COVID-19 Interactive Interface
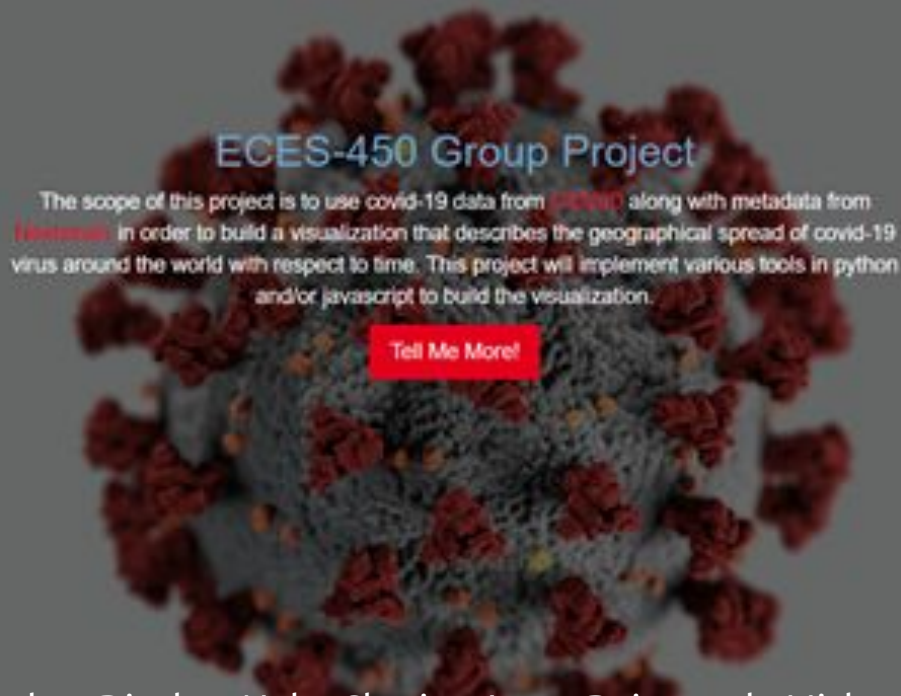
Presenters: Joshua Shelley, Joshua Divaker, Neha Cherian, Lyssa Buissereth, Michael Russo
ECES 450/650
Dr. Gail Rosen
June 8, 2020

Background: COVID-19

- Disease rooted from the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
- Novel coronavirus
  - Has not been previously identified
- Oily membrane
  - Basically, a layer of fat protecting the virus from the rest of the world
- To date, worldwide:
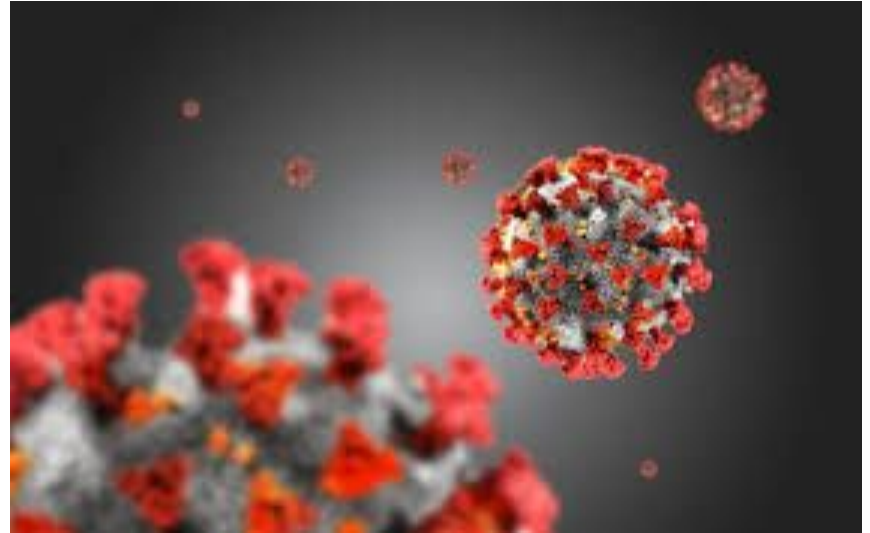 - ~ 7 million confirmed cases
  - ~ 400,00 deaths

