Modeling and Optimization for Machine Learning

Summer 2021

Monday

- 9:00 Introductions and troubleshooting
- 11:00 Discussion and coffee (15 min)
- 11:15 Basic notions: Modeling --- variables, criteria, constraints
- 12:15 Lunch break
- 13:15 Gradient descent, stochastic gradient descent
- 14:15 Discussion and coffee (30 min)
- 14:45 Intro to practicum: Modeling and optimization for least-squares
- 15:30 Practicum [comparing Google Sheets to SGD in Python]
- 17:00 END

Tuesday

- 9:30 Modeling with convex functions
• 10:30 Discussion and coffee (30 min)
• 11:00 Neural networks models and optimization
• 12:00 Lunch break
• 13:15 Working with constraints in optimization
• 14:15 Discussion and coffee (30 min)
• 14:45 Case study 3: Neural networks for 3D data
• 15:45 Practicum: CVX and other solvers
• 17:00 END

Wednesday

• 9:30 Tackling high-dimensionality: sparsity, low-rank, and other important ideas
• 10:30 Discussion and coffee
• 11:00 Case study 4: Algorithms for inference
• 12:00 Lunch break
• 13:00 Advanced models: GANs, adversarial optimization, robust optimization, cycle consistency
• 14:00 Discussion and coffee
• 14:30 Case study 5: Constructing adversarial examples
• 15:30 Practicum
Thursday

- 9:30 Metric learning, similarity driven learning
- 10:30 Discussion and coffee (30 mins)
- 11:00 Contrastive learning, self-supervised learning
- 12:00 Lunch break
- 13:00 Case study 6: Analyzing an industrial time-series dataset from scratch - models and methods
- 14:00 Discussion and coffee (30 mins)
- 14:30 Case study 7: Streaming stochastic gradients for large-scale automatic learning with images
- 15:30 Practicum: Implement 2nd order trend filtering OR implement Metric Learning and try kNN OR try a contrastive learning method
- 17:00 END

Friday

- 9:30 Interaction of optimization with neural network architecture (clipping, momentum, ADAM, and more)
- 10:30 Discussion and coffee
- 11:00 Case study 7: Clustering, embedding, and visualization
- 12:00 Lunch break
- 13:00 Optimization and modeling: Ask me Anything (AMA) -- open floor for discussion.
- 14:00 Discussion and coffee
- 14:15 Practical guide to OPTML (S+J)
- 16:00 Course Closing