M.Sc.IT Information TechnologySemester- I

Data Science

Submited By

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SEAT NO: _____

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This is to certify that **Prashant Dnyaneshwar Shingade** Student of M.Sc.ITPart I (Sem-I) with Seat No.____and college enrolled Roll no.**211532** has satisfactorily completed the practical work in Information Technology Laboratory for the Course in the program of INFORMATION TECHNOLOGY from the UNIVERSITY OF MUMBAI for the academic year 2021-2022 .

Subject In-Charge: _____ HOD:

Examiner: _____

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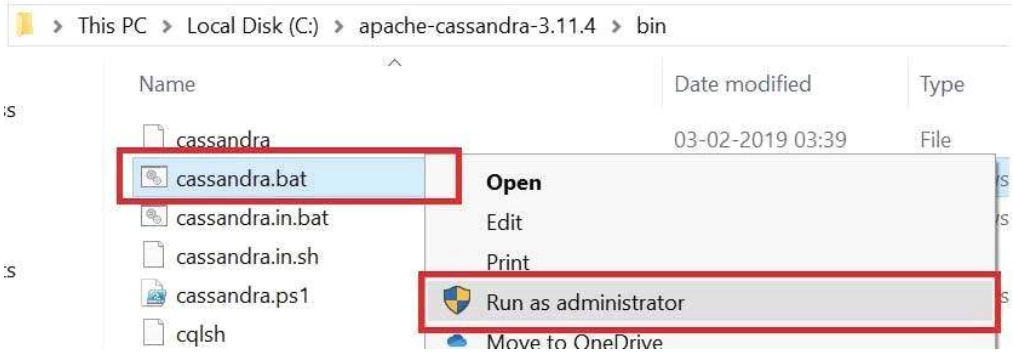
Practical 1:

Creating Data Model using Cassandra.

Go to Cassandra directory C:\apache-cassandra-3.11.4\bin



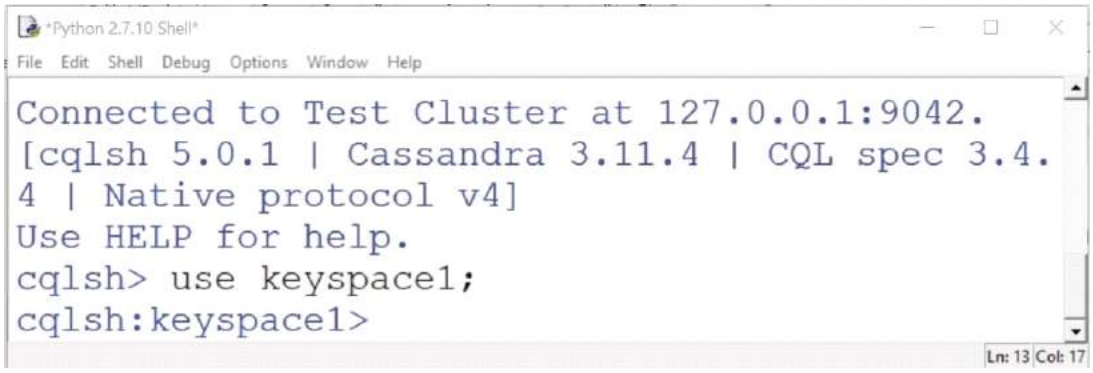
Run Cassandra.bat file

Open C:\apache-cassandra-3.11.4\bin\cqlsh.py with python 2.7 and run

Creating a Keyspace using Cqlsh

Create keyspace keyspace1 with replication = {'class':'SimpleStratergy', 'replication_factor': 3};

Use keyspace1;



Create table dept (dept_id int PRIMARY KEY, dept_name text, dept_loc text);
Create table emp (emp_id int PRIMARY KEY, emp_name text, dept_id int, emailtext, phone text);

Insert into dept (dept_id, dept_name, dept_loc) values (1001, 'Accounts', 'Mumbai');Insert into dept (dept_id, dept_name, dept_loc) values (1002, 'Marketing', 'Delhi'); Insert into dept (dept_id, dept_name, dept_loc) values (1003, 'HR', 'Chennai');

Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1001, 'ABCD', 1001, 'abcd@company.com', '1122334455');
Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1002, 'DEFG', 1001, 'defg@company.com', '2233445566');
Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1003, 'GHIJ',1002,

'ghij@company.com', '3344556677');

Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1004, 'JKLM', 1002, 'jklm@company.com', '4455667788');

Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1005, 'MNOP', 1003,'mnop@company.com', '5566778899');

Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1006, 'MNOP', 1003, 'mnop@company.com', '5566778844');

```
cqlsh:keyspace1> select * from emp;

 emp_id | dept_id | email             | emp_name | phone
--------+---------+-------------------+----------+------------
   1006 |    1003 | mnop@company.com |     MNOP | 5566778844
   1004 |    1002 | jklm@company.com |     JKLM | 4455667788
   1005 |    1003 | mnop@company.com |     MNOP | 5566778899
   1001 |    1001 | abcd@company.com |     ABCD | 1122334455
   1003 |    1002 | ghij@company.com |     GHIJ | 3344556677
   1002 |    1001 | defg@company.com |     DEFG | 2233445566

(6 rows)
```

```
cqlsh:keyspace1> select * from dept;

 dept_id | dept_loc | dept_name
---------+----------+-----------
    1001 |   Mumbai |  Accounts
    1003 |  Chennai |        HR
    1002 |    Delhi | Marketing

(3 rows)
```

update dept set dept_name='Human Resource' where dept_id=1003;

```
cqlsh:keyspace1> select * from dept;

 dept_id | dept_loc | dept_name
---------+----------+----------------
    1001 |   Mumbai |       Accounts
    1003 |  Chennai | Human Resource
    1002 |    Delhi |      Marketing

(3 rows)
```

```
cqlsh:keyspace1> delete from emp where emp_id=1006;
cqlsh:keyspace1> select * from emp;

 emp_id | dept_id | email             | emp_name | phone
--------+---------+-------------------+----------+------------
   1004 |    1002 | jklm@company.com |     JKLM | 4455667788
   1005 |    1003 | mnop@company.com |     MNOP | 5566778899
   1001 |    1001 | abcd@company.com |     ABCD | 1122334455
   1003 |    1002 | ghij@company.com |     GHIJ | 3344556677
   1002 |    1001 | defg@company.com |     DEFG | 2233445566

(5 rows)
```

Practical 2:

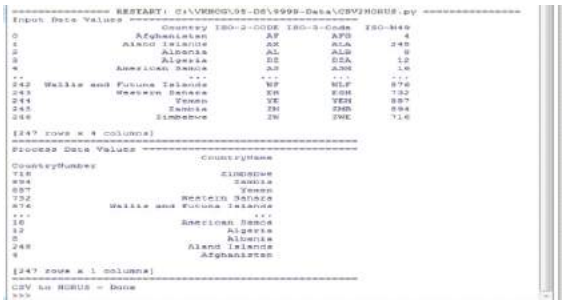
Write Python / R Program to convert from the following formats to HORUS format:

- **Text delimited CSVto HORUS format.Code:**

```
# Utility Start CSV to HORUS ================================
# Standard
Tools import
pandas as pd#
Input
Agreement
=========================================
sInputFileName='C:/VKHCG/05-DS/9999-Data/Country_Code.csv'
InputData=pd.read_csv(sInputFileName,encoding="latin-1") print('Input
Data Values ==================================')
print(InputData)
print('================================================
====
=')
# Processing Rules ========================================
ProcessData=InputData
# Remove columns ISO-2-Code and ISO-3-
CODE ProcessData.drop('ISO-2-CODE',
axis=1,inplace=True)ProcessData.drop('ISO-3-
Code',  axis=1,inplace=True) # Rename Country
and ISO-M49
ProcessData.rename(columns={'Country': 'CountryName'},
inplace=True) ProcessData.rename(columns={'ISO-M49':
'CountryNumber'}, inplace=True)# Set new Index
ProcessData.set_index('CountryNumber',
inplace=True)# Sort data by CurrencyNumber
ProcessData.sort_values('CountryName', axis=0, ascending=False,
inplace=True) print('Process Data Values
==================================') print(ProcessData)
print('================================================
=')
# Output Agreement
=========================================

OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-CSV-Country.csv'
OutputData.to_csv(sOutputFileName, index = False)
print('CSV to HORUS - Done')
# Utility done
=========================================
```

Output:



- **XML to HORUS**

FormatCode:

```
# Utility Start XML to HORUS ==================================
# Standard Tools import
pandas aspd import
xml.etree.ElementTree as ET
def df2xml(data):
    header = data.columns     root
= ET.Element('root')
                                  f
or rowin
range(data.shape[0]):
        entry =
ET.SubElement(root,'entry')for
index in range(data.shape[1]):
            schild=str(header[index]
) child = ET.SubElement(entry,
schild)if str(data[schild][row])
!= 'nan': child.text =
str(data[schild][row]) else:
                child.text =
'n/a' entry.append(child)

                                resu
lt =ET.tostring(root)
                                retur
n result def
xml2df(xml_data):
root =
ET.XML(xml_data)
all_records = []     for i,
child inenumerate(root):
        record = {}         forsubchild in child:
```

```
            record[subchild.tag] =
subchild.text
all_records.append(record)
    return pd.DataFrame(all_records)


sInputFileName='C:/VKHCG/05-DS/9999-Data/Country_Code.xml'

InputData = open(sInputFileName).read()
print('================================================
=') print('Input Data Values ===================================')
print('================================================
=') print(InputData)
print('================================================
=')
#================================================================
=
=
# Processing Rules
==========================================
#=========================================================
====
=
=
ProcessDataXML=Inpu
tData# XML to Data
Frame
ProcessData=xml2df(ProcessDataXML)
# Remove columns ISO-2-Code and ISO-3-
CODE ProcessData.drop('ISO-2-CODE',
axis=1,inplace=True)ProcessData.drop('ISO-3-
Code',  axis=1,inplace=True) # Rename Country
and ISO-M49
ProcessData.rename(columns={'Country': 'CountryName'},
inplace=True) ProcessData.rename(columns={'ISO-M49':
'CountryNumber'}, inplace=True)# Set new Index
ProcessData.set_index('CountryNumber',
inplace=True)# Sort data by CurrencyNumber
ProcessData.sort_values('CountryName', axis=0, ascending=False,
inplace=True)
print('================================================
====
=') print('Process Data Values ================================')
print('================================================
```

=') print(ProcessData)
print('==========
=') OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-XML-Country.csv'
OutputData.to_csv(sOutputFileName, index = False)
print('==========
=') print('XML to HORUS - Done')
print('==========
=') # Utility done
========== **Output:**

- **JSON to HORUS**

  FormatCode:

  # Utility Start JSON to HORUS ==========
  # Standard Tools
  #==========
  ====
  =
  =
  import pandas
  as pd# Input
  Agreement
  ==========
  sInputFileName='C:/VKHCG/05-DS/9999-Data/Country_Code.json'
  InputData=pd.read_json(sInputFileName, orient='index',
  encoding="latin-1")print('Input Data Values
  ==========')

```
print(InputData)
print('================================================
=
=')
# Processing Rules ============================================
ProcessData=InputData
# Remove columns ISO-2-Code and ISO-3-
CODE ProcessData.drop('ISO-2-CODE',
axis=1,inplace=True)ProcessData.drop('ISO-3-
Code',  axis=1,inplace=True) # Rename Country
and ISO-M49
ProcessData.rename(columns={'Country': 'CountryName'},
inplace=True) ProcessData.rename(columns={'ISO-M49':
'CountryNumber'}, inplace=True)# Set new Index
ProcessData.set_index('CountryNumber',
inplace=True)# Sort data by CurrencyNumber

ProcessData.sort_values('CountryName', axis=0, ascending=False,
inplace=True) print('Process Data Values
==================================') print(ProcessData)
print('================================================
===') # Output Agreement
==========================================
OutputData=ProcessData
sOutputFileName='c:/VKHCG/05-DS/9999-Data/HORUS-JSON-Country.csv'
OutputData.to_csv(sOutputFileName, index = False)
print('JSON to HORUS - Done')
# Utility done
```

```
>>>
============== RESTART: C:\VKHCG\05-DS\9999-Data\JSON2HORUS.py ==============
Input Data Values ===================================
                          Country ISO-2-CODE ISO-3-Code  ISO-M49
0                     Afghanistan          AF         AFG        4
1                   Aland Islands          AX         ALA      248
10                      Argentina          AR         ARG       32
100                       Hungary          HU         HUN      348
101                       Iceland          IS         ISL      352
..                            ...         ...         ...      ...
95                         Guyana          GY         GUY      328
96                          Haiti          HT         HTI      332
97      Heard and Mcdonald Islands          HM         HMD      334
98   Holy Seeÿ(Vatican City State)          VA         VAT      336
99                       Honduras          HN         HND      340

[247 rows x 4 columns]
================================================
Process Data Values =================================
                          CountryName
CountryNumber
716                          Zimbabwe
894                            Zambia
887                             Yemen
732                    Western Sahara
876             Wallis and Futuna Islands
...                               ...
16                      American Samoa
12                             Algeria
8                              Albania
248                      Aland Islands
4                          Afghanistan

[247 rows x 1 columns]
================================================
JSON to HORUS - Done
>>>
```

========== **Output:**

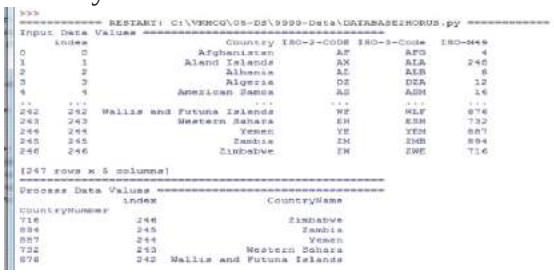
- **MySql Database to HORUS**

FormatCode:

```
# Utility Start Database to HORUS
================================ # Standard Tools
#=================================================
====
=
=
import pandas
as pd import
sqlite3 as sq #
Input
Agreement
==========================================
sInputFileName='C:/VKHCG/05-DS/9999-Data/utility.db'
sInputTable='Country_Code' conn = sq.connect(sInputFileName)
sSQL='select
* FROM ' + sInputTable + ';' InputData=pd.read_sql_query(sSQL,
conn) print('Input Data Values
==================================')
print(InputData)
print('=================================================
=')
# Processing Rules ========================================

ProcessData=InputData
# Remove columns ISO-2-Code and ISO-3-
CODE ProcessData.drop('ISO-2-CODE',
axis=1,inplace=True)ProcessData.drop('ISO-3-
Code', axis=1,inplace=True) # Rename Country
and ISO-M49
ProcessData.rename(columns={'Country': 'CountryName'},
inplace=True) ProcessData.rename(columns={'ISO-M49':
'CountryNumber'}, inplace=True)# Set new Index
ProcessData.set_index('CountryNumber',
inplace=True)# Sort data by CurrencyNumber
ProcessData.sort_values('CountryName', axis=0, ascending=False,
inplace=True) print('Process Data Values
==================================') print(ProcessData)
print('=================================================
=')
# Output Agreement
==========================================
OutputData=ProcessData
```

sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-CSV-Country.csv'
OutputData.to_csv(sOutputFileName, index = False)
print('Database to HORUS - Done')
# Utility done



========== **Output:**

- **Picture (JPEG) to HORUS**

FormatCode:

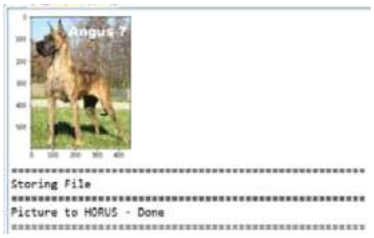
Utility Start Picture to HORUS
==========# Standard Tools
#==
=
=
from scipy.misc
import imread import
pandas as pdimport
matplotlib.pyplot as
plt
import numpy as np

Input Agreement
==========
sInputFileName='C:/VKHCG/05-DS/9999-Data/Angus.jpg'
InputData = imread(sInputFileName, flatten=False,
mode='RGBA')

print('Input Data Values
==========') print('X:
',InputData.shape[0]) print('Y:
',InputData.shape[1])print('RGBA: ',
InputData.shape[2])
print('==========
=')
# Processing Rules ==========
ProcessRawData=InputData.flatten()
y=InputData.shape[2] + 2
x=int(ProcessRawData.shape[0]/y)

```
ProcessData=pd.DataFrame(np.reshape(ProcessRawData, (x, y)))
sColumns= ['XAxis','YAxis','Red', 'Green', 'Blue','Alpha']
ProcessData.columns=sColumns
ProcessData.index.names =['ID']
print('Rows:
',ProcessData.shape[0])
print('Columns
:',ProcessData.shape[1])
print('==================================================
=') print('Process Data Values ================================')
print('==================================================
=') plt.imshow(InputData)
plt.show()
print('==================================================
=
=')
# Output Agreement
========================================
OutputData=ProcessD
ataprint('Storing File')
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Picture.csv'
OutputData.to_csv(sOutputFileName, index = False)
print('==================================================
=') print('Picture to HORUS - Done')
print('==================================================
=')
```

Output:



- **Video to HORUS Format Code:**

  Movie to Frames

```
# Utility Start Movie to HORUS (Part 1)
======================# Standard Tools
#============================================================
import os
```

```
import
shutil
import
cv2
#============================================================
sInputFileName='C:/VKHCG/05-DS/9999-
Data/dog.mp4' sDataBaseDir='C:/VKHCG/05-
DS/9999-Data/temp' if
os.path.exists(sDataBaseDir):
shutil.rmtree(sDataBaseDir) if not
os.path.exists(sDataBaseDir):
os.makedirs(sDataBaseDir)
print('=====================================================')
print('Start Movie to Frames')
print('=====================================================')
vidcap =
cv2.VideoCapture(sInputFileName)
success,image =
vidcap.read() count = 0 while
success:
success,image = vidcap.read() sFrame=sDataBaseDir + str('/dog-
frame-' +str(format(count, '04d'))+ '.jpg') print('Extracted: ', sFrame)
cv2.imwrite(sFrame, image) if os.path.getsize(sFrame) == 0:
count += -1 os.remove(sFrame)
print('Removed: ', sFrame) if
cv2.waitKey(10)
== 27: # exit if Escape is hit break count += 1
print('=====================================================')
print('Generated : ', count, ' Frames')
print('=====================================================')
print('Movie to Frames HORUS - Done')

print('================================================
===') # Utility done
================================================
```

Now frames are created and need to load them into HORUS.

Frames to Horus

```
# Utility Start Movie to HORUS (Part 2)
======================# Standard Tools
#============================================================
```

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```
from scipy.misc
import imread import
pandas as pdimport
matplotlib.pyplot as
plt import numpy as
np import os
# Input Agreement
==========================================
sDataBaseDir='C:/VKHCG/05-DS/9999-Data/temp' f=0 for
file inos.listdir(sDataBaseDir): if file.endswith(".jpg"):
f += 1
sInputFileName=os.path.join(sDataBaseDir, file)
print('Process : ', sInputFileName)
InputData = imread(sInputFileName, flatten=False, mode='RGBA')
print('Input Data Values
==================================') print('X:
',InputData.shape[0]) print('Y: ',InputData.shape[1])
print('RGBA: ',InputData.shape[2])
        print('================================================
===') # Processing Rules
========================================
ProcessRawData=InputData.flatten()
y=InputData.shape[2] + 2
x=int(ProcessRawData.shape[0]/y)
ProcessFrameData=pd.DataFrame(np.reshape(ProcessRawData, (x, y)))
ProcessFrameData['Frame']=file
print('================================================')
print('Process Data Values ================================')
print('================================================')
plt.imshow(InputData)
plt.show()
if f == 1:
ProcessData=ProcessFrameD
ataelse:
ProcessData=ProcessData.append(ProcessFrame
Data)if f > 0:
```



sColumns= ['XAxis','YAxis','Red',
'Green', 'Blue','Alpha','FrameName'] ProcessData.columns=sColumns
print('==========
===')
ProcessFrameData.index.names
=['ID'] print('Rows:
',ProcessData.shape[0])
print('Columns
:',ProcessData.shape[1])
print('==========
===') # Output Agreement
==========
OutputData=ProcessData
print('Storing File')
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Movie-Frame.csv'
OutputData.to_csv(sOutputFileName, index = False)
print('==========')
print('Processed ; ', f,' frames')
print('==========') print('Movie to
HORUS - Done')
print('==========')

Output:

dog-frame-0000.jpeg **dog-frame-0001.jpeg**

dog-frame-0100.jpeg **dog-frame-0101.jpeg**

Check the files from C:\VKHCG\05-DS\9999-Data\temp
The movie clip is converted into 102 picture frames and then to
HORUSformat. **G. Audio to HORUS Format Code:**

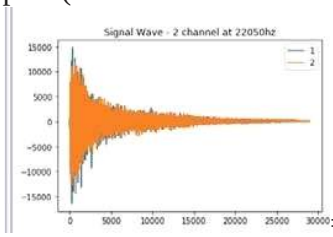
Utility Start Audio to HORUS ==========

```
# Standard Tools
#=========================================================
====
=
from scipy.io import
wavfileimport pandas
as pd import
matplotlib.pyplot as plt
import numpy as np
#=============================================================
= def
show_info(aname,
a,r):
   print ('----------------')     print
("Audio:", aname)     print ('------------
----')     print ("Rate:", r)     print ('-----
-----------')     print ("shape:",
a.shape)print ("dtype:", a.dtype)
                  print ("min,
max:", a.min(), a.max())
   print ('.....')plot_info(aname, a,r)
#=============================================================
= def
plot_info(aname,
a,r):
   sTitle= 'Signal Wave - '+ aname + ' at ' +
str(r) +'hz'          plt.title(sTitle)
        sLegend=[]        for c in
range(a.shape[1]):        sLabel = 'Ch' +
str(c+1) sLegend=sLegend+[str(c+1)]
        plt.plot(a[:,c], label=sLabel)
        plt.legend(sLegend)
        plt.show()
#=============================================================
=
sInputFileName='C:/VKHCG/05-DS/9999-Data/2ch-sound.wav'
print('=====================================================')
print('Processing : ', sInputFileName)
print('=====================================================')
InputRate, InputData =
wavfile.read(sInputFileName) show_info("2
channel", InputData,InputRate)
ProcessData=pd.DataFrame(InputData)
sColumns=['Ch1','Ch2']
```

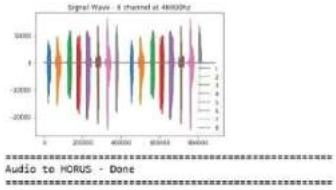
```
ProcessData.columns=sColumns OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-
Audio-

OutputData.to_csv(sOutputFileName, index = False)
#=========================================================
====
=
sInputFileName='C:/VKHCG/05-DS/9999-Data/4ch-sound.wav'
print('=====================================================')
print('Processing : ', sInputFileName)
print('=====================================================')
InputRate, InputData =
wavfile.read(sInputFileName) show_info("4
channel", InputData,InputRate)
ProcessData=pd.DataFrame(InputData)
sColumns=['Ch1','Ch2','Ch3', 'Ch4']
ProcessData.columns=sColumns
OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Audio-4ch.csv'
OutputData.to_csv(sOutputFileName, index = False)
#=========================================================
====
=
sInputFileName='C:/VKHCG/05-DS/9999-Data/6ch-sound.wav'
print('=====================================================')
print('Processing : ', sInputFileName)
print('=====================================================')
InputRate, InputData =
wavfile.read(sInputFileName) show_info("6
channel", InputData,InputRate)
ProcessData=pd.DataFrame(InputData)
sColumns=['Ch1','Ch2','Ch3', 'Ch4',
'Ch5','Ch6']
ProcessData.columns=sColumns
OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Audio-6ch.csv'
OutputData.to_csv(sOutputFileName, index = False)
#=========================================================
====
=
sInputFileName='C:/VKHCG/05-DS/9999-Data/8ch-sound.wav'
print('=====================================================')
print('Processing : ', sInputFileName)
print('=====================================================')
```

InputRate, InputData =
wavfile.read(sInputFileName)show_info("8
channel", InputData,InputRate)
ProcessData=pd.DataFrame(InputData)
sColumns= ['Ch1','Ch2','Ch3', 'Ch4', 'Ch5','Ch6','Ch7','Ch8']
ProcessData.columns=sColumns
OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Audio-8ch.csv'
OutputData.to_csv(sOutputFileName, index = False)

print('==========



==========') print('Audio to HORUS - Done') **Output:**



Practical 3: Utilities and Auditing

- **Fixers Utilities:**
  Fixers enable your solution to take your existing data and fix a specific qualityissue.

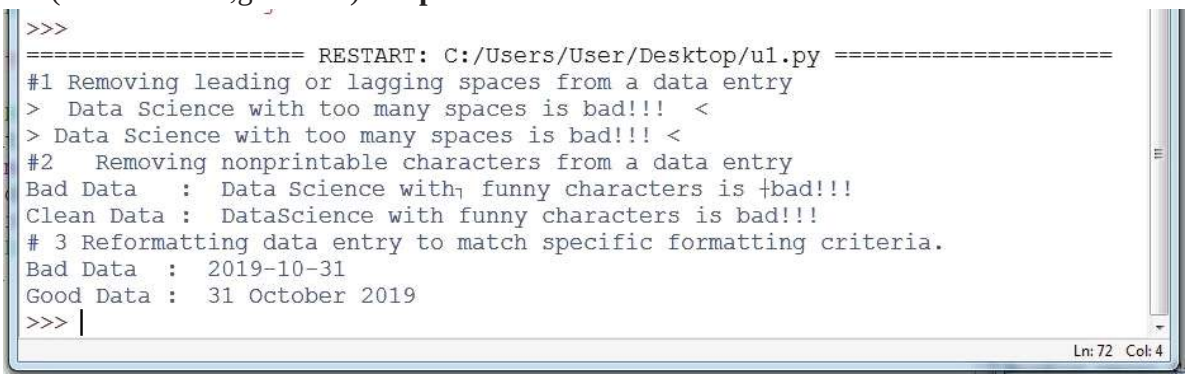
#---------- Program to Demonstrate Fixers utilities ----------
-- import string import datetime as dt
 # 1 Removing leading or lagging spaces from a data entryprint('#1 Removing leading or lagging spaces from a data entry'); baddata = " Data Science with too many spaces is bad!!! " print('>',baddata,'<') cleandata=baddata.strip() print('>',cleandata,'<')

 # 2 Removing nonprintable characters from a data entry print('#2 Removing nonprintable characters from a data entry')printable = set(string.printable) baddata = "Data\x00Science with\x02 funny characters is

\x10bad!!!" cleandata=".join(filter(lambda x: x in
string.printable,baddata)) print('Bad Data : ',baddata);
print('Clean Data : ',cleandata)

 # 3 Reformatting data entry to match specific formatting criteria.# Convert YYYY/MM/DD to DD Month YYYY
print('# 3 Reformatting data entry to match specific
formattingcriteria.') baddate = dt.date(2019, 10, 31)
baddata=format(baddate,'%Y-%m-%d') gooddate =

dt.datetime.strptime(baddata,'%Y-%m-%d')
gooddata=format(gooddate,'%d %B %Y') print('Bad Data : ',baddata)
print('Good Data : ',gooddate) **Output:**



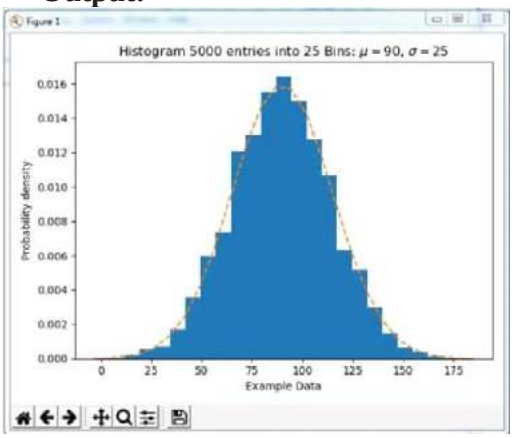
- **Data Binning or Bucketing**

Binning is a data preprocessing technique used to reduce the effects of minor observation errors. Statistical data binning is a way to group a number of more or less continuous valuesinto a smaller number of “bins.”

Code :
import numpy as np
import matplotlib.mlab
as mlab import
matplotlib.pyplot as plt
import scipy.stats as
stats np.random.seed(0)
# example data
mu = 90 # mean of distribution sigma =
25 #standard deviation of distribution x
= mu + sigma *
np.random.randn(5000) num_bins = 25

```
fig, ax =
plt.subplots() # the
histogram of the
data
n, bins, patches = ax.hist(x, num_bins, density=1)
# add a 'best fit' line y = stats.norm.pdf(bins, mu, sigma) # mlab.normpdf(bins, mu,
sigma)ax.plot(bins, y, '--') ax.set_xlabel('Example Data') ax.set_ylabel('Probability
density') sTitle=r'Histogram ' + str(len(x)) + ' entries into ' + str(num_bins) + ' Bins:
$\mu=' + str(mu)
+ '$, $\sigma=' +
str(sigma) + '$'
ax.set_title(sTitle)
fig.tight_layout()

sPathFig='C:/VKHCG/05-DS/4000-UL/0200-DU/DU-
Histogram.png' fig.savefig(sPathFig) plt.show()
```

Output:



- **Averaging of Data**

The use of averaging of features value enables the reduction of data volumes in acontrol fashion to improve effective data processing. C:\VKHCG\05-DS\4000- UL\0200-DU\DU-Mean.py **Code:**

```
import pandas as pd
#################################################################
#####
InputFileName='IP_DATA_CORE.csv'
OutputFileName='Retrieve_Router_Location.csv'
Base='C:/VKHCG'
print('#################################')
print('Working
```

```
Base :',Base, ' using ')
print('################################')
sFileName=Base
+ '/01-Vermeulen/00-RawData/' + InputFileName print('Loading
:',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
usecols=['Country','Place Name','Latitude','Longitude'], encoding="latin-
1") IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'},
inplace=True)AllData=IP_DATA_ALL[['Country',
'Place_Name','Latitude']]
print(AllData)
MeanData=AllData.groupby(['Country', 'Place_Name'])['Latitude'].mean()
print(MeanData)
################################################################
#####
```

Output:

Outlier Detection

Outliers are data that is so different from the rest of the data in the data set that it may becaused by an error in the data source. There is a technique called outlier detection that, with good data science, will identify these outliers. C:\VKHCG\05-DS\4000-UL\0200- DU\DU-Outliers.py **Code:**

```
################################################################
# -*- coding: utf-8 -*-
################################################################
#####
import pandas as pd
################################################################
InputFileName='IP_DATA_CORE.csv'
OutputFileName='Retrieve_Router_Location.csv'
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base)
print('################################')
################################################################
```

```
## sFileName=Base + '/01-Vermeulen/00-RawData/' +
    InputFileName print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
usecols=['Country','Place Name','Latitude','Longitude'], encoding="latin-
1") IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'},
inplace=True)
LondonData=IP_DATA_ALL.loc[IP_DATA_ALL['Place_Name']=='Lond
on'] AllData=LondonData[['Country',
'Place_Name','Latitude']] print('All Data') print(AllData)
MeanData=AllData.groupby(['Country', 'Place_Name'])['Latitude'].mean()
StdData=AllData.groupby(['Country', 'Place_Name'])['Latitude'].std()
print('Outliers')
UpperBound=float(MeanData+StdD
ata)print('Higher than ',
UpperBound)
OutliersHigher=AllData[AllData.Latitude>UpperBound
]print(OutliersHigher)
LowerBound=float(MeanData-
StdData)print('Lower than ',
LowerBound)
OutliersLower=AllData[AllData.Latitude<LowerBound]

print(OutliersLower)
print('Not Outliers')
OutliersNot=AllData[(AllData.Latitude>=LowerBound)
&(AllData.Latitude<=UpperBound)]
print(OutliersNot)
################################################################
#####
```

Output:

