Green Swan Terminal

Sophisticated Trading of Prediction Markets

CIS 4010: Senior Design

Sparsh Agrawal, Rishabh Mandayam, Alex Keri, Mike Zhou, Justina Lam

The University of Pennsylvania

Penn
University of Pennsylvania

Green Swan Terminal

Sophisticated Trading of Prediction Markets

by

Sparsh Agrawal, Rishabh Mandayam, Alex Keri, Mike Zhou, Justina Lam

Instructor:	B. Thau Loo
Teaching Assistant:	K. Matur
Project Duration:	August, 2024 - May, 2025
Faculty:	School of Engineering and Applied Sciences

Executive Summary

We have developed a financial terminal for Kalshi, designed to provide both proprietary trading firms and retail investors with the infrastructure to intelligently navigate prediction markets.

Our terminal offers a sophisticated market viewer, portfolio analytics, NLP-enhanced news insights, and an automated alpha execution system. It is available as a secure physical deployment for institutions, ensuring data integrity and low-latency access.

Our **Market Viewer** provides a comprehensive overview of all Kalshi-traded markets, helping users understand event relationships. For instance, traders can calculate the beta of event contract A to event contract B to gauge correlation. Additionally, we integrate our proprietary **fair-value models** into all event contracts, providing a more accurate depiction of current market pricing.

The **Portfolio Analytics** screen allows traders to easily assess their exposures. Our **fair-value engine** provides a stable, accurate view of risk and position values. To further enhance decision-making, we leverage an in-house **NLP-powered news scraper**, enabling traders to connect breaking news to their portfolios. Our chat assistant allows them to ask deeper questions to analyze exposure to recent headlines.

However, our **trading execution system** is our most significant value-add. Users can deploy alphas in a **cost-efficient, capital-efficient, profitable manner** via our **automated execution engine**, which adjusts dynamically based on user-defined risk parameters. Traders can also supplement automation with **manual order book tools**, providing full control over execution.

Our backend is built on a **stable, distributed system**, ensuring high **fault tolerance** while handling large data throughput at low latency.

To validate our execution platform, we systematically traded from **Jan 23, 2025, to Feb 12, 2025**, starting with **$225 in capital**. The trick was that instead of using any fundamental model—we only used our in-built market fairs engine. We used no trader oversight meaning that when adverse news events would occur we would take the loss fully relying on our engine's risk models to minimize our losses. Using our default risk parameters, we **consistently generated $150 in daily PnL**, ending with **$3,315** and achieving an annualized Sharpe ratio of **5.245** based on dollar PnL. Notably, we had zero days in the red. During this period, we executed **280.95K shares** with **zero system failures**. Our trading accounted for **5% of daily volume in Kalshi's daily-high weather markets**, including **12,000 shares traded in the Super Bowl advertisement markets alone**.

With prediction markets on the rise — evidenced by **$1B+ in Kalshi trades in November 2024 alone** — our platform is positioned to serve retail investors and professional traders alike. We differentiate ourselves from traditional brokers like **Interactive Brokers, Thinkorswim, and Robinhood**, as well as algo-trading platforms like **QuantConnect**, by offering the **only** full-suite terminal built specifically for **event-contract markets**. Our specialized tools include **full limit order books, real-time event data, and ultra-efficient execution**, giving traders an unparalleled edge.

Our users, equipped with our platform and deeper insights into contract values, are primed to thrive in this rapidly expanding market.

Figure 1: Trading during Superbowl

Market	Contracts	Avg price	Cost	Value	Payout	Total return
Highest temperature in Philadelphia on Jan 31, 2025?						
No · 46° or below	6	98¢	$5.88	$6	Paid out	+$0.12 (2%)
No · 47° to 48°	41	96¢	$39.25	$40.60	Paid out	+$1.35 (3%)
No · 49° to 50°	496	66¢	$326.80	$358.02	Paid out	+$31.22 (10%)
No · 51° to 52°	231	41¢	$94.54	$90.05	Paid out	-$4.49 (-5%)
No · 53° to 54°	82	78¢	$63.94	$77.72	Paid out	+$13.78 (22%)
No · 55° or above	9	44¢	$3.99	$4.20	Paid out	+$0.21 (5%)
Total	865		$534.40	$576.59		+$42.19 (8%)

