

# Results

November 2020  
Universitat Politècnica de Catalunya  
FINAL REPORT: <https://github.com/imagesegmentation2020/indoor>

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# Overview

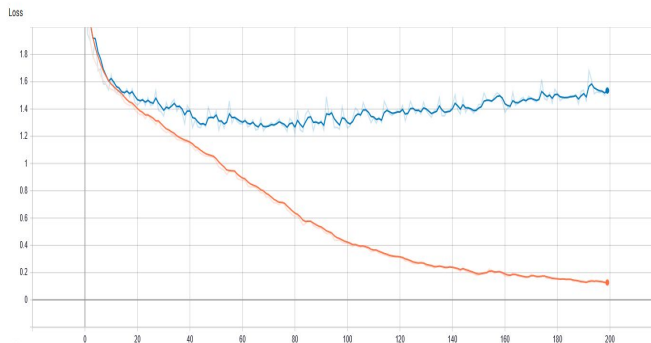
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# Hyperparameter Tuning (ADAM LR 1e-3 WD 0)

## Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

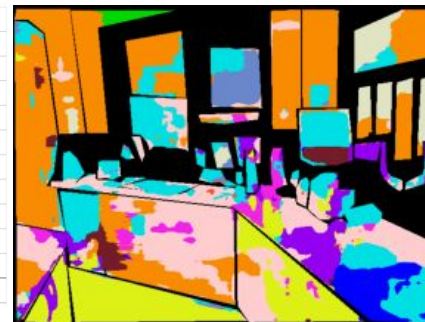
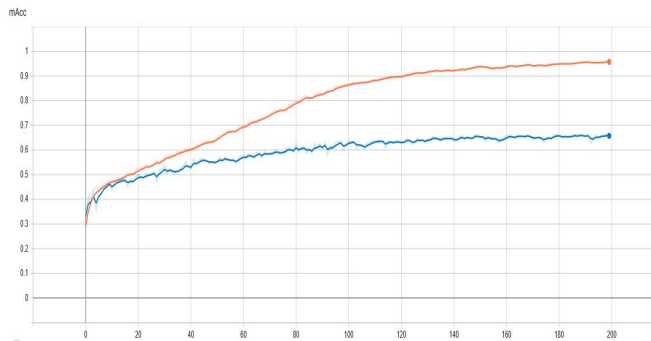
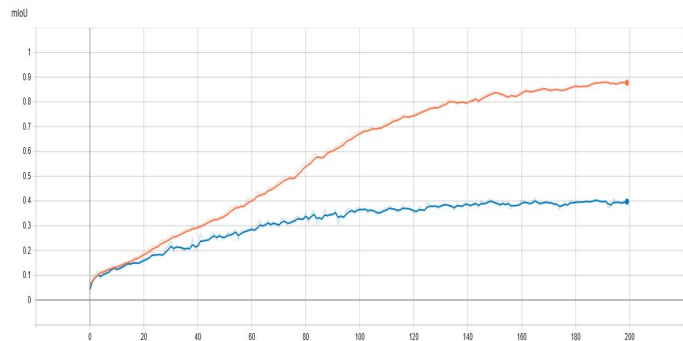


Best epoch = 165

IoU = 41.09 %

Acc = 65.73 %

■ Train  
■ Validation

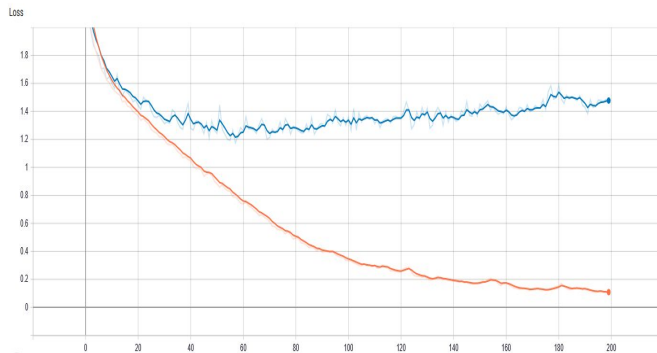


	train	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
train	88.73	58.85	83.68	82.0	93.29	88.73	84.09	82.73	88.61	78.99	87.63	93.35	92.05
Validation	30.93	15.28	58.12	27.36	69.35	46.93	36.42	45.44	25.19	20.97	41.49	70.19	46.51

# Hyperparameter Tuning (ADAM LR 5e-4 WD 0)

## Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

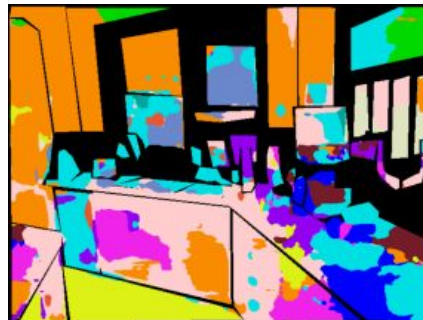
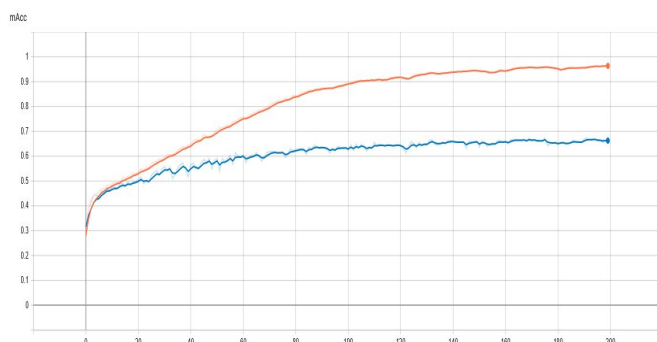
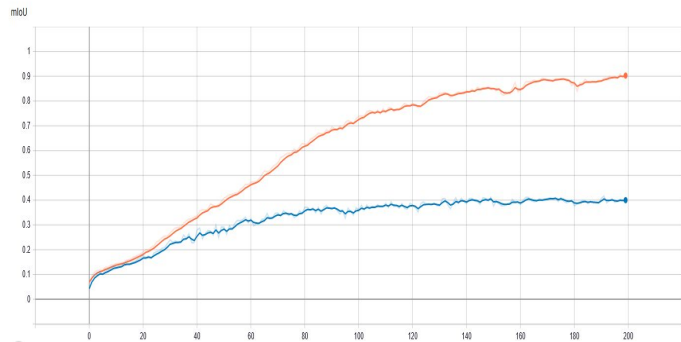


