Kaizen Thought Leadership:

COVID-19 AND ARTIFICIAL INTELLIGENCE: PART 1

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Artificial Intelligence: Can it Help in the COVID-19 Crisis?

Part: 1

This article is the first of a three-part series that attempts to evaluate the capabilities of Artificial Intelligence considering the current pandemic due to the corona virus.

Back in 2015, Bill Gates gave a TED talk, where he said that the next global disaster would most likely be an infectious virus and how unprepared we are to handle it. He talked about the need for a global warning and response system for epidemics and having a system to recruit, train, equip health workers, a rapid response research team [https://www.gatesnotes.com/Health/We-Are-Not-Ready-for-the-Next-Epidemic]. Unfortunately, very little was done by governments to heed to this warning. In the U.S, the response from the authorities to COVID-19 clearly shows they were not prepared to handle the situation. There is little room for excuse because unlike China, the western countries clearly had the advantage of time to prepare after the first news reports of the outbreak in Wuhan were reported in early January. It could very well be that CDC's epidemic modeling research did not anticipate a pandemic like this or CDC did not leverage the advances in artificial intelligence (AI) sufficiently and be at the forefront of epidemic disease modeling.

The first step in containing a pandemic is to understand and track how the disease is spreading. The physicians now know the symptoms in an infected patient and have understood quite a bit of how it spreads. However, it is too early to say the we fully understand all symptoms and the risks of COVID-19 exposure. The uncertainty in understanding how the disease is spreading is evident from CDC's note on their website, "*More cases of COVID-19 are likely to be identified in the United States in the coming days, including more instances of community spread. It's likely that at some point, widespread transmission of COVID-19 in the United States will occur.*" [8]

With the world having been caught off guard, could the much talked about Artificial Intelligence help us in any way?

Traditional epidemiology research modeled propagation of diseases using compartment models [1, 4]. Compartment models assume a fixed population which is divided into compartments. The most basic compartment model is SIR – Susceptible, Infected, Recovered. The sub-divided population placed in compartments if they are susceptible to infection, already infected, recovered. As always, there are assumptions for the model:

a. Age, demographic and spatial structure is ignored
b. There is no initial immunity as all 'members' of the susceptible population are equally likely to get infected
c. The model infers permanent immunity; once recovered, a second infection is impossible
d. Discrete individuals do not exist in the model and it is assumed that individuals who reside in the compartments are identical and as such variation among individuals is unimportant.

There are several extensions of the SIR model that allow for temporary immunity and other similar models. As diseases have different characteristics, these models may be extended to include biology (stages of immunity, vector/ pathogen dynamics, super-infection), demography (birth and death processes, age, gender), interventions (drug therapy, vaccines, VC) and geography (spatial structure, migration).

However, due to the restrictive nature of assumptions & the lack of a generalized compartment model, these models fall short of adequately predicting how many people will be infected by COVID-19.

Network or graph models provide a natural way of describing a population and their interactions. Nodes (vertices) of the graph represent individuals and edges (links) depict interactions between individuals that could potentially lead to transmission of infection. Unlike the compartment models, network models enable the study of spatial transmission of infections [4]. Agent-based simulation models capture the spatiotemporal dynamics of infectious disease propagation. Individuals in a closed population are explicitly represented by agents associated to places where they interact with other agents. They are endowed with mobility, through a transportation network allowing them to move between places within the urban environment, in order to represent the spatial heterogeneity and the complexity involved in infectious diseases diffusion [9]. However, both network and agent-based models can at best model a small population and are not scalable.

An AI-based practical solution was developed in China [6] where data from pre-installed QR-code scanners at key locations such as grocery stores, subway stations, and public places was used to track & record every individual's health status. If an individual was confirmed positive for COVID-19, then his last known visits would be traced identified from the QR-code scanners and all individuals present in that location at approximately that time were quarantined. Other commercial products are employing AI and machine learning to sift through newspapers in different languages, social media posts, and other data to detect subtle signs of the geolocations where COVID-19 is spreading [2, 3]. While both these approaches are reactive in nature and not predictive, if they allow medical professionals and first responders to get any head start on the virus in their communities, it is worth investing in and researching them.

It is amply clear that existing solutions for disease modeling are not scalable and have very restrictive assumptions. It is important to leverage recent advances in deep learning, network analysis, and cloud computing, to build more realistic pandemic disease models. In the words of Plato "Our need will be the real creator". With a war like footing now being adopted to combat this virus, tools like AI should be used across the board to find innovative ways to combat this pandemic.

The next article in this series would focus on how AI can aid in understanding the business impact of the COVID-19 pandemic. We will explore ideas on how business can avoid falling into a trap of continuing to use historical data without treat as they emerge in the post-pandemic era of doing business and how visionary leadership is even more critical in this time than before while using the cutting edge technological tools at our disposal.

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