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Global Speaker

- Passionate to **learn**.
- Passionate to **share knowledge**.
- Passionate to work on **Microsoft Technologies**

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AGENDA SLIDE

Part 1

01	02	03	04	05

AI Overview

what AI, responsible AI, different types machine learning models.

Computer Vision

Azure AI Vision, included in Azure AI Vision

NLP

conversational AI, Azure AI services

Gen AI

Generative AI, Azure OpenAI Service

Demos

All as discussed

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What is Artificial Intelligence?

Software that **imitates human capabilities**

- **Predicting outcomes** and **recognizing patterns** based on historic data.

- Recognizing **abnormal events** and **making decisions.**

- Interpreting **visual input.**

- **Understanding language** and engaging in conversations.

- **Extracting information** from sources to gain knowledge.
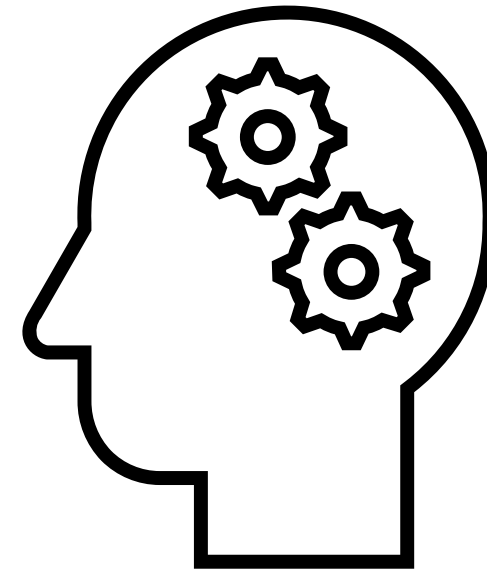
Common AI workloads

	Machine Learning	**Predictive models** based on data and statistics – the foundation for AI.
	Computer Vision	**Capabilities within AI** to interpret the world visually through cameras, video, and images.
	Natural Language Processing	**Capabilities within AI** for a computer to interpret **written or spoken** language and respond appropriately. (e.g. ChatGPT, Bing Copilot)
	Document Intelligence	**Capabilities within AI** that deal with **managing, processing**, and using high volumes of data found in forms and documents.
	Knowledge Mining	Capabilities within AI to extract information from **large volumes of often unstructured data t**o create a searchable knowledge store.
	Generative AI	**Capabilities within AI** that create original content in a variety of formats including natural **language, image, code, and more**.

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Principles of responsible AI

	Challenge or Risk	Example
Fairness	Bias can affect results.	A loan-approval model **discriminates by gender due to bias in the data** with which it was trained.
Reliability & safety	Errors may cause harm.	An **autonomous vehicle experiences** a system failure and causes a collision.
Privacy & security	Private data could be exposed.	A medical diagnostic bot is trained using **sensitive patient data**, which is stored insecurely.
Inclusiveness	Solutions may not work for everyone.	A predictive app provides **no audio output for visually impaired users.**
Transparency	Users must trust a complex system.	An **AI-based financial tool** makes investment recommendations – what are they based on?
Accountability	Who's liable for AI-driven decisions?	An **innocent person is convicted of a crime based on evidence** from facial recognition – who's responsible?

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What is machine learning?

Creating <u>predictive models</u> by finding relationships in data

Training

1. Training data
(**past** observations)

$[x_1, x_2, x_3]$, y
$[x_1, x_2, x_3]$, y
$[x_1, x_2, x_3]$, y
$[x_1, x_2, x_3]$, y
$[x_1, x_2, x_3]$, y

Features *Label*
(x)   (y)

2. Algorithm
(Generalizes the relationship
between x and y as a function)

3. Model
(encapsulates the function)

$y = f(x)$

Inferencing

$[x_1, x_2, x_3]$ ŷ

4. Inferencing data
(unlabeled features)

Prediction
(inferred label)

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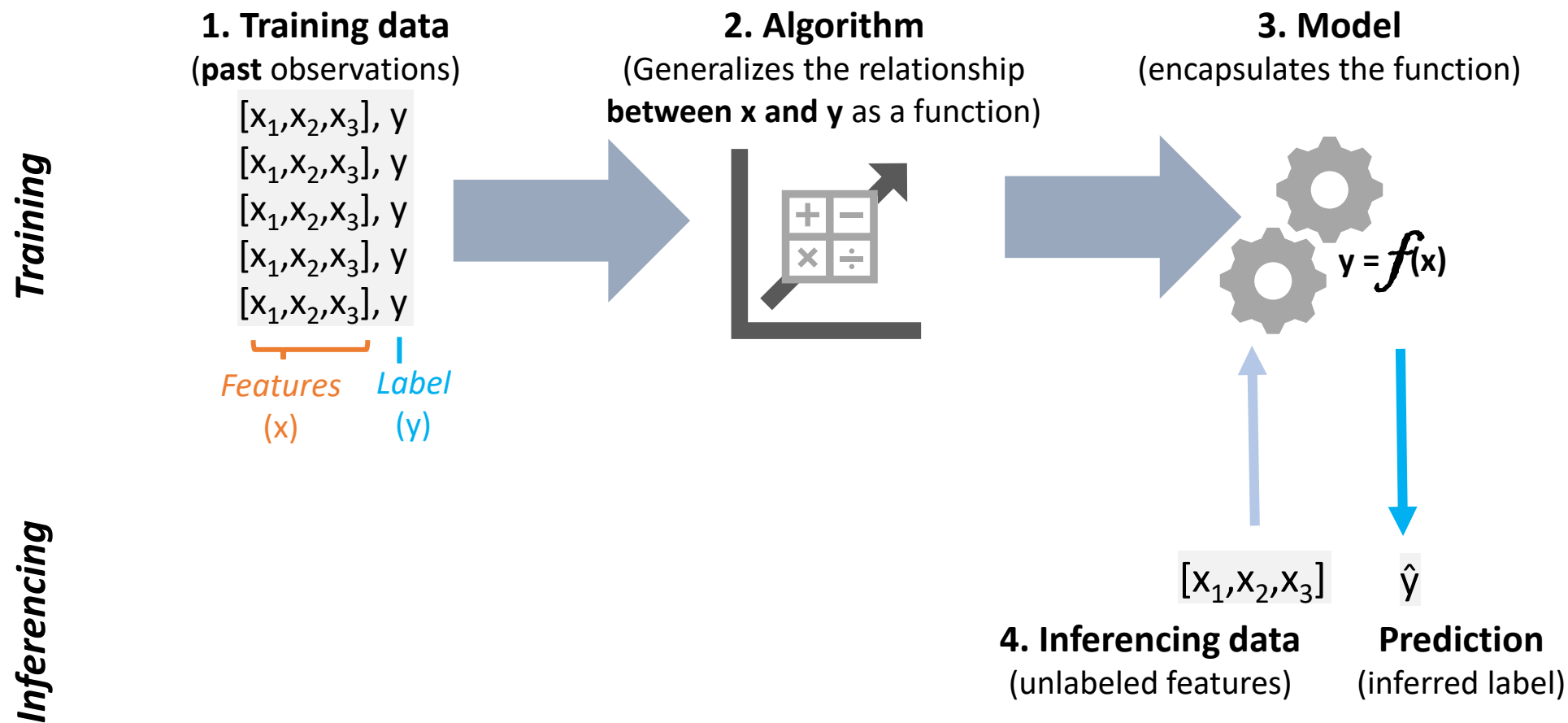
Types of machine learning

