Available online at www.sciencedirect.com
SCIENCE DIRECT®
Electronic Notes in Theoretical Computer Science
ELSEVIER Electronic Notes in Theoretical Computer Science 134 (2005) 3–18
www.elsevier.com/locate/entcs

Towards a General Solution to Drawing Area-Proportional Euler Diagrams

Stirling Chow [1,2] Frank Ruskey [3]

Department of Computer Science
University of Victoria
Victoria, B.C., Canada

Abstract

We present a deterministic algorithm for drawing Euler diagrams using n simple polygons so that the regions have a prescribed area. Our solution works for all Euler diagrams that have a region of common intersection (i.e., region $\{1, 2, \ldots, n\}$), and for any weight function. When there is no region for $\{1, 2, \ldots, n\}$, the algorithm can still be applied, but will sometimes create an Euler diagram where the curves are self-intersecting.

Keywords: diagrams, drawing, area-proportional, Euler, Venn

1 Introduction

An Euler diagram is said to be area-proportional if the diagram's regions have areas that are directly proportional to a specified weight function. Figure 1 shows an area-proportional Euler diagram for three pos/neg tests for glaucoma where, for example, the region representing the 7 patients who tested positive exclusively with Retinal Test #1 has exactly twice the area of the region representing the 14 patients who tested positive on all three tests.

When used for data visualization, area-proportional Euler diagrams leverage viewers' perceptual capabilities (i.e., comparing areas) in addition to their

[1] Research supported in part by an NSERC Canada Graduate Scholarship.
[2] Email: schow@cs.uvic.ca
[3] Research supported in part by NSERC.

1571-0661/$ – see front matter
doi:10.1016/j.entcs.2005.02.017

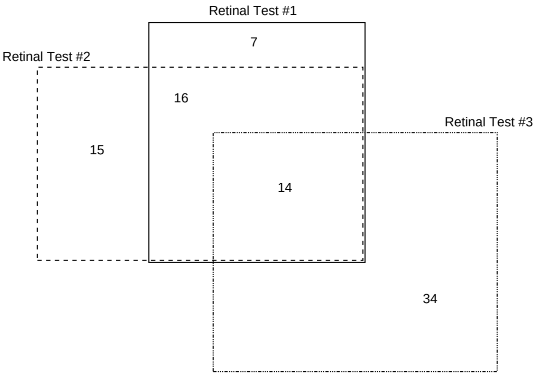

Fig. 1. Conformance data for three glaucoma diagnostic tests; the region within a curve represents patients who tested positive (adapted from an example by Artes and Chauhan [2]).

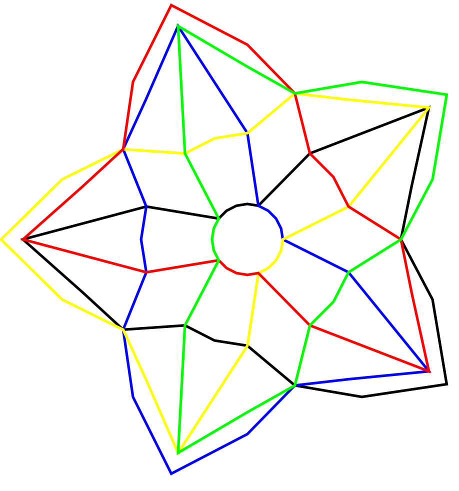

Fig. 2. An example of a 5-Venn diagram where all regions have equal area.

cognitive capabilities (i.e., reading labels). Although studies need to be performed, it is believed that a "good" area-proportional Euler diagram should be more effective at conveying information than a comparable standard Euler diagram. Area-proportionality may also have applications to the general Euler diagram generation problem. For example, Flower et al. [6] have developed a hill-climbing algorithm that begins with an arbitrary Euler diagram and repeatedly applies small changes to increase the diagram's suitability according to various metrics. An area-proportional Euler diagram in which every region has equal area (see Figure 2) may converge faster to a solution than one in which the areas have a large variance.

At GD 2003, we presented algorithms for drawing area-proportional Euler diagrams for two and three sets [4]. In this paper, we introduce a new algo-