Seminar Hora Informaticae Institute of Computer Science, Prague

Tuesday, March 12, 2024, 14.00 – 15.30 (2 – 3:30 PM) CET

Meeting Room 318, Address: Pod Vodárenskou věží 2, Prague 8

ZOOM Meeting ID: 954 7823 4977 , Passcode: 712564

ZOOM: https://cesnet.zoom.us/j/95478234977?pwd=dXoyekFHbDJ0MkNrTjVVS3F2STZgUT09

Oliver Sutton, Department of Mathematics, King's College London:

Learning from few examples - nonlinearity and dimensionality.

A lot of attention has been given to the curses and blessings of learning with high dimensional data, and in this talk we will examine how these affect a system's ability to learn from few examples. For example, proving tight bounds on the generalisation performance of even simple classifiers in a conventional distribution-agnostic way typically requires that the quantity of training data grows extremely quickly with the data dimension. The 'curse of dimensionality' embodied by this conventional wisdom would seem to suggest that it is not possible to learn such data from just a few examples - yet we frequently observe this happening in practice! Moreover, practical experience shows that using nonlinear feature maps which artificially inflate data up into higher dimensions often make the learning problem an easier one, something which seems to contradict the expected 'curses of dimensionality'. We reveal that there are in fact large families of data distributions with certain geometric properties where high dimensional concentration phenomena actually make learning and generalising from few examples easier in higher dimensions. We also show that it is possible for carefully designed feature maps to embed data into higher dimensions in a way which meaningfully accelerates these 'blessings of dimensionality'.

References:

1) Sutton, Zhou, Gorban, Tyukin (2023). Relative intrinsic dimensionality is intrinsic to learning. In: Iliadis, L., Papaleonidas, A., Angelov, P., Jayne, C. (eds) ICANN 2023. Lecture Notes in Computer Science, vol 14254. Springer, Cham. https://doi.org/10.1007/978-3-031-44207-0_43

2) Sutton, Gorban, Tyukin (2023). Towards a mathematical understanding of learning from few examples with nonlinear feature maps, preprint: https://arxiv.org/abs/2211.03607

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Oliver Sutton (https://oliversutton.info) has a background in numerical analysis, the field of applied mathematics concerned with theoretical insights into the fundamental properties of the algorithms and methods of the computational sciences. As the breakthrough development of our age, he is deeply interested in the theoretical and practical aspects of learning algorithms and AI systems. These present the potential to up-end the world as we know it - either for good or for bad. It is vital, therefore, that we understand how these algorithms make their decisions, how their worst risks can be mitigated, and how they can be harnessed for positive impact on the world. Therefore Oliver is particularly interested in the following areas of research:

* Adversarial attacks, stealth attacks, and other stability properties of neural networks

* When and how it is possible to learn from few examples

* How the quirks of high dimensional geometry help and hinder learning machines.

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HORA INFORMATICAE (meaning: TIME FOR INFORMATICS) is a broad-spectrum scientific seminar devoted to all core areas of computer science and its interdisciplinary interfaces with other sciences and applied domains. Original contributions addressing classical and emerging topics are welcome. Founded by Jiří Wiedermann, the seminar is running since 1994 at the Institute of Computer Science of the Czech Academy of Sciences in Prague.

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