Appendix II: Training Notes

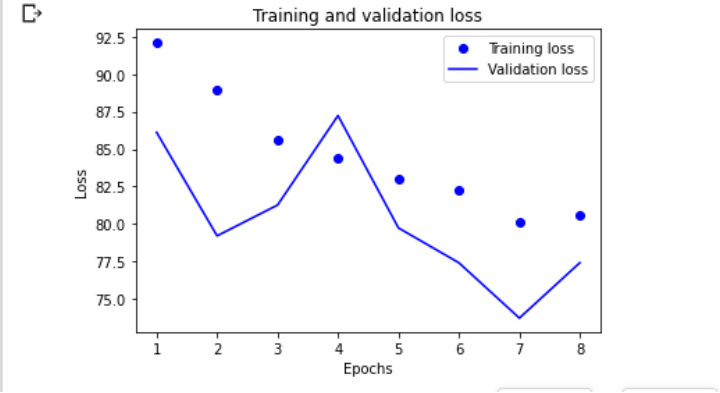
VGG-16

Exploring

- After checked for several, 256 is the largest, training first 8 epochs

```
Epoch 1/8
115/115 [==============================] - 606s 5s/step - loss: 92.0876 - mean_squared_error: 92.0876 - val_loss: 86.1167 - val_mean_squared_error: 86.1167
Epoch 2/8
115/115 [==============================] - 584s 5s/step - loss: 88.9326 - mean_squared_error: 88.9326 - val_loss: 79.2106 - val_mean_squared_error: 79.2106
Epoch 3/8
115/115 [==============================] - 578s 5s/step - loss: 85.5973 - mean_squared_error: 85.5973 - val_loss: 81.2628 - val_mean_squared_error: 81.2628
Epoch 4/8
115/115 [==============================] - 582s 5s/step - loss: 84.3599 - mean_squared_error: 84.3599 - val_loss: 87.2341 - val_mean_squared_error: 87.2341
Epoch 5/8
115/115 [==============================] - 592s 5s/step - loss: 83.0054 - mean_squared_error: 83.0054 - val_loss: 79.7384 - val_mean_squared_error: 79.7384
Epoch 6/8
115/115 [==============================] - 589s 5s/step - loss: 82.2771 - mean_squared_error: 82.2771 - val_loss: 77.4123 - val_mean_squared_error: 77.4123
Epoch 7/8
115/115 [==============================] - 588s 5s/step - loss: 80.0924 - mean_squared_error: 80.0924 - val_loss: 73.7232 - val_mean_squared_error: 73.7232
Epoch 8/8
115/115 [==============================] - 575s 5s/step - loss: 80.5576 - mean_squared_error: 80.5576 - val_loss: 77.4173 - val_mean_squared_error: 77.4173
<keras.callbacks.History at 0x7f93c0036e90>
```

- Performance

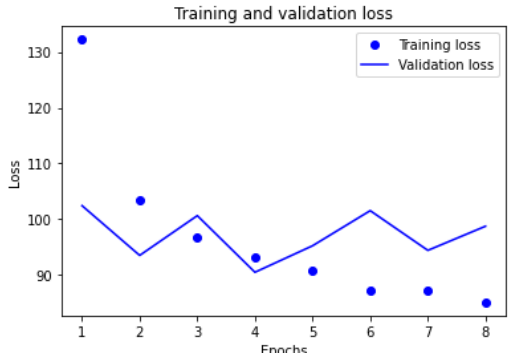


- Another 4 batches

```
Epoch 1/8
115/115 [==============================] - 576s 5s/step - loss: 78.0781 - mean_squared_error: 78.0781 - val
Epoch 2/8
115/115 [==============================] - 572s 5s/step - loss: 78.0497 - mean_squared_error: 78.0497 - val
Epoch 3/8
115/115 [==============================] - 581s 5s/step - loss: 77.2724 - mean_squared_error: 77.2724 - val
Epoch 4/8
115/115 [==============================] - 583s 5s/step - loss: 75.5404 - mean_squared_error: 75.5404 - val
Epoch 5/8
 25/115 [=====>........................] - ETA: 6:09 - loss: 73.0481 - mean_squared_error: 73.0481
---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
<ipython-input-62-7afb32da40a8> in <module>()
      9     validation_data = validation_generator,
     10     steps_per_epoch = 115,
---> 11     validation_steps = 29
     12 )
```

- Now, try ReLU as final activation and add another dense layer
  - First 8 epochs: initial error 200+

```
Epoch 1/8
115/115 [==============================] - 624s 5s/step - loss: 132.2128 - mean_squared_error: 132.2128 - val_loss: 102.4393 - val_mean_squared_error: 102.4393
Epoch 2/8
115/115 [==============================] - 588s 5s/step - loss: 103.5528 - mean_squared_error: 103.5528 - val_loss: 93.5284 - val_mean_squared_error: 93.5284
Epoch 3/8
115/115 [==============================] - 562s 5s/step - loss: 96.6785 - mean_squared_error: 96.6785 - val_loss: 100.6528 - val_mean_squared_error: 100.6528
Epoch 4/8
115/115 [==============================] - 571s 5s/step - loss: 93.1170 - mean_squared_error: 93.1170 - val_loss: 90.5083 - val_mean_squared_error: 90.5083
Epoch 5/8
115/115 [==============================] - 564s 5s/step - loss: 90.7506 - mean_squared_error: 90.7506 - val_loss: 95.2579 - val_mean_squared_error: 95.2579
Epoch 6/8
115/115 [==============================] - 575s 5s/step - loss: 87.3390 - mean_squared_error: 87.3390 - val_loss: 101.5452 - val_mean_squared_error: 101.5452
Epoch 7/8
115/115 [==============================] - 589s 5s/step - loss: 87.1802 - mean_squared_error: 87.1802 - val_loss: 94.4309 - val_mean_squared_error: 94.4309
Epoch 8/8
115/115 [==============================] - 601s 5s/step - loss: 85.1149 - mean_squared_error: 85.1149 - val_loss: 98.7566 - val_mean_squared_error: 98.7566
<keras.callbacks.History at 0x7f93406c4a50>
```



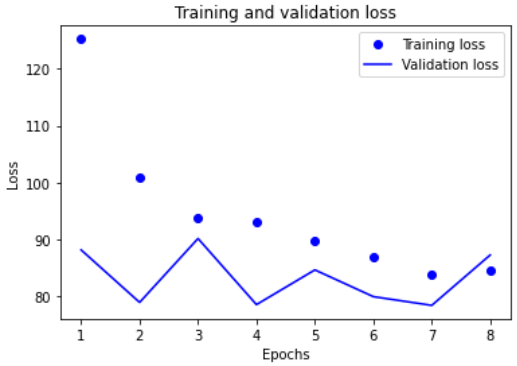
- Go back to 2 dense layers and relu
  - Initial training loss: 280+

```
Epoch 1/8
115/115 [==============================] - 583s 5s/step - loss: 98.2382 - mean_squared_error: 98.2382 - val_loss: 85.3507 - val_mean_squared_error: 85.3507
Epoch 2/8
115/115 [==============================] - 572s 5s/step - loss: 92.1936 - mean_squared_error: 92.1936 - val_loss: 82.7627 - val_mean_squared_error: 82.7627
Epoch 3/8
115/115 [==============================] - 579s 5s/step - loss: 87.0654 - mean_squared_error: 87.0654 - val_loss: 79.6216 - val_mean_squared_error: 79.6216
Epoch 4/8
115/115 [==============================] - 571s 5s/step - loss: 84.2742 - mean_squared_error: 84.2742 - val_loss: 84.6530 - val_mean_squared_error: 84.6530
Epoch 5/8
115/115 [==============================] - 580s 5s/step - loss: 82.7098 - mean_squared_error: 82.7098 - val_loss: 86.9783 - val_mean_squared_error: 86.9783
Epoch 6/8
115/115 [==============================] - 583s 5s/step - loss: 80.9716 - mean_squared_error: 80.9716 - val_loss: 81.6318 - val_mean_squared_error: 81.6318
Epoch 7/8
110/115 [===========================>..] - ETA: 20s - loss: 81.2029 - mean_squared_error: 81.2029
```

  - Reached the limit of allowed GPU usage, have to try tomorrow

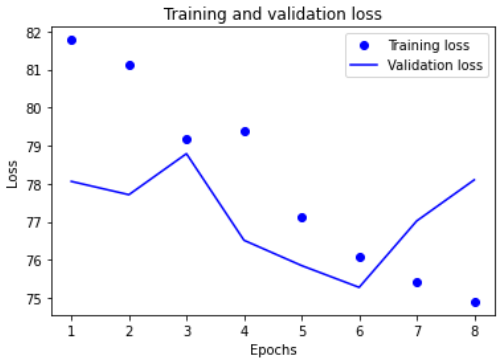
- Running on Jupyter notebook

```
Epoch 1/8
115/115 [==============================] - 233s 2s/step - loss: 125.2378 - mean_squared
_error: 125.2378 - val_loss: 88.1374 - val_mean_squared_error: 88.1374
Epoch 2/8
115/115 [==============================] - 203s 2s/step - loss: 100.7895 - mean_squared
_error: 100.7895 - val_loss: 78.9153 - val_mean_squared_error: 78.9153
Epoch 3/8
115/115 [==============================] - 210s 2s/step - loss: 93.7233 - mean_squared_
error: 93.7233 - val_loss: 90.1454 - val_mean_squared_error: 90.1454
Epoch 4/8
115/115 [==============================] - 201s 2s/step - loss: 93.0283 - mean_squared_
error: 93.0283 - val_loss: 78.5253 - val_mean_squared_error: 78.5253
Epoch 5/8
115/115 [==============================] - 203s 2s/step - loss: 89.7729 - mean_squared_
error: 89.7729 - val_loss: 84.6296 - val_mean_squared_error: 84.6296
Epoch 6/8
115/115 [==============================] - 196s 2s/step - loss: 86.9344 - mean_squared_
error: 86.9344 - val_loss: 79.9254 - val_mean_squared_error: 79.9254
Epoch 7/8
115/115 [==============================] - 196s 2s/step - loss: 83.8817 - mean_squared_
error: 83.8817 - val_loss: 78.3896 - val_mean_squared_error: 78.3896
Epoch 8/8
115/115 [==============================] - 195s 2s/step - loss: 84.6074 - mean_squared_
error: 84.6074 - val_loss: 87.2523 - val_mean_squared_error: 87.2523
```



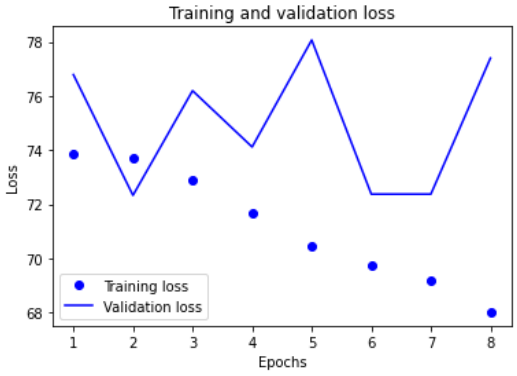

```
Epoch 1/8
230/230 [==============================] - 404s 2s/step - loss: 81.7764 - mean_squared_
error: 81.7764 - val_loss: 78.0599 - val_mean_squared_error: 78.0599
Epoch 2/8
230/230 [==============================] - 409s 2s/step - loss: 81.1123 - mean_squared_
error: 81.1123 - val_loss: 77.7105 - val_mean_squared_error: 77.7105
Epoch 3/8
230/230 [==============================] - 412s 2s/step - loss: 79.1702 - mean_squared_
error: 79.1702 - val_loss: 78.7884 - val_mean_squared_error: 78.7884
Epoch 4/8
230/230 [==============================] - 408s 2s/step - loss: 79.3694 - mean_squared_
error: 79.3694 - val_loss: 76.5128 - val_mean_squared_error: 76.5128
Epoch 5/8
230/230 [==============================] - 385s 2s/step - loss: 77.1083 - mean_squared_
error: 77.1083 - val_loss: 75.8488 - val_mean_squared_error: 75.8488
Epoch 6/8
230/230 [==============================] - 384s 2s/step - loss: 76.0949 - mean_squared_
error: 76.0949 - val_loss: 75.2758 - val_mean_squared_error: 75.2758
Epoch 7/8
230/230 [==============================] - 389s 2s/step - loss: 75.4087 - mean_squared_
error: 75.4087 - val_loss: 77.0208 - val_mean_squared_error: 77.0208
Epoch 8/8
230/230 [==============================] - 398s 2s/step - loss: 74.8992 - mean_squared_
error: 74.8992 - val_loss: 78.1005 - val_mean_squared_error: 78.1005
```

Out[22]: <keras.callbacks.History at 0x20c16b6a550>




```
Epoch 1/8
230/230 [==============================] - 429s 2s/step - loss: 73.8664 - mean_squared_
error: 73.8664 - val_loss: 76.7911 - val_mean_squared_error: 76.7911
Epoch 2/8
230/230 [==============================] - 368s 2s/step - loss: 73.7121 - mean_squared_
error: 73.7121 - val_loss: 72.3293 - val_mean_squared_error: 72.3293
Epoch 3/8
230/230 [==============================] - 367s 2s/step - loss: 72.8843 - mean_squared_
error: 72.8843 - val_loss: 76.1970 - val_mean_squared_error: 76.1970
Epoch 4/8
230/230 [==============================] - 370s 2s/step - loss: 71.6714 - mean_squared_
error: 71.6714 - val_loss: 74.1175 - val_mean_squared_error: 74.1175
Epoch 5/8
230/230 [==============================] - 368s 2s/step - loss: 70.4417 - mean_squared_
error: 70.4417 - val_loss: 78.0715 - val_mean_squared_error: 78.0715
Epoch 6/8
230/230 [==============================] - 387s 2s/step - loss: 69.7167 - mean_squared_
error: 69.7167 - val_loss: 72.3739 - val_mean_squared_error: 72.3739
Epoch 7/8
230/230 [==============================] - 392s 2s/step - loss: 69.1768 - mean_squared_
error: 69.1768 - val_loss: 72.3747 - val_mean_squared_error: 72.3747
Epoch 8/8
230/230 [==============================] - 389s 2s/step - loss: 68.0131 - mean_squared_
error: 68.0131 - val_loss: 77.4036 - val_mean_squared_error: 77.4036
```

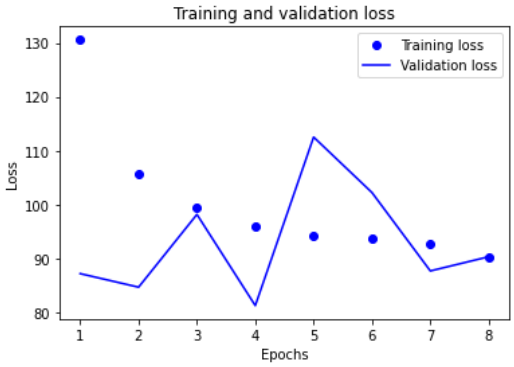
Out[13]: <keras.callbacks.History at 0x19f29fc63d0>



- Try learning rate 0.00001 with SGD

```
Epoch 1/8
230/230 [==============================] - 393s 2s/step - loss: 130.5979 - mean_squared
_error: 130.5979 - val_loss: 87.1345 - val_mean_squared_error: 87.1345
Epoch 2/8
230/230 [==============================] - 389s 2s/step - loss: 105.6709 - mean_squared
_error: 105.6709 - val_loss: 84.6182 - val_mean_squared_error: 84.6182
Epoch 3/8
230/230 [==============================] - 389s 2s/step - loss: 99.5450 - mean_squared_
error: 99.5450 - val_loss: 98.1407 - val_mean_squared_error: 98.1407
Epoch 4/8
230/230 [==============================] - 385s 2s/step - loss: 95.9482 - mean_squared_
error: 95.9482 - val_loss: 81.1982 - val_mean_squared_error: 81.1982
Epoch 5/8
230/230 [==============================] - 385s 2s/step - loss: 94.2707 - mean_squared_
error: 94.2707 - val_loss: 112.5131 - val_mean_squared_error: 112.5131
Epoch 6/8
230/230 [==============================] - 396s 2s/step - loss: 93.5828 - mean_squared_
error: 93.5828 - val_loss: 102.1992 - val_mean_squared_error: 102.1992
Epoch 7/8
230/230 [==============================] - 426s 2s/step - loss: 92.5747 - mean_squared_
error: 92.5747 - val_loss: 87.6354 - val_mean_squared_error: 87.6354
Epoch 8/8
230/230 [==============================] - 407s 2s/step - loss: 90.2952 - mean_squared_
error: 90.2952 - val_loss: 90.2751 - val_mean_squared_error: 90.2751
```

