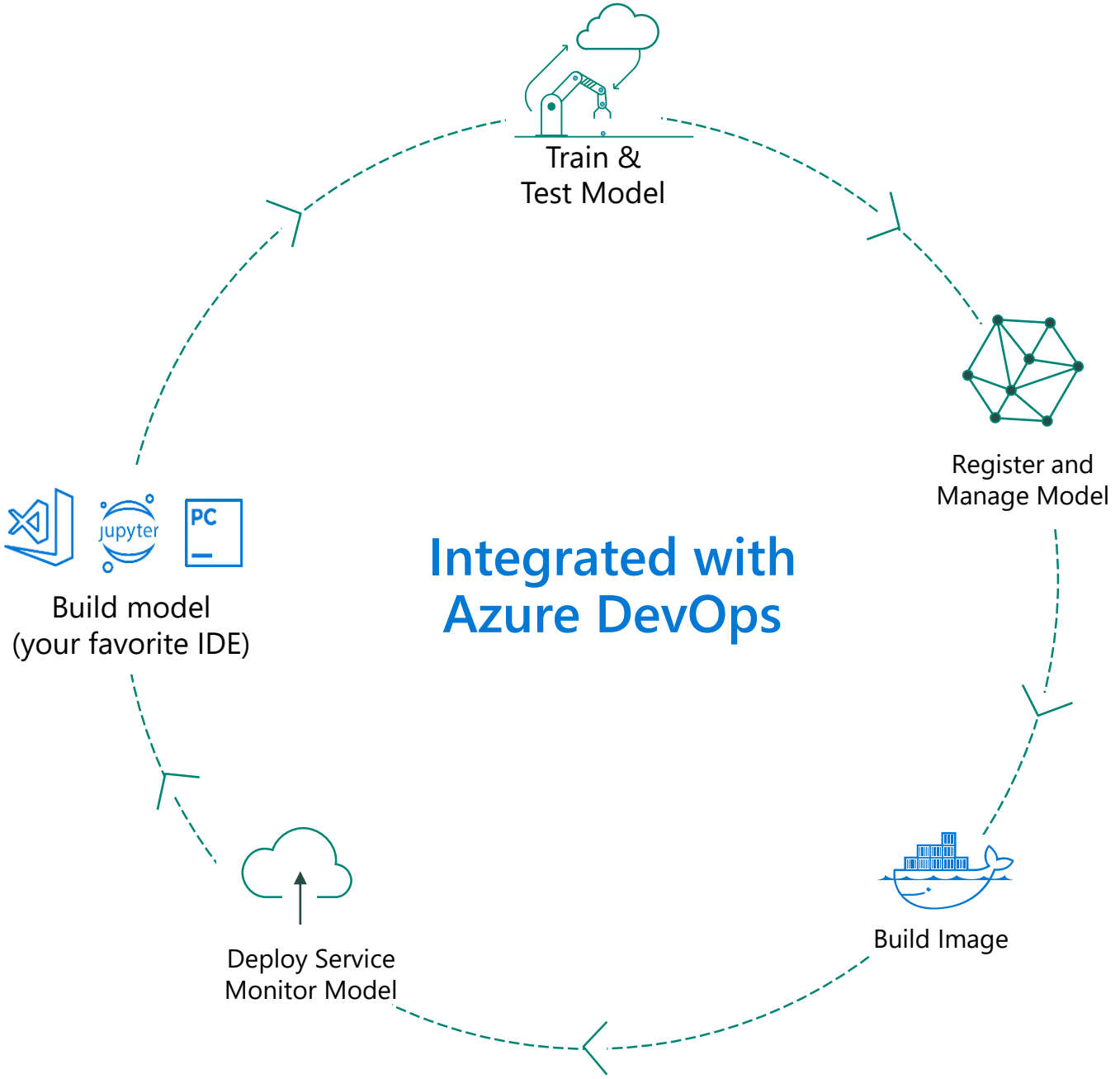
2.減少團隊之間的摩擦並增強協作

3.改進模型跟踪，版本控制，監視和管理

4.為現代ML模型創建真正的周期性生命週期

5.標準化機器學習流程，以準備增加法規和政策

Azure MLOps Helps You Bring ML to Production



Resources

Integrating the Data Science and App Development Cycles

Francesca Lazzeri, Microsoft
Medium: https://aka.ms/AA5ib6c

MLOps: Manage, deploy, and monitor models with Azure Machine Learning Service

Microsoft Docs: https://aka.ms/AA5kjqo

Train and deploy machine learning models with Azure Pipelines

Microsoft Docs: https://aka.ms/AA5kjqq

Microsoft AI Platform

https://www.microsoft.com/en-us/ai/ai-platform

特別感謝

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