In28 Minutes

AI-900
Azure AI Fundamentals

Getting Started

Machine Learning

Text Analytics

Cognitive Services

Speech

- Azure has *200+ services*. Exam expects you to understand *20+ services* related to AI.
- Exam *tests* your AI fundamentals and **decision making abilities**:
  - Which AI/ML service do you choose in which situation?
- This course is **designed** to help you *make these choices*
- **Our Goal** : Help you get certified and start your journey with Azure and AI

Our Approach

- Three-pronged approach to reinforce concepts:
  - Presentations (Video)
  - Demos (Video)
  - **Two kinds of quizzes**:
    - Text quizzes
    - Video quizzes
- (Recommended) Take your time. Do not hesitate to replay videos!
- (Recommended) Have Fun!

FASTEST ROADMAPS

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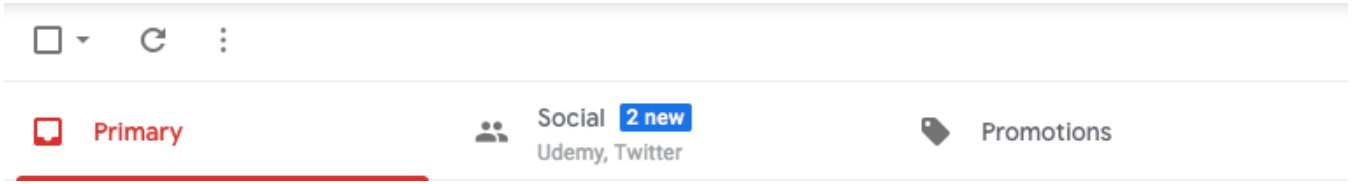
- Google Cloud Certifications
- Azure Certifications
- AWS Certifications
- DevOps
- Java Full Stack
- Java Microservices

Artificial Intelligence

Artificial Intelligence - All around you

In 28 Minutes



- Self-driving cars
- Spam Filters
- Email Classification
- Fraud Detection

What is AI? (Oxford Dictionary)

In 28 Minutes

The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages

Understanding Types of AI

- **Strong artificial intelligence (or general AI):** Intelligence of machine = Intelligence of human
  - A machine that can solve problems, learn, and plan for the future
  - An expert at everything (including learning to play all sports and games!)
  - Learns like a child, building on it's own experiences
  - We are far away from achieving this! (Estimates: few decades to never)
- **Narrow AI (or weak AI):** Focuses on specific task
  - Examples: Self-driving cars and virtual assistants
  - **Machine learning:** Learn from data (examples)

Tags:

Water 100% confidence Sky 100% confidence
Lake 95% confidence Outdoor 95% confidence
Skyscraper 89% confidence Reflection 61% confidence
Overlooking 33% confidence Day 12% confidence

Description:

a city skyline with water 27% confidence

Racy Content: False 75% confidence

Adult Content: False 78% confidence

Exploring Machine Learning Examples - 1

In28 Minutes

- Identify Tags for an Image

Tags:

Water 100% confidence Sky 100% confidence

Lake 95% confidence Outdoor 95% confidence

Skyscraper 89% confidence Reflection 61% confidence

Overlooking 33% confidence Day 12% confidence

Description:

Exploring Machine Learning Examples - 2

In28 Minutes

- House Price Calculation

Home size (Square Yds)	Age	Condition (1-10)	Price $$$
300	10	5	XYZ
200	15	9	ABC
250	1	10	DEF
150	2	34	GHI

Exploring Machine Learning vs Traditional Programming

In28 Minutes

- **Traditional Programming**: Based on Rules
  - IF this DO that
  - Example: Predict price of a home
    - Design an algorithm taking all factors into consideration:
      - Location, Home size, Age, Condition, Market, Economy etc
- **Machine Learning**: Learning from Examples (NOT Rules)
  - Give millions of examples
  - Create a Model
  - Use the model to make predictions!
- **Challenges**:
  - No of examples needed
  - Availability of skilled personnel
  - Complexity in implementing MLOps

Home size (Square Yds)	Age	Condition (1-10)	Price $$$
300	10	5	XYZ
200	15	9	ABC
250	1	10	DEF
150	2	34	GHI

What you will learn?

- Three approaches to building AI solutions in Azure
  - **Use Pre-Trained Models**: Get intelligence from text, images, audio, video
    - Azure AI Services (Language, Vision, Face, Speech..)
  - **Build simple models**: Without needing data scientists
    - Limited/no-code experience
    - Example: Azure AI Vision (Custom Vision)
    - Example: Azure Machine Learning
      - Automated machine learning
  - **Build complex models**: Using data scientists and team
    - Build Your Own ML Models from ZERO (code-experienced)
    - Example: Using Azure Machine Learning
- Use AI with caution!
  - Challenges, risks and principles

Tags:

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Machine Learning Fundamentals - Scenarios

In28 Minutes

Scenario	Solution
Categorize: Building a computer system as intelligent as a human. An expert at everything (all sports & games!)	Strong AI
Categorize: Building a computer system that focuses on specific task (Self-driving cars, virtual assistants, object detection from images)	Narrow AI (or weak AI)
Categorize: AI that focuses on learning from examples	Machine learning
How is ML different from traditional programming?	Traditional Programming: Rules. Machine Learning: Examples
Which Azure service helps you use Pre-Trained Models?	Azure AI Services
Which Azure services helps you build simple models without needing data scientists or AI/ML skills?	Azure Machine Learning(Automated machine learning), Azure AI Vision (Custom Vision)
Which Azure service helps you build complex ML models?	Azure Machine Learning

Different Types of AI Workloads

In 28 Minutes

Example	AI Workload Type
Filtering inappropriate content on social media; Recommending products based on user history; Adjusting website content based on user preferences	Content Moderation & Personalization
Facial recognition systems; Self-driving car navigation systems; Object detection in surveillance videos; Augmented reality applications	Computer Vision Workloads
Language translation services; Voice recognition and response systems; Sentiment analysis in customer feedback;	Natural Language Processing Workloads
Analyzing large datasets to uncover trends; Extracting useful information from unstructured data; Mining customer data for insights; Predictive analytics in business intelligence	Knowledge Mining Workloads
Automated invoice processing; Resume parsing for recruitment; Document classification and archiving; Data extraction from legal documents	Document Intelligence Workloads
Creating new images or text based on learned patterns; AI-generated music or art; Automated content generation for social media;Generate code;	Generative AI Workloads

Different Types of AI Workloads - Scenarios

In 28 Minutes

Scenario	Workload
Recommend shows based on a user's watch history	Content Personalization
Detect and filter profanity in user-generated content	Content Moderation
Detect objects like people, cars, or animals in an image	Computer Vision
Analyze a product review to determine if it's positive or negative	Natural Language Processing
Analyze social media data to uncover customer behavior patterns	Knowledge Mining
Automatically sort, classify, and extract information from legal documents	Document Intelligence
Extract key details from an identity document	Document Intelligence
Write a new article based on a given topic or user prompt	Generative AI
Generate boilerplate code based on developer prompts	Generative AI

Pre-Trained Models (APIs)

Exploring Pre-Trained Models - Azure AI Services

In 28 Minutes

- **Azure AI Services** - "Make AI Easy!"
  - AI without building custom models
  - Does NOT need machine-learning expertise
  - Exposed as APIs
- **Key Services:**
  - Get **intelligence** from:
    - **Images**: Azure AI Vision, Azure AI Face
    - **Forms and Documents**: Azure AI Document Intelligence
    - **Text**: Azure AI Language, Azure AI Translator
    - **Audio**: Azure AI Speech
    - **Use Generative AI**: Azure OpenAI, Model Catalog
    - **Others**: Azure AI Bot Service, Azure AI Content Safety, ..
  - **Simplified Management**: Azure Portal and Azure AI Foundry

Result:

Statue of Liberty 95% confidence

Getting Intelligence From Images - Terminology

In 28 Minutes

- **Image analysis**: Extract tags, create text description
- **Image classification**: Classify image into groups
- **Object detection**: Identify objects in image
  - For each object:
    - class of object, confidence level, coordinates of a bounding box
  - Goes deeper than image classification
  - **Semantic segmentation**: Go even deeper
    - Identify the individual pixels that belong to a particular object
- **Face detection**: Detect human faces
- **Optical character recognition (OCR)**: Detect text in images (license plates, invoices etc)
- **Spatial analysis**: Location-based data (street addresses, GPS coordinates, ..)

Getting Intelligence From Images - Terminology - Scenarios

In 28 Minutes

Scenario	Terminology
Automatically generate descriptive captions for a set of photos	Image Analysis
Sort images into categories like ‘food’, ‘animals’, or ‘landscapes’	Image Classification
Identify cars, bikes, and pedestrians in a street image with bounding boxes	Object Detection
Detect every pixel that belongs to a tree in a forest photo	Semantic Segmentation
Recognize and extract text from a scanned receipt	Optical Character Recognition (OCR)
Detect faces in group photos for automatic tagging	Face Detection
Identifying location based on a image	Spatial Analysis

Getting Started - Azure AI Vision

In 28 Minutes

- Computers don't have biological eyes
  - BUT they can get intelligence from images!
    - An image is a set of pixels, each with a numerical value
    - Filters can be used to process images (For example: Edge Filter)
- **Azure AI Vision Service**: Get intelligence from images
  - **Analyze Image API**:
    - Generate a caption for an image
    - Detect objects in images
    - Create tags for images
  - **Read OCR API**: Optical character recognition (OCR)
  - **Custom Vision** - Create your own model (LATER)
    - Customize image recognition to fit your business

Result:

Statue of Liberty 95% confidence

Getting started with Azure AI Vision - Analyze Image

In 28 Minutes

- Extract visual features from image content
- **Operations**:
  - **Tag Image**: Generates a list of words, or tags relevant to a image
  - **Generate image captions**: Generate a caption of an image (description/caption - multiple)
  - **Generate dense captions**: Generate detailed, natural language descriptions for multiple regions within an image
  - **Detect Objects**: Performs object detection on the specified image

Tags:

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Skyscraper 89% confidence Reflection 61% confidence

Overlooking 33% confidence Day 12% confidence

Description:

a city skyline with water 27% confidence

Racy Content: Adult Content:

Exploring Azure AI Vision - Image tagging

In28 Minutes

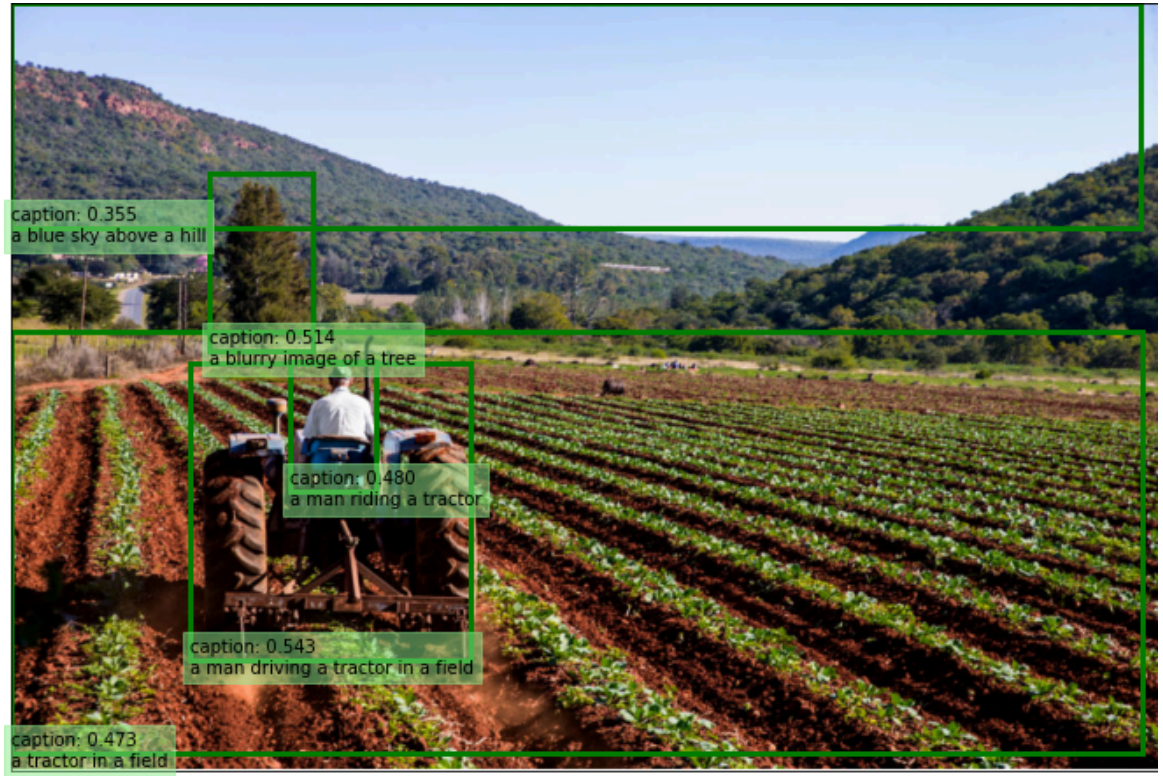

```
{
    "metadata":{"width": 300,"height": 200},
    "tagsResult":
    {
        "values":
        [
            { "name": "grass","confidence": 0.9960499405860901},
            { "name": "outdoor","confidence": 0.9956876635551453},
        ]
    }
}
```


Exploring Azure AI Vision - Captions


```
"captions": [{"text": "a man pointing at a screen","confidence": 0.4891590476036072}]
```


Exploring Azure AI Vision - Dense Captions


```
{"text": "a man driving a tractor in a farm", "confidence": 0.535620927810669,
    "boundingBox": {"x": 0,"y": 0,"w": 850,"h": 567}},
{"text": "a blurry image of a tree", "confidence": 0.5139822363853455,
    "boundingBox": {"x": 147,"y": 126,"w": 76,"h": 131}
```

Exploring Azure AI Vision - Object detection

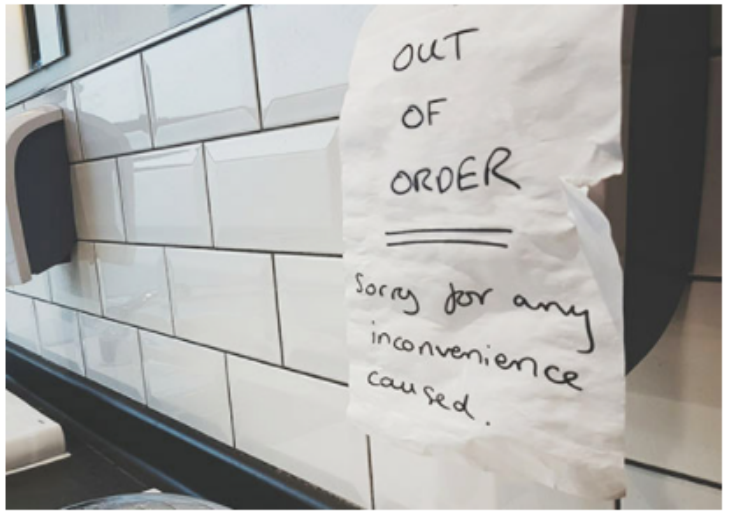
In 28 Minutes


```
"objectsResult":{
"values":[
{"name":"kitchen appliance","confidence":0.501,"boundingBox":{"x":730,"y":66,..}},
{"name":"computer keyboard","confidence":0.51,"boundingBox":{"x":523,"y":377,..}},
{"name":"Laptop","confidence":0.85,"boundingBox":{"x":471,"y":218,..}}
]}
```


Exploring Azure AI Vision - OCR Operations

In28 Minutes

- **Optical character recognition (OCR)**: Detect text in images (license plates, invoices etc)
- **Azure AI Vision**: Offers simple OCR features(Read OCR API)
- **Input**: General, unstructured documents or images
- **Usecase**: Quick extraction of small amounts of text (immediate results)
- **Result**: Lines, Words (each with bounding box coordinates)

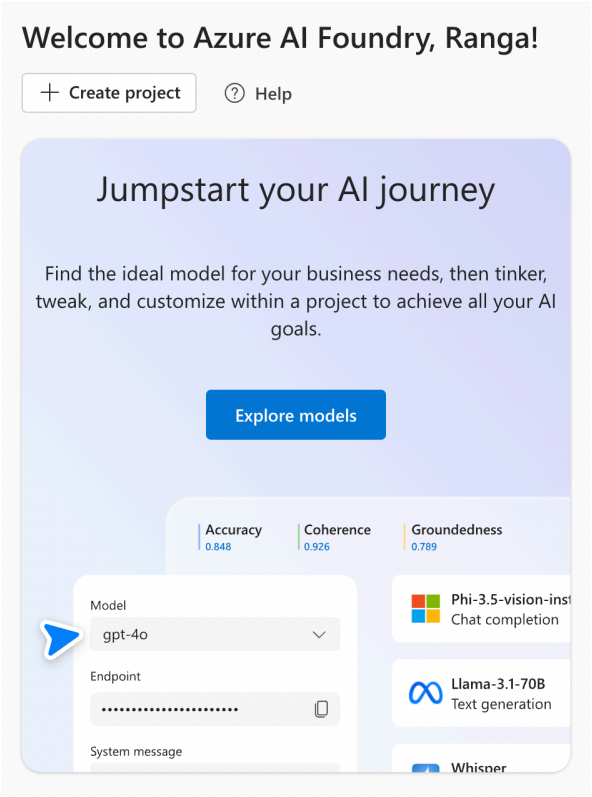


Transcript:

OUT
OF
ORDER
Sorry for any
inconvenience
caused .

