TFM_Narices

September 12, 2020

1 Borrador TFM

[1]:
```
import os
import re
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

import tensorflow as tf
from tensorflow import keras
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import RandomForestRegressor
from sklearn.preprocessing import StandardScaler
from sklearn import metrics
```

```
/usr/local/lib/python3.6/dist-packages/statsmodels/tools/_testing.py:19:
FutureWarning: pandas.util.testing is deprecated. Use the functions in the
public API at pandas.testing instead.
  import pandas.util.testing as tm
```

Clase para cargar los .dat en un dataframe

[0]:
```
class LoadDatFile():
  """
  This class aims to load the .dat files form UCI, and resturs a
  pandas.dataframe object

  :inputs: folder where
  """
  def __init__(self, folder):
      self.path = folder

  @property
  def df(self):
    ls_files = os.listdir(self.path)
    df = pd.DataFrame()
```

```
    for f in ls_files:
      path_file = os.path.join(folder, f)
      dftemp = self.proc_datfile(path_file)
      df = df.append(dftemp)
    return df

  def proc_datfile(self, path_file):
    df = pd.read_table(path_file, engine='python', sep ='\s+\d+:', header=None)
    df['Batch ID'] = self.find_batch(path_file)
    return df

  @staticmethod
  def find_batch(path_file):
    base = os.path.basename(path_file)
    name, ext = os.path.splitext(base)
    num = re.findall(r'\d+', name)[0]
    #num = num.zfill(2)
    return int(num)
```

Clase para dar formato al dataframe

[0]:
```
class GasDataFrame():

  def __init__(self, df):
    self.df = df.copy()
    df_gas = self.add_gas_info(self.df)
    self.df_gas = df_gas

  @staticmethod
  def add_gas_info(df):
    df[['GAS', 'CONCENTRATION']] = df.iloc[:,0].str.split(";",expand=True,)
    df.drop(df.columns[0], axis=1, inplace=True)
    df['GAS'] = df['GAS'].astype('int')
    df['CONCENTRATION'] = df['CONCENTRATION'].astype('float')
    return df
```

[0]:
```
class DataFrameUtils:
  def __init__(self, df):
    self.df = df.copy()

  def get_crosstab(self):
    df = self.df
    return pd.crosstab(df['Batch ID'], df['GAS']).sort_index()

  def print_crosstab(self):
    tab = self.get_crosstab()
    print(tab.to_markdown())
```

[57]:
```
folder = './drive/My Drive/data_uci/'
df = LoadDatFile(folder).df
df_gas = GasDataFrame(df).df_gas
df_gas
```

[57]:

	1	2	3	…	Batch ID	GAS	CONCENTRATION
0	15596.1621	1.868245	2.371604	…	1	1	10.0
1	26402.0704	2.532401	5.411209	…	1	1	20.0
2	42103.5820	3.454189	8.198175	…	1	1	30.0
3	42825.9883	3.451192	12.113940	…	1	1	40.0
4	58151.1757	4.194839	11.455096	…	1	1	50.0
..	…	…	…	… …	… …		…
465	13384.8262	2.820931	4.007378	…	9	6	10.0
466	13382.9619	2.825174	4.010915	…	9	6	10.0
467	13336.8725	2.822288	3.980818	…	9	6	10.0
468	13351.1318	2.824358	3.987819	…	9	6	10.0
469	13314.9336	2.816502	3.982182	…	9	6	10.0

[13910 rows x 131 columns]

[7]:
```
df_gas[['Batch ID', 'GAS', 'CONCENTRATION']].dtypes
```

[7]:
```
Batch ID           int64
GAS                int64
CONCENTRATION    float64
dtype: object
```

2 Calculamos cuantas muestras de cada gas tenemos por Batch

[8]:
```
pd.crosstab(df_gas['Batch ID'], df_gas['GAS'])
```

[8]:

GAS	1	2	3	4	5	6
Batch ID						
1	90	98	83	30	70	74
2	164	334	100	109	532	5
3	365	490	216	240	275	0
4	64	43	12	30	12	0
5	28	40	20	46	63	0
6	514	574	110	29	606	467
7	649	662	360	744	630	568
8	30	30	40	33	143	18
9	61	55	100	75	78	101
10	600	600	600	600	600	600

3 Rango de concentración

[9]:
```
pivot = pd.pivot_table(df_gas, index =['GAS'], values='CONCENTRATION',␣
↪aggfunc=['min', 'max', 'mean', 'std'])
pivot.round(2)
```

[9]:

	min	max	mean	std
	CONCENTRATION	CONCENTRATION	CONCENTRATION	CONCENTRATION
GAS				
1	2.5	600.0	114.95	86.64
2	2.5	300.0	116.10	79.89
3	2.5	1000.0	323.55	272.02
4	2.5	300.0	126.32	76.71
5	10.0	1000.0	228.57	217.38
6	1.0	230.0	47.66	32.58

Estos valores minimo-maximo para cada gas no corresponden a los especificados en UCI.

> *Ammonia, Acetaldehyde, Acetone, Ethylene, Ethanol, and Toluene, dosed at a wide variety of concentration levels in the intervals (50,1000), (5,500), (12,1000), (10,300), (10,600), and (10,100) ppmv, respectively.*

[0]:
```
dict_conc_interv = {
    'Amonia':      '(50,1000)',
    'Acetaldehyde':'(5,500)',
    'Acetone':     '(12,1000)',
    'Ethylene':    '(10,300)',
    'Ethanol':     '(10,600)',
    'Toluene':     '(10,100)'}
```

3.1 Summarize both tables

[11]:
```
df_interv = df_gas.copy()
df_interv['range'] = df_gas.groupby('GAS')[['CONCENTRATION']].transform(lambda␣
↪x: str(min(x)) +'-'+ str(max(x)) ).astype(str)
pd.crosstab(index = df_interv['Batch ID'],
            columns = [df_interv['GAS'], df_interv['range']],
            margins=True)
```

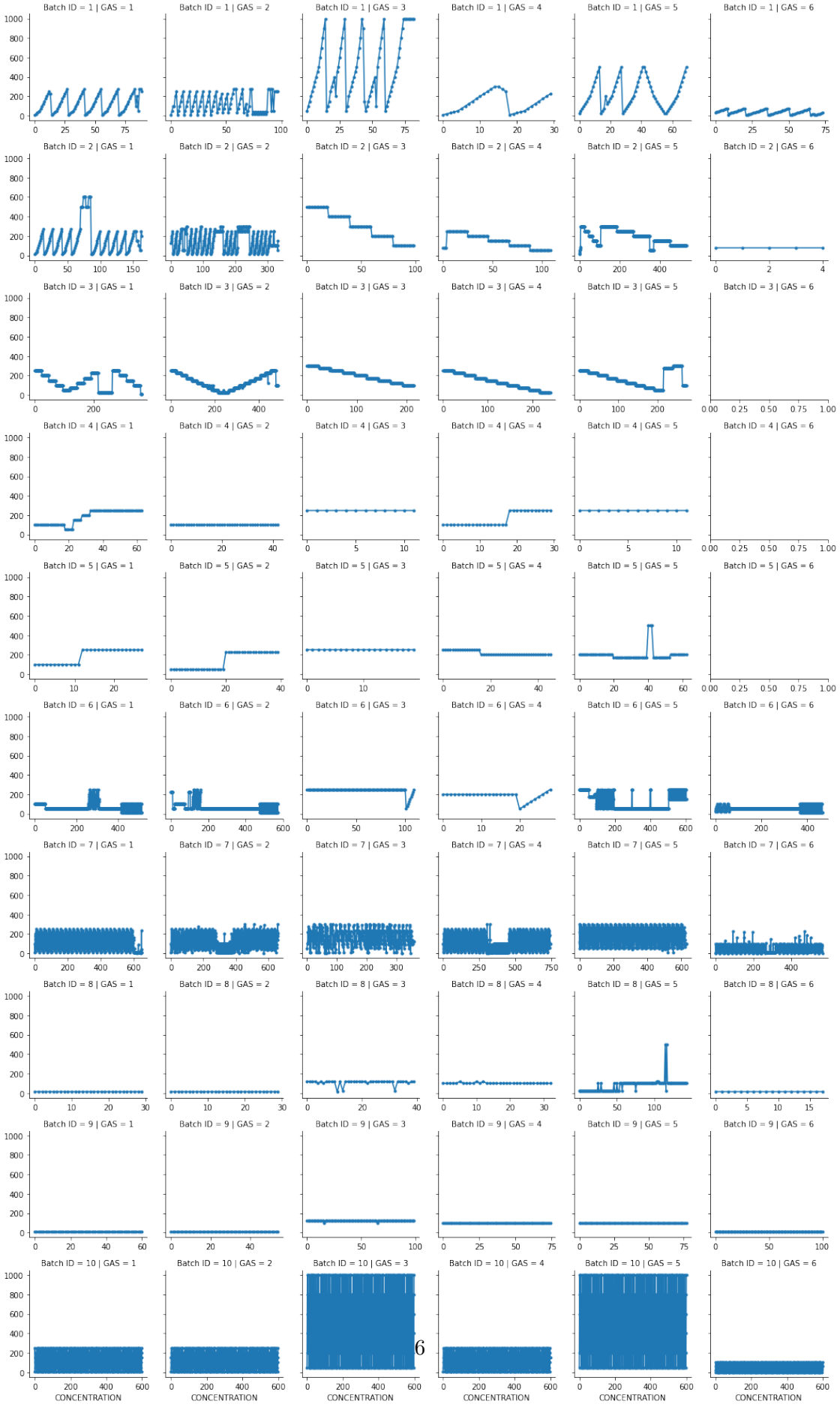
[11]:

GAS	1	2	3	4	5	6	All
range	2.5-600.0	2.5-300.0	2.5-1000.0	2.5-300.0	10.0-1000.0	1.0-230.0	
Batch ID							
1	90	98	83	30	70	74	445
2	164	334	100	109	532	5	1244
3	365	490	216	240	275	0	1586
4	64	43	12	30	12	0	161
5	28	40	20	46	63	0	197

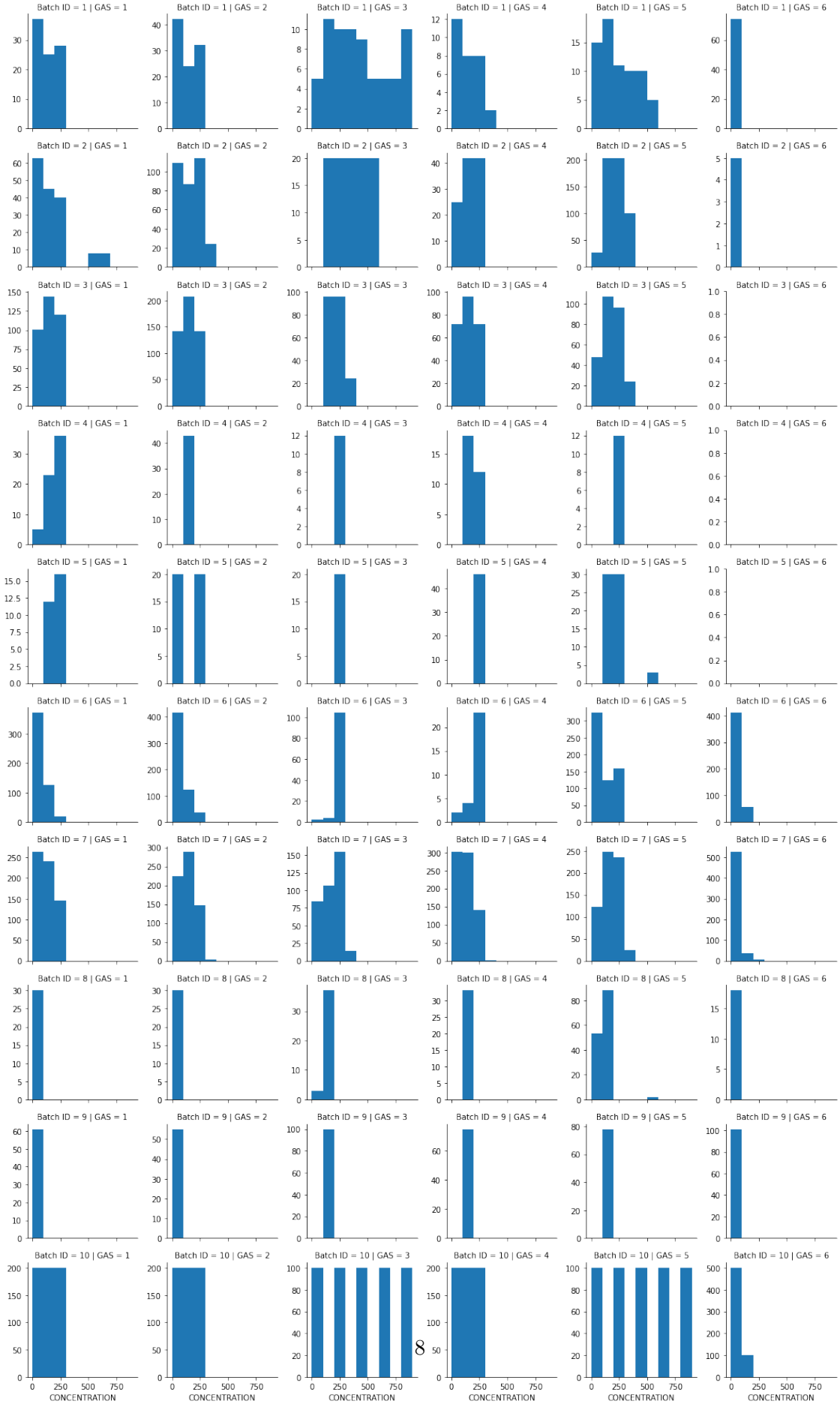
6	514	574	110	29	606	467	2300
7	649	662	360	744	630	568	3613
8	30	30	40	33	143	18	294
9	61	55	100	75	78	101	470
10	600	600	600	600	600	600	3600
All	2565	2926	1641	1936	3009	1833	13910

##Plot

[12]:
```
g = sns.FacetGrid(df_gas, col='GAS', row='Batch ID', sharex=False, height=2.5)
g = g.map(plt.plot, "CONCENTRATION", marker='.')
```


Batch ID = 1 | GAS = 1
Batch ID = 1 | GAS = 2
Batch ID = 1 | GAS = 3
Batch ID = 1 | GAS = 4
Batch ID = 1 | GAS = 5
Batch ID = 1 | GAS = 6
Batch ID = 2 | GAS = 1
Batch ID = 2 | GAS = 2
Batch ID = 2 | GAS = 3
Batch ID = 2 | GAS = 4
Batch ID = 2 | GAS = 5
Batch ID = 2 | GAS = 6
Batch ID = 3 | GAS = 1
Batch ID = 3 | GAS = 2
Batch ID = 3 | GAS = 3
Batch ID = 3 | GAS = 4
Batch ID = 3 | GAS = 5
Batch ID = 3 | GAS = 6
Batch ID = 4 | GAS = 1
Batch ID = 4 | GAS = 2
Batch ID = 4 | GAS = 3
Batch ID = 4 | GAS = 4
Batch ID = 4 | GAS = 5
Batch ID = 4 | GAS = 6
Batch ID = 5 | GAS = 1
Batch ID = 5 | GAS = 2
Batch ID = 5 | GAS = 3
Batch ID = 5 | GAS = 4
Batch ID = 5 | GAS = 5
Batch ID = 5 | GAS = 6
Batch ID = 6 | GAS = 1
Batch ID = 6 | GAS = 2
Batch ID = 6 | GAS = 3
Batch ID = 6 | GAS = 4
Batch ID = 6 | GAS = 5
Batch ID = 6 | GAS = 6
Batch ID = 7 | GAS = 1
Batch ID = 7 | GAS = 2
Batch ID = 7 | GAS = 3
Batch ID = 7 | GAS = 4
Batch ID = 7 | GAS = 5
Batch ID = 7 | GAS = 6
Batch ID = 8 | GAS = 1
Batch ID = 8 | GAS = 2
Batch ID = 8 | GAS = 3
Batch ID = 8 | GAS = 4
Batch ID = 8 | GAS = 5
Batch ID = 8 | GAS = 6
Batch ID = 9 | GAS = 1
Batch ID = 9 | GAS = 2
Batch ID = 9 | GAS = 3
Batch ID = 9 | GAS = 4
Batch ID = 9 | GAS = 5
Batch ID = 9 | GAS = 6
Batch ID = 10 | GAS = 1
Batch ID = 10 | GAS = 2
Batch ID = 10 | GAS = 3
Batch ID = 10 | GAS = 4
Batch ID = 10 | GAS = 5
Batch ID = 10 | GAS = 6
CONCENTRATION
CONCENTRATION
CONCENTRATION
CONCENTRATION
CONCENTRATION
CONCENTRATION

[13]:
```
g = sns.FacetGrid(df_gas, col='GAS', row='Batch ID',
                  sharey=False, height=2.5)
g = g.map(plt.hist, "CONCENTRATION", bins=range(0,1000,100))
```


Batch ID = 1 | GAS = 1
Batch ID = 1 | GAS = 2
Batch ID = 1 | GAS = 3
Batch ID = 1 | GAS = 4
Batch ID = 1 | GAS = 5
Batch ID = 1 | GAS = 6
Batch ID = 2 | GAS = 1
Batch ID = 2 | GAS = 2
Batch ID = 2 | GAS = 3
Batch ID = 2 | GAS = 4
Batch ID = 2 | GAS = 5
Batch ID = 2 | GAS = 6
Batch ID = 3 | GAS = 1
Batch ID = 3 | GAS = 2
Batch ID = 3 | GAS = 3
Batch ID = 3 | GAS = 4
Batch ID = 3 | GAS = 5
Batch ID = 3 | GAS = 6
Batch ID = 4 | GAS = 1
Batch ID = 4 | GAS = 2
Batch ID = 4 | GAS = 3
Batch ID = 4 | GAS = 4
Batch ID = 4 | GAS = 5
Batch ID = 4 | GAS = 6
Batch ID = 5 | GAS = 1
Batch ID = 5 | GAS = 2
Batch ID = 5 | GAS = 3
Batch ID = 5 | GAS = 4
Batch ID = 5 | GAS = 5
Batch ID = 5 | GAS = 6
Batch ID = 6 | GAS = 1
Batch ID = 6 | GAS = 2
Batch ID = 6 | GAS = 3
Batch ID = 6 | GAS = 4
Batch ID = 6 | GAS = 5
Batch ID = 6 | GAS = 6
Batch ID = 7 | GAS = 1
Batch ID = 7 | GAS = 2
Batch ID = 7 | GAS = 3
Batch ID = 7 | GAS = 4
Batch ID = 7 | GAS = 5
Batch ID = 7 | GAS = 6
Batch ID = 8 | GAS = 1
Batch ID = 8 | GAS = 2
Batch ID = 8 | GAS = 3
Batch ID = 8 | GAS = 4
Batch ID = 8 | GAS = 5
Batch ID = 8 | GAS = 6
Batch ID = 9 | GAS = 1
Batch ID = 9 | GAS = 2
Batch ID = 9 | GAS = 3
Batch ID = 9 | GAS = 4
Batch ID = 9 | GAS = 5
Batch ID = 9 | GAS = 6
Batch ID = 10 | GAS = 1
Batch ID = 10 | GAS = 2
Batch ID = 10 | GAS = 3
Batch ID = 10 | GAS = 4
Batch ID = 10 | GAS = 5
Batch ID = 10 | GAS = 6
CONCENTRATION
CONCENTRATION
CONCENTRATION
CONCENTRATION
CONCENTRATION
CONCENTRATION

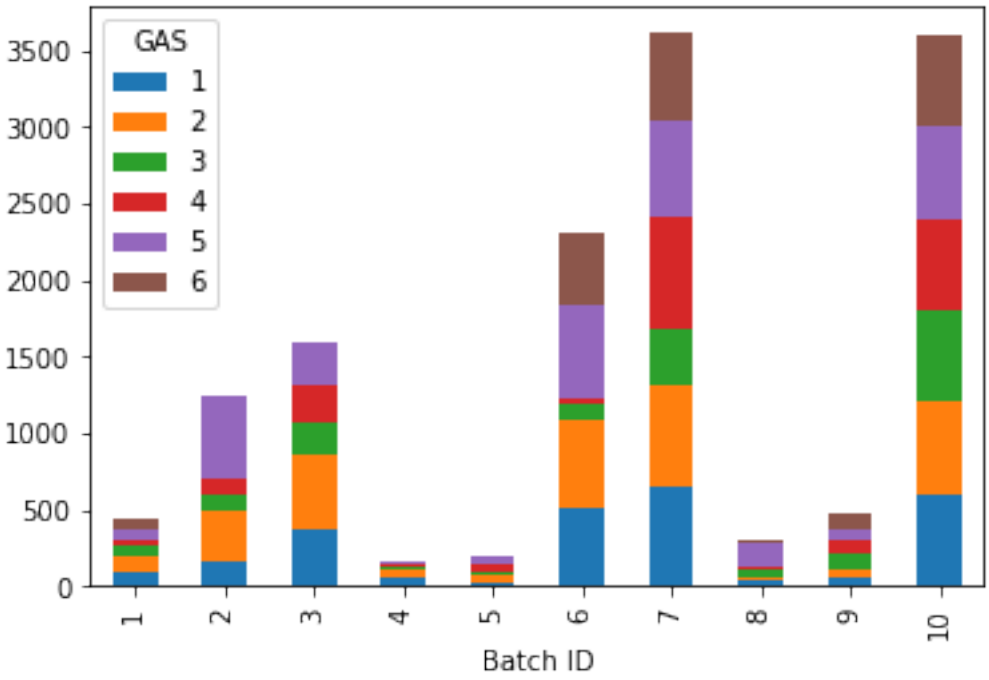
4 Distribucion de gases en cada batch

4.1 Conteo

Los datos no estan balanceados en cada Batch

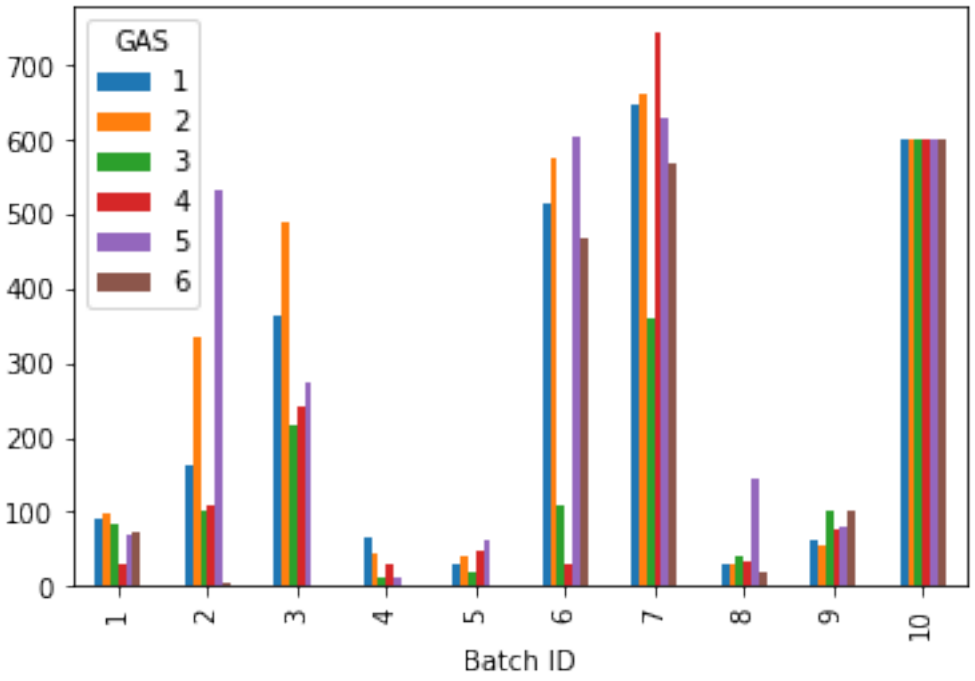
[58]:
```
props = df_gas.groupby("Batch ID")['GAS'].value_counts(normalize=False).
↪unstack()
props.plot(kind='bar', stacked='True')
```

[58]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f03ea4fa128>
```



[59]:
```
props.plot(kind='bar')
```

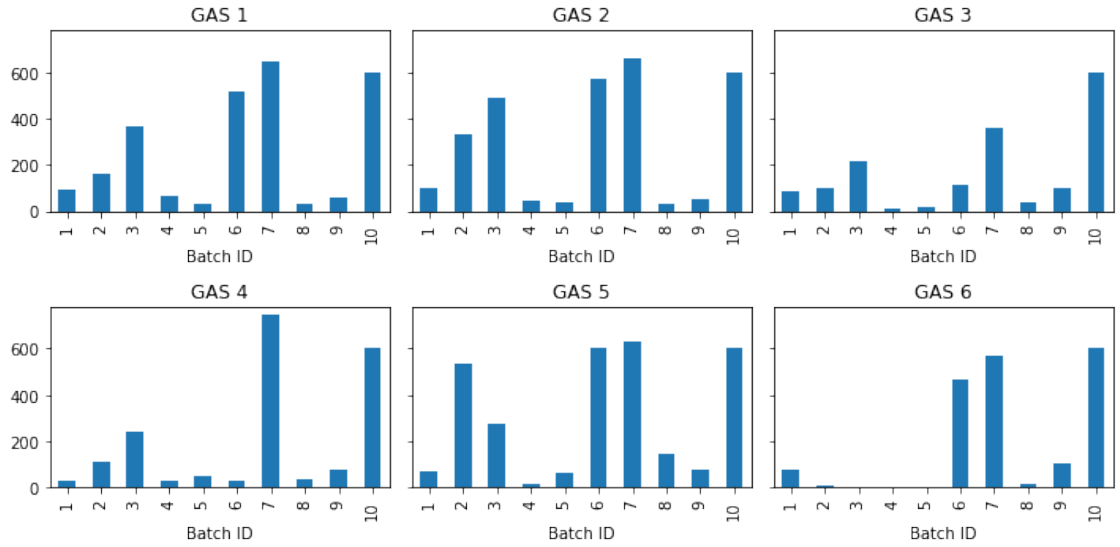
[59]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f04045df828>
```



Podriamos elegir para entrenar los Batch01, 07, 09 y 10, ya que estan en proporcion equilibrados.

Si realizamos un conteo vemos que el Batch 01 y 09 tienen una cantidad de muestras muy inferior a los Batch 07 y 10.

[16]:
```
n = len(props.columns)
fig, axes = plt.subplots(2, n//2 , figsize=(10,5), sharey=True)
axes = axes.flatten()
for i, ax in zip(props.columns, axes):
  plt.figure()
  props[i].plot(kind='bar', ax=ax);
  ax.title.set_text('GAS ' + str(i))
fig.tight_layout()
```




```
<Figure size 432x288 with 0 Axes>
```

```
<Figure size 432x288 with 0 Axes>
```

```
<Figure size 432x288 with 0 Axes>
```

```
<Figure size 432x288 with 0 Axes>
```

```
<Figure size 432x288 with 0 Axes>
```

```
<Figure size 432x288 with 0 Axes>
```

4.2 Proporción

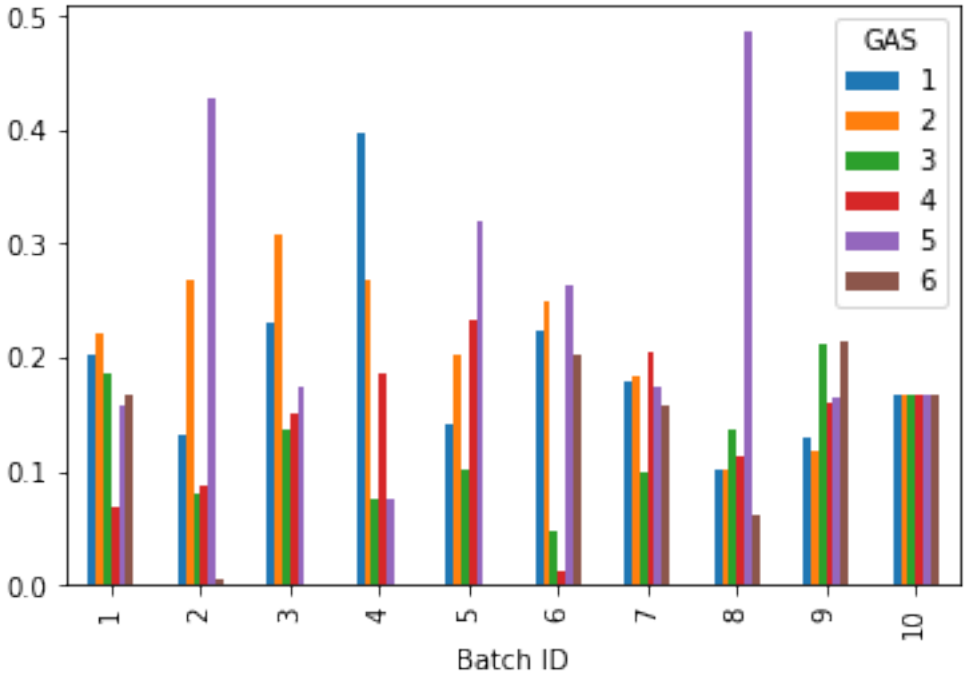
En proporción, el muestreo por gas esta equilibrado, exceptuando

- gas6 que no aparece en los Batch 3,4,y 5
- gas4 infrarepresentado en Batch6

[17]:
```
props = df_gas.groupby("Batch ID")['GAS'].value_counts(normalize=True).unstack()
props.plot(kind='bar')
props
```

[17]:
```
GAS              1         2         3         4         5         6
Batch ID
1         0.202247  0.220225  0.186517  0.067416  0.157303  0.166292
```

2	0.131833	0.268489	0.080386	0.087621	0.427653	0.004019
3	0.230139	0.308953	0.136192	0.151324	0.173392	NaN
4	0.397516	0.267081	0.074534	0.186335	0.074534	NaN
5	0.142132	0.203046	0.101523	0.233503	0.319797	NaN
6	0.223478	0.249565	0.047826	0.012609	0.263478	0.203043
7	0.179629	0.183227	0.099640	0.205923	0.174370	0.157210
8	0.102041	0.102041	0.136054	0.112245	0.486395	0.061224
9	0.129787	0.117021	0.212766	0.159574	0.165957	0.214894
10	0.166667	0.166667	0.166667	0.166667	0.166667	0.166667



5 Comparacion con tablas y datos descritos en UCI

UCI especifica que:

1: Ethanol; 2: Ethylene; 3: Ammonia; 4: Acetaldehyde; 5: Acetone; 6: Toluene

[0]:
```
def apply_gas_dict(df):
    """
    UCI s ays 1: Ethanol; 2: Ethylene; 3: Ammonia; 4: Acetaldehyde; 5: Acetone;␣
 ↪6: Toluene
    """
    df = df.copy()
    dict_gas = {'1': 'Ethanol_UCI',
                '2': 'Ethylene_UCI',
```

```
                '3': 'Ammonia_UCI',
                '4': 'Acetaldehyde_UCI',
                '5': 'Acetone_UCI',
                '6': 'Toluene_UCI'}

    dict_corregido = {'1': 'Acetone',
                      '2': 'Acetaldehyde',
                      '3': 'Ethanol',
                      '4': 'Ethylene',
                      '5': 'Ammonia',
                      '6': 'Toluene'}
    df['GAS_NAME'] = df.GAS.astype(str).replace(dict_corregido)
    return df
```

[19]:
```
def load_uci_table():
  df = pd.DataFrame(columns = ['Batch ID',
                               'Ethanol_UCI',
                               'Ethylene_UCI',
                               'Ammonia_UCI',
                               'Acetaldehyde_UCI',
                               'Acetone_UCI',
                               'Toluene_UCI',
                               ])

  df.loc[len(df)] = ['Batch 01', 83 , 30,  70,  98,  90,   74]
  df.loc[len(df)] = ['Batch 02', 100, 109, 532, 334, 164,   5]
  df.loc[len(df)] = ['Batch 03', 216, 240, 275, 490, 365,   0]
  df.loc[len(df)] = ['Batch 04', 12 , 30,  12,  43,  64,    0]
  df.loc[len(df)] = ['Batch 05', 20 , 46,  63,  40,  28,    0]
  df.loc[len(df)] = ['Batch 06', 110, 29,  606, 574, 514, 467]
  df.loc[len(df)] = ['Batch 07', 360, 744, 630, 662, 649, 568]
  df.loc[len(df)] = ['Batch 08', 40,  33,  143, 30,  30,   18]
  df.loc[len(df)] = ['Batch 09', 100, 75,  78,  55,  61,  101]
  df.loc[len(df)] = ['Batch 10', 600, 600, 600, 600, 600, 600]
  df = df.set_index('Batch ID')
  df = df.sort_index(axis =1)
  return df

df_uci = load_uci_table()
df_uci
```

[19]:

Batch ID	Acetaldehyde_UCI	Acetone_UCI	…	Ethylene_UCI	Toluene_UCI
Batch 01	98	90	…	30	74
Batch 02	334	164	…	109	5
Batch 03	490	365	…	240	0
Batch 04	43	64	…	30	0

```
Batch 05              40          28  …          46           0
Batch 06             574         514  …          29         467
Batch 07             662         649  …         744         568
Batch 08              30          30  …          33          18
Batch 09              55          61  …          75         101
Batch 10             600         600  …         600         600

[10 rows x 6 columns]
```

[20]:
```
pd.crosstab(df_gas['Batch ID'], df_gas['GAS'])
```

[20]:
```
GAS         1    2    3    4    5    6
Batch ID
1          90   98   83   30   70   74
2         164  334  100  109  532    5
3         365  490  216  240  275    0
4          64   43   12   30   12    0
5          28   40   20   46   63    0
6         514  574  110   29  606  467
7         649  662  360  744  630  568
8          30   30   40   33  143   18
9          61   55  100   75   78  101
10        600  600  600  600  600  600
```

6 Series clasification

Probamos primero una red muy muy simple, que identifique qué gas es.