Machine Learning

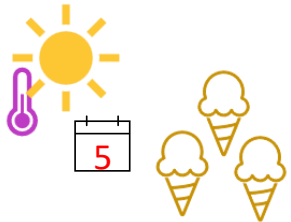**Supervised machine learning**
Training data includes known labels

Unsupervised machine learning
Training data is unlabeled

Regression
Label is a **numeric value**

Predict the **number of ice creams sold** based on day, season, and weather

Classification
Label is a categorization (or *class*)

Binary classification
Label *is* or *is not* a class
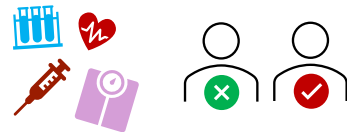
Predict whether a patient is at-risk **for diabetes based** on clinical data

Multiclass classification
Label is one of multiple classes
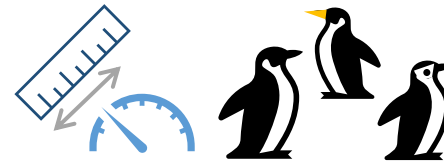
Predict the species of **a penguin based on its measurements**

Clustering
Similar items are grouped together
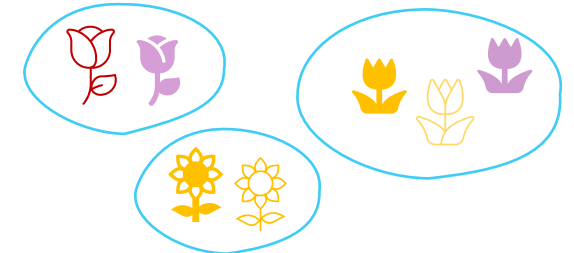
Separate plants into groups based **on common characteristics**

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Model training and evaluation

Multiple training iterations with different algorithms and parameters

1. Training data
(past observations)

$[x_1,x_2,x_3], y$
$[x_1,x_2,x_3], y$
$[x_1,x_2,x_3], y$
$[x_1,x_2,x_3], y$
$[x_1,x_2,x_3], y$

- - - - - - - - -

$[x_1,x_2,x_3], y$
$[x_1,x_2,x_3], y$
$[x_1,x_2,x_3], y$

Validation data
(with known labels)

2. Algorithm
(Generalizes the relationship
between x and y as a function)

3. Model
(encapsulates the function)

$y = f(x)$

5. Evaluate model
*(compare predicted labels
to actual labels)*

4. Predictions
(from the validation data)

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Predicative AI vs Generative AI

|	Predicative AI	Gen AI
Function	Predicts the most probable **output** given input data.	Creates **new data similar** to the **input** data distribution.
Training	Typically trained on **labeled data** for classification tasks.	Often trained on **unlabeled data** for generating new content.
Output Variety	**Limited to predicting** predefined classes or values.	Capable of **producing diverse outputs, sometimes novel.**

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Deep learning (Subset of ML)

Human neural network

- **Neurons fire** in response to electrochemical stimuli
- **When fired,** the signal is passed to connected neurons

Artificial neural network


$$\int \left(f(x,w) \right)$$
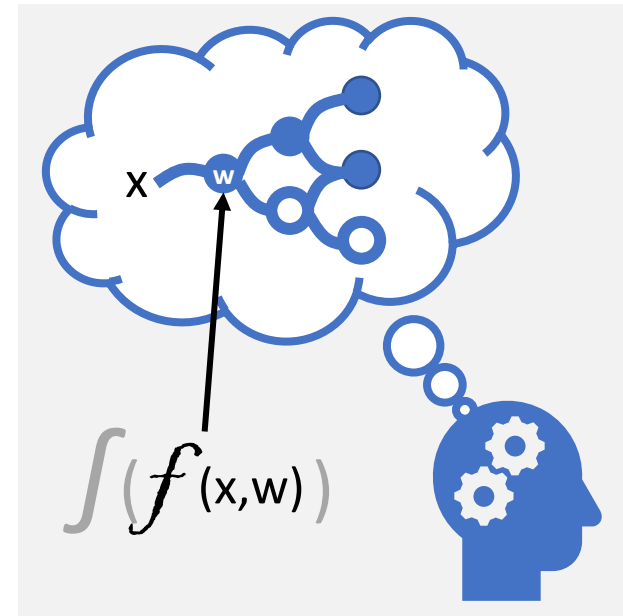
- Each neuron is a function that operates on **an *input* value (x) and a *weight* (w)**
- The function is wrapped in **an *activation function*** that determines whether to pass the output on

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What is Azure Machine Learning (Azure ML)?

- **Azure Machine Learning** is a **cloud-based platform** for machine learning.
- **Azure Machine Learning Studio** is a user interface for accessing Azure Machine Learning capabilities.
- **Machine learning models** trained with Azure Machine Learning can be published as services.
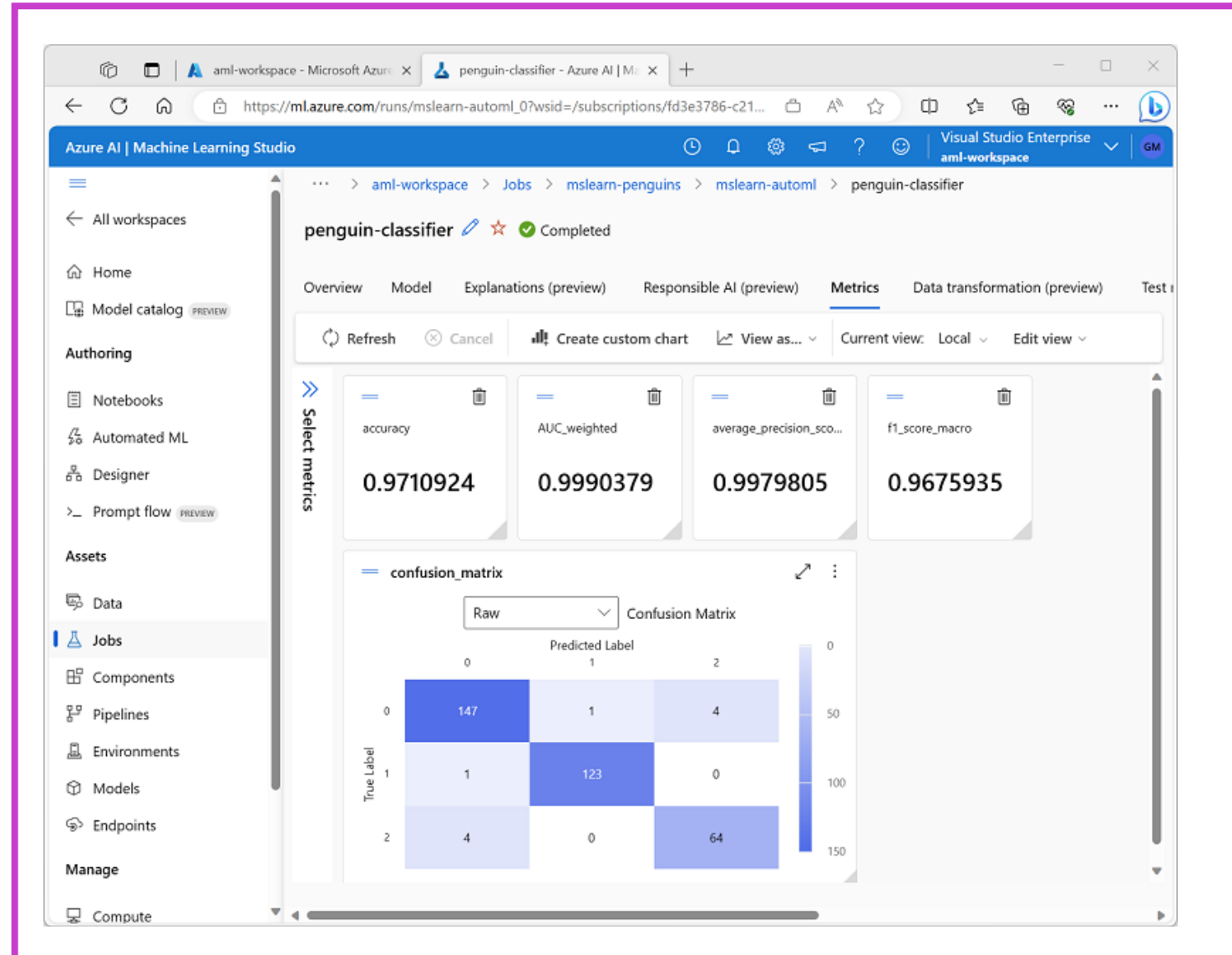
Demo: Explore Automated Machine Learning in Azure Machine Learning Studio

