Estimate generation v2

Global Power Plant Database; World Resources Institute

- Use advanced models for generation estimation in the Global Power Plant Database.
- Primary model is a two-hidden-layer neural network.

In [1]:

```
# import what we'll need and set parameters

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.patches as mpatches
import tensorflow as tf
from keras.models import Sequential
from keras.layers import Flatten, Dense, Lambda, Dropout
from keras.layers import LeakyReLU
from keras.callbacks import EarlyStopping, ModelCheckpoint
from keras.utils.vis_utils import model_to_dot
from IPython.display import SVG
from sklearn.model_selection import train_test_split
from sklearn import metrics
from skimage import io
import pydot

GPPD_FILENAME = '../../output_database/global_power_plant_database.csv'
WEIGHTS_FILE = "model/estimate_generation.h5"
VALIDATION_FRACTION = 0.2
```

```
Using TensorFlow backend.
```

In [2]:

```
# set up fuel colors

fuel_color = { 'Biomass':'#33a02c',
               'Coal':'sienna',
               'Cogeneration':'#e31a1c',
               'Gas':'#a6cee3',
               'Geothermal':'#b2df8a',
               'Hydro':'#1f78b4',
               'Nuclear':'#6a3d9a',
               'Oil':'black',
               'Other':'gray',
               'Petcoke':'#fb9a99',
               'Solar':'#ffff99',
               'Storage':'#ff1010',   # need better color
               'Waste':'#fdbf6f',
               'Wave_and_Tidal':'#b15928',
               'Wind':'#ff7f00'
}
```

In [3]:

```
# read in database
df = pd.read_csv(GPPD_FILENAME)
df.head()
```

Out[3]:

	country	country_long	name	gppd_idnr	capacity_mw	latitude	longitu
0	AFG	Afghanistan	Kajaki Hydroelectric Power Plant Afghanistan	GEODB0040538	33.00	32.3220	65.119(
1	AFG	Afghanistan	Mahipar Hydroelectric Power Plant Afghanistan	GEODB0040541	66.00	34.5560	69.4787
2	AFG	Afghanistan	Naghlu Dam Hydroelectric Power Plant Afghanistan	GEODB0040534	100.00	34.6410	69.717(
3	AFG	Afghanistan	Nangarhar (Darunta) Hydroelectric Power Plant ...	GEODB0040536	11.55	34.4847	70.3633
4	AFG	Afghanistan	Northwest Kabul Power Plant Afghanistan	GEODB0040540	42.00	34.5638	69.113⁴

5 rows × 22 columns

In [4]:

```
# show count for number of valid entries in each column
df.count()
```

Out[4]:

```
country                     25657
country_long                25657
name                        25637
gppd_idnr                   25657
capacity_mw                 25657
latitude                    25657
longitude                   25657
fuel1                       25657
fuel2                        1670
fuel3                         295
fuel4                         107
commissioning_year          13933
owner                       17157
source                      25657
url                         25657
geolocation_source          25657
year_of_capacity_data       16065
generation_gwh_2013           371
generation_gwh_2014           386
generation_gwh_2015           887
generation_gwh_2016          8326
estimated_generation_gwh    24633
dtype: int64
```

In [5]:

```
# prepare data for training
# don't include plants with zero generation (min capacity factor = 0.01)
# (may simply result from missing data)
# should address this issue in the future!

MIN_CAPACITY_FACTOR = 0.01
MAX_CAPACITY_FACTOR = 1.0

# convert string-type columns to categories (assume no NaNs in these columns)
factorized_countries,country_key = df['country'].astype('category').factorize()
df['country_factorized'] = factorized_countries
factorized_fuel1,fuel1_key = df['fuel1'].astype('category').factorize()
df['fuel1_factorized'] = factorized_fuel1

# create new data frame with relevant predictor variable (X) columns and 2016 ge
neration
# clean data frame by removing NaNs
X_columns = ['country_factorized','capacity_mw','latitude','longitude','commissi
oning_year','fuel1_factorized']
df_clean = df[X_columns + ['generation_gwh_2016']].dropna(how='any')

# convert 2016 generation into capacity factor and remove rows with erroneous ca
pacity factors
df_clean['capacity_factor'] = df_clean.apply(lambda row:row['generation_gwh_2016
']/(24.0*365.0*0.001*row['capacity_mw']),axis=1)
df_clean = df_clean[df_clean.capacity_factor >= MIN_CAPACITY_FACTOR]
df_clean = df_clean[df_clean.capacity_factor <= MAX_CAPACITY_FACTOR]

# create np arrays from data frame
X_data = df_clean[X_columns].as_matrix()
y_column = ['capacity_factor']
y_data = df_clean[y_column].as_matrix()

# show results
print(X_data)
print(y_data)
print(len(X_data))
print(len(y_data))
```

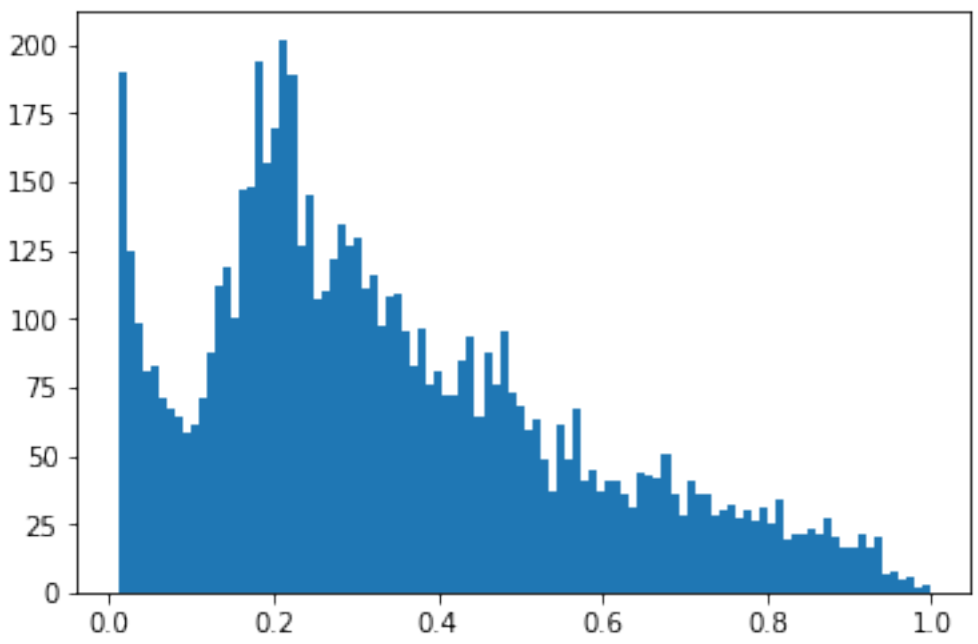
```
[[    8.       289.        47.2078    11.0057  1981.         0.    ]
 [    8.       500.        47.2696    10.9678  1981.         0.    ]
 [   55.      1480.        53.8506     9.345   1986.         5.    ]
 ...,
 [  157.        28.        14.3611   108.7203  2014.         0.    ]
 [  157.        19.5       12.1526   108.3787  2010.         0.    ]
 [  157.        30.        15.86     107.6538  2009.         0.    ]
]
[[ 0.04692255]
 [ 0.02934475]
 [ 0.81033799]
 ...,
 [ 0.41992825]
 [ 0.46247512]
 [ 0.46689498]]
6904
6904
```

In [6]:

```
# examine training data to confirm valid capacity factors

print(u"Y data max: {0}, min: {1}".format(y_data.max(),y_data.min()))
plt.hist(y_data,bins=100)
plt.show()
```

```
Y data max: 0.998536954444, min: 0.010049329739
```



In [7]:

```
# calculate scaling values for normalizing input data

mean_vals = np.mean(X_data,axis=0)
range_vals = np.max(X_data,axis=0) - np.min(X_data,axis=0)
```

In [8]:

```
# set up neural network

INPUT_SHAPE = X_data[0].shape
print(u"Input shape is: {0}".format(INPUT_SHAPE))
DROPOUT_RATE = 0.15
DENSE_LAYER_SIZE = 256

def myNet(activation_type='relu'):
    model = Sequential()
    model.add(Lambda(lambda x: (x-mean_vals)/range_vals, input_shape = INPUT_SHA
PE))   # normalization
    model.add(Dense(DENSE_LAYER_SIZE,activation=activation_type))
    model.add(Dropout(DROPOUT_RATE))
    model.add(Dense(DENSE_LAYER_SIZE,activation=activation_type))
    model.add(Dropout(DROPOUT_RATE))
    model.add(Dense(DENSE_LAYER_SIZE,activation=activation_type))
    model.add(Dense(1,activation='sigmoid'))    # will restrict output to [0,1]
    return model

model = myNet()
model.compile(loss='mean_squared_error',optimizer='adam',metrics=['mean_absolute
_error'])
print("Model contains {0} parameters.".format(model.count_params()))
print(model.summary())
```

```
Input shape is: (6,)
Model contains 133633 parameters.
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lambda_1 (Lambda)            (None, 6)                 0
_________________________________________________________________
dense_1 (Dense)              (None, 256)               1792
_________________________________________________________________
dropout_1 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_2 (Dense)              (None, 256)               65792
_________________________________________________________________
dropout_2 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_3 (Dense)              (None, 256)               65792
_________________________________________________________________
dense_4 (Dense)              (None, 1)                 257
=================================================================
Total params: 133,633
Trainable params: 133,633
Non-trainable params: 0
_________________________________________________________________
None
```

In [9]:

```
# fit model

def fit_model(model,weights_file):
    BATCH_SIZE = 64
    NUM_EPOCHS = 512
    early_stop = EarlyStopping(monitor='val_loss',min_delta=0.0001,patience=64)
    check_point = ModelCheckpoint(weights_file,monitor='val_loss',save_best_only
=True,mode='max')
    history_object = model.fit(x=X_data, y=y_data,
                               batch_size = BATCH_SIZE,
                               epochs = NUM_EPOCHS,
                               verbose = 1,
                               callbacks = [early_stop,check_point],
                               validation_split = VALIDATION_FRACTION)
    return history_object

# fit model
history_object = fit_model(model,WEIGHTS_FILE)

# reload model with best weights from training
model = myNet()
model.load_weights(WEIGHTS_FILE)
model.compile(loss='mean_squared_error',optimizer='adam',metrics=['mean_absolute
_error'])
print("Finished training; model reloaded with optimum weights.")
```

```
Train on 5523 samples, validate on 1381 samples
Epoch 1/512
5523/5523 [==============================] - 1s 203us/step - loss: 0
.0471 - mean_absolute_error: 0.1709 - val_loss: 0.0450 - val_mean_ab
solute_error: 0.1705
Epoch 2/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0386 - mean_absolute_error: 0.1504 - val_loss: 0.0424 - val_mean_ab
solute_error: 0.1597
Epoch 3/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0362 - mean_absolute_error: 0.1438 - val_loss: 0.0356 - val_mean_ab
solute_error: 0.1456
Epoch 4/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0354 - mean_absolute_error: 0.1426 - val_loss: 0.0326 - val_mean_ab
solute_error: 0.1338
Epoch 5/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0350 - mean_absolute_error: 0.1414 - val_loss: 0.0318 - val_mean_ab
solute_error: 0.1305
Epoch 6/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0345 - mean_absolute_error: 0.1399 - val_loss: 0.0346 - val_mean_ab
solute_error: 0.1426
```

```
Epoch 7/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0343 - mean_absolute_error: 0.1390 - val_loss: 0.0322 - val_mean_ab
solute_error: 0.1328
Epoch 8/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0339 - mean_absolute_error: 0.1388 - val_loss: 0.0315 - val_mean_ab
solute_error: 0.1303
Epoch 9/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0340 - mean_absolute_error: 0.1388 - val_loss: 0.0318 - val_mean_ab
solute_error: 0.1298
Epoch 10/512
5523/5523 [==============================] - 1s 105us/step - loss: 0
.0334 - mean_absolute_error: 0.1371 - val_loss: 0.0326 - val_mean_ab
solute_error: 0.1368
Epoch 11/512
5523/5523 [==============================] - 1s 105us/step - loss: 0
.0331 - mean_absolute_error: 0.1371 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1302
Epoch 12/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0330 - mean_absolute_error: 0.1368 - val_loss: 0.0304 - val_mean_ab
solute_error: 0.1285
Epoch 13/512
5523/5523 [==============================] - 1s 105us/step - loss: 0
.0327 - mean_absolute_error: 0.1354 - val_loss: 0.0317 - val_mean_ab
solute_error: 0.1341
Epoch 14/512
5523/5523 [==============================] - 1s 133us/step - loss: 0
.0325 - mean_absolute_error: 0.1353 - val_loss: 0.0311 - val_mean_ab
solute_error: 0.1320
Epoch 15/512
5523/5523 [==============================] - 1s 139us/step - loss: 0
.0321 - mean_absolute_error: 0.1341 - val_loss: 0.0330 - val_mean_ab
solute_error: 0.1380
Epoch 16/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0322 - mean_absolute_error: 0.1340 - val_loss: 0.0300 - val_mean_ab
solute_error: 0.1265
Epoch 17/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0318 - mean_absolute_error: 0.1334 - val_loss: 0.0297 - val_mean_ab
solute_error: 0.1267
Epoch 18/512
5523/5523 [==============================] - 1s 93us/step - loss: 0.
0317 - mean_absolute_error: 0.1328 - val_loss: 0.0304 - val_mean_abs
olute_error: 0.1280
Epoch 19/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0312 - mean_absolute_error: 0.1323 - val_loss: 0.0297 - val_mean_ab
solute_error: 0.1281
Epoch 20/512
```

```
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0316 - mean_absolute_error: 0.1332 - val_loss: 0.0289 - val_mean_ab
solute_error: 0.1245
Epoch 21/512
5523/5523 [==============================] - 1s 136us/step - loss: 0
.0312 - mean_absolute_error: 0.1321 - val_loss: 0.0312 - val_mean_ab
solute_error: 0.1336
Epoch 22/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0309 - mean_absolute_error: 0.1313 - val_loss: 0.0298 - val_mean_ab
solute_error: 0.1273
Epoch 23/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0307 - mean_absolute_error: 0.1308 - val_loss: 0.0294 - val_mean_abs
olute_error: 0.1260
Epoch 24/512
5523/5523 [==============================] - 1s 131us/step - loss: 0
.0303 - mean_absolute_error: 0.1295 - val_loss: 0.0335 - val_mean_ab
solute_error: 0.1374
Epoch 25/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0304 - mean_absolute_error: 0.1296 - val_loss: 0.0294 - val_mean_ab
solute_error: 0.1284
Epoch 26/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0301 - mean_absolute_error: 0.1285 - val_loss: 0.0286 - val_mean_ab
solute_error: 0.1236
Epoch 27/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0300 - mean_absolute_error: 0.1297 - val_loss: 0.0279 - val_mean_ab
solute_error: 0.1223
Epoch 28/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0297 - mean_absolute_error: 0.1282 - val_loss: 0.0327 - val_mean_abs
olute_error: 0.1382
Epoch 29/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0296 - mean_absolute_error: 0.1281 - val_loss: 0.0288 - val_mean_ab
solute_error: 0.1240
Epoch 30/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0301 - mean_absolute_error: 0.1290 - val_loss: 0.0282 - val_mean_ab
solute_error: 0.1211
Epoch 31/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0294 - mean_absolute_error: 0.1274 - val_loss: 0.0296 - val_mean_ab
solute_error: 0.1267
Epoch 32/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0291 - mean_absolute_error: 0.1269 - val_loss: 0.0283 - val_mean_ab
solute_error: 0.1234
Epoch 33/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
```

```
.0295 - mean_absolute_error: 0.1279 - val_loss: 0.0283 - val_mean_ab
solute_error: 0.1231
Epoch 34/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0290 - mean_absolute_error: 0.1265 - val_loss: 0.0284 - val_mean_ab
solute_error: 0.1250
Epoch 35/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0290 - mean_absolute_error: 0.1261 - val_loss: 0.0276 - val_mean_abs
olute_error: 0.1211
Epoch 36/512
5523/5523 [==============================] - 1s 123us/step - loss: 0
.0286 - mean_absolute_error: 0.1259 - val_loss: 0.0289 - val_mean_ab
solute_error: 0.1245
Epoch 37/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0289 - mean_absolute_error: 0.1264 - val_loss: 0.0276 - val_mean_abs
olute_error: 0.1204
Epoch 38/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0286 - mean_absolute_error: 0.1253 - val_loss: 0.0286 - val_mean_ab
solute_error: 0.1250
Epoch 39/512
5523/5523 [==============================] - 1s 182us/step - loss: 0
.0285 - mean_absolute_error: 0.1250 - val_loss: 0.0273 - val_mean_ab
solute_error: 0.1189
Epoch 40/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0283 - mean_absolute_error: 0.1244 - val_loss: 0.0278 - val_mean_abs
olute_error: 0.1189
Epoch 41/512
5523/5523 [==============================] - 1s 143us/step - loss: 0
.0283 - mean_absolute_error: 0.1244 - val_loss: 0.0270 - val_mean_ab
solute_error: 0.1168
Epoch 42/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0282 - mean_absolute_error: 0.1235 - val_loss: 0.0274 - val_mean_ab
solute_error: 0.1186
Epoch 43/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0281 - mean_absolute_error: 0.1241 - val_loss: 0.0278 - val_mean_ab
solute_error: 0.1217
Epoch 44/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0280 - mean_absolute_error: 0.1236 - val_loss: 0.0270 - val_mean_ab
solute_error: 0.1189
Epoch 45/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0279 - mean_absolute_error: 0.1233 - val_loss: 0.0289 - val_mean_ab
solute_error: 0.1255
Epoch 46/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0278 - mean_absolute_error: 0.1227 - val_loss: 0.0303 - val_mean_abs
```

```
olute_error: 0.1294
Epoch 47/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0279 - mean_absolute_error: 0.1236 - val_loss: 0.0274 - val_mean_ab
solute_error: 0.1211
Epoch 48/512
5523/5523 [==============================] - 1s 140us/step - loss: 0
.0277 - mean_absolute_error: 0.1226 - val_loss: 0.0281 - val_mean_ab
solute_error: 0.1223
Epoch 49/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0281 - mean_absolute_error: 0.1233 - val_loss: 0.0275 - val_mean_ab
solute_error: 0.1201
Epoch 50/512
5523/5523 [==============================] - 1s 145us/step - loss: 0
.0275 - mean_absolute_error: 0.1216 - val_loss: 0.0289 - val_mean_ab
solute_error: 0.1258
Epoch 51/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0277 - mean_absolute_error: 0.1226 - val_loss: 0.0272 - val_mean_ab
solute_error: 0.1175
Epoch 52/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0273 - mean_absolute_error: 0.1217 - val_loss: 0.0269 - val_mean_ab
solute_error: 0.1164
Epoch 53/512
5523/5523 [==============================] - ETA: 0s - loss: 0.0272
- mean_absolute_error: 0.121 - 1s 106us/step - loss: 0.0272 - mean_a
bsolute_error: 0.1214 - val_loss: 0.0287 - val_mean_absolute_error:
0.1209
Epoch 54/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0274 - mean_absolute_error: 0.1220 - val_loss: 0.0289 - val_mean_ab
solute_error: 0.1252
Epoch 55/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0270 - mean_absolute_error: 0.1209 - val_loss: 0.0272 - val_mean_ab
solute_error: 0.1164
Epoch 56/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0270 - mean_absolute_error: 0.1214 - val_loss: 0.0272 - val_mean_abs
olute_error: 0.1178
Epoch 57/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0272 - mean_absolute_error: 0.1210 - val_loss: 0.0272 - val_mean_abs
olute_error: 0.1170
Epoch 58/512
5523/5523 [==============================] - 1s 136us/step - loss: 0
.0270 - mean_absolute_error: 0.1208 - val_loss: 0.0337 - val_mean_ab
solute_error: 0.1372
Epoch 59/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0273 - mean_absolute_error: 0.1214 - val_loss: 0.0270 - val_mean_ab
```

```
solute_error: 0.1160
Epoch 60/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0267 - mean_absolute_error: 0.1205 - val_loss: 0.0271 - val_mean_ab
solute_error: 0.1171
Epoch 61/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0269 - mean_absolute_error: 0.1199 - val_loss: 0.0271 - val_mean_ab
solute_error: 0.1166
Epoch 62/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0267 - mean_absolute_error: 0.1193 - val_loss: 0.0284 - val_mean_ab
solute_error: 0.1243
Epoch 63/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0269 - mean_absolute_error: 0.1210 - val_loss: 0.0280 - val_mean_ab
solute_error: 0.1204
Epoch 64/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0270 - mean_absolute_error: 0.1204 - val_loss: 0.0296 - val_mean_ab
solute_error: 0.1273
Epoch 65/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0264 - mean_absolute_error: 0.1191 - val_loss: 0.0288 - val_mean_ab
solute_error: 0.1240
Epoch 66/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0267 - mean_absolute_error: 0.1199 - val_loss: 0.0274 - val_mean_ab
solute_error: 0.1177
Epoch 67/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0265 - mean_absolute_error: 0.1186 - val_loss: 0.0276 - val_mean_ab
solute_error: 0.1173
Epoch 68/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0265 - mean_absolute_error: 0.1195 - val_loss: 0.0280 - val_mean_ab
solute_error: 0.1184
Epoch 69/512
5523/5523 [==============================] - 1s 122us/step - loss: 0
.0266 - mean_absolute_error: 0.1190 - val_loss: 0.0289 - val_mean_ab
solute_error: 0.1228
Epoch 70/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0261 - mean_absolute_error: 0.1181 - val_loss: 0.0270 - val_mean_ab
solute_error: 0.1159
Epoch 71/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0258 - mean_absolute_error: 0.1166 - val_loss: 0.0290 - val_mean_ab
solute_error: 0.1222
Epoch 72/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0264 - mean_absolute_error: 0.1188 - val_loss: 0.0272 - val_mean_ab
solute_error: 0.1181
```

```
Epoch 73/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0261 - mean_absolute_error: 0.1186 - val_loss: 0.0280 - val_mean_ab
solute_error: 0.1178
Epoch 74/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0262 - mean_absolute_error: 0.1179 - val_loss: 0.0280 - val_mean_ab
solute_error: 0.1189
Epoch 75/512
5523/5523 [==============================] - 1s 125us/step - loss: 0
.0260 - mean_absolute_error: 0.1177 - val_loss: 0.0280 - val_mean_ab
solute_error: 0.1162
Epoch 76/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0259 - mean_absolute_error: 0.1164 - val_loss: 0.0288 - val_mean_ab
solute_error: 0.1211
Epoch 77/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0264 - mean_absolute_error: 0.1191 - val_loss: 0.0277 - val_mean_ab
solute_error: 0.1194
Epoch 78/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0257 - mean_absolute_error: 0.1171 - val_loss: 0.0275 - val_mean_ab
solute_error: 0.1157
Epoch 79/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0257 - mean_absolute_error: 0.1165 - val_loss: 0.0289 - val_mean_ab
solute_error: 0.1248
Epoch 80/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0257 - mean_absolute_error: 0.1165 - val_loss: 0.0282 - val_mean_ab
solute_error: 0.1169
Epoch 81/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0256 - mean_absolute_error: 0.1166 - val_loss: 0.0274 - val_mean_ab
solute_error: 0.1170
Epoch 82/512
5523/5523 [==============================] - 1s 122us/step - loss: 0
.0258 - mean_absolute_error: 0.1170 - val_loss: 0.0269 - val_mean_ab
solute_error: 0.1167
Epoch 83/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0256 - mean_absolute_error: 0.1166 - val_loss: 0.0285 - val_mean_ab
solute_error: 0.1184
Epoch 84/512
5523/5523 [==============================] - 1s 130us/step - loss: 0
.0257 - mean_absolute_error: 0.1162 - val_loss: 0.0275 - val_mean_ab
solute_error: 0.1183
Epoch 85/512
5523/5523 [==============================] - 1s 130us/step - loss: 0
.0257 - mean_absolute_error: 0.1167 - val_loss: 0.0273 - val_mean_ab
solute_error: 0.1167
Epoch 86/512
```

```
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0254 - mean_absolute_error: 0.1159 - val_loss: 0.0269 - val_mean_ab
solute_error: 0.1158
Epoch 87/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0251 - mean_absolute_error: 0.1150 - val_loss: 0.0291 - val_mean_ab
solute_error: 0.1241
Epoch 88/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0256 - mean_absolute_error: 0.1164 - val_loss: 0.0282 - val_mean_ab
solute_error: 0.1173
Epoch 89/512
5523/5523 [==============================] - 1s 130us/step - loss: 0
.0254 - mean_absolute_error: 0.1153 - val_loss: 0.0268 - val_mean_ab
solute_error: 0.1158
Epoch 90/512
5523/5523 [==============================] - 1s 135us/step - loss: 0
.0254 - mean_absolute_error: 0.1158 - val_loss: 0.0277 - val_mean_ab
solute_error: 0.1187
Epoch 91/512
5523/5523 [==============================] - 1s 126us/step - loss: 0
.0253 - mean_absolute_error: 0.1156 - val_loss: 0.0269 - val_mean_ab
solute_error: 0.1148
Epoch 92/512
5523/5523 [==============================] - 1s 130us/step - loss: 0
.0259 - mean_absolute_error: 0.1174 - val_loss: 0.0287 - val_mean_ab
solute_error: 0.1220
Epoch 93/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0249 - mean_absolute_error: 0.1146 - val_loss: 0.0284 - val_mean_ab
solute_error: 0.1204
Epoch 94/512
5523/5523 [==============================] - 1s 123us/step - loss: 0
.0251 - mean_absolute_error: 0.1153 - val_loss: 0.0276 - val_mean_ab
solute_error: 0.1156
Epoch 95/512
5523/5523 [==============================] - 1s 131us/step - loss: 0
.0250 - mean_absolute_error: 0.1149 - val_loss: 0.0277 - val_mean_ab
solute_error: 0.1157
Epoch 96/512
5523/5523 [==============================] - 1s 128us/step - loss: 0
.0248 - mean_absolute_error: 0.1137 - val_loss: 0.0299 - val_mean_ab
solute_error: 0.1251
Epoch 97/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0245 - mean_absolute_error: 0.1134 - val_loss: 0.0289 - val_mean_ab
solute_error: 0.1197
Epoch 98/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0249 - mean_absolute_error: 0.1146 - val_loss: 0.0285 - val_mean_ab
solute_error: 0.1194
Epoch 99/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
```

```
.0247 - mean_absolute_error: 0.1136 - val_loss: 0.0285 - val_mean_ab
solute_error: 0.1192
Epoch 100/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0248 - mean_absolute_error: 0.1139 - val_loss: 0.0282 - val_mean_ab
solute_error: 0.1172
Epoch 101/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0250 - mean_absolute_error: 0.1144 - val_loss: 0.0296 - val_mean_ab
solute_error: 0.1238
Epoch 102/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0246 - mean_absolute_error: 0.1142 - val_loss: 0.0284 - val_mean_ab
solute_error: 0.1206
Epoch 103/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0246 - mean_absolute_error: 0.1135 - val_loss: 0.0275 - val_mean_ab
solute_error: 0.1182
Epoch 104/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0248 - mean_absolute_error: 0.1138 - val_loss: 0.0288 - val_mean_ab
solute_error: 0.1219
Epoch 105/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0245 - mean_absolute_error: 0.1129 - val_loss: 0.0294 - val_mean_ab
solute_error: 0.1208
Epoch 106/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0247 - mean_absolute_error: 0.1136 - val_loss: 0.0276 - val_mean_ab
solute_error: 0.1176
Epoch 107/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0245 - mean_absolute_error: 0.1132 - val_loss: 0.0277 - val_mean_ab
solute_error: 0.1171
Epoch 108/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0244 - mean_absolute_error: 0.1135 - val_loss: 0.0283 - val_mean_ab
solute_error: 0.1191
Epoch 109/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0243 - mean_absolute_error: 0.1128 - val_loss: 0.0275 - val_mean_ab
solute_error: 0.1164
Epoch 110/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0244 - mean_absolute_error: 0.1128 - val_loss: 0.0276 - val_mean_ab
solute_error: 0.1163
Epoch 111/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0241 - mean_absolute_error: 0.1125 - val_loss: 0.0276 - val_mean_ab
solute_error: 0.1142
Epoch 112/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0243 - mean_absolute_error: 0.1126 - val_loss: 0.0280 - val_mean_ab
```

