INDIA COVID-19 SITUATION REPORT

About

Coronaviruses (CoV) are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV).

Coronavirus disease (COVID-19) is a new strain that was discovered in 2019 and has not been previously identified in humans.

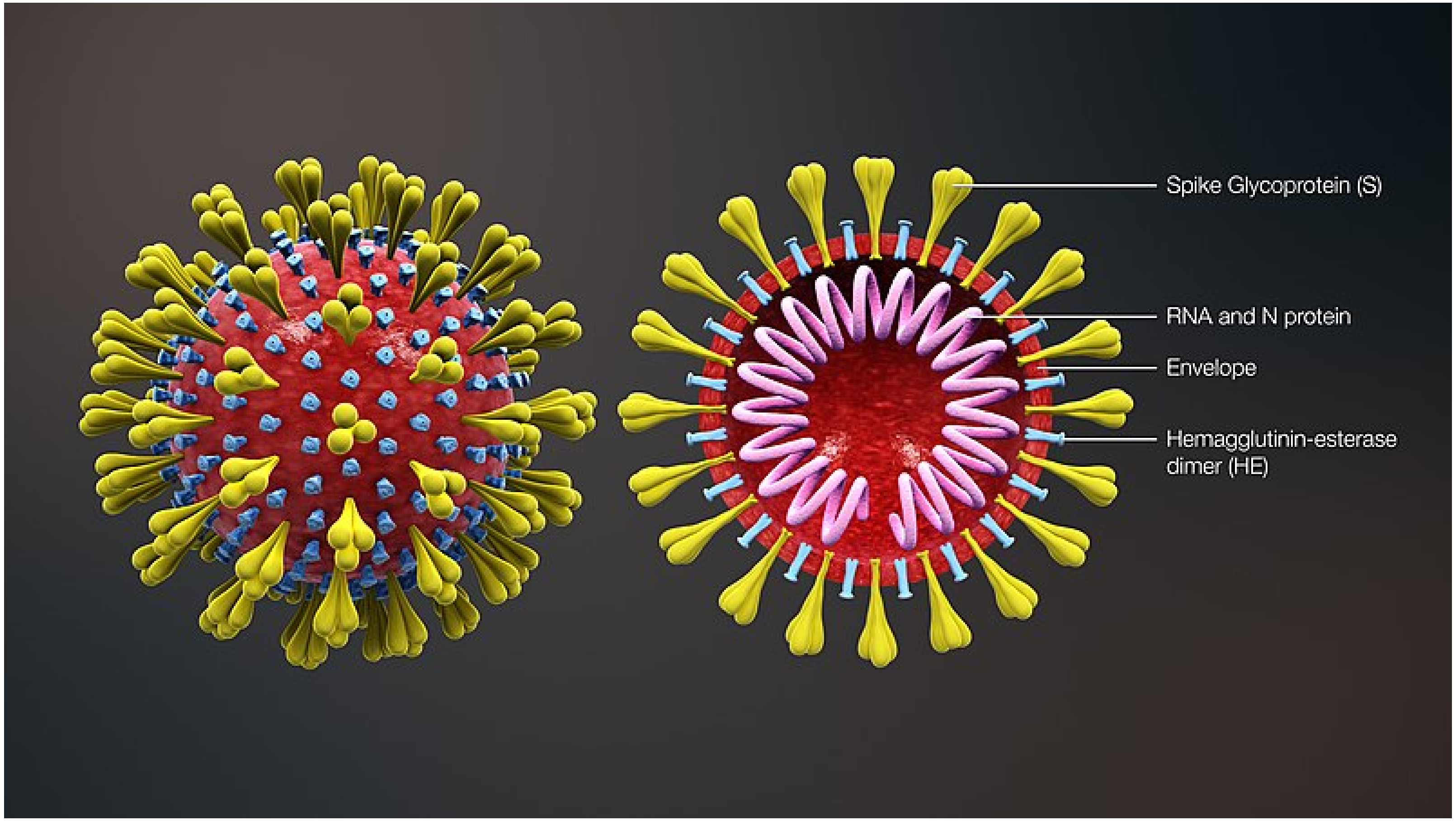
Coronaviruses are zoonotic, meaning they are transmitted between animals and people. Detailed investigations found that SARS-CoV was transmitted from civet cats to humans and MERS-CoV from dromedary camels to humans. Several known coronaviruses are circulating in animals that have not yet infected humans.

Common signs of infection include respiratory symptoms, fever, cough, shortness of breath and breathing difficulties. In more severe cases, infection can cause pneumonia, severe acute respiratory syndrome, kidney failure and even death.

Standard recommendations to prevent infection spread include regular hand washing, covering mouth and nose when coughing and sneezing, thoroughly cooking meat and eggs. Avoid close contact with anyone showing symptoms of respiratory illness such as coughing and sneezing.

In [1]:

```python
from IPython.core.display import Image, display
display(Image('https://upload.wikimedia.org/wikipedia/commons/thumb/e/eb/3D_medical_animation_corona_virus.jpg/800px-3D_
```



Context

From World Health Organization - On 31 December 2019, WHO was alerted to several cases of pneumonia in Wuhan City, Hubei Province of China. The virus did not match any other known virus. This raised concern because when a virus is new, we do not know how it affects people.

So daily level information on the affected people can give some interesting insights when it is made available to the broader data science community.

Johns Hopkins University has made an excellent dashboard using the affected cases data. Data is extracted from the google sheets associated and made available here.

Content

2019 Novel Coronavirus (2019-nCoV) is a virus (more specifically, a coronavirus) identified as the cause of an outbreak of respiratory illness first detected in Wuhan, China. Early on, many of the patients in the outbreak in Wuhan, China reportedly had some link to a large seafood and animal market, suggesting animal-to-person spread. However, a growing number of patients reportedly have not had exposure to animal markets, indicating person-to-person spread is occurring. At this time, it’s unclear how easily or sustainably this virus is spreading between people - CDC

This dataset has daily level information on the number of affected cases, deaths and recovery from 2019 novel coronavirus. Please note that this is a time series data and so the number of cases on any given day is the cumulative number.

The data is available from 22 Jan, 2020.

In [2]:

```
import os
os.chdir(r'G:\AAIC\AAIC\AAIC Assignment\CORONA\India corona\India_corona_29_march')
```

In [3]:

```
# IMPORTING SOME LIBRARY

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.colors as mcolors
import random
import math
import time
import datetime
import operator

from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.svm import SVR
from sklearn.metrics import mean_squared_error, mean_absolute_error
from sklearn.metrics import r2_score
from xgboost import XGBClassifier
# from datetime import datetime, date

plt.style.use('seaborn')
%matplotlib inline
```

In [4]:

```
# IMPORTING SOME LIBRARY

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.colors as mcolors
import random
import math
import time
import datetime
import operator

from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.svm import SVR
from sklearn.metrics import mean_squared_error, mean_absolute_error
from sklearn.metrics import r2_score
from xgboost import XGBClassifier

plt.style.use('seaborn')
%matplotlib inline



import pycountry
import plotly.express as px
from plotly.offline import init_notebook_mode, iplot
import plotly.graph_objs as go
import plotly.offline as py
from plotly.offline import download_plotlyjs,init_notebook_mode,plot,iplot
```

