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2025 USA-NA-AIO Round 2, Problem 1, Part 12

USAAIO 

May 2025

Part 12 (10 points, coding task)

In this part, you are asked to do the following tasks to test the effectiveness of our PINN model.

1. Generate a dataset $\{(t, x) \in \{0, 0.01, \dots, 1\}^2\}$. Save the dataset as a tensor with name `tx_test` and shape `(101, 2)`.
2. For each data point, compute $u(t, x)$ whose formula is given in Part 1. Save the result as a tensor with name `u_test` and shape `(101, 2)`.
3. For each data point, use our trained PINN model to compute the predicted value $U(t, x \mid \theta)$. Save the result as a tensor with name `U_test` and shape `(101, 2)`.
4. Print the mean squared error between `u_test` and `U_test`.
5. Generate two 2-dim scatter plots for (t, x) by using the above data points.
 - In Figure 1, the value on each position is the ground-truth temperature $u(t, x)$.
 - In Figure 2, the value on each position is the predicted temperature $U(t, x \mid \theta)$.
 - In each plot,
 - Set `c` as the values on those scattered positions
 - Set `cmap='viridis'`
 - Add `plt.colorbar(label='Value')`.

```
### WRITE YOUR SOLUTION HERE ###
```

```
model.to('cpu')
data_1dim = torch.linspace(0, 1, 101)
data_grid = torch.meshgrid(data_1dim, data_1dim)
tx_test = torch.stack([data_grid[0].reshape(-1), data_grid[1].reshape(-1)], dim=1)
u_test = torch.exp(- alpha * torch.pi**2 * tx_test[:,0]) * torch.sin(torch.pi * tx_test[:,1])
U_test = model(tx_test).reshape(-1).detach()

mse = torch.mean((u_test - U_test)**2).item()
print(mse)

plt.figure(1)
plt.scatter(tx_test[:,0], tx_test[:,1], c=u_test, cmap='viridis')
plt.xlabel('t')
plt.ylabel('x')
plt.colorbar(label='Value')
plt.title('Ground-truth')

plt.show()

plt.figure(2)
plt.scatter(tx_test[:,0], tx_test[:,1], c=U_test, cmap='viridis')
plt.xlabel('t')
plt.ylabel('x')
plt.colorbar(label='Value')
plt.title('Predicted')

plt.show()

""" END OF THIS PART """
```

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