

AI-900

Azure AI Fundamentals

Getting Started

In 28
Minutes



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!



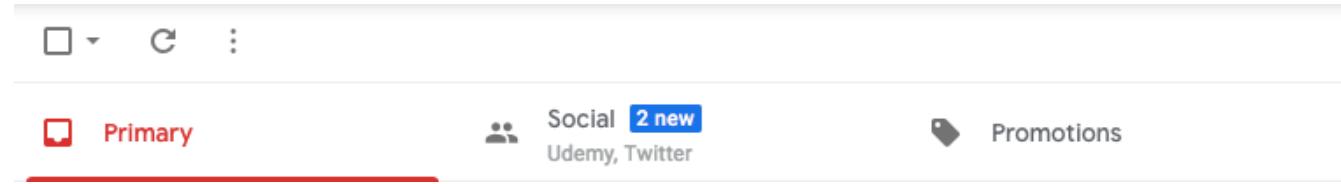
FASTEST ROADMAPS

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Artificial Intelligence

Artificial Intelligence - All around you



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

What is AI? (Oxford Dictionary)

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 its 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: Adult Content:

False 75% confidence False 78% confidence

Exploring Machine Learning Examples

- Identifying objects from images
 - <https://azure.microsoft.com/en-in/products/ai-services/ai-vision>
- Alpha Go
- House Price Calculation



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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

- **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:** Azure Cognitive Services (Azure AI Services)
 - Get intelligence from text, images, audio, video
 - **Build simple models:** Without needing data scientists
 - Limited/no-code experience
 - Example: Custom Vision (Azure AI 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



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Machine Learning Fundamentals - Scenarios

In 28
Minutes

Scenario	Solution
Categorize: Building a computer system as intelligent as a human. An expert at everything (all sports and 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)
Category of AI that focuses on learning from data (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 Cognitive Services (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), Custom Vision (Azure AI Vision)
Which Azure service helps you build complex ML models?	Azure Machine Learning

Different Types of AI Workloads

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;	Generative AI Workloads

Pre-Trained Models (APIs)

Exploring Pre-Trained Models - Azure AI Services

- Azure AI Services - "bring AI within reach of every developer"
 - AI without building custom models
 - Does NOT need machine-learning expertise
 - Exposed as APIs
- Help programs see, hear, speak, search, understand (just like humans):
 - Get intelligence from:
 - Images/videos: Azure AI vision, Azure AI Vision, Azure AI Document Intelligence
 - Text: Azure AI Language, Translator Text, Text-to-Speech API
 - Audio :Speech-to-Text API, Language Understanding Intelligent Service - LUIS
 - Others:
 - Conversations (QnA Maker, Azure Bot Service)



Result:

Statue of Liberty 95% confidence

Cognitive Services renamed to Azure AI Services (& others)

- 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:**
 - There are no changes to pricing
 - The name Cognitive Services will continue to be used in Azure billing, cost analysis, price list, and price APIs
 - There are no breaking changes to application programming interfaces (APIs) or SDKs



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Exploring Vision Related APIs

- **Vision:** Get intelligence from videos & images
 - <https://portal.vision.cognitive.azure.com/demo/dense-captioning>
 - <https://portal.vision.cognitive.azure.com/demo/face-detection>
 - <https://portal.vision.cognitive.azure.com/demo/video-summary-and-frame-locator>
- Identify & analyze content within images & video
- Important APIs:
 - **Computer Vision** - Analyze content in images & videos
 - **Face API** - Detect & identify people in images
 - **Custom Vision** - Customize image recognition to fit your business



Result:

Statue of Liberty 95% confidence

Exploring Vision - Some Terminology

- **Image analysis:** Extract tags from image
 - Create text description about an image
- **Image classification:** Classify image into different 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
- **Face detection:** Detect human faces
 - Face detection and analysis: Security, tag friends on facebook, Identity validation
- **Optical character recognition (OCR):** Detect text in images (license plates, invoices etc)



Objects	[{ "rectangle": { "x": 112, "y": 711, "w": 269, "h": 243 }, "object": "Bicycle wheel", "parent": { "object": "Wheel", "confidence": 0.775 }, "confidence": 0.574 }, { "rectangle": { "x": 566, "y": 723, "w": 268, "h": 243 }, "object": "Wheel", "confidence": 0.585 }, { "rectangle": { "x": 96, "y": 568, "w": 759, "h": 409 }, "object": "bicycle", "parent": { "object": "cycle", "confidence": 0.928 }, "confidence": 0.927 }, { "object": "cycle", "parent": { "object": "Land vehicle", "parent": { "object": "Vehicle", "confidence": 0.923 }, "confidence": 0.91 } }]
Tags	[{ "name": "text", "confidence": 0.9999137 }, { "name": "grass", "confidence": 0.999893069 }, { "name": "outdoor", "confidence": 0.9880197 }, { "name": "bicycle", "confidence": 0.9697462 }, { "name": "bicycle wheel", "confidence": 0.897627 }, { "name": "sign", "confidence": 0.842304945 }, { "name": "bike", "confidence": 0.7690854 }, { "name": "wheel", "confidence": 0.7583429 }, { "name": "land vehicle", "confidence": 0.6875147 }, { "name": "vehicle", "confidence": 0.575855851 }]

Getting started with Computer Vision API

- **Computer Vision API:** Process images and return information
 - Docs: <https://centralus.dev.cognitive.microsoft.com/docs/services/>
 - **Analyze Image:** Extract visual features from image content:
 - Can you describe the image? (description/caption)?
 - Can you categorize the image? (tags)
 - What is in the image?
 - objects/faces/celebrities/monuments with box co-ordinates
 - What type of image is it? (clip art/line drawing)
 - What kind of color scheme is used in the image?
 - Does an image have mature content?
 - **Simple Operations:**
 - **Describe Image:** Can you describe the image? (description/caption - multiple)
 - **Detect Objects:** Performs object detection on the specified image
 - **Recognize Domain Specific Content:** Identify celebrities, landmarks
 - **Tag Image:** Generates a list of words, or tags relevant to a image
 - **Get Area of Interest:** most important area of the image
 - **Get Thumbnail:** Generates a thumbnail image (user-specified width and height)



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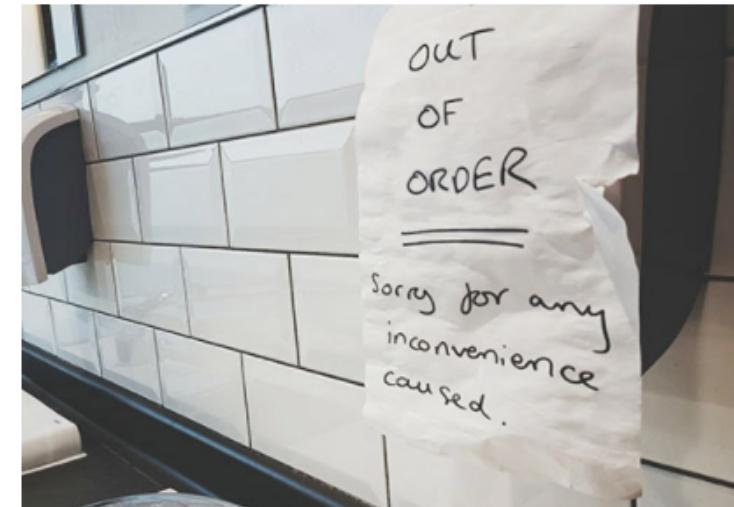
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Understanding Computer Vision API - OCR Operations