Playing with Azure AI Services

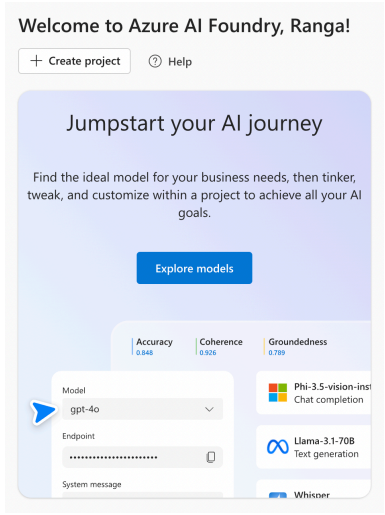
- **Azure Account**
  - Needed to access and manage Azure resources
  - Can use free or pay-as-you-go subscription
- **Azure AI Services Resource**
  - One resource to access vision, language, speech, .. APIs
  - Create this in the Azure Portal (select region, pricing tier, etc.)
- **Azure AI Foundry**
  - **Azure AI Foundry** helps simplify management of AI assets
  - Create and manage **projects** that group models, data, and deployments
- (Optional) Demos are optional for AI-900
  - Understanding things at 10,000 feet level is sufficient!
  - Re-Watch if possible



Azure AI Foundry – End-to-End AI Development Platform

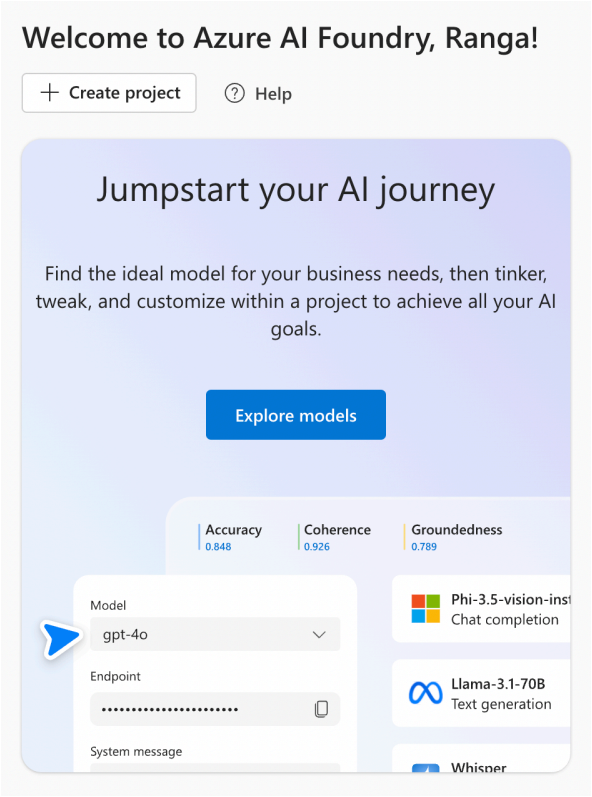
In 28 Minutes

- Microsoft's unified platform for building, testing, and deploying AI solutions
  - Recommended way to build most AI-powered applications on Azure
- **Key Features**
  - **Azure AI Foundry Portal**: Web-based UI for managing and deploying AI workflows
  - **Model Catalog**: Access pre-trained models (e.g., Hugging Face) for quick deployment
  - **Playgrounds**: Experiment and test prompts in-browser
  - **VS Code Containers**: Cloud-based dev environment with preloaded SDKs
    - Write, test, and deploy from within the browser
  - **IDE Support**: Compatible with Visual Studio, VS Code, and others
  - **Fine-Tuning Support**: Customize generative models with your data



Azure AI Foundry Resource Hierarchy

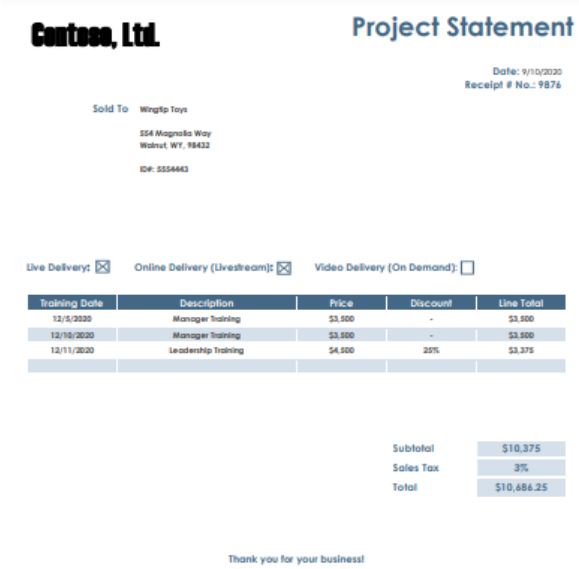
- **Hierarchy Structure: Hub > Multiple Projects**
- **Hub**:
  - Acts as the **top-level container** in Azure AI Foundry
  - Designed to **organize and manage related AI projects** under one umbrella
  - Share and have centralized control over:
    - Data
    - Credentials
    - Configuration and Resources
- ✅ **Best Practice**: Create **separate hubs for each business area** to isolate concerns and maintain clarity
  - *Finance AI Hub*: Manages forecasting, fraud detection models
  - *HR AI Hub*: Handles resume parsing, internal chatbot systems



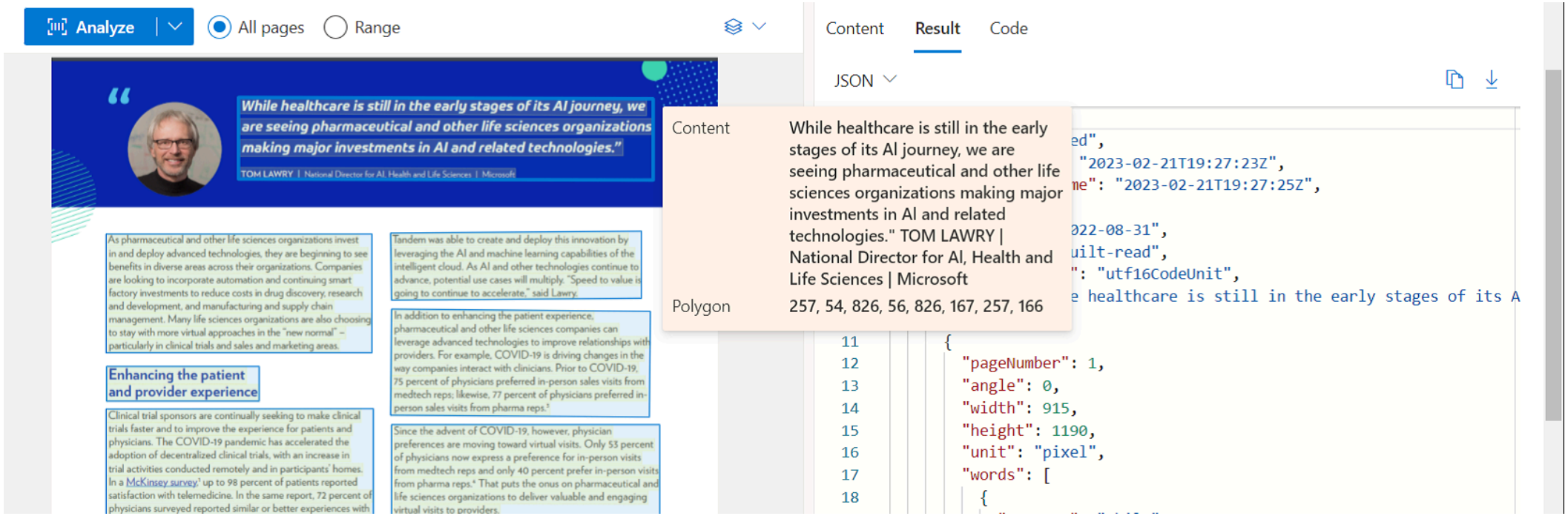
Azure AI Document Intelligence - Complex OCR

In 28 Minutes

- Build intelligent document processing solutions
  - **Generic Document analysis models**
    - **Read**: Extract printed and handwritten text.
    - **Layout**: Extract document structure - header, title, sections,..
  - **Prebuilt models**: Simple to use pre-trained models
    - **Invoice**:Extract customer and vendor details.
    - **Identity**:Extract verification details.
    - **Check**:Extract relevant information from checks.
    - **Pay Stub**:Extract pay stub details.
    - **Bank Statement**: Extract account info & details from bank stmts.
    - **Contract**:Extract agreement and party details.
    - **Credit card**:Extract payment card information.
    - **Receipt**:Extract sales transaction details.
  - **Custom models**: Create your own models

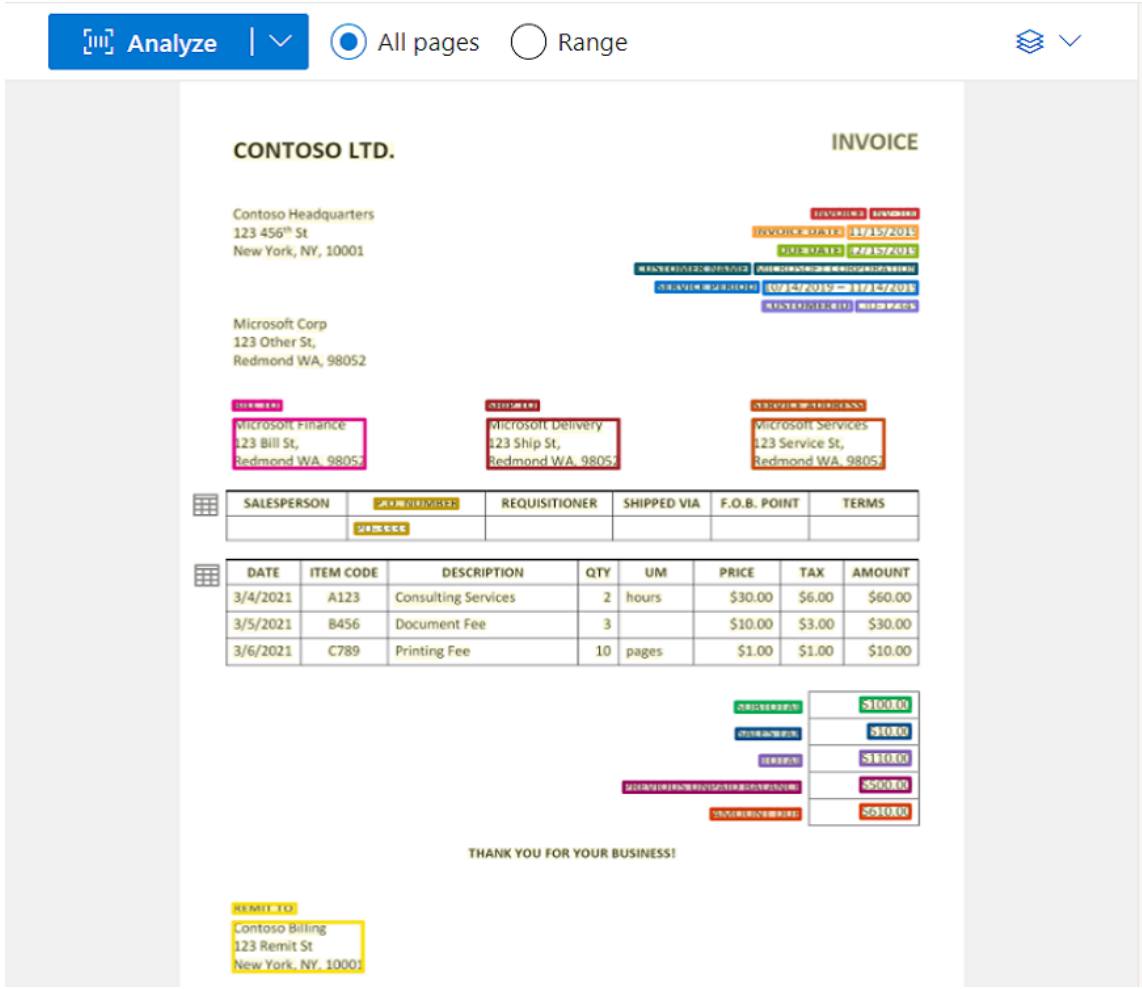


Exploring Azure AI Document Intelligence - Read



Exploring Azure AI Document Intelligence - Invoice

In 28 Minutes



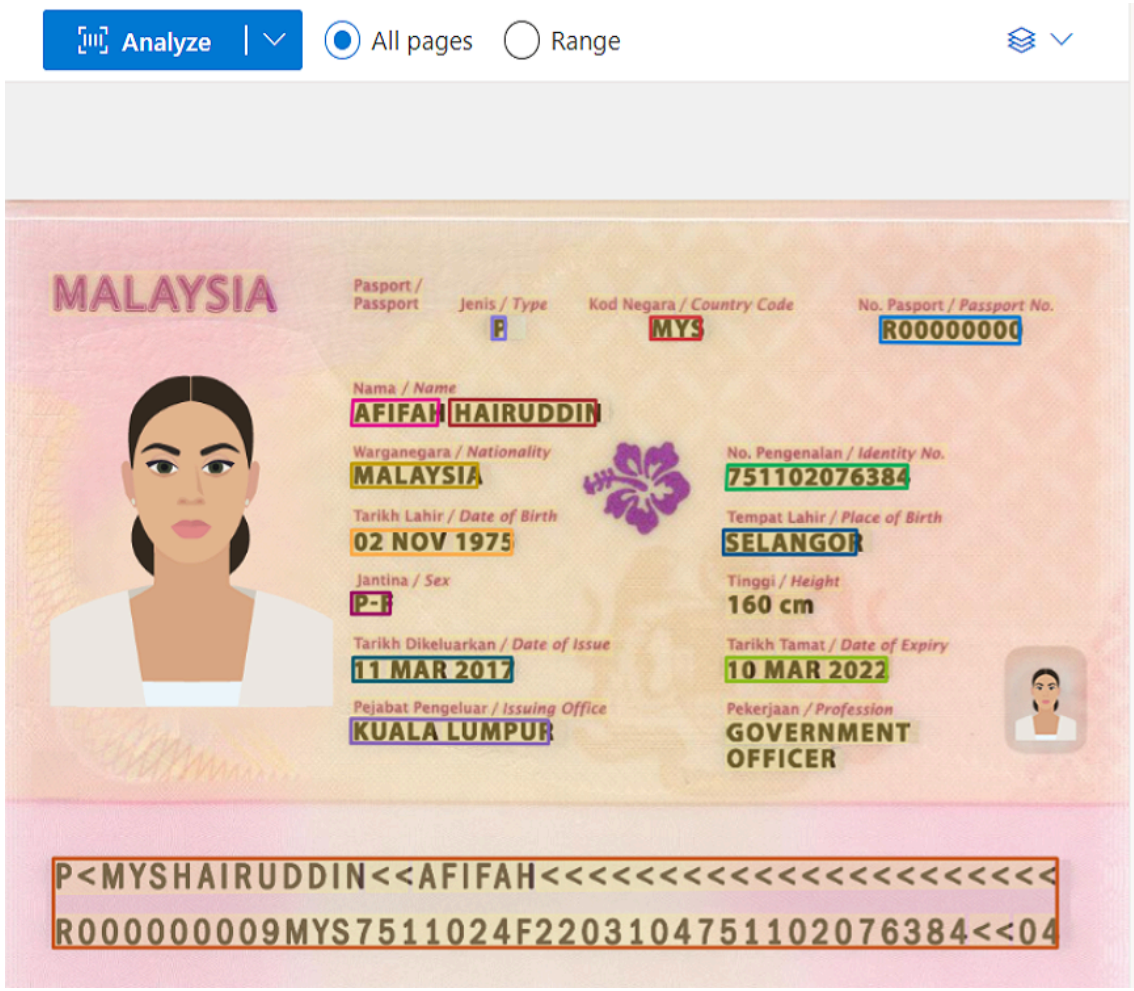
Fields | Content | Result | Code

Prebuilt invoice | Key-Value pairs

INVOICE: INV-100	92.40%
INVOICE DATE: 11/15/2019	90.80%
DUE DATE: 12/15/2019	90.70%
CUSTOMER NAME: MICROSOFT CORPORATION	88.90%
SERVICE PERIOD: 10/14/2019 – 11/14/2019	87.40%
CUSTOMER ID: CID-12345	90.70%

Exploring Azure AI Document Intelligence - Identity

In 28 Minutes

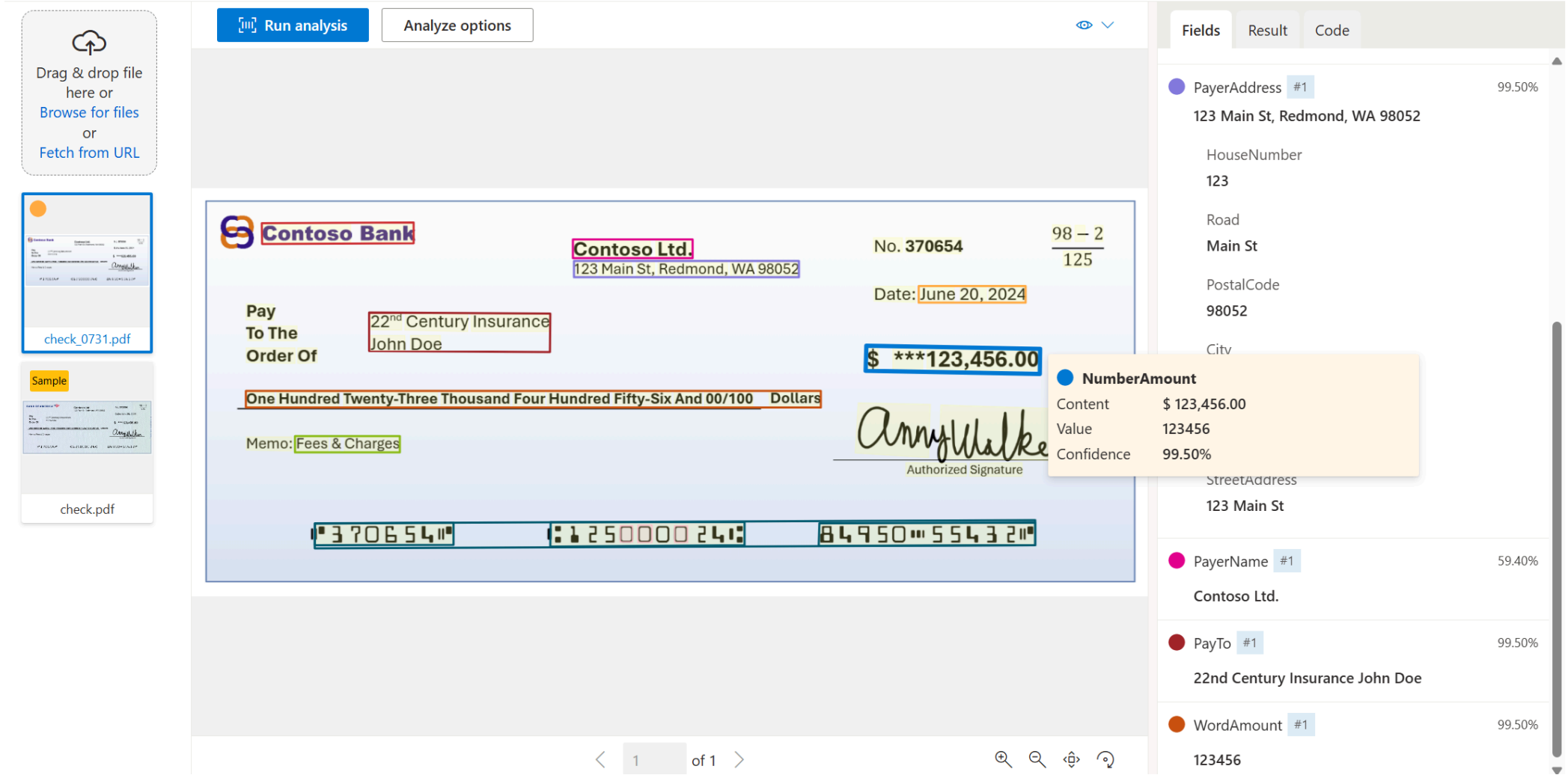


Fields | Result | Code

DocType: **idDocument.passport**

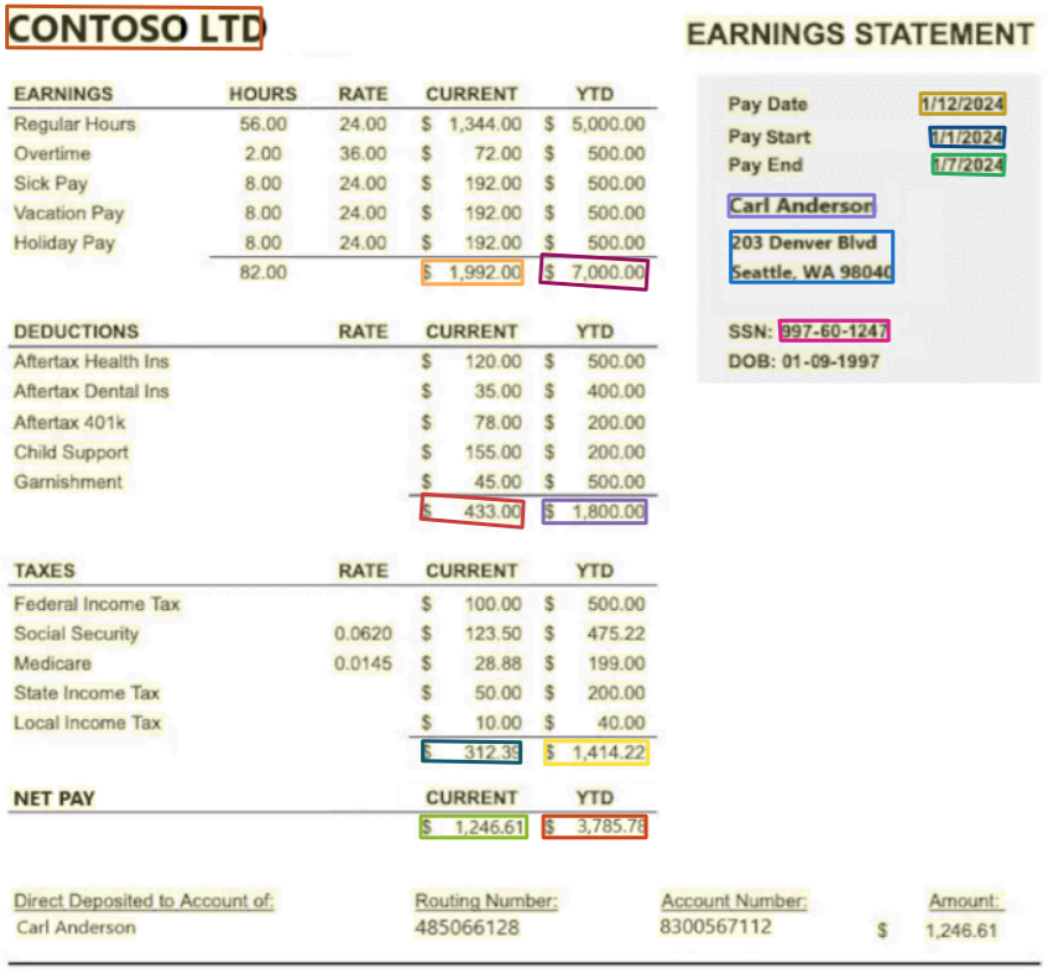
CountryRegion #1	MYS	99.00%
DateOfBirth #1	1975-11-02	99.00%
DateOfExpiration #1	2022-03-10	99.00%
DateOfIssue #1	2017-03-11	99.00%
DocumentNumber #1	R00000000	99.00%
DocumentType #1		99.00%

