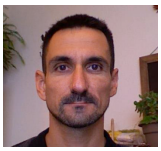
Calculability and Complexity Theory

Course level: Master **Course code: MLDM** CCT **ECTS Credits: 3**.00

Course instructors: Richard Baron, Philippe Ezequel (UJM, Saint- Etienne)



Education period (Dates): 1st semester **Language of instruction:** English

Expected prior-knowledge: Basics on analysis of algorithms, complexity, maths, graph theory.

Aim and learning outcomes:

Computability theory: The intrinsic limitations of computation are introduced. The aim is to learn basic well known undecidable problems and eventually to be able to identify new undecidable ones, using classical techniques.
Computational complexity theory: Theoretical models of computation are introduced, so as to define formally the fact that some problems are inherently difficult to solve. The methodology used to prove that a given problem is difficult is presented.

Topics to be taught (may be modified)~40h:

Computability theory (~20h):

- Formal models of computation: Turing machines, Markov algorithms, recursive functions. Church-Turing thesis.
- Recursive and recursively enumerable sets, decidability and semi-decidability.
- Halting problem, Rice theorem and its applications, Busy Beavers.

Computational complexity theory (~20h):

- Non-deterministic Turing Machine.
- Classes of complexity : P/NP.
- NP-completeness : definition, methodology, examples.

Teaching methods: Lectures.

Form(s) of Assessment: written exam

Literature and study materials:
Reference books:

- T. Cormen, C. Leiserson, and R. Rivest, "Introduction to Algorithms," The MIT Press, 1990.
- J. Kleinberg and E. Tardos , "Algorithm Design", Pearson International Edition, 2006.
- M. Garey, D. Johnson, "Computers and intractability : a guide to the theory of NP-Completeness", W.H. Freeman, 1979
- N. Cutland, "Computability: An Introduction to Recursive Function Theory", Cambridge University Press, 1980
- D.-Z. Du, K.-I. Ko, "Theory of computational complexity", Wiley-Interscience, 2000

Additional information:

Richard Baron
University Jean Monnet, Saint-Etienne
E-mail: richard.baron@univ-st-etienne.fr
Web pages: http://labh-curien.univ-st-etienne.fr/~baron

Home page: *http://mldm.univ-st-etienne.fr*