- **OCR:** Simple OCR (detects text in an image)
 - Quick extraction of small amounts of text (immediate results)
 - Result: Lines > Words (each with bounding box coordinates)
- **Read:** Perform OCR on complex documents
 - Optimized for text-heavy images OR multi-page documents OR documents with multiple languages
 - Executes asynchronously
 - Additional call to get the result
 - Result: Pages > Lines > Words (each with bounding box coordinates)

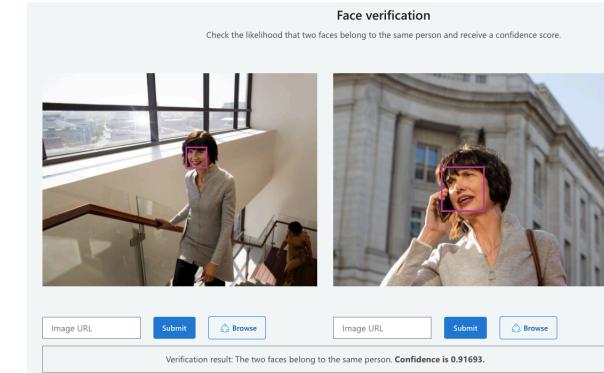


Transcript:

OUT
OF
ORDER
Sorry for any
inconvenience
caused .

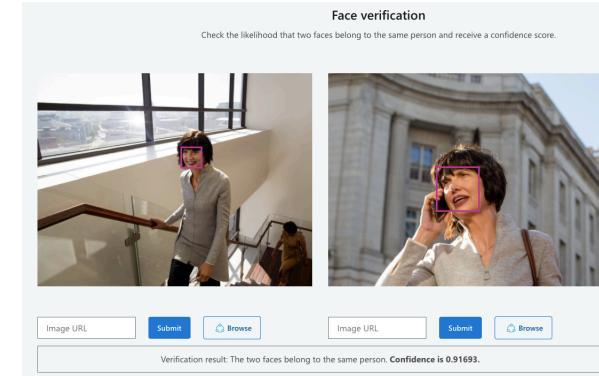
Getting Started with Face API

- Face API: Advanced Face detection:
 - Age, Emotion, Glasses, Hair, Makeup
 - Detect human faces, find similar faces, match face with a group ..
 - Demo: <https://portal.vision.cognitive.azure.com/demo/face-detection>
- (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
- Important concepts:
 - FaceList (up to 1K faces) & LargeFaceList (up to 1M faces)
 - PersonGroup (up to 1K persons) & LargePersonGroup (up to 1M persons)
 - Each person can have multiple face images



Understanding Face API Operations

- **Detect:** Detect human faces (box co-ordinates)
 - Options to request for age, gender, headPose, smile, facialHair, glasses, emotion, hair, makeup, occlusion, accessories, blur, exposure, noise and mask details
 - Up to 100 faces in an image
- **Find Similar:** Find similar faces (Find images of this specific person)
 - Input 1: Image to match for (facId)
 - Input 2: Images to match against (facId array or FaceListId or LargeFaceListId)
 - Output: Array of the most similar faces [along with confidence]



Understanding Face API Operations - 2

- **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: Images to match against (faceId array or FaceListId or LargeFaceListId)
 - 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}

Exploring Form Recognizer API

- **Form Recognizer:** Get intelligence from scanned forms
 - Extract information from forms & images
 - DEMO: <https://documentintelligence.ai.azure.com/studio>
 - Make sure to login into Azure
- **Operations (over pdf or image):**
 - Analyze Business Card (Get Analyze Business Card Result)
 - Analyze ID Document
 - Analyze Invoice
 - Analyze Receipt
 - **Custom Form:** Design & extract key-value pairs, tables, and semantic values from custom documents - pdf or image



Azure AI Services - Vision - Scenarios

In 28
Minutes

Scenario	Solution
Recommend Service: Detect and identify people and emotions in images	Face API
Recommend Service: Extract visual features from image content (description/tags)	Computer Vision API (Azure AI Vision)
Recommend Service: Get intelligence from scanned forms	Form Recognizer API (Azure AI Document Intelligence)
When do you use Read operation to perform OCR?	Text-heavy images OR multi-page documents OR documents with multiple languages
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

Azure AI Services - Face API - Scenarios

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

Exploring Search APIs (Bing)

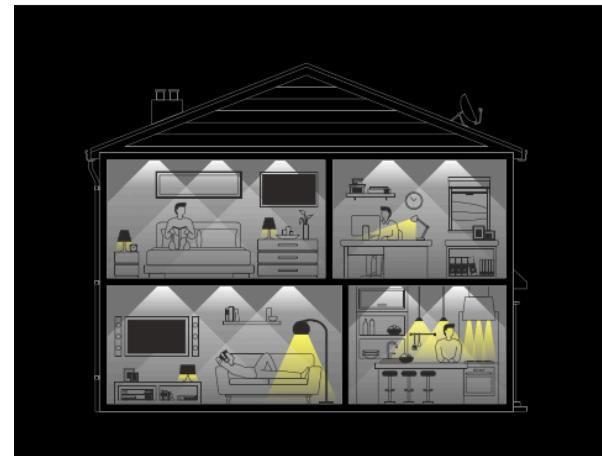
- **Web Search API:** Execute web search using API
- **Image Search API:** search for relevant images
- **News Search API:** search for relevant news articles
- **Visual Search API:** search based on an image



Azure AI Services - Natural Language Processing

- Get intelligence from a conversation, speech or written text in human languages
 - **Language:** Extract meaning from unstructured text
 - **Text analytics:** Detect sentiment, key phrases and named entities.
 - <https://language.cognitive.azure.com/tryout/namedEntities>
 - <https://language.cognitive.azure.com/tryout/keyPhrases>
 - **Translator:** Translate to/from 90 languages
 - **Speech:** Integrate speech into apps and services
 - **Speech service:** Speech to text, Text to speech, Translation and Speaker recognition
 - **Build Conversations:**
 - **QnA maker:** Conversational question and answer layer
 - **LUIS:** Language Understanding Intelligent Service
 - Understands spoken (and text) commands
 - Get info from users natural language utterances
 - Examples: Book me a flight to Cairo, Order me 2 pizzas
 - DEMO: <https://www.luis.ai/>

< Language Understanding



Make a statement about lighting and LUIS will interpret and adjust the house accordingly

