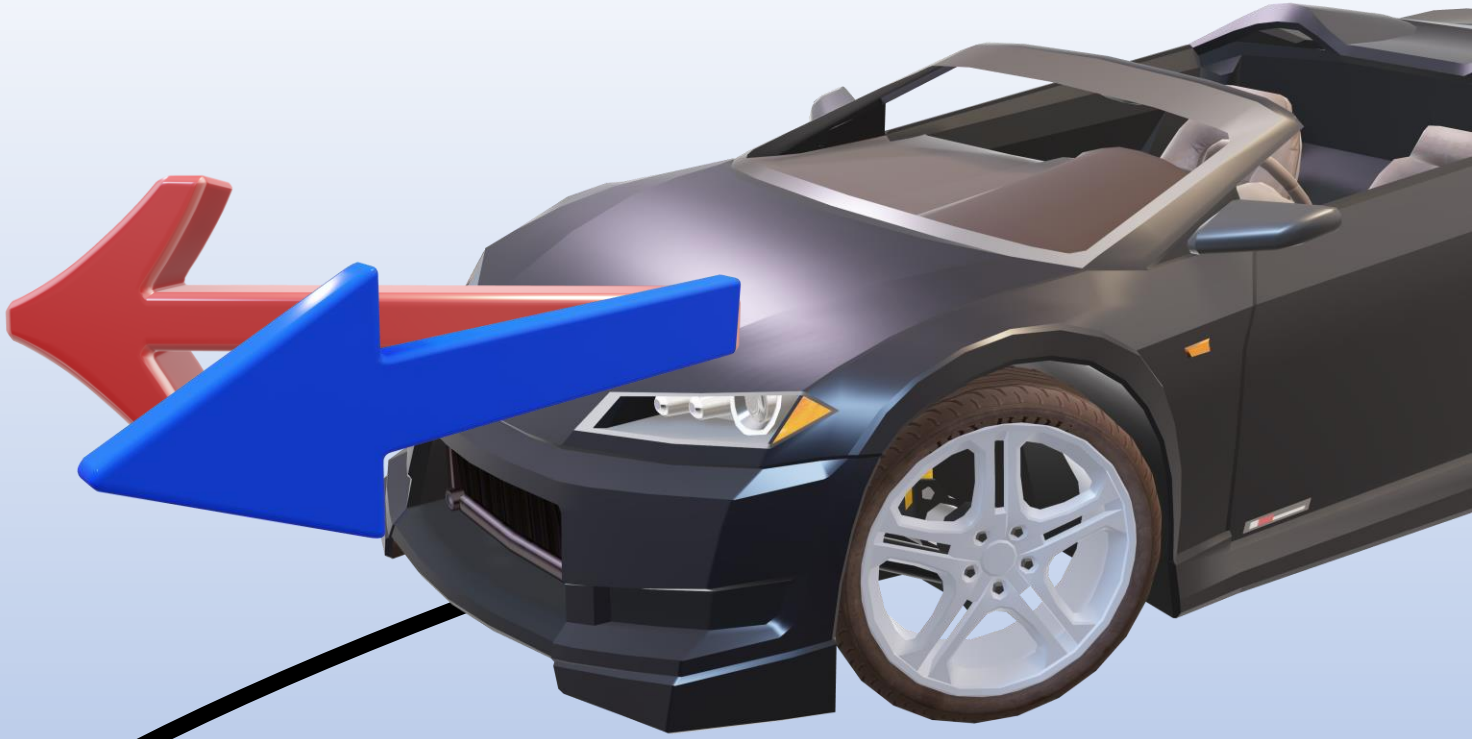
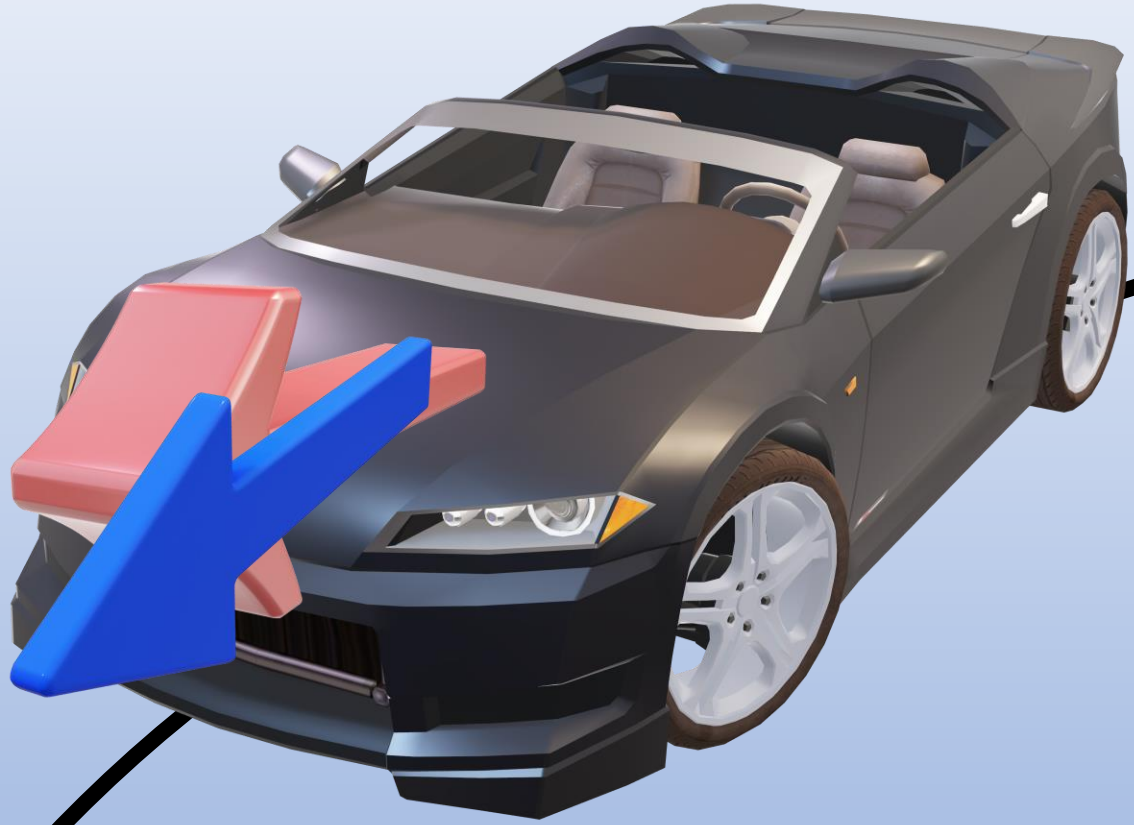


