ICONIC LANGUAGE REPRESENTATION IN A RECURSIVE NEURAL SYSTEM

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Abstract

In a totally reduced view of the interaction of a learning machine with a "world", such a machine can receive world-state information, it can act on the world and it can receive data from the world that controls learning. We see the learning machine as a classical state machine whose states are its constructs of the experienced world. Learning is a process of developing state structure that is related to taking appropriate actions in the world. There are only two ways that states can acquire an assignment - unsupervised and supervised. The difficulty with unsupervised learning is that should the machine ever be required to describe some of its own constructs there will need to be internal decodings of the arbitrarily assigned states. We believe that this does not remove the need for some states having arbitrary assignments but the only way that the machine can have an "understanding" of the world is through the following alternative way of assigning values to states. It is suggested that the states of the world are best represented through a many-to-some relationship between the state variables of the world and the state variables of the state machine. As the perception of the states of the world can only occur through some senses our definition of an *iconic state* is 'a state assigned to the state variables of the state machine in such a way that it represents the sensory pattern that is generated by a world state'.

Three key points are made in this paper. The first is that "iconic" states arise naturally in all recursive neural nets which are trained on world states in one of a limited possible ways. The second point is that this leads to a new paradigm of cognitive representation. Language is seen as a vehicle for retrieving iconic representations in a recursive system - this is dubbed the "iconic hypothesis". The third point is that while a similar idea has been presented as a "symbol grounding problem" [1], the "iconic hypothesis" goes further in suggesting that a recursive neural system can operate in both a symbolic fashion and use grounded internal states. To illustrate these points we introduce an architectural concept (the Neural State Machine Model - NSMM) which allows a clear formalisation of the concept of iconic representations. Examples of the application of this concept to representation of visuo-linguistic data are given.

Details of this approach may be found in [2].

References

- [1] Harnad, S. The Symbol Grounding Problem. *Physica D.* 42, 335 - 346 , 1990.
- [2] Aleksander, I. and Morton, H.B. *Neurons and symbols: the stuff that mind is made of.* London: Chapman and Hall (in press), (1993).