Math773
Topics Topics in Data Science

Part I: Learning kernels in operators

Part II: Probability theory for TSC

Part III: Time series modeling

Fei Lu, Fall 2023

Part I: Learning kernels in operators

- **Overview and review of nonparametric regression**
- **Finitely many particles**
- **Coercivity**
- **Infinitely many particles: mean-field**
- **DARTR and its Bayesian perspective**
- **Small noise analysis**

References:

- **CS02**: Felipe Cucker and Steve Smale. On the mathematical foundations of learning. Bulletin of the American mathematical society, 39(1):1–49, 2002.
- **GKKH02**: Laszlo Gyorfi, Michael Kohler, Adam Krzyzak, and Harro Walk. A distribution-free theory of nonparametric regression. Springer, 2002.
- **Tsy08:** AB Tsybakov. Introduction to nonparametric estimation. Springer 2008.
- **Maggioni** etc.

Week 1-6, lectures

Part II: Probability theory for TSC

- Time Series Classification methods

+ Random Forest: Mur22intro, Chp18
+ ROCKET
+ ResNet
+ Signature methods

- Theory: Bayes error

+ **DGL96:** Luc Devroye, Laszlo Gyorfi, and Gabor Lugosi. A probabilistic theory of pattern recognition, volume 31. Springer Science & Business Media, 1996.
  chp2,6,7,8,12
+ **Mur22intro:** Kevin P Murphy. Probabilistic machine learning: an introduction. MIT press, 2022.
+ **Mur22adv:** Kevin P Murphy. Probabilistic machine learning: advanced topics. MIT press, 2022.

Week 7-10: presentations+lectures

Part III: Time series modeling

- Neural Network for Sequences

Mur22intro: Part III, Deep Neural Networks
+ chp13: Neural Networks
+ chp14: Neural Networks for images
+ chp15: Neural Networks for sequences

Mur22adv: Part III Prediction
+ chp14: predictive models: an overview
+ chp15: Generalized linear models
+ chp16: Deep Neural Networks
+ chp17: Bayesian Neural networks
+ chp18: Gaussian processes

Week 11-15: presentations+lectures