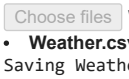
```
import numpy as np # For Linear Algebra
import pandas as pd # To Work With Data
# for visualizations
import plotly.express as px
import plotly.graph_objects as go
from plotly.subplots import make_subplots
from datetime import datetime # Time Series analysis.
```

```
from google.colab import files
uploaded = files.upload()

df = pd.read_csv("Weather.csv")
```



- **Weather.csv**(text/csv) - 9275 bytes, last modified: 08/11/2023 - 100% done

```
Saving Weather.csv to Weather.csv
```

```
df.head() # This will show us top 5 rows of the dataset by default.
```

	Unnamed: 0	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0	1901	17.99	19.43	23.49	26.41	28.28	28.60	27.49	26.98	26.26	25.08	21.73	18.95
1	1	1902	19.00	20.39	24.10	26.54	28.68	28.44	27.29	27.05	25.95	24.37	21.33	18.78
2	2	1903	18.32	19.79	22.46	26.03	27.93	28.41	28.04	26.63	26.34	24.57	20.96	18.29
3	3	1904	17.77	19.39	22.95	26.73	27.83	27.85	26.84	26.73	25.84	24.36	21.07	18.84
4	4	1905	17.40	17.79	21.78	24.84	28.32	28.69	27.67	27.47	26.29	26.16	22.07	18.71

```
#We have got an unexpected column named Unnamed: 0. Well, this is a very common problem. We face this when our csv file has an index colu
df = pd.read_csv("Weather.csv", index_col=0)
```

```
#Now, we'll make an attribute that would contain date (month, year). So that we could get temperature values with the timeline.
df1 = pd.melt(df, id_vars='YEAR', value_vars=df.columns[1:]) ## This will melt the data
df1.head()
```

	YEAR	variable	value
0	1901	JAN	17.99
1	1902	JAN	19.00
2	1903	JAN	18.32
3	1904	JAN	17.77
4	1905	JAN	17.40

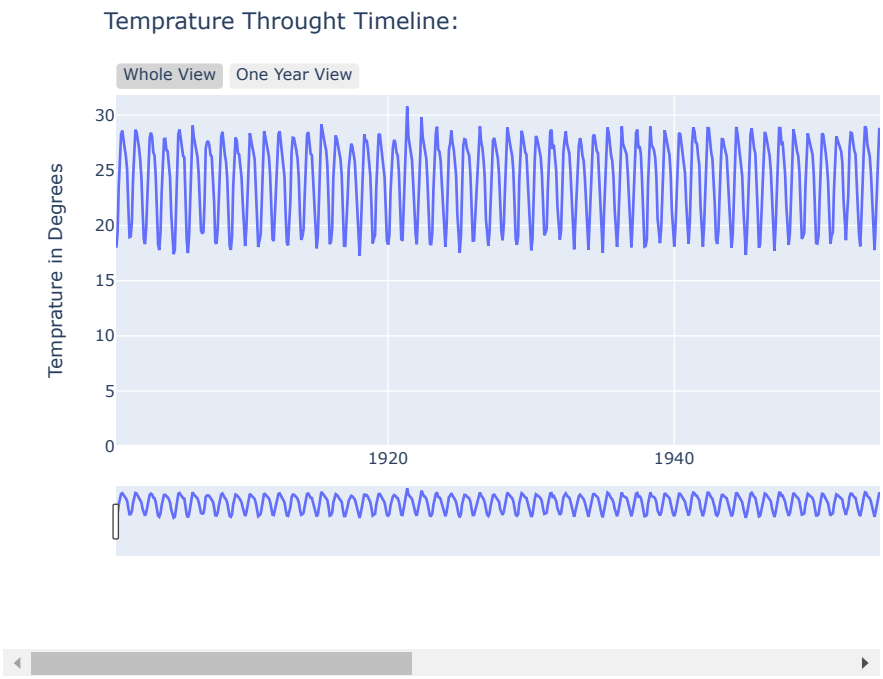
```
df1['Date'] = df1['variable'] + ' ' + df1['YEAR'].astype(str)
df1.loc[:,'Date'] = df1['Date'].apply(lambda x : datetime.strptime(x, '%b %Y')) ## Converting String to datetime object
df1.head()
```

```
<ipython-input-6-d71fd63c6d90>:2: DeprecationWarning: In a future version, `df.iloc[:, i] = newvals` will attempt to set the values
  df1.loc[:,'Date'] = df1['Date'].apply(lambda x : datetime.strptime(x, '%b %Y')) ## Converting String to datetime object
```

