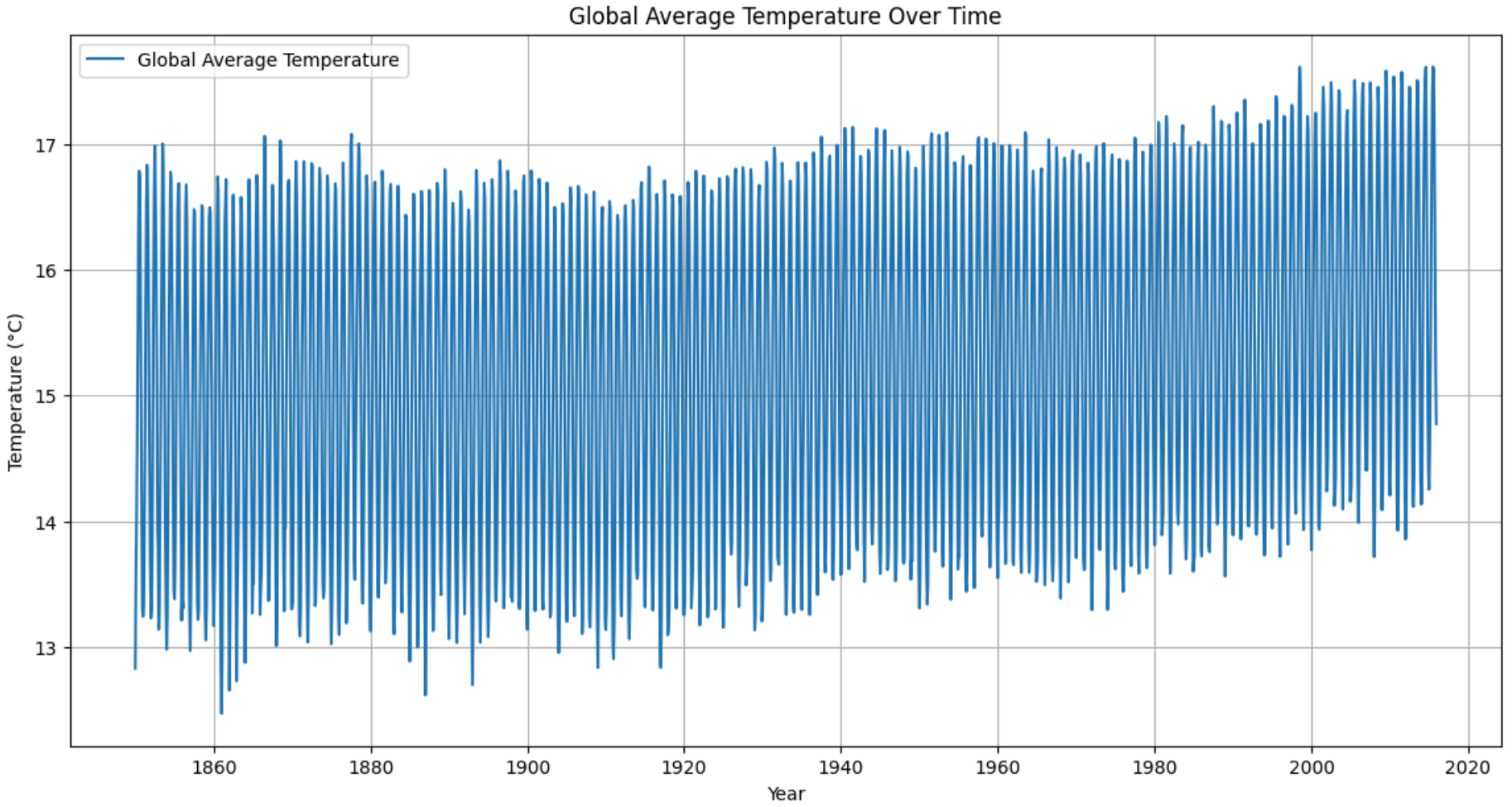
In [2]:
```
import pandas as pd

df = pd.read_csv("~/dataset/gcloud/GlobalTemperatures_cleansed.csv")

df['dt'] = pd.to_datetime(df['dt'])

df.set_index('dt', inplace=True)
```

