Reasoning with projected contours

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Abstract. Projected contours enable Euler diagrams to scale better. They enable the representation of information using less syntax and can therefore increase visual clarity. Here informal reasoning rules are given that allow the transformation of spider diagrams with respect to projected contours.

1 Spider diagrams and projected contours

A spider diagram [3] is an Euler diagram with plane trees (spiders) that represent the existence of elements and shading in regions that indicate upper bounds on the cardinalities of sets they denote. Projected contours [1, 2] here are dashed and non-projected contours are called given contours. The semantics of projected contours are given in [1]: a projected contour represents the intersection of the set denoted by its label with the set denoted by its **context** (the smallest region, defined in terms of given contours, that it intersects).

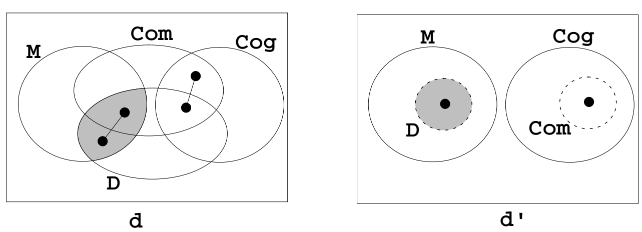

Fig. 1. Two semantically equivalent spider diagrams.

In Fig. 1, let our universe of discourse be the people attending Diagrams 2004. Let M be the set of mathematicians, Cog be the set of cognitive scientists, Com be the set of people able to turn a computer on, and D be the set of people able to draw a decent diagram. Both diagrams assert there is nobody who is both a mathematician and a cognitive scientist, there is *at least* one cognitive scientist who can turn on a computer and only one mathematician who can draw a decent diagram. Note that $d2$ does *not* assert that no mathematicians are able to turn on a computer, nor does it assert cognitive scientists are unable to draw decent diagrams. The projected contour labelled D in $d2$ represents $M \cap D$ only. Likewise the projected contour labelled Com in $d2$ only denotes $Cog \cap Com$.

2 Reasoning rules

Here we introduce informally four of the reasoning rules that allow us to reason with spider diagrams that contain projected contours. We illustrate their application by using them to transform the spider diagram in Fig.2 into the diagram of Fig.4. The transformation is illustrated in Fig.3.
Note the spider diagram in Fig.2 asserts $A \cap B$ is non-empty and D is a subset of $A \cup B \cup C$ (equivalently, in the complement of $A \cup B \cup C$, D is empty).

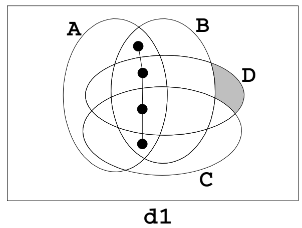

Fig. 2. Initial spider diagram.

1. **Rule 1:Replacing a given contour with a projected contour**. Applying this rule may result in some of the existing projected contours being erased. (We apply Rule 1 to the given contour labelled D in $d1$ giving $d2$).

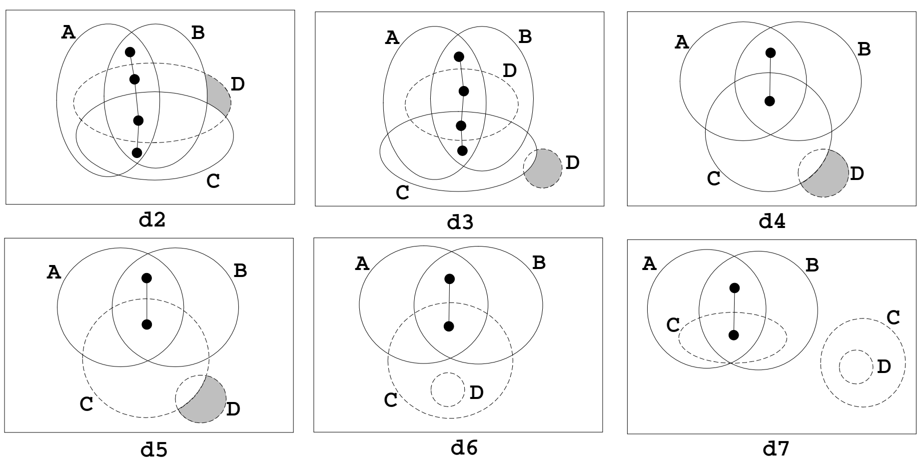

Fig. 3. Reasoning with projected contours.

2. **Rule 2:Splitting a projected contour** allows us to replace a projected contour with two projected contours that partition the context of the original. This rule is reversible. (We apply this rule to the projected contour labelled D in $d2$ giving $d3$).
3. **Rule 3:Erasing a projected contour** allows us to erase any projected contour providing we also erase partial shading and leave at most one foot of each spider in a zone. (Applying this rule to $d3$ gives $d4$).

4. In transforming $d4$ into $d5$ we use rule 1 to replace the given contour labelled C with a projected contour.
5. **Rule 4:Erasing a shaded zone** allows us to erase any shaded zone provided no spiders touch it and the resultant diagram still represents it by either exclusion or containment of contours. This rule is reversible. (We apply this rule to the shaded zone of $d5$ to give $d6$).
6. To transform $d6$ into $d7$ we use rule 2 again, this time splitting the projected contour labelled C. Finally, we transform $d7$ into $d8$ by erasing the projected contour in $A \cup B$ using rule 3.

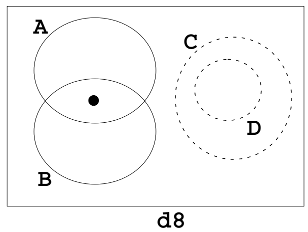

Fig. 4. Resultant, semantically equivalent, spider diagram.

We have used four reasoning rules to transform $d1$ of Fig.2 into the semantically equivalent, and much clearer, $d8$ of Fig. 4. The reasoning rules 1-3 here could similarly be used in Fig.1 to transform d into d'.

3 Further work

Work on a system of spider diagrams to include projected contours is progressing. Syntax, semantics and reasoning rules have been developed and formally defined and work is currently underway to show this extended system to be both sound and complete. More information on this and related works can be found at *www.cmis.brighton.ac.uk/research/vmg*.

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References

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