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Review on Contact Tracing with Machine Learning

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Abstract:- Contact tracing is an essential component of public health surveillance. It is however, labor-intensive and expensive to carry out. Contact tracing has been difficult to execute in several countries, and no impact analyses based on empirical data have been conducted to estimate its impact on COVID-19 mortality. We looked on the efficacy of the current CDC definition of a close contact, as well as the distribution of untraced secondary cases. Using latest COVID-19 transmission estimates, we show that fewer than 1 in 5 instances will result in untraced cases.

Keywords:- *Contact Tracing, Transmission, Infection Control, Surveillance.*

I. INTRODUCTION

In the event of an infectious disease outbreak, contact tracing is an important part of the public health response. The goal of this advise is to emphasise the importance of community participation and engagement in the contact tracing process. The guidance and related products lay out best practises for community engagement and show how they can be used in any community-based contact tracing strategy. The information supplied can be utilised alone or in conjunction with other materials that support strategies, implementation plans, or training and capacity-building modules.

SARS-CoV-2 disease (COVID-19), a coronavirus, is the most recent threat to the world's health and economic sectors. The burden of this sickness is growing by the second, infecting more people every second, with an estimated 40 million fatalities if left untreated. Tracing the primary and secondary contacts of confirmed COVID-19 cases using contact-tracing technologies and devices is one of the most effective approaches to reduce the spread of this infection. Using this tracing technology, China has been able to effectively control the spread of COVID-19. Given the immediate need to expand COVID-19 infection tracing options to other developing nations, there is a lot of interest for employing smart phones and other devices to reduce illness spread and make therapy more accessible. As a result, the number of COVID-19 infection tracing technologies has exploded. They now include proximity tracking technologies that follow people's movements using location-based (GPS) or Bluetooth technology to identify those who may have been exposed to an infected person. Other technologies, such as characteristic tracking systems, collect self-reported signs and symptoms to determine the severity of COVID-19 infection or the likelihood of infection. When these tools are used in conjunction with the contact-tracing procedure, they can be quite beneficial.

II. CONTACT TRACING AND ITS PURPOSE

Contact tracing is the process of finding people who may have come into contact with an infected person ("contacts") and collecting additional information about them in the field of public health. Public health strives to reduce illnesses in the population by tracing the contacts of infected individuals, testing them for infection, isolating or treating the infected, and tracing their contacts. Tuberculosis, vaccine-preventable infections like measles, sexually transmitted infections (including HIV), blood-borne infections, Ebola, some dangerous bacterium infections, and new virus infections (e.g. SARS COV, H1N1, and SARS COV-2) are among diseases for which contact tracing is routinely used.

The purpose of contact tracing are:

- To decrease the spread of an infection by interrupting ongoing transmission.
- To warn contacts about the risk of infection and provide preventive or prophylactic therapy.
- To provide diagnosis, counselling, and therapy to people who have already been infected.
- To assist in preventing reinfection of the previously infected patient if the infection is curable.
- To get knowledge on the epidemiology of a disease in a specific population.

For decades, contact tracing has been a cornerstone of public health's approach to infectious disease control. Smallpox was eradicated, for example, not by universal inoculation but through extensive contact tracing to locate all afflicted people. Following that, diseased individuals were isolated, and the surrounding community and contacts at risk of catching smallpox were immunised.

CLUSTERING AN UNSUPERVISED ALGORITHM

Clustering analysis is an unsupervised learning method that divides data points into multiple distinct bunches or groups, with data points belonging to the same group having similar properties and data points belonging to different groups having different properties in some ways.

DBSCAN is a data clustering technique that clusters data points in a given space based on density. The DBSCAN algorithm gathers data points that are close together and labels outliers as noise. For the purpose of contact tracing with Machine Learning, we will utilise the DBSCAN method.

MORE ABOUT THE ALGORITHM

DBSCAN (Density-Based Spatial Clustering of Applications with Noise) is a density-based clustering base technique. It can find clusters of various forms and sizes in a vast amount of data that is noisy and contains outliers.

