Foreword

Manuel Lima’s book on Trees

  Ben Shneiderman (draft May 24, 2013)

Soaring oak trees are an attraction for those who sit under them or those who climb up for a better view. The cool shade of leafy maples or broad willows encourages calm reflections, while the eye-catching concentric circles of tree rings reminds us of how time passes and seasons change. Trees can also inspire a Newton to notice the proverbial falling apple or a Darwin to see the schema for all life forms.

The recursive branching structure of trees, which is a compelling metaphor for organizing knowledge, was strongly on my mind as I sought to show the nested structure of folders on a computer hard drive. My innovation went beyond turning a 3D tree into a nested planar diagram, I was eager to show the leafy-ness of each branch as an area whose relative size showed the magnitude of its leafy-ness. Furthermore, I wanted to ensure that all the areas would fill the containing rectangle and not spill outside. These constraints, and the variable depth of tree structures challenged me for months till the sudden Aha! moment hit me while in the faculty coffee room. It took me several days to work out the details, write the code, and convince myself that the solution would work. It was challenging intellectual work, but in retrospect the solution seems obvious.

However, what continues to surprise and delight me is how many improvements, variations, and extensions have been made by hundreds of other researchers. They invented squarified layouts, causing me to respond with further refinements, as well as circular designs, spiral layouts, text-friendly horizontal aspect ratios, organic-looking voronoi layouts, animated transitions as values changed, and much more. Treemaps were implemented in many programming languages and on many platforms, emerging even on small cellphone displays. What would a sonified treemap sound like?

We studied the 20-year history of interactive tree representations in "Innovation trajectories for information visualizations: Comparing treemaps, cone trees, and hyperbolic trees" (*Information Visualization Journal Volume 11, Number* 2 (2011), 87-105), with the goal of trying to understand why treemaps have flourished. It’s hard to prove, but the treemaps had a simple visual representation that was enhanced by repeated refinements and multiple evaluations tied to specific tasks. In short, treemaps solved problems that people cared about -- computer storage, stock market trading, production/marketing patterns -- in a way that is comprehensible and visually appealing. One glance is often enough to understand what has happened and what needs to be done. Treemaps are simple, practical, shareable, actionable, and occasionally attractive. But they are also imperfect, solve only some problems, and have limitations, so there is lots of room for future innovation in showing trees.

Manuel Lima’s remarkable history of tree diagrams shows how appealing and pliable the metaphor has been for more than 800 years. He diligently tracks historical evolutions and cultural crossovers, showing the many domains of human accomplishment that were supported and explicated by tree structures. The human interpretations of trees are sometimes almost as beautiful as their natural inspirations, but they are equally gnarled, cracked, twisted, and sometimes impenetrable. Still this thorough and enchanting review opens the reader’s mind to consider new uses of tree structures, new problems to be solved, and new ways to draw on natural beauty.

Natural and diagrammatic representations of trees come in many varieties, each with its own charm, virtues, and uses. Genealogical trees and organizational trees have unique items at interior as well as leaf nodes. By contrast treemaps were designed for trees that have values only at the leaves thereby supporting aggregation going up the tree.

Some trees are broad and shallow, others are narrow and deep; some trees are balanced with fixed depth, others have varying branching factors and erratic depth. Some uses of trees require comparisons across nodes or branches, while other uses require comparisons across two or more trees, such as changes to the US budget over many years. Other challenges in dynamic trees are to represent created or removed nodes, show movements of branches, and highlight large changes in absolute or relative values. I expect more tree visualization innovation, maybe stimulated by the examples in this book.

Trees have long inspired poetry such as Joyce Kilmer’s memorable couplet: “I think that I shall never see a poem as lovely as a tree.” She steers us back to admiring nature’s gifts, which is good advice to those seeking to create fruitful innovations.