Computational Modeling in Human-Computer Interaction

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ABSTRACT

We propose a workshop on rapidly emerging topic of Computational Modeling in HCI to address the challenges of increasing complexity of human behaviors we are able to track and collect today. The goal of this workshop is to reconcile two seemingly competing approaches to computational modeling: theoretical modeling, which seeks to explain behaviors vs. algorithmic modeling, which seeks to predict behaviors. The workshop will address: 1) convergence of the two approaches at the intersection of HCI, 2) updates to theoretical and methodological foundations, 3) bringing disparate modeling communities to CHI, and 4) sharing datasets, code, and best practices. This workshop seeks to establish Computational Modeling as a theoretical foundation for work in Human-Computer Interaction (HCI) to model the human accurately across domains and support design, optimization, and evaluation of user interfaces to solve a variety of human-centered problems.

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CCS CONCEPTS

• **Human-centered computing → Human computer interaction (HCI)**.

KEYWORDS

Computational Modeling; Machine Learning; Data Mining; Computational Interaction.

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INTRODUCTION

The proliferation of personal, mobile, and wearable devices and smart environments outfitted with precision sensors enabled tracking and collecting staggering amounts of human behavior traces data about people and their environments. For example, fitness trackers count each step we take, web search engines process and store each Internet search we make, social media sites record each personal connection we establish and each message we post, map and navigation applications record each place we visit. This offers a new source of data to study human behavior at scale and create future User Interfaces that can automatically act in response to people's behaviors. However, it is not immediately obvious how to: 1) explore such large amounts of heterogeneous and unlabeled data stored in behavior logs to understand people's behaviors, and 2) leverage it to build future behavior-aware User Interfaces.

The complexity of behaviors stored in large behavior logs greatly exceeds the capabilities of existing human behavior models that use data from empirical studies to manually define behaviors (e.g., GOMS [3]) or estimate them using simple regression (e.g., Fitts' Law [12]). One promising solution, that addresses both challenges above, is computational modeling [10], which mathematically encodes a complex system (such as cognition, behaviors, and environments in which behavior is situated) to explore the system and act in response to modeled behaviors through prediction and simulation. Computational Modeling has applications across HCI, including Computational Interaction, Cognitive Modeling, Precision Healthcare, to name a few.

In recent years Human-Computer Interaction (HCI) researchers and practitioners have adopted two seemingly competing approaches to computational modeling: theoretical modeling vs. algorithmic modeling.

Theoretical computational models are motivated by the precision and expressiveness that computer programs offer for explaining people's behaviors. Such models hold the promise of explaining complex

emergent phenomena by seeking a strong correspondence between theoretical assumptions and empirical observations of human behavior. Such models have found particular success in cognitive modeling in HCI to theorize and explain cognitive processes and their behavioral consequences [7]. However, such models might lack practical applications [2], might miss valuable knowledge hiding in large behavior logs simply because it is inconsistent with existing theory [6], and might lack predictive power [11] necessary to automatically act in response to people's behaviors in future behavior-aware User Interfaces.

Algorithmic models leverage Data Mining and Machine Learning (ML) methods to extract novel and potentially useful patters from large data [5] and use the patterns to classify and predict future behaviors. Such models have shown great promise in automatically detecting people's activity and learning people's preferences for various enacted behaviors from the data [1]. However, such algorithm-driven, black-box models make it difficult to explore behaviors and inform the design of potential future User Interfaces because they: 1) have no semantic knowledge about behaviors that generated the data [2], 2) give no guarantee that their prediction performance is due to their correct mathematical representation of people's behaviors and not some other (potentially spurious) correlations in the data [11], and 3) offer little insights into their inner workings [8].

The overarching goal of this workshop is to start a discussion about a set of guidelines necessary to establish Computational Modeling as a theoretical foundation for work in Human-Computer Interaction (HCI) to model the human accurately across domains and support design, optimization, and evaluation of user interfaces to solve a variety of human-centered problems.

Same Problems, Different Approaches. For their success, the two computational modeling approaches need to converge at the intersection of HCI where they contribute to understanding people's behaviors and creating technology that can reason about people's behaviors in a way that will have a positive, broader impact on people's lives. Both approaches have seen success in HCI, at times working separately on the same problem (e.g., modeling menu interactions from theoretical foundation [4] and a using a deep learning method [9]). This suggests that the difference between the two computational modeling approaches are at the methodological level only. Yet, challenges remain in combining these two approaches; something that this workshop seeks to address.

Updating Theoretical and Methodological Foundations. Computational Modeling has found applications in the fields of Science, Engineering, and even Design [10]. Yet, little of the advancements from other fields have seen introduction in HCI. Although, some of the cutting-edge Machine Learning methods have seen applications in algorithmic modeling in HCI, the theoretical models lag significantly behind their counterparts in other fields, such as cognitive science. This workshop will bring together researchers from different disciplines within the HCI community to discuss updates to our current theories and methods.

Bringing Disparate Communities to CHI. Computational Modeling draws from many fields outside of HCI and has applications in almost all aspects of human-centered design. Yet, research across those fields remains isolated. To overcome this, this workshop seeks to bring together researchers and practitioners from both computational modeling camps and broader community from Cognitive Science, Artificial Intelligence, Machine Learning, Data Science, Visual Analytics, and Computational Interaction to discuss the future direction for Computational Modeling in HCI.

