Krirk Nirunwiroj

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Education

University of Wisconsin-Madison — Madison, WI
B.S. in Computer Science, Data Science, and Certificate in Mathematics — Sep 2020 - May 2024
(Graduated with **Distinction in the Major**) — GPA: 3.80/4.00
Relevant Coursework: Large Language Model in Practice, Artificial Intelligence, Classification and Regression Trees, Database Management Systems, Big Data Systems, Algorithms, Multivariable Calculus, Linear Algebra, Linear Optimization, Theory of Probability, Graphs and Networks

Research Experiences

Research Assistant — Madison, WI
*A research sub-group led by **Dr. Yun-Shiuan Chuang**, advised by **Professor Junjie Hu** and **Professor Timothy T. Rogers,** Knowledge and Concepts Lab, UW-Madison* — Dec 2023 - Sep 2024
- Studied human-like LLM agent construction by infusing topic-specific opinions based on belief networks.
- Conducted a factor analysis to identify the underlying belief network across 64 topics and 564 instances.
- Developed LangChain pipeline and a wrapper class for quantization and local loading of open-source models.
- Optimized large-scale experiments with the HTC system, improving experiment efficiency.

Data Analyst Research Intern — Madison, WI
*Epistemic Analytics Lab, Center for Research on Complex Thinking, Wisconsin Center for Education Research, UW-Madison, advised by **Professor David Williamson Shaffer*** — Mar 2023 - May 2024
- Implemented the data analysis pipeline of iPlan, a land-use management game, using Ordered Network Analysis (ONA) to study the strategic thinking of players, collaborating with multiple classes across the USA. [Repo] [Game]
- Engaged in QA testing, identified challenges, and proposed solutions for Codey, an application for developing, validating, and implementing automated coding schemes.
- Collaborated with multiple external researchers on formatting data and using ENA and ONA in their projects.

Student Researcher — Madison, WI
*TRASHBOT, an automated trash collection drone project led by **Dr. Ryan Jacobs**, Informatics Skunkworks, Department of Material Science & Engineering, UW-Madison* — Oct - Dec 2022
- Trained and fine-tuned a YOLOv7 model with the TACO dataset to identify trash in 80 categories.
- Collaborated with the drone navigation team for real-time trash detection integration.

Research Assistant — Nakhon Pathom, Thailand
*LAIGA, a machine learning-based framework for assessing and identifying leaders in college students, advised by **Professor Suppawong Tuarob,** Mahidol University* — Jun - Aug 2021
- Conducted an extensive literature review on 21st-century skills and leadership assessment.
- Automated correlation-based feature subset selection and model selection algorithms using Java with Weka API.
- Tuned model hyperparameters to optimize performance, ensuring the resulting model's accuracy.
- Achieved a 5.87% MAPE in leadership assessment and an 83.2% F1 score in leadership identification.

Publications

[1] Chuang, Y. S., **Nirunwiroj, K.**[†], Studdiford, Z.[†], Goyal, A., Frigo, V. V., Yang, S., Shah, D., Hu, J., & Rogers, T. T. (In press). Beyond demographics: Aligning role-playing LLM-based agents using human belief networks. ***Findings of the Association for Computational Linguistics: EMNLP 2024***. (Long paper)

[2] Chuang, Y. S., **Nirunwiroj, K.**[†], Studdiford, Z.[†], Goyal, A., Frigo, V. V., Yang, S., Shah, D., Hu, J., & Rogers, T. T. (In press). Beyond demographics: Aligning role-playing LLM-based agents using human belief networks. ***NeurIPS 2024 Workshop on Behavioral Machine Learning.*** Available at https://openreview.net/forum?id=yhF93Bwmmd (Short paper)
[Preprint: https://doi.org/10.48550/arXiv.2406.17232]
- Explores how integrating empirically derived human belief networks can significantly improve the alignment of role-playing LLM agents with human behavior beyond demographic information alone.

