Zombie Dynamics :

Optimal Learning in Agent-Based Models with Dynamic Environment

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Abstract

Artificial intelligence is rapidly becoming ubiquitous in everyday life, and is widespread in its applications, from uses in search engines to learning and control in complex autonomous systems. Multi-agent systems are often used to probe the properties of large systems where a complicated set of rules allows them to act "intelligently". Learning agents are able to become more competent in unknown environments via a *critic* which operates a feedback mechanism into a machine learning algorithm. However, little work has been done on agent-based learning in systems with dynamic environments, where agent environments can change rapidly, as a function of time or interaction with the agents themselves. This project seeks to assess different mechanisms in reinforcement learning and prediction in agents in a hostile, rapidly-changing setting : a zombie apocalypse.

Aims

The aim of the project is to assess different methods of agent learning of long-term strategies in a system far from equilibrium. The student will

- Simulate an agent-based human-zombie system in a dynamic environment
- Implement different learning mechanisms (reinforcement, stochastic feedback, strategy-sharing)
- Compare learning strategies for optimal survival state and learning rate

Methods

A short and simple set of agent-based rules will be used in simulation, in order to maintain a low inherent system complexity. Agents will be allowed to learn by different strategies such as by reinforcement learning, a genetic-algorithm-like stochastic mechanism with feedback, and communication-learning where agents are able to pass on learned strategies to others.

The system is expected to demonstrate certain classic emergent phenomena on the short-term, namely **particle aggregation**, **flocking** and **swarm behaviour**. In addition to this, particles are allowed to act upon their environment :

- Leaving ant-colony-like pheromone signals (local communication)
- Altering the terrain's energy landscape (construction)
- Low-effectiveness long-distance communication (radio)

These possibilities will allow agents to learn a variety of survival strategies; learning will occur over long timescales, rendering this analogy suitable to agents in a rapidly-evolving environment, such as in **riots and crowd panic situations**, **warfare simulations** or **economics**.

Introductory Reading

S. J. Russell and P. Norvig, *Artificial Intelligence : A Modern Approach*, second edition, Prentice Hall (2003).