Varun Nagaraj Rao

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EDUCATION

Princeton University Princeton, NJ
Doctor of Philosophy in Computer Science Aug 2022 - Present
Research: Societal Impacts of AI on Labor
Selected Coursework: HCI (TA), Technology Policy and Law, Privacy, Ethics of Computing (TA), Responsible AI (TA)

Carnegie Mellon University Pittsburgh, PA
Master of Science in Electrical and Computer Engineering **GPA 3.96/4.0** Dec 2019
Coursework: Computer Vision (16-720B), Machine Learning (PhD) (10-701), Convex Optimization (18-660), Security and Fairness in Deep Learning (18-739), Advanced Multimodal Machine Learning (11-777), Foundations of Cloud and ML Infrastructure (18-847F)

PES Institute of Technology Bangalore, India
Bachelor of Engineering in Computer Science and Engineering **GPA 9.97/10 (**Rank 1/132) May 2018

RESEARCH EXPERIENCE

Princeton University Princeton, NJ
Research Assistant, Center for Information Technology Policy (CITP) (Advisor: Prof. Andrés Monroy-Hernández) Aug'22 - Present
- Workers Algorithm Observatory (WAO): Understanding gig worker concerns and building tools (e.g. FairFare) to measure and mitigate AI and algorithmic systems harms; Focus on rideshare and delivery platforms.
- OpenDeli: Designing a protocol for decentralized food delivery enhancing worker agency
- Defined and measured a new form of discrimination through image selection by job advertisers on Facebook.

Carnegie Mellon University Pittsburgh, PA
Research Assistant, CyLab Security & Privacy Institute (Advisors: Prof. Camille Cobb and Prof. Lujo Bauer) Aug - Dec 2019
- Understanding the privacy needs and attitudes of incidental home IoT users by conducting in-person focus groups.

Carnegie Mellon University Pittsburgh, PA
Research Assistant, Robotics Institute (Advisor: Dr. Donghyun Yoo and Prof. Kris Kitani) Sept 2018 - May 2019
- Deep Learning based 6DoF Camera Pose Estimation from monocular RGB and depth images - SOTA on 7 scenes dataset.

Carnegie Mellon University Pittsburgh, PA
Undergraduate Research Intern, Electrical and Computer Engineering (Advisor: Dr. Tze Meng Low) June - July 2017
- Implemented an exact Triangle Counting Algorithm with a speedup of up to 2000 times the baseline miniTri algorithm.

PUBLICATIONS

Societal Impacts of AI and Technology:
1. **V. N. Rao**, S. Dalal, E. Agarwal, D. Calacci, A. Monroy-Hernández, "Rideshare Transparency: Translating Gig Worker Insights on AI Platform Design to Policy" (*in submission*)
2. **V. N. Rao**, E. Agarwal, S. Dalal, D. Calacci, A. Monroy-Hernández, "QuaLLM: An LLM-based Framework to Extract Quantitative Insights from Online Forums", *CHI 2024 LLMs as Research Tools Workshop, (in submission to archival venue)*
3. **V. N. Rao**, A. Korolova, "Discrimination through Image Selection by Job Advertisers on Facebook", *ACM Conference on Fairness, Accountability, and Transparency (FAccT'23)* (Preliminary versions presented at *EAAMO'22* and *PLSC'23*)
4. C. Cobb**,** S. Bhagavatula*, K.A. Garrett*, A. Hoffman*, **V. N. Rao*,** L. Bauer, "I would have to evaluate their objections: Privacy tensions between smart home device owners and incidental users"**,** *Privacy Enhancing Technologies Symposium (PETS 2021)*

Explainable AI and Multimodal Machine Learning:
1. **V. N. Rao**, S. Choudhary, A. Deshpande, R. Satzoda, S. Appalaraju, V. Mahadevan "RAVEN: Multitask Retrieval Augmented Vision-Language Learning" *(in submission)* [arXiv]
2. **V. N. Rao*,** X. Zhen*, K. Hovsepian, M. Shen, "A First Look: Towards Explainable TextVQA Models via Visual and Textual Explanations", *Workshop on Multimodal Artificial Intelligence (MAI), NAACL 2021*
3. **V. N. Rao,** M. Shen, "Misspelling Detection from Noisy Product Images", *Conference on Computational Linguistics - Industry Track* (COLING 2020) - **Outstanding Paper Award** (top 2.5% - 16/644)
4. S. Suresh*, **V. N. Rao***, G. Srinivasa, "Gamification of a Visual Question Answer System", *Technology for Education (T4E) IEEE 2018*, and *VQA Challenge and Visual Dialog Workshop, Computer Vision and Pattern Recognition (CVPR) 2018.*
5. **V. N. Rao**, R. Mahale, S Pai, and V. Kumar. "Extracting and Visualizing Character Associations in Literary Fiction using Association Rule Learning." *Advances in Computing, Communications and Informatics (ICACCI) IEEE 2018*

High Performance Computing:

1. T. M. Low, **V. N. Rao**, M. Lee, D. Popovici, F. Franchetti, and S. McMillan. "First look: Linear algebra-based triangle counting without matrix multiplication." *High Performance Extreme Computing Conference (HPEC), IEEE 2017* (***MIT/IEEE/DARPA Graph Challenge 2017 Honorable Mention***)

Computer Science Education:

1. M. Ferland*, **V. N. Rao***, A. Arora, F. Reiber, M. Luu, R. Huynh, S. Poulsen, A. Poel, M. Shindler, "A Dynamic Programming Concept Inventory: Key Steps, Challenges and Consequences" *(in submission)*
2. M. Luu, M. Ferland*, **V. N. Rao***, A. Arora, R. Huynh, F. Reiber, J. Wong-Ma, M. Shindler, "What is an Algorithms Course? Survey Results of Introductory Undergraduate Algorithms Courses in the U.S.", *Technical Symposium on Computer Science Education (SIGCSE 2023)*

PROFESSIONAL EXPERIENCE

Amazon Web Services   San Francisco, CA
Applied Scientist II Intern, AWS Bedrock   May - Aug 2023

- Showed that captioning, VQA and image classification can be modeled through a unified retrieval augmented encoder-decoder vision-language architecture, with no pretraining and additional trainable parameters; paper under review.
- Experiments demonstrate the benefits on image captioning (+1 CIDEr on MSCOCO, +4 CIDEr on NoCaps) and VQA (+3 % accuracy on VQA v2) tasks compared to the non-retrieval baselines.

Amazon.com Inc   Seattle, WA
Applied Scientist II, Multimodal AI - Product Assurance, Risk and Security (PARS)   Feb 2020 - July 2021

- Explainable multimodal text-in-image and classification models to help protect customers and build seller trust.
- Invited Talk "Explainable Multimodal TextVQA Models" - Amazon Machine Learning Conference (AMLC) 2020
- Outstanding Paper Award for "Misspelling Detection from Noisy Product Images" (top 2.5% - 16/644) at COLING 2020

Apple, Inc   Cupertino, CA
Computer Vision Intern - Core Recognition Team   May - Aug 2019

- Enhanced the accuracy of the OCR system by upto 28% and expanded support for handwritten text.

Akamai Technologies   Bangalore, India
Software Development Intern - Analytics Database Team   Feb - Apr 2018

- Designed and implemented a release checklisting framework that reduced the time for checklisting in a sprint by upto 2 days.

SKILLS

- Programming Languages: Python, C++; Deep Learning and Computer Vision Libraries: PyTorch, OpenCV

TECH POLICY AND CS EDUCATION OUTREACH:

- Influenced bill language of U.S. first rideshare transparency law passed in Colorado, [SB24-75](#). Released a [policy memo](#) and [blogpost](#). Influencing bill language of a federal digital labor platform transparency and accountability bill along with NELP.
- Co-author of a [report](#) to Colorado Independent Drivers United (CIDU) using rideshare trip data collected via the [FairFare tool](#) to measure platform take rate
- Co-author of CITP's Supreme Court [Amicus Brief](#) in Gonzalez v. Google, examining scope of Section 230 of CDA for recommender systems. Contributed a technical explanation of recommendation systems operation
- Signed on to CITP's U.S. Dist. Ct. for the Northern Dist. of CA [Amicus Brief](#) in Netchoice v. Bonta;examines whether California's Age-Appropriate Design Code Act that regulates the use of dark patterns by online services, violates the First Amendment
- CS Education Research with collaborators from UC Irvine on surveying undergraduate algorithms courses in the U.S. and creation of concept inventory for dynamic programming

SERVICE

- Reviewer - FAccT'24, NAACL'22-23, EMNLP'22-24, ACL'22-24, SIGCSE'23, WebConf 2023, NeurIPS Ethics Review 2023-24
- Teaching Assistant:
  - COS436 Human Computer Interaction (Prof. Andrés Monroy-Hernández), Fall 2024, Princeton University
  - COS598I Responsible AI in Societal Deployment (Prof. Lydia Liu), Spring 2024, Princeton University
    Responsibilities: designing course assignments, holding office hours and grading.
  - COS350 Ethics of Computing (Prof. Arvind Narayanan), Fall 2023, Princeton University
    Responsibilities: designing course assignments, holding office hours, leading precepts/lecture and grading.

INVITED TALKS

- "On Ad Delivery Algorithms", Course: Ethics of Computing (Prof. Arvind Narayanan), Fall 2023, Princeton University
- "Societal Impact of AI on Labor - Studies of Rideshare and Social Media Ad Platforms", Course: Designing the Future of Work (Prof. Andrés Monroy-Hernández), Spring 2024, Princeton University

- "Societal Concerns in Targeted Ad Delivery Algorithms", Course: Responsible AI in Societal Deployment (Prof. Lydia Liu), Spring 2024, Princeton University

WORKSHOPS AND SUMMER SCHOOLS

- Organizer, CSCW 2024 [Workshop on Worker Data Collectives to Improve Accountability, Combat Surveillance and Reduce Inequalities](#)
- Who Counts? Sex and Gender Bias in Data - Workshop, University of California Los Angeles, July 2022
- Graduate Summer School on Algorithmic Fairness, University of California Los Angeles, July 2022
- Boston Differential Privacy Summer School, Boston University, June 2022
- Data Mining and Machine Learning Summer School, Indian Institute of Technology Gandhinagar, June 2016

ACADEMIC HONORS

- COLING 2020 Outstanding Paper Award
- MIT/DARPA Graph Challenge 2017 Honorable Mention
- Gold Medalist and Hamsa Kartik Alumni Award for Rank 1 in CSE Department, PES University 2018
- Prof. MRD and Prof. CNR Rao Scholarship for being in top 5 performers of CSE Department, PES University 2014-18
- Summer Research Fellowship, Indian Academy of Sciences (IAS) 2017
- Scholarship for Higher Education - INSPIRE Scheme for being in top 1% of AISSCE (Class 12), Govt. of India, 2014
- Certificate of Merit in Computer Science Class XII Examination for being in top 0.1% across India, CBSE 2014