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PRACTITIONER COMMUNITY

June 17th, 2021

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Welcome

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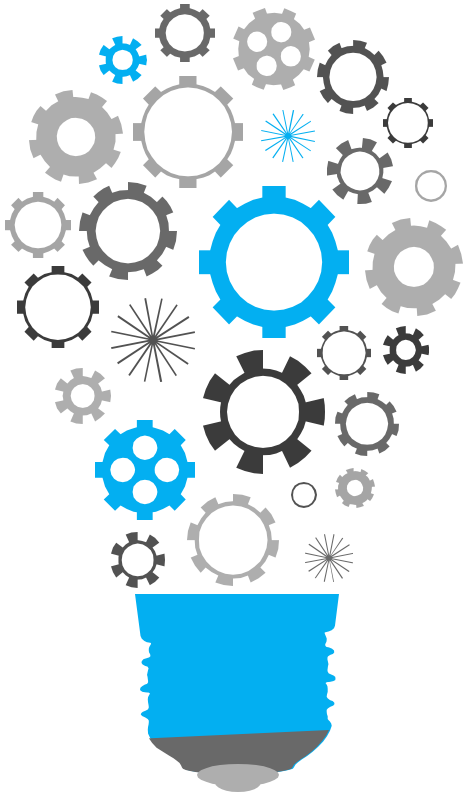
Agenda

We have prepared a very interesting agenda for today's session



- **AI News & Updates**
- **Business Case Overview**
- **AI Model Building**
- **Q&A Time**

Go to **www.menti.com** and use the code **3939 7971**

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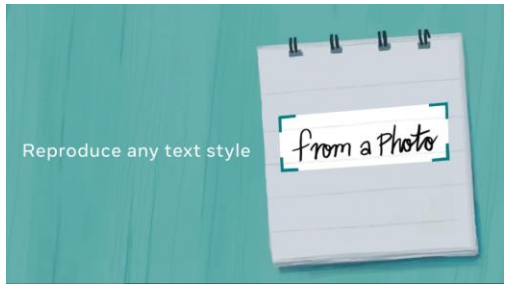
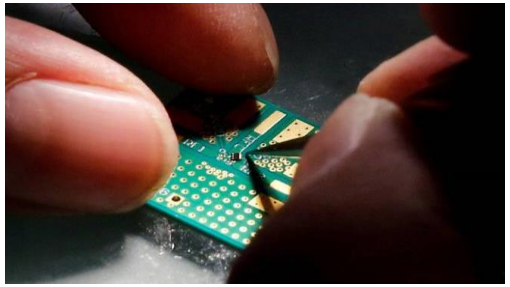
News and Updates



Facebook's new AI tool can replicate, replace and edit handwritten text using a single word in an image.
Read more…

By developers, for developers: Metabob's AI tool will forever change how developers approach debugging.
Read more…



Google is using AI to design chipsets in just six hours.
Read more…

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News and Updates

Artificial Intelligence predicts how patients with viral infection will fare.
Read more…

Microsoft Azure

Azure Maps Creator is now generally available in Microsoft Azure Service.
Read more…

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News and Updates

An update by

Jair Ribeiro
Senior Business Analyst – Artificial Intelligence

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Business Problem Statement
IRec – Image Recognition Emission Class

Requirement is to automate the mundane **manual audit of the trucks entering the factory**.

Why Audit?

- To capture the license plate numbers
- Check the Emission class of the truck
- Making sure trucks meet minimum emission class requirement

Pilot Site: **Tuve**

On a high-level following is the problem statement

Truck Emission Class detection

- Auto detect the Emission class of all incoming trucks into plant
- Create a report with logistics company details
- Share report on Power BI board for further actions

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PL Sustainable transport system

Identified areas and actions to acheive by 2025

World class sustainable transport system

" To lead by example, we should have a world class sustainable transport system by 2025 "

REDUCE
TRANSPORT DEMAND

- Localization and **nearshoring** supply base
- Reduce **unnecessary shipments**
- Reduce **air shipment** acceptance
- 3-D printing for low running parts

OPTIMIZE
TRANSPORATION

- Proactive transport network optimization
- Focus on load consolidation and filling degree in the supply chain
- Loadsharing with other shippers

IMPROVE
FLEET EFFICIENCY

- **Emission class requirements**
- Utilize right mode of transports – increase usage of rail and sea
- Slow steaming ships and alternative fuel, High capacity vehicles
- LNG/CNG and early adaptation of electric trucks

*Reduce CO2 emissions from freight transports per produced unit by 30% by 2025**

** 2018 as a base*

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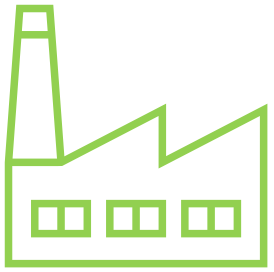
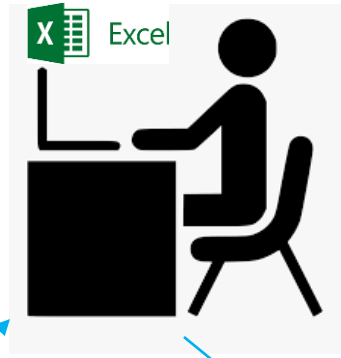
Emission Class – AS IS Process



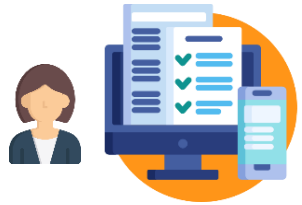
Trucks parked at Tuve Factory-LX gate



Manual entry into Excel at LX gate

Manual Capture by requesting the truck Driver

Frequency:
Goods receipt capture: Every day; 2 shifts
Sustainability report: 1 full day once per year



Stakeholder have limited access to the data

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AI – Computer Vision Solution

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Artificial Intelligence On
Microsoft Azure Cloud

AI Solution reading the
License Plate Number

Windows Azure

Send License Plate Number

IP Camera

Camera sending the Images to cloud

Receive make, model and emission class of the truck

API

B
Biluppgifter

API Service Layer

FACTORY

Send make, model and emission class of truck

Stakeholder to access the data

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BUSINESS VALUE

- Scale up the As-Is process
- High confidence in data quality
- Reduced human effort to capture the data
- Reduced turn around time to aggregate the results
- User friendly Power BI dashboard-updated once a day
- Inline with digitization and sustainability ambitions

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High Level Technical Flow

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Volvo Facility Network

- Outdoor All weather - Casing IP66/IP67
- Resolution 1920x1080
- **Frame rate** Up to **25/30 FPS** (50/60 HZ) in all resolutions
- Power over Ethernet **POE**
- IR illumination Optimized IR (**Day & Night**)
- Operating conditions -40 °C to 60 °C (-40 °F to 140 °F)
- **Event Triggers Features** - Cross Line Detection, Video Motion Detection
- Lux - Color: 0.07 lux, at 50 IRE F1.2; **B/W : 0.01 lux**, at 50 IRE F1.2
- Video compression - H.264
- Connectors Shielded RJ45

