


# Kumar Tanmay

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## Education

**Indian Institute of Technology, Kharagpur, India** 2018 - 2022

Bachelor of Technology (Hons.) in Instrumentation Engineering  
Department: Electrical Engineering | Minor: Computer Science  
CGPA: 8.97/10.0, **Department Rank 3**

**Rajendra Vidyalaya, Jamshedpur, India** 2018

Indian School Certificate (ISC) - 12th Grade - English, Science, Maths, and Computer Science  
Percentage score: 95.6%, **Ranked 1st in school**

**Rajendra Vidyalaya, Jamshedpur, India** 2016

Indian Certificate of Secondary Education (ICSE) - 10th Grade  
Percentage score: 96.5%, **Ranked 1st in school**

## Talks/Presentations

**DUBLIN: Visual Document Understanding By Language-Image Network** [[Slides](#), [Video](#)] Dec 2023  
EMNLP 2023

**A Case and Framework for In-Context Ethical Policies in LLMs** [[Slides](#), [Video](#)] Dec 2023  
EMNLP 2023

## Publications ([Google Scholar](#))

\* = equal contribution

**Kumar Tanmay\***, Sanchit Ahuja\*, Sunayana Sitaram, Vishrav Chaudhary. “Data Efficient Multilingual Instruction Finetuning”. *COLM*. 2024. (Working paper)

**Kumar Tanmay\***, Aditi Khandelwal\*, Utkarsh Agarwal\*, Monojit Choudhury. “Understanding Moral Development of LLMs through the lens of Kohlberg’s Theory of Moral Development”. *ACL/COLM*. 2024. (Working paper)

Utkarsh Agarwal\*, **Kumar Tanmay\***, Aditi Khandelwal\*, Monojit Choudhury. “Ethical Reasoning and Moral Value Alignment of LLMs Depend on the Language we Prompt them in”. *LREC-COLING*. 2024. (Under Review, [pdf](#))

Aditi Khandelwal\*, Utkarsh Agarwal\*, **Kumar Tanmay\***, Monojit Choudhury. “Do Moral Judgment and Reasoning Capability of LLMs Change with Language? A Study using the Multilingual Defining Issues Test”. *EACL*. 2024. (Accepted, [pdf](#))

**Kumar Tanmay\***, Aditi Khandelwal\*, Utkarsh Agarwal\*, Monojit Choudhury. “Probing the Moral Development of Large Language Models through Defining Issues Test”. *Workshop on AI meets Moral Philosophy and Moral Psychology (MP<sup>2</sup>) - Neurips*. 2023. (Published, Workshop, [pdf](#))


Abhinav Rao\*, Aditi Khandelwal\*, **Kumar Tanmay\***, Utkarsh Agarwal\*, Monojit Choudhury. “Ethical Reasoning over Moral Alignment: A Case and Framework for In-Context Ethical Policies in LLMs”. *Findings of EMNLP*. 2023. (Published, [Poster](#), [pdf](#))

Kriti Aggarwal\*, Aditi Khandelwal\*, **Kumar Tanmay\***, Owais Mohammed Khan, Qiang Liu, Monojit Choudhury, Hardik Hansrajibhai Chauhan, Subhojit Som, Vishrav Chaudhary, Saurabh Tiwary. “DUBLIN: Visual Document Understanding By Language-Image Network”. *EMNLP Industry Track*. 2023. (Published, [Poster](#), [pdf](#))

**Kumar Tanmay\***, Kumar Ayush\*. “Augmented Reality Based Recommendations based on Perceptual Shape Style Compatibility with Objects in the Viewpoint and Color Compatibility with the Background”. *Advances in Image Manipulation Workshop (AIM) - ICCV*. 2019. (Published, Workshop, [pdf](#))

Kumar Ayush\*, Burak Uzcent\*, **Kumar Tanmay**, Marshall Burke, David Lobell, Stefano Ermon. “Efficient Poverty Mapping from High Resolution Remote Sensing Images”. *AAAI*. 2021. (Published, [Oral](#), [pdf](#))

Shuvam Chakraborty, Kumar Ayush\*, Burak Uzcent\*, **Kumar Tanmay**, Evan Sheehan, Stefano Ermon. “Efficient Conditional Pre-training for Transfer Learning”. *Workshop on Learning with Limited Labelled Data for Image and Video Understanding (L3D-IVU) - CVPR*. 2022. (Published, Workshop, [pdf](#))

