



Race to Vaccination: Covid-19

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Introduction

The project revolves around using multiple datasets available for covid-19 vaccinations and finding some insights for the future. After more than a year since the pandemic started, multiple vaccines have been developed by different countries and research centers. The project shows the current statistics related to people's vaccinations and the type of vaccines used by different countries. It also tries to find the extent of pandemic in terms of time.

Data Sets Used

We have tried to work on multiple data sets from various sources.

1. Vaccine Supply Data
 1. This dataset in the form of a csv file contains information for countries and the vaccine donations or purchases from different governments. It also gives the number of vaccines supplied.
 2. Data Source: [Airfinity – Predictive science intelligence](#)
 3. Imported using a downloaded csv file.
2. Daily and total vaccination for Covid-19 in world
 1. This dataset provides the information for number of vaccinations administered, number of people vaccinated (1 dose) and number of fully vaccinated people (2 doses) for each country on each day.
 2. Data Source: [COVID-19 World Vaccination Progress | Kaggle](#)
 3. Imported using Kaggle API

```
!kaggle datasets download -d gpreda/covid-world-vaccination-progress
!kaggle datasets download -d sudalairajkumar/undata-country-profiles
```

Data Pre-processing

Since the data had multiple NAN values for certain countries on certain dates when either the vaccinations were not reported or there was no vaccination done.

Such values have been dropped.

Also, there are some rows with missing data. Such data values have been replaced using liner interpolation applied after grouping the countries.

```
vac_data_interpolated = vac_data.groupby('country').apply(lambda group: group.interpolate('linear',
limit_direction='forward'))
vac_data_interpolated.isna().sum()
```

Data Structures Used

1. Hash Maps

Hash Maps do accessing in just $O(1)$ so used to store the daily rate of vaccination across the countries / list of manufacturers.

The data structure is input to the plotting library to populate the world chart.

The country name is used as a hash key which gives access to the number of vaccinations and list of manufacturers used.

```
table_map = {}
for c in explore_list:
    table_map[get_code(c)] = exploredf.loc[exploredf.country == c].iloc[-1]
    ['daily_vaccinations_per_million']
```

2. Heaps

Heaps have been used to find the country with maximum vaccinations so far.

Heaps are also useful for finding the date in history when maximum vaccinations were done.

Heaps have a time complexity of $O(n)$ for creation.

```
heapq.heapify(mod_tuples_date)
heapq.heapify(mod_tuples_country)
```

Time complexity of $O(1)$ for extracting from the head and $O(\log n)$ to heapify.

```
max_val2 = (heapq.heappop(mod_tuples_date))
print("On",max_val2[1],max_val2[2],"did",-1*max_val2[0],"vaccinations per million.")
```

On 2021-02-13 Seychelles did 24415.0 vaccinations per million.

```
max_val = (heapq.heappop(mod_tuples_country))
print(max_val[1],"with",-1*max_val[0],"vaccinations per million is most vaccinated country")
Israel with 1077388.0 vaccinations per million is most vaccinated country
```

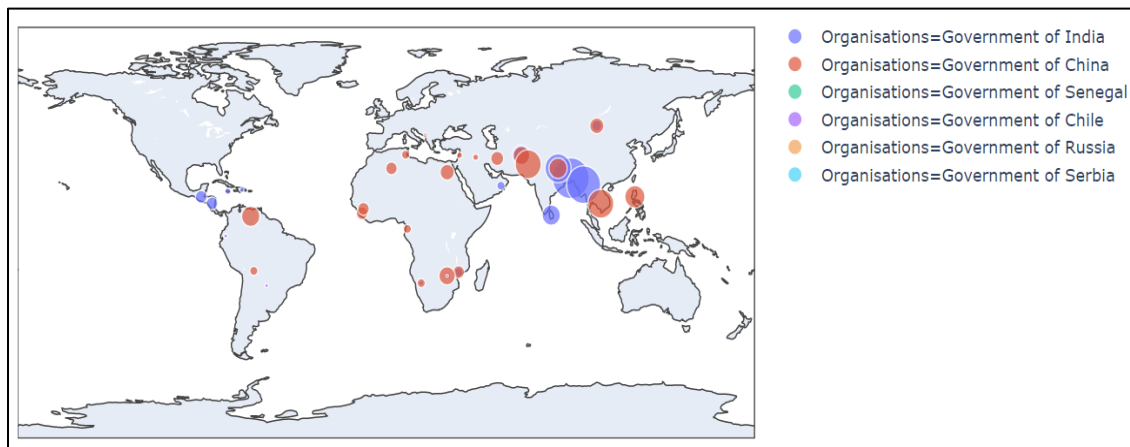
Hence, heaps have an advantage over lists that would ideally sort the vaccinations to get the most vaccinated country in $O(n \log n)$. Instead, heaps will give the most vaccinated country or date in $O(n) + O(\log n)$.

Also, later on when new data (eg: country) is added to the data set then we easily add the new data and find the maximum in $O(1)$ and heapify in $O(\log n)$

Plotting and Visualizing

1. Plotting the daily rate of vaccination for each country
2. Plotting the different types of vaccines used by the countries.
3. Visualizing vaccine donations

Countries are donating vaccines because they believe in vaccine for everyone. This is the only way in which the world will be covid-19 free. Countries like India, China, Serbia, Russia, etc are donating vaccines free of cost for economically backward countries.

