Hagenberg Prescriptive Analytics Days 2024

scch { software competence center hagenberg } 25 YEARS

DAY 2 – OPEN PROBLEM SESSION:

On day two of the HPAD, the workshop's contributors joined for a **discussion-breakfast** to report about **open problems** that have emerged as eminent and related during the previous day's presentations. The goal is to share these emerged thoughts with the goal to exchange expert-knowledge, references to prior work and research motivation among the contributors and the audience.

J. Antoch: **Realizing of interpretability of Change Point Detection.**
Problem: In several lectures (See abstracts of Lectures 1.,3., and 6., below) the need to interpret the prognosis of an anomaly detection model was mentioned.

Proposed Solutions: How CPD in various situations can help has been discussed. Namely, for

i. CPD and non-parametric, especially Bootstrapping Methods [1],
ii. CPD for signals that are not independently distributed [2],
iii. CPD and techniques involving permutation of the sample [3],
iv. CPD of multiple CPs [4].

[1] Béatrice Bucchia, Martin Wendler. Change-point detection and bootstrap for Hilbert space valued random fields. Journal of Multivariate Analysis, Vol. 155, 2017, 344-368, ISSN 0047-259X, https://doi.org/10.1016/j.jmva.2017.01.007.

[2] J. Antoch, M. Huškova, Z. Prášková. Effect of dependence on statistics for determination of change, Journal of Statistical Planning and Inference, Vol. 60, Issue 2,1997, 291-310, ISSN 0378-3758, https://doi.org/10.1016/S0378-3758(96)00138-3.

[3] Jaromír Antoch, Marie Hušková, Permutation tests in change point analysis, Statistics & Probability Letters, Vol. 53, Issue 1, 2001, Pages 37-46, ISSN 0167-7152, https://doi.org/10.1016/S0167-7152(01)00009-8

[4] Niu, Y. S., Hao, N., & Zhang, H. (2016). Multiple Change-Point Detection: A Selective Overview. Statistical Science, 31(4), 611–623. http://www.jstor.org/stable/26408091

I. Bukovsky: **Using linear activation functions in Deep Learning Methods for realizing intrinsic explanations of predictive models.**
Problem: The explainability of deep learning methods for anomaly detection has often the draw-back of lacking the ability to back-trace detections to relevant features.

Proposed Solution: Using so called HONU's (Higher Order Neural Units [5]) as the building blocks of deep learning architectures has the advantage that due to the injective nature of the activation functions used, intrinsic invertibility of single neurons allows for a higher reverse engineering capability.

[5] I. Bukovsky, G. Dohnal, P. M. Benes, K. Ichiji, N. Homma, „Letter on Convergence of In-Parameter-Linear Nonlinear Neural Architectures With Gradient Learnings," in IEEE Transactions on Neural Networks and Learning Systems, vol. 34, no. 8, 5189-5192 2023, doi 10.1109/TNNLS.2021.3123533

F. Sobieczky: **Extending linear regression with the help of AI-models.**
Problem: By analyzing the Clementinum Temperature data, Prof. Antoch showed in his lecture that the higher degrees of freedom of less complex regression models induces an ambiguity in the interpretation of 'epochs' (which can be abused in political contexts). Similar ambiguities may arise in AI-assisted regression models [6].

Proposed Solution: By introducing 'Void Space regression', the usual segmented regression models, as well as many Off-Line CPD techniques, may be augmented by allowing for void spaces between segments – which make ambiguities between changes of epochs impossible.

[6] F. Sobieczky, M. Geiß. Explainable AI by BAPC -- Before and After correction Parameter Comparison. arXiv:2103.07155v2 [stat.ML]; https://doi.org/10.48550/arXiv.2103.07155.