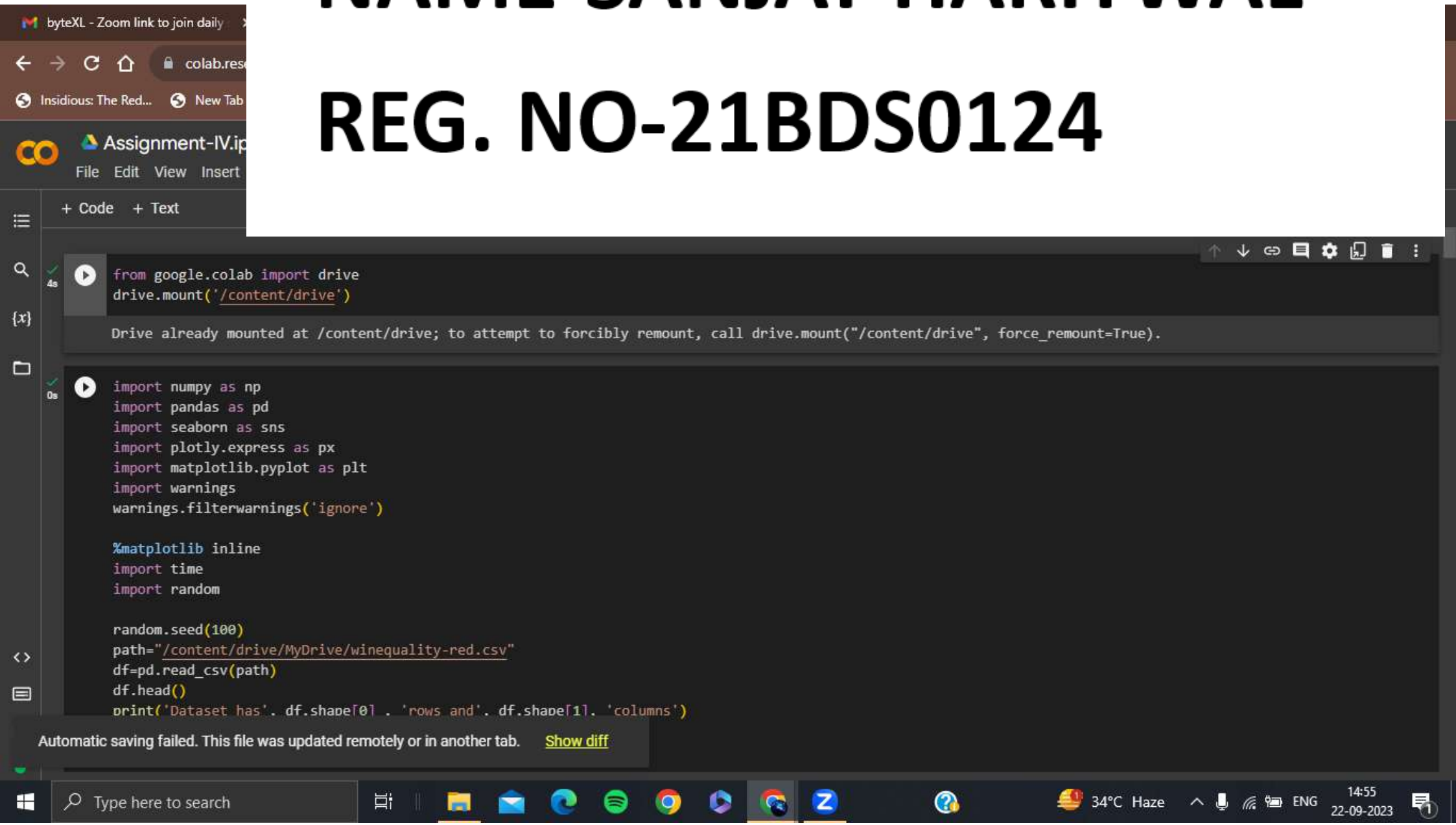
NAME-SANJAY HARITWAL

REG. NO-21BDS0124



byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
[21] import numpy as np
     import pandas as pd
     import seaborn as sns
     import plotly.express as px
     import matplotlib.pyplot as plt
     import warnings
     warnings.filterwarnings('ignore')

     %matplotlib inline
     import time
     import random

     random.seed(100)
     path="/content/drive/MyDrive/winequality-red.csv"
     df=pd.read_csv(path)
     df.head()
     print('Dataset has', df.shape[0] , 'rows and', df.shape[1], 'columns')
```

```
Dataset has 1599 rows and 12 columns
```

```
[8] df.head()
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

	acidity	acidity	acid	sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality

Type here to search

34°C Haze ENG 14:55 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
Dataset has 1599 rows and 12 columns
```

```
df.head()
```

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	5
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.68	9.8	5
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.65	9.8	5
3	11.2	0.28	0.56	1.9	0.075	17.0	60.0	0.9980	3.16	0.58	9.8	6
4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	5

```
[9] df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 12 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:55 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 12 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   fixed acidity         1599 non-null   float64
 1   volatile acidity      1599 non-null   float64
 2   citric acid           1599 non-null   float64
 3   residual sugar        1599 non-null   float64
 4   chlorides             1599 non-null   float64
 5   free sulfur dioxide   1599 non-null   float64
 6   total sulfur dioxide  1599 non-null   float64
 7   density               1599 non-null   float64
 8   pH                    1599 non-null   float64
 9   sulphates             1599 non-null   float64
 10  alcohol               1599 non-null   float64
 11  quality               1599 non-null   int64  
dtypes: float64(11), int64(1)
memory usage: 150.0 KB
```

```
[10] print(df.columns)
     print(df.shape)
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

ual sugar',
, 'density',

Type here to search

34°C Haze ENG 14:55 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
print(df.columns)
print(df.shape)
```

```
Index(['fixed acidity', 'volatile acidity', 'citric acid', 'residual sugar',
       'chlorides', 'free sulfur dioxide', 'total sulfur dioxide', 'density',
       'pH', 'sulphates', 'alcohol', 'quality'],
      dtype='object')
(1599, 12)
```

[13]

```
df.duplicated().sum()
```

```
240
```

[12]

