

Connected to .venv (Python 3.11.5)

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In [ ]: import random
import numpy as np
import torch
from torch import nn
from torch.nn import functional as F
from torch.utils.data import random_split
import matplotlib.pyplot as plt
from tqdm import tqdm
from causal_dnn import CausalDNN
from linear_dnn import LinearDNN
from helper_utils import *

if __name__ == "__main__":
    # Set the seed for reproducibility
    torch.manual_seed(12345)
    # Example usage:
    n = 15000
    d_in = 5
    d_out = 1
    d_param = 2
    dim_z = 1
    h_arch = [20, 20]
    X = torch.randn(n, d_in)
    # True CATE
    #  $\beta(x) = 2 - x_2 + 0.25 * x_1^3$ 
    trub = 2 - X[:,1] + .25 * torch.pow(X[:,0], 3)
    # True Baseline
    #  $\alpha(x) = 0.2 * x_1 - 1.3 * x_2 - 0.5 * x_3$ 
    trua = X[:,0] * 0.2 - X[:,1] * 1.3 - X[:,2] * 0.5
    # Treatment (constant propensity)
    z = (torch.rand(n, dim_z) > .5)
    # Reshape variables
    trub = torch.reshape(trub, (n, 1))
    trua = torch.reshape(trua, (n, 1))
    z = torch.reshape(z, (n, 1))
    # Outcomes are linear in treatments
    y = trua + torch.mul(trub, z) + torch.randn(n, 1)
    # Collect data
    dat = {"X": X, "y": y, "z": z}

    # Estimate CATEs over Entire Dataset
    model = CausalDNN(num_output=d_param, num_input=d_in, hidden_arch=h_arch, lr=0.
    loss_values = model.train(X, y, z, epochs=1000, tol = 1e-3)

    het_alpha = model.alpha_vec.detach().numpy()
    het_beta = model.beta_vec.detach().numpy()