Kumar Ayush\*, Burak Uzcent\*, Chenlin Meng\*, **Kumar Tanmay**, Marshall Burke, David Lobell, Stefano Ermon. “Geography-Aware Self-Supervised Learning”. *ICCV*. 2021. (Published, Poster, [Webpage](#), [pdf](#), )

## Patents

**Kumar Tanmay**, Monojit Choudhury, Subhojit Som, Vishrav Chaudhary, Saurabh Tiwary. “An Efficient Method for Variable Input Resolution Training of Vision Transformer Models”. 2023. (Filed, Microsoft)

**Kumar Tanmay**, Monojit Choudhury, Subhojit Som, Vishrav Chaudhary, Saurabh Tiwary. “A Template-based Multimodal Instruction Tuning Method to Enhance Visual Document Understanding”. 2023. (Filed, Microsoft)

## Work Experience

*Research Fellow, **Turing Team**, Microsoft Research and Development, India*

**Visual Document Understanding, Image QA, Table QA**

Jul 2022 - Aug 2023

Advisors: [Dr. Subhojit Som](#), [Vishrav Chaudhary](#) and [Prof. Monojit Choudhury](#)

- Co-led the development of DUBLIN (*accepted in EMNLP Industry Track 2023*), a large-scale transformer-based encoder-decoder model for visual document understanding that can analyze both text and visual elements in document images (including infographics, webpages, tables, forms, natural images, etc.) achieving state-of-the-art-performance on diverse downstream tasks such as QA, information extraction, bounding box prediction, summarization, image captioning, and classification.
- Standardized 20 multimodal datasets into a unified benchmark format, implementing metrics such as CIDEr, ANLS, Relaxed Accuracy, EM, and F1 score for comprehensive model evaluation.
- Developed a novel and efficient method to handle variable input resolution images, enabling DUBLIN to process documents with varying aspect ratios resulting in significant performance gains for long documents.
- Incorporated synthetic table data derived from private logs and introduced a novel training strategy as part of curriculum learning to enhance the model’s ability to understand tables.
- Developed a template-based multimodal instruction tuning method by creating templates for various tasks thus eliminating the need for external task-specific layers.
- Achieved significant performance improvements, with an average 5% enhancement across 20 benchmarking datasets with notable gains in AI2D (21%), InfographicsVQA (7.5%), and DocVQA (5.6%) compared to existing pixel-only and specialized pipeline based state-of-the-art models.
- Curated multimodal datasets for TableQA and ImageQA to train DUBLIN to support real-world production scenarios in Microsoft Bing.

**Ethical Generalization and Value Pluralism in Large Language Models (LLMs)**

Dec 2022 - Oct 2023

Advisor: [Prof. Monojit Choudhury](#)

- Developed a psychometric assessment tool inspired by the Kohlbergian Moral Development and Defining Issues Test frameworks to evaluate the moral judgment and reasoning capabilities of LLMs, including GPT-4, LLaMA, PaLM, and GPT3.x series. *Accepted in [MP<sup>2</sup>](#) Neurips 2023*.
- Established a comprehensive framework to facilitate the infusion of ethical policies for moral alignment in LLMs by leveraging in-context learning to address complex social dilemmas characterized by conflicting values. *Accepted in Findings of EMNLP 2023*.
- Conducted an in-depth examination of the “Foreign Language Effect” in LLMs, with a specific focus on understanding the moral reasoning abilities of these models within multilingual contexts. *One paper accepted in EACL 2024 and another under review in LREC-COLING 2024*.

**Cryptographically Secure Large Language Models (LLMs)**

Oct 2023 - Present

Advisor: [Dr. Nishanth Chandran](#)

- Engaged in instruction training the Turing Language Model to differentiate instructions from data, employing cryptographic delimiters to prevent man-in-the-middle threats. Focus is on bolstering model security against jailbreak attacks, addressing challenges unaddressed by prompt engineering or post-processing.

**Multilingual Instruction Finetuning**

Sep 2023 - Present

Advisors: [Vishrav Chaudhary](#) and [Prof. Monojit Choudhury](#)

- Engaged in improving the reasoning capabilities of Turing Language Generation Models in multilingual settings, focusing on transformer architectures with 6.7B and 13.6B parameters.
- Established a robust 2.2M multilingual instruction dataset using GPT-4 and GPT-3.5 Turbo, employing systematic prompt engineering methods.
- Analyzed tokenizer fertility across 100+ languages to address tokenization impact, and implemented a systematic pipeline for filtering undesirable samples from the multilingual dataset.
- Conducted extensive instruction tuning experiments, resulting in a remarkable 25% average performance improvement over non-instruction-finetuned models.

