Preparation to exam AI 100

« Designing and Implementing an Azure AI Solution »

Module 1 – Analyze Solution Requirement (25-30%)

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What is the Microsoft AI 100 exam?

- AI-100 Certification is for engineers who have intermediate to an expert level understanding of Machine Learning and are responsible for deploying end-to-end AI solutions on Azure using various AI & ML services.

In 220 minutes = 57 Questions + 5 Questions in case study

Part 1

Recommend Cognitive Services APIs to meet business requirements

Microsoft

Microsoft Cognitive Services

- Microsoft Cognitive Services is a set of machine learning algorithms available as a service for anyone to use
- Instead of building this intelligence for our apps from scratch, we can use these services for vision, speech, language, knowledge, and search
  - You can try each service for free
  - When you decide to integrate a service into your app, you sign up for a paid subscription

Cognitive Services
Microsoft

Cognitive Services ♡ Save for later
Microsoft

Create

Cognitive Services is a product bundle that enables customers to access multiple services with a single API key.

Product features:

Access to Vision, Language, Search, and Speech services using a single API

Quickly connect services together to achieve more insights into your content

Easily integrate with other services like Azure Search

Create
All Cognitive Services

* Name

PrepaAI100-CognitiveServices ✓

* Subscription

Conso interne de la plateforme Windows Azure 2 ⌄

* Location

(Europe) West Europe ⌄

Location specifies the region only for included regional services. This does not specify a region for included non-regional services. See service status page for more details.

* Pricing tier (View full pricing details)

S0 ⌄

* Resource group

RG-Prepa-AI-100 ⌄

Create new

☑ * I confirm I have read and understood the notice below.

Microsoft will use data you send to Bing Search Services to improve Microsoft products and services. Where you send personal data to this service, you are responsible for obtaining sufficient consent from the data subjects. The Data Protection Terms in the Online Services Terms do not apply to Bing Search Services.

Please refer to the Online Services Terms for details. Microsoft offers policy controls that may be used to disable new deployments.

Create   Automation options

PrepaAI100-CognitiveServices - Quick start
Cognitive Services

Search (Ctrl+/)

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

RESOURCE MANAGEMENT

- Keys
- Quick start
- Pricing tier
- Billing By Subscription
- Properties
- Locks
- Export template

Monitoring

- Alerts
- Metrics

Congratulations! Your keys are ready.

Now explore the Quickstart guidance to get up and running with Cognitive Services.

1 Grab your keys

Key1 ⓘ

[▌▌▌▌▌▌▌▌▌▌▌▌▌▌▌▌ e]

Endpoint ⓘ

https://prepaai100-cognitiveservices.cognitiveservices.azure.com/

Every call to Cognitive Services requires a subscription key. This key needs to be either passed through a query string parameter or specified in the request header. You can find your keys in the API resource 'Overview' or 'Keys' from the left menu.

2 Make an API call to this endpoint: https://prepaai100-cognitiveservices.cognitiveservices.azure.com/

Get in-depth information about each properties and methods of the API. Test your keys with the built-in testing console without writing a single line of code. Once you have the API running, you can check your consumption and the API health on Azure portal in your API 'Overview'.

Content Moderator API reference
Content Moderator Portal
Computer Vision API reference
Face API reference
Language Understanding API reference
Language Understanding Portal
Translator Text API reference
Custom Translator (preview) Portal

Cognitive Services Area

- Vision: image classification and recognition
- Speech: conversion between speech and text
- Language: Spell check, Analytics, translation
- Knowledge : Q&A
- Search: text, image, video

Vision API

- Vision services to resolve imaging or visual content :
  - Computer vision
  - Content moderator
  - Face API (attribute detection, recognition)
  - Video Indexer
  - Custom Vision Service
  - Emotion API

Develop solutions by using intelligent algorithms that identify items from images and videos
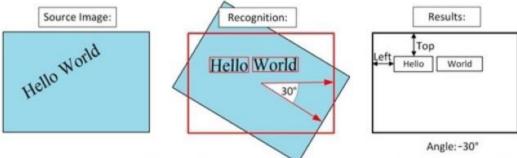
- Use the Computer Vision API to analyze images for insights, extract text from images, and generate high-quality thumbnails
  1. Create a Cognitive Services account.
  2. Get information about the visual content found in an image.
  3. Generate a thumbnail of an image.
  4. Detect and extract printed text from an image.
  5. Detect and extract handwritten text from an image.

You can use the Computer Vision API to

- Analyze images (JPEG, PNG, GIF, BMP) for insight
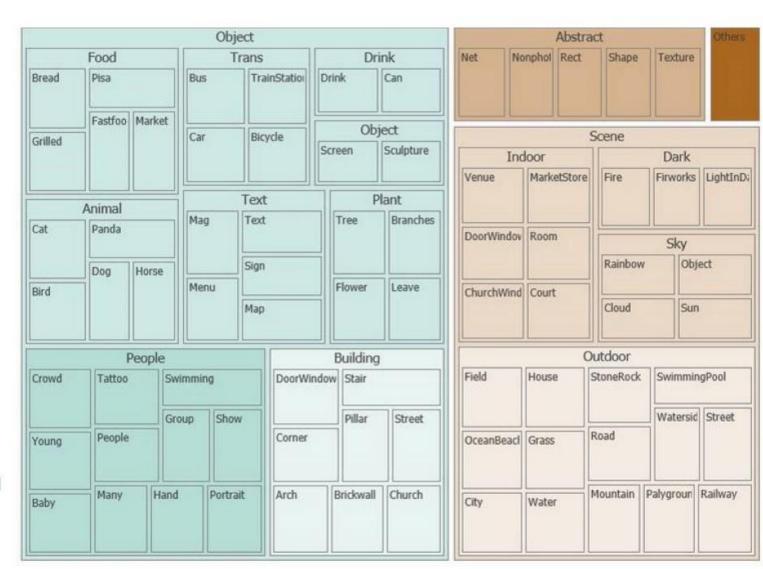- Extract printed text from images using optical character recognition (OCR)
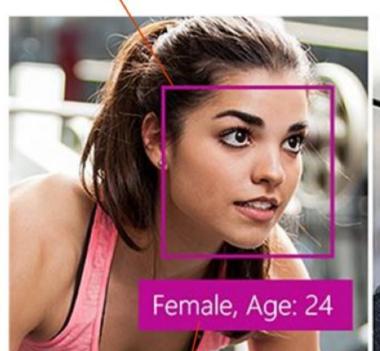 - Support 25 languages

Source Image:

Hello World

Recognition:

Hello World

30°

Results:

Top

Left

Hello   World

Angle: -30°

- Recognize printed and handwritten text from images
- Recognize celebrities and landmarks
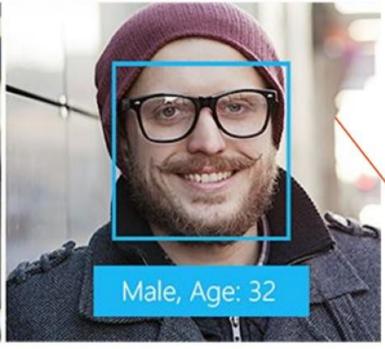- Analyze video
- Generate a thumbnail of an image

Tagging & Categorizing for Computer vision API

- ## Tagging images
  - 2000 recognizables objects, living beings, scenary and actions

- ## Categorizing images
  - 86-category concept

- ## Domain-specific content
  - Celebrity or landmark recognition

Face location

Submitted faces

Female, Age: 24

Male, Age: 32

Metadata about face

Custom Vision Service

- Image classification service
- User provided, custom, domain specific model
  - Increased specificity
  - Reduced distractors
- Help for classification challenge like
  - Image deformation, background distractions, Partial obscuring of object...
- Not a « black Box model » to analyze an image because you provided your specific model that you have trained

Image Classification Pipeline

Input
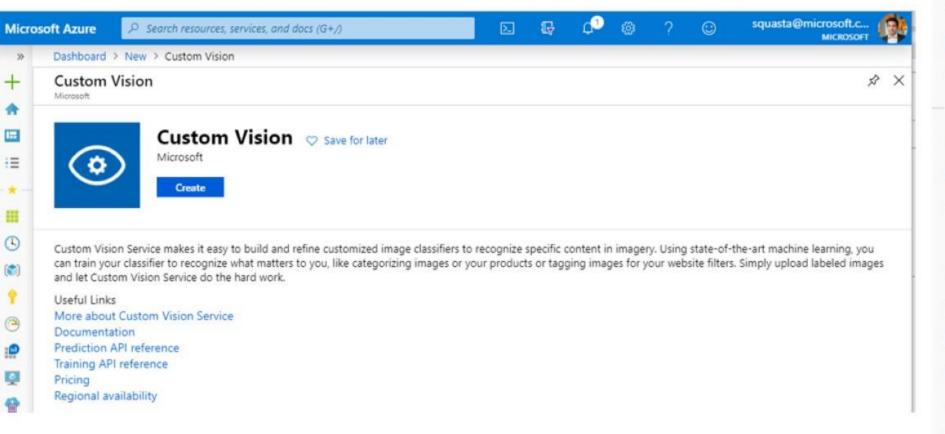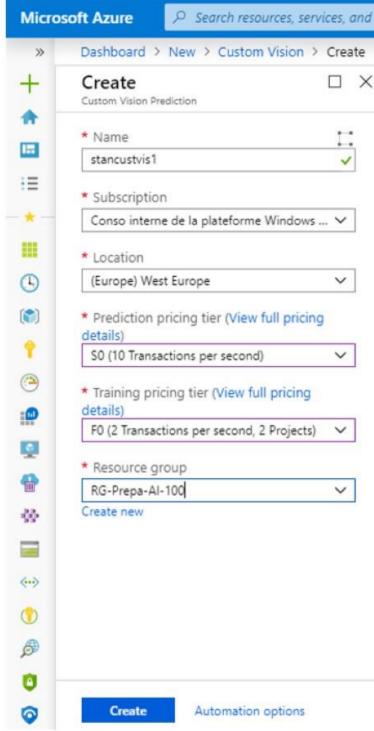- Pre-classified, training set of images

Learning
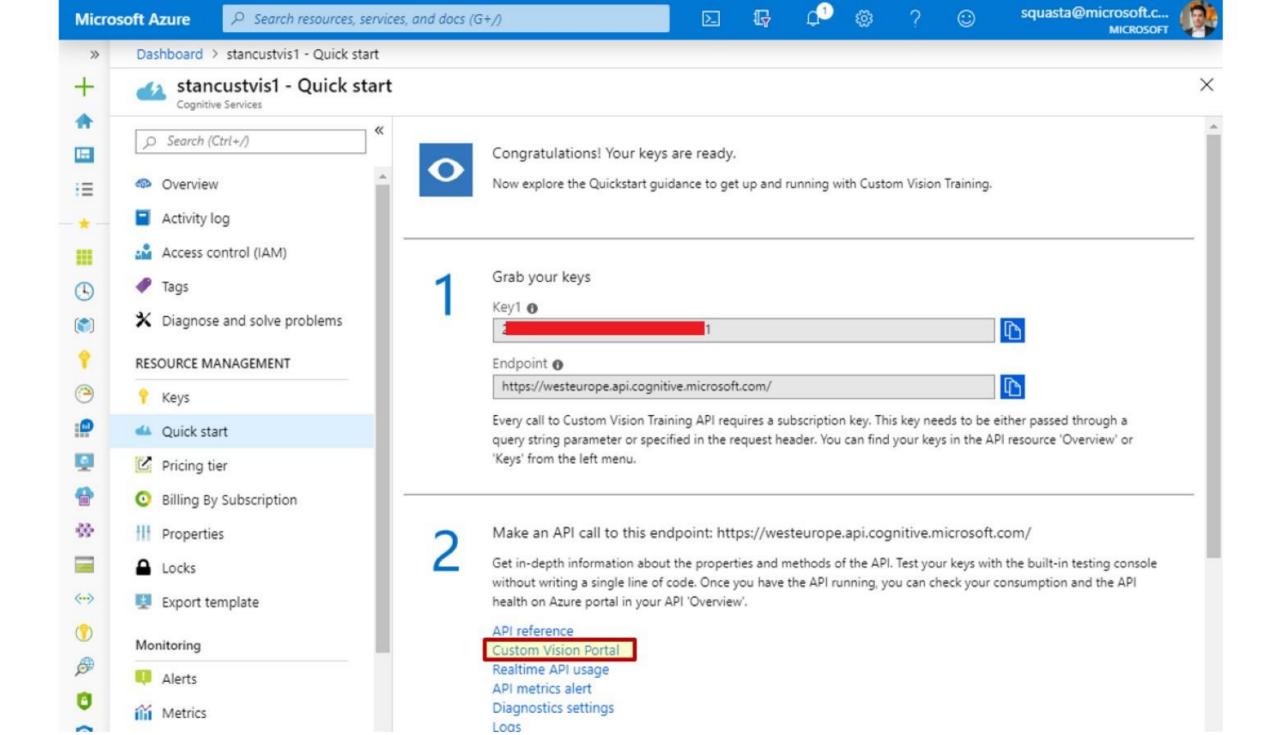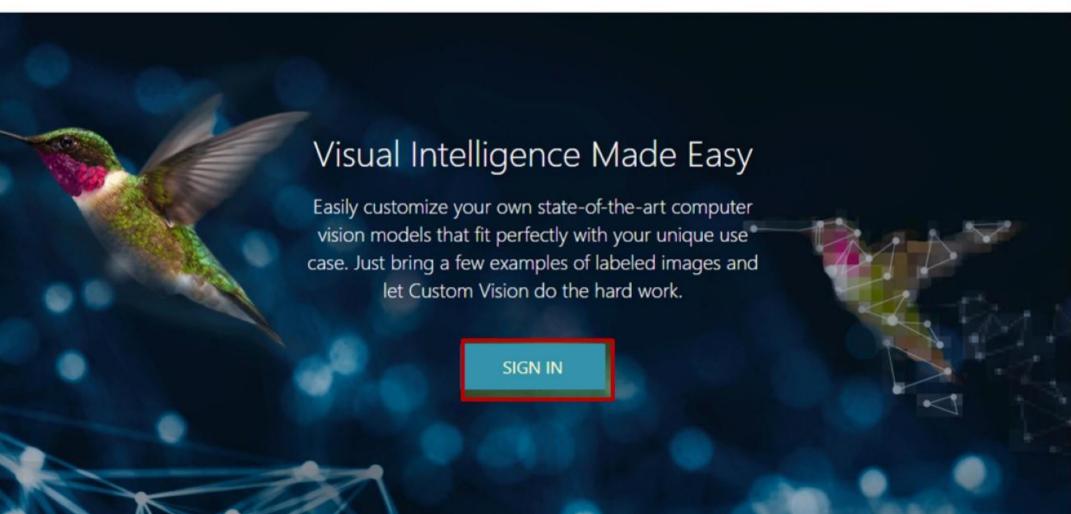- Train the model to distinguish between each category