    # Generate the graph
    plt.plot(loss_values)
    plt.xlabel('Epoch')
    plt.ylabel('Loss')
    plt.title('Loss over epochs')
```

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plt.show()

# Generate comparison graph
plt.scatter(trub, het_beta)
plt.xlabel('True CATE')
plt.ylabel('Estimated CATE')
plt.title('True vs Estimated CATE')
plt.show()

# Split data for cross-fitting
split1 = int(n/3)
split2 = int(n/3)
split3 = n-split1-split2
samp1, samp2, samp3 = random_split(torch.cat([X, y, z], dim=1), (split1, split2, split3))
dat1 = {"X": samp1.dataset[:, 0:d_in], "y": samp1.dataset[:, d_in:d_in+d_out], "z": samp1.dataset[:, d_in+d_out:d_in+d_out+d_out]}
dat2 = {"X": samp2.dataset[:, 0:d_in], "y": samp2.dataset[:, d_in:d_in+d_out], "z": samp2.dataset[:, d_in+d_out:d_in+d_out+d_out]}
dat3 = {"X": samp3.dataset[:, 0:d_in], "y": samp3.dataset[:, d_in:d_in+d_out], "z": samp3.dataset[:, d_in+d_out:d_in+d_out+d_out]}

# Create models
model1 = CausalDNN(num_output=d_param, num_input=d_in, hidden_arch=h_arch, lr=0.001)
model2 = CausalDNN(num_output=d_param, num_input=d_in, hidden_arch=h_arch, lr=0.001)
model3 = CausalDNN(num_output=d_param, num_input=d_in, hidden_arch=h_arch, lr=0.001)

# Train models
model1.train(dat1["X"], dat1["y"], dat1["z"], epochs=1000, tol = 1e-3)
model2.train(dat2["X"], dat2["y"], dat2["z"], epochs=1000, tol = 1e-3)
model3.train(dat3["X"], dat3["y"], dat3["z"], epochs=1000, tol = 1e-3)

# Make Lambda
lproj1 = make_lam(dat1, model3)
lproj2 = make_lam(dat2, model1)
lproj3 = make_lam(dat3, model2)

# Define statistic
H_func=lambda x,y: y[:,1]

# Compute influence functions
if1 = proc_res(dat1, model2, lproj3, H_func)
if2 = proc_res(dat2, model3, lproj1, H_func)
if3 = proc_res(dat3, model1, lproj2, H_func)

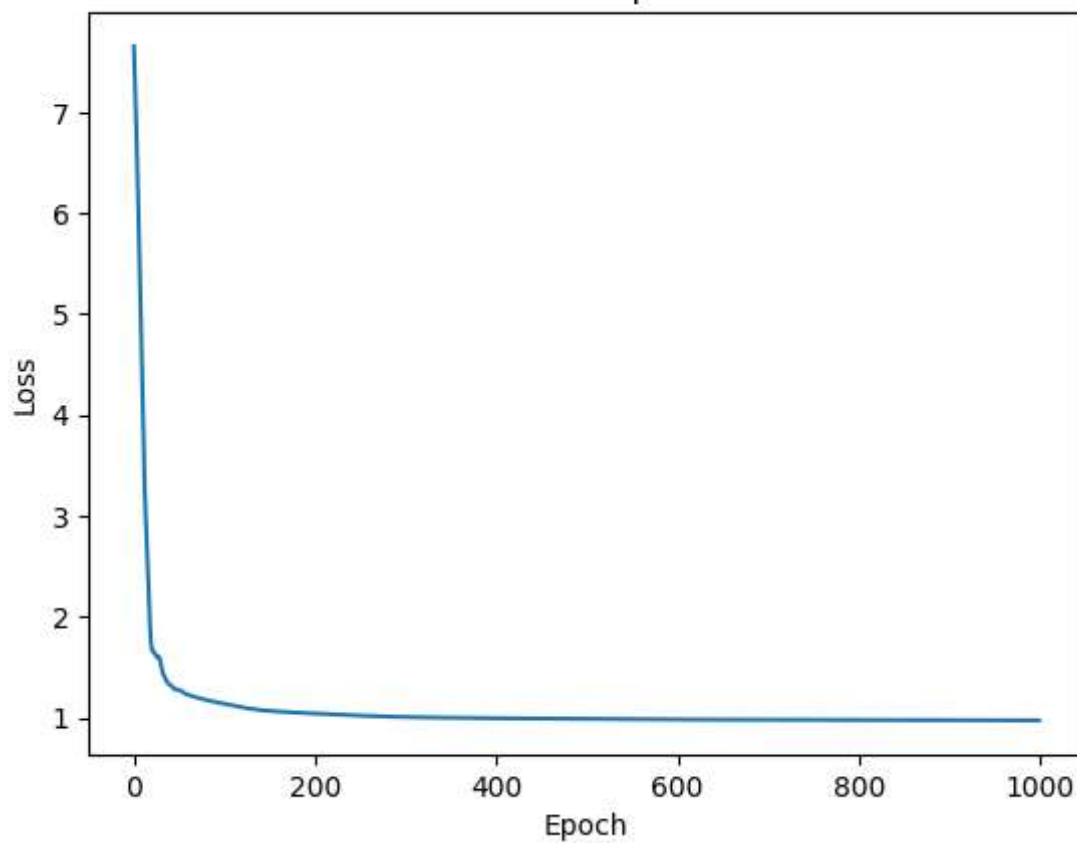
# Compute ATE and Confidence Intervals
ate_beta = torch.cat([if1, if2, if3], dim=0).mean(dim=0)
ate_se = ((1/3)*(if1.var() + if2.var() + if3.var())/n).sqrt()

# Report results
print(f'ATE: {ate_beta.item():.3f}')
print(f'95% CI: [{ate_beta.item()-1.96*ate_se.item():.3f}, {ate_beta.item()+1.96*ate_se.item():.3f}]')
print(f'True ATE: {trub.mean().item():.3f}')

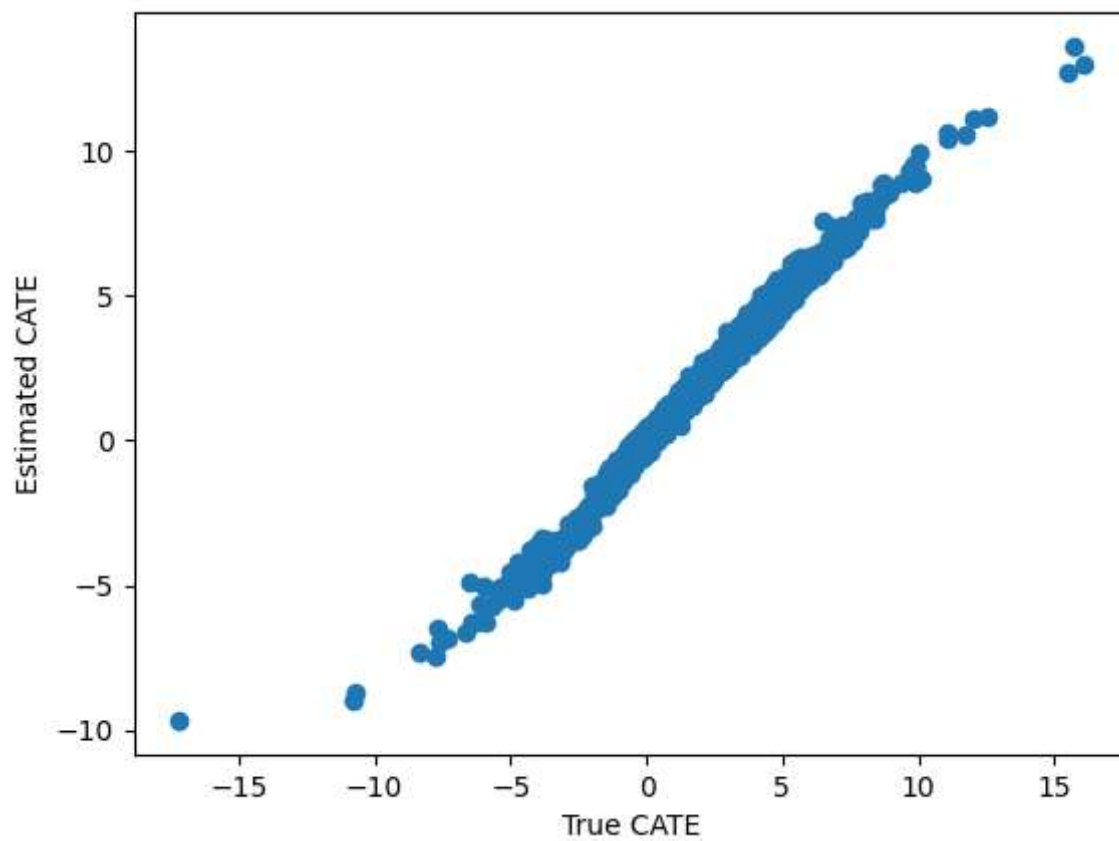
```