Make a statement (voice or text)
Turn lights off

Apply

Exploring Text Analytics API

- **Text Analytics:** Natural language processing (NLP)
 - Demo: <https://azure.microsoft.com/en-in/services/cognitive-services/text-analytics/#overview>
 - Sentiment analysis, key phrase extraction & language detection
 - Operations:
 - Detect Language
 - Language Name, ISO 6391 Code, Score (NaN-ambiguous)
 - Entities containing personal information: returns a list of entities with personal information ("SSN", "Bank Account" etc) in the document
 - Key Phrases: returns a list of strings denoting the key phrases
 - Example: Summarize a document
 - Named Entity Recognition: list of general named entities in a given document
 - Person, Location, Organization, Quantity, DateTime, URL, Phone Number, IP Address etc
 - Sentiment: detailed sentiment analysis
 - positive/negative review - example: 0.1(negative), 0.9(positive)

We went to Contoso Steakhouse located at midtown NYC last week for a dinner party, and we adore the spot! They provide marvelous food and they have a great menu. The chief cook happens to be the owner (I think his name is John Doe) and he is super nice, coming out of the kitchen and greeted us all. We enjoyed very much dining in the place! The Sirloin steak I ordered was tender and juicy, and the place was impeccably clean. You can even pre-order from their online menu at www.contososteakhouse.com, call 312-555-0176 or send email to order@contososteakhouse.com! The only complaint I have is the food didn't come fast enough. Overall I highly recommend it!



Exploring Translator and Speech API

- **Translator Text API:** text-to-text translation
 - One FROM language with multiple TO languages (example: en to fr, de)
- **API involving Speech:**
 - **Speech-to-Text API:** Real-time & Batch transcription (speech recognition)
 - Demo: <https://azure.microsoft.com/en-us/products/ai-services/speech-to-text/>
 - **Text-to-Speech API:** Speech synthesis
 - Demo: <https://azure.microsoft.com/en-in/products/ai-services/text-to-speech/>
 - **Translation:** Speech-to-Text and Speech-to-Speech API
 - Demo: <https://azure.microsoft.com/en-in/products/ai-services/speech-translation/>

Try Speech Translation with this demo app, built on our JavaScript SDK

Source Language

English (India) ▾

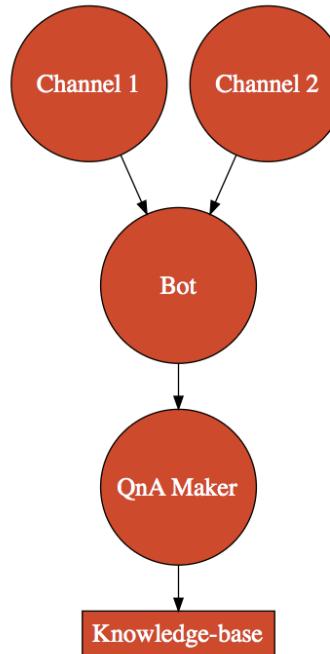
Target Language

Finnish* ▾

 Speak  Upload File

Getting Started with Conversational AI

- Software that can carry a conversation like humans (Talk with humans like a human)
- Demo: <https://www.microsoft.com/en-us/research/project/health-bot/> (I have fever)
- Use cases: Customer support, Reservations, Automation
- Services:
 - **QnA Maker:** Convert your FAQ into a Q&A Bot
 - You need a knowledge base (cannot talk to db)
 - **Azure Bot Service:** Build your own bots
 - Enable multiple conversation channels
 - Channels: Alexa, Office 365 email, Facebook, Microsoft Teams, Skype, Slack, Telegram
 - **Recommended Architecture:** QnA Maker service + Azure Bot Service



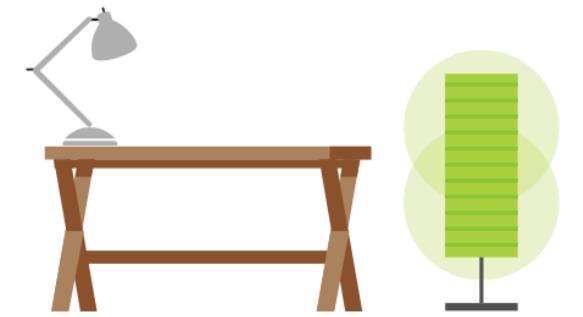
Exploring LUIS: Language Understanding Intelligent Service

- Understands spoken (and text) commands
 - Get info from users natural language utterances
 - Book me a flight to Cairo
 - Order me 2 pizzas
 - Demo 1: <https://aidemos.microsoft.com/luis/demo>
 - **Demo 2**
 - Demo 3: <https://www.luis.ai>
- Detects:
 - Intents (FoodOrder, BookFlight) and
 - Entities (Pizzas, Cairo)
- Integrate with Azure Bot Services for an end-to-end conversational solution

turn the table light off

all lights off

Smart Light Application in action



LUIS application response ⓘ

```
[{"query": "turn the table light off", "topScoringIntent": {"intent": "TurnOff", "score": 0.91770214}, "entities": [{"entity": "table", "type": "Light", "startIndex": 9, "endIndex": 13, "resolution": null, "score": 0.8063946}]}]
```

Azure AI Services - NLP - Scenarios

In 28
Minutes

Scenario	Solution
Categorize: Get intelligence from a conversation, speech or written text in human languages	Natural Language Processing
Recommend Service: Detect sentiment, key phrases and named entities from text	Text Analytics API
Recommend Service: Detect Key Phrases from a document	Text Analytics API
Recommend Service: Perform text-to-text translation	Translator Text API
Recommend Service: Speech recognition	Speech-to-Text API
Recommend Service: Speech synthesis	Text-to-Speech API

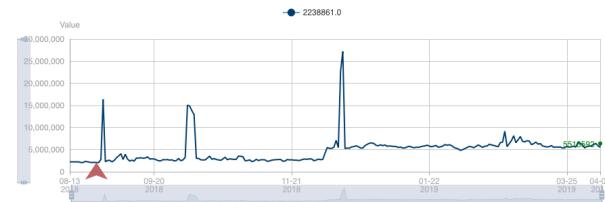
Azure AI Services - NLP - Scenarios - 2

In 28
Minutes

Scenario	Solution
Recommend Service: Translate speech in one language to text in another	Speech-to-Text
Categorize: Software that can carry a conversation like humans	Conversational AI
Recommend Service: Convert your FAQ into a Question and Answer REST API	QnA Maker
Recommend Service: Build a chat bot to answer questions from your knowledge base	QnA Maker service + Azure Bot Service
QnA Maker service: Can you directly connect QnA Maker service to a database or an external system?	No. You need to import the question and answers first.
Recommend Service: Understands spoken (and text) commands (Get intent and entities)	Luis: Language Understanding Intelligent Service
Recommend Service: Perform sentiment analysis on reviews	Text Analytics API

