# Adyasha Patra

## Education

**University of California, San Diego**, MS in Computer Science — Graduation: Jan 2027
*Pursuing Depth Specialization in AI/ML* — **GPA: 4.0/4.0**

**Indian Institute of Technology, Bombay, India**, BTech in Computer Science — Graduation: May 2025
*Honors in CS and Minor in Artificial Intelligence and Data Science* — **GPA: 9.24/10**

## Publications

**Code-Switched Language Identification(LID) for Speech** — July 2024 – November 2024
*Accepted for Publication at EACL 2026* — Guide: Prof. Preethi Jyothi

- Developed an innovative solution to address the real-world challenge of routing multilingual voice queries to the appropriate monolingual or code-switched spoken language understanding(SLU) models
- Improved the identification of embedded English in code-switched languages, overcoming limitations of state-of-the-art language identification models in complex multilingual scenarios
- Addressed overfitting of English in monolingual non-English datasets through parameter-efficient finetuning techniques(PEFT) such as LoRA and adapters, utilizing minimal accented English data

**Word Grouping for NLP Applications** — May 2024 – October 2024
[Preprint] — Guide: Prof. Ganesh Ramakrishnan

- Proposed a novel word-grouping strategy for Indian languages to unify syntactic structures across parallel sentences, addressing the challenges posed by the agglutinative and inflectional nature of these languages
- Demonstrated the effectiveness of the grouping technique through both intrinsic and extrinsic evaluations, including improved machine translation accuracy from Hindi to five Indian languages
- Surpassed traditional phrasal chunking by offering finer semantic granularity and improved alignment, demonstrated by well-aligned dependency parse trees across multiple languages following word grouping

## Research Experience

**Faster LLM Reasoning Using Speculative Tool Invocation** — Sept 2025 - Present
Graduate Researcher | WukLab @ UCSD — Guide: Prof. Yiying Zhang

- Designed & benchmarked a dual-model speculative tool-calling framework (Speculator–Actor) on the GAIA dataset, for pre-execution & caching of safe read-only tools to accelerate LLM agent reasoning
- Performed knowledge distillation on Qwen3-4B using tool-calling trajectories generated by Gemini-2.5-Pro

**Improving Performance of Math Prover Agentic Models** — Oct 2025 - Present
Graduate Researcher | Rose-STL Lab @ UCSD — Guide: Prof. Rose Yu

- Surveyed state-of-the-art Lean4 theorem provers & datasets (DeepSeek-Prover, Gödel, Kimina, NuminaMath)
- Enhancing informal mathematical reasoning in theorem-proving models by transforming Lean4 formal proofs into informal derivations and training Process Reward Models (PRMs) for step-level reasoning evaluation

**ASR to Support Users for Speech Pathologies** — Jan 2025 – May 2025
Undergraduate Researcher | CSALT @ IIT Bombay — Guide: Prof. Preethi Jyothi

- Motivated by Google's Project Euphonia, approached the challenge of personalized ASR for pathological speech by proposing Single Utterance Test-time Adaptation (SUTA) on Wav2Vec 2.0, achieving substantial improvements on the Torgo dataset for dysarthic speakers
- Independently designed a SUTA pipeline that adapts the feature extractor and layer norm layers during inference, and benchmarked it against LoRA-based fine-tuning of Whisper for dysarthric speech

**Multilingual Pre-tokenizer** — Jan 2024 – June 2024
Undergraduate Researcher | BharatGen — Guide: Prof. Ganesh Ramakrishnan

- Enhanced multilingual tokenization for Indian languages by developing a pre-tokenization strategy to address challenges such as suffix-prefix variations and sandhi, key features of Indian linguistic structures
- Combined the pre-tokenization pipeline with Byte Pair Encoding (BPE) and evaluated the impact of the strategy

by analyzing enhancements in fertility scores & continuation rate
- Validated on the IndicCORP-v2 dataset, containing 9.89 million unique Hindi words with expert linguist review

**Cross-lingual Transfer Learning** Jan 2024 – June 2024
Undergraduate Researcher | CSALT @ IIT Bombay Guide: Prof. Preethi Jyothi

- Performed an extensive literature review of state-of-the-art multilingual models and downstream NLP tasks
- Analyzed zero-shot cross-lingual transfer performance by fine-tuning multilingual XLM-R and mT5 models across 11 languages, demonstrating improved transfer when source and target languages share linguistic similarities
- Developed an instance-level finetuning approach using expert models, enhancing accuracy in the target language

## Internships

**Technical Intern (CTO's Office)** July 2025 – Sept 2025
Prodigal (YC W18) Mumbai, India

- Developed a multi-agent autonomous system that takes inputs from Google Sheets, Databricks, & GitHub, while parsing Asana chats for context, to automatically generate dbt models & transformation workflows in SQL
- Automated dbt lifecycle, PRs, & GitHub commits, enabling iterative feedback loops with minimal manual effort
- Optimized production workflow, reducing run-time by 40% via Databricks monitoring and fleet cluster migration