Evaluation
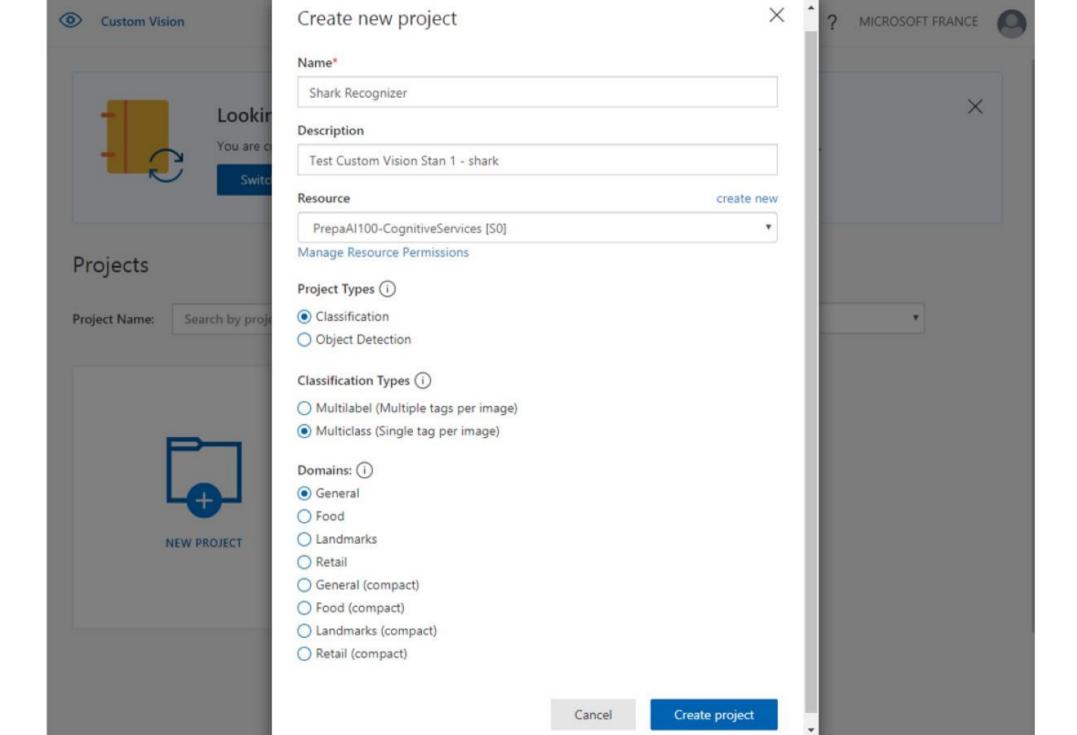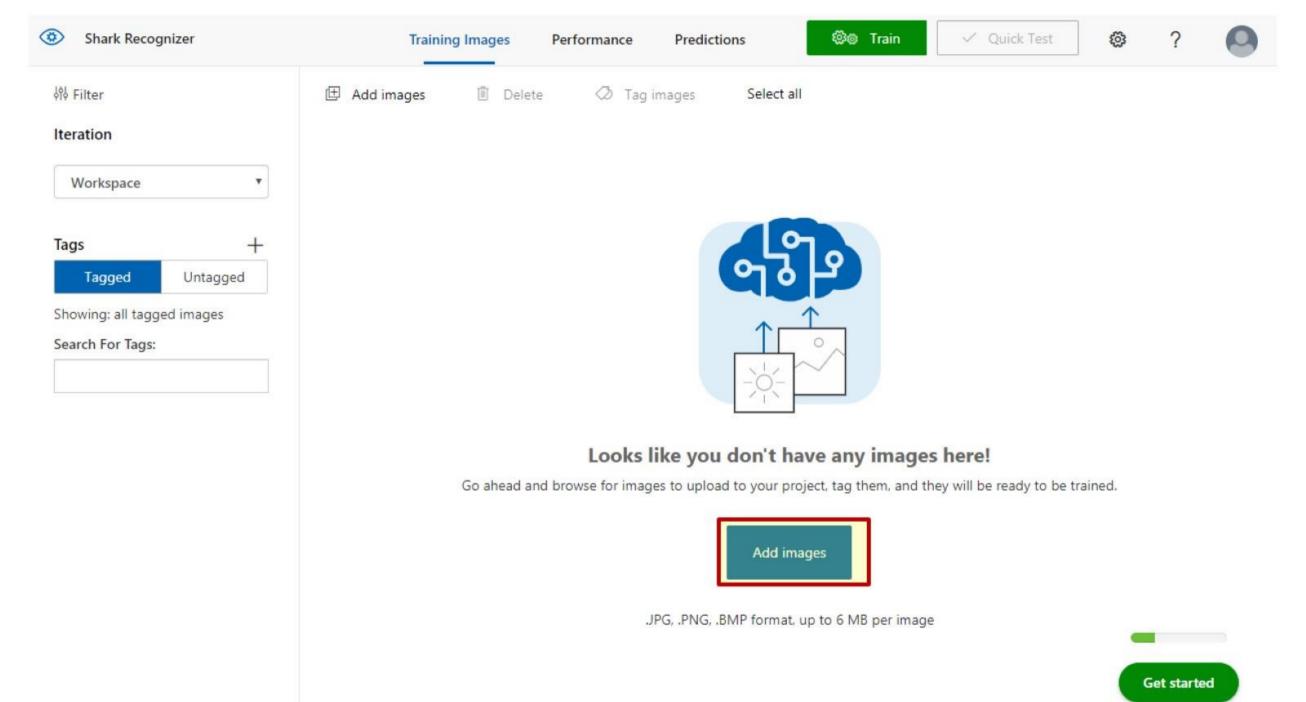- Validate the model produces accurate predictions with new images

Dashboard > stancustvis1 - Quick start

stancustvis1 - Quick start
Cognitive Services

✕

Search (Ctrl+/)

⟳ Overview

▣ Activity log

▲ Access control (IAM)

🏷 Tags

✕ Diagnose and solve problems

RESOURCE MANAGEMENT

🔑 Keys

☁ Quick start

✎ Pricing tier

○ Billing By Subscription

⫴ Properties

🔒 Locks

⬆ Export template

Monitoring

🔔 Alerts

📈 Metrics

👁

Congratulations! Your keys are ready.

Now explore the Quickstart guidance to get up and running with Custom Vision Training.

1 Grab your keys

Key1 ℹ

a███████████████████1

Endpoint ℹ

https://westeurope.api.cognitive.microsoft.com/

Every call to Custom Vision Training API requires a subscription key. This key needs to be either passed through a query string parameter or specified in the request header. You can find your keys in the API resource 'Overview' or 'Keys' from the left menu.

2 Make an API call to this endpoint: https://westeurope.api.cognitive.microsoft.com/

Get in-depth information about the properties and methods of the API. Test your keys with the built-in testing console without writing a single line of code. Once you have the API running, you can check your consumption and the API health on Azure portal in your API 'Overview'.

API reference
Custom Vision Portal
Realtime API usage
API metrics alert
Diagnostics settings
Logs

Microsoft | Cognitive Services | Custom Vision

Visual Intelligence Made Easy

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

SIGN IN

Create new project

Name*

Shark Recognizer

Description

Test Custom Vision Stan 1 - shark

Resource   create new

PrepaAI100-CognitiveServices [S0]   ▼

Manage Resource Permissions

Project Types ⓘ

◉ Classification

○ Object Detection

Classification Types ⓘ

○ Multilabel (Multiple tags per image)

◉ Multiclass (Single tag per image)

Domains: ⓘ

◉ General

○ Food

○ Landmarks

○ Retail

○ General (compact)

○ Food (compact)

○ Landmarks (compact)

○ Retail (compact)

Cancel   Create project

Projects

Project Name: Search by proj

NEW PROJECT

Training Images   Performance   Predictions   Train   Quick Test

Filter

Iteration

Workspace ▼

Tags ＋

Tagged   Untagged

Showing: all tagged images

Search For Tags:

Add images   Delete   Tag images   Select all

Looks like you don't have any images here!

Go ahead and browse for images to upload to your project, tag them, and they will be ready to be trained.

Add images

.JPG, .PNG, .BMP format, up to 6 MB per image

Get started

Image upload

×

● ─────────── ● ─────────── ○
Add Tags   Uploading   Summary

✓ 26 images uploaded successfully

✗ 1 file(s) ignored because they exceeded 6MB or are not images

Done

Image upload   ✕

○────────────────○────────────────○
Add Tags   Uploading   Summary

23 images will be added...

Add some tags to this batch of images...

My Tags

Whale Shark

Upload 23 files

Shark Recognizer

Training Images   Performance   Predictions   ⚙ Train   ✓ Quick

Filter

⊞ Add images   🗑 Delete   ⊘ Tag images   Select all

Iteration

Workspace ▾

Tags +

Tagged   Untagged

Showing:

Whale Shark ✕

shark ✕

Search For Tags:

☑ shark 26 ···

☑ Whale Shark 22 ···

Choose Training Type ✕

Training Types ⓘ

◉ Fast Training

◯ Advanced Training

Train

Use advanced training for improved performance, especially on challenging and fine-grained datasets. With advanced training, you can specify a compute time budget for training and Custom Vision will experimentally identify the best training and augmentation settings. For quick iterations, you can use the fast training.

Choose Training Type

Training Types ⓘ

○ Fast Training
● Advanced Training

In most cases, the more time you select the better the model will be. You're charged based on the compute time used to train your model, so choose your budget based on your need.

Training budget: **1 hour** ⓘ

1 hour | | | 24 hours

☑ Send me an email notification after training completes

Email address

squasta@microsoft.com

Train

👁 Shark Recognizer   Training Images   **Performance**   Predictions   🗗 Train

▤ Iterations   🌐 Prediction URL   🗑 Delete   ⭳ Export

Probability Threshold: 50% ⓘ

|━━━━━●━━━━━━━━━━|

Iteration 1

Iteration 1
Training...

Iteration 1

Training...
Last checked: **8/20/2019, 5:45:56 PM**

Your Azure Custom Vision training was successful

MA   **Microsoft Azure**
To ● Stanislas Quastana

ⓘ If there are problems with how this message is displayed, click here to view it in a web browser.

■■ Microsoft Azure

View the results of your Azure Custom Vision training job

Your Azure Custom Vision training job Shark Recognizer is complete.

View results >

Training Images   **Performance**   Predictions   ⚙️ Train   ✓ Quick Test   ⚙️   ?   👤

✓ Publish   ⊕ Prediction URL   🗑 Delete   ↓ Export

Iterations

Probability Threshold: 50% ⓘ

Iteration 1

Advanced Trained : 2 minutes ago with General domain, Training Budget: 1 hour

Finished training on **8/20/2019, 5:47:05 PM** using **General** domain
Iteration id: **dbefbcf4-60fe-4ecb-bff1-4f90bd236b12**
Classification type: **Multiclass (Single tag per image)**

Precision ⓘ   Recall ⓘ   AP ⓘ

100.0%   100.0%   100.0%

Performance Per Tag

Tag	Precision ⌃	Recall	A.P.	Image count
Whale Shark	100.0%	100.0%	100.0%	22
shark	100.0%	100.0%	100.0%	26

Get started

Precision vs Recall

- **Precision** : represents that ability for a classifier to label all instances correctly
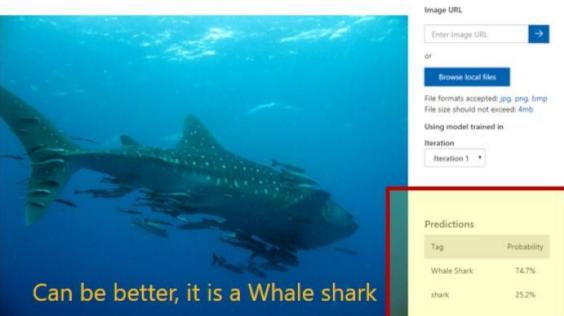
- **Recall** : represents the ability for a classifier to find all instances of a particular label

Improving Custom Vision model
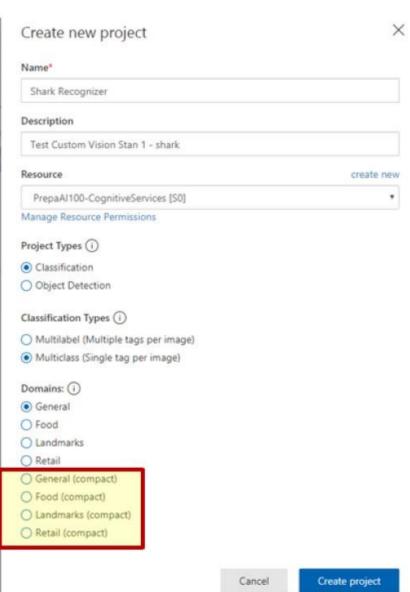
- Adding more pictures for training
  - Minimum 50 images per tag
  - Use the result of positive or negative prediction
- Diverse type of images : angle, light, background...
- Balance number of images across tags
- Negative image handling

Working with Custom Vision Service Prediction API

- Use code instead of *customai* portal
- Use information from Azure Portal
  - API key
  - Project ID
  - Prediction URL
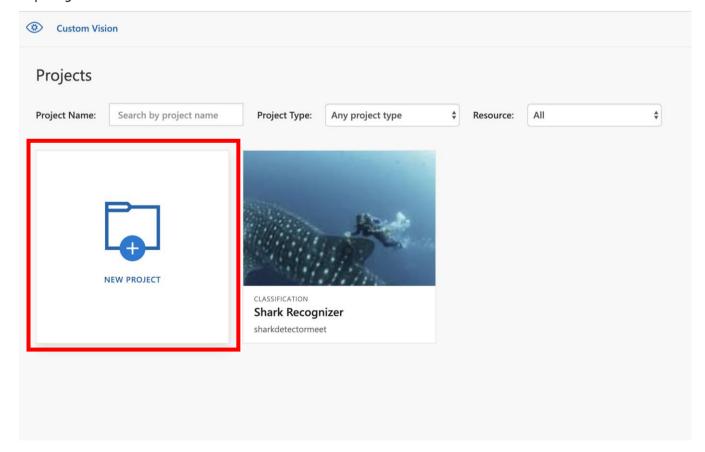
Using a Custom Vision Service Model domains

- ## Use standard domains
  - Higher accuracy
  - Support Online use only (HTTP calls to the API)

- ## Use compact domains
  - **Lower accuracy**
  - Support Online and <mark>**offline**</mark> use

Create new project ✕

Name *
> Shark Recognizer

Description
> Test Custom Vision Stan 1 - shark

Resource   create new
> PrepaAI100-CognitiveServices [S0]   ▾

Manage Resource Permissions

Project Types ⓘ
- ⦿ Classification
- ○ Object Detection

Classification Types ⓘ
- ○ Multilabel (Multiple tags per image)
- ⦿ Multiclass (Single tag per image)

Domains: ⓘ
- ⦿ General
- ○ Food
- ○ Landmarks
- ○ Retail
- ○ General (compact)
- ○ Food (compact)
- ○ Landmarks (compact)
- ○ Retail (compact)

Cancel   Create project

Hands on lab – Let's try out the Vision Recognition

Step 1: Go to https://www.customvision.ai/

Hands on lab - Let's try out the Vision Recognition

Step 2: Create new project!