1. DATA CLEANING & UNDERSTANDING

In [5]:

```
df = pd.read_csv('covid_19_india.csv')
print('Shape of the data:', pd.read_csv('covid_19_india.csv').shape)
df['Total_confirm'] = df['ConfirmedIndianNational'] + df['ConfirmedForeignNational']

# spelling mistake of Chhattisgarh
for i in range(0, len(df['State/UnionTerritory'])):
    if df['State/UnionTerritory'][i] == 'Chattisgarh':
        temp_i = i
temp_i
df.drop(temp_i, inplace=True)
df.reset_index(inplace=True)

df.head()
```

```
Shape of the data: (446, 8)
```

Out[5]:

	index	Sno	Date	Time	State/UnionTerritory	ConfirmedIndianNational	ConfirmedForeignNational	Cured	Deaths	Total_confirm
0	0	1	30/01/20	6:00 PM	Kerala	1	0	0	0	1
1	1	2	31/01/20	6:00 PM	Kerala	1	0	0	0	1
2	2	3	01/02/20	6:00 PM	Kerala	2	0	0	0	2
3	3	4	02/02/20	6:00 PM	Kerala	3	0	0	0	3
4	4	5	03/02/20	6:00 PM	Kerala	3	0	0	0	3

2. CREATE CONFIRM DATA FRAME: `df_confirm`

In [6]:

```
df_confirm = pd.DataFrame(index=list(df['Date']) ,columns=list(df['State/UnionTerritory'])).T
print(df_confirm.shape)
df_confirm.head(3)
```

```
(445, 445)
```

Out[6]:

	30/01/20	31/01/20	01/02/20	02/02/20	03/02/20	04/02/20	05/02/20	06/02/20	07/02/20	08/02/20	...	28/03/20	28/03/20	28/03/20	28/03/20	28/0
Kerala	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	
Kerala	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	
Kerala	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	

3 rows × 445 columns

In [7]:

```
confirm = list(df['Total_confirm'])
for i,j in zip([i for i in range(0, len(list(df_confirm.keys()))+1)], confirm):
    df_confirm.iloc[i][i] = j

df_confirm.head()
```

Out[7]:

	30/01/20	31/01/20	01/02/20	02/02/20	03/02/20	04/02/20	05/02/20	06/02/20	07/02/20	08/02/20	...	28/03/20	28/03/20	28/03/20	28/03/20	28/0
Kerala	1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	
Kerala	NaN	1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	
Kerala	NaN	NaN	2	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	
Kerala	NaN	NaN	NaN	3	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	
Kerala	NaN	NaN	NaN	NaN	3	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	

5 rows × 445 columns

2.1 FILL THE `NaN` VALUES AS `0`

In [8]:

```
df_confirm.fillna(0, inplace=True)
df_confirm.head()
```

Out[8]:

	30/01/20	31/01/20	01/02/20	02/02/20	03/02/20	04/02/20	05/02/20	06/02/20	07/02/20	08/02/20	...	28/03/20	28/03/20	28/03/20	28/03/20	28/0
Kerala	1	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	1	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	2	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	3	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	3	0	0	0	0	0	...	0	0	0	0	

5 rows × 445 columns

2.2 COMBINE ALL SIMMILAR DATES:

In [9]:

```
df_confirm = df_confirm.groupby(axis=1, level=0).sum()
df_confirm.head()
```

Out[9]:

	01/02/20	01/03/20	02/02/20	02/03/20	03/02/20	03/03/20	04/02/20	04/03/20	05/02/20	05/03/20	...	25/03/20	26/02/20	26/03/20	27/02/20	27/0
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	2	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	3	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	3	0	0	0	0	0	...	0	0	0	0	

5 rows × 59 columns

In [10]:

```
df_confirm['27/03/20'].sum()
```

Out[10]:

```
724
```

3. CREATE DEATH DATAFRAME: df_death

In [11]:

```
df_death = pd.DataFrame(index=list(df['Date']) ,columns=list(df['State/UnionTerritory'])).T


# Death details entry to the empty dataframe
death = list(df['Deaths'])
for i,j in zip([i for i in range(0, len(list(df_death.keys()))+1)], death):
    df_death.iloc[i][i] = j


# fill the NaN value as 0
df_death.fillna(0, inplace=True)
# df_death.head()


# Combine all the similar dataes:
df_death = df_death.groupby(axis=1, level=0).sum()
df_death.head()
```

Out[11]:

	01/02/20	01/03/20	02/02/20	02/03/20	03/02/20	03/03/20	04/02/20	04/03/20	05/02/20	05/03/20	...	25/03/20	26/02/20	26/03/20	27/02/20	27/0
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	

5 rows × 59 columns

4. CREATE CURED DATAFRAME: df_cured

In [12]:

```
# create new data frame df_cured
df_cured = pd.DataFrame(index=list(df['Date']) ,columns=list(df['State/UnionTerritory'])).T
# print(df_cured.shape)
# df_cured.head(3)


# cured details entry to the empty dataframe
cured = list(df['Cured'])
for i,j in zip([i for i in range(0, len(list(df_cured.keys()))+1)], cured):
    df_cured.iloc[i][i] = j

# df_cured.head()



# fill the NaN value as 0
df_cured.fillna(0, inplace=True)
# df_cured.head()



# Combine all the similar dataes:
df_cured = df_cured.groupby(axis=1, level=0).sum()
df_cured.head()
```

Out[12]:

	01/02/20	01/03/20	02/02/20	02/03/20	03/02/20	03/03/20	04/02/20	04/03/20	05/02/20	05/03/20	...	25/03/20	26/02/20	26/03/20	27/02/20	27/0
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	
Kerala	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	