[0]:
```
df_gas = GasDataFrame(df).df_gas
gas_X = df_gas.drop(columns = ['Batch ID', 'GAS']).to_numpy()
gas_y = df_gas['GAS'].to_numpy()
```

gas_X debe tener 128 columnas por cada feature + columna de concentración

[22]:
```
gas_X.shape
```

[22]:
```
(13910, 129)
```

[23]:
```
gas_y.shape
```

[23]:
```
(13910,)
```

[0]:
```
X_train, X_test, y_train, y_test = train_test_split( gas_X, gas_y, test_size=0.
↪33, random_state=42)
```

[0]:
```
# TensorFlow and tf.keras
def gen_model_seq():
```

```
  model = keras.Sequential([
      keras.layers.Flatten(input_shape=(129,1)),
      keras.layers.Dense(64, activation='relu'),
      keras.layers.Dense(10)
  ])
  return model
```

[26]:
```
model = gen_model_seq()
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
flatten (Flatten)            (None, 129)               0
_________________________________________________________________
dense (Dense)                (None, 64)                8320
_________________________________________________________________
dense_1 (Dense)              (None, 10)                650
=================================================================
Total params: 8,970
Trainable params: 8,970
Non-trainable params: 0
_________________________________________________________________
```

[0]:
```
def gen_and_complile_model():
  model = gen_model_seq()
  model.compile(optimizer='adam',
                loss=tf.keras.losses.
 ↪SparseCategoricalCrossentropy(from_logits=True),
                metrics=['accuracy'])
  return model

model = gen_and_complile_model()
```

[28]:
```
model.fit(X_train, y_train, epochs=30)
```

```
Epoch 1/30
292/292 [==============================] - 0s 1ms/step - loss: 530.7297 -
accuracy: 0.7528
Epoch 2/30
292/292 [==============================] - 0s 1ms/step - loss: 93.7540 -
accuracy: 0.8487
Epoch 3/30
292/292 [==============================] - 0s 1ms/step - loss: 78.0227 -
accuracy: 0.8792
Epoch 4/30
```

```
292/292 [==============================] - 0s 1ms/step - loss: 53.2138 -
accuracy: 0.9099
Epoch 5/30
292/292 [==============================] - 0s 1ms/step - loss: 53.8713 -
accuracy: 0.9099
Epoch 6/30
292/292 [==============================] - 0s 1ms/step - loss: 48.8201 -
accuracy: 0.9193
Epoch 7/30
292/292 [==============================] - 0s 1ms/step - loss: 50.0959 -
accuracy: 0.9206
Epoch 8/30
292/292 [==============================] - 0s 1ms/step - loss: 44.8140 -
accuracy: 0.9310
Epoch 9/30
292/292 [==============================] - 0s 1ms/step - loss: 41.6443 -
accuracy: 0.9331
Epoch 10/30
292/292 [==============================] - 0s 1ms/step - loss: 50.6090 -
accuracy: 0.9299
Epoch 11/30
292/292 [==============================] - 0s 1ms/step - loss: 33.5061 -
accuracy: 0.9402
Epoch 12/30
292/292 [==============================] - 0s 1ms/step - loss: 43.4197 -
accuracy: 0.9303
Epoch 13/30
292/292 [==============================] - 0s 1ms/step - loss: 49.8614 -
accuracy: 0.9330
Epoch 14/30
292/292 [==============================] - 0s 1ms/step - loss: 35.5175 -
accuracy: 0.9433
Epoch 15/30
292/292 [==============================] - 0s 1ms/step - loss: 54.4669 -
accuracy: 0.9388
Epoch 16/30
292/292 [==============================] - 0s 1ms/step - loss: 45.0005 -
accuracy: 0.9468
Epoch 17/30
292/292 [==============================] - 0s 1ms/step - loss: 29.1493 -
accuracy: 0.9586
Epoch 18/30
292/292 [==============================] - 0s 1ms/step - loss: 44.9257 -
accuracy: 0.9412
Epoch 19/30
292/292 [==============================] - 0s 1ms/step - loss: 29.4971 -
accuracy: 0.9547
Epoch 20/30
```

```
292/292 [==============================] - 0s 1ms/step - loss: 31.9371 -
accuracy: 0.9549
Epoch 21/30
292/292 [==============================] - 0s 1ms/step - loss: 30.8999 -
accuracy: 0.9569
Epoch 22/30
292/292 [==============================] - 0s 1ms/step - loss: 36.1312 -
accuracy: 0.9506
Epoch 23/30
292/292 [==============================] - 0s 1ms/step - loss: 28.4054 -
accuracy: 0.9546
Epoch 24/30
292/292 [==============================] - 0s 1ms/step - loss: 37.1475 -
accuracy: 0.9481
Epoch 25/30
292/292 [==============================] - 0s 1ms/step - loss: 33.9665 -
accuracy: 0.9540
Epoch 26/30
292/292 [==============================] - 0s 1ms/step - loss: 23.9793 -
accuracy: 0.9635
Epoch 27/30
292/292 [==============================] - 0s 1ms/step - loss: 25.5179 -
accuracy: 0.9624
Epoch 28/30
292/292 [==============================] - 0s 1ms/step - loss: 28.4417 -
accuracy: 0.9588
Epoch 29/30
292/292 [==============================] - 0s 1ms/step - loss: 21.0488 -
accuracy: 0.9677
Epoch 30/30
292/292 [==============================] - 0s 1ms/step - loss: 32.1179 -
accuracy: 0.9589
```

[28]:
```
<tensorflow.python.keras.callbacks.History at 0x7f040a38fb00>
```

[29]:
```
test_loss, test_acc = model.evaluate(X_test,  y_test, verbose=2)
print('\nTest accuracy:', test_acc)
```

```
144/144 - 0s - loss: 21.2053 - accuracy: 0.9750

Test accuracy: 0.9749509692192078
```

6.1 Utilizamos batch 1 a 9 para entrenar, y 10 para validar.

[0]:
```
```

[0]:
```
model.evaluate?
```

[31]:
```
X_test.shape, y_test.shape
```

[31]:
```
((4591, 129), (4591,))
```

[32]:
```
for batch in range(1,11,1):
  df_train = df_gas[df_gas['Batch ID'] != batch]
  df_test = df_gas[df_gas['Batch ID'] == batch]

  X_train = df_train.drop(columns = ['Batch ID', 'GAS']).to_numpy()
  y_train = df_train['GAS'].to_numpy()

  X_test = df_test.drop(columns = ['Batch ID', 'GAS']).to_numpy()
  y_test = df_test['GAS'].to_numpy()

  print('Train Size:', X_train.shape, y_train.shape)
  print('Test Size:', X_test.shape, y_test.shape)

  model = gen_and_complile_model()
  model.fit(X_train, y_train, epochs=10)
  test_loss, test_acc = model.evaluate(X_test,  y_test, verbose=0)
  print('\nTest accuracy:', test_acc, '/n')
```

```
Train Size: (13465, 129) (13465,)
Test Size: (445, 129) (445,)
Epoch 1/10
421/421 [==============================] - 1s 1ms/step - loss: 890.1250 -
accuracy: 0.7234
Epoch 2/10
421/421 [==============================] - 1s 1ms/step - loss: 45.8999 -
accuracy: 0.8821
Epoch 3/10
421/421 [==============================] - 1s 1ms/step - loss: 29.9606 -
accuracy: 0.9134
Epoch 4/10
421/421 [==============================] - 1s 1ms/step - loss: 23.3824 -
accuracy: 0.9291
Epoch 5/10
421/421 [==============================] - 1s 1ms/step - loss: 21.9654 -
accuracy: 0.9317
Epoch 6/10
421/421 [==============================] - 1s 1ms/step - loss: 28.5117 -
accuracy: 0.9279
Epoch 7/10
421/421 [==============================] - 1s 1ms/step - loss: 25.8699 -
accuracy: 0.9319
Epoch 8/10
421/421 [==============================] - 1s 1ms/step - loss: 23.2699 -
```

```
accuracy: 0.9451
Epoch 9/10
421/421 [==============================] - 1s 1ms/step - loss: 27.8271 -
accuracy: 0.9349
Epoch 10/10
421/421 [==============================] - 1s 1ms/step - loss: 17.7736 -
accuracy: 0.9597

Test accuracy: 0.5752809047698975 /n
Train Size: (12666, 129) (12666,)
Test Size: (1244, 129) (1244,)
Epoch 1/10
396/396 [==============================] - 1s 1ms/step - loss: 432.2158 -
accuracy: 0.7544
Epoch 2/10
396/396 [==============================] - 0s 1ms/step - loss: 66.9042 -
accuracy: 0.8838
Epoch 3/10
396/396 [==============================] - 1s 1ms/step - loss: 53.3759 -
accuracy: 0.8985
Epoch 4/10
396/396 [==============================] - 1s 1ms/step - loss: 56.6921 -
accuracy: 0.9045
Epoch 5/10
396/396 [==============================] - 1s 1ms/step - loss: 49.2480 -
accuracy: 0.9150
Epoch 6/10
396/396 [==============================] - 1s 1ms/step - loss: 51.3558 -
accuracy: 0.9229
Epoch 7/10
396/396 [==============================] - 1s 1ms/step - loss: 35.3077 -
accuracy: 0.9406
Epoch 8/10
396/396 [==============================] - 1s 1ms/step - loss: 56.2778 -
accuracy: 0.9173
Epoch 9/10
396/396 [==============================] - 1s 1ms/step - loss: 43.5309 -
accuracy: 0.9314
Epoch 10/10
396/396 [==============================] - 1s 1ms/step - loss: 45.5454 -
accuracy: 0.9312

Test accuracy: 0.88987135887146 /n
Train Size: (12324, 129) (12324,)
Test Size: (1586, 129) (1586,)
Epoch 1/10
386/386 [==============================] - 1s 1ms/step - loss: 823.7858 -
accuracy: 0.7521
```

```
Epoch 2/10
386/386 [==============================] - 1s 1ms/step - loss: 48.1436 -
accuracy: 0.8956
Epoch 3/10
386/386 [==============================] - 0s 1ms/step - loss: 55.8589 -
accuracy: 0.8934
Epoch 4/10
386/386 [==============================] - 1s 1ms/step - loss: 41.6233 -
accuracy: 0.9089
Epoch 5/10
386/386 [==============================] - 1s 1ms/step - loss: 37.9332 -
accuracy: 0.9171
Epoch 6/10
386/386 [==============================] - 1s 1ms/step - loss: 45.8240 -
accuracy: 0.9190
Epoch 7/10
386/386 [==============================] - 0s 1ms/step - loss: 36.4146 -
accuracy: 0.9323
Epoch 8/10
386/386 [==============================] - 0s 1ms/step - loss: 31.7398 -
accuracy: 0.9439
Epoch 9/10
386/386 [==============================] - 1s 1ms/step - loss: 38.8626 -
accuracy: 0.9403
Epoch 10/10
386/386 [==============================] - 1s 1ms/step - loss: 30.3878 -
accuracy: 0.9490

Test accuracy: 0.8404791951179504 /n
Train Size: (13749, 129) (13749,)
Test Size: (161, 129) (161,)
Epoch 1/10
430/430 [==============================] - 1s 1ms/step - loss: 377.3626 -
accuracy: 0.7194
Epoch 2/10
430/430 [==============================] - 1s 1ms/step - loss: 55.4924 -
accuracy: 0.8816
Epoch 3/10
430/430 [==============================] - 1s 1ms/step - loss: 35.4001 -
accuracy: 0.9156
Epoch 4/10
430/430 [==============================] - 1s 1ms/step - loss: 45.6815 -
accuracy: 0.9137
Epoch 5/10
430/430 [==============================] - 1s 1ms/step - loss: 38.4132 -
accuracy: 0.9294
Epoch 6/10
430/430 [==============================] - 1s 1ms/step - loss: 38.0282 -
```

```
accuracy: 0.9307
Epoch 7/10
430/430 [==============================] - 1s 1ms/step - loss: 35.5062 -
accuracy: 0.9374
Epoch 8/10
430/430 [==============================] - 1s 1ms/step - loss: 36.2272 -
accuracy: 0.9361
Epoch 9/10
430/430 [==============================] - 1s 1ms/step - loss: 29.4466 -
accuracy: 0.9444
Epoch 10/10
430/430 [==============================] - 1s 1ms/step - loss: 37.8980 -
accuracy: 0.9406

Test accuracy: 0.8633540272712708 /n
Train Size: (13713, 129) (13713,)
Test Size: (197, 129) (197,)
Epoch 1/10
429/429 [==============================] - 1s 1ms/step - loss: 592.3022 -
accuracy: 0.7602
Epoch 2/10
429/429 [==============================] - 1s 1ms/step - loss: 65.2022 -
accuracy: 0.8706
Epoch 3/10
429/429 [==============================] - 1s 1ms/step - loss: 38.5422 -
accuracy: 0.9117
Epoch 4/10
429/429 [==============================] - 1s 1ms/step - loss: 49.1547 -
accuracy: 0.9090
Epoch 5/10
429/429 [==============================] - 1s 1ms/step - loss: 35.0421 -
accuracy: 0.9297
Epoch 6/10
429/429 [==============================] - 1s 1ms/step - loss: 40.7398 -
accuracy: 0.9289
Epoch 7/10
429/429 [==============================] - 1s 1ms/step - loss: 43.4645 -
accuracy: 0.9285
Epoch 8/10
429/429 [==============================] - 1s 1ms/step - loss: 27.6607 -
accuracy: 0.9483
Epoch 9/10
429/429 [==============================] - 1s 1ms/step - loss: 24.1146 -
accuracy: 0.9522
Epoch 10/10
429/429 [==============================] - 1s 1ms/step - loss: 28.7843 -
accuracy: 0.9492
```

```
Test accuracy: 0.989847719669342 /n
Train Size: (11610, 129) (11610,)
Test Size: (2300, 129) (2300,)
Epoch 1/10
363/363 [==============================] - 0s 1ms/step - loss: 629.0081 -
accuracy: 0.7400
Epoch 2/10
363/363 [==============================] - 0s 1ms/step - loss: 62.0682 -
accuracy: 0.8756
Epoch 3/10
363/363 [==============================] - 0s 1ms/step - loss: 39.3352 -
accuracy: 0.9041
Epoch 4/10
363/363 [==============================] - 0s 1ms/step - loss: 40.5401 -
accuracy: 0.8982
Epoch 5/10
363/363 [==============================] - 0s 1ms/step - loss: 34.6782 -
accuracy: 0.9208
Epoch 6/10
363/363 [==============================] - 0s 1ms/step - loss: 26.8851 -
accuracy: 0.9364
Epoch 7/10
363/363 [==============================] - 0s 1ms/step - loss: 42.5727 -
accuracy: 0.9146
Epoch 8/10
363/363 [==============================] - 0s 1ms/step - loss: 35.9639 -
accuracy: 0.9336
Epoch 9/10
363/363 [==============================] - 0s 1ms/step - loss: 30.7206 -
accuracy: 0.9385
Epoch 10/10
363/363 [==============================] - 0s 1ms/step - loss: 34.9918 -
accuracy: 0.9403

Test accuracy: 0.8873913288116455 /n
Train Size: (10297, 129) (10297,)
Test Size: (3613, 129) (3613,)
Epoch 1/10
322/322 [==============================] - 0s 1ms/step - loss: 925.5214 -
accuracy: 0.6996
Epoch 2/10
322/322 [==============================] - 0s 1ms/step - loss: 46.5796 -
accuracy: 0.8878
Epoch 3/10
322/322 [==============================] - 0s 1ms/step - loss: 39.9182 -
accuracy: 0.8967
Epoch 4/10
322/322 [==============================] - 0s 1ms/step - loss: 28.3105 -
```

```
accuracy: 0.9269
Epoch 5/10
322/322 [==============================] - 0s 1ms/step - loss: 38.3610 -
accuracy: 0.9093
Epoch 6/10
322/322 [==============================] - 0s 1ms/step - loss: 24.9000 -
accuracy: 0.9354
Epoch 7/10
322/322 [==============================] - 0s 1ms/step - loss: 28.1273 -
accuracy: 0.9309
Epoch 8/10
322/322 [==============================] - 0s 1ms/step - loss: 19.1270 -
accuracy: 0.9458
Epoch 9/10
322/322 [==============================] - 0s 1ms/step - loss: 29.3389 -
accuracy: 0.9331
Epoch 10/10
322/322 [==============================] - 0s 1ms/step - loss: 22.1983 -
accuracy: 0.9415

Test accuracy: 0.8131746649742126 /n
Train Size: (13616, 129) (13616,)
Test Size: (294, 129) (294,)
Epoch 1/10
426/426 [==============================] - 1s 1ms/step - loss: 397.2526 -
accuracy: 0.7756
Epoch 2/10
426/426 [==============================] - 1s 1ms/step - loss: 43.1349 -
accuracy: 0.8944
Epoch 3/10
426/426 [==============================] - 1s 1ms/step - loss: 30.5835 -
accuracy: 0.9122
Epoch 4/10
426/426 [==============================] - 1s 1ms/step - loss: 27.3231 -
accuracy: 0.9181
Epoch 5/10
426/426 [==============================] - 1s 1ms/step - loss: 24.7221 -
accuracy: 0.9288
Epoch 6/10
426/426 [==============================] - 1s 1ms/step - loss: 17.9285 -
accuracy: 0.9425
Epoch 7/10
426/426 [==============================] - 1s 1ms/step - loss: 20.1519 -
accuracy: 0.9415
Epoch 8/10
426/426 [==============================] - 1s 1ms/step - loss: 24.1106 -
accuracy: 0.9346
Epoch 9/10
```

```
426/426 [==============================] - 1s 1ms/step - loss: 17.2226 -
accuracy: 0.9540
Epoch 10/10
426/426 [==============================] - 1s 1ms/step - loss: 18.1335 -
accuracy: 0.9488

Test accuracy: 0.7585033774375916 /n
Train Size: (13440, 129) (13440,)
Test Size: (470, 129) (470,)
Epoch 1/10
420/420 [==============================] - 1s 1ms/step - loss: 597.5807 -
accuracy: 0.7493
Epoch 2/10
420/420 [==============================] - 1s 1ms/step - loss: 42.5939 -
accuracy: 0.8993
Epoch 3/10
420/420 [==============================] - 1s 1ms/step - loss: 35.7533 -
accuracy: 0.9244
Epoch 4/10
420/420 [==============================] - 1s 1ms/step - loss: 33.6308 -
accuracy: 0.9248
Epoch 5/10
420/420 [==============================] - 1s 1ms/step - loss: 27.9049 -
accuracy: 0.9415
Epoch 6/10
420/420 [==============================] - 1s 1ms/step - loss: 27.0822 -
accuracy: 0.9413
Epoch 7/10
420/420 [==============================] - 1s 1ms/step - loss: 36.0376 -
accuracy: 0.9373
Epoch 8/10
420/420 [==============================] - 1s 1ms/step - loss: 25.9061 -
accuracy: 0.9540
Epoch 9/10
420/420 [==============================] - 1s 1ms/step - loss: 25.2523 -
accuracy: 0.9560
Epoch 10/10
420/420 [==============================] - 1s 1ms/step - loss: 29.9146 -
accuracy: 0.9490

Test accuracy: 0.6617021560668945 /n
Train Size: (10310, 129) (10310,)
Test Size: (3600, 129) (3600,)
Epoch 1/10
323/323 [==============================] - 0s 1ms/step - loss: 381.9645 -
accuracy: 0.8075
Epoch 2/10
323/323 [==============================] - 0s 1ms/step - loss: 66.3484 -
```

```
accuracy: 0.9033
Epoch 3/10
323/323 [==============================] - 0s 1ms/step - loss: 42.3328 -
accuracy: 0.9287
Epoch 4/10
323/323 [==============================] - 0s 1ms/step - loss: 46.0363 -
accuracy: 0.9290
Epoch 5/10
323/323 [==============================] - 0s 1ms/step - loss: 43.8296 -
accuracy: 0.9249
Epoch 6/10
323/323 [==============================] - 0s 1ms/step - loss: 38.5740 -
accuracy: 0.9411
Epoch 7/10
323/323 [==============================] - 0s 1ms/step - loss: 30.4791 -
accuracy: 0.9475
Epoch 8/10
323/323 [==============================] - 0s 1ms/step - loss: 34.1246 -
accuracy: 0.9531
Epoch 9/10
323/323 [==============================] - 0s 1ms/step - loss: 33.6402 -
accuracy: 0.9527
Epoch 10/10
323/323 [==============================] - 0s 1ms/step - loss: 27.3958 -
accuracy: 0.9565

Test accuracy: 0.7013888955116272 /n
```

Esto refleja que las difencia entre el ultimo batch y el resto son significativas.

[33]:
```
df_gas.groupby('Batch ID')['GAS'].count()
```

[33]:
```
Batch ID
1      445
2     1244
3     1586
4      161
5      197
6     2300
7     3613
8      294
9      470
10    3600
Name: GAS, dtype: int64
```

[34]:
```
X_test.shape
```

[34]:
```
(3600, 129)
```

[0]:

7 Probamos ahora una red para predecir la concentracion de cada gas

[0]:
```
df_train_reg = df_gas[df_gas['GAS'] == 1]

gas_X = df_train_reg.drop(columns = ['Batch ID', 'GAS', 'CONCENTRATION']).
 ↪to_numpy()
gas_y = df_train_reg['CONCENTRATION'].to_numpy()

X_train, X_test, y_train, y_test = train_test_split( gas_X, gas_y, test_size=0.
 ↪33, random_state=42)
```

[38]:
```
from keras.callbacks import ModelCheckpoint
from keras.models import Sequential
from keras.layers import Dense, Activation, Flatten
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_absolute_error
from matplotlib import pyplot as plt
import seaborn as sb
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import warnings
warnings.filterwarnings('ignore')
warnings.filterwarnings('ignore', category=DeprecationWarning)
from xgboost import XGBRegressor


NN_model = Sequential()

# The Input Layer :
NN_model.add(Dense(128, kernel_initializer='normal',input_dim = X_train.
 ↪shape[1], activation='relu'))

# The Hidden Layers :
NN_model.add(Dense(128, kernel_initializer='normal',activation='relu'))
NN_model.add(Dense(128, kernel_initializer='normal',activation='relu'))
NN_model.add(Dense(128, kernel_initializer='normal',activation='relu'))

# The Output Layer :
NN_model.add(Dense(1, kernel_initializer='normal',activation='linear'))
```

```
# Compile the network :
NN_model.compile(loss='mean_absolute_error', optimizer='adam',␣
 ↪metrics=['mean_absolute_error'])
NN_model.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_6 (Dense)              (None, 128)               16512
_________________________________________________________________
dense_7 (Dense)              (None, 128)               16512
_________________________________________________________________
dense_8 (Dense)              (None, 128)               16512
_________________________________________________________________
dense_9 (Dense)              (None, 128)               16512
_________________________________________________________________
dense_10 (Dense)             (None, 1)                 129
=================================================================
Total params: 66,177
Trainable params: 66,177
Non-trainable params: 0
_________________________________________________________________
```

[0]:
```
checkpoint_name = 'Weights-{epoch:03d}--{val_loss:.5f}.hdf5'
checkpoint = ModelCheckpoint(checkpoint_name, monitor='val_loss', verbose = 1,␣
 ↪save_best_only = True, mode ='auto')
callbacks_list = [checkpoint]
```

[40]:
```
NN_model.fit(X_train, y_train, epochs=500, batch_size=32, validation_split = 0.
 ↪2, callbacks=callbacks_list)
```

```
Train on 1374 samples, validate on 344 samples
Epoch 1/500
1374/1374 [==============================] - 0s 179us/step - loss: 44.7740 -
mean_absolute_error: 44.7740 - val_loss: 27.4497 - val_mean_absolute_error:
27.4497

Epoch 00001: val_loss improved from inf to 27.44971, saving model to Weights-001
--27.44971.hdf5
Epoch 2/500
1374/1374 [==============================] - 0s 69us/step - loss: 37.1102 -
mean_absolute_error: 37.1102 - val_loss: 36.2748 - val_mean_absolute_error:
36.2748

Epoch 00002: val_loss did not improve from 27.44971
Epoch 3/500
```

```
1374/1374 [==============================] - 0s 68us/step - loss: 31.2540 -
mean_absolute_error: 31.2540 - val_loss: 24.6900 - val_mean_absolute_error:
24.6900

Epoch 00003: val_loss improved from 27.44971 to 24.68999, saving model to
Weights-003--24.68999.hdf5
Epoch 4/500
1374/1374 [==============================] - 0s 69us/step - loss: 27.0987 -
mean_absolute_error: 27.0987 - val_loss: 24.6940 - val_mean_absolute_error:
24.6940

Epoch 00004: val_loss did not improve from 24.68999
Epoch 5/500
1374/1374 [==============================] - 0s 68us/step - loss: 24.3593 -
mean_absolute_error: 24.3593 - val_loss: 19.7519 - val_mean_absolute_error:
19.7519

Epoch 00005: val_loss improved from 24.68999 to 19.75187, saving model to
Weights-005--19.75187.hdf5
Epoch 6/500
1374/1374 [==============================] - 0s 74us/step - loss: 25.6449 -
mean_absolute_error: 25.6449 - val_loss: 21.8310 - val_mean_absolute_error:
21.8310

Epoch 00006: val_loss did not improve from 19.75187
Epoch 7/500
1374/1374 [==============================] - 0s 72us/step - loss: 21.6193 -
mean_absolute_error: 21.6193 - val_loss: 17.0571 - val_mean_absolute_error:
17.0571

Epoch 00007: val_loss improved from 19.75187 to 17.05710, saving model to
Weights-007--17.05710.hdf5
Epoch 8/500
1374/1374 [==============================] - 0s 67us/step - loss: 19.5065 -
mean_absolute_error: 19.5065 - val_loss: 15.3290 - val_mean_absolute_error:
15.3290

Epoch 00008: val_loss improved from 17.05710 to 15.32899, saving model to
Weights-008--15.32899.hdf5
Epoch 9/500
1374/1374 [==============================] - 0s 66us/step - loss: 19.8139 -
mean_absolute_error: 19.8139 - val_loss: 15.3589 - val_mean_absolute_error:
15.3589

Epoch 00009: val_loss did not improve from 15.32899
Epoch 10/500
1374/1374 [==============================] - 0s 68us/step - loss: 20.5112 -
mean_absolute_error: 20.5112 - val_loss: 31.4665 - val_mean_absolute_error:
```

```
31.4665

Epoch 00010: val_loss did not improve from 15.32899
Epoch 11/500
1374/1374 [==============================] - 0s 67us/step - loss: 20.7886 -
mean_absolute_error: 20.7886 - val_loss: 18.8919 - val_mean_absolute_error:
18.8919

Epoch 00011: val_loss did not improve from 15.32899
Epoch 12/500
1374/1374 [==============================] - 0s 67us/step - loss: 17.8609 -
mean_absolute_error: 17.8609 - val_loss: 19.7079 - val_mean_absolute_error:
19.7079

Epoch 00012: val_loss did not improve from 15.32899
Epoch 13/500
1374/1374 [==============================] - 0s 75us/step - loss: 17.7283 -
mean_absolute_error: 17.7283 - val_loss: 15.4335 - val_mean_absolute_error:
15.4335

Epoch 00013: val_loss did not improve from 15.32899
Epoch 14/500
1374/1374 [==============================] - 0s 70us/step - loss: 16.0649 -
mean_absolute_error: 16.0649 - val_loss: 16.8692 - val_mean_absolute_error:
16.8692

Epoch 00014: val_loss did not improve from 15.32899
Epoch 15/500
1374/1374 [==============================] - 0s 74us/step - loss: 20.2307 -
mean_absolute_error: 20.2307 - val_loss: 18.2513 - val_mean_absolute_error:
18.2513

Epoch 00015: val_loss did not improve from 15.32899
Epoch 16/500
1374/1374 [==============================] - 0s 71us/step - loss: 16.9644 -
mean_absolute_error: 16.9644 - val_loss: 15.2732 - val_mean_absolute_error:
15.2732

Epoch 00016: val_loss improved from 15.32899 to 15.27318, saving model to
Weights-016--15.27318.hdf5
Epoch 17/500
1374/1374 [==============================] - 0s 69us/step - loss: 15.0145 -
mean_absolute_error: 15.0145 - val_loss: 14.2688 - val_mean_absolute_error:
14.2688

Epoch 00017: val_loss improved from 15.27318 to 14.26876, saving model to
Weights-017--14.26876.hdf5
Epoch 18/500
```

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1374/1374 [==============================] - 0s 70us/step - loss: 16.7092 -
mean_absolute_error: 16.7091 - val_loss: 16.2414 - val_mean_absolute_error:
16.2414

Epoch 00018: val_loss did not improve from 14.26876
Epoch 19/500
1374/1374 [==============================] - 0s 67us/step - loss: 14.8650 -
mean_absolute_error: 14.8650 - val_loss: 13.2807 - val_mean_absolute_error:
13.2807

Epoch 00019: val_loss improved from 14.26876 to 13.28069, saving model to
Weights-019--13.28069.hdf5
Epoch 20/500
1374/1374 [==============================] - 0s 67us/step - loss: 14.4654 -
mean_absolute_error: 14.4654 - val_loss: 13.5134 - val_mean_absolute_error:
13.5134

Epoch 00020: val_loss did not improve from 13.28069
Epoch 21/500
1374/1374 [==============================] - 0s 68us/step - loss: 15.4411 -
mean_absolute_error: 15.4411 - val_loss: 18.8723 - val_mean_absolute_error:
18.8723

Epoch 00021: val_loss did not improve from 13.28069
Epoch 22/500
1374/1374 [==============================] - 0s 72us/step - loss: 14.4425 -
mean_absolute_error: 14.4425 - val_loss: 11.7169 - val_mean_absolute_error:
11.7169

Epoch 00022: val_loss improved from 13.28069 to 11.71690, saving model to
Weights-022--11.71690.hdf5
Epoch 23/500
1374/1374 [==============================] - 0s 67us/step - loss: 16.9120 -
mean_absolute_error: 16.9120 - val_loss: 28.3081 - val_mean_absolute_error:
28.3081

Epoch 00023: val_loss did not improve from 11.71690
Epoch 24/500
1374/1374 [==============================] - 0s 70us/step - loss: 15.6742 -
mean_absolute_error: 15.6742 - val_loss: 11.2855 - val_mean_absolute_error:
11.2855

Epoch 00024: val_loss improved from 11.71690 to 11.28553, saving model to
Weights-024--11.28553.hdf5
Epoch 25/500
1374/1374 [==============================] - 0s 69us/step - loss: 11.2796 -
mean_absolute_error: 11.2796 - val_loss: 12.2913 - val_mean_absolute_error:
12.2913
```

```
Epoch 00025: val_loss did not improve from 11.28553
Epoch 26/500
1374/1374 [==============================] - 0s 73us/step - loss: 13.2278 -
mean_absolute_error: 13.2278 - val_loss: 12.5868 - val_mean_absolute_error:
12.5868

Epoch 00026: val_loss did not improve from 11.28553
Epoch 27/500
1374/1374 [==============================] - 0s 69us/step - loss: 13.4196 -
mean_absolute_error: 13.4196 - val_loss: 14.8864 - val_mean_absolute_error:
14.8864

Epoch 00027: val_loss did not improve from 11.28553
Epoch 28/500
1374/1374 [==============================] - 0s 69us/step - loss: 12.9554 -
mean_absolute_error: 12.9554 - val_loss: 12.1227 - val_mean_absolute_error:
12.1227

Epoch 00028: val_loss did not improve from 11.28553
Epoch 29/500
1374/1374 [==============================] - 0s 71us/step - loss: 12.0300 -
mean_absolute_error: 12.0300 - val_loss: 11.9800 - val_mean_absolute_error:
11.9800

Epoch 00029: val_loss did not improve from 11.28553
Epoch 30/500
1374/1374 [==============================] - 0s 69us/step - loss: 15.7371 -
mean_absolute_error: 15.7371 - val_loss: 12.8144 - val_mean_absolute_error:
12.8144

Epoch 00030: val_loss did not improve from 11.28553
Epoch 31/500
1374/1374 [==============================] - 0s 84us/step - loss: 10.8208 -
mean_absolute_error: 10.8208 - val_loss: 9.2165 - val_mean_absolute_error:
9.2165

Epoch 00031: val_loss improved from 11.28553 to 9.21649, saving model to
Weights-031--9.21649.hdf5
Epoch 32/500
1374/1374 [==============================] - 0s 70us/step - loss: 10.1715 -
mean_absolute_error: 10.1715 - val_loss: 11.2053 - val_mean_absolute_error:
11.2053

Epoch 00032: val_loss did not improve from 9.21649
Epoch 33/500
1374/1374 [==============================] - 0s 77us/step - loss: 10.8237 -
mean_absolute_error: 10.8237 - val_loss: 10.5401 - val_mean_absolute_error:
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10.5401

Epoch 00033: val_loss did not improve from 9.21649
Epoch 34/500
1374/1374 [==============================] - 0s 69us/step - loss: 11.4352 -
mean_absolute_error: 11.4352 - val_loss: 9.8602 - val_mean_absolute_error:
9.8602

Epoch 00034: val_loss did not improve from 9.21649
Epoch 35/500
1374/1374 [==============================] - 0s 69us/step - loss: 11.7144 -
mean_absolute_error: 11.7144 - val_loss: 12.4021 - val_mean_absolute_error:
12.4021

Epoch 00035: val_loss did not improve from 9.21649
Epoch 36/500
1374/1374 [==============================] - 0s 69us/step - loss: 10.8315 -
mean_absolute_error: 10.8315 - val_loss: 15.2439 - val_mean_absolute_error:
15.2439

Epoch 00036: val_loss did not improve from 9.21649
Epoch 37/500
1374/1374 [==============================] - 0s 71us/step - loss: 13.2350 -
mean_absolute_error: 13.2350 - val_loss: 12.5962 - val_mean_absolute_error:
12.5962

Epoch 00037: val_loss did not improve from 9.21649
Epoch 38/500
1374/1374 [==============================] - 0s 71us/step - loss: 11.5076 -
mean_absolute_error: 11.5076 - val_loss: 11.3143 - val_mean_absolute_error:
11.3143

Epoch 00038: val_loss did not improve from 9.21649
Epoch 39/500
1374/1374 [==============================] - 0s 70us/step - loss: 10.6497 -
mean_absolute_error: 10.6497 - val_loss: 9.9721 - val_mean_absolute_error:
9.9721

Epoch 00039: val_loss did not improve from 9.21649
Epoch 40/500
1374/1374 [==============================] - 0s 69us/step - loss: 10.5795 -
mean_absolute_error: 10.5795 - val_loss: 16.8838 - val_mean_absolute_error:
16.8838

Epoch 00040: val_loss did not improve from 9.21649
Epoch 41/500
1374/1374 [==============================] - 0s 71us/step - loss: 14.7481 -
mean_absolute_error: 14.7481 - val_loss: 9.9537 - val_mean_absolute_error:
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9.9537

Epoch 00041: val_loss did not improve from 9.21649
Epoch 42/500
1374/1374 [==============================] - 0s 76us/step - loss: 12.2581 -
mean_absolute_error: 12.2581 - val_loss: 9.7388 - val_mean_absolute_error:
9.7388

Epoch 00042: val_loss did not improve from 9.21649
Epoch 43/500
1374/1374 [==============================] - 0s 67us/step - loss: 10.4143 -
mean_absolute_error: 10.4143 - val_loss: 9.9179 - val_mean_absolute_error:
9.9179

Epoch 00043: val_loss did not improve from 9.21649
Epoch 44/500
1374/1374 [==============================] - 0s 68us/step - loss: 10.1904 -
mean_absolute_error: 10.1904 - val_loss: 10.0092 - val_mean_absolute_error:
10.0092

Epoch 00044: val_loss did not improve from 9.21649
Epoch 45/500
1374/1374 [==============================] - 0s 71us/step - loss: 11.0481 -
mean_absolute_error: 11.0481 - val_loss: 13.5326 - val_mean_absolute_error:
13.5326

Epoch 00045: val_loss did not improve from 9.21649
Epoch 46/500
1374/1374 [==============================] - 0s 69us/step - loss: 11.9255 -
mean_absolute_error: 11.9255 - val_loss: 12.0905 - val_mean_absolute_error:
12.0905

Epoch 00046: val_loss did not improve from 9.21649
Epoch 47/500
1374/1374 [==============================] - 0s 68us/step - loss: 9.6114 -
mean_absolute_error: 9.6114 - val_loss: 9.6573 - val_mean_absolute_error: 9.6573

Epoch 00047: val_loss did not improve from 9.21649
Epoch 48/500
1374/1374 [==============================] - 0s 74us/step - loss: 16.7350 -
mean_absolute_error: 16.7350 - val_loss: 12.8281 - val_mean_absolute_error:
12.8281

Epoch 00048: val_loss did not improve from 9.21649
Epoch 49/500
1374/1374 [==============================] - 0s 70us/step - loss: 11.1243 -
mean_absolute_error: 11.1243 - val_loss: 10.3179 - val_mean_absolute_error:
10.3179
```

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Epoch 00049: val_loss did not improve from 9.21649
Epoch 50/500
1374/1374 [==============================] - 0s 70us/step - loss: 11.0313 -
mean_absolute_error: 11.0313 - val_loss: 8.7838 - val_mean_absolute_error:
8.7838

Epoch 00050: val_loss improved from 9.21649 to 8.78379, saving model to
Weights-050--8.78379.hdf5
Epoch 51/500
1374/1374 [==============================] - 0s 68us/step - loss: 10.8263 -
mean_absolute_error: 10.8263 - val_loss: 9.8247 - val_mean_absolute_error:
9.8247

Epoch 00051: val_loss did not improve from 8.78379
Epoch 52/500
1374/1374 [==============================] - 0s 74us/step - loss: 9.7265 -
mean_absolute_error: 9.7265 - val_loss: 10.2380 - val_mean_absolute_error:
10.2380

Epoch 00052: val_loss did not improve from 8.78379
Epoch 53/500
1374/1374 [==============================] - 0s 67us/step - loss: 11.2995 -
mean_absolute_error: 11.2995 - val_loss: 10.8571 - val_mean_absolute_error:
10.8571

Epoch 00053: val_loss did not improve from 8.78379
Epoch 54/500
1374/1374 [==============================] - 0s 69us/step - loss: 9.1133 -
mean_absolute_error: 9.1133 - val_loss: 9.4683 - val_mean_absolute_error: 9.4683

Epoch 00054: val_loss did not improve from 8.78379
Epoch 55/500
1374/1374 [==============================] - 0s 71us/step - loss: 9.9526 -
mean_absolute_error: 9.9526 - val_loss: 10.0503 - val_mean_absolute_error:
10.0503

Epoch 00055: val_loss did not improve from 8.78379
Epoch 56/500
1374/1374 [==============================] - 0s 70us/step - loss: 11.0670 -
mean_absolute_error: 11.0670 - val_loss: 11.9407 - val_mean_absolute_error:
11.9407

Epoch 00056: val_loss did not improve from 8.78379
Epoch 57/500
1374/1374 [==============================] - 0s 69us/step - loss: 9.7104 -
mean_absolute_error: 9.7104 - val_loss: 9.8975 - val_mean_absolute_error: 9.8975
```

