Qualitative spatial and temporal reasoning: exploiting the connections to algebra and topology

Gerard Ligozat
Université Paris-Sud, Paris, France

Abstract

A typical instance of a qualitative temporal reasoning calculus is Allen's temporal interval calculus. When using the calculus, a central problem is the problem of consistency: given a binary constraint network, which expresses qualitative constraints between a finite set of intervals in terms of disjunctions of the 13 possible basic relations, determine whether there exists an instantiation of the network in terms of intervals in the time line. The problem is NP-complete, and extensive work has been devoted to characterizing tractable subclasses of disjunctive relations, resulting in a description of all the tractable subclasses.

From a theoretical point of view, Allen's calculus has many good properties:

- *the underlying constraint algebra is a relation algebra, in Tarski's sense;*
- *testing path-consistency is a complete method for testing consistency for well-determined subclasses of relations;*
- *scenarios, i.e. atomic path-consistent networks are consistent and determine unique qualitative configurations;*
- *the first order theory associated to the calculus is aleph-zero categorical;*
- *tractable subclasses can be characterized either syntactically (ORD-Horn relations) or topologically (preconvex relations).*

Many qualitative spatial and temporal calculi have been developed in the past years along lines which are prima facie quite similar to those at work in Allen's calculus. However, it is apparent that many of the properties mentioned above no longer hold.

In this talk we describe some of the main points where specific calculi differ from Allen's calculus, and discuss the new questions that arise. In the discussion, we make use of algebraic and topological concepts, such as weak representations and conceptual spaces. We describe some first results of the approach.

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