## Methods for Faster Inference with Large Language Models (LLMs)

Oct 2023 - Present

Advisor: [Dr. Tejas Indulal Dhamecha](#)

- Exploring methods from matrix compression, quantization, early-exit decoding, and uncertainty quantification to make LLMs amenable to single GPU deployment and faster inference.

## Internship/Academic Research Experience

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*qure.ai, Mumbai*

### Classification and Localization of Tubes and Catheters in Chest X-Ray Images

Summer 2021

Advisors: [Tarun Raj](#) and [Dr. Pooja Rao](#)

[[qXR-BT](#)]

- Developed an end-to-end pipeline for classification and segmentation of medical entities (tubes & catheters) in Chest X-Rays, addressing class imbalance through a weighted-binary cross-entropy loss function.
- Developed a two-step strategy for precise tube tip localization using deep learning-based segmentation and advanced image processing techniques.
- Conducted extensive experiments with various CNN architectures, surpassing baseline methods and contributing to the successful integration of models into qure.ai's deep learning stack for the [qXR-BT](#) product.

*Sustainability and AI Lab, Stanford University, CA*

### Machine Learning for Socioeconomic, Sustainability and Computer Vision Tasks

Fall 2020

Advisor: [Prof. Marshall Burke](#) and [Prof. Stefano Ermon](#)

*Remote Collaborator*

- **Geography-Aware Self-Supervised Learning (ICCV 2021):** Helped develop and validate a novel contrastive learning method for remote sensing data, leveraging spatio-temporal structures and geo-location showing improvements in image classification, object detection, and semantic segmentation.
- **Efficient Poverty Mapping from High Resolution Remote Sensing Images (AAAI 2021):** Helped develop and validate a novel reinforcement learning method to optimize acquisition of high-resolution satellite images based on analysis of free low-resolution imagery, enhancing poverty prediction in Uganda.
- **Efficient Conditional Pre-training for Transfer Learning (CVPRW 2022):** Helped develop and validate efficient and adaptable methods for pre-training dataset filtering to reduce high training costs, emphasizing performance, adaptability, and flexibility.

## Undergraduate Research Projects

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### Medical Tube Abnormality Detection in Chest-X Rays using Deep Learning

Sep 2021 - Mar 2022

Advisor: [Prof. Pabitra Mitra](#)

[[Bachelor's Thesis](#)]

Developed DL algorithms for abnormal tube position detection in Chest X-Rays, achieving a 24% improvement via knowledge distillation. Created a proprietary dataset, incorporating segmentation masks for anatomical regions and ideal tip positions, leading to a 35% avg. improvement in abnormalities detection across tube types. Developed CNN-based segmentation models and applied image processing techniques for optimal detection.

### Typologically Diverse QA - Zero-Shot and Few Shot Language Jackknifing

Fall 2021

Self-Project

[[PDF](#)]

Investigated cross-lingual generalization of multilingual BERT (mBERT) using [TYDI QA](#) dataset, exploring its performance on QA tasks across various languages. Identified linguistic feature impacts on zero-shot transfer, finding that fine-tuning mBERT as a language model on QA questions significantly improved zero-shot cross-lingual understanding, addressing question interpretation challenges.

### Effect of Negative Labels on Conditional Generative Adversarial Networks

Spring 2021

Self-Project

[[PDF](#)]

Proposed a novel data augmentation technique for stabilizing the training of class-conditional Generative Adversarial Networks (CGANs), addressing issues such as non-convergence and mode-collapse. Additionally, introduced a new evaluation metric based on the classification ability of the Discriminator, demonstrating its positive correlation with visual inspection, surpassing traditional metrics like Inception score and FID.

### Augmented Reality Based Context Aware Recommendations

Summer 2019

Self-Project

[[PDF](#)]

Developed a novel consumer targeting system by modeling AR-based data. Created persuasive recommendations by using statistical modeling, an exemplar part-based 2D-3D alignment method to find the best matching 3D models of furniture present in the user's preferred purchase viewpoint in the AR app and a combination of 3D style compatibility and color compatibility algorithms. *Work published in ICCV Workshop 2019.*

## Other Selected Projects

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**MusicAnalyst**, OpenAnalytics (intra-collegiate tech competition), IIT Kharagpur Spring 2022

Led a hostel team, developing a neural network based [model](#) to predict popularity (highest possible revenue) of music tracks based on features associated with the music. Incorporated a meticulously designed loss function to address class imbalance challenges. *Received Second Prize.*

