Sebastian Wyszynski

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Education

University of Illinois Urbana-Champaign Aug. 2022 - May 2025
B.S. Mathematics and Computer Science *Current GPA: 3.9/4.0*

Coursework
- Machine Learning, Object-Oriented & Functional Programming, Data Structures & Algorithms, Systems Programming, Linear Algebra, Non-Linear Optimization, Graph Theory, Compilers

Skills

Languages: Python, C/C++, Rust, Javascript, OCaml, HTML/CSS, LaTeX
Tools: Git/GitHub, Unix, Docker, Pip, Cargo
Libraries: Pandas, NumPy, Sympy, Matplotlib, OpenAI, Pytorch, Requests, Yew, Actix-Web

Experience

Research Assistant | *University of Illinois Urbana-Champaign* Aug. 2024 – Present
- Collaborated with and oversaw undergraduate students in updating AISC standards for enhanced seismic stability
- Designed ML models using Python and scikit-learn to replicate numerical simulation outputs, enabling the creation of more earthquake-resistant building designs.
- Utilized statistical models and advanced data visualization techniques to manage and interpret large datasets.

AI Engineer Intern | *QT Info Systems* May 2024 – Aug. 2024
- Collaborated with a team of three software developers to craft an ChatGPT-like interface.
- Retrieved and processed data from several REST APIs, improving LLM accuracy and integration efficiency by 40%
- Enhanced user experience through innovative function-calling techniques, ensuring seamless data integration.

Research Assistant | *University of Illinois Urbana-Champaign* Jan. 2024 – May 2024
- Automated seismic design using a modular computational framework along with Pandas and object-oriented programming enhancing package efficiency by 4x!
- Contributed to data-driven architectural patterns; selected by Mr. Shitao Shi from 300 applicants.
- Project won Best Audience Choice at the Undergraduate Spring Research Symposium; one of four team members.

Undergraduate Teaching Assistant | *University of Illinois Urbana-Champaign* Jan. 2024 – May 2024
- Conducted weekly office hours and labs, boosting student understanding and problem-solving abilities.
- Simplified and explained data structures and algorithms for 400+ students, enhancing their comprehension.
- Provided one-on-one support to students, helping them achieve their goals.

Research Intern | *Harvard Medical School at Mass General Brigham* Jun. 2023 – Aug. 2023
- Iafrate Research Group for Oncology Research, analyzed 2M+ genetic markers in R; enhanced report efficiency.
- Pioneered cell-free DNA analysis, and developed ML model, increasing early cancer diagnostic accuracy

Projects

Rusty Reflexes | *Rust, Yew, Actix-Web, Gloo, Playwright* Aug. 2024 - Dec. 2024
- Engineered responsive frontend components using Rust and Yew framework for an interactive multiplayer Jeopardy-style buzzer application with real-time bidirectional communication through WebSocket protocols.
- Developed automated testing suites using Playwright within an Agile development team

Snake Game Q-Learning | *Python, Pygame, Reinforcement Learning* Jun. 2024
- Developed and implemented the classic Snake Game, integrating various solving algorithms to enhance gameplay.
- Focused on Q-Learning as the primary algorithm, gaining insight into designing effective reward functions.
- Simplified state encoding to reduce complexity, understanding the trade-offs and errors introduced by this approach, which led to more manageable model training.

Lego Line Taxi @ HackIllinois2024 | *Python, OpenCV, Raspberry-Pi, Circuitry* Feb. 2024
- Developed an autonomous robot that follows a line and avoids obstacles, utilizing state machine architecture.
- Employed color filtering for accurate path alignment and ultrasonic sensors for obstacle detection.
- Developed line following and obstacle avoidance algorithms while addressing sensor inaccuracies.

Personal Statement

Columbia University

PhD in Computer Science

Sebastian Wyszynski

I have always been immersed in the world of science fiction. From seeing imaginary tech in video games to experiencing life-changing tools become reality, I have always pondered indescribable, unattainable technology. Later on, I remember watching *I, Robot* and seeing Isaac Asimov's award-winning novel come to life. Self-driving cars going 125 mph constantly! Artificial general intelligence exists! But how would AI integrate itself into society in practice?

This question, along with many others, sparked my curiosity about the future of deep learning. As years passed, I witnessed inventions like self-driving cars and powerful LLMs able to complete complex tasks which has not only reignited but also deepened my passion for driving innovation. As an undergraduate at the University of Illinois Urbana-Champaign (UIUC), I have experience working and researching within a variety of domains and thus with many different domain experts. The insights I gained from my research continue to shape and influence my work to this day.

