



INSIGHTS mid-term **review** in CERN

Machine learning algorithms for image and sound recognition

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PANGEA FORMAZIONE - INSIGHTS



ESR 8: Daria Morozova

Master in Economics at National Research University
«Higher School of Economics», Moscow, in 2017
Specialist (5 yrs) in Mathematics and System Programming
at Lomonosov Moscow State University, Moscow, in 2014

Data researcher at National Research University,
«World university rankings» (2018)
Leading specialist of pricing and market research at
Dixy Group, Moscow (2014-2015)

MAIN FOCUS DURING INSIGHTS
WP4 @ Pangea Formazione

SECONDMENT:



intelligent urban
traffic control



UAV swarm
coordination

Machine learning algorithms for image and sound recognition



IoT and Industry 4.0 offer huge amounts of data with relative ease

We'd like to exploit this chance to improve **some aspects of life** through automated processing.

Smart mobility

Images and sounds from traffic lights could help to improve traffic control on small (single crossroad) or medium scale (road network).



UAV for search-and-rescue missions

Images and sounds collected by onboard devices can support UAVs swarms in coordinating research efforts and/or implement collision avoidance rules when communications to ground control fail.



General framework for applications

INPUT

PROCESSING

OUTPUT

Video



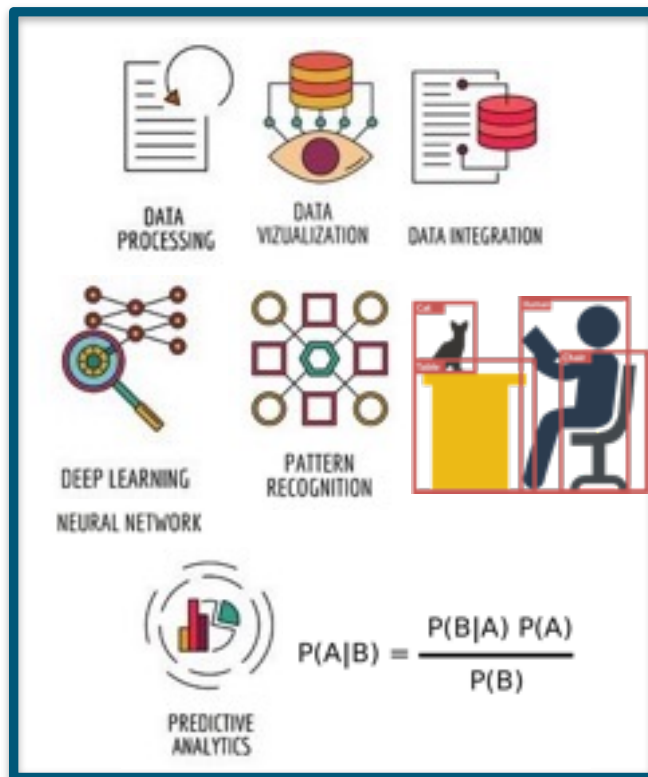
Audio



Metadata



Configuration



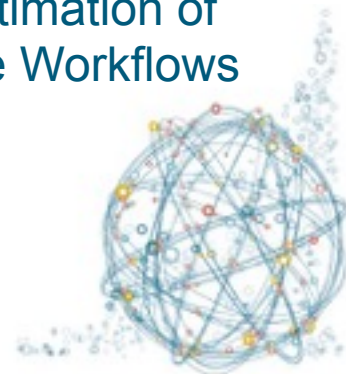
Bounding Box Detection



Object Classification



Estimation of the Workflows



Application to vehicle detection



Data collection

- Exploit public image dataset

2

Data preprocessing

- Computer vision techniques
- Setup of training & test

3

CNN

- Pre-trained *deep learning* nets

4

Dashboard

- Comparison of performance on different tasks

5

Vehicle detection

- Locate of object vs. background
- Detect pedestrians and different class of vehicles

The whole procedure requires multiple steps.

Our **attack strategy**

- to lower initially our goals, so to obtain a first working implementation of the complete process
- to focus afterwards on improving each aspects separately



INPUT VIDEO



OUTPUT VIDEO





Application to vehicle detection

Vehicle Detection

Input

Analyzer YOLO SSD Mask R-CNN

Choose detection algorithm

Details

Select video to analyze:

Browse... test_long.mp4 Upload complete

Run analysis

Start data processing

Upload video

Output Video

The screenshot shows a web application interface for vehicle detection. At the top, there's a navigation bar with 'Vehicle Detection' and an 'Input' button. Below this, there are three tabs for the detection algorithm: 'Analyzer', 'YOLO', 'SSD', and 'Mask R-CNN'. A callout box points to these tabs with the text 'Choose detection algorithm'. Under the 'Details' section, there's a 'Select video to analyze:' area with a 'Browse...' button and a file named 'test_long.mp4' with an 'Upload complete' status. A callout box points to this area with the text 'Upload video'. To the right of this is a 'Run analysis' button, with a callout box pointing to it that says 'Start data processing'. Below the interface, there's a section labeled 'Output Video' with a callout box pointing to a video frame. The video frame shows a street scene with a black car in the foreground and a white car in the background. Blue bounding boxes are drawn around the cars, and a label 'car: 0.5457' is visible above the black car.