5 rows × 59 columns

5. FOR ANALYSIS

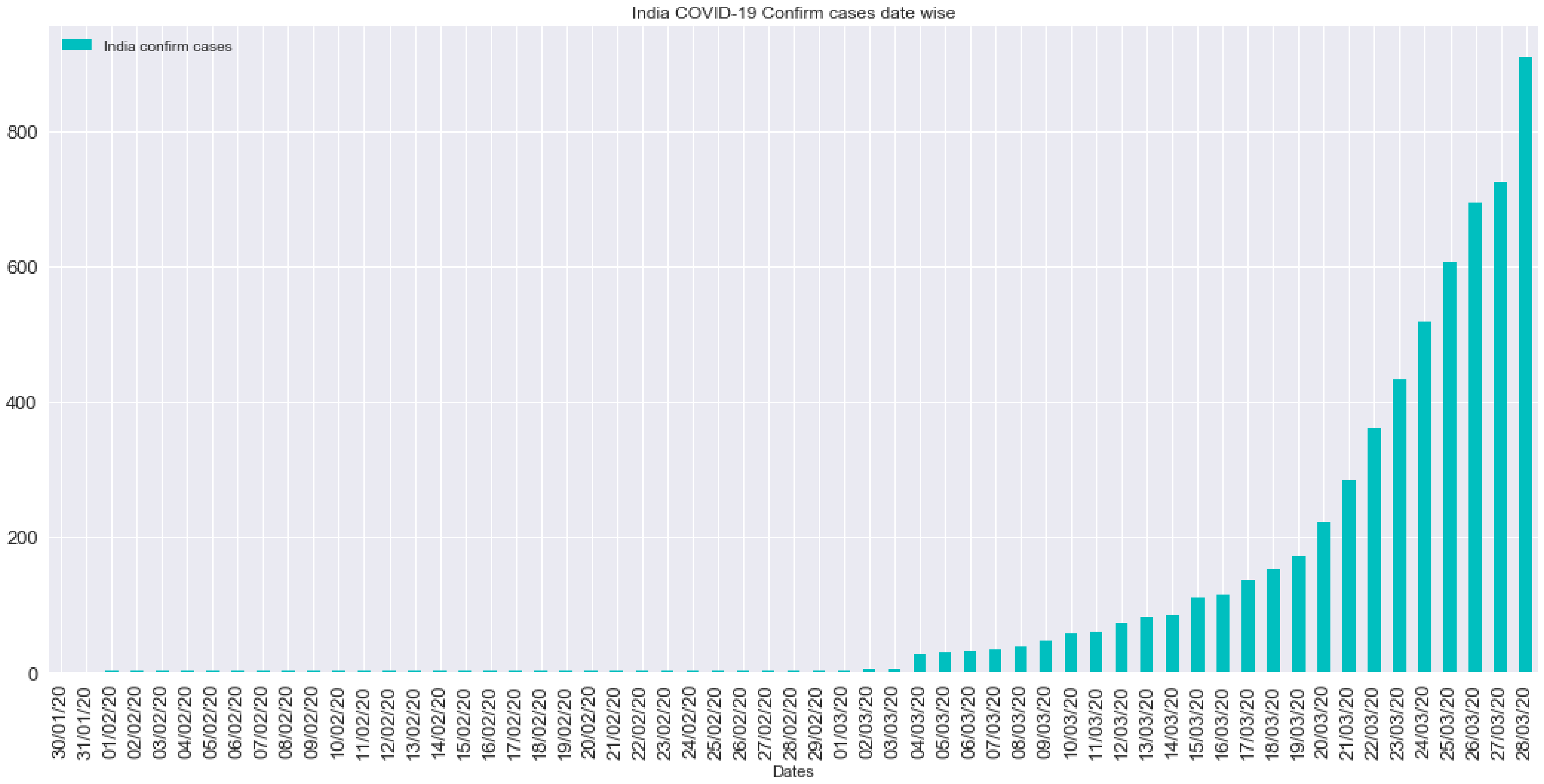
In [13]:

```
dates = list(df['Date'].unique())
india_confirm_cases = []
india_death_cases = []
india_mortality_rate = []
india_recovery_rate = []
total_recovered = []
total_active = []
for i in dates:
    confirm_sum = df_confirm[i].sum()
    death_sum = df_death[i].sum()
    recovery_sum = df_cured[i].sum()
    india_confirm_cases.append(confirm_sum)
    india_death_cases.append(death_sum)
    india_mortality_rate.append(death_sum / confirm_sum)
    india_recovery_rate.append(recovery_sum / confirm_sum)
    total_recovered.append(recovery_sum)
    total_active.append(confirm_sum - death_sum - recovery_sum)
```

6. CONFIRM CASES DATE WISE:

```
In [14]: import operator

         plt.rcParams['figure.figsize'] = (18,8)
         bar_df = pd.DataFrame({'Dates':dates[0:], 'India confirm cases':india_confirm_cases[0:]})

         bar_df.plot.bar(x='Dates', y='India confirm cases', rot=90, color='c', title='India COVID-19 Confirm cases date wise', f
```

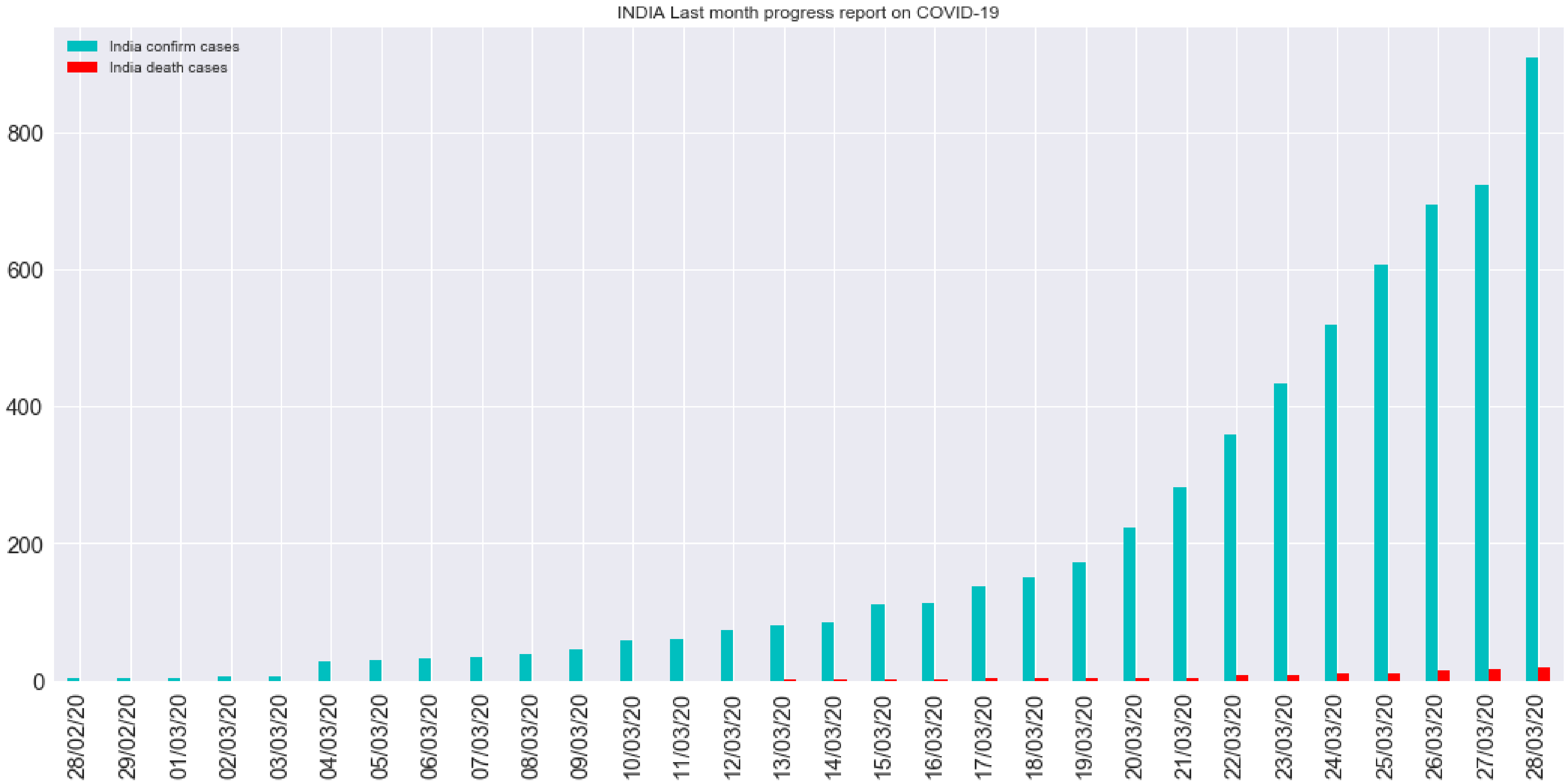
```
Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x18ff54aea58>
```



