Global Computing Lab

HERMIT: Elastic, Resizable Allocations to Improve Resource Utilization

Joseph Teague

THE UNIVERSITY OF
TENNESSEE
KNOXVILLE
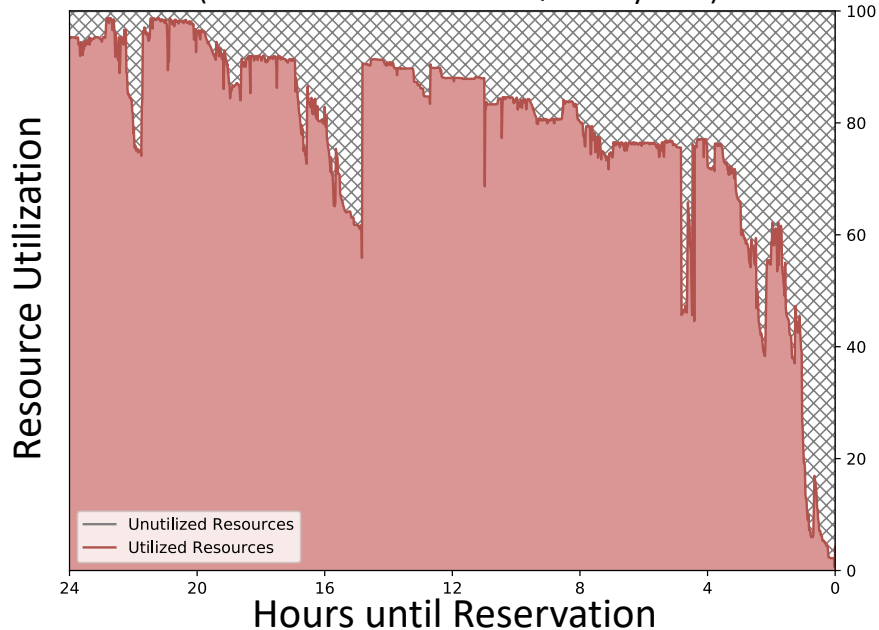
BIG ORANGE. BIG IDEAS.®

Improving Resource Utilization

- Internship at: Lawrence Livermore National Laboratory
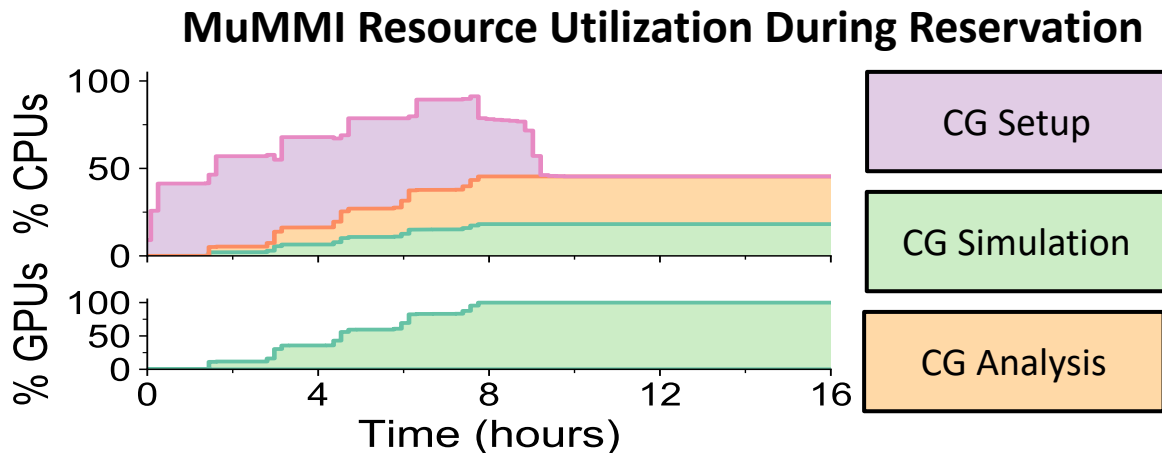
- Mentor: Stephen Herbein

