Azure MVP

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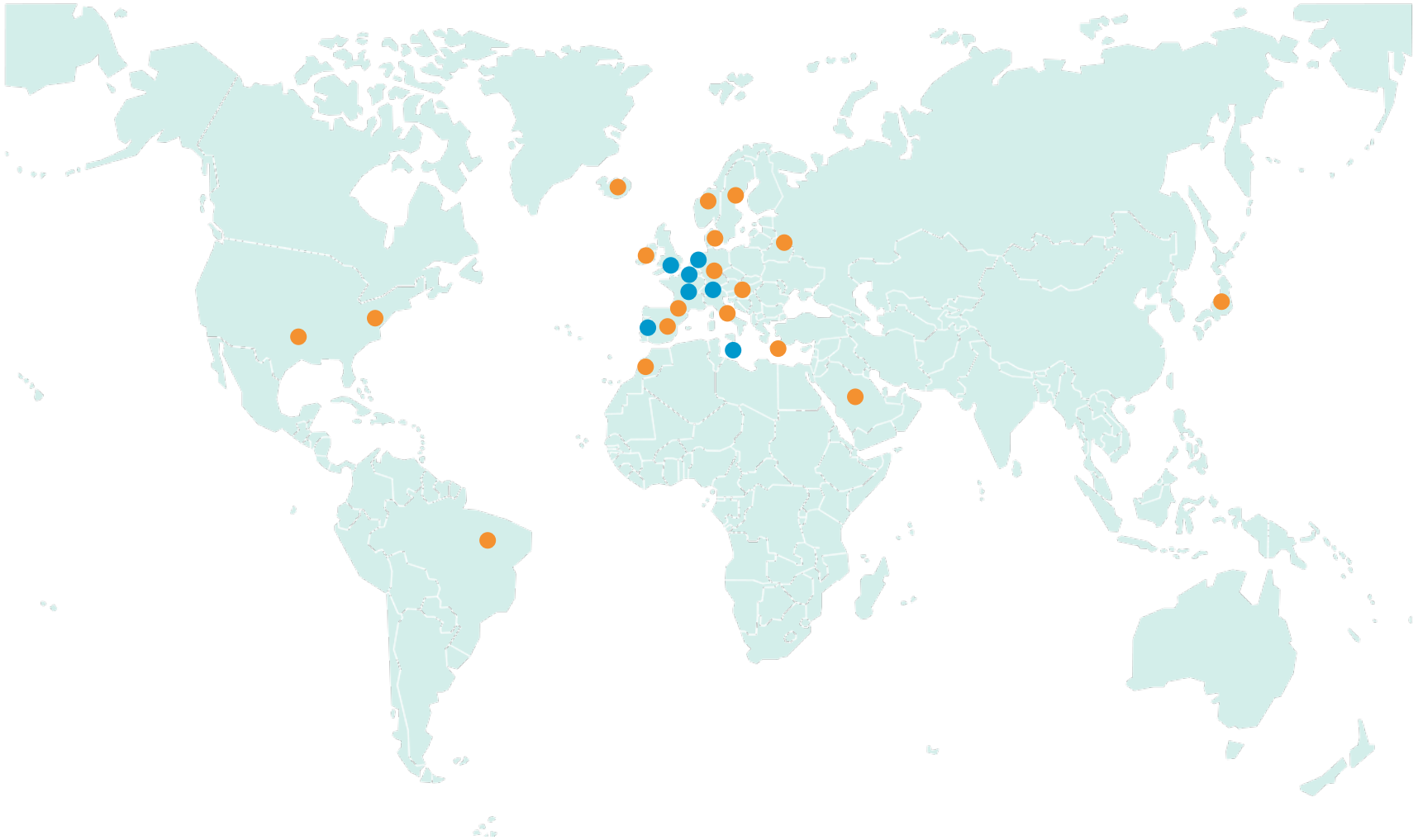
Hi, I am Sam, CTO of Codit

Azure Machine Learning

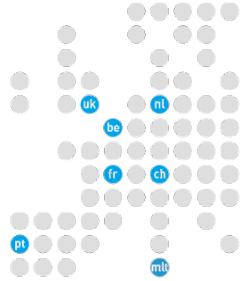
Streamlining your Machine Learning projects with AzureML

All source code is available on
https://github.com/SamVanhoutte/azureml-demo

About Codit



2000 Belgium
2004 France
2013 Portugal
2016 Switzerland
2016 UK
2016 The Netherlands
2017 Malta
2020 Luxemburg



200
worldwide

Largest Microsoft partner in Europe for Data driven, integration, API management, IoT, AI and Azure Solutions

Microsoft Partner
Microsoft

Gold Application Development
Gold Application Integration
Gold Cloud Platform
Gold Data Analytics

