

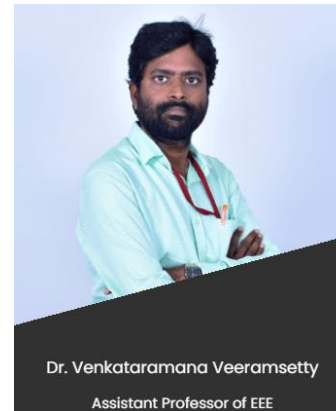
One Week Training Program on Azure AI Fundamentals

14.09.2021 -- 17.09.2021



**SCHOOL OF COMPUTER
SCIENCE & ARTIFICIAL
INTELLIGENCE**

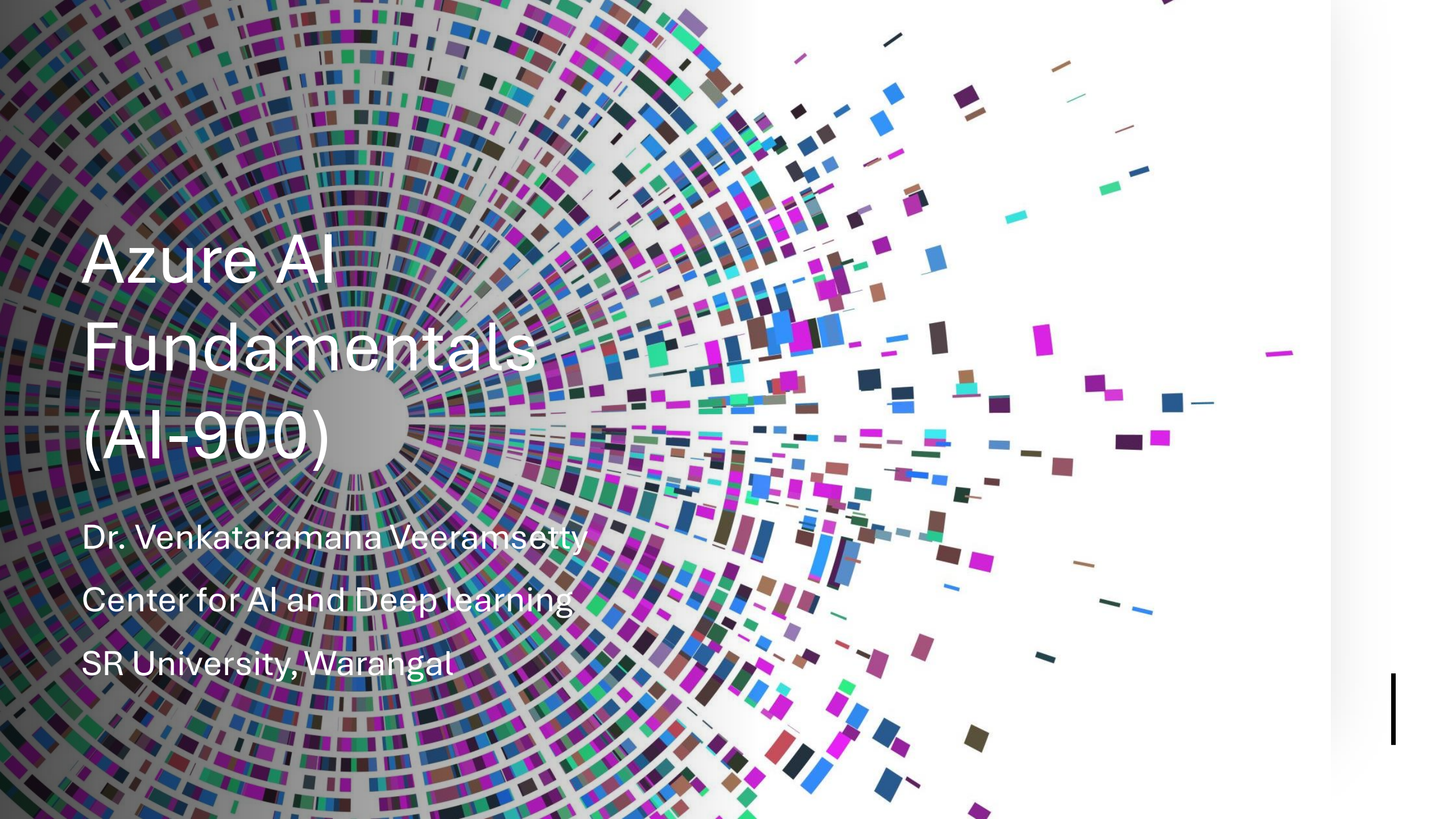
Resource Person



Dr. Venkataramana Veeramsetty
Assistant Professor of EEE



Department of Electrical and
Electronics Engineering



Azure AI Fundamentals (AI-900)

Dr. Venkataramana Veeramsetty
Center for AI and Deep learning
SR University, Warangal

Introduction to AI

AI enables us to build amazing software that can improve health care, enable people to overcome physical disadvantages, empower smart infrastructure, create incredible entertainment experiences, and even save the planet!

<https://www.microsoft.com/en-us/videoplayer/embed/RE4vyDI?postJsllMsg=true>

What is AI

Artificial intelligence is an intelligence that was developed in the form some mathematical operations and implemented using computer programming in order to make machines behaves like human intelligence to perform some task like

- Decision making
- Language translation
- Visual perceptions
- Speech recognition etc.

Key Elements of AI



Machine learning - This is often the foundation for an AI system, and is the way we "teach" a computer model to make prediction and draw conclusions from data.



Anomaly detection - The capability to automatically detect errors or unusual activity in a system.



Computer vision - The capability of software to interpret the world visually through cameras, video, and images.



Natural language processing - The capability for a computer to interpret written or spoken language, and respond in kind.



Conversational AI - The capability of a software "agent" to participate in a conversation.

Understand machine learning

Machine Learning is the foundation for most AI solutions.

Sustainable farming techniques are essential to maximize food production while protecting a fragile environment. *The Yield*, an agricultural technology company based in Australia, uses sensors, data and machine learning to help farmers make informed decisions related to weather, soil and plant conditions.

<https://www.microsoft.com/en-us/videoplayer/embed/RE4voJG?postJsllMsg=true>

How machine learning works

<https://docs.microsoft.com/en-us/learn/wwl-data-ai/get-started-ai-fundamentals/media/machine-learn.gif>

Machine learning in Microsoft Azure



Microsoft Azure provides the **Azure Machine Learning** service - a cloud-based platform for creating, managing, and publishing machine learning models.



Automated machine learning



Azure Machine Learning designer



Data and compute management



Pipelines

Automated machine learning

This feature enables non-experts to quickly create an effective machine learning model from data.

Azure Machine Learning designer

A graphical interface enabling no-code development of machine learning solutions.

Data and compute management

Cloud-based data storage and compute resources that professional data scientists can use to run data experiment code at scale.

Pipeline

Data scientists, software engineers, and IT operations professionals can define pipelines to orchestrate model training, deployment, and management tasks.

Understand anomaly detection

Imagine you're creating a software system to monitor credit card transactions and detect unusual usage patterns that might indicate fraud.

An application that tracks activity in an automated production line and identifies failures.

A racing car telemetry system that uses sensors to proactively warn engineers about potential mechanical failures before they happen.

<https://docs.microsoft.com/en-us/learn/wwl-data-ai/get-started-ai-fundamentals/media/anomaly-detection.gif>

Understand computer vision

Computer Vision is an area of AI that deals with visual processing. [Seeing AI](#)

Image classification

Object detection

Semantic segmentation

Image analysis

Face detection, analysis, and recognition

Optical character recognition (OCR)

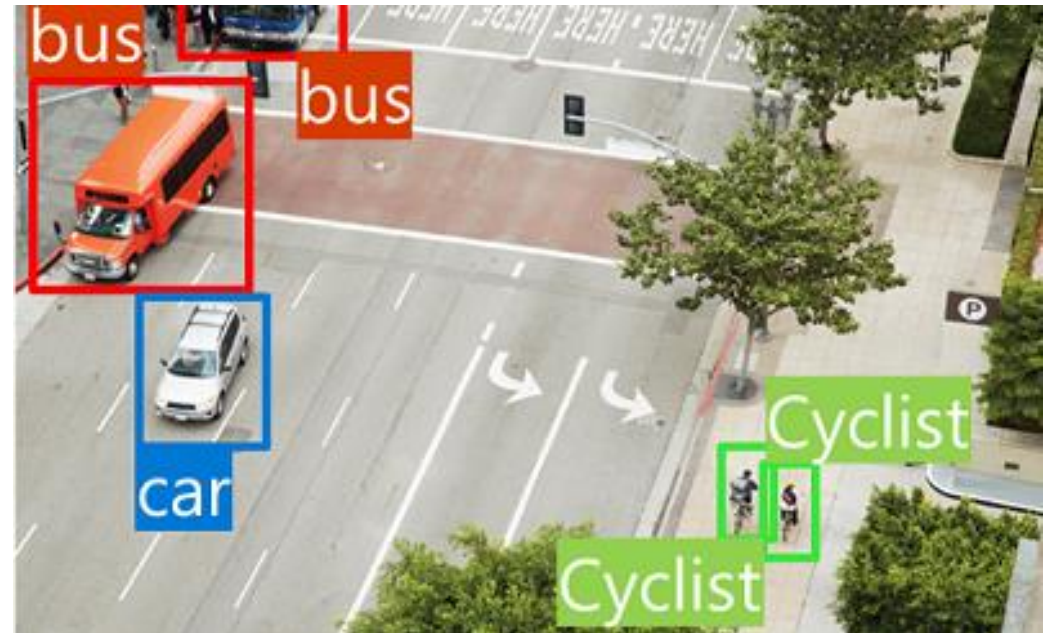
Image classification

Image classification involves training a machine learning model to classify images based on their contents. For example, in a traffic monitoring solution you might use an image classification model to classify images based on the type of vehicle they contain, such as taxis, buses, cyclists, and so on.