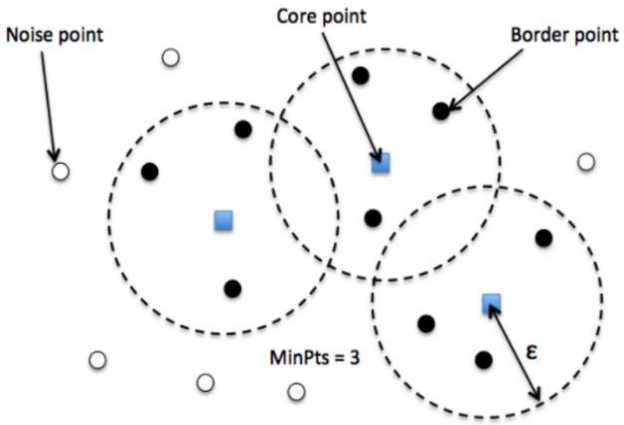
The DBSCAN algorithm uses two parameters:

minPts: For a region to be deemed dense, it must have a certain number of points clustered together (a threshold).

eps (ε): A distance measurement that will be used to find points in the vicinity of any given point.

Reachability, when it comes to density, reachability means that a point is reachable from another if it is within a certain distance (eps) of it.

Connectivity, On the other hand, uses a transitivity-based chaining strategy to evaluate if points belong to a specific cluster. P and q points, for example, could be linked if p->r->s->t->q, where a->b indicates that b is in the vicinity of a.



IMPORTANTS POINTS

Core- This is a point that has at least *m* points within distance *n* from itself.

Border -This is a point that has at least one Core point at a distance *n.*

Noise - This is a point that is neither a Core nor a Border. And it has less than *m* points within distance *n* from itself**.**

III. IMPLEMENTATION OF ALGORITHM

We've set eps (ε) to 0.0018244 (radial distance of 6 feet in kilometres) and minPts to 3. After applying these algorithm parameter values to our dataset, we constructed clusters, and the algorithm predicted the result of contact tracing using these clusters.

DATASET : Fig. 1 (Dataset Information)

Data Information:

	TimeStamp	id	latitude	longitude
0	Aug 27, 2020 5:33 PM	Arthur	13.9880	60.0775
1	Aug 27, 2020 8:13 PM	Walter	13.9032	60.0294
2	Aug 27, 2020 6:22 PM	Arthur	13.9332	60.0784
3	Aug 27, 2020 3:38 AM	Walter	13.9675	60.0021
4	Aug 27, 2020 1:11 AM	James	13.9664	60.0405
5	Aug 27, 2020 5:09 PM	William	13.9612	60.0646
6	Aug 27, 2020 12:24 PM	Arthur	13.9400	60.0684
7	Aug 27, 2020 4:23 PM	John	13.9981	60.0065
8	Aug 27, 2020 3:35 AM	Arthur	13.9113	60.0994
9	Aug 27, 2020 3:37 PM	Arthur	13.9084	60.0122
10	Aug 27, 2020 8:27 PM	Walter	13.9954	60.0506

