

# Mit Kotak

<https://mitkotak.github.io>

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## Education

**Massachusetts Institute of Technology**, Cambridge, MA  
SM Computational Science and Engineering

July 2023-Present

**University of Illinois at Urbana-Champaign**, Champaign, IL

August 2019-May 2023

Bachelor of Science in Engineering Physics (with **Highest Honors**)

Senior Thesis: **Efficient Execution of DG-FEM workloads on GPUs via CUDAGraphs**

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

**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

## Publications

**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/wp-content/uploads/2023/01/CASC-2023-Brochure-Web-01-31-2023.pdf>

**Streamlined HPC Environments with CVMFS and CyberGIS-Compute**

Alexander Michels, **Mit Kotak**, Anand Padmanabhan, Shaowen Wang

IGUIDE Forum 2023

Available at <https://docs.lib.purdue.edu/iguide/2023/presentations/8/>

**CyberGIS-Compute: Middleware for Democratizing Scalable Geocomputation**

Alexander Michels, Anand Padmanabhan, Zimo Xiao, **Mit Kotak**, Furqan Baig, Shaowen Wang

Under review at SoftwareX

Available at <https://dx.doi.org/10.2139/ssrn.4625703>

## Talks

Optimizing Equivariant Tensor Products (MIT Graphics Seminar 2023)

Optimizing Equivariant Tensor Products (**Sparse Tensor Computation Workshop 2023**)

Efficiently Executing Discontinuous Galerkin Finite-Element (DG-FEM) workloads on GPUs via Data Flow Graphs (**UIUC URS 2023, NCUR 2023**)

Task Graph Parallelism on GPUs via CUDAGraphs (**CEEDS AST Review 2022**)

## Posters

Efficiently Executing NumPy on GPUs via the CUDAGraph API (**UIUC URS 2022**)

Analysis of bottle bioassay data: Creating an RShiny app to assist in insecticide resistance monitoring (**Entomology 2023**)

## Research

**Research Lab for Electronics**

July 2023-Present

## Experience

**Dr. Tess Smidt**

Working on optimizing tensor product operation in **e3nn framework** through domain specific computing.

**Center for Exascale-enabled Scramjet Design**

May 2021-May 2023

**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 *CUDA*Graph API.
- Implemented a *CUDA*Graph backend for *Pytato*, a lazy-evaluating array interface that lowers *n*-d array programs to computation graphs.
- Developed a *CUDA*Graph backend for *Arraycontext*, an array abstraction for mapping *numpy*-like operations onto *CUDA*Graph 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 2022*) and annual undergraduate research symposium (*UIUC URS 2022*).

### Center for Theoretical Astrophysics

June 2021-June 2023

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*, *department news website*, and *NCSA's award winning exhibit at Engineering Open House*.
- **Applied for and received** undergraduate research support grants for summer research (RSG 2022, RSG 2023).

### CyberGIS Center for Advanced Digital and Spatial Studies

March 2022-May 2023

Dr. Anand Padmanabhan

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.
- **Integrated** the *CyberGIS-Compute* framework with *CVMFS* (Cern Virtual Machine File System).

### National Center for Supercomputing Applications

August 2022-June 2023

Dr. Antonios Tsokaros

Worked on High Performance Computing for Magnetized Neutron Stars.

- **In progress: Writing** a 100 page primer for 3D visualizations in numerical relativity.

### 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

#### College of Veterinary Medicine

January 2023-May 2023

Dr. Becky Smith

- Built an *R shiny* web application for *CDC-funded Midwest Center of Excellence in Vector-Borne Disease* for monitoring pesticide usage which was presented at *Entomology 2023*.

#### Office of Undergraduate Research

March 2021-May 2023

Undergraduate Research Ambassador

- Held **one-to-one peer mentoring sessions** with **50+ 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.