Exploring Azure AI Document Intelligence - Check



Exploring Azure AI Document Intelligence - Pay Stub

In 28 Minutes



CONTOSO LTD

EARNINGS STATEMENT

EARNINGS	HOURS	RATE	CURRENT	YTD
Regular Hours	56.00	24.00	$ 1,344.00	$ 5,000.00
Overtime	2.00	36.00	$ 72.00	$ 500.00
Sick Pay	8.00	24.00	$ 192.00	$ 500.00
Vacation Pay	8.00	24.00	$ 192.00	$ 500.00
Holiday Pay	8.00	24.00	$ 192.00	$ 500.00
	82.00		$ 1,992.00	$ 7,000.00

Pay Date 1/12/2024
Pay Start 1/1/2024
Pay End 1/7/2024

Carl Anderson
203 Denver Blvd
Seattle, WA 98040

SSN: 997-60-1247
DOB: 01-09-1997

DEDUCTIONS	RATE	CURRENT	YTD
Aftertax Health Ins		$ 120.00	$ 500.00
Aftertax Dental Ins		$ 35.00	$ 400.00
Aftertax 401k		$ 78.00	$ 200.00
Child Support		$ 155.00	$ 200.00
Garnishment		$ 45.00	$ 500.00
		$ 433.00	$ 1,800.00

TAXES	RATE	CURRENT	YTD
Federal Income Tax		$ 100.00	$ 500.00
Social Security	0.0620	$ 123.50	$ 475.22
Medicare	0.0145	$ 28.88	$ 199.00
State Income Tax		$ 50.00	$ 200.00
Local Income Tax		$ 10.00	$ 40.00
		$ 312.39	$ 1,414.22

NET PAY	CURRENT	YTD
	$ 1,246.61	$ 3,785.78

Direct Deposited to Account of:	Routing Number:	Account Number:	Amount:
Carl Anderson	485066128	8300567112	$ 1,246.61

- CurrentPeriodGrossPay #1 — 99.50%
  1992
- CurrentPeriodNetPay #1 — 99.50%
  1246.61
- CurrentPeriodTaxes #1 — 99.50%
  312.39
- EmployeeAddress #1 — 99.50%
  203 Denver Blvd Seattle, WA 98040
  - HouseNumber: 203
  - Road: Denver Blvd
  - PostalCode: 98040
  - City: Seattle
  - State

Azure AI Services - Document Intelligence - Scenarios

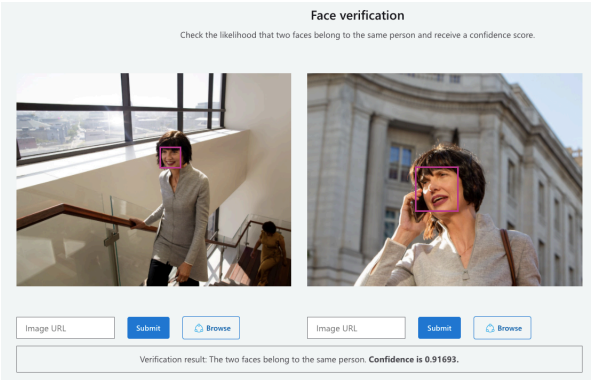
In 28 Minutes

Scenario	Model to use
Extract printed and handwritten text from scanned documents	Read
Identify headings, paragraphs, and tables in a PDF document	Layout
Extract customer name, invoice date, and total amount from an invoice	Prebuilt - Invoice
Extract full name, ID number, and date of birth from a passport	Prebuilt - Identity
Extract check number and payment amount from a scanned bank check	Prebuilt - Check
Extract earnings and deductions from a salary slip	Prebuilt - Pay Stub
Extract transactions and account details from a bank statement	Prebuilt - Bank Statement
Extract contract title and party names from a legal agreement	Prebuilt - Contract
Extract masked credit card number and cardholder name from a scan	Prebuilt - Credit Card
Train a model to extract custom fields from insurance claims	Custom Model

Getting Started with Facial Recognition

In 28 Minutes

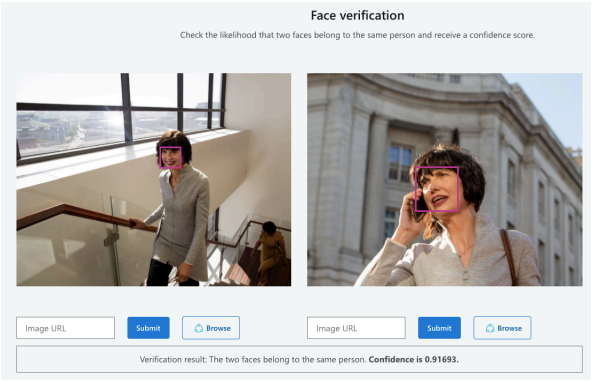
- **Azure AI Face**: Powerful face analysis service in Azure
  - Pre-built algorithms to detect, recognize, and analyze faces.
  - Predict Age, Emotion, Glasses, Hair, Makeup
  - Detect human faces, find similar faces, match face with a group ..
  - **Important concepts**:
    - Single Face Image - faceId
    - List of Face Images
      - FaceList (up to 1K faces) & LargeFaceList (up to 1M faces)
    - List of Persons
      - PersonGroup (up to 1K persons) & LargePersonGroup (up to 1M persons)
      - Each person can have multiple face images
- (Remember) Improve accuracy of face identification:
  - Quality of images (Higher face image quality)
    - Recommendations: frontal, clear, and face size - 200x200 pixels or bigger
  - Variety of images: From diff. angles in variety of lighting setups



Understanding Azure AI Face Service Operations

In 28 Minutes

- **Detect**: Detect human faces (box co-ordinates)
  - Face attributes supported: age, gender, headPose, smile, facialHair, glasses, emotion, hair, makeup, occlusion (part of face is covered - glasses, masks..) , accessories,
  - Up to 100 faces in an image
- **Find Similar**: Find similar faces (Find images of this specific person)
  - Input 1: Image to match for (faceId)
  - Input 2: Images to match against (faceId array or FaceListId or LargeFaceListId)
  - Output: Array of the most similar faces [along with confidence]



Understanding Azure AI Face Service Operations - 2

In 28 Minutes

- **Group**: Divide candidate faces (3-1000) into groups based on face similarity
  - Input: faceIds
  - Output: Matching groups of faceIds
- **Identify**: 1-to-many identification
  - Find closest matches of the specific query person face.
    - Input 1: Image to match for (faceId)
    - Input 2: Persons to match against (personGroupId OR largePersonGroupId)
    - Output: Person candidates for that face (ranked by confidence)
- **Verify**: Two things you can do
  - Do two faces belong to same person?
    - Input: faceId1 vs faceId2
  - Does a face belong to a specific person?
    - Input: faceId vs (personId in a (personGroupId OR largePersonGroupId))
  - Output: `{ "isIdentical": true, "confidence": 0.9}`

Azure AI Services - Scenarios - 1

In 28 Minutes

Scenario	Solution
Recommend Service: Detect and identify people and emotions in images	Azure AI Face Service
Recommend Service: Extract visual features from image content (description/tags)	Azure AI Vision
How can you improve accuracy of face identification?	Images - frontal, clear, and face size - 200x200 pixels or bigger. Variety of images: From diff. angles in variety of lighting setups
Identify headings, paragraphs, and tables in a PDF document	Azure AI Document Intelligence - Layout Model

Azure AI Services - Scenarios - 2

Scenario	Solution
Recommend Face Service Operation: Divide candidate faces (3-1000) into groups based on face similarity (Do all the faces belong to a group?)	Group
Recommend Face Service Operation: Find closest matches of the specific query person face in a group	Identify
Recommend Face Service Operation: Do two faces belong to same person?	Verify
Recommend Face Service Operation: Does a face belong to a specific person?	Verify

Core Principles of Azure AI Services

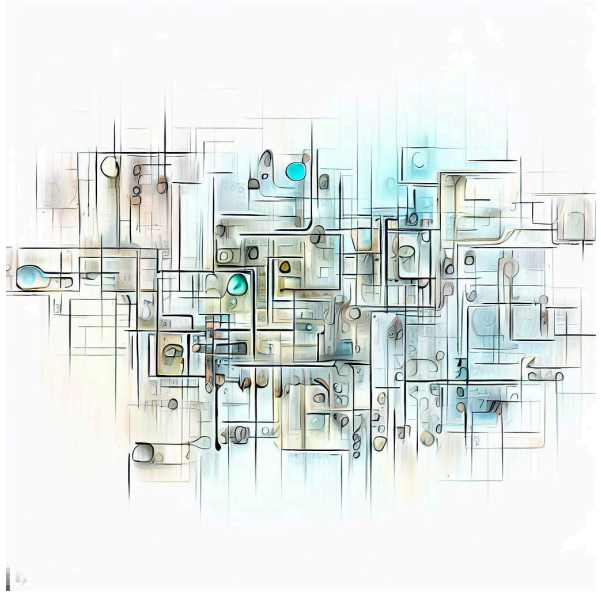
In 28 Minutes

- **1. Prebuilt and Ready to Use**
  - Pre-trained, production-ready models
  - ✅ No need to start from scratch
  - *Example*: Use Azure AI Vision without any ML training
- **2. Accessed Through APIs**
  - Exposed via REST APIs and SDKs for easy integration
  - ✅ Use your favorite language (Java, JavaScript, Python,..)
  - *Example*: Call Azure AI Vision Service directly from your app
- **3. Available and Secure on Azure**
  - ✅ Benefit from Azure's global availability, and encryption standards
  - *Example*: Deploy AI services within your Azure region to meet data residency requirements

Types of Azure AI Service Resources

In 28 Minutes

- **1. Multi-Service Resource**
  - Access **multiple Azure AI services** using a **single key**
  - All AI usage is **billed together under one resource**
  - *Best for applications using multiple services (e.g., Speech + Vision + Language)*
  - Also referred to as the **Azure AI Services resource**
- **2. Single-Service Resource**
  - Provides access to **only one specific Azure AI service**
  - Each service has its **own key and endpoint**
  - *Ideal when you only need one AI service*
    - *Or when you want separate billing and usage metrics*
  - *Example*: Create a dedicated resource for **Azure AI Vision** to isolate costs



Creating and Linking an Azure AI Services Resource

- **Using the Azure Portal**: Create Multi-Service Resource or Single-Service Resource
- **Azure AI Foundry Portal**
  - Unified UI for accessing **multiple Azure AI services + generative AI models**
  - Create Hub and Project linking the service resource
- **Studio Interfaces**
  - Interactive UIs to **explore individual Azure AI services**
  - Examples: Vision Studio, Language Studio, Speech Studio, Content Safety Studio
  - Link to an existing AI service resource via the **Settings** page

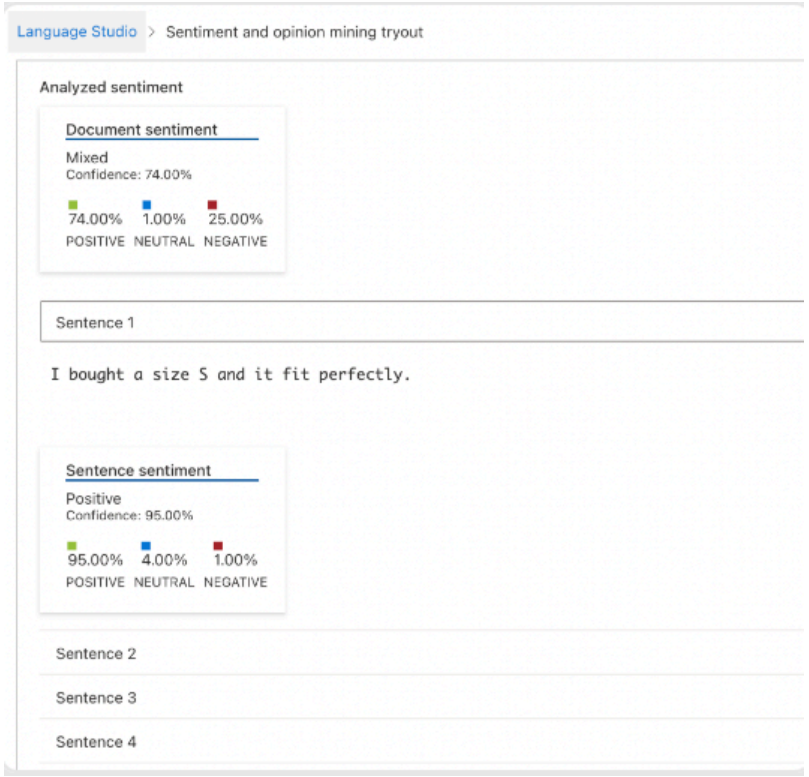
Authentication to Azure AI Services and Portals

In 28 Minutes

- **API Access**
  - Most Azure AI services are exposed through **RESTful APIs**
  - To make an API call, you must include:
    - **Endpoint URL**: Unique to your resource and region
    - **Resource Key**: Used for authentication (passed in the request header)
- **Azure AI Foundry Portal & Studio Interfaces**
  - Azure AI Foundry Portal & Studio interfaces (e.g., Vision Studio, Language Studio) require you to sign in with **Azure Portal credentials**
  - Once signed in, you can:
    - Link your Azure AI resource
    - Explore and test capabilities

Exploring Azure AI Language - Getting Started

- **Natural language processing (NLP)**: Get insights from unstructured text data. Extract, classify, and summarize information to gain insights.
  - **Usecases**:
    - Detect sentiment for a product review
    - Summarize an essay
    - Extract PII (Personally Identifiable Information) from text
- **Azure AI Language**: Understand and analyze text
  - Things you can do: Sentiment analysis, key phrase identification, text summarization, and conversational language understanding



Text Analysis – Common Techniques

In 28 Minutes

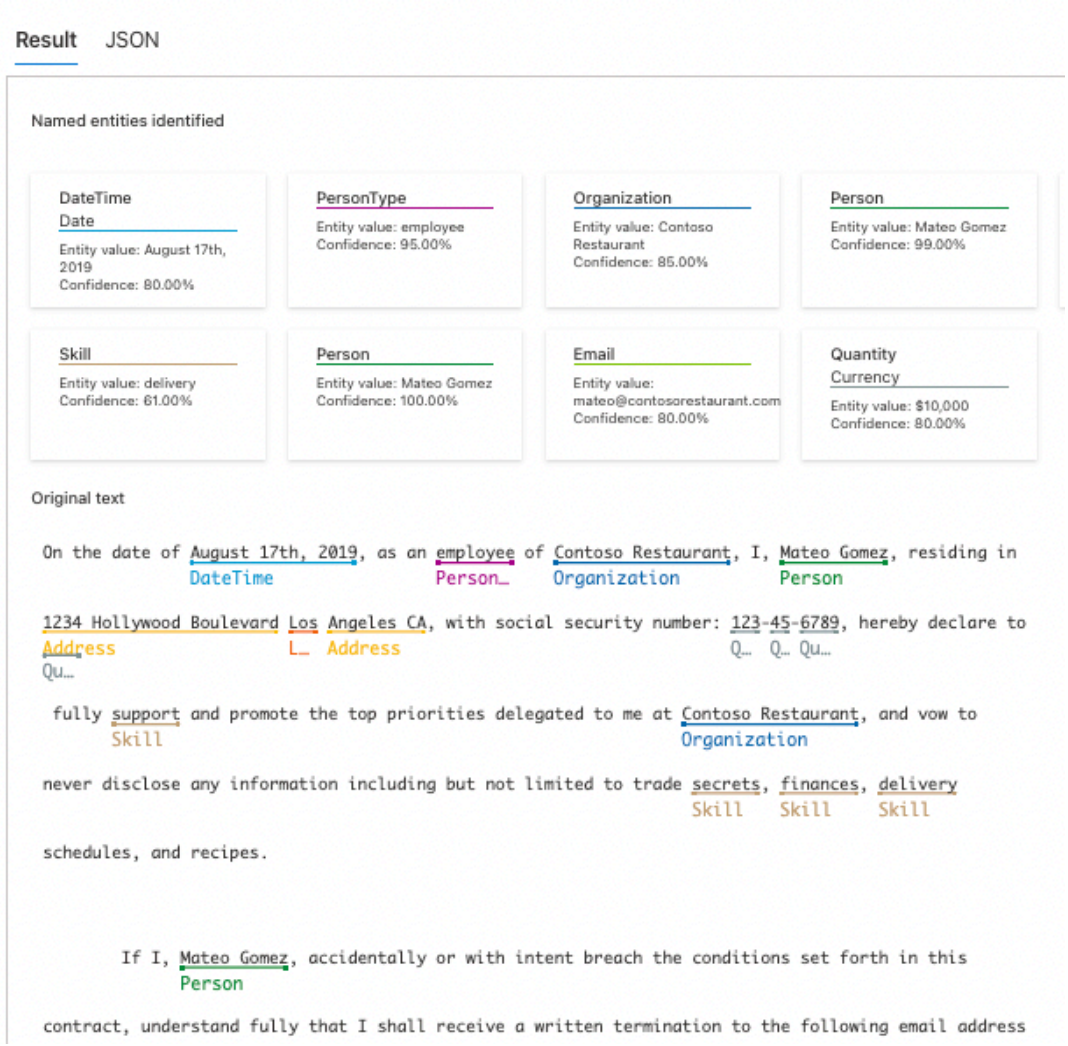
Technique	Description	Example
Text Normalization	Lowercase and remove punctuation	“Mr Banks has worked in many banks.” → “mr banks has worked in many banks”
Stop Word Removal	Remove common words with little meaning	“The cat sat on a mat” → “cat sat mat”
n-grams	Group words into 2- or 3-word phrases for better context	“I have” (bi-gram), “He walked away” (tri-gram)
Stemming	Reduce words to their root form	“power”, “powered”, “powerful” → “power”
Frequency Analysis	Counts word or phrase occurrences to identify themes	In the sentence “I love my phone because my phone is fast”, the word “phone” appears twice → highlights its importance