Hands on lab - Let's try out the Vision Recognition
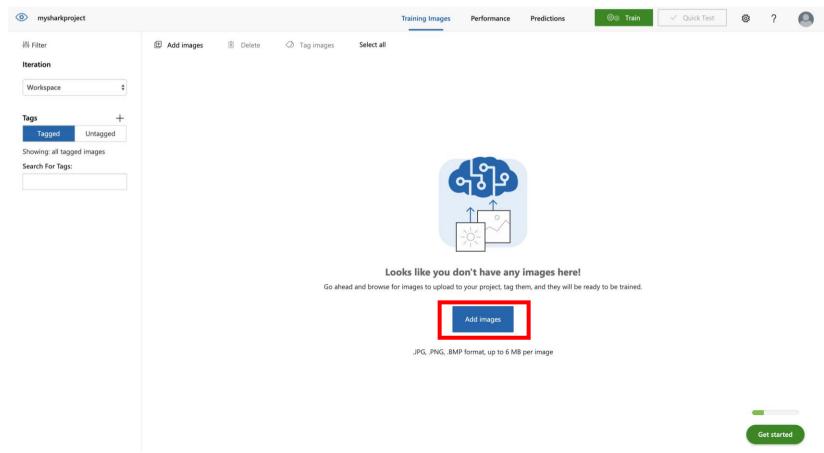
Step 3: Enter input for your project

Create new project ✕

Name*

mysharkproject

Description

testproject

Resource   create new

sharkdetectormeet [S0]

Manage Resource Permissions

Project Types ⓘ
- ⦿ Classification
- ◯ Object Detection

Classification Types ⓘ
- ◯ Multilabel (Multiple tags per image)
- ⦿ Multiclass (Single tag per image)

Domains: ⓘ
- ⦿ General
- ◯ Food
- ◯ Landmarks
- ◯ Retail
- ◯ General (compact)
- ◯ Food (compact)
- ◯ Landmarks (compact)
- ◯ Retail (compact)

Cancel   Create project

Create New Resource ✕

Name*

mysharkproject

Subscription*

Ads TINA Engineering

Resource Group*   create new

meetb

Kind

CognitiveServices

Location

South Central US

Pricing Tier

S0

Create resource

Hands on lab - Let's try out the Vision Recognition

Step 4: Add images

Hands on lab - Let's try out the Vision Recognition

Step 5: Download images and upload them.

To download go to
https://github.com/arifmarias/ai-100-prep/blob/master/sharks.zip
and
https://github.com/arifmarias/ai-100-prep/blob/master/whalesharks.zip

Once you unzip, only upload the images from the sharks.zip

Hands on lab - Let's try out the Vision Recognition
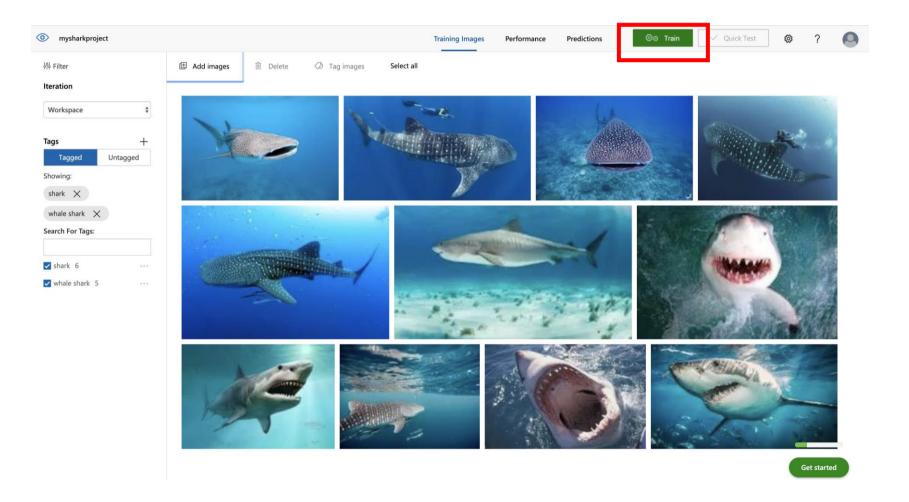
Step 6: Download images and upload them.

Now upload the images from the whale shark folder

Image upload   ✕

○ ─────────────── ● ─────────────── ●
Add Tags   Uploading   Summary

5 images will be added...

Add some tags to this batch of images...

My Tags

| whale shark |

Upload 5 files

Hands on lab - Let's try out the Vision Recognition

Step 6: Train the model

Hands on lab - Let's try out the Vision Recognition
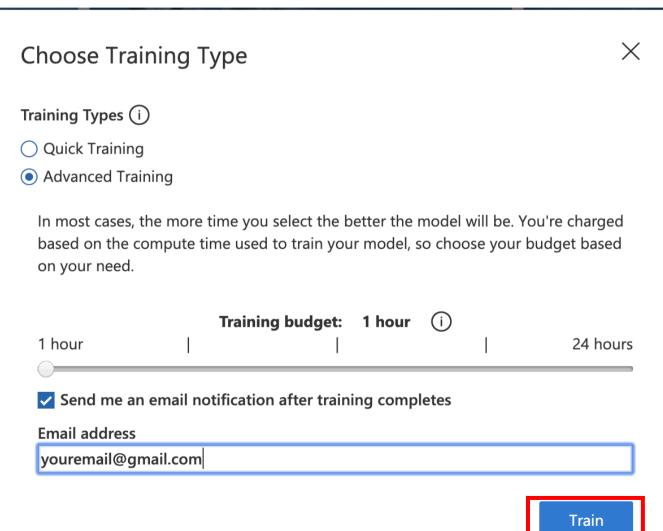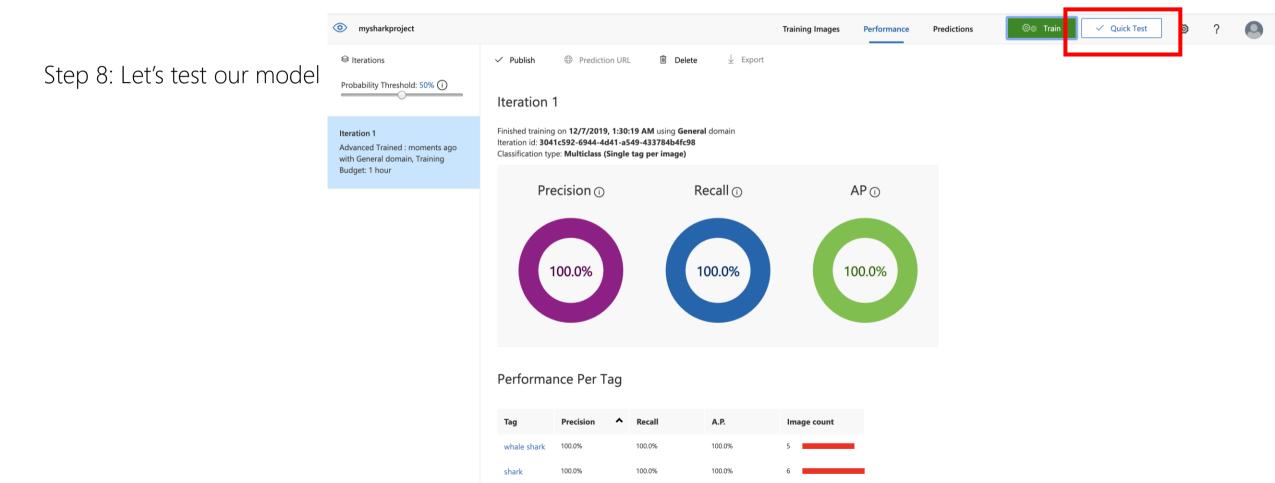
Step 7: Choose your training
For this workshop we will choose advance training.
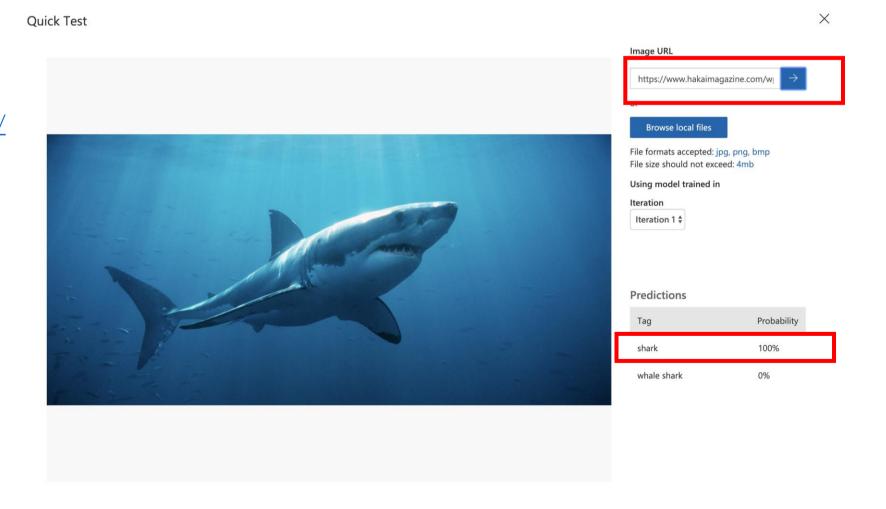
Don't forget to enter your email

Choose Training Type   ✕

Training Types ⓘ

○ Quick Training

◉ Advanced Training

In most cases, the more time you select the better the model will be. You're charged based on the compute time used to train your model, so choose your budget based on your need.

Training budget: 1 hour ⓘ

1 hour | | | 24 hours

☑ **Send me an email notification after training completes**

Email address

youremail@gmail.com

Train

Hands on lab - Let's try out the Vision Recognition

Step 8: Let's test our model

Hands on lab - Let's try out the Vision Recognition

Step 9: Paste this url and test Your model – https://www.hakaimagazine.com/wp-content/uploads/header-shark-eddies.jpg

Hands on lab - Let's try out the Vision Recognition

Step 9: Paste this url and test
Your model –
https://www.hakaimagazine.com/
wp-content/uploads/header-
tourist-shark-feeding.jpg

Hands on lab - Identify faces and expressions by using the Computer Vision API in Azure Cognitive Services

Go to this link - https://docs.microsoft.com/en-us/learn/modules/identify-faces-with-computer-vision/1-introduction

Hands on lab - Process images with the Computer Vision service

Go to this link - https://docs.microsoft.com/en-us/learn/modules/create-computer-vision-service-to-classify-images/1-introduction

Speech Service

- Speech technologies used in products like Cortana and Microsoft Office
- The Speech service unites the Azure speech features previously available via the Bing Speech API, Translator Speech, Custom Speech, and Custom Voice services

Main Speech service functions

- Speech to text (=speech recognition or transcription)
  - In real-time, batch
  - End of speech detection, automatic text formating, profanity masking
  - Can call on **Language Understanding (LUIS)** to derive user intent from transcribed speech
  - You can use your own data to train the models (ex: Accoustic model, Langage model..)
- Text to speech
  - Voice font (give your app a voice by training the model on samples of human voice
- Speech translation
  - In real-time, can process recorded speech
  - Result as text or synthetized speech

Speech scenarios

- Create voice-triggered apps
  - If your app is used in a specific domain, for example, medicine or IT, you can create a language model
  - If your app is used in a noisy environment, such as a factory, you can create a custom acoustic model
- Transcribe call center recording
  - You can easily index the text for full-text search or apply Text Analytics to detect sentiment, language, and key phrases.
  - You can also use language mode and acoustic model
- Implement voice bots

Translator Text
Microsoft

Translator Text ♡ Save for later
Microsoft

Create

Microsoft Translator API is an ISO and HIPAA compliant neural machine translation (NMT) service that developers can easily integrate into their applications, websites, tools, or any solution requiring multi-language support such as company websites, e-commerce sites, customer support applications, messaging applications, internal communication, and more.

Extend the reach of your applications

Translate text to and from 60+ supported languages through the open REST interface of Translator API.

Transliterate into different alphabets

Display text in different alphabets to make it easier to read - translate from Chinese characters to PinYin, display any of the supported transliteration languages in the Latin alphabet, and even show words written in the Latin alphabet in non-Latin characters such as Arabic, Hindi or Japanese.

Bilingual dictionary
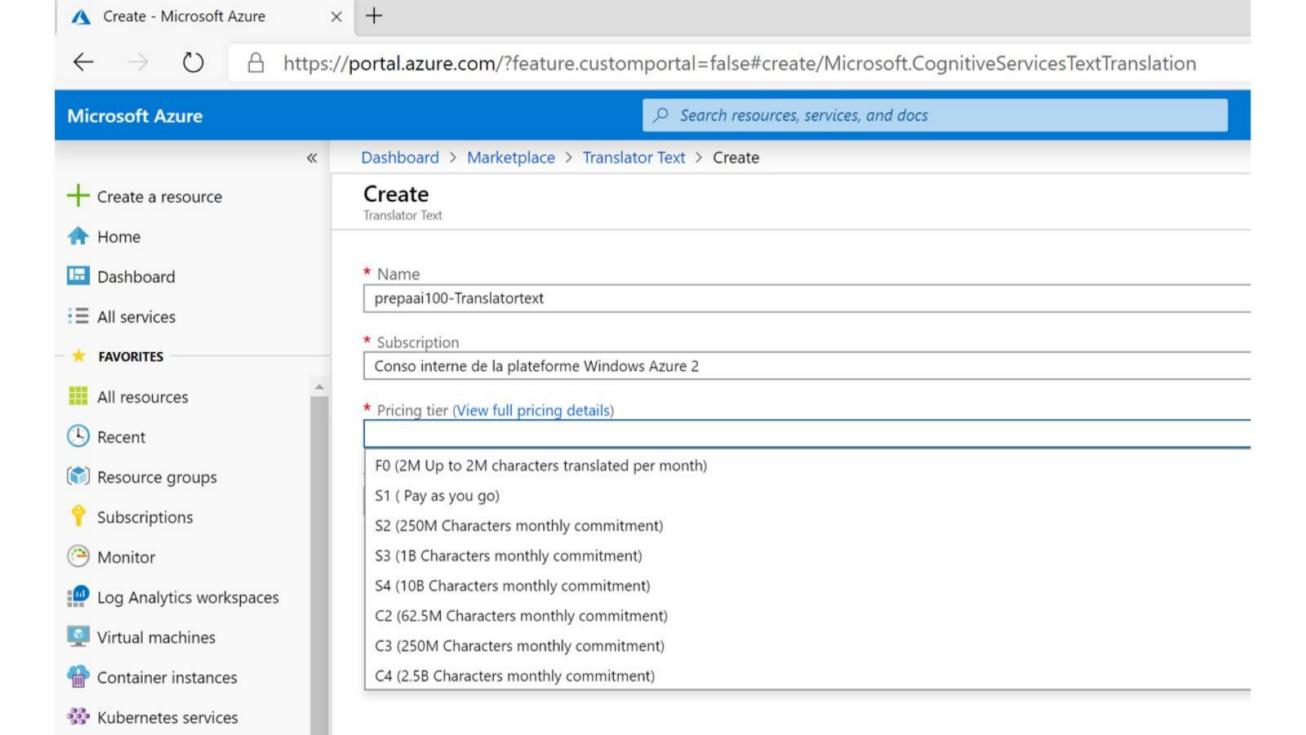
Find alternative translations for words from or to English and the context for alternate word translations by giving examples of human translated sentences.

