

# Machine Learning for TSMO

MacAdam Consulting

# Outline


1. **Personal Experiences**
2. **How Machine Learning Works**
3. **Video Analytics State of the Industry**

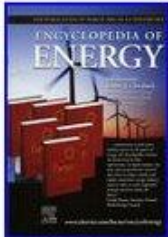
# Personal ML Experiences


**Google**  
Image Labeler BETA **Google Image Labeler**


time left    off-limits my labels  
**00:03** Your partner has suggested 3 labels. **tie** **conference**  
score **400** **speech**  
passes **1**


**Images labeled so far:**

  
*passed*  
704 x 576 pixels  
[atlaseye.web.cern.ch](http://atlaseye.web.cern.ch)

  
matched: **energy**  
954 x 1390 pixels  
[www.social.mtu.edu](http://www.social.mtu.edu)

  
matched: **sea**  
2928 x 1954 pixels  
[www.epa.gov](http://www.epa.gov)


  
matched: **airplane**  
432 x 177 pixels  
[www.airandspacemagazine.com](http://www.airandspacemagazine.com)



# Personal ML Experiences

☰ Cycle Mainline Highways - Current Find Road Section Share Location ?

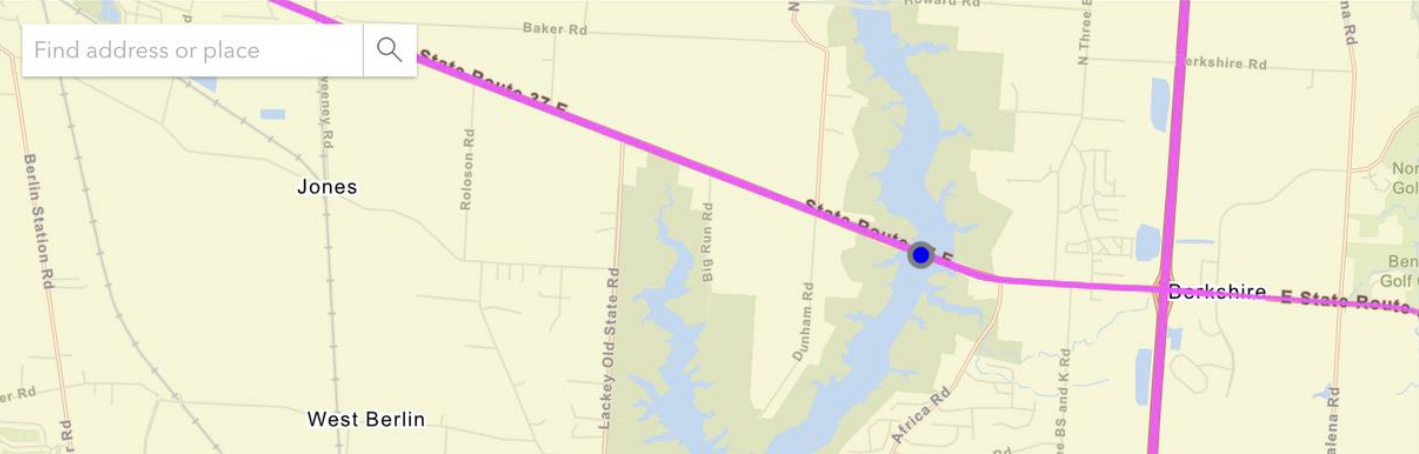
Forward View



County: DEL | Route: 036R | Mile Post: 16.628 | Dir: Incr | Date: 06/23/2021 | Coord: 40.269311, -82.952778 | PCR: 94 | AADT: 19478 | AADT Truck: 2294

Map

Find address or place



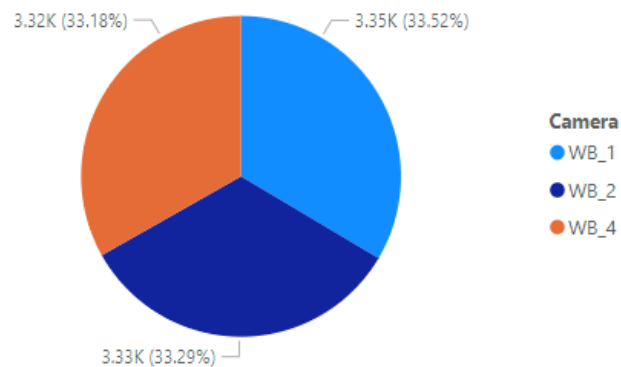
The image displays a software interface for road data analysis. At the top, there's a navigation bar with a menu icon, the text 'Cycle Mainline Highways - Current', and buttons for 'Find Road Section', 'Share Location', and a help icon. Below this is a 'Forward View' section showing a three-panel perspective of a highway. The left panel shows the left shoulder and guardrail, the middle panel shows the road ahead, and the right panel shows the right shoulder and a lake. Below the forward view is a data bar with the following information: County: DEL, Route: 036R, Mile Post: 16.628, Dir: Incr, Date: 06/23/2021, Coord: 40.269311, -82.952778, PCR: 94, AADT: 19478, AADT Truck: 2294. At the bottom is a 'Map' section with a search bar and a map showing the road's location in Delaware, with labels for 'Jones', 'West Berlin', and 'Berkshire'. The road is highlighted in pink on the map.