Understanding Decision Services: Make smarter decisions

- **Anomaly Detector:** Find anomalies
 - Unusual actions, behavior or errors
 - Batch or real-time
 - Example Usecases:
 - Find Fraud
 - Unusual transactions on a credit card
 - Defective parts
 - Demo: <https://centralus.dev.cognitive.microsoft.com/docs/services/AnomalyDetector>
 - **Content moderator:** Detect unwanted content
 - Image, Text (PII, custom list) & Video moderation
 - Returns content assessment results to your systems
 - You can use this information to take decisions
 - Take content down, send to human judge ..
 - Examples APIs:
 - **Image-Evaluate:** Returns probabilities of image having racy or adult content
 - **Text-Screen:** Profanity scan in 100+ languages (custom & shared blacklists)



Azure AI Services - Decision Services and Others

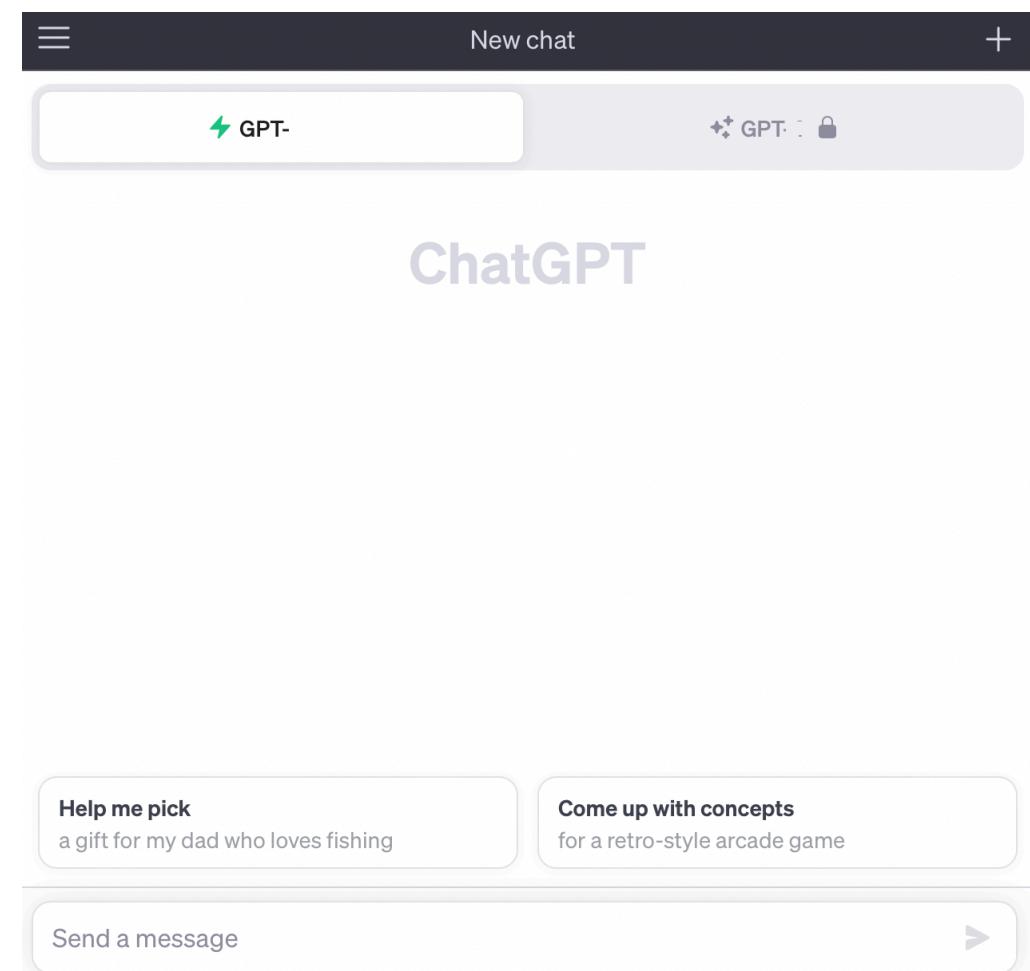
In 28
Minutes

Scenario	Solution
Recommend Service: Unusual actions, behavior or errors (Unusual transactions on a credit card or Fraud)	Anomaly Detector
Recommend Service: Detect unwanted content (text, image or video)	Content moderator
Recommend Service: Perform profanity scan on reviews posted on a website	Content moderator
Access multiple Azure Cognitive Services with a single key and endpoint	Cognitive Services Multi-service account
What do you need to invoke a Cognitive Service API?	Endpoint (the HTTP address at which your service is hosted) and key (a secret value used by client applications to authenticate themselves)

Generative AI with Azure

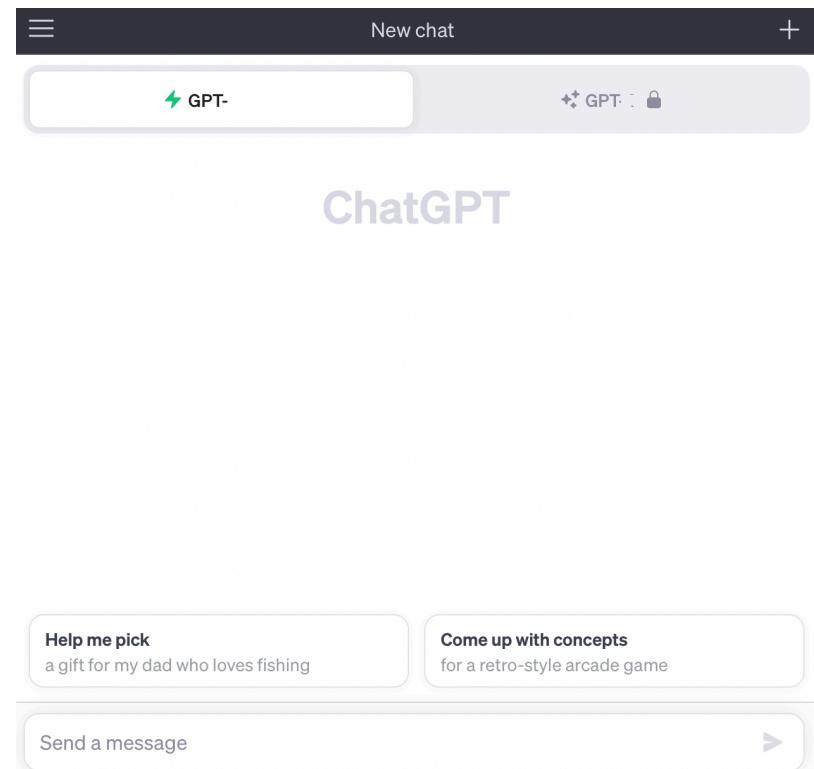
Playing with ChatGPT

- **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?



