

# JAPNEET SINGH

☎ 765-694-9001 ✉ [sing1041@purdue.edu](mailto:sing1041@purdue.edu) [in linkedin.com/in/japneet-singh6](https://www.linkedin.com/in/japneet-singh6) [github japneet644](https://github.com/japneet644) [🎓 Japneet Singh](#)

## Education

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### Purdue University

*Ph.D. in Electrical and Computer Engineering, West Lafayette, IN, USA*

**Aug 2022 - May 2026 (Expected)**

*GPA: 4.0 / 4.0*

### Indian Institute of Technology Kanpur

*B.Tech-M.Tech (Dual Degree) in Electrical Engineering, Kanpur, India*

**Jul 2017 - May 2022**

*B.Tech GPA: 9.6/10.0, M.Tech GPA: 10.0/10.0*

## Professional Experience

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### Purdue University | Graduate Research Assistant

**Aug 2022 - present**

- Developed a testing framework to evaluate the goodness of fit of comparison data to a Bradley-Terry-Luce(BTL) model.
- Established the minimax optimality of the test and conducted evaluations on real-world datasets using Python.
- Extended the testing framework to generalized Thurstone models based on maximum likelihood based techniques.
- Evaluated how accurately real-world datasets, such as NFL matches, LMSYS LLM leaderboard, and preference datasets for LLM and RL reward models, etc, conform to an underlying BTL or a Thurstone model based on the hypothesis test.
- Working on extending the framework to contextual BTL models used for modeling preferences in fine-tuning of LLMs.

### Indian Institute of Technology Kanpur | Researcher (Master's Thesis)

**Jan 2021 - Apr 2022**

- Researched on weighted matrix completion and analyzed the impact of subspace information on the reconstruction error.
- Designed a weighted nuclear-norm minimization algorithm, provided its convergence analysis and Python simulations.
- Quantified performance gains in multi-user wireless networks, demonstrating a 20% increase in per-user data rate.

### University of California Santa Cruz | Research Intern

**May 2021 - Jul 2021**

- Introduced two new architectures that achieve a 1000x reduction in storage costs and a 200x decrease in communication costs associated with blockchain's historical data and simultaneously provide the confidentiality of the stored data.
- Developed a construction of the secret sharing scheme satisfying the requirements of the protocol.

### Indian Institute of Technology Kanpur | SURGE Research Fellow

**May 2019 - Jul 2019**

- Trained conditional generative models in *TensorFlow* to combat slowing down of MCMC algorithms near criticality.
- Used trained generative adversarial network (GAN) models for unsupervised phase transition detection.
- Proposed a hybrid conditional GAN & MCMC algorithm adapting to distribution errors and improving accuracy by 10%.

## Projects

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### Large Language Model (LLM) Based Search Engine Optimization | *Python, LangChain*

- Developed a LLM based query understanding and rewriting system using LangChain to improve search query specificity.
- Implemented a search result filtering method that utilizes advanced RAG techniques such as top-K retrieval and re-ranking to provide LLM-driven answers for the user queries.

### Testing for Ranking Models | *Python*

- Developed a test to validate the common contextual BTL modeling assumptions in preference datasets used for LLM training with RLHF. The test justified using a mixture of reward models for RLHF as it better fits the preference data.

### IEEE Signal Processing Cup 2021 | *MATLAB, Python*

- Developed channel estimation techniques for frequency selective channels through Dictionary Learning.
- Optimized IRS configuration for maximizing spectral efficiency using gradient ascent and Newton's Algorithm.

## Technical Skills

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**Languages:** Python, C, C++, SQL,  $\text{\LaTeX}$ , MATLAB

**Software's/Libraries:** Git, TensorFlow, PyTorch, LangChain, Solidworks

## Selected Publications

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- *Minimax Hypothesis Testing for the Bradley-Terry-Luce Model*. Under review. [\[Link\]](#)
- *Hypothesis Testing for the Generalized Thurstone model*. Under review. [\[Link\]](#)
- *Doebelin Coefficients and Related Measures*. IEEE Transactions on Information Theory, Feb 2024. [\[Link\]](#)
- Testing for the Bradley-Terry-Luce model. Proceedings of IEEE ISIT 2023. [\[Link\]](#)
- *Conditional generative models for sampling and phase transition indication in spin systems*. SciPost Phys., 2021. [\[Link\]](#)

## Awards

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- **2022:** Recipient of the **Dr. Vijay K. Varma Talent Award**, graduation award at IIT-Kanpur.
- **2021:** **Qualcomm Innovation Fellowship 2022**, India.
- **2017-21:** **Academic Excellence Award**, for 4 consecutive years at IIT-Kanpur,
- **2016:** **KVPY scholarship Awardee**, India.