Extending the CS 4501 Cybersecurity and Elections Curriculum

An Analysis of the 2000 United States Presidential Election

A Thesis Prospectus
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By
Kaitlyn Bruns

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

ADVISORS

Benjamin Laugelli, Department of Engineering and Society

Rosanne Vrugtman, Department of Computer Science

Briana Morrison, Department of Computer Science

Introduction

Maintaining the confidentiality and integrity of the voting process is critical infrastructure for many democratic societies. The design and accessibility of election voting machines is becoming—and has been—a threat to this infrastructure. Although technical in nature, analyzing voting machine technology from a social perspective stands to benefit all citizens but especially those who are members of previously disenfranchised groups.

The University of Virginia's Computer Science Department teaches its traditionally technical courses isolated from social analysis, and this prevents students from considering the potentially dangerous societal impacts the programs they create may have. For example, in CS 4501 Cybersecurity and Elections, the controversy surrounding the recount of the 2000 United States Presidential Election is analyzed for its surface-level offenders: lack of ballot transparency and faulty vote counters (Davidson et al., 2022). A deeper analysis would more carefully consider the immense social power of the voting machine and how its accessibility can be weaponized.

Solving the technical aspects behind a flawed voting system may eliminate physical vulnerabilities and protect against foreign or domestic attacks, but ignoring social aspects will leave the challenge only partially resolved, at best. Because maintaining the integrity of the voting system is sociotechnical in nature, it requires attention to both its technical and social aspects. In what follows, I introduce an addition to the CS 4501 Cybersecurity in Elections curriculum that functions to better educate students on their current social impact and responsibility to protect users and—to an extent—democracy in decisions that may face in the workplace. Proceeding that, I will show the necessity of this addition by examining the 2000 United States Presidential Election in the context of technological politics to show how the social

power of election machines can be used to influence elections and enact voter disenfranchisement.

Technical Project

To earn a Bachelor of Science in Computer Science at UVA, students must complete 15 credits of upper-level computer science electives. This ranges from topics in cybersecurity to software testing to database management. In a series of cybersecurity classes, students learn technical definitions and applications in CS 3710 Intro to Cybersecurity alongside some famous historical attacks (Orebaugh, 2022). Followed by CS 4501 Cybersecurity in Elections, students read about the historical context of voter disenfranchisement and are exposed to more sophisticated and targeted attacks to the voting system (Davidson et al., 2022).

While I credit the department for trying to involve the importance of historic background in these courses, there seems to be a gap in understanding as to how the technical definitions are continuing to shape society. This results from historical events and modern applications being taught in isolation. By not bridging this gap in CS 4501 specifically, the UVA CS department is missing an opportunity to more comprehensively educate students on the background and dangers of programs they may be designing; furthermore, not evaluating how technical applications could affect the future through the lens of history increases the risk of repeating social and political tragedies. When confronted with workplace scenarios that require professionals to make decisions which could affect certain groups more than others, UVA students may not be adequately equipped to consider all consequences.

According to the CS 4501: Cybersecurity in Elections syllabus, the course "provides an overview of the historical, cultural, and political significance of voting" and "the technical issues of securing election processes." Currently, these goals are met by educating students on the

"legislative history of voting in the US" and "the cultural significance of voting in American democracy." I argue that students cannot truly understand the political significance of voting technology without considering its modern-day social implications and potential and active cases of disenfranchisement. By synthesizing cybersecurity and election phenomena alongside its social causes and effects, the class will better prepare students to evaluate a broader range of design consequences and become more considerate and effective members of the workplace.

To achieve this goal and implement the strategies I stated above, I look towards implementing Diane Halpern's Four-part model as described in her paper "Teaching critical thinking for transfer across domains: Disposition, skills, structure, training, and metacognitive monitoring." Halpern recognizes the importance of kickstarting critical thinking in specific scenarios but also finds flaws in the way many adults transfer and use it in other contexts (Halpern, 1998). This is an ideal framework to implement since my goal is to take the critical thinking skills engineers learn in their STS courses and transfer them to also be used when developing computer programs—especially those that interact heavily with the public. Her empirically based model was designed to mend this contextual gap using four pillars of training: (1) "a dispositional component to prepare learners for effortful cognitive work," (2) "instruction in the skills of critical thinking," (3) "training in the structural aspects of problems and arguments to promote transcontextual transfer of critical-thinking skills," and (4) "a metacognitive component that includes checking for accuracy and monitoring progress toward the goal" (Halpern, 1998).

