

Project Title : Distributed Semantic Northeastern Policy Chatbot with Akka Cluster and LLM Integration

Project Team : Individual

Introduction and Motivation: This project develops an intelligent, domain-specific chatbot focused on Northeastern University’s policy documents. The system leverages the Akka Actor Model to provide a fault-tolerant, distributed architecture that concurrently handles multiple user queries across cluster nodes. By integrating Qdrant’s vector similarity search with large language models (LLMs) such as OpenAI GPT or HuggingFace, the chatbot delivers precise, context-aware answers to natural language questions about university policies. This combination of scalable actor systems and advanced NLP aims to transform static policy texts into an accessible, interactive knowledge resource, improving user experience for students, faculty, and staff seeking timely policy information.

Key Use Cases:

- **Policy Information Retrieval:** Users ask detailed questions about Northeastern’s policies (e.g., academic, housing, legal), receiving semantically relevant, comprehensive, and up-to-date answers.
- **Efficient Multi-User Support:** The Akka Cluster design ensures the system handles multiple simultaneous sessions with high availability and responsiveness.
- **Audit and Logging:** LoggingActors track query flow without impeding performance, supporting monitoring and future improvements.

Example Queries and Expected Responses:

User Query	Expected Chatbot Response
<i>"What is Northeastern’s policy on academic integrity?"</i>	“Northeastern’s Academic Integrity Policy prohibits cheating, plagiarism, and unauthorized collaboration. Violations can result in penalties up to dismissal. See Policy ID 111 for the complete guidelines.”
<i>"When was the last revision of the housing policy?"</i>	“The University Housing Policy was last revised on March 10, 2025. Recent changes include updated guest visitation rules and maintenance procedures.”

Expected Outcomes:

- A distributed Akka Cluster actor system with at least two locally simulated nodes running specialized actors (RoutingActor, LLMACTOR, LoggingActor).
- Integration of Qdrant vector search for semantic indexing and retrieval of policy documents.
- LLM-driven natural language generation that contextualizes search results to generate precise answers.
- Demonstration of Akka’s tell, ask, and forward messaging patterns in an end-to-end user query flow.
- A runnable prototype, accompanied by documentation and a demonstration of system resiliency and concurrency.