

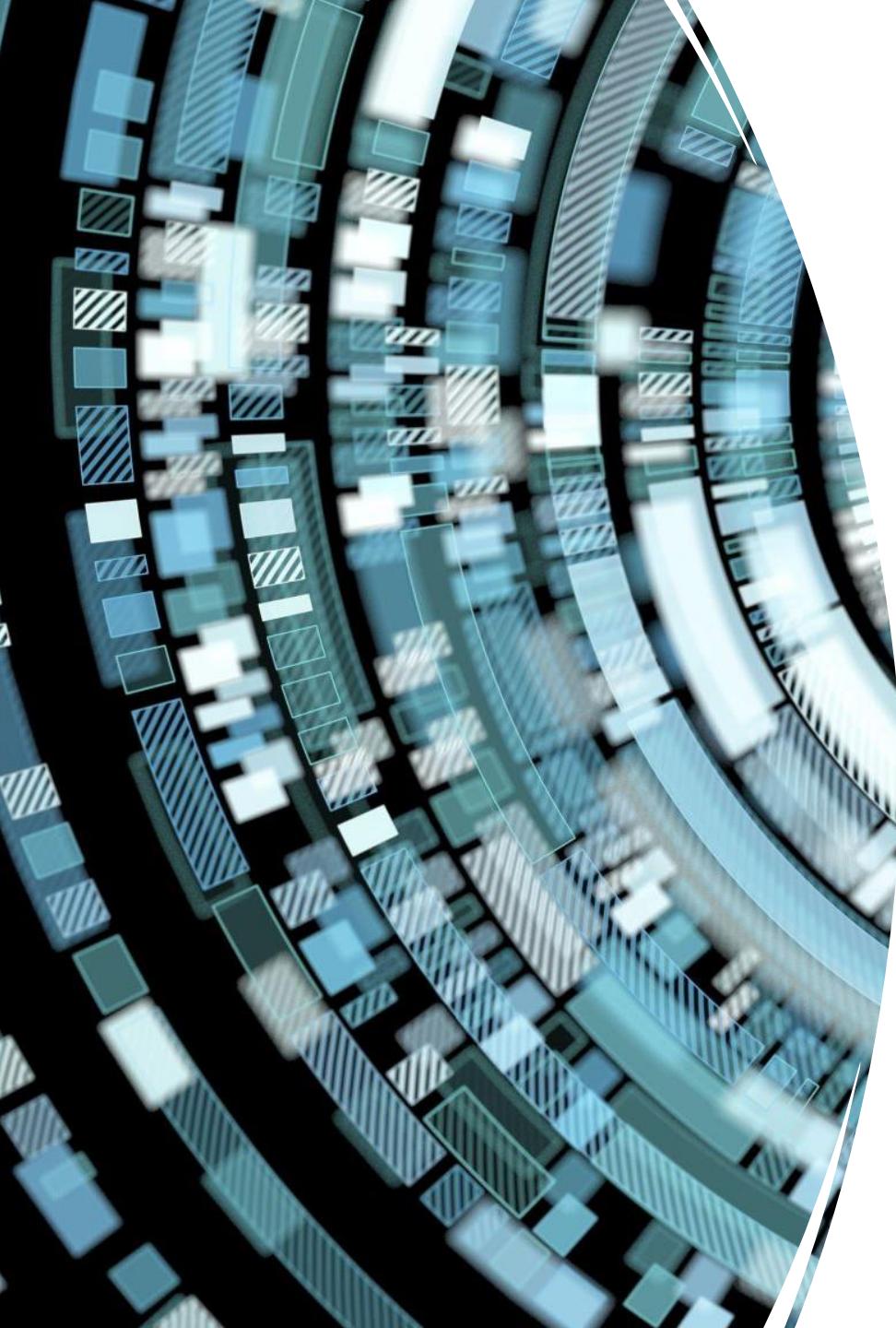


Customer

MLOps workshop

Date





Microsoft contacts

- **Serge Retkowsky**
serge.retkowsky@microsoft.com



Program overview

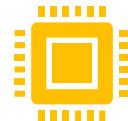
Workshop Prerequisites



Activate and Access an
[Azure Subscription](#)



