Object detection with YOLO

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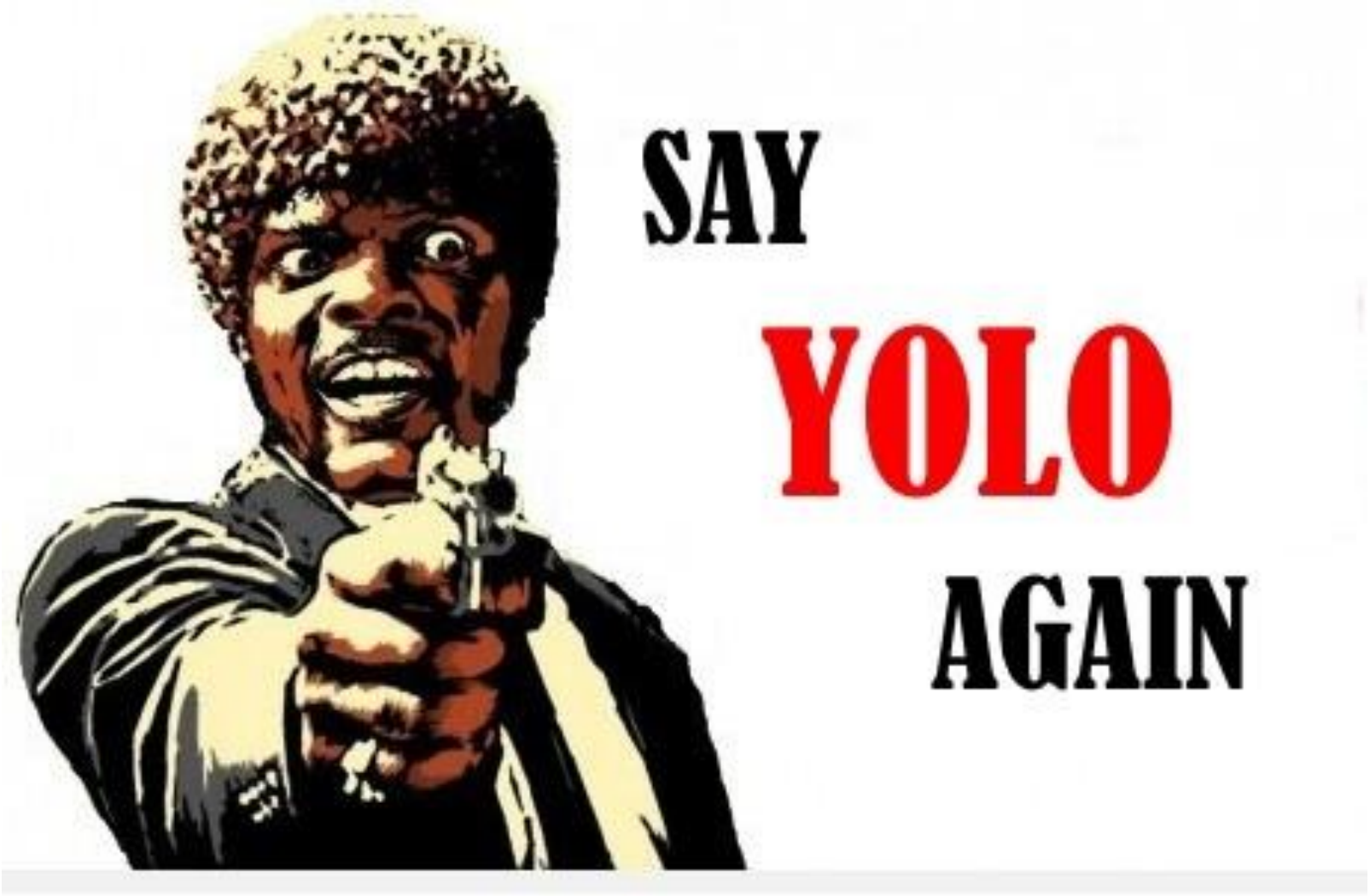
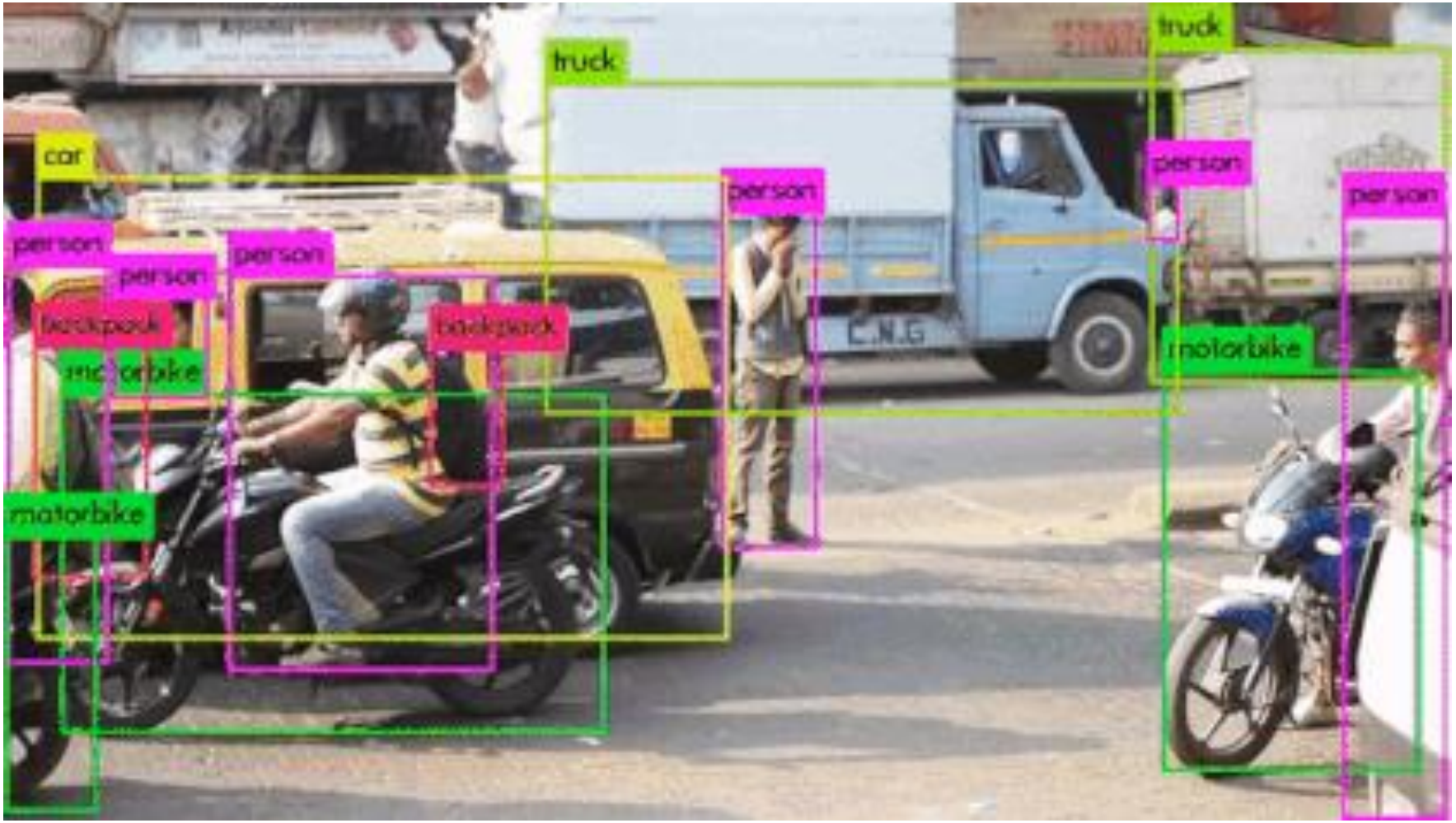
Agenda