Image cred: elgin.edu

Background: Transmission

- Each virus carries instructions to make a million copies of itself.
- And so each cell infected by the coronavirus is subject to releasing millions of new viruses.
- With each genome replication process arises an opportunity for mutations to occur
  - As it spread from person to person, the more random mutations accumulate
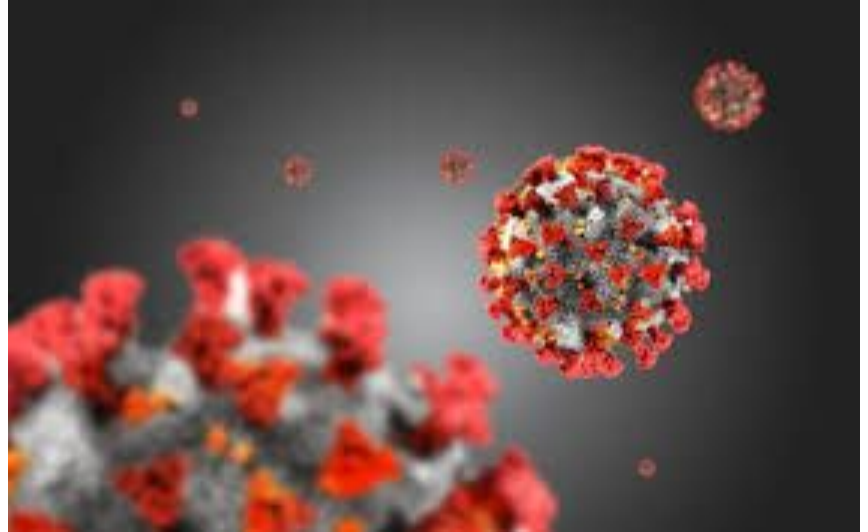- These accumulated mutations allow scientists to track the virus's evolution around the world.

Image cred: elgin.edu

Background: Genetic Variation in COVID-19

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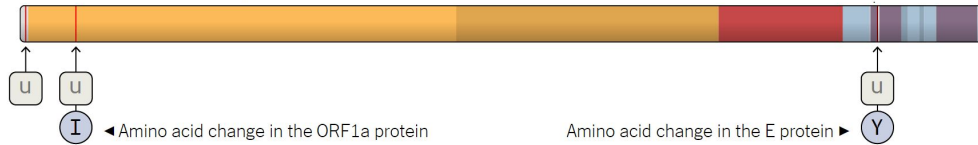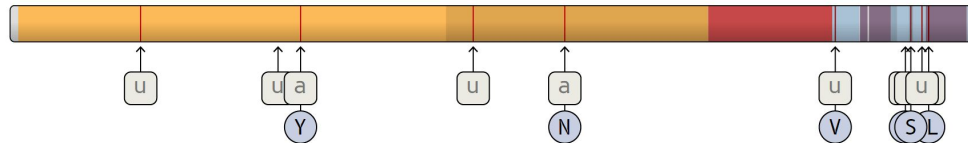
Aim

- Create a site that will allow visitors to easily visualize the locations, relative sizes of breakouts, and spread of different SARS-CoV-2 strains around the world.
- The site's user interface will consist of a interactive geojson map accompanied by visualizations of outbreak data.
- When a user clicks one geographical representation, the site will display the different SARS-CoV-2 sequences in both a pie and time series charts
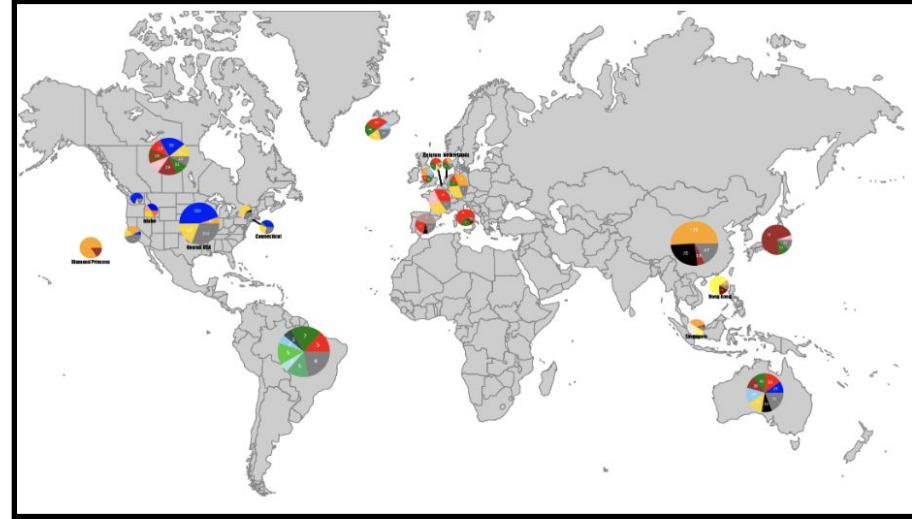
Fig.1 Conceptual overview of our proposed interactive map with corresponding pie charts. **[2]**