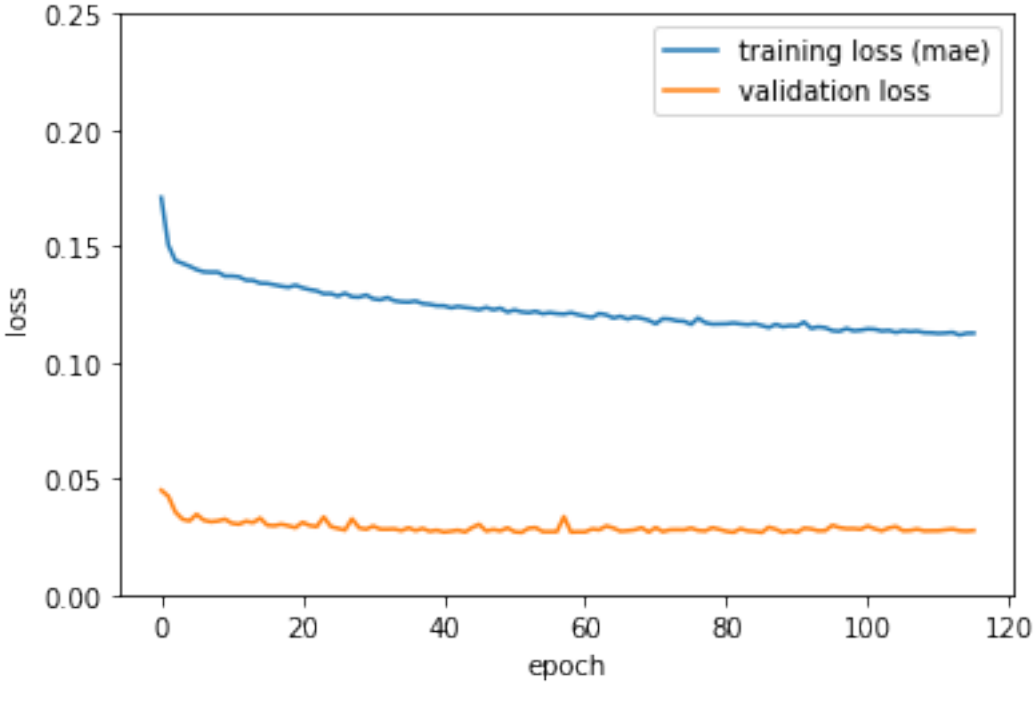
```
solute_error: 0.1171
Epoch 113/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0242 - mean_absolute_error: 0.1129 - val_loss: 0.0283 - val_mean_ab
solute_error: 0.1184
Epoch 114/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0240 - mean_absolute_error: 0.1118 - val_loss: 0.0276 - val_mean_ab
solute_error: 0.1162
Epoch 115/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0243 - mean_absolute_error: 0.1125 - val_loss: 0.0275 - val_mean_ab
solute_error: 0.1150
Epoch 116/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0242 - mean_absolute_error: 0.1126 - val_loss: 0.0277 - val_mean_ab
solute_error: 0.1166
Finished training: model reloaded with optimum weights.
```

In [10]:

```
# plot training loss history

def plot_loss(hist_obj):
    plt.plot(hist_obj.history['mean_absolute_error'])
    plt.plot(hist_obj.history['val_loss'])
    plt.ylabel('loss')
    plt.xlabel('epoch')
    plt.legend(['training loss (mae)','validation loss'],loc='upper right')
    plt.ylim([0,0.25])
    plt.show()

plot_loss(history_object)
```



In [11]:

```
# visualize model

#SVG(model_to_dot(model).create(prog='dot',format='svg'))
```

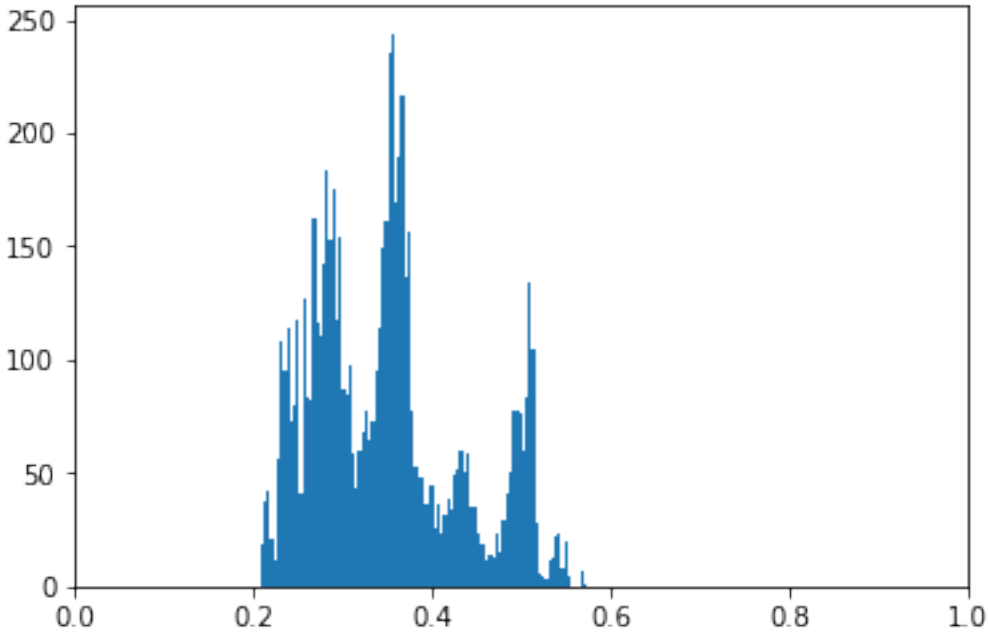
In [12]:

```
# examine results of model applied to training data

def prediction_histogram(model):
    predicted_values = model.predict(X_data)
    print(u"Predicted values in range: {0}".format(((predicted_values >= 0.0) &
(predicted_values <= 1.0)).sum()))
    print(u"Predicted max: {0}, min: {1}".format(predicted_values.max(),predicte
d_values.min()))
    plt.hist(predicted_values,bins=100)
    plt.xlim(0,1)
    plt.show()
    return predicted_values

predicted_values = prediction_histogram(model)
```

```
Predicted values in range: 6904
Predicted max: 0.573645412922, min: 0.207647696137
```

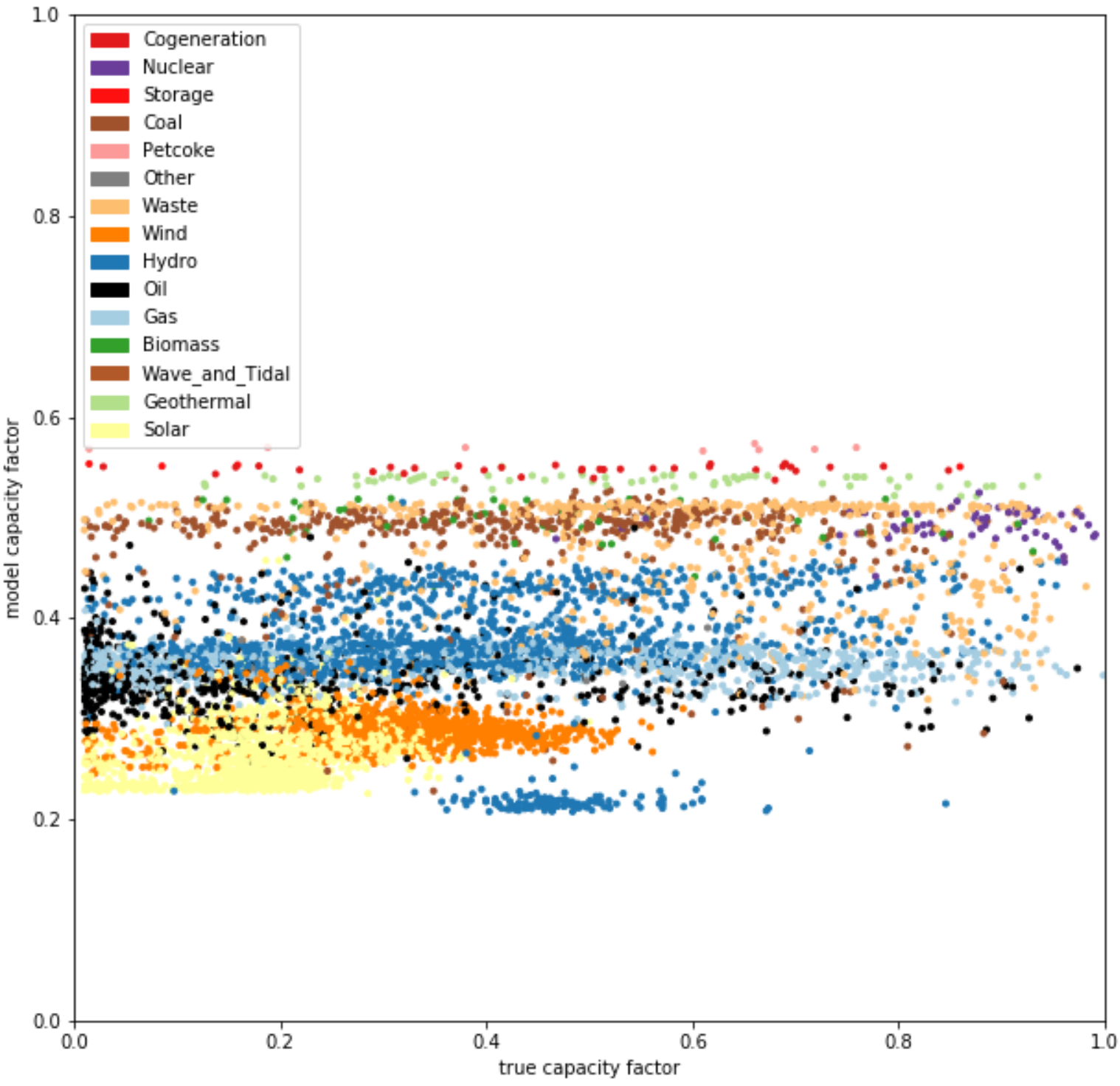


In [13]:

```
# plot predicted values vs. true values

def plot_predicted(pred_vals):
    label_patches = [mpatches.Patch(color=v,label=k) for k,v in fuel_color.iteri
tems()]
    fig = plt.figure(figsize=(10,10))
    colors = [fuel_color[fuel1_key[int(c)]] for c in X_data[:,5]]
    plt.scatter(y_data,pred_vals,marker='.',c=colors)
    plt.xlabel('true capacity factor')
    plt.ylabel('model capacity factor')
    plt.legend(handles=label_patches,loc='upper left')
    plt.xlim([0,1])
    plt.ylim([0,1])
    plt.show()

plot_predicted(predicted_values)
```



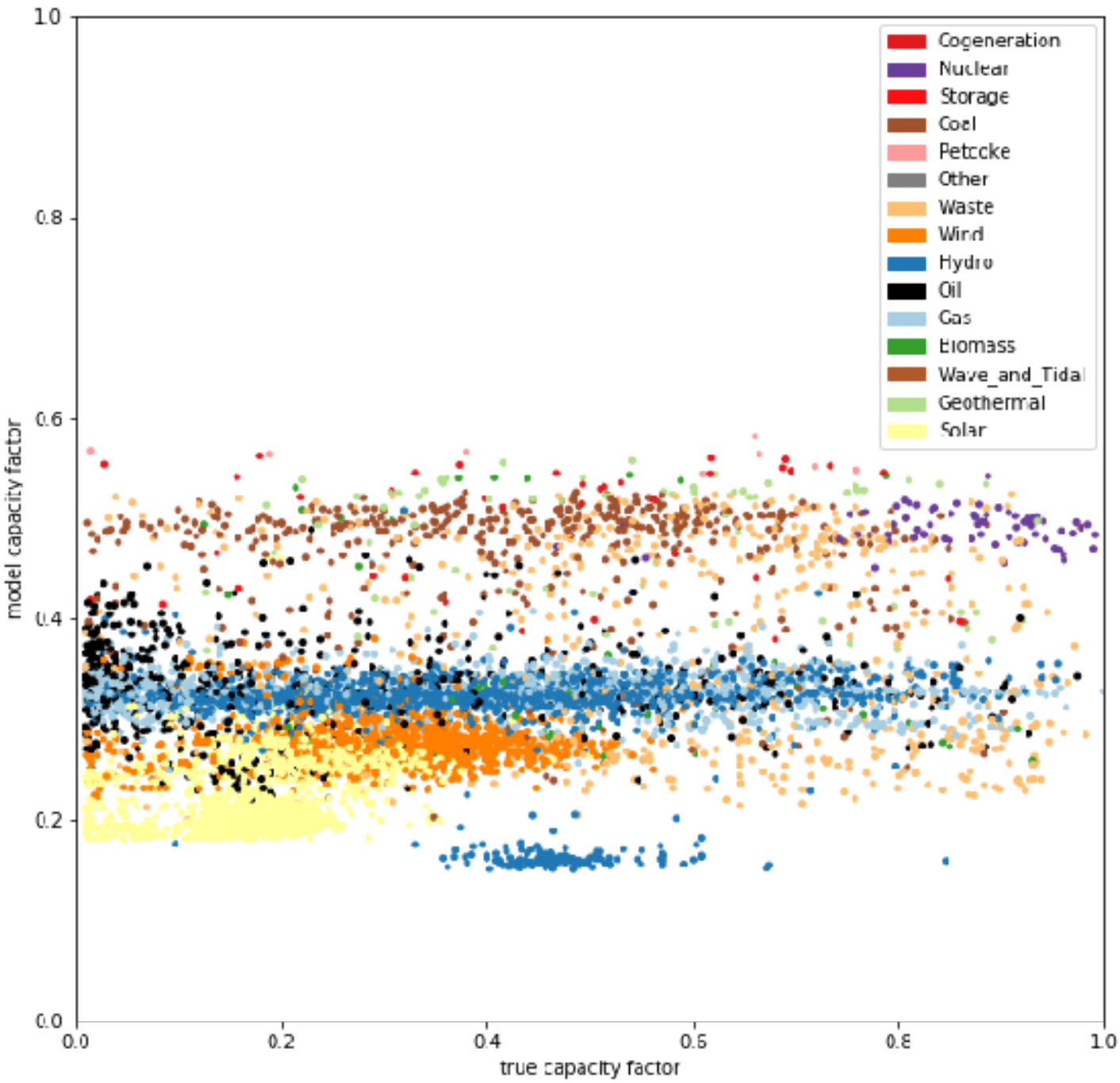
In [14]:

```
# for comparison show predicted vs true values using a model trained with mean a
bsolute error as loss function

mae_model = io.imread("./images/model1_mae_128.png")
fig = plt.figure(figsize=(10,10))
plt.imshow(mae_model)
plt.axis('off')
```