This session

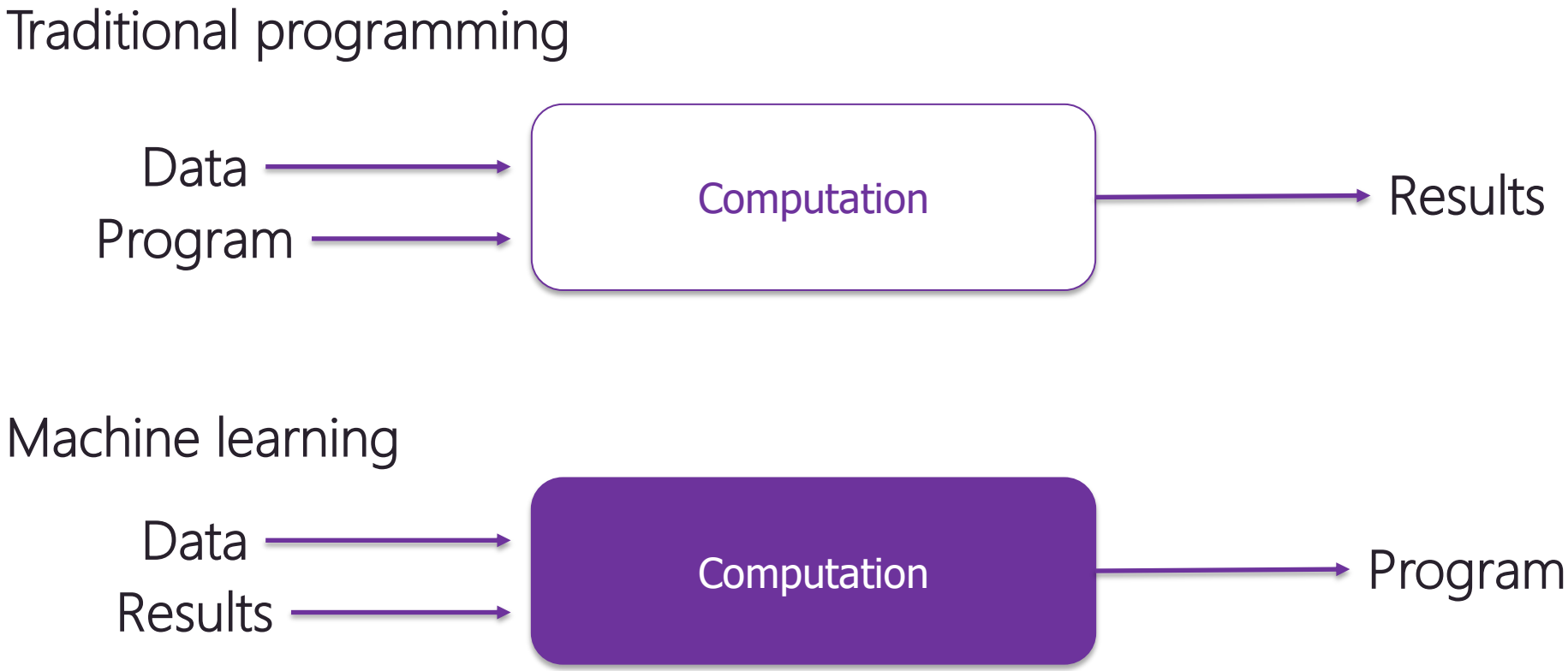
Machine learning concepts

Azure Machine Learning

From experiment to service

The MLOps approach

A different approach to problem solving



Azure Machine Learning

Machine learning on Azure

Domain specific pretrained models
To simplify solution development


Vision


Speech


Language


Web search


Decision

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 Machine Learning


Azure Databricks


Machine Learning VMs

Powerful infrastructure
To accelerate deep learning


CPU


GPU


FPGA

Azure Machine Learning

Experience
SDK, Notebooks, Drag&drop, Wizard

MLOps
Reproducible, Reusable, Automatable, Git, CLI, REST

Dataset mgmt
Profiling, drift, labeling

Model training
Experiments, Runs

Model mgmt
Models

Model Serving
Batch, RealTime

Compute
Jobs, Clusters, Instances

Orchestration