Comparison of Previous Methods (Lit. Review)

<u>Open access epidemiologic data & interactive dashboard to monitor the COVID-19 outbreak in Canada (Berry, et al)</u>

- Interactive COVID-19 data visualization is a fundamental tool
  - Public health
  - Research
  - Wider audience

- Reported cases are documented per each providence
- More information for each province is supplemented within the website. (location, report date, travel history, exposure source, time series deaths, and recoveries)

- Comparison
  - Berry, et al: visualization of infectious rates
  - Our team: visualization of variability of COVID-19 strains
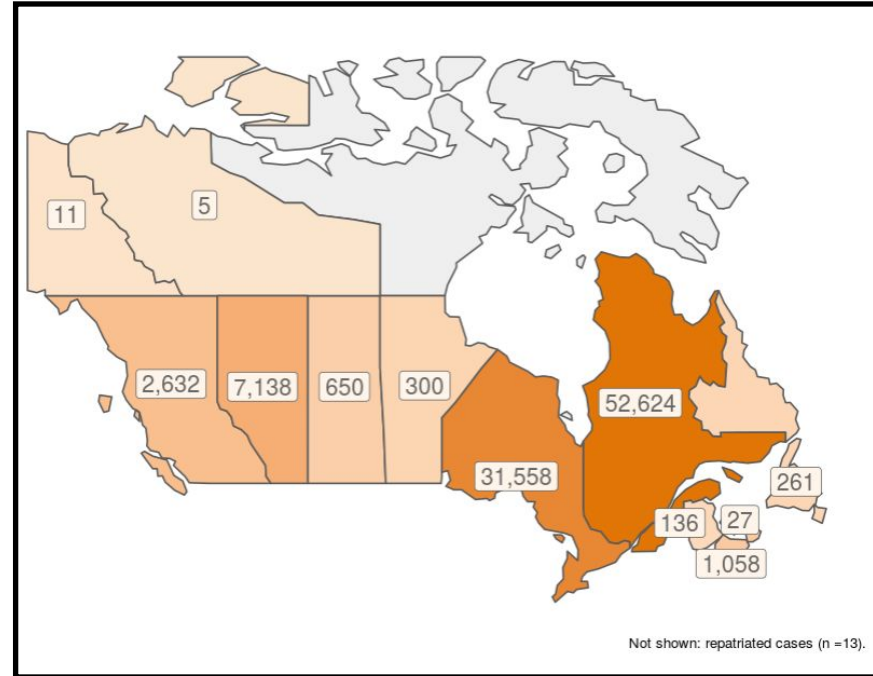
Fig. 2 Reported cases for both confirmed and presumptive positive cases. **[1]**

Materials

- Server
- VPN (*pro tempore*)
- GISAID Data
- ISM data analysis
- Multiple languages
  - HTML
  - CSS
  - JS
  - Python