```
df.describe().T
```

	count	mean	std	min	25%	50%	75%	max
fixed acidity	1599.0	8.319637	1.741096	4.60000	7.1000	7.90000	9.200000	15.90000
volatile acidity	1599.0	0.527821	0.179060	0.12000	0.3900	0.52000	0.640000	1.58000
citric acid	1599.0	0.270976	0.194801	0.00000	0.0900	0.26000	0.420000	1.00000
						000	2.600000	15.50000
chlorides	1599.0	0.087467	0.047065	0.01200	0.0700	0.07900	0.090000	0.61100

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:55 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[12]

	count	mean	std	min	25%	50%	75%	max
fixed acidity	1599.0	8.319637	1.741096	4.60000	7.1000	7.90000	9.200000	15.90000
volatile acidity	1599.0	0.527821	0.179060	0.12000	0.3900	0.52000	0.640000	1.58000
citric acid	1599.0	0.270976	0.194801	0.00000	0.0900	0.26000	0.420000	1.00000
residual sugar	1599.0	2.538806	1.409928	0.90000	1.9000	2.20000	2.600000	15.50000
chlorides	1599.0	0.087467	0.047065	0.01200	0.0700	0.07900	0.090000	0.61100
free sulfur dioxide	1599.0	15.874922	10.460157	1.00000	7.0000	14.00000	21.000000	72.00000
total sulfur dioxide	1599.0	46.467792	32.895324	6.00000	22.0000	38.00000	62.000000	289.00000
density	1599.0	0.996747	0.001887	0.99007	0.9956	0.99675	0.997835	1.00369
pH	1599.0	3.311113	0.154386	2.74000	3.2100	3.31000	3.400000	4.01000
sulphates	1599.0	0.658149	0.169507	0.33000	0.5500	0.62000	0.730000	2.00000
alcohol	1599.0	10.422983	1.065668	8.40000	9.5000	10.20000	11.100000	14.90000
quality	1599.0	5.636023	0.807569	3.00000	5.0000	6.00000	6.000000	8.00000

[14] df.nunique()

Automatic saving failed. This file was updated remotely or in another tab. Show diff

volatile acidity 143

Type here to search

34°C Haze ENG 14:55 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
df.nunique()
```

```
fixed acidity           96
volatile acidity       143
citric acid             80
residual sugar          91
chlorides              153
free sulfur dioxide     60
total sulfur dioxide   144
density                436
pH                      89
sulphates               96
alcohol                 65
quality                  6
dtype: int64
```

```
[23]
from sklearn.preprocessing import LabelEncoder
bins = (2, 6.5, 8)
group_names = ['bad', 'good']
df['quality'] = pd.cut(df['quality'], bins = bins, labels = group_names)
label_quality = LabelEncoder()
df['quality'] = label_quality.fit_transform(df['quality'])
df['quality'].value_counts()
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

```
Name: quality, dtype: int64
```

Type here to search

34°C Haze ENG 14:55 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

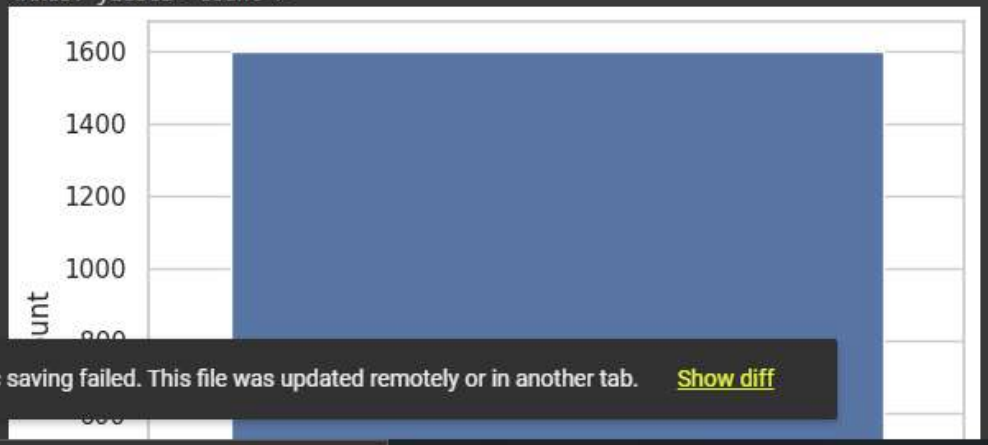
RAM Disk

```
group_names = ['bad', 'good']
df['quality'] = pd.cut(df['quality'], bins = bins, labels = group_names)
label_quality = LabelEncoder()
df['quality'] = label_quality.fit_transform(df['quality'])
df['quality'].value_counts()
```

```
0    1382
1     217
Name: quality, dtype: int64
```

```
sns.countplot(df['quality'])
```

```
<Axes: ylabel='count'>
```



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

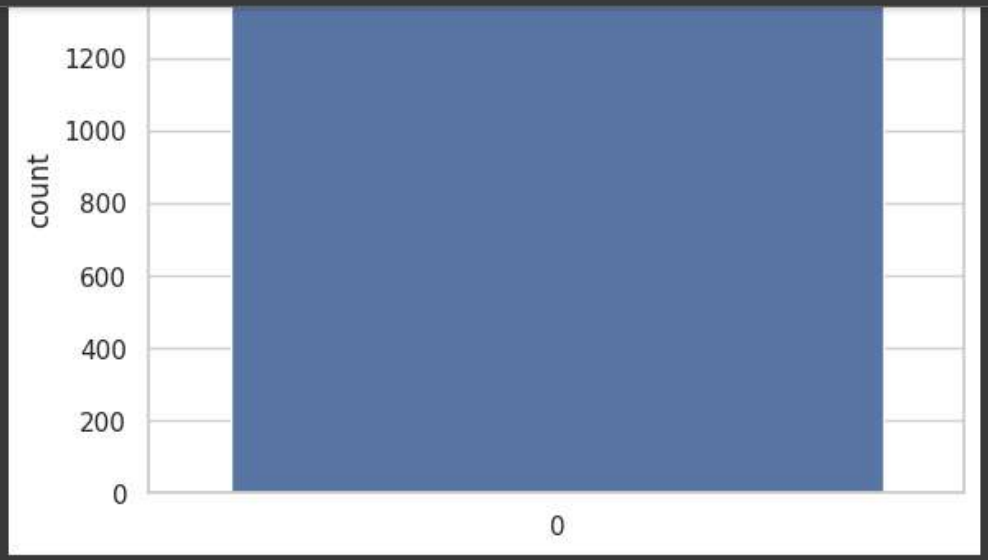
Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

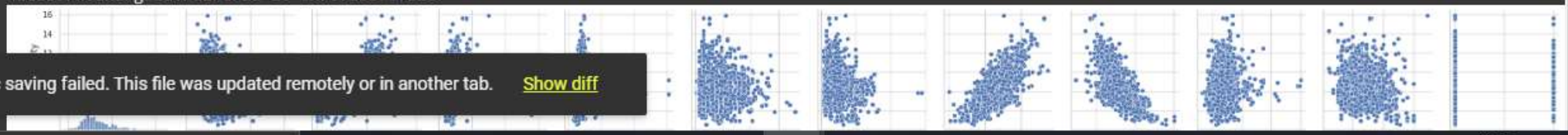


0s