In the summer of 2023, I joined Dr. Stefan Kaluziak as part of the Iafrate Research Group through Harvard Medical School in studying the human genome. We sought to diagnose cancer through statistical differences in cell-free DNA patterns. Our objective was to leverage these DNA patterns in the bloodstream to signal tumor growth in the body. I formulated a k-means

clustering algorithm to group the data into comprehensible groups. However, despite using sophisticated ML tools on this problem, it became clear that in order to isolate the relevant signal, more advanced numerical techniques would be required. This inspired me to deepen my understanding of statistical learning theory, particularly in the context of modern advancements in deep learning. Given my foundation in both mathematics and computer science, I'm well-prepared to engage with these complex concepts and rapidly deepen my expertise in this field.

In the Spring of 2024, I had the honor to be a part of the Undergraduate Research in Scientific Advancement (URSA) program at UIUC. I worked with Shitao Shi, a Ph.D student, to enhance an iterative seismic building modeling codebase he built. My main contributions were refactoring, restructuring, and testing for performance. I improved clarity and maintainability of the system through object-oriented programming, design patterns, and automated testing. I also gained valuable domain specific knowledge in seismic stability and the building standards engineers use when designing buildings. Our work led to a four-fold performance increase, culminating in a presentation of my work at the Undergraduate Research Symposium, where the project was recognized for the Best Audience Choice award out of over fifty projects.

After a successful first project, I went on to work with Shitao on an additional project, this time taking on a greater leadership role. As his mentorship responsibilities expanded within URSA, Shi entrusted me with leading a group of students. This project focuses on updating the American Institute of Steel Construction's standards for seismic building construction. The goal of this work was to produce a reduced dimensionality finite element method (FEM) model

augmented with machine learning to mimic the outputs of the currently used (full-dimensional) FEM model. The current FEM model simulates an earthquake acting upon a building in three dimensions, performing calculations for all columns and joints. Our work focuses on developing lower-dimensional representations to reduce computational requirements while maintaining comparable performance. Although the project is still ongoing, our preliminary results are highly promising.

Though I have found a passion in applied research, I recognize the importance of giving back to the community that supported my growth. I have consistently acted as a peer mentor to incoming candidates in my fraternity. Additionally, I worked as an undergraduate teaching assistant for my computer science program's 'Data Structures and Algorithms' (CS 225) course, where I drew on my own experience with the material to effectively explain concepts to students. This Fall semester, I stepped in as a leader to guide students who were embarking on their first research projects. These experiences in mentoring not only sharpen my ability to communicate complex topics but also deepen my appreciation for collaborative research where diverse perspectives and clear communication are essential.

As an undergraduate at UIUC, I dedicated myself to expanding my knowledge in my mathematics and CS major. However, my passion for deep learning remained a constant inspiration. Taking the UIUC machine learning theory course (CS 446) solidified my passion for machine learning. While my research experience covers a range of topics, I am eager to hone my skills in the emerging field of geometric deep learning, wherein neural networks are endowed with symmetries inherent in data to improve their performance, robustness, and generalization.

One such successful example is the incorporation of convolutional neural networks allowing the detection of objects in the presence of arbitrary translations. My goal is to contribute to the advancement of graph-based machine learning models and leverage my previous research experience to effectively apply this to various domains. I am especially drawn to Dr. Vondrick's work at Columbia University on robust perception through equivariance, which introduces a framework that uses dense intrinsic constraints in natural images to robustify inference against adversarial examples at test time. His innovative approach of restoring feature equivariance at inference time has demonstrated significant improvements in adversarial robustness across multiple datasets and tasks, including ImageNet, Cityscapes, PASCAL VOC, and MS-COCO, showing up to 15 points improvement without requiring model retraining.

After my Doctorate degree, I plan to continue pushing the boundaries of machine learning research. My diverse research experiences have shown me that the most impactful breakthroughs often emerge at the intersection of different fields. Combined with my commitment to mentoring and teaching others, I am confident in my ability to not only conduct innovative research but also to communicate complex ideas effectively across disciplines. This positions me to tackle new challenges in machine learning with both rigor and creativity. A PhD at Columbia University would be transformative, providing the advanced expertise needed to further my development as a versatile researcher. Every step in my journey has reinforced my passion for discovery and innovation. Enrolling in this program represents the critical next step in my journey toward becoming a transformative and versatile researcher.