



DIVE INTO CODE

Traffic sign detection on real Vietnamese streets



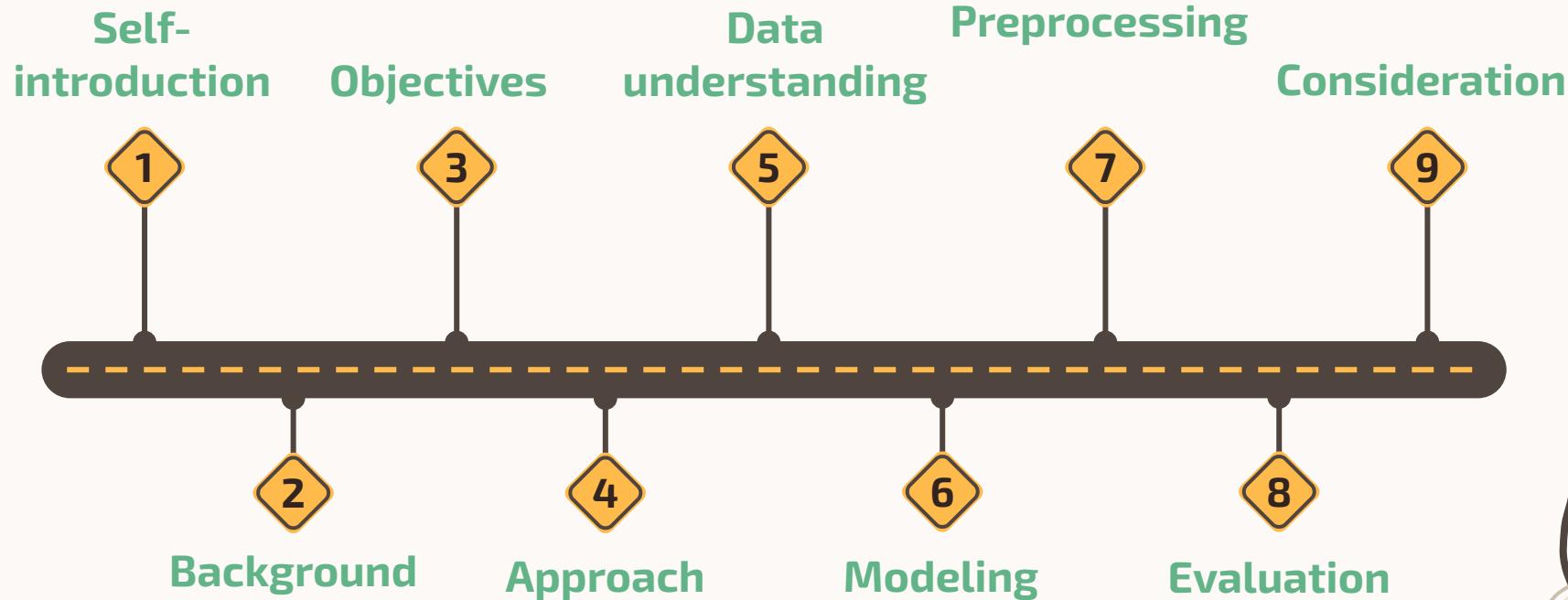
mef2103 - Ho Hoang Thien Long





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01 Self-introduction

Hometown Dalat City, Vietnam.

Academic Final year student in Computer Engineering.

Hobby Engineering, gadget, DIY, have fun with friends.



**HO HOANG
THIEN LONG**



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02

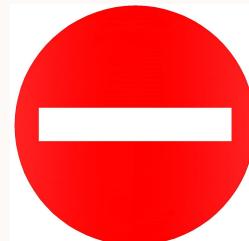
Background



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Traffic sign exists to:

- guide and protect drivers.
- Control traffic flow.





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Propose a solution!





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Objectives



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Traffic sign detection



Real-time detection

≥ 24 FPS



$\geq 70\%$ mAP@0.5
score on valid set



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Approach



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Dataset?

- 1 Use existed dataset from **Zalo AI challenge 2020**.

Model?

- 2 Choose **YOLOv4 - darknet**, a highly accurate and fast image detection model