Security, management, deployment

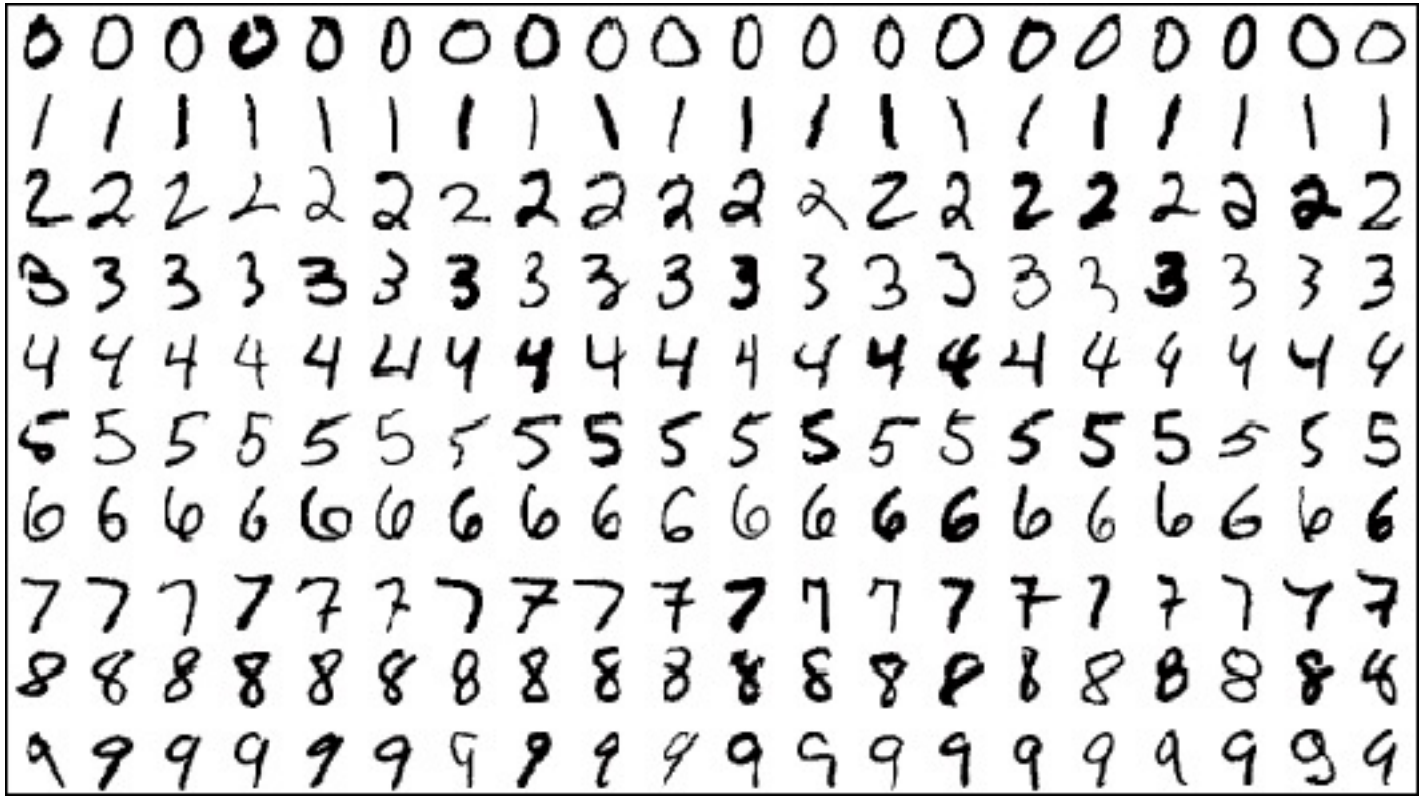
Cloud
CPU, GPU, FPGA

Edge
CPU, GPU, NPU

Experimenting like a pro

The sample: MNIST

- Handwritten digits
- 60.000 images: 28x28px



> Classification problem

Evaluation of a classifier

$$\text{Accuracy} = \frac{TP + TN}{TP + FP + FN + TN}$$

Percentage of correct predictions

$$\text{Recall} = \frac{TP}{TP + FN}$$

How many of the actual samples in the classes were well classified (also called sensitivity)

$$\text{Precision} = \frac{TP}{TP + FP}$$

How many of the predicted samples in a class were well classified

$$\text{F1 score} = \frac{2*(\text{Recall} * \text{Precision})}{(\text{Recall} + \text{Precision})}$$

Combines recall & precision

	p' (Predicted)	n' (Predicted)
p (Actual)	True Positive	False Negative
n (Actual)	False Positive	True Negative

