

Theory of High Frequency Trading Systems Testing

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Computer Based Trading

Electronic Trading is based on computers

Algorithmic Trading (AT) – computer algorithms programmed to meet particular trading desires, slice and dice orders to trade both temporally across the trading day and spatially across markets

High Frequency Trading (HFT) – subset of algorithmic trading using ultra-fast computers and market linkages both to make and take liquidity across and between markets

Algorithmic Trading



* From Bernard L. Madoff Investment Securities LLC

High Frequency Trading

HFT - typically is used to refer to professional traders acting in a proprietary capacity that engage in strategies that generate a large number of trades on a daily basis

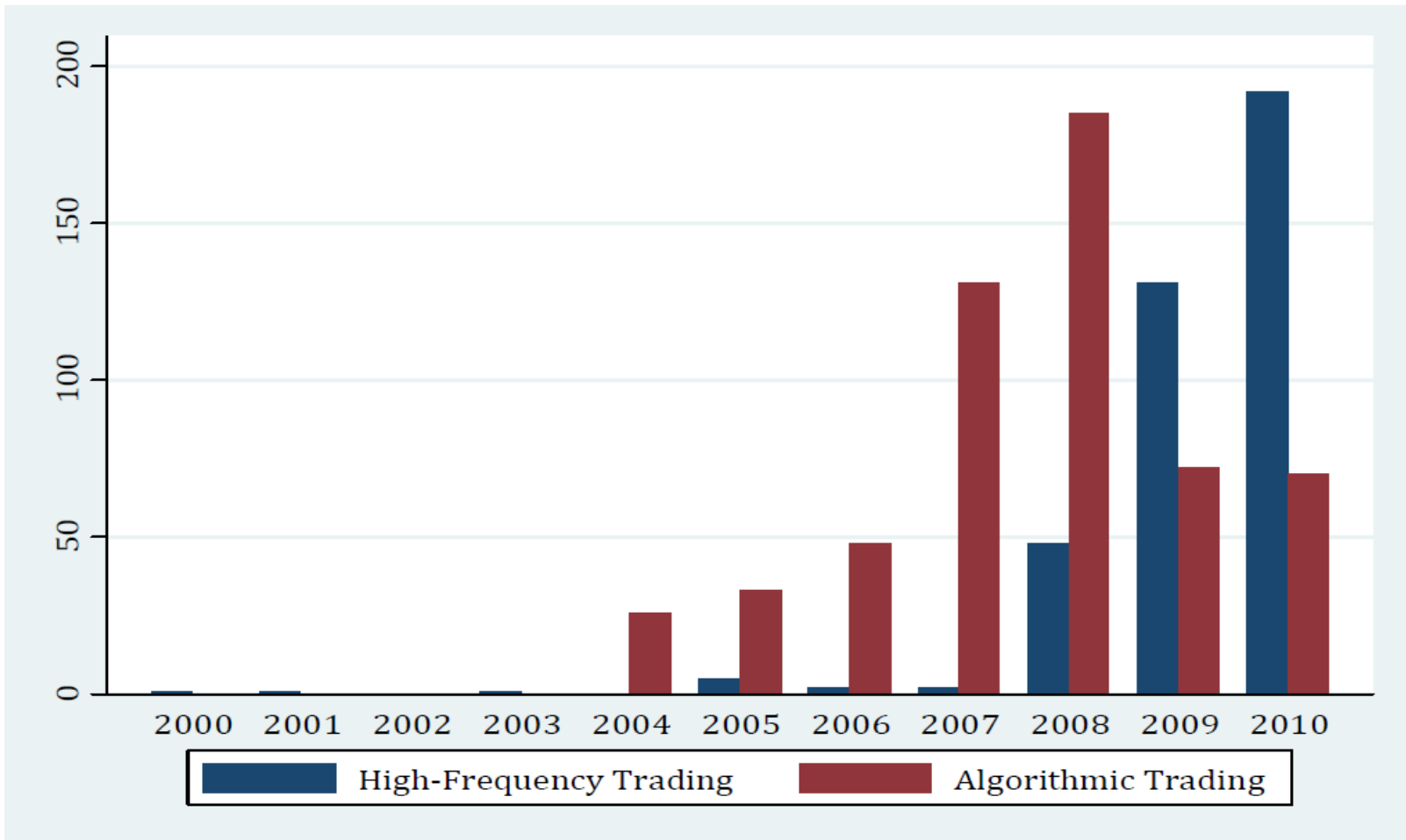
Other characteristics of the HFT firms:

- Use of extraordinarily high-speed and sophisticated computer programs for generating, routing, and executing orders; use of co-location services and individual data feeds offered by exchanges and others to minimize network and other types of latencies;
- Very short timeframes for establishing and liquidating positions;
- The submission of numerous orders that are cancelled shortly after submission;
- Ending the trading day in as close to a flat position as possible.

Estimate of HFT volumes:

Europe	30-50%
USA	60-70%
United Kingdom	77%

Popular Subject



* Number of Search Hits in Financial Times

Multilateral Trading Facility

- ❑ MTF - introduced within MIFID and describes a trading venue that brings together buyers and sellers
- ❑ A core regulatory obligation placed on trading venues, whether Regulated Markets (RMs) or Multilateral Trading Facilities (MTFs) is to maintain a fair and orderly market
- ❑ In today's competitive market trading venues have to satisfy these requirements in extreme HFT conditions

Requirements

Daily Capacity	> 100 M orders
Response Times	< 300 μS
Load Bursts	> 40 K orders / sec

* Turquoise systems outperforms each of these parameters three times

Requirements

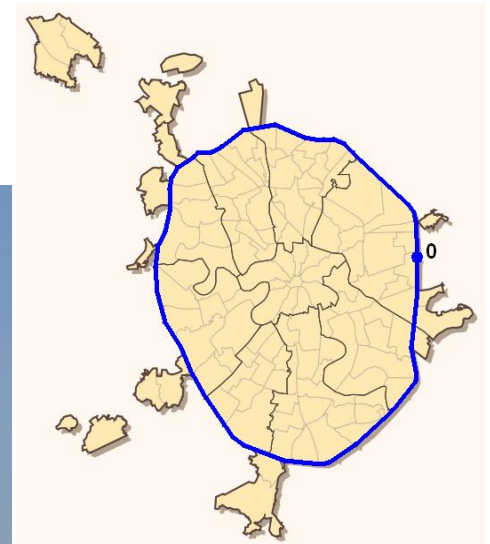
300 microseconds is:

- Time it takes to travel around Moscow at the speed of light
- Time it takes a flying passenger jet to cover the distance of 7.5 cm
- 1,000 times faster than the blink of an eye

