Statement Of Purpose

I am Sagar Bag, a second-year student at IIT Madras. My deep interest in AI and ML has led me to engage with AI and ML communities, particularly through the **AI Club at CFI** at IITM. Through my involvement, I developed a foundation in ML, acquiring skills in PyTorch, NumPy, Pandas, and more during my freshman year. I was fortunate to be selected to contribute to the **low-light media enhancement** project at the AI Club. I have researched and implemented architectures focused on the **Retinex theory**, incorporating **LUTs (Look up Tables)** for low latency and consistency in video enhancement. Recently, I studied night-time flare removal using diffusion models.

Despite my branch being civil engineering, my initiative and determination have allowed me to self-learn ML and related technologies while maintaining a **CGPA of 9.25**, which I believe reflects my dedication to both my studies and personal growth. To strengthen my foundation, I pursued courses like **"Probability and Statistics"** and **"Linear Algebra"** and completed a course in **Scientific Computing**, where I excelled.

Securing a research internship at **Telekinesis.ai**, a spin-off from **Prof. Jan Peters's** prestigious **Intelligent Autonomous Systems Lab at TU Darmstadt**, was a profound experience. Initially, adapting to the demanding research environment was challenging, given it was my first internship, but with the guidance of exceptional mentors, I learned a great deal over the course of six months. My research focused on **6D pose estimation**, where I developed and tested four different pipelines. One of the pipelines achieved high accuracy but with significant latency. To improve this, I worked on a low-latency model optimized for robot activity, reducing processing time while maintaining a balance with accuracy. Additionally, I explored the combination of RGB data with point cloud data to enhance pose estimation, resulting in more robust and efficient models for real-world robotic applications. Later, I worked on **generating complex robotic sequences and environments** using natural language processing, leveraging state-of-the-art LLMs to automate tasks. I was really happy to see months of hard work finally show great results and it solidified my passion for research

In late October 2024, I joined **Sarvam.ai**, an Indian startup focused on generative AI solutions for Indian languages. I developed **evaluation pipelines for agent conversations** and RAG retrievals, along with LLM proxy-based **data generation to create benchmarks** for agent evaluation. This work tracked improvements in our agents and sharpened my skills in evaluating AI and real-world challenges.

I am deeply fascinated by the cutting-edge research conducted by Kyoto University's esteemed faculty. Specifically, I am intrigued by **Prof. Takayuki Ito's** work, whose research paper **"Multi-agent Systems Negotiation to Deal with Dynamic Scheduling in Disturbed Industrial Context"** delves into theoretical modelling together with real-world applications of negotiation-based reactive control(NRC) methods to streamline manufacturing systems. I am especially interested in broadening this idea by investigating the potential for multi-agent systems to be combined with Large Language Models to create more **adaptive, resilient decision-making frameworks** for practical applications.

Prof. Hidetoshi Shimodaira's novel method in **"Revisiting Cosine Similarity via Normalized ICA-transformed Embeddings"** provides useful insights into cosine similarity through Independent Component Analysis, enhancing interpretability in NLP and word semantics. Based on this research, I intend to explore further the meaning and optimization of the architecture of LLMs, with specific emphasis on **enhancing their interpretability through advanced mathematical techniques**. This will facilitate better semantic comprehension and more effective processing of language.

A summer research internship at Kyoto University presents an exceptional opportunity to advance my journey toward a Ph.D. in Machine-Learning, specifically applying techniques to AI-driven systems, including LLMs and multi-agent systems. The university's world-class research environment, innovative projects, and distinguished faculty provide the ideal platform for applying my theoretical knowledge to real-world challenges. Collaborating with esteemed researchers like Prof. Takayuki Ito and Prof. Hidetoshi Shimodaira will expose me to advanced methodologies and sharpen my academic and research approach.

Kyoto University's emphasis on pioneering research in ML, combined with its outstanding faculty and resources, makes it a top choice for my Ph.D. aspirations. This internship would allow me to immerse myself in Kyoto's academic community, refine my expertise, and contribute meaningfully to cutting-edge projects. Experiencing Japan's rich cultural heritage, a long-cherished dream, further adds to my excitement about this opportunity.