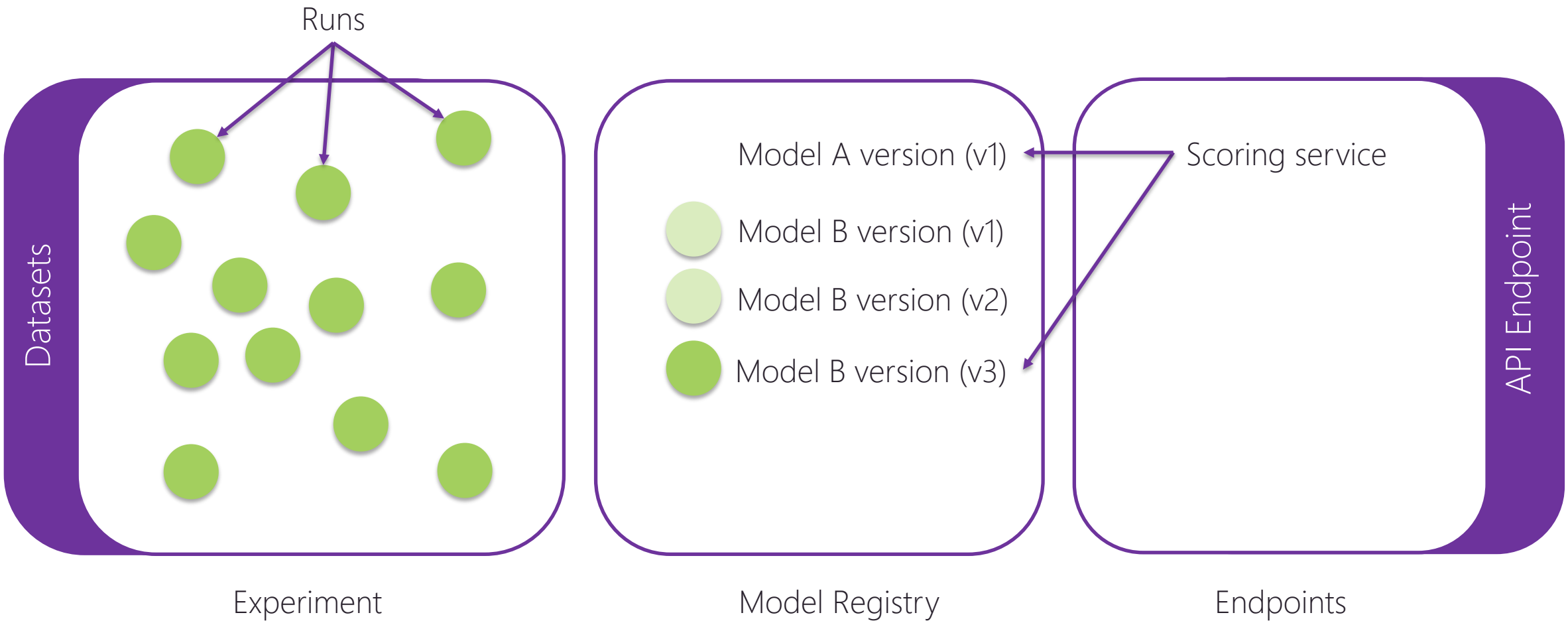
Free and maintained for you to use

- Open source effort for the community
  - Arcus for Azure Machine Learning
    - Interactive experimenting (notebook), with centralized logging & snapshotting
    - Cloud training & experiments, with standard templates, logging and evaluations
  - Arcus for Machine Learning
    - Common operations for DataFrames
    - Images
      - IO: load from dataframe, Load from Url, Slice Images, Caching, Transform
      - Explorer: Visualize Images, Compare images (expected/In/out)
    - Time Series: Time Windowing

Training & experimenting approach

- Experiment locally (Jupyter Notebook)
  - Smaller datasets
  - Focus on syntax and feasibility
  - Immediate feedback, short training cycles
- Script generation
- Schedule trainings in the cloud
  - Hyper parameters as script arguments
  - Multiple runs in parallel, through scheduling queue by AzureML
  - Docker image generation, based on required packages and sizing needs
  - Every experiment gets logged & tracked

Experiments, models & endpoints



Azure Machine Learning
experimenting

```
C:\Users\samva>demo01.exe_
```

Training a model (train.py)

- File that will be used as entry point for training image:
  - Docker image, built using requirements (pip/conda)
  - Train.py file started with training
- Leverage arguments for dynamic input/behavior
  - Hyper parameters
  - Limit size of training data
- Output metrics (to AzureML)
- Save trained model to `outputs` folder.

