Vehicle Interaction Learning

Xiaosong Jia

07/27/2019

Results

HighD

	IOU > 0.9	Change Lane Acc	Interaction Cls Acc
Original	94.2%	94.4%	97.6%
Clip+ DownSample	92.6%	92.8%	97.8%
…+max_norm_v1	92.2%	91.4%	97.8%
…+max_norm_v2	92.3%	92.6%	98.0%

NGSIM

	IOU > 0.9	Change Lane Acc	Interaction Cls Acc
Original	64.5	59.5%	93.4%
Clip+ DownSample	61.5%	62.8%	94.4%
Clip+ DownSample +deeper	61.6%	63.2%	94.4%
…+max_norm_v1	22.3%	19.8%	93.8%
…+max_norm_v2	23.0%	21.4%	94.3%
…+max_norm_v2+deeper	31.9%	33.1%	94.2%

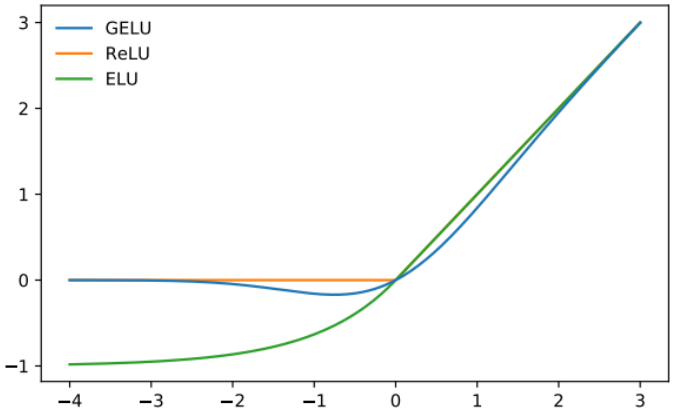
New Technique

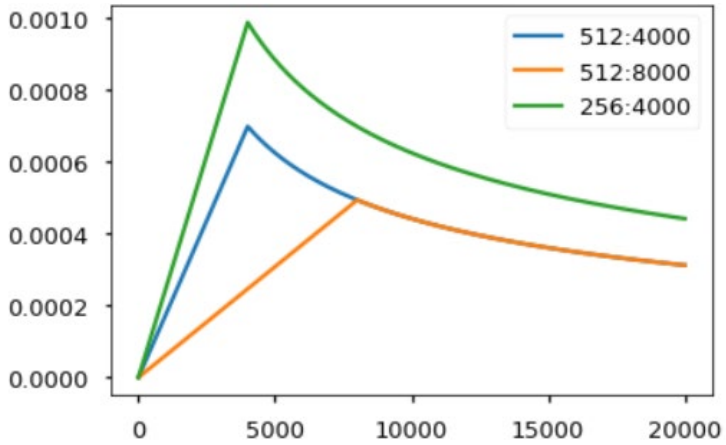
- GELU

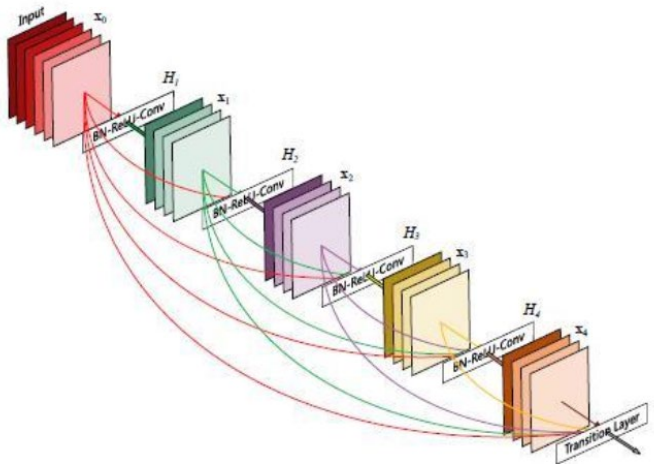
$$\mathrm{GELU}(x) = xP(X \leq x) = x\Phi(x)$$

