ÁREA TEMÁTICA 11	
Título:	Optimal decision-making in complex systems
Vagas:	Mestrado: 1 Doutorado: 1
Descrição:	The combination of data analysis and decision-making has been a fruitful field of industrial and academic research that has a demonstrated record of successes in a vast range of complex tasks, ranging from automotive industry, health-care and personalized medicine, energy generation and distribution, supply-chain management, computer graphics and resource management. The field of sequential decision making based on machine learning algorithms and technologies (see [1], for an introductory reference) is currently very active, with many theoretical and methodological advances, as well as augmented generalization capabilities that allow these technique to operate within large and high-dimensional setups. There is evidence to trust that such a development will continue in the coming years, with more efficient and flexible models and algorithms, and with many new applications in which richer and smarter hierarchical structures would be better suited for reasoning. It is, however, of critical importance that care is taken so that machine-learning-based decision-making solutions are operated safely, reliably and predictably, so that all aspects related to exploration-exploitation are accounted for, already at the design of the utility functions [2]. With this research topic, we first focus on state-of-the-art techniques for sequential-decision making based on classical decision processes, and then we shall analyze the most recent algorithmic developments that aim at incorporating more flexible machine learning models. We aim at studying the constrained optimization methods that solve sequential decision problems [3], coupled with flexible statistical machine learning methods for latent-variable modelling [4]. We are thus looking for students with a proven experience in optimization, machine learning and decision processes, as well as a genuine interest in the analysis and the operation of complex systems with actionable capacity and stochastic nature. Applications to interconnected high-dimensional real-time systems will set the playground.
Palavras-Chaves:	Artificial Intelligence, Machine Learning, Numerical Optimization, Decision Making.
Referências	[1] Vincent François-Lavet , Peter Henderson, Riashat Islam, Marc G. Bellemare, and Joelle Pineau, ”Deep Reinforcement Learning”, *Foundations and Trends in Machine Learning*, vol. 11, 3-4, pp 2019-354, 2019. http://dx.doi.org/10.1561/2200000071 [2] Dario Amodei, Chris Olah, Jacob Steinhardt, Paul Christiano, John Schulman, Dan Mané, “Concrete problems in AI safety”, *arXiv*, 2016. https://arxiv.org/abs/1606.06565 [3] Dimitri P. Bertsekas, *Reinforcement Learning and Optimal Control*, Athena, 2019. [4] David Barber, *Bayesian Reasoning and Machine Learning*, Cambridge University,2012.