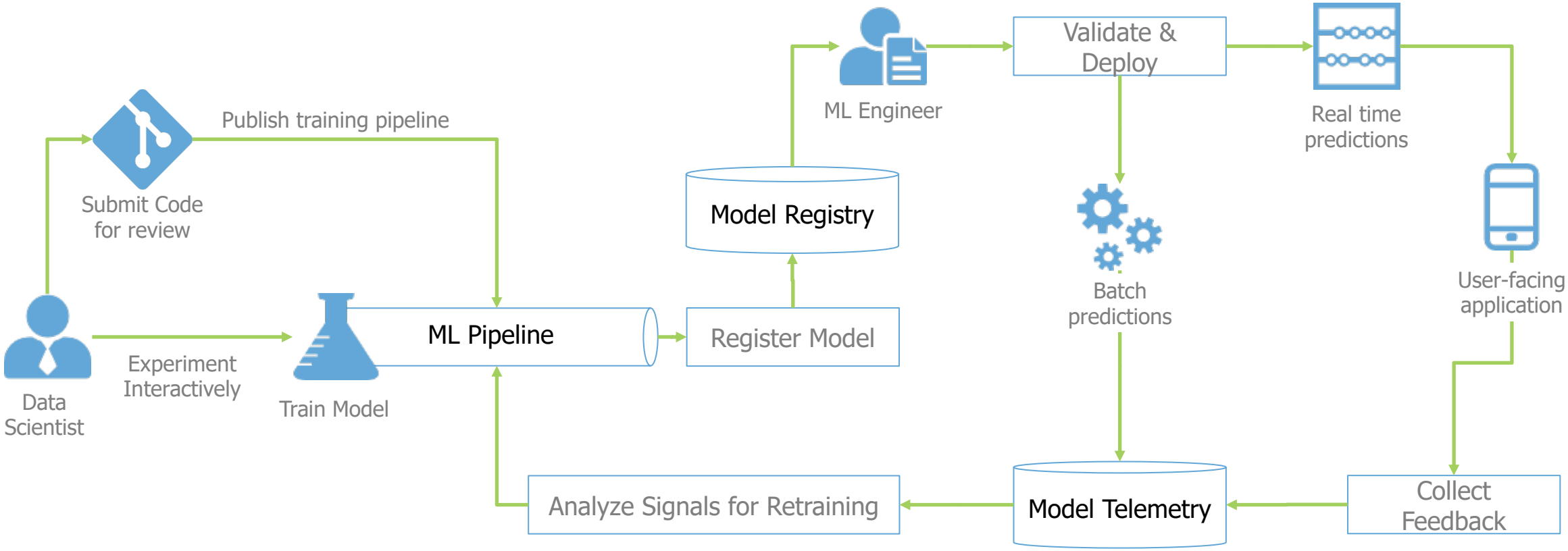
- Example file

Servicing a model (score.py)

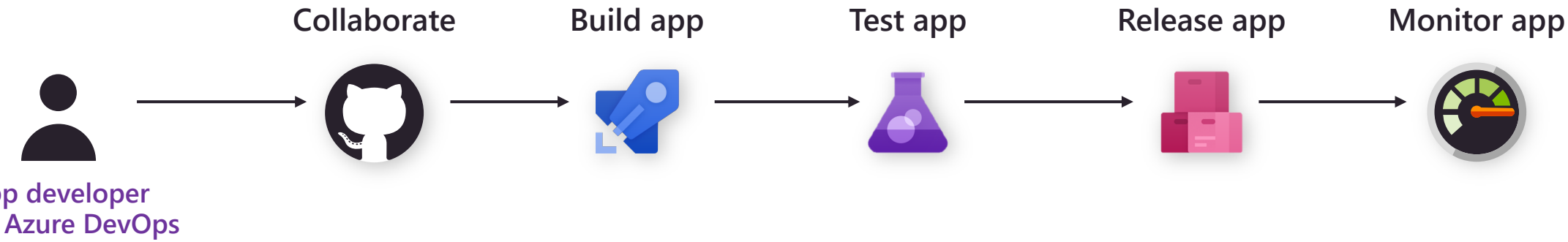
- File that will be hosted in the model endpoint (docker container) and should contain two methods:
  - `def init():`
    - Called once, when deployment is started
    - Used to load the model (often pkl file) and any other required objects
    - Using the get_model_path to locate model inside the docker container
  - `def run(raw_data):`
    - Called interactively when data samples are to be predicted
    - Raw_data is json structure (with 'data' property)
- Example file

ML Ops

MLOps process (generalized)