Exploring Azure AI Language - Text Analytics API

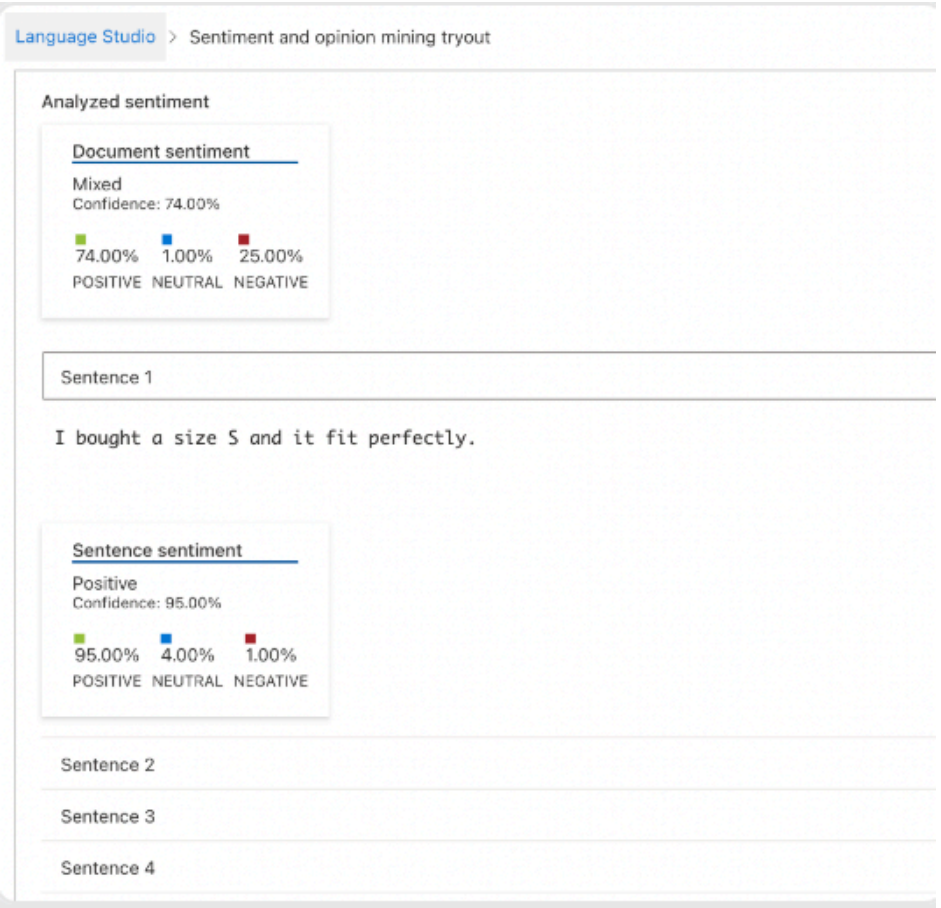
In 28 Minutes

- **Text Analytics**: Natural language processing (NLP)
  - Sentiment analysis, key phrase extraction & language detection
- **Operations**:
  - **Named Entity Recognition**: Identify entities
    - Person, Location, Organization, Quantity, DateTime, URL, Phone Number etc
  - **Entities containing personal information**: Identify entities with personal information ("SSN", "Bank Account" etc) in the document
  - **Sentiment analysis and opinion mining**: Evaluate text and return sentiment scores and labels for each sentence
    - positive/negative review - example: 0.1(negative), 0.9(positive)
  - **Detect Language**: With confidence level score - NaN:ambiguous
  - **Key Phrases**: Identify key concepts
  - **Summarization**: Summarize a document

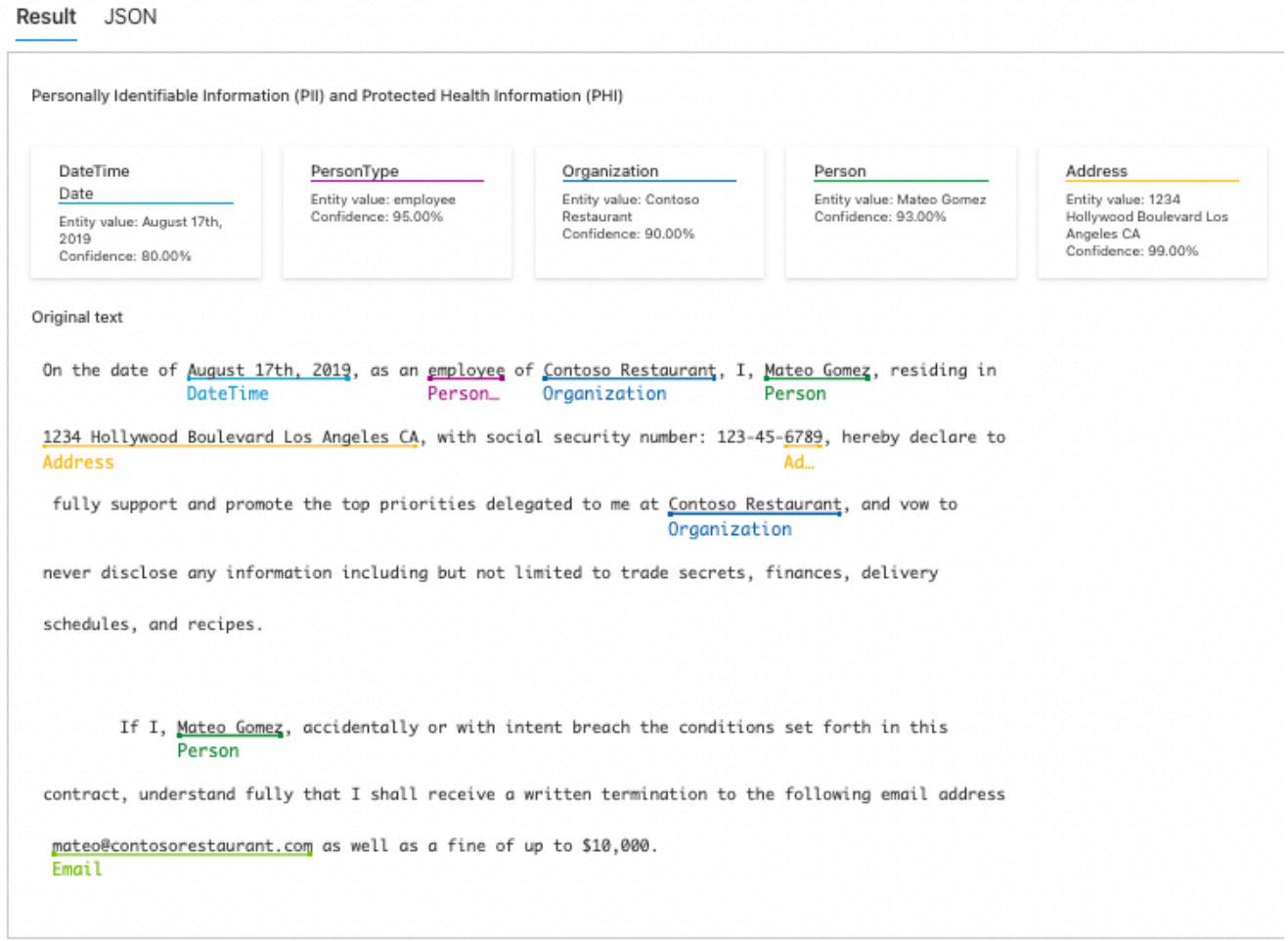
Azure AI Lang. Text Analytics - Named entity recognition



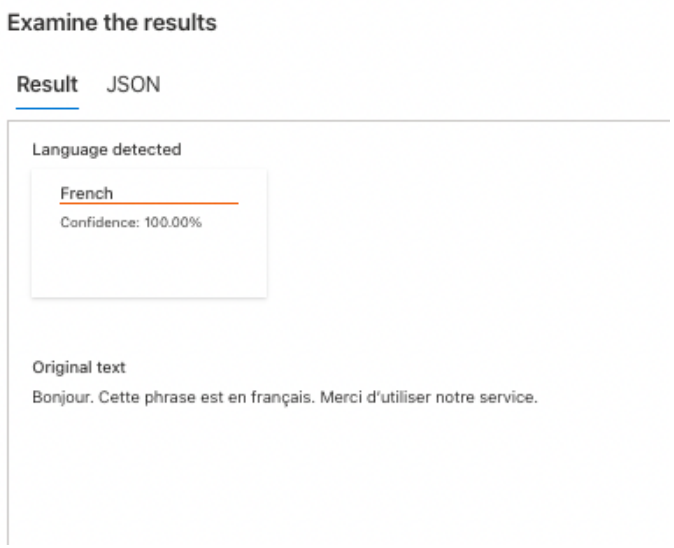
Azure AI Lang. Text Analytics - Sentiment analysis



Azure AI Lang. Text Analytics - PII detection

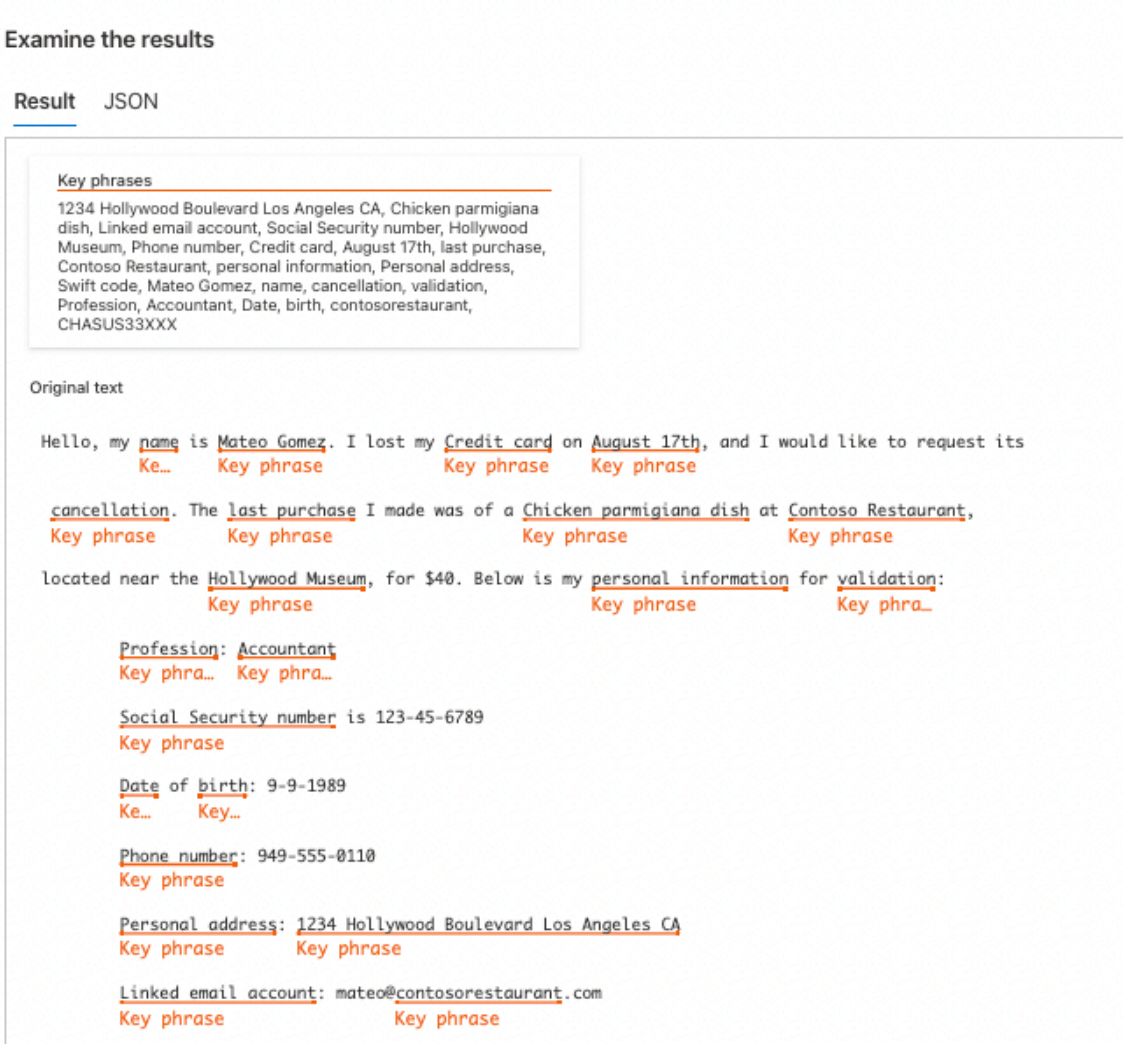


Azure AI Lang. Text Analytics - Language detection



Azure AI Lang. Text Analytics - Key phrase extraction

In 28 Minutes



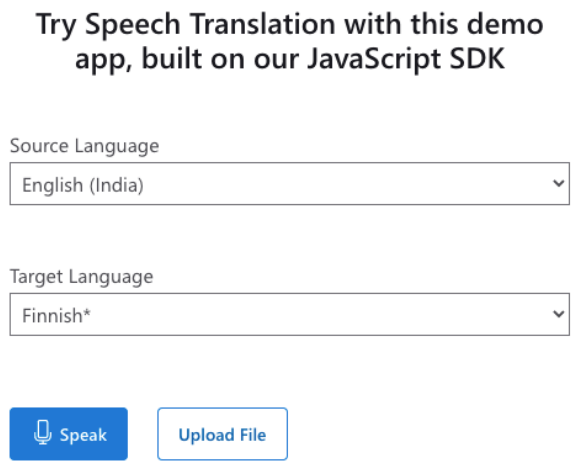
Azure AI Language: Other Features

Service	Input	Output
Conversational Language Understanding	User utterances (e.g., "Book me a flight to Delhi tomorrow")	Intent (`BookFlight`) and extracted entities (`Location: Delhi`, `Date: Tomorrow`)
Custom Question Answering	Natural language questions + knowledge base (e.g., FAQs, documents)	Relevant answer from the source content with confidence score
Orchestration Workflow	User utterances + configured skills (e.g., CLU, QnA, etc.)	Routed response from the appropriate skill

Getting Started with Azure AI Speech Service

In 28 Minutes

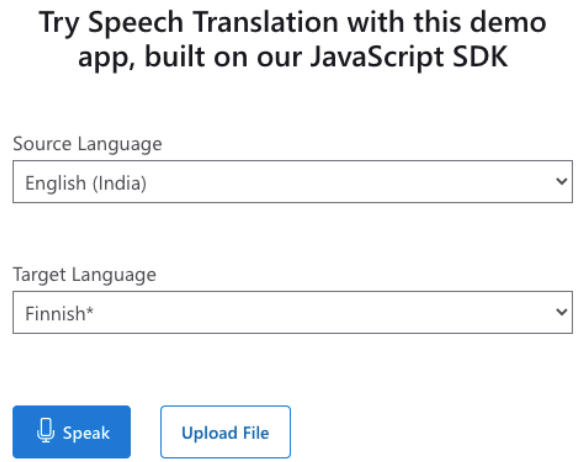
- **Azure AI Speech**: Enhance customer experiences through speech to text, text to speech, and speech translation features.
  - **Usecases**: Video subtitling, Audio Content Creation, Voice assistants, Live meeting transcriptions
  - **Capabilities**:
    - **Azure AI Speech to text API**: Real-time & Batch transcription (speech recognition)
    - **Azure AI Text to speech API**: Convert text into human like speech (speech synthesis)
    - **Speech to text translation**: Input audio stream in source language translated to text in a different target language.
    - **Speech to speech translation**: Input audio stream in source language translated to output audio stream in a different target language.



Getting Started with Azure AI Translator

In 28 Minutes

- **Language-to-Language Translation Service**
  - Translate from **one source language** to **multiple target languages**
  - ✅ *Example*: English → French, German (en → fr, de)
- 🧠 Key Capabilities
  - **Text Translation**
    - Real-time, quick, and accurate translation of text
    - Ideal for chat, apps, and live communication
  - **Document Translation**
    - Translate large or complex documents while preserving layout
    - Supports multiple formats (DOCX, PPTX, HTML, PDF, etc.)
    - ⚡ **Synchronous**: Translate a single file instantly
    - 🔁 **Asynchronous**: Batch translation for multiple documents



Azure AI Services - NLP - Scenarios

In 28 Minutes

Scenario	Solution
Recommend Service: Detect sentiment, key phrases and named entities from text	Azure AI Language - Text Analytics API
Recommend Service: Detect Key Phrases from a document	Azure AI Language - Text Analytics API
Recommend Service: Perform text-to-text translation	Azure AI Translator
Recommend Service: Speech recognition	Azure AI Speech Service - Speech to text API
Recommend Service: Speech synthesis	Azure AI Speech Service - Text to Speech API
Recommend Service: Perform sentiment analysis on reviews posted on a website	Azure AI Language - Text Analytics API

Other Azure AI Services - A Quick Look

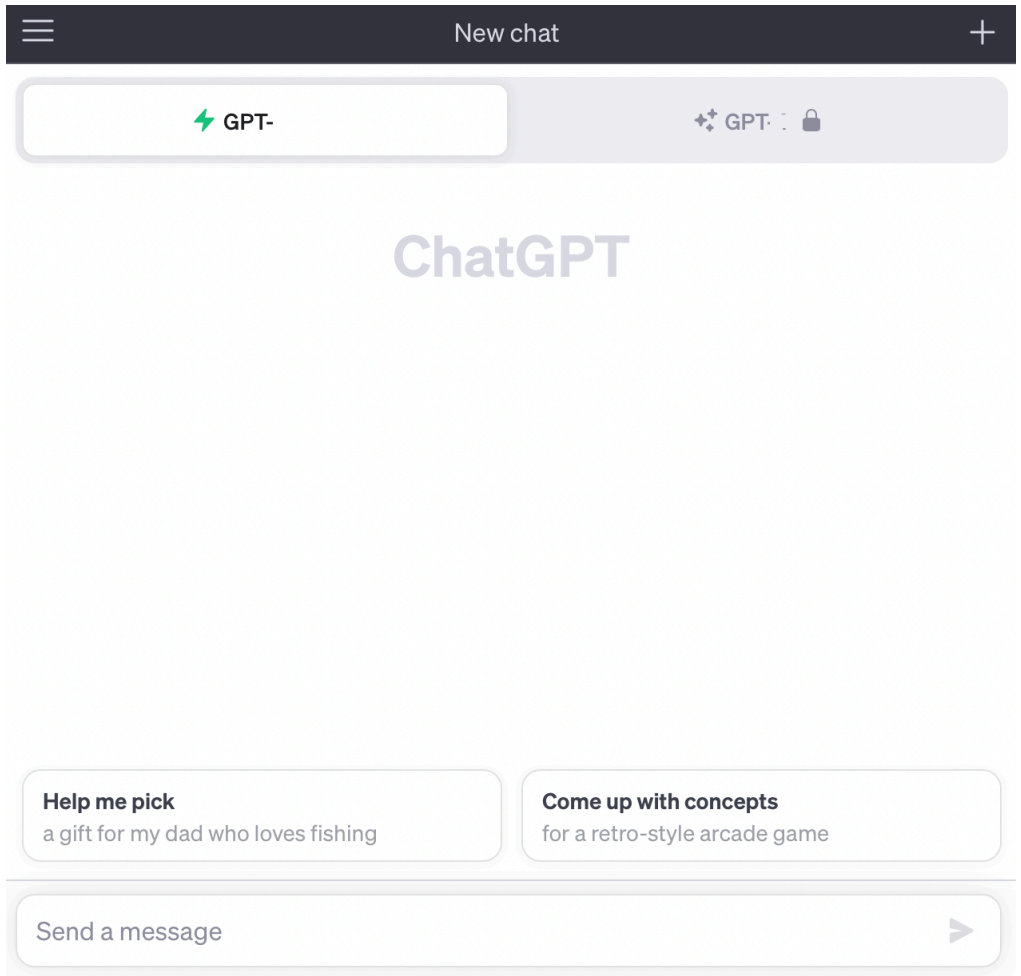
In 28 Minutes

Service	Quick Overview
Azure AI Bot Service	Build intelligent, multichannel bots using low-code or code-first. Integrates with CLU, QnA, and other AI services.
Azure AI Search	AI-powered search over diverse content types using indexing and enrichment. Supports OCR, sentiment, translation, and more.
Azure AI Content Safety (earlier Azure Content Moderator)	Screens images, videos, and text for unwanted content (e.g., PII, profanity, adult content). Returns moderation scores and flags.