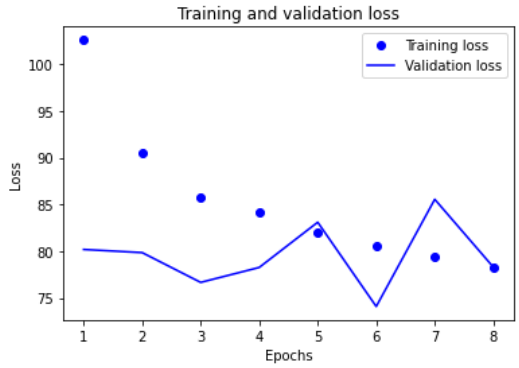
Out[23]: <keras.callbacks.History at 0x1a04e750940>



- With re-scaling

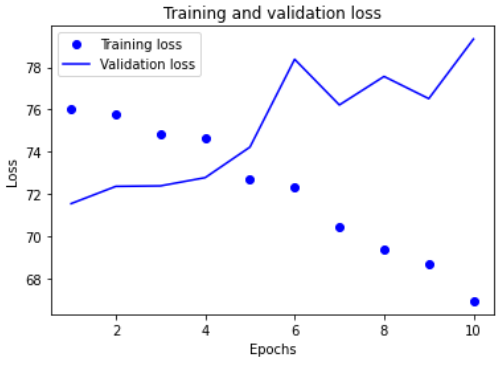
```
Epoch 1/8
230/230 [==============================] - 461s 2s/step - loss: 102.5947 - mean_squared
_error: 102.5947 - val_loss: 80.1942 - val_mean_squared_error: 80.1942
Epoch 2/8
230/230 [==============================] - 394s 2s/step - loss: 90.4844 - mean_squared_
error: 90.4844 - val_loss: 79.8568 - val_mean_squared_error: 79.8568
Epoch 3/8
230/230 [==============================] - 394s 2s/step - loss: 85.8209 - mean_squared_
error: 85.8209 - val_loss: 76.6730 - val_mean_squared_error: 76.6730
Epoch 4/8
230/230 [==============================] - 394s 2s/step - loss: 84.1210 - mean_squared_
error: 84.1210 - val_loss: 78.2706 - val_mean_squared_error: 78.2706
Epoch 5/8
230/230 [==============================] - 396s 2s/step - loss: 81.9829 - mean_squared_
error: 81.9829 - val_loss: 83.1064 - val_mean_squared_error: 83.1064
Epoch 6/8
230/230 [==============================] - 392s 2s/step - loss: 80.5987 - mean_squared_
error: 80.5987 - val_loss: 74.0958 - val_mean_squared_error: 74.0958
Epoch 7/8
230/230 [==============================] - 380s 2s/step - loss: 79.3640 - mean_squared_
error: 79.3640 - val_loss: 85.5555 - val_mean_squared_error: 85.5555
Epoch 8/8
230/230 [==============================] - 380s 2s/step - loss: 78.2576 - mean_squared_
error: 78.2576 - val_loss: 78.3148 - val_mean_squared_error: 78.3148
```

Out[15]: <keras.callbacks.History at 0x1bbd726c370>



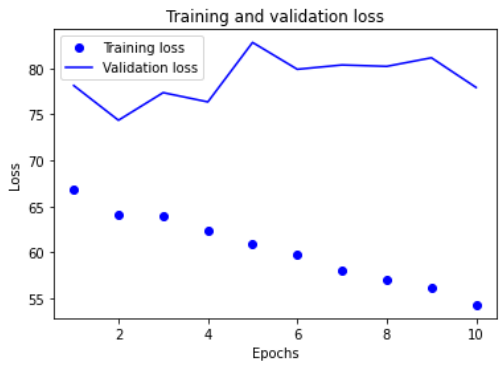

```
Epoch 1/10
230/230 [==============================] - 399s 2s/step - loss: 76.0124 - mean_squared_
error: 76.0124 - val_loss: 71.5425 - val_mean_squared_error: 71.5425
Epoch 2/10
230/230 [==============================] - 404s 2s/step - loss: 75.7523 - mean_squared_
error: 75.7523 - val_loss: 72.3602 - val_mean_squared_error: 72.3602
Epoch 3/10
230/230 [==============================] - 405s 2s/step - loss: 74.8231 - mean_squared_
error: 74.8231 - val_loss: 72.3838 - val_mean_squared_error: 72.3838
Epoch 4/10
230/230 [==============================] - 406s 2s/step - loss: 74.6167 - mean_squared_
error: 74.6167 - val_loss: 72.7745 - val_mean_squared_error: 72.7745
Epoch 5/10
230/230 [==============================] - 404s 2s/step - loss: 72.6824 - mean_squared_
error: 72.6824 - val_loss: 74.2204 - val_mean_squared_error: 74.2204
Epoch 6/10
230/230 [==============================] - 402s 2s/step - loss: 72.3079 - mean_squared_
error: 72.3079 - val_loss: 78.3798 - val_mean_squared_error: 78.3798
Epoch 7/10
230/230 [==============================] - 403s 2s/step - loss: 70.4197 - mean_squared_
error: 70.4197 - val_loss: 76.2163 - val_mean_squared_error: 76.2163
Epoch 8/10
230/230 [==============================] - 402s 2s/step - loss: 69.3623 - mean_squared_
error: 69.3623 - val_loss: 77.5666 - val_mean_squared_error: 77.5666
Epoch 9/10
230/230 [==============================] - 404s 2s/step - loss: 68.6685 - mean_squared_
error: 68.6685 - val_loss: 76.5154 - val_mean_squared_error: 76.5154
Epoch 10/10
230/230 [==============================] - 402s 2s/step - loss: 66.9290 - mean_squared_
error: 66.9290 - val_loss: 79.3385 - val_mean_squared_error: 79.3385
```

Out[18]: <keras.callbacks.History at 0x1bcc238b700>



```
Epoch 1/10
230/230 [==============================] - 421s 2s/step - loss: 66.8870 - mean_squared_
error: 66.8870 - val_loss: 78.1265 - val_mean_squared_error: 78.1265
Epoch 2/10
230/230 [==============================] - 420s 2s/step - loss: 64.1622 - mean_squared_
error: 64.1622 - val_loss: 74.3554 - val_mean_squared_error: 74.3554
Epoch 3/10
230/230 [==============================] - 405s 2s/step - loss: 63.8941 - mean_squared_
error: 63.8941 - val_loss: 77.3547 - val_mean_squared_error: 77.3547
Epoch 4/10
230/230 [==============================] - 395s 2s/step - loss: 62.3949 - mean_squared_
error: 62.3949 - val_loss: 76.3474 - val_mean_squared_error: 76.3474
Epoch 5/10
230/230 [==============================] - 395s 2s/step - loss: 60.9105 - mean_squared_
error: 60.9105 - val_loss: 82.8097 - val_mean_squared_error: 82.8097
Epoch 6/10
230/230 [==============================] - 396s 2s/step - loss: 59.7904 - mean_squared_
error: 59.7904 - val_loss: 79.8915 - val_mean_squared_error: 79.8915
Epoch 7/10
230/230 [==============================] - 394s 2s/step - loss: 57.9829 - mean_squared_
error: 57.9829 - val_loss: 80.3627 - val_mean_squared_error: 80.3627
Epoch 8/10
230/230 [==============================] - 395s 2s/step - loss: 56.9951 - mean_squared_
error: 56.9951 - val_loss: 80.2107 - val_mean_squared_error: 80.2107
Epoch 9/10
230/230 [==============================] - 394s 2s/step - loss: 56.1949 - mean_squared_
error: 56.1949 - val_loss: 81.1421 - val_mean_squared_error: 81.1421
Epoch 10/10
230/230 [==============================] - 393s 2s/step - loss: 54.2942 - mean_squared_
error: 54.2942 - val_loss: 77.9158 - val_mean_squared_error: 77.9158
```

Out[21]: <keras.callbacks.History at 0x1bcc238b070>

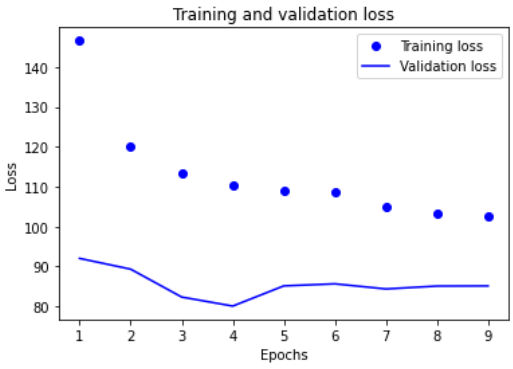


Formalized VGG

- Call back
  - Learning rate scheduler: decrease exponentially after 10 epochs
  - Patience = 5
  - Save the best model

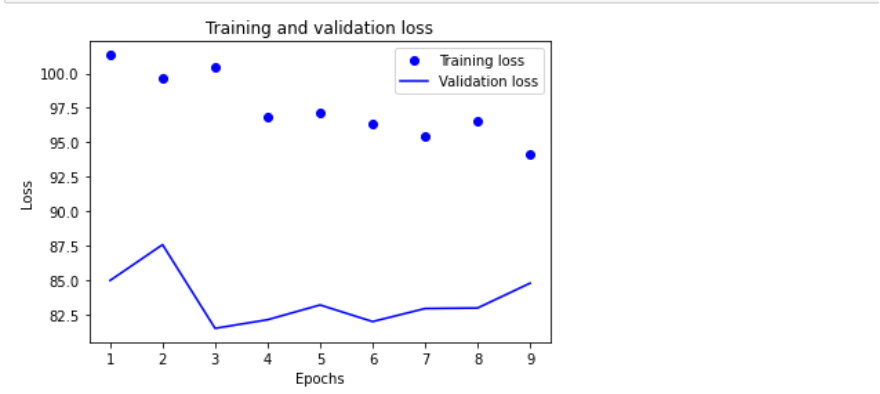
- First attempts at running 30 epochs
  - Stopped at epoch 9 because validation error stopped improving since epoch 4
  - Saved model as my_VGG16

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
178/178 [==============================] - 345s 2s/step - loss: 146.6126 - mean_squared
_error: 146.6126 - val_loss: 92.0483 - val_mean_squared_error: 92.0483
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
178/178 [==============================] - 306s 2s/step - loss: 120.2775 - mean_squared
_error: 120.2775 - val_loss: 89.3505 - val_mean_squared_error: 89.3505
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
178/178 [==============================] - 303s 2s/step - loss: 113.2469 - mean_squared
_error: 113.2469 - val_loss: 82.3598 - val_mean_squared_error: 82.3598
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
178/178 [==============================] - 313s 2s/step - loss: 110.2808 - mean_squared
_error: 110.2808 - val_loss: 80.0999 - val_mean_squared_error: 80.0999
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
178/178 [==============================] - 303s 2s/step - loss: 108.9179 - mean_squared
_error: 108.9179 - val_loss: 85.1592 - val_mean_squared_error: 85.1592
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
178/178 [==============================] - 303s 2s/step - loss: 108.6652 - mean_squared
_error: 108.6652 - val_loss: 85.6712 - val_mean_squared_error: 85.6712
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
178/178 [==============================] - 302s 2s/step - loss: 105.0581 - mean_squared
_error: 105.0581 - val_loss: 84.3903 - val_mean_squared_error: 84.3903
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
178/178 [==============================] - 302s 2s/step - loss: 103.2994 - mean_squared
_error: 103.2994 - val_loss: 85.1144 - val_mean_squared_error: 85.1144
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
178/178 [==============================] - 303s 2s/step - loss: 102.5154 - mean_squared
_error: 102.5154 - val_loss: 85.1480 - val_mean_squared_error: 85.1480

Out[55]: <tensorflow.python.keras.callbacks.History at 0x25855097be0>
```

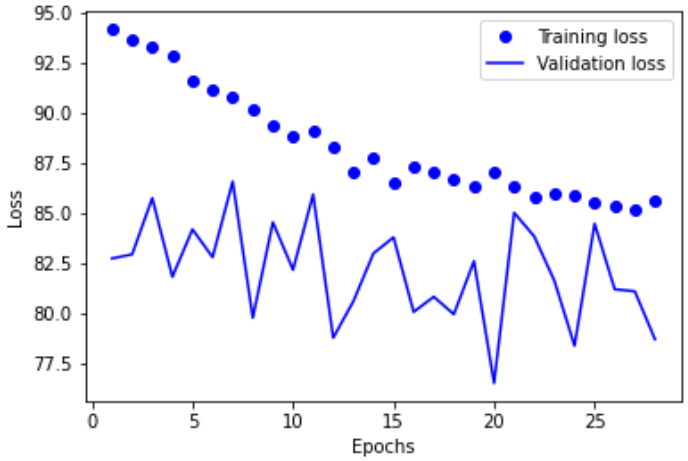


- Second attempt
  - Change learning rate scheduler to start exponential declining after 1 epoch
  - Change patience to 25

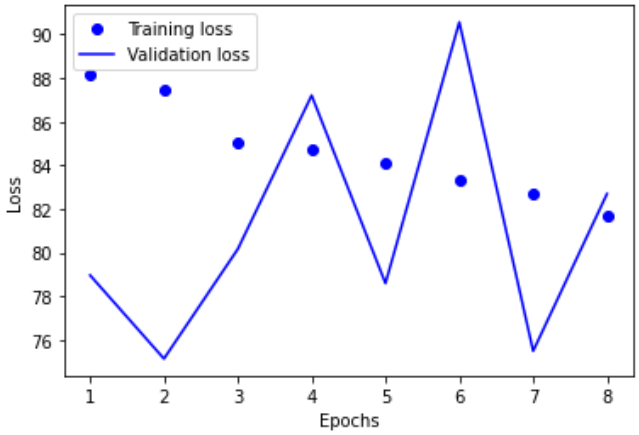
```
Epoch 00003: LearningRateScheduler reducing learning rate to tf.Tensor(8.187307e-06, sh
ape=(), dtype=float32).
178/178 [==============================] - 315s 2s/step - loss: 100.4246 - mean_squared
_error: 100.4246 - val_loss: 81.4724 - val_mean_squared_error: 81.4724
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to tf.Tensor(7.4081813e-06, s
hape=(), dtype=float32).
178/178 [==============================] - 313s 2s/step - loss: 96.8239 - mean_squared_
error: 96.8239 - val_loss: 82.1002 - val_mean_squared_error: 82.1002
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to tf.Tensor(6.7031992e-06, s
hape=(), dtype=float32).
178/178 [==============================] - 312s 2s/step - loss: 97.1200 - mean_squared_
error: 97.1200 - val_loss: 83.1744 - val_mean_squared_error: 83.1744
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to tf.Tensor(6.065305e-06, sh
ape=(), dtype=float32).
178/178 [==============================] - 312s 2s/step - loss: 96.3193 - mean_squared_
error: 96.3193 - val_loss: 81.9647 - val_mean_squared_error: 81.9647
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to tf.Tensor(5.4881148e-06, s
hape=(), dtype=float32).
178/178 [==============================] - 323s 2s/step - loss: 95.4842 - mean_squared_
error: 95.4842 - val_loss: 82.9154 - val_mean_squared_error: 82.9154
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to tf.Tensor(4.9658515e-06, s
hape=(), dtype=float32).
178/178 [==============================] - 324s 2s/step - loss: 96.5140 - mean_squared_
error: 96.5140 - val_loss: 82.9539 - val_mean_squared_error: 82.9539
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to tf.Tensor(4.493288e-06, sh
ape=(), dtype=float32).
178/178 [==============================] - 308s 2s/step - loss: 94.0955 - mean_squared_
error: 94.0955 - val_loss: 84.7562 - val_mean_squared_error: 84.7562
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to tf.Tensor(4.065695e-06, sh
ape=(), dtype=float32).
 30/178 [====>.........................] - ETA: 3:23 - loss: 92.5846 - mean_squared_err
or: 92.5846
```



- Not improving by much, need to raise the learning rate instead of lowering it every epoch
  - Implement exponential declining after another 5 epochs, and rate is e^(-0.05)
  - Set patience to 8

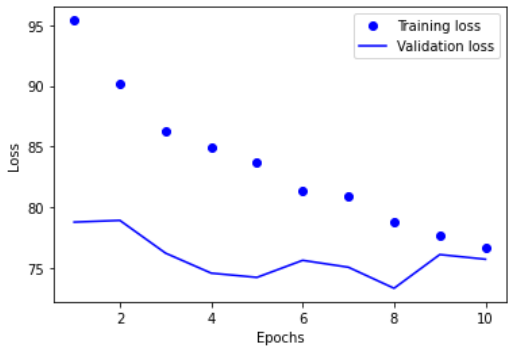


- Validation loss demonstrated a general downward trend, stop exponential declining of the learning rate, train at 0.00005 for another 30 epochs with patience = 8

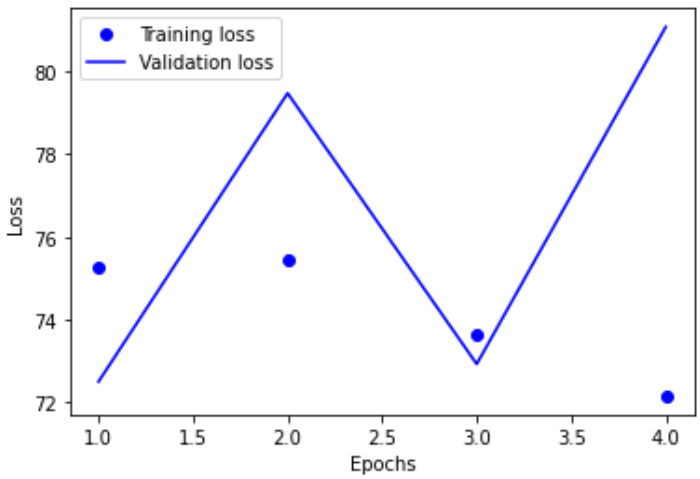


- 0.0001 learning rate and 10 epochs

