

# Azure Machine Learning overview

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# Overview

## Machine Learning Frameworks



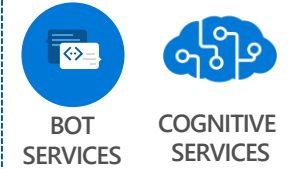
## Infrastructure Services



## Platform Services



## Software Services



+



+





# Customvision Services



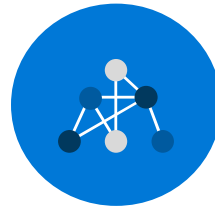
# Azure AI

## AI apps & agents



Azure Bot Service  
Azure Cognitive Services

## Machine learning



Azure Databricks  
Azure Machine Learning

## Knowledge mining



Azure Cognitive Search

# Machine Learning on Azure

## Domain specific pretrained models

To reduce time to market



Vision



Speech



Language



Search

## Familiar Data Science tools

To simplify model development



PyCharm



Jupyter



Visual Studio Code



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



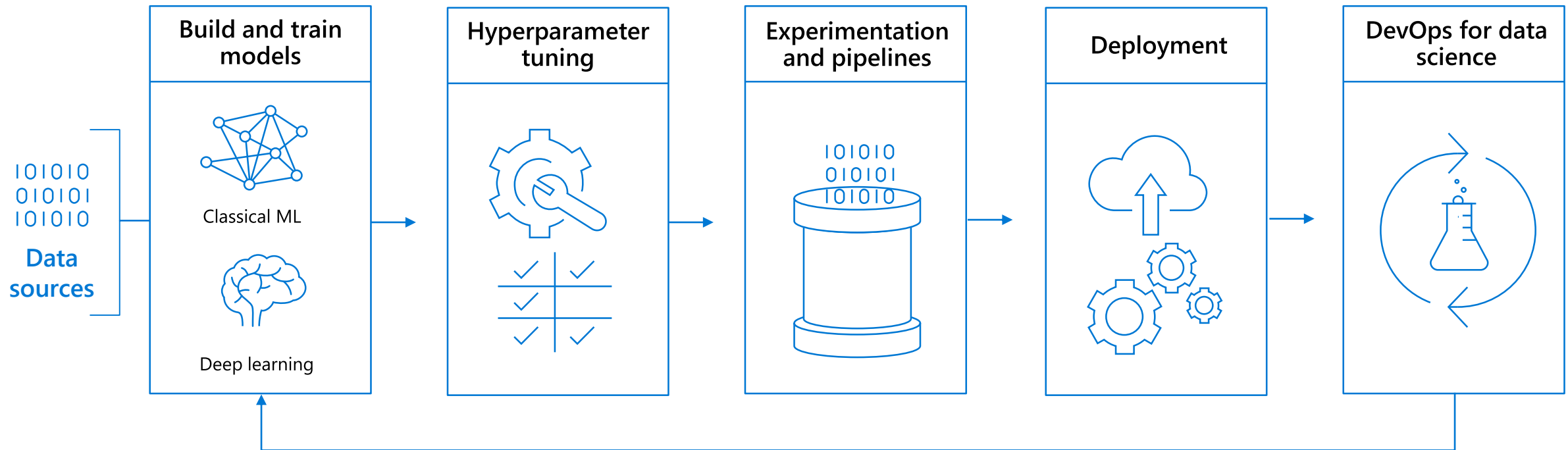
FPGA



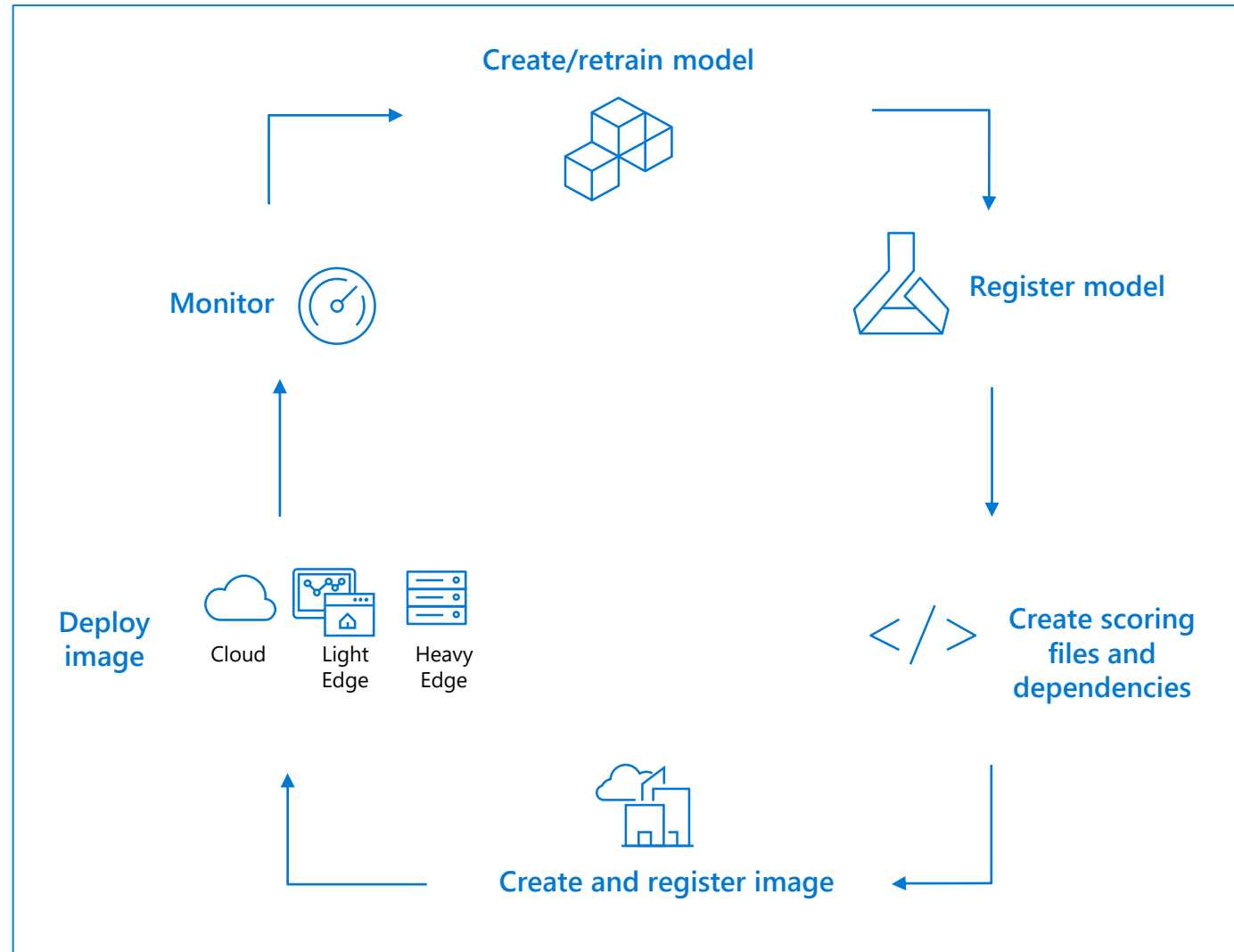
From the Intelligent Cloud to the Intelligent Edge



# Building blocks for a Data Science Project



# Model management in Azure Machine Learning



# Azure Machine Learning service

Set of Azure Cloud  
Services



Python  
SDK

---

That enables you to:

- ✓ Prepare Data
- ✓ Build Models
- ✓ Train Models

- ✓ Manage Models
- ✓ Track Experiments
- ✓ Deploy Models



# ML workspace

The screenshot shows the MLScronj - Compute interface. The left sidebar contains navigation links: Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Authoring (Preview), Automated machine learning, Notebook VMs, Visual interface, Assets, Experiments, Pipelines, Compute (highlighted), Models, Images, Deployments, Activities, Settings, Properties, Locks, Export template, and Monitoring. The main content area has tabs for Experiments, Pipelines, Compute (selected), Models, Images, Deployments, and Activities. The Compute tab displays a table of compute resources. Annotations include: 'runs' pointing to the Compute tab in the sidebar; 'Models, images, ...' pointing to the Models and Images tabs; 'Notebook VMs' pointing to the 'cpu-scronj-nbvm' and 'gpu-scronj-nbvm' rows; and 'Compute VMs' pointing to the 'cpu-cluster' row.