In this demo, you will see how machine learning features can be used to train a machine learning model to make predictions.

1. Follow along on the exercise page at: **https://aka.ms/ai900-auto-ml**

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Images and image processing

An image is an array of pixel values

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	255	255	255	0	0
0	0	255	255	255	0	0
0	0	255	255	255	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Filters are applied to change images

| -1	-1	-1	0	0	0	0
-1	8	-1	0	0	0	0
-1	-1	255	255	255	0	0
0	0	255	0	255	0	0
0	0	255	255	255	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Convolutional Neural Networks

1. Labeled mages are used to train the model
2. Filter layers extract *feature maps* from each image
3. The feature maps are flattened
4. The feature values are fed into a fully connected neural network
5. The output layer produces a probability value for each possible class label
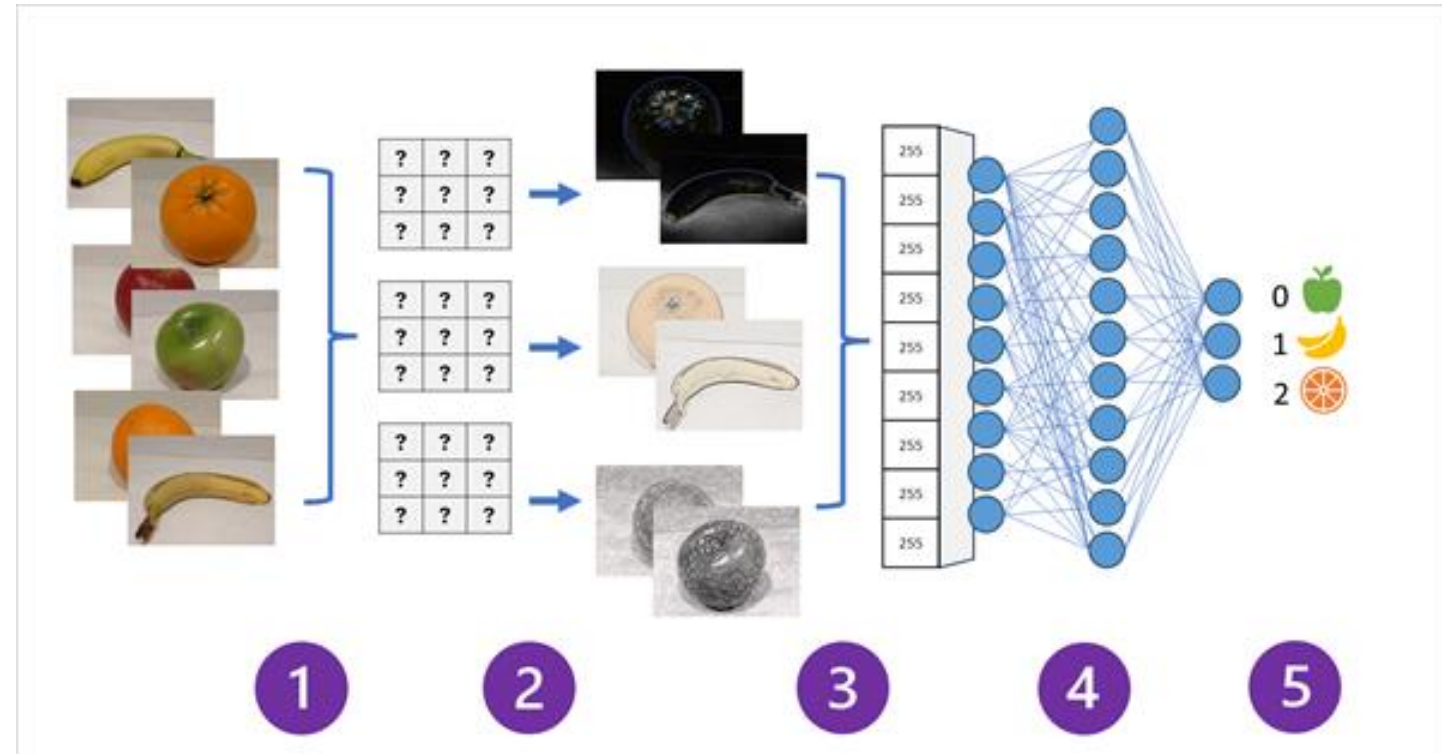
- During training, the filter kernels start with random weights. These weights are iteratively adjusted to improve the accuracy of the predictions based on the known labels.
- The trained model uses learned weights to extract features from new images and predict their class.

