In [2]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [3]:

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

In [4]:

```
df
```

Out[4]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	t
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
1020	59	1	1	140	221	0	1	164	1	0.0	2	0	2	
1021	60	1	0	125	258	0	0	141	1	2.8	1	1	3	
1022	47	1	0	110	275	0	0	118	1	1.0	1	1	2	
1023	50	0	0	110	254	0	0	159	0	0.0	2	0	2	
1024	54	1	0	120	188	0	1	113	0	1.4	1	1	3	

1025 rows × 14 columns

1.Data cleaning:

In [5]:

```
df.info() #Data cleaning means fixing bad data in your data set. Bad data could be: Empty
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1025 entries, 0 to 1024
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   age       1025 non-null   int64  
 1   sex       1025 non-null   int64  
 2   cp        1025 non-null   int64  
 3   trestbps  1025 non-null   int64  
 4   chol      1025 non-null   int64  
 5   fbs       1025 non-null   int64  
 6   restecg   1025 non-null   int64  
 7   thalach   1025 non-null   int64  
 8   exang     1025 non-null   int64  
 9   oldpeak   1025 non-null   float64
 10  slope     1025 non-null   int64  
 11  ca        1025 non-null   int64  
 12  thal      1025 non-null   int64  
 13  target    1025 non-null   int64  
dtypes: float64(1), int64(13)
memory usage: 112.2 KB
```

In [6]:

```
df['sex'] = df['sex'].astype('object')
df['cp'] = df['cp'].astype('object')
df['fbs'] = df['fbs'].astype('object')
df['restecg'] = df['restecg'].astype('object')
df['exang'] = df['exang'].astype('object')
df['slope'] = df['slope'].astype('object')
df['ca'] = df['ca'].astype('object')
df['thal'] = df['thal'].astype('object')
df.dtypes
```

Out[6]:

```
age           int64
sex          object
cp           object
trestbps      int64
chol          int64
fbs          object
restecg      object
thalach       int64
exang        object
oldpeak     float64
slope        object
ca           object
thal         object
target        int64
dtype: object
```

In [7]:

```
df.isnull()
```

Out[7]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	
0	False	False	False	False	False	False	False	False	False	False	False	Fa
1	False	False	False	False	False	False	False	False	False	False	False	Fa
2	False	False	False	False	False	False	False	False	False	False	False	Fa
3	False	False	False	False	False	False	False	False	False	False	False	Fa
4	False	False	False	False	False	False	False	False	False	False	False	Fa
...	...	...	...	...	...	...	...	...	...	...	...	
1020	False	False	False	False	False	False	False	False	False	False	False	Fa
1021	False	False	False	False	False	False	False	False	False	False	False	Fa
1022	False	False	False	False	False	False	False	False	False	False	False	Fa
1023	False	False	False	False	False	False	False	False	False	False	False	Fa
1024	False	False	False	False	False	False	False	False	False	False	False	Fa

1025 rows × 14 columns

In [8]:

```
df.isnull().sum()
```

Out[8]:

```
age         0
sex         0
cp          0
trestbps    0
chol        0
fbs         0
restecg     0
thalach     0
exang       0
oldpeak     0
slope       0
ca          0
thal        0
target      0
dtype: int64
```

In [9]:

```
###Before we plot the outliers, let's change the labeling for better visualization and in
heart dataset.
df['target'] = df.target.replace({1: "Disease", 0: "No_disease"})
df['sex'] = df.sex.replace({1: "Male", 0: "Female"})
df['cp'] = df.cp.replace({0: "typical_angina",1: "atypical_angina",2:"non-anginal pain",3
df['exang'] = df.exang.replace({1: "Yes", 0: "No"})
df['fbs'] = df.fbs.replace({1: "True", 0: "False"})
df['slope'] = df.slope.replace({0: "upsloping", 1:"flat",2:"downsloping"})
df['thal'] = df.thal.replace({1: "fixed_defect", 2: "reversable_defect",3:"normal"})
```

```
  Cell In[9], line 2
    heart dataset.
          ^
SyntaxError: invalid syntax
```

