

Junaid Ali

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Education

Max Planck Institute for Software Systems and Saarland University

2018- 2024

PhD. In Computer Science (Thesis submitted)

Saarland University

2013 - 2017

Masters in Visual Computing: Top 5% out of 50

GPA 1.2

Selected Courses: Differential Equations in Image Processing and Computer vision, Partial Differential Equations and Boundary value problems, Machine learning, Calculus of Variations, Statistical Natural Language Processing, Vision for Graphics, Geometric Modeling.

Lahore University of Management Sciences

2007- 2011

Bachelor of Science (Honors) Computer Science: Top 10% out of 400

CGPA 3.5, Subject-GPA 3.6

Selected Courses: Discrete Mathematics, Probability, Ordinary differential equations, Computer Vision, Algorithms and Advanced Programming in Java.

Projects

Amazon web services

November 2022 – May 2023

Applied Scientist Intern

- Our paper on **evaluating the fairness of discriminative foundation models in computer vision** was accepted at **AIES23**. We propose a **novel taxonomy** for bias evaluation of **discriminative foundation models**, such as Contrastive Language-Pretraining (**CLIP**), that are used for labeling tasks. We then systematically evaluate existing methods for mitigating bias in these models with respect to our taxonomy. Specifically, we evaluate OpenAI's CLIP and OpenCLIP models for key applications, such as zero-shot classification, image retrieval and image captioning (based on **GPT-2**). We categorize desired behaviors based around three axes: (i) if the task concerns humans; (ii) how subjective the task is (i.e., how likely it is that people from a diverse range of backgrounds would agree on a labeling); and (iii) the intended purpose of the task and if fairness is better served by impartiality (i.e., making decisions independent of the protected attributes) or representation (i.e., making decisions to maximize diversity). Finally, we provide quantitative **fairness evaluations** for both binary-valued and multi-valued protected attributes **over ten diverse datasets**. We find that fair PCA, a post-processing method for fair representations, works very well for debiasing in most of the aforementioned tasks while incurring only minor loss of performance. However, different debiasing approaches vary in their effectiveness depending on the task. Hence, one should choose the debiasing approach depending on the specific use case.

Max Planck Institute for Software Systems

June 2018-Current

PhD student with Krishna P. Gummadi

During my PhD I am working on fairness in machine learning.

- Our work on moderating inconsistency between human decision-makers was accepted at human-centered AI workshop at **NeurIPS23** and at **CSCW24**. Prior research in psychology has found that people's decisions are often inconsistent. An individual's decisions vary across time, and decisions vary even more across people. Inconsistencies have been identified not only in subjective matters, like matters of taste, but also in settings one might expect to be more objective, such as sentencing, job performance evaluations, or real estate appraisals. In our study, we explore whether algorithmic decision aids can be used to moderate the degree of inconsistency in human decision-making in the context of real estate appraisal. In a series of **large-scale human-subject experiments**, we study how different forms of algorithmic assistance influence the way that people review and update their estimates of real estate prices. Through **statistical testing**, we find that both (i) asking respondents to review their estimates in a series of algorithmically chosen pairwise comparisons and (ii) providing respondents with algorithmic advice are effective strategies for influencing human responses. Compared to simply reviewing initial estimates one by one, the aforementioned strategies lead to (i) a higher propensity to update initial estimates, (ii) a higher accuracy of post-review estimates, and (iii) a higher degree of agreement between the post-review estimates of different respondents.