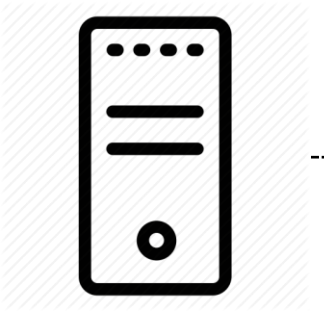
IP POE Camera: AXIS P1448-LE
LPR-Front at Tuve: LX Gate

Captures the images only when the truck arrives at the Gate

RJ45 Cable
Images are transmitted

Network Switch

RJ45 Cable



Stand Alone Windows 10 Machine
Saving images for last three days

Camera, Switch & Stand-alone machine exist in the same facility network area

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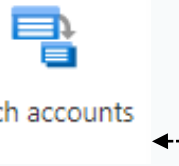
Microsoft Azure

Azure

Microsoft Azure Blob Storage



Batch accounts

Tables
Tabular data storage

Copy batch scheduled pushing data to Azure

Fetch the Truck details from Biluppgifter

Power BI

Biluppgifter

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Solution pipeline - Azure

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Volvo Facility Network

Standalone m/c at facility network

AZCOPY script moving files to Azure

Scheduled job running on stand alone machine at factory

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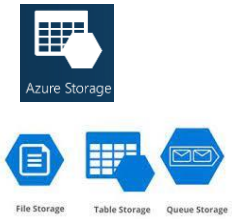
Microsoft Azure Environment Pipeline & Services



ADF V2 Pipeline

Azure Data Factory

Classify Images

Azure Batch

Custom Script SortRawImages .py

Sort Images

Custom Model CloudClassifier .py

Truck/No Truck

Detect Number Plate Region

Azure Batch

Crop Number plate region

Custom Model NmberPlateDetection .py

Detect Number Plate Text - OCR

Azure Batch

ExtractNumberPlateOCR.py

Off the shelf - Computer Vision Read API

Microsoft Cognitive Services

Cleaned Valid Plate Numbers

Check Number Plate Status

Azure Batch

API call to Biluppgifter

Biluppgifter

Azure Cosmos DB

Power BI

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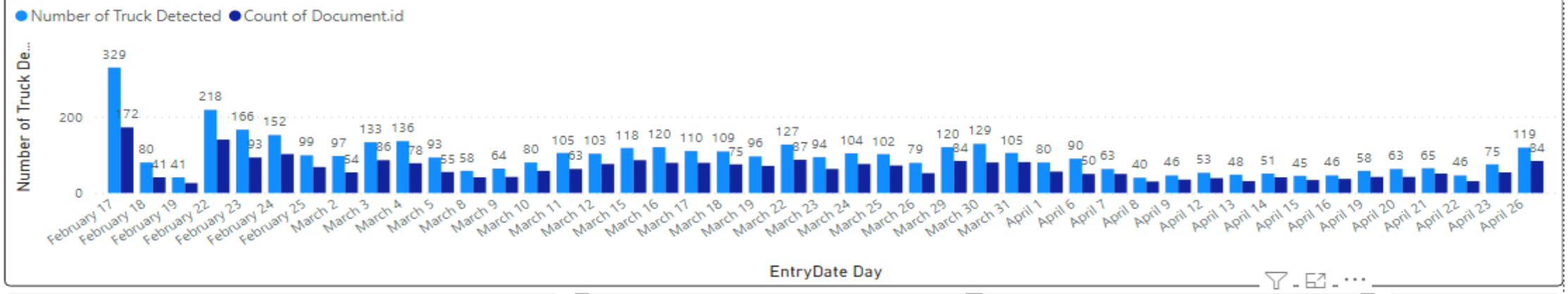
Solution output

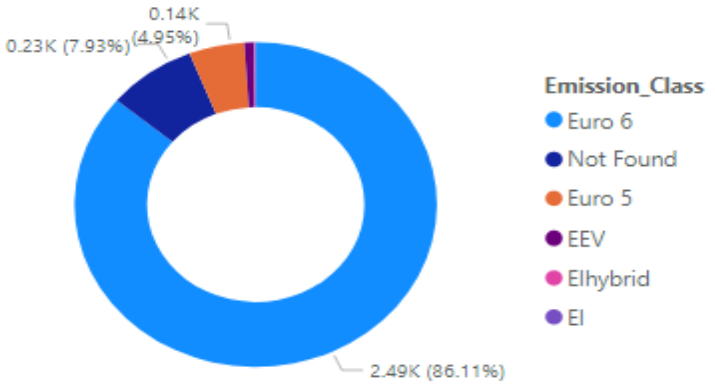
Year	Month	Day	Total number of Truck Detected	Licence Number plate Detected	Count of Truck Details Received
All	All	All	4355	3992	2887

IREC Data Analysis

Count of Total Trucks by Month and Day



Count of Valid Number Plate by Emission_Class



Legal_Name	First Legal_Group	Count of Document.id
A. R. J. Transport Aktiebolag	Aktiebolag	1
Aktiebolaget Lundby Åkeriet	Aktiebolag	449
Aktiebolaget Melvin Levin	Aktiebolag	1
Aktiebolaget Tingstad Papper	Aktiebolag	1
ALD Automotive AB	Aktiebolag	1
Alexander LS Transport AB	Aktiebolag	4
Andalens Åkeri Aktiebolag	Aktiebolag	6
Angered Byggvaror Aktiebolag	Aktiebolag	4
Aros Fjärrgods AB	Aktiebolag	2
Åsundens Åkeri AB	Aktiebolag	1
Augustsson Fordonsvård AB	Aktiebolag	2
B.X.S Trans AB	Aktiebolag	2
Balto AB	Aktiebolag	2
BBS Transport AB	Aktiebolag	3
Bengt Norrmans Åkeri Aktiebolag	Aktiebolag	3
Total	**Aktiebolag**	**2887**

NumberplateValue
AAG673
AAZ720
ABK42G
ABS21C
ADO293
AEN23J
AGX605
ANG254
AON127
APP390
ARH691
AUF451
AUH359
AUN236
AUO812