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Epoch 00057: val_loss did not improve from 8.78379
Epoch 58/500
1374/1374 [==============================] - 0s 71us/step - loss: 8.6918 -
mean_absolute_error: 8.6918 - val_loss: 9.3499 - val_mean_absolute_error: 9.3499

Epoch 00058: val_loss did not improve from 8.78379
Epoch 59/500
1374/1374 [==============================] - 0s 71us/step - loss: 9.6751 -
mean_absolute_error: 9.6751 - val_loss: 9.7196 - val_mean_absolute_error: 9.7196

Epoch 00059: val_loss did not improve from 8.78379
Epoch 60/500
1374/1374 [==============================] - 0s 70us/step - loss: 8.3328 -
mean_absolute_error: 8.3328 - val_loss: 8.5203 - val_mean_absolute_error: 8.5203

Epoch 00060: val_loss improved from 8.78379 to 8.52034, saving model to
Weights-060--8.52034.hdf5
Epoch 61/500
1374/1374 [==============================] - 0s 74us/step - loss: 12.1523 -
mean_absolute_error: 12.1523 - val_loss: 10.7190 - val_mean_absolute_error:
10.7190

Epoch 00061: val_loss did not improve from 8.52034
Epoch 62/500
1374/1374 [==============================] - 0s 75us/step - loss: 10.3453 -
mean_absolute_error: 10.3453 - val_loss: 9.3973 - val_mean_absolute_error:
9.3973

Epoch 00062: val_loss did not improve from 8.52034
Epoch 63/500
1374/1374 [==============================] - 0s 70us/step - loss: 10.7710 -
mean_absolute_error: 10.7710 - val_loss: 14.8398 - val_mean_absolute_error:
14.8398

Epoch 00063: val_loss did not improve from 8.52034
Epoch 64/500
1374/1374 [==============================] - 0s 69us/step - loss: 10.0878 -
mean_absolute_error: 10.0878 - val_loss: 8.4945 - val_mean_absolute_error:
8.4945

Epoch 00064: val_loss improved from 8.52034 to 8.49448, saving model to
Weights-064--8.49448.hdf5
Epoch 65/500
1374/1374 [==============================] - 0s 69us/step - loss: 9.5451 -
mean_absolute_error: 9.5451 - val_loss: 10.6376 - val_mean_absolute_error:
10.6376

Epoch 00065: val_loss did not improve from 8.49448
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Epoch 66/500
1374/1374 [==============================] - 0s 68us/step - loss: 9.5925 -
mean_absolute_error: 9.5925 - val_loss: 9.0094 - val_mean_absolute_error: 9.0094

Epoch 00066: val_loss did not improve from 8.49448
Epoch 67/500
1374/1374 [==============================] - 0s 69us/step - loss: 9.8557 -
mean_absolute_error: 9.8557 - val_loss: 12.0093 - val_mean_absolute_error:
12.0093

Epoch 00067: val_loss did not improve from 8.49448
Epoch 68/500
1374/1374 [==============================] - 0s 70us/step - loss: 9.0216 -
mean_absolute_error: 9.0216 - val_loss: 13.4800 - val_mean_absolute_error:
13.4800

Epoch 00068: val_loss did not improve from 8.49448
Epoch 69/500
1374/1374 [==============================] - 0s 70us/step - loss: 10.1048 -
mean_absolute_error: 10.1048 - val_loss: 9.0290 - val_mean_absolute_error:
9.0290

Epoch 00069: val_loss did not improve from 8.49448
Epoch 70/500
1374/1374 [==============================] - 0s 70us/step - loss: 8.1728 -
mean_absolute_error: 8.1728 - val_loss: 8.6789 - val_mean_absolute_error: 8.6789

Epoch 00070: val_loss did not improve from 8.49448
Epoch 71/500
1374/1374 [==============================] - 0s 71us/step - loss: 10.1671 -
mean_absolute_error: 10.1671 - val_loss: 9.6299 - val_mean_absolute_error:
9.6299

Epoch 00071: val_loss did not improve from 8.49448
Epoch 72/500
1374/1374 [==============================] - 0s 72us/step - loss: 10.9462 -
mean_absolute_error: 10.9462 - val_loss: 9.4955 - val_mean_absolute_error:
9.4955

Epoch 00072: val_loss did not improve from 8.49448
Epoch 73/500
1374/1374 [==============================] - 0s 72us/step - loss: 11.6400 -
mean_absolute_error: 11.6400 - val_loss: 12.8148 - val_mean_absolute_error:
12.8148

Epoch 00073: val_loss did not improve from 8.49448
Epoch 74/500
1374/1374 [==============================] - 0s 69us/step - loss: 11.6358 -
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mean_absolute_error: 11.6358 - val_loss: 9.8513 - val_mean_absolute_error:
9.8513

Epoch 00074: val_loss did not improve from 8.49448
Epoch 75/500
1374/1374 [==============================] - 0s 70us/step - loss: 8.4635 -
mean_absolute_error: 8.4635 - val_loss: 9.1004 - val_mean_absolute_error: 9.1004

Epoch 00075: val_loss did not improve from 8.49448
Epoch 76/500
1374/1374 [==============================] - 0s 69us/step - loss: 8.3013 -
mean_absolute_error: 8.3013 - val_loss: 9.2728 - val_mean_absolute_error: 9.2728

Epoch 00076: val_loss did not improve from 8.49448
Epoch 77/500
1374/1374 [==============================] - 0s 76us/step - loss: 9.1826 -
mean_absolute_error: 9.1826 - val_loss: 8.8012 - val_mean_absolute_error: 8.8012

Epoch 00077: val_loss did not improve from 8.49448
Epoch 78/500
1374/1374 [==============================] - 0s 69us/step - loss: 8.9993 -
mean_absolute_error: 8.9993 - val_loss: 11.2491 - val_mean_absolute_error:
11.2491

Epoch 00078: val_loss did not improve from 8.49448
Epoch 79/500
1374/1374 [==============================] - 0s 69us/step - loss: 10.2275 -
mean_absolute_error: 10.2275 - val_loss: 9.7643 - val_mean_absolute_error:
9.7643

Epoch 00079: val_loss did not improve from 8.49448
Epoch 80/500
1374/1374 [==============================] - 0s 70us/step - loss: 11.3287 -
mean_absolute_error: 11.3287 - val_loss: 8.7766 - val_mean_absolute_error:
8.7766

Epoch 00080: val_loss did not improve from 8.49448
Epoch 81/500
1374/1374 [==============================] - 0s 71us/step - loss: 8.2701 -
mean_absolute_error: 8.2701 - val_loss: 9.3135 - val_mean_absolute_error: 9.3135

Epoch 00081: val_loss did not improve from 8.49448
Epoch 82/500
1374/1374 [==============================] - 0s 74us/step - loss: 10.5017 -
mean_absolute_error: 10.5017 - val_loss: 16.3958 - val_mean_absolute_error:
16.3958

Epoch 00082: val_loss did not improve from 8.49448
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Epoch 83/500
1374/1374 [==============================] - 0s 69us/step - loss: 10.0584 -
mean_absolute_error: 10.0584 - val_loss: 9.1044 - val_mean_absolute_error:
9.1044

Epoch 00083: val_loss did not improve from 8.49448
Epoch 84/500
1374/1374 [==============================] - 0s 71us/step - loss: 8.6110 -
mean_absolute_error: 8.6110 - val_loss: 10.6544 - val_mean_absolute_error:
10.6544

Epoch 00084: val_loss did not improve from 8.49448
Epoch 85/500
1374/1374 [==============================] - 0s 71us/step - loss: 8.7660 -
mean_absolute_error: 8.7660 - val_loss: 8.0898 - val_mean_absolute_error: 8.0898

Epoch 00085: val_loss improved from 8.49448 to 8.08976, saving model to
Weights-085--8.08976.hdf5
Epoch 86/500
1374/1374 [==============================] - 0s 70us/step - loss: 8.7047 -
mean_absolute_error: 8.7047 - val_loss: 8.7680 - val_mean_absolute_error: 8.7680

Epoch 00086: val_loss did not improve from 8.08976
Epoch 87/500
1374/1374 [==============================] - 0s 71us/step - loss: 8.2747 -
mean_absolute_error: 8.2747 - val_loss: 9.3553 - val_mean_absolute_error: 9.3553

Epoch 00087: val_loss did not improve from 8.08976
Epoch 88/500
1374/1374 [==============================] - 0s 68us/step - loss: 8.9671 -
mean_absolute_error: 8.9671 - val_loss: 10.0099 - val_mean_absolute_error:
10.0099

Epoch 00088: val_loss did not improve from 8.08976
Epoch 89/500
1374/1374 [==============================] - 0s 68us/step - loss: 8.8748 -
mean_absolute_error: 8.8748 - val_loss: 9.8913 - val_mean_absolute_error: 9.8913

Epoch 00089: val_loss did not improve from 8.08976
Epoch 90/500
1374/1374 [==============================] - 0s 68us/step - loss: 8.4656 -
mean_absolute_error: 8.4656 - val_loss: 8.3370 - val_mean_absolute_error: 8.3370

Epoch 00090: val_loss did not improve from 8.08976
Epoch 91/500
1374/1374 [==============================] - 0s 69us/step - loss: 10.2624 -
mean_absolute_error: 10.2624 - val_loss: 9.4482 - val_mean_absolute_error:
9.4482
```

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Epoch 00091: val_loss did not improve from 8.08976
Epoch 92/500
1374/1374 [==============================] - 0s 74us/step - loss: 8.5884 -
mean_absolute_error: 8.5884 - val_loss: 12.5506 - val_mean_absolute_error:
12.5506

Epoch 00092: val_loss did not improve from 8.08976
Epoch 93/500
1374/1374 [==============================] - 0s 75us/step - loss: 9.7791 -
mean_absolute_error: 9.7791 - val_loss: 10.8931 - val_mean_absolute_error:
10.8931

Epoch 00093: val_loss did not improve from 8.08976
Epoch 94/500
1374/1374 [==============================] - 0s 69us/step - loss: 9.1581 -
mean_absolute_error: 9.1581 - val_loss: 9.3519 - val_mean_absolute_error: 9.3519

Epoch 00094: val_loss did not improve from 8.08976
Epoch 95/500
1374/1374 [==============================] - 0s 69us/step - loss: 10.1845 -
mean_absolute_error: 10.1845 - val_loss: 9.1358 - val_mean_absolute_error:
9.1358

Epoch 00095: val_loss did not improve from 8.08976
Epoch 96/500
1374/1374 [==============================] - 0s 73us/step - loss: 9.1450 -
mean_absolute_error: 9.1450 - val_loss: 12.3274 - val_mean_absolute_error:
12.3274

Epoch 00096: val_loss did not improve from 8.08976
Epoch 97/500
1374/1374 [==============================] - 0s 72us/step - loss: 10.7333 -
mean_absolute_error: 10.7333 - val_loss: 10.0046 - val_mean_absolute_error:
10.0046

Epoch 00097: val_loss did not improve from 8.08976
Epoch 98/500
1374/1374 [==============================] - 0s 70us/step - loss: 9.2792 -
mean_absolute_error: 9.2792 - val_loss: 9.5993 - val_mean_absolute_error: 9.5993

Epoch 00098: val_loss did not improve from 8.08976
Epoch 99/500
1374/1374 [==============================] - 0s 73us/step - loss: 7.3836 -
mean_absolute_error: 7.3836 - val_loss: 10.8354 - val_mean_absolute_error:
10.8354

Epoch 00099: val_loss did not improve from 8.08976
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Epoch 100/500
1374/1374 [==============================] - 0s 70us/step - loss: 8.1403 -
mean_absolute_error: 8.1403 - val_loss: 8.9275 - val_mean_absolute_error: 8.9275

Epoch 00100: val_loss did not improve from 8.08976
Epoch 101/500
1374/1374 [==============================] - 0s 70us/step - loss: 8.7994 -
mean_absolute_error: 8.7994 - val_loss: 12.1571 - val_mean_absolute_error:
12.1571

Epoch 00101: val_loss did not improve from 8.08976
Epoch 102/500
1374/1374 [==============================] - 0s 76us/step - loss: 9.3417 -
mean_absolute_error: 9.3417 - val_loss: 9.3645 - val_mean_absolute_error: 9.3645

Epoch 00102: val_loss did not improve from 8.08976
Epoch 103/500
1374/1374 [==============================] - 0s 72us/step - loss: 7.8499 -
mean_absolute_error: 7.8499 - val_loss: 7.7533 - val_mean_absolute_error: 7.7533

Epoch 00103: val_loss improved from 8.08976 to 7.75330, saving model to
Weights-103--7.75330.hdf5
Epoch 104/500
1374/1374 [==============================] - 0s 68us/step - loss: 7.8910 -
mean_absolute_error: 7.8910 - val_loss: 8.0566 - val_mean_absolute_error: 8.0566

Epoch 00104: val_loss did not improve from 7.75330
Epoch 105/500
1374/1374 [==============================] - 0s 70us/step - loss: 7.2628 -
mean_absolute_error: 7.2628 - val_loss: 8.3648 - val_mean_absolute_error: 8.3648

Epoch 00105: val_loss did not improve from 7.75330
Epoch 106/500
1374/1374 [==============================] - 0s 71us/step - loss: 7.5752 -
mean_absolute_error: 7.5752 - val_loss: 7.3034 - val_mean_absolute_error: 7.3034

Epoch 00106: val_loss improved from 7.75330 to 7.30342, saving model to
Weights-106--7.30342.hdf5
Epoch 107/500
1374/1374 [==============================] - 0s 68us/step - loss: 7.1906 -
mean_absolute_error: 7.1906 - val_loss: 12.2158 - val_mean_absolute_error:
12.2158

Epoch 00107: val_loss did not improve from 7.30342
Epoch 108/500
1374/1374 [==============================] - 0s 67us/step - loss: 9.7599 -
mean_absolute_error: 9.7599 - val_loss: 10.1424 - val_mean_absolute_error:
10.1424
```

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Epoch 00108: val_loss did not improve from 7.30342
Epoch 109/500
1374/1374 [==============================] - 0s 68us/step - loss: 8.5149 -
mean_absolute_error: 8.5149 - val_loss: 14.2164 - val_mean_absolute_error:
14.2164

Epoch 00109: val_loss did not improve from 7.30342
Epoch 110/500
1374/1374 [==============================] - 0s 73us/step - loss: 8.4782 -
mean_absolute_error: 8.4782 - val_loss: 11.3981 - val_mean_absolute_error:
11.3981

Epoch 00110: val_loss did not improve from 7.30342
Epoch 111/500
1374/1374 [==============================] - 0s 68us/step - loss: 8.9770 -
mean_absolute_error: 8.9770 - val_loss: 8.3622 - val_mean_absolute_error: 8.3622

Epoch 00111: val_loss did not improve from 7.30342
Epoch 112/500
1374/1374 [==============================] - 0s 75us/step - loss: 10.4796 -
mean_absolute_error: 10.4796 - val_loss: 13.8316 - val_mean_absolute_error:
13.8316

Epoch 00112: val_loss did not improve from 7.30342
Epoch 113/500
1374/1374 [==============================] - 0s 73us/step - loss: 9.0445 -
mean_absolute_error: 9.0445 - val_loss: 8.3107 - val_mean_absolute_error: 8.3107

Epoch 00113: val_loss did not improve from 7.30342
Epoch 114/500
1374/1374 [==============================] - 0s 76us/step - loss: 8.3033 -
mean_absolute_error: 8.3033 - val_loss: 7.9478 - val_mean_absolute_error: 7.9478

Epoch 00114: val_loss did not improve from 7.30342
Epoch 115/500
1374/1374 [==============================] - 0s 71us/step - loss: 8.1741 -
mean_absolute_error: 8.1741 - val_loss: 8.5518 - val_mean_absolute_error: 8.5518

Epoch 00115: val_loss did not improve from 7.30342
Epoch 116/500
1374/1374 [==============================] - 0s 68us/step - loss: 7.2152 -
mean_absolute_error: 7.2152 - val_loss: 7.3231 - val_mean_absolute_error: 7.3231

Epoch 00116: val_loss did not improve from 7.30342
Epoch 117/500
1374/1374 [==============================] - 0s 68us/step - loss: 7.7195 -
mean_absolute_error: 7.7195 - val_loss: 9.0035 - val_mean_absolute_error: 9.0035
```

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Epoch 00117: val_loss did not improve from 7.30342
Epoch 118/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.3988 -
mean_absolute_error: 7.3988 - val_loss: 8.3886 - val_mean_absolute_error: 8.3886

Epoch 00118: val_loss did not improve from 7.30342
Epoch 119/500
1374/1374 [==============================] - 0s 71us/step - loss: 8.1014 -
mean_absolute_error: 8.1014 - val_loss: 8.0362 - val_mean_absolute_error: 8.0362

Epoch 00119: val_loss did not improve from 7.30342
Epoch 120/500
1374/1374 [==============================] - 0s 67us/step - loss: 8.3384 -
mean_absolute_error: 8.3384 - val_loss: 13.2163 - val_mean_absolute_error:
13.2163

Epoch 00120: val_loss did not improve from 7.30342
Epoch 121/500
1374/1374 [==============================] - 0s 70us/step - loss: 9.1068 -
mean_absolute_error: 9.1068 - val_loss: 10.0146 - val_mean_absolute_error:
10.0146

Epoch 00121: val_loss did not improve from 7.30342
Epoch 122/500
1374/1374 [==============================] - 0s 74us/step - loss: 6.9263 -
mean_absolute_error: 6.9263 - val_loss: 8.1106 - val_mean_absolute_error: 8.1106

Epoch 00122: val_loss did not improve from 7.30342
Epoch 123/500
1374/1374 [==============================] - 0s 72us/step - loss: 7.4161 -
mean_absolute_error: 7.4161 - val_loss: 9.4438 - val_mean_absolute_error: 9.4438

Epoch 00123: val_loss did not improve from 7.30342
Epoch 124/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.7584 -
mean_absolute_error: 6.7584 - val_loss: 7.7670 - val_mean_absolute_error: 7.7670

Epoch 00124: val_loss did not improve from 7.30342
Epoch 125/500
1374/1374 [==============================] - 0s 71us/step - loss: 8.3241 -
mean_absolute_error: 8.3241 - val_loss: 10.8467 - val_mean_absolute_error:
10.8467

Epoch 00125: val_loss did not improve from 7.30342
Epoch 126/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.9336 -
mean_absolute_error: 6.9336 - val_loss: 10.8455 - val_mean_absolute_error:
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10.8455

Epoch 00126: val_loss did not improve from 7.30342
Epoch 127/500
1374/1374 [==============================] - 0s 74us/step - loss: 7.6849 -
mean_absolute_error: 7.6849 - val_loss: 7.7261 - val_mean_absolute_error: 7.7261

Epoch 00127: val_loss did not improve from 7.30342
Epoch 128/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.3249 -
mean_absolute_error: 6.3249 - val_loss: 7.4878 - val_mean_absolute_error: 7.4878

Epoch 00128: val_loss did not improve from 7.30342
Epoch 129/500
1374/1374 [==============================] - 0s 68us/step - loss: 8.0283 -
mean_absolute_error: 8.0283 - val_loss: 10.5315 - val_mean_absolute_error:
10.5315

Epoch 00129: val_loss did not improve from 7.30342
Epoch 130/500
1374/1374 [==============================] - 0s 72us/step - loss: 9.1627 -
mean_absolute_error: 9.1627 - val_loss: 8.3148 - val_mean_absolute_error: 8.3148

Epoch 00130: val_loss did not improve from 7.30342
Epoch 131/500
1374/1374 [==============================] - 0s 70us/step - loss: 7.3870 -
mean_absolute_error: 7.3870 - val_loss: 8.2330 - val_mean_absolute_error: 8.2330

Epoch 00131: val_loss did not improve from 7.30342
Epoch 132/500
1374/1374 [==============================] - 0s 73us/step - loss: 7.5528 -
mean_absolute_error: 7.5528 - val_loss: 7.3861 - val_mean_absolute_error: 7.3861

Epoch 00132: val_loss did not improve from 7.30342
Epoch 133/500
1374/1374 [==============================] - 0s 73us/step - loss: 6.8042 -
mean_absolute_error: 6.8042 - val_loss: 8.0851 - val_mean_absolute_error: 8.0851

Epoch 00133: val_loss did not improve from 7.30342
Epoch 134/500
1374/1374 [==============================] - 0s 77us/step - loss: 7.2874 -
mean_absolute_error: 7.2874 - val_loss: 7.4010 - val_mean_absolute_error: 7.4010

Epoch 00134: val_loss did not improve from 7.30342
Epoch 135/500
1374/1374 [==============================] - 0s 68us/step - loss: 7.6524 -
mean_absolute_error: 7.6524 - val_loss: 9.7323 - val_mean_absolute_error: 9.7323
```

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Epoch 00135: val_loss did not improve from 7.30342
Epoch 136/500
1374/1374 [==============================] - 0s 81us/step - loss: 7.0053 -
mean_absolute_error: 7.0053 - val_loss: 7.9614 - val_mean_absolute_error: 7.9614

Epoch 00136: val_loss did not improve from 7.30342
Epoch 137/500
1374/1374 [==============================] - 0s 72us/step - loss: 7.9191 -
mean_absolute_error: 7.9191 - val_loss: 7.1989 - val_mean_absolute_error: 7.1989

Epoch 00137: val_loss improved from 7.30342 to 7.19890, saving model to
Weights-137--7.19890.hdf5
Epoch 138/500
1374/1374 [==============================] - 0s 78us/step - loss: 7.3930 -
mean_absolute_error: 7.3930 - val_loss: 9.9631 - val_mean_absolute_error: 9.9631

Epoch 00138: val_loss did not improve from 7.19890
Epoch 139/500
1374/1374 [==============================] - 0s 70us/step - loss: 9.3158 -
mean_absolute_error: 9.3158 - val_loss: 7.6523 - val_mean_absolute_error: 7.6523

Epoch 00139: val_loss did not improve from 7.19890
Epoch 140/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.4960 -
mean_absolute_error: 6.4960 - val_loss: 8.1787 - val_mean_absolute_error: 8.1787

Epoch 00140: val_loss did not improve from 7.19890
Epoch 141/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.8658 -
mean_absolute_error: 6.8658 - val_loss: 6.8950 - val_mean_absolute_error: 6.8950

Epoch 00141: val_loss improved from 7.19890 to 6.89505, saving model to
Weights-141--6.89505.hdf5
Epoch 142/500
1374/1374 [==============================] - 0s 73us/step - loss: 7.1881 -
mean_absolute_error: 7.1881 - val_loss: 8.7377 - val_mean_absolute_error: 8.7377

Epoch 00142: val_loss did not improve from 6.89505
Epoch 143/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.0504 -
mean_absolute_error: 7.0504 - val_loss: 9.6378 - val_mean_absolute_error: 9.6378

Epoch 00143: val_loss did not improve from 6.89505
Epoch 144/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.3835 -
mean_absolute_error: 7.3835 - val_loss: 8.7705 - val_mean_absolute_error: 8.7705

Epoch 00144: val_loss did not improve from 6.89505
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Epoch 145/500
1374/1374 [==============================] - 0s 68us/step - loss: 7.8527 -
mean_absolute_error: 7.8527 - val_loss: 8.8193 - val_mean_absolute_error: 8.8193

Epoch 00145: val_loss did not improve from 6.89505
Epoch 146/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.7967 -
mean_absolute_error: 6.7967 - val_loss: 13.0389 - val_mean_absolute_error:
13.0389

Epoch 00146: val_loss did not improve from 6.89505
Epoch 147/500
1374/1374 [==============================] - 0s 74us/step - loss: 8.2168 -
mean_absolute_error: 8.2168 - val_loss: 9.5184 - val_mean_absolute_error: 9.5184

Epoch 00147: val_loss did not improve from 6.89505
Epoch 148/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.2225 -
mean_absolute_error: 7.2225 - val_loss: 10.1626 - val_mean_absolute_error:
10.1626

Epoch 00148: val_loss did not improve from 6.89505
Epoch 149/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.7701 -
mean_absolute_error: 6.7701 - val_loss: 8.1966 - val_mean_absolute_error: 8.1966

Epoch 00149: val_loss did not improve from 6.89505
Epoch 150/500
1374/1374 [==============================] - 0s 71us/step - loss: 7.1748 -
mean_absolute_error: 7.1748 - val_loss: 10.0747 - val_mean_absolute_error:
10.0747

Epoch 00150: val_loss did not improve from 6.89505
Epoch 151/500
1374/1374 [==============================] - 0s 71us/step - loss: 7.6207 -
mean_absolute_error: 7.6207 - val_loss: 8.3773 - val_mean_absolute_error: 8.3773

Epoch 00151: val_loss did not improve from 6.89505
Epoch 152/500
1374/1374 [==============================] - 0s 74us/step - loss: 6.4993 -
mean_absolute_error: 6.4993 - val_loss: 7.2616 - val_mean_absolute_error: 7.2616

Epoch 00152: val_loss did not improve from 6.89505
Epoch 153/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.9486 -
mean_absolute_error: 7.9486 - val_loss: 8.4345 - val_mean_absolute_error: 8.4345

Epoch 00153: val_loss did not improve from 6.89505
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Epoch 154/500
1374/1374 [==============================] - 0s 73us/step - loss: 7.5666 -
mean_absolute_error: 7.5666 - val_loss: 7.8817 - val_mean_absolute_error: 7.8817

Epoch 00154: val_loss did not improve from 6.89505
Epoch 155/500
1374/1374 [==============================] - 0s 72us/step - loss: 7.5674 -
mean_absolute_error: 7.5674 - val_loss: 8.3353 - val_mean_absolute_error: 8.3353

Epoch 00155: val_loss did not improve from 6.89505
Epoch 156/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.4695 -
mean_absolute_error: 7.4695 - val_loss: 8.5021 - val_mean_absolute_error: 8.5021

Epoch 00156: val_loss did not improve from 6.89505
Epoch 157/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.8385 -
mean_absolute_error: 6.8385 - val_loss: 7.6554 - val_mean_absolute_error: 7.6554

Epoch 00157: val_loss did not improve from 6.89505
Epoch 158/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.7908 -
mean_absolute_error: 6.7908 - val_loss: 10.4179 - val_mean_absolute_error:
10.4179

Epoch 00158: val_loss did not improve from 6.89505
Epoch 159/500
1374/1374 [==============================] - 0s 68us/step - loss: 9.2129 -
mean_absolute_error: 9.2129 - val_loss: 7.2795 - val_mean_absolute_error: 7.2795

Epoch 00159: val_loss did not improve from 6.89505
Epoch 160/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.6820 -
mean_absolute_error: 6.6820 - val_loss: 7.9775 - val_mean_absolute_error: 7.9775

Epoch 00160: val_loss did not improve from 6.89505
Epoch 161/500
1374/1374 [==============================] - 0s 73us/step - loss: 6.3338 -
mean_absolute_error: 6.3338 - val_loss: 9.1699 - val_mean_absolute_error: 9.1699

Epoch 00161: val_loss did not improve from 6.89505
Epoch 162/500
1374/1374 [==============================] - 0s 79us/step - loss: 7.2427 -
mean_absolute_error: 7.2427 - val_loss: 8.3147 - val_mean_absolute_error: 8.3147

Epoch 00162: val_loss did not improve from 6.89505
Epoch 163/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.4161 -
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mean_absolute_error: 7.4161 - val_loss: 12.9667 - val_mean_absolute_error:
12.9667

Epoch 00163: val_loss did not improve from 6.89505
Epoch 164/500
1374/1374 [==============================] - 0s 68us/step - loss: 7.4701 -
mean_absolute_error: 7.4701 - val_loss: 9.5743 - val_mean_absolute_error: 9.5743

Epoch 00164: val_loss did not improve from 6.89505
Epoch 165/500
1374/1374 [==============================] - 0s 69us/step - loss: 8.0706 -
mean_absolute_error: 8.0706 - val_loss: 7.6615 - val_mean_absolute_error: 7.6615

Epoch 00165: val_loss did not improve from 6.89505
Epoch 166/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.3853 -
mean_absolute_error: 7.3853 - val_loss: 8.0276 - val_mean_absolute_error: 8.0276

Epoch 00166: val_loss did not improve from 6.89505
Epoch 167/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.0748 -
mean_absolute_error: 6.0748 - val_loss: 9.4788 - val_mean_absolute_error: 9.4788

Epoch 00167: val_loss did not improve from 6.89505
Epoch 168/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.2887 -
mean_absolute_error: 6.2887 - val_loss: 8.3977 - val_mean_absolute_error: 8.3977

Epoch 00168: val_loss did not improve from 6.89505
Epoch 169/500
1374/1374 [==============================] - 0s 70us/step - loss: 7.8536 -
mean_absolute_error: 7.8536 - val_loss: 9.0955 - val_mean_absolute_error: 9.0955

Epoch 00169: val_loss did not improve from 6.89505
Epoch 170/500
1374/1374 [==============================] - 0s 71us/step - loss: 7.0320 -
mean_absolute_error: 7.0320 - val_loss: 8.4384 - val_mean_absolute_error: 8.4384

Epoch 00170: val_loss did not improve from 6.89505
Epoch 171/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.0120 -
mean_absolute_error: 6.0120 - val_loss: 8.7521 - val_mean_absolute_error: 8.7521

Epoch 00171: val_loss did not improve from 6.89505
Epoch 172/500
1374/1374 [==============================] - 0s 72us/step - loss: 7.1756 -
mean_absolute_error: 7.1756 - val_loss: 6.9829 - val_mean_absolute_error: 6.9829
```

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Epoch 00172: val_loss did not improve from 6.89505
Epoch 173/500
1374/1374 [==============================] - 0s 75us/step - loss: 7.5387 -
mean_absolute_error: 7.5387 - val_loss: 7.4623 - val_mean_absolute_error: 7.4623

Epoch 00173: val_loss did not improve from 6.89505
Epoch 174/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.3501 -
mean_absolute_error: 6.3501 - val_loss: 8.7294 - val_mean_absolute_error: 8.7294

Epoch 00174: val_loss did not improve from 6.89505
Epoch 175/500
1374/1374 [==============================] - 0s 71us/step - loss: 7.3018 -
mean_absolute_error: 7.3018 - val_loss: 9.9626 - val_mean_absolute_error: 9.9626

Epoch 00175: val_loss did not improve from 6.89505
Epoch 176/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.9788 -
mean_absolute_error: 5.9788 - val_loss: 7.8671 - val_mean_absolute_error: 7.8671

Epoch 00176: val_loss did not improve from 6.89505
Epoch 177/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.8228 -
mean_absolute_error: 6.8228 - val_loss: 8.9176 - val_mean_absolute_error: 8.9176

Epoch 00177: val_loss did not improve from 6.89505
Epoch 178/500
1374/1374 [==============================] - 0s 70us/step - loss: 7.5694 -
mean_absolute_error: 7.5694 - val_loss: 9.2273 - val_mean_absolute_error: 9.2273

Epoch 00178: val_loss did not improve from 6.89505
Epoch 179/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.7016 -
mean_absolute_error: 6.7016 - val_loss: 7.5379 - val_mean_absolute_error: 7.5379

Epoch 00179: val_loss did not improve from 6.89505
Epoch 180/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.8512 -
mean_absolute_error: 6.8512 - val_loss: 7.1301 - val_mean_absolute_error: 7.1301

Epoch 00180: val_loss did not improve from 6.89505
Epoch 181/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.5149 -
mean_absolute_error: 6.5149 - val_loss: 8.4307 - val_mean_absolute_error: 8.4307

Epoch 00181: val_loss did not improve from 6.89505
Epoch 182/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.7285 -
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mean_absolute_error: 6.7285 - val_loss: 8.6689 - val_mean_absolute_error: 8.6689

Epoch 00182: val_loss did not improve from 6.89505
Epoch 183/500
1374/1374 [==============================] - 0s 74us/step - loss: 6.8298 -
mean_absolute_error: 6.8298 - val_loss: 7.7721 - val_mean_absolute_error: 7.7721

Epoch 00183: val_loss did not improve from 6.89505
Epoch 184/500
1374/1374 [==============================] - 0s 75us/step - loss: 7.3560 -
mean_absolute_error: 7.3560 - val_loss: 7.6470 - val_mean_absolute_error: 7.6470

Epoch 00184: val_loss did not improve from 6.89505
Epoch 185/500
1374/1374 [==============================] - 0s 67us/step - loss: 7.0297 -
mean_absolute_error: 7.0297 - val_loss: 8.1448 - val_mean_absolute_error: 8.1449

Epoch 00185: val_loss did not improve from 6.89505
Epoch 186/500
1374/1374 [==============================] - 0s 75us/step - loss: 5.7984 -
mean_absolute_error: 5.7984 - val_loss: 7.0734 - val_mean_absolute_error: 7.0734

Epoch 00186: val_loss did not improve from 6.89505
Epoch 187/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.4164 -
mean_absolute_error: 6.4164 - val_loss: 10.3440 - val_mean_absolute_error:
10.3440

Epoch 00187: val_loss did not improve from 6.89505
Epoch 188/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.9868 -
mean_absolute_error: 7.9868 - val_loss: 7.7166 - val_mean_absolute_error: 7.7166

Epoch 00188: val_loss did not improve from 6.89505
Epoch 189/500
1374/1374 [==============================] - 0s 67us/step - loss: 5.7370 -
mean_absolute_error: 5.7370 - val_loss: 6.5539 - val_mean_absolute_error: 6.5539

Epoch 00189: val_loss improved from 6.89505 to 6.55386, saving model to
Weights-189--6.55386.hdf5
Epoch 190/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.7710 -
mean_absolute_error: 5.7710 - val_loss: 9.1019 - val_mean_absolute_error: 9.1019

Epoch 00190: val_loss did not improve from 6.55386
Epoch 191/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.9212 -
mean_absolute_error: 5.9212 - val_loss: 6.8503 - val_mean_absolute_error: 6.8503
```

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Epoch 00191: val_loss did not improve from 6.55386
Epoch 192/500
1374/1374 [==============================] - 0s 71us/step - loss: 7.0279 -
mean_absolute_error: 7.0279 - val_loss: 10.2172 - val_mean_absolute_error:
10.2172

Epoch 00192: val_loss did not improve from 6.55386
Epoch 193/500
1374/1374 [==============================] - 0s 75us/step - loss: 8.1412 -
mean_absolute_error: 8.1412 - val_loss: 10.4228 - val_mean_absolute_error:
10.4228

Epoch 00193: val_loss did not improve from 6.55386
Epoch 194/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.1044 -
mean_absolute_error: 6.1044 - val_loss: 7.8398 - val_mean_absolute_error: 7.8398

Epoch 00194: val_loss did not improve from 6.55386
Epoch 195/500
1374/1374 [==============================] - 0s 68us/step - loss: 7.4524 -
mean_absolute_error: 7.4524 - val_loss: 7.6057 - val_mean_absolute_error: 7.6057

Epoch 00195: val_loss did not improve from 6.55386
Epoch 196/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.9754 -
mean_absolute_error: 7.9754 - val_loss: 11.0927 - val_mean_absolute_error:
11.0927

Epoch 00196: val_loss did not improve from 6.55386
Epoch 197/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.4948 -
mean_absolute_error: 6.4948 - val_loss: 8.3530 - val_mean_absolute_error: 8.3530

Epoch 00197: val_loss did not improve from 6.55386
Epoch 198/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.6489 -
mean_absolute_error: 6.6489 - val_loss: 8.4865 - val_mean_absolute_error: 8.4865

