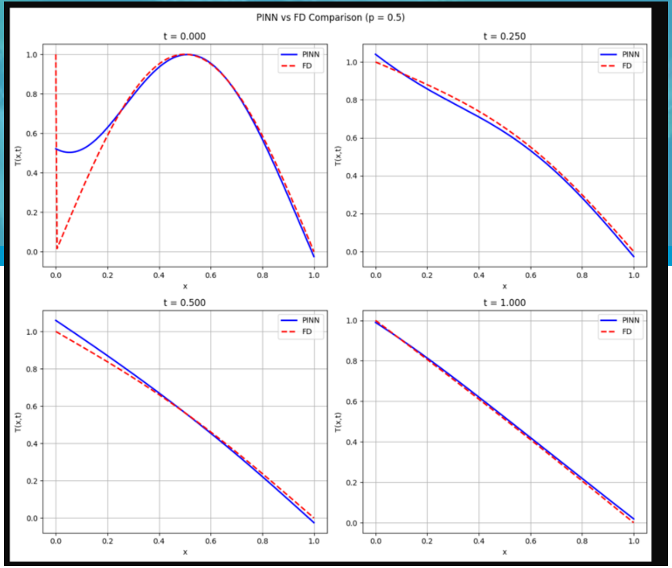
DEC 2 2025

Parametric & Inverse PINN for 1D Heat Diffusion



EPS 109 Final Project

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Problem Statement

- Build a physics-informed neural model for how heat spreads in a 1D material
- Use a single network that works across different material settings
- Recover unknown material properties from partial temperature observations
- Validate the neural predictions against a standard numerical method

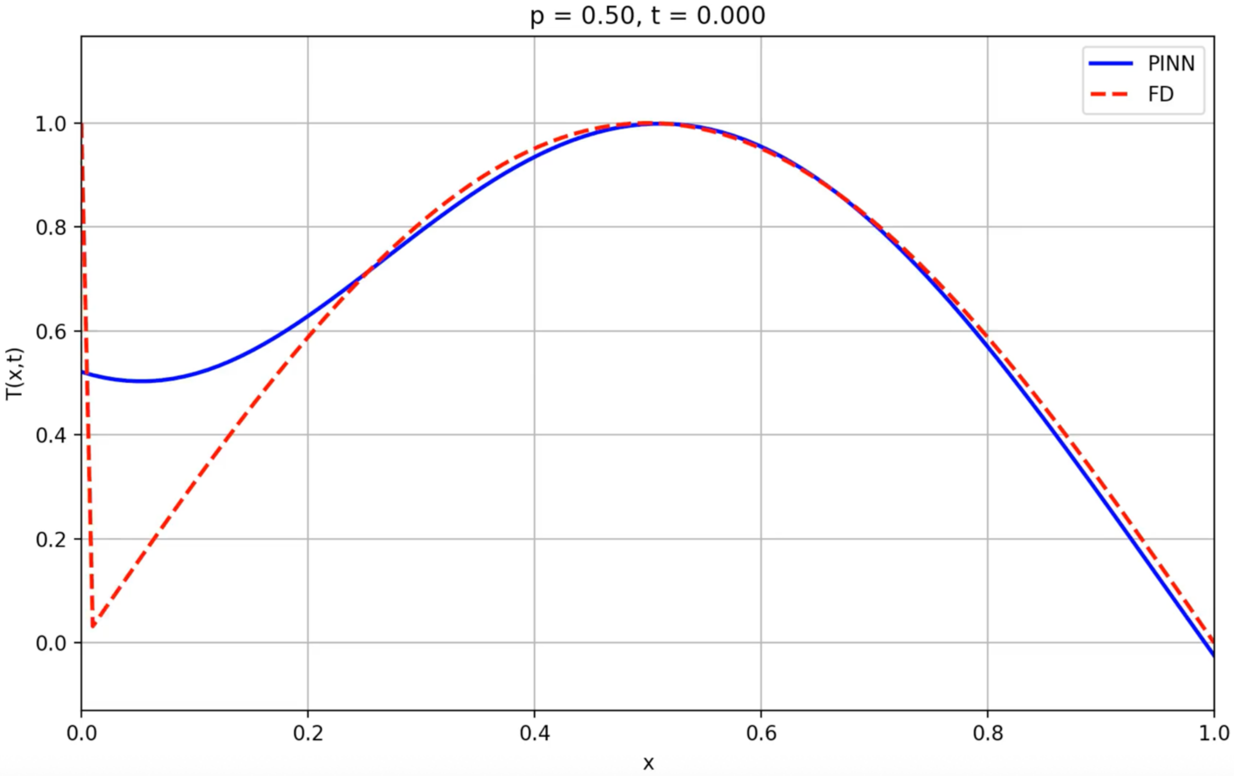
PINN Training Approach

- I built a physics-informed neural network (PINN) to model how heat spreads through a one-dimensional material
- The model operates in a parametric mode, learning to solve the system across different material settings (indexed by p)
- It also supports an inverse mode, where the model recovers an unknown material property from limited observations
- Model validation was done by comparing predictions against a classical finite-difference solver
- The approach demonstrates learning physical behavior directly from governing constraints — not from labeled data

Results & Interpretation

- One model solves many different material scenarios without retraining
- Can also infer unknown material properties from partial observations
- Successfully recovered a hidden parameter with high precision
- Predictions match a classical numerical solver, confirming correctness
- Demonstrates neural approaches as efficient tools for simulation and parameter estimation

Visualization



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