7. CONFIRM & DEATH LAST MONTH

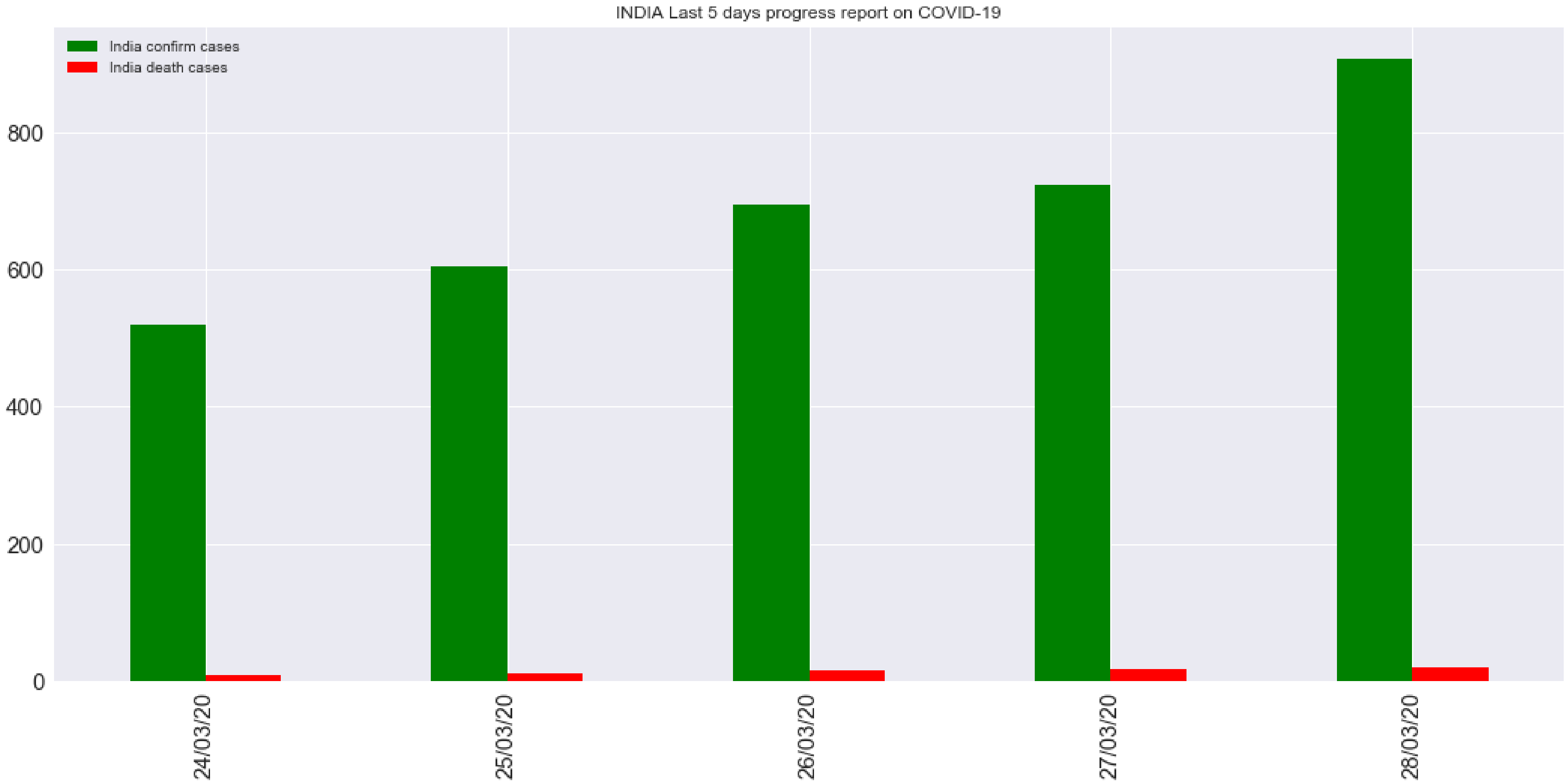
In [15]:

```
confirm_cases = india_confirm_cases[-30:]
death_cases = india_death_cases[-30:]
index = dates[-30:]
df = pd.DataFrame({'India confirm cases': confirm_cases,
                   'India death cases': death_cases}, index=index)
ax = df.plot.bar(color=['c', 'r'], title='INDIA Last month progress report on COVID-19', fontsize=15)
```



8. CONFIRM & DEATH LAST 5 DAYS

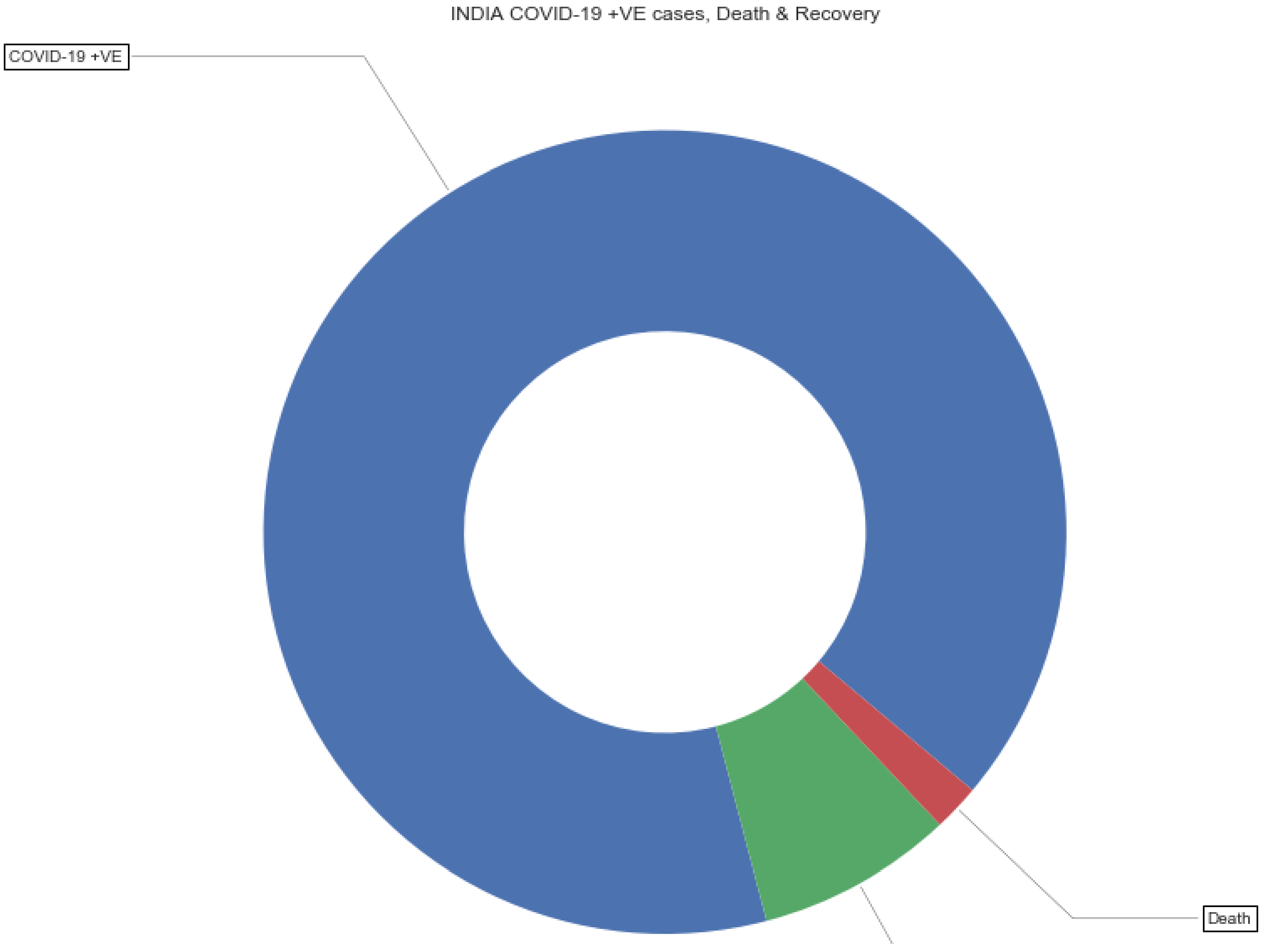
```
In [16]: confirm_cases = india_confirm_cases[-5:]
         death_cases = india_death_cases[-5:]
         index = dates[-5:]
         df = pd.DataFrame({'India confirm cases': confirm_cases,
                            'India death cases': death_cases}, index=index)
         ax = df.plot.bar(color=['g', 'r'], title='INDIA Last 5 days progress report on COVID-19', fontsize=15)
```



