CHAPTER-1DataHandlingusingPandas–I

Pandas:

- Itisapackageusefulfordataanalysisandmanipulation.
- Pandas provide an easy way to create, manipulate and wrangle the data.
- Pandas provide powerful and easy-to-use data structures, as well as the means to quickly perform operations on these structures.

DatascientistsusePandasforitsfollowingadvantages:

- Easilyhandlesmissingdata.
- It usesSeries for one-dimensional data structureandDataFrame for multi-dimensional data structure.
- Itprovidesanefficientwaytoslicethedata.
- It provides a flexible way to merge, concatenate or reshape thedata.

DATASTRUCTUREINPANDAS

A data structure is a way to arrange the data in such a way that so it can be accessed quickly and we can perform various operation on this data like- retrieval, deletion, modification etc.

Pandasdealswith3datastructure-

1. Series
2. Data Frame
3. Panel

Wearehavingonlyseriesanddataframeinoursyllabus.

Series

Series-Series is a one-dimensional array like structure with homogeneous data, which can be used to handle and manipulate data. What makes it special is its index attribute, which has incredible functionality and is heavily mutable.

Ithastwo parts-

1. **Datapart(Anarrayofactual data)**
2. **Associatedindexwithdata(associatedarrayofindexesordatalabels)**

e.g.-

Index	Data
0	10
1	15
2	18
3	22

- ✓ We can say that **Series** is a labeled *one-dimensionalarray which can hold any type of data.*
- ✓ Dataof**Series**is*alwaysmutable*,meansitcanbechanged.
- ✓ But the size of Data of **Series**is *alwaysimmutable*, means it cannot be changed.
- ✓ **Series** may be considered as a **Data Structure with two arrays**out which **one array** works as *Index(Labels)* and the **second array**works as *original Data.*
- ✓ ***RowLabels***inSeriesarecalled*Index*.

SyntaxtocreateaSeries:

<SeriesObject>=pandas.Series(data,index=idx*(optional)*)

- ✓ Wheredatamaybe*pythonsequence(Lists)*,ndarray, scalar value or a python dictionary.

HowtocreateSerieswithndarray

Program-

```
importpandasas pd
importnumpyas np
arr=np.array([10,15,18,22])
s= pd.Series(arr)
print(s)
```

DefaultIndex

Output-

0 10
1 15
2 18
3 22

Data

Herewecreatean array of 4 values.

HowtocreateSerieswithMutableindex

Program-

```
importpandasas pd
import numpy as np
arr=np.array(['a','b','c','d'])
s=pd.Series(arr,
   index=['first','second','third','fourth'])
print(s)
```

Output-

```
firsta
secondb
thirdc
```

CreatingaseriesfromScalarvalue

Tocreateaseriesfromscalarvalue,anindexmustbeprovided.Thescalar value will be repeated as per the length of index.

```
import pandas as pd
s = pd.Series(50, index =[0, 1, 2, 3, 4])
print(s)

```

```
0    50
1    50
2    50
3    50
4    50
dtype: int64
```

CreatingaseriesfromaDictionary

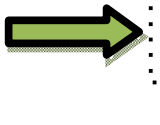
```
# import the pandas lib as pd
import pandas as pd

# create a dictionary
d = {'Name' : 'Hardik', 'Iplteam' : 'MI', 'Runs' : 1500}

# create a series
s = pd.Series(d)

print(s)

```

```
Name       Hardik
Iplteam        MI
Runs         1500
dtype: object
```

MathematicalOperationsinSeries

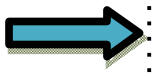
```
import pandas as pd
s=pd.Series([1,2,3,4,5])
print('To Multiply all values in a series by 2')
print('-----------------------------------------------------')
print(s*2)
print('To Find the Square of  all the values in a series ')
print('-----------------------------------------------------')
print(s**2)
print('To print all the values in a series that are greater than 2')
print('-----------------------------------------------------')
print(s[s>2])
```

```
To Multiply all values in a series by 2
-----------------------------------------------------
0     2
1     4
2     6
3     8
4    10
dtype: int64
To Find the Square of  all the values in a series
-----------------------------------------------------
0     1
1     4
2     9
3    16
4    25
dtype: int64
To print all the values in a series that are greater than 2
-----------------------------------------------------
2    3
3    4
4    5
dtype: int64
```



PrintallthevaluesoftheSeriesbymultiplyingthemby2.

PrintSquareofallthevaluesoftheseries.



PrintallthevaluesoftheSeriesthataregreaterthan2.

Example - 2

```
import pandas as pd
s1=pd.Series([1,2,3,4,5],index=['a','b','c','d','e'])
s2=pd.Series([10,20,30,40,50],index=['a','b','c','d','e'])
s3=pd.Series([5,14,23,32],index=['a','b','c','d'])
print('To Add Series1 & series2')
print('-----------------------------------------------------')
print(s1+s2)
print('To Add Series2 & Series3')
print('-----------------------------------------------------')
print(s2+s3)
print('To Add Series2 & series3 and Filled Non Matching Index with 0')
print('-----------------------------------------------------')
print(s2.add(s3,fill_value=0))
```

```
To Add Series1 & series2
-----------------------------------------------------
a    11
b    22
c    33
d    44
e    55
dtype: int64
To Add Series2 & Series3
-----------------------------------------------------
a    15.0
b    34.0
c    53.0
d    72.0
e     NaN
dtype: float64
To Add Series2 & series3 and Filled Non Matching Index with 0
-----------------------------------------------------
a    15.0
b    34.0
c    53.0
d    72.0
e    50.0
dtype: float64
```

While adding two series, if Non-Matching Index is found in either of the Series, Then NaN will be printed corresponds to Non-Matching Index.

If Non-Matching Index is found in either of the series, then this Non-Matching Index corresponding value of that series will be filled as 0.

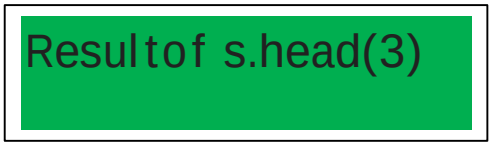
HeadandTailFunctionsinSeries

head (): It is used to access the first 5 rows of a series.

Note:Toaccessfirst3rowswecancallseries_name.head(3)

```
:
1  import pandas as pd
2  import numpy as np
3  arr=np.array([10,15,18,22,55,77,42,48,97])
4  # create a series from array
5  s = pd.Series(arr)
6  # to print fiest 5 rows
7  print (s.head())
8  # To print first 3 rows
9  print(s.head(3))
```

```
0    10
1    15
2    18
3    22
4    55
dtype: int32
0    10
1    15
2    18
dtype: int32
```



tail(): It is used to access the last 5 rows of a series.

Note:Toaccesslast4rowswecancallseries_name.tail(4)

```
import pandas as pd
import numpy as np
arr=np.array([10,15,18,22,55,77,42,48,97])
# create a series from array
s = pd.Series(arr)
# to print last 5 rows
print (s.tail())
# To print last 4 rows
print(s.tail(4))
```

```
4    55
5    77
6    42
7    48
8    97
dtype: int32
5    77
6    42
7    48
8    97
dtype: int32
```

SelectioninSeries

Seriesprovidesindexlabellocandilocand[]toaccessrowsand columns.

1. locindexlabel:-

Syntax:-

series_name.loc[StartRange:StopRange]Example-

```
1 import pandas as pd
2 import numpy as np
3 arr=np.array([10,15,18,22,55,77])
4 s = pd.Series(arr)
5 print(s)
6 print(s.loc[:2])
7 print(s.loc[3:4])
8 s.loc[2:3]
```

ToPrintValuesfromIndex0to2

ToPrintValuesfromIndex3to4

```
0    10
1    15
2    18
3    22
4    55
5    77
dtype: int32
0    10
1    15
2    18
dtype: int32
3    22
4    55
dtype: int32

2    18
3    22
dtype: int32
```

2. SelectionUsingilocindexlabel:-

Syntax:-

series_name.iloc[StartRange:StopRange]Example-

```
1 import pandas as pd
2 import numpy as np
3 arr=np.array([10,15,18,22,55,77])
4 s = pd.Series(arr)
5 print(s)
6 print(s.iloc[:2])
7 print(s.iloc[3:4])
8 s.iloc[2:3]
```

ToPrintValuesfromIndex0to1.

```
0    10
1    15
2    18
3    22
4    55
5    77
dtype: int32
0    10
1    15
dtype: int32
3    22
dtype: int32

2    18
dtype: int32
```

3. SelectionUsing[]:

Syntax:-series_name[StartRange>:StopRange]or

series_name[index]

Example-

```
1  import pandas as pd
2  import numpy as np
3  arr=np.array([10,15,18,22,55,77])
4  s = pd.Series(arr)
5  print(s)
6  print(s[1])
7  print('\n')
8  print(s[3:4])
9  s[:3]
```

ToPrintValuesatIndex3.

```
0    10
1    15
2    18
3    22
4    55
5    77
dtype: int32
15


3    22
dtype: int32

0    10
1    15
2    18
dtype: int32
```

IndexinginSeries

Pandasprovideindexattributetogetorsettheindexofentriesorvalues in series.

Example-

```
:
1  import pandas as pd
2  import numpy as np
3  arr=np.array(['a','b','c','d'],)
4  s=pd.Series(arr,index=['first','second','third','fourth'])
5  print(s)
6  # To print only indexes in series
7  print('\n indexes in Series are:::')
8  print(s.index)
9
```

```
first     a
second    b
third     c
fourth    d
dtype: object

 indexes in Series are:::
Index(['first', 'second', 'third', 'fourth'], dtype='object')
```

SlicinginSeries

Slicing is a way to retrieve subsets of data from a pandas object. A slice object syntax is –

SERIES_NAME[start:end:step]

The segments start representing the first item, end representing thelast item, and step representing the increment between each item thatyou would like.

Example:-

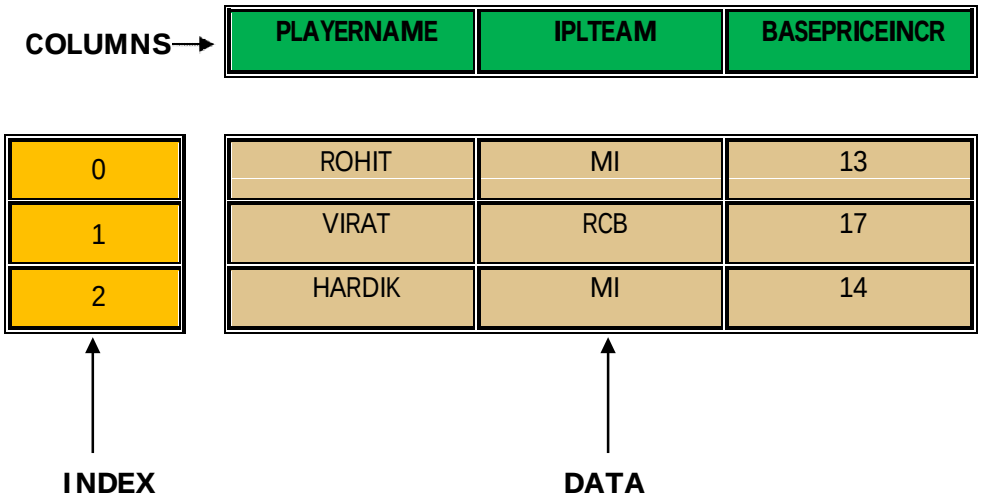
```
import pandas as pd
import numpy as np
arr=np.array([10,15,18,22,55,77])
s = pd.Series(arr,index=['A','B','C','D','E','F'])
print(s)
print(s[1:5:2])
print(s[0:6:2])

```

```
A    10
B    15
C    18
D    22
E    55
F    77
dtype: int32
B    15
D    22
dtype: int32
A    10
C    18
E    55
dtype: int32
```

DATAFRAME

DATAFRAME-It is a two-dimensional object that is usefulin representing data in the form of rows and columns.It is similar to a spreadsheet or an SQL table. This is the most commonly used pandas object. Once we store the data into the Dataframe, we can perform various operations that are useful in analyzing and understanding the data.

DATAFRAME STRUCTURE



PROPERTIESOFDATAFRAME

1. ADataframehasaxes(indices)-
   - Rowindex(axis=0)
   - Columnindex(axes=1)
2. It is similar to a spreadsheet , whose row index is called index and column index is called column name.
3. ADataframecontainsHeterogeneousdata.
4. ADataframeSizeisMutable.
5. ADataframeDataisMutable.

Adataframecanbecreatedusinganyofthe following-

1. **Series**
2. **Lists**
3. **Dictionary**
4. **Anumpy2D array**

How to create Empty Dataframe

```
: import pandas as pd
df=pd.DataFrame()
print(df)
```

```
Empty DataFrame
Columns: []
Index: []
```

HowtocreateDataframeFromSeries

Program -

```
importpandasas pd

s=pd.Series(['a','b','c','d'])

df=pd.DataFrame(s)

print(df)
```

Output -

```
   0
0  a
1  b
2  c
3  d
```

DefaultColumnNameAs0

DataFramefromDictionaryofSeries

Example-

```
import pandas as pd
name=pd.Series(['Hardik','Virat'])
team=pd.Series(['MI','RCB'])
dic={'Name':name,'Team':team}
df=pd.DataFrame(dic)
print(df)
```

```
     Name Team
0  Hardik   MI
1   Virat  RCB
```

DataFramefromListofDictionaries

Example-

```
import pandas as pd
l = [{'Name': 'Sachin', 'SirName':'Bhardwaj'},
     {'Name': 'Vinod', 'SirName':'Verma'},
     {'Name': 'Rajesh', 'SirName':'Mishra'}]
df1=pd.DataFrame(l)
print(df1)
```

```
     Name   SirName
0  Sachin  Bhardwaj
1   Vinod     Verma
2  Rajesh    Mishra
```

IterationonRowsandColumns

If we want to access record or data from a data frame row wise or column wise then iteration is used. Pandas provide 2 functions to perform iterations-

1. iterrows()
2. iteritems()

iterrows()

Itisusedtoaccessthedatarowwise. Example-

```
import pandas as pd
l = [{'Name': 'Sachin', 'SirName':'Bhardwaj'},
     {'Name': 'Vinod', 'SirName':'Verma'}]
df1=pd.DataFrame(l)
print(df1)
for(row_index,row_value) in df1.iterrows():
    print('\n Row index is ::',row_index)
    print('Row Value is::')
    print(row_value)
```

```
     Name   SirName
0  Sachin  Bhardwaj
1   Vinod     Verma

 Row index is :: 0
Row Value is::
Name          Sachin
SirName    Bhardwaj
Name: 0, dtype: object

 Row index is :: 1
Row Value is::
Name        Vinod
SirName     Verma
Name: 1, dtype: object
```

iteritems()

It is used to access the data column wise.

Example-

```
import pandas as pd
l = [{'Name': 'Sachin', 'SirName':'Bhardwaj'},
     {'Name': 'Vinod', 'SirName':'Verma'}]
df1=pd.DataFrame(l)
print(df1)
for(col_name,col_value) in df1.iteritems():
    print('\n')
    print('Column Name is ::',col_name)
    print('Column Values are::')
    print(col_value)
```

```
     Name   SirName
0  Sachin  Bhardwaj
1   Vinod     Verma


Column Name is :: Name
Column Values are::
0    Sachin
1     Vinod
Name: Name, dtype: object


Column Name is :: SirName
Column Values are::
0    Bhardwaj
1       Verma
Name: SirName, dtype: object
```

Selectoperationindataframe

Toaccessthecolumndata,wecanmentionthecolumnnameas subscript.

e.g.-df[empid]Thiscanalsobedonebyusingdf.empid.

Toaccessmultiplecolumnswecanwriteasdf[[col1,col2,---]]

Example-

```
import pandas as pd
empdata={ 'empid':[101,102,103,104,105,106],
          'ename':['Sachin','Vinod','Lakhbir','Anil','Devinder','UmaSelvi'],
          'Doj':['12-01-2012','15-01-2012','05-09-2007','17-01- 2012','05-09-2007','16-01-2012'] }
df=pd.DataFrame(empdata)
print(df)
```

```
   empid     ename         Doj
0    101    Sachin   12-01-2012
1    102     Vinod   15-01-2012
2    103   Lakhbir   05-09-2007
3    104      Anil  17-01- 2012
4    105  Devinder   05-09-2007
5    106  UmaSelvi   16-01-2012
```

```
>>df.empidordf['empid']
0    101
1    102
2    103
3    104
4    105
5    106
Name:empid,dtype:int64

>>df[['empid','ename']]
   empid          ename
0    101         Sachin
1    102          Vinod
2    103        Lakhbir
3    104           Anil
4    105       Devinder
5    106       UmaSelvi
```

ToAdd&Renameacolumnindata frame

```
importpandasas pd

s=pd.Series([10,15,18,22]) df=pd.DataFrame(s)

df.columns=['List1'] ⟶ To Rename the default column of Data
                       Frame as List1

df['List2']=20 ⟶ TocreateanewcolumnList2withallvalues as 20

df['List3']=df['List1']+df['List2']
        ↓
AddColumn1andColumn2andstorein

Newcolumn List3

print(df)
```

Output-

	List1	List2	List3
0	10	20	30
1	15	20	35
2	18	20	38
3	22	20	42

ToDeleteaColumnindataframe

Wecandeletethecolumnfromadataframebyusinganyof the the following –

1. del
2. pop()
3. drop()

>>del df['List3'] ⟶Wecansimplydeleteacolumnbypassing columnnameinsubscriptwithdf

>>df

Output-

	List1	List2
0	10	20
1	15	20
2	18	20
3	22	20

>>df.pop('List2') ⟶ wecansimplydeleteacolumnbypassingcolumn name in pop method.