([†] joint second author)

[3] **Nirunwiroj, K.** (2023). Chitchat bots: A comparative study and behavioral analysis of large language models using epistemic network analysis. In G. Arastoopour Irgens & S. Knight (Eds.), *Fifth International Conference on Quantitative Ethnography: Conference Proceedings Supplement* (pp. 154–157). Retrieved from https://www.qesoc.org/images/pdf/ICQE23_Supplement_Proceedings.pdf#page=157

- Used Epistemic Network Analysis (ENA) to conduct a comparative behavioral analysis between Bard AI and GPT3.5 with over 200 responses on 2 topics.

[4] Pongpaichet, S., **Nirunwiroj, K.**, & Tuarob, S. (2022). Automatic assessment and identification of leadership in college students. *IEEE Access*, *10*, 79041–79060. https://doi.org/10.1109/access.2022.3193935

- Presents an automated system for assessing and identifying leadership in college students using multiple machine learning techniques.

Presentation

Nirunwiroj, K., "Chitchat Bots: A Comparative Study and Behavioral Analysis of Large Language Models Using Epistemic Network Analysis," International Conference on Quantitative Ethnography 2023, *October 8-12, 2023, Melbourne, Australia*

Honors and Awards

Winner, Semi-finals of the **Meta Llama Hackathon** (Meta AI Accelerator Pitchathon Thailand) Sep 2024

- Engaged in core experiments and benchmarks for the proposed product with the Preceptor AI team.

First Runner-up, Agoda Intern Pitch Competition 2022 Jul 2022

- Pitched a new travel planner feature with a team of 7, competing among 100+ interns.

Winner, CheeseHacks 2021 at UW-Madison Oct 2021

- Developed a deaf-blindness assistance app with a team of 4, winning against 100+ participants.

Dean's List, College of Letters and Science at UW-Madison 2020 - 2023

Full Scholarship, The Ministry of Higher Education, Science, Research and Innovation of Thailand 2019 - Present
(Royal Thai Government Scholarship)

- Selected from approximately 1,000 students nationwide for the fully-funded scholarship, which supports undergraduate, master's, and Ph.D. studies at leading international universities.

Work Experiences

CARIVA (Thailand) Co., LTD. Bangkok, Thailand
AI Engineer Intern, PreceptorAI Team Jul 2024 - Present

- Developed LLM systems for generating differential diagnoses from patient cases.
- Proposed customized SAMMO and ensemble techniques, improving top-5 diagnostic accuracy by up to 7.14%.
- Integrated Prompt Flow into the pipeline, streamlining experimentation and accelerating product deployment.
- Applied RAGChecker with the National Comprehensive Cancer Network dataset to evaluate the RAG system, increasing performance and reducing hallucinations in rare diseases and precision medicine tasks.
- Implemented a Reranker model to further refine RAG output quality and relevance.

Phuket Wittayalai School Phuket, Thailand
UX/UI Designer & Full Stack Developer Aug 2024 - Present

- Developed a scalable course enrollment platform, supporting over 2,000 users with high uptime and efficiency.
- Designed and delivered a Figma prototype, securing approval from the curriculum committee.
- Architected the full-stack solution, implementing the front end with React and the back end with Node.js.

Agoda Services Co., LTD. Bangkok, Thailand
Software Engineer Intern, YCS Desktop team May - Aug 2022

- Boosted website efficiency by removing RUM and BoomerangJS and utilized Grafana for performance tracking.
- Fortified security by transitioning the C# codebase from REST to Gateway API.
- Modified database queries, tests, and codes in Scala and SQL, shifting from the main to a copied database.
- Updated payment method appearance using React, anticipating a 5% UPC payment option increase.

Teaching Experiences

Student Assistant Madison, WI
College Algebra (Precalculus), Department of Mathematics, UW-Madison Sep 2021 - May 2022

- Facilitated in-class discussions and managed student queries during breakout groups for 50+ students.

