

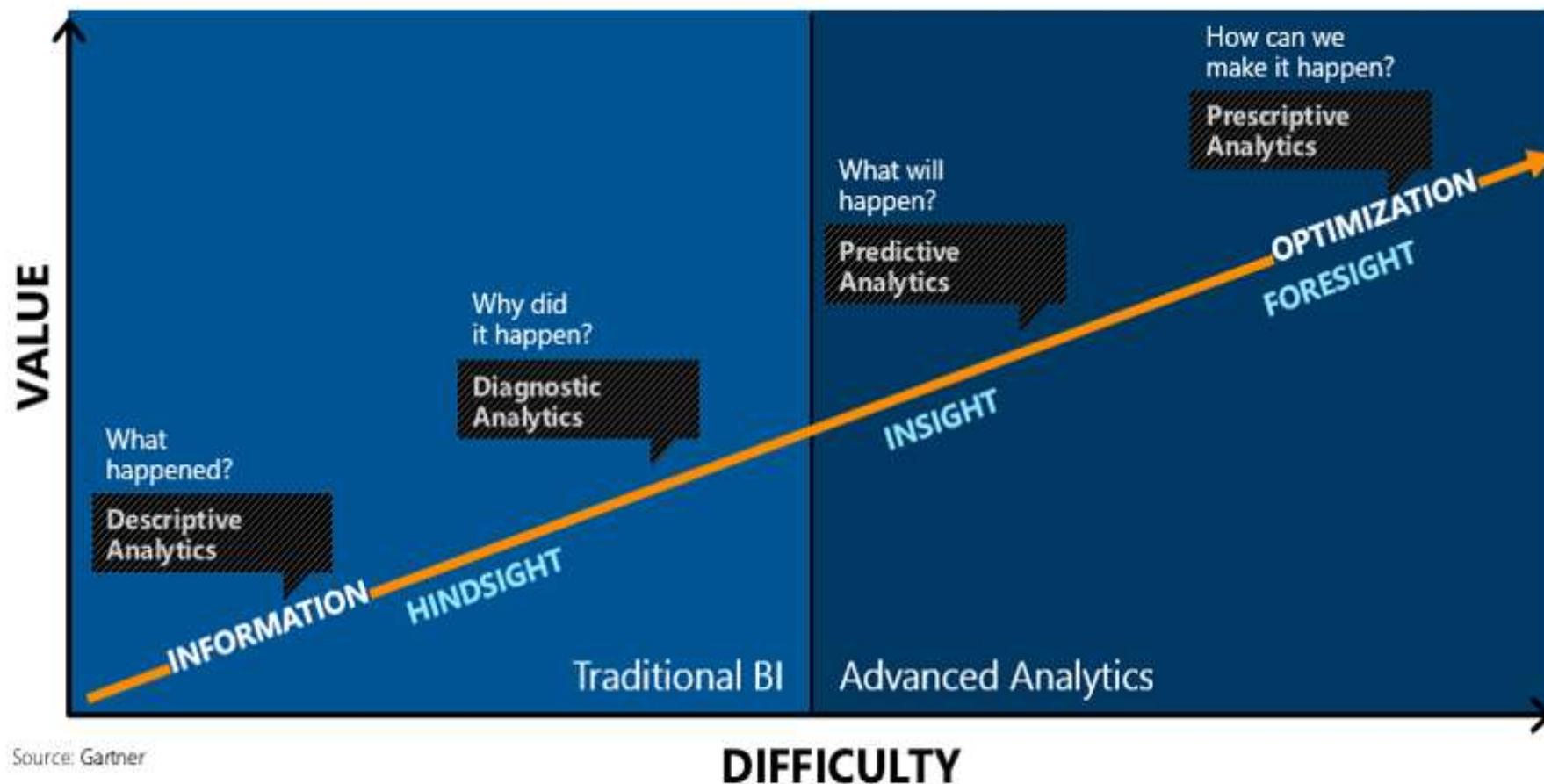


Azure Machine Learning and AI

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What is advanced analytics?



A GLOSSARY OF ARTIFICIAL-INTELLIGENCE TERMS

- **ARTIFICIAL INTELLIGENCE**

AI is the broadest term, applying to any technique that enables computers to mimic human intelligence, using logic, if-then rules, decision trees, and machine learning (including deep learning).

- **MACHINE LEARNING**

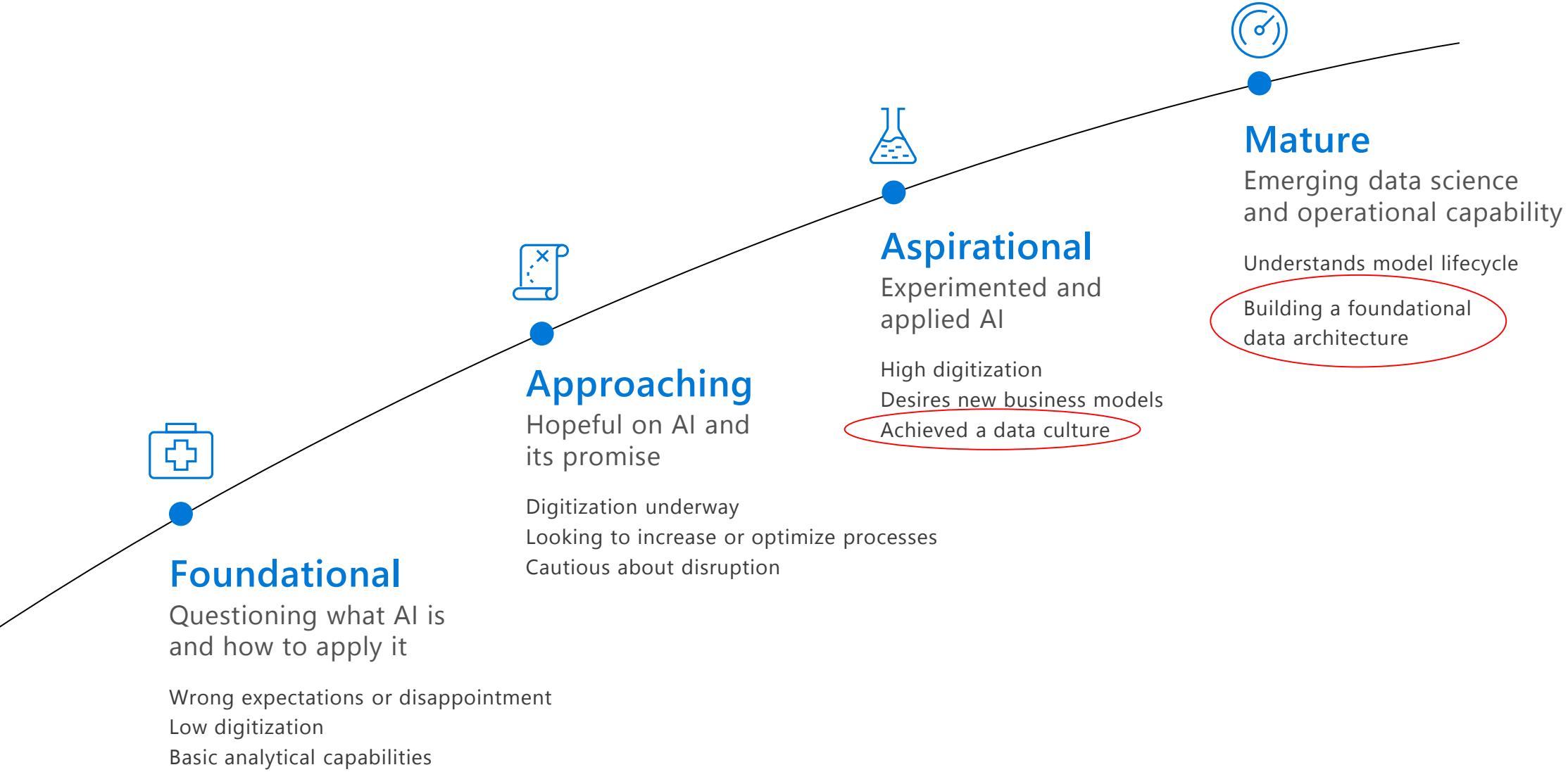
The subset of AI that includes abstruse statistical techniques that enable machines to improve at tasks with experience. The category includes deep learning.

- **DEEP LEARNING**

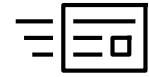
The subset of machine learning composed of algorithms that permit software to train itself to perform tasks, like speech and image recognition, by exposing multilayered neural networks to vast amounts of data.

Machine learning is a data science technique that allows computers to use existing data to forecast future behaviors, outcomes, and trends.

Enterprise AI Maturity Model



Helping you innovate across your business



Marketing

Product recommendation



Customer insights



Churn analytics



Sales

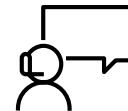
Lead scoring



Sales insights



Dynamic pricing



Service

Intelligent chatbots



Virtual assistants



Waiting line optimization



Finance

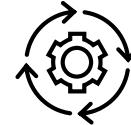
Financial forecasting



Cash flow forecasting



Risk management



Operations

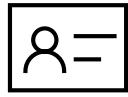
Predictive maintenance



Demand forecasting



Quality assurance



Workforce

Employee insights



HR insights



Resource planning

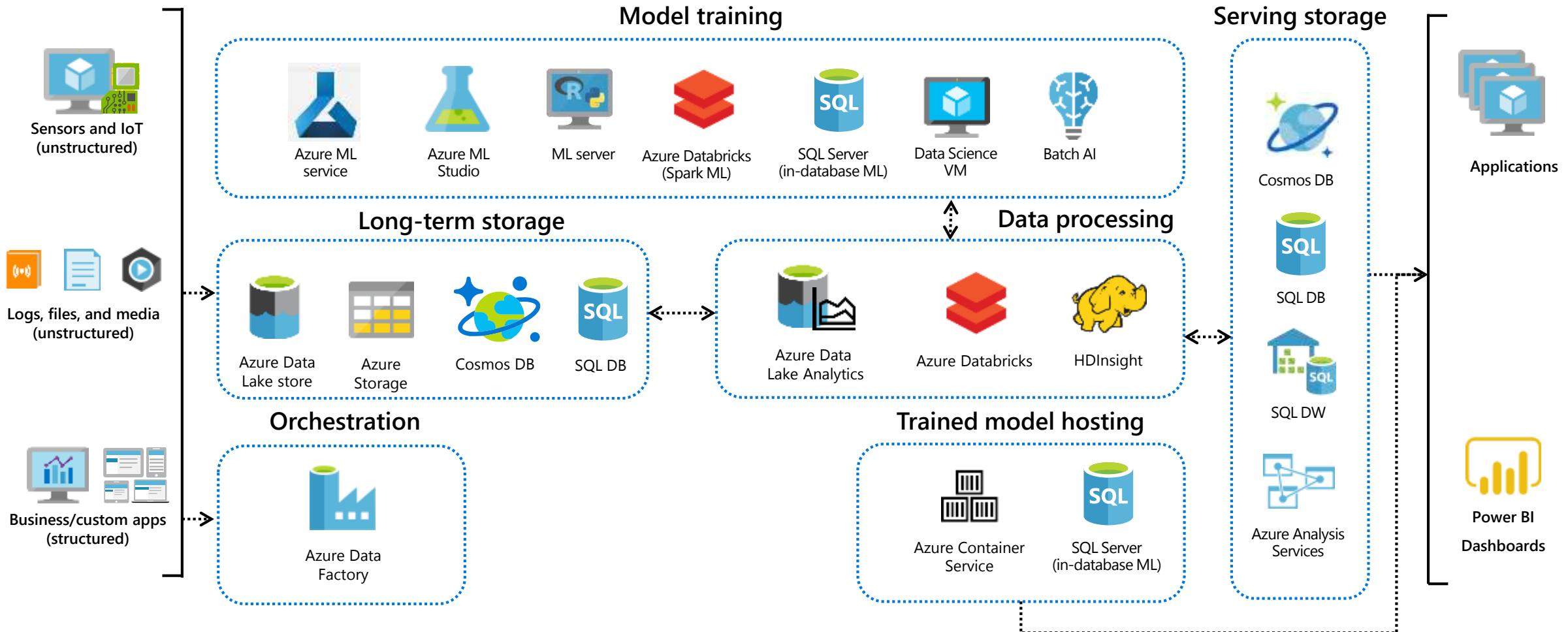
Machine Learning and AI in the Microsoft Stack

- 1 Azure Machine Learning Studio
- 2 Deep Learning
- 3 Data Science Virtual Machine (DSVM)
- 4 Azure Machine Learning service
- 5 Azure Databricks
- 6 Machine Learning Server
- 7 SQL Server 2017/2019 ML Services, SQL Server 2019 BDC
- 8 Power BI
- 9 Azure Cognitive Services
- 10 Automated Machine Learning (AutoML)



Advanced analytics pattern in Azure

Data collection and understanding, modeling, and deployment

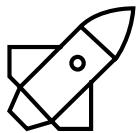


Azure Machine Learning Studio

Azure machine learning studio

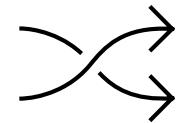


A fully-managed cloud service that enables you to easily build, deploy and share predictive analytics solutions



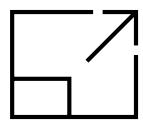
Fast

Use Azure Machine Learning to deploy your model into production as a web service in minutes



Simple

Work with familiar coding languages such as R and Python while benefitting from hundreds of built-in packages and support for custom code



Flexible

Deploy models to production as web services that can be called from any device, anywhere, using any data source



Shareable

Easily share your solution with the world on the Azure Marketplace

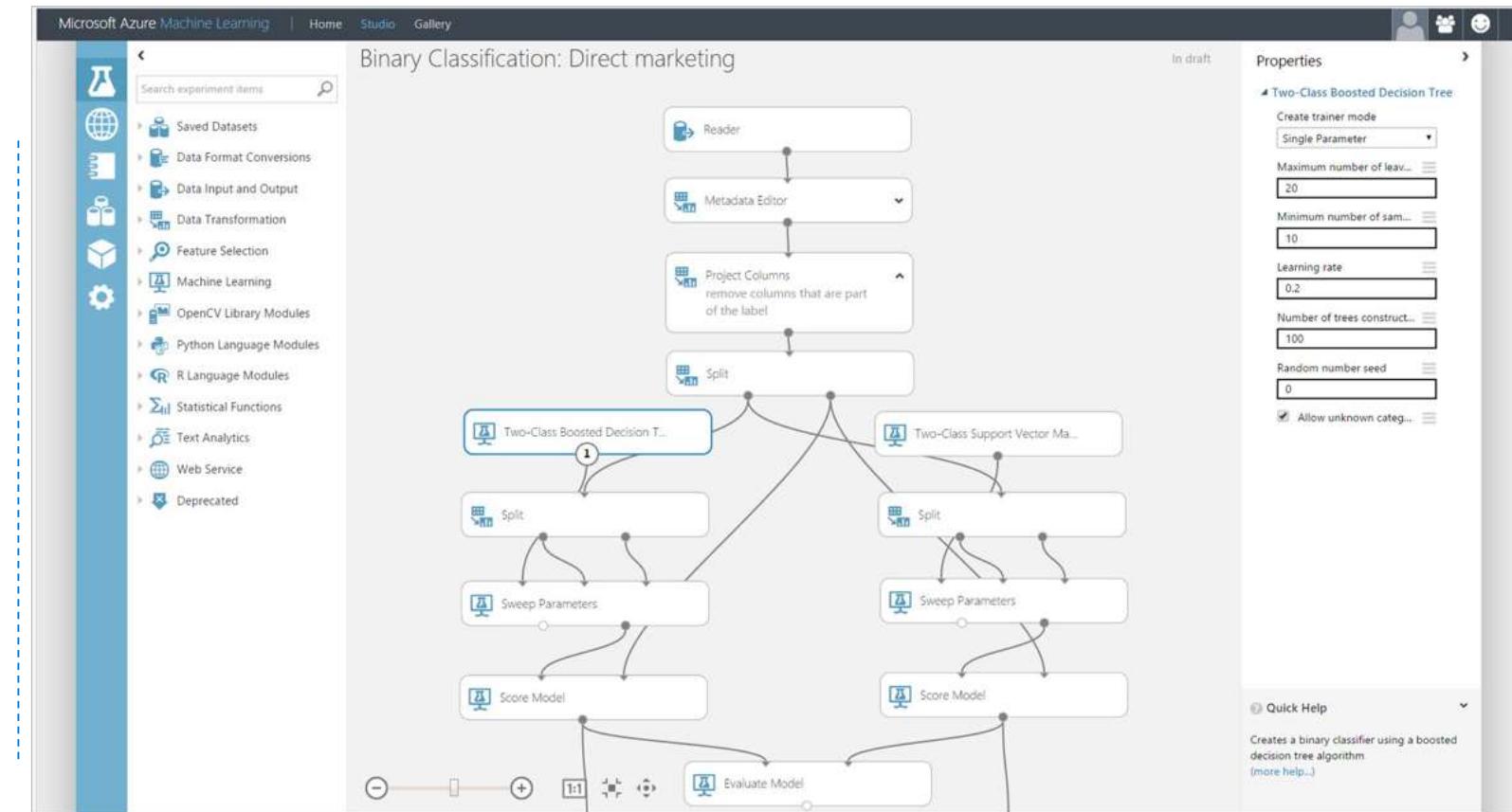
AZURE MACHINE LEARNING STUDIO

Platform for emerging data scientists to graphically build and deploy experiments

- Rapid experiment composition
- > 100 easily configured modules for data prep, training, evaluation
- Extensibility through R & Python
- Serverless training and deployment

Some numbers:

- 100's of thousands of deployed models serving billions of requests



[Browse all](#)[Industries](#) ▾[Solutions](#)[Projects](#)[Models](#)[Experiments](#)[Custom Modules](#)[More](#) ▾

Refine by

Results

Sort by: [New and Noteworthy](#) ▾

CATEGORIES

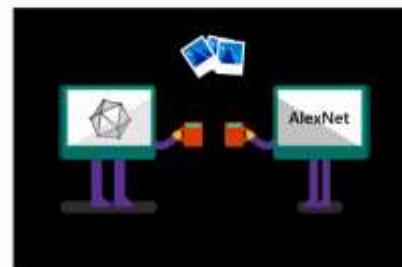
- Solution
- Project
- Model
- Experiment
- Machine Learning API
- Custom Module
- Tutorial
- Collection
- Notebook
- Classroom Training
- Video Training

SHOW

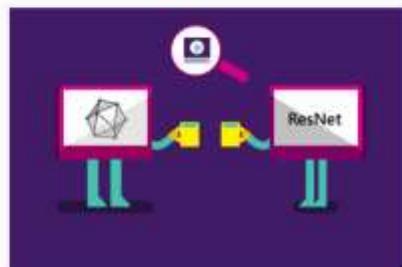
- Microsoft content only

TAGS

- R
- Classification
- Linear Regression
- test
- Machine Learning

 [MODEL](#)**AlexNet 1.2**

AlexNet is a convolutional neural network for classification.

 [MODEL](#)**ResNet-50 1.2**

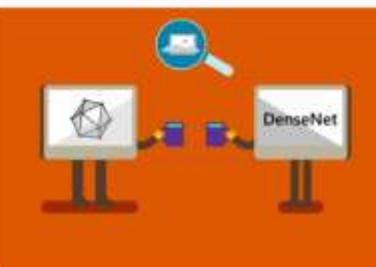
ResNet-50 is a deep convolutional network for classification.

 [MODEL](#)**ShuffleNet 1.2**

ShuffleNet is a deep convolutional network for classification.

 [MODEL](#)**ZFNet 1.2**

ZFNet (aka VGG16) is a deep convolutional network for classification.

 [MODEL](#)**DenseNet 121 1.2**

DenseNet-121 is a convolutional neural network for classification.



ONNX, WinML
24K ↓ 203 8 months ago

Microsoft



ONNX, WinML
267 ↓ 28 8 months ago

Microsoft



ONNX, WinML
229 ↓ 17 8 months ago

Microsoft



ONNX, WinML
88 ↓ 4 8 months ago

Microsoft



ONNX, WinML
54 ↓ 6 8 months ago

Microsoft

Data Science Virtual Machines (DSVM)

Data Science Virtual Machines

NAME	PUBLISHER	CATEGORY
 Deep Learning Virtual Machine	Microsoft	Compute
 Data Science Virtual Machine for Linux (CentOS)	Microsoft	Analytics
 Geo AI Data Science VM with ArcGIS	Microsoft	Compute
 Intel Optimized Data Science VM for Linux (Ubuntu)	Intel Software	Compute
 Data Science Virtual Machine - Windows 2016	Microsoft	Databases
 Data Science Virtual Machine for Linux (Ubuntu)	Microsoft	
 Data Science Virtual Machine - Windows 2016	Microsoft	Databases

Deep Learning Virtual Machine

Microsoft

The Deep Learning Virtual Machine (DLVM) is a specially configured variant of the [Data Science Virtual Machine](#)(DSVM) to make it easier to use GPU-based VM instances for training deep learning models. It is supported on Windows 2016, or the Ubuntu Data Science Virtual Machine and shares the same core VM images (and hence all the rich toolset) as the DSVM. We also provide end-to-end AI samples for image and text understanding. The deep learning virtual machine also makes the rich set of tools and samples on the DSVM more easily discoverable. In terms of the tooling, the Deep Learning Virtual Machine provides several popular deep learning frameworks, tools to acquire and pre-process image, textual data.

The DLVM contains several tools for AI including popular GPU editions of deep learning frameworks like Microsoft Cognitive Toolkit, TensorFlow, Keras, Caffe2, Chainer; tools to acquire and pre-process image, textual data, tools for data science modeling and development activities such as Microsoft R Server Developer Edition, Anaconda Python, Jupyter notebooks for Python and R, IDEs for Python and R , SQL database and many other data science and ML tools.

The DLVM runs on Azure GPU NC-series VM instances. These GPUs use discrete device assignment, resulting in performance close to bare-metal, and are well-suited to deep learning problems..

The Deep Learning Virtual Machine (DLVM), based on the Data Science Virtual Machine (DSVM) images is a pre-configured environment specifically to build and deploy deep learning models using Azure GPU based VM instances. As part of the provisioning you can choose between a [Windows Server 2016 edition of the DSVM](#) OR the [Ubuntu Linux edition of the DSVM](#). The DLVM has builtin GPU drivers and GPU editions of popular deep learning frameworks. It shares the same images (and hence all the rich toolset) as the DSVM but is configured to make deep learning easier. We also provide end-to-end AI samples for image and text understanding. The deep learning virtual machine also enables the rich set of tools and samples on the DSVM more easily discoverable.

Deploying this VM instance requires access to Azure GPU NC-series VM instances available in select Azure regions. Check [here](#) for availability of various services by Azure regions. Please ensure the disk type chosen during provisioning is "HDD" not "SSD" as required by NC-series VMs.

This offering is the next generation of the Deep Learning toolkit for DSVM with enhanced toolset and a choice of Windows 2016 or Ubuntu Linux platforms. You can continue to use existing VM instances of the deep learning toolkit. Only new instances will use the DLVM offering.

Data Science Virtual Machine - Windows 2016

Microsoft

The '**Data Science Virtual Machine (DSVM)**' is a 'Windows Server 2016 with Containers' VM & includes popular tools for data exploration, analysis, modeling & development.

Highlights:

- Microsoft ML Server - Dev Edition (Scalable R & Python)
- Azure Machine Learning Workbench
- Anaconda Python
- SQL Server 2017 Dev. Edition - With In-Database R and Python analytics
- Microsoft Office 365 ProPlus BYOL - Shared Computer Activation
- Julia Pro + Juno Editor
- Jupyter notebooks
- Visual Studio Community Ed. + Python, R & node.js tools
- Power BI Desktop
- Deep learning tools e.g. Microsoft Cognitive Toolkit (CNTK, TensorFlow, Chainer, & mxnet)
- ML algorithm libraries e.g. xgboost, Vowpal Wabbit
- Azure SDKs + libraries for various Azure Cloud offerings. Integration tools are included for:
 1. Azure Machine Learning
 2. Azure Data Factory
 3. Stream Analytics
 4. SQL Data Warehouse
 5. Hadoop + Apache Spark (HDICluster)
 6. Data Lake
 7. Blob storage
 8. ML & Data Science tutorials as Jupyter notebooks

This image also includes tools for ML model operationalization as web services in the cloud, using Azure ML or Microsoft R Server.

This image is pre-configured with Nvidia drivers, CUDA Toolkit, & cuDNN library for GPU workloads available if using [NC class VM SKUs](#).

Data Science Virtual Machine for Linux (Ubuntu)

Microsoft

The Data Science Virtual Machine for Linux is an Ubuntu-based virtual machine image that makes it easy to get started with deep learning on Azure. The Microsoft Cognitive Toolkit, TensorFlow, MXNet, Caffe, Caffe2, Chainer, NVIDIA DIGITS, Deep Water, Keras, Theano, Torch, and PyTorch are built, installed, and configured so they are ready to run immediately. The NVIDIA driver, CUDA 9, and cuDNN 7 are also included. All frameworks are the GPU versions but work on the CPU as well. Many sample Jupyter notebooks are included. TensorFlow Serving, MXNet Model Server, and TensorRT are included to test inferencing.

The Data Science Virtual Machine for Linux also contains popular tools for data science and development activities, including:

- Microsoft R Server 9.3 with Microsoft R Open 3.4.3, MicrosoftML package with machine learning algorithms, RevoScaleR and revoscaler for distributed and remote computing, and R and Python Operationalization
- Anaconda Python 2.7 and 3.5
- JupyterHub with sample notebooks
- Spark local 2.3.1 with PySpark and SparkR Jupyter kernels
- Single node local Hadoop
- Azure command-line interface
- Visual Studio Code, IntelliJ IDEA, PyCharm, and Atom
- H2O, Deep Water, and Sparkling Water
- Julia
- Vowpal Wabbit for online learning
- xgboost for gradient boosting
- SQL Server 2017
- Intel Math Kernel Library

You can view a full list of installed tools for the Linux edition [here](#).

GPU optimized virtual machine sizes

09/23/2018 • 9 minutes to read • Contributors 

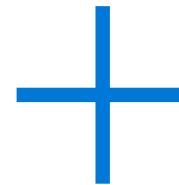
GPU optimized VM sizes are specialized virtual machines available with single or multiple NVIDIA GPUs. These sizes are designed for compute-intensive, graphics-intensive, and visualization workloads. This article provides information about the number and type of GPUs, vCPUs, data disks, and NICs. Storage throughput and network bandwidth are also included for each size in this grouping.

- **NC, NCv2, NCv3, ND, and NDv2** sizes are optimized for compute-intensive and network-intensive applications and algorithms. Some examples are CUDA- and OpenCL-based applications and simulations, AI, and Deep Learning. The NCv3-series is focused on high-performance computing workloads featuring NVIDIA's Tesla V100 GPU. The ND-series is focused on training and inference scenarios for deep learning. It uses the NVIDIA Tesla P40 GPU.
- The **NC-series** features an Intel Xeon® E5-2690 v3 2.60GHz processor.
- The **NCSv3, NCSv2, and ND** sizes feature an Intel Xeon® E5-2690 v4 2.60GHz processor.
- **NV and NVv2** sizes are optimized and designed for remote visualization, streaming, gaming, encoding, and VDI scenarios using frameworks such as OpenGL and DirectX. These VMs are backed by the NVIDIA Tesla M60 GPU.