Best epoch = 191

IoU = 41.64 %

Acc = 67.27 %

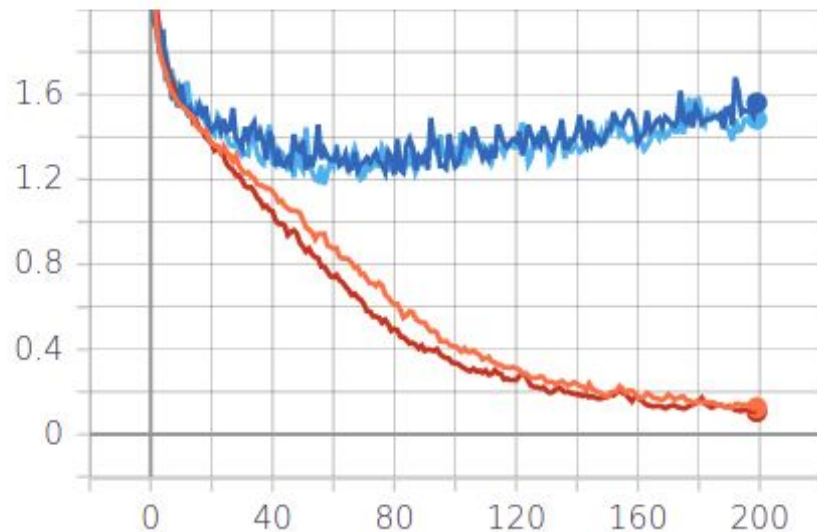
■ Train  
■ Validation



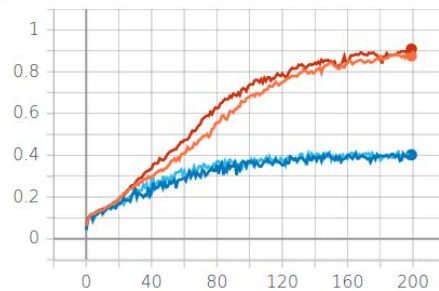
	bed	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	95.04	69.83	86.12	87.9	94.41	92.16	87.66	88.17	92.12	87.38	91.09	94.82	93.6
Validation	40.97	14.14	61.65	29.75	69.38	49.14	39.82	40.02	27.07	22.46	31.97	70.91	44.08

# Hyperparameter Tuning (ADAM Learning rate COMPARISON 1e-3 VS 5e-4)

Loss



mIoU



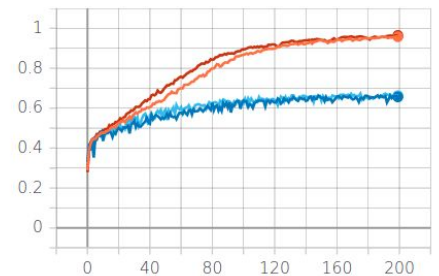
Learning rate 1e-3

Train  
Validation

Learning rate 5e-4

Train  
Validation

mAcc

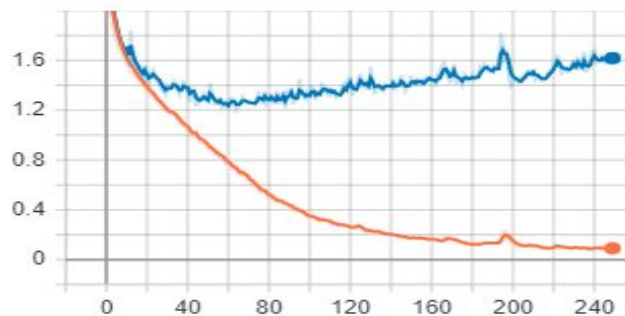


# Hyperparameter Tuning (ADAM LR 5e-4 WD 1e-4)

Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

Loss



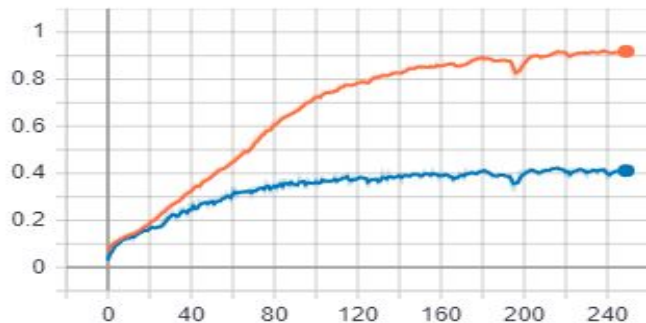
Best epoch = 216

IoU = 42.54 %

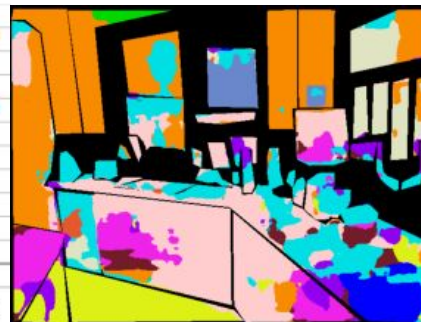
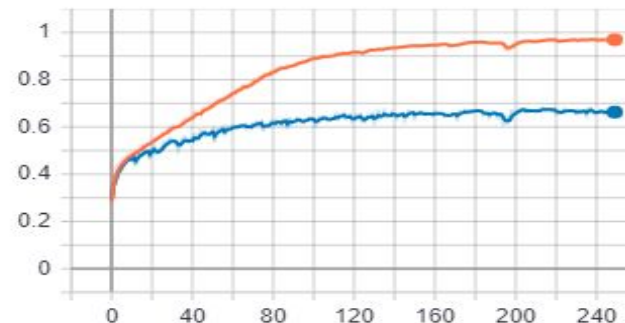
Acc = 67.51 %

Train  
Validation

mIoU



mAcc

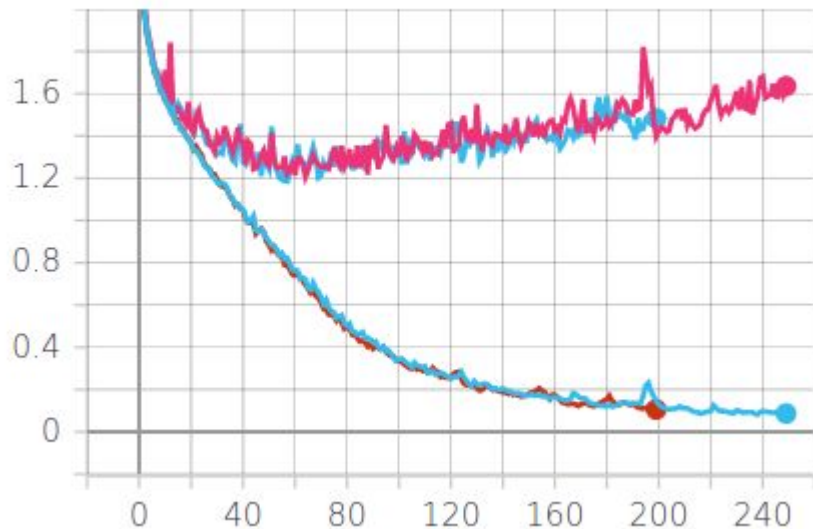


	bed	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	96.16	76.26	90.52	90.42	95.68	94.43	91.26	90.4	95.46	90.59	95.37	96.25	95.86
Validation	34.58	13.34	65.25	30.55	70.67	49.47	39.54	41.86	28.07	22.1	38.07	70.84	48.75

