

Effective use of Artificial Intelligence(AI) to Fight Against COVID-19

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ABSTRACT: As the COVID-19 coronavirus outbreak continues to spread across the globe, companies and researchers are looking to use artificial intelligence as a way of addressing the challenges of the virus. Here are just some of the projects using AI to address the coronavirus outbreak.

Artificial Intelligence (AI) is a potentially powerful tool in the fight against the COVID-19 pandemic. AI can, for present purposes, be defined as Machine learning (ML), Natural Language Processing (NLP), and Computer Vision applications to teach computers to use big data-based models for pattern recognition, explanation, and prediction. These functions can be useful to recognize (diagnose), predict, and explain (treat) COVID-19 infections, and help manage socio-economic impacts. Since the outbreak of the pandemic, there has been a scramble to use and explore AI, and other data analytic tools, for these purposes.

KEYWORDS: AI, COVID-19, Machine Learning(ML), Natural Language Processing(NLP), Computer Vision

I.INTRODUCTION

A number of research projects are using AI to identify drugs that were developed to fight other diseases but which could now be repurposed to take on coronavirus. By studying the molecular setup of existing drugs with AI, companies want to identify which ones might disrupt the way COVID-19 works.

In this article, I provide an early review, discussing the actual and potential contribution of AI to the fight against COVID-19, as well as the current constraints on these contributions. It aims to draw quick take-aways from a fast expanding discussion and growing body of work, in order to serve as an input for rapid responses in research, policy and medical analysis. The cost of the pandemic in terms of lives and economic damage will be terrible; at the time of writing, great uncertainty surrounded estimates of just how terrible, and of how successful both non-pharmaceutical and pharmaceutical responses can be. Improving AI, one of the most promising data analytic tools to have been developed over the past decade or so, so as to help reduce these uncertainties, is a worthwhile pursuit.

The infection process of COVID-19 was identified relatively early on. It was found that the virus binds to a particular protein on the surface of cells called ACE2. And what we could do with our knowledge graph is to look at the processes surrounding that entry of the virus and its replication, rather than anything specific in COVID-19 itself. That allows us to look back a lot more at the literature that concerns different coronaviruses, including SARS, etc. and all of the kinds of biology that goes on in that process of viruses being taken in cells

The key take-aways are as follows. I find that AI has not yet been impactful against COVID-19. Its use of AI is hampered by a lack of data, and by too much noisy and outlier data. Overcoming these constraints will require a careful balance between data privacy and public health concerns, and more rigorous human-AI interaction. It is unlikely that these will be addressed in time to be of much help during the present pandemic. Instead, AI may “help with the next pandemic”. In the meantime, gathering diagnostic data on who is infectious will be essential to save lives and limiting the economic havoc due to containment.

- Artificial intelligence (AI) could help us respond to the COVID-19 pandemic
- But first, we must ask serious questions about reliability, safety and fairness.
- Here's how we can co-design an audit framework for AI systems.

Imagine a hypothetical scenario: a head of state meets with the founders of a health-tech startup that claims to have designed an artificial intelligence (AI)-powered application that can predict which COVID-19 patients are more at risk of developing severe respiratory diseases. The stakes are high from both a health and an economic perspective. Plus, time is short.

What should happen next?

As confirmed cases pass 2 million worldwide, such an application would be a welcome tool. It could support physicians in the bed-allocation decision-making process and improve the flow management of patients. When combined with mass testing at identified infection sites and strategic locations including airports and train stations, such a tool could ideally assist in preventing overcrowding in hospitals and help loosen social distancing rules.

No such tool is currently in use, though a group of New York University researchers is currently working on something similar. Nevertheless, let's continue with this thought experiment to grasp the governance challenges associated with artificial intelligence, and why auditing for accountability matters in times of crisis.

Due diligence starts with asking the right questions.

Any leader faced with a new technological solution like this hypothetical app must ask three main questions. First, is the app reliable? Second, is it safe? Finally is it fair? In turn, these questions raise a myriad of supporting questions regarding the definitions of reliability, safety and fairness being considered, as well as their assessment metrics.

