

HLAgent: Scalable AI Agent for HLA Region Analysis with a natural language interface

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Accurate human leukocyte antigen (HLA) imputation and fine-mapping are critical for understanding the genetic basis of autoimmune diseases, as the HLA region exhibits exceptional polymorphism that significantly challenges conventional SNP-based association analyses. Existing command-line bioinformatics tools require manual tuning and complex format conversions, creating barriers for researchers. Here, we introduce HLAgent, a scalable multi-agent AI system that analyzes the HLA region through a natural language interface powered by state-of-the-art large language models (LLMs). HLAgent enables researchers to perform high level HLA analysis through conversational interactions. HLAgent supports Google's Agent to Agent (A2A) protocol, which allows it to interact with other specialized AI agents, and also supports Model Context Protocol (MCP), HLAgent dynamically incorporates external tools and services, allowing researchers to leverage community-developed resources to provide more accurate, domain aligned answers to HLA related questions. A key feature of HLAgent is its flexible workflow orchestration, which empowers researchers to customize analytical pipelines, selectively execute specific nodes, and resume computations from intermediate checkpoints. By providing an intuitive AI agent chat user experience, HLAgent facilitates the transformation of raw data into actionable biological insights aligned with the wisdom stage of the DIKW hierarchy. This approach democratizes access to advanced HLA analysis, potentially accelerating discoveries in autoimmune disease and precision medicine.