In [5]:
```
!pip install seaborn
```

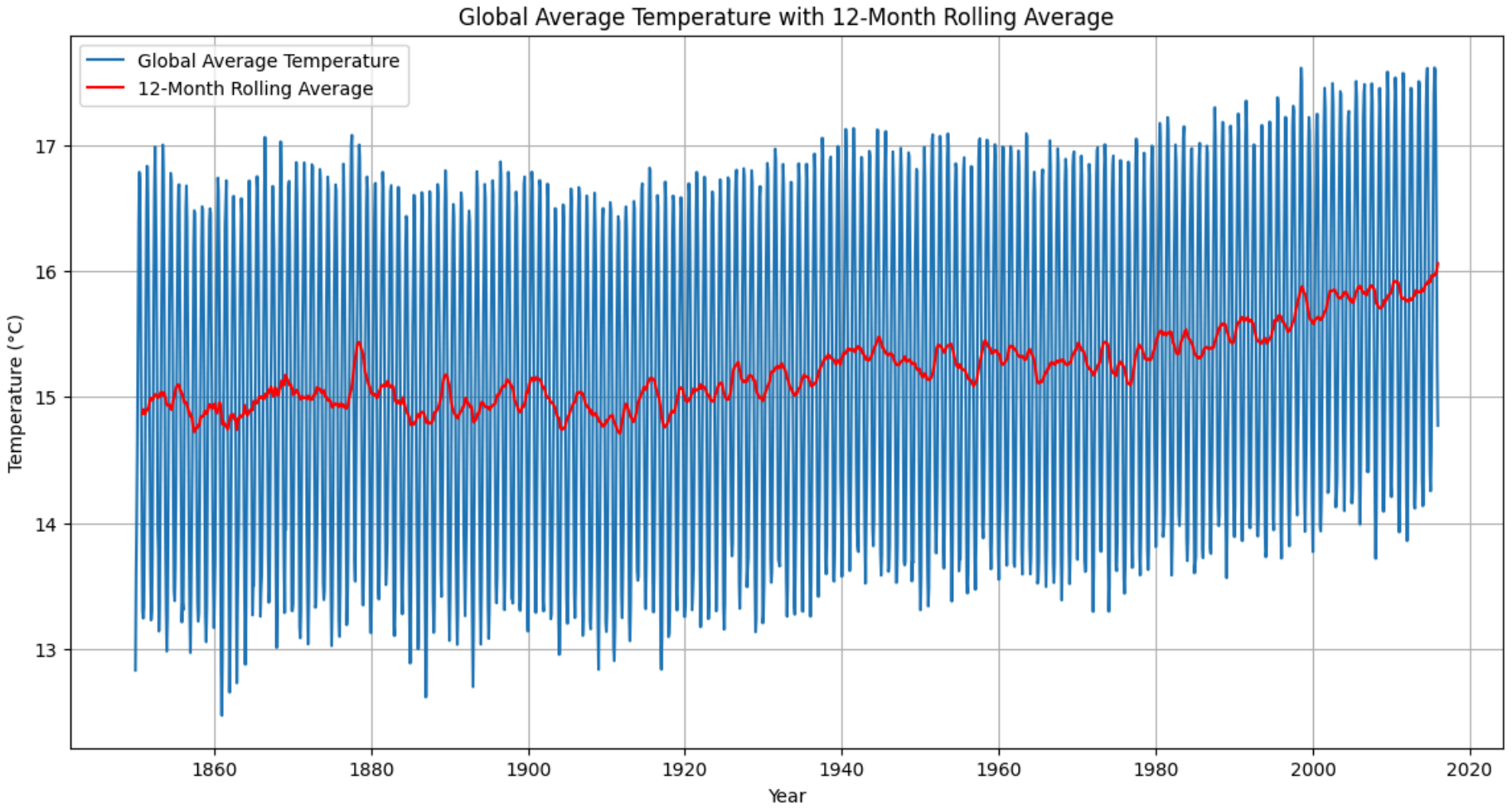
```
Defaulting to user installation because normal site-packages is not writeable
Collecting seaborn
  Downloading seaborn-0.13.2-py3-none-any.whl.metadata (5.4 kB)
Requirement already satisfied: numpy!=1.24.0,>=1.20 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from
seaborn) (1.24.4)
Requirement already satisfied: pandas>=1.2 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from seaborn)
(2.0.3)
Requirement already satisfied: matplotlib!=3.6.1,>=3.4 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (f
rom seaborn) (3.7.5)
Requirement already satisfied: contourpy>=1.0.1 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from mat
plotlib!=3.6.1,>=3.4->seaborn) (1.1.1)
Requirement already satisfied: cycler>=0.10 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from matplot
lib!=3.6.1,>=3.4->seaborn) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from ma
tplotlib!=3.6.1,>=3.4->seaborn) (4.56.0)
Requirement already satisfied: kiwisolver>=1.0.1 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from ma
tplotlib!=3.6.1,>=3.4->seaborn) (1.4.7)
Requirement already satisfied: packaging>=20.0 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from matp
lotlib!=3.6.1,>=3.4->seaborn) (24.2)