	YEAR	variable	value	Date
0	1901	JAN	17.99	1901-01-01
1	1902	JAN	19.00	1902-01-01
2	1903	JAN	18.32	1903-01-01
3	1904	JAN	17.77	1904-01-01
4	1905	JAN	17.40	1905-01-01

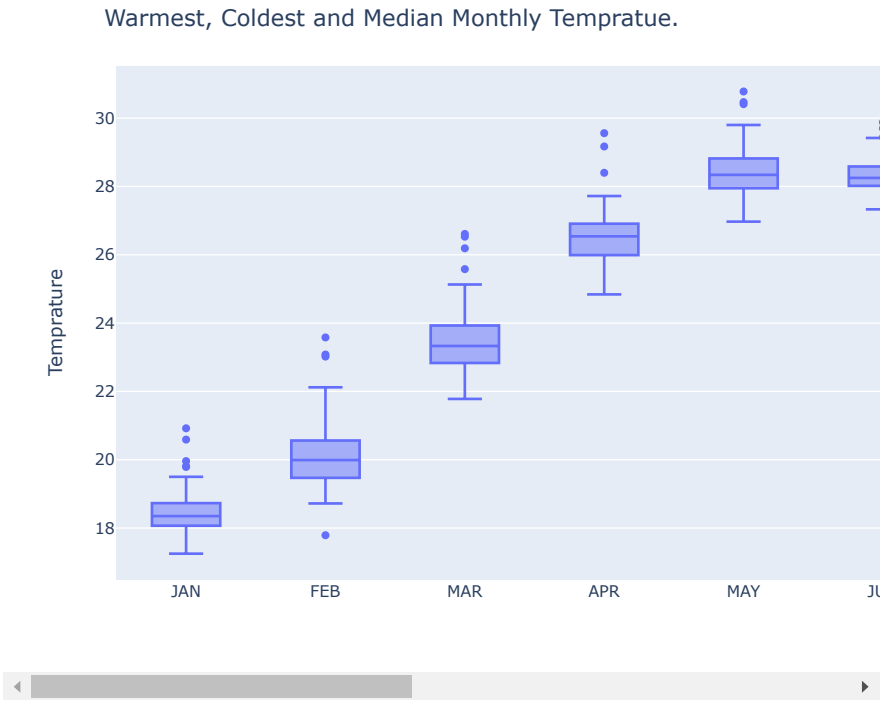
```
# Temperature through time
df1.columns=['Year', 'Month', 'Temprature', 'Date']
df1.sort_values(by='Date', inplace=True) ## To get the time series right.
fig = go.Figure(layout = go.Layout(yaxis=dict(range=[0, df1['Temprature'].max()+1])))
fig.add_trace(go.Scatter(x=df1['Date'], y=df1['Temprature']), )
fig.update_layout(title='Temprature Throught Timeline:',
                  xaxis_title='Time', yaxis_title='Temprature in Degrees')
fig.update_layout(xaxis=go.layout.XAxis(
    rangeselector=dict(
        buttons=list([dict(label="Whole View", step="all"),
                      dict(count=1,label="One Year View",step="year",stepmode="todate")
```

```
                    ])),
        rangeslider=dict(visible=True),type="date")
)
fig.show()
```




```
#On a closer look, by clicking on One Year View, we can see that the graph seems distorted because this is how the
#values really are. The temperature varies every year with months
```

```
#WARMEST/COODEST/AVERAGE
fig = px.box(df1, 'Month', 'Temprature')
fig.update_layout(title='Warmest, Coldest and Median Monthly Tempratue.')
fig.show()
```