Out[14]:

```
(-0.5, 616.5, 592.5, -0.5)
```



In [15]:

```
# calculate simple r2 for training data, model value

r2_score = metrics.r2_score(y_data,predicted_values)
print(u"R2 score: {0}".format(r2_score))
```

```
R2 score: 0.189851925633
```

In [16]:

```
# PROBLEM: model mostly predicts capacity factor within a narrow band
# try model with different activation to avoid possible dying relu neuron proble
m

model2 = myNet(activation_type = 'sigmoid')
model2.compile(loss='mean_squared_error',optimizer='adam',metrics=['mean_absolut
e_error'])
print("Model contains {0} parameters.".format(model2.count_params()))
print(model2.summary())
```

```
Model contains 133633 parameters.
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lambda_3 (Lambda)            (None, 6)                 0
_________________________________________________________________
dense_9 (Dense)              (None, 256)               1792
_________________________________________________________________
dropout_5 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_10 (Dense)             (None, 256)               65792
_________________________________________________________________
dropout_6 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_11 (Dense)             (None, 256)               65792
_________________________________________________________________
dense_12 (Dense)             (None, 1)                 257
=================================================================
Total params: 133,633
Trainable params: 133,633
Non-trainable params: 0
_________________________________________________________________
None
```

In [19]:

```
# fit model
WEIGHTS_FILE2 = "model2/estimate_generation.h5"

# fit model
history_object2 = fit_model(model2,WEIGHTS_FILE2)

# reload model with best weights from training
model2 = myNet(activation_type = 'sigmoid')
model2.load_weights(WEIGHTS_FILE2)
model2.compile(loss='mean_squared_error',optimizer='adam',metrics=['mean_absolut
e_error'])
print("Finished training; model reloaded with optimum weights.")
```

```
Train on 5523 samples, validate on 1381 samples
Epoch 1/512
5523/5523 [==============================] - 1s 192us/step - loss: 0
.0517 - mean_absolute_error: 0.1835 - val_loss: 0.0512 - val_mean_ab
solute_error: 0.1826
Epoch 2/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0511 - mean_absolute_error: 0.1829 - val_loss: 0.0508 - val_mean_ab
solute_error: 0.1827
Epoch 3/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0508 - mean_absolute_error: 0.1823 - val_loss: 0.0522 - val_mean_ab
solute_error: 0.1814
Epoch 4/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0507 - mean_absolute_error: 0.1811 - val_loss: 0.0500 - val_mean_ab
solute_error: 0.1836
Epoch 5/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0503 - mean_absolute_error: 0.1808 - val_loss: 0.0511 - val_mean_ab
solute_error: 0.1797
Epoch 6/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0495 - mean_absolute_error: 0.1774 - val_loss: 0.0495 - val_mean_ab
solute_error: 0.1837
Epoch 7/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0498 - mean_absolute_error: 0.1786 - val_loss: 0.0513 - val_mean_ab
solute_error: 0.1798
Epoch 8/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0488 - mean_absolute_error: 0.1764 - val_loss: 0.0493 - val_mean_ab
solute_error: 0.1822
Epoch 9/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0491 - mean_absolute_error: 0.1764 - val_loss: 0.0505 - val_mean_ab
solute_error: 0.1806
Epoch 10/512
```

```
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0492 - mean_absolute_error: 0.1764 - val_loss: 0.0496 - val_mean_ab
solute_error: 0.1833
Epoch 11/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0491 - mean_absolute_error: 0.1768 - val_loss: 0.0498 - val_mean_ab
solute_error: 0.1835
Epoch 12/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0487 - mean_absolute_error: 0.1755 - val_loss: 0.0511 - val_mean_ab
solute_error: 0.1819
Epoch 13/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0487 - mean_absolute_error: 0.1752 - val_loss: 0.0503 - val_mean_ab
solute_error: 0.1875
Epoch 14/512
5523/5523 [==============================] - 1s 164us/step - loss: 0
.0486 - mean_absolute_error: 0.1755 - val_loss: 0.0503 - val_mean_ab
solute_error: 0.1844
Epoch 15/512
5523/5523 [==============================] - 1s 128us/step - loss: 0
.0483 - mean_absolute_error: 0.1746 - val_loss: 0.0506 - val_mean_ab
solute_error: 0.1872
Epoch 16/512
5523/5523 [==============================] - 1s 150us/step - loss: 0
.0483 - mean_absolute_error: 0.1750 - val_loss: 0.0508 - val_mean_ab
solute_error: 0.1861
Epoch 17/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0488 - mean_absolute_error: 0.1753 - val_loss: 0.0509 - val_mean_ab
solute_error: 0.1842
Epoch 18/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0480 - mean_absolute_error: 0.1743 - val_loss: 0.0512 - val_mean_ab
solute_error: 0.1873
Epoch 19/512
5523/5523 [==============================] - 1s 139us/step - loss: 0
.0486 - mean_absolute_error: 0.1749 - val_loss: 0.0508 - val_mean_ab
solute_error: 0.1865
Epoch 20/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0485 - mean_absolute_error: 0.1746 - val_loss: 0.0508 - val_mean_ab
solute_error: 0.1881
Epoch 21/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0485 - mean_absolute_error: 0.1751 - val_loss: 0.0527 - val_mean_ab
solute_error: 0.1852
Epoch 22/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0482 - mean_absolute_error: 0.1739 - val_loss: 0.0515 - val_mean_abs
olute_error: 0.1855
Epoch 23/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
```

```
.0483 - mean_absolute_error: 0.1750 - val_loss: 0.0556 - val_mean_ab
solute_error: 0.1857
Epoch 24/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0481 - mean_absolute_error: 0.1736 - val_loss: 0.0535 - val_mean_ab
solute_error: 0.1853
Epoch 25/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0484 - mean_absolute_error: 0.1744 - val_loss: 0.0526 - val_mean_abs
olute_error: 0.1849
Epoch 26/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0480 - mean_absolute_error: 0.1738 - val_loss: 0.0531 - val_mean_abs
olute_error: 0.1848
Epoch 27/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0479 - mean_absolute_error: 0.1736 - val_loss: 0.0527 - val_mean_abs
olute_error: 0.1853
Epoch 28/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0474 - mean_absolute_error: 0.1722 - val_loss: 0.0512 - val_mean_ab
solute_error: 0.1892
Epoch 29/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0477 - mean_absolute_error: 0.1729 - val_loss: 0.0518 - val_mean_abs
olute_error: 0.1864
Epoch 30/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0477 - mean_absolute_error: 0.1736 - val_loss: 0.0530 - val_mean_ab
solute_error: 0.1853
Epoch 31/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0474 - mean_absolute_error: 0.1719 - val_loss: 0.0524 - val_mean_abs
olute_error: 0.1849
Epoch 32/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0473 - mean_absolute_error: 0.1723 - val_loss: 0.0523 - val_mean_abs
olute_error: 0.1852
Epoch 33/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0469 - mean_absolute_error: 0.1712 - val_loss: 0.0515 - val_mean_ab
solute_error: 0.1865
Epoch 34/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0475 - mean_absolute_error: 0.1722 - val_loss: 0.0515 - val_mean_abs
olute_error: 0.1922
Epoch 35/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0476 - mean_absolute_error: 0.1729 - val_loss: 0.0515 - val_mean_abs
olute_error: 0.1843
Epoch 36/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0466 - mean_absolute_error: 0.1703 - val_loss: 0.0531 - val_mean_abs
```

```
olute_error: 0.1849
Epoch 37/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0474 - mean_absolute_error: 0.1718 - val_loss: 0.0548 - val_mean_ab
solute_error: 0.1839
Epoch 38/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0472 - mean_absolute_error: 0.1708 - val_loss: 0.0524 - val_mean_ab
solute_error: 0.1834
Epoch 39/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0466 - mean_absolute_error: 0.1700 - val_loss: 0.0521 - val_mean_abs
olute_error: 0.1835
Epoch 40/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0463 - mean_absolute_error: 0.1693 - val_loss: 0.0510 - val_mean_abs
olute_error: 0.1867
Epoch 41/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0465 - mean_absolute_error: 0.1695 - val_loss: 0.0504 - val_mean_abs
olute_error: 0.1845
Epoch 42/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0461 - mean_absolute_error: 0.1694 - val_loss: 0.0523 - val_mean_abs
olute_error: 0.1829
Epoch 43/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0463 - mean_absolute_error: 0.1695 - val_loss: 0.0527 - val_mean_abs
olute_error: 0.1824
Epoch 44/512
5523/5523 [==============================] - 1s 105us/step - loss: 0
.0462 - mean_absolute_error: 0.1687 - val_loss: 0.0518 - val_mean_ab
solute_error: 0.1814
Epoch 45/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0461 - mean_absolute_error: 0.1682 - val_loss: 0.0504 - val_mean_abs
olute_error: 0.1820
Epoch 46/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0461 - mean_absolute_error: 0.1683 - val_loss: 0.0500 - val_mean_ab
solute_error: 0.1829
Epoch 47/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0460 - mean_absolute_error: 0.1686 - val_loss: 0.0510 - val_mean_abs
olute_error: 0.1809
Epoch 48/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0460 - mean_absolute_error: 0.1680 - val_loss: 0.0499 - val_mean_abs
olute_error: 0.1806
Epoch 49/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0459 - mean_absolute_error: 0.1678 - val_loss: 0.0520 - val_mean_abs
olute_error: 0.1787
```

```
Epoch 50/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0458 - mean_absolute_error: 0.1676 - val_loss: 0.0493 - val_mean_ab
solute_error: 0.1814
Epoch 51/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0460 - mean_absolute_error: 0.1675 - val_loss: 0.0494 - val_mean_abs
olute_error: 0.1807
Epoch 52/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0455 - mean_absolute_error: 0.1669 - val_loss: 0.0493 - val_mean_abs
olute_error: 0.1799
Epoch 53/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0459 - mean_absolute_error: 0.1679 - val_loss: 0.0489 - val_mean_ab
solute_error: 0.1787
Epoch 54/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0455 - mean_absolute_error: 0.1667 - val_loss: 0.0504 - val_mean_abs
olute_error: 0.1792
Epoch 55/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0452 - mean_absolute_error: 0.1663 - val_loss: 0.0489 - val_mean_ab
solute_error: 0.1808
Epoch 56/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0456 - mean_absolute_error: 0.1675 - val_loss: 0.0487 - val_mean_abs
olute_error: 0.1775
Epoch 57/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0453 - mean_absolute_error: 0.1665 - val_loss: 0.0495 - val_mean_abs
olute_error: 0.1769
Epoch 58/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0451 - mean_absolute_error: 0.1664 - val_loss: 0.0484 - val_mean_abs
olute_error: 0.1767
Epoch 59/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0451 - mean_absolute_error: 0.1656 - val_loss: 0.0488 - val_mean_abs
olute_error: 0.1761
Epoch 60/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0454 - mean_absolute_error: 0.1666 - val_loss: 0.0489 - val_mean_abs
olute_error: 0.1766
Epoch 61/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0452 - mean_absolute_error: 0.1664 - val_loss: 0.0490 - val_mean_abs
olute_error: 0.1764
Epoch 62/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0451 - mean_absolute_error: 0.1655 - val_loss: 0.0474 - val_mean_abs
olute_error: 0.1775
Epoch 63/512
```

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5523/5523 [==============================] - 1s 99us/step - loss: 0.
0449 - mean_absolute_error: 0.1647 - val_loss: 0.0474 - val_mean_abs
olute_error: 0.1793
Epoch 64/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0449 - mean_absolute_error: 0.1654 - val_loss: 0.0472 - val_mean_ab
solute_error: 0.1788
Epoch 65/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0451 - mean_absolute_error: 0.1659 - val_loss: 0.0491 - val_mean_abs
olute_error: 0.1735
Epoch 66/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0448 - mean_absolute_error: 0.1650 - val_loss: 0.0506 - val_mean_ab
solute_error: 0.1757
Epoch 67/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0451 - mean_absolute_error: 0.1657 - val_loss: 0.0470 - val_mean_ab
solute_error: 0.1746
Epoch 68/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0449 - mean_absolute_error: 0.1649 - val_loss: 0.0468 - val_mean_ab
solute_error: 0.1768
Epoch 69/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0447 - mean_absolute_error: 0.1647 - val_loss: 0.0480 - val_mean_ab
solute_error: 0.1717
Epoch 70/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0447 - mean_absolute_error: 0.1649 - val_loss: 0.0468 - val_mean_abs
olute_error: 0.1753
Epoch 71/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0450 - mean_absolute_error: 0.1650 - val_loss: 0.0467 - val_mean_ab
solute_error: 0.1736
Epoch 72/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0446 - mean_absolute_error: 0.1646 - val_loss: 0.0463 - val_mean_ab
solute_error: 0.1770
Epoch 73/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0445 - mean_absolute_error: 0.1645 - val_loss: 0.0475 - val_mean_abs
olute_error: 0.1709
Epoch 74/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0442 - mean_absolute_error: 0.1637 - val_loss: 0.0461 - val_mean_abs
olute_error: 0.1760
Epoch 75/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0445 - mean_absolute_error: 0.1646 - val_loss: 0.0460 - val_mean_ab
solute_error: 0.1764
Epoch 76/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
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0441 - mean_absolute_error: 0.1637 - val_loss: 0.0478 - val_mean_abs
olute_error: 0.1721
Epoch 77/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0441 - mean_absolute_error: 0.1631 - val_loss: 0.0471 - val_mean_abs
olute_error: 0.1707
Epoch 78/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0447 - mean_absolute_error: 0.1648 - val_loss: 0.0458 - val_mean_abs
olute_error: 0.1723
Epoch 79/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0442 - mean_absolute_error: 0.1634 - val_loss: 0.0461 - val_mean_abs
olute_error: 0.1712
Epoch 80/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0441 - mean_absolute_error: 0.1631 - val_loss: 0.0458 - val_mean_abs
olute_error: 0.1733
Epoch 81/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0442 - mean_absolute_error: 0.1640 - val_loss: 0.0459 - val_mean_abs
olute_error: 0.1702
Epoch 82/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0446 - mean_absolute_error: 0.1640 - val_loss: 0.0458 - val_mean_abs
olute_error: 0.1720
Epoch 83/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0436 - mean_absolute_error: 0.1627 - val_loss: 0.0472 - val_mean_ab
solute_error: 0.1695
Epoch 84/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0442 - mean_absolute_error: 0.1638 - val_loss: 0.0473 - val_mean_ab
solute_error: 0.1686
Epoch 85/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0437 - mean_absolute_error: 0.1626 - val_loss: 0.0454 - val_mean_abs
olute_error: 0.1690
Epoch 86/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0440 - mean_absolute_error: 0.1630 - val_loss: 0.0450 - val_mean_abs
olute_error: 0.1678
Epoch 87/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0434 - mean_absolute_error: 0.1618 - val_loss: 0.0458 - val_mean_abs
olute_error: 0.1697
Epoch 88/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0437 - mean_absolute_error: 0.1625 - val_loss: 0.0458 - val_mean_abs
olute_error: 0.1677
Epoch 89/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0437 - mean_absolute_error: 0.1623 - val_loss: 0.0466 - val_mean_abs
```

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olute_error: 0.1678
Epoch 90/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0436 - mean_absolute_error: 0.1620 - val_loss: 0.0449 - val_mean_ab
solute_error: 0.1694
Epoch 91/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0435 - mean_absolute_error: 0.1617 - val_loss: 0.0446 - val_mean_abs
olute_error: 0.1672
Epoch 92/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0435 - mean_absolute_error: 0.1623 - val_loss: 0.0454 - val_mean_abs
olute_error: 0.1684
Epoch 93/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0433 - mean_absolute_error: 0.1614 - val_loss: 0.0441 - val_mean_abs
olute_error: 0.1659
Epoch 94/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0433 - mean_absolute_error: 0.1613 - val_loss: 0.0440 - val_mean_ab
solute_error: 0.1675
Epoch 95/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0439 - mean_absolute_error: 0.1627 - val_loss: 0.0465 - val_mean_abs
olute_error: 0.1662
Epoch 96/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0433 - mean_absolute_error: 0.1615 - val_loss: 0.0434 - val_mean_abs
olute_error: 0.1653
Epoch 97/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0432 - mean_absolute_error: 0.1617 - val_loss: 0.0437 - val_mean_abs
olute_error: 0.1641
Epoch 98/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0426 - mean_absolute_error: 0.1599 - val_loss: 0.0431 - val_mean_ab
solute_error: 0.1640
Epoch 99/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0432 - mean_absolute_error: 0.1613 - val_loss: 0.0434 - val_mean_abs
olute_error: 0.1636
Epoch 100/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0433 - mean_absolute_error: 0.1615 - val_loss: 0.0454 - val_mean_abs
olute_error: 0.1645
Epoch 101/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0434 - mean_absolute_error: 0.1619 - val_loss: 0.0433 - val_mean_ab
solute_error: 0.1650
Epoch 102/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0432 - mean_absolute_error: 0.1606 - val_loss: 0.0435 - val_mean_abs
olute_error: 0.1644
```

```
Epoch 103/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0431 - mean_absolute_error: 0.1613 - val_loss: 0.0450 - val_mean_abs
olute_error: 0.1660
Epoch 104/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0425 - mean_absolute_error: 0.1594 - val_loss: 0.0427 - val_mean_abs
olute_error: 0.1610
Epoch 105/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0427 - mean_absolute_error: 0.1600 - val_loss: 0.0422 - val_mean_ab
solute_error: 0.1660
Epoch 106/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0425 - mean_absolute_error: 0.1601 - val_loss: 0.0435 - val_mean_ab
solute_error: 0.1612
Epoch 107/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0423 - mean_absolute_error: 0.1596 - val_loss: 0.0418 - val_mean_abs
olute_error: 0.1632
Epoch 108/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0426 - mean_absolute_error: 0.1596 - val_loss: 0.0416 - val_mean_ab
solute_error: 0.1617
Epoch 109/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0425 - mean_absolute_error: 0.1596 - val_loss: 0.0456 - val_mean_abs
olute_error: 0.1633
Epoch 110/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0423 - mean_absolute_error: 0.1590 - val_loss: 0.0431 - val_mean_ab
solute_error: 0.1606
Epoch 111/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0422 - mean_absolute_error: 0.1588 - val_loss: 0.0421 - val_mean_abs
olute_error: 0.1591
Epoch 112/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0428 - mean_absolute_error: 0.1600 - val_loss: 0.0423 - val_mean_abs
olute_error: 0.1594
Epoch 113/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0422 - mean_absolute_error: 0.1585 - val_loss: 0.0424 - val_mean_ab
solute_error: 0.1591
Epoch 114/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0425 - mean_absolute_error: 0.1595 - val_loss: 0.0438 - val_mean_abs
olute_error: 0.1612
Epoch 115/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0419 - mean_absolute_error: 0.1578 - val_loss: 0.0415 - val_mean_abs
olute_error: 0.1574
Epoch 116/512
```

