Exploring Public Engagement with the Social Impact of Algorithms

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Abstract
We discuss *Logical Conclusion*, an analog interactive installation which presents issues surrounding the social impacts of algorithms used by corporations and governments via logic puzzles with physical elements that visitors manipulate to solve. We present the combination of physicality and participation as promising tools to engage the public with the ways that complex technologies interact with society. We also pose questions regarding how such strategies might be extended by the addition of responsive tangible computing elements.

Introduction
As corporations and governments have increased access to computing power, they are using those tools to computationally predict individual behavior and traits. Those predictions are then used to make decisions which impact people's lives in complex ways. For example, in the United States, jurisdictions may use predictive algorithms to suggest sentences for convicted criminals [3]. Meanwhile, the Chinese government is implementing its social credit score system to determine which citizens can purchase train tickets [2].

These systems impact people's lives, but they can be obscured by the organizations that use them. The way

Figure 1: *Logical Conclusion* installation detail showing "School for Algorithms" welcome letter. Photo by Yufan Zhang.

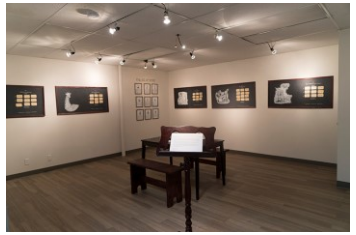

Figure 2: *Logical Conclusion* Installation view. Photo by Yufan Zhang.

predictive algorithms arrive at their results can be difficult or even impossible for humans to fully understand, which makes them hard to discuss as social issues to be addressed with political strategies [5]. While journalistic and scholarly investigation of these issues contribute to mitigating this challenge, art is a promising tool for engaging the public with the social implications of technological progress, with the potential to connect abstract concepts to personal experience [13].

Logical Conclusion (**Error! Reference source not found.**, Figure 2) is an analog interactive installation that was the result of an iterative process of research creation or practice-based research. The goal of the work was to provide a way for members of the public to gain exposure to this issue and actively reflect on the ways that institutions use predictive algorithmic systems in ways that impact citizens' lives; it was not intended to expose the technical functions behind such algorithms. This paper lays out the motivation for this work, discusses the form that it took, and provides a provocation for future work regarding active ways to engage participants with abstract technical concepts that have social impact.

Related Work

Artists have created work both *with* and *about* algorithms to investigate their use. Karl Sims's *Galapagos* algorithmically evolves digital creatures based on which one visitors stand in front of [11]. Jesse Colin Jackson's *Marching Cubes* has visitors assemble blocks following the marching cubes algorithm [8]. Much work in this genre investigates creativity, or how humans navigate their technological world. Work that focuses on the social implications of algorithms such as *Biometric Mirror* often points to opacity and privacy concerns [9]. *Logical Conclusion* extends this perspective by providing ways for members of the public to actively work on simplified puzzles, to make the impact of such systems more understandable to non-experts and providing time to reflect on the issue.

Logical Conclusion

Logical Conclusion was exhibited from 1-28 June 2018 at EMMEDIA in Calgary, AB, Canada. Inspired by Lewis Carroll's logic puzzles [1], the installation consists of nine blackboards within a fictional "School for Algorithms" to which visitors had been "transported". Each blackboard has an illustration silk screened upon it, featuring magnetic tiles (Figure 3) with the terms of a logic puzzle laser-cut onto them. The tiles are arranged into the initial set of assertions for the puzzle. Visitors can rearrange the tiles to eliminate terms and reach the simplified and often absurd-sounding "logical conclusion" of the puzzle.

Each puzzle is based on a predictive algorithm. To develop the puzzles, the authors examined public information such as news articles, corporate blog posts, and government reports about each how each algorithm works, extracting inputs to create premises in the form of "A are B" and "B are C", therefore "A are C" based on the information gathered. The puzzles are significantly simplified, both so that people unfamiliar with logic puzzles can solve them, and because the connection to formal logic was the focus of the installation. Figure 5Figure 5 depicts an example puzzle from the supplementary workbook.

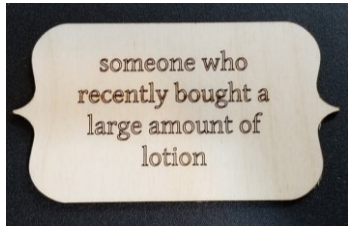

Figure 3: Magnetic piece from a *Logical Conclusion* puzzle.

