

WORKSHOP TITLE: Producing Figurative Language

PAPER TITLE: An Emergent Model of Metaphors as Transformations of Vector Spaces

KEYWORDS: metaphor, compositionality, distributional semantics, conceptual spaces, dynamic systems

This paper will seek to investigate the computational generation of metaphor based on transformations of high dimensional conceptual spaces. In the mathematical logic of vector space models, semantics are described in terms of the geometric relationships between points, and these points, taking words as their indices, are defined through an analysis of the distribution of words in a linguistic corpus. Figurative language implies transformations of these spaces: through metaphoric action, a new geometry arises characterised by a congruence between the spatial situation of source and target.

Vector space models lend themselves naturally to compositionality due to the mathematically interactive characteristics of their constituents (Mitchell and Lapata 2010). Generally, this compositionality is practically achieved by treating predicates as matrices that facilitate the transformation of concept vectors into new compound vectors (Grefenstette et al. 2013). A primary motivation of this approach is the computational tractability of its operations—by the same token, however, there has been a focus amongst computational linguistics on the productivity of such systems rather than on the theory that explains their procedures.

This paper will reassess the construction of vector spaces in terms of the theory of dynamic systems, modelling conceptual spaces as emergent attractors arising from non-linear interactions within the environment of a linguistic corpus. Along with a continuously unfolding statistical analysis of the underlying corpus, the model proposed here considers the set of potential transformations between vector spaces through higher-order matrices as one of the constraints that defines any emergent conceptual space. As these transformations manifest themselves pragmatically as figurative language, the system is, in effect, perpetually generating metaphor in the course of the ongoing emergence of semantic structures. Metaphor production is therefore recast as one of the fundamental operations in a linguistic model, the stuff that facilitates syntagmatic connectivity and the emergence of syntax through functional composition.

Mitchell, J. and Lapata, M. (2010). Composition in distributional models of semantics. *Cognitive Science*, 34(8):1388–1439.

Grefenstette, E., Dinu, G., Zhang, Y., Sadrzadeh, M., and Baroni, M. (2013). Multi-step regression learning for compositional distributional semantics. In *10th International Conference on Computational Semantics*.