

# **MACHINE LEARNING RECOMMENDATION SYSTEMS**

## **HOW DOES MACHINE LEARNING AFFECT SOCIAL MEDIA CONSUMERS?**

A Thesis Prospectus  
In STS 4500  
Presented to  
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Bachelor of Science in Computer Science

By  
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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.

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Every day, billions of people worldwide use different forms of social media. More impressively, as described in Orłowski (2020) each of these individuals experience social media in an entirely different way, as each of their feeds is carefully curated by machine learning (ML) algorithms in order to keep an individual on the application longer, generating more revenue for companies (00:48:11). As society continues to progress through the information age, social media is becoming increasingly more popular (Pew Research Center, 2021), meaning the demand from companies for methods to keep users engaged with their application is also increasing. One of these methods is the use of recommendation systems.

Loosely put, recommendation systems use machine learning in order to predict what users would want to see next. As an example, if a user has recently followed a professional basketball player, these algorithms would then recommend that the user follows that player's team. Although this is a very simple example, these recommendations can be eerily accurate. Another more complex example would be an individual buying pregnancy tests, and then 8-9 months later being recommended baby diapers by the same website. Over time these systems have gone from basic recommendations to the backbone of modern online shopping and social media.

The state-of-the-art report and tightly coupled STS research project proposed in this prospectus aim to determine how fast these systems are advancing, the future of these systems, and most importantly the repercussions of these systems on the individual, and society from a global perspective. More specifically, the state-of-the-art report will give a comprehensive summary of the current technology in recommendation systems, and follow this up by also exploring and subsequently discussing new methods being discovered in recent years.

For the STS research project, the paper will primarily focus on the effects of how

individual users are affected by the consistent use of social media, and more specifically, how they are affected by the machine learning models determining what they see every time they open social media. Additionally, the paper will briefly discuss some of the wider implications of these systems and how it has affected society as a whole.

The state-of-the-art report will be written in CS4991 and overseen by the course instructor Rosanne Vrugtman. Additionally, the STS portion of the project will be completed in STS 4600 by an unknown course instructor. These reports will be conducted simultaneously during the Spring of 2023 semester, with the exact timeline depicted in Figure 1 shown below.

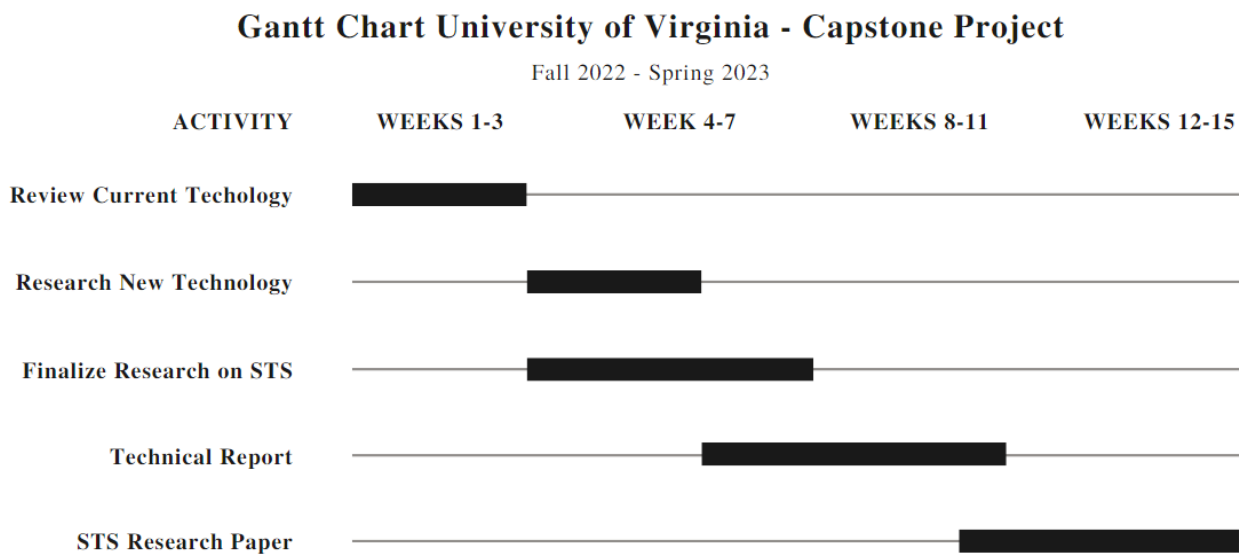


Figure 1: Gantt chart for UVa Recommendation System Capstone. This figure shows the projected timeline of both the technical and STS portions of the Capstone project. (Keaton, 2022).

