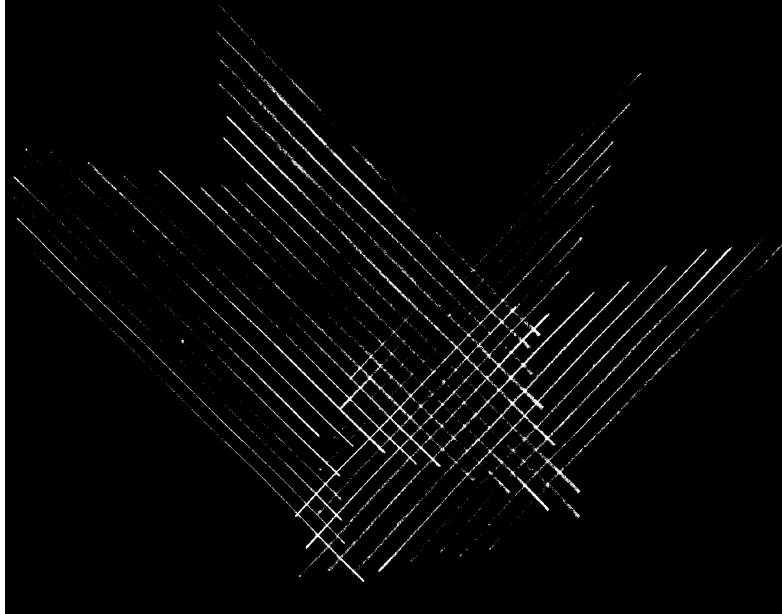




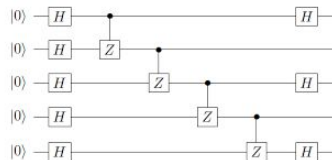
Molecular
Quantum
Solutions



Xenakis - The Automated Quantum Circuit Composer



What



Automated circuit design

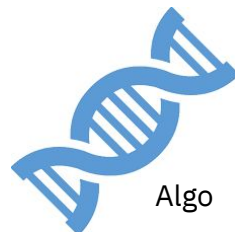
Why



Less expert knowledge needed
and time saving

How

010100|0101|010101|0101 ...
100101|0010|101001|0101 ...

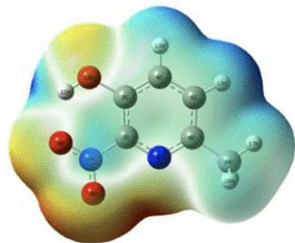
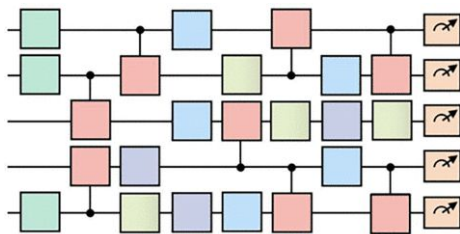


Algo

Bitstring circuit composition
and genetic algorithm

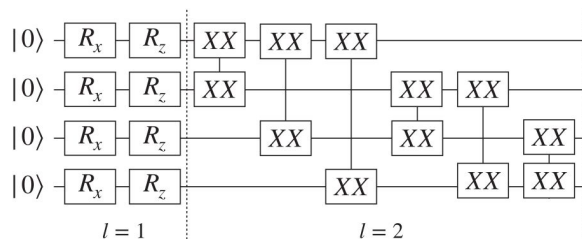
Applications

Chemistry



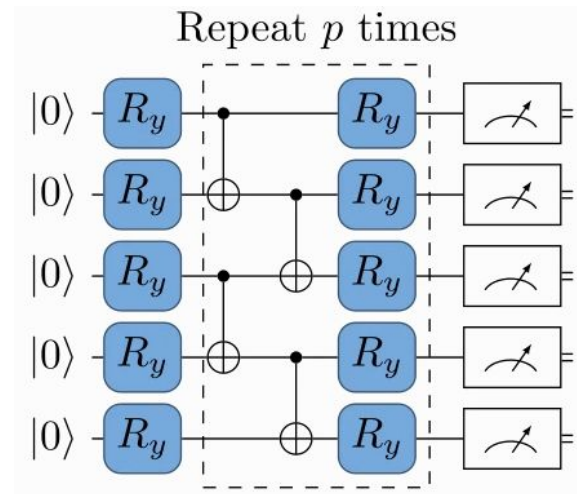
Variational algorithms
(VQE, QAOA)