- Our paper **on accounting for model uncertainty in algorithmic discrimination** was accepted at **AIES21**. Traditional approaches to ensure group fairness in machine learning aim to equalize “total” error rates for different subgroups in the population. In contrast, we argue that the fairness approaches should instead focus only on equalizing errors arising due to **model uncertainty** (a.k.a epistemic uncertainty), caused due to lack of knowledge about the best model or due to lack of data. In other words, our proposal calls for ignoring the errors that occur due to uncertainty inherent in the data, i.e., aleatoric uncertainty. We draw a connection between **predictive multiplicity** and model uncertainty and argue that the techniques from predictive multiplicity could be used to identify errors made due to model uncertainty. We propose scalable **convex proxies** to come up with classifiers that exhibit predictive multiplicity and empirically show that our methods are comparable in performance and up to four orders of magnitude faster than the current state-of-the-art. We also propose methods to achieve our goal of equalizing group error rates arising from predictive multiplicity in algorithmic decision making.
- Our paper **on loss-aversively fair classification** was accepted at **AIES19**. Motivated by extensive literature in behavioral economics and behavioral psychology (prospect theory), we propose a notion of fair updates that we refer to as **loss-averse updates**. Loss-averse updates constrain the updates to yield improved (more beneficial) outcomes to subjects compared to the status quo. We propose **convex and tractable proxy** measures that would allow this notion to be incorporated in the training of a variety of linear and non-linear classifiers. We show how our proxy measures can be combined with existing measures for training **nondiscriminatory classifiers**.
- Our paper **on the fairness of time-critical influence maximization in social networks**, was accepted in Human-Centered Machine Learning (**HCML**) workshop at **NeurIPS19**, **ICDE22** and **TKDE21**, a top tier journal in data mining. While existing algorithmic techniques usually aim at maximizing the total number of people influenced, the population often comprises several socially salient groups, e.g., based on gender or race. As a result, these techniques could lead to **disparity across different groups** in receiving important information. Furthermore, in many of these applications, the spread of **influence is time-critical**, i.e., it is only beneficial to be influenced before a time deadline. As we show in this paper, the time-criticality of the information could further exacerbate the disparity of influence across groups. This disparity, introduced by algorithms aimed at maximizing total influence, could have far-reaching consequences, impacting people's prosperity and putting minority groups at a big disadvantage. In this work, we propose a notion of group fairness in time-critical influence maximization. We introduce surrogate objective functions to solve the influence maximization problem under fairness considerations. By exploiting the **submodularity** structure of our objectives, we provide computationally **efficient algorithms with guarantees** that are effective in enforcing fairness during the propagation process. We study the disparity in influence and demonstrate the effectiveness of our approaches through extensive experiments using synthetic datasets and a real-world dataset.
- Our paper **on unifying model explainability and accuracy through reasoning labels** was accepted in Safety and Robustness in Decision Making (**SRDM**) workshop at **NeurIPS19**. we draw upon the insight that in many situations model explainability is a means to assess another related yet distinct criterion - model robustness. In order to render the link between explainability and robustness more explicit, we propose to use **human-understandable reasoning labels** during the training process of DNNs. The reasoning labels are jointly learned with the traditional classification labels. This joint training enables the model to predict a set of reasoning labels with every predicted class label. Then, we tie model **explainability and robustness** by introducing a notion of prediction consistency, whereby the model predictions are accepted—or considered robust—only when the predicted class and the predicted reasoning labels follow a certain pre-specified mapping. We show that by adopting such a framework, one can improve the classification accuracy of the state-of-the-art models (on consistent samples). We further show that using this notion of consistency makes the model more robust to adversarial perturbations.

Max Planck Institute for Software Systems
 Research intern with **Manuel G. Rodriguez**

May 2017-May 2018

- Although point processes have demonstrable predictive power, their generative models make assumptions regarding their functional form. While modeling them by making the intensity of point processes dependent on history through recurrent neural networks (RNNs) yields more expressive model for point processes, modeling any sequential data with just RNNs has a disadvantage as the only source of variability is the output probability density. Inspired by the success of **variational autoencoders** (VAE) in generation of new data, we hypothesize that VAE parametrized by **recurrent marked point processes** (RMTPP) would be a good method to generate plausible and diverse point processes. In order to assess this hypothesis, we built a set up combining VAE and RNNs. Our experiments with homogeneous and inhomogeneous Poisson processes and Hawkes processes confirm this hypothesis. We show that our approach can generate point processes which can **statistically significantly** mimic input point processes. Marked point processes could be used for many applications, e.g. automated music generation.