```
Epoch 1/10
178/178 [==============================] - 335s 2s/step - loss: 95.3914 - mean_squared_
error: 95.3914 - val_loss: 78.8058 - val_mean_squared_error: 78.8058
Epoch 2/10
178/178 [==============================] - 309s 2s/step - loss: 90.2278 - mean_squared_
error: 90.2278 - val_loss: 78.9456 - val_mean_squared_error: 78.9456
Epoch 3/10
178/178 [==============================] - 307s 2s/step - loss: 86.2565 - mean_squared_
error: 86.2565 - val_loss: 76.2541 - val_mean_squared_error: 76.2541
Epoch 4/10
178/178 [==============================] - 302s 2s/step - loss: 84.9408 - mean_squared_
error: 84.9408 - val_loss: 74.6080 - val_mean_squared_error: 74.6080
Epoch 5/10
178/178 [==============================] - 303s 2s/step - loss: 83.7144 - mean_squared_
error: 83.7144 - val_loss: 74.2595 - val_mean_squared_error: 74.2595
Epoch 6/10
178/178 [==============================] - 303s 2s/step - loss: 81.3884 - mean_squared_
error: 81.3884 - val_loss: 75.6617 - val_mean_squared_error: 75.6617
Epoch 7/10
178/178 [==============================] - 303s 2s/step - loss: 80.8989 - mean_squared_
error: 80.8989 - val_loss: 75.0960 - val_mean_squared_error: 75.0960
Epoch 8/10
178/178 [==============================] - 302s 2s/step - loss: 78.8583 - mean_squared_
error: 78.8583 - val_loss: 73.3646 - val_mean_squared_error: 73.3646
Epoch 9/10
178/178 [==============================] - 304s 2s/step - loss: 77.7545 - mean_squared_
error: 77.7545 - val_loss: 76.1359 - val_mean_squared_error: 76.1359
Epoch 10/10
178/178 [==============================] - 303s 2s/step - loss: 76.6743 - mean_squared_
error: 76.6743 - val_loss: 75.7536 - val_mean_squared_error: 75.7536
Out[54]: <tensorflow.python.keras.callbacks.History at 0x23a9e291910>
```

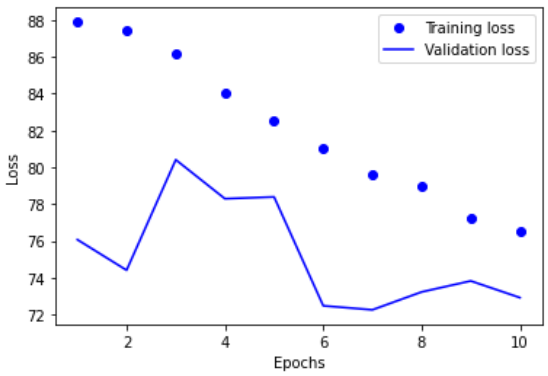


- Another 4 epochs



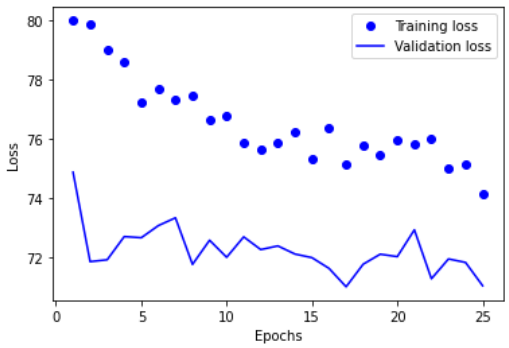
- Learning rate: 0.00005

```
Epoch 1/10
178/178 [==============================] - 310s 2s/step - loss: 87.8959 - mean_squared_
error: 87.8959 - val_loss: 76.0690 - val_mean_squared_error: 76.0690
Epoch 2/10
178/178 [==============================] - 307s 2s/step - loss: 87.4619 - mean_squared_
error: 87.4619 - val_loss: 74.4099 - val_mean_squared_error: 74.4099
Epoch 3/10
178/178 [==============================] - 309s 2s/step - loss: 86.1584 - mean_squared_
error: 86.1584 - val_loss: 80.4111 - val_mean_squared_error: 80.4111
Epoch 4/10
178/178 [==============================] - 309s 2s/step - loss: 84.0565 - mean_squared_
error: 84.0565 - val_loss: 78.2950 - val_mean_squared_error: 78.2950
Epoch 5/10
178/178 [==============================] - 310s 2s/step - loss: 82.5447 - mean_squared_
error: 82.5447 - val_loss: 78.3913 - val_mean_squared_error: 78.3913
Epoch 6/10
178/178 [==============================] - 307s 2s/step - loss: 81.0328 - mean_squared_
error: 81.0328 - val_loss: 72.4768 - val_mean_squared_error: 72.4768
Epoch 7/10
178/178 [==============================] - 310s 2s/step - loss: 79.5954 - mean_squared_
error: 79.5954 - val_loss: 72.2576 - val_mean_squared_error: 72.2576
Epoch 8/10
178/178 [==============================] - 308s 2s/step - loss: 78.9839 - mean_squared_
error: 78.9839 - val_loss: 73.2275 - val_mean_squared_error: 73.2275
Epoch 9/10
178/178 [==============================] - 309s 2s/step - loss: 77.1960 - mean_squared_
error: 77.1960 - val_loss: 73.8266 - val_mean_squared_error: 73.8266
Epoch 10/10
178/178 [==============================] - 306s 2s/step - loss: 76.5333 - mean_squared_
error: 76.5333 - val_loss: 72.9190 - val_mean_squared_error: 72.9190
```



- Go back to epoch 5 with learning rate 0.00001, declining learning rate after 5 epochs at rate of e^-0.1

```
Epoch 00023: LearningRateScheduler reducing learning rate to tf.Tensor(1.6529875e-06,
shape=(), dtype=float32).
178/178 [==============================] - 285s 2s/step - loss: 75.0047 - mean_square
d_error: 75.0047 - val_loss: 71.9428 - val_mean_squared_error: 71.9428
Epoch 24/30

Epoch 00024: LearningRateScheduler reducing learning rate to tf.Tensor(1.4956848e-06,
shape=(), dtype=float32).
178/178 [==============================] - 285s 2s/step - loss: 75.1511 - mean_square
d_error: 75.1511 - val_loss: 71.8242 - val_mean_squared_error: 71.8242
Epoch 25/30

Epoch 00025: LearningRateScheduler reducing learning rate to tf.Tensor(1.3533515e-06,
shape=(), dtype=float32).
178/178 [==============================] - 286s 2s/step - loss: 74.1426 - mean_square
d_error: 74.1426 - val_loss: 71.0394 - val_mean_squared_error: 71.0394
```

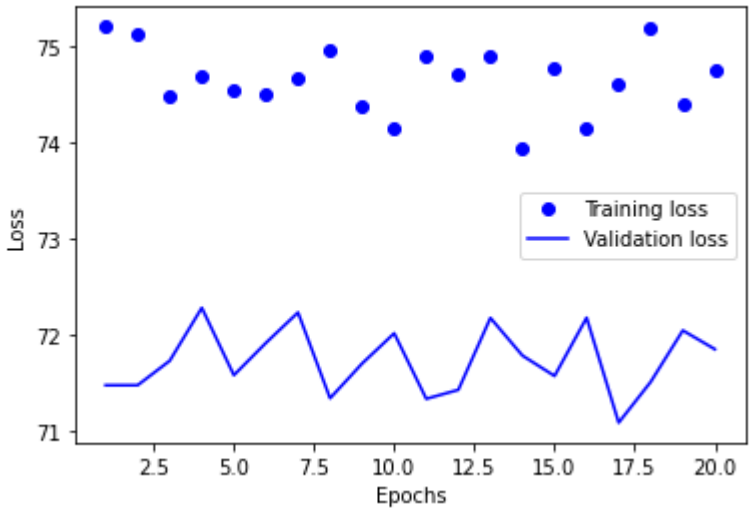


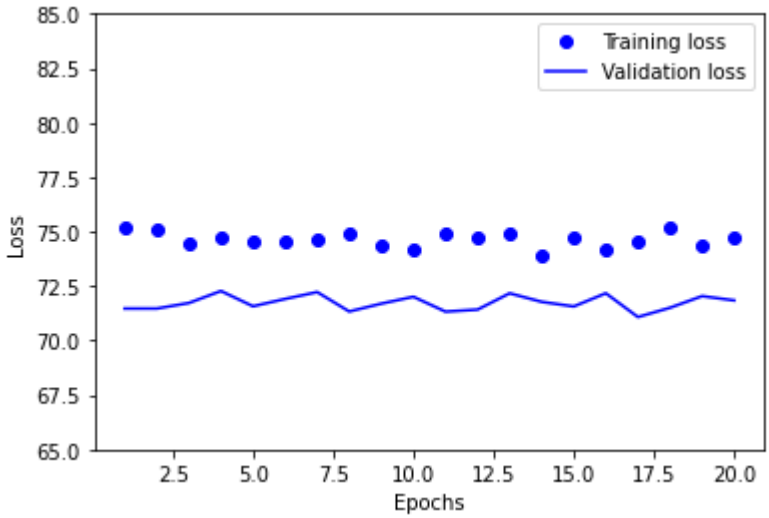
Epoch 17: 71.003 → 71.768 PICK
Epoch 25: 71.039 → 71.602

- Another 20 rounds with declining rate from 2 epochs, patience=10, declining rate = e^-0.15

```
Epoch 1/20

Epoch 00001: LearningRateScheduler reducing learning rate to 1.3533515357266879e-06.
178/178 [==============================] - 305s 2s/step - loss: 75.1998 - mean_squared_
error: 75.1998 - val_loss: 71.4680 - val_mean_squared_error: 71.4680
Epoch 2/20

Epoch 00002: LearningRateScheduler reducing learning rate to 1.3533515357266879e-06.
178/178 [==============================] - 302s 2s/step - loss: 75.1147 - mean_squared_
error: 75.1147 - val_loss: 71.4685 - val_mean_squared_error: 71.4685
Epoch 3/20

Epoch 00003: LearningRateScheduler reducing learning rate to tf.Tensor(1.1648405e-06, s
hape=(), dtype=float32).
178/178 [==============================] - 301s 2s/step - loss: 74.4771 - mean_squared_
error: 74.4771 - val_loss: 71.7228 - val_mean_squared_error: 71.7228
Epoch 4/20

Epoch 00004: LearningRateScheduler reducing learning rate to tf.Tensor(1.0025874e-06, s
hape=(), dtype=float32).
178/178 [==============================] - 302s 2s/step - loss: 74.6896 - mean_squared_
error: 74.6896 - val_loss: 72.2739 - val_mean_squared_error: 72.2739
Epoch 5/20

Epoch 00005: LearningRateScheduler reducing learning rate to tf.Tensor(8.6293494e-07, s
hape=(), dtype=float32).
178/178 [==============================] - 304s 2s/step - loss: 74.5463 - mean_squared_
error: 74.5463 - val_loss: 71.5728 - val_mean_squared_error: 71.5728
Epoch 6/20

Epoch 00006: LearningRateScheduler reducing learning rate to tf.Tensor(7.427349e-07, sh
ape=(), dtype=float32).
178/178 [==============================] - 302s 2s/step - loss: 74.5056 - mean_squared_
error: 74.5056 - val_loss: 71.9089 - val_mean_squared_error: 71.9089
Epoch 7/20

Epoch 00007: LearningRateScheduler reducing learning rate to tf.Tensor(6.3927786e-07, s
hape=(), dtype=float32).
178/178 [==============================] - 302s 2s/step - loss: 74.6658 - mean_squared_
error: 74.6658 - val_loss: 72.2253 - val_mean_squared_error: 72.2253
Epoch 8/20
```

```
Epoch 00008: LearningRateScheduler reducing learning rate to tf.Tensor(5.502315e-07, sh
ape=(), dtype=float32).
178/178 [==============================] - 298s 2s/step - loss: 74.9478 - mean_squared_
error: 74.9478 - val_loss: 71.3326 - val_mean_squared_error: 71.3326
Epoch 9/20

Epoch 00009: LearningRateScheduler reducing learning rate to tf.Tensor(4.735886e-07, sh
ape=(), dtype=float32).
178/178 [==============================] - 303s 2s/step - loss: 74.3688 - mean_squared_
error: 74.3688 - val_loss: 71.6944 - val_mean_squared_error: 71.6944
Epoch 10/20

Epoch 00010: LearningRateScheduler reducing learning rate to tf.Tensor(4.0762149e-07, s
hape=(), dtype=float32).
178/178 [==============================] - 304s 2s/step - loss: 74.1483 - mean_squared_
error: 74.1483 - val_loss: 72.0088 - val_mean_squared_error: 72.0088
Epoch 11/20

Epoch 00011: LearningRateScheduler reducing learning rate to tf.Tensor(3.5084304e-07, s
hape=(), dtype=float32).
178/178 [==============================] - 305s 2s/step - loss: 74.8842 - mean_squared_
error: 74.8842 - val_loss: 71.3269 - val_mean_squared_error: 71.3269
Epoch 12/20

Epoch 00012: LearningRateScheduler reducing learning rate to tf.Tensor(3.019734e-07, sh
ape=(), dtype=float32).
178/178 [==============================] - 310s 2s/step - loss: 74.7120 - mean_squared_
error: 74.7120 - val_loss: 71.4203 - val_mean_squared_error: 71.4203
Epoch 13/20

Epoch 00015: LearningRateScheduler reducing learning rate to tf.Tensor(1.9254671e-07,
shape=(), dtype=float32).
178/178 [==============================] - 308s 2s/step - loss: 74.7671 - mean_square
d_error: 74.7671 - val_loss: 71.5647 - val_mean_squared_error: 71.5647
Epoch 16/20

Epoch 00016: LearningRateScheduler reducing learning rate to tf.Tensor(1.6572648e-07,
shape=(), dtype=float32).
178/178 [==============================] - 307s 2s/step - loss: 74.1353 - mean_square
d_error: 74.1353 - val_loss: 72.1708 - val_mean_squared_error: 72.1708
Epoch 17/20

Epoch 00017: LearningRateScheduler reducing learning rate to tf.Tensor(1.426421e-07,
shape=(), dtype=float32).
178/178 [==============================] - 306s 2s/step - loss: 74.5915 - mean_square
d_error: 74.5915 - val_loss: 71.0791 - val_mean_squared_error: 71.0791
Epoch 18/20

Epoch 00018: LearningRateScheduler reducing learning rate to tf.Tensor(1.2277319e-07,
shape=(), dtype=float32).
178/178 [==============================] - 307s 2s/step - loss: 75.1764 - mean_square
d_error: 75.1764 - val_loss: 71.5040 - val_mean_squared_error: 71.5040
Epoch 19/20

Epoch 00019: LearningRateScheduler reducing learning rate to tf.Tensor(1.0567186e-07,
shape=(), dtype=float32).
178/178 [==============================] - 308s 2s/step - loss: 74.3958 - mean_square
d_error: 74.3958 - val_loss: 72.0383 - val_mean_squared_error: 72.0383
Epoch 20/20