Azure Machine Learning service

WHAT IS 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

Azure Machine Learning service features

Workspace – Top level container for model management and experimentation. Also, creates and manages storage, container registry, key vault and app insights

Experiments – Grouping of training runs for a given script

Pipelines – Stitch together multiple stages to create machine learning workflows

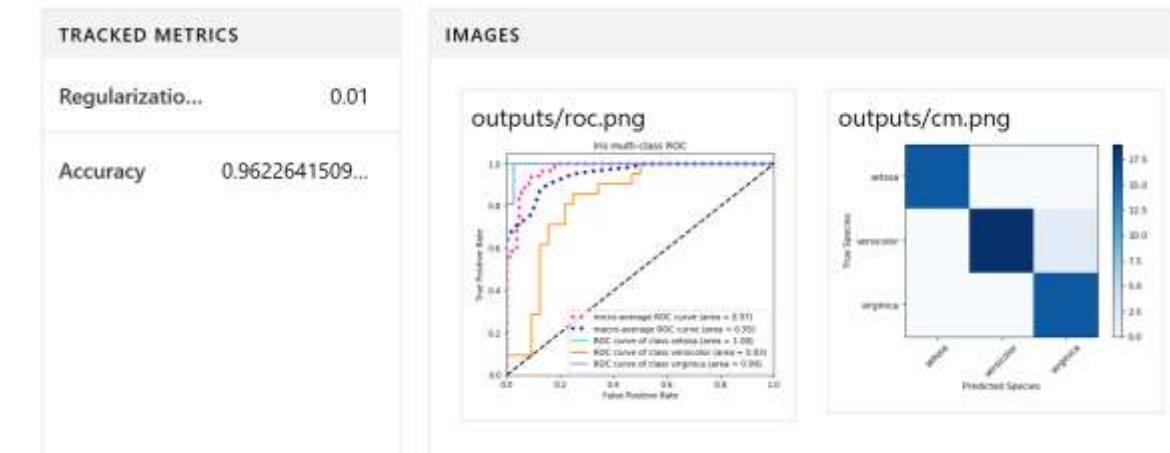
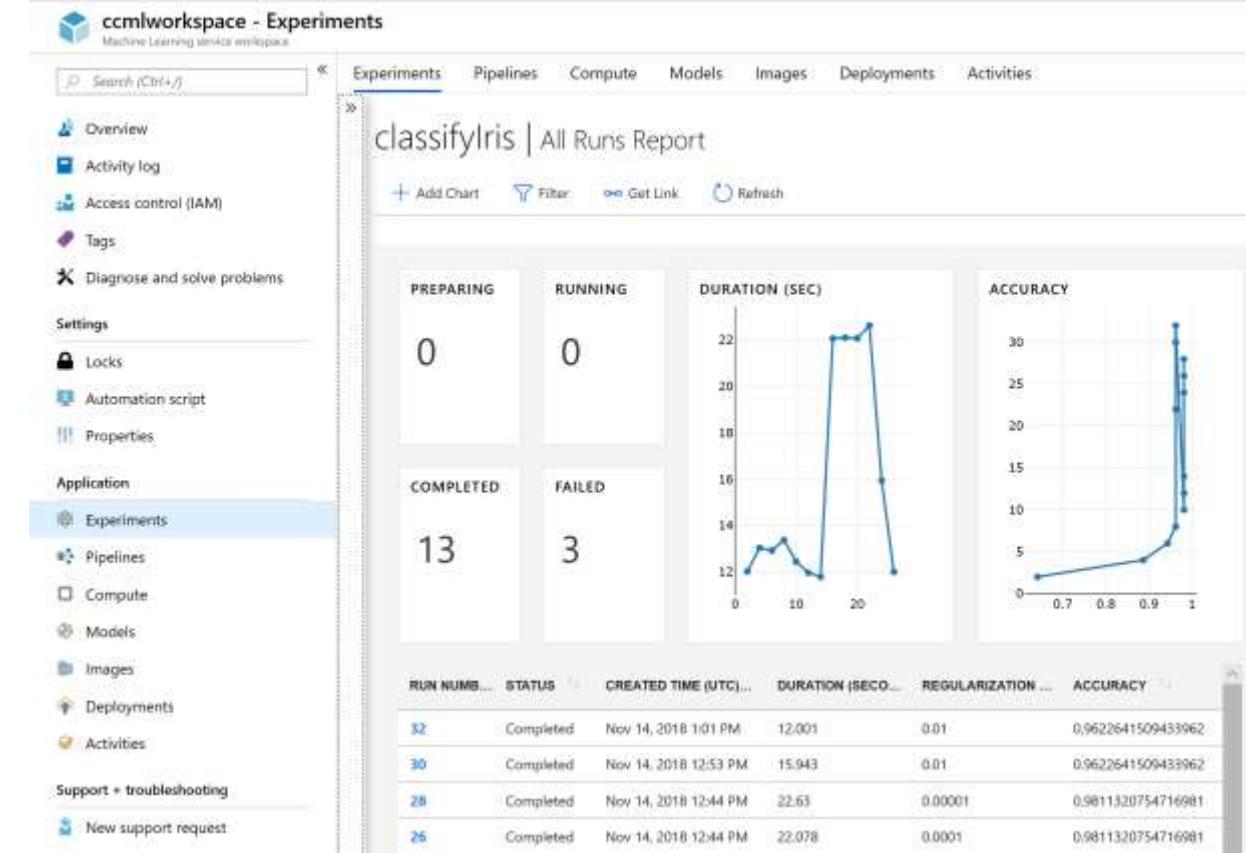
Compute – Compute resources for training or image deployment

Models – Encapsulation of trained models

Images – Docker images containing trained models to be deployed to a compute target

Deployments – Deployment of an image to web services, IoT Edge and FPGAs

Data Stores – Abstraction layer over Azure storage



Custom AI

Typical E2E Process

Prepare



Prepare Data

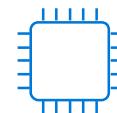
Azure Data Factory

Azure Databricks

Experiment



Build model
(your favorite IDE)



Train &
Test Model

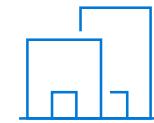
Data Science Virtual Machine

Azure Databricks

Machine Learning Compute

Orchestrate

Operationalize/Deploy



Build Image

Azure ML service

Deploy Service
Monitor Model

Azure Container Instances

Azure Kubernetes Service



Azure ML Concept

Model Management

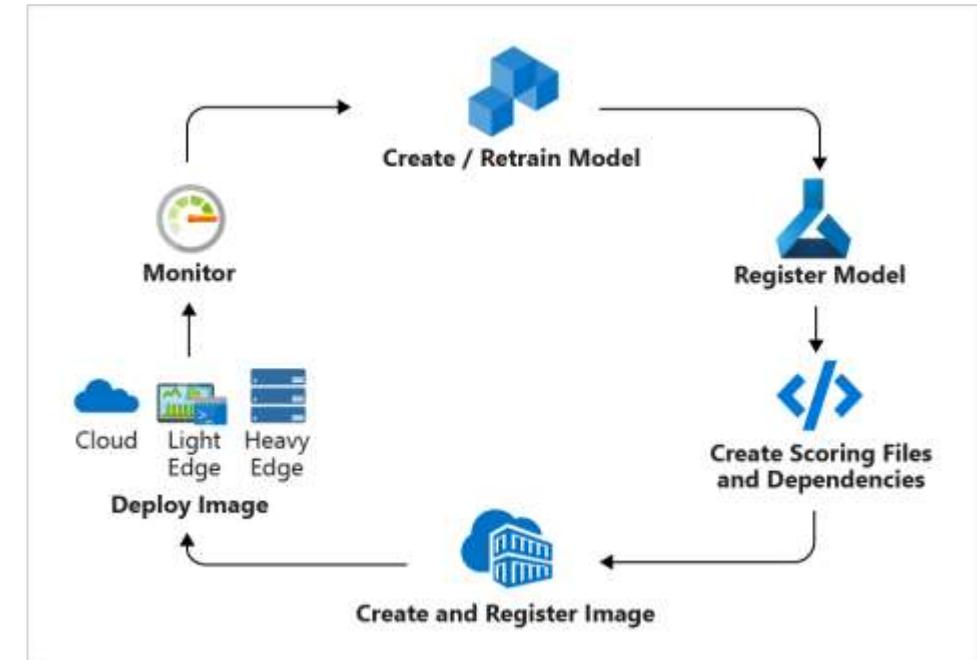
**Model Management in Azure ML
usually involves these four steps**

Step 1: Register Model using the Model Registry

Step 2: Register Image using the Image Registry
(the Azure Container Registry)

Step 3: Deploy the Image to cloud or to edge devices

Step 4: Monitor models—you can monitor input, output,
and other relevant data from your model.



Azure ML Artifact

Compute Target

Compute Targets are the compute resources used to run training scripts or host your model when deployed as a web service.

They can be created and managed using the Azure Machine Learning SDK or CLI.

You can attach to existing resources.

You can start with local runs on your machine, and then scale up and out to other environments.

Currently supported compute targets

Compute Target	Training	Deployment
Local Computer	✓	
A Linux VM in Azure (such as the Data Science Virtual Machine)	✓	
Azure ML Compute	✓	
Azure Databricks	✓	
Azure Data Lake Analytics	✓	
Apache Spark for HDInsight	✓	
Azure Container Instance		✓
Azure Kubernetes Service		✓
Azure IoT Edge		✓
Field-programmable gate array (FPGA)		✓

Azure ML service Artifacts

Image and Registry



Image contains

1. A model.
2. A scoring script used to pass input to the model and return the output of the model.
3. Dependencies needed by the model or scoring script/application.

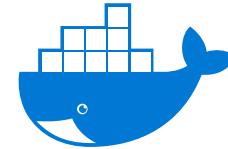


Image Registry

Keeps track of images created from models.

Metadata tags can be attached to images. Metadata tags are stored by the image registry and can be used in image searches

Two types of images

1. **FPGA image:** Used when deploying to a field-programmable gate array in the Azure cloud.
2. **Docker image:** Used when deploying to compute targets such as Azure Container Instances and Azure Kubernetes Service.

Azure ML Artifact

Deployment

Deployment is an instantiation of an image. Two options:



Web service

A deployed web service can run on Azure Container Instances, Azure Kubernetes Service, or field-programmable gate arrays (FPGA).

Can receive scoring requests via an exposed a load-balanced, HTTP endpoint.

Can be monitored by collecting Application Insight telemetry and/or model telemetry.

Azure can automatically scale deployments.

IoT Module

A deployed IoT Module is a Docker container that includes the model, associated script and additional dependencies.

Is deployed using **Azure IoT Edge** on edge devices.

Can be monitored by collecting Application Insight telemetry and/or model telemetry.

Azure IoT Edge will ensure that your module is running and monitor the device that is hosting it.

Why Intelligent Edge?

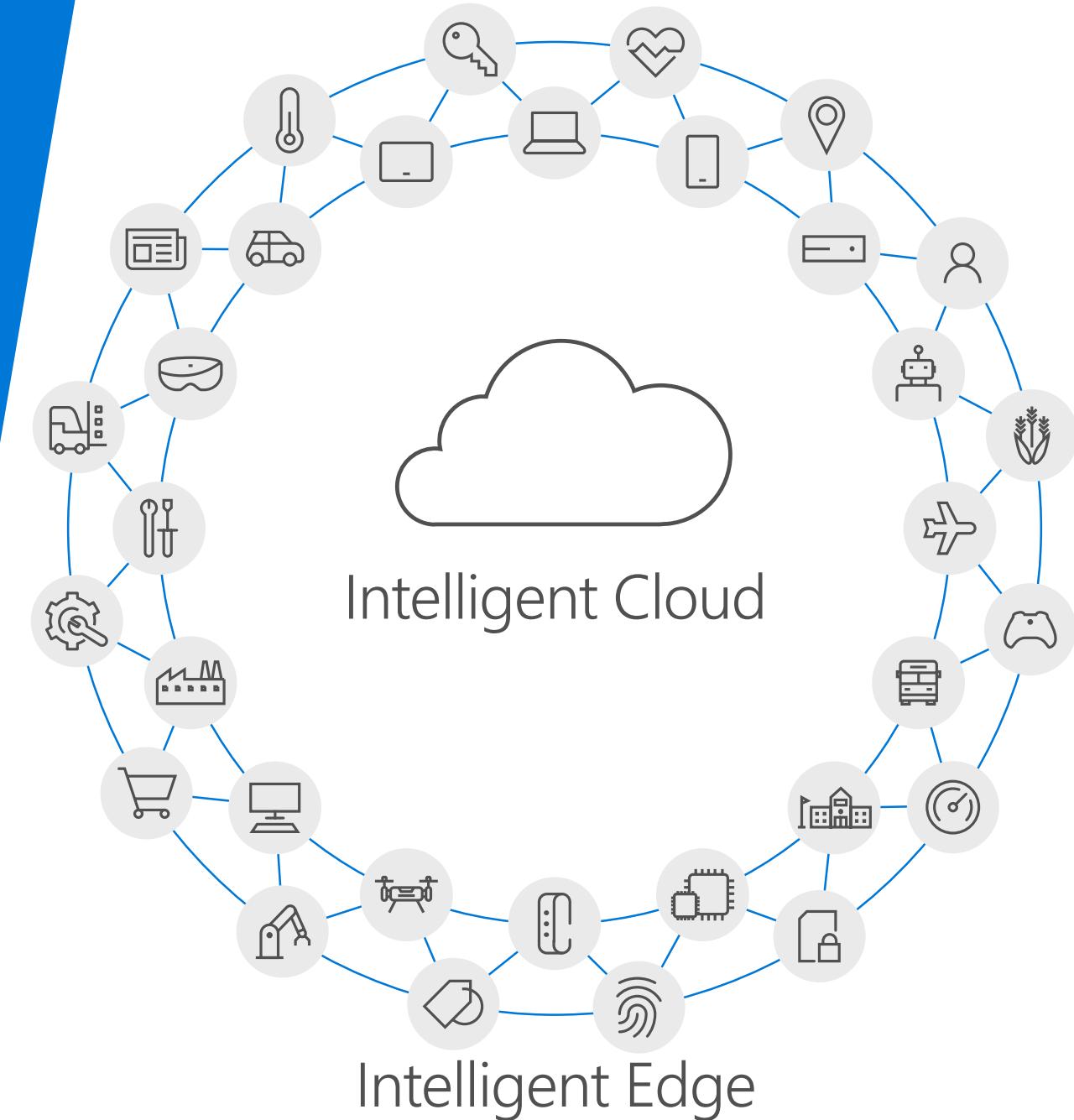
High-speed data processing, analytics and shorter response times are more essential than ever.

Intelligent Cloud

- Business agility and scalability: unlimited computing power available on demand.

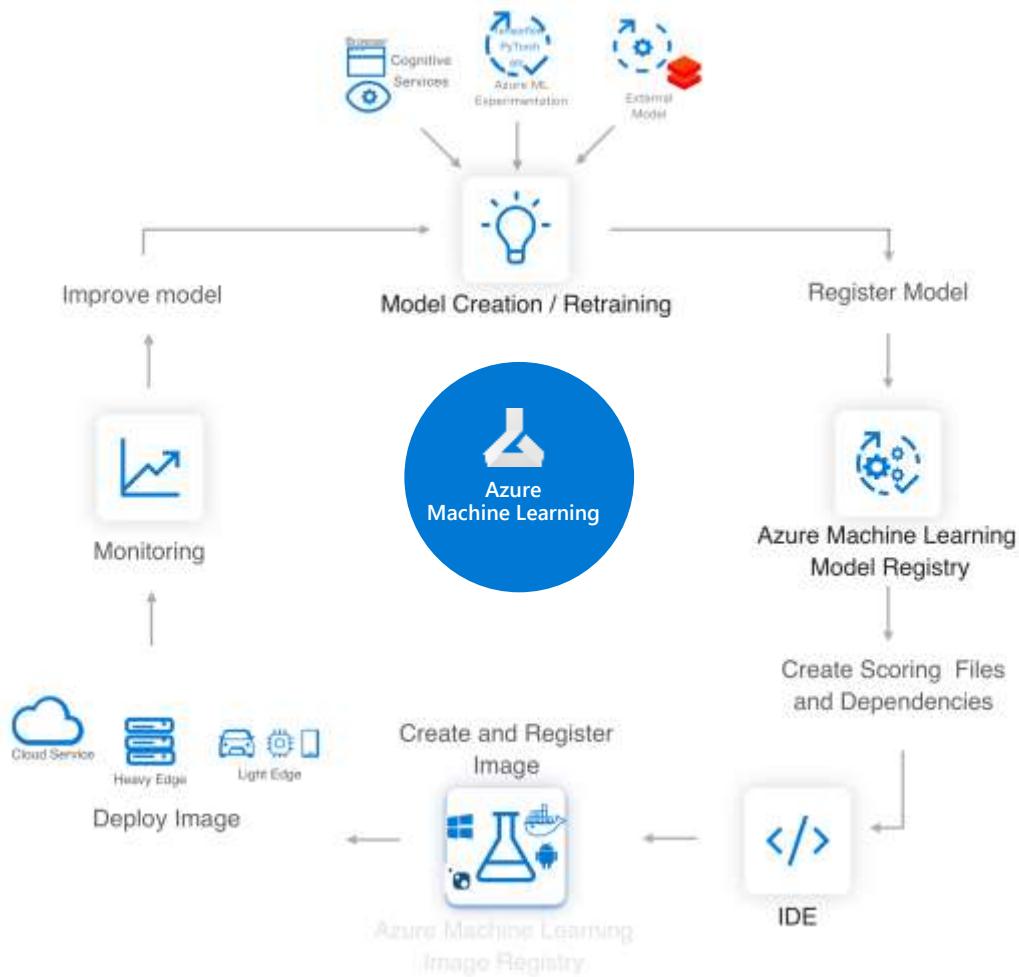
Intelligent Edge

- Can handle priority-one tasks locally even without cloud connection.
- Can handle generated data that is too large to pull rapidly from the cloud.
- Enables real-time processing through intelligence in or near to local devices.
- Flexibility to accommodate data privacy related requirements.



Azure ML service

Lets you easily implement this AI/ML Lifecycle



Workflow Steps

Develop machine learning training scripts in Python.

Create and configure a compute target.

Submit the scripts to the configured compute target to run in that environment. During training, the compute target stores run records to a datastore. There the records are saved to an experiment.

Query the experiment for logged metrics from the current and past runs. If the metrics do not indicate a desired outcome, loop back to step 1 and iterate on your scripts.

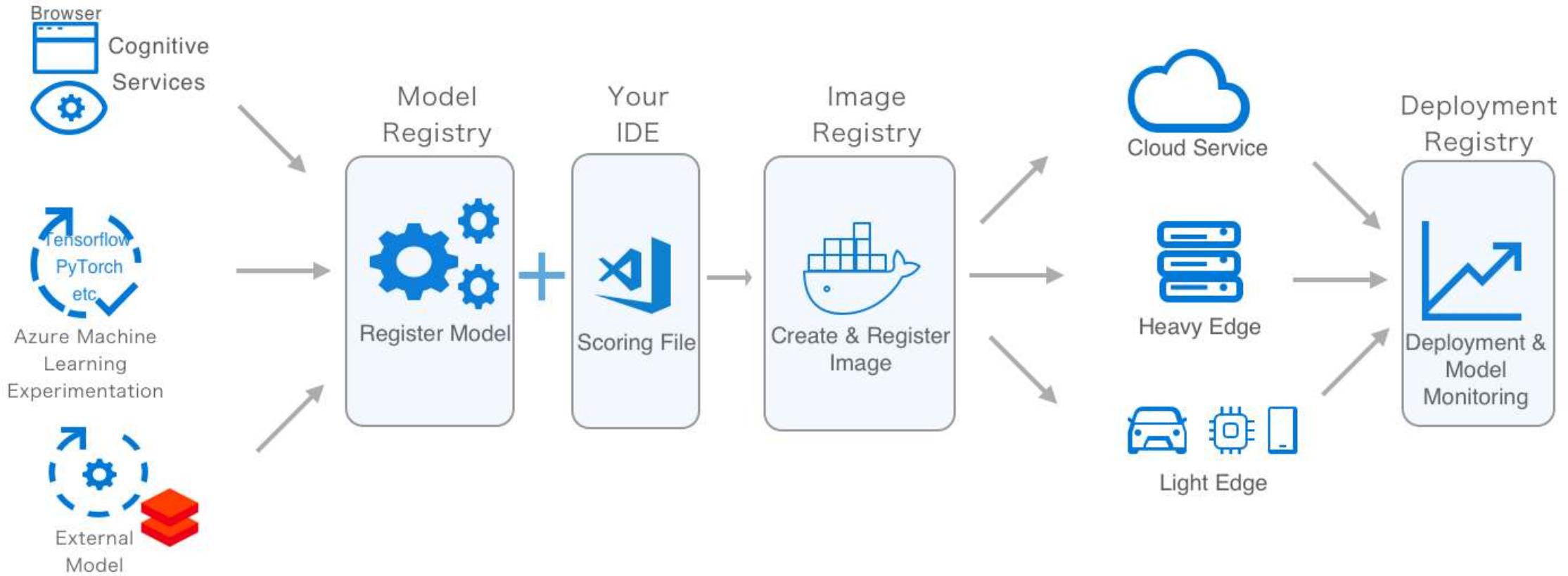
Once a satisfactory run is found, register the persisted model in the model registry.

Develop a scoring script.

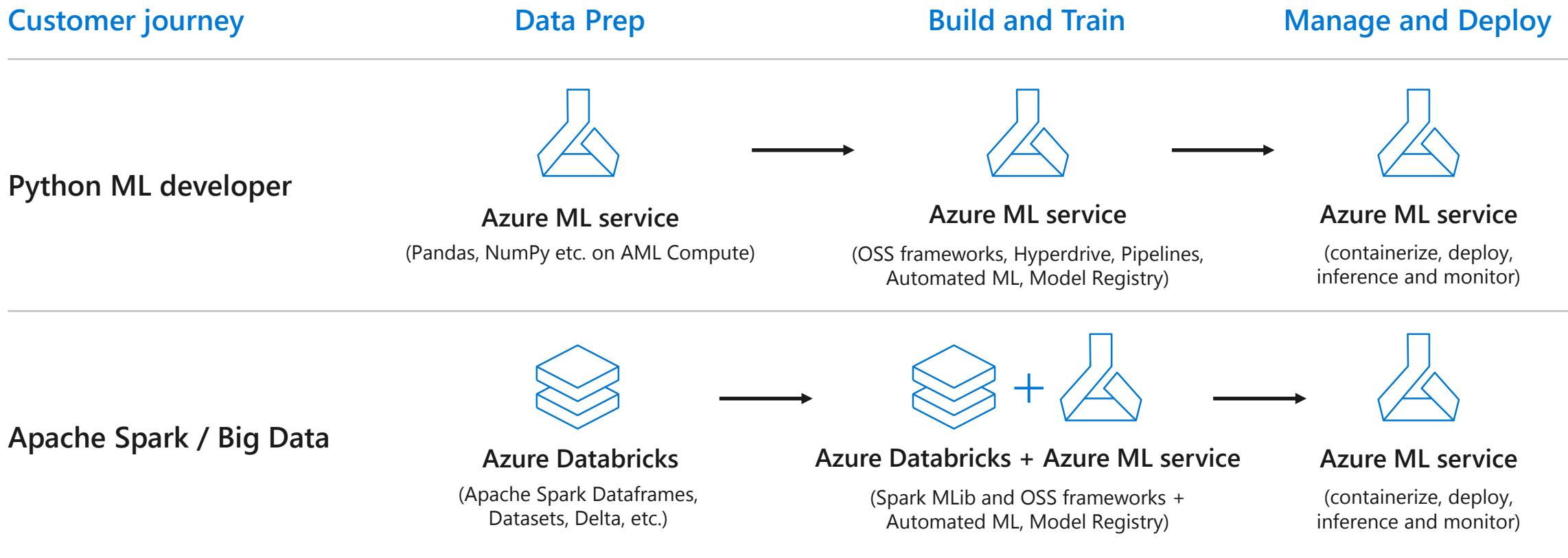
Create an Image and register it in the image registry.

Deploy the image as a web service in Azure.

Azure ML: How to deploy models at scale



Productive Services



Comparable Table

	Azure Machine Learning Studio	Azure Machine Learning Services
Pros	<ul style="list-style-type: none">• Rapid development (Drag and Drop)• Works well with relatively simple datasets• Pre-built ML algorithms• Cheap	<ul style="list-style-type: none">• Fast (VMs with GPUs)• Different optimization methods, CI/CD pipeline• Full control during training• Manage computing resources (choose VM size)• Use open source ML libraries
Cons	<ul style="list-style-type: none">• Can be slow• Limited optimization methods, operationalized architecture• Less control during training• Fixed computing resources	<ul style="list-style-type: none">• More elaborate to build, require deeper knowledge of machine learning• Deeper models need much more data with much more memory• Higher costs for VM with GPU

Azure Databricks

Databricks Spark as a managed service on Azure

Azure Databricks key audiences & benefits



Data scientist

- Integrated workspace
- Easy data exploration
- Collaborative experience
- Interactive dashboards
- Faster insights
 - Best Spark & serverless
 - Databricks managed Spark



Data engineer

- Improved ETL performance
 - Zero management clusters, serverless
- Easy to schedule jobs**
- Automated workflows**
- Enhanced monitoring & troubleshooting**
 - Automated alerts & easy access to logs
- Zero Management Spark**
- Cluster democratization (serverless)**



CDO, VP of analytics

- Fast, collaborative analytics platform accelerating time to market
- No dev-ops required**
- Enterprise grade security**
 - Encryption
 - End-to-end auditing
 - Role-based control
 - Compliance

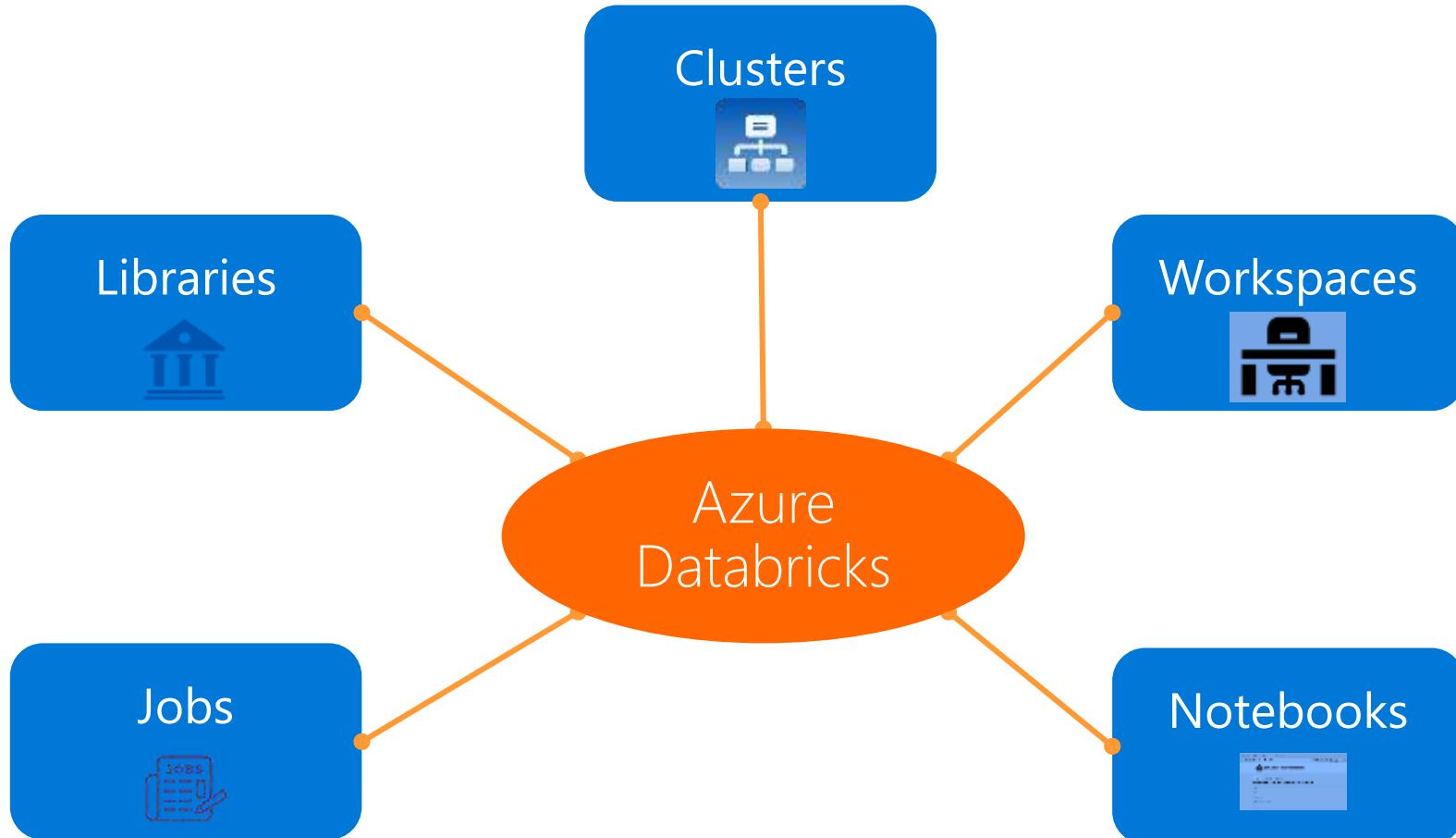
Unified analytics platform

A Z U R E D A T A B R I C K S

- Azure Databricks is a **first party** service on Azure.
 - Unlike with other clouds, it is not an Azure Marketplace or a 3rd party hosted service.
- Azure Databricks is integrated seamlessly with Azure services:
 - [Azure Portal](#): Service can be launched directly from Azure Portal
 - [Azure Storage Services](#): Directly access data in Azure Blob Storage and Azure Data Lake Store
 - [Azure Active Directory](#): For user authentication, eliminating the need to maintain two separate sets of users in Databricks and Azure.
 - [Azure SQL DW and Azure Cosmos DB](#): Enables you to combine structured and unstructured data for analytics
 - [Apache Kafka for HDInsight](#): Enables you to use Kafka as a streaming data source or sink
 - [Azure Event Hub & Azure IOT Hubs](#): Enables you to use Event Hub and IOT Hub as a streaming data source
 - [Azure Billing](#): You get a single bill from Azure
 - [Azure Power BI](#): For rich data visualization
 - [Azure Data Factory](#): ETL/ELT - See [here](#)



AZURE DATA BRICKS CORE ARTIFACTS



PROVISIONING AZURE DATABRICKS WORKSPACE

- Azure Databricks is provisioned directly from the Azure Portal like any other Azure service
 - In contrast, with other clouds, it has to be provisioned through the Databricks portal.
 - With Azure Databricks, the Azure Portal offers a unified portal to provision and administer Azure Databricks as well as other Azure services.
- Any Azure user with the appropriate subscription and authorization can provision Azure Databricks service*.
 - There is no need for a separate Databricks account

The screenshot shows two views of the Microsoft Azure Portal. The top view is a modal window titled 'Azure Databricks Service' where a new workspace is being created. It requires input for 'Workspace name' (mytestworkspace), 'Subscription' (Azure conversion - External), 'Resource group' (Create new: mytestresgroup), and 'Location' (East US 2). The bottom view shows the 'mytestworkspace' resource group in the Azure Portal, displaying its overview, activity log, access control, tags, and settings. It also lists other resources like Virtual machines, Load balancers, Storage accounts, and Active Directory. A large red 'Databricks' icon is visible on the right, indicating the workspace is ready for use.

After provisioning the is complete

Provisioning the Azure Databricks Service

* During the current preview phase, the subscription has to be whitelisted.

Data understanding services

Comparing Notebooks in Azure Databricks against other IDEs

	Notebooks in Azure Databricks	Other IDEs
Requires software installation	No	Yes
Execution environment	Azure Databricks only	Pieced together, disparate solutions
Serverless service	Yes	No
Kernels supported	Spark	Python, PySpark
Languages supported	Python, Scala, R, SQL, Bash Shell	Python, SQL, Bash Shell
Visualizations	Provides extensive visualizations library in addition to supporting 3rd party libraries.	Supports standard Jupyter Notebook visualizations and libraries like Matplotlib
Supports role-based access control	Full Azure Active Directory integration	No
Collaborative workspaces	Simultaneous, multi-user collaboration	No
Run notebooks as scheduled jobs	Yes	No
Source control	GitHub, Bitbucket	Yes, but not optimal

MIXING LANGUAGES IN NOTEBOOKS

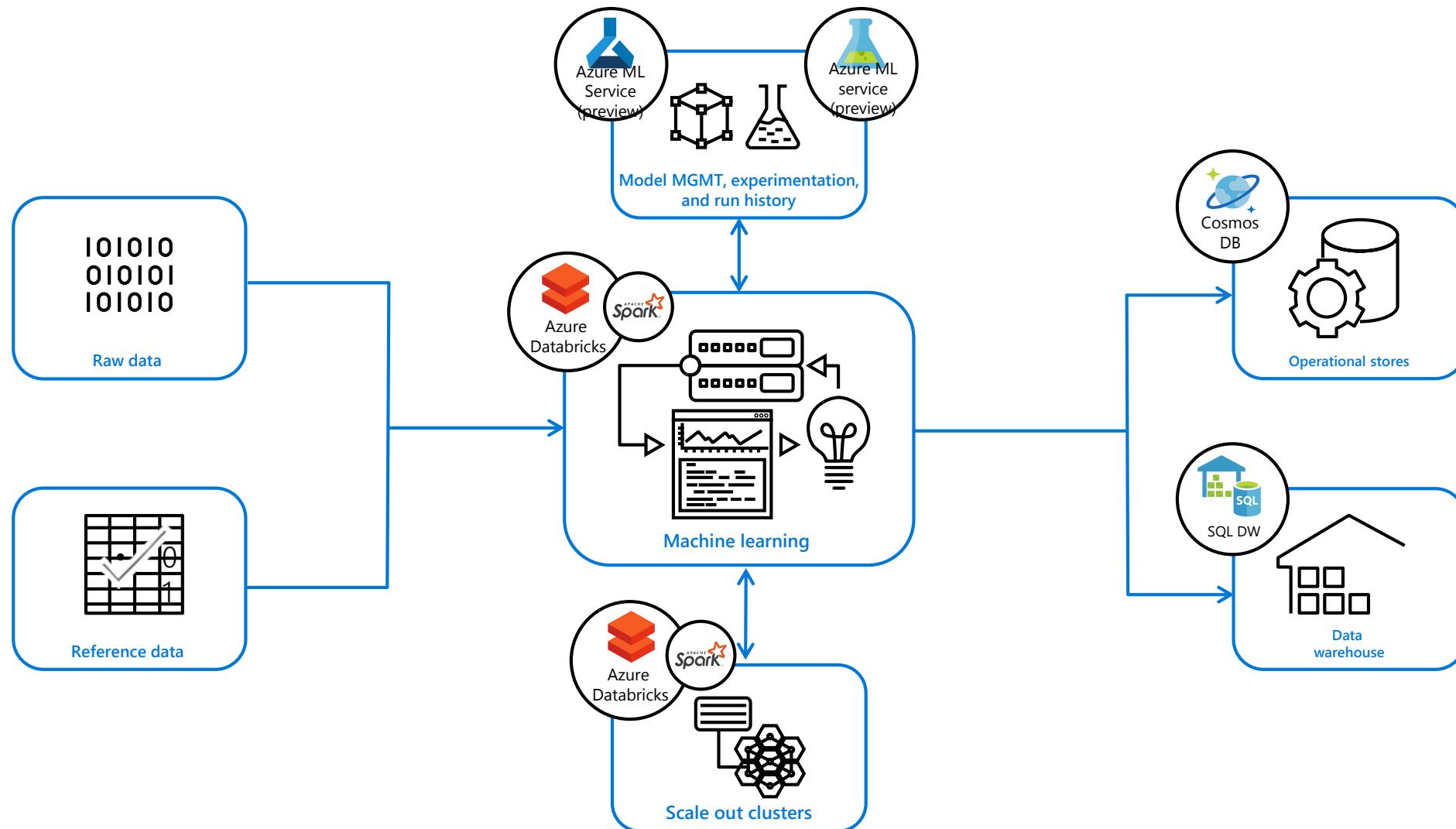
You can mix multiple languages in the same notebook

Normally a notebook is associated with a specific language. However, with Azure Databricks notebooks, you can mix multiple languages in the same notebook. This is done using the language magic command:

- `%python` Allows you to execute python code in a notebook (even if that notebook is not python)
- `%sql` Allows you to execute sql code in a notebook (even if that notebook is not sql).
- `%r` Allows you to execute r code in a notebook (even if that notebook is not r).
- `%scala` Allows you to execute scala code in a notebook (even if that notebook is not scala).
- `%sh` Allows you to execute shell code in your notebook.
- `%fs` Allows you to use Databricks Utilities - dbutils filesystem commands.
- `%md` To include rendered markdown

Train and evaluate machine learning architecture

For Cloud environments



Azure Databricks for machine learning modeling

Fast, easy, and collaborative Apache Spark™-based analytics platform

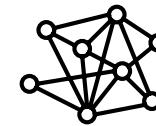


Tools

Use best-in-class notebooks to quickly access model performance and revert when needed

Schedule notebook activities as jobs in and let Azure Data Factory orchestrate the rest

Capture model telemetry at every stage to enable reproducible results

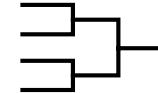


Frameworks

TensorFlow, Keras, and XGBoost, all installed and configured for Spark clusters

Leverage parallelized ML algorithms from battle-tested libraries

Get seamless updates of the Spark stack to ensure uninterrupted operations



Infrastructure

Provision autoscaling clusters on-demand

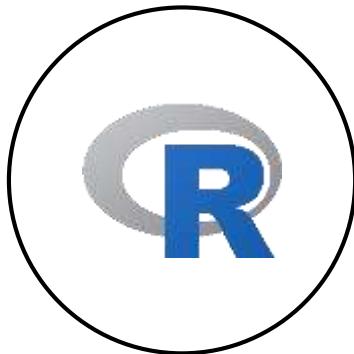
Enable distributed, multi-GPU training with Horovod via a native runtime

Take advantage of Azure ML Services to for simple Kubernetes Cluster deployments

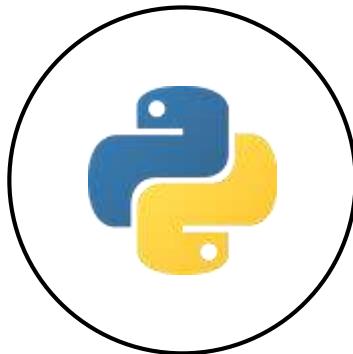


Custom IDEs

Build in your environment of choice



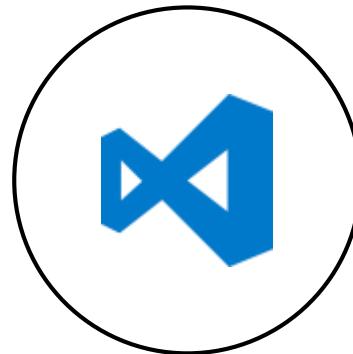
R studio



PyCharm



Notebooks



Visual studio tools for AI

SPARK MACHINE LEARNING (ML) OVERVIEW

Enables Parallel, Distributed ML for large datasets on Spark Clusters

- Offers a set of parallelized machine learning algorithms (see next slide)
- Supports [Model Selection](#) (hyperparameter tuning) using [Cross Validation](#) and [Train-Validation Split](#).
- Supports Java, Scala or Python apps using [DataFrame](#)-based API (as of Spark 2.0). Benefits include:
 - An uniform API across ML algorithms and across multiple languages
 - Facilitates [ML pipelines](#) (enables combining multiple algorithms into a single pipeline).
 - Optimizations through Tungsten and Catalyst
- Spark MLlib comes pre-installed on Azure Databricks
- 3rd Party libraries supported include: [H2O Sparkling Water](#), [SciKit-learn](#) and [XGBoost](#)

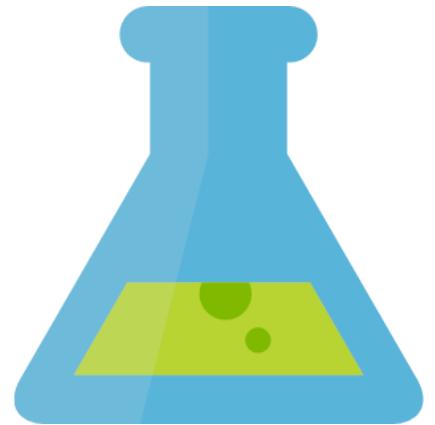


M M L S P A R K

[Microsoft Machine Learning Library](#) for Apache Spark (MMLSpark) lets you easily create scalable machine learning models for large datasets.

It includes integration of SparkML pipelines with the [Microsoft Cognitive Toolkit](#) and [OpenCV](#), enabling you to:

- Ingress and pre-process image data
- Featurize images and text using pre-trained deep learning models
- Train and score classification and regression models using implicit featurization



SPARK ML ALGORITHMS

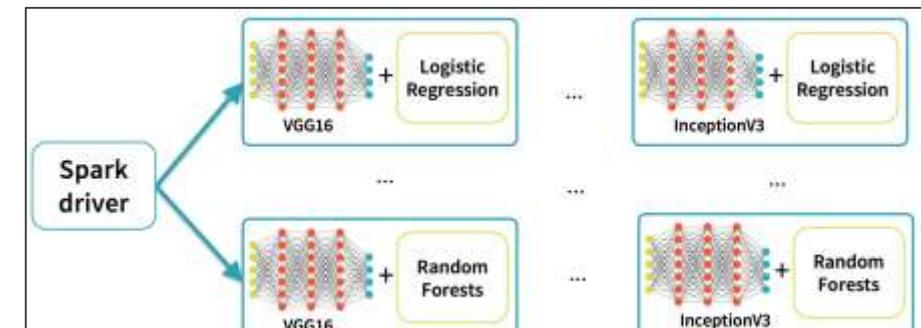
Spark ML Algorithms

Classification and Regression	<ul style="list-style-type: none">• Linear Models (SVMs, logistic regression, linear regression)• Naïve Bayes• Decision Trees• Ensembles of trees (Random Forest, Gradient-Boosted Trees)• Isotonic regression
Clustering	<ul style="list-style-type: none">• k-means and streaming k-means• Gaussian mixture• Power iteration clustering (PIC)• Latent Dirichlet allocation (LDA)
Collaborative Filtering	<ul style="list-style-type: none">• Alternating least squares (ALS)
Dimensionality Reduction	<ul style="list-style-type: none">• SVD• PCA
Frequent Pattern Mining	<ul style="list-style-type: none">• FP-growth• Association rules
Basic Statistics	<ul style="list-style-type: none">• Summary statistics• Correlations• Stratified sampling• Hypothesis testing• Random data generation

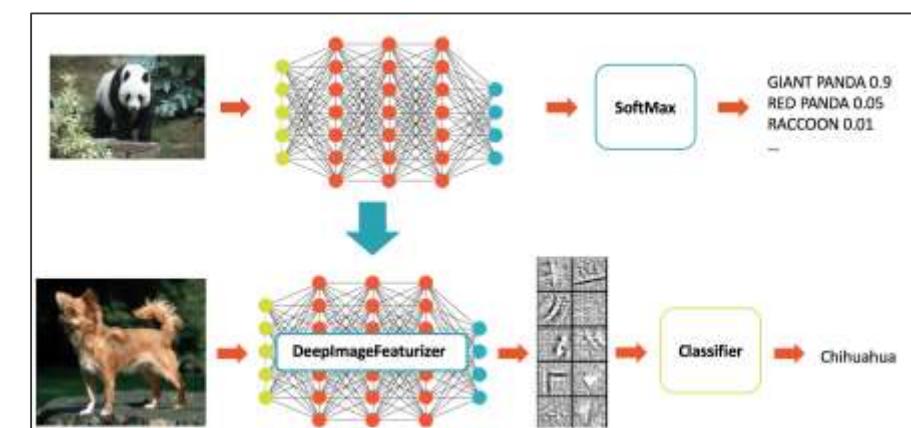
DEEP LEARNING

Azure Databricks supports and integrates with a number of Deep Learning libraries and frameworks to make it easy to build and deploy Deep Learning applications

- Supports Deep Learning Libraries/frameworks including:
 - [Microsoft Cognitive Toolkit \(CNTK\)](#)
 - [TensorFlow](#)
 - [Keras](#)
 - [Theano](#)
- Offers [Spark Deep Learning Pipelines](#), a suite of tools for working with and processing images using deep learning using [transfer learning](#). It includes high-level APIs for common aspects of deep learning so they can be done efficiently in a few lines of code:
 - Image loading
 - Applying pre-trained models as transformers in a Spark ML pipeline
 - Transfer learning
 - Distributed hyperparameter tuning
 - Deploying models in DataFrames and SQL



Distributed Hyperparameter Tuning

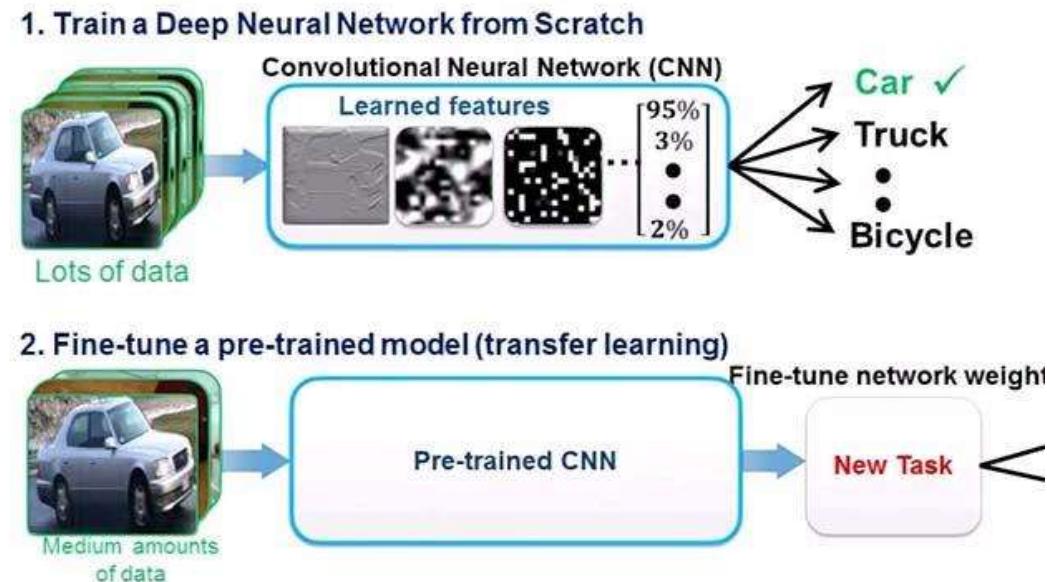


Transfer Learning

DEEP LEARNING PIPELINES

Transfer Learning

- Transfer learning is a research problem in machine learning that focuses on storing knowledge gained while solving one problem and applying it to a different but related problem.
- Transfer Learning APIs for common aspects of deep learning so they can be done efficiently in a few lines of code
- For example, knowledge gained while learning to recognize cars could apply when trying to recognize trucks.



TRANSFER LEARNING

Pre-Trained Libraries

- **ImageNet** – formally a project aimed at (manually) labeling and categorizing images into almost 22,000 separate object categories for the purpose of computer vision research
- **InceptionV3** – Created @ Google Brain
- **Xception** – Proposed by [François Chollet](#), the creator and chief maintainer of the Keras library
- **ResNet50** – The Convolutional Neural Network that the Microsoft team won the *ImageNet Large Scale Visual Recognition Competition* (ILSVRC) in 2015 and surpassed the human performance on ImageNet dataset.
- **VGG16/VGG19** – Introduced in 2014. This network is characterized by its simplicity, using only 3×3 convolutional layers stacked on top of each other. The 16 and 19 stand for the number of weight layers in the network. VGG stands for Visual Geometry Group.

Databricks Runtime for ML

Ready to use clusters with built-in ML Frameworks
including TensorFlow, Keras, Horovod, and more



HorovodEstimator
simplified distributed training

GPU support
on Azure (NC/NC-v3) instances now supported!

Azure Databricks Runtime for Machine Learning

AZURE Databricks Runtime for Machine Learning

- Pre-installed packages for machine learning like Tensorflow, Keras, Horovod and XGBoost
- Pre-configured HorovodEstimator for seamless integration of Horovod with the Spark DataFrames
- Support for GPU enabled VMs for specialized compute for your deep learning needs
- Multi-GPU trainings of deep neural networks using Horovod
- Unlock complex machine learning and deep learning scenarios with a few lines of code

AZURE DATABRICKS RUNTIME FOR MACHINE LEARNING

New Cluster [Cancel](#) [Create Cluster](#) 2-8 Workers: 224.0-896.0 GB Memory, 24-96 Cores, 6-24 DBU
1 Driver: 112.0 GB Memory, 12 Cores, 3 DBU Cost \$0.55 per DBU

Cluster Type [Serverless Pool \(beta, R/Python/SQL\)](#) [Standard](#) [Learn more about Serverless Pools](#)

Cluster Name ArtificialIntelligenceForAll

Databricks Runtime Version [4.1 ML Beta \(includes Apache Spark 2.3.0, GPU, Scala 2.11\)](#) [NVIDIA EULA](#)

Python Version 2

Driver Type Standard_NC12 (beta) 112.0 GB Memory, 2 GPUs, 3 DBU

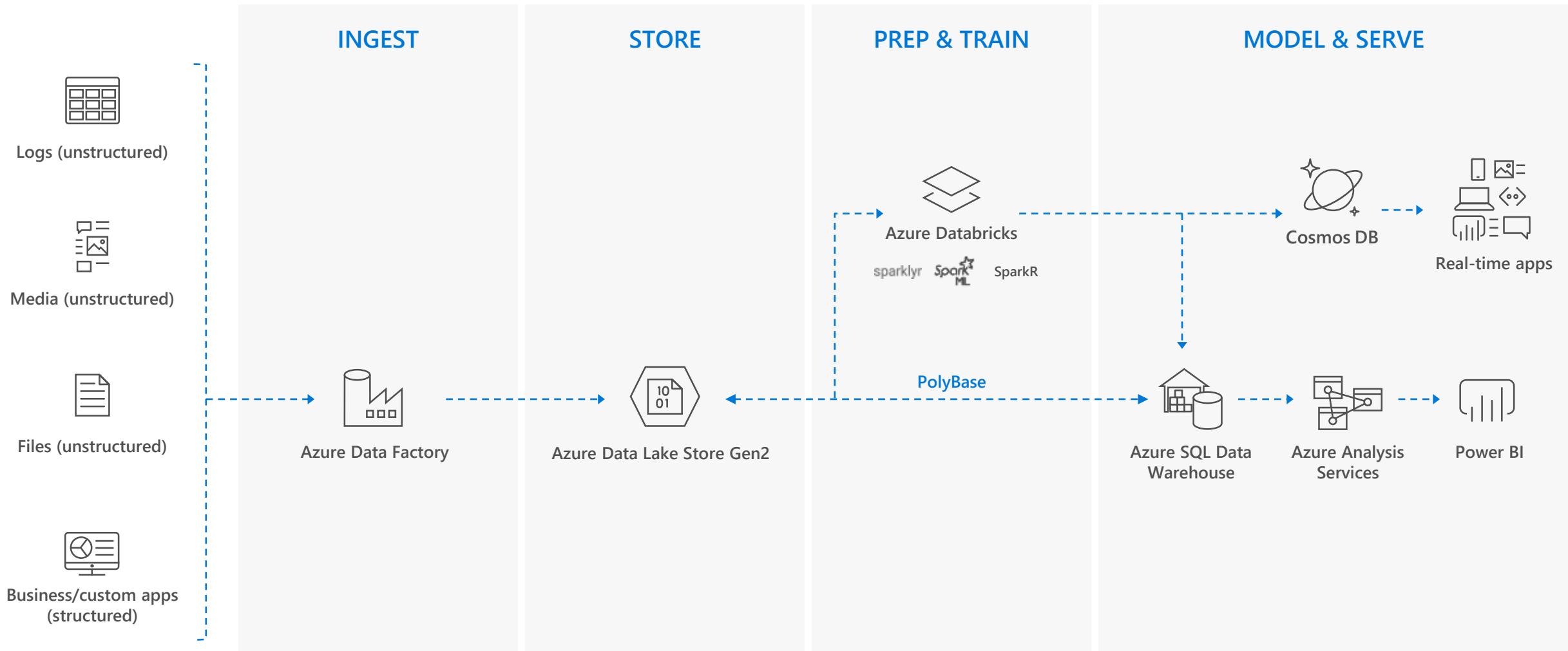
Worker Type Standard_NC12 (beta) 112.0 GB Memory, 2 GPUs, 3 DBU

Min Workers 2

Max Workers 8

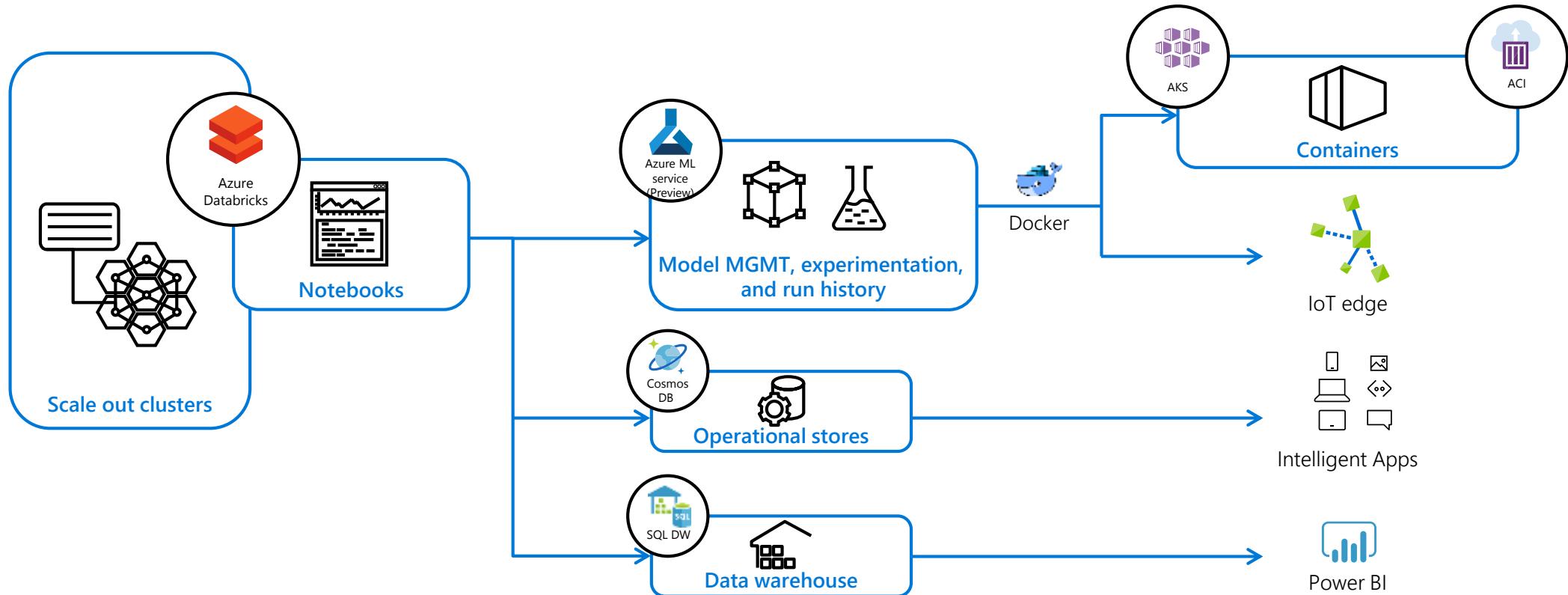
Enable Autoscaling

ADVANCED ANALYTICS ON BIG DATA



Microsoft Azure also supports other Big Data services like Azure HDInsight, Azure Machine Learning to allow customers to tailor the above architecture to meet their unique needs.

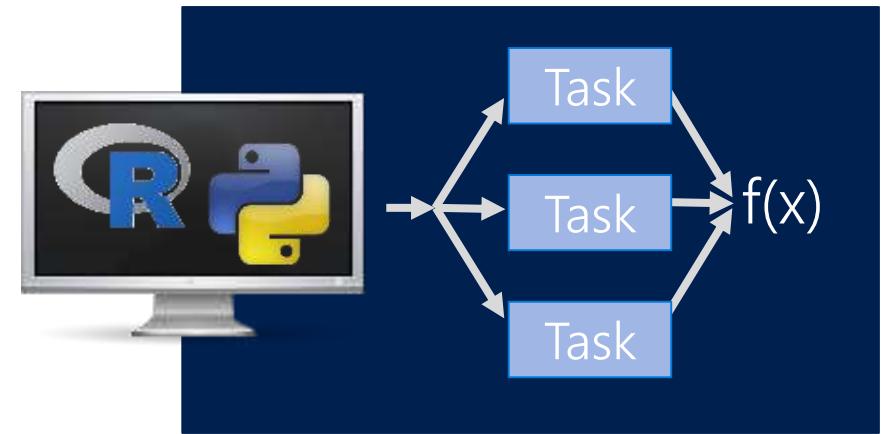
Operationalization and management architecture



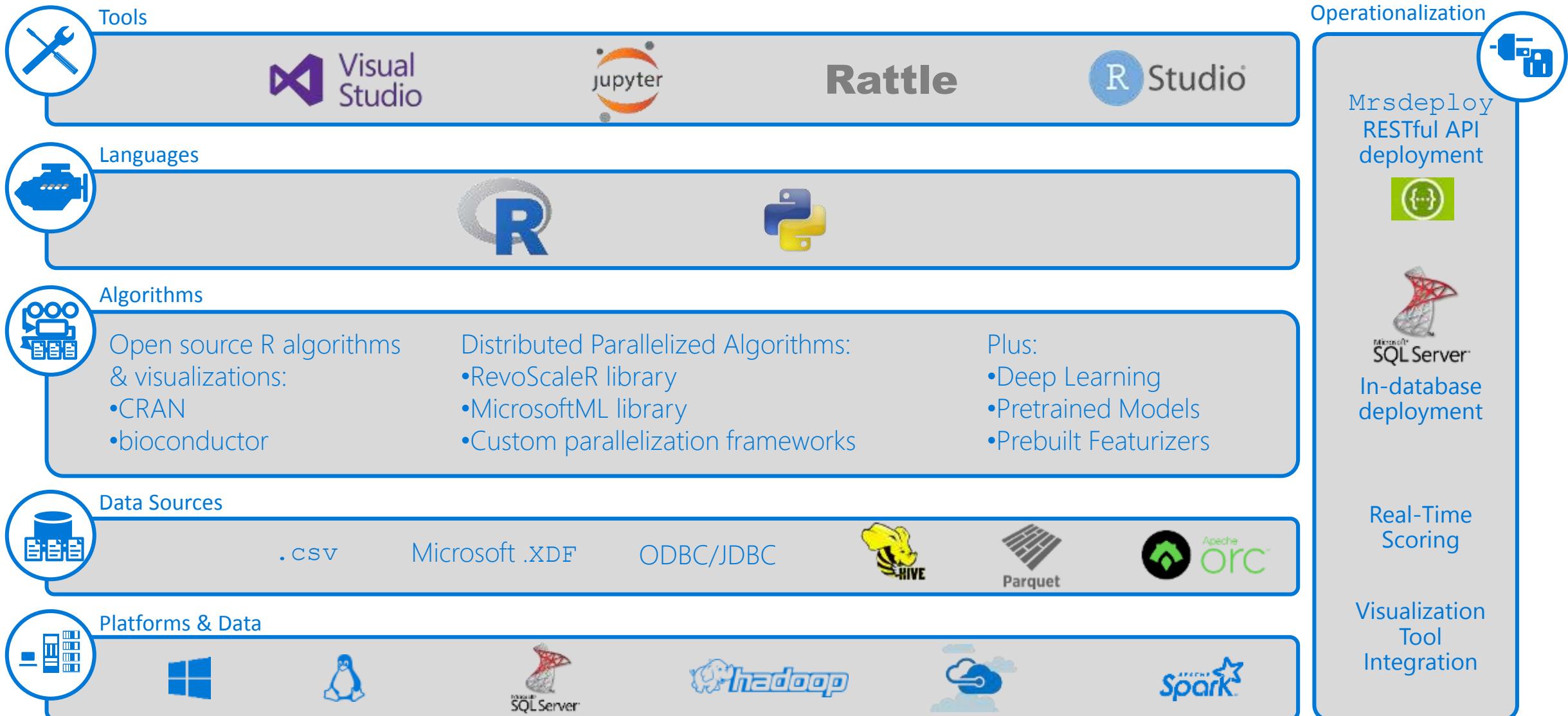
MACHINE LEARNING SERVER

BIG DATA SCALE WITH MICROSOFT ML SERVER

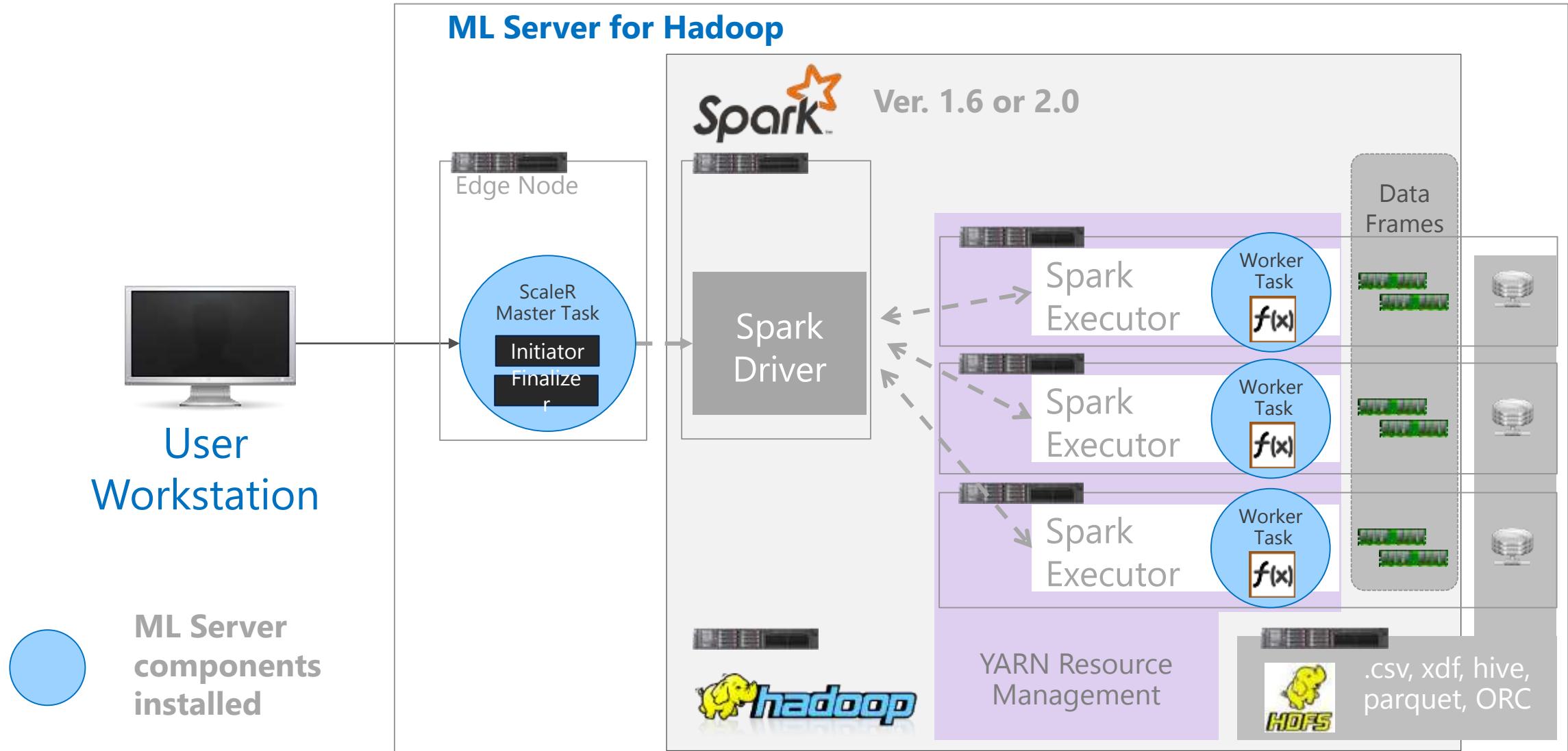
- Full support for R and Python
- Scale via parallel & distributed computation
- On-premises deploys to multiple platforms:
 - Machine Learning Server for Hadoop
 - Machine Learning Server for Linux
 - Machine Learning Server for Windows
- In Azure, available within:
 - ML Server on HDInsight (Hadoop + Spark)
 - Machine Learning Server on Linux VM
 - Data Science VM (Linux and Windows)
- ML Server provides the underlying functionality integrated into SQL Server as Machine Learning Services (In-Database), which is available to:
 - All editions of SQL Server 2017
 - It is also available in Azure SQL Database



