Eurographics Conference on Visualization (EuroVis), Posters Track (2016)
T. Isenberg and F. Sadlo (Guest Editors)

Large-scale Argument Visualization (LSAV)

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Abstract

Arguments are structures of premises and conclusions that underpin rational reasoning processes. Within complex knowledge domains, especially if they are contentious, argument structures can become large and complex. Visualization tools have been developed that support argument analysts and help them to work with arguments. Until recently, arguments were manually analyzed from natural language text, or constructed from scratch, but new communication modes mean that increasing amounts of debate and the arguments therein can be captured digitally. Furthermore, new tools and techniques for argument mining are beginning to automate the process of extracting argument structure from natural language; leading to much larger argument datasets that present problems for the current generation of argument visualization tools. Additionally, individual argument analysts have different foci which can lead to increased complexity within datasets, and additional facets that argument visualizations should account for but do not. We propose a tool for interacting with argument corpora that enable users to explore and understand the reasoning structure of large-scale arguments. The tool will support a range of interactivity techniques and will help users to explore and analyse large-scale arguments, to more rapidly comprehend complex new problem domains.

Categories and Subject Descriptors (according to ACM CCS): H.5.2 [Computer Graphics]: User Interfaces—Graphical user interfaces(GUI)

1. Introduction

Argumentation explains the relations between logical reasons and the conclusion. The aim of argumentation is to justify or refute the standpoint of someone by providing strong reasons [Gov13]. Using visual representation provides a better and deeper understanding of arguments and topics especially given that humans, in general, are highly visual [Mun14]. A difficulty in understanding argumentative structures stems from a tension between needing an overview of the whole structure whilst also investigating the fine structure between the different arguments' elements [BM11].

Computer-Supported Argument Visualization (CSAV) faces the challenge of making arguments readable by using different representation techniques. Based on their layouts, existing CSAV tools can be divided into four categories. First is the indented layout, in which argument nodes are placed along vertically distributed rows. The indented layout is used to show the hierarchical structure of arguments in tools such as Collaboratorium which improves collaborative deliberations as it helps in organising discussions by defining their main components such as issue, idea, support and opposing of discussed topics [KI08]. Hermes that supports argumentative discourse among decision makers [KP01], and Evidence Hub that provides an infrastructure for debating and building evidence-based knowledge [DLBS13]. However, the indented layout fails to provide an overview of the whole structure. Second is the node-link layout, which uses nodes to present argument components and links to express the relations between these components. It has been used in most of the argument tools with a tree structure such as CompediumLD which helps practitioners designing learning activities [BCC*08], Metafora that helps students to gain the critical skills which are needed to engage in collaborative learning in science education [DMM*13], and Rationale which is a tool for diagramming reasoning on any topic [VG07]. However, when the number of nodes and relations increases, node-link layout fails to present the arguments clearly and space-efficiently. Third is the nested layout, a space filling technique used by SenseMaker that allows small group of the students to organise their ideas and provide collection of evidence to share with others [Bel97] and other browsing argument maps allows users to get an overview of large amount of information called Issue Map [BM12]. This layout uses the position to express the relations between the nodes. All the children nodes are enclosed within the parent node area, and therefore, it overcomes the problem of wasted space in the node-link layout. However, it is hard to understand the type of relations between the nodes in this layout as the child nodes are enfolded inside the parent ones. The fourth one is the Matrix layout that is used to make argument's relations explicit. The matrix, or tabular, layout uses rows and columns to denote arguments' components and cells to represent the relations between components. Belvedere, which supports students to improve their critical thinking and discussion of science issues [SWCP95], combines the matrix layout with the node-link tree. However, it is not easy to track the relations between the