- What is YOLO
- How YOLO works
- Benefits and limitations
- Real life application
- Q&A
- Sources

What is Yolo?

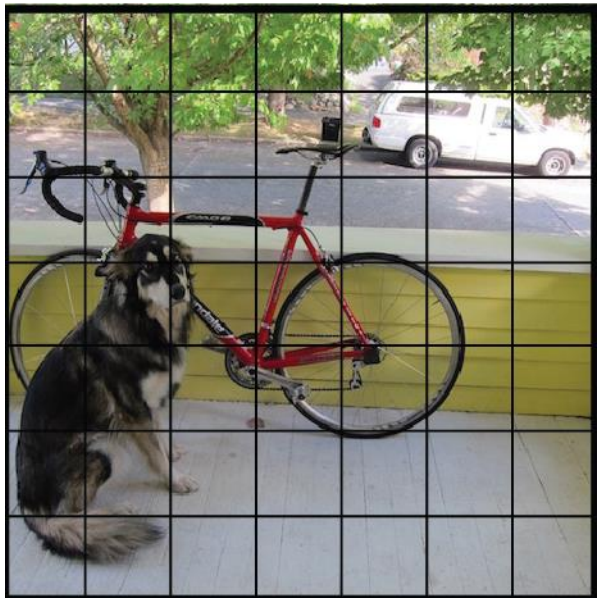


You Only Look Once



How YOLO works – Grid cells

- Divide the image in a S x S Grid
- The grid cells work independent of each other
- Fixed number of bounding boxes per cell