- Hosted drop-in sessions in the Pre-Calculus Lab, providing support to fellow students.
- Collaborated with professors to address challenges, offering solutions and teaching approaches.

Instructor Phuket, Thailand
C++ Programming Workshop, Phuket Wittayalai School Oct 2017
- Delivered an intensive C++ programming lecture to 30 gifted-program middle school students.
- Offered after-class consultations, assisting with programming concepts and advising on educational pathways.

Selected Projects

Oyasumi Madison, WI
Team Lead, Android Developer; Team of 4 [Repo] Sep - Dec 2023
- Developed a sleeping diary app with features: dream notes, AI interpretation, and a sleep tracker.
- Designed user interfaces and created a prototype for the app proposal using Figma.
- Implemented the app in Android Studio using Java, integrating SQLite, GPT-3.5, and visualization libraries.
- Created a presentation poster and demonstration video, presenting the app to an audience of over 100 people.

Agoda Travel Planner Bangkok, Thailand
UX/UI Desginer, Presenter; Team of 7 Jun - Aug 2022
- Used Figma to design a new travel planner feature for the Agoda mobile application.
- Demonstrated and presented to over 100 interns, senior employees, and the executive board of Agoda.

SixCents Madison, WI
Full Stack Developer; Team of 4; [React: Repo; Present] [Flutter: Repo; Present] Oct 2021 - Mar 2022
- Developed a deaf-blindness assistance app featuring Text-to-Braille, Image-to-Braille, and handwriting recognition
- Assumed a leadership role, providing direction for naming, graphics, demonstration, and presentation.
- Implemented vibration features and image recognition for the image-to-Braille feature using Heroku and Flask.

Leadership and Involvement

International Conference on Quantitative Ethnography 2023 Melbourne, Australia
Poster Presenter/Reviewer and Organizer Assistant 2023
- Anonymously reviewed research posters, maintaining high academic and presentation standards.
- Developed and designed instructional materials for ENA and ONA workshops.
- Managed bibliographic data for conference proceedings using Zotero.

Epistemic Analytics Lab Madison, WI
Data Analyst Research Intern and Outreach Member 2023 - 2024
- Reviewed prospective interns' profiles and interviewed candidates for internship positions.
- Improved guidelines for new interns, mentoring in data analysis techniques and lab technologies.
- Facilitated technical support and problem-solving in Codey and ONA workshops at the QE Summer Institute 2023, assisting over 20 international quantitative ethnography researchers.

Thai Student Association at UW-Madison Madison, WI
Vice President 2021 - 2022
- A key organizer of the Laos-Thai-Cambodian New Year event, drawing over 60 attendees in collaboration with APIDA, the Multicultural Student Center, and Thai instructors at UW-Madison.
- Oversaw 3 event planning committees, ensuring effective collaboration and event success.
- Enhanced and maintained the organization's online presence, including the website, social media, and store.
- Handled financial oversight, maintaining expenditure records in collaboration with the financial chair.

Technical Skills

Languages: Python, R, SQL, AQL, C, C++, C#, Scala, Java, JavaScript, HTML, CSS, Dart, LaTeX
Frameworks & Platforms:
- **NLP/ML/Analytics**: Hugging Face, Transformers, LangChain, OpenAI, Vertex AI, Azure AI, MLflow, Prompt Flow, PyTorch, Scikit-learn, TensorFlow, NumPy, Pandas, Weka, Epistemic Network Analysis, Ordered Network Analysis
- **Web & App Development**: React, Node.js, Flutter, Flask, Android Studio, Postman, Dialogflow, Figma
- **Cloud, DevOps & Big Data**: Google Cloud Platform, Modal, Docker, Hadoop, Spark, Cassandra, Kafka, ArangoDB