9. INDIA: +VE VS RECOVERY VS DEATH

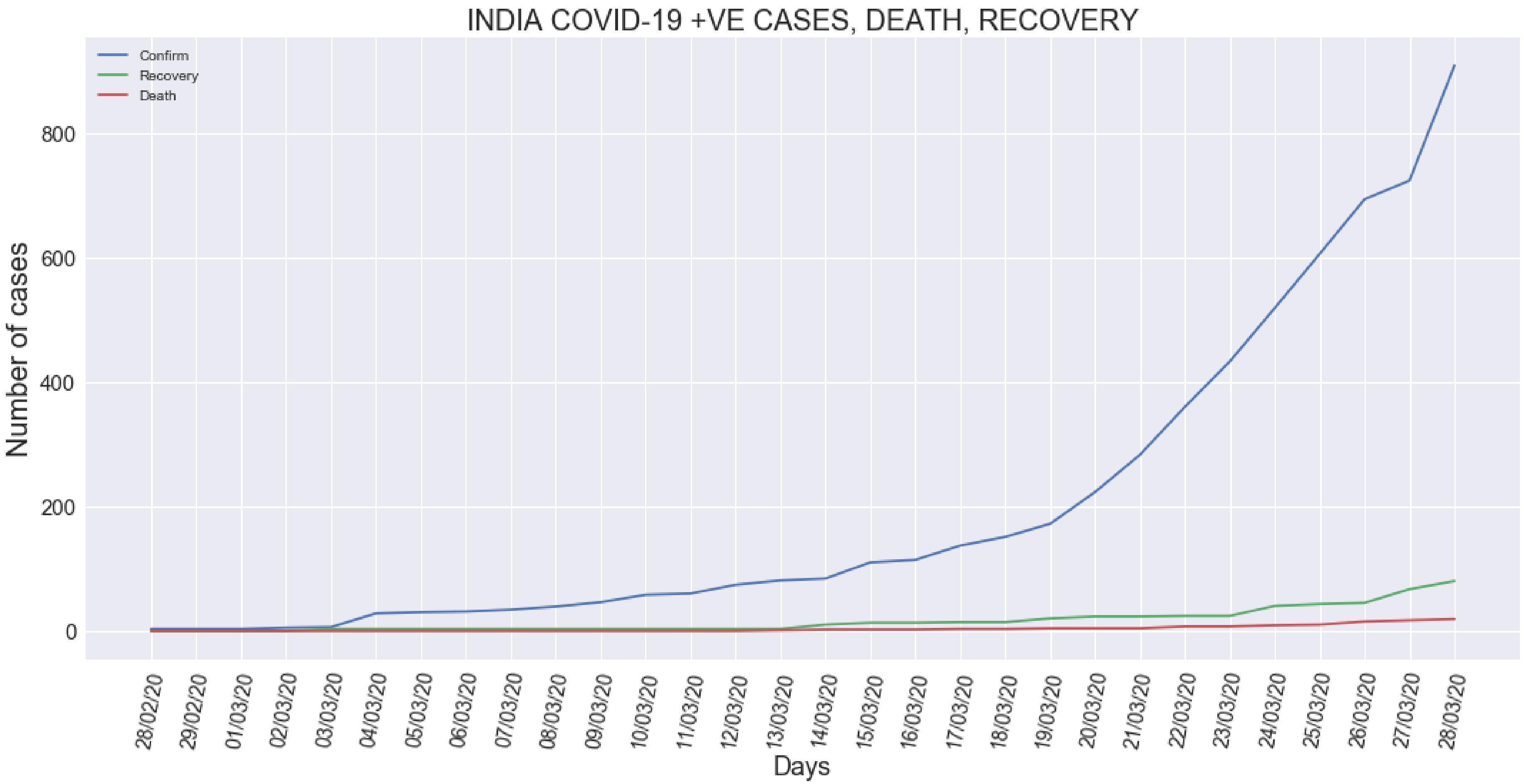
In [17]:

```
fig, ax = plt.subplots(figsize=(22, 11), subplot_kw=dict(aspect="equal"))

recipe = ['COVID-19 +VE', 'Recovery', 'Death']

data = [india_confirm_cases[-1], total_recovered[-1], india_death_cases[-1]]

wedges, texts = ax.pie(data, wedgeprops=dict(width=0.5), startangle=-40)

bbox_props = dict(boxstyle="square,pad=0.3", fc="w", ec="k", lw=1)
kw = dict(arrowprops=dict(arrowstyle="-"),
          bbox=bbox_props, zorder=0, va="center")

for i, p in enumerate(wedges):
    ang = (p.theta2 - p.theta1)/2. + p.theta1
    y = np.sin(np.deg2rad(ang))
    x = np.cos(np.deg2rad(ang))
    horizontalalignment = {-1: "right", 1: "left"}[int(np.sign(x))]
    connectionstyle = "angle,angleA=0,angleB={}".format(ang)
    kw["arrowprops"].update({"connectionstyle": connectionstyle})
    ax.annotate(recipe[i], xy=(x, y), xytext=(1.35*np.sign(x), 1.4*y),
                horizontalalignment=horizontalalignment, **kw)

ax.set_title("INDIA COVID-19 +VE cases, Death & Recovery")

plt.show()
```


INDIA COVID-19 +VE cases, Death & Recovery
COVID-19 +VE
Death
Recovery

10. INDIA LINE GRAPH

```
In [18]: plt.figure(figsize=(18,8))
         plt.plot(dates[-30:], india_confirm_cases[-30:])
         plt.plot(dates[-30:], total_recovered[-30:])
         plt.plot(dates[-30:], india_death_cases[-30:])
         plt.title('INDIA COVID-19 +VE CASES, DEATH, RECOVERY', size=20)
         plt.xlabel('Days', size=18)
         plt.ylabel('Number of cases', size=20)
         plt.legend(['Confirm', 'Recovery', 'Death'])
         plt.xticks(size=20, rotation=80, fontsize=14)
         plt.yticks(size=15)
         plt.show()
```