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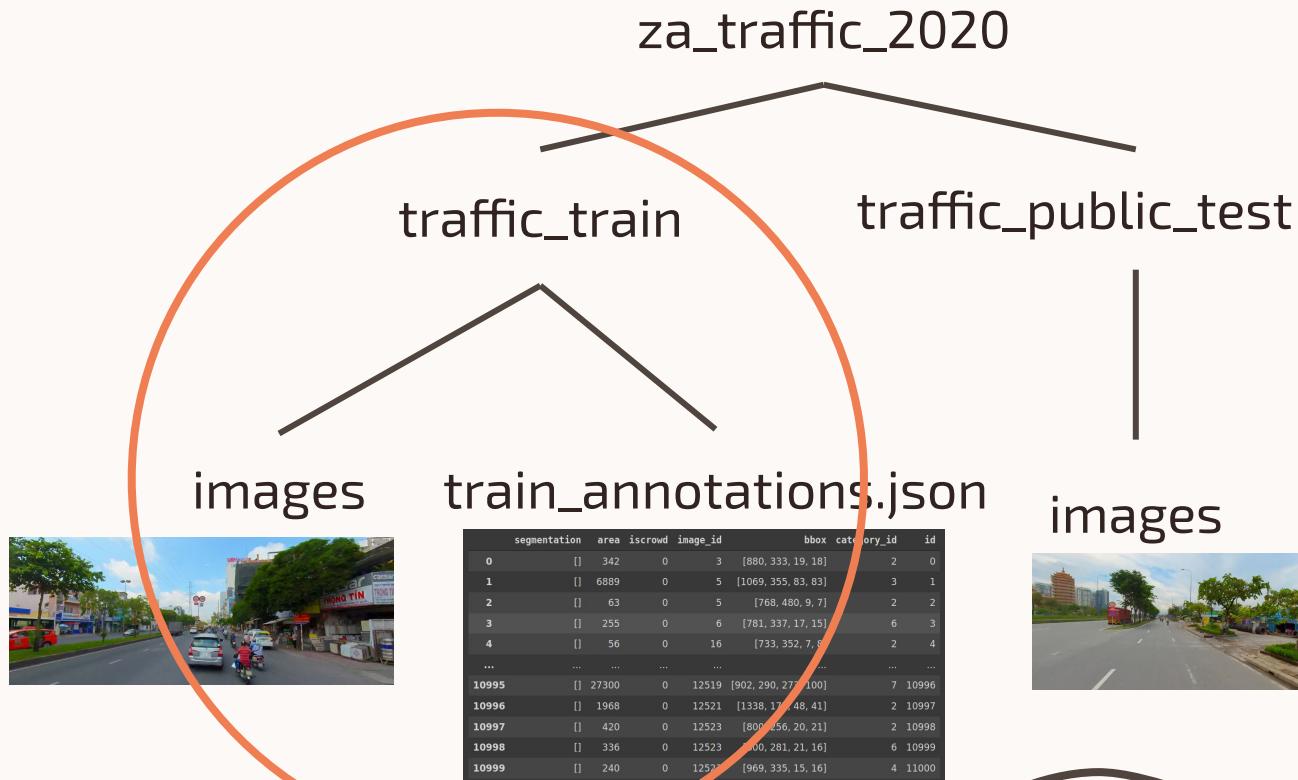
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Data understanding

(data_analysis.ipynb)



File structure

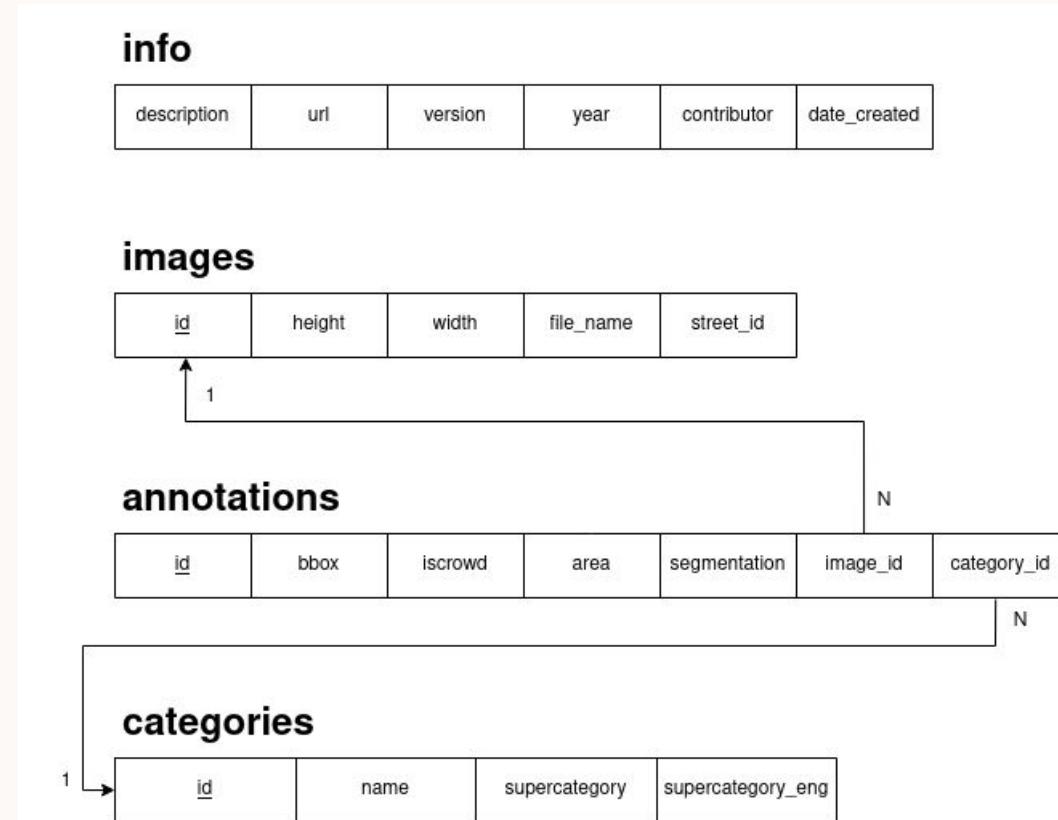




train_annotations.json

COCO format

No NULL values





categories

1 - No entry



2 - No stopping and parking



3 - No turning



4 - Speed limit



5 - No others



6 - Danger



7 - Mandatory





images

There are **4500** training images taken across Vietnamese streets.
There are total **11000** bounding boxes (bboxes).

