Toward Human-AI Co-Evolution: Integrated Learning Framework and Critical Self-Regulation Mechanisms

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Abstract

Human-AI Integrated Learning (HAI-IL) reconceptualizes collaborative cognition through a four-layer constructivist framework (self, cognitive, interaction, external), demonstrating how adaptive co-evolution occurs across cognitive, decision-making, and feedback dimensions. Where traditional learning systems separate human and machine roles, HAI-IL establishes interdependent symbiosis: Externally, learners operate as unified human-AI entities (Hybrid-intelligence), while internally, AI functions as cognitive extensions rather than replacements. A self-regulation mechanism driving Ethical Dual-Spiral (human chain and AI chain) Regulation ensures alignment between human values and AI operations, dynamically monitoring system outputs against "AI for Social Good" principles. Our findings reveal this framework enhances proactive human agency while enabling neural-like adaptability in AI agents. The model demonstrates particular efficacy in multiple-fields, where HAI-IL mitigates workforce polarization risks inherent to AI-deployment. We suggest that AI development needs deeply integration with human. By establishing technical benchmarks through dual-perspective measurement methodologies, HAI-IL moves beyond reactive human-AI interactions toward true mutual adaptation systems.

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