HPC has transformed financial services

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Scalable FPGA systems accelerate High-Frequency-Trading (HFT)

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Parallel algorithms help speedup the financial models and algorithms

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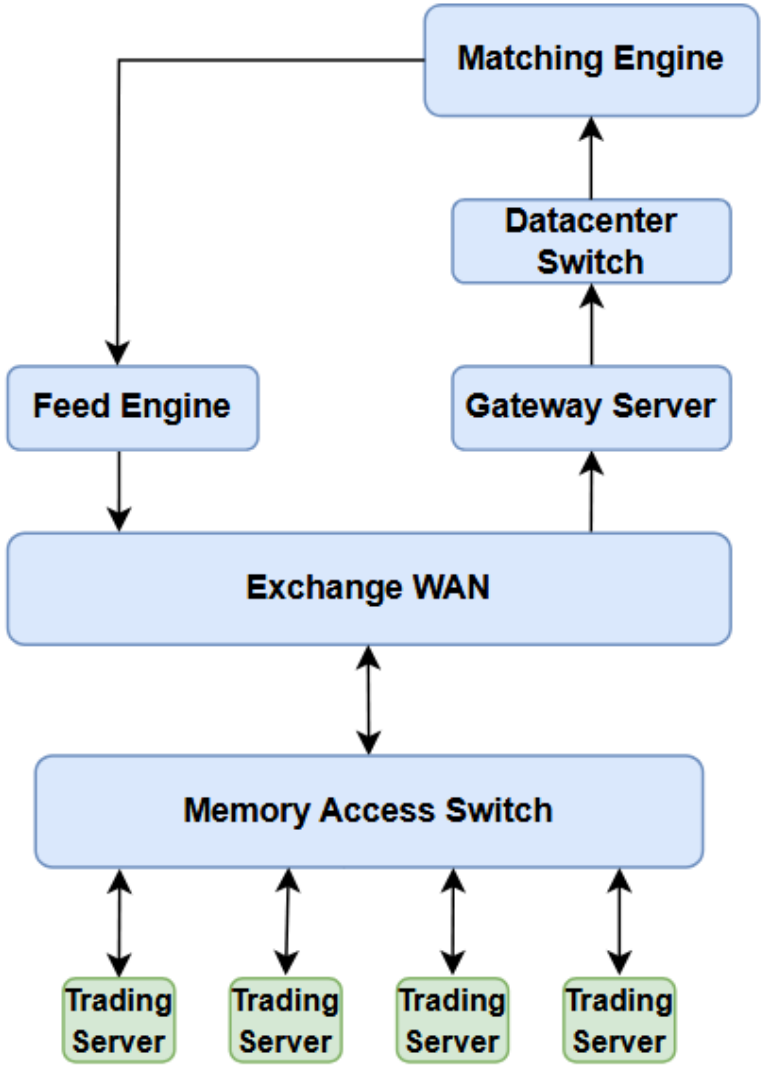
Hardware

🧠 What is High-Frequency Trading (HFT)?

- A trading strategy that executes thousands to millions of orders in fractions of a second
- Relies on ultra-low-latency data processing and decision making
- Success is determined by **speed** – microseconds can make or break a trade
- Used for arbitrage, market making, and short-term opportunities

Hardware



How FPGA Accelerates HFT ?

- **Bypasses OS latency**: Uses UDP offloading to process packets directly in hardware
- **Real-time protocol decoding**: Supports FAST message parsing with pipelined microcode architecture
- **Parallel data paths**: Simultaneous decoding of multiple market data streams
- **Low and deterministic latency**: Ideal for sub-microsecond trading decisions
- **Custom hardware logic**: Tailored for specific trading strategies and faster execution

C. Leber, B. Geib, and H. Litz, "High frequency trading acceleration using fpgas," in 201121st International Conference on Field Programmable Logic and Applications, pp. 317–322, 2011