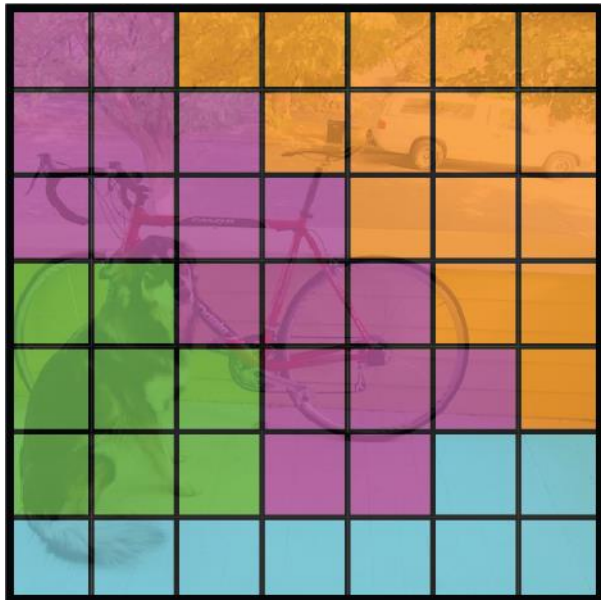


How YOLO works – Object Detection

- Each grid cell predicts bounding boxes and probabilities for them
- YOLOv3 predicts an objectness score for each bounding box using logistic regression
- High confidence score is shown as a thicker box-border

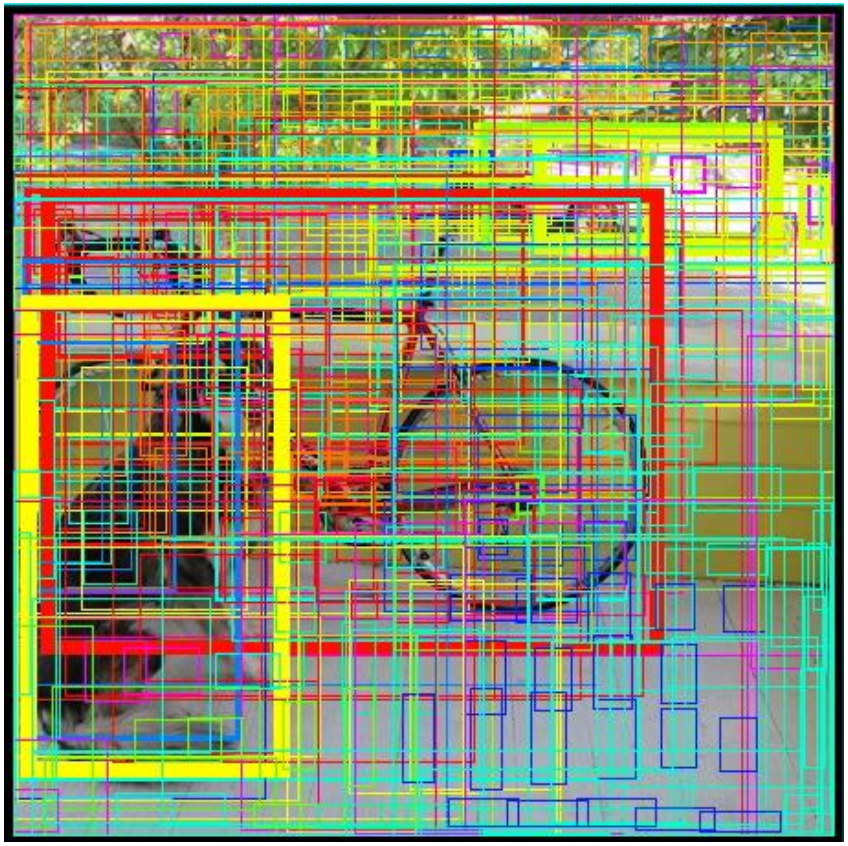
How YOLO works - Classification

- Each grid cell predicts the highest possible class which could be inside the cell.
- The Classification is done independent of the object detection.



