First Workshop on Quantum Computing and Quantum-Inspired Technology for Data-Intensive Systems and Applications (Q-Data)

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ABSTRACT

Quantum computing has seen significant advancements with the emergence of commercial quantum hardware from major tech companies and startups. These developments, alongside new classical hardware accelerators inspired by quantum technologies, facilitate the rapid solving of complex optimization problems and recently spawned a flurry of research in various communities.

The primary objective of the Q-Data workshop is to explore how quantum computing and related technologies can enhance data processing, data management, data analysis systems, and techniques. It also focuses on hybrid approaches integrating quantum and classical computing methodologies to enhance such data systems and techniques. This workshop will spur new research efforts in this emerging field and pave the way for building next-generation data-intensive systems with quantum computing support.

CCS CONCEPTS

• **Information systems → Data management systems**; • **Computer systems organization → Quantum computing**.

KEYWORDS

Data-Intensive Systems, Databases, Data Management and Processing, Quantum Computing, Quantum-Inspired Technology

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1 INTRODUCTION

Whereas quantum computing started out as a purely theoretical concept, the last few years have seen a "Cambrian explosion" of first-generation commercial quantum hardware culminating from decades of foundational research. Players, including the likes of Google, IBM, and Intel, as well as startup companies like IQM, D-Wave, IonQ, and Rigetti, are now producing hardware devices that implement quantum computing using various technologies. At the same time, the recent advances in quantum computing have inspired a new generation of classical hardware accelerators, offered commercially by providers such as Fujitsu, Toshiba, and 1Qubit, that mirror the interfaces and take inspiration from internal processes of quantum computers. These accelerators, including digital annealers, as well as GPU- and FPGA-based simulators of quantum computation, obtain approximate solutions for extremely large, combinatorial optimization problems quickly.

Using quantum computing and related technologies has become conveniently possible with standard IT interfaces. Several software frameworks have recently appeared that make solving a diverse range of problems using quantum computers easier. At the same time, multiple cloud providers nowadays offer quantum computing as a service, making the technology accessible to broad shares of the population. Taken together, these developments have recently spawned a flurry of research in various fields, ranging from operations research to machine learning, to analyze the transformative potential of quantum computing for specific use cases.

Having a track record of exploring the potential of emerging hardware for data processing, the time is right for the database community to start investigating novel use cases and algorithms for quantum computing in the database domain. We propose to organize a workshop that brings together researchers and practitioners from the database systems and quantum computing communities with the goal of investigating various ways of integrating emerging quantum computing techniques, as well as quantum-inspired hardware accelerators, with data-intensive systems and their applications. Compared to the QDSM (Quantum Data Science and Management)[1] workshop at VLDB 2023, which focuses on the interactions of quantum computing and quantum machine learning with data science and data management technologies, our workshop is especially mindful of applying quantum computing to designing and implementing data-intensive systems and applications (i.e., exploring quantum computing in the different systems' and applications' components). In addition, our workshop has a broader focus in terms of hardware, integrating quantum computers as well as various quantum-inspired accelerators that feature similar interfaces and processes. Other workshops on quantum computing, outside of the database community, do not share our focus on data management and systems.

2 TOPICS OF INTEREST

Topics of interest for the workshop include (but are not limited to):

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[1] https://www.ifis.uni-luebeck.de/ groppe/qdsm/2023

- Enhancing database system components (e.g., query optimizer, query scheduler, transaction scheduler, authentication and integrity manager) with quantum computing and quantum-inspired accelerators
- Data processing systems that integrate quantum-based and quantum-inspired accelerators
- Data processing systems that integrate both quantum and classical computing approaches
- Quantum machine learning for autonomous databases, database tuning, workload management, and learned indexes
- Approaches for data exploration, discovery, and integration based on quantum computing and quantum-inspired hardware accelerators
- Formal analysis and experimental evaluations assessing the potential of quantum computing for specific use cases in data processing and data management
- Vision papers describing novel database system designs and novel use cases in data processing and management enabled by quantum computing
- Quantum computing libraries and programming interfaces for database systems
- Quantum computing enhanced data exploration, discovery, and integration
- Domain-specific approaches exploiting quantum computers and quantum-inspired accelerators for data analysis (e.g., in finance or health care)

3 SOLICITATIONS AND REVIEW PROCESS

Q-Data solicits two types of contributions: *Papers* and *Abstracts*.
Papers: We will accept full (up to 12 pages) and short (up to 6 pages) papers, with unlimited pages for references, in three categories:

- Algorithms: The primary contribution lies in algorithms that allow solving problems that are relevant to the database community on quantum computers or quantum-inspired accelerators. Long papers are expected to provide significant experimental or formal analysis results evaluating the proposed algorithm.
- Systems: The primary contribution lies in proposing new architectures or frameworks that use quantum computing or quantum-inspired accelerators to address the various data processing and management problems. Long papers are expected to evaluate the implementation of the proposed system thoroughly.
- Experiments: The primary contribution lies in experimental analysis, quantifying properties of existing or novel algorithms that are at least partially executed on quantum computers or quantum-inspired accelerators (or use corresponding simulators). Long papers are expected to provide a more detailed experimental analysis.

Abstracts: Since the workshop focuses on a relatively new area, we will encourage the authors to submit a 1-page abstract about the preliminary findings of their ongoing projects or even raw ideas that are not fully explored. An abstract submission is expected to have a single author. Accepted abstracts will appear in the proceedings.

The workshop will follow the SIGMOD submission guidelines[2], and the ACM publications' conflict of interest policy [3]. To avoid conflicts of interest, we will impose a *triple-blind* submission and review policy. In addition to the traditional double-blind submission that hides the authors' and referees' names from each other, the triple-blind reviewing goes further and hides the referee names among referees during paper discussions.

Tentative important dates are listed below:

- Paper submission: April 26, 2024, 11:59 PM PST
- Author notification: May 10, 2024
- Camera-ready submission: June 1, 2024
- Workshop day: June 9, 2024

4 WORKSHOP ORGANIZATION

Workshop Co-Chairs:

- Ibrahim Sabek (University of Southern California, USA)
- Immanuel Trummer (Cornell University, USA)
- Stefan Prestel (Quantum Brilliance, Germany)

Steering Committee:

- Le Gruenwald (University of Oklahoma, USA)
- Sven Groppe (University of Lübeck, Germany)
- Jiaheng Lu (University of Helsinki, Finland)
- Wolfgang Mauerer (Technical University of Applied Sciences Regensburg, Germany)

Workshop Publicity Chair:

- Manuel Schönberger (Technical University of Applied Sciences Regensburg, Germany)

Program Committee Members:

- Christoph Koch (EPFL, Switzerland)
- Gokul Ravi (University of Michigan, USA)
- Johanna Barzen (University of Stuttgart, Germany)
- Kurt Stockinger (Zurich University of Applied Sciences, Switzerland)
- Manuel Wimmer (JKU Linz, Austria)
- Markus Zajac (Fernuniversität Hagen, Germany)
- Manuel Schönberger (Technical University of Applied Sciences Regensburg, Germany)
- Sebastian Feld (TU Delft, Netherlands)
- Stuart Hadfield (Quantum AI Lab at NASA Ames Research Center, USA)
- Umut Çalikyilmaz (University of Lübeck, Germany)
- Uta Störl (Fernuniversität Hagen, Germany)
- Valter Uotila (University of Helsinki, Finland)

[2] https://www.acm.org/publications/proceedings-template
[3] https://www.acm.org/publications/policies/conflict-of-interest