AUTONOMOUS GENERATION OF COMPLEX STRUCTURES

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Complex Structures. By complex structure here we mean "something" that can be *described* or *encoded* using some formal language; "complex" means that the language contains a large number of words or that the description requires many words (or both). More precisely: if A is the finite set of language words, $|A|$ is the number of elements of A and N is the number of words in the description, $C = -\log\left(1/\left|A\right|^{N}\right) = N\log\left(|A|\right)$ is taken as the definition of the structure complexity. Note that words in language can simply designate other structures - and so on, on multiple levels. The structures (strings of words, in fact) can then be *materialized*, in many copies, as physical objects. These materializations can be *transient*, then capable of reproducing, to preserve the code.

Structures Generation. The structures are *generated* in successive *steps*, from less complex proto-structures, by continuous augmentations and enhancements, *random* or *finalized*. A *selection* mechanism (due to interactions with the external environment; or sometimes intrinsic, inner) then proceeds to gradually reduce the number of surviving, interesting proto-structures. The generation of the structures must be *autonomous*: it is not the work or the project of some external entity.

Random generation. We will start from A, the set of the one-word structures. After the selection (sel) we are left with $B_1 = sel(A)$ structures, a subset of A; next $B_2 = sel(B_1 \times A)$ is the set of selected two-words structures; recursively $B_{n+1} = sel(B_n \times A)$. The model then provides an indication of the *optimal* number of steps to be taken to generate N-words structures. It is shown that there is always an optimal choice, intermediate between the N-steps case and the extreme (often impracticable) one-step case.

Finalized generation. However, in the case of extremely complex structures, if the growth of the structures is only random, even the optimal choices are impracticable. It seems necessary to resort to *finalized* (directed, targeted) enhancements/improvements - always driven by interactions with the external environment. This type of growth inevitably requires a certain *plasticity* of the structure and a sort of his *learning ability*.

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