Object detection

Object detection machine learning models are trained to classify individual objects within an image and identify their location with a bounding box. For example, a traffic monitoring solution might use object detection to identify the location of different classes of vehicle.



Semantic segmentation

Semantic segmentation is an advanced machine learning technique in which individual pixels in the image are classified according to the object to which they belong. For example, a traffic monitoring solution might overlay traffic images with "mask" layers to highlight different vehicles using specific colors.



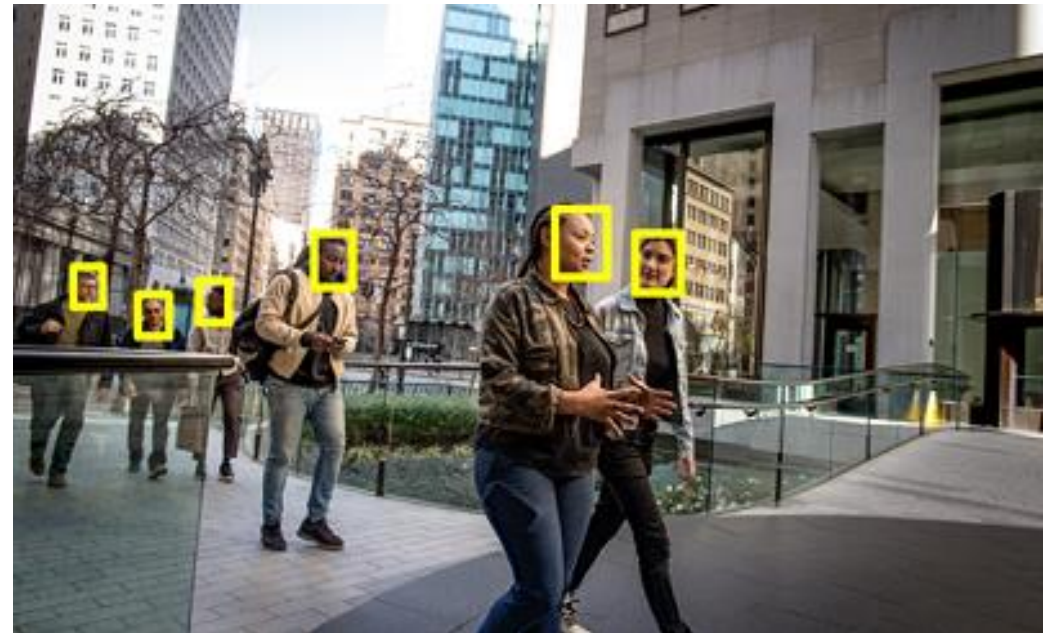
Image analysis

You can create solutions that combine machine learning models with advanced image analysis techniques to extract information from images, including "tags" that could help catalog the image or even descriptive captions that summarize the scene shown in the image.



Face detection, analysis, and recognition

Face detection is a specialized form of object detection that locates human faces in an image. This can be combined with classification and facial geometry analysis techniques to infer details such as age and emotional state; and even recognize individuals based on their facial features.



Optical character recognition (OCR) |

Optical character recognition is a technique used to detect and read text in images.



Computer vision services in Microsoft Azure

Computer Vision--You can use this service to analyze images and video, and extract descriptions, tags, objects, and text.

Custom Vision--Use this service to train custom image classification and object detection models using your own images.

Face--The Face service enables you to build face detection and facial recognition solutions.

Form Recognizer-- Use this service to extract information from scanned forms and invoices.

<https://aidemos.microsoft.com/computer-vision>

Natural language processing

Natural language processing (NLP) is the area of AI that deals with creating software that understands written and spoken language

- Analyze and interpret text in documents, email messages, and other sources.
- Interpret spoken language and synthesize speech responses.
- Automatically translate spoken or written phrases between languages
- Interpret commands and determine appropriate actions.

Example



Starship Commander, is a virtual reality (VR) game from Human Interact, that takes place in a science fiction world. The game uses natural language processing to enable players to control the narrative and interact with in-game characters and starship systems.



<https://www.microsoft.com/en-us/videoplayer/embed/RE4vyDj?postJsllMsg=true>

CoinNet: A Mobile App



Center for AI and Deep Learning,
Developed an AI based Mobile
Application to identify Indian Currency

This app can be helpful for the visually
impaired people to recognize currency
notes

Natural language processing in Microsoft Azure



In Microsoft Azure, you can use the following cognitive services to build natural language processing solutions:



Text Analytics: Use this service to analyze text documents and extract key phrases, detect entities (such as places, dates, and people), and evaluate sentiment (how positive or negative a document is)



Translator Text: Use this service to translate text between more than 60 languages.



Speech: Use this service to recognize and synthesize speech, and to translate spoken languages



Language Understanding Intelligent Service (LUIS): Use this service to train a language model that can understand spoken or text-based commands



<https://aidemos.microsoft.com/luis/demo>

Conversational AI



Conversational AI is the term used to describe solutions where AI agents participate in conversations with humans



Conversational AI solutions use *bots* to manage dialogs with users.



These dialogs can take place through web site interfaces, email, social media platforms, messaging systems, phone calls, and other channels.

Where we can use

Customer support for products or services.

Reservation systems for restaurants, airlines, cinemas, and other appointment-based businesses.

Health care consultations and self-diagnosis.

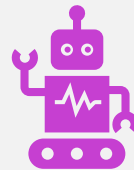
Home automation and personal digital assistants

<https://www.microsoft.com/en-us/videoplayer/embed/RE4vC2P?postJsllMsg=true>

Conversational AI in Microsoft Azure



QnA Maker



Azure Bot Service

QnA Maker

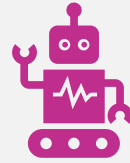


This cognitive service enables you to quickly build a *knowledge base* of questions and answers that can form the basis of a dialog between a human and an AI agent.



QnA service can only retrieve answers from the Knowledgebase, nothing else. You can think it as a fancier Database, you can query it using human language.

Azure Bot Service



This service provides a platform for creating, publishing, and managing bots.



Developers can use the *Bot Framework* to create a bot and manage it with Azure Bot Service - integrating back-end services like QnA Maker and LUIS, and connecting to channels for web chat, email, Microsoft Teams, and others.



<https://www.microsoft.com/en-us/research/project/health-bot/>

You want to create a model to predict sales of ice cream based on historic data that includes daily ice cream sales totals and weather measurements. Which Azure service should you use?