1622 px



626
px



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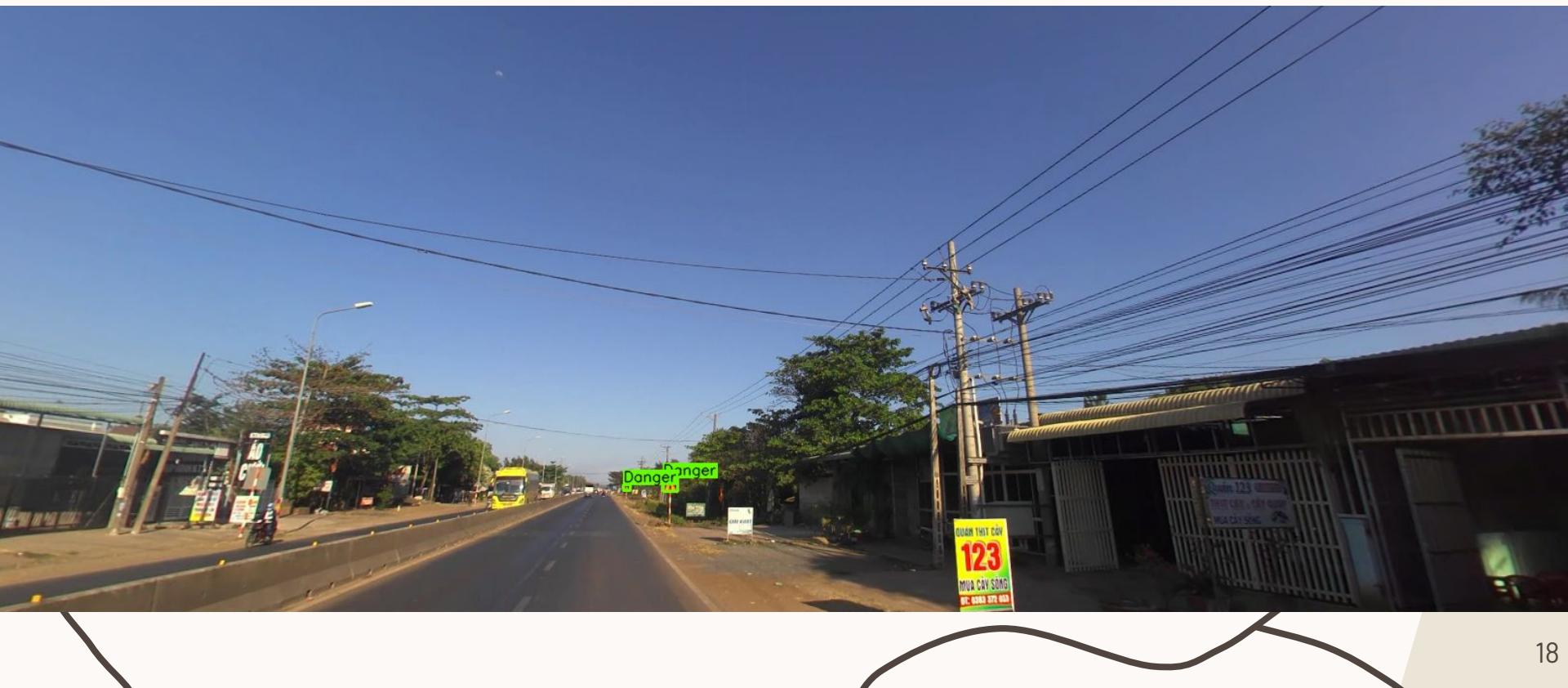
annotations





