UNIVERSITAT JAUME I

Institut Universitari de Matemàtiques i Aplicacions de Castelló · IMAC

Thematic Semester on

QUANTUM MATHEMATICS

The Mathematics inspired by Quantum Mechanics

QUANTUM MACHINE LEARNING: WHEN PHYSICS FLIRTED WITH MACHINE LEARNING, AND THEY FELL IN LOVE

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Abstract: The last few years have seen how Machine Learning (ML) has become a mature field with nunerous real applications, even to problems that were unthinkable just a decade ago. For its part, the emergence of Quantum Computing (QC) and its promising potentialities has attracted the attention to many researchers and companies towards the achievement of a real quantum supremacy. These two ingredients have been the basis for the appearance of Quantum Machine Learning (QML), a multidicisplinary approach that is influenced by ML, QC and Physics in general. QML is not a hermetic and unique way of learning but a general term that encompasses many different and alternative ways to handle problems.

When one thinks of QML, two main approaches usually arise, either how classical ML can help in quantum experimentation and technologies, or how quantum methodologies can improve classical ML, oftentimes by speeding up the learning process. Whilst both approaches are completely plausible, they tend to produce a border between classical and quantum realms that might hinder the progress of QML, which is predestined to be one of the main pillars of science and technology in the years to come. Therefore, in order to create a new and useful QML, it makes sense to promote the active collaboration of both fields working in unison to produce new and disruptive approaches. Some of the works on this matter in the last few years include probabilistic quantum clustering or quantum autoencoders with genetic algorithms. Next years will likely see the proposal of new learning paradigms and the adaptation of others, like active learning, to the quantum environment.

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