3314430: Multiobjective Machine Learning (In English, Fall 2022)

Hall 1.114, Rudower Chausee 25, Monday: TBD

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This course is directed to expose graduate students to newer facets of machine learning (ML). While ML literature has extensively focused on training accurate models (single objective), recent works have made some strides in lieu of multiobjective versions of the problem. For instance, problems in image recognition weigh a higher importance to recall (reduction of false negatives) over precision. Objectives like accuracy, computational complexity, and AUCROC are also equally important in any classification task, not restricted to imaging. Similarly, objectives like algorithmic bias (fairness) and explainability are very common in GDPR type applications involving a lot of personal data classification and handling. Our focus will be on understanding the current space of multiobjective ML literature along three different fronts as follows.

- Applications – In depth analysis and survey of multiple practical applications where multiobjective ML is potentially useful. Examples include (but not restricted to) energy markets, finance, profiling, and imaging.
- Modeling and Optimization – Detailed review of multiobjective methods for model parameter estimation. This involves multiple aspects like model classes, hyperparameters, and custom functionals for training.
- Solvers – Thorough study of the current landscape of multiobjective solvers for machine learning. Some examples include USEMO, BoTorch, and HyperASPO.

By the end of the course, students would be able to spot real-world situations where multiobjective ML can be deployed. They would also be equipped with knowledge to formulate and solve such problems using state of the art solvers or pose crucial algorithmic questions demanding next generation methods. Several research works (publications) will be distributed during the course of the study. The following texts may be adhered [Jin06, ABC$^+$20] to as key references to get started with the concepts. The tentative outline of the course is as follows.

- Class 1 – Basics of Multiobjective Optimization and Machine Learning.
- Class 2 – Following.
  - Introduction to Multiobjective Machine Learning Problems.
  - Division into smaller (2-3 per group) groups (for reading assignments and question module preparation).
  - Assignment of research works/papers to each of these groups.
- Classes 3-12 – Groupwise seminars and questionnaire.
- Classes 13-end – Discussions on prospective and new research directions (both theoretical and algorithmic).

Grading: This is completely attributed to the quality of presentations, understanding of texts, and interactions/participation.

References

[ABC$^+$20] Charles Audet, Jean Bigeon, Dominique Cartier, Sébastien Le Digabel, and Ludovic Salomon. Performance indicators in multiobjective optimization. *European Journal of Operational Research*, 292, 11 2020.

[Jin06] Yaochu Jin. *Multi-objective machine learning*, volume 16. Springer Science & Business Media, 2006.