Chapter XVI
On Information, Meaning, Space and Geometry

Sándor Darányi
University of Gothenburg, Sweden & University College Borås, Sweden

Péter Wittek
National University of Singapore, Singapore

ABSTRACT

Current methods of automatic indexing, automatic classification, and information retrieval treat index and query terms, that is, vocabulary units in any language, as locations in a geometry. With spatial sense relations among such units identified, and syntax added, the making of a geometric equivalent of language for advanced communication is an opportunity to be explored.

INTRODUCTION

In what follows, we offer a few general considerations, with theoretical overtones, working toward the definition and generation of a geometric language for practical purposes, prominently for information retrieval (IR). This chapter is a non-mathematical introduction to the mathematical modelling of meaning of both words and sentences, outlining already existing components of such an endeavour, and hinting at directions of synthesis. Technical aspects of realization will be discussed in forthcoming articles.

A mathematical treatise of the dependence of information visualization on structures being visualized, first and foremost, the interdependencies between language and space, has been long overdue. Elements of such a systematic treatise are emerging in the interacting fields of information retrieval and language technology, whenever the structure of concept space is discussed by addressing subject classifications inhabiting such
spaces and influencing the efficiency of information retrieval. Fine recent examples on the topic include van Rijsbergen (2004) and Widdows (2004). In a general sense, questions about the nature of information and meaning, in the form of word and sentence semantics, are pertinent to the outcome of the modelling effort: the better the mathematical description of linguistic information (and the behaviour of linguistic and nonlinguistic information per se), the higher hopes one may have for constructing more efficient IR models and systems. On the other hand, the number of observations pointing in the same direction, the feasibility of such a general model, is on the increase, a fact hopefully justifying our attempt at listing some of them.

To start with an immediate difficulty, meaning is both perceived and processed; therefore, it can be assigned both to percept and concept spaces. This distinction goes back to Karl Pearson (1911, pp. 191-208, reprinted in Kockelmans, 1999, pp. 191-205), for whom perceptual spaces are, strictly speaking subjective, whereas concept spaces as a means of scientific description are objective. Further, “[S]pace is not a thing but an order of things. To say that a thing exists in space is to assert that our perceptive faculty has distinguished this thing as a group of sense perceptions from other groups of sense perceptions which actually (or possibly) coexist. In other words, space is not a real thing in the sense on an immediately given phenomenon, but merely our mode of perceiving phenomena, in short a mode of our perceptive faculty” (Kockelmans, 1999, p. 190). On the other hand, if the space of perception is like this, the question arises: “What is conceptual space – the space with which we deal in the science of geometry? We have seen that our perceptive faculty presents sense-impressions to us as separated into groups, and further that through this separation is most serviceable for practical purposes, it is not very exactly and clearly defined “at the limits.” How do we represent in thought, in conception, this separation into groups that results from our mode of perception? The answer is, “we conceive sense-impressions to be bound by surfaces, to be limited by straight or curved lines. Thus our consideration of conceptual space leads us once to a discussion of surfaces and lines – to a study, in fact, of Geometry” (Pearson, 1911, p. 191). Likewise, for Wittgenstein, geometry is the grammar of space (Baker, 2003, p. 521) and of spatial relations (Hacker, 1996, p. 50), that is Pearson’s distinction prevails. This raises the question whether such phrases as “perceptual space” and “concept space” have a geometric reality; that is, if kinds of geometry can model percept and concept agglomerations to a reasonable extent; and in particular, whether meaning in language, regardless of being considered a percept or a concept, can be adequately reproduced by means of geometry.

This chapter offers four arguments in favour of representing meaning by means of metric space, the first three of them relating to word meaning, the last one to sentence semantics. The point of departure will be Bateson’s definition of information, and how this inherently brings geometry into the picture. Then, we connect the concept of distance in geometry with the concept of difference as offered by Bateson. Next, we argue that a component of word meaning, namely lexical or sense relations, are inherent in established IR practice in the vector space information retrieval model, and their applicability can be further extended by enriching the information representation convention. Finally, we suggest ways for the generation of sentences which use geometric locations, that is, coordinates, as their words.

**EXAMPLES FOR SPACE AS A METAPHORICAL VEHICLE OF LANGUAGE AND INFORMATION**

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