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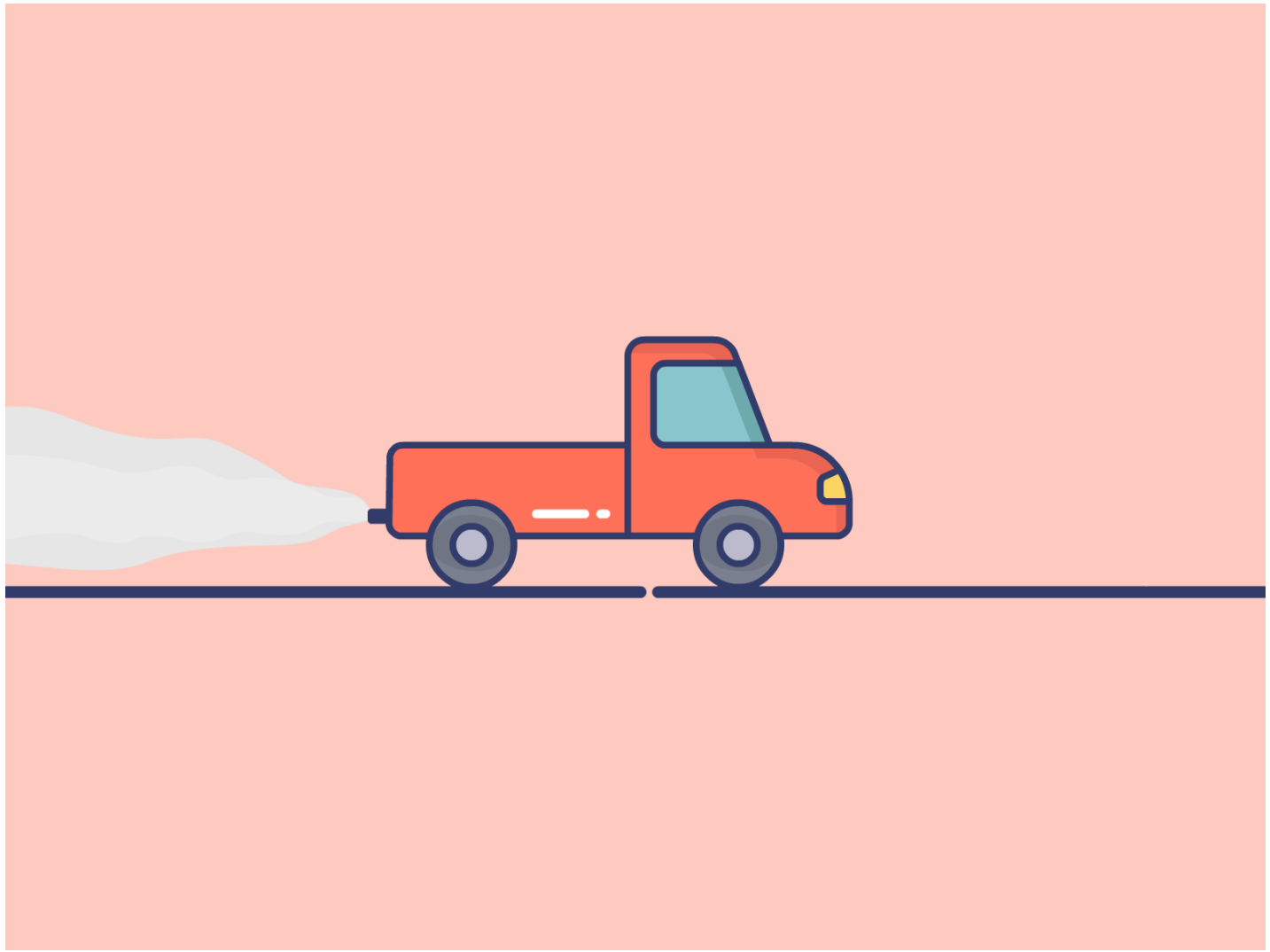
Building the Truck/No Truck Model Using Transfer Learning



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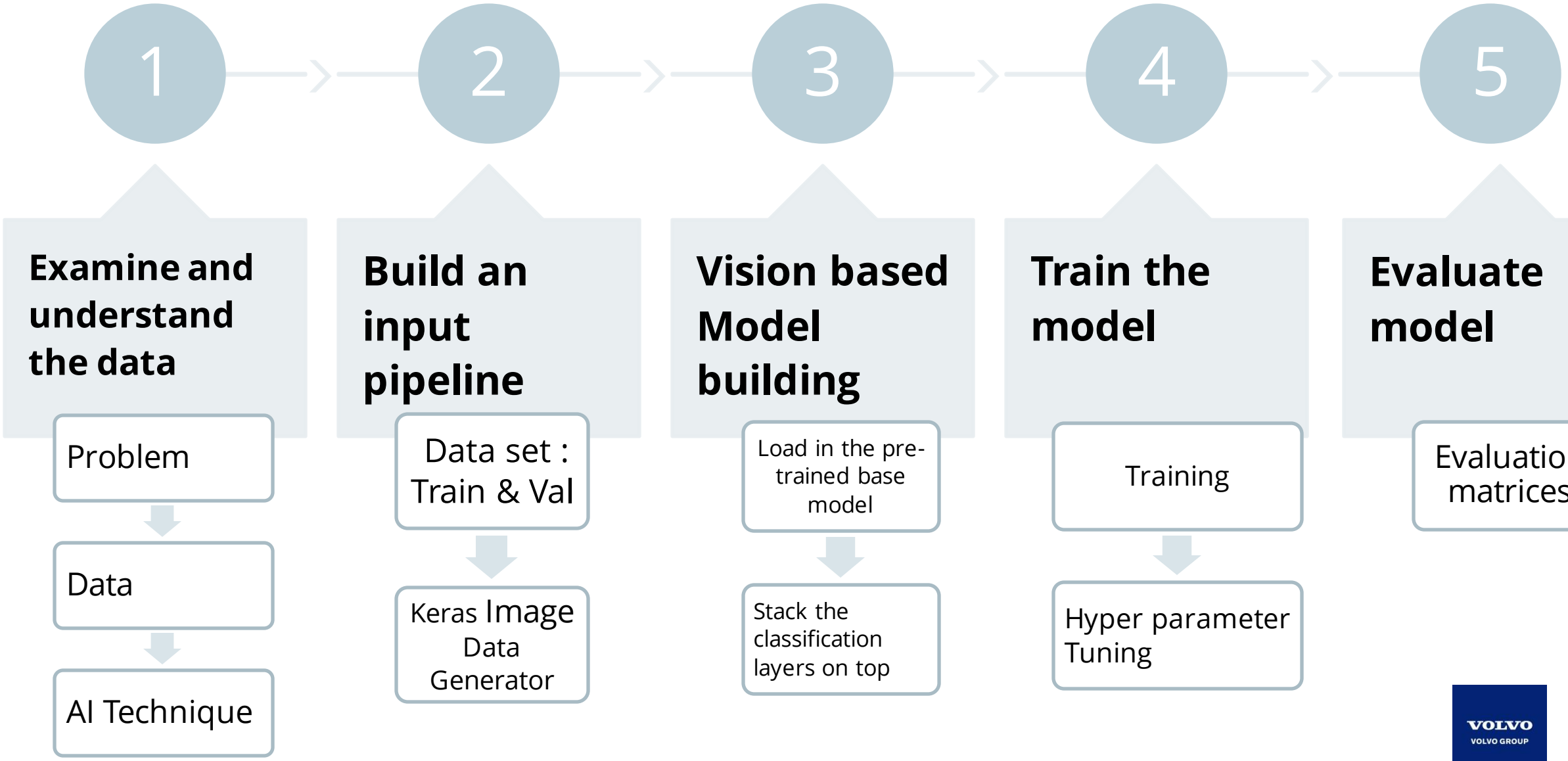
Machine learning workflow