Epoch 00020: LearningRateScheduler reducing learning rate to tf.Tensor(9.095261e-08,
shape=(), dtype=float32).
178/178 [==============================] - 305s 2s/step - loss: 74.7472 - mean_square
d_error: 74.7472 - val_loss: 71.8428 - val_mean_squared_error: 71.8428
```





Epoch 17: 71.019 → 72.461
Epoch 20: 71.8428 → 72.270

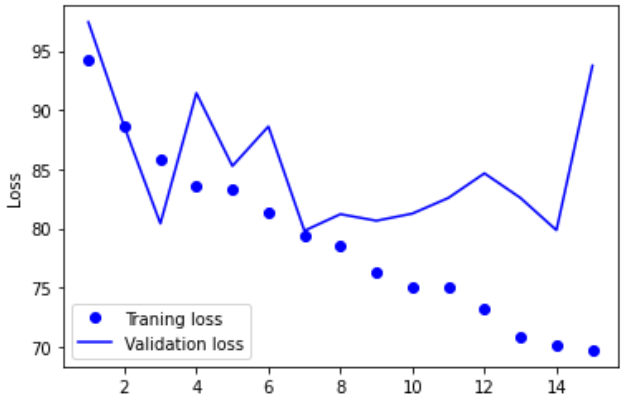
ResNet

- Warming up with learning rate 0.0001, 2 epochs
- Try 30 epochs with 0.00001 learning rate with exponential declining after 15 with e^-0.05, patience = 8

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 321s 441ms/step - loss: 94.2917 - mean_squar
ed_error: 94.2917 - val_loss: 97.4187 - val_mean_squared_error: 97.4187
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 315s 442ms/step - loss: 88.6131 - mean_squar
ed_error: 88.6131 - val_loss: 88.5752 - val_mean_squared_error: 88.5752
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 316s 443ms/step - loss: 85.7637 - mean_squar
ed_error: 85.7637 - val_loss: 80.4144 - val_mean_squared_error: 80.4144
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 318s 446ms/step - loss: 83.5418 - mean_squar
ed_error: 83.5418 - val_loss: 91.4282 - val_mean_squared_error: 91.4282
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 313s 440ms/step - loss: 83.2737 - mean_squar
ed_error: 83.2737 - val_loss: 85.2670 - val_mean_squared_error: 85.2670
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 315s 443ms/step - loss: 81.3629 - mean_squar
ed_error: 81.3629 - val_loss: 88.6109 - val_mean_squared_error: 88.6109
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 312s 438ms/step - loss: 79.3266 - mean_squar
ed_error: 79.3266 - val_loss: 79.8032 - val_mean_squared_error: 79.8032
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 314s 440ms/step - loss: 78.5277 - mean_squar
ed_error: 78.5277 - val_loss: 81.2031 - val_mean_squared_error: 81.2031
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 312s 438ms/step - loss: 76.3062 - mean_squar
ed_error: 76.3062 - val_loss: 80.6488 - val_mean_squared_error: 80.6488
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 315s 442ms/step - loss: 75.0748 - mean_squar
ed_error: 75.0748 - val_loss: 81.2544 - val_mean_squared_error: 81.2544
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 315s 443ms/step - loss: 74.9880 - mean_squar
ed_error: 74.9880 - val_loss: 82.5774 - val_mean_squared_error: 82.5774
Epoch 12/30
```

```
Epoch 00012: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 314s 441ms/step - loss: 73.1968 - mean_squar
ed_error: 73.1968 - val_loss: 84.6513 - val_mean_squared_error: 84.6513
Epoch 13/30

Epoch 00013: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 318s 446ms/step - loss: 70.8411 - mean_squar
ed_error: 70.8411 - val_loss: 82.5792 - val_mean_squared_error: 82.5792
Epoch 14/30

Epoch 00014: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 319s 448ms/step - loss: 70.1475 - mean_squar
ed_error: 70.1475 - val_loss: 79.8480 - val_mean_squared_error: 79.8480
Epoch 15/30

Epoch 00015: LearningRateScheduler reducing learning rate to 9.999999747378752e-06.
712/712 [==============================] - 315s 443ms/step - loss: 69.7273 - mean_squar
ed_error: 69.7273 - val_loss: 93.7436 - val_mean_squared_error: 93.7436
```

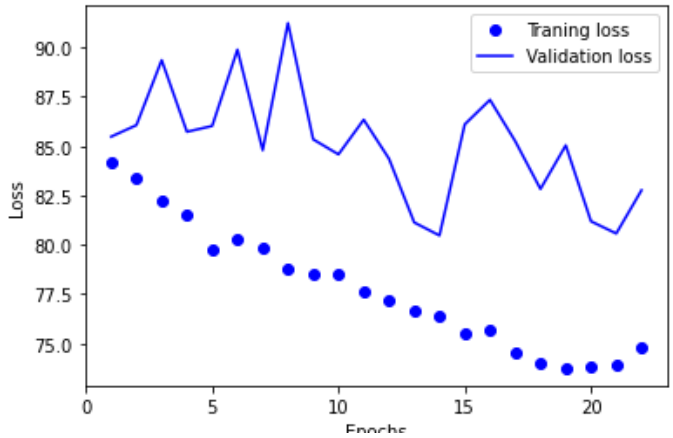
```
plt.show()
```



- Adjust learning rate to 0.000002, start from epoch 2: 88.575, change exponential declining to after 10 epochs

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 317s 440ms/step - loss: 84.1440 - mean_squar
ed_error: 84.1440 - val_loss: 85.4815 - val_mean_squared_error: 85.4815
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 311s 437ms/step - loss: 83.3416 - mean_squar
ed_error: 83.3416 - val_loss: 86.0651 - val_mean_squared_error: 86.0651
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 312s 437ms/step - loss: 82.2525 - mean_squar
ed_error: 82.2525 - val_loss: 89.3611 - val_mean_squared_error: 89.3611
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 311s 437ms/step - loss: 81.4845 - mean_squar
ed_error: 81.4845 - val_loss: 85.7279 - val_mean_squared_error: 85.7279
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 311s 437ms/step - loss: 79.7806 - mean_squar
ed_error: 79.7806 - val_loss: 86.0238 - val_mean_squared_error: 86.0238
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 311s 436ms/step - loss: 80.2477 - mean_squar
ed_error: 80.2477 - val_loss: 89.8937 - val_mean_squared_error: 89.8937
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 310s 436ms/step - loss: 79.8503 - mean_squar
ed_error: 79.8503 - val_loss: 84.7938 - val_mean_squared_error: 84.7938
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 312s 439ms/step - loss: 78.7429 - mean_squar
ed_error: 78.7429 - val_loss: 91.2391 - val_mean_squared_error: 91.2391
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 312s 438ms/step - loss: 78.5227 - mean_squar
ed_error: 78.5227 - val_loss: 85.3445 - val_mean_squared_error: 85.3445
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 311s 436ms/step - loss: 78.4826 - mean_squar
ed_error: 78.4826 - val_loss: 84.5822 - val_mean_squared_error: 84.5822
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to tf.Tensor(1.9024588e-06, s
hape=(), dtype=float32).
712/712 [==============================] - 310s 435ms/step - loss: 77.6442 - mean_squar
ed_error: 77.6442 - val_loss: 86.3416 - val_mean_squared_error: 86.3416
Epoch 12/30
```

```
Epoch 00012: LearningRateScheduler reducing learning rate to tf.Tensor(1.8096749e-06, s
hape=(), dtype=float32).
712/712 [==============================] - 314s 440ms/step - loss: 77.1694 - mean_squar
ed_error: 77.1694 - val_loss: 84.3666 - val_mean_squared_error: 84.3666
Epoch 13/30

Epoch 00013: LearningRateScheduler reducing learning rate to tf.Tensor(1.7214161e-06, s
hape=(), dtype=float32).
712/712 [==============================] - 315s 442ms/step - loss: 76.6345 - mean_squar
ed_error: 76.6345 - val_loss: 81.1324 - val_mean_squared_error: 81.1324
Epoch 14/30

Epoch 00014: LearningRateScheduler reducing learning rate to tf.Tensor(1.6374617e-06, s
hape=(), dtype=float32).
712/712 [==============================] - 314s 441ms/step - loss: 76.4251 - mean_squar
ed_error: 76.4251 - val_loss: 80.4694 - val_mean_squared_error: 80.4694
Epoch 15/30

Epoch 00015: LearningRateScheduler reducing learning rate to tf.Tensor(1.5576018e-06, s
hape=(), dtype=float32).
712/712 [==============================] - 314s 441ms/step - loss: 75.5145 - mean_squar
ed_error: 75.5145 - val_loss: 86.1035 - val_mean_squared_error: 86.1035
Epoch 16/30

Epoch 00016: LearningRateScheduler reducing learning rate to tf.Tensor(1.4816367e-06,
shape=(), dtype=float32).
712/712 [==============================] - 316s 444ms/step - loss: 75.7149 - mean_squ
ared_error: 75.7149 - val_loss: 87.3501 - val_mean_squared_error: 87.3501
Epoch 17/30

Epoch 00017: LearningRateScheduler reducing learning rate to tf.Tensor(1.4093764e-06,
shape=(), dtype=float32).
712/712 [==============================] - 315s 443ms/step - loss: 74.5518 - mean_squ
ared_error: 74.5518 - val_loss: 85.2508 - val_mean_squared_error: 85.2508
Epoch 18/30

Epoch 00018: LearningRateScheduler reducing learning rate to tf.Tensor(1.3406403e-06,
shape=(), dtype=float32).
712/712 [==============================] - 317s 445ms/step - loss: 74.0261 - mean_squ
ared_error: 74.0261 - val_loss: 82.8265 - val_mean_squared_error: 82.8265
Epoch 19/30

Epoch 00019: LearningRateScheduler reducing learning rate to tf.Tensor(1.2752565e-06,
shape=(), dtype=float32).
712/712 [==============================] - 319s 448ms/step - loss: 73.7399 - mean_squ
ared_error: 73.7399 - val_loss: 85.0400 - val_mean_squared_error: 85.0400
Epoch 20/30

Epoch 00020: LearningRateScheduler reducing learning rate to tf.Tensor(1.2130615e-06,
shape=(), dtype=float32).
712/712 [==============================] - 320s 449ms/step - loss: 73.8471 - mean_squ
ared_error: 73.8471 - val_loss: 81.1897 - val_mean_squared_error: 81.1897
Epoch 21/30

Epoch 00021: LearningRateScheduler reducing learning rate to tf.Tensor(1.1538998e-06,
shape=(), dtype=float32).
712/712 [==============================] - 319s 448ms/step - loss: 73.9262 - mean_squ
ared_error: 73.9262 - val_loss: 80.5711 - val_mean_squared_error: 80.5711
Epoch 22/30

Epoch 00022: LearningRateScheduler reducing learning rate to tf.Tensor(1.0976235e-06,
shape=(), dtype=float32).
712/712 [==============================] - 321s 450ms/step - loss: 74.7756 - mean_squ
ared_error: 74.7756 - val_loss: 82.7631 - val_mean_squared_error: 82.7631
```

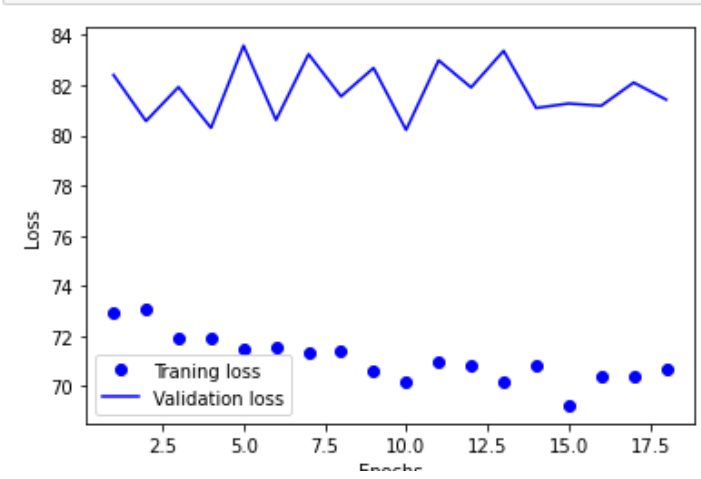


- Training loss seems stabilizing, continue training with declining weights of e^-0.15, after 2 epochs with initial learning rate 1e-6

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 346s 460ms/step - loss: 72.9707 - mean_squar
ed_error: 72.9707 - val_loss: 82.4120 - val_mean_squared_error: 82.4120
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 298s 419ms/step - loss: 73.0491 - mean_squar
ed_error: 73.0491 - val_loss: 80.5705 - val_mean_squared_error: 80.5705
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to tf.Tensor(8.607079e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 297s 417ms/step - loss: 71.9304 - mean_squar
ed_error: 71.9304 - val_loss: 81.9275 - val_mean_squared_error: 81.9275
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to tf.Tensor(7.4081817e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 297s 417ms/step - loss: 71.8887 - mean_squar
ed_error: 71.8887 - val_loss: 80.2970 - val_mean_squared_error: 80.2970
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to tf.Tensor(6.376281e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 299s 420ms/step - loss: 71.5151 - mean_squar
ed_error: 71.5151 - val_loss: 83.5787 - val_mean_squared_error: 83.5787
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to tf.Tensor(5.4881156e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 297s 417ms/step - loss: 71.5882 - mean_squar
ed_error: 71.5882 - val_loss: 80.6119 - val_mean_squared_error: 80.6119
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to tf.Tensor(4.7236645e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 297s 417ms/step - loss: 71.3553 - mean_squar
ed_error: 71.3553 - val_loss: 83.2383 - val_mean_squared_error: 83.2383
Epoch 8/30
```

```
Epoch 00008: LearningRateScheduler reducing learning rate to tf.Tensor(4.0656957e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 297s 417ms/step - loss: 71.3915 - mean_squar
ed_error: 71.3915 - val_loss: 81.5539 - val_mean_squared_error: 81.5539
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to tf.Tensor(3.4993766e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 298s 418ms/step - loss: 70.6520 - mean_squar
ed_error: 70.6520 - val_loss: 82.6869 - val_mean_squared_error: 82.6869
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to tf.Tensor(3.0119412e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 297s 417ms/step - loss: 70.2114 - mean_squar
ed_error: 70.2114 - val_loss: 80.2178 - val_mean_squared_error: 80.2178
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to tf.Tensor(2.5924018e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 297s 417ms/step - loss: 70.9541 - mean_squar
ed_error: 70.9541 - val_loss: 82.9904 - val_mean_squared_error: 82.9904
Epoch 12/30

Epoch 00012: LearningRateScheduler reducing learning rate to tf.Tensor(2.2313009e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 297s 417ms/step - loss: 70.8374 - mean_squar
ed_error: 70.8374 - val_loss: 81.9110 - val_mean_squared_error: 81.9110
Epoch 13/30
```

```
Epoch 00016: LearningRateScheduler reducing learning rate to tf.Tensor(1.2245637e-07,
shape=(), dtype=float32).
712/712 [==============================] - 317s 445ms/step - loss: 70.3816 - mean_squ
ared_error: 70.3816 - val_loss: 81.1809 - val_mean_squared_error: 81.1809
Epoch 17/30

Epoch 00017: LearningRateScheduler reducing learning rate to tf.Tensor(1.0539917e-07,
shape=(), dtype=float32).
712/712 [==============================] - 315s 442ms/step - loss: 70.4180 - mean_squ
ared_error: 70.4180 - val_loss: 82.1049 - val_mean_squared_error: 82.1049
Epoch 18/30

Epoch 00018: LearningRateScheduler reducing learning rate to tf.Tensor(9.07179e-08, s
hape=(), dtype=float32).
712/712 [==============================] - 312s 437ms/step - loss: 70.6720 - mean_squ
ared_error: 70.6720 - val_loss: 81.4239 - val_mean_squared_error: 81.4239
```



Epoch 18: 81.4239 →86.546

Go Back to the Beginning

- Go back to the beginning, adjust learning rate to 5e-7, start from epoch 2: 88.575, change exponential declining to after 8 epochs with rate e^-0.1
  - Decay 0.001/100 → 0.001/200