Figure 2: Philadelphia Daily Weather Trading Example - execution system leans no on all as it tries to maintain delta neutrality throughout the session

Contents

1

Value Proposition

Our financial terminal for Kalshi is the only full-suite solution built specifically for event-driven prediction markets, delivering best in class market insights and execution capabilities for both professional trading firms and retail investors. Our platform's value proposition is anchored on the following elements:

- **Unmatched Market Insight:** Our **Market Viewer** provides a holistic view of all Kalshi-traded markets. Traders can analyze event correlations (e.g., beta calculations between contracts) enhanced by our proprietary **fair-value models**, ensuring an accurate depiction of market pricing.
- **Advanced Analytics and Decision Support:** The **Portfolio Analytics** screen, powered by our stable fair-value engine gives users a real-time and precise understanding of risk and position exposures. Complemented by our in-house **NLP-powered news scraper** and interactive chat assistant, traders gain actionable insights instantly to connect breaking news with market dynamics.
- **Superior Execution Capabilities:** Our **automated alpha execution system** dynamically adjusts based on user-defined risk parameters, market volatility, and current holdings, ensuring cost-efficient and capital-efficient trade deployments. For users who require granular control, our manual order book tools offer full oversight of order execution while maintaining the same execution speed and reliability as the systematic enginer.
- **Reliability and Performance:** Built on a **stable, custom distributed system**, our backend guarantees high fault tolerance and low-latency performance, even during periods of heavy trading. Secure physical deployments for institutional clients further ensure data integrity and ultra-fast access.
- **Tailored Solutions for Every Trader:** By offering both a secure physical terminal for institutions and a web-based application for retail investors, our platform meets the distinct needs of diverse market participants—providing enterprise-grade tools in a user-friendly format.
- **Proven Value Add:** Our rigorous proof-of-concept stress tested our alpha deployment engine. We showed that our system is able to add execution edge by profiting with only our market fit prices and no oversight. Our zero system failures during trading further validates the platform's capacity to generate profitable returns in real-market conditions.

By combining these features, our platform not only enhances trading efficiency and risk management but also becomes an indispensable tool in the rapidly expanding ecosystem of prediction markets.

2

Market and Customer Segments

Kalshi's Market Growth

Over the past year, prediction markets have achieved a series of landmark legal victories, opening the door for exchanges to list contracts related to high-impact events such as elections, sports, and entertainment, including the Grammys. These courtroom successes have been complemented by appointments of industry advocates, like Brian Quintenz — a member of Kalshi's board of directors — who was recently nominated to head the CFTC, the body that oversees Kalshi's operations.

As a result, platforms like Kalshi have seen significant growth. Trading volumes have surged as these markets gain mainstream acceptance. For example, in the run-up to the 2024 U.S. presidential election, Kalshi's election contracts saw open interest surpass $1 billion despite being approved just weeks before the election. On a smaller scale, the Super Bowl alone saw tens of millions of dollars traded in real-time during the game, demonstrating the growing enthusiasm for event-driven markets.

This momentum signals the onset of a liquidity flywheel: as markets grow in popularity, their liquidity increases, attracting more participants. The liquidity in major markets like elections has reached a level where they're now influencing broader financial decisions, as evidenced by the impact of Kalshi's election contracts on Wall Street.

While Kalshi admittedly currently primarily caters to retail investors, as liquidity increases it will inevitably attract institutional clients. Kalshi's markets have the potential to create a transformative externality within global financial markets: providing accurate, real-time pricing for key risks that investors and institutions traditionally face. Kalshi's mission to offer individuals and traders the tools to hedge these risks will only become more crucial as the platform reaches the liquidity necessary to meet the growing demand for precise risk management.

To support this transition, we have built a comprehensive terminal designed to equip traders with the insights and execution power needed to capitalize on this expanding market.

Customer Segments

Professional & Institutional Traders: These market participants require advanced analytics, robust risk management capabilities, and high-performance execution systems. Our terminal equips them with a comprehensive suite of tools to manage large, complex portfolios, providing both the insights and the infrastructure necessary to make informed, strategic decisions. From real-time event data to our automated alpha execution engine, professional traders can operate at scale with unmatched precision.

