QCSHQD: Quantum Computing as a Service for Hybrid Classical-Quantum Software Development

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Introduction

Quantum Computing (QC) is transitioning from theoretical frameworks to an indispensable powerhouse of computational capability, resulting in extensive adoption across both industrial and academic domains. QC presents exceptional advantages, including unparalleled processing speed and the potential to solve complex problems beyond the capabilities of classical computers. Nevertheless, academic researchers and industry practitioners encounter various challenges in harnessing the benefits of this technology.

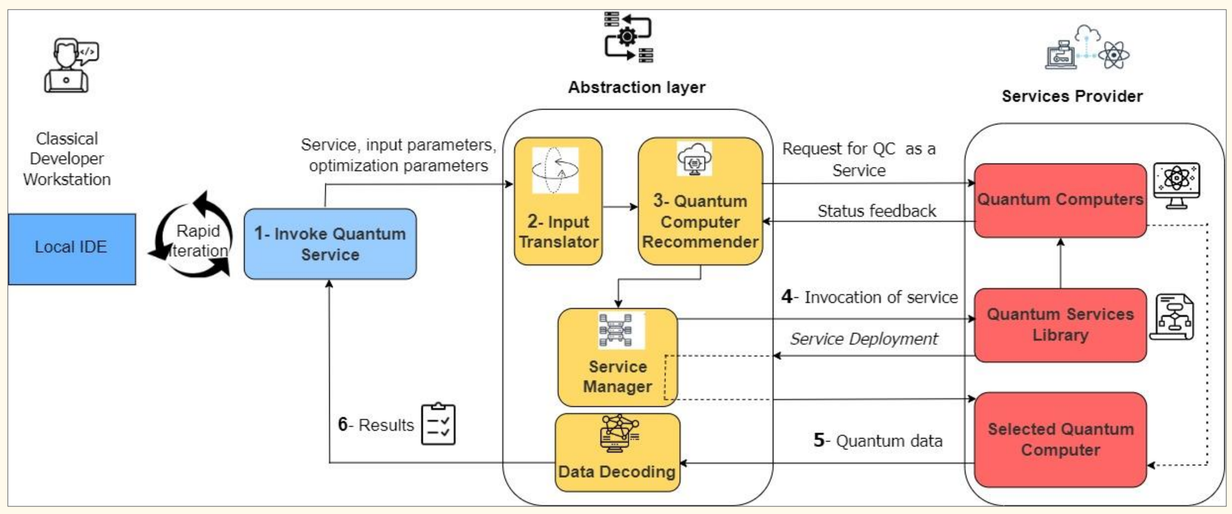
Research Questions

RQ1. What existing tools and frameworks provide Quantum Computing as a Service (QCaaS)?
RQ2. What challenges are associated with using tools and frameworks that hybridize classical and quantum computers?
RQ3. How has the prototype version of QCSHQD improved the identified challenges in the existing frameworks?
RQ4. How does QCSHQD outperform existing frameworks in terms of efficiency, accuracy, scalability, and reliability?

Motivation

- Complexity of Quantum Computing: Classical developers lack expertise in quantum mechanics and finds the quantum computing landscape more complex than classical computing.
- Accessibility of Quantum Resources: Even if classical developers had the necessary knowledge, gaining access to quantum computing resources is another hurdle. Quantum computers are not widely accessible, and interfacing with them requires specific tools, methods, and processes.

Proposed QCSHQD Framework



Objective

To present a framework named "QCSHQD" democratizing access to QC resources for classical developers who want to harness QC power.

Ongoing Work

- Develop the background and knowledge necessary for research in quantum computing.
- conduct a systematic mapping study focusing on existing tools and frameworks provide Quantum Computing as a Service (QCaaS).

Future Work

- Conduct a repository mining to identify the needs and challenges of classical developers interested in leveraging quantum resources
- Implement a pilot version of QCSHQD, based on findings from the repository mining and the systematic mapping study
- Implementing full version of QCSHQD, followed by conducting a thorough evaluation of its efficiency and practical applicability.
- Investigate the impact of our QCSHQD framework on the existing quantum software development process and will encompass conducting comparative analyses with other existing tools

Publications

- **Tavassoli Sabzevari, M.**, Esposito, M., Taibi, D., & Khan, A. (2024). QCSHQD: Quantum computing as a service for Hybrid classical-quantum software development: A Vision. In Proceedings of the 1st ACM International Workshop on Quantum Software Engineering: The Next Evolution (QSE-NE'24). https://dl.acm.org/doi/pdf/10.1145/3663531.3664751
- Esposito, M., **Tavassoli Sabzevari, M.**, Ye, B., Falessi, D., Khan, A., & Taibi, D. (2024). $Classi|Q\rangle$: Towards a Translation Framework to Bridge the Classical-Quantum Programming Gap. In Proceedings of the 1st ACM International Workshop on Quantum Software Engineering: The Next Evolution (QSE-NE'24). https://dl.acm.org/doi/pdf/10.1145/3663531.3664752

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