



## TP: Quantum Computation

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**Objectives:** The fundamental objectives of this work are the analysis, implementation and simulation of quantum algorithms, using the tools and techniques learned in the practical classes. Besides a Qiskit/Haskell script, a report detailing this practical work is required. It should preferably be in English and follow the structure of an article/experimental report.

**Work description:** The projects are individual. Each student may choose an algorithm from the list below, or propose one. Each work should contain (and will be evaluated on) the following elements:

1. **Introduction** - Each work should start by describing the problem addressed, the main idea behind the algorithm and any known quantum techniques/subroutines involved.
2. **Algorithm** - The algorithm should be described in clear terms with a mathematical description.
3. **Implementation** - The work should provide a coded implementation of the algorithm, for at least a couple of distinct examples.
  - This section will be evaluated for code presentation and documentation;
  - Points will be awarded for implementation ease-of-use and scalability.
4. **Results and discussion** - The implementation should be simulated and its results discussed.
  - Are the results as expected? If not, point to possible faults in the implementation, algorithm or hardware limitations.
  - What future work may be developed from the implementation?

**Suggested topics:** (possible source articles)

1. **Quantum state preparation with universal gate decompositions** (article)
2. **Quantum Artificial Life in an IBM Quantum Computer** (article)
3. **Quantum circuit representation of Bayesian networks** (article)
4. **Towards Pricing Financial Derivatives with an IBM Quantum Computer** (article)
5. **Solving Sudoku game using a hybrid classical-quantum algorithm** (article)
6. **Exact Ising model simulation on a quantum computer**(article)
7. **Quantum fault tolerance in small experiments**(article)
8. **Simulating Chemistry Using Quantum Computers**(article)
9. **Option Pricing using Quantum Computers**(article)