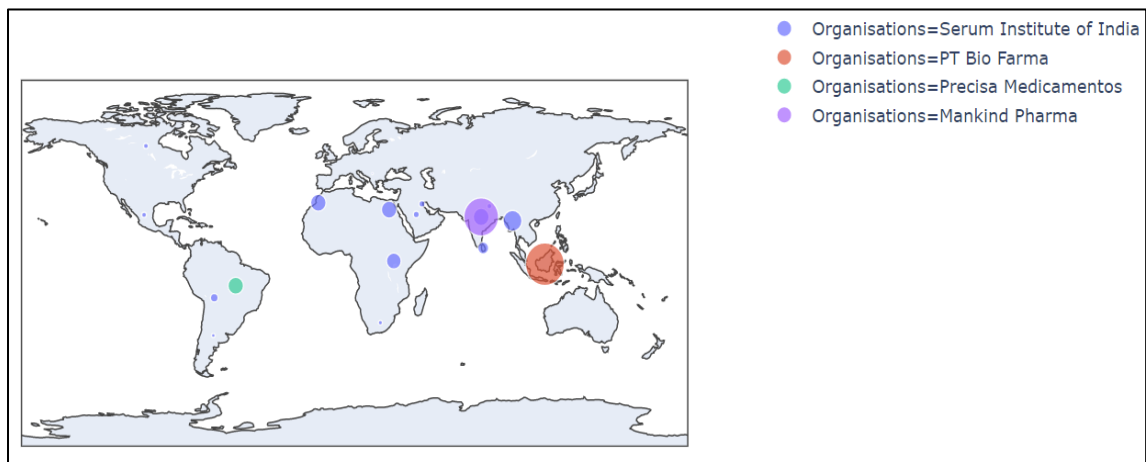


We can see that India has donated vaccines to Sri Lanka, Nepal, Myanmar, Bangladesh. The analysis shows that countries have been donating vaccines to their neighboring countries.

By doing such donations they are trying to create their alliances or asking for future benefits. This has been a way for donor countries to build political connection.

There have also been initiatives like COVAX for fair distribution of vaccines throughout the world.

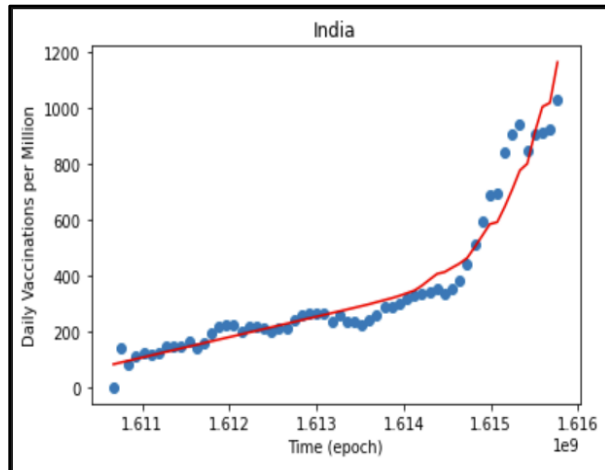
4. Visualizing vaccine purchases



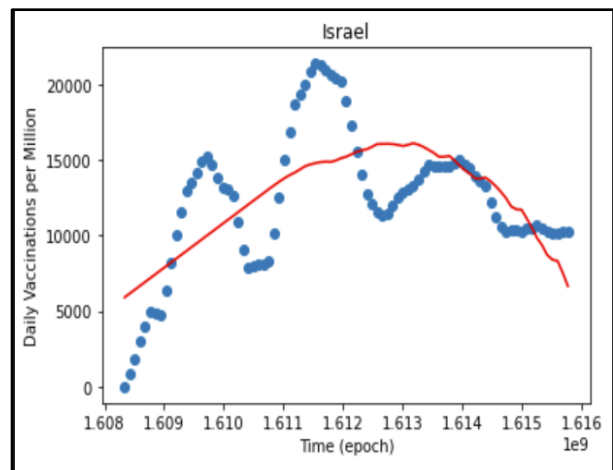
This graph shows that countries are using vaccines developed in their own countries. Also, promoting purchase of vaccines to the countries that they have good political relations with.

Linear Regression

The project uses a linear regression model on time, time square and daily vaccination to find the vaccination trend. We aim at finding the number of vaccinations in a day in future. This helps in answering the extent of this pandemic.



Certain countries show an increasing trend since they have started vaccinating their population recently.



Also, there are a few countries who did vast amount of vaccination since the start of year 2021, hence they are now having a downward trend because they are almost on the stage of vaccinating their whole population.

Conclusion

Vaccine drive for every country will end during different phases. For Russia we predict the vaccination drive to end on 4th April 2021. The countries who are ahead in the race of vaccination should contribute more to the world instead of concentrating on just their own country.

References

1. [COVID-19 'vaccine diplomacy': China, Russia and India cherry-picking the countries they help | World News | Sky News](#)
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4. [https://mea.gov.in/media-briefings.htm?dtl/33483/Transcript of Virtual Weekly Media Briefing by the Official Spokesperson February 04 2021](https://mea.gov.in/media-briefings.htm?dtl/33483/Transcript+of+Virtual+Weekly+Media+Briefing+by+the+Official+Spo+kesperson+February+04+2021)
5. <https://www.middleeasteye.net/news/covid-19-israel-gives-vaccines-countries-jerusalem-embassy>