>>df

	List1
0	10
1	15
2	18
3	22

ToDeleteaColumnUsingdrop()

```
importpandasas pd
s=pd.Series([10,20,30,40])
df=pd.DataFrame(s)
df.columns=['List1']
df['List2']=40
df1=df.drop('List2',axis=1)  ⟶ (axis=1)meanstodeleteData
                                column wise
df2=df.drop(index=[2,3],axis=0) ⟶ (axis=0)meanstodelete
                                datarowwisewithgivenindex
print(df)
print("Afterdeletion::")
print(df1)
print("Afterrowdeletion::")
print(df2)
```

```
Output-
   List1  List2
0    10    40
1    20    40
2    30    40
3    40    40
Afterdeletion::
   List1
0    10
1    20
2    30
3    40
Afterrowdeletion::
   List1
0    10
1    20
```

Accessing the data frame through loc() andiloc()methodorindexingusingLabels

Pandasprovideloc()andiloc()methodstoaccessthesubsetfroma data frame using row/column.

Accessingthedataframethroughloc()

Itisusedtoaccessagroupofrowsandcolumns.

Syntax-

Df.loc[StartRow:EndRow,StartColumn:EndColumn]

Note-If wepass:in roworcolumnpartthenpandasprovide the entirerows or columns respectively.

```
1  import pandas as pd
2  Runs={ 'TCS': { 'Qtr1':2500,'Qtr2':2000,'Qtr3':3000,'Qtr4':2000},
3
4          'WIPRO': {'Qtr1':2800,'Qtr2':2400,'Qtr3':3600,'Qtr4':2400},
5
6          'L&T': { 'Qtr1':2100,'Qtr2':5700,'Qtr3':35000,'Qtr4':2100}}
7  df=pd.DataFrame(Runs)
8  print(df)
9  print(df.loc['Qtr3', : ])
10 print(df.loc['Qtr1':'Qtr3', : ])
11
```

Toaccessasinglerow

```
       TCS  WIPRO    L&T
Qtr1  2500   2800   2100
Qtr2  2000   2400   5700
Qtr3  3000   3600  35000
Qtr4  2000   2400   2100
TCS       3000
WIPRO     3600
L&T      35000
Name: Qtr3, dtype: int64
       TCS  WIPRO    L&T
Qtr1  2500   2800   2100
Qtr2  2000   2400   5700
Qtr3  3000   3600  35000
```

ToaccessmultipleRowsQtr1toQtr3

Example2:-

```
import pandas as pd
Runs={ 'TCS': { 'Qtr1':2500,'Qtr2':2000,'Qtr3':3000,'Qtr4':2000},

        'WIPRO': {'Qtr1':2800,'Qtr2':2400,'Qtr3':3600,'Qtr4':2400},

        'L&T': { 'Qtr1':2100,'Qtr2':5700,'Qtr3':35000,'Qtr4':2100}}
df=pd.DataFrame(Runs)
print(df)
print(df.loc[ : ,'TCS' ])
print(df.loc[ : , 'TCS':'WIPRO'])
```

Toaccesssinglecolumn

ToaccessMultipleColumnnamelyTCSandWIPRO

```
       TCS  WIPRO    L&T
Qtr1  2500   2800   2100
Qtr2  2000   2400   5700
Qtr3  3000   3600  35000
Qtr4  2000   2400   2100
Qtr1    2500
Qtr2    2000
Qtr3    3000
Qtr4    2000
Name: TCS, dtype: int64
       TCS  WIPRO
Qtr1  2500   2800
Qtr2  2000   2400
Qtr3  3000   3600
Qtr4  2000   2400
```

Example-3

```
1 import pandas as pd
2 empdata={ 'empid':[101,102,103,104,105,106],
3           'ename':['Sachin','Vinod','Lakhbir','Anil','Devinder','UmaSelvi'],
4           'Doj':['12-01-2012','15-01-2012','05-09-2007','17-01- 2012','05-09-2007','16-01-2012'] }
5 df=pd.DataFrame(empdata)
6 print(df)
7 print(df.loc[0])
8 df.loc[0:2]
```

Toaccessfirstrow

Toaccessfirst3Rows

```
   empid     ename          Doj
0    101    Sachin   12-01-2012
1    102     Vinod   15-01-2012
2    103   Lakhbir   05-09-2007
3    104      Anil  17-01- 2012
4    105  Devinder   05-09-2007
5    106  UmaSelvi   16-01-2012
empid           101
ename        Sachin
Doj      12-01-2012
Name: 0, dtype: object
```

	empid	ename	Doj
0	101	Sachin	12-01-2012
1	102	Vinod	15-01-2012
2	103	Lakhbir	05-09-2007

Accessingthedataframethroughiloc()

Itis usedtoaccessagroupofrowsandcolumnsbasedonnumeric index value.

Syntax-

Df.loc[StartRowindexs:EndRowindex,StartColumnindex:EndColumnindex]

Note -If we pass : in row or column part then pandas providethe entire rows or columns respectively.

```
1  import pandas as pd
2  Runs={ 'TCS': { 'Qtr1':2500,'Qtr2':2000,'Qtr3':3000,'Qtr4':2000},
3
4          'WIPRO': {'Qtr1':2800,'Qtr2':2400,'Qtr3':3600,'Qtr4':2400},
5
6          'L&T': { 'Qtr1':2100,'Qtr2':5700,'Qtr3':35000,'Qtr4':2100}}
7  df=pd.DataFrame(Runs)
8  print(df)
9  print(df.iloc[0 :2 ,1:2 ])
10 print(df.iloc[ : , 0:2])
11
```