Requirement already satisfied: pillow>=6.2.0 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from matplo
tlib!=3.6.1,>=3.4->seaborn) (10.4.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/lib/python3/dist-packages (from matplotlib!=3.6.1,>=3.4->sea
born) (2.4.6)
Requirement already satisfied: python-dateutil>=2.7 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from
matplotlib!=3.6.1,>=3.4->seaborn) (2.9.0.post0)
Requirement already satisfied: importlib-resources>=3.2.0 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages
(from matplotlib!=3.6.1,>=3.4->seaborn) (6.4.5)
Requirement already satisfied: pytz>=2020.1 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from pandas>
=1.2->seaborn) (2025.1)
Requirement already satisfied: tzdata>=2022.1 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from panda
s>=1.2->seaborn) (2025.1)
Requirement already satisfied: zipp>=3.1.0 in /home/kaanthanvishnu/.local/lib/python3.8/site-packages (from importli
b-resources>=3.2.0->matplotlib!=3.6.1,>=3.4->seaborn) (3.20.2)
Requirement already satisfied: six>=1.5 in /usr/lib/python3/dist-packages (from python-dateutil>=2.7->matplotlib!=3.
6.1,>=3.4->seaborn) (1.14.0)
Downloading seaborn-0.13.2-py3-none-any.whl (294 kB)
Installing collected packages: seaborn
Successfully installed seaborn-0.13.2
```

