Towards Exascale Computing in CSCAPES and EASI

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CSCAPES

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- **SciDAC applied math institute (2006-11)**
  - **Combinatorial Scientific Computing for Petascale Simulations**
  - **Participants: Purdue, SNL, ANL, Ohio State**
- **Sandia research focus:**
  - **Partitioning and load balancing**
  - **Sparse matrix ordering**
  - **Graph coloring**
  - **Software: Zoltan and Isorropia**

cscapes

EASI

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- Joint Math/CS institute (2010-)
  - Extreme-Scale Algorithms and Software Institute
  - Participants: SNL, ORNL, U. Illinois, U. Berkeley, U. Tennessee
- Research focus:
  - Architecture Aware Algorithms
  - Multi-precision algorithms
  - Resilient algorithms
  - Libraries for the algorithms.

Towards Exascale in CSCAPES

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- Scaling the graph partitioner
  - Partitioning for nodes/cores ?
  - Hierarchical partitioning
  - Partitioner that uses a hybrid programming model
- Partition for millions of processing elements
  - Hierarchical partitioning ?
  - How to represent the architecture itself
    - Another graph ?
    - Who is responsible to provide it ?
  - Dynamic repartition
    - How often will the dynamic repartition will be called ?
  - Dynamic task scheduling on the nodes – Who will do this ?

Towards Exascale in EASI

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- Right programming model for future machines
  - MPI + Open MP, MPI + Threads, MPI + Collection of Thread teams + Thread Teams ?
- Optimize for better communication, NUMA access, and memory access.
- How to write libraries that survive these changes
- How to keep the applications code “serial”
- How to support applications moving from 32-bit to new libraries ? Templates ?

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Thank You