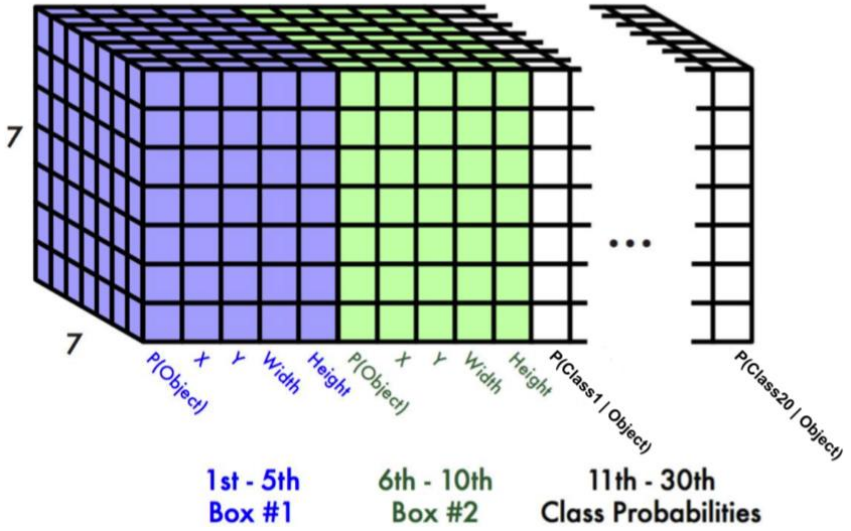
How YOLO works – Full dataset

- The bounding box-class determination can become quite crowdy on the first glance
- Many bounding boxes have a low probability
- Thresholds can help

