

# Jacob Mantooth

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## RESEARCH EXPERIENCE

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### Mean First Passage Times for Transport Equations August 2023 –

- Develop a general theory for the mean first passage time (MFPT) for velocity jump processes
- Utilizing computational simulations to visualize and analyze how diffusing particles respond to radial directional cues within these constrained environments
- Comparing analytical solutions to numerical simulations in predicting the outcomes of radial directional guidance on diffusion

### Exploring Tetrahedral Meshes in Finite Element Research May 2023 – August 2023

- Conducted detailed finite element analysis using tetrahedral meshing
- Applied tetrahedral meshing techniques to solve structural problems in Brunille beams, enhancing the precision and reliability of stress and deformation predictions under various load conditions

### Understanding Reinforcement Learning Through Games August 2022 – May 2023

- Investigated reinforcement learning strategies within various game environments, focusing on continuous, single-discrete, and multi-discrete action spaces to determine optimal models for different scenarios.
- Designed and developed three unique game simulations tailored to test the effectiveness of reinforcement learning algorithms in diverse settings.
- Conducted comparative analyses of four distinct reinforcement learning methods across each game, documenting performance metrics to evaluate and refine each algorithm's efficiency and accuracy.

### Generalizing the Boltzmann Equations August 2022 – May 2023

- Explored the dynamic interactions between two colliding rarefied gases composed of monatomic molecules, aiming to understand fundamental kinetic behaviors
- Sought to derive the Boltzmann Equation utilizing the Edgeworth series expansion instead of the traditional Maxwellian distribution, enhancing the theoretical framework for non-equilibrium statistical mechanics

### Mathematics of Deep Learning, and SVD May 2021 – December 2022

- Examined the mathematics of deep learning
- Explored the PCA dimensional reduction and linear regression and how these work when interchanged
- Provided a proof for the interactions of PCA and linear regression
- Using Python, Jupyter notebooks, TensorFlow, NumPy, and Pandas, created deep learning models to examine the mathematical tools utilized

### Comparing RL to OC Methods on the Continuous Mountain Car Problem May 2022 – July 2022

- Compared three methods in solving the continuous mountain car problem
- Investigated the trade-off between data-driven RL methods and model-driven optimal control methods on the continuous mountain car problem
- Used Hamilton-Jacobi-Bellman (HJB) equation to train an approximating neural network for the value function

### Temperatures Affect on Ultra Sonic Waves January 2021 – May 2021

- Investigated the relationship between temperature changes and the propagation characteristics of ultrasonic waves, focusing on practical implications in various mediums.
- Conducted experiments using multiple oil types to demonstrate that increasing temperatures lead to a measurable decrease in sound velocity, thereby validating theoretical predictions.

### **Covid-19 and Travel** June 2020 – December 2020

- Analyzed Google travel data to uncover diverse relationships between travel patterns and Covid-19 transmission rates, providing insights into pandemic dynamics.
- Developed and deployed multiple interactive models to visually represent the impact of Covid-19 on U.S. travel trends; hosted online to facilitate accessible public and academic review
- Employed statistical methods to identify correlations between travel activities and virus spread, enhancing the predictive accuracy of Covid-19 outbreak models.

### **Operation Research** January 2020 – May 2020

- Assigned to a local oil trucking business named Cantrell Jackson to manage and evaluate data to improve their operations
- The primary goal was to optimize truck efficiency and evaluate each customer to determine their value to the company

## **EDUCATION**

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**University of Notre Dame**  
*Ph.D, Applied Mathematics*

August 2023–  
 Southbend, IN

**East Central University**  
*B.S., Mathematics, Physics*

August 2019 – May 2023  
 Ada, OK

**Lindsay High School**  
*High School Diploma*

August 2015 – May 2019  
 Lindsay, OK

## **POSTER PRESENTATIONS**

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**Understanding Reinforcement Learning Through Games**  
*Oklahoma Research Day*

March 2023

**Comparing RL to OC Methods on the Mountain Car Problem (1st Place Winner)**  
*2022 Computational Mathematics REU at Emory University*

July 2022

**Temperatures Affect on Ultra Sonic Waves**  
*McNair Intern Poster Display*

April 2022

**Mathematics of Deep Learning, and SVD**  
*Oklahoma Research Day at the Capital (Chosen to be my school only representative )*  
*Oklahoma Research Day*  
*Oklahoma Academy of Science*

March 2022  
 March 2022  
 November 2021

**Covid-19 and Travel**  
*Oklahoma Research Day*  
*Oklahoma Academy of Science*

March 2021  
 November 2020

**Cantrell Jackson**  
*Oklahoma Research Day*

March 2020

## ORAL PRESENTATIONS

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### Understanding Reinforcement Learning Through Games (2nd Place Winner)

OK-AR MAA

March 2023

### Mathematics of Deep Learning, and SVD

Oklahoma Academy of Science

November 2021

### Covid-19 & Travel

Oklahoma Academy of Science

November 2020

## CONFERENCE ATTENDED

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### 30th Annual UMBC McNair Scholars Research Conference

October 2022

### OK-LSAMP 28th Annual Research Symposium

October 2022

## SKILLS

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**Languages** : Python, Matlab, HTML, Git, R, Linux, C , Excel

**Skills** : Computer skills, Leadership experience, Communication skills, Collaboration talent, People skills, Problem-solving abilities

## PROFESSIONAL EXPERIENCE

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### ECU Tutor

2021-2022

*Tutor*

Ada, OK

- One-on-one tutoring in Mathematics, Biology, and Physics
- Adapted teaching style to the unique needs of students
- Prepared weekly lesson plans to help students prepare for their courses
- Recognize the primary role of helping students become more confident, more successful, self-directed learners

### TH Rogers Lumber Co. Lindsay

2020-2021

*Yard Foreman*

Lindsay, OK

- Manages yard operations and works in yard to assist customers
- Managed dry wall delivers to customer
- Maintained yard and warehouse upkeep and repairs
- Ensure safe and effective use of forklift machines
- load products, and deliver and transport materials to customer sites

### Super C

2019-2020

*Manager*

Lindsay, OK

- Ensure that grocery shelves are maintained clean and organized
- Provide excellent customer services for sales growth
- Unload/load delivery trucks
- Ensure safe and effective use of forklift machines
- Manage daily operations of grocery store to meet store goals

## RECOGNITION'S & SCHOLARSHIP'S

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- 2nd Place Winner of the 2023 Research Presentation at OK-AR MAA
- 1st Place Winner of the 2022 Research Poster Competition in the Undergraduate Math/Computer Science Category at Emory REU
- NASA Fellowship
- Ronald E. McNair Research Fellowship
- LSMAP Scholar
- McNair Scholar
- President honor roll(x3)
- Dean honor roll (x2)
- Lance Fenton Math Scholarship
- Higginbotham Family Scholarship
- Charles & Lila Acker Math Scholarship
- Oklahoma Teacher's Promise Scholarship