I led the following two projects:

- **Relationship between Frame-rates and Speed perception:** I investigated the urban legend that speed perception is dependent on frame-rate. To measure the dependence of frame-rate on speed perception, we performed three **psychophysical experiments** using basic stimuli (**Gabor patches**), **animated content** and **real-world footage**. The results show that there is no significant effect of frame-rate on speed perception. There was a lot of variation in participants' responses. Inconsistencies in people's opinions regarding HFR content is not new. There are studies which demonstrate the incongruity of participants' opinions regarding HFR. Our work concludes that frame-rate does not alter speed perception. Perhaps, lack of artifacts in HFR is sometimes being misconstrued by some imaginative viewers as difference in speed. Even if there is an effect, it is too small to be measured.
- **Relationship between Frame-rates and Flicker perception:** Flicker can be defined as jittery motion due to temporal variation in pixels. Since flicker is the most prominent difference between two frame-rates, we posit that it is also a major contributor to the "**film-look**". This work explores the relationship between frame-rate and flicker. Given an input video, we present a model to **calculate per-pixel flicker**. We also present a flicker driven guide to use variable frame-rate technology. For this purpose, we take input video and goal flicker visibility maps, and solve an optimization problem for **spatially and temporally variable**, and spatially and temporally smooth **frame-rate maps**, such that perceived flicker matches with the goal flicker. We use these frame-rate maps as an input for the method proposed by Templin et al. to produce output frames, which have required flicker. By manipulating flicker with our technique, filmmakers can reap the benefits of HFR, without incurring the unwanted "**soap-operatic**" effects.

I worked on a project to improve the results of **3D face reconstruction** from monocular videos.

- I implemented the Hessian and its **Eigen functions** computation, of **flexural energy**. The motivation was to use these Eigen functions as bases for 3D face reconstruction in order to account for **bending** and **stretching** deformations in a triangular mesh, such that we can capture more nuanced feature in human face. The result provided significant improvement compared to **Laplacian bases**.

Social recommendation engine for food.

- Developed and conceived the idea.
- Designed features
- Developed Marketing strategy and competitive analysis.
- Developed cellphone applications for Android and Nokia platforms.

Besides developing android and Samsung TV application, I also mentored interns.

During this job I worked on automated nodules detection in lungs.

- We worked in collaboration with Shaukat Khanum Cancer hospital. The first stage was to construct 3D model of lungs from CT images using mutual information.
- We used **morphological filters** to distinguish cancerous nodules from healthy tissue.

Talks and presentations

Google research

June 2023

Responsible AI group New York

Gave an hour-long research talk on **designing fair systems**.

NeurIPS 2023

December 2022

Human-centric AI Workshop

Gave a talk for our paper on **moderating inconsistency between human decision-makers**.

ICDE 2022

May 2022

A premiere conference on data engineering.

Presented a poster for our paper on **the fairness of time-critical influence maximization in social networks**.

AIES 2022

May 2021

A premiere conference on fairness and ethics in AI.

Gave a talk and presented a poster for our paper on **accounting for model uncertainty in algorithmic decision making**.

NeurIPS 2019

December 2019

Human-centric machine learning workshop

Gave a talk on our paper on **the fairness of time-critical influence maximization in social networks**.

Machine learning summer school (MLSS London)

June 2019

Presented a poster for our paper on **loss aversive fairness**.

AIES 2019

January 2019

A premiere conference on fairness and ethics in AI.

Presented a poster for our paper on **loss aversive fairness**.

Max Planck Institute for intelligent systems

January 2018

Gave a talk on our work on **marked point process generation through variational recurrent marked temporal point processes (RMTTP)**.

Honors and Awards

MLSS London: 11.6 % acceptance rate out of **1200** applicants.

2019

Machine learning summer school is a prestigious and very competitive summer school. It includes lectures by some of the world's leading experts.