Multi-modal models
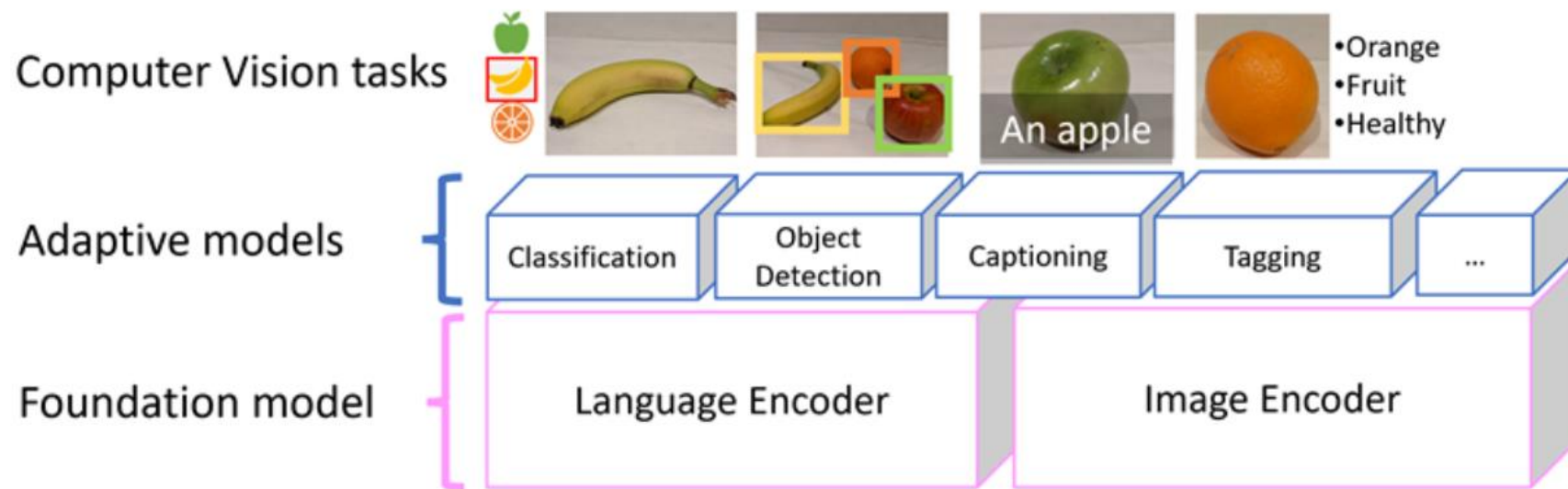
- A newer approach to modeling involves combining language and vision models that encode image and text data
- The model encapsulates semantic relationships between features extracted from the images and text extracted from related captions.
- A multi-modal model can be used as a *foundation* model for more specialized *adaptive* models.

Computer vision services in Azure

| Vision	Face
• Image Analysis: • Image tagging, captions, model customization, and more. • Optical Character Recognition (OCR) • Spatial analysis	• Face detection • Face recognition

Image analysis 4.0 with the *AI Vision* Service

Capabilities include:

- Model customization

- Read text from images

- Detect people in images

- Generate image captions

- Detect objects

- Tag visual features

- Smart crop
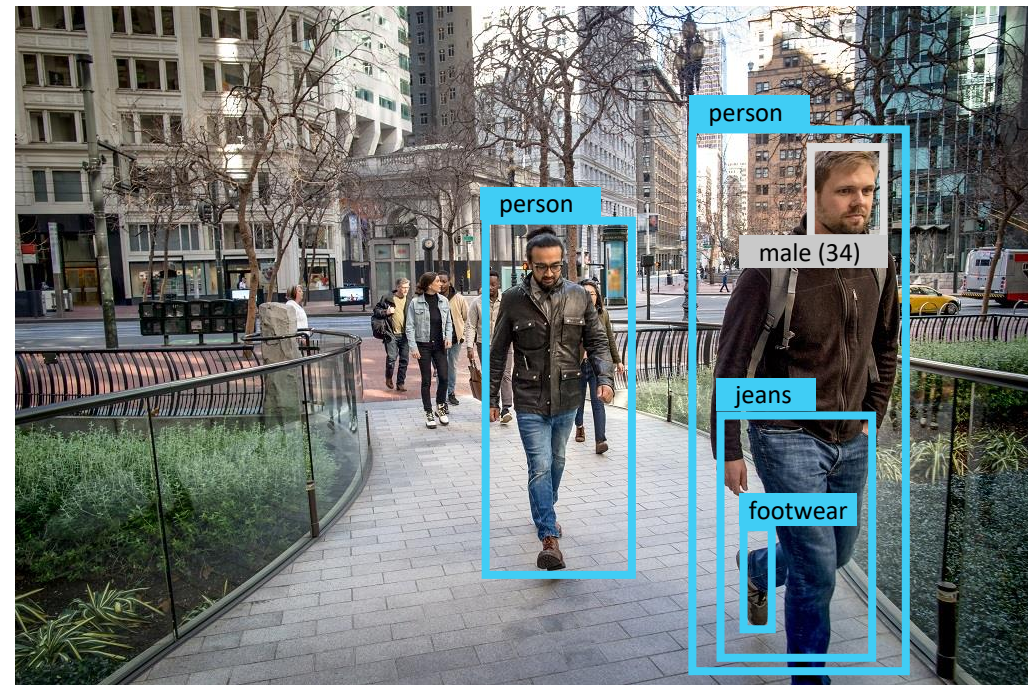
Caption: A group of people walking on a sidewalk
Tags: Building, jeans, street, outdoor, jacket, city, person
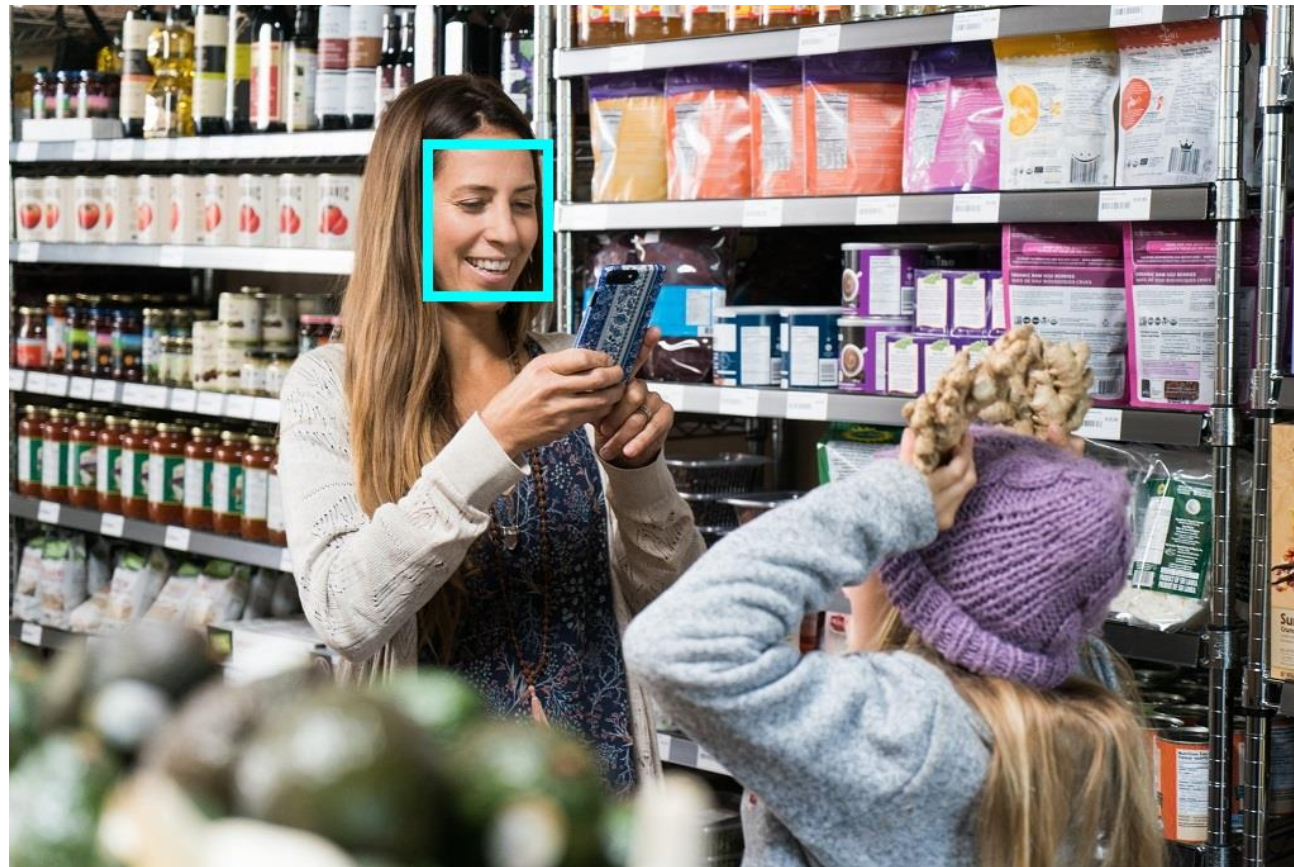
Detecting faces with the *Face* Service