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5523/5523 [==============================] - 1s 99us/step - loss: 0.
0420 - mean_absolute_error: 0.1587 - val_loss: 0.0423 - val_mean_abs
olute_error: 0.1576
Epoch 117/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0420 - mean_absolute_error: 0.1581 - val_loss: 0.0414 - val_mean_ab
solute_error: 0.1570
Epoch 118/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0417 - mean_absolute_error: 0.1574 - val_loss: 0.0413 - val_mean_abs
olute_error: 0.1581
Epoch 119/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0415 - mean_absolute_error: 0.1572 - val_loss: 0.0400 - val_mean_abs
olute_error: 0.1579
Epoch 120/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0417 - mean_absolute_error: 0.1575 - val_loss: 0.0405 - val_mean_abs
olute_error: 0.1549
Epoch 121/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0411 - mean_absolute_error: 0.1559 - val_loss: 0.0393 - val_mean_ab
solute_error: 0.1545
Epoch 122/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0414 - mean_absolute_error: 0.1568 - val_loss: 0.0429 - val_mean_abs
olute_error: 0.1587
Epoch 123/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0413 - mean_absolute_error: 0.1562 - val_loss: 0.0390 - val_mean_ab
solute_error: 0.1512
Epoch 124/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0410 - mean_absolute_error: 0.1558 - val_loss: 0.0390 - val_mean_abs
olute_error: 0.1552
Epoch 125/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0413 - mean_absolute_error: 0.1572 - val_loss: 0.0424 - val_mean_ab
solute_error: 0.1575
Epoch 126/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0414 - mean_absolute_error: 0.1568 - val_loss: 0.0387 - val_mean_abs
olute_error: 0.1511
Epoch 127/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0413 - mean_absolute_error: 0.1568 - val_loss: 0.0385 - val_mean_abs
olute_error: 0.1500
Epoch 128/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0410 - mean_absolute_error: 0.1553 - val_loss: 0.0390 - val_mean_ab
solute_error: 0.1508
Epoch 129/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
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0407 - mean_absolute_error: 0.1555 - val_loss: 0.0381 - val_mean_abs
olute_error: 0.1501
Epoch 130/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0409 - mean_absolute_error: 0.1555 - val_loss: 0.0393 - val_mean_ab
solute_error: 0.1523
Epoch 131/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0410 - mean_absolute_error: 0.1562 - val_loss: 0.0379 - val_mean_abs
olute_error: 0.1498
Epoch 132/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0411 - mean_absolute_error: 0.1560 - val_loss: 0.0388 - val_mean_ab
solute_error: 0.1504
Epoch 133/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0404 - mean_absolute_error: 0.1543 - val_loss: 0.0376 - val_mean_abs
olute_error: 0.1472
Epoch 134/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0412 - mean_absolute_error: 0.1559 - val_loss: 0.0392 - val_mean_abs
olute_error: 0.1512
Epoch 135/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0410 - mean_absolute_error: 0.1556 - val_loss: 0.0379 - val_mean_abs
olute_error: 0.1481
Epoch 136/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0403 - mean_absolute_error: 0.1541 - val_loss: 0.0390 - val_mean_abs
olute_error: 0.1490
Epoch 137/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0406 - mean_absolute_error: 0.1549 - val_loss: 0.0378 - val_mean_ab
solute_error: 0.1484
Epoch 138/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0404 - mean_absolute_error: 0.1543 - val_loss: 0.0376 - val_mean_abs
olute_error: 0.1482
Epoch 139/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0402 - mean_absolute_error: 0.1539 - val_loss: 0.0371 - val_mean_ab
solute_error: 0.1464
Epoch 140/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0398 - mean_absolute_error: 0.1532 - val_loss: 0.0368 - val_mean_abs
olute_error: 0.1457
Epoch 141/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0403 - mean_absolute_error: 0.1543 - val_loss: 0.0368 - val_mean_ab
solute_error: 0.1449
Epoch 142/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0401 - mean_absolute_error: 0.1535 - val_loss: 0.0366 - val_mean_abs
```

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olute_error: 0.1458
Epoch 143/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0397 - mean_absolute_error: 0.1533 - val_loss: 0.0387 - val_mean_ab
solute_error: 0.1498
Epoch 144/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0395 - mean_absolute_error: 0.1525 - val_loss: 0.0373 - val_mean_abs
olute_error: 0.1466
Epoch 145/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0401 - mean_absolute_error: 0.1541 - val_loss: 0.0365 - val_mean_ab
solute_error: 0.1450
Epoch 146/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0397 - mean_absolute_error: 0.1532 - val_loss: 0.0366 - val_mean_abs
olute_error: 0.1448
Epoch 147/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0393 - mean_absolute_error: 0.1521 - val_loss: 0.0358 - val_mean_abs
olute_error: 0.1431
Epoch 148/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0391 - mean_absolute_error: 0.1517 - val_loss: 0.0365 - val_mean_ab
solute_error: 0.1436
Epoch 149/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0393 - mean_absolute_error: 0.1525 - val_loss: 0.0373 - val_mean_abs
olute_error: 0.1462
Epoch 150/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0396 - mean_absolute_error: 0.1526 - val_loss: 0.0357 - val_mean_ab
solute_error: 0.1427
Epoch 151/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0390 - mean_absolute_error: 0.1514 - val_loss: 0.0359 - val_mean_ab
solute_error: 0.1431
Epoch 152/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0390 - mean_absolute_error: 0.1513 - val_loss: 0.0355 - val_mean_ab
solute_error: 0.1415
Epoch 153/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0392 - mean_absolute_error: 0.1517 - val_loss: 0.0351 - val_mean_ab
solute_error: 0.1394
Epoch 154/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0391 - mean_absolute_error: 0.1519 - val_loss: 0.0353 - val_mean_abs
olute_error: 0.1397
Epoch 155/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0390 - mean_absolute_error: 0.1518 - val_loss: 0.0353 - val_mean_abs
olute_error: 0.1402
```

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Epoch 156/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0390 - mean_absolute_error: 0.1517 - val_loss: 0.0352 - val_mean_ab
solute_error: 0.1406
Epoch 157/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0391 - mean_absolute_error: 0.1516 - val_loss: 0.0356 - val_mean_ab
solute_error: 0.1422
Epoch 158/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0391 - mean_absolute_error: 0.1515 - val_loss: 0.0370 - val_mean_ab
solute_error: 0.1464
Epoch 159/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0386 - mean_absolute_error: 0.1506 - val_loss: 0.0359 - val_mean_ab
solute_error: 0.1416
Epoch 160/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0390 - mean_absolute_error: 0.1511 - val_loss: 0.0372 - val_mean_ab
solute_error: 0.1461
Epoch 161/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0391 - mean_absolute_error: 0.1512 - val_loss: 0.0366 - val_mean_ab
solute_error: 0.1440
Epoch 162/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0387 - mean_absolute_error: 0.1507 - val_loss: 0.0352 - val_mean_abs
olute_error: 0.1399
Epoch 163/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0387 - mean_absolute_error: 0.1503 - val_loss: 0.0348 - val_mean_abs
olute_error: 0.1394
Epoch 164/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0384 - mean_absolute_error: 0.1503 - val_loss: 0.0353 - val_mean_abs
olute_error: 0.1399
Epoch 165/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0395 - mean_absolute_error: 0.1518 - val_loss: 0.0353 - val_mean_ab
solute_error: 0.1415
Epoch 166/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0391 - mean_absolute_error: 0.1512 - val_loss: 0.0355 - val_mean_abs
olute_error: 0.1417
Epoch 167/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0388 - mean_absolute_error: 0.1507 - val_loss: 0.0344 - val_mean_ab
solute_error: 0.1378
Epoch 168/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0387 - mean_absolute_error: 0.1502 - val_loss: 0.0347 - val_mean_abs
olute_error: 0.1382
Epoch 169/512
```

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5523/5523 [==============================] - 1s 101us/step - loss: 0
.0386 - mean_absolute_error: 0.1502 - val_loss: 0.0346 - val_mean_ab
solute_error: 0.1391
Epoch 170/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0387 - mean_absolute_error: 0.1506 - val_loss: 0.0348 - val_mean_abs
olute_error: 0.1396
Epoch 171/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0385 - mean_absolute_error: 0.1500 - val_loss: 0.0347 - val_mean_abs
olute_error: 0.1383
Epoch 172/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0385 - mean_absolute_error: 0.1504 - val_loss: 0.0346 - val_mean_abs
olute_error: 0.1389
Epoch 173/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0386 - mean_absolute_error: 0.1503 - val_loss: 0.0351 - val_mean_abs
olute_error: 0.1410
Epoch 174/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0387 - mean_absolute_error: 0.1506 - val_loss: 0.0343 - val_mean_abs
olute_error: 0.1371
Epoch 175/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0383 - mean_absolute_error: 0.1500 - val_loss: 0.0348 - val_mean_ab
solute_error: 0.1392
Epoch 176/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0384 - mean_absolute_error: 0.1500 - val_loss: 0.0351 - val_mean_abs
olute_error: 0.1383
Epoch 177/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0385 - mean_absolute_error: 0.1502 - val_loss: 0.0346 - val_mean_abs
olute_error: 0.1383
Epoch 178/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0385 - mean_absolute_error: 0.1502 - val_loss: 0.0348 - val_mean_abs
olute_error: 0.1378
Epoch 179/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0385 - mean_absolute_error: 0.1501 - val_loss: 0.0355 - val_mean_abs
olute_error: 0.1416
Epoch 180/512
5523/5523 [==============================] - 1s 122us/step - loss: 0
.0388 - mean_absolute_error: 0.1511 - val_loss: 0.0353 - val_mean_ab
solute_error: 0.1402
Epoch 181/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0385 - mean_absolute_error: 0.1498 - val_loss: 0.0347 - val_mean_ab
solute_error: 0.1392
Epoch 182/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
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0383 - mean_absolute_error: 0.1505 - val_loss: 0.0346 - val_mean_abs
olute_error: 0.1379
Epoch 183/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0384 - mean_absolute_error: 0.1502 - val_loss: 0.0351 - val_mean_abs
olute_error: 0.1399
Epoch 184/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0386 - mean_absolute_error: 0.1504 - val_loss: 0.0344 - val_mean_abs
olute_error: 0.1375
Epoch 185/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0382 - mean_absolute_error: 0.1494 - val_loss: 0.0349 - val_mean_abs
olute_error: 0.1395
Epoch 186/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0386 - mean_absolute_error: 0.1501 - val_loss: 0.0345 - val_mean_abs
olute_error: 0.1387
Epoch 187/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0380 - mean_absolute_error: 0.1491 - val_loss: 0.0343 - val_mean_ab
solute_error: 0.1376
Epoch 188/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0383 - mean_absolute_error: 0.1493 - val_loss: 0.0345 - val_mean_ab
solute_error: 0.1385
Epoch 189/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0378 - mean_absolute_error: 0.1492 - val_loss: 0.0342 - val_mean_abs
olute_error: 0.1373
Epoch 190/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0380 - mean_absolute_error: 0.1489 - val_loss: 0.0341 - val_mean_abs
olute_error: 0.1368
Epoch 191/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0385 - mean_absolute_error: 0.1503 - val_loss: 0.0344 - val_mean_abs
olute_error: 0.1380
Epoch 192/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0384 - mean_absolute_error: 0.1499 - val_loss: 0.0343 - val_mean_ab
solute_error: 0.1386
Epoch 193/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0384 - mean_absolute_error: 0.1502 - val_loss: 0.0346 - val_mean_abs
olute_error: 0.1392
Epoch 194/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0383 - mean_absolute_error: 0.1497 - val_loss: 0.0348 - val_mean_abs
olute_error: 0.1397
Epoch 195/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0382 - mean_absolute_error: 0.1491 - val_loss: 0.0348 - val_mean_abs
```

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olute_error: 0.1397
Epoch 196/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0384 - mean_absolute_error: 0.1496 - val_loss: 0.0348 - val_mean_ab
solute_error: 0.1393
Epoch 197/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0385 - mean_absolute_error: 0.1498 - val_loss: 0.0370 - val_mean_abs
olute_error: 0.1465
Epoch 198/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0380 - mean_absolute_error: 0.1494 - val_loss: 0.0346 - val_mean_ab
solute_error: 0.1392
Epoch 199/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0382 - mean_absolute_error: 0.1497 - val_loss: 0.0347 - val_mean_abs
olute_error: 0.1390
Epoch 200/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0383 - mean_absolute_error: 0.1493 - val_loss: 0.0357 - val_mean_ab
solute_error: 0.1438
Epoch 201/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0382 - mean_absolute_error: 0.1494 - val_loss: 0.0348 - val_mean_ab
solute_error: 0.1390
Epoch 202/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0382 - mean_absolute_error: 0.1492 - val_loss: 0.0363 - val_mean_abs
olute_error: 0.1437
Epoch 203/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0384 - mean_absolute_error: 0.1495 - val_loss: 0.0344 - val_mean_abs
olute_error: 0.1387
Epoch 204/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0378 - mean_absolute_error: 0.1481 - val_loss: 0.0342 - val_mean_abs
olute_error: 0.1371
Epoch 205/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0379 - mean_absolute_error: 0.1492 - val_loss: 0.0347 - val_mean_ab
solute_error: 0.1382
Epoch 206/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0381 - mean_absolute_error: 0.1494 - val_loss: 0.0357 - val_mean_abs
olute_error: 0.1433
Epoch 207/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0382 - mean_absolute_error: 0.1491 - val_loss: 0.0346 - val_mean_abs
olute_error: 0.1382
Epoch 208/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0380 - mean_absolute_error: 0.1487 - val_loss: 0.0343 - val_mean_abs
olute_error: 0.1369
```

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Epoch 209/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0379 - mean_absolute_error: 0.1492 - val_loss: 0.0344 - val_mean_ab
solute_error: 0.1381
Epoch 210/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0379 - mean_absolute_error: 0.1485 - val_loss: 0.0342 - val_mean_abs
olute_error: 0.1381
Epoch 211/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0379 - mean_absolute_error: 0.1484 - val_loss: 0.0351 - val_mean_abs
olute_error: 0.1416
Epoch 212/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0381 - mean_absolute_error: 0.1497 - val_loss: 0.0342 - val_mean_abs
olute_error: 0.1365
Epoch 213/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0379 - mean_absolute_error: 0.1487 - val_loss: 0.0341 - val_mean_ab
solute_error: 0.1375
Epoch 214/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0381 - mean_absolute_error: 0.1491 - val_loss: 0.0340 - val_mean_abs
olute_error: 0.1357
Epoch 215/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0380 - mean_absolute_error: 0.1490 - val_loss: 0.0345 - val_mean_abs
olute_error: 0.1381
Epoch 216/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0380 - mean_absolute_error: 0.1486 - val_loss: 0.0346 - val_mean_abs
olute_error: 0.1395
Epoch 217/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0376 - mean_absolute_error: 0.1475 - val_loss: 0.0338 - val_mean_abs
olute_error: 0.1363
Epoch 218/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0374 - mean_absolute_error: 0.1475 - val_loss: 0.0342 - val_mean_ab
solute_error: 0.1381
Epoch 219/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0379 - mean_absolute_error: 0.1488 - val_loss: 0.0349 - val_mean_abs
olute_error: 0.1403
Epoch 220/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0378 - mean_absolute_error: 0.1480 - val_loss: 0.0338 - val_mean_abs
olute_error: 0.1369
Epoch 221/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0379 - mean_absolute_error: 0.1485 - val_loss: 0.0344 - val_mean_abs
olute_error: 0.1383
Epoch 222/512
```

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5523/5523 [==============================] - 1s 100us/step - loss: 0
.0379 - mean_absolute_error: 0.1487 - val_loss: 0.0343 - val_mean_ab
solute_error: 0.1388
Epoch 223/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0380 - mean_absolute_error: 0.1488 - val_loss: 0.0345 - val_mean_abs
olute_error: 0.1400
Epoch 224/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0376 - mean_absolute_error: 0.1482 - val_loss: 0.0348 - val_mean_ab
solute_error: 0.1396
Epoch 225/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0381 - mean_absolute_error: 0.1491 - val_loss: 0.0341 - val_mean_ab
solute_error: 0.1365
Epoch 226/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0382 - mean_absolute_error: 0.1489 - val_loss: 0.0341 - val_mean_abs
olute_error: 0.1374
Epoch 227/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0377 - mean_absolute_error: 0.1482 - val_loss: 0.0341 - val_mean_ab
solute_error: 0.1375
Epoch 228/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0376 - mean_absolute_error: 0.1483 - val_loss: 0.0336 - val_mean_abs
olute_error: 0.1357
Epoch 229/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0377 - mean_absolute_error: 0.1478 - val_loss: 0.0342 - val_mean_ab
solute_error: 0.1393
Epoch 230/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0376 - mean_absolute_error: 0.1478 - val_loss: 0.0349 - val_mean_abs
olute_error: 0.1410
Epoch 231/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0374 - mean_absolute_error: 0.1473 - val_loss: 0.0338 - val_mean_ab
solute_error: 0.1368
Epoch 232/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0378 - mean_absolute_error: 0.1482 - val_loss: 0.0356 - val_mean_abs
olute_error: 0.1439
Epoch 233/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0378 - mean_absolute_error: 0.1480 - val_loss: 0.0345 - val_mean_abs
olute_error: 0.1404
Epoch 234/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0377 - mean_absolute_error: 0.1479 - val_loss: 0.0370 - val_mean_ab
solute_error: 0.1485
Epoch 235/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
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0384 - mean_absolute_error: 0.1497 - val_loss: 0.0349 - val_mean_abs
olute_error: 0.1396
Epoch 236/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0374 - mean_absolute_error: 0.1471 - val_loss: 0.0347 - val_mean_ab
solute_error: 0.1409
Epoch 237/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0381 - mean_absolute_error: 0.1494 - val_loss: 0.0341 - val_mean_ab
solute_error: 0.1383
Epoch 238/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0377 - mean_absolute_error: 0.1484 - val_loss: 0.0337 - val_mean_abs
olute_error: 0.1349
Epoch 239/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0375 - mean_absolute_error: 0.1476 - val_loss: 0.0340 - val_mean_abs
olute_error: 0.1374
Epoch 240/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0374 - mean_absolute_error: 0.1474 - val_loss: 0.0340 - val_mean_ab
solute_error: 0.1380
Epoch 241/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0375 - mean_absolute_error: 0.1477 - val_loss: 0.0343 - val_mean_abs
olute_error: 0.1398
Epoch 242/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0373 - mean_absolute_error: 0.1471 - val_loss: 0.0351 - val_mean_ab
solute_error: 0.1418
Epoch 243/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0372 - mean_absolute_error: 0.1473 - val_loss: 0.0335 - val_mean_abs
olute_error: 0.1363
Epoch 244/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0373 - mean_absolute_error: 0.1475 - val_loss: 0.0340 - val_mean_ab
solute_error: 0.1384
Epoch 245/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0374 - mean_absolute_error: 0.1476 - val_loss: 0.0336 - val_mean_abs
olute_error: 0.1364
Epoch 246/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0376 - mean_absolute_error: 0.1479 - val_loss: 0.0343 - val_mean_abs
olute_error: 0.1379
Epoch 247/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0373 - mean_absolute_error: 0.1471 - val_loss: 0.0338 - val_mean_ab
solute_error: 0.1368
Epoch 248/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0369 - mean_absolute_error: 0.1461 - val_loss: 0.0352 - val_mean_abs
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olute_error: 0.1423
Epoch 249/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0374 - mean_absolute_error: 0.1478 - val_loss: 0.0339 - val_mean_ab
solute_error: 0.1367
Epoch 250/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0373 - mean_absolute_error: 0.1477 - val_loss: 0.0334 - val_mean_abs
olute_error: 0.1352
Epoch 251/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0376 - mean_absolute_error: 0.1477 - val_loss: 0.0355 - val_mean_abs
olute_error: 0.1433
Epoch 252/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0371 - mean_absolute_error: 0.1470 - val_loss: 0.0348 - val_mean_abs
olute_error: 0.1410
Epoch 253/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0375 - mean_absolute_error: 0.1472 - val_loss: 0.0347 - val_mean_abs
olute_error: 0.1407
Epoch 254/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0372 - mean_absolute_error: 0.1467 - val_loss: 0.0345 - val_mean_abs
olute_error: 0.1390
Epoch 255/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0368 - mean_absolute_error: 0.1458 - val_loss: 0.0353 - val_mean_abs
olute_error: 0.1434
Epoch 256/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0374 - mean_absolute_error: 0.1473 - val_loss: 0.0336 - val_mean_ab
solute_error: 0.1370
Epoch 257/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0370 - mean_absolute_error: 0.1464 - val_loss: 0.0338 - val_mean_abs
olute_error: 0.1372
Epoch 258/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0371 - mean_absolute_error: 0.1464 - val_loss: 0.0334 - val_mean_ab
solute_error: 0.1359
Epoch 259/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0373 - mean_absolute_error: 0.1471 - val_loss: 0.0334 - val_mean_ab
solute_error: 0.1350
Epoch 260/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0378 - mean_absolute_error: 0.1475 - val_loss: 0.0339 - val_mean_ab
solute_error: 0.1397
Epoch 261/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0371 - mean_absolute_error: 0.1463 - val_loss: 0.0335 - val_mean_ab
solute_error: 0.1359
```

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Epoch 262/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0373 - mean_absolute_error: 0.1465 - val_loss: 0.0332 - val_mean_ab
solute_error: 0.1338
Epoch 263/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0369 - mean_absolute_error: 0.1460 - val_loss: 0.0339 - val_mean_abs
olute_error: 0.1380
Epoch 264/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0370 - mean_absolute_error: 0.1460 - val_loss: 0.0334 - val_mean_abs
olute_error: 0.1348
Epoch 265/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0369 - mean_absolute_error: 0.1458 - val_loss: 0.0335 - val_mean_ab
solute_error: 0.1363
Epoch 266/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0371 - mean_absolute_error: 0.1465 - val_loss: 0.0331 - val_mean_abs
olute_error: 0.1349
Epoch 267/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0372 - mean_absolute_error: 0.1464 - val_loss: 0.0345 - val_mean_abs
olute_error: 0.1406
Epoch 268/512
5523/5523 [==============================] - 1s 94us/step - loss: 0.
0368 - mean_absolute_error: 0.1462 - val_loss: 0.0338 - val_mean_abs
olute_error: 0.1379
Epoch 269/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0369 - mean_absolute_error: 0.1459 - val_loss: 0.0339 - val_mean_abs
olute_error: 0.1395
Epoch 270/512
5523/5523 [==============================] - 1s 93us/step - loss: 0.
0368 - mean_absolute_error: 0.1454 - val_loss: 0.0360 - val_mean_abs
olute_error: 0.1448
Epoch 271/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0368 - mean_absolute_error: 0.1460 - val_loss: 0.0335 - val_mean_abs
olute_error: 0.1362
Epoch 272/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0369 - mean_absolute_error: 0.1459 - val_loss: 0.0350 - val_mean_abs
olute_error: 0.1403
Epoch 273/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0367 - mean_absolute_error: 0.1456 - val_loss: 0.0331 - val_mean_abs
olute_error: 0.1345
Epoch 274/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0368 - mean_absolute_error: 0.1454 - val_loss: 0.0335 - val_mean_abs
olute_error: 0.1373
Epoch 275/512
```