Home > MLScronj - Compute

MLScronj - Compute  
Machine Learning service workspace

Search (Ctrl+/)

Experiments Pipelines **Compute** Models Images Deployments Activities

Compute

+ Add Compute Refresh Delete Detach

<input type="checkbox"/>	NAME ↑↓	TYPE ↑↓	PROVISIONING STATE ↑↓	CREATED DATE ↑↓	VIRTUAL MACHINE SIZE
<input type="checkbox"/>	cpu-scronj-nbvm	Virtual Machine	Succeeded	Wed Sep 04 2019	STANDARD_D4_V2
<input type="checkbox"/>	gpu-scronj-nbvm	Virtual Machine	Succeeded	Wed Sep 04 2019	STANDARD_NC6
<input type="checkbox"/>	vmsscrongcpu	Machine Learning Compute	Succeeded (0 nodes)	Tue Sep 03 2019	STANDARD_DS4_V2
<input type="checkbox"/>	mlsscrongpu	Machine Learning Compute	Succeeded (0 nodes)	Tue Sep 03 2019	STANDARD_NC6
<input type="checkbox"/>	cpu-cluster	Machine Learning Compute	Succeeded (0 nodes)	Fri Sep 06 2019	STANDARD_D4_V2

runs

Models, images, ...

Notebook VMs

Compute VMs

Other team members may be invited to workspace

Home > mlschronj

**mlschronj**  
Resource group

<<

Overview

Activity log

Access control (IAM)

Tags

Events

Settings

Quickstart

Deployments

Policies

Properties

Locks

Export template

Cost Management

Cost analysis

Cost alerts

Budgets

Advisor recommendations

+ Add

Edit columns

Delete resource group

Refresh

Move

Export to CSV

Assign tags

Delete

Subscription (change) : Microsoft Azure Internal Consumption

Deployments : 3 Succeeded

Subscription ID : 5a4ff4ee-da20-421e-9a1d-c5c5e2bf0da3

Tags (change) : Click here to add tags

Filter by name...