Generative AI with Azure

Playing with ChatGPT

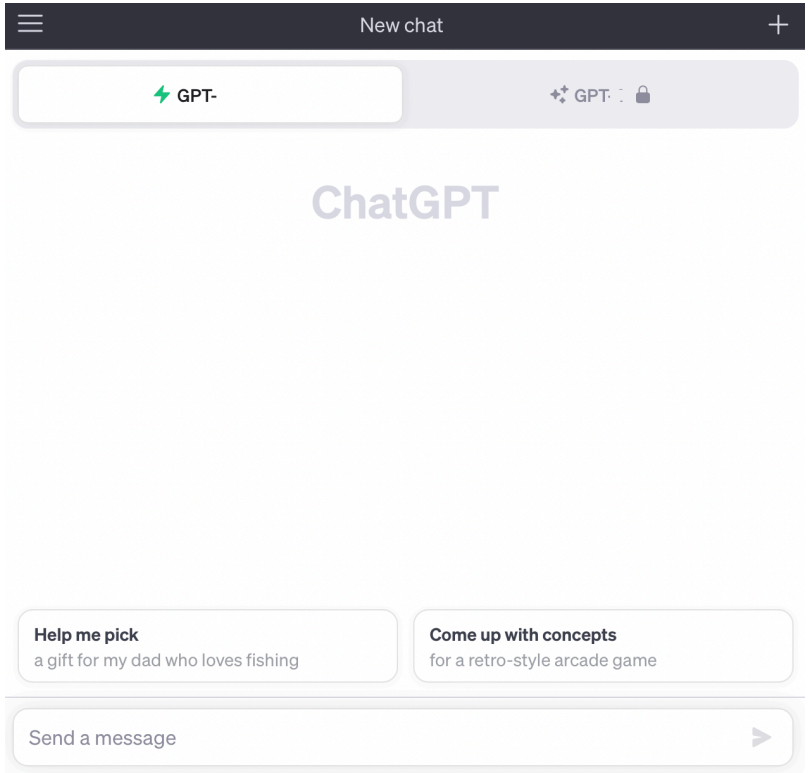
- **ChatGPT**: OpenAI's Generative AI Chatbot!
- **A Demo of ChatGPT**:
  - You are **Lex Friedman**. You are going to interview **Sachin Tendulkar** tomorrow. What are the FIRST FIVE questions that you are going to ask?
  - Act as **Sachin Tendulkar**. You are meeting **Roger Federer**. What questions would you ask?
  - Generate a **bulleted list of items** I need for an 15 day Everest Base Camp trek
    - I will be staying in tea houses on the trek. Can you update the list?



Playing with ChatGPT - Coding, Learning and Design

In 28 Minutes

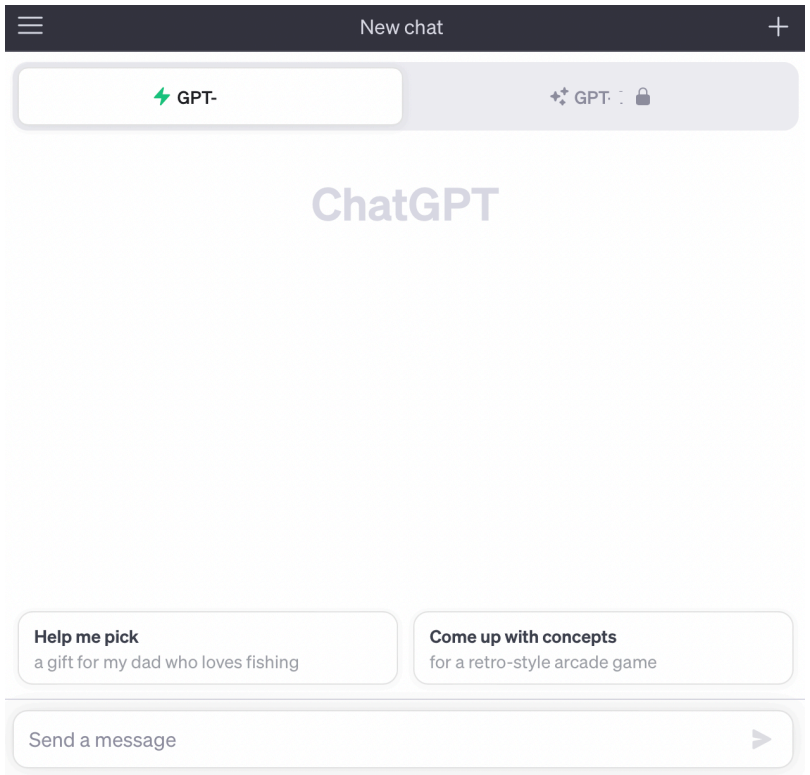
- Write **a Python function** to determine if a year is a leap year
- I'm learning Python for loop. Give me **a few exercises** to try?
- Can you **design a REST API** for todos? Give me an example request and response for each.
- I want to store information about courses, students, enrollments and reviews **in a relational table**. Can you suggest a structure?
- I like **learning concepts using a lot of examples**. What would be the books you would recommend to learn Design Patterns?



Playing with ChatGPT - Exploring Technology

In 28 Minutes

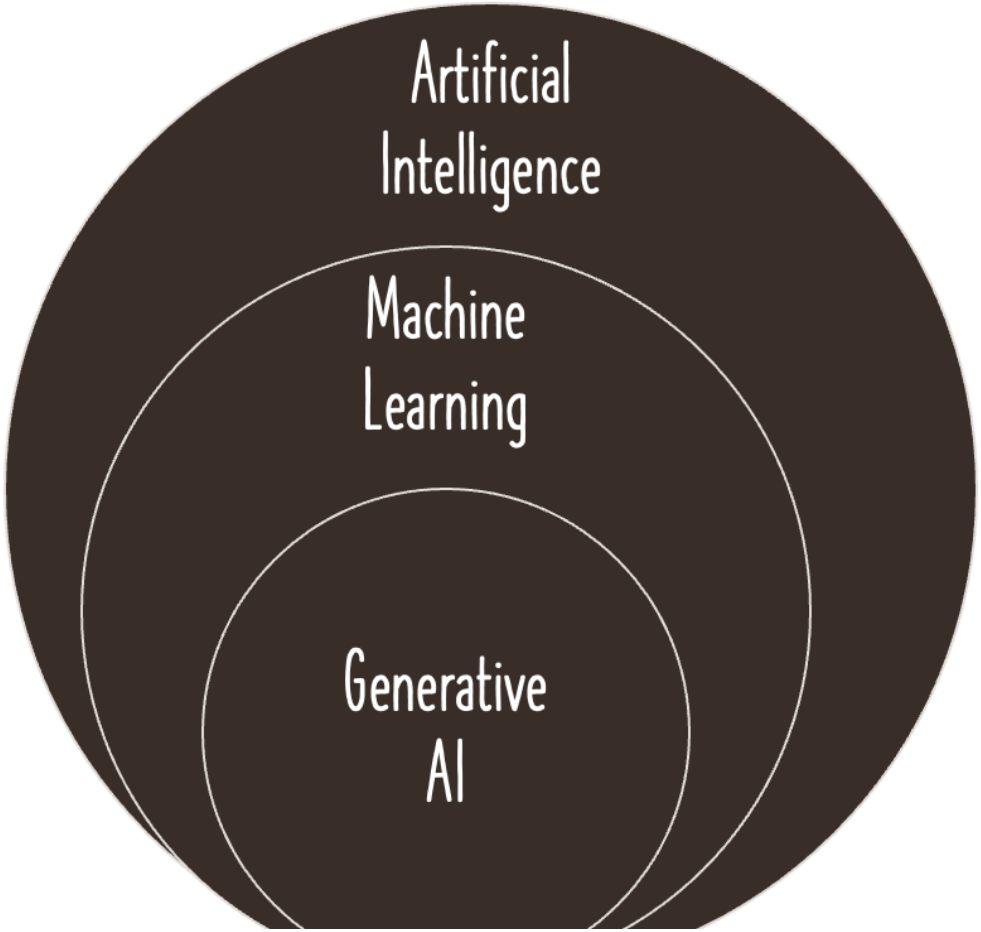
- Can you make list of **Top 10 technologies** that I might want to learn as a cloud engineer?
- For a new project, I'm considering React and Angular as front end frameworks.
  - Can you **compare them and present the results in a tabular format**? Feature/Factor in the column and the framework in the row.
- I like to **learn in a step-by-step approach** by breaking down complex concepts into smaller, more manageable parts.
  - How can I learn Docker? Give me a list of 10 step by step exercises I can begin with. Make sure you order them in increasing order of difficulty. Present the results in a table.



Generative AI - How is it different?

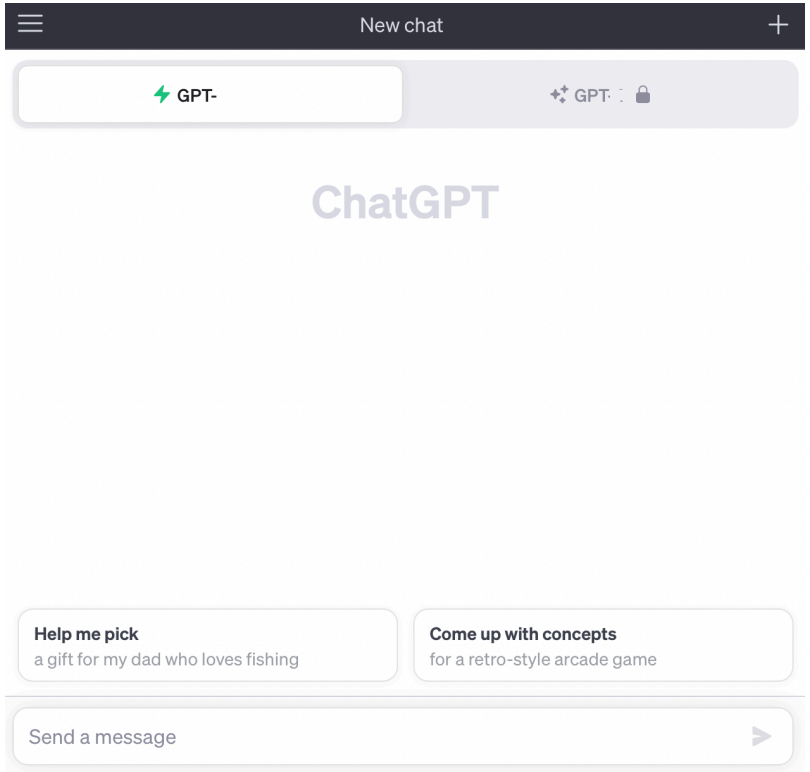
In 28 Minutes

- **Artificial Intelligence**: Create machines that can simulate human-like intelligence and behavior
  - **Machine Learning**: Learning from examples
    - **Generative AI**: Learning from examples to create new content



Generative AI - Generating New Content

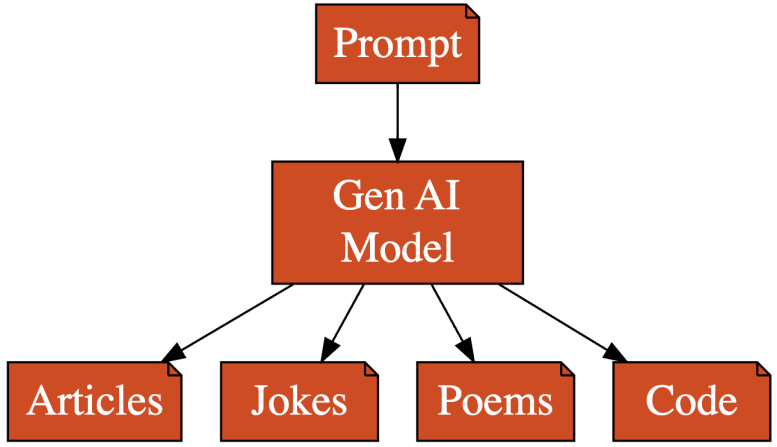
- **Goal**: Generating New Content
  - Instead of making predictions, Generative AI focuses on creating new data samples
  - **Examples**:
    - **Text Generation**: Writing e-mails, essays & poems. Generating ideas.
    - **Writing Code**: Write, debug & analyze programs
    - **Images Generation**: Creating paintings, drawings, or other forms of images
- How else is Generative AI different?
  - Let's find out!



Generative AI - Needs Huge Volumes of Data

In 28 Minutes

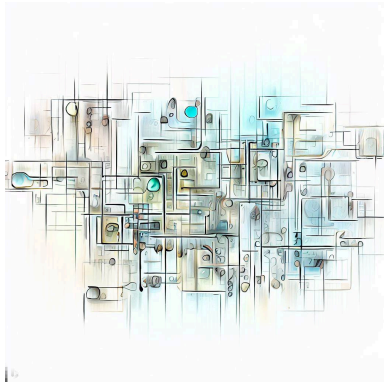
- **Generative AI models**: Statistical models that learn to generate new data by analyzing existing data
  - More data analyzed => Better new data similar to existing data
  - **Example**: GPT-3 model was trained on a dataset of 500 billion words of text
- **Datasets used include**:
  - Images, text and code scraped from the open web:
    - Wikipedia
    - Books
    - Open source code (syntax of programming languages and the semantics of code)
    - Conversations



Generative AI - Uses Self Supervised Learning

In 28 Minutes

- **Self-supervised learning**: Model learns from the data itself
  - WITHOUT requiring explicit labels or annotations
- **How does this work?**
  - **Example for text model:**
    - **1:** Model tries to predict next word based on preceding words:
      - Model is given example sentence: "The sun is shining and the sky is __."
      - Model predicts the missing word
    - **2:** Model's predicted word is compared to the actual word that comes next:
      - Learns from its mistakes and adjusts its internal representations
        - Neural Networks, Loss Calculation, Backpropagation etc..
    - **3:** Repeated for all text from training dataset
  - Model captures the relationships between words, contextual cues, and semantic meanings:
    - If prompted with "The sun is shining and the sky is," the model might generate:
      - "The sun is shining and the sky is **clear**."
      - "The sun is shining and the sky is **blue**."
      - "The sun is shining and the sky is **filled** -- with fluffy clouds."



Understanding Deep Learning

- How does **learning** in Generative AI happen?
  - Generative AI makes use of **Deep Learning**
- Let's consider an example:
  - Young artists learn by studying styles and techniques from different art pieces
  - With practice, they become proficient enough to create their own unique pieces
- **Deep learning**: Approach where a computer program learns from a large amount of data
  - Starts by understanding simple patterns
  - With time, it learns to recognize complex patterns
  - Using the skills learned through deep learning, Generative AI can generate new content, whether it's images, music, or text

Understanding Loss Function

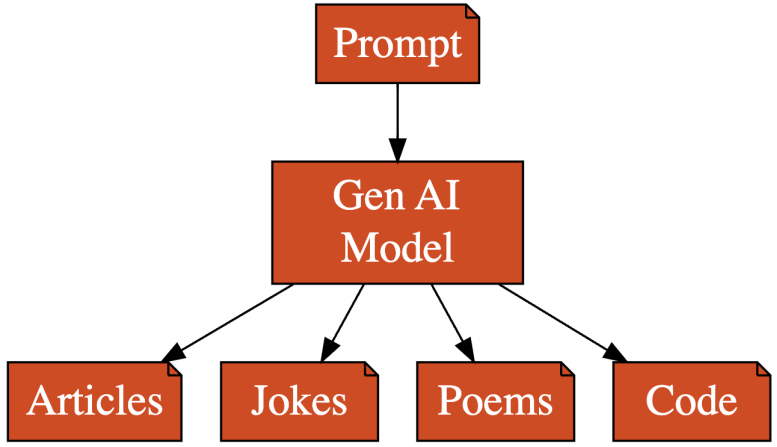
In 28 Minutes

- Let's consider **an example**:
  - Imagine you're teaching someone to paint
  - You give them feedback on their work:
    - You tell them what's good and what needs improvement
  - The loss function in deep learning is like this feedback
    - How far off is the current output of a model from the desired result?
    - **Goal of a deep learning system**: Minimize the 'loss'
- In Simple Terms: **The loss function is a score that tells us how well the AI is performing**
  - A lower score => AI's output is close to what we want
  - A high score => it's far from the target
- AI's goal: Adjust and learn in a way that this score (**Loss**) gets lower over time

Key Step In Generative AI For Text - Next Word

In28 Minutes

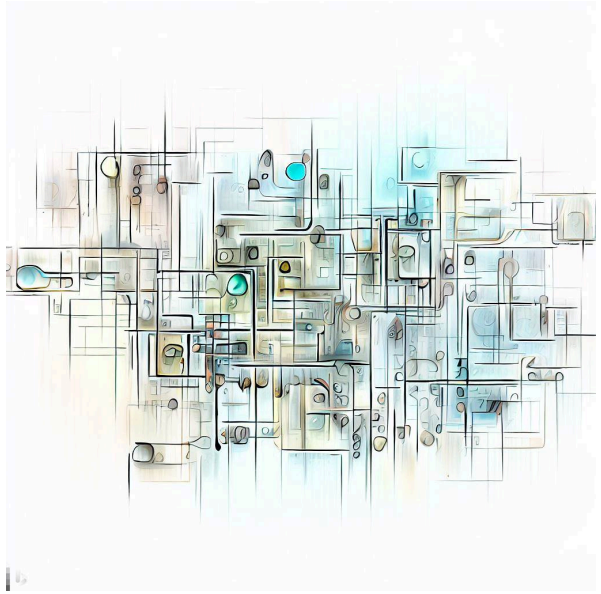
- A key step in Generative AI For Text is **predicting** the next word
- During training, text based Generative AI models **learn the probability** that a word might occur in a specific context
  - **Context**: "The cat sat on the"
  - **Example probabilities for next word**:
    - "mat": 0.4, "table": 0.2, "chair": 0.2, "moon": 0.1
  - Model **might** choose the highest probable word and go on to predict subsequent words
  - HOWEVER, you can **control** which of the words is chosen by controlling a few parameters!
    - temperature, top_k, top_p etc!