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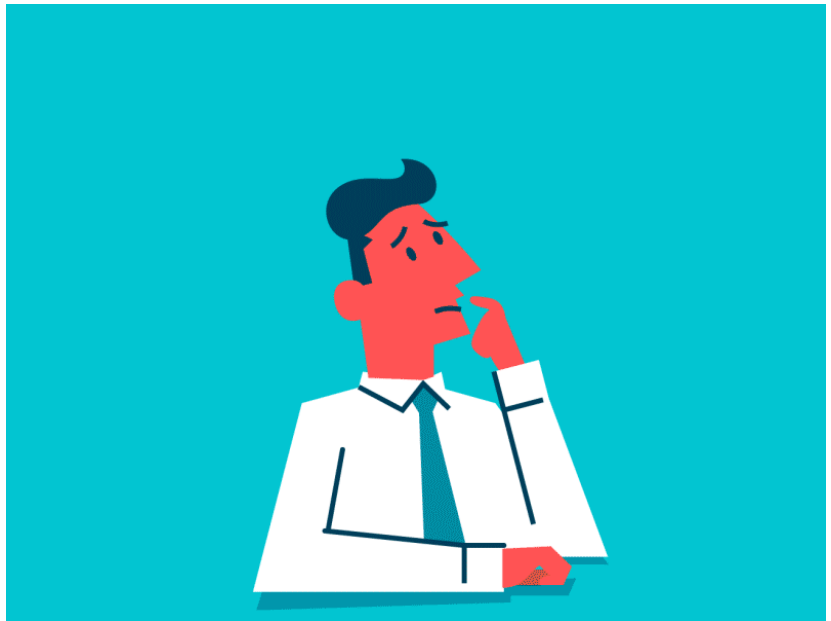
1. Examine and understand the data

- Understand the problem your solving
- Understand the Data
- Identify the right AI technique to solve



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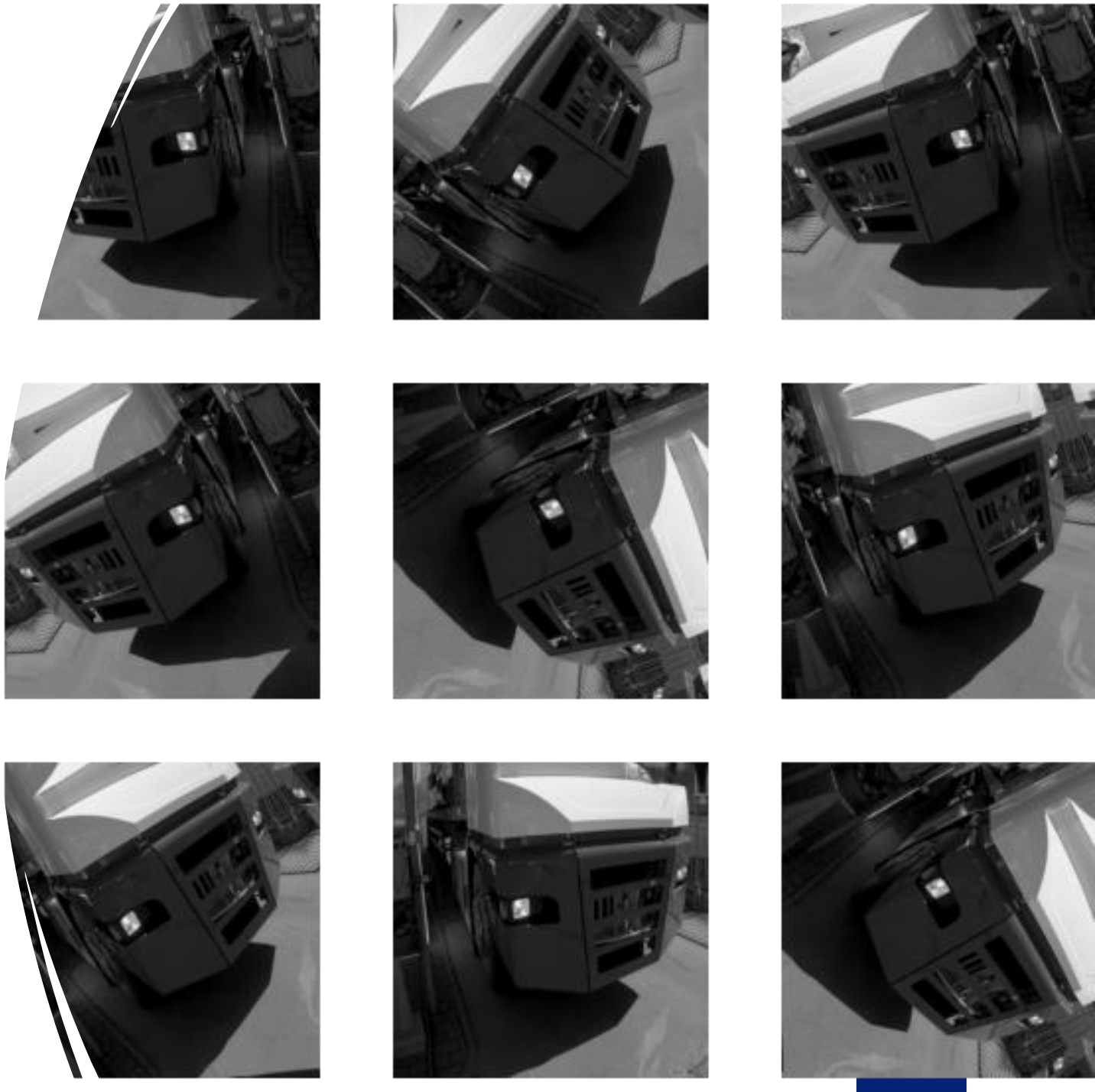
2. Build an input pipeline, in this case using Keras Image Data Generator

- The training Data set has **5622** files belonging to 2 classes.
- The Validation data set has **1228** files belonging to 2 classes.
- When you don't have a large image dataset, it's a good practice to **artificially introduce sample diversity** by applying random, yet realistic, transformations to the training images.



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3. Building Vision Model

Create the base model from the pre-trained convnets

- We have built the base model from the Xception model developed at Google.

This is pre-trained on the ImageNet dataset, a large dataset consisting of 1.4M images and 1000 classes.

- ImageNet is a research training dataset with a wide variety of categories like Person, car, jackfruit etc.