SELF-DRIVING MODELS



WITH SYNTHETIC DATA

SELF-DRIVING MODELS WITH SYNTHETIC DATA

SELF-DRIVING MODELS WITH SYNTHETIC DATA

Why struggle on Google Maps, if you can play videogames?

Giulio D'Erasmo
Jacopo Nudo
Andrea Potì
Amedeo Ranaldi

TASK

DATASET

TRAINING

ANALISYS
RESULT

FUTURE WORK

01 What we do

- Predict the steering angle of a self-driving car based on visual input from cameras only.
- We implement from scratch baseline and improvement models training with and without transfer learning the entire architectures.
- Trained on synthetic data: GTA V

02 In order to

This allows the car to navigate its environment and make decisions about how to move in order to avoid obstacles and reach its destination.

03 Motivation

Not so noble motivation. Aim to do a project about videogames and neural networks, also hot topic in INVIDIA challange and not so much explored.

TASK

DATASET

TRAINING

ANALISYS RESULT

FUTURE WORK

How we collect our data

Training data was collected by a bot driving in the GTA V videogame :

- Recording mode 30 fps
- Fixed speed of the car
- Wide variety of roads and different set of places and weather conditions.

300.000 images!

TASK

DATASET

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FUTURE WORK

Data cleaning

- If the steering angle is not varing in the next 10 frames, the capture is **paused**
- Deleted first and last ~200 frames
- Balancing of the dataset randomly removing some frames where the steering angle is ≈ 0

Pre-processing

- Train/Test split 80/20
- Crop bottom part: luggage rack and radar map
- Downsampling from 480x800 to 240x400
- Data augmentation:
  - Random brightness change
  - Random horizontal and vertical flips
  - Random shift of the image
- Target steering angle normalized from [-40,40] in [0,1]

Final dataset size is ≈150.000

01 Models

- ***Baseline*:** CNN End-to-End model
- **CNN + BN**
- **Inception Resnet v2** (backbone change)

02 Training details

- About 8 m/epoch
- GPU RTX2070 Super
- Batch creation with balance steering angles
- Variation loss → MSE/Weighted MSE