In [6]:
```
import matplotlib.pyplot as plt
import seaborn as sns
```

```
plt.figure(figsize=(14, 7))
plt.plot(df.index, df['LandAndOceanAverageTemperature'], label='Global Average Temperature')
plt.title('Global Average Temperature Over Time')
plt.xlabel('Year')
plt.ylabel('Temperature (°C)')
plt.legend()
plt.grid(True)
plt.show()
```

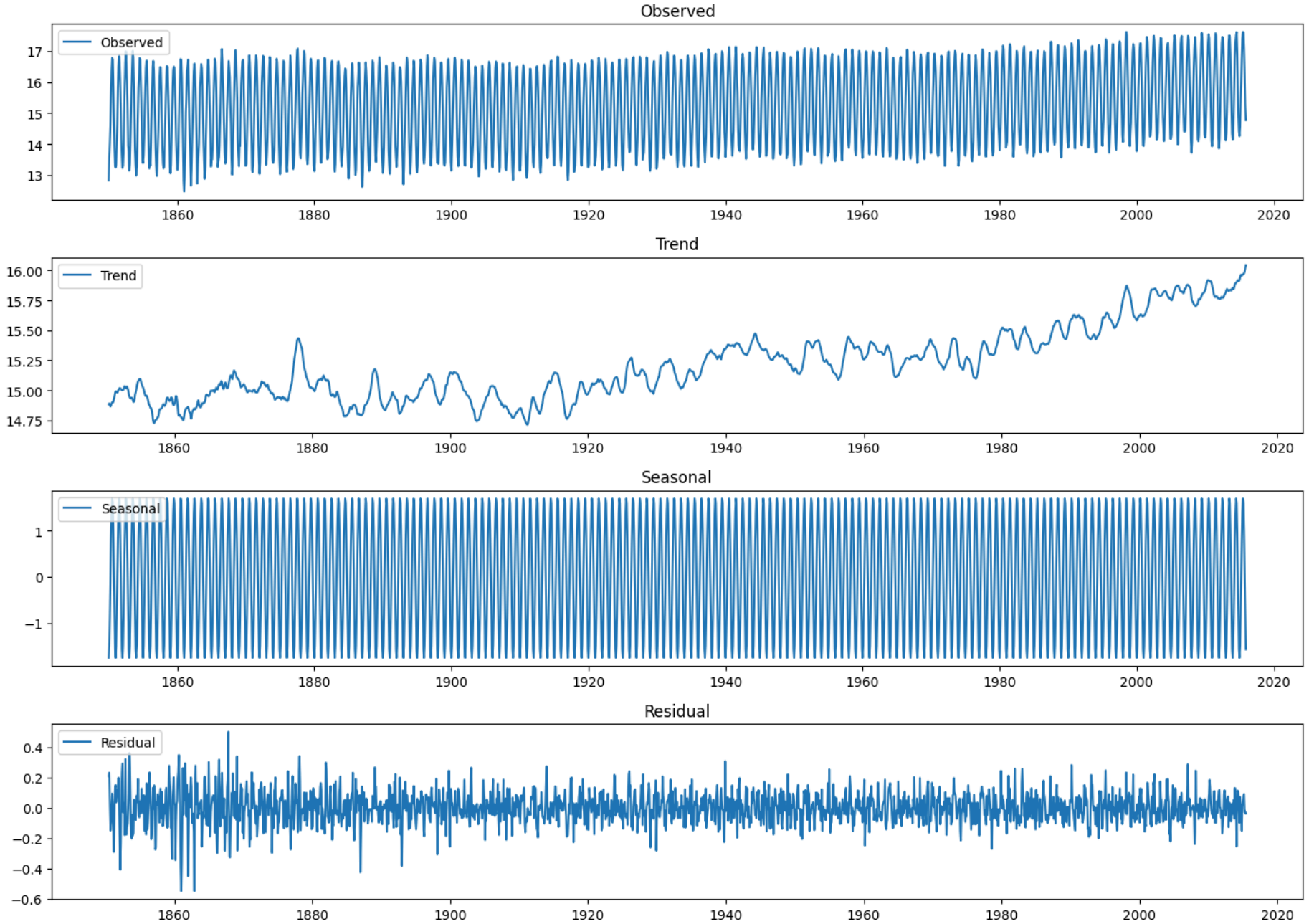


In [7]:
```
df['12_month_rolling_avg'] = df['LandAndOceanAverageTemperature'].rolling(window=12).mean()

plt.figure(figsize=(14, 7))
plt.plot(df.index, df['LandAndOceanAverageTemperature'], label='Global Average Temperature')
plt.plot(df.index, df['12_month_rolling_avg'], label='12-Month Rolling Average', color='red')
plt.title('Global Average Temperature with 12-Month Rolling Average')
plt.xlabel('Year')
plt.ylabel('Temperature (°C)')
plt.legend()
plt.grid(True)
plt.show()
```



In [8]:
```
from statsmodels.tsa.seasonal import seasonal_decompose

# Perform time-series decomposition
decomposition = seasonal_decompose(df['LandAndOceanAverageTemperature'].dropna(), model='additive', period=12)

# Plot the decomposed components
plt.figure(figsize=(14, 10))

plt.subplot(411)
plt.plot(decomposition.observed, label='Observed')
```

```
plt.legend(loc='upper left')
plt.title('Observed')

plt.subplot(412)
plt.plot(decomposition.trend, label='Trend')
plt.legend(loc='upper left')
plt.title('Trend')

plt.subplot(413)
plt.plot(decomposition.seasonal, label='Seasonal')
plt.legend(loc='upper left')
plt.title('Seasonal')

plt.subplot(414)
plt.plot(decomposition.resid, label='Residual')
plt.legend(loc='upper left')
plt.title('Residual')

plt.tight_layout()
plt.show()
```


Observed
Observed
17
16
15
14
13
1860
1880
1900
1920
1940
1960
1980
2000
2020
Trend
Trend
16.00
15.75
15.50
15.25
15.00
14.75
1860
1880
1900
1920
1940
1960
1980
2000
2020
Seasonal
Seasonal
1
0
−1
1860
1880
1900
1920
1940
1960
1980
2000
2020
Residual
Residual
0.4
0.2
0.0
−0.2
−0.4
−0.6
1860
1880
1900
1920
1940
1960
1980
2000
2020

In [ ]: