Outreach, Tutorials, and Educational Activities

Presenter: Prof. Patrick Bridges

Educational Activities

- Organized the 10th and 11th Workshop on Extreme Scale MPI (ExaMPI) at SC 2023 and 2024
- Tutorial on *MPI Advance - Optimizations and Extensions to MPI* at the NNSA-University Workshop on Exascale Simulation Technologies (NUWEST) workshop
- Organized SIAM PP24 mini-symposium on *Realistic Proxy Applications and Datasets for Heterogeneous Architecture Scalable Communication*
- Organizing the 4th and 5th Workshops on Compiler-assisted Correctness Checking and Performance Optimization for HPC (C3PO) at ISC 2024 and 2025
- Hackathons
  - Weekly online mini-hackathons with students to help with their research
  - April 9-10, 2024 – in-person hackathon for students focused on specific research problems
  - May 19-20, 2025 – in-person hackathon on

Courses Offered – Spring 2024/Fall 2025

- UNM
  - CS 491/591 Special Topics: HPC
  - CS 591 Special Topics: Scalable Systems Seminar
- TNTech
  - CSC 4760/5760 Parallel Programming
  - CSC 7750 HPC Seminar
- UA
  - CS 691 Special Topics in HPC

Assignment #1

- Goal: Implement basic point-to-point send and receive primitives
- Explore different low-level networking primitives
  - Sockets
  - Light-weight Communication Interface (LCI)
  - Libfabric/UCX
- Using ExaMPI infrastructure to support process startup and teardown and integration with Slurm

API Specification

```
int     MY_MPI_Rank()       // Provided
int     MY_MPI_Size()       // Provided
void    MY_MPI_Barrier()    // Provided
void    MY_MPI_Init()       // Provided
void    MY_MPI_Finalize()   // Provided
double  MY_MPI_Wtime()      // Provided
void    MY_MPI_Ssend(void *buf, size_t len, int dest)          // TODO!
void    MY_MPI_Recv (void *buf, size_t len, int src)           // TODO!
void    MY_MPI_Bcast_linear(void* buf, size_t len, int root) // TODO!
void    MY_MPI_Bcast_ring  (void* buf, size_t len, int root) // TODO!
```

Next Assignments

Assignment #2

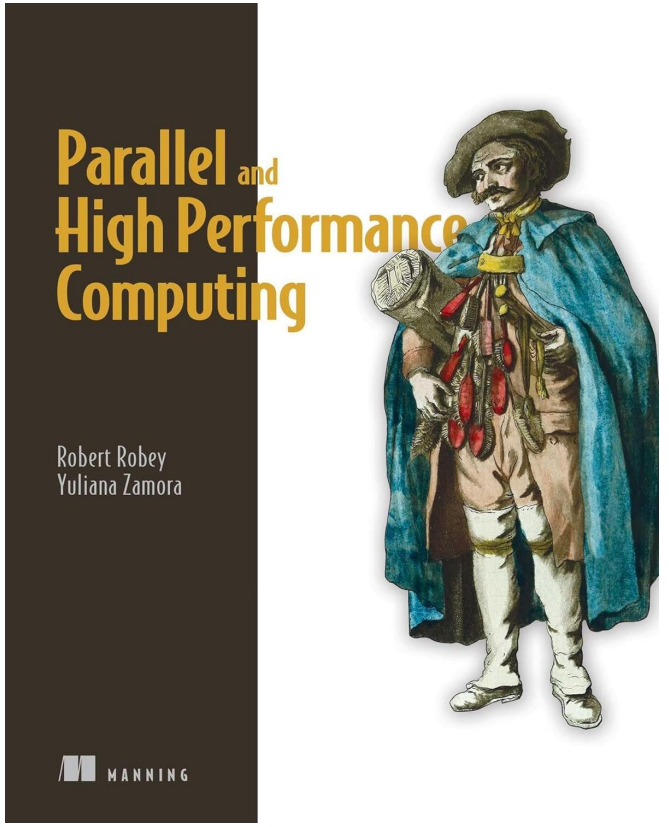
- Extend Assignment #1 to include
  - tags
  - eager and rendezvous protocols
  - non-blocking communication and progress

Assignment #3

- Implement collective primitives with different algorithms
  - reduce/allreduce
  - gather
  - scatter

TN Tech – CSC 4760/5760 Parallel Programming

- Standard concepts of parallel programming (speedup, Flynn, etc)
- Focus on MPI and Kokkos Programming
- C++ as underlying programming language
- MPI+Kokkos Programming as advanced topic
- Specifically skip: OpenMP and CUDA in favor of Kokkos as the high-level, on-node programming model
- Rudiments of cluster usage and access issues
- Current book: Robey & Zamora



TNTech – CSC 7750 HPC Seminar

- For PhD students and interested MS students
- Data reorganization
- Fault tolerance
- Polyalgorithms
- Many-task systems (WAMTA 2024 workshop highlights)
- Methods of HPC research
- Special topics include
  - Space-filling curves
  - Meta-programming
  - FFTs
  - Shared materials from PSAAP April Hackathon (RDMA)
- How to formulate research