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5523/5523 [==============================] - 1s 97us/step - loss: 0.
0368 - mean_absolute_error: 0.1461 - val_loss: 0.0332 - val_mean_abs
olute_error: 0.1353
Epoch 276/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0368 - mean_absolute_error: 0.1458 - val_loss: 0.0334 - val_mean_abs
olute_error: 0.1348
Epoch 277/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0365 - mean_absolute_error: 0.1450 - val_loss: 0.0333 - val_mean_abs
olute_error: 0.1349
Epoch 278/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0369 - mean_absolute_error: 0.1462 - val_loss: 0.0332 - val_mean_abs
olute_error: 0.1357
Epoch 279/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0372 - mean_absolute_error: 0.1467 - val_loss: 0.0333 - val_mean_abs
olute_error: 0.1341
Epoch 280/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0363 - mean_absolute_error: 0.1445 - val_loss: 0.0334 - val_mean_abs
olute_error: 0.1365
Epoch 281/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0367 - mean_absolute_error: 0.1452 - val_loss: 0.0333 - val_mean_abs
olute_error: 0.1354
Epoch 282/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0368 - mean_absolute_error: 0.1456 - val_loss: 0.0333 - val_mean_abs
olute_error: 0.1362
Epoch 283/512
5523/5523 [==============================] - 1s 94us/step - loss: 0.
0372 - mean_absolute_error: 0.1463 - val_loss: 0.0355 - val_mean_abs
olute_error: 0.1416
Epoch 284/512
5523/5523 [==============================] - 1s 105us/step - loss: 0
.0369 - mean_absolute_error: 0.1460 - val_loss: 0.0331 - val_mean_ab
solute_error: 0.1342
Epoch 285/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0364 - mean_absolute_error: 0.1446 - val_loss: 0.0329 - val_mean_abs
olute_error: 0.1340
Epoch 286/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0367 - mean_absolute_error: 0.1453 - val_loss: 0.0335 - val_mean_abs
olute_error: 0.1363
Epoch 287/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0371 - mean_absolute_error: 0.1459 - val_loss: 0.0331 - val_mean_abs
olute_error: 0.1339
Epoch 288/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
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0367 - mean_absolute_error: 0.1452 - val_loss: 0.0332 - val_mean_abs
olute_error: 0.1342
Epoch 289/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0365 - mean_absolute_error: 0.1446 - val_loss: 0.0335 - val_mean_abs
olute_error: 0.1352
Epoch 290/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0364 - mean_absolute_error: 0.1442 - val_loss: 0.0330 - val_mean_abs
olute_error: 0.1341
Epoch 291/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0367 - mean_absolute_error: 0.1452 - val_loss: 0.0337 - val_mean_abs
olute_error: 0.1382
Epoch 292/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0366 - mean_absolute_error: 0.1454 - val_loss: 0.0330 - val_mean_ab
solute_error: 0.1347
Epoch 293/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0366 - mean_absolute_error: 0.1445 - val_loss: 0.0338 - val_mean_ab
solute_error: 0.1388
Epoch 294/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0365 - mean_absolute_error: 0.1448 - val_loss: 0.0332 - val_mean_abs
olute_error: 0.1359
Epoch 295/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0363 - mean_absolute_error: 0.1442 - val_loss: 0.0330 - val_mean_abs
olute_error: 0.1346
Epoch 296/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0365 - mean_absolute_error: 0.1445 - val_loss: 0.0333 - val_mean_abs
olute_error: 0.1366
Epoch 297/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0367 - mean_absolute_error: 0.1452 - val_loss: 0.0332 - val_mean_abs
olute_error: 0.1360
Epoch 298/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0361 - mean_absolute_error: 0.1438 - val_loss: 0.0332 - val_mean_abs
olute_error: 0.1354
Epoch 299/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0364 - mean_absolute_error: 0.1443 - val_loss: 0.0335 - val_mean_abs
olute_error: 0.1379
Epoch 300/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0366 - mean_absolute_error: 0.1446 - val_loss: 0.0331 - val_mean_abs
olute_error: 0.1353
Epoch 301/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0363 - mean_absolute_error: 0.1442 - val_loss: 0.0344 - val_mean_abs
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olute_error: 0.1402
Epoch 302/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0365 - mean_absolute_error: 0.1444 - val_loss: 0.0331 - val_mean_abs
olute_error: 0.1340
Epoch 303/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0365 - mean_absolute_error: 0.1444 - val_loss: 0.0336 - val_mean_abs
olute_error: 0.1371
Epoch 304/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0361 - mean_absolute_error: 0.1437 - val_loss: 0.0337 - val_mean_abs
olute_error: 0.1369
Epoch 305/512
5523/5523 [==============================] - 1s 94us/step - loss: 0.
0361 - mean_absolute_error: 0.1443 - val_loss: 0.0329 - val_mean_abs
olute_error: 0.1351
Epoch 306/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0363 - mean_absolute_error: 0.1437 - val_loss: 0.0330 - val_mean_abs
olute_error: 0.1352
Epoch 307/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0365 - mean_absolute_error: 0.1442 - val_loss: 0.0330 - val_mean_abs
olute_error: 0.1359
Epoch 308/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0360 - mean_absolute_error: 0.1436 - val_loss: 0.0332 - val_mean_abs
olute_error: 0.1352
Epoch 309/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0361 - mean_absolute_error: 0.1436 - val_loss: 0.0331 - val_mean_abs
olute_error: 0.1368
Epoch 310/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0359 - mean_absolute_error: 0.1433 - val_loss: 0.0326 - val_mean_abs
olute_error: 0.1342
Epoch 311/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0360 - mean_absolute_error: 0.1435 - val_loss: 0.0323 - val_mean_abs
olute_error: 0.1327
Epoch 312/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0360 - mean_absolute_error: 0.1434 - val_loss: 0.0326 - val_mean_abs
olute_error: 0.1330
Epoch 313/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0359 - mean_absolute_error: 0.1436 - val_loss: 0.0326 - val_mean_abs
olute_error: 0.1335
Epoch 314/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0361 - mean_absolute_error: 0.1438 - val_loss: 0.0327 - val_mean_ab
solute_error: 0.1349
```

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Epoch 315/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0362 - mean_absolute_error: 0.1443 - val_loss: 0.0331 - val_mean_ab
solute_error: 0.1365
Epoch 316/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0362 - mean_absolute_error: 0.1440 - val_loss: 0.0326 - val_mean_ab
solute_error: 0.1334
Epoch 317/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0358 - mean_absolute_error: 0.1428 - val_loss: 0.0335 - val_mean_abs
olute_error: 0.1358
Epoch 318/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0363 - mean_absolute_error: 0.1439 - val_loss: 0.0326 - val_mean_abs
olute_error: 0.1339
Epoch 319/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0360 - mean_absolute_error: 0.1430 - val_loss: 0.0324 - val_mean_abs
olute_error: 0.1335
Epoch 320/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0360 - mean_absolute_error: 0.1428 - val_loss: 0.0327 - val_mean_abs
olute_error: 0.1344
Epoch 321/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0358 - mean_absolute_error: 0.1427 - val_loss: 0.0325 - val_mean_abs
olute_error: 0.1318
Epoch 322/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0358 - mean_absolute_error: 0.1427 - val_loss: 0.0322 - val_mean_abs
olute_error: 0.1326
Epoch 323/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0361 - mean_absolute_error: 0.1439 - val_loss: 0.0336 - val_mean_abs
olute_error: 0.1395
Epoch 324/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0357 - mean_absolute_error: 0.1424 - val_loss: 0.0323 - val_mean_ab
solute_error: 0.1317
Epoch 325/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0358 - mean_absolute_error: 0.1425 - val_loss: 0.0326 - val_mean_ab
solute_error: 0.1345
Epoch 326/512
5523/5523 [==============================] - 1s 133us/step - loss: 0
.0356 - mean_absolute_error: 0.1430 - val_loss: 0.0322 - val_mean_ab
solute_error: 0.1320
Epoch 327/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0358 - mean_absolute_error: 0.1427 - val_loss: 0.0327 - val_mean_ab
solute_error: 0.1350
Epoch 328/512
```

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5523/5523 [==============================] - 1s 138us/step - loss: 0
.0356 - mean_absolute_error: 0.1427 - val_loss: 0.0323 - val_mean_ab
solute_error: 0.1331
Epoch 329/512
5523/5523 [==============================] - 1s 144us/step - loss: 0
.0359 - mean_absolute_error: 0.1434 - val_loss: 0.0322 - val_mean_ab
solute_error: 0.1313
Epoch 330/512
5523/5523 [==============================] - 1s 178us/step - loss: 0
.0357 - mean_absolute_error: 0.1422 - val_loss: 0.0327 - val_mean_ab
solute_error: 0.1335
Epoch 331/512
5523/5523 [==============================] - 1s 132us/step - loss: 0
.0364 - mean_absolute_error: 0.1438 - val_loss: 0.0323 - val_mean_ab
solute_error: 0.1323
Epoch 332/512
5523/5523 [==============================] - 1s 135us/step - loss: 0
.0358 - mean_absolute_error: 0.1425 - val_loss: 0.0321 - val_mean_ab
solute_error: 0.1319
Epoch 333/512
5523/5523 [==============================] - 1s 154us/step - loss: 0
.0356 - mean_absolute_error: 0.1423 - val_loss: 0.0326 - val_mean_ab
solute_error: 0.1354
Epoch 334/512
5523/5523 [==============================] - 1s 144us/step - loss: 0
.0359 - mean_absolute_error: 0.1432 - val_loss: 0.0323 - val_mean_ab
solute_error: 0.1316
Epoch 335/512
5523/5523 [==============================] - 1s 128us/step - loss: 0
.0361 - mean_absolute_error: 0.1433 - val_loss: 0.0321 - val_mean_ab
solute_error: 0.1310
Epoch 336/512
5523/5523 [==============================] - 1s 123us/step - loss: 0
.0359 - mean_absolute_error: 0.1430 - val_loss: 0.0329 - val_mean_ab
solute_error: 0.1370
Epoch 337/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0357 - mean_absolute_error: 0.1424 - val_loss: 0.0321 - val_mean_ab
solute_error: 0.1323
Epoch 338/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0359 - mean_absolute_error: 0.1429 - val_loss: 0.0320 - val_mean_ab
solute_error: 0.1321
Epoch 339/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0357 - mean_absolute_error: 0.1425 - val_loss: 0.0319 - val_mean_ab
solute_error: 0.1311
Epoch 340/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0355 - mean_absolute_error: 0.1420 - val_loss: 0.0325 - val_mean_ab
solute_error: 0.1346
Epoch 341/512
5523/5523 [==============================] - 1s 123us/step - loss: 0
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.0355 - mean_absolute_error: 0.1413 - val_loss: 0.0331 - val_mean_ab
solute_error: 0.1372
Epoch 342/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0356 - mean_absolute_error: 0.1416 - val_loss: 0.0320 - val_mean_ab
solute_error: 0.1317
Epoch 343/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0354 - mean_absolute_error: 0.1416 - val_loss: 0.0337 - val_mean_ab
solute_error: 0.1363
Epoch 344/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0357 - mean_absolute_error: 0.1421 - val_loss: 0.0323 - val_mean_ab
solute_error: 0.1319
Epoch 345/512
5523/5523 [==============================] - ETA: 0s - loss: 0.0362
- mean_absolute_error: 0.142 - 1s 104us/step - loss: 0.0360 - mean_a
bsolute_error: 0.1425 - val_loss: 0.0343 - val_mean_absolute_error:
0.1401
Epoch 346/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0354 - mean_absolute_error: 0.1417 - val_loss: 0.0321 - val_mean_ab
solute_error: 0.1317
Epoch 347/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0351 - mean_absolute_error: 0.1410 - val_loss: 0.0322 - val_mean_ab
solute_error: 0.1322
Epoch 348/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0354 - mean_absolute_error: 0.1412 - val_loss: 0.0317 - val_mean_ab
solute_error: 0.1296
Epoch 349/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0352 - mean_absolute_error: 0.1410 - val_loss: 0.0328 - val_mean_ab
solute_error: 0.1350
Epoch 350/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0357 - mean_absolute_error: 0.1419 - val_loss: 0.0333 - val_mean_ab
solute_error: 0.1367
Epoch 351/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0349 - mean_absolute_error: 0.1409 - val_loss: 0.0319 - val_mean_ab
solute_error: 0.1324
Epoch 352/512
5523/5523 [==============================] - 1s 143us/step - loss: 0
.0354 - mean_absolute_error: 0.1415 - val_loss: 0.0320 - val_mean_ab
solute_error: 0.1314
Epoch 353/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0356 - mean_absolute_error: 0.1424 - val_loss: 0.0328 - val_mean_ab
solute_error: 0.1359
Epoch 354/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
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.0356 - mean_absolute_error: 0.1417 - val_loss: 0.0319 - val_mean_ab
solute_error: 0.1313
Epoch 355/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0353 - mean_absolute_error: 0.1417 - val_loss: 0.0327 - val_mean_ab
solute_error: 0.1340
Epoch 356/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0349 - mean_absolute_error: 0.1403 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1312
Epoch 357/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0354 - mean_absolute_error: 0.1419 - val_loss: 0.0319 - val_mean_abs
olute_error: 0.1312
Epoch 358/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0352 - mean_absolute_error: 0.1412 - val_loss: 0.0325 - val_mean_abs
olute_error: 0.1333
Epoch 359/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0356 - mean_absolute_error: 0.1419 - val_loss: 0.0316 - val_mean_abs
olute_error: 0.1303
Epoch 360/512
5523/5523 [==============================] - 1s 94us/step - loss: 0.
0351 - mean_absolute_error: 0.1409 - val_loss: 0.0314 - val_mean_abs
olute_error: 0.1306
Epoch 361/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0354 - mean_absolute_error: 0.1416 - val_loss: 0.0319 - val_mean_abs
olute_error: 0.1313
Epoch 362/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0351 - mean_absolute_error: 0.1408 - val_loss: 0.0318 - val_mean_abs
olute_error: 0.1308
Epoch 363/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0352 - mean_absolute_error: 0.1412 - val_loss: 0.0319 - val_mean_abs
olute_error: 0.1321
Epoch 364/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0351 - mean_absolute_error: 0.1408 - val_loss: 0.0323 - val_mean_abs
olute_error: 0.1336
Epoch 365/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0352 - mean_absolute_error: 0.1413 - val_loss: 0.0327 - val_mean_abs
olute_error: 0.1348
Epoch 366/512
5523/5523 [==============================] - 1s 94us/step - loss: 0.
0348 - mean_absolute_error: 0.1402 - val_loss: 0.0323 - val_mean_abs
olute_error: 0.1332
Epoch 367/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0349 - mean_absolute_error: 0.1402 - val_loss: 0.0317 - val_mean_abs
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olute_error: 0.1311
Epoch 368/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0350 - mean_absolute_error: 0.1405 - val_loss: 0.0320 - val_mean_abs
olute_error: 0.1335
Epoch 369/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0350 - mean_absolute_error: 0.1408 - val_loss: 0.0333 - val_mean_abs
olute_error: 0.1365
Epoch 370/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0353 - mean_absolute_error: 0.1411 - val_loss: 0.0316 - val_mean_abs
olute_error: 0.1308
Epoch 371/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0352 - mean_absolute_error: 0.1410 - val_loss: 0.0322 - val_mean_abs
olute_error: 0.1334
Epoch 372/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0351 - mean_absolute_error: 0.1403 - val_loss: 0.0319 - val_mean_abs
olute_error: 0.1312
Epoch 373/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0351 - mean_absolute_error: 0.1412 - val_loss: 0.0322 - val_mean_abs
olute_error: 0.1335
Epoch 374/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0350 - mean_absolute_error: 0.1406 - val_loss: 0.0321 - val_mean_abs
olute_error: 0.1335
Epoch 375/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0348 - mean_absolute_error: 0.1400 - val_loss: 0.0347 - val_mean_abs
olute_error: 0.1403
Epoch 376/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0348 - mean_absolute_error: 0.1402 - val_loss: 0.0328 - val_mean_abs
olute_error: 0.1330
Epoch 377/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0349 - mean_absolute_error: 0.1403 - val_loss: 0.0317 - val_mean_abs
olute_error: 0.1316
Epoch 378/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0349 - mean_absolute_error: 0.1402 - val_loss: 0.0313 - val_mean_abs
olute_error: 0.1298
Epoch 379/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0351 - mean_absolute_error: 0.1409 - val_loss: 0.0320 - val_mean_abs
olute_error: 0.1323
Epoch 380/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0350 - mean_absolute_error: 0.1404 - val_loss: 0.0318 - val_mean_abs
olute_error: 0.1318
```

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Epoch 381/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0349 - mean_absolute_error: 0.1407 - val_loss: 0.0317 - val_mean_abs
olute_error: 0.1311
Epoch 382/512
5523/5523 [==============================] - 1s 93us/step - loss: 0.
0345 - mean_absolute_error: 0.1394 - val_loss: 0.0317 - val_mean_abs
olute_error: 0.1298
Epoch 383/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0349 - mean_absolute_error: 0.1400 - val_loss: 0.0317 - val_mean_abs
olute_error: 0.1312
Epoch 384/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0347 - mean_absolute_error: 0.1399 - val_loss: 0.0315 - val_mean_ab
solute_error: 0.1306
Epoch 385/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0348 - mean_absolute_error: 0.1398 - val_loss: 0.0315 - val_mean_abs
olute_error: 0.1305
Epoch 386/512
5523/5523 [==============================] - 1s 97us/step - loss: 0.
0346 - mean_absolute_error: 0.1397 - val_loss: 0.0313 - val_mean_abs
olute_error: 0.1292
Epoch 387/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0350 - mean_absolute_error: 0.1406 - val_loss: 0.0325 - val_mean_ab
solute_error: 0.1331
Epoch 388/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0349 - mean_absolute_error: 0.1401 - val_loss: 0.0324 - val_mean_ab
solute_error: 0.1343
Epoch 389/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0350 - mean_absolute_error: 0.1406 - val_loss: 0.0326 - val_mean_ab
solute_error: 0.1344
Epoch 390/512
5523/5523 [==============================] - 1s 95us/step - loss: 0.
0349 - mean_absolute_error: 0.1406 - val_loss: 0.0316 - val_mean_abs
olute_error: 0.1314
Epoch 391/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0347 - mean_absolute_error: 0.1397 - val_loss: 0.0320 - val_mean_abs
olute_error: 0.1332
Epoch 392/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0352 - mean_absolute_error: 0.1409 - val_loss: 0.0327 - val_mean_ab
solute_error: 0.1376
Epoch 393/512
5523/5523 [==============================] - 1s 140us/step - loss: 0
.0348 - mean_absolute_error: 0.1398 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1310
Epoch 394/512
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5523/5523 [==============================] - 1s 115us/step - loss: 0
.0348 - mean_absolute_error: 0.1402 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1309
Epoch 395/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0347 - mean_absolute_error: 0.1401 - val_loss: 0.0318 - val_mean_ab
solute_error: 0.1320
Epoch 396/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0349 - mean_absolute_error: 0.1404 - val_loss: 0.0341 - val_mean_ab
solute_error: 0.1374
Epoch 397/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0345 - mean_absolute_error: 0.1395 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1294
Epoch 398/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0343 - mean_absolute_error: 0.1392 - val_loss: 0.0317 - val_mean_ab
solute_error: 0.1320
Epoch 399/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0347 - mean_absolute_error: 0.1393 - val_loss: 0.0337 - val_mean_ab
solute_error: 0.1367
Epoch 400/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0347 - mean_absolute_error: 0.1397 - val_loss: 0.0312 - val_mean_ab
solute_error: 0.1291
Epoch 401/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0346 - mean_absolute_error: 0.1396 - val_loss: 0.0322 - val_mean_ab
solute_error: 0.1322
Epoch 402/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0345 - mean_absolute_error: 0.1391 - val_loss: 0.0323 - val_mean_ab
solute_error: 0.1340
Epoch 403/512
5523/5523 [==============================] - 1s 143us/step - loss: 0
.0345 - mean_absolute_error: 0.1394 - val_loss: 0.0315 - val_mean_ab
solute_error: 0.1322
Epoch 404/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0346 - mean_absolute_error: 0.1400 - val_loss: 0.0315 - val_mean_ab
solute_error: 0.1302
Epoch 405/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0344 - mean_absolute_error: 0.1385 - val_loss: 0.0318 - val_mean_ab
solute_error: 0.1319
Epoch 406/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0346 - mean_absolute_error: 0.1391 - val_loss: 0.0332 - val_mean_ab
solute_error: 0.1370
Epoch 407/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
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.0345 - mean_absolute_error: 0.1396 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1310
Epoch 408/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0346 - mean_absolute_error: 0.1396 - val_loss: 0.0317 - val_mean_ab
solute_error: 0.1331
Epoch 409/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0346 - mean_absolute_error: 0.1392 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1312
Epoch 410/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0346 - mean_absolute_error: 0.1395 - val_loss: 0.0322 - val_mean_ab
solute_error: 0.1325
Epoch 411/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0346 - mean_absolute_error: 0.1396 - val_loss: 0.0314 - val_mean_abs
olute_error: 0.1312
Epoch 412/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0345 - mean_absolute_error: 0.1389 - val_loss: 0.0313 - val_mean_abs
olute_error: 0.1308
Epoch 413/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0344 - mean_absolute_error: 0.1390 - val_loss: 0.0329 - val_mean_ab
solute_error: 0.1337
Epoch 414/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0344 - mean_absolute_error: 0.1394 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1314
Epoch 415/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0342 - mean_absolute_error: 0.1383 - val_loss: 0.0319 - val_mean_ab
solute_error: 0.1326
Epoch 416/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0346 - mean_absolute_error: 0.1397 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1308
Epoch 417/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0345 - mean_absolute_error: 0.1395 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1322
Epoch 418/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0342 - mean_absolute_error: 0.1389 - val_loss: 0.0320 - val_mean_ab
solute_error: 0.1325
Epoch 419/512
5523/5523 [==============================] - 1s 102us/step - loss: 0
.0346 - mean_absolute_error: 0.1392 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1306
Epoch 420/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0344 - mean_absolute_error: 0.1390 - val_loss: 0.0314 - val_mean_abs
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olute_error: 0.1289
Epoch 421/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0343 - mean_absolute_error: 0.1388 - val_loss: 0.0320 - val_mean_abs
olute_error: 0.1310
Epoch 422/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0341 - mean_absolute_error: 0.1382 - val_loss: 0.0322 - val_mean_ab
solute_error: 0.1307
Epoch 423/512
5523/5523 [==============================] - 1s 96us/step - loss: 0.
0343 - mean_absolute_error: 0.1386 - val_loss: 0.0316 - val_mean_abs
olute_error: 0.1310
Epoch 424/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0347 - mean_absolute_error: 0.1396 - val_loss: 0.0319 - val_mean_abs
olute_error: 0.1318
Epoch 425/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0339 - mean_absolute_error: 0.1382 - val_loss: 0.0314 - val_mean_abs
olute_error: 0.1305
Epoch 426/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0341 - mean_absolute_error: 0.1380 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1287
Epoch 427/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0341 - mean_absolute_error: 0.1388 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1306
Epoch 428/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0343 - mean_absolute_error: 0.1394 - val_loss: 0.0313 - val_mean_ab
solute_error: 0.1298
Epoch 429/512
5523/5523 [==============================] - 1s 131us/step - loss: 0
.0342 - mean_absolute_error: 0.1384 - val_loss: 0.0311 - val_mean_ab
solute_error: 0.1296
Epoch 430/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0344 - mean_absolute_error: 0.1394 - val_loss: 0.0320 - val_mean_ab
solute_error: 0.1321
Epoch 431/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0343 - mean_absolute_error: 0.1386 - val_loss: 0.0317 - val_mean_ab
solute_error: 0.1319
Epoch 432/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0341 - mean_absolute_error: 0.1383 - val_loss: 0.0310 - val_mean_abs
olute_error: 0.1284
Epoch 433/512
5523/5523 [==============================] - 1s 143us/step - loss: 0
.0342 - mean_absolute_error: 0.1384 - val_loss: 0.0311 - val_mean_ab
solute_error: 0.1300
```