```
========== RESTART: C:\VKHCG\05-DS\4000-UL\0200-DU\DU-Outliers.py
==========
############################
#####
Working Base : C:/VKHCG
############################
#####
Loading : C:/VKHCG/01-Vermeulen/00-
RawData/IP_DATA_CORE.csvAll Data
    Country Place_Name  Latitude
1910      GB     London   51.5130
1911      GB     London   51.5508
1912      GB     London   51.5649
1913      GB     London   51.5895
```

1914 GB London 51.5232
... ...

[1502 rows x 3
columns]Outliers
Higher than
51.51263550786781
Country Place_Name
Latitude
1910 GB London 51.5130
1911 GB London 51.5508
1912 GB London 51.5649
1913 GB London 51.5895
1914 GB London 51.5232
1916 GB London 51.5491
1919 GB London 51.5161
1920 GB London 51.5198
1921 GB London 51.5198 1923 GB London 51.5237 1924 GB London 51.5237
Lower than
51.50617687562166
Country Place_Name
Latitude
1915 GB London 51.4739
Not Outliers
Country Place_Name Latitude

- **Logging**

Write a Python / R program for basic logging in data science.

C:\VKHCG\77-Yoke\Yoke_Logging.py **Code:**

```
import sys import os
import logging import
uuid import shutil
import time
################################################################
##### Base='C:/VKHCG'
################################################################
#####
sCompanies=['01-Vermeulen','02-Krennwallner','03-Hillman','04-
Clark'] sLayers=['01-Retrieve','02-Assess','03-Process','04-
Transform','05- Organise','06Report']
sLevels=['debug','info','warning','error']
```

```
for sCompany in
   sCompanies:
   sFileDir=Base + '/' +
   sCompany
if not os.path.exists(sFileDir):
       os.makedirs(sFil
eDir)for sLayer in
sLayers:
       log = logging.getLogger()  # root logger         forhdlr in log.handlers[:]: # remove all old handlers log.
       #-------------------------------------------------------------------------------
--         sFileDir=Base + '/' + sCompany + '/' + sLayer +
'/Logging'if os.path.exists(sFileDir):
           shutil.rmtree(sFileDir) time.sleep(2) if not
os.path.exists(sFileDir): os.makedirs(sFileDir)
           skey=str(uuid.uuid4())



       sLogFile=Base + '/' + sCompany + '/' +
sLayer +'/Logging/Logging_'+skey+'.log'
print('Set up:',sLogFile)
       # set up logging to file - see previous section for more details
       logging.basicConfig(level=logging.DEBUG,
format='%(asctime)s %(name)-12s %(levelname)-8s %(message)s',
datefmt='%m-%d %H:%M',
                           filename=sLogFile,
filemode='w')
       # define a Handler which writes INFO messages or higher
to thesys.stderrconsole = logging.StreamHandler()
console.setLevel(logging.INFO)
       # set a format which is simpler for console use
       formatter = logging.Formatter('%(name)-12s: %(levelname)-8s
       %(message)s')# tell the handler to use this format
console.setFormatter(formatter)         # add the
handler to the root logger
logging.getLogger('').addHandler(console)

        # Now, we can log to the root logger, or any other logger. First the root...
logging.info('Practical Data Science is fun!.')

       for sLevel in sLevels:
          sApp='Apllication-'+ sCompany + '-' + sLayer
+ '-' +sLevel    logger = logging.getLogger(sApp)             if sLevel == 'debug':
              logger.debug('Practical Data Science logged a debugging
message.')              if sLevel == 'info':                  logger.info('Practical
DataScience logged information message.')      if sLevel == 'warning':
```

```
        logger.warning('Practical Data Science logged a warning
message.')if sLevel == 'error':
        logger.error('Practical Data Science logged an error message.') #----------
        --
```

Output:

```
>>>
================= RESTART: C:\VKHCG\77-Yoke\Yoke_Logging.py =================
Set up: C:/VKHCG/01-Vermeulen/01-Retrieve/Logging/Logging_61705603-bb6e-47f0-b5a
9-23d42e267311.log
root        : INFO     Practical Data Science is fun!.
Apllication-01-Vermeulen-01-Retrieve-info: INFO     Practical Data Science logge
d information message.
Apllication-01-Vermeulen-01-Retrieve-warning: WARNING  Practical Data Science lo
gged a warning message.
Apllication-01-Vermeulen-01-Retrieve-error: ERROR    Practical Data Science logg
ed an error message.
Set up: C:/VKHCG/01-Vermeulen/02-Assess/Logging/Logging_a7fecb9b-4d40-474e-bc2d-
994958d85194.log
```

Practical 4

- Perform the following data processing using R.

Use R-Studio for the following:
>library(readr)
Warning message:package ‘readr’ was built under R version

3.4.4Load a table named IP_DATA_ALL.csv.

```
>IP_DATA_ALL <-
read_csv("C:/VKHCG/01-
Vermeulen/00RawData/IP_DATA_ALL.c
sv") Parsed with column specification:
cols(
  ID = col_double(),
  Country =
  col_character(),
  `Place Name` = col_character(),
  `Post Code` =
  col_double(),Latitude
  = col_double(),
  Longitude =
  col_double(),
  `First IP Number` = col_double(),
  `Last IP Number` = col_double()


>View(IP_DATA_ALL)
>spec(IP_DATA_
ALL)cols(
```

```
  ID = col_double(),
  Country =
  col_character(),
  `Place Name` = col_character(),
  `Post Code` =
  col_double(),Latitude
  = col_double(),
  Longitude =
  col_double(),
  `First IP Number` = col_double(),
  `Last IP Number` = col_double()
)
```

This informs you that you have the following eight columns:

- ID of type integer
- Place name of type character
- Post code of type character
- Latitude of type numeric double
- Longitude of type numeric double
- First IP number of type integer
- Last IP number of type integer

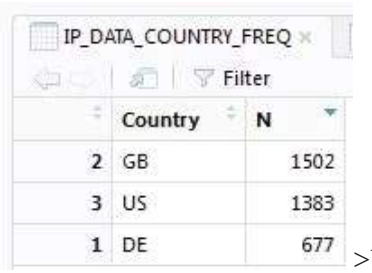
```
>library(tibble)
>set_tidy_names(IP_DATA_ALL, syntactic = TRUE, quiet =
FALSE)New names:
Place Name ->
Place.NamePost
Code -> Post.Code
First IP Number ->
First.IP.NumberLast IP
Number -> Last.IP.Number
```

This informs you that four of the field names are not valid and suggests new field names thatare valid.You can fix any detected invalid column names by executing IP_DATA_ALL_FIX=set_tidy_names(IP_DATA_ALL, syntactic = TRUE, quiet = TRUE) By using command View(IP_DATA_ALL_FIX), you can check that you have fixed thecolumns. The new table IP_DATA_ALL_FIX.csv will fix the invalid column names withvalid names.

```
>sapply(IP_DATA_ALL_FIX, typeof)
          ID        Country      Place.Name       Post.Code
                   Latitude "double"               "character"
                   "character"     "double"        "double"
     Longitude First.IP.Number
      Last.IP.Number"double"     "double"
                        "double"
>library(data.table)
```

>hist_country=data.table(Country=unique(IP_DATA_ALL_FIX[is.na(IP_DATA_ALL_
FIX ['Country']) == 0,]$Country))
>setorder(hist_country,'Country')

>View(hist_country_fix)
>IP_DATA_COUNTRY_FREQ=data.table(with(IP_DATA_ALL_FIX, table(Country)))


IP_DATA_COUNTRY_FREQ

Filter

	Country	N
2	GB	1502
3	US	1383
1	DE	677

>View(IP_DATA_COUNTRY_FREQ)

- The two biggest subset volumes are from the US and GB.
- The US has just over four times the data as GB.

hist_latitude
=data.table(Latitude=unique(IP_DATA_ALL_FIX
[is.na(IP_DATA_ALL_with_ID ['Latitude']) == 0,
]$Latitude)) setkeyv(hist_latitude, 'Latitude')
setorder(hist_latitude)
hist_latitude_with_id=rowid_to_column(hist_latitude, var
= "RowID")
View(hist_latitude_with_id)
IP_DATA_Latitude_FREQ=data.table(with(IP_DATA_ALL_FIX,table(Latitude)))
View(IP_DATA_Latitude_FREQ)

	Latitude	N
133	51.5092	1478
1	40.6888	130
107	48.15	114
9	40.7143	113

40.6888.

-
- The two biggest data volumes are from latitudes 51.5092 and

- The spread appears to be nearly equal between the top-two latitudes.

>sapply(IP_DATA_ALL_FIX[,'Latitude'], min,
na.rm=TRUE)Latitude 40.6888
What does this tell
you?
Fact: The range of latitude for the Northern Hemisphere is from 0 to 90. So, if you do not haveany latitudes farther south than 40.6888, you can improve your retrieve routine.

```
>sapply(IP_DATA_ALL_FIX[,'Country'], min,
na.rm=TRUE)Country         "DE"
```

Minimum business frequency is from DE – Denmark.

```
>sapply(IP_DATA_ALL_FIX[,'Latitude'], max,
na.rm=TRUE)Latitude
 51.5895
>sapply(IP_DATA_ALL_FIX[,'Country'], max, na.rm=TRUE)
Co
  u
  n
  t
  r
  y

  "
  U
  S
  "
```

The result is 51.5895. What does this tell you?

Fact: The range in latitude for the Northern Hemisphere is from 0 to 90. So, if you do not haveany latitudes more northerly than 51.5895, you can improve your retrieve routine.

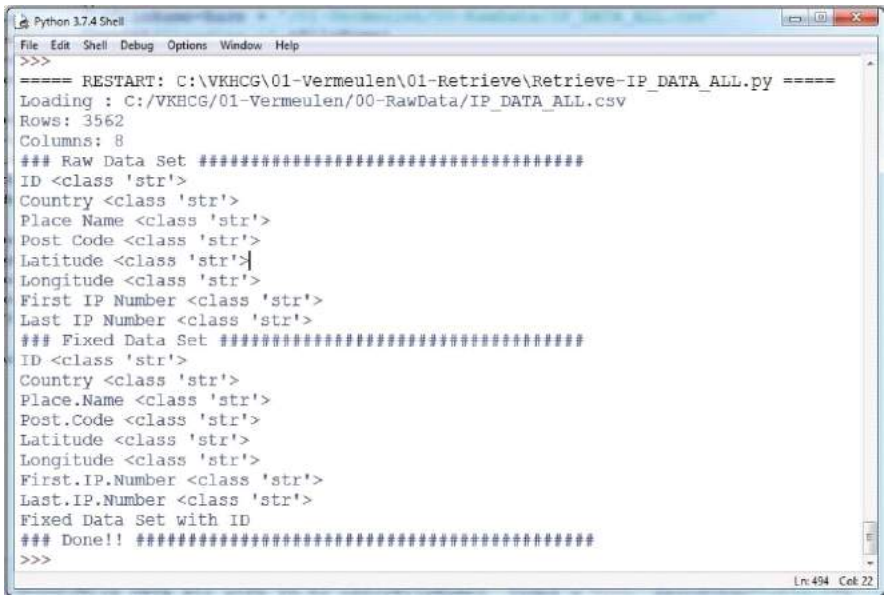
```
>sapply(IP_DATA_ALL_FIX [,'Latitude'], mean, na.rm=TRUE)
Latitude
46.69097
>sapply(IP_DATA_ALL_FIX [,'Latitude'], median, na.rm=TRUE)
Latitude
  48.15
>sapply(IP_DATA_ALL_FIX [,'Latitude'], range, na.rm=TRUE)
     Lati
tude
[1,]
40.688
8
[2,]  51.5895
>sapply(IP_DATA_ALL_FIX [,'Latitude'], quantile, na.rm=TRUE)
     Latitude
0%    40.6888
25%   40.7588
50%   48.1500
75%   51.5092
100% 51.5895
>sapply(IP_DATA_ALL_FIX [,'Latitude'], sd,
na.rm=TRUE)Latitude
```

4.890387
>sapply(IP_DATA_ALL_FIX [,'Longitude'], sd,
na.rm=TRUE)Longitude
38.01702

- **Program to retrieve different attributes of data.**

```
##### C:\ VKHCG\01-Vermeulen\01-Retrieve\Retrive_IP_DATA_ALL.py### import sys import os import pandas as pd
################################################################
##### Base='C:/VKHCG'
################################################################
###
## sFileName=Base + '/01-Vermeulen/00-RawData/IP_DATA_ALL.csv'
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
################################################################
#####
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-Python'if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)                print('Rows:', IP_DATA_ALL.shape[0])                print('Columns:', IP_DATA_ALL.shape[1])     print('### Raw Data Set ##################################')          for i in
range(0,len(IP_DATA_ALL.columns)):
    print(IP_DATA_ALL.columns[i],type(IP_DATA_ALL.columns[i]))

print('### Fixed Data Set ##################################')
IP_DATA_ALL_FIX=IP_DATA_ALL
for i in range(0,len(IP_DATA_ALL.columns)):
cNameOld=IP_DATA_ALL_FIX.columns[i] + '     '
cNameNew=cNameOld.strip().replace(" ", ".")
IP_DATA_ALL_FIX.columns.values[i] = cNameNew
print(IP_DATA_ALL.columns[i],type(IP_DATA_ALL.columns[i]))
################################################################
#####
#print(IP_DATA_ALL_FIX.head())
################################################################
#####
print('Fixed Data Set with ID')
IP_DATA_ALL_with_ID=IP_DATA_ALL_
FIX IP_DATA_ALL_with_ID.index.names =
['RowID']
#print(IP_DATA_ALL_with_ID.head())
```

```
sFileName2=sFileDir +
'/Retrieve_IP_DATA.csv'
IP_DATA_ALL_with_ID.to_csv(sFileName2, index = True,
encoding="latin-1")
#################################################################
### print('### Done!!
################################################')
#################################################################
###
```

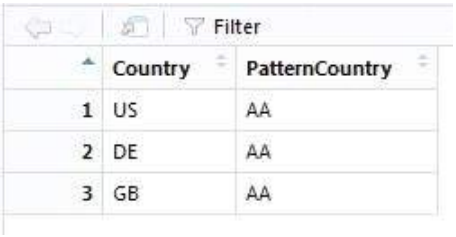


- Data Pattern

To determine a pattern of the data values, Replace all alphabet values with an uppercase case *A*, all numbers with an uppercase *N*, and replace any spaces with a lowercase letter *b* and all other unknown characters with a lowercase *u*. As a result, "Good Book 101" becomes "AAAAbAAAAbNNNu."This pattern creation is beneficial for designing any specific assess rules. This pattern view of data is a quick way to identify common patterns or determine standard layouts.

```
library(readr)

FileName=paste0('c:/VKHCG/01-Vermeulen/00-
RawData/IP_DATA_ALL.csv') IP_DATA_ALL <- read_csv(FileName)
hist_country=data.table(Country=unique(IP_DATA_ALL$Country))
pattern_country=data.table(Country=hist_country$Country,
PatternCountry=hist_country$Country)
oldchar=c(letters,LETTERS)
newchar=replicate(length(oldchar)
,"A")for (r in
seq(nrow(pattern_country))){
s=pattern_country[r,]$PatternCou
```

```
ntry; for (c in
seq(length(oldchar))){
   s=chartr(oldchar[c],newchar[c],s)
  };
  for (n in seq(0,9,1)){
   s=chartr(as.character(n),"N
   ",s)
  };
  s=chartr(" ","b",s)
s=chartr(".","u",s)
pattern_country[r,]$PatternCountry=
s;
};
View(pattern_country)
```



	Country	PatternCountry
1	US	AA
2	DE	AA
3	GB	AA

Example 2: This is a common use of patterns to separate common standards and structures. Pattern can be loaded in separate retrieve procedures. If the same two patterns, NNNNuNNuNN and uuNNuNNuNN, are found, you can send NNNNuNNuNN directly to be converted into a date, while uuNNuNNuNN goes through a quality-improvement process to then route back to the same queue as NNNNuNNuNN, once it complies.

```
library(readr)
library(data.t
able)
Base='C:/VK
HCG'
FileName=paste0(Base,'/01-Vermeulen/00-RawData/IP_DATA_ALL.csv')
IP_DATA_ALL <- read_csv(FileName)
hist_latitude=data.table(Latitude=unique(IP_DATA_ALL$Latitude))
pattern_latitude=data.table(latitude=hist_latitude$Latitude,

Patternlatitude=as.character(hist_latitude$Latitude))
oldchar=c(letters,LETTERS)
newchar=replicate(length(oldchar),"A") for (r in
seq(nrow(pattern_latitude))){

s=pattern_latitude[r,]$Patternlatitude;  for (c in
seq(length(oldchar))){
   s=chartr(oldchar[c],newchar[c],s)
```

```
  };
  for (n in seq(0,9,1)){
    s=chartr(as.character(n),"N
    ",s)
  };
  s=chartr(" ","b",s)
s=chartr("+","u",s)  s=chartr("-
","u",s) s=chartr(".","u",s)
pattern_latitude[r,]$Patternlatitude=s;
};
setorder(pattern_latitude,latit
ude)
View(pattern_latitude[1:3])
```

Filter

	latitude	Patternlatitude
1	40.6888	NNuNNNN
2	40.7038	NNuNNNN
3	40.7055	NNuNNNN

- Loading IP_DATA_ALL:

This data set contains all the IP address allocations in the world. It will help you to locateyourcustomers when interacting with them online.

Create a new Python script file and save it as Retrieve-IP_DATA_ALL.py in directoryC:\VKHCG\01-Vermeulen\01-Retrieve.

```
##############Retrieve-IP_DATA_ALL.py#########################
# -*- coding: utf-8 -*-
################################################################
#####
## import sys import os import pandas as pd
################################################################
#####Base='C:/VKHCG'
################################################################
###
##  sFileName=Base  +  '/01-Vermeulen/00-RawData/IP_DATA_ALL.csv'
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1")
#####################################################################
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
print('Rows:', IP_DATA_ALL.shape[0])
print('Columns:',IP_DATA_ALL.shape[1])
print('### Raw Data Set
```

```
#####################################') for i
in
range(0,len(IP_DATA_ALL.columns)):
   print(IP_DATA_ALL.columns[i],type(IP_DATA_ALL.columns[i]))

print('### Fixed Data Set ###################################')
IP_DATA_ALL_FIX=IP_DATA_ALL
for i in range(0,len(IP_DATA_ALL.columns)):
cNameOld=IP_DATA_ALL_FIX.columns[i] + '     ' cNameNew=cNameOld.strip().replace(" ", ".")
IP_DATA_ALL_FIX.columns.values[i] = cNameNew
   print(IP_DATA_ALL.columns[i],type(IP_DATA_ALL.columns[i]))
#print(IP_DATA_ALL_FIX.head())
print('Fixed Data Set with ID')
IP_DATA_ALL_with_ID=IP_DATA_ALL_
FIX IP_DATA_ALL_with_ID.index.names =
['RowID']
#print(IP_DATA_ALL_with_ID.head())

sFileName2=sFileDir + '/Retrieve_IP_DATA.csv'
IP_DATA_ALL_with_ID.to_csv(sFileName2, index = True,
encoding="latin-1")
#####################################################################
### print('### Done!!
#############################################')
#####################################################################
###
```

```
>>>
===== RESTART: C:\VKHCG\01-Vermeulen\01-Retrieve\Retrieve-IP_DATA_ALL.py =====
Loading : C:/VKHCG/01-Vermeulen/00-RawData/IP_DATA_ALL.csv
Rows: 3562
Columns: 8
### Raw Data Set ###################################
ID <class 'str'>
Country <class 'str'>
Place Name <class 'str'>
Post Code <class 'str'>
Latitude <class 'str'>
Longitude <class 'str'>
First IP Number <class 'str'>
Last IP Number <class 'str'>
### Fixed Data Set ###################################
ID <class 'str'>
Country <class 'str'>
Place.Name <class 'str'>
Post.Code <class 'str'>
Latitude <class 'str'>
Longitude <class 'str'>
First.IP.Number <class 'str'>
Last.IP.Number <class 'str'>
Fixed Data Set with ID
### Done!! ############################################
>>>
```

Start your Python editor and create a text file named Retrieve-IP_Routing.py in directory.C:\VKHCG\01-Vermeulen\01-Retrieve.

```
#####################################################################
# -*- coding: utf-8 -*-
#############################################################
#####
## import sys import os import pandas as pd
```

```
from math import radians, cos, sin, asin, sqrt
##############################################################
#####
def haversine(lon1, lat1, lon2, lat2,stype):
   """
   Calculate the great circle distance between two
pointson the earth (specified in decimal degrees)
   """

   lon1, lat1, lon2, lat2 = map(radians, [lon1, lat1, lon2,
   lat2])# haversine formula                              dlon =
   lon2 - lon1                    dlat = lat2
- lat1      a = sin(dlat/2)**2 + cos(lat1) * cos(lat2) *
sin(dlon/2)**2     c = 2 * asin(sqrt(a))      if stype ==
       'km':r = 6371 # Radius of earth in kilometers
else:
       r = 3956 # Radius of earth in
miles     d=round(c * r,3)     return d
##############################################################
#####Base='C:/VKHCG'
##############################################################
###
##  sFileName=Base   +   '/01-Vermeulen/00-RawData/IP_DATA_CORE.csv'
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
usecols=['Country','Place Name','Latitude','Longitude'], encoding="latin-
1")
##############################################################
#####
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
##############################################################
#####
IP_DATA = IP_DATA_ALL.drop_duplicates(subset=None, keep='first', inplace=False)
IP_DATA.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
IP_DATA1 =
IP_DATA
IP_DATA1.insert(0,
'K', 1)
IP_DATA2 = IP_DATA1
##############################################################
#####
print(IP_DATA1.shape)
##################################################################
```

```
IP_CROSS=pd.merge(right=IP_DATA1,left=IP_DATA2,on='K')
IP_CROSS.drop('K', axis=1, inplace=True)
IP_CROSS.rename(columns={'Longitude_x': 'Longitude_from',
'Longitude_y':'Longitude_to'}, inplace=True)
IP_CROSS.rename(columns={'Latitude_x': 'Latitude_from', 'Latitude_y':
'Latitude_to'},inplace=True)
IP_CROSS.rename(columns={'Place_Name_x': 'Place_Name_from', 'Place_Name_y':
'Place_Name_to'}, inplace=True)
IP_CROSS.rename(columns={'Country_x': 'Country_from', 'Country_y':
'Country_to'},inplace=True)
#################################################################
IP_CROSS['DistanceBetweenKilometers'] = IP_CROSS.apply(lambda row:
haversine(

        row['Longitude_f
rom'],
row['Latitude_from'],
row['Longitude_to'],

        'km')
        ,axis=1)
#################################################################
#####
IP_CROSS['DistanceBetweenMiles'] = IP_CROSS.apply(lambda row:
haversine(
        row['Longitude_f
rom'],
row['Latitude_from'],
row['Longitude_to'],
row['Latitude_to'],
        'miles')
        ,axis=1)
print(IP_CROSS.shape)
sFileName2=sFileDir + '/Retrieve_IP_Routing.csv'
IP_CROSS.to_csv(sFileName2, index = False, encoding="latin-1")
#################################################################
#####print('### Done!!
##########################################')
#################################################################
#####
```

Output:
See the file named Retrieve_IP_Routing.csv in C:\VKHCG\01-Vermeulen\01-Retrieve\01EDS\02-Python.

1	Country_from	Place_Name_from	Latitude_from	Longitude_from	Country_to	Place_Name_to	Latitude_to	Longitude_to	DistanceBetweenKilometers	DistanceBetweenMiles
2	US	New York	40.7528	-73.9725	US	New York	40.7528	-73.9725	0	0
3	US	New York	40.7528	-73.9725	US	New York	40.7214	-74.0052	4.448	2.762
4	US	New York	40.7528	-73.9725	US	New York	40.7662	-73.9862	1.885	1.17
5	US	New York	40.7528	-73.9725	US	New York	40.7449	-73.9782	1.001	0.622
6	US	New York	40.7528	-73.9725	US	New York	40.7605	-73.9933	1.95	1.211
7	US	New York	40.7528	-73.9725	US	New York	40.7588	-73.968	0.767	0.476
8	US	New York	40.7528	-73.9725	US	New York	40.7637	-73.9727	1.212	0.753
9	US	New York	40.7528	-73.9725	US	New York	40.7553	-73.9924	1.699	1.055
10	US	New York	40.7528	-73.9725	US	New York	40.7308	-73.9975	3.228	2.004
11	US	New York	40.7528	-73.9725	US	New York	40.7694	-73.9609	2.088	1.297

Total Records: 22501

So, the distance between a router in New York (40.7528, -73.9725) to anoher router in NewYork (40.7214, -74.0052) is 4.448 kilometers, or 2.762 miles.

Building a Diagram for the Scheduling of Jobs

Start your Python editor and create a text file named Retrieve-Router-Location.py indirectory.

C:\VKHCG\01-Vermeulen\01-Retrieve.

```
##################    Retrieve-Router-Location.py
######################## -*- coding: utf-8 -*-
#######################################################################
## import sys
import osimport
pandas as pd
#######################################################################
InputFileName='IP_DATA_CORE.csv'
OutputFileName='Retrieve_Router_Location.csv'
#######################################################################
#####Base='C:/VKHCG'

####################################################################### sFileName=Base
+ '/01-Vermeulen/00-RawData/' + InputFileName print('Loading
:',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
usecols=['Country','Place Name','Latitude','Longitude'], encoding="latin-
1")
#######################################################################
#####
IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
#######################################################################
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-
Python'if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
ROUTERLOC = IP_DATA_ALL.drop_duplicates(subset=None, keep='first', inplace=False)

print('Rows :',ROUTERLOC.shape[0])

print('Columns :',ROUTERLOC.shape[1])
```

```
sFileName2=sFileDir + '/' + OutputFileName
ROUTERLOC.to_csv(sFileName2, index = False, encoding="latin-1")
#################################################################
#####print('### Done!!
################################################')
#################################################################
#####
```

```
>>>
=== RESTART: C:\VKHCG\01-Vermeulen\01-Retrieve\Retrieve-Router-Location.py ===
Loading : C:/VKHCG/01-Vermeulen/00-RawData/IP_DATA_CORE.csv
Rows : 150
Columns : 4
### Done!! ############################################
```

Output:

See the file named Retrieve_Router_Location.csv in C:\VKHCG\01-Vermeulen\01-Retrieve\01-EDS\02-Python.

1	Country	Place_Name	Latitude	Longitude
2	US	New York	40.7528	-73.9725
3	US	New York	40.7214	-74.0052
4	US	New York	40.7662	-73.9862
5	US	New York	40.7449	-73.9782
6	US	New York	40.7605	-73.9933
7	US	New York	40.7588	-73.968
8	US	New York	40.7637	-73.9727
9	US	New York	40.7553	-73.9924
10	US	New York	40.7308	-73.9975

Krennwallner AG

The company has two main jobs in need of your attention:

- *Picking content for billboards*: I will guide you through the data sciencerequired to pick advertisements for each billboard in the company.

- *Understanding your online visitor data*: I will guide you through theevaluation of the web traffic to the billboard's online web servers.

Picking Content for Billboards

Start your Python editor and create a text file named Retrieve-DE-Billboard-Locations.py indirectory.

C:\VKHCG\02-Krennwallner\01-Retrieve.

```
################## Retrieve-DE-Billboard-Locations.py
                                                    ##########
###### -*- coding: utf-8 -*-
#################################################################
###
```

```
## import sys import os import pandas as pd
#################################################################
#####
InputFileName='DE_Billboard_Locations.csv'
OutputFileName='Retrieve_DE_Billboard_Location
s.csv' Company='02-Krennwallner'
#################################################################
#####Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#################################################################
#####Base='C:/VKHCG'
sFileName=Base + '/' + Company + '/00-RawData/' + InputFileName
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
usecols=['Country','PlaceName','Latitude','Longitude'])

IP_DATA_ALL.rename(columns={'PlaceName': 'Place_Name'},
inplace=True)
#################################################################
#####
sFileDir=Base + '/' + Company + '/01-Retrieve/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
ROUTERLOC = IP_DATA_ALL.drop_duplicates(subset=None, keep='first', inplace=False)

print('Rows :',ROUTERLOC.shape[0])

print('Columns :',ROUTERLOC.shape[1])

sFileName2=sFileDir + '/' + OutputFileName
ROUTERLOC.to_csv(sFileName2, index = False)

#################################################################
#####print('### Done!!
################################################')
#################################################################
#####
```

```
>>>
 RESTART: C:\VKHCG\02-Krennwallner\01-Retrieve\Retrieve-DE-Billboard-Locations.py
################################
Working Base : C:/VKHCG  using  win32
################################
Loading : C:/VKHCG/02-Krennwallner/00-RawData/DE_Billboard_Locations.csv
Rows : 8873
Columns : 4
### Done!! ############################################
```

See the file named Retrieve_Router_Location.csv in C:\VKHCG\02-Krennwallner\01-Retrieve\01-EDS\02-Python.

1	Country	Place_Name	Latitude	Longitude
2	US	New York	40.7528	-73.9725
3	US	New York	40.7214	-74.0052
4	US	New York	40.7662	-73.9862
5	US	New York	40.7449	-73.9782
6	US	New York	40.7605	-73.9933
7	US	New York	40.7588	-73.968
8	US	New York	40.7637	-73.9727
9	US	New York	40.7553	-73.9924
10	US	New York	40.7308	-73.9975

Understanding Your Online Visitor Data

Let’s retrieve the visitor data for the billboard we have in Germany.

Several times it was found that common and important information is buried somewhere in the company’s various data sources. Investigating any direct suppliers or consumers’ upstream or downstream data sources attached to the specific business process is necessary. That is part of your skills that you are applying to data science. Numerous insightful fragments of information was found in the data sources surrounding a customer’s business processes.

Start your Python editor and create a file named Retrieve-Online-Visitor.py in directoryC:\VKHCG\02-Krennwallner\01-Retrieve.