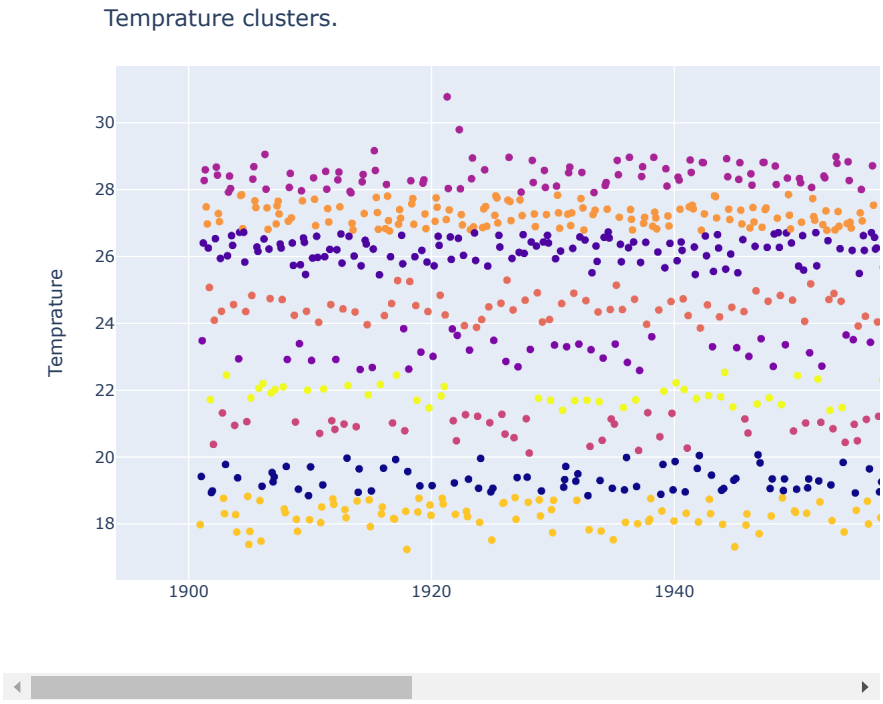

```
from sklearn.cluster import KMeans
sse = []
target = df1['Temprature'].to_numpy().reshape(-1,1)
num_clusters = list(range(1, 10))

for k in num_clusters:
    km = KMeans(n_clusters=k)
    km.fit(target)
    sse.append(km.inertia_)
```

```
fig = go.Figure(data=[
    go.Scatter(x = num_clusters, y=sse, mode='lines'),
    go.Scatter(x = num_clusters, y=sse, mode='markers')
])

fig.update_layout(title="Evaluation on number of clusters:",
                 xaxis_title = "Number of Clusters:",
                 yaxis_title = "Sum of Squared Distance",
                 showlegend=False)
fig.show()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value

/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value

/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value

/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value

/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value

/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value

/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value

/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value

/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarn

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value
```

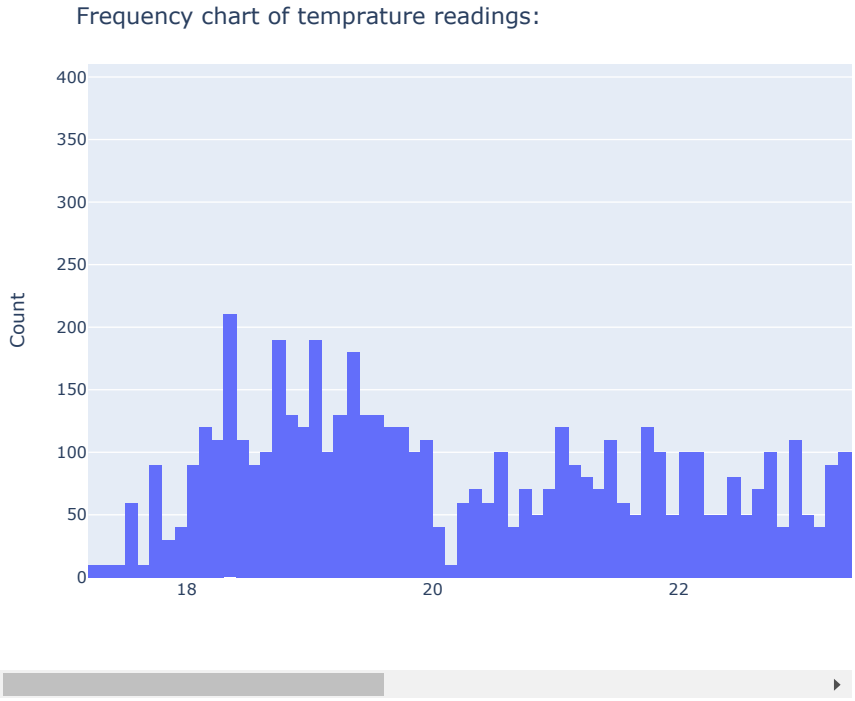

```
#A cluster size of 3 seems a good choice here

Km = KMeans(3)
km.fit(df1['Temprature'].to_numpy().reshape(-1,1))
df1.loc[:,'Temp Labels'] = km.labels_
fig = px.scatter(df1, 'Date', 'Temprature', color='Temp Labels')
fig.update_layout(title = "Temprature clusters.",
                 xaxis_title="Date", yaxis_title="Temprature")
fig.show()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning

The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of
```



