UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Matematica e Informatica
ACADEMIC YEAR	2017/2018
MASTER'S DEGREE (MSC)	COMPUTER SCIENCE
SUBJECT	ALGORITHM SCIENCE AND ENGINEERING
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50341-Discipline Informatiche
CODE	06321
SCIENTIFIC SECTOR(S)	INF/01
HEAD PROFESSOR(S)	GIANCARLO RAFFAELE Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**GIANCARLO RAFFAELE** Monday 15:00 17:00 Stanza 106 Dipartimento di Matematica ed Informatica Thursday 15:00 17:00 Stanza 106 Dipartimento di Matematica ed Informatica

DOCENTE: Prof. RAFFAELE GIANCARLO

PREREQUISITES	At least one course of programming and of algorithms and data structures. Moreover, basic knowledge of algebra and geometry are required.
LEARNING OUTCOMES	Knowledge and Understanding Acquisition of advanced methods for the design and analysis of algorithms. Ability to use the specific language proper of this specialised area. Ability to apply knowledge and understanding. Ability to develop software based on efficient algorithms for large datasets. Autonomy of Judgment Tp be able to evaluate the implications and the results of algorithmic studies and of computational complexity associated to those topics.. Communication Abilities Ability to explain algorithmic results even to a non-expert audience. To be able to illustrate the technological fall-out coming from algorithmic theory. Ability to Learn Ability to follow-up the advances of the field via the consultation of advanced texts and publications proper of the subject area.
ASSESSMENT METHODS	Oral Exam The oral exam consists of a discussion on the algorithmic techniqes presented during the lectures, on the mathematical laws connected to them. Its goal is to verify, in addition to the knowledge acquired by the candidate, the degree of exposition of the material in the course. The final grade, suitably scaled as follows, will be based on the following conditions: a) Basic knowledge of advanced algorithmics for management of BIG DATA, and limited ability to apply those techniques autonomously in new contexts, sufficient ability of exposition of the techniques and concepts associated to them (grade (18-21); b)Good knowledge of advanced algorithmics for management of BIG DATA, and good ability to apply those techniques autonomously in new contexts, good ability of exposition of the techniques and concepts associated to them (grade (22-25); c) Deep knowledge of advanced algorithmics for management of BIG DATA, and gvery ood ability to apply those techniques autonomously in new contexts, very good ability of exposition of the techniques and concepts associated to them (grade (26-28); d) Excellent knowledge of advanced algorithmics for management of BIG DATA, and excellent ability to apply those techniques autonomously in new contexts, excellent ability of exposition of the techniques and concepts associated to them (grade (29-30L);
EDUCATIONAL OBJECTIVES	To expose the student to the advanced techniques for the design and analysis of computer algorithms. In particular, the entire spectrum of dynamic data structures is covered, with an in-depth study of the intrinsic computational complexity of difficult problems or problems that involve a large quantity of data.
TEACHING METHODS	Class Lectures in which advanced tools for the analysis of algorithms are provided, being followed by the discussion of problems for the management of Big Data.
SUGGESTED BIBLIOGRAPHY	William J.Cook, William H. Cunningham, William R. Pulleyblank, Alexander SchrijverI. Combinatorial Optimization, Wiley 1997 Per le parti che rigurdano algoritmi di approsssimazione- For the part regarding approximation algorithms Robert Endre Tarjan. Data Structure and Network Algoritms, SIAM 1984 Per le parti che riguardano strutture dati in memoria interna-for the part regarding data structures in internal memory Camil Demetrescu, Irene Finocchi,Giuseppe F. Italiano, Algoritmi e Strutture dati, McGraw Hill, 2005 per le parti che riguardano l'analisi ammortizzata di algoritmi. For the part regarding amortised analysis of algorithms. H. Cormen. C. Leiserson, R, Rivest, C. Stein Introduzione agli algoritmi e strutture dati, McGraw Hill, 2001

	Per le parti che riguardano hashing e schemi di approsssimazione-for the parts regarding hashing and approximation schemes Materiale distribuito dal docente. Tutto il resto del sillabus. The remaining part of the syllabus.

SYLLABUS

Hrs	Frontal teaching
3	Preliminary Notions and Background Amortised Analysis of Algorithms: the method of credits; the potential method. Experimental analysis of Algorithms.
6	Internal Memory Advanced Data Structures: Balancing Red-Black Trees and analysis of the operations they support. Linking and Cutting of Trees.
6	ADVANCED DATA STRUCTURES IN INTERNAL MEMORY: Amortization Self-adjusting binary trees and analysis of the operations they support. Self-organizing Data Structure. Self-organizing List.
4	Space Succinct Dictionaries Universal Hashing. Bloom Filters
5	External Memory Algorithms. Motivation. External Memory Computational Model and the Memory Hierarchy. Sorting and Searching for large datasets.
6	Steaming Model Motivation. The straming model of computation. Examples of streaming algorithms for mining large datasets. Synoptic Data Structures
6	Data Compression Schemes and their analysis. Static and adaptive data compression schemes. Compression Boosting and its engineering. Efficient data structures for data compression. Benchmarks for data compression performance analysis.
6	NP-Completness Theory and Polynomial Approximations. Polynomial time approximation schemes. Non-approximability. The classes P, NP and Max-SNP Hard.
6	Approximation Algorithms and Heuristic Methods. TSP with triangle inequality. Nearest Neighbour method, Insertion Method, Christofdes heuristics. Tour improvement algorithms: 2-opt, 3-opt, Lin-Kernaghan method, Chaiin Lin-Kernaghan. Held- Karp lower bound.