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annotations



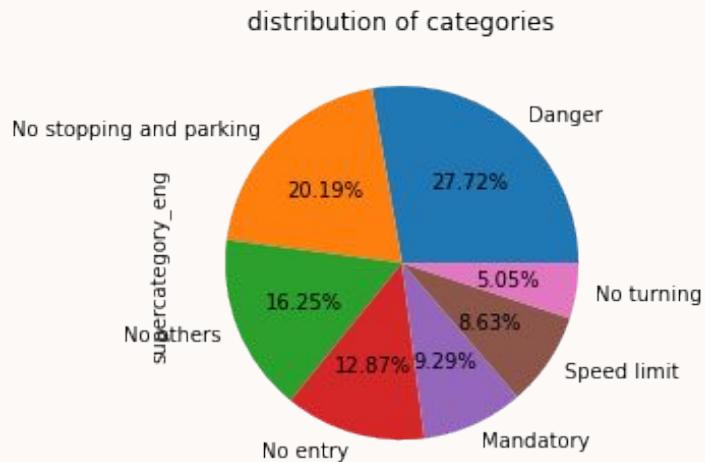


annotations





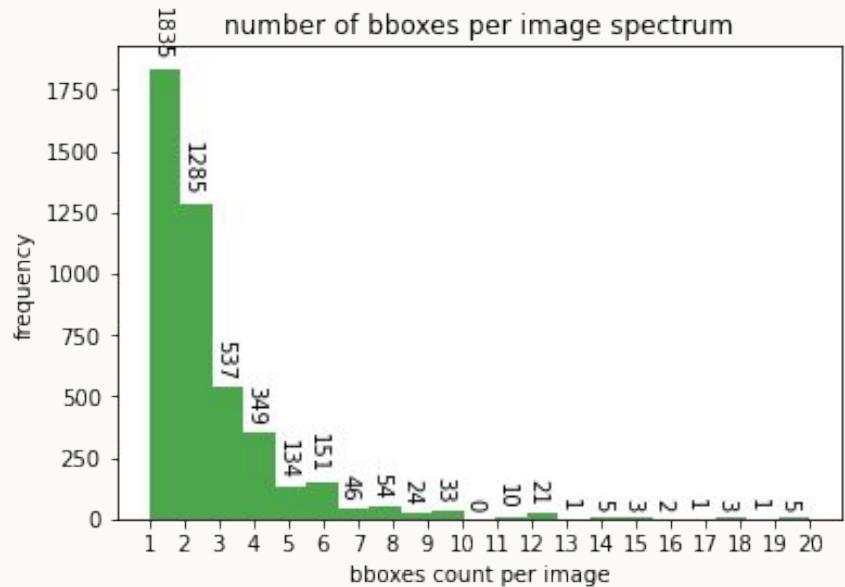
annotations



subcategory_eng

bboxes

frequency



Danger account for the most.

average **2 - 3** bboxes/image.



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Modeling

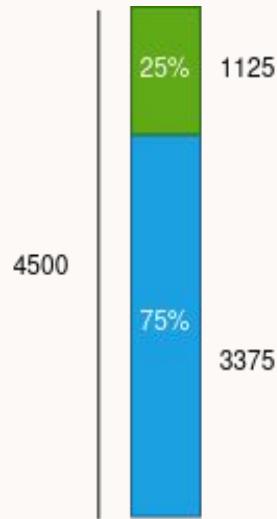
(`prepare_data.ipynb` &
`prepare_model.ipynb` &
`train.ipynb`)