**Research Intern** May 2025 - June 2025
Zingle AI Remote

- Conducted comparative analysis of code agents (Copilot, Cursor, OpenAI Codex, Claude Code) for database documentation in large codebases, assessing correctness, coverage, and usability to guide tooling adoption
- Studied core design principles and workflows of Windsurf and Cursor IDEs to evaluate the need for developing a new IDE for the startup, supporting strategic decision-making
- Analyzed agentic tool call patterns and inefficiencies to better understand existing workflows and identify gaps in current IDE solutions

**Summer Analyst** | Software Developer May 2024 - July 2024
Goldman Sachs Bangalore, India

- Engineered a robust and scalable approval workflow mechanism for the firm's inventory management platform, using Java and Spring Boot to streamline operations and ensure seamless adaptability
- Enhanced risk mitigation by implementing an additional level of check, reducing the potential for critical errors
- Accelerated feature onboarding by developing an extendible & modular framework, reducing development time

**Student Researcher** | Guide: Prof. Andreas Waag May 2023 – July 2023
Technical University of Braunschweig Braunschweig,Germany

- Enhanced lensless microscope magnification to 1.26 by multi-tilt superimposition & Angular Spectrum Method
- Implemented a system to detect rotation angles using the SIFT algorithm, achieving 94.67% accuracy for USAF
- Developed a robust GUI for holographic microscopy, supporting multi-object segmentation & real-time analysis

## Technical Projects

**Dynamic Agentic RAG** | InterIIT Tech | Problem Statement Lead October 2024 - December 2024
**InterIIT Gold for Problem Statement** IIT Bombay

- Designed a dynamic Retrieval-Augmented Generation (RAG) system for efficient query resolution and analysis, simultaneously accounting for token efficiency tailored to the financial domain
- Implemented a novel decomposer framework, build upwards from Contragen to iteratively break down multi-hop queries into parallelizable units, leveraging a critic-generator model for optimal performance
- Explored persona-based multi-agent collaboration for complex analytical queries, incorporating supervisor-agent and swarm interaction paradigms utilizing LangGraph for architecture and LangSmith for testing purposes
- Built a LLM model agnostic and embedding model agnostic architecture, with rigorous testing over 5 open-source and closed-source LLMs and 3 finance-specific and general embedding models

**Incorporating Rewrite Feedback in RLHF** | Human Centered AI | IIT Bombay Jan 2025 - May 2025

- Designed and implemented a synthetic dataset generation pipeline leveraging large language models (Llama-2 and Gemini) to produce paired responses and rewrite-based feedback for reward model training in RLHF
- Developed a binary and rewrite-based scalar reward model using pairwise preference loss to effectively distinguish and rank responses, improving evaluation and fine-tuning of language models
- Automated response evaluation and rewriting by integrating LLM-based preference judgments and rewrite generation, simulating high-quality human feedback under limited data constraints

**Contrastive and Graph-based Learning**
Organization of Web Information | IIT Bombay Jan 2025 - May 2025

- Fine-tuned stance-aware sentence transformers using Siamese and Triplet contrastive learning to distinguish opposing viewpoints in Kialo debates
- Explored information bottleneck trade-offs by compressing BERT representations for intent classification on CLINC-150, incorporating autoencoders and stochastic noise to analyze performance vs. compression
- Enhanced multi-hop QA retrieval by constructing a Graph of Passages and leveraging Graph Neural Networks to model inter-passage relationships, improving passage ranking over standard dense and sparse retrieval methods

**ML for Retrieval** | Information Retrieval | IIT Bombay August 2024 - November 2024

- Optimized large-scale image retrieval using neural locality-sensitive hashing (LSH), leveraging multiple hash tables to mitigate collisions and enhance scalability for complex datasets
- Designed & trained GNN models for large-scale network analysis & link prediction, integrating LSH for inference
- Improved retrieval performance on HotpotQA and WikiNQ datasets by fine-tuning BERT models with query and document likelihood approaches, boosting Mean Average Precision (MAP) by 20% compared to baseline

**Pre-emptive Shielding in RL with Blackout Constraints**
Formal Methods for ML | IIT Bombay August 2024 - November 2024

- Designed and implemented a pre-emptive delta-shield mechanism for the Pacman agent to recommend safe actions under partial observability, including blackout intervals limiting adversary state visibility
- Extended and modified an existing probabilistic shield codebase by integrating blackout scenarios, adapting state-space representation and shield logic to handle uncertainty during blackouts

