Arnav Malhotra

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Research & Patents

System and Method for Dynamic State Transposition and Preemptive Evasion of Spatiotemporal Correlated Errors *Provisional Patent Filed*

- A novel hardware architecture that allows quantum processors to physically "dodge" errors. Unlike traditional error correction which reacts to noise after it happens, this system utilizes a dynamic lattice topology to preemptively transpose quantum states into a "safety manifold" before impact. This active evasion protocol preserves coherence without the massive overhead of standard correction cycles.

System and Method for Resolving Cosmic Ray Events in Superconducting Quantum Processors via Adaptive Control Systems *Provisional Patent Filed*

- Describing a hardware-integrated, adaptive control layer, this filing outlines a novel architecture designed to mitigate the impact of correlated environmental noise—such as high-energy ionizing radiation—which currently serves as a critical barrier to the scalability of superconducting quantum architectures. By utilizing high-speed, pre-computed logic structures to perform real-time error signature identification, the proposed system targets autonomous mitigation protocols within the processor's ultra-short coherence window.

High Fidelity Synthetic Financial Universes (fsynth) *Python Package, Preprint*

- This paper introduces fsynth, a multi-factor synthetic engine that integrates a Heston-based stochastic volatility model with Merton jump diffusion, governed by a hidden Markov regime-switching process. By using macro-regime states alongside company specific "genes," the engine generates plausible universes containing both price action and fundamental accounting data.

Empirical Tests for a Hedging Framework for the Quantum Binomial Options Pricing Model *Preprint*

- This paper derives and tests analytical formulae for hedging with the Quantum Binomial Options Pricing Model. The simulation reveals that the Quantum Binomial Options Pricing model is, at least in its current state, not viable for usage in actually hedging derivatives. This is due to numerical instabilities, particularly in the Quantum Theta and Quantum Vega. We conclude that the single period Quantum Binomial Options Pricing Model is currently unsuitable for practical applications of hedging.

Projects & Open Source

yfinance (Library Contributor) | *30M+ Monthly Downloads*

- Active contributor to yfinance, the industry-standard Python library for accessing Yahoo! Finance market data.
- **The Problem:** Identified critical gaps in the API where key metrics (PEG Ratio) were being dropped, causing failures for downstream quantitative scripts.
- **The Fix:** Engineered a fallback mechanism that parses the Key Statistics HTML page when the API fails, ensuring continuous data availability.

EVE Online Market Strategies

- Used for making ISK in the game EVE online, a popular MMORPG known for its intricate economy closely resembling the real world. There is an intraregional arbitrage calculator for Jita, as well as a market price prediction and opportunities calculator.

Experience

The Stuyvesant Spectator New York, NY

Web Department Lead

- Directing the digital infrastructure for an award-winning high school publication. I lead the web department in maintaining site reliability, optimizing the editorial deployment pipeline, and ensuring 24/7 uptime for the student body and readership.

Education

Stuyvesant High School New York, NY

Class of 2028 (Sophomore)

- **Courses:** AP Calculus BC, AP Precalculus, AP Statistics, AP Human Geography, AP Environmental Science