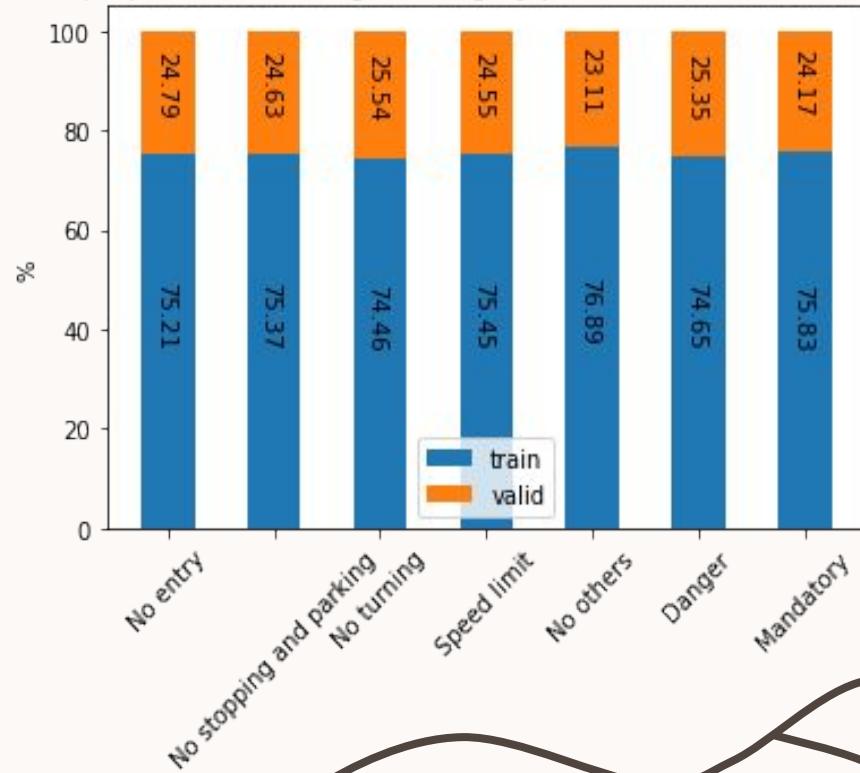
Train test split

test_size = 0.25

Images proportions



bboxes proportion according to category presented as a stacked bar chart





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Augmentate training images

ShiftScaleRotate

6014-augmented-0.png



Resize

1382-augmented-0.png



MotionBlur, MultiplicativeNoise, RandomBrightnessContrast

5634-augmented-0.png



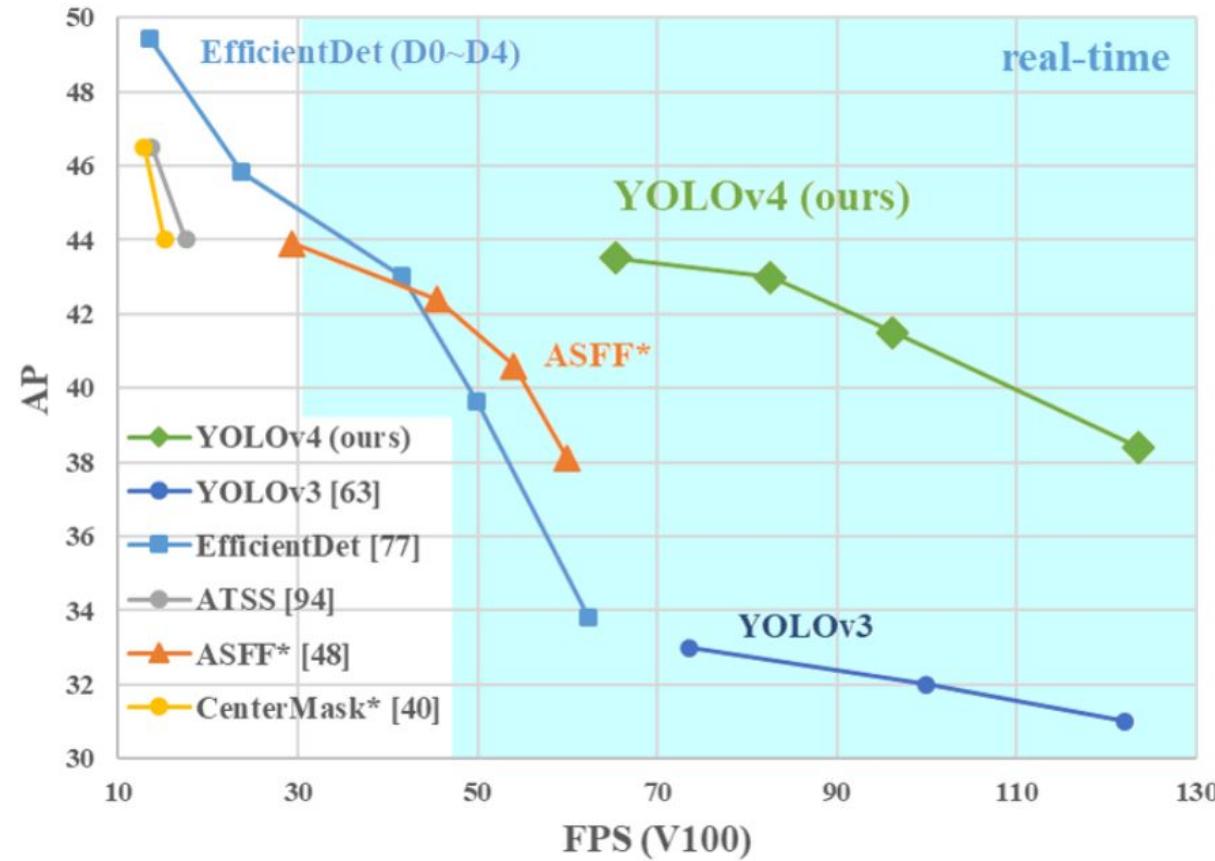


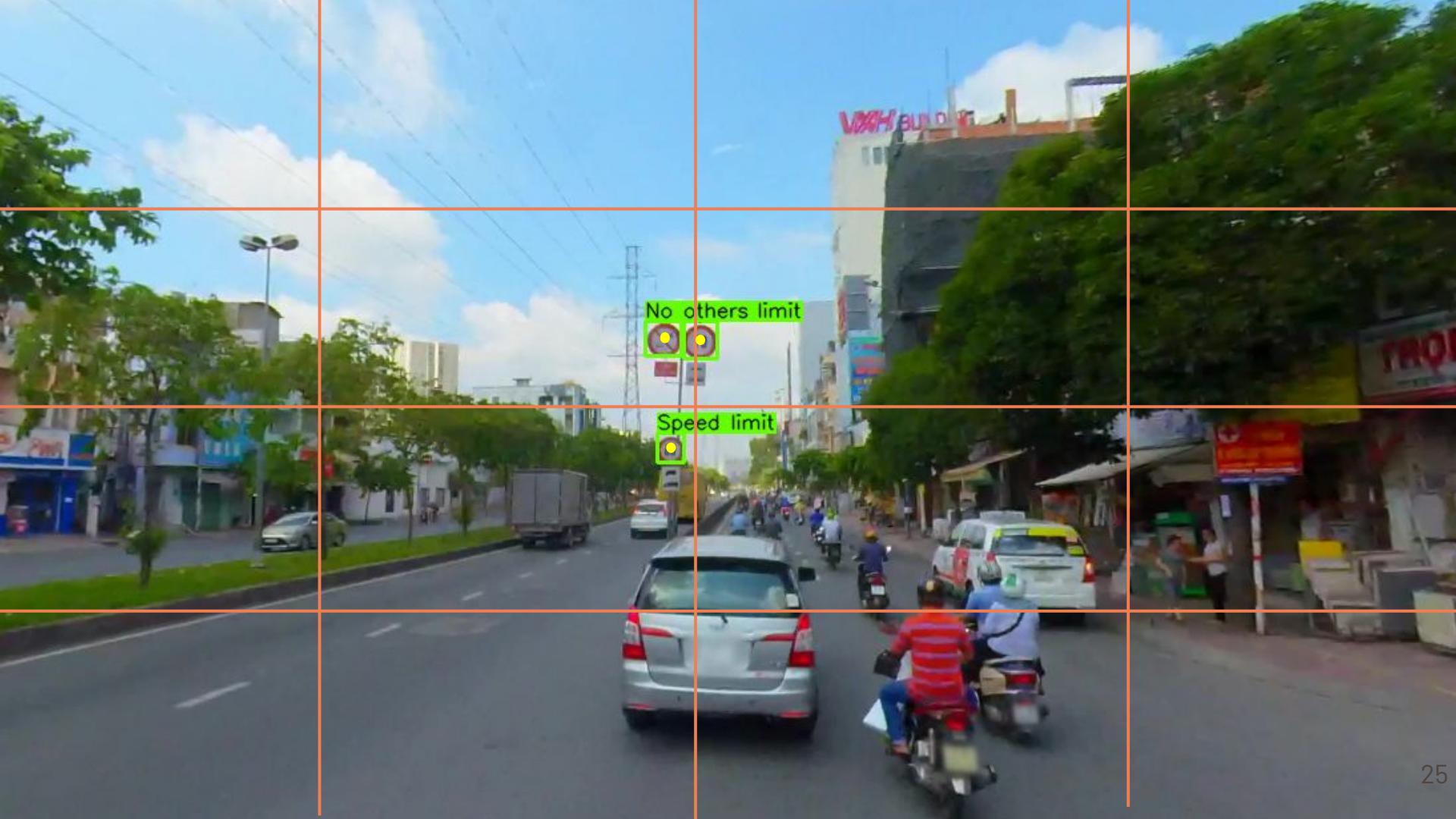
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YOLOv4

<https://arxiv.org/pdf/2004.10934v1.pdf>

MS COCO Object Detection





YOLOv4

Added more state-of-the-art features to YOLOv3

- Grid Weighted-Residual-Connection.
- Mish-activation.
- Mosaic data augmentation.
- Apply both one-stage and two-stage detection.
- ...



Loss function:

$$L_{total} = L_{classification} + L_{localization} + L_{confidence}$$



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Darknet

Open source neural network in C
<https://pjreddie.com/darknet/>

- GPU computing.
- Parallel computing backend.





Training

- Max_batches = (7[classes] * 2000) = 14000
- batch=64

Using GPU Tesla T4 of Google Colab

- 10 sec/batch
- => Total training time = $10 * 14000 = 140000$ sec = 39 hours