ToaccessFirsttwoRowsand Second column

ToaccessallRowsandFirstTwo columns Record

```
       TCS  WIPRO    L&T
Qtr1  2500   2800   2100
Qtr2  2000   2400   5700
Qtr3  3000   3600  35000
Qtr4  2000   2400   2100
      WIPRO
Qtr1   2800
Qtr2   2400
       TCS  WIPRO
Qtr1  2500   2800
Qtr2  2000   2400
Qtr3  3000   3600
Qtr4  2000   2400
```

head()andtail()Method

Themethodhead()givesthefirst5rowsandthemethodtail() returns the last 5 rows.

```
importpandasaspd
empdata={'Doj':['12-01-2012','15-01-2012','05-09-2007',
                '17-01-2012','05-09-2007','16-01-2012'],
         'empid':[101,102,103,104,105,106],
         'ename':['Sachin','Vinod','Lakhbir','Anil','Devinder','UmaSelvi']
         }
df=pd.DataFrame(empdata)
print(df)
print(df.head())
print(df.tail())
```

Output-

```
          Dojempid     ename
0  12-01-2012    101    Sachin
1  15-01-2012    102     Vinod
2  05-09-2007    103   Lakhbir  ------> Data Frame
3  17-01-2012    104      Anil
4  05-09-2007    105  Devinder
5  16-01-2012    106  UmaSelvi
```

```
          Dojempid     ename
0  12-01-2012    101    Sachin
1  15-01-2012    102     Vinod  ------> head()displaysfirst5rows
2  05-09-2007    103   Lakhbir
3  17-01-2012    104      Anil
4  05-09-2007    105  Devinder
```

```
          Dojempid     ename
1  15-01-2012    102     Vinod
2  05-09-2007    103   Lakhbir
3  17-01-2012    104      Anil  ------> tail()displaylast5rows
4  05-09-2007    105  Devinder
5  16-01-2012    106  UmaSelvi
```

To display first 2 rows we can use head(2) and to returns last2 rows we can use tail(2) and to return 3rdto 4throw we can write df[2:5].

```
importpandasaspd
empdata={'Doj':['12-01-2012','15-01-2012','05-09-2007',
                '17-01-2012','05-09-2007','16-01-2012'],
         'empid':[101,102,103,104,105,106],
         'ename':['Sachin','Vinod','Lakhbir','Anil','Devinder','UmaSelvi']
         }
df=pd.DataFrame(empdata)
print(df)
print(df.head(2))
print(df.tail(2))
print(df[2:5])
```

Output-

```
          Dojempid      ename
0  12-01-2012    101     Sachin
1  15-01-2012    102      Vinod
2  05-09-2007    103    Lakhbir
3  17-01-2012    104       Anil
4  05-09-2007    105Devinder
5    16-01-2012    106UmaSelvi
```

```
          Doj   empidename
0  12-01-2012    101Sachin
1  15-01-2012    102   Vinod
```

→ head(2)displaysfirst2rows

```
          Dojempid      ename
4  05-09-2007    105Devinder
5  16-01-2012    106UmaSelvi
```

→ tail(2)displayslast2rows

```
          Dojempid      ename
2  05-09-2007    103    Lakhbir
3  17-01-2012    104       Anil
4  05-09-2007    105Devinder
```

→ df[2:5]display2ndto4throw

BooleanIndexinginDataFrame

Boolean indexing helps us to select the data from the DataFramesusing a boolean vector. We create a DataFrame with a boolean index to use the boolean indexing.

```
1  import pandas as pd
2  dic= {
3         'Name': ['Sachin Bhardwaj', 'Vinod Verma', 'Rajesh Mishra'],
4         'Age': [32, 35, 40]
5      }
6  # creating a DataFrame with boolean index vector
7  df = pd.DataFrame(dic, index = [True, False, True])
8  print(df)
9  print(df.loc[True])
10 print()
11 print('Result of iloc method')
12 print(df.iloc[1])
```

ToReturnDataframewhereindexis True

Wecanpassonlyintegervalueiniloc

```
                 Name  Age
True   Sachin Bhardwaj   32
False      Vinod Verma   35
True     Rajesh Mishra   40
                 Name  Age
True  Sachin Bhardwaj   32
True    Rajesh Mishra   40

Result of iloc method
Name    Vinod Verma
Age              35
dtype: object
```

Concatoperationindataframe

Pandas provides various facilities for easily combining together**Series, DataFrame.**

```
pd.concat(objs,axis=0,join='outer',join_axes=None,ignore_index=False)
```

- **objs**–Thisisasequenceormappingofseries,DataFrame,or Panel objects.
- **axis**–{0,1,...},default0.Thisistheaxistoconcatenatealong.
- **join**–{'inner','outer'},default'outer'.Howtohandleindexeson otheraxis(es).Outerforunionandinnerforintersection.
- **ignore_index**– boolean, default False. If True, do not use the index values on the concatenation axis. The resulting axis will be labeled 0, ..., n - 1.
- **join_axes**–This is the list of Index objects. Specific indexes to use for the other (n-1) axes instead of performing inner/outer set logic.

TheConcat()performsconcatenationoperationsalonganaxis.

Example-1

```
1  import pandas as pd
2  dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
3          'Value2': ['B', 'D', 'F', 'H', 'J']}
4  dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
5          'Value2': ['L', 'N', 'P', 'R', 'T']}
6  df1=pd.DataFrame(dic1)
7  df2=pd.DataFrame(dic2)
8  df3=pd.concat([df1,df2])
9  print(df3)
10
```

```
  id Value1 Value2
0  1      A      B
1  2      C      D
2  3      E      F
3  4      G      H
4  5      I      J
0  2      K      L
1  3      M      N
2  6      O      P
3  7      Q      R
4  8      S      T
```

Example-2

```
1  import pandas as pd
2  dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
3          'Value2': ['B', 'D', 'F', 'H', 'J']}
4  dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
5          'Value2': ['L', 'N', 'P', 'R', 'T']}
6  df1=pd.DataFrame(dic1)
7  df2=pd.DataFrame(dic2)
8  df3=pd.concat([df1,df2],ignore_index=True)
9  print(df3)
10
```

```
  id Value1 Value2
0  1      A      B
1  2      C      D
2  3      E      F
3  4      G      H
4  5      I      J
5  2      K      L
6  3      M      N
7  6      O      P
8  7      Q      R
9  8      S      T
```

If you want the row labels to adjust automatically according to the join, you will have to set the argument ignore_index as True while calling the concat() function.

