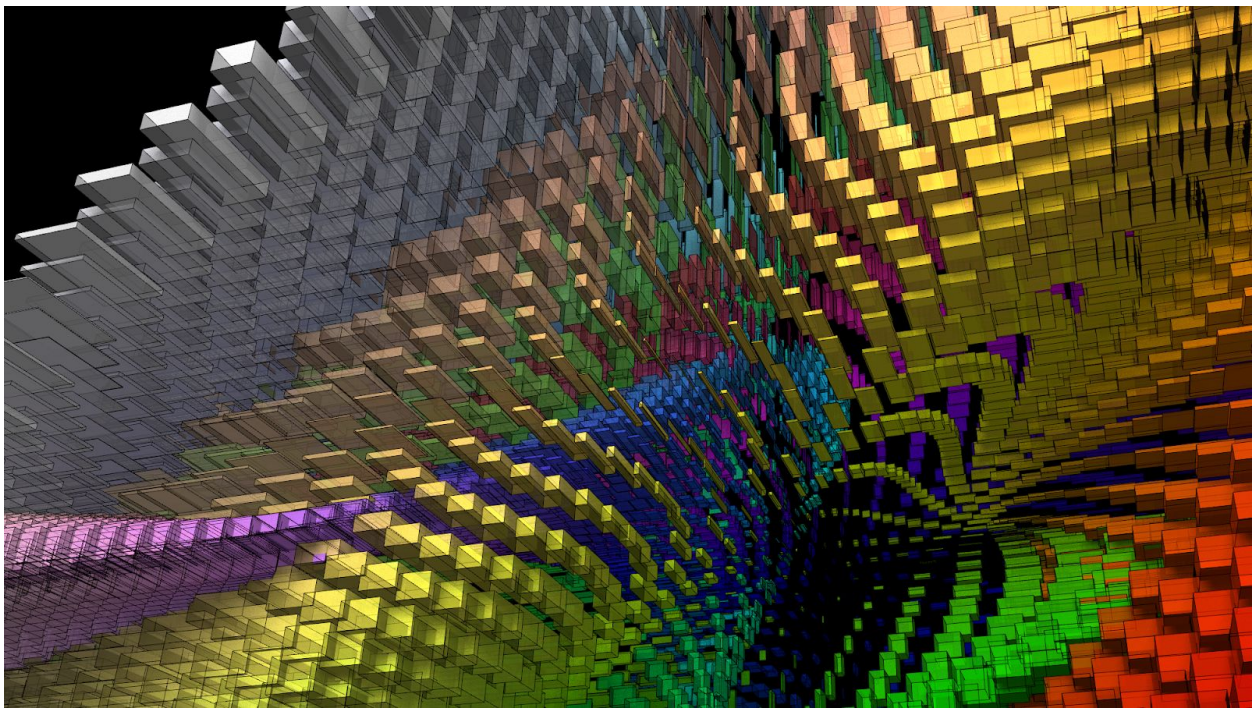
UN/SUPERVISED OWL

INTRODUCTION TO NEURAL NETWORKS AND AUTOENCODERS



Syllabus

The workshop will introduce participants to neural networks and autoencoders. These tools will be applied to the specific parametric models, which will yield solution spaces to be traversed, analysed and explored. The following tasks will be demonstrated:

Dimensionality Reduction – simplifying the data
Dimensionality Reduction can be most intuitively understood as mapping. From a mathematical point of view, the act of mapping is understood as a transformation between spaces. In ML this transformation is usually done between hyperspaces and spaces of low dimensionality – hence the Reduction in name. Particularly useful as a **Solution Space Analysis** tool and a good way to limit the solution space range.

Classification – understanding patterns
The most popular tool used for supervised learning currently are neural networks. Classification will be useful whenever a binary decision must be made – if a pattern seems like something we want to detect. The pattern can be just about anything – a cat in an image, word in a recording or a shape in a parametric model. The greatest challenge with Supervised Learning is the collection of datasets. Once there is enough data, it seems nothing is impossible. In design, classification can help with **Rationalization** as well as with **Evaluation**.

Regression – estimating values
While classification uses neural networks for pattern recognition, regression will benefit by using that tool for value estimation. Again, the greatest challenge is to obtain a source dataset. The applications of regression will be very similar to the ones of classification - **Rationalization** and **Evaluation**.

Learning Objectives

At course completion the student will:

- understand a range of machine learning methods
- be able to couple parametric models with machine learning tools
- setup unsupervised (autoencoders) and supervised (neural network) learning using Grasshopper
- be aware of data preprocessing necessary for successful training

Tutor

Mateusz Zwierzycki is a PhD candidate at the Chair of Digital Design Methods BTU Cottbus, where he is involved in machine learning research. Previously he worked at CITA (Copenhagen) on such projects as Complex Modelling and DuraArk. His research interests focus on machine learning, architectural geometry and generative algorithms. Mateusz was a tutor of many international programming workshops and courses. Author of the Starling, Anemone, Volvox, Squid, Owl plugins for Grasshopper. He collaborated on various projects with companies such as zieta prozessdesign and Joris Laarman Lab, where he applied his digital modelling, programming and simulation skills. Currently runs Object - computational design consultancy.

Links
Website https://theobject.co https://www.b-tu.de/fg-digitales-entwerfen/
Linkedin https://www.linkedin.com/company/theobjectco

Wed 9 Dec 2020
10:30 - 14:00 Machine Learning overview, Owl introduction
16:00 - 18:30 Supervised Learning - neural networks

Thu 10 Dec 2020
10:00 - 13:00 Supervised Learning - neural networks
14:00 - 17:00 Unsupervised Learning - autoencoders

Thu 17 Dec 2020
10:00 - 12:00 Students Q&A

Hardware / Software requirements

The seminar will use Rhino and Grasshopper with Owl plugin (can be downloaded from food4rhino.com)

References

1. Gero, John S. 1991. “Ten Problems for Ai in Design.” In Workshop on AI in Design, IJCAI-91. http://papers.cumincad.org/cgi-bin/works/paper/46ce
2. Stasiuk, David, and Mette Ramsgard Thomsen. 2014. “Learning to Be a Vault: Implementing Learning Strategies for Design Exploration in Inter-Scalar Systems.” CAAD Education - Volume 1 - ECAADe 32. Newcastle upon Tyne, UK: Northumbria University. http://papers.cumincad.org/data/works/att/ecaade2014_192.content.pdf
3. Tamke, Martin, Paul Nicholas, and Mateusz Zwierzycki. 2018. “Machine Learning for Architectural Design: Practices and Infrastructure.” International Journal of Architectural Computing 16 (2): 123–43. https://doi.org/10.1177/1478077118778580.

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workshop is free for students, covered by fundings of
faculty of architecture BUT, Brno, CZ