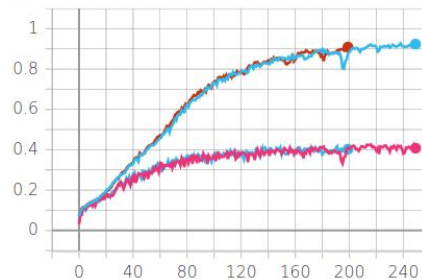


# Hyperparameter Tuning (ADAM Weight Decay COMPARISON 0 VS $1e-4$ )

Loss



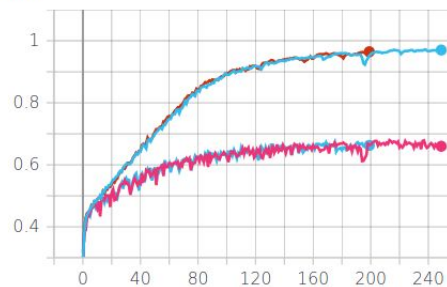
mIoU



Without Weight Decay

■ Train  
■ Validation

mAcc



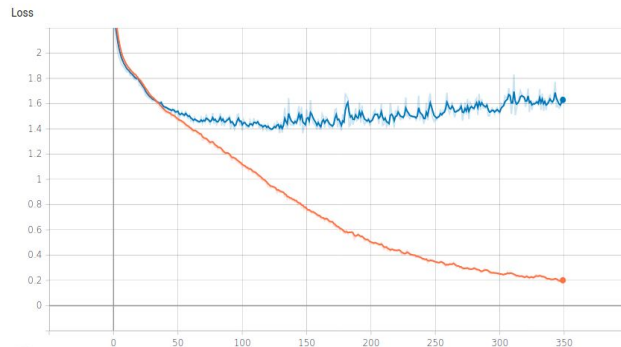
Weight Decay

■ Train  
■ Validation

# Hyperparameter Tuning (SGD LR 1e-3 WD 0)

## Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

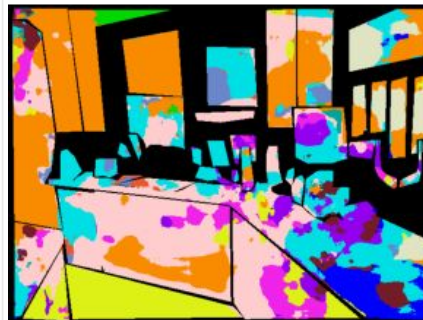
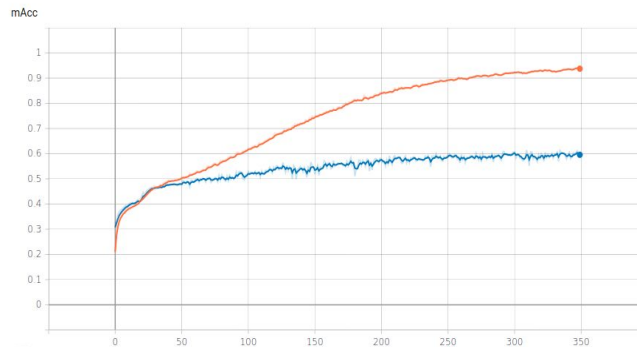
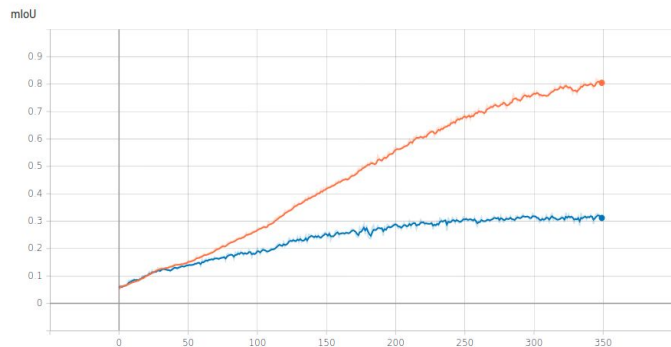


Best epoch = 323

IoU = 33.14 %

Acc = 60.56 %

Train  
Validation



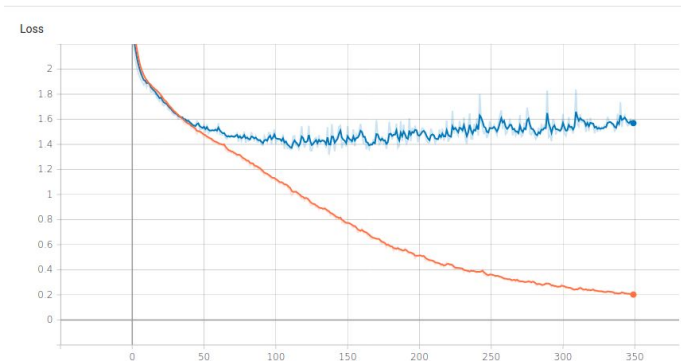
	bed	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	88.6	47.76	73.13	75.56	91.41	87.96	82.22	78.2	81.55	76.81	74.07	92.77	90.1
Validation	28.81	12.65	54.29	24.12	56.3	39.59	33.71	33.57	15.34	14.87	12.0	66.47	39.16



# Hyperparameter Tuning (SGD LR 1e-3 WD 1e-4)

## Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

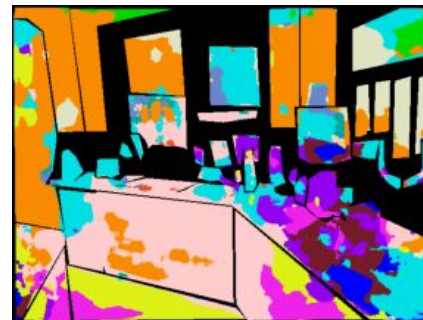
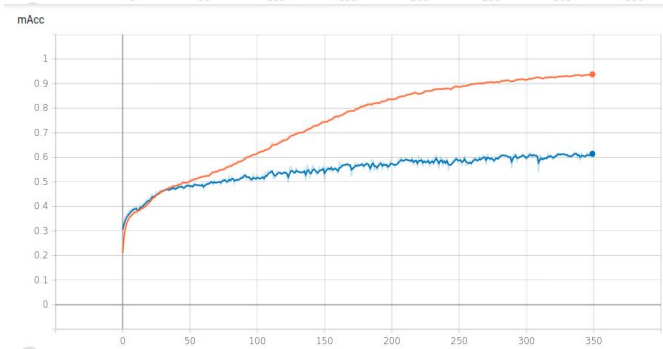
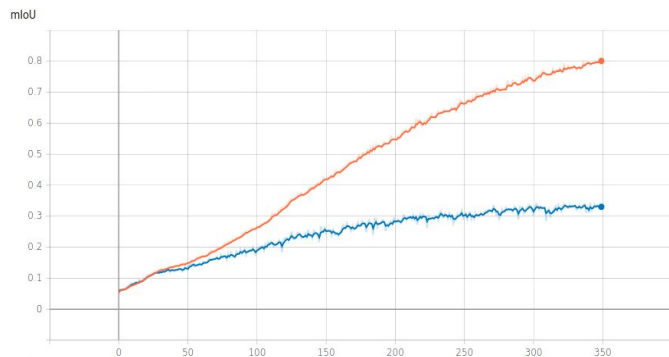


Best epoch = 341

IoU = 34.35 %

Acc = 61.65 %

█ Train  
█ Validation



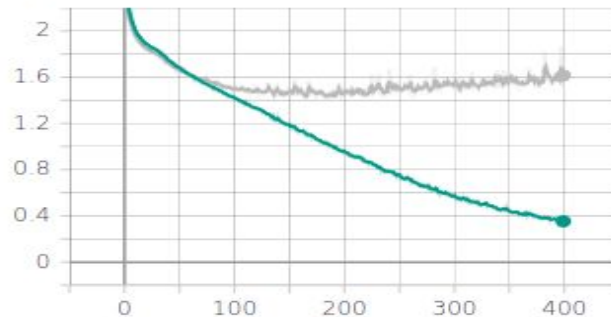
	bag	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	85.52	57.1	70.54	74.12	91.04	87.1	81.57	78.66	80.32	73.49	62.34	91.98	88.48
Validation	30.73	10.49	50.67	23.75	60.53	41.39	35.21	31.76	15.29	16.96	20.67	68.12	41.01

