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Emergent Quantumness in Neural Networks

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In this talk, I will show that equilibrium dynamics of trainable variables (e.g. bias vector or weight matrix) in an artificial neural network can be approximated by Madelung equations if the quantum phase is identified with the free energy of non-trainable variables (e.g. state vector of neurons). In addition, if the number of active neurons changes, then the free energy is multivalued and the equilibrium dynamics is better approximated by Schrödinger equation with "Planck's constant" determined by the chemical potential. This shows that quantum mechanics provides a correct statistical description of the dynamics of the grand canonical ensemble of neural networks at the learning equilibrium. I will also briefly discuss a possibility of using the emergent quantumness for building an artificial quantum computer and a possibility that the entire universe on its most fundamental level is a neural network.

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