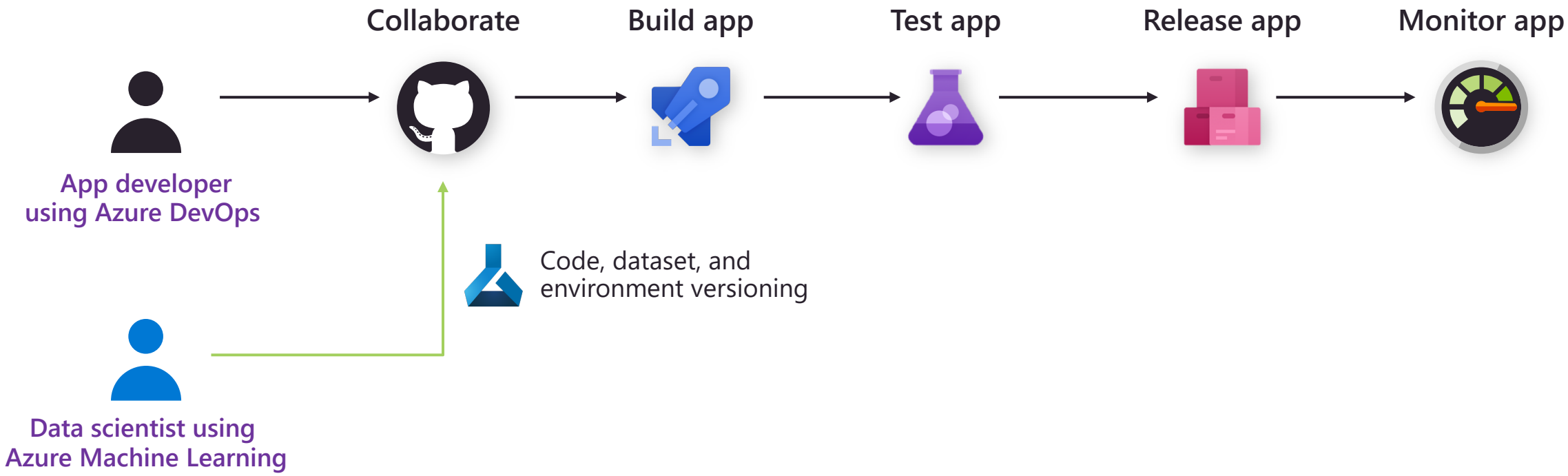


MLOps with Azure Machine Learning



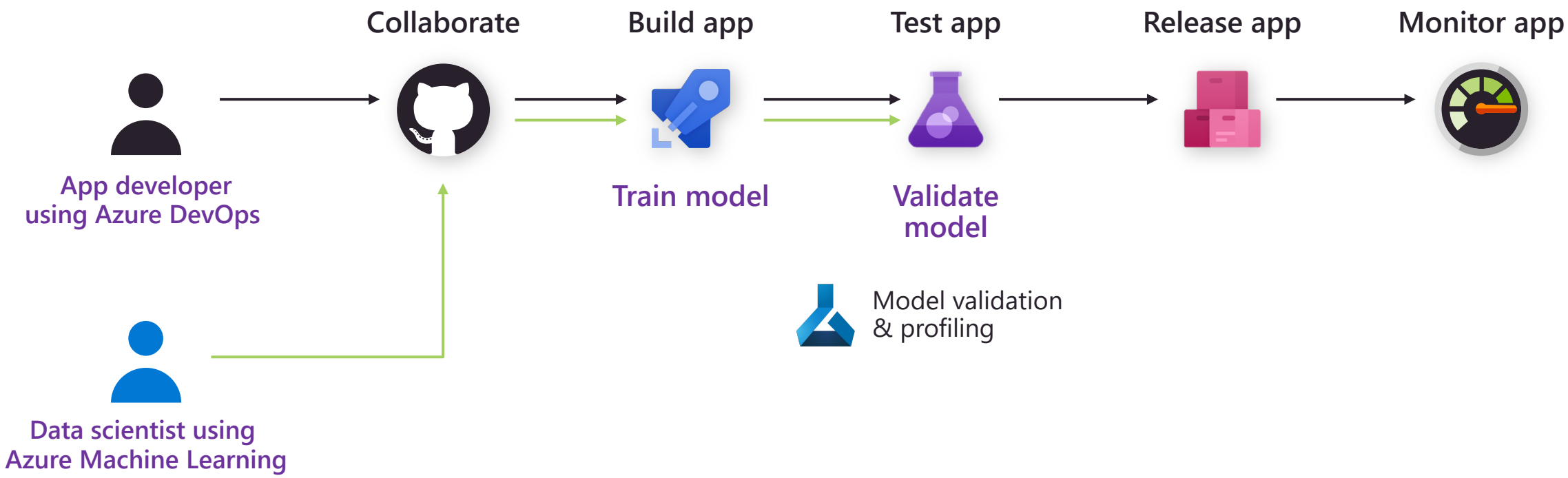
- Model reproducibility
- Model validation
- Model deployment
- Model retraining

MLOps with Azure Machine Learning



- [x] Model reproducibility
- [ ] Model validation
- [ ] Model deployment
- [ ] Model retraining

