Mit Kotak

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Education	**University of Illinois at Urbana-Champaign**, Champaign, IL	August 2019-Present
	Bachelor of Science in Engineering Physics	Graduation: May 2023

Senior Thesis: 'A case study on the effectiveness of graph APIs'
Advisor: Dr. Andreas Klöckner
Minors: Computational Science and Engineering, Statistics
GPA: overall 3.90/4.0
Dean's List: Fall 2019, Spring 2020, Fall 2020, Spring 2021

Parkland College, Champaign, IL   Summer 2020-Fall 2020
Associate in General Studies   Received: May 2021
GPA: overall 4.0/4.0;
Dean's List: Fall 2020

Presentations

Efficiently Executing NumPy on GPUs via the CUDAGraph API. (UIUC URS 202)
Task Graph Parallelism on GPUs via CUDAGraphs. (CEESD AST Review 202)

Research Experience

Center for Exascale-enabled Scramjet Design
May 2021-Present
Dr. Andreas Klöckner
Worked on *Efficient execution of array dataflow graphs on GPU hardware.*

- **Co-designed and Co-developed a multi-layered framework** with a graduate student for executing data flow graphs on GPUs via an array-based programming interface.

  - Extended *PyCUDA*, a python-based GPU scripting language, to provide runtime code generation for NVIDIA's *CUDAGraph* API.
  - Implemented a *CUDAGraph* backend for *Pytato*, a lazy-evaluating array interface that lowers *n-d* array programs to computation graphs.
  - Developed a *CUDAGraph* backend for *Arraycontext*, an array abstraction for mapping *numpy-like* operations onto *CUDAGraph* driver API calls.

- **Benchmarked a speedup of upto 5x** for Finite-Element based Discontinuous Galerkin Operators.
- **Presented results** at semestrial lab funding reviews (CEESD AST Review 202) and annual undergraduate research symposium (UIUC URS 202).
- **Senior Thesis: Modelling the performance** of CUDAGraph API's runtime scheduler through a set of microbechmarks and writing the paper.

Center for Theoretical Astrophysics
June 2021-Present
Dr. Stuart L. Shapiro
Worked on *3D Visualization of Relativistic Magnetohydrodynamics.*

- **Led a team of 4 undergraduates** to create 3D visualizations of neutron stars, black hole binaries and black holes disks using a VisIt-CLI based software package across 6 supercomputing clusters .
- **Spearheaded** the usage of isosurface shell rendering (5-10 times faster than the conventional volume rendering) for visualizing the density profile.
- **Co-developed a set of *Python* scripts** for efficiently measuring the circumference of a black hole disk at a given density.
- **Visualizations featured** in 2 *Phys. Rev. Journal* articles, CASC 2023 and department news website.
- **Applied for and received** undergraduate research support grants for summer research (RSG 2022, RSG 2023).

CyberGIS Center
March 2022-Present
Dr. Anand Padmanabhan
Worked on *CyberGIS-Compute: Geospatial Middleware for Simplifying Access to High-Performance Computing.*

- **Developed a self contained Dockerized framework** that can independently run the full CyberGIS-Compute stack on local machines. This streamlined the development process for model contributors and developers in the CyberGIS-Compute community.

- **Provided continued software support** for a *Python-based* GUI and *Typescript-based REST-ful* API server.
- **In progress: Integrating** the *CyberGIS-Compute* framework with CVMFS (Cern Virtual Machine File System).

National Center for Supercomputing Applications
August 2022-Present
Dr. Antonios Tsokaros
Worked on *High Performance Computing for Magnetized Neutron Stars.*
- **In progress: Developing** the *Einstein Toolkit* and *COCAL* code to perform full magnetohydrodynamics (GRMHD) simulations of magnetized NSs and examine their astrophysical signatures in a variety of scenarios.
- **In progress: Writing** a 50-60 page manual for 3D visualizations in numerical relativity.

Published Visualizations

What happens when Black Holes collide ?
Mit Kotak, Eric Yu, Jinghan Huang, Jing Zhou, Milton Ruiz, Antonios Tsokaros, Lunan Sun, Stuart L. Shapiro
Coalition for Academic Scientific Computation 2023 Brochure, Page 14
Available at https://casc.org/researchpub/brochures/

Self-gravitating disks around rapidly spinning, tilted black holes: General relativistic simulations
Antonios Tsokaros, Milton Ruiz, Stuart L. Shapiro, Vasileios Paschalidis
Physical Review Letters, Vol. 128, Iss. 6 — 11 February 2022
Available at doi.org/10.48550/arXiv.2209.04454. Also at arXiv:2209.04454

Magnetohydrodynamic simulations of self-consistent rotating neutron stars with mixed poloidal and toroidal magnetic fields
Antonios Tsokaros, Milton Ruiz, Stuart L. Shapiro, and Kōji Uryū
Physical Review Letters, Vol. 128, Iss. 6 — 11 February 2022
Available at doi.org/10.48550/arXiv.2111.00013. Also at arXiv:2111.00013

Grants/Awards

2021 Philip J. and Betty M. Anthony Undergraduate Summer Research Award – $3,000
2022 Office of Undergraduate Summer Research Support Grant – $2,000
2022 1st place in UIUC Image of Research Competition — $300
2022 National Center for Supercomputing Applications Student Pushing Innovation (SPIN) – $7,200
2023 Office of Undergraduate Summer Research Support Grant – $1,000

Work Experience

Office of Undegraduate Research
March 2021-Present
Undergraduate Research Ambassador
- Held **one-to-one peer mentoring sessions** with **40+ undergraduates**, **Led** ”Getting Started with Research” workshops and helped organize the annual undergraduate research symposium (latest one had 500 presenters).
- **Developed** a chatbot *that could answer commonly asked questions regarding finding research opportunities.*

Illinois Technology Services
March 2020-March 2022
Data and Technology Innovation Group - Student Success Team
- **Built several machine learning models** *to predict students at risk of performing poorly in core classes. Average recall: 90%. Average precision: 90%*
- **Experimented with Random Forest, SVM, KNN, Gradient Boosting classifiers.** *Assembled sparse feature matrices, bucketed class categories, and up sampled some classes to improve accuracy by 60%.*
- **Built a web interface** *where academic advisors can view the predicted performance of students in core classes. Helped advisors understand courses other than prerequisites that determine student success.*

Illinois ATLAS Teaching and Learning with Technology
January 2021-July 2021
Department of Economics & School of Literatures, Culture & Linguistics
- **Implemented job application** bot *using Selenium, Beautiful Soup and Django for the Department of Economics.*
- **Analyzed data for 11 departmental websites** *using Google Analytics API & Python packages (pandas, Numpy) for the School of Literatures, Culture & Linguistics.*