Currently available methods:

- YOLO v3
- SSD
- Mask R-CNN

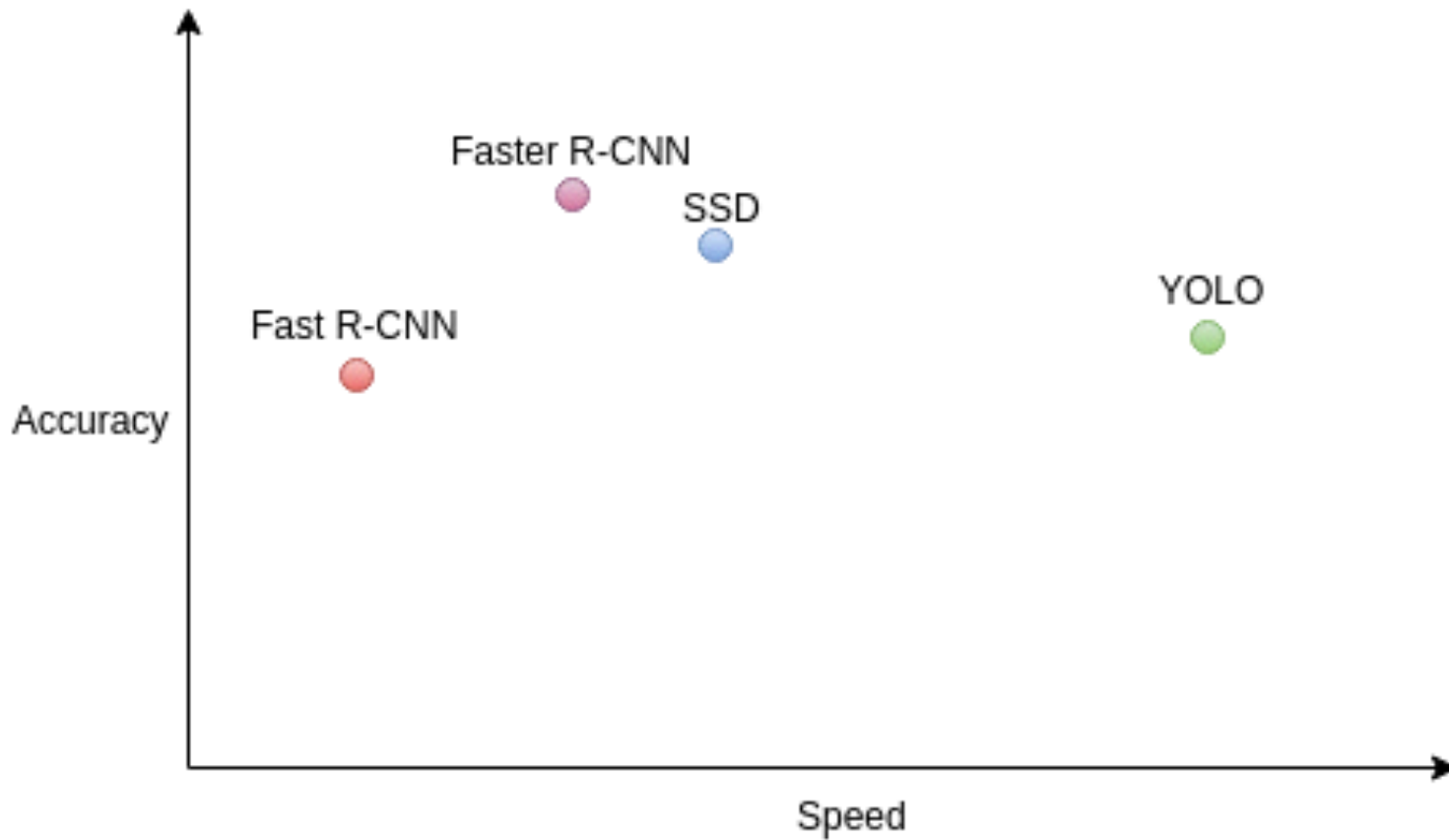
with no customizations yet





Application to vehicle detection

Comparison of methods



Application to vehicle detection: next steps



Data collection

- Audio data
- Emergency vehicles image dataset

2

Data preprocessing

- More advanced techniques

3

CNN

- Retrain neural networks & metrics
- Check accuracy & loss
- Download weights
- Fine tuning of parameters

4

Dashboard

- More appropriate models & datasets

5

Vehicle detection

- Improve detection of special classes of interest



Thank you!



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DATA SCIENCE PER IL MANAGEMENT