- Warm-up learning rate

- DenseNet

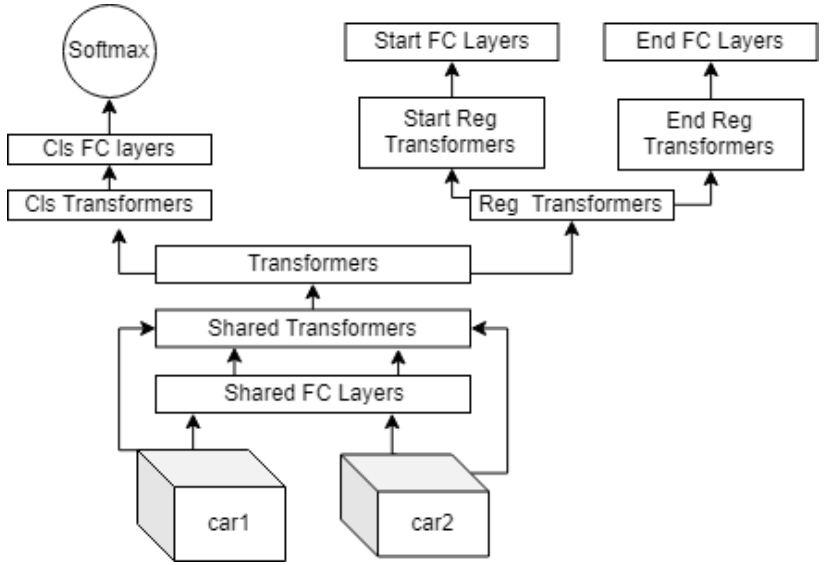




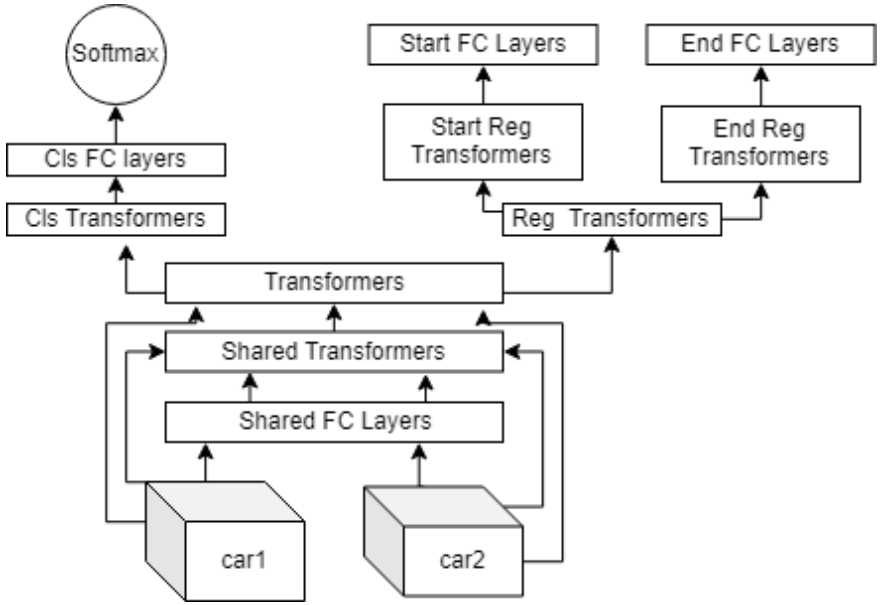


NGSIM Results

	IOU > 0.9	Change Lane Acc	Interaction Cls Acc
Clip+ DownSample	61.5%	62.8%	94.4%
…+GELU+warm_up	69.9%	68.6%	94.9%
…+GELU+warm_up+only regression	68.4%	72.2%	\
…+GELU+warm_up+Densenet_v1	71.5%	80.7%	96.0%
…+GELU+warm_up+Densenet_v2	71.9%	82.4%	95.8%



Original Model



Original Model + DenseNet_v1

NGSIM Data Analysis

	PreCar Lane Avg (before)	PreCar Lane Avg (after)	FollowCar Lane Avg (before)	FollowCar Lane Avg (after)
HighD	1.06	2.0	1.02	1.02
NGSIM	1.55	1.39	1.19	1.18

- Late appear, Front car swing, Both swing, Lane jump
- Rule: before change lane and after change lane, front and follow car must keep in the same lane (HighD: 10129/10304, NGSIM: 7297/7916

- After cleaning data, NGSIM_clip_downsample, IoU0.9 Acc: 74.2%, Change_Lane_Acc: 87.1%, Traj_Cls_Acc:96.8%

Transferring Results

Train on HighD
validation on NGSIM

	IOU > 0.9	Change Lane Acc	Interaction Cls Acc
Clip+down_sample	37.8%	49.5%	90.8%
max_norm_v2	26.0%	36.2%	65.7%
max_norm_v2_xy_augmentation(exchange):	34.2%	39.7%	70.0%
max_norm_v2_xy_augmentation(no exchange)	15.8%	18.5%	69.5%

Train on NGSIM
validation on HighD

	IOU > 0.9	Change Lane Acc	Interaction Cls Acc
Clip+down_sample	43.4%	50.2%	78.5%
max_norm_v2	68.5%	67.5%	78.5%

NGSIM vs HighD (max_norm)

	NGSIM	HighD
X1_mean	-4.37e-02	-1.62e-02
Y1_mean	4.74e-01	4.12e-02
X1_scale_mean	1.83e+01	3.37e+02
Y1_scale_mean	1.41e+03	4.24e+00
X2_mean	-2.25e-01	-2.10e-02
Y2_mean	4.22e-01	-1.30e-02
X2_scale_mean	1.83e+01	3.37e+02
Y2_scale_mean	1..41e+03	4.24e+00

Future Work

- Rule for negative sample?
- Better model for NGSIM
- Further transfer learning