**Shape Prior Segmentation** | Medical Image Computing | IIT Bombay January 2024 - May 2024

- Improved segmentation on ACDC heart dataset using Shape Prior Module, combining local & global shape priors
- Enhanced scalability, ensuring robust performance of SPM across CNNs & Transformer-based architectures

**Compiler Design** | Implementation of Programming Languages | IIT Bombay January 2024 - May 2024

- Built a comprehensive compiler for C-like language using Lex and Yacc, ensuring accurate syntax analysis
- Designed and implemented key compiler components, such as lexical analysis, parsing, abstract syntax trees, intermediate code, and register transfer language, culminating in the generation of MIPS Assembly code

**Text Style Transfer** | AI and ML | IIT Bombay August 2023 - November 2023

- Investigated Transformer-based architectures for text style transfer without explicit latent space disentanglement
- Conducted reproducibility with architecture modifications, analyzing the impact of changes on text attributes

**Coherence-Enhancing Diffusion** | Digital Image Processing | IIT Bombay August 2023 - November 2023

- Implemented Coherence-Enhancing Diffusion for better flow and completion of interrupted lines in images
- Extended the algorithm to color spaces and conducted a comparative analysis of HSI and RGB models

**Optimal Cue-Stick Control** | Reinforcement Learning | IIT Bombay August 2023 - November 2023

- Developed a reinforcement learning-based billiards agent using Python to optimize cue-stick control
- Utilized state estimation and predictive modeling to improve the agent's accuracy across various game levels

**Minimax Graph Solver** | Design & Analysis of Algorithms | IIT Bombay January 2023 - May 2023

- Engineered a minimax dynamic programming algorithm for a two-player weighted directed graph game
- Implemented memoization to determine optimal strategies, achieving efficient space & time complexity

**Railway Planner** | Data Structures and Algorithms Lab | IIT Bombay August 2022 - November 2022

- Developed an interactive Railway Planner in C++ utilizing various data structures namely Trees, Graphs, Priority queues, Dictionaries and Tries and algorithms, such as QuickSort and KMP Pattern matching
- Utilized Multigraph model and customized Dijkstra's algorithm for optimal route finding with constraints

**Cinemas A-Z** | Software Systems Lab | IIT Bombay August 2022 - November 2022

- Built a web app to view movie and TV show details from IMDb, Rotten Tomatoes, and Metacritic in one platform
- Added 1,000+ movies via web scraping with BeautifulSoup and included a live scraper for real-time updates
- Developed a user database for account management, allowing dynamic recommendations based on user activity

## Scholastic Achievements

- Honoured with the Desai Sethi Scholarship by IIT Bombay in recognition of academic achievements (2023)
- Secured All India Rank of 68 in Joint Entrance Examination JEE Main among 1 million students (2021)
- Achieved All India Rank 284 in JEE Advanced among 0.15 million candidates (2021)
- Awarded the Kishore Vaigyanic Protsahan Yojana KVPY fellowship with an All India Rank of 67 (2020)

## Positions of Responsibility

**General Secretary** May 2024 – Present
Computer Science and Engineering Association, IIT Bombay

- Spearheading a council of 20 members in organizing department cultural and sports events throughout the year
- Managing a budget of 1 million INR, ensuring effective allocation of resources and successful event execution

**Insitute Student Mentor and Department Academic Mentor** May 2023 – Present
Institute Student Mentor Program, IIT Bombay

- Mentoring 12 freshmen by providing guidance and support to help them acclimate to college life
- Mentored 6 sophomores providing them necessary help and guidance regarding academics and internships

**Teaching Assistant** June 2023 – June 2024
CS663: Foundations of Digital Image Processing, Fall 2024, IIT Bombay

- Assisted in providing academic support and graded assignments for around 230 students

**Class Representative** June 2023 – June 2024
Computer Science & Engineering Department, IIT Bombay

- Serving as the primary point of contact between professors, CSE council and a batch of 180+ undergraduates
- Putting forward the concerns of the students to authorities and helping professors in smooth conduct of courses

## Technical Skills

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| **Programming** | C/C++, Python, Java, Bash |
| **Data Science** | Numpy, Pandas, Matplotlib, PyTorch, MATLAB, OpenCV |
| **Development** | Spring Boot, Kafka, HTML, CSS, JavaScript, Git LaTeX |

## Languages Known

English (**Proficient**) Oriya (**Native**) Hindi (**Fluent**) Bengali (**Fluent**)

## Extracurricular Activities

- Selected among the top 35 teams from 500 for the first-ever Peak XV Summit Hack: Consumer AI (2025)
- Attended the two-day Google DeepMind Research Symposium in Bangalore, India (2025)
- Volunteered in community service and built solar lamps for underpriviledged areas (2024)
- Travelled to 11 European countries experiencing diverse cultures with a group of fellow students (2023)
- Completed a year-long training course in Badminton through National Sports Organization NSO (2022)