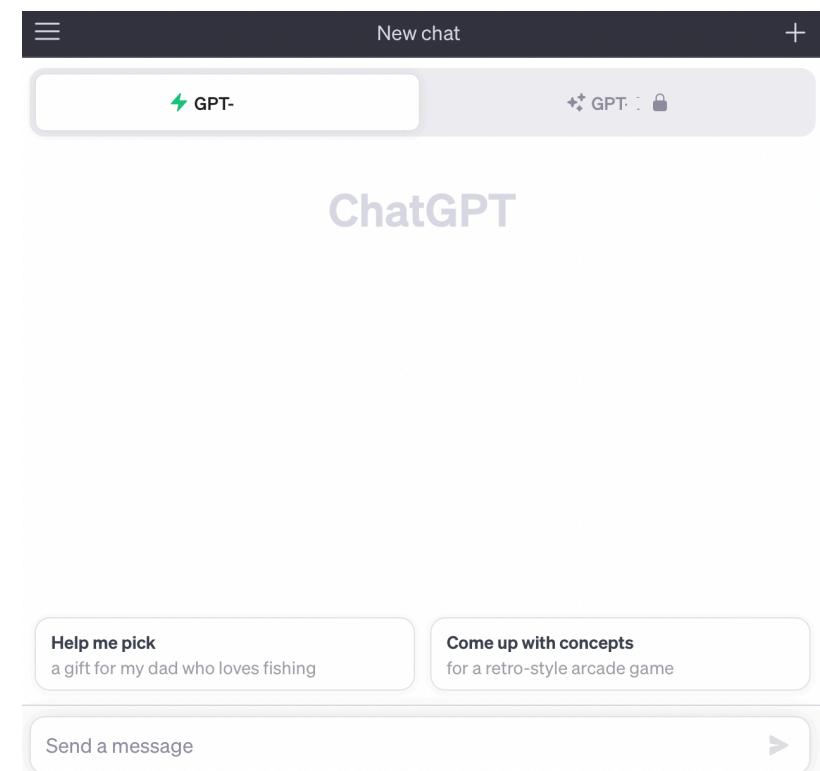
Playing with ChatGPT - Coding, Learning and Design

- 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?



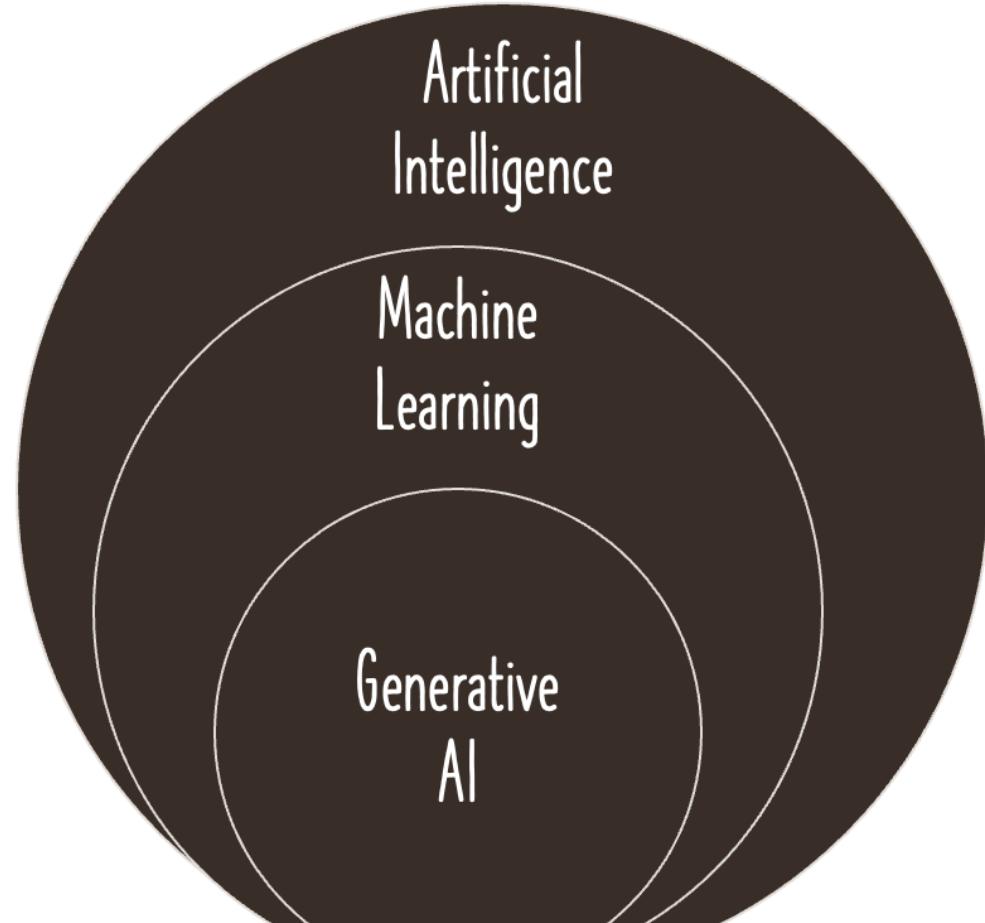
Playing with ChatGPT - Exploring Technology

- 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.



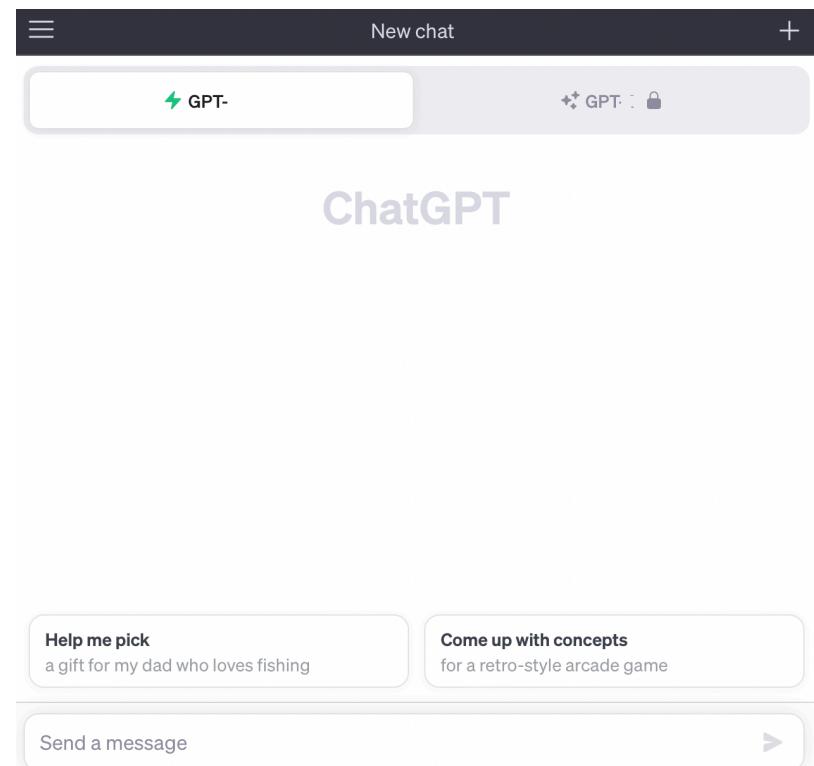
Generative AI - How is it different?

