Benjamin M. Cobb

537 Budds Landing Rd, Warwick, MD 21912 | bcobb33@gatech.edu | (443) 941-7300 |
Website: https://www.ben-cobb.com/ | GitLab: https://gitlab.com/Ben_Cobb

EDUCATION

Georgia Institute of Technology, Atlanta, GA, August 2019 – present
Graduate Research Assistant enrolled in the Computational Science and Engineering (CSE) PhD program
GPA: 4.0

Wake Forest University, Winston-Salem, NC, August 2015 – May 2019
Bachelor of Science with Honors in Computer Science
Bachelor of Science in Mathematical Business
Minor in Chinese
Graduated Magnum Cum Laude

WORK EXPERIENCE

Graduate Research Assistant
Georgia Institute of Technology, Atlanta, GA, August 2019 – present
- Researching Tensor Decompositions and Tensor Kernels
- Currently engaged in implementing dense Tensor Kernels, such as the Tensor Times Matrix (TTM) and Gram kernels, using Kokkos for use in the GenTen project through Sandia National Labs
- Collaborating with researchers at Sandia National Labs
- Learned to use Kokkos to write performance portable applications

Graduate Teaching Assistant
Georgia Institute of Technology, Atlanta, GA, August – December 2020
- TA'ed graduate level algorithms course with 200+ students
- Graded exams and homework
- Developed and proofread homework problems
- Explained concepts such as dynamic programming, NP-completeness, divide-and-conquer, local search algorithms and multiple types of proofs to students during office hours

Sandia National Laboratories Computer Science Research Institute Summer Intern
Sandia National Laboratories, Albuquerque, NM, May – August 2020
- Researched portable tensor kernels for use in combustion simulation anomaly detection
- Researched tensor surrogate models
- Worked closely with employees in the Scalable Algorithms department
- Received hands-on experience developing, unit testing and benchmarking code on Sandia's advanced testbeds
- Implemented performance portable dense Tensor Times Matrix (TTM) kernels as part of the GenTen project
- Became proficient with the Kokkos programming model

SuperComputing (SC) 2020 Student Volunteer
Virtual, November 2020
- Moderated presentation and panel on advanced OpenMP
- Handled questions and comments from attendees
- Presented poster on tensor research

URECA Researcher
Wake Forest University, Winston-Salem, NC, May – August 2018
- Researched hypergraph partitioning methods applied to Sparse Matrix Vector products (SpMxV)
- Worked to speed up the coarsening phase of the Karlsruhe Hypergraph Partitioner (KaHyPar) using Wedge-Sampling heuristics
- Learned the many nuances of hypergraph partitioning, the useful applications of hypergraph models and how to proficiently use Linux command line

Resident Advisor
Wake Forest University, Winston-Salem, NC, August 2016 – May 2019
- Presented housing reforms for transfer students to the directors of the Residence Life and Housing Board, which were subsequently implemented into official Wake Forest housing policy
- Met and engaged with transfer student residents on a weekly basis to cultivate a close-knit community
- Mediated resident conflicts through arbitrative conversations

PROJECTS

GenTen Portable Tensor Decompositions
Sandia National Laboratories, Albuquerque, NM, October 2019 – present
url: https://gitlab.com/tensors/genten
- Implemented Tensor Times Matrix (TTM) and Gram kernels utilizing the Kokkos programming model portable to both CPU and GPU architectures
- Benchmarked kernels on Intel, ARM, IBM and NVIDIA architectures
- Demonstrated that TTM kernel implementations outperform other state-of-the-art-tensor contraction implementations such as Eigen (Used by Google's TensorFlow) and the Matlab Tensor Toolbox
- Used Roofline model to show Gram kernel implementation achieved maximum bandwidth performance on V100 GPU

MATLAB Tensor Toolbox
Wake Forest University, Winston-Salem, NC, March – May 2018
- Worked to implement polynomial time perfect minimum cost Bipartite Matching algorithm for use in the Matlab Tensor Toolbox score function to calculate ktensor least-squares cosine differences
- Created multiple unit tests to verify correctness
- Gained experience rigorously testing and refining contributable code