Retail Investors: Retail traders are increasingly seeking access to sophisticated tools that were once reserved for institutional investors. Our platform bridges this gap by offering intuitive yet powerful solutions for navigating prediction markets. Retail investors gain the same edge as larger firms, with

features like portfolio analytics, fair-value models, and execution strategies designed to maximize returns while managing risk, all through a user-friendly interface.

Macro Investors & View-Driven Strategists: Our platform is designed for macro investors who hold strong, high-level views on economic, political, and market trends, yet often struggle to effectively translate these insights into actionable trades. With our terminal, these investors can seamlessly express their macro perspectives through intuitive tools such as the Market Viewer, real-time event pricing, fair-value models, and, in particular, our execution system. By leveraging our advanced execution engine and customizable risk parameters, macro investors can rapidly deploy and adjust their strategies, ensuring that their market views are efficiently and profitably realized.

Financial Institutions & Brokerages: Financial institutions and brokerages can integrate our specialized tools into their existing infrastructure, enhancing their offerings and enabling more sophisticated risk management. Our platform supports high-throughput, low-latency trading, ensuring these entities can provide their clients with a seamless experience. The robust back-end and scalable solutions make it easy for institutions to incorporate prediction market insights into their broader financial strategies.

3

Competition

The competitive landscape for our platform can be divided into two primary segments: alternative trading terminals and in-house trading platforms built by professionals.

Alternative Trading Platforms

These platforms serve retail and institutional traders, offering a variety of tools for general trading. Key competitors in this segment include:

- Interactive Brokers
- TD Ameritrade
- TradeStation
- Robinhood
- QuantConnect

Interactive Brokers and Robinhood have recently ventured into prediction markets, but their offerings fall short of the comprehensive suite of tools our platform provides. These platforms primarily target retail traders, focusing on mobile-first solutions. However, they do not support algorithmic trading, advanced risk management, or display order book information, all of which are critical for sophisticated market participants. Additionally, they lack the ability to display relevant headlines tied to trades, nor do they feature AI-driven chat assistants for parsing key news in real-time.

We believe these platforms are not direct competitors for our target segment, as they cater to retail investors who typically trade at lower volumes. In contrast, our platform is designed to support high-volume, event-driven trading strategies, targeting professional and institutional traders who require advanced analytics, execution tools, and seamless integration with real-time market data.

In fact, we see these competitors as complementary rather than direct threats. As they drive greater volume and liquidity in prediction markets, they create a more fertile environment for sophisticated market participants, such as our clients, to thrive. Increased market liquidity helps scale operations and improves profitability for traders utilizing our platform's advanced features.

In-House Trading Platforms

Building an in-house trading platform for a proprietary trading firm would be significantly more costly and time-consuming than adopting our solution. The development of such a platform requires a team of highly skilled software engineers and quantitative analysts. With software engineering salaries at top-tier quantitative trading firms now averaging above $250,000 per year for entry-level positions, the cost to develop a comprehensive execution system could easily surpass several million dollars, not including ongoing operational expenses.

The Bloomberg Terminal validates this theory. Despite the high annual cost of $24,000 per user, many firms opt to purchase the Bloomberg Terminal rather than build an in-house solution. The upfront cost, development time, and ongoing maintenance required to develop a comparable system make it a far more efficient choice to purchase a ready-made solution, especially one that offers the full range of functionality we provide.

4

Cost and Revenue

Costs

The costs associated with developing, operating, and scaling our financial terminal for Kalshi can be broken down into the following categories:

1. Development & R&D:

- Ongoing software development, including enhancements to the market viewer, portfolio analytics, and the fair-value engine.
- Research and development of proprietary models, such as the NLP-powered news scraper and automated alpha execution engine.
- Continuous testing, optimization, and integration of new features to ensure the platform remains at the forefront of event-driven trading.

