

# Mit Kotak

<https://mitkotak.github.io>

Champaign, Illinois, United States

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## Education

**University of Illinois at Urbana-Champaign**, Champaign, IL  
Bachelor of Science in Engineering Physics (with **Highest Honors**)  
Senior Thesis: 'A case study on the effectiveness of graph APIs'  
Advisor: **Dr. Andreas Klöckner**  
Minors: **Computational Science and Engineering, Statistics**  
GPA: 3.91/4.0  
Dean's List: Fall 2019, Spring 2020, Fall 2020, Spring 2021

August 2019-Present  
Graduation: May 2023

**Parkland College**, Champaign, IL  
Associate in General Studies  
GPA: overall 4.0/4.0;  
Dean's List: Fall 2020

Summer 2020-Fall 2020  
Received: May 2021

## Presentations

*Efficiently Executing NumPy on GPUs via the CUDAGraph API.* (**UIUC URS 2022**)  
*Task Graph Parallelism on GPUs via CUDAGraphs.*(**CEEDS AST Review 2022**)

## Research Experience

**Center for Exascale-enabled Scramjet Design**  
**Dr. Andreas Klöckner**

May 2021-Present

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 (**CEEDS AST Review 2022**) and annual undergraduate research symposium (**UIUC URS 2022**).
- **Senior Thesis: Modeling the performance** of CUDAGraph API's runtime scheduler through a set of microbenchmarks and writing the paper.

**Center for Theoretical Astrophysics**  
**Dr. Stuart L. Shapiro**

June 2021-Present

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 for Advanced Digital and Spatial Studies**  
**Dr. Anand Padmanabhan**

March 2022-Present

Worked on *CyberGIS-Compute: Geospatial Middleware for Simplifying Access to High-Performance Computing.*

- **Provided continued software support** for a *Python*-based GUI and *Typescript*-based *RESTful* 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 neutron stars (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](https://doi.org/10.48550/arXiv.2209.04454). Also at [arXiv:2209.04454](https://arxiv.org/abs/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](https://doi.org/10.48550/arXiv.2111.00013). Also at [arXiv:2111.00013](https://arxiv.org/abs/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 1<sup>st</sup> 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 Undergraduate 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, BeautifulSoup 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.