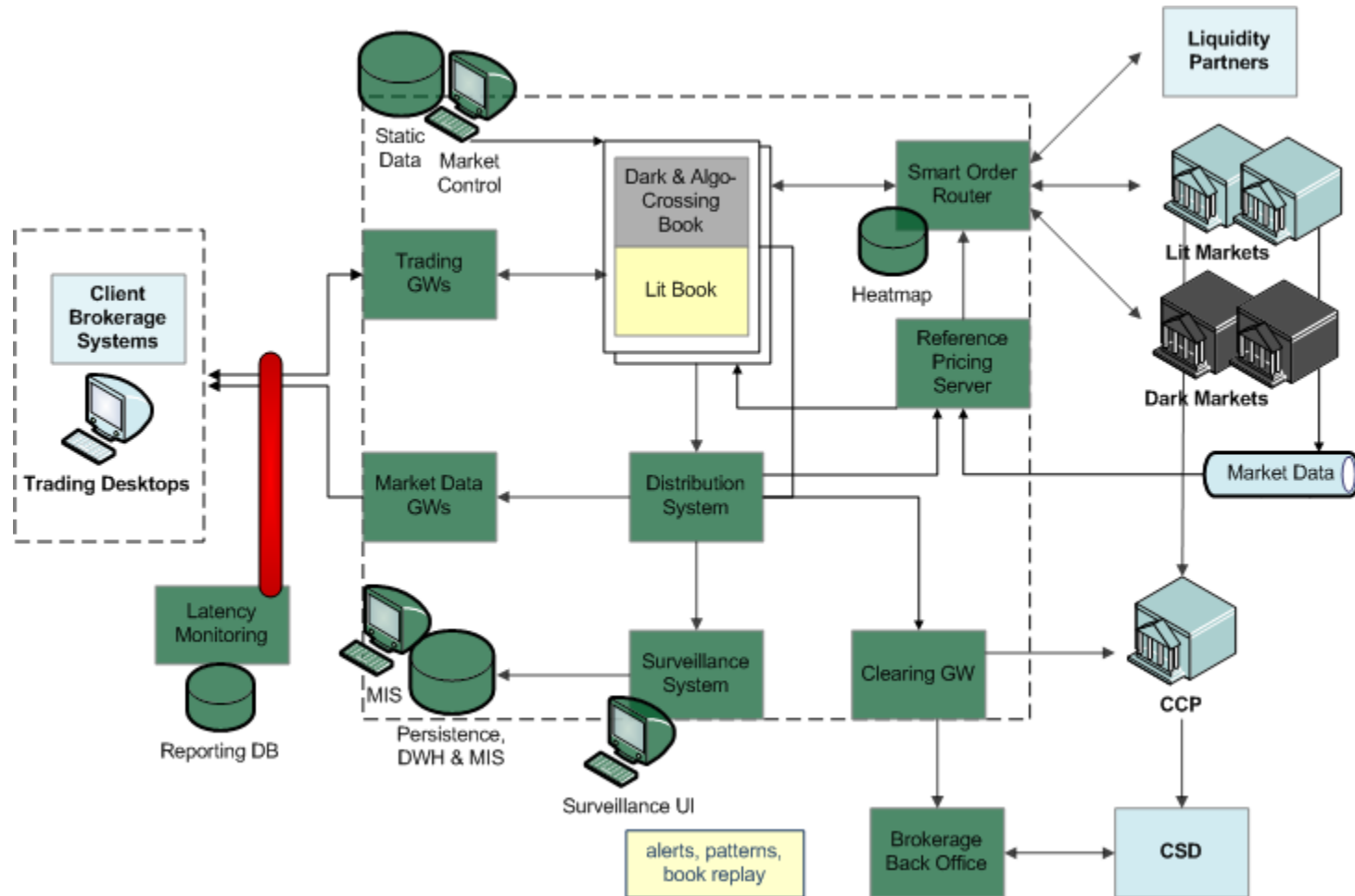
100 M orders is:

- Ten kilometers of paper order tickets

4 K orders add \$1 to oil price within 5 seconds



Trading Venue



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Modeling Approaches

- Simple Design
- Record Replay
- Clever Robots
- Randomization
- Feedback Loop

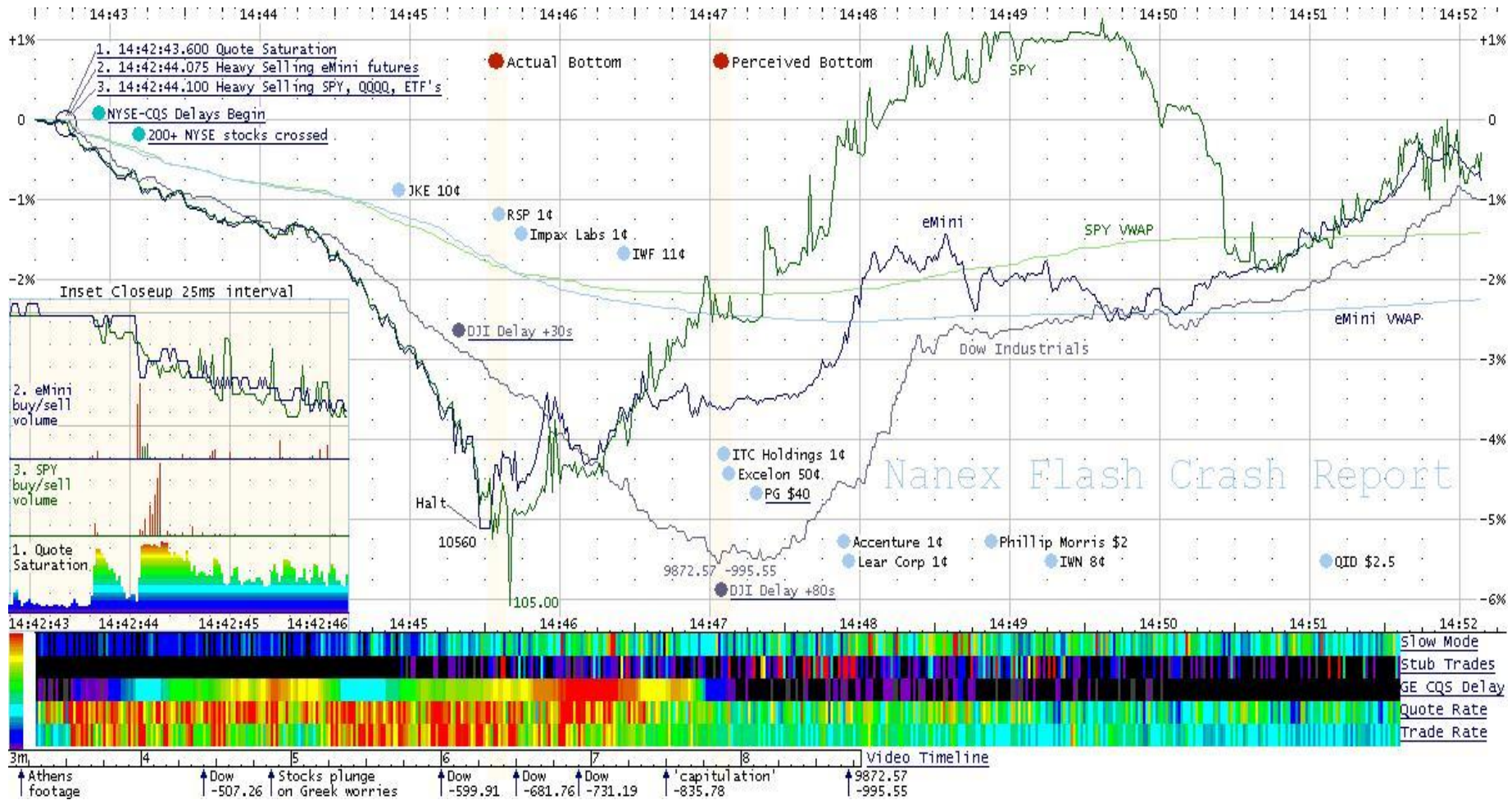
Surveillance Systems

Trading venue should provide efficient surveillance system to pick up and report to authorities:

- Money Laundering
- Market Manipulation
- Violating Fiduciary and Front Running
- Trading Disruptions

Order flow from “Simple Design” data model should result in lots of alerts in surveillance system

Flash Crash



* Nanex Flash Crash Summary Report

Protection Methods

CBT can result in self-enforced feed back loops that turn small events into huge disruptions. Protection methods:

- Price Bands
- Circuit Breakers
- Throttles and Risk Controls

Microsecond discrepancy in input data can result in triggering one of protection methods and driving “Record-Replay” method out of its way

Clever Robots

Implement a set of HFT strategies and run them simultaneously against the trading venue

MTF Commission Level:

- Passive Orders – 0.20 bps
- Aggressive Orders – 0.28 bps

Execution venue receives 0.08 bps (basic point = 0.01 %)

Any simulation method should be cost efficient. Unfortunately clever robots approach is not economically feasible

Robin Hood Tax – 0.05%

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BLOG

19 OCT 11



Randomization

Modification of “Simple Design” method to avoid surveillance system constraints

Tune parameters to avoid triggering protection methods

Not limited to historical data like “Record-Replay”