Epoch 00198: val_loss did not improve from 6.55386
Epoch 199/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.3148 -
mean_absolute_error: 6.3148 - val_loss: 7.1215 - val_mean_absolute_error: 7.1215

Epoch 00199: val_loss did not improve from 6.55386
Epoch 200/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.4389 -
mean_absolute_error: 6.4389 - val_loss: 8.2045 - val_mean_absolute_error: 8.2045
```

```
Epoch 00200: val_loss did not improve from 6.55386
Epoch 201/500
1374/1374 [==============================] - 0s 70us/step - loss: 7.2877 -
mean_absolute_error: 7.2877 - val_loss: 7.9178 - val_mean_absolute_error: 7.9178

Epoch 00201: val_loss did not improve from 6.55386
Epoch 202/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.6233 -
mean_absolute_error: 5.6233 - val_loss: 6.4175 - val_mean_absolute_error: 6.4175

Epoch 00202: val_loss improved from 6.55386 to 6.41753, saving model to
Weights-202--6.41753.hdf5
Epoch 203/500
1374/1374 [==============================] - 0s 75us/step - loss: 6.1449 -
mean_absolute_error: 6.1449 - val_loss: 9.2293 - val_mean_absolute_error: 9.2293

Epoch 00203: val_loss did not improve from 6.41753
Epoch 204/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.5446 -
mean_absolute_error: 6.5446 - val_loss: 6.8672 - val_mean_absolute_error: 6.8672

Epoch 00204: val_loss did not improve from 6.41753
Epoch 205/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.7086 -
mean_absolute_error: 5.7086 - val_loss: 7.9025 - val_mean_absolute_error: 7.9025

Epoch 00205: val_loss did not improve from 6.41753
Epoch 206/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.9529 -
mean_absolute_error: 6.9529 - val_loss: 9.8731 - val_mean_absolute_error: 9.8731

Epoch 00206: val_loss did not improve from 6.41753
Epoch 207/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.8821 -
mean_absolute_error: 6.8821 - val_loss: 9.3902 - val_mean_absolute_error: 9.3902

Epoch 00207: val_loss did not improve from 6.41753
Epoch 208/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.6438 -
mean_absolute_error: 6.6438 - val_loss: 6.7800 - val_mean_absolute_error: 6.7800

Epoch 00208: val_loss did not improve from 6.41753
Epoch 209/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.2140 -
mean_absolute_error: 6.2140 - val_loss: 7.1647 - val_mean_absolute_error: 7.1647

Epoch 00209: val_loss did not improve from 6.41753
```

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Epoch 210/500
1374/1374 [==============================] - 0s 75us/step - loss: 5.3742 -
mean_absolute_error: 5.3742 - val_loss: 7.3034 - val_mean_absolute_error: 7.3034

Epoch 00210: val_loss did not improve from 6.41753
Epoch 211/500
1374/1374 [==============================] - 0s 68us/step - loss: 7.5267 -
mean_absolute_error: 7.5267 - val_loss: 10.7543 - val_mean_absolute_error:
10.7543

Epoch 00211: val_loss did not improve from 6.41753
Epoch 212/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.7123 -
mean_absolute_error: 7.7123 - val_loss: 7.2984 - val_mean_absolute_error: 7.2984

Epoch 00212: val_loss did not improve from 6.41753
Epoch 213/500
1374/1374 [==============================] - 0s 73us/step - loss: 6.0977 -
mean_absolute_error: 6.0977 - val_loss: 7.7909 - val_mean_absolute_error: 7.7909

Epoch 00213: val_loss did not improve from 6.41753
Epoch 214/500
1374/1374 [==============================] - 0s 73us/step - loss: 7.1308 -
mean_absolute_error: 7.1308 - val_loss: 8.0054 - val_mean_absolute_error: 8.0054

Epoch 00214: val_loss did not improve from 6.41753
Epoch 215/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.1672 -
mean_absolute_error: 7.1672 - val_loss: 6.9479 - val_mean_absolute_error: 6.9479

Epoch 00215: val_loss did not improve from 6.41753
Epoch 216/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.5562 -
mean_absolute_error: 6.5562 - val_loss: 8.2247 - val_mean_absolute_error: 8.2247

Epoch 00216: val_loss did not improve from 6.41753
Epoch 217/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.2551 -
mean_absolute_error: 7.2551 - val_loss: 7.4209 - val_mean_absolute_error: 7.4209

Epoch 00217: val_loss did not improve from 6.41753
Epoch 218/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.0566 -
mean_absolute_error: 6.0566 - val_loss: 6.5486 - val_mean_absolute_error: 6.5486

Epoch 00218: val_loss did not improve from 6.41753
Epoch 219/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.4860 -
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mean_absolute_error: 6.4860 - val_loss: 8.9488 - val_mean_absolute_error: 8.9488

Epoch 00219: val_loss did not improve from 6.41753
Epoch 220/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.8276 -
mean_absolute_error: 6.8276 - val_loss: 8.9433 - val_mean_absolute_error: 8.9433

Epoch 00220: val_loss did not improve from 6.41753
Epoch 221/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.8302 -
mean_absolute_error: 6.8302 - val_loss: 8.1352 - val_mean_absolute_error: 8.1352

Epoch 00221: val_loss did not improve from 6.41753
Epoch 222/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.8553 -
mean_absolute_error: 5.8553 - val_loss: 7.4677 - val_mean_absolute_error: 7.4677

Epoch 00222: val_loss did not improve from 6.41753
Epoch 223/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.3743 -
mean_absolute_error: 5.3743 - val_loss: 7.9112 - val_mean_absolute_error: 7.9112

Epoch 00223: val_loss did not improve from 6.41753
Epoch 224/500
1374/1374 [==============================] - 0s 77us/step - loss: 5.2817 -
mean_absolute_error: 5.2817 - val_loss: 7.2973 - val_mean_absolute_error: 7.2973

Epoch 00224: val_loss did not improve from 6.41753
Epoch 225/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.9955 -
mean_absolute_error: 5.9955 - val_loss: 8.0222 - val_mean_absolute_error: 8.0222

Epoch 00225: val_loss did not improve from 6.41753
Epoch 226/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.7593 -
mean_absolute_error: 6.7593 - val_loss: 7.7016 - val_mean_absolute_error: 7.7016

Epoch 00226: val_loss did not improve from 6.41753
Epoch 227/500
1374/1374 [==============================] - 0s 75us/step - loss: 5.7508 -
mean_absolute_error: 5.7508 - val_loss: 7.4254 - val_mean_absolute_error: 7.4254

Epoch 00227: val_loss did not improve from 6.41753
Epoch 228/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.9495 -
mean_absolute_error: 5.9495 - val_loss: 6.9274 - val_mean_absolute_error: 6.9274

Epoch 00228: val_loss did not improve from 6.41753
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Epoch 229/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.0077 -
mean_absolute_error: 6.0077 - val_loss: 6.5848 - val_mean_absolute_error: 6.5848

Epoch 00229: val_loss did not improve from 6.41753
Epoch 230/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.0280 -
mean_absolute_error: 6.0280 - val_loss: 9.1100 - val_mean_absolute_error: 9.1100

Epoch 00230: val_loss did not improve from 6.41753
Epoch 231/500
1374/1374 [==============================] - 0s 73us/step - loss: 6.6732 -
mean_absolute_error: 6.6732 - val_loss: 7.6555 - val_mean_absolute_error: 7.6555

Epoch 00231: val_loss did not improve from 6.41753
Epoch 232/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.4349 -
mean_absolute_error: 6.4349 - val_loss: 15.1349 - val_mean_absolute_error:
15.1349

Epoch 00232: val_loss did not improve from 6.41753
Epoch 233/500
1374/1374 [==============================] - 0s 71us/step - loss: 10.1821 -
mean_absolute_error: 10.1821 - val_loss: 7.3012 - val_mean_absolute_error:
7.3012

Epoch 00233: val_loss did not improve from 6.41753
Epoch 234/500
1374/1374 [==============================] - 0s 76us/step - loss: 6.5425 -
mean_absolute_error: 6.5425 - val_loss: 7.4002 - val_mean_absolute_error: 7.4002

Epoch 00234: val_loss did not improve from 6.41753
Epoch 235/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.2666 -
mean_absolute_error: 6.2666 - val_loss: 7.2602 - val_mean_absolute_error: 7.2602

Epoch 00235: val_loss did not improve from 6.41753
Epoch 236/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.8412 -
mean_absolute_error: 5.8412 - val_loss: 7.4870 - val_mean_absolute_error: 7.4870

Epoch 00236: val_loss did not improve from 6.41753
Epoch 237/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.7974 -
mean_absolute_error: 5.7974 - val_loss: 7.3222 - val_mean_absolute_error: 7.3222

Epoch 00237: val_loss did not improve from 6.41753
Epoch 238/500
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1374/1374 [==============================] - 0s 70us/step - loss: 6.5535 -
mean_absolute_error: 6.5535 - val_loss: 8.4732 - val_mean_absolute_error: 8.4732

Epoch 00238: val_loss did not improve from 6.41753
Epoch 239/500
1374/1374 [==============================] - 0s 73us/step - loss: 5.9397 -
mean_absolute_error: 5.9397 - val_loss: 6.9892 - val_mean_absolute_error: 6.9892

Epoch 00239: val_loss did not improve from 6.41753
Epoch 240/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.7545 -
mean_absolute_error: 5.7545 - val_loss: 7.8427 - val_mean_absolute_error: 7.8427

Epoch 00240: val_loss did not improve from 6.41753
Epoch 241/500
1374/1374 [==============================] - 0s 74us/step - loss: 6.2264 -
mean_absolute_error: 6.2264 - val_loss: 7.2354 - val_mean_absolute_error: 7.2354

Epoch 00241: val_loss did not improve from 6.41753
Epoch 242/500
1374/1374 [==============================] - 0s 76us/step - loss: 6.2243 -
mean_absolute_error: 6.2243 - val_loss: 7.9208 - val_mean_absolute_error: 7.9208

Epoch 00242: val_loss did not improve from 6.41753
Epoch 243/500
1374/1374 [==============================] - 0s 74us/step - loss: 6.3853 -
mean_absolute_error: 6.3853 - val_loss: 7.8421 - val_mean_absolute_error: 7.8421

Epoch 00243: val_loss did not improve from 6.41753
Epoch 244/500
1374/1374 [==============================] - 0s 73us/step - loss: 5.7585 -
mean_absolute_error: 5.7585 - val_loss: 7.3567 - val_mean_absolute_error: 7.3567

Epoch 00244: val_loss did not improve from 6.41753
Epoch 245/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.7247 -
mean_absolute_error: 5.7247 - val_loss: 11.2198 - val_mean_absolute_error:
11.2198

Epoch 00245: val_loss did not improve from 6.41753
Epoch 246/500
1374/1374 [==============================] - 0s 71us/step - loss: 7.1833 -
mean_absolute_error: 7.1833 - val_loss: 6.7922 - val_mean_absolute_error: 6.7922

Epoch 00246: val_loss did not improve from 6.41753
Epoch 247/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.8881 -
mean_absolute_error: 5.8881 - val_loss: 9.2816 - val_mean_absolute_error: 9.2816
```

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Epoch 00247: val_loss did not improve from 6.41753
Epoch 248/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.3120 -
mean_absolute_error: 6.3120 - val_loss: 9.9839 - val_mean_absolute_error: 9.9839

Epoch 00248: val_loss did not improve from 6.41753
Epoch 249/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.4439 -
mean_absolute_error: 6.4439 - val_loss: 9.5966 - val_mean_absolute_error: 9.5966

Epoch 00249: val_loss did not improve from 6.41753
Epoch 250/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.9357 -
mean_absolute_error: 6.9357 - val_loss: 7.2040 - val_mean_absolute_error: 7.2040

Epoch 00250: val_loss did not improve from 6.41753
Epoch 251/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.5894 -
mean_absolute_error: 5.5894 - val_loss: 7.4728 - val_mean_absolute_error: 7.4728

Epoch 00251: val_loss did not improve from 6.41753
Epoch 252/500
1374/1374 [==============================] - 0s 72us/step - loss: 6.0388 -
mean_absolute_error: 6.0388 - val_loss: 7.1719 - val_mean_absolute_error: 7.1719

Epoch 00252: val_loss did not improve from 6.41753
Epoch 253/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.3865 -
mean_absolute_error: 6.3865 - val_loss: 8.6108 - val_mean_absolute_error: 8.6108

Epoch 00253: val_loss did not improve from 6.41753
Epoch 254/500
1374/1374 [==============================] - 0s 78us/step - loss: 6.2994 -
mean_absolute_error: 6.2994 - val_loss: 7.9711 - val_mean_absolute_error: 7.9711

Epoch 00254: val_loss did not improve from 6.41753
Epoch 255/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.8838 -
mean_absolute_error: 5.8838 - val_loss: 6.4597 - val_mean_absolute_error: 6.4597

Epoch 00255: val_loss did not improve from 6.41753
Epoch 256/500
1374/1374 [==============================] - 0s 71us/step - loss: 7.0973 -
mean_absolute_error: 7.0973 - val_loss: 6.6304 - val_mean_absolute_error: 6.6304

Epoch 00256: val_loss did not improve from 6.41753
Epoch 257/500
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1374/1374 [==============================] - 0s 70us/step - loss: 5.6490 -
mean_absolute_error: 5.6490 - val_loss: 6.9740 - val_mean_absolute_error: 6.9740

Epoch 00257: val_loss did not improve from 6.41753
Epoch 258/500
1374/1374 [==============================] - 0s 74us/step - loss: 5.8387 -
mean_absolute_error: 5.8387 - val_loss: 8.1115 - val_mean_absolute_error: 8.1115

Epoch 00258: val_loss did not improve from 6.41753
Epoch 259/500
1374/1374 [==============================] - 0s 72us/step - loss: 6.3728 -
mean_absolute_error: 6.3728 - val_loss: 8.0008 - val_mean_absolute_error: 8.0008

Epoch 00259: val_loss did not improve from 6.41753
Epoch 260/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.7610 -
mean_absolute_error: 7.7610 - val_loss: 7.3705 - val_mean_absolute_error: 7.3705

Epoch 00260: val_loss did not improve from 6.41753
Epoch 261/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.9135 -
mean_absolute_error: 5.9135 - val_loss: 6.2058 - val_mean_absolute_error: 6.2058

Epoch 00261: val_loss improved from 6.41753 to 6.20582, saving model to
Weights-261--6.20582.hdf5
Epoch 262/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.3135 -
mean_absolute_error: 5.3135 - val_loss: 7.4405 - val_mean_absolute_error: 7.4405

Epoch 00262: val_loss did not improve from 6.20582
Epoch 263/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.8926 -
mean_absolute_error: 6.8926 - val_loss: 7.7312 - val_mean_absolute_error: 7.7312

Epoch 00263: val_loss did not improve from 6.20582
Epoch 264/500
1374/1374 [==============================] - 0s 73us/step - loss: 6.4779 -
mean_absolute_error: 6.4779 - val_loss: 6.6835 - val_mean_absolute_error: 6.6835

Epoch 00264: val_loss did not improve from 6.20582
Epoch 265/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.4776 -
mean_absolute_error: 5.4776 - val_loss: 8.4501 - val_mean_absolute_error: 8.4501

Epoch 00265: val_loss did not improve from 6.20582
Epoch 266/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.2925 -
mean_absolute_error: 5.2925 - val_loss: 7.4641 - val_mean_absolute_error: 7.4641
```

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Epoch 00266: val_loss did not improve from 6.20582
Epoch 267/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.8303 -
mean_absolute_error: 6.8303 - val_loss: 14.2410 - val_mean_absolute_error:
14.2410

Epoch 00267: val_loss did not improve from 6.20582
Epoch 268/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.6088 -
mean_absolute_error: 6.6088 - val_loss: 6.9561 - val_mean_absolute_error: 6.9561

Epoch 00268: val_loss did not improve from 6.20582
Epoch 269/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.4997 -
mean_absolute_error: 5.4997 - val_loss: 6.7842 - val_mean_absolute_error: 6.7842

Epoch 00269: val_loss did not improve from 6.20582
Epoch 270/500
1374/1374 [==============================] - 0s 72us/step - loss: 4.9415 -
mean_absolute_error: 4.9415 - val_loss: 6.5189 - val_mean_absolute_error: 6.5189

Epoch 00270: val_loss did not improve from 6.20582
Epoch 271/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.8755 -
mean_absolute_error: 5.8755 - val_loss: 7.4660 - val_mean_absolute_error: 7.4660

Epoch 00271: val_loss did not improve from 6.20582
Epoch 272/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.6827 -
mean_absolute_error: 5.6827 - val_loss: 9.4138 - val_mean_absolute_error: 9.4138

Epoch 00272: val_loss did not improve from 6.20582
Epoch 273/500
1374/1374 [==============================] - 0s 67us/step - loss: 5.9308 -
mean_absolute_error: 5.9308 - val_loss: 6.7220 - val_mean_absolute_error: 6.7220

Epoch 00273: val_loss did not improve from 6.20582
Epoch 274/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.8309 -
mean_absolute_error: 5.8309 - val_loss: 7.4953 - val_mean_absolute_error: 7.4953

Epoch 00274: val_loss did not improve from 6.20582
Epoch 275/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.9358 -
mean_absolute_error: 4.9358 - val_loss: 6.0589 - val_mean_absolute_error: 6.0589

Epoch 00275: val_loss improved from 6.20582 to 6.05886, saving model to
```

```
Weights-275--6.05886.hdf5
Epoch 276/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.0089 -
mean_absolute_error: 6.0089 - val_loss: 7.8334 - val_mean_absolute_error: 7.8334

Epoch 00276: val_loss did not improve from 6.05886
Epoch 277/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.3286 -
mean_absolute_error: 5.3286 - val_loss: 6.8026 - val_mean_absolute_error: 6.8026

Epoch 00277: val_loss did not improve from 6.05886
Epoch 278/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.6554 -
mean_absolute_error: 5.6554 - val_loss: 7.8708 - val_mean_absolute_error: 7.8708

Epoch 00278: val_loss did not improve from 6.05886
Epoch 279/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.3266 -
mean_absolute_error: 7.3266 - val_loss: 11.1998 - val_mean_absolute_error:
11.1998

Epoch 00279: val_loss did not improve from 6.05886
Epoch 280/500
1374/1374 [==============================] - 0s 69us/step - loss: 7.5107 -
mean_absolute_error: 7.5107 - val_loss: 8.5808 - val_mean_absolute_error: 8.5808

Epoch 00280: val_loss did not improve from 6.05886
Epoch 281/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.9181 -
mean_absolute_error: 4.9181 - val_loss: 7.3283 - val_mean_absolute_error: 7.3283

Epoch 00281: val_loss did not improve from 6.05886
Epoch 282/500
1374/1374 [==============================] - 0s 73us/step - loss: 5.4161 -
mean_absolute_error: 5.4161 - val_loss: 6.3363 - val_mean_absolute_error: 6.3363

Epoch 00282: val_loss did not improve from 6.05886
Epoch 283/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.6167 -
mean_absolute_error: 6.6167 - val_loss: 8.2915 - val_mean_absolute_error: 8.2915

Epoch 00283: val_loss did not improve from 6.05886
Epoch 284/500
1374/1374 [==============================] - 0s 72us/step - loss: 6.0638 -
mean_absolute_error: 6.0638 - val_loss: 9.4563 - val_mean_absolute_error: 9.4563

Epoch 00284: val_loss did not improve from 6.05886
Epoch 285/500
```

```
1374/1374 [==============================] - 0s 76us/step - loss: 5.2093 -
mean_absolute_error: 5.2093 - val_loss: 6.6796 - val_mean_absolute_error: 6.6796

Epoch 00285: val_loss did not improve from 6.05886
Epoch 286/500
1374/1374 [==============================] - 0s 76us/step - loss: 5.9394 -
mean_absolute_error: 5.9394 - val_loss: 8.4028 - val_mean_absolute_error: 8.4028

Epoch 00286: val_loss did not improve from 6.05886
Epoch 287/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.4933 -
mean_absolute_error: 5.4933 - val_loss: 6.9109 - val_mean_absolute_error: 6.9109

Epoch 00287: val_loss did not improve from 6.05886
Epoch 288/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.0884 -
mean_absolute_error: 5.0884 - val_loss: 7.4657 - val_mean_absolute_error: 7.4657

Epoch 00288: val_loss did not improve from 6.05886
Epoch 289/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.5705 -
mean_absolute_error: 5.5705 - val_loss: 6.7024 - val_mean_absolute_error: 6.7024

Epoch 00289: val_loss did not improve from 6.05886
Epoch 290/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.0195 -
mean_absolute_error: 6.0195 - val_loss: 8.2285 - val_mean_absolute_error: 8.2285

Epoch 00290: val_loss did not improve from 6.05886
Epoch 291/500
1374/1374 [==============================] - 0s 79us/step - loss: 5.3945 -
mean_absolute_error: 5.3945 - val_loss: 9.3973 - val_mean_absolute_error: 9.3973

Epoch 00291: val_loss did not improve from 6.05886
Epoch 292/500
1374/1374 [==============================] - 0s 73us/step - loss: 5.5340 -
mean_absolute_error: 5.5340 - val_loss: 6.6497 - val_mean_absolute_error: 6.6497

Epoch 00292: val_loss did not improve from 6.05886
Epoch 293/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.3875 -
mean_absolute_error: 6.3875 - val_loss: 7.1349 - val_mean_absolute_error: 7.1349

Epoch 00293: val_loss did not improve from 6.05886
Epoch 294/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.9568 -
mean_absolute_error: 4.9568 - val_loss: 6.3390 - val_mean_absolute_error: 6.3390
```

```
Epoch 00294: val_loss did not improve from 6.05886
Epoch 295/500
1374/1374 [==============================] - 0s 75us/step - loss: 5.5582 -
mean_absolute_error: 5.5582 - val_loss: 7.8873 - val_mean_absolute_error: 7.8873

Epoch 00295: val_loss did not improve from 6.05886
Epoch 296/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.2399 -
mean_absolute_error: 5.2399 - val_loss: 8.2316 - val_mean_absolute_error: 8.2316

Epoch 00296: val_loss did not improve from 6.05886
Epoch 297/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.1365 -
mean_absolute_error: 6.1365 - val_loss: 7.3553 - val_mean_absolute_error: 7.3553

Epoch 00297: val_loss did not improve from 6.05886
Epoch 298/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.2802 -
mean_absolute_error: 6.2802 - val_loss: 7.2654 - val_mean_absolute_error: 7.2654

Epoch 00298: val_loss did not improve from 6.05886
Epoch 299/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.3451 -
mean_absolute_error: 6.3451 - val_loss: 9.1808 - val_mean_absolute_error: 9.1808

Epoch 00299: val_loss did not improve from 6.05886
Epoch 300/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.7558 -
mean_absolute_error: 6.7558 - val_loss: 8.1144 - val_mean_absolute_error: 8.1144

Epoch 00300: val_loss did not improve from 6.05886
Epoch 301/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.1641 -
mean_absolute_error: 5.1641 - val_loss: 10.2173 - val_mean_absolute_error:
10.2173

Epoch 00301: val_loss did not improve from 6.05886
Epoch 302/500
1374/1374 [==============================] - 0s 70us/step - loss: 7.2575 -
mean_absolute_error: 7.2575 - val_loss: 7.2988 - val_mean_absolute_error: 7.2988

Epoch 00302: val_loss did not improve from 6.05886
Epoch 303/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.3033 -
mean_absolute_error: 5.3033 - val_loss: 6.9695 - val_mean_absolute_error: 6.9695

Epoch 00303: val_loss did not improve from 6.05886
Epoch 304/500
```

```
1374/1374 [==============================] - 0s 68us/step - loss: 5.1301 -
mean_absolute_error: 5.1301 - val_loss: 7.2759 - val_mean_absolute_error: 7.2759

Epoch 00304: val_loss did not improve from 6.05886
Epoch 305/500
1374/1374 [==============================] - 0s 72us/step - loss: 4.9969 -
mean_absolute_error: 4.9969 - val_loss: 7.3505 - val_mean_absolute_error: 7.3505

Epoch 00305: val_loss did not improve from 6.05886
Epoch 306/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.2646 -
mean_absolute_error: 5.2646 - val_loss: 7.3191 - val_mean_absolute_error: 7.3191

Epoch 00306: val_loss did not improve from 6.05886
Epoch 307/500
1374/1374 [==============================] - 0s 76us/step - loss: 5.3436 -
mean_absolute_error: 5.3436 - val_loss: 8.3035 - val_mean_absolute_error: 8.3035

Epoch 00307: val_loss did not improve from 6.05886
Epoch 308/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.7893 -
mean_absolute_error: 6.7893 - val_loss: 7.0471 - val_mean_absolute_error: 7.0471

Epoch 00308: val_loss did not improve from 6.05886
Epoch 309/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.3719 -
mean_absolute_error: 5.3719 - val_loss: 8.4978 - val_mean_absolute_error: 8.4978

Epoch 00309: val_loss did not improve from 6.05886
Epoch 310/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.8943 -
mean_absolute_error: 5.8943 - val_loss: 7.2799 - val_mean_absolute_error: 7.2799

Epoch 00310: val_loss did not improve from 6.05886
Epoch 311/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.4214 -
mean_absolute_error: 6.4214 - val_loss: 6.6026 - val_mean_absolute_error: 6.6026

Epoch 00311: val_loss did not improve from 6.05886
Epoch 312/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.5474 -
mean_absolute_error: 5.5474 - val_loss: 7.8921 - val_mean_absolute_error: 7.8921

Epoch 00312: val_loss did not improve from 6.05886
Epoch 313/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.9029 -
mean_absolute_error: 5.9029 - val_loss: 7.7375 - val_mean_absolute_error: 7.7375
```

```
Epoch 00313: val_loss did not improve from 6.05886
Epoch 314/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.6342 -
mean_absolute_error: 6.6342 - val_loss: 7.5127 - val_mean_absolute_error: 7.5127

Epoch 00314: val_loss did not improve from 6.05886
Epoch 315/500
1374/1374 [==============================] - 0s 73us/step - loss: 5.6980 -
mean_absolute_error: 5.6980 - val_loss: 7.7772 - val_mean_absolute_error: 7.7772

Epoch 00315: val_loss did not improve from 6.05886
Epoch 316/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.1134 -
mean_absolute_error: 6.1134 - val_loss: 7.7016 - val_mean_absolute_error: 7.7016

Epoch 00316: val_loss did not improve from 6.05886
Epoch 317/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.5771 -
mean_absolute_error: 5.5771 - val_loss: 9.8416 - val_mean_absolute_error: 9.8416

Epoch 00317: val_loss did not improve from 6.05886
Epoch 318/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.9647 -
mean_absolute_error: 5.9647 - val_loss: 7.1919 - val_mean_absolute_error: 7.1919

Epoch 00318: val_loss did not improve from 6.05886
Epoch 319/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.1710 -
mean_absolute_error: 5.1710 - val_loss: 6.8491 - val_mean_absolute_error: 6.8491

Epoch 00319: val_loss did not improve from 6.05886
Epoch 320/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.3221 -
mean_absolute_error: 6.3221 - val_loss: 12.4362 - val_mean_absolute_error:
12.4362

Epoch 00320: val_loss did not improve from 6.05886
Epoch 321/500
1374/1374 [==============================] - 0s 70us/step - loss: 7.0506 -
mean_absolute_error: 7.0506 - val_loss: 7.0889 - val_mean_absolute_error: 7.0889

Epoch 00321: val_loss did not improve from 6.05886
Epoch 322/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.9444 -
mean_absolute_error: 5.9444 - val_loss: 5.9545 - val_mean_absolute_error: 5.9545

Epoch 00322: val_loss improved from 6.05886 to 5.95450, saving model to
Weights-322--5.95450.hdf5
```

```
Epoch 323/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.6644 -
mean_absolute_error: 4.6644 - val_loss: 7.1450 - val_mean_absolute_error: 7.1450

Epoch 00323: val_loss did not improve from 5.95450
Epoch 324/500
1374/1374 [==============================] - 0s 72us/step - loss: 6.7971 -
mean_absolute_error: 6.7971 - val_loss: 7.0833 - val_mean_absolute_error: 7.0833

Epoch 00324: val_loss did not improve from 5.95450
Epoch 325/500
1374/1374 [==============================] - 0s 73us/step - loss: 5.7768 -
mean_absolute_error: 5.7768 - val_loss: 6.9124 - val_mean_absolute_error: 6.9124

Epoch 00325: val_loss did not improve from 5.95450
Epoch 326/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.8842 -
mean_absolute_error: 4.8842 - val_loss: 8.0365 - val_mean_absolute_error: 8.0365

Epoch 00326: val_loss did not improve from 5.95450
Epoch 327/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.6883 -
mean_absolute_error: 5.6883 - val_loss: 6.7519 - val_mean_absolute_error: 6.7519

Epoch 00327: val_loss did not improve from 5.95450
Epoch 328/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.0839 -
mean_absolute_error: 5.0839 - val_loss: 7.1807 - val_mean_absolute_error: 7.1807

Epoch 00328: val_loss did not improve from 5.95450
Epoch 329/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.6273 -
mean_absolute_error: 5.6273 - val_loss: 7.7549 - val_mean_absolute_error: 7.7549

Epoch 00329: val_loss did not improve from 5.95450
Epoch 330/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.4464 -
mean_absolute_error: 5.4464 - val_loss: 7.6419 - val_mean_absolute_error: 7.6419

Epoch 00330: val_loss did not improve from 5.95450
Epoch 331/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.9360 -
mean_absolute_error: 4.9360 - val_loss: 5.7528 - val_mean_absolute_error: 5.7528

Epoch 00331: val_loss improved from 5.95450 to 5.75279, saving model to
Weights-331--5.75279.hdf5
Epoch 332/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.6494 -
```

```
mean_absolute_error: 5.6494 - val_loss: 7.6325 - val_mean_absolute_error: 7.6325

Epoch 00332: val_loss did not improve from 5.75279
Epoch 333/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.8058 -
mean_absolute_error: 5.8058 - val_loss: 8.7966 - val_mean_absolute_error: 8.7966

Epoch 00333: val_loss did not improve from 5.75279
Epoch 334/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.9831 -
mean_absolute_error: 4.9831 - val_loss: 7.1028 - val_mean_absolute_error: 7.1028

Epoch 00334: val_loss did not improve from 5.75279
Epoch 335/500
1374/1374 [==============================] - 0s 72us/step - loss: 6.4722 -
mean_absolute_error: 6.4722 - val_loss: 9.6147 - val_mean_absolute_error: 9.6147

Epoch 00335: val_loss did not improve from 5.75279
Epoch 336/500
1374/1374 [==============================] - 0s 77us/step - loss: 6.9193 -
mean_absolute_error: 6.9193 - val_loss: 7.2513 - val_mean_absolute_error: 7.2513

Epoch 00336: val_loss did not improve from 5.75279
Epoch 337/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.9292 -
mean_absolute_error: 4.9292 - val_loss: 8.2283 - val_mean_absolute_error: 8.2283

Epoch 00337: val_loss did not improve from 5.75279
Epoch 338/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.4414 -
mean_absolute_error: 5.4414 - val_loss: 7.2703 - val_mean_absolute_error: 7.2703

Epoch 00338: val_loss did not improve from 5.75279
Epoch 339/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.5164 -
mean_absolute_error: 5.5164 - val_loss: 6.1380 - val_mean_absolute_error: 6.1379

Epoch 00339: val_loss did not improve from 5.75279
Epoch 340/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.0169 -
mean_absolute_error: 5.0169 - val_loss: 6.0510 - val_mean_absolute_error: 6.0510

Epoch 00340: val_loss did not improve from 5.75279
Epoch 341/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.1427 -
mean_absolute_error: 6.1427 - val_loss: 8.4636 - val_mean_absolute_error: 8.4636

Epoch 00341: val_loss did not improve from 5.75279
```

```
Epoch 342/500
1374/1374 [==============================] - 0s 70us/step - loss: 7.4264 -
mean_absolute_error: 7.4264 - val_loss: 6.5267 - val_mean_absolute_error: 6.5267

Epoch 00342: val_loss did not improve from 5.75279
Epoch 343/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.3876 -
mean_absolute_error: 5.3876 - val_loss: 6.5081 - val_mean_absolute_error: 6.5081

Epoch 00343: val_loss did not improve from 5.75279
Epoch 344/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.2686 -
mean_absolute_error: 5.2686 - val_loss: 6.8234 - val_mean_absolute_error: 6.8234

Epoch 00344: val_loss did not improve from 5.75279
Epoch 345/500
1374/1374 [==============================] - 0s 71us/step - loss: 4.9821 -
mean_absolute_error: 4.9821 - val_loss: 6.1996 - val_mean_absolute_error: 6.1996

Epoch 00345: val_loss did not improve from 5.75279
Epoch 346/500
1374/1374 [==============================] - 0s 84us/step - loss: 4.8695 -
mean_absolute_error: 4.8695 - val_loss: 7.6077 - val_mean_absolute_error: 7.6077

Epoch 00346: val_loss did not improve from 5.75279
Epoch 347/500
1374/1374 [==============================] - 0s 71us/step - loss: 7.2154 -
mean_absolute_error: 7.2154 - val_loss: 9.2566 - val_mean_absolute_error: 9.2566

Epoch 00347: val_loss did not improve from 5.75279
Epoch 348/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.7554 -
mean_absolute_error: 5.7554 - val_loss: 6.1040 - val_mean_absolute_error: 6.1040

Epoch 00348: val_loss did not improve from 5.75279
Epoch 349/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.3233 -
mean_absolute_error: 5.3233 - val_loss: 6.0269 - val_mean_absolute_error: 6.0269

Epoch 00349: val_loss did not improve from 5.75279
Epoch 350/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.4940 -
mean_absolute_error: 4.4940 - val_loss: 8.1844 - val_mean_absolute_error: 8.1844

Epoch 00350: val_loss did not improve from 5.75279
Epoch 351/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.3951 -
mean_absolute_error: 6.3951 - val_loss: 7.4227 - val_mean_absolute_error: 7.4227
```

```
Epoch 00351: val_loss did not improve from 5.75279
Epoch 352/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.8906 -
mean_absolute_error: 4.8906 - val_loss: 6.1194 - val_mean_absolute_error: 6.1194

Epoch 00352: val_loss did not improve from 5.75279
Epoch 353/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.9989 -
mean_absolute_error: 4.9989 - val_loss: 7.0943 - val_mean_absolute_error: 7.0943

Epoch 00353: val_loss did not improve from 5.75279
Epoch 354/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.5870 -
mean_absolute_error: 5.5870 - val_loss: 6.5597 - val_mean_absolute_error: 6.5597

Epoch 00354: val_loss did not improve from 5.75279
Epoch 355/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.8245 -
mean_absolute_error: 4.8245 - val_loss: 7.2895 - val_mean_absolute_error: 7.2895

Epoch 00355: val_loss did not improve from 5.75279
Epoch 356/500
1374/1374 [==============================] - 0s 75us/step - loss: 5.5661 -
mean_absolute_error: 5.5661 - val_loss: 8.6253 - val_mean_absolute_error: 8.6253

Epoch 00356: val_loss did not improve from 5.75279
Epoch 357/500
1374/1374 [==============================] - 0s 73us/step - loss: 4.9957 -
mean_absolute_error: 4.9957 - val_loss: 6.4840 - val_mean_absolute_error: 6.4840

Epoch 00357: val_loss did not improve from 5.75279
Epoch 358/500
1374/1374 [==============================] - 0s 76us/step - loss: 5.7023 -
mean_absolute_error: 5.7023 - val_loss: 6.9168 - val_mean_absolute_error: 6.9168

Epoch 00358: val_loss did not improve from 5.75279
Epoch 359/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.8439 -
mean_absolute_error: 5.8439 - val_loss: 6.0328 - val_mean_absolute_error: 6.0328

Epoch 00359: val_loss did not improve from 5.75279
Epoch 360/500
1374/1374 [==============================] - 0s 77us/step - loss: 4.6804 -
mean_absolute_error: 4.6804 - val_loss: 6.4881 - val_mean_absolute_error: 6.4881

Epoch 00360: val_loss did not improve from 5.75279
Epoch 361/500
```