# Hyperparameter Tuning (SGD LR 1e-5 WD 0)

Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

Loss



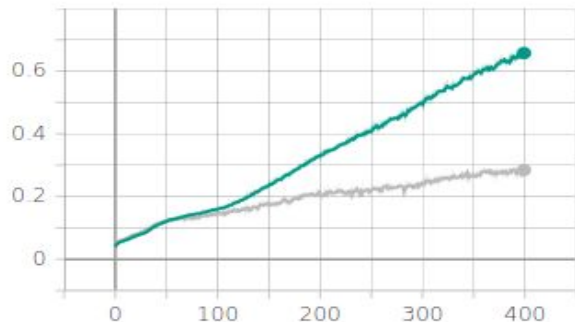
Best epoch = 399

IoU = 29.13 %

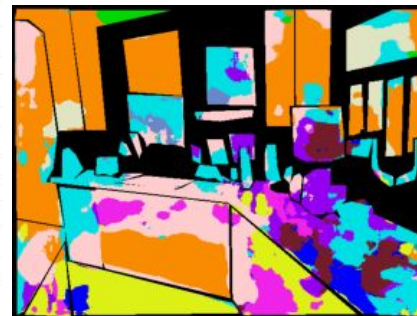
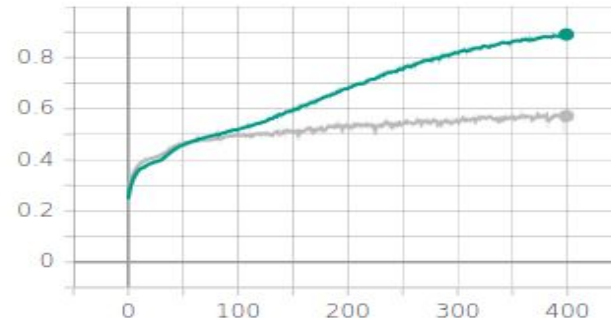
Acc = 58.44 %

Train  
Validation

mIoU



mAcc



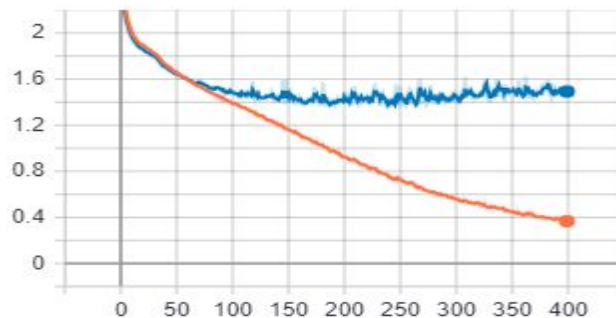
	bed	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	76.95	5.01	61.56	59.61	88.68	80.72	76.34	67.36	69.81	65.48	37.77	89.39	83.96
Validation	22.55	0.68	39.69	15.27	56.43	38.79	33.53	30.34	13.06	11.39	14.54	66.11	36.3

# Hyperparameter Tuning (SGD LR 1e-5 WD 1e-4)

## Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

Loss



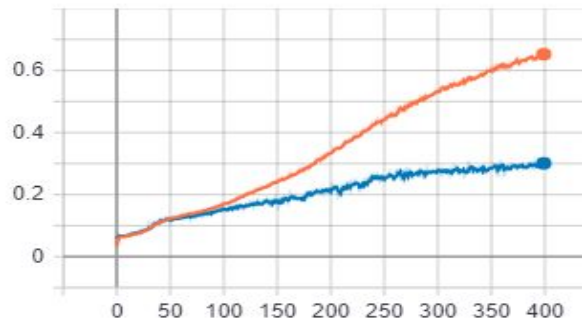
Best epoch = 379

IoU = 30.59 %

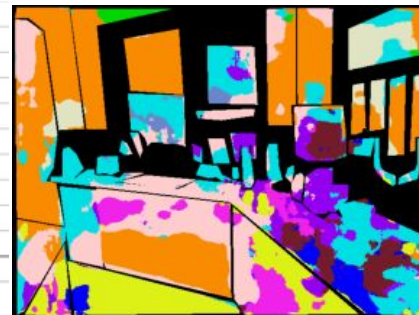
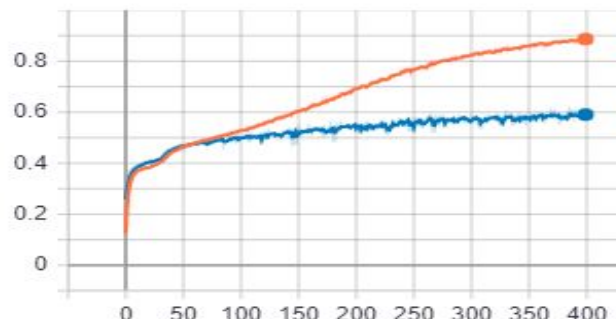
Acc = 58.90 %

Train  
Validation

mIoU



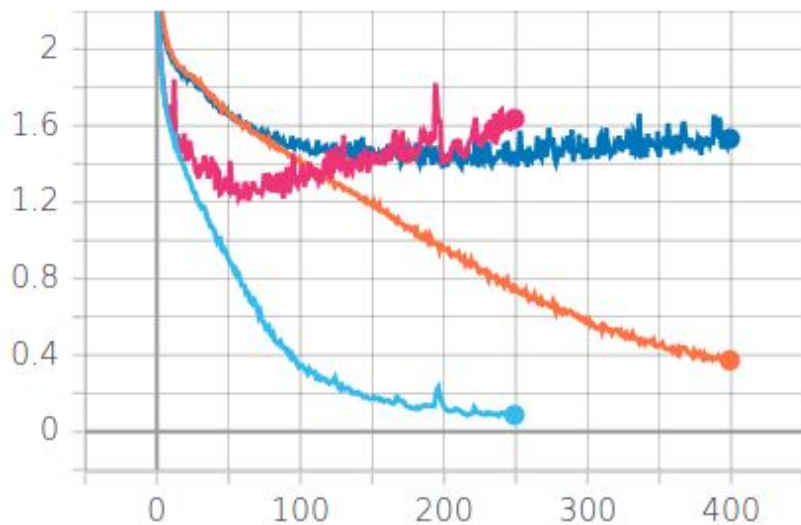
mAcc



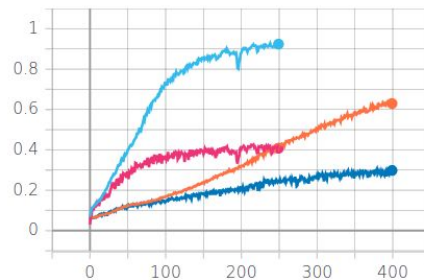
	bed	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	73.22	0.17	54.8	51.62	87.15	79.56	72.33	63.05	53.0	59.17	20.39	88.69	83.58
Validation	24.98	0.11	43.48	19.2	58.79	37.92	34.21	27.13	13.51	13.85	18.13	67.07	39.35

