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High Frequency Parallel Crypto Asset Valuation

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Background

- Application
  - High Frequency Trading
  - Large Volume and low latency
  - Sustained throughput is key
  - Time-constrained

- Project Scope
  - Parsing market data
  - Valuation model to price assets
  - Aggregating data to produce internal view of market

Valuation Model Complexity

- Weighted Midpoint
- Volume Weighted Average Price
- Depth Volume Weighted Average Price

$$\text{Valuation} = \frac{\text{bidSize} * \text{askPrice} + \text{askSize} * \text{bidPrice}}{\text{bidSize} * \text{askSize}}$$

$$\text{VWAP} = \frac{\sum Price * Volume}{\sum Volume}$$

As a mid price take the mid between the average buy price and average sell price measured over various different volumes

E.g. Suppose the state of the market is
Bid Size | Bid | Offer | Offer Size
1 | 10 | 11 | 3
4 | 9 | 12 | 3

So if I were to buy:
1: total cost is 11
2: total cost is 11
3: total cost is 11
4: total cost is 11.25
5: total cost is 11.40
Mean over all volumes: 11.13

And if I were to sell:
1: total cost is 10
2: total cost is 9.5
3: total cost is 9.333
4: total cost is 9.25
5: total cost is 9.2
Mean over all volumes: 9.457

And the mid of these is: 10.2935
Compared with the weighted mid using only first depth: 10.25

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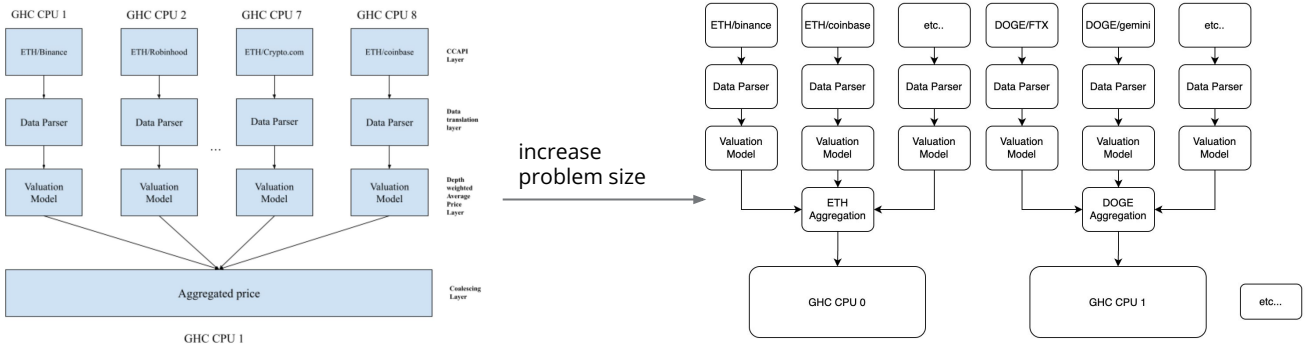
Approach

- Technologies Used
  - 2.4 GHz 8-Core Intel Core i9
  - CCAPI library
  - Pthreads Library
  - CPP pub/sub library

