



Programme of Course "Teoria dell'Informazione"

- Code: F0158
- Type of course unit: Elective (Bachelor Degree in Computer Science curriculum General), Elective (Master Degree in Computer Science curriculum GSEEM), Elective (Master Degree in Computer Science curriculum General)
- Level of course unit: Undergraduate Degrees, Postgraduate Degrees
- Semester: 2

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

Teachers: Filippo Mignosi (Filippo.Mignosi@univaq.it)

1	Course objectives	Knowledge of the fundamental concepts of Information Theory and ability to manipulate them formally. Deep understanding of common-sense concepts like "information", "representation", "learning", "model". Ability to translate intuitive solutions constructed with such concepts into concrete applications in different technological areas
2	Course content and learning outcomes (dublin descriptors)	<p>Topics of the module include:</p> <ul style="list-style-type: none"> • Information and entropy: joint, conditional, and mutual. • Relative measures, AEP and its consequences. • Representation and codes: uniform, variable length, and adaptive. Kraft-McMillan Inequality and its consequences. • Source Coding and Compression algorithms (Shannon, Arithmetic, Huffman, Ziv and Lempel coding, integer encoding, gamma and omega Elias coding) • Basic concepts of channel coding, channel capacity. • Basic concepts of modern Cryptography. <p>On successful completion of this module, the student should :</p> <ul style="list-style-type: none"> • understand and explain fundamental concepts such as entropy, mutual information, capacity, compression, coding theorem, coding theory, coding and Cryptography; compute entropy and mutual information of random variables; formulate and prove The main theorems treated such as: i) AEP and its consequences, ii) Optimality of Huffman coding, and of arithmetical coding, iii) the entropy is a lower bound for the expected length of a u.d block code, iv) if P is different from NP then there exists no perfectly secret encryption scheme with key shorter than the message. • understand and apply fundamental concepts in information theory such as probability, entropy, information content and their inter-relationships, AEP, data compression; implement and analyze basic coding and compression algorithms; • be able to evaluate the aspects of information theory that can be applied in the real world. The student should also be able to link the theoretical aspect of the discipline to the practical ones (such as data compression) • explain how information theory and coding contributes to modern communications technology; be able to describe the main results of information theory to other non-specialist people in the scientific community. • Be able to read and understand books and papers concerning the arguments treated in the course. Solve advanced problems in the area.
3	Course prerequisites	Basic probability and discrete mathematics. Ability to develop software applications.
4	Teaching methods and language	<p>Italian and english Language: Italian Reference textbooks</p> <ul style="list-style-type: none"> • Arora, Barak, Computational Complexity: A Modern Approach, . Cambridge

		University press . 2009. • Cover e Thomas, <i>Elements of Information Theory</i> . 2006.
5	Assessment methods	Written and oral.