

# Systematic Trade Execution Engine

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See important disclosures at the end of this presentation.

## | Outline

1. Trade Execution
2. Execution Algorithms
3. Trading System Overview
4. Backtesting
5. Executing Slippage Sensitive Trades

## | Trade Execution

- Definition (simplified): The trade execution problem is buying or selling a specific quantity of securities in a specific time period.
- Example 1: Buy 1000 Microsoft shares between 9:30 am EST (market open) and 4:00 pm EST (market close).
- Example 2: Sell 50,000 Ford shares in the next 30 min.
- Example 3: Buy \$100,000 worth of Microsoft and sell \$100,000 worth of Apple in the next 2 hours.

Components of a trade execution:



# | Trade Execution (cont'd)

- Example 1: Buy 1000 Microsoft shares between 9:30 am EST and 4:00 pm EST.

## Microsoft Corporation (MSFT) [Add to watchlist](#)

NasdaqGS - NasdaqGS Real Time Price. Currency in USD

**105.64** +0.82 (+0.78%)

As of 10:27AM EST. Market open.



For illustrative purposes only

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## | Execution Algorithms

- Market and Limit orders
- TWAP
- VWAP
- TWAP + Predictive Models

# | Execution Algorithms - Market orders

Send a market order just after the markets open.

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# | Execution Algorithms - Limit orders

Send a limit order just after the markets open.

Note that the limit order would have been costly had the markets gone up instead.

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# | Execution Algorithms - TWAP

Divide the 1000 sized order into 100 sized orders and execute each 100 sized order every 39 mins.

(6.5 hours / 10 = 39 mins)

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**Trades**

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# | Execution Algorithms - VWAP

Divide the 1000 sized order into 100 sized orders and execute each 100 sized order at intervals divided using volume profile.



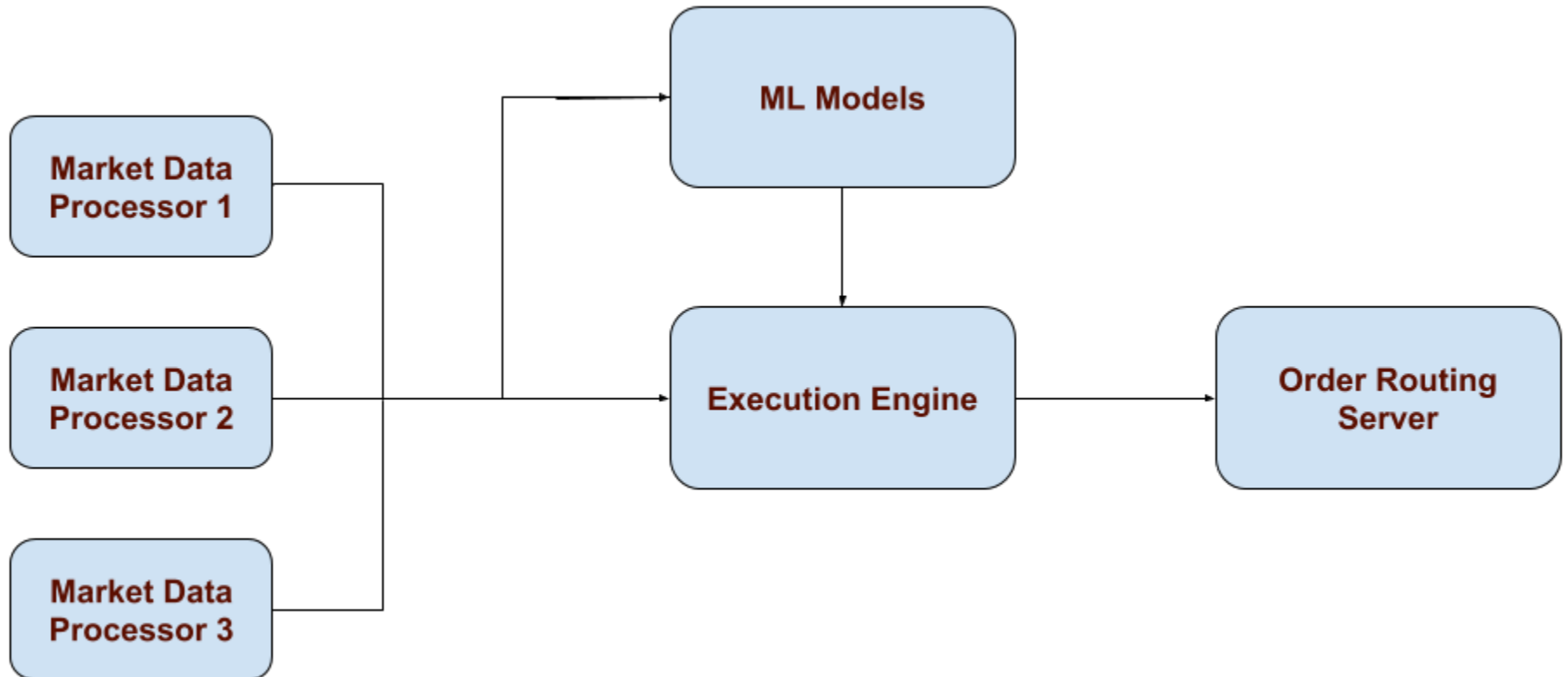
## | Execution Algorithms - TWAP + Predictive Models

