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

- 17:00 END

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 t ime -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 lear ning 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