# Hyperparameter Tuning (Optimizers COMPARISON SGD vs Adam)

Loss



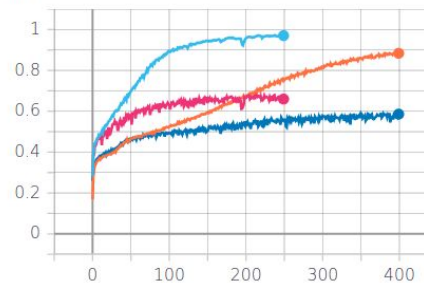
mIoU



ADAM with Learning rate 5e-4  
and weight decay 1e-4

Train  
Validation

mAcc



SGD with Learning rate 5e-4  
and weight decay 1e-4

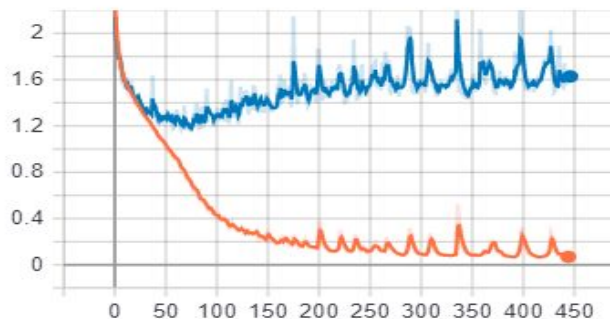
Train  
Validation

# Hyperparameter Tuning (ADAM LR 1e-5 WD 1e-4 dropout 0.2)

## Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

Loss



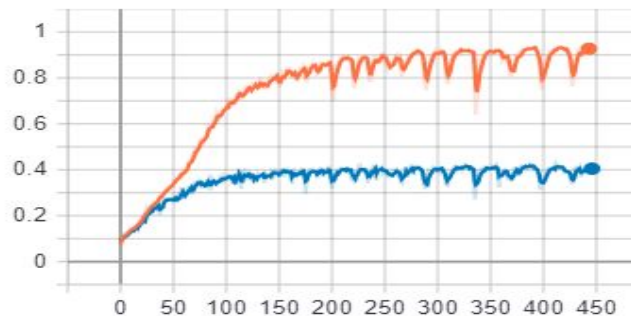
Best epoch = 412

IoU = 42.48 %

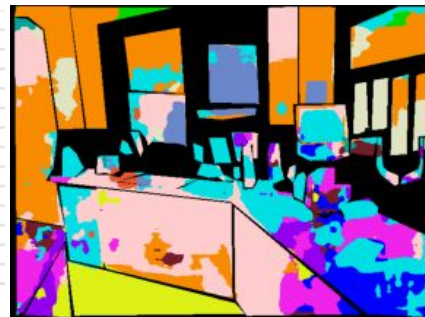
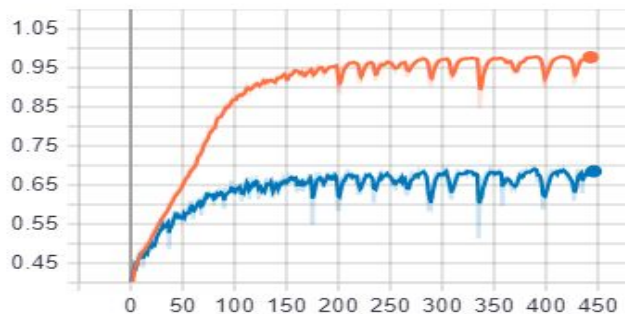
Acc = 69.30 %

Train  
Validation

mIoU



mAcc



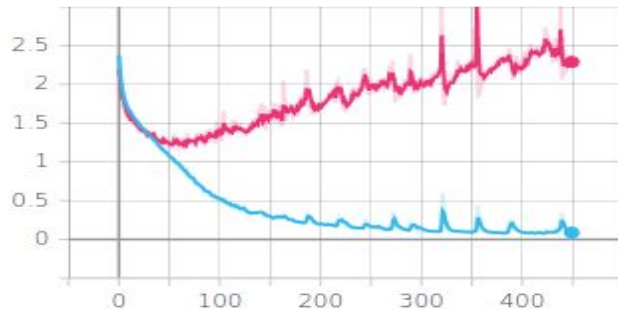
	train	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	95.67	82.62	86.29	93.01	96.77	95.58	92.99	91.32	93.33	91.92	84.02	96.81	96.8
Validation	39.0	14.03	58.33	30.49	72.24	49.5	43.1	44.74	24.88	25.21	29.54	71.91	49.29

# Hyperparameter Tuning (ADAM LR 1e-5 WD 1e-4 dropout 0.5)

Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

Loss



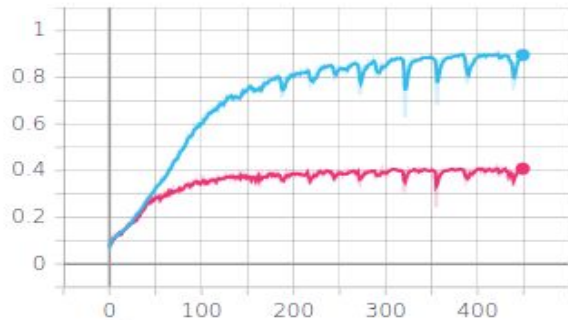
Best epoch = 421

IoU = 41.34 %

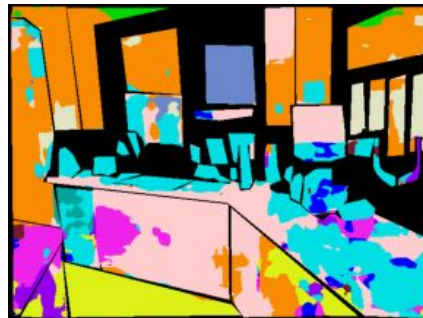
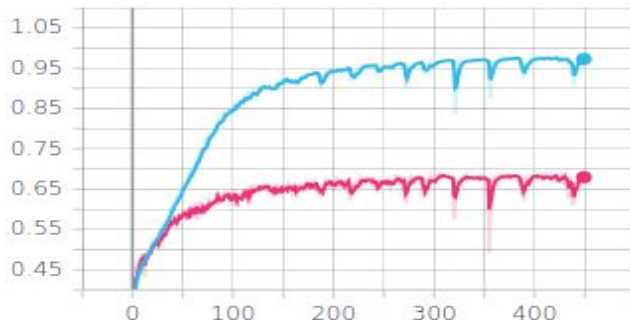
Acc = 68.60 %

Train  
Validation

mIoU



mAcc

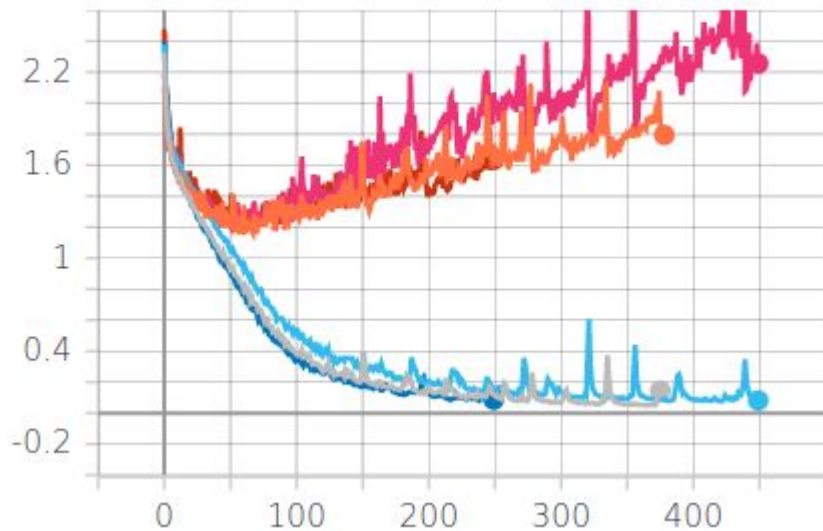


	bag	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	94.02	67.11	84.2	91.1	96.67	95.99	94.21	89.8	89.39	92.01	80.93	97.41	94.81
Validation	39.72	12.44	58.16	26.46	71.14	49.96	41.65	43.01	21.13	24.75	27.52	73.02	48.52