```
sns.pairplot(df)
```

1m

```
<seaborn.axisgrid.PairGrid at 0x78f158f97b20>
```



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

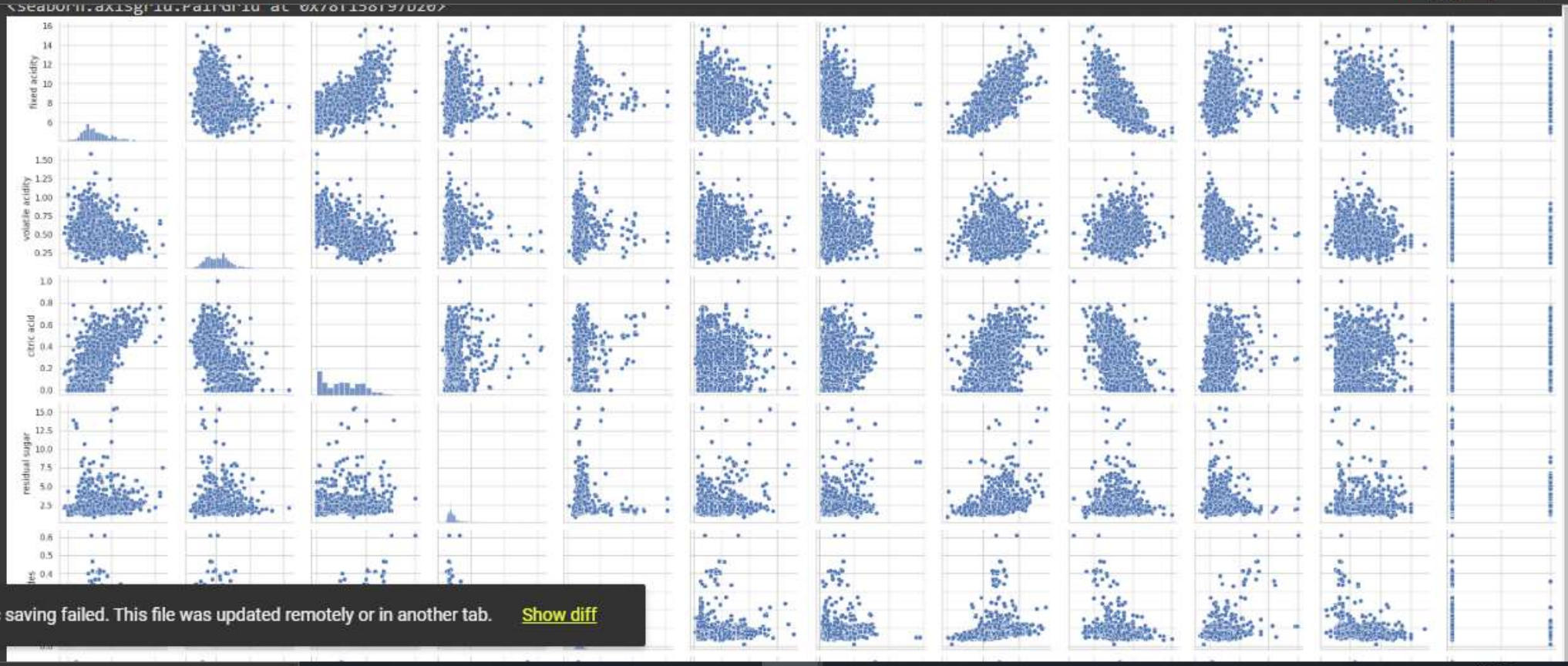
File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

<seaborn.axisgrid.PairGrid at 0x781158f97b20>



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

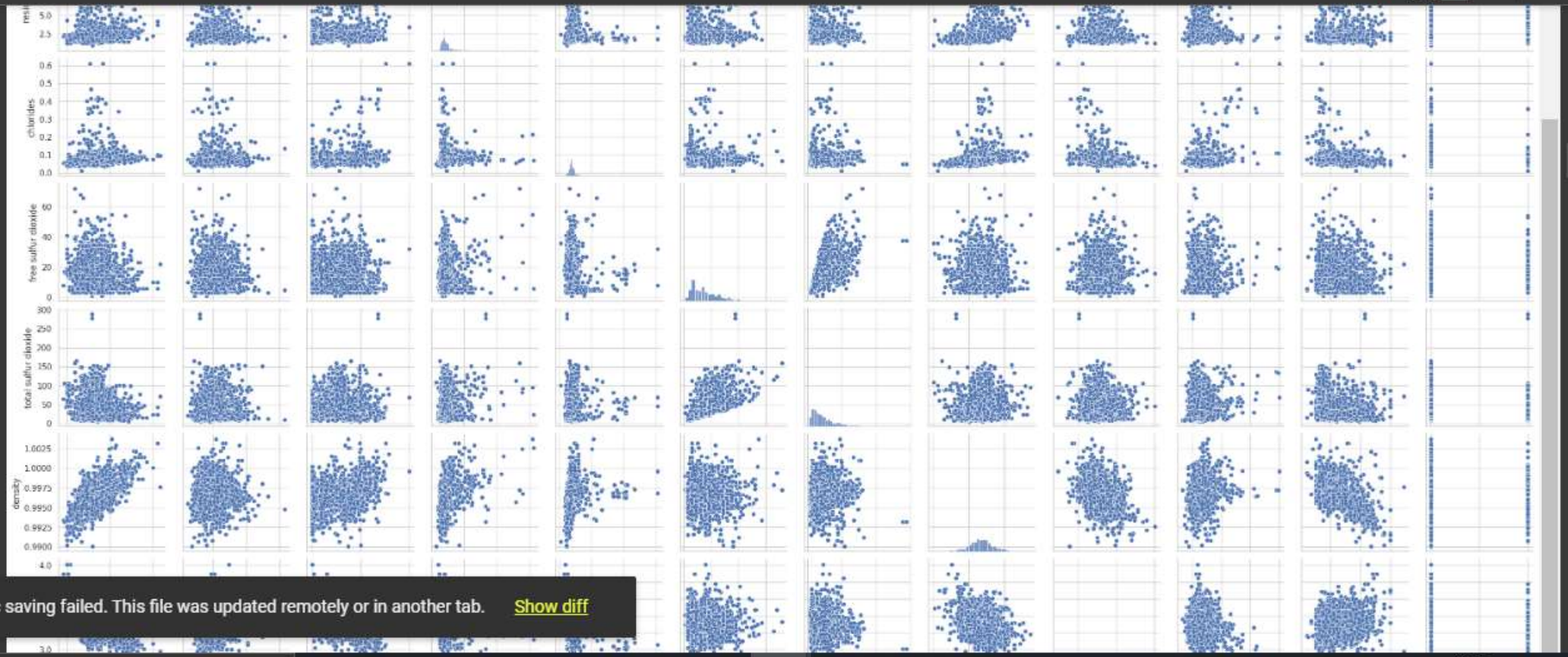
Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

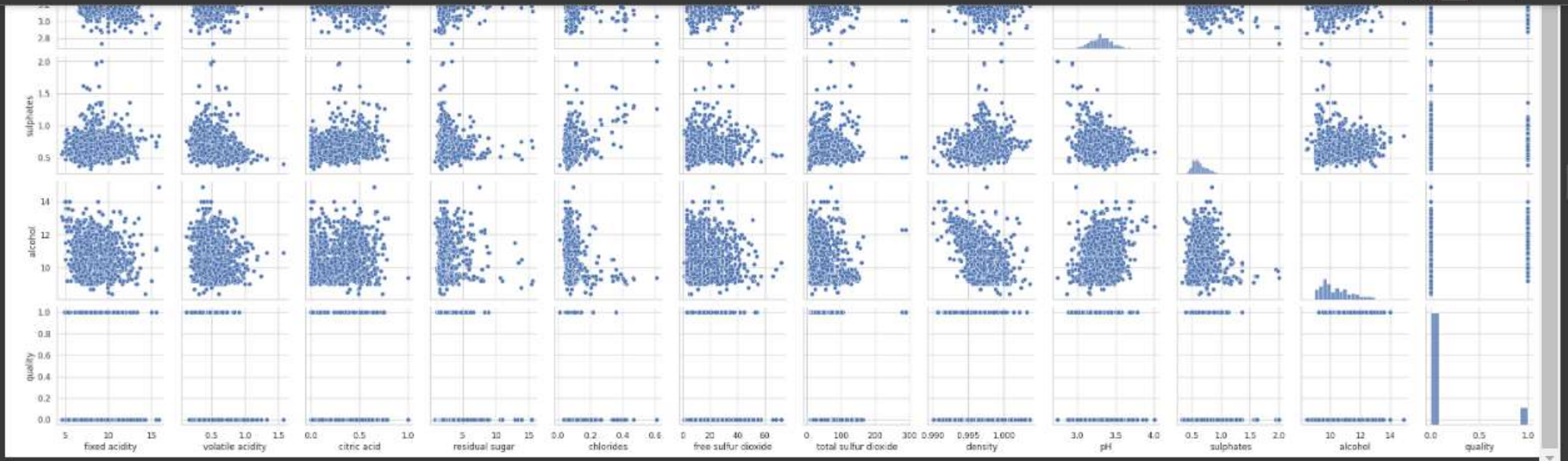
Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk



1m