11. STATE WISE ANALYSIS

In [19]:

```
df = pd.read_csv('covid_19_india.csv')

# Create another sate dataframe for state wise analysis
state_confirm_df = df_confirm.copy()
state_death_df = df_death.copy()
state_recovery_df = df_cured.copy()

# Combine sate rows in a single row
state_confirm_df = state_confirm_df.groupby(axis=0, level=0).sum()
state_death_df = state_death_df.groupby(axis=0, level=0).sum()
state_recovery_df = state_recovery_df.groupby(axis=0, level=0).sum()

states = sorted(list(state_confirm_df.index))
```

In [20]:

```
state_confirm = []
state_death = []
state_recovery = []

for i in states:
    a = state_confirm_df.loc[i][list(df['Date'])[-1]]
    b = state_death_df.loc[i][list(df['Date'])[-1]]
    c = state_recovery_df.loc[i][list(df['Date'])[-1]]
    state_confirm.append(a)
    state_death.append(b)
    state_recovery.append(c)
```

In [21]:

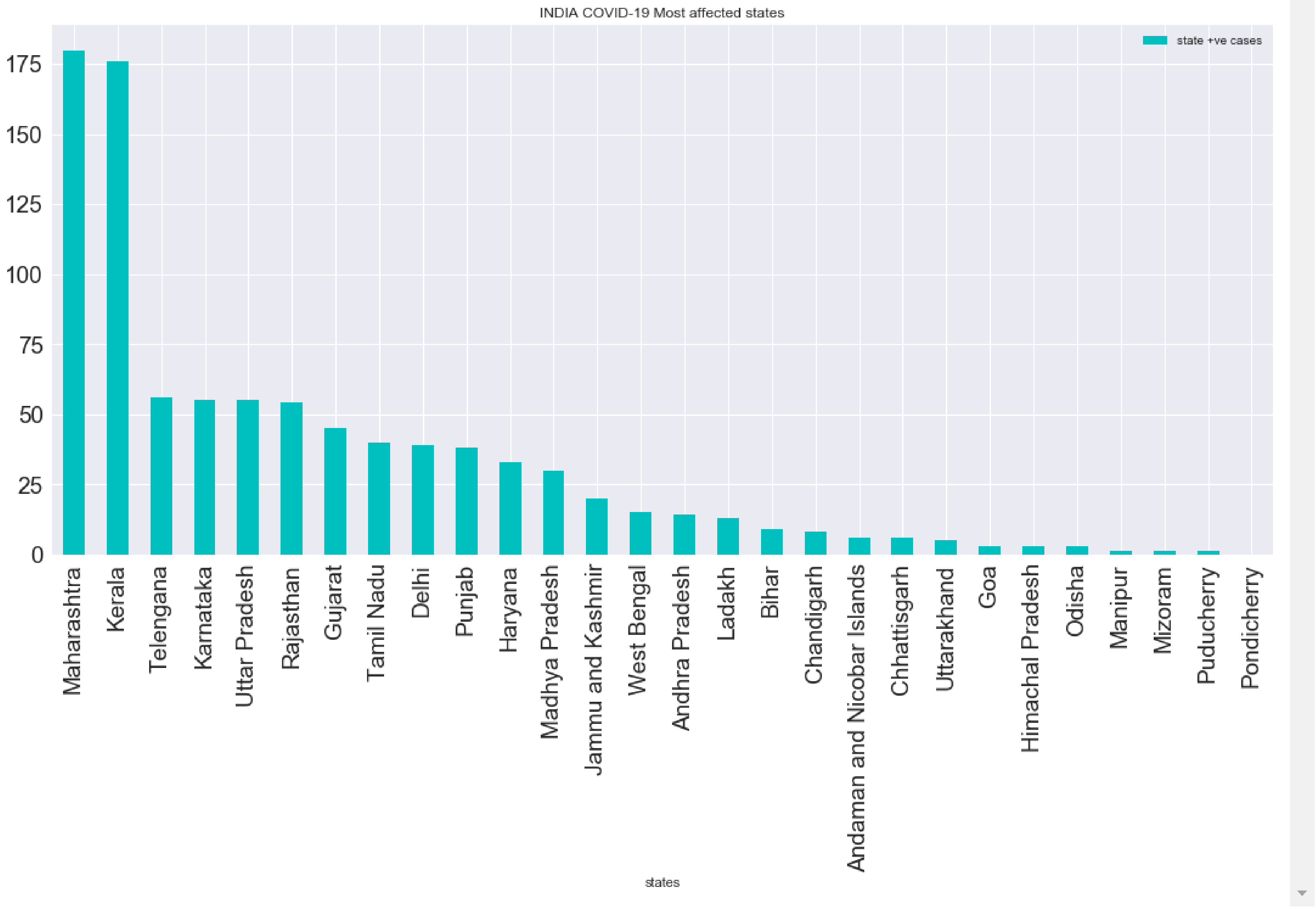
```
state_confirm_dict = dict(sorted(dict(zip(states, state_confirm)).items(), key=operator.itemgetter(1), reverse=True))
```

In [22]:

```
import operator

plt.rcParams['figure.figsize'] = (18,8)
bar_df = pd.DataFrame({'states':list(state_confirm_dict.keys())[0:], \
                       'state +ve cases':list(state_confirm_dict.values())[0:]})

bar_df.plot.bar(x='states', y='state +ve cases', rot=90, color='c', title='INDIA COVID-19 Most affected states', fontsiz
```

Out[22]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x18ff5e44da0>
```



12. FUTURE PREDICTION: SVR

In [23]:
```
days_in_future = 10
future_forecast = np.array([i for i in range(len(dates) + days_in_future)]).reshape(-1, 1)

print(len(future_forecast), ': Length of future_forecast')

adjusted_dates = future_forecast[:-10]
```

```
69 : Length of future_forecast
```

In [24]:
```
start = '30/01/2020'
start_date = datetime.datetime.strptime(start, '%d/%m/%Y')
future_forecast_dates = []
for i in range(len(future_forecast)):
    future_forecast_dates.append((start_date + datetime.timedelta(days=i)).strftime('%d/%m/%Y'))
```

In [25]:
```
day_since_30_1 = np.array([i for i in range(len(dates))]).reshape(-1, 1)
```

In [26]:
```
x_train_confirm, x_test_confirm, y_train_confirm, y_test_confirm = train_test_split(day_since_30_1, india_confirm_cases,
                                                                                    test_size=0.02, shuffle=False)
```

In [27]:
```
svm_model = SVR(shrinking=True, kernel='poly', gamma=0.01, epsilon=1, degree=7, C=0.1)
svm_model.fit(x_train_confirm, y_train_confirm)

svm_test_pred = svm_model.predict(x_test_confirm)
print('MSE:', mean_squared_error(svm_test_pred, y_test_confirm))
print('MAE:', mean_absolute_error(svm_test_pred, y_test_confirm))
print('R^2:', r2_score(svm_test_pred, y_test_confirm))
```