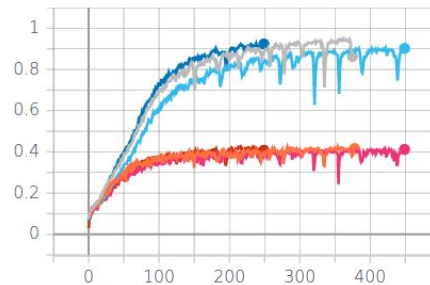


# Dropout (Dropouts COMPARISON 0 vs 0.2 vs 0.5)

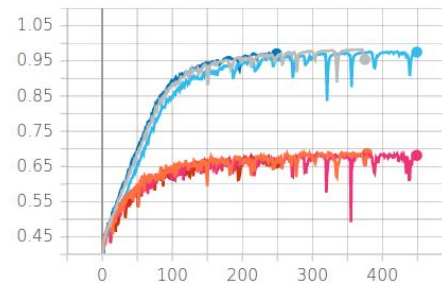
Loss



mIoU



mAcc



No Dropout

Train  
Validation

Dropout 0.2

Train  
Validation

Dropout 0.5

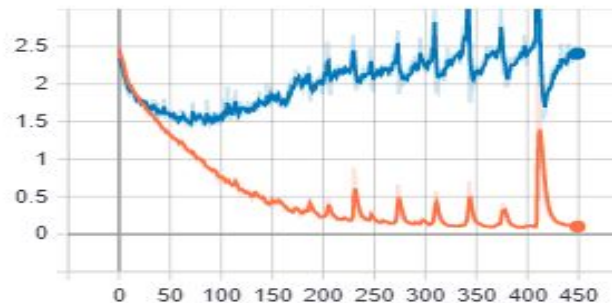
Train  
Validation

# Hyperparameter Tuning (ADAM LR 1e-5 WD 1e-4 dropout 0.2 WEIGHTED LOSS)

Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

Loss



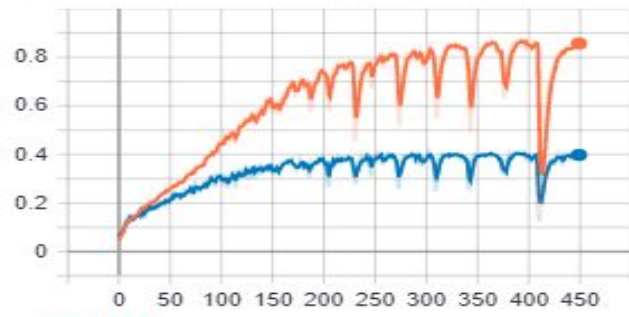
Best epoch = 302

IoU = 40.99 %

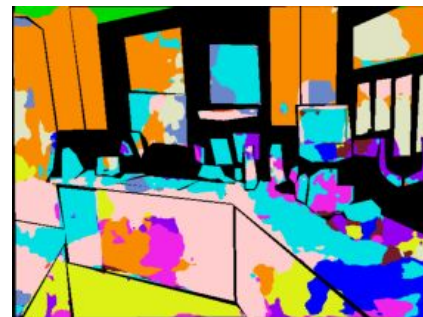
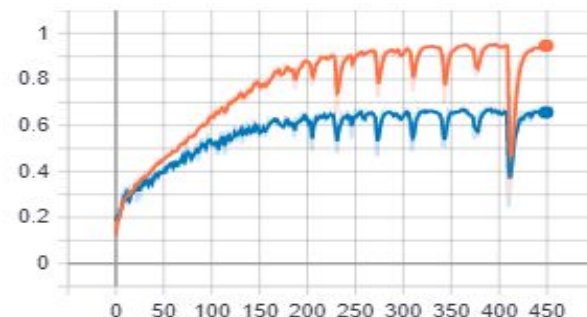
Acc = 66.87 %

Train  
Validation

mIoU



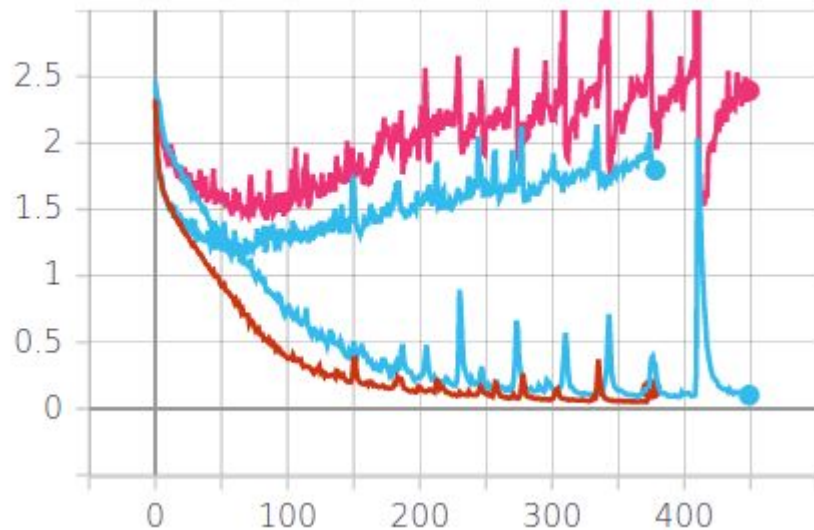
mAcc



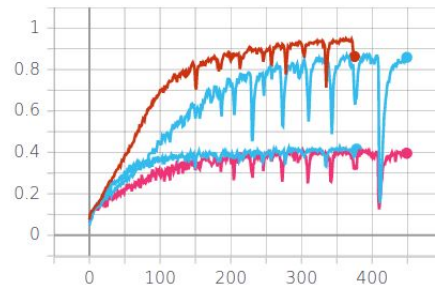
	bed	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	91.47	61.86	71.6	85.72	92.64	86.29	81.54	80.4	89.37	81.72	77.6	89.12	87.04
Validation	36.83	22.69	57.56	30.73	69.71	47.7	38.4	39.36	23.42	26.11	26.85	68.82	44.71

