UNIVERSITY OF NEBRASKA AT OMAHA

MATH/CSCI 8520 Advanced Topics in Operations **Research (Topic: Nonlinear Programming)**

MW 5:30-6:45pm | Dr. Fabio Vitor

Prerequisite: Some operations research course or permission of instructor.

Nonlinear programming is a class of optimization models studied mainly in operations research. Nonlinear programs seek to either maximize or minimize a nonlinear objective function restricted to a set of nonlinear inequality and/or equality constraints. Optimally solving a nonlinear program results in a solution that satisfies all constraints and provides the best possible objective function value. Nonlinear programming is a useful tool to model various problems from numerous businesses and industries, and is also used in machine learning and statistical modeling.

This course will study nonlinear optimization models and their solutions. Course will focus on modeling, theory, and algorithms.

Nonlinear Optimization in Machine Learning and Statistics

Study some of the nonlinear optimization models and methods used for machine learning and statistical modeling

- Supervised, semi-supervised, and unsupervised learning •
- Reinforcement learning
- Linear and logistic regression, time series analysis, and K-means clustering •
- First and higher-order methods

Nonlinear Optimization in Industry

Model some industry problems using nonlinear programming and learn to solve them using commercial and open-source solvers

- Optimal control and production inventory •
- Electrical networks and mechanical design •
- Water resources management and other resource allocation problems •
- Risk aversion and facility location models •



Example of a Facility Location Problem



Nonlinear Programming Theory

Study the main theoretical concepts in nonlinear programming

- Convex analysis
- Karush-Kuhn-Tucker and Fritz John optimality conditions •

Nonlinear Programming Algorithms

Study algorithms to solve unconstrained and constrained problems

- Gradient and search methods
- Penalty and barrier algorithms
- Feasible search directions

Do you want to learn the impact of operations research? Visit https://youtu.be/9-MITCoka-Q

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- Lagrangian duality