Example-3

```
1  import pandas as pd
2  dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
3          'Value2': ['B', 'D', 'F', 'H', 'J']}
4  dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
5          'Value2': ['L', 'N', 'P', 'R', 'T']}
6  df1=pd.DataFrame(dic1)
7  df2=pd.DataFrame(dic2)
8  merge={'Data1':df1,'Data2':df2}
9  df3=pd.concat(merge)
10 print(df3)
11
```

```
        id Value1 Value2
Data1 0  1      A      B
      1  2      C      D
      2  3      E      F
      3  4      G      H
      4  5      I      J
Data2 0  2      K      L
      1  3      M      N
      2  6      O      P
      3  7      Q      R
      4  8      S      T
```

pandas also provides you with an option to label the DataFrames, after the concatenation, with a key so that you may know which data came from which DataFrame.

Example-4

```
1  import pandas as pd
2  dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
3          'Value2': ['B', 'D', 'F', 'H', 'J']}
4  dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
5          'Value2': ['L', 'N', 'P', 'R', 'T']}
6  df1=pd.DataFrame(dic1)
7  df2=pd.DataFrame(dic2)
8  df3=pd.concat([df1,df2],axis=1)
9  print(df3)
10
```

```
  id Value1 Value2 id Value1 Value2
0  1      A      B  2      K      L
1  2      C      D  3      M      N
2  3      E      F  6      O      P
3  4      G      H  7      Q      R
4  5      I      J  8      S      T
```

To concatenate DataFrames along column, you can specify the axis parameter as 1.

Mergeoperationindataframe

Two DataFrames might hold different kinds of information about the same entity and linked by some common feature/column. To join these DataFrames,pandas provides multiple functions like merge(), join() etc.

Example-1

```
1  import pandas as pd
2  dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
3          'Value2': ['B', 'D', 'F', 'H', 'J']}
4  dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
5          'Value2': ['L', 'N', 'P', 'R', 'T']}
6  dic3 = {'id': ['1', '2', '3', '4', '5', '7', '8', '9', '10', '11'],
7          'Value3': [12, 13, 14, 15, 16, 17, 15, 12, 13, 23]}
8  df1=pd.DataFrame(dic1)
9  df2=pd.DataFrame(dic2)
10 df3=pd.concat([df1,df2])
11 df4=pd.DataFrame(dic3)
12 df5=pd.merge(df3,df4,on='id')
13 print(df5)
```

	id	Value1	Value2	Value3
0	1	A	B	12
1	2	C	D	13
2	2	K	L	13
3	3	E	F	14
4	3	M	N	14
5	4	G	H	15
6	5	I	J	16
7	7	Q	R	17
8	8	S	T	15

This will give the common rows between thetwo data frames for the corresponding columnvalues (‘id’).

Example-2

```
import pandas as pd
dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
        'Value2': ['B', 'D', 'F', 'H', 'J']}
dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
        'Value2': ['L', 'N', 'P', 'R', 'T']}
dic3 = {'id': ['1', '2', '3', '4', '5', '7', '8', '9', '10', '11'],
        'Value3': [12, 13, 14, 15, 16, 17, 15, 12, 13, 23]}
df1=pd.DataFrame(dic1)
df2=pd.DataFrame(dic2)
df3=pd.concat([df1,df2])
df4=pd.DataFrame(dic3)
df5=pd.merge(df3,df4,left_on='id', right_on='id')
print(df5)
```

	id	Value1	Value2	Value3
0	1	A	B	12
1	2	C	D	13
2	2	K	L	13
3	3	E	F	14
4	3	M	N	14
5	4	G	H	15
6	5	I	J	16
7	7	Q	R	17
8	8	S	T	15

It might happen that the column on whichyou want to merge the Data Frames havedifferent names (unlike in this case). Forsuch merges, you will have to specify theargumentsleft_onastheleftDataFramena me andright_onas the right DataFramename.

Joinoperationindataframe

I tisusedtomergedataframesbasedonsomecommoncolumn/key.

1. Full Outer Join:- The full outer join combines the results ofboth the left and the right outer joins. The joined data frame willcontain all records from both the data frames and fill in NaNs formissing matches on either side. You can perform a full outer join byspecifying the how argument as outer in merge() function.

Example-

```
:
1  import pandas as pd
2  dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
3          'Value2': ['B', 'D', 'F', 'H', 'J']}
4  dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
5          'Value2': ['L', 'N', 'P', 'R', 'T']}
6  df1=pd.DataFrame(dic1)
7  df2=pd.DataFrame(dic2)
8  df3=pd.merge(df1,df2,on='id',how='outer')
9  print(df3)
```

	id	Value1_x	Value2_x	Value1_y	Value2_y
0	1	A	B	NaN	NaN
1	2	C	D	K	L
2	3	E	F	M	N
3	4	G	H	NaN	NaN
4	5	I	J	NaN	NaN
5	6	NaN	NaN	O	P
6	7	NaN	NaN	Q	R
7	8	NaN	NaN	S	T

The resulting DataFrame had allthe entries from both the tableswith NaN valuesformissingmatches on either side. However,one more thing to notice is thesuffix which got appended to thecolumnnamestoshowwhich columncame from which DataFrame. Thedefaultsuffixesare x and y,however, you can modify them byspecifyingthe suffixes

Example-2

```
import pandas as pd
dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
        'Value2': ['B', 'D', 'F', 'H', 'J']}
dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
        'Value2': ['L', 'N', 'P', 'R', 'T']}
df1=pd.DataFrame(dic1)
df2=pd.DataFrame(dic2)
df3=pd.merge(df1, df2, left_on='id',right_on='id',how='outer',suffixes=('_left','_right'))
print(df3)
```

```
  id Value1_left Value2_left Value1_right Value2_right
0  1          A          B         NaN          NaN
1  2          C          D           K            L
2  3          E          F           M            N
3  4          G          H         NaN          NaN
4  5          I          J         NaN          NaN
5  6        NaN        NaN           O            P
6  7        NaN        NaN           Q            R
7  8        NaN        NaN           S            T
```

2. Inner Join:- The inner join produce only those records thatmatch in both the data frame. You have to pass inner in how argumentinside merge() function.