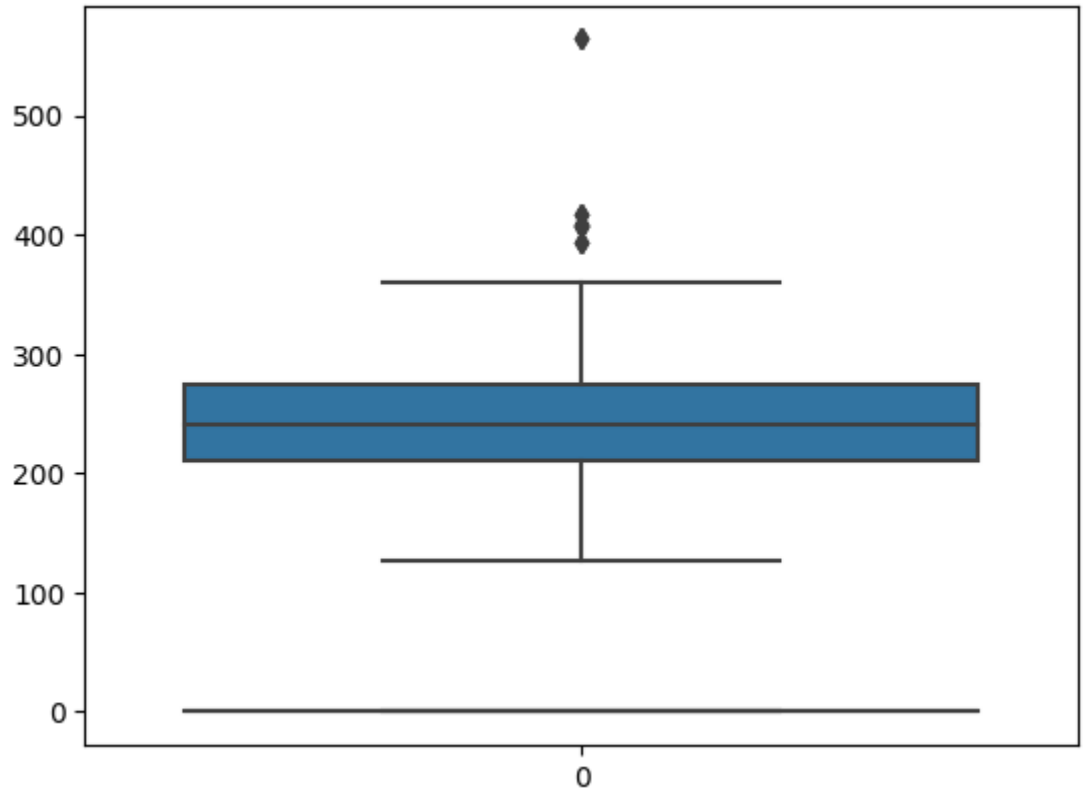
In [18]:

```
sns.boxplot(df["target"])

sns.boxplot(df['chol'])
```