- A.
Azure Machine Learning
- B.
QnA Maker
- C.
Text Analytics

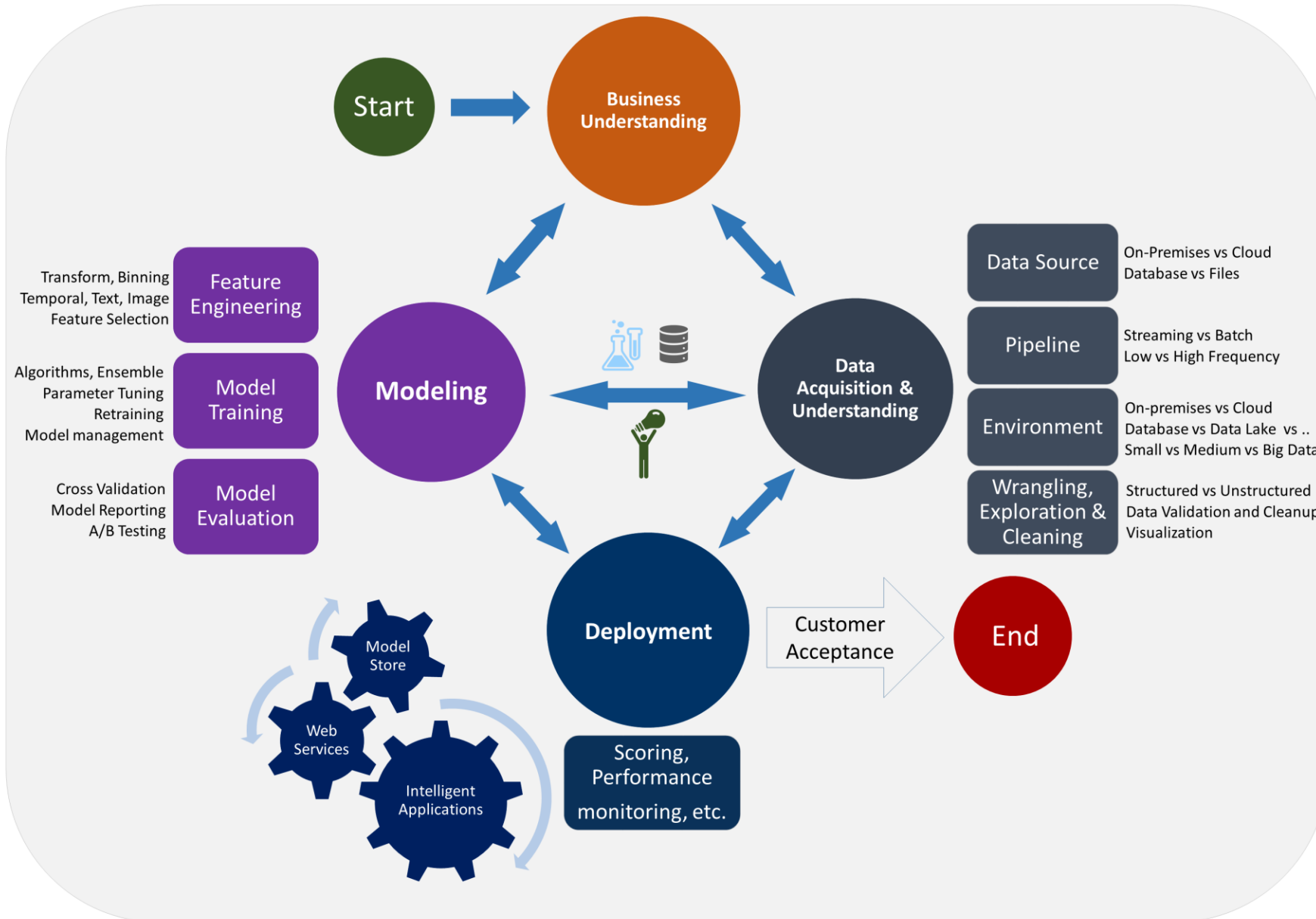
You want to train a model that classifies images of dogs and cats based on a collection of your own digital photographs. Which Azure service should you use?

- A. Computer Vision
- B. Custom Vision
- Azure Bot Service

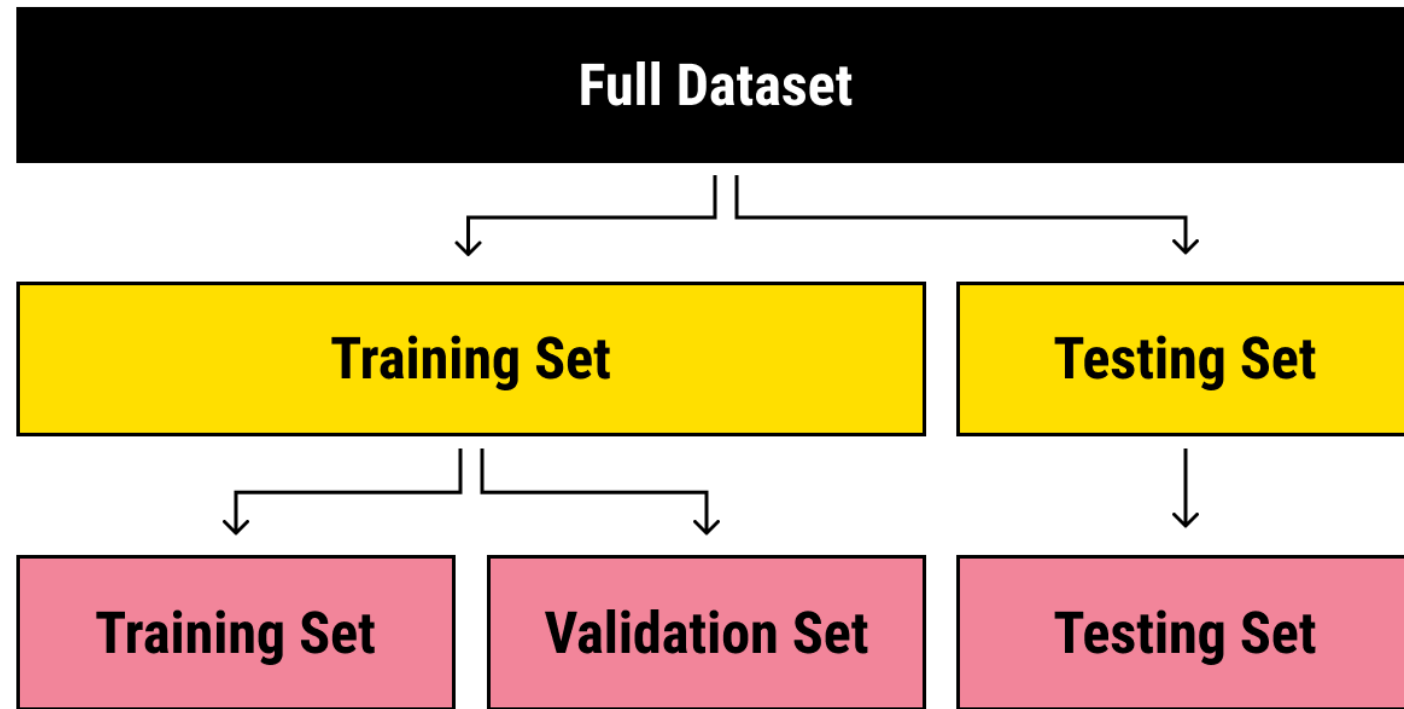
You are designing an AI application that uses computer vision to detect cracks in car windshields, and warns drivers when a windshield should be repaired or replaced. When tested in good lighting conditions, the application successfully detects 99% of dangerously damaged glass. Which of the following statements should you include in the application's user interface?

- A. When used in good lighting conditions, this application can be used to identify potentially dangerous cracks and defects in windshields. If you suspect your windshield is damaged, even if the application does not detect any defects, you should have it inspected by a professional.
- B. This application detects damage in your windshield. If the application detects a defect, have the windshield replaced or repaired. If no defect is detected, you're good to go!
- C. This application detects damage in any glass surface, but you must accept responsibility for using it only in appropriate lighting conditions.