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Epoch 434/512
5523/5523 [==============================] - 1s 125us/step - loss: 0
.0343 - mean_absolute_error: 0.1393 - val_loss: 0.0310 - val_mean_ab
solute_error: 0.1291
Epoch 435/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0342 - mean_absolute_error: 0.1385 - val_loss: 0.0311 - val_mean_ab
solute_error: 0.1302
Epoch 436/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0341 - mean_absolute_error: 0.1387 - val_loss: 0.0311 - val_mean_ab
solute_error: 0.1302
Epoch 437/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0342 - mean_absolute_error: 0.1389 - val_loss: 0.0312 - val_mean_ab
solute_error: 0.1299
Epoch 438/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0337 - mean_absolute_error: 0.1377 - val_loss: 0.0307 - val_mean_ab
solute_error: 0.1278
Epoch 439/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0339 - mean_absolute_error: 0.1377 - val_loss: 0.0312 - val_mean_ab
solute_error: 0.1294
Epoch 440/512
5523/5523 [==============================] - 1s 100us/step - loss: 0
.0340 - mean_absolute_error: 0.1381 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1278
Epoch 441/512
5523/5523 [==============================] - 1s 99us/step - loss: 0.
0338 - mean_absolute_error: 0.1381 - val_loss: 0.0307 - val_mean_abs
olute_error: 0.1282
Epoch 442/512
5523/5523 [==============================] - 1s 98us/step - loss: 0.
0338 - mean_absolute_error: 0.1374 - val_loss: 0.0310 - val_mean_abs
olute_error: 0.1286
Epoch 443/512
5523/5523 [==============================] - 1s 105us/step - loss: 0
.0339 - mean_absolute_error: 0.1378 - val_loss: 0.0309 - val_mean_ab
solute_error: 0.1288
Epoch 444/512
5523/5523 [==============================] - 1s 105us/step - loss: 0
.0341 - mean_absolute_error: 0.1383 - val_loss: 0.0317 - val_mean_ab
solute_error: 0.1298
Epoch 445/512
5523/5523 [==============================] - 1s 101us/step - loss: 0
.0342 - mean_absolute_error: 0.1381 - val_loss: 0.0307 - val_mean_ab
solute_error: 0.1284
Epoch 446/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0341 - mean_absolute_error: 0.1387 - val_loss: 0.0319 - val_mean_ab
solute_error: 0.1327
Epoch 447/512
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5523/5523 [==============================] - 1s 119us/step - loss: 0
.0338 - mean_absolute_error: 0.1377 - val_loss: 0.0312 - val_mean_ab
solute_error: 0.1304
Epoch 448/512
5523/5523 [==============================] - 1s 134us/step - loss: 0
.0341 - mean_absolute_error: 0.1382 - val_loss: 0.0315 - val_mean_ab
solute_error: 0.1295
Epoch 449/512
5523/5523 [==============================] - 1s 132us/step - loss: 0
.0334 - mean_absolute_error: 0.1374 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1276
Epoch 450/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0339 - mean_absolute_error: 0.1373 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1290
Epoch 451/512
5523/5523 [==============================] - 1s 125us/step - loss: 0
.0337 - mean_absolute_error: 0.1377 - val_loss: 0.0309 - val_mean_ab
solute_error: 0.1292
Epoch 452/512
5523/5523 [==============================] - 1s 133us/step - loss: 0
.0338 - mean_absolute_error: 0.1374 - val_loss: 0.0313 - val_mean_ab
solute_error: 0.1297
Epoch 453/512
5523/5523 [==============================] - 1s 142us/step - loss: 0
.0337 - mean_absolute_error: 0.1376 - val_loss: 0.0313 - val_mean_ab
solute_error: 0.1306
Epoch 454/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0340 - mean_absolute_error: 0.1380 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1308
Epoch 455/512
5523/5523 [==============================] - 1s 125us/step - loss: 0
.0338 - mean_absolute_error: 0.1376 - val_loss: 0.0306 - val_mean_ab
solute_error: 0.1276
Epoch 456/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0339 - mean_absolute_error: 0.1375 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1298
Epoch 457/512
5523/5523 [==============================] - 1s 129us/step - loss: 0
.0336 - mean_absolute_error: 0.1368 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1290
Epoch 458/512
5523/5523 [==============================] - 1s 135us/step - loss: 0
.0337 - mean_absolute_error: 0.1375 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1274
Epoch 459/512
5523/5523 [==============================] - 1s 136us/step - loss: 0
.0336 - mean_absolute_error: 0.1375 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1293
Epoch 460/512
5523/5523 [==============================] - 1s 135us/step - loss: 0
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.0334 - mean_absolute_error: 0.1366 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1291
Epoch 461/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0339 - mean_absolute_error: 0.1381 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1282
Epoch 462/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0333 - mean_absolute_error: 0.1364 - val_loss: 0.0315 - val_mean_ab
solute_error: 0.1313
Epoch 463/512
5523/5523 [==============================] - 1s 129us/step - loss: 0
.0336 - mean_absolute_error: 0.1371 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1288
Epoch 464/512
5523/5523 [==============================] - 1s 141us/step - loss: 0
.0335 - mean_absolute_error: 0.1367 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1267
Epoch 465/512
5523/5523 [==============================] - 1s 122us/step - loss: 0
.0334 - mean_absolute_error: 0.1365 - val_loss: 0.0307 - val_mean_ab
solute_error: 0.1271
Epoch 466/512
5523/5523 [==============================] - 1s 124us/step - loss: 0
.0336 - mean_absolute_error: 0.1369 - val_loss: 0.0311 - val_mean_ab
solute_error: 0.1297
Epoch 467/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0338 - mean_absolute_error: 0.1377 - val_loss: 0.0311 - val_mean_ab
solute_error: 0.1295
Epoch 468/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0334 - mean_absolute_error: 0.1366 - val_loss: 0.0310 - val_mean_ab
solute_error: 0.1310
Epoch 469/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0333 - mean_absolute_error: 0.1363 - val_loss: 0.0309 - val_mean_ab
solute_error: 0.1285
Epoch 470/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0336 - mean_absolute_error: 0.1373 - val_loss: 0.0304 - val_mean_ab
solute_error: 0.1269
Epoch 471/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0333 - mean_absolute_error: 0.1364 - val_loss: 0.0304 - val_mean_ab
solute_error: 0.1273
Epoch 472/512
5523/5523 [==============================] - 1s 123us/step - loss: 0
.0333 - mean_absolute_error: 0.1364 - val_loss: 0.0306 - val_mean_ab
solute_error: 0.1277
Epoch 473/512
5523/5523 [==============================] - 1s 123us/step - loss: 0
.0333 - mean_absolute_error: 0.1365 - val_loss: 0.0301 - val_mean_ab
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solute_error: 0.1260
Epoch 474/512
5523/5523 [==============================] - 1s 122us/step - loss: 0
.0332 - mean_absolute_error: 0.1364 - val_loss: 0.0321 - val_mean_ab
solute_error: 0.1324
Epoch 475/512
5523/5523 [==============================] - 1s 125us/step - loss: 0
.0336 - mean_absolute_error: 0.1368 - val_loss: 0.0303 - val_mean_ab
solute_error: 0.1276
Epoch 476/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0335 - mean_absolute_error: 0.1364 - val_loss: 0.0301 - val_mean_ab
solute_error: 0.1270
Epoch 477/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0332 - mean_absolute_error: 0.1358 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1279
Epoch 478/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0334 - mean_absolute_error: 0.1366 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1290
Epoch 479/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0330 - mean_absolute_error: 0.1359 - val_loss: 0.0303 - val_mean_ab
solute_error: 0.1274
Epoch 480/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0333 - mean_absolute_error: 0.1361 - val_loss: 0.0299 - val_mean_ab
solute_error: 0.1255
Epoch 481/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0328 - mean_absolute_error: 0.1353 - val_loss: 0.0301 - val_mean_ab
solute_error: 0.1260
Epoch 482/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0331 - mean_absolute_error: 0.1360 - val_loss: 0.0303 - val_mean_ab
solute_error: 0.1262
Epoch 483/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0330 - mean_absolute_error: 0.1354 - val_loss: 0.0306 - val_mean_ab
solute_error: 0.1278
Epoch 484/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0331 - mean_absolute_error: 0.1359 - val_loss: 0.0303 - val_mean_ab
solute_error: 0.1273
Epoch 485/512
5523/5523 [==============================] - 1s 105us/step - loss: 0
.0330 - mean_absolute_error: 0.1354 - val_loss: 0.0307 - val_mean_ab
solute_error: 0.1287
Epoch 486/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0330 - mean_absolute_error: 0.1359 - val_loss: 0.0311 - val_mean_ab
solute_error: 0.1302
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Epoch 487/512
5523/5523 [==============================] - 1s 103us/step - loss: 0
.0333 - mean_absolute_error: 0.1363 - val_loss: 0.0304 - val_mean_ab
solute_error: 0.1271
Epoch 488/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0335 - mean_absolute_error: 0.1367 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1282
Epoch 489/512
5523/5523 [==============================] - 1s 104us/step - loss: 0
.0328 - mean_absolute_error: 0.1347 - val_loss: 0.0302 - val_mean_ab
solute_error: 0.1272
Epoch 490/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0331 - mean_absolute_error: 0.1359 - val_loss: 0.0300 - val_mean_ab
solute_error: 0.1268
Epoch 491/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0332 - mean_absolute_error: 0.1360 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1283
Epoch 492/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0329 - mean_absolute_error: 0.1355 - val_loss: 0.0306 - val_mean_ab
solute_error: 0.1282
Epoch 493/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0328 - mean_absolute_error: 0.1351 - val_loss: 0.0306 - val_mean_ab
solute_error: 0.1282
Epoch 494/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0331 - mean_absolute_error: 0.1358 - val_loss: 0.0306 - val_mean_ab
solute_error: 0.1284
Epoch 495/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0329 - mean_absolute_error: 0.1352 - val_loss: 0.0301 - val_mean_ab
solute_error: 0.1270
Epoch 496/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0332 - mean_absolute_error: 0.1364 - val_loss: 0.0299 - val_mean_ab
solute_error: 0.1263
Epoch 497/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0328 - mean_absolute_error: 0.1347 - val_loss: 0.0300 - val_mean_ab
solute_error: 0.1263
Epoch 498/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0331 - mean_absolute_error: 0.1362 - val_loss: 0.0304 - val_mean_ab
solute_error: 0.1290
Epoch 499/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0332 - mean_absolute_error: 0.1361 - val_loss: 0.0304 - val_mean_ab
solute_error: 0.1290
Epoch 500/512
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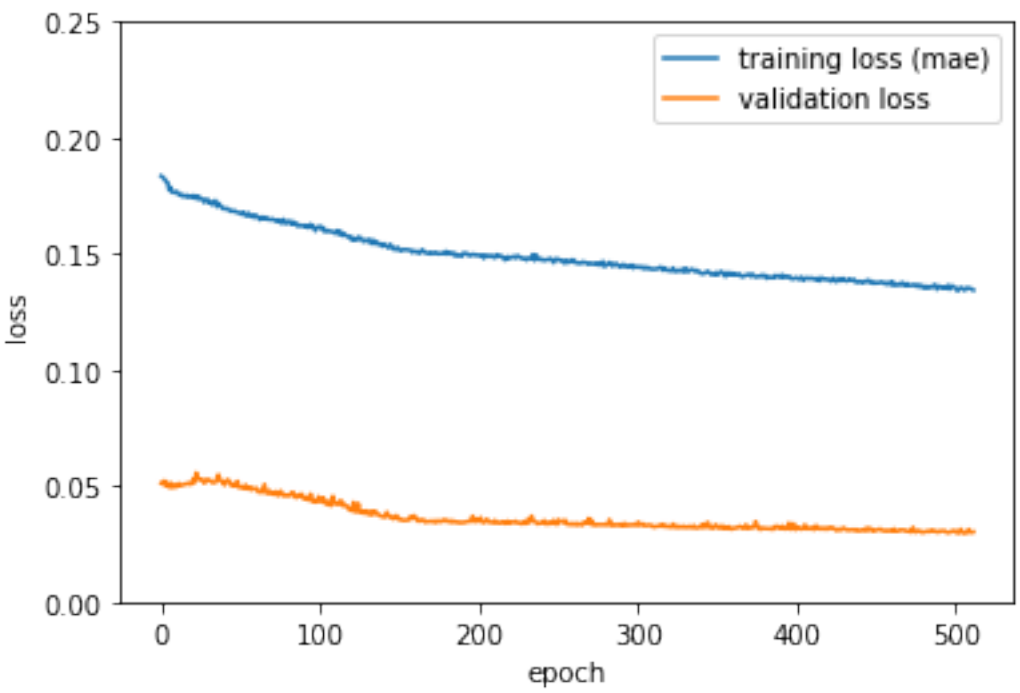
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0329 - mean_absolute_error: 0.1355 - val_loss: 0.0308 - val_mean_ab
solute_error: 0.1290
Epoch 501/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0328 - mean_absolute_error: 0.1352 - val_loss: 0.0300 - val_mean_ab
solute_error: 0.1269
Epoch 502/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0325 - mean_absolute_error: 0.1340 - val_loss: 0.0302 - val_mean_ab
solute_error: 0.1289
Epoch 503/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0327 - mean_absolute_error: 0.1350 - val_loss: 0.0297 - val_mean_ab
solute_error: 0.1260
Epoch 504/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0328 - mean_absolute_error: 0.1354 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1305
Epoch 505/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0328 - mean_absolute_error: 0.1353 - val_loss: 0.0302 - val_mean_ab
solute_error: 0.1282
Epoch 506/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0326 - mean_absolute_error: 0.1344 - val_loss: 0.0296 - val_mean_ab
solute_error: 0.1255
Epoch 507/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0324 - mean_absolute_error: 0.1345 - val_loss: 0.0297 - val_mean_ab
solute_error: 0.1261
Epoch 508/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0328 - mean_absolute_error: 0.1353 - val_loss: 0.0300 - val_mean_ab
solute_error: 0.1275
Epoch 509/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0327 - mean_absolute_error: 0.1352 - val_loss: 0.0313 - val_mean_ab
solute_error: 0.1312
Epoch 510/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0330 - mean_absolute_error: 0.1352 - val_loss: 0.0300 - val_mean_ab
solute_error: 0.1273
Epoch 511/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0327 - mean_absolute_error: 0.1347 - val_loss: 0.0300 - val_mean_ab
solute_error: 0.1266
Epoch 512/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0324 - mean_absolute_error: 0.1344 - val_loss: 0.0302 - val_mean_ab
solute_error: 0.1276
Finished training; model reloaded with optimum weights.
```

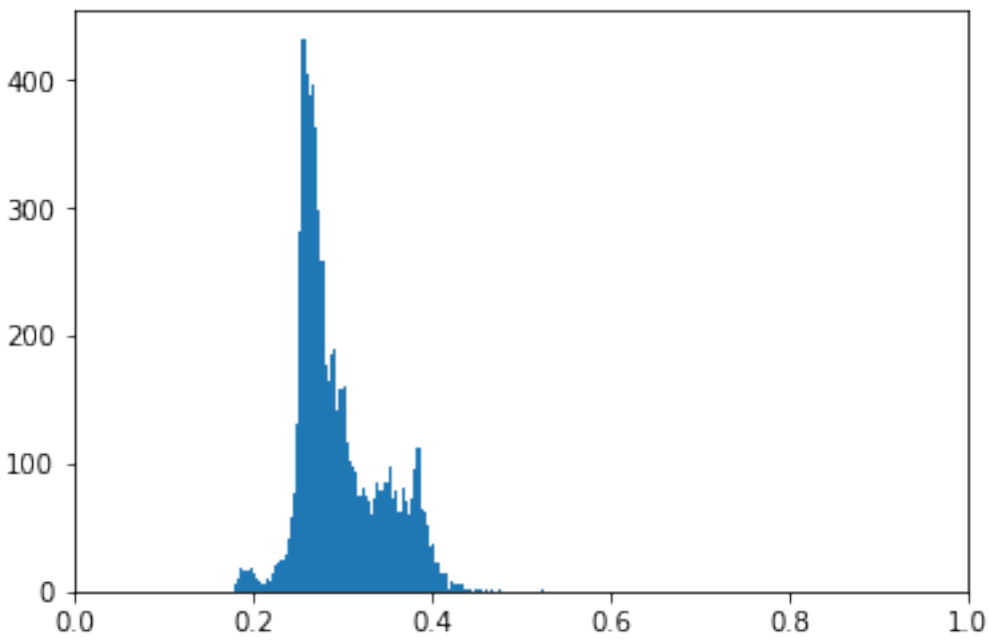
In [20]:

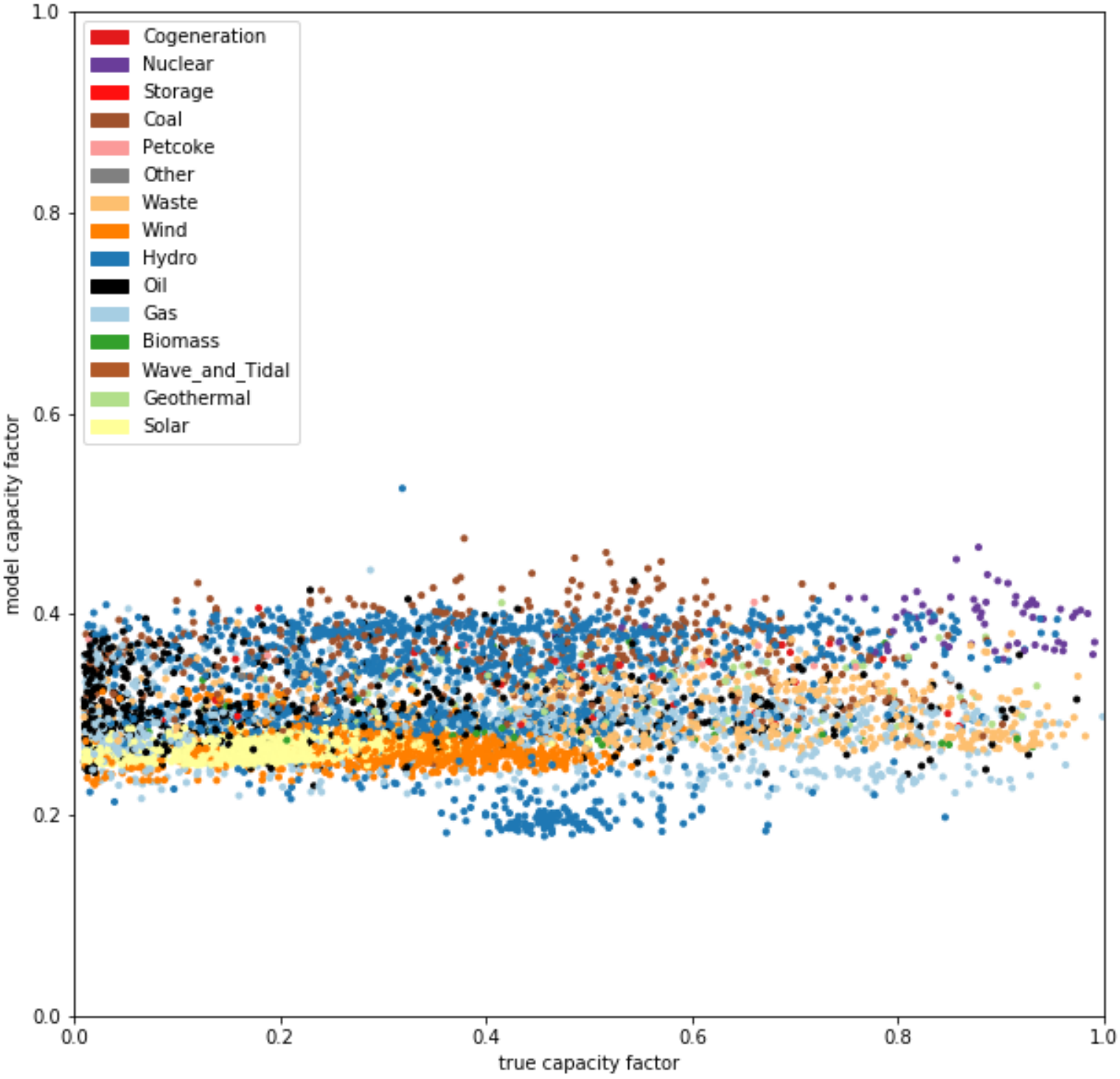
```
# examine model fit results