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1374/1374 [==============================] - 0s 71us/step - loss: 4.4718 -
mean_absolute_error: 4.4718 - val_loss: 6.4502 - val_mean_absolute_error: 6.4502

Epoch 00361: val_loss did not improve from 5.75279
Epoch 362/500
1374/1374 [==============================] - 0s 76us/step - loss: 5.7339 -
mean_absolute_error: 5.7339 - val_loss: 6.1501 - val_mean_absolute_error: 6.1501

Epoch 00362: val_loss did not improve from 5.75279
Epoch 363/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.5110 -
mean_absolute_error: 4.5110 - val_loss: 6.4506 - val_mean_absolute_error: 6.4506

Epoch 00363: val_loss did not improve from 5.75279
Epoch 364/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.7738 -
mean_absolute_error: 4.7738 - val_loss: 7.5428 - val_mean_absolute_error: 7.5428

Epoch 00364: val_loss did not improve from 5.75279
Epoch 365/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.9457 -
mean_absolute_error: 4.9457 - val_loss: 7.3843 - val_mean_absolute_error: 7.3843

Epoch 00365: val_loss did not improve from 5.75279
Epoch 366/500
1374/1374 [==============================] - 0s 78us/step - loss: 5.7197 -
mean_absolute_error: 5.7197 - val_loss: 8.6354 - val_mean_absolute_error: 8.6354

Epoch 00366: val_loss did not improve from 5.75279
Epoch 367/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.2095 -
mean_absolute_error: 5.2095 - val_loss: 8.8512 - val_mean_absolute_error: 8.8512

Epoch 00367: val_loss did not improve from 5.75279
Epoch 368/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.7754 -
mean_absolute_error: 5.7754 - val_loss: 6.7117 - val_mean_absolute_error: 6.7117

Epoch 00368: val_loss did not improve from 5.75279
Epoch 369/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.4078 -
mean_absolute_error: 5.4078 - val_loss: 11.6445 - val_mean_absolute_error:
11.6445

Epoch 00369: val_loss did not improve from 5.75279
Epoch 370/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.3964 -
mean_absolute_error: 6.3964 - val_loss: 7.8439 - val_mean_absolute_error: 7.8439
```

```
Epoch 00370: val_loss did not improve from 5.75279
Epoch 371/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.8605 -
mean_absolute_error: 4.8605 - val_loss: 7.8781 - val_mean_absolute_error: 7.8781

Epoch 00371: val_loss did not improve from 5.75279
Epoch 372/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.6841 -
mean_absolute_error: 5.6841 - val_loss: 9.6307 - val_mean_absolute_error: 9.6306

Epoch 00372: val_loss did not improve from 5.75279
Epoch 373/500
1374/1374 [==============================] - 0s 67us/step - loss: 6.9575 -
mean_absolute_error: 6.9575 - val_loss: 12.0958 - val_mean_absolute_error:
12.0958

Epoch 00373: val_loss did not improve from 5.75279
Epoch 374/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.7369 -
mean_absolute_error: 5.7369 - val_loss: 8.0176 - val_mean_absolute_error: 8.0176

Epoch 00374: val_loss did not improve from 5.75279
Epoch 375/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.8071 -
mean_absolute_error: 5.8071 - val_loss: 6.5948 - val_mean_absolute_error: 6.5948

Epoch 00375: val_loss did not improve from 5.75279
Epoch 376/500
1374/1374 [==============================] - 0s 74us/step - loss: 4.8518 -
mean_absolute_error: 4.8518 - val_loss: 6.4762 - val_mean_absolute_error: 6.4762

Epoch 00376: val_loss did not improve from 5.75279
Epoch 377/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.1485 -
mean_absolute_error: 4.1485 - val_loss: 7.0447 - val_mean_absolute_error: 7.0447

Epoch 00377: val_loss did not improve from 5.75279
Epoch 378/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.9384 -
mean_absolute_error: 4.9384 - val_loss: 6.0005 - val_mean_absolute_error: 6.0005

Epoch 00378: val_loss did not improve from 5.75279
Epoch 379/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.2937 -
mean_absolute_error: 5.2937 - val_loss: 7.8915 - val_mean_absolute_error: 7.8915

Epoch 00379: val_loss did not improve from 5.75279
```

```
Epoch 380/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.1220 -
mean_absolute_error: 5.1220 - val_loss: 6.8651 - val_mean_absolute_error: 6.8651

Epoch 00380: val_loss did not improve from 5.75279
Epoch 381/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.0088 -
mean_absolute_error: 5.0088 - val_loss: 5.9346 - val_mean_absolute_error: 5.9346

Epoch 00381: val_loss did not improve from 5.75279
Epoch 382/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.2985 -
mean_absolute_error: 5.2985 - val_loss: 6.5707 - val_mean_absolute_error: 6.5707

Epoch 00382: val_loss did not improve from 5.75279
Epoch 383/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.8970 -
mean_absolute_error: 5.8970 - val_loss: 6.8356 - val_mean_absolute_error: 6.8356

Epoch 00383: val_loss did not improve from 5.75279
Epoch 384/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.6620 -
mean_absolute_error: 4.6620 - val_loss: 7.3106 - val_mean_absolute_error: 7.3106

Epoch 00384: val_loss did not improve from 5.75279
Epoch 385/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.3991 -
mean_absolute_error: 5.3991 - val_loss: 6.3030 - val_mean_absolute_error: 6.3030

Epoch 00385: val_loss did not improve from 5.75279
Epoch 386/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.8009 -
mean_absolute_error: 4.8009 - val_loss: 6.3951 - val_mean_absolute_error: 6.3951

Epoch 00386: val_loss did not improve from 5.75279
Epoch 387/500
1374/1374 [==============================] - 0s 73us/step - loss: 5.4890 -
mean_absolute_error: 5.4890 - val_loss: 6.9139 - val_mean_absolute_error: 6.9139

Epoch 00387: val_loss did not improve from 5.75279
Epoch 388/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.7850 -
mean_absolute_error: 5.7850 - val_loss: 7.5410 - val_mean_absolute_error: 7.5410

Epoch 00388: val_loss did not improve from 5.75279
Epoch 389/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.0321 -
mean_absolute_error: 5.0321 - val_loss: 6.8206 - val_mean_absolute_error: 6.8206
```

```
Epoch 00389: val_loss did not improve from 5.75279
Epoch 390/500
1374/1374 [==============================] - 0s 74us/step - loss: 4.6449 -
mean_absolute_error: 4.6449 - val_loss: 7.5354 - val_mean_absolute_error: 7.5354

Epoch 00390: val_loss did not improve from 5.75279
Epoch 391/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.6920 -
mean_absolute_error: 4.6920 - val_loss: 6.0702 - val_mean_absolute_error: 6.0702

Epoch 00391: val_loss did not improve from 5.75279
Epoch 392/500
1374/1374 [==============================] - 0s 68us/step - loss: 6.3336 -
mean_absolute_error: 6.3336 - val_loss: 9.3801 - val_mean_absolute_error: 9.3801

Epoch 00392: val_loss did not improve from 5.75279
Epoch 393/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.8484 -
mean_absolute_error: 5.8484 - val_loss: 8.5320 - val_mean_absolute_error: 8.5320

Epoch 00393: val_loss did not improve from 5.75279
Epoch 394/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.9781 -
mean_absolute_error: 5.9781 - val_loss: 9.4562 - val_mean_absolute_error: 9.4562

Epoch 00394: val_loss did not improve from 5.75279
Epoch 395/500
1374/1374 [==============================] - 0s 72us/step - loss: 6.0909 -
mean_absolute_error: 6.0909 - val_loss: 6.8690 - val_mean_absolute_error: 6.8690

Epoch 00395: val_loss did not improve from 5.75279
Epoch 396/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.6044 -
mean_absolute_error: 5.6044 - val_loss: 6.0379 - val_mean_absolute_error: 6.0379

Epoch 00396: val_loss did not improve from 5.75279
Epoch 397/500
1374/1374 [==============================] - 0s 76us/step - loss: 5.0431 -
mean_absolute_error: 5.0431 - val_loss: 6.0776 - val_mean_absolute_error: 6.0776

Epoch 00397: val_loss did not improve from 5.75279
Epoch 398/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.4730 -
mean_absolute_error: 4.4730 - val_loss: 5.4625 - val_mean_absolute_error: 5.4625

Epoch 00398: val_loss improved from 5.75279 to 5.46247, saving model to
Weights-398--5.46247.hdf5
```

```
Epoch 399/500
1374/1374 [==============================] - 0s 67us/step - loss: 4.8186 -
mean_absolute_error: 4.8186 - val_loss: 7.4922 - val_mean_absolute_error: 7.4922

Epoch 00399: val_loss did not improve from 5.46247
Epoch 400/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.1047 -
mean_absolute_error: 6.1047 - val_loss: 6.1657 - val_mean_absolute_error: 6.1657

Epoch 00400: val_loss did not improve from 5.46247
Epoch 401/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.2108 -
mean_absolute_error: 5.2108 - val_loss: 7.6274 - val_mean_absolute_error: 7.6274

Epoch 00401: val_loss did not improve from 5.46247
Epoch 402/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.6952 -
mean_absolute_error: 5.6952 - val_loss: 7.7721 - val_mean_absolute_error: 7.7721

Epoch 00402: val_loss did not improve from 5.46247
Epoch 403/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.9942 -
mean_absolute_error: 4.9942 - val_loss: 6.2884 - val_mean_absolute_error: 6.2884

Epoch 00403: val_loss did not improve from 5.46247
Epoch 404/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.7355 -
mean_absolute_error: 4.7355 - val_loss: 5.7878 - val_mean_absolute_error: 5.7878

Epoch 00404: val_loss did not improve from 5.46247
Epoch 405/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.4148 -
mean_absolute_error: 4.4148 - val_loss: 6.1241 - val_mean_absolute_error: 6.1241

Epoch 00405: val_loss did not improve from 5.46247
Epoch 406/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.9153 -
mean_absolute_error: 5.9153 - val_loss: 6.9933 - val_mean_absolute_error: 6.9933

Epoch 00406: val_loss did not improve from 5.46247
Epoch 407/500
1374/1374 [==============================] - 0s 74us/step - loss: 4.9268 -
mean_absolute_error: 4.9268 - val_loss: 6.6087 - val_mean_absolute_error: 6.6087

Epoch 00407: val_loss did not improve from 5.46247
Epoch 408/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.2198 -
mean_absolute_error: 4.2198 - val_loss: 7.6520 - val_mean_absolute_error: 7.6520
```

```
Epoch 00408: val_loss did not improve from 5.46247
Epoch 409/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.9762 -
mean_absolute_error: 4.9762 - val_loss: 6.6623 - val_mean_absolute_error: 6.6623

Epoch 00409: val_loss did not improve from 5.46247
Epoch 410/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.6842 -
mean_absolute_error: 4.6842 - val_loss: 6.9150 - val_mean_absolute_error: 6.9150

Epoch 00410: val_loss did not improve from 5.46247
Epoch 411/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.3818 -
mean_absolute_error: 5.3818 - val_loss: 6.1595 - val_mean_absolute_error: 6.1595

Epoch 00411: val_loss did not improve from 5.46247
Epoch 412/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.7839 -
mean_absolute_error: 5.7839 - val_loss: 7.0121 - val_mean_absolute_error: 7.0121

Epoch 00412: val_loss did not improve from 5.46247
Epoch 413/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.7987 -
mean_absolute_error: 5.7987 - val_loss: 6.2186 - val_mean_absolute_error: 6.2186

Epoch 00413: val_loss did not improve from 5.46247
Epoch 414/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.7530 -
mean_absolute_error: 4.7530 - val_loss: 6.4986 - val_mean_absolute_error: 6.4986

Epoch 00414: val_loss did not improve from 5.46247
Epoch 415/500
1374/1374 [==============================] - 0s 72us/step - loss: 4.8133 -
mean_absolute_error: 4.8133 - val_loss: 6.2406 - val_mean_absolute_error: 6.2406

Epoch 00415: val_loss did not improve from 5.46247
Epoch 416/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.9568 -
mean_absolute_error: 4.9568 - val_loss: 6.6252 - val_mean_absolute_error: 6.6252

Epoch 00416: val_loss did not improve from 5.46247
Epoch 417/500
1374/1374 [==============================] - 0s 74us/step - loss: 4.8533 -
mean_absolute_error: 4.8533 - val_loss: 7.3964 - val_mean_absolute_error: 7.3964

Epoch 00417: val_loss did not improve from 5.46247
Epoch 418/500
```

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1374/1374 [==============================] - 0s 82us/step - loss: 5.0687 -
mean_absolute_error: 5.0687 - val_loss: 7.2194 - val_mean_absolute_error: 7.2194

Epoch 00418: val_loss did not improve from 5.46247
Epoch 419/500
1374/1374 [==============================] - 0s 68us/step - loss: 5.1067 -
mean_absolute_error: 5.1067 - val_loss: 7.6705 - val_mean_absolute_error: 7.6705

Epoch 00419: val_loss did not improve from 5.46247
Epoch 420/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.6503 -
mean_absolute_error: 4.6503 - val_loss: 6.9590 - val_mean_absolute_error: 6.9590

Epoch 00420: val_loss did not improve from 5.46247
Epoch 421/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.7382 -
mean_absolute_error: 4.7382 - val_loss: 7.0472 - val_mean_absolute_error: 7.0472

Epoch 00421: val_loss did not improve from 5.46247
Epoch 422/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.3829 -
mean_absolute_error: 5.3829 - val_loss: 8.2637 - val_mean_absolute_error: 8.2637

Epoch 00422: val_loss did not improve from 5.46247
Epoch 423/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.6593 -
mean_absolute_error: 5.6593 - val_loss: 13.8322 - val_mean_absolute_error:
13.8322

Epoch 00423: val_loss did not improve from 5.46247
Epoch 424/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.6794 -
mean_absolute_error: 5.6794 - val_loss: 7.2717 - val_mean_absolute_error: 7.2717

Epoch 00424: val_loss did not improve from 5.46247
Epoch 425/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.8496 -
mean_absolute_error: 5.8496 - val_loss: 8.2561 - val_mean_absolute_error: 8.2561

Epoch 00425: val_loss did not improve from 5.46247
Epoch 426/500
1374/1374 [==============================] - 0s 67us/step - loss: 6.1566 -
mean_absolute_error: 6.1566 - val_loss: 9.8262 - val_mean_absolute_error: 9.8262

Epoch 00426: val_loss did not improve from 5.46247
Epoch 427/500
1374/1374 [==============================] - 0s 67us/step - loss: 6.3873 -
mean_absolute_error: 6.3873 - val_loss: 6.4204 - val_mean_absolute_error: 6.4204
```

```
Epoch 00427: val_loss did not improve from 5.46247
Epoch 428/500
1374/1374 [==============================] - 0s 72us/step - loss: 4.7772 -
mean_absolute_error: 4.7772 - val_loss: 6.9623 - val_mean_absolute_error: 6.9623

Epoch 00428: val_loss did not improve from 5.46247
Epoch 429/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.2475 -
mean_absolute_error: 4.2475 - val_loss: 7.2752 - val_mean_absolute_error: 7.2752

Epoch 00429: val_loss did not improve from 5.46247
Epoch 430/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.9472 -
mean_absolute_error: 4.9472 - val_loss: 7.2275 - val_mean_absolute_error: 7.2275

Epoch 00430: val_loss did not improve from 5.46247
Epoch 431/500
1374/1374 [==============================] - 0s 73us/step - loss: 4.8968 -
mean_absolute_error: 4.8968 - val_loss: 6.4898 - val_mean_absolute_error: 6.4898

Epoch 00431: val_loss did not improve from 5.46247
Epoch 432/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.7278 -
mean_absolute_error: 4.7278 - val_loss: 6.9718 - val_mean_absolute_error: 6.9718

Epoch 00432: val_loss did not improve from 5.46247
Epoch 433/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.2231 -
mean_absolute_error: 5.2231 - val_loss: 7.0946 - val_mean_absolute_error: 7.0946

Epoch 00433: val_loss did not improve from 5.46247
Epoch 434/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.4690 -
mean_absolute_error: 5.4690 - val_loss: 6.7358 - val_mean_absolute_error: 6.7359

Epoch 00434: val_loss did not improve from 5.46247
Epoch 435/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.6033 -
mean_absolute_error: 5.6033 - val_loss: 7.1806 - val_mean_absolute_error: 7.1806

Epoch 00435: val_loss did not improve from 5.46247
Epoch 436/500
1374/1374 [==============================] - 0s 72us/step - loss: 4.3148 -
mean_absolute_error: 4.3148 - val_loss: 6.3719 - val_mean_absolute_error: 6.3719

Epoch 00436: val_loss did not improve from 5.46247
Epoch 437/500
```

```
1374/1374 [==============================] - 0s 78us/step - loss: 4.3128 -
mean_absolute_error: 4.3128 - val_loss: 6.9506 - val_mean_absolute_error: 6.9506

Epoch 00437: val_loss did not improve from 5.46247
Epoch 438/500
1374/1374 [==============================] - 0s 74us/step - loss: 5.6649 -
mean_absolute_error: 5.6649 - val_loss: 7.3245 - val_mean_absolute_error: 7.3245

Epoch 00438: val_loss did not improve from 5.46247
Epoch 439/500
1374/1374 [==============================] - 0s 71us/step - loss: 4.9795 -
mean_absolute_error: 4.9795 - val_loss: 7.3512 - val_mean_absolute_error: 7.3512

Epoch 00439: val_loss did not improve from 5.46247
Epoch 440/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.8876 -
mean_absolute_error: 5.8876 - val_loss: 7.4567 - val_mean_absolute_error: 7.4567

Epoch 00440: val_loss did not improve from 5.46247
Epoch 441/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.4897 -
mean_absolute_error: 4.4897 - val_loss: 6.9141 - val_mean_absolute_error: 6.9141

Epoch 00441: val_loss did not improve from 5.46247
Epoch 442/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.7285 -
mean_absolute_error: 4.7285 - val_loss: 6.8674 - val_mean_absolute_error: 6.8674

Epoch 00442: val_loss did not improve from 5.46247
Epoch 443/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.8528 -
mean_absolute_error: 4.8528 - val_loss: 8.1929 - val_mean_absolute_error: 8.1929

Epoch 00443: val_loss did not improve from 5.46247
Epoch 444/500
1374/1374 [==============================] - 0s 71us/step - loss: 6.0842 -
mean_absolute_error: 6.0842 - val_loss: 7.0617 - val_mean_absolute_error: 7.0617

Epoch 00444: val_loss did not improve from 5.46247
Epoch 445/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.4513 -
mean_absolute_error: 5.4513 - val_loss: 7.1674 - val_mean_absolute_error: 7.1674

Epoch 00445: val_loss did not improve from 5.46247
Epoch 446/500
1374/1374 [==============================] - 0s 77us/step - loss: 5.1406 -
mean_absolute_error: 5.1406 - val_loss: 6.5111 - val_mean_absolute_error: 6.5111
```

```
Epoch 00446: val_loss did not improve from 5.46247
Epoch 447/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.1826 -
mean_absolute_error: 5.1826 - val_loss: 11.2139 - val_mean_absolute_error:
11.2139

Epoch 00447: val_loss did not improve from 5.46247
Epoch 448/500
1374/1374 [==============================] - 0s 74us/step - loss: 5.9613 -
mean_absolute_error: 5.9613 - val_loss: 10.2818 - val_mean_absolute_error:
10.2818

Epoch 00448: val_loss did not improve from 5.46247
Epoch 449/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.0607 -
mean_absolute_error: 5.0607 - val_loss: 7.6801 - val_mean_absolute_error: 7.6801

Epoch 00449: val_loss did not improve from 5.46247
Epoch 450/500
1374/1374 [==============================] - 0s 74us/step - loss: 4.7116 -
mean_absolute_error: 4.7116 - val_loss: 5.9893 - val_mean_absolute_error: 5.9893

Epoch 00450: val_loss did not improve from 5.46247
Epoch 451/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.2097 -
mean_absolute_error: 4.2097 - val_loss: 7.8835 - val_mean_absolute_error: 7.8835

Epoch 00451: val_loss did not improve from 5.46247
Epoch 452/500
1374/1374 [==============================] - 0s 84us/step - loss: 4.7581 -
mean_absolute_error: 4.7581 - val_loss: 6.4391 - val_mean_absolute_error: 6.4391

Epoch 00452: val_loss did not improve from 5.46247
Epoch 453/500
1374/1374 [==============================] - 0s 73us/step - loss: 5.1378 -
mean_absolute_error: 5.1378 - val_loss: 6.9480 - val_mean_absolute_error: 6.9480

Epoch 00453: val_loss did not improve from 5.46247
Epoch 454/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.6042 -
mean_absolute_error: 4.6042 - val_loss: 6.3289 - val_mean_absolute_error: 6.3289

Epoch 00454: val_loss did not improve from 5.46247
Epoch 455/500
1374/1374 [==============================] - 0s 73us/step - loss: 5.2358 -
mean_absolute_error: 5.2358 - val_loss: 8.2371 - val_mean_absolute_error: 8.2371

Epoch 00455: val_loss did not improve from 5.46247
```

```
Epoch 456/500
1374/1374 [==============================] - 0s 72us/step - loss: 4.9949 -
mean_absolute_error: 4.9949 - val_loss: 7.3875 - val_mean_absolute_error: 7.3875

Epoch 00456: val_loss did not improve from 5.46247
Epoch 457/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.7073 -
mean_absolute_error: 6.7073 - val_loss: 6.8419 - val_mean_absolute_error: 6.8419

Epoch 00457: val_loss did not improve from 5.46247
Epoch 458/500
1374/1374 [==============================] - 0s 76us/step - loss: 4.3896 -
mean_absolute_error: 4.3896 - val_loss: 5.8177 - val_mean_absolute_error: 5.8177

Epoch 00458: val_loss did not improve from 5.46247
Epoch 459/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.3923 -
mean_absolute_error: 5.3923 - val_loss: 6.9102 - val_mean_absolute_error: 6.9102

Epoch 00459: val_loss did not improve from 5.46247
Epoch 460/500
1374/1374 [==============================] - 0s 72us/step - loss: 4.6063 -
mean_absolute_error: 4.6063 - val_loss: 7.6543 - val_mean_absolute_error: 7.6543

Epoch 00460: val_loss did not improve from 5.46247
Epoch 461/500
1374/1374 [==============================] - 0s 72us/step - loss: 4.8307 -
mean_absolute_error: 4.8307 - val_loss: 6.4225 - val_mean_absolute_error: 6.4225

Epoch 00461: val_loss did not improve from 5.46247
Epoch 462/500
1374/1374 [==============================] - 0s 71us/step - loss: 4.3014 -
mean_absolute_error: 4.3014 - val_loss: 7.4498 - val_mean_absolute_error: 7.4498

Epoch 00462: val_loss did not improve from 5.46247
Epoch 463/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.7141 -
mean_absolute_error: 4.7141 - val_loss: 5.8599 - val_mean_absolute_error: 5.8599

Epoch 00463: val_loss did not improve from 5.46247
Epoch 464/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.7360 -
mean_absolute_error: 4.7360 - val_loss: 6.6290 - val_mean_absolute_error: 6.6290

Epoch 00464: val_loss did not improve from 5.46247
Epoch 465/500
1374/1374 [==============================] - 0s 77us/step - loss: 4.0829 -
mean_absolute_error: 4.0829 - val_loss: 5.2782 - val_mean_absolute_error: 5.2782
```

```
Epoch 00465: val_loss improved from 5.46247 to 5.27816, saving model to
Weights-465--5.27816.hdf5
Epoch 466/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.4869 -
mean_absolute_error: 4.4869 - val_loss: 6.0217 - val_mean_absolute_error: 6.0217

Epoch 00466: val_loss did not improve from 5.27816
Epoch 467/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.4526 -
mean_absolute_error: 4.4526 - val_loss: 6.6850 - val_mean_absolute_error: 6.6850

Epoch 00467: val_loss did not improve from 5.27816
Epoch 468/500
1374/1374 [==============================] - 0s 73us/step - loss: 4.1949 -
mean_absolute_error: 4.1949 - val_loss: 6.5466 - val_mean_absolute_error: 6.5466

Epoch 00468: val_loss did not improve from 5.27816
Epoch 469/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.4002 -
mean_absolute_error: 5.4002 - val_loss: 6.8912 - val_mean_absolute_error: 6.8912

Epoch 00469: val_loss did not improve from 5.27816
Epoch 470/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.6408 -
mean_absolute_error: 4.6408 - val_loss: 6.1578 - val_mean_absolute_error: 6.1578

Epoch 00470: val_loss did not improve from 5.27816
Epoch 471/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.7385 -
mean_absolute_error: 4.7385 - val_loss: 6.4476 - val_mean_absolute_error: 6.4476

Epoch 00471: val_loss did not improve from 5.27816
Epoch 472/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.4633 -
mean_absolute_error: 5.4633 - val_loss: 6.7125 - val_mean_absolute_error: 6.7125

Epoch 00472: val_loss did not improve from 5.27816
Epoch 473/500
1374/1374 [==============================] - 0s 71us/step - loss: 4.9342 -
mean_absolute_error: 4.9342 - val_loss: 7.2391 - val_mean_absolute_error: 7.2391

Epoch 00473: val_loss did not improve from 5.27816
Epoch 474/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.3089 -
mean_absolute_error: 5.3089 - val_loss: 7.2996 - val_mean_absolute_error: 7.2996

Epoch 00474: val_loss did not improve from 5.27816
```

```
Epoch 475/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.1928 -
mean_absolute_error: 5.1928 - val_loss: 8.1431 - val_mean_absolute_error: 8.1431

Epoch 00475: val_loss did not improve from 5.27816
Epoch 476/500
1374/1374 [==============================] - 0s 69us/step - loss: 6.6400 -
mean_absolute_error: 6.6400 - val_loss: 7.8728 - val_mean_absolute_error: 7.8728

Epoch 00476: val_loss did not improve from 5.27816
Epoch 477/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.4225 -
mean_absolute_error: 5.4225 - val_loss: 6.8855 - val_mean_absolute_error: 6.8855

Epoch 00477: val_loss did not improve from 5.27816
Epoch 478/500
1374/1374 [==============================] - 0s 76us/step - loss: 4.8056 -
mean_absolute_error: 4.8056 - val_loss: 7.3961 - val_mean_absolute_error: 7.3961

Epoch 00478: val_loss did not improve from 5.27816
Epoch 479/500
1374/1374 [==============================] - 0s 69us/step - loss: 4.9346 -
mean_absolute_error: 4.9346 - val_loss: 5.9572 - val_mean_absolute_error: 5.9572

Epoch 00479: val_loss did not improve from 5.27816
Epoch 480/500
1374/1374 [==============================] - 0s 70us/step - loss: 6.2879 -
mean_absolute_error: 6.2879 - val_loss: 7.3158 - val_mean_absolute_error: 7.3158

Epoch 00480: val_loss did not improve from 5.27816
Epoch 481/500
1374/1374 [==============================] - 0s 70us/step - loss: 5.7074 -
mean_absolute_error: 5.7074 - val_loss: 10.4009 - val_mean_absolute_error:
10.4009

Epoch 00481: val_loss did not improve from 5.27816
Epoch 482/500
1374/1374 [==============================] - 0s 72us/step - loss: 5.1824 -
mean_absolute_error: 5.1824 - val_loss: 5.8628 - val_mean_absolute_error: 5.8628

Epoch 00482: val_loss did not improve from 5.27816
Epoch 483/500
1374/1374 [==============================] - 0s 70us/step - loss: 3.8493 -
mean_absolute_error: 3.8493 - val_loss: 6.1374 - val_mean_absolute_error: 6.1374

Epoch 00483: val_loss did not improve from 5.27816
Epoch 484/500
1374/1374 [==============================] - 0s 71us/step - loss: 4.0048 -
```

```
mean_absolute_error: 4.0048 - val_loss: 5.6611 - val_mean_absolute_error: 5.6611

Epoch 00484: val_loss did not improve from 5.27816
Epoch 485/500
1374/1374 [==============================] - 0s 73us/step - loss: 4.4168 -
mean_absolute_error: 4.4168 - val_loss: 7.4353 - val_mean_absolute_error: 7.4353

Epoch 00485: val_loss did not improve from 5.27816
Epoch 486/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.8191 -
mean_absolute_error: 4.8191 - val_loss: 5.7817 - val_mean_absolute_error: 5.7817

Epoch 00486: val_loss did not improve from 5.27816
Epoch 487/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.8393 -
mean_absolute_error: 5.8393 - val_loss: 8.5692 - val_mean_absolute_error: 8.5693

Epoch 00487: val_loss did not improve from 5.27816
Epoch 488/500
1374/1374 [==============================] - 0s 67us/step - loss: 5.2572 -
mean_absolute_error: 5.2572 - val_loss: 6.3444 - val_mean_absolute_error: 6.3444

Epoch 00488: val_loss did not improve from 5.27816
Epoch 489/500
1374/1374 [==============================] - 0s 74us/step - loss: 4.8099 -
mean_absolute_error: 4.8099 - val_loss: 8.9338 - val_mean_absolute_error: 8.9338

Epoch 00489: val_loss did not improve from 5.27816
Epoch 490/500
1374/1374 [==============================] - 0s 72us/step - loss: 4.5095 -
mean_absolute_error: 4.5095 - val_loss: 7.2249 - val_mean_absolute_error: 7.2249

Epoch 00490: val_loss did not improve from 5.27816
Epoch 491/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.4989 -
mean_absolute_error: 5.4989 - val_loss: 7.5046 - val_mean_absolute_error: 7.5046

Epoch 00491: val_loss did not improve from 5.27816
Epoch 492/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.8619 -
mean_absolute_error: 4.8619 - val_loss: 6.7457 - val_mean_absolute_error: 6.7457

Epoch 00492: val_loss did not improve from 5.27816
Epoch 493/500
1374/1374 [==============================] - 0s 73us/step - loss: 4.9769 -
mean_absolute_error: 4.9769 - val_loss: 6.4311 - val_mean_absolute_error: 6.4311

Epoch 00493: val_loss did not improve from 5.27816
```

```
Epoch 494/500
1374/1374 [==============================] - 0s 69us/step - loss: 5.4620 -
mean_absolute_error: 5.4620 - val_loss: 5.9208 - val_mean_absolute_error: 5.9208

Epoch 00494: val_loss did not improve from 5.27816
Epoch 495/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.4619 -
mean_absolute_error: 5.4619 - val_loss: 10.4245 - val_mean_absolute_error:
10.4245

Epoch 00495: val_loss did not improve from 5.27816
Epoch 496/500
1374/1374 [==============================] - 0s 73us/step - loss: 6.4464 -
mean_absolute_error: 6.4464 - val_loss: 7.1200 - val_mean_absolute_error: 7.1200

Epoch 00496: val_loss did not improve from 5.27816
Epoch 497/500
1374/1374 [==============================] - 0s 70us/step - loss: 4.7889 -
mean_absolute_error: 4.7889 - val_loss: 6.6865 - val_mean_absolute_error: 6.6865

Epoch 00497: val_loss did not improve from 5.27816
Epoch 498/500
1374/1374 [==============================] - 0s 68us/step - loss: 4.2895 -
mean_absolute_error: 4.2895 - val_loss: 6.7100 - val_mean_absolute_error: 6.7100

Epoch 00498: val_loss did not improve from 5.27816
Epoch 499/500
1374/1374 [==============================] - 0s 71us/step - loss: 4.8569 -
mean_absolute_error: 4.8569 - val_loss: 7.1223 - val_mean_absolute_error: 7.1223

Epoch 00499: val_loss did not improve from 5.27816
Epoch 500/500
1374/1374 [==============================] - 0s 71us/step - loss: 5.5924 -
mean_absolute_error: 5.5924 - val_loss: 7.0042 - val_mean_absolute_error: 7.0042

Epoch 00500: val_loss did not improve from 5.27816
```

[40]:
```
<keras.callbacks.callbacks.History at 0x7f040ac745c0>
```

[0]:
```
weights_file = 'Weights-465--5.27816.hdf5' # choose the best checkpoint
NN_model.load_weights(weights_file) # load it
NN_model.compile(loss='mean_absolute_error', optimizer='adam',␣
 ↪metrics=['accuracy'])
```

[48]:
```
test_loss, test_acc = NN_model.evaluate(X_test,  y_test, verbose=2)
test_loss, test_acc
```

[48]:
```
(21.795207506650453, 0.1652892529964447)
```

Tengo que investigar, no entiendo muy bien esta red, no me cuadra ese valor de accuracy, es peor que el azar.