Ideally, the answers to these questions should enable the audit of such an AI-system, meaning that a research committee, or any appointed competent third party, should be able to evaluate whether the system is trustworthy by examining the appropriate documentation.

Unfortunately, gaining access to – and reviewing – such documentation may be challenging in practice. The difficulties presented are largely related to deep learning (DL) – a subclass of machine learning – and the degree of maturity of the AI industry.



AI can help us respond to COVID-19 – if we ask the right questions about reliability, safety and fairness.

II.METHODOLOGY

Even Medical science has always been data rich. For centuries, scientists have collected data through experiments, longitudinal studies, research and everyday-to-day activities such as taking case notes after meeting with a patient. However, AI the COVID-19 pandemic has seriously altered the game.

While the biggest medical research programs have dealt with hundreds of thousands of cases, the pandemic affects billions of people. With so much data from many different sources flying in, artificial intelligence, or, is being used to help combat this virus.

Machine-learning is a powerful but limited statistical technique.

At its core, deep learning (DL) is a statistical technique for classifying patterns – based on sample data – using neural networks with multiple layers. By leveraging the exponential growth of human and machine-generated data, DL

systems have achieved impressive breakthroughs in various domains, especially computer vision and speech recognition.

These results are remarkable in important respects but limited in others. For one thing, deep learning systems are notoriously opaque. Indeed, their logic cannot be easily interpreted using plain language. If we're going to rely on automated systems to assist in making critical decisions, such as deciding which patient requires critical care, the systems must be understandable by both physicians and patients. In practice, this requires including their perspectives in the planning, design and development of such an app so as to enable them to be part of the decision-making process.

Furthermore, data is central to DL's learning process. DL knowledge is primarily drawn from the patterns identified in their training sets, usually labelled data, which are the initial set of clinical data used to train their predictive model. This, in turn, creates privacy and data integrity challenges: ensuring the maintenance and protection of accurate labelled clinical data is quite difficult.

There is no standardized process for documenting AI services.

More fundamentally, what does "appropriate" mean when evaluating AI? Is it information about a training dataset? A description of the model, including performance characteristics and potential pitfalls? What about a comprehensive risk assessment framework that incorporates bias-mitigation strategies?

Addressing this question is particularly difficult partly because the AI industry community currently has no standardized process for documenting AI systems. As opposed to the software industry, where companies have long-established processes created to create transparency and accountability with their services (including design documents, performance tests and cybersecurity protocols), AI practitioners are still trying to figure out what these processes should be. This lack of standardized protocols is a reminder and an expression of the youth of this field.

The way forward

Considering the rapid adoption of AI in high-stakes domains, the question of "how do we ensure trustworthy use of AI through audit frameworks?" is too important to be left to the industry. On the other hand, its responses vary a lot depending on the use-case being considered and requires a sound understanding of the system introduced and therefore cannot be addressed by policymakers alone.

Only a genuine multistakeholder process could provide satisfactory answers. At the World Economic Forum, we've taken concrete steps toward this very goal: building a community of policymakers, civil society, industry actors and academia that is co-designing an audit framework for AI systems.

Only together can we build an AI for COVID-19 patients that is meaningfully auditable and helps the world withstand and recover from global risks.

Personalized protective strategies can greatly benefit from precise classifications of the population based on categorized COVID-19 susceptibility. The earlier observation that elderly people have a higher risk to COVID-19 is challenged by a recent finding that more and more young adults suffer from severe COVID-19 symptoms, indicating an urgent need of a comprehensive risk evaluation based on personalized genetic and physiological characteristics. Human angiotensin-converting enzyme 2 (ACE2), expressed in epithelial cells of lung, small intestines, heart, and kidneys, is an entry receptor for SARS-CoV-2 spike glycoprotein. It is hypothesized that increased expression of ACE2, from using ACE2-stimulating drugs to treat hypertension and diabetes, could actually worsen clinical outcomes of COVID-19 infection. Indeed, this hypothesis should be further tested with strict experimental designs and long-term clinical observations. Therefore, biochemistry (e.g., ACE2 expression level) and clinical data (e.g., age, respiratory pattern, viral load, and survival) of COVID-19 patients with underlying medical conditions can be analysed by machine learning approaches to not only identify any reliable features (e.g., ACE2) for risk prediction, but also further perform risk classification and prediction for a balanced preparation of ongoing disease treatment and COVID-19 defense (Fig.1). ACE2 genetic polymorphism, represented by diverse genetic variants in human genome, has been shown to affect virus-binding activity (1), suggesting a possible genetic predisposition to COVID-19 infection. Therefore, machine learning analysis of genetic variants from asymptomatic, mild or severe COVID-19 patients can be performed