03 Evaluation metrics

$$MAE = \frac{1}{n}\sum|y_i - \hat{y}_i|$$

$$RMSE = \sqrt{\frac{1}{n}\sum(y_i - \hat{y}_i)^2}$$

TASK

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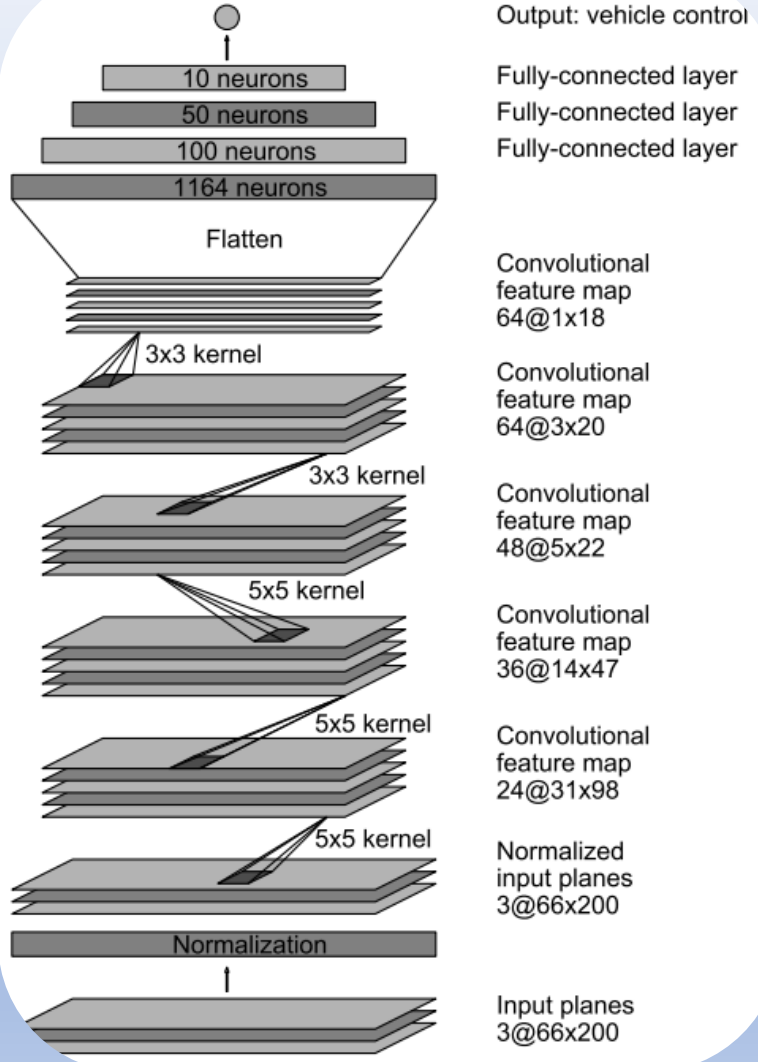
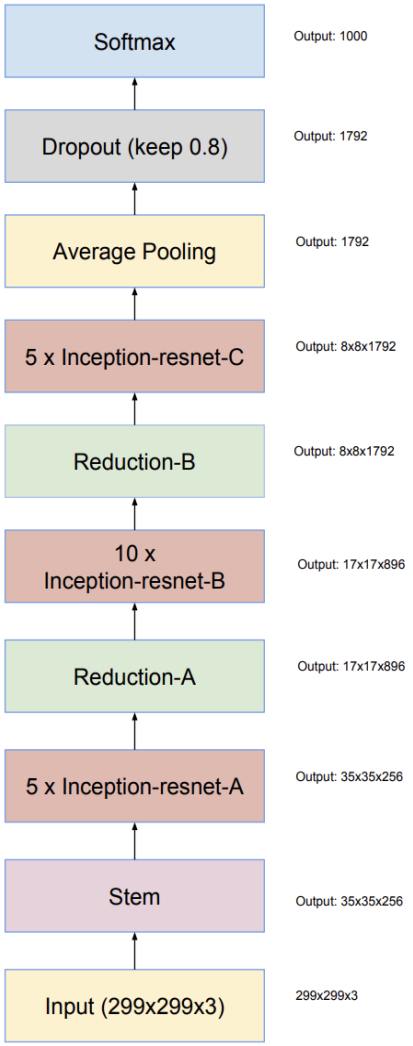
CNN