Growing up with a mother who was a high school teacher, I witnessed the challenges in the education field from an early age. Inspired by this exposure, I use my coding skills to help ease the burdens on educators and enhance the learning experience through various projects, including a virtual physics lab application I developed during the COVID-19 pandemic to assist my AP Physics teacher. These projects confirmed the feasibility of my ideas and fueled my vision of using computer science to revolutionize education. When I later discovered machine learning (ML) and natural language processing (NLP), I realized their vast potential for transforming educational systems, particularly in Thailand, where I observed significant shortcomings. This realization, along with my passion for education, led me to secure **a full scholarship from Thailand's Ministry of Higher Education, Science, Research and Innovation** to study computer science in the USA. These opportunities guided my undergraduate research on NLP and ML applications in education—a pursuit I am eager to advance further during my Ph.D. studies at Columbia University.

Early in my research on applying machine learning to education, I co-authored the paper "*Automatic Assessment and Identification of Leadership in College Students*" with Dr. Siripen Pongpaichet and **Dr. Suppawong Tuarob** from Mahidol University [1]. We developed a machine-learning framework to identify student leaders using academic profiles and data from learning management systems. Our models classified leaders and predicted leadership scores in *Administrative*, *Conceptual*, and *Interpersonal* aspects. By optimizing features and fine-tuning algorithms like Random Forests and Support Vector Machines, we achieved a 5.87% mean absolute percentage error and an 83.2% F-score. This project not only honed my ML skills but also provided valuable tools for educators to recognize and nurture leadership qualities in students.

To deepen my understanding of Learning Science, I joined the Epistemic Analytics Lab at the Wisconsin Center for Education Research (WCER) as a data analyst research intern under **Dr. David Williamson Shaffer**, primarily on the iPlan project. Using Ordered Network Analysis (ONA), which

models directional coded data as dynamic networks via singular value decomposition, I analyzed the actions and behavior of over 500 users in the iPlan land-use planning game, collaborating with multiple classes in the US schools. This research revealed diverse strategies employed by players, highlighting the potential to assess students based on their strategic thinking rather than just numerical scores or grades.

Building on my work at the Epistemic Analytics Lab, I explored the application of Large Language Models (LLMs) to Learning Science by studying the behaviors of ChatGPT and Bard AI. I generated over 200 responses from conversations between the two AIs and coded them across five dimensions: *Agreement*, *Appreciation*, *Negative*, *Robot*, and *Suggestion*. Using Epistemic Network Analysis (ENA), a symmetrical counterpart model to ONA, I created a comparison model highlighting statistical differences. Bard AI expressed appreciation and agreement more frequently, mimicking human interaction, while ChatGPT provided suggestions and explicitly identified as an AI. I presented my research poster, "*Chitchat Bots: A Comparative Study and Behavioral Analysis of Large Language Models Using Epistemic Network Analysis*," at the **International Conference on Quantitative Ethnography 2023** [2]. This project demonstrated the diverse behaviors of LLMs and their ability to simulate human interaction, deepening my interest in exploring their potential and the possibility of applying them to educational tools to improve student learning.

Seeking more hands-on experience in LLM and NLP research, I collaborated with **Dr. Junjie Hu** as a second author on the paper "*Beyond Demographics: Aligning Role-playing LLM-based Agents Using Human Belief Networks*," accepted for **EMNLP 2024 Findings** [3] and the **NeurIPS 2024** Workshop on Behavioral ML [4]. We investigated integrating belief networks into LLM agents to better emulate human-like opinions. My role involved preprocessing and analyzing belief survey data through factor analysis to uncover underlying belief networks. Using this data, I implemented a LangChain pipeline to construct LLM agents capable of generating opinions on controversial topics. I also created a

custom LangChain-compatible wrapper class to load and quantize open-source models such as Mistral AI and Llama locally. Results showed that integrating specific topic opinions improved alignment across related belief network topics, highlighting belief networks' potential for enhancing LLM agents' social simulations. By improving human-likeness in AI agents' responses, they can more accurately reflect human opinion, benefiting many educational tasks such as teaching assessment. This possibility of leveraging AI technologies to enhance the education system solidified my decision to pursue a graduate degree in Computer Science, focusing on NLP.