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 318s 442ms/step - loss: 84.6461 - mean_squar
ed_error: 84.6461 - val_loss: 88.5671 - val_mean_squared_error: 88.5671
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 312s 438ms/step - loss: 83.4533 - mean_squar
ed_error: 83.4533 - val_loss: 89.6107 - val_mean_squared_error: 89.6107
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 311s 436ms/step - loss: 83.8160 - mean_squar
ed_error: 83.8160 - val_loss: 89.4373 - val_mean_squared_error: 89.4373
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 310s 435ms/step - loss: 83.9910 - mean_squar
ed_error: 83.9910 - val_loss: 89.6765 - val_mean_squared_error: 89.6765
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 311s 436ms/step - loss: 83.9021 - mean_squar
ed_error: 83.9021 - val_loss: 86.3845 - val_mean_squared_error: 86.3845
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 311s 436ms/step - loss: 82.5169 - mean_squar
ed_error: 82.5169 - val_loss: 87.0772 - val_mean_squared_error: 87.0772
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 313s 440ms/step - loss: 82.7255 - mean_squar
ed_error: 82.7255 - val_loss: 90.2069 - val_mean_squared_error: 90.2069
Epoch 8/30
```

- Go back to the beginning, adjust learning rate to 5e-7, start from epoch 7: 79.80, change exponential declining to after 8 epochs with rate e^-0.1

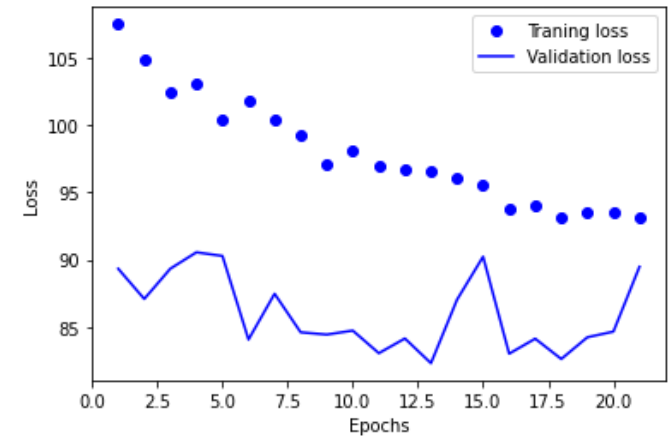
```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 328s 455ms/step - loss: 75.4827 - mean_squ
ared_error: 75.4827 - val_loss: 81.7917 - val_mean_squared_error: 81.7917
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 336s 472ms/step - loss: 75.1820 - mean_squ
ared_error: 75.1820 - val_loss: 78.2426 - val_mean_squared_error: 78.2426
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
712/712 [==============================] - 325s 456ms/step - loss: 75.6660 - mean_squ
ared_error: 75.6660 - val_loss: 83.8559 - val_mean_squared_error: 83.8559
Epoch 4/30


 Epoch 00004: LearningRateScheduler reducing learning rate to 4.999999987376214e-07.
 712/712 [==============================] - 319s 447ms/step - loss: 73.9816 - mean_squ
 ared_error: 73.9816 - val_loss: 82.3900 - val_mean_squared_error: 82.3900
 Epoch 5/30
```

Model 2: 2 dense layers with 64 neurons each

- Learning rate 1e-6, decline at 20 epochs at e^-0.1,

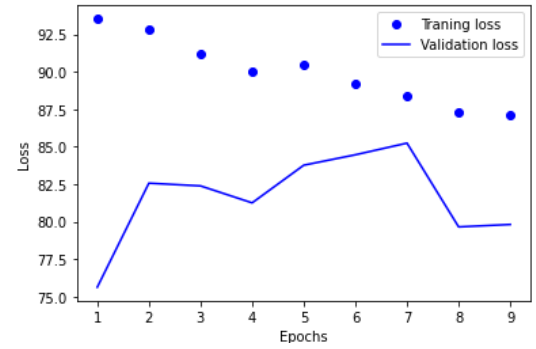
```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 315s 436ms/step - loss: 107.5094 - mean_squa
red_error: 107.5094 - val_loss: 89.3297 - val_mean_squared_error: 89.3297
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 311s 436ms/step - loss: 104.9094 - mean_squa
red_error: 104.9094 - val_loss: 87.0852 - val_mean_squared_error: 87.0852
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 310s 435ms/step - loss: 102.4402 - mean_squa
red_error: 102.4402 - val_loss: 89.3329 - val_mean_squared_error: 89.3329
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 311s 436ms/step - loss: 103.0820 - mean_squa
red_error: 103.0820 - val_loss: 90.5502 - val_mean_squared_error: 90.5502
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 311s 436ms/step - loss: 100.4282 - mean_squa
red_error: 100.4282 - val_loss: 90.2802 - val_mean_squared_error: 90.2802
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 311s 437ms/step - loss: 101.8226 - mean_squa
red_error: 101.8226 - val_loss: 84.0706 - val_mean_squared_error: 84.0706
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 311s 436ms/step - loss: 100.4195 - mean_squa
red_error: 100.4195 - val_loss: 87.4720 - val_mean_squared_error: 87.4720
Epoch 8/30
```

```
Epoch 00008: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 310s 435ms/step - loss: 99.2804 - mean_squar
ed_error: 99.2804 - val_loss: 84.6066 - val_mean_squared_error: 84.6066
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 312s 438ms/step - loss: 97.0618 - mean_squar
ed_error: 97.0618 - val_loss: 84.4389 - val_mean_squared_error: 84.4389
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 309s 434ms/step - loss: 98.1280 - mean_squar
ed_error: 98.1280 - val_loss: 84.7352 - val_mean_squared_error: 84.7352
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 310s 435ms/step - loss: 96.9118 - mean_squar
ed_error: 96.9118 - val_loss: 83.0549 - val_mean_squared_error: 83.0549
Epoch 12/30

Epoch 00012: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 310s 436ms/step - loss: 96.6722 - mean_squar
ed_error: 96.6722 - val_loss: 84.1486 - val_mean_squared_error: 84.1486
Epoch 13/30

Epoch 00013: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 313s 439ms/step - loss: 96.5481 - mean_squar
ed_error: 96.5481 - val_loss: 82.3115 - val_mean_squared_error: 82.3115
Epoch 14/30

    Epoch 00014: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
    712/712 [==============================] - 311s 437ms/step - loss: 96.1187 - mean_squar
    ed_error: 96.1187 - val_loss: 87.0315 - val_mean_squared_error: 87.0315
    Epoch 15/30

    Epoch 00015: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
    712/712 [==============================] - 312s 437ms/step - loss: 95.5418 - mean_squar
    ed_error: 95.5418 - val_loss: 90.2269 - val_mean_squared_error: 90.2269
    Epoch 16/30

    Epoch 00016: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
    712/712 [==============================] - 311s 436ms/step - loss: 93.7345 - mean_squar
    ed_error: 93.7345 - val_loss: 83.0187 - val_mean_squared_error: 83.0187
    Epoch 17/30

    Epoch 00017: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
    712/712 [==============================] - 314s 440ms/step - loss: 94.0461 - mean_squar
    ed_error: 94.0461 - val_loss: 84.1330 - val_mean_squared_error: 84.1330
    Epoch 18/30

Epoch 00018: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 312s 438ms/step - loss: 93.1613 - mean_squ
ared_error: 93.1613 - val_loss: 82.6225 - val_mean_squared_error: 82.6225
Epoch 19/30

Epoch 00019: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 312s 438ms/step - loss: 93.5322 - mean_squ
ared_error: 93.5322 - val_loss: 84.2374 - val_mean_squared_error: 84.2374
Epoch 20/30

Epoch 00020: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 312s 438ms/step - loss: 93.5062 - mean_squ
ared_error: 93.5062 - val_loss: 84.6598 - val_mean_squared_error: 84.6598
Epoch 21/30

Epoch 00021: LearningRateScheduler reducing learning rate to tf.Tensor(9.0483735e-07,
shape=(), dtype=float32).
712/712 [==============================] - 313s 439ms/step - loss: 93.1386 - mean_squ
ared_error: 93.1386 - val_loss: 89.4752 - val_mean_squared_error: 89.4752
```



- Learning rate may be too small, increase to 3e-6

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 3.0000001061125666e-06.
712/712 [==============================] - 319s 442ms/step - loss: 93.5322 - mean_squar
ed_error: 93.5322 - val_loss: 75.6223 - val_mean_squared_error: 75.6223
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 3.0000001061125666e-06.
712/712 [==============================] - 316s 443ms/step - loss: 92.8640 - mean_squar
ed_error: 92.8640 - val_loss: 82.5688 - val_mean_squared_error: 82.5688
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 3.0000001061125666e-06.
712/712 [==============================] - 315s 442ms/step - loss: 91.2222 - mean_squar
ed_error: 91.2222 - val_loss: 82.3863 - val_mean_squared_error: 82.3863
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 3.0000001061125666e-06.
712/712 [==============================] - 315s 442ms/step - loss: 90.0534 - mean_squar
ed_error: 90.0534 - val_loss: 81.2543 - val_mean_squared_error: 81.2543
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 3.0000001061125666e-06.
712/712 [==============================] - 320s 449ms/step - loss: 90.4495 - mean_squar
ed_error: 90.4495 - val_loss: 83.7678 - val_mean_squared_error: 83.7678
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 3.0000001061125666e-06.
712/712 [==============================] - 319s 448ms/step - loss: 89.1820 - mean_squar
ed_error: 89.1820 - val_loss: 84.4632 - val_mean_squared_error: 84.4632
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 3.0000001061125666e-06.
712/712 [==============================] - 318s 446ms/step - loss: 88.4162 - mean_squar
ed_error: 88.4162 - val_loss: 85.2417 - val_mean_squared_error: 85.2417
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to 3.0000001061125666e-06.
712/712 [==============================] - 319s 447ms/step - loss: 87.2963 - mean_squar
ed_error: 87.2963 - val_loss: 79.6499 - val_mean_squared_error: 79.6499
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to 3.0000001061125666e-06.
712/712 [==============================] - 317s 445ms/step - loss: 87.0864 - mean_squar
ed_error: 87.0864 - val_loss: 79.8113 - val_mean_squared_error: 79.8113
```



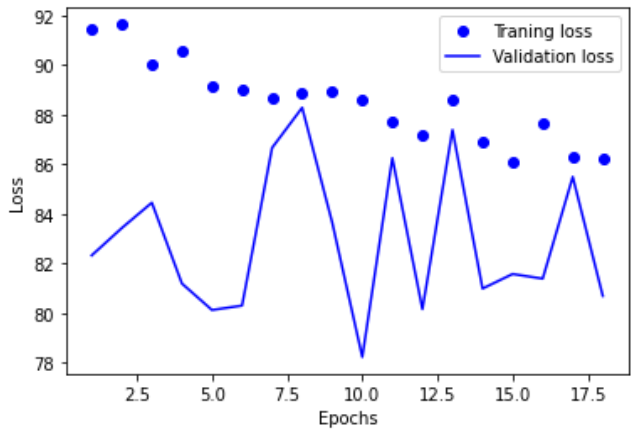
- This is looking okay, keep training,

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 3.0000001061125666-06.
712/712 [==============================] - 319s 447ms/step - loss: 85.4587 - mean_squar
ed_error: 85.4587 - val_loss: 87.5288 - val_mean_squared_error: 87.5288
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 3.0000001061125666-06.
712/712 [==============================] - 316s 443ms/step - loss: 84.4929 - mean_squar
ed_error: 84.4929 - val_loss: 81.5807 - val_mean_squared_error: 81.5807
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 3.0000001061125666-06.
712/712 [==============================] - 317s 445ms/step - loss: 84.4529 - mean_squar
ed_error: 84.4529 - val_loss: 84.7655 - val_mean_squared_error: 84.7655
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 3.0000001061125666-06.
712/712 [==============================] - 318s 446ms/step - loss: 84.2751 - mean_squar
ed_error: 84.2751 - val_loss: 88.9658 - val_mean_squared_error: 88.9658
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 3.0000001061125666-06.
712/712 [==============================] - 321s 451ms/step - loss: 82.9029 - mean_squar
ed_error: 82.9029 - val_loss: 76.8776 - val_mean_squared_error: 76.8776
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 3.0000001061125666-06.
712/712 [==============================] - 320s 450ms/step - loss: 82.0052 - mean_squar
ed_error: 82.0052 - val_loss: 90.8949 - val_mean_squared_error: 90.8949
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 3.0000001061125666-06.
 70/712 [=>............................] - ETA: 3:49 - loss: 81.4781 - mean_squared_err
or: 81.4781
```

- Too volatile, decrease the learning rate to 1e-6 and restart from validation loss = 75.622

```
Epoch 00001: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 319s 443ms/step - loss: 91.4750 - mean_squar
ed_error: 91.4750 - val_loss: 82.3288 - val_mean_squared_error: 82.3288
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 322s 452ms/step - loss: 91.6364 - mean_squar
ed_error: 91.6364 - val_loss: 83.4309 - val_mean_squared_error: 83.4309
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 319s 448ms/step - loss: 90.0427 - mean_squar
ed_error: 90.0427 - val_loss: 84.4537 - val_mean_squared_error: 84.4537
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 320s 449ms/step - loss: 90.5504 - mean_squar
ed_error: 90.5504 - val_loss: 81.1953 - val_mean_squared_error: 81.1953
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 316s 444ms/step - loss: 89.1746 - mean_squar
ed_error: 89.1746 - val_loss: 80.1279 - val_mean_squared_error: 80.1279
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 315s 442ms/step - loss: 89.0098 - mean_squar
ed_error: 89.0098 - val_loss: 80.3055 - val_mean_squared_error: 80.3055
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 314s 440ms/step - loss: 88.6831 - mean_squar
ed_error: 88.6831 - val_loss: 86.6657 - val_mean_squared_error: 86.6657
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 314s 441ms/step - loss: 88.8614 - mean_squar
ed_error: 88.8614 - val_loss: 88.2831 - val_mean_squared_error: 88.2831
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 314s 441ms/step - loss: 88.9401 - mean_squar
ed_error: 88.9401 - val_loss: 83.6507 - val_mean_squared_error: 83.6507
Epoch 10/30
```

```
Epoch 00010: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 314s 441ms/step - loss: 88.5726 - mean_squar
ed_error: 88.5726 - val_loss: 78.2332 - val_mean_squared_error: 78.2332
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 314s 441ms/step - loss: 87.7181 - mean_squar
ed_error: 87.7181 - val_loss: 86.2524 - val_mean_squared_error: 86.2524
Epoch 12/30

Epoch 00012: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 315s 442ms/step - loss: 87.1758 - mean_squar
ed_error: 87.1758 - val_loss: 80.1633 - val_mean_squared_error: 80.1633
Epoch 13/30

Epoch 00013: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 314s 441ms/step - loss: 88.6067 - mean_squar
ed_error: 88.6067 - val_loss: 87.3879 - val_mean_squared_error: 87.3879
Epoch 14/30

Epoch 00014: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 313s 440ms/step - loss: 86.9255 - mean_squar
ed_error: 86.9255 - val_loss: 80.9911 - val_mean_squared_error: 80.9911
Epoch 15/30

Epoch 00015: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 313s 440ms/step - loss: 86.0768 - mean_squar
ed_error: 86.0768 - val_loss: 81.5788 - val_mean_squared_error: 81.5788
Epoch 16/30


Epoch 00016: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 317s 445ms/step - loss: 87.6727 - mean_squar
ed_error: 87.6727 - val_loss: 81.3912 - val_mean_squared_error: 81.3912
Epoch 17/30

Epoch 00017: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 317s 445ms/step - loss: 86.3236 - mean_squar
ed_error: 86.3236 - val_loss: 85.4931 - val_mean_squared_error: 85.4931
Epoch 18/30