```
[26] fig = plt.figure(figsize=(15, 12))
     plt.suptitle('Histograms of Numerical Columns', fontsize=20)
     for i in range(df.shape[1]):
```

8s

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

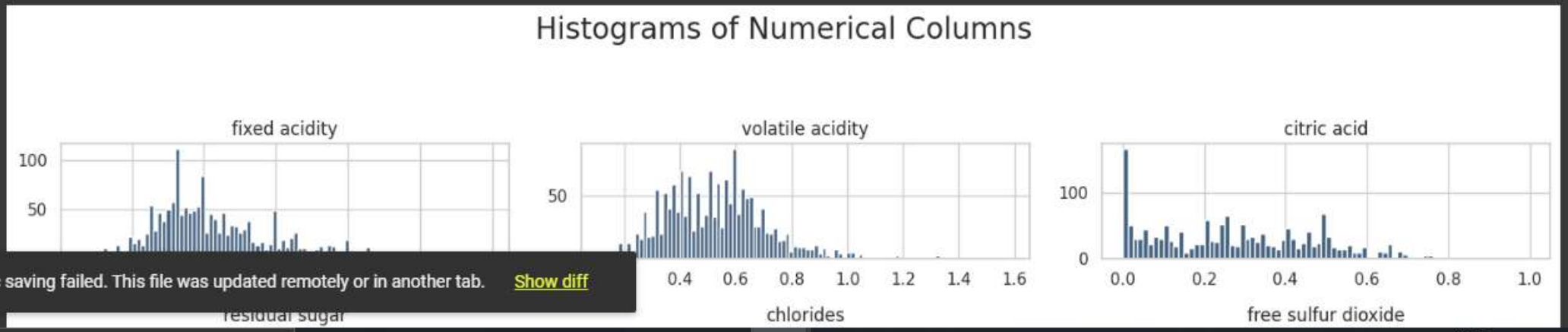
RAM Disk

[26] 8s

```
fig = plt.figure(figsize=(15, 12))
plt.suptitle('Histograms of Numerical Columns', fontsize=20)
for i in range(df.shape[1]):
    plt.subplot(6, 3, i + 1)
    f = plt.gca()
    f.set_title(df.columns.values[i])

    vals = np.size(df.iloc[:, i].unique())
    if vals >= 100:
        vals = 100

    plt.hist(df.iloc[:, i], bins=vals, color='#3F5D7D')
plt.tight_layout(rect=[0, 0.03, 1, 0.95])
```



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

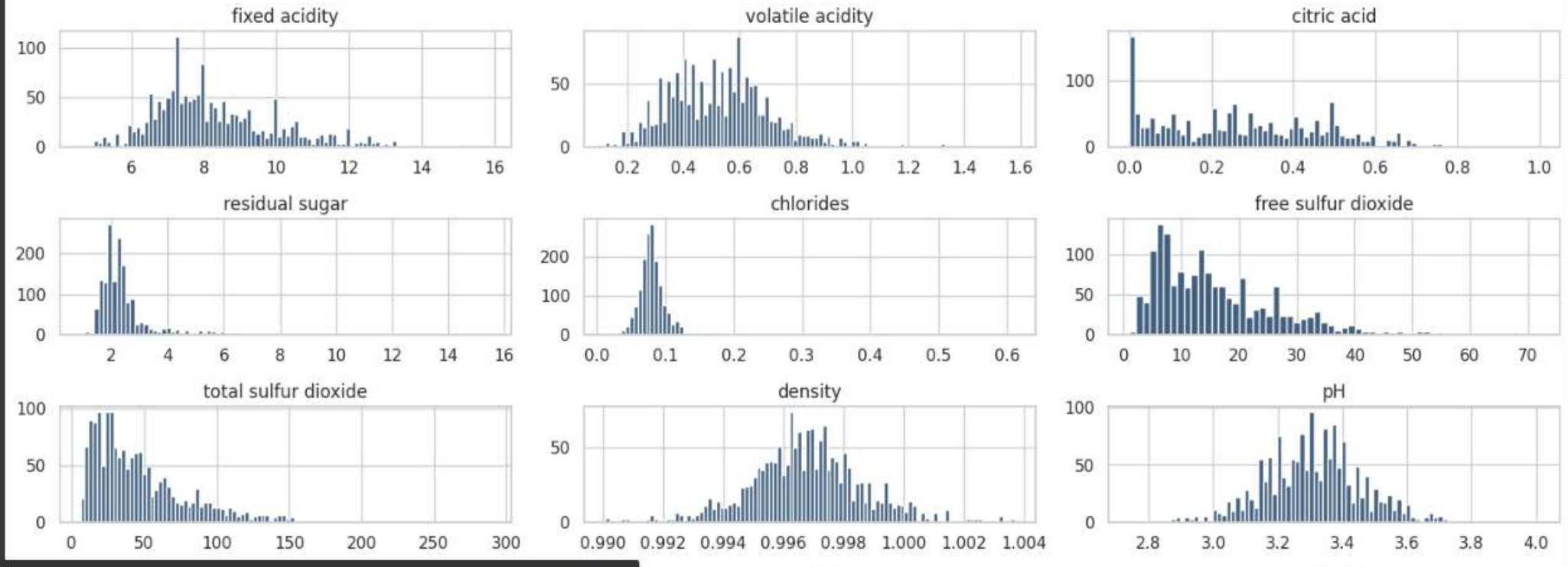
File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

8s



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

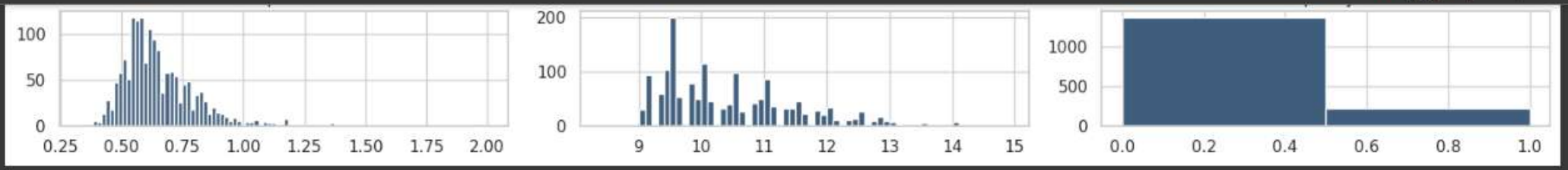
File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[26]



[27]
```
df.isna().any()
```