All types

All locations

No grouping

17 items

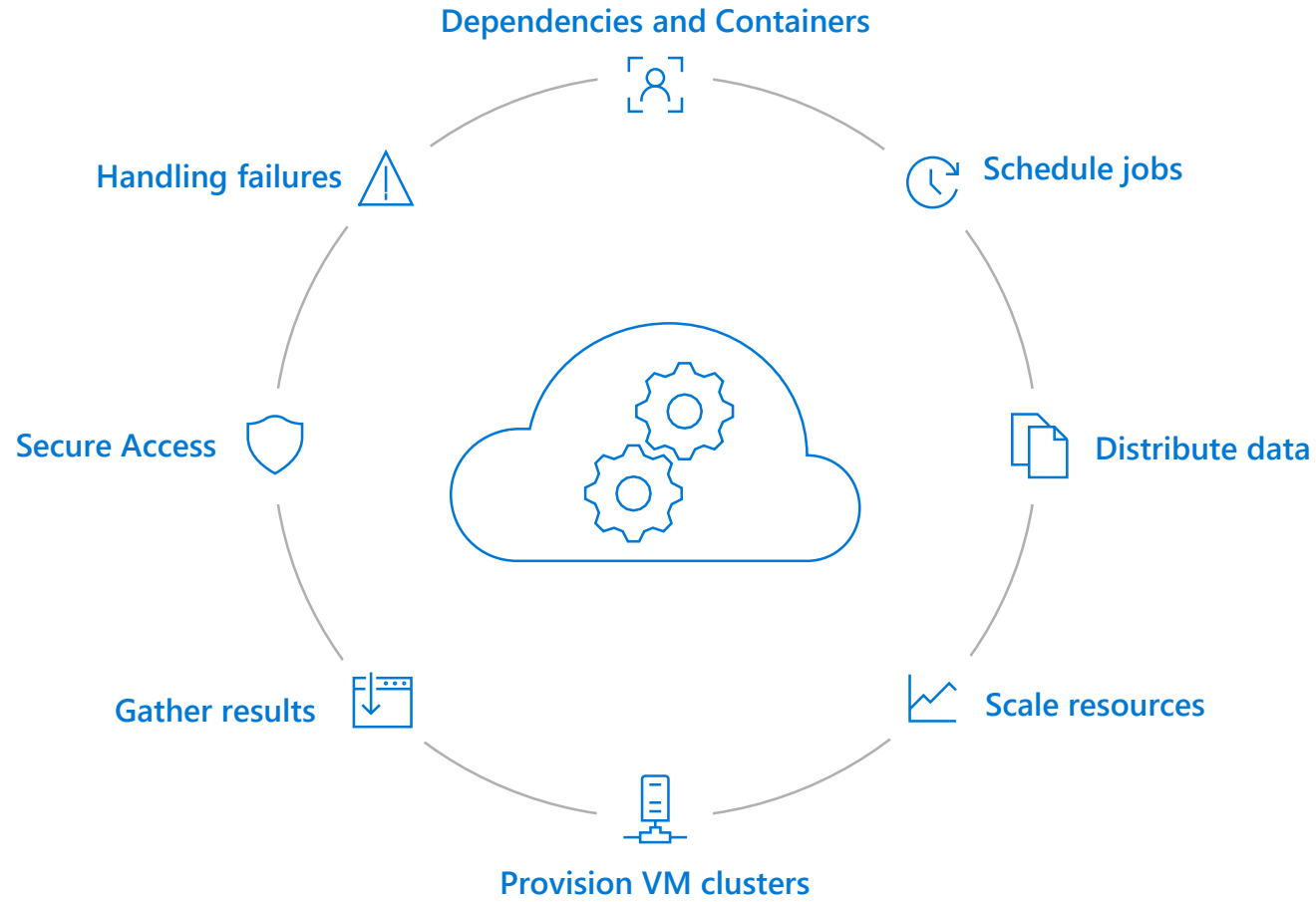
Show hidden types

NAME	TYPE	LOCATION
gpu-scronj-nbvm67b42711	virtual machine	West Europe
gpu-scronj-nbvm67b42711	Network interface	West Europe
gpu-scronj-nbvm67b42711	Network security group	West Europe
gpu-scronj-nbvm67b42711	Public IP address	West Europe
gpu-scronj-nbvm67b42711	Virtual network	West Europe
gpu-scronj-nbvm67b42711_osDisk	Disk	West Europe
MLschronj	Machine Learning service workspace	West Europe
mlschronj1352848569	Key vault	West Europe
mlschronj4949374477	Storage account	West Europe
mlschronj5247165409	Application Insights	West Europe
mlschronj7e6dac5c	Container registry	West Europe

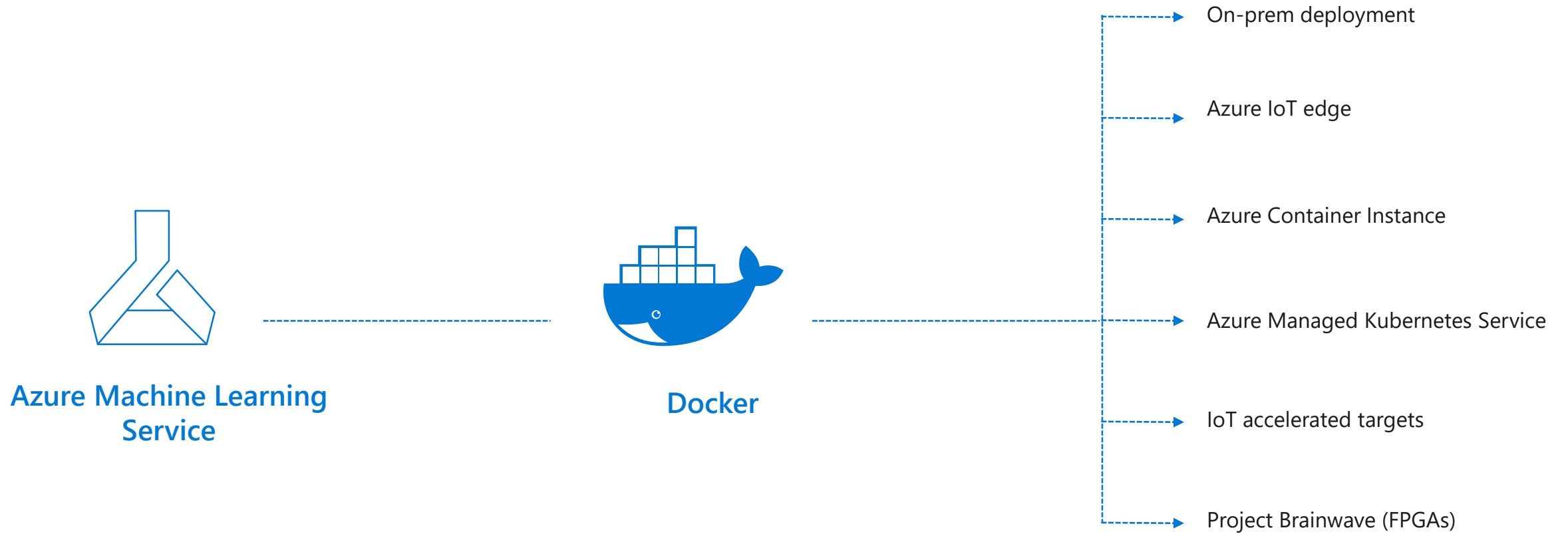


A lot of resources are created. For security, deployment, storage, ...