Out[18]:

```
<Axes: >
```

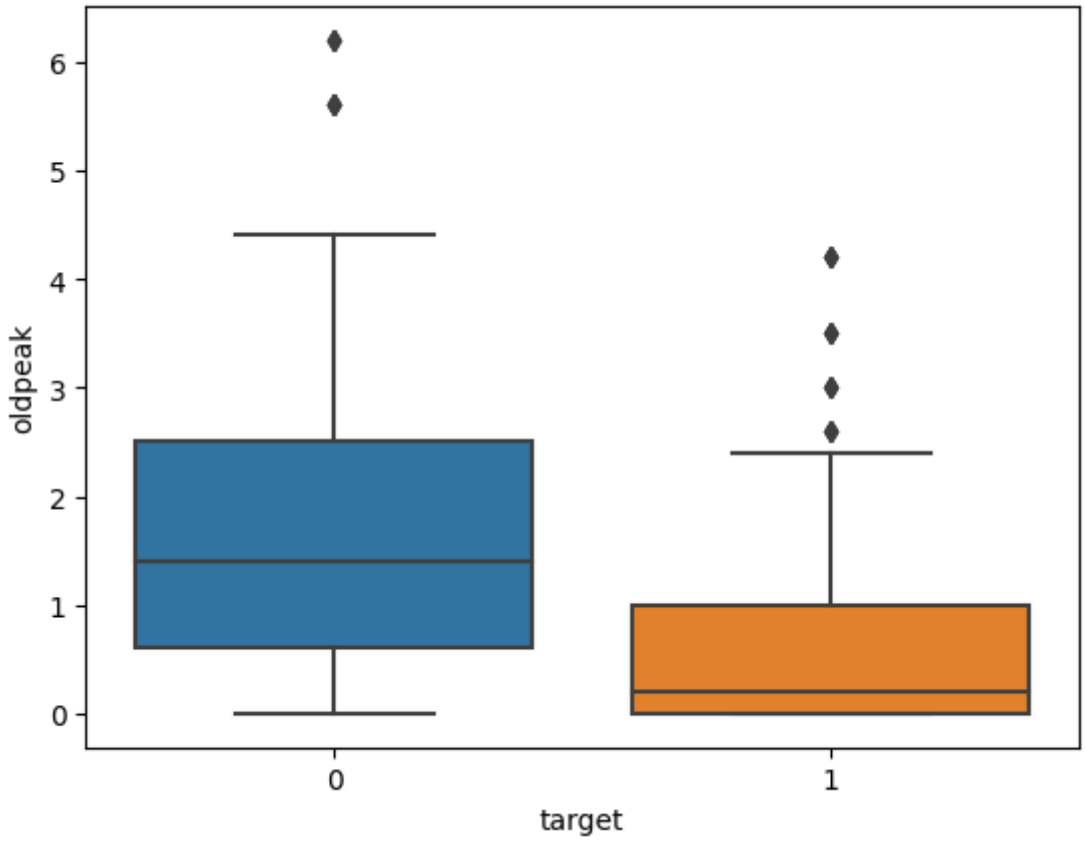


In [19]:

```
sns.boxplot(x='target', y='oldpeak', data=df)
```

Out[19]:

```
<Axes: xlabel='target', ylabel='oldpeak'>
```



In [20]:

```
###define continuous variable & plot
continous_features = ['age','trestbps','chol','thalach','oldpeak']
def outliers(df_out, drop = False):
    for each_feature in df_out.columns:
        feature_data = df_out[each_feature]
        Q1 = np.percentile(feature_data, 25.) # 25th percentile of the data of the given
        Q3 = np.percentile(feature_data, 75.) # 75th percentile of the data of the given
        IQR = Q3-Q1 #Interquartile Range
        outlier_step = IQR * 1.5 #That's we were talking about above
        outliers = feature_data[~((feature_data >= Q1 - outlier_step) & (feature_data <=
        if not drop:
            print('For the feature {}, No of Outliers is {}'.format(each_feature, len(out
        if drop:
            df.drop(outliers, inplace = True, errors = 'ignore')
            print('Outliers from {} feature removed'.format(each_feature))
outliers(df[continous_features])
```

```
For the feature age, No of Outliers is 0
For the feature trestbps, No of Outliers is 30
For the feature chol, No of Outliers is 16
For the feature thalach, No of Outliers is 4
For the feature oldpeak, No of Outliers is 7
```

In [21]:

```
###Drop Outliers
outliers(df[continous_features],drop=True)
```

```
Outliers from age feature removed
Outliers from trestbps feature removed
Outliers from chol feature removed
Outliers from thalach feature removed
Outliers from oldpeak feature removed
```

In [22]:

```
###Duplicate rows:
```

In [23]:

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

In [24]:

```
duplicated
```

Out[24]:

```
683
```

In [25]:

```
if duplicated:
    print("Duplicated rows :{}".format(duplicated))
else:
    print("No duplicates")
```

```
Duplicated rows :683
```

In [26]:

```
###Displaying duplicate rows
duplicates=df[df.duplicated(keep=False)]
duplicates.head()
```

Out[26]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	targ
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	

In [27]:

```
df.drop_duplicates()
```

Out[27]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	ta
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
723	68	0	2	120	211	0	0	115	0	1.5	1	0	2	
733	44	0	2	108	141	0	1	175	0	0.6	1	0	2	
739	52	1	0	128	255	0	1	161	1	0.0	2	1	3	
843	59	1	3	160	273	0	0	125	0	0.0	2	0	2	
878	54	1	0	120	188	0	1	113	0	1.4	1	1	3	

285 rows × 14 columns

In [28]:

```
duplicates.head()
```

Out[28]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	targ
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	

In [29]:

```
df.drop_duplicates()
```

Out[29]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	ta
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
723	68	0	2	120	211	0	0	115	0	1.5	1	0	2	
733	44	0	2	108	141	0	1	175	0	0.6	1	0	2	
739	52	1	0	128	255	0	1	161	1	0.0	2	1	3	
843	59	1	3	160	273	0	0	125	0	0.0	2	0	2	
878	54	1	0	120	188	0	1	113	0	1.4	1	1	3	

285 rows × 14 columns

In [30]:

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

In [31]:

```
duplicated
```

Out[31]:

683

2.Data integration

In [32]:

```
#This process of bringing data together in one place is called data integration.
#To do data integration, we can merge multiple pandas DataFrames using the merge function

dataset1="C:/Users/Mayuri Tambe/Downloads/student.csv"
dataset2 ="C:/Users/Mayuri Tambe/Downloads/mark.csv"
```