```
fixed acidity           False
volatile acidity        False
citric acid             False
residual sugar          False
chlorides               False
free sulfur dioxide     False
total sulfur dioxide    False
density                 False
pH                      False
sulphates               False
alcohol                 False
quality                 False
dtype: bool
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

ontsize = 15,

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[28] 1s
```
df.corrwith(df.quality).plot.bar(
        figsize = (20, 10), title = "Correlation with quality", fontsize = 15,
        rot = 45, grid = True)
```

```
<Axes: title={'center': 'Correlation with quality'}>
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

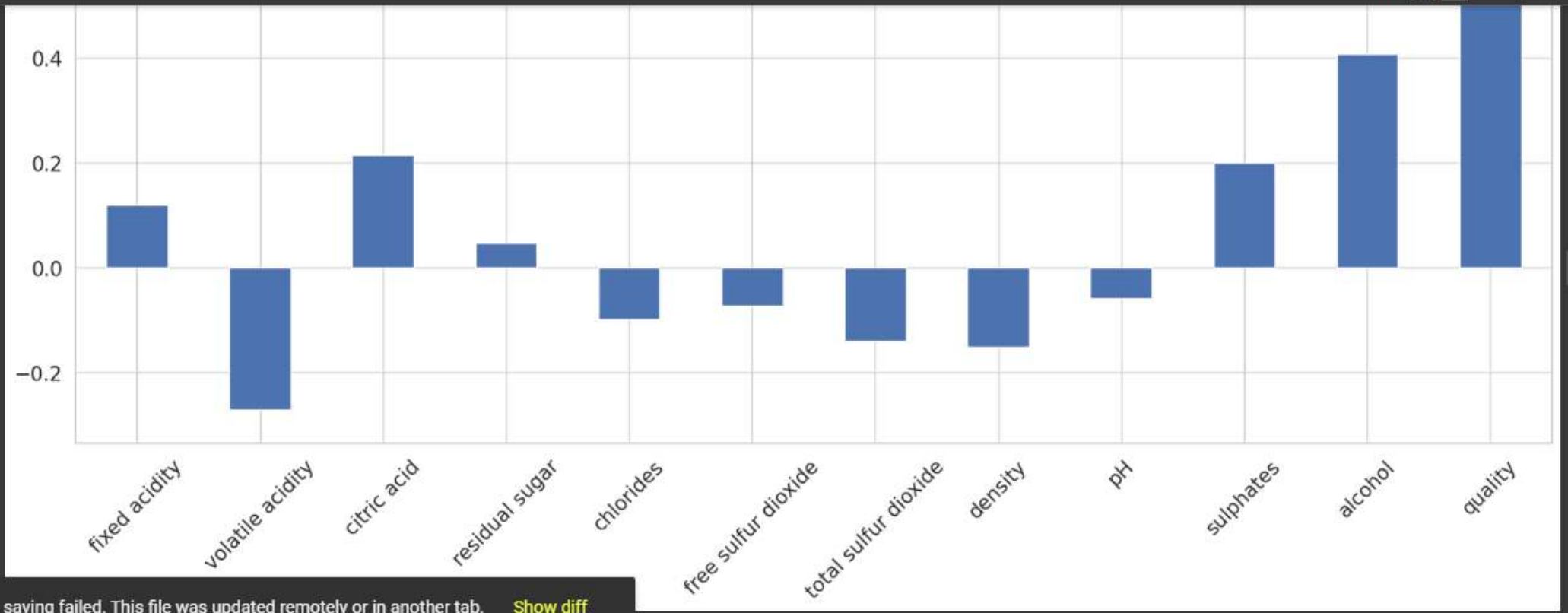
File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[28]



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[28]


```
sns.set(style="white")
corr = df.corr()
corr.head()
```

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality
fixed acidity	1.000000	-0.256131	0.671703	0.114777	0.093705	-0.153794	-0.113181	0.668047	-0.682978	0.183006	-0.061668	0.120061
volatile acidity	-0.256131	1.000000	-0.552496	0.001918	0.061298	-0.010504	0.076470	0.022026	0.234937	-0.260987	-0.202288	-0.270712
citric acid	0.671703	-0.552496	1.000000	0.143577	0.203823	-0.060978	0.035533	0.364947	-0.541904	0.312770	0.109903	0.214716
residual sugar	0.114777	0.001918	0.143577	1.000000	0.055610	0.187049	0.203028	0.355283	-0.085652	0.005527	0.042075	0.047779
chlorides	0.093705	0.061298	0.203823	0.055610	1.000000	0.005562	0.047400	0.200632	-0.265026	0.371260	-0.221141	-0.097308

[31]
```
mask = np.zeros_like(corr, dtype=np.bool)
mask[np.triu_indices_from(mask)] = True
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
mask[np.triu_indices_from(mask)] = True

f, ax = plt.subplots(figsize=(18, 15))

cmap = sns.diverging_palette(220, 10, as_cmap=True)

sns.heatmap(corr, mask=mask, cmap=cmap, vmax=.3, center=0,
            square=True, linewidths=.5, cbar_kws={"shrink": .5})
```

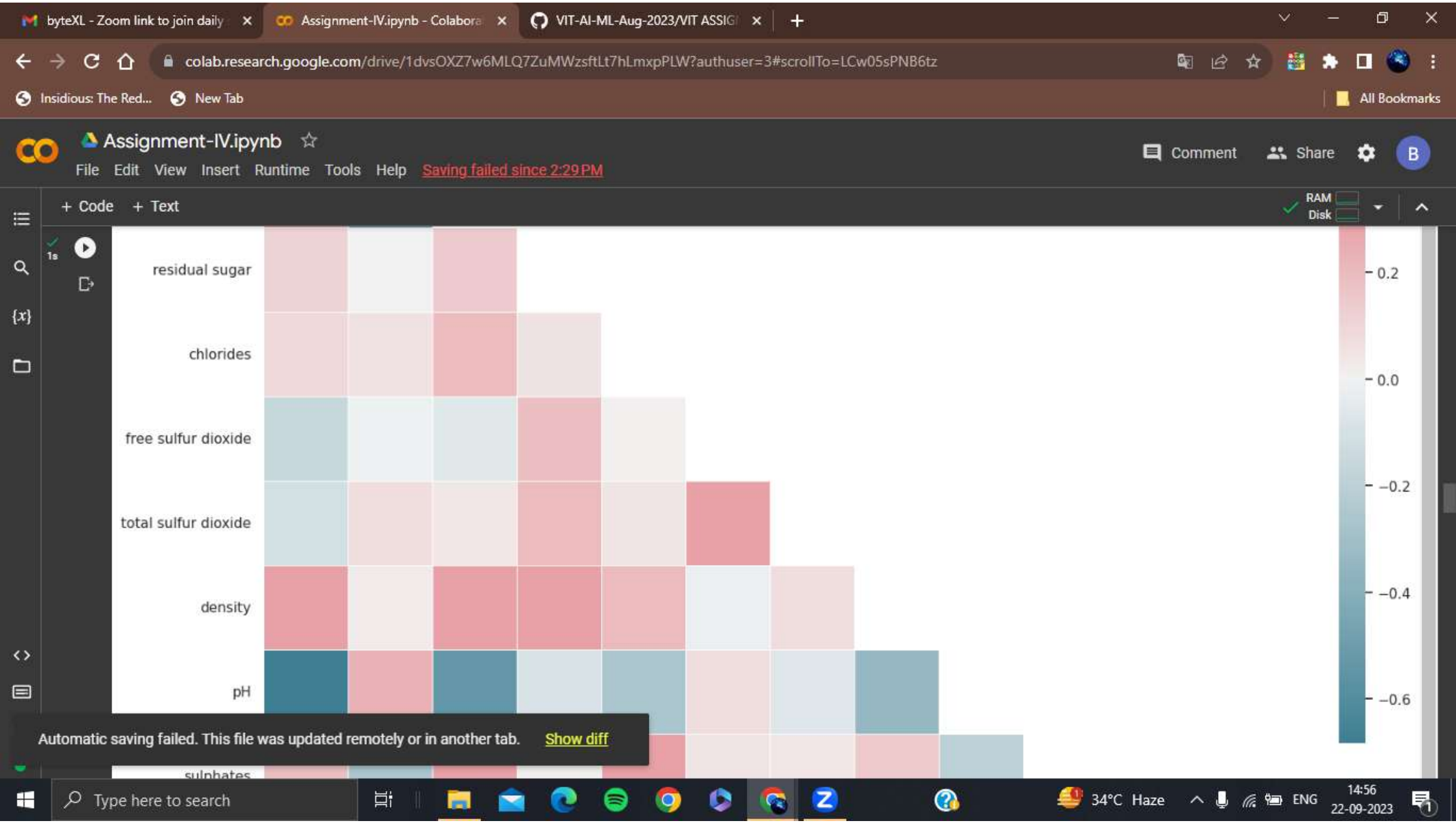
1s