8 Crear n categorias, para cada pareja gas concentracion

[51]:
```
folder = './drive/My Drive/data_uci/'
df = LoadDatFile(folder).df
df_gas = GasDataFrame(df).df_gas
df_gas
```

[51]:

	1	2	3	…	Batch ID	GAS	CONCENTRATION
0	15596.1621	1.868245	2.371604	…	1	1	10.0
1	26402.0704	2.532401	5.411209	…	1	1	20.0
2	42103.5820	3.454189	8.198175	…	1	1	30.0
3	42825.9883	3.451192	12.113940	…	1	1	40.0
4	58151.1757	4.194839	11.455096	…	1	1	50.0
..	…	…	…	…	…	…	…
465	13384.8262	2.820931	4.007378	…	9	6	10.0
466	13382.9619	2.825174	4.010915	…	9	6	10.0
467	13336.8725	2.822288	3.980818	…	9	6	10.0
468	13351.1318	2.824358	3.987819	…	9	6	10.0
469	13314.9336	2.816502	3.982182	…	9	6	10.0

[13910 rows x 131 columns]

[0]:
```
df_gas_1 = df_gas[df_gas['GAS'] == 1]
df_net = df_gas.drop(columns = 'GAS')

df_train = df_net[df_net['Batch ID'] != 'Batch 09']
df_test  = df_net[df_net['Batch ID'] == 'Batch 09']

df_train = df_train.drop(columns = 'Batch ID')
df_test  = df_test.drop(columns = 'Batch ID')

X_tr = df_train.drop(columns = 'CONCENTRATION')
y_tr = df_train['CONCENTRATION']

X_test = df_test.drop(columns = 'CONCENTRATION')
y_test = df_test['CONCENTRATION']
```

[53]:
```
X_tr
```

[53]:

	1	2	3	…	126	127	128
0	15596.1621	1.868245	2.371604	…	-0.545079	-0.902241	-2.654529

```
1    26402.0704  2.532401   5.411209  … -0.889333 -1.323505 -1.749225
2    42103.5820  3.454189   8.198175  … -1.334558 -1.993659 -2.348370
3    42825.9883  3.451192  12.113940  … -1.432205 -2.146158 -2.488957
4    58151.1757  4.194839  11.455096  … -1.930107 -2.931265 -4.088756
..          …       …        …  …       …       …       …
465  13384.8262  2.820931   4.007378  … -1.617656 -2.457614 -6.226359
466  13382.9619  2.825174   4.010915  … -1.613554 -2.493870 -6.859804
467  13336.8725  2.822288   3.980818  … -1.612525 -2.504918 -6.263872
468  13351.1318  2.824358   3.987819  … -1.606879 -2.438701 -6.044784
469  13314.9336  2.816502   3.982182  … -1.630569 -2.463957 -5.726544

[13910 rows x 128 columns]
```

[60]:
```
model = keras.Sequential([
     keras.layers.Flatten(input_shape=(128,1)),
     keras.layers.Dense(128, activation='relu'),
     keras.layers.Dense(1)
 ])

model.compile(loss='mean_absolute_error', optimizer='adam',␣
 ↪metrics=['accuracy'])
#model.compile(loss=tf.keras.losses.
 ↪SparseCategoricalCrossentropy(from_logits=True),
#              optimizer='adam',
#              metrics=['mean_absolute_error'])

model.fit(X_tr, y_tr, epochs=30)
```

```
Epoch 1/30
435/435 [==============================] - 1s 1ms/step - loss: 532.0547 -
accuracy: 0.0028
Epoch 2/30
435/435 [==============================] - 1s 1ms/step - loss: 258.0534 -
accuracy: 0.0034
Epoch 3/30
435/435 [==============================] - 1s 1ms/step - loss: 194.3401 -
accuracy: 0.0039
Epoch 4/30
435/435 [==============================] - 1s 1ms/step - loss: 193.1693 -
accuracy: 0.0040
Epoch 5/30
435/435 [==============================] - 1s 1ms/step - loss: 204.1605 -
accuracy: 0.0027
Epoch 6/30
435/435 [==============================] - 1s 1ms/step - loss: 171.5872 -
accuracy: 0.0028
Epoch 7/30
```

```
435/435 [==============================] - 1s 1ms/step - loss: 195.1407 -
accuracy: 0.0040
Epoch 8/30
435/435 [==============================] - 1s 1ms/step - loss: 163.2994 -
accuracy: 0.0032
Epoch 9/30
435/435 [==============================] - 1s 1ms/step - loss: 174.5983 -
accuracy: 0.0037
Epoch 10/30
435/435 [==============================] - 1s 1ms/step - loss: 167.2411 -
accuracy: 0.0037
Epoch 11/30
435/435 [==============================] - 1s 1ms/step - loss: 170.4145 -
accuracy: 0.0036
Epoch 12/30
435/435 [==============================] - 1s 1ms/step - loss: 143.2311 -
accuracy: 0.0037
Epoch 13/30
435/435 [==============================] - 1s 1ms/step - loss: 158.9278 -
accuracy: 0.0040
Epoch 14/30
435/435 [==============================] - 1s 1ms/step - loss: 134.3957 -
accuracy: 0.0027
Epoch 15/30
435/435 [==============================] - 1s 1ms/step - loss: 155.3580 -
accuracy: 0.0027
Epoch 16/30
435/435 [==============================] - 1s 1ms/step - loss: 145.2088 -
accuracy: 0.0034
Epoch 17/30
435/435 [==============================] - 1s 1ms/step - loss: 142.4660 -
accuracy: 0.0040
Epoch 18/30
435/435 [==============================] - 1s 1ms/step - loss: 144.3614 -
accuracy: 0.0047
Epoch 19/30
435/435 [==============================] - 1s 1ms/step - loss: 148.1335 -
accuracy: 0.0040
Epoch 20/30
435/435 [==============================] - 1s 1ms/step - loss: 134.5695 -
accuracy: 0.0043
Epoch 21/30
435/435 [==============================] - 1s 1ms/step - loss: 134.2375 -
accuracy: 0.0045
Epoch 22/30
435/435 [==============================] - 1s 1ms/step - loss: 128.5403 -
accuracy: 0.0036
Epoch 23/30
```

```
435/435 [==============================] - 1s 1ms/step - loss: 132.0456 -
accuracy: 0.0039
Epoch 24/30
435/435 [==============================] - 1s 1ms/step - loss: 99.1302 -
accuracy: 0.0038
Epoch 25/30
435/435 [==============================] - 1s 1ms/step - loss: 124.4118 -
accuracy: 0.0041
Epoch 26/30
435/435 [==============================] - 1s 1ms/step - loss: 106.7542 -
accuracy: 0.0039
Epoch 27/30
435/435 [==============================] - 1s 1ms/step - loss: 123.3218 -
accuracy: 0.0036
Epoch 28/30
435/435 [==============================] - 1s 1ms/step - loss: 96.8359 -
accuracy: 0.0041
Epoch 29/30
435/435 [==============================] - 1s 1ms/step - loss: 112.4855 -
accuracy: 0.0040
Epoch 30/30
435/435 [==============================] - 1s 1ms/step - loss: 91.9182 -
accuracy: 0.0027
```

[60]:
```
<tensorflow.python.keras.callbacks.History at 0x7f040a186a20>
```

[61]:
```
test_loss, test_acc = model.evaluate(X_test,  y_test, verbose=2)
print('\nTest accuracy:', test_acc)
```

```
␣
↪---------------------------------------------------------------------------

AttributeError                            Traceback (most recent call␣
↪last)

<ipython-input-61-0a8946d81ba5> in <module>()
----> 1 test_loss, test_acc = model.evaluate(X_test,  y_test, verbose=2)
      2 print('\nTest accuracy:', test_acc)


/usr/local/lib/python3.6/dist-packages/tensorflow/python/keras/engine/
↪training.py in _method_wrapper(self, *args, **kwargs)
     64   def _method_wrapper(self, *args, **kwargs):
     65     if not self._in_multi_worker_mode():  # pylint:␣
↪disable=protected-access
---> 66       return method(self, *args, **kwargs)
```

```
        67
        68     # Running inside `run_distribute_coordinator` already.


       /usr/local/lib/python3.6/dist-packages/tensorflow/python/keras/engine/
↪training.py in evaluate(self, x, y, batch_size, verbose, sample_weight, steps,␣
↪callbacks, max_queue_size, workers, use_multiprocessing, return_dict)
      1087               logs = tmp_logs  # No error, now safe to assign to␣
↪logs.
      1088               callbacks.on_test_batch_end(step, logs)
   -> 1089       callbacks.on_test_end()
      1090
      1091       logs = tf_utils.to_numpy_or_python_type(logs)


       /usr/local/lib/python3.6/dist-packages/tensorflow/python/keras/callbacks.
↪py in on_test_end(self, logs)
       478     logs = self._process_logs(logs)
       479     for callback in self.callbacks:
   --> 480       callback.on_test_end(logs)
       481
       482   def on_predict_begin(self, logs=None):


       /usr/local/lib/python3.6/dist-packages/tensorflow/python/keras/callbacks.
↪py in on_test_end(self, logs)
       896   def on_test_end(self, logs=None):
       897     if not self._called_in_fit:
   --> 898       self._finalize_progbar(logs)
       899
       900   def on_predict_end(self, logs=None):


       /usr/local/lib/python3.6/dist-packages/tensorflow/python/keras/callbacks.
↪py in _finalize_progbar(self, logs)
       933       self.progbar.target = self.seen
       934     logs = logs or {}
   --> 935     self.progbar.update(self.seen, list(logs.items()), finalize=True)
       936
       937


       AttributeError: 'NoneType' object has no attribute 'update'
```

No es viable

[62]:
```
regressor = LinearRegression()
regressor.fit(X_tr, y_tr)
```

[62]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)
```

[63]:
```
coeff_df = pd.DataFrame(regressor.coef_, X_tr.columns, columns=['Coefficient'])
coeff_df
```

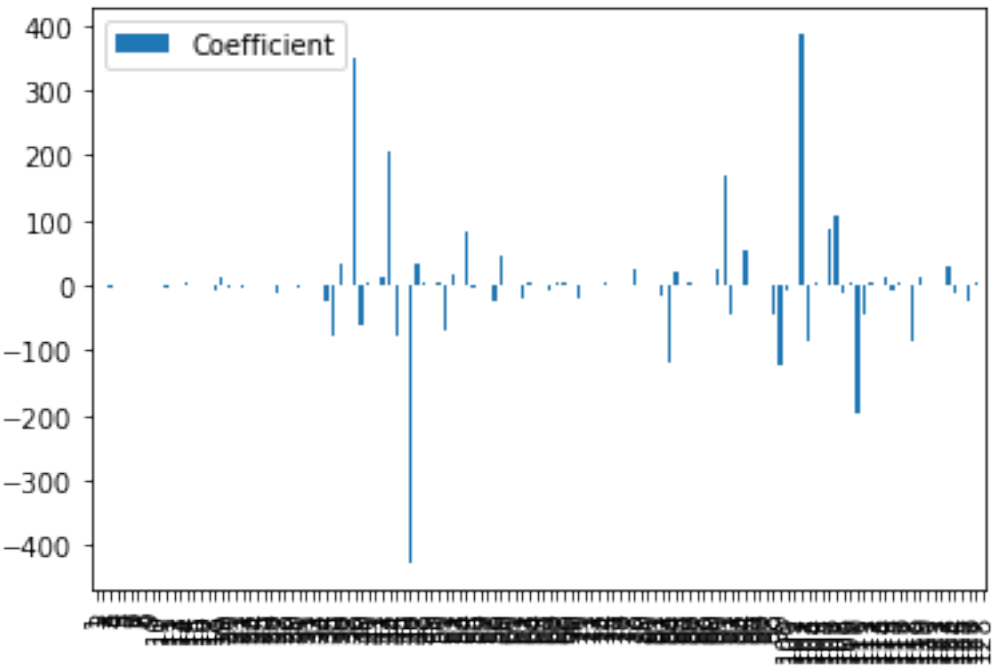
[63]:

	Coefficient
1	0.000522
2	0.706375
3	-4.081963
4	0.859733
5	-0.037980
..	…
124	-11.005861
125	-0.875119
126	-24.120533
127	4.067758
128	-0.489733

[128 rows x 1 columns]

[64]:
```
coeff_df.plot.bar()
```

[64]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f040ad37240>
```



[65]:
```
y_pred = regressor.predict(X_test)
df = pd.DataFrame({'Actual': y_test, 'Predicted': y_pred})
df1 = df.head(25)
```

```
␣
↪---------------------------------------------------------------------------

ValueError                                Traceback (most recent call␣
↪last)

<ipython-input-65-cf53c575cb44> in <module>()
----> 1 y_pred = regressor.predict(X_test)
      2 df = pd.DataFrame({'Actual': y_test, 'Predicted': y_pred})
      3 df1 = df.head(25)


/usr/local/lib/python3.6/dist-packages/sklearn/linear_model/_base.py in␣
↪predict(self, X)
    223             Returns predicted values.
    224         """
--> 225         return self._decision_function(X)
    226
    227     _preprocess_data = staticmethod(_preprocess_data)


/usr/local/lib/python3.6/dist-packages/sklearn/linear_model/_base.py in␣
↪_decision_function(self, X)
    205         check_is_fitted(self)
    206
--> 207         X = check_array(X, accept_sparse=['csr', 'csc', 'coo'])
    208         return safe_sparse_dot(X, self.coef_.T,
    209                                dense_output=True) + self.intercept_


/usr/local/lib/python3.6/dist-packages/sklearn/utils/validation.py in␣
↪check_array(array, accept_sparse, accept_large_sparse, dtype, order, copy,␣
↪force_all_finite, ensure_2d, allow_nd, ensure_min_samples,␣
↪ensure_min_features, warn_on_dtype, estimator)
    584                             " minimum of %d is required%s."
    585                             % (n_samples, array.shape,␣
↪ensure_min_samples,
--> 586                                context))
    587
    588     if ensure_min_features > 0 and array.ndim == 2:
```

```
        ValueError: Found array with 0 sample(s) (shape=(0, 128)) while a␣
    ↪minimum of 1 is required.
```

[0]:
```
df1.plot(kind='bar',figsize=(10,8))
plt.grid(which='major', linestyle='-', linewidth='0.5', color='green')
plt.grid(which='minor', linestyle=':', linewidth='0.5', color='black')
plt.show()
```

[0]:
```
y_test.unique()
```

[0]:
```
print('Mean Absolute Error:', metrics.mean_absolute_error(y_test, y_pred))
print('Mean Squared Error:', metrics.mean_squared_error(y_test, y_pred))
print('Root Mean Squared Error:', np.sqrt(metrics.mean_squared_error(y_test,␣
 ↪y_pred)))
```

9 RandomForest

[0]:
```
# load dataset
df = LoadDatFile(folder).df
df_gas = GasDataFrame(df).df_gas
```

[0]:
```
df_gas_1 = df_gas[df_gas['GAS']==1]

df_tr = df_gas_1[df_gas_1['Batch ID'] <= 8 ]
df_test = df_gas_1[df_gas_1['Batch ID'] == 9 ]

df_tr = df_tr.drop(columns = ['GAS', 'Batch ID'])
df_test = df_test.drop(columns = ['GAS', 'Batch ID'])

X_tr = df_tr.drop(columns = ['CONCENTRATION'])
X_test = df_test.drop(columns = ['CONCENTRATION'])

y_tr = df_tr['CONCENTRATION']
y_test = df_test['CONCENTRATION']
```

[67]:
```
regr = RandomForestRegressor(max_depth=2, random_state=0)
regr.fit(X_tr, y_tr)
```

[67]:
```
RandomForestRegressor(bootstrap=True, ccp_alpha=0.0, criterion='mse',
                      max_depth=2, max_features='auto', max_leaf_nodes=None,
                      max_samples=None, min_impurity_decrease=0.0,
                      min_impurity_split=None, min_samples_leaf=1,
                      min_samples_split=2, min_weight_fraction_leaf=0.0,
                      n_estimators=100, n_jobs=None, oob_score=False,
```

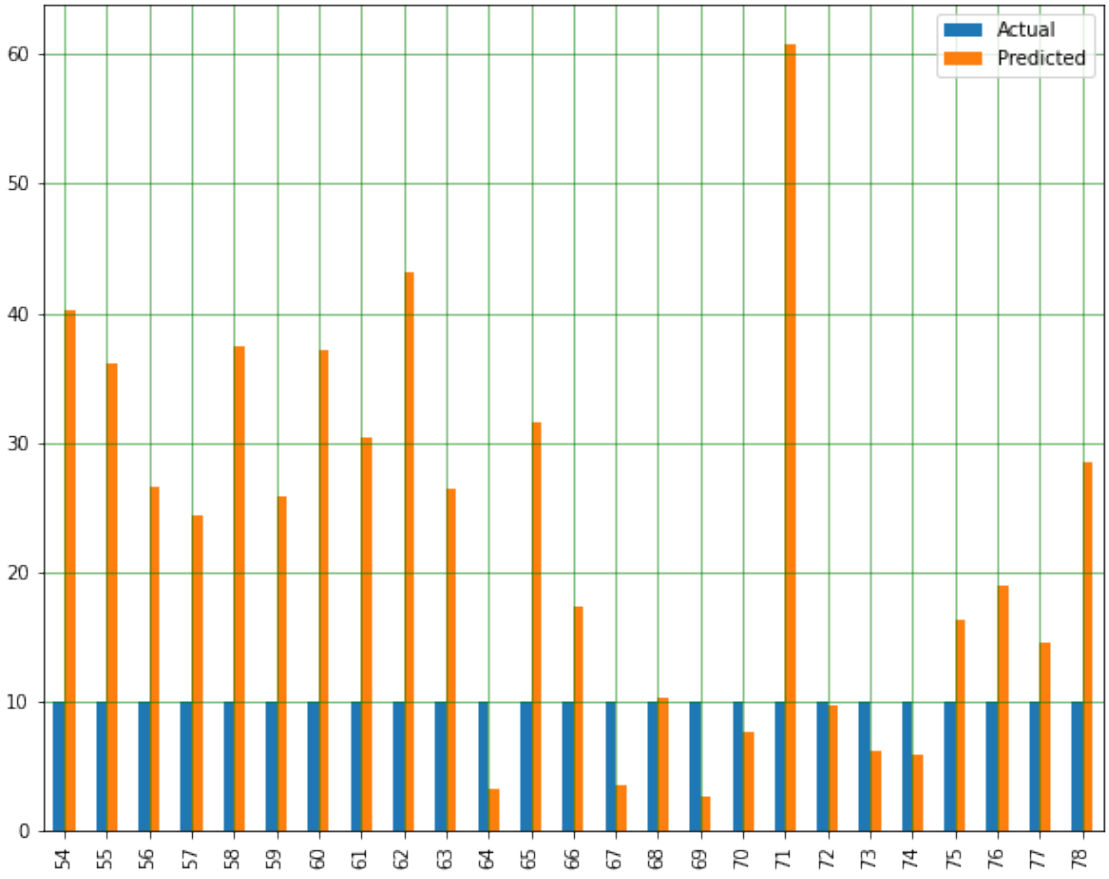
```
                      random_state=0, verbose=0, warm_start=False)
```

[68]:
```
regr.score(X_tr, y_tr)
```

[68]:
```
0.8219579063531003
```

[0]:
```
y_pred = regressor.predict(X_test)
df = pd.DataFrame({'Actual': y_test, 'Predicted': y_pred})
df1 = df.head(25)
```

[70]:
```
df1.plot(kind='bar',figsize=(10,8))
plt.grid(which='major', linestyle='-', linewidth='0.5', color='green')
plt.grid(which='minor', linestyle=':', linewidth='0.5', color='black')
plt.show()
```



10 Vamos a ver las señales

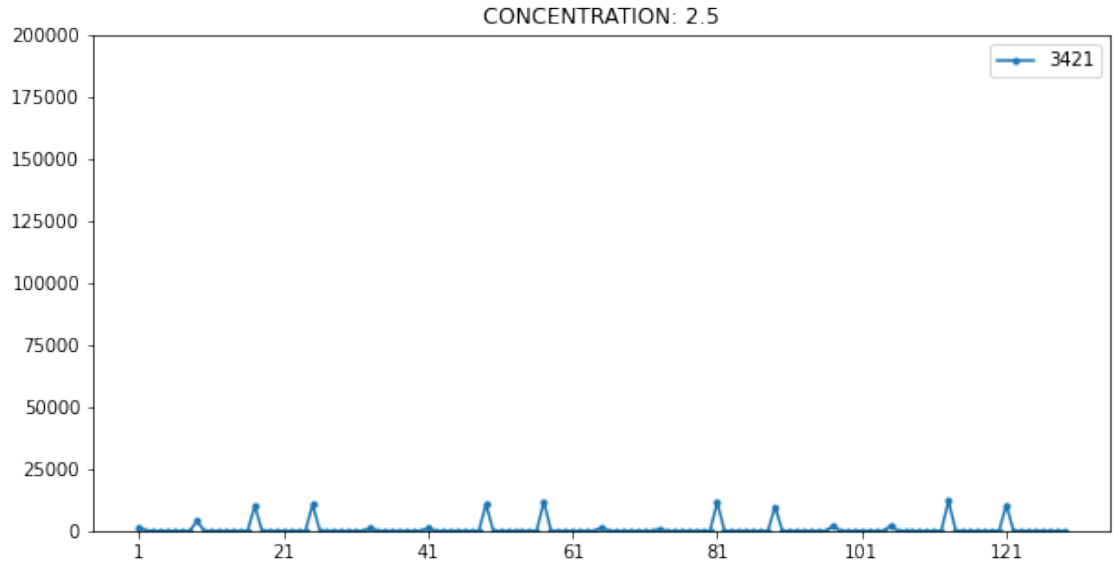
[0]:
```
df = LoadDatFile(folder).df
df_gas = GasDataFrame(df).df
df_gas_1 = df_gas[df_gas['GAS']==2]
df_signal = df_gas_1.drop(columns = ['GAS', 'Batch ID'])
```

[73]:
```
np.sort(df_signal['CONCENTRATION'].unique())
```

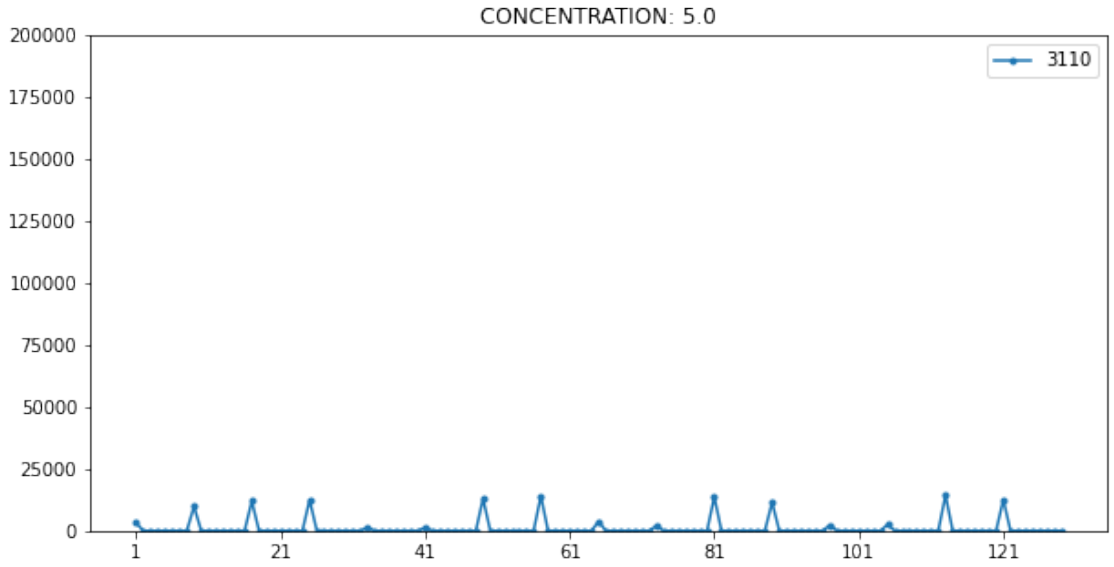
[73]:
```
array([  2.5,   5. ,  10. ,  20. ,  25. ,  30. ,  40. ,  50. ,  55. ,
        60. ,  70. ,  75. ,  80. ,  85. ,  90. , 100. , 110. , 120. ,
       125. , 130. , 140. , 150. , 160. , 170. , 175. , 180. , 190. ,
       200. , 210. , 220. , 225. , 230. , 240. , 250. , 275. , 280. ,
       290. , 300. ])
```

[74]:
```
for val in np.sort(df_signal['CONCENTRATION'].unique()):
  df_plot = df_signal[df_signal['CONCENTRATION']==val]
  plt.figure()
  df_plot.T.iloc[:,:10].plot(figsize=(10,5), style = '.-')
  plt.ylim([0, 200_000])
  plt.title('CONCENTRATION: ' + str(val))
```

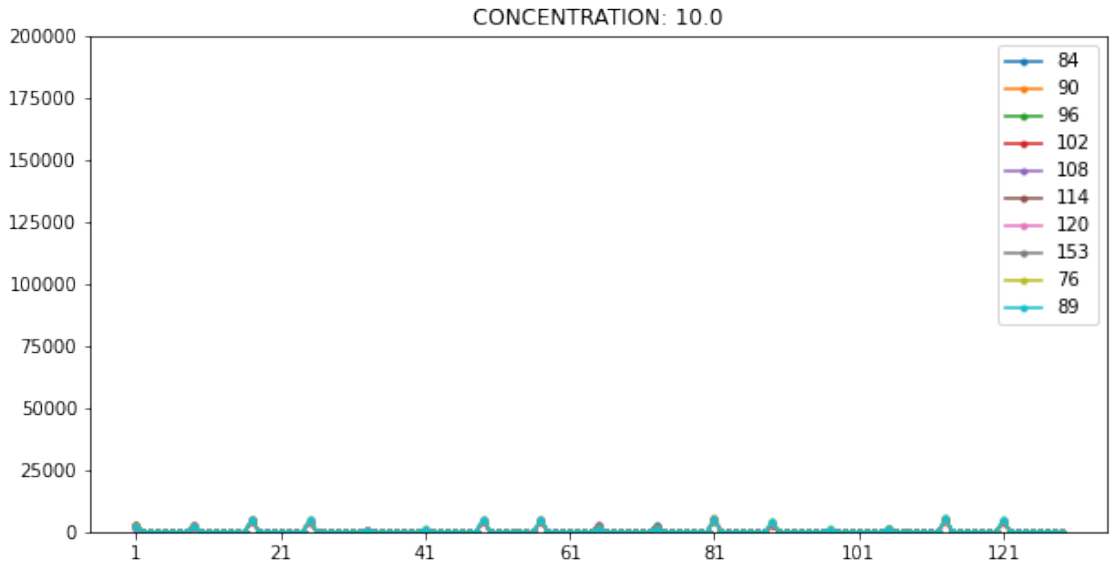
```
<Figure size 432x288 with 0 Axes>
```



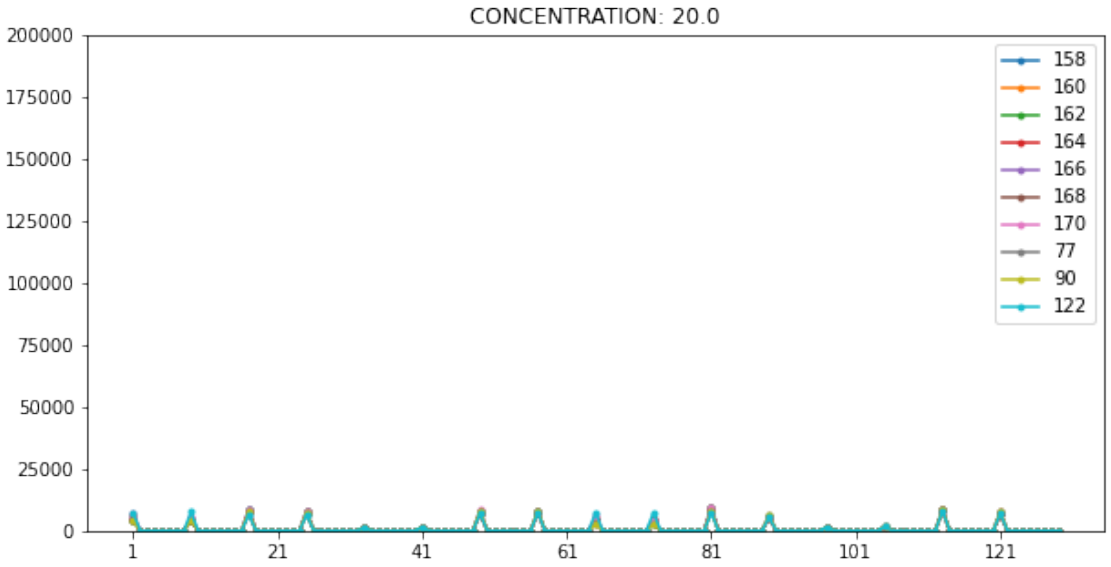

```
<Figure size 432x288 with 0 Axes>
```



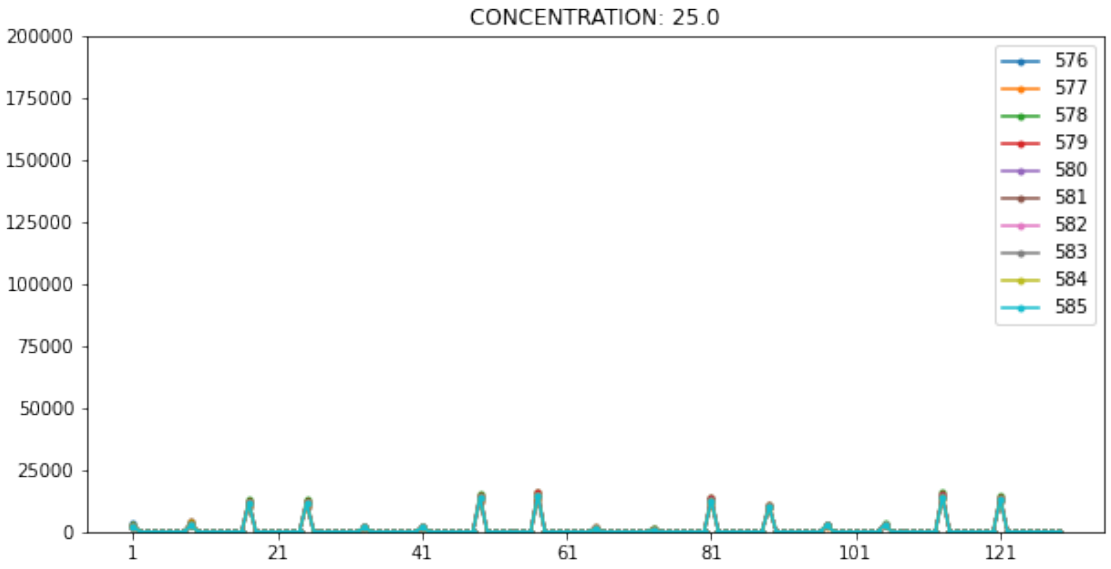
<Figure size 432x288 with 0 Axes>



<Figure size 432x288 with 0 Axes>



<Figure size 432x288 with 0 Axes>



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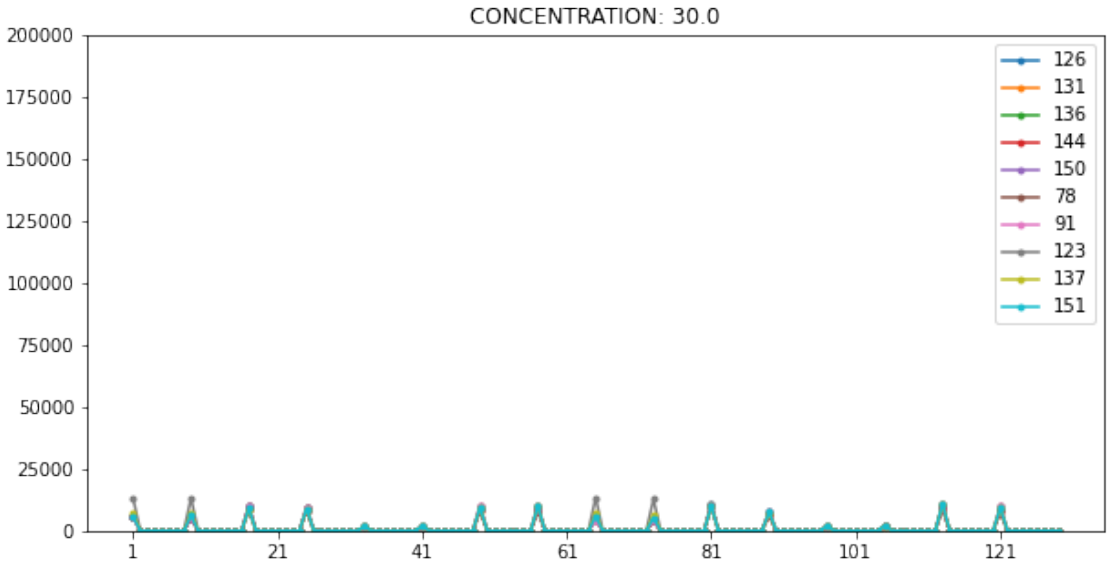

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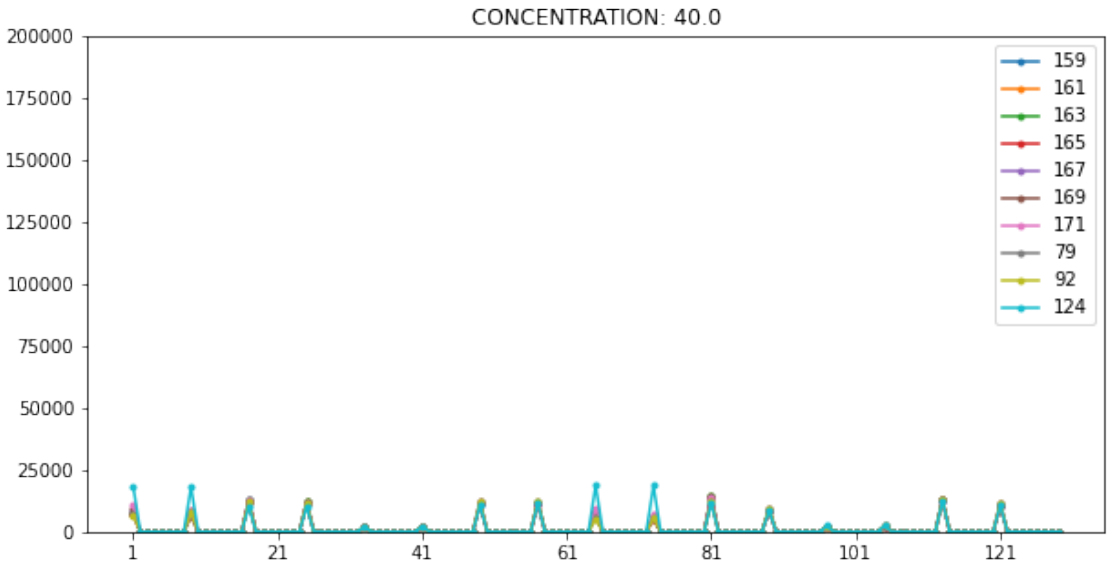

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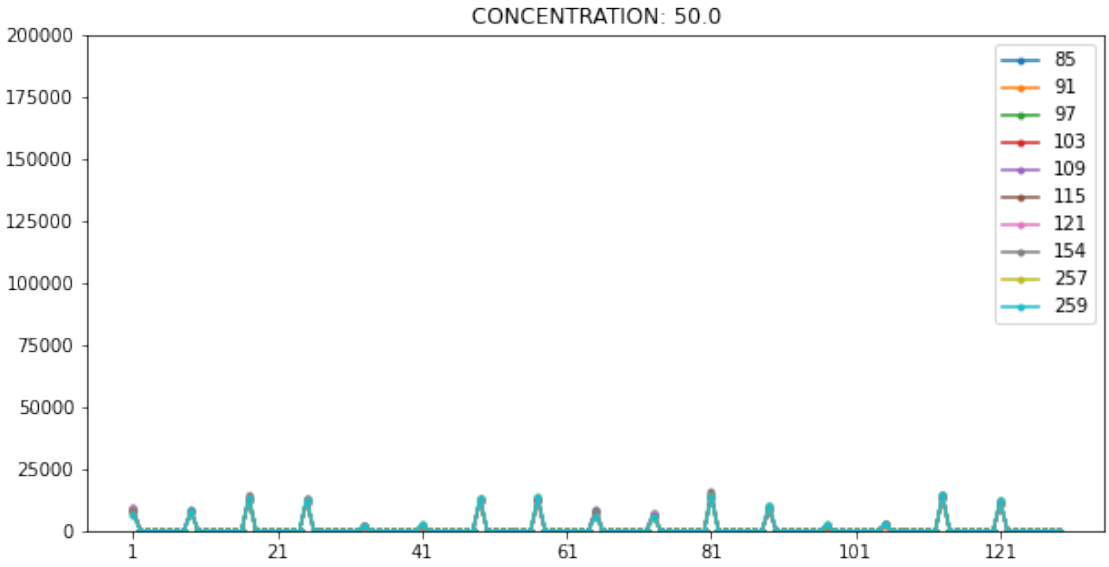

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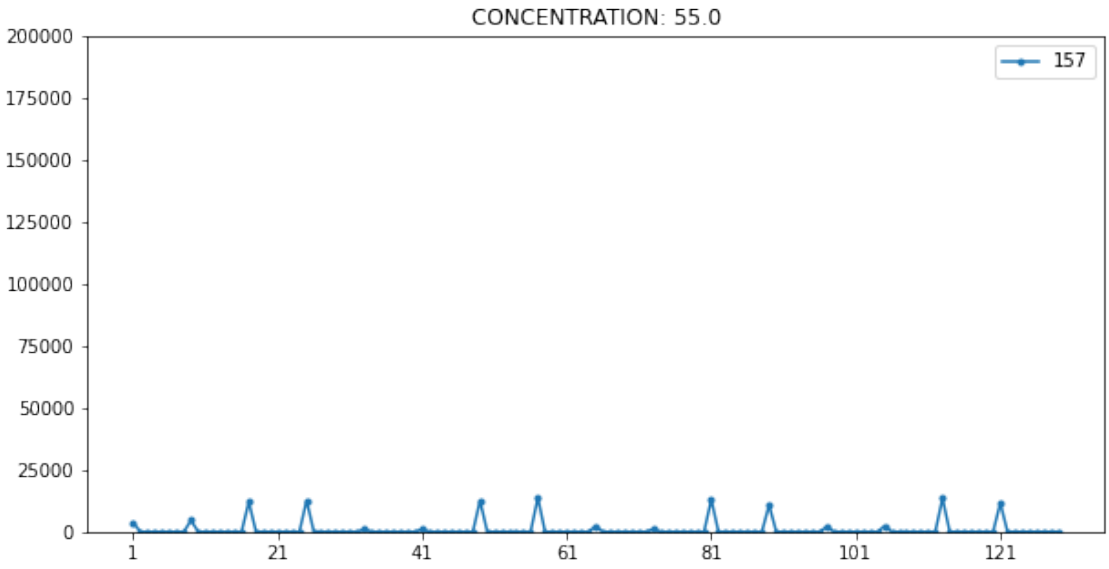