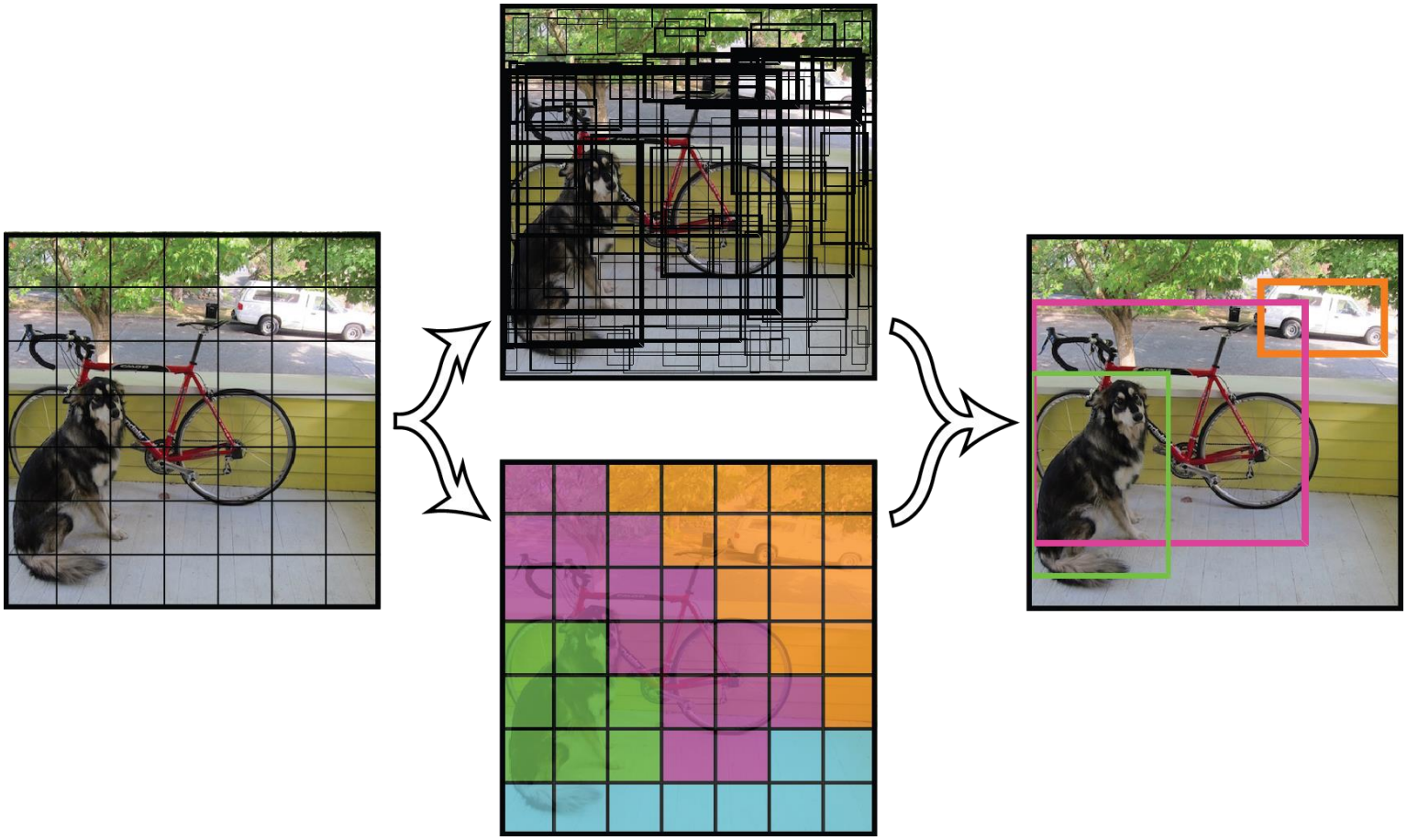


How YOLO works – Output Tensor

- Each grid cell predicts 3 bounding boxes
  - 4 coordinates (x,y,w,h)
  - 1 confidence value
  - n class probabilities
- Pascal VOC:
  - 7x7 Grid
  - 2 bounding boxes / cell
  - 20 classes
- 7x7x(2x5+20) = 1470 outputs

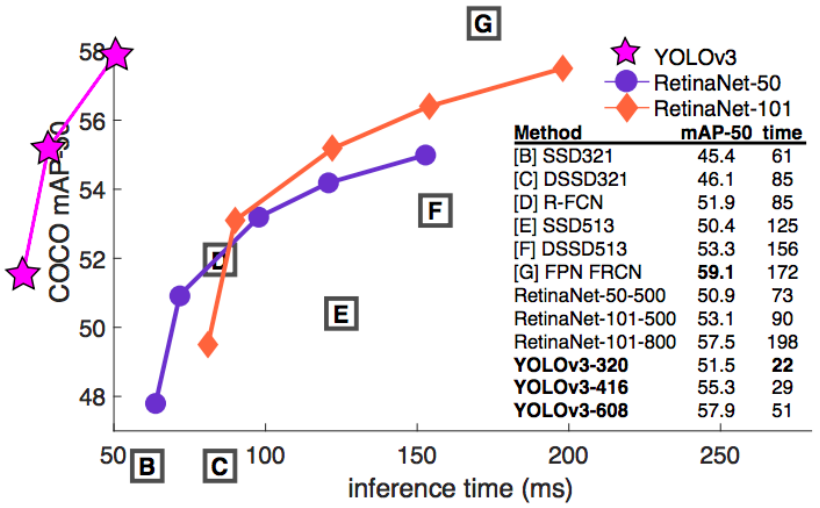


How YOLO works – Overall process



Benefits and limitations

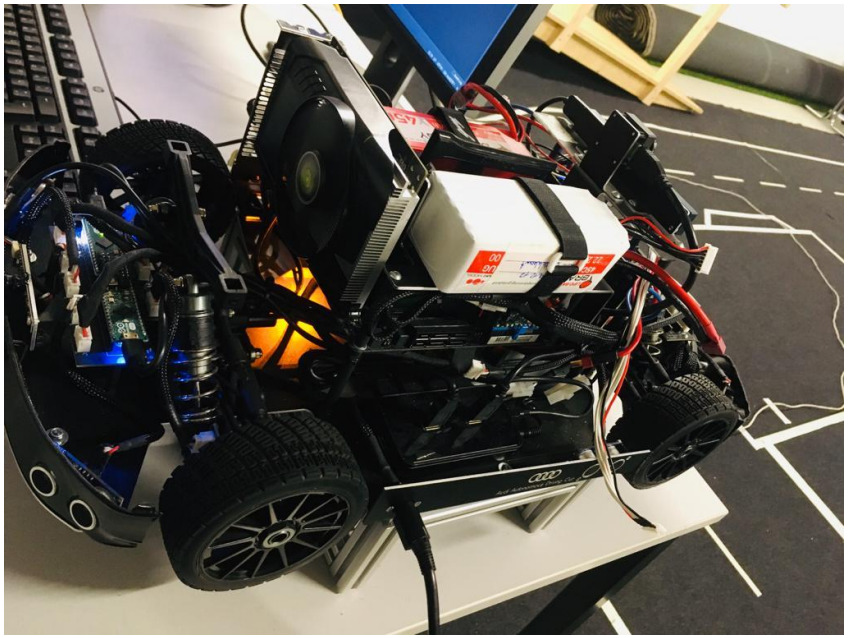
- YOLO is extremely fast
- YOLO achieves more than twice the mean average precision of other real-time systems
- inability to detect multiple objects that are either too close or too small