**EthPhoto**, OpenSoft (inter-hostel tech competition), IIT Kharagpur Spring 2022

Co-led the hostel team, developing a decentralized location & tag based photo-sharing app using Ethereum blockchain technology and IPFS storage. *Received Third Prize.*

### Pet Projects 🐾

implemented the following deep learning algorithms in Python/PyTorch

(a) Knowledge Distillation, (b) Deep Convolutional Generative Adversarial Networks (DCGAN), (c) Global Wheat Detection: Detection of Wheat Heads using Faster-RCNN algorithm; confidence scores calculated using weighted boxes fusion (better than Non-Maximum Suppression), (d) Sentiment Analysis using Naive Bayes and Logistic Regression, (e) Character-based model (using LSTM) for Sonnet Generation.

## Awards and Achievements

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**OpenAnalytics Intra-collegiate Tech Competition (Captain) - Second Prize - IIT Kharagpur** 2022

Led a team, developing a neural network based model to predict popularity of music tracks based on the features associated with the music. Competition featured 50 teams.

**OpenSoft Inter-hostel Tech Competition (Co-Captain) - Third Prize - IIT Kharagpur** 2022

Co-led the hostel team, developing a decentralized photo-sharing application (EthPhoto) using Ethereum blockchain technology and IPFS storage. Competition featured 14 teams.

**Honda Young Engineer & Scientist's (Y-E-S) Fellowship Finalist** 2021

Amongst 20 finalists from all over India.

**Kamalavati Syngal and Goralal Syngal Memorial Scholarship** 2019

Awarded for academic excellence at IIT Kharagpur.

**Kishore Vaigyanik Protsahan Yojana (KVPY) Scholarship** 2017

Awarded to 1323 students from around 100,000 applicants by Dept. of Science and Technology, Govt. of India for exceptional aptitude in basic sciences.

**Abhay Seva Sansthan Gold Medal (Class XII)** 2018

Awarded for scoring 100% in Computer Science in ISC (12th grade) board examination.

**C. D. Sinha Award** 2018

Awarded for outstanding performance (95.6%) in ISC (12th grade) board examination.

**Abhay Seva Sansthan Gold Medal (Class X)** 2016

Awarded for scoring 100% in Computer Science in ICSE (10th grade) board examination.

**S. P. Sinha Scholarship** 2016

Awarded full scholarship for 11th & 12th grade due to outstanding performance (96.5%) in ICSE (10th grade) board examination.

## Technical Skills

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**Languages:** Python, C, C++, R, MATLAB, Octave, Spark

**Libraries:** PyTorch, PyTorch Lightning, Tensorflow, Keras, NumPy, Scikit-learn, Selenium, Pandas, OpenCV, Beautiful Soup, Scipy, NLTK, Flask, Tesseract, EasyOCR

## Relevant Coursework + Online MOOCs

Programming & Data Structures (+Lab)

Mathematics I & II

Algorithms I (+Lab)

Marketing & Market Research

[NLP with Probabilistic Models](#)

[Machine Learning](#)

Signals & Networks (+Lab)

Theory and App. of Blockchain

Probability and Stochastic Processes

Big Data Processing

Principles Of Programming Languages

[Convolutional Neural Networks](#)

Data Analytics

Digital Signal Processing

Social Computing

Artificial Intelligence

Transform Calculus

[Sequence Models](#)

## Extracurricular Activities

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**Reviewer/Sub-reviewer** for [ACL 2023](#), [AAACL-IJCNLP 2023](#), and [NAACL 2024](#).

**Teaching Assistant** (2023) for a workshop course in Practical NLP and Large Language Models (LLMs) for undergraduate students at the Indian Institute of Science (IISc) as part of [Kotak-IISc AI-ML Centre](#).

**Volunteer Teacher at eVidyaloka** (2023): Taught Maths and Science to underprivileged children in remote areas of Jharkhand via Skype.

**Technovation Mentor for Youth Coding Initiative** (2022): Mentored 5 high-school girls to build a business plan and mobile app for autistic children that we piloted with 10 families.

**Captain** (2022) of the OpenAnalytics (intra-collegiate tech competition) team of my hall of residence, IIT Kharagpur.

**Co-Captain** (2022) of the OpenSoft (inter-hostel tech competition) team of my hall of residence, IIT Kharagpur.

**Student Academic Mentor, Student Welfare Group, IIT Kharagpur** (2020 - 2022): Looked after the orientation and guidance of 5 new students to ease their transition into college life.

**National Sports Organization** (2018 - 2020): Involved in Health & Fitness/Athletics as part of NSO, IIT Kharagpur.