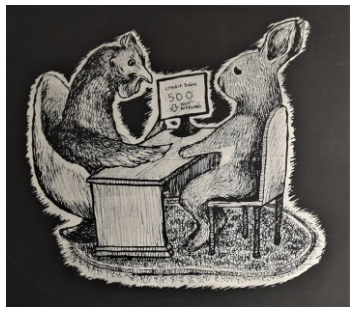

Figure 4: Example illustration from *Logical Conclusion* puzzle. Photo by Yufan Zhang.

~ EXAMPLE ~

HOW GOVERNMENTS CHOOSE

Given:

1. (People who play video games) have [friends who post a lot on social media].
2. [People who post a lot on social media] may {disagree with the government}.

The first two premises in this puzzle combine to form "{People who play video games} have {friends who may disagree with the government}."

3. {People whose friends may disagree with the government} do not ((deserve a visa)).

Combine the result of the first two premises with the last to reach the conclusion: "{People who play video games} do not ((deserve a visa))"

The terms that are the same (indicated by bracket style) connect the premises. Then you can eliminate them.

The terms that don't have a match are part of your conclusion. Read through the premises to see how you can connect them based on the information you have.

Therefore:

(People who play video games) do not ((deserve a visa)).

3

Figure 5: Example puzzle from *Logical Conclusion* workbook.

Some of the algorithms will likely be familiar to visitors, such as Facebook's News Feed algorithm [10]. Some may seem funny, such as Target's algorithm to predict pregnancy [6]. Others are more disconcerting, such as the Skynet algorithm to identify terrorists [4], or an algorithm to fire teachers [12].

Working through the puzzles provides time to think through predictive tasks as computational steps; thus, making the puzzles accessible was prioritized over representing the exact function of the algorithms. A reference sheet was available for visitors should they want more information about the algorithms, and a workbook with all 20 puzzles, including the nine on blackboards in the exhibition, was available (Figure 6).

Each puzzle is accompanied by an illustration (Figure 4), inspired by John Tenniel's *Alice in Wonderland*

Figure 6: *Logical Conclusion* workbooks. Photo by Yufan Zhang. The full workbook is available online at `http://kathrynblair.com/home/logical-conclusion`

illustrations, depicting an animal character that the algorithm impacts. The illustrations are meant to emphasize the absurdity of puzzles and provide a way for visitors to connect with people who may be impacted by the algorithms.

The installation is presented as the "School for Algorithms," a fictional Victorian school implied by blackboards and workbooks as well as an acceptance letter (visible in **Error! Reference source not found.**). This setting reinforces the rigidity of the logic in the puzzles, and the rigidity with which the results of predictive algorithms can be implemented by institutions using them.

Discussion and Future Work

The first author collected verbal feedback from visitors about the exhibition, but was not able to conduct a formal study. Based on anecdotal feedback, we found that visitors were able to connect the content in the gallery to social issues, both ones they were aware of such as the Facebook News Feed algorithm, and ones they hadn't known about. Visitors mentioned that the illustrations and school context were humorous, which contrasted the serious content, throwing it into relief. Visitors mentioned that stepping though the puzzles helped them think about how computer programs are used to make decisions. However, the puzzles were challenging for many visitors, which proved to be a barrier to the work.

A possible avenue illuminated by this work is that exploring how computers function by manipulating analog physical elements may be a promising way to make their workings less abstract and more relatable to people without computing expertise. Moreover, being actively engaged in working on the puzzles seemed to encourage visitors to operationalize their understanding of computational thinking and seemed to provide time for reflection on the social issues at play. Supporting computational learning with tangible elements is an area of active scholarship in education [7], and we present *Logical Conclusion* as a provocation for further consideration of how these qualities could be enhanced by the addition of physical computing-enabled, responsive elements. An additional question posed by this project is how the physical materiality and any fictional conceit (in this case, the school) around a tangible experience might be employed to enhance the relatability and accessibility of such systems.

The authors intend to investigate more fully (1) the role of participation in efforts to communicate complex technical issues, where visitors must actively think through the implications of the topic at hand; (2) the role that tangible elements can play with when combined with active participation to make complex technical issues more accessible and (3) how to provide a space for public discourse around the social implications of technology more thoroughly. The authors are developing future interactive installations and will conduct formal qualitative user studies to better understand visitors' experience and whether the strategies discussed here have the intended impact.

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