```
<Axes: >
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023


byteXL - Zoom link to join daily
Assignment-IV.ipynb - Colabora
VIT-AI-ML-Aug-2023/VIT ASSIG
colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz
Insidious: The Red...
New Tab
All Bookmarks
Assignment-IV.ipynb
File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM
Comment
Share
B
+ Code + Text
RAM
Disk
residual sugar
chlorides
free sulfur dioxide
total sulfur dioxide
density
pH
sulphates
0.2
0.0
−0.2
−0.4
−0.6
Automatic saving failed. This file was updated remotely or in another tab.
Show diff
Type here to search
34°C Haze
ENG
14:56
22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

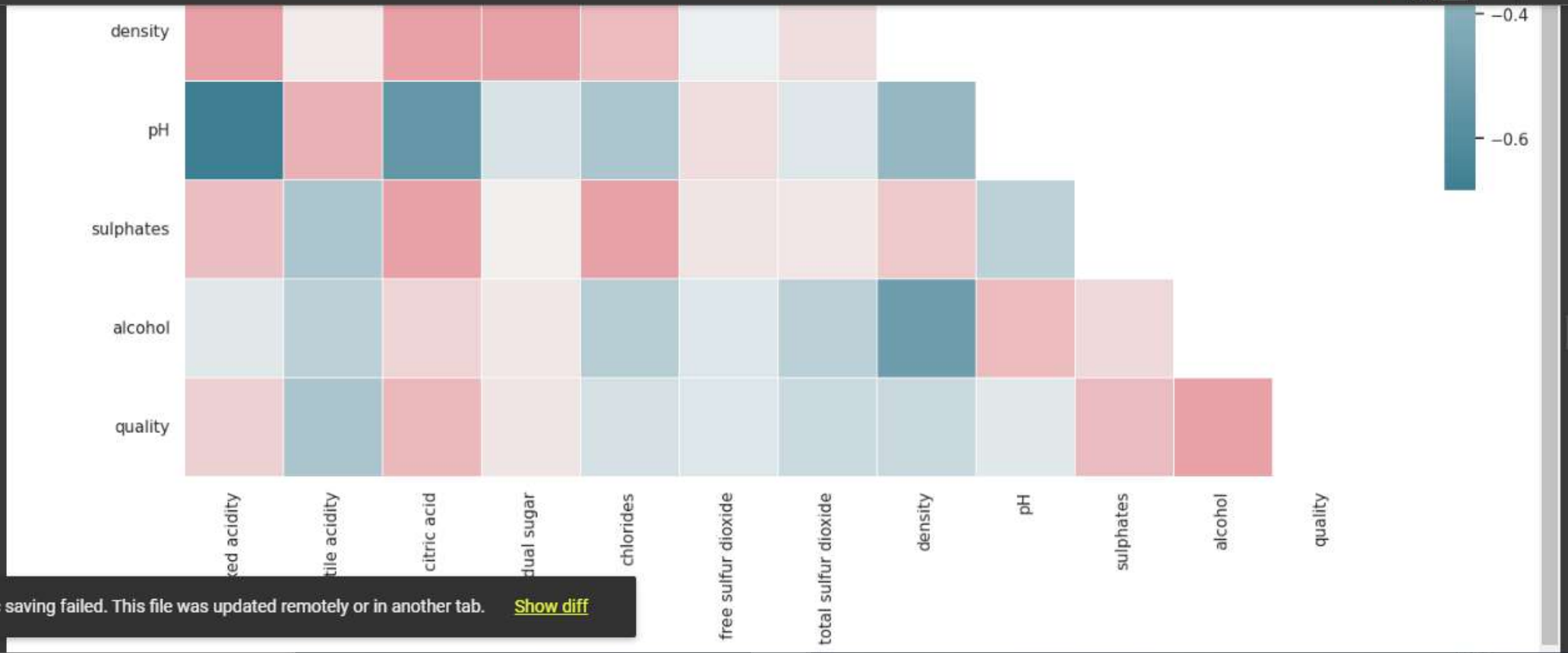
Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:56 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[41]
```
X = df.drop('quality',axis=1)
y=df['quality']
X.head()
y.head()
features_label=df.columns[:11]
```

```
X = df.drop('quality',axis=1)
y=df['quality']
X.head()
```

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.68	9.8
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.65	9.8
3	11.2	0.28	0.56	1.9	0.075	17.0	60.0	0.9980	3.16	0.58	9.8
4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4

[35]
```
y.head()
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[35] y.head()

```
0    0
1    0
2    0
3    0
4    0
Name: quality, dtype: int64
```

[39] features_label=df.columns[:11]

```
from sklearn.ensemble import RandomForestClassifier
classifier = RandomForestClassifier(n_estimators = 200, criterion = 'entropy', random_state = 0)
classifier.fit(X, y)
importances = classifier.feature_importances_
indices = np. argsort(importances)[::-1]
for i in range(X.shape[1]):
    print ("%2d) %-*s %f" % (i + 1, 30, features_label[i],importances[indices[i]]))
```

```
 1) fixed acidity                 0.178690
 2) volatile acidity              0.128748
 3) citric acid                   0.106496
 4) residual sugar                0.095718
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

8) density 0.070104

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

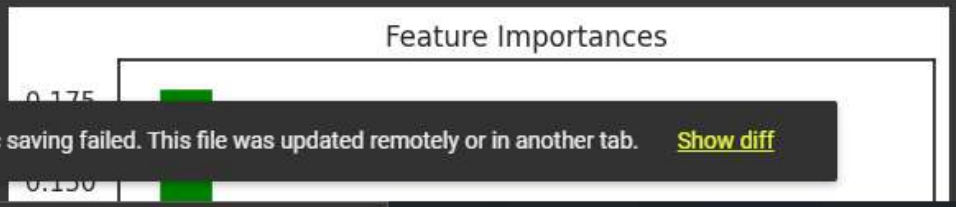
+ Code + Text

RAM Disk

```
[40] for i in range(X.shape[1]):
         print ("%2d) %-*s %f" % (i + 1, 30, features_label[i],importances[indices[i]]))
```

```
 1) fixed acidity                 0.178690
 2) volatile acidity              0.128748
 3) citric acid                   0.106496
 4) residual sugar                0.095718
 5) chlorides                     0.089280
 6) free sulfur dioxide           0.083482
 7) total sulfur dioxide          0.070669
 8) density                       0.070104
 9) pH                            0.060459
10) sulphates                     0.060048
11) alcohol                       0.056307
```

```
plt.title('Feature Importances')
plt.bar(range(X.shape[1]),importances[indices], color="green", align="center")
plt.xticks(range(X.shape[1]),features_label, rotation=90)
plt.xlim([-1, X.shape[1]])
plt.show()
```



