Munich Center for Machine Learning - Research and Transfer

Bernd Bischl, Director MCML
The Munich Center for Machine Learning is a joint research initiative of Ludwig-Maximilians-Universität München (LMU) and Technische Universität München (TUM). It is part of the German and Bavarian government's AI strategy.
Our Goals

Advance mathematical, computational, and statistical foundations of ML
45 PIs - 470 top ranked publications
Language-based Expert-AI Cooperation
Hinrich Schütze, Barbara Plank et al.

Challenges
- Representation and Formalism
- Human-centric aspects
- Data
Multimodal Research is to improve machine understanding of images and text: Image captioning, text-to-image generation, vision language representation learning. One way to determine if two agents are able to communicate effectively through language is to have one agent describe an object, such as a cat, to the other.

Do DALL-E and Flamingo understand each other?

Hang Li, J. Gu, R. Koner, S. Sharifzadeh, Volker Tresp, LMU Munich, Siemens AG
Stable Diffusion
Björn Ommer et al.

The fundamental multimodal research and the cooperation of experts and artificial agents allows for the creation of new tools like Stable Diffusion.

Prompt: "a photograph of an astronaut riding a horse"
Interpretable ML
Bernd Bischl et al.

Motivation: ML models are black boxes -> produce explanations to increase trust

Research: Develop new model-agnostic interpretation methods for improved insights

Problem: Feature effects are misleading when features interact

Solution: Split feature space into regions to obtain regional effects

Interpretability for AutoML

Explanations in AutoML:
- Visualize effect of HP $\lambda$ on performance $c(\lambda)$
- Introduce sampling bias in HP space
- Misleading in regions with few points (high uncertainty)

Solution:
Partition in regions with similar uncertainty and add uncertainty bands
AutoML for Interpretability
Bernd Bischl et al.

Idea: Quantify “interpretability” via functional decomposition for model selection:

\[ f(x) = f_0 + \sum_{j=1}^{p} \left( f_j, ALE(x_j) \right) + IA(x) \]

Dimensions as proxy of “interpretability”:
- Number of features (NF)
- Main effect complexity (MEC)
- Interaction strength (IAS)

Multi-objective (MO) optimization of generalization error (GE) and rel. num. of used features (NF):

\[ \min(\hat{GE}, NF) \]

Solution “less complex” (fewer NF), similar performance
Our Talent Programs

Postdoc Transfer positions: PhD & Postdoctoral program

MCML Junior Research Groups: Focus on research

Thomas Bayes Fellowship: Focus on teaching

Bring young AI talents to Munich and educate next generations of experts
Our Scientific Transfer

Accelerate the process of scientific discovery by consulting and open source

StaBLab
Statistical Consulting

TUM|Stat
Statistical Consulting

MLCU@LMU
Machine Learning Consulting

Reproducibility
Open Source Software Workshops / Training

Empirical Sciences

ML Methods

OSC
LMU Open Science Center
Teaching ML@LMU

AIM@LMU (AI as major Minor)

Transfer AI/ML/DS education to other domains:

Lectures:
- Introduction to artificial intelligence
- Introduction to machine learning
- Artificial intelligence in science and society
- Practical applications of artificial intelligence

Bsc + MSC Statistics and Data Science

Machine Learning Specialization Lectures:

- Supervised Learning
- Optimization
- Deep Learning
- Advanced Deep Learning
- Deep Learning for Natural Language Processing
- Advanced Machine Learning
- Automated Machine Learning
- Applied Machine Learning
- Interpretable Machine Learning
- Consulting project
- Master thesis
Machine Learning Consulting Unit (MLCU)

- Machine Learning Consulting within the university and MCML

- Research and Consulting Projects with industry

- Incubator for collaborations and (methodological) research with applied sciences

- Knowledge transfer across different disciplines

https://www.slds.stat.uni-muenchen.de/consulting
Our Partners in Industry

Transfer technology to industry including (start-ups) and to society
Innovationslabor Big Data Science

Website: innolab.ifi.lmu.de

- Statistics, Machine Learning, Data Science
- Teaching of Data Science Toolboxes
- Large-scale computing
- Software development
- Project management
- Use cases from industry, research and development
- Implementation of prototypes
Exemplary Transfer and Industry Collaborations

April 14-16th, LMU Main building

We are a proud member

Co-Sponsors our 2023 DataFest

Joint conferences and hackathons
Entrepreneurship transfer

One of our missions is to foster transfer

This means transfer to industry & society

And to transfer entrepreneurial thinking into the startup ecosystem

We organize bootcamps and hackathons, to transfer entrepreneurial thinking together with our partners
Our Ecosystem

Strengthen the network and increase the visibility of Munich & Germany
Upcoming: AutoML Fall School 2023 in Munich

Aleksandra Faust (Google Brain)
Luigi Nardi (Stanford & Lund University)
Luc de Raedt (KU Leuven)
Nick Erickson & Alex Smola (Amazon)
Thank you for your attention.