Example-

```
import pandas as pd
dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
        'Value2': ['B', 'D', 'F', 'H', 'J']}
dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
        'Value2': ['L', 'N', 'P', 'R', 'T']}
df1=pd.DataFrame(dic1)
df2=pd.DataFrame(dic2)
df3=pd.merge(df1, df2, on='id', how='inner')
print(df3)
```

```
  id Value1_x Value2_x Value1_y Value2_y
0  2        C        D        K        L
1  3        E        F        M        N
```

3. RightJoin:-Theright join produce a complete set of recordsfrom data frame B(Right side Data Frame) with the matching records(whereavailable) in data frameA(Left side data frame). If thereis nomatch right side will contain null. You have to pass right in howargument inside merge() function.

Example-

```
import pandas as pd
dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
        'Value2': ['B', 'D', 'F', 'H', 'J']}
dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
        'Value2': ['L', 'N', 'P', 'R', 'T']}
df1=pd.DataFrame(dic1)
df2=pd.DataFrame(dic2)
df3=pd.merge(df1, df2, on='id', how='right')
print(df3)
```

```
  id Value1_x Value2_x Value1_y Value2_y
0  2        C        D        K        L
1  3        E        F        M        N
2  6      NaN      NaN        O        P
3  7      NaN      NaN        Q        R
4  8      NaN      NaN        S        T
```

4. Left Join:- Theleft join produce a complete set of recordsfrom data frame A(Left side Data Frame) with the matching records(where available) in data frame B(Right side data frame). If there isno match left side will contain null. You have to pass left in howargument inside merge() function.

Example-

```
import pandas as pd
dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
        'Value2': ['B', 'D', 'F', 'H', 'J']}
dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
        'Value2': ['L', 'N', 'P', 'R', 'T']}
df1=pd.DataFrame(dic1)
df2=pd.DataFrame(dic2)
df3=pd.merge(df1, df2, on='id', how='left')
print(df3)
```

```
  id Value1_x Value2_x Value1_y Value2_y
0  1        A        B      NaN      NaN
1  2        C        D        K        L
2  3        E        F        M        N
3  4        G        H      NaN      NaN
4  5        I        J      NaN      NaN
```

5. JoiningonIndex:-Sometimes you havetoperformthejoinon the indexes or the row labels. For that you have to specifyright_index(for the indexes of the right data frame) and left_index(for the indexes of left data frame) as True.

Example-

```
import pandas as pd
dic1= { 'id': ['1', '2', '3', '4', '5'],'Value1': ['A', 'C', 'E', 'G', 'I'],
        'Value2': ['B', 'D', 'F', 'H', 'J']}
dic2= {'id': ['2', '3', '6', '7', '8'],'Value1': ['K', 'M', 'O', 'Q', 'S'],
        'Value2': ['L', 'N', 'P', 'R', 'T']}
df1=pd.DataFrame(dic1)
df2=pd.DataFrame(dic2)
df3= pd.merge(df1, df2, right_index=True, left_index=True)
print(df3)
```

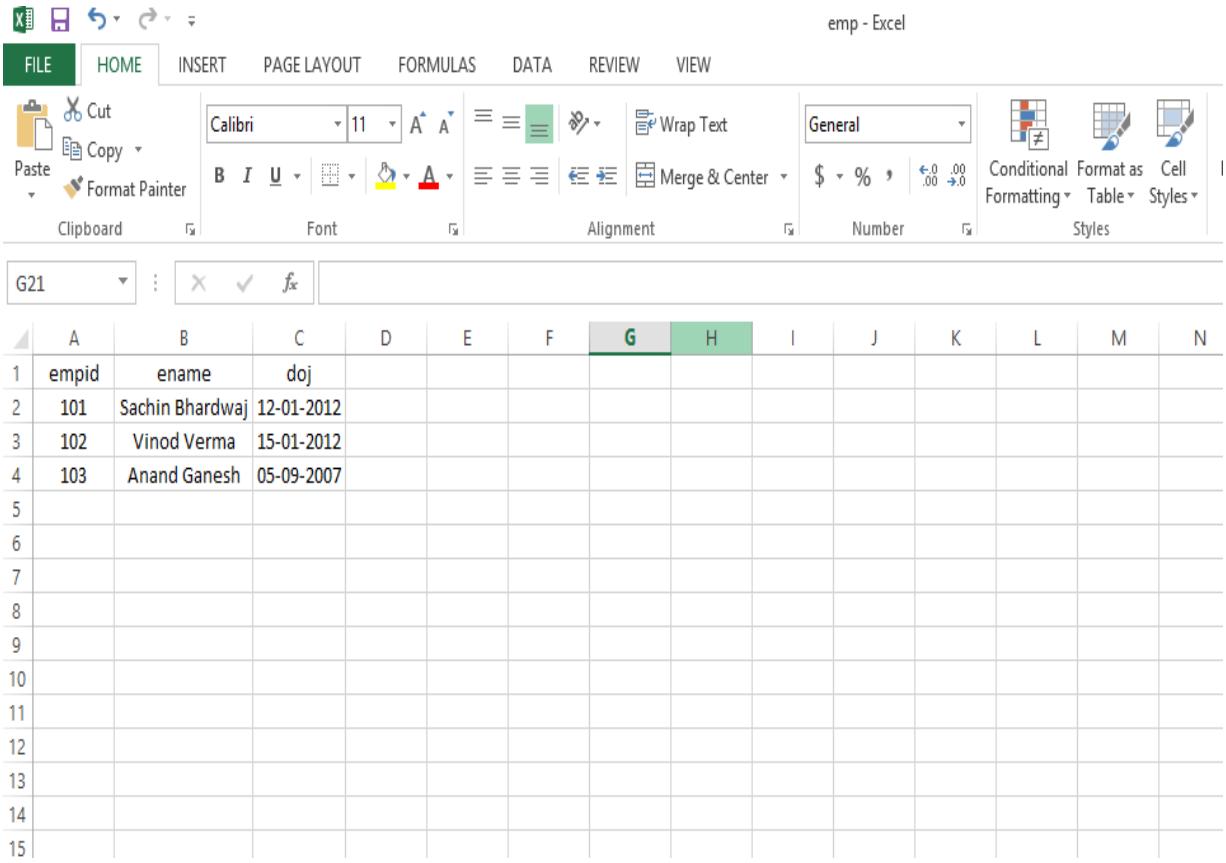
```
  id_x Value1_x Value2_x id_y Value1_y Value2_y
0    1        A        B    2        K        L
1    2        C        D    3        M        N
2    3        E        F    6        O        P
3    4        G        H    7        Q        R
4    5        I        J    8        S        T
```

