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import matplotlib as mpl
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
from sklearn.preprocessing import MinMaxScaler
from scipy import stats
import seaborn as sns
import tensorflow as tf
from tensorflow import keras
import sklearn
import sys
import io

def plot_learning_curves(loss, val_loss):
    plt.figure()
    plt.plot(np.arange(len(loss)), loss, "b.-", label="Training loss")
    plt.plot(np.arange(len(val_loss)), val_loss, "r.-", label="Validation loss")
    plt.gca().xaxis.set_major_locator(mpl.ticker.MaxNLocator(integer=True))
    plt.legend(fontsize=14)
    plt.xlabel("Epochs")
    plt.ylabel("Loss")
    plt.grid(True)

n_steps = 50
forecast = 10

#EXTRACT FLOW, Z SCORE, OUTLIERS
data_west = pd.read_csv('denoised_data_1016_west.csv')
data_west_o = np.array(data_west.FLOW)

#EXRTEND DATA
array_to_concatinate = data_west_o[288:]
for iter in range (35):
    data_west_o = np.concatenate([data_west_o,array_to_concatinate])

#SCALE AND RESHAPE DATA
scaler = MinMaxScaler()
array = data_west_o.reshape(-1, 1)
array_scaled = scaler.fit_transform(array)

flow_resaped = array_scaled[:len(array_scaled) - (len(array_scaled) % (n_steps+forecast)
#TRAIN SET, VALIDATION SET, TEST SET
test = int(0.7 * flow_resaped.shape[0])
valid = int(0.9 * flow_resaped.shape[0])

X_train = flow_resaped[:test, :n_steps]
X_valid = flow_resaped[test:valid, :n_steps]
X_test = flow_resaped[valid:, :n_steps]
print(X_test.shape)
print(X_test[-1:].shape)

#prepare targets
Y = np.empty((flow_resaped.shape[0], n_steps, forecast))
for step_ahead in range(1, forecast + 1):
    Y[:, :, step_ahead - 1] = flow_resaped[:, step_ahead:step_ahead + n_steps, 0]

y_train = Y[:test]
y_valid = Y[test:valid]
y_test = Y[valid:]

#DEFINE AND COMPILE MODEL
model = keras.models.Sequential([
    keras.layers.LSTM(20, return_sequences=True, input_shape=[None, 1]),
    keras.layers.LSTM(20, return_sequences=True),
    keras.layers.TimeDistributed(keras.layers.Dense(forecast))
])

def last_time_step_mse(Y_true, Y_pred):
    return keras.metrics.mean_squared_error(Y_true[:, -1], Y_pred[:, -1])

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model.compile(loss="mse", optimizer="adam", metrics=[last_time_step_mse])

early_stopping_cb = keras.callbacks.EarlyStopping(patience=10, restore_best_weights=True)
history = model.fit(X_train, y_train, epochs=1000,
                    validation_data=(X_valid, y_valid), callbacks=[early_stopping_cb])

