Hierarchical Timeline Exploration for Collaborative Text Writing

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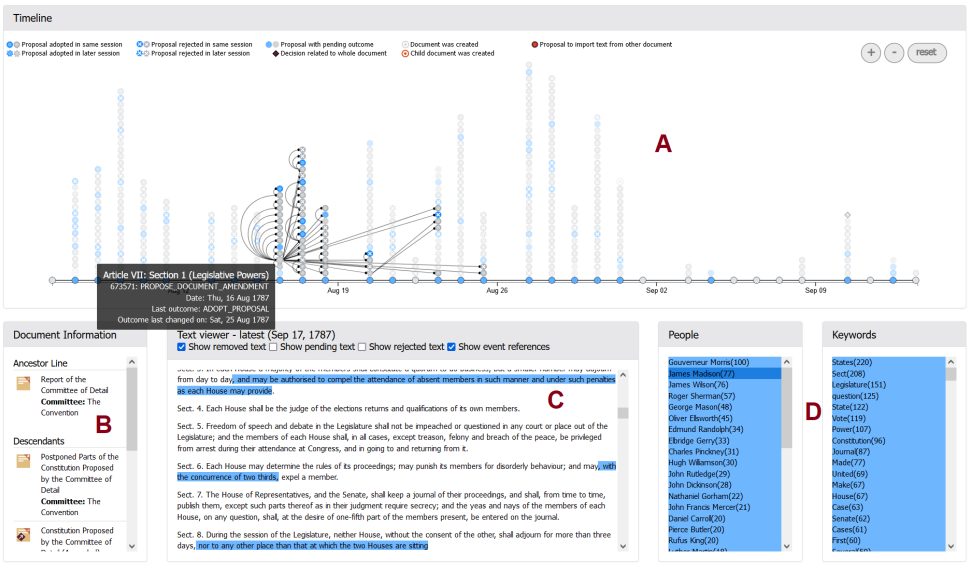

Figure 1: Interface for the document visualization tool showing user interaction with timeline. The upper area timeline (A) shows event symbols stacked according to the dates on which they occur. Events have their own procedural hierarchy, which is displayed as connecting paths to other events when the cursor hovers over one of the event symbols, alongside a description box. The lower area shows: other documents related to the text under analysis (B), the text itself (C), and panels for people and keywords involved (D). Clicking on one of the events, a segment of the text, a person's name, or a keyword will highlight all events related to the clicked object in blue.

Abstract

Visualizing event timelines for collaborative text writing is instrumental for navigating and understanding this type of data, as the size and complexity of both text and timelines increase. They are often employed in applications such as code repositories and collaborative text editors. In this poster, we present a visualization approach to explore historical records from the writing of legislative texts, which were discussed and voted on by assemblies of representatives. Focusing on event timelines from text documents that involve multiple people and different topics, we allow for exploring the history of text changes and tracking the provenance of given text sections, while highlighting the connections between all elements involved.

Index Terms: Human-centered computing—Visualization—Visualization application domains—Information visualization

1 Introduction

Collaborative text development can take many forms, from source code management to the building and maintenance of knowledge repositories. Typically, they involve several actors proposing and enacting changes with different protocols for approval, and as such, history keeping and navigation are essential to understanding the current state of the text and how it came to be. Histories are often structured as hierarchical sequences of events, where each proposed alteration can itself receive further alteration proposals. Visually representing this data is also further complicated by the different types of operations that can be done according to each domain and the relationships that can be formed between authors, metadata objects, and the text itself.

We present an approach to tackle this challenge, focusing on the domain of historical records in humanities - in particular, the drafting of foundational legal texts in constitutional conventions. Our approach builds upon the Quill Project [1], a research initiative that investigates text analysis and data visualization containing well-organized, event-based datasets representing the negotiation of legal texts in historical negotiation processes. Our approach is designed and developed alongside humanities researchers that work closely with the Quill platform. This poster focuses on exploring the timeline, which is a component of a larger analytical tool.

2 Related Work

The work described in this poster closely relates to techniques that visualize the evolution of text over time. Among them, we can cite History Flow [4] and Flow Circle [3] as examples of visualizing contributions and interactions between public encyclopedia editors, or CodeTimeline [2] and Chronicler [5] as examples of collaborative source code evolution. The motivation for our work lies in the different layers of relationships between events contained in Quill datasets, which need to be represented via other visual channels.

3 Methodology

Although Quill datasets contain several types of events describing procedures or actions that can occur during the negotiation of a text, we focus on *amendments* and their related events, which represent

proposals for direct changes or additions to the text.

Datasets for this visualization consist of event sequences for a document timeline. These events have two hierarchical components: the first is the temporal negotiation structure, which groups the events according to the *sessions* and *committees* in which they took place over time. The second is the hierarchy of amendments, in which amendment events can be nested into one another as new amendments discuss smaller parts of a previous one. Finally, events contain links to people, keywords, and text sections involved.

