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An Exascale Programming, Multi-objective Optimisation and Resilience Management Environment Based on Nested Recursive Parallelism

AllScale

Enable developers to be **productive**

and to **port** their **applications**

to **any scale of system**

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AllScale In a Nutshell

- **Single high level API based on C++ templates close to the user problem**
  - User level API
    - High-level abstractions (e.g. n-body, stencil, branch-and-bound, linear algebra, monte carlo, dynamic programming)
    - Recursive data structures (e.g. grids, meshes, …)
  - Core API
    - Generic function template for recursive parallelism
    - Set of recursive data structure templates
    - Synchronization, control- and data-flow primitives
- **Aggressively exploits flexible and scalable parallelism**
  - nested recursive parallelism
  - supports small scale to extreme scale parallel architectures
- **Holistic compiler and runtime system**
  - no information hiding/encapsulation between different SW layers
  - maintains maximum information across SW stack
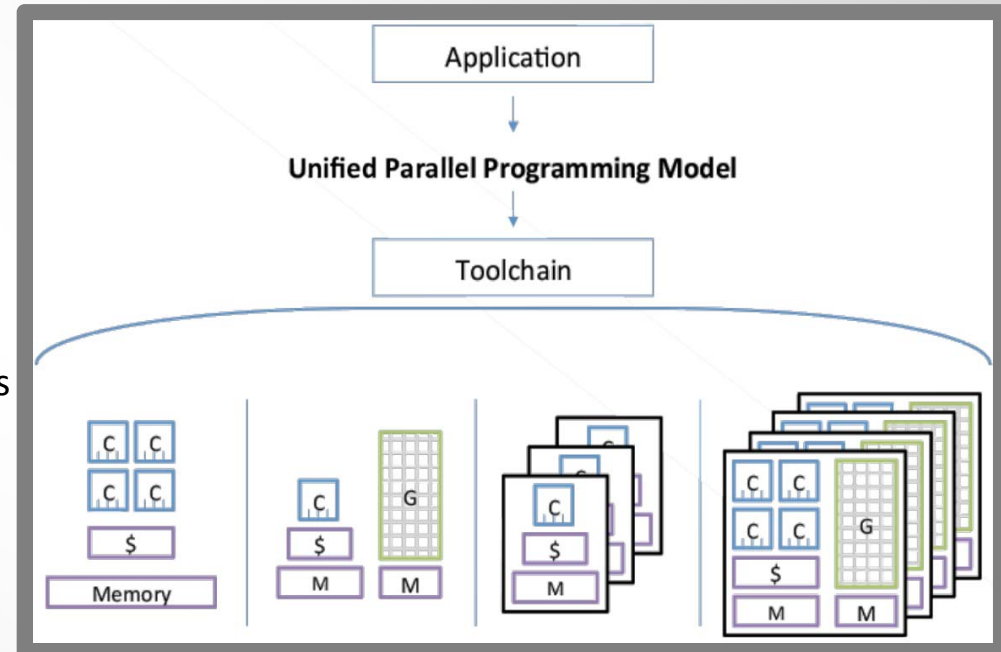
Proposed Technology Suggested for Inclusion in an EsD

- AllScale API (TRL 4)

- AllScale source to source compiler (TRL 3)

- AllScale runtime system (TRL 5-6)

How to Use AllScale Technology for an EsD

- AllScale API based on C++ templates

- Existing codes to be parallelized must be re-implemented using the AllScale API

- AllScale API Implementations
  - standard tool chain
  - AllScale toolchain (compiler and runtime system)

- Adjust AllScale runtime system for other toolchains

AllScale Pre- or co-requisite work for an EsD

- Existence of a functional complete application exhibiting sufficient potential for large scale parallel architectures.

- Existing codes must be re-implemented using the AllScale API

- Online performance monitoring for performance monitoring at scale.

Additional work to make AllScale ready for an EsD

- AllScale toolchain requires substantial engineering to reach TRL7 by the end of EsD:
  - AllScale API and compiler: 72 PMs
  - AllScale runtime system: 36 PMs

Information needed to prepare for EsD projects

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- Information on codes to be parallelized.

- Information on target architectures

- Time frame for stabilization/engineering work available during project duration.