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

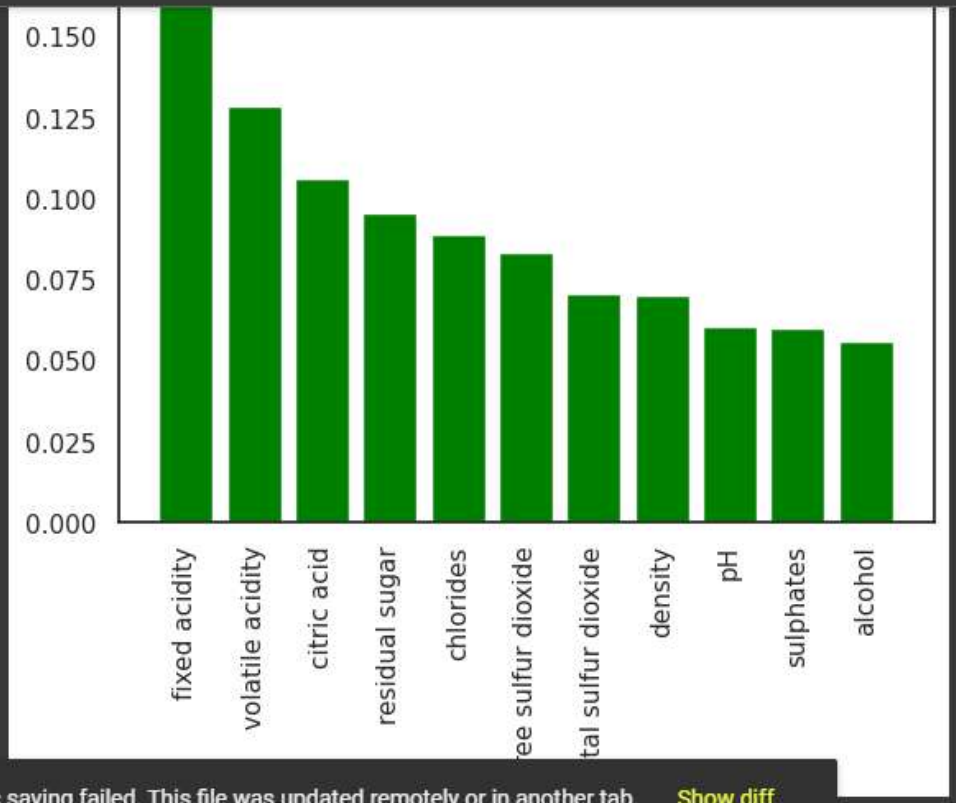
Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk



Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
[43] from sklearn.model_selection  import train_test_split
     X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.20, random_state = 5)
```

```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train2 = pd.DataFrame(sc.fit_transform(X_train))
X_test2 = pd.DataFrame(sc.transform(X_test))
X_train2.columns = X_train.columns.values
X_test2.columns = X_test.columns.values
X_train2.index = X_train.index.values
X_test2.index = X_test.index.values
X_train = X_train2
X_test = X_test2
```

```
[45] from sklearn.decomposition import PCA
     pca = PCA(n_components = 4)
     X_train = pca.fit_transform(X_train)
     X_test = pca.transform(X_test)
     explained_variance = pca.explained_variance_ratio_
     print(pd.DataFrame(explained_variance))
```

```
          0
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[45]
```
print(pd.DataFrame(explained_variance))
```

```
          0
0  0.281687
1  0.171462
2  0.143245
3  0.114765
```

```
from sklearn.linear_model import LogisticRegression
classifier = LogisticRegression(random_state = 0, penalty = 'l2')
classifier.fit(X_train, y_train)

y_pred = classifier.predict(X_test)
from sklearn.metrics import confusion_matrix, accuracy_score, f1_score, precision_score, recall_score
acc = accuracy_score(y_test, y_pred)
prec = precision_score(y_test, y_pred)
rec = recall_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)
results = pd.DataFrame([['Logistic Regression', acc, prec, rec, f1]],
              columns = ['Model', 'Accuracy', 'Precision', 'Recall', 'F1 Score'])
print(results)
```

```
                Model  Accuracy  Precision   Recall  F1 Score
0  Logistic Regression   0.86875        0.6  0.26087  0.363636
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

```
classifier = SVC(random_state = 0, kernel = 'rbf')
```

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
[48]
                Model  Accuracy  Precision   Recall  F1 Score
0  Logistic Regression   0.86875        0.6  0.26087  0.363636
```

```
from sklearn.svm import SVC
classifier = SVC(random_state = 0, kernel = 'rbf')
classifier.fit(X_train, y_train)

y_pred = classifier.predict(X_test)
acc = accuracy_score(y_test, y_pred)
prec = precision_score(y_test, y_pred)
rec = recall_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)

model_results = pd.DataFrame([['SVM (RBF)', acc, prec, rec, f1]],
               columns = ['Model', 'Accuracy', 'Precision', 'Recall', 'F1 Score'])

results = results.append(model_results, ignore_index = True)
print(results)
```

```
                Model  Accuracy  Precision    Recall  F1 Score
0  Logistic Regression   0.86875   0.600000  0.260870  0.363636
1           SVM (RBF)   0.87500   0.714286  0.217391  0.333333
2           SVM (RBF)   0.87500   0.714286  0.217391  0.333333
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

```
classifier = RandomForestClassifier(random_state = 0, n_estimators = 100,
```

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
[51] from sklearn.ensemble import RandomForestClassifier
     classifier = RandomForestClassifier(random_state = 0, n_estimators = 100,
                                         criterion = 'entropy')
     classifier.fit(X_train, y_train)

     # Predicting Test Set
     y_pred = classifier.predict(X_test)
     acc = accuracy_score(y_test, y_pred)
     prec = precision_score(y_test, y_pred)
     rec = recall_score(y_test, y_pred)
     f1 = f1_score(y_test, y_pred)

     model_results = pd.DataFrame([['Random Forest (n=100)', acc, prec, rec, f1]],
                   columns = ['Model', 'Accuracy', 'Precision', 'Recall', 'F1 Score'])

     results = results.append(model_results, ignore_index = True)
     print(results)
```

```
                  Model  Accuracy  Precision    Recall  F1 Score
0   Logistic Regression  0.868750   0.600000  0.260870  0.363636
1            SVM (RBF)  0.875000   0.714286  0.217391  0.333333
2            SVM (RBF)  0.875000   0.714286  0.217391  0.333333
3  Random Forest (n=100)  0.903125   0.741935  0.500000  0.597403
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

```
                                                  y = y_train,
```

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[52] 4s

```
from sklearn.model_selection import cross_val_score
accuracies = cross_val_score(estimator = classifier, X= X_train, y = y_train,
                             cv = 10)
print("Random Forest Classifier Accuracy: %0.2f (+/- %0.2f)"  % (accuracies.mean(), accuracies.std() * 2))
```

