COURSE DESCRIPTION

University Units
School of Computing and Informatics, and
School of Engineering

Post-graduate Programme
Electrical Engineering and Computing

Degree
☒ Academic Master's ☒ Doctorate (Ph.D.) ☐ Professional Master's

Course
Cellular Automata

Faculty
Pedro Paulo Balbi de Oliveira

Teaching Load
48 hours

Course Overview

Introduction to the notion of cellular automata, from their phenomenological aspects to some of their theoretical elements, as well as characterisation of various of their properties, both from the dynamics and computational points of view. Complementarily, emphasis is given to computacional experimentation with them by means of the *Mathematica* software.

Syllabus

1. Characterisation of the cellular automata (CAs), as discrete dynamical systems, as arrays of
2. coupled finite automata, and as models of complex systems.
3. Phenomenology of CAs, with one- and two-dimensional known examples.
4. Study of the elementary CAs.
5. Properties of CAs: number conservation, reversibility, etc.
6. Dynamics of the CAs, and study of parameters associated to the estimation of their dynamical behaviour.
7. Representations of the rule and configuration spaces.
8. Computability of the CAs, and the notions of implicit and explicit computations. Universal CAs.
9. Variations of CAs: non-homogeneity, asynchrony, rule composition.
10. Elements of the NKS methodology within the context of cellular automata.
11. Applications of CAs.

Grading

Grade A (Excellent): Grade points between 9 and 10
Grade B (Good): Grade points between 8 and 8.9
Grade C (Satisfactory): Grade points between 7 and 7.9
Grade D (Unsatisfactory): Grade points between 0 and 6.9

Bibliography:

Chopard, B. e Droz M. *Cellular Automata Modeling of Physical Systems*. Cambridge University Press, 2005.

Kari, J. "Theory of cellular automata: A survey", *Theoretical Computer Science*, 334:3-33, 2005.

Ilachinski, A. *Cellular Automata: A Discrete Universe*, World Scientific, 2001.

Mitchell, M. "Computation in cellular automata: A Selected Review". In: H.G. Schuster and T.Gramms, editors. *Nonstandard Computation*. Wiley-VCH, p. 95-140, 1998.

Schiff, J.L. *Cellular Automata: A Discrete View of the World*. Wiley, 2007.

Wolfram, S. *A New Kind of Science*. Wolfram Media, 2002.

Wolfram, S. *Cellular Automata and Complexity*, Westview Press, 2002.