Mental Health Diagnosis Algorithms
(STS Topic)

ChoreoNova Ticketing System
(Technical Topic)

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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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In the medical profession, the diagnosis is often the most important aspect of the treatment for the patient. If a doctor does not treat the correct issue in a patient, the patient will be wasting crucial time and possibly worsen their condition. Often, the diagnosis is one of the easiest parts of the treatment of a patient. A broken leg can be examined by an X-ray and strep throat can be detected by a chemical test on a sample of mucus. These diagnoses are straight forward, as there is a criteria of empirical data and evidence required to make the diagnosis. If there is a fracture on the X-ray, it is sufficient to say that there is a broken leg. If the cotton swab returns a positive marking, then the patient most likely has strep throat. There are of course false positives and negatives in these examples, but they are in the vast minority.

The strategies to diagnose are laid out very concretely and work well. However, in the field of mental health, the diagnostic strategy still shows room for improvement, as nearly half of people diagnosed with Bipolar Disorder were misdiagnosed (Amna, 2013). In addition, people that did have Bipolar Disorder on average wait over a decade to be correctly diagnosed (Campbell, 2012). Where the diagnosis for a broken leg had an empirical oriented diagnosis process, the diagnosis for depression and other mental health disorders often revolve around a doctor classifying symptoms of a patient and seeing how they respond to certain medicines or treatments.

An orthopedist is able to deal with the problem head on, and see the actual break in a bone. However, a psychiatrist cannot simply detect depression, and instead must detect it based on symptoms of the patient (American Psychiatric Association, 2013). Even the best psychiatrist may miss out on certain important symptoms or focus too strongly on symptoms that don't best represent the patient's issue. If the psychiatrist works off of a set criteria, their weights could

still be different than the weights of another psychiatrist with the same exact criteria. Due to this, there have been many attempts to make a machine learning algorithm that would diagnose people with the same symptoms the same way, and to a high degree of accuracy.

The primary goal of this thesis is to determine if an accurate algorithm is possible, what the algorithm would represent, and if this is an appropriate substitute for the current diagnostic method.

This thesis will examine what the upper limit of accuracy is for this algorithm. Until science reaches a point where it can map out the human brain and determine exactly what deficiencies cause problems such as depression, it is likely not possible to diagnose correctly 100% of the time. If a mechanic received a car that wasn't running and were told things by the customer such as "The car takes 5 key turns to start up" or "The engine makes a sound when going fast," they might have a general idea of what is wrong with the car, but wouldn't know for certain until they opened the hood and checked out the engine. A psychiatrist must make the diagnosis without metaphorically "popping the hood" and must work by these peripheral issues for a large amount of diagnoses. A machine learning algorithm may be able to use more of these peripheral issues to make the diagnosis, and weigh them in a more consistent manner, but it is very unlikely the algorithm would properly diagnose the issue every time without actually having empirical analysis of the brain.

This thesis will also explore what the algorithm truly represents and determines. These algorithms often work backwards- they have a large sample of people that have been either diagnosed or not diagnosed with a mental illness. Each of these people will have weights determined for different criteria, and the model will then try to find patterns in the weights to see

what causes a person to be put in either group. Once this model is created, it can then be used in a predictive manner, and either diagnose or not diagnose a new patient. However, this algorithm will have similar pitfalls to the previous strategy. There are still psychiatrists needed to score the patients, and if the weights were self reported, there would be no baseline or proper scale from patient to patient. A patient with a higher pain tolerance may classify a symptom lower than another patient with a lower pain tolerance might classify the same symptom. This model would simply represent what modern science believes qualifies a person as either having or not having a certain mental illness.

This thesis will finally examine the impact technology like this would have on society. It is currently an expensive and lengthy process to receive a mental health diagnosis. If this diagnosis is actually a misdiagnosis, this greatly affects the financial and general well-being of a patient. A better process is undoubtedly needed, as more people could receive more accurate diagnoses, and could do so for cheaper than before. An accurate algorithm would also be deployed in developing nations where the current diagnosis method is not viable due to a low number of healthcare professionals. However, an algorithm of this importance would need to truly be accurate to a high degree, or it would simply cause even more misdiagnoses than before.

