Research project: Enactive learning

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Context

The Holy Grail of artificial intelligence is to implement learning as it occurs in humans and other organisms. Current AI learning systems use externally coded algorithms to optimise their processing of inputs according to the requirements of a human programmer; however, in biological learning, organisms make self-related choices about *what* they should learn. Biological learning is therefore *not* something that individuals do, but instead something that *autonomous collectives* of individuals do in order to survive. This *enactive* view links learning closely to *purpose* as an important distinction between biological and physical systems:

- A group of many agents makes a ***choice*** when these agents collectively organise their behaviour in a way that preserves the integrity of that entire collective group.
- We say this choice has the ***purpose*** of preserving the group's integrity if the causal process leading to that particular choice exists *because* it has been successful in the past at preserving that group's integrity. In such cases, we say that the group is ***autonomous*** (i.e., preserves its own integrity).
- An autonomous group ***enacts*** its identity by adapting its structure so that dynamical flow processes do not destroy, but rather *preserve* that same structure.
- ***Learning*** is the process by which a group adapts its structure to enact an identity.

Methods

Agent-based systems possess ***structure***, in the form of the component agents' states and their relations to each other, and behaviour, in the ways that agents interact with local dynamical ***flows***. This suggests we might use an ABM simulation to demonstrate enactive learning:

- Agents act by moving, secreting/consuming the local concentration of two Turing flows A and I, and modifying local evaporation/diffusion characteristics of these flows.
- Agents' actions are conditioned by the local concentration of the flows A and I.
- Agents possess variable genetic structure that defines a mapping from their local flow concentration to their actions.
- Flows obey Turing dynamics, which may be implemented structurally.
- Agents' genetic structure is subject to random variation – possibly also recombination.
- Agents' ability to survive and propagate depends on their access to a resource R that becomes available through their *collective* ability to produce a target Turing pattern.
- It would be extremely advisable to keep the complexity of this system (agents' decisions, the variable Turing parameters, etc.) as simple as possible!
- The simulation is coded in compact, modular, pedagogically simple julia, using *only* the Anatta toolset.

Research question

Can a collection of genetically structured agents within a simple Turing environment spontaneously enact an autonomous niche that fulfils a *group* survival criterion?