to classify and predict people based on their vulnerability or resistance to potential COVID-19 infection, by which the machine learning model can also return those prioritized genetic variants, such as ACE2 polymorphism, in their decision-making process as important features for functional and mechanistic studies (Fig 1).

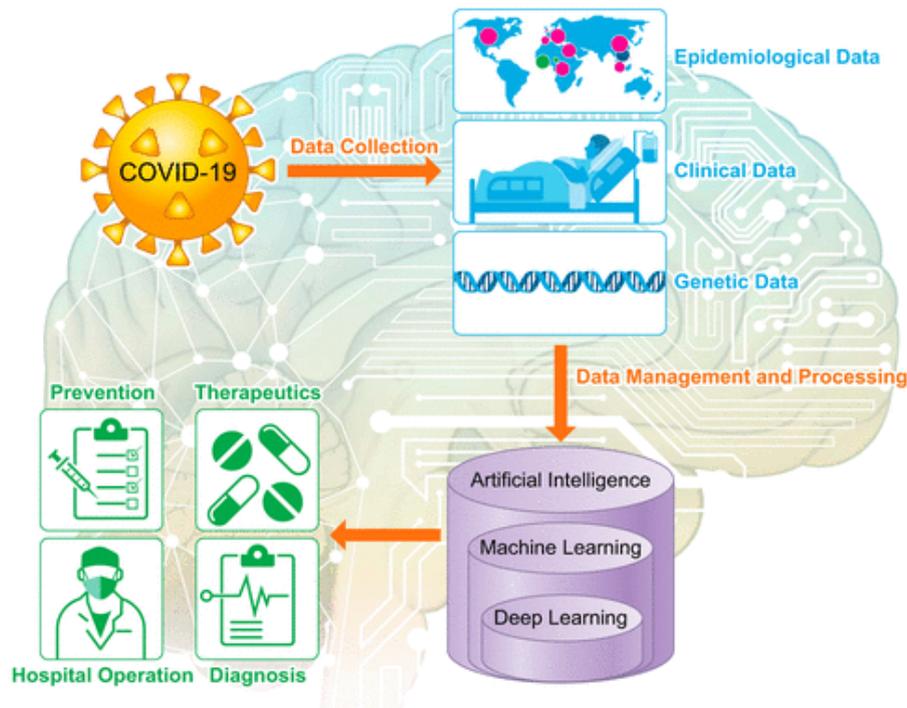


Fig. 1. Application of artificial intelligence and machine learning in the fight against COVID-19.

There are some areas where AI can contribute to the fight against COVID-19: i) early warnings and alerts, ii) tracking and prediction, iii) data dashboards, iv) diagnosis and prognosis, v) treatments, and cures, and vi) social control.

Monitoring how the virus and lockdown is affecting mental health

Johannes Eichstaedt, assistant professor in Stanford University's department of psychology, has been examining Twitterposts to estimate how COVID-19, and the changes that it's brought to the way we live our lives, is affecting our mental health.

Using AI-driven text analysis, Eichstaedt queried over two million tweets hashtagged with COVID-related terms during February and March, and combined it with other datasets on relevant factors including the number of cases, deaths, demographics and more, to illuminate the virus' effects on mental health.

The analysis showed that much of the COVID-19-related chat in urban areas was centred on adapting to living with, and preventing the spread of, the infection. Rural areas discussed adapting far less, which the psychologist attributed to the relative prevalence of the disease in urban areas compared to rural, meaning those in the country have had less exposure to the disease and its consequences.

