

Tuesday Workshops

Introduction to Mathematical Optimization

Mathematical optimization underpins many applications in science and engineering, as it provides a set of formal tools to compute the ‘best’ action, design, control, or model from a set of possibilities. In data science and machine learning, mathematical optimization is the engine of model fitting. This workshop will provide an overview of the key elements of this topic (unconstrained, constrained, convex optimization, optimization for model fitting), and will have a practical focus, with participants formulating and solving optimization problems early and often using standard modeling languages and solvers. By introducing common models from machine learning and other fields, this workshop aims to make participants comfortable with optimization modeling so that they may use it for rapid prototyping and experimentation in their own work. Students should be comfortable with linear algebra, differential multivariable calculus, and basic probability and statistics. Experience with Python will be helpful, but not required.

Topics to be discussed in this workshop include:

- Formulating optimization problems
- Fundamentals of constrained and unconstrained optimization
- Convex optimization
- Optimization methods for model fitting in machine learning
- Optimization in Python using SciPy and CVXPY
- In-depth Jupyter Notebook examples from machine learning, statistics, and other fields



About the Instructor: Kevin Carlberg is an AI Research Science Manager at Facebook Reality Labs and an Affiliate Associate Professor of Applied Mathematics and Mechanical Engineering at the University of Washington. His research combines concepts from machine learning, computational physics, and high-performance computing to drastically reduce the cost of simulating nonlinear dynamical systems at extreme scale and to develop technologies that enable the future of virtual and augmented reality.

Previously, Kevin was a Distinguished Member of Technical Staff at Sandia National Laboratories in Livermore, California, where he led a research group of PhD students, postdocs, and technical staff in applying these techniques to a range of national-security applications in mechanical and aerospace engineering.