Resource Drains and System Utilization

System Underutilization Prior to Drain Event
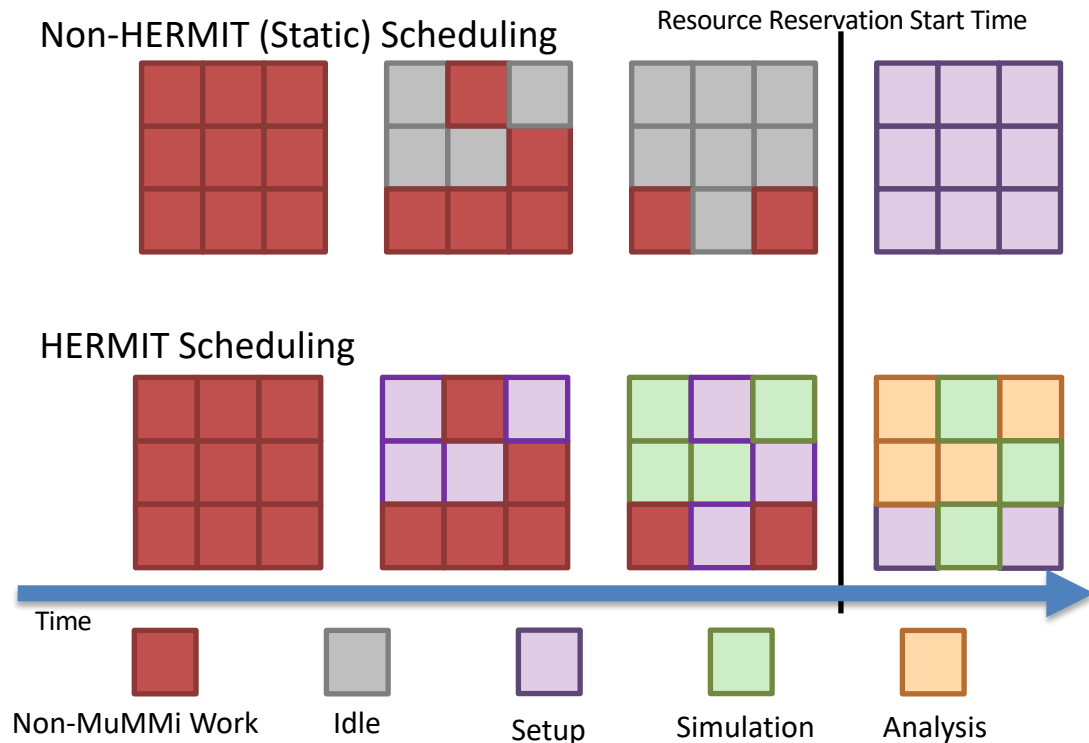(Historical Drain on LLNL Quartz System)

- *Resource drain events* are present in systems using common static schedulers

- Caused by:
  - Resource reservations
  - Shutdowns
  - Need to make room for a large job

- Examined four historical drain events on LLNL systems

- Utilization averages 75-85% for the 24 hours preceding the underlying event

Joseph Teague, Stephen Herbein, and Dong H. Ahn. "HERMIT is Elastic and Resizable Scheduling for Multiple (In)dependent Tasks." Supercomputing '19 (In Review).

Workflow Utilization During Reservations

MuMMI Resource Utilization During Reservation

- Example workflow: National Cancer Institute PILOT2 Initiative's MuMMI

- Certain requirements, e.g. preprocessing steps, can result in initial underutilization and resource "ramp up"

