Title: Quantum Algorithms for Optimizing Urban Transportation

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Abstract

Transportation is a fundamental aspect of modern urban life, profoundly influencing the daily experiences of countless individuals residing in major cities. Its pivotal role extends beyond mere convenience, as transportation systems significantly shape energy consumption patterns and substantially impact the environment. Our choices in optimising transportation affect the efficiency of our daily commutes and play a critical role in determining the sustainability of our cities and the planet's well-being. As cities grow and face escalating congestion, energy usage, and environmental sustainability challenges, exploring innovative solutions becomes imperative.

Within this context, the convergence of quantum computing and transportation optimisation stands out as a compelling pathway toward minimising commuting times, energy consumption, and carbon emissions and enhancing the efficient utilisation of vehicles. In a hypothetical urban environment without private vehicles, the focus lies in designing a quantum algorithm capable of optimising public transportation systems to offer citizens seamless, eco-friendly, and energy-efficient travel experiences. Additionally, exploration extends to assessing the viability of integrating such a system with vehicles owned by external entities.

Building upon prior research that explores the quantum iteration of the vehicle routing problem, the objective is to devise an algorithm adept at dynamically allocating resources, such as large buses and small cars, in response to real-time demand and passenger distribution across geographical locations. Notably, existing studies in this realm indicate progress, yet they underscore the persistent limitations, leaving considerable scope for further advancements and refinements.

We intend to use the Qiskit framework, a robust quantum computing platform, to implement an algorithm to optimise public transportation. We want to simulate real-world complexities by employing mock data representative of a major city's public transport system. Furthermore, we intend to enhance authenticity by exploring the integration of actual data from a major city. This approach aims to validate the algorithm's efficacy and demonstrates its relevance to the intricacies of urban mobility.

Keywords: quantum computing, algorithms, optimization, urban transportation, computation, energy consumption, carbon emissions, operations, efficiency, vehicle routing

ACM Classification:

- Theory of computation → Models of computation → Quantum computation theory → Quantum complexity theory
- Computer systems organization → Architectures → Other architectures
- Applied computing → Operations research → Transportation

References

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