

# Final Project

# Business Case

In this report, three topics regarding covid-19 are covered:

- The covid-19 pandemic test, case, recovery, death, and vaccination totals are covered followed by time-series modeling to determine the progression of the pandemic.
- A logit model is used to determine the log odds relationship between government covid-19 regulations and cases of SARS-CoV-2.
- SARS-CoV-2 symptoms, lifecycle, testing, and vaccines are explained followed by a recurrent neural network that is used to predict the next nucleotide in the sequence of a SARS-CoV-2 genome.

# Forecasting The Pandemic

## Active Cases of Virus

|    | Country        | Active Cases |
|----|----------------|--------------|
| 1  | United States  | 6948028      |
| 2  | France         | 4197252      |
| 3  | Brazil         | 1371216      |
| 4  | Belgium        | 793295       |
| 5  | Italy          | 562832       |
| 6  | India          | 553874       |
| 7  | Poland         | 388235       |
| 8  | United Kingdom | 379848       |
| 9  | Ukraine        | 323448       |
| 10 | Russia         | 282382       |

The United States has cumulatively had, and still has, the most cases of the virus.

## Total Tests for Virus

|    | Country        | Tests     |
|----|----------------|-----------|
| 1  | United States  | 401946739 |
| 2  | India          | 242650025 |
| 3  | China          | 160000000 |
| 4  | United Kingdom | 124452321 |
| 5  | Russia         | 119900000 |
| 6  | France         | 63999096  |
| 7  | Italy          | 49551436  |
| 8  | Germany        | 48979281  |
| 9  | Spain          | 42707830  |
| 10 | Turkey         | 38338045  |

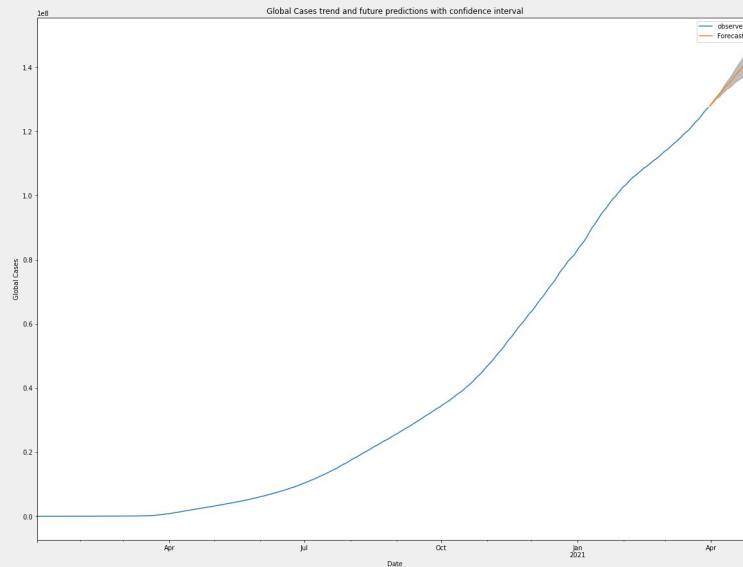
The United States likely has the most cases because it has tested the most.

## Total Vaccinations for Virus

|   | Country        | Active Cases | Vaccinations |
|---|----------------|--------------|--------------|
| 1 | United States  | 6948028      | 145812835    |
| 2 | China          | 173          | 110962000    |
| 3 | India          | 553874       | 61113354     |
| 4 | United Kingdom | 379848       | 34119095     |
| 5 | Brazil         | 1371216      | 18082153     |

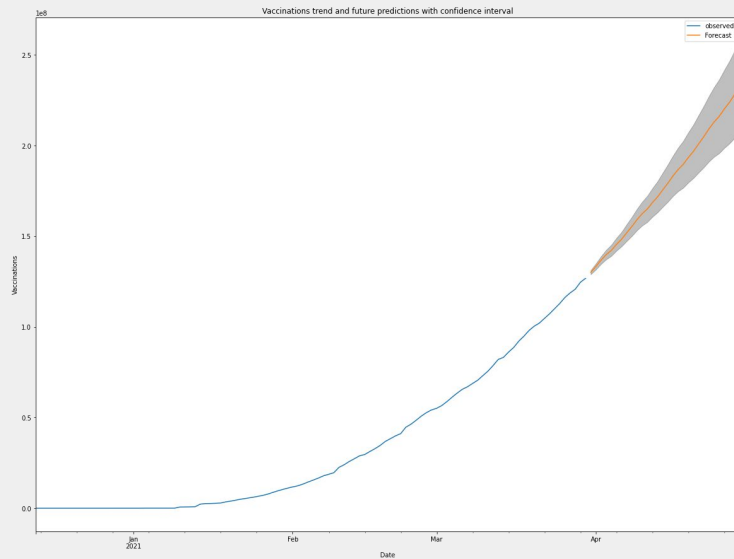
The United States leads in vaccinations.

