Making Tools that People Will Use: User-Centered Design in Computational Biology Research

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User-Centered Design (UCD) focuses on deeply understanding the needs of users and ensuring these needs are met by tools and software. UCD methodology aims to make tools easier to use, reduce time spent in development and the need for user support, as well as make it easier to create and maintain documentation. The goal of UCD is to ultimately make a tool that meets user needs and is a pleasure to use. This workshop will give an overview of UCD and several examples of how UCD practices are already being used at several institutions. Attendees will leave with ideas of how to incorporate UCD into their tool development as well as general resources to get started.

Keywords: User Centered Design, User Experience, UX/UI, Usability

1. Introduction, Background, and Motivation

Effective software tools are needed in computational biology to help understand the results of computational analyses, visualize multi-scale datasets and mathematical models, and generate insights[1]. As progress in artificial intelligence in the biomedical space is manifesting itself primarily in the form of augmented intelligence, it is becoming even more important to design approaches that enable efficient interactions between powerful software and human experts. Additionally, users of computational biology tools are diverse, often with particular needs unique to their area of research. Developing tools that address the specialized needs of practitioners, either a few individuals or a larger given field, is commonly known as User-Centered Design (UCD)[2]. The goal of UCD is to create a product that satisfies users' needs, has an interface that is easy-to-use, and, in general, is a tool that people want to use.

User-Centered Design is design based upon an explicit understanding of users, tasks, and environments, and is driven and refined by iterative user-centered evaluation[2]. While UCD increases the number of users and their satisfaction with a tool, UCD also can reduce development costs/time

as well as the effort required for user support and documentation[3]. UCD can be applied to tools that are simple or complex, that are made for only a few users or a few thousand users, or that are interacted with via a graphical user interface (GUI), command line interface (CLI), or application programming interface (API).

While UCD has been broadly applied across many industries, it typically has not been applied in computational biology and bioinformatics research, where the focus tends to be more on the optimization of underlying algorithms and the computational core of the software[4-6]. This approach often neglects a tool's usability, in the interface components of the tool as well as in user's workflow both inside and outside the tool.

This workshop will be an overview of how UCD has been successfully applied to computational biology tools and bioinformatics resources. Speakers will discuss how they have incorporated various aspects of this discipline into their tool development, including tips for success and lessons learned. Attendees will leave with an understanding of common UCD practices as well as models of how they might apply them to their own tools.

2. Workshop Presenters

The three-hour workshop will begin with an overview presentation of User-Centered Design, and will followed by four presentations. The workshop will conclude with a panel discussion session, which will be moderated by Nils Gehlenborg and Mary Goldman.

2.1 Workshop Speakers

Ljubomir Bradic (Sage Bionetworks)
Ljubomir is the Director of Design at Sage Bionetworks, where he leads the design of Sage Bionetwork's data sharing and collaboration platform, as well as the Digital Health platform. He specializes in complex problem spaces in environments with fluid requirements, particularly early startups. His deep understanding of the software development life cycle comes from being a startup founder and previous experience as a product manager and developer.

Jeremy Kriegel (Audible, Inc)
Jeremy was previously the UX Lead for the Broad Institute and is currently the Director of User Experience at Audible, Inc. Over the past two decades, he has worked on user experience problems as a consultant and as a part of internal teams at organizations that range from start-ups to Fortune 100 companies.

Zinaida Perova (EMBL-EBI)
Zinaida Perova is a Project Lead at the European Bioinformatics Institute. Her work is aimed to further expand the PDX Finder resource to cover other patient-derived cancer models, such as cancer cell lines and organoids. She has a PhD and postdoctoral experience in Biological Sciences.

Galabina Yordanova (EMBL-EBI)
Galabina is a User Experience Architect at the European Bioinformatics Institute. She is currently working on the Data Submission process for the Human Cell Atlas and on the COVID-19 Data Portal: covid19dataportal.org. She has worked in the field of product management and user experience design for the last 15 years, bringing her expertise to a variety of online products and services.

2.2 Panel Moderators

Nils Gehlenborg (Harvard Medical School)
Nils has over 15 years of experience in applying user-centered design approaches in biomedical data visualization tool development and has played a central role in the establishment of the VIZBI and BioVis meetings.

Mary Goldman (UC Santa Cruz Genomics Institute)
Mary has been working in genomics for ten years, both for the UCSC Genome Browser and UCSC Xena. She began her role in User-Centered Design five years ago and leads the User Centered Design Working Group at the UC Santa Cruz Genomics Institute.

3. Speakers Abstracts

Systems Design Methods for Building Bioinformatics Applications
Ljubomir Bradic
This talk will introduce Systems Design principles for creating long lasting and scalable ecosystems of bioinformatics applications. Based on methods used at Sage Bionetworks, we will demonstrate how commercial software industry design techniques and methodologies have been adapted to deliver software that supports open science initiatives. We will also cover design and organizational best practices for working in resource constrained environments.

User-Centered Design for the Broad Institute
Jeremy Kriegel
User-Centered Design recognizes that all tool development starts with an understanding of the user and a real-world problem they experience. Good design needs an in-depth understanding of users' tasks, motivations, goals, and steps they take, as well as an overall grasp of the context in which they use a tool and what other technologies they rely on. UCD can be applied at any stage of development of a project but is ideally incorporated through the entire process. I will talk about several User-Centered Design practices that can be applied to development of a computational biology tool, from inception to launch and ongoing efforts. Applying these methods helps ensure that a tool fits well into a user’s workflow, addresses their needs, and is a pleasure to use.

User centric development of the PDX Finder database

Zinaida Perova

PDX Finder is an open and comprehensive global database of patient derived xenograft models and data. PDX Finder was developed using User-Experience Design methods through iterative collaboration between users and developers from the start thorough the entire life of the project. We worked as a multi-disciplinary team to understand the user's problems, needs and general scope of the project. This talk will lay out the UX methods that were used from conception to development to release, including defining user personas, identifying stakeholders, outlining the user journey, as well as how we used various workshops to refine standards, needs and database design before implementation. Finally, this talk will end with the usability sessions and metrics we developed and measured to ensure that PDX Finder met user needs.

User research - how discovery and evaluation helps guide the development of our data portals

Galabina Yordanova

In the field of bioinformatics software development, there is sometimes a tendency to quickly move on with system architecture specification of what looks like the obvious solution for a tool or a service. It is rare to dedicate time on understanding the workflows and needs of the intended users of those tools or systems. Building knowledge about user needs and getting feedback on whether suggested solutions will help teams build tools and services which help researchers do their work in a more efficient way. Sharing the insights of those findings helps to align multi-disciplinary or international teams, so that everyone is working towards a common outcome.

I will talk about the user research methods we applied for two of our projects - the Human Cell Atlas data platform and the COVID-19 Data portal. I will share our experience and how these user research activities helped align the team, improve our understanding of user needs and guide the development of those portals.

4. Conclusion

This workshop will highlight a number of User-Centered Design methods, strategies, and tools currently being used to help design and create computational bioinformatics tools and resources. By supporting scientists with better tools, that are easy-to-use and fit well within a user's workflow, we enable them to focus on their research and advancing science.

References

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