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

AllScale

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AllScale will focus research in key areas to address critical areas of difficulty:
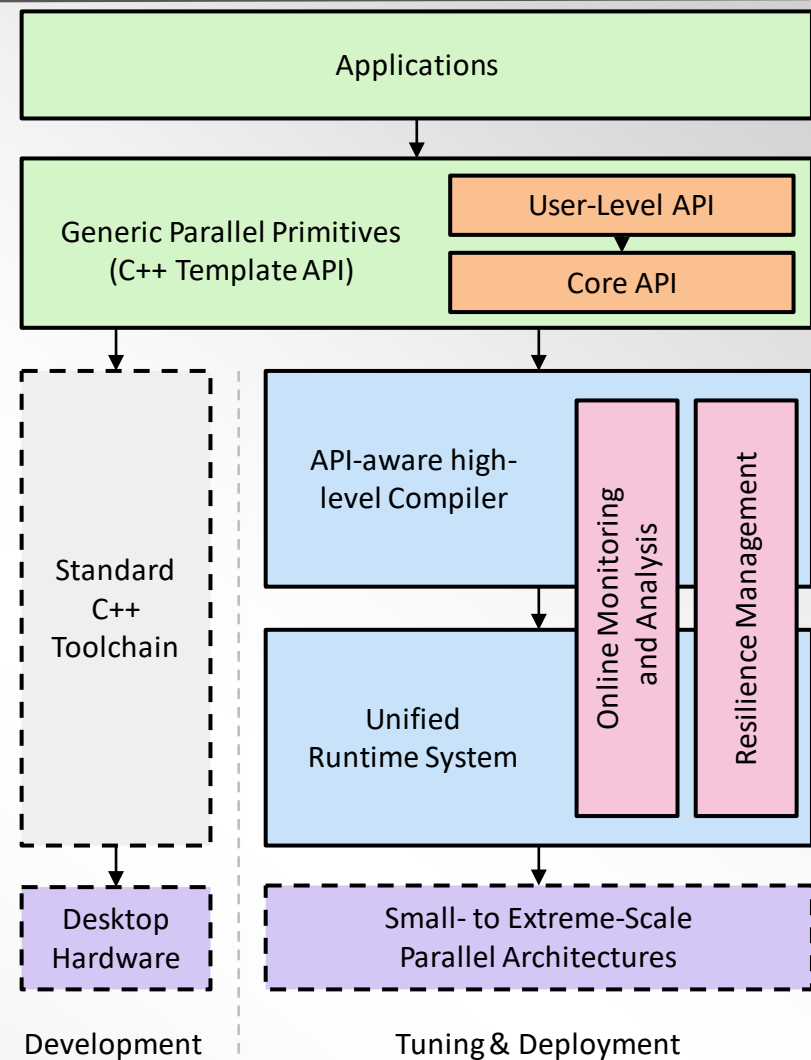
- Isolated parallelization that hampers global optimization
- Flat parallelism unfit for large-scale HPC
- Optimisation limited to single objectives
- Manual coordination to exploit all levels of parallelism
- Increased probability of errors in Exascale computing
- Post-mortem analysis of non-functional system behavior

AllScale will achieve a core set of objectives within the lifetime of the project:

- Single-source-to-anyscale application development
- Exploit the potential of nested recursive parallelism for HPC
- Multi-objective optimization for execution time, energy and resource usage
- Unified runtime system
- Mitigating increase risk of HW failures
- Scalable Online analysis of non-functional system behavior

AllScale follows three design principles:

- Use a single parallel programming model to target all the levels of hardware parallelism available in extreme scale computing systems.
- Leverage the inherent advantages of nested recursive parallelism for adaptive parallelisation, automatic resilience management and auto-tuning for multiple optimisation objectives.
- Provide a programming interface that will be fully compatible with widely used industry standards and existing toolchains.

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Applications

Generic Parallel Primitives (C++ Template API)

User-Level API

Core API

Standard C++ Toolchain

API-aware high-level Compiler

Online Monitoring and Analysis

Resilience Management

Unified Runtime System

Desktop Hardware

Small- to Extreme-Scale Parallel Architectures

Development

Tuning & Deployment