Dynamic Abstractions: Building the Next Generation of Cognitive Tools and Interfaces

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ABSTRACT

This workshop provides a forum to discuss, brainstorm, and prototype the next generation of interfaces that leverage the dynamic experiences enabled by recent advances in AI and the generative capabilities of foundation models. These models simplify complex tasks by generating outputs in various representations (e.g., text, images, videos) through diverse input modalities like natural language, voice, and sketch. They interpret user intent to generate and transform representations, potentially changing how we interact with information and express ideas. Inspired by this potential, technologists, theorists, and researchers are exploring new forms of interaction by building demos and communities dedicated to concretizing and advancing the vision of working with dynamic abstractions. This UIST workshop provides a timely space to discuss AI's impact on how we might design and use cognitive tools (e.g., languages, notations, diagrams). We will explore the challenges, critiques, and opportunities of this space by thinking through and prototyping use cases across various domains.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; **Interaction design**; **Visualization**; **Interaction paradigms**; **Graphical user interfaces**; **Interaction techniques**.

KEYWORDS

dynamic abstractions, cognitive tools, interaction design

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1 INTRODUCTION

The human mind is dynamic, constantly weaving abstract ideas and navigating various levels of abstraction. For example, software programmers transition between high-level functional requirements and low-level implementation details. Scientists develop theories based on empirical data, forming and testing hypotheses to explain natural phenomena. Mathematicians move from abstract theorems to practical applications, creating models that solve real-world problems. Artists transform abstract concepts into tangible art forms through their chosen mediums. Every day, individuals parse the hierarchies and networks of concepts presented in various representations such as texts, equations, and diagrams. Overall, our minds continuously operate on multiple levels of abstraction, integrating and synthesizing complex ideas [6, 20, 24, 27].

To externalize and act on these ideas, humans invented powerful cognitive tools—representations such as languages, symbols, notations (e.g., number systems), and diagrams. For centuries, they have supported our complex cognitive processes, enabling us to think the unthinkable, solve intricate problems, and grasp and articulate highly complex ideas [10, 25]. Thus, working with technology should allow for fluid and dynamic forms of human thought—technology should not unnecessarily restrict our interactions with information at a single level of abstraction.

Recent advances in AI and the generative capabilities of foundation models present an opportunity to design the next generation of dynamic interfaces and interactions that extend the capabilities of traditional cognitive tools [4, 7, 17–19, 21, 27]. Researchers have

already begun to build the next generation of interfaces and interactions that adapt fluidly to our intents and dynamically transform representations in real-time to support our complex and dynamic cognitive processes (e.g., [1, 3, 5, 8, 9, 11–15, 18, 20, 22, 23, 26]). We are already witnessing a surge of innovative tools showcasing this potential. One example is tldraw, an open-source whiteboarding tool that allows users to instantly create and update interactive websites by simply sketching interfaces and providing annotations as instructions [16].

This workshop (https://dynamicabstractions.github.io/uist2024-workshop) aims to build on the success of the recent Dynamic Abstractions group[1] meetup at CHI 2024, where over 120 participants gathered to show interest in a community dedicated to exploring ways to develop the next generation of dynamic interfaces and interactions. At UIST, we will continue to energize this interest and foster collaboration among researchers and industry professionals to advance the vision of dynamic abstractions.

2 WORKSHOP PLANS & GOALS

Our one-day workshop will include in-person activities, including two keynote talks, two group discussions, and a prototyping session. Below, we describe each session in detail.

2.1 Preparatory Activities

2.1.1 Survey. Prior to the workshop, to engage the broader community of technologists, industry professionals, and researchers interested in this space, we will use social media platforms and the Discord channel (90+ members) already set up for the Dynamic Abstractions group to survey topics and themes they want the workshop attendees to discuss.

2.2 Workshop Activities

Opening and introductions (9:00 - 10:00). The workshop will begin with the organizers introducing themselves and outlining the activities and goals for the day. This will be followed by 1-minute lightning talks from each attendee, where they will share their research interests and any relevant work related to the workshop topics. This session aims to familiarize participants with one another and set the stage for collaborative discussions.

Activity 1: Keynote 1 (10:00 - 11:00). The first keynote session will feature a 50-minute presentation followed by a 10-minute Q&A session moderated by one of the organizers. We plan to invite a keynote speaker from the industry who has worked on similar problems and is building tools with the same goal. This industry perspective is crucial as it provides practical insights and real-world applications that complement academic research. The keynote speaker will share the latest developments and future directions in dynamic interfaces, setting the tone for the workshop's themes.

Activity 2: Group Brainstorming & Discussion (11:00 - 12:00). In this session, attendees will be assigned to tables focused on preselected domains such as programming, creative writing, and data science. Participants will engage in brainstorming compelling applications and use cases for these domains, as well as answering key questions related to dynamic abstractions, such as:

- What examples of dynamic abstractions exist?
- What design methods can we use to build dynamic abstractions?
- What new challenges or opportunities do they introduce?
- Which domains can benefit from dynamic abstractions?
- How will dynamic abstractions change the social and political (in addition to cognitive) landscape of how we use technology?

The session will involve using post-its and a poster board to pin ideas, followed by group discussions. In the final 15 minutes, groups will present their insights, followed by a one-hour lunch break.

Activity 3: Prototyping (13:00 - 14:30). Attendees will prototype ideas that leverage the concept of dynamic abstractions. This hands-on session aims to translate brainstorming ideas into tangible prototypes, encouraging them to prototype, for example, dynamic and intelligent interfaces for diverse domains such as programming and data visualization. Organizers will participate in each group as facilitators to foster discussion, provide assistance, and manage time. At the end of the session, participants will present their prototypes to the group, reflecting on the challenges encountered during the process and identifying new opportunities and design patterns for applying these concepts to other domains and tasks.

Activity 4: Keynote 2 (14:30 - 15:30). The second keynote speaker will deliver a 50-minute talk on a relevant topic, providing further insights and inspiration. The session will also include a 10-minute Q&A moderated by one of the organizers, allowing attendees to engage with the speaker and dive deeper into the subject matter.

Activity 5: Group Discussion - Research Agenda (15:30 - 16:30). Participants will engage in a group discussion to identify and prioritize research agendas related to dynamic abstractions. Building on previous activities, such as keynotes, prototyping, and group discussion sessions, this session will focus on defining key research questions, exploring potential methodologies, and identifying collaborative opportunities. The goal is to create a clear roadmap for future research efforts and foster collaboration.

Activity 6: Summary and Future Plans (16:30 - 17:00). The final session will summarize the day's discussions and activities. Organizers will outline future plans, including potential collaborations, follow-up meetings, and next steps for advancing research on dynamic abstractions. Participants will be encouraged to share their thoughts and feedback. The workshop will conclude with closing remarks from the organizers, thanking participants for their contributions and encouraging collaboration within the newly formed community. Attendees will also be encouraged to join the Dynamic Abstractions group Discord server to continue the conversation.

3 POST-WORKSHOP PLANS & GOALS

We will write an article summarizing the outcomes of the workshop and post it on the Dynamic Abstractions website [2]. This article will highlight key insights from the keynotes and discussions and contain our collaboratively envisioned future research agenda. To ensure this workshop can serve as a bridge to a wider community, we will also publicize this article across social media platforms and the Dynamic Abstractions group Discord channel, engaging our community and inviting further discussion, feedback, and membership.

[1] https://dynamicabstractions.github.io/

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