Agent-Based Simulation Modeling of Crowds on Collective Intelligence Genome

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Abstract

One of the most widely used techniques for the analysis of crowds, such as evacuations, pedestrian flow, or vehicular traffic, among others, is agent-based simulation. Reasoning and decision making are crucial processes, but modeling them correctly requires knowledge representation; the methodologies used to represent knowledge and manage interactions between agents are fundamental to creating effective and realistic models. Multi-agent models often oversimplify human or social behaviors, which can result in unrealistic representations. The lack of modeling accuracy and the complex interaction between agents can limit the validity of the results, being one of the biggest challenges in multi-agent models. We propose making use of the collective intelligence genome proposed by Thomas Malone as a methodology for the representation of crowds through agent-based simulation. The definitions that compose it can be understood as an ontology for crowd representation. We have related the components of the genome directly to the components of an agent-based simulation model: What=agent actions, why=behavior motivators, how = how they perform actions, and describe it as an ontology. We have also developed case studies to test the methodology.

Keywords

Crowds, agent-based simulation, collective intelligence, collective intelligence genome and agent-based simulation methodology.

Biographies

Dr. Lindsay Álvarez-Pomar is an Associate Professor and researcher in the area of Industrial Engineering. She obtained her PhD in Engineering at the Universidad Distrital Francisco José de Caldas, with emphasis in Information Science and Knowledge. Her academic background also includes a master's degree in industrial engineering from Universidad de los Andes. In addition, she is an Industrial Engineer graduated from Universidad Distrital Francisco José de Caldas. Currently, Professor Alvarez-Pomar is a professor at the Universidad Distrital Francisco José de Caldas. Her research interests include collective intelligence, urban mobility, simulation, knowledge management and production management. She is co-founder and researcher of the research group Knowledge Acquisition and Representation - Expert Systems and Simulation (ARCOSES) at the same university.

M.Sc. Oscar Buitrago-Suescún is an associate professor at the Universidad Militar Nueva Granada (UMNG) in Colombia. He has a degree in chemical engineering from Universidad Nacional de Colombia and a master's degree in industrial engineering from Universidad de Los Andes. In his academic role, Professor Buitrago-Suescún has contributed to various areas of industrial and chemical engineering. He has participated in research related to the optimization of industrial processes and the evaluation of technical efficiency in educational institutions. His contributions in areas such as optimization, data envelopment analysis and industrial processes stand out.

M.Sc. Andrés Zambrano-Arenas is a software developer and Data architect with an academic background in engineering. He studied at the University of La Rioja, where he obtained his master's degree in Big Data. He is a systems engineer from the Universidad Cooperativa de Colombia. In his professional career, he has worked at the Ministry of Finance and Public Credit of Colombia, at the Secretariat of Social Integration of Bogota, at the Colombia Compra Agency, Parques Nacionales Naturales and other governmental entities in Colombia, where he has contributed to projects related to information management and processing. His main research interests are data architecture and the representation and analysis of organizational systems.