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# Artificial Intelligence Techniques to Enhance Actors' Decision Strategies in Socio-ecological Agent-Based Models

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**Abstract:** Agent-Based Models (ABMs) are indispensable to studying the aggregated impacts of individual actions of heterogeneous interacting adaptive agents. Concurrently, artificial intelligence has been employed for decades to simulate autonomous actions of individual entities that react, learn and exchange information with an environment and one another. There are obvious synergies between the two computational approaches. For example, artificial intelligence is often used to enhance agents' behaviour in ABMs. Artificial intelligence learning algorithms (AILAs) allow for a richer agents' architecture for operationalization of more realistic learning decisions beyond a simplistic treatment of agents' cognitive and sensory capacities. Firstly, we review recent socio-economic and spatial ABMs that employ different AILAs to create individually, socially and spatially intelligent agents. We provide a systematic structured analysis of the types of AILAs employed in various application domains, their specific operationalization in an agent's decision-making for various tasks, treatment of spatial and social environment in the design of AILAs, and the level of empirical information used in ABM. We highlight the trends in the current practice of AILAs used to enhance ABMs, which social simulation modellers may rely on when designing their ABM simulations. Secondly, we present an example of a spatial agent based model where agents rely on both information from their spatial landscape and water quality in the local watershed as well as on the comprehensive risk assessment. We compare the performance of the model using simplified decision making on the agent level vs. agents enhanced with an artificial intelligence learning.

**Keywords:** *Machine Learning; Multi-Agent Systems; Spatial Intelligence; Social Intelligence; Supervised Learning.*