Epoch 00018: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
712/712 [==============================] - 320s 449ms/step - loss: 86.1997 - mean_squar
ed_error: 86.1997 - val_loss: 80.6943 - val_mean_squared_error: 80.6943
```



- Saved model

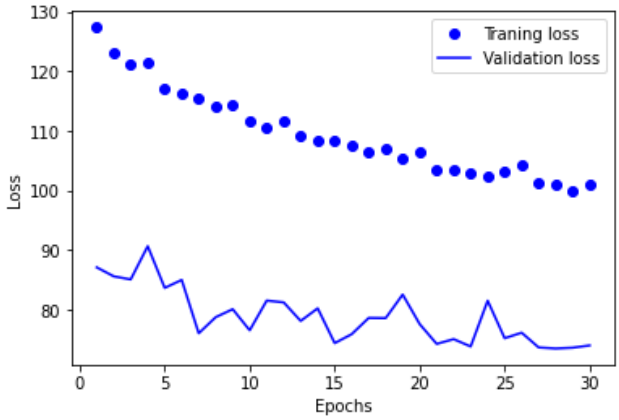
Model 3: 64, 32

- Learning rate 2e-6, exponential declining rate after 20 epochs and at rate of e^-0.05, patience = 8

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 328s 449ms/step - loss: 127.3486 - mean_squa
red_error: 127.3486 - val_loss: 87.0886 - val_mean_squared_error: 87.0886
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 309s 434ms/step - loss: 122.9511 - mean_squa
red_error: 122.9511 - val_loss: 85.5831 - val_mean_squared_error: 85.5831
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 304s 427ms/step - loss: 121.1848 - mean_squa
red_error: 121.1848 - val_loss: 85.0642 - val_mean_squared_error: 85.0642
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 304s 427ms/step - loss: 121.3137 - mean_squa
red_error: 121.3137 - val_loss: 90.6421 - val_mean_squared_error: 90.6421
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 304s 427ms/step - loss: 117.0648 - mean_squa
red_error: 117.0648 - val_loss: 83.6455 - val_mean_squared_error: 83.6455
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 304s 427ms/step - loss: 116.1495 - mean_squa
red_error: 116.1495 - val_loss: 84.9805 - val_mean_squared_error: 84.9805
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 305s 428ms/step - loss: 115.3191 - mean_squa
red_error: 115.3191 - val_loss: 76.0350 - val_mean_squared_error: 76.0350
Epoch 8/30
```

```
Epoch 00008: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 304s 427ms/step - loss: 114.1687 - mean_squa
red_error: 114.1687 - val_loss: 78.7333 - val_mean_squared_error: 78.7333
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 305s 428ms/step - loss: 114.2401 - mean_squa
red_error: 114.2401 - val_loss: 80.0756 - val_mean_squared_error: 80.0756
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 304s 427ms/step - loss: 111.6747 - mean_squa
red_error: 111.6747 - val_loss: 76.5303 - val_mean_squared_error: 76.5303
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 305s 427ms/step - loss: 110.4268 - mean_squa
red_error: 110.4268 - val_loss: 81.5175 - val_mean_squared_error: 81.5175
Epoch 12/30

Epoch 00012: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 310s 435ms/step - loss: 111.6726 - mean_squa
red_error: 111.6726 - val_loss: 81.2147 - val_mean_squared_error: 81.2147
Epoch 13/30

Epoch 00013: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 305s 428ms/step - loss: 109.1867 - mean_squa
red_error: 109.1867 - val_loss: 78.1015 - val_mean_squared_error: 78.1015
Epoch 14/30

Epoch 00014: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 310s 436ms/step - loss: 108.3565 - mean_sq
uared_error: 108.3565 - val_loss: 80.2196 - val_mean_squared_error: 80.2196
Epoch 15/30

Epoch 00015: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 313s 439ms/step - loss: 108.4414 - mean_sq
uared_error: 108.4414 - val_loss: 74.3812 - val_mean_squared_error: 74.3812
Epoch 16/30

Epoch 00016: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 311s 437ms/step - loss: 107.3900 - mean_sq
uared_error: 107.3900 - val_loss: 75.8826 - val_mean_squared_error: 75.8826
Epoch 17/30

Epoch 00017: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 305s 428ms/step - loss: 106.5327 - mean_sq
uared_error: 106.5327 - val_loss: 78.6066 - val_mean_squared_error: 78.6066
Epoch 18/30

Epoch 00018: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 305s 428ms/step - loss: 107.0878 - mean_sq
uared_error: 107.0878 - val_loss: 78.5752 - val_mean_squared_error: 78.5752
Epoch 19/30

Epoch 00019: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 305s 428ms/step - loss: 105.4487 - mean_sq
uared_error: 105.4487 - val_loss: 82.5338 - val_mean_squared_error: 82.5338
Epoch 20/30
```

```
Epoch 00020: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
712/712 [==============================] - 304s 427ms/step - loss: 106.4080 - mean_sq
uared_error: 106.4080 - val_loss: 77.5745 - val_mean_squared_error: 77.5745
Epoch 21/30

Epoch 00021: LearningRateScheduler reducing learning rate to tf.Tensor(1.9024588e-06,
shape=(), dtype=float32).
712/712 [==============================] - 306s 429ms/step - loss: 103.5017 - mean_sq
uared_error: 103.5017 - val_loss: 74.2542 - val_mean_squared_error: 74.2542
Epoch 22/30

Epoch 00022: LearningRateScheduler reducing learning rate to tf.Tensor(1.8096749e-06,
shape=(), dtype=float32).
712/712 [==============================] - 308s 433ms/step - loss: 103.5340 - mean_sq
uared_error: 103.5340 - val_loss: 75.0513 - val_mean_squared_error: 75.0513
Epoch 23/30

Epoch 00023: LearningRateScheduler reducing learning rate to tf.Tensor(1.7214161e-06,
shape=(), dtype=float32).
712/712 [==============================] - 308s 433ms/step - loss: 102.9714 - mean_sq
uared_error: 102.9714 - val_loss: 73.8166 - val_mean_squared_error: 73.8166
Epoch 24/30

Epoch 00024: LearningRateScheduler reducing learning rate to tf.Tensor(1.6374617e-06,
shape=(), dtype=float32).
712/712 [==============================] - 305s 428ms/step - loss: 102.3991 - mean_sq
uared_error: 102.3991 - val_loss: 81.4951 - val_mean_squared_error: 81.4951
Epoch 25/30

Epoch 00025: LearningRateScheduler reducing learning rate to tf.Tensor(1.5576018e-06,
shape=(), dtype=float32).
712/712 [==============================] - 305s 428ms/step - loss: 103.1902 - mean_sq
uared_error: 103.1902 - val_loss: 75.2034 - val_mean_squared_error: 75.2034
Epoch 26/30

Epoch 00026: LearningRateScheduler reducing learning rate to tf.Tensor(1.4816367e-06,
shape=(), dtype=float32).
712/712 [==============================] - 304s 426ms/step - loss: 104.1576 - mean_sq
uared_error: 104.1576 - val_loss: 76.1319 - val_mean_squared_error: 76.1319
Epoch 27/30

Epoch 00027: LearningRateScheduler reducing learning rate to tf.Tensor(1.4093764e-06,
shape=(), dtype=float32).
712/712 [==============================] - 304s 426ms/step - loss: 101.3568 - mean_sq
uared_error: 101.3568 - val_loss: 73.6587 - val_mean_squared_error: 73.6587
Epoch 28/30

Epoch 00028: LearningRateScheduler reducing learning rate to tf.Tensor(1.3406403e-06,
shape=(), dtype=float32).
712/712 [==============================] - 303s 425ms/step - loss: 100.9775 - mean_sq
uared_error: 100.9775 - val_loss: 73.4840 - val_mean_squared_error: 73.4840
Epoch 29/30

Epoch 00029: LearningRateScheduler reducing learning rate to tf.Tensor(1.2752565e-06,
shape=(), dtype=float32).
712/712 [==============================] - 304s 426ms/step - loss: 99.7903 - mean_squ
ared_error: 99.7903 - val_loss: 73.6164 - val_mean_squared_error: 73.6164
Epoch 30/30

Epoch 00030: LearningRateScheduler reducing learning rate to tf.Tensor(1.2130615e-06,
shape=(), dtype=float32).
712/712 [==============================] - 304s 427ms/step - loss: 101.0194 - mean_sq
uared_error: 101.0194 - val_loss: 73.9940 - val_mean_squared_error: 73.9940
```



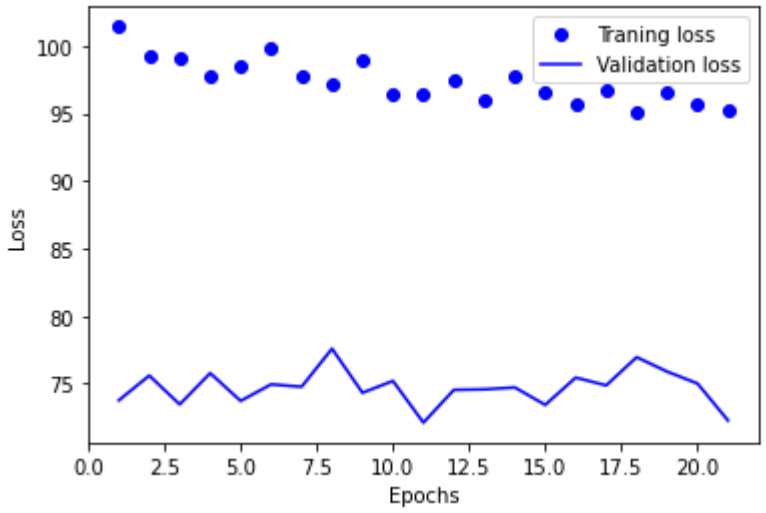
Epoch 30: 73.994 → 75.723

- Looks good, continue training with current learning rate and decline after 2 epochs with the same rate, and set patience to 10

```
Epoch 00001: LearningRateScheduler reducing learning rate to 1.2130615232308628e-06.
712/712 [==============================] - 312s 437ms/step - loss: 101.4236 - mean_squa
red_error: 101.4236 - val_loss: 73.7616 - val_mean_squared_error: 73.7616
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 1.2130615232308628e-06.
712/712 [==============================] - 312s 438ms/step - loss: 99.2546 - mean_squar
ed_error: 99.2546 - val_loss: 75.5937 - val_mean_squared_error: 75.5937
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to tf.Tensor(1.1538998e-06, s
hape=(), dtype=float32).
712/712 [==============================] - 313s 439ms/step - loss: 99.0434 - mean_squar
ed_error: 99.0434 - val_loss: 73.4604 - val_mean_squared_error: 73.4604
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to tf.Tensor(1.0976235e-06, s
hape=(), dtype=float32).
712/712 [==============================] - 308s 432ms/step - loss: 97.7679 - mean_squar
ed_error: 97.7679 - val_loss: 75.7734 - val_mean_squared_error: 75.7734
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to tf.Tensor(1.0440917e-06, s
hape=(), dtype=float32).
712/712 [==============================] - 328s 460ms/step - loss: 98.4601 - mean_squar
ed_error: 98.4601 - val_loss: 73.7158 - val_mean_squared_error: 73.7158
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to tf.Tensor(9.931708e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 316s 444ms/step - loss: 99.8839 - mean_squar
ed_error: 99.8839 - val_loss: 74.9424 - val_mean_squared_error: 74.9424
Epoch 7/30
```

```
Epoch 00007: LearningRateScheduler reducing learning rate to tf.Tensor(9.4473336e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 310s 435ms/step - loss: 97.7037 - mean_squar
ed_error: 97.7037 - val_loss: 74.7629 - val_mean_squared_error: 74.7629
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to tf.Tensor(8.986582e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 308s 432ms/step - loss: 97.1641 - mean_squar
ed_error: 97.1641 - val_loss: 77.5836 - val_mean_squared_error: 77.5836
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to tf.Tensor(8.5483015e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 312s 438ms/step - loss: 98.9107 - mean_squar
ed_error: 98.9107 - val_loss: 74.3175 - val_mean_squared_error: 74.3175
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to tf.Tensor(8.131396e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 313s 439ms/step - loss: 96.4572 - mean_squar
ed_error: 96.4572 - val_loss: 75.1951 - val_mean_squared_error: 75.1951
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to tf.Tensor(7.734823e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 311s 436ms/step - loss: 96.4759 - mean_squar
ed_error: 96.4759 - val_loss: 72.1097 - val_mean_squared_error: 72.1097
Epoch 12/30

Epoch 00012: LearningRateScheduler reducing learning rate to tf.Tensor(7.3575916e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 312s 438ms/step - loss: 97.3895 - mean_squar
ed_error: 97.3895 - val_loss: 74.5345 - val_mean_squared_error: 74.5345
Epoch 13/30

Epoch 00013: LearningRateScheduler reducing learning rate to tf.Tensor(6.998758e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 314s 441ms/step - loss: 95.9872 - mean_squar
ed_error: 95.9872 - val_loss: 74.5729 - val_mean_squared_error: 74.5729
Epoch 14/30

Epoch 00014: LearningRateScheduler reducing learning rate to tf.Tensor(6.6574245e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 314s 441ms/step - loss: 97.7287 - mean_squar
ed_error: 97.7287 - val_loss: 74.7137 - val_mean_squared_error: 74.7137
Epoch 15/30

Epoch 00015: LearningRateScheduler reducing learning rate to tf.Tensor(6.332738e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 315s 443ms/step - loss: 96.5963 - mean_squar
ed_error: 96.5963 - val_loss: 73.4239 - val_mean_squared_error: 73.4239
Epoch 16/30

Epoch 00016: LearningRateScheduler reducing learning rate to tf.Tensor(6.023887e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 316s 444ms/step - loss: 95.6985 - mean_squar
ed_error: 95.6985 - val_loss: 75.4451 - val_mean_squared_error: 75.4451
Epoch 17/30
```

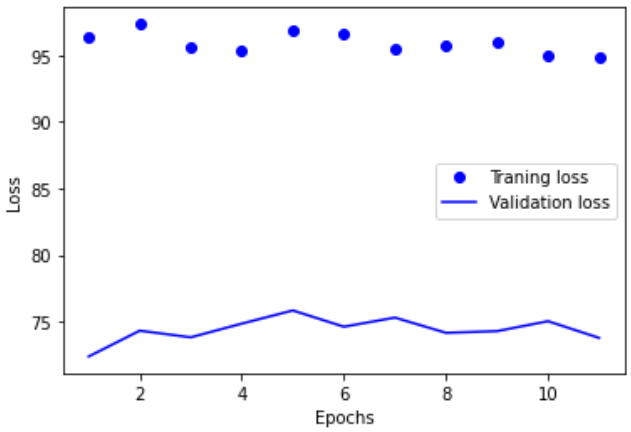
```
Epoch 00017: LearningRateScheduler reducing learning rate to tf.Tensor(5.7300986e-07,
shape=(), dtype=float32).
712/712 [==============================] - 314s 441ms/step - loss: 96.6980 - mean_squ
ared_error: 96.6980 - val_loss: 74.8654 - val_mean_squared_error: 74.8654
Epoch 18/30

Epoch 00018: LearningRateScheduler reducing learning rate to tf.Tensor(5.4506387e-07,
shape=(), dtype=float32).
712/712 [==============================] - 314s 441ms/step - loss: 95.1440 - mean_squ
ared_error: 95.1440 - val_loss: 76.9516 - val_mean_squared_error: 76.9516
Epoch 19/30

Epoch 00019: LearningRateScheduler reducing learning rate to tf.Tensor(5.184808e-07,
shape=(), dtype=float32).
712/712 [==============================] - 309s 434ms/step - loss: 96.5379 - mean_squ
ared_error: 96.5379 - val_loss: 75.8861 - val_mean_squared_error: 75.8861
Epoch 20/30

Epoch 00020: LearningRateScheduler reducing learning rate to tf.Tensor(4.9319425e-07,
shape=(), dtype=float32).
712/712 [==============================] - 318s 446ms/step - loss: 95.6100 - mean_squ
ared_error: 95.6100 - val_loss: 75.0015 - val_mean_squared_error: 75.0015
Epoch 21/30

Epoch 00021: LearningRateScheduler reducing learning rate to tf.Tensor(4.691409e-07,
shape=(), dtype=float32).
712/712 [==============================] - 317s 445ms/step - loss: 95.2608 - mean_squ
ared_error: 95.2608 - val_loss: 72.2674 - val_mean_squared_error: 72.2674
```



Epoch 11: 72.110 →74.703
Epoch 21: 72.267 → 73.93

- Go back to epoch 11: 72.110 and decrease learning rate from 7.73e-7 at rate of e^-0.1

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to tf.Tensor(6.3338615e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 334s 463ms/step - loss: 96.3893 - mean_squar
ed_error: 96.3893 - val_loss: 72.3709 - val_mean_squared_error: 72.3709
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to tf.Tensor(5.7311144e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 324s 455ms/step - loss: 97.3596 - mean_squar
ed_error: 97.3596 - val_loss: 74.3117 - val_mean_squared_error: 74.3117
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to tf.Tensor(5.185726e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 322s 452ms/step - loss: 95.6469 - mean_squar
ed_error: 95.6469 - val_loss: 73.8126 - val_mean_squared_error: 73.8126
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to tf.Tensor(4.692239e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 323s 453ms/step - loss: 95.3770 - mean_squar
ed_error: 95.3770 - val_loss: 74.8417 - val_mean_squared_error: 74.8417
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to tf.Tensor(4.245713e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 325s 456ms/step - loss: 96.8234 - mean_squar
ed_error: 96.8234 - val_loss: 75.8327 - val_mean_squared_error: 75.8327
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to tf.Tensor(3.8416798e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 321s 451ms/step - loss: 96.6097 - mean_squar
ed_error: 96.6097 - val_loss: 74.6104 - val_mean_squared_error: 74.6104
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to tf.Tensor(3.4760953e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 330s 463ms/step - loss: 95.4372 - mean_squar
ed_error: 95.4372 - val_loss: 75.2947 - val_mean_squared_error: 75.2947
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to tf.Tensor(3.145301e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 333s 468ms/step - loss: 95.7296 - mean_squar
ed_error: 95.7296 - val_loss: 74.1524 - val_mean_squared_error: 74.1524
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to tf.Tensor(2.845986e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 334s 468ms/step - loss: 95.9800 - mean_squar
ed_error: 95.9800 - val_loss: 74.2767 - val_mean_squared_error: 74.2767
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to tf.Tensor(2.5751544e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 329s 462ms/step - loss: 94.9320 - mean_squar
ed_error: 94.9320 - val_loss: 75.0256 - val_mean_squared_error: 75.0256
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to tf.Tensor(2.3300959e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 336s 471ms/step - loss: 94.9187 - mean_squar
ed_error: 94.9187 - val_loss: 73.7681 - val_mean_squared_error: 73.7681
```



Epoch 1: 72.3709 → 74.226

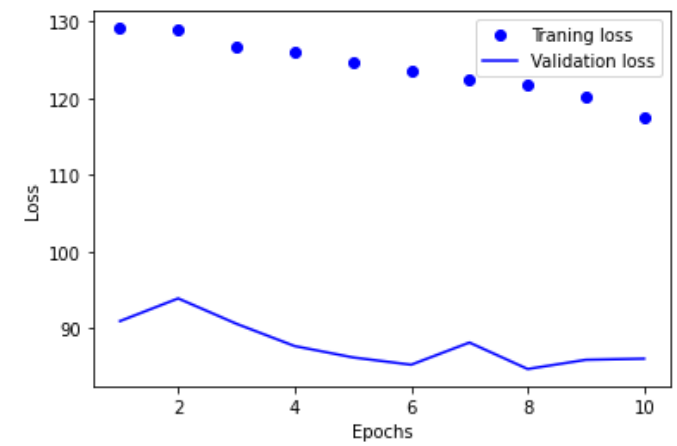
```
Epoch 1/2

