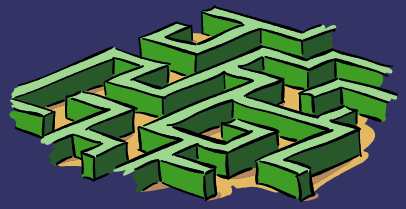
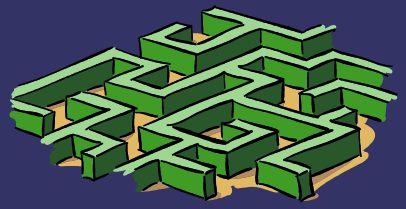


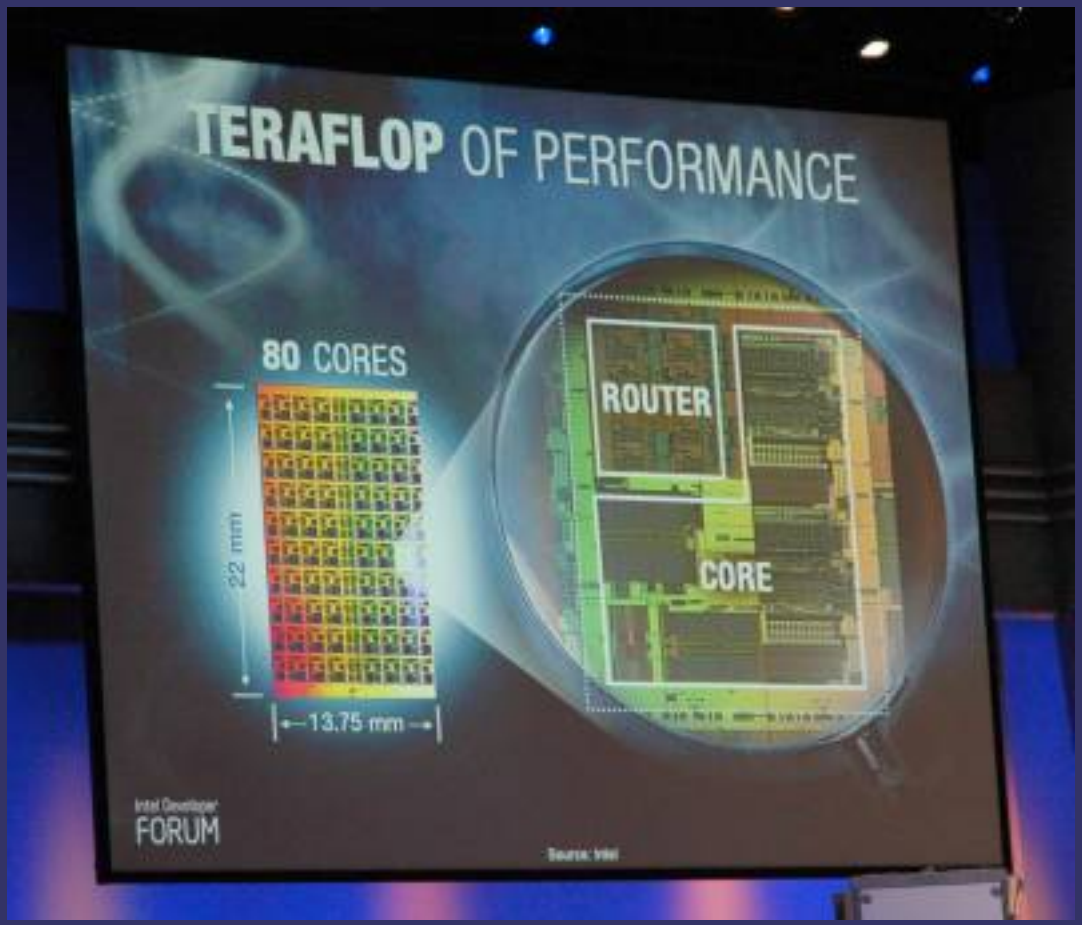
iCSE: Interactive Computational Science and Engineering

