# Implementing a unitary quantum perceptron with quantum computing

The recent advances in quantum technologies transform the perceptron -the fundamental building block of neural networks- to its quantum version. Its realization on quantum hardware is still an active research field. Here, we follow the recent work (1) on a unitary quantum perceptron, which is implemented as a single (fast) adiabatic passage in a model of interacting spins. The adiabatic procedure has already been demonstrated with superconducting qubits (2) and trapped ions (3).

In this project, we simulate the aforementioned physical system with quantum computing. To demonstrate the learning ability of the quantum perceptron, we train it to perform the XOR gate. Contrary to their classical counterpart (4), quantum perceptrons can realize the XOR gate. Moreover, inspired by the energetic efficiency of Google's Sycamore quantum processor over the supercomputer (5), we compare the power consumption of classical and quantum perceptrons. Interestingly, the quantum perceptron is also energetically more efficient.

References:


1. E. Torrontegui and J. J. Garcia-Ripoll, EPL 125, 30004 (2019), arXiv:1801.00934
2. Lucero E., et. al., Nat. Phys., 8 (2012) 719.
3. P. Huber, et. al., (2021), arXiv:2111.08977.
4. H. Nishimori, Statistical Physics of Spin Glasses and Information Processing (Oxford University Press, 2001).
5. Arute, F., Arya, K., Babbush, R. *et al.* Quantum supremacy using a programmable superconducting processor. *Nature* 574, 505–510 (2019).