```
################################################################
# -*- coding: utf-8 -*-
###########################################################
#####
## import sys import os import pandas as pd import gzip as gz
#############################################################
#####
InputFileName='IP_DATA_ALL.csv'
OutputFileName='Retrieve_Online_V
isitor'CompanyIn= '01-Vermeulen'
CompanyOut= '02-Krennwallner'
#################################################################
#####Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
```

```
#################################################################
#####Base='C:/VKHCG'

sFileName=Base + '/' + CompanyIn + '/00-RawData/' + InputFileName
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
  usecols=['Country','Place Name','Latitude','Longitude','First IP Number','Last IP Number'])

IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
IP_DATA_ALL.rename(columns={'First IP Number': 'First_IP_Number'}, inplace=True)
IP_DATA_ALL.rename(columns={'Last IP Number': 'Last_IP_Number'},
inplace=True)
#################################################################
sFileDir=Base + '/' + CompanyOut + '/01-Retrieve/01-EDS/02-Python'
if notos.path.exists(sFileDir):
   os.makedirs(sFileDir)

visitordata = IP_DATA_ALL.drop_duplicates(subset=None, keep='first', inplace=False)
visitordata10=visitordata.head(10)

print('Rows
:',visitordata.shape[0])
print('Columns
:',visitordata.shape[1])

print('Export CSV') sFileName2=sFileDir
+ '/' +OutputFileName + '.csv'
visitordata.to_csv(sFileName2, index =
False) print('Store All:',sFileName2)

sFileName3=sFileDir + '/' + OutputFileName +
'_10.csv'visitordata10.to_csv(sFileName3, index =
False) print('Store 10:',sFileName3)

for z in ['gzip', 'bz2', 'xz']:
if z == 'gzip':
      sFileName4=sFileName2 + '.gz'
else:
      sFileName4=sFileName2 + '.' + z
visitordata.to_csv(sFileName4, index = False,
compression=z)print('Store :',sFileName4)
#################################################################
## print('Export JSON') for sOrient in
['split','records','index','columns','values','table']:
   sFileName2=sFileDir + '/' + OutputFileName + '_' + sOrient +
'.json'
```

```
visitordata.to_json(sFileName2,orient=sOrient,force_ascii=True)
print('Store All:',sFileName2)

   sFileName3=sFileDir + '/' + OutputFileName + '_10_' + sOrient +
'.json'
visitordata10.to_json(sFileName3,orient=sOrient,force_ascii=True)
print('Store 10:',sFileName3)

   sFileName4=sFileName2 +
'.gz' file_in =
open(sFileName2, 'rb') file_out
= gz.open(sFileName4, 'wb')
   file_out.writelines(file_in)
file_in.close()
                        file_out.clos
e() print('Store GZIP
All:',sFileName4)

   sFileName5=sFileDir + '/' + OutputFileName + '_' + sOrient +
'_UnGZip.json'     file_in = gz.open(sFileName4, 'rb')     file_out
= open(sFileName5, 'wb')  file_out.writelines(file_in)
                        file_in.close()file_out.close()
   print('Store UnGZIP All:',sFileName5)
#################################################################
#####print('### Done!!
################################################')
#################################################################
#####
```

```
== RESTART: C:\VKHCG\02-Krennwallner\01-Retrieve\Retrieve-Online-Visitor.py ==
################################
Working Base : C:/VKHCG  using  win32
################################
Loading : C:/VKHCG/01-Vermeulen/00-RawData/IP_DATA_ALL.csv
Rows : 3562
Columns : 6
Export CSV
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.csv
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10.csv
Store : C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.csv.gz
Store : C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.csv.bz2
Store : C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.csv.xz
Export JSON
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_split.json
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10_split.json
Store GZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_split.json.gz
Store UnGZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_split_UnGZip.json
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_records.json
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10_records.json
Store GZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_records.json.gz
Store UnGZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_records_UnGZip.json
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_index.json
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10_index.json
Store GZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_index.json.gz
Store UnGZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_index_UnGZip.json
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_columns.json
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10_columns.json
Store GZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_columns.json.gz
Store UnGZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_columns_UnGZip.json
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_values.json
```

Output:

See the file named Retrieve_Online_Visitor.csv in C:\VKHCG\02-Krennwallner\01-Retrieve\01-EDS\02-Python.

	A	B	C	D	E	F
1	Country	Place_Name	Latitude	Longitude	First_IP_Number	Last_IP_Number
2	US	New York	40.6888	-74.0203	400887248	400887263
3	US	New York	40.6888	-74.0203	400904512	400904543
4	US	New York	40.6888	-74.0203	401402080	401402095
5	US	New York	40.6888	-74.0203	402261072	402261087
6	US	New York	40.6888	-74.0203	402288032	402288047
7	US	New York	40.6888	-74.0203	641892352	641900543
8	US	New York	40.6888	-74.0203	644464896	644465151
9	US	New York	40.6888	-74.0203	758770912	758770927
10	US	New York	40.6888	-74.0203	1075972352	1075975167

You can also see the following JSON files of only ten

records.XML processing.

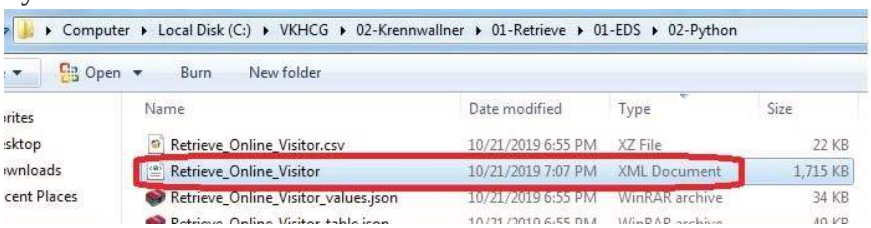
Start Python editor and create a file named Retrieve-Online-Visitor-XML.py indirectoryC:\VKHCG\02-Krennwallner\01-Retrieve.

```
##################################################################
# -*- coding: utf-8 -*-
##################################################################
#####
import sys

import os
import
pandas as
pd
import xml.etree.ElementTree as ET
##################################################################
#####
def df2xml(data):
    header = data.columns     root
= ET.Element('root')     for
row inrange(data.shape[0]):
        entry =
ET.SubElement(root,'entry')for
index in range(data.shape[1]):
            schild=str(header[index]
) child = ET.SubElement(entry,
schild)if str(data[schild][row])
!= 'nan': child.text =
str(data[schild][row]) else:
                child.text =
'n/a' entry.append(child)
                                re
sult =ET.tostring(root)
```

```
   return result
#################################################################
#####
def xml2df(xml_data):
   root =
ET.XML(xml_data)
all_records = []     for i,
child inenumerate(root):
       record = {}         forsubchild in child:
          record[subchild.tag] =
subchild.text
all_records.append(record)
   return pd.DataFrame(all_records)
#################################################################
#####
InputFileName='IP_DATA_ALL.csv'
OutputFileName='Retrieve_Online_Visitor
.xml'CompanyIn= '01-Vermeulen'
CompanyOut= '02-Krennwallner'
#################################################################
#####
if sys.platform == 'linux':
   Base=os.path.expanduser('~') +
   '/VKHCG'
else:
   Base='C:/VKHCG'
#################################################################
#####

print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#################################################################
#####
## sFileName=Base + '/' + CompanyIn + '/00-RawData/' + InputFileName
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False)

IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
IP_DATA_ALL.rename(columns={'First IP Number': 'First_IP_Number'}, inplace=True)
IP_DATA_ALL.rename(columns={'Last IP Number': 'Last_IP_Number'}, inplace=True)
IP_DATA_ALL.rename(columns={'Post Code': 'Post_Code'}, inplace=True)
#################################################################
## sFileDir=Base + '/' + CompanyOut + '/01-Retrieve/01-EDS/02-
Python' ifnot os.path.exists(sFileDir):
```

```
    os.makedirs(sFileDir)

visitordata = IP_DATA_ALL.head(10000)

print('Original Subset Data
Frame') print('Rows
:',visitordata.shape[0])
print('Columns
:',visitordata.shape[1])
print(visitordata)

print('Export XML')
sXML=df2xml(visitordata)

sFileName=sFileDir + '/' + OutputFileName file_out = open(sFileName,
'wb') file_out.write(sXML) file_out.close() print('Store XML:',sFileName)
xml_data =open(sFileName).read() unxmlrawdata=xml2df(xml_data)
print('Raw XML DataFrame') print('Rows :',unxmlrawdata.shape[0])
print('Columns
:',unxmlrawdata.shape[1]) print(unxmlrawdata) unxmldata =
unxmlrawdata.drop_duplicates(subset=None, keep='first', inplace=False)
print('Deduplicated XML Data Frame') print('Rows :',unxmldata.shape[0])
print('Columns :',unxmldata.shape[1]) print(unxmldata)
#print('### Done!! ############################################')
```

Output:
See a file named Retrieve_Online_Visitor.xml in C:\VKHCG\02-Krennwallner\01-Retrieve\01-EDS\02-Python.



This enables you to deliver XML format data as part of the retrieve step.

Hillman Ltd
Start yourPython editor and create a file named Retrieve-Incoterm-EXW.py in directory

```
import os
```

```
import sys
import
pandas as
pd
IncoTerm='
EXW'
InputFileName='Incoterm_2010.csv'
OutputFileName='Retrieve_Incoterm_' + IncoTerm +
'_RuleSet.csv'Company='03-Hillman'
################################################################
#####Base='C:/VKHCG'
print('##################################') print('Working
Base :',Base, ' using ', sys.platform)
print('##################################')
sFileDir=Base +
'/' + Company + '/01-Retrieve/01-EDS/02-Python'
if notos.path.exists(sFileDir):
   os.makedirs(sFileDir)
################################################################
#####
### Import Incoterms
################################################################
#####
## sFileName=Base + '/' + Company + '/00-RawData/' +
InputFileNameprint('############') print('Loading :',sFileName)
IncotermGrid=pd.read_csv(sFileName,header=0,low_memory=Fa
lse) IncotermRule=IncotermGrid[IncotermGrid.Shipping_Term
== IncoTerm] print('Rows :',IncotermRule.shape[0])
print('Columns
:',IncotermRule.shape[1]) print('############') print(IncotermRule)
sFileName=sFileDir + '/' + OutputFileName
IncotermRule.to_csv(sFileName, index = False)
print('### Done!! ############################################')
```

Output

See the file named Retrieve_Incoterm_EXW.csv in C:\VKHCG\03-Hillman\01-Retrieve\01EDS\02-Python. Open this file,

```
>>>
===== RESTART: C:\VKHCG\03-Hillman\01-Retrieve\Retrieve-Incoterm-EXW.py =====
##############################
Working Base : C:/VKHCG using  win32
##############################
############
Loading : C:/VKHCG/03-Hillman/00-RawData/Incoterm_2010.csv
Rows : 1
Columns : 9
############
  Shipping_Term  Seller Carrier Port_From  ... Port_To Terminal Named_Place  Buyer
0           EXW  Seller   Buyer      Buyer  ...   Buyer    Buyer       Buyer  Buyer

[1 rows x 9 columns]
### Done!! ############################################
```

FCA—Free Carrier (Named Place of Delivery) import os import sys import pandas aspd

```
#################################################################
IncoTerm='FCA'
InputFileName='Incoterm_2010.csv'
OutputFileName='Retrieve_Incoterm_' + IncoTerm + '_RuleSet.csv'

#################################################################
#####Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#################################################################
#####
sFileDir=Base + '/' + Company + '/01-Retrieve/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#################################################################
#####
### Import Incoterms
#################################################################
## sFileName=Base + '/' + Company + '/00-RawData/' +
InputFileNameprint('############') print('Loading :',sFileName)
IncotermGrid=pd.read_csv(sFileName,header=0,low_memory=Fa
lse) IncotermRule=IncotermGrid[IncotermGrid.Shipping_Term
== IncoTerm] print('Rows :',IncotermRule.shape[0])
print('Columns
:',IncotermRule.shape[1]) print('############')
print(IncotermRule)sFileName=sFileDir + '/' +
OutputFileName IncotermRule.to_csv(sFileName, index =
False) print('### Done!!
################################################')
```

Output:

```
>>>
===== RESTART: C:\VKHCG\03-Hillman\01-Retrieve\Retrieve-Incoterm-FCA.py =====
##################################
Working Base : C:/VKHCG  using  win32
##################################
############
Loading : C:/VKHCG/03-Hillman/00-RawData/Incoterm_2010.csv
Rows : 1
Columns : 9
############
  Shipping_Term  Seller Carrier Port_From  ... Port_To Terminal Named_Place  Buyer
1           FCA  Seller  Seller     Buyer  ...   Buyer    Buyer       Buyer  Buyer

[1 rows x 9 columns]
### Done!! ############################################
```

CPT—Carriage Paid To (Named Place of Destination) C:\VKHCG\03-Hillman\01-Retrieve.

CIP—Carriage and Insurance Paid To (Named Place of Destination)

DAT—Delivered at Terminal (Named Terminal at Port or Place of Destination)DAP—Delivered at Place (Named Place of Destination)

DDP—Delivered Duty Paid (Named Place of Destination)

By this term, the seller is responsible for delivering the goods to the named place in the country of the buyer and pays all costs in bringing the goods to the destination, including import duties and taxes. The seller is not responsible for unloading. This term places the maximum obligations on the seller and minimum obligations on the buyer. No risk or

responsibility is transferred to the buyer until delivery of the goods at the named place of destination.

Possible Shipping Routes

There are numerous potential shipping routes available to the company. The retrieve step can generate the potential set, by using a route combination generator. This will give you a set of routes, but it is highly unlikely that you will ship along all of them. It is simply a population of routes that can be used by the data science to find the optimum solution.

Start your Python editor and create a file named Retrieve-Warehouse-Incoterm-Chains.py indirectory C:\VKHCG\03-Hillman\01-Retrieve.

Adopt New Shipping Containers

Adopting the best packing option for shipping in containers will require that I introduce a new concept. Shipping of containers is based on a concept reducing the packaging you use down to an optimum set of sizes having the following requirements:

- The product must fit within the box formed by the four sides of a cube.
- The product can be secured using packing foam, which will fill any void volume in thepackaging.
- Packaging must fit in shipping containers with zero space gaps.
- Containers can only hold product that is shipped to a single warehouse, shop, or customer.

Start your Python editor and create a text file named Retrieve-Container-Plan.py in directory .C:\VKHCG\03-Hillman\01-Retrieve.

***** Replace pd.DataFrame.from_items with pd.DataFrame.from_dict**

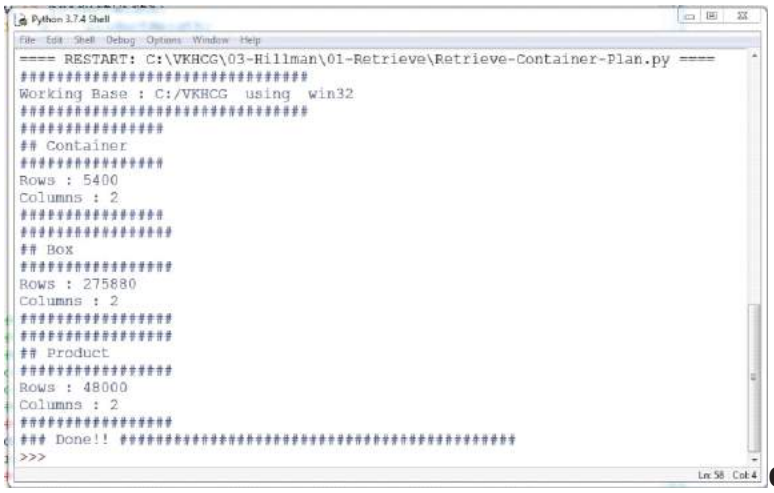
```
import sys
import os
import
pandas as
pd
################################################################
ContainerFileName='Retrieve_Containe
r.csv'BoxFileName='Retrieve_Box.csv'
```

```
   ProductFileName='Retrieve_Product.cs
   v' Company='03-Hillman'
   ############################################################
   #####Base='C:/VKHCG'
   ############################################################
   #####print('#################################')
   print('Working Base :',Base, ' using ', sys.platform)
   print('#################################')
   ############################################################
   #####
   sFileDir=Base + '/' + Company + '/01-Retrieve/01-EDS/02-
   Python'if not os.path.exists(sFileDir):
      os.makedirs(sFileDir)
   ############################################################
   #####
   ### Create the Containers
   ############################################################

   containerHeigth=range(1,6) containerStep=1 c=0 for l in
   containerLength:for w in containerWidth:    for h in containerHeigth:
            containerVolume=(l/containerStep)*(w/containerStep)*(h/containerStep)

   c=c+1


ContainerLine=[('ShipType', ['Container']),
         ('UnitNumber', ('C'+format(c,"06d"))),
         ('Length',(format(round(l,3),".4f"))),
         ('Width',(format(round(w,3),".4f"))),
         ('Height',(format(round(h,3),".4f"))),
         ('ContainerVolume',(format(round(containerVolume,6),".6f")))]

   if c==1:else:



ContainerFrame = pd.DataFrame.from_dict(ContainerLine)

 ContainerRow = pd.DataFrame.from_dict(ContainerLine) ContainerFrame =
 ContainerFrame.append(ContainerRow)

            ContainerFrame.index.name = 'IDNumber'

   print('################')    print('##
   Container')
   print('################')
```

```
print('Rows
:',ContainerFrame.shape[0])
print('Columns
:',ContainerFrame.shape[1])
print('################')
#################################################################
sFileContainerName=sFileDir + '/' + ContainerFileName
ContainerFrame.to_csv(sFileContainerName, index = False)
#############################################################
#####
## Create valid Boxes with packing foam
#########################################################
#####
## boxLength=range(1,21) boxWidth=range(1,21) boxHeigth=range(1,21)
packThick=range(0,6) boxStep=10 b=0 for l in boxLength:
                    for w inboxWidth:           for h in boxHeigth:
                    for t in packThick:
            boxVolume=round((l/boxStep)*(w/boxStep)*(h/boxStep),6)
productVolume=round(((l-t)/boxStep)*((w-t)/boxStep)*((h-t)/boxStep),6)          ifproductVolume > 0:
                b=b+1
                BoxLine=[('ShipType', ['Box']),
                  ('UnitNumber', ('B'+format(b,"06d"))),
                  ('Length',(format(round(l/10,6),".6f"))),
                  ('Width',(format(round(w/10,6),".6f"))),
                  ('Height',(format(round(h/10,6),".6f"))),
                  ('Thickness',(format(round(t/5,6),".6f"))),
                  ('BoxVolume',(format(round(boxVolume,9),".9f"))),
('ProductVolume',(format(round(productVolume,9),".9f")))]                ifb==1:


else:

BoxFrame = pd.DataFrame.from_dict(BoxLine)

 BoxRow = pd.DataFrame.from_dict(BoxLine)
 BoxFrame = BoxFrame.append(BoxRow)

BoxFrame.index.name =
'IDNumber'
print('################')
print('## Box')
print('################')
print('Rows
:',BoxFrame.shape[0])
print('Columns
```

```
:',BoxFrame.shape[1])
print('#################')
#####################################################################
sFileBoxName=sFileDir + '/' + BoxFileName
BoxFrame.to_csv(sFileBoxName, index = False)
#############################################################
#####
## Create valid Product
#########################################################
#####
## productLength=range(1,21) productWidth=range(1,21)
productHeigth=range(1,21) productStep=10 p=0 for l in productLength:     forw in productWidth: for h in product
        productVolume=round((l/productStep)*(w/productStep)*(h/productSte
p),6) if productVolume > 0:
            p=p+1
            ProductLine=[('ShipType',
              ['Product']), ('UnitNumber',
              ('P'+format(p,"06d"))),
              ('Length',(format(round(l/10,6),".6f"))),
              ('Width',(format(round(w/10,6),".6f"))),
              ('Height',(format(round(h/10,6),".6f"))),
              ('ProductVolume',(format(round(productVolume,9),".9f")))]

if p==1:else:



ProductFrame = pd.DataFrame.from_dict(ProductLine)

 ProductRow = pd.DataFrame.from_dict(ProductLine)
 ProductFrame = ProductFrame.append(ProductRow)
BoxFrame.index.name =

'IDNumber' print('#################')
print('## Product')
print('#################')
print('Rows
:',ProductFrame.shape[0]) print('Columns
:',ProductFrame.shape[1])
print('#################')
#####################################################################
sFileProductName=sFileDir + '/' + ProductFileName
ProductFrame.to_csv(sFileProductName, index = False)
```

```
#################################################################
####
#################################################################
#####print('### Done!!
################################################')
#################################################################
#####
```



Output:

Your second simulation is the cardboard boxes for the packing of the products. The requirement is for boxes having a dimension of 100 centimeters × 100 centimeters × 100 centimeters to 2.1 meters × 2.1 meters × 2.1 meters. You can also use between zero and 600centimeters of packing foam to secure any product in the box.

See the container data file Retrieve_Container.csv and Retrieve_Box.csv in C:\VKHCG\03- Hillman\01-Retrieve\01-EDS\02-Python.

Create a Delivery Route

The model enables you to generate a complex routing plan for the shipping routes of the company. Start your Python editor and create a text file named Retrieve-Route-Plan.py in directory .
C:\VKHCG\03-Hillman\01-Retrieve.

```
import os
import sys
import
pandasas pd
from geopy.distance import vincenty
#################################################################
#####
InputFileName='GB_Postcode_Warehouse
.csv'
OutputFileName='Retrieve_GB_Warehous
e.csv'Company='03-Hillman'
```

```
#################################################################
#####Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)

#################################################################
## sFileDir=Base + '/' + Company + '/01-Retrieve/01-EDS/02-Python'
if notos.path.exists(sFileDir):
   os.makedirs(sFileDir)
#################################################################
#####
## sFileName=Base + '/' + Company + '/00-RawData/' + InputFileName
print('###########') print('Loading :',sFileName)
Warehouse=pd.read_csv(sFileName,header=0,low_memory=False)
WarehouseClean=Warehouse[Warehouse.latitude != 0]
WarehouseGood=WarehouseClean[WarehouseClean.longitude != 0]
WarehouseGood.drop_duplicates(subset='postcode', keep='first',
inplace=True)WarehouseGood.sort_values(by='postcode', ascending=1)
#################################################################
#####
sFileName=sFileDir + '/' + OutputFileName
WarehouseGood.to_csv(sFileName, index =
False)
WarehouseLoop =

WarehouseGood.head(20)for i in

range(0,WarehouseLoop.shape[0]):

   print('Run :',i,' ========>>>>>>>>>>>',WarehouseLoop['postcode'][i])
   WarehouseHold = WarehouseGood.head(10000)
   WarehouseHold['Transaction']=WarehouseHold.apply(lambda row:
            'WH-to-WH'
            ,axis=1)
   OutputLoopName='Retrieve_Route_' + 'WH-' +
WarehouseLoop['postcode'][i] +'_Route.csv'

   WarehouseHold['Seller']=WarehouseHold.apply(lambda
            row:'WH-' + WarehouseLoop['postcode'][i]
            ,axis=1)
   WarehouseHold['Seller_Latitude']=WarehouseHold.apply(lambda row:
            WarehouseHold['latitude'][i],axis=1)
   WarehouseHold['Seller_Longitude']=WarehouseHold.apply(lambda row:
            WarehouseLoop['longitude'][i],axis=1)
```

```
    WarehouseHold['Buyer']=WarehouseHold.apply(lambda
            row:'WH-' + row['postcode'],axis=1)

    WarehouseHold['Buyer_Latitude']=WarehouseHold.apply(lambda row:
row['latitude'],axis=1)
    WarehouseHold['Buyer_Longitude']=WarehouseHold.apply(lambda row:
row['longitude'],axis=1)

    WarehouseHold['Distance']=WarehouseHold.apply(lambda row: round(
vincenty((WarehouseLoop['latitude'][i],WarehouseLoop['longitude'][i]),
(row['latitude'],row['longitude'])).miles,6),axis=1)

    WarehouseHold.drop('id', axis=1, inplace=True)
    WarehouseHold.drop('postcode', axis=1, inplace=True)
    WarehouseHold.drop('latitude', axis=1, inplace=True)
    WarehouseHold.drop('longitude', axis=1, inplace=True)
    ################################################################
    ####
    sFileLoopName=sFileDir + '/' + OutputLoopName
    WarehouseHold.to_csv(sFileLoopName, index =
    False)
#################################################################
#####print('### Done!!
################################################')
#################################################################
#####
```

Output:

```
====== RESTART: C:\VKHCG\03-Hillman\01-Retrieve\Retrieve-Route-Plan.py
======##################################
Working Base : C:/VKHCG using
win32
##############################
### ############
Loading : C:/VKHCG/03-Hillman/00-
RawData/GB_Postcode_Warehouse.csvRun : 0  =======>>>>>>>>>>>
AB10
Run : 1 =======>>>>>>>>>>>
AB11 Run : 2
=======>>>>>>>>>>> AB12 Run :
3 =======>>>>>>>>>>> AB13
Run : 4 =======>>>>>>>>>>>
AB14 Run : 5
=======>>>>>>>>>>> AB15 Run :
6 =======>>>>>>>>>>> AB16
```

Run : 7 =======>>>>>>>>>>
AB21 Run : 8
=======>>>>>>>>>> AB22 Run :
9 =======>>>>>>>>>> AB23
Run : 10 =======>>>>>>>>>>
AB24Run : 19
=======>>>>>>>>>> AB37
Done!!
>>>
See the collection of files similar in format to Retrieve_Route_WH-AB11_Route.csv inC:\VKHCG\03-Hillman\01-Retrieve\01-EDS\02-Python.

	Transaction	Seller	Seller_Latitude	Seller_Longitude	Buyer	Buyer_Latitude	Buyer_Longitude	Distance
2	WH-to-WH	WH-AB11	57.13875	-2.09089	WH-AB10	57.13514	-2.11731	1.024915
3	WH-to-WH	WH-AB11	57.13875	-2.09089	WH-AB11	57.13875	-2.09089	0
4	WH-to-WH	WH-AB11	57.13875	-2.09089	WH-AB12	57.101	-2.1106	2.715503
5	WH-to-WH	WH-AB11	57.13875	-2.09089	WH-AB13	57.10801	-2.23776	5.922893

Global Post Codes
Open RStudio and use R to process the following R script:
Retrieve-Postcode-Global.r.

```
library(readr)
All_Countries <- read_delim("C:/VKHCG/03-Hillman/00-RawData/All_Countries.txt",
                            "\t", col_names =
                            FALSE,col_types =
                            cols(
X12 = col_skip(),
                              X6        =
                              col_skip(),
                              X7        =
                              col_skip(),
                              X8        =
                              col_skip(),
X9 = col_skip()),                       na = "null",
trim_ws = TRUE)
write.csv(All_Countries,          file =
"C:/VKHCG/03-Hillman/01-Retrieve/01-
EDS/01R/Retrieve_All_Countries.csv")
```

Output:
The program will successfully uploaded a new file named Retrieve_All_Countries.csv, afterremoving column No. 6, 7, 8, 9 and 12 from All_Countries.txt

	A	B	C	D	E	F	G	H
1		X1	X2	X3	X4	X5	X10	X11
2	1	x1	x2	x3	x4	x5	x10	x11
3	2	AD	AD100	Canillo			42.5833	1.6667
4	3	AD	AD200	Encamp			42.5333	1.6333
5	4	AD	AD300	Ordino			42.6	1.55
6	5	AD	AD400	La Massana			42.5667	1.4833
7	6	AD	AD500	Andorra la Vella			42.5	1.5
8	7	AD	AD600	Sant Juli<c3> de Lòria			42.4667	1.5
9	8	AD	AD700	Escaldes-Engordany			42.5	1.5667
10	9	AR	3636	POZO CERCADO (EL CHORRO (F), DPTO. RIVADAVIA (S))	Salta	A	-23.4933	-61.9267
11	10	AR	4123	LAS SALADAS	Salta	A	-25.7833	-64.5

Clark Ltd

Clark is the financial powerhouse of the group. It must process all the money-related data sources.**Forex**-The first financial duty of the company is to perform any foreign exchange trading.**Forex Base Data**-Previously, you found a single data source (Euro_ExchangeRates.csv) for forex rates in Clark. Earlier in the chapter, I helped you to create the load, as part of your R processing.

The relevant file is Retrieve_Retrieve_Euro_ExchangeRates.csv in directoryC:\ VKHCG\04-Clark\01-Retrieve\01-EDS\01-R. So, that data is ready.

Financials - Clark generates the financial statements for all the group's companies.**Financial Base Data** - You found a single data source (Profit_And_Loss.csv) inClark for financials and, as mentioned previously, a single data source(Euro_ExchangeRates.csv) for forex rates. The file relevant file is Retrieve_Profit_And_Loss.csv in directory C:\VKHCG\04-Clark\01-Retrieve\ 01-EDS\01-R.

Person Base Data

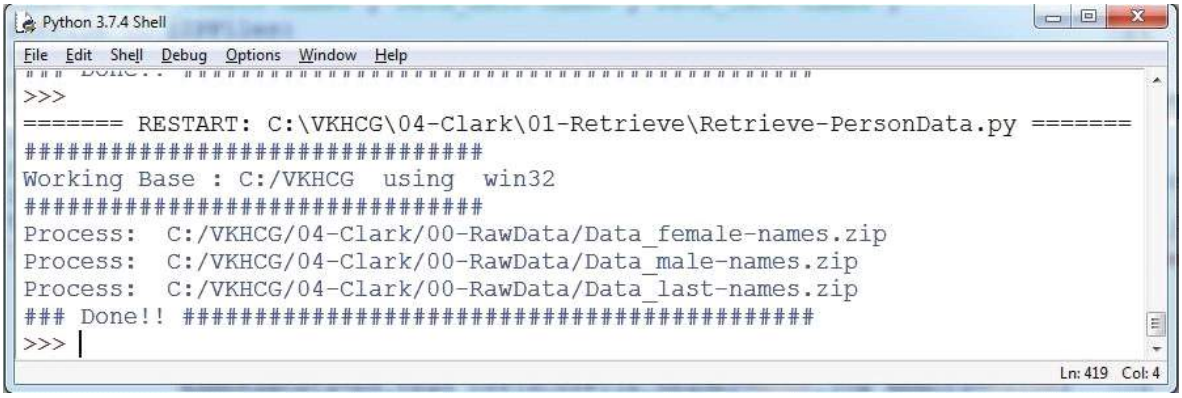
Start Python editor and create a file named Retrieve-PersonData.py in directory . C:\VKHCG\04-Clark\01-Retrieve.

