THE UNIVERSITY OF ARIZONA
COLLEGE OF ENGINEERING
Systems & Industrial Engineering

SIE 549 OPTIMIZATION FOR MACHINE LEARNING

COURSE DESCRIPTION

This course will provide senior undergraduate and graduate students an introduction to mathematical nonlinear optimization with applications in machine learning. This course will involve analysis of optimization algorithms, in particular, scalability of algorithms to large datasets will be discussed in theory and in implementation. The fundamental algorithms for nonlinear optimization are studied and applied to supervised learning models, including but not limited to nonlinear regression, logistic regression, and support vector machines. Students will write their own implementation of the algorithms in the MATLAB/Python programming language and explore their performance on realistic data sets.

EXPECTED LEARNING OUTCOMES

This course aims to teach engineering students the application of optimization methods to solve machine learning problems. Students will:

- Understand and characterize optimal solutions for nonlinear optimization. - Learn fundamental algorithms for unconstrained optimization.
- Specialize optimization methods for machine learning.
- Gain practical skills in implementing these algorithms in MATLAB/Python.
- Explore the trade-offs between time and accuracy in machine learning methods.

COURSE FORMAT

- In-Person | 1**5-week** semester
- Tailored to your **professional needs**
- **3-credit** hour | You may apply it towards SIE MS and PhD programs
- **SIE 270, SIE 340, and SIE 305** (recommended but not required)

PROGRAM DIRECTOR
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ENROLLMENT
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COURSE TOPICS

REVIEW MATHEMATICAL PRELIMINARIES

DATA FITTING AND DENOISING

PROJECTED/PROXIMAL GRADIENT METHOD

OPTIMALITY CONDITIONS

GRADIENT AND ACCELERATED GRADIENT METHODS

STOCHASTIC OPTIMIZATION

CONVEX OPTIMIZATION

SUBGRADIENT METHOD

VARIANCE REDUCTION METHODS

Real-World Application

Flexible/Interactive Learning

Bridge Theory & Practice

Innovative Curriculum

Distinguished Faculty

FROM EFFICIENCY TO INNOVATION–LEAD THE FUTURE OF INDUSTRIAL ENGINEERING.