

Putting a Spin on Language: Quantum Mechanical Interpretation of Modal Operators for Natural Language

Adriana Correia (Utrecht University)

An interpretation based on vector spaces for natural language in connection with Lambek pregroups is now established in the literature as the DisCoCat model. To overcome the expressive limitations of pregroup grammars (and of the original Syntactic Calculus), extended typological grammars rely on modal operators that allow for controlled forms of reordering and restructuring. A vector-based interpretation for these operators has not yet been proposed. In this talk, I will present three angles on these topics: firstly, I will make an argument for the use of density matrices instead of vectors to represent words, then I will present an interpretation of the Lambek calculus that operates directly in density matrices and finally I will propose an interpretation for the modal control operators, also in density matrices, that is analogous to a quantum mechanical "spin" space. Applied on a particular example, where different applications of the modal operators give rise to derivational ambiguity, we will see that this construction permits these different readings to be stored in orthogonal spin states. This construction has the potential of not only integrating the derivational ambiguity with other information already encoded in the density matrices at word-level, but also of creating quantum interference in the sentence derivation process, which can give rise to novel applications of vector-based interpretations in natural language processing.