High Integrity Systems Project
TSA Tasks 05

Prof. Dr. Matthias F. Wagner
Dr. Fatima Sajid Butt

Winter Semester 2024/2025

Now we are getting to the center in *Time Series Analysis*! Please start from now on to look into the journals too!

1. Please summarize chapter 12 of the book *Modern time series forecasting with Python*! Explain the training, prediction and forecasting. Especially explain:
   - the *encoder/decoder* idea,
   - the basic *FFN* structure, strengths, waeknesses and applications,
   - the *RNNs*, especially the *LSTM* in detail,
   - the *CNN* models, and
   - the *hybrid models*!
2. Please run the corresponding code of chapter 12, comment the code and explain it! Please explain also errors and how you solved them!
3. The Matlab code *Time Series Forecasting Using Deep Learning* uses an LSTM. Please let this example run and explain it in detail!
4. Please summarize the ideas of chapter 13 of the book *Modern time series forecasting with Python*!
5. Please run the corresponding code of chapter 13, comment the code and explain it! Please explain also errors and how you solved them!
6. C/C++ and FORTRAN (!) still provide the fastest code for numerical calculations. Python is pretty slow, being an interpreted script language, albeit using libraries written in compiled languages. A compiled language of rising importance is *Julia*, promising FORTRAN-like performace in benchmarks.
   - Please give an overview of *Julia*!
   - Please look into Julia scientific libraries, e.g. SciML, Machine Learning in Julia and modeling and simulation.
   - Please have a look at the paper
     Berman, E. and Ginesin, J., 2024. The State of Julia for Scientific Machine Learning. arXiv preprint arXiv:2410.10908.

7. As discussed, the group has to provide updated versions of your cumulative HIS project document!