



# Bilateral AI Cluster of Excellence

## Towards a Strategy on AI for Science

The Cluster of Excellence Bilateral AI [[www.bilateral-ai.net](http://www.bilateral-ai.net)] fully supports the European Commission's "Strategy for AI in Science". Arguably, achieving this goal requires a fundamental shift – away from narrow AI systems toward a *broad AI*, which has both an understanding of the world and broad cognitive abilities. A broad AI should successfully perform complex cognitive tasks by virtue of its sensory perception, previous experience, learned skills, knowledge representation, and reasoning. A broad AI would be applicable to different problems and tasks and in particular to AI in Science.

As an illustrative example: in one of BilAI's ongoing projects, researchers actively explore the potential use of LLMs to automate parts of the research process (e.g., automating ways to collect/extract data, compiling parts of surveys). While these applications yield measurable efficiency gains, the resulting outputs often lack transparency, contextual understanding, and reliability—necessitating continuous human oversight. To address these limitations, the team is employing a bilateral approach that combines the generative capabilities of LLMs with the structured reasoning power of knowledge graphs.

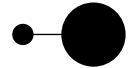
### Current AI Systems Fall Short of Scientific Standards

While recent advances in AI show strong capabilities in specific areas, current AI systems are in a sense narrow. They struggle with genuine understanding, complex multi-step logic, and robust abstractions. Furthermore, they often hallucinate, lack contextual awareness, and provide outputs that cannot be comprehended by humans.

This "black box problem" poses serious risks in high-stakes domains: incomprehensible outputs hinder reproducibility, erode trust in AI-assisted research and violate core scientific standards in research.

### Hybrid Approach to AI in Science

As argued by leading AI scientists, a hybrid approach that tightly integrates machine learning (sub-symbolic AI) with knowledge-based reasoning (symbolic AI), such as logic, ontologies, and knowledge graphs is key to building next level AI systems, which is in particular needed for systems that aid and augment scientific processes, starting from data collection to data interpretation, hypothesis generation, experiment design, and deriving conclusions. A hybrid approach can learn from structured and unstructured data while also reasoning, generalizing and explaining their conclusions in ways that humans can understand by seamlessly blending intuitive pattern recognition with structured, logical reasoning, and verbalizing logical conclusions "back" into human-accessible language or visualizations. It in particular serves hypothesis-driven, interdisciplinary science, where flexibility and formal validation must coexist.



## Strategic Impact: Advancing Core EU Objectives

The hybrid AI approach is uniquely positioned to significantly enhance robustness, adaptability, and interpretability—directly addressing the core shortcomings of current AI systems for science while preserving and amplifying their strengths. Bilateral AI addresses political priorities at the national level that the European Commission has identified as essential. To maximize impact, these initiatives must be strongly supported and scaled across the entire European Union:

### 1. Strategic Autonomy

By investing in foundational AI research developed in Europe, the EU can further reduce its dependence on foreign platforms and asserts technological sovereignty in science and research. The EU must avoid becoming dependent on foreign-developed AI models that embed opaque reasoning, untraceable training data and value systems that are not aligned with European principles.

### 2. Research and Innovation Ecosystems

There is a need to train a new generation of AI scientists who can bridge disciplines and support excellence in foundational research that emerges bottom-up, as evidenced by recent AI advancements beyond large-scale projects. Furthermore, foundational research projects should be complemented by translational projects that make emerging results and tools available for high-impact areas such as drug discovery, safety-critical systems, environmental sustainability, and responsible data infrastructures.

## Policy Recommendations

To realize the transformative potential of novel AI technology and ensure alignment with the EU's strategic ambitions, we recommend the following:

- To effectively position the EU at the forefront of global AI leadership, the EU should formally establish hybrid AI approaches as a cornerstone of the EU's AI strategy
- Creation of dedicated funding lines for foundational AI for science: Ensure Horizon Europe and successor programs explicitly support long-term, high-impact foundational research on AI, not just application-driven funding lines.
- Prevent regulatory fragmentation that could hinder the cross-border scaling of AI solutions within the EU by coordinating national strategies. Currently advances in AI depend on broad access to high-quality data for research. Without decisive steps to enable such access across Member States, the EU risks falling behind international technology leaders.
- Accelerate AI-driven scientific innovation by expanding investments in the European High Performance Computing Joint Undertaking (EuroHPC) to meet the specific demands of next-generation AI-development.