

## train\_PhaseClassifier

March 9, 2022

```
[1]: from thermoclassifier.phases.net import PhaseClassifier
from thermoclassifier.dataset.dataset_creator import *
from torch.utils.data import DataLoader
import torch
import torch.nn as nn
from torch.optim import Adam
import numpy as np
import matplotlib.pyplot as plt
```

```
[49]: def epoch(net, train_loader, loss_func, optimizer, batch_size, seq_len):
    epoch_losses = np.zeros([len(train_loader), ])
    correct = 0
    incorrect = 0

    for i, d in enumerate(train_loader):
        # Scale inputs and get predictions
        inp = d[:, :, :-1]
        inp[:, :, 0] /= 1000
        predictions = net(inp.float()).squeeze()

        # Each batch consists of measurement batches, where seq_len
        ↳ measurements are put into one batch. In such a
        # measurement batch, every measurement has the same label as it needs
        ↳ to be from the same element in phase.
        # This leads to a target array where the target class is contained for
        ↳ each measurement in the measurement
        # batch. With this, CrossEntropyLoss would not work as the predictions
        ↳ are made for the whole measurement
        # batch and CEL therefore expects only on class label per measurement
        ↳ batch. Therefore, only the first
        # element of the last dimension of d is considered as target (all the
        ↳ entries in the last dimension are the
        # same anyways so it could be any entry)
        targets = d[:, :, -1][:, 0].long()

        correct += (predictions.argmax(dim=-1) == targets).sum().item()
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        incorrect += len(targets) - (predictions.argmax(dim=-1) == targets).
        ↪sum().item()

        #print(predictions.argmax(dim=-1), targets)

        # Calculate the loss
        loss = loss_func(predictions, targets)
        epoch_losses[i] = loss

        # Backward step
        net.zero_grad()
        loss.backward()
        optimizer.step()

    print('Training accuracy: ', correct/(correct + incorrect))

    return epoch_losses.mean()

```

[50]: *# Training and testing routines*

```

def train(net, train_loader, batch_size, seq_len, save=True):
    # Hyperparameters
    nr_epochs = 5000
    lr = 0.001

    loss_func = nn.CrossEntropyLoss()
    optimizer = Adam(net.parameters(), lr=lr)

    losses = np.zeros([nr_epochs, ])

    # Save the net with the lowest training loss as the best net
    best_net = net
    best_loss = epoch(net, train_loader, loss_func, optimizer, batch_size, ↵
    ↪seq_len)

    for i in range(nr_epochs):
        losses[i] = epoch(net, train_loader, loss_func, optimizer, batch_size, ↵
        ↪seq_len)

        if losses[i] < best_loss:
            best_net = net

        if i % 10 == 0:
            print(losses[i])

    return best_net

```

```

def test(net, test_loader):
    correct = 0
    incorrect = 0

    for d in test_loader:
        inp = d[:, :, :-1]
        inp[:, :, 0] /= 1000
        predictions = net(inp.float())
        targets = d[:, :, -1][:, 0].long()

        correct += (predictions.argmax(dim=-1).flatten() == targets).sum().
→item()
        incorrect += len(targets) - (predictions.argmax(dim=-1).flatten() ==
→targets).sum().item()

    accuracy = correct/(correct + incorrect)
    print('Test accuracy: ', accuracy)

    return accuracy

```

```

[51]: # Hyperparameters
seq_len = 1
batch_size = 256

# Create the dataset
measurement = 'C'
dc = DatasetCreator(elements=None, splits=(0.8, 0.2), validation=False,
→seq_len=seq_len, measurement=measurement, user='phase')
train_dataset, test_dataset, val_dataset = dc.get_datasets()

# Create the DataLoaders
train_loader = DataLoader(train_dataset, batch_size=batch_size, shuffle=True)
test_loader = DataLoader(test_dataset, batch_size=batch_size, shuffle=True)
if val_dataset:
    val_loader = DataLoader(val_dataset)

# Create the network
t = True
net = PhaseClassifier(train=t, measurement=measurement)

```

Dataset shape: (102693, 1, 4)

```

[52]: # Train the network
best_net = train(net, train_loader, batch_size, seq_len)

# Test the trained network
test(best_net, test_loader)

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Training accuracy: 0.8720555441948331
0.33171043978698217
Training accuracy: 0.8801865755212137
Training accuracy: 0.8795536209868248
Training accuracy: 0.8811311384417633
Training accuracy: 0.8771873448044171
Training accuracy: 0.8727177120154246
Training accuracy: 0.8800307713281333
Training accuracy: 0.8821925545071232
Training accuracy: 0.880546872717712
Training accuracy: 0.8819588482175027
Test accuracy: 0.877785542355773

```

[52]: 0.877785542355773

```

[43]: net = torch.load(r"C:\Users\danie\Documents\Montanuni\Masterarbeit\5_
↳Programmcodes\packages\ThermoClassifier\ThermoClassifier\phases\models\new\PhaseClassifier.
↳pth")
test(net, test_loader)

```

22862 2896

Test accuracy: 0.8875689106297073

[43]: 0.8875689106297073

```

[55]: torch.save(best_net, 'PhaseClassifier_8778.pth')

```

[ ]: