

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

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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 $U(t, x | \theta)$. 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 $U(t, x | \theta)$.
 - In each plot,
 - Set `c` as the values on those scattered positions
 - Set `cmap='viridis'`
 - Add `plt.colorbar(label='Value')`.

USAAIO **May 2025**

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 * t
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 """

[Skip to main content](#)

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