



UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

OPTIMIZATION

Enrollment year	2021/2022
Academic year	2021/2022
Regulations	DM270
Department	DEPARTMENT OF MATHEMATICS "FELICE CASORATI"
Course	MATHEMATICS
Curriculum	PERCORSO COMUNE
Year of study	1°
Period	2nd semester (01/03/2022 - 10/06/2022)
ECTS	6
Language	

The activity is split

509008 - OPTIMIZATION - UNIT 1

509009 - OPTIMIZATION - UNIT 2



OPTIMIZATION - UNIT 1

Enrollment year	2021/2022
Academic year	2021/2022
Regulations	DM270
Academic discipline	MAT/09 (OPERATIONAL RESEARCH)
Department	DEPARTMENT OF MATHEMATICS "FELICE CASORATI"
Course	MATHEMATICS
Curriculum	PERCORSO COMUNE
Year of study	1°
Period	2nd semester (01/03/2022 - 10/06/2022)
ECTS	3
Lesson hours	24 lesson hours
Language	Italian
Activity type	ORAL TEST
Teacher	PAVARINO LUCA FRANCO (titolare) - 3 ECTS
Prerequisites	Courses of Mathematical Analysis and Numerical Analysis
Learning outcomes	The course offers an overview of the theory and applications of Optimization, showing the main results and their application to concrete problems arising from the applications.
Course contents	<ol style="list-style-type: none">1. Introduction to Optimization methods. Matlab Optimization Toolbox.2. Derivative – free methods: Nelder – Mead.3. Newton method.4. Descent methods (line search):<ul style="list-style-type: none">- stepsize selection, Wolfe conditions, backtracking.- Newton direction.- Quasi – Newton directions(rank 1 update, DFP and BFGS methods)- Gradient direction.- Conjugate gradient (methods of Fletcher – Reeves, Polak – Ribiere, Hestenes – Stiefel).

	<p>5. Trust – Region methods.</p> <p>6. Nonlinear Least – Square:</p> <ul style="list-style-type: none"> - Gauss – Newton. - Levenberg - Marquardt. <p>7. Application to neural networks and Deep Learning.</p>
Teaching methods	Lectures and Matlab laboratory
Reccomended or required readings	Nocedal, Jorge; Wright, Stephen J. Numerical optimization. Second edition. Springer, 2006.
Assessment methods	Final project, presentation and oral exam
Further information	
Sustainable development goals - Agenda 2030	\$lbl legenda sviluppo sostenibile



OPTIMIZATION - UNIT 2	
Enrollment year	2021/2022
Academic year	2021/2022
Regulations	DM270
Academic discipline	MAT/08 (NUMERICAL ANALYSIS)
Department	DEPARTMENT OF MATHEMATICS "FELICE CASORATI"
Course	MATHEMATICS
Curriculum	PERCORSO COMUNE
Year of study	1°
Period	2nd semester (01/03/2022 - 10/06/2022)
ECTS	3
Lesson hours	24 lesson hours
Language	Italian
Activity type	ORAL TEST
Teacher	DUMA DAVIDE - 3 ECTS
Prerequisites	Standard courses of Mathematical Analysis and Numerical Analysis
Learning outcomes	This course will review the theory and applications of Data Analysis, illustrating the main results and the applications of the theory to practical problems.
Course contents	<ul style="list-style-type: none">- Recap of geometry, linear algebra, probability in high dimensional spaces.- Gaussians in high dimensions. Data fitting on a spherical Gaussian.- Singular Value Decomposition (SVD)- Best rank-k approximations- Application of SVD: principal component analysis (PCA), mixed clustering of spherical Gaussians, max-cut problem- Overfitting and uniform convergence. Occam's razor- Learning of decision trees. Support Vector Machines (SVM) and VC dimension.

	- Clustering: k-means, k-center, k-median, spectral clustering, recursive clustering and sparse cuts, graph partitioning and communities search.
Teaching methods	Lectures and Matlab laboratory
Reccomended or required readings	Avrim Blum, John Hopcroft, Ravindran Kannan. "Foundations of Data Science". Cambridge University Press, Jan 23, 2020
Assessment methods	Final project, presentation and oral examination
Further information	
Sustainable development goals - Agenda 2030	\$lbl legenda sviluppo sostenibile