Anyone can use the Face service to detect:

- Blur

- Exposure

- Glasses

- Head pose

- Noise

- Occlusion

Only Managed Microsoft customers can access facial recognition capabilities:

- Similarity matching

- Identity verification

*To support Microsoft's Responsible AI Principles, Facial Recognition is under a Limited Access policy.
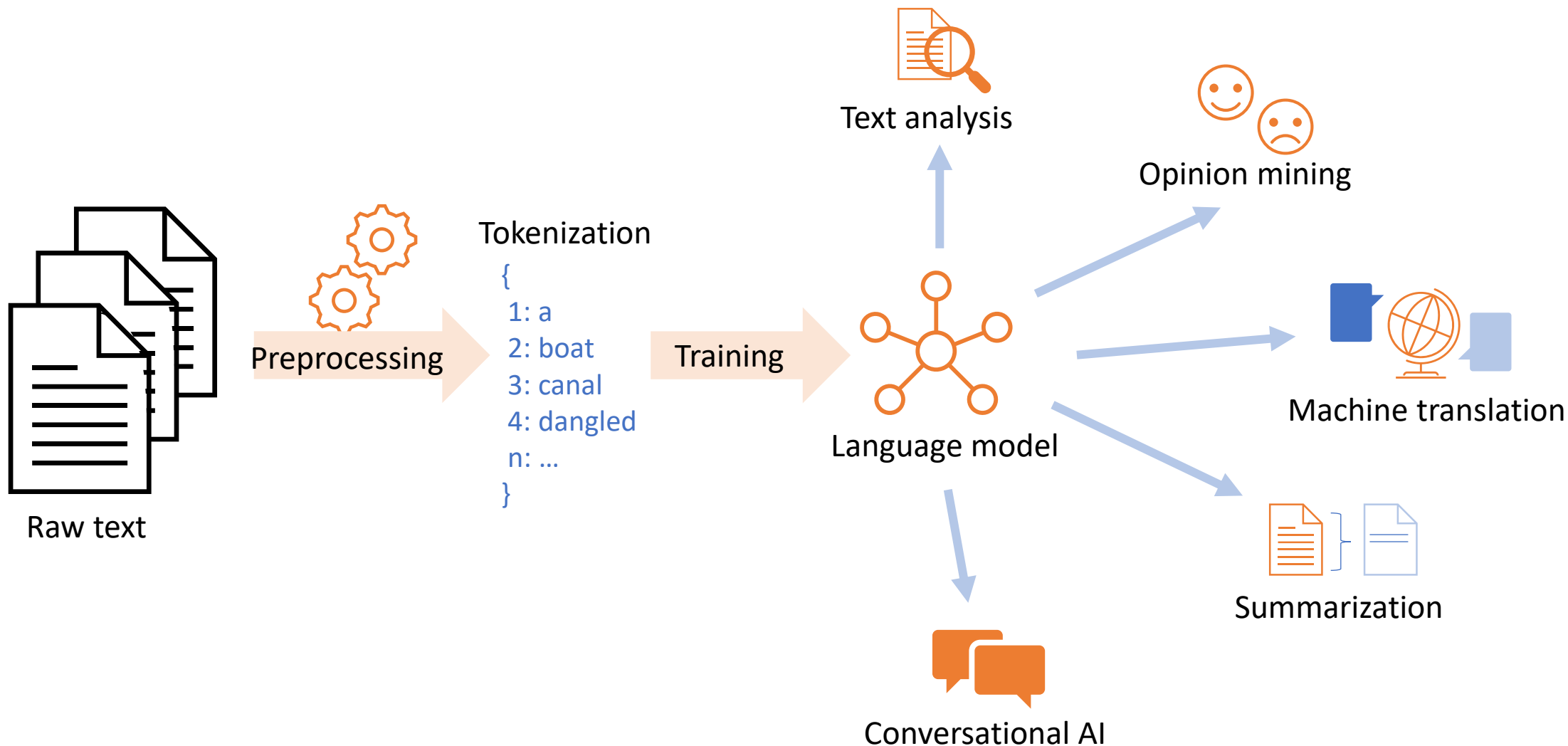
Demo: Detect faces in Vision Studio

In this demo, you will take a look at the face detection capabilities of the **Azure AI Face** service.

1. Follow along on the exercise page at: **https://aka.ms/ai900-face**

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What is natural language processing?

Raw text → Preprocessing → Tokenization

```
{
1: a
2: boat
3: canal
4: dangled
n: …
}
```

→ Training → Language model

- Text analysis
- Opinion mining
- Machine translation
- Summarization
- Conversational AI

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Natural language processing and conversational AI in Azure

Language	**Speech**	**Translator**
• **Language detection**	• **Text to speech**	• **Text translation**
• Key phrase extraction	• **Speech to text**	• **Document translation**
• Named entity detection	• **Speech translation**	• Custom translation
• **Sentiment analysis and opinion mining**	• Speaker identification	• …
• **Personal information detection**	• Language identification	
• **Summarization**	• …	
• **Question answering**		
• **Conversational language understanding**		
• …		

Analyzing text

I had a wonderful vacation in France.

- **Predominant Language:** English

- **Sentiment:** .88 (positive)

- **Key Phrases:** "wonderful vacation"

- **Entities:** France

Question answering

Define a *knowledge* base of **question and answer** pairs:

- By entering questions and answers
- From an **existing FAQ document**
- By using built-in *chit-chat*