Methods - Schematic
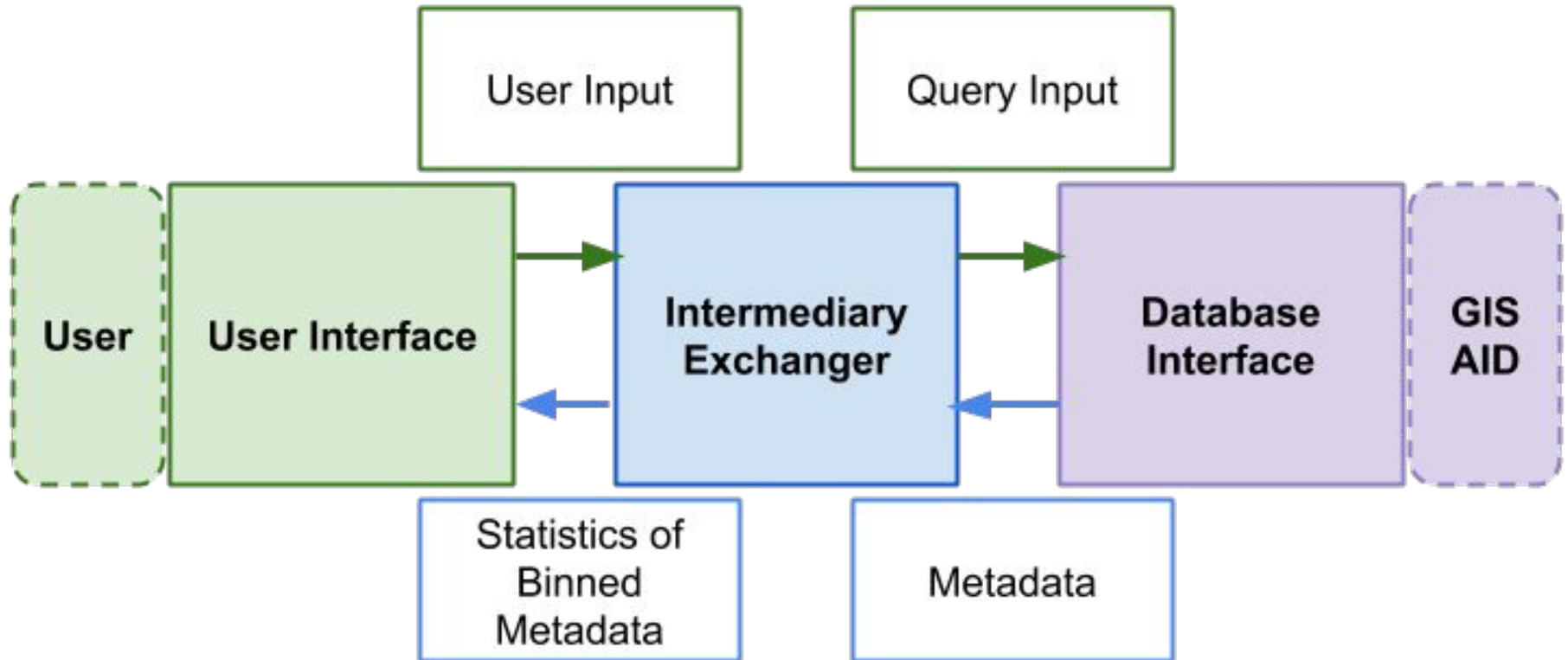
Methods

	Purpose	Inputs	Outputs	Code
User Interface	Chart COVID-19 cases based on user's ROI	Mouse clicks	Coordinates	●HTML ●CSS ●JS ●Python ●Django ORM ●MapBox & geojson
		Statistics	Visualization	
Intermediary Exchanger	Translate user input, bin GISAID query's metadata, and compute stats	Coordinates	Geojson	●JS ●Python
		GISAID metadata	Summary statistics	

Methods

	Purpose	Inputs	Outputs	Code
Database Interface	Use translated user input to query local database. Gather the json metadata from query results to create pie & time series charts	Latitude / Longitude / Date	Query	●Python ●Mafft ●Sequence data from GISAID website ●Run pipeline_0_filter.sh, pipeline_1_mafft.sh, pipeline_2_run_ISM.py. ●Json tables
		GISAID metadata	Json tables	

Results/Demo

VPN:

- Connect with cisco anyconnect to drexel vpn

Website:

- http://10.248.19.125/

Summary

- An interactive, animated map for the COVID-19 outbreak was created.

- Helps users identify mutational signatures of the virus using ISM (an entropy-based analysis)

- The map is based on GISAID data and Nextstrain for the sequence data and metadata and the ISM data analysis by Dr. Gail Rosen and Zhengqiao Zhao

- The map utilizes Python, Gunicorn, Nginx, Postgresql for developing the environment and Geojson and MapboxJS for visualization.

- Everything is built on open-source, readily available, and easy to manipulate software/code.

Future Directions

- GISAID provides API for access to their data for daily updation

- Display momentum of spread

- Display testing facilities and containment score

- Display details about the patient

Sources

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2. Rosen, Gail. "EESI/ISM." GitHub, June 3, 2020. https://github.com/EESI/ISM.
3. Django Docs https://docs.djangoproject.com/en/3.0/
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5. Beaumont, P. (2020, May 1). *Where did Covid-19 come from? What we know about its origins*. Retrieved from The Guardian: https://www.theguardian.com/world/2020/may/01/could-covid-19-be-manmade-what-we-know-about-origins-trump-chinese-lab-coronavirus
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7. Grubaugh, N. D., Ladner, J. T., & al, e. (2019). Tracking virus outbreaks in the twenty-first century . *Nature Microbiology* , 10-19.
8. Corum, J., & Zimmer, C. (2020, April 30). *How Coronavirus Mutates and Spreads*. Retrieved from The New York Times: https://www.nytimes.com/interactive/2020/04/30/science/coronavirus-mutations.html

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Sources

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