

## ARTIFICIAL INTELLIGENCE SYSTEM DESIGN WITH MICROSOFT AZURE QUANTUM

### ПРОЕКТУВАННЯ СИСТЕМ ШТУЧНОГО ІНТЕЛЕКТУ З ВИКОРИСТАННЯМ MICROSOFT AZURE QUANTUM

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**Abstract.** *The integration of artificial intelligence (AI) with quantum computing offers transformative capabilities for solving complex problems. This article explores AI system design using Microsoft Azure Quantum, a leading quantum computing platform. Also, review of quantum computing fundamentals, AI principles, and Azure Quantum's features. This work aims to guide in leveraging Azure Quantum for advanced AI system design.*

Quantum computing, with its ability to process information in multiple states simultaneously, promises to revolutionize artificial intelligence (AI) by providing computational power far beyond that of classical computers. This potential makes previously unsolvable AI problems manageable. Microsoft Azure Quantum leads the integration of AI and quantum computing, offering a platform that combines quantum hardware, algorithms, and scalable cloud infrastructure. This enables the creation of advanced AI systems using both quantum and classical computing resources. This article explores the design principles for building AI systems on Azure Quantum.

Designing AI systems on Azure Quantum involves leveraging existing research on quantum algorithms for AI and machine learning (AI/ML), which has shown promising results in enhancing computational efficiency and solving complex problems that are infeasible for classical computers.

Quantum computers can process vast amounts of data simultaneously, enabling faster training of machine learning models and more accurate predictions. They also offer unique approaches to problem-solving, such as solving combinatorial optimization problems and enhancing machine learning techniques through quantum-enhanced feature spaces, which can lead to better generalization and performance of AI models. However, integrating quantum computing with existing AI/ML systems presents several challenges. Quantum computers currently face issues like decoherence and error rates, which can affect the reliability of computations. Additionally, there is a need for hybrid architectures that seamlessly combine classical and quantum computing resources, requiring frameworks and algorithms to effectively manage these heterogeneous environments.

Microsoft Azure Quantum plays a strategically important role in advancing AI research with a robust platform that facilitates the integration of quantum computing into AI workflows, offering tools and resources that bridge the gap between theoretical research and practical application. By supporting the development and deployment of quantum-enhanced AI systems, Azure Quantum enables for exploring innovative solutions and push the boundaries of AI capabilities. This strategic importance is underscored by its comprehensive infrastructure, which supports both quantum and classical computations, making it a pivotal resource for the future of AI system design.

#### Бібліографія

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