model.save("lstm_1016_west.h5")
plot_learning_curves(history.history["loss"], history.history["val_loss"])
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(1055, 50, 1)
(1, 50, 1)
Train on 7381 samples, validate on 2109 samples
Epoch 1/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0169 - 1a
Epoch 2/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0084 - 1a
Epoch 3/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0075 - 1a
Epoch 4/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0072 - 1a
Epoch 5/1000
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Epoch 147/1000
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7381/7381 [=====] - 15s 2ms/sample - loss: 0.0052 - 1a
Epoch 211/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0052 - 1a
Epoch 212/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0052 - 1a
Epoch 213/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0052 - 1a
Epoch 214/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0052 - 1a
Epoch 215/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 216/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 217/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 218/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0052 - 1a
Epoch 219/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 220/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 221/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0052 - 1a
Epoch 222/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 223/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 224/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 225/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 226/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 227/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 228/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 229/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 230/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 231/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 232/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 233/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 234/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 235/1000
```

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7381/7381 [=====] - 16s 2ms/sample - loss: 0.0050 - 1a
Epoch 236/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0051 - 1a
Epoch 237/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0051 - 1a
Epoch 238/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 239/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 240/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 241/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 242/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 243/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 244/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 245/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 246/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 247/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0050 - 1a
Epoch 248/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0050 - 1a
Epoch 249/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 250/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0050 - 1a
Epoch 251/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 252/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0050 - 1a
Epoch 253/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 254/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 255/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0050 - 1a
Epoch 256/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 257/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 258/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 259/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 260/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 261/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 262/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 263/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 264/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
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Epoch 265/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 266/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 267/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 268/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0050 - 1a
Epoch 269/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 270/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 271/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 272/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 273/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 274/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 275/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0049 - 1a
Epoch 276/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0049 - 1a
Epoch 277/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 278/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 279/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 280/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 281/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 282/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0049 - 1a
Epoch 283/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0049 - 1a
Epoch 284/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 285/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 286/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 287/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 288/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 289/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0048 - 1a
Epoch 290/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 291/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 292/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 293/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 294/1000
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7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 295/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 296/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0048 - 1a
Epoch 297/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 298/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 299/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 300/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 301/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0048 - 1a
Epoch 302/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 303/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 304/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 305/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0048 - 1a
Epoch 306/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0048 - 1a
Epoch 307/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0048 - 1a
Epoch 308/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 309/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0048 - 1a
Epoch 310/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0048 - 1a
Epoch 311/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 312/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 313/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0047 - 1a
Epoch 314/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0048 - 1a
Epoch 315/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 316/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 317/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0048 - 1a
Epoch 318/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 319/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0047 - 1a
Epoch 320/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 321/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 322/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 323/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
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Epoch 324/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 325/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0047 - 1a
Epoch 326/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 327/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 328/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 329/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 330/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 331/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 332/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 333/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 334/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 335/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 336/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 337/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 338/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 339/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 340/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 341/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 342/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 343/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 344/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 345/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 346/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 347/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 348/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 349/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 350/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 351/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 352/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 353/1000
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7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 354/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 355/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 356/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 357/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 358/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 359/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 360/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 361/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 362/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 363/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 364/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 365/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 366/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 367/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 368/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 369/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 370/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 371/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 372/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 373/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 374/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 375/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 376/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 377/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 378/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 379/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 380/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 381/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 382/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 383/1000
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Epoch 383/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 384/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0047 - 1a
Epoch 385/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0046 - 1a
Epoch 386/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 387/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 388/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 389/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 390/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 391/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 392/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0046 - 1a
Epoch 393/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 394/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 395/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 396/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 397/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 398/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 399/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 400/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 401/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 402/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 403/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 404/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0046 - 1a
Epoch 405/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0046 - 1a
Epoch 406/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 407/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 408/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 409/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 410/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 411/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 412/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
```



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7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 413/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 414/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 415/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0046 - 1a
Epoch 416/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 417/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 418/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 419/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 420/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 421/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 422/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0046 - 1a
Epoch 423/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 424/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 425/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 426/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 427/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0046 - 1a
Epoch 428/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 429/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 430/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 431/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 432/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 433/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 434/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 435/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 436/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0046 - 1a
Epoch 437/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 438/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 439/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 440/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 441/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 442/1000
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Epoch 442/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 443/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 444/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 445/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 446/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 447/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 448/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 449/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 450/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 451/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 452/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 453/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 454/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 455/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 456/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 457/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 458/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 459/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 460/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 461/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 462/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0046 - 1a
Epoch 463/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 464/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0044 - 1a
Epoch 465/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 466/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0044 - 1a
Epoch 467/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 468/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 469/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 470/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 471/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0044 - 1a
```

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7381/7381 [-----] - 15s 2ms/sample - loss: 0.0044 - 1a
Epoch 472/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0044 - 1a
Epoch 473/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 474/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0044 - 1a
Epoch 475/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0044 - 1a
Epoch 476/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0044 - 1a
Epoch 477/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 478/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 479/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0044 - 1a
Epoch 480/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0044 - 1a
Epoch 481/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 482/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0044 - 1a
Epoch 483/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0044 - 1a
Epoch 484/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0044 - 1a
Epoch 485/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0045 - 1a
Epoch 486/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0045 - 1a
Epoch 487/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0044 - 1a
Epoch 488/1000
7381/7381 [=====] - 15s 2ms/sample - loss: 0.0044 - 1a
Epoch 489/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0044 - 1a
Epoch 490/1000
7381/7381 [=====] - 16s 2ms/sample - loss: 0.0044 - 1a

```