# Personal ML Experiences

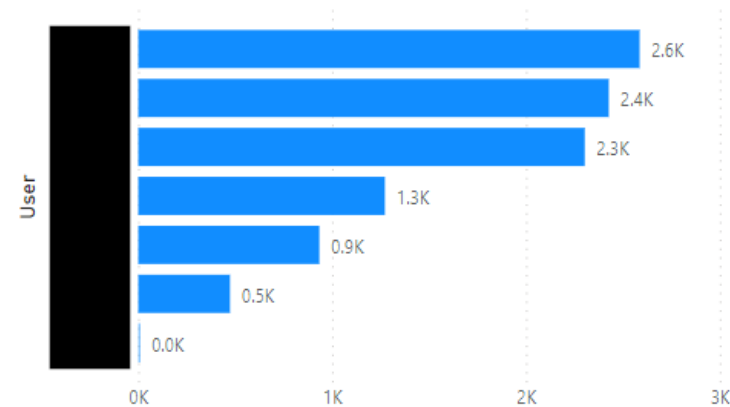
## TSMO Truck Classification

TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS  
Making Our System Work Better

Completed Classifications by Camera



Completed Classifications by User



67.73K

Clicks

Most Recent Image Load

10/19/2021 1:10:48 PM

Outstanding Images as of Most Recent Load

320

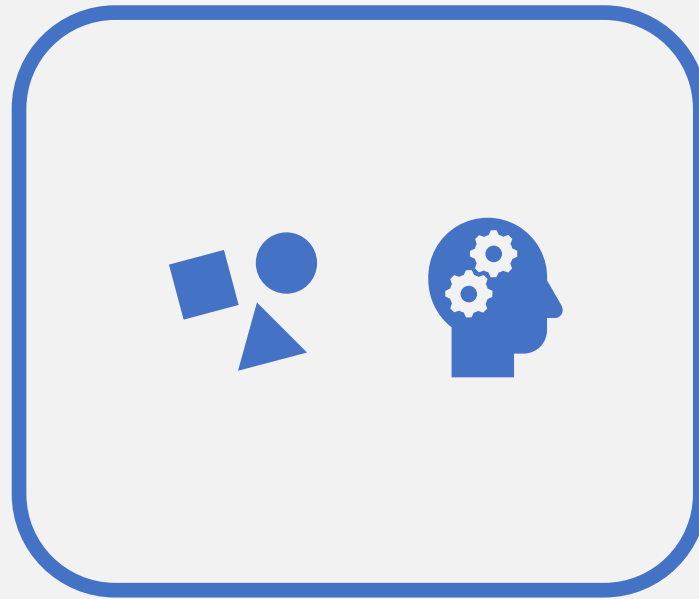
Completed Images

9996

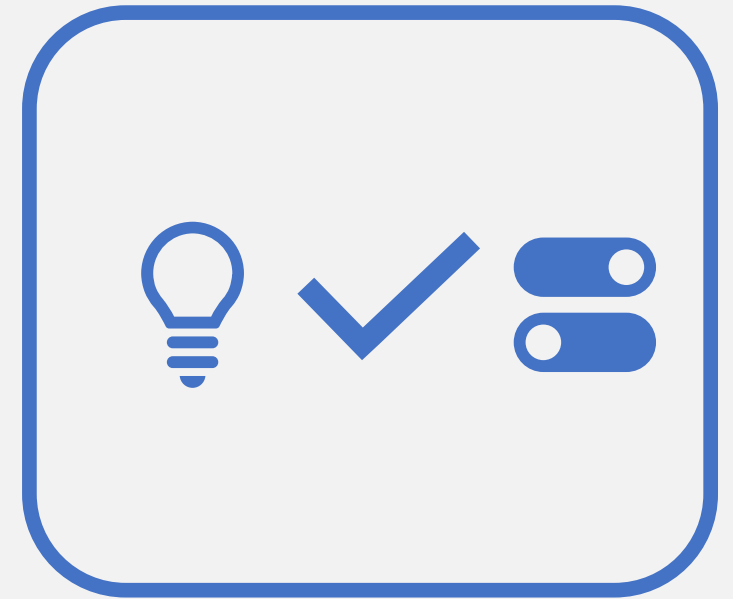
# How Machine Learning Works



**PARSE DATA**



**LEARN**



**DECISIONS**

# How Machine Learning Works

## Basic ML



## Advanced ML



# How Machine Learning Works

## Basic ML



## Advanced ML





# AI & ML for TSMO

- Traffic signal optimization
- Demand forecasting
- Predictive maintenance
- Incident detection and response
- Ramp metering
- Video analytics

# Video Analytics basics

- Object detection
- Image classification
- Localization
- Object tracking
- Anomaly detection
- Activity recognition
- Segmentation

# State of the Industry

- Traffic Queues
- Wrong Way Drivers
- Volume / Occupancy
- Vehicle Classification
- Pedestrians
- Traffic Crashes
- High Speeds
- Rest Area Parking
- Stopped Vehicles
- Origin-Destination
- Objects on Roadway
- Average Traffic Speeds
- Low Visibility