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



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



Prerequisites by Role



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

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



Workshop 2

Azure ML fundamentals

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



Workshop 3

No Code with Azure ML

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



Workshop 4

Azure Computer Vision

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



Workshop 5

MLOps

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

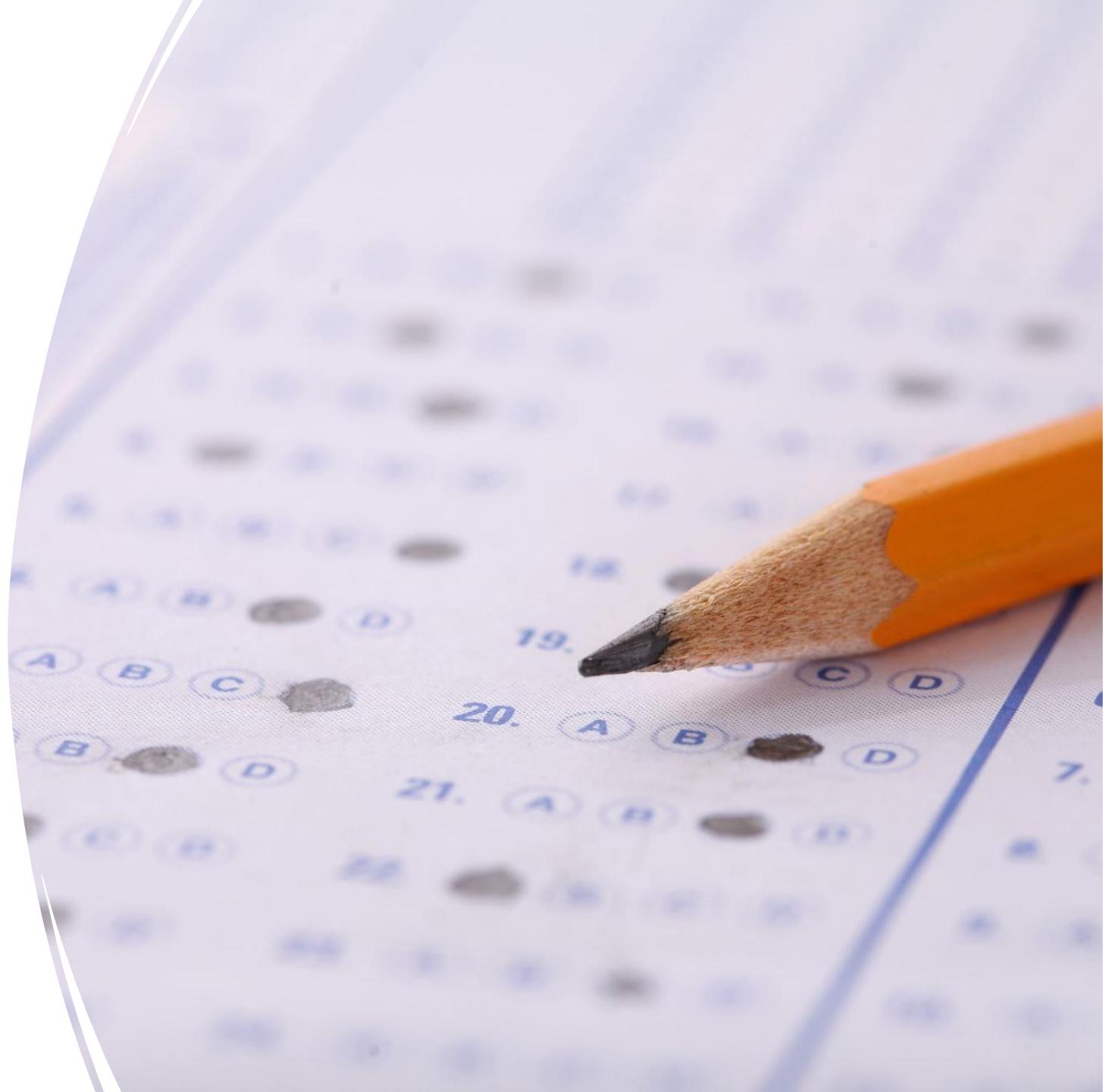


Workshop 6

Azure Databricks

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

Quiz time 1



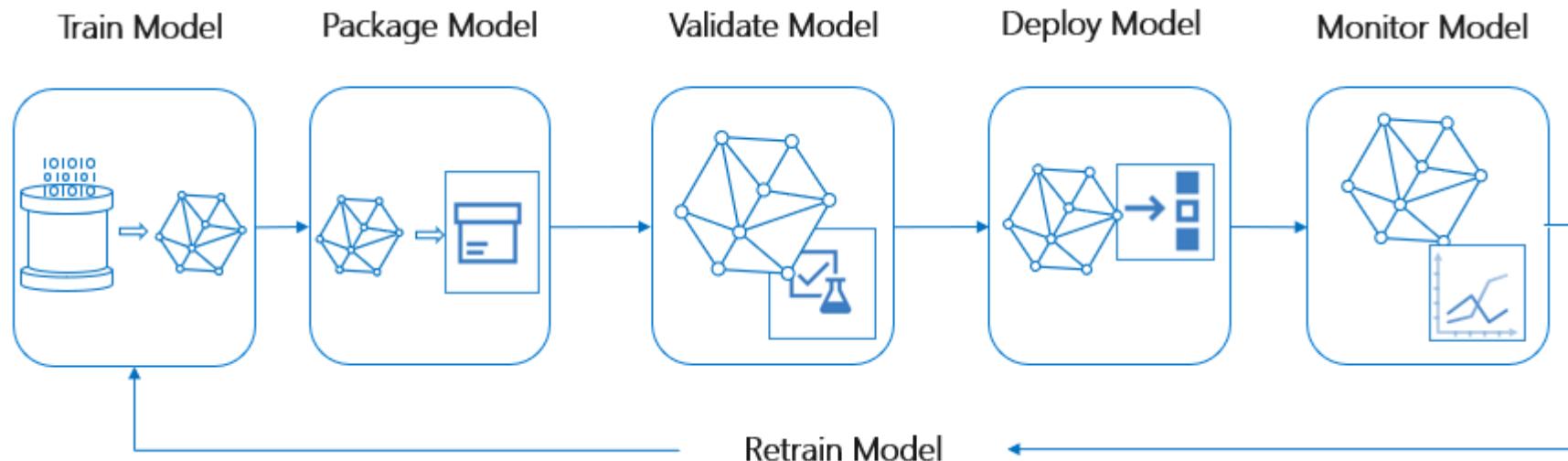
MLOps

MLOps

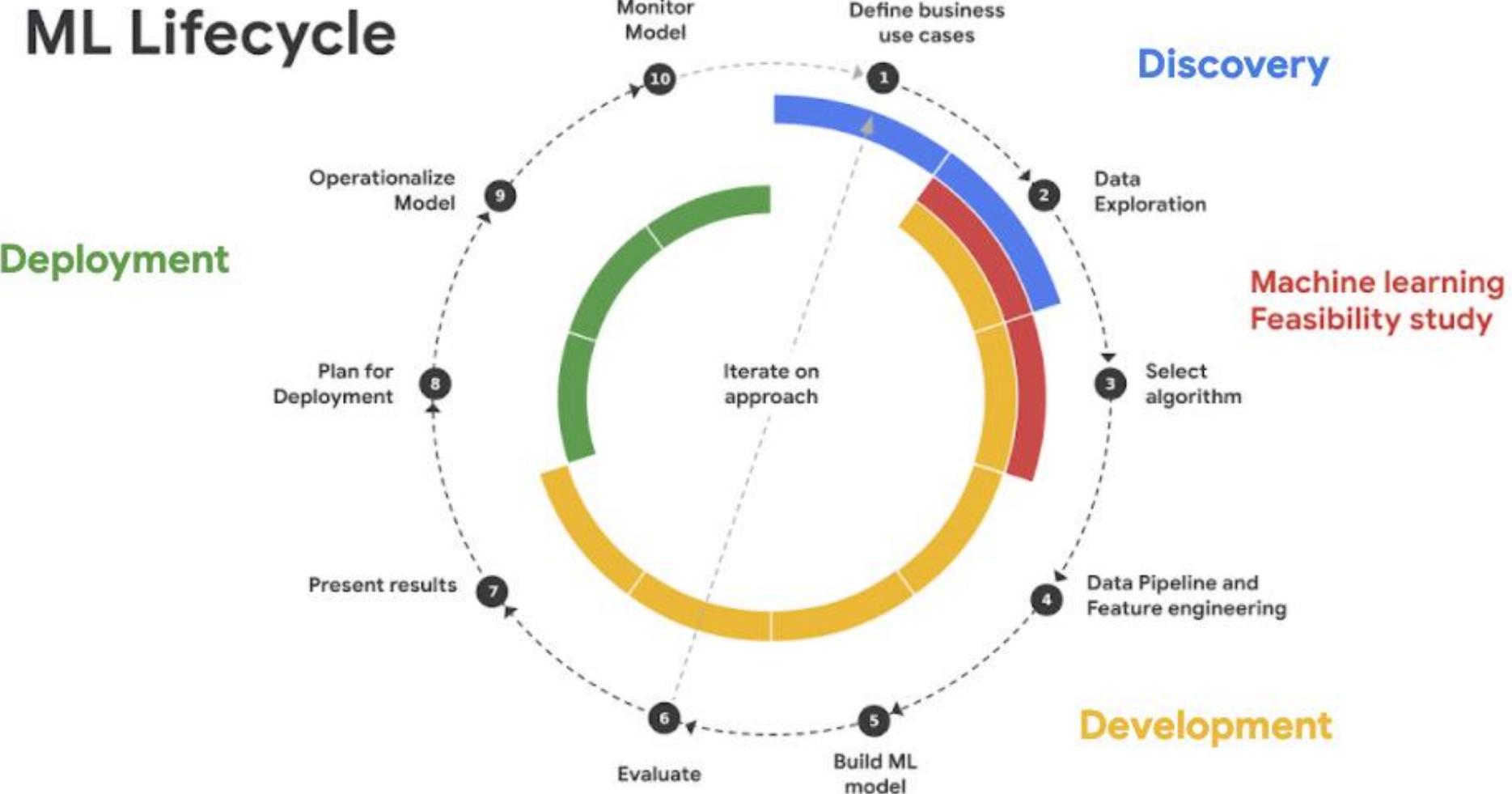
MLOps (*machine learning operations*) includes the **culmination of people, processes, practices** and underpinning **technologies** that **automate** the **deployment, monitoring, and management of machine learning (ML) models** into **production** in a **scalable and fully governed** way to finally provide **measurable business value** from machine learning.

MLOps

- **Develop & train model** that solves a real business problem
- **Package model** so you can use it somewhere else
- **Validate model behavior** – functionally, in terms of responsiveness, in terms of regulatory compliance
- **Deploy model** – use the model to make predictions
- **Monitor model** behavior & business value, know **when to replace / deprecate a stale model**



MLOps





Azure ML Pipelines



Azure (DevOps) Pipelines

Azure Machine Learning Pipelines



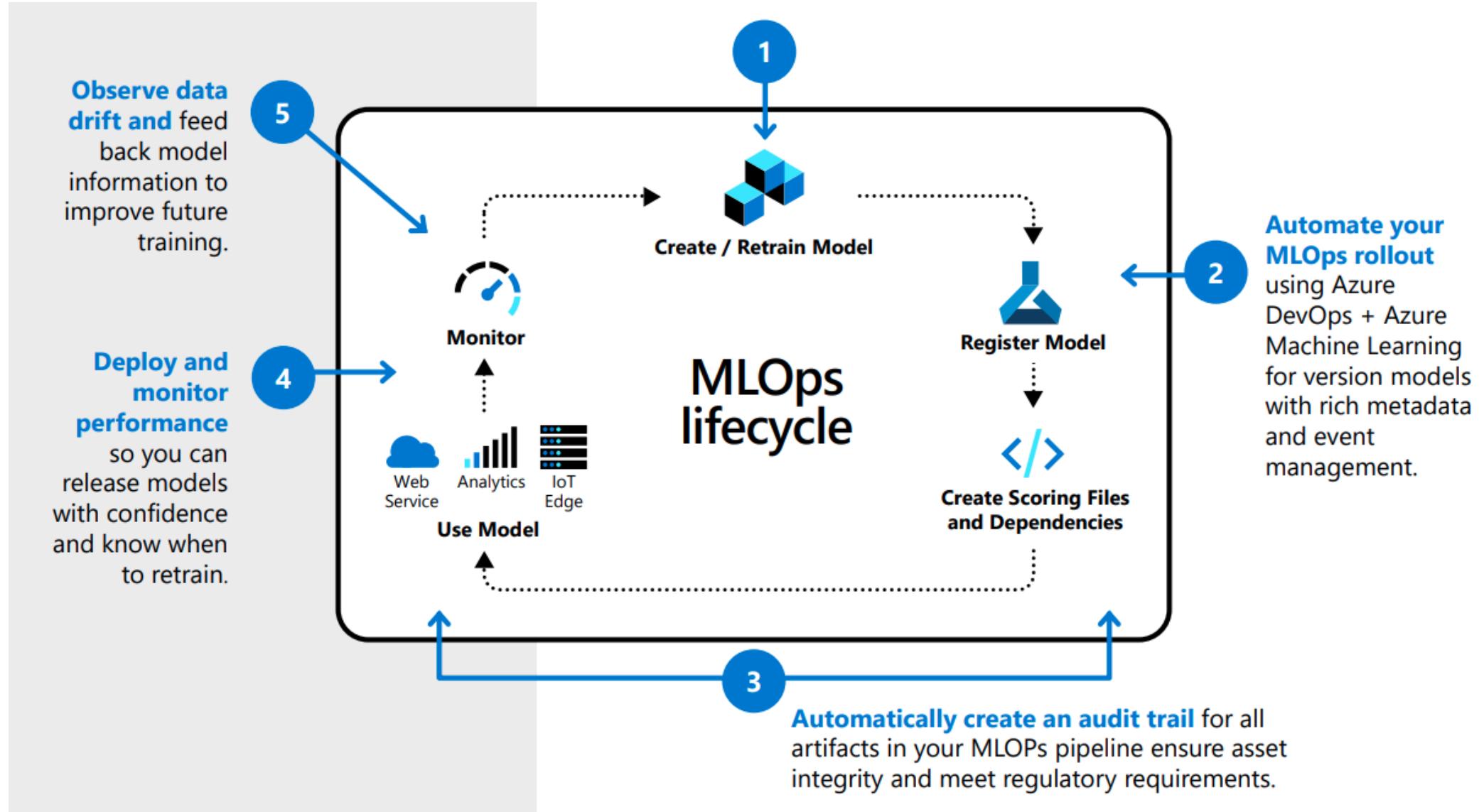
- **Workflows** with of steps that can use **Data Sources, Datasets, and Compute** targets.
- **Reusability.**
- **Tracking** and versioning of ML concepts.

Azure DevOps Pipelines

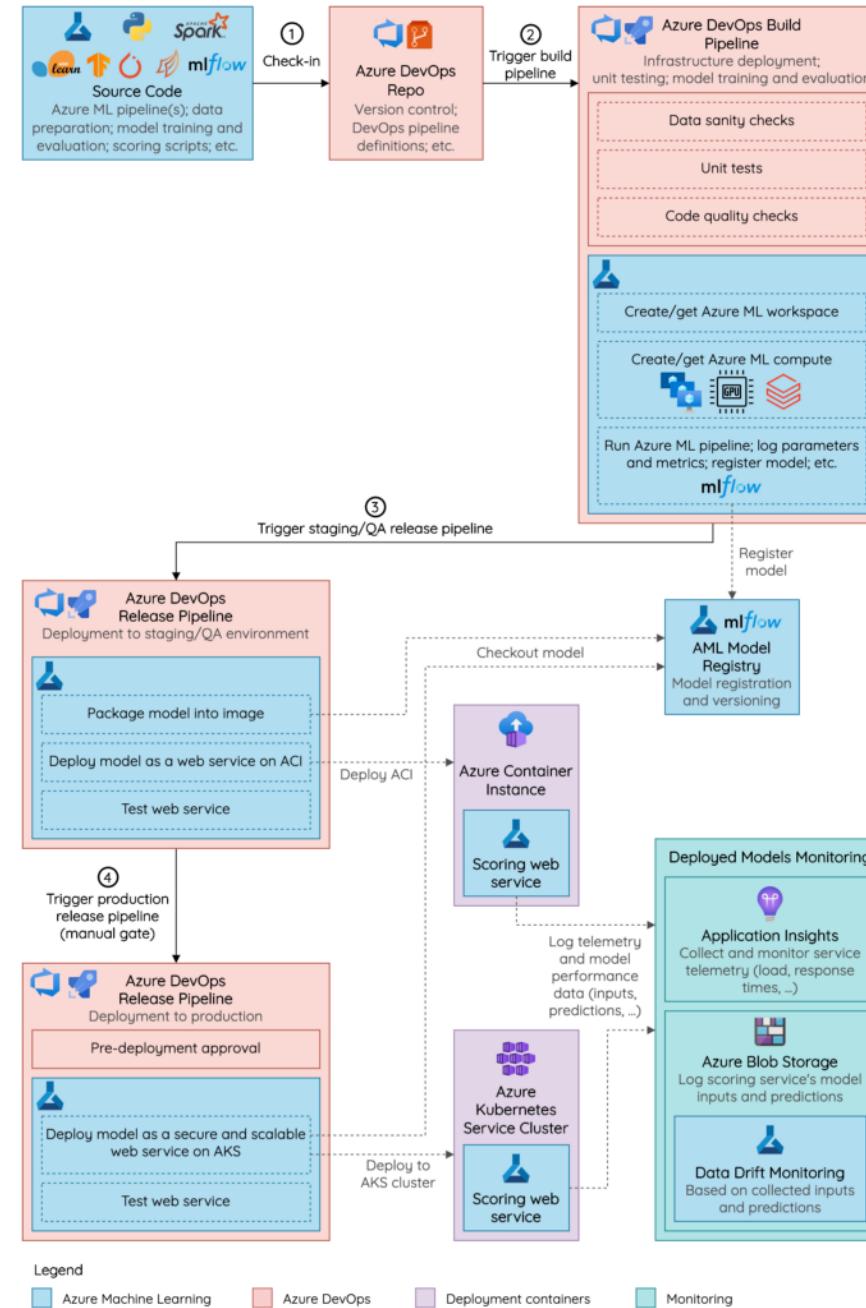


- Orchestration for **Continuous Integration** and **Continuous Delivery**.
- Gates, tasks, and processes for **quality**.
- **Integration** with other services.
- **Triggers** on code and non-code events.