- Divide the 1000 sized order into 100 sized orders and execute each 100 sized order every 39 mins. (6.5 hours / 10 = 39 mins)
- Within each 39 min interval, use a predictive model to send or withhold an order. Based on the signal, you may want to modify or cancel an existing order as well.
- Order should be executed at the end of each 39 min interval.
- Examples of predictive models: Generalized Linear models, Neural Networks.

Components:

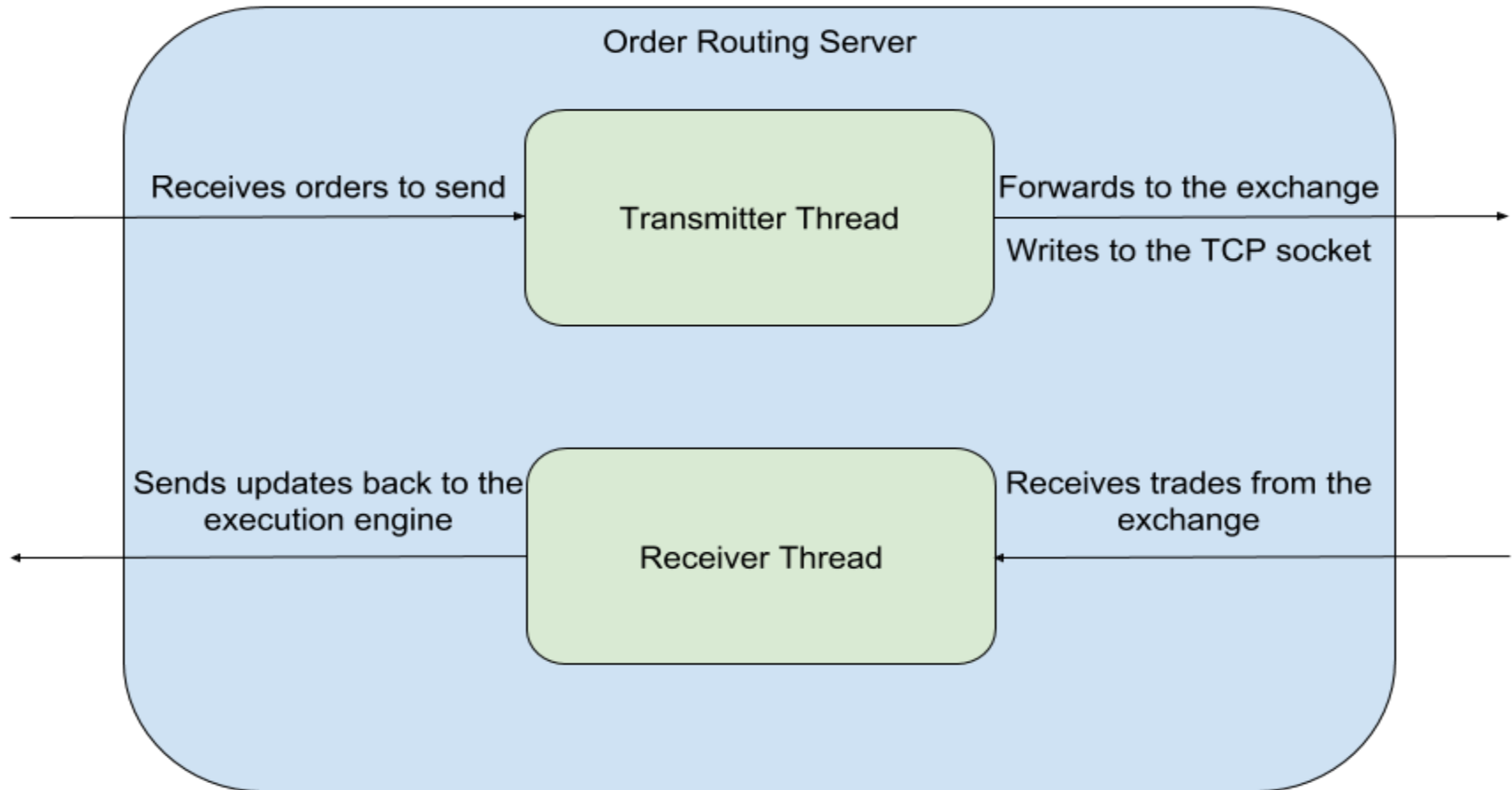
- **Market Data Processor**: Processes the market data events from a specific source. Constructs the market data update and pushes to a queue.
- **ML Models**: This component takes in the market data, computes the required features and generates signals for each security we are interested in.
- **Execution Engine**: This component takes in the market data (bid/ask prices), ML signal and current orders and position to decide whether to send an order now.
- **Order Routing Server**: Manages the connection with the exchanges as well as the active orders.