I will achieve part 1 by designing new learning targets and explicitly stating them at the beginning of each class which have been shown to positively impact student understanding and performance on assessment tasks (Fadhil, 2018). To implement part 2, I recommend

supplementing preexisting technical lectures with a non-technical analysis and discussion questions based on social frameworks studied in STS courses. I will achieve parts 3 and 4 by replacing some class sessions with Socratic seminars and asking students to write a discussion post afterwards to expand on some topics they may have not gotten the chance to express during the class period. This gives students who may not feel comfortable participating an opportunity to share their thoughts and is proven to cultivate higher thinking skills and help students gauge their own learning (Lam, 2018). Together, my plan to rebuild the CS 4501 Cybersecurity in Elections curriculum using Halpern's Four-part model will inspire students to think more carefully about the impacts of their technical decisions and better prepare them for controversial workplace decisions.

STS Project

The 2000 United States Presidential Election is one of the most controversial elections in history. For the first time since 1888, presidential candidate George W. Bush became president-elect despite losing the popular vote to Al Gore; however, the road to this decision was tumultuous. After November 8th, 2000, Bush had secured the popular vote in Florida which gave him the required electoral votes to win the election, but the margin was so small—about 500 votes—that Florida law required a recount (Posner, 2000). Issues surfaced with ballot transparency, faulty voting punch card machines, and voter access but ultimately ended in a Supreme Court battle which decided the Florida recount was unconstitutional. This left thousands of ballots to never be properly counted and questions about the integrity of Florida's elections (Posner, 2000).

Florida's election failure brought the poor performance of their technology and equipment mainstream. Butterfly ballots were purposely designed with confusing layouts and

deceptive candidate bubblings. The machines designed to punch out and count the ballots often failed to completely release the bubble—a term coined as "hanging chad"—and could not count the vote successfully. The response of politicians and computer scientists was to transition from the ballot-punch cards to election machines with touchscreen user interfaces. While this switch may have resolved the technical issues that resulted in the complications with the 2000 Florida election, it does not begin to consider the social factors which drove the use of misleading ballots and faulty machinery and which became apparent as a result of the recount.

By not considering the election and its instruments as tools that wield social and political power, Florida (and the rest of the United States) risk repeating mistakes from history by targeting and disenfranchising certain groups–whether intentional or unintentional. If we continue to think that the voting machines only perform the functional work of recording vote counts, we'll miss how their accessibility can be weaponized. Accessibility can include physical accessibility where voters wait in long lines or cannot access small, distant poll locations. It can even extend to intellectual accessibility since misleading ballots cannot be properly used and ill-informed poll workers cannot properly maintain election machines or voter registration databases.

Drawing on the social framework designed by Langdon Winner in, "Do Artifacts Have Politics" I argue that election technology performs social and political work by prioritizing the votes of white people and those of higher socioeconomic status and disenfranchising groups previously barred from voting like black people and those of lower socioeconomic status (Winner, 2017). Using technological politics, I will address concerns of power and control in the design of election machines and how that has shaped unequal social and political conditions for historically disenfranchised groups. Whether technical decisions are a result of explicit or

implicit bias, the government and election designers have a responsibility to guarantee universal suffrage.

To support my arguments, I will analyze evidence from scholars Paul M. Schwartz and Hanes Walton, Jr. and a team from the United States Commission on Civil Rights. In Schwartz's piece "Voting Technology and Democracy," he explores the 2000 United States Presidential Election from the perspective of a systems analyst. He proves feedback quality from election machines varied from county to county in Florida and that it was distributed unequally to promote racial and socioeconomic bias (Schwartz, 2002). Walton in his article "The Disenfranchisement of the African American Voter in the 2000 Presidential Election: The Silence of the Winner and Loser" identifies unsettling inconsistencies in the vote recounts of majority-black districts in Florida. He also provides evidence to suggest the accessibility to those machines was purposefully made more difficult for black voters (Walton, 2001). A team from the United States Commission on Civil Rights investigated voting rights violations in the election and found a higher number of voting barriers in counties with higher black populations and greater poverty (United States Commission on Civil Rights, n.d.). Together, these articles paint the picture of the voter disenfranchisement which occurred in the 2000 Election and fuel the argument that it was wielded by the social power of election machines and their accessibility.

Conclusion

By extending CS 4501 Cybersecurity and Election's syllabus to include more modern analyses of popular technologies and attacks, the UVA CS Department can improve upon their existing cybersecurity curriculum. One particular instance that benefits from social analysis is the case of the 2000 United States Presidential Election. By viewing the technologies used in the election through the lens of technological politics, the computer science students at UVA gain a

better understanding of how election machines have the ability to shape—and even control—power dynamics and the marginalization of certain groups. By having a better grasp on these potential dangers, I would like to see future election machine designers and election coordinators enact more responsible plans-of-action that protect democracy. More broadly, I hope this introduces to students the social power of the programs they have created and will continue to create in the future. In light of this insight, I anticipate students will more carefully consider the intentional and unintentional consequences of the technologies they will be tasked with and—in turn—stop cycles of explicit and implicit bias.

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