Add both online and offline neural machine translation into your Android app
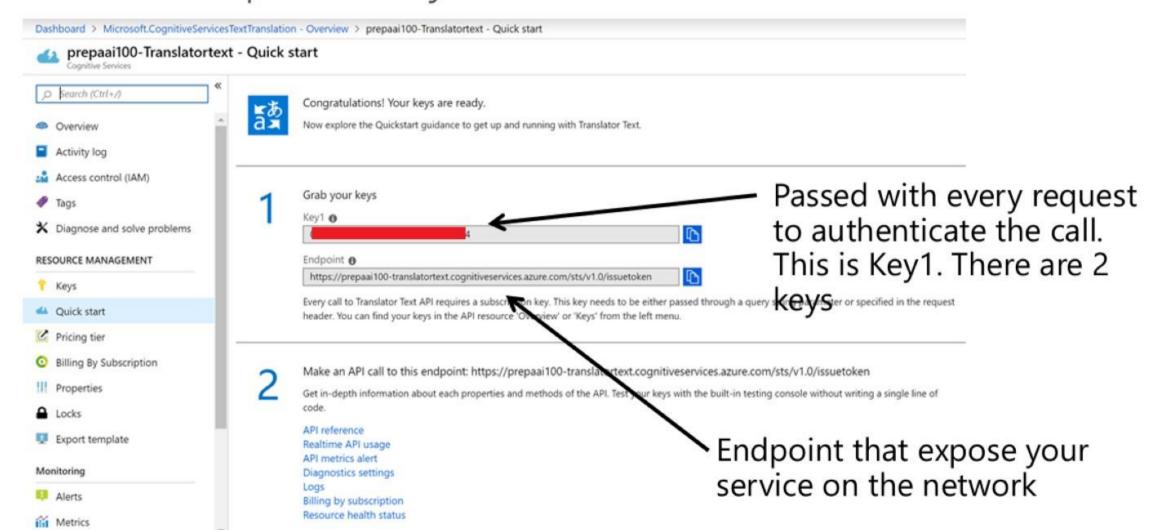
With the Microsoft Translator app local feature (Preview) on Android, easily add online and offline neural translation to your apps. Call the Translator app to integrate text translation capabilities into your own app. The Translator app will return the translations by using the Translator cloud service when the device is online or the offline packs when it is offline. It will use your existing Translator Text API subscription for billing.
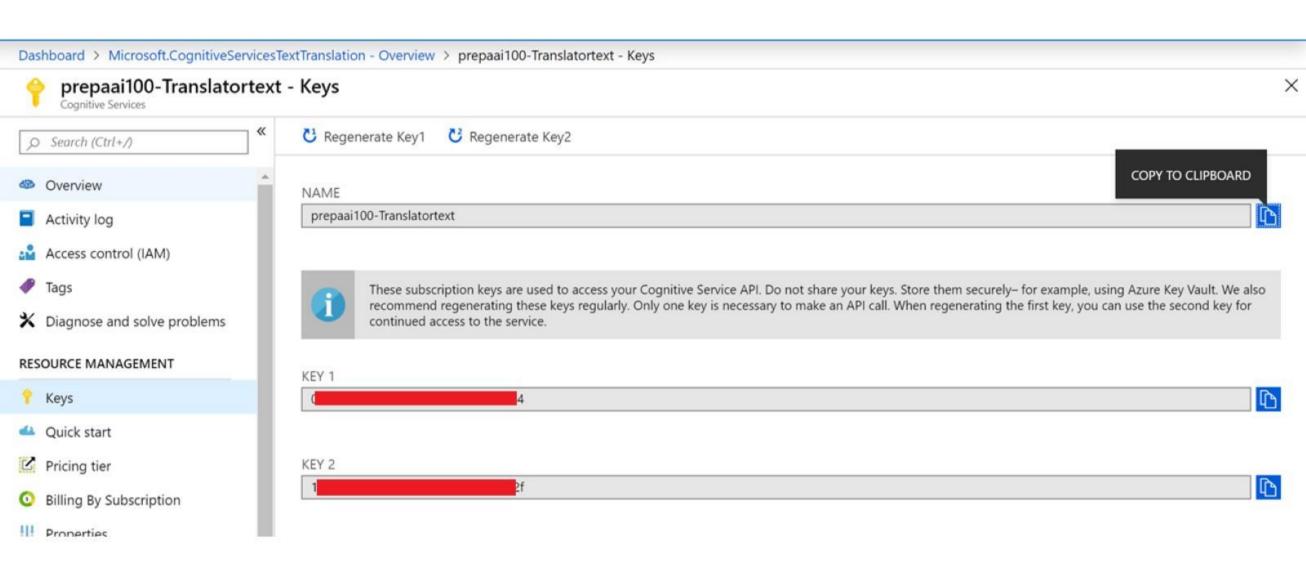
Automatically detect languages

Easily and accurately detect the language of any text string to decide which one needs to be translated and into which language(s).

https://portal.azure.com/?feature.customportal=false#create/Microsoft.CognitiveServicesTextTranslation

Microsoft Azure

Search resources, services, and docs

+ Create a resource

🏠 Home

▦ Dashboard

☰ All services

⭐ FAVORITES

▦ All resources

🕐 Recent

◎ Resource groups

🔑 Subscriptions

◎ Monitor

▦ Log Analytics workspaces

▣ Virtual machines

🗑 Container instances

▦ Kubernetes services

Dashboard > Marketplace > Translator Text > Create

Create
Translator Text

* Name

prepaai100-Translatortext

* Subscription

Conso interne de la plateforme Windows Azure 2

* Pricing tier (View full pricing details)

F0 (2M Up to 2M characters translated per month)

S1 (Pay as you go)

S2 (250M Characters monthly commitment)

S3 (1B Characters monthly commitment)

S4 (10B Characters monthly commitment)

C2 (62.5M Characters monthly commitment)

C3 (250M Characters monthly commitment)

C4 (2.5B Characters monthly commitment)

With Speech Translation API subscription created your are now able to access your API endpoint and subscription key

Passed with every request to authenticate the call. This is Key1. There are 2 keys

Endpoint that expose your service on the network

prepaai100-Translatortext - Keys
Cognitive Services

×

Ċ Regenerate Key1   Ċ Regenerate Key2

COPY TO CLIPBOARD

NAME

| prepaai100-Translatortext | |

Search (Ctrl+/)

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

RESOURCE MANAGEMENT

- Keys
- Quick start
- Pricing tier
- Billing By Subscription
- Properties

ⓘ These subscription keys are used to access your Cognitive Service API. Do not share your keys. Store them securely– for example, using Azure Key Vault. We also recommend regenerating these keys regularly. Only one key is necessary to make an API call. When regenerating the first key, you can use the second key for continued access to the service.

KEY 1

| ████████████████4 | |

KEY 2

| 1████████████████2f | |

Develop solutions by using intelligent algorithms related natural language processing

- Custom acoustic model
- Custom language model

Custom acoustic model

- Creating a custom acoustic model is helpful if your application is designed for use in an environment, such as a noisy factory, or by a particular user population.
- Walkthrough
  1. Prepare the data : a set of audio files (.WAV) of speech data and a text file of transcriptions of each audio file.
     - Data should be representative
  2. Import the acoustic data set
  3. Create the custom acoustic model based on an existing model
     1. Microsoft Search & Dictation AM or Microsoft Conversational model

Custom language model

- Create a custom language model for text queries or utterances you expect users to say or type in an application.

  - You can then use this custom language model in conjunction with existing state-of-the-art speech models from Microsoft to add voice interaction to your application

- Walkthrough

  1. Prepare the data : provide a list of example utterances to the system (=specific vocabulary link to usage ex: medical, …) in plain text
  2. Import the language data set
  3. Create the custom language model

Language APIs
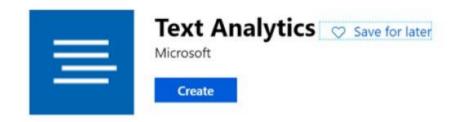
- Bing Spell Check
  - Contextual grammar and spell checking
- LUIS (Language Understanding Intelligent Service)
  - Custom machine learning intelligence to a user's conversational, natural language text to predict overall meaning and pull out relevant detailed information
- Translator Text
  - Translator (more than 60 languages) & Custom translator
- Text Analytics
  - Help you to extract information from text. To identify : language, discover sentiment, extract key phrases, detect well-known entities. Score between 0 (negative) to 1 (positive)

Test Text Analytics API

Text Analytics
Microsoft

Text Analytics ♡ Save for later
Microsoft

Create

Use a few lines of code to easily analyze sentiment, extract key phrases, recognize entities and detect language for any kind of text.

Sentiment analysis

Find out what users think about your products or services. You can score the overall sentiment of text.

Key phrase extraction

Automatically extract key phrases from text to quickly identify the main points.

Language detection

Determine what language a piece of text is written in-from 120 supported languages.

Named Entity Recognition

Identify and categorize entities in your text as people, locations, organizations, date/time, currencies and more. Well-known entities are also recognized and linked to information available on the web.

Useful Links
More about Text Analytics API

Bing Search

- The Bing Web Search API is a RESTfull API that provides an experience similar to Bing.com/Search by returning search results that Bing determines are relevant to the user's query.
  - The results may include Web pages, images, videos, news, and entities, along with related search queries, spelling corrections, time zones, unit conversion, translations, and calculations.
  - Search response : a **JSON** file with the following format :

```
{
    "_type": "SearchResponse",
    "queryContext": {...},
    "webPages": {...},
    "images": {...},
    "relatedSearches": {...},
    "videos": {...},
    "news": {...},
    "spellSuggestion": {...},
    "computation": {...},
    "timeZone": {...},
    "rankingResponse": {...}
}, ...
```

Bing Search

- If you're interested in specific types of content such as images, videos, and news, you can request only those answers by using the responseFilter query parameter

```
{
  "_type": "SearchResponse",
  "queryContext": {
    "originalQuery": "Microsoft Cognitive Services"
  },
  "webPages": {
    "webSearchUrl": "https://www.bing.com/search?q=Microsoft+cognitive+services",
    "totalEstimatedMatches": 22300000,
    "value": [
      {
        "id": "https://api.cognitive.microsoft.com/api/v7/#WebPages.0",
        "name": "Microsoft Cognitive Services",
        "url": "https://www.microsoft.com/cognitive-services",
        "displayUrl": "https://www.microsoft.com/cognitive-services",
        "snippet": "Knock down barriers between you and your ideas. Enable natural and conte
        "deepLinks": [
          {
            "name": "Face API",
            "url": "https://azure.microsoft.com/services/cognitive-services/face/",
            "snippet": "Add facial recognition to your applications to detect, identify, and
          },
          {
            "name": "Text Analytics",
            "url": "https://azure.microsoft.com/services/cognitive-services/text-analytics/"
            "snippet": "Cognitive Services; Text Analytics API; Text Analytics API . Detect
          },
          {
```

```
GET https://api.cognitive.microsoft.com/bing/v7.0/search?
q=sailing+dinghies&responseFilter=images%2Cvideos%2Cnews&mkt=en-us HTTP/1.1
Ocp-Apim-Subscription-Key: 123456789ABCDE
User-Agent: Mozilla/5.0 (compatible; MSIE 10.0; Windows Phone 8.0; Trident/6.0; IEMobile/10.0;
ARM; Touch; NOKIA; Lumia 822)
X-Search-ClientIP: 999.999.999.999
X-Search-Location:  47.60357;long:-122.3295;re:100
```

Hands on lab - Classify and moderate text with Azure Content Moderator

Go to this link - https://docs.microsoft.com/en-us/learn/modules/classify-and-moderate-text-with-azure-content-moderator/1-introduction

Bing Search

- Bing News Search
- Bing Web Search
- Bing Video Search
- Bing Autosuggest
  - Need to send a request to the API each time a user types a new characters in search box
- Bing Custom Search
- Bing Entities Search
  - Returns entities and place

Bing Search

- Bing Images Search
- Bing Visual Search
  - Upload and image and API identify variety of details about it
- Bing Local Business Search

Recommendations and decision making Custom Decision Service

- In a typical web or mobile application, a front page links to several articles or other types of content. As the front page loads, it could request the Custom Decision Service to rank articles included on that front page
    - So, when a user chooses an article by clicking on it, a second request could be sent to the Custom Decision Service, which will log the outcome of that user decision
- Custom Decision Service is easy to use, as it requires only an RSS feed for your content and a few lines of JavaScript to be added into your application

Custom Decision Service

- Custom Decision Service converts your content into features for machine learning

- Some common-use cases for Custom Decision Service include:
  - Personalizing articles on a news website
  - Personalizing video content on a media portal
  - Optimizing ad placements or web pages that the ad directs to
  - Ranking recommended items on a shopping website
  - Anomaly detector

Custom Decision Service

- Custom Decision Service can be applied to both webpages and mobile apps. The APIs can be called from either a browser or an app

Azure Bot Service

- Is now compliant with the following
  - ISO 27001:2013
  - ISO 27018:2014
  - PCI DSS
  - Microsoft HIPAA BAA
    - Health Insurance Portability and Accountability Act Business Associate Agreement
  - SOC 1 & SOC 2

Enable robust GDPR compliance

- New offerings include the general availability of the Azure GDPR Data Subject Request (DSR) portal, Azure Policy, Compliance Manager for GDPR, Data Log Export, and the Azure Security and Compliance Blueprint for GDPR
  - Azure Data Subject Request (DSR) portal enables you to fulfill GDPR requests
  - Azure Policy enables you to set policies to conform to the GDPR
  - Extend Azure Policies for the GDPR into Azure Security Center
  - The Azure Security and Compliance GDPR Blueprint accelerates your GDPR deployment
  - Compliance Manager for Azure helps you assess and manage GDPR compliance

Part 3

Select the software, services, and storage required to support a solution

Microsoft

AI reference Architecture

https://docs.microsoft.com/en-
us/azure/architecture/browse/#ai--machine-learning

When you need Custom AI ?

- Data restrictions
- Algorithm limitations
- Network contraints
- Domain specific needs

➜ Azure Machine Learning Service is Microsoft offering for Custom AI

Machine Learning at scale

- Before deciding which ML services to use in training and operationalization, consider whether you need to train a model at all, or if a prebuilt model can meet your requirements. In many cases, using a prebuilt model is just a matter of calling a web service or using an ML library to load an existing model.

- Some options include:
  - Use the web services provided by Azure Cognitive Services.
  - Use the pretrained neural network models provided by the Cognitive Toolkit.
  - Embed the serialized models provided by Core ML for an iOS app

Machine Learning at scale

- If a prebuilt model does not fit your data or your scenario, options in Azure include Azure Machine Learning, HDInsight with Spark MLlib and MMLSpark, Azure Databricks, Cognitive Toolkit, and SQL Machine Learning Services.

- If you decide to use a custom model, you must design a pipeline that includes model training and operationalization

Machine Learning at scale

- Machine learning at scale addresses two different scalability concerns:
  - The first is **training a model against large data sets** that require the scale-out capabilities of a cluster to train
  - The second centers on **operationalizing the learned model so it can scale** to meet the demands of the applications that consume it. Typically this is accomplished by deploying the predictive capabilities as a web service that can then be scaled out

Challenges with Machine learning at scale

- You typically need a lot of data to train a model, especially for deep learning models
- You need to prepare these big data sets before you can even begin training your model
- The model training phase must access the big data stores. It's common to perform the model training using the same big data cluster, such as **Spark**, that is used for data preparation
- For scenarios such as deep learning, not only will you need a cluster that can provide you scale-out on CPUs, but your cluster will need to consist of GPU-enabled nodes

Choosing a natural language processing technology in Azure

- In Azure, the following services provide natural language processing (NLP) capabilities:
  - **Azure HDInsight with Spark NLP and Spark Mllib**
    - If you need to train custom models against a large corpus of text data
    - If you need low-level NLP capabilities like tokenization, stemming, lemmatization, and term frequency/inverse document frequency (TF/IDF)
  - **Azure Databricks**
  - **Microsoft Cognitive Services** :
    - if you want prebuilt models
    - If you need simple, high-level NLP capabilities like entity and intent identification, topic detection, spell check, or sentiment analysis
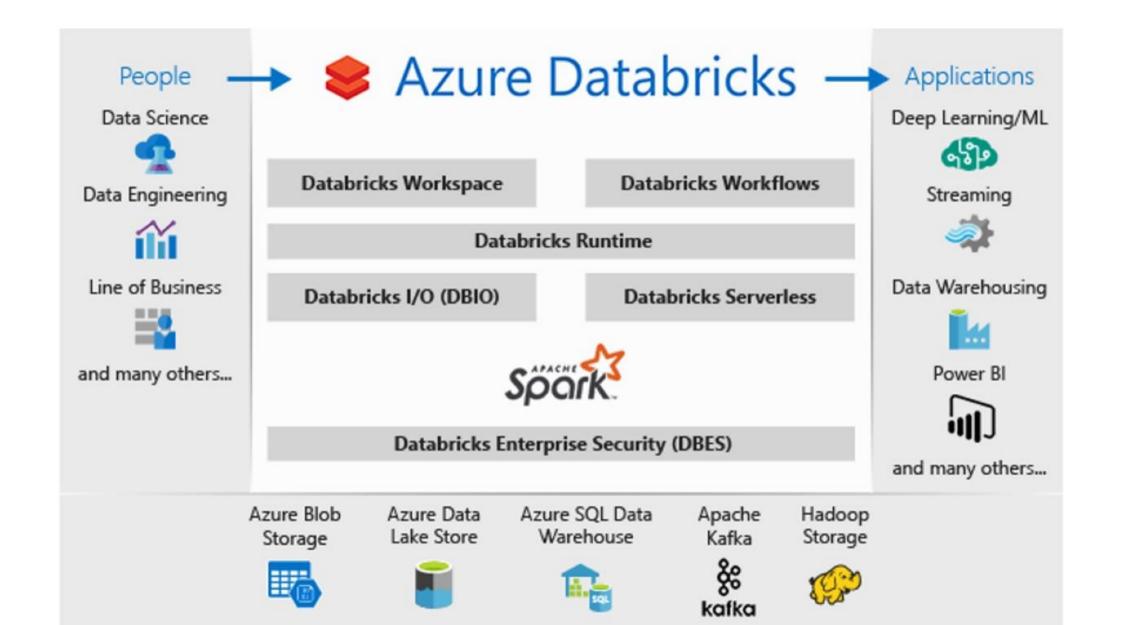
Azure HDInsight vs Cognitive Services

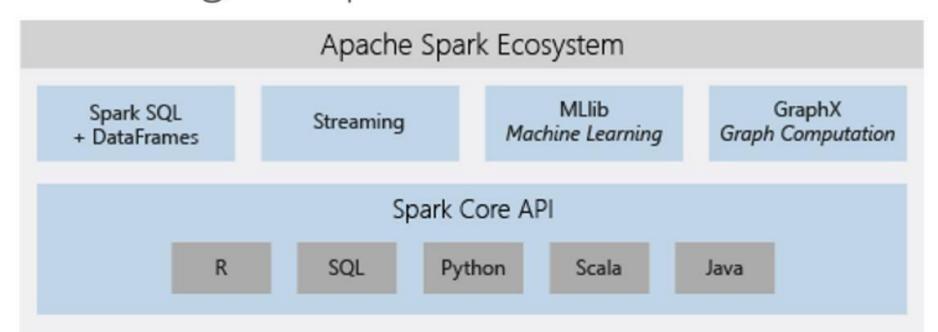| Capability	Azure HDInsight	Microsoft Cognitive Services
Provides pretrained models as a service	No	Yes
REST API	Yes	Yes
Programmability	Python, Scala, Java	C#, Java, Node.js, Python, PHP, Ruby
Support processing of big data sets and large documents	Yes	No

Azure Databricks

- Azure Databricks is an Apache Spark-based analytics platform optimized for the Microsoft Azure cloud services platform
  - Designed with the founders of Apache Spark, Databricks is integrated with Azure to provide one-click setup, streamlined workflows, and an interactive workspace that enables collaboration between data scientists, data engineers, and business analysts
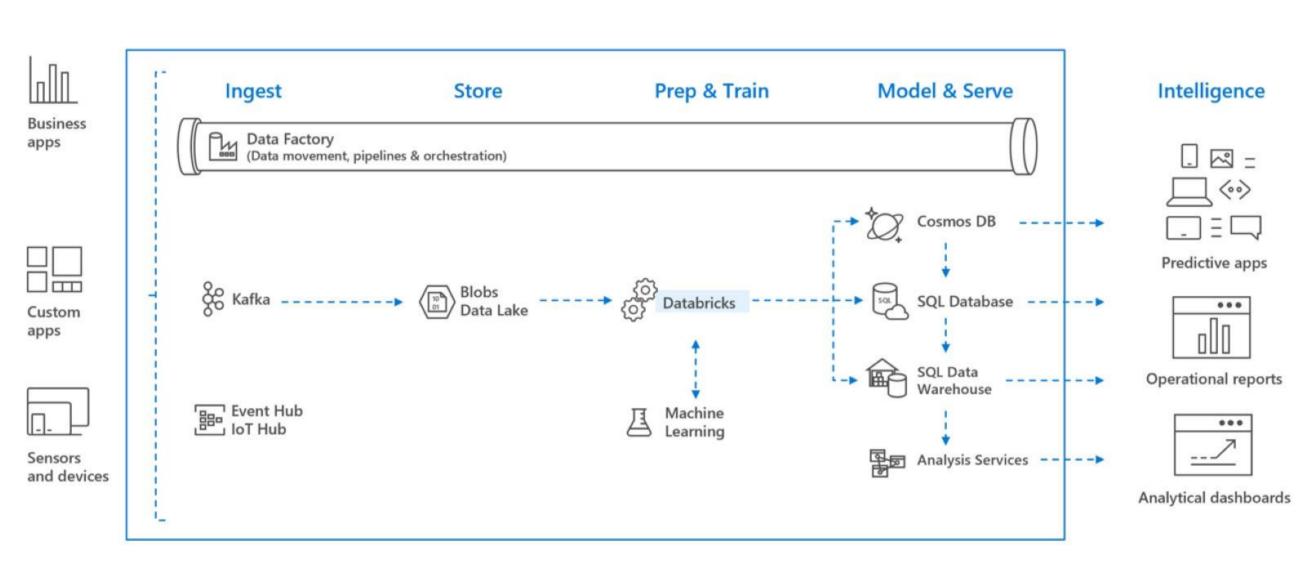
Azure Databricks

People → Azure Databricks → Applications

People
- Data Science
- Data Engineering
- Line of Business
- and many others...

Azure Databricks
- Databricks Workspace
- Databricks Workflows
- Databricks Runtime
- Databricks I/O (DBIO)
- Databricks Serverless
- Apache Spark
- Databricks Enterprise Security (DBES)

Applications
- Deep Learning/ML
- Streaming
- Data Warehousing
- Power BI
- and many others...

Azure Blob Storage · Azure Data Lake Store · Azure SQL Data Warehouse · Apache Kafka · Hadoop Storage

Apache Spark-based analytics platform

- Azure Databricks comprises the complete open-source Apache Spark cluster technologies and capabilities. Spark in Azure Databricks includes the following components

Apache Spark Ecosystem			
Spark SQL + DataFrames	Streaming	MLlib Machine Learning	GraphX Graph Computation
Spark Core API			
R	SQL	Python	Scala	Java

Azure Databricks
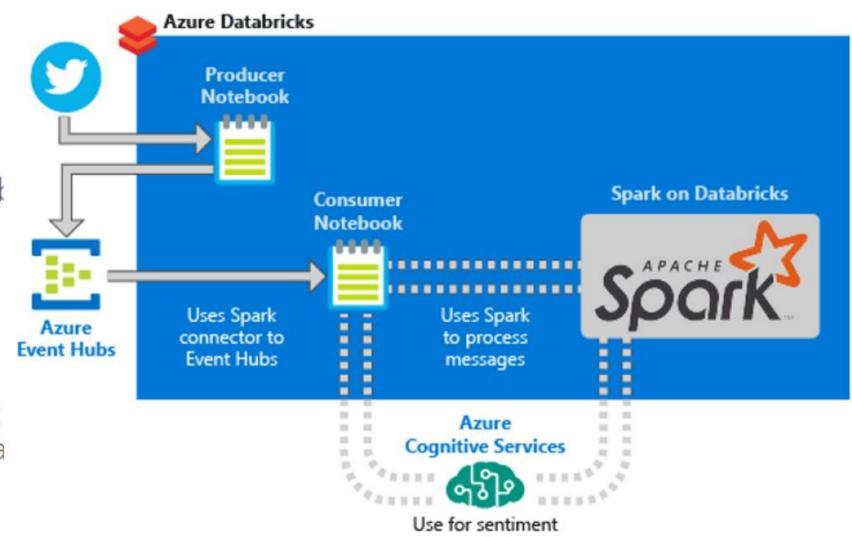
- Azure Databricks is a fast, easy, and collaborative Apache Spark-based analytics service

- For a **big data pipeline**, the data (raw or structured) is ingested into Azure through **Azure Data Factory in batches**, or streamed near real-time using Kafka, Event Hub, or IoT Hub

- This **data lands in a data lake for long term persisted storage**, in Azure Blob Storage or Azure Data Lake Storage

- As part of your analytics workflow, use Azure Databricks to read data from multiple data sources such as Azure Blob Storage, Azure Data Lake Storage, Azure Cosmos DB, or Azure SQL Data Warehouse and turn it into breakthrough insights using Spark

Example : Databrick + cognitives services

- Run sentiment analysis on a stream of data using Azure Databricks in near real time
- You set up data ingestion system using Azure Event Hub
- You consume the messages from Event Hubs into Azure Databricks using the Spark Event Hubs connector
- Finally, you use Cognitive Service APIs to run sentiment analysis on the streamed data

https://docs.microsoft.com/en-us/azure/azure-databricks/databricks-sentiment-analysis-cognitive-services

Training of Python scikit-learn and deep learning models on Azure

- This reference architecture shows recommended practices for tuning the hyperparameters (training parameters) of python models. Two scenarios are covered: hyperparameter tuning of scikit-learn models and deep learning models with GPUs

https://docs.microsoft.com/en-us/azure/architecture/reference-architectures/ai/training-python-models

Azure Storage Blobs

Training results

Microsoft Data Science Virtual Machine (DSVM)

Training and test data and script

Training results

Azure Machine Learning service
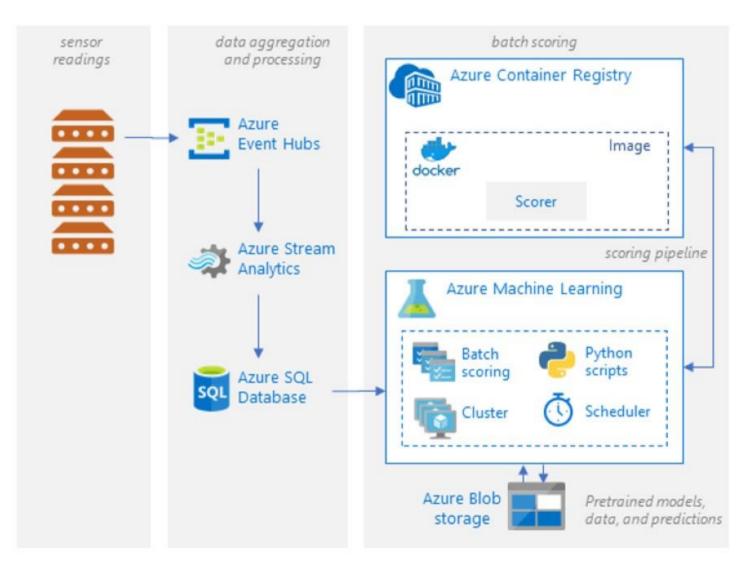
Script execution commands

Status

Azure Machine Learning compute

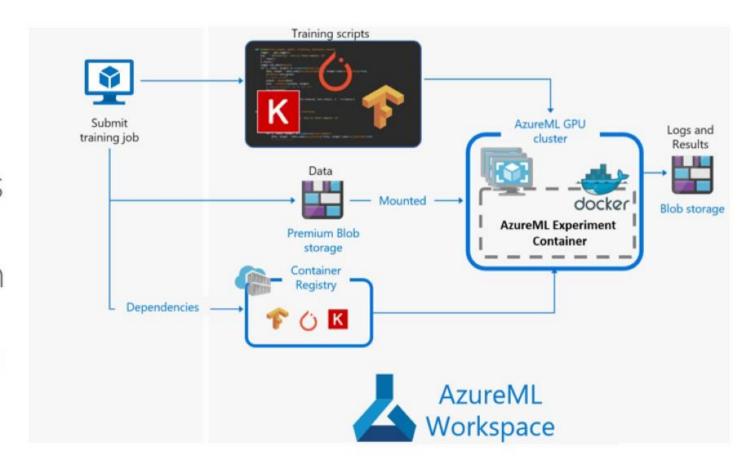Docker container

Azure Container Registry

Batch scoring of Python machine learning models on Azure

- This reference architecture shows how to build a scalable solution for batch scoring many models on a schedule in parallel using Azure Machine Learning Service.