Note: You can choose to have these components as separate processes or have them all in a single process or a combination of the two approaches.

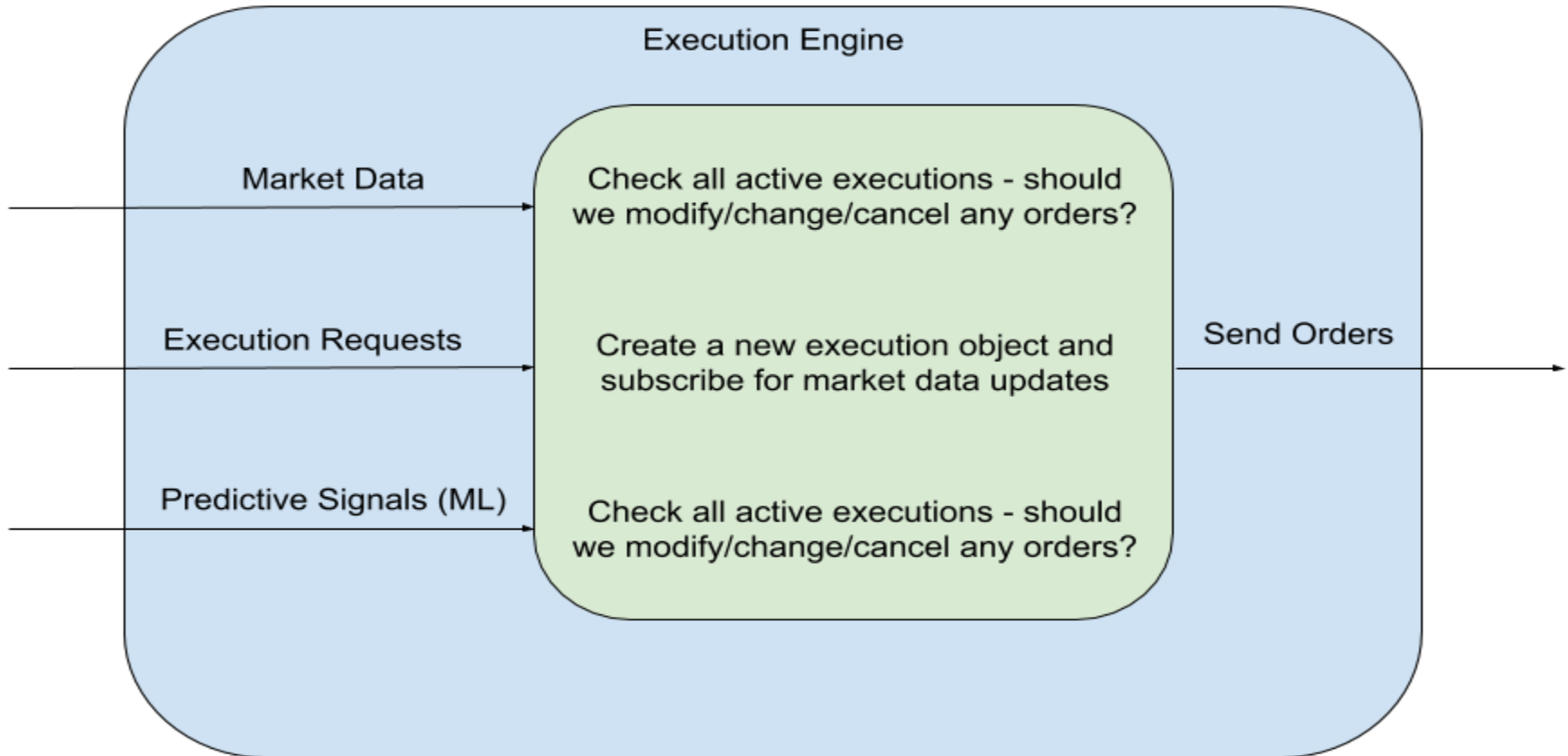


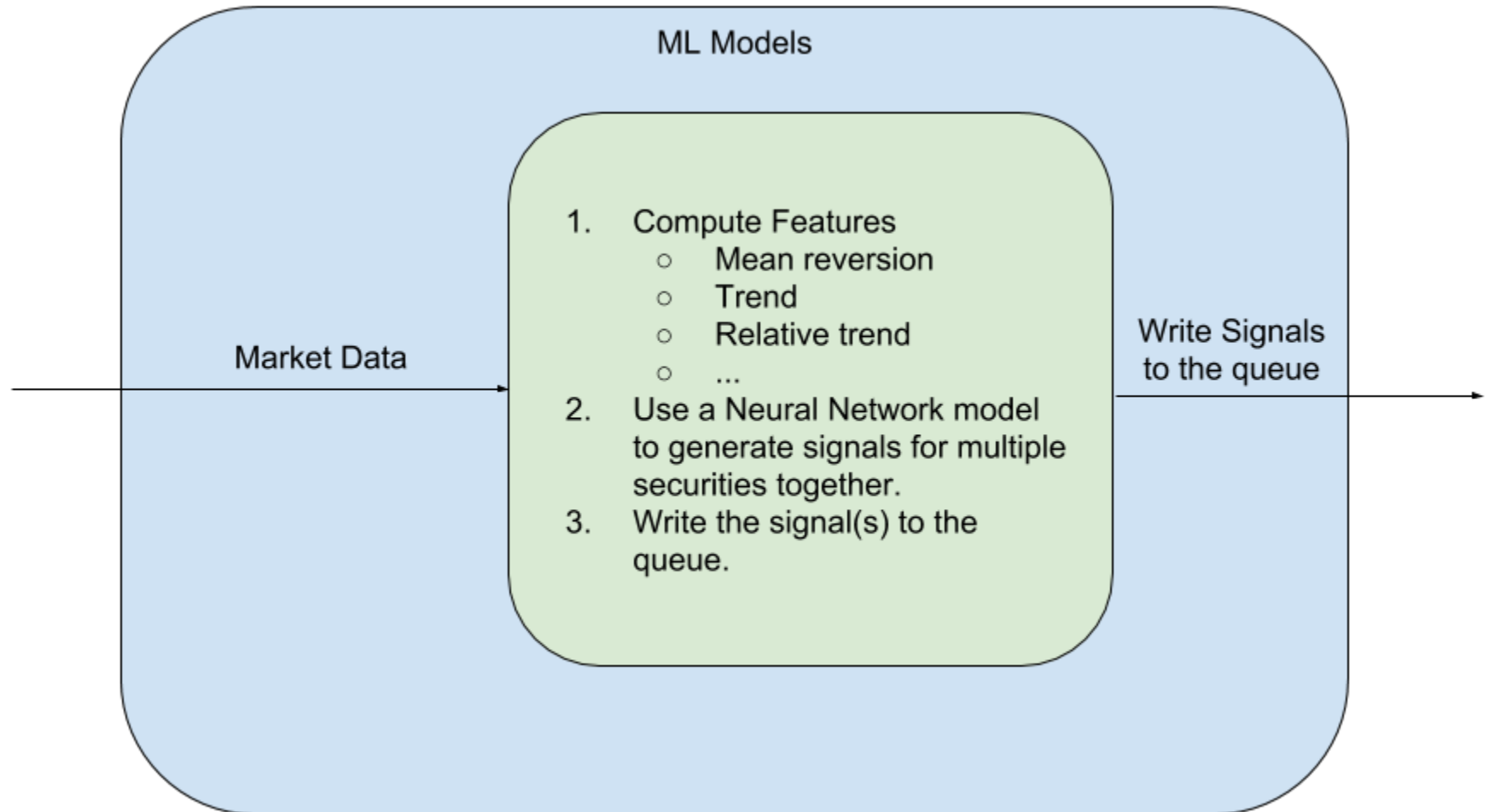
# | Trading System Overview - Order Routing Server