Consume **the knowledge base** from client apps, **including bots.**
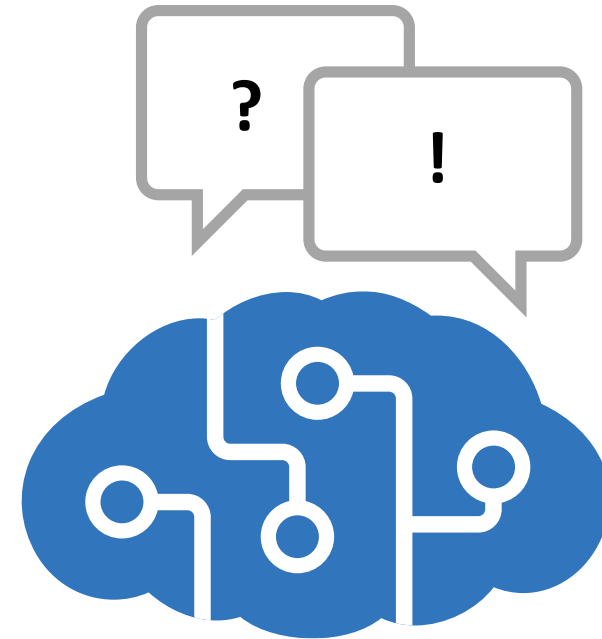
Azure bot service
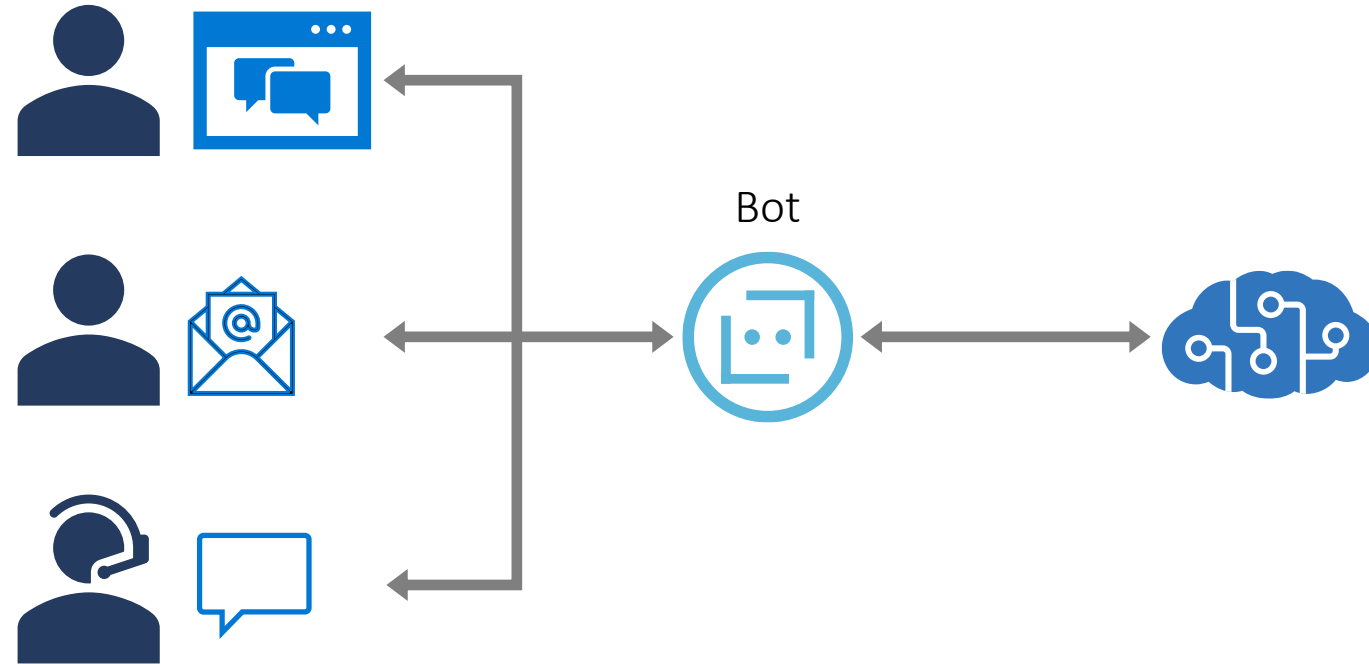
- Cloud-based platform for developing and managing bots

- Integration with **AI** Language and other services

- Connectivity through multiple channels

Demo: Use Form Recognizer

In this demo, you'll see **Azure AI Language**'s question answering capabilities in action.

1. Follow along on the exercise page at:
   https://aka.ms/ai900-question-answering

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What is generative AI?

AI: imitates human behavior by using machine learning to interact with the environment and execute tasks without explicit directions on what to output.

Generative AI: creates original content, such as generative AI that has been built into chat applications. Generative AI applications take in natural language input, and return appropriate responses in a variety of formats:

Natural language generation

Image generation

Code generation

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Large language models

Generative AI applications are powered by *large language models* (LLMs), which are a specialized type of machine learning model that you can use to perform natural language processing (NLP) tasks, including:

- Determining *sentiment* or otherwise classifying natural language text.

- Summarizing text.

- Comparing multiple text sources for semantic similarity.

- Generating new natural language.

Copilots

Copilots are often **integrated into other applications** and provide a way for users to get help with common tasks from a generative AI model.

- **Developers can build copilots that submit prompts** to large language models and generate content for use in applications.

- **Business users can use** copilots to boost their productivity and creativity with AI-generated content.
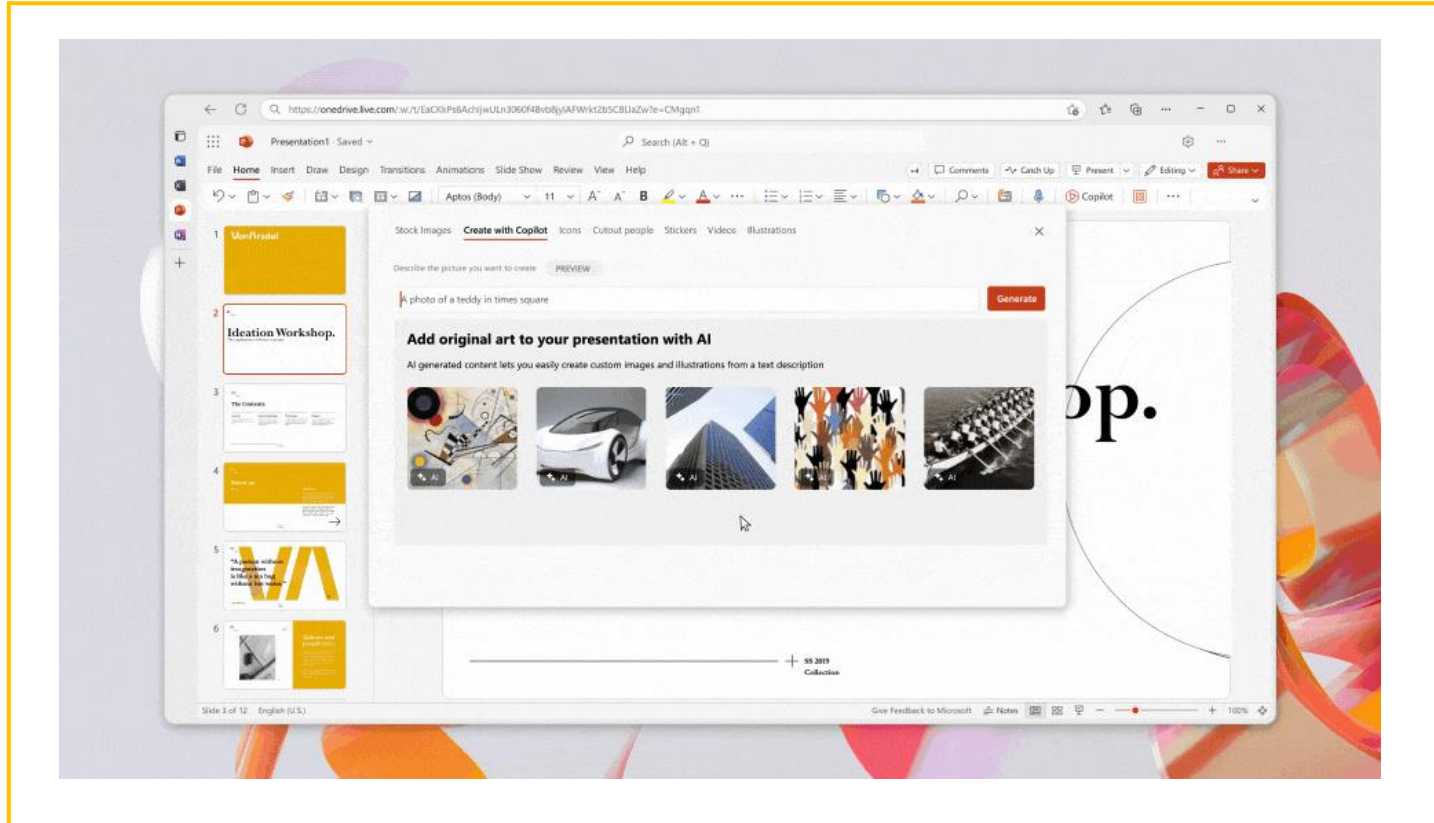
What are copilots?

