dortmund university

Data Science for Dynamical Systems (DS4DS)

Final project

Project task

1) Get access to the three datasets (Moodle)
2) Study the datasets and **select two** out of the three
   a) An unknown ODE with noisy measurements
   b) The 1D Kuramoto-Sivashinsky PDE with an unknown parameter
   c) The 2D Cahn-Hillard PDE with known parameter values
3) Use a method of your choice to train a model that is able to predict the state for 100 time steps as accurately as possible (measured in terms of the MSE)
4) Present your results in the oral exam

The data sets

- A detailed description can be found in the Jupyter Notebook “TaskDescription.ipynb”
- Note that the trajectories are longer than the time horizon over which we want to have a good prediction
  → This means that one can use each trajectory many times, starting at different initial conditions (i.e., time steps)
- In case of the dataset b) (Kuramoto-Sivashinsky), it may be difficult to train a single model for both trajectories. It is ok to train two individual models

Hidden test challenge

- Please submit your final model at least two days before the presentation.
- It should accept an initial condition $x_0 \in \mathbb{R}^n$ and produce a time series of length 101 (the initial condition plus 100 steps) → $X \in \mathbb{R}^{n \times 101}$
- We will evaluate your model on a previously unseen dataset
- **Note**: The performance is not the main criterion for a good grade! This is more of a fun challenge to see how well you have done.

The final presentation

Time: 20 minutes for the presentation, 10 minutes for the follow-up discussion and questions

Content:

1) Which datasets have you decided on and why?
   Important: Do not describe the dataset, everyone should know them!
2) Which approaches have you selected and why?
3) How have you implemented your approach? Which challenges/obstacles did you have to overcome?
4) Presentation of the numerical results
5) A critical assessment of your numerical results
   - How good is the performance?
   - What are the reasons that your approach did or did not work?
   - What needs to be changed / done in addition in order to improve your results?
6) Conclusion and outlook