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Quantum Computing: From Theory to Engineering Practice

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Quantum computing is often introduced as a fundamentally new computational paradigm. However, beyond its theoretical foundations, it is increasingly becoming an engineering discipline that spans multiple layers, from abstract algorithms to physical implementations. In this talk, we present a structured overview of quantum technologies through an "engineering stack"perspective. Starting from the motivation behind quantum computation, we discuss how quantum algorithms, noise-aware modeling, control techniques, and quantum optical implementations are interconnected in practice. We further highlight the emerging need for engineers who can operate across these layers, especially in the context of near-term quantum devices. Selected examples from ongoing research, including device-level simulations and quantum optimization studies, will be presented to illustrate these concepts. Finally, we briefly discuss recent initiatives at Istanbul Technical University, including efforts toward establishing a graduate program in Quantum Computing and Technologies, as well as industry-oriented activities through the Qready initiative.

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