TECHNICAL REPORT

GenTen Performance Portable Dense TTM Kernels
Sandia National Laboratories, Albuquerque, NM, August 2020
url: https://cfwebprod.sandia.gov/cfdocs/CompResearch/docs/proceedings/csri20.pdf
- Published report with technical details of Tensor Times Matrix (TTM) kernel and benchmark results as part of Sandia National Lab's Computer Science Research Institute (CSRI) Summer Program
- Detailed motivating combustion simulation anomaly detection application
- Demonstrated that TTM kernel achieved GEMM like performance for problem sizes of interest

PRESENTATIONS

Center for Research into Novel Computing Hierarchies (CRNCH) Summit
Georgia Institute of Technology, Atlanta, GA, January 2021
- Presented poster on Tensor Times Matrix (TTM) and Gram kernel benchmark results
- Explained Application to Sequentially Truncated Higher Order Singular Value Decomposition (ST-HOSVD)
- Explained research to those unfamiliar with tensor decompositions

GT@SC20
Georgia Institute of Technology, Atlanta, GA, November 2020
- Presented poster on Tensor Times Matrix (TTM) kernel benchmark results
- Explained importance of code portability
- Highlighted performance results competitive with other state-of-the-art, less portable libraries

Computer Science Research Institute (CSRI) Poster Blitz
Sandia National Laboratories, Albuquerque, NM, August 2020
- Presented progress on summer research project to researchers at Sandia National Labs
- Answered technical questions pertaining to project

Wake Forest Computer Science Honors Thesis Defense
Wake Forest, Winston-Salem, NC, May 2019
- Presented honors thesis on hypergraph partitioning methods and wedge-sampling heuristics for Sparse Matrix Vector products (SpMxV) to panel of computer science professors
- Successfully defended thesis

Undergraduate Research Day
Wake Forest, Winston-Salem, NC, May 2019
- Presented poster on hypergraph partitioning methods and wedge-sampling heuristics for Sparse Matrix Vector products (SpMxV)
- Explained research to those unfamiliar with hypergraph partitioning methods, wedge-sampling heuristics and SpMxV

FELLOWSHIPS

Presidential Fellowship (PF)
Georgia Institute of Technology, Atlanta, GA, August 2019 – present
- $5,500 in financial support to Georgia Tech doctoral applicants in the top 10% of the applicant pool
- Renewable for up to three additional years

Wake Forest Research Fellowship (WFRF)
Wake Forest University, Winston-Salem, NC, May – August 2018
- $4,000 stipend and housing over the course of a summer
- Supports students participating in research under the mentorship of a Wake Forest faculty member

NOTABLE GRADUATE LEVEL COURSES

Computational Science and Engineering Algorithms
Georgia Institute of Technology, Atlanta, GA, August – December 2019
Grade: A

Computational Data Analysis
Georgia Institute of Technology, Atlanta, GA, August – December 2019
Grade: A

Numerical Linear Algebra
Georgia Institute of Technology, Atlanta, GA, January – May 2020
Grade: A

High Performance Computing
Georgia Institute of Technology, Atlanta, GA, January – May 2020
Grade: A

High Performance Parallel Computing
Georgia Institute of Technology, Atlanta, GA, August – December 2020
Grade: A

High Performance Computer Architecture
Georgia Institute of Technology, Atlanta, GA, January 2021 – present
Grade: In Progress

SKILLS

Languages: C/C++, Python, Matlab, Latex, Bash

High Performance Computing: Kokkos, OpenMP, MPI, CUDA, Cache aware programming

Software Development: Git, CMake, Unit Tests, Vim, Slurm, Tmux, Linux Command Line, Scripting

Performance Analysis: Roofline Bandwidth Analysis, VTune

Expertise: Tensor Kernels, Tensor Decompositions, Tensor Analysis, Unsupervised Machine Learning