Generative AI Text - Uses Tokens instead of Words

In 28 Minutes

- **TOKEN**: A unit of text that might be a word
  - BUT it can be a sub word, punctuation mark, a number, ..
  - **Why Tokens?**
    - Tokens are **more consistent** than words
      - Words can have multiple meanings, depending on the context
        - "bank" might mean financial institution or a river bank
      - Tokens are more consistent
        - Example tokens: bank_river, bank_financial or light_verb, light_noun, ..
    - Tokens are **smaller** and more manageable
    - Tokens are **more efficient** to process
      - Because tokens are consistent, it easy for models to learn relationships and things like parts of speech

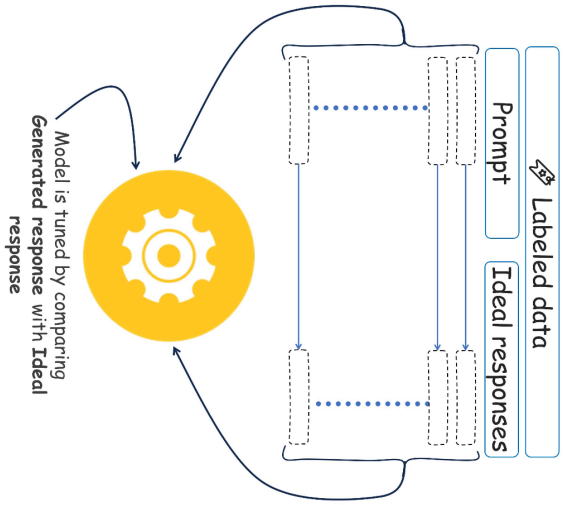


- **Generative AI For Text Models:**
  - Understand relationships between ~~**Words**~~ **Tokens**
  - Good at predicting Next ~~**Word**~~ **Token**!
  - Have a **token limit** on context and generated text
    - Example: 1,024 tokens or 4,096 tokens

Generative AI Text - Uses SFT

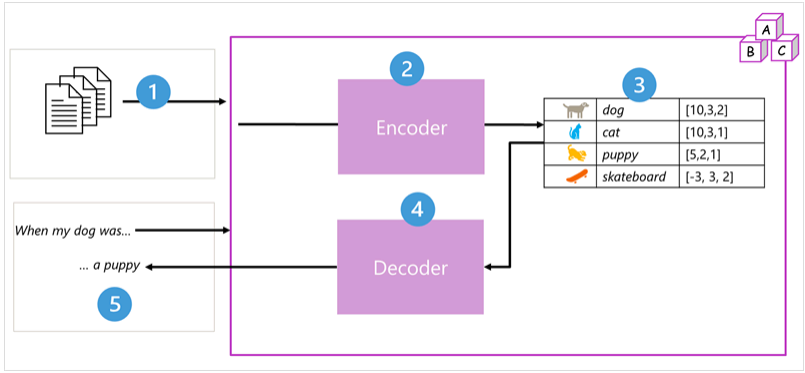
In 28 Minutes

- After basic training, Gen. AI Model can predict **NEXT WORD** in a sequence based on contextual information
  - Given: "My favorite sport is"
    - Model picks a probable word (basketball:20%, soccer:18%, cricket:10%)
  - Given: "A question?"
    - Model might follow up with "Another Question?"
- **HOW to make model to respond to questions with answers?**
  - Given a question, how to make the model give an answer
  - **Solution**: Supervised Fine-Tuning
- Model is trained with **Labeled Data**
  - 1000s of Prompt and Ideal Response combinations
  - Model learns to respond to a question with an answer
  - Surprisingly less number of prompts add this capability

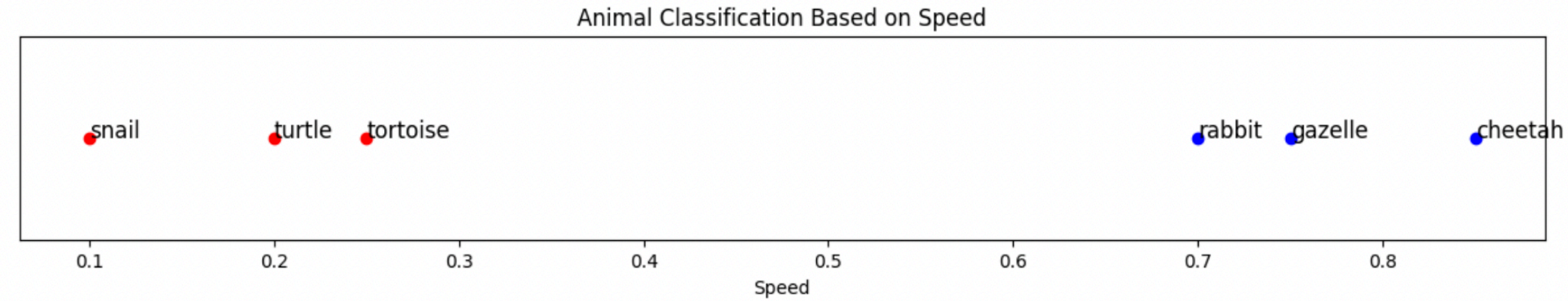


Evolution to Transformer Architecture - 1

- **Goal of Language Models**: Understand language and write new content.
- **Understanding Language**:
  - "The quick brown fox jumps over a lazy dog."
  - **Tokenization**: Split the words based on a rule (e.g., whitespace)
    - ['The', 'quick', 'brown', 'fox', 'jumps', 'over', 'a', 'lazy', 'dog']
  - Remove stop words
    - ['quick', 'brown', 'fox', 'jumps', 'lazy', 'dog']
  - Assign a number to each unique token.
    - {'quick': 0, 'brown': 1, 'fox': 2, 'jumps': 3, 'lazy': 4, 'dog': 5}
  - Determine Embeddings



What are Embeddings?



- **Embeddings**: Vector representations of words in a high-dimensional space
  - Captures semantic relationships and contextual information
- **Example**: You can use multiple dimensions to represent animals:
  - Habitat: "aquatic," "terrestrial," or "arboreal."
  - Diet: "carnivore," "herbivore," or "omnivore."
  - Size: "small," "medium," or "large."
  - Movement: "flying," "running," "swimming," or "crawling."

