Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica

Course catalogue

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Programme of Module "Web Algorithms"

- Code: DT0167
- Type of course unit: Compulsory (Master Degree in Computer Science curriculum NEDAS), Elective (Master Degree in Computer Science curriculum SEAS), Compulsory (Master Degree in Computer Science curriculum UBIDIS)
- Level of course unit: Postgraduate Degrees
- Semester: 1

Number of ects credits: (Master Degree in Computer Science) 6 (workload 150 hours)

Teachers: Cosimo Vinci (cosimo.vinci@univaq.it)

1	**Course objectives**	Knowledge of advanced algorithmic techniques; ability to individuate, formalize and solve optimization problems; concept of approximation; knowledge of the web search and sponsored web search strategies in search engines; ability to collaborate for the realization of applicative projects in group.
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • Review of computational complexity and intractability. Optimization problems. Approximation algorithms. • Algorithmic techniques: greedy. local search, dynamic programming and linear programming. • Polynomial Time Approximation Schemes (PTAS) and Fully Polynomial Time Approximation Schemes (FPTAS). • Prestige and centrality indices in social networks. • Web search: Pagerank, Topical Pagerank, TrustRank, Hubs and Authorities. • Sponsored web search: matching markets and market clearing prices, auctions, VCG and GSP mechanisms. On successful completion of this module, the student should : • Acquire knowledge of advanced algorithmic techniques for NP-Hard optimization problems. In particular, the student will have mastery command of main algorithmic (approximation) techniques like greedy, local search, dynamic programming, linear programming: Polynomial Time Approximation Schemes (PTAS) and Fully Polynomial Time Approximation Schemes (FPTAS). Moreover the student will acquire knowledge on the basic centrality and prestige indices in social networks, on the main popularity indices for ranking pages in web search and finally of matching markets, auctions and the most important mechanisms adopted for the ranking and payment of sponsored search links. • Acquire the ability of abstracting models and formal algorithmic problems from real computational problems, understanding the degree of approximability and designing efficient algorithmic solutions. • Acquire autonomy in individuating, formalizing and understanding the degree of approximability of real computational problems and identify independently their most efficient solutions. • Being able to understand complex algorithmic solutions and to formal proving performances of their algorithmic solutions for complex computational problems. • Acquire the ability of understanding the ranking strategies adopted by search engines in web search and sponsored web search. • The course aims to develop in graduate students competencies and abilities necessary in their future studies and/or works, especially with respect to doctoral studies and in general to any research activity on algorithmic and web search topics.

3	**Course prerequisites**	KNOWLEDGE: fundamentals of programming, discrete mathematics, algorithms and data structures, computer architectures, reading and understanding of the English language SKILLS: ability to integrate classroom and homework study, ability to interact with the teacher during the class for originating discussion.
4	**Teaching methodsand language**	Lectures and exercises **Language**: English **Reference textbooks** • Vijay V. Vazirani, ***Approximation Algorithms***. Springer. 2001. • G. Ausiello, P. Crescenzi, G. Gambosi, V. Kann, A. Marchetti-Spaccamela, M. Protasi, ***Complexity and Approximation***. Springer. 1999. • Jure Leskovec, Anand Rajaraman and Jeff Ullman, ***Mining of Massive Datasets***. Stanford University. 2011. *http://infolab.stanford.edu/~ullman/mmds/book.pdf* • Soumen Chakrabarti, ***Mining the Web – Discovering Knowledge from Hypertext Data***. Morgan Kaufmann. 2003. • David Easley and Jon Kleinberg, ***Networks, Crowds, and Markets***. Cambridge University Press. 2010. *https://www.cs.cornell.edu/home/kleinber/networks-book/*
5	**Assessment methods**	Written test followed by an oral exam. The written exam consists into two different parts (one part is related to approximation algorithm, the other one is related to web-search and sponsored web-search), and each part should be completed in 1:45 minutes. A student can decide to do the two parts in different exam dates. The minimum score to pass each part is 18/30, and the final score is the average of the two scores. An eventual oral exam consists into a detailed oral discussion of the written exam, and, eventually some further questions about the theoretical part of the course.