- Transfer learning : click

```
model.summary()

Model: "model"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_2 (InputLayer)         [(None, 720, 720, 3)]     0
_________________________________________________________________
sequential (Sequential)      (None, 720, 720, 3)       0
_________________________________________________________________
tf.math.truediv (TFOpLambda) (None, 720, 720, 3)       0
_________________________________________________________________
tf.math.subtract (TFOpLambda (None, 720, 720, 3)       0
_________________________________________________________________
xception (Functional)        (None, 23, 23, 2048)      20861480
_________________________________________________________________
global_average_pooling2d (Gl (None, 2048)              0
_________________________________________________________________
dropout (Dropout)            (None, 2048)              0
_________________________________________________________________
dense (Dense)                (None, 1)                 2049
=================================================================
Total params: 20,863,529
Trainable params: 9,480,393
Non-trainable params: 11,383,136
_________________________________________________________________
```


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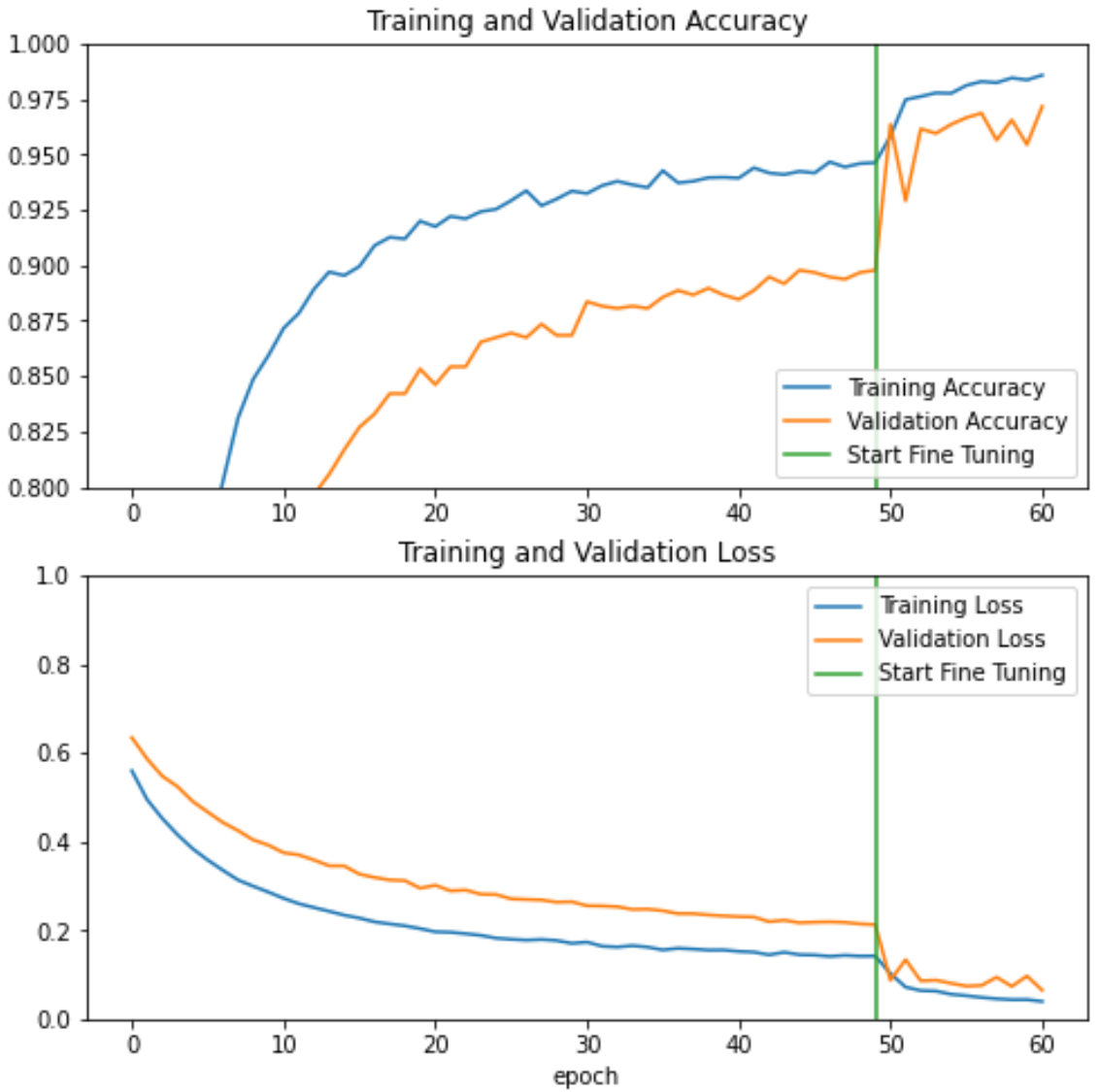
4.Train & Hyper Parameter Tuning

- In the feature extraction experiment, you were only training a few layers on top of an Xception base model.
- The weights of the pre-trained network were not updated during training.
- One way to increase performance even further is to train (or "fine-tune") the weights of the top layers of the pre-trained model alongside the training of the classifier you added.
- The training process will force the weights to be tuned from generic feature maps to features associated specifically with the dataset.



After fine tuning the model nearly reaches 96% accuracy on the validation set.

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5. Evaluation and prediction

- Finally, you can verify the performance of the model on new data using test set.

```
loss, accuracy = model.evaluate(test_dataset)
print('Test accuracy :', accuracy)
```

```
15/15 [==============================] - 110s 7s/step - loss: 0.0860 - accuracy: 0.9583
Test accuracy : 0.9583333134651184
```

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License Plate Detection Model using YOLO