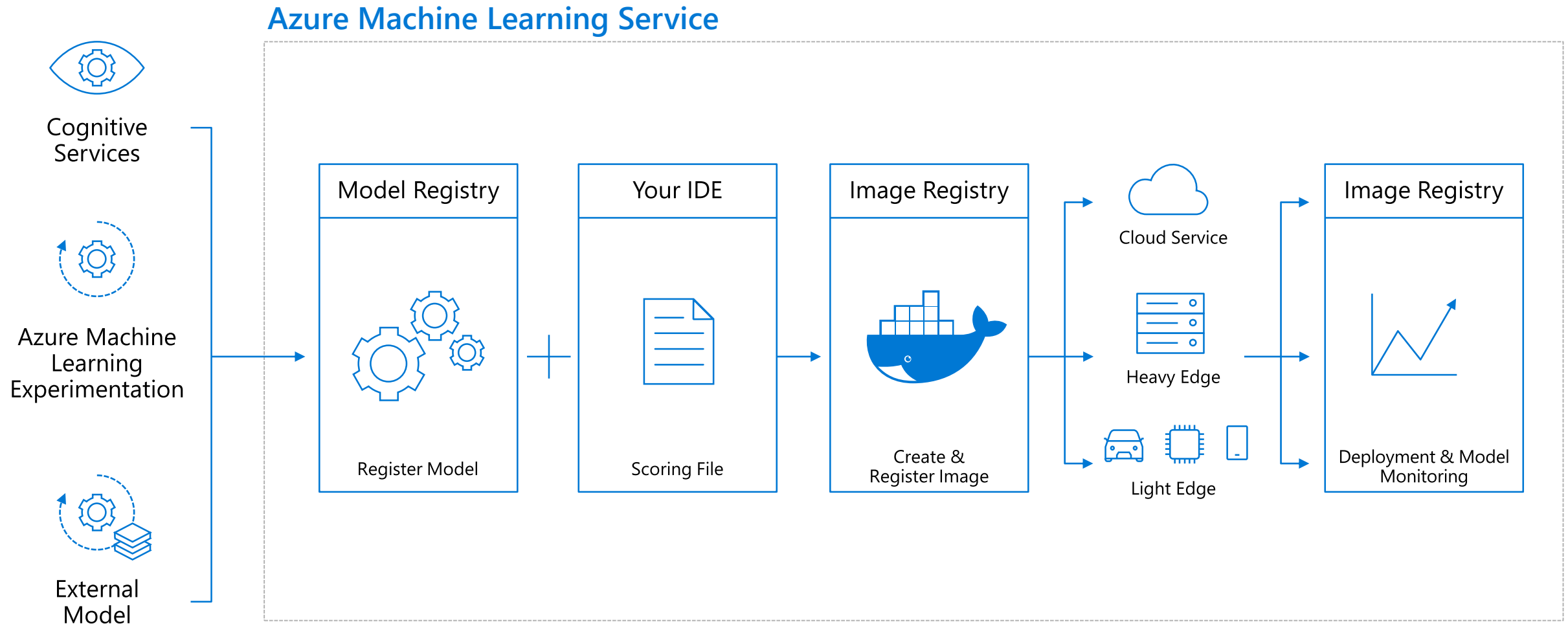
# Distributed training on managed compute