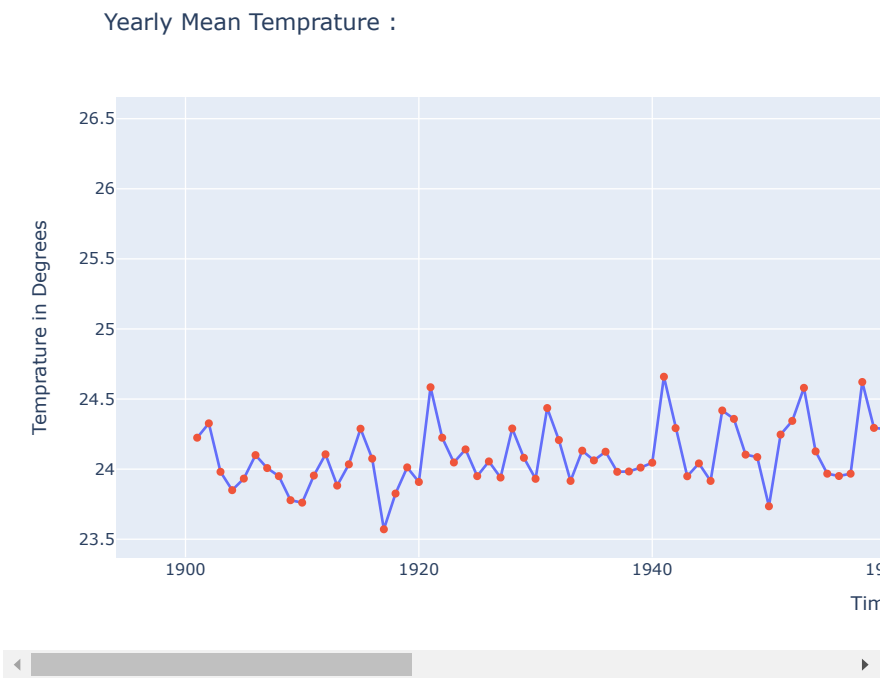

```
#Insights:
#Despite having 4 seasons we can see 3 main clusters based on temperatures.
#Jan, Feb and Dec are the coldest months.
#Apr, May, Jun, Jul, Aug and Sep; all have hotter temperatures.
#Mar, Oct and Nov are the months that have temperatures neither too hot nor too cold.
```

```
fig = px.histogram(x=df1['Temprature'], nbins=200, histnorm='density')
fig.update_layout(title='Frequency chart of temprature readings:',
                  xaxis_title='Temprature', yaxis_title='Count')
```

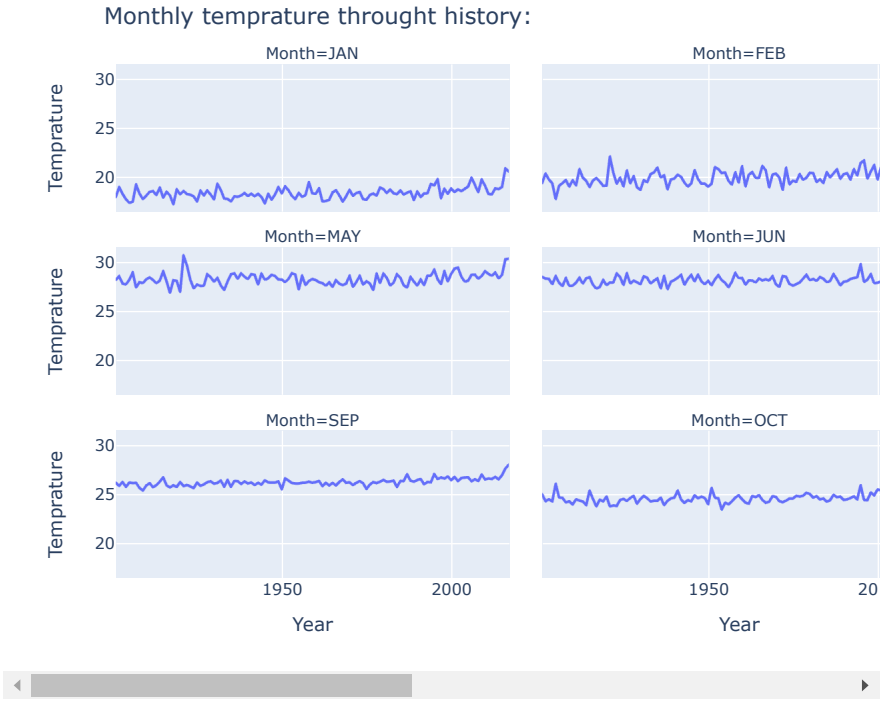



```
#Let’s see if we can get some insights from yearly mean temperature data. I am going to treat this as a time series as well.

#Yearly average temperature

df['Yearly Mean'] = df.iloc[:,1:].mean(axis=1) ## Axis 1 for row wise and axis 0 for columns.
fig = go.Figure(data=[
    go.Scatter(name='Yearly Tempratures' , x=df['YEAR'], y=df['Yearly Mean'], mode='lines'),
    go.Scatter(name='Yearly Tempratures' , x=df['YEAR'], y=df['Yearly Mean'], mode='markers')
])
```

```
fig.update_layout(title='Yearly Mean Temprature :',
                  xaxis_title='Time', yaxis_title='Temprature in Degrees')
fig.show()
```