Machine Learning Server at a glance



ML Server for Hadoop/Spark: In-memory, massive parallelism





SQL Server 2017/2019 Machine Learning Services



In-database analytics with SQL Server 2017

Reduce data movement

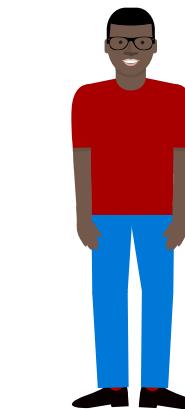
Eliminate data movement, reduce unnecessary duplication and leverage database data protections

Operationalize scripts and models

Operationalize R or Python scripts & models over SQL Server data by calling familiar T-SQL stored procedures from your application

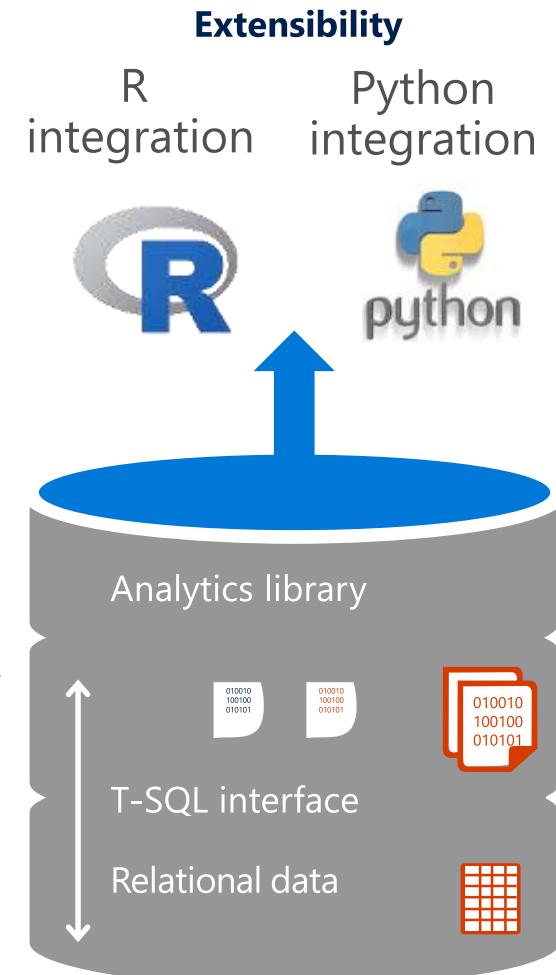
R and Python with in-memory scalability

Scale your analytics with multi-threading and parallel processing



Data Scientist
Interacts directly with data

SQL Developer/DBA
Manage data and analytics together

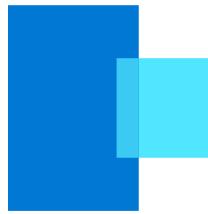


Combine the best of open source languages with Microsoft innovation

Languages	Big data scale	Innovations
	<ul style="list-style-type: none">RevoScaleR LibraryMicrosoftML LibraryEnsemble & GroupBy Modelingrevoscalepy Library	<ul style="list-style-type: none">T-SQL IntegrationReal-Time ScoringDeep Neural NetworksPre-Trained Image & Text Featurizers
		

- Run any open source **R or Python**
- Leverage thousands from packages in **R & Python open source communities**
- Scale and accelerate R with **RevoScaleR, revoscalepy, MicrosoftML** parallelized libraries
- Innovate in AI with **Deep Neural Network toolkit**
- Deploy common AI easily including **prebuilt neural networks**
- Innovate with open source **AI** such as Tensorflow & Theano

SQL Server 2019 enables intelligence over all your data



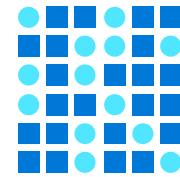
Integrating all data

Unified access to all your data with
unparalleled performance



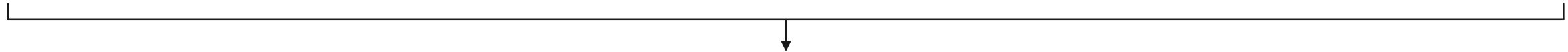
Managing all data

Easily and securely manage
data big and small



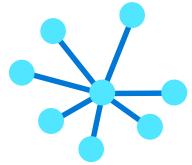
Analyzing all data

Build intelligent apps and
AI with all your data



Simplified management and analysis through a unified deployment, governance, and tooling

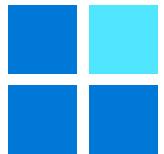
All on a unified data services platform



Connect to all of your data
Including Relational, noSQL, Hadoop



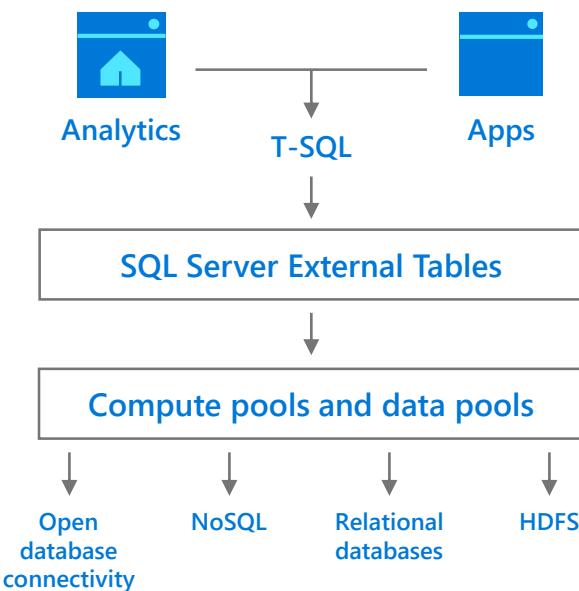
Create intelligence from all your data
Using Spark and SQL



Manage this through a single pane of glass
With Azure Data Studio

SQL Server 2019 big data, analytics, and AI

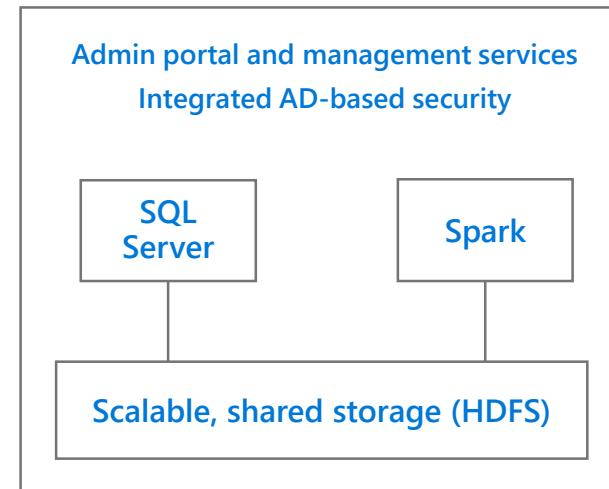
Data virtualization



Combine data from many sources without moving or replicating it

Scale out compute and caching to boost performance

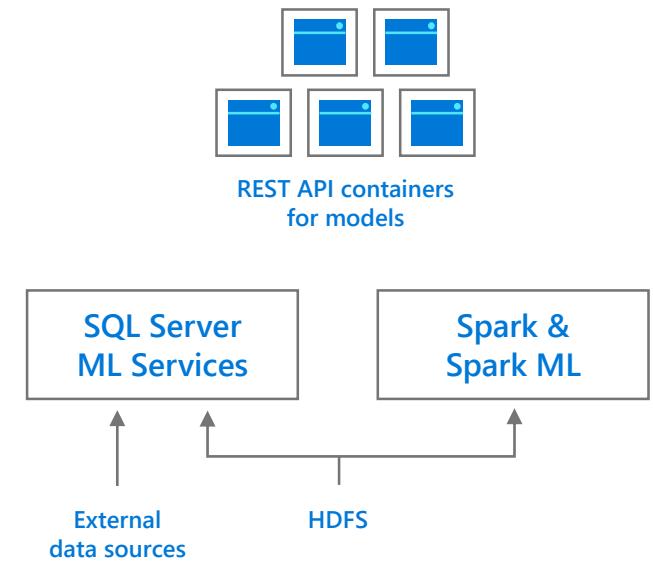
Managed SQL Server, Spark, and data lake



Store high volume data in a data lake and access it easily using either SQL or Spark

Management services, admin portal, and integrated security make it all easy to manage

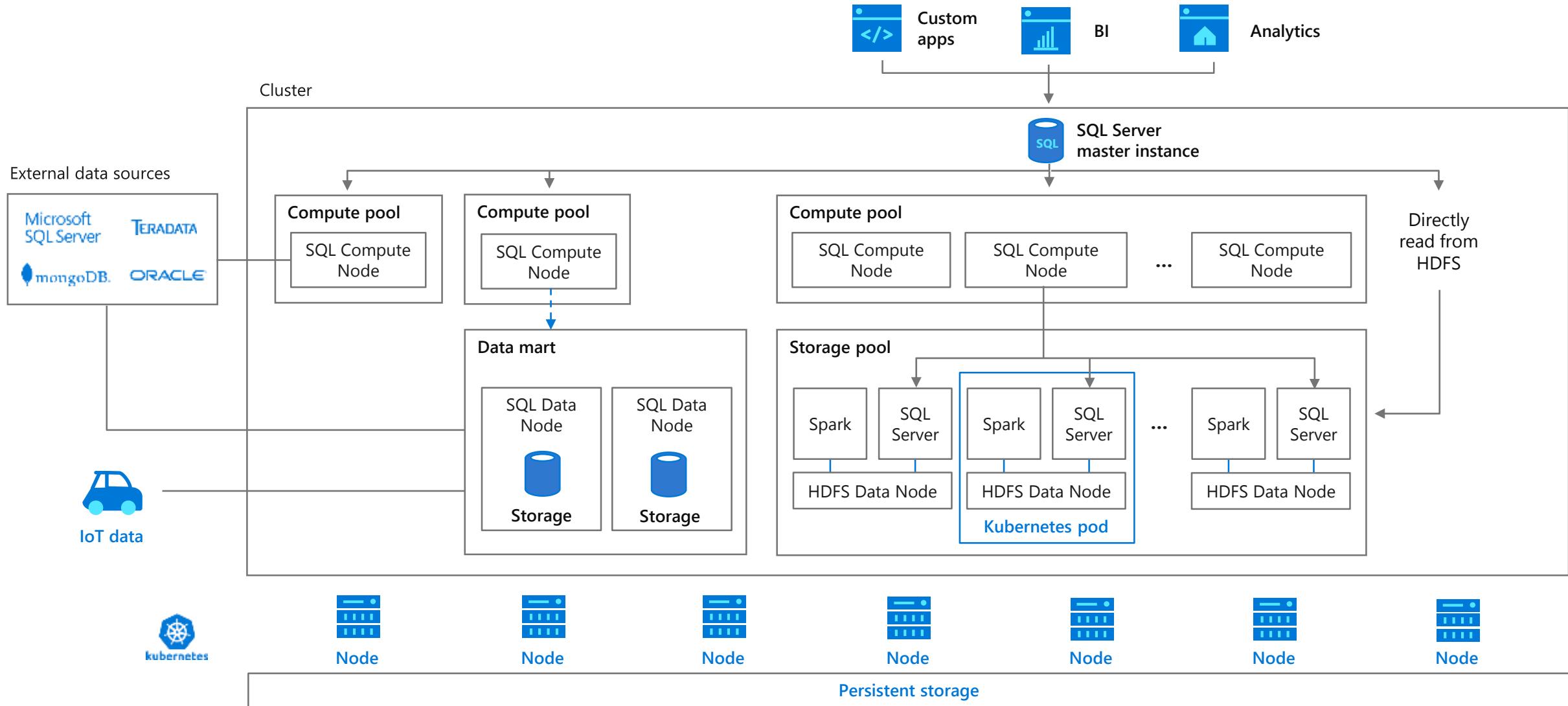
Complete AI platform



Easily feed integrated data from many sources to your model training

Ingest and prep data and then train, store, and operationalize your models all in one system

SQL Server big data clusters



SQL Database with Machine Learning services

GA
ETA
Q2 2019

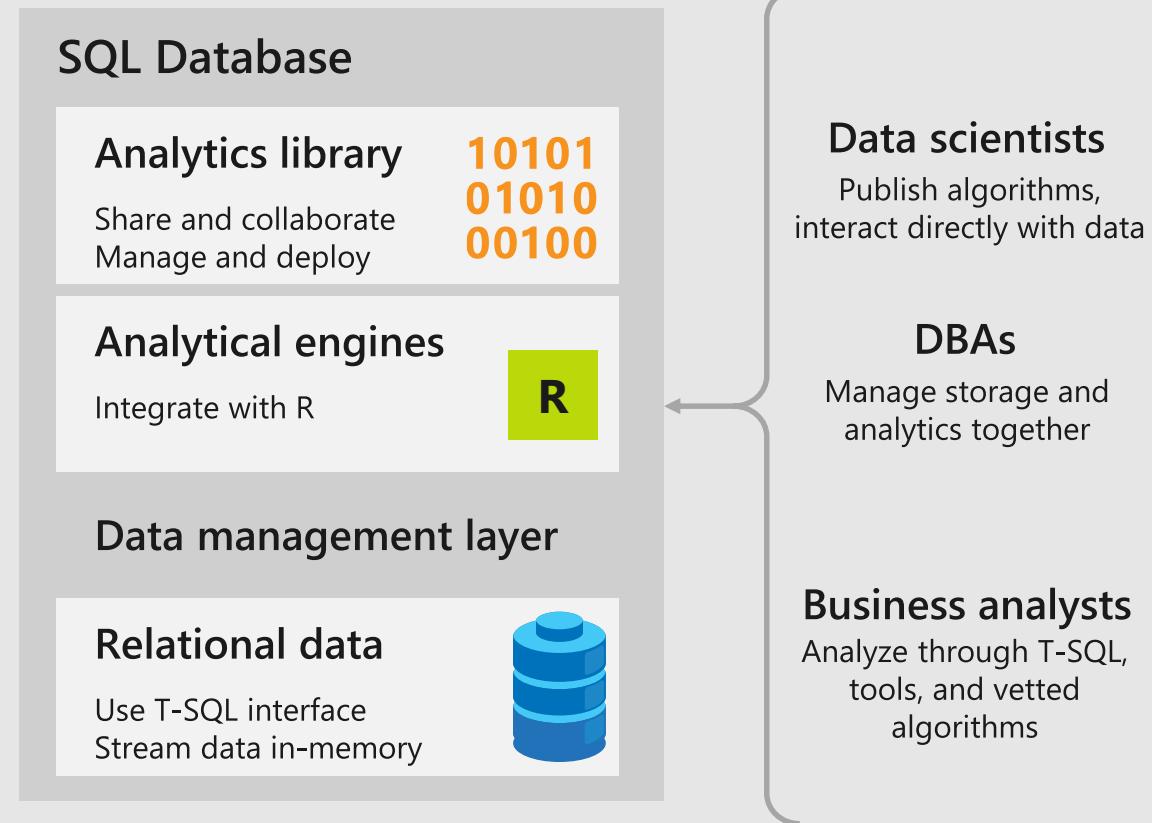
R integration enables end to end machine learning in Azure SQL Database – without moving data

Operationalize your machine learning scripts and models directly in a fully managed database in the cloud.

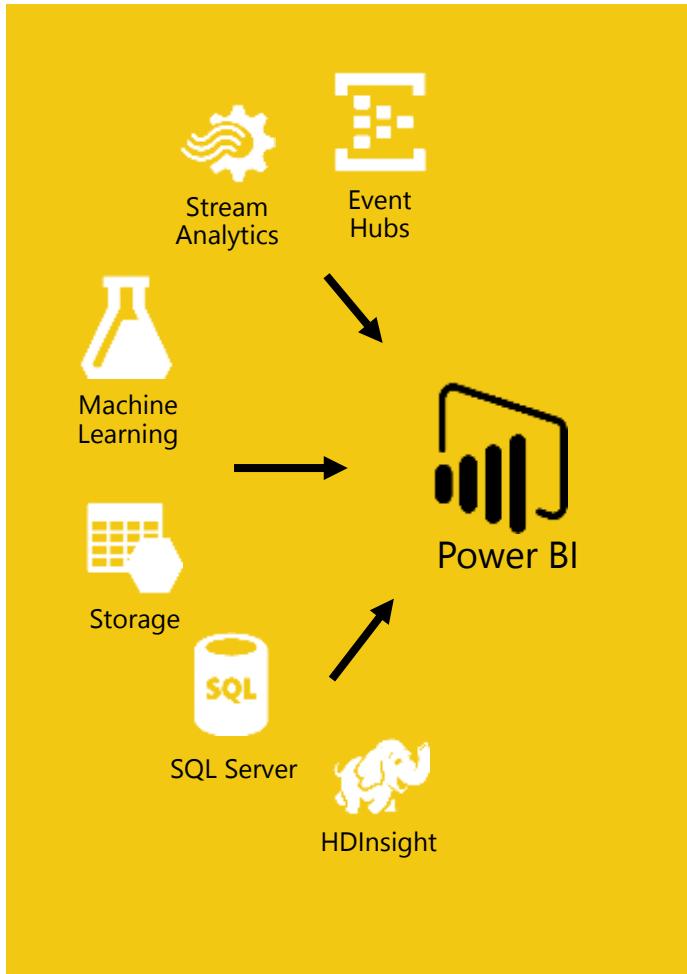
Expose predictions to any application using your database, easily and seamlessly.

Take advantage of predictions via simple stored procedures for apps connecting to SQL Database.

[Learn more.](#)



Integration with Azure services



Azure and Power BI have the built-in connectivity and integration to bring business intelligence efforts to life

Integration can be achieved without the need to develop complex solutions:

- Direct connect:
 - Azure SQL Database
 - Azure SQL Data Warehouse
 - Spark on Azure HDInsight
- Power BI Desktop
- Real-time dashboards with Azure Stream Analytics

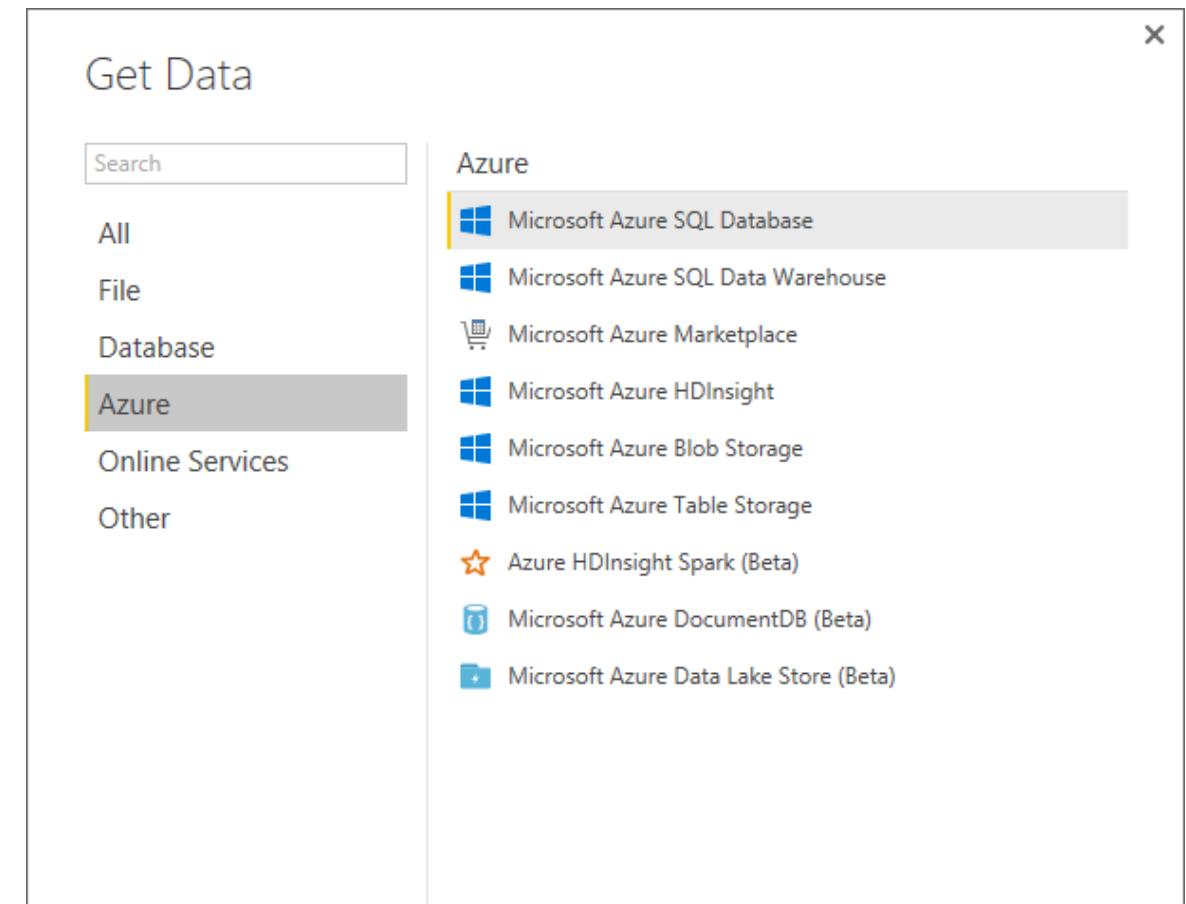
Note: Direct Connect Azure services were covered earlier in this module

Integration with Azure services

Power BI Desktop

Connect to various Azure services, and create queries

- Queries can be integrated with other data source types, not necessarily Azure
- Datasets sourced from a Power BI Desktop file can be refreshed



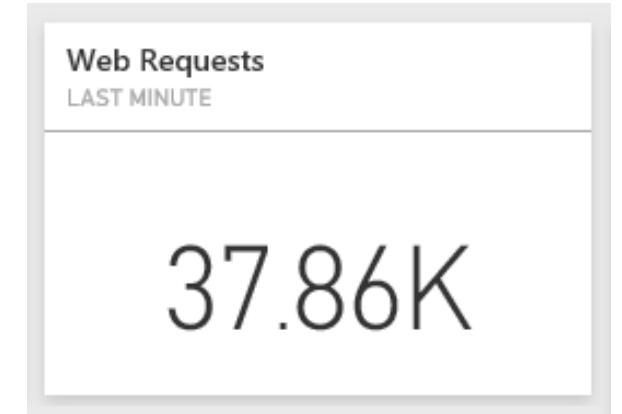
Note: Power BI Desktop is covered in detail in the next module

Integration with Azure services

Real-time dashboards with Azure Stream Analytics

Use Azure Stream Analytics to push live, streaming data to Power BI

- Enables real-time dashboards at scale, over data from devices and applications
- Can stream millions of events per second
- Can perform aggregation over time windows



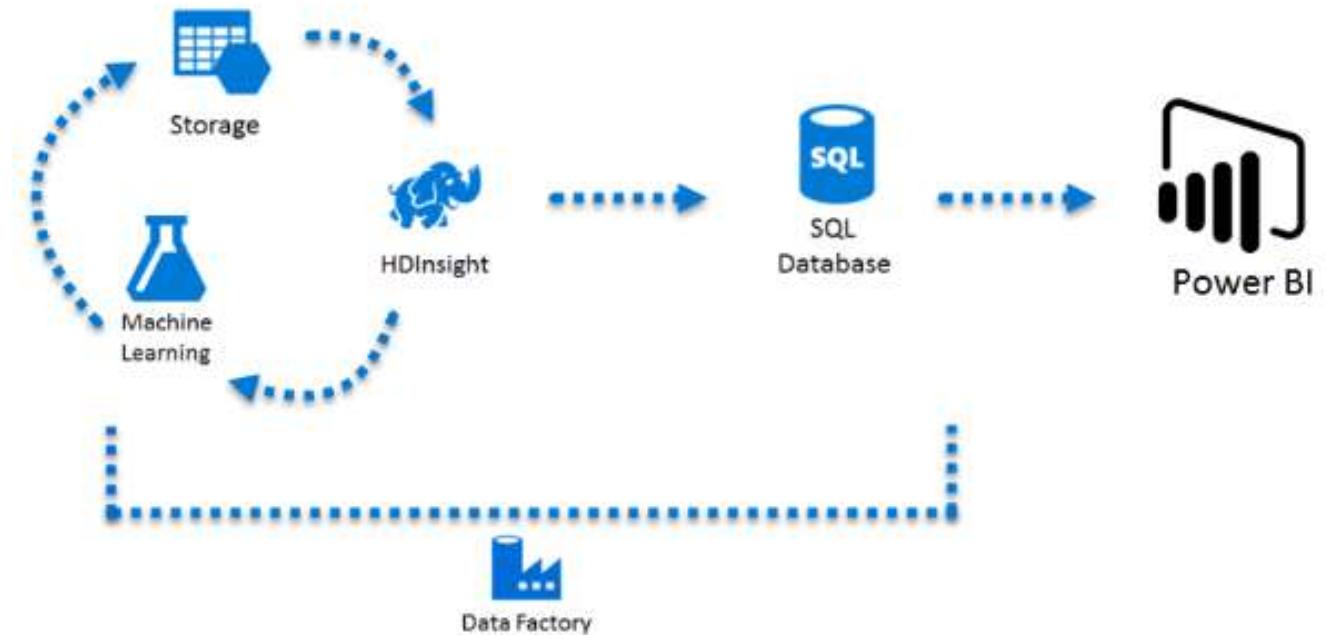
Tip: Use Q&A to ask: "Show Web Requests where Timestamp is last minute"

Integration with Azure services

Advanced analytics

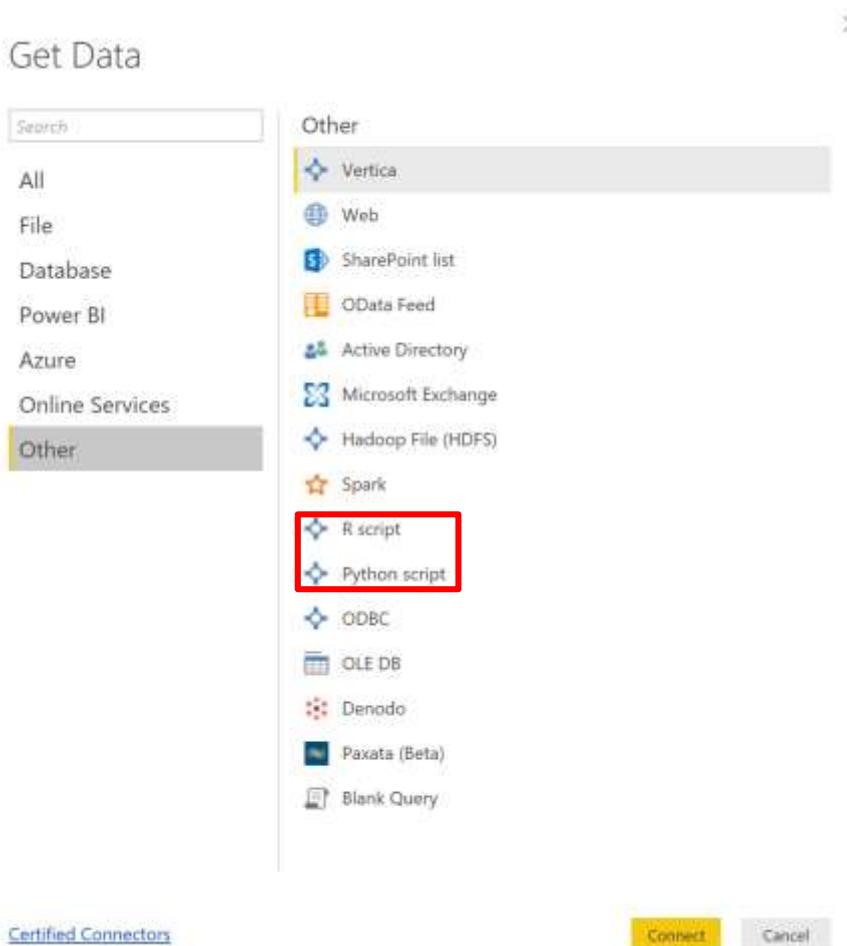
Coalesce Azure services
together to drive advanced
analytics:

- **Azure HDInsight:**
Big Data processing
- **Azure Machine Learning:**
Predictive analytics
- **Azure Data Factory:**
Orchestration at scale



Describing additional capabilities

Running R and Python scripts

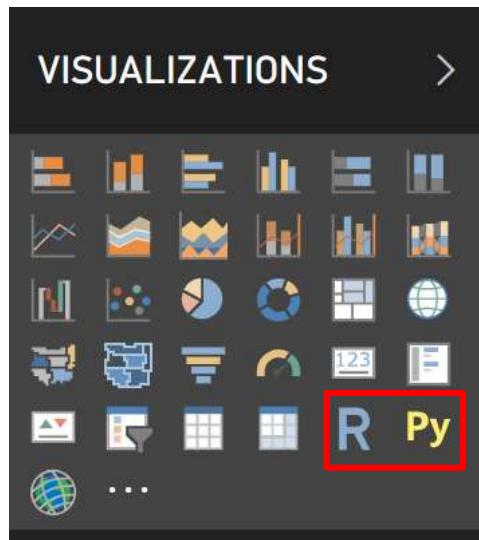


R Python scripts can be ran directly in Power BI Desktop, and resulting datasets imported into a Power BI Desktop data model

- R, Python must be installed on the local machine
- Only data frames are imported
- Columns typed as Complex and Vector are not imported
- Can be refreshed with a gateway

Describing additional capabilities

Generating R and Python visuals



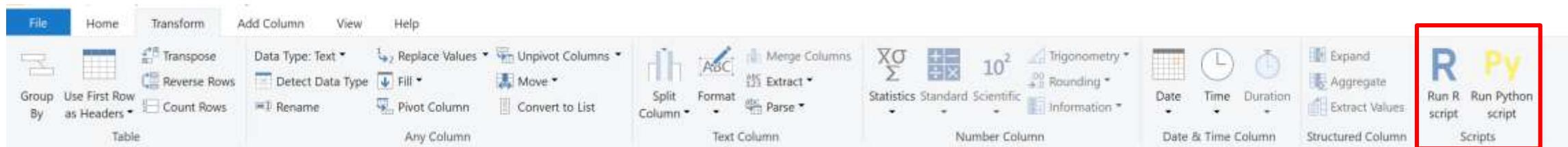
R and Python visuals render from R script, accepting input fields

Benefits:

- Leverage the voluminous and growing number of out-of-the-box plots available in R and Python
- Easily customize R and Python visuals by developing the script
- Combine advanced analytics in visuals
- Interact with R and Python visuals in Power BI Desktop (filter, and cross-filter are supported)

Transform your data

Using R or Python



Built-in intelligence to empower everyone

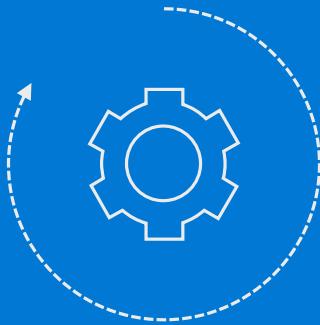
Point and click to explain the increase/decrease

Data transformations "by example"

Relationship and data type detection

Built in integration with R and Python





Power BI AutoML

Entities Machine learning models

Edit entities

Add entities

Save

Close

ENTITY NAME

ENTITY TYPE

ACTIONS

▶ Accounts

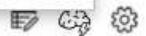
Account



+ Add a machine learning model

▶ Contacts

Contact



▶ Events

Custom



▶ Leads

Lead



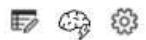
▶ Messages

Custom



▶ Opportunities

Opportunity



▶ Owners

Owner



▶ Products

Product



Entities Machine learning models

Add a model

Save

Close

Choose model

Select data

Customize inputs

Name + train

Choose a model type



Classification

Identify the category or class an entity belongs to.



