Interactive Event Sequence Visualization and Querying

EventFlow Demonstration

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The University of Maryland Human-Computer Interaction Lab has developed EventFlow, which has distinctive innovative features such as: (1) visual representation of temporal patterns (of point and interval events) for individual records and for the aggregate of all records (2) novel graphical query language to pose temporal queries such as Find all records with Event A followed by B followed by C (infection, fever, bleeding), or Event A during Interval B (stroke while taking warfarin), (3) query results are presented visually, organized by the matching and non-matching histories, (4) a search and replace feature (replace all sequences of normal blood pressure point events with an interval that shows the duration, (5) efficient internal data structures to support retrieval and aggregated view presentation, and (6) many features to organize, clean, transform, and simplify the data.

Temporal event data is a fundamental component of electronic health records. As such, many visualization tools have been designed for the exploration of this data type, however, they rely heavily on the assumption that the underlying data is fit to be explored. In many cases though, event patterns must be extensively transformed in order to better reflect either the real world events that generated them or the perspective of a given study. Without this step, population-level trends can be obscured.

Temporal event data wrangling, however, is deceivingly difficult and error prone even for expert users. Standard, command-based query languages are poorly suited for specifying even the simplest event patterns, and attempts at more accessible query languages frequently omit critical features such as events that occur over a period of time (intervals) or the absence of an event. Perhaps most importantly is that query alone is not enough to get users through a typical temporal event data wrangling process. Event patterns not only need to be found, but also transformed and re-represented. An improved query and wrangling process not only benefits database professionals, but also dramatically increase the range of users who can access this type of data.

The EventFlow visualization tool is built to extend beyond the typical bounds of data exploration, and serve as a
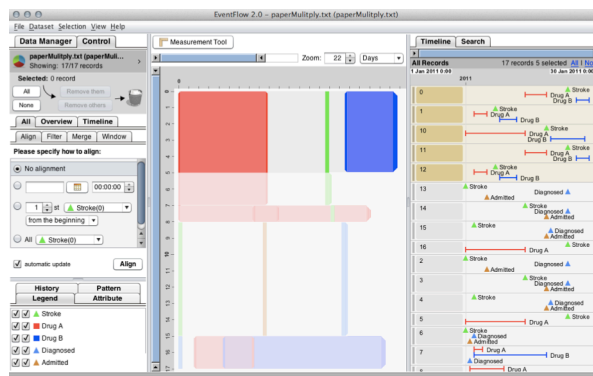

Figure 1 – The EventFlow interactive analysis tool (www.cs.umd.edu/hcil/eventflow) with a small sample dataset. On the left are found controls and legend, in the middle is the overview of all sequence patterns in the dataset, and on the right a scrollable timeline browser shows all the individual records. The top sequence in the overview is selected (drug A, followed by stroke, followed by drug B). The distance between events corresponds to the average time between events. The height of the bar corresponds to the proportion of records with that sequence. The records with the selected sequence are highlighted at the top in the timeline view.

critical aid for both temporal event query and data transformation.

PAPERS

1. Monroe, M, Lan, R., Lee, H., Plaisant, C., Shneiderman. B., Temporal Event Sequence Simplification. *IEEE Conference on Visual Analytics Science and Technology (VAST* 2013), 2227-2236.

2. Monroe, M., Lan, R., Morales del Olmo, J., Shneiderman, B., Plaisant, C., Millstein, J., The Challenges of Specifying Intervals and Absences in Temporal Queries: A Graphical Language Approach. *Proc. of ACM Conference on Human-Computer Interaction* (CHI 2013), 2349-2358.