2 threads: Transmitter thread and Receiver thread



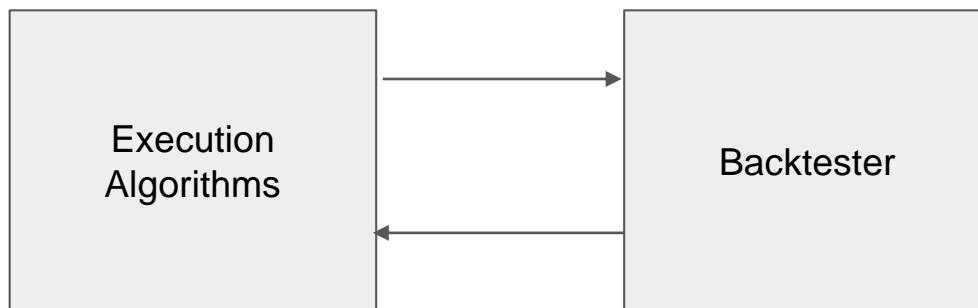
Event driven architecture





## | Backtesting

- Why do we need to backtest?
- Backtesting is a way to imitate the market. Backtester is a proxy for the exchange.
- Most backtesters have inherent limitations under which they can be reliable - because backtester cannot reliably predict the impact of our own orders and trades.
- Event-based backtesting would be more reliable in most cases:
  - a. Helps avoid look-ahead bias.
  - b. Enables re-use of the execution algorithm components, since we don't have to write the execution algorithm code for backtesting separately.





## | Executing Slippage Sensitive Trades

Some important questions to consider:

- How should we execute illiquid securities?
- What the penalty of crossing the bid-ask spread is very high (e.g. in future contracts)?
- What if the order size is very large, say 5% of average daily volume?
- Should we employ a different tactic for securities that do not move throughout the day (e.g. SHV)?  
What about the securities that move a lot?
- What if the portfolio has certain execution assumptions? How should we handle them?

## Questions?

[contact@qplum.co](mailto:contact@qplum.co)

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