TreeViz: Treemap Visualization of Hierarchically Structured Information

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INTRODUCTION

TreeViz is an Apple Macintosh implementation of the treemap technique for visualizing hierarchical information structures [2,4].

TreeViz enables users to visualize and browse large hierarchically structured information spaces. TreeViz enables the drawing of hierarchies an order of magnitude larger (# nodes) than is possible with typical presentation methods, given the same display space.

BACKGROUND AND GOALS

The primary goal of this project is the development of improved methods for the visualization of large hierarchically structured information spaces.

Scientific visualization has received a great deal of attention in recent years. There are many reasons for this but chief among them is the simple observation that humans have difficulty extracting meaningful information from large volumes of data. Our increasing ability to produce, disseminate, and collect information has quite naturally led to a demand for tools which aid in the analysis of this information and support our intuition.

Visualization tools increase the bandwidth of the human-computer interface. TreeViz harnesses the power of the machine to graphically encode information, and the power of the human visual processing system to analyze and search this graphical information space.

METHODOLOGY

The treemap visualization technique make efficient use of the available display space, mapping hierarchies onto a rectangular region in a space-filling manner. This efficient use of space allows large hierarchies to be displayed and facilitates the presentation of semantic information.

Presentations of hierarchically structured information typically fall into one or more of the following categories:

- **textual** (listings),
- **positional** (outlines), or
- **diagrammatic** (tree drawings [3]).

The treemap **mosaic** approach eliminates white space; each node is a tile in the overall mosaic. The position, size, color and pattern of tiles convey the properties of individual nodes, just as the patterns and colors of the entire mosaic convey properties of the hierarchy as a whole.

Treemaps partition the display space into a collection of rectangular bounding boxes representing the tree structure (Figures 1-3). The drawing of nodes within their bounding boxes is entirely dependent on the content of the nodes.

The display size of a node is based on the magnitude of its weight relative to the weight of the entire tree [1]. A node's weight can be assigned based on any numeric attribute, as long as the weight of each node is greater than or equal to the sum of the weights of its children.

Trees with well over 1000 nodes can be drawn on a 13" display. Interactive control allows users to specify the presentation of both structural (depth bounds, etc.) and content (display properties such as color mappings) information.

PROJECT RESULTS

Results so far are very encouraging and feedback from users has been positive. An initial counter-balanced, within-subject experiment compared TreeViz with the UNIX command line for directory-browsing tasks. TreeViz performance times were faster for "global" tasks such as locating the largest files in the hierarchy, and comparable to UNIX for "local" questions such as determining the size of a particular file. The subjects were given approximately 15 minutes of treemap training; at least one year of previous UNIX experience was required.

CONCLUSION

Space-filling mosaic approaches to the visualization of hierarchies have great potential. The algorithms are general and the possibilities for mapping information about individual nodes to the display are appealing.

Hierarchies are a natural way of organizing information and have become a ubiquitous part of life in the computer age. The treemap approach to visualizing hierarchies enables meaningful drawings of large hierarchies in a limited space. Treemaps can aid decision-making processes by helping users create accurate mental models of the content and structure of hierarchically structured information spaces.

ACKNOWLEDGEMENTS

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EXAMPLE

A weighted tree with 26 nodes.

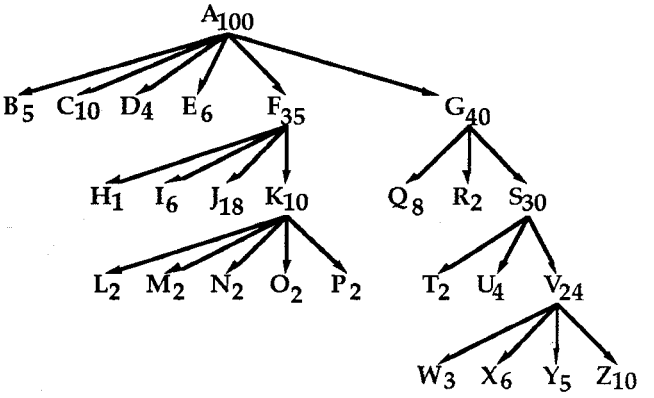

Figure 1: Traditional Tree Diagram Representation.

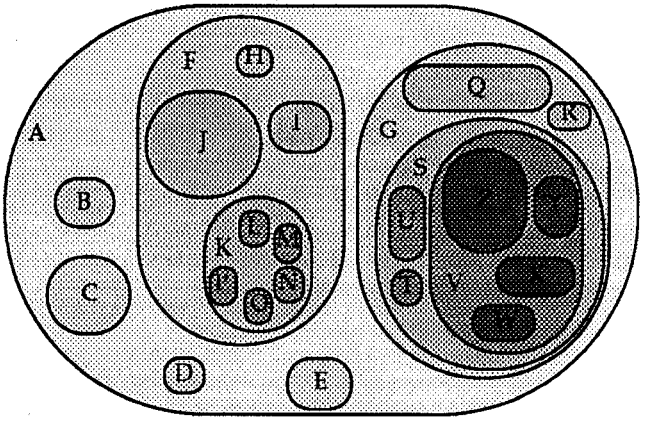

Figure 2: Venn Diagram Representation.
Node size is proportional to weight.

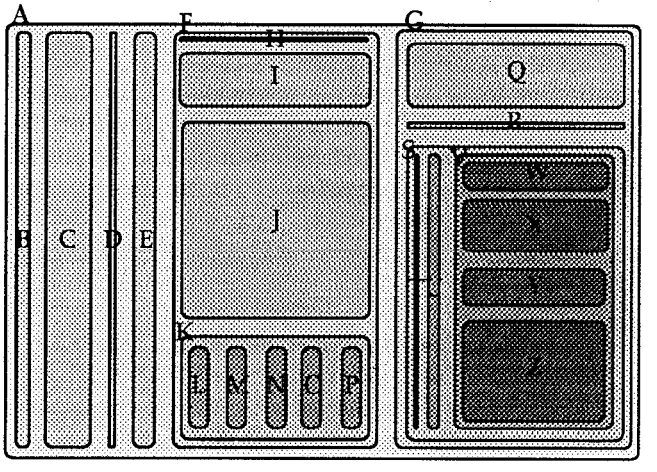

Figure 3: TreeViz Treemap Representation.
Scales transparently to well over 1000 nodes on a 13" screen. Seeing is believing!