# Hyperparameter Tuning (WEIGHTED LOSS COMPARISON)

Loss



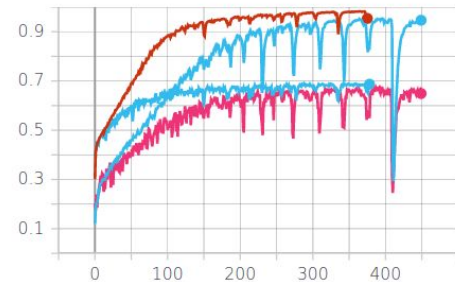
mIoU



Standard Crossentropy

■ Train  
■ Validation

mAcc



Weighted Crossentropy

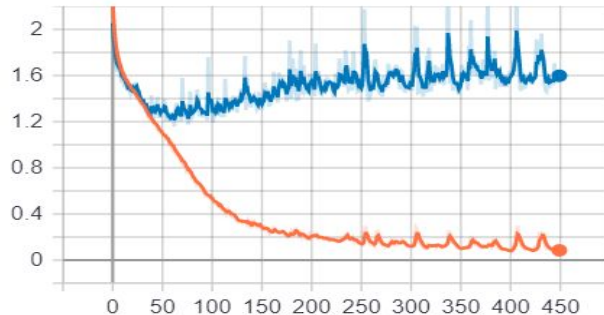
■ Train  
■ Validation

# Data Augmentation (ColorJitter)

## Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

Loss



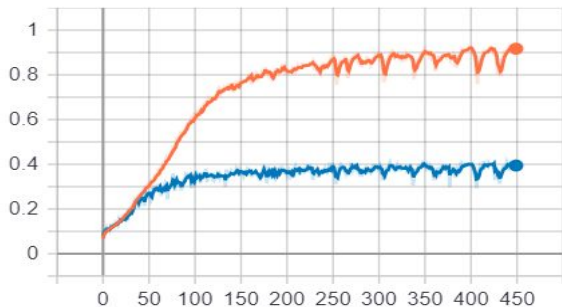
Best epoch = 348

IoU = 41.61 %

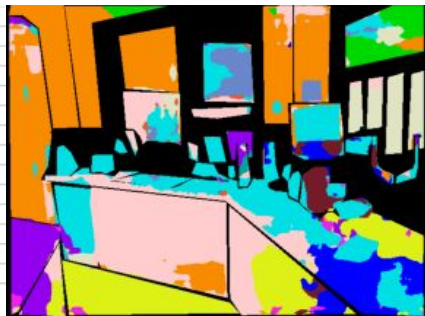
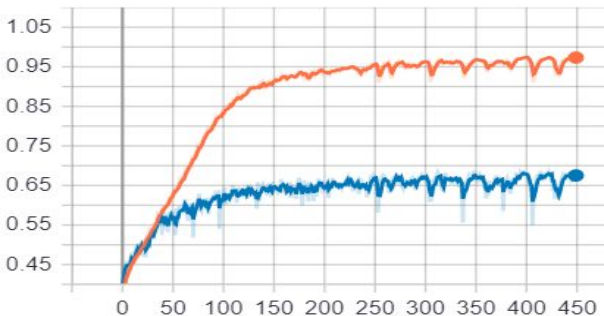
Acc = 68.69 %

Train  
Validation

mIoU



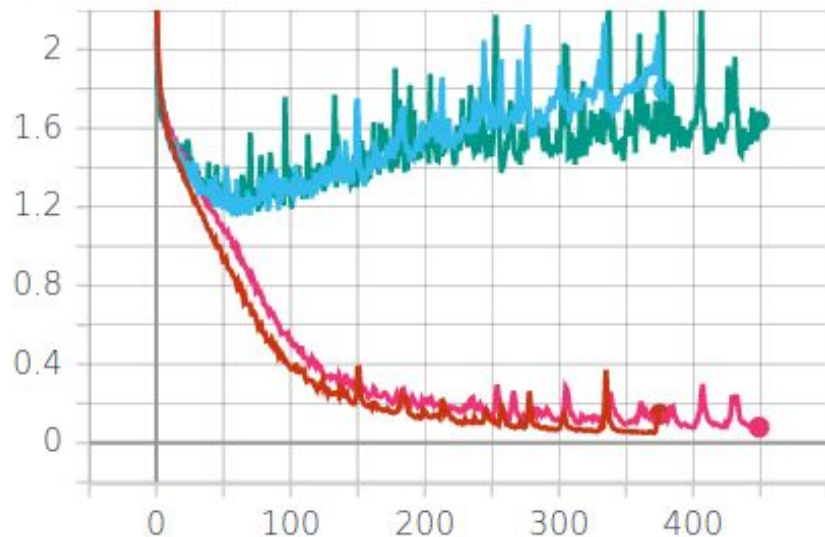
mAcc



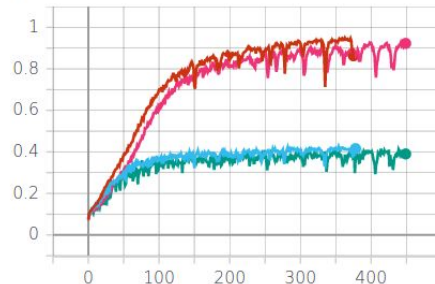
	bed	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	91.54	77.89	81.81	90.2	95.38	94.11	90.69	89.34	93.28	89.45	84.81	95.57	95.24
Validation	40.06	12.03	56.67	33.38	72.73	49.43	41.66	49.44	19.67	21.3	26.55	72.76	45.27

# Hyperparameter Tuning (ColorJitter COMPARISON)

Loss



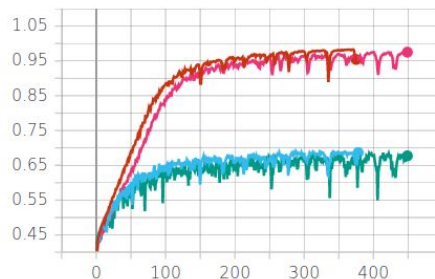
mIoU



Without ColorJitter

■ Train  
■ Validation

mAcc



With ColorJitter

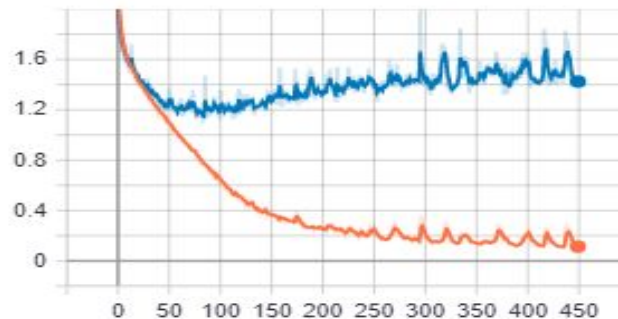
■ Train  
■ Validation

# Data Augmentation (Horizontal Flip)

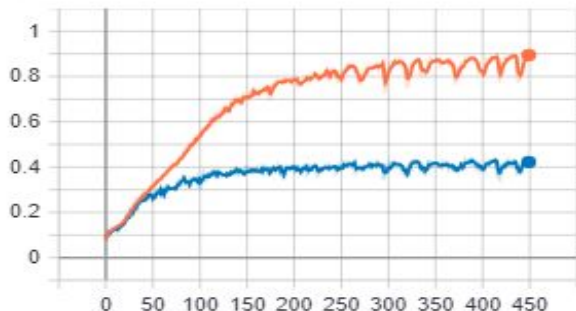
## Symptoms:

- Overfitting
- Validation loss decreases at first, then starts increasing
- Training loss continues to go down

