**CUDA GPUs: Fast & Energy-Efficient Financial Computations**

**CPUs** (Graphics Processing Units) are standard graphic cards (PCIx16 bus) with many cores.
- ideal for parallel tasks like Monte Carlo
- up to 100 times faster than conventional processors (CPUs) by the same (or less) power consumption.

**CUDA** is a C-like programming language for NVIDIA's GPUs (Tesla, GeForce, etc).

**Iterative Portfolio Optimization**

1. choose any [admissible] initial portfolio
2. modify fractions of the risky assets
3. IF new portfolio has better yield GOTO 2
   ELSE step back to the previous portfolio
4. stop when the best portfolio is reached

2.6*10^6 Monte Carlo Paths per iteration for each stock

Totally: 10^14 computation steps done OVERNIGHT

**Stylized fact:**
- 7 stocks
- 10000 trades
- 300 iterations

Only 2 KWh consumed!!!

**Nested Stoch. Analysis**

A hot topic for Solvency II but, in principle, relevant for the risk management of any portfolio of derivatives that are priced by the Monte Carlo Simulation.

1) simulate scenarios on [0, t] under the real-world measure
2) for each scenario simulate (a lot of) paths on [t, T] under the martingale measure

**Swing options with local, global and "middle" constraints**

**Specification of a one REAL contract:**
- daily quantity: min 0 MWh, max 1000 MWh
- monthly quant.: min 11000 MWh, max 24000 MWh
- yearly quant.: min 245000 MWh, max 288000 MWh

- with only one global constraint (either monthly or yearly) would be just a standard problem (of bang-bang type).
- with both monthly and yearly constraints rather challenging, probably not bang-bang type!

**Approach:**

1) with daily and monthly constraints only:
   \[ Q_{\text{min}} = n \cdot q_{\text{min}}, \quad Q_{\text{max}} = k \cdot q_{\text{max}} \Rightarrow \text{bang-bang} \]
2) find all admissible combinations of monthly swings w.r.t. the annual constraints, e.g. maximum monthly swings (i.e. 24) in Jan-Oct. and minimum monthly swings (i.e. 11) in Nov. & Dec. gives 262000 MWh, thus it is an admissible combination. Price all such combinations via LS Monte Carlo and choose that with the maximum value. Intuitive and straightforward but very computationally intensive => CUDA

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