2. Infrastructure:

- Significant investment in secure physical deployments, particularly for institutional clients, to ensure data integrity and low-latency access.
- Maintenance of a stable, distributed system architecture that supports high throughput and fault tolerance, particularly for processing large amounts of market data.
- Cloud-based resources for scalability, ensuring the system can handle increasing user loads and growing trade volumes. This is for our retail market.

3. Operational Costs:

- Ongoing maintenance of the platform, including technical support for users and routine system updates.
- Continuous acquisition of data feeds, with costs related to licensing agreements for real-time market data, historical data, and news content. Along with Kalshi Exchnage data, we would like to show alternative data feeds helpful in evaluting prediciton contracts.
- Operational expenses related to data storage, bandwidth, and ensuring seamless integration with Kalshi's platform.
- **Significant customer support for institutional clients, providing personalized assistance to ensure smooth operations.**

4. Scaling Costs:

- As user base and trading volumes grow, the costs related to scaling infrastructure will increase, including the expansion of server capacity and cloud resources.

- Ensuring system robustness will require additional investments in disaster recovery, load balancing, and redundancy measures.
- Expansion of technical support teams and operational infrastructure to meet the demands of a larger user base and to support the increasing complexity of the system.

5. Physical Terminal Costs:

- For institutional clients, we ship secure physical terminals that enable easy deployment and secure access to the platform. These terminals are estimated to cost approximately $500 each to manufacture.

Revenue Model

We have structured our pricing model to balance accessibility with long-term scalability, ensuring sustainable revenue growth as Kalshi expands.

1. Professional & Institutional Traders

For enterprise clients, we offer a **per-user subscription model at $250 per month**, with plans to increase pricing as adoption grows. We will provide the physical terminal at-cost (anticipated to be $500). As prediction markets grow and our platform evolves we hope to reach pricing levels closer to Bloomberg's **$2,000 per user per month** model while allowing firms to scale their usage dynamically.

This pricing ensures that as professional trading firms onboard more users, our revenue scales accordingly. We hope to leverage this access to professional traders to gain insights in user-desires as we increase our product offerings.

Our proof-of-concept systematic strategy—running with minimal capital, no trader oversight, no fundamental fair model beyond our arbitrage free market fit prices, and only running on a few markets (up to our current limited API limits) —**consistently generated well over $1,000 in monthly PnL**. Professional firms unconstrained by these restrictions will easily be able to cover platform costs while remaining highly profitable.

2. Retail Traders

Retail investors access our platform via a **web-based application**, with the following pricing structure:

- A **$100 monthly subscription fee** for portfolio analytics, fair-value models, and execution tools.
- A **trading fee**, calculated as:

$$\lceil 0.035 \times C \times P \times (1 - P) \rceil$$

  where:

  - P is the price of the contract in dollars.
  - C is the number of contracts traded.

This fee structure is essentially adding on **half of Kalshi's trading fees**, ensuring that retail traders can execute efficiently without excessive costs. These markets are very volatile and most participants anticipate edge well beyond the fees we would be charging.

3. Additional Revenue Streams

Beyond direct subscriptions, we are exploring multiple revenue expansion opportunities:

- **White-Label Solutions**: Custom deployments for hedge funds and brokerages, priced via enterprise contracts with starting setup fees of ($10,000–$50,000).
- **Broker Partnerships & Rebates**: Potential revenue-sharing agreements with Kalshi and other prediction markets if we expand into them.

By diversifying our revenue streams, we ensure our platform remains not only profitable but also an integral part of the event-driven trading ecosystem.

5

Stakeholders

Stakeholders

Our platform serves a diverse set of stakeholders, each benefiting from our unique suite of tools and capabilities in event-driven markets.

Primary Users

- **Proprietary Trading Firms:** These firms rely on high-speed, reliable execution systems and cutting-edge analytics to gain a competitive edge in event-driven markets. Our platform provides them with a fully-integrated solution that offers automated trading execution, real-time market insights, and advanced risk management tools, enabling them to efficiently deploy capital and maximize returns.

  Our platform is also built to be modular for sophisticated investors. We make it very easy for firms to embed their proprietary models with our platform to the degree that they want.