CSV File

A CSV is a comma separated values file, which allows data to be saved in a tabular format. CSV is a simple file such as a spreadsheet or database. Files in the csv format can be imported and exported from programs that store data in tables, such as Microsoft excel or Open Office.

CSV files data fields are most often separated, or delimited by a comma. Here the data in eachrow are delimited by comma and individual rows are separated by newline.

To create a csv file, first choose your favorite text editor such as- Notepad and open a new file. Then enter the text data you want the file to contain, separating each value with a comma and each row with a new line. Save the file with the extension.csv. You can open thefile using MS Excel or another spread sheet program. It will create the table of similar data.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	empid	ename	doj											
2	101	Sachin Bhardwaj	12-01-2012											
3	102	Vinod Verma	15-01-2012											
4	103	Anand Ganesh	05-09-2007											
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														

pd.read_csv()methodisusedtoreadacsvfile.

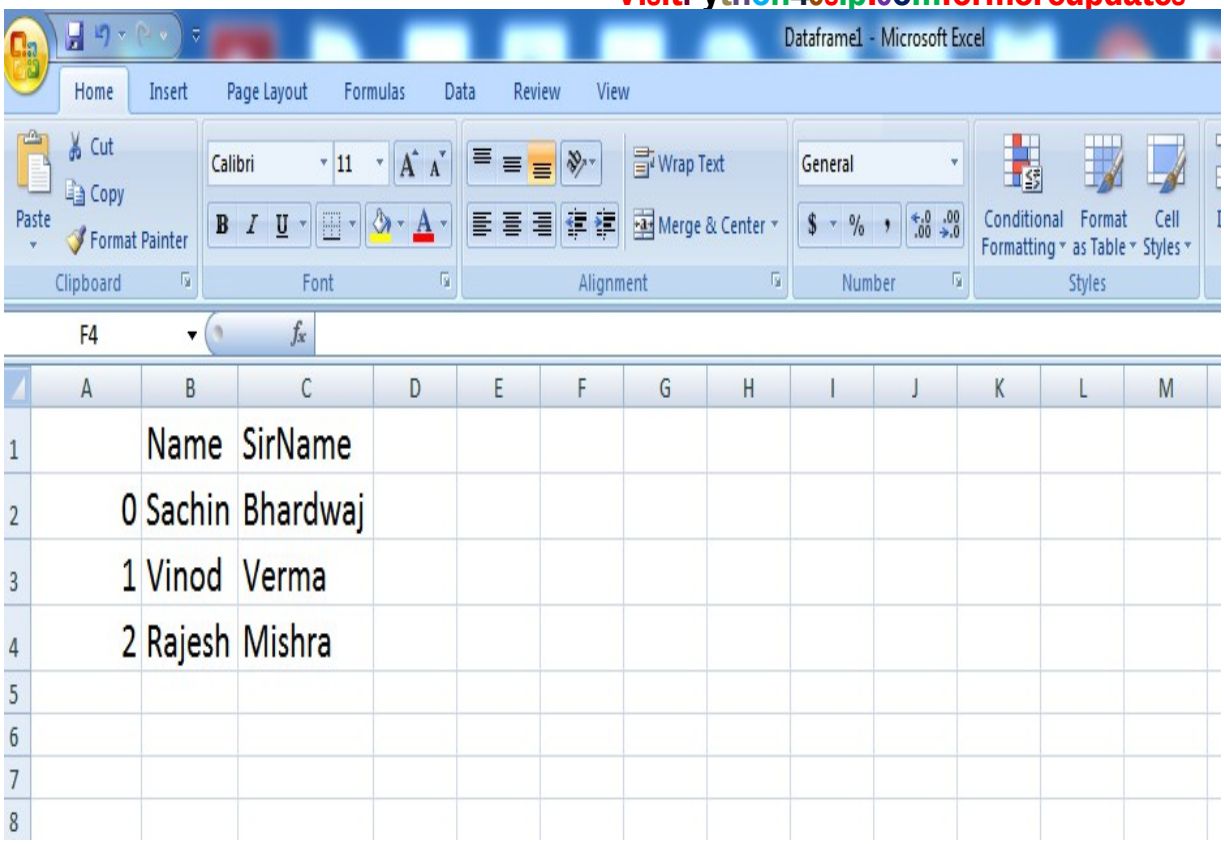
```
1  # importing pandas module
2  import pandas as pd
3  # making data frame
4  df = pd.read_csv("E:\emp.csv")
5  print(df)
6
```

```
   empid           ename         doj
0    101  Sachin Bhardwaj  12-01-2012
1    102      Vinod Verma  15-01-2012
2    103     Anand Ganesh  05-09-2007
```

Exportingdatafromdataframeto CSV File

To export a data frame into a csv file first of all, we create a data frame say df1 and use dataframe.to_csv(' E:\Dataframe1.csv ') method to exportdata frame df1 into csv file Dataframe1.csv.

```
1 import pandas as pd
2 l = [{'Name': 'Sachin', 'SirName':'Bhardwaj'},
3      {'Name': 'Vinod', 'SirName':'Verma'},
4      { 'Name': 'Rajesh','SirName':'Mishra'}]
5 df1=pd.DataFrame(l)
6 # saving the dataframe
7 df1.to_csv('E:\Dataframe1.csv')
```



Andnowthecontentofdf1isexportedtocsvfile Dataframe1.