Content

Course Code	Course Name	Semester	Theory	Practice	Lab	Credit	ECTS
VM 521	Optimisation	1	4	0	0	3	8

Prerequisites	
Admission Requirements	

Language of Instruction	English
Course Type	Compulsory
Course Level	Masters Degree
Objective	Our first aim in this course is to learn the mathematical construction and solution methods of optimization problems under constraints or without constraints. Secondly, it is to address the optimization problems encountered in Data Science as an application.
Content	Introduction to Mathematical Definitions and Concepts Convexity Derivative Taylor polynomials Unconstrained Optimization Local vs global problem Primary and secondary conditions Algorithms, two basic strategies: line search and trust region Least Squares Problems-Regression Application Optimization Under Constraints feasible region Equality constraint-Inequality constraint and Lagrange method Geometric View Linear programming-Quadratic Programming Simplex method, dual problem Interior points method Application: Machine Learning Problems Clustering-Binary classification-Audio processing-Recommendation Systems-Logistic correlation-Deep learning-Artificial neural networks..etc.
References	Numerical Optimization, J. Nocedal& S. J. Wright, Springer, 1999. ve 2. basım: 2006. Introduction to Global Optimization, R. Horst , P. M.Pardolas&N. V. Thoai, Kluwer Academic Publishers, 1995. The Princeton Companion to Applied Mathematics, Edited by Nicholas J. Higham, Princeton University Press, 2015 https://nhigham.com/2016/03/29/the-top-10-algorithms-in-applied-mathematics/ Linear Programming and Network Flows, Mokhtar S. Bazaraa, John J. Jarvis, Hanif D. Sherali. John Wiley, 2004. Third edition A gentle introduction to optimization / B. Guenin , J. Könemann , L. Tunçel Cambridge University Press http://www.veridefteri.com/: en güncel kaynaklar, ders notları, haber, bilimsel programlama

Theory Topics

Week	Weekly Contents
1	Introduction to the course syllabus and the relationship between Data Science and Optimization
2	Introduction to Mathematical Definitions and Concepts, Convexity. Derivative. Taylor polynomials.

Week	Weekly Contents
3	Unrestricted Optimization. Local vs global problem. Primary and secondary conditions. Problem Application.
4	Numerical Methods and Algorithms. Least Squares Problems-Regression Application.
5	Optimization Under Constraints, Feasible region, Equality-Inequality constraints. Lagrange multiplier method.
6	Geometric View and Applications
7	Midterm
8	Linear programming. Simplex method, dual problem
9	Quadratic Programming. Problems.
10	Application: Artificial Learning Problems Clustering-Binary classification-Audio processing-Recommendation Systems-Logistic correlation-Deep learning-Artificial neural networks..etc
11	Application: Artificial Learning Problems Clustering-Binary classification-Audio processing-Recommendation Systems-Logistic correlation-Deep learning-Artificial neural networks..etc