# Arnav Samal

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## Education

**Present – Nov 2022** | **National Institute of Technology (NIT) Rourkela** — **Rourkela, India**
B.Tech., Computer Science & Engineering | CGPA: 9.12

## Research Experience

**Present – May 2025** | **IIT Hyderabad | Lab 1055 (AI & Vision-Language Group), Dept. of CS** — **Hyderabad, India**
*Research Intern | Advisor: Prof. Vineeth N Balasubramanian*
Working on concept bottleneck models (CBMs) in vision and language for improved ante-hoc interpretability in medical imaging tasks.

**May 2025 – Mar 2025** | **KIIT University | RespAI Lab, Dept. of CS** [🌐] — **Remote**
*Undergraduate Researcher | Mentor: Dr. Murari Mandal*
Investigated mechanistic interpretability for reasoning in large language models using sparse autoencoders to identify and steer interpretable features that influence reasoning performance.

**Mar 2025 – Dec 2024** | **NIT Rourkela | CoNLP Lab, Dept. of CS** — **Rourkela, India**
*Undergraduate Researcher | Mentor: Dr. Tapas Kumar Mishra*
Focused on anisotropy in transformer models, examining its effects on model behavior and performance, and studying approaches to mitigate representation degradation.

**Aug 2024 – May 2024** | **IIT Hyderabad | Data-driven Intelligence & Learning Lab, Dept. of AI** [🌐] — **Hyderabad, India**
*Research Intern | Advisor: Dr. Konda Reddy Mopuri*
Worked on explainability in vision transformers, specifically post-hoc explanation techniques and token pruning methods to enhance interpretability.

## Select Projects

**SketchWarp** — Mar'25 - May'25
*Paper | Source Code*

- Developed a self-supervised learning framework in PyTorch for dense photo-to-sketch correspondences, enabling automatic image-to-sketch warping.
- Designed and implemented training and evaluation pipelines inspired by the "*Learning Dense Correspondences between Photos and Sketches*" paper.
- **Technologies:** *Python*, *PyTorch*

**Capsule Vision Challenge 2024 | Team Seq2Cure** — Sep'24 - Nov'24
*Preprint | Competition Website | Source Code*

- Developed a fine-tuned, multi-model ensemble combining CNN and Transformer architectures, leveraging techniques like weighted random sampling and focal loss to address significant class imbalance.
- The proposed method secured the 5th position in the international challenge, resulting in co-authorship in the official challenge summary paper.
- **Technologies:** *Python*, *PyTorch*, *timm*, *scikit-learn*

**NeurIPS Ariel Data Challenge 2024 | Team Markov's Chain** — Aug'24 - Oct'24
*Competition Website | Source Code*

- Developed a pipeline for exoplanet spectral prediction using calibrated multi-sensor time-series data, implementing spatial-temporal aggregation, phase detection via gradient analysis, and Nelder-Mead optimization.
- Ranked in the top 20% in the NeurIPS-Ariel Challenge, with an evaluation score of 0.5704.
- **Technologies:** *Python*, *SciPy*, *NumPy*

**Measuring Patch Importance in ViT's (Vanilla & Attention Rollout)** May'24 - Jun'24

*Paper* | *Blog* | *Source Code*

- Analyzed patch importance in Vision Transformers using attention scores of the [CLS] token across MHSA mechanims in all blocks, visualizing the distribution of top-k patch tokens.
- Implemented Attention Rollout to propagate attention through layers, creating interpretable visualizations of information flow and enhancing understanding of self-attention mechanisms.
- **Technologies:** *Python*, *PyTorch*, *timm*

## Technical Skills

- **Programming Languages**: Python, C++, C, SQL
- **Libraries & Frameworks**: PyTorch, JAX, HuggingFace Transformers, scikit-learn, SciPy, NumPy, Matplotlib, Flask
- **Tools & Platforms**: Git, GitHub, Conda, Docker, Jupyter, LaTeX, Microsoft SQL Server

## Honours and Awards

**Departmental Rank #9** [🌐] Ranked 9th in the Computer Science & Engineering department at NIT Rourkela based on cumulative academic performance.

**ACM-IKDD Uplink 2025 Program** [🌐] Selected for the competitive CS mentorship program (acceptance rate ∼2%)

**Research in Intelligence & Security Challenges (RISC) 2025 Program** [🌐] Selected for the prestigious program at the University of Maryland

**Worldwide Rank 5 | Capsule Vision Challenge 2024** Top-performing team (Team Seq2Cure) in the Capsule Vision Challenge organized by CVIP 2024.

**2nd Place | HackFest 2024** Secured 2nd place at the hackathon organized by ML4E for undergraduates.

**Kaggle Expert |** Earned expert status for contributions in Datasets & Notebooks.

## Leadership & Extra-Curricular Activities

**ML4E Society, NIT Rourkela** *Core Member* Aug'23 – Present

- Helped establish and grow a student-led machine learning society; conducted sessions, mentored juniors, and contributed to research discussions.

**Inquizzitive, NIT Rourkela** *Quizzer* Sept'23 – Present

- Active member of the quizzing society; participated in quizzes and contributed to team prep and discussions on trivia and strategy.

**Rotaract Club, NIT Rourkela** *Member* Oct'23 – Mar'24

- Contributed to social initiatives, helping organize and participate in community outreach and development events.

**Innovision 2K23, NIT Rourkela** *Event Coordinator, Organizer* Sept'23 – Nov'23

- Assisted in planning and executing events at the annual technical fest; worked closely with teams to ensure smooth coordination.