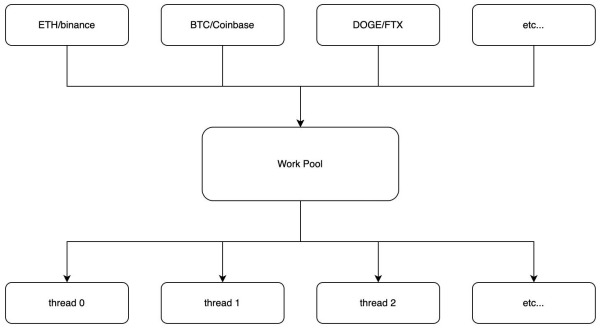
- Serial Algorithm
- Workload mapping

Workload Mapping

- Static



- Dynamic



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Scaling Problem Size

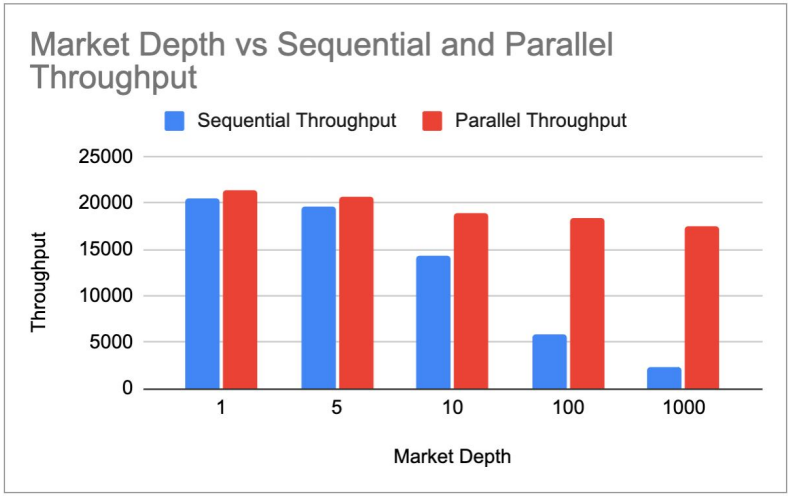
- Valuation Model Complexity
  - Increase the depth of market data utilized
- Raw problem size (exchange/asset pairs)
  - 25 exchange/asset pairs -> 480 exchange/asset pairs

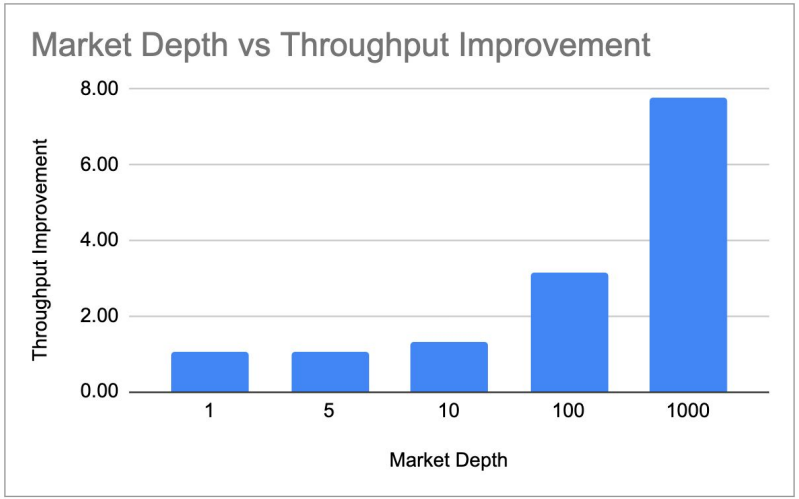
Results

- Overview
  - Metrics
  - Sustained throughout(sequential vs. parallel)
  - Computational Cost of Valuation Model
  - Market Depth vs. Throughput
  - Market Depth vs. Valuation Model Computation Cost
  - CPU utilizations

Results Continued

- Sustained throughout(sequential vs. parallel)





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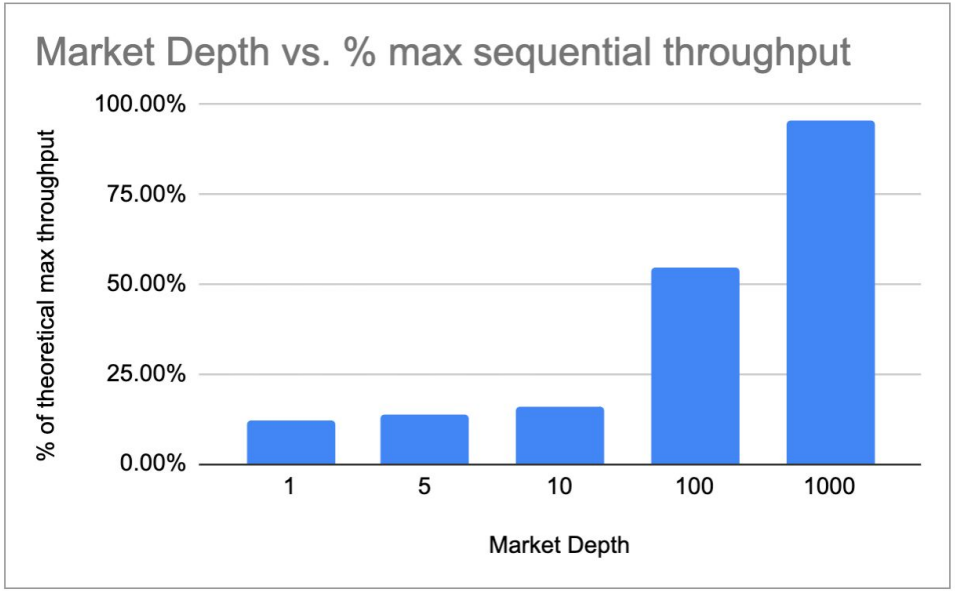
Results Continued