Forecast

Estimate values and trends based on historical data.

Binary Prediction

Examples: Determining the likelihood of a sales lead converting or the probability of a customer responding to a marketing campaign.

[New to machine learning models?](#)

Next

Cancel

Entities Machine learning models

+ Add a model

Save

Close

Choose model

Select data

Customize inputs

Name + train

Select the historical outcome data for your binary prediction model

In order to predict the likelihood that an event will occur, your model needs to learn from past situations where the event outcome is known.

Historical outcome field

Choose the historical true/false outcome that you want the model to study and be able to predict in the future. [Learn more.](#)

[If the field you need doesn't exist, create a calculated field in Power Query.](#)

Accounts

ChurnedAccounts

Back

Next

Cancel



Entities Machine learning models Choose model Select data Customize inputs Name + train

Add a model

Save

Close

Customize your input fields

We've selected relevant inputs based on the entity that you selected. You can customize them below or proceed with the recommended inputs selected.

Search

[Advanced configuration](#) [Reset](#) [Clear](#)

142 fields selected

Base entity

Accounts

- ClassificationCode
- ChurnedAccounts *(historical outcome field)*
- Description
- IndustryCode
- PrimaryOwnerContactID
- SecondaryOwnerContactID

Related entities

Contacts via PrimaryOwnerContactID

- ContactID
- Department
- Gender
- JobTitle

Contacts via SecondaryOwnerContactID

- ContactID
- Department

The flow suggests default set of inputs for the ML model, including those from related entities in the Dataflow.

Back

Next

Cancel

Entities Machine learning models

Choose model

Select data

Customize inputs

Name + train

Add a model

Save

Close

Name and review your model

Model name

AccountChurnRisk

Description

Likelihood of accounts being inactive or canceled

Report label for true outcomes

Churned

e.g., "Converted", "Churned", "Dropped Out"

Report label for false outcomes

Retained

e.g., "Retained", "Lost"

Training details

Model type: Binary Prediction

Base entity: Accounts

Historical outcome: ChurnedAccounts

Input fields: 142

Training data: The model will take a statistically significant sample of the 250,000 rows found in Accounts and train on approximately 80% of the sample data. It will then test its algorithm on the remaining sample data and report on its prediction accuracy.

Back

Train

Cancel

Entities Machine learning models

Edit entities

Add entities

Save

Close

ENTITY NAME

ACTIONS ENTITY TYPE

LAST REFRESH ACTIONS

STATUS

▶ Accounts

Account



▶ Contacts

Contact



▶ Events

Event



▶ Leads

Lead



▶ Messages

Message



▶ Opportunities

Opportunity



▶ Owners

Owner



▶ Products

Product



Your model is training



After you close this dialog, we'll notify you when it's ready and show you how it performed.

We estimate it may take up to 30 minutes for your model to train, based on the size of your dataset.

1. Create and train your model



2. Improve it



3. Apply it



What's next:

Evaluate, customize and retrain your model until it's optimized.

Apply your model to future data for predictive insights.

OK

Entities Machine learning models

MODEL NAME

MODEL TYPE

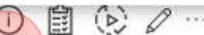
AccountChurnRisk

Prediction

**AccountChurnRisk training is complete**

Preview the model results then make changes or apply it.

Preview model accuracy



7/1/2018 3:32 PM

Trained

Entities [Machine learning models](#)

MODEL NAME	MODEL TYPE	BASE ENTITY	ACTIONS
AccountChurnRisk	Prediction	Accounts	

AccountChurnRisk details

Status: Trained

Description
Likelihood of accounts being inactive or canceled

Base entity
Accounts

Historical outcome field
ChurnedAccounts

Number of input fields used
142

True outcome label
Churned

False outcome label
Retained

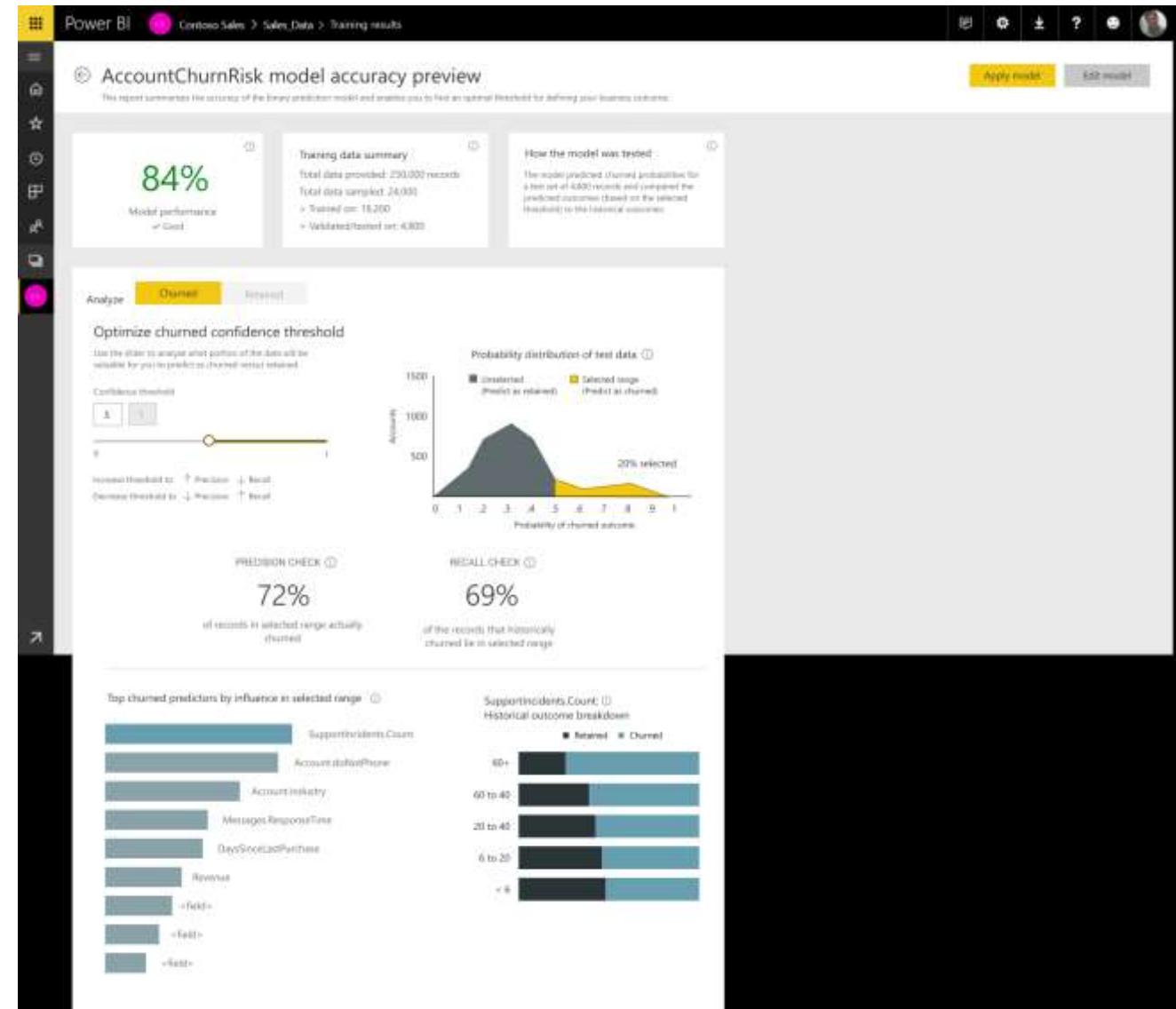
Model performance
76%

Training history

Finish time	Status
4/11/18, 4:13:15 PM	Succeeded
4/11/18, 11:58:28 AM	Failed
4/10/18, 11:58:28 AM	Succeeded

[View model accuracy](#)

- The model accuracy preview report includes the top influencers for the model, including a breakdown of how the different values for that influencer affects the outcome.



AccountChurnRisk model accuracy preview

This report summarizes the accuracy of the binary prediction model and enables you to find an optimal threshold for defining your business outcome.

84%

Model performance



Training data summary

Total data provided: 250,000 records

Total data sampled: 24,000

> Trained on: 19,200

> Validated/tested on: 4,800

How the model was tested

The model predicted churned probabilities for a test set of 4,800 records and compared the predicted outcomes (based on the selected threshold) to the historical outcomes.

Analyze

Churned

Retained

Optimize churned confidence threshold

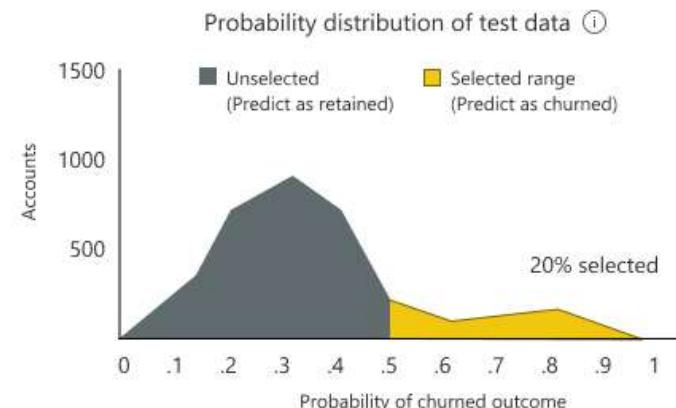
Use the slider to analyze what portion of the data will be valuable for you to predict as churned versus retained.

Confidence threshold

.5 1

Increase threshold to ↑ Precision ↓ Recall

Decrease threshold to ↓ Precision ↑ Recall



PRECISION CHECK

72%

of records in selected range actually
churned

RECALL CHECK

69%

of the records that historically
churned lie in selected range

AccountChurnRisk has been applied to Accounts

You can view its results after the next data refresh.

Primary

Edit entities

Add entities

Save

Close

ENTITY N

Edit Queries

Power Query

A

Get Data

Refresh

Options

Manage Columns

Transform Table

Reduce Rows

Add Column

AI insights

Data transformations

C

Accounts

Contacts

Events

Leads

Messages

Opportunities

Owners

Products

E

L

M

O

O

P

Pr

	Stepname	ChurnRisk_Score	ChurnRisk_Outcome	ChurnRisk_Reason
1	90...	98	Retained	{"Account.Industry":"Manufacturi
2	3D...	67	Retained	{"Account.Industry":"Manufacturi
3	3AD...	86	Retained	{"Account.Industry":"Manufacturi
4	958...	98	Retained	{"Account.Industry":"Manufacturi
5	F1F...	27	Churned	{"Account.Industry":"Manufacturi
6	3E4...	55	Retained	{"Account.Industry":"Manufacturi
7	365...	100	Retained	{"Account.Industry":"Manufacturi
8	31D...	1	Churned	{"Account.Industry":"Manufacturi
9	358...	8	Churned	{"Account.Industry":"Manufacturi
10	811...	6	Churned	{"Account.Industry":"Manufacturi
11	014...	1	Churned	{"Account.Industry":"Manufacturi
12	-B6...	71	Retained	{"Account.Industry":"Manufacturi
13	9F4...	57	Retained	{"Account.Industry":"Manufacturi
14	8C6...	92	Retained	{"Account.Industry":"Manufacturi
15	323...	52	Retained	{"Account.Industry":"Manufacturi
22				

Name

Accounts

Applied Steps

Source

Navigation 1

Navigation 2

Applied AutoML.Account...

Expanded Record

Save

Azure Cognitive Services

Microsoft & NDA Customers only—do not share



Microsoft Bot Framework

Your bots — wherever your users are talking.

Build and connect intelligent bots to interact with your users naturally wherever they are, from text/sms to Skype, Slack, Office 365 mail and other popular services.

Get started

```
public Message Post([FromBody]Message message)
```

```
{  
    if (message.Type == "Message")  
    {
```



```
        var convStatus = GetConversationStatus();  
        switch (ConvStatus)  
        {
```

Hey Pizza bot!



```
            case ConversationStatus.Closed:  
                break;
```



```
No thanks, I'd like to try something new.
```



```
We have added 3 new items:
```

- 1) Hawlaiian
- 2) BBQ Chicken
- 3) The Works



```
Option 3 please.
```



```
Shall I send this to your home?
```



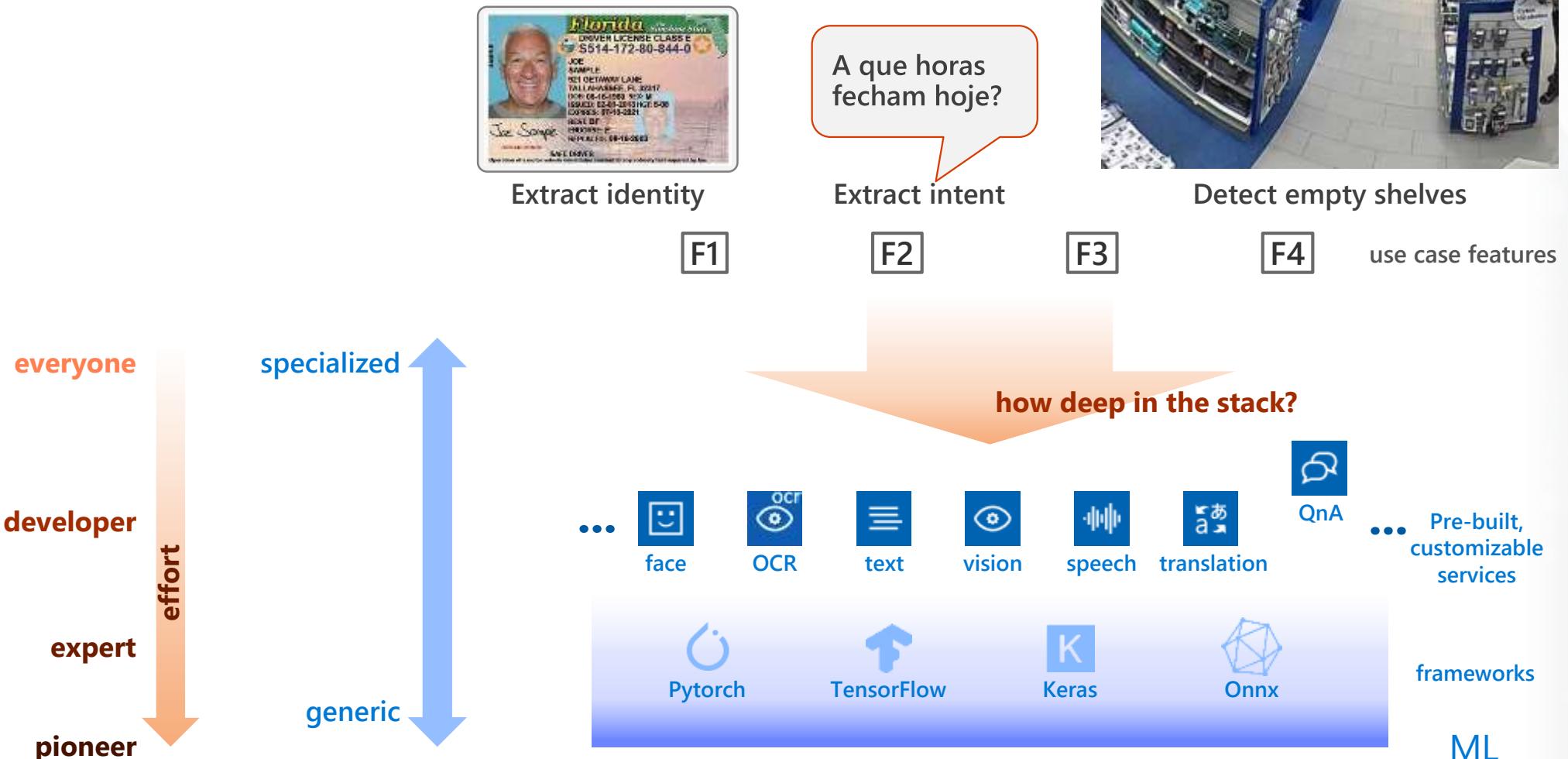
```
break;  
case OrderStatus.GetAddress:
```



www.botframework.com

Role of Cognitive Services

making it easier to infuse AI



Microsoft Cognitive Services

Give your apps a human side



Vision

From faces to feelings, allow your apps to understand images and video



Speech

Hear and speak to your users by filtering noise, identifying speakers, and understanding intent



Language

Process text and learn how to recognize what users want



Knowledge

Map complex information and data in order to solve specific tasks



Search

Access billions of web pages, images, videos, and news with the power of Bing



Labs

An early look at emerging Cognitive Services technologies: discover, try, and give feedback on new technologies before general availability

Cognitive Services capabilities

Infuse your apps, websites, and bots with human-like intelligence



Vision

- Object, scene, and activity detection
- Face recognition and identification
- Celebrity and landmark recognition
- Emotion recognition
- Text and handwriting recognition (OCR)
- Video metadata, audio, and keyframe extraction and analysis
- Explicit or offensive content moderation
- Custom image recognition



Speech

- Speech transcription (Speech-to-text)
- Speech Synthesis (Text-to-speech)
- Real-time speech translation
- Speaker identification and verification
- Custom Speech models for transcription and translation
- Custom voice



Language

- Language detection
- Text sentiment analysis
- Key phrase extraction
- Entity recognition
- Spell checking
- Explicit or offensive text content moderation, PII detection
- Text translation
- Customizable text translation
- Contextual language understanding



Knowledge

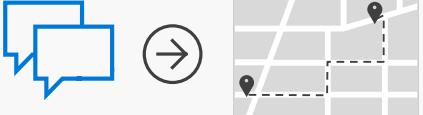
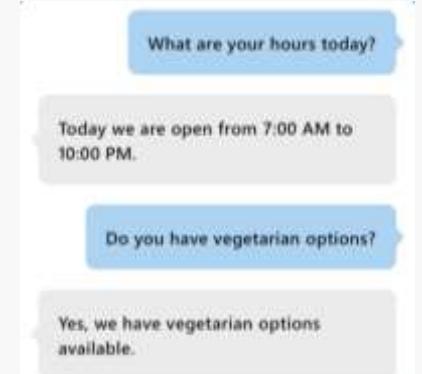
- Q&A extraction from unstructured text
- Knowledge base creation from collections of Q&As
- Semantic matching for knowledge bases
- Customizable content personalization learning



Search

- Ad-free web, news, image, and video search results
- Trends for video, news
- Image identification, classification and knowledge extraction
- Identification of similar images and products
- Named entity recognition and classification
- Knowledge acquisition for named entities
- Search query autosuggest
- Ad-free custom search engine creation

A variety of real-world applications

Vision	Speech	Language	Knowledge	Search														
 What is in the image or video? Intelligent Image insights  <table border="1"><tr><td>Category</td><td>People; 5 faces</td></tr><tr><td>Adult/Racy?</td><td>False/False</td></tr><tr><td>Dominant colors</td><td></td></tr><tr><td>Accent color</td><td></td></tr></table> Computer Vision	Category	People; 5 faces	Adult/Racy?	False/False	Dominant colors		Accent color		 Give me directions to the nearest local branch Speech to text  <table border="1"><tr><td>Convert spoken audio to text</td></tr><tr><td>Convert text to spoken audio</td></tr><tr><td>Extract intent of user</td></tr></table> Speech Service	Convert spoken audio to text	Convert text to spoken audio	Extract intent of user	 Play today's customer call recording Natural Language Processing  Intent: PlayCall Content: Customer# Date/Time.date: today Now Playing 11/29/2016 Customer Call Language Understanding	 QnA Pair of this site? Automatic extraction of questions and answers  QnA Maker	 Search for 'fraud prevention' Intelligent web search <table border="1"><tr><td> Information Communications Media Market News It also investigates the top three expected Fraud Detection and Prevention programs, in terms of demand in key markets...</td></tr><tr><td> The Big Question: In-House or Outsourced Fraud Protection? First, let's point out that there is not one absolute answer—there are "pros" and "cons" to each. Those who favor in-house...</td></tr><tr><td> How to Protect Your Business from Online Fraud this Holiday Season Michael heads fraud prevention tool. Online and mobile shopping are expected to continue growing apace...</td></tr></table> Bing News Search	 Information Communications Media Market News It also investigates the top three expected Fraud Detection and Prevention programs, in terms of demand in key markets...	 The Big Question: In-House or Outsourced Fraud Protection? First, let's point out that there is not one absolute answer—there are "pros" and "cons" to each. Those who favor in-house...	 How to Protect Your Business from Online Fraud this Holiday Season Michael heads fraud prevention tool. Online and mobile shopping are expected to continue growing apace...
Category	People; 5 faces																	
Adult/Racy?	False/False																	
Dominant colors																		
Accent color																		
Convert spoken audio to text																		
Convert text to spoken audio																		
Extract intent of user																		
 Information Communications Media Market News It also investigates the top three expected Fraud Detection and Prevention programs, in terms of demand in key markets...																		
 The Big Question: In-House or Outsourced Fraud Protection? First, let's point out that there is not one absolute answer—there are "pros" and "cons" to each. Those who favor in-house...																		
 How to Protect Your Business from Online Fraud this Holiday Season Michael heads fraud prevention tool. Online and mobile shopping are expected to continue growing apace...																		



Vision



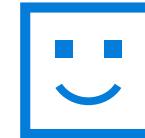
Computer Vision

Distill actionable information from images



Video Indexer

Process and extract smart insights from videos



Face

Detect, identify, analyze, organize, tag faces in photos, and even recognize emotions



Content Moderator

Machine-assisted moderation of text and images, augmented with human review tools



Custom Vision

Customizable web service that learns to recognize specific content in imagery

Vision – Face

Azure Cognitive Services

Face Detection

Face API detects up to 64 human faces with high precision face location in an image. And the image can be specified by file in bytes or valid URL.

Face Recognition

Face recognition is widely used in many scenarios including security, natural user interface, image content analysis and management, mobile apps, and robotics. Four face recognition functions are provided: face verification, finding similar faces, face grouping, and person identification.

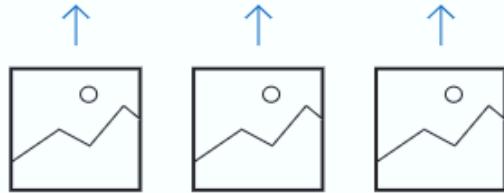
Key features:

- Detect human faces and compare similar ones
- Organize images into groups based on similarity
- Identify previously tagged people in images



Custom Vision

Azure Cognitive Services



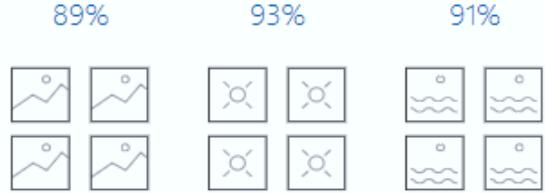
Upload Images

Bring your own labeled images, or use Custom Vision to quickly add tags to any unlabeled images.



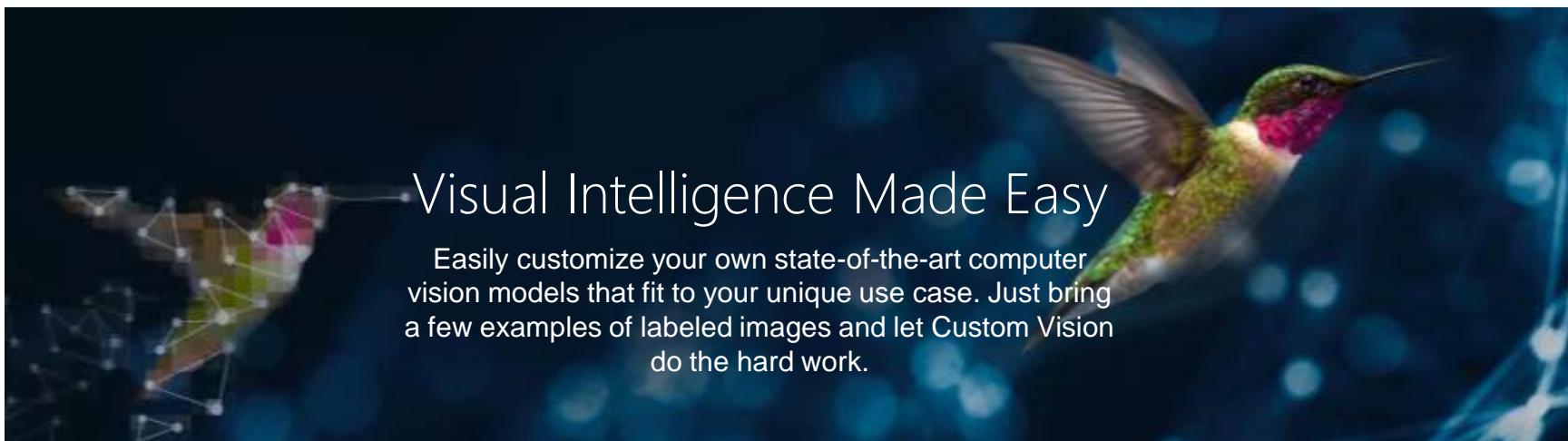
Train

Use your labeled images to teach Custom Vision the concepts you care about.



Evaluate

Use simple REST API calls to quickly tag images with your new custom computer vision model.

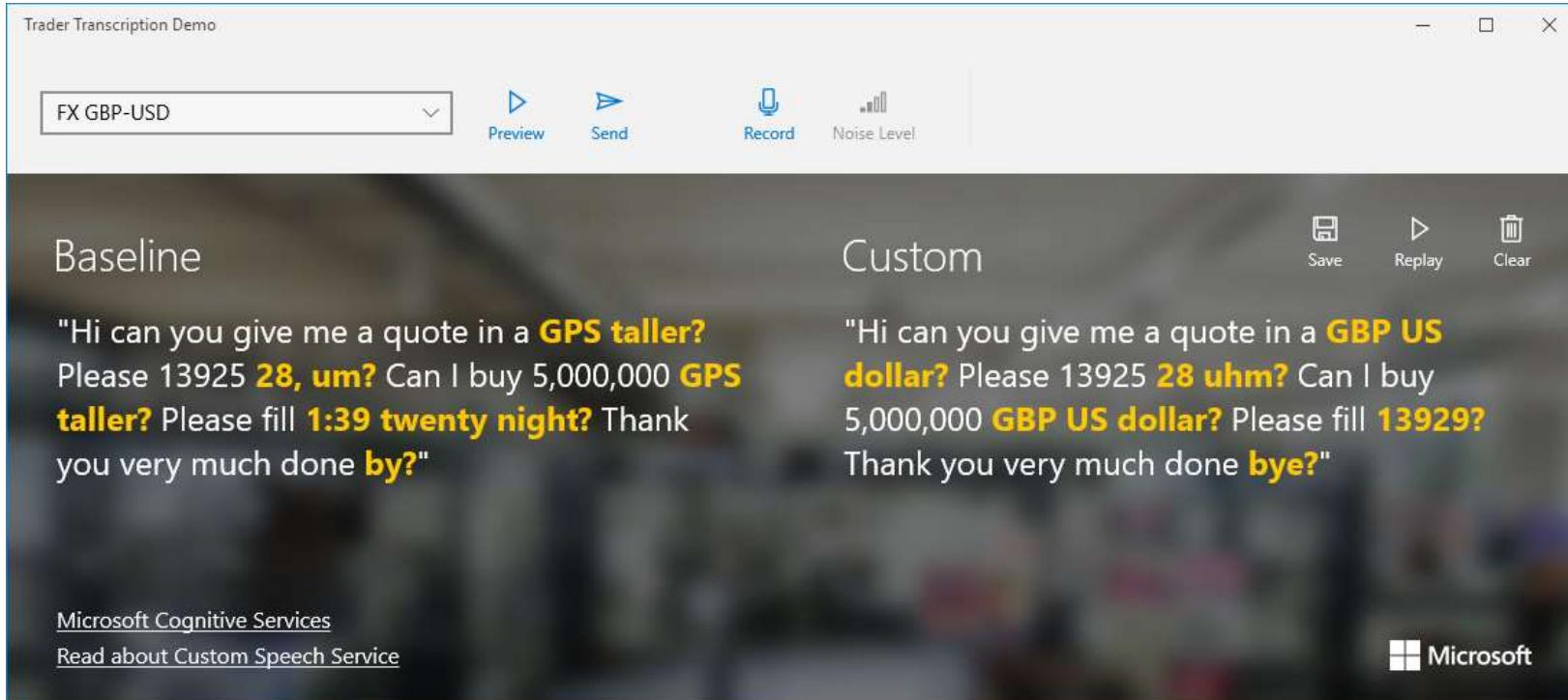


Visual Intelligence Made Easy

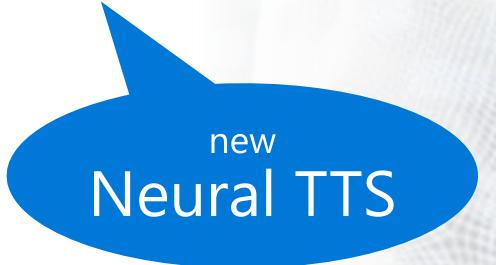
Easily customize your own state-of-the-art computer vision models that fit to your unique use case. Just bring a few examples of labeled images and let Custom Vision do the hard work.

