

Abstract

While modern search engines are excellent resources for finding information on the web, in order to put together that information into a useful mental model for learning or making a decision – such as picking a new car or choosing a JavaScript library – people often need to collect information about the options available and the criteria on which to evaluate the options, synthesize such information from various sources into a meaningful structure, and share and justify the results with others. This sensemaking process, often highly iterative and cyclical, puts a significant cognitive burden on users, and often requires them to externalize their evolving mental models rather than keeping everything in their working memory. However, not only the tools that people use for externalization – such as browser tabs, documents, spreadsheets, or note-taking apps – poorly support the constant shifts between collecting, extracting, organizing, and reorganizing that are needed, but worse yet, even if they do put in the work to organize and share an external representation of their learning outcome or decision rationale (such as creating a list of suitable cars or a table of front-end libraries), it can still be difficult for subsequent users to evaluate whether they can or should trust and reuse that work without wasting it.

In this thesis, I explore interactive systems which bridge the gap between the rapidly evolving mental models in peoples’ heads and the externalization of those models by **exploring opportunities to reduce the costs and increase the benefits of externalization**, thereby capturing more of the cognitive work that users engage in while making sense of information in order to help them as well as subsequent people who might benefit from their work.

To help the initial users forage and structure information, my collaborators and I together designed **Unakite**, a browser extension that enables people to easily collect and organize information into a comparison table in a sidebar as they are searching and browsing, which proved to be able to significantly lowered the friction of externalizing mental models compared to conventional approaches like taking notes and saving screenshots in a separate Google Doc. Building on Unakite, we explored approaches to further reduce the cost of externalization and help people focus on their main activity of reading and making sense of web content, such as by intelligently and automatically keeping track of key information and evidence on behalf of a user (the **Crystalline** system) and leveraging novel lightweight interaction techniques (the **Wigglite** system). To help subsequent users explore and evaluate previous users’ work, I developed both a framework and the **Strata** system that collects and visualizes key signals about the context, trustworthiness, and thoroughness of previous design decisions and rationale.

Despite these advances, the dynamic and evolving nature of sensemaking – particularly in the early stages – means that the structures people created often become obsolete as their mental representations evolve over the course of an investigation. To complete my dissertation, I propose to integrate my existing work together, and in addition, explore what kinds of knowledge organizational structure (e.g., lists, mind maps, affinity diagrams, etc.) are the most appropriate during different stages of sensemaking, and how can tools support users in fluidly and effortlessly transforming these structures to reflect their evolving mental models. Similar to my previous work, I plan to evaluate the new systems through a series of lab and field studies with people solving their real-world problems.