W16_NN_MultipleHouses

January 6, 2021

1 settings

[1]:
```
#settings:
show_every = 10
NNtrain_for = 100
learningrate1 = 3e-3
houses = [28,37,40,42,105,115,56,51,58,70,99,100]
reset_scheduler_after_n_epochs = 10
```

2 Initialization

[2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

from tqdm import tqdm

from IPython.display import display, HTML
import time
```

[3]:
```
import random
#Neural Network imports
import torch
import torch.nn as nn
import torch.optim as optim

from sklearn.preprocessing import StandardScaler
from sklearn.metrics import r2_score
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_squared_error as mese
from sklearn.metrics import mean_absolute_error

from sklearn import linear_model
from sklearn.svm import SVR
```

```
scalerx = StandardScaler()
scalery = StandardScaler()
```

[4]:
```
#cuda imports
ngpu = torch.cuda.device_count() # number of available gpus
device = torch.device("cuda:4") if (torch.cuda.is_available() and ngpu > 0)␣
↪else "cpu" #cuda:0 for gpu 0, cuda:4 for gpu 5
torch.backends.cudnn.benchmark=True # Uses cudnn auto-tuner to find the best␣
↪algorithm to use for your hardware

#Random Seed
random.seed(1337)
torch.manual_seed(1337)
```

[4]:
```
<torch._C.Generator at 0x7efe4bac10f0>
```

Make all functions:

[5]:
```
#Parameters:
layerSize = 128
outputSize = 1
featureSize = 178
relu = nn.ReLU()

#class maken voor NN
class Net(nn.Module):
    def __init__(self):
        super(Net, self).__init__()
        self.fc1 = nn.Linear(featureSize, layerSize)
        self.fc2 = nn.Linear(layerSize, outputSize)

    def forward(self, x):
        x = relu(self.fc1(x))
        x = self.fc2(x)
        return x

def init_NN():
    model = Net().to(device)
    model.float()

    #Training parameters:
    optimizer = optim.Adam(model.parameters(), lr=learningrate1)
    criterion = nn.SmoothL1Loss()
    return model, optimizer, criterion
model, optimizer, criterion = init_NN()
```

[6]:
```
def det(tensor):
    """
    Zet de tensor om van een tensor naar numpy op de CPU.
    """
    return tensor.cpu().detach().numpy()

def calculate_metrics_for_model(output,target):
    """
    Calculates all the desired evaluation metrics for the model.
    """
    yhat = scalery.inverse_transform(det(output))
    y = scalery.inverse_transform(det(target))
    actual, pred = np.array(y), np.array(yhat)

    mae = mean_absolute_error(yhat, y)
    mse = mese(yhat, y)
    mape = np.mean(np.abs((actual - pred) / actual)) * 100
    r2 = r2_score(yhat, y)
    return [mae, mse, mape, r2]

def GetGlobalData(nr):
    """
    Get the data for the MVLR, SVR and NN.
    """
    house_nr = str(nr)
    if len(house_nr)==1:
        house_nr = "00"+str(house_nr)
    if len(house_nr)==2:
        house_nr = "0"+str(house_nr)
    df = pd.read_pickle('/home/18005152/notebooks/zero/Data:/testDataFrames/
 ↪TEST/MachineLearning_consumption_'+str(house_nr))
    return df

def NormalScaler(df):
    """
    Scale the data according to the normal method.
    """
    #scale the data
    #X:
    scalerx.fit(df.loc[:,~df.columns.isin(["consumption"])])
    scaled_dataX = scalerx.transform(df.loc[:,~df.columns.
 ↪isin(["consumption"])]).tolist()
    #Y:
    scalery.fit(df.loc[:,df.columns.isin(["consumption"])])
    datay = scalery.transform(df.loc[:,df.columns.isin(["consumption"])])
    return datay,scaled_dataX
```

```
def Split_Normal(dataX,dataY):
    """
    Split the data according to the method.
    """
    #split the data
    train_X = dataX[0:5800]
    train_y = dataY[0:5800].reshape(-1,1)

    valid_X = dataX[5800:7952]
    valid_y = dataY[5800:7952].reshape(-1,1)

    test_X = dataX[7952:8663]
    test_y = dataY[7952:8663].reshape(-1,1)
    return train_X, train_y, valid_X, valid_y, test_X, test_y

def MakeTrainLoader(train_X, train_y, valid_X, valid_y, test_X, test_y):
    """
    Function for making the dataloaders.
    This is mainly for the NN.
    """
    #Make tensors from the numpy arrays.
    train_X_t = torch.from_numpy(np.array(train_X)).to(device).float()
    train_y_t = torch.from_numpy(np.array(train_y)).to(device).float()

    valid_X_t = torch.from_numpy(np.array(valid_X)).to(device).float()
    valid_y_t = torch.from_numpy(np.array(valid_y)).to(device).float()

    test_X_t = torch.from_numpy(np.array(test_X)).to(device).float()
    test_y_t = torch.from_numpy(np.array(test_y)).to(device).float()

    #Tensor Datasets
    train_set = torch.utils.data.TensorDataset(train_X_t, train_y_t)
    valid_set = torch.utils.data.TensorDataset(valid_y_t, valid_X_t)
    test_set = torch.utils.data.TensorDataset(test_y_t, test_X_t)

    #Tensor DataLoaders
    train_loader = torch.utils.data.DataLoader(train_set, batch_size=64,␣
 ↪shuffle=False, num_workers = 0)#, pin_memory=True)
    valid_loader = torch.utils.data.DataLoader(valid_set, batch_size=64,␣
 ↪shuffle=False, num_workers = 0)#, pin_memory=True)
    test_loader = torch.utils.data.DataLoader(test_set, batch_size=64,␣
 ↪shuffle=False, num_workers = 0)
    return train_loader, valid_loader, test_loader

def train_NN_Nepochs(train_loader,N):
    """
    Training function for the training of the NN.
```