- **Retail Investors:** With a growing interest in prediction markets, retail investors seek sophisticated tools that were once reserved for institutional traders. Our platform provides an intuitive user interface combined with deep market insights and automated trading capabilities, empowering retail traders to participate in and profit from event-driven trading while managing risk effectively.

  There is a middle market currently between retail users who want to make fun bets on their phones and full-fledged trading firms. This market comprises of people trying to trade in a sophisticated manner without the ability to readily develop tooling for their needs. Our platform is perfect for this clientele.

Secondary Stakeholders

- **Financial Institutions:** Banks, hedge funds, and other financial institutions can leverage our platform to enhance their event-driven trading strategies. The platform's scalability, low-latency performance, and comprehensive analytics enable these institutions to deploy advanced trading models and gain greater exposure to emerging markets without needing to develop the infrastructure to handle Kalshi on their own.
- **Market Makers/Brokers:** Market makers and brokers benefit from the rich data and analytics our platform provides, helping them better understand market movements and optimize liquidity provision. By integrating our platform into their operations, they can enhance their market-making strategies and gain a deeper understanding of event-driven price dynamics.
- **Kalshi:** As the underlying market platform, Kalshi benefits from increased liquidity, higher trading volumes, and broader market engagement due to our platform's adoption by both professional and retail traders. Our terminal provides a seamless bridge between Kalshi's event markets and the broader trading community, ensuring smooth operation and expanded market activity.

- **Industry Analysts and Regulators:** Analysts benefit from the platform's in-depth market data, which can be used to monitor trends, identify market anomalies, and gain insights into the evolution of event-driven trading. The increased liquidity that Kalshi will have due to our product lowering the barrier to entry will enable more accurate pricing of key risks that regualtors can use to guide their decisions.

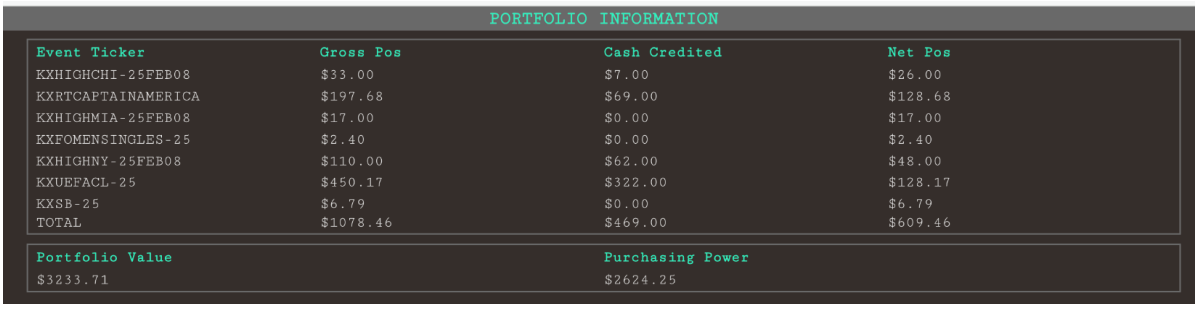
In sum, our platform serves a diverse set of stakeholders, each benefiting from our market-leading tools and infrastructure designed specifically for the growing event-driven market sector.

A

App Development Appendix

The frontend for our application is still in development. Below we have a sample of screenshots of the development in progress:

Figure A.1: A manual trading set up showing our event viewer, trade viewer, fills viewer, orderbook viewer (where the user can place orders), primitive positions viewer, and weather charting