Speech

Azure Cognitive Services



- Speaker Recognition
- Speech to Text
- Text to Speech



For optimal result in Speech to Text, **customize**:

- acoustic models for your use environments, such as vehicles
- field-specific vocabulary and grammar, such as medical or IT
- pronunciation of abbreviations and acronyms, such as "IOU" for "I owe you."



Speech



Speaker Recognition

Use speech to identify and verify individual speakers



Translator Speech

Easily conduct real-time speech translation with a simple REST API call



Custom Speech

Overcome speech recognition barriers like speaking style, background noise, and vocabulary



Unified Speech service

Unified speech service for **speech-to-text** (general and custom speech models), **text-to-speech** (general and custom voice models) and **speech translation** (general and custom translator)



Bing Speech

Convert speech to text and back again to understand user intent

Allow your apps to process natural language with pre-built scripts, evaluate sentiment and learn how to recognize what users want

The screenshot shows the Microsoft Azure Language API interface. On the left, there is a text input field containing the sentence: "I had a wonderful trip in Seattle, I enjoyed the Space Needle and Pike Place Market." Below the text input is a large green button labeled "Analyze". To the right of the text input, there are two tabs: "Analyzed text" (which is selected) and "JSON". Under the "Analyzed text" tab, the results are displayed in a table:

PROPERTY	RESULTS
LANGUAGES:	English (confidence: 100 %)
KEY PHRASES:	
SENTIMENT:	73 %
LINKED ENTITIES (PREVIEW):	8

Language



Text Analytics

Detect sentiment, key phrases, language, and extract top entities from your text



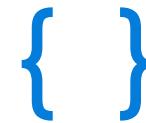
Bing Spell Check

Detect and correct spelling mistakes within your app



Translator Text

Easily perform speech and text translation



Language Understanding

Teach your apps to understand commands from your users

LUIS – Language Understanding

Azure Cognitive Services

LUIS aims to be the most comprehensive cloud-based service for **conversational understanding**, and the **easiest to use** for developers with no AI expertise:

- extracts **intent**/action and **entities** from **user utterances**
- includes dictionaries, which can be extended with customer-specific terms

Roadmap highlights coming up:

- 2H2018 easier to use together with **Azure Bot, Speech** and **QnA Maker** services





Knowledge

Map complex information and data in order to solve specific tasks

The screenshot shows a chat interface for the Microsoft FAQ QnA bot. The title bar reads "Microsoft FAQ QnA bot". The first message is from the bot: "Hi, I'm a QnA chat bot. How can I help you today?". This message is labeled "Bot". The user's message is "What is a product key?". The bot's response is: "A product key is a 25-character code that comes with a Microsoft Office product. The product key allows you to install and activate the Office product on your PC.". This message is timestamped "Bot at 2:52:10 PM". At the bottom, there is a message input field with a camera icon and the placeholder "Type your message...", and a send button icon.

Microsoft FAQ QnA bot

? 27

×

Hi, I'm a QnA chat bot. How can I help you today?

Bot

What is a product key?

You

A product key is a 25-character code that comes with a Microsoft Office product. The product key allows you to install and activate the Office product on your PC.

Bot at 2:52:10 PM

Type your message...



Knowledge



Custom Decision

Create custom experiences with adaptive, contextual decision-making



QnA Maker

Distill information into conversational, easy-to-navigate answers



Search

Add Bing Search APIs to your apps and harness the ability to comb billions of webpages, images, videos, and news with a single API call



Accent Chairs You'll Love | Wayfair

USD 251.68



Abbyson Living BR-AC1059-BLU Sierra Tufted Velvet Wingback ...



Pair of Guillerme et Chambron Black Cerused Oak 'Edouard ...

USD 8600





Search



Bing Search

Web Search
Image Search
News Search
Video Search



Bing Visual Search

Get rich insights to help build
compelling image applications on
the device of your choice



Bing Entity Search

Enrich user experiences with
contextual entity search results



Bing Autosuggest

Give your app intelligent
autosuggest options for searches



Bing Custom Search

Create a highly-customized
web search experience

Bing Statistics add-in

Get powerful Bing API usage insights in an easy-to-use add-in



Microsoft Cognitive Services Labs

Labs provides developers with an early look at emerging Cognitive Services technologies

Early adopters who do not need market-ready technology can discover, try and provide feedback on new Cognitive Services technologies before they are generally available

Labs are not Azure services





Microsoft Cognitive Services Labs



Project Gesture

Incorporate gesture-based controls into your apps. Quickly define and implement customized hand gestures, creating a more natural user experience



Project Event Tracking

Find events associated with Wikipedia entities. Begin with a Wikipedia entity, and receive a list of related events organized by time



Project Ink Analysis

Cloud APIs to understand digital ink content created by users through document layout analysis and handwriting and shape recognition



Project Answer Search

Enhance the user experience of your sites and applications by instantly answering search queries with relevant facts and results from across the web



Project Local Insights

Score the attractiveness of a location, based on how many of a particular amenity are within a specific distance



Project URL Preview

Preview URLs to show users where they're going and help flag adult content



Microsoft Cognitive Services Labs



Project Conversation Learner

Teach new behaviors to task-oriented conversational interfaces through example interactions



Project Personality Chat

Enhance your bot's conversational capabilities, by handling small talk, in line with a distinct chosen personality



Project Knowledge Exploration

Enable interactive search experiences over structured data via natural language inputs



Project Academic Knowledge

Tap into the wealth of academic content in the Microsoft Academic Graph



Project Entity Linking

Power your app's data links with named entity recognition and disambiguation



Project Anomaly Finder

The Anomaly Finder API helps you to monitor data over time and detect anomalies with machine learning that adapts to your unique data by automatically applying a statistical model

QnA Maker

Azure Cognitive Services

Q&A

- Who are the target audience for the QnA Maker tool?

QnA Maker is primarily meant to provide a FAQ data source which you can query from your Bot/Application. Although developers will find this useful, content owners will especially benefit from this tool. QnA Maker is a completely no-code way of managing the content that powers your Bot/Application.

- How do I login to the QnA Maker Portal?

You can login with your Microsoft account.

- Is the QnA Maker Service free?

Yes, currently the QnA Maker tool is free to use. However, we do meter the usage per account. See the Subscription Keys section of the documentation for details.

- My URLs have valid FAQ content, but the tool cannot extract them. Why not?

It's possible that the tool is not able to auto-extract QnA from valid FAQ URLs. In such cases, you have an option to copy-paste the QnA content in a txt and try ingesting it. Alternately, you can always editorially add content to your knowledge base.

new: pre-built
Chit-chat

From FAQ web page to Bot with a push of a button: upload and maintain your own Q&A content

Text Analytics

Azure Cognitive Services

Extract insights from customer feedback and social network postings.

I had a wonderful trip to Seattle and enjoyed seeing the Space Needle!



i LANGUAGES:	English (confidence: 100 %)
i KEY PHRASES:	Seattle, wonderful trip, Space Needle
i SENTIMENT:	98 %
i LINKED ENTITIES (PREVIEW):	I had a wonderful trip to Seattle and enjoyed seeing the Space Needle !

Links backed by Wikipedia
in select languages

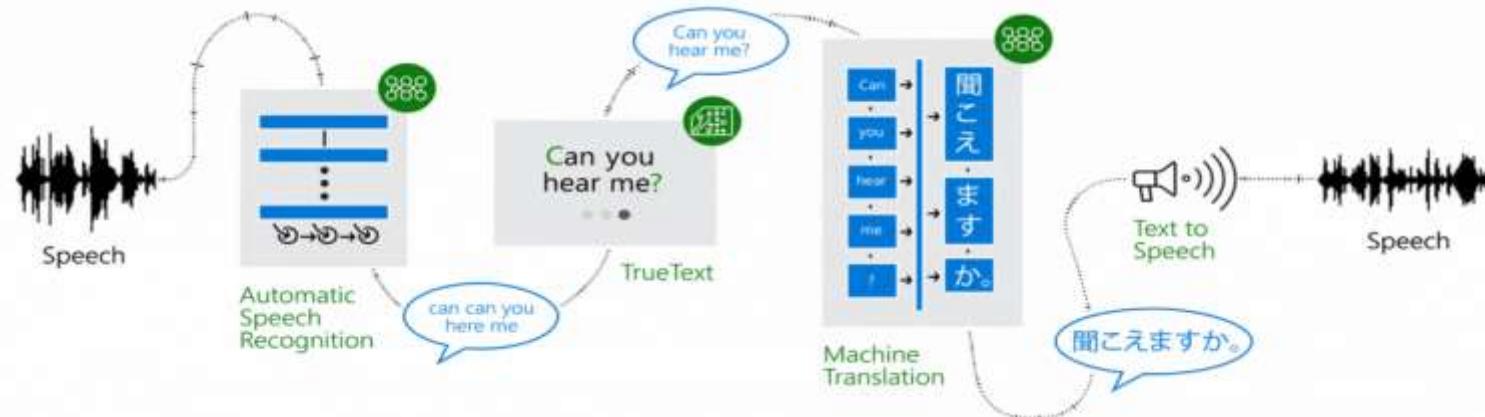
- submit up to 100 calls per minute, each with up to 1,000 documents of up to 5,000 characters each

Translation

Azure Cognitive Services

- Text Translator –
- translate dynamic content in your mobile, desktop and web apps
 - ✓ automatically detect languages
 - ✓ transliterate into different alphabets

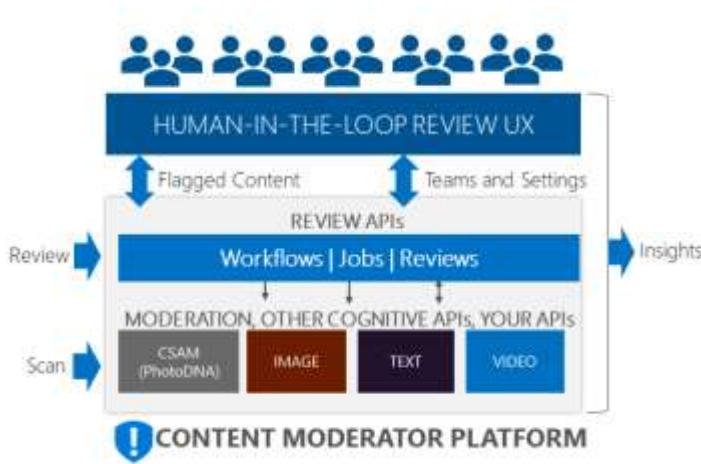
Speech Translator –
service assembly



60+ supported languages: <https://docs.microsoft.com/en-us/azure/cognitive-services/Translator/language-support>

Content Moderator

Azure Cognitive Services



Content Moderator helps businesses manage risks associated with user generated content (UGC) by using machine-assisted content moderation APIs and a human review tool.

Features include:

- ✓ Detection of potential adult, racy, and offensive, illegal, and unwanted image & video content
- ✓ Identification of possible profanity and undesirable text
- ✓ Built-in human review tool for improving the results
- ✓ Workflows that allow you to add other API's and extract more content insights

Customers using Content Moderator technologies include:

- ✓ Online marketplaces/e-Commerce sites for moderating catalogs and chatbots
- ✓ Social media/messaging/gaming platforms for moderating user content and digital assets
- ✓ Enterprises/K-12 solution providers moderating user content and information chatbots
- ✓ Global content moderation service providers using AI to augment human moderation teams

Resources:

- [Blog](#)
- [Case Study](#)
- [Documentation](#)
- [Samples](#)

Bing Search

Azure Cognitive Services



Accent Chairs You'll Love | Wayfair
USD 251.68



Abbyson Living BR-AC1059-BLU Sierra Tufted Velvet Wingback ...



Pair of Guillerme et Chambron Black Cerused Oak 'Edouard ...
USD 8600



Add Bing Search APIs to your apps and harness the ability to comb billions of webpages, images, videos, and news with a single API call

Focus search to your sources of choice, creating a compelling experience for your business-specific content

Use Case Patterns

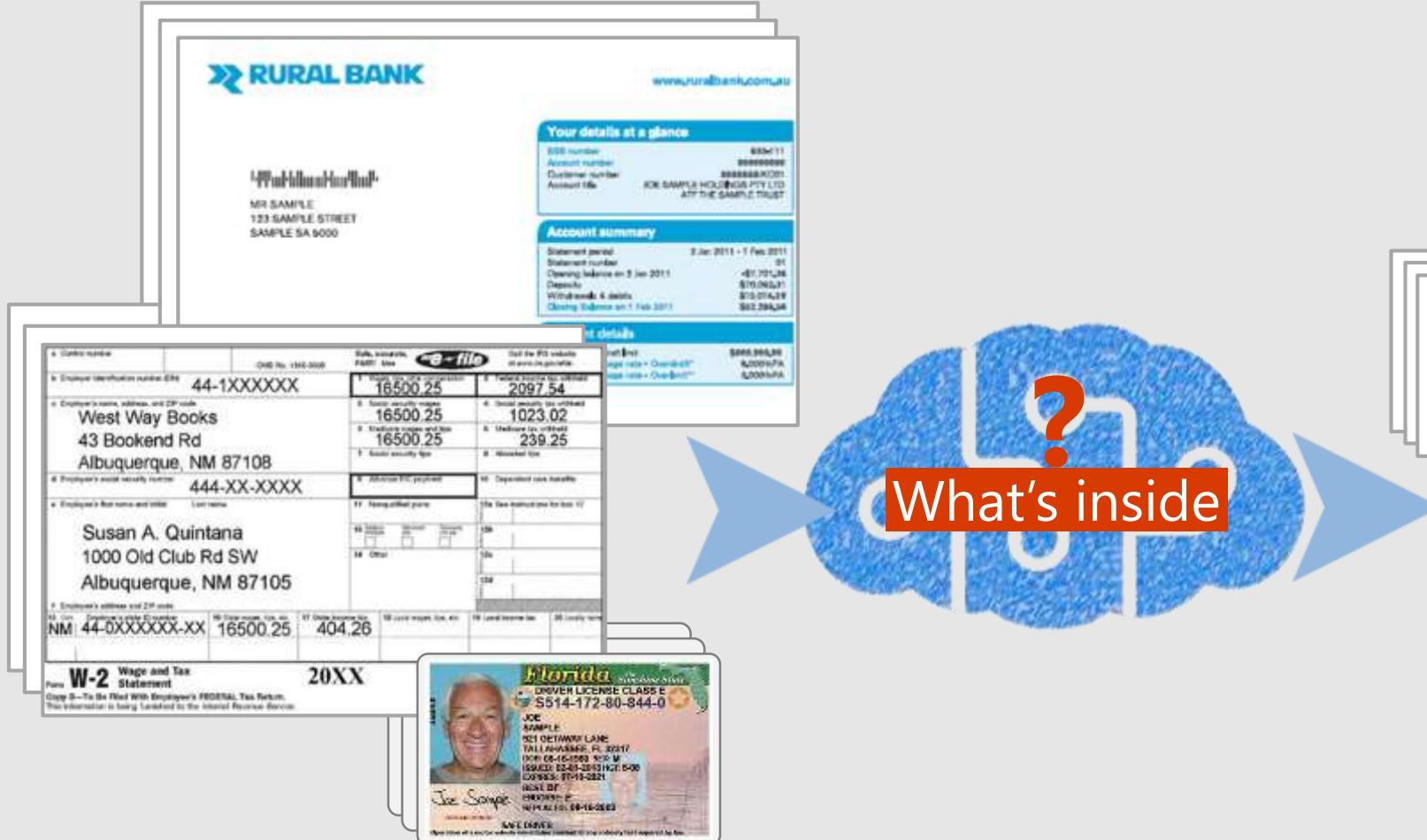
Azure Cognitive Services

- Ingest paper
- Identify customers and staff
- Customer care
- Customer understanding

Ingest paper

use case

multiple applications to customer acquisition and operations



Applications

- account creation, identification
 - credit analysis, risk analysis
 - order entry, invoice entry
 - ...
- ✓ savings on tedious data entry
✓ focus analyst attention

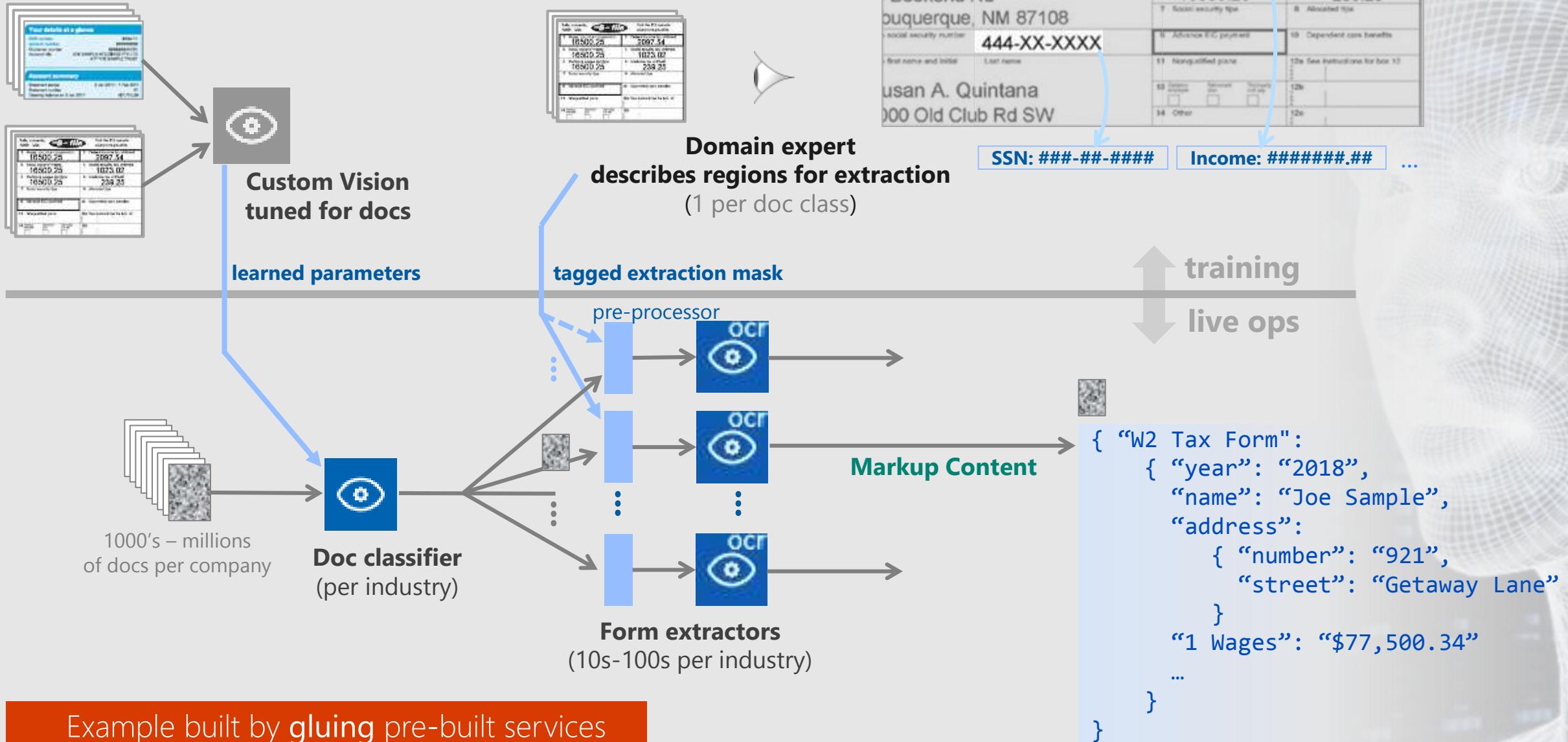
Searchable content

image + markup

```
{ "Bank Statement": [  
    { "bank": "Rural Bank",  
      "acc name": "Joe Sample",  
      "opening": {  
          "balance": "$7,701.18",  
          "date": "01/02/2011"  
      }  
      "deposits": "$70,062.31"  
      ...  
    }]  
}
```

Ingest paper

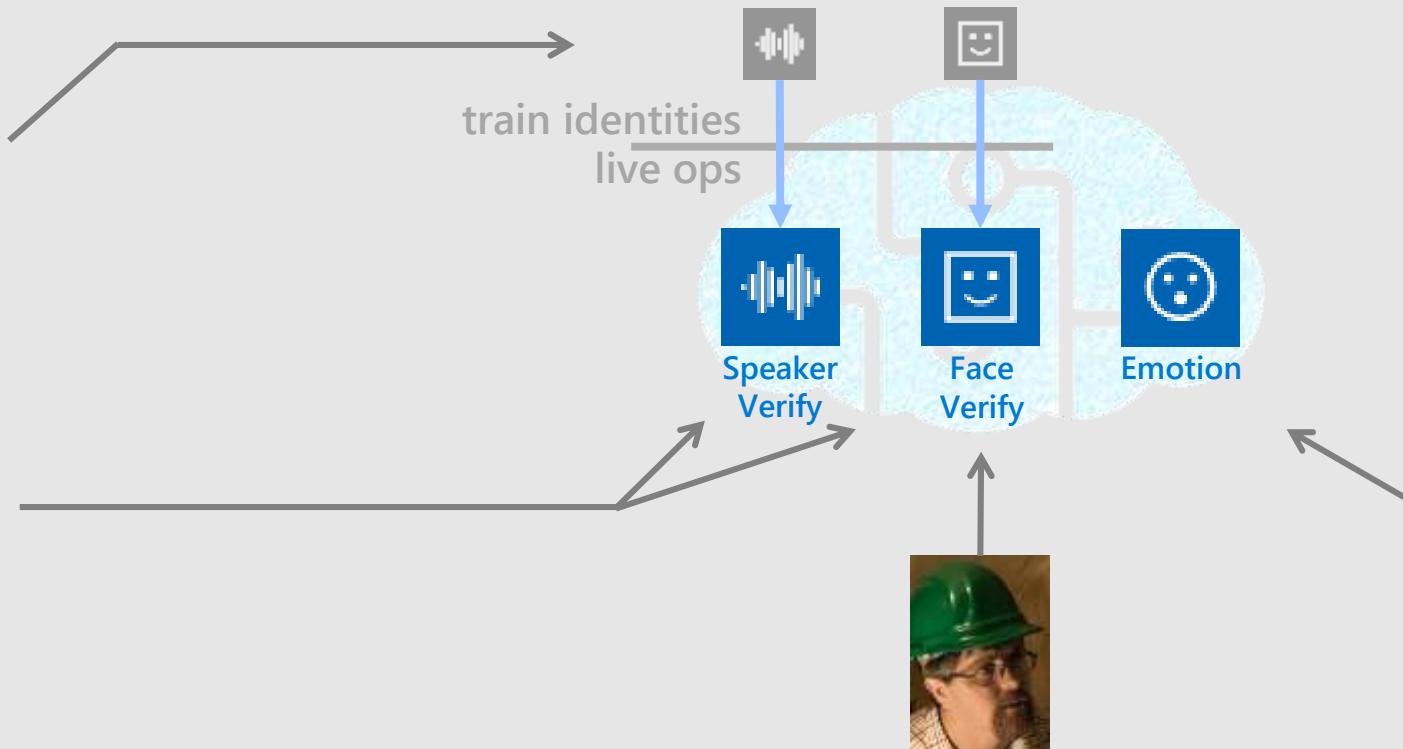
use case
example Solution Architecture



Identify customers and staff

unlock multifactor authentication

use case



Practical when:

- ✓ passwords cumbersome
- ✓ customer fingerprints not available
- ✓ staff using gloves, carrying tools etc.

Extra security:

- light-touch extra verification before sensitive operations

Applications

- customer identification
 - greeting, in-store support
 - satisfaction
 - ...
- ✓ light-touch identification
- ✓ on-the-spot instant survey



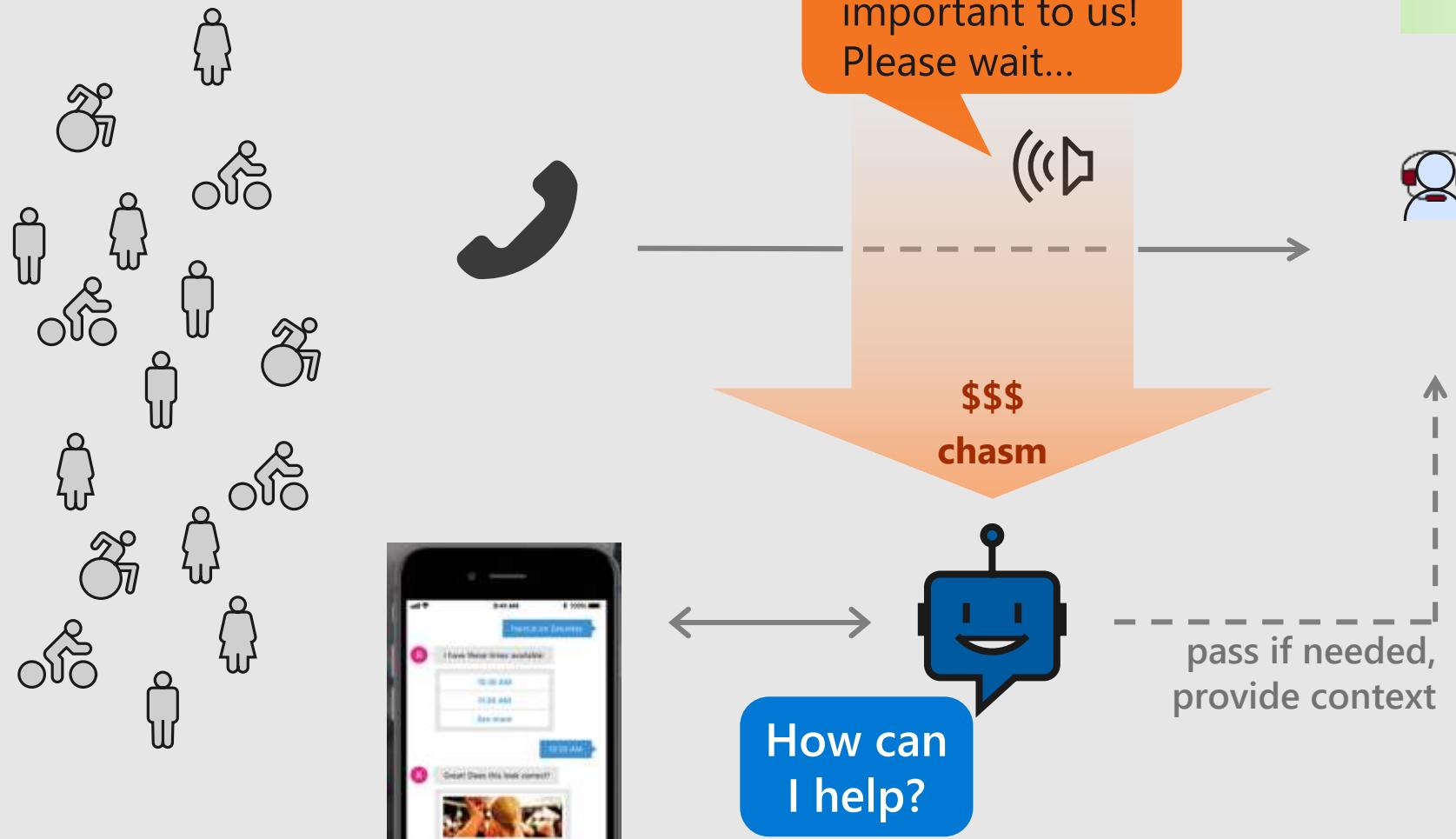
"happy": 0.999... "disgust": 0.6847,
"sadness": 0.2135,
"happy": 0.992... "anger": 0.0955...

Assess and react:

- emotion at point-of-help & checkout
- reinforce happiness with rewards, or instant direct to customer care

Customer care

use case
investment chasm is smaller than you think



Applications

- marketing & general information
 - sales & support
 - reach other languages
 - ...
- ✓ escalation of value-ad operations
- ✓ scale to larger markets

Customer care

start with:

QnA Maker no-code tool for domain practitioners

- Who are the target audience for the QnA Maker tool?
QnA Maker is primarily meant to provide a FAQ data source which can be used by a Bot/Application. Although developers will find this useful, content creators and domain practitioners will find this the most useful tool. QnA Maker is a completely no-code way of managing the knowledge base.

- How do I login to the QnA Maker Portal?
You can login with your Microsoft account.