Method	mAP-50	time
[B] SSD321	45.4	61
[C] DSSD321	46.1	85
[D] R-FCN	51.9	85
[E] SSD513	50.4	125
[F] DSSD513	53.3	156
[G] FPN FRCN	**59.1**	172
RetinaNet-50-500	50.9	73
RetinaNet-101-500	53.1	90
RetinaNet-101-800	57.5	198
YOLOv3-320	51.5	**22**
YOLOv3-416	55.3	29
YOLOv3-608	57.9	51

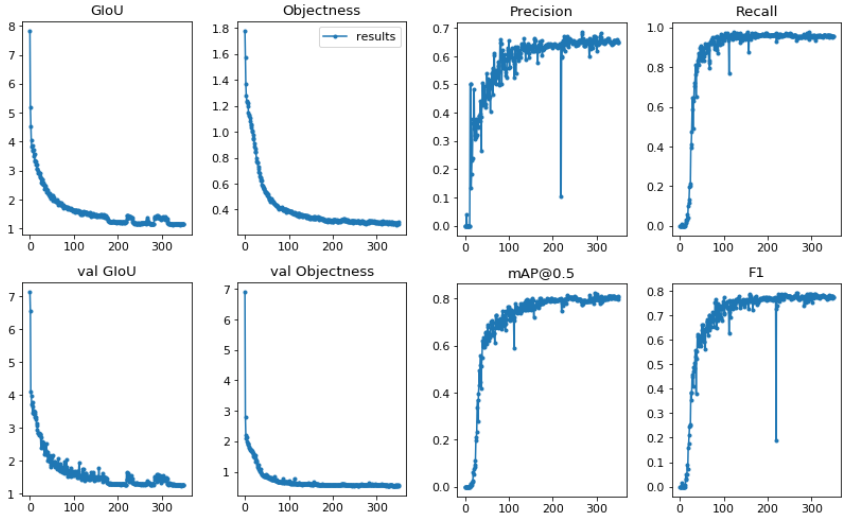
Reallife Application – Taco (Team Autonomous Car Offenburg)

- The car is originally developed by Audi
- NVIDIA Geforce 1050
- Wide angle camera
- 1240x330 Pixel image resolution



Reallife Application – Training

- Google Colab
- Graphic card:
  Nvidia Tesla P100-PCIE-16GB
- Epochs: 350
  Training Dataset: 2631 images
  Time: ~2min/epoch

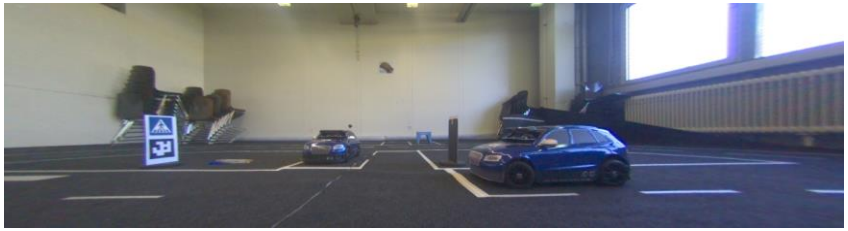


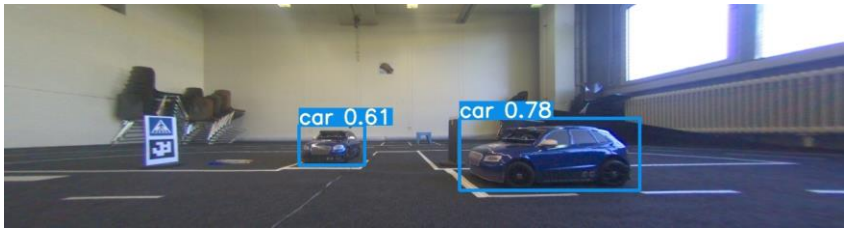
Reallife Application – Detections

Reallife Application – outlook

- Integrate YOLO in the software of the car and run performance tests

- Win the future mobility cup ☺
  - Members Of the Audi Cup
  - Car racing





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Sources

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- https://pjreddie.com/darknet/yolo/
- https://sr155.wordpress.com/2013/12/05/jump-to-the-end/
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