



# OPTIMIZATION FROM FUNDAMENTALS

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**INTENDED AUDIENCE :** Mathematics, any engineering and science discipline

### COURSE OUTLINE :

This course will cover the topic of Optimization from its fundamentals. It will start with an overview of real analysis and convexity. With this base it will cover linear programming, convex optimization and nonlinear programming, complementarity problems and algorithms for the same. We will end with dynamic optimization.

### ABOUT INSTRUCTOR :

Prof. Ankur A. Kulkarni is an Associate Professor and the Kelkar Family Chair in Quantitative Finance at the Indian Institute of Technology Bombay (IITB). He is a systems theorist with an interest in decision making in distributed, decentralised and strategic environments, with informational complexities, which he investigates using the lens of game theory, information theory, control theory, machine learning, and mathematical optimization. His current focus is on strategic inference, stealth, privacy, information elicitation and nudging. He has published 30 papers in international journals and more than 30 papers in international conferences. He has been a consultant to the Securities and Exchange Board of India wherein he was solely responsible for suggesting regulatory interventions for high frequency algorithmic trading. He presently serves on the IT-Project Advisory Board of SEBI and is responsible for advising SEBI on utilizing advanced technologies such as AI/ML and data analytics and guiding data-related policies for internal use and public use. He is also an advisor to the Tata Consultancy Services and on the technical advisory committee of Maha-IT, a Govt of Maharashtra enterprise. He was previously a consultant to HDFC Life Insurance Company wherein he tackled the problem of design of incentives for sales agents; to Kotak Mahindra Bank Limited on anti-money laundering and anomaly detection, and to Bank of Baroda on smart cash management. He received his B.Tech. from IITB in 2006, followed by M.S. in 2008 and Ph.D. in 2010, both from the University of Illinois at Urbana-Champaign (UIUC). He was an Associate (from 2015--2018) of the Indian Academy of Sciences, Bangalore (a honour reserved for only 100 scientists under the age of 35 across all fields), he has been an editor for several conferences, a recipient of the INSPIRE Faculty Award of the Department of Science and Technology, Government of India, 2013, and of several Best Paper awards and the Excellence in Teaching Award at IIT Bombay. He has been a visitor to MIT in the USA, University of Cambridge in UK, NUS in Singapore, University of Paris, IISc in Bangalore and KTH in Sweden.

### COURSE PLAN :

- Week 1:** Introduction to optimization and overview of real analysis
- Week 2:** Optimization over open sets
- Week 3:** Optimization over surface
- Week 4:** Transformation of optimization problems and convex analysis
- Week 5:** Introduction to linear programming
- Week 6:** Linear programming and duality
- Week 7:** Linear programming and duality
- Week 8:** Nonlinear and convex optimization
- Week 9:** Nonlinear and convex optimization
- Week 10:** Algorithms
- Week 11:** Algorithms
- Week 12:** Dynamic optimization