In [33]:

```
df1 = pd.read_csv(dataset1, header = 0)
df2 = pd.read_csv(dataset2, header = 0)
```

```
---------------------------------------------------------------------------
FileNotFoundError                         Traceback (most recent call last)
Cell In[33], line 1
----> 1 df1 = pd.read_csv(dataset1, header = 0)
      2 df2 = pd.read_csv(dataset2, header = 0)

File ~\AppData\Roaming\Python\Python311\site-packages\pandas\util\_decorators.py:211, in deprecate_kwarg.<locals>._deprecate_kwarg.<locals>.wrapper(*args, **kwargs)
    209     else:
    210         kwargs[new_arg_name] = new_arg_value
--> 211 return func(*args, **kwargs)

File ~\AppData\Roaming\Python\Python311\site-packages\pandas\util\_decorators.py:331, in deprecate_nonkeyword_arguments.<locals>.decorate.<locals>.wrapper(*args, **kwargs)
    325 if len(args) > num_allow_args:
    326     warnings.warn(
    327         msg.format(arguments=_format_argument_list(allow_args)),
    328         FutureWarning,
    329         stacklevel=find_stack_level(),
    330     )
--> 331 return func(*args, **kwargs)

File ~\AppData\Roaming\Python\Python311\site-packages\pandas\io\parsers\readers.py:950, in read_csv(filepath_or_buffer, sep, delimiter, header, names, index_col, usecols, squeeze, prefix, mangle_dupe_cols, dtype, engine, converters, true_values, false_values, skipinitialspace, skiprows, skipfooter, nrows, na_values, keep_default_na, na_filter, verbose, skip_blank_lines, parse_dates, infer_datetime_format, keep_date_col, date_parser, dayfirst, cache_dates, iterator, chunksize, compression, thousands, decimal, lineterminator, quotechar, quoting, doublequote, escapechar, comment, encoding, encoding_errors, dialect, error_bad_lines, warn_bad_lines, on_bad_lines, delim_whitespace, low_memory, memory_map, float_precision, storage_options)
    935 kwds_defaults = _refine_defaults_read(
    936     dialect,
    937     delimiter,
   (...)
    946     defaults={"delimiter": ","},
    947 )
    948 kwds.update(kwds_defaults)
--> 950 return _read(filepath_or_buffer, kwds)

File ~\AppData\Roaming\Python\Python311\site-packages\pandas\io\parsers\readers.py:605, in _read(filepath_or_buffer, kwds)
    602 _validate_names(kwds.get("names", None))
    604 # Create the parser.
--> 605 parser = TextFileReader(filepath_or_buffer, **kwds)
    607 if chunksize or iterator:
    608     return parser

File ~\AppData\Roaming\Python\Python311\site-packages\pandas\io\parsers\readers.py:1442, in TextFileReader.__init__(self, f, engine, **kwds)
   1439     self.options["has_index_names"] = kwds["has_index_names"]
   1441 self.handles: IOHandles | None = None
-> 1442 self._engine = self._make_engine(f, self.engine)

File ~\AppData\Roaming\Python\Python311\site-packages\pandas\io\parsers\re
```

```
aders.py:1735, in TextFileReader._make_engine(self, f, engine)
   1733     if "b" not in mode:
   1734         mode += "b"
-> 1735 self.handles = get_handle(
   1736     f,
   1737     mode,
   1738     encoding=self.options.get("encoding", None),
   1739     compression=self.options.get("compression", None),
   1740     memory_map=self.options.get("memory_map", False),
   1741     is_text=is_text,
   1742     errors=self.options.get("encoding_errors", "strict"),
   1743     storage_options=self.options.get("storage_options", None),
   1744 )
   1745 assert self.handles is not None
   1746 f = self.handles.handle

File ~\AppData\Roaming\Python\Python311\site-packages\pandas\io\common.py:
856, in get_handle(path_or_buf, mode, encoding, compression, memory_map, i
s_text, errors, storage_options)
    851 elif isinstance(handle, str):
    852     # Check whether the filename is to be opened in binary mode.
    853     # Binary mode does not support 'encoding' and 'newline'.
    854     if ioargs.encoding and "b" not in ioargs.mode:
    855         # Encoding
--> 856         handle = open(
    857             handle,
    858             ioargs.mode,
    859             encoding=ioargs.encoding,
    860             errors=errors,
    861             newline="",
    862         )
    863     else:
    864         # Binary mode
    865         handle = open(handle, ioargs.mode)

FileNotFoundError: [Errno 2] No such file or directory: 'C:/Users/Mayuri T
ambe/Downloads/student.csv'
```