```
Random Forest Classifier Accuracy: 0.89 (+/- 0.04)
```

1m

```
parameters = {"max_depth": [3, None],

              'min_samples_split': [2, 5, 10],
              'min_samples_leaf': [1, 5, 10],
              "bootstrap": [True, False],
              "criterion": ["entropy"]}

from sklearn.model_selection import GridSearchCV
grid_search = GridSearchCV(estimator = classifier,
                           param_grid = parameters,
                           scoring = "accuracy",
                           cv = 10,
                           n_jobs = -1)

t0 = time.time()
grid_search = grid_search.fit(X_train, y_train)
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

```
rf_best_accuracy = grid_search.best_score
```

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

1m

```
from sklearn.model_selection import GridSearchCV
grid_search = GridSearchCV(estimator = classifier,
                           param_grid = parameters,
                           scoring = "accuracy",
                           cv = 10,
                           n_jobs = -1)

t0 = time.time()
grid_search = grid_search.fit(X_train, y_train)
t1 = time.time()
print("Took %0.2f seconds" % (t1 - t0))

rf_best_accuracy = grid_search.best_score_
rf_best_parameters = grid_search.best_params_
rf_best_accuracy, rf_best_parameters
```

```
Took 100.39 seconds
(0.8991510826771654,
 {'bootstrap': False,
  'criterion': 'entropy',
  'max_depth': None,
  'min_samples_leaf': 1,
  'min_samples_split': 2})
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

30s

```
parameters = {"max_depth": [None],

              'min_samples_split': [8, 10, 12],
              'min_samples_leaf': [1, 2, 3],
              "bootstrap": [True],
              "criterion": ["entropy"]}

from sklearn.model_selection import GridSearchCV
grid_search = GridSearchCV(estimator = classifier,
                           param_grid = parameters,
                           scoring = "accuracy",
                           cv = 10,
                           n_jobs = -1)

t0 = time.time()
grid_search = grid_search.fit(X_train, y_train)
t1 = time.time()
print("Took %0.2f seconds" % (t1 - t0))

rf_best_accuracy = grid_search.best_score_
rf_best_parameters = grid_search.best_params_
rf_best_accuracy, rf_best_parameters
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

{'bootstrap': True,

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

30s [56] Took 30.56 seconds

```
(0.8881951279527559,
 {'bootstrap': True,
  'criterion': 'entropy',
  'max_depth': None,
  'min_samples_leaf': 1,
  'min_samples_split': 8})
```

1m [57]

```
parameters = {"max_depth": [3, None],

              'min_samples_split': [2, 5, 10],
              'min_samples_leaf': [1, 5, 10],
              "bootstrap": [True, False],
              "criterion": ["gini"]}
from sklearn.model_selection import GridSearchCV
grid_search = GridSearchCV(estimator = classifier,
                           param_grid = parameters,
                           scoring = "accuracy",
                           cv = 10,
                           n_jobs = -1)

t0 = time.time()
grid_search = grid_search.fit(X_train, y_train)
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

```
best_accuracy = grid_search.best_score
```

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

1m

```
                        param_grid = parameters,
                        scoring = "accuracy",
                        cv = 10,
                        n_jobs = -1)

    t0 = time.time()
    grid_search = grid_search.fit(X_train, y_train)
    t1 = time.time()
    print("Took %0.2f seconds" % (t1 - t0))

    rf_best_accuracy = grid_search.best_score_
    rf_best_parameters = grid_search.best_params_
    rf_best_accuracy, rf_best_parameters
```

```
Took 87.44 seconds
(0.8983698326771654,
 {'bootstrap': True,
  'criterion': 'gini',
  'max_depth': None,
  'min_samples_leaf': 1,
  'min_samples_split': 2})
```

23s

```
[58] parameters = {"max_depth": [None],
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

[58] 23s

```
    parameters = {"max_depth": [None],
                  'min_samples_split': [2, 3, 4],
                  'min_samples_leaf': [8, 10, 12],
                  "bootstrap": [True],
                  "criterion": ["gini"]}

    from sklearn.model_selection import GridSearchCV
    grid_search = GridSearchCV(estimator = classifier,
                               param_grid = parameters,
                               scoring = "accuracy",
                               cv = 10,
                               n_jobs = -1)

    t0 = time.time()
    grid_search = grid_search.fit(X_train, y_train)
    t1 = time.time()
    print("Took %0.2f seconds" % (t1 - t0))

    rf_best_accuracy = grid_search.best_score_
    rf_best_parameters = grid_search.best_params_
    rf_best_accuracy, rf_best_parameters
```

```
Took 23.19 seconds
```

Automatic saving failed. This file was updated remotely or in another tab. Show diff

```
 'max_depth': None,
```

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
[58] rf_best_accuracy, rf_best_parameters
```

23s

```
Took 23.19 seconds
(0.8819389763779528,
 {'bootstrap': True,
  'criterion': 'gini',
  'max_depth': None,
  'min_samples_leaf': 8,
  'min_samples_split': 2})
```

```
rf_best_accuracy, rf_best_parameters
```

0s

```
(0.8819389763779528,
 {'bootstrap': True,
  'criterion': 'gini',
  'max_depth': None,
  'min_samples_leaf': 8,
  'min_samples_split': 2})
```

```
[60] y_pred = grid_search.predict(X_test)
     acc = accuracy_score(y_test, y_pred)
     prec = precision_score(y_test, y_pred)
     rec = recall_score(y_test, y_pred)
     f1 = f1_score(y_test, y_pred)
```

0s

Automatic saving failed. This file was updated remotely or in another tab. Show diff

```
)', acc, prec, rec, f1]],
columns = ['Model', 'Accuracy', 'Precision', 'Recall', 'F1 Score'])
```

Type here to search

34°C Haze ENG 14:57 22-09-2023

byteXL - Zoom link to join daily | Assignment-IV.ipynb - Colabora | VIT-AI-ML-Aug-2023/VIT ASSIG

colab.research.google.com/drive/1dvsOXZ7w6MLQ7ZuMWzsftLt7hLmxpPLW?authuser=3#scrollTo=LCw05sPNB6tz

Insidious: The Red... | New Tab | All Bookmarks

Assignment-IV.ipynb

File Edit View Insert Runtime Tools Help Saving failed since 2:29 PM

Comment Share B

+ Code + Text

RAM Disk

```
y_pred = grid_search.predict(X_test)
acc = accuracy_score(y_test, y_pred)
prec = precision_score(y_test, y_pred)
rec = recall_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)

model_results = pd.DataFrame([['Random Forest (n=100, GSx2 + Gini)', acc, prec, rec, f1]],
               columns = ['Model', 'Accuracy', 'Precision', 'Recall', 'F1 Score'])

results = results.append(model_results, ignore_index = True)
results
```

	Model	Accuracy	Precision	Recall	F1 Score
0	Logistic Regression	0.868750	0.600000	0.260870	0.363636
1	SVM (RBF)	0.875000	0.714286	0.217391	0.333333
2	SVM (RBF)	0.875000	0.714286	0.217391	0.333333
3	Random Forest (n=100)	0.903125	0.741935	0.500000	0.597403
4	Random Forest (n=100, GSx2 + Gini)	0.881250	0.700000	0.304348	0.424242

Automatic saving failed. This file was updated remotely or in another tab. Show diff

Type here to search

34°C Haze ENG 14:58 22-09-2023