

Creation of a Database Security Course at the University of Virginia

Engineering Productivity and Satisfaction During Work-From-Home

A Thesis Prospectus
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By:

Bevan Charles

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Technical Team Members:

Bevan Charles

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

Sean Ferguson, Department of Engineering and Society

Daniel Graham, Department of Computer Science

Introduction

Software companies are nothing without two things: data and consumers. For any software-related endeavor, a data lake is mandatory to build anything meaningful. In the context of university curriculums, databases are used in order to learn how to store and use data, though securing databases often takes a backseat to this learning. Even if college classes briefly touch on database security, students often take shortcuts and discount security just to create fully functional databases. This is bad practice and the introduction of a database security course would help students learn how to apply security principles to their existing knowledge of database fundamentals.

To ensure that database security is not being overlooked, creating a course on it is a necessity to create a software engineer who knows how to protect consumer data and create secure software that is less likely to be compromised. One of the focuses of this course would be discussions revolving around the various methods through which databases are breached. Students would then learn how to protect databases and have multiple assignments to demonstrate their understanding of the material. This course will create not only a student who can secure a database, but one that will keep security and user privacy at the forefront of software engineering innovation.

For my STS research, I have chosen a topic of interest since the start of the COVID-19 pandemic: how well software engineering teams are working in the industry remotely versus in office. Does working from home bring an endless stream of distraction or does the time you save each day on the commute end up making you a happier, harder-working individual? Being looked at through a lens of sociotechnical system of users and practices, I'll look to identify some of the shifts in software engineering practices that have occurred the past couple of years and look to see how that is affecting the user, in this case, the professional software engineer.

Technical Topic

Above all else, I think there is a need for a database security course because of the large number of data breaches that continue to happen each year. As more software continues to roll out each year, it is inevitable that hackers see it as a growing market and see higher vulnerability potential. Though many smaller-scale attacks go unreported, there were 3950 confirmed data breaches during 2020. While that number may seem smaller than expected, the number of people affected in each of these breaches is astronomical. For example, in January 2020, a Microsoft database was left unprotected and revealed the personal information of more than 280 million users. While the leaked information here was mainly email addresses and transcripts of support logs between customers and Microsoft agents, the information can get way more personal than that (Winder, 2020). Healthcare information, especially, houses some of a person's most private information and can leak information that can be used against them. For example, health insurance companies can use consumer information they get ahold of to increase insurance rates and really put a financial toll on their customers (Allen, 2018). Though consumers are "protected" by the Affordable Care Act which disallows medical companies from denying service to patients, these companies can and do use consumer information to hike up certain plan's prices and assume how risky adding an individual to one of their plans is.

From 2017 to 2019, the number of people affected by a data breach increased by an astonishing 80% (Sobers, 2021). Though this is a problem within the software industry, college students will not comprehend the gravity of it until encountering it in some professional capacity or being exposed to it in their university curriculums. According to the Washington Post, a 2016 study found that out of the top ten computer science programs in the country, not a single one of them required their CS majors to complete even one cybersecurity elective (Peterson, 2016).

Introducing a database security course would be a great way to allow computer science majors the opportunity to get accustomed to the idea of database attacks and how often and easily they can occur. This course will integrate material taught in both CS 3710: Introduction to Cybersecurity and CS 4750: Database Systems. Introduction to cybersecurity does a great job of raising general awareness of technical security among CS majors and does an even better job of emphasizing current events to show the gravity and backlash of cyberattacks. On the other hand, CS 4750 does a great job of teaching database fundamentals and necessary background that any student will need to have in order to take a class on database security. It also very briefly touches on database security, though it is not an emphasis of the class.

Additionally, having the chance to have interned at three companies in the past – a financial tech startup, a government defense contractor, and a large corporate bank – it has become obvious that at an internship, security in databases is almost never a focal point. Since the duration of most summer internships is only around eight to twelve weeks, companies are instead using this time to evaluate their interns in more of a team-fit and technical aptitude. Rather than having you focus on software security principles, they instead focus on your raw coding ability in order to determine if you have the skill level to join their company. Additionally, companies have a premonition that students are not fully professional software engineers yet, and so they leave cybersecurity and data privacy matters to be handled by full time employees to avoid security slip-ups, which have been shown to be incredibly costly. With students unable to learn about database security during summer internships, this teaching responsibility should be placed on the university.

The first two weeks of the proposed database security class will be a refresher for students on database materials and cybersecurity principles. Though most or all students will be

familiar with this material, it will be helpful in providing a concrete database background so no student feels left behind. The next four weeks, weeks three through six, of the class will be dedicated to learning the different types of engineered database vulnerabilities and how these open up opportunities for database attacks. Some of the vulnerabilities that students will learn about will include database cloud configuration errors, denial of service attacks, SQL injection attacks, and lack of distributing proper access controls. Students are not expected to have any background on these vulnerabilities and material will be taught from scratch and supplemented by showing historical and current events of these attacks occurring. Weeks seven through eleven will then show robust practices for securing databases and staying proactive to prevent these attacks. The final three weeks of the class would then look at database auditing and how to recover from database attacks once they've already happened. Students will use different technical tools like database servers and database auditing tools for hands-on experience where they can demonstrate how well they understand the technical material. Periodic quizzes will also be distributed to make sure that students are following material with no major learning impediments. This plan will create a software engineer who prioritizes database security rather than one who waits for problems to arise and deals with them later.