```
################################################################
# -*- coding: utf-8 -*-

import sys import os import shutil import
zipfileimport pandas as pd
Base='C:/VKHCG'
print('################################
###')
print('Working Base :',Base, ' using ',
sys.platform)
print('################################
###')
Company='04-Clark'
ZIPFiles=['Data_female-names','Data_male-names','Data_last-
names'] for ZIPFile in ZIPFiles:
```

```
    InputZIPFile=Base+'/'+Company+'/00-RawData/' + ZIPFile + '.zip'
    OutputDir=Base+'/'+Company+'/01-Retrieve/01-EDS/02-Python/' +
    ZIPFileOutputFile=Base+'/'+Company+'/01-Retrieve/01-EDS/02-
    Python/Retrieve-
'+ZIPFile+'.csv'     zip_file = zipfile.ZipFile(InputZIPFile, 'r')
zip_file.extractall(OutputDir)
    zip_file.close()
    t=0     for dirname, dirnames, filenames in
os.walk(OutputDir):         for filename in
filenames:
          sCSVFile = dirname + '/'
+ filename         t=t+1            if
t==1:

NameRawData=pd.read_csv(sCSVFile,header=None,low_memory=
False) NameData=NameRawData   else:
              NameRawData=pd.read_csv(sCSVFile,header=None,low_memory=False)
              NameData=NameData.append(NameRawData)
    NameData.rename(columns={0 :
    'NameValues'},inplace=True)
    NameData.to_csv(OutputFile, index = False)
    shutil.rmtree(OutputDir)
print('Process: ',InputZIPFile)
print('### Done!! ################################################')
```

This generates three files named

Retrieve-Data_female-names.csvRetrieve-Data_male-names.csv Retrieve-Data_last-names.csv

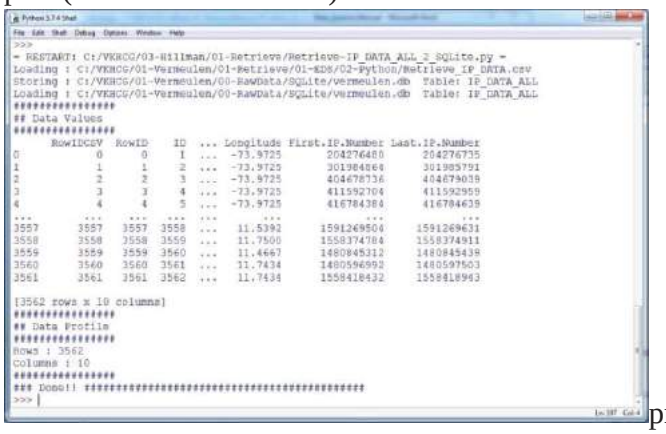


Connecting to other Data Sources

A. Program to connect to different data sources.

SQLite:

```
# -*- coding:
utf-8 -*-import
sqlite3 as sq
import pandas
as pd
Base='C:/VKH
CG'
sDatabaseName=Base + '/01-Vermeulen/00-
RawData/SQLite/vermeulen.db' conn = sq.connect(sDatabaseName)
sFileName='C:/VKHCG/01-Vermeulen/01-Retrieve/01-EDS/02-
Python/Retrieve_IP_DATA.c
sv'print('Loading
:',sFileName)
IP_DATA_ALL_FIX=pd.read_csv(sFileName,header=0,low_memory=
False) IP_DATA_ALL_FIX.index.names =  ['RowIDCSV']
sTable='IP_DATA_ALL'
print('Storing :',sDatabaseName,' Table:',sTable)
IP_DATA_ALL_FIX.to_sql(sTable, conn,
if_exists="replace") print('Loading :',sDatabaseName,'
Table:',sTable) TestData=pd.read_sql_query("select * from
IP_DATA_ALL;", conn) print('#################')
print('## Data Values') print('#################')
print(TestData) print('#################') print('## Data
Profile') print('#################') print('Rows
:',TestData.shape[0]) print('Columns :',TestData.shape[1])
print('#################')
```




```
print('### Done!!
################################################')
```

MySQL:

Open MySql

Create a database “DataScience”

Create a python file and add the following code:

```
################ Connection With MySQL ####################
import mysql.connector
```

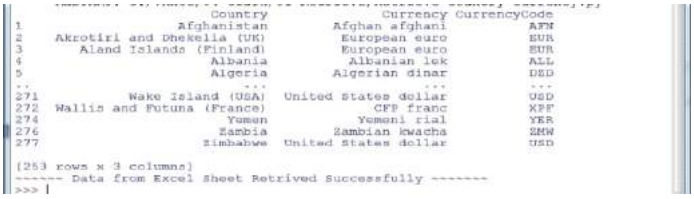
```
                                        conn =
  mysql.connector.connect(host='localhost',
                          database='DataScience',

                                password='root')
conn.connect
if(conn.is_connected):
   print('###### Connection With MySql Established Successfullly
##### ')else:
   print('Not Connected -- Check Connection Properites')
```

```
>>>
 RESTART: C:/Users/User/AppData/Local/Programs/Python/Python37-32/mysqlconnection.py
###### Connection With MySql Established Successfullly #####
>>>
```

Microsoft Excel

```
##################Retrieve-Country-Currency.py
#################################################################
#####
# -*- coding: utf-8 -*-
#############################################################
#####
## import os import pandas as pd
#############################################################
#####Base='C:/VKHCG'
#############################################################
#####
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-
Python'#if not os.path.exists(sFileDir):
#os.makedirs(sFileDir)
#############################################################
#####
CurrencyRawData = pd.read_excel('C:/VKHCG/01-
Vermeulen/00RawData/Country_Currency.xlsx')
sColumns = ['Country or territory', 'Currency', 'ISO-
4217']CurrencyData =
CurrencyRawData[sColumns]
CurrencyData.rename(columns={'Country or territory': 'Country', 'ISO-
4217':'CurrencyCode'}, inplace=True)
CurrencyData.dropna(subset=['Currency'],inplace=True)
CurrencyData['Country'] = CurrencyData['Country'].map(lambda x:
x.strip())CurrencyData['Currency'] =
CurrencyData['Currency'].map(lambda x: x.strip())
CurrencyData['CurrencyCode'] =
CurrencyData['CurrencyCode'].map(lambdax: x.strip())
print(CurrencyData)
```

```
print('~~~~~~ Data from Excel Sheet Retrived Successfully ~~~~~~~ ')
#################################################################
#####
sFileName=sFileDir + '/Retrieve-Country-Currency.csv'
CurrencyData.to_csv(sFileName, index = False)
#################################################################
```
#####**OUTPUT:**



```
                      Country                 Currency CurrencyCode
1                 Afghanistan          Afghan afghani          AFN
2    Akrotiri and Dhekelia (UK)           European euro          EUR
3       Aland Islands (Finland)           European euro          EUR
4                     Albania             Albanian lek          ALL
5                     Algeria          Algerian dinar          DZD
..                        ...                     ...          ...
271          Wake Island (USA)  United States dollar          USD
272  Wallis and Futuna (France)             CFP franc          XPF
274                     Yemen            Yemeni rial          YER
276                    Zambia          Zambian kwacha          ZMW
277                  Zimbabwe  United States dollar          USD

[253 rows x 3 columns]
------ Data from Excel Sheet Retrived Successfully -------
>>>
```

Assess Superstep

Practical 5: Assessing Data

Data quality refers to the condition of a set of qualitative or quantitative variables. Dataquality is a multidimensional measurement of the acceptability of specific data sets. Inbusiness, data quality is measured to determine whether data can be used as a basis forreliable intelligence extraction for supporting organizational decisions. Data profiling involves observing in your data sources all the viewpoints that theinformation offers. The main goal is to determine if individual viewpoints are accurateand complete. The Assess superstep determines what additional processing to apply tothe entries that are noncompliant.

Errors

Typically, one of four things can be done with an error to the data.

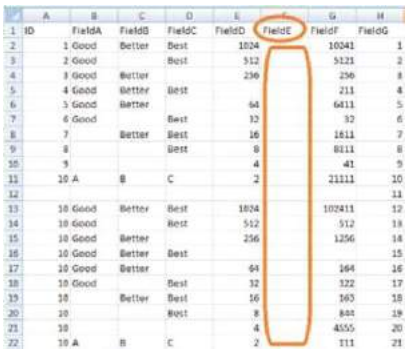
- Accept the Error
- Reject the Error
- Correct the Error
- Create a Default Value

- **Perform error management on the given data using pandas package.**

Python pandas package enables several automatic error-management features. **File Location:** C:\VKHCG\01-Vermeulen\02-Assess

MissingValues in Pandas:

- **Drop the Columns Where All Elements Are Missing Values**



	A	B	C	D	E	F	G	H
1	ID	FieldA	FieldB	FieldC	FieldD	FieldE	FieldF	FieldG
2		1 Good	Better	Best	1024		10241	1
3		2 Good		Best	512		5121	2
4		3 Good	Better		256		256	3
5		4 Good	Better	Best			211	4
6		5 Good	Better		64		6411	5
7		6 Good		Best	32		32	6
8		7	Better	Best	16		1611	7
9		8		Best	8		8111	8
10		9			4		41	9
11		10 A	B	C	2		21111	10
12								11
13		10 Good	Better	Best	1024		102411	12
14		10 Good		Best	512		512	13
15		10 Good	Better		256		1256	14
16		10 Good	Better	Best				15
17		10 Good	Better		64		164	16
18		10 Good		Best	32		322	17
19		10	Better	Best	16		163	18
20		10		Best	8		841	19
21		10			4		4555	20
22		10 A	B	C	2		111	21

Code :

```
################### Assess-Good-Bad-01.py#########################
# -*- coding: utf-8 -*-
#############################################################
#####
## import sys import os import pandas as pd
#############################################################
#####

Base='C:/VKHCG'
#############################################################
##### print('###################################')
print('Working Base :',Base, ' using ', sys.platform)
print('###################################')
#############################################################
#####
## sInputFileName='Good-or-Bad.csv' sOutputFileName='Good-or-Bad-
• csv'
Company='01-Vermeulen'
#############################################################
##### Base='C:/VKHCG'
#############################################################
#####
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#############################################################
#####
### Import Warehouse
#############################################################
#####
sFileName=Base + '/' + Company + '/00-RawData/' + sInputFileName
print('Loading :',sFileName)
RawData=pd.read_csv(sFileName,header
=0)
```

```
print('############################
####')
print('## Raw Data Values')
print('################################')
print(RawData)
print('################################')
print('## Data Profile')
print('################################')
print('Rows :',RawData.shape[0])
print('Columns :',RawData.shape[1])
print('############################
###')
#####################################################################
sFileName=sFileDir + '/' + sInputFileName
RawData.to_csv(sFileName, index = False)
#####################################################################
TestData=RawData.dropna(axis=1, how='all')
#############################################################
##### print('################################')
print('## Test Data Values')
print('################################')
print(TestData)
print('################################')
print('## Data Profile')
print('################################')

print('Rows :',TestData.shape[0])
print('Columns :',TestData.shape[1])
print('############################
###')
#####################################################################
sFileName=sFileDir + '/' + sOutputFileName
TestData.to_csv(sFileName, index = False)
#############################################################
##### print('################################')
print('### Done!! ####################')
print('################################')
#############################################################
#####
```

Output: >>>

```
======= RESTART: C:\VKHCG\01-Vermeulen\02-Assess\Assess-Good-Bad-01.py
=======
############################
#####
```

```
Working Base : C:/VKHCG using win32
################################
Loading : C:/VKHCG/01-Vermeulen/00-RawData/Good-or-Bad.csv
################################
## Raw Data Values
##########################
#####
    ID FieldA  FieldB FieldC  FieldD  FieldE    FieldF
FieldG0                                 1.0   Good
Better   Best  1024.0                    NaN   10241.0      1
1    2.0   Good    NaN   Best   512.0    NaN    5121.0      2
•    3.0   Good  Better   NaN   256.0    NaN     256.0      3
•    4.0   Good  Better   Best    NaN    NaN     211.0      4
•    5.0   Good  Better   NaN    64.0    NaN    6411.0      5
•    6.0   Good    NaN   Best    32.0    NaN      32.0      6
•    7.0    NaN  Better   Best    16.0    NaN    1611.0      77      8.0      NaN    NaN   Best              8.0
8    9.0    NaN    NaN    NaN     4.0    NaN      41.0      99      10.0             A       B       C       2.0
10   NaN    NaN    NaN    NaN    NaN    NaN      NaN      11
 11  10.0   Good  Better   Best  1024.0    NaN  102411.0     12
 12  10.0   Good    NaN   Best   512.0    NaN     512.0     13
 13  10.0   Good  Better   NaN   256.0    NaN    1256.0     14
 14  10.0   Good  Better   Best    NaN    NaN       NaN     15
 15  10.0   Good  Better   NaN    64.0    NaN     164.0     16
 16  10.0   Good    NaN   Best    32.0    NaN     322.0     17
 17  10.0    NaN  Better   Best    16.0    NaN     163.0     18
 18  10.0    NaN    NaN   Best     8.0    NaN     844.0     19
 19  10.0    NaN    NaN    NaN     4.0    NaN    4555.0     20
20   10.0     A      B      C     2.0    NaN     111.0     21
```

All of column E has been deleted, owing to the fact that all values in that column were missingvalues/errors.

- **Drop the Columns Where Any of the Elements Is Missing Values**

```
################## Assess-Good-Bad-
02.py########################## import sys import os import
pandas aspd Base='C:/VKHCG' sInputFileName='Good-or-Bad.csv'
sOutputFileName='Good-or-Bad-02.csv'
Company='01-Vermeulen'
################################################################
#####Base='C:/VKHCG'
################################################################
#####print('################################')
print('Working Base :',Base, ' using ', sys.platform)
```

```
print('################################')
#################################################################
#####
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python' if not
os.path.exists(sFil
   eDir):
   os.makedirs(sFil
   eDir)
#####################################################################
### Import Warehouse
#################################################################
#####
sFileName=Base + '/' + Company + '/00-RawData/' + sInputFileName
print('Loading :',sFileName)
RawData=pd.read_csv(sFileName,header
=0)
print('############################
####')
print('## Raw Data Values')
print('################################')
print(RawData)
print('################################')
print('## Data Profile')
print('################################')
print('Rows :',RawData.shape[0])
print('Columns :',RawData.shape[1])
print('############################
###')
#####################################################################
sFileName=sFileDir + '/' + sInputFileName
RawData.to_csv(sFileName, index = False)
#####################################################################
TestData=RawData.dropna(axis=1, how='any')
#################################################################
##### print('################################')
print('## Test Data Values')
print('################################')
print(TestData)
print('################################')

print('## Data Profile')
print('################################')
print('Rows :',TestData.shape[0])
print('Columns :',TestData.shape[1])
print('############################
###')
```

```
    ################################################################
    sFileName=sFileDir + '/' + sOutputFileName
    TestData.to_csv(sFileName, index = False)
    ################################################################
    ##### print('##################################')
    print('### Done!! ####################')
    print('##################################')
    ################################################################
    #####
>>>
======= RESTART: C:\VKHCG\01-Vermeulen\02-Assess\Assess-Good-Bad-02.py
=======
############################
#####
Working Base : C:/VKHCG using win32
################################
Loading : C:/VKHCG/01-Vermeulen/00-RawData/Good-or-Bad.csv
################################
## Raw Data Values
############################
#####
    ID FieldA  FieldB FieldC  FieldD  FieldE    FieldF
FieldG0                                 1.0   Good  Better
Best  1024.0                            NaN   10241.0      1
1    2.0   Good     NaN   Best   512.0    NaN    5121.0      2################################
## Data Profile
############################
#####
Rows : 21
Columns : 8
############################
#####
############################
#####
## Test Data Values
############################
#####
   FieldG
0       1
1       2
################################
## Data Profile
############################
#####
```

```
Rows : 21
Columns : 1
############################
#####
############################
#####

### Done!!
####################
############################
#####
>>>
```

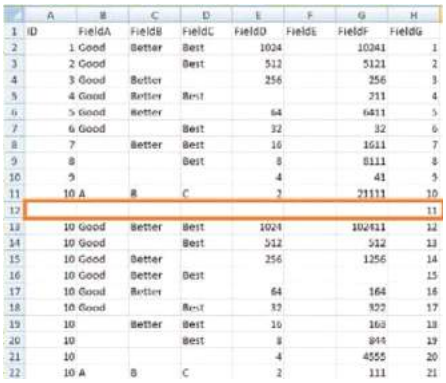
- **Keep Only the Rows That Contain a Maximum of Two Missing Values**

```
#####################    Assess-Good-Bad-03.py  ################
# -*- coding: utf-8 -*-
#############################################################
#####
## import sys import os import pandas as pd
#################################################################
## sInputFileName='Good-or-Bad.csv' sOutputFileName='Good-
or-Bad-03.csv'
Company='01-Vermeulen'
Base='C:/VKHCG'
#############################################################
#####print('################################')
print('Working Base :',Base, ' using Windows ~~~~')
print('################################')
#############################################################
#####
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#############################################################
#####
### Import Warehouse
#############################################################
#####
sFileName=Base + '/' + Company + '/00-RawData/' + sInputFileName
print('Loading :',sFileName)
RawData=pd.read_csv(sFileName,header
=0)
print('############################
####')
```

```
print('## Raw Data Values')
print('###################################')
print(RawData)
print('###################################')
print('## Data Profile')
print('###################################')
print('Rows :',RawData.shape[0])
print('Columns :',RawData.shape[1])
print('##############################
###')
#####################################################################
sFileName=sFileDir + '/' + sInputFileName
RawData.to_csv(sFileName, index = False)
#####################################################################
## TestData=RawData.dropna(thresh=2)
print('###################################')  print('## Test Data Values')
print('###################################') print(TestData)

print('###################################')    print('## Data
Profile')print('###################################')
print('Rows :',TestData.shape[0])
print('Columns :',TestData.shape[1])
print('##############################
###')
sFileName=sFileDir + '/' +
sOutputFileName
TestData.to_csv(sFileName, index =
False)
#############################################################
#####print('###################################')
print('### Done!! ######################')
```

	A	B	C	D	E	F	G	H
1	ID	FieldA	FieldB	FieldC	FieldD	FieldE	FieldF	FieldG
2	1	Good	Better	Best	1024		10241	1
3	2	Good		Best	512		5121	2
4	3	Good	Better		256		256	3
5	4	Good	Better	Best			211	4
6	5	Good	Better		64		6411	5
7	6	Good		Best	32		32	6
8	7		Better	Best	16		1611	7
9	8			Best	8		8111	8
10	9				4		41	9
11	10	A	B	C	2		21111	10
12	10	Good	Better	Best	1024		102411	12
13	10	Good		Best	512		512	13
14	10	Good	Better		256		1256	14
15	10	Good	Better	Best				15
16	10	Good	Better		64		164	16
17	10	Good		Best	32		322	17
18	10		Better	Best	16		163	18
19	10			Best	8		844	19
20	10				4		4555	20
21	10	A	B	C	2		111	21

```
print('###################################')
#############################################################
#####
```



	A	B	C	D	E	F	G	H
1	ID	FieldA	FieldB	FieldC	FieldD	FieldE	FieldF	FieldG
2		1 Good	Better	Best	1024		10241	1
3		2 Good		Best	512		5121	2
4		3 Good	Better		256		256	3
5		4 Good	Better	Best			711	4
6		5 Good	Better		64		6411	5
7		6 Good		Best	32		32	6
8		7	Better	Best	16		1611	7
9		8		Best	8		8111	8
10		9			4		41	9
11		10 A	B	C	2		21111	10
12								11
13		10 Good	Better	Best	1024		102411	12
14		10 Good		Best	512		512	13
15		10 Good	Better		256		1256	14
16		10 Good	Better	Best				15
17		10 Good	Better		64		164	16
18		10 Good		Best	32		322	17
19		10	Better	Best	16		168	18
20		10		Best	8		844	19
21		10			4		4555	20
22		10 A	B	C	2		111	21

Before After

Row with more than two missing values got deleted.

The next step along the route is to generate a full network routing solution for the company, toresolve the data issues in the retrieve data.

- **Write Python / R program to create the network routing diagram from the givendata onrouters.**

```
########## Assess-Network-Routing-Company.py
###################### import sys import os import pandas
as pd
#####################################################################
pd.options.mode.chained_assignment = None
#############################################################
#####Base='C:/VKHCG'
#############################################################
#####print('##################################')
print('Working Base :',Base, ' using Windows')
print('##################################')
#############################################################
#####
sInputFileName1='01-Retrieve/01-EDS/01-R/Retrieve_Country_Code.csv'
sInputFileName2='01-Retrieve/01-EDS/02-
Python/Retrieve_Router_Location.csv' sInputFileName3='01-Retrieve/01-
EDS/01-R/Retrieve_IP_DATA.csv'
#############################################################
###
sOutputFileName='Assess-Network-Routing-
Company.csv' Company='01-Vermeulen'

#############################################################
#####
#############################################################
#####
### Import Country Data
#############################################################
#####
```

```
sFileName=Base + '/' + Company + '/' + sInputFileName1
print('################################') print('Loading
:',sFileName)print('################################')
CountryData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
print('Loaded Country:',CountryData.columns.values)
print('################################')
#####################################################################
## Assess Country Data
#############################################################
##### print('################################')
print('Changed :',CountryData.columns.values)
CountryData.rename(columns={'Country': 'Country_Name'},
inplace=True) CountryData.rename(columns={'ISO-2-CODE':
'Country_Code'}, inplace=True)CountryData.drop('ISO-M49', axis=1,
inplace=True)
CountryData.drop('ISO-3-Code', axis=1,
inplace=True)CountryData.drop('RowID',
axis=1, inplace=True) print('To
:',CountryData.columns.values)
print('################################')
#############################################################
#####
#############################################################
#####
### Import Company Data
#############################################################
#####
sFileName=Base + '/' + Company + '/' + sInputFileName2
print('################################')
print('Loading :',sFileName)
print('################################')
CompanyData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1")
print('Loaded Company :',CompanyData.columns.values)
print('################################')
#############################################################
#####
## Assess Company Data
#############################################################
#####print('################################')
print('Changed :',CompanyData.columns.values)
CompanyData.rename(columns={'Country': 'Country_Code'},
inplace=True)print('To :',CompanyData.columns.values)
print('################################')
```

```
### Import Customer Data
#################################################################
#####

sFileName=Base + '/' + Company + '/' + sInputFileName3
print('################################')
print('Loading :',sFileName)
print('################################')
CustomerRawData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1")
print('################################')
print('Loaded Customer
:',CustomerRawData.columns.values)
print('################################')
#################################################################
#####
CustomerData=CustomerRawData.dropna(axis=0, how='any')
print('################################') print('Remove Blank Country
Code') print('Reduce Rows from', CustomerRawData.shape[0],' to ',
CustomerData.shape[0])print('################################')
#################################################################
print('################################')
print('Changed :',CustomerData.columns.values)
CustomerData.rename(columns={'Country': 'Country_Code'},
inplace=True) print('To :',CustomerData.columns.values)
print('################################')
#################################################################
#####print('################################')
print('Merge Company and Country Data')
print('################################')
CompanyNetworkData=pd.merg
      e(CompanyData,
CountryData,
how='inner',
      on='Country_Code'
      )
#################################################################
##### print('################################')
print('Change ',CompanyNetworkData.columns.values)
for i in
   CompanyNetworkData.columns.values
   :j='Company_'+i
   CompanyNetworkData.rename(columns={i: j}, inplace=True)
print('To ', CompanyNetworkData.columns.values)
print('################################')
```

```
#################################################################
#####
#################################################################
#####
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#################################################################
#####

sFileName=sFileDir + '/' + sOutputFileName
print('###################################')
print('Storing :', sFileName)
print('###################################')
CompanyNetworkData.to_csv(sFileName, index = False,
encoding="latin-1")
#################################################################
#####
#################################################################
#####print('###################################')
print('### Done!! ######################')
print('###################################')
#####################################################################
```

Output:

Go to C:\VKHCG\01-Vermeulen\02-Assess\01-EDS\02-Python folder and openAssess-Network-Routing-Company.csv

	A	B	C	D	E
1	ny_Countr	Company_Place_Name	Company_Latitude	Company_Longitude	Company_Country_Name
2	US	New York	40.7528	-73.9725	United States of America
3	US	New York	40.7214	-74.0052	United States of America
4	US	New York	40.7662	-73.9862	United States of America
5	US	New York	40.7449	-73.9782	United States of America
6	US	New York	40.7605	-73.9933	United States of America
7	US	New York	40.7588	-73.968	United States of America
8	US	New York	40.7637	-73.9727	United States of America
9	US	New York	40.7553	-73.9924	United States of America

Next, Access the the customers location using network router location.

```
####################Assess-Network-Routing-Customer.py
###################### import sys import os import pandas as pd
#################################################################
#####
pd.options.mode.chained_assignment = None
#################################################################
#####Base='C:/VKHCG'
print('###################################')
```

```
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#################################################################
#####
sInputFileName=Base+'/01-Vermeulen/02-Assess/01-EDS/02-Python/Assess-NetworkRouting-
Customer.csv'
#################################################################
sOutputFileName='Assess-Network-Routing-
Customer.gml'Company='01-Vermeulen'
#################################################################
### Import Country Data
#################################################################
#####
## sFileName=sInputFileName
print('##################################') print('Loading
:',sFileName)print('##################################')

CustomerData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1") print('Loaded Country:',CustomerData.columns.values)
print('##################################') print(CustomerData.head())
print('##################################') print('### Done!!
####################') print('################################')
#################################################################
```

Output

	A	B	C	D	E
1	ier_Countr	tomer_Place_Na	Customer_Latitude	Customer_Longitude	Customer_Country_Name
2	BW	Gaborone	-24.6464	25.9119	Botswana
3	BW	Francistown	-21.1667	27.5167	Botswana
4	BW	Maun	-19.9833	23.4167	Botswana
5	BW	Molepolole	-24.4167	25.5333	Botswana
6	NE	Niamey	13.5167	2.1167	Niger
7	MZ	Maputo	-25.9653	32.5892	Mozambique
8	MZ	Tete	-16.1564	33.5867	Mozambique
9	MZ	Quelimane	-17.8786	36.8883	Mozambique
10	MZ	Chimoio	-19.1164	33.4833	Mozambique
11	MZ	Matola	-25.9622	32.4589	Mozambique
12	MZ	Pemba	-12.9608	40.5078	Mozambique
13	MZ	Lichinga	-13.3128	35.2406	Mozambique
14	MZ	Maxixe	-23.8597	35.3472	Mozambique
15	MZ	Chibuto	-24.6867	33.5306	Mozambique
16	MZ	Ressano Garcia	-25.4428	31.9953	Mozambique
17	GH	Tema	5.6167	-0.0167	Ghana
18	GH	Kumasi	6.6833	-1.6167	Ghana
19	GH	Takoradi	4.8833	-1.75	Ghana
20	GH	Accra	5.55	-0.2167	Ghana

Assess-Network-Routing-Customer.csv

Assess-Network-Routing-Node.py

```
#################################################################
## import sys import os import pandas as pd
#################################################################
#####
pd.options.mode.chained_assignment = None
#################################################################
#####Base='C:/VKHCG'
```

```
#############################################################
#####print('#################################')
print('Working Base :',Base, ' using ', sys.platform)
print('#################################')
#############################################################
#####
sInputFileName='01-Retrieve/01-EDS/02-Python/Retrieve_IP_DATA.csv'
#####################################################################
sOutputFileName='Assess-Network-Routing-
Node.csv'Company='01-Vermeulen'
#####################################################################
### Import IP Data
#############################################################
#####
sFileName=Base + '/' + Company + '/' + sInputFileName
print('#################################')
print('Loading :',sFileName)
print('#################################')

IPData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1")print('Loaded IP :', IPData.columns.values)
print('#################################')
#####################################################################
print('#################################')
print('Changed
:',IPData.columns.values)
IPData.drop('RowID', axis=1,
inplace=True)IPData.drop('ID', axis=1,
inplace=True)
IPData.rename(columns={'Country': 'Country_Code'}, inplace=True)
IPData.rename(columns={'Place.Name': 'Place_Name'}, inplace=True)
IPData.rename(columns={'Post.Code': 'Post_Code'}, inplace=True)
IPData.rename(columns={'First.IP.Number': 'First_IP_Number'}, inplace=True)
IPData.rename(columns={'Last.IP.Number': 'Last_IP_Number'}, inplace=True) print('To
:',IPData.columns.values)
print('#################################')
#############################################################
#####print('#################################'
) print('Change ',IPData.columns.values)
for iin IPData.columns.values:
    j='Node_'+i
    IPData.rename(columns={i: j},
inplace=True)print('To ',
IPData.columns.values)
```

```
print('##############################
###')
#####################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#############################################################
#####
## sFileName=sFileDir + '/' + sOutputFileName
print('##################################') print('Storing :', sFileName)
print('##################################')
IPData.to_csv(sFileName, index = False, encoding="latin-1")
#############################################################
#####print('##################################')
print('### Done!! ####################')
print('##################################')
#############################################################
#####
```

Output:
C:/VKHCG/01-Vermeulen/02-Assess/01-EDS/02-Python/Assess-Network- RoutingNode.csv

	A	B	C	D	E	F	G
1	Node_Country_Code	Node_Place_Name	Node_Post_Code	Node_Latitude	Node_Longitude	ode_First_IP_Numb	Node_Last_IP_Number
2	BW	Gaborone		-24.6464	25.9119	692781056	692781567
3	BW	Gaborone		-24.6464	25.9119	692781824	692783103
4	BW	Gaborone		-24.6464	25.9119	692909056	692909311
5	BW	Gaborone		-24.6464	25.9119	692909568	692910079
6	BW	Gaborone		-24.6464	25.9119	693051392	693052415
7	BW	Gaborone		-24.6464	25.9119	693078272	693078527
8	BW	Gaborone		-24.6464	25.9119	693608448	693616639
9	BW	Gaborone		-24.6464	25.9119	696929792	696930047
10	BW	Gaborone		-24.6464	25.9119	700438784	700439039
11	BW	Gaborone		-24.6464	25.9119	702075904	702076927
12	BW	Gaborone		-24.6464	25.9119	702498816	702499839
13	BW	Gaborone		-24.6464	25.9119	702516224	702517247
14	BW	Gaborone		-24.6464	25.9119	774162663	774162667
15	BW	Gaborone		-24.6464	25.9119	1401887232	1401887743
16	BW	Gaborone		-24.6464	25.9119	1754209024	1754209279
17	NE	Niamey		13.5167	2.1167	696918528	696919039
18	NE	Niamey		13.5167	2.1167	696922112	696924159
19	NE	Niamey		13.5167	2.1167	701203456	701203711
20	NE	Niamey		13.5167	2.1167	758886912	758887167
21	NE	Niamey		13.5167	2.1167	1347294153	1347294160
22	NE	Niamey		13.5167	2.1167	1755108096	1755108351
23	NE	Niamey		13.5167	2.1167	1755828480	1755828735
24	MZ	Maputo		-25.9653	32.5892	692883456	692883967
25	MZ	Maputo		-25.9653	32.5892	692944896	692946943

Directed Acyclic Graph (DAG)

A directed acyclic graph is a specific graph that only has one path through the graph.

- **Write a Python / R program to build directed acyclic graph.**

Open your python editor and create a file named Assess-DAG-Location.py in directoryC:\VKHCG\01-Vermeulen\02-Assess

```
################################################################
## import networkx as nx import matplotlib.pyplot as plt import sys
import os import pandas as pd
################################################################
#####Base='C:/VKHCG'
################################################################
#####print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
#####
sInputFileName='01-Retrieve/01-EDS/02-Python/Retrieve_Router_Location.csv'
sOutputFileName1='Assess-DAG-Company-Country.png' sOutputFileName2='Assess-
DAG-Company-Country-Place.png'
Company='01-Vermeulen'
################################################################
#####
### Import Company Data
################################################################
#####
sFileName=Base + '/' + Company + '/' +
sInputFileName
print('##################################')
print('Loading :',sFileName)

print('##################################')
CompanyData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
print('Loaded Company :',CompanyData.columns.values)
print('##################################')
################################################################
## print(CompanyData) print('##################################')
print('Rows : ',CompanyData.shape[0])
print('##################################')
################################################################
#####
G1=nx.DiGr
aph()
G2=nx.DiGr
aph()
################################################################
for i in range(CompanyData.shape[0]):
G1.add_node(CompanyData['Country'][i])
```

```
    sPlaceName= CompanyData['Place_Name'][i] + '-' + CompanyData['Country'][i]
    G2.add_node(sPlaceName)

print('################################')
for n1 in
    G1.nodes(): for
    n2 in
    G1.nodes():
if n1 != n2:
            print('Link :',n1,' to ', n2)
G1.add_edge(n1,n2)
print('##############################
##')

print('################################')
print("Nodes of
graph: ")
print(G1.nodes())
print("Edges of
graph: ")
print(G1.edges())
print('################################')
#################################################################
#####
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
#################################################################
#####
sFileName=sFileDir + '/' + sOutputFileName1
print('################################
') print('Storing :', sFileName)
print('################################
')
nx.draw(G1,pos=nx.spectral_layout(G
1), nodecolor='r',edge_color='g',
with_labels=True,node_size=8000,
font_size=12) plt.savefig(sFileName)
# saveas png plt.show() # display
#####################################################################

print('################################'
) for n1 in G2.nodes():     for
n2 inG2.nodes(): if n1 != n2:
            print('Link :',n1,' to ', n2)
G2.add_edge(n1,n2)
```

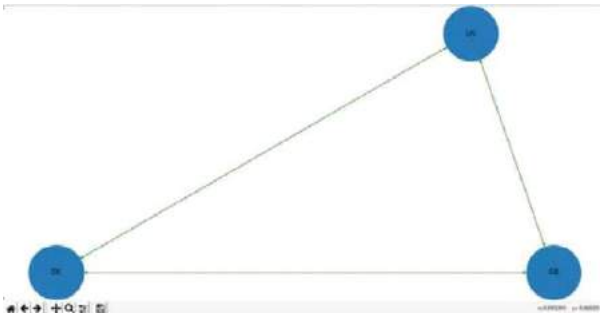
```
print('##############################
##')

print('################################')
print("Nodes of
graph: ")
print(G2.nodes())
print("Edges of
graph: ")
print(G2.edges())
print('################################')
#############################################################
#####
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
#############################################################
#####
sFileName=sFileDir + '/' + sOutputFileName2
print('################################')
print('Storing :', sFileName)
print('################################'
) nx.draw(G2,pos=nx.spectral_layout(G2),
nodecolor='r',edge_color='b',
with_labels=True,node_size=8000,
font_size=12) plt.savefig(sFileName)
# saveas png plt.show() # display
#####################################################################
```

Output:

```
##########################
#####
Rows : 150
##########################
#####
##########################
#####
```

Link : US to DE Link : US to GB Link : DE to US Link : DE to GB Link : GB

to US Link :
GB to DE
##########################
#####
##########################
####
 # Nodes of graph: ['US', 'DE',
'GB']Edges of graph:
[('US', 'DE'), ('US', 'GB'), ('DE', 'US'), ('DE', 'GB'), ('GB', 'US'), ('GB', 'DE')]



Customer Location DAG
################### **Assess-DAG-**
Location.py################### import networkx as nx import
matplotlib.pyplot as plt import sys import os import pandas as pd
###
#####Base='C:/VKHCG'
###
#####print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
###
#####
sInputFileName='01-Retrieve/01-EDS/02-Python/Retrieve_Router_Location.csv'
sOutputFileName1='Assess-DAG-Company-Country.png' sOutputFileName2='Assess-
DAG-Company-Country-Place.png'
Company='01-Vermeulen'
###
#####
Import Company Data
###
sFileName=Base + '/' + Company + '/' +
sInputFileName
print('################################')
print('Loading :',sFileName)
print('################################')

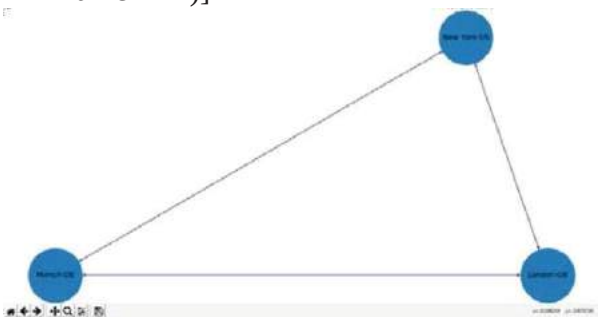
```
CompanyData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
print('Loaded Company :',CompanyData.columns.values)
print('#################################')
#############################################################
## print(CompanyData) print('#################################')
print('Rows : ',CompanyData.shape[0])
print('#################################')
#############################################################
#####
G1=nx.DiGr
aph()
G2=nx.DiGr
aph()
#################################################################
for i in range(CompanyData.shape[0]):
G1.add_node(CompanyData['Country'][i])

   G2.add_node(sPlaceName)

print('#################################'
) for n1 in G1.nodes():     for
n2 inG1.nodes(): if n1 != n2:
          print('Link :',n1,' to
', n2)G1.add_edge(n1,n2)
print('#################################') print('#################################')
print("Nodes of
graph: ")
print(G1.nodes())
print("Edges of
graph: ")
print(G1.edges())
print('#################################')
#############################################################
#####
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#############################################################
#####
sFileName=sFileDir + '/' + sOutputFileName1
print('#################################
') print('Storing :', sFileName)
print('#################################
')
nx.draw(G1,pos=nx.spectral_layout(G
1), nodecolor='r',edge_color='g',
```

```
with_labels=True,node_size=8000,
font_size=12) plt.savefig(sFileName)
# saveas png plt.show() # display
############################################################
#####print('################################'
) for n1 in G2.nodes():     for
n2 inG2.nodes(): if n1 != n2:
          print('Link :',n1,' to ', n2)
G2.add_edge(n1,n2)
print('##############################
##')

print('################################')
print("Nodes of
graph: ")
print(G2.nodes())
print("Edges of
graph: ")
print(G2.edges())
print('################################')
############################################################
#####
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
############################################################
#####

sFileName=sFileDir + '/' + sOutputFileName2
print('################################
') print('Storing :', sFileName)
print('################################
')
nx.draw(G2,pos=nx.spectral_layout(G
2), nodecolor='r',edge_color='b',
with_labels=True,node_size=8000,
font_size=12) plt.savefig(sFileName)
# saveas png
plt.show() # display
############################################################
#####
```

Output:

```
################################
Link : New York-US to Munich-
DE Link : New York-US to
```

London-GB Link : Munich-DE to
New York-US Link : Munich-DE
to London-GB Link : London-
GB to New York-US Link :
London-GB to Munich-DE
##########################
#####
##########################
#####
Nodes of graph:
['New York-US', 'Munich-DE',
'London-GB']Edges of graph:
[('New York-US', 'Munich-DE'), ('New York-US', 'London-GB'), ('Munich-DE', 'New YorkUS'), ('Munich-DE', 'London-GB'), ('London-GB', 'New York-US'), ('London-GB', 'MunichDE')]



Open your Python editor and create a file named Assess-DAG-GPS.py in directory C:\VKHCG\01-Vermeulen\02-Assess.

```
import networkx as nx import matplotlib.pyplot as plt import sys
import os import pandas as pd Base='C:/VKHCG'
print('##################################') print('Working Base
:',Base, 'using ', sys.platform)
print('##################################') sInputFileName='01-
Retrieve/01-EDS/02- Python/Retrieve_Router_Location.csv'

sOutputFileName='Assess-DAG-Company-
GPS.png'Company='01-Vermeulen'
### Import Company Data
sFileName=Base + '/' + Company + '/' +
sInputFileName
print('##################################')
print('Loading :',sFileName)
print('##################################')
CompanyData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1") print('Loaded                    Company
                    :',CompanyData.columns.values)
print('##################################')
                    print(CompanyData)
```

```
print('#################################')                print('Rows                :
',CompanyData.shape[0])                print('#################################')
G=nx.Graph() for i in
range(CompanyData.shape[0]):
   nLatitude=round(CompanyData['Latitude'][i],2)
   nLongitude=round(CompanyData['Longitude'][i],2)

   if nLatitude < 0:
      sLatitude = str(nLatitude*-1) + ' S'
else:
      sLatitude = str(nLatitude) + ' N'

   if nLongitude < 0:
      sLongitude = str(nLongitude*-1) + ' W'
else:
      sLongitude = str(nLongitude) + ' E'

   sGPS= sLatitude + '-' +
   sLongitude
   G.add_node(sGPS)

print('################################'
) for n1 in G.nodes():     for n2 in G.nodes():
if n1 != n2:
         print('Link :',n1,' to ', n2)
G.add_edge(n1,n2)
print('############################
###')

print('################################')
print("Nodes of graph: ")
print(G.number_of_nodes())
print("Edges of graph: ")
print(G.number_of_edges())
print('############################
####')
```

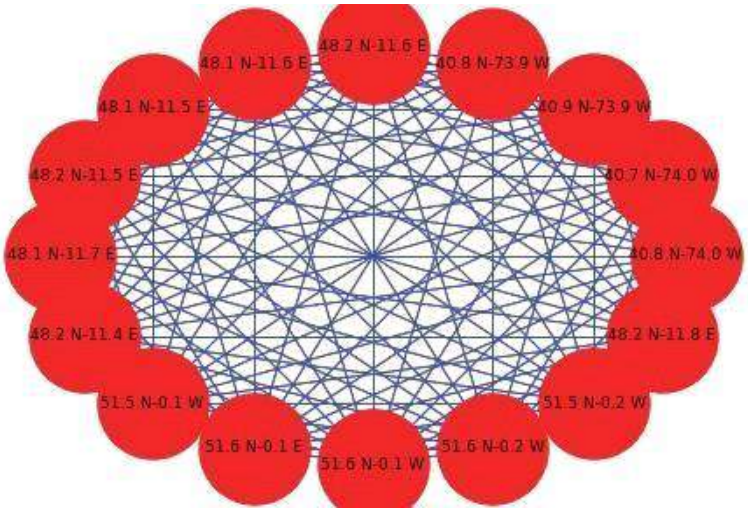
Output:

```
=== RESTART: C:\VKHCG\01-Vermeulen\02-Assess\Assess-DAG-GPS-unsmoothed.py
===
#########################
#####

Working Base : C:/VKHCG using win32
#################################
```

Loading : C:/VKHCG/01-Vermeulen/01-Retrieve/01-EDS/02Python/Retrieve_Router_Location.csv
################################
Loaded Company : ['Country' 'Place_Name' 'Latitude' 'Longitude']
################################

	Country	Place_Name	Latitude	Longitude
0	US	New York	40.7528	-73.9725
1	US	New York	40.7214	-74.0052

-
-



- **Write a Python / R program to pick the content for Bill Boards from the givendata.**

Picking Content for Billboards

The basic process required is to combine two sets of data and then calculate the number ofvisitors per day from the range of IP addresses that access the billboards in Germany.

Bill Board Location: Rows -
8873Access Visitors: Rows -
75999
Access Location Record: Rows – 1,81,235

Open Python editor and create a file named **Assess-DE-Billboard.py** in directoryC:\VKHCG\02-Krennwallner\02-Assess

################# **Assess-DE-Billboard.py**###################### import sys import os importsqlite3 as sq import pandas as pd
##
#####Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)

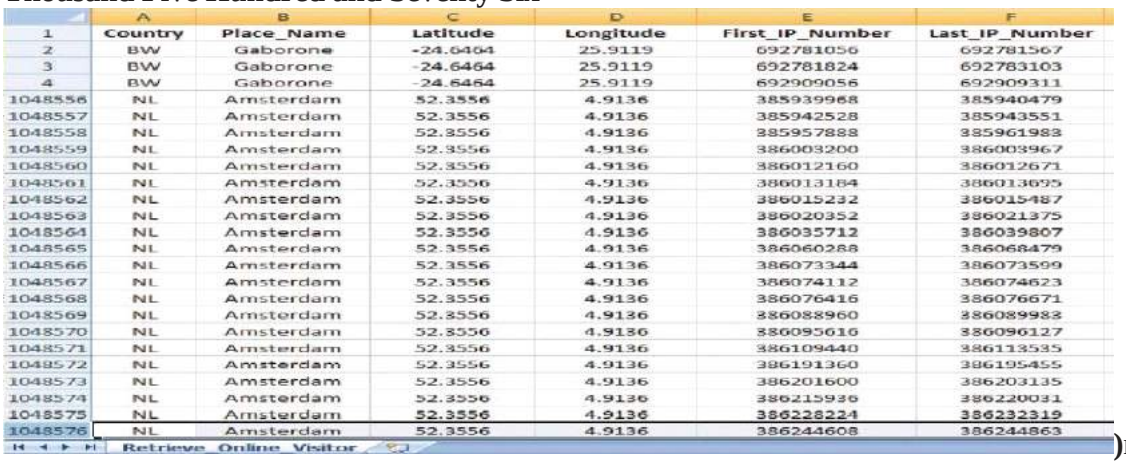
```
print('##############################
#')

sInputFileName1='01-Retrieve/01-EDS/02-
Python/Retrieve_DE_Billboard_Locations.csv' sInputFileName2='01-Retrieve/01-
EDS/02-Python/Retrieve_Online_Visitor.csv' sOutputFileName='Assess-DE-
Billboard-Visitor.csv'
Company='02-Krennwallner'
################################################################
#####
sDataBaseDir=Base + '/' + Company + '/02-
Assess/SQLite'if not os.path.exists(sDataBaseDir):
os.makedirs(sDataBaseDir)
########################################
####################
sDatabaseName=sDataBaseDir +
'/krennwallner.db'conn =
sq.connect(sDatabaseName)
#####################################################################
### Import Billboard Data
#############################################################
#####
sFileName=Base + '/' + Company + '/' +
sInputFileName1
print('################################')
print('Loading :',sFileName)
print('################################')
BillboardRawData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin1")
BillboardRawData.drop_duplicates(subset=None, keep='first', inplace=True)
BillboardData=BillboardRawData
print('Loaded Company :',BillboardData.columns.values)
print('################################')
#############################################################
#####
## print('################')   sTable='Assess_BillboardData' print('Storing
:',sDatabaseName,' Table:',sTable) BillboardData.to_sql(sTable, conn,
if_exists="replace") print('################')
#############################################################
#####
## print(BillboardData.head())
print('################################')
print('Rows :
',BillboardData.shape[0]) print('################################')
#############################################################
#####
```

```
### Import Billboard Data
#################################################################
#####
sFileName=Base + '/' + Company + '/' +
sInputFileName2
print('################################')
print('Loading :',sFileName)
print('################################')
VisitorRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
VisitorRawData.drop_duplicates(subset=None, keep='first', inplace=True)
VisitorData=VisitorRawData[VisitorRawData.Country=='DE']
print('Loaded Company :',VisitorData.columns.values)
print('################################')

#################################################################
## print('################')  sTable='Assess_VisitorData' print('Storing
:',sDatabaseName,' Table:',sTable) VisitorData.to_sql(sTable, conn,
if_exists="replace") print('################')
#################################################################
#####
## print(VisitorData.head())
print('################################') print('Rows :
',VisitorData.shape[0]) print('################################')
#################################################################
#####
## print('################') sTable='Assess_BillboardVisitorData'
print('Loading :',sDatabaseName,' Table:',sTable) sSQL="select distinct"
sSQL=sSQL+ " A.Country AS BillboardCountry," sSQL=sSQL+ "
A.Place_Name AS BillboardPlaceName," sSQL=sSQL+ " A.Latitude AS
BillboardLatitude, " sSQL=sSQL+ " A.Longitude AS
BillboardLongitude," sSQL=sSQL+ " B.Country AS VisitorCountry,"
sSQL=sSQL+ " B.Place_Name AS VisitorPlaceName," sSQL=sSQL+ "
B.Latitude AS VisitorLatitude, " sSQL=sSQL+ " B.Longitude AS
VisitorLongitude," sSQL=sSQL+ " (B.Last_IP_Number -
B.First_IP_Number) * 365.25 * 24 * 12AS VisitorYearRate"
sSQL=sSQL+ " from" sSQL=sSQL+ " Assess_BillboardData as A"
sSQL=sSQL+ " JOIN " sSQL=sSQL+ " Assess_VisitorData as B"
sSQL=sSQL+ " ON " sSQL=sSQL+ " A.Country = B.Country"
sSQL=sSQL+ " AND " sSQL=sSQL+ "
A.Place_Name = B.Place_Name;"
BillboardVistorsData=pd.read_sql_query(s
SQL,conn) print('################')
#################################################################
## print('################') sTable='Assess_BillboardVistorsData'
print('Storing :',sDatabaseName,' Table:',sTable)
BillboardVistorsData.to_sql(sTable, conn, if_exists="replace")
```

```
print('################')
############################################################
#####
## print(BillboardVistorsData.head())
print('################################')
print('Rows :
',BillboardVistorsData.shape[0])
print('################################')
############################################################
#####
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
############################################################
#####print('################################')
print('Storing :', sFileName)
print('################################')
sFileName=sFileDir + '/' + sOutputFileName
BillboardVistorsData.to_csv(sFileName, index = False)

print('### Done!! ############################################')
############################################################
#####
```

Output:

C:\VKHCG\02-Krennwallner\01-Retrieve\01-EDS\02-Python\Retrieve_Online_Visitor.csv containing, 10,48,576**(Ten lack Forty Eight Thousand Five Hundred and Seventy Six**



	A	B	C	D	E	F
1	Country	Place_Name	Latitude	Longitude	First_IP_Number	Last_IP_Number
2	BW	Gaborone	-24.6464	25.9119	692781056	692781567
3	BW	Gaborone	-24.6464	25.9119	692781824	692783103
4	BW	Gaborone	-24.6464	25.9119	692909056	692909311
1048556	NL	Amsterdam	52.3556	4.9136	385939968	385940479
1048557	NL	Amsterdam	52.3556	4.9136	385942528	385943551
1048558	NL	Amsterdam	52.3556	4.9136	385957888	385961983
1048559	NL	Amsterdam	52.3556	4.9136	386003200	386003967
1048560	NL	Amsterdam	52.3556	4.9136	386012160	386012671
1048561	NL	Amsterdam	52.3556	4.9136	386013184	386013695
1048562	NL	Amsterdam	52.3556	4.9136	386015232	386015487
1048563	NL	Amsterdam	52.3556	4.9136	386020352	386021375
1048564	NL	Amsterdam	52.3556	4.9136	386035712	386039807
1048565	NL	Amsterdam	52.3556	4.9136	386060288	386068479
1048566	NL	Amsterdam	52.3556	4.9136	386073344	386073599
1048567	NL	Amsterdam	52.3556	4.9136	386074112	386074623
1048568	NL	Amsterdam	52.3556	4.9136	386076416	386076671
1048569	NL	Amsterdam	52.3556	4.9136	386088960	386089983
1048570	NL	Amsterdam	52.3556	4.9136	386095616	386096127
1048571	NL	Amsterdam	52.3556	4.9136	386109440	386113535
1048572	NL	Amsterdam	52.3556	4.9136	386191360	386195455
1048573	NL	Amsterdam	52.3556	4.9136	386201600	386203135
1048574	NL	Amsterdam	52.3556	4.9136	386215936	386220031
1048575	NL	Amsterdam	52.3556	4.9136	386228224	386232319
1048576	NL	Amsterdam	52.3556	4.9136	386244608	386244863

Retrieve_Online_Visitor

)rows.

SQLite Visitor's Database

C:/VKHCG/02-Krennwallner/02-Assess/SQLite/krennwallner.db Table:

```
  BillboardCountry BillboardPlaceName  ...  VisitorLongitude
  VisitorYearRate
0               DE              Lake  ...            8.5667     26823960.0
1               DE              Horb  ...            8.6833     26823960.0
2               DE              Horb  ...            8.6833     53753112.0
```

3	DE	Horb	...			8.6833	107611416.0	
4	DE	Horb	...			8.6833	13359384.0	

	A	B	C	D	E	F	G	H	I
1	BillboardCountry	BillboardPlaceName	BoardLatitu	BoardLongi	VisitorCount	VisitorPlaceName	VisitorLatitu	VisitorLongitu	VisitorYearRate
2	DE	Lake	51.7833	8.5667	DE	Lake	51.7833	8.5667	26823960
3	DE	Horb	48.4333	8.6833	DE	Horb	48.4333	8.6833	26823960
4	DE	Horb	48.4333	8.6833	DE	Horb	48.4333	8.6833	53753112
5	DE	Horb	48.4333	8.6833	DE	Horb	48.4333	8.6833	107611416
6	DE	Horb	48.4333	8.6833	DE	Horb	48.4333	8.6833	13359384
7	DE	Horb	48.4333	8.6833	DE	Horb	48.4889	8.6734	26823960
8	DE	Horb	48.4333	8.6833	DE	Horb	48.4889	8.6734	53753112
9	DE	Hardenberg	51.1	7.7333	DE	Hardenberg	51.1	7.7333	26823960
181221	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1167	8.6833	1157112
181222	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1167	8.6833	24299352
181223	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1167	8.6833	807769368
181224	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1172	8.7281	53753112
181225	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1172	8.7281	26823960
181226	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1172	8.7281	107611416
181227	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1172	8.7281	1577880
181228	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1184	8.6095	15042456
181229	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1184	8.6095	10834776
181230	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1319	8.6838	736344
181231	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1319	8.6838	0
181232	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1327	8.7668	736344
181233	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1492	8.7097	1723360536
181234	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1492	8.7097	430761240
181235	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1528	8.745	26823960
181236	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1878	8.6632	1577880

Assess-DE-Billboard-Visitor

- **Write a Python / R program to generate GML file from the given csv file.Understanding Your Online Visitor Data**

Online visitors have to be mapped to their closest billboard, to ensure we understandwhere and what they can access.

Open your Python editor and create a file called Assess-Billboard_2_Visitor.py indirectory C:\VKHCG\ 02-Krennwallner\02-Assess. import networkx as nx
import sys import os import sqlite3
as sq importpandas as pd
from geopy.distance import vincenty
##
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
##
#####
Company='02-Krennwallner'
sTable='Assess_BillboardVisitorData'
sOutputFileName='Assess-DE-Billboard-Visitor.gml'
##
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'if not os.path.exists(sDataBaseDir):

```
   os.makedirs(sDataBaseDir)
#################################################################
#####
sDatabaseName=sDataBaseDir +
'/krennwallner.db'conn =
sq.connect(sDatabaseName)
#####################################################################
## print('################')  print('Loading :',sDatabaseName,'
Table:',sTable)
sSQL="select " sSQL=sSQL+ " A.BillboardCountry," sSQL=sSQL+
" A.BillboardPlaceName," sSQL=sSQL+ "
ROUND(A.BillboardLatitude,3)AS BillboardLatitude, "
sSQL=sSQL+ " ROUND(A.BillboardLongitude,3) AS
BillboardLongitude," sSQL=sSQL+" (CASE WHEN
A.BillboardLatitude < 0 THEN " sSQL=sSQL+ " 'S' ||
ROUND(ABS(A.BillboardLatitude),3)" sSQL=sSQL+ " ELSE "
sSQL=sSQL+ " 'N' || ROUND(ABS(A.BillboardLatitude),3)"
sSQL=sSQL+ " END ) AS sBillboardLatitude," sSQL=sSQL+ "
(CASE WHEN A.BillboardLongitude < 0 THEN " sSQL=sSQL+ "
'W' || ROUND(ABS(A.BillboardLongitude),3)" sSQL=sSQL+ "
ELSE " sSQL=sSQL+ " 'E' ||
ROUND(ABS(A.BillboardLongitude),3)" sSQL=sSQL+ " END ) AS
sBillboardLongitude," sSQL=sSQL+ " A.VisitorCountry,"
sSQL=sSQL+ " A.VisitorPlaceName,"

sSQL=sSQL+ " ROUND(A.VisitorLatitude,3) AS
VisitorLatitude, " sSQL=sSQL+ "
ROUND(A.VisitorLongitude,3) AS VisitorLongitude,"
sSQL=sSQL+ " (CASE WHEN A.VisitorLatitude
< 0 THEN " sSQL=sSQL+ "  'S' ||
ROUND(ABS(A.VisitorLatitude),3)" sSQL=sSQL+ " ELSE "
sSQL=sSQL+ " 'N' ||ROUND(ABS(A.VisitorLatitude),3)"
sSQL=sSQL+ " END ) AS sVisitorLatitude," sSQL=sSQL+ "
(CASEWHEN A.VisitorLongitude < 0 THEN " sSQL=sSQL+ "
'W' || ROUND(ABS(A.VisitorLongitude),3)" sSQL=sSQL+ "
ELSE " sSQL=sSQL+ " 'E' ||
ROUND(ABS(A.VisitorLongitude),3)" sSQL=sSQL+ " END )
AS sVisitorLongitude," sSQL=sSQL+ " A.VisitorYearRate"
sSQL=sSQL+ " from" sSQL=sSQL+ "
Assess_BillboardVistorsData AS A;"
BillboardVistorsData=pd.read_sql_query(sSQL, conn)
print('################')
#####################################################################
## BillboardVistorsData['Distance']=BillboardVistorsData.apply(lambda
row:round(
   vincenty((row['BillboardLatitude'],row['BillboardLongitude']),
            (row['VisitorLatitude'],row['VisitorLongitude'])).miles
```

```
          ,4)
      ,axis=1)
#############################################################
#####
G=nx.Graph()
#####################################################################
for i in range(BillboardVistorsData.shape[0]):
   sNode0='MediaHub-' +
BillboardVistorsData['BillboardCountry'][i]sNode1='B-'+
BillboardVistorsData['sBillboardLatitude'][i] + '-'
sNode1=sNode1 +
BillboardVistorsData['sBillboardLongitude'][i]
   G.add_node(sNode1,
            Nodetype='Billboard',
            Country=BillboardVistorsData['BillboardCountry'][i],
            PlaceName=BillboardVistorsData['BillboardPlaceName'][i],
            Latitude=round(BillboardVistorsData['BillboardLatitude'][i],3)
            ,
            Longitude=round(BillboardVistorsData['BillboardLongitude'][i
            ],3))

   sNode2='M-'+ BillboardVistorsData['sVisitorLatitude'][i] + '-'
sNode2=sNode2 + BillboardVistorsData['sVisitorLongitude'][i]
   G.add_node(sNode2,
            Nodetype='Mobile',
            Country=BillboardVistorsData['VisitorCountry'][i],
            PlaceName=BillboardVistorsData['VisitorPlaceName'][i],
            Latitude=round(BillboardVistorsData['VisitorLatitude'][i],3),
            Longitude=round(BillboardVistorsData['VisitorLongitude'][i],3
            ))

   print('Link Media Hub :',sNode0,' to Billboard :
', sNode1)  G.add_edge(sNode0,sNode1)
              print('LinkPost Code :',sNode1,' to
GPS : ', sNode2)



G.add_edge(sNode1,sNode2,distance=round(BillboardVistorsData['Distance'][i]))
#################################################################
print('################################') print("Nodes of graph:
",nx.number_of_nodes(G)) print("Edges of graph:
",nx.number_of_edges(G))
print('################################')
#############################################################
#####
```

```
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
##############################################################
#####
sFileName=sFileDir + '/' + sOutputFileName
print('################################')
print('Storing :', sFileName)
print('################################')
nx.write_gml(G,sFileN
ame)
sFileName=sFileName
+'.gz'
nx.write_gml(G,sFileN
ame)
##############################################################
#####
##############################################################
##### print('### Done!!
############################################')
##############################################################
#####
```

Output:

This will produce a set of demonstrated values onscreen, plus a graph data filenamed Assess-DE-Billboard-Visitor.gml.

(It takes a long time to complete the process, after completion the gml file can be viewed intext editor)

Hence, we have applied formulae to extract features, such as the distance between thebillboard and the visitor.

Planning an Event for Top-Ten Customers

Open Python editor and create a file named Assess-Visitors.py in directory C:\VKHCG\02-Krennwallner\02-Assess

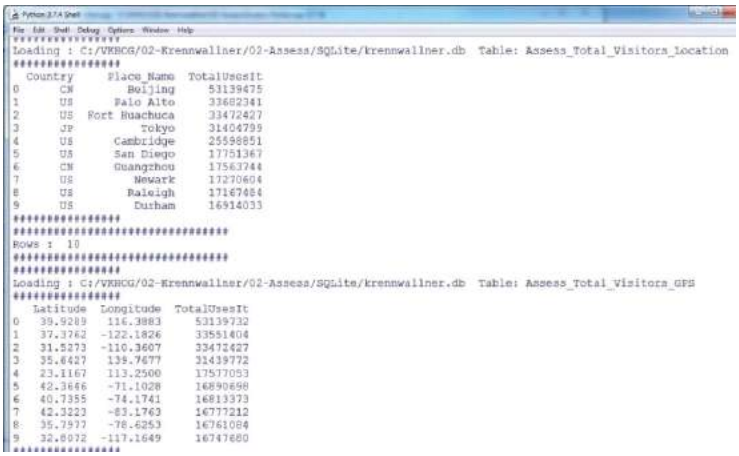
```
##############################################################
#####
## import sys import os import sqlite3 as sq import pandas as pd from
pandas.io import sql
##############################################################
##### Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')

##################################################################
Company='02-Krennwallner'
```

```
sInputFileName='01-Retrieve/01-EDS/02-
Python/Retrieve_Online_Visitor.csv'
##############################################################
#####
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
if not
   os.path.exists(sDataBaseDi
   r):
   os.makedirs(sDataBaseDir)
#####################################################################
sDatabaseName=sDataBaseDir +
'/krennwallner.db'conn =
sq.connect(sDatabaseName)
#####################################################################
### Import Country Data
#############################################################
#####
sFileName=Base + '/' + Company + '/' +
sInputFileName
print('################################')
print('Loading :',sFileName)
print('################################')
VisitorRawData=pd.read_csv(sFileName,
                    hea
der=0,
low_memory=False,
encoding="latin-1",
                    skip_blank_lines=True)
VisitorRawData.drop_duplicates(subset=None, keep='first',
inplace=True)VisitorData=VisitorRawData print('Loaded Company
:',VisitorData.columns.values)
print('################################')
#############################################################
#####
## print('################')  sTable='Assess_Visitor' print('Storing
:',sDatabaseName,' Table:',sTable) VisitorData.to_sql(sTable, conn,
if_exists="replace") print('################')
#############################################################
#####
print(VisitorData.head())
print('################################')
print('Rows : ',VisitorData.shape[0])
print('################################')
#############################################################
#####
```

```
## print('################')   sView='Assess_Visitor_UseIt' print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP VIEW IF EXISTS " +
sView + ";" sql.execute(sSQL,conn) sSQL="CREATE VIEW " + sView
+ " AS" sSQL=sSQL+ " SELECT" sSQL=sSQL+ " A.Country,"
sSQL=sSQL+ "
A.Place_Name," sSQL=sSQL+ " A.Latitude," sSQL=sSQL+ "
A.Longitude,"sSQL=sSQL+ " (A.Last_IP_Number -
A.First_IP_Number) AS UsesIt" sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Visitor
as A"sSQL=sSQL+ " WHERE"

sSQL=sSQL+ " Country is not
null" sSQL=sSQL+ " AND"
sSQL=sSQL+ "
Place_Name is not null;" sql.execute(sSQL,conn)
##############################################################
#####
## print('################')  sView='Assess_Total_Visitors_Location'
print('Creating :',sDatabaseName,'
View:',sView) sSQL="DROP VIEW IF
EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView +
" AS"sSQL=sSQL+ " SELECT"
sSQL=sSQL+ "
Country," sSQL=sSQL+ "
Place_Name,"sSQL=sSQL+ "
SUM(UsesIt) AS
TotalUsesIt" sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Visitor_UseIt"
sSQL=sSQL+ " GROUP BY"
sSQL=sSQL+
" Country," sSQL=sSQL+ "
Place_Name" sSQL=sSQL+ " ORDER
BY" sSQL=sSQL+
" TotalUsesIt DESC" sSQL=sSQL+ "
LIMIT10;" sql.execute(sSQL,conn)
##################################################################
## print('################') sView='Assess_Total_Visitors_GPS'
print('Creating :',sDatabaseName,' View:',sView) sSQL="DROP VIEW
IFEXISTS " + sView + ";"
sql.execute(sSQL,conn)
```

```
sSQL="CREATE VIEW " + sView +
" AS"sSQL=sSQL+ " SELECT"
sSQL=sSQL+ "
Latitude," sSQL=sSQL+ "
Longitude,"sSQL=sSQL+ "
SUM(UsesIt) AS
TotalUsesIt" sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Visitor_UseIt"
sSQL=sSQL+ " GROUP BY"
sSQL=sSQL+
" Latitude," sSQL=sSQL+ "
Longitude" sSQL=sSQL+ " ORDER
BY" sSQL=sSQL+
" TotalUsesIt DESC" sSQL=sSQL+ "
LIMIT10;" sql.execute(sSQL,conn)
#################################################################
## sTables=['Assess_Total_Visitors_Location',
'Assess_Total_Visitors_GPS']for sTable in sTables:
   print('################')          print('Loading
:',sDatabaseName,'  Table:',sTable)
                                                sS
QL="SELECT "
   sSQL=sSQL+ " *"
              sSQL=sSQL+ " FROM"
              sSQL=sSQL+ " " + sTable
+ ";"
TopData=pd.read_sql_query(sSQL, conn)

   print('################')
print(TopData)
                        print('##############
##')
print('############################
####')
print('Rows : ',TopData.shape[0])
   print('################################')
#############################################################
#####print('### Done!!
##############################################')
#############################################################
#####
```

Output:



```
Python 3.7.4 Shell
File  Edit  Shell  Debug  Options  Window  Help
################
Loading : C:/VKHCG/02-Krennwallner/02-Assess/SQLite/krennwallner.db  Table: Assess_Total_Visitors_Location
###############
  Country       Place_Name  TotalUsesIt
0      CN          Beijing     53139475
1      US        Palo Alto     33682341
2      US  Fort Huachuca      33472427
3      JP            Tokyo     31404799
4      US        Cambridge     25598851
5      US        San Diego     17751367
6      CN        Guangzhou     17563744
7      US            Newark    17270604
8      US          Raleigh     17167484
9      US            Durham    16914033
###############
##############################
Rows :  10
##############################
###############
Loading : C:/VKHCG/02-Krennwallner/02-Assess/SQLite/krennwallner.db  Table: Assess_Total_Visitors_GPS
###############
   Latitude  Longitude  TotalUsesIt
0   39.9289   116.3883     53139732
1   37.3762  -122.1826     33551404
2   31.5273  -110.3607     33472427
3   35.6427   139.7677     31439772
4   23.1167   113.2500     17577053
5   42.3666   -71.1028     16890698
6   40.7355   -74.1741     16813373
7   42.3223   -83.1763     16777212
8   35.7977   -78.6253     16761084
9   32.8072  -117.1649     16747680
###############
```

- **Write a Python / R program to plan the locations of the warehouses from thegiven data.**

Planning the Locations of the Warehouses

Planning the location of the warehouses requires the assessment of the GPS locations of these warehouses against the requirements for Hillman's logistics needs. Open your editor and create a file named Assess-Warehouse-Address.py in directory C:\VKHCG\03- Hillman\02-Assess.

