Syllabus of INDE-517
(counted as elective for both CAAM and OR majors)
Optimization Foundations of Data Science
Spring Semester 2024

1 General information

- **Instructor**: Prof. Shiqian Ma. Email: sqma@rice.edu.

- **Lecture**: Wednesday 1PM - 3:30PM.

- **Course Objectives and Learning Outcomes**. Students will acquire knowledge of the modern optimization algorithms used in data science and machine learning. Students will learn the development of the algorithms, their theory, their applicability and how to use them in practice solving data science and machine learning applications.

- **Textbook (Optional)**.

  - Optimization for Data Analysis, by Wright and Recht. Part of this book can be found here: https://people.eecs.berkeley.edu/~brecht/opt4ml_book/

- **Topics Covered**

  - Gradient method
  - Nesterov's accelerated gradient method, Heavy-ball method
  - Stochastic gradient descent
  - Adaptive methods: ADAM, AdaGrad, etc.
  - Coordinate Descent method
  - Subgradient method
  - Proximal gradient method
  - Duality
  - Automatic Differentiation
  - Decentralized and Federated Optimization
  - Applications: matrix factorization, support vector machine, logistic regression, deep learning (deep neural network)