plot_loss(history_object2)
predicted_values2 = prediction_histogram(model2)
plot_predicted(predicted_values2)
r2_score = metrics.r2_score(y_data,predicted_values2)
print(u"R2 score: {0}".format(r2_score))
```




```
Predicted values in range: 6904
Predicted max: 0.525287032127, min: 0.178858473897
```





R2 score: 0.00593649236261

In [21]:

```
# conclusion: not much better
# try LeakyReLU
# PROBLEM: Error with LeakyReLU and Keras/Tensorflow backend
# https://github.com/keras-team/keras/issues/9349

RELU_LEAKAGE = 0.2

def myNet_Leaky():
    model = Sequential()
    model.add(Lambda(lambda x: (x-mean_vals)/range_vals, input_shape = INPUT_SHA
PE))   # normalization
    model.add(Dense(DENSE_LAYER_SIZE,activation='linear'))
    model.add(LeakyReLU(alpha=RELU_LEAKAGE))
    model.add(Dropout(DROPOUT_RATE))
    model.add(Dense(DENSE_LAYER_SIZE,activation='linear'))
    model.add(LeakyReLU(alpha=RELU_LEAKAGE))
    model.add(Dropout(DROPOUT_RATE))
    model.add(Dense(DENSE_LAYER_SIZE,activation='linear'))
    model.add(LeakyReLU(alpha=RELU_LEAKAGE))
    model.add(Dense(1,activation='sigmoid'))    # will restrict output to [0,1]
    return model

model3 = myNet_Leaky()
model3.compile(loss='mean_squared_error',optimizer='adam',metrics=['mean_absolut
e_error'])
print("Model contains {0} parameters.".format(model3.count_params()))
print(model3.summary())
```

```
Model contains 133633 parameters.
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lambda_6 (Lambda)            (None, 6)                 0
_________________________________________________________________
dense_21 (Dense)             (None, 256)               1792
_________________________________________________________________
leaky_re_lu_1 (LeakyReLU)    (None, 256)               0
_________________________________________________________________
dropout_11 (Dropout)         (None, 256)               0
_________________________________________________________________
dense_22 (Dense)             (None, 256)               65792
_________________________________________________________________
leaky_re_lu_2 (LeakyReLU)    (None, 256)               0
_________________________________________________________________
dropout_12 (Dropout)         (None, 256)               0
_________________________________________________________________
dense_23 (Dense)             (None, 256)               65792
_________________________________________________________________
leaky_re_lu_3 (LeakyReLU)    (None, 256)               0
_________________________________________________________________
dense_24 (Dense)             (None, 1)                 257
=================================================================
Total params: 133,633
Trainable params: 133,633
Non-trainable params: 0
_________________________________________________________________
None
```

In [22]:

```
# fit model
WEIGHTS_FILE3 = "model3/estimate_generation.h5"

# fit model
history_object3 = fit_model(model3,WEIGHTS_FILE3)

# reload model with best weights from training
model3 = myNet_Leaky()
model3.load_weights(WEIGHTS_FILE3)
model3.compile(loss='mean_squared_error',optimizer='adam',metrics=['mean_absolut
e_error'])
print("Finished training; model reloaded with optimum weights.")
```

```
Train on 5523 samples, validate on 1381 samples
Epoch 1/512
5523/5523 [==============================] - 1s 235us/step - loss: 0
.0472 - mean_absolute_error: 0.1712 - val_loss: 0.0484 - val_mean_ab
solute_error: 0.1745
Epoch 2/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0406 - mean_absolute_error: 0.1555 - val_loss: 0.0386 - val_mean_ab
```

```
solute_error: 0.1526
Epoch 3/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0380 - mean_absolute_error: 0.1487 - val_loss: 0.0347 - val_mean_ab
solute_error: 0.1407
Epoch 4/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0370 - mean_absolute_error: 0.1462 - val_loss: 0.0341 - val_mean_ab
solute_error: 0.1396
Epoch 5/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0360 - mean_absolute_error: 0.1436 - val_loss: 0.0331 - val_mean_ab
solute_error: 0.1344
Epoch 6/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0358 - mean_absolute_error: 0.1432 - val_loss: 0.0321 - val_mean_ab
solute_error: 0.1323
Epoch 7/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0356 - mean_absolute_error: 0.1423 - val_loss: 0.0332 - val_mean_ab
solute_error: 0.1387
Epoch 8/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0350 - mean_absolute_error: 0.1410 - val_loss: 0.0325 - val_mean_ab
solute_error: 0.1325
Epoch 9/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0351 - mean_absolute_error: 0.1420 - val_loss: 0.0340 - val_mean_ab
solute_error: 0.1396
Epoch 10/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0347 - mean_absolute_error: 0.1409 - val_loss: 0.0357 - val_mean_ab
solute_error: 0.1435
Epoch 11/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0346 - mean_absolute_error: 0.1398 - val_loss: 0.0332 - val_mean_ab
solute_error: 0.1379
Epoch 12/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0343 - mean_absolute_error: 0.1396 - val_loss: 0.0323 - val_mean_ab
solute_error: 0.1346
Epoch 13/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0341 - mean_absolute_error: 0.1388 - val_loss: 0.0327 - val_mean_ab
solute_error: 0.1342
Epoch 14/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0341 - mean_absolute_error: 0.1390 - val_loss: 0.0340 - val_mean_ab
solute_error: 0.1382
Epoch 15/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0337 - mean_absolute_error: 0.1384 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1305
```

```
Epoch 16/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0339 - mean_absolute_error: 0.1384 - val_loss: 0.0325 - val_mean_ab
solute_error: 0.1322
Epoch 17/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0336 - mean_absolute_error: 0.1382 - val_loss: 0.0338 - val_mean_ab
solute_error: 0.1404
Epoch 18/512
5523/5523 [==============================] - 1s 157us/step - loss: 0
.0337 - mean_absolute_error: 0.1378 - val_loss: 0.0312 - val_mean_ab
solute_error: 0.1295
Epoch 19/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0335 - mean_absolute_error: 0.1375 - val_loss: 0.0309 - val_mean_ab
solute_error: 0.1290
Epoch 20/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0331 - mean_absolute_error: 0.1369 - val_loss: 0.0332 - val_mean_ab
solute_error: 0.1352
Epoch 21/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0334 - mean_absolute_error: 0.1368 - val_loss: 0.0326 - val_mean_ab
solute_error: 0.1359
Epoch 22/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0330 - mean_absolute_error: 0.1367 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1335
Epoch 23/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0332 - mean_absolute_error: 0.1374 - val_loss: 0.0338 - val_mean_ab
solute_error: 0.1404
Epoch 24/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0331 - mean_absolute_error: 0.1360 - val_loss: 0.0321 - val_mean_ab
solute_error: 0.1354
Epoch 25/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0329 - mean_absolute_error: 0.1366 - val_loss: 0.0326 - val_mean_ab
solute_error: 0.1376
Epoch 26/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0329 - mean_absolute_error: 0.1368 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1273
Epoch 27/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0328 - mean_absolute_error: 0.1360 - val_loss: 0.0313 - val_mean_ab
solute_error: 0.1326
Epoch 28/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0324 - mean_absolute_error: 0.1353 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1287
Epoch 29/512
```

```
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0322 - mean_absolute_error: 0.1353 - val_loss: 0.0326 - val_mean_ab
solute_error: 0.1369
Epoch 30/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0320 - mean_absolute_error: 0.1342 - val_loss: 0.0341 - val_mean_ab
solute_error: 0.1418
Epoch 31/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0320 - mean_absolute_error: 0.1338 - val_loss: 0.0335 - val_mean_ab
solute_error: 0.1398
Epoch 32/512
5523/5523 [==============================] - 1s 149us/step - loss: 0
.0319 - mean_absolute_error: 0.1340 - val_loss: 0.0322 - val_mean_ab
solute_error: 0.1351
Epoch 33/512
5523/5523 [==============================] - 1s 128us/step - loss: 0
.0317 - mean_absolute_error: 0.1336 - val_loss: 0.0340 - val_mean_ab
solute_error: 0.1400
Epoch 34/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0322 - mean_absolute_error: 0.1347 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1289
Epoch 35/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0319 - mean_absolute_error: 0.1337 - val_loss: 0.0307 - val_mean_ab
solute_error: 0.1321
Epoch 36/512
5523/5523 [==============================] - 1s 122us/step - loss: 0
.0322 - mean_absolute_error: 0.1347 - val_loss: 0.0304 - val_mean_ab
solute_error: 0.1281
Epoch 37/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0316 - mean_absolute_error: 0.1336 - val_loss: 0.0303 - val_mean_ab
solute_error: 0.1303
Epoch 38/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0316 - mean_absolute_error: 0.1336 - val_loss: 0.0330 - val_mean_ab
solute_error: 0.1383
Epoch 39/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0313 - mean_absolute_error: 0.1330 - val_loss: 0.0294 - val_mean_ab
solute_error: 0.1272
Epoch 40/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0312 - mean_absolute_error: 0.1326 - val_loss: 0.0313 - val_mean_ab
solute_error: 0.1342
Epoch 41/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0312 - mean_absolute_error: 0.1323 - val_loss: 0.0411 - val_mean_ab
solute_error: 0.1531
Epoch 42/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
```

```
.0311 - mean_absolute_error: 0.1320 - val_loss: 0.0321 - val_mean_ab
solute_error: 0.1361
Epoch 43/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0312 - mean_absolute_error: 0.1325 - val_loss: 0.0342 - val_mean_ab
solute_error: 0.1412
Epoch 44/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0318 - mean_absolute_error: 0.1345 - val_loss: 0.0363 - val_mean_ab
solute_error: 0.1464
Epoch 45/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0309 - mean_absolute_error: 0.1314 - val_loss: 0.0294 - val_mean_ab
solute_error: 0.1278
Epoch 46/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0311 - mean_absolute_error: 0.1316 - val_loss: 0.0292 - val_mean_ab
solute_error: 0.1239
Epoch 47/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0307 - mean_absolute_error: 0.1309 - val_loss: 0.0318 - val_mean_ab
solute_error: 0.1352
Epoch 48/512
5523/5523 [==============================] - 1s 145us/step - loss: 0
.0305 - mean_absolute_error: 0.1316 - val_loss: 0.0296 - val_mean_ab
solute_error: 0.1266
Epoch 49/512
5523/5523 [==============================] - 1s 130us/step - loss: 0
.0312 - mean_absolute_error: 0.1323 - val_loss: 0.0299 - val_mean_ab
solute_error: 0.1290
Epoch 50/512
5523/5523 [==============================] - 1s 125us/step - loss: 0
.0304 - mean_absolute_error: 0.1303 - val_loss: 0.0281 - val_mean_ab
solute_error: 0.1228
Epoch 51/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0306 - mean_absolute_error: 0.1312 - val_loss: 0.0307 - val_mean_ab
solute_error: 0.1327
Epoch 52/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0307 - mean_absolute_error: 0.1316 - val_loss: 0.0291 - val_mean_ab
solute_error: 0.1246
Epoch 53/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0310 - mean_absolute_error: 0.1320 - val_loss: 0.0305 - val_mean_ab
solute_error: 0.1331
Epoch 54/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0308 - mean_absolute_error: 0.1315 - val_loss: 0.0304 - val_mean_ab
solute_error: 0.1319
Epoch 55/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0302 - mean_absolute_error: 0.1293 - val_loss: 0.0286 - val_mean_ab
```

```
solute_error: 0.1249
Epoch 56/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0307 - mean_absolute_error: 0.1315 - val_loss: 0.0293 - val_mean_ab
solute_error: 0.1280
Epoch 57/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0304 - mean_absolute_error: 0.1303 - val_loss: 0.0285 - val_mean_ab
solute_error: 0.1243
Epoch 58/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0306 - mean_absolute_error: 0.1311 - val_loss: 0.0301 - val_mean_ab
solute_error: 0.1285
Epoch 59/512
5523/5523 [==============================] - 1s 107us/step - loss: 0
.0303 - mean_absolute_error: 0.1303 - val_loss: 0.0336 - val_mean_ab
solute_error: 0.1403
Epoch 60/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0302 - mean_absolute_error: 0.1299 - val_loss: 0.0330 - val_mean_ab
solute_error: 0.1378
Epoch 61/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0303 - mean_absolute_error: 0.1297 - val_loss: 0.0301 - val_mean_ab
solute_error: 0.1328
Epoch 62/512
5523/5523 [==============================] - 1s 112us/step - loss: 0
.0307 - mean_absolute_error: 0.1305 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1336
Epoch 63/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0300 - mean_absolute_error: 0.1290 - val_loss: 0.0364 - val_mean_ab
solute_error: 0.1444
Epoch 64/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0299 - mean_absolute_error: 0.1291 - val_loss: 0.0287 - val_mean_ab
solute_error: 0.1262
Epoch 65/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0299 - mean_absolute_error: 0.1292 - val_loss: 0.0304 - val_mean_ab
solute_error: 0.1319
Epoch 66/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0301 - mean_absolute_error: 0.1299 - val_loss: 0.0291 - val_mean_ab
solute_error: 0.1266
Epoch 67/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0303 - mean_absolute_error: 0.1301 - val_loss: 0.0279 - val_mean_ab
solute_error: 0.1208
Epoch 68/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0301 - mean_absolute_error: 0.1293 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1345
```

```
Epoch 69/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0296 - mean_absolute_error: 0.1281 - val_loss: 0.0312 - val_mean_ab
solute_error: 0.1344
Epoch 70/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0298 - mean_absolute_error: 0.1286 - val_loss: 0.0359 - val_mean_ab
solute_error: 0.1440
Epoch 71/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0299 - mean_absolute_error: 0.1288 - val_loss: 0.0316 - val_mean_ab
solute_error: 0.1327
Epoch 72/512
5523/5523 [==============================] - 1s 116us/step - loss: 0
.0298 - mean_absolute_error: 0.1289 - val_loss: 0.0294 - val_mean_ab
solute_error: 0.1259
Epoch 73/512
5523/5523 [==============================] - 1s 115us/step - loss: 0
.0300 - mean_absolute_error: 0.1299 - val_loss: 0.0281 - val_mean_ab
solute_error: 0.1233
Epoch 74/512
5523/5523 [==============================] - 1s 122us/step - loss: 0
.0292 - mean_absolute_error: 0.1277 - val_loss: 0.0280 - val_mean_ab
solute_error: 0.1224
Epoch 75/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0294 - mean_absolute_error: 0.1278 - val_loss: 0.0281 - val_mean_ab
solute_error: 0.1224
Epoch 76/512
5523/5523 [==============================] - 1s 126us/step - loss: 0
.0295 - mean_absolute_error: 0.1285 - val_loss: 0.0351 - val_mean_ab
solute_error: 0.1434
Epoch 77/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0293 - mean_absolute_error: 0.1276 - val_loss: 0.0351 - val_mean_ab
solute_error: 0.1406
Epoch 78/512
5523/5523 [==============================] - 1s 125us/step - loss: 0
.0296 - mean_absolute_error: 0.1281 - val_loss: 0.0279 - val_mean_ab
solute_error: 0.1261
Epoch 79/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0296 - mean_absolute_error: 0.1283 - val_loss: 0.0377 - val_mean_ab
solute_error: 0.1475
Epoch 80/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0295 - mean_absolute_error: 0.1273 - val_loss: 0.0311 - val_mean_ab
solute_error: 0.1339
Epoch 81/512
5523/5523 [==============================] - 1s 117us/step - loss: 0
.0297 - mean_absolute_error: 0.1285 - val_loss: 0.0307 - val_mean_ab
solute_error: 0.1332
Epoch 82/512
```