- Cross-line Detection

# State of the Industry



SOUTHWEST RESEARCH INSTITUTE



# Current Approaches

1. Existing ITS CCTVs
2. Beyond existing CCTVs
3. Custom software

# 1. Using Existing CCTVs

Traffic information is presented and managed in a web-based user interface and captured for database storage, analysis and reporting.



# 1. Using Existing CCTVs

## TrafficCamera

Most powerful AI at the edge

**FLOW.**



# Different Approaches

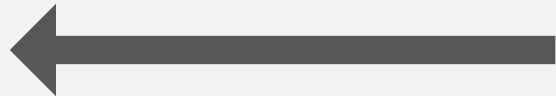
## Basic ML

- Fixed CCTV position
- Perfect lighting
- High resolution
- Limited detection
- Frame rate
- Occlusion

## Advanced ML

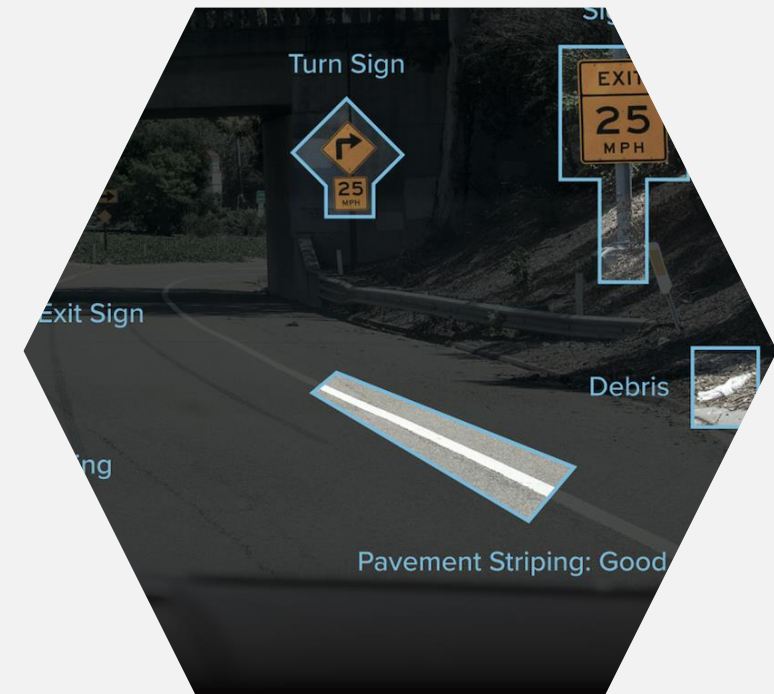
- Adaptive Learning

None of these limitations





# 2. Beyond Existing CCTVs



# 3. Custom Software



# Current Approaches

## Pros

## Cons

### Existing CCTVs

Leverage existing ITS investments  
Out of the box insights

Limited application and footprint  
Some babysitting

### Beyond Existing CCTVs

Fill in the gaps  
Additional insights

Not real-time

### Software

Extendable beyond video  
Adaptive learning

Requires expertise to build and maintain models

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Supporting innovative transportation solutions

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