## Module 5 - Algorithmic Trading

## Trading Strategies

- Execution algorithms
  - VWAP (Volume Weighted Average Price) Pre-trade schedule based on historical volumes.
  - TWAP (Time Weighted Average Price) Executes desired quantity at a constant rate.
  - PVOL (Percentage Of Volume) Targets a user-defined participation rate.
- Proprietary trading
  - Arbitrages
  - Technical indicators, trend following, mean reversion, breakout, range, momentum
  - Spreads trading
  - Fundamentals analysis
  - Systematic trading
- Portfolio management
  - Robo-Advisors
- Risk management
  - o Auto-hedgers
- Market-making strategies

## Algorithmic Trading

Algorithmic trading uses computer algorithms to automatically determine parameters of orders such as

- whether to initiate the orders,
- the timing of orders,
- the price of orders,
- management of the orders after submission,
- with limited or no human intervention

The definition does not include any system used only for order routing to trading venues, processing orders where no determination of any trading parameters is involved, confirming orders or post-trade processing of transactions.

## High Frequency Trading (HFT)

High frequency trading is a subset of algorithmic trading that executes large numbers of transactions in seconds or fractions of a second by using:

- Technology and infrastructure to minimise latencies such as co-location, high speed connectivity, compute-optimized servers and hardwares
- System determination of positions taking and risk management without human intervention
- High market data processing rates
- High order submissions and cancellations rates

## Risk of Algorithmic Trading

Algorithmic trading carries financial risks to its owner, as well as poses risk to stability of financial system:

- Technical issues (disconnection, server breakdown, power-cut)
- Errant algorithms a.k.a programming "bugs"
- Market risks unexpected events, price fluctuations, and volatility
- Model risks software and design flaws
- Market impact and amplification of systematic risk
- The flash crash, Knight Trading "Knightmare"

#### Preventive measures:

- Risk controls
- Circuit breakers
- Kill switches
- Pre-trade risk controls
- Speed bumps
- Active monitoring tools and alerting mechanisms

## Algorithmic Trading Skills

**Trading Skills** 

management, execution

Understanding market, research and develop profitable trade ideas, risk

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#### **Programming Skills**

Automate trading strategies, backtesting and validation of trading model, high frequency trading, real-time trading and risk management

#### **Modeling Skills**

Quantitative analysis, develop mathematical model of trading, turn ideas into analytics and signals, parameterization, market prediction

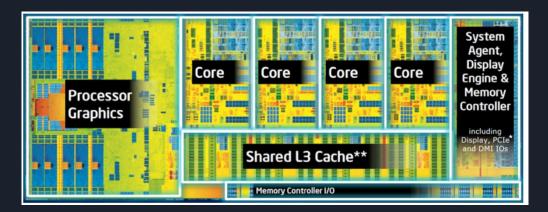
## What is concurrency?



Bobby Fischer playing 50 opponents simultaneously, 1964. He won 47 of the matches, drew 2, and lost 1.

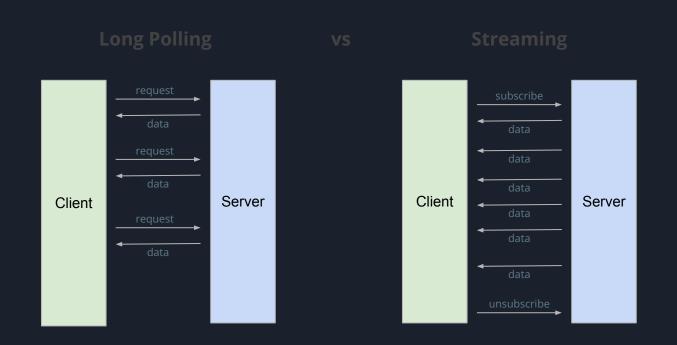
## CPU Cores and Multithreading

A core is a physical component of the CPU that can execute instructions, while a thread is a virtual sequence of instructions that can be executed by a core. Multithreading is a technique that is designed to improve performance by allowing a single architecture core to perform multiple tasks.

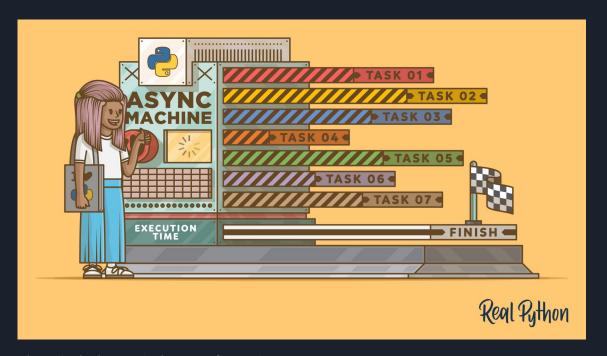


https://www.intel.com/content/dam/www/public/us/en/documents/white-papers/ia-introduction-basics-paper.pdf

## Polling vs Event-driven Processing



## Asynchronous Programming



https://realpython.com/python-async-features/

## Classroom exercises: week\_05

- Synchronous call
- Multi-threading
- Asynchronous programming
  - Coroutines
  - Await
  - Tasks
  - Event loop
- Websocket programming