STS Topic

The COVID-19 pandemic has forever changed the dynamic of the professional industry. For software engineering roles especially, companies and teams found themselves at home five days a week, seeing and hearing each other's voices through a screen rather than being in close physical proximity to one another. This topic is increasingly relevant as many companies are now making the decision of whether they will allow their employees to work remotely indefinitely and how it will affect employees on an individual level and the company as a whole.

Although it is a relatively new idea which needs polishing, I believe that remote should always be given as a choice to employees and will be a strong adoption going forward.

A number of questions and considerations about remote work are raised, one of which is whether the geographical location of your software engineers even matters, since everyone is working remotely anyways. Okay is a company that creates and provides tools to companies like Airbnb and Google to measure how efficiently their teams are working. After analysis of around 50,000 code base pull requests from a diverse range of companies, Okay found that if members on your team are operating with a difference of three or more hours, your team's productivity and output take a detrimental hit (Boulanger, 2021). Additionally, a false assumption that doesn't always hold true is that work from home means everyone is operating more functionally with less distractions during work hours. Tyler Corwin, a software engineer at Figmints, a digital marketing company, talks about not having 'the same drive' to get work-related tasks during the first month of remote work. He had a rough one-month transition period where he struggled with intrateam communication, finding motivation, and dealing with his kids. But after a month of adapting and now happily working remotely for over a year, he can't see himself returning to the office five days a week (Sargent, 2021). One of the ways Corwin has found himself to be more motivated and productive is to create a list of "fallback" tasks – tasks that he works on while waiting on responses from teammates. Though Corwin found himself starting off the work-from-home ritual on the wrong foot, he developed common methodologies to follow in order to ensure he would work more efficiently from home.

Many people truly have enjoyed the pace of working from home and have truly embraced it, even with children to worry about. Denny Jovic, a software engineer at AdHawk, talks about his decision to switch to full-time remote work and how it has had such a positive impact on his

life. He recounts the brutal commute he had to endure working five days a week in the office and how it meant that he would only actually get to spend about two hours per day with his baby daughter. Switching to work from home worked well for Jovic because him and his wife came up with a balanced plan to help each other out when necessary. He writes that working from home is not all that different from working in the office and that “oddly enough, you actually gain time [back] being out of the office” (Jovic, 2019). Like Jovic and his wife who were able to conquer working from home, many people found themselves thriving while working remote and enjoying the time back they would’ve wasted on commuting to the office. It is interesting to note that before COVID-19 and remote work became very popular, a survey conducted of workers from nine different countries found that those who worked full time from home were 70% less productive than their counterparts who were in the office (Lippe, 2019). After 2020, however, these findings tell a completely different story. Nathan Schultz, a senior executive at Chegg, found that once he stopped constantly worrying and checking in on his employees who were forced to work from home due to the pandemic, their productivity increased and members of his team even started doing projects ahead of schedule (Apollo Technical, 2021). This trend shows that as new technology emerges, it becomes easier to have interactions similar to those found in the workplace and really close the gap between efficiencies in working in an office versus remote. For example, products like Zoom and Slack are communication methods proven to keep employees connected and in a steady stream of communication (Lyons, 2020). Though one of the initial rebuttals to work from home was the idea of employees being isolated and forgetting how to succeed in a group setting, these video conferencing and communication platforms do a great job of negating such concerns.

Working from home also gives people a chance to do a lot during the day that they usually wouldn't get the opportunity for if they had to commute every day. The average round trip commute time in America is fifty-two minutes per day, which would equate to four hours and twenty minutes of time per week, allowing you to spend that time on self-betterment, whether that be getting some much needed-rest, spending time with loved ones, or exercising to improve physical health (Henry, 2020). Facebook founder and CEO, Mark Zuckerberg, has even reported that working from home has given him more time with his family which makes him happier and in turn, makes him more productive at work. To practice what he preaches, Zuckerberg said that Facebook employees can continue to work from home even after the COVID-19 pandemic. In a memo sent out to all Facebook employees, Zuckerberg writes, "We've learned over the past year that good work can get done anywhere, and I'm even more optimistic that remote work at scale is possible, particularly as remote video presence and virtual reality continue to improve" (Porterfield, 2021). Facebook is just one of several big tech companies to demonstrate that work from home can truly be an asset rather than a disadvantage under the right circumstances, which entail a healthy home situation and a proper balance between work and life.

Conclusion and Future Steps

A permanent return to office is something that is almost unimaginable for software engineers. After all, why go back to an office space to do something you can do just as, if not, more, efficiently, from home? Tim Cook, the CEO of Apple, published the news that employees would have to return to the office for at least three days a week. Cher Scarlett, a software engineer at Apple, and a large number of other Apple employees are upset to hear this news, especially because they say they were churning out the same high-quality products Apple is

known for and supported this sentiment by demonstrating that Apple stock prices had hit an all-time high just this past year during remote work (Kelly, 2021). Though a period that will be looked back at as a dark time in world history, a silver lining of COVID-19 was that it shed light on mental health issues. Scarlett suffers from a mental illness and has found deep comfort in working from home. In addition to her mental illness, being a single mother adds stress to returning to the office. Obviously, there are many others like Scarlett out there, and a primary focus of my future study will be the effect of remote work on mental health and whether working from home will be mentally sustainable for software engineers. Remote work has only been so successful because employees are happier with their work and life situations, but it will be interesting to dive into whether this happiness begins to subside after a few years of working out of the office.

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