MLOps with Azure Machine Learning



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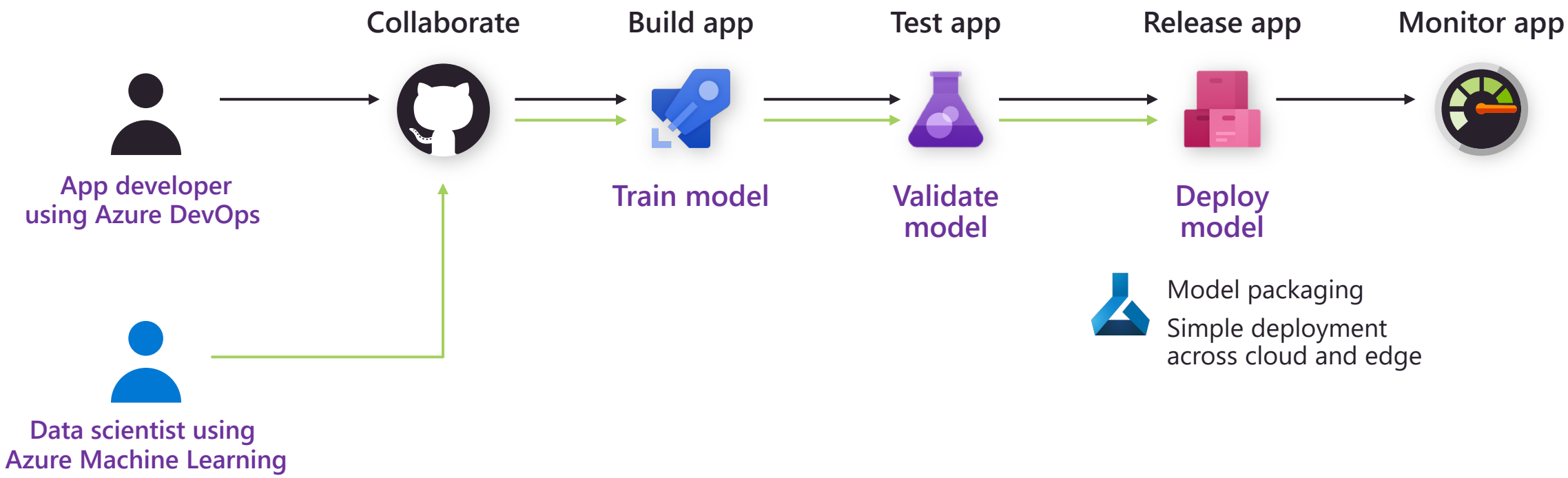
MLOps with Azure Machine Learning



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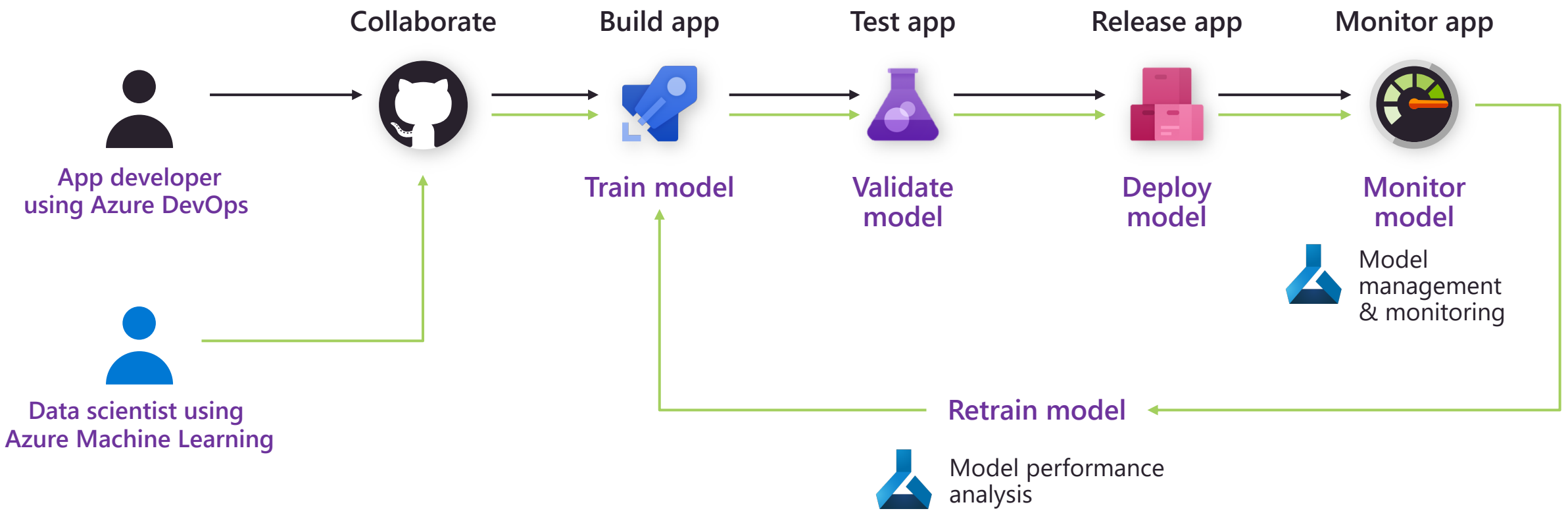
MLOps with Azure Machine Learning