100% |██████████| 1000/1000 [00:04<00:00, 246.97it/s]

Loss over epochs



True vs Estimated CATE



```
100%|██████████| 1000/1000 [00:03<00:00, 261.62it/s]
100%|██████████| 1000/1000 [00:03<00:00, 262.39it/s]
100%|██████████| 1000/1000 [00:03<00:00, 266.33it/s]
 92%|██████████| 183/200 [00:00<00:00, 494.52it/s]
```

Training stopped at epoch 184, Loss: 0.0009999831672757864

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100%|██████████| 200/200 [00:00<00:00, 477.25it/s]
100%|██████████| 200/200 [00:00<00:00, 461.44it/s]
100%|██████████| 200/200 [00:00<00:00, 485.37it/s]
 56%|██████████| 113/200 [00:00<00:00, 485.64it/s]
```

Training stopped at epoch 114, Loss: 0.0009982878109440207

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100%|██████████| 200/200 [00:00<00:00, 491.31it/s]
100%|██████████| 200/200 [00:00<00:00, 498.68it/s]
100%|██████████| 200/200 [00:00<00:00, 490.33it/s]
 58%|██████████| 116/200 [00:00<00:00, 473.82it/s]
```

Training stopped at epoch 117, Loss: 0.000983965815976262

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100%|██████████| 200/200 [00:00<00:00, 478.24it/s]
100%|██████████| 200/200 [00:00<00:00, 480.68it/s]
100%|██████████| 200/200 [00:00<00:00, 481.91it/s]
```

ATE: 2.058

95% CI: [1.990, 2.126]

True ATE: 2.000