sensor readings

data aggregation and processing

batch scoring

Azure Container Registry

docker

Image

Scorer

Azure Event Hubs

Azure Stream Analytics

scoring pipeline

Azure Machine Learning

Azure SQL Database

Batch scoring

Python scripts

Cluster

Scheduler

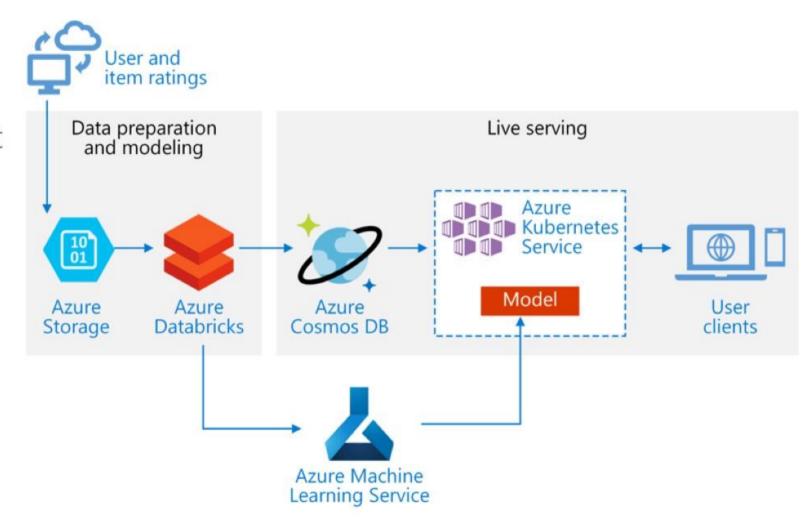Azure Blob storage

Pretrained models, data, and predictions

Distributed training of deep learning models on Azure

- This reference architecture shows how to conduct distributed training of deep learning models across clusters of GPU-enabled VMs
- The scenario is image classification, but the solution can be generalized for other deep learning scenarios such as segmentation and object detection
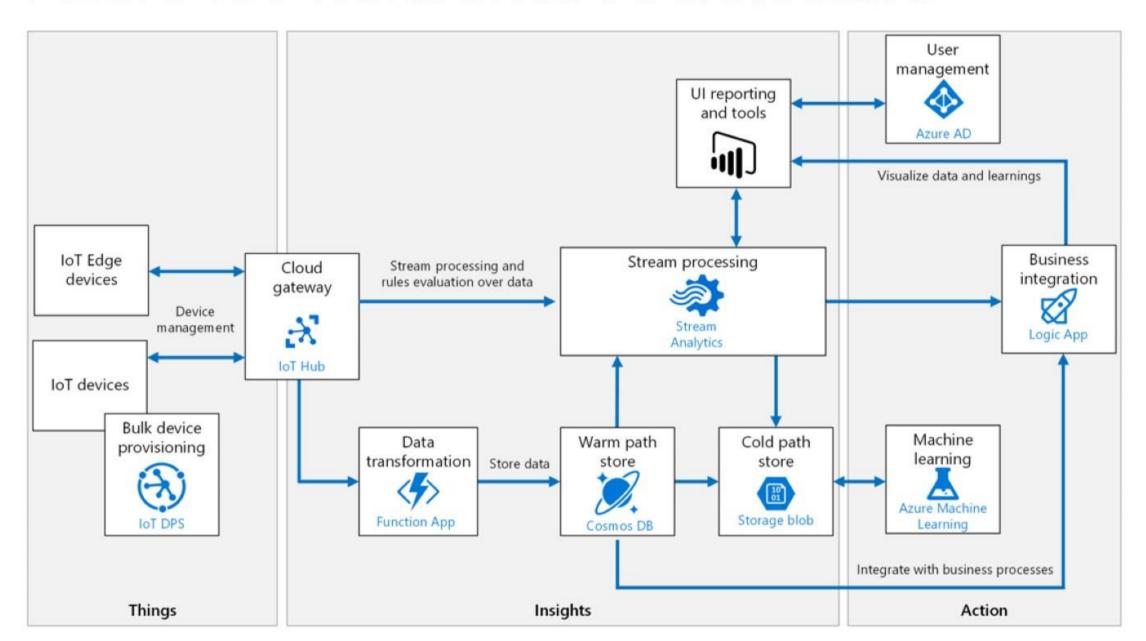
Build a real-time recommendation API on Azure

- This reference architecture shows how to train a recommendation model using Azure Databricks and deploy it as an API by using Azure Cosmos DB, Azure Machine Learning, and Azure Kubernetes Service (AKS)

- This architecture can be generalized for most recommendation engine scenarios, including recommendations for products, movies, and news
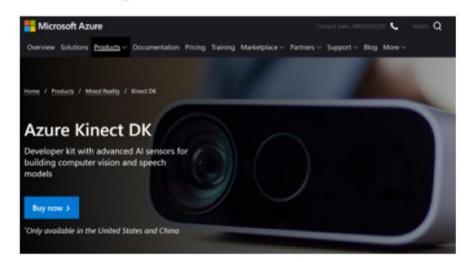
Azure IoT Reference Architecture

Process IoT telemetry data

- There are two ways to process telemetry data, hot path and cold path. The difference has to do with requirements for latency and data access
  - The **hot path** analyzes data in near-real-time, as it arrives. In the hot path, telemetry must be processed with very low latency. The hot path is typically implemented using a stream processing engine. The output may trigger an alert or be written to a structured format that can be queried using analytical tools
  - **For warm path storage, Microsoft recommend Cosmo DB**
  - The **cold path** performs batch processing at longer intervals (hourly or daily). The cold path typically operates over large volumes of data, but the results don't need to be as timely as the hot path. In the cold path, raw telemetry is captured and then fed into a batch process

What is Edge computing ?
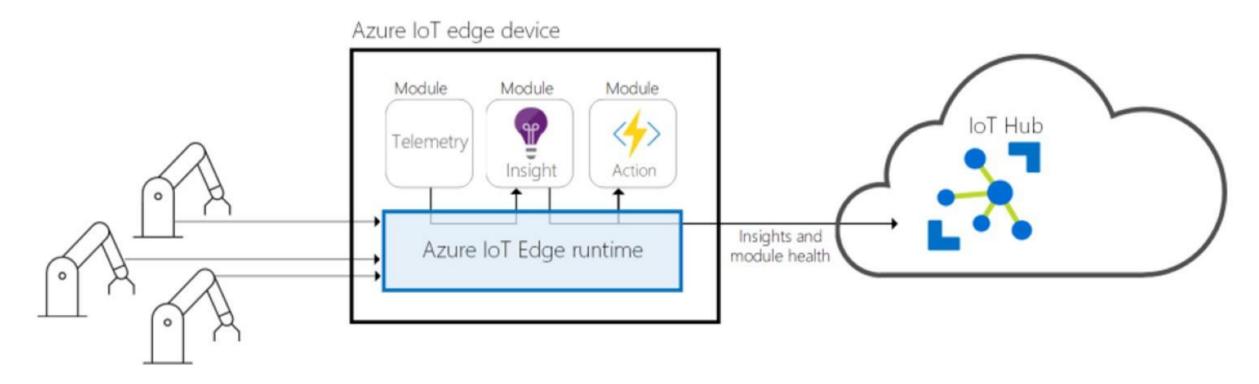
- Set of connected sytems and devices that gather and analyze/process data-close to the users/devices
- Edge computing solves problems of latency, bandwidth, offline support, connectivity, resource utilization, Intellectual Property Security
- Examples in Microsoft portfolio
  - Azure Databox Edge
  - Azure Stack
  - Azure IoT Edge
  - Azure Kinect DK

Edge Tiers
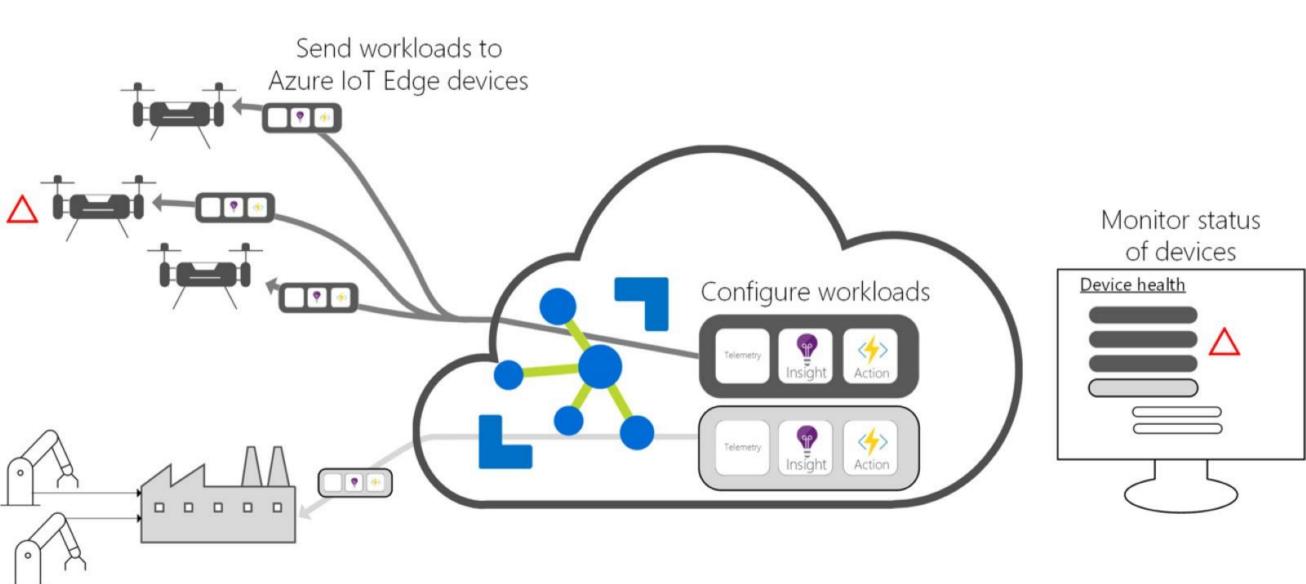
- Datacenter
- Server
- Gateway (ex: protocol gateway)
- Device

Azure IoT Edge
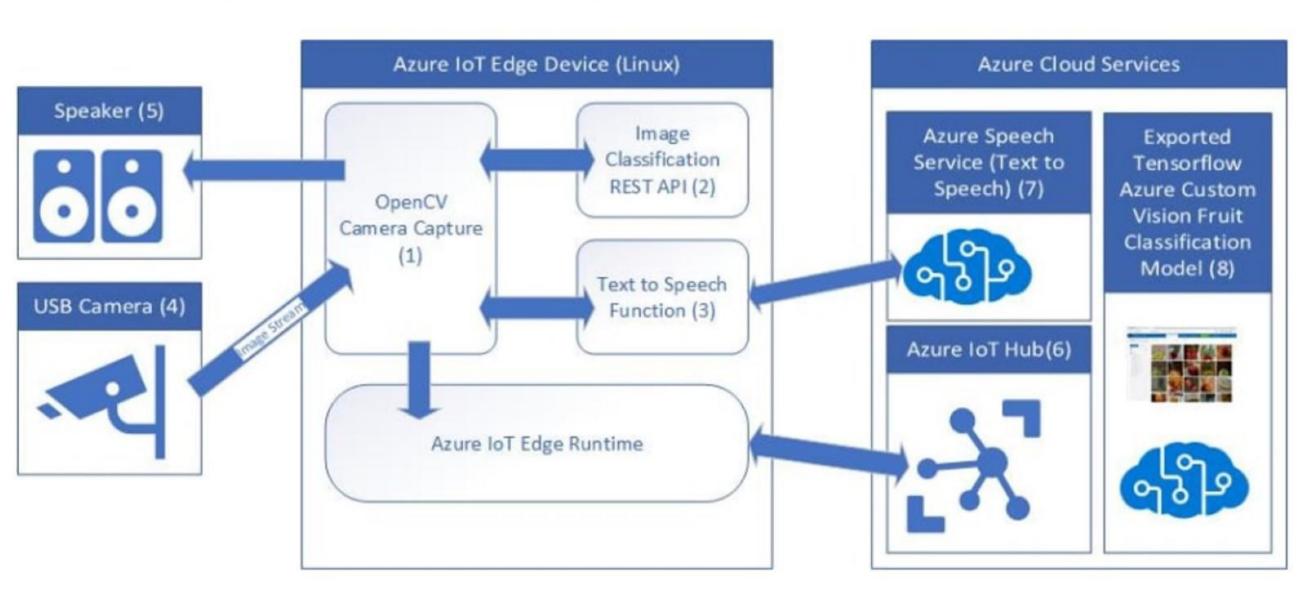
Example of IoT Edge solution

Send workloads to
Azure IoT Edge devices

Monitor status
of devices

Device health

Configure workloads

Telemetry | Insight | Action

Telemetry | Insight | Action
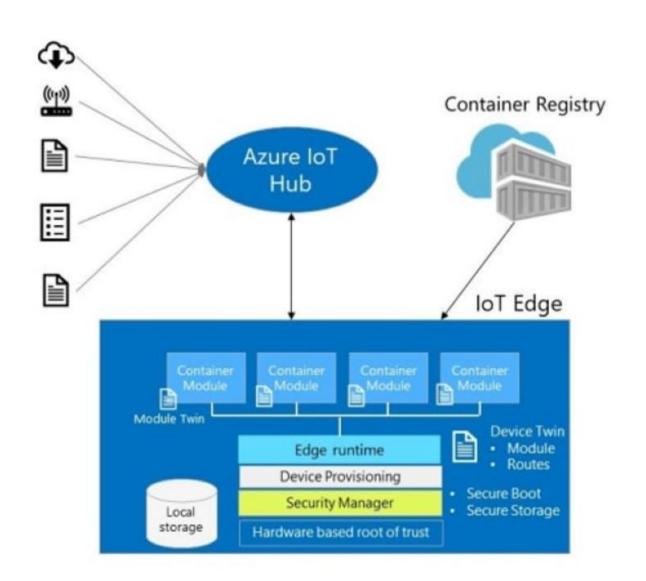
Example of IoT Edge solution

Azure Edge in action

1. Develop your Container Workloads
2. Upload Modules to a Container Registry
3. Provision IoT Edge Device Agents
4. Select Device/Deployment Set
5. Define Modules
6. Define Message Routes
7. Define Module Parameters

IoT hub
Microsoft

Basics Size and scale Review + create

Create an IoT Hub to help you connect, monitor, and manage billions of your IoT assets. Learn More

