Multi Micro-Agent System Middleware Model based on Event Sourcing and CQRS Patterns for Complex and Massively Distributed Artificial Intelligence Systems

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Abstract

Distributed and multi-agent systems are a natural solution for solving complex distributed intelligence problems that require high performance computing. However, setting up such solutions requires making wise choices to resolve emerging issues such as load balancing, high availability, fault tolerances, failure recovery, and distributed agent communication models. In recent years, micro-service architectures have reached a high level of maturity due to the development of containerization solutions such Docker, container orchestration solutions such Kubernetes, cloud computing such AWS, security standards such Oauth2 and Open Id Connect protocols, the Big Data tools ecosystem, and the DevOps tools ecosystem. The challenges of micro-services architectures have been accompanied by the search for suitable patterns and the development of a Framework to find the simplest and the best way to implement and orchestrate such architectures. The Command Request Responsibility Segregation (CQRS) and Event Sourcing patterns which are based on distributed asynchronous event-driven architectures are a couple of patterns that have demonstrated their effectiveness for the implementation of massively distributed architectures based on micro-services. However, the middleware and Framework for the development of multi-agent systems have not evolved and have not followed the same trend and have remained in architectures hampered by old specifications such as the FIPA, Foundation for Intelligent Physical Agents. Therefore, frameworks for multi-agent systems such JADE (Java Agent Development) that meet its specifications, have been widely consumed by the scientific community to solve complex problems of distributed artificial intelligence. However, in the production environment of such solutions is handicapped by the performance of this kind of Framework because of their building model architectural witch uses a non-high scalable data distribution and processing models. These problems appear clearly for the problems which require high performance computing, with a very high level of load growth and for massively distributed architectures in which the number of agents is very large. The development of a new generation of Brokers such KAFKA, opens new opportunities to build a new generation of Frameworks for multi-agent systems with a very high level of performance compared to the existing models. This presentation aims to expose the problematic of challenges of Distributed Artificial Intelligence based on Multi Agent Systems, and present new models of middleware for massively multi-micro-agent distributed systems based on event driven architecture and using event sourcing and CQRS Patterns.