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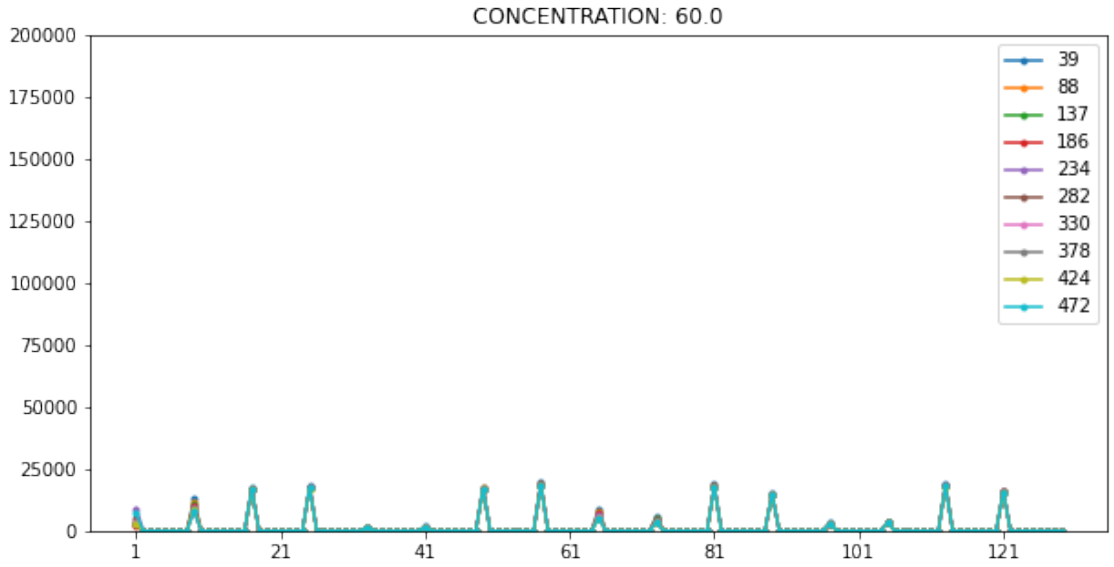

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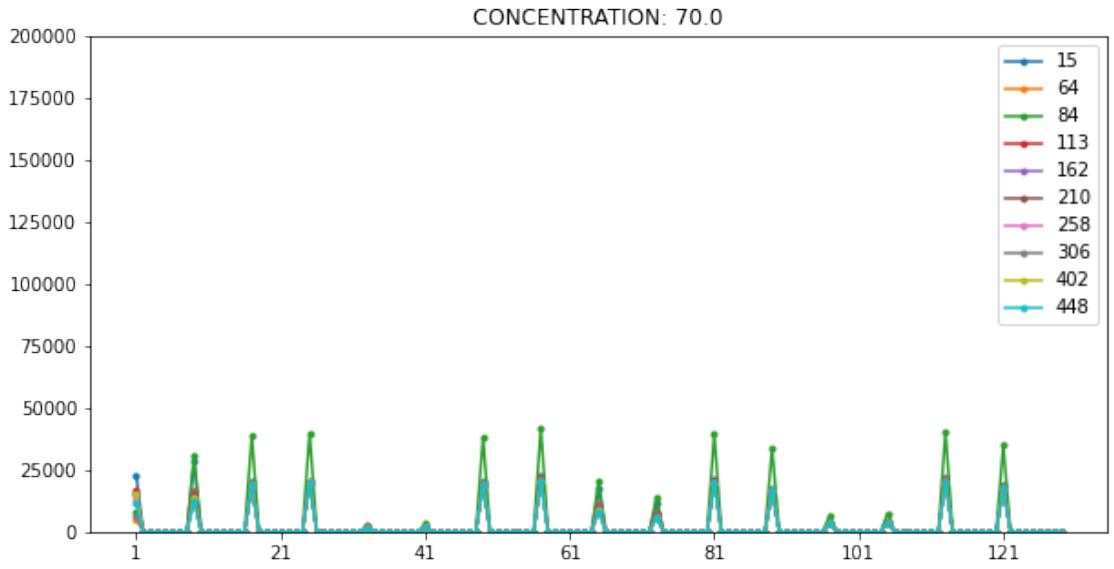

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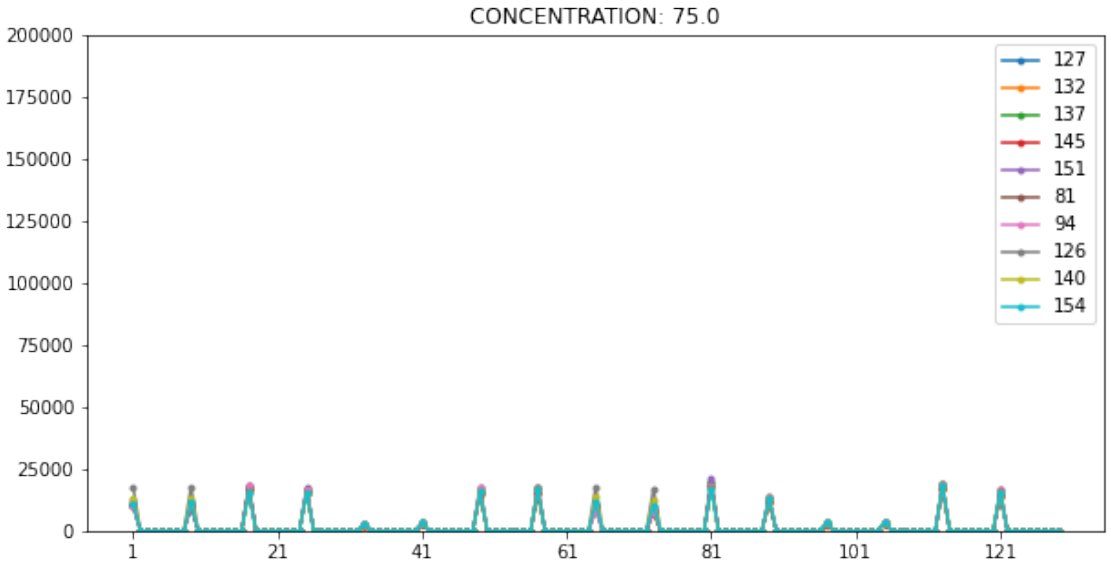

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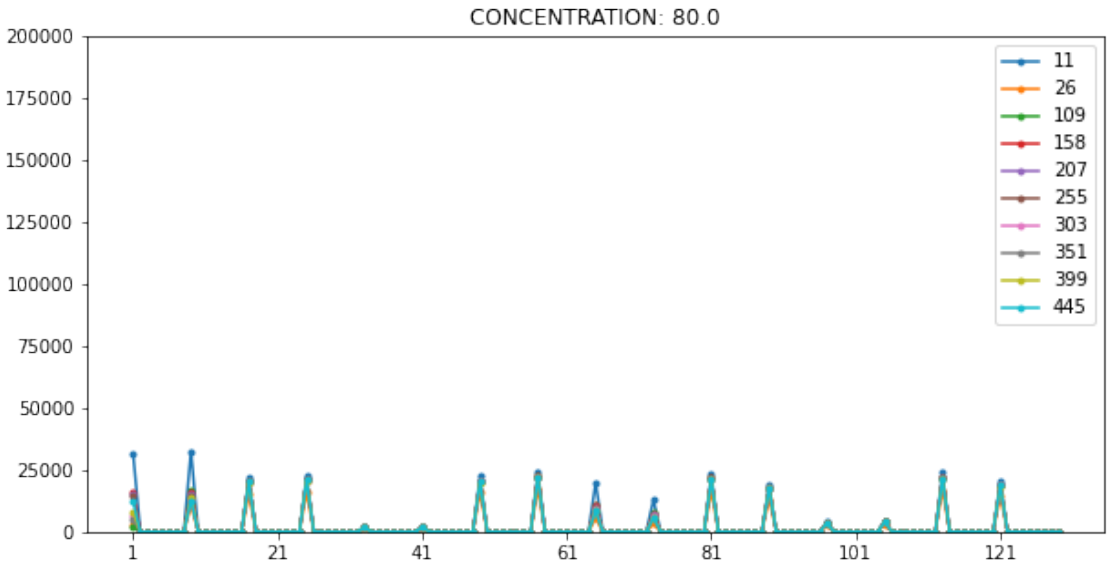

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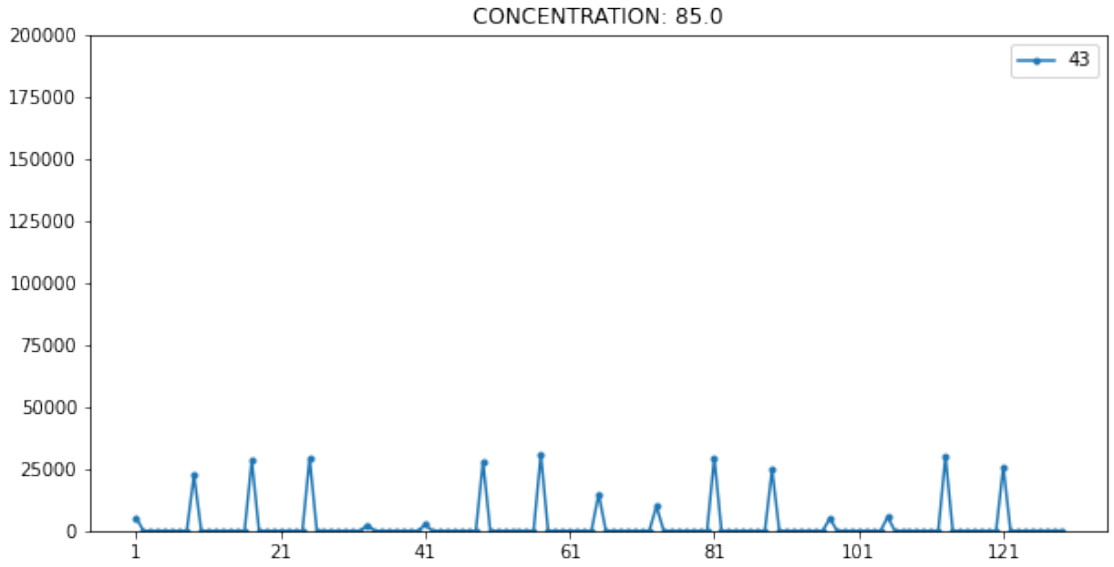

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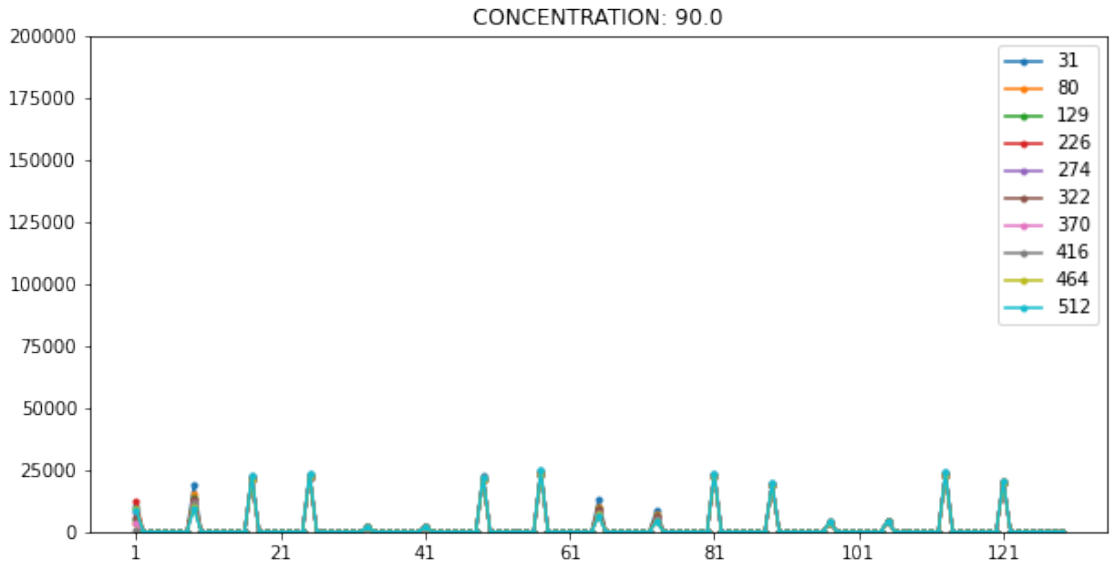

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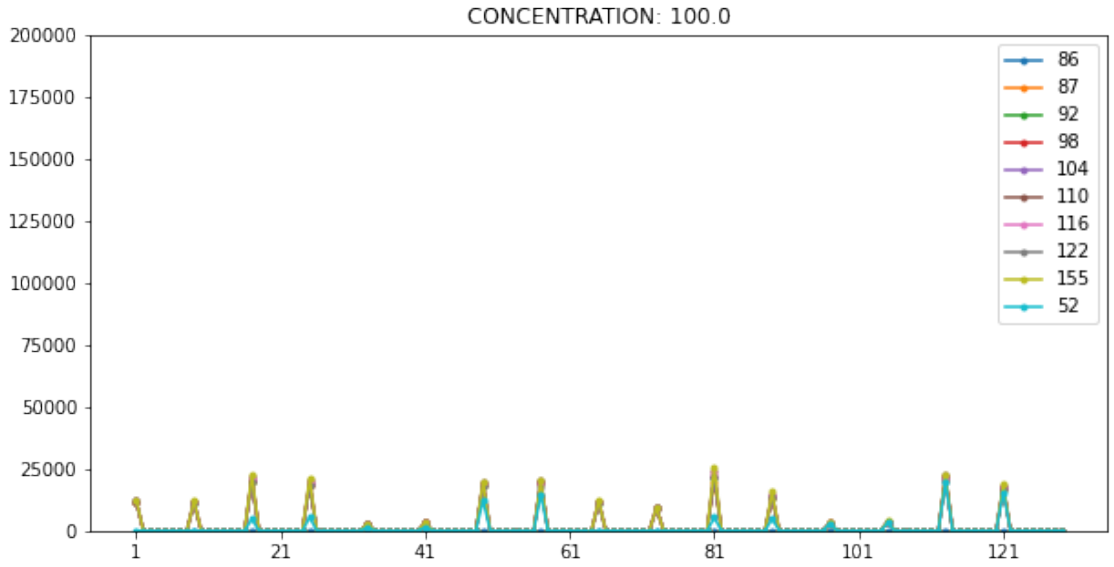

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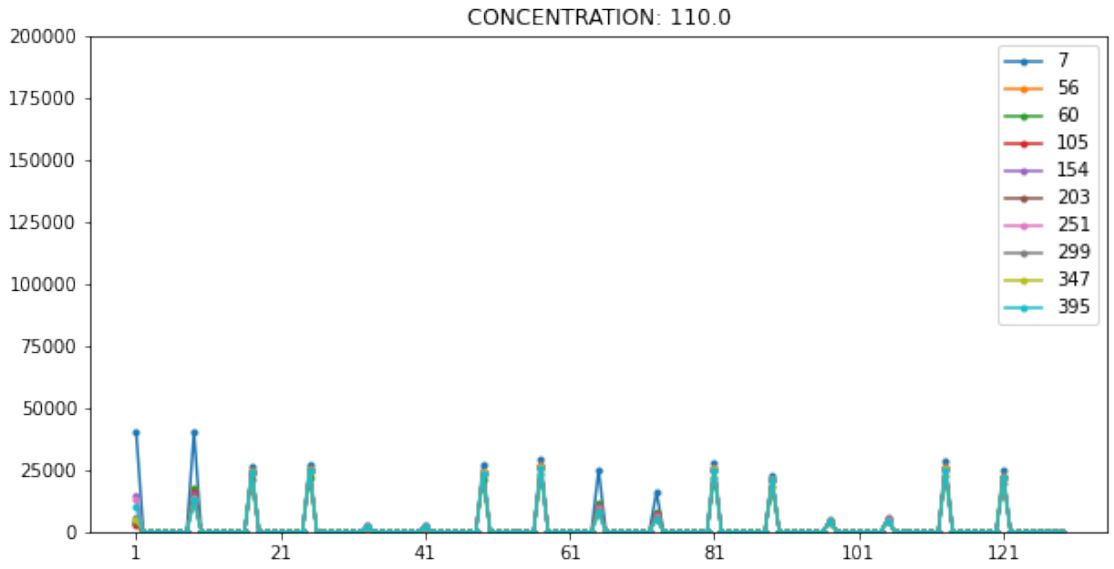

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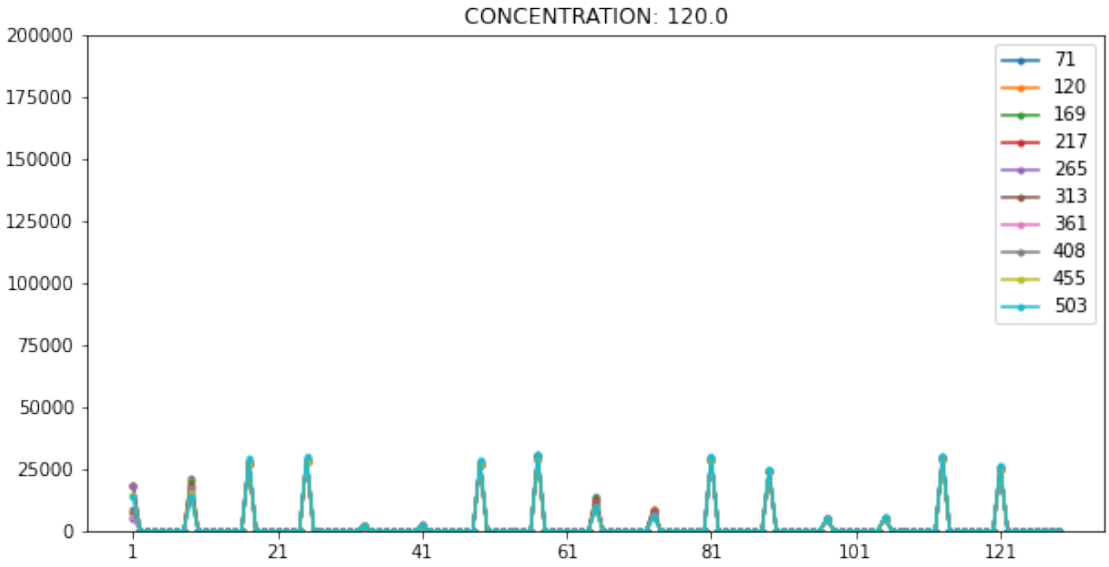

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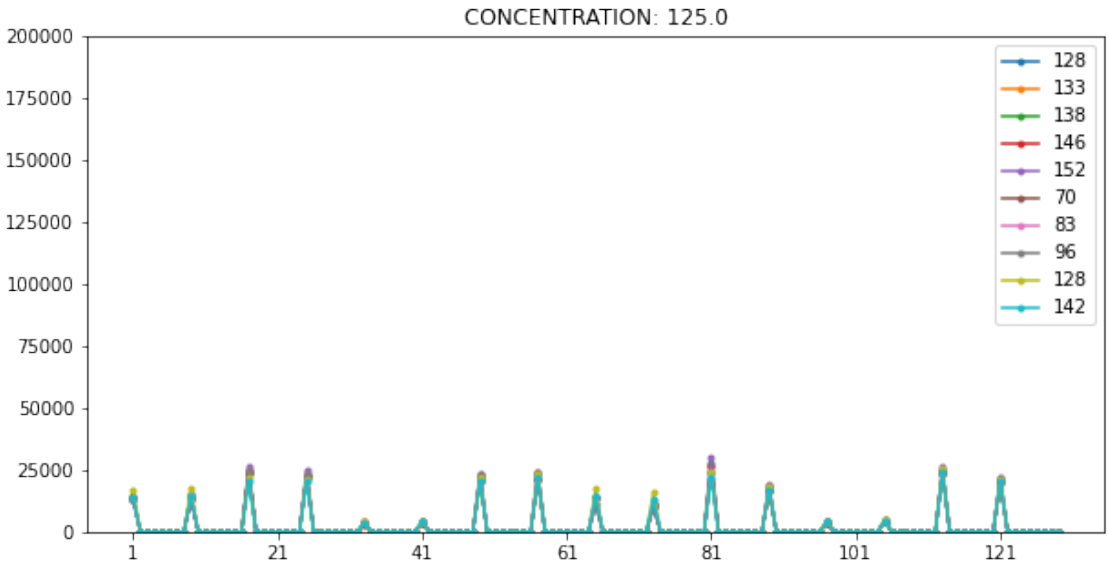

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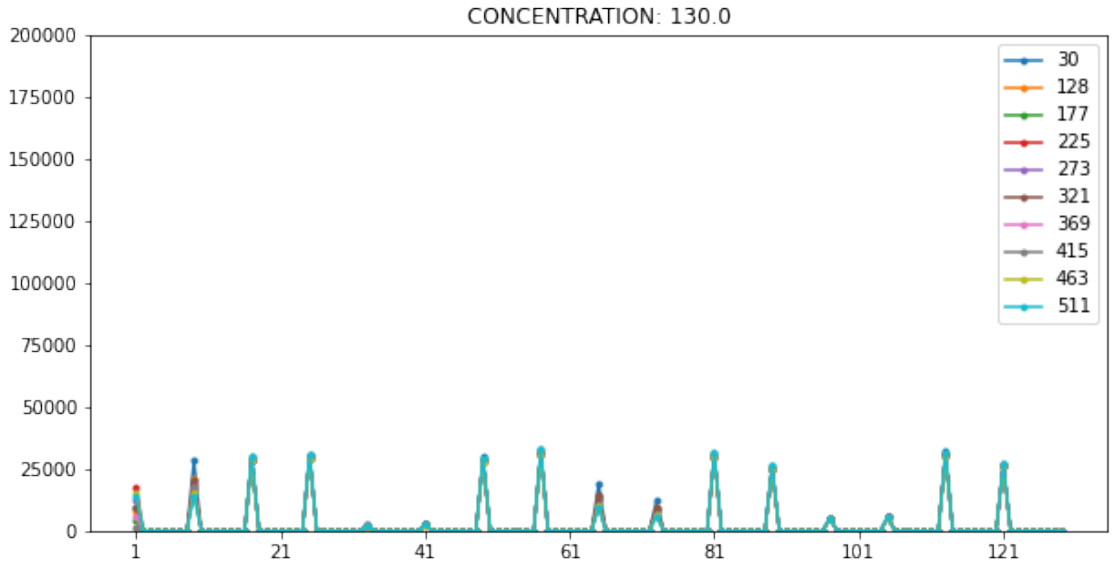

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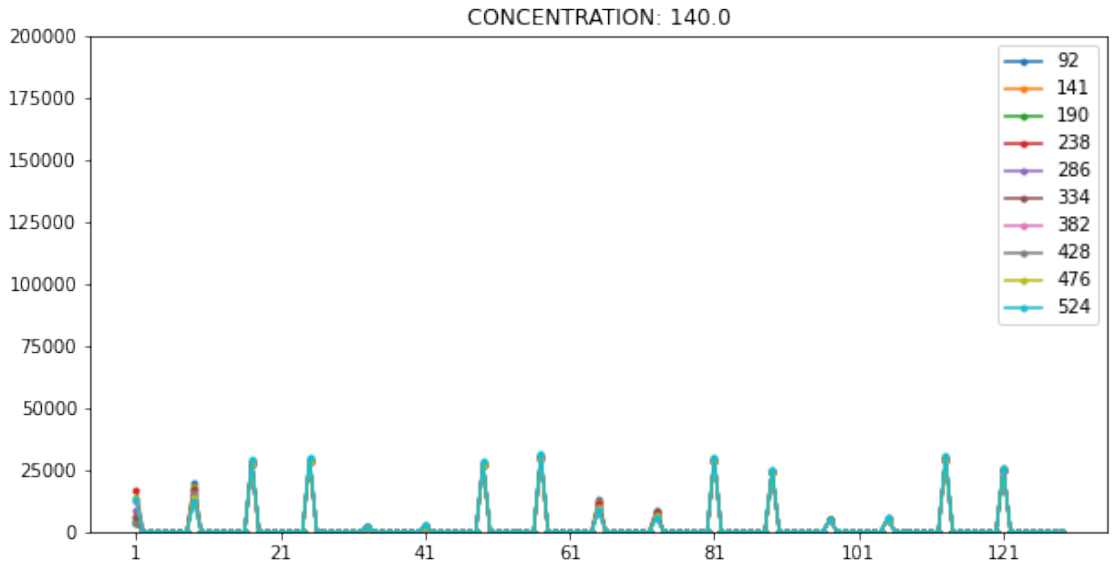

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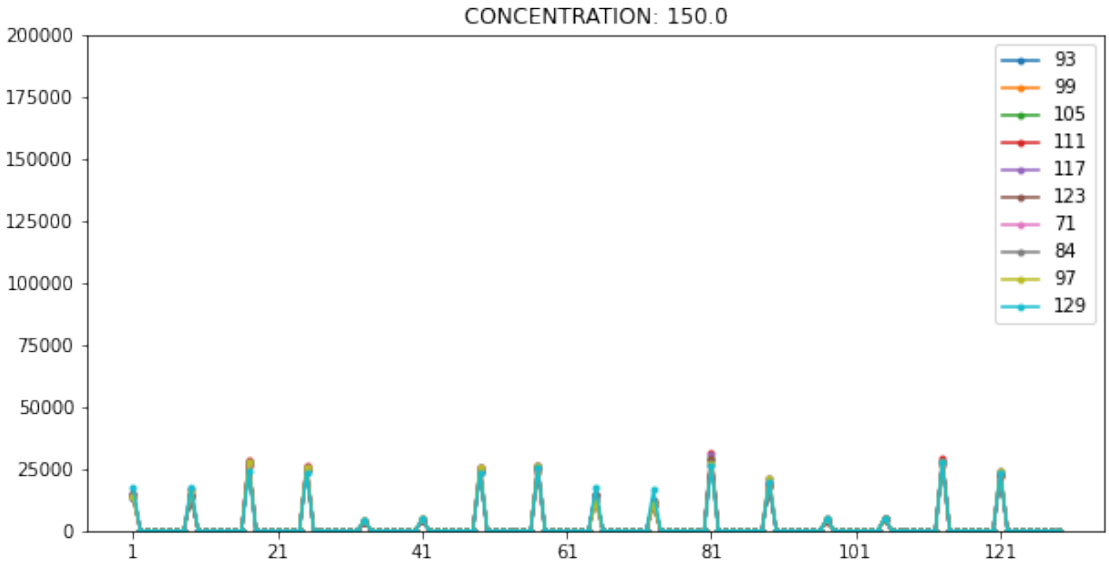

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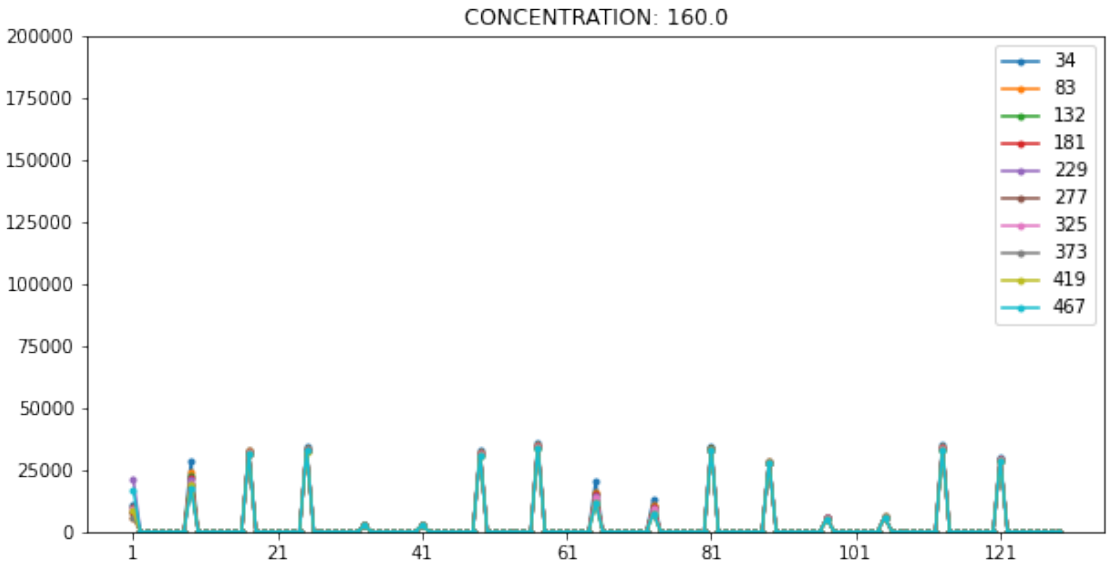

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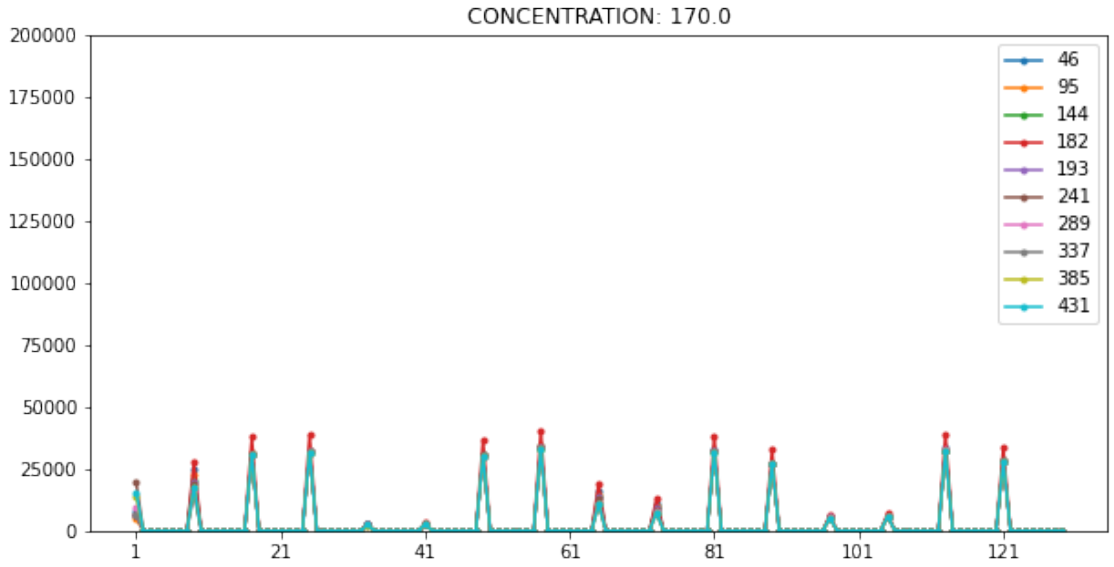

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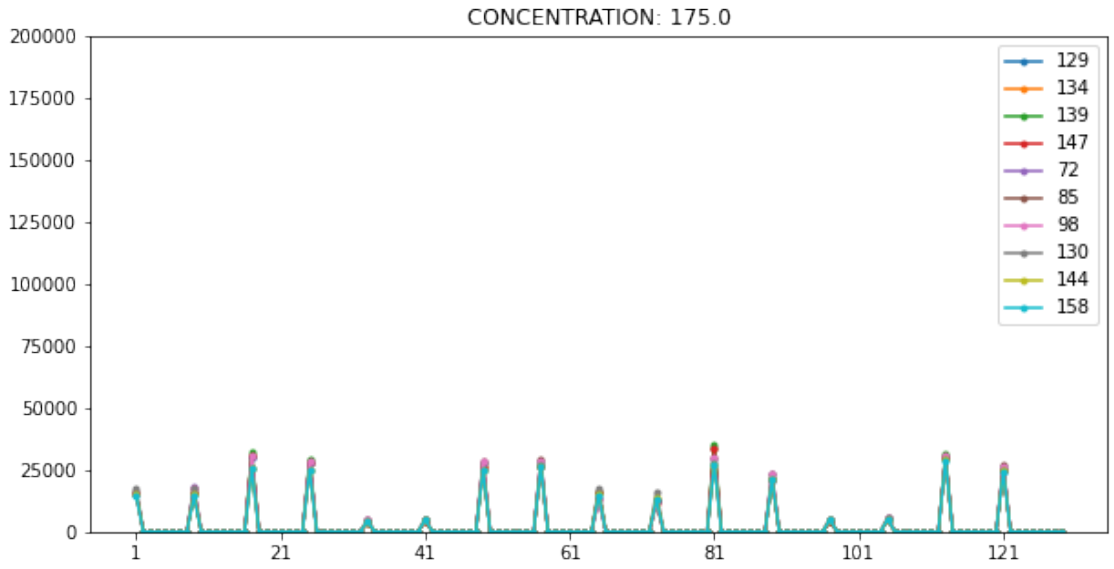

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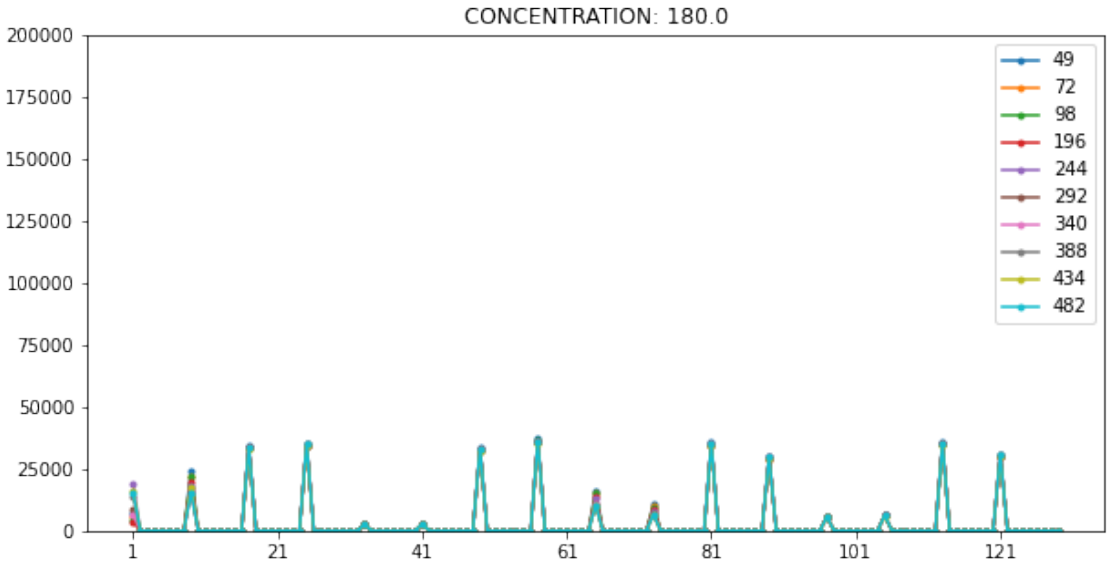

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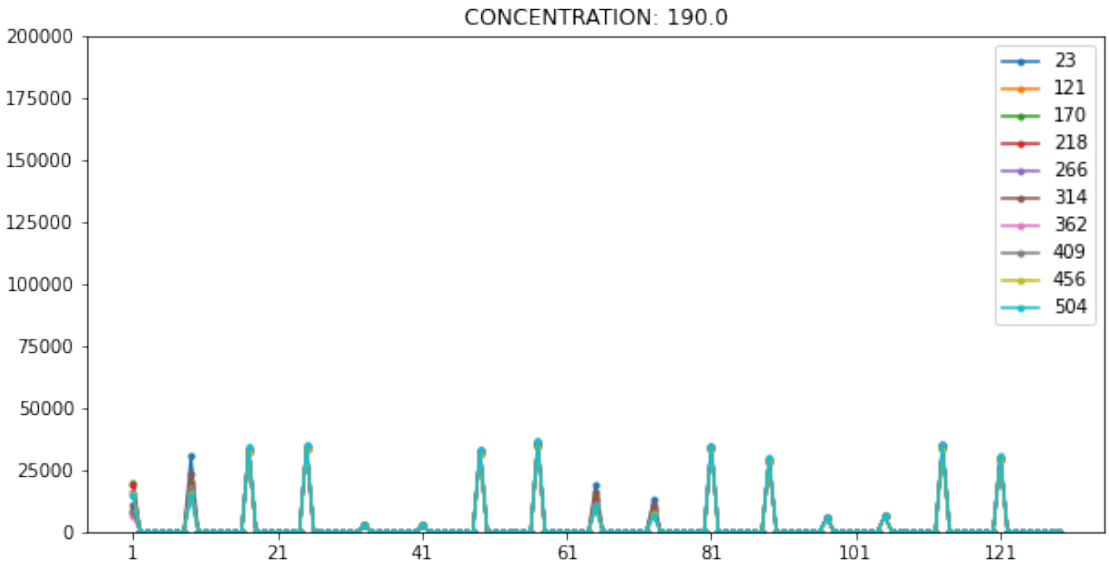