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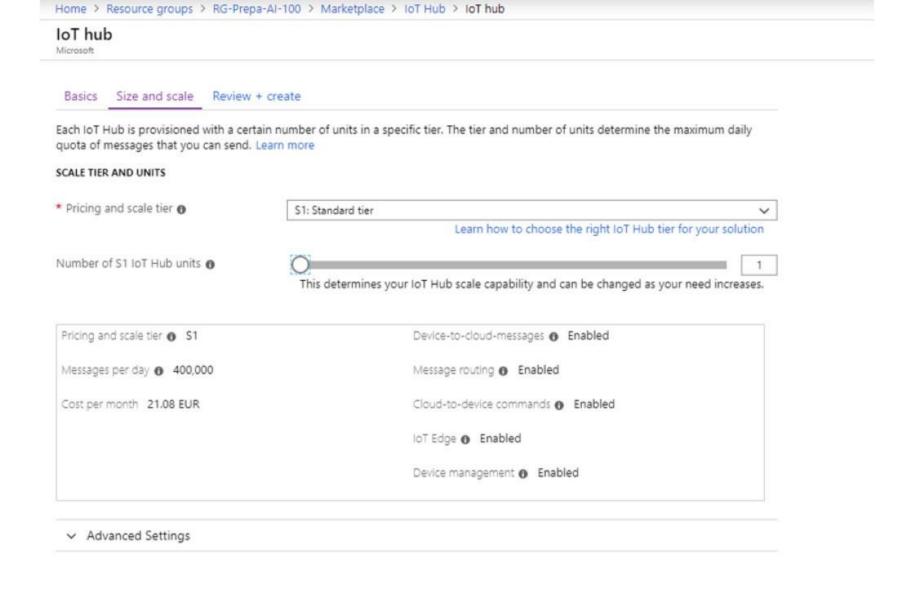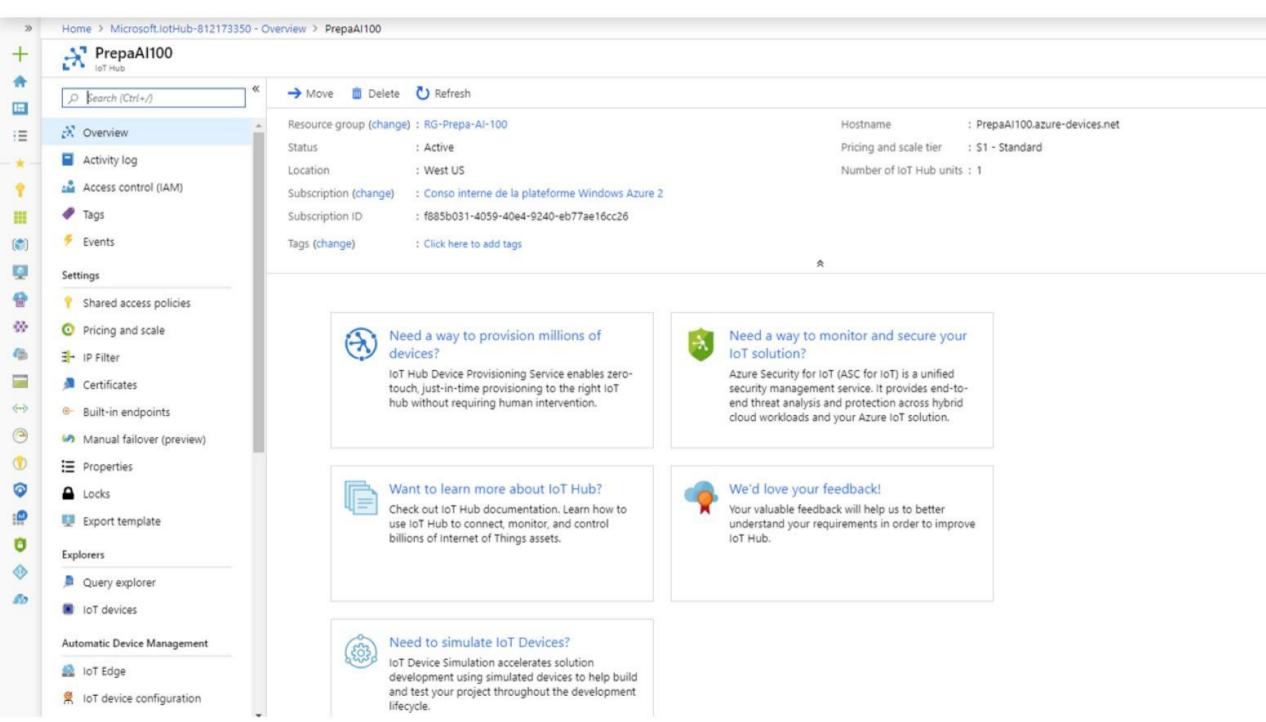
Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

* Subscription ⓘ
Conso interne de la plateforme Windows Azure 2 ⌄

* Resource Group ⓘ
RG-Prepa-AI-100 ⌄
Create new

* Region ⓘ
West US ⌄

* IoT Hub Name ⓘ
PrepaAI100 ✓

IoT hub
Microsoft

Basics   **Size and scale**   Review + create

Each IoT Hub is provisioned with a certain number of units in a specific tier. The tier and number of units determine the maximum daily quota of messages that you can send. Learn more

SCALE TIER AND UNITS

* Pricing and scale tier ❶

| S1: Standard tier | ⌄ |

Learn how to choose the right IoT Hub tier for your solution

Number of S1 IoT Hub units ❶

◯━━━━━━━━━━━━━━━━━━━━━━━━━━ | 1 |

This determines your IoT Hub scale capability and can be changed as your need increases.

Pricing and scale tier ❶ S1	Device-to-cloud-messages ❶ Enabled
Messages per day ❶ 400,000	Message routing ❶ Enabled
Cost per month 21.08 EUR	Cloud-to-device commands ❶ Enabled
	IoT Edge ❶ Enabled
	Device management ❶ Enabled

⌄ Advanced Settings

Review + create   « Previous: Basics   Automation options

PrepaAI100
IoT Hub

→ Move   🗑 Delete   ⟳ Refresh

Overview
Activity log
Access control (IAM)
Tags
Events

Settings
Shared access policies
Pricing and scale
IP Filter
Certificates
Built-in endpoints
Manual failover (preview)
Properties
Locks
Export template

Explorers
Query explorer
IoT devices

Automatic Device Management
IoT Edge
IoT device configuration

Resource group (change)   : RG-Prepa-AI-100

Status   : Active

Location   : West US

Subscription (change)   : Conso interne de la plateforme Windows Azure 2

Subscription ID   : f885b031-4059-40e4-9240-eb77ae16cc26

Tags (change)   : Click here to add tags

Hostname   : PrepaAI100.azure-devices.net

Pricing and scale tier : S1 - Standard

Number of IoT Hub units : 1

Need a way to provision millions of devices?

IoT Hub Device Provisioning Service enables zero-touch, just-in-time provisioning to the right IoT hub without requiring human intervention.

Need a way to monitor and secure your IoT solution?

Azure Security for IoT (ASC for IoT) is a unified security management service. It provides end-to-end threat analysis and protection across hybrid cloud workloads and your Azure IoT solution.

Want to learn more about IoT Hub?

Check out IoT Hub documentation. Learn how to use IoT Hub to connect, monitor, and control billions of Internet of Things assets.

We'd love your feedback!

Your valuable feedback will help us to better understand your requirements in order to improve IoT Hub.

Need to simulate IoT Devices?

IoT Device Simulation accelerates solution development using simulated devices to help build and test your project throughout the development lifecycle.

PrepaAI100 - IoT Edge
IoT Hub

+ Add an IoT Edge device   ⟲ Add an IoT Edge deployment   ⟳ Refresh   🗑 Delete

ⓘ   Deploy Azure services and solution-specific code to on-premises devices. Use IoT Edge devices to perform compute and analytics tasks on data before it's sent to the cloud.

IoT Edge devices   IoT Edge deployments

IoT Edge devices

Field
+ ✕   Select or enter your own   ▾   Operator   Value
= ▾

+ Add new clause

Query devices

☐	DEVICE ID	RUNTIME RESPONSE	IOT EDGE MODULE COUNT	CONNECTED CLIENT COUNT	D

No results

Sidebar:

🔍 Search (Ctrl+/)

- Certificates
- Built-in endpoints
- Manual failover (preview)
- Properties
- Locks
- Export template

Explorers
- Query explorer
- IoT devices

Automatic Device Management
- IoT Edge
- IoT device configuration

Messaging
- File upload
- Message routing

Security

Create a device

☐ ✕

ℹ Find Certified for Azure IoT devices in the Device Catalog ⧉

* Device ID ⓘ

RaspberryPI3-Stan ✓

Authentication type ⓘ

(Symmetric key)

* Primary key ⓘ

Enter your primary key

* Secondary key ⓘ

Enter your secondary key

Auto-generate keys ⓘ

☑

Connect this device to an IoT hub ⓘ

(Enable) Disable

Child devices ⓘ

0

Choose child devices

Save

PrepaAI100 - IoT Edge
IoT Hub

+ Add an IoT Edge device   **Add an IoT Edge deployment**   **↻ Refresh**   **🗑 Delete**

Certificates

Built-in endpoints

Manual failover (preview)

Properties

Locks

Export template

Explorers

Query explorer

IoT devices

Automatic Device Management

IoT Edge

IoT device configuration

Messaging

File upload

Message routing

Security

Overview

Security Alerts

ℹ Deploy Azure services and solution-specific code to on-premises devices. Use IoT Edge devices to perform compute and analytics tasks on data before it's sent to the cloud.

IoT Edge devices   IoT Edge deployments

IoT Edge devices

+ ✕   Field
Select or enter your own   Operator =   Value

+ Add new clause

Query devices   **</> Switch to query editor**

	DEVICE ID	RUNTIME RESPONSE	IOT EDGE MODULE COUNT	CONNECTED CLIENT COUNT	DEPLOYMENT COUNT
☐	RaspberryPI3-Stan	N/A	0	0	0

RaspberryPI3-Stan
PrepaAI100

🖫 Save   Set Modules   Manage Child Devices   ☰ Device Twin   Manage keys ⌄   Refresh

Device ID ⓘ   RaspberryPI3-Stan

Primary Key ⓘ   ••••••••••••••••••••••••••••••••••••••

Secondary Key ⓘ   ••••••••••••••••••••••••••••••••••••••

Primary Connection String ⓘ   •••

Secondary Connection String ⓘ   •••

IoT Edge Runtime Response ⓘ   NA

Enable connection to IoT Hub ⓘ   ⦿ Enable   ◯ Disable

Modules   IoT Edge Hub connections   Deployments

NAME	TYPE	SPECIFIED IN DEPLOYMENT	REPORTED BY DEVICE	RUNTIME STATUS	EXIT CODE
$edgeAgent	Module Identity	NA	NA	NA	NA
$edgeHub	Module Identity	NA	NA	NA	NA

PrepaAI100 - IoT Edge
IoT Hub

+ Add an IoT Edge device   **Add an IoT Edge deployment**   **Refresh**   **Delete**

- Certificates
- Built-in endpoints
- Manual failover (preview)
- Properties
- Locks
- Export template

Explorers

- Query explorer
- IoT devices

Automatic Device Management

- IoT Edge
- IoT device configuration

Messaging

- File upload
- Message routing

ℹ Deploy Azure services and solution-specific code to on-premises devices. Use IoT Edge devices to perform compute and analytics tasks on data before it's sent to the cloud.

IoT Edge devices   IoT Edge deployments

IoT Edge devices

Field	Operator	Value
Select or enter your own	=	

+ Add new clause

Query devices   **</> Switch to query editor**

DEVICE ID	RUNTIME RESPONSE	IOT EDGE MODULE COUNT	CONNECTED CLIENT COUNT	DEPLOYMENT COUNT
UbuntuIoTStan1	OK	3	1	0
raspberrypi	417 - The device's deployment c...	1	0	0

UbuntuIoTStan1
PrepaAI100

🖫 Save   ⊂ Set Modules   ⊹ Manage Child Devices   ☰ Device Twin   🔍 Manage keys ⌄   ↻ Refresh

Device ID ⓘ	UbuntuIoTStan1
Primary Key ⓘ	••••••••••••••••••••••••••••••••
Secondary Key ⓘ	••••••••••••••••••••••••••••••••
Primary Connection String ⓘ	••
Secondary Connection String ⓘ	••
IoT Edge Runtime Response ⓘ	200 -- OK
Enable connection to IoT Hub ⓘ	● Enable ○ Disable

Modules   IoT Edge Hub connections   Deployments

NAME	TYPE	SPECIFIED IN DEPLOYMENT	REPORTED BY DEVICE	RUNTIME STATUS	EXIT CODE
$edgeAgent	IoT Edge System Module	✓ Yes	✓ Yes	running	0
$edgeHub	IoT Edge System Module	✓ Yes	✓ Yes	running	0
SimulatedTemperatureSensor	IoT Edge Custom Module	✓ Yes	✓ Yes	running	0

```
stan@UbuntuIoTStan1:~$ sudo iotedge list
NAME                        STATUS     DESCRIPTION    CONFIG
SimulatedTemperatureSensor  running    Up 2 hours     mcr.microsoft.com/azureiotedge-simulated-temperature-sensor:1.0
edgeAgent                   running    Up 2 hours     mcr.microsoft.com/azureiotedge-agent:1.0
edgeHub                     running    Up 2 hours     mcr.microsoft.com/azureiotedge-hub:1.0
```

EdgeAgent, EdgeHub

- ## EdgeHub :
  - local IoT Hub proxy
  - Support AMQP and MQTT, not HTTP
  - Optimizes connections to the Cloud
  - Automatic local message storage
  - Facilitate module communication
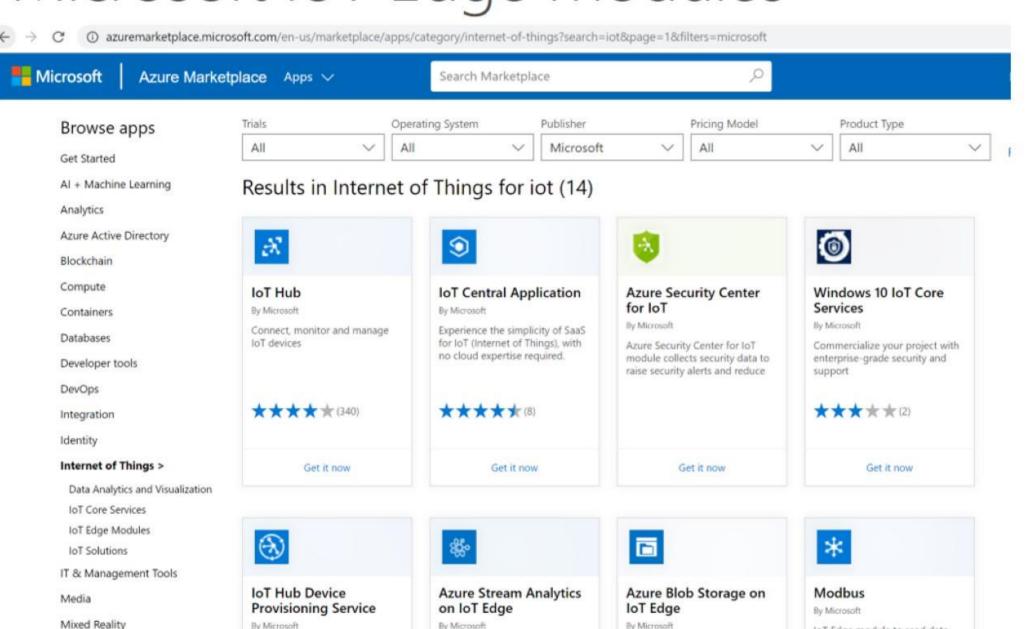
- ## EdgeAgent