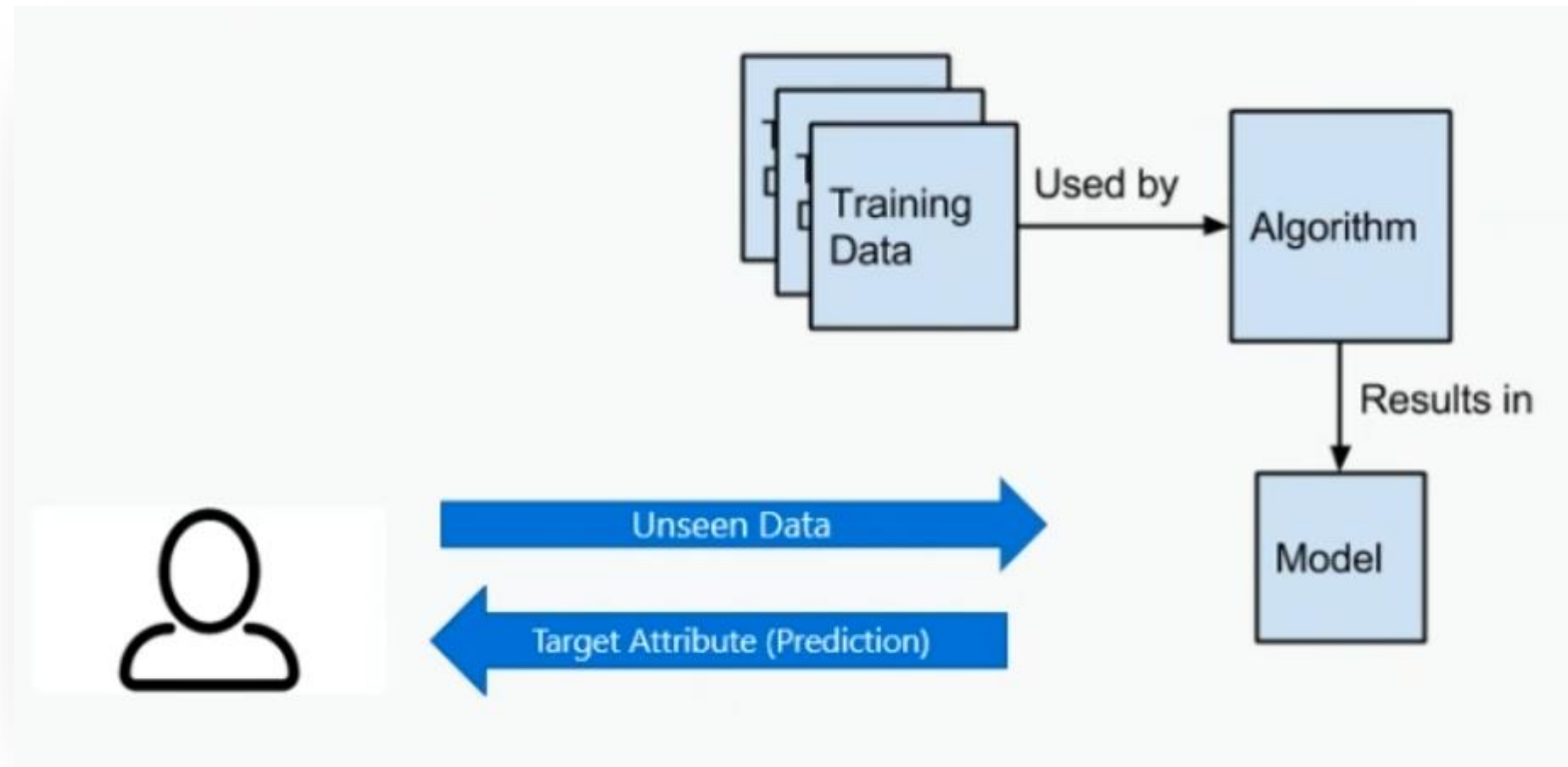
Data Science Lifecycle



Data Split



What is a Model



Challenges in AI

Bias – Amazon recruitment tool bias against women

Errors – Autonomous vehicle may face collision

Data could be exposed – Medical chat bot may expose sensitive patient data

Solutions may not work for everyone - App without audio

Users must trust a complex system – AI model/system should be user friendly

Who is liable for AI driven systems? - Suspecting an innocent as a criminal based on FR

Principals of Responsible AI

Fairness

Reliability & Safety

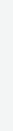
Privacy & Security

Inclusiveness

Transparency

Accountability

[Responsible AI](#)



Fairness



AI systems should treat all people fairly



Azure Machine Learning includes the capability to interpret models and quantify the extent to which each feature of the data influences the model's prediction.



This capability helps data scientists and developers identify and mitigate bias in the model.



<https://www.microsoft.com/en-us/videoplayer/embed/RE4vqfa?postJsllMsg=true>

Reliability & Safety



AI systems should perform reliably and safely.



For example, consider an AI-based software system for an autonomous vehicle; or a machine learning model that diagnoses patient symptoms and recommends prescriptions. Unreliability in these kinds of system can result in substantial risk to human life.



AI-based software application development must be subjected to rigorous testing and deployment management processes to ensure that they work as expected before release.

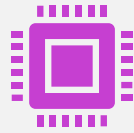


<https://www.microsoft.com/en-us/videoplayer/embed/RE4vvl?postJsllMsg=true>

Privacy & Security



AI systems should be secure and respect privacy.



The machine learning models on which AI systems are based rely on large volumes of data, which may contain personal details that must be kept private. Even after the models are trained and the system is in production, it uses new data to make predictions or take action that may be subject to privacy or security concerns.



<https://www.microsoft.com/en-us/videoplayer/embed/RE4voJF?postJsllMsg=true>

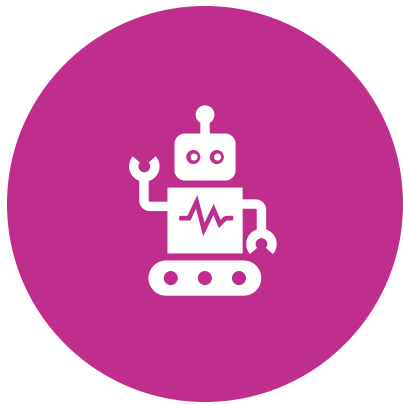
Inclusiveness

AI systems should empower everyone and engage people.

AI should bring benefits to all parts of society, regardless of physical ability, gender, sexual orientation, ethnicity, or other factors.

<https://www.microsoft.com/en-us/videoplayer/embed/RE4vl9v?postJsllMsg=true>

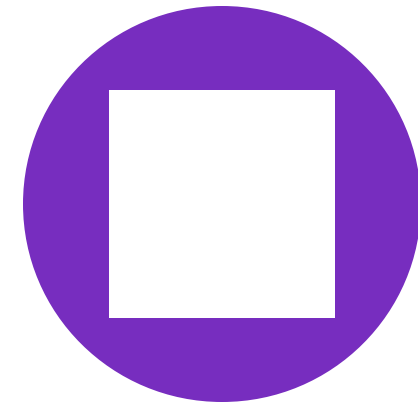
Transparency



AI SYSTEMS SHOULD BE UNDERSTANDABLE.



USERS SHOULD BE MADE FULLY AWARE OF THE PURPOSE OF THE SYSTEM, HOW IT WORKS, AND WHAT LIMITATIONS MAY BE EXPECTED.



[TTPS://WWW.MICROSOFT.COM/EN-US/VIDEOPLAYER/EMBED/RE4VQFB?POSTJSLLMSG=TRUE](https://www.microsoft.com/en-us/VIDEOPLAYER/EMBED/RE4VQFB?POSTJSLLMSG=TRUE)

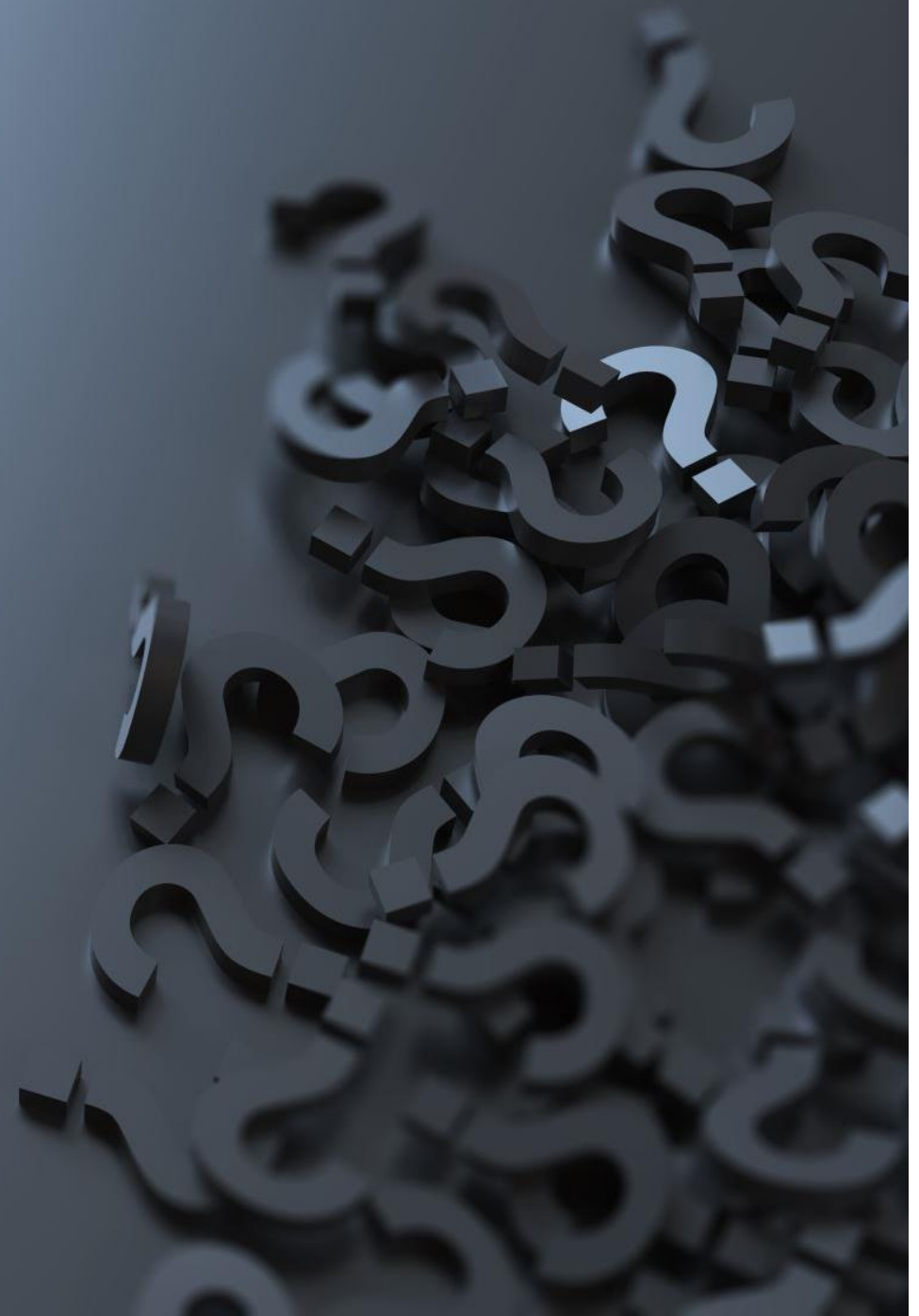
Accountability

People should be accountable for AI systems.