- **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



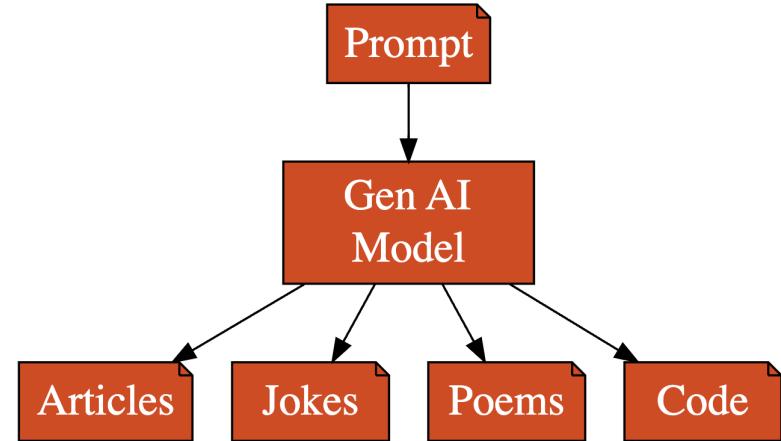
Generative AI - Generating New Content

- **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!



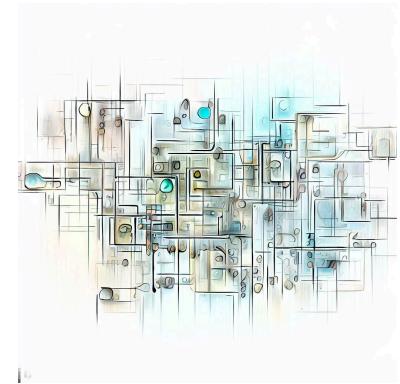
Generative AI - Needs Huge Volumes of Data

- **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

- **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

- 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



Getting Started with Azure OpenAI API

- Azure OpenAI API: Integrate Generative AI into your apps
 - Understand and generate natural language and code
 - Generate and edit images
 - Convert speech into text
 - Fine tune models
- Models:
 - gpt-4, gpt-3.5-turbo, dall-e, ..
- Demo:
 - *<https://learn.microsoft.com/en-us/azure/ai-services/openai/quickstart>*



GPT

Learn how to generate text



Embeddings

Learn how to search, classify, and compare text



Speech to text

Learn how to turn speech into text



Image generation

Learn how to generate or edit images



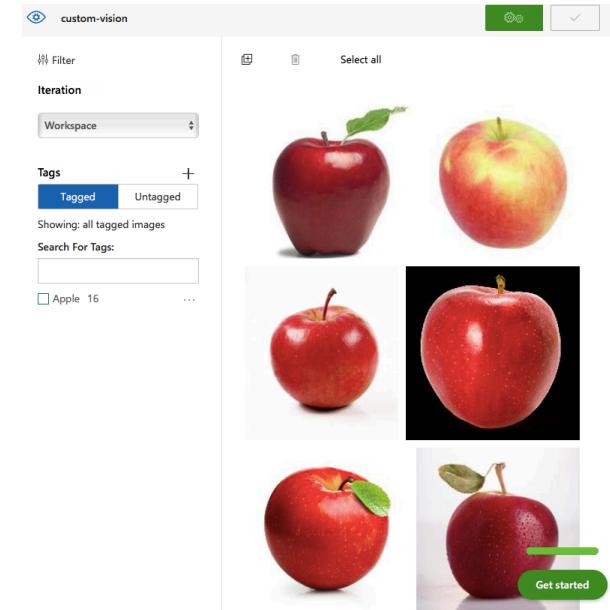
Fine-tuning

Learn how to train a model for your use case

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

- 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

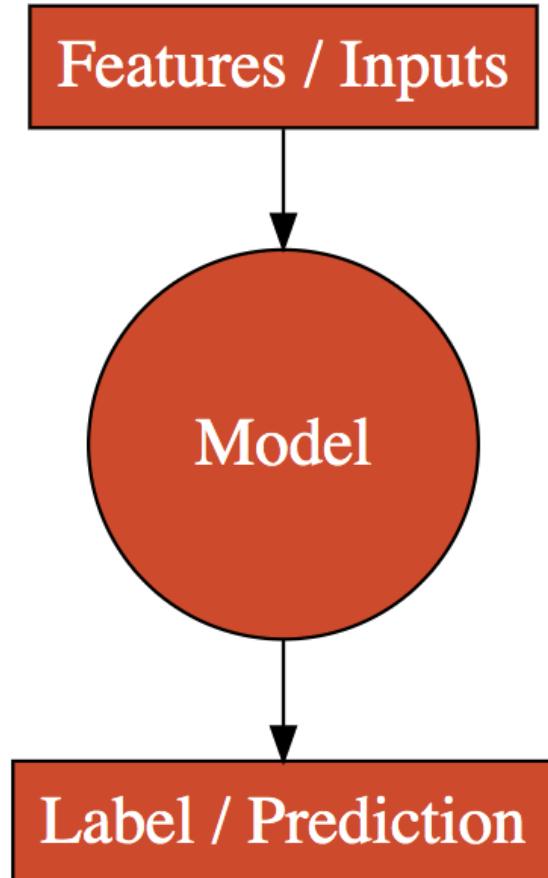
Creating Machine Learning Models - Features and Labels

- **Goal of Machine Learning: Create a Good Model**

- Give inputs to a model
 - Model returns the prediction
 - Inputs are called Features
 - Prediction is called Label

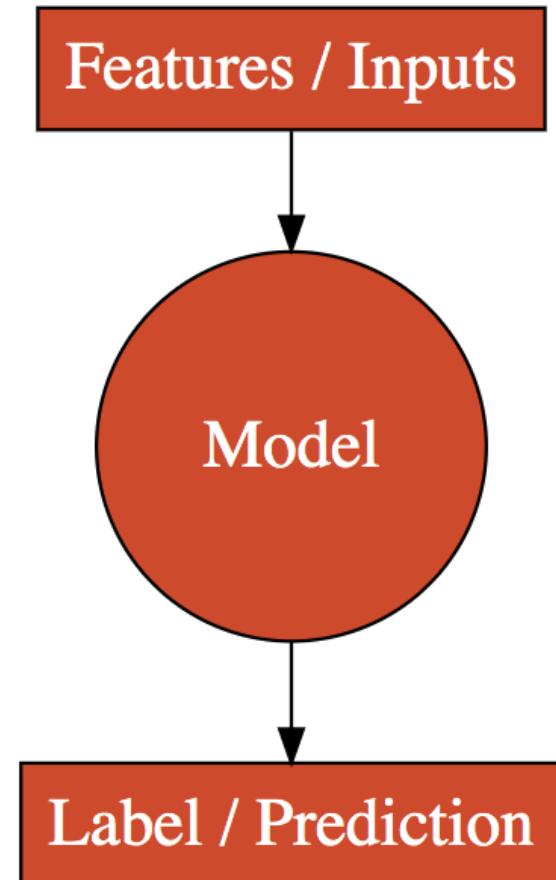
- **Example: House Price Prediction Model**