Feedback Loop

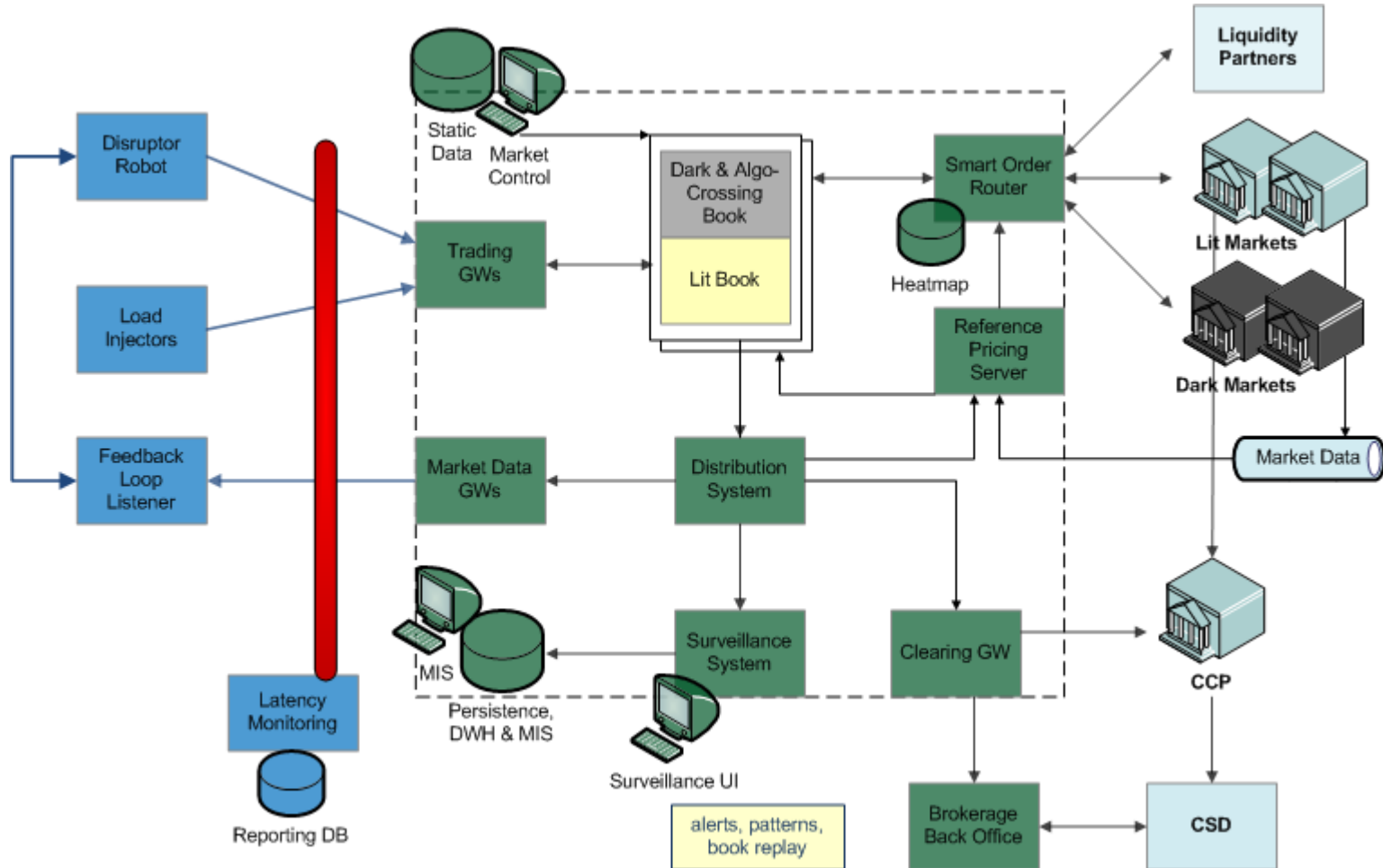
Load injectors work in Randomization mode

Feedback listener receives signals of amplified events and passes them to load injectors to change their mode

Special disruptor robot is able to trigger such events

How do we check that our models are ok?

Test Harness



About Exactpro



Exactpro Systems is a technology consulting company specializing in software development and testing for the financial services industry.

We started in late 2009 and had an 8-people team. We have now grown to 28 people in Moscow and 60 in Kostroma.

We just opened a new office in Obninsk and looking for bright people to join us.

Exactpro offers an enjoyable and fair working environment, training in financial instruments and IT-technologies, business trips to London, Milan and New-York.

Thank You

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Test Automation for Trading Systems

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