Designers and developers of AI-based solution should work within a framework of governance and organizational principles that ensure the solution meets ethical and legal standards that are clearly defined.

<https://www.microsoft.com/en-us/videoplayer/embed/RE4vvlk?postJsllMsg=true>

Practice Questions ?



Learning Algorithms



SUPERVISED LEARNING



UNSUPERVISED LEARNING
(CLUSTERING & ASSOCIATION)

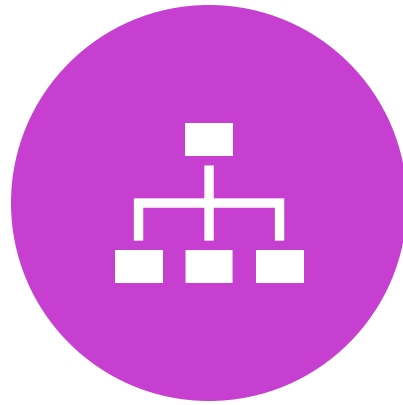


SEMI SUPERVISED LEARNING
(LABEL AND UNLABEL)

Real time problems



REGRESSION



CLASSIFICATION

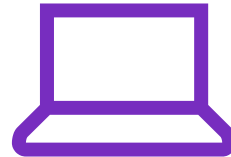


CLUSTERING

Regression



Simple Linear
Regression



Multiple Linear
Regression



Polynomial Regression

Advantages & Limitations of Regression



Continues value
prediction



Simple to understand
and implement



Simple mathematics



Much lower training
time as it is simple
model



Cannot perform well
on complex real time
problems

Applications

Load demand prediction

Stock price prediction

Credit score assessment

Classification



The diagram consists of two identical rectangular frames side-by-side. Each frame has a thick red border and a light pink inner rectangle. The word 'Binary' is centered in the left frame, and 'Categorical' is centered in the right frame. Both words are in a large, black, sans-serif font.

Binary

Categorical

|

Binary Classification Problems

Patient affected with covid or not?

Can issue credit card or not?

Categorical Classification Problem

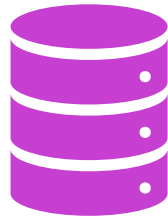
Type of faults (Ex, LG, LL, LLG, LLLG)

Mood of tweet (Ex. Happy, Sad, Angry)

Microsoft AI Platform



Azure AI Services



Azure
Infrastructures



Tools

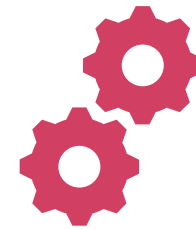
Azure AI Services



Pre – Built AI Services
(Cognitive Services (Cloud +
Edge))

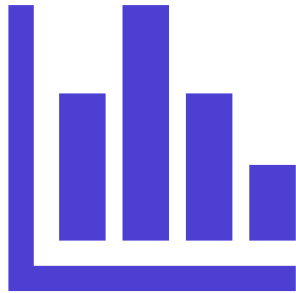


Conversational AI (Bot
Services)



Custom AI (Azure Machine
Learning Services)

Azure Infrastructure



AI On Data (To store data)



AI To Compute (To run machine
learning models)

AI on Data

Cosmos DB

My SQL DB

SQL DB

Data Lake

AI to Compute

Spark

AKS

IoT Edge

Azure Databricks

[Data Science Virtual Machines](#)

DLVM

Tools



Azure ML



Deep Learning
Frameworks

Azure ML

Azure ML VS code

Azure ML studio

Azure ML Workspace

Deep Learning Frameworks

Cognitive Tool Kit

TensorFlow

Caffe

SciKit Learn

Keras

Conda With Jupyter Notebook



Can install jupyter notebook on variety of platforms



Live code with narative text



Graphics



Audience- Developers& Data Scientists



Difficulty level- B To A



Free service

Jupyter Notebook

Preferable for ML tasks

Open source

Can share via GitHub, JupyterHub and Azure

Multi language support (Python, Julia and R)

Azure Notebooks



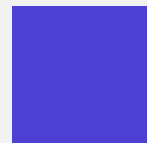
Azure cloud + Jupyter Notebook



Audience- Developers& Data
Scientists



Difficulty level- B To A



Free Service

Azure Notebook



Most popular libraries pre-installed



Can Install Others



Data upload support



Leverage Azure Subscription VM



Azure Machine Learning Service

DSVM/DLVM



Preconfigured
development/experimental
environment



CPU or GPU based instances



Audience- Developers& Data
Scientists



Difficulty level- B To A

Cloud based VM



Cloud workstation



Part of ML services To run jupyter notebook



Audience- Developers& Data Scientists



Difficulty level- B To A



Run on compute target, that will cost

ML studio



Own graphical interface To develop ML model (Drag & Drop)



Audience- Data Scientists



Difficulty level- Beginners



Free Service

ML Service



Develop, Train, Evaluate and Deploy
Production Grade ML models



Audience- Developers & Data
Scientists



Difficulty level- B To A



Paid service

Visual Studio

17 languages supported

Inbuilt Git

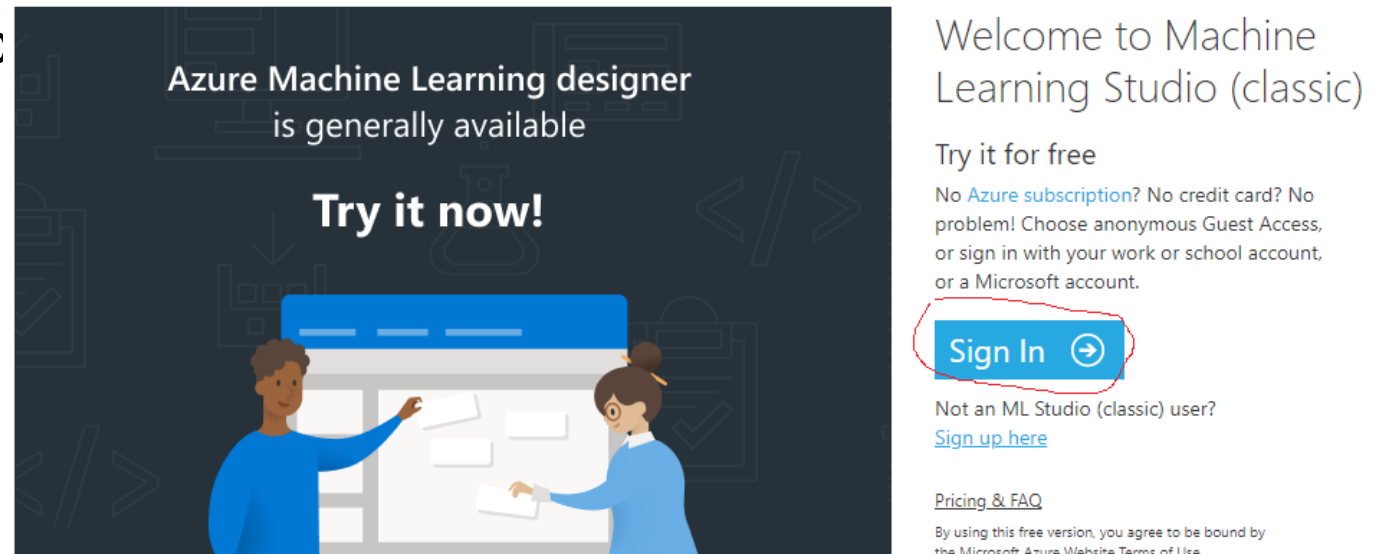
Integrated Debugger

ML Studio Classic



ML studio Classic

Login to portal ML studio classic
: <https://studio.azureml.net/>



Azure Machine Learning designer
is generally available

Try it now!