# Deployment from Azure ML Workspace

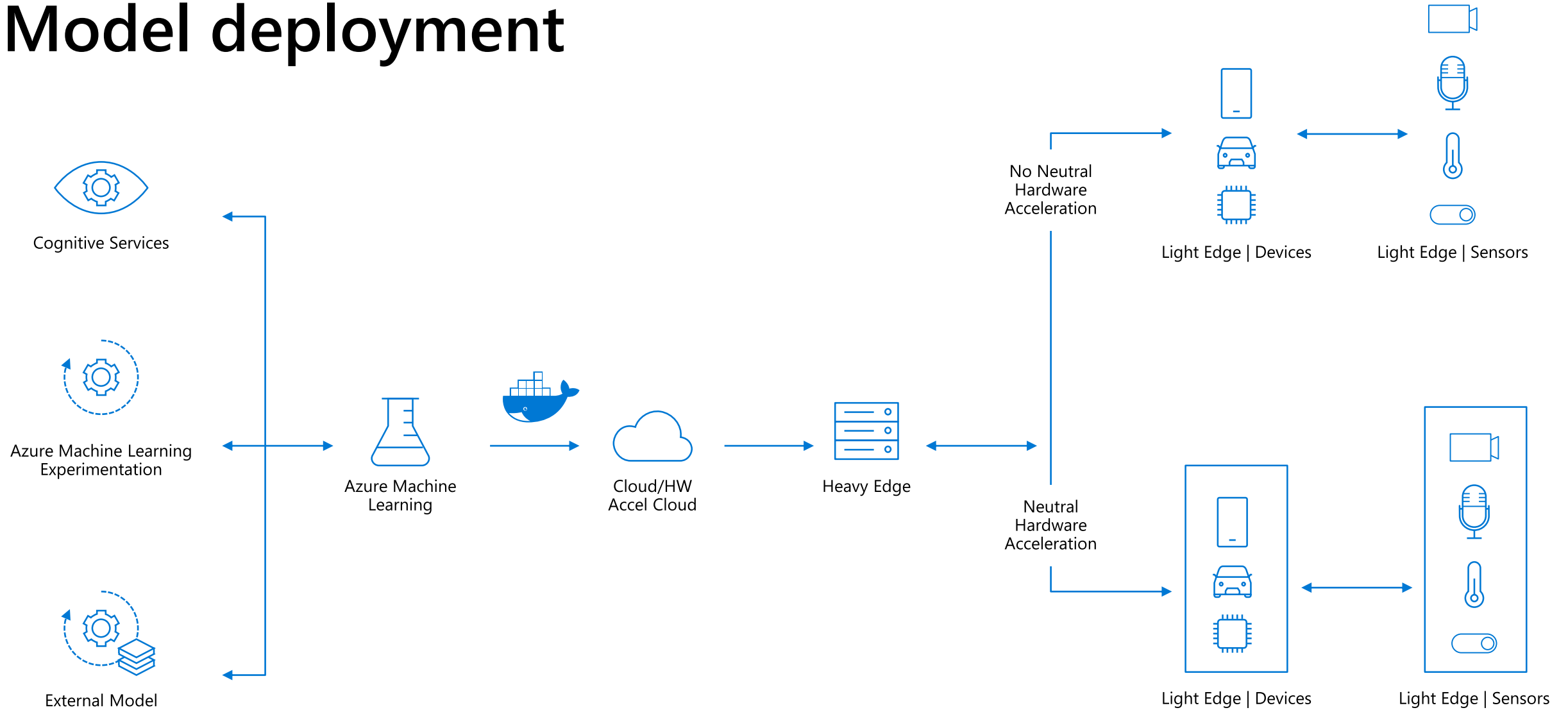


# Deploy Azure ML models at scale





# Model deployment



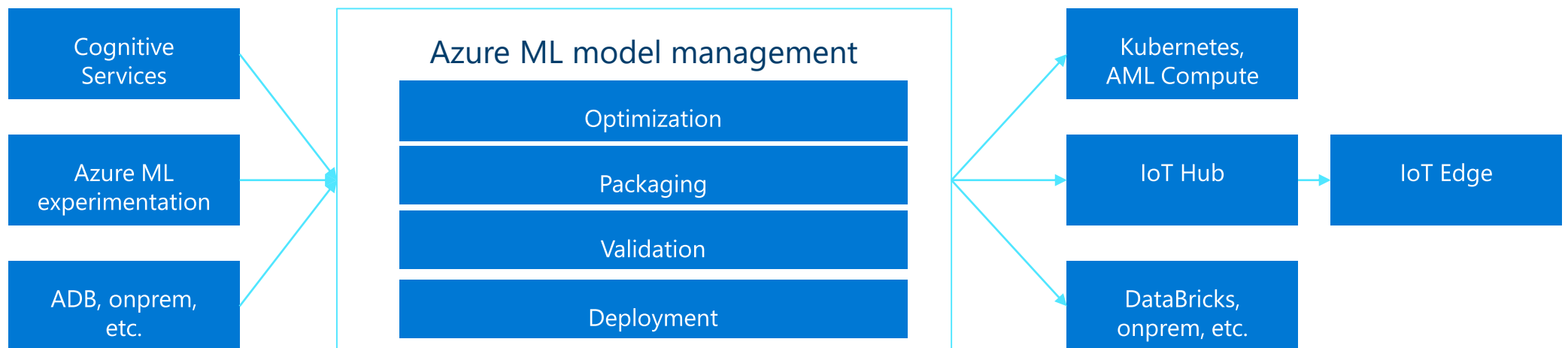
# Deploy to cloud and edge

## Cloud

Register Model ->  
Build Container ->  
Deploy to AKS ->  
Model Telemetry


## Edge

Register Model ->  
Convert model ->  
Build endpoint specific container ->  
Register in IoT Hub ->  
Deploy to IoT Edge ->  
Model Telemetry