```
################### Assess-Warehouse-Address.py################### import os import pandas as pd from geopy.geocoders importNominatim geolocator = Nominatim()
##################################################################
InputDir='01-Retrieve/01-EDS/01-R'
InputFileName='Retrieve_GB_Postcode_Warehou
se.csv' EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName='Assess_GB_Warehouse_Addre
ss.csv' Company='03-Hillman'
##########################################################
######Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using Windows')
print('################################')
##########################################################
######
sFileDir=Base + '/' + Company + '/' +
EDSDirif not os.path.exists(sFileDir):

    os.makedirs(sFileDir)
##########################################################
######
# sFileDir=Base + '/' + Company + '/' + OutputDir if not
os.path.exists(sFileDir):
    os.makedirs(sFileDir)
##########################################################
######
# sFileName=Base + '/' + Company + '/' + InputDir + '/' + InputFileName
print('###########') print('Loading :',sFileName)
```

```
Warehouse=pd.read_csv(sFileName,header=0,low_memory=False)
Warehouse.sort_values(by='postcode', ascending=1)
#############################################################
######
## Limited to 10 due to service limit on Address Service.
#############################################################
######
WarehouseGoodHead=Warehouse[Warehouse.latitude != 0].head(5)
WarehouseGoodTail=Warehouse[Warehouse.latitude != 0].tail(5)
#############################################################
######
WarehouseGoodHead['Warehouse_Point']=WarehouseGoodHead.apply(lambda row:
        (str(row['latitude'])+','+str(row['longitude']))
        ,axis=1)
WarehouseGoodHead['Warehouse_Address']=WarehouseGoodHead.apply(lambda
row:geolocator.reverse(row['Warehouse_Point']).address
       ,axis=1)
WarehouseGoodHead.drop('Warehouse_Point', axis=1, inplace=True)
WarehouseGoodHead.drop('id', axis=1, inplace=True)
WarehouseGoodHead.drop('postcode', axis=1, inplace=True)
#############################################################
######
WarehouseGoodTail['Warehouse_Point']=WarehouseGoodTail.apply(lambda row:
        (str(row['latitude'])+','+str(row['longitude']))
        ,axis=1)
WarehouseGoodTail['Warehouse_Address']=WarehouseGoodTail.apply(lambda
row:
        geolocator.reverse(row['Warehouse_Point']).address
       ,axis=1)
WarehouseGoodTail.drop('Warehouse_Point', axis=1, inplace=True)
WarehouseGoodTail.drop('id', axis=1, inplace=True)
WarehouseGoodTail.drop('postcode', axis=1, inplace=True)
#############################################################
######
WarehouseGood=WarehouseGoodHead.append(WarehouseGoodTail, ignore_index=True)
print(WarehouseGood)
#################################################################
sFileName=sFileDir + '/' + OutputFileName
WarehouseGood.to_csv(sFileName, index =
False)
#############################################################
#####print('### Done!!
#############################################')
#############################################################
######
```

Output:

```
##############################
Working Base : C:/VKHCG  using Windows
##############################
###########
Loading : C:/VKHCG/03-Hillman/01-Retrieve/01-EDS/01-R/Retrieve_GB_Postcode_Warehouse.csv
    latitude  longitude                                  Warehouse_Address
0  57.135140  -2.117310  35, Broomhill Road, Broomhill, Aberdeen, Aberd...
1  57.138750  -2.090890  South Esplanade West, Torry, Aberdeen, Aberdee...
2  57.101000  -2.110600  A92, Cove and Altens, Aberdeen, Aberdeen City,...
3  57.108010  -2.237760  Colthill Circle, Milltimber, Countesswells, Ab...
4  57.100760  -2.270730  Johnston Gardens East, Peterculter, South Last...
5  53.837717  -1.780013  HM Revenue and Customs, Riverside Estate, Temp...
6  53.794470  -1.766539  Listerhills Road Norcroft Street, Listerhills ...
7  51.518556  -0.714794  Sorting Office, Stafferton Way, Fishery, Maide...
8  54.890923  -2.943847  Royal Mail (Delivery Office), Junction Street,...
9  57.481338  -4.223951  Inverness Sorting & Delivery Office, Strothers...
### Done!! ############################################
>>>
```

- **Write a Python / R program using data science via clustering to determine newwarehouses using the given data.**

Global New Warehouse: Hillman wants to add extra global warehouses, and you arerequired to assess wherethey should be located. We only have to collect the possible locations for warehouses.

The following example will show you how to modify the data columns you read in that are totally ambiguous. Open Python editor and create a file named Assess-Warehouse-Global.pyin directory
C:\VKHCG\03-Hillman\02-Assess

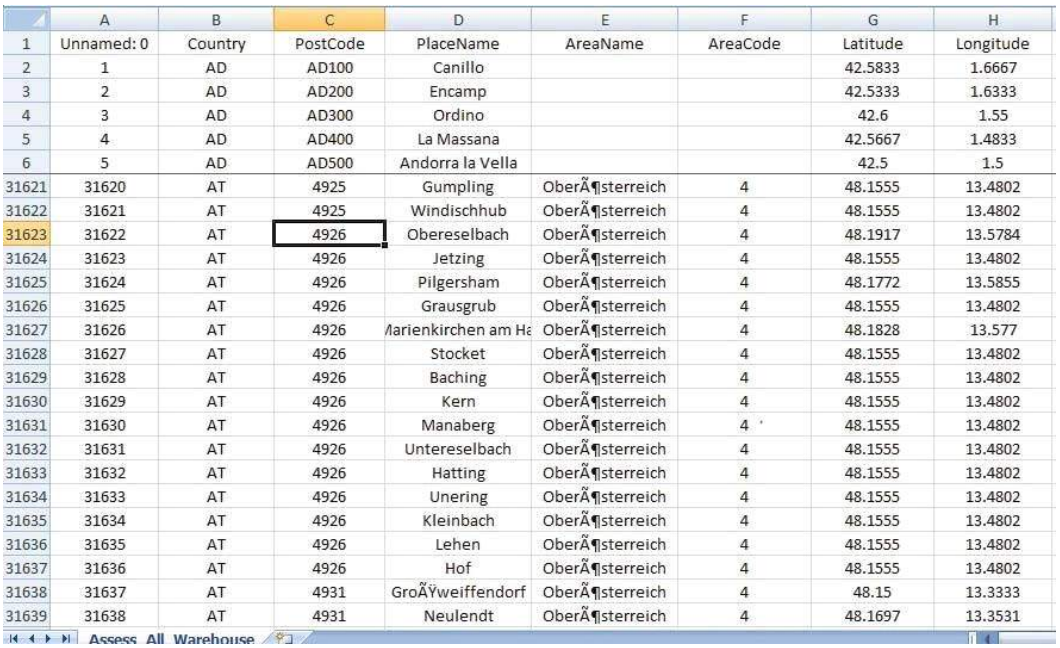
```
#################          Assess-
Warehouse- Global.py##############
import sys import osimport pandas as pd
################################################################
#####Base='C:/VKHCG'
################################################################
#####print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
#####
Company='03-Hillman'
InputDir='01-Retrieve/01-EDS/01-R'
InputFileName='Retrieve_All_Countries
.csv' EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName='Assess_All_Warehous
e.csv'
################################################################
## sFileDir=Base + '/' + Company + '/' + EDSDir
if notos.path.exists(sFileDir):
```

```
    os.makedirs(sFileDir)

#################################################################
sFileDir=Base + '/' + Company + '/' +
OutputDirif not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
#############################################################
#####
## sFileName=Base + '/' + Company + '/' + InputDir + '/' + InputFileName
print('###########') print('Loading :',sFileName)
Warehouse=pd.read_csv(sFileName,header=0,low_memory=False,
          encoding="latin-1")
          ################################################################
#####
sColumns={'X1' :
          'Country','X2' :
          'PostCode',
          'X3' : 'PlaceName',
          'X4' : 'AreaName',
          'X5' : 'AreaCode',
          'X10' : 'Latitude',
          'X11' : 'Longitude'}
Warehouse.rename(columns=sColumns,inplace=True)
WarehouseGood=Warehouse
#################################################################
#####
sFileName=sFileDir + '/' + OutputFileName
WarehouseGood.to_csv(sFileName, index = False)
#################################################################
#####print('### Done!!
##############################################')
#################################################################
#####
```

This will produce a set of demonstrated values onscreen, plus a graph data file named Assess_All_Warehouse.csv.

Output:

Open Assess0_All_Warehose.csv from C:\VKHCG\03-Hillman\02-Assess\01-EDS\02Python



	A	B	C	D	E	F	G	H
1	Unnamed: 0	Country	PostCode	PlaceName	AreaName	AreaCode	Latitude	Longitude
2	1	AD	AD100	Canillo			42.5833	1.6667
3	2	AD	AD200	Encamp			42.5333	1.6333
4	3	AD	AD300	Ordino			42.6	1.55
5	4	AD	AD400	La Massana			42.5667	1.4833
6	5	AD	AD500	Andorra la Vella			42.5	1.5
31621	31620	AT	4925	Gumpling	OberÃ¶sterreich	4	48.1555	13.4802
31622	31621	AT	4925	Windischhub	OberÃ¶sterreich	4	48.1555	13.4802
31623	31622	AT	4926	Obereselbach	OberÃ¶sterreich	4	48.1917	13.5784
31624	31623	AT	4926	Jetzing	OberÃ¶sterreich	4	48.1555	13.4802
31625	31624	AT	4926	Pilgersham	OberÃ¶sterreich	4	48.1772	13.5855
31626	31625	AT	4926	Grausgrub	OberÃ¶sterreich	4	48.1555	13.4802
31627	31626	AT	4926	Marienkirchen am Ha	OberÃ¶sterreich	4	48.1828	13.577
31628	31627	AT	4926	Stocket	OberÃ¶sterreich	4	48.1555	13.4802
31629	31628	AT	4926	Baching	OberÃ¶sterreich	4	48.1555	13.4802
31630	31629	AT	4926	Kern	OberÃ¶sterreich	4	48.1555	13.4802
31631	31630	AT	4926	Manaberg	OberÃ¶sterreich	4	48.1555	13.4802
31632	31631	AT	4926	Untereselbach	OberÃ¶sterreich	4	48.1555	13.4802
31633	31632	AT	4926	Hatting	OberÃ¶sterreich	4	48.1555	13.4802
31634	31633	AT	4926	Unering	OberÃ¶sterreich	4	48.1555	13.4802
31635	31634	AT	4926	Kleinbach	OberÃ¶sterreich	4	48.1555	13.4802
31636	31635	AT	4926	Lehen	OberÃ¶sterreich	4	48.1555	13.4802
31637	31636	AT	4926	Hof	OberÃ¶sterreich	4	48.1555	13.4802
31638	31637	AT	4931	GroÃŸweiffendorf	OberÃ¶sterreich	4	48.15	13.3333
31639	31638	AT	4931	Neulendt	OberÃ¶sterreich	4	48.1697	13.3531

Assess_All_Warehouse

- **Using the given data, write a Python / R program to plan the shipping routes forbest-fit international logistics.**

Hillman requires an international logistics solution to support all the requiredshippingroutes.

Open Python editor and create a file named Assess-Best-Fit-Logistics.py in directoryC:\VKHCG\03-Hillman\02-Assess

```
import sys import os import
pandasas pd import
networkx as nx from
geopy.distance import
vincenty import sqlite3 as sq
from
pandas.io import sql
################################################################
######
if sys.platform == 'linux':
    Base=os.path.expanduser('~') +
    '/VKHCG'
else:
    Base='C:/VKHCG'
print('############################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
######
Company='03-Hillman'
InputDir='01-Retrieve/01-EDS/01-R'
InputFileName='Retrieve_All_Countrie
```

```
s.csv' EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName='Assess_Best_Logisti
cs.gml'
#################################################################
sFileDir=Base + '/' + Company + '/' +
EDSDirif not os.path.exists(sFileDir):

################################################################
# sFileDir=Base + '/' + Company + '/' + OutputDir if not
os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#############################################################
######
sDataBaseDir=Base + '/' + Company + '/02-
Assess/SQLite'if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
#############################################################
######
sDatabaseName=sDataBaseDir +
'/Hillman.db'conn =
sq.connect(sDatabaseName)
################################################################
# sFileName=Base + '/' + Company + '/' + InputDir + '/' + InputFileName
print('###########') print('Loading :',sFileName)
Warehouse=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1")#################################################################
sColumns={'X1' :
        'Country','X2' :
        'PostCode',
        'X3' : 'PlaceName',
        'X4' : 'AreaName',
        'X5' : 'AreaCode',
        'X10' : 'Latitude',
        'X11' : 'Longitude'}
Warehouse.rename(columns=sColumns,inplace=T
rue)WarehouseGood=Warehouse
#print(WarehouseGood.head())
#################################################################
RoutePointsCountry=pd.DataFrame(WarehouseGood.groupby(['Country'])[['Latitude','Longitude']].me
an()) #print(RoutePointsCountry.head())
print('################')
sTable='Assess_RoutePointsCountry'
print('Storing :',sDatabaseName,'
Table:',sTable)
RoutePointsCountry.to_sql(sTable, conn, if_exists="replace")
print('################')
#############################################################
######
RoutePointsPostCode=pd.DataFrame(WarehouseGood.groupby(['Cou
ntry', 'PostCode'])[['Latitude','Longitude']].mean())
#print(RoutePointsPostCode.head())
print('################')
sTable='Assess_RoutePointsPostCode'
print('Storing :',sDatabaseName,'
Table:',sTable)
```

```
RoutePointsPostCode.to_sql(sTable, conn, if_exists="replace")
print('################')
############################################################
######
RoutePointsPlaceName=pd.DataFrame(WarehouseGood.groupby(['Country',
'PostCode','PlaceName'])[['Latitude','Longitude']].mean())
#print(RoutePointsPlaceName.head())
print('################')
sTable='Assess_RoutePointsPlaceName'
print('Storing :',sDatabaseName,'
Table:',sTable)
RoutePointsPlaceName.to_sql(sTable, conn, if_exists="replace")
print('################')
############################################################
######
### Fit Country to Country
############################################################
######
# print('################')  sView='Assess_RouteCountries'

print('Creating :',sDatabaseName,'
View:',sView) sSQL="DROP VIEW IF
EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView +
" AS"sSQL=sSQL+ " SELECT
DISTINCT"
sSQL=sSQL+ " S.Country AS
SourceCountry," sSQL=sSQL+ "
S.Latitude AS SourceLatitude,"
sSQL=sSQL+ " S.Longitude AS
SourceLongitude," sSQL=sSQL+ "
T.Country ASTargetCountry,"
sSQL=sSQL+ " T.Latitude AS
TargetLatitude,"
sSQL=sSQL+ " T.Longitude AS
TargetLongitude"sSQL=sSQL+   "          FROM"          sSQL=sSQL+       "
Assess_RoutePointsCountry AS S" sSQL=sSQL+ "
," sSQL=sSQL+ "
Assess_RoutePointsCountry AST"
       sSQL=sSQL+    "    WHERE
S.Country    <>
T.Country" sSQL=sSQL+ " AND"
sSQL=sSQL+ " S.Country in ('GB','DE','BE','AU','US','IN')"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " T.Country in ('GB','DE','BE','AU','US','IN');"
sql.execute(sSQL,conn)

print('################')  print('Loading
:',sDatabaseName,'
Table:',sView)sSQL="
SELECT "
sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " +
sView + ";"
```

```
RouteCountries=pd.read_sql_query(sSQL, conn)

RouteCountries['Distance']=RouteCountries.apply(lambda
row:round(
   vincenty((row['SourceLatitude'],row['SourceLongitude']),
            (row['TargetLatitude'],row['TargetLongitude'])).miles,4),axis=1)

print(RouteCountries.head(5))
############################################################
######
### Fit Country to Post Code
############################################################
######
# print('################')   sView='Assess_RoutePostCode' print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP VIEW IF
EXISTS " +sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView +
" AS"sSQL=sSQL+ " SELECT
DISTINCT"
sSQL=sSQL+ " S.Country AS
SourceCountry," sSQL=sSQL+ "
S.Latitude AS SourceLatitude,"
sSQL=sSQL+ " S.Longitude AS
SourceLongitude," sSQL=sSQL+ "
T.Country ASTargetCountry,"
sSQL=sSQL+ " T.PostCode AS
TargetPostCode," sSQL=sSQL+ "
T.Latitude AS TargetLatitude,"
sSQL=sSQL+ " T.Longitude AS
TargetLongitude"sSQL=sSQL+   "                    FROM"          sSQL=sSQL+      "

Assess_RoutePointsCountry AS S" sSQL=sSQL+ "
,"
sSQL=sSQL+ " Assess_RoutePointsPostCode
AS T"sSQL=sSQL+ " WHERE S.Country =
T.Country" sSQL=sSQL+ " AND"
sSQL=sSQL+ " S.Country in ('GB','DE','BE','AU','US','IN')"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " T.Country in ('GB','DE','BE','AU','US','IN');"
sql.execute(sSQL,conn)

print('################')  print('Loading
:',sDatabaseName,'
Table:',sView)sSQL="
SELECT "
sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " +
sView + ";"
RoutePostCode=pd.read_sql_query(sSQL, conn)

RoutePostCode['Distance']=RoutePostCode.apply(lambda
row:round(
```

```
    vincenty((row['SourceLatitude'],row['SourceLongitude']),
             (row['TargetLatitude'],row['TargetLongitude'])).miles
           ,4)
      ,axis=1)

print(RoutePostCode.head(5))
#############################################################
######
### Fit Post Code to Place Name
#############################################################
######
# print('################')  sView='Assess_RoutePlaceName'
print('Creating :',sDatabaseName,' View:',sView) sSQL="DROP
VIEW IFEXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT DISTINCT"
sSQL=sSQL+
" S.Country AS SourceCountry,"
sSQL=sSQL+ " S.PostCode AS
SourcePostCode," sSQL=sSQL+ " S.Latitude
AS SourceLatitude," sSQL=sSQL+ "
S.Longitude AS SourceLongitude,"
sSQL=sSQL+ " T.Country AS
TargetCountry," sSQL=sSQL+ " T.PostCode
AS TargetPostCode," sSQL=sSQL+ "
T.PlaceName AS TargetPlaceName,"
sSQL=sSQL+ "T.Latitude AS TargetLatitude,"
sSQL=sSQL+  "      T.Longitude AS
TargetLongitude"sSQL=sSQL+       "                          FROM"  sSQL=sSQL+       "
Assess_RoutePointsPostCode          AS          S"
sSQL=sSQL+      "      ,"      sSQL=sSQL+      "
Assess_RoutePointsPLaceName         AS         T"
sSQL=sSQL+ " WHERE" sSQL=sSQL+ "
S.Country = T.Country"
sSQL=sSQL+ "AND"
sSQL=sSQL+ " S.PostCode =
T.PostCode"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " S.Country in ('GB','DE','BE','AU','US','IN')"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " T.Country in ('GB','DE','BE','AU','US','IN');"


print('################')  print('Loading
:',sDatabaseName,'
Table:',sView)sSQL="
SELECT "
sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " +
sView + ";"
RoutePlaceName=pd.read_sql_
query(sSQL, conn)
```

```
RoutePlaceName['Distance']=RoutePlaceName.apply(lambda row:
round(
   vincenty((row['SourceLatitude'],row['SourceLongitude']),
             (row['TargetLatitude'],row['TargetLongitude'])).miles
          ,4)
     ,axis=1)

print(RoutePlaceName.head(5))
#############################################################
######
G=nx.Graph()
#############################################################
######
# print('Countries:',RouteCountries.shape)
for i inrange(RouteCountries.shape[0]):
   sNode0='C-' +
   RouteCountries['SourceCountry'][i]
   G.add_node(sNode0,
            Nodetype='Country',
            Country=RouteCountries['SourceCountry'][i],
            Latitude=round(RouteCountries['SourceLatitude'][i],
            4),
            Longitude=round(RouteCountries['SourceLongitude'][
            i],4))

   sNode1='C-' +
   RouteCountries['TargetCountry'][i]
   G.add_node(sNode1,
            Nodetype='Country',
            Country=RouteCountries['TargetCountry'][i],
            Latitude=round(RouteCountries['TargetLatitude'][i],4
            ),
            Longitude=round(RouteCountries['TargetLongitude'][
            i],4))
   G.add_edge(sNode0,sNode1,distance=round(RouteCountries['Distance'][i],3))
   #print(sNode0,sNode1)
#################################################################
print('Post
Code:',RoutePostCode.shape)for i
in
range(RoutePostCode.shape[0]):
   sNode0='C-' +
   RoutePostCode['SourceCountry'][i]
   G.add_node(sNode0,
            Nodetype='Country',
            Country=RoutePostCode['SourceCountry'][i],
            Latitude=round(RoutePostCode['SourceLatitude'][i],4
            ),
            Longitude=round(RoutePostCode['SourceLongitude'][
            i],4))

   sNode1='P-' + RoutePostCode['TargetPostCode'][i]  + '-' +
   RoutePostCode['TargetCountry'][i]G.add_node(sNode1,
            Nodetype='PostCode',
            Country=RoutePostCode['TargetCountry'][i],
            PostCode=RoutePostCode['TargetPostCode'][i],
```

```
            Latitude=round(RoutePostCode['TargetLatitude'][i],4
            ),
            Longitude=round(RoutePostCode['TargetLongitude'][
            i],4))
   G.add_edge(sNode0,sNode1,distance=round(RoutePostCode['Distance'][i],3))

   #print(sNode0,sNode1)
############################################################
######
print('Place
Name:',RoutePlaceName.shape)for i
in range(RoutePlaceName.shape[0]):
   sNode0='P-' + RoutePlaceName['TargetPostCode'][i] + '-'
sNode0=sNode0 + RoutePlaceName['TargetCountry'][i]
   G.add_node(sNode0,
            Nodetype='PostCode',
            Country=RoutePlaceName['SourceCountry'][i],
            PostCode=RoutePlaceName['TargetPostCode'][i],
            Latitude=round(RoutePlaceName['SourceLatitude'][i],4
            ),
            Longitude=round(RoutePlaceName['SourceLongitude'][
            i],4))

   sNode1='L-'                                          +
RoutePlaceName['TargetPlaceName'][i]         +         '-'
sNode1=sNode1                                         +
RoutePlaceName['TargetPostCode'][i]          +        '-'
sNode1=sNode1                                         +
RoutePlaceName['TargetCountry'][i]
   G.add_node(sNode1,
            Nodetype='PlaceName',
            Country=RoutePlaceName['TargetCountry'][i],
            PostCode=RoutePlaceName['TargetPostCode'][i],
            PlaceName=RoutePlaceName['TargetPlaceName'][i],
            Latitude=round(RoutePlaceName['TargetLatitude'][i],4
            ),
            Longitude=round(RoutePlaceName['TargetLongitude'][i
            ],4))
   G.add_edge(sNode0,sNode1,distance=round(RoutePlaceName['Distance'][i],3))
   #print(sNode0,sNode1)
#####################################################################
sFileName=sFileDir + '/' +
OutputFileName
print('##########################
#####')
print('Storing :', sFileName)
print('##########################
#####')
nx.write_gml(G,sFile
Name)
sFileName=sFileNam
e                    +'.gz'
nx.write_gml(G,sFile
Name)
############################################################
###### print('################################')
```

```
print('Path:', nx.shortest_path(G,source='P-SW1-GB',target='P-01001-US',weight='distance'))
print('Path length:', nx.shortest_path_length(G,source='P-SW1-GB',target='P-01001-
US',weight='distance')) print('Path length (1):', nx.shortest_path_length(G,source='P-SW1-
GB',target='C-GB',weight='distance')) print('Path length (2):',
nx.shortest_path_length(G,source='C-GB',target='C-US',weight='distance')) print('Path length (3):',
nx.shortest_path_length(G,source='C-US',target='P-01001-US',weight='distance'))
print('################################') print('Routes from P-SW1-GB < 2: ',
nx.single_source_shortest_path(G,source='P-SW1-GB' ,cutoff=1)) print('Routes from P-01001-
US < 2: ',nx.single_source_shortest_path(G,source='P-01001-US' ,cutoff=1))
print('################################')
#################################################################
print('################')
print('Vacuum
Database')
sSQL="VACUU
M;"
sql.execute(sSQL,co
nn)
print('###########
#####')
#########################################################
######print('### Done!!
##########################################')
#########################################################
######
```

Output:

You can now query features out of a graph, such as shortage pathsbetween locations and paths from a givenlocation, using Assess_Best_Logistics.gml with appropirate application.

I. Write a Python / R program to decide the best packing option to ship incontainer from the given data.

Hillman wants to introduce new shipping containers into its logistics strategy. This program will through a process of assessing the possible container sizes.This example introduces features with ranges or tolerances.

Open Python editor and create a file named Assess-Shipping-Containers.py in directoryC:\VKHCG\03-Hillman\02-Assess

```
import sys import
os import pandas
as pd import
sqlite3 as sq from
pandas.io import
sql
##############
######
##############
######
##############
##########
```

```
Base='C:/VKHCG'
print('##########################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#############################################################
######
Company='03-Hillman'
InputDir='01-Retrieve/01-EDS/02-
Python'
InputFileName1='Retrieve_Product
.csv'
InputFileName2='Retrieve_Box.csv
'
InputFileName3='Retrieve_Contain
er.csv'EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName='Assess_Shipping_Containers.csv'
#############################################################
######
sFileDir=Base + '/' + Company + '/' +
EDSDirif not os.path.exists(sFileDir):
os.makedirs(sFileDir)
#############################################################
######
# sFileDir=Base + '/' + Company + '/' + OutputDir if not
os.path.exists(sFileDir):     os.makedirs(sFileDir)
#############################################################
######
sDataBaseDir=Base + '/' + Company + '/02-
Assess/SQLite'if not os.path.exists(sDataBaseDir):
os.makedirs(sDataBaseDir)
#####################################################################
sDatabaseName=sDataBaseDir +
'/hillman.db'conn =
sq.connect(sDatabaseName)
#############################################################
######
#############################################################
######
### Import Product Data
#############################################################
######
# sFileName=Base + '/' + Company + '/' + InputDir + '/' +
InputFileName1print('###########') print('Loading :',sFileName)
ProductRawData=pd.read_csv(sFileName,
                hea
der=0,
low_memory=
False,

                )
ProductRawData.drop_duplicates(subset=None, keep='first',
inplace=True) ProductRawData.index.name = 'IDNumber'
ProductData=ProductRawData[ProductRawData.Length <=
0.5].head(10) print('Loaded Product :',ProductData.columns.values)
```

```
print('################################')
############################################################
######
# print('################')  sTable='Assess_Product' print('Storing
:',sDatabaseName,' Table:',sTable) ProductData.to_sql(sTable, conn,
if_exists="replace") print('################')
############################################################
######
# print(ProductData.head())
print('################################') print('Rows :
',ProductData.shape[0]) print('################################')
############################################################
######
############################################################
######
### Import Box Data
############################################################
######
sFileName=Base + '/' + Company + '/' + InputDir + '/' +
InputFileName2print('###########')
print('Loading :',sFileName)
BoxRawData=pd.read_csv(sFileName,
                hea
der=0,
low_memory=
False,
                encoding="latin-1"
                )
BoxRawData.drop_duplicates(subset=None, keep='first',
inplace=True)BoxRawData.index.name = 'IDNumber'
BoxData=BoxRawData[BoxRawData.Length <= 1].head(1000)
print('Loaded Product :',BoxData.columns.values)
print('################################')
################################################################
# print('################')  sTable='Assess_Box' print('Storing
:',sDatabaseName,' Table:',sTable) BoxData.to_sql(sTable, conn,
if_exists="replace") print('################')
############################################################
######
# print(BoxData.head()) print('################################')
print('Rows : ',BoxData.shape[0])
print('################################')
############################################################
######
############################################################
######
### Import Container Data
############################################################
######
# sFileName=Base + '/' + Company + '/' + InputDir + '/' +
InputFileName3print('###########') print('Loading :',sFileName)
ContainerRawData=pd.read_csv(sFileName,
                hea
der=0,
low_memory=
False,
```

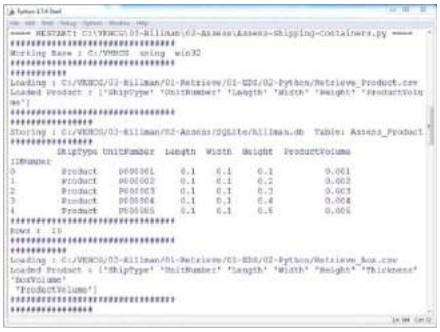
```
                encoding="latin-1"
                )
ContainerRawData.drop_duplicates(subset=None, keep='first',
inplace=True) ContainerRawData.index.name = 'IDNumber'
ContainerData=ContainerRawData[ContainerRawData.Length <=
2].head(10) print('Loaded Product :',ContainerData.columns.values)
print('################################')
############################################################
######