Welcome to Machine Learning Studio (classic)

Try it for free


No [Azure subscription](#)? No credit card? No problem! Choose anonymous Guest Access, or sign in with your work or school account, or a Microsoft account.


Sign In →


Not an ML Studio (classic) user?
[Sign up here](#)


[Pricing & FAQ](#)


By using this free version, you agree to be bound by the Microsoft Azure Website Terms of Use.

EXPERIMENTS

WEB SERVICES


DATASETS

TRAINED MODELS

SETTINGS

MY EXPERIMENTS

SAMPLES




NAME


AUTHOR


STATUS

LAST EDITED

No experiments found

NEW

DELETE

ADD TO PROJECT

Click on "New" for New experiment





PROJECTS

experiments

MY EXPERIMENTS

SAMPLES



EXPERIMENTS

NEW



DATASET



MODULE



PROJECT
PREVIEW



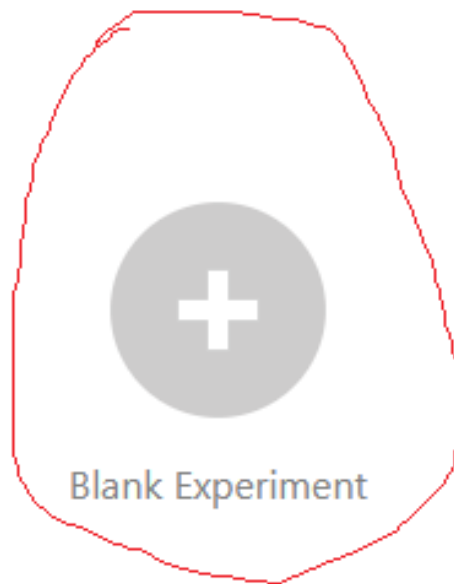
EXPERIMENT



Search experiment templates



Microsoft Samples



Experiment
Tutorial



Sample 1: Download
dataset from UCI: Adult 2
class dataset



Select "Automobile Price Dataset" for
Automobile price prediction project
and drag

The screenshot displays a software interface for managing experiment items. On the left, a sidebar contains a search bar labeled "Search experiment items" and a section titled "Saved Datasets" with a sub-section "Samples". The "Samples" list includes several datasets: "Adult Census Income...", "Airport Codes Dataset", "Automobile price dat...", "Bike Rental UCI dataset", "Bill Gates RGB Image", and "Blood donation data". The "Automobile price dat..." entry is circled in red. A red arrow originates from this entry and points to a box on the right labeled "Automobile price data (Raw)" with a circled "1" below it. Above this arrow, the word "DRAG" is written in red, indicating the action being performed.

Search experiment items

Saved Datasets

Samples

- Adult Census Income...
- Airport Codes Dataset
- Automobile price dat...
- Bike Rental UCI dataset
- Bill Gates RGB Image
- Blood donation data

DRAG

Automobile price data (Raw)

1

Symboling: 06

normalized-losses:
41

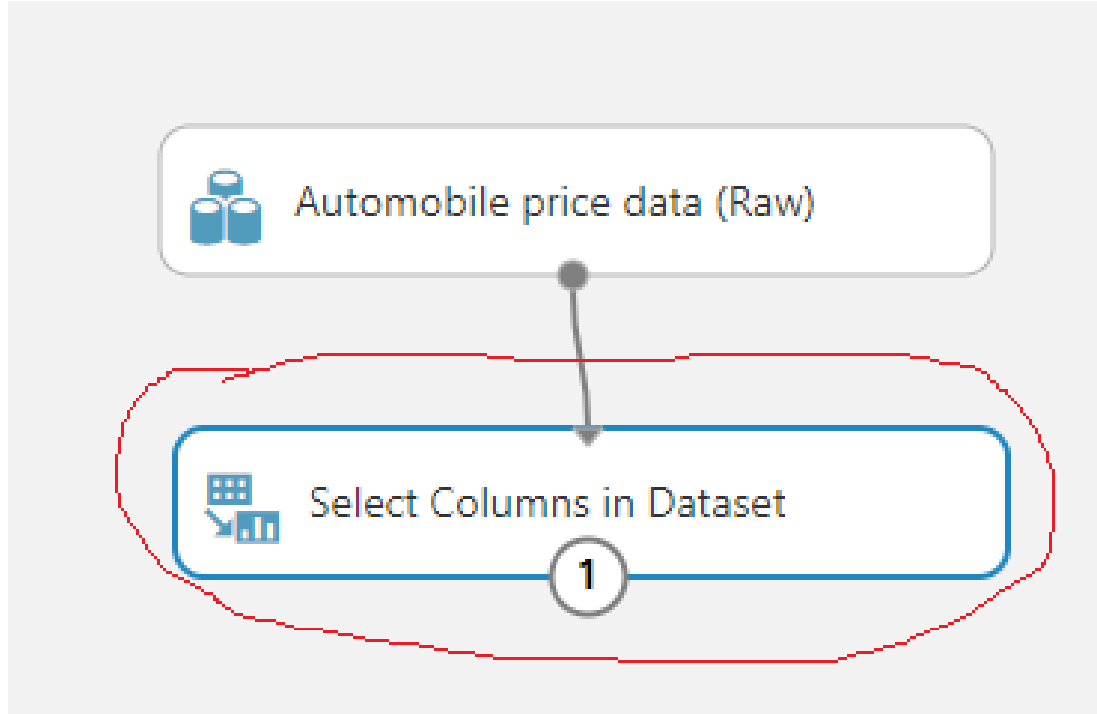
num-of-doors, horsepower, peak-rpm, :2

Bore, stroke, Price:4

wheel-base, fuel-type, Make, body-style, Aspiration,
Curb weight, engine-type, num-of-cylinders, engine-
location, drive-wheel, length, width, height, fuel type,
engine-size, fuel system, compression-ratio, city-mpg,
highway-mpg, :0

Missing Value Information for each Column

Remove "Normalized loss column due to more missing values"



Select columns

BY NAME
WITH RULES

☐ Allow duplicates and preserve column order in selection

Begin With
ALL COLUMNS NO COLUMNS

Exclude column names normalized-losses X

+

-

✓

Microsoft Machine Learning Studio (classic)

CSE 3B-Free-Workspace

Experiment created on 8/24/2021

missin

Saved Datasets

- Samples
 - Automobile price data (...)
 - Flight on-time performa...
- Data Transformation
 - Manipulation
 - Clean Missing Data
 - Deprecated
 - Missing Values Scrubber

Automobile price data (Raw)

Select Columns in Dataset

Clean Missing Data

1 2

In draft

Draft saved at 1:49:32 PM

Properties Project

Clean Missing Data

Columns to be cleaned

Selected columns:
All columns

Launch column selector

Minimum missing value ra...
0

Maximum missing value r...
1

Cleaning mode
Remove entire row

Missing Values Treatment

Microsoft Machine Learning Studio (classic)

Experiment created on 8/24/2021

split

Automobile price data (Raw)