Using YOLOv4 config files

- yolo4.conv.137
- yolov4-custom.cfg



Convert to YOLO annotations

123.txt (<class idx> <x_center> <y_center> <w> <h>)

```
0 0.49642371469312846 0.5248235045826511 0.004581956116896904 0.009782892547647248  
6 0.49710206379130606 0.533893360079413 0.004775770144947688 0.012374279832436342
```

Data

- images
 - 123.png
 - 123.txt
- train.txt
- valid.txt
- classes.names
- classes.data

Train.txt
(path to images)

```
data/images/1558.png  
data/images/1824.png  
data/images/4914.png  
data/images/6087.png  
data/images/4842.png
```

valid.txt

```
data/images/11235.png  
data/images/5001.png  
data/images/5101.png  
data/images/11918.png  
data/images/11508.png
```

classes.names

```
No_entry  
No_stopping_and_parking  
No_turning  
Speed_limit  
No_others  
Danger  
Mandatory
```

classes.data

```
classes = 7  
train = data/train.txt  
valid = data/valid.txt  
names = data/classes.names  
backup = backup
```



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Evaluation (test.ipynb)



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Before evaluate...

- Change input image bigger: $[608 \times 608] \rightarrow [1024 \times 1024]$
=> less feature losses -> better score.
- Get the best weights at 8100 iteration.



