Final presentation

Lyft Motion Prediction for Autonomous Vehicles

(aka The Pain)

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Competition

- Task: predict the motion of traffic agents (cars, cyclists, pedestrians etc.)
- Previous 99 frames → predict in the next 50 frames
- Data in zarr format
- L5kit library to visualize and work with data
Models and parameters

- **Score**: negative log likelihood of the ground truth data (lower score is better)
- **Different models** (resnet base), parameters
- **Pretrained model**: 23.610 (place 371, 1.9h)
- **Our own best**: 138.518 (place 709, 6.65 h)
- **Total 32 submissions, ~80h model training and predictions**
Raster and pixel size

❖ Careful selection of raster and pixel size

❖ Good raster size depends on vehicle's velocity
❖ What is good raster size?
Raster formula

- Pick maximum speed: 89 km/h $\rightarrow$ 24.72 m/s (speed limit in State of California)
- Calculate the maximum distance in 5 seconds $\rightarrow$ 
  $5 \times 24.72 = 123.61$ m
- Divide it by the size of the pixels $\rightarrow$ 123.61/ 0.5 = 247.2
- We should try raster size 247.2
- Good baseline model results previously with size 224
Smaller pixel settings $\rightarrow$ higher resolution
Score and time based on pixel size

<table>
<thead>
<tr>
<th>Pixel Size in Real World (M)</th>
<th>Time (Min)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>126,625</td>
<td>188,965</td>
</tr>
<tr>
<td>0.5</td>
<td>138,5</td>
<td>216,019</td>
</tr>
<tr>
<td>1</td>
<td>183,443333</td>
<td>214,713</td>
</tr>
</tbody>
</table>
Mix and match

Pixel size [0.2 x 0.2]

- raster_size = 120, score = 897.288
- raster_size = 124, score = 1142.256
- raster_size = 126, score = 7038.143

Pixel size [0.25 x 0.25]

- raster_size = 122, score = 1115.957
- raster_size = 124, score = 1244.440
- raster_size = 126, score = 7037.562

+ memory limits ( “Your notebook tried to allocate more memory than is available. It has restarted”)
The pains

- Training takes a lot of time...
- Computing metrics (no examples)
- Time wasted on things that didn’t work
- Theory didn’t work in practice
- No previous experience or knowledge

Kaggle restrictions
- (memory, GPU time)
- Inaccurate error messages
- Kaggle problems (submission errors)

Documentation is insufficient

Limited resources

Small community. Not much help available

Social distancing

Notebook stopped working after 40 min
The Gains

◊ Some insight into the hot topic of Autonomous Vehicles
◊ How Kaggle competitions work
◊ Some Pytorch, L5kit
◊ We had fun working together
Team work
……lots of it
Thank you!
Links to our Kaggle notebooks

◈ [https://www.kaggle.com/kristiinakeps/batch-pred](https://www.kaggle.com/kristiinakeps/batch-pred)  
(for predicting based on a model for batch size testing)

◈ [https://www.kaggle.com/kristiinakeps/batch-test](https://www.kaggle.com/kristiinakeps/batch-test)  
(for creating models and predicting to evaluate batch size)

◈ [https://www.kaggle.com/kristiinakeps/combined-version](https://www.kaggle.com/kristiinakeps/combined-version)  
(versions with different models)

(for evaluating pixel sizes)

◈ [https://www.kaggle.com/hbparman/mix-match](https://www.kaggle.com/hbparman/mix-match)  
(best result)

(versions with different parameter testing)