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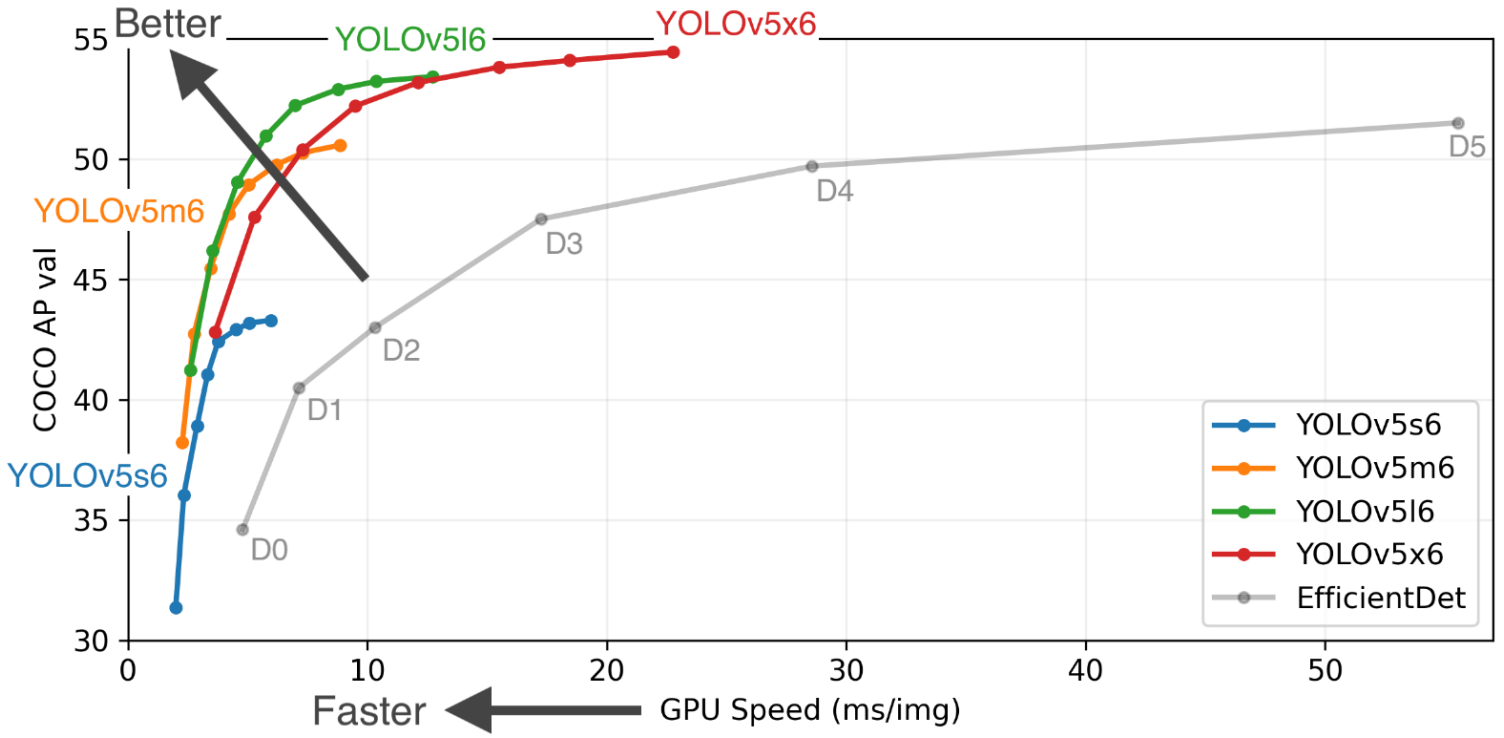
Computer Vision - Object Detection

When it comes to deep learning-based object detection, there are three primary object detectors you'll encounter:

- R-CNN and their variants, including the original R-CNN, Fast R- CNN, and Faster R-CNN
- Single Shot Detector (SSDs)
- YOLO

YOLO

- The biggest advantage of using YOLO is its superb speed – it's incredibly fast and can process 45 frames per second.



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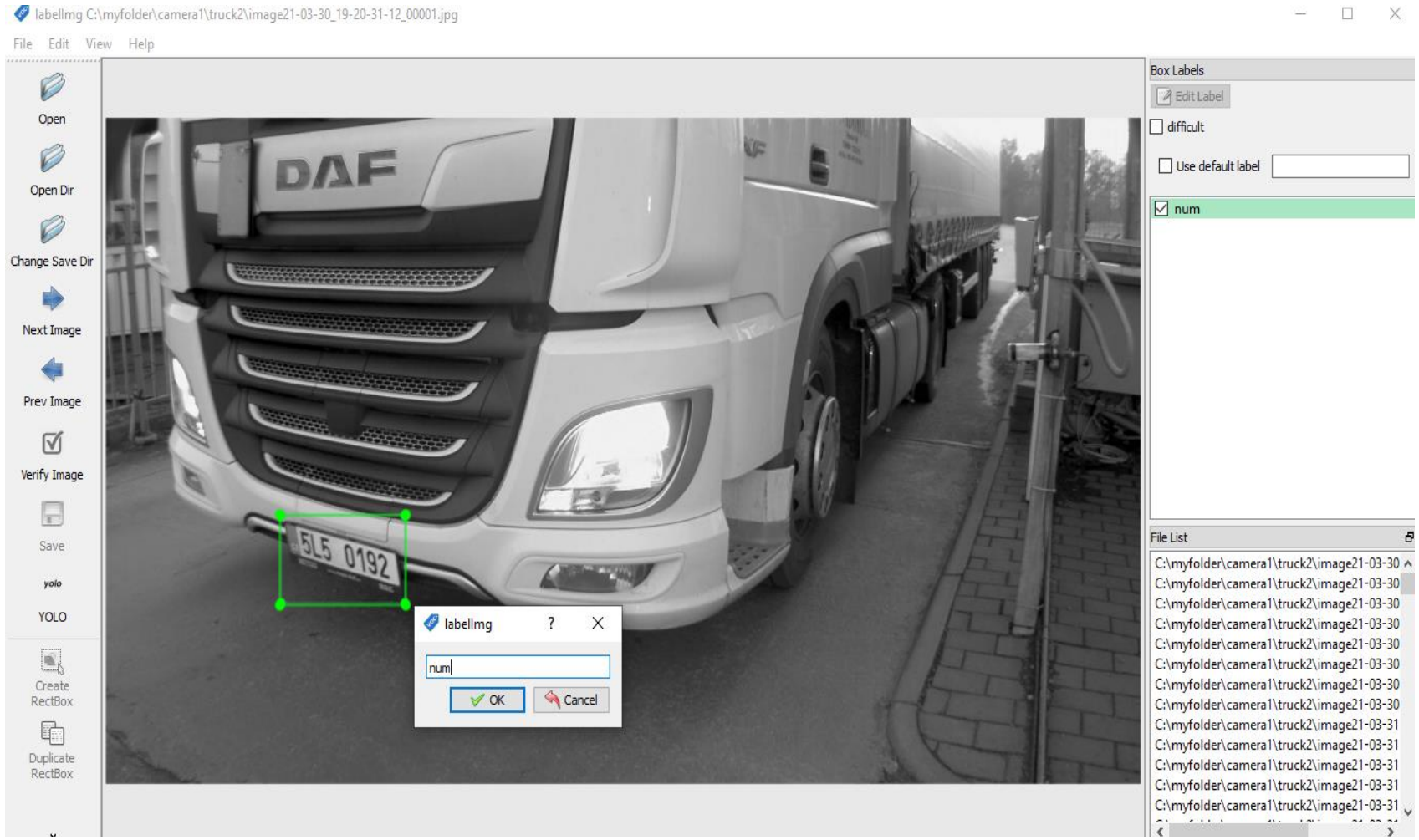
Data preparation and Image labelling

- Resizing, preprocessing the images, if necessary.
- Image labelling

- After using a tool like CVAT, makesense.ai or Label box to label your images

- export your labels to **YOLO format**, with one *.txt file per image (if no objects in image, no *.txt file is required).
The *.txt file specifications are:



