

OVERALL GUIDELINES FOR YOU

- Properly focus on the target problem
 - Your hands on the wheel
 - Not e.g. where the driver is looking
- Be specific
- Prepare purpose and audience information
- Data philosophy
 - Either collect wide variance of data or normalize the data
 - 10 values
 - 10! Collection to cover all scenarios
 - Or sort them always as input \Rightarrow 1 single use case
 - Vector preprocessing: minmax scaler
 - $[10, 25] \Rightarrow \text{min: } 10 \Rightarrow [0, 15] \Rightarrow [0, 1]$
 - $[25, 40] \Rightarrow \text{min: } 25 \Rightarrow [0, 15] \Rightarrow [0, 1]$
 - $[100, 115] \Rightarrow \text{min: } 100 \Rightarrow [0, 15] \Rightarrow [0, 1]$
 - Given a hand parallel to Z-axis
 - 360 degree rotations
 - Or rotate to be a frontal hand
 - Wheel colors: wide diversity
 - Collect wide diversity for colors of interest
 - Gray scale: reduce contrast
 - Convert to black and white
 - Wheel black
 - Hand white
 - Concern: quality of your algorithm to convert
 - Find the wheel. Detect its circle. Black its color
 - Tip: be sure your coding ideas are strong/valid
- Observe: it is hard to collect extreme collection of every aspect
 - Eventually we need to mix
 - For example: male + age group 2 + black skin
 - Due to resources limitations

GENERAL DATA ASPECTS

GENDER

- Male 65%
- Female 35%

AGE

- Group 1: 18 - 30 25%
 - Assuming 18 is the minimum the driving age
- Group 2: 31 - 45 25%
- Group 3: 46 - 55 25%
- Group 4: 56 and up 25%

HAND GLOVES AND ACCESSORIES

- Gloves Min 5%
 - Compete coverage and naked fingers
 - Wide diversity of colors / basic colors
 - In 1 hand or 2 hands
 - Thin vs thick
- Skin color: wide diversity in American society
- Hand accessories (rings, tattoos, nail polisher)
- People with less than 5 fingers
- Artificial hands

STEERING WHEEL

- List of colors from car manufacturer:
 - Black, blue, white, yellow
- Input from the manufacturer: circle
- Wheel customer wrappers/covers: not allowed

CLOTHES

- Specifics materials has effect on the coloring
- Sleeve: short and long
- Clock

WEATHER

- List all weather: sunny, cloudy, rainy, etc
- Wide diversity of colors and **shadows**
 - E.g. Trees/houses shadow
- Day (RGB) and night (IR) vision

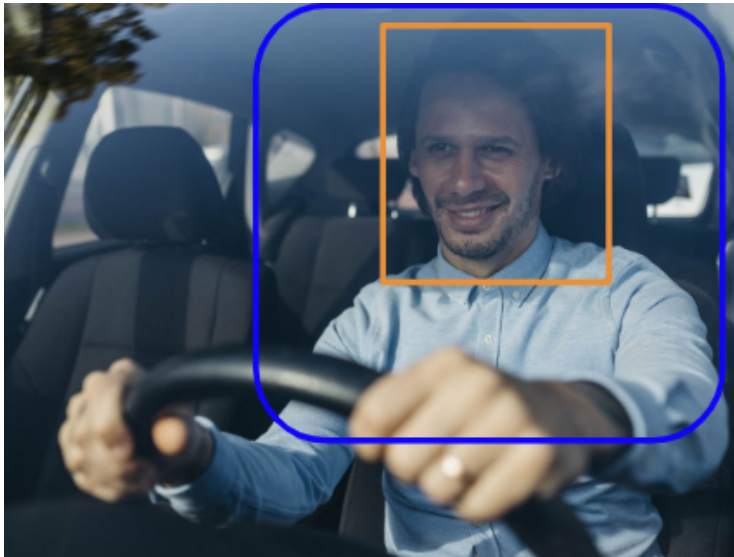
TASK: HAND-ON WHEEL TASK

- Steering Wheel Components
 - 2: Upper and lower
 - 8: regions
 - Pivot
 - 2 Spoke
 - Like $2 \times 8 + 3$ positions
- A single hand
 - **Wheel hand pose**
 - 1- 5 fingers touch
 - Half grip / full grip / straight hand
 - We may need to be more specific
 - Finger tips touch
 - Palm area
 - Left or right
- Two hands
 - List all variations
- No hand
 - Don't hold objects
 - All hands poses without the wheel
 - Hold objects
 - Mobile
 - Water bottle
 - Cup
 - Pen
 - Sandwich
 - Smoke
 - Book
 - Make-up
 - Sun glasses
 - Region-based
 - Divide the car space to regions

- Ask for data per region
 - Consider hands out of the view
- Move your hands within the region
- Brainstorm with others
- Provide gif images to the different scenarios

TASK: FACE DETECTOR

- A computer vision system will **crop the driver seat** (specific box, blue one) and search for the person's face in this box
- The DC (data collection) team would like to know what all the different data aspects that we need to collect
- List all possible aspects and their details for the system to be **robust to any person**
- If you have questions, make your own realistic assumptions



DATA ANNOTATION AND VERIFICATION

- Data **annotation** is the process of **labeling or tagging** data with **relevant** information to make it usable for machine learning.
 - This could be manual annotation
 - Or pre-labeling though available ML models
 - It is more common in supervised learning
- Data annotation for Hands-on wheel
 - A **box** (subimage) for the hand; act as input
 - The box **label**: on or off; act as output
- Collected data

