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# ALUMNI SEMINAR: : Quantum circuit synthesis with diffusion models

GORKA MUNOZ-GIL

April 23, 2024

15:00 to 16:00

Seminar Room

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Quantum computing has recently emerged as a transformative technology. Yet, its promised advantages rely on efficiently translating quantum operations into viable physical realizations. In this talk, I will show how to use generative machine learning model, specifically denoising diffusion models (DMs), to facilitate this transformation. Leveraging text-conditioning, we steer the model to produce desired quantum operations within gate-based quantum circuits. Notably, DMs allow to sidestep during training the exponential overhead inherent in the classical simulation of quantum dynamics—a consistent bottleneck in preceding ML techniques. We demonstrate the model's capabilities across two tasks: entanglement generation and unitary compilation. The model excels at generating new circuits and supports typical DM extensions such as masking and editing to, for instance, align the circuit generation to the constraints of the targeted quantum device. Given their flexibility and generalization abilities, we envision DMs as pivotal in quantum circuit synthesis, enhancing both practical applications but also insights into theoretical quantum computation.

**Hosted by:** Prof. Dr. Maciej Lewenstein