Exploring Embeddings with an Example

In 28 Minutes

- On the right is an embedding of a single word
  - OpenAI Embeddings API provides 1536-dimensional vector embeddings
  - i.e. Each word is being looked at from 1536 different dimensions
- Widely used in natural language processing (NLP) tasks
  - **Text Similarity**: Measure semantic similarity between texts
  - **Recommendation Systems**: Recommend items based on user preferences
  - **Clustering**: Group similar texts
  - **Outlier Detection**: Find text that does not fit the group
  - Example: Similarity Calculation
    - Given two sentences
      - "The sun is shining brightly." and "Cats and dogs are popular pets."
    - Calculate similarity between the sentence embeddings.
    - Higher similarity indicates semantic closeness.

```
[0.00020168583432678133,
 0.017162907868623734,
 0.02314572036266327,
 0.01056084968149662,
 0.04190816730260849,
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```
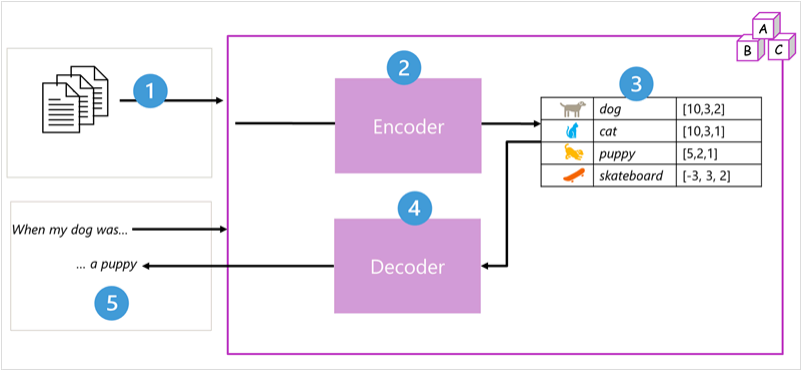
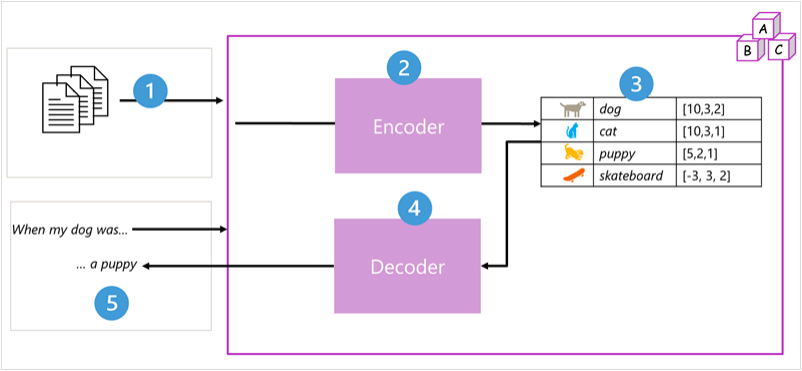

Evolution to Transformer Architecture - 2

- Understanding text is NOT about individual words
  - It is about understanding the context when these words are used
- **Earlier Models Had Limitations**
  - **Recurrent Neural Networks (RNNs)** tried to preserve sentence context using hidden states
    - BUT critical information could be lost over long sequences
  - RNNs treated all words equally, making it hard to isolate relevant signals from irrelevant noise
- **Transformers Changed the Game**
  - Transformers introduced the concept of 'attention' — a way to weigh the importance of each word in a sentence relative to others.



Evolution to Transformer Architecture - 3

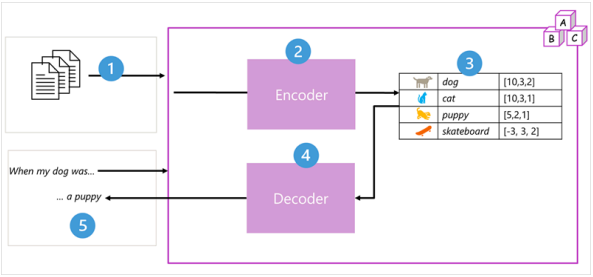
- **Transformers Changed the Game**
  - Enabled models to identify what matters most in a sentence, preserving relevant meaning over distance
  - Attention laid the foundation for today's powerful generative AI tools
  - **Encoding**: Encoder analyzes token relationships and context
    - **Attention**: Technique used to examine a sequence of text tokens and try to quantify the strength of the relationships between them
    - **Embedding Generation**: Tokens are transformed into vector representations
  - **Decoding**: Predicts the next token based on previously generated ones



How Transformers Understand Text - An Example

In28 Minutes

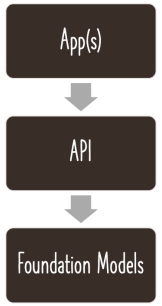
- **Input Sentence**: “The cat sat on the mat”
  - **1. Tokenization & Embedding**
    - Tokens: ['the', 'cat', 'sat', 'on', 'the', 'mat']
    - Each token is converted into a vector using embeddings
  - **2. Positional Encoding**
    - Adds info about word order (e.g., “cat” is position 1)
    - Combined with word embeddings to encode both meaning + position
  - **3. Multi-Head Attention**
    - Multiple attention heads analyze relationships from different angles:
      - Head 1: Focuses on "cat" → "sat" (subject-action)
      - Head 2: Focuses on "on" → "mat" (preposition-object)
    - Attention assigns weights to highlight important connections
  - **4. Output**
    - A context-aware representation of the sentence
    - Ready for tasks like next-word prediction



Multi-Head Attention – With Example

In28 Minutes

- **Goal**: Capture different types of relationships between words
- **Example Sentence**: *"The cat sat on the mat"*
  - **Head 1**: Grammatical focus
    - High attention between **"cat"** and **"sat"** (subject-verb)
  - **Head 2**: Prepositional focus
    - High attention between **"on"** and **"mat"**
  - **Head 3**: Contextual focus
    - Links **"the"** with nearby nouns **"cat"**, **"mat"**
- **Why Multiple Heads?**
  - A single attention head may miss certain patterns
  - Multiple heads process the same input differently and capture diverse patterns
  - **All Heads Combined** → Richer, more nuanced understanding of sentence meaning



Comparing Large and Small Language Models

In 28 Minutes

Feature	Large Language Models	Small Language Models
Training Data	Trained on vast datasets	Trained on focused or domain-specific datasets
Conversational Scope	Handles a wide range of contexts and topics	Optimized for specific topics or use cases
Model Size	Very large (billions of parameters)	Compact and efficient
Deployment	Difficult to deploy locally (requires cloud/GPU)	Easy to deploy on local devices
Fine-Tuning Cost	Expensive and resource-intensive	Faster and cheaper to fine-tune

Predictive Machine Learning vs Generative AI

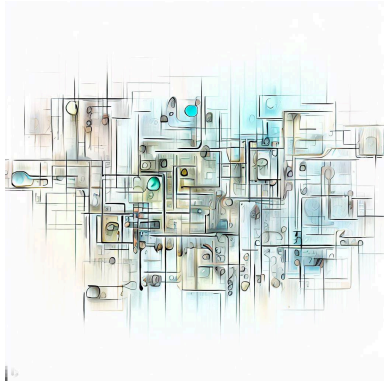
In 28 Minutes

Feature	Predictive Machine Learning	Generative AI
Goal	Make a Good Prediction	Generating New Content
Input	Features	Prompt
Output	Prediction (Label)	New Content
Use Cases	House Price Prediction, Fraud Detection, and more	Text Generation, Code Generation, Music Composition, and more
Volume of Training Data	Requires substantial labeled data	Requires significant amount of data
Time needed for Training	Training time can vary based on data size and complexity	Training time can be substantial for complex models

Improving Quality of Generative AI Responses

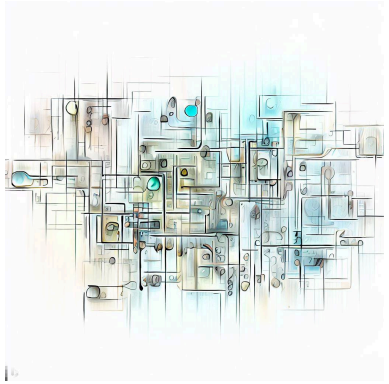
In 28 Minutes

- **Prompt Engineering**: process of prompt improvement
  - **1: Have a Clear Goal and Expectations** (Be specific about what you want)
    - ❌ "Tell me about marketing"
    - ✅ "Give me 3 key trends in SaaS for 2045"
  - **2: Add Context** (Share background or intended use)
    - ✅ "I'm preparing a pitch deck for enterprise clients"
  - **3: Provide a Source to Ground the Response**
    - Link to your data, document, or example
    - ✅ "Use insights from this PDF of our Q1 survey"
  - **4: Iterate and Refine**
    - Treat it like a conversation; build upon each version
    - ✅ "Can you shorten that to 100 words?" or "Now rewrite in a more casual tone"
  - **5: Use System Message to set the stage**
    - Guide tone, style, or role of the assistant
    - ✅ "You're a helpful assistant that responds in a cheerful, friendly manner"



Additional Generative AI Mechanisms

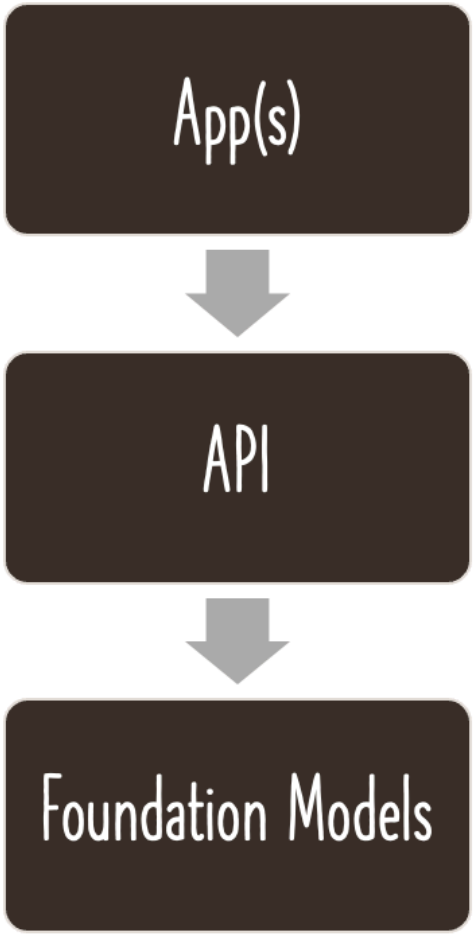
- **Retrieval-Augmented Generation (RAG)**
  - Combines language model generation with real-time document retrieval
  - ✅ *Example*: AI uses your knowledge base while drafting a response (always up-to-date)
- **Fine-Tuning**
  - Customizes a base language model using your specific data or style
  - ✅ *Example*: Fine-tune GPT on 1000s of support tickets to match your company's tone
- **Security and Governance Controls**
  - Ensures safe, compliant use of generative AI across teams and systems
  - ✅ *Example*: Role-based access, prompt monitoring, and filtering sensitive outputs



Generative AI - Foundation Models and LLMs

In28 Minutes

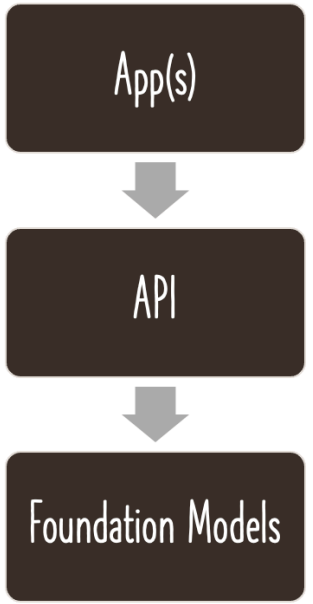
- **Traditional ML Models**:
  - Needed task specific training
  - Multiple tasks => Multiple trainings => Multiple models
- **Foundation Models**: Pre-Trained Multi Task Models
  - Trained once (called pre-training)
  - Same model can be used for multiple tasks
    - Chatbot
    - Classification
    - Summarization
  - Some models are multi modal as well: Text, video, audio, image...
- **Large Language Models**: Focused on text
  - **REMEMBER**: Subset of Foundation Models
  - Models that are trained on a lot of text to generate more text!



Generative AI - Foundation Models

In28 Minutes

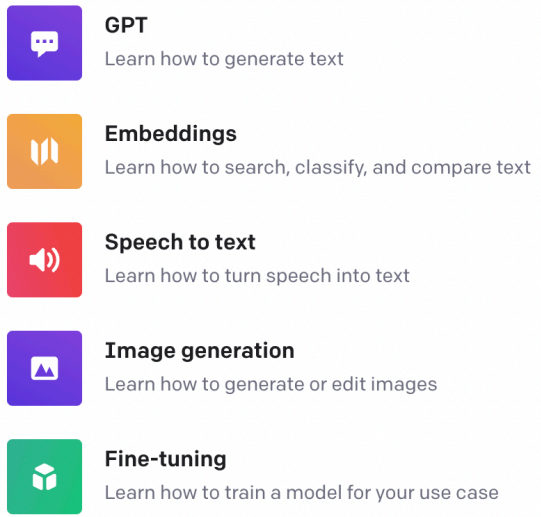
- From Bottom to Top:
  - Foundation Models:
    - OpenAI:
      - GPT (2, 3, 3.5, 4, 5, ..): Text, code and more..
      - DALL·E (1, 2, ...): Images
    - Open Source:
      - **OpenLLaMA** (Meta): Generate text, images, and code
    - Other Vendors: Google Gemini, ...
  - API:
    - OpenAI API
    - Azure OpenAI
    - Google Gemini API, ...
  - Applications
    - ChatGPT
    - DALL·E
    - Bing Search, ...



Getting Started with Azure OpenAI API

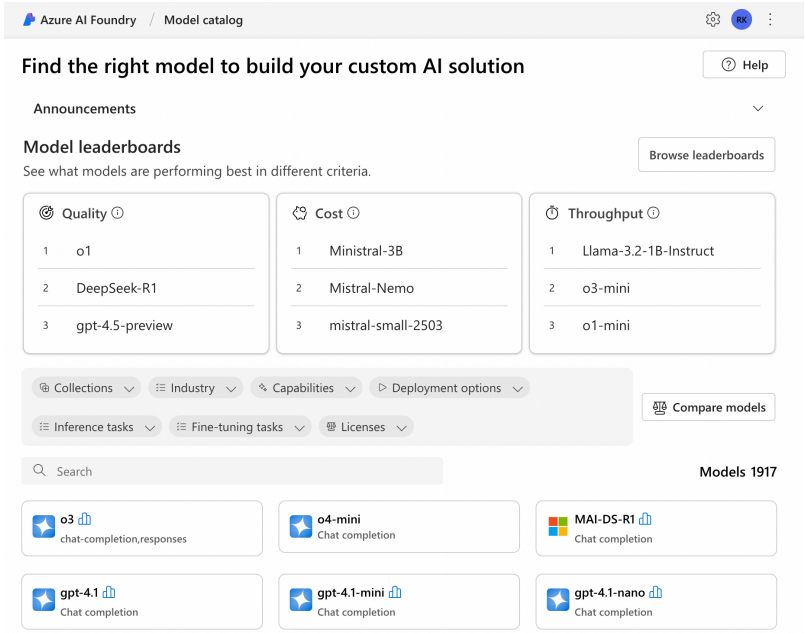
In 28 Minutes

- **Azure OpenAI API**: REST API access to OpenAI's powerful language models
  - Understand and generate natural language and code
  - Generate and edit images
  - Convert speech into text
  - Fine tune models
- **Models**:
  - gpt, dall-e, o series ..
- **Demo**:
  - ***https://learn.microsoft.com/en-us/azure/ai-services/openai/quickstart***



Azure AI Foundry model catalog

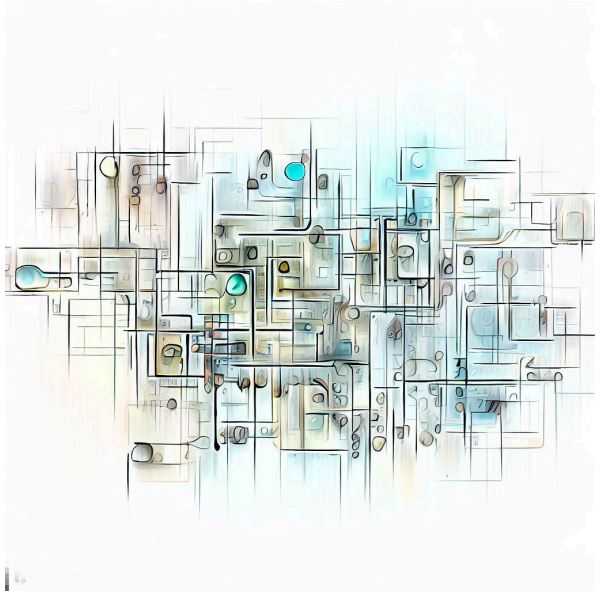
- **MaaS (Model as a Service)**: Access and use a variety of open-source models without having to provision infrastructure or manage back-end operations
- **Azure AI Foundry model catalog**: Enables MaaS
- **Streamlined journey**: From model selection to deployment
  - Discover, evaluate, fine-tune, deploy and manage AI models
  - Most popular large language and vision foundation models curated by Microsoft, OpenAI, Hugging Face, Meta, Mistral AI among others.



NIST & Microsoft's Approach to Responsible Generative AI

In 28 Minutes

- **NIST AI Risk Management Framework (AI RMF):** Developed by the U.S. National Institute of Standards and Technology (NIST)
  - Provides guidance to identify, assess, manage, & monitor AI risks
  - Four core functions: Map, Measure, Manage, Govern
- **Microsoft's Responsible Generative AI Process:** Practical and actionable framework for safe generative AI development
  - Follows **four key stages**:
    - **1**: Map potential harms
    - **2**: Measure presence of harms
    - **3**: Mitigate harms at multiple layers
    - **4**: Operate with responsibility and transparency
  - Stages correspond to the functions in the NIST AI RMF



Microsoft's Approach to Responsible Generative AI - 1

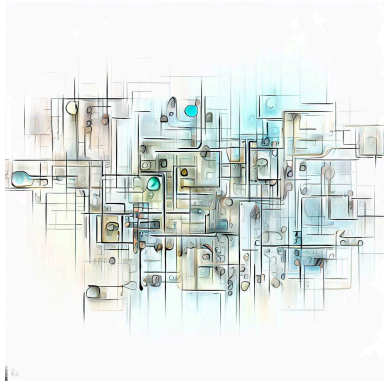
In 28 Minutes

- **1: Map potential harms**
  - Identify potential harms
    - Offensive content, discriminatory content, factual inaccuracies, illegal or unethical practices
  - Prioritize identified harms
  - Test and verify the prioritized harms
    - "red team" testing - deliberate probing of solution for weaknesses
  - Document and share the verified harms
- **2: Measure potential harms**
  - Use Manual and automatic testing
  - Create a diverse list of prompts
  - Categorize output according to level of potential harm

Microsoft's Approach to Responsible Generative AI - 2

In28 Minutes

- **3: Mitigate potential harms**: At all layers
  - **Model Layer**: Selecting the right model and fine-tuning it
  - **Safety System Layer**: Use content filters
    - Provided by the model platform
  - **System message and grounding layer**: Construction of right prompts
    - Using the right approach (for ex: grounding data and RAG)
  - **User experience layer**: Restricting user flexibility in your application
- **4: Manage a responsible generative AI solution**
  - **Pre-release**: Legal, Privacy, Security and Accessibility reviews
  - **Phased delivery plan**: Proper incident response plan (incl. a rollback plan)
  - **Capabilities**: Block harmful responses, or specific client IP addresses.
    - Get User Feedback (enable users to report harmful content).
  - **Utilize Azure AI Content Safety**: Prompt shields (scan prompts)
    - Protected material detection(copyright check)



Generative AI & Azure AI Services - Scenarios - 1

In28 Minutes

Scenario	Solution
A developer wants to access models like GPT or DALL·E through a REST API	Azure OpenAI API
A user wants to quickly try out and deploy Llama model	Azure AI Foundry – Model Catalog
A designer wants to create original artwork using AI	Generative AI – Image Generation
A search system retrieves relevant documents and then drafts a natural-language response using Generative AI	RAG (Retrieval-Augmented Generation)

Generative AI & Azure AI Services - Scenarios - 2

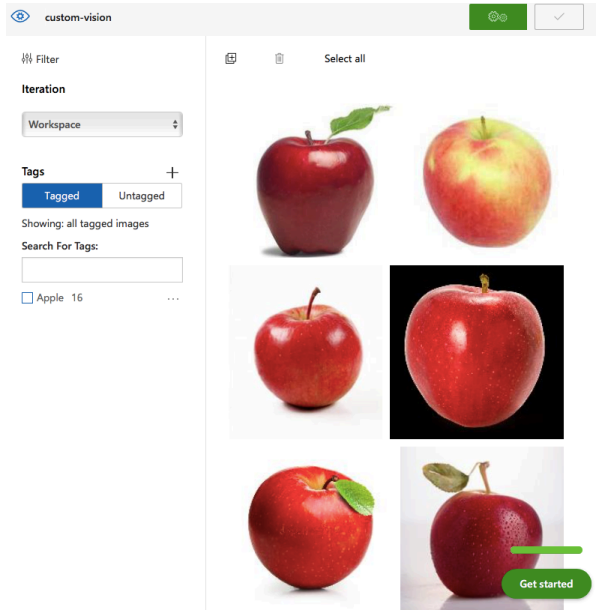
In28 Minutes

Scenario	Solution
Vector representations of words in a high-dimensional space. Captures semantic relationships and contextual information.	Embeddings
A mechanism that weighs the importance of each word relative to others in a sentence	Attention
Identifying potential harms like offensive content: Which Stage of Microsoft's Responsible Generative AI process?	Stage 1: Map Potential Harms
Creating a phased release plan and preparing rollback strategies for AI deployment: Which Stage of Microsoft's Responsible Generative AI process?	Stage 4: Manage a Responsible Generative AI Solution

Building ML Models

Custom Vision (Azure AI Vision)

- **Custom Vision (Azure AI Vision)**: Create custom models using your own images
  - Project Types
    - **Classification**: Predict labels for an image
      - Two Classification Types
        - 1: Multilabel (Multiple tags per image)
        - 2: Multiclass (Single tag per image)
    - **Object Detection**: Returns coordinates of objects in an image
- **Best Practices:**
  - Pick the domain closest to your scenario
    - Different domains are available for Classification and Object Detection projects!
  - Sufficient images (Add more images to improve accuracy)
  - From different angles



Understanding Machine Learning

In 28 Minutes

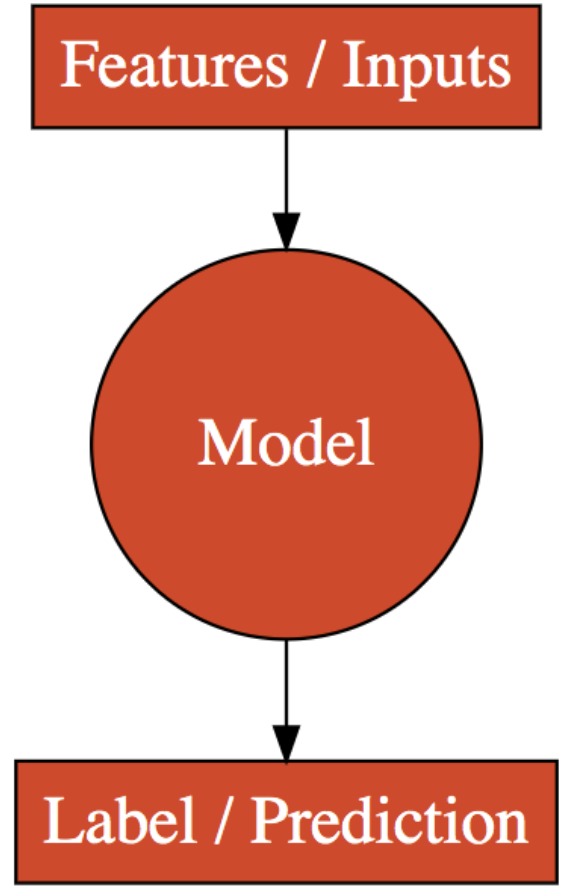
- **Traditional Programming**: Based on Rules
- **Machine Learning**: Learning from Examples

Home size (Square Yds)	Age	Condition (1-10)	Price $$$
300	10	5	XYZ
200	15	9	ABC
250	1	10	DEF
150	2	34	GHI

Creating Machine Learning Models - Features and Labels

In28 Minutes

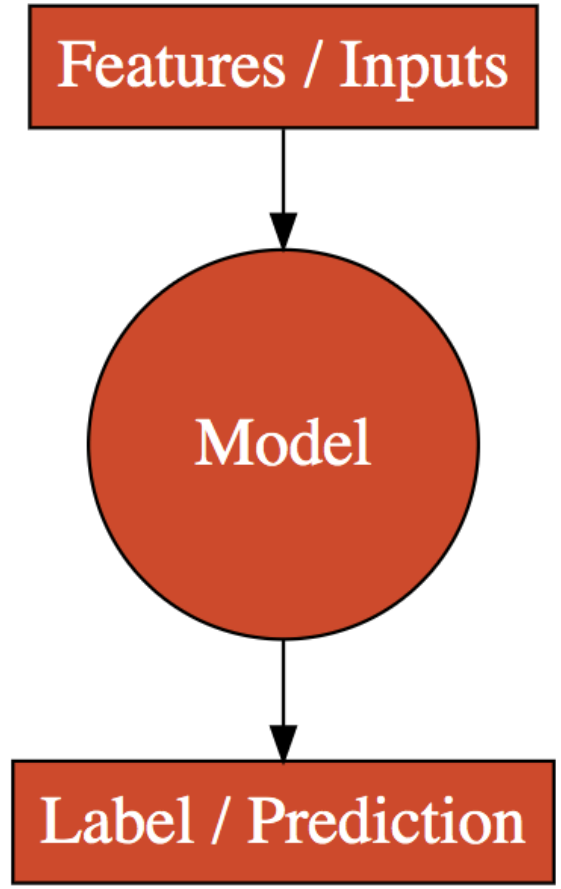
- **Goal** of Machine Learning: **Create a Good Model**
  - Give inputs to a model
    - Model returns the prediction
    - Inputs are called Features
    - Predication is called Label
- **Example**: House Price Prediction Model
  - **Label**: price
  - **Features**:
    - area: Total area of house (m^2)
    - rooms: No. of rooms
    - bedrooms: No. of bedrooms
    - furniture: Is it furnished?
    - floor: Which floor?
    - age: How many years?
    - balcony: has balcony or not



Creating ML Models - Features and Labels - Examples

In28 Minutes

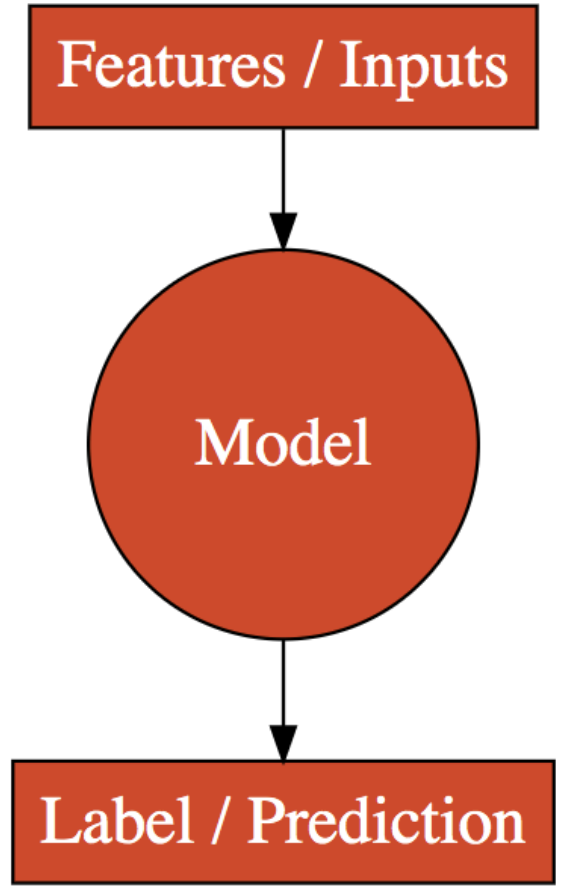
- Used Car Price Prediction Model
  - **Label**: price
  - **Features**: manufacturer, year, model, age, condition, cylinders, location
- Spam Email Classification Model
  - **Label**: isSpam
  - **Features**: sender, subject, content
- Grant a Loan Model
  - **Label**: shouldWeGrantALoan
  - **Features**: doesOwnCar, doesOwnRealEstate, creditScore, isMarried, doesHaveChildren, totalIncome, totalCredit



Creating ML Models - Choosing Technique

In 28 Minutes

- **Supervised Learning**: Features & Label
  - Label is a numeric value with a range of possibilities => **Regression**
    - Example: Used Car Price Prediction, House Price Calculation, Predicting sea level, Predicting no of vehicles that use a specific high way
    - How much will it rain tomorrow?
  - Label has limited set of possibilities (YES or NO, 0 or 1, Type 1 or Type 2 or Type 3) => **Classification**
    - Spam Email, Grant a Loan, Determine the type of cloud
    - Will it rain today?
  - Summary: Supervised machine learning models
    - Classification: Predicting category
    - Regression: Predicting numeric value
- **Unsupervised Learning**: No Label
  - **Clustering**: Divide customers into groups
    - Group similar entities based on their features



Machine Learning Fundametals - Scenarios

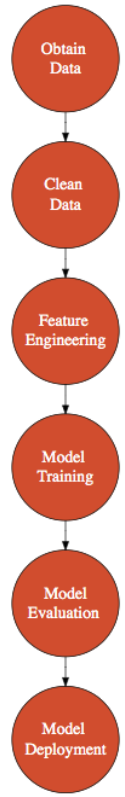
In 28 Minutes

Scenario	Solution
Categorize into features and labels for house price prediction: price, area, rooms, age	price is label. Others can be features
Categorize into features and label for used vehicle price prediction: manufacturer, year, model, age, condition, cylinders, location, price	price is label. Others can be features
Categorize: Used Car Price Prediction	Regression
Categorize: Spam Email Identification	Classification
Categorize: Predict amount of rainfall in the next year	Regression
Categorize: Should we grant a loan?	Classification
Categorize: Identify the type of vehicle in an image	Classification
Categorize: Find a specific dance form in a video	Classification
Categorize: Divide customers into groups	Clustering

Creating Machine Learning Models - Steps

In28 Minutes

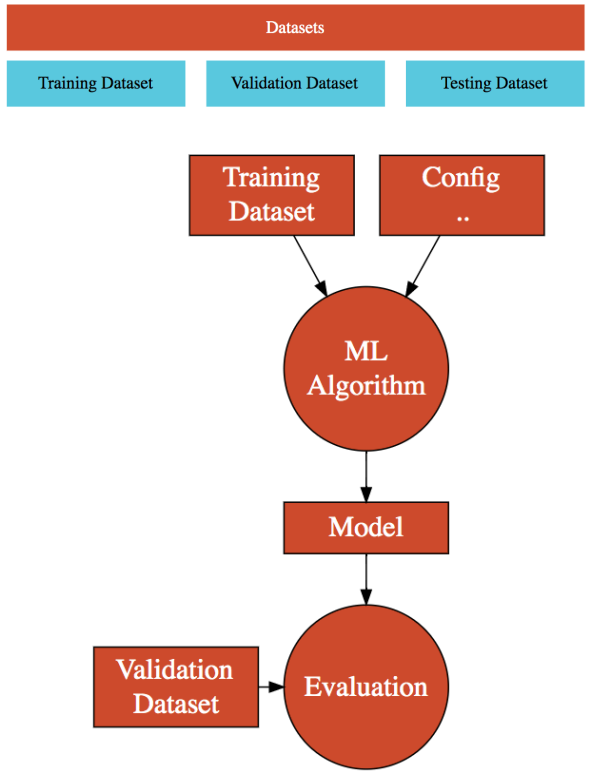
- **1:** Obtain Data
- **2:** Clean Data
- **3:** Feature Engineering: Identify Features and Label
- **4:** Create a Model using the Dataset and the ML algorithm
- **5:** Evaluate the accuracy of the model
- **6:** Deploy the model for use



Understanding Machine Learning Terminology

In28 Minutes

- **Process**
  - **Training**: The process of creating a model
  - **Evaluation**: Is the model working?
  - **Inference**: Using model to do predictions in production
- **Dataset**: Data used to create, validate & test the model
  - **Features**: Inputs
  - **Label**: Output/Prediction