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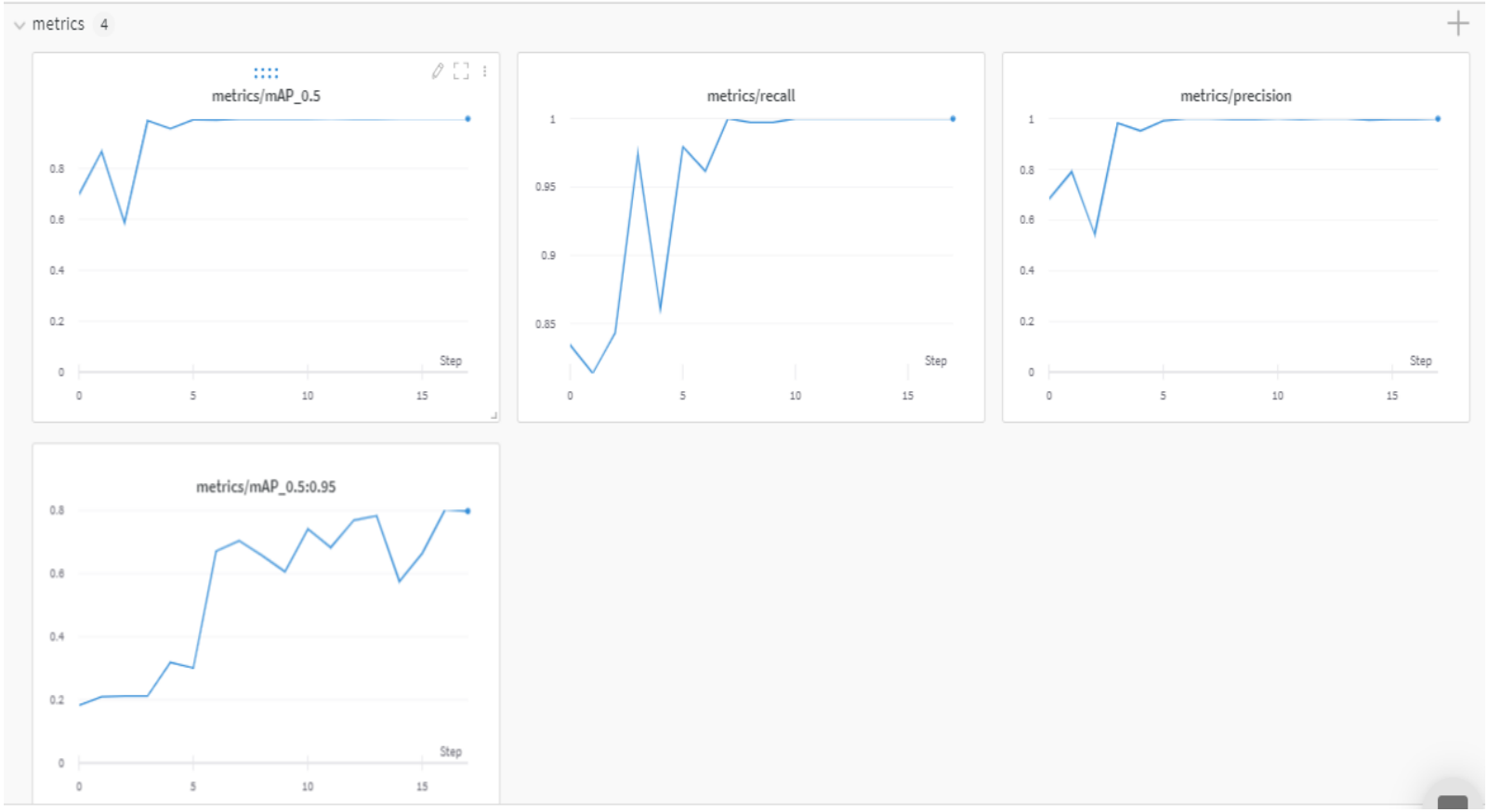
Model Training and Evaluation Metrices:

- The model was able to Achieve 99.67% accuracy with the threshold of 0.50 IOU, that is with at least 50% or above overlapping with ground truth of labelled images.
- Similarly, 80.28% of accuracy with the threshold of 0.95 IOU, that is with at least 95% or above overlapping with ground truth of labelled images.

```
# Train YOLOv5s on COCO128 for 5 epochs$
python train.py --img 640 --batch 16 --epochs 25 --data data.yaml --weights yolov5s.pt
```

Mean average precision (mAP), recall, precision where the evaluation matrix considered for the case.



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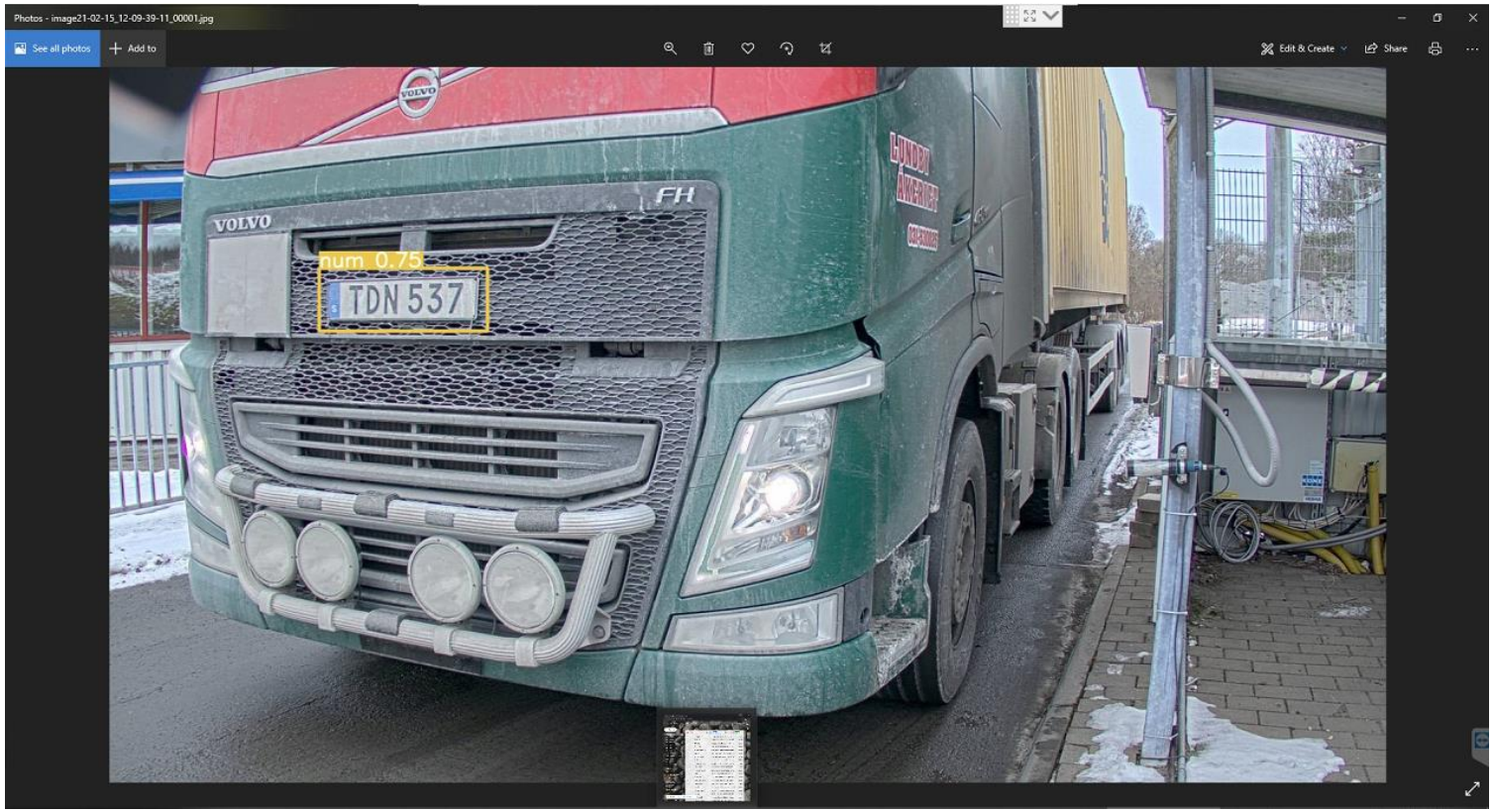
Output