MLOps lifecycle



An example of a MLOps customer architecture

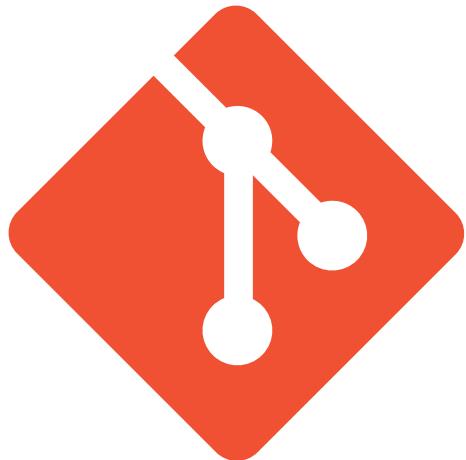


Industrialisation des projets de machine learning au sein de la Data Factory d'Intermarché | by Khalil El Mahrsi | Jan, 2021 | Medium

Collaboration



Source Control



- Code and comments only (not Jupyter Notebook output).
- Plus every part of the pipeline.
- And Infrastructure and dependencies.
- And maybe a subset of data.

Everything should be in source control!

Except your training data which should be a known, shared data source

Continuous Integration



- **Triggered** on code change.
- **Refresh and execute** AML Pipeline.
- **Code quality** and unit testing.
- Pull request process.

Azure MLOps

Asset management & orchestration services to help manage the ML lifecycle.

ML Experimentation

Training Services



Run History



Compute



Storage



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 DevOps



Azure Boards

Deliver value to your users faster using proven agile tools to plan, track, and discuss work across your teams.



Azure Pipelines

Build, test, and deploy with CI/CD that works with any language, platform, and cloud. Connect to GitHub or any other Git provider and deploy continuously.



Azure Repos

Get unlimited, cloud-hosted private Git repos and collaborate to build better code with pull requests and advanced file management.



Azure Test Plans

Test and ship with confidence using manual and exploratory testing tools.



Azure Artifacts

Create, host, and share packages with your team, and add artifacts to your CI/CD pipelines with a single click.

Extensions Marketplace

Access extensions from Slack to SonarCloud to 1,000 other apps and services—built by the community.

Marketplace Azure DevOps

Visual Studio Visual Studio Code **Azure DevOps** Subscriptions Build your own Publish extensions

Search Azure DevOps extensions 

1477 Results Showing: All categories Hosted On: Any Price: Any Certification: Any Sort By: Installs

| | | | | | |
|--|--|--|--|---|---|
|  Code Search Microsoft  145K Code Search provides fast, flexible and accurate search across all your code   |  Test & Feedback Microsoft  131K Now everyone on the team can own quality. Capture findings, create issues, and...   |  Azure DevOps Open in Excel Microsoft DevLabs  116K This extension opens work items and query results in Excel from Azure DevOps   |  SonarQube SonarSource  53.1K Detect bugs, vulnerabilities and code smells across project branches and pull...   |  Delivery Plans Microsoft  49K Manage your portfolio of work with a calendar based view across teams and...   |  Replace Tokens Guillaume Rouchon  48.2K Task to replace tokens in files.   |
|  CatLight Catlight.io  42.6K Build & task status notifications in your tray   |  Work Item Visualization Microsoft DevLabs  38.4K Visualize relationships between work items from within the work item form.   |  Analytics Microsoft  34.6K Gain insights into the health and status of your Azure DevOps Server projects. Not...   |  Folder Management Microsoft DevLabs  32.5K Create a folder in your source repositories from the web. No need to clone the repository...   |  Microsoft Teams Integration Microsoft  29.2K Microsoft Teams makes collaborating on software projects a breeze - from ide...   |  IIS Web App Deploy Microsoft  28.9K Using WinRM connect to the host Computer, to deploy a Web project using Web...   |

<https://marketplace.visualstudio.com/search?target=AzureDevOps&category>All%20categories&sortBy=Installs>

Azure ML for Azure DevOps



Machine Learning
Microsoft DevLabs | 3,081 installs | ★★★★★ (1) | Free

Submit experiments from a DevOps Pipeline, track code from Azure Repos or GitHub, trigger release pipelines when an ML model is registered, and automate ML deployments using Azure Pipelines.

[Get it free](#)

[Overview](#) [Q & A](#) [Rating & Review](#)

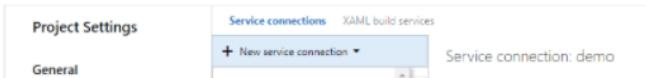
Overview

New MLOps (DevOps for Machine Learning) capabilities in Azure Machine Learning brings the sophistication of DevOps to data science, with orchestration and management capabilities to enable effective ML Lifecycle management.

Key Features

- Using Azure Resource Manager an AzureML Service Connection type can be created to access your artifacts
- By registering a new version of a model into an AzureML service workspace, a trigger can be configured to
- Azure DevOps server task for running published ML pipelines
- Azure DevOps tasks for AzureML specific actions such as model profiling and model deployment.

How to set up your service connection



Project Settings Service connections XAML build services
General + New service connection ▾
Service connection: demo

Categories
Azure Pipelines Azure Artifacts

Tags
Deploy task Utility task

Works with
Azure DevOps Services

Resources
License

More Info
Version 1.0.20
Released on 05/05/2019 à 02:30:37
Last updated 05/12/2019 à 20:23:08
Publisher Microsoft DevLabs
Report Report Abuse

<https://marketplace.visualstudio.com/items?itemName=ms-air-aiagility.vss-services-azureml>

Code quality matters!

Even in data science

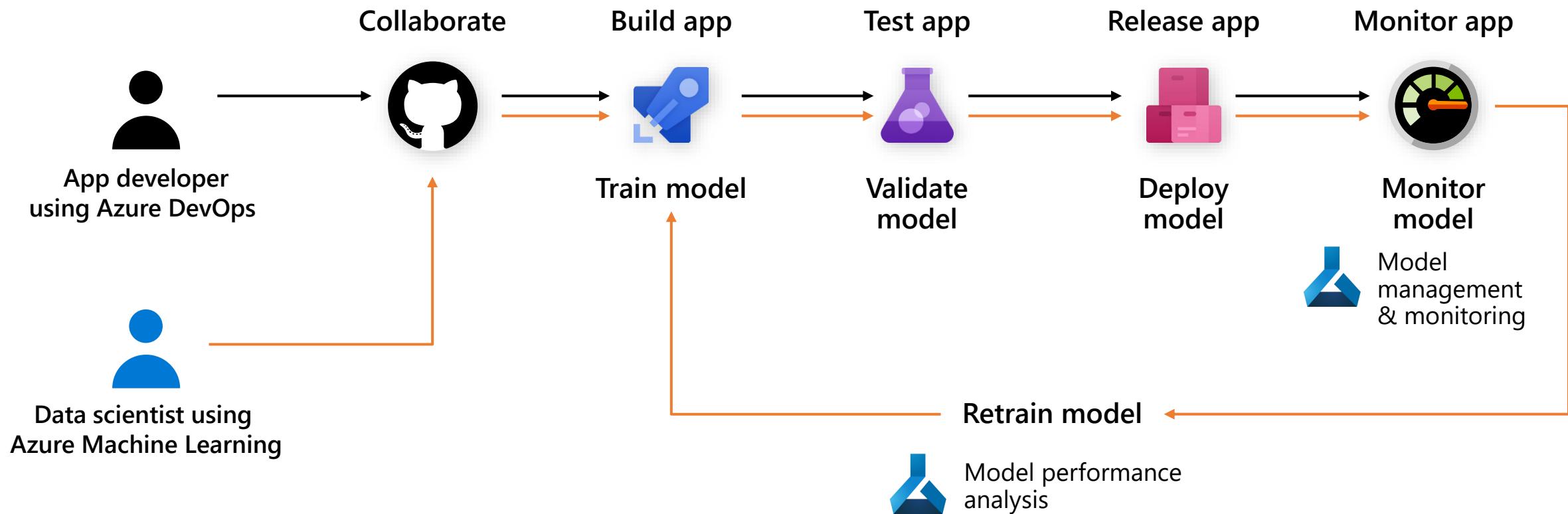
Azure (DevOps) Pipelines “Build”

Continuous Delivery



- Trigger on **model registration**.
- **Deploy** to test and staging environments.
- Run integration and load **tests**.
- **Control**: rollout, feature flags, A/B testing.

MLOps Workflow



✓ Model reproducibility

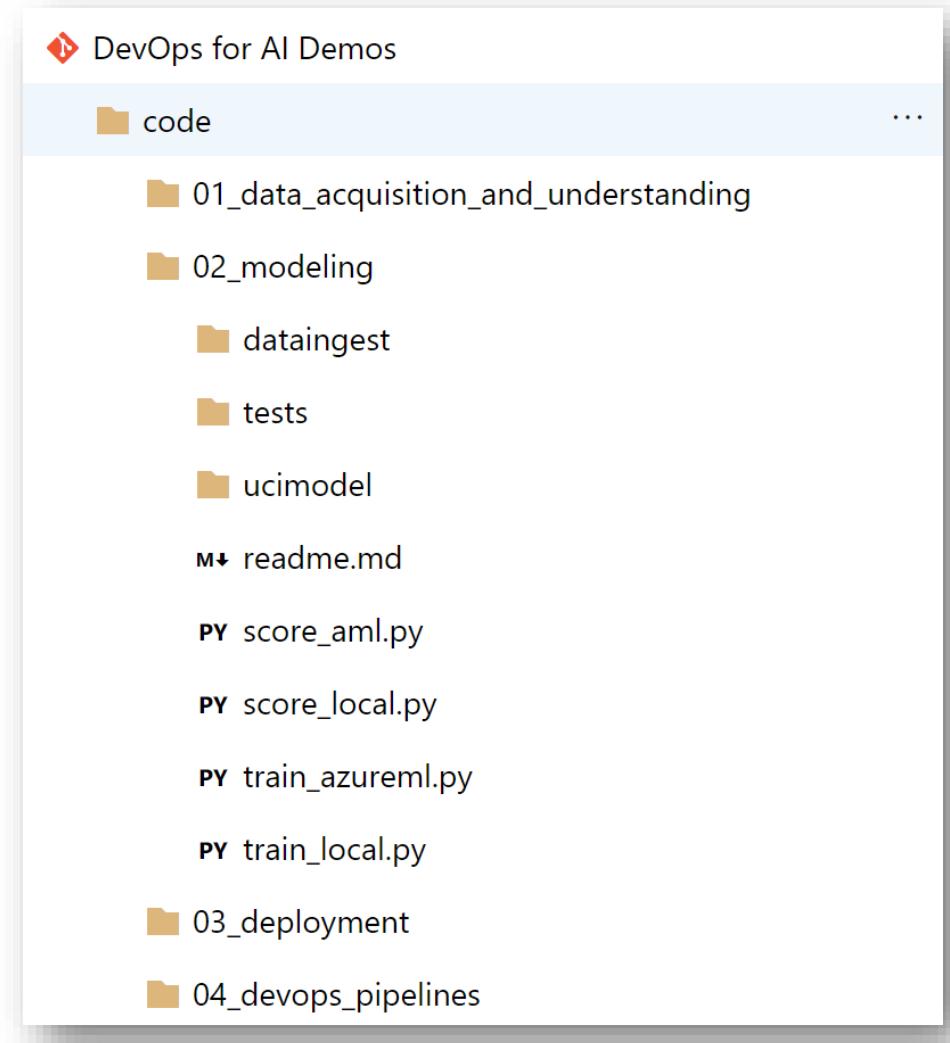
✓ Model validation

✓ Model deployment

✓ Model retraining

Model Training

- **Training script** (train.py): The training script contains logic specific to the model that you are training.
- **Scoring file** (score.py): When the model is deployed as a web service, the scoring file receives data from clients and scores it against the model. The output is then returned to the client.
- **Experiment settings** (project.json): Links your project (training.py and other files required for training) with an experiment in your workspace.
- **RunConfig settings** (myconfig.runconfig): Defines how the training script is ran on the compute target that is used for training.
- **Conda environment** (conda_dependencies.yml): Defines the packages needed to run the training script.
- **Deployment environment** (prod_dependencies.yml): Defines the packages needed to run the model and scoring file in the deployment environment.