```
MSE: 3762.07130866224
MAE: 45.478333711624146
R^2: -0.7014962380103387
```

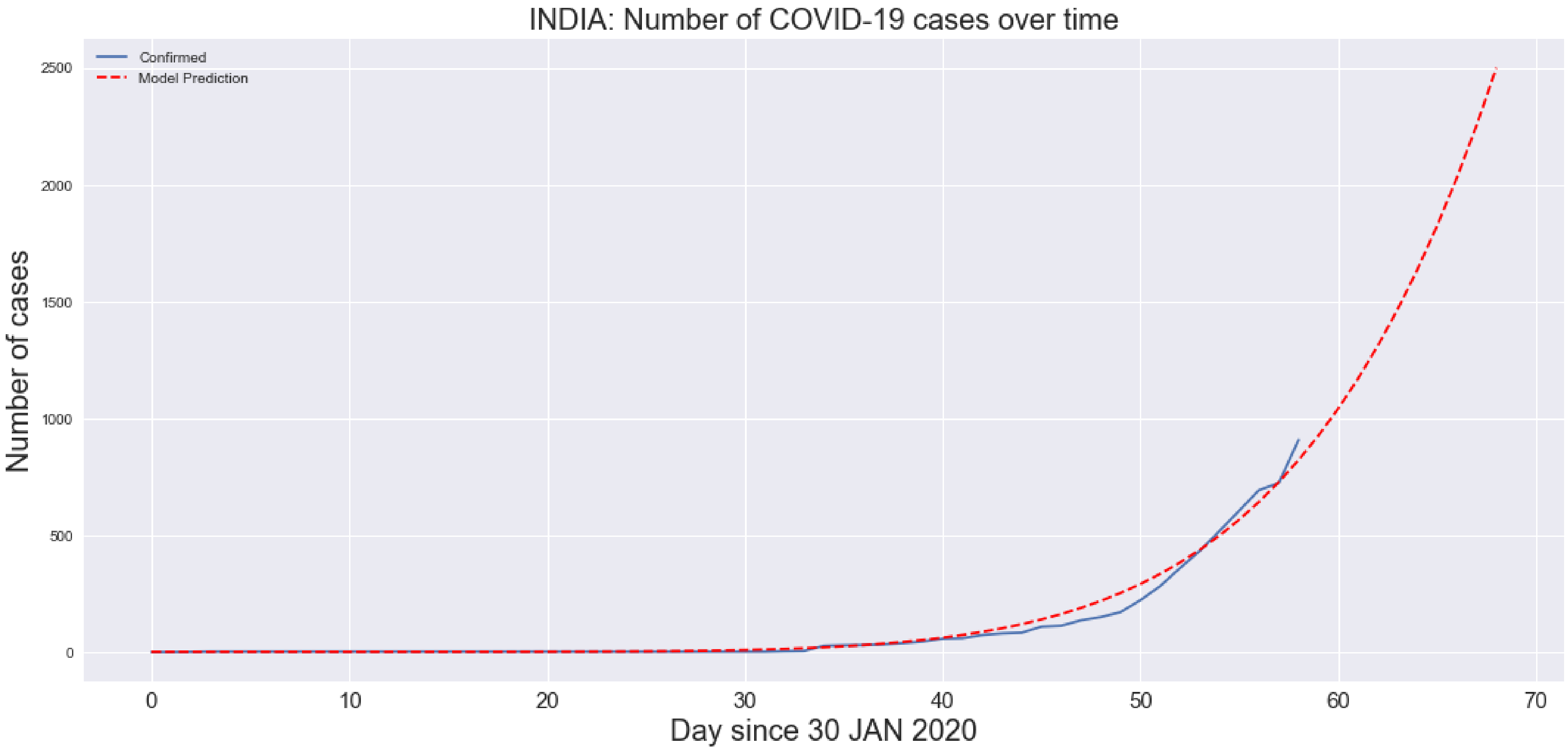
In [28]:
```
future_svm_pred = svm_model.predict(future_forecast)
```

In [29]:
```
last_dates = future_forecast_dates[-10:]
```

In [30]:

```python
last_pred = list(future_svm_pred)[-10:]
last_pred_list = [int(round(i)) for i in last_pred]
for i, j in zip(last_dates, last_pred_list):
    print(i, ':', j)


plt.figure(figsize=(18,8))
plt.plot(adjusted_dates, india_confirm_cases)
plt.plot(future_forecast, future_svm_pred, linestyle='dashed', color='red')
plt.title('INDIA: Number of COVID-19 cases over time', size=20)
plt.xlabel('Day since 30 JAN 2020', size=20)
plt.ylabel('Number of cases', size=20)
plt.legend(['Confirmed', 'Model Prediction'])
plt.xticks(size=15)
plt.show()
```

```
29/03/2020 : 927
30/03/2020 : 1042
31/03/2020 : 1170
01/04/2020 : 1310
02/04/2020 : 1466
03/04/2020 : 1636
04/04/2020 : 1824
05/04/2020 : 2029
06/04/2020 : 2254
07/04/2020 : 2500
```

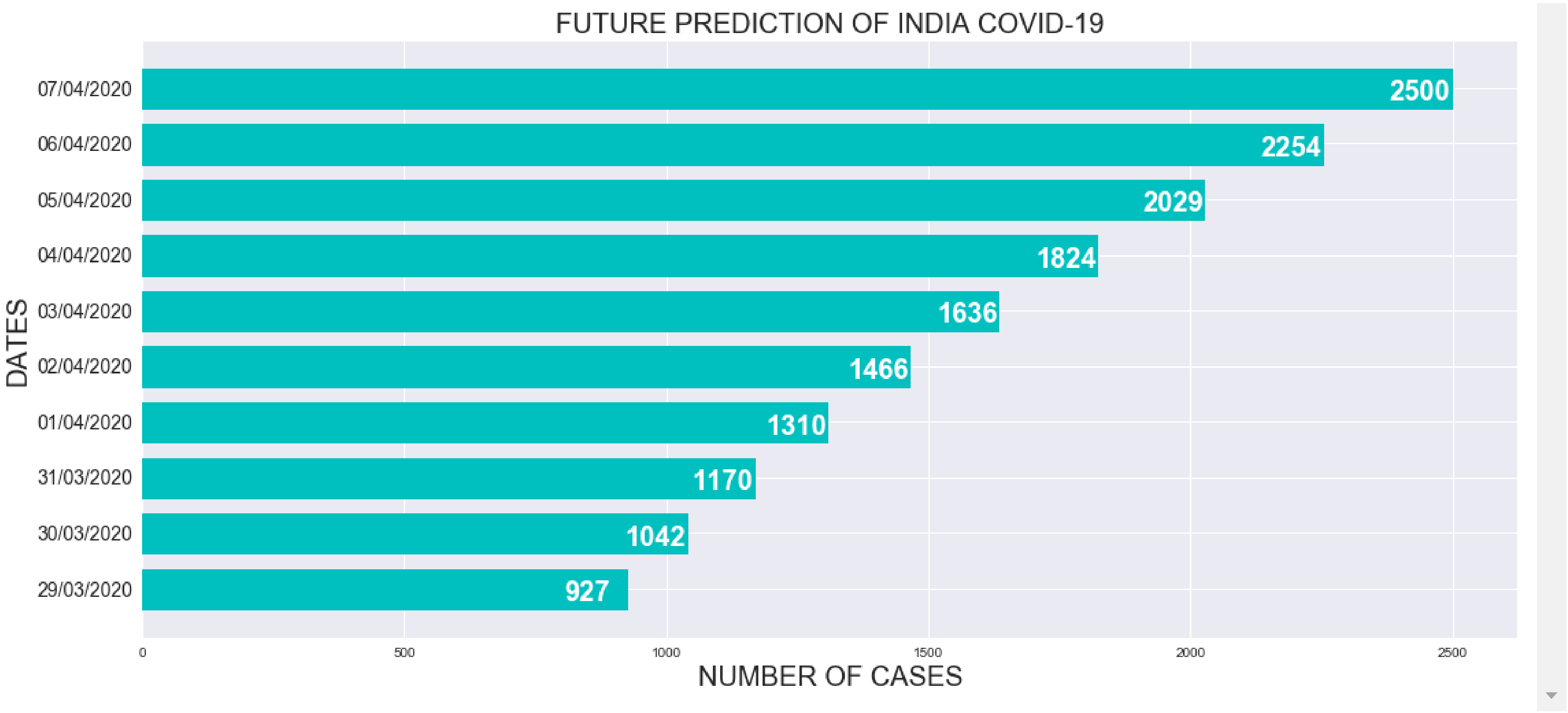


13. INDIA COVID-19 FUTURE PREDICTION DATE WISE

In [31]:
```
temp_dict = dict(zip(last_dates, last_pred_list))
```

In [36]:

```
import os
import numpy as np
import matplotlib.pyplot as plt

x = list(temp_dict.keys())
y = list(temp_dict.values())

fig, ax = plt.subplots()
width = 0.75 # the width of the bars
ind = np.arange(len(y))  # the x locations for the groups
ax.barh(ind, y, width, color="c")
ax.set_yticks(ind+width/30)
ax.set_yticklabels(x, minor=False, fontsize=14)

plt.title('FUTURE PREDICTION OF INDIA COVID-19', fontsize=20)
plt.xlabel('NUMBER OF CASES', fontsize=20)
plt.ylabel('DATES', fontsize=20)
#plt.show()
plt.savefig(os.path.join('test.png'), dpi=300, format='png', bbox_inches='tight', color='c')

for i, v in enumerate(y):
    ax.text(v + -120, i + -0.2, str(v), color='w', fontweight='bold', fontsize=20)
```



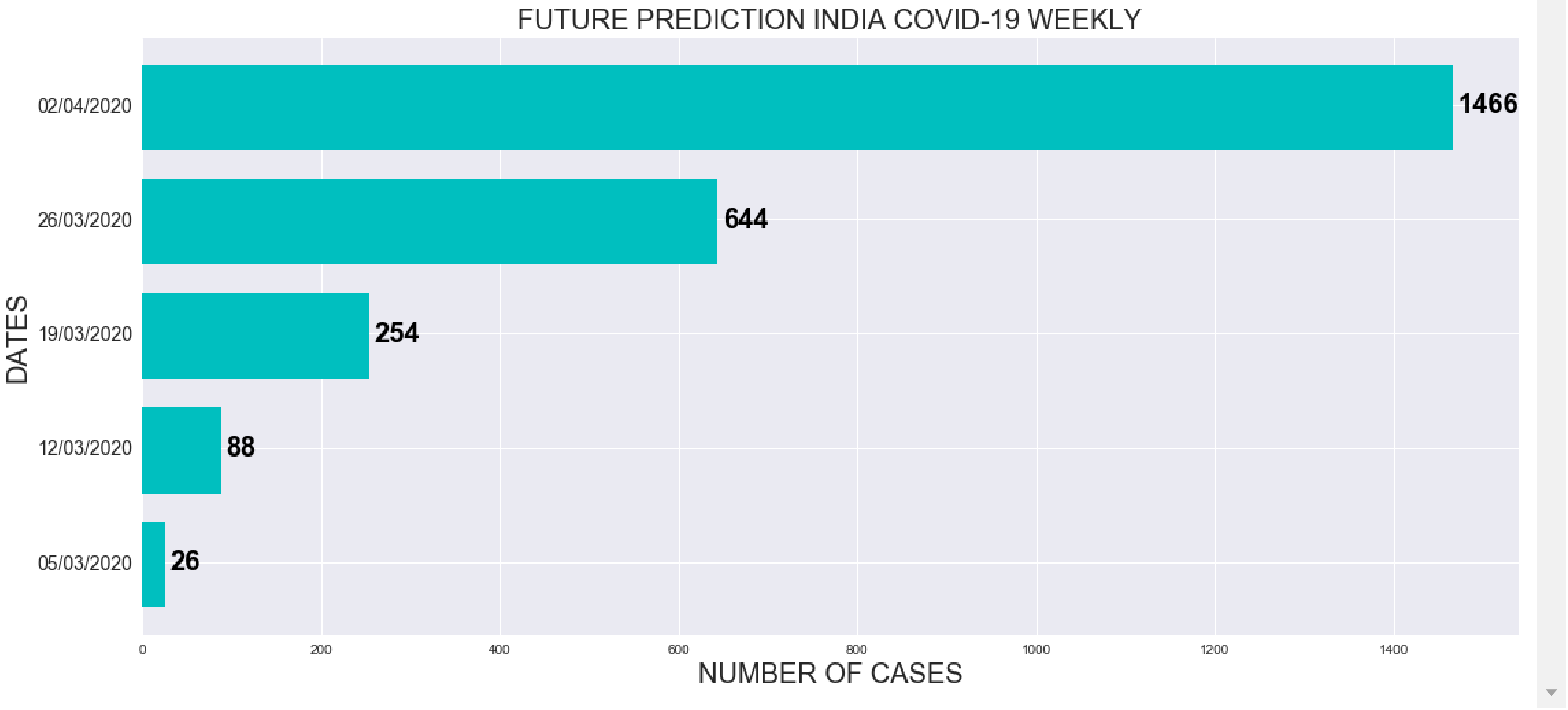
14. INDIA COVID-19 FUTURE PREDICTION WEEKLY

```
In [33]: future_forecast_dates
         future_prediction  = [int(round(future_svm_pred[i])) for i in range(len(future_svm_pred))]
```

```
In [34]: weeks = future_forecast_dates[0::7][-5:]
         weeks_report = future_prediction[0::7][-5:]
```

In [37]:

```
import os
import numpy as np
import matplotlib.pyplot as plt

x = weeks
y = weeks_report

fig, ax = plt.subplots()
width = 0.75 # the width of the bars
ind = np.arange(len(y))  # the x locations for the groups
ax.barh(ind, y, width, color="c")
ax.set_yticks(ind+width/30)
ax.set_yticklabels(x, minor=False, fontsize=14)

plt.title('FUTURE PREDICTION INDIA COVID-19 WEEKLY', fontsize=20)
plt.xlabel('NUMBER OF CASES', fontsize=20)
plt.ylabel('DATES', fontsize=20)
#plt.show()
plt.savefig(os.path.join('test.png'), dpi=300, format='png', bbox_inches='tight', color='c')

for i, v in enumerate(y):
    ax.text(v + 5, i + -0.05, str(v), color='k', fontweight='bold', fontsize=20)
```


FUTURE PREDICTION INDIA COVID-19 WEEKLY
DATES
02/04/2020
26/03/2020
19/03/2020
12/03/2020
05/03/2020
1466
644
254
88
26
0
200
400
600
800
1000
1200
1400
NUMBER OF CASES

THANK YOU