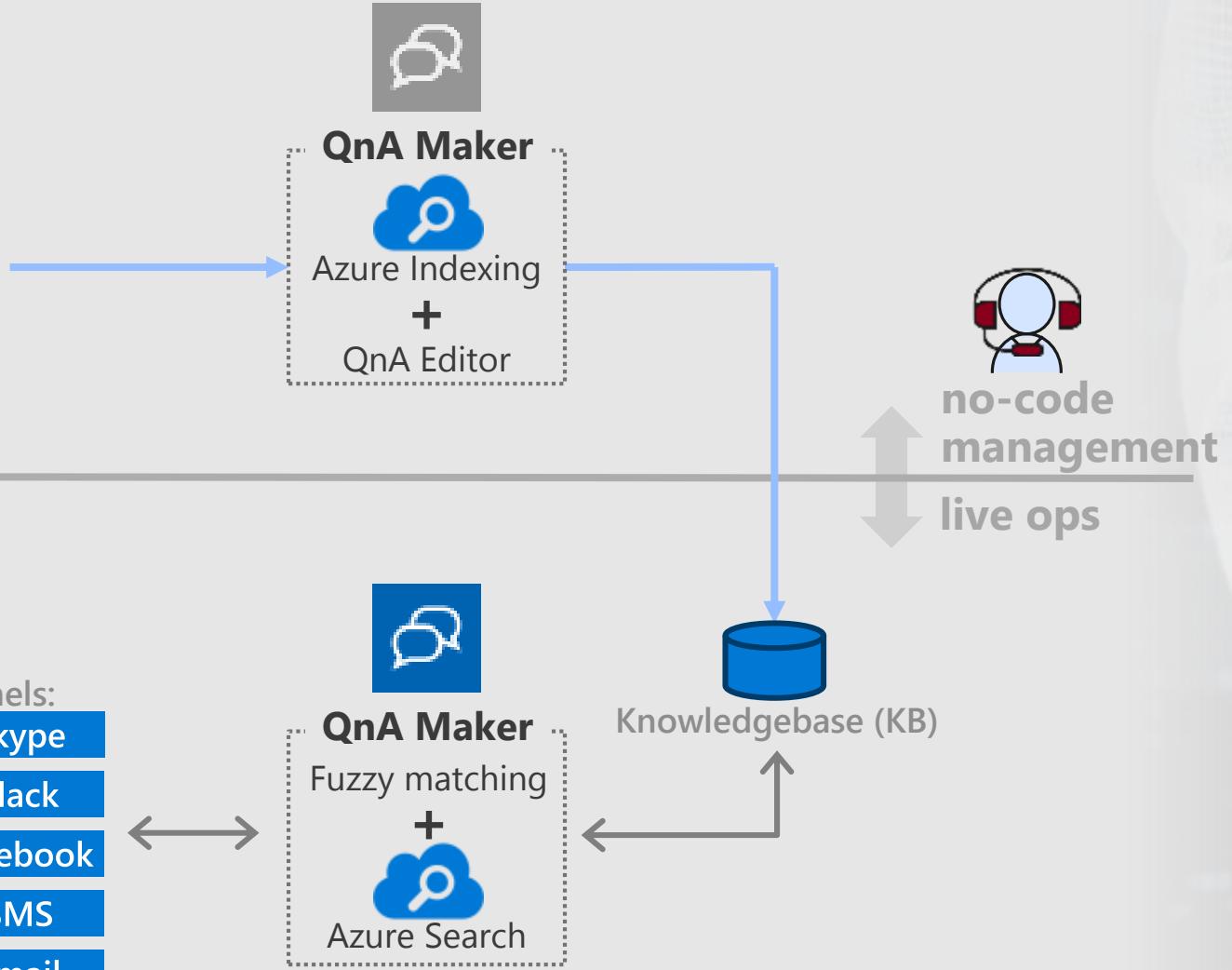
- Is the QnA Maker Service free?
Yes, currently the QnA Maker tool is free to use. However, we do charge for the use of the service via Azure Subscription Keys. See the Subscription Keys section of the documentation for details.

FAQs, user manuals



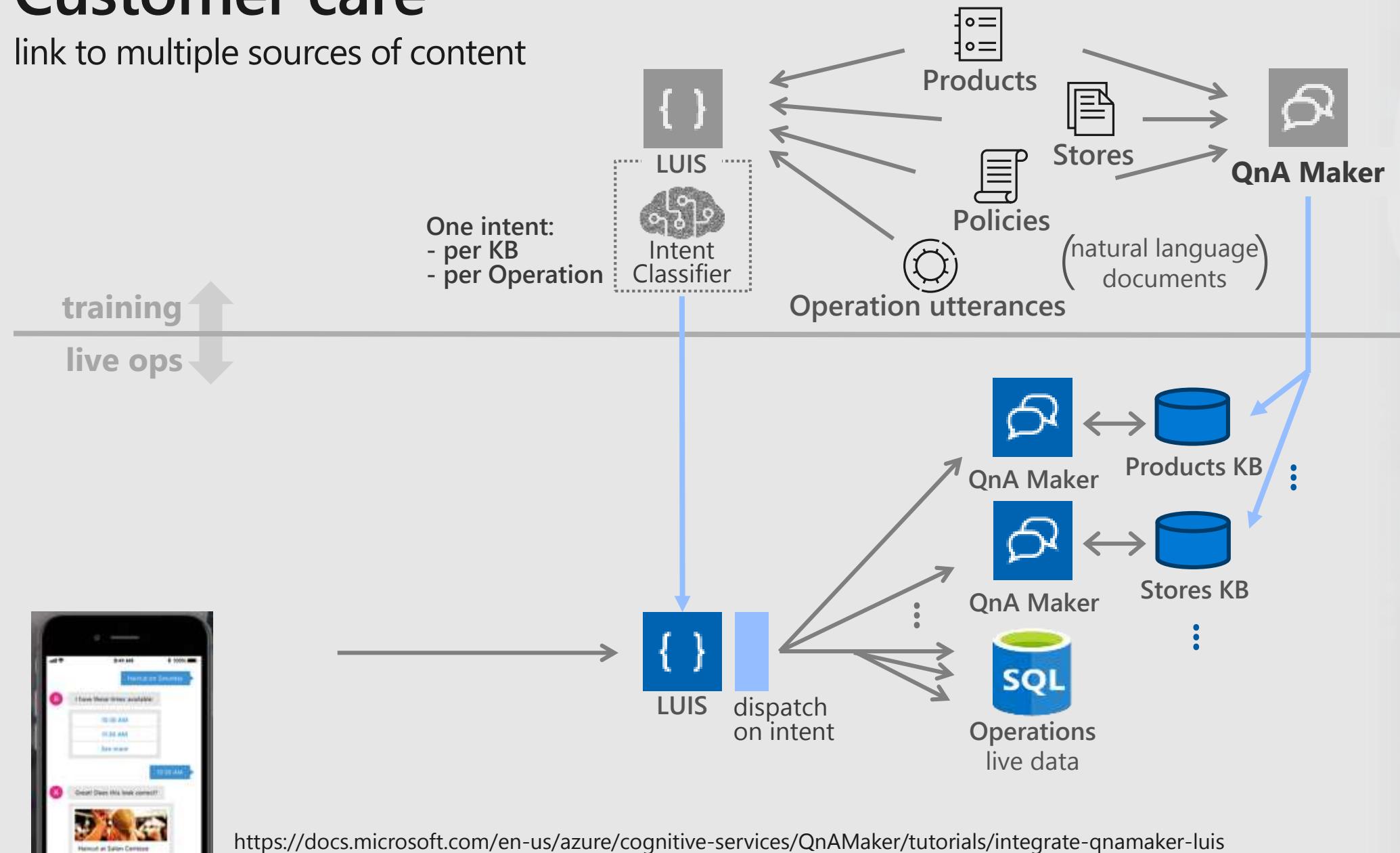
channels:

- Skype
- Slack
- Facebook
- SMS
- Email
- Web



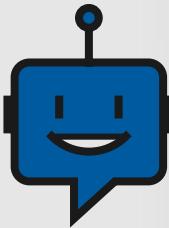
Customer care

link to multiple sources of content

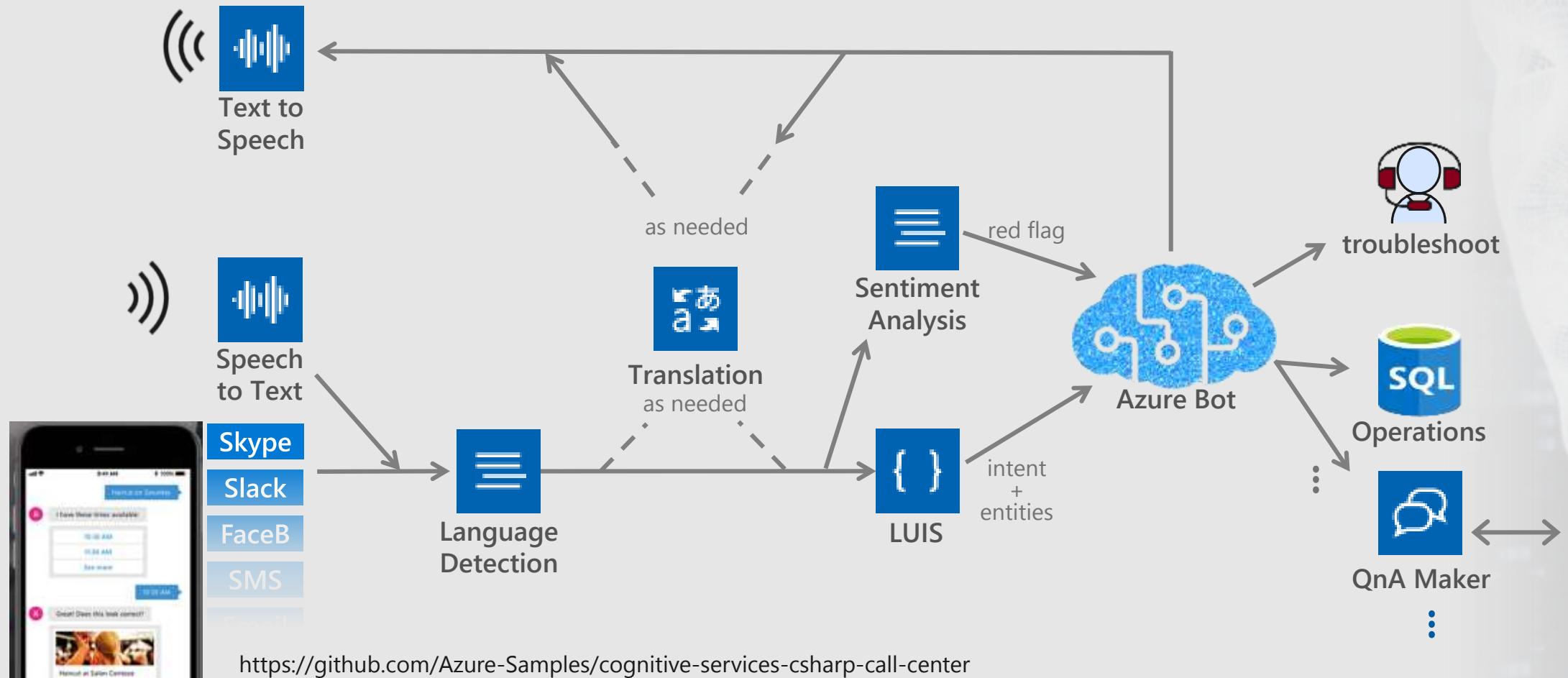


Customer care

Voice and Text, Multilingual, Multistep, Sentiment-Aware Dialogue



live ops

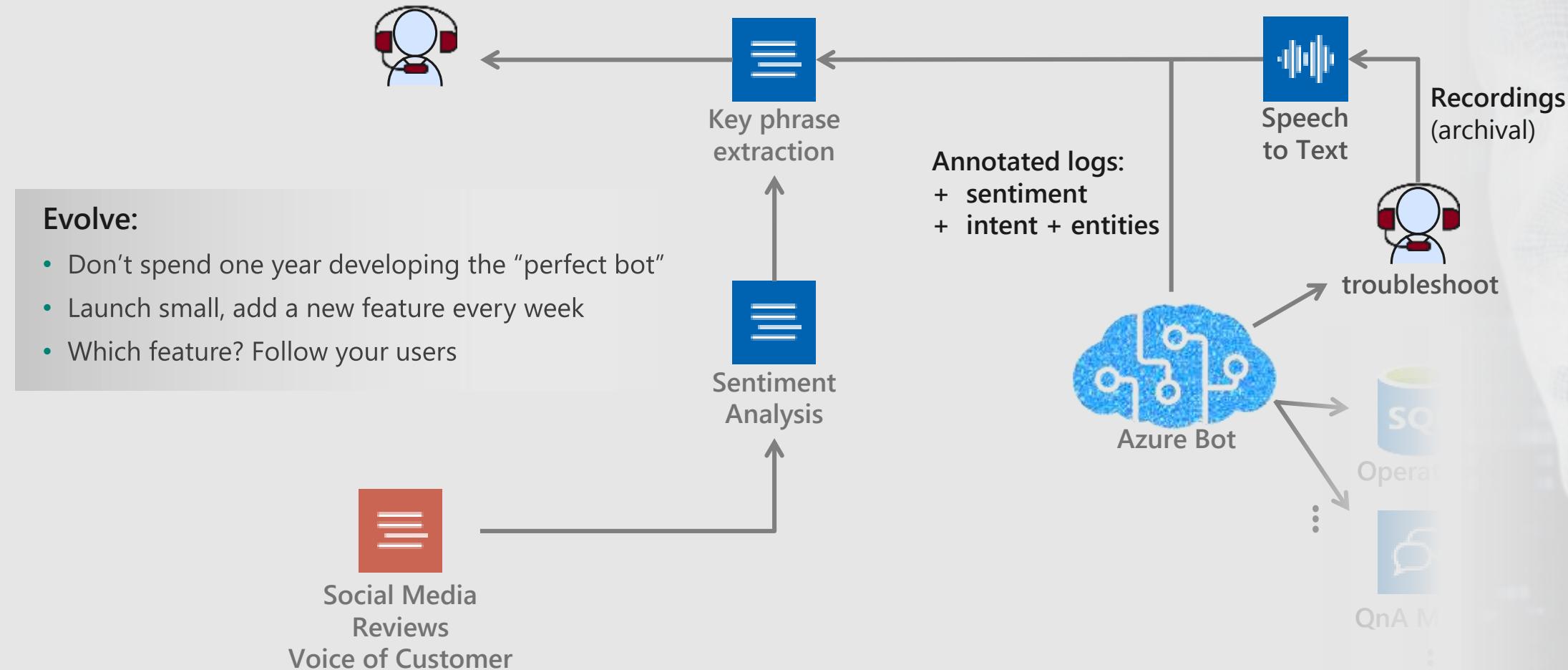


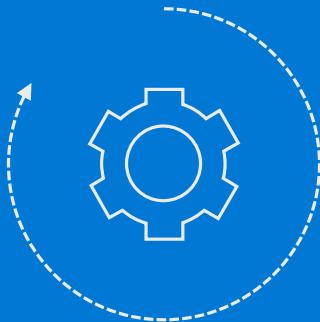
Customer Understanding

Closing the feedback loop

Applications

- evolve chat bot
 - evolve business processes
- ✓ stay fresh





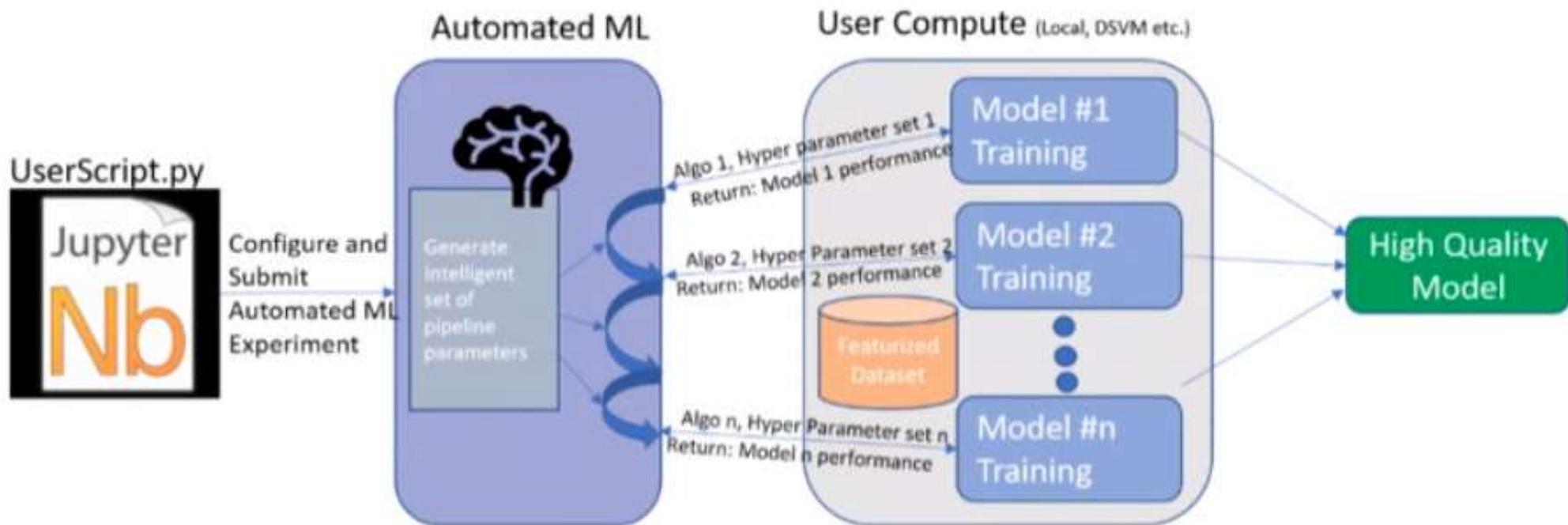
Automated Machine Learning

(in Machine Learning Services)

What is automated machine learning?

Automated machine learning (automated ML) picks an algorithm and hyperparameters for you and generates a model ready for deployment. The model can be downloaded to be further customized as well.

AutoML



Azure Automated ML

Current Capabilities

Category	Value
ML Problem Spaces	Classification Regression Forecasting
Frameworks	Scikit Learn
Languages	Python
Data Type and Data Formats	Numerical Text Scikit-learn supported data formats (Numpy, Pandas)
Data sources	Local Files, Azure Blob Storage
Compute Target	Automated Hyperparameter Tuning Azure ML Compute (Batch AI), Azure Databricks
	Automated Model Selection Local Compute, Azure ML Compute (Batch AI), Azure Databricks

Web UI [Azure portal - Preview]

Create automated ML experiments from UI only ("no code")

- Get started with ML quickly
- Powered by the automated ML SDK – easily customize advanced settings
- Automate the end-to-end ML workflow from the UI
- Easily explore and monitor all your experiments from a single place

Roadmap

Private Preview - 2/11

- Getting started experience
- Start an automated ml training job on your data (upload/Blob)
- Explore data
- View progress and results for training job and each iteration
- View automated ML dashboard for an overview

May 2019 – General Availability

- Apply data transformations
- Support additional 1p & 3p data source
- Continue experiment in Jupyter Notebook

Public Preview - April 2019

- Set advanced settings for the training job
- Forecasting support
- Automatically deploy a model
- Advanced data exploration (visualizations, correlations, etc.)
- View model Explainability
- Support additional 1p data sources (e.g. Azure SQL, ADLS, ...)

Automated Machine Learning Workspace

Machine Learning service workspace

Search (Ctrl+ /)

Create a new automated machine learning experiment

* Experiment name

myfirstautomlexperiment



* Training compute ⓘ

amlcompute-4a57de20b3f1

[Create new](#)[Cancel](#)[Next](#)

Automated Machine Learning Workspace

Machine Learning service workspace

-  Overview
-  Activity log
-  Access control (IAM)

-  Tags
-  Diagnose and solve problems

Settings

-  Locks
-  Automation script

Properties

Application

-  Automated machine learning
-  Experiments
-  Pipelines
-  Compute
-  Models
-  Images
-  Deployments
-  Activities

Support + troubleshooting

-  Usage + quotas
-  New support request

Create a new automated machine learning experiment

* Experiment name



* Training compute ⓘ

[Create new](#)

Select a file from Azure blob storage account

* Storage account

* Container

Location: [azureml / ExperimentRun / AutoML_1789d859-9036-47aa-8128-8905ec59c9e7_0](#)

NAME	MODIFIED	BLOB TYPE	SIZE
[..]	-	-	-
Training data.csv	11/21/2018, 11:34:36 AM	Block blob	2.88 KiB

[Data Preview](#)[Data Profile](#)

(Showing first 10 rows)

 Use first row as header Include in training Include in training

DATE

APPLIANCES

LIGHTS

T1

RH 1

T2

RH 2

T3

Automated Machine Learning Workspace

Machine Learning service workspace

 Search (Ctrl+ /)**Data Preview****Data Profile**

(Showing first 10 rows)

 Use first row as headers Include in training Include in training

DATE	# APPLIANCES	# LIGHTS	# T1	# RH_1	# T2	# RH_2	# T3
2016-01-11 17:00:00	60	30	19.89	47.59666666666666	19.19999999999999	44.78999999999999	19.78999999999999
2016-01-11 17:00:00	60	30	19.89	46.69333333333333	19.19999999999999	44.72249999999999	19.78999999999999
2016-01-11 17:00:00	50	30	19.89	46.29999999999999	19.19999999999999	44.62666666666666	19.78999999999999
2016-01-11 17:00:00	50	40	19.89	46.06666666666666	19.19999999999999	44.59	19.78999999999999
2016-01-11 17:00:00	60	40	19.89	46.33333333333333	19.19999999999999	44.53	19.78999999999999
2016-01-11 17:00:00	60	30	19.89	47.59666666666666	19.19999999999999	44.78999999999999	19.78999999999999
2016-01-11 17:00:00	60	30	19.89	46.69333333333333	19.19999999999999	44.72249999999999	19.78999999999999
2016-01-11 17:00:00	50	30	19.89	46.29999999999999	19.19999999999999	44.62666666666666	19.78999999999999
2016-01-11 17:00:00	50	40	19.89	46.06666666666666	19.19999999999999	44.59	19.78999999999999
2016-01-11 17:00:00	60	40	19.89	46.33333333333333	19.19999999999999	44.53	19.78999999999999

Training job settings:

* Training job type ⓘ

* Target column ⓘ

* Primary metric ⓘ

Number of iterations:

Automated Machine Learning Workspace

Machine Learning service workspace

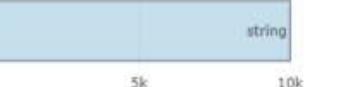
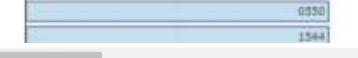
 Search (Ctrl+ /)

Data Preview

Data Profile

feature name:

 Condensed view

Feature	Profile	Type Distribution	Type	Min	Max	Count	Not M
ID			Decimal	21787	10147979	10000	
Case Number	No graph data		String	HA301809	HY901925	10000	
Date	No graph data		String	03/17/2015 01:00:00 PM	07/05/2015 12:50:00 PM	10000	
Block	No graph data		String	0000X E 100TH PL	136XX S INDIANA AVE	10000	
			String				

Training job settings:

* Training job type ⓘ

 Classification

* Target column ⓘ

 Freight cost

* Primary metric ⓘ

 Accuracy

Number of iterations:

 100

Home > Automated_Machine_Learning_WS

Automated Machine Learning Workspace

Machine Learning service workspace

Search (Ctrl+ /) <

- Overview
- Activity log
- Access control (IAM)
- Tags
- Diagnose and solve problems

Settings

- Locks
- Automation script
- Properties

Application

- Automated machine learning
- Experiments
- Pipelines
- Compute
- Models
- Images
- Deployments
- Activities

Support + troubleshooting

- Usage + quotas
- New support request

No graph data

Case Number	Date	Block
string	String	String
0 5k 10k	0 5k 10k	0 5k 10k
HA301809	03/17/2015 01:00:00 PM	0000X E 100TH PL
HY901925	07/05/2015 12:50:00 PM	136XX S INDIANA AVE
10000	10000	10000

No graph data

No graph data

No graph data

Training job settings:

* Training job type ⓘ Classification

* Target column ⓘ Freight cost

* Primary metric ⓘ Accuracy

Number of iterations: 100

Cancel Start

Automated Machine Learning Workspace

Machine Learning service workspace

Search (Ctrl+ /)

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

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Locks

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Properties

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Automated machine learning

Experiments

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Activities

Support + troubleshooting

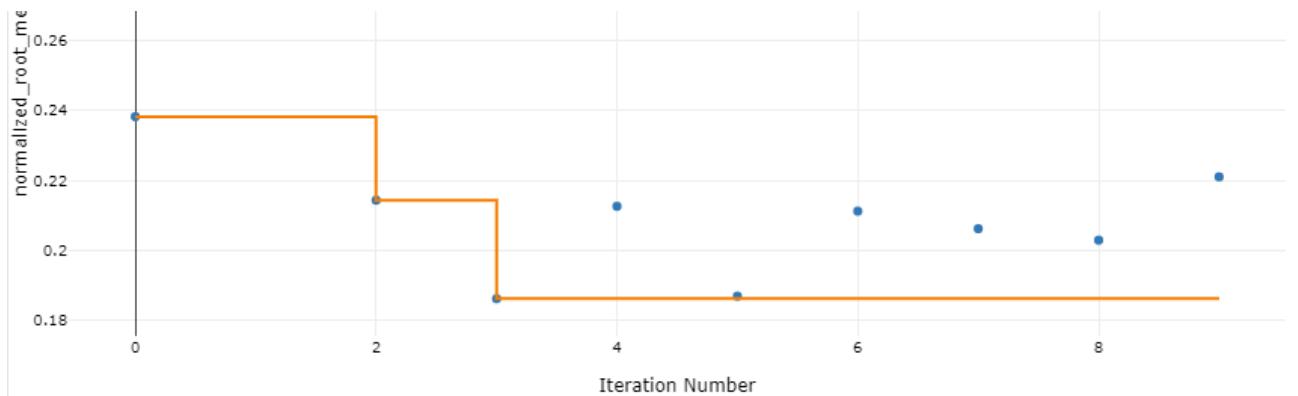
Usage + quotas

New support request

New support request

Myfirstautomlexperiment | Run #XXX

Back Refresh



ITERATIONS

Search to filter items...

Iteration	Run Preprocessor	Run Algorithm	normalized_root_mean_squared_error ↑	Status	Created	Duration	Model
9		Ensemble	0.19099667318...	Completed	11/28/2018, 12:59:45 P...	00:00:39	Download
3	RobustScaler	ExtremeRandomTrees	0.19513896354...	Completed	11/28/2018, 12:57:31 P...	00:00:17	Download
4	StandardScalerWrap...	ExtremeRandomTrees	0.19690530822...	Completed	11/28/2018, 12:57:57 P...	00:00:19	Download
2	MaxAbsScaler	LightGBM	0.21437660385...	Completed	11/28/2018, 12:57:14 P...	00:00:13	Download
7	StandardScalerWrap...	RandomForest	0.21440081245...	Completed	11/28/2018, 12:59:12 P...	00:00:13	Download
8	StandardScalerWrap...	RandomForest	0.21459043019...	Completed	11/28/2018, 12:59:31 P...	00:00:10	Download
5	MaxAbsScaler	RandomForest	0.21490561849...	Completed	11/28/2018, 12:58:21 P...	00:00:11	Download
0	StandardScalerWrap...	DecisionTree	0.24119126692...	Completed	11/28/2018, 12:56:41 P...	00:00:10	Download
6	RobustScaler	KNN	0.26113259680...	Completed	11/28/2018, 12:58:37 P...	00:00:15	Download
1	StandardScalerWrap...	ElasticNet	0.34577860514...	Completed	11/28/2018, 12:56:57 P...	00:00:11	Download

Created

Nov 21, 2018 11:43:31 AM

Completed

--

Last refresh time

Nov 21, 2018 11:51:26 AM

Status

Completed

RUN SETTINGS

Training compute my-automl-compute

Training job type Classification

Target column Freight cost

Primary Metric Accuracy

Max iterations 100



Automated Machine Learning Workspace

Machine Learning service workspace

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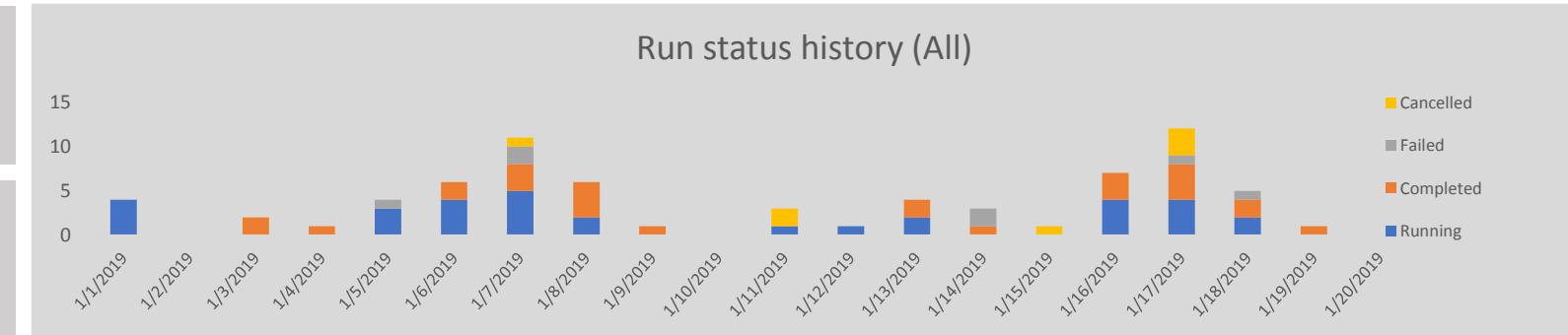
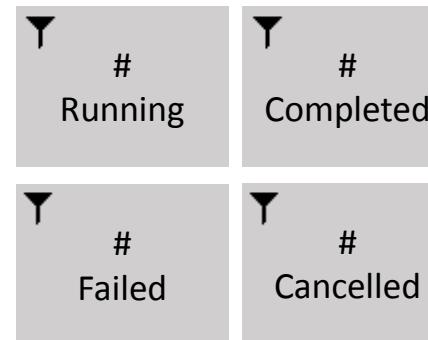
New support request