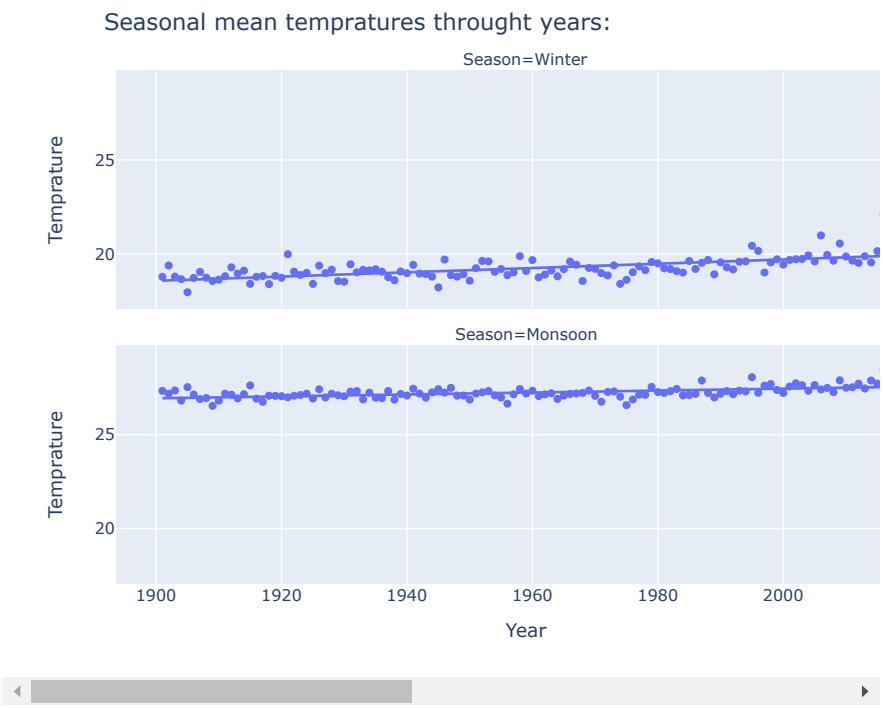



```
#Monthly temperatures through history
fig = px.line(df1, 'Year', 'Temprature', facet_col='Month', facet_col_wrap=4)
fig.update_layout(title='Monthly temprature throught history:')
fig.show()
```



