A Comparison of Subsumption Based Agents With Differing Layers and Behaviour Pattern on Pac Man World

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1. Problem

(a) Motivation: Analysis of the impact of differing layer structures in subsumption based agents on agent behaviour in a Pac Man like simulation. Understanding how a subsumption agent with artificial senses reacts to the dynamic and unpredictable environment of Pac-Man will shed light on the relative strengths and weaknesses of subsumption architectures and its variations.

(b) Description: The subsumption-based agent is built using a layered control structure. It is designed to make decisions without a centralized plan, relying instead on simple sensory input and predefined behaviors. This experiment seeks to compare subsumption agents in terms of effectiveness and adaptability to various game states.

2. Prior Work

Rodney Brooks' **subsumption architecture** pioneered the idea that intelligent behavior can emerge from simple, layered control structures without centralized planning.

3. Key Idea and Expected Result

The expected result is that the subsumption agents will have various risk-taking behaviours and success rates depending on their differing layers. The key idea is to identify under which conditions the subsumption agents fail and contrast this with their variations. The analysis will focus on the efficiency (path length), robustness (survival time), and accuracy (food collection rate) of both agents.

4. The Experiment

Implement a Pac-Man-like grid-world simulator in Python that supports variable grid sizes and complexity; walls, food items, and ghost agents and game-over logic when Pac-Man contacts a ghost.

Develop the basic subsumption agent with following layers:

- **Layer 0**: Avoid bumping into walls
- **Layer 1**: Avoid ghosts
- **Layer 2**: Explore randomly
- **Layer 3**: Move toward stronger food smells (distance-based, walls don’t block scent)

The subsumption agent has virtual visual, smell and sound senses. Visual sensing allows the agent to see the walls (but not what's behind them), food and ghosts when the food or ghosts are directly looked at. Smelling allows the agent to have a prediction of where the food might be, and the sound sensor allows the agent to hear the ghosts wandering around (they go booo!).

Set expectations: Before running the simulations, determine expectations of how each agents would behave and compare their traits (such as risk adversity, fastness, success rate etc.)

Run experiments across multiple configurations: Different maze sizes (20x10, 10x10), varying number of ghosts (0, 2, 3, 4), differing ghost behaviour and food placing (randomly or in clusters), two agents with different layers/behaviours.

Metrics to be recorded: Win rate (collecting all food before getting captured), total food collected, path length, agent survivability time, behavioral explainability.

Capture the two agents behaviours and compare them in terms of evaluation criterion.

5. Evaluation Criterion

- In what conditions are the subsumption agents expected to fail? In what conditions are they expected to win?
- In what conditions are the subsumption agents more likely to fail in reality? How can they improve?
- Is there a difference between what was expected and what actually happened?
- What are the key differences between the two agents and what is the reason behind it?