Available online at www.sciencedirect.com
SCIENCE DIRECT®
Electronic Notes in Theoretical Computer Science
ELSEVIER Electronic Notes in Theoretical Computer Science 134 (2005) 103–126
www.elsevier.com/locate/entcs

Measuring and Reducing Clutter in Euler Diagrams

Chris John

Visual Modelling Group
University of Brighton
Brighton BN2 4GJ, UK

Abstract

When modelling with three or more sets Euler diagrams can become crowded or cluttered and their ability to intuitively represent relationships between sets diminishes. Projections are a notation that bring syntactic efficiency to Euler diagrams and the flexibility to represent relationships between sets in a variety of semantically equivalent ways. This paper briefly outlines the first sound and complete system of Euler diagrams to incorporate the notation of projections. It defines a metric for measuring clutter in a diagram and outlines an algorithm that, given a diagram of the system, finds a semantically equivalent diagram(s) with the minimal measure of clutter.

Keywords: Projections, Clutter, congestion.

1 Introduction

Euler diagrams, or Euler circles, first appeared in 1761 [1]. Euler had the representation of classical syllogisms in mind, not sets, and his motivation appears to have been to offer a diagrammatic alternative to sentential logic: *'These circles...are extremely commodious for unfolding all the bloated mysteries of logic, which art finds it so difficult to explain'.*

Over a hundred years later John Venn [2] developed his diagrammatic structures for representing syllogisms and it is his name with which most people associate diagrams of this type today. The American philosopher and mathematician Charles Peirce developed several systems of diagrammatic reasoning

[1] Email: C.John@brighton.ac.uk

1571-0661/$ – see front matter
doi:10.1016/j.entcs.2005.01.035

[3], also exploiting the properties of exclusion and containment, while developing the notation of *x-sequences* to symbolize the existence of elements. In recent years advances in computing have accompanied a resurgence in the field of diagrammatic reasoning and a greater degree of formalism. Eric Hammer produced a simple, sound and complete system of Euler diagrams [4]. Sun-Joo Shin developed several systems based on Venn diagrams [5] and several systems of '*spider diagrams*' [6], [7], [8] based on Venn and Euler diagrams, have been developed at the University of Brighton.

The original notion of projections was proposed in [9], and developed in [10] and [11]. The notation grew from a desire to limit the congestion that besets Euler diagrams as more sets are considered. Informally, a projection is a set represented within a context (a sub-domain of the universe of discourse). Outside of its context the projection does not assert anything. A projection may be represented in one or many ways by curves called projected contours. First we outline the system of Euler diagrams that we will augment with projections and detail two of its weaknesses.

2 Euler diagrams

Euler diagrams use the topological properties of enclosure, exclusion and intersection to represent the set-theoretic concepts of subset, disjoint set and set intersection respectively, with shading representing the empty set. The following examples of the system informally illustrate the syntax, semantics and reasoning using transformation rules.

The LHS diagram of Figure 1 has three contours labelled A, B and C. By the enclosure of the contour labelled B inside the contour labelled A we can infer that the set represented by the contour labelled B is a subset of the set represented by the contour labelled A. Similarly, by the exclusion of the contours labelled A and C we can infer that the sets these contours represent are disjoint.

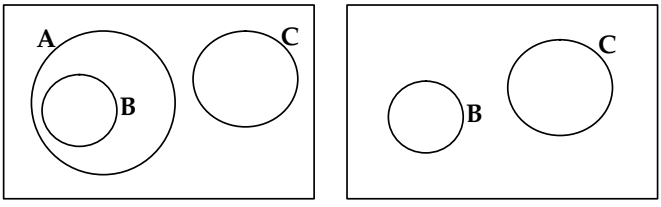

Fig. 1. Euler diagrams.

Just as we could infer from the premises $B \subseteq A$ and $A \cap C = \emptyset$, the conclusion $B \cap C = \emptyset$, so we can apply a simple reasoning rule *'Erase contour'* to the