:',sDatabaseName,' Table:',sTable) BoxData.to_sql(sTable, conn,
if_exists="replace") print('################')
############################################################
######
# print(ContainerData.head())
print('################################') print('Rows :
',ContainerData.shape[0]) print('################################')
############################################################
######
############################################################
######
### Fit Product in Box
############################################################
######
# print('################')
sView='Assess_Product_in_Box'print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP VIEW
IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS" sSQL=sSQL+ " SELECT" sSQL=sSQL+ " P.UnitNumber
AS ProductNumber," sSQL=sSQL+ " B.UnitNumber AS BoxNumber," sSQL=sSQL+ "
(B.Thickness *1000) AS PackSafeCode," sSQL=sSQL+ " (B.BoxVolume - P.ProductVolume)
AS PackFoamVolume,"sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) * 167
AS Air_Dimensional_Weight,"sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10))
* 333 AS Road_Dimensional_Weight," sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) *
(B.Height*10)) * 1000AS Sea_Dimensional_Weight," sSQL=sSQL+ " P.Length AS
Product_Length," sSQL=sSQL+ " P.Width AS Product_Width," sSQL=sSQL+ " P.Height AS
Product_Height," sSQL=sSQL+ " P.ProductVolume AS Product_cm_Volume,"
sSQL=sSQL+ " ((P.Length*10) * (P.Width*10) * (P.Height*10)) AS
Product_ccm_Volume," sSQL=sSQL+ " (B.Thickness * 0.95) AS
Minimum_Pack_Foam,"sSQL=sSQL+ " (B.Thickness * 1.05) AS
Maximum_Pack_Foam," sSQL=sSQL+ " B.Length - (B.Thickness * 1.10) AS
Minimum_Product_Box_Length," sSQL=sSQL+ " B.Length - (B.Thickness * 0.95)
AS Maximum_Product_Box_Length," sSQL=sSQL+ " B.Width - (B.Thickness *
1.10) AS Minimum_Product_Box_Width," sSQL=sSQL+ " B.Width - (B.Thickness
* 0.95) AS Maximum_Product_Box_Width," sSQL=sSQL+ " B.Height -
(B.Thickness * 1.10) AS Minimum_Product_Box_Height," sSQL=sSQL+ "
B.Height - (B.Thickness * 0.95) AS Maximum_Product_Box_Height,"
sSQL=sSQL+ " B.Length AS Box_Length," sSQL=sSQL+ " B.Width AS
Box_Width," sSQL=sSQL+ " B.Height AS Box_Height," sSQL=sSQL+ "
B.BoxVolume AS Box_cm_Volume," sSQL=sSQL+ " ((B.Length*10) *
(B.Width*10) * (B.Height*10)) AS Box_ccm_Volume,"
sSQL=sSQL+ " (2 * B.Length * B.Width) + (2 * B.Length * B.Height) + (2 * B.Width *
B.Height) ASBox_sqm_Area,"
```

```
sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) * 3.5 AS
Box_A_Max_Kg_Weight," sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) *
7.7 AS Box_B_Max_Kg_Weight," sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) *
(B.Height*10)) * 10.0 AS Box_C_Max_Kg_Weight" sSQL=sSQL+ " FROM" sSQL=sSQL+ "
Assess_Product as P" sSQL=sSQL+ " ," sSQL=sSQL+ " Assess_Box as B"
sSQL=sSQL+ " WHERE"
sSQL=sSQL+ " P.Length >= (B.Length -
(B.Thickness * 1.10))" sSQL=sSQL+ " AND"
sSQL=sSQL+ " P.Width >=
(B.Width - (B.Thickness * 1.10))" sSQL=sSQL+ "
AND" sSQL=sSQL+ " P.Height >= (B.Height -
(B.Thickness * 1.10))" sSQL=sSQL+ " AND"
sSQL=sSQL+ " P.Length <=
(B.Length - (B.Thickness * 0.95))" sSQL=sSQL+ "
AND" sSQL=sSQL+ " P.Width <= (B.Width -
(B.Thickness * 0.95))"sSQL=sSQL+ " AND"
sSQL=sSQL+ " P.Height <= (B.Height - (B.Thickness *
0.95))"sSQL=sSQL+ " AND" sSQL=sSQL+ " (B.Height
-
B.Thickness) >= 0" sSQL=sSQL+ " AND"
sSQL=sSQL+ " (B.Width - B.Thickness) >=
0" sSQL=sSQL+ " AND" sSQL=sSQL+ "
(B.Height -

B.Thickness) >= 0" sSQL=sSQL+ " AND"
sSQL=sSQL+ " B.BoxVolume >=
P.ProductVolume;" sql.execute(sSQL,conn)
####################################
###### ####################
### Fit Box in Pallet
############################################################
######
# t=0 for l in range(2,8):     for w in range(2,8):         for h in range(4):             t
+= 1
 PalletLine=[('IDNumber',[t]),
          ('ShipType', ['Pallet']),
                  ('UnitNumber', ('L-'+format(t,"06d"))),
                  ('Box_per_Length',(format(2**l,"4d"))),
                  ('Box_per_Width',(format(2**w,"4d"))),
('Box_per_Height',(format(2**h,"4d")))]            if
            t==1: PalletFrame =
            pd.DataFrame.from_items(PalletLine)
else:
             PalletRow =
             pd.DataFrame.from_items(PalletLine)
             PalletFrame =
             PalletFrame.append(PalletRow)
PalletFrame.set_index(['IDNumber'],inplace=True)
############################################################
######
PalletFrame.head()
print('############################
#####')
print('Rows : ',PalletFrame.shape[0])
print('################################')
```

```
    ############################################################
    ######
    ### Fit Box on Pallet
    ############################################################
    ######
    # print('################')  sView='Assess_Box_on_Pallet' print('Creating
    :',sDatabaseName,' View:',sView) sSQL="DROP VIEW IF
    EXISTS " +sView + ";"
    sql.execute(sSQL,conn)

    sSQL="CREATE VIEW " + sView + " AS" sSQL=sSQL+ " SELECT DISTINCT"
    sSQL=sSQL+ " P.UnitNumber AS PalletNumber," sSQL=sSQL+ " B.UnitNumber AS
    BoxNumber," sSQL=sSQL+ " round(B.Length*P.Box_per_Length,3) AS
    Pallet_Length," sSQL=sSQL+ " round(B.Width*P.Box_per_Width,3) AS
    Pallet_Width," sSQL=sSQL+ " round(B.Height*P.Box_per_Height,3) AS
    Pallet_Height," sSQL=sSQL+ " P.Box_per_Length
    * P.Box_per_Width * P.Box_per_Height AS Pallet_Boxes" sSQL=sSQL+ " FROM"
    sSQL=sSQL+ " Assess_Box as B" sSQL=sSQL+ " ," sSQL=sSQL+ " Assess_Pallet as
    P"sSQL=sSQL+ " WHERE"
    sSQL=sSQL+ "
    round(B.Length*P.Box_per_Length,3) <=20"
    sSQL=sSQL+ " AND" sSQL=sSQL+ "
    round(B.Width*P.Box_per_Width,3) <= 9"
    sSQL=sSQL+ " AND" sSQL=sSQL+ "
    round(B.Height*P.Box_per_Height,3)
    <= 5;" sql.execute(sSQL,conn)
    ############################################################
    ######
    sTables=['Assess_Product_in_Box','Assess_Box_on_P
    allet'] for sTable in sTables:
       print('################')       print('Loading
    :',sDatabaseName,'
       Table:',sTable)sSQL="
       SELECT "
    sSQL=sSQL+ " *"
                    sSQL=sSQL+"
    FROM"       sSQL=sSQL+ "
    " +
    sTable + ";"
    SnapShotData=pd.read_sql_qu
    ery(s

   print('################')
sTableOut=sTable + '_SnapShot'
       print('Storing :',sDatabaseName,' Table:',sTable)
    SnapShotData.to_sql(sTableOut, conn, if_exists="replace")
    print('################')
    ############################################################
    ######
    ### Fit Pallet in Container
    ############################################################
    ######
    # sTables=['Length','Width','Height'] for sTable in sTables:

       sView='Assess_Pallet_in_Container_'  +
    sTable  print('Creating   :',sDatabaseName,'
```

```
    View:',sView)  sSQL="DROP  VIEW  IF
    EXISTS " + sView + ";"
       sql.execute(sSQL,conn)

       sSQL="CREATE VIEW " + sView + " AS"
                                  sSQL=sSQL+ "SELECT
    DISTINCT"                     sSQL=sSQL+ " C.UnitNumber
    AS
    ContainerNumber,"     sSQL=sSQL+ " P.PalletNumber,"
    sSQL=sSQL+ " P.BoxNumber,"     sSQL=sSQL+ " round(C."
    + sTable + "/P.Pallet_" + sTable + ",0)"  sSQL=sSQL+ " AS
    Pallet_per_" + sTable + ","     sSQL=sSQL+ " round(C." +
    sTable + "/P.Pallet_" + sTable + ",0)"
                                  sSQL=sSQL+ " * P.Pallet_Boxes AS
    Pallet_" + sTable + "_Boxes,"     sSQL=sSQL+ "
    P.Pallet_Boxes" sSQL=sSQL+ " FROM"
                                  sSQL=sSQL+ " Assess_Container as
    C" sSQL=sSQL+ " ,"
       sSQL=sSQL+ "
    Assess_Box_on_Pallet_SnapShot as P"
    sSQL=sSQL+ " WHERE"     sSQL=sSQL+ "
    round(C.Length/P.Pallet_Length,0) > 0"
                  sSQL=sSQL+" AND"
                  sSQL=sSQL+ "
    round(C.Width/P.Pallet_Width,0) > 0"
                sSQL=sSQL+ "AND"
                sSQL=sSQL+ "
    round(C.Height/P.Pallet_Height,
       0) > 0;"sql.execute(sSQL,conn)

       print('################')       print('Loading
:',sDatabaseName,' Table:',sView)
       sSQL=" SELECT "     sSQL=sSQL+
    " *" sSQL=sSQL+ " FROM"
                                  sSQL=sSQL+
    " " +
    sView + ";"
    SnapShotData=pd.read_sql_query(sSQL,
    conn)
   print('################')
sTableOut= sView + '_SnapShot'
       print('Storing :',sDatabaseName,' Table:',sTableOut)
    SnapShotData.to_sql(sTableOut, conn, if_exists="replace")
    print('################')
    ############################################################
    ######
    # print('################')
    sView='Assess_Pallet_in_Container'print('Creating
    :',sDatabaseName,' View:',sView)
    sSQL="DROP VIEW IF EXISTS " + sView + ";"
    sql.execute(sSQL,conn)



    sSQL="CREATE VIEW " + sView + " AS" sSQL=sSQL+ " SELECT" sSQL=sSQL+ "
    CL.ContainerNumber," sSQL=sSQL+ " CL.PalletNumber," sSQL=sSQL+ "
    CL.BoxNumber," sSQL=sSQL+ " CL.Pallet_Boxes AS Boxes_per_Pallet," sSQL=sSQL+ "
```

```
CL.Pallet_per_Length,"sSQL=sSQL+ " CW.Pallet_per_Width," sSQL=sSQL+ "
CH.Pallet_per_Height," sSQL=sSQL+ "

CL.Pallet_Length_Boxes * CW.Pallet_Width_Boxes * CH.Pallet_Height_Boxes AS
Container_Boxes" sSQL=sSQL+ " FROM" sSQL=sSQL+ "
Assess_Pallet_in_Container_Length_SnapShot as CL" sSQL=sSQL+ " JOIN"
sSQL=sSQL+ "Assess_Pallet_in_Container_Width_SnapShot as CW" sSQL=sSQL+ "
ON"
sSQL=sSQL+ " CL.ContainerNumber =
CW.ContainerNumber" sSQL=sSQL+ " AND" sSQL=sSQL+
" CL.PalletNumber = CW.PalletNumber" sSQL=sSQL+ "
AND" sSQL=sSQL+ " CL.BoxNumber = CW.BoxNumber"
sSQL=sSQL+ " JOIN" sSQL=sSQL+ "
Assess_Pallet_in_Container_Height_SnapShot as CH"
sSQL=sSQL+ " ON" sSQL=sSQL+ " CL.ContainerNumber =
CH.ContainerNumber" sSQL=sSQL+ " AND" sSQL=sSQL+ "
CL.PalletNumber = CH.PalletNumber" sSQL=sSQL+ " AND"
sSQL=sSQL+ " CL.BoxNumber = CH.BoxNumber;"
sql.execute(sSQL,conn)
##################################################################
sTables=['Assess_Product_in_Box','Assess_Pallet_in_Contai
ner'] for sTable in sTables:
   print('################')       print('Loading
:',sDatabaseName,' Table:',sTable)
   sSQL=" SELECT "
                                sSQL=sSQ
L+ " *"sSQL=sSQL+ " FROM"

                                sSQL=sSQ
L+ "
" + sTable + ";"
PackData=pd.read_sql_query(sSQL
, conn)
   print('################')
print(PackData)
                        print('############
####')
print('############################
#####')
print('Rows : ',PackData.shape[0])
print('############################
#####')
sFileName=sFileDir + '/' + sTable +
'.csv'print(sFileName)
   PackData.to_csv(sFileName, index = False) print('### Done!!
##########################################')
##########################################################
######
```



J. Write a Python program to create a delivery route using the given data.

Creating a Delivery Route

Hillman requires the complete grid plan of the delivery routes for the company, to ensure the suppliers,warehouses, shops, and customers can be reached by its new strategy. This new plan will enable the optimum routes between suppliers, warehouses, shops, and customers.

Open Python editor and create a file named Assess-Shipping-Routes.py in directoryC:\VKHCG\03-Hillman\02-Assess.

```
################################################################
# import sys import os import pandas as pd import sqlite3 as sq from
pandas.ioimport sql import networkx as nx
from geopy.distance import vincenty
############################################################
######
# nMax=3 nMaxPath=10 nSet=False nVSet=False
############################################################
######Base='C:/VKHCG'
############################################################
######print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
####################################################################
Company='03-
Hillman'
InputDir1='01-Retrieve/01-EDS/01-
R' InputDir2='01-Retrieve/01-
EDS/02-Python'
InputFileName1='Retrieve_GB_Postcode_Warehou
se.csv'
InputFileName2='Retrieve_GB_Postcodes_Shops.c
sv' EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName1='Assess_Shipping_Routes.gml'
OutputFileName2='Assess_Shipping_Routes.txt'
############################################################
######
sFileDir=Base + '/' + Company + '/' +
EDSDirif not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
############################################################
######
```

```
# sFileDir=Base + '/' + Company + '/' + OutputDir if not
os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#############################################################
######
sDataBaseDir=Base + '/' + Company + '/02-
Assess/SQLite'if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
#############################################################
######
sDatabaseName=sDataBaseDir +
'/hillman.db'conn =
sq.connect(sDatabaseName)
#############################################################
######
#############################################################
######
### Import Warehouse Data
#############################################################
######
sFileName=Base + '/' + Company + '/' + InputDir1 + '/' + InputFileName1
print('###########')
print('Loading :',sFileName)
WarehouseRawData=pd.read_csv(sFileName,
                hea
der=0,
low_memory=
False,
                encoding="'latin-1"
                )

WarehouseRawData.index.name = 'IDNumber'
WarehouseData=WarehouseRawData.head(nMax)
WarehouseData=WarehouseData.append(WarehouseRawData.tail(nMax))
WarehouseData=WarehouseData.append(WarehouseRawData[WarehouseRawData.postcode=='K
A13']) if nSet==True:

WarehouseData=WarehouseData.append(WarehouseRawData[WarehouseRawData.postcode=='SW1
W']) WarehouseData.drop_duplicates(subset=None, keep='first', inplace=True)
print('Loaded Warehouses :',WarehouseData.columns.values)
print('###################################')
#############################################################
######
# print('################')  sTable='Assess_Warehouse_UK'
print('Storing :',sDatabaseName,' Table:',sTable)
WarehouseData.to_sql(sTable, conn, if_exists="replace")
print('################')
#####################################################################
# print(WarehouseData.head())
print('###################################')
print('Rows :
',WarehouseData.shape[0])
print('###################################')
#############################################################
######
```

```
### Import Shop Data
#############################################################
######
# sFileName=Base + '/' + Company + '/' + InputDir1 + '/' + InputFileName2
print('###########') print('Loading :',sFileName)
ShopRawData=pd.read_csv(sFileName,
                hea
der=0,
low_memory=
False,
                encoding="latin-1"
                )
ShopRawData.drop_duplicates(subset=None, keep='first', inplace=True)
ShopRawData.index.name = 'IDNumber'
ShopData=ShopRawData
print('Loaded Shops :',ShopData.columns.values)
print('################################')
#############################################################
######
# print('################') sTable='Assess_Shop_UK'
print('Storing :',sDatabaseName,' Table:',sTable)
ShopData.to_sql(sTable, conn, if_exists="replace")
print('################')
#################################################################
# print(ShopData.head()) print('################################')
print('Rows : ',ShopData.shape[0])
print('################################')
#############################################################
######
### Connect HQ
#############################################################
######
# print('################')
sView='Assess_HQ'print('Creating
:',sDatabaseName,' View:',sView)
sSQL="DROP VIEW IF EXISTS " + sView +
";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT" sSQL=sSQL+ "
W.postcode AS HQ_PostCode," sSQL=sSQL+ "
'HQ-' || W.postcode AS HQ_Name," sSQL=sSQL+
" round(W.latitude,6) ASHQ_Latitude,"
sSQL=sSQL+ " round(W.longitude,6) AS

sSQL=sSQL+ " FROM" sSQL=sSQL+ "
Assess_Warehouse_UK as W"
sSQL=sSQL+ " WHERE"
sSQL=sSQL+ "TRIM(W.postcode)
in ('KA13','SW1W');"
sql.execute(sSQL,conn)
#############################################################
######
```

```
### Connect Warehouses
############################################################
######
# print('################')
sView='Assess_Warehouse'print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP
VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS" sSQL=sSQL+ "
SELECT" sSQL=sSQL+ " W.postcode AS
Warehouse_PostCode," sSQL=sSQL+ " 'WH-' ||
W.postcode ASWarehouse_Name," sSQL=sSQL+ "
round(W.latitude,6) AS Warehouse_Latitude,"
sSQL=sSQL+ " round(W.longitude,6) AS
Warehouse_Longitude"
sSQL=sSQL+ " FROM" sSQL=sSQL+ "
Assess_Warehouse_UK
as W;"
sql.execute(sSQL,conn)
#################################################################
### Connect Warehouse to Shops by PostCode
-
############################################################
######
# print('################')  sView='Assess_Shop' print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP VIEW IF EXISTS " + sView
+ ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView +
" AS"sSQL=sSQL+ " SELECT"
sSQL=sSQL+ " TRIM(S.postcode) AS Shop_PostCode," sSQL=sSQL+ "
'SP-' ||TRIM(S.FirstCode) || '-' || TRIM(S.SecondCode) AS Shop_Name,"
sSQL=sSQL+ " TRIM(S.FirstCode) AS Warehouse_PostCode,"
sSQL=sSQL+ " round(S.latitude,6) AS Shop_Latitude,"
sSQL=sSQL+ " round(S.longitude,6) AS Shop_Longitude"
sSQL=sSQL+ " FROM" sSQL=sSQL+ "
Assess_Warehouse_UK asW" sSQL=sSQL+ " JOIN"
sSQL=sSQL+ " Assess_Shop_UK as S" sSQL=sSQL+ " ON"
sSQL=sSQL+ " TRIM(W.postcode) =
TRIM(S.FirstCo
de);"
sql.execute(sSQL
,conn)
############################################################
#####
############################################################
######
G=nx.Graph()
############################################################
######
# print('################')  sTable = 'Assess_HQ' print('Loading
:',sDatabaseName,' Table:',sTable) sSQL=" SELECT
DISTINCT"sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
```

```
sSQL=sSQL+ " " + sTable + ";"
RouteData=pd.read_sql_query(sSQL,
conn)print('################')
#################################################################
#  print(RouteData.head()) print('################################')

print('HQ Rows : ',RouteData.shape[0])
print('################################')
#########################################################
######
# for i in range(RouteData.shape[0]):
                                          sNode0=RouteData['HQ_Na
   me'][i]G.add_node(sNode0,
            Nodetype='HQ',
            PostCode=RouteData['HQ_PostCode'][i],
            Latitude=round(RouteData['HQ_Latitude'][i],6)
            ,
            Longitude=round(RouteData['HQ_Longitude'][i
            ],6))
#################################################################
# print('################')  sTable = 'Assess_Warehouse' print('Loading
:',sDatabaseName,' Table:',sTable) sSQL=" SELECT
DISTINCT"sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " + sTable + ";"
RouteData=pd.read_sql_query(sSQL,
conn)print('################')
#################################################################
#  print(RouteData.head()) print('################################')
print('Warehouse Rows : ',RouteData.shape[0])
print('################################')  for i in
range(RouteData.shape[0]):
   sNode0=RouteData['Warehouse_Na
   me'][i]G.add_node(sNode0,
            Nodetype='Warehouse',
            PostCode=RouteData['Warehouse_PostCode'][i],
            Latitude=round(RouteData['Warehouse_Latitude'][i],6
            ),
Longitude=round(RouteData['Warehouse_Longitude'][i],6))
print('################')  sTable = 'Assess_Shop'
print('Loading
:',sDatabaseName,' Table:',sTable) sSQL=" SELECT
DISTINCT"sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " + sTable + ";"
RouteData=pd.read_sql_query(sSQL,
conn)print('################')
print(RouteData.head())
print('############################
#####')
print('Shop Rows :
',RouteData.shape[0])
print('############################
#####')
```

```
    for i in range(RouteData.shape[0]):
       sNode0=RouteData['Shop_Name'][i]
       G.add_node(sNode0,
                  Nodetype='Shop',
                  PostCode=RouteData['Shop_PostCode'][i],
                  WarehousePostCode=RouteData['Warehouse_PostCo
                  de'][i],
                  Latitude=round(RouteData['Shop_Latitude'][i],6),
                  Longitude=round(RouteData['Shop_Longitude'][i],6)
                  )
    ##################################################################
    ## Create Edges
    ############################################################
    ###### print('#################################')
    print('Loading Edges')
    print('############################
    #####')

    for sNode0 in
    nx.nodes_iter(G):for
    sNode1 in
    nx.nodes_iter(G):

          if
    G.node[sNode0]['Nodetype']=='HQ' and \
    G.node[sNode1]['Nodetype']=='HQ' and \
    sNode0 != sNode1:
                distancemeters=r
    ound(\vincenty(\

                                                                                    ,0)

(\
 G.node[sNode0]['Latitude'],\
 G.node[sNode0]['Longitude']\
 ),\(\
  G.node[sNode1]['Latitude']\
  ,\ G.node[sNode1]['Longitude']\
  )\
  ).meters\

           distancemiles=round(\
                       vincenty(\
                                  (\
                                   G.node[sNode0]['Latitude'],\
                                   G.node[sNode0]['Longitude']\
```

```
                                        )
                                        ,
                                        \

                                        (
                                        \
                                         G.node[sNode1]['Latitude']\
                                         ,\
                                         G.node[sNode1]['Longi
                                         tude']\
                                         )\
                                         ).miles\
                                ,3)




    else:


if distancemiles >= 0.05:
   cost = round(150+(distancemiles * 2.5),6)
   vehicle='V001'

   cost = round(2+(distancemiles * 0.10),6)
   vehicle='ForkLift'



              G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                    DistanceMiles=distancemiles,
    \
                          Cost=cost,Vehicle=v
    ehicle)if nVSet==True:
                  print('Edge-H-H:',sNode0,' to ',
    sNode1, \' Distance:',distancemeters,'meters',\
                    distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

        if G.node[sNode0]['Nodetype']=='HQ' and \
    G.node[sNode1]['Nodetype']=='Warehouse' and \
    sNode0 != sNode1:
              distancemeters=r
    ound(\vincenty(\
                                      (\
                                       G.node[sNode0]['Latitude'],\
                                       G.node[sNode0]['Longitude']\
                                       )
                                       ,
                                       \

                                       (
                                       \
                                        G.node[sNode1]['Latitude']\
```

```
,0)

G.node[sNode1]['Longitude']\
)\
).meters\

        distancemiles=round(\
                    vincenty(\
                                (\
                                 G.node[sNode0]['Latitude'],\
                                 G.node[sNode0]['Longitude']\
                                 )
                                 ,
                                 \

                                 (
                                 \
                                  G.node[sNode1]['Latitude']\
                                  ,\
                                  G.node[sNode1]['Longi
                                  tude']\
                                  )\
                                  ).miles\




      else:

             ,3)
 if distancemiles >= 10:
    cost = round(50+(distancemiles * 2),6)
    vehicle='V002'

    cost = round(5+(distancemiles * 1.5),6)
    vehicle='V003'

      if distancemiles <= 50:
                  G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                             DistanceMiles=distancemiles,
      \                           Cost=cost,Vehicle=vehicle)
      if nVSet==True:
                      print('Edge-H-W:',sNode0,' to ',
      sNode1, \' Distance:',distancemeters,'meters',\
                        distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

            if nSet==True and \
               G.node[sNode0]['Nodetype']=='Warehou
               se'  and
      \         G.node[sNode1]['Nodetype']=='Warehouse' and
      \          sNode0 !=
                  sNode1:
                  distancemeters=r
                  ound(\
      vincenty(\                                    (\
```

```
                                    G.node[sNode0]['Latitude'],\
                                    G.node[sNode0]['Longitude']\
                                    )
                                    ,
                                    \

                                    (
                                    \
                                     G.node[sNode1]['Latitude']\
                                     ,\
                                     G.node[sNode1]['Longi
                                     tude']\
                                     )\
                                     ).meters\
                                ,0)
            distancemiles=round(\
                            vincenty(\
                                    (\
                                     G.node[sNode0]['Latitude'],\
                                     G.node[sNode0]['Longitude']\
                                     )
                                     ,
                                     \

                                     (
                                     \
                                      G.node[sNode1]['Latitude']\
```

```
                                                                                ,3)
G.node[sNode1]['Longitude']\
)\
).miles\
```

```
      else:

 if distancemiles >= 10:
    cost = round(50+(distancemiles * 1.10),6)
    vehicle='V004'

    cost = round(5+(distancemiles * 1.05),6)
    vehicle='V005'


                if distancemiles <= 20:
                   G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                           DistanceMiles=distancemiles,
      \
                                   Cost=cost,Vehicle=v
      ehicle)if nVSet==True:
```

```
                    print('Edge-W-W:',sNode0,' to ',
    sNode1, \' Distance:',distancemeters,'meters',\
                     distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

          if G.node[sNode0]['Nodetype']=='Warehouse' and \
             G.node[sNode1]['Nodetype']=='Shop' and \
             G.node[sNode0]['PostCode']==G.node[sNode1]['WarehousePostCode']
             and \
    sNode0 != sNode1:

                distancemeters=r
    ound(\vincenty(\
                                    (\
                                     G.node[sNode0]['Latitude'],\
                                     G.node[sNode0]['Longitude']\
                                     )
                                     ,
                                     \

                                     (
                                     \
                                      G.node[sNode1]['Latitude']\
                                      ,\
                                      G.node[sNode1]['Longi
                                      tude']\
                                      )\
                                      ).meters\
                                ,0)
        distancemiles=round(\
                         vincenty(\
                                    (\
                                     G.node[sNode0]['Latitude'],\
                                     G.node[sNode0]['Longitude']\
                                     )
                                     ,
                                     \

                                     (
                                     \
                                      G.node[sNode1]['Latitude']\
                                      ,\
                                      G.node[sNode1]['Longi
                                      tude']\
                                      )\
                                      ).miles\




    else:

                ,3)
if distancemiles >= 10:
```

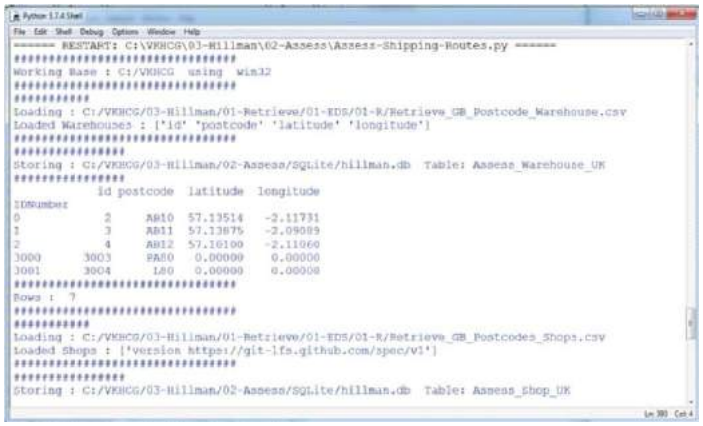
```
cost = round(50+(distancemiles * 1.50),6)
vehicle='V006'

cost = round(5+(distancemiles * 0.75),6)

                vehicle=
 'V007'             if
 distancemiles <= 10:
                G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                    DistanceMiles=distancemiles,
 \
                        Cost=cost,Vehicle=v
 ehicle)if nVSet==True:
                  print('Edge-W-S:',sNode0,' to ',
 sNode1, \' Distance:',distancemeters,'meters',\
                   distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

       if nSet==True and \
          G.node[sNode0]['Nodetype']=='Sho
          p' and \
          G.node[sNode1]['Nodetype']=='Sho
          p' and \
          G.node[sNode0]['WarehousePostCode']==G.node[sNode1]['WarehousePostCode']
 and \sNode0 != sNode1:

            distancemeters=r
 ound(\vincenty(\
                                  (\
                                   G.node[sNode0]['Latitude'],\
                                   G.node[sNode0]['Longitude']\
                                   )
                                   ,
                                   \

                                   (
                                   \
                                    G.node[sNode1]['Latitude']\
                                    ,\
                                    G.node[sNode1]['Longi
                                    tude']\
                                    )\
                                    ).meters\
                           ,0)
    distancemiles=round(\
                   vincenty(\
                                  (\
                                   G.node[sNode0]['Latitude'],\
                                   G.node[sNode0]['Longitude']\
                                   )
                                   ,
                                   \

                                   (
                                   \
                                    G.node[sNode1]['Latitude']\
```

```
                                        ,\
                                        G.node[sNode1]['Longi
                                        tude']\
                                        )\
                                        ).miles\
                                ,3)
                if distancemiles >=
  0.05:                 cost =
  round(5+(distancemiles * 0.5),6)
                    vehicle='V008'

  else:


cost = round(1+(distancemiles * 0.1),6)
vehicle='V009'



                if distancemiles <= 0.075:
                    G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                            DistanceMiles=distancemiles,
  \
                                Cost=cost,Vehicle=v
  ehicle)if nVSet==True:
                        print('Edge-S-S:',sNode0,' to ', sNode1, \

                          distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

          if nSet==True and \
             G.node[sNode0]['Nodetype']=='Sho
             p' and \
             G.node[sNode1]['Nodetype']=='Sho
             p' and \
             G.node[sNode0]['WarehousePostCode']!=G.node[sNode1]['WarehousePostCode'
  ] and \sNode0 != sNode1:

                distancemeters=r
  ound(\vincenty(\
                                      (\
                                       G.node[sNode0]['Latitude'],\
                                       G.node[sNode0]['Longitude']\
                                       )
                                       ,
                                       \

                                       (
                                       \
                                        G.node[sNode1]['Latitude']\
                                        ,\
                                        G.node[sNode1]['Longi
                                        tude']\
                                        )\
                                        ).meters\
                                ,0)
       distancemiles=round(\
                           vincenty(\
```

```
                                    (\
                                     G.node[sNode0]['Latitude'],\
                                     G.node[sNode0]['Longitude']\
                                     )
                                     ,
                                     \

                                     (
                                     \
                                      G.node[sNode1]['Latitude']\
                                      ,\
                                      G.node[sNode1]['Longi
                                      tude']\
                                      )\
                                      ).miles\
                              ,3)

                cost = round(1+(distancemiles *
                0.1),6)vehicle='V010'

                if distancemiles <= 0.025:
                   G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters,  \
                           DistanceMiles=distancemiles,
\
                                 Cost=cost,Vehicle=v
ehicle)if nVSet==True:
                           print('Edge-S-S:',sNode0,' to ',
sNode1, \' Distance:',distancemeters,'meters',\
distancemiles,'miles','Cost',
cost,'Vehicle',vehicle) sFileName=sFileDir + '/'
+ OutputFileName1
print('################################')
print('Storing :',sFileName)
print('################################')
nx.write_gml(G,sFileName) sFileName=sFileName +'.gz'
nx.write_gml(G,sFileName)
print('Nodes:',nx.number_of_nodes(G))
print('Edges:',nx.number_of_edges(G))
sFileName=sFileDir + '/'
+ OutputFileName2
print('################################')
print('Storing :',sFileName)
print('################################')

print('################################')
print('Loading Paths')
print('##########################
#####')
f = open(sFileName,'w') l=0 sline =
'ID|Cost|StartAt|EndAt|Path|Measure' if
nVSet==True: print ('0', sline) f.write(sline+
'\n') forsNode0 in nx.nodes_iter(G):     for
sNode1 in nx.nodes_iter(G):     if sNode0 !=
sNode1 and \ nx.has_path(G, sNode0,
sNode1)==True and \
```

```
            nx.shortest_path_length(G, \
source=sNode0, \
                                    target=sN
ode1, \weight='DistanceMiles') <
nMaxPath:
                l+=1
                                sID='{:.0f}'.fo
rmat(l)spath =
','.join(nx.shortest_path(G, \
source=sNode0, \
                                target=sNode1
, \weight='DistanceMiles'))
                                slength=
'{:.6f}'.format(\                   nx.shortest_path_length(G, \
source=sNode0, \                      target=sNode1, \
weight='DistanceMiles'))                  sline = sID +
'|"DistanceMiles"|"' + sNode0 + '"|"' \                 +
sNode1 +'"|"' + spath + '"|' + slength                  if
nVSet==True: print(sline)    f.write(sline + '\n')
                                    l+=1
sID='{:.0f}'.format(l)                spath =
','.join(nx.shortest_path(G, \
                        source=sNode0, \ target=sNode1, \

                        weight='DistanceMeters')) slength=
'{:.6f}'.format(\
nx.shortest_path_length(G, \
                                    source=sNode0, \
target=sNode1, \
                                    weight='DistanceMete
rs'))
                sline = sID + '|"DistanceMeters"|"' + sNode0 + '"|"'
\                 + sNode1 + '"|"' + spath + '"|' + slength
if nVSet==True: print (sline)
                                                f.write(slin
e + '\n')l+=1


                sID='{:.0f}'.format(l)
                spath =
','.join(nx.shortest_path(G, \
source=sNode0, \
                                target=sNode
1, \weight='Cost'))          slength=
'{:.6f}'.format(\
nx.shortest_path_length(G, \
source=sNode0, \
                                target=sNode1,
\ weight='Cost'))              sline = sID +
'|"Cost"|"'
+ sNode0 + '"|"' \                + sNode1 +
'"|"' + spath + '"|' + slength        if
nVSet==True:
print (sline)
                            f.write(slin
e + '\n')f.close()
print('Nodes:',nx.number_of_node
```

```
s(G))
print('Edges:',nx.number_of_edge
s(G)) print('Paths:',sID)
print('#################')
print('Vacuum
Database')
sSQL="VACUU
M;"
sql.execute(sSQL,conn) print('#################') print('### Done!!
##############################################'
```



Clark Ltd

Clark Ltd is the accountancy company that handles everything related to the VKHCG's financesand personnel. Let's investigate Clark with new knowledge.

K. Write a Python program to create Simple forex trading planner from the givendata.

Simple Forex Trading Planner

Clark requires the assessment of the group's forex data, for processing and data qualityissues. I will guide youthrough an example of a forex solution.

Open your Python editor and create a file named Assess-Forex.py in directory C:\VKHCG\04-Clark\02-Assess.