Model Training

CI pipeline captures:

1. Create sandbox
2. Run unit tests and code quality checks
3. Attach to compute
4. Train model
5. Evaluate model
6. Register model

The screenshot shows a pipeline named "DevOps for AI - Build Model - AzureML". The pipeline consists of the following tasks:

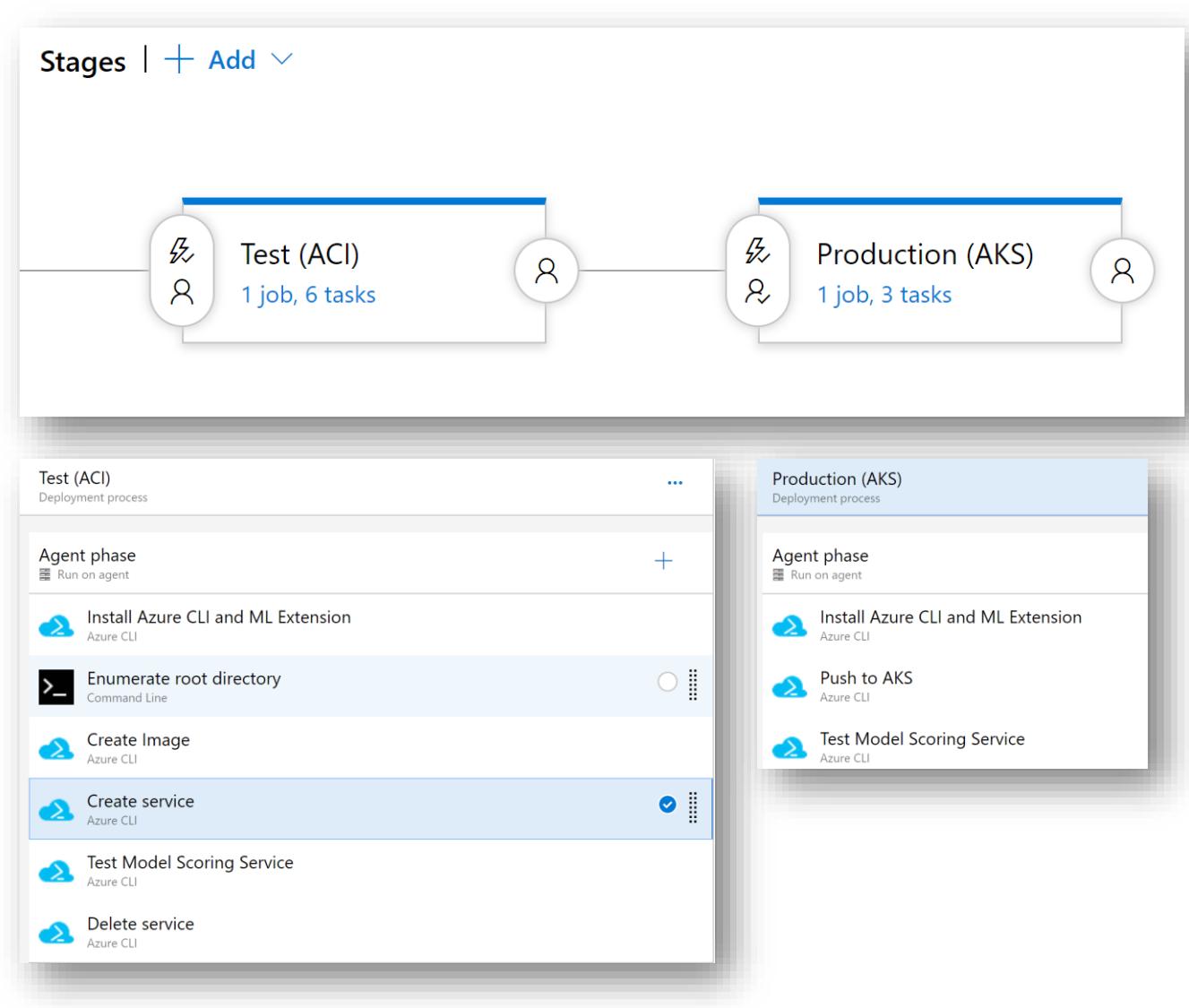
- Create Conda Environment (Conda Environment)
- Prepare Conda Environment (using yml) (Command Line)
- Install Azure CLI ML Extension (Preview) (Azure CLI) - This task is highlighted with a red box.
- Unit tests (model code) (Command Line)
- Code Quality (flake8) (Command Line)
- Publish Unit Test Results (Publish Test Results)
- AzureML: Attach to an experiment (Azure CLI)
- AzureML: create dsvm run config (Azure CLI)
- AzureML: train model (Azure CLI)
- AzureML: download trained model (Azure CLI) - This task is highlighted with a red box.
- Integration tests (Command Line)
- Publish Test Results (Publish Test Results)
- AzureML: register model (Azure CLI) - This task is highlighted with a red box.
- Copy Model Requirements (Copy Files)

Model Deployment

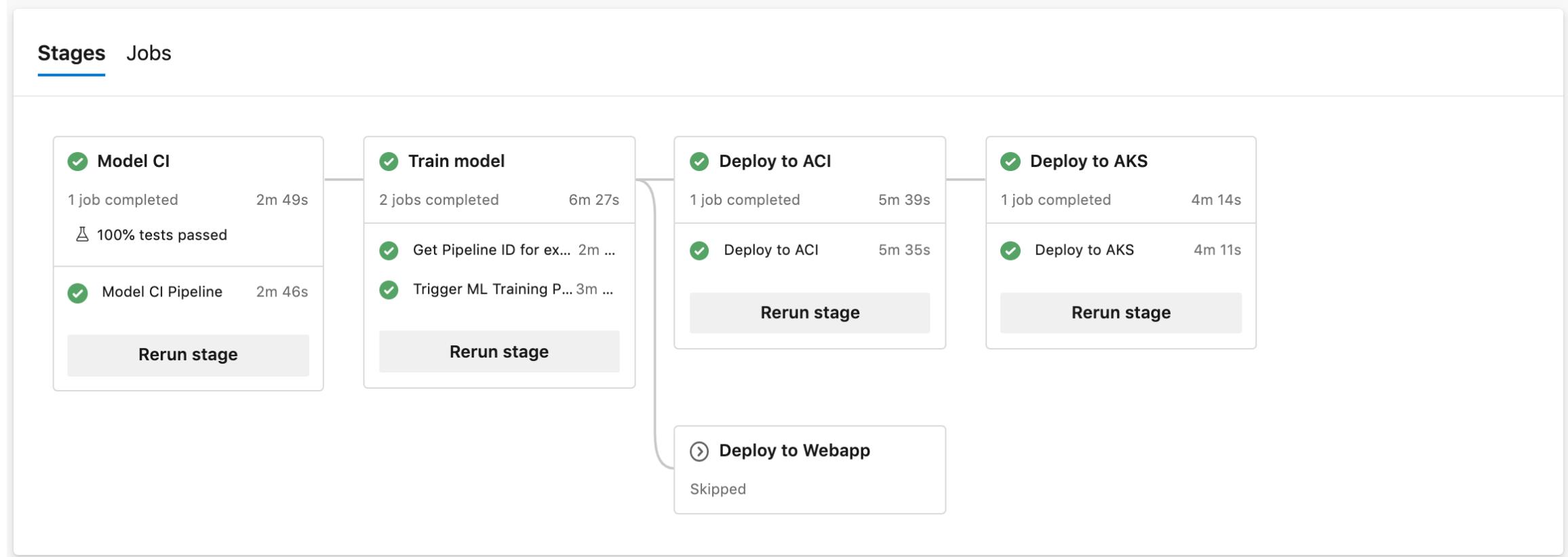
CD pipeline captures:

1. Package model into container image
2. Validate and profile model
3. Deploy model to Dev/Test (ACI)
4. If all is well, proceed to rollout to AKS

Everything is done via the CLI or the marketplace addon



MLOps pipeline example



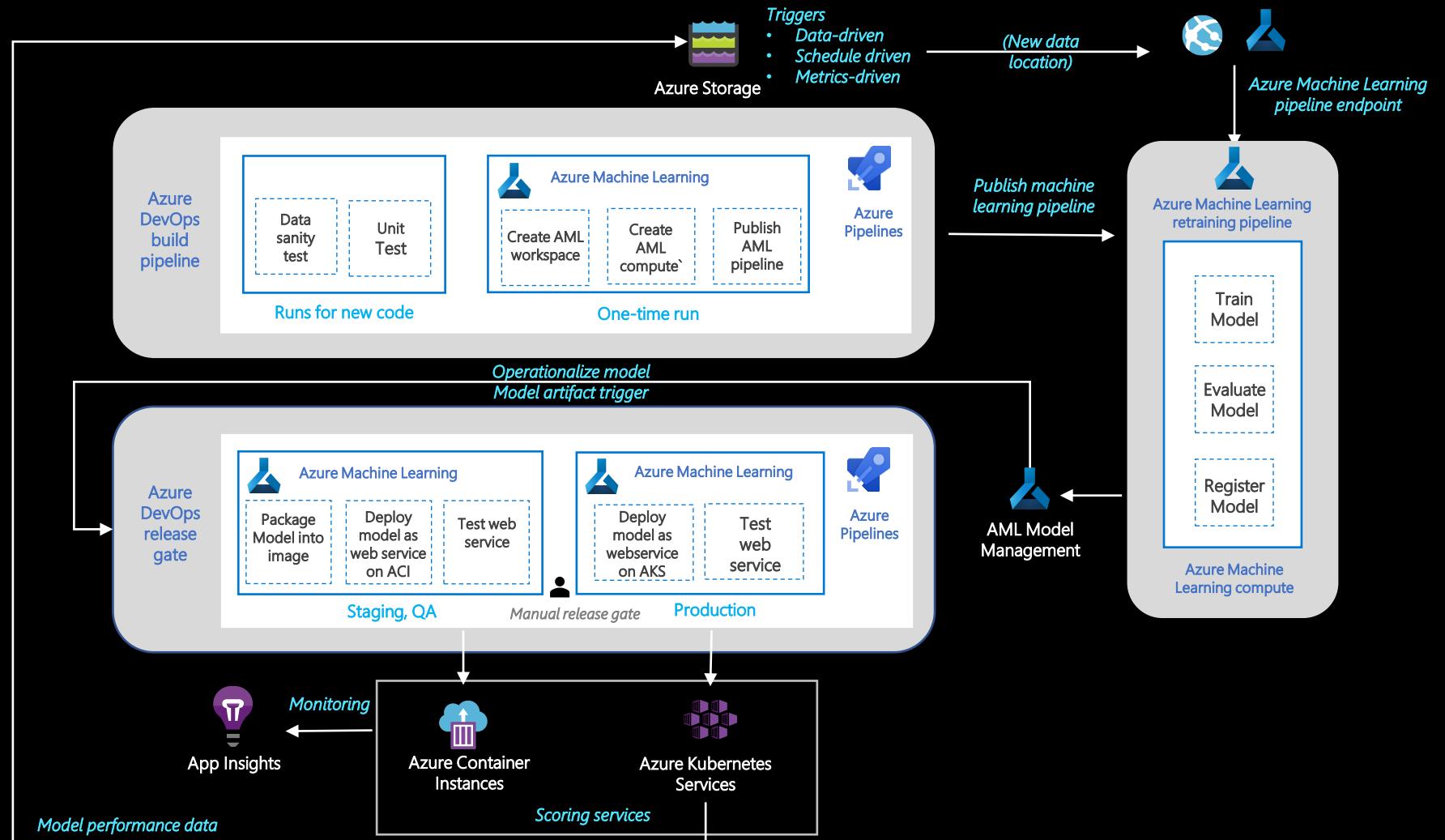
MLOps architecture



Azure ML Pipelines



Azure (DevOps) Pipelines



Model reproducibility

Model validation

Model deployment

Model retraining

Best Practices

Stitch tools together across the entire ML workflow

-  “Having a **completely automated pipeline** with monitoring, evaluation and model deployment is something we feel all ML-based projects should have.”
-  “Automate the pipeline for training and deploying models and **integrate with the actual product**. Build rich dashboards showing value provided to users.”
-  “We focused more on building a super solid data pipeline which continuously loads and massages data and enabled us to **try different AI algorithms with different hyper parameters** etc without much hassle.”

Data, data, data

-  “Be relaxed about framework / machine learning code, but **careful & deliberate about data & objectives.**”
-  “**Reuse the modules or data as much as possible** to reduce the duplicate effort.”
-  “Elaborate **versioning** of the provenance of models/data: each model is tagged with a **provenance tag** that explains with which **data it has been trained on AND which version of the model**. Each dataset is tagged with information about **where it originated from and which version of the code was used to extract it** (and any related features).”

Education

“Most people have the ability to do **independent science work and experimentation**: investigating, getting data, finding a new approach, what evaluation is useful, fitting in with the engineering team which already has a lot of metrics.”

“People doing the models tend to be trained (e.g., MS or PhD in ML).

... It took a week or two for someone new to onboard our team. She was from Microsoft and had a ML background.”

Model Debugging and Interpretability

- “Keep the model as simple as you can.” “Slowly move towards more complex models only if they show improvement.”
- “Multiple tiny AI modules embedded at various points of a conventional / layered / tiered software architecture rather than a single monolithic **back-box AI that lacks explainability and debuggability**.”
- “**Visualization**: finding feature slices that are better or worse for a model.”

Model Evolution, Evaluation, and Deployment

“Explain results with tests and reproducible results.”

“**Score cards** for the evaluation of flights and storing flight information. Between two flights at least one thing has changed: one of the models, training data etc. These are experiments but not all of them are put in production. If things look good, then all these are put into a **combo** flight.”

“**Human-driven evaluation loop**: We have an evaluation loop to see how the model is doing, we spot check and have a human look at errors to see why this particular category is not doing well and then hypothesize to figure out the problem source.”

Model Evolution, Evaluation, and Deployment

- “**Don’t** completely decouple model building from the rest of software. Have engineering and model pieces and sprints for each. We have meetings altogether and use the same source control.”
- “Using an automated pipeline of training and deploying models and integrating them with the actual product.”
- “It’s easier to **recreate the experimental environment** inside containers.”

Best Practices Summary - OK

- ✓ ML tools need to be better stitched into the ML workflow and the workflow needs to be automated.
- ✓ Center development around data (sharing, provenance, versioning).
- ✓ Educating non-specialists in ML takes a lot of time but it worth the effort.
Leveraging internal training and knowledge sharing.
- ✓ ML models are difficult to debug. Using simple, explainable, and composable models helps.
- ✓ Using carefully designed test sets, score cards for evaluating combo flights, human-in-the-loop evaluation.
- ✓ Do not decouple model building from the rest of the software.

MLOPS Best Practices

Train Model

1. Data scientists will work in topic branches off of master.
2. When code is pushed to the Git repo, then trigger a CI (continuous integration) pipeline.
3. First run: Provision infra-as-code (ML workspace, compute targets, datastores).
4. For new code: Every time new code is committed to the repo, run unit tests, data quality checks, train model.

We recommend the following steps in your CI process:

1. **Train Model** - run training code / algo & output a [model](#) file which is stored in the [run history](#).
2. **Evaluate Model** - compare the performance of newly trained model with the model in production. If the new model performs better than the production model, the following steps are executed. If not, they will be skipped.
3. **Register Model** - take the best model and register it with the [Azure ML Model registry](#). This allows us to version control it.

MLOPS Best Practices

Operationalize Model

1. You can package and validate your ML model using the **Azure ML CLI**.
2. Once you have registered your ML model, you can use Azure ML + Azure DevOps to deploy it.
3. You can define a **release definition** in Azure Pipelines to help coordinate a release. Using the DevOps extension for Machine Learning, you can include artifacts from Azure ML, Azure Repos, and GitHub as part of your Release Pipeline.
4. In your release definition, you can leverage the Azure ML CLI's **model deploy** command to deploy your Azure ML model to the cloud (ACI or AKS).
5. **Define your deployment as a gated release**. This means that once the model web service deployment in the Staging/QA environment is successful, a notification is sent to approvers to manually review and approve the release. Once the release is approved, the model scoring web service is deployed to Azure Kubernetes Service(AKS) and the deployment is tested.

A photograph of a stack of papers or documents. A pair of dark-rimmed glasses is placed on top of the stack, resting on the left edge. The background is blurred, showing more of the document stack.

MLOps documentation

MLOps

<https://mlops-github.com/>

Machine Learning Ops

A collection of resources on how to facilitate Machine Learning Ops with GitHub.

Learn how to use GitHub for automation, collaboration and reproducibility in your machine learning workflows.



Blog Posts

Blog Posts that are relevant to using GitHub for Data Science and ML Ops.



GitHub Actions

A collection of open source GitHub Actions that facilitate ML Ops.



Examples

Repository templates, examples, and related projects that demonstrate how various GitHub Features can be used for Data Science and ML Ops.



Talks

Recorded talks, demos and tutorials.



Team

More information about the team that works on MLOps at GitHub.



Docs

Documentation and resources for getting started.

MLOps documentation

- MLOps website:

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

- Whitepapers

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

- Documentation

<https://docs.microsoft.com/en-us/azure/machine-learning/concept-model-management-and-deployment>

- Code samples

<https://docs.microsoft.com/en-us/samples/azure-samples/mlopsdatabricks/mlops-with-azure-devops/>

- MLOps examples

<https://github.com/Microsoft/MLOps>

[microsoft/MLOpsPython: MLOps using Azure ML Services and Azure DevOps \(github.com\)](https://github.com/microsoft/MLOpsPython)

[microsoft/aml-acceleration-template: A template repository for quickly adopting Azure Machine Learning \(github.com\)](https://github.com/microsoft/aml-acceleration-template)

Azure Machine Learning Acceleration Template



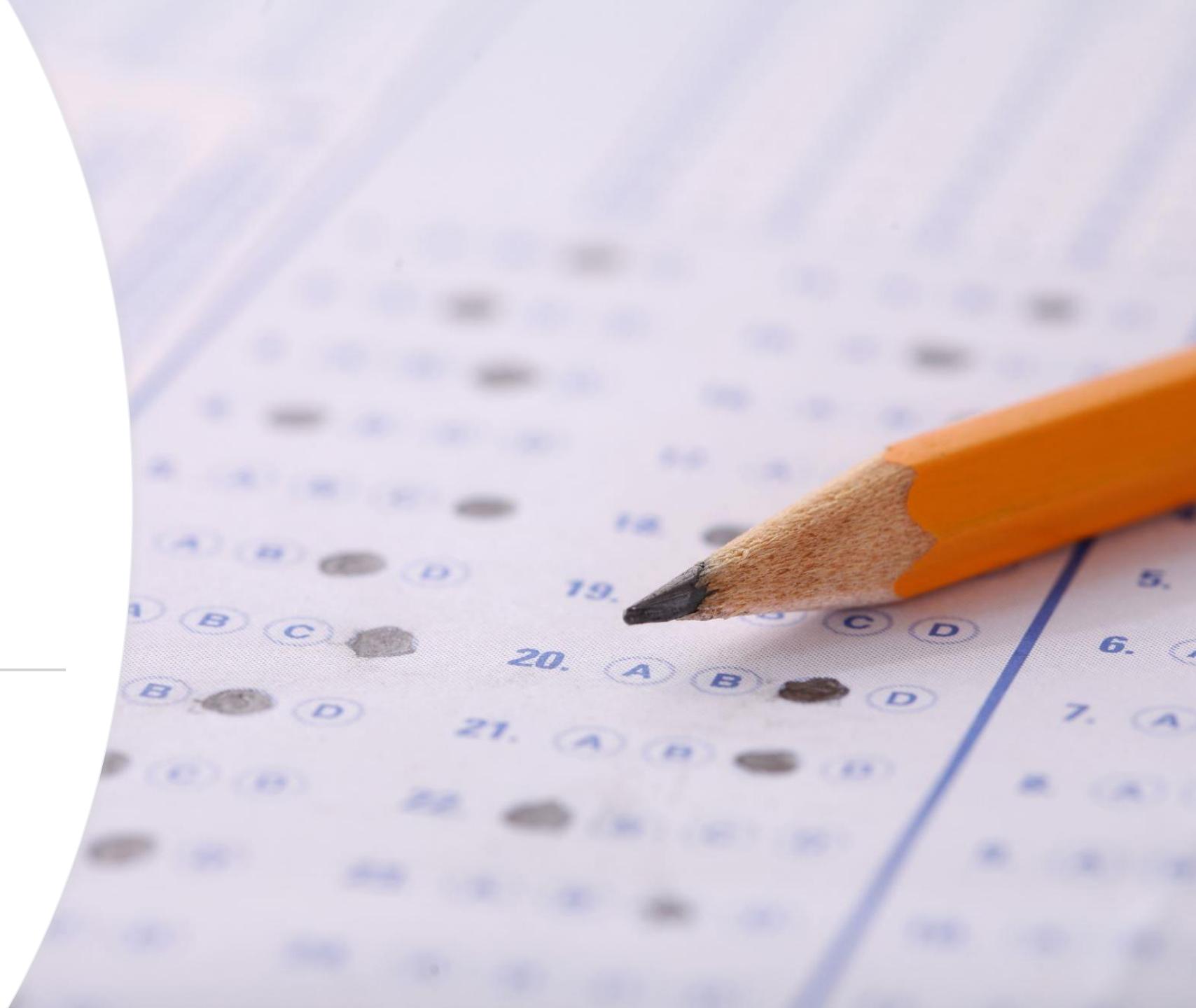
This repo features an Azure Machine Learning (AML) Acceleration template which enables you to quickly onboard your existing Machine Learning code to AML. The template enables a smooth ML development process between your local machine and the Azure Cloud. Furthermore, it includes simple examples for running your model's training and batch inferencing as [Machine Learning Pipelines](#) for automation.

If you want to follow a guided approach to use this repo, start with [migrating your first workload to AML](#) and walk through the individual sections.

Getting Started

We recommend you to start with [migrating your first workload to AML](#) as it covers all prerequisites and outlines a simple and proven step-by-step approach.

Quiz time 2





Pause (10 minutes)

Lab



Lab demo materials + demo script

<https://aka.ms/MLOpsCloudWorkshop>

microsoft / MCW-ML-Ops

Code Issues Pull requests Actions Projects Wiki Security Insights

master MCW-ML-Ops / Hands-on lab / HOL step-by-step - MLOps.md Go to file ...

shirokar add install Azure ML CLI extension task ✓ Latest commit 64e1935 on 12 Nov 2020 History

4 contributors

706 lines (390 sloc) | 51.5 KB Raw Blame

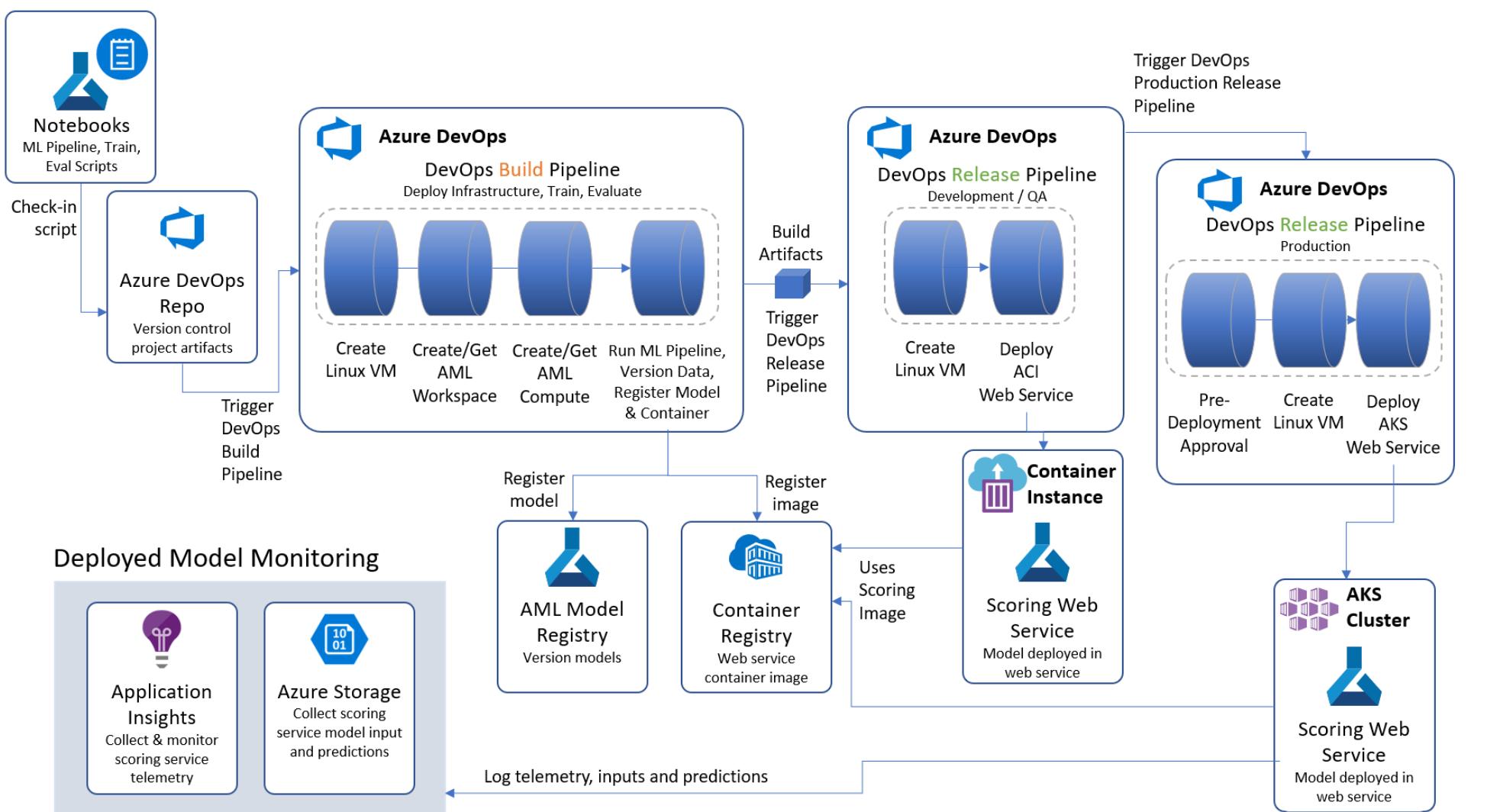


Microsoft Cloud Workshop

MLOps
Hands-on lab step-by-step
October 2020

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MLOps Hands-On Lab

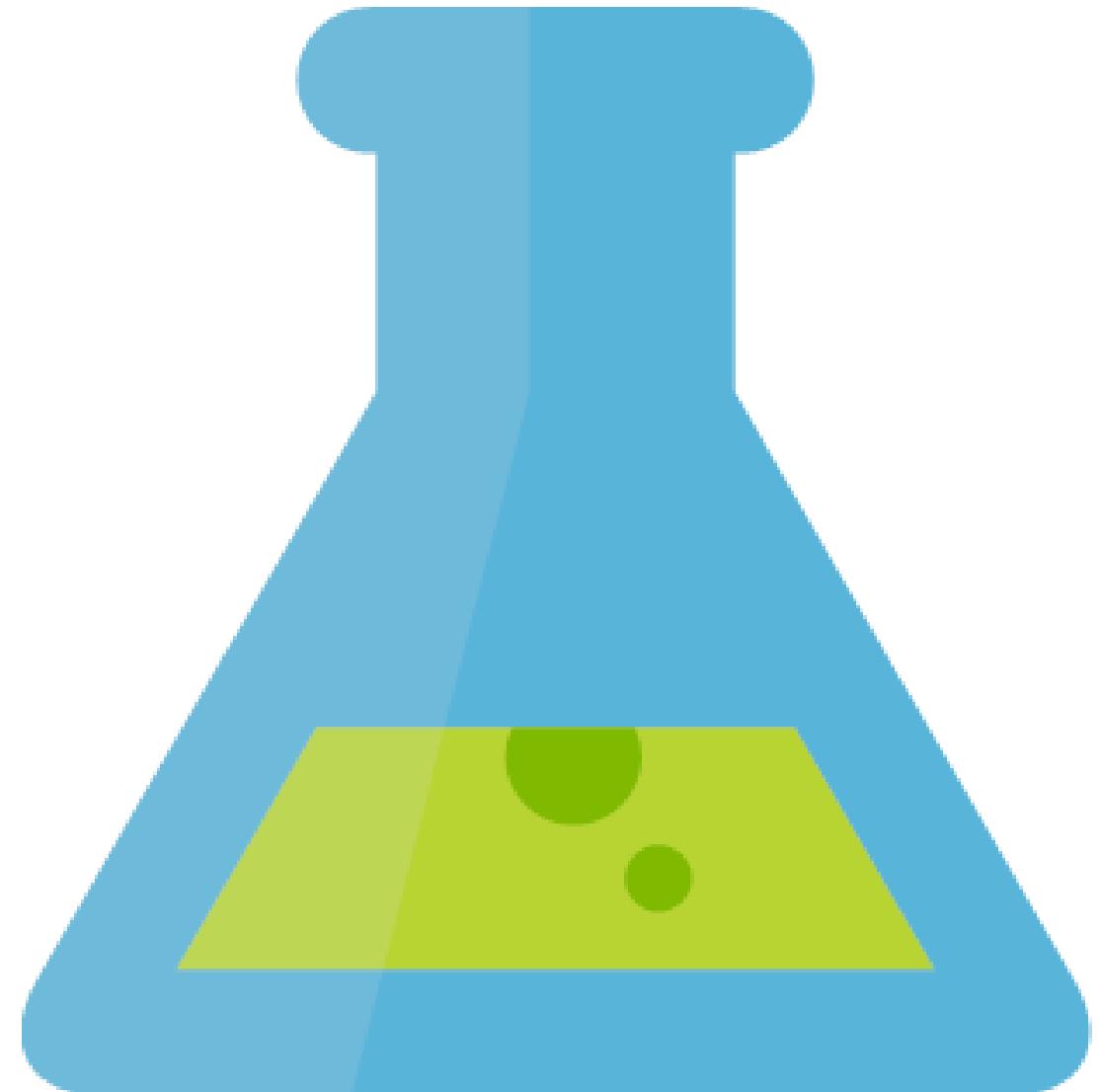


<https://aka.ms/MLOpsCloudWorkshop>

MLOps hands-on lab

-
1. Create and evaluating a ML model with Azure ML
 2. Registering the model with Azure ML
 3. Creating a MLOps project with Azure DevOps
 4. Building pipeline
 5. Pipeline release
 6. Production release pipeline
 7. Testing the pipeline
 8. Deploy production deployment stage
 9. Examining deployed model performance

<https://aka.ms/MLOpsCloudWorkshop>



1) Azure ML Workspace creation



- Dashboard
- All services
- FAVORITES
- What's new
- Recent
- All resources
- Help + support
- Activity log
- Advisor
- Alerts
- App Services
- Azure Active Directory
- Azure Data Explorer Cl...
- Analysis Services
- Application Insights
- Azure Databricks
- Azure Synapse Analytics...



Machine Learning

Microsoft

Azure benefit eligible

Create

Overview

Plans

Usage Information + Support

Reviews

Azure Machine Learning empowers developers and data scientists with a wide range of productive experiences for building, training, and deploying machine learning models. Create an Azure Machine Learning workspace to train, manage, and deploy machine-learning experiments and web services.

Media



More offers from Microsoft

See All

Azure ML workspace creation

Choose your Azure subscription and specify a workspace name

Dashboard > New > Machine Learning >

Machine Learning

Create a machine learning workspace

Basics Networking Advanced Tags Review + create

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription *  Microsoft Azure Internal Consumption

Resource group *  (New)  Create

Workspace details

Specify the name and region for the workspace.

