

Personal Statement

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Research Preparation & Experience

I am a senior in Electrical Engineering and Computer Science at Gwangju Institute of Science and Technology (GIST), minoring in Artificial Intelligence and Mathematics, and will graduate in February 2027. My academic journey has been driven by curiosity about how intelligent systems adapt to new situations and reason.

In the summer of 2024, I joined an exchange program at UC Berkeley, where I took courses in AI and Data Science. This experience not only strengthened my understanding of the core theories of AI and data-driven analysis but also gave me the foundation to pursue research on adaptive reasoning.

I am conducting research under the supervision of Professor Sundong Kim,¹ in the Data Science Laboratory at GIST, which pursues research toward AGI. I am currently working on combining generative models with reinforcement learning to address visual reasoning tasks,² and this project is drawing my attention not only to performance improvements but also to the possibility that models can enhance their reasoning capabilities through interaction with their environment and self-improvement. Building on this, I am also focusing on research in test-time adaptation of large language models (LLMs), exploring how LLMs might evolve from static systems into active learners.

To gain a deeper understanding of human cognition and reasoning, I undertook a six-month research internship at Forschungszentrum Jülich with support from Max Planck Korea. At INM-7, directed by Prof. Simon B. Eickhoff,³ I contributed to the Mathematical Neuroscience Group. There, I processed large-scale MRI data of Parkinson’s patients on high-performance computing systems to construct multimodal connectomes, contributing to machine learning-based disease prediction research. Working with brain connectivity patterns provided me with insights into how biological intelligence adapts and maintains functionality in uncertain environments. This experience highlighted the intersection of cognitive neuroscience and AI research and further solidified my commitment to adaptive reasoning.

Research Motivation & Vision

My interest in AI did not begin with its utility in automating complex tasks, but rather with a fundamental question: how can AI systems emulate the uniquely human ability to reason—understanding context and adapting to new environments even with incomplete information? I see AI not as a replacement for human intelligence, but as a collaborative partner that augments human creativity and intuition. Much like the Industrial Revolution reshaped society, AI represents a transformative force, and its future should be one where machines think with us, not for us.

Human judgment is often framed as rational and logical, yet in practice it is intertwined with emotion, social norms, and cultural context. Even notions of “right and wrong” are socially constructed, which means that for AI to genuinely contribute to society, it must go beyond producing correct answers to demonstrate contextual flexibility and value alignment. Just as interpretable linear models are sometimes preferred in medicine over more accurate but opaque deep learning systems, the usefulness of AI will be determined not only by performance but also by its compatibility with human modes of reasoning. From this perspective, I believe adaptive reasoning should be a central focus of the next generation of AI research.

While current LLMs have achieved remarkable success in problem-solving and linguistic reasoning, they still struggle to adapt quickly to unfamiliar settings due to the fixed nature of their parameters. Humans, by contrast, can derive new rules from only a few examples and adjust their behavior accordingly. Current models often fail outside their training distribution, revealing a gap that cannot be bridged by static fine-tuning alone, which functions more like memorization than genuine adaptation. To close this gap, AI systems require mechanisms of self-improvement that enable them to adjust strategies through interaction with their environment.

Reinforcement learning (RL) is particularly compelling in this regard because it captures the fundamental loop of human learning: action, feedback, and adaptation. Just as humans acquire new strategies through trial and error, RL agents can progressively adapt by leveraging environmental feedback. Unlike approaches that simply incorporate external knowledge, RL provides a pathway for systems to restructure internal parameters and knowledge representations, cultivating adaptive reasoning capabilities.

¹<https://scholar.google.com/citations?user=3yQIQfAAAAAJ>

²<https://arxiv.org/abs/2410.11324>

³<https://scholar.google.com/citations?user=wjpISMAAAAAAJ>

My long-term research goal is to enable AI systems to simulate new environments from limited observations, iteratively generate their own training data, and autonomously adapt. This involves not mere parameter adjustment but the reorganization of internal knowledge structures and the discovery of new strategies. In contrast to current retrieval-augmented generation (RAG) systems, which remain dependent on external knowledge sources, I aim to develop models that internalize knowledge structurally and deploy it flexibly in response to situational demands.