- Bounding box with confidence value is displayed on sample test image
- Other Different input Sources

```
0 # webcam
file.jpg # image
file.mp4 # video
path/ # directory
 path/*.jpg # glob
 'https://youtu.be/NUsoVlDFqZg' # YouTube video
'rtsp://example.com/media.mp4' # RTSP, RTMP, HTTP stream
```



- A custom Function build to crop bounding box.
- This cropped image will be further used by Read API to extract text from the image.

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LESSONS LEARNT

- Procurement of the hardware equipment
- Vendor Management
- Camera Installation & Setup
- Network Issues
- Saving pictures on machine
- Stakeholder Management
- Computer Vision Solution Setup

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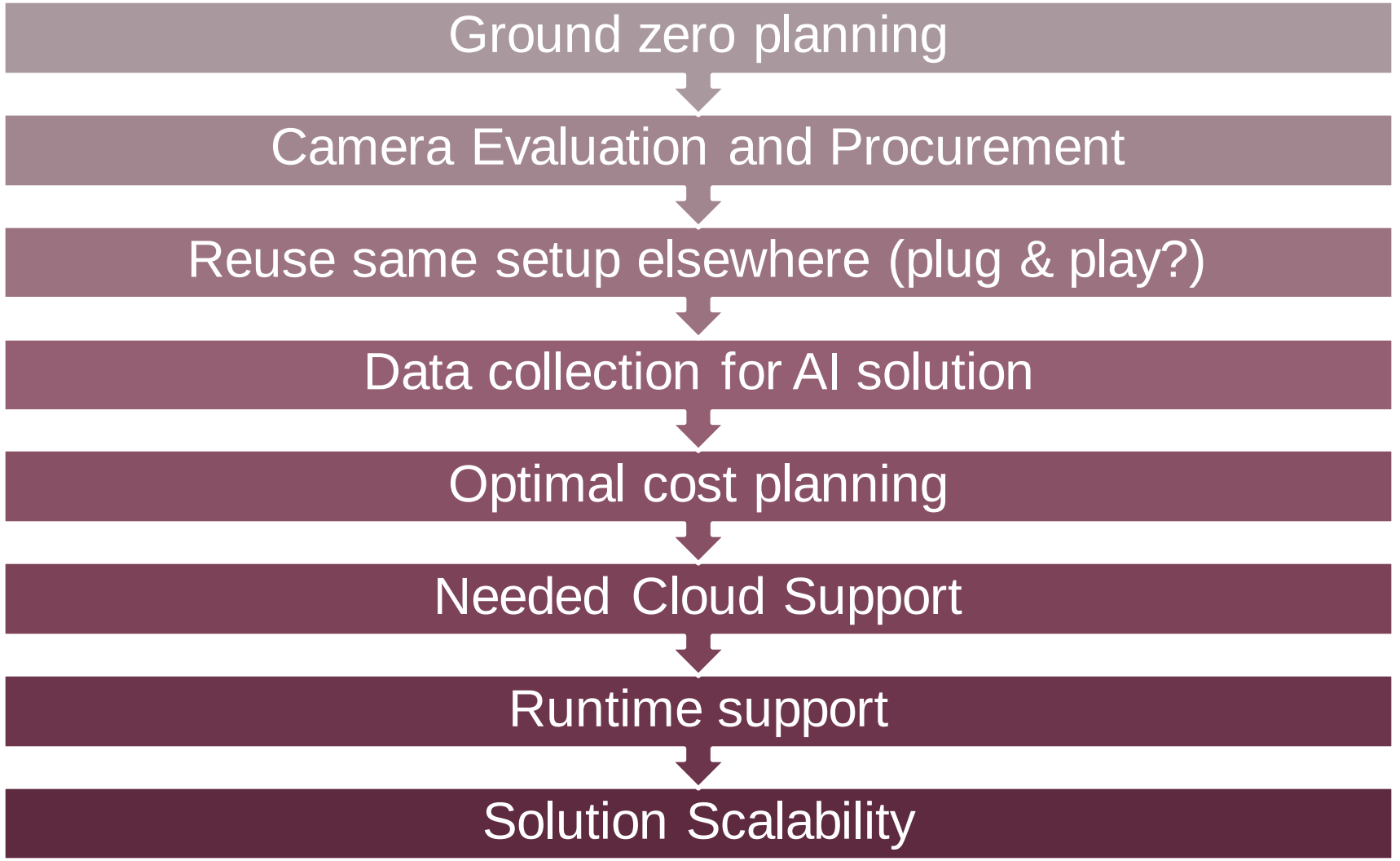
Recommendations



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QUESTION & ANSWER TIME

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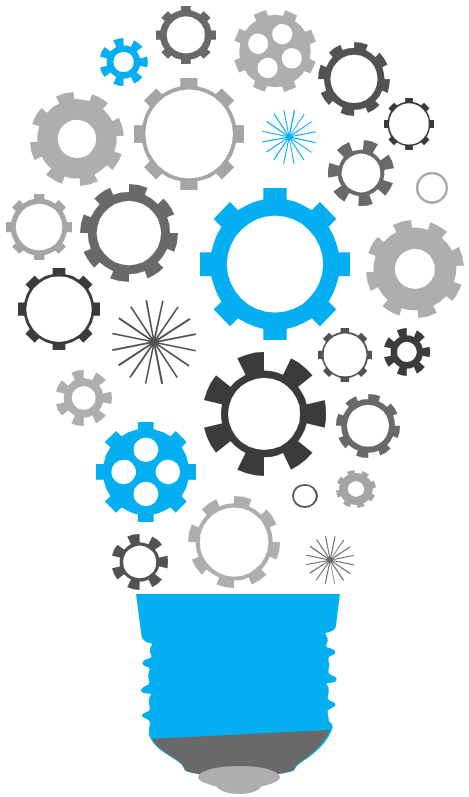
Useful Links

Here you have the links for the content we have shared during the presentation. Click on the icon to access the site.



AI Enterprise Guidelines

AI & ML Community Portal

Emerging Technologies and Integration

AI & ML Yammer Group

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Thank You

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