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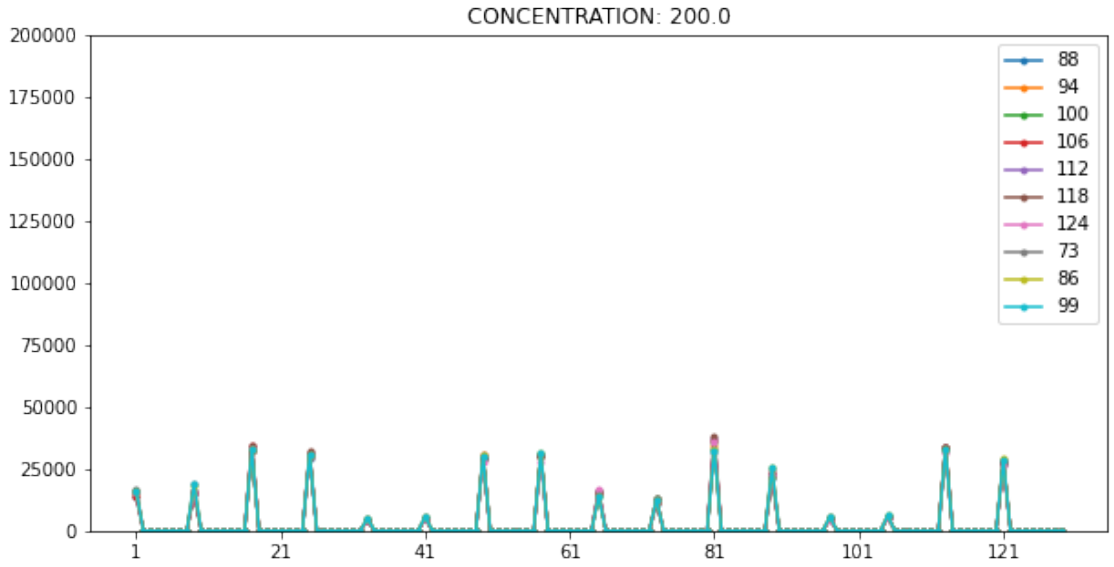

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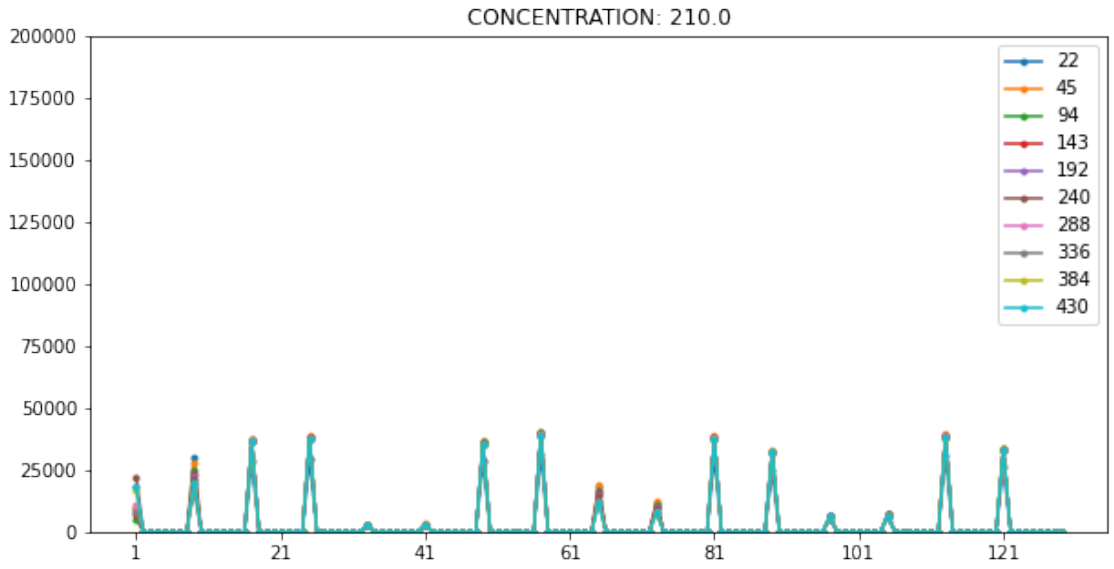

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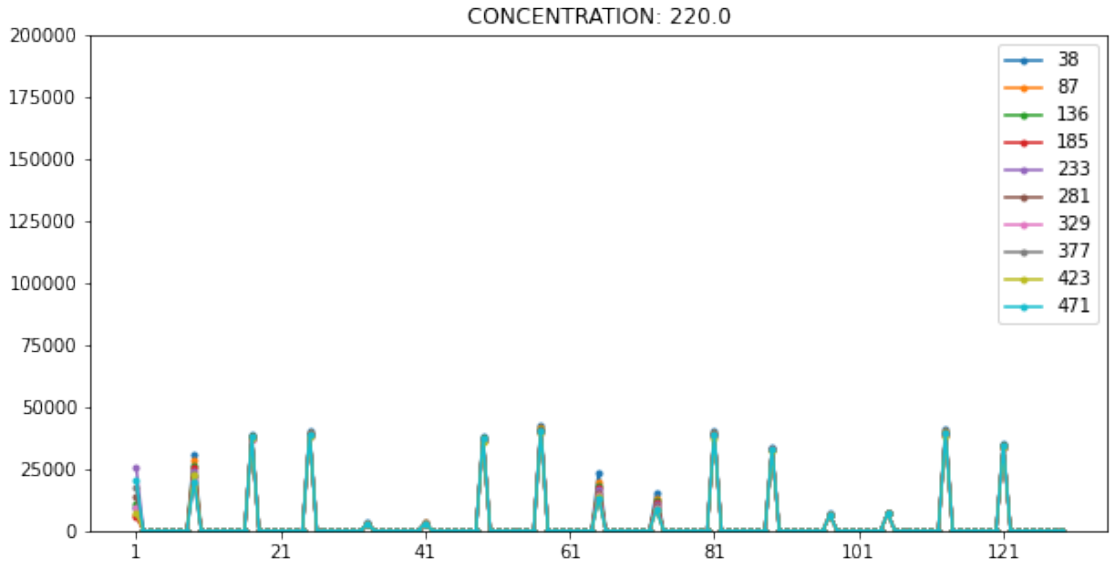

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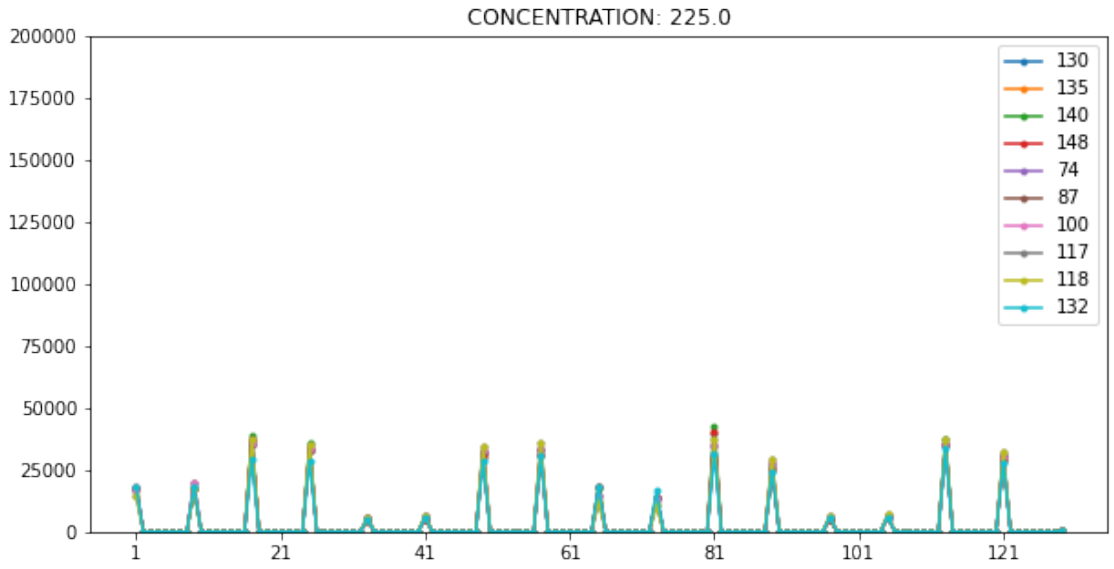

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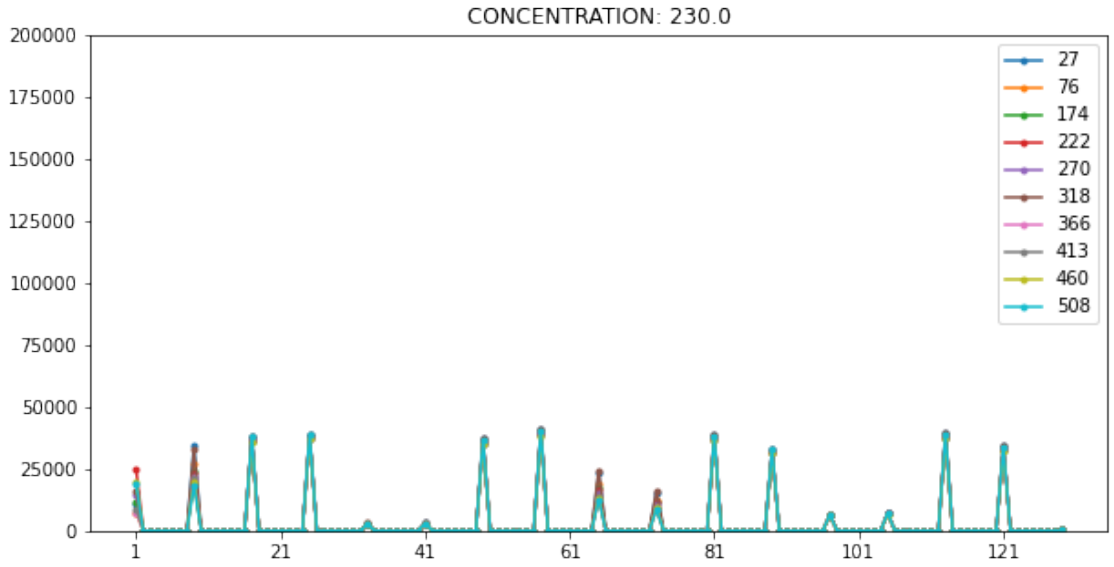

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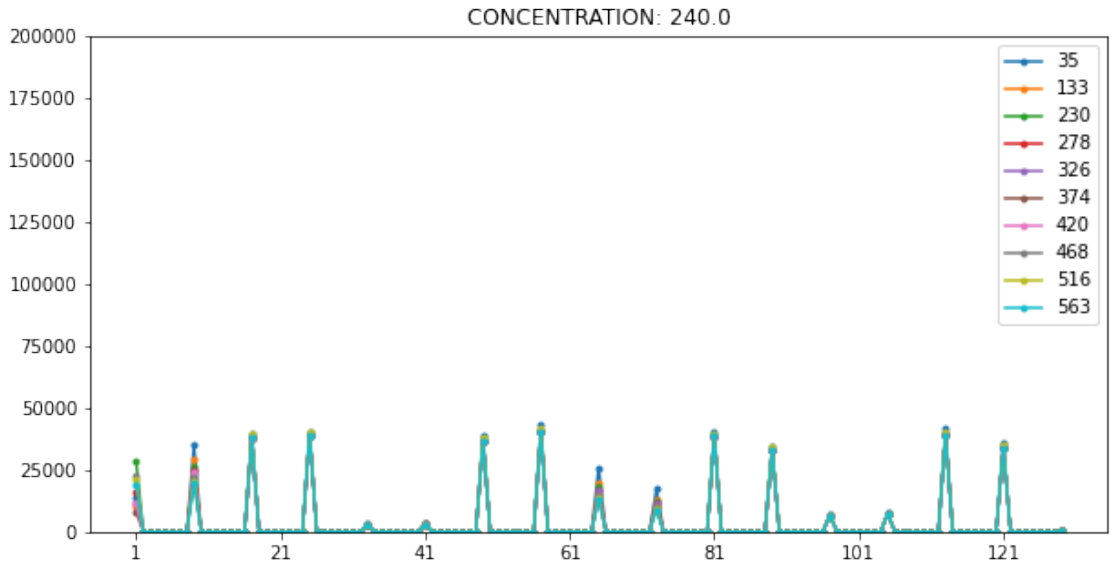

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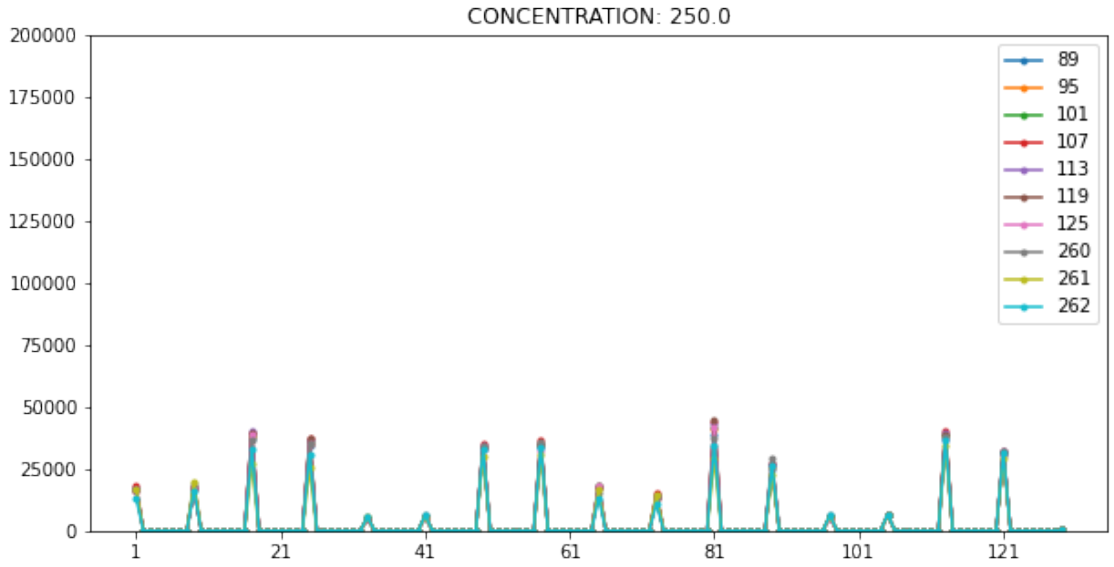

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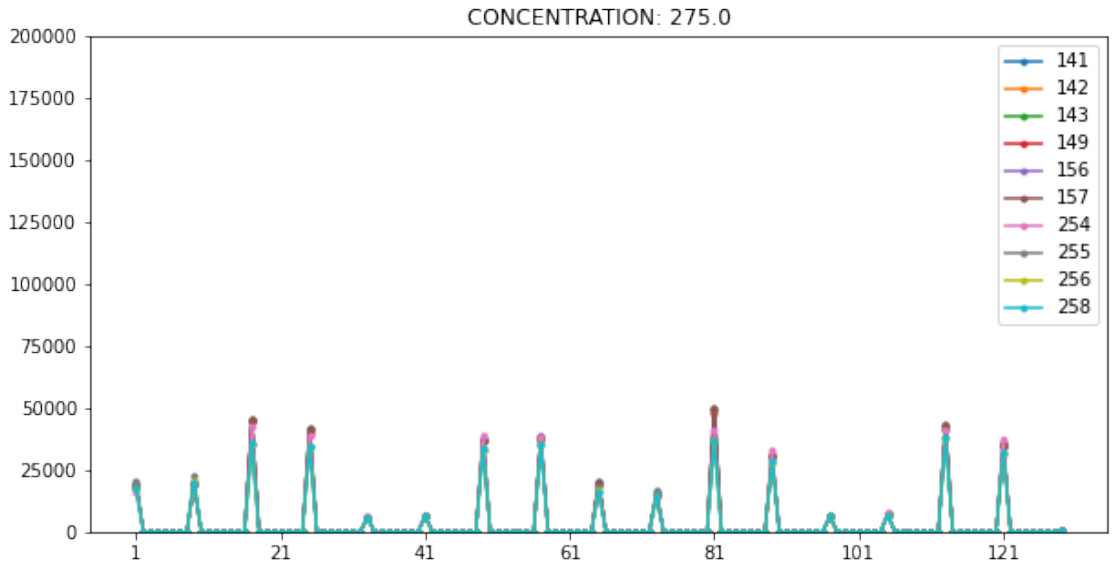

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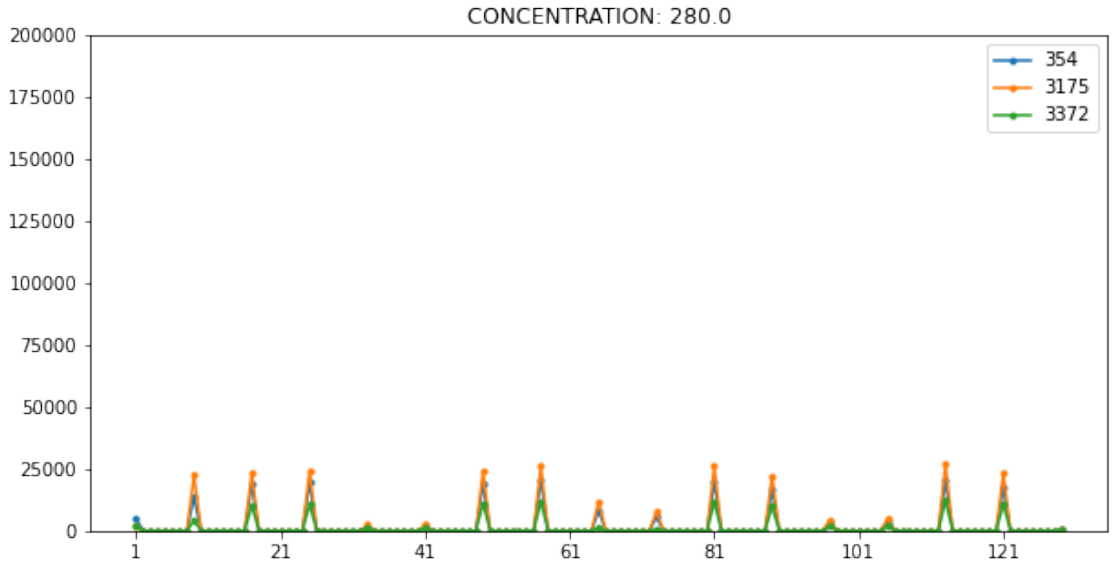

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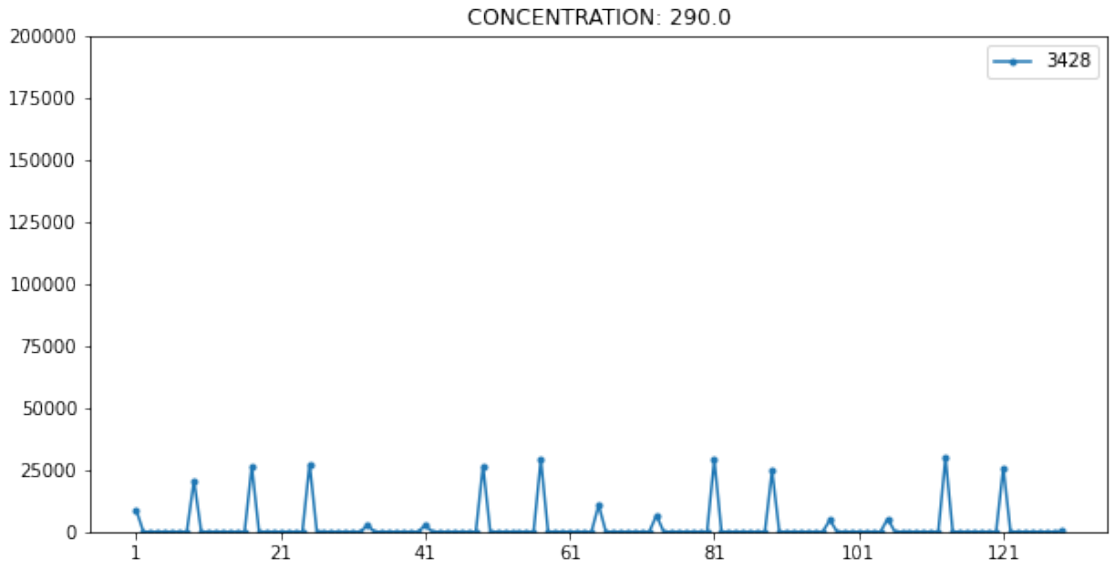

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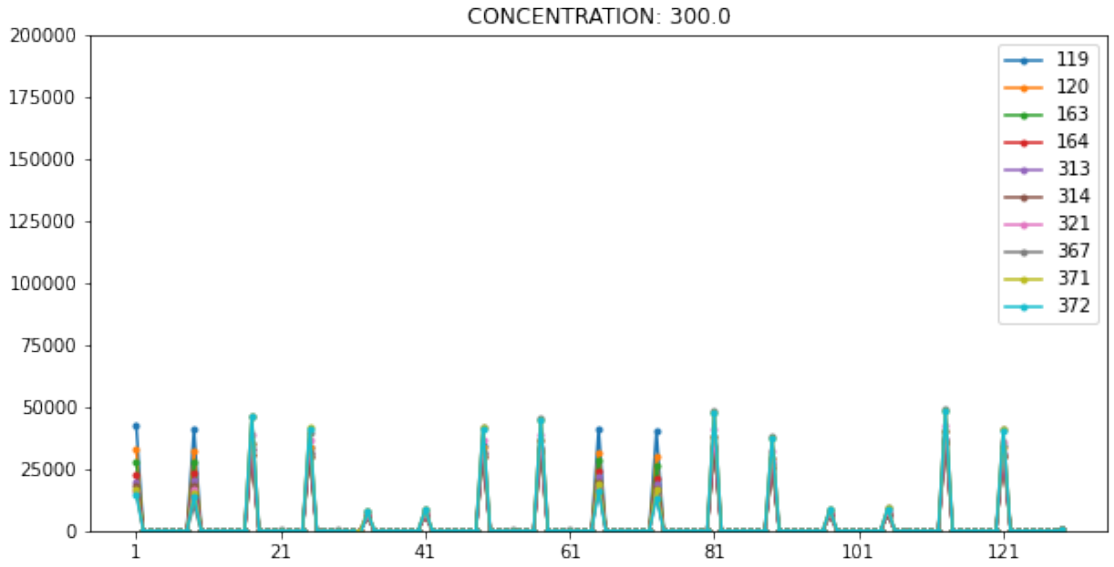


[75]:
```
df_signal.T.iloc[:,:10]
```

[75]:

	84	85	…	92	93
1	3115.218700	9056.404300	…	11700.587900	13078.871100
2	1.144049	1.428937	…	1.472016	1.508245
3	0.725879	2.588769	…	2.916336	3.469116
4	0.892731	3.392774	…	4.678075	5.441586
5	2.289280	4.306132	…	5.767297	6.649036
…	…	…	…	…	…
125	1.195833	5.564010	…	11.816688	15.709908
126	-0.764849	-3.049120	…	-4.617763	-6.362538
127	-1.163802	-4.741565	…	-7.495574	-10.935900
128	-1.468700	-5.263950	…	-8.263003	-11.847542
CONCENTRATION	10.000000	50.000000	…	100.000000	150.000000

[129 rows x 10 columns]

[76]:
```
df_signal2 = df_signal.set_index('CONCENTRATION')
df_signal2
```

[76]:

	1	2	3	…	126	127
128						
CONCENTRATION				…		
10.0	3115.2187	1.144049	0.725879	…	-0.764849	-1.163802
-1.468700						
50.0	9056.4043	1.428937	2.588769	…	-3.049120	-4.741565
-5.263950						
100.0	-518.4101	0.975693	3.553487	…	-0.016275	-0.062814

```
-0.528959
100.0          11840.9336  1.570923  3.078159  … -4.665714  -7.480605
-8.019985
200.0          13599.6171  1.589595  3.995321  … -7.787530 -12.765952
-13.719466
…                    …        …        …   …        …         …
…
10.0            3145.7364  1.471956  0.672651  … -1.049748  -1.650719
-4.629468
10.0            3100.3169  1.464953  0.669793  … -1.040478  -1.758638
-4.402991
10.0            3094.9610  1.464087  0.661045  … -1.035727  -1.645654
-4.446835
10.0            3077.1680  1.461638  0.660697  … -1.045257  -1.678745
-4.503662
10.0            3055.7124  1.458077  0.657973  … -1.040518  -1.743317
-4.520586

[2926 rows x 128 columns]
```

[84]:
```
df_in = df_signal.groupby(by = 'CONCENTRATION').mean()
df_in
```

[84]:

CONCENTRATION	1	2	…	127	128
1.0	1852.392984	1.392755	…	-0.543036	-3.650937
2.5	1164.519980	1.294471	…	-0.697506	-3.536910
5.0	13024.134876	2.939570	…	-0.938242	-3.420160
10.0	13282.774302	2.811189	…	-1.939551	-5.195182
15.0	21031.670554	3.753302	…	-1.819710	-5.017361
20.0	18134.985791	4.295256	…	-1.662052	-5.027393
25.0	25537.575036	4.394593	…	-2.553921	-6.395948
30.0	28822.505257	4.339897	…	-2.908935	-6.555700
35.0	31165.604293	4.427983	…	-3.150309	-7.275026
40.0	26909.032950	6.282935	…	-2.846519	-7.094169
45.0	31472.224763	5.241707	…	-4.044682	-9.177417
50.0	52855.170803	8.280159	…	-4.783142	-10.605804
55.0	36542.859811	4.476269	…	-4.363132	-9.503399
60.0	31925.760669	7.300112	…	-3.854980	-8.934335
65.0	43149.446196	5.351888	…	-5.199613	-11.184016
70.0	39754.572029	7.369848	…	-5.881562	-12.485529
75.0	56476.245552	7.689863	…	-5.545611	-10.962116
80.0	31157.848778	8.045161	…	-4.863346	-10.826278
85.0	11707.655542	3.363196	…	-6.573850	-14.142050
90.0	24832.246497	5.091128	…	-7.093396	-15.000553
95.0	13067.545282	6.916126	…	-7.749631	-16.429024
100.0	45764.672232	10.013633	…	-6.099172	-13.349686

```
110.0          5175.652800   2.257638  … -1.538246  -4.196041
120.0           434.415500   1.117354  … -0.648270  -3.137312
130.0          9738.113800   3.078789  … -3.076319  -8.044937
140.0          1710.598100   1.406218  … -2.022591  -6.198009
150.0          4825.386700   2.126884  … -1.497630  -4.104239
160.0          5087.730125   2.239785  … -2.404773  -6.245925
180.0          6388.382800   2.094905  … -6.521141 -14.567395
190.0           174.116700   1.045112  … -0.856211  -4.033758
220.0          1727.691400   1.572056  … -0.803800  -3.473778
230.0          6010.680550   2.486696  … -3.623601  -8.416047

[32 rows x 128 columns]
```

[0]:
```
for col_name, col_data in df_in.iteritems():
  df_in[col_name] = (col_data - col_data.mean())/col_data.std()
```

[79]:
```
df_in.head()
```

[79]:
```
                    1         2         3    …       126       127       128
CONCENTRATION                                …
2.5           -1.500890 -1.559691 -0.910886  …  1.504269  1.473719  1.405403
5.0           -1.174686 -1.159163 -0.808032  …  1.291645  1.274753  1.116898
10.0          -1.340556 -1.571497 -0.816150  …  1.881590  1.805156  1.744221
20.0          -1.121225 -1.543714 -0.784057  …  1.613242  1.593177  1.855930
25.0          -1.437201 -1.323139 -0.924079  …  0.986406  1.052565  1.517928

[5 rows x 128 columns]
```

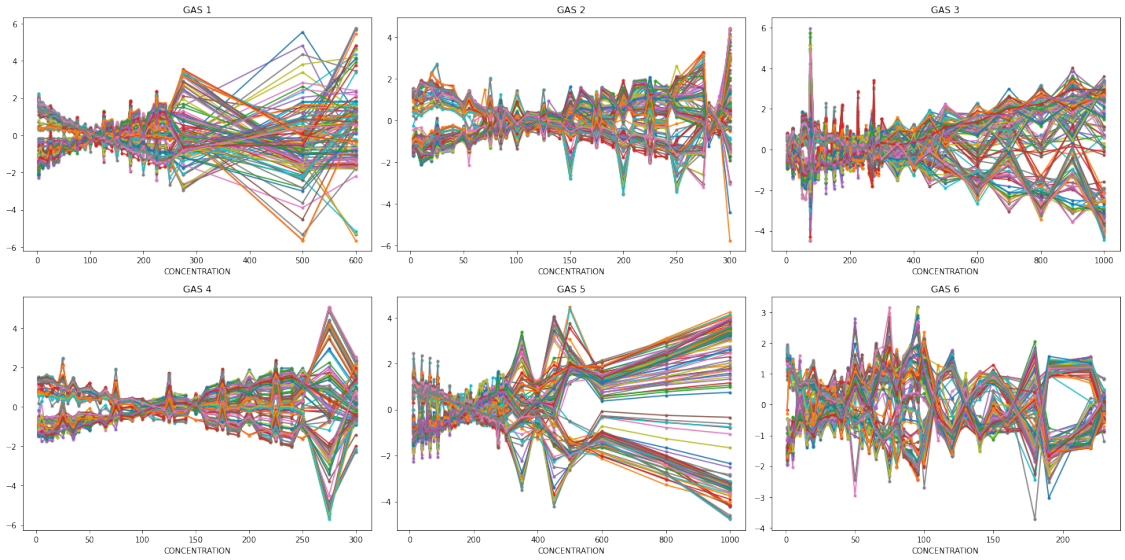
[80]:
```
fig, axes = plt.subplots(2,3)
axes = axes.flatten()
for gas, ax in zip(range(1,7,1), axes):
  df_gas = GasDataFrame(df).df
  # Selecciono el gas
  df_gas_1 = df_gas[df_gas['GAS']==gas]
  df_signal = df_gas_1.drop(columns = ['GAS', 'Batch ID'])

  #Agrupo las señales por concentracion y calculo su media
  df_in = df_signal.groupby(by = 'CONCENTRATION').mean()

  # Estandarizo cada concentracion
  for col_name, col_data in df_in.iteritems():
    df_in[col_name] = (col_data - col_data.mean())/col_data.std()

  # Represento el grafico
  ax = df_in.plot(figsize=(20,10), style='.-', ax=ax)
  ax.legend().remove()
  ax.title.set_text('GAS ' + str(gas))
```

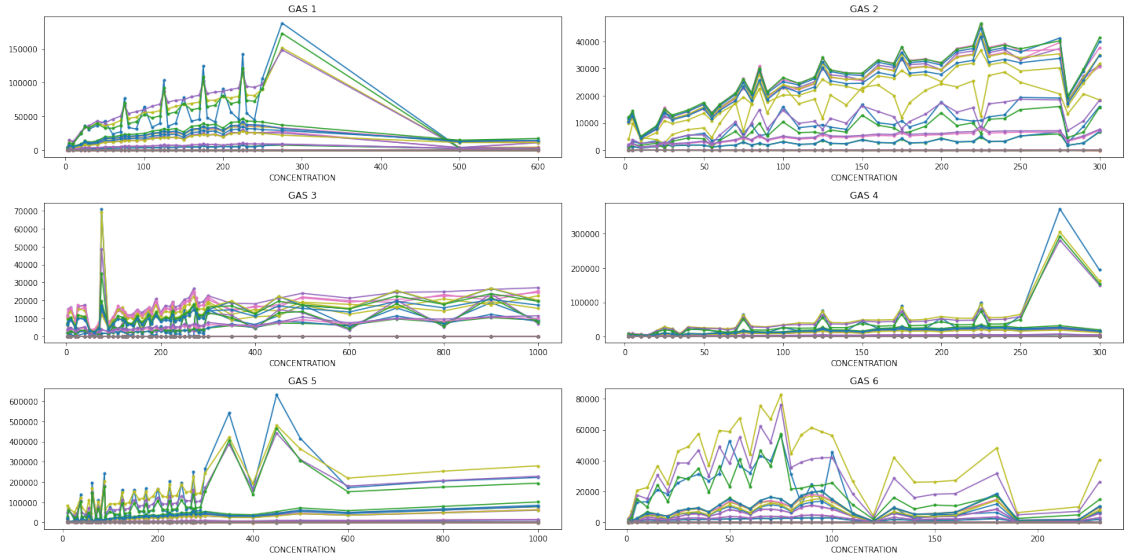
```
fig.tight_layout()
```



[0]:
```
def concentration_plot(ax, df_gas, gas=1):
  df = df_gas.copy()
  df_signal = df[df['GAS'] == gas]
  df_signal = df_signal.drop(columns = ['GAS', 'Batch ID'])
  df_in = df_signal.groupby(by = 'CONCENTRATION')
  ax = df_in.mean().plot(style='.-', ax=ax)
  ax.get_legend().remove()
  ax.title.set_text('GAS ' + str(gas))
```

[82]:
```
fig, axes = plt.subplots(3, 2, figsize=(20,10))

for i, ax in enumerate(axes.flatten()):
  concentration_plot(ax, df_gas, gas=i+1)
plt.tight_layout()
```



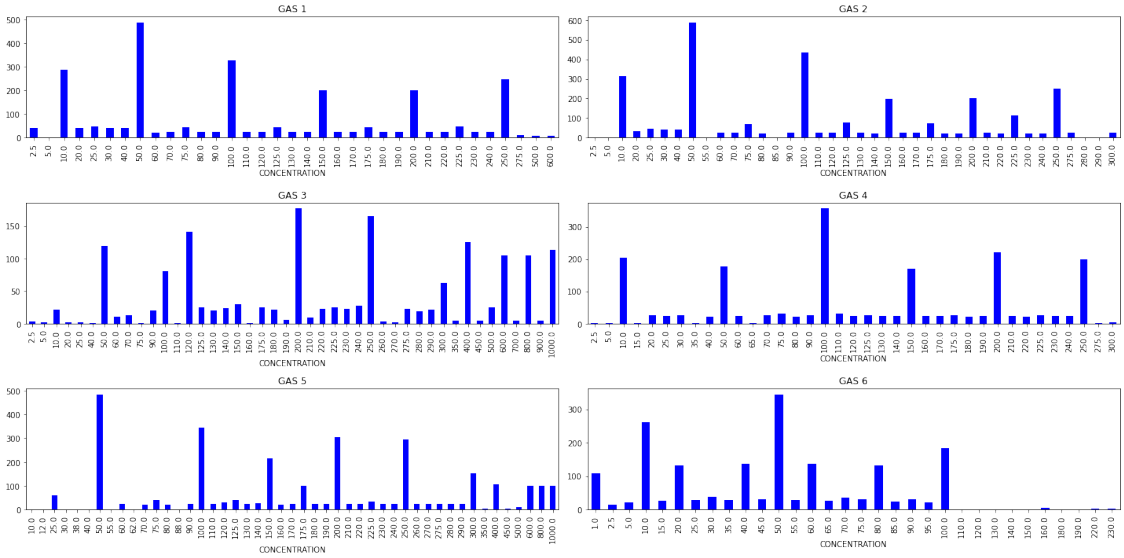
[89]:
```
def concentration_plot_count(ax, df_gas, gas=1):
  df = df_gas.copy()
  df_signal = df[df['GAS'] == gas]
  df_signal = df_signal.drop(columns = ['GAS', 'Batch ID'])
  df_in = df_signal.groupby(by = 'CONCENTRATION')

  #ax = df_in.count().plot(style='.-', ax=ax, color='b')
  ax = df_in.count().plot.bar(ax=ax, color='blue')
  ax.get_legend().remove()
  ax.title.set_text('GAS ' + str(gas))

fig, axes = plt.subplots(3, 2, figsize=(20,10))

for i, ax in enumerate(axes.flatten(), start=1):
  print(i)
  concentration_plot_count(ax, df_gas, gas=i)
plt.tight_layout()
```

```
1
2
3
4
5
6
```


GAS 1
GAS 2
GAS 3
GAS 4
GAS 5
GAS 6
CONCENTRATION