  - Instanciates module
  - Ensures modules run
  - Monitors modules status
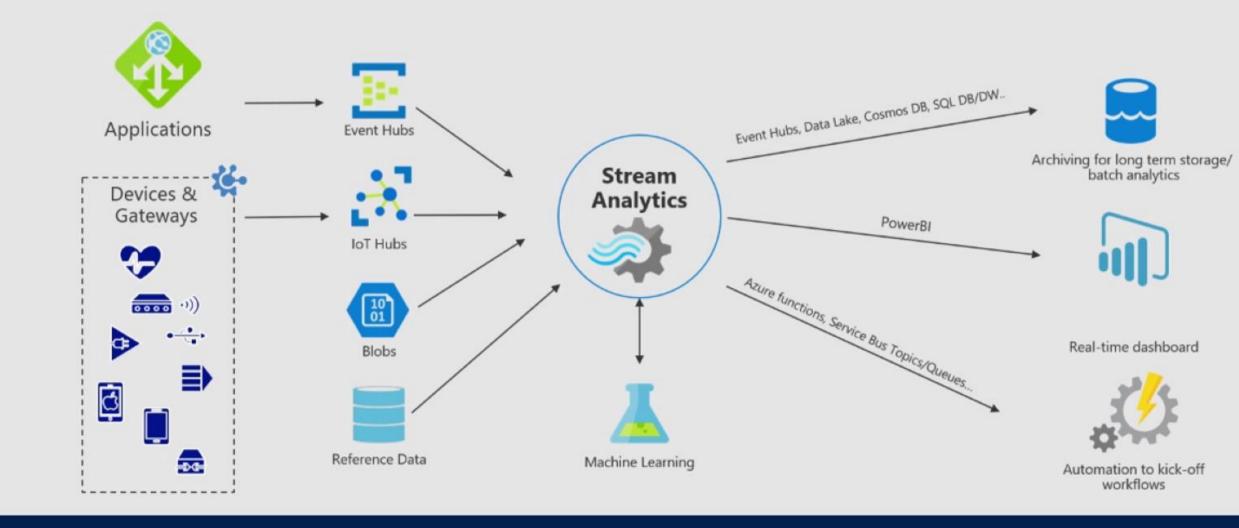
```
stan@UbuntuIoTStan1:~$ sudo iotedge list
NAME                          STATUS     DESCRIPTION      CONFIG
SimulatedTemperatureSensor    running    Up 2 hours       mcr.microsoft.com
edgeAgent                     running    Up 2 hours       mcr.microsoft.com
edgeHub                       running    Up 2 hours       mcr.microsoft.com
```

Microsoft IoT Edge modules
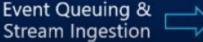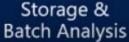
Stream Analytics: Canonical hot-path pipeline design

Applications

Devices & Gateways

Event Hubs

IoT Hubs

Blobs

Reference Data

Stream Analytics

Machine Learning

Event Hubs, Data Lake, Cosmos DB, SQL DB/DW...

Archiving for long term storage/batch analytics

PowerBI

Real-time dashboard

Azure functions, Service Bus Topics/Queues...

Automation to kick-off workflows

Event production → Event Queuing & Stream Ingestion → Stream Analytics ↔ Storage & Batch Analysis → Presentation & Action

Azure Stream Analytics

- Unlocking Real-Time Insight
  - When insights are perishable and time to decision is critical
  - When you need to query data while it is still in motion

- Easy to start
  - Simple SQL Like Language
    - Inputs -> Query -> Outputs
  - Integrate with the rest of the Azure ecosystem
  - Can run on the Edge with Azure IoT Edge Runtime
    - But still managed from the Cloud
    - Same language for both Cloud and Edge « jobs »
    - Cross Platform : runs on Docker Container (Linux/Windows, x86/x64/ARM)
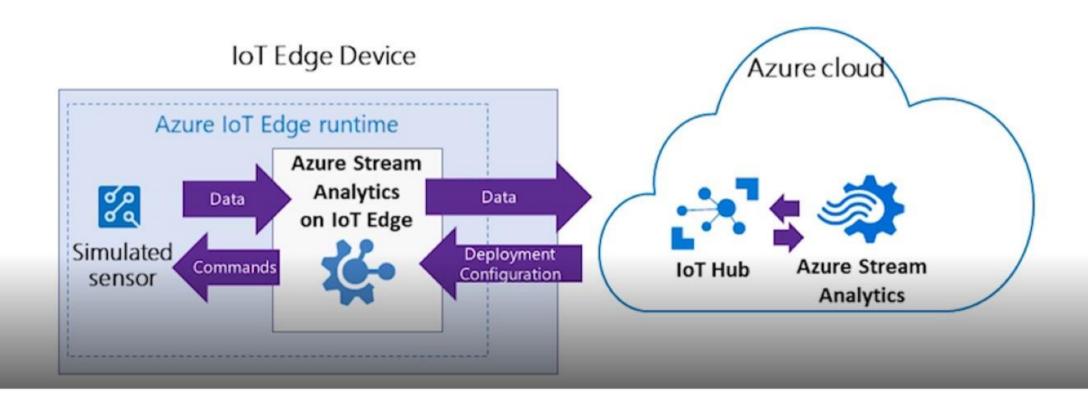
Azure Stream Analytics

Demo Architecture

- <u>Simulated sensor</u>: sends temperature and humidity
- <u>ASA</u>: triggers an alert if the temperature is above 25, and reset sensor

ASAEdgejob2
Query

🖫 Save   ↻ Discard   ⚙ Test

▼ 🔁 Inputs (1)

    ⁂ temperature   🗎 •••

▼ 🔁 Outputs (1)

    ⁂ alert

Need help with your query? Check out some of the most common Stream Analytics query patterns here.

```
1  SELECT
2        'reset' AS command
3  INTO
4     alert
5  FROM
6     temperature TIMESTAMP BY timeCreated
7  GROUP BY TumblingWindow(second,2)
8  HAVING Avg(machine.temperature) > 25
9
```

Your query could be put in logs that are in a potentially different geography.
Missing some language constructs? Let us know! (Powered by UserVoice - Privacy Policy)

{"temperature":45....	{"temperature":21....	"2017-11-10T07:2...	"2017-11-10T07:2...	0
{"temperature":45....	{"temperature":20....	"2017-11-10T07:2...	"2017-11-10T07:2...	0
{"temperature":47....	{"temperature":20....	"2017-11-10T07:2...	"2017-11-10T07:2...	0

ASAEdgejob2
Stream Analytics job

▶ Start   ■ Stop   🗑 Delete

ℹ Saved setting

Saved settings for

ℹ Edge jobs can be deployed to devices running Azure IoT Edge using IoT Hub. For details, please refer to our documenta

- 🌐 Overview
- 📘 Activity log
- 👥 Access control (IAM)
- 🏷 Tags
- 🔧 Diagnose and solve problems

SETTINGS

- 🔒 Locks

JOB TOPOLOGY

- ⤢ Inputs
- <> Query
- ⤢ Outputs

Job Topology

Inputs	Query	Outputs
1 ⤢	<>	1 ⤢
temperature		alert

Monitoring

InputEvents, OutputEvents and one more metric past hour

100

80

Main edge Scenarios for Azure Stream Analytics

- ## Low-latency command and control

  - Azure Stream Analytics can analyze sensor data in near real time and issu commands when you detect anomalies

- ## Limited connectivity to the cloud

  - Your Streaming logic runs independently of the network connectivity

- ## Limited bandwidth

  - With Azure Stream Analytics you can filter or aggregate data before sending it to the cloud

- ## Compliance

  - With Azure Stream Analytics you can anonymize or aggregate data before sending it to the cloud

Built-in ML based Anomaly Detection

Easily invoked with simple function calls

Un-supervised learning models

Support in-line learning and real-time scoring

2 broad categories of anomalies detected:
Temporary Anomalies: Spikes, Dips
Persistent Anomalies: Slow +/- trends, Bi-level changes
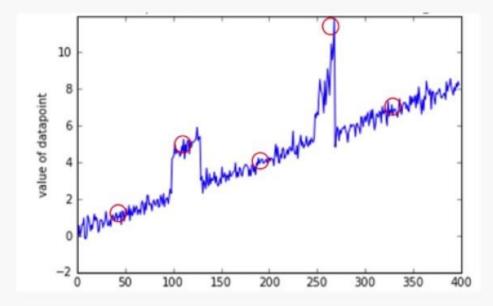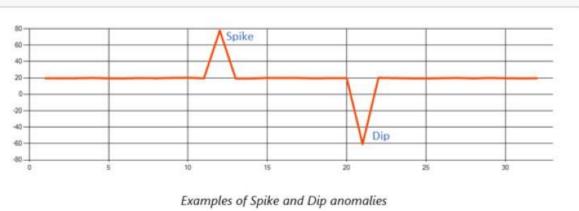
Customer benefits
Time to Value
Lower costs
Better performance than 'Bring Your Own Model'
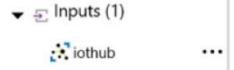
Examples of Spike and Dip anomalies

adASAMxChip

Query

 Save   Discard   Test

Inputs (1)

 iothub   ...

Outputs (1)

 pbi

Need help with your query? Check out some of the most common Stream Analytics query patterns here.

```
 1   With ADStep as
 2   (
 3   SELECT
 4       EVENTPROCESSEDUTCTIME as time,
 5       z,
 6       AnomalyDetection_SpikeAndDip(z, 9Y, 500, 'spikesanddips') OVER(LIMIT DURATION(ss, 120)) as scores
 7   FROM
 8       iothub
 9   )
10
11   SELECT
12       time,
13       z,
14       CAST(GetRecordPropertyValue(scores, 'IsAnomaly') as bigint) as IsAnomaly,
15       CAST(GetRecordPropertyValue(scores, 'Score') as float) as Score
16   INTO
```
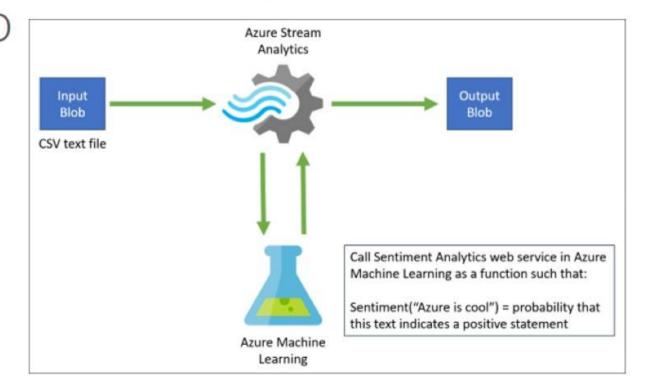
Your query could be put in logs that are in a potentially different geography.
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Performing sentiment analysis by using Azure Stream Analytics and Azure Machine Learning Studio

- Azure Stream Analytics job that integrates Azure Machine Learning Studio

Stream analytics with Spark or Storm

- Another option for stream analytics is Apache Spark in Azure Databrick, or Apache Storm
- Along with the other projects of Apache such as Hadoop and Spark, Storm is one of the star performers in the field of data analysis

Situation	Spark	Storm
Stream processing	Batch processing	Micro-batch processing
Latency	Latency of a few seconds	Latency of milliseconds
Multi-language support	Lesser language support	Multiple language support

Identify storage required to store logging, bot state data, and Cognitive Services output

Choose the right data store

- Relational database management options
  - Azure SQL DB
  - Azure Database for PostgreSQL
  - Azure Database for MySQL
  - Azure Database for MariaDB
  - SQL Server Big Data Clusters
- Key Value Stores
  - CosmosDB
  - Azure cache for Redis
- Document database
  - CosmosDB

Choose the right data store

- Graph database
  - CosmosDB
- Column family databases
  - CosmosDB
  - Azure cache for Redis
- Data analytics
  - SQL Data Warehouse (now called Synapse Analytics)
  - SQL Server Big Data Clusters
  - Azure Data Lake
  - Azure Data Explorer
- Search engine databases
  - Azure Search
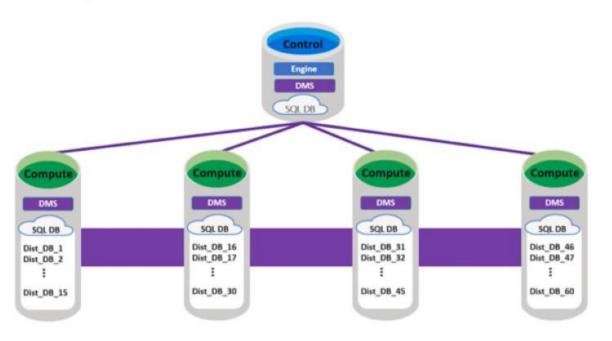
Choose the right data store

- Time Series Databases
  - Time Series Insights
- Object Storage
  - Blob Storage
- Shared files
  - File Storage

Azure SQL Data Warehouse

- SQL Data Warehouse is a cloud-based Enterprise Data Warehouse (EDW) that uses Massively Parallel Processing (MPP) to quickly run complex queries across petabytes of data

- Combines SQL relational databases with massively parallel processing

- Use SQL Data Warehouse as a key component of a big data solution. Import big data into SQL Data Warehouse with simple PolyBase T-SQL queries, and then use the power of MPP to run high-performance analytics
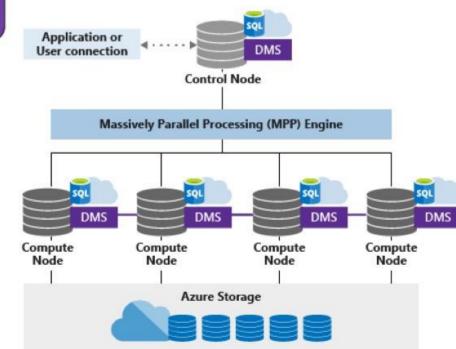
SQL DW Fundamentals

Control
Connection and tool endpoint.
Coordinates compute activity.

Compute
Handles query processing,
ability to scale up/down

DMS: Data Movement Services
Coordinates data movement
between nodes

Azure Data Lake Store

- Azure Data Lake Storage Gen2 is a set of capabilities dedicated to big data analytics, built on [Azure Blob storage](#)
  - Data Lake Storage Gen2 is the result of converging the capabilities of our two existing storage services, Azure Blob storage and Azure Data Lake Storage Gen1
  - Data Lake Storage Gen2 allows you to easily manage massive amounts of data
  - Data Lake Storage Gen2 allows you to manage and access data just as you would with a Hadoop Distributed File System (HDFS). The new ABFS driver is available within all Apache Hadoop environments including Azure HDInsight, Azure Databricks and SQL Data Warehouse

Azure Data Lake Analytics

- Azure Data Lake Analytics is an on-demand analytics job service that simplifies big data
- Instead of deploying, configuring, and tuning hardware, you write queries to transform your data and extract valuable insights
- The analytics service can handle jobs of any scale instantly by setting the dial for how much power you need. You only pay for your job when it is running, making it cost-effective