Cambridge Quantum

CAMBRIDGE QUANTUM'S Quantum Software Development Platform

(tket)CQ

What is TKET?

TKET is an advanced software development kit for the creation and execution of programs for gate-based quantum computers. It is platform-agnostic, and its state-of-the-art circuit optimisation routines allow users to extract as much power as possible from any of today's Noisy Intermediate-Scale Quantum (NISQ) devices. TKET is open source and easily accessible through the PyTKET Python package, with extension modules providing compatibility with many quantum computers, classical simulators, and popular quantum software libraries.

Optimising circuits

TKET can automatically handle many of the idiosyncrasies of NISQ devices, lowering the barrier to working with quantum computers. It enables users to build circuits without worrying about the device architecture, and to use a far larger and more expressive gateset than available natively on any device. As well as reducing circuit size, TKET also provides tools to reduce noise in NISQ devices and improve overall performance. These features free users to focus on their projects and avoid getting lost in low-level programming.

Across multiple platforms

Today, TKET is enabling our partners, collaborators and clients to effortlessly work across multiple platforms and to tackle some of the most challenging problems in finance, chemistry, material science, AI, and optimisation.

TKET IS AGNOSTIC TO THE INPUT LANGUAGE, enabling you to combine and deploy the best solutions.

STATE OF THE ART PERFORMANCE

The toolset enables platform-agnostic software development and extracts as much power as possible from Noisy Intermediate-Scale Quantum (NISQ) devices.

LANGUAGE-AGNOSTIC MULTIPLE FRONT-ENDS

Qiskit Cirq Quil ProjectQ PyZX QASM Quipper

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RETARGETABLE • MULTIPLE BACKENDS

IBM Google rigetti ProjectQ OQC aws AQT Azure Honeywell IONQ

Agnosticism

TKET is platform agnostic, both in the input language and the target device. It can act as a cross-compiler, translating programs written for one platform to a totally different one. This enables developers and researchers to reuse software, and easily rerun experiments on new hardware, with minimal code changes, and without sacrificing performance. TKET future-proofs high-level solutions as developers can react instantly to the availability of newer and better quantum hardware. TKET also provides high-level operations relevant to specific problems domains, allowing developers to work at a higher level of abstraction, without sacrificing the ability to target particular systems or devices.

Capabilities

Quantum hardware imposes many restrictions which require that circuits have a specific form, otherwise they cannot run. Every device supports only a limited set of quantum gates. Many devices permit multi-qubit operations only between specific pairs of qubits, while others impose unpredictable performance penalties if a gate involves the "wrong" qubits. TKET's class-leading circuit layout, qubit routing, and gate synthesis routines automatically ensure that the compiled quantum circuits adhere to restrictions imposed by the quantum hardware, and do so with the minimum performance overhead.

Seamless integration

Extension modules are available for interfacing TKET with a number of popular quantum software packages, including Qiskit, Cirq, Pennylane and pyQuil. They target an array of devices, including those provided by IBMQ, Google, Rigetti and Honeywell and utilise highly optimised classical simulators such as Stim and Qulacs. A uniform interface connects with supported backends, allowing for their seamless insertion into high-level code.

Qermit error mitigation

The simplest way to reduce the impact of noise in a quantum circuit is to reduce the number of quantum gates in the circuit; therefore TKETs circuit optimisation methods are an important tool to minimise the impact of noise when using NISQ hardware. However this is not the whole story.