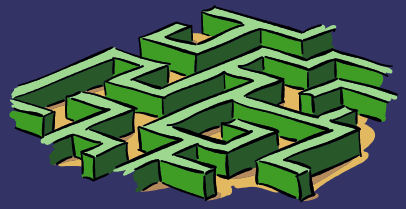
Stillwater Supercomputing Solutions

E. Theodore L. Omtzigt



Intel's Stacked TFlop Computer

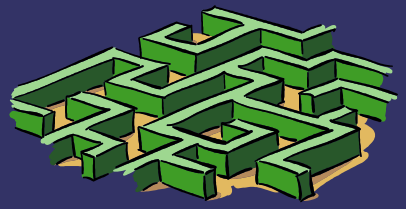




Trends in Computing

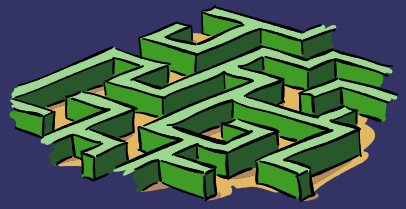
- Today:
  - 10GFlops in CPU
  - 500GFlops in a $300 GPU
  - 30TFlops with special purpose compute accelerators
  - 280TFlops with Blue Gene/L
- End of the decade:
  - TFlops with Multi-Core CPU
  - PFlops with Cell based clusters

Scale of available computes is expanding



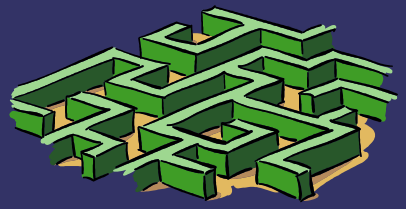
Gotchas

- Not all computes are created equal
- General Purpose CPU
  - 5-10 GFlops peak on BLAS L3
  - 100 MFlops on FEM codes
- Clusters of general purpose CPUs
  - Sustain only 5-10% of peak performance



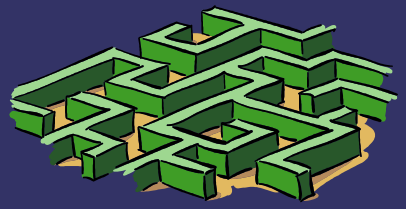
Application Specific Computes

- Much more efficient
  - GPU can sustain 500 GFlops on color computation (shader programs)
  - GRAPE cluster can sustain 50 TFlops on force calculation
- Does that change the application architecture?
  - Organization, data location/management, usage....