Epoch 00001: LearningRateScheduler reducing learning rate to tf.Tensor(2.1083578e-07, s
hape=(), dtype=float32).
712/712 [==============================] - 323s 453ms/step - loss: 95.5241 - mean_squar
ed_error: 95.5241 - val_loss: 73.1161 - val_mean_squared_error: 73.1161
Epoch 2/2

Epoch 00002: LearningRateScheduler reducing learning rate to tf.Tensor(1.907721e-07, sh
ape=(), dtype=float32).
712/712 [==============================] - 321s 451ms/step - loss: 95.5911 - mean_squar
ed_error: 95.5911 - val_loss: 74.6395 - val_mean_squared_error: 74.6395
```

Epoch 2: 74.6395 → 77.569

Model 4: 128, 64dropout = 0.75, 0.5

- Learning rate 9e-7, exponential declining rate after 2 epochs and at rate of e^-0.1, patience = 15

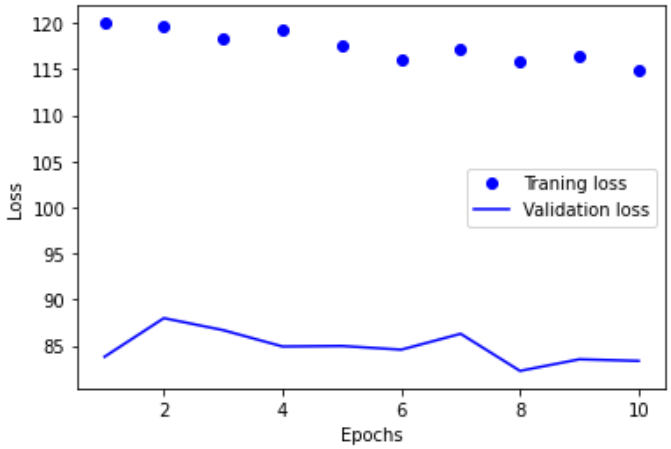
```
Epoch 1/10

Epoch 00001: LearningRateScheduler reducing learning rate to 8.999999749903509e-07.
711/711 [==============================] - 314s 441ms/step - loss: 129.1077 - mean_squa
red_error: 129.1077 - val_loss: 90.9541 - val_mean_squared_error: 90.9541
Epoch 2/10

Epoch 00002: LearningRateScheduler reducing learning rate to 8.999999749903509e-07.
711/711 [==============================] - 314s 442ms/step - loss: 128.9435 - mean_squa
red_error: 128.9435 - val_loss: 93.9134 - val_mean_squared_error: 93.9134
Epoch 3/10

Epoch 00003: LearningRateScheduler reducing learning rate to 8.999999749903509e-07.
711/711 [==============================] - 316s 444ms/step - loss: 126.6184 - mean_squa
red_error: 126.6184 - val_loss: 90.6127 - val_mean_squared_error: 90.6127
Epoch 4/10

Epoch 00004: LearningRateScheduler reducing learning rate to 8.999999749903509e-07.
711/711 [==============================] - 319s 448ms/step - loss: 125.9932 - mean_squa
red_error: 125.9932 - val_loss: 87.7062 - val_mean_squared_error: 87.7062
Epoch 5/10

Epoch 00005: LearningRateScheduler reducing learning rate to 8.999999749903509e-07.
711/711 [==============================] - 320s 450ms/step - loss: 124.6885 - mean_squa
red_error: 124.6885 - val_loss: 86.2272 - val_mean_squared_error: 86.2272
Epoch 6/10

Epoch 00006: LearningRateScheduler reducing learning rate to tf.Tensor(8.143536e-07, sh
ape=(), dtype=float32).
711/711 [==============================] - 319s 448ms/step - loss: 123.5396 - mean_squa
red_error: 123.5396 - val_loss: 85.2764 - val_mean_squared_error: 85.2764
Epoch 7/10

Epoch 00007: LearningRateScheduler reducing learning rate to tf.Tensor(7.3685754e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 318s 448ms/step - loss: 122.4718 - mean_squa
red_error: 122.4718 - val_loss: 88.1658 - val_mean_squared_error: 88.1658
Epoch 8/10

Epoch 00008: LearningRateScheduler reducing learning rate to tf.Tensor(6.6673624e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 318s 447ms/step - loss: 121.8521 - mean_squa
red_error: 121.8521 - val_loss: 84.7189 - val_mean_squared_error: 84.7189
Epoch 9/10

Epoch 00009: LearningRateScheduler reducing learning rate to tf.Tensor(6.0328784e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 316s 445ms/step - loss: 120.2884 - mean_squa
red_error: 120.2884 - val_loss: 85.9179 - val_mean_squared_error: 85.9179
Epoch 10/10

Epoch 00010: LearningRateScheduler reducing learning rate to tf.Tensor(5.458774e-07, sh
ape=(), dtype=float32).
711/711 [==============================] - 314s 442ms/step - loss: 117.5885 - mean_squa
red_error: 117.5885 - val_loss: 86.0662 - val_mean_squared_error: 86.0662
```



Epoch 10: 86.0662 → 86.369

- Continue from epoch 8: 84.719, learning rate 6.667e-7, exponential declining rate after 1 epoch and at rate of e^-0.05, patience = 15

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 6.666999752269476e-07.
711/711 [==============================] - 339s 451ms/step - loss: 119.9872 - mean_squa
red_error: 119.9872 - val_loss: 83.7901 - val_mean_squared_error: 83.7901
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to tf.Tensor(6.3418463e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 298s 419ms/step - loss: 119.6468 - mean_squa
red_error: 119.6468 - val_loss: 87.9820 - val_mean_squared_error: 87.9820
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to tf.Tensor(6.032551e-07, sh
ape=(), dtype=float32).
711/711 [==============================] - 295s 414ms/step - loss: 118.2385 - mean_squa
red_error: 118.2385 - val_loss: 86.6766 - val_mean_squared_error: 86.6766
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to tf.Tensor(5.7383403e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 296s 417ms/step - loss: 119.2110 - mean_squa
red_error: 119.2110 - val_loss: 84.9052 - val_mean_squared_error: 84.9052
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to tf.Tensor(5.4584785e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 297s 417ms/step - loss: 117.6115 - mean_squa
red_error: 117.6115 - val_loss: 84.9604 - val_mean_squared_error: 84.9604
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to tf.Tensor(5.1922655e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 299s 420ms/step - loss: 115.9801 - mean_squa
red_error: 115.9801 - val_loss: 84.5625 - val_mean_squared_error: 84.5625
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to tf.Tensor(4.939036e-07, sh
ape=(), dtype=float32).
711/711 [==============================] - 304s 428ms/step - loss: 117.2246 - mean_squa
red_error: 117.2246 - val_loss: 86.2847 - val_mean_squared_error: 86.2847
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to tf.Tensor(4.6981566e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 300s 421ms/step - loss: 115.7710 - mean_squa
red_error: 115.7710 - val_loss: 82.2590 - val_mean_squared_error: 82.2590
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to tf.Tensor(4.469025e-07, sh
ape=(), dtype=float32).
711/711 [==============================] - 308s 433ms/step - loss: 116.3779 - mean_squa
red_error: 116.3779 - val_loss: 83.5166 - val_mean_squared_error: 83.5166
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to tf.Tensor(4.2510683e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 306s 430ms/step - loss: 114.9175 - mean_squa
red_error: 114.9175 - val_loss: 83.3436 - val_mean_squared_error: 83.3436
Epoch 11/30
```



- It's not learning too much, adjust the learning rate to 1e-6, declining after 5 epochs

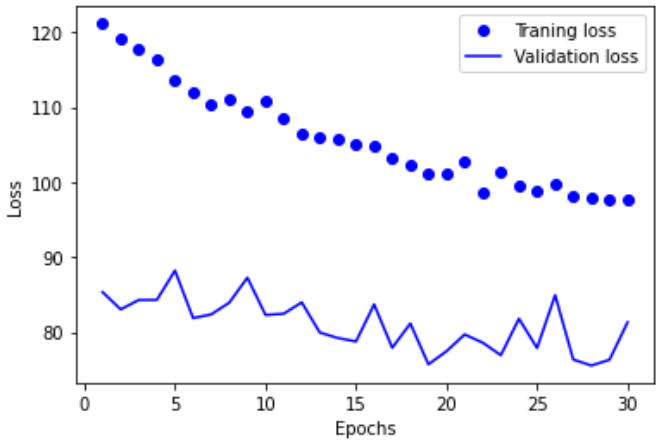
```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
711/711 [==============================] - 309s 430ms/step - loss: 121.6178 - mean_squa
red_error: 121.6178 - val_loss: 85.0492 - val_mean_squared_error: 85.0492
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
711/711 [==============================] - 303s 426ms/step - loss: 119.3627 - mean_squa
red_error: 119.3627 - val_loss: 82.7634 - val_mean_squared_error: 82.7634
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
711/711 [==============================] - 302s 425ms/step - loss: 119.0240 - mean_squa
red_error: 119.0240 - val_loss: 85.5720 - val_mean_squared_error: 85.5720
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 9.999999974752427e-07.
215/711 [========>.....................] - ETA: 2:52 - loss: 120.6459 - mean_squared_er
ror: 120.6459
```

- Again, adjust the learning rate to 2e-6, declining after 10 epochs

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 306s 426ms/step - loss: 121.1732 - mean_squa
red_error: 121.1732 - val_loss: 85.3288 - val_mean_squared_error: 85.3288
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 302s 424ms/step - loss: 119.2391 - mean_squa
red_error: 119.2391 - val_loss: 83.0309 - val_mean_squared_error: 83.0309
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 302s 424ms/step - loss: 117.8438 - mean_squa
red_error: 117.8438 - val_loss: 84.2835 - val_mean_squared_error: 84.2835
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 302s 424ms/step - loss: 116.4842 - mean_squa
red_error: 116.4842 - val_loss: 84.2939 - val_mean_squared_error: 84.2939
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 302s 425ms/step - loss: 113.5395 - mean_squa
red_error: 113.5395 - val_loss: 88.2107 - val_mean_squared_error: 88.2107
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 302s 425ms/step - loss: 112.0918 - mean_squa
red_error: 112.0918 - val_loss: 81.8665 - val_mean_squared_error: 81.8665
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 302s 425ms/step - loss: 110.3262 - mean_squa
red_error: 110.3262 - val_loss: 82.3563 - val_mean_squared_error: 82.3563
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 302s 424ms/step - loss: 111.0676 - mean_squa
red_error: 111.0676 - val_loss: 83.9344 - val_mean_squared_error: 83.9344
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 303s 425ms/step - loss: 109.4433 - mean_squa
red_error: 109.4433 - val_loss: 87.2692 - val_mean_squared_error: 87.2692
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 303s 426ms/step - loss: 110.9548 - mean_squa
red_error: 110.9548 - val_loss: 82.2871 - val_mean_squared_error: 82.2871
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to tf.Tensor(1.9024588e-06, s
hape=(), dtype=float32).
711/711 [==============================] - 313s 440ms/step - loss: 108.5638 - mean_squa
red_error: 108.5638 - val_loss: 82.4407 - val_mean_squared_error: 82.4407
Epoch 12/30

Epoch 00012: LearningRateScheduler reducing learning rate to tf.Tensor(1.8096749e-06, s
hape=(), dtype=float32).
711/711 [==============================] - 310s 436ms/step - loss: 106.4527 - mean_squa
red_error: 106.4527 - val_loss: 83.9663 - val_mean_squared_error: 83.9663
Epoch 13/30

Epoch 00013: LearningRateScheduler reducing learning rate to tf.Tensor(1.7214161e-06, s
hape=(), dtype=float32).
711/711 [==============================] - 310s 435ms/step - loss: 106.0050 - mean_squa
red_error: 106.0050 - val_loss: 79.9367 - val_mean_squared_error: 79.9367
Epoch 14/30

Epoch 00014: LearningRateScheduler reducing learning rate to tf.Tensor(1.6374617e-06, s
hape=(), dtype=float32).
711/711 [==============================] - 316s 444ms/step - loss: 105.7243 - mean_squa
red_error: 105.7243 - val_loss: 79.2058 - val_mean_squared_error: 79.2058
Epoch 15/30
```

```
Epoch 00015: LearningRateScheduler reducing learning rate to tf.Tensor(1.5576018e-06,
shape=(), dtype=float32).
711/711 [==============================] - 323s 454ms/step - loss: 105.0067 - mean_sq
uared_error: 105.0067 - val_loss: 78.7507 - val_mean_squared_error: 78.7507
Epoch 16/30

Epoch 00016: LearningRateScheduler reducing learning rate to tf.Tensor(1.4816367e-06,
shape=(), dtype=float32).
711/711 [==============================] - 347s 488ms/step - loss: 104.7385 - mean_sq
uared_error: 104.7385 - val_loss: 83.6961 - val_mean_squared_error: 83.6961
Epoch 17/30

Epoch 00017: LearningRateScheduler reducing learning rate to tf.Tensor(1.4093764e-06,
shape=(), dtype=float32).
711/711 [==============================] - 352s 495ms/step - loss: 103.1882 - mean_sq
uared_error: 103.1882 - val_loss: 77.9087 - val_mean_squared_error: 77.9087
Epoch 18/30

Epoch 00018: LearningRateScheduler reducing learning rate to tf.Tensor(1.3406403e-06,
shape=(), dtype=float32).
711/711 [==============================] - 344s 484ms/step - loss: 102.3536 - mean_sq
uared_error: 102.3536 - val_loss: 81.1486 - val_mean_squared_error: 81.1486
Epoch 19/30

Epoch 00019: LearningRateScheduler reducing learning rate to tf.Tensor(1.2752565e-06,
shape=(), dtype=float32).
711/711 [==============================] - 340s 478ms/step - loss: 101.1296 - mean_sq
uared_error: 101.1296 - val_loss: 75.6959 - val_mean_squared_error: 75.6959
Epoch 20/30

Epoch 00020: LearningRateScheduler reducing learning rate to tf.Tensor(1.2130615e-06,
shape=(), dtype=float32).
711/711 [==============================] - 342s 481ms/step - loss: 101.1921 - mean_sq
uared_error: 101.1921 - val_loss: 77.4511 - val_mean_squared_error: 77.4511
Epoch 21/30

Epoch 00021: LearningRateScheduler reducing learning rate to tf.Tensor(1.1538998e-06,
shape=(), dtype=float32).
711/711 [==============================] - 343s 482ms/step - loss: 102.7356 - mean_sq
uared_error: 102.7356 - val_loss: 79.6797 - val_mean_squared_error: 79.6797
Epoch 22/30

Epoch 00022: LearningRateScheduler reducing learning rate to tf.Tensor(1.0976235e-06,
shape=(), dtype=float32).
711/711 [==============================] - 334s 470ms/step - loss: 98.5318 - mean_squ
ared_error: 98.5318 - val_loss: 78.5857 - val_mean_squared_error: 78.5857
Epoch 23/30

Epoch 00023: LearningRateScheduler reducing learning rate to tf.Tensor(1.0440917e-06,
shape=(), dtype=float32).
711/711 [==============================] - 338s 475ms/step - loss: 101.2609 - mean_sq
uared_error: 101.2609 - val_loss: 76.9154 - val_mean_squared_error: 76.9154
Epoch 24/30

Epoch 00024: LearningRateScheduler reducing learning rate to tf.Tensor(9.931708e-07,
shape=(), dtype=float32).
711/711 [==============================] - 311s 437ms/step - loss: 99.5164 - mean_squ
ared_error: 99.5164 - val_loss: 81.7855 - val_mean_squared_error: 81.7855
Epoch 25/30

Epoch 00025: LearningRateScheduler reducing learning rate to tf.Tensor(9.4473336e-07,
shape=(), dtype=float32).
711/711 [==============================] - 316s 445ms/step - loss: 98.9089 - mean_squ
ared_error: 98.9089 - val_loss: 77.8809 - val_mean_squared_error: 77.8809
Epoch 26/30