In [ ]:

```
df1.head()
```

In [34]:

```
df2.head()
```

Out[34]:

	Student_id	Mark	City
0	1	95	Chennai
1	2	70	Delhi
2	3	98	Mumbai
3	4	75	Pune
4	5	89	Kochi

In [35]:

```
####Student_id is common to both datasets. Perform data integration on both the DataFrame
##respect to the Student_id column using the pd.merge() function, and then print the firs
##the new DataFrame:
```

```
  Input In [35]
    respect to the Student_id column using the pd.merge() function, and th
en print the first 10 values of
            ^
SyntaxError: invalid syntax
```

In [36]:

```
df = pd.merge(df1, df2, on = 'Student_id')
df.head(10)
```

Out[36]:

	Student_id	Age	Gender	Grade	Employed	Mark	City
0	1	19	Male	1st Class	yes	95	Chennai
1	2	20	Female	2nd Class	no	70	Delhi
2	3	18	Male	1st Class	no	98	Mumbai
3	4	21	Female	2nd Class	no	75	Pune
4	5	19	Male	1st Class	no	89	Kochi
5	6	20	Male	2nd Class	yes	69	Gwalior
6	7	19	Female	3rd Class	yes	52	Bhopal
7	8	21	Male	3rd Class	yes	54	Chennai
8	9	22	Female	3rd Class	yes	55	Delhi
9	10	21	Male	1st Class	no	94	Mumbai

3.Data transformation

To transform the data into a machine-learning-digestible format. All machine learning algorithms are based on mathematics. So, we need to convert all the columns into numerical format

In [39]:

```
#Data transformation is the process of converting raw data into a a format or structure t

url='C:/Users/Mayuri Tambe/Downloads/heart.csv'
df=pd.read_csv(url)
```

In [40]:

```
df
```

Out[40]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	t
0	52	1	0	125	212	0	1	168	0	1.0	2	2	3	
1	53	1	0	140	203	1	0	155	1	3.1	0	0	3	
2	70	1	0	145	174	0	1	125	1	2.6	0	0	3	
3	61	1	0	148	203	0	1	161	0	0.0	2	1	3	
4	62	0	0	138	294	1	1	106	0	1.9	1	3	2	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
1020	59	1	1	140	221	0	1	164	1	0.0	2	0	2	
1021	60	1	0	125	258	0	0	141	1	2.8	1	1	3	
1022	47	1	0	110	275	0	0	118	1	1.0	1	1	2	
1023	50	0	0	110	254	0	0	159	0	0.0	2	0	2	
1024	54	1	0	120	188	0	1	113	0	1.4	1	1	3	

1025 rows × 14 columns

In [53]:

```
url="C:/Users/Mayuri Tambe/Downloads/AirQuality.csv"
ddf=pd.read_csv(url,encoding='cp1252')
```

```
C:\Users\Mayuri Tambe\AppData\Local\Temp\ipykernel_11180\1761435286.py:2:
DtypeWarning: Columns (0) have mixed types. Specify dtype option on import
or set low_memory=False.
  ddf=pd.read_csv(url,encoding='cp1252')
```

In [62]:

```
ddf
```

Out[62]:

	stn_code	sampling_date	state	location	agency	type	so2	no2	rspm
0	150.0	February - M021990	Andhra Pradesh	Hyderabad	NaN	1	4.8	17.4	NaN
1	151.0	February - M021990	Andhra Pradesh	Hyderabad	NaN	2	3.1	7.0	NaN
2	152.0	February - M021990	Andhra Pradesh	Hyderabad	NaN	1	6.2	28.5	NaN
3	150.0	March - M031990	Andhra Pradesh	Hyderabad	NaN	1	6.3	14.7	NaN
4	151.0	March - M031990	Andhra Pradesh	Hyderabad	NaN	2	4.7	7.5	NaN
...	...	...	...	...	...	...	...	...	...
435736	SAMP	24-12-2015	West Bengal	ULUBERIA	West Bengal State Pollution Control Board	5	22.0	50.0	143.0
435737	SAMP	29-12-2015	West Bengal	ULUBERIA	West Bengal State Pollution Control Board	5	20.0	46.0	171.0
435738	NaN	NaN	andaman-and-nicobar-islands	NaN	NaN	NaN	NaN	NaN	NaN
435739	NaN	NaN	Lakshadweep	NaN	NaN	NaN	NaN	NaN	NaN
435740	NaN	NaN	Tripura	NaN	NaN	NaN	NaN	NaN	NaN