## MACHINE LEARNING RECOMMENDATION SYSTEMS

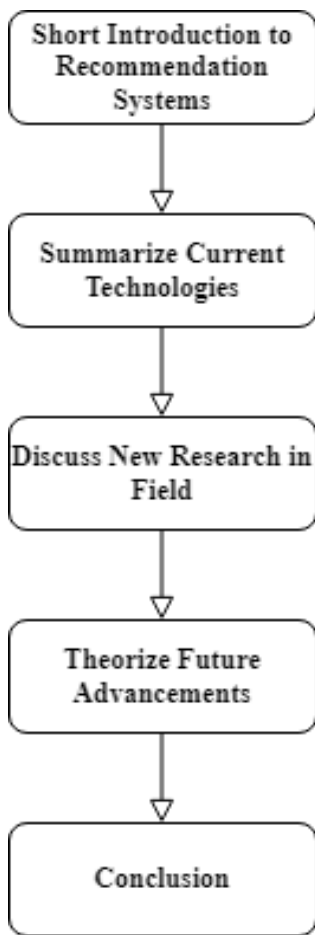
Machine learning is used by nearly every social media platform in order to curate posts for individual users, recommend other users to follow, and for countless other behind-the-scenes uses. According to Quinn (2022), machine learning can be heavily attributed to the massive

success of companies such as Tik Tok, which uses every piece of data possible in order to create the perfect feed for its users (para. 10) . These nearly perfected feeds have become a part of everyone's daily life, and according to Munawar (2017) the effectiveness and efficiency of the systems making it happen are becoming increasingly important to the success of businesses (p. 196). Due to this, research in the field of recommendation systems has also become increasingly important to these applications, as every social media platform is looking for an edge over its competitors to captivate user attention. According to Ricci (2015), there are currently 5 main forms of recommendation systems, the two most prevalent being content-based, and collaborative filtering (p. 11-13). As described by Ricci (2015) content-based recommendation systems take past user interests and compare them with new items the user is yet to see, in order to find the best possible item to show the user next (p. 11-12). Alternatively, Ricci (2015) describes the collaborative filtering model, which uses other users with similar interests in order to recommend new items (p. 12). As an example, if users A and B both liked item X, and then user A liked item Y, the system would learn to recommend item Y to user B. There are a number of other less relevant model types, described by Ricci (2015), including demographic, knowledge-based, and hybrid models. Most popular social media websites have used at least one of these five methods to keep users active and engaged. Over time, these algorithms have continued to become more accurate and efficient to an overly potent degree.

The goals of this state-of-the-art report are to (1) give an overview of the current algorithms and types of machine learning used in recommendation systems, (2) explore and subsequently discuss new methods being discovered and employed by researchers worldwide,

and (3) theorize future advancements based on the needs of the industry. The full outline for the report is shown below in Figure 2.

In order to compile this report, research will be completed for each section separately. The first two sections will heavily reference both Ko's "A Survey of Recommendation Systems: Recommendation Models, Techniques, and Application Fields" and Ricci's "Recommender Systems: Introduction and Challenges". Following this, research will



continue to be conducted in order to find the most up-to-date advancements in the field, along with any promising ongoing studies. Next, the report will discuss research that has yet to occur, and where the biggest gaps lay within the field. Finally, the piece will conclude with a summary of the report and any other closing remarks.

Due to the technical portion of this project being a state-of-the-art report, the only resource that will be required is access to all relevant machine-learning journals through the UVa Library.

The anticipated outcome of this technical report is to have a paper that is capable of informing any individuals in the field of new technologies or methods in recommendation systems, while also serving as a strong up-to-date summary for those entering the field. The report should be both useful and informative to seasoned professionals in the field of machine learning and

Figure 2: Flow chart for Technical Portion of Capstone Project. This figure shows the proposed outlining to the state-of-the-art report. (Keaton, 2022).

social media, while also being general enough that those without expertise are able to understand and digest what is being discussed.

## **HOW DOES MACHINE LEARNING AFFECT SOCIAL MEDIA CONSUMERS?**

While these recommendation systems have the capability to provide great benefits for the user and developer alike, they can also heavily affect the personal lives of social media users. As an example, Aydin et al. (2021) found that some users are using social media for more than seven hours a day (p. 4), and are consequently having negative effects due to their social media usage (p. 13). Similarly, Ferguson (2021), found that social media usage enhances and reinforces the emotions that the user seeks out, rather than creating new ones (p. 122-123). To this point, Ferguson (2021) states directly that “. . . if positive interactions and disclosures predict positive outcomes, negative interactions, and disclosures predict more negative outcomes” (p. 123). While this conclusion is not concrete in proving that social media is an outwardly negative aspect of an individual's life, it does show that it can have negative effects within the right circumstances. This enhanced emotional effect may be caused in part by the artificial positive reinforcement that, as described in Orłowski (2020) “leaves you even more, and admit it, vacant and empty before you did it” (Chamath Section).