Epoch 00026: LearningRateScheduler reducing learning rate to tf.Tensor(8.986582e-07,
shape=(), dtype=float32).
711/711 [==============================] - 316s 444ms/step - loss: 99.6686 - mean_squ
ared_error: 99.6686 - val_loss: 84.9260 - val_mean_squared_error: 84.9260
Epoch 27/30
```

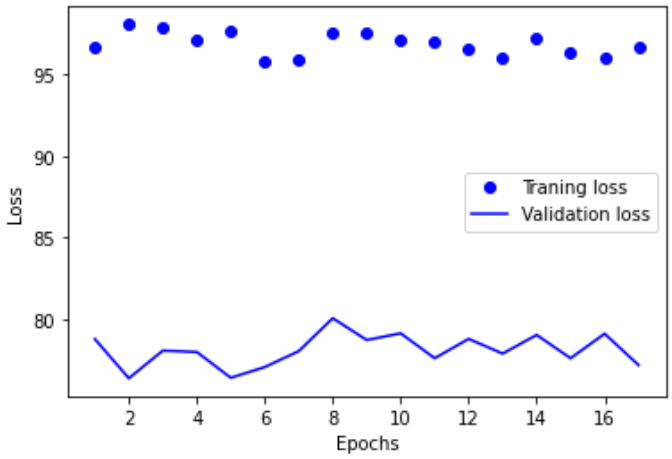
```
Epoch 00027: LearningRateScheduler reducing learning rate to tf.Tensor(8.5483015e-07,
shape=(), dtype=float32).
711/711 [==============================] - 320s 450ms/step - loss: 98.1453 - mean_squ
ared_error: 98.1453 - val_loss: 76.3324 - val_mean_squared_error: 76.3324
Epoch 28/30

Epoch 00028: LearningRateScheduler reducing learning rate to tf.Tensor(8.131396e-07,
shape=(), dtype=float32).
711/711 [==============================] - 314s 441ms/step - loss: 97.9668 - mean_squ
ared_error: 97.9668 - val_loss: 75.5361 - val_mean_squared_error: 75.5361
Epoch 29/30

Epoch 00029: LearningRateScheduler reducing learning rate to tf.Tensor(7.734823e-07,
shape=(), dtype=float32).
711/711 [==============================] - 316s 444ms/step - loss: 97.7524 - mean_squ
ared_error: 97.7524 - val_loss: 76.2973 - val_mean_squared_error: 76.2973
Epoch 30/30

Epoch 00030: LearningRateScheduler reducing learning rate to tf.Tensor(7.3575916e-07,
shape=(), dtype=float32).

711/711 [==============================] - 317s 445ms/step - loss: 97.6293 - mean_squ
ared_error: 97.6293 - val_loss: 81.3039 - val_mean_squared_error: 81.3039
```



- Start from epoch 28: 75.536, with learning rate 3e-7, declining after 3 epochs with rate e^-0.15

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 3.000000106112566e-07.
711/711 [==============================] - 314s 436ms/step - loss: 96.6757 - mean_squar
ed_error: 96.6757 - val_loss: 78.8239 - val_mean_squared_error: 78.8239
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 3.000000106112566e-07.
711/711 [==============================] - 317s 446ms/step - loss: 98.0244 - mean_squar
ed_error: 98.0244 - val_loss: 76.4297 - val_mean_squared_error: 76.4297
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 3.000000106112566e-07.
711/711 [==============================] - 308s 433ms/step - loss: 97.7895 - mean_squar
ed_error: 97.7895 - val_loss: 78.1203 - val_mean_squared_error: 78.1203
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to tf.Tensor(2.582124e-07, sh
ape=(), dtype=float32).
711/711 [==============================] - 309s 434ms/step - loss: 97.0398 - mean_squar
ed_error: 97.0398 - val_loss: 78.0347 - val_mean_squared_error: 78.0347
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to tf.Tensor(2.2224546e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 309s 434ms/step - loss: 97.5814 - mean_squar
ed_error: 97.5814 - val_loss: 76.4592 - val_mean_squared_error: 76.4592
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to tf.Tensor(1.9128844e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 308s 433ms/step - loss: 95.7434 - mean_squar
ed_error: 95.7434 - val_loss: 77.1142 - val_mean_squared_error: 77.1142
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to tf.Tensor(1.6464348e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 308s 433ms/step - loss: 95.8747 - mean_squar
ed_error: 95.8747 - val_loss: 78.0869 - val_mean_squared_error: 78.0869
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to tf.Tensor(1.4170995e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 308s 433ms/step - loss: 97.4643 - mean_squar
ed_error: 97.4643 - val_loss: 80.0959 - val_mean_squared_error: 80.0959
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to tf.Tensor(1.2197087e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 308s 433ms/step - loss: 97.4875 - mean_squar
ed_error: 97.4875 - val_loss: 78.7664 - val_mean_squared_error: 78.7664
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to tf.Tensor(1.049813e-07, sh
ape=(), dtype=float32).
711/711 [==============================] - 309s 434ms/step - loss: 97.0633 - mean_squar
ed_error: 97.0633 - val_loss: 79.1729 - val_mean_squared_error: 79.1729
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to tf.Tensor(9.0358235e-08, s
hape=(), dtype=float32).
711/711 [==============================] - 309s 434ms/step - loss: 96.9271 - mean_squar
ed_error: 96.9271 - val_loss: 77.6541 - val_mean_squared_error: 77.6541
Epoch 12/30

Epoch 00012: LearningRateScheduler reducing learning rate to tf.Tensor(7.777205e-08, sh
ape=(), dtype=float32).
711/711 [==============================] - 308s 433ms/step - loss: 96.4882 - mean_squar
ed_error: 96.4882 - val_loss: 78.8344 - val_mean_squared_error: 78.8344
Epoch 13/30

Epoch 00013: LearningRateScheduler reducing learning rate to tf.Tensor(6.693902e-08, sh
ape=(), dtype=float32).
711/711 [==============================] - 308s 433ms/step - loss: 95.9900 - mean_squar
ed_error: 95.9900 - val_loss: 77.9349 - val_mean_squared_error: 77.9349
Epoch 14/30
```

```
Epoch 00014: LearningRateScheduler reducing learning rate to tf.Tensor(5.7614947e-08, s
hape=(), dtype=float32).
711/711 [==============================] - 308s 432ms/step - loss: 97.2130 - mean_squar
ed_error: 97.2130 - val_loss: 79.0742 - val_mean_squared_error: 79.0742
Epoch 15/30

Epoch 00015: LearningRateScheduler reducing learning rate to tf.Tensor(4.9589644e-08, s
hape=(), dtype=float32).
711/711 [==============================] - 309s 434ms/step - loss: 96.3565 - mean_squar
ed_error: 96.3565 - val_loss: 77.6527 - val_mean_squared_error: 77.6527
Epoch 16/30

Epoch 00016: LearningRateScheduler reducing learning rate to tf.Tensor(4.26822e-08, sha
pe=(), dtype=float32).
711/711 [==============================] - 308s 432ms/step - loss: 95.9456 - mean_squar
ed_error: 95.9456 - val_loss: 79.1496 - val_mean_squared_error: 79.1496
Epoch 17/30

Epoch 00017: LearningRateScheduler reducing learning rate to tf.Tensor(3.6736907e-08, s
hape=(), dtype=float32).
711/711 [==============================] - 307s 431ms/step - loss: 96.6082 - mean_squar
ed_error: 96.6082 - val_loss: 77.2346 - val_mean_squared_error: 77.2346
```

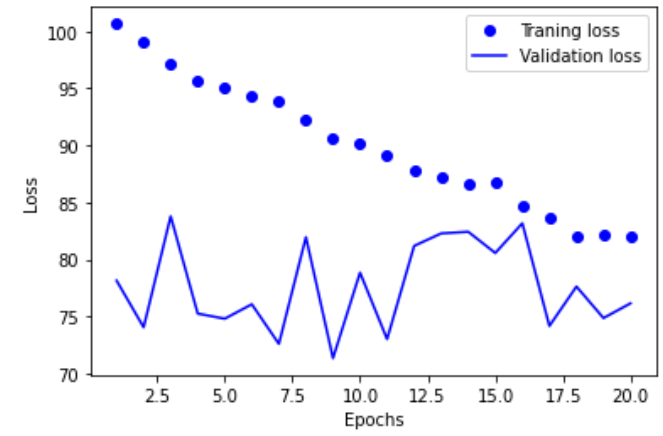


79.146

- Let's see what happens if increase learning rate to 5e-6, declining after 15 epochs at e^-0.15

```
Epoch 1/30

Epoch 00001: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 347s 488ms/step - loss: 100.6660 - mean_squa
red_error: 100.6660 - val_loss: 78.1512 - val_mean_squared_error: 78.1512
Epoch 2/30

Epoch 00002: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 314s 441ms/step - loss: 99.0235 - mean_squar
ed_error: 99.0235 - val_loss: 74.0584 - val_mean_squared_error: 74.0584
Epoch 3/30

Epoch 00003: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 313s 440ms/step - loss: 97.1567 - mean_squar
ed_error: 97.1567 - val_loss: 83.7877 - val_mean_squared_error: 83.7877
Epoch 4/30

Epoch 00004: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 313s 441ms/step - loss: 95.6235 - mean_squar
ed_error: 95.6235 - val_loss: 75.2583 - val_mean_squared_error: 75.2583
Epoch 5/30

Epoch 00005: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 314s 441ms/step - loss: 95.0653 - mean_squar
ed_error: 95.0653 - val_loss: 74.8113 - val_mean_squared_error: 74.8113
Epoch 6/30

Epoch 00006: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 314s 441ms/step - loss: 94.3850 - mean_squar
ed_error: 94.3850 - val_loss: 76.0789 - val_mean_squared_error: 76.0789
Epoch 7/30

Epoch 00007: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 315s 443ms/step - loss: 93.9420 - mean_squar
ed_error: 93.9420 - val_loss: 72.6019 - val_mean_squared_error: 72.6019
Epoch 8/30

Epoch 00008: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 313s 440ms/step - loss: 92.1940 - mean_squar
ed_error: 92.1940 - val_loss: 81.9618 - val_mean_squared_error: 81.9618
Epoch 9/30

Epoch 00009: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 314s 441ms/step - loss: 90.6708 - mean_squar
ed_error: 90.6708 - val_loss: 71.3517 - val_mean_squared_error: 71.3517
Epoch 10/30

Epoch 00010: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 315s 443ms/step - loss: 90.1863 - mean_squar
ed_error: 90.1863 - val_loss: 78.8500 - val_mean_squared_error: 78.8500
Epoch 11/30

Epoch 00011: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 317s 445ms/step - loss: 89.0659 - mean_squar
ed_error: 89.0659 - val_loss: 73.0212 - val_mean_squared_error: 73.0212
Epoch 12/30

Epoch 00012: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 315s 443ms/step - loss: 87.7684 - mean_squar
ed_error: 87.7684 - val_loss: 81.1920 - val_mean_squared_error: 81.1920
Epoch 13/30

Epoch 00013: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 314s 441ms/step - loss: 87.2792 - mean_squar
ed_error: 87.2792 - val_loss: 82.2863 - val_mean_squared_error: 82.2863
Epoch 14/30

Epoch 00014: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 316s 444ms/step - loss: 86.6587 - mean_squar
ed_error: 86.6587 - val_loss: 82.4317 - val_mean_squared_error: 82.4317
Epoch 15/30
```

```
Epoch 00015: LearningRateScheduler reducing learning rate to 4.999999873689376e-06.
711/711 [==============================] - 315s 443ms/step - loss: 86.7324 - mean_squ
ared_error: 86.7324 - val_loss: 80.5685 - val_mean_squared_error: 80.5685
Epoch 16/30

Epoch 00016: LearningRateScheduler reducing learning rate to tf.Tensor(4.3035398e-06,
shape=(), dtype=float32).
711/711 [==============================] - 314s 442ms/step - loss: 84.7591 - mean_squ
ared_error: 84.7591 - val_loss: 83.1779 - val_mean_squared_error: 83.1779
Epoch 17/30

Epoch 00017: LearningRateScheduler reducing learning rate to tf.Tensor(3.704091e-06,
shape=(), dtype=float32).
711/711 [==============================] - 313s 440ms/step - loss: 83.6771 - mean_squ
ared_error: 83.6771 - val_loss: 74.1743 - val_mean_squared_error: 74.1743
Epoch 18/30

Epoch 00018: LearningRateScheduler reducing learning rate to tf.Tensor(3.1881405e-06,
shape=(), dtype=float32).
711/711 [==============================] - 313s 440ms/step - loss: 81.9736 - mean_squ
ared_error: 81.9736 - val_loss: 77.6309 - val_mean_squared_error: 77.6309
Epoch 19/30

Epoch 00019: LearningRateScheduler reducing learning rate to tf.Tensor(2.7440578e-06,
shape=(), dtype=float32).
711/711 [==============================] - 316s 444ms/step - loss: 82.1046 - mean_squ
ared_error: 82.1046 - val_loss: 74.8684 - val_mean_squared_error: 74.8684
Epoch 20/30

Epoch 00020: LearningRateScheduler reducing learning rate to tf.Tensor(2.3618325e-06,
shape=(), dtype=float32).
711/711 [==============================] - 314s 441ms/step - loss: 82.0653 - mean_squ
ared_error: 82.0653 - val_loss: 76.1593 - val_mean_squared_error: 76.1593
```



- Start from Epoch: 9: 71.352, learning rate 2e-6, same schedule, declining after 5 epochs

```
Epoch 00001: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 317s 441ms/step - loss: 88.9125 - mean_squar
ed_error: 88.9125 - val_loss: 73.3715 - val_mean_squared_error: 73.3715
Epoch 2/10

Epoch 00002: LearningRateScheduler reducing learning rate to 1.9999999949504854e-06.
711/711 [==============================] - 311s 437ms/step - loss: 88.5203 - mean_squar
ed_error: 88.5203 - val_loss: 80.6348 - val_mean_squared_error: 80.6348
Epoch 3/10

Epoch 00003: LearningRateScheduler reducing learning rate to tf.Tensor(1.7214159e-06, s
hape=(), dtype=float32).
711/711 [==============================] - 312s 439ms/step - loss: 87.4389 - mean_squar
ed_error: 87.4389 - val_loss: 80.1978 - val_mean_squared_error: 80.1978
Epoch 4/10

Epoch 00004: LearningRateScheduler reducing learning rate to tf.Tensor(1.4816363e-06, s
hape=(), dtype=float32).
711/711 [==============================] - 312s 438ms/step - loss: 86.6994 - mean_squar
ed_error: 86.6994 - val_loss: 75.0118 - val_mean_squared_error: 75.0118
Epoch 5/10

Epoch 00005: LearningRateScheduler reducing learning rate to tf.Tensor(1.2752562e-06, s
hape=(), dtype=float32).
711/711 [==============================] - 314s 442ms/step - loss: 85.9460 - mean_squar
ed_error: 85.9460 - val_loss: 79.8085 - val_mean_squared_error: 79.8085
Epoch 6/10

Epoch 00006: LearningRateScheduler reducing learning rate to tf.Tensor(1.0976231e-06, s
hape=(), dtype=float32).
711/711 [==============================] - 318s 447ms/step - loss: 85.0023 - mean_squar
ed_error: 85.0023 - val_loss: 76.8640 - val_mean_squared_error: 76.8640
Epoch 7/10

Epoch 00007: LearningRateScheduler reducing learning rate to tf.Tensor(9.447329e-07, sh
ape=(), dtype=float32).
711/711 [==============================] - 313s 440ms/step - loss: 84.3783 - mean_squar
ed_error: 84.3783 - val_loss: 77.0948 - val_mean_squared_error: 77.0948
Epoch 8/10

Epoch 00008: LearningRateScheduler reducing learning rate to tf.Tensor(8.1313914e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 312s 439ms/step - loss: 85.4346 - mean_squar
ed_error: 85.4346 - val_loss: 78.9316 - val_mean_squared_error: 78.9316
Epoch 9/10

Epoch 00009: LearningRateScheduler reducing learning rate to tf.Tensor(6.9987533e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 314s 442ms/step - loss: 84.8661 - mean_squar
ed_error: 84.8661 - val_loss: 78.7238 - val_mean_squared_error: 78.7238
Epoch 10/10

Epoch 00010: LearningRateScheduler reducing learning rate to tf.Tensor(6.0238824e-07, s
hape=(), dtype=float32).
711/711 [==============================] - 311s 438ms/step - loss: 84.1133 - mean_squar
ed_error: 84.1133 - val_loss: 73.8476 - val_mean_squared_error: 73.8476
```