MODELLO D (inglese)			
General Information	AA 2018-2019		
Academic subject	Numerical Methods for Computer Science		
Degree course	Master Degree in Computer Science		
Curriculum			
ECTS credits	12		
Compulsory attendance	No		
Language	English		
Subject teacher	Name Surname	Mail address	SSD
	Nicoletta Del Buono	nicoletta.delbuono@uniba.it	MAT/08– Numerical Analysis
ECTS credits details	8	4	
Basic teaching activities	Lectures	Laboratory experiments	
Class schedule			
Period	Second term		
Year	First year		
Type of class	Lectures- Laboratory experiments		
Time management			
Hours	124		
Hours of lectures	64		
Tutorials and lab	60		
Academic calendar			
Class begins	February 25, 2019		
Class ends	May 31, 2019		
Syllabus			
Prerequisites/requirements	Basic knowledge of methods in Numerical Analysis		
Expected learning outcomes (according to Dublin Descriptors) (it is recommended that they are congruent with the learning outcomes contained in A4a, A4b, A4c tables of the SUA-CdS)	*Knowledge and understanding* Knowledge and understanding of numerical linear algebra techniques useful for treating structured data. Application of optimization methods for solving problems in data mining, image processing and information retrieval. Knowledge and understanding of classical methods in statistical learning. *Applying knowledge and understanding* Acquiring the main numerical linear algebra techniques and statistical learning methods for treating real world problems. Ability to design efficient numerical codes implementing numerical techniques for solving problems in data mining, image processing and information retrieval. *Making informed judgements and choices* Judgment autonomy is acquired through critical study and interpretation of texts. The achievement of an adequate autonomy is verified through the exercises, which are held during the teaching programme and with the final written and oral examinations.		

	Communicating knowledge and understanding Students are able to express the topics included in the teaching programme by emploing the specific lexicon of the discipline. *Lifelong learning skills* Learning an appropriate studying methodology, supported by text consultation and implementation of the techniques proposed during the course.
Contents	• Numerical Linear Algebra Basic and Advanced Notions • Systems of nonlinear equations and optimization. • Least squared approximation methods. • Low Rank matrix approximation techniques and dimensionality reduction methods • Mathematical methods for information retrieval. • Explorative Data Analysis
Course program	Numerical Linear Algebra. Space of matrices. Operation of matrices. Properties of square and rectangular matrices. Vector spaces and subspaces. Spanning sets. Range and Null spaces. Basis of subspaces. Rank, connectivity and graphs. Properties of AA^T and A^TA. Linear Transformations. Similarity. Structured matrices and their properties. Norms, scalar product and orthogonality. Gram-Schmidt ortho-normalization algorithm. QR factorization. Eigenvalues, eigen-vectors and their properties. QR method. Power method. Systems of nonlinear equations. Newton methods and theirs properties. Nonlinear programming. Gradient methods. Line search mechanism. Constraint optimization and KKT conditions. Penalization and barriers optimization methods. Linear programming and Simplex method. Least squared approximation methods. Linear regression techniques. Singular Value Decomposition. Eckart-Young Theorem. Truncated SVD. Principal Component Analysis. Latent Semantic Indexing. Mathematical Models and Text Retrieval. Eigenbased methods for web information retrieval. Hits and Pagerank algorithms. Nonnegative matrix factorization and dimensionality reduction techniques.
Bibliography	1. V. Comincioli, Metodi numerici e statistici per le scienze applicate, Milano, Ambrosiana, 1992. 2. C. Meyer, Matrix Analysis and Applied Linear Algebra, SIAM, 2003. 3. A. N. Langville, C. D. Meyer: Google's PageRank and beyond. Princeton Univ. Press, 2006. 4. M. W. Berry, M. Browne. Understanding Search Engines: Mathematical Models and Text Retrieval. SIAM, 1999. 5. A. Cichocki, R. Zdunek, A.H. Phan, S.I Amari, Nonnegative Matrix and Tensor Factorizations, Wiley, 2009 6. M. Turk and A. Pentland. Eigenfaces for recognition. Journal of Cognitive Neuroscience 3(1): 71–86. doi:10.1162/jocn.1991.3.1.71 (1991)
Notes	All the references will be integrated by suggested readings, slides and notes provided during the lectures

Teaching methods	Lectures with slides. Laboratory experiments with open source software and available datasets
Assessment methods (indicate at least the type written, oral, other)	Written and oral examinations
Evaluation criteria (Explain for each expected learning outcome what a student has to know, or is able to do, and how many levels of achievement there are).	Students are to be evaluated on the basis of the degree of their knowledge concerning the various topic included in the syllabus.
Further information	