The framework that is highlighted in this research is the Social Construction of Technology (SCOT). SCOT posits that our technology is a reflection of our social beliefs and systems. It often seems that a certain technology changes society through its adoption, but in reality, the adoption was so widespread because it was formed with our social behaviours in mind. The telephone is a great example of this, as phone calls did not change the way humans communicate other than allow them to do it from further away. Video calling is an extension of

this, as it is exactly the same as a face-to-face conversation other than being in the same room. A new technology isn't going to revolutionize a social order that is generally accepted.

Building a machine learning program to diagnose mental health disorders is great evidence for the SCOT. Rather than technology finding a new or innovative way to diagnose or help people with a mental illness, technology is being employed to do what humans already do. Psychiatrists already weigh different factors and symptoms of a patient, and this machine learning algorithm would simply do so with a more consistent and fact-based manner. Exploring this topic will not just be an investigation into technology, it will also be a look into why people are diagnosed the way they are, how the current diagnostic method came into place, and what other diagnostic theories were either discarded or not given a proper chance.

SCOT places a heavy emphasis on society's current behaviours and beliefs. An adopted technology will either make a familiar process more convenient or better, so this adoption will definitely have a considerable impact on society. For this reason, it is very important to evaluate the current beliefs and practices and ensure that they would be appropriate to perpetuate for many years to come. Vaping made inhaling nicotine products much more convenient and cleaner, and vaping has had widespread adoption. It took an already human practice and made it simpler. However, smoking is a very bad practice and leads to many health issues. Similar to the machine learning algorithm for mental health, if the current diagnostic practice is not in our best interest, perhaps it is best not to perpetuate it.

For this thesis, the aim is (1) to find the reasoning behind current and previous attempts at creating machine learning programs to aid mental health diagnoses, and (2) to find circumstances in which this machine learning program would be useful, convenient, and appropriate.

The reasoning behind a certain diagnostic algorithm is perhaps the most important quality of the system. If the reasoning behind building a certain program is in true SCOT fashion, and simply to serve as a vehicle to make the current practice more efficient, then the current practice must be heavily scrutinized. Some of the issues of the current process might be fixed with an algorithm, such as human error or bias, but it must be known if there are other inherent issues in the current practice that will not be addressed in the algorithm. If the reasoning behind a new algorithm isn't based on current processes, then it would not only be scrutinized on its own merit, but also compared to the current process. The medical community might not accept a diagnostic strategy so different from their own, and even patients might not be keen to trust a process that is alien to them.

A circumstance in which a machine learning algorithm replaces the current diagnostic method is hard to imagine. It is likely that this algorithm wouldn't be completely accepted by doctors or patients at the beginning. An autonomous vehicle can drive thousands of miles without fault, but it is unknown how a company can mathematically prove to a customer that the computer will not have an error and crash one day. A machine learning algorithm will make what it believes is the best choice, but there is no way to know that this is the correct choice, or the choice we would make. Also, while this algorithm can be correct, this does not mean that it is also useful. This algorithm would potentially help millions in countries that don't have a great healthcare infrastructure, as they could receive diagnoses that they couldn't have before. However, this would not actually help these people if they could not then receive a treatment for their illness.

This thesis aims to find a technology based approach that will improve the mental health diagnostic process. This technology would have to improve upon the current process, be accepted by all relevant parties, and actually provide a useful service. This useful service could be as small as confirming a psychiatrist's diagnosis, or as large as prescribing a treatment. SCOT is an interesting framework to view technologies such as smartphones and the internet. However, as technology encroaches into more important subjects like healthcare, this theory may encapsulate the issue of allowing current beliefs and practices to influence technology.

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