435741 rows × 13 columns

In [ ]:

```
###stn_code, agency, sampling_date, location_monitoring_agency do not add much value to t
dataset in terms of information. Therefore, we can drop those columns.
###Dropping rows where no date is available.
```

In [64]:

```
ddf=ddf.drop(['stn_code','agency','sampling_date','location_monitoring_station'], axis =
#dropping columns that aren't required
```

In [65]:

```
ddf=ddf.dropna(subset=['date']) # dropping rows where no date is availabl
```

In [67]:

```
# defining columns of importance, which shall be used reguarly
COLS = ['so2', 'no2', 'rspm', 'spm', 'pm2_5']
from sklearn.impute import SimpleImputer
# invoking SimpleImputer to fill missing values
imputer = SimpleImputer(missing_values=np.nan, strategy='mean')
ddf[COLS] = imputer.fit_transform(ddf[COLS])
```

In [68]:

```
ddf[COLS]
```

Out[68]:

	so2	no2	rspm	spm	pm2_5
0	4.8	17.4	108.833285	220.784295	40.791467
1	3.1	7.0	108.833285	220.784295	40.791467
2	6.2	28.5	108.833285	220.784295	40.791467
3	6.3	14.7	108.833285	220.784295	40.791467
4	4.7	7.5	108.833285	220.784295	40.791467
...	...	...	...	...	...
435733	20.0	44.0	148.000000	220.784295	40.791467
435734	17.0	44.0	131.000000	220.784295	40.791467
435735	18.0	45.0	140.000000	220.784295	40.791467
435736	22.0	50.0	143.000000	220.784295	40.791467
435737	20.0	46.0	171.000000	220.784295	40.791467

435734 rows × 5 columns

In [69]:

```
ddf['type'].value_counts()
```

Out[69]:

```
1                   179013
2                    96089
3                    86791
Industrial Areas     51746
4                     8979
Sensitive Areas       5536
5                     1304
Sensitive              495
Industrial             233
6                      158
Name: type, dtype: int64
```

In [70]:

```
ddf['type']
```

Out[70]:

```
0         1
1         2
2         1
3         1
4         2
         ..
435733    5
435734    5
435735    5
435736    5
435737    5
Name: type, Length: 435734, dtype: object
```

In [ ]:

```
###Converting Categorical Data to Numerical Data Using Label Encoding
```

In [72]:

```
ddf['state'].value_counts()
```

Out[72]:

```
Maharashtra             60382
Uttar Pradesh           42816
Andhra Pradesh          26368
Punjab                  25634
Rajasthan               25589
Kerala                  24728
Himachal Pradesh        22896
West Bengal             22463
Gujarat                 21279
Tamil Nadu              20597
Madhya Pradesh          19920
Assam                   19361
Odisha                  19278
Karnataka               17117
Delhi                    8551
Chandigarh               8520
Chhattisgarh             7831
Goa                      6206
Jharkhand                5968
Mizoram                  5338
Telangana                3978
Meghalaya                3853
Puducherry               3785
Haryana                  3420
Nagaland                 2463
Bihar                    2275
Uttarakhand              1961
Jammu & Kashmir          1289
Daman & Diu               782
Dadra & Nagar Haveli      634
Uttaranchal               285
Arunachal Pradesh          90
Manipur                    76
Sikkim                      1
Name: state, dtype: int64
```

In [73]:

```
from sklearn.preprocessing import LabelEncoder
labelencoder=LabelEncoder()
ddf["state"]=labelencoder.fit_transform(ddf["state"])
ddf.head(5)
```

Out[73]:

	state	location	type	so2	no2	rspm	spm	pm2_5	date
0	0	Hyderabad	1	4.8	17.4	108.833285	220.784295	40.791467	01-02-1990
1	0	Hyderabad	2	3.1	7.0	108.833285	220.784295	40.791467	01-02-1990
2	0	Hyderabad	1	6.2	28.5	108.833285	220.784295	40.791467	01-02-1990
3	0	Hyderabad	1	6.3	14.7	108.833285	220.784295	40.791467	01-03-1990
4	0	Hyderabad	2	4.7	7.5	108.833285	220.784295	40.791467	01-03-1990