Automated machine learning dashboard

Back Refresh Start a new run

All dates

All experiments



Run Id	Experiment	Status	Created ↓	Start Time (UTC)	End Time (UTC)
AutoML_f8cd6760-cd15-45ed-9fb7-1ab0c393d381	automl-energydemandforecasting	Completed	1/16/2019, 2:02:41 PM	1/16/2019, 2:02:49 PM	1/16/2019, 2:05:25 PM
AutoML_90035379-3598-43e4-bdbe-25ef58b9f68d	automl-energydemandforecasting	Completed	1/16/2019, 1:47:52 PM	1/16/2019, 1:48:04 PM	1/16/2019, 1:56:10 PM
AutoML_485cf88e-ab69-4767-99ea-617cd1c32816	test6	Preparing	1/16/2019, 1:46:28 PM		
AutoML_aebec027-bb42-4ddc-bb92-b0592e9c6d54	automl-local-classification	Completed	1/16/2019, 9:58:59 AM	1/16/2019, 9:59:01 AM	1/16/2019, 10:02:03 AM
AutoML_1ea5ee12-66a4-4d02-811f-a402f34baf65	automl-energydemandforecasting	NotStarted	1/15/2019, 4:37:06 PM		
AutoML_d49089a2-82c5-4b41-a2b1-27f7fd36c029	energy1	Failed	1/15/2019, 4:28:44 PM	1/15/2019, 4:47:12 PM	1/15/2019, 5:04:25 PM
AutoML_d4d41524a-0637-412f-aba6-82a3ef500c17	ccc	Failed	1/11/2019, 9:06:33 PM		1/11/2019, 9:21:37 PM
AutoML_d0c051c0-242e-43f4-a695-bd03bfaf2054	bbb	Failed	1/11/2019, 8:37:03 PM		1/11/2019, 8:49:48 PM
AutoML_40bbe4cd-942b-427f-9de4-3abb5be6f2ce	aaa	Failed	1/10/2019, 2:22:09 PM		1/10/2019, 2:45:08 PM

|◀ ▶| 1 2 3 ▶|

1 - 15 of 43

Model deployment options

A side-by-side comparison of capabilities and features

	Azure Machine Learning	Azure Databricks	SQL Server or SQL Database
Scoring interface provided	Web service	Notebook or Job	T-SQL stored procedure
Deployment environments	SQL Server, Hadoop AKS, ACI IoT, IoT edge Spark and Batch AI	Azure Databricks cluster, model export AKS, ACI edge via AML IoT, IoT edge via AML	SQL Server 2017 database instance on-premises or in Azure VM
Scalability of scoring interface	Scales by deploying more instances in Azure Container Services	Can scale across cluster resources	Limited to capacity of single server
Scoring requirements	Create a Docker image that contains scoring service, model, and dependencies	Load the trained model from storage and apply to scoring in notebook in Python, Scala, R, or SQL.	Need to author Python or R code within a T-SQL stored procedure that loads the trained model from a table where it is stored and applies it in scoring.
Model packaging	Docker image	Serialized to storage	Serialized to table

Machine learning and AI portfolio

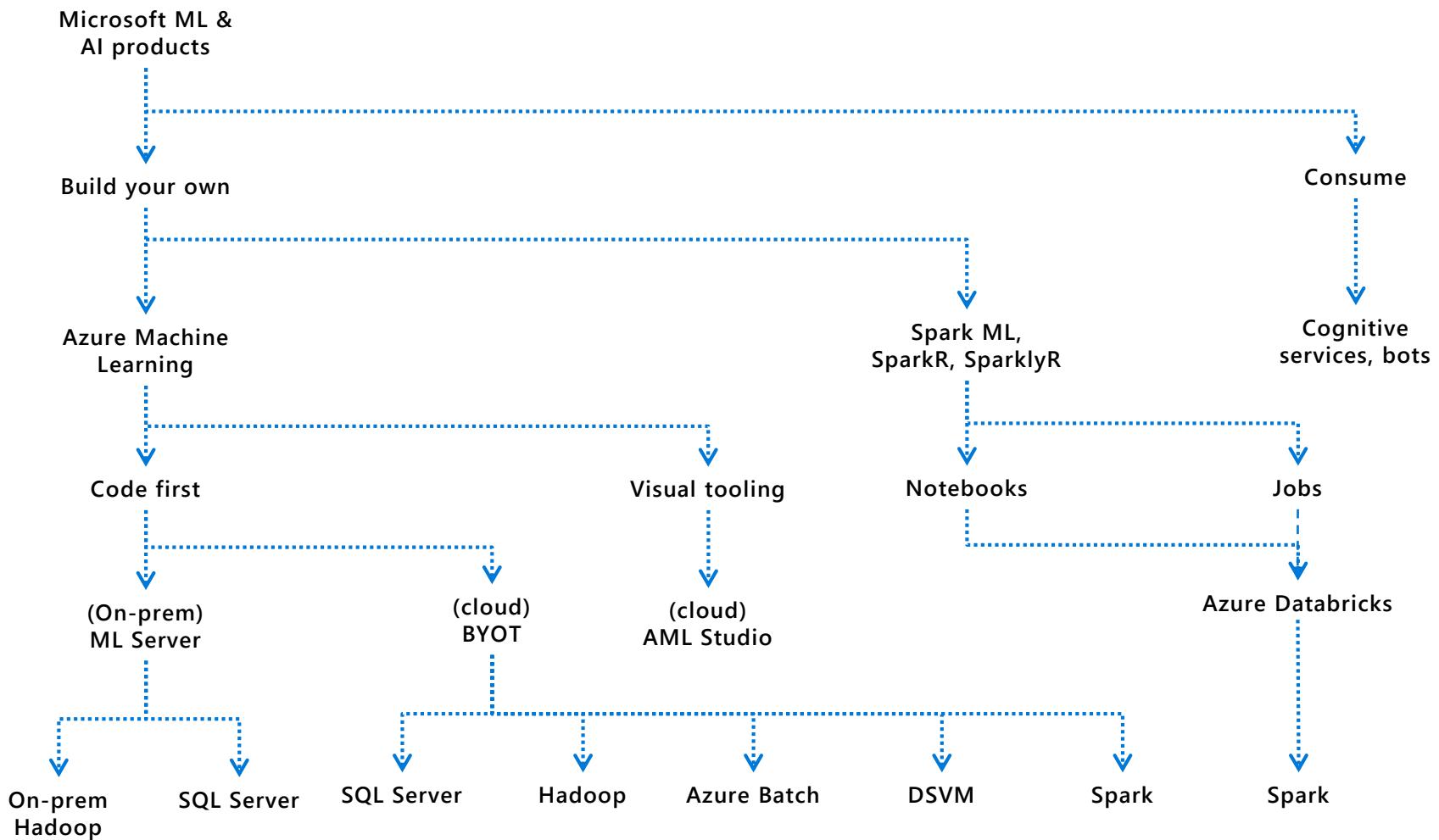
When to use what

Build your own or consume pre-trained models?

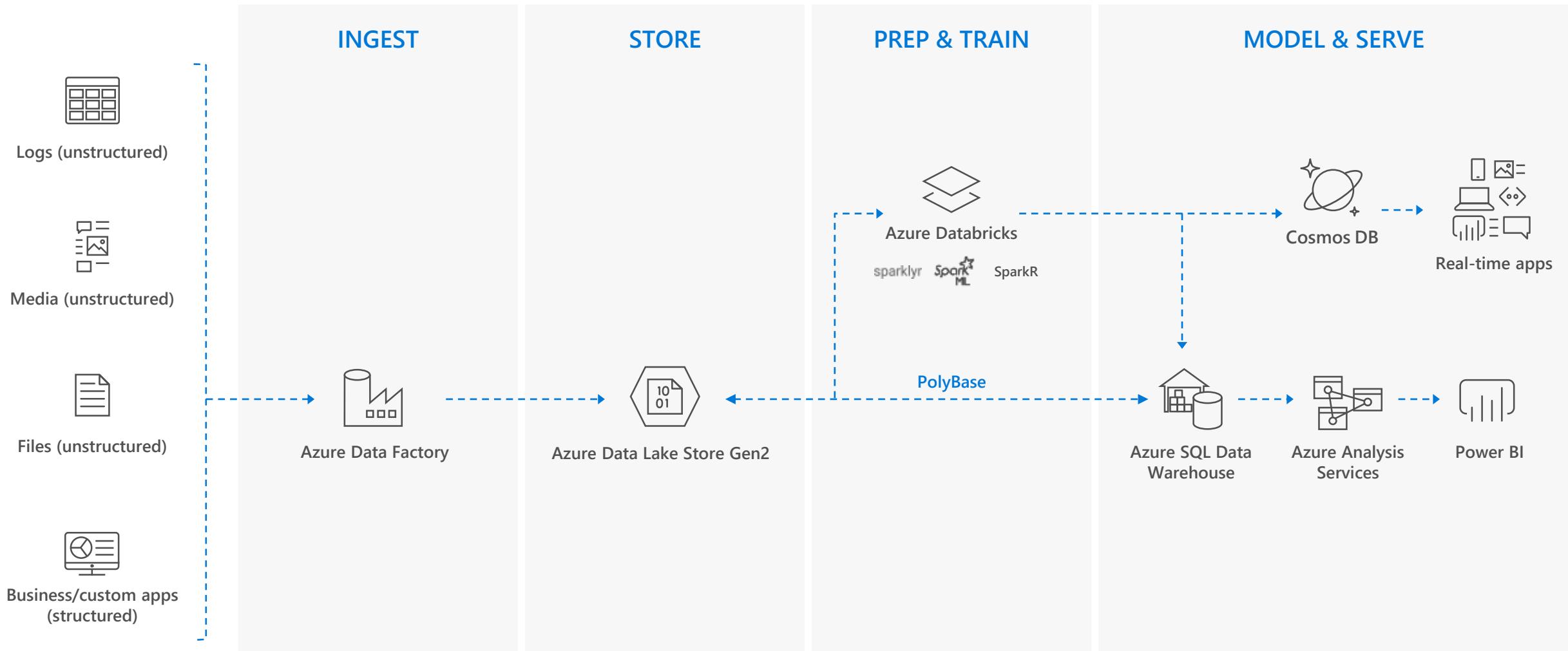
Which experience do you want?

Deployment target

What engines do you want to use?



ADVANCED ANALYTICS ON BIG DATA



Microsoft Azure also supports other Big Data services like Azure HDInsight, Azure Machine Learning to allow customers to tailor the above architecture to meet their unique needs.

Resources

- Ivan Kosyakov:
- [Artificial Intelligence Decision Tree](#)
- [Big Data Decision Tree v4](#)
- [Business Intelligence Solutions Decision Tree](#)

Q & A



James Serra, Big Data Evangelist

Email me at: jamesserra3@gmail.com

Follow me at: [@JamesSerra](https://twitter.com/JamesSerra)

Link to me at: www.linkedin.com/in/JamesSerra

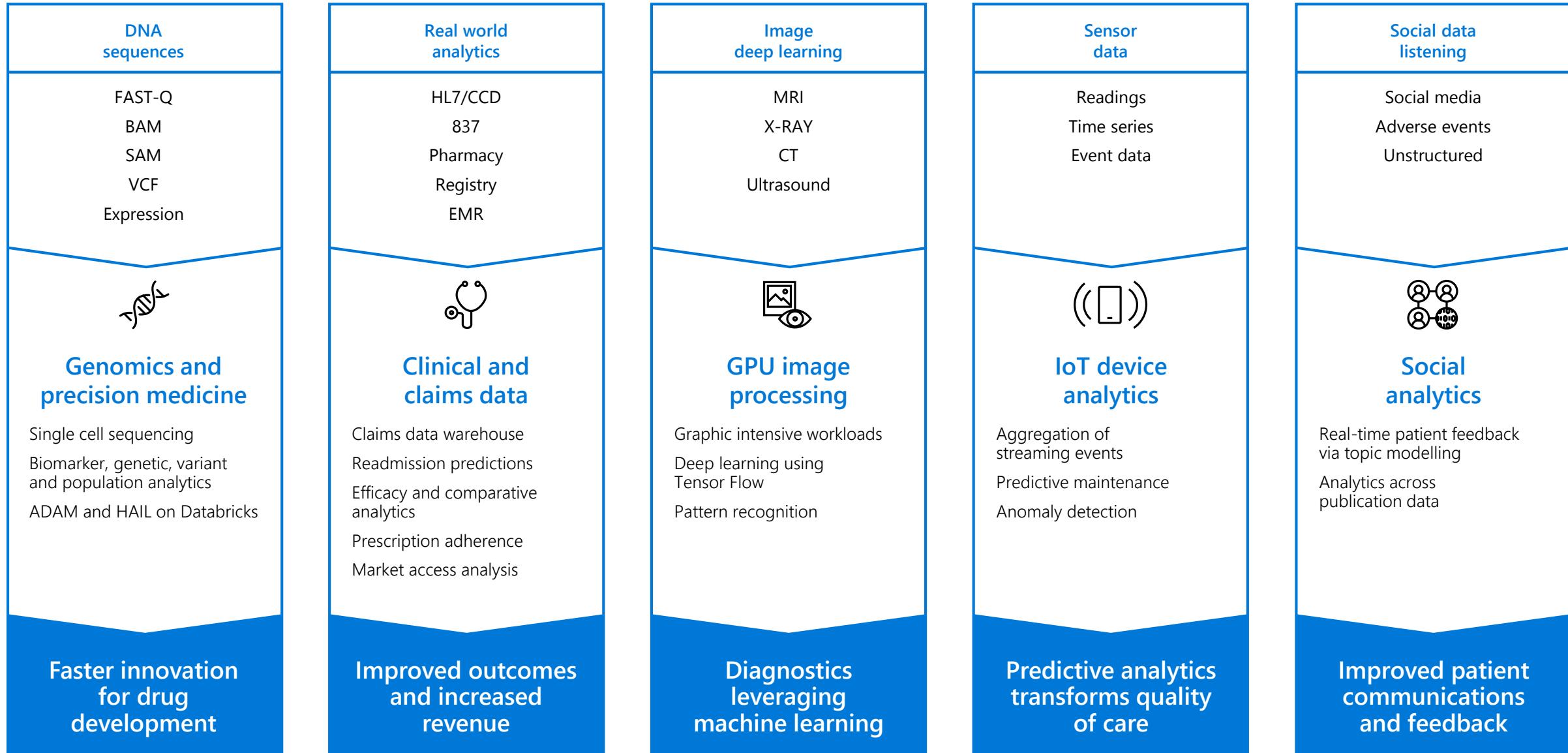
Visit my blog at: JamesSerra.com (where this slide deck is posted via the "Presentations" link on the top menu)

Data Science is for every industry

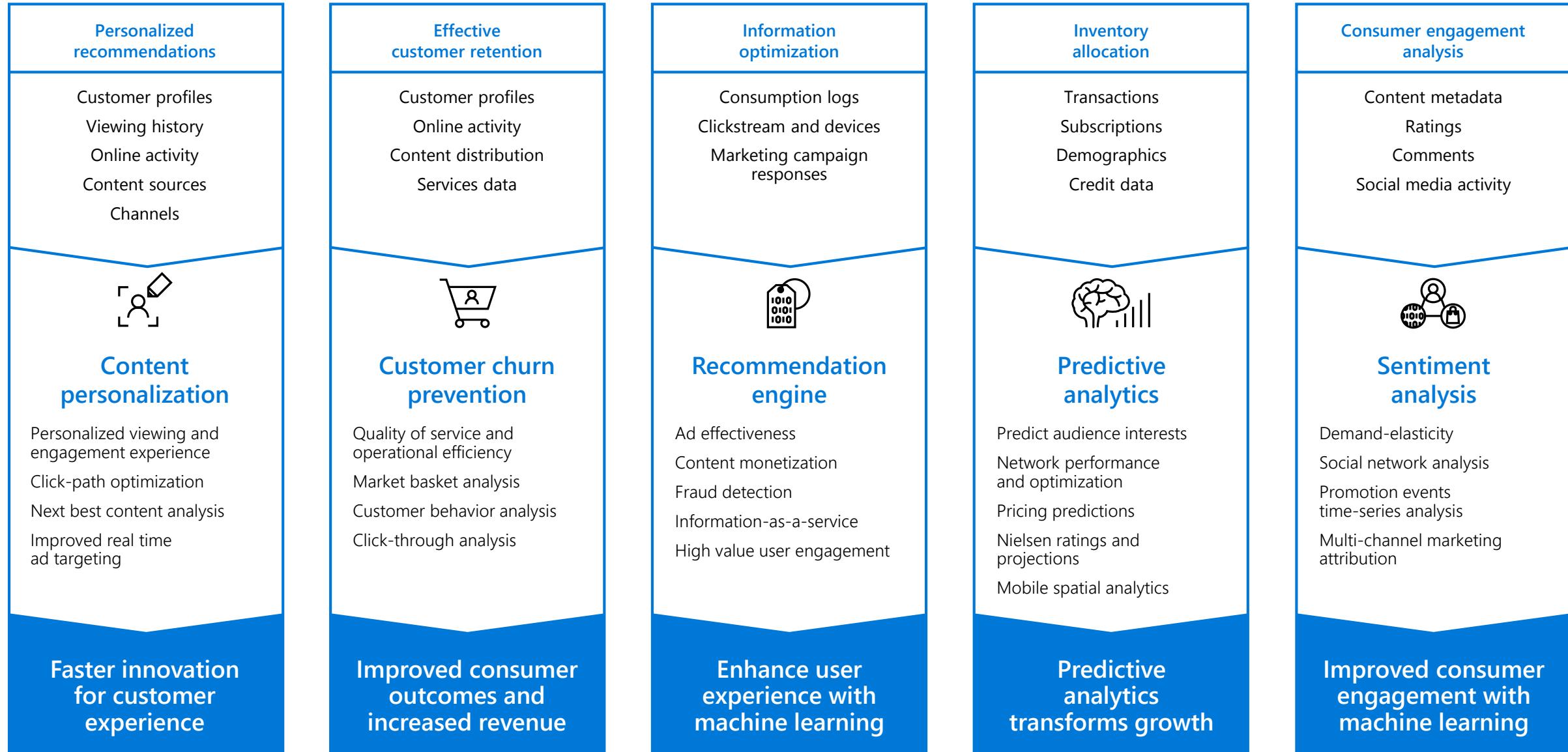
Financial services use cases

Effective customer engagement	Decision services management	Risk and revenue management	Risk and compliance management	Recommendation engine
<p>Customer profiles Credit history Transactional data LTV Loyalty</p> 	<p>Customer segmentation CRM data Credit data Market data</p> 	<p>Transaction data Demographics Purchasing history Trends</p> 	<p>CRM Credit Risk Merchant records Products and services</p> 	<p>Clickstream data Products Services Customer service data</p> 
<p>Customer analytics</p> <p>Customer 360 degree evaluation Customer segmentation Reduced customer churn Underwriting, servicing and delinquency handling Insights for new products</p>	<p>Financial modeling</p> <p>Commercial/retail banking, securities, trading and investment models Decision science, simulations and forecasting Investment recommendations</p>	<p>Risk, fraud, threat detection</p> <p>Real-time anomaly detection Card monitoring and fraud detection Security threat identification Risk aggregation</p>	<p>Credit analytics</p> <p>Enterprise DataHub Regulatory and compliance analysis Credit risk management Automated credit analytics</p>	<p>Marketing analytics</p> <p>Recommendation engine Predictive analytics and targeted advertising Fast marketing and multi-channel engagement Customer sentiment analysis</p>
<p>Faster innovation for a better customer experience</p>	<p>Improved consumer outcomes and increased revenue</p>	<p>Enhanced customer experience with machine learning</p>	<p>Transform growth with predictive analytics</p>	<p>Improved customer engagement with machine learning</p>

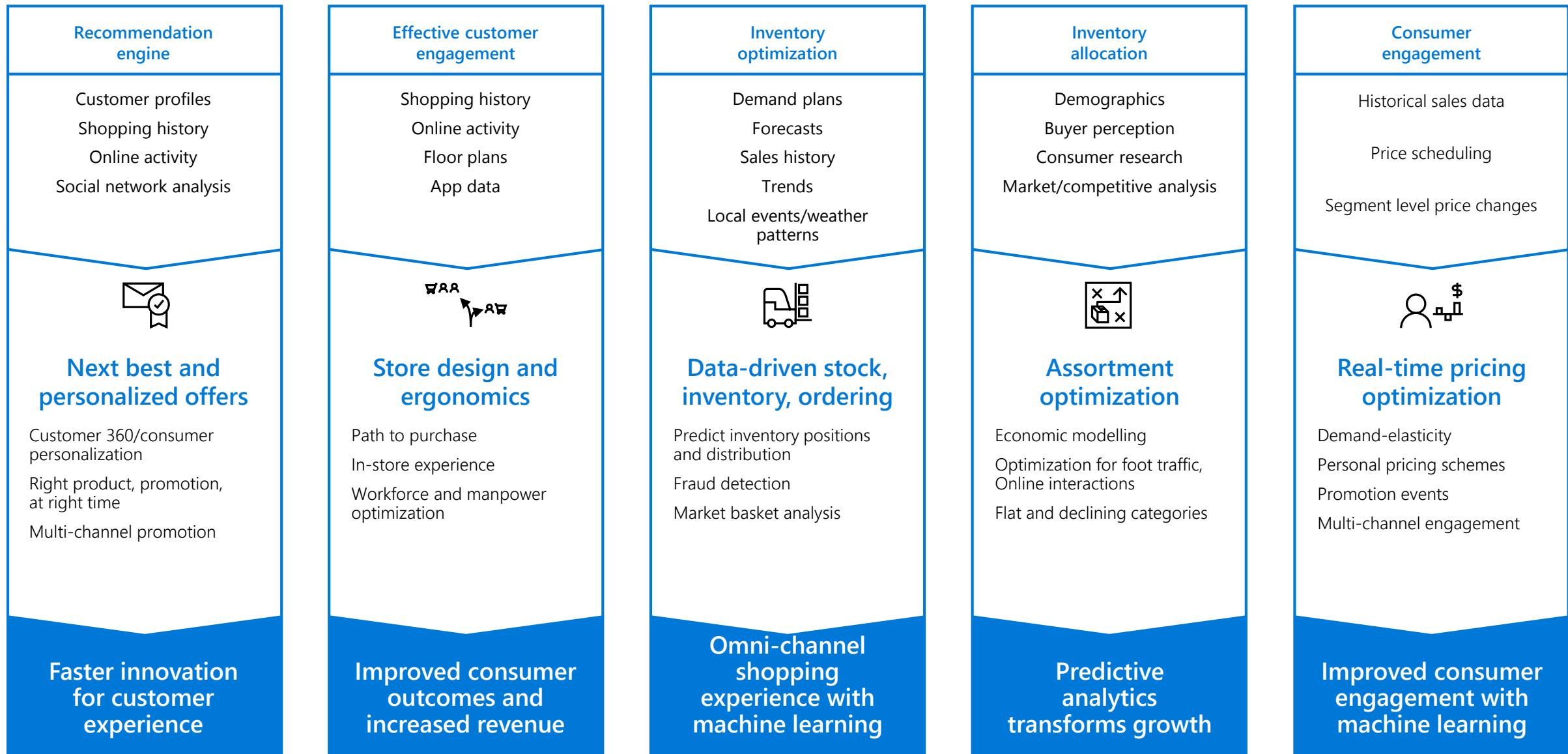
Health and life sciences use cases



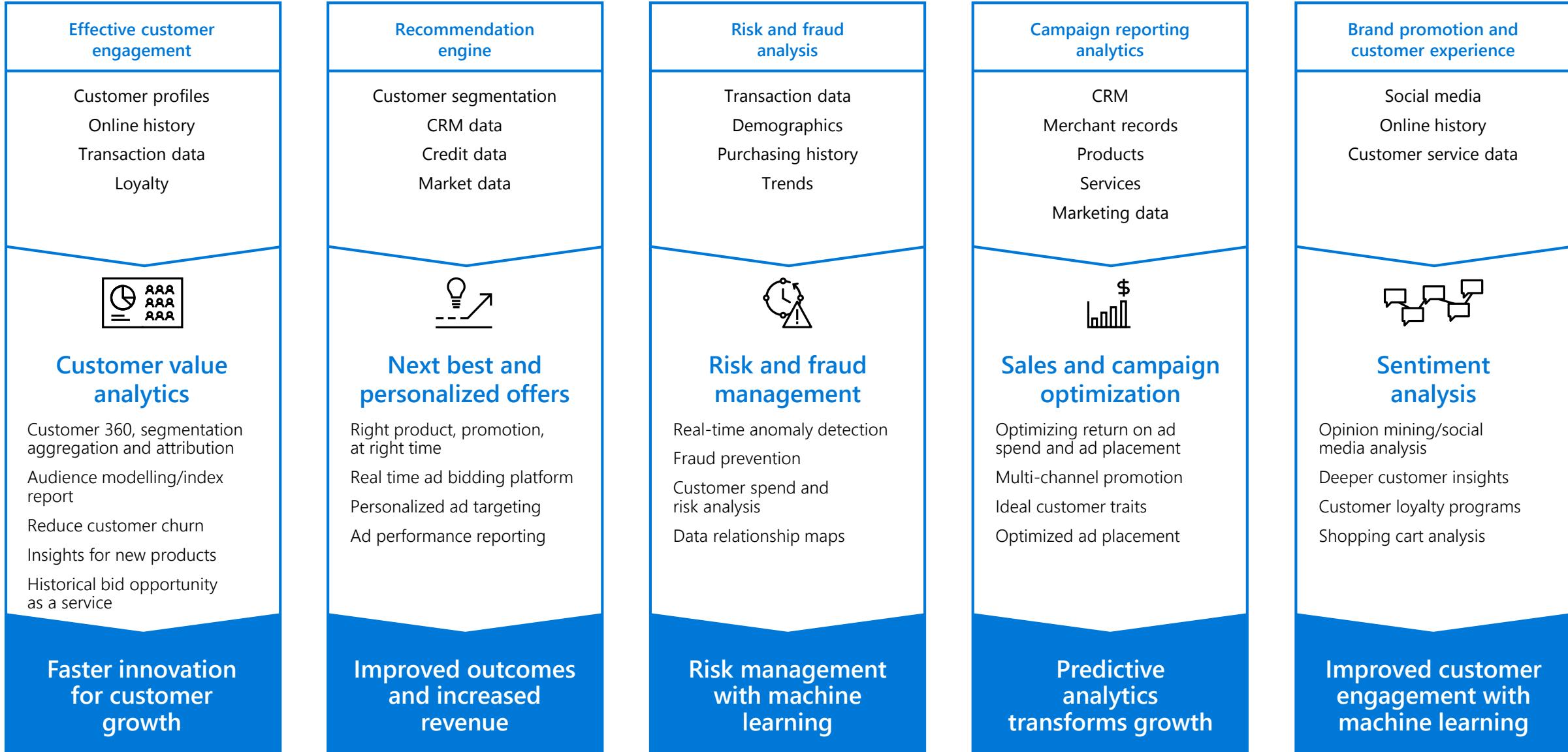
Media and entertainment use cases



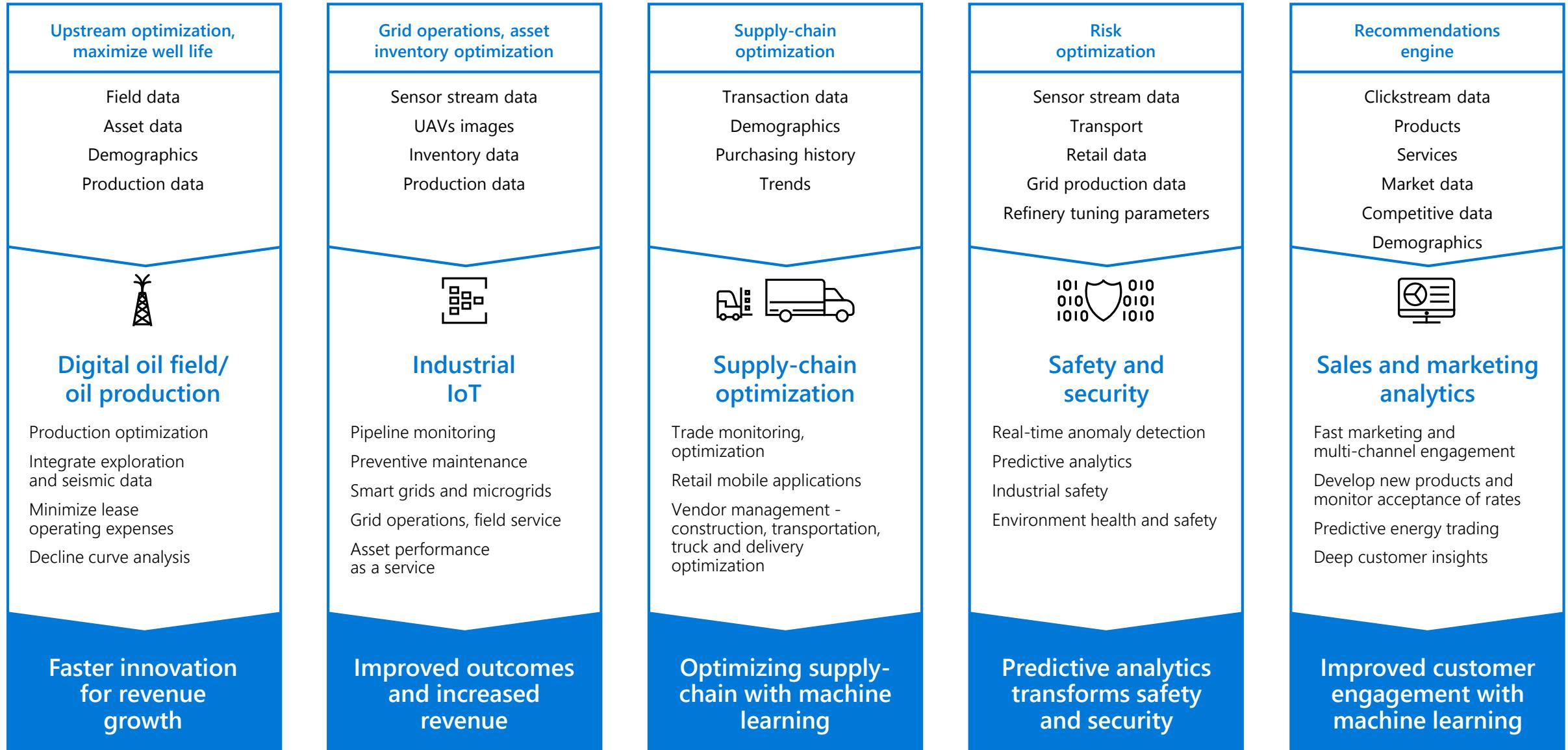
Retail use cases



Advertising and marketing tech use cases



Oil, gas, and energy use cases



Security use cases

Security controls to leverage all data	Actionable threat intelligence	Risk and fraud analysis	Compliance management	Identity and access management for analytics
Firewall/network logs Apps Data access layers	Firewall/network logs Network flows Authentications	Firewall/network logs Web/app logs Social media content	Firewall/network logs Web Applications Devices OS	Files Tables Clusters Reports Dashboards Notebooks
 Intrusion detection and predictive analytics Prevention of DDoS attacks Threat classifications Data loss/anomaly detection in streaming Cybermetrics and changing use patterns	 Security intelligence Real-time data correlation Anomaly detection Security context, enrichment Offence scoring, prioritization Security orchestration	 Fraud detection and prevention e-Tailing Inventory monitoring Social media monitoring Phishing scams Piracy protection	 Security compliance reporting Ad-hoc/historic incident reports SOC/NOC dashboards Deep OS auditing Data loss detection in IoT User behavior analytics	 Fine-grained data analytics security Role-based access controls Auditing and governance File integrity monitoring Row level and column level access permissions