The power of animation

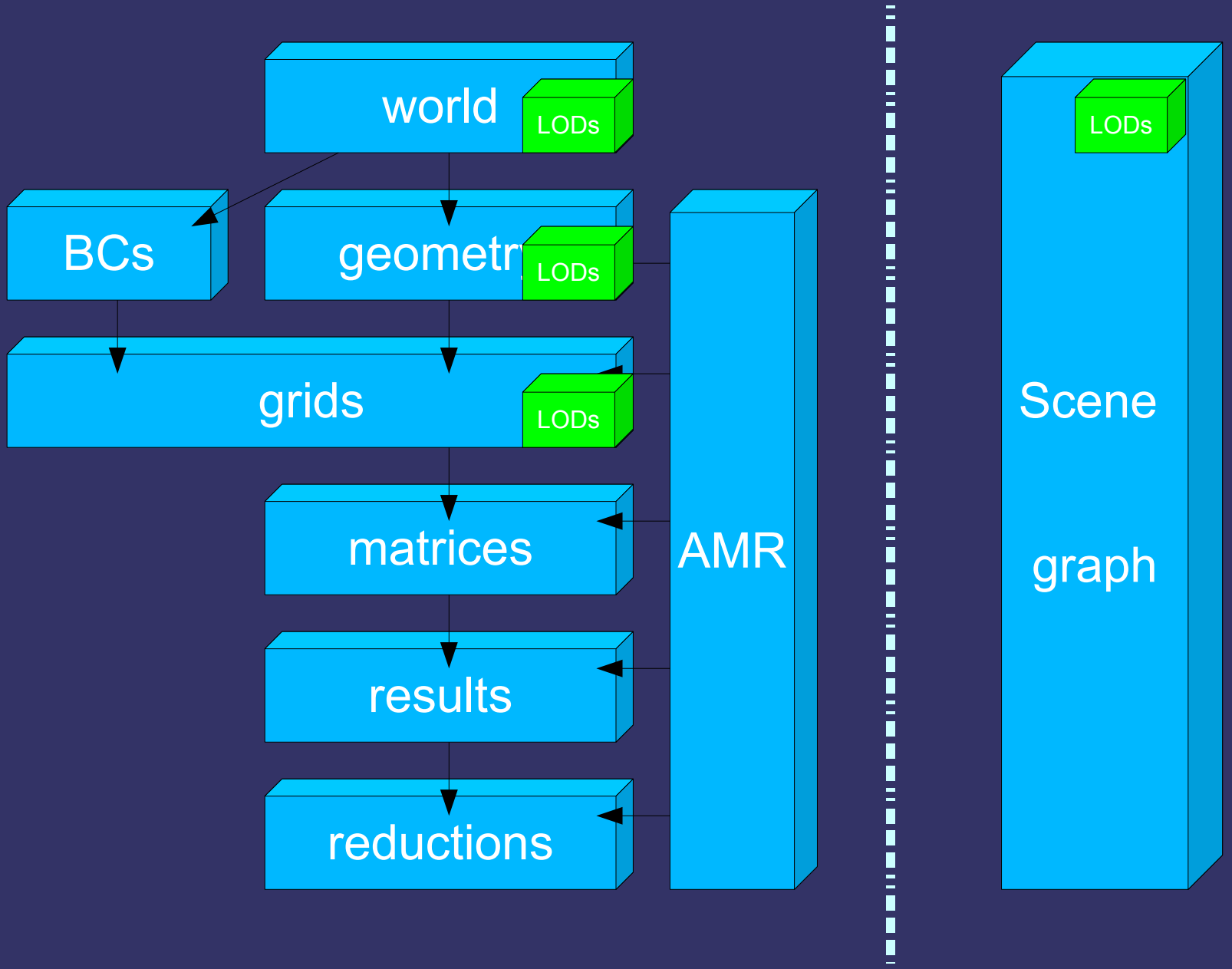
- Molecular Dynamics
- Galaxy Evolution
- FEA

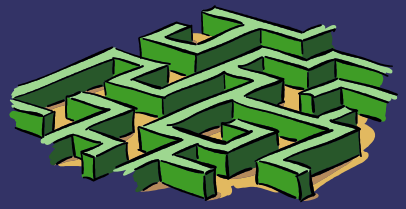


Interactivity Of CSE

- Interactivity
  - Improves Understanding
  - Creates Intuition
  - Enables Communication of complex ideas
- Can we make CSE interactive?
  - Quantify compute, memory foot-print, I/O band-width

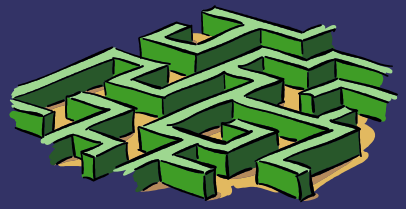
Functional Components





Desirable Organization

- Divide and Conquer
  - Stand-alone component build processes
  - thread/process/DMM capable
  - SW pipelining (LODs)
- Reactive System Organization
  - Component Registration
  - Policy driven event dispatch/routing/filtering
- Encapsulate Components
  - Abstract and Event-driven interface



FEniCS as a SW experiment

- Build process isolation
  - Win32 build!
- Derive and Prototype abstract interfaces
  - Automated mesher
  - Grid Hierarchy abstraction (DUNE-like)
  - Matrix/Solver abstractions
    - Block compressed
- Component test suites