In [ ]:

```
###One Hot Encoding
```

In [75]:

```
dfAndhra=ddf[(ddf['state']==0)]
dfAndhra
```

Out[75]:

	state	location	type	so2	no2	rspm	spm	pm2_5	date
0	0	Hyderabad	1	4.8	17.4	108.833285	220.784295	40.791467	01-02-1990
1	0	Hyderabad	2	3.1	7.0	108.833285	220.784295	40.791467	01-02-1990
2	0	Hyderabad	1	6.2	28.5	108.833285	220.784295	40.791467	01-02-1990
3	0	Hyderabad	1	6.3	14.7	108.833285	220.784295	40.791467	01-03-1990
4	0	Hyderabad	2	4.7	7.5	108.833285	220.784295	40.791467	01-03-1990
...	...	...	...	...	...	...	...	...	...
26363	0	Rajahmundry	2	7.0	13.0	71.000000	220.784295	40.791467	13-12-2015
26364	0	Rajahmundry	2	7.0	18.0	77.000000	220.784295	40.791467	16-12-2015
26365	0	Rajahmundry	2	8.0	23.0	64.000000	220.784295	40.791467	19-12-2015
26366	0	Rajahmundry	2	7.0	19.0	61.000000	220.784295	40.791467	22-12-2015
26367	0	Rajahmundry	2	6.0	17.0	71.000000	220.784295	40.791467	25-12-2015

26368 rows × 9 columns

In [76]:

```
dfAndhra['location'].value_counts()
```

Out[76]:

```
Hyderabad         7764
Visakhapatnam     7108
Vijayawada        2093
Chittoor          1003
Tirupati           986
Kurnool            857
Patancheru         698
Guntur             629
Nalgonda           618
Ramagundam         554
Nellore            408
Khammam            385
Warangal           336
Ananthapur         324
Ongole             317
Kadapa             316
Srikakulam         315
Rajahmundry        311
Eluru              300
Vishakhapatnam     297
Kakinada           288
Vizianagaram       282
Sangareddy          85
Karimnagar          67
Nizamabad           27
Name: location, dtype: int64
```

In [77]:

```
from sklearn.preprocessing import OneHotEncoder
onehotencoder=OneHotEncoder(sparse=False,handle_unknown='error',drop='first')
pd.DataFrame(onehotencoder.fit_transform(dfAndhra[["location"]]))
```

Out[77]:

	0	1	2	3	4	5	6	7	8	9	...	14	15	16	17	18	19	20	21
0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
26363	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26364	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26365	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26366	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26367	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

26368 rows × 24 columns

In [ ]:

```
#####You have successfully converted categorical data to numerical data using the OneHotE
```

4.Error Correction

In [ ]:

```
####In heart dataset it can be observed that feature 'ca' should range from 0-3, however,
##listed 0-4. So let's find the '4' and change them to NaN.
```

In [78]:

```
df['ca'].unique()
```

Out[78]:

```
array([2, 0, 1, 3, 4], dtype=int64)
```

In [79]:

```
df[df['ca']==4]
```

Out[79]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	ta
52	38	1	2	138	175	0	1	173	0	0.0	2	4	2	
83	38	1	2	138	175	0	1	173	0	0.0	2	4	2	
128	52	1	2	138	223	0	1	169	0	0.0	2	4	2	
208	38	1	2	138	175	0	1	173	0	0.0	2	4	2	
242	38	1	2	138	175	0	1	173	0	0.0	2	4	2	
290	52	1	2	138	223	0	1	169	0	0.0	2	4	2	
340	38	1	2	138	175	0	1	173	0	0.0	2	4	2	
348	43	1	0	132	247	1	0	143	1	0.1	1	4	3	
417	52	1	2	138	223	0	1	169	0	0.0	2	4	2	
428	43	1	0	132	247	1	0	143	1	0.1	1	4	3	
465	38	1	2	138	175	0	1	173	0	0.0	2	4	2	
521	58	1	1	125	220	0	1	144	0	0.4	1	4	3	
597	38	1	2	138	175	0	1	173	0	0.0	2	4	2	
743	58	1	1	125	220	0	1	144	0	0.4	1	4	3	
749	58	1	1	125	220	0	1	144	0	0.4	1	4	3	
831	58	1	1	125	220	0	1	144	0	0.4	1	4	3	
970	38	1	2	138	175	0	1	173	0	0.0	2	4	2	
993	43	1	0	132	247	1	0	143	1	0.1	1	4	3	