Although the effects of social media on an individual's mental health have been studied in depth, and many potential causes have been found as shown in Figure 3, this article will focus primarily on the development of recommendation systems alongside social media. To aid in this goal, research surrounding mental health will be conducted within a time series of pre-social media, early social media, and social media within the recommendation system era. Next, an analysis will be done on the general consequences of recommendation systems, such as the



Figure 3: Visualization of Potential Mental Illness Factors Caused by Social Media. This figure shows a list of possible causes for mental health issues stemming from social media. (Keaton, 2022).

the political polarization of nations that Ferguson (2021) touches on in his article (p.120). Additionally, the paper will heavily reference statements given by those directly involved with the creation of these systems, as seen in Orlowksis's (2020) *The Social Dilemma*. Finally, the article will describe how these algorithms intertwine with society as a whole. This idea will be explored using the Actor-Network Theory (ANT) approach to the social construction of technology, as described by Johnson (2005). An outline of this connection is shown below in Figure 4, which visualizes the beginnings of the network involving both social media and recommendation systems, and how they are involved in greater society. This figure attempts to highlight the wide array of society that is directly connected to social media. Although there are

countless more areas that could be added, these are the most important eight, that are directly intertwined with social media.

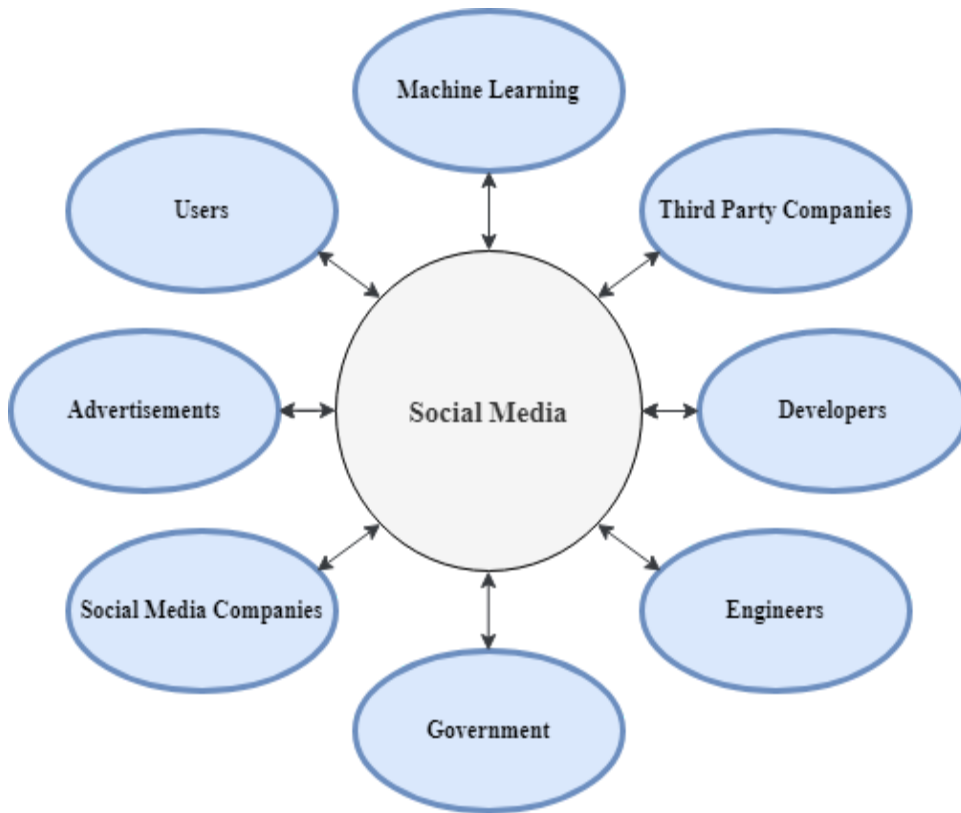


Figure 4: ANT Representation of Social Media. This figure shows the proposed ANT system surrounding social media. (Keaton, 2022).

This STS research paper will be in the form of a scholarly article and will be considered a success if it is able to adequately discover and discuss the effects of recommendation systems, machine learning, and social media on both individuals and society as a whole. While doing this, the paper will remain digestible to a broad and general audience, who do not have deep knowledge in the fields of psychology or machine learning.

## THE FUTURE OF RECOMMENDATION SYSTEMS

Although machine learning is an incredible leap in technological advancement, there needs to be discussion around the ramifications of these same advancements. These recommendation systems are becoming too powerful for how few regulations there are



surrounding them. With no future regulations, and allowing the systems to continue to develop at the speeds they are, they could cause serious long-term damage to both individuals and society as a whole. This Capstone project will, over the course of the next few months, attempt to answer just how fast these advances are continuing, and also how heavily the current systems are influencing both individuals and society. Within the technical portion of the assignment, there will be answers regarding the future of the systems, along with an overview of the past for those new in the field. The sociotechnical portion, however, will be much more simple, serving as a strong summary for the general public as to how recommendation systems are affecting them, and those around them, in everyday life. Through this combination, the question of “Does there need to be regulations on recommendation systems and social media?” will hopefully be answered in depth and with confidence, prior to any long-term repercussions.

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