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<center>Ethical Permissibility of Algorithmic High Frequency Trading</center>

*Section 1*

Algorithmic and high frequency trading involves the rapid, systematic, and automated execution of financial trading, usually of stocks. The moral permissibility of this practice being used in the same markets as traditional human traders is called into question. It is either morally permissible because a human has to write the algorithm and technology, or morally impermissible because the systems do not treat human trading adversaries as self-interested stakeholders. The moral impermissibility of creating algorithmic trading systems is concluded using the Social Contract Theory and showing how high frequency algorithmic traders can not act rationally towards humans in accordance with the theory. The creation of separate markets for types of securities, along with separation of human and automated traders, is shown to be a morally permissible implication of this immorality.

*Section 2*

Access to information is crucial in trading stocks, cryptocurrencies, or any valuable asset with high speed and volume markets. Actors within the market who can most quickly gain insights from unstructured seas of data on securities they are trading leverage favorable positions and can turn a profit from trades, either for personal investment or on behalf of clients' portfolios. Due to the lucrative nature of this field, research and breakthroughs in technology are quickly integrated into the stacks of traders' tools. Development of algorithms to digest this data and execute subsequent trades that will have the most utility automatically has gained popularity for decades, but with the exponential innovations of large language models for semantic understanding of information like financial statements, and high powered computing and data transfer for quicker action, the margin for non-industry standard traders to succeed in investment

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is shrinking. The only actors in markets who submit buy and sell offers fast enough are often algorithms using millions of dollars worth of computation and whose trade requests are submitted with powerful software and hardware. This creates a barrier to entry for people without access to wealths of technological equipment. These systems, however, can not operate without reasoning and development from someone with technical and industry expertise, making profit possible for people with programming and financial knowledge. Is it morally permissible for engineers to implement high frequency automated trading systems to trade securities on the same financial markets as individual personal investors?

*Section 3*

One answer to the question of automated high frequency trading systems' access to the same markets as individual investors is that their trading is morally permissible. Real engineers, quantitative researchers, or other programmers spend time and resources to develop the strongest trading software and most efficient hardware to maximize returns. Claiming that their development and deployment practice is not morally permissible delegitimizes their innovation and ability, while also failing to recognize that other traders can generate algorithms and trading computers of their own with profits rewarded to the most sound research. Alternatively, it can be viewed as morally impermissible to program and implement automated traders. After production, high frequency algorithmic systems are allowed uninterrupted access to financial assets, leading to dangerous indeterminate behavior based on infinitesimally quick decisions, not immune to feedback loops which continuously harm the financial wellbeing of adversaries. The computational components needed for this trading speed are expensive and monopolized by wealthy companies, rendering the idea that all programmers can develop high frequency traders

an illusion. This illusion makes investors who can not quickly process information adversaries of automated traders, experiencing the loss needed to create profit in the zero-sum game of trading.

*Section 4*

Ethical theory leads to the conclusion that it is not morally permissible for algorithmic high frequency traders to be allowed access to the same trading markets as individual personal investors. Their use violates multiple of the Association for Computing Machinery's Codes of Ethics and Professional Conduct. One basic rule violated is ACM Code 2.6, requiring computation professionals to "Perform work only in areas of competence" (ACM, 2018). Many firms who focus on high frequency algorithmic trading, like Akuna Capital, claim that for trading positions "No prior trading knowledge is required...we'll teach you how to leverage our proprietary technology" (2023). Operating in trading without domain expertise allows programmers to develop algorithms under a maxim that does not include all stakeholders of their actions. The lack of competence in trading due to focus on software and hardware optimization detaches programmers from the far-reaching impact of their pursuit for massive profit. The dissociation with the product also collides with the ACM's code 2.6, mandating programmers to "Give comprehensive and thorough evaluations of computer systems and their impacts, including analysis of possible risks" (ACM 2018). High frequency traders act on split-second decisions made after producing enormous amounts of data. Modern engineers have gotten trading speeds down to "one 64 millionth of a second… time it takes for a computer to process an order and send it out to another machine " (Reed, 2021). Conversely, classical research has concluded that in a human being, "recognition reaction", which would be required to analyze data and trade based on it, is on average bounded below at 384 milliseconds for even simple stimuli (Kosinski, 2008). Because automated high-frequency systems will act according specifically to algorithms,

they can make billions of trading decisions by the time a rational human investor can make sense of them. On May 6, 2010, a "flash crash" occurred, in which "the Dow Jones Industrial Average (DJIA) dropped 998.5 points…followed by an astounding 600-point recovery within 20 minutes" (Madhavan, 2012). This accounted for nearly $1 trillion of monetary movement, with many of the catalysts for the intense algorithmic sell-off still "not well understood" (Madhavan, 2012). There is no guarantee that these automated systems will not once again recognize some inciting data and permanently destroy the value of human investors' assets, and the human beings who lost their wealth and well-being would still be unable to assert why they have lost so much or be able to recover, with automated systems and their programmers continuing to profit off of their loss. The Social Contract Theory designates high frequency trading as morally impermissible on these grounds, as the self-interested action of creating personal algorithmic traders does not consider other investors. Russ Shafer-Landau describes this quandary by asserting that "If we are rational, we will agree to curb our self-interest…We'll do this conditionally-that is, on the condition that others do so as well" (Shafer-Landau 2021). A high frequency algorithm can only seek to maximize its own gains with no ability to relent in respect of another trader. The programmers are therefore acting irrationally, and thus, are acting immorally when programming algorithmic traders. They are not "acknowledging that all people are stakeholders in computing" (ACM, 2018), denying the first Code of Ethics, 1.1, from the ACM.

*Section 5*

This only establishes High Frequency Trading algorithms as morally impermissible when they are interacting in the same market as human traders. Because of the difference in decision making speed, automated traders are acting immorally when they trade against a human. Another automated trader, however, can make decisions with equal latency, presenting a case for their use

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in a separate market. Cooper, Davis, and Van Vliet claim that a market is transparent "if trade and quote data is disseminated in real-time so that all traders can make informed decisions" (2016). If separate trading markets for high stakes securities with dense price indicators, like cryptocurrencies, were to be established, and lower stakes securities like bonds could be limited to human buying and selling, equal access is assured to both parties on either end of a trade. This guarantee treats all ends as stakeholders, as the entire market's well-being is considered, focus can be placed on reports of trades to ensure systems are not acting indeterminately, and engineers and traders can focus on areas of their expertise. These markets would satisfy the ACM Code of Ethics, and limiting the securities each actor can trade is a concession that the Social Contract Theory requires moral actors to embrace. Although algorithmic high frequency traders act immorally when they trade against human beings in financial markets, a path to their moral permissibility exists if they limit their competition and security types traded.

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