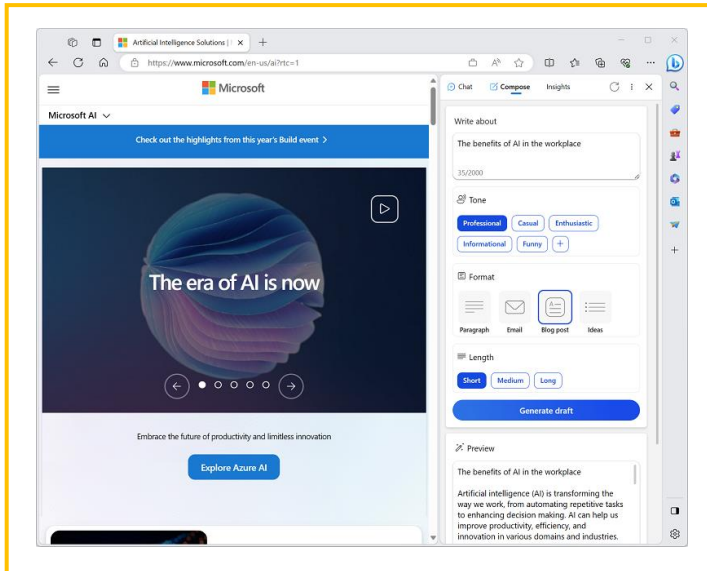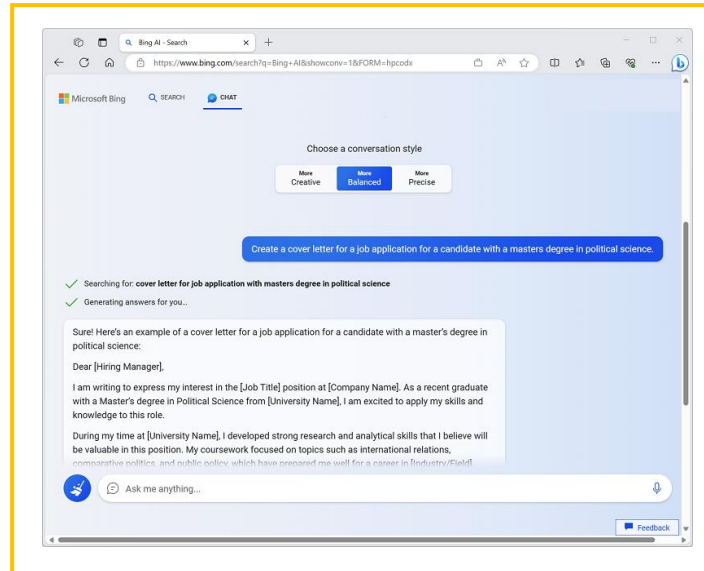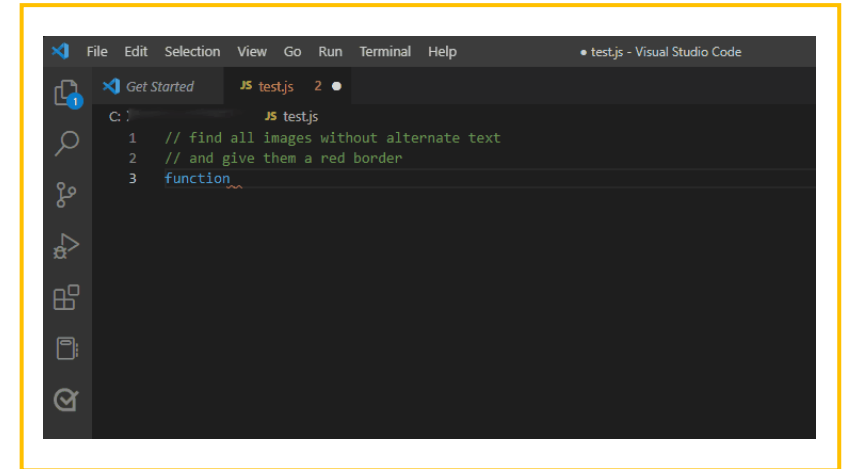Other examples of copilots

Microsoft Edge browser copilot	Microsoft Bing copilot	GitHub copilot

And many more!

Improve generative AI responses with prompt engineering

The term *prompt engineering* describes the process of prompt improvement.

Both developers who design applications and consumers who use applications can improve the quality of responses from generative AI by using direct language, system messages, examples, and/or grounding data.

	Description	Example
Direct language	You can get the most useful completions by being explicit about the kind of response you want.	"**Create a list** of 10 things to do in Edinburgh during August".
System messages	Describe how the chat should act.	"You're a **helpful** assistant that **responds in a cheerful, friendly** manner".
Providing examples	LLMs generally support *zero-shot learning* in which responses can be generated without prior examples. However, you can also provide a few example responses, known as *few-shot learning*.	"Visit the castle in the morning before the crowds arrive".
Grounding data	You can include *grounding* data to provide context.	Including **email text** with the prompt "Summarize my email".

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What is Azure OpenAI?

Azure OpenAI service is Microsoft's cloud solution for deploying, customizing, and hosting large language models.

Azure OpenAI service consists of:
- Pre-trained generative AI models.
- Customization capabilities.
- Built-in tools to detect and mitigate harmful use cases so users can implement AI responsibly.
- Enterprise-grade security with role-based access control (RBAC) and private networks.

You can use several methods to develop Azure OpenAI solutions: Azure AI Studio, REST API, supported SDKs, and Azure CLI.

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What models does Azure OpenAI support?

| Azure OpenAI supports many LLMs:	Description
GPT-4	A set of models that improve on GPT-3.5 and can understand as well as generate natural language and code.
GPT-3.5	A set of models that improve on GPT-3 and can understand as well as generate natural language and code.
Embeddings	A set of models that can convert text into numerical vector form to facilitate text similarity.
DALL-E (preview)	A series of models in preview that can generate original images from natural language.