Select Columns in Dataset

Clean Missing Data

Select Columns in Dataset

Split Data

Splitting mode: Split Rows

Fraction of rows in the first split: 0.70

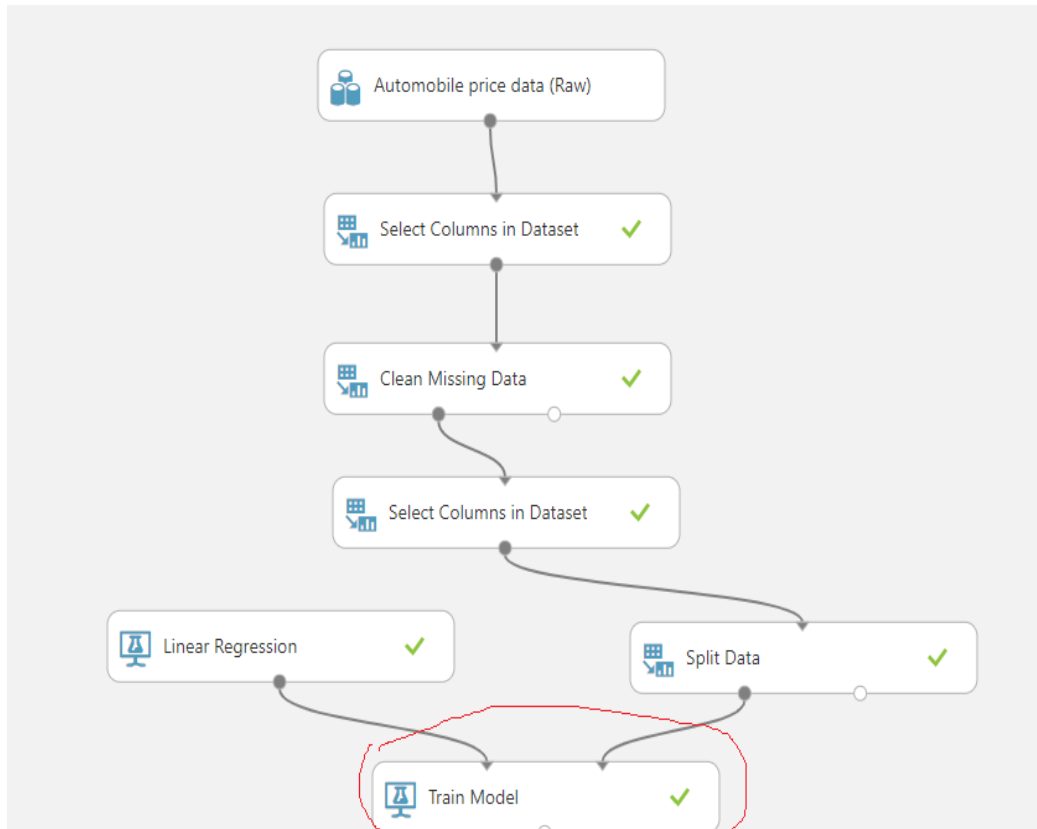
Randomized split: ☒

Random seed: 0

Stratified split: False

```
graph TD; A[Automobile price data (Raw)] --> B[Select Columns in Dataset]; B --> C[Clean Missing Data]; C --> D[Select Columns in Dataset]; D --> E[Split Data];
```

Data Split





Select a single column

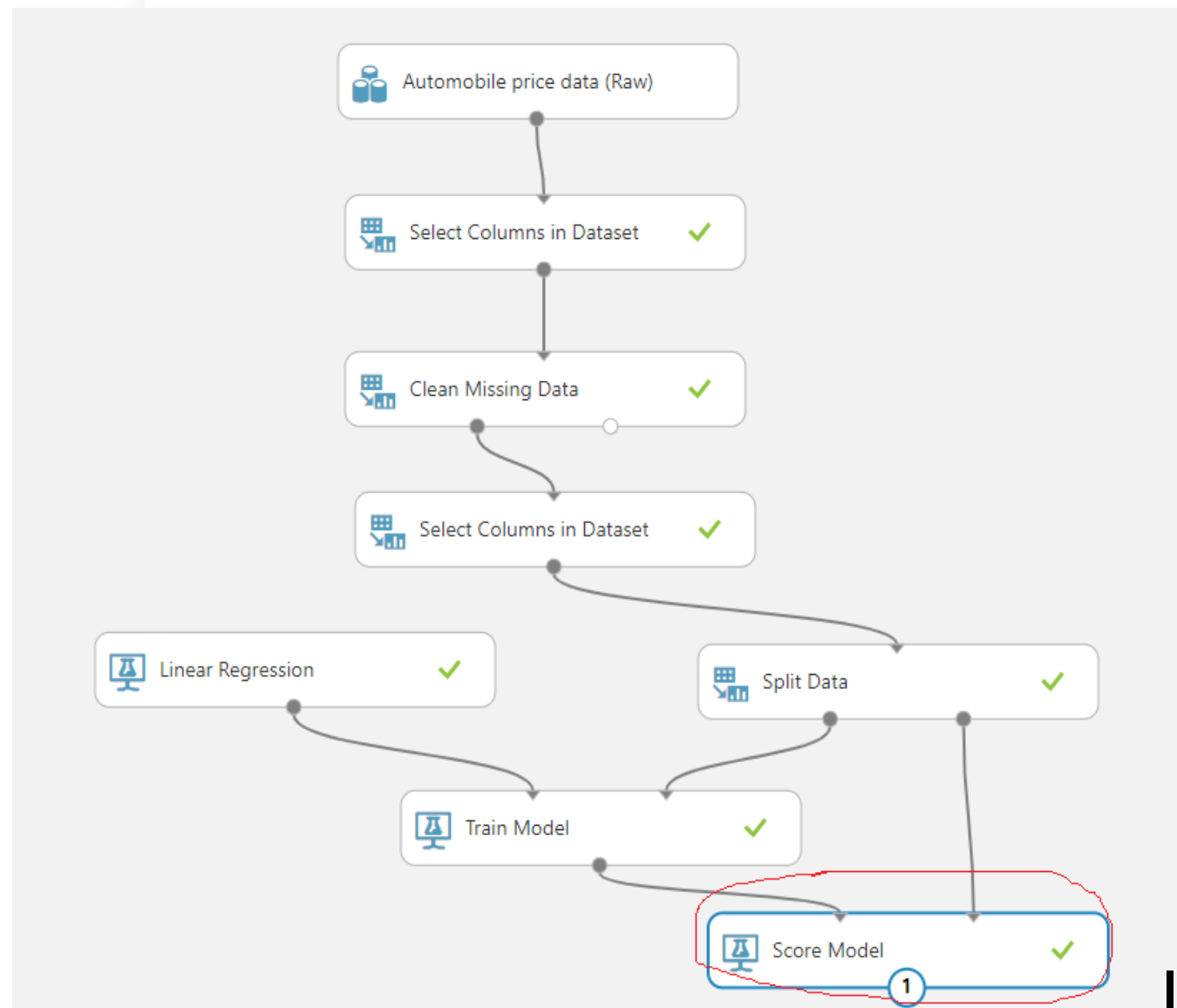
BY NAME

WITH RULES

Include column names price X

Train Model (Linear Regression Model)

price	Scored Labels
	
15510	13284.899402
7689	7658.867692
8195	8863.220012
6295	5905.454253
11048	10750.34708
34184	38369.412133
5499	5894.125916
7957	9549.224752
41315	30915.948926
22625	19695.952699
8358	7009.537182
16515	14835.627755
16500	14329.457978
6229	7277.974231



Test Model

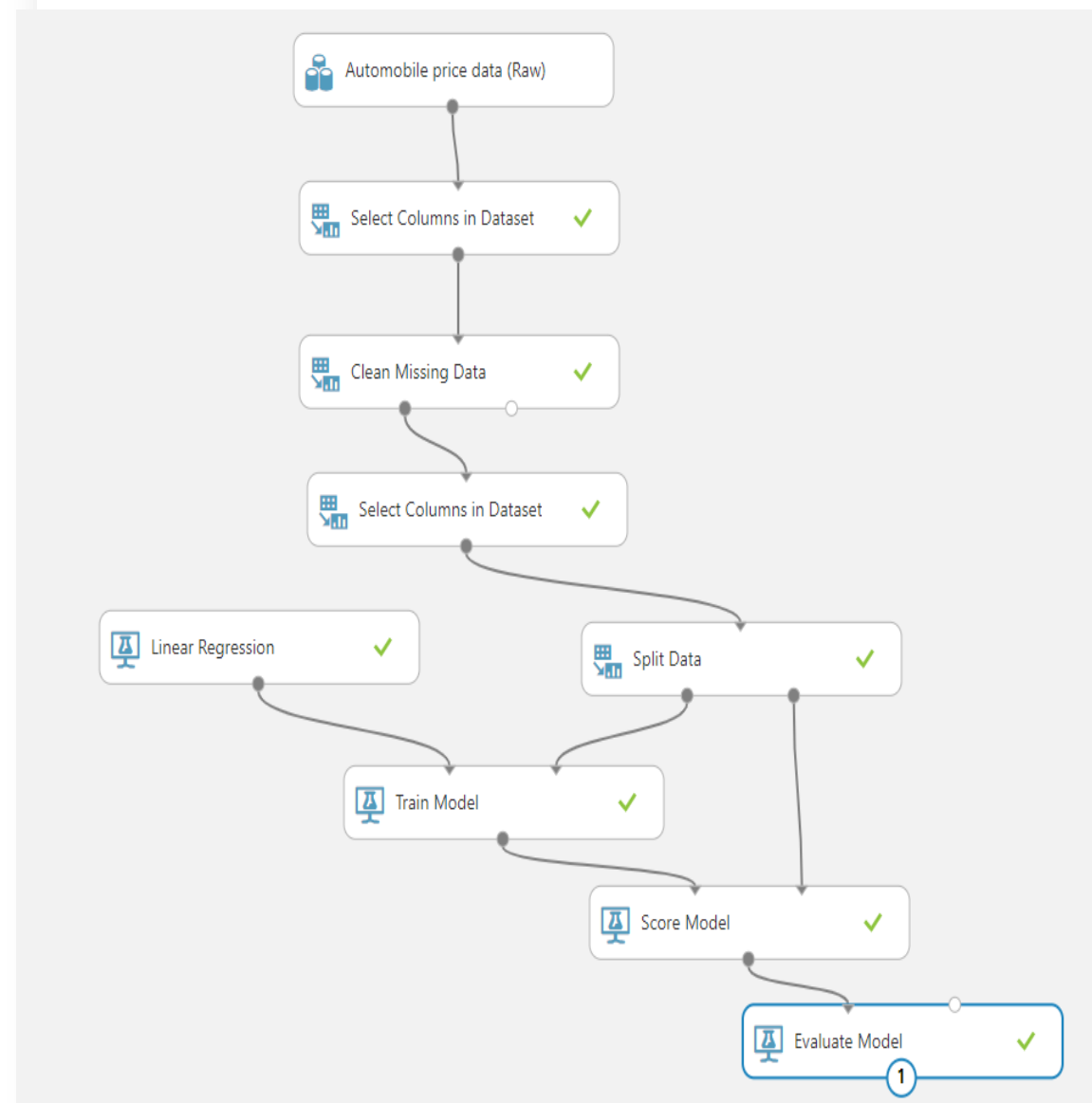
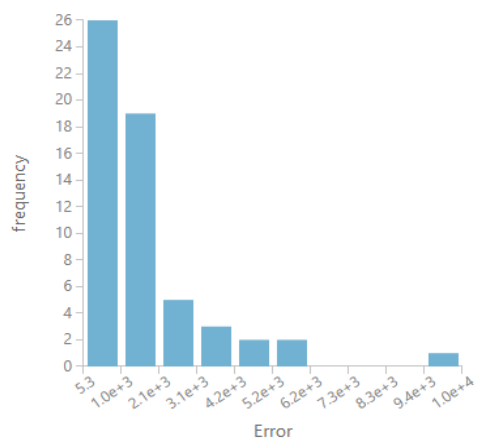
Evaluate Model