Workspace name *  

Region *  Central

Storage account *  (new) 3230164  Create

Key vault *  (new) 837375  Create

Application insights *  (new) 7036690  Create

Container registry *  (new)  Create

[Review + create](#) [< Previous](#) [Next : Networking](#)



Search (Ctrl+ /)



Delete

Cancel

Redeploy

Refresh

Overview

Inputs

Outputs

Template

We'd love your feedback! →

... Deployment is in progress



Deployment name: Microsoft.MachineLearningServices
Subscription: Microsoft Azure Internal Consumption
Resource group: [REDACTED]

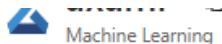
Start time: 30/11/2020 à 09:52:45

Correlation ID: db0e5fad-7f09-4d1a-8658-b9ee21e3f684

^ Deployment details [\(Download\)](#)

| Resource | Type | Status | Operation details |
|----------|--|----------|-----------------------------------|
| 2337375 | Microsoft.KeyVault/vaults | OK | Operation details |
| 7036690 | Microsoft.Insights/components | OK | Operation details |
| | Microsoft.ContainerRegistry/registries | OK | Operation details |
| 3230164 | Microsoft.Storage/storageAccounts | Accepted | Operation details |

Creation of the workspace



Machine Learning

Search (Ctrl+ /) <>

[Download config.json](#) [Delete](#)

Overview

[Activity log](#)[Access control \(IAM\)](#)[Tags](#)[Diagnose and solve problems](#)[Events](#)

Settings

[Private endpoint connections](#)[Properties](#)[Locks](#)

Monitoring

[Alerts](#)[Metrics](#)[Diagnostic settings](#)[Logs](#)

Automation

Essentials

Workspace edition : Basic

Resource group : [REDACTED]

Location : Central

Subscription : Microsoft Azure Internal Consumption

Subscription ID : [REDACTED]

Studio web URL : <https://ml.azure.com/?tid=72f988bf-86f1-41af-91ab-2d7cd011db4>

Storage : [REDACTED] 30164

Registry : [REDACTED]

Key Vault : [REDACTED] 37375

Application Insights : [REDACTED] 036690

Manage your machine learning lifecycle

Use the Azure Machine Learning studio to build, train, evaluate, and deploy machine learning models. [Learn more](#)

[Launch studio](#)[Getting started quickly](#)[Join the community](#)

The workspace is created |

- [≡](#)
- [+ New](#)
- [Home](#)
- Author
 - [Notebooks](#)
 - [Automated ML](#)
 - [Designer](#)
- Assets
 - [Datasets](#)
 - [Experiments](#)
 - [Pipelines](#)
 - [Models](#)
 - [Endpoints](#)
- Manage
- [Compute](#)



Home

Azure Machine Learning 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](#)

Tutorials



What is Azure Machine Learning?



Train your first ML model with Notebook



Create, explore and deploy Automated ML experiments.

You can access to Azure ML Studio |

Microsoft Azure Machine Learning

Compute

Create compute instance

Compute instances

Virtual Machine

Settings

Select virtual machine

Select the virtual machine size you would like to use for your compute instance.

Region: francecentral

Virtual machine type: CPU

Virtual machine size: Standard_D11_v2

Search by VM name...

Total available quota: 596 cores

| Name ↑ | Category | Cores ⓘ | Available quota ⓘ | RAM | Storage | Cost ⓘ |
|-----------------|------------------|---------|-------------------|--------|---------|-----------|
| Standard_D11_v2 | Memory optimized | 2 | 96 cores | 14 GB | 100 GB | \$0.23/hr |
| Standard_D12_v2 | Memory optimized | 4 | 96 cores | 28 GB | 200 GB | \$0.47/hr |
| Standard_D13_v2 | Memory optimized | 8 | 96 cores | 56 GB | 400 GB | \$0.94/hr |
| Standard_D14_v2 | Memory optimized | 16 | 96 cores | 112 GB | 800 GB | \$1.87/hr |
| Standard D15 v2 | Memory optimized | 20 | 96 cores | 140 GB | 1000 GB | \$2.34/hr |

Showing 61 VM sizes | Current selection: Standard_D11_v2

Name ↑

Category

Cores ⓘ

Available quota ⓘ

RAM

Storage

Cost ⓘ

Standard_D11_v2

Memory optimized

2

96 cores

14 GB

100 GB

\$0.23/hr

Standard_D12_v2

Memory optimized

4

96 cores

28 GB

200 GB

\$0.47/hr

Standard_D13_v2

Memory optimized

8

96 cores

56 GB

400 GB

\$0.94/hr

Standard_D14_v2

Memory optimized

16

96 cores

112 GB

800 GB

\$1.87/hr

Standard D15 v2

Memory optimized

20

96 cores

140 GB

1000 GB

\$2.34/hr

Let's create a compute instance
to host our Python notebooks

The screenshot shows the Microsoft Azure Machine Learning interface. On the left, there's a sidebar with various options like New, Home, Author, Notebooks, Automated ML, Designer, Assets, Datasets, Experiments, Pipelines, Models, Endpoints, Manage, Compute (which is selected), Datastores, and Data Labeling. The main area is titled 'Compute' and shows 'Compute instances' selected. A sub-menu for 'Compute' is open, showing 'Virtual Machine' and 'Settings'. The main content area is titled 'Create compute instance' and 'Configure Settings'. It lists a single virtual machine configuration: Standard_D11_v2, Memory optimized, 2 cores, 96 cores, 14 GB RAM, 100 GB Storage, and \$0.23/hr cost per hour. Below this, there's a field for 'Compute name *' containing 'computeinstancesr', which is highlighted with a red rectangle. There's also a checkbox for 'Enable SSH access' and a link to 'Show advanced settings'.

Choose a name for your
compute instance |

- [!\[\]\(2deac9a2100ab0cbc86213bccc223870_img.jpg\) New](#)
- [!\[\]\(e3a22f83b52df7c25080091effb6a866_img.jpg\) Home](#)
- [Author](#)
 - [!\[\]\(69aa93c7180ab24cb03f088a79a4d3e7_img.jpg\) Notebooks](#)
 - [!\[\]\(3bde85a787a336841bf0f19604705a07_img.jpg\) Automated ML](#)
 - [!\[\]\(34beb1ef82800cc2ef61a88c0b58123b_img.jpg\) Designer](#)
- [Assets](#)
 - [!\[\]\(c9dc7449ccc1dfd10c7a6eb4854cc95b_img.jpg\) Datasets](#)
 - [!\[\]\(9d50487514a1c6ac8ee788df5ab9d588_img.jpg\) Experiments](#)
 - [!\[\]\(9518408f9be48cd92520f5e075826fd7_img.jpg\) Pipelines](#)
 - [!\[\]\(fcc704754e1c78a97596db1f56e3f92a_img.jpg\) Models](#)
 - [!\[\]\(52826a7a7126fec71a311c02fe181eec_img.jpg\) Endpoints](#)
- [Manage](#)
 - [!\[\]\(6524f837aa424cba8ebad8e73645100e_img.jpg\) Compute](#)

 > Compute

Compute

[Compute instances](#) [Compute clusters](#) [Inference clusters](#) [Attached compute](#)[+ New](#) [Refresh](#) [Start](#) [Stop](#) [Restart](#) [Delete](#) [View quota](#)[Show all](#)

| Name | Status | Application URI | Virtual machine size | Created on |
|-------------------|---|--------------------------------|----------------------|--------------------|
| computeinstancesr |  Running | JupyterLab Jupyter RStudio SSH | STANDARD_D11_V2 | 30 nov. 2020 09:55 |

Your compute instance is running.



Quit

Files Running Clusters AzureML Samples

Select items to perform actions on them.

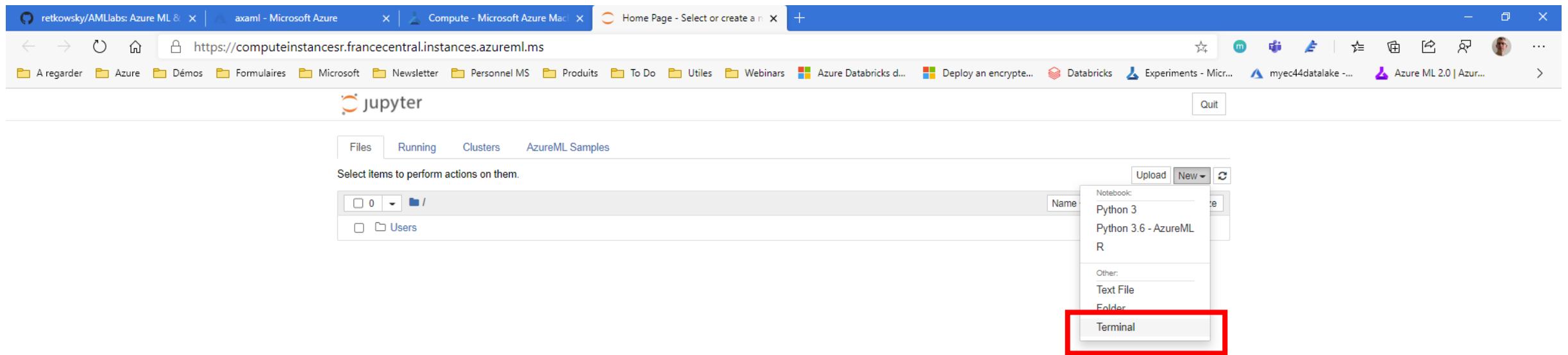
Upload New ▾

0 /

Name ▾ Last Modified File size

The notebook list is empty.

Let's run a Jupyter instance |



Run a terminal session

```
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code$ 
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code$ 
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code$ 
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code$ 
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code$ dir
Users
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code$ 
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code$ 
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code$ cd Users
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code/Users$ dir
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code/Users$ 
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code/Users$ dir
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code/Users$ 
azureuser@computeinstancesr:/mnt/batch/tasks/shared/LS_root/mounts/clusters/computeinstancesr/code/Users$ git clone https://github.com/retkowsky/AMLlabs
```

git clone https://github.com/retkowsky/AMLlabs

Do a git clone to import all the
content of the Azure ML lab |

Select items to perform actions on them.

Upload New 

| <input type="checkbox"/> | 0 |  / Users / AMLabs | Name  | Last Modified | File size |
|--------------------------|---|---|--|---------------|-----------|
| | |  .. | | seconds ago | |
| | |   Code | | seconds ago | |
| | |   data | | seconds ago | |
| | |   DatabricksArchive | | seconds ago | |
| | |  Lab0 Settings.ipynb | | seconds ago | 524 kB |
| | |  Lab1 Experiments.ipynb | | seconds ago | 220 kB |
| | |  Lab2 AutoML.ipynb | | seconds ago | 146 kB |
| | |  Lab3 Estimator.ipynb | | seconds ago | 93.9 kB |
| | |  Lab4 Explainability.ipynb | | seconds ago | 5.43 MB |
| | |  Lab5 Training and hyperparameter tuning.ipynb | | seconds ago | 268 kB |
| | |  Lab6 Azure ML deployment.ipynb | | seconds ago | 65 kB |
| | |  Lab7 Pipelines.ipynb | | seconds ago | 69.4 kB |
| | |  mnist.py | | seconds ago | 5.3 kB |
| | |  README.md | | seconds ago | 324 B |