Sharing Datasets, Code, and Best Practices. To establish Computational Modeling as a scientific method in HCI requires following best practices, such as reproducibility of computational models and replicability of experimental results. This workshop will be an opportunity for the community to discuss what those best practices are and to establish a platform to share datasets and code.

ORGANIZERS

The organizers of the workshop are well-known researchers in the field of Human-Computer Interaction, Cognitive Science, and Computational Interaction who bring their expertise to advance the agenda of the workshop. The organizers are prominent members of HCI community and have served as members of the program committees and editorial boards for premier HCI conferences and journals.

Nikola Banovic, Ph.D., is an Assistant Professor of Electrical Engineering and Computer Science at the University of Michigan. Dr. Banovic received his Ph.D. from the Human-Computer Interaction Institute (HCII) at Carnegie Mellon University, and his B.Sc. and M.Sc. degrees from the University of Toronto. His research focuses on creating computational models of human behavior to study, describe, and understand complex human behaviors and enable technology that automatically reasons about and acts in response to people's behavior to help them be productive, healthy, and safe. Dr. Banovic has been named NSERC Post-graduate Fellow and Yahoo! Fellow and published award-winning research on methods to study and model human behavior in premier HCI conferences.

Antti Oulasvirta, Ph.D., is an Associate Professor at Aalto University where he leads the User Interfaces research group. He was previously a Senior Researcher at the Max Planck Institute for Informatics. Antti received his doctorate in Cognitive Science from the University of Helsinki in 2006, after which he was a Fulbright Scholar at the School of Information in University of California-Berkeley in and a Senior Researcher at Helsinki Institute for Information Technology (HIIT). He was awarded the ERC Starting Grant (2015-2020) for research on computational design of user interfaces.

Per Ola Kristensson, Ph.D., is a University Reader in the Department of Engineering at the University of Cambridge and interested in intelligent interactive systems that enable people to be more creative, expressive and satisfied in their daily lives. His PhD thesis was on gesture keyboard technology for touchscreens and in 2007 he co-founded ShapeWriter, Inc. to commercialize this technology. In

2008-2011 he was a Junior Research Fellow at the University of Cambridge and in 2011-2014 he was a Lecturer at the University of St. Andrews. In 2013 he was recognized as an Innovator Under 35 (TR35) by MIT Technology Review and appointed a Member of the Royal Society of Edinburgh Young Academy of Scotland. He has been awarded the ACM User Interface Software and Technology (UIST) Lasting Impact Award, the Royal Society of Edinburgh Early Career Prize in Physical Sciences and the Sir Thomas Makdougall Brisbane Medal.

PRE-WORKSHOP PLANS

We plan to broadly advertise the workshop to different communities of researchers and practitioners. This will include posting announcements distribution lists as CHI-ANNOUNCEMENTS and social media, such as Twitter and Facebook. We will send targeted email invitations to leading researchers in different academic institutions inviting them to participate and with a request to distribute the announcement within their organizations. We will launch a website soon after the workshop acceptance decisions. The website will feature a Call for Proposals, information about organizers, news and announcements, and paper submission instructions.

WORKSHOP STRUCTURE

We propose to organize the workshop as part of pre-conference program for CHI 2019. The workshop will last 1 day. We project the attendance to be around 20 participants (including the organizers).

The first half of the workshop (the morning) will be dedicated to introducing the topic of the workshop. All participants will be asked to briefly present their position paper. This will be followed by a session in which participants will decide on group discussion topics for the second part of the workshop. Participants will vote on already proposed topics in this document and propose new discussion topics. We will use the outcomes to prepare the afternoon groups sessions in which participants will discuss these topics.

The second half of the workshop (the afternoon) will consist of group discussions around the topics of the workshop. The participants will choose a group topic which they will join and discuss. Each group will be asked to create a paper poster detailing the outcomes of the group discussion.

POST-WORKSHOP PLANS

We will summarize the results of the workshop and publish it as a report on the workshop's website. The participants will present outcomes of group discussions as posters during a break at the conference. We will also invite participants to submit extended versions of their 3 to 6 pages position papers following the workshop. Depending on the quality of submissions, we might invite participants to author a joint review of the field as a journal article. We will continue to use the workshop as a venue

to bring the community together for potential future collaborations and sharing of datasets, code, and best practices.

CALL FOR PARTICIPATION

Computational Modeling is a rapidly emerging topic in HCI that offers a promise to address the challenges of increasing complexity of human behaviors we are able to track and collect today. The goal of this workshop is to reconcile two seemingly competing approaches to computational modeling: theoretical modeling, which seeks to explain behaviors vs. algorithmic modeling, which seeks to predict behaviors. The workshop will address: 1) convergence of the two approaches at the intersection of HCI, 2) updates to theoretical and methodological foundations, 3) bringing disparate modeling communities to CHI, and 4) sharing datasets, code, and best practices. This workshop seeks to establish Computational Modeling as a theoretical foundation for work in Human-Computer Interaction (HCI) to model the human accurately across domains and support design, optimization, and evaluation of user interfaces to solve a variety of human-centered problems.

Potential participants should submit a 3 to 6 pages long position paper (including references) in the CHI Extended Abstracts Format describing their interest and/or previous work related to the workshop topic. Papers should be submitted to the workshop website. We will select papers based on relevance, quality, and diversity. At least one author of each accepted position paper must attend the workshop and all participants must register for both the workshop and for at least one day of the conference.

Workshop website: http://hcicompmodeling.wordpress.com

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