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ground truth



prediction



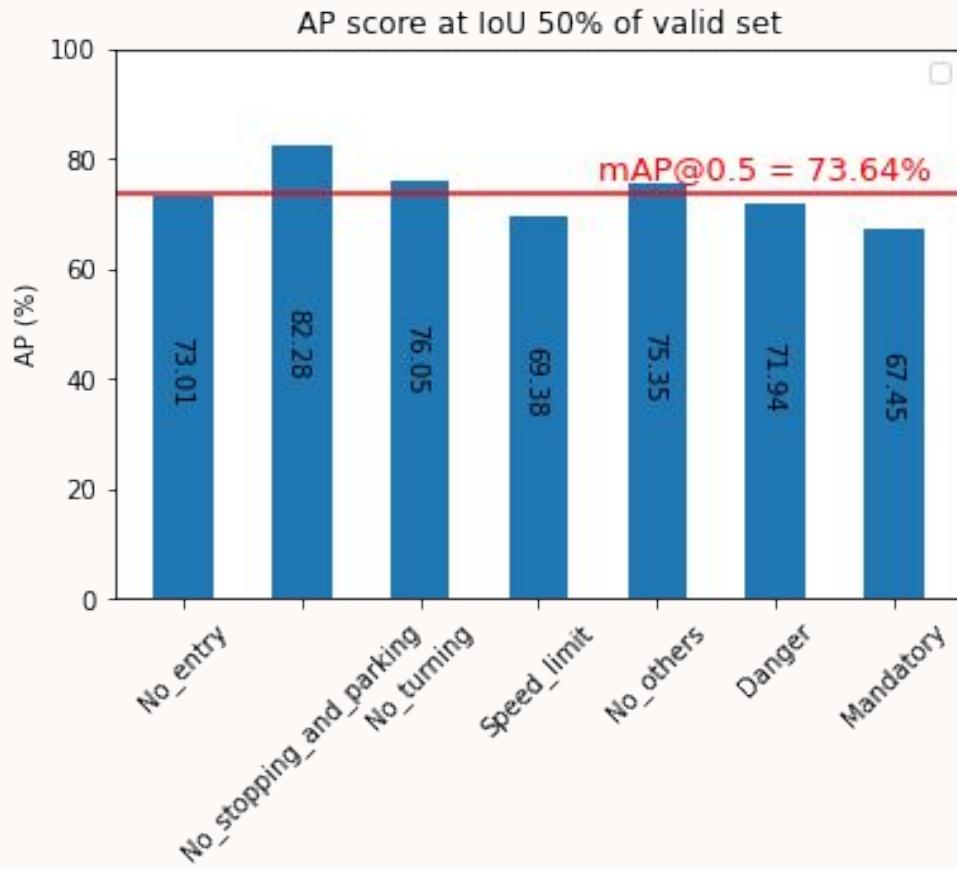
DIVE INTO CODE



ground truth



prediction



mAP score



Summary

	608 x 608	832 x 832	1024 x 1024	1120 x 1120
mAP@50 (%)	68.78	72.29	73.64	72.97
Processing time (ms/image)	50	51	76	86
FPS	20	19	13	12

=> More than [1024 x 1024]: lower score, higher processing time.



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original

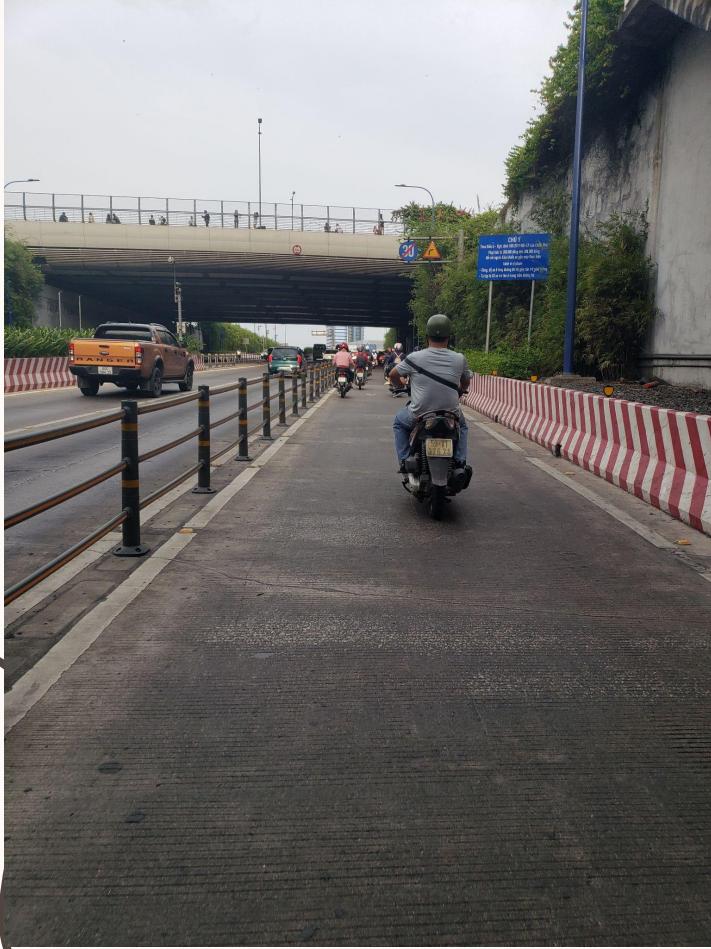


Real world
testing!