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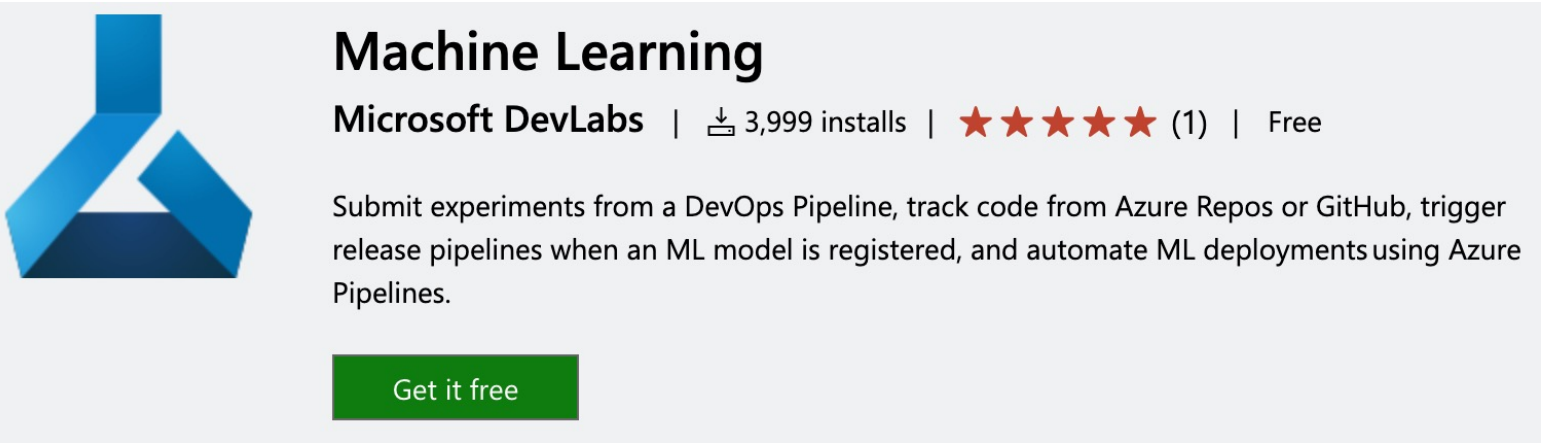
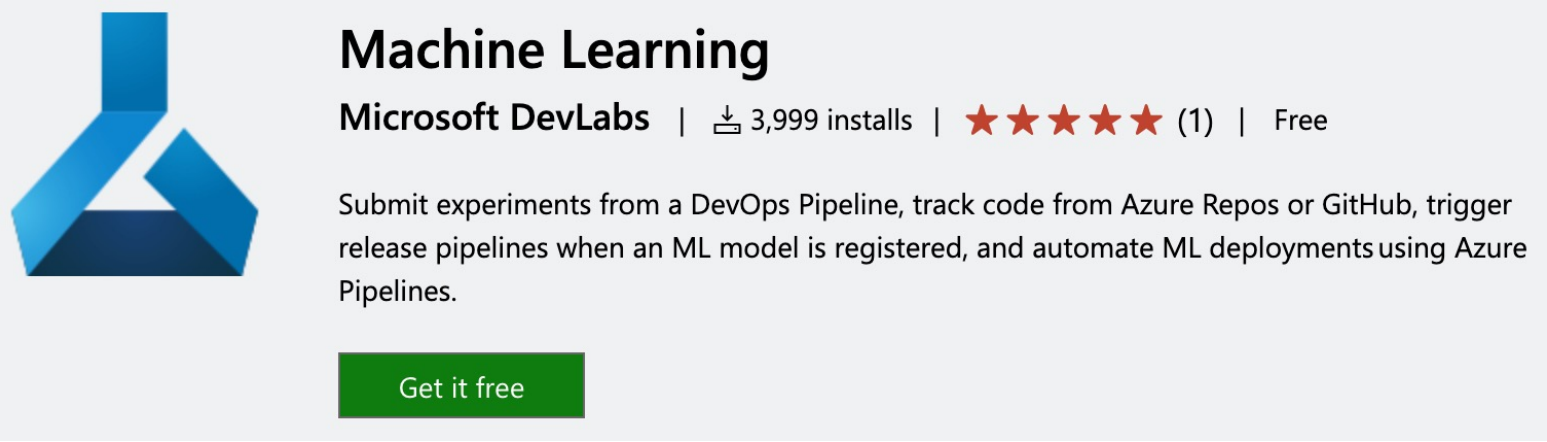
Leveraging Azure DevOps : CI (training pipeline)

- Build Model
  - Linting (code quality analysis)
  - Unit Tests
  - Code coverage
  - Build & publish ML pipeline in ML Workspace
  - Publish artifact (model)
- Train model
  - Trigger ML pipeline
  - Verify metrics of the model (cancel if not better)
- Create pipeline artifact
  - Create artifact (model.json) with the model information



Leveraging Azure DevOps : CD (model deploy)

- Deploy model to ACI
- Deploy model to AKS
- Deploy model to AppService



MLOps with Azure DevOps
from repo to service

```
C:\Users\samva>demo02.exe_
```

Takeaways

AzureML drives collaboration & traceability of your ML projects

- Track your experiments (code, results, hyper params)
- Combine flexibility, ease of use and enterprise quality
- Treat your machine learning models like code, and leverage the MLOps approach

https://www.arcus-azure.net
https://github.com/SamVanhoutte/azureml-demo
https://github.com/microsoft/MLOpsPython

Thank you. Let's connect!