Inception



TASK

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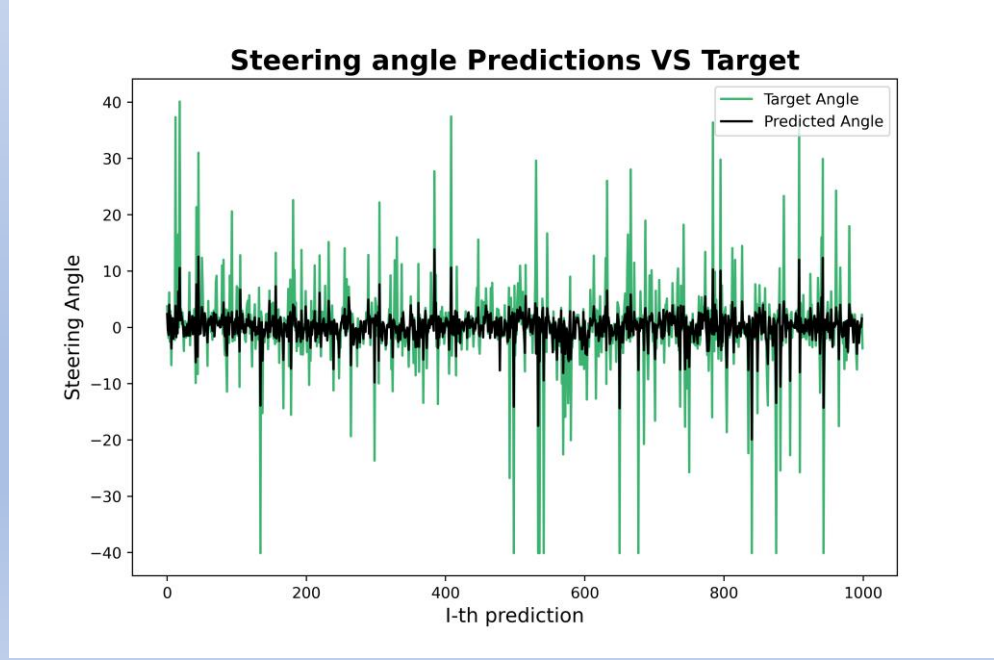
FUTURE WORK

Some numbers:

Model	Test Loss	MAE	RMSE	Epochs	Running Time
CNN	0.0329	3.9200	0.0552	85	0.3 h/epc
CNN + BN	0.0162	2.5644	0.0471	125	0.3 h/epc
Inception Resnet V2	0.2929	20.8183	0.0189	8	1.5 h/epc

CNN + BN:

Prediction visualization



TASK

DATASET

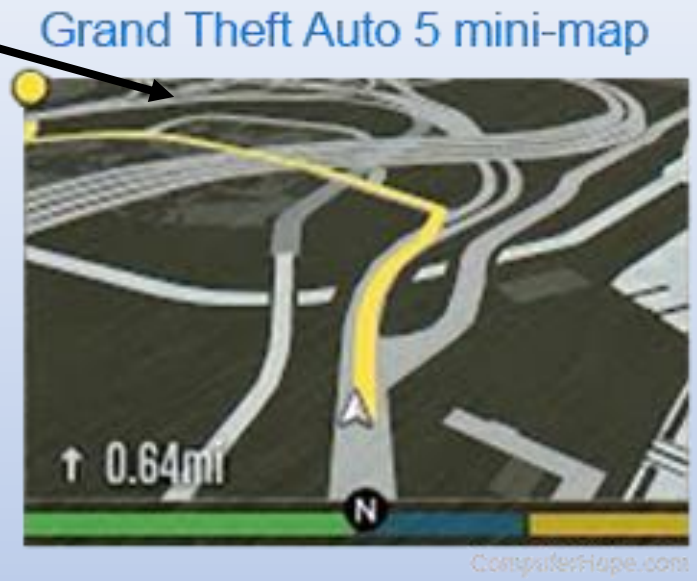
TRAINING

ANALISYS RESULT

FUTURE WORK

Further next:

- Add minimap as input
- Try powerful backbone ViT



Bibliography:

- [1604.07316] End to End Learning for Self-Driving Cars (arxiv.org)
- [1811.02759] Learning to Steer by Mimicking Features from Heterogeneous Auxiliary Networks (arxiv.org)

Thanks for your attention

and be safe while driving… for now!