- **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



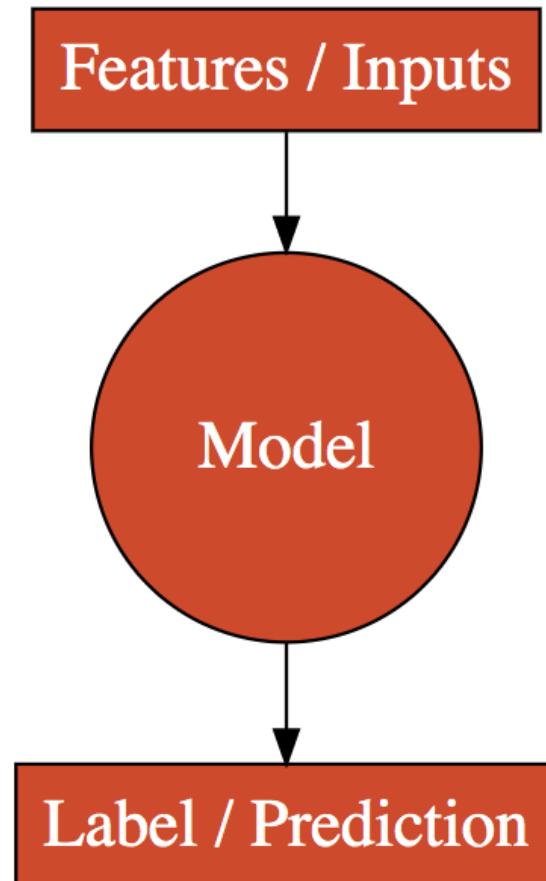
Creating ML Models - Features and Labels - Examples

- 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

- **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



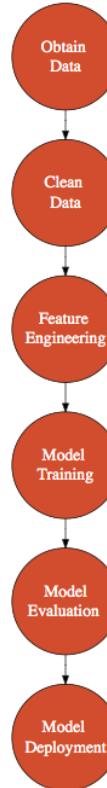
Machine Learning Fundamentals - Scenarios

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

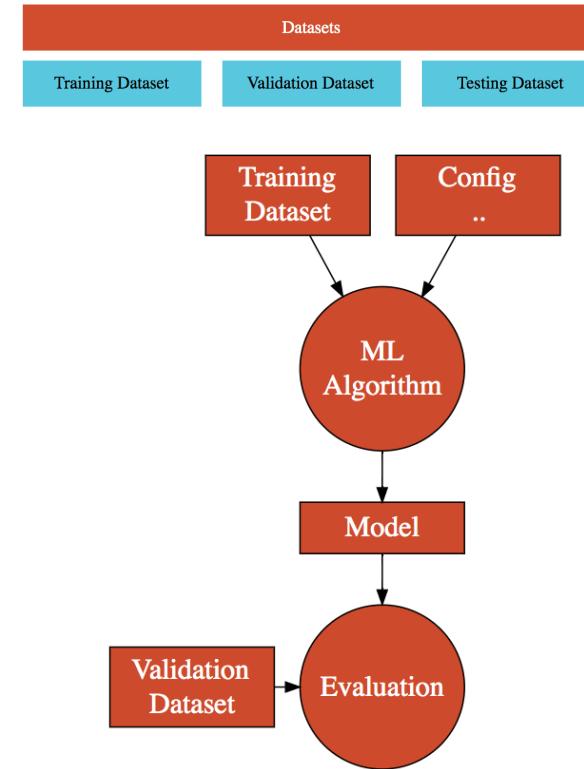
Creating Machine Learning Models - Steps

