Module 3: Portfolio Milestone

Natural Language Processing

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**Final Portfolio Project Plan**

This project will develop a chatbot that demonstrates adaptive control in an uncertain dynamic environment, specifically designed to support emergency response coordination. The chatbot will assist personnel by interpreting natural language inputs, managing real-time data, and adapting its responses based on evolving conditions such as limited resources, conflicting reports, and sudden environmental changes. The system's core functionality relies on reinforcement learning (RL), allowing it to learn optimal actions through feedback and improve over time.

The chatbot’s adaptability will be driven by Q-learning or Deep Q-Networks (DQN). Thus, enabling it to modify its policy as new information emerges. This reflects key principles from control theory, where systems must remain stable and effective despite unpredictable disturbances (Åström & Wittenmark, 2013). Natural language understanding and generation will be powered by large language models such as OpenAI’s GPT, supported by preprocessing tools like spaCy and NLTK. Integration of RLlib for training, along with Python-based frameworks like Flask or FastAPI, will form the software backbone. A lightweight database such as SQLite or MongoDB will handle state tracking and user interactions.

The chatbot architecture includes an NLP-based input module, a simulated dynamic environment, a state encoder, an RL-based decision engine, and a response generator. A feedback loop will refine the chatbot’s behavior continuously, using both user interactions and environmental changes. This modular design ensures that the system can operate effectively under uncertainty and learn from experience.

In summary, this chatbot will serve as a practical demonstration of how adaptive AI systems can support complex decision-making tasks in real-time, high-stakes scenarios. By combining RL and NLP within a responsive framework, the project highlights the potential for intelligent, self-improving virtual assistants in emergency and dynamic environments.

**References**

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 Sutton, R. S., & Barto, A. G. (2018). *Reinforcement learning: An introduction* (2nd ed.). MIT Press.

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