There are also differences in how the young and old are discussing COVID-19. "In older counties across the US, there's talk about Trump and the economic impact, whereas in young counties, it's much more problem-focused coping; the one language cluster that stand out there is that in counties that are younger, people talk about washing their hands," Eichstaedt said.



"We really need to measure the wellbeing impact of COVID-19, and we very quickly need to think about scalable mental healthcare and now is the time to mobilise resources to make that happen," Eichstaedt told the Stanford virtual conference.

Forecasting how coronavirus cases and deaths will spread across cities – and why

Google-owned machine-learning community Kaggle is setting a number of COVID-19-related challenges to its members, including forecasting the number of cases and fatalities by city as a way of identifying exactly why some places are hit worse than others.

"The goal here isn't to build another epidemiological model... there are lots of good epidemiological models out there. Actually, the reason we have launched this challenge is to encourage our community to play with the data and try and pick apart the factors that are driving difference in transmission rates across cities," Kaggle's CEO Anthony Goldbloom told the Stanford conference.

Currently, the community is working on a dataset of infections in 163 countries from two months of this year to develop models and interrogate the data for factors that predict spread.

Most of the community's models have been producing feature-importance plots to show which elements may be contributing to the differences in cases and fatalities. So far, said Goldbloom, latitude and longitude are showing up as having a bearing on COVID-19 spread. The next generation of machine-learning-driven feature-importance plots will tease out the real reasons for geographical variances.

Using AI to Make Data-Driven Decisions

Data scientists have been primarily focused on four key issues when trying to interpret page sets of data: volume, velocity, variety and veracity. These 'four Vs' are a significant challenge. With COVID-19, data is coming in from all over the world, at different times, from many sources and from systems with varying degrees of certification and accuracy.

In December 2019, an artificial intelligence platform called BlueDot, which scans data from hundreds of sources, detected a cluster of pneumonia-like illnesses in Wuhan, China. Today, almost everyone knows this was ground zero of the coronavirus pandemic. Without BlueDot, it may have taken weeks longer for the world to become aware of this highly infectious virus. The platform was also able to understand travel patterns and people's movements, and give early researchers the ability to know how the contagion would spread.

Researchers and practicing physicians trying to learn more about the coronavirus and how to treat the resultant COVID-19 disease are now inundated with information. AI can help them sift through that information in order to find the most pertinent information to help them make better and faster decisions. The Covid-19 Open Research Dataset contains a growing library of over 24,000 papers that helps doctors and scientists find the articles that are most helpful to them.

AI Scientists says the volume of data in front of health professionals is immense. "We have electronic health records, including a medical history and laboratory test results for each patient. And we also have a huge amount of medical image data including x-rays, CT scans and MRI scans. In hospitals doctors are relying on all this data to make critical diagnosis decisions and also treatment decisions," he explains.

AI-powered tools, such as AliveCor and CLEW, are being used to detect the signals that preempt cardiac arrest and respiratory deterioration respectively. This means that lives, which might be lost to COVID-19, can potentially be saved.

Innovative Usage of AI to Flatten the Curve

Making a quick diagnosis is critical to counter the spread of the novel coronavirus. While humans can collect data, they are limited in how fast they can interpret it. In China, a smart image-reading system, called Ping An Smart Healthcare, uses AI to analyze multiple CT scan images of the same patient and measure the changes in lesions. It has

been used to conduct hundreds of thousands of screenings far faster and with greater consistency than human operators. As a result, hundreds of potential cases were detected quickly, helping stem the spread of the virus.

Chinese technology company Alibaba has developed an AI system for detecting coronavirus from chest CT scans. It has a 96 percent accuracy level and can complete a diagnosis in 20 seconds, whereas human experts require about 15 minutes. The system, powered by deep learning algorithms, is able to differentiate between COVID-19 and viral pneumonia.

AI is also being applied to other types of imaging. For example, scanners deployed at airports can quickly detect if someone has a fever so they can be more thoroughly screened before entering the community.

Sun says, “We can use AI to help flatten the curve, prevent the disease from spreading, and enable high-throughput diagnostics. This is very important because good prevention and diagnosis could help avoid skyrocketing cases that overwhelm our healthcare system. For COVID-19 the most important question is related to resource allocation to identify who are the people that we should test and quarantine first.”