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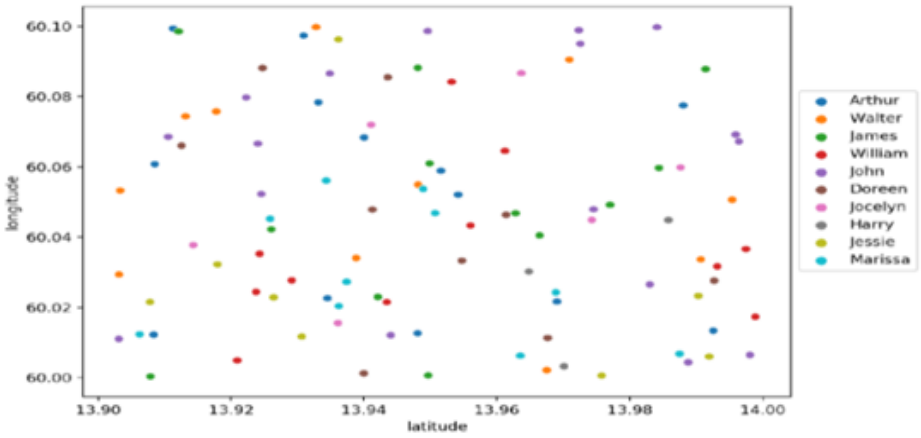
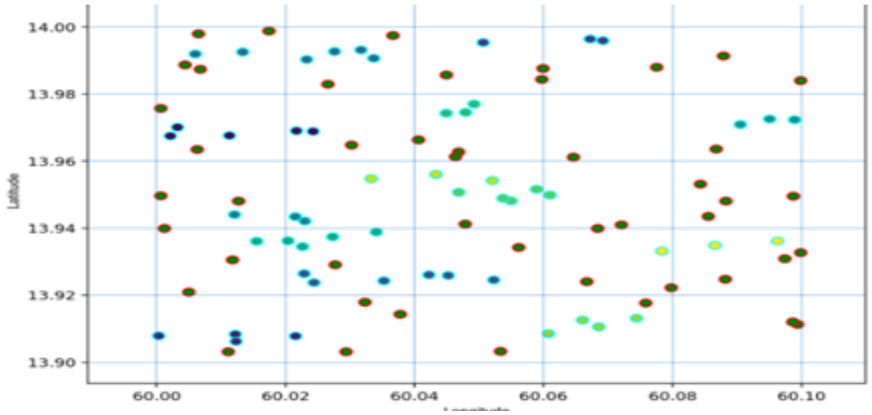
PLOT FOR DATA POINTS : Fig. 2



CLUSTERS DETECTED: Fig. 3



COMPARISION OF DBSCAN WITH K MEANS:

PARAMETER	K MEANS	DBSCAN
CLUSTER SHAPE	Spherical	Arbitrary
NO. OF CLUSTER	Require to specify cluster	Not required
EFFICIENCY ON LARGE DATA	Prefered for large data	Less Prefered for multi dimensional data
NOISE HANDLING	Do not handle noise	Noise handling ability
EFFECT ON VARYING DENSITIES DATA	No effect on working	Not very well in sparse dataset

Advantages and Disadvantages of Using DBSCAN

Advantages

- Unlike K-Means, where clusters are more or less spherical, clusters can adopt any irregular shape.
- Is excellent at differentiating high-density clusters from low-density clusters within a dataset.
- It is not necessary to specify the number of clusters in advance.
- The DBSCAN method is capable of locating clusters of any size or shape.
- While clustering, I was able to identify noisy data.

Disadvantages

- In the case of fluctuating density clusters, the DBSCAN algorithm fails.
- If the dataset has a neck, it will fail.
- When dealing with high-dimensional data, this method does not function effectively.
- Choosing a meaningful distance threshold can be difficult if the data and scale are not well understood.
- DBSCAN is unable to cluster data sets with enormous densities because the minPts-combination cannot be selected suitably for all clusters.

IV. CONCLUSION

In the ongoing struggle against the COVID-19 pandemic, digital technology, AI, and big data have arrived in full force at the doorsteps of global health. These technology applications, which are supported by national governments, serve as an alarm system, allowing for speedy contact tracing and notification as well as mass reach to the community. For epidemiologists and behavioural scientists, the massive amounts of data collected by these digital platforms represent a vast store of research that can aid in planning for future pandemics. Beyond its use in combating and managing COVID-19, digital technology can supplement, and in some circumstances, amplify, the traditional manner to implementing global health programmes. However, like with any new technology, additional safeguards such as privacy protection and specific skill training are required to avoid blindspots that may overshadow the benefits.

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