You have now all the notebooks
and all the additional files |

2) Azure DevOps
account



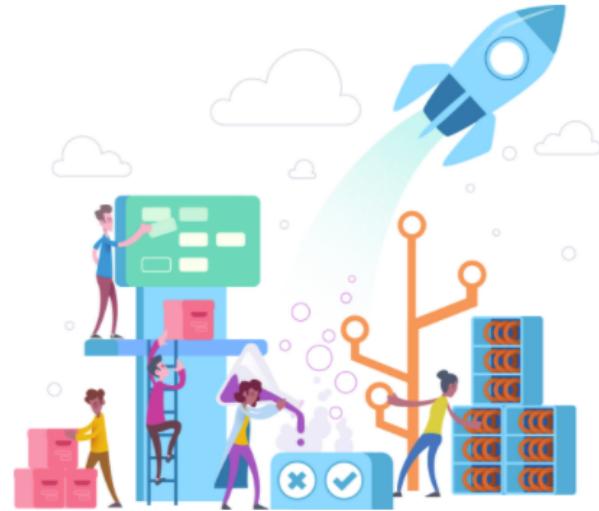
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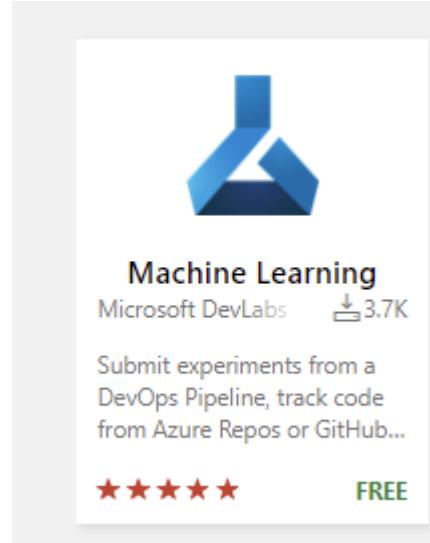
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Install Azure ML addon for |
DevOps |

3) Setup the MLOps
hands-on lab



MLOps Hands-On Lab

Use this link to have the full detailed hands-on instructions:

<https://aka.ms/MLOpsCloudWorkshop>

Or you can use the full link:

<https://github.com/microsoft/MCW-ML-Ops/blob/master/Hands-on%20lab/HOL%20step-by-step%20-%20MLOps.md>



Microsoft Cloud
Workshop

Q&A



Call to Action

Microsoft Learn

Azure ML training



Build AI solutions with Azure Machine Learning

10 hr 11 min • Learning Path • 14 Modules

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

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MLOps Microsoft Learn



MODULE

Start the machine learning lifecycle with MLOps

30 min ★★★★★ 4.7 (55)

Azure Functional Consultant Intermediate

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MODULE

Introduction to MLOps for IoT Edge

36 min ★★★★★ 4.6 (64)

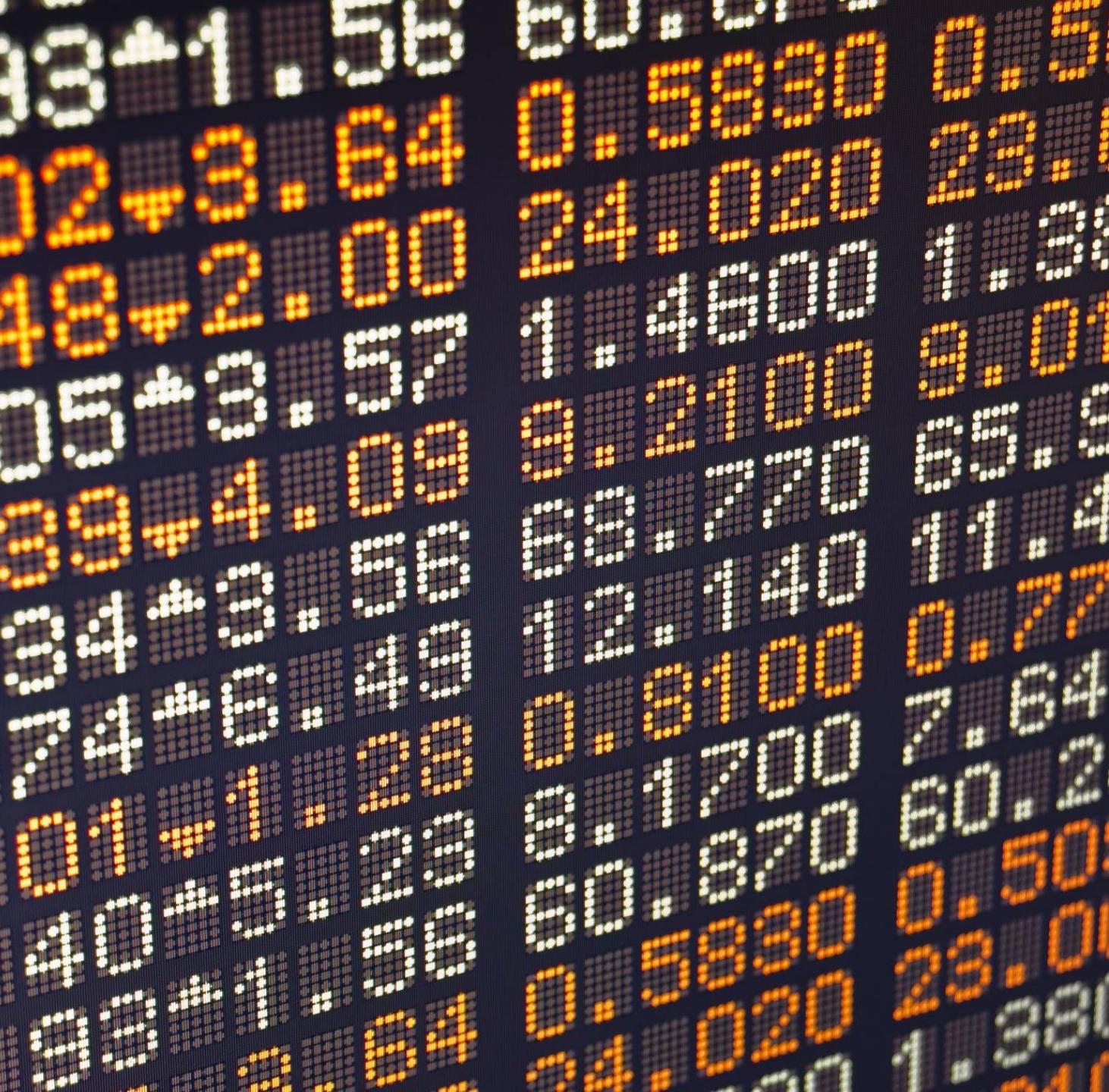
Azure AI Edge Engineer Beginner

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MLOps Labs

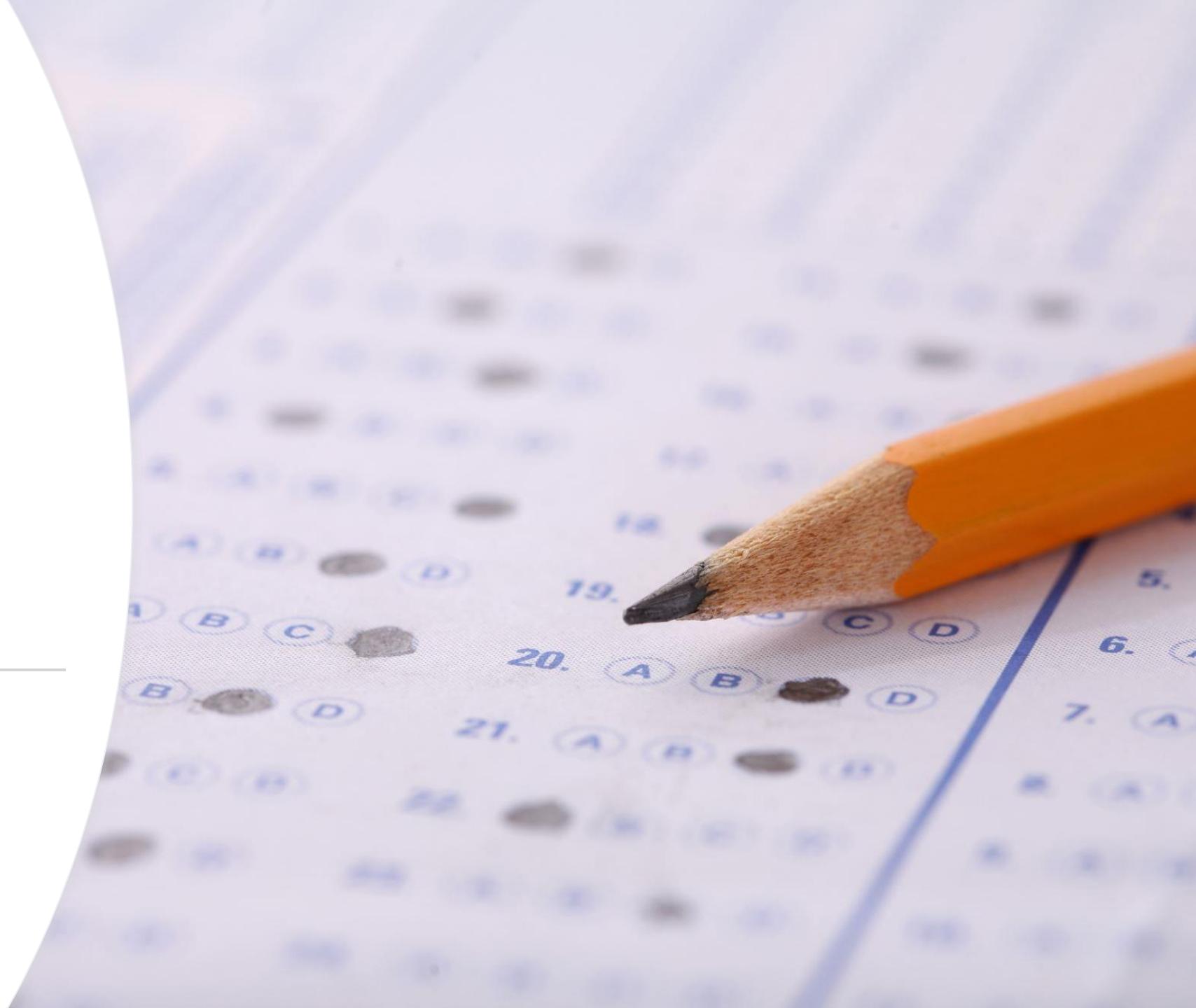
- [WorkshopMLOps/2. Workshop Azure MLOps.pdf at master · retkowsky/WorkshopMLOps \(github.com\)](#)
- [microsoft/MLOps: MLOps examples \(github.com\)](#)
- [MLops/mlopsworkshop.md at master · ignaciofls/MLops \(github.com\)](#)

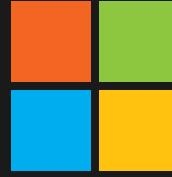


Additional links

- <https://github.com/Microsoft/MLOpsPython> (reference architecture for MLOps + python)
- <https://github.com/Microsoft/Recommenders> (recommender systems with E2E mlops baked in)
- <https://github.com/MicrosoftDocs/pipelines-azureml> (CI/CD with the azure ML CLI)
- https://github.com/Microsoft/MLOps_VideoAnomalyDetection (self-supervised learning with hyperparameter tuning and automated retraining)
- <https://www.azuredevopslabs.com/labs/vstsextend/aml/> (automated template to deploy MLOps on ADO)
- https://github.com/Azure/ACE_Azure_ML/tree/master/devops (set up azure ML + azure DevOps together for predictive maintenance)
- <https://github.com/microsoft/nlp> (Natural language processing examples using MLOps + GitHub + Azure)
- <https://github.com/microsoft/AIArchitecturesAndPractices>

Quiz time 3





Microsoft Azure

Be future
ready

Build on
your terms

Operate hybrid
seamlessly

Trust
your cloud