Introduction to Algorithmic Trading

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Outline

- Overview of financial markets
- Electronic exchange
- Types of Trading Rationales
- Automated Trading
- DEMO Trading Strategy
- May 6, 2010 ?

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History of Financial Markets

Amsterdam Stock Exchange
17th Century

Source: moaf.org

Chicago Board of Trade
1980's

Source: Wall Street Journal

New York Stock Exchange
21st Century

Source: Yahoo Finance

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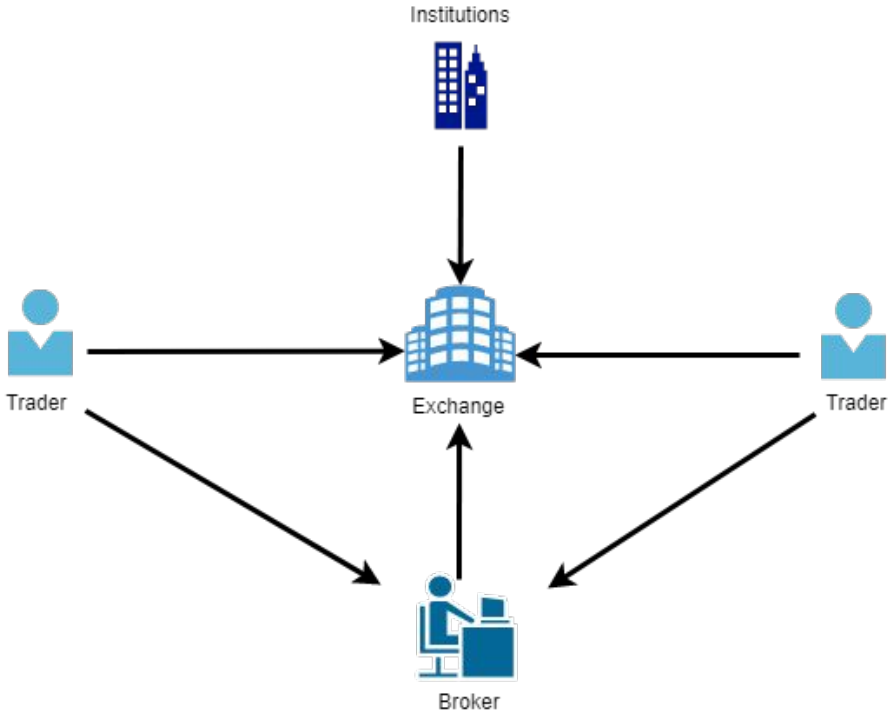
Stock Exchange



- Buyers must find sellers and sellers must find buyers.
- Buy side and sell side
- Brokers
- Market Makers

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Trading Instruments

- Equities: Stocks, Equity Indices, IPOs
- Fixed Income: Fixed Deposit, Bonds, Credit products
- Commodity: Bullion, Crude Oil, Agri Commodity
- Property: Real estate, Mortgage (MBS)
- Derivatives: Futures, Options, Swaps, Forward Contracts
- Currencies: Forex, Crypto
- ETF’s, Mutual Funds

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Market Participants

Buy Side

- Retail Traders/ Investors
- Asset Managers, Hedge Funds, Private Equity
- Proprietary Trading firms