- 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

- **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

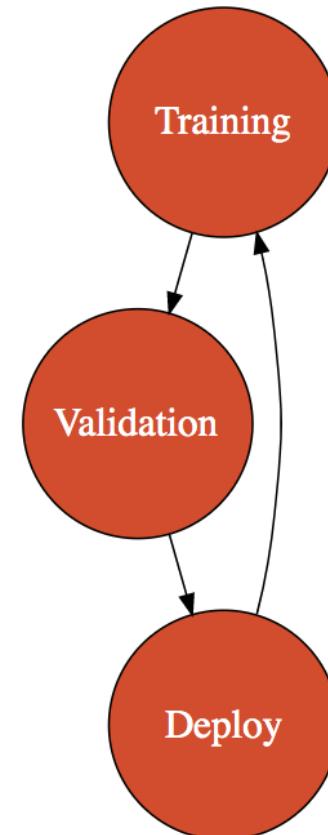


ML Stages and Terminology - Scenarios

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

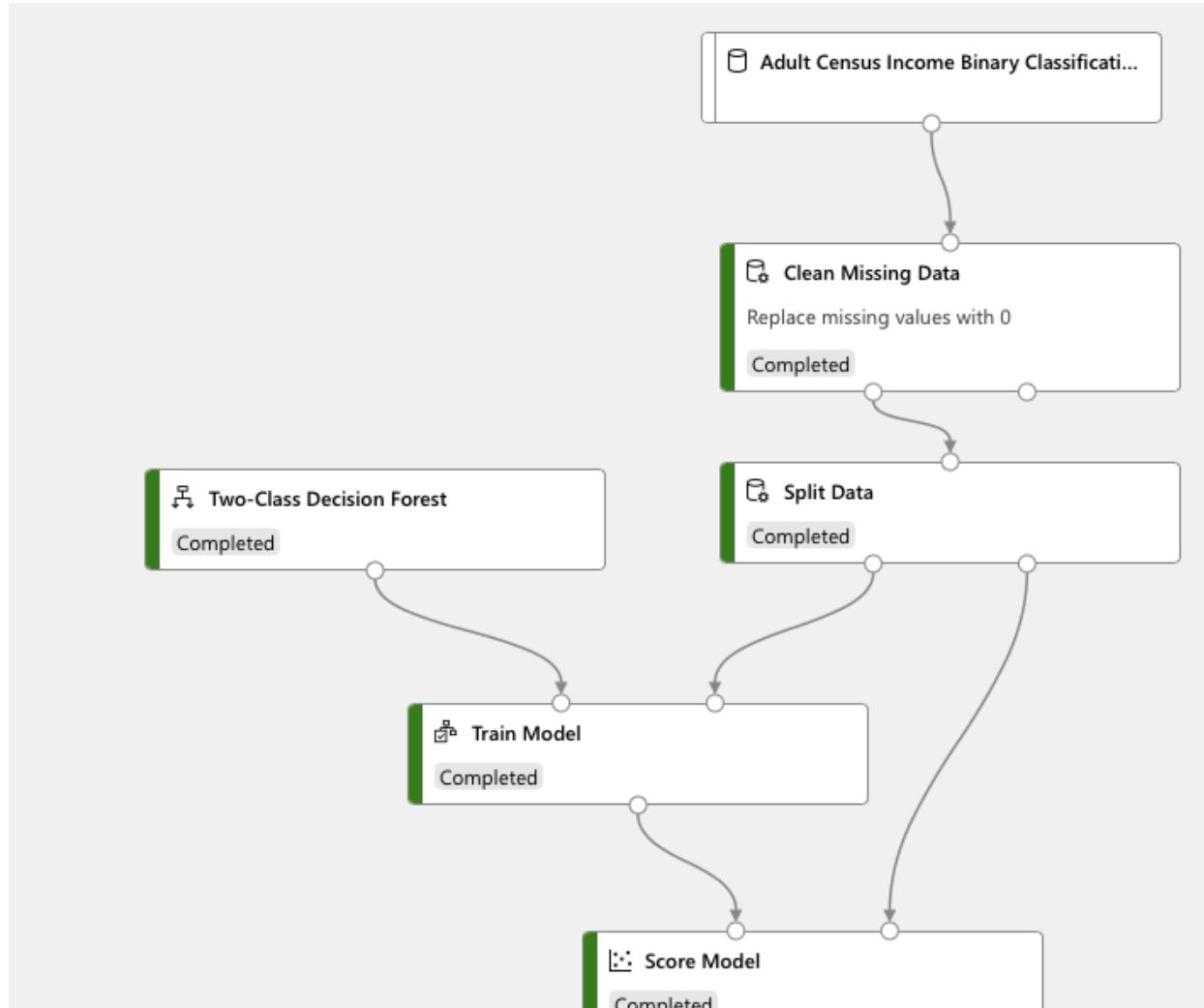
Azure Machine Learning

- **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

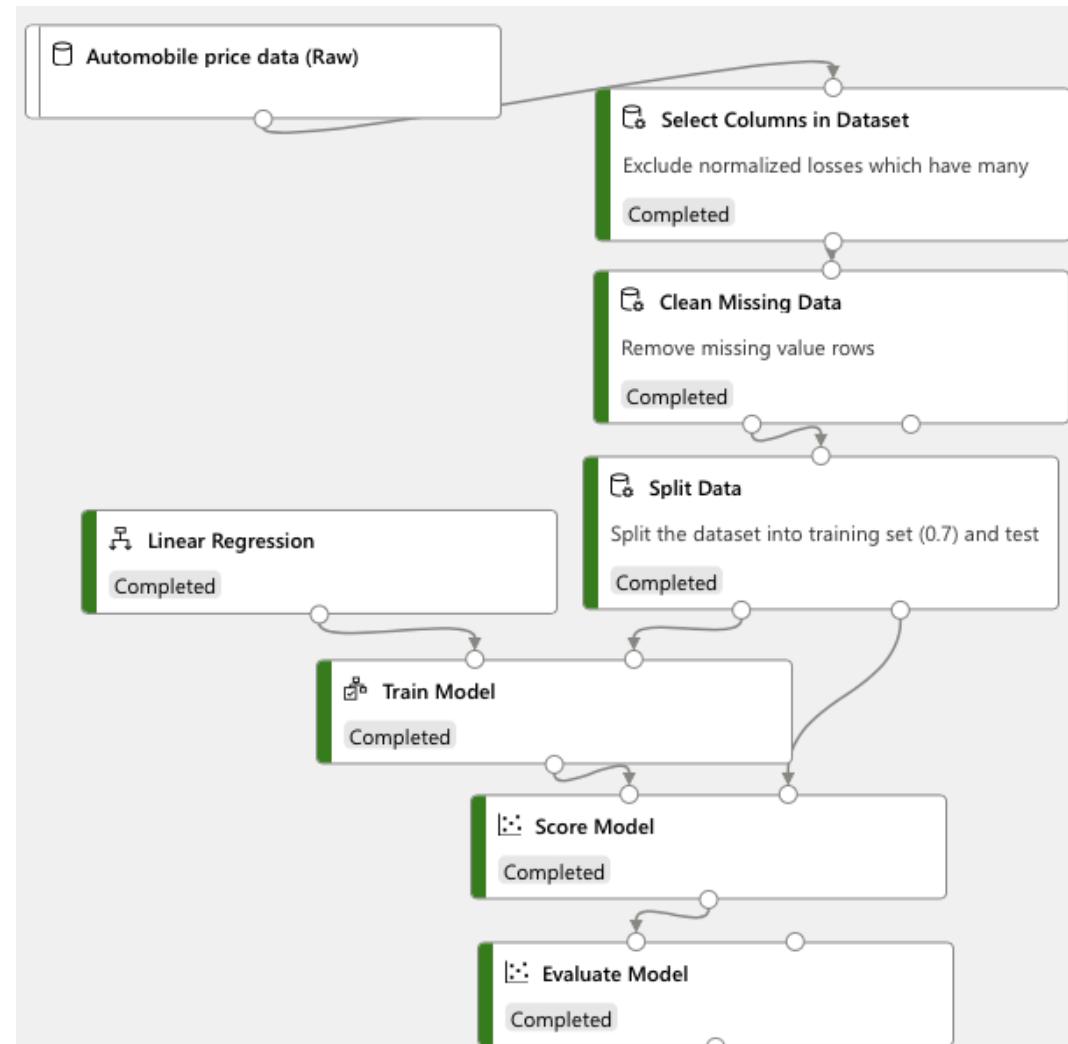


Sample Pipeline - Classification

In 28
Minutes

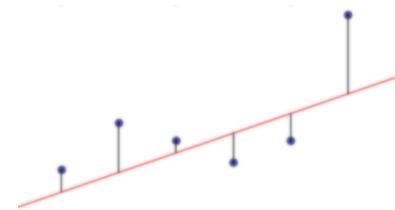


Sample Pipeline - Regression



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

- Terminology:
 - **Predicted label:** What's predicated?
 - **True label:** What's expected?
 - **Confusion matrix:** Matrix matching predicted label vs true label
- Different usecases have different needs:
 - **Examples:** Spam, fraud, sick patient detection
- Metrics:
 - **Accuracy:** Proportion of accurate results to total cases
 - **Precision:** $(\text{True Positive}) / (\text{True Positive} + \text{False Positive})$
 - **Recall:** $(\text{True Positive}) / (\text{True Positive} + \text{False Negative})$
 - **F1 Score:** $2 \left(\frac{\text{Precision} \cdot \text{Recall}}{\text{Precision} + \text{Recall}} \right)$
 - When you need balance between Precision and Recall

		PREDICTION	
		Negative	Positive
ACTUAL	Negative	True Negative	False Positive
	Positive	False Negative	True Positive

ML Model Evaluation - Scenarios

In 28
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

- **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

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

In 28
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

- 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

In 28
Minutes

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

In 28
Minutes

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

Get Ready

Certification Exam

- 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!

- 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!

- 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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