NetSciX2026: International School and Conference on Network Science
February 17^{th}-20^{th}, 2026 - Auckland, New Zealand

Topology and Geometry of a Human+GenAI Cointelligence Structure

Keywords: Curvature, Cognitive mechanisms, Persistent Homology, Human-AI Networks

Extended Abstract

Generative Artificial Intelligence (GenAI) platforms have undergone rapid evolution driven by advancements in deep learning and natural language processing, consolidation of computational capacity, semiconductor power, and the proliferation of multimodal models. Models like OpenAI's GPT-1 (2018) and GPT-2 (2019) demonstrated the capacities of large language models (LLMs), but it was GPT-3 (2020) with 175 billion parameters that enabled human-like text generation [1]. Google with Gemini(LaMDA and PaLM models), Anthropic with Claude, Meta with LLaMA, and other platforms such as Deepseek, Perplexity, Grok, MidJourney, Stability AI, and the integration of GPT-4 into Microsoft's Azure and Copilot, to name a few, have expanded the user's possibilities.

LLM platforms have created new interactions with humans, allowing them to be supported in decision-making processes and, even more so, to obtain answers to specific needs based on a text string as an instruction (i.e., prompts). The traditional human-computer interaction transforms into a new perspective of human-AI dynamics that could change the human cognitive mechanisms and create a cointelligence.

The different roles GenAI platforms assume in daily life can range from being used as support decision tools to agential roles. GenAI platforms, especially the new generation of LLM systems, have increased and popularized their use and have become an everyday tool for many people and in industries ranging from basic education to scientific research. By 2024, an estimated over 1 billion people worldwide had interacted with GenAI tools in several activities and industries, redesigning workflows and best practices for adoption and scaling to add value, according to the strategy of several companies around the world [2]. However, the trajectories of GenAI platforms suggest continued user expansion as models become more efficient and accessible.

As a result, cognitive mechanisms(attention, perception, reasoning, emoting, learning, synthesizing, rearrangement, and manipulation of stored information, memory storage, retrieval, and metacognition) [3], a series of operations carried out in creating and manipulating mental representations of information, could be transformed by incorporating GenAI tools. These mechanisms are changed because of the exponential growth of asking activities on LLM platforms. Functions like writing an essay, creating a code, resolving a math problem, or comparing two books are essential to the learning process of a concept or a skill, recalling a memory, or solving a problem. What happens when the cognitive mechanism is a result of a prompt to a machine? Could LLM Platforms change agency capacity? Could the capabilities of the human mind be limited? Could human-machine create a cointelligence system?

In this paper, I analyze the evolution of cointelligence structure as a result of interactions between cognitive mechanisms and GenAI using a toy model based on a survey battery. The exponential growth of different AI tools is used to support a large variety of activities and decision-making processes that represent the transformation of intelligence, but GenAi is not a replacement or substitute. This scenario emerges as part of a topological and geometric data analysis of the structure of interactions in a cointelligence scenario between human cognitive

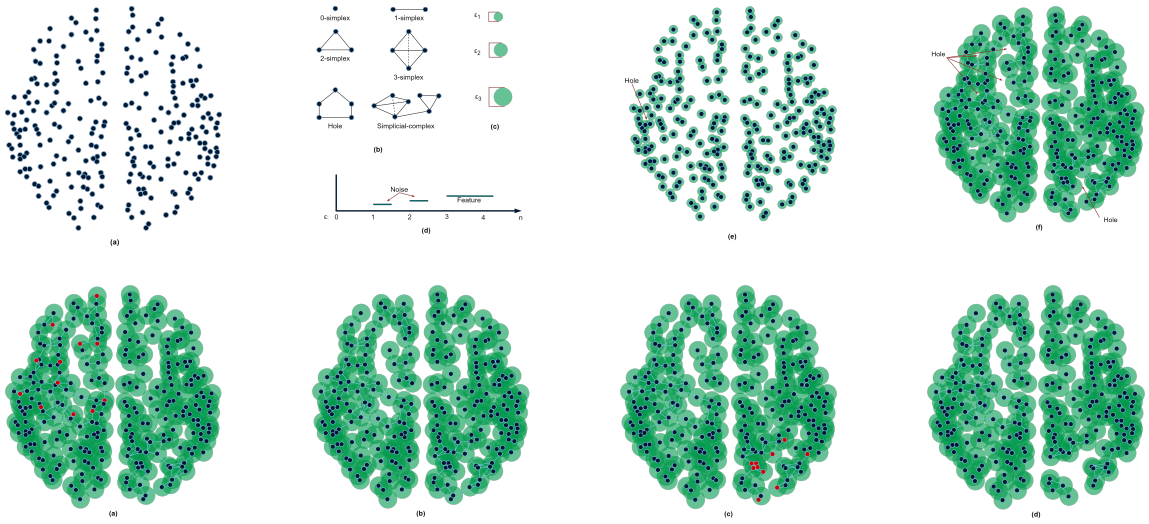

Figure 1: **(a)** Cloud Points. **(b)** Simplicial complex and Homology. **(c)** Filtration sequence: single Hole.**(d)** Filtration sequence: an example of a Hole in a Vietoris-Rips Complex.**(e)** Failures in Cognitive Mechanism Network in t. **(f)** New Homology in Cognitive Mechanism Network in t_1. **(g)** Failures in Cognitive Mechanism Network in t_2. **(h)** New Homology in Cognitive Mechanism Network in t_3.

mechanisms and GenAI. To develop this proposal, first analyzed the features of brain functionality from a basic network structure model. Second, an empirical analysis of the cognitive mechanisms using persistent homology and curvature. Third, a model that represents the interactions of GenAI using the same methods. Fourth, a joint model is developed with some experiments and results.

The sophisticated evolution of LLM platforms seems set to replace some cognitive mechanisms (Figure 1), such as those related to everyday tasks or high-skilled tasks, that humans have developed over the centuries. However, one of the challenges for human-AI dynamics is linking information to co-create knowledge and a cointelligence that simultaneously captures complex capacities of the human brain networks, the cognitive mechanisms, and the GenAI networks. For instance, improving the human intelligence participation of the hierarchical structure of the asking processes into modules at multiple levels of complexity, considering information derived from structural connectivity between Humans and AI, at the same time, detailing dynamic properties between brain networks and GenAI networks.

References

[1] Tom B. Brown et al. “Language models are few-shot learners”. In: *Proceedings of the 34th International Conference on Neural Information Processing Systems*. NIPS ’20. Vancouver, BC, Canada: Curran Associates Inc., 2020.

[2] Alex Singla et al. *The state of AI: How organizations are rewiring to capture value*. QuantumBlack. AI by McKinsey. 2025.

[3] Denise Krch. “Cognitive Processing”. In: *Encyclopedia of Clinical Neuropsychology*. Ed. by Jeffrey S. Kreutzer, John DeLuca, and Bruce Caplan. New York, NY: Springer New York, 2011, pp. 627–627. URL: https://doi.org/10.1007/978-0-387-79948-3_1443.