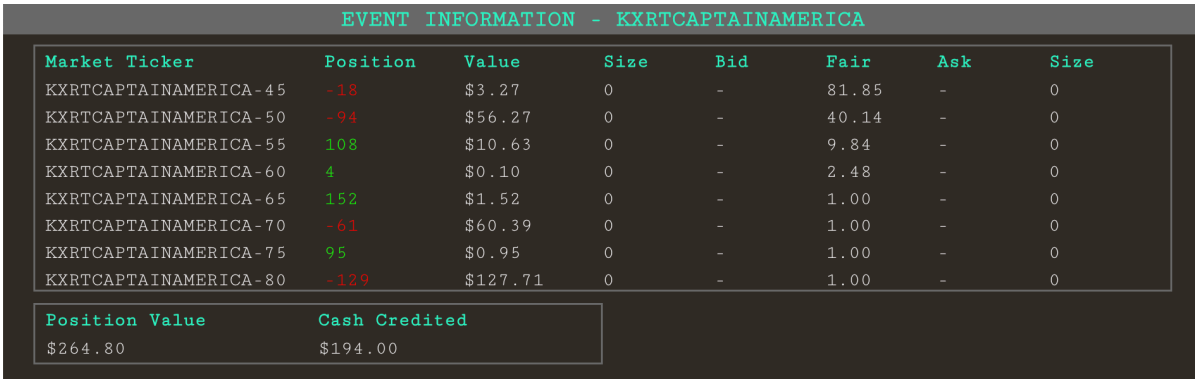


PORTFOLIO INFORMATION

Event Ticker	Gross Pos	Cash Credited	Net Pos
KXHIGHCHI-25FEB08	$33.00	$7.00	$26.00
KXRTCAPTAINAMERICA	$197.68	$69.00	$128.68
KXHIGHMIA-25FEB08	$17.00	$0.00	$17.00
KXFOMENSINGLES-25	$2.40	$0.00	$2.40
KXHIGHNY-25FEB08	$110.00	$62.00	$48.00
KXUEFACL-25	$450.17	$322.00	$128.17
KXSB-25	$6.79	$0.00	$6.79
TOTAL	$1078.46	$469.00	$609.46

Portfolio Value	Purchasing Power
$3233.71	$2624.25

Figure A.2: Our UI view of our portfolio's value



EVENT INFORMATION - KXRTCAPTAINAMERICA

Market Ticker	Position	Value	Size	Bid	Fair	Ask	Size
KXRTCAPTAINAMERICA-45	-18	$3.27	0	-	81.85	-	0
KXRTCAPTAINAMERICA-50	-94	$56.27	0	-	40.14	-	0
KXRTCAPTAINAMERICA-55	108	$10.63	0	-	9.84	-	0
KXRTCAPTAINAMERICA-60	4	$0.10	0	-	2.48	-	0
KXRTCAPTAINAMERICA-65	152	$1.52	0	-	1.00	-	0
KXRTCAPTAINAMERICA-70	-61	$60.39	0	-	1.00	-	0
KXRTCAPTAINAMERICA-75	95	$0.95	0	-	1.00	-	0
KXRTCAPTAINAMERICA-80	-129	$127.71	0	-	1.00	-	0

Position Value	Cash Credited
$264.80	$194.00

Figure A.3: Our portfolio screen for for Captain America's final rotten tomatoes score