# Automated ML 1/3

[Home](#) > [mlschronj](#) > MLschronj - Automated machine learning

 **MLschronj - Automated machine learning**  
Machine Learning service workspace

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Authoring (Preview)

**Automated machine learning**

Notebook VMs

Visual interface

Assets

Experiments

Pipelines

Compute

Models

Images

Deployments

Activities

Settings

Properties

Locks

Export template

Monitoring

Metrics

Support + troubleshooting

Usage + quotas

New support request

Create a new automated machine learning experiment [We'd love to get your feedback](#)

[Back](#) [Refresh](#)

Experiment name \*

Testdata

Select a training compute \*

cpu-cluster

Storage Account

mlschronj4949374477

Storage Container

azureml-blobstore-8de4ea8d-b8c5-4878-b259-6e96dd5ac88e

Blob

bankmarketing\_train.csv

Use first row as header

Yes

Preview

Profile

Search to filter items...

HOUSING	LOAN	CONTACT	MONTH	DAY_OF_WEEK	DURATION
<input checked="" type="checkbox"/> Included	<input checked="" type="checkbox"/> Included	<input checked="" type="checkbox"/> Included	<input checked="" type="checkbox"/> Included	<input type="checkbox"/> Ignored	<input checked="" type="checkbox"/> Included
no	yes	cellular	may	mon	371
yes	no	telephone	may	thu	285
no	no	cellular	may	fri	52
no	no	telephone	jun	fri	355
yes	no	cellular	jul	fri	189

Prediction Task \*

Classification

Target column \*

y

Advanced Settings

Train many models on compute

Data profiling

Include and exclude data

# Automated ML 2/3

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Authoring (Preview)

Automated machine learning

Notebook VMs

Visual interface

Assets

Experiments

Pipelines

Compute

Models

Images

Deployments

Activities

Settings

Properties

Locks

Export template

Monitoring

Metrics

Support + troubleshooting

Usage + quotas

y

Advanced Settings

Primary metric \*

accuracy

Exit criteria

Training job time (minutes)

60

Max number of iterations

100

Metric score threshold

Metric Score Threshold

Preprocessing

☒

Validation

Validation type

K-fold cross validation

Number of Cross Validations \*

5

Concurrency

Max concurrent iterations

4

Max cores per iteration

Max cores per iteration

Blocked Algorithms \*

☐ LogisticRegression

☐ SGD

☐ MultinomialNaiveBayes

☐ BernoulliNaiveBayes

☐ SVM

☐ LinearSVM

☐ KNN

☐ DecisionTree

Select optimization

Parallel execution

Include and exclude algorithms

# Automated ML 3/3

MLschronj - Automated machine learning

Machine Learning service workspace

Search (Ctrl+/)

«

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Authoring (Preview)

Automated machine learning

Notebook VMs

Visual interface

Assets

Experiments

Pipelines

Compute

Models

Images

Deployments

Activities

Settings

Properties

Locks

Export template

Monitoring

Metrics

Support + troubleshooting

Usage + quotas

New support request

Run Detail

Back


Refresh

Logs

Cancel Run

Run is **Completed**.

ITERATION CHART



ITERATIONS

Search to filter items...

ITERATION	NAME	SPEARMAN_CORRELATI...	STATUS	CREATED	DURATION	MODEL
18	VotingEnsemble	0.9481454915191199	Completed	9/6/2019, 1:46:40 PM	00:00:15	<a href="#">Download</a>
1	MinMaxScaler, RandomForest	0.9478935612679532	Completed	9/6/2019, 1:43:07 PM	00:00:13	<a href="#">Download</a>
19	StackEnsemble	0.9476876839264905	Completed	9/6/2019, 1:46:56 PM	00:00:16	<a href="#">Download</a>
8	StandardScalerWrapper, LassoLars	0.9450852549004514	Completed	9/6/2019, 1:44:33 PM	00:00:10	<a href="#">Download</a>
5	StandardScalerWrapper, LassoLars	0.9447977436326458	Completed	9/6/2019, 1:43:57 PM	00:00:10	<a href="#">Download</a>
4	RobustScaler, DecisionTree	0.944428559470864	Completed	9/6/2019, 1:43:45 PM	00:00:10	<a href="#">Download</a>
12	StandardScalerWrapper, LassoLars	0.9441052650451134	Completed	9/6/2019, 1:45:23 PM	00:00:10	<a href="#">Download</a>

Deploy models

Download Best Model VotingEnsemble

Deploy Best Model VotingEnsemble

[Learn more about deploying models](#)

RUN SUMMARY

Experiment Name

taxi-experiment

Run Id

AutoML\_06b23c98-dc01-4...