Software

🚀 How HPC Software works in Modern Financial Systems

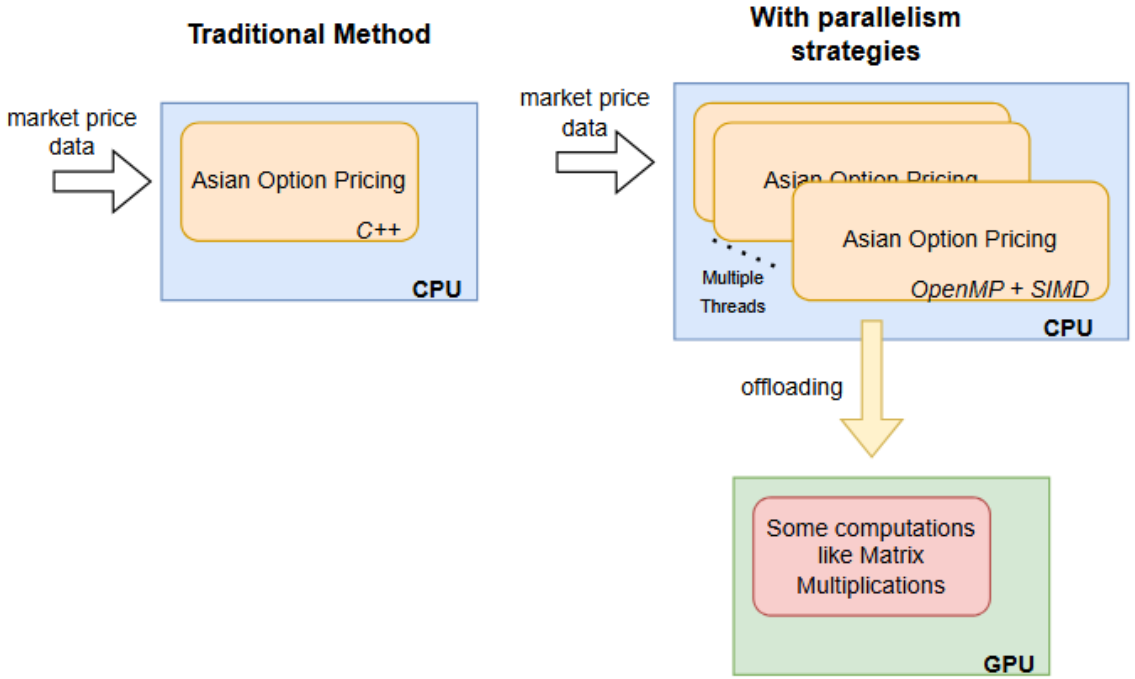
- Financial models are becoming more **complex** and **data-intensive**
- Real-time pricing and risk assessment require **high-speed computation**
- Modern hardware (CPUs, GPUs) demands software that can fully utilize **parallelism**
- HPC frameworks help improve **performance**, **scalability**, and **responsiveness**

Software

🧩 Exploiting Parallelism in Financial Workloads

- Financial applications like **option pricing** and **market simulation** are inherently parallel

- Techniques:
  - **SIMD vectorization** (data-level parallelism)
  - **OpenMP** for thread-level CPU parallelism
  - **CUDA** for GPU acceleration

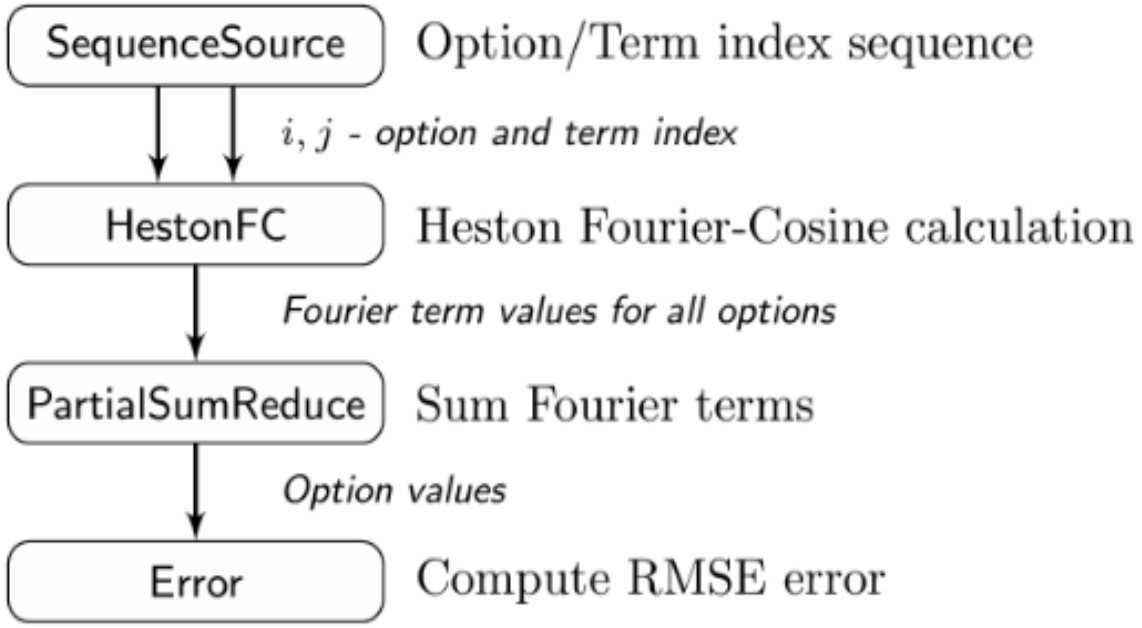


S. Li and J. Lin, "Many-core programming with asian option pricing," in 2014 SeventhWorkshop on High Performance Computational Finance, pp. 45–52, 2014.

Software

🧪 HPC Framework for Heston Model

- Calibration of stochastic models (e.g., **Heston model**) is **computationally expensive**
- **Xcelerit** framework for parallel execution with high-level C++ code
- Modular pipeline design supports efficient computation:
  - Input generation → HestonFC → Aggregation → Error evaluation
- Supports **GPU/CPU** backend without low-level coding



M. Dixon, J. Lotze, and M. Zubair, "A portable and fast stochastic volatility modelcalibration using multi and many-core processors," in 2014 Seventh Workshop on HighPerformance Computational Finance, pp. 23–28, 2014.

Future HPC&Finance

🔍 Future Directions

- Many existing studies apply HPC to finance, but exploration is still limited.
- Leverage the full power of supercomputer to operate large-scale simulations (e.g., stress testing, what-if analysis).
- Hardware accelerators (GPUs, FPGAs) are underutilized for: Real-time risk management during live trading.

Q & A

Thanks for listening !