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How to use Azure OpenAI

Azure OpenAI Studio:

- Build and deploy AI models for software applications

- Powered by generative AI models optimized for various tasks

- Azure OpenAI models include: **GPT-4**, **GPT-3.5**, **Embeddings** and **DALL-E models**

Playgrounds:

- Experiment with Azure OpenAI models without coding

- Use the assistant setup to instruct the model about how it should behave
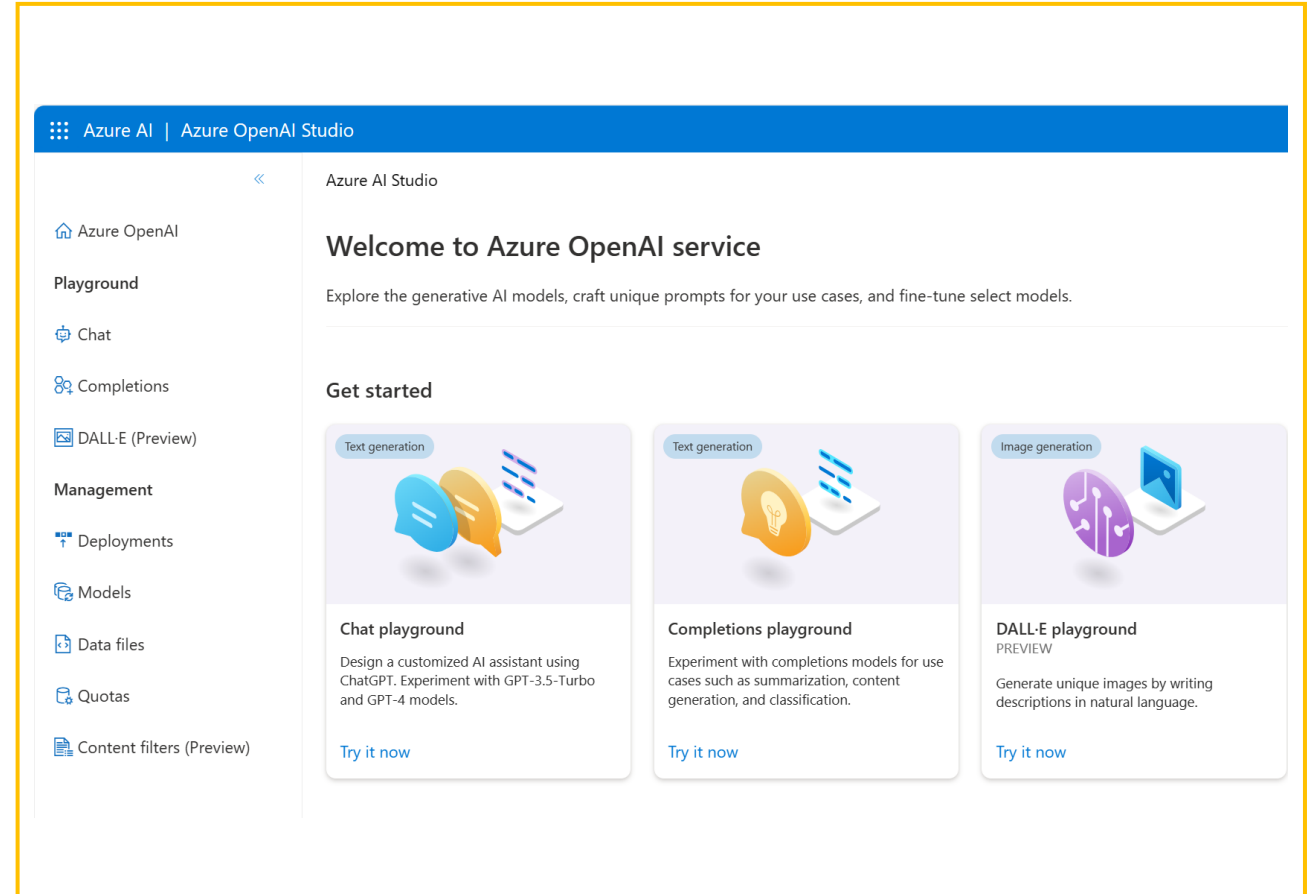
Azure OpenAI's natural language capabilities

Generative pre-trained transformer (GPT) models are excellent at both understanding and creating natural language.

For example, given a prompt where the user types in text asking for a cooking recipe:

Here's an example of the Azure OpenAI generated response:

```
Write recipe instructions for a fruit pie
based on these ingredients:

Strawberries
Blueberries
Flour
Eggs
Milk
```

```
Instructions:
1. Preheat your oven to 350 degrees Fahrenheit.
2. In a medium bowl, mix together 1 cup of flour and 1
egg until it forms a dough.
3. Grease a 9-inch pie dish with butter or non-stick
cooking spray.
4. Roll out the dough and place it in the pie dish.
5. In a separate bowl, mix together 1 cup of strawberries,
1 cup of blueberries, and 1 cup of milk.
6. Pour the fruit mixture into the pie dish.
7. Bake
```

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Azure OpenAI's code generation capabilities

GPT models translate natural language or code snippets into code.

Code generation goes beyond just writing code from natural language prompts. Given the following code, it can generate unit tests as shown on the right:

Python

```python
# Python 3
def mult_numbers(a, b):
  return a * b


# Unit test
def
```

Python

```python
# Python 3
def mult_numbers(a, b):
  return a * b


# Unit test
def test_mult_numbers():
  assert mult_numbers(3, 4) == 12
  assert mult_numbers(0, 10) == 0
  assert mult_numbers(4, 0) == 0


# Unit test
def test_mult_numbers_negative():
  assert mult_numbers(-1, 10) == -10
  assert mult_numbers(10, -1) == -10
```

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# Azure OpenAI's image generation capabilities

Generative AI models can edit and create images. The model that works with images is called DALL-E, which supports image creation, image editing and image variations creation.

- **Image generation:** With DALL-E, you can even request an image in a particular style. Styles can be used for edits and variations as well.

- **Editing an image:** DALL-E can edit the image as requested by changing its style, adding or removing items, or generating new content to add.

- **Image variations:** Image variations can be created by providing an image and specifying how many variations of the image you would like.

Prompt: Create four variations of an image of an elephant with a hamburger.
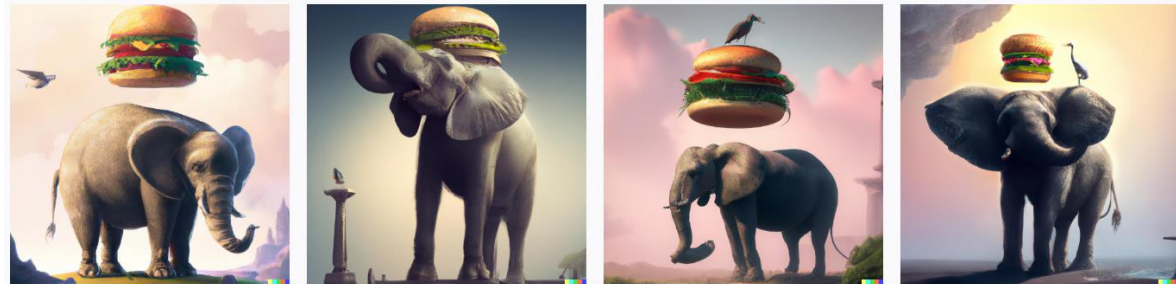
# Demo: Explore Azure OpenAI Service

In this demo, you'll see **Azure OpenA**I's capabilities in action.

1. Follow along on the exercise page at:
   **https://aka.ms/ai900-azure-openai**

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