Bench marking for PINNs

1 Methodology

PINNs are powerful neural networks that help solve PDEs faster and more efficiently. In this report we implement PINNs to tackle a simple conduction problem and to bench mark its use.

2 Implementation

We use the ready made package names deepxde in order to solve our problem at hand. In this section we will explain how to implement the said library in order to solve our PDE. Since we will be performing bench marking we will assume $K_1 = K_2$. So the equation becomes :

$$\mathbf{K}\nabla^2 T = 0$$

This further simplifies into the original one dimensional heat flow equation with the given constraints :

$$T(0) = 1800$$

$$T(0.3) = 300$$

We can now explain the relevant code blocks used to solve the problem.

2.1 Importing Relevant Libraries:

```
import deepxde as dde
import matplotlib.pyplot as plt
import numpy as np
# Import tf if using backend tensorflow.compat.v1 or tensorflow
from deepxde.backend import tf
```

Figure 1: Libraries

2.2 Defining the Geometry and Model

This block helps define the Dirichlet Boundary conditions as well as makes the model. The layer size is take arbitrarily from the documentation as well as the other hyper parameters.

```
geom = dde.geometry.Interval(0, 0.3)
bc = dde.icbc.DirichletBC(geom, func, boundary)
data = dde.data.PDE(geom, pde, bc, 16, 2, solution=func, num_test=100)

layer_size = [1] + [50] * 3 + [1]
activation = "relu"
initializer = "Glorot uniform"
net = dde.nn.FNN(layer_size, activation, initializer)

model = dde.Model(data, net)
model.compile("adam", lr=0.001, metrics=["l2 relative error"])

losshistory, train_state = model.train(iterations=10000)
```

Figure 2: Geometry and model

3 Results and Discussions

The loss comes out to be almost zero as a simple linear pattern is observed.The train test loss graphs can be shown below as well as the prediction.

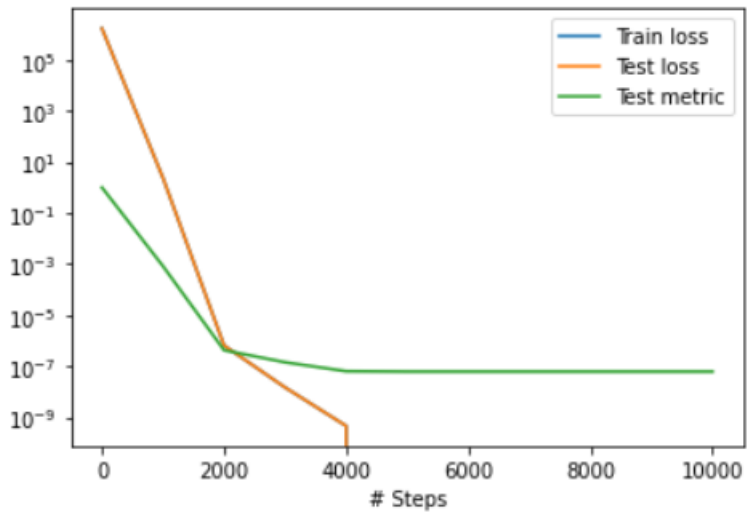

Figure 3: Loss Graph

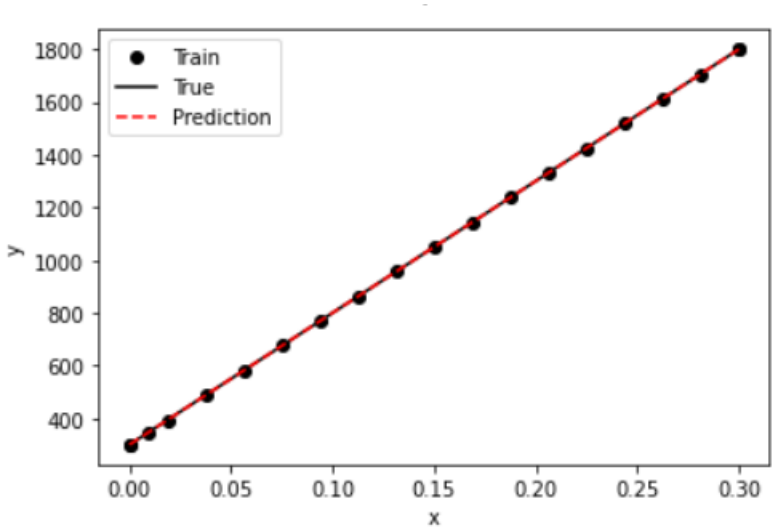

Figure 4: Prediction

Deep XDE is a good device to try to solve these PDEs how ever it lacks a data centric approach.I will also learn more about the M.Raissi and how to implement their PINN for further research.