A Quantitative Treatment of Spatial Data

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Abstract: This paper aims at an efficient treatment of spatial data by quantitative representation. We propose a new framework called PLCA, which provides a symbolic representation for the figure in two-dimensional plane, that focuses on the connections between regions. It is based on the simple objects: points (P), lines (L), circuits (C) and areas (A).   The entire figure is represented as a combination of these objects.   Pairs of areas, circuits or lines never cross.   The simple, clear data structure based on objects makes the system easy to implement and feasible.

For a figure that consists of a set of regions in two-dimensional plane, there exists a corresponding consistent PLCA expression.   For a consistent PLCA expression, there is a unique figure in two-dimensional plane in the sense of connection pattern, if there exists.   Topological reasoning can be performed on a PLCA expression, such as judging the connection patterns of areas.   We define the operations of area integration and area division on a PLCA expression, and they correspond to the real actions on figures.

We can add attributes to each object, such as the properties that hold on an area or that an object stands for, and make an attributed PLCA corresponds to the alteration of the classification level of objects.   Semantic spatial reasoning can be performed on an attributes PLCA.