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Designing richer Human-Machine Interactions for Complex Organizations: A Category-Theoretic Approach with Memory Evolutive Systems

Abstract: This talk introduces a conceptual mathematical framework that advances Human-Machine Interactions in complex organizations by enabling richer, multi-level artificial cognitive systems that not only process and store data but may also. generate new strategies (a challenge in AI). This framework is applied to model a conceptual "Data-Analyser", DA, operating within a social organism S, supported by a human group, G. In this model, DA comprises four interactive units related to: Receptors, Processing, Long-term Memory and Output. G and DA collaborate on data collection, shared learning, situational anticipation, and adaptive decision-making. Notably, the DA is also designed to learn autonomously, developing its own procedures, even creating new ones in time.

Our framework is grounded on the "Memory Evolutive Systems" (MES) theory due to Ehresmann and Vanbremeersch [cf. M.E.S in Elsevier 2007], a Category-Theoretic mathematical approach for evolutionary, hierarchical, multi-scale, multi-agent, and multi-temporality complex systems. It leverages the MES' "Emergence Theorem" which models how such systems evolve through successive "complexification" processes over time. In particular, a core outcome of these processes is the creation of a "macro-landscape," a collective global workspace emerging when multi-agents named "co-regulators" can cooperate. Here, it models how G and DA act as co-regulators of S, forming a 'macro-landscape' through two phases: first by constructing a shared understanding of the situation ("retrospection") and then by collaboratively searching strategies, evaluating them, and selecting one ("prospection"). This co-regulatory dynamic enhances both individual and cooperative decision-making between G and DA over time, enabling richer, multi-level artificial cognitive systems.
To illustrate, we propose an application of this framework in health prevention within a care home for vulnerable persons.

Keywords: Human-Machine-interactions; Theory of categories; Memory Evolutive Systems; Artificial Intelligence; Memory; Learning, Data Analyzer.

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