Sell Side

- Investment Banks
- Broker-Dealers
- Insurance companies
- Market Makers

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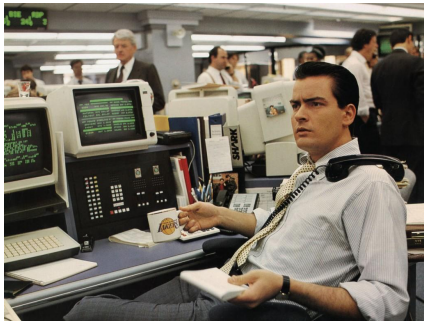
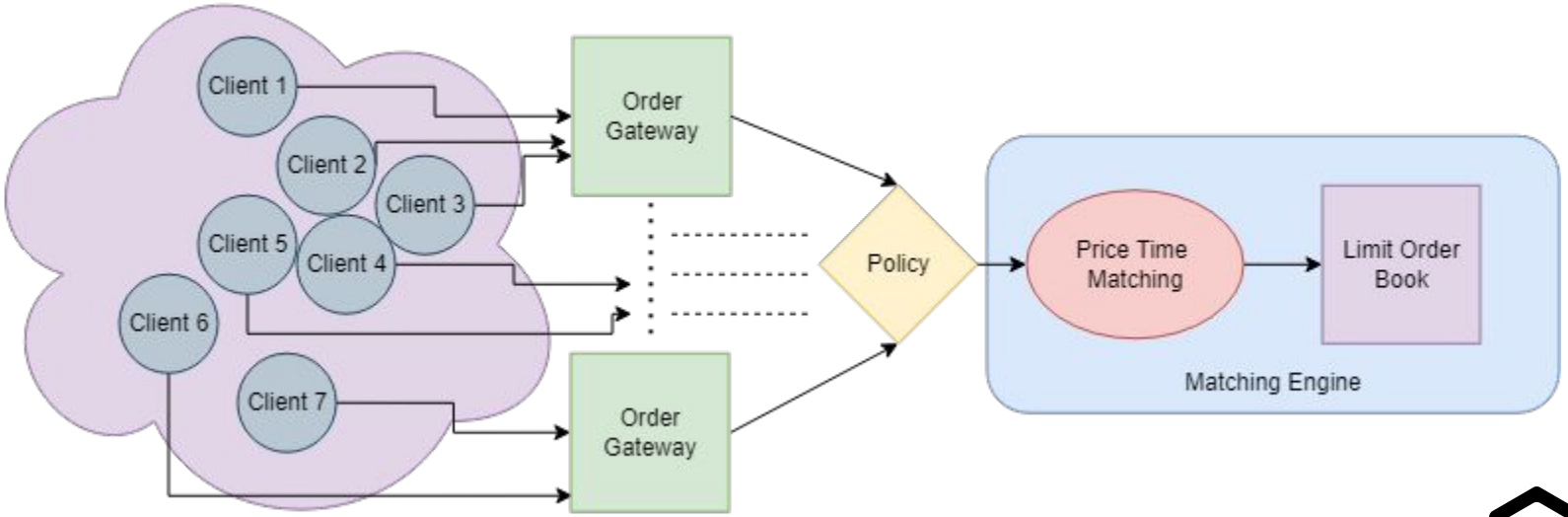
Electronic Exchange

- The first electronic exchange was started on 1971.
- By 1992 electronic trading accounted for 42% of the trading volume in U.S.
- Faster execution
- Decimalization
- API trading



Working of a Electronic Exchange



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Basic Order Types

Market Order

- Gets executed at market price.
- Price is not guaranteed due to slippage and liquidity issues.
- Execution is fast.
- Consume liquidity (taker).
- Larger orders may significantly move the market.

Limit Order

- Execution happens against the ask or bid price.
- Price is certainly guaranteed
- Execution is slow. Partial fill can happen or may not even happen.
- Usually provides liquidity (maker).
- Larger orders can be executed without affecting the market.

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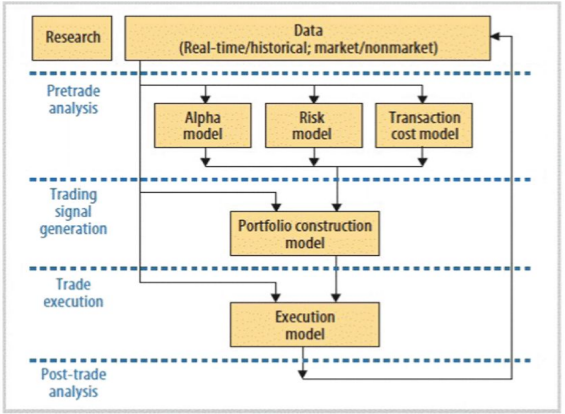
Discretionary vs Systematic

Discretionary

Source: the balance

Systematic



Source: Research Gate

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Systematic Trading

- Systematic Trading involves set of instruction and steps that is executed by an algorithm.
- It can be backtested and risks can be quantified using historical data and quantitative models.
- Avoid human cognitive biases and risk associated with human emotions.
- Complex strategies can be only executed using systematic trading as they are not possible for humans. A good example is HFT strategies.
- Systematic Trading strategies can be fully automated to run without any human intervention.

