Yandex
Overview

› Yandex Services
› Yandex.Taxi
› Yandex Technologies
› SDC Yandex Taxi
› Algorithms Design Evolvement
› Car Detection
› 3D Car Detection
› Windup
› Upcoming Plans
since 1989
search engine technology

1997
yandex.ru

world-class information search
on-demand transport services
navigation products
mobile applications
Yandex Taxi – one of the largest online taxi services in Russia & CIS

- 2–5 min average waiting time
- >200,000 active cars
- 6 countries
- 149 cities
Technologies

› Machine learning (MatrixNet)
› Speech recognition
› Language recognition and synthesis (SpeechKit)
› Antivirus technologies
› Computer vision
› Duplicate image detection
› Behaviour analytics technology (Crypta)
› Real-time bidding platform
› Weather forecasting technology (Meteum)
› Personal recommendations technology (Disco)
Algorithms Design Evolution

Data → Labelling → ML → Deployment

constant ongoing improvement process
Car Detection Pipeline

Data → Labelling → ML → Deployment

↓

Car

↑
Data for Car Detection

DATA → DATA Collection → Cloud Storage

DATA Collection → Cloud Storage
Labelling for Car Detection

Objects detection → Labelling
ML for Car Detection

ML

Yolo

SSD

Modifications
Deployment for Car Detection

- Drive PX
- Tensor RT
- FuseNet
3D Car Detection Pipeline

Data Detection

Data → Labelling → ML → Deployment

Data Recollection
Data for 3D Detection

Lidar Detection

Lidar Point Cloud
ML for 3D Car Detection

- Lidar Bird View (BV)
- Image (RGB)
- ROI Pooling
- Concatenation
- Prior boxes classification
- Prior boxes coordinates regression
<table>
<thead>
<tr>
<th>Method</th>
<th>Moderate</th>
<th>Easy</th>
<th>Hard</th>
<th>Runtime</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV3D (lidar only)</td>
<td>0.77</td>
<td>0.858</td>
<td>0.689</td>
<td>240ms</td>
</tr>
<tr>
<td>MV3D</td>
<td>0.769</td>
<td>0.86</td>
<td>0.684</td>
<td>360ms</td>
</tr>
<tr>
<td>Ours (bev only)</td>
<td>0.749</td>
<td>0.821</td>
<td>0.736</td>
<td>95ms</td>
</tr>
</tbody>
</table>
Deployment for 3D Car Detection

Deployment

- TensorRT
- Graph freezing
- DrivePX
Wind-up

- Data
- Labelling
- ML
- Deployment

Constant improvement process

› image segmentation
› depth estimation
› end-to-end
Upcoming Plans

city test-drives

>=10 cars fleet growth

2018

more sensors => more experiments
Thank you! Questions?

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