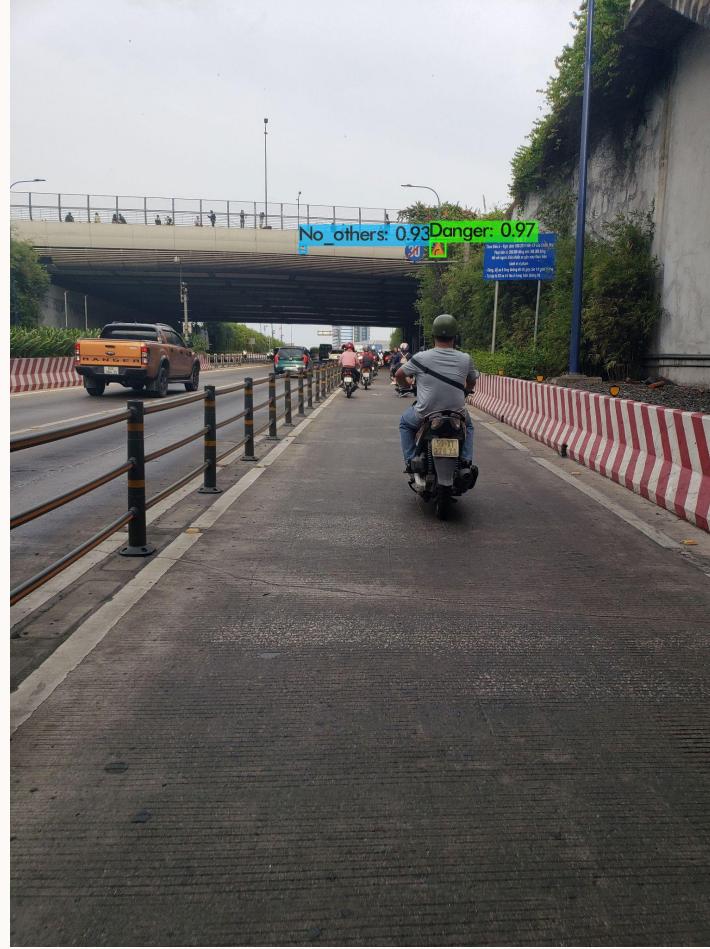
prediction



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original



prediction



DIVE INTO CODE



original



prediction



DIVE INTO CODE



original



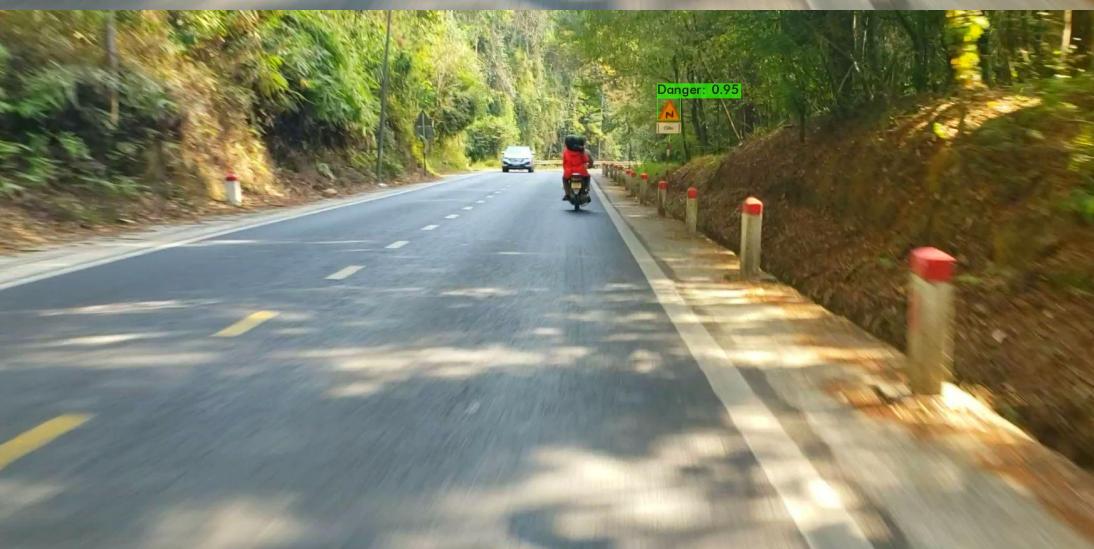
prediction



DIVE INTO CODE



original



prediction



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Consideration



Consideration

- YOLOv4 meets 2/3 of my proposed objectives.
 - ✓ Can detect traffic sign in Vietnamese street
 - ✓ > 70% mAP@0.5
 - ✗ 24 FPS
- In the near future...
 - Try with video, webcam for real-time detection.
 - Try more methods of augmentation to detect more cases.



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Q&A!

Thank you for listening!