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Algorithmic Trading

- Development of electronic trading platforms lead to automate execution, which lowered the bar of algorithmic trading.
- Technologies like DMA (Direct Market Access) and FIX (Financial Information eXchange) gave access to real-time information. This also increased the quality and granularity of historical data.
- Lower latency and increased data granularity gave birth to a high speed version of algorithmic trading know as High Frequency Trading or HFT.
- High Frequency Trading involves buying and selling securities in a very small duration of time usually a HFT position lasts for less than a second. And this is repeated multiple times during a normal trading session.
- High Frequency Trading can be only executed using a computer algorithm. Analyzing the markets at nanosecond level and sending multiple orders in a fraction of second is not possible manually.

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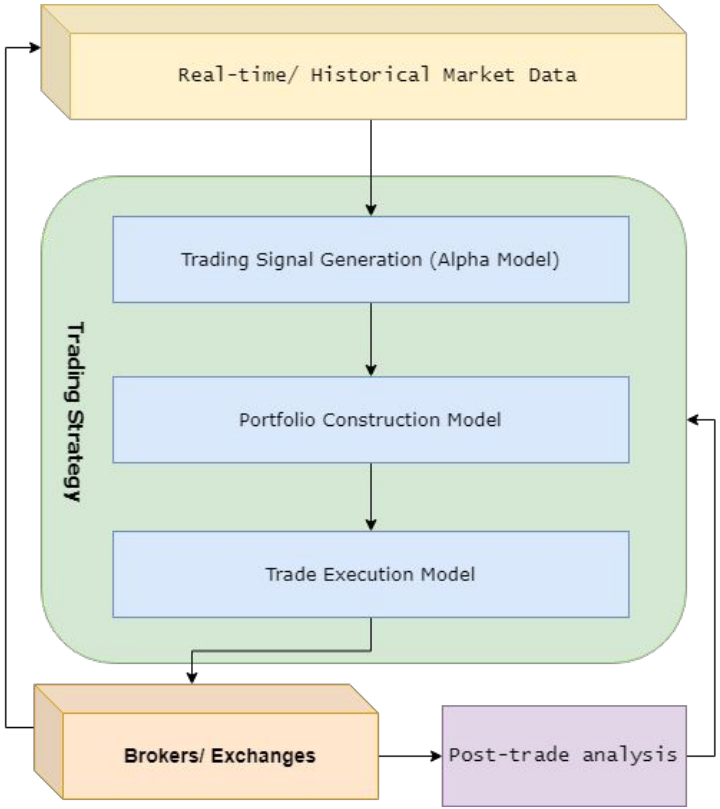
Architecture of a Trading System



- Trading systems depends on data for trade generation from the trading strategy.
- The alpha model generates a the trading signals which are combined using a portfolio construction model for optimal risk profile.
- The orders of trades are sent to brokers/exchange by the trade execution model for optimal execution.
- Order fill data is analysed by during post-trade analysis.

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Classification of Trading Strategies

Momentum

- Time series
- Cross-sectional

Source: auquan

Mean-reversion

- Statistical Arbitrage
- Time series
- Pairs-trading

Market making

Source: River financials

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Risks with Automated Trading

- **Extreme market events**: Trading systems are designed for particular market regime and condition, during extreme market conditions the algorithm may not be able to take decisions and lead to adverse effects.

- **Lack of Transparency**: Automated trading system can get very complex and turns into a black box.

- **Bug in the algorithm**: With increasing complexity the chances of having bugs in the system increases and in turn increases the chance of catastrophe.
  https://www.bbc.com/news/magazine-19214294
  https://www.henricodolfing.com/2019/06/project-failure-case-study-knight-capital.html