# Virus Cases Forecast



The cumulative cases of the virus are projected to increase by 12.8% over the next month.

# Virus Vaccinations Forecast



The cumulative virus vaccinations are projected to increase by 83.3% over the next month.



# Government Regulations In Response To Covid-19

## Government Regulation Relationship With Virus Cases

Regulations that decreased log odds of virus cases:

- school closures
- travel restrictions
- state of emergency declarations
- wage support
- tax credits
- interest rate lowering

Government regulations such as disallowing public gatherings and mandating wearing masks did not decrease the log odds of the presence of virus cases.

## Logit Metrics

Precision Score: 0.8072260328601053

Recall Score: 0.8241521110703962

F1 Score: 0.8156012651852449

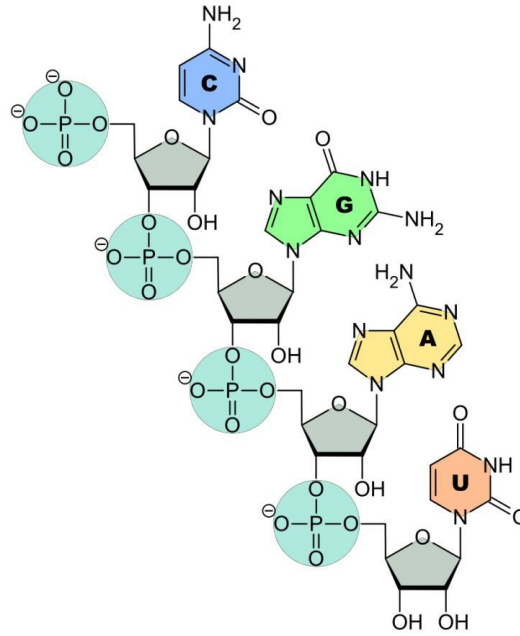
Accuracy Score: 0.817523923444976

Specificity Score: 0.8278185297400733

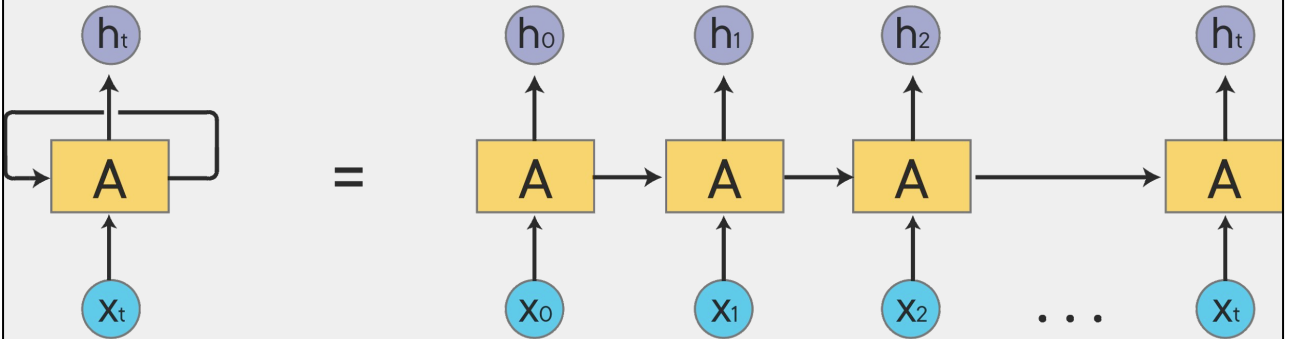
ROC AUC: 0.8176583048418117

# Sars-CoV-2 Genome

# RNA



## Recurrent Neural Network



Recurrent Neural Network is a neural network that passes its output,  $h$ , from a layer back into itself as input for the next layer. An RNN is used to predict the next nucleotide in the genome.

## RNN Metrics

Loss 40

Accuracy 82

Precision 94

Recall 73

# Conclusion

- Predicting the next nucleotide in a genome will be useful in reconstructing fragmented genomes for curing genetic diseases.
- The virus spread is slowing and will decrease more as more people get vaccinated.
- Instead of wearing masks and preventing gatherings, carrying handkerchiefs in which people could sneeze or cough and sanitizing areas where people gather would be sufficient in preventing the spread of SARS-CoV-2.



## Future Work

Using neural networks to predict sequences of nucleotides or amino acids.

Thank You

## Sources

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<https://medium.com/>

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