At Columbia University, the diverse NLP coursework offers an exciting path for deepening my expertise in the field. I am particularly drawn to *COMS 6998: Natural Language Generation and Summarization*, where I can explore multimodal generation and long-format question answering. This course's focus on ethical considerations will help me build responsible NLP systems. *COMS W4995: Semantic Representations for NLP* will deepen my understanding of semantics—which is essential for creating meaningful educational NLP applications. Lastly, *COMS 6998 (15): Introduction to Deep Learning and LLM-based Generative AI Systems* offers hands-on experience with LLMs, from pretraining to fine-tuning. These courses, paired with Columbia's renowned faculty, will equip me to develop innovative NLP solutions for education.

During the doctoral program, I am particularly excited to work with **Dr. Zhou Yu** and **Dr. Smaranda Muresan**, whose research closely aligns with my interests in AI and NLP for education. Dr. Yu's work on real-time intelligent systems, like the LLM-based Negotiation Coaching System ACE [5], resonates with my goal of designing educational tools that use LLMs to support underrepresented groups. Similarly, Dr. Muresan's research on aligning AI systems with human values aligns with my work on belief networks in LLM agents [3][4]. Her study, "*Is ChatGPT a Better Explainer than My Professor?*" which evaluates LLMs in educational settings [6], inspires my research interests in using LLMs for complex teaching systems requiring long-form text and summarization.

Though my journey to becoming an educator-researcher harnessing AI for better learning is long, Columbia University offers the ideal environment to pursue these aspirations. With experience across various research labs, I am confident that I can quickly adapt to new teams, projects, and cultures under the guidance of esteemed faculty. Becoming a Columbia Ph.D. student is a crucial next step toward my dream of advancing language technologies that enhance student education globally.

References

[1] Pongpaichet, S., **Nirunwiroj, K.**, & Tuarob, S. (2022). Automatic assessment and identification of leadership in college students. *IEEE Access*, *10*, 79041–79060. https://doi.org/10.1109/access.2022.3193935

[2] **Nirunwiroj, K.** (2023). Chitchat bots: A comparative study and behavioral analysis of large language models using epistemic network analysis. In G. Arastoopour Irgens & S. Knight (Eds.), *Fifth International Conference on Quantitative Ethnography: Conference Proceedings Supplement* (pp. 154–157). Retrieved from https://www.qesoc.org/images/pdf/ICQE23_Supplement_Proceedings.pdf#page=157

[3] Chuang, Y. S., **Nirunwiroj, K.**, Studdiford, Z., Goyal, A., Frigo, V. V., Yang, S., Shah, D., Hu, J., & Rogers, T. T. (In press). Beyond demographics: Aligning role-playing LLM-based agents using human belief networks. *Findings of the Association for Computational Linguistics: EMNLP 2024*.

[4] Chuang, Y. S., **Nirunwiroj, K.**, Studdiford, Z., Goyal, A., Frigo, V. V., Yang, S., Shah, D., Hu, J., & Rogers, T. T. (In press). Beyond demographics: Aligning role-playing LLM-based agents using human belief networks. *NeurIPS 2024 Workshop on Behavioral Machine Learning*. Available at https://openreview.net/forum?id=yhF93Bwmmd

[5] Shea, R., Kallala, A., Liu, X. L., Morris, M. W., & Yu, Z. (2024). ACE: A LLM-based negotiation coaching system. *arXiv Preprint*. https://arxiv.org/abs/2410.01555

[6] Li, G., Alshomary, M., & Muresan, S. (2024). "Is ChatGPT a better explainer than my professor?": Evaluating the explanation capabilities of LLMs in conversation compared to a human baseline. *arXiv Preprint*. https://arxiv.org/abs/2406.18512