This, added Sun, will help with the allocation of medical supplies and expertise so hotspots can be addressed before they spread. And geospatial data can also be made publicly available so citizens can avoid areas with high infection rates.

In Taiwan, data collected by the government was used to identify cruise ship passengers who were potentially infected. Then, by using geospatial data from telecommunications companies, potential high-risk areas were made public.

“So, in the future if things become worse, we should really consider using AI to build a predictive model combining the geospatial data as well as health records so that we can proactively test and quarantine citizens as well as allocate resources to the right region,” recommends Sun.

“We have the technology to collect the data and the right AI technology to prioritize our health and medical resources,” he adds. “Now we need government permission to build privacy preserved systems with innovative ideas.”

How to Cure and Prevent the Next Plague

While detection and diagnosis are critical to controlling, and perhaps even halting, the spread of COVID-19, finding a cure and vaccine are also critical. With so many scientists around the globe are working on these challenges, there is a vast array of data being produced at an accelerated pace.

AI is helping researchers scour thousands of research papers, both new and old, in order to uncover clues that will lead to finding a cure and vaccine – a challenging task given humans have never successfully produced a vaccine for any coronavirus-based disease before.

A major part of creating a cure is understanding the structures of the proteins that make up this pathogen and how they interact under different conditions. Systems such as Google’s AlphaFold and others are being used to help researchers around the world.

“We need to know the protein 3D structure in order to design drugs to neutralize the protein structure,” says Sun. “Once we have this 3D form, we can use AI in simulation to identify possible compounds to treat the disease. IBM has already used their supercomputer, Summit, to identify 77 most likely candidate compounds to be tested.”

In the past, this was a painstaking and time-consuming activity. However, AI can be used to model three-dimensional protein structures and conduct virtual experiments faster than traditional laboratory experiments. Speed is critical. Sun explains that as the novel coronavirus that causes COVID-19 is an RNA-based, not DNA-based virus and therefore it can mutate quickly. Already, researchers have detected eight different strains of the novel coronavirus. AI can help track and predict the trend of these mutations – an important consideration for treating the disease and eventually developing a vaccine.

The 3D models and treatment candidates identified by these different AI tools still need to be validated through further experiments and clinical trials, but the time taken to reach this stage has been massively accelerated through the use of AI.

“Monitoring the mutation can help pharmaceutical companies to better identify the right target to develop a drug,” says Sun. “But if existing drugs don’t work, then we are facing the step of discovering less well-known molecules, testing in a lab with human trials as well as figuring out how to mass manufacture those new molecules or compounds.”

III. CONCLUSIONS

AI is not yet playing a significant role in the fight against COVID-19, at least from the epidemiological, diagnostic and pharmaceutical points of view. Its use is constrained by a lack of data and by too much noisy and outlier data. The creation of unbiased time series data for AI training is necessary. A growing number of international initiatives in this regard is encouraging; however, there is an imperative for more diagnostic testing. Not only for providing training data to get AI models operational, but moreover for more effectively managing the pandemic and reducing its cost in terms of human lives and economic damage.



At the time of writing, the significant efforts of all affected countries have been to shut down their economies through lockdowns, enforcing social distancing, and cancelling events. These measures seem, for now, to have succeeded in slowing down the spread. However, whether these measures are sustainable for more than a couple of weeks is doubtful.

More diagnostic testing will be helpful to eventually halt the pandemic, limit the economic damage from lockdowns, and avoid a rebound once restriction are relaxed. At present, we just do not know how many people are infected. In essence, it may be, as a study in Science suggests, that 86 percent of all infections may be undocumented. If this is the case, then the danger of a rebound of the pandemic is highly likely. Thus, overcoming limited data in terms of who is infectious is critical.

Finally, data is central to whether AI will be an effective tool against future epidemics and pandemics. The fear is, as I already mentioned, that public health concerns would trump data privacy concerns. Governments may want to continue the extraordinary surveillance of their citizens long after the pandemic is over. Thus, concerns about the erosion of data privacy are justified.

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