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Time-series Momentum

Notebook Link : https://bit.ly/3vLUHJo

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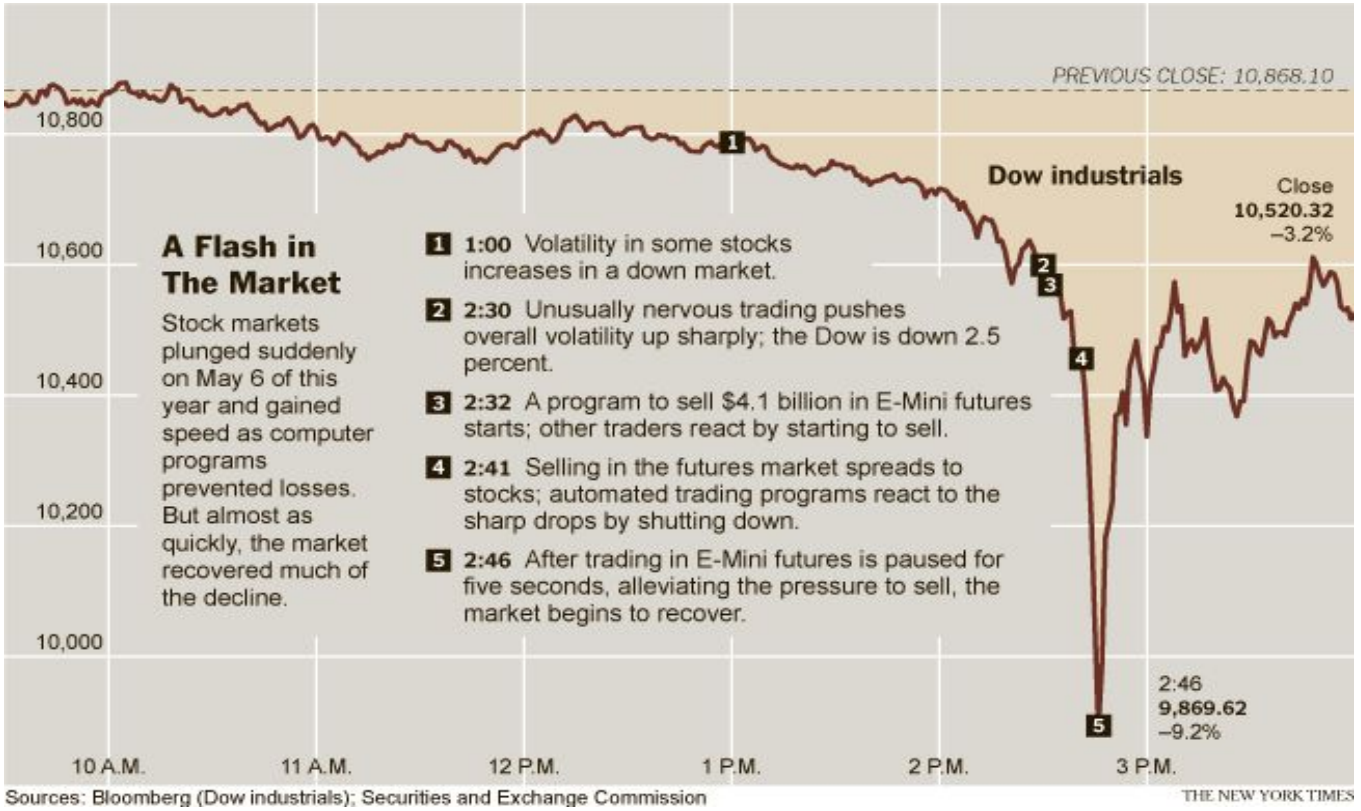
Flash Crash of 2010



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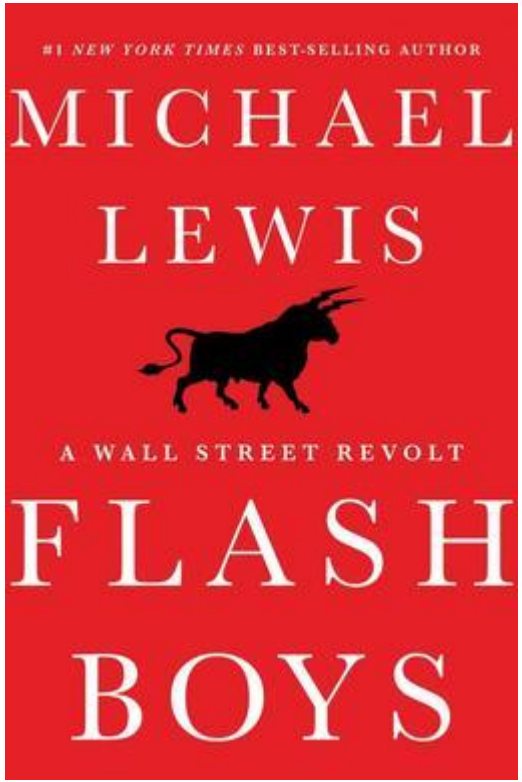
More into Flash Crash



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