Bulldogs Team

Team Member: Dr. Rui Zhu
(Kettering University)

Mentor: Dr. John Holmen
(Oak Ridge National Laboratory)

Mentor: Yvonne Phillips
(Morehouse College)

- Target Course(s): CS425 Parallel Programming and Algorithms, CS457 Wireless and Mobile Security
- Goal:
  - Integrating HPC with Cybersecurity, Cryptography, and Machine Learning to develop curriculums
  - Identify applicable HPC resources from ORNL/wider HPC community and develop course descriptions
  - Create and refine course schedules, hands-on labs, etc.
- GitHub Repo: https://github.com/ruikobe/KetteringTeamFacHack23
- Theme Song: George Thorogood & The Destroyers - Bad To The Bone

Course Description

- The CS-425 **Parallel Programming and Algorithms** course introduces students to the foundations of parallel computing.

- The course will include material on emerging multicore hardware, shared-memory programming models, message passing programming models used for cluster computing, data-parallel programming models for GPUs, and problem-solving on large-scale clusters using MapReduce.

- A key aim of the course is for students to gain a hands-on knowledge of the fundamentals of parallel programming by writing efficient parallel programs using some of the programming models that students learn in class.

Topics

1. Introduction to Parallel Computing
2. Parallel Programming Platforms
3. Principles of Parallel Algorithm Design
4. Basic Communication Operations
5. Analytical Modeling of Parallel Programs
6. Programming Using the Message Passing Paradigm, e.g., Message-Passing Interface (MPI)
7. Programming Shared Address Space Platforms
8. Dense Matrix, Sorting, Searching, and Graph Algorithms
9. Graphics Processing Units (GPUs)
10. Compute Unified Device Architecture (CUDA)

Potential HPC Resources

- A few courses bringing together parallel programming, parallel algorithm, and HPC:

  https://www.cs.purdue.edu/homes/ayg/CS525/index.html

  https://faculty.cc.gatech.edu/~umit/GT/CSE/2020/CSE6230.html

- Training archives from some of the larger HPC centers:

  https://www.alcf.anl.gov/support-center/training-assets

  https://docs.alcf.anl.gov/account-project-management/allocation-management/overview/

  Allocations at various HPC center:

  https://docs.alcf.anl.gov/account-project-management/allocation-management/overview/

  https://www.chpc.utah.edu/userservices/allocations.php

  https://docs.olcf.ornl.gov/accounts/accounts_and_projects.html

  https://tacc.utexas.edu/use-tacc/allocations/

Sample Datasets

- CRAWDAD dataset

  There are huge data sets in different fields, e.g., cybersecurity, wireless networking, IoT, Transportation, Power and Energy, etc.

- BLE-WBAN: RF real-world dataset of BLE devices in human-centric healthcare environments

  In communication and networking research, obtaining large, real-world datasets related to the physical layer has always been challenging, especially in IoT and Health IoT.

- Dataset from HPC center of ORNL, and other HPC centers