```
    """
    model, optimizer, criterion = init_NN()
    model.train()
    for i in range(N):
        for batch_idx, data_target in enumerate(train_loader):
            data = data_target[0]
            target = data_target[1]
            data = data.view(-1, data.shape[1])
            optimizer.zero_grad()

            output = model(data)
            loss = criterion(output, target)
            loss.backward()
            optimizer.step()
    return calculate_metrics_for_model(output, target)

def validate_NN(d1,target):
    """
    Validation function for the training of the NN.
    """
    model.eval()
    d1 = torch.from_numpy(np.array(d1)).to(device).float()
    target = torch.from_numpy(np.array(target)).to(device).float()
    output = model(d1)
    return calculate_metrics_for_model(output, target)
```

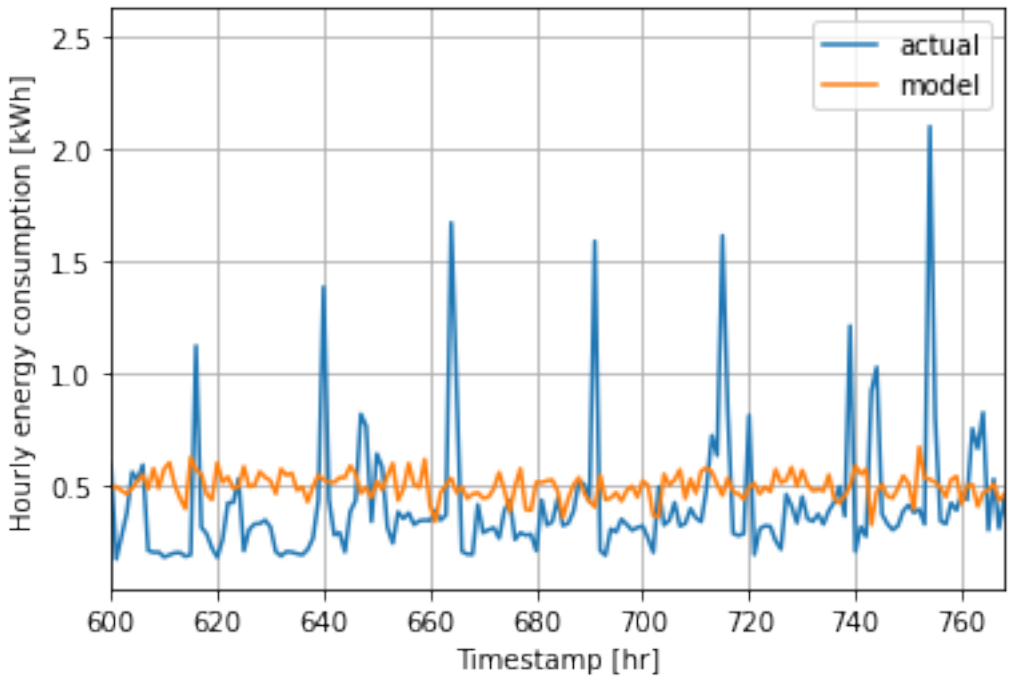
3 Main loop:

[7]:
```
#stats savelist:
NN_stats = pd.DataFrame()#NN

#Learning loop:
for i in tqdm(range(len(houses))):
    house_number = houses[i]
    """
    Data loading...
    """
    #laad de data in:
    df = GetGlobalData(house_number)
    #scale de data:
    Y_data, X_data  = NormalScaler(df)
    #splits de data:
    train_X, train_y, valid_X, valid_y, test_X, test_y =␣
 ↪Split_Normal(X_data,Y_data)
    #maak een dataloader van de data:
```

```
    train_loader, validation_loader, test_loader = MakeTrainLoader(train_X,␣
↪train_y, valid_X, valid_y, test_X, test_y)

    """
    Training
    """
    NN_train_stats = train_NN_Nepochs(train_loader,NNtrain_for)

    """
    Evaluation
    """
    NN_valid_stats = validate_NN(valid_X,valid_y)

    """
    Testing
    """
    NN_test_stats = validate_NN(test_X,test_y)

    """
    Save metrics
    """
    index =␣
↪["MAE_train","MSE_train","MAPE_train","R2_train","MAE_valid","MSE_valid","MAPE_valid","R2_v
    New_Stats = pd.DataFrame(NN_train_stats+NN_valid_stats+NN_test_stats,␣
↪index=index, columns=[str(house_number)])
    NN_stats = pd.concat([NN_stats,New_Stats],axis=1)
```

```
100%|      | 12/12 [04:32<00:00, 22.71s/it]
```

[10]:
```
T = torch.from_numpy(np.array(valid_X)).to(device).float()
yhat = scalery.inverse_transform(det(model(T)))
y = scalery.inverse_transform(valid_y)
plt.plot(y, label='actual')
plt.plot(yhat, label="model")
plt.xlabel("Timestamp [hr]")
plt.ylabel("Hourly energy consumption [kWh]")
plt.grid()
plt.legend()
plt.xlim([600, 768])
plt.savefig("NN_consumption_house100.png")
```



[ ]:
```
(NN_stats)
```

[11]:
```
NN_stats.to_pickle("NN_statistics")
```

[12]:
```
pd.read_pickle("NN_statistics").to_excel("NN.xlsx")
```

4 summarize stats with mean

[ ]:
```
(NN_stats).mean(axis=1)
```