Ultimately, my vision is to advance AGI in a form that is human-centered and socially aligned. If AI can think adaptively like humans in unfamiliar contexts, it could serve as a trustworthy, fair, and transparent partner across critical domains—addressing uncertainty in medical diagnosis, supporting personalized education, and enabling rapid decision-making in disaster response. I believe that research on adaptive reasoning is not only a step toward technical progress but also a foundation for realizing a broader vision of human-centered AI.

Learning from Challenges

Since I view adaptive reasoning as a core capability for advancing toward AGI, I considered the Abstract Reasoning Corpus (ARC) a natural and rigorous benchmark to test it. ARC explicitly evaluates generalization and reasoning in AI, where models must solve novel problems from only a few provided examples. Its grid-based inputs contain complex structural patterns that LLMs struggle to process effectively, and the ARC-2 dataset includes roughly 1,000 distinct tasks with unique rules, making it virtually impossible to solve through simple pattern learning alone.

Within these challenging constraints, my research team systematically explored various complementary strategies. We applied multimodal vision-language models to identify objects within the grids and incorporated RL-based feedback and test-time scaling techniques to improve both grid recognition and overall problem-solving performance. Despite these efforts, ARC's difficulty remained unresolved. The latent space failed to capture high-level abstractions, and even with data augmentation or multitask learning, generalization was limited.

Through this process, I gained an important insight: humans can internalize rules and generate strategies from very limited experiences, whereas current models require continuous injections of external data. This gap suggests the need for a self-improvement framework in which models generate their own data and transform it into training resources without relying on external labels.

Although work with ARC did not yield dramatic improvements, it became a turning point for me. What might be considered a “failure” instead gave me the opportunity to refine my research direction, leading to my current focus on test-time self-improvement for adaptive reasoning.

Leadership

I have had the opportunity to exercise leadership in a variety of contexts, which has taught me both responsibility and the

importance of collaboration as an aspiring researcher.

During my military service, I worked as a teaching assistant for trainees, where I learned firsthand the value of teamwork and trust. In academic settings, I later took on leading roles in international collaborations. At Forschungszentrum Jülich in Germany, I designed and coordinated part of a data-processing pipeline for large-scale MRI datasets in a brain connectome project, while preparing a first-author manuscript. Presenting machine learning approaches during group meetings also strengthened my ability to communicate complex ideas clearly to diverse audiences.

I have also demonstrated leadership in industrial and educational settings. As team leader in the Hyundai Motor AI Challenge, I directed the development of a vessel waiting-time prediction model using port logistics data, with our team placing in the Top 25 out of 330. Through the Google Developer Student Club, I guided fellow undergraduates in analyzing state-of-the-art models and Kaggle solutions, fostering collaborative learning. I also served as a teaching assistant for ML and DL courses, leading review sessions and supporting students through assignments and exams.

These experiences taught me that leadership is not only about achieving results but about helping a team learn and grow, even when resources are limited or setbacks occur. Going forward, I hope to continue practicing this kind of leadership within the research community, supporting collaboration and contributing to broader scientific progress.

Expectations and Contributions at AAI-UC

Although I have been fortunate to gain research experiences across institutions, I still lack opportunities to engage in open discussion with the broader AI community about how to situate and refine my ideas. Most of my work has taken place within individual labs, and I now seek to expose my research vision to critical dialogue with participants and mentors who approach AI reasoning from different perspectives.

During AAI-UC, I hope to discuss in particular how we can identify and filter high-quality data during test time. While my own work has focused on self-improvement at test time, I would like to learn from researchers with deeper expertise in machine learning and deep learning about how to determine which data leads to more efficient model learning—not only at test time but also in training more broadly. I believe that discussions on data selection and filtering will be essential for advancing adaptive reasoning in AI.

At the same time, I hope to contribute by actively engaging with the research questions of fellow participants, listening to their challenges, and helping refine their ideas through constructive feedback. I believe that research grows stronger when questions are shared and examined collectively, and I would like to help create such an environment. I would also be glad to share lessons from my international and interdisciplinary experiences, particularly how different research cultures approach similar problems, if this perspective could be useful to our discussions. Above all, I hope to help foster an open and inclusive atmosphere where participants feel comfortable exchanging ideas, asking questions, and learning from one another.