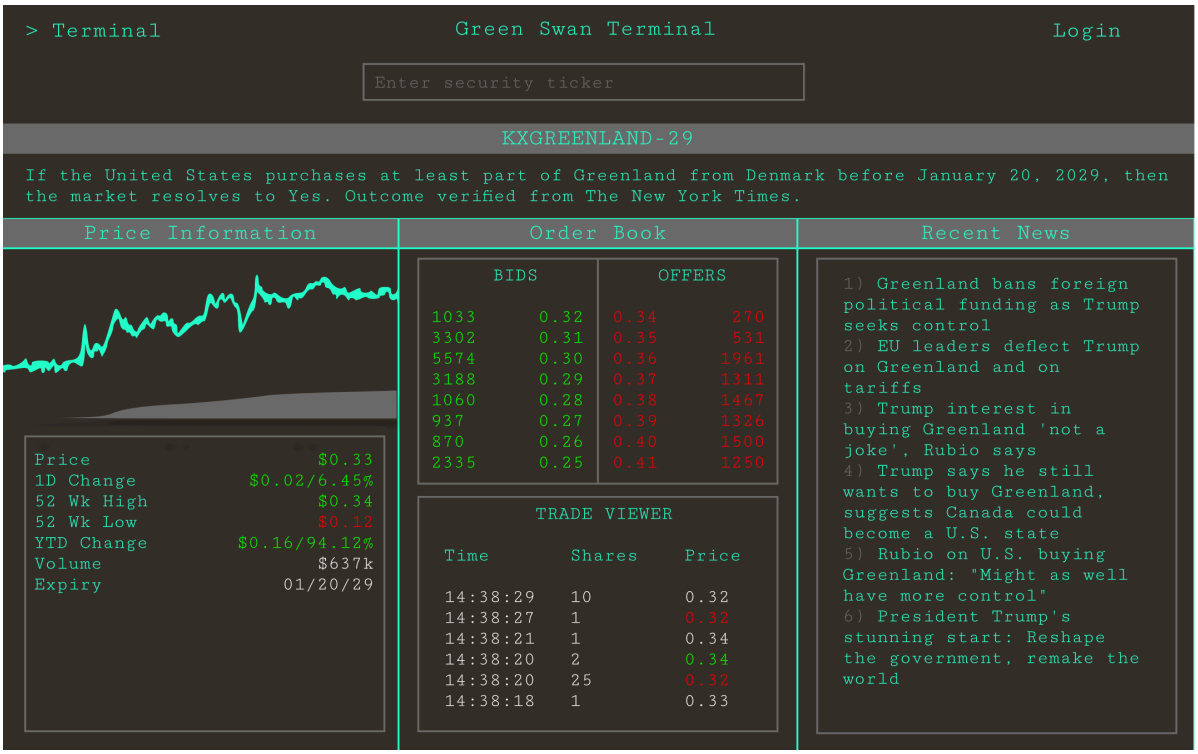


Figure A.4: Our UI screen for viewing the KXGreenland-29 ticker. Note this is a Figma and in development.

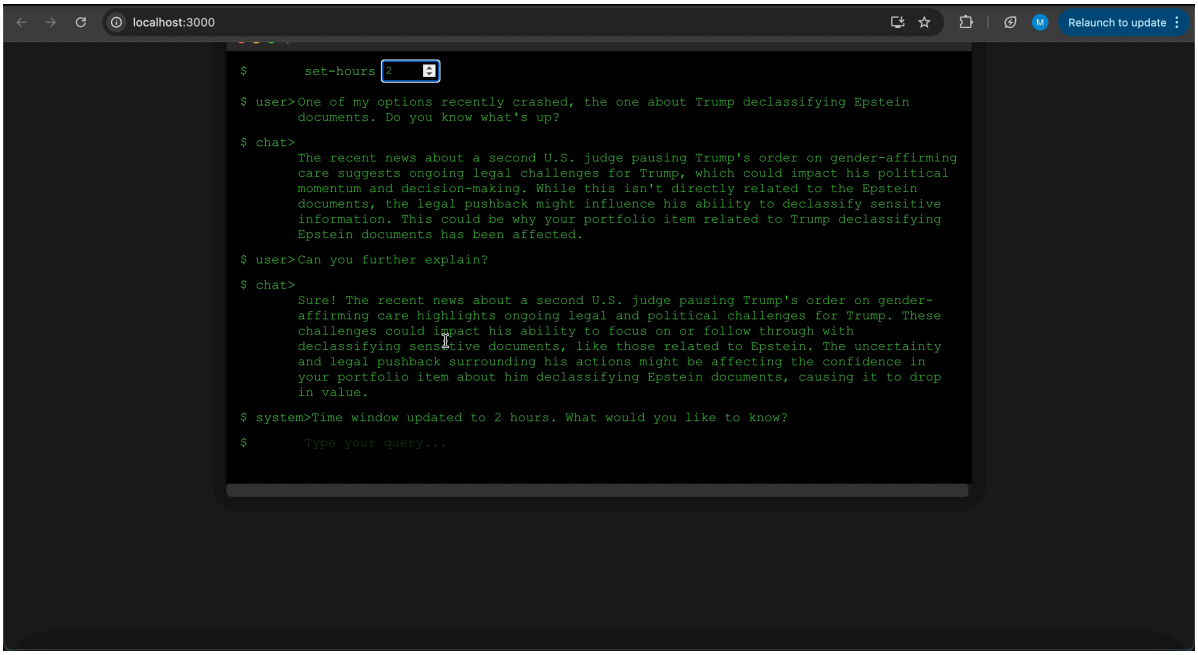


Figure A.5: Our chat page where a user is asking about how recent news affects their portfolio