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Analysis of Distributed Representation of Constituent Structure in Connectionist Systems

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Abstract:

A general method, the tensor product representation, is described for the distributed representation of value/variable bindings. The method allows the fully distributed representation of symbolic structures: the roles in the structures, as well as the fillers for those roles, can be arbitrarily non-local. Fully and partially localized special cases reduce to existing cases of connectionist representations of structured data; the tensor product representation generalizes these and the few existing examples of fully distributed representations of structures. The representation saturates gracefully as larger structures are represented; it permits its recursive construction of complex representations from simpler ones; it respects the independence of the capacities to generate and maintain multiple bindings in parallel; it extends naturally to continuous structures and continuous representational patterns; it permits values to also serve as variables; it enables analysis of the interference of symbolic structures stored in associative memories; and it leads to characterization of optimal distributed representations of roles and a recirculation algorithm for learning them.

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