The timeline visualization is shown in Figure 1: the timeline (A) and panels containing other related documents (B), the text (C), and lists of people and keywords (D). These elements can be clicked to highlight events in which they appear on the timeline.

3.1 Timeline Representation

We represent the event sequence as a two-layer hierarchical timeline. *Sessions* are ordered along a horizontal line as orange dots, and each amendment event within a session is then placed vertically over it. Sessions may contain an impractically large amount of events. We remove all events that do not directly reference the composition of the document, and condense multiple events into one symbol that semantically contains the entire process for deciding an amendment. Figure 2 illustrates this process. The color and shapes of all symbols were chosen to retain consistency and familiarity with other icons already on the Quill platform and, at the same time, to be compact enough in size to be stacked while maintaining scalability. These colors may change as a result of interaction, as seen in Figure 1. An example of the timeline in its default colors can be seen in Figure 3.

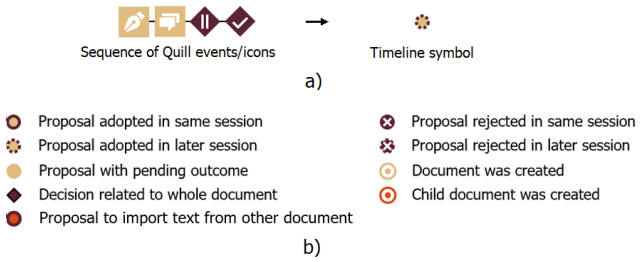

Figure 2: Example of conversion from Quill icons to timeline symbols. (a) Four events ("amendment proposal", "debate", "postpone", "decision to accept") are converted into a single timeline symbol ("proposal accepted at a later date"). (b) All symbols in the visualization.

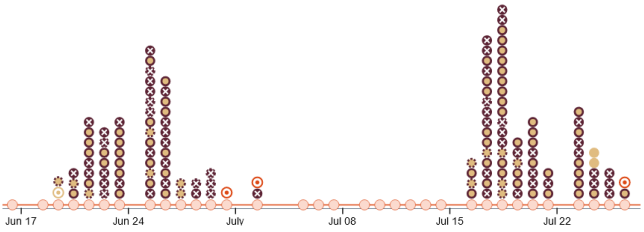

Figure 3: Timeline with default colors. When selecting elements for highlighting, the color scheme changes.

3.2 Event depth

The amendment hierarchy forms a tree spanning all events in the dataset, starting at the document's creation event. *Event Depth*, therefore, refers to the tree level in which each amendment is located. Figure 4 illustrates the event depth of amendment proposals in a document timeline. To depict depth without overloading the visualization, we display it as a cursor hover effect: hovering over a symbol will display lines connecting itself to its parent amendment, as well as its children and all their descendants in the tree. The opacity of the non-connected amendments is reduced to provide a further focus on the connected amendments, as shown in Figure 1.

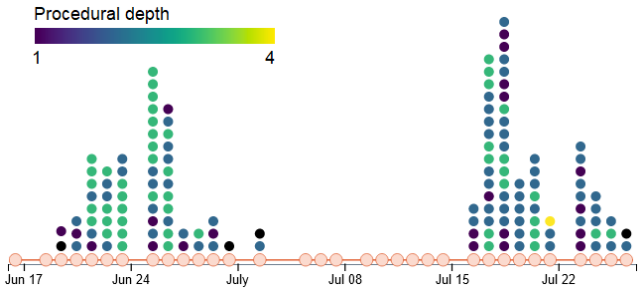

Figure 4: Different levels of procedural depth in the event tree. This information is translated to the visualization as connecting paths between child and parent events as each event is examined.

3.3 Entity Selection

The timeline allows for elements to be selected and highlighted. As seen in the interface (Figure 1), users can click any text sentence, keyword, person name, or event to highlight all amendments related to it on the timeline. The visualization's color scheme changes, displaying non-selected symbols in grey while selected symbols attain shades of blue. This way, we can display multiple types of event relationships at the same time, using different visual channels for event depth and events connected by a user-defined filter. The timeline in Figure 1 illustrates a selection that is being made.

4 Conclusion

This poster presented a visualization approach to display event history timelines for collaborative text development, applied to historical legal documents. This approach is developed alongside humanities experts, who provide domain requirements and feedback along the process, including a future user study. Our approach still presents limitations and directions for future work. For one, an individual text may represent only a step of the writing process for a larger document, being often copied or imported into other texts; a method to visualize the interaction between multiple timelines would therefore improve the visualization. Another direction is improving summarization and scalability, grouping events either vertically or horizontally, and providing summaries of text differences over time.

Acknowledgments

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