```
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0295 - mean_absolute_error: 0.1282 - val_loss: 0.0321 - val_mean_ab
solute_error: 0.1358
Epoch 83/512
5523/5523 [==============================] - 1s 126us/step - loss: 0
.0291 - mean_absolute_error: 0.1270 - val_loss: 0.0273 - val_mean_ab
solute_error: 0.1214
Epoch 84/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0292 - mean_absolute_error: 0.1271 - val_loss: 0.0345 - val_mean_ab
solute_error: 0.1408
Epoch 85/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0296 - mean_absolute_error: 0.1281 - val_loss: 0.0428 - val_mean_ab
solute_error: 0.1530
Epoch 86/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0295 - mean_absolute_error: 0.1280 - val_loss: 0.0330 - val_mean_ab
solute_error: 0.1363
Epoch 87/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0294 - mean_absolute_error: 0.1276 - val_loss: 0.0278 - val_mean_ab
solute_error: 0.1224
Epoch 88/512
5523/5523 [==============================] - 1s 133us/step - loss: 0
.0292 - mean_absolute_error: 0.1274 - val_loss: 0.0274 - val_mean_ab
solute_error: 0.1195
Epoch 89/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0289 - mean_absolute_error: 0.1265 - val_loss: 0.0272 - val_mean_ab
solute_error: 0.1200
Epoch 90/512
5523/5523 [==============================] - 1s 125us/step - loss: 0
.0291 - mean_absolute_error: 0.1268 - val_loss: 0.0280 - val_mean_ab
solute_error: 0.1236
Epoch 91/512
5523/5523 [==============================] - 1s 129us/step - loss: 0
.0292 - mean_absolute_error: 0.1270 - val_loss: 0.0281 - val_mean_ab
solute_error: 0.1238
Epoch 92/512
5523/5523 [==============================] - 1s 143us/step - loss: 0
.0291 - mean_absolute_error: 0.1277 - val_loss: 0.0344 - val_mean_ab
solute_error: 0.1409
Epoch 93/512
5523/5523 [==============================] - 1s 123us/step - loss: 0
.0291 - mean_absolute_error: 0.1269 - val_loss: 0.0361 - val_mean_ab
solute_error: 0.1444
Epoch 94/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0293 - mean_absolute_error: 0.1278 - val_loss: 0.0425 - val_mean_ab
solute_error: 0.1552
Epoch 95/512
5523/5523 [==============================] - 1s 133us/step - loss: 0
```

```
.0288 - mean_absolute_error: 0.1259 - val_loss: 0.0332 - val_mean_ab
solute_error: 0.1388
Epoch 96/512
5523/5523 [==============================] - 1s 138us/step - loss: 0
.0291 - mean_absolute_error: 0.1271 - val_loss: 0.0341 - val_mean_ab
solute_error: 0.1401
Epoch 97/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0290 - mean_absolute_error: 0.1263 - val_loss: 0.0283 - val_mean_ab
solute_error: 0.1242
Epoch 98/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0292 - mean_absolute_error: 0.1275 - val_loss: 0.0310 - val_mean_ab
solute_error: 0.1310
Epoch 99/512
5523/5523 [==============================] - 1s 174us/step - loss: 0
.0293 - mean_absolute_error: 0.1273 - val_loss: 0.0339 - val_mean_ab
solute_error: 0.1407
Epoch 100/512
5523/5523 [==============================] - 1s 121us/step - loss: 0
.0287 - mean_absolute_error: 0.1263 - val_loss: 0.0286 - val_mean_ab
solute_error: 0.1263
Epoch 101/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0292 - mean_absolute_error: 0.1273 - val_loss: 0.0309 - val_mean_ab
solute_error: 0.1330
Epoch 102/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0288 - mean_absolute_error: 0.1260 - val_loss: 0.0333 - val_mean_ab
solute_error: 0.1376
Epoch 103/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0288 - mean_absolute_error: 0.1265 - val_loss: 0.0347 - val_mean_ab
solute_error: 0.1406
Epoch 104/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0289 - mean_absolute_error: 0.1264 - val_loss: 0.0320 - val_mean_ab
solute_error: 0.1347
Epoch 105/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0289 - mean_absolute_error: 0.1264 - val_loss: 0.0352 - val_mean_ab
solute_error: 0.1413
Epoch 106/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0288 - mean_absolute_error: 0.1265 - val_loss: 0.0281 - val_mean_ab
solute_error: 0.1222
Epoch 107/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0287 - mean_absolute_error: 0.1262 - val_loss: 0.0351 - val_mean_ab
solute_error: 0.1422
Epoch 108/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0288 - mean_absolute_error: 0.1258 - val_loss: 0.0340 - val_mean_ab
```

```
solute_error: 0.1393
Epoch 109/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0284 - mean_absolute_error: 0.1250 - val_loss: 0.0333 - val_mean_ab
solute_error: 0.1367
Epoch 110/512
5523/5523 [==============================] - 1s 110us/step - loss: 0
.0286 - mean_absolute_error: 0.1263 - val_loss: 0.0288 - val_mean_ab
solute_error: 0.1267
Epoch 111/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0285 - mean_absolute_error: 0.1251 - val_loss: 0.0377 - val_mean_ab
solute_error: 0.1457
Epoch 112/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0283 - mean_absolute_error: 0.1250 - val_loss: 0.0275 - val_mean_ab
solute_error: 0.1220
Epoch 113/512
5523/5523 [==============================] - 1s 138us/step - loss: 0
.0287 - mean_absolute_error: 0.1251 - val_loss: 0.0352 - val_mean_ab
solute_error: 0.1418
Epoch 114/512
5523/5523 [==============================] - 1s 134us/step - loss: 0
.0282 - mean_absolute_error: 0.1247 - val_loss: 0.0291 - val_mean_ab
solute_error: 0.1269
Epoch 115/512
5523/5523 [==============================] - 1s 144us/step - loss: 0
.0281 - mean_absolute_error: 0.1249 - val_loss: 0.0276 - val_mean_ab
solute_error: 0.1221
Epoch 116/512
5523/5523 [==============================] - 1s 149us/step - loss: 0
.0281 - mean_absolute_error: 0.1239 - val_loss: 0.0289 - val_mean_ab
solute_error: 0.1278
Epoch 117/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0287 - mean_absolute_error: 0.1251 - val_loss: 0.0283 - val_mean_ab
solute_error: 0.1238
Epoch 118/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0282 - mean_absolute_error: 0.1248 - val_loss: 0.0290 - val_mean_ab
solute_error: 0.1280
Epoch 119/512
5523/5523 [==============================] - 1s 111us/step - loss: 0
.0281 - mean_absolute_error: 0.1243 - val_loss: 0.0406 - val_mean_ab
solute_error: 0.1484
Epoch 120/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0282 - mean_absolute_error: 0.1242 - val_loss: 0.0382 - val_mean_ab
solute_error: 0.1485
Epoch 121/512
5523/5523 [==============================] - 1s 113us/step - loss: 0
.0283 - mean_absolute_error: 0.1249 - val_loss: 0.0285 - val_mean_ab
solute_error: 0.1219
```

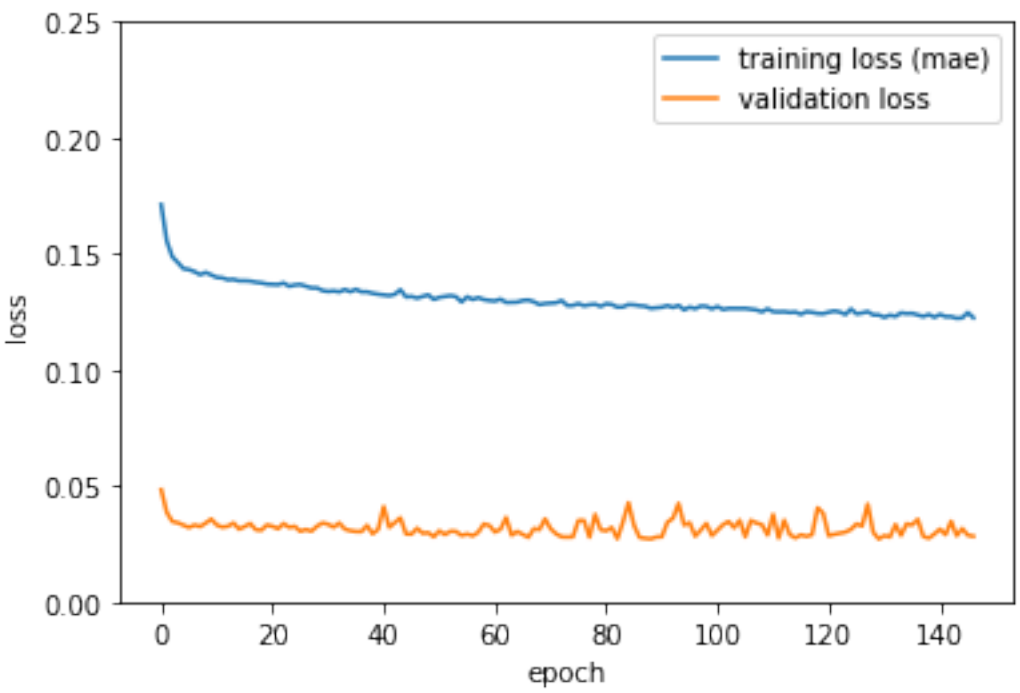
```
Epoch 122/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0285 - mean_absolute_error: 0.1254 - val_loss: 0.0292 - val_mean_ab
solute_error: 0.1267
Epoch 123/512
5523/5523 [==============================] - 1s 119us/step - loss: 0
.0283 - mean_absolute_error: 0.1249 - val_loss: 0.0297 - val_mean_ab
solute_error: 0.1295
Epoch 124/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0283 - mean_absolute_error: 0.1239 - val_loss: 0.0301 - val_mean_ab
solute_error: 0.1319
Epoch 125/512
5523/5523 [==============================] - 1s 114us/step - loss: 0
.0288 - mean_absolute_error: 0.1262 - val_loss: 0.0313 - val_mean_ab
solute_error: 0.1348
Epoch 126/512
5523/5523 [==============================] - 1s 126us/step - loss: 0
.0281 - mean_absolute_error: 0.1241 - val_loss: 0.0336 - val_mean_ab
solute_error: 0.1372
Epoch 127/512
5523/5523 [==============================] - 1s 120us/step - loss: 0
.0281 - mean_absolute_error: 0.1245 - val_loss: 0.0328 - val_mean_ab
solute_error: 0.1354
Epoch 128/512
5523/5523 [==============================] - 1s 118us/step - loss: 0
.0281 - mean_absolute_error: 0.1251 - val_loss: 0.0422 - val_mean_ab
solute_error: 0.1511
Epoch 129/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0280 - mean_absolute_error: 0.1237 - val_loss: 0.0301 - val_mean_ab
solute_error: 0.1282
Epoch 130/512
5523/5523 [==============================] - 1s 128us/step - loss: 0
.0278 - mean_absolute_error: 0.1237 - val_loss: 0.0272 - val_mean_ab
solute_error: 0.1187
Epoch 131/512
5523/5523 [==============================] - 1s 133us/step - loss: 0
.0274 - mean_absolute_error: 0.1226 - val_loss: 0.0286 - val_mean_ab
solute_error: 0.1259
Epoch 132/512
5523/5523 [==============================] - 1s 140us/step - loss: 0
.0278 - mean_absolute_error: 0.1236 - val_loss: 0.0280 - val_mean_ab
solute_error: 0.1228
Epoch 133/512
5523/5523 [==============================] - 1s 131us/step - loss: 0
.0278 - mean_absolute_error: 0.1230 - val_loss: 0.0334 - val_mean_ab
solute_error: 0.1381
Epoch 134/512
5523/5523 [==============================] - 1s 128us/step - loss: 0
.0283 - mean_absolute_error: 0.1246 - val_loss: 0.0287 - val_mean_ab
solute_error: 0.1244
Epoch 135/512
```

```
5523/5523 [==============================] - 1s 128us/step - loss: 0
.0281 - mean_absolute_error: 0.1242 - val_loss: 0.0337 - val_mean_ab
solute_error: 0.1378
Epoch 136/512
5523/5523 [==============================] - 1s 130us/step - loss: 0
.0281 - mean_absolute_error: 0.1244 - val_loss: 0.0332 - val_mean_ab
solute_error: 0.1364
Epoch 137/512
5523/5523 [==============================] - 1s 129us/step - loss: 0
.0279 - mean_absolute_error: 0.1236 - val_loss: 0.0356 - val_mean_ab
solute_error: 0.1414
Epoch 138/512
5523/5523 [==============================] - 1s 143us/step - loss: 0
.0276 - mean_absolute_error: 0.1230 - val_loss: 0.0282 - val_mean_ab
solute_error: 0.1205
Epoch 139/512
5523/5523 [==============================] - 1s 128us/step - loss: 0
.0278 - mean_absolute_error: 0.1239 - val_loss: 0.0275 - val_mean_ab
solute_error: 0.1162
Epoch 140/512
5523/5523 [==============================] - 1s 128us/step - loss: 0
.0277 - mean_absolute_error: 0.1227 - val_loss: 0.0293 - val_mean_ab
solute_error: 0.1279
Epoch 141/512
5523/5523 [==============================] - 1s 131us/step - loss: 0
.0280 - mean_absolute_error: 0.1239 - val_loss: 0.0314 - val_mean_ab
solute_error: 0.1330
Epoch 142/512
5523/5523 [==============================] - 1s 127us/step - loss: 0
.0278 - mean_absolute_error: 0.1229 - val_loss: 0.0290 - val_mean_ab
solute_error: 0.1242
Epoch 143/512
5523/5523 [==============================] - 1s 140us/step - loss: 0
.0277 - mean_absolute_error: 0.1229 - val_loss: 0.0348 - val_mean_ab
solute_error: 0.1393
Epoch 144/512
5523/5523 [==============================] - 1s 137us/step - loss: 0
.0273 - mean_absolute_error: 0.1222 - val_loss: 0.0285 - val_mean_ab
solute_error: 0.1247
Epoch 145/512
5523/5523 [==============================] - 1s 108us/step - loss: 0
.0276 - mean_absolute_error: 0.1224 - val_loss: 0.0317 - val_mean_ab
solute_error: 0.1332
Epoch 146/512
5523/5523 [==============================] - 1s 106us/step - loss: 0
.0280 - mean_absolute_error: 0.1247 - val_loss: 0.0288 - val_mean_ab
solute_error: 0.1254
Epoch 147/512
5523/5523 [==============================] - 1s 109us/step - loss: 0
.0275 - mean_absolute_error: 0.1225 - val_loss: 0.0283 - val_mean_ab
solute_error: 0.1220
Finished training; model reloaded with optimum weights.
```

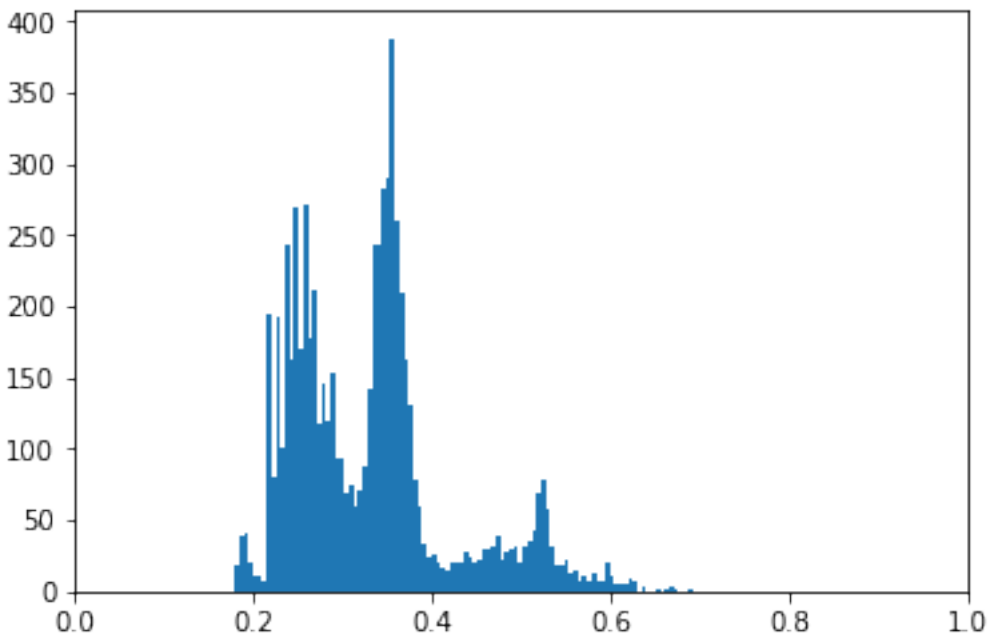
In [23]:

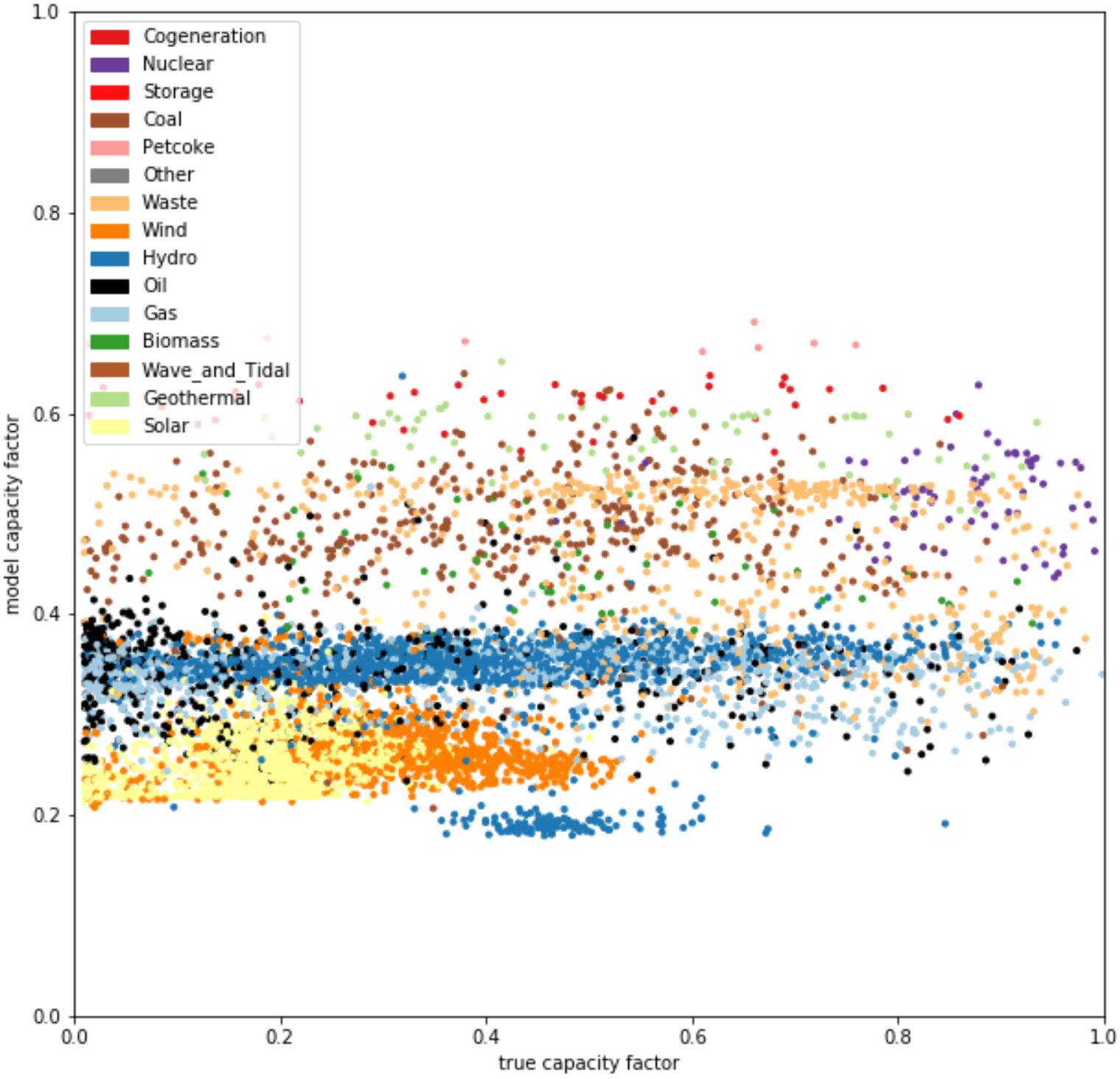
```
# examine model fit results

plot_loss(history_object3)
predicted_values3 = prediction_histogram(model3)
plot_predicted(predicted_values3)
r2_score = metrics.r2_score(y_data,predicted_values3)
print(u"R2 score: {0}".format(r2_score))
```




```
Predicted values in range: 6904
Predicted max: 0.690942883492, min: 0.179257959127
```





R2 score: 0.153435372515