Finance



Quantum Monte Carlo

Scheduling & Logistics



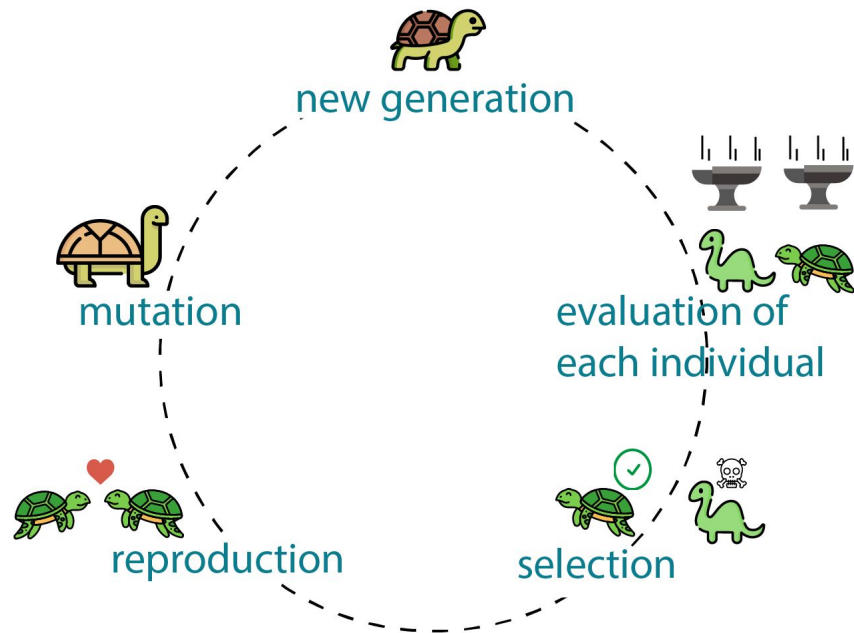
VQE

010100|0101|010101|0101 ...
 100101|0010|101001|0101 ...

Gate identifier

Qubits identifier

} appended to define circuit



- ❑ Method validated via VQE for H₂ and H₂O
- ❑ Best ansatz circuit were found for H₂ to determine the ground state energy
- ❑ For both molecules the generated Ansatz circuits improved the accuracy of the ground state energy calculation per generation

Evaluation on Genetic Algorithms as an optimizer of Variational Quantum Eigensolver(VQE) method

Hikaru Wakaura*

QuantScape Inc. QuantScape Inc., 4-11-18, Manshon-Shimizudai, Meguro, Tokyo, 153-0064, Japan

Takao Tomono

Digital Innovation Div. TOPPAN Inc. , 1-5-1, Taito, Taito, Tokyo, 110-8560, Japan[†]

Shoya Yasuda

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Kanagawa-ku, Yokohama, Kanagawa, 221-0073, Japan[‡]*

(Dated: October 2021)

A Genetic Algorithm for Quantum Circuit Generation in OpenQASM

Teong Joo Ong¹(✉) and Chye Cheah Tan²

¹ Southern University College, PTD 64888, Jalan Selatan Utama, Off Jalan Skudai,
81300 Skudai, Johor, Malaysia

tjong@sc.edu.my

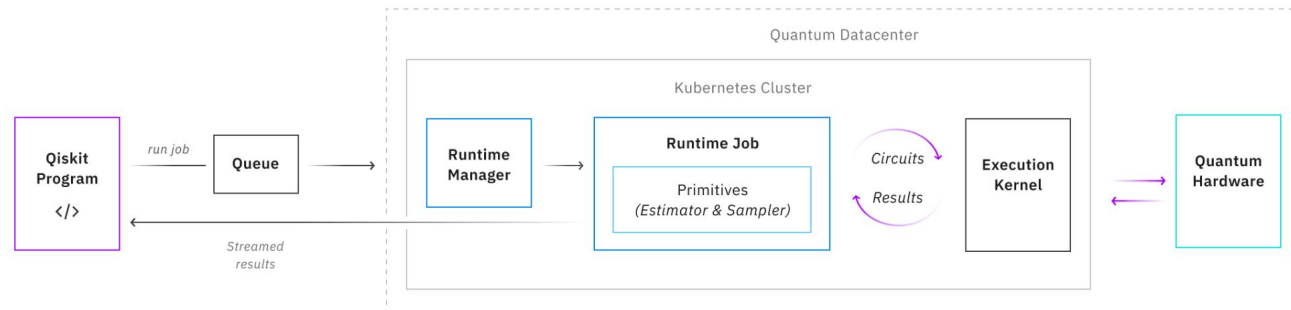
² Asia Pacific University of Technology, Jln Teknologi 5, Taman Teknologi Malaysia,
57000 Kuala Lumpur, Malaysia