- Market Depth vs. Theoretical Max Throughput



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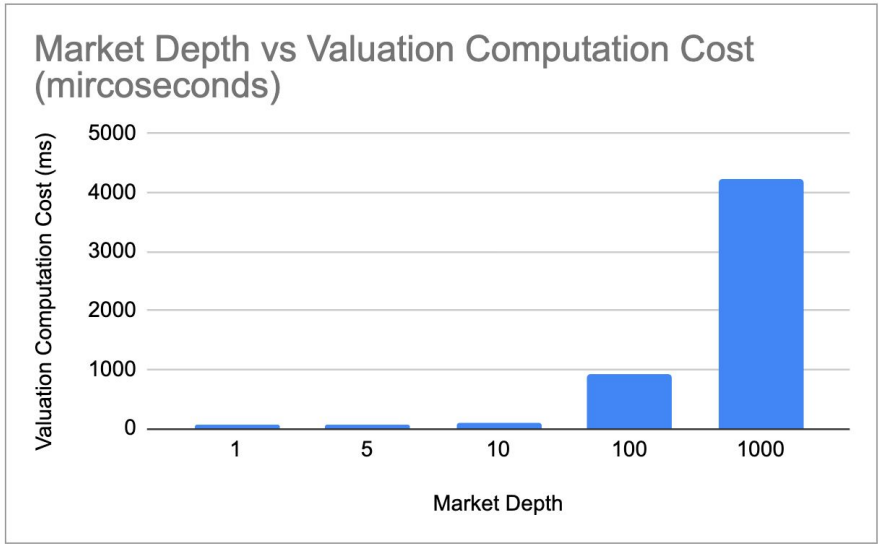
Results Continued

- Market Depth vs. Valuation Model Computation Cost



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Results Continued

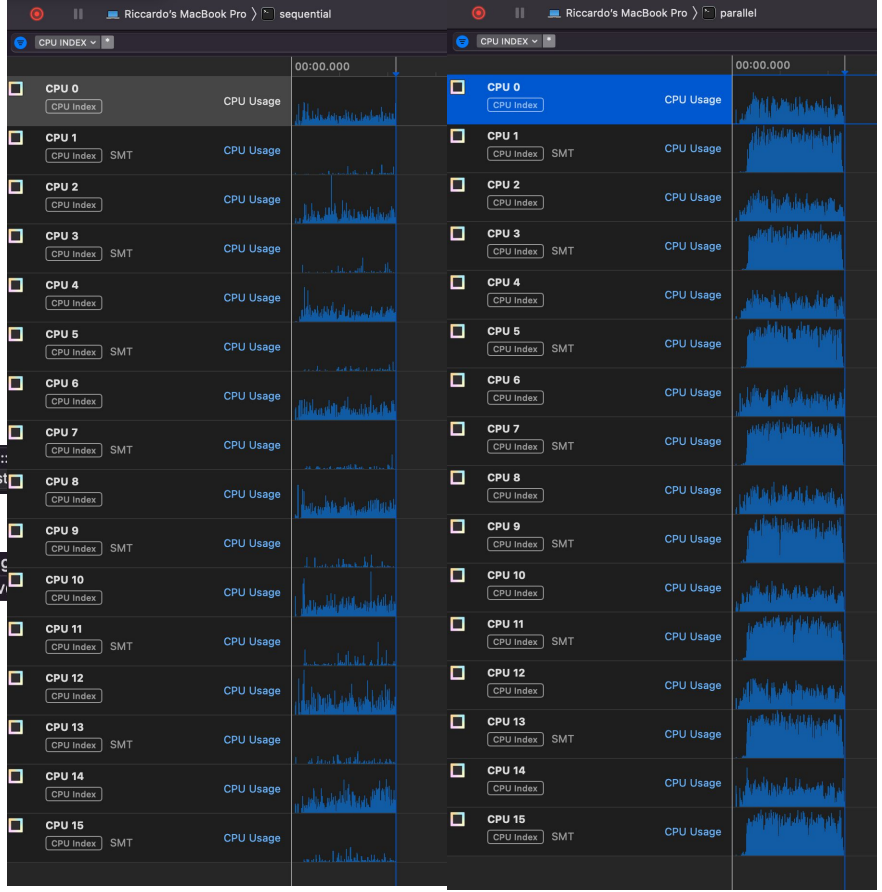
- Breakdown of algorithm
- CPU Utilization

Market Depth = 100

29.40 Gc	22.8%	303.36 Mc	> MarketDataParser::parse(ccapi::Message const&, std::
2.29 Gc	1.7%	5.36 Mc	> ValuationEngine::priceAsset(std::__1::vector<Order, st

Market Depth = 1000

55.04 Gc	28.7%	574.61 Mc	> MarketDataParser::parse(ccapi::Messag
18.31 Gc	9.5%	-	> ValuationEngine::priceAsset(std::__1::v



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References

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