

# GEORGE TSOUKALAS

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## EDUCATION

### Rutgers University

New Brunswick, New Jersey

*Bachelor of Science - Mathematics & Computer Science; GPA: 4.00/4.00*

*September 2019 - May 2023*

- **(2021) David Martin Weiss Memorial Award:** Awarded to a sophomore demonstrating excellence as a math major.
- **(2022) Weill Scholarship:** Awarded to full-time students majoring in mathematics based on academic merit.
- **(2022) John Bogart Prize:** For exceptional achievement in mathematics.

## RESEARCH EXPERIENCE

### Matrix Analysis REU

College of William & Mary, Virginia

*Undergraduate Researcher*

*May 2021 - September 2021*

- Researched generalized notions of graph adjacency matrices, including questions of eigenvalue assignments and disparity.
- Characterized  $k$ -NIM trees, extending a characterization of 1-NIM Trees by mentor Charles R. Johnson.
- Utilized singularity analysis to enumerate these trees according to the newly found characterization.
- **Publication:** (Submitted)  $k$ -NIM Trees: Characterization and Enumeration, arXiv:2208.05450, July 2022.

### Numerical Semigroups REU

San Diego State University, California

*Undergraduate Researcher*

*May 2022 - August 2022*

- Researched connections between numerical semigroups and a geometric object called the Kunz Cone.
- Uncovered several key properties regarding symmetries of the Kunz Cone and their action on unimaximal faces.
- Performed probabilistic analysis on Erdős-Rényi type random numerical semigroups towards Wilf's Conjecture.

## PROJECTS

- **Indie Game Development:** Developed a Roblox game which registered over 23M player visits, including a total of 6.1M unique players. Recorded 100K+ daily active users over multiple months. Appeared within the top 10, of thousands, for average playtime sitewide. Utilized knowledge of client-server architecture. Published bi-weekly updates.
- **Jigsaw Puzzle Solver:** Implemented a deep convolutional network in TensorFlow to find matches among input puzzle pieces, with fairly good accuracy. Additionally implemented a direct approach to compare edges of pieces according to several metrics, including CIE94 and the  $\ell^p$  norm. Used topological sort to find linear extension of resultant piece ordering.
- **$N$  superimposed  $N$ -Queen Problem:** Implemented simulated annealing and various probability scheduling algorithms to achieve lower bounds on best-possible configurations for the  $N$  superimposed  $N$ -Queen problem for several unresolved cases  $N = 8, 9, 10$  following work by Vasquez (2004).
- **Othello/Reversi Computer Engine:** Implemented both Othello/Reversi and MiniMax to test heuristics for tree-search towards creating a strong machine opponent - strength was intermediate. Used Python's pygame for visualization. Working towards implementing Deep Reinforcement Learning to improve performance.
- **Directed Reading Program:** With a graduate student as a mentor, researched continuum cardinal invariants, including the bounding, domination, splitting, and reaping numbers. Presented Cichon's Diagram of cardinal characteristic results.

## TECHNICAL SKILLS

- **Languages:** Python, Lua, Java, C, C++, Javascript
- **Frameworks:** TensorFlow, Keras, Scikit-Learn, PyTorch, NodeJS
- **Math Software:** Lean4, Sage, Maple, MatLab

## PRESENTATIONS

- **Geometric characteristics of symmetric numerical semigroups in the Kunz Cone** - *San Diego State*, August 2022
- **Eigenvalues, Multiplicities, and Graphs** - *College of William & Mary*, July 2021
- **Cardinal characteristics of the Continuum** - *Rutgers University*, May 2021

## RELEVANT COURSEWORK

- Algorithms (Graduate)
- Artificial Intelligence
- Machine Learning
- Nonlinear Optimization (Graduate)
- Probability Theory (Graduate)
- Formal Languages & Automata
- Combinatorics I & II (Graduate)
- Graph Theory (Graduate)
- Game Theory (Graduate)
- Linear Algebra
- Matrix Analysis
- Mathematical Analysis I & II
- Measure Theory (Graduate)
- Ergodic Theory (Graduate)
- Fourier Analysis (Graduate)
- Complex Analysis (Graduate)
- Algebra I (Graduate)
- Point-Set Topology

## SERVICE

### Department of Mathematics

Rutgers University

*Undergraduate Grader*

*August 2020 - May 2021*

- Graded for two sections of Math 311: Intro to Real Analysis, providing timely feedback to both the students and the instructor.

### SAS Honors Program

Rutgers University

*Undergraduate Tutor*

*September 2020 - Present*

- Tutored peers in Math 300: Introduction to Mathematical Reasoning and Math 411: Mathematical Analysis I.