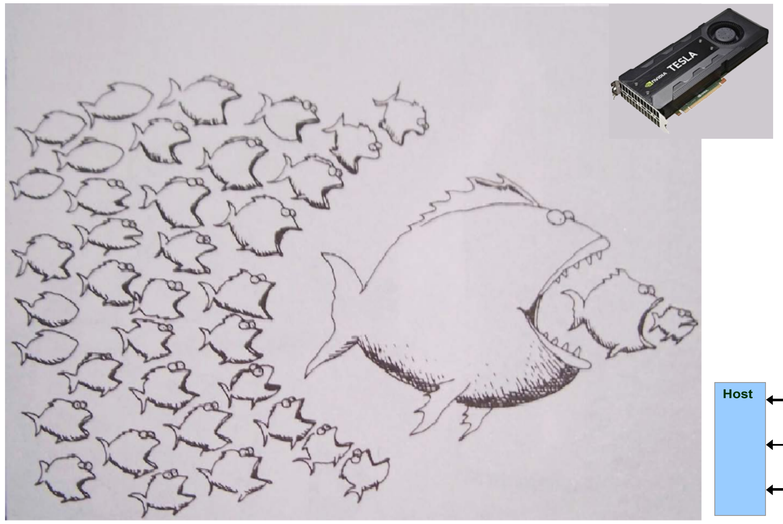
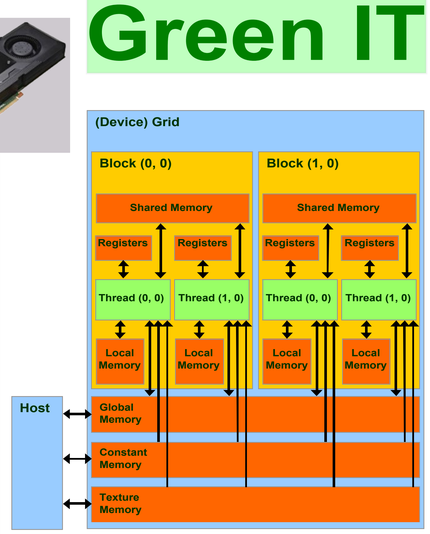
CUDA GPUs: Fast & Energy-Efficient Financial Computations

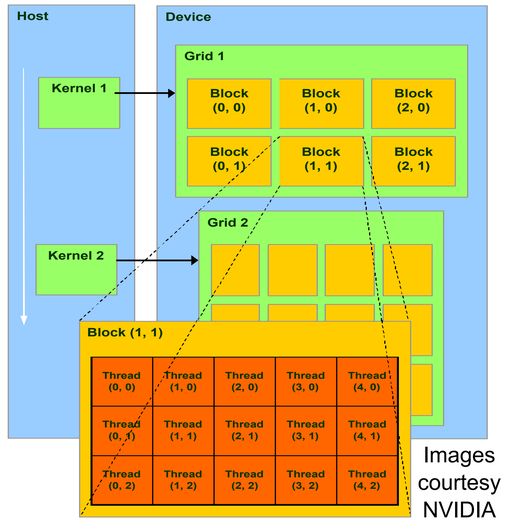
CPUs (Graphics Processing Units) are standard graphic cards (PCIx16 bus) with many cores.
- ideal for *parallel tasks* like *Monte Carlo*
- up to 100 times faster than conventional processors (CPUs) by the same (or less) power consumption.

CUDA is a C-like programming language for NVIDIAs GPUs (Tesla, GeForce, etc).