In [80]:

```
df.loc[df['ca']==4,'ca']=np.NaN
```

In [81]:

```
df['thal'].nunique()
```

Out[81]:

```
4
```

In [82]:

```
df['thal'].unique()
```

Out[82]:

```
array([3, 2, 1, 0], dtype=int64)
```

In [84]:

```
df[df['thal']==3]
```

Out[84]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal
0	52	1	0	125	212	0	1	168	0	1.0	2	2.0	3
1	53	1	0	140	203	1	0	155	1	3.1	0	0.0	3
2	70	1	0	145	174	0	1	125	1	2.6	0	0.0	3
3	61	1	0	148	203	0	1	161	0	0.0	2	1.0	3
7	55	1	0	160	289	0	0	145	1	0.8	1	1.0	3
...	...	...	...	...	...	...	...	...	...	...	...	...	...
1015	58	1	0	128	216	0	0	131	1	2.2	1	3.0	3
1017	53	1	0	123	282	0	1	95	1	2.0	1	2.0	3
1018	41	1	0	110	172	0	0	158	0	0.0	2	0.0	3
1021	60	1	0	125	258	0	0	141	1	2.8	1	1.0	3
1024	54	1	0	120	188	0	1	113	0	1.4	1	1.0	3

410 rows × 14 columns

In [85]:

```
df.loc[df['thal']==3,'thal']=np.NaN
```

In [86]:

```
###Now, we can replace changed NaN values(missing values).
df.isna().sum()
```

Out[86]:

```
age          0
sex          0
cp           0
trestbps     0
chol         0
fbs          0
restecg      0
thalach      0
exang        0
oldpeak      0
slope        0
ca          18
thal       410
target       0
dtype: int64
```

In [87]:

```
df = df.fillna(df.median())
df.isnull().sum()
```

Out[87]:

```
age         0
sex         0
cp          0
trestbps    0
chol        0
fbs         0
restecg     0
thalach     0
exang       0
oldpeak     0
slope       0
ca          0
thal        0
target      0
dtype: int64
```

5.Data model building

In [88]:

```
####Create a variable called X to store the independent features. Use the drop() function
##the features, leaving out the dependent or the target variable, which in this case is n
##for heart dataset. Then, print out the top five instances of the variable. Add the foll
##do this:
X = df.drop('target', axis=1)
```

In [89]:

```
X.head()
```

Out[89]:

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal
0	52	1	0	125	212	0	1	168	0	1.0	2	2.0	2.0
1	53	1	0	140	203	1	0	155	1	3.1	0	0.0	2.0
2	70	1	0	145	174	0	1	125	1	2.6	0	0.0	2.0
3	61	1	0	148	203	0	1	161	0	0.0	2	1.0	2.0
4	62	0	0	138	294	1	1	106	0	1.9	1	3.0	2.0

In [90]:

```
##1. Print the shape of your new created feature matrix using the X.shape command:
X.shape
```

Out[90]:

```
(1025, 13)
```

In [91]:

```
y = df['target']
y.head(10)
```

Out[91]:

```
0    0
1    0
2    0
3    0
4    0
5    1
6    0
7    0
8    0
9    0
Name: target, dtype: int64
```

In [92]:

```
y.shape
```

Out[92]:

```
(1025,)
```

In [93]:

```
from sklearn import preprocessing
df=df.apply(preprocessing.LabelEncoder().fit_transform)
```

In [94]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,random_state=0)
```

In [95]:

```
###Print the shape of X_train, X_test, y_train, and y_test. Add the following code to do
print("X_train : ",X_train.shape)
print("X_test : ",X_test.shape)
print("y_train : ",y_train.shape)
print("y_test : ",y_test.shape)
```

```
X_train :  (820, 13)
X_test :  (205, 13)
y_train :  (820,)
y_test :  (205,)
```

In [96]:

```
###Using Supervised Learning
##When the prediction is between two classes, it is known as binary classification. An ex
##predicting whether or not a person has a heart disease (in this case, the classes are y
from sklearn.tree import DecisionTreeClassifier
from sklearn import metrics
clf = DecisionTreeClassifier()
clf = clf.fit(X_train, y_train)
y_pred = clf.predict(X_test)
print(y_pred)
```

```
[1 0 0 1 0 0 0 0 0 0 0 0 1 0 1 1 1 0 1 0 1 1 1 1 1 1 1 0 1 1 1 0 0 1 0 0 0
 0 1 1 0 1 1 1 1 1 1 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 1 0 0 0 0 1 1 1 1 1 1 0
 0 0 0 1 0 0 0 0 1 0 1 0 1 0 1 0 0 0 1 1 1 0 0 0 1 1 1 1 0 0 1 0 1 0 1 1
 0 1 0 1 0 1 0 0 1 0 1 1 0 0 1 1 1 1 0 0 0 1 1 1 0 0 1 0 1 1 0 1 0 0 1 1 1
 1 0 1 1 1 0 0 0 1 1 0 0 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 0 1 1 0 0 1 0 0 1
 0 1 0 1 0 0 1 0 1 0 1 1 1 0 0 1 1 1 0 1]
```

In [ ]:

```

```