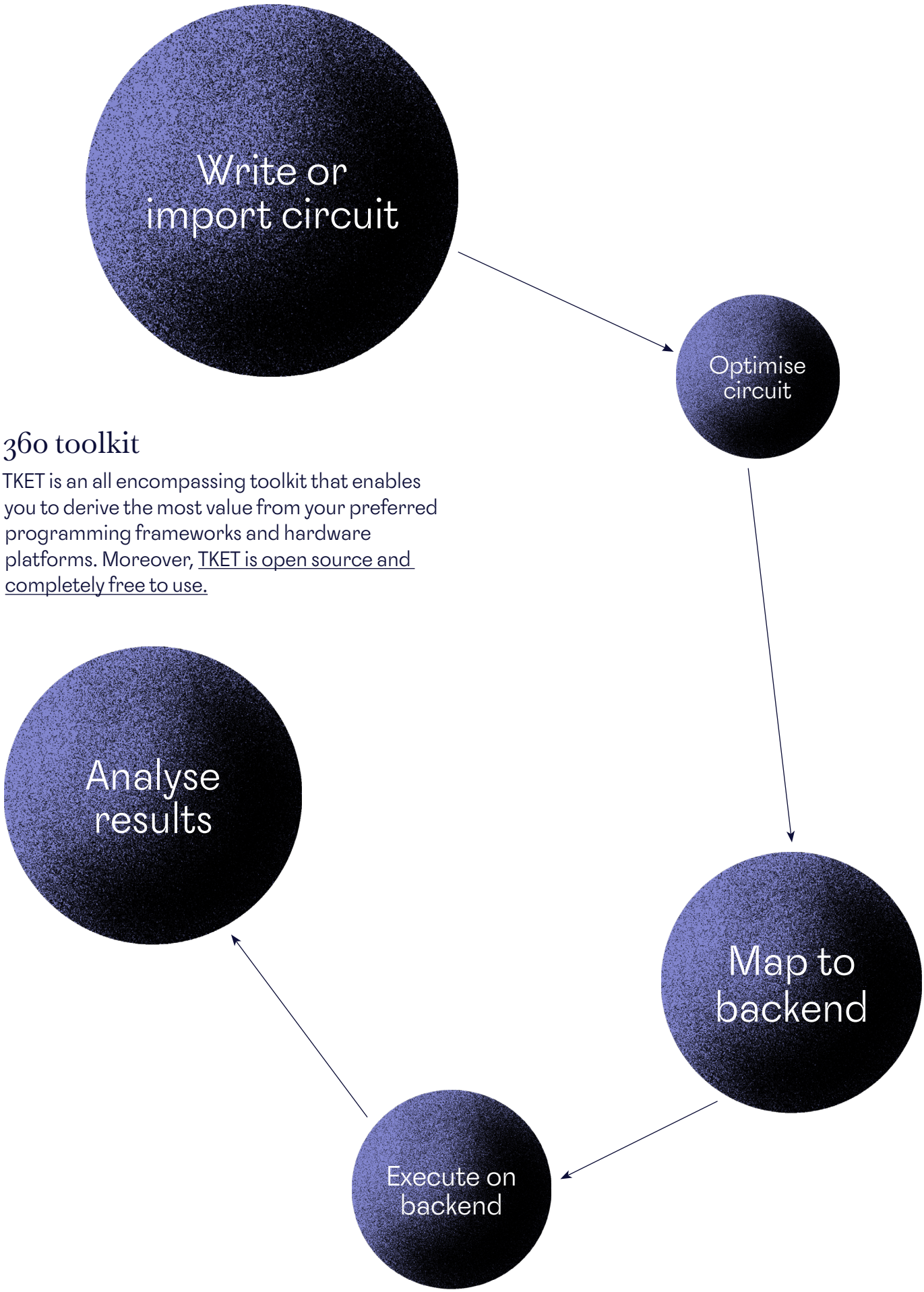
Qermit is an open source python module which implements specially designed error mitigation protocols which can improve the accuracy of quantum computations implemented on NISQ devices. These protocols can improve mean circuit fidelity or give better estimates of expected values of observables. Qermit's composable design allows users to mix and match protocols without having to adapt their circuit or algorithm design.

By virtue of being implemented on the TKET platform, Qermit may be used with a wide range of quantum hardware and in conjunction with several common quantum software development kits.

Qermit seamlessly integrates error mitigation into experiments built on the TKET platform.

Current protocols

The error mitigation protocols presently available through Qermit include Zero-Noise Extrapolation, Probabilistic Error Cancellation, Clifford Data Regression and State Preparation and Measurement error correction, as well as a host of others. An experiment in Qermit is constructed as a data flow graph. Each vertex represents a sub-process, such as circuit generation, which is required to run an experiment. Edges move data between sub-processes and vertices may be amended to adapt the protocol where necessary. Graphs and sub-graphs may also be reused in other original error mitigation protocols. This ensures the extensibility of Qermit, allowing for simple combinations of error mitigation protocols and the facilitation of new protocol prototyping.



360 toolkit

TKET is an all encompassing toolkit that enables you to derive the most value from your preferred programming frameworks and hardware platforms. Moreover, TKET is open source and completely free to use.

TKET'S COMPILATION ROUTINES AUTOMATICALLY ENSURE QUANTUM CIRCUITS CONSTRUCTED

by the user adhere to restrictions imposed by the quantum hardware.

WHY GET STARTED WITH TKET TODAY?

Open source and completely free to use.

Enables you to extract maximal value from current and future hardware platforms.

Integrated with all commonly deployed programming frameworks and hardware backends.

Multiple features designed to minimise the influence of device error.

Provides state-of-the-art circuit optimisation, compilation and error mitigation.

Supported by a rapidly growing community and team of collaborative experts.

CONTACT US

Please contact our team at
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Cambridge Quantum

We set out our vision to positively transform the world using the power of quantum computing back in 2014. Today, we are recognised as one of the foremost quantum computing companies, delivering science-led, enterprise-driven solutions to tackle hard problems across a diverse range of industries.

Cambridge Quantum designs, engineers and deploys algorithms and enterprise application libraries, translating cutting-edge research into industry leading technologies through a product-centric focus. TKET, our hardware-agnostic software development platform, and other technologies are currently utilised by an expansive and ever-growing user base.

The team at Cambridge Quantum has been developing the theoretical foundations of quantum computing for over 25 years, forging ahead with breakthroughs in the fields of quantum chemistry, quantum artificial intelligence, quantum cybersecurity and quantum algorithms.

At present, we have the deepest roster of researchers, developers and engineers, working to democratise quantum computation and realise the benefits for the greatest possible number of people.

FOR MORE INFORMATION

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