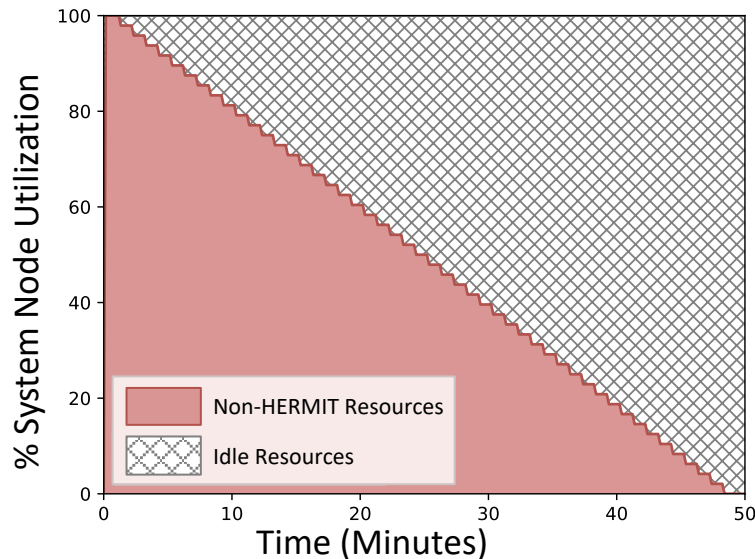- **Can underutilization be leveraged to reduce this ramp-up behavior?**

Frank Di Natale, et. al. "A Massively Parallel Infrastructure for Adaptive Multiscale Simulations: Modeling RAS Initiation Pathway for Cancer." Supercomputing '19 (Accepted).

HERMIT vs. Static Scheduling

Non-HERMIT (Static) Scheduling

Resource Reservation Start Time

HERMIT Scheduling

Time

Non-MuMMi Work   Idle   Setup   Simulation   Analysis

- Static schedulers allow resources to go idle prior to a *drain event* (in this case a resource reservation)

- Resources remain idle until *after* the drain event

- HERMIT reclaims resources, allowing them to be put to use *prior to* the drain event
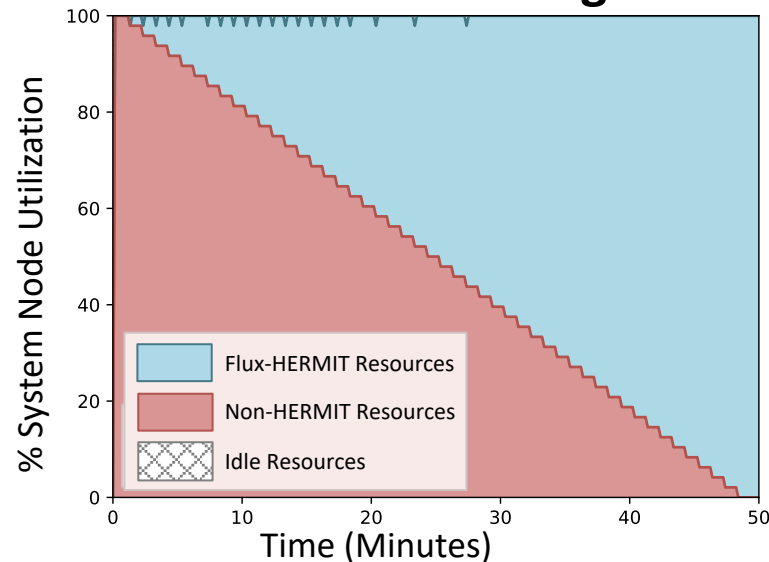
Joseph Teague, Stephen Herbein, and Dong H. Ahn. "HERMIT is Elastic and Resizable Scheduling for Multiple (In)dependent Tasks." Supercomputing '19 (In Review).

BIG ORANGE
BIG IDEAS

HERMIT Preliminary Results

Resource Utilization Without HERMIT

Resource Utilization Using HERMIT

- Drain emulated on development cluster

- 48-node Xeon system

- Static scheduling stopped on nodes in tiered fashion to induce drain, system utilization examined when using HERMIT

Joseph Teague, Stephen Herbein, and Dong H. Ahn. "HERMIT is Elastic and Resizable Scheduling for Multiple (In)dependent Tasks." Supercomputing '19 (In Review).

BIG ORANGE
BIG IDEAS

Observations and Future Work

- HERMIT shows promise for improving resource utilization preceding emulated drain events.

Future Work:

- Classify types of drains and system conditions

- Evaluate HERMIT's performance during these realistic drains

- Evaluate HERMIT's benefit to production workflows

Joseph Teague, Stephen Herbein, and Dong H. Ahn. "HERMIT is Elastic and Resizable Scheduling for Multiple (In)dependent Tasks." Supercomputing '19 (In Review).