

1. Article Title:

Quantum Kernels for Real-World Predictions Based on Electronic Health Records

2. Journal Source:

IEEE Transactions on Quantum Engineering

3. FDP Theme:

Artificial Intelligence, Enhanced Life-Saving Approaches for Human Systems
Therapeutic Practices

4. Team Name:

Team Alpha

5. Team Members:

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6. Summary:

This study presents the first large-scale empirical investigation of quantum kernels for real-world prediction tasks using Electronic Health Records (EHRs). The researchers compared quantum support vector machines (QSVM) with classical SVMs using a dataset focused on predicting six-month persistence of rheumatoid arthritis patients on biologic therapies. By constructing a 12-point configuration space with different feature and sample sizes, they assessed empirical quantum advantage (EQA) using performance metrics like F1 score and balanced accuracy.

Interestingly, while classical tools remained robust in most cases, quantum kernels showed advantage in certain hard classification instances, particularly in scenarios with small datasets and a high feature-to-sample ratio. The authors introduced the Terrain Ruggedness Index (PTRI) to assess complexity in the configuration space and identify areas more likely to yield quantum advantage.

Despite noise and limited resources, the team successfully executed 24 configurations on

both simulated and real quantum processors (IBM's `ibmq_dublin`). They utilized the `ZZFeatureMap` to encode data and custom kernel matrices, applying regularization techniques to optimize outcomes. The paper emphasizes that empirical quantum advantage is context-specific and domain-informed, highlighting potential pathways to integrate quantum tools in healthcare analytics.

7. Application of Principles/Practices in Your Function (Individual):

- **Member 1:** I analyze complex health datasets and apply hybrid quantum-classical models to enhance early prediction of patient therapy outcomes.
- **Member 2:** I integrate quantum computing concepts into health informatics education, encouraging interdisciplinary learning.
- **Member 3:** I explore small data diagnostic challenges and introduce PTRI-based insights to improve model development.
- **Member 4:** I manage EHR data preprocessing and support ethical deployment of quantum simulations in clinical studies.
- **Member 5:** I evaluate the performance metrics across configurations and identify instances of empirical quantum advantage for therapeutic applications.

8. Integration and Scalability of Technologies:

The research offers a scalable framework to identify quantum advantage in health prediction tasks. With proper metric tracking (e.g., F1, PTRI) and configuration space tuning, the model can be generalized to other domains in life sciences and precision medicine. Leveraging hybrid quantum-classical approaches allows for experimentation in low-sample, high-noise environments, making it especially valuable for rare disease studies or tightly regulated clinical trials.

9. Conclusion:

This article demonstrates that quantum kernels, when applied strategically, can provide a meaningful edge over classical methods in select real-world health prediction tasks. While classical models remain competitive, the tailored application of quantum methods in complex, small-data scenarios—supported by new metrics like PTRI—opens promising directions for AI-driven therapeutic practices. The study sets a precedent for responsible, empirical, and scalable exploration of quantum computing in healthcare analytics.