Green IT





Images courtesy NVIDIA

Iterative Portfolio Optimization

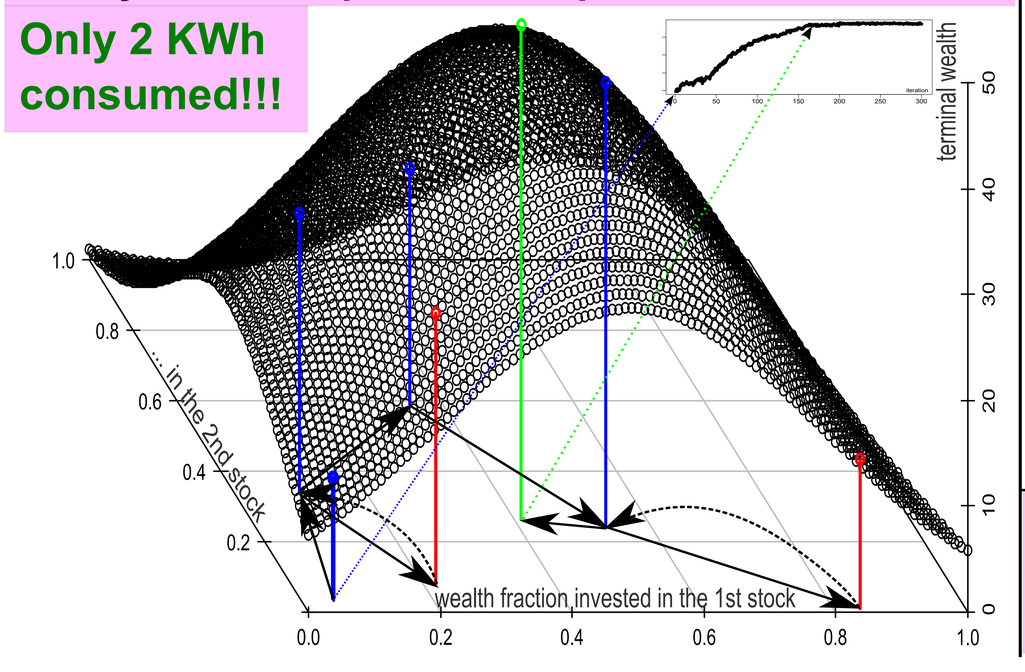
1) choose any [admissible] initial portfolio
2) modify fractions of the risky assets
3) IF new portfolio has better yield GOTO 2
   ELSE step back to the previous portfolio
4) stop when the best portfolio is reached

Stylized fact:
7 stocks
10000 trades
300 iterations

$2.6*10^6$ Monte Carlo Paths per iteration foreach stock

Totally: 10^{14} computation steps done OVERNIGHT

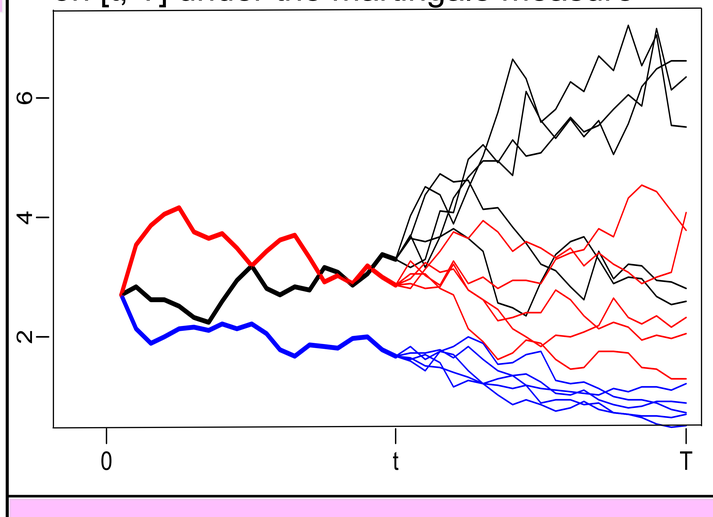
Only 2 KWh consumed!!!



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:
   $Q_{min} = n*q_{min}$, $Q_{max} = k * q_{max}$ => bang-bang
2) find **all** admissible combinations of monthly swings w.r.t. the annual constrains, 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

Vasily Nekrasov. **E-mail**: finanzmaster@gmx.net **Mobile**: +4917634981371 **Skype**: mscfinance **Web**: www.yetanotherquant.de