23–28 September 2019

Schedule

	09:30 - 11:00	11:00-11:30	11:30 - 13:00	13:00-14:30	14:30 - 16:00	16:00-16:30	16:30 - 18:00
Monday	Quantum Computing & Algorithms	Coffee Break	Quantum Computing & Algorithms	Lunch	Introduction to Quantum Programming	Coffee Break	Introduction to Quantum Programming
Tuesday	Quantum Programming Practice	Coffee Break	Quantum Programming Practice	Lunch	Quantum Programming Practice	Coffee Break	Quantum Programming Practice
Wednesday	Quantum Programming Practice	Coffee Break	Quantum Programming Practice	Lunch	Quantum Programming Practice	Coffee Break	Quantum Programming Practice
Thursday	The Language Q#	Coffee Break	The Language Q#	Lunch	The Language Q#	Coffee Break	The Language Q#
Friday	The Language Quipper	Coffee Break	The Language Quipper	Lunch	The Language Quipper	Coffee Break	The Language Quipper
Saturday	Quantum Machine Learning with Quantum Circuits	Coffee Break	Quantum Machine Learning with Quantum Annealers	Lunch	Students' Workshop	Coffee Break	Students' Workshop

Abstracts of the Lectures

Fabrizio Illuminati - **Introduction to Quantum Computing and Algorithms**	This lecture will give a basic introduction to the theory of Quantum Computation and Quantum Algorithms.
Tomas Babej - **Introduction to Quantum Programming**	In this lecture we will address the paradigms of quantum computing based on quantum annealing (D-Wave's stack),) and continuous-variable QC (based on Xanadu's stack), with practical, hands-on examples.
Andres Paz - **The Language Q#**	We introduce Q# and explain why we created Q#, some of the language specific features, and its interoperability with other languages, in particular C# and Python. We will then do some hands-on workshops in which students have to perform tasks on their own computer to learn about quantum programming
Benoit Valiron - **The language Quipper**	This lecture is devoted to functional programming for quantum computation. First, we will develop a formal computational model for quantum programming and derive a framework for sound functional, quantum programming languages. We shall then discuss and play with a concrete implementation: Quipper.
Alejandro Perdomo Ortiz - **Quantum Machine Learning**	This lecture is devoted to introduce quantum-assisted machine learning with Quantum Circuits and with Quantum Annealers. With quantum computing technologies nearing the era of commercialisation and quantum advantage, machine learning (ML) has been proposed as one of the promising killer applications. Despite significant effort, there has been a disconnect between most quantum ML proposals, the needs of ML practitioners, and the capabilities of near-term quantum devices towards a conclusive demonstration of a meaningful quantum advantage in the near future. In this set of lectures, we provide concrete examples of intractable ML tasks that could be enhanced with near-term devices. We argue that to reach this target, the focus should be on areas where ML researchers are struggling, such as generative models in unsupervised and semi-supervised learning, instead of the popular and more tractable supervised learning tasks. We focus on hybrid quantum-classical approaches and illustrate some of the key challenges we foresee for near-term implementations. We will present as well recent experimental implementations of these quantum ML models in both gate-based (superconducting-qubit and ion-trap) quantum computers and in quantum annealers.