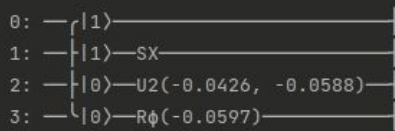
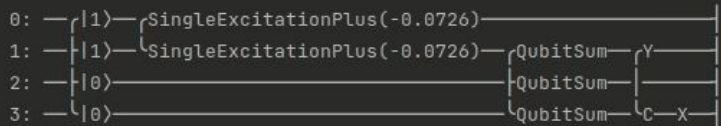
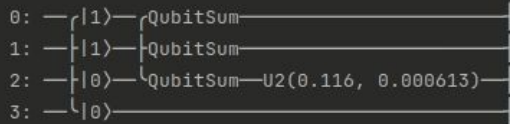
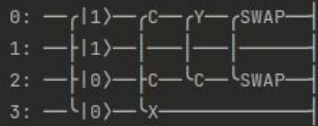
chyecheah.t@staffemail.apu.edu.my

PennyLaneAI/pennylane-qiskit

The PennyLane-Qiskit plugin integrates the Qiskit quantum computing framework and IBM Q with PennyLane's quantum machine learning capabilities.

24 Contributors 10 Issues 102 Stars 40 Forks





The algorithm in action

Service/consultancy



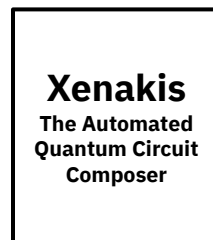
Contractual work for optimizing code/circuits for specific applications

Web user interface subscription



Ease of use for non-experts

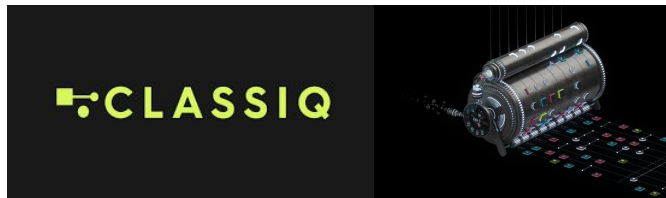
Software product license



Open-source and freely licensed package

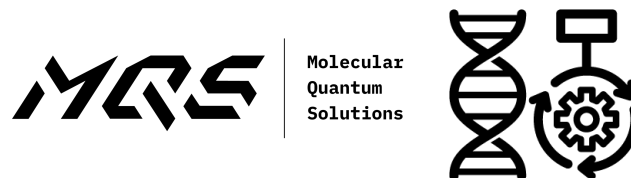
High performance image product

Competitor and patents



Patents

- ❑ Quantum Circuit modeling
 - ❑ Debugger for quantum computers
-
- ❑ Optimization of circuit formulated as Constraint Satisfaction Problem (CSP) and graph
 - ❑ VQE use-case not validated as far as we could evaluate



Patents

- ❑ Qubit reduction hardware-software method filed for two EU patents which can be connected with Xenakis
-
- ❑ Very flexible software and hardware co-design due to fitness function adaptation
 - ❑ Genetic algorithm can be used as a pre-compilation step and then substituted with more heuristic optimizers for final compilation
 - ❑ First validated use-case: VQE for quantum chemistry
 - ❑ Next use-case: Quantum Monte Carlo



**Molecular
Quantum
Solutions**

<https://MQS.dk>

contact@mq.s.dk

“Any musical piece is akin to a boulder with complex forms, with striations and engraved designs atop and within, which ... can decipher in a thousand different ways without ever finding the right answer or the best one ...”

- Iannis Xenakis