- Natural Driving
 - Fine-grained (static car)
- Bbox of hands
 - Full labeling
 - Slow, costive, especially for millions of example
 - Pre-label / Data distillation
 - Use multiple ML models that can find the hand
 - Do vote. If agree, this is a hand
 - If don't and no enough data, ask manual
- Hand labels
 - We already have it from the collection script of steps
 - This is a common technique
 - Natural driving
 - Do correctness labeling
- Data verification
 - Per person, assign same task to others and compare to find people who don't do well (e.g. don't understand or not honest)

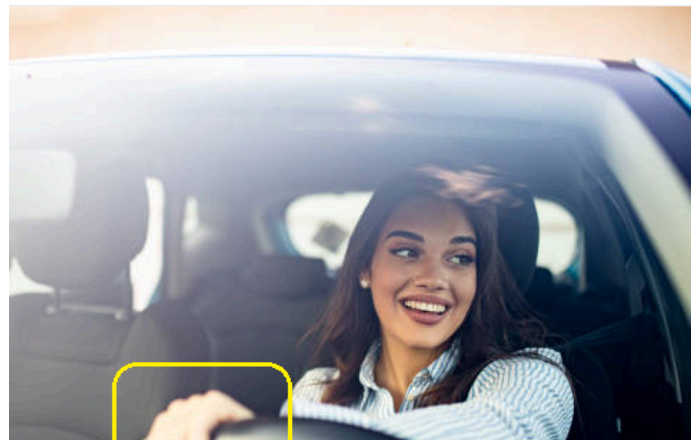
DATA LABELING TOOLS

- We need to guide data labeling team
- We need box and multiple tags for box (on/off, left/right)
- We may need temporal labeling (subclips)

DATA COLLECTION, ANNOTATION AND VERIFICATION

Data Collection:

The process of gathering and collecting information or data.



Data Annotation:

All the direct / indirect information and metadata needed for the project.

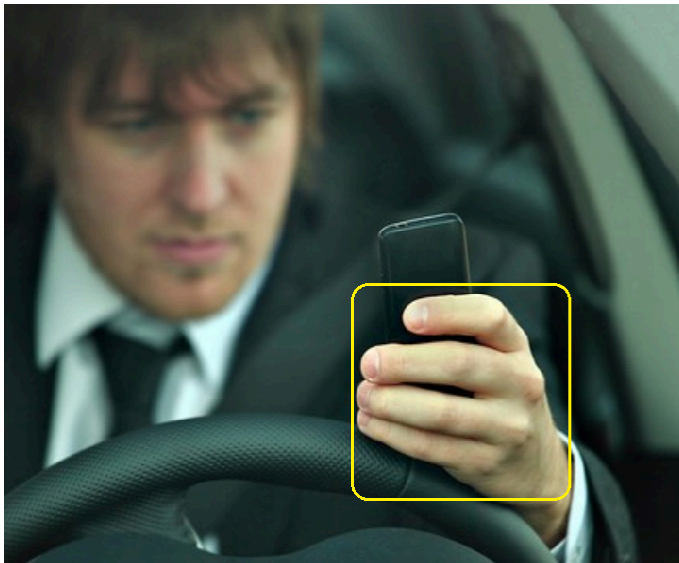
It is the process of labeling the data. Supervised learning is a technique that takes an input and has a label in ground truth. The ground truth and any kind of labeling or tagging the data with specific information is called data annotation.

Data Verification:

It is the process to check and validate the accuracy / quality of the data.

Data distillation:

It is the process of selecting/using tools or models on the internet to discover the labeling.



Tool:

Software frames, libraries or platforms that provide resources to facilitate the development of machine learning models. Filter tools based on their high confidence in the market and make sure if it is legally ok to use them (check licenses) .

Label:

Assigned category or tag that is associated with a specific data.

Ex: input -> Driver's hand — Output ->

ON (is a label / tag)

Ex: input -> Driver's hand — Output -> OFF (is another label / tag)

Auto label:

Annotate the data as much as possible while collecting it or through ML models.

IS THE BOX ON THE HAND?

How to prepare the data?

MANUAL COLLECTION AND VALIDATION.

- **Data collection:** A team gathers the data.
- **Data Verifications:** Human labelers who do the labeling manually (a person-to-person handoff, where the task completed by one individual is passed on to a coworker for review).
- Advantages
 - High accuracy if the people are
 - Well trained
 - Given good requirements
 - Given visual examples
- Disadvantages
 - Time Consuming
 - Slow
 - Costs a lot of money
 - Boring job = People can do some random/inaccurate choices to get the job done

AUTOMATED COLLECTION - MANUAL VALIDATION

- **Data collection:** One external tool (Automate the hand detection)
- **Data Verification:** Human labelers who judge whether the tool chooses right or wrong.
- Advantages
 - Faster detection method.
- Disadvantages
 - Less accuracy.
 - Needs human validation.

AUTOMATED COLLECTION AND VALIDATION

- **Data collection:** Several external tools (Tools trained with different models or different datasets and does the same task)
- **Data Verification:** Vote between tools results.
 - Tools' answers match => We are very confident that the answer is correct.
 - Tools' answers do NOT match => Give to the manual labelers.

- Advantages
 - Faster detection method.
 - Less human validation.
- Disadvantages
 - We may not find models or a single model
 - Tip: use high confidence to filter bad results

IS THE HAND ON OR OFF?

- **Data Collection:**
 - Natural Driving
 - NO data annotation
 - Covers light/weather conditions
 - Fine-Grained
 - The data can be annotated while filming
 - Has a frame time (quantification information)
 - Covers all scenarios
 - NO light/weather conditions

- **Annotation Tool:**

Labeling needs for now / for the future

- Label on the picture's level
 - Indoor/Outdoor
 - Sunny weather .. etc
- Label on the box level
 - Right/Left hand
 - On/Off wheel
 - Male/Female