Task Type

regression

Status

Completed

RUN SETTINGS

Compute Target

local

N Cross Validations

5

Max Cores Per Iteration

1

Primary Metric

spearman\_correlation

Metric Operation

maximize

Blacklisted Algorithms

XGBoostRegressor, XGBoos...

Training models in parallel

Download models

Train of clusters if needed



# Databricks aspects

# Databricks access to workspace

Cmd 9

```
1 # Step 1 - Load training data and define model training function
2 #####
3 import os
4 import numpy as np
5 import pandas as pd
6 from sklearn import linear_model
7 from sklearn.externals import joblib
8 from sklearn.preprocessing import StandardScaler
9 from sklearn.metrics import accuracy_score
10 from sklearn.model_selection import train_test_split
11 import azureml
12 from azureml.core import Run
13 from azureml.core import Workspace
14 from azureml.core.run import Run
15 from azureml.core.experiment import Experiment
16 from azureml.core.model import Model
17 import pickle
18 import json
19
20 # Verify AML SDK Installed
21 # view version history at https://pypi.org/project/azureml-sdk/#history
22 print("SDK Version:", azureml.core.VERSION)
23
24
25 # Load our training data set
26 pathToCsvFile = os.path.join('/dbfs' + tempFolderName, 'UsedCars_Affordability.csv')
27 df_affordability = pd.read_csv(pathToCsvFile, delimiter=',')
28 print(df_affordability)
29
```

```
7 #Provide values for the Resource Group and Workspace that will be created
8 resource_group = "amlscronj"
9 workspace_name = "amlscronj"
10 workspace_region = 'westeurope' # eastus, westcentralus, southeastasia
11
12 # By using the exist_ok param, if the workspace already exists we get no error
13 ws = Workspace.create(
14     name = workspace_name,
15     subscription_id = subscription_id,
16     resource_group = resource_group,
17     location = workspace_region,
18     exist_ok = True)
19
20 print("Workspace Provisioning complete.")
21
22
23 # Create an experiment, log metrics and register the created model
24 experiment_name = "Experiment-03-40"
25 model_name = "usedcarsmodel"
26 training_set_percentage = 0.50
27 registered_model, model, scaler, score, run = train_eval_register_model
```

# Deployment from Databricks: to ACI or AKS

Cmd 22

```
1 # Step 5 - Create container image configuration
2 #####
3 # Build the ContainerImage
4 runtime = "python"
5 driver_file = "score.py"
6 conda_file = "mydeployenv.yml"
7
8 from azureml.core.image import ContainerImage
9
10 image_config = ContainerImage.image_configuration(execution_script = driver_file,
11                                                  runtime = runtime,
12                                                  conda_file = conda_file)
```

Command took 0.02 seconds -- by scronj@mic

Cmd 23

## Deploy the container image to ACI

Cmd 24

With the Container Image configuration in hand, you are almost ready to deploy to ACI. the following cell to create this configuration.

Cmd 25

```
1 # Step 6 - Create ACI configuration
2 #####
3 from azureml.core.webservice import AciWebservice, Webservice
4
5 aci_config = AciWebservice.deploy_configuration(
6     cpu_cores = 1,
7     memory_gb = 1,
8     tags = {'name': 'Azure ML ACI 2'},
9     description = 'This is a second ACI.')
```

Cmd 27

```
1 # Step 7 -Deploy the webservice to ACI
2 #####
3 service_name = "usedcarsmlserviceaci2"
4
5 webservice = Webservice.deploy_from_model(
6     workspace=ws,
7     name=service_name,
8     deployment_config=aci_config,
9     models = [registered_model],
10    image_config=image_config,
11 )
12
13 webservice.wait_for_deployment(show_output=True)
```

Creating image

Image creation operation finished for image usedcarsmlserviceaci2:1, opera

Creating service

Running.....

SucceededACI service creation operation finished, operation "Succeeded"

Command took 7.26 minutes -- by scronj@microsoft.com at 28.3.2019, 16:04:11 on databrickl