DOI: 10.2312/eurp.20161143

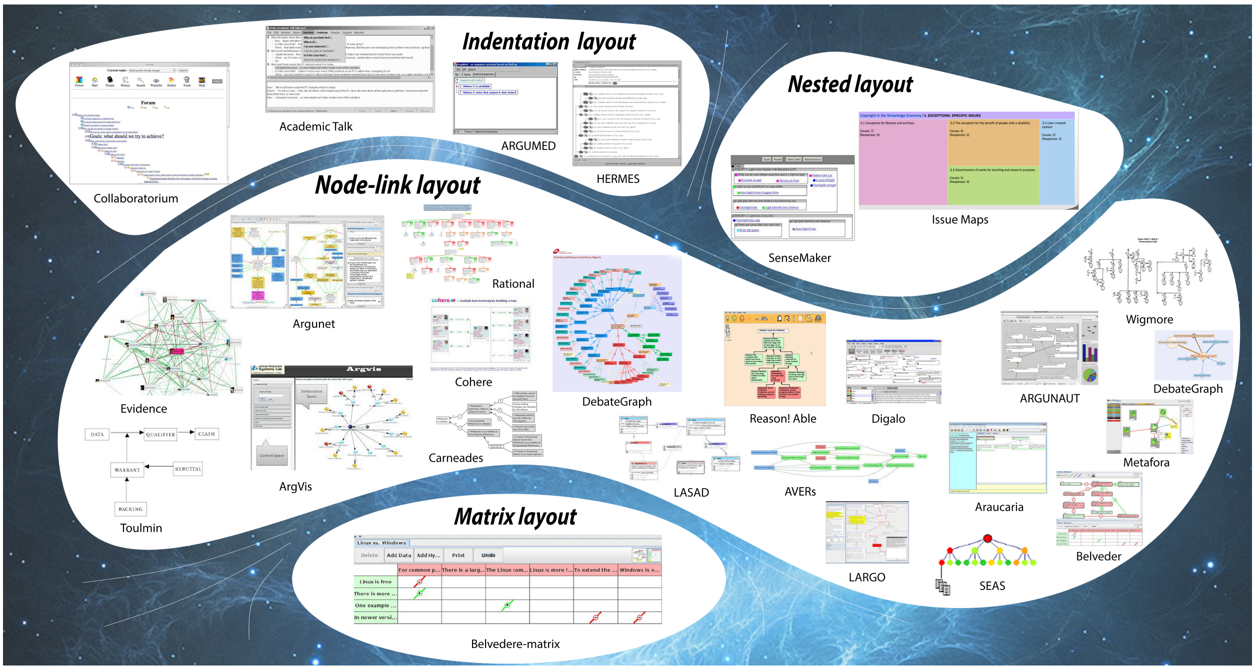

Figure 1: *Snapshots of existing argument visualization tools.*

nodes of the graph. In addition, it lacks the ability to present the overview of the whole structure. Figure 1 illustrates a range of argument tools organised according to their characteristic layout. We aim to address the perceived deficiencies of existing argument visualization tools whilst increasing their utility for comprehending and navigating increasingly large argument corpora. For designing and validating the new visualization tool, we are going to use the nested model [Mun14].

2. Visualization Approach

Based on the brief description provided above of the argument visualization tools and their features, there is still a gap in the literature in presenting large-scale arguments. To fill in this gap, the visual interface of the proposed tool will include different views. The first one is the main view where the argument elements will be presented. We are going to use radial adjacency layout that presents the hierarchy structure of the arguments clearly and spaces efficiently. The main conclusion of the arguments will be at the center of the layout surrounded by all the different types of child nodes. The size of each node depends on the number of the sub-nodes. The number of the layers will present the depth of the tree while the length of each layer depends on the length of the longest child node's label. A very thin and colored layer will be introduced between the nodes to show the type of relations between them, i.e., support or against, to satisfy the user requirement which is showing the relations between the arguments' elements. i.e., evidence. The second view is the exploring one. In this view, we will use the indented layout to present the selected node. The node will be presented with all the related nodes to help the users in navigating through the debate maps from the high level to deeper levels of details. For a quick exploration of the structure, the Fisheye technique is going to be used [TAVHS06]. It offers a relatively quick navigation and avoids unnecessary exploration. Expanding/ collapsing mechanism [LPP*06] is an example of focus-plus-context, which authorizes users to extend/collapse nodes to explore the layout. By using this feature, users can skim level by level, or explore the levels they are more interested in. By using dynamic query [AWS92], users can use a slider to select how many layers they like to present. The texts of the argument nodes, i.e., labels, are long, but their presence is essential to the understanding of the argument map. Therefore, presenting the argument's text in a map that contains hundreds of arguments remains a challenge that needs to be tackled. To solve this problem, several methods can be potentially used [FP99], such as giving a title of the label, using a small size of the font, using link breaks, dividing the text into two lines, and performing truncation. The latter is considered as the most effective method to reduce the space needed for large text in graphs, and therefore it will be adopted it in our proposed visualization tool.

3. Conclusion

We propose an argument visualization tool that can usefully handle arguments at increasing scale. This tool will help stakeholders to reach decisions by enabling them to navigate through arguments, explore logical reasons, and understand relations between arguments. Stakeholders may include policy and health analysts, academics, and employees, etc. Moreover, the new tool will enable the users to interchange the argument data among the various argument tools by allowing the argument map to be saved using an argument international format.

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