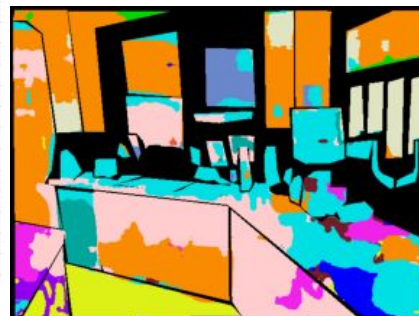
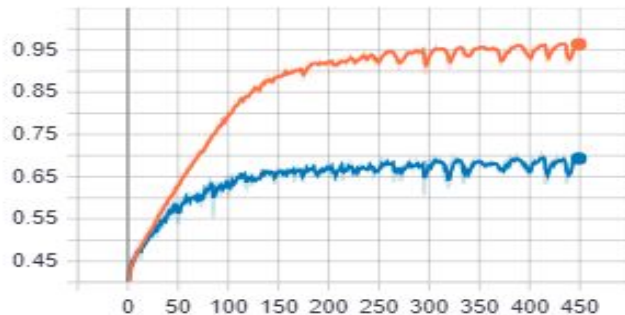
Loss



mIoU



mAcc

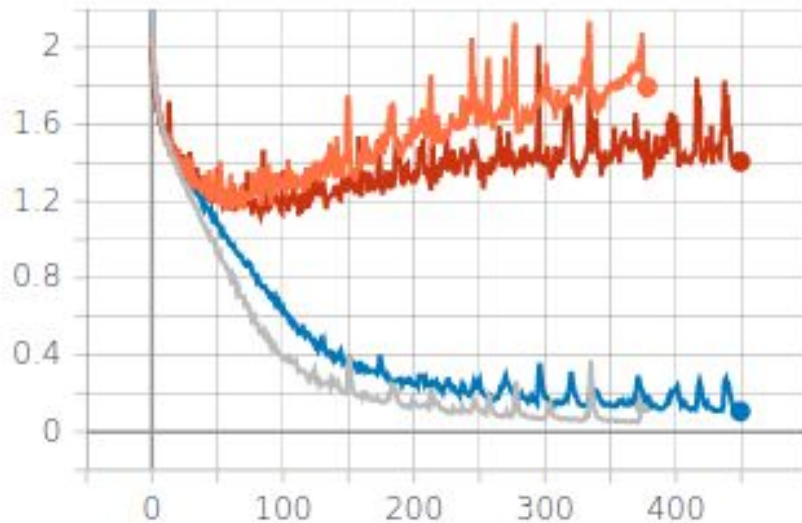


	bed	books	ceiling	chair	floor	furniture	objects	picture	sofa	table	tv	wall	window
Train	92.41	64.76	86.82	88.11	94.85	92.39	88.28	86.29	90.65	87.08	88.07	94.96	93.74
Validation	43.05	10.94	62.81	38.61	72.31	49.08	41.83	47.03	25.68	25.77	27.14	71.22	50.81

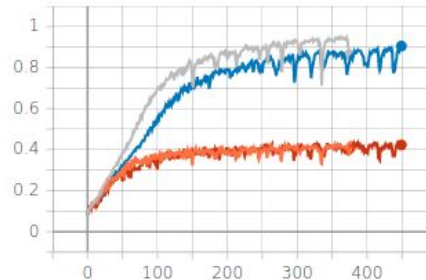


# Data Augmentation (Horizontal Flip COMPARISON)

Loss



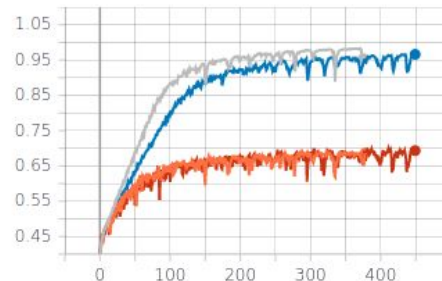
mIoU



Without Horizontal Flip

Train  
Validation

mAcc



With Horizontal Flip

Train  
Validation

# Pretrained model: DEEPLABV3-RESNET101

PyTorch

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## DEEPLABV3-RESNET101

By Pytorch Team

DeepLabV3 model with a ResNet-101 backbone

View on GitHub >Open on Google Colab >



```
import torch
model = torch.hub.load('pytorch/vision:v0.6.0', 'deeplabv3_resnet101', pretrained=True)
model.eval()
```

All pre-trained models expect input images normalized in the same way, i.e. mini-batches of 3-channel RGB images of shape  $(N, 3, H, W)$ , where  $N$  is the number of images,  $H$  and  $W$  are expected to be at least 224 pixels. The images have to be loaded in to a range of  $[0, 1]$  and then normalized using `mean = [0.485, 0.456, 0.406]` and `std = [0.229, 0.224, 0.225]`.

The model returns an `OrderedDict` with two Tensors that are of the same height and width as the input Tensor, but with 21 classes. `output['out']` contains the semantic masks, and `output['aux']` contains the auxiliary loss values per-pixel. In inference mode, `output['aux']` is not useful. So, `output['out']` is of shape  $(N, 21, H, W)$ . More documentation can be found [here](#).

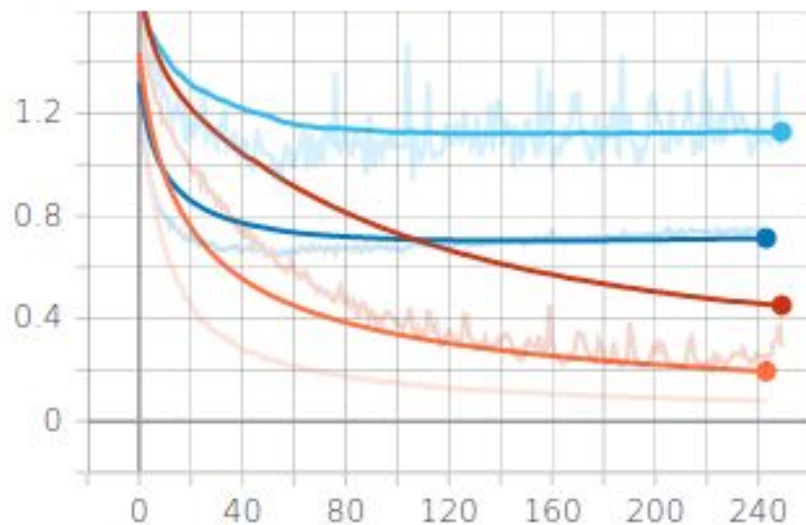
```
# Download an example image from the pytorch website
import urllib
url, filename = ("https://github.com/pytorch/hub/raw/master/images/dog.jpg", "dog.jpg")
try: urllib.URLopener().retrieve(url, filename)
except: urllib.request.urlretrieve(url, filename)
```

Source : [https://pytorch.org/hub/pytorch\\_vision\\_deeplabv3\\_resnet101/](https://pytorch.org/hub/pytorch_vision_deeplabv3_resnet101/)

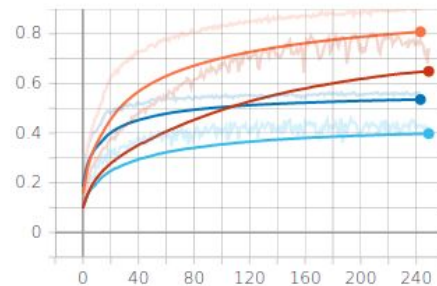
DEEPLABV3-RESNET101

# Pretrained model : DEEPLABV3-RESNET101

Loss



mIoU



**SGD LR 1e-3 WD 1e-4**

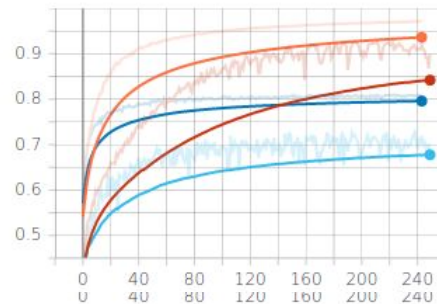
Train  
Validation

Best epoch = 195

IoU = **56.44** %

Acc = **80.83** %

mAcc



**Adam LR 1e-3 WD 1e-4**

Train  
Validation

Best epoch = 193

IoU = 45.94 %

Acc = 72.74 %