  - Dataset Types
    - **Training Dataset**: Dataset used to create a model
    - **Validation Dataset**: Dataset used to validate the model (and choose the right algorithm) - Model Evaluation
    - **Testing Dataset**: Dataset used to do final testing before deployment



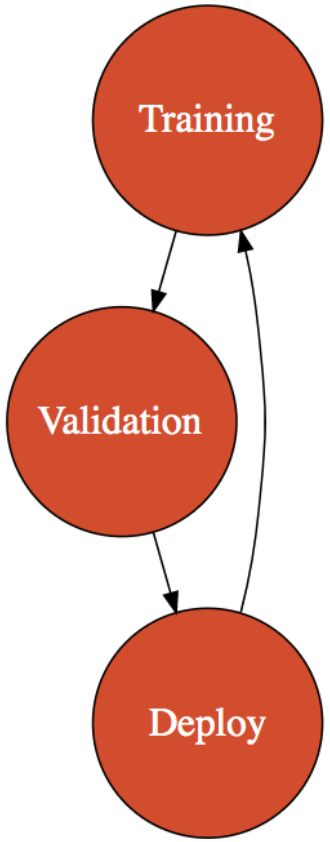
ML Stages and Terminology - Scenarios

In28 Minutes

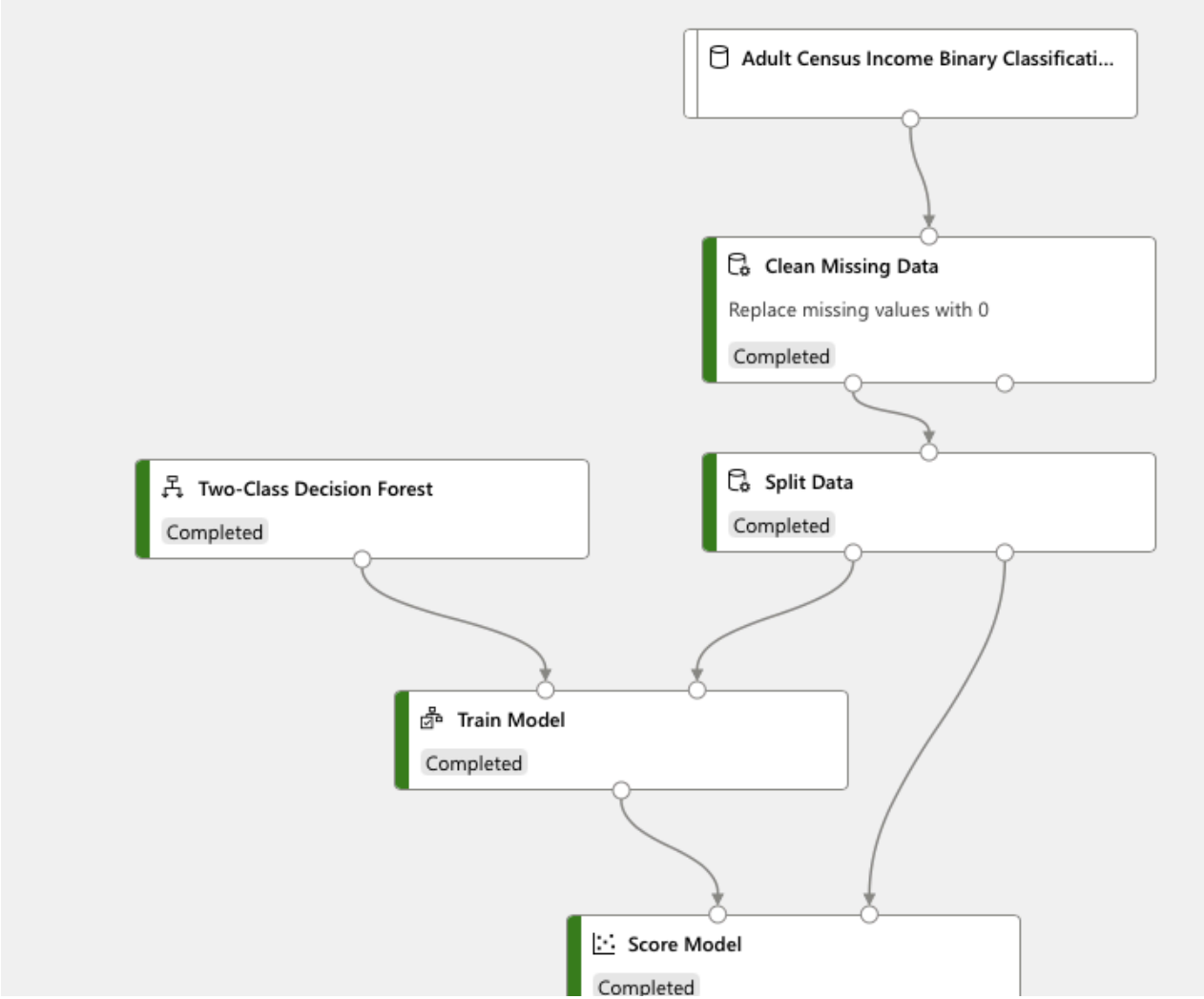
Scenario	Solution
Determine Stage: You remove data having null values from your dataset	Clean Data (Data Preparation)
Determine Stage: Normalize or split data into multiple features	Feature Engineering
Determine Stage: You evaluate the accuracy metrics of a model	Model Evaluation
Terminology: Using model to do predictions in production	Inference
Terminology: The process of creating a model	Training
Terminology: Dataset used to (train) or create a model	Training Dataset
Terminology: Dataset used to evaluate a model	Validation Dataset
Terminology: Dataset used to do final testing before deployment	Testing Dataset

Azure Machine Learning

- **Azure Machine Learning**: Simplifies creation of your models
  - Manage data, code, compute, models etc
  - Prepare data
  - Train models
  - Publish models
  - Monitor models
- **Multiple options to create models**
  - **Automated machine learning**: Build custom models with minimum ML expertise
  - **Azure Machine Learning designer**: Enables no-code development of models
    - Build Your Own Models: Data Scientists
      - Data and compute management, pipelines

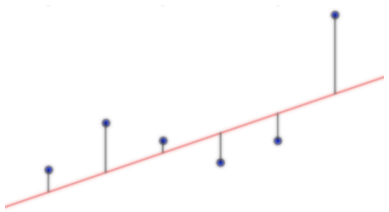


Sample Pipeline - Classification



Sample Pipeline - Regression

Model Evaluation - Regression Models



- **Mean Absolute Error (MAE)**: How close is a prediction to actual value?
  - Lower the better
- **Mean Squared Error (MSE)**: Average of squares of the distance between actual and predicted
  - When you want to penalize large prediction errors (housing value predictions)
  - Lower the better
  - Alternative:
    - **Root Mean Squared Error**: Square root of Root of MSE
      - Lower the better

Model Evaluation - Classification Models

In 28 Minutes

- Terminology:
  - **Predicted label**: What's predicated?
  - **True label**: What's expected?
  - **Confusion matrix**: Matrix matching predicted label vs true label

		PREDICTION	
		Negative	**Postive**
ACTUAL	**Negative**	True Negative	False Positive
	Positive	False Negative	True Positive

- Different usecases have different needs:
  - **Examples**: Spam, fraud, sick patient detection
- Metrics:
  - **Accuracy**: Proportion of accurate results to total cases
  - **Precision**: (True Positive)/ (True Positive + False Positive)
  - **Recall**: (True Positive)/ (True Positive + False Negative)
  - **F1 Score**: 2 *((Precision* Recall) / (Precision + Recall))
    - When you need balance between Precision and Recall

ML Model Evaluation - Scenarios

In28 Minutes

Scenario	Solution
Model Evaluation Terminology: What's predicated?	Predicted label
Model Evaluation Terminology: What's expected?	True label
Model Evaluation Terminology: Matrix matching predicted label vs true label	Confusion matrix
Model Evaluation metrics for Classification	Accuracy, Precision, Recall, F1 Score
Model Evaluation metrics for Regression	Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error(RMSE)

Azure Machine Learning - Terminology

In28 Minutes

- **Studio**: Website for Azure Machine Learning
- **Workspace**: Top-level resource for Azure Machine Learning
  - **Azure Machine Learning designer**: drag-and-drop interface to create your ML workflows (Canvas)
    - **Pipelines**: Reusable workflows (training and re-training)
    - **Datasets**: Manage your data
    - **Module**: An algorithm to run on your data
      - Data preparation: Data Transformation, Feature Selection
      - Machine learning algorithms: Regression, Classification, Clustering
      - Building and evaluating models: Model Training, Model Scoring and Evaluation
    - **Compute**:
      - Compute Instances: Development machines (CPU or GPU instances) for data engineers and data scientists
        - Pre-configured with tools such as Jupyter,ML packages etc
      - Compute Clusters: Training machines
        - Single or multi node compute cluster for your training
      - Inference Clusters: Deployment machines
        - Deploy your model to Azure Kubernetes Service or Azure Container Instances
      - Attached Compute: Use HDInsight cluster, a Virtual Machine, or a Databricks cluster as target for Azure Machine Learning workspace

Building Custom ML Models in Azure - Scenarios

In28 Minutes

Scenario	Solution
Recommend Service: Create custom models using your own images	Custom Vision (Azure AI Vision service)
Terminology: Website for Azure Machine Learning	Azure Machine Learning Studio
Drag-and-drop interface to create your ML workflows	Azure Machine Learning designer
Reusable workflows (training and re-training)	Pipelines
Data used for training	Dataset
What are the components that can be dragged on to canvas to build a pipeline?	Modules
What are training machines for Azure Machine Learning called?	Compute Clusters

Building Custom ML Models in Azure - Scenarios - 2

In28 Minutes

Scenario	Solution
What are deployment machines for Azure Machine Learning called?	Inference Clusters
Why do you split data when you build a ML model?	To use a part of training and rest of data for validation of model
How can you consume an Azure Machine Learning model?	Publish it and access it as a web service (REST API endpoint)
Languages popularly used with ML	Python and R
Store and version your models. Organize and keep track of your trained models.	Model registration

Most important AI considerations

Challenges in Building AI Solutions

- Importance of Datasets
  - What if the data has a bias? (Bias can affect results)
    - (Solutions may not work for everyone)
  - Obtaining data
- Evolving field
  - What if an AI system causes errors?
    - Accident made by a self driving car
      - Errors may cause harm
  - Scarcity of skills (Data Scientists, ...)
- ML lifecycle (MLOps)
- Security (What if the data used to build the model is exposed?)
- Explainability of model (Users must trust a complex system)
- Who will face the consequences?
  - Who's liable for AI-driven decisions?

Tags:

Water 100% confidence Sky 100% confidence
Lake 95% confidence Outdoor 95% confidence
Skyscraper 89% confidence Reflection 61% confidence
Overlooking 33% confidence Day 12% confidence

Description:

a city skyline with water 27% confidence

Racy Content: Adult Content:

False 75% confidence False 78% confidence

Responsible AI Principles

In 28 Minutes

- AI without unintended negative consequences:
  - **1: Fairness** - Fair to all groups of people
    - "System's decisions don't discriminate or run a gender, race, sexual orientation, or religion bias toward a group or individual"
      - Data should reflect diversity, Model should evolve with time
  - **2: Reliability and safety** - Continues working under high loads, unexpected situations etc
    - What happens in bad weather? What if GPS is down? What happens if data is bad?
      - Test, Test and Test
  - **3: Privacy and security** - Of people and data! (information and controls)
    - Important consideration from day ZERO!
  - **4: Inclusiveness** - Nobody left out
    - Violation: Leaving out a certain group of people (ex: people with disabilities)
  - **5: Transparency** - Explainability, debuggability
    - Clear explanation to users
  - **6: Accountability** - Meets ethical and legal standards
    - AI is NOT the final decision maker. An enterprise, a team or a person is

Tags:

Water 100% confidence Sky 100% confidence
Lake 95% confidence Outdoor 95% confidence
Skyscraper 89% confidence Reflection 61% confidence
Overlooking 33% confidence Day 12% confidence

Description:

a city skyline with water 27% confidence

Racy Content: Adult Content:

False 75% confidence False 78% confidence

AI considerations - Scenarios

Scenario	Solution
Identify violated principle: You find that a ML model does not grant loans to people of certain gender	Fairness
Identify violated principle: More accidents caused by a self driving car in bad weather	Reliability and Safety
Identify related principle: Securing data used to create the model	Privacy and security
Identify related principle: Making sure that the dataset used does not have any errors (missing values etc)	Reliability and Safety
Identify violated principle: People with disabilities cannot use a specific AI solution	Inclusiveness

AI considerations - Scenarios - 2

Scenario	Solution
Identify related principle: Giving your customers control/choice over the data that is used by your AI system	Privacy and security
Identify related principle: Ensuring that an AI system works reliably under unexpected situation	Reliability and Safety
Identify violated principle: You do not know how a AI system reached a specific inference	Transparency
Identify related principle: Ensuring that there is sufficient information to debug problems with an AI system	Transparency
Identify related principle: Having a team that can override decision made by an AI system	Accountability

Review

Azure AI Services – Review - 1

In 28 Minutes

Service	Description	Example Use Cases
Azure AI Vision	Analyze images and videos using pre-trained vision models	Object detection, image tagging, generate captions, very basic OCR operations
Azure AI Custom Vision	Train custom image classification models tailored to your use case	Identify product types, detect brand logos
Azure AI Document Intelligence	Extract structured data from unstructured documents (OCR)	Extract customer and vendor details from invoice, Extract pay stub details
Azure AI Language	Perform NLP tasks: Sentiment analysis, key phrase identification, text summarization, and conversational language understanding	Customer feedback analysis, document summarization
Azure AI Face	Detect, identify, and analyze human faces in images	Face identification, emotion detection

Azure AI Services – Review - 2

Service	Description	Example Use Cases
Azure AI Speech	Convert speech to text, text to speech, and translate spoken language	Voice assistants, call transcription, real-time voice translation
Azure AI Translator	Real-time multi-language translation of text	Global customer support, multilingual apps
Azure AI Content Safety	Detect and filter harmful, offensive, or inappropriate content	Moderating user-generated content in apps or forums
Azure AI Search	Add enterprise search to your applications	Search across enterprise content, internal knowledge base
Azure OpenAI	Access OpenAI models (GPT - text, Codex - code, DALL·E - image) through Azure	Chatbots, code generation, content creation

Azure AI Services – Review - 3

Service	Description	Example Use Cases
Azure Machine Learning	Full-featured ML development and deployment platform for custom ML workflows	End-to-end model training, tuning, deployment, and monitoring
Azure Machine Learning Automatic ML	Build custom ML models with minimal expertise using automation	Build simple models without data scientists or AI/ML skills
Azure AI Foundry	End-to-end platform to build, evaluate, and deploy AI services	Deploy an open source Generative AI model, Tune your Generative AI model, Explore model catalog

Some Keywords To Remember! - Image Processing

In 28 Minutes

Keyword	Description	Azure AI Service Option
Image classification	Classify images into different custom product types	Azure AI Vision (Custom Vision)
Object detection	Detect and locate multiple objects in an image	Azure AI Vision (Object Detection)
Optical character recognition	Extract printed or handwritten text from images	Azure AI Vision (Read OCR) or Azure AI Document Intelligence
Facial detection and facial analysis	Detect faces and analyze features like emotion, age, and gender	Azure AI Face

Some Keywords To Remember! - Text Analysis

In28 Minutes

Keyword	Description	Azure AI Service Option
Key phrase extraction	Extract main points or concepts from text	Azure AI Language (Text Analytics)
Entity recognition	Identify and classify named entities like people, places, or organizations	Azure AI Language (Text Analytics)
Sentiment analysis	Determine the emotional tone in text	Azure AI Language (Text Analytics)
Text Translation	Translate text between languages	Azure AI Translator

Some Keywords To Remember! - Speech

In 28 Minutes

Keyword	Description	Azure AI Service Option
Speech recognition	Convert spoken audio into text	Azure AI Speech (Speech to Text)
Speech synthesis	Convert text into natural-sounding speech	Azure AI Speech (Text to Speech)
Speech Translation	Translate speech from one language to another	Azure AI Speech

Some Keywords To Remember! - Generative AI

In 28 Minutes

Keyword	Description	Notes
Deep Learning	Approach where a computer program learns from a large amount of data. Starts by understanding simple patterns. With time, it learns to recognize complex patterns.	Used to create Generative AI Models
Embeddings	Vector representations of words in a high-dimensional space.Captures semantic relationships and contextual information for a word in a sentence.	Typically stored in vector databases.
Attention	A way to weigh the importance of each word in a sentence relative to others. Enables models to identify what matters most in a sentence.	Fundamental Building Block of Transformer Architecture
Retrieval Augmented Generation	Combines language model generation with real-time document retrieval	AI uses your knowledge base while drafting a response
Foundation Models	Pre-Trained Multi Task Models.Large Language Models are Foundation Models Focused on text	Example: GPT, Dall-e, Gemini, Llama

Cognitive Services renamed to Azure AI Services (& others)

In 28 Minutes

- Azure Cognitive Search has been renamed to **Azure AI Search**
- Custom Vision is renamed to **Azure AI Vision**
- Face Service is renamed to **Azure AI Face detection**
- Form Recognizer is now **Azure AI Document Intelligence**!
- Speech Service is now **Azure AI Speech Service**!
- Translator Service is now **Azure AI Translator Service**!
- **Key things to remember**:
  - The name Cognitive Services will continue to be used in Azure billing, cost analysis, price list, and APIs
  - There are no breaking changes to application programming interfaces (APIs) or SDKs

Tags:

Water 100% confidence Sky 100% confidence
Lake 95% confidence Outdoor 95% confidence
Skyscraper 89% confidence Reflection 61% confidence
Overlooking 33% confidence Day 12% confidence

Description:

a city skyline with water 27% confidence

Racy Content: Adult Content:

False 75% confidence False 78% confidence

⚠ Deprecated or Retired Azure Services

In 28 Minutes

Deprecated Service	Description	Successor / Migration Path
Language Understanding (LUIS)	Intent and entity recognition service	Migrate to **Conversational Language Understanding (CLU)** in Azure Language Service
QnA Maker	Question-answering service	Use **Custom Question Answering** in Azure Language Service
Form Recognizer	Rebranded under unified AI service offering	Now part of **Azure AI Document Intelligence**
Azure Cognitive Services (legacy)	Legacy entry point for AI services, now consolidated	Use **Azure AI Services** and/or individual studios (Vision, Language, Speech)

Get Ready

Certification Exam

In28 Minutes

- Certification Home Page
  - ***https://docs.microsoft.com/en-gb/learn/certifications/exams/AI-900***
- Different Types of Multiple Choice Questions
  - Type 1 : Single Answer - 2/3/4 options and 1 right answer
  - Type 2 : Multiple Answer - 5 (or more) options and 2 (or more) right answers
- No penalty for wrong answers
  - Feel free to guess if you do not know the answer
- 40 questions and 60 minutes
  - Should be a pretty easy exam
  - Mark questions for future consideration and review them before final submission
- Result immediately shown after exam completion
- Email with detailed scores (a couple of days later)

You are all set!

Let's clap for you!

In28 Minutes

- Congratulations
- You have put your best foot forward to become Microsoft Certified: Azure AI Fundamentals
- Make sure you prepare well and
- Good Luck!

Do Not Forget!

In 28 Minutes

- Recommend the course to your friends!
  - Do not forget to review!
- Your Success = My Success
  - Share your success story with me on LinkedIn (Ranga Karanam)
  - Share your success story and lessons learnt in Q&A with other learners!

What Next?

FASTEST ROADMAPS

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- Google Cloud Certifications
- Azure Certifications
- AWS Certifications
- DevOps
- Java Full Stack
- Java Microservices