Fulbright Scholarship (declined): Less than 200 students from a nationwide population of **200 million**.

2013

I was awarded Fulbright scholarship for masters in computer science at Stony Brook university, however I chose not to avail the opportunity. The scholarship includes full tuition waiver and living stipend for the duration of study.

Plan9 Tech Incubator: 14 teams were selected from a nationwide population of **200 million**.

2012- 2013

Our start-up Nosh Genie was selected in Plan9, a tech incubator. After rigorous testing and pitching sessions, 14 teams were selected. This incubation included free office space, stipend money, laptops, mentoring session and marketing support.

International Conference on Machine Vision Project Competition: 1st prize out of 30 teams.

2012-2013

We presented our bachelor's computer vision course project at ICMV. The project was a video editing. In this project we first performed color-based feature tracking in consecutive video frames. We then used the tracked points to place warped input images on those points generating effects like moving pictures in a newspaper, as in Harry Potter films.

National Outreach Undergraduate Scholarship: 50 students from a nationwide population of **200 million**

2007-2011

My undergraduate studies were funded during 4 years by the university, through the program named National Outreach Program (NOP). In this program few talented students in need of financial assistance are funded by the university as long as they maintain a certain GPA.

Academics Award: Top 5% out of 110 students

2005

Received award for academic performance in high school.

Teaching

Teaching Assistant (Bachelors):
**Computational Biology and
Distributed Software Systems**

Programming

Python, C++, Pytorch, OpenCv

Languages

English, Urdu and basic German

Teaching Assistant (Grad School):
Human Centered Machine Learning
<http://courses.mpi-sws.org/hcml-ws18/>

Publications

6) (De)Noise: Moderating the Inconsistency of Human Decisions,
Junaid Ali, Nina Grgić-Hlača, Krishna P. Gummadi and Jennifer Wortman Vaughan
in Human Centered AI (HCAI) workshop at **Neurips'19, Oral Presentation**

Also accepted at a premier conference in social computing

De)Noise: Moderating the Inconsistency of Human Decisions,
Nina Grgić-Hlača, **Junaid Ali**, Krishna P. Gummadi and Jennifer Wortman Vaughan
in Computer-Supported Cooperative Work in Social Computing (CSCW '24)

5) Evaluating the Fairness of Discriminative Foundation models in Computer Vision,
Junaid Ali, Matthäus Kleindessner, Florian Wenzel, Volkan Cevher, Kailash Budhathoki and Chris Russell
in AAAI/ACM Conference on AI, Ethics, and Society (**AIES '23**). Acceptance rate 29%

4) Accounting for Model Uncertainty in Algorithmic Discrimination,
Junaid Ali, Preethi Lahoti and Krishna P. Gummadi
in AAAI/ACM Conference on AI, Ethics, and Society (**AIES '21**). Acceptance rate 37%

3) Unifying Model Explanability and Accuracy Through Reasoning Labels,

Vedant Nanada, **Junaid Ali**, Krishna P. Gummadi and Muhammad Bilal Zafar
In Safety and Robustness in Decision Making (SRDM) Workshop at **NeurIPS'19**, 2019

2) On the Fairness of Time-Critical Influence Maximization in Social Networks,

Junaid Ali, Mahmoudreza Babaei, Abhijnan Chakraborty, Baharan Mirzasoleiman, Krishna P. Gummadi and Adish Singla
In Human-Centric Machine Learning (HCML) Workshop at **NeurIPS '19**, 2019, **Oral Presentation**

Also accepted at:

Journal: TKDE 21' (Transactions on Knowledge and Data Engineering, premier journal in data engineering), **Full paper**

Conference: ICDE22' (International Conference on Data Engineering, premier conference in data engineering), **extended abstract**

1) Loss-Aversively Fair Classification

Junaid Ali, Muhammad Bilal Zafar, Adish Singla and Krishna P. Gummadi
in AAAI/ACM Conference on AI, Ethics, and Society (**AIES 19**). Acceptance rate 32%