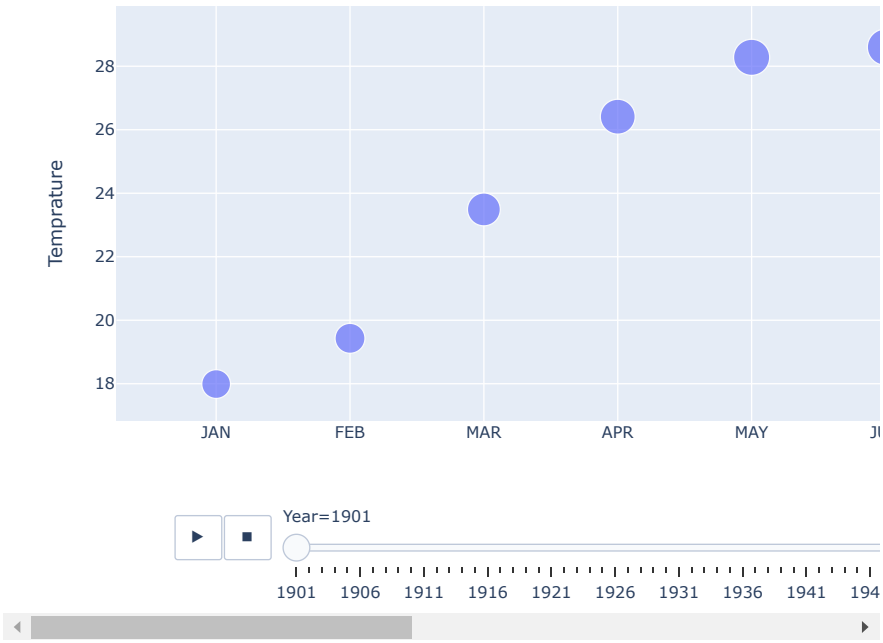

```
#We can see clear positive trend lines. Let’s see if we could find any trend in seasonal mean temperatures.

#Seasonal Weather Analysis

df['Winter'] = df[['DEC', 'JAN', 'FEB']].mean(axis=1)
df['Summer'] = df[['MAR', 'APR', 'MAY']].mean(axis=1)
df['Monsoon'] = df[['JUN', 'JUL', 'AUG', 'SEP']].mean(axis=1)
df['Autumn'] = df[['OCT', 'NOV']].mean(axis=1)
seasonal_df = df[['YEAR', 'Winter', 'Summer', 'Monsoon', 'Autumn']]
seasonal_df = pd.melt(seasonal_df, id_vars='YEAR', value_vars=seasonal_df.columns[1:])
seasonal_df.columns=['Year', 'Season', 'Temprature']

fig = px.scatter(seasonal_df, 'Year', 'Temprature', facet_col='Season', facet_col_wrap=2, trendline='ols')
```

```
fig.update_layout(title='Seasonal mean tempratures throught years:')
fig.show()
```




```
#We can again see a positive trend line between temperature and time. The trend line does not have a very high positive correlation with
```

```
#Let’s try to find out if we can get something out of an animation
px.scatter(df1, 'Month', 'Temprature', size='Temprature', animation_frame='Year')
```




```
#Weather Forecasting with Machine Learning
#Let’s try to forecast monthly mean temperature for year 2018.
```

```
# I am using decision tree regressor for prediction as the data does not actually have a linear trend.
from sklearn.tree import DecisionTreeRegressor
from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score

df2 = df1[['Year', 'Month', 'Temprature']].copy()
df2 = pd.get_dummies(df2)
y = df2[['Temprature']]
x = df2.drop(columns='Temprature')

dtr = DecisionTreeRegressor()
```

```
train_x, test_x, train_y, test_y = train_test_split(x,y,test_size=0.3)
dtr.fit(train_x, train_y)
pred = dtr.predict(test_x)
r2_score(test_y, pred)
```

```
0.9572632268290467
```

```
#A high r2 value means that our predictive model is working good. Now, Let's see the foretasted data for 2018.
next_Year = df1[df1['Year']==2017][['Year', 'Month']]
next_Year.Year.replace(2017,2018, inplace=True)
next_Year= pd.get_dummies(next_Year)
temp_2018 = dtr.predict(next_Year)

temp_2018 = {'Month':df1['Month'].unique(), 'Temprature':temp_2018}
temp_2018=pd.DataFrame(temp_2018)
temp_2018['Year'] = 2018
temp_2018
```

	Month	Temprature	Year
0	JAN	19.02	2018
1	FEB	23.08	2018
2	MAR	23.52	2018
3	APR	27.72	2018
4	MAY	30.47	2018
5	JUN	29.44	2018
6	JUL	28.07	2018
7	AUG	28.17	2018
8	SEP	27.72	2018
9	OCT	27.24	2018
10	NOV	23.92	2018
11	DEC	21.89	2018

```
forecasted_temp = pd.concat([df1,temp_2018], sort=False).groupby(by='Year')['Temprature'].mean().reset_index()
fig = go.Figure(data=[
    go.Scatter(name='Yearly Mean Temprature', x=forecasted_temp['Year'], y=forecasted_temp['Temprature'], mode='lines'),
    go.Scatter(name='Yearly Mean Temprature', x=forecasted_temp ['Year'], y=forecasted_temp['Temprature'], mode='markers')
])
fig.update_layout(title='Forecasted Temprature:',
                  xaxis_title='Time', yaxis_title='Temprature in Degrees')
fig.show()
```