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Area-Universal Rectangular Layouts

A rectangular layout is a partition of a rectangle into a finite set of interior-disjoint rectangles. Rectangular layouts appear in various applications: as rectangular cartograms in cartography, as floorplans in building architecture and VLSI design, in treemap visualizations, and as graph drawings. Often areas are associated with the rectangles of a rectangular layout and it might hence be desirable if one rectangular layout can represent several area assignments. A layout is *area-universal* if any assignment of areas to rectangles can be realized by a combinatorially equivalent rectangular layout. We identify a simple necessary and sufficient condition for a rectangular layout to be area-universal: a rectangular layout is area-universal if and only if it is *one-sided*. More generally, given any rectangular layout L and any assignment of areas to its regions, we show that there can be at most one layout (up to horizontal and vertical scaling) which is combinatorially equivalent to L and achieves a given area assignment. We also investigate similar questions for perimeter assignments. The adjacency requirements for the rectangles of a rectangular layout can be specified in various ways, most commonly via the dual graph of the layout. We show how to find an area-universal layout for a given set of adjacency requirements whenever such a layout exists.