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AREA OF EXPERTISE: Knowledge Representation and Reasoning

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DISSERTATION TITLE: *A Simple, General and Efficient Representation of Qualitative Spatial Information; An Approach Based on Bintrees*

Spatial data is used in a great number of highly valuable applications, like route planning, automatic navigation, modeling of physical processes, etc. However, on a computer spatial data is often represented as complex numerical objects, and therefore requires advanced numerical algorithms to process. Despite this numerical complexity, we humans tend to think of spatial data in qualitative terms (e.g. "x overlaps y" or "x is north of y") and not in quantitative terms (e.g. "x is 3.42 meters away from y"). Motivated by this observation, this thesis aims at improving the efficiency and applicability of answering queries involving qualitative relationships over spatial data.

The work contains an algorithm for translating spatial data from complex numerical objects, into a simpler structure known as a bintree. The novelty of the work is the development of an algorithm that translates the spatial objects into these simpler structures in such a way that the qualitative relationships are preserved. This simpler structure uses less storage space on disk compared to the original spatial data, and allows qualitative queries of the form "Which roads intersect E18?" or "Which buildings are next to a park and is north of Oslo?" to be answered more efficiently. The experimental results presented in the thesis show that the bintree representation uses only 30% of the space of the original spatial data, thus making this representation cheaper to share and download. Furthermore, the bintrees answers qualitative queries 21.3 times faster for simple queries and 7.3 times faster for complex queries. The simpler structure is also easier to work with, thus requiring less advanced software. These features are useful both on large servers serving thousands of such queries a second, by reducing the overall load on the server, and on smaller devices such a smart phone, by allowing the smart phone to handle larger amounts of data.