Experiment created on 8/24/2021 > Evaluate Model > Evaluation results

Metrics

Mean Absolute Error	1605.514464
Root Mean Squared Error	2385.271889
Relative Absolute Error	0.266248
Relative Squared Error	0.083112
Coefficient of Determination	0.916888

Error Histogram





Azure Machine Learning Service

Machine Learning Project Workflow



Import data



Explore data (Missing Values, Outliers)



Preprocess data (Missing value imputation, outlier treatment, normalization)



Model Selection



Model Training

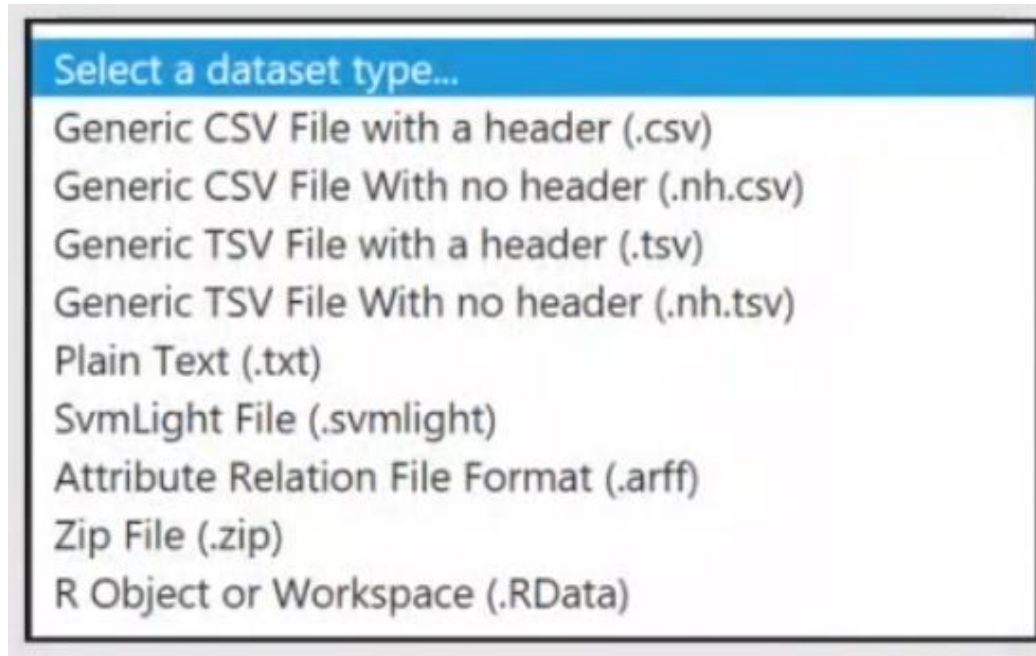


Model Testing



Model Deployment





Import Data

Data Sources:

Azure blob storage

Web URL

Hadoop Using HiveQL

Azure Table Storage

Azure SQL Database

SQL Server on Azure VM

oData

Explore data

Identify Independent/dependent features

Outlier Identification (Box plot/z-score)

Missing Values

Any bias information

Identify similar features / unusual features

Cluster data if required

Min Max Values

Box Plot/Schattel plot/bar chart

Processing Data/ Data Transformation



Missing value treatment: Removal or Replace



Outlier treatment: Using Box Plot or Z-score



Normalize data: Min-Max or Standard



Data Split: Train, Validation and Test



Filtering: Remove noisy data



SMOTE: Synthetic Minority Over-Sampling Techniques (To avoid imbalance classes)

Model Selection: Regression



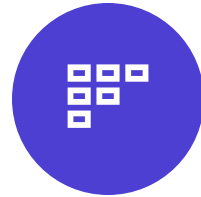
LINEAR
REGRESSION



POLYNOMIAL
REGRESSION



DECISION TREE



SUPPORT VECTOR
REGRESSION



RANDOM FOREST



NEURAL NETS

Model Selection: Classification

Logistic Regression (Binary Classification)

Decision Tree

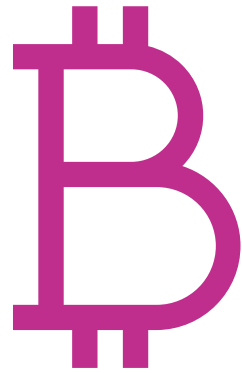
Random Forest

SVM

ANN

CNN

Model Selection: Clustering



K-Means



Kohonen's SOM

Model Training

Hyper parameter tuning

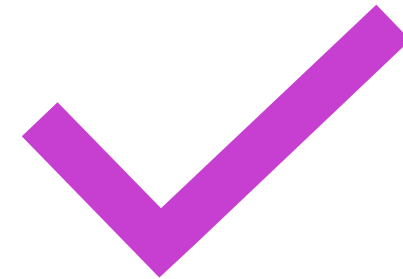
Optimizer selection

Train Model on training data and do parallel testing using validation data

Model Testing



Test the model on testing data



Evaluate the model in terms
of metrics



Azure Cognitive Services

Azure Cognitive Services



Building AI application from scratch is complex task which involves many sub tasks



Microsoft provides Azure Cognitive Services to help developers to build application and host it



It consists APIs, SDKs and Services



Core Features: Speech, Language, Vision, Search, Decision



Your Apps



Vision
Speech
Language
Search
Decision

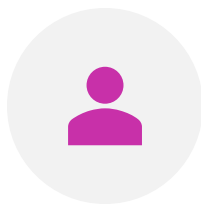
Azure Cognitive Services: Vision



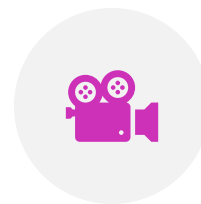
COMPUTER VISION



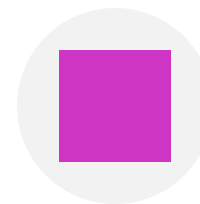
CUSTOM VISION
SERVICE: CUSTOMIZED
IMAGE CLASSIFIER



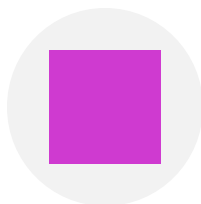
FACE API: FACE
RECOGNITION AND
ATTRIBUTES DETECTION



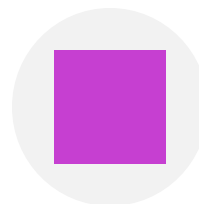
VIDEO INDEXER: TO
EXTRACT INSIGHTS
FROM VIDEO




INK RECOGNIZER



FORM RECOGNIZER



READ API



Azure Cognitive Services: Speech

Text – Speech

Speech – Text

Speech Translation

Azure Cognitive Services: Language

Translate text

QnA maker

Text Analytics

Language Understanding

Language Understanding

LUIS is a cloud-based API service that applies custom machine learning intelligence to user's conversation, predict overall meaning of text, pull out relevant and detailed information

Thank you