```
################################################################
# import sys import os import sqlite3 as sq import pandas as pd
################################################################
######

Base='C:/VKHCG'
print('############################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
######
Company='04-Clark' sInputFileName1='01-Vermeulen/01-Retrieve/01-EDS/02-
Python/Retrieve-Country-Currency.csv' sInputFileName2='04-Clark/01-Retrieve/01-
EDS/01- R/Retrieve_Euro_EchangeRates.csv'
################################################################
```

```
sDataBaseDir=Base + '/' + Company + '/02-
Assess/SQLite'if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
#############################################################
######
sDatabaseName=sDataBaseDir +
'/clark.db'conn =
sq.connect(sDatabaseName)
#####################################################################
### Import Country Data
#############################################################
######
sFileName1=Base + '/' +
sInputFileName1
print('############################
#####')
print('Loading :',sFileName1)
print('############################
#####')
CountryRawData=pd.read_csv(sFileName1,header=0,low_memory=False, encoding="latin-1")

CountryData=CountryRawData
print('Loaded Company :',CountryData.columns.values)
print('################################')
#############################################################
######
# print('################')  sTable='Assess_Country' print('Storing
:',sDatabaseName,' Table:',sTable) CountryData.to_sql(sTable, conn,
if_exists="replace") print('################')
#############################################################
######
# print(CountryData.head())
print('################################') print('Rows :
',CountryData.shape[0]) print('################################')
#############################################################
######
### Import Forex Data
#############################################################
######
sFileName2=Base + '/' +
sInputFileName2
print('############################
#####')
print('Loading :',sFileName2)
print('############################
#####')
ForexRawData=pd.read_csv(sFileName2,header=0,low_memory=False, encoding="latin-1")
ForexRawData.drop_duplicates(subset=None, keep='first', inplace=True)
ForexData=ForexRawData.head(5) print('Loaded
Company :',ForexData.columns.values)
print('################################')
#############################################################
######
# print('################')  sTable='Assess_Forex' print('Storing
:',sDatabaseName,' Table:',sTable) ForexData.to_sql(sTable, conn,
if_exists="replace") print('################')
```

```
############################################################
######
# print(ForexData.head())
print('################################') print('Rows :
',ForexData.shape[0]) print('################################')
############################################################
######
# print('################')  sTable='Assess_Forex' print('Loading
:',sDatabaseName,' Table:',sTable) sSQL="select distinct"
sSQL=sSQL+ "A.CodeIn" sSQL=sSQL+ " from"
sSQL=sSQL+ " Assess_Forex as
A;"
CodeData=pd.read_sql_query(sSQL,
conn)print('################')
#####################################################################

for c in range(CodeData.shape[0]):
print('################')  sTable='Assess_Forex  &  2x
Country > ' + CodeData['CodeIn'][c]
   print('Loading :',sDatabaseName,'
Table:',sTable)  sSQL="select  distinct"
sSQL=sSQL+  "  A.Date,"  sSQL=sSQL+  "
A.CodeIn,"  sSQL=sSQL+ "
B.Country as CountryIn,"  sSQL=sSQL+ "
B.Currency as CurrencyNameIn,"
                    sSQL=sSQL+ "A.CodeOut,"
                    sSQL=sSQL+ " C.Country as
CountryOut,"  sSQL=sSQL+ " C.Currency
as CurrencyNameOut," sSQL=sSQL+ "
A.Rate" sSQL=sSQL+ " from"
                    sSQL=sSQL+ "
Assess_Forex as A"  sSQL=sSQL+ "
JOIN" sSQL=sSQL+ " Assess_Country as
B" sSQL=sSQL+ " ON A.CodeIn =
B.CurrencyCode"sSQL=sSQL+ " JOIN"
                        sSQL=sSQL+ "
Assess_Country as C"  sSQL=sSQL+ " ON

A.CodeOut = C.CurrencyCode"
                                sSQL=s
SQL+ "WHERE"
   sSQL=sSQL+ " A.CodeIn ='" + CodeData['CodeIn'][c] + "';"
ForexData=pd.read_sql_query(sSQL, conn).head(1000)
   print('################')
                                print(Fore
xData)print('################')
sTable='Assess_Forex_' + CodeData['CodeIn'][c]
print('Storing :',sDatabaseName,' Table:',sTable)
ForexData.to_sql(sTable, conn, if_exists="replace")
print('################')
print('################################')
print('Rows : ',ForexData.shape[0])
print('################################')
############################################################
######print('### Done!!
#############################################')
```

```
##########################################################
######
```

Output:

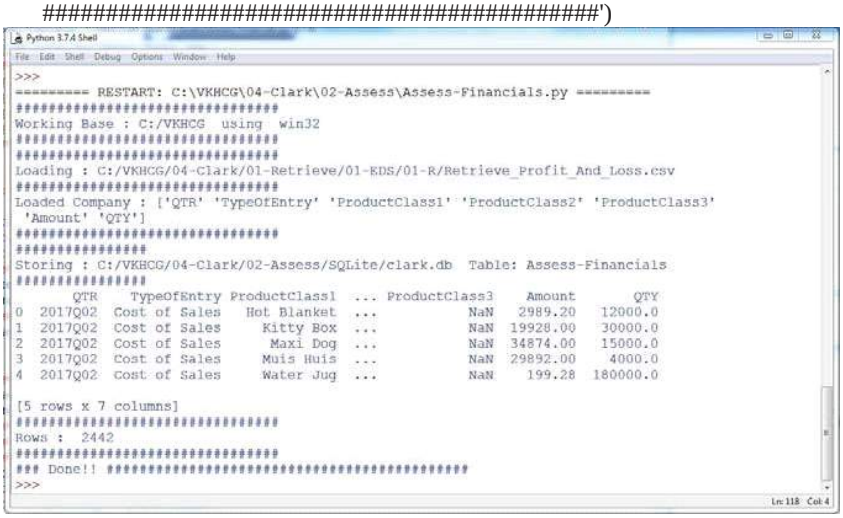
This will produce a set of demonstrated values onscreen by removing duplicate records and other related dataprocessing.

L. Write a Python program to process the balance sheet to ensure that only good data is processing.

Financials
Clark requires you to process the balance sheet for the VKHCG group companies. Go through a sample balancesheet data assessment, to ensure that only the good data is processed.
Open Python editor and create a file named Assess-Financials.py in directory C:\VKHCG\04-Clark\02-Assess.

```
import sys
import os
import sqlite3 as
sq import
pandas as pd if
sys.platform ==
'linux':
   Base=os.path.expanduser('~') +
'/VKHCG'else:
   Base='C:/VKHCG'
print('############################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
Company='04-Clark'
sInputFileName='01-Retrieve/01-EDS/01-
R/Retrieve_Profit_And_Loss.csv' sDataBaseDir=Base + '/' +
Company +'/02-Assess/SQLite' if not
os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
sDatabaseName=sDataBaseDir + '/clark.db'
conn = sq.connect(sDatabaseName) ### Import
Financial DatasFileName=Base + '/' + Company
+ '/' + sInputFileName
print('################################')
print('Loading :',sFileName)
print('############################
#####')
FinancialRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
FinancialData=FinancialRawData print('Loaded
Company
:',FinancialData.columns.values)
print('############################
#####')
print('################')  sTable='Assess-

Table:',sTable) FinancialData.to_sql(sTable, conn,
if_exists="replace") print('################')
print(FinancialData.head())
print('################################')
print('Rows :
```

',FinancialData.shape[0])
print('################################')print('### Done!!
##')



Write a Python program to store all master records for the financial calendar

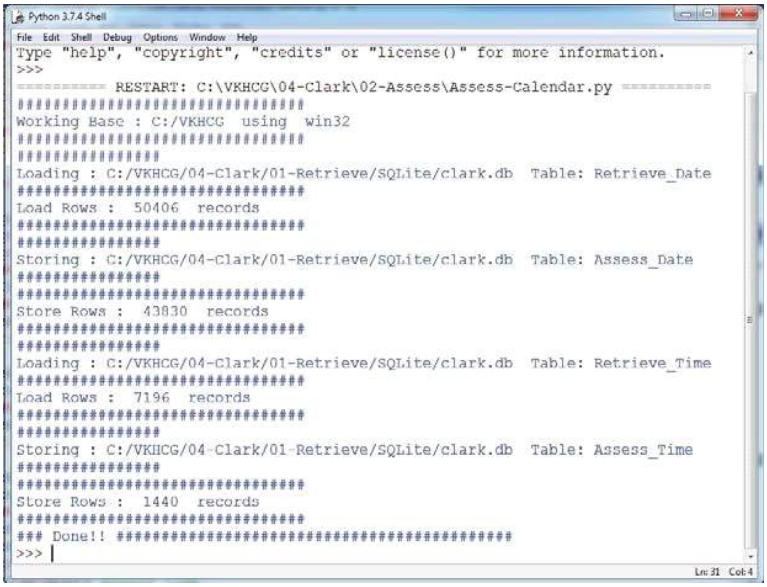
Financial Calendar

Clark stores all the master records for the financial calendar. So we import thecalendar from the retrieve step’sdata storage.

Open Python editor and create a file named Assess-Calendar.py in directory C:\VKHCG\04-Clark\02-Assess.

```
################################################################
# import sys import os import sqlite3 as sq import pandas as pd
################################################################
######
if sys.platform == 'linux':
   Base=os.path.expanduser('~') + '/VKHCG'
else:
   Base='C:/VKHCG'
print('############################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
######
Company='04-Clark'
################################################################
######
sDataBaseDirIn=Base + '/' + Company + '/01-
Retrieve/SQLite'if not os.path.exists(sDataBaseDirIn):
   os.makedirs(sDataBaseDirIn)
sDatabaseNameIn=sDataBaseDirIn +
'/clark.db' connIn =sq.connect(sDatabaseNameIn)
################################################################
sDataBaseDirOut=Base + '/' + Company + '/01-
Retrieve/SQLite'if not os.path.exists(sDataBaseDirOut):
   os.makedirs(sDataBaseDirOut)
sDatabaseNameOut=sDataBaseDirOut +
'/clark.db'connOut =
sq.connect(sDatabaseNameOut)
```

```
#############################################################
# sTableIn='Retrieve_Date' sSQL='select * FROM ' + sTableIn + ';'
print('################')  sTableOut='Assess_Time'
print('Loading
:',sDatabaseNameIn,' Table:',sTableIn)
dateRawData=pd.read_sql_query(sSQL, connIn)
dateData=dateRawData
#############################################################
######print('################################')
print('Load Rows : ',dateRawData.shape[0], ' records')
print('################################')
dateData.drop_duplicates(subset='FinDate', keep='first', inplace=True)
#############################################################
######
# print('################')
sTableOut='Assess_Date' print('Storing
:',sDatabaseNameOut,' Table:',sTableOut)
dateData.to_sql(sTableOut, connOut,
if_exists="replace")print('################')
#############################################################
######print('################################')
print('Store Rows : ',dateData.shape[0], ' records')
print('################################')
#############################################################
######
#############################################################
######
sTableIn='Retrieve_Time'
sSQL='select * FROM ' +
sTableIn + ';'
print('################')
sTableOut='Assess_Time' print('Loading
:',sDatabaseNameIn,' Table:',sTableIn)
timeRawData=pd.read_sql_query(sSQL,
connIn)timeData=timeRawData
#############################################################
######print('################################')
print('Load Rows : ',timeData.shape[0], ' records')
print('################################')
timeData.drop_duplicates(subset=None, keep='first', inplace=True)
#############################################################
######
# print('################')  sTableOut='Assess_Time' print('Storing
:',sDatabaseNameOut,' Table:',sTableOut) timeData.to_sql(sTableOut,
connOut, if_exists="replace") print('################')
#############################################################
######print('################################')
print('Store Rows : ',timeData.shape[0], ' records')
print('################################')
#############################################################
######print('### Done!!
############################################')
#############################################################
######
```



M. Write a Python program to generate payroll from the given data.

People

Clark Ltd generates the payroll, so it holds all the staff records. Clark also handles all payments to suppliers andreceives payments from customers' details on all companies.

Open Python editor and create a file named Assess-People.py in directory C:\VKHCG\04-Clark\02-Assess.

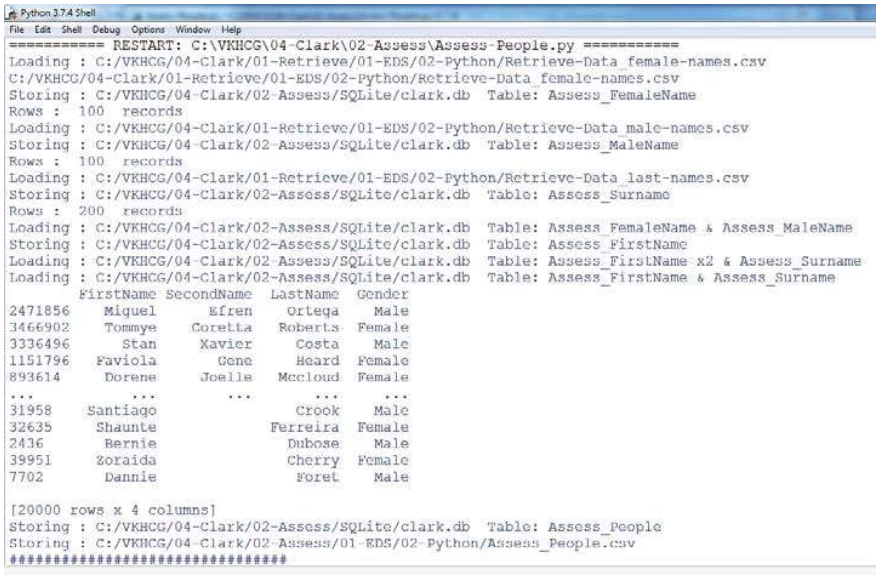
```
################################################################
# import sys import os import sqlite3 as sq import pandas as pd
################################################################
######Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
######
Company='04-Clark' sInputFileName1='01-Retrieve/01-EDS/02-
Python/Retrieve- Data_female-names.csv' sInputFileName2='01-
Retrieve/01-EDS/02- Python/Retrieve-Data_male-names.csv'
sInputFileName3='01-Retrieve/01-EDS/02- Python/Retrieve-Data_last-
names.csv' sOutputFileName1='Assess-Staff.csv'
sOutputFileName2='Assess-Customers.csv'
################################################################
##
sDataBaseDir=Base + '/' + Company + '/02-
Assess/SQLite'if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
################################################################
######
sDatabaseName=sDataBaseDir +
'/clark.db'conn =
sq.connect(sDatabaseName)
################################################################
### Import Female Data
################################################################
######
```

```
sFileName=Base + '/' + Company + '/' +
sInputFileName1
print('################################')
print('Loading :',sFileName)
print('############################
#####')
print(sFileName)

FemaleRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
FemaleRawData.rename(columns={'NameValues' : 'FirstName'},inplace=True)
FemaleRawData.drop_duplicates(subset=None, keep='first', inplace=True)
FemaleData=FemaleRawData.sample(100)
print('################################')
############################################################
######
# print('################')
sTable='Assess_FemaleName'print('Storing
:',sDatabaseName,' Table:',sTable)
FemaleData.to_sql(sTable, conn, if_exists="replace")
print('################')
print('################################')
print('Rows : ',FemaleData.shape[0], ' records')
print('################################')
############################################################
######
### Import Male Data sFileName=Base + '/' + Company
+ '/' + sInputFileName2
print('############################
#####')
print('Loading :',sFileName)
print('############################
#####')
MaleRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
MaleRawData.rename(columns={'NameValues' : 'FirstName'},inplace=True)
MaleRawData.drop_duplicates(subset=None, keep='first', inplace=True)
MaleData=MaleRawData.sample(100)
print('################################')
sTable='Assess_MaleName'
print('Storing :',sDatabaseName,'
Table:',sTable) MaleData.to_sql(sTable,
conn, if_exists="replace")
print('################')
############################################################
######print('################################')
print('Rows : ',MaleData.shape[0], ' records')
print('################################')
############################################################
######
### Import Surname Data
sFileName=Base + '/' + Company + '/' +
sInputFileName3
print('################################')
print('Loading :',sFileName)
print('############################
#####')
```

```
SurnameRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1")SurnameRawData.rename(columns={'NameValues' : 'LastName'},inplace=True)
SurnameRawData.drop_duplicates(subset=None, keep='first', inplace=True)
SurnameData=SurnameRawData.sample(200)
print('################')
sTable='Assess_Surname'
print('Storing :',sDatabaseName,' Table:',sTable)
SurnameData.to_sql(sTable, conn,
if_exists="replace")print('################')
print('################################')
print('Rows : ',SurnameData.shape[0], '
records')
print('############################
####') print('################')
sTable='Assess_FemaleNa
me & Assess_MaleName'
print('Loading
:',sDatabaseName,' Table:',sTable)
sSQL="select distinct" sSQL=sSQL+ "
A.FirstName," sSQL=sSQL+ " 'Female' as
Gender" sSQL=sSQL+

sSQL=sSQL+ " UNION"
sSQL=sSQL+ " select
distinct" sSQL=sSQL+ "
A.FirstName,"
sSQL=sSQL+ " 'Male' as
Gender"sSQL=sSQL+ "
from"
sSQL=sSQL+ " Assess_MaleName as A;"
FirstNameData=pd.read_sql_query(sSQL, conn)
print('################')
############################################################
#######print('################')
sTable='Assess_FirstName' print('Storing
:',sDatabaseName,' Table:',sTable)
FirstNameData.to_sql(sTable, conn,
if_exists="replace")
print('################')
############################################################
######
############################################################
######
# print('################') sTable='Assess_FirstName x2 &
Assess_Surname' print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="select distinct" sSQL=sSQL+ " A.FirstName," sSQL=sSQL+ "
B.FirstName AS SecondName," sSQL=sSQL+ " C.LastName,"
sSQL=sSQL+" A.Gender" sSQL=sSQL+ " from" sSQL=sSQL+ "
Assess_FirstName as A" sSQL=sSQL+ " ," sSQL=sSQL+ "
Assess_FirstName as B" sSQL=sSQL+ " ,"sSQL=sSQL+ "
Assess_Surname as C" sSQL=sSQL+ " WHERE" sSQL=sSQL+ "
A.Gender = B.Gender" sSQL=sSQL+ " AND"
sSQL=sSQL+ " A.FirstName <>
B.FirstName;"
PeopleRawData=pd.read_sql_query(sSQL, conn)People1Data=PeopleRawData.sample(10000)
```

```
sTable='Assess_FirstName &
Assess_Surname'print('Loading
:',sDatabaseName,' Table:',sTable)
sSQL="select distinct" sSQL=sSQL+ "
A.FirstName," sSQL=sSQL+ "" AS
SecondName," sSQL=sSQL+ "
B.LastName," sSQL=sSQL+ "
A.Gender" sSQL=sSQL+ " from"
sSQL=sSQL+ "
Assess_FirstName as A" sSQL=sSQL+ "
," sSQL=sSQL+ " Assess_Surname as
B;"
PeopleRawData=pd.read_sql_query(sSQ
L, conn)
People2Data=PeopleRawData.sample(10
000)
PeopleData=People1Data.append(People
2Data) print(PeopleData)
print('################')
#print('################') sTable='Assess_People'
print('Storing :',sDatabaseName,' Table:',sTable)
PeopleData.to_sql(sTable, conn, if_exists="replace")
print('################') sFileDir=Base + '/' +
Company + '/02-Assess/01-EDS/02-Python' if not
os.path.exists(sFileDir): os.makedirs(sFileDir)
sOutputFileName = sTable+'.csv' sFileName=sFileDir +
'/' + sOutputFileName
print('################################')
print('Storing :',sFileName)
print('################################')
PeopleData.to_csv(sFileName, index = False)
print('################################')
############################################################
######print('### Done!!
##########################################')
############################################################
######
```

OUTPUT:



Practical 6:

Processing Data

A. Build the time hub, links, and satellites.

Open your Python editor and create a file named Process_Time.py. Save it into directoryC:\VKHCG\01-Vermeulen\03-Process.

```
import sys import os from datetime
importdatetime from datetime
import timedelta from pytz import
timezone, all_timezonesimport
pandas as pd import sqlite3 as sq
from pandas.io import sql import
uuid
pd.options.mode.chained_assignme
nt = None if sys.platform ==
'linux':
   Base=os.path.expanduser('~') +
'/VKHCG'else:
```

```
   Base='C:/VKHCG'
print('############################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
Company='01-Vermeulen'
InputDir='00-RawData'
InputFileName='VehicleData.csv'
sDataBaseDir=Base + '/' + Company + '/03-
Process/SQLite' if not
os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
############################################################
######
sDatabaseName=sDataBaseDir +
'/Hillman.db'conn1 =
sq.connect(sDatabaseName)
#####################################################################
# sDataVaultDir=Base + '/88-DV' if not
   os.path.exists(sDataBaseDir):os.makedirs(sDataBaseDir)
sDatabaseName=sDataVaultDir +
'/datavault.db'conn2 =
sq.connect(sDatabaseName)
base =
datetime(2018,1,1,0,0,0)
numUnits=10*365*24
date_list = [base - timedelta(hours=x) for x in
range(0,numUnits)] t=0 for i in date_list:
   now_utc=i.replace(tzinfo=timezone('UTC'))

print(sDateTime)
                    sDateTimeKey=sDateTime.replace
(' ','-').replace(':','-')  t+=1
   IDNumber=str(uuid.uuid4())
   TimeLine=[('ZoneBaseKey',
   ['UTC']),
          ('IDNumber', [IDNumber]),
          ('nDateTimeValue',
          [now_utc]),
          ('DateTimeValue',
          [sDateTime]),
('DateTimeKey',
[sDateTimeKey])]                          ift==1:
     TimeFrame =
pd.DataFrame.from_items(TimeLine)else:
       TimeRow =
       pd.DataFrame.from_items(TimeLine)
       TimeFrame =
       TimeFrame.append(TimeRow)
#################################################################
TimeHub=TimeFrame[['IDNumber','ZoneBaseKey','DateTimeKey','DateTimeValue']]
TimeHubIndex=TimeHub.set_index(['IDNumber'],inplace=False)
TimeFrame.set_index(['IDNumber'],inplace=True)
sTable = 'Process-Time'
```

```
print('Storing :',sDatabaseName,' Table:',sTable)
TimeHubIndex.to_sql(sTable, conn1,
if_exists="replace")sTable = 'Hub-Time'
print('Storing :',sDatabaseName,'
Table:',sTable) TimeHubIndex.to_sql(sTable,
conn2, if_exists="replace")
active_timezones=all_timezonesz=0 for zone
in active_timezones:
   t=0     for j in
range(TimeFrame.sha
pe[0]):
      now_date=TimeFrame['nDateTimeValue'][j]
DateTimeKey=TimeFrame['DateTimeKey'][j]
now_utc=now_date.replace(tzinfo=timezone('UTC'))
sDateTime=now_utc.strftime("%Y-%m-%d %H:%M:%S")
now_zone = now_utc.astimezone(timezone(zone))
sZoneDateTime=now_zone.strftime("%Y-%m-%d
%H:%M:%S")print(sZoneDateTime)         t+=1
      z+=1
      IDZoneNumber=str(uuid.uuid4())
      TimeZoneLine=[('ZoneBaseKey',
      ['UTC']),
            ('IDZoneNumber',
[IDZoneNumber]),('DateTimeKey',
[DateTimeKey]),
            ('UTCDateTimeValue',
            [sDateTime]),('Zone', [zone]),
            ('DateTimeValue', [sZoneDateTime])]
if t==1:
      TimeZoneFrame = pd.DataFrame.from_items(TimeZoneLine)

else:


TimeZoneRow = pd.DataFrame.from_items(TimeZoneLine)
TimeZoneFrame = TimeZoneFrame.append(TimeZoneRow)



TimeZoneFrameIndex=TimeZoneFrame.set_index(['IDZoneNumber'],inplace=
False) sZone=zone.replace('/','-').replace(' ','')          sTable = 'Process-Time-
'+sZone
   print('Storing :',sDatabaseName,' Table:',sTable)
   TimeZoneFrameIndex.to_sql(sTable, conn1,
   if_exists="replace")sTable = 'Satellite-Time-'+sZone
   print('Storing :',sDatabaseName,' Table:',sTable)
   TimeZoneFrameIndex.to_sql(sTable, conn2, if_exists="replace")

print('Vacuum
Databases')
sSQL="VACUUM;
"
sql.execute(sSQL,conn1) sql.execute(sSQL,conn2)
print('################') print('### Done!!
##############################################') You
have built
```

your first hub and satellites for time in the data vault.
The data vault has been built in directory ..\ VKHCG\88-DV\datavault.db. You can access it with your SQLitetools

Golden Nominal

A golden nominal record is a single person's record, with distinctive references for use by all systems. This gives the system a single view of the person. I use first name, other names, last name, and birth date as my golden nominal. The data we have in the assess directory requires a birth date to become a golden nominal. The proram will generate a golden nominal using our sample data set.
Open your Python editor and create a file called Process-People.py in the ..

C:\VKHCG\04-Clark\03-Process directory.

```
################################################################
######
# import sys import os import sqlite3 as sq import pandas as pd from
pandas.ioimport sql from datetime import datetime, timedelta from pytz
import timezone, all_timezones from random import randint import
uuid if sys.platform == 'linux':
   Base=os.path.expanduser('~') +
'/VKHCG'else:
   Base='C:/VKHCG'
print('##################################')
print('Working
Base :',Base, ' using ', sys.platform)
print('##################################')
Company='04-
Clark' sInputFileName='02-Assess/01-EDS/02-
Python/Assess_People.csv' sDataBaseDir=Base + '/' +
Company +'/03-Process/SQLite' if not
os.path.exists(sDataBaseDir): os.makedirs(sDataBaseDir)
sDatabaseName=sDataBaseDir + '/clark.db' conn1 =
sq.connect(sDatabaseName) sDataVaultDir=Base + '/88-
DV' if not os.path.exists(sDataBaseDir):
                                        os.makedirs(sDataBaseDir
) sDatabaseName=sDataVaultDir + '/datavault.db' conn2 =
sq.connect(sDatabaseName) ### Import Female Data
sFileName=Base + '/' + Company + '/' + sInputFileName
print('##################################')
print('Loading
:',sFileName) print('##################################')
print(sFileName)
RawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
RawData.drop_duplicates(subset=None, keep='first', inplace=True)

start_date = datetime(1900,1,1,0,0,0)
start_date_utc=start_date.replace(tzinfo=timezone('UTC'))

HoursBirth=100*365*24
RawData['BirthDateUTC']=RawData.apply(lambda row:
            (start_date_utc + timedelta(hours=randint(0, HoursBirth)))
            ,axis=1)
zonemax=len(all_timez
ones)-1
RawData['TimeZone']=RawData.apply(lambda row:
            (all_timezones[randint(0, zonemax)])
```

```
            ,axis=1)
RawData['BirthDateISO']=RawData.apply(lambda
row:
            row["BirthDateUTC"].astimezone(timezone(row['TimeZone']))

            ,axis=1)
RawData['BirthDateKey']=RawData.apply(lambda
row:
            row["BirthDateUTC"].strftime("%Y-%m-%d %H:%M:%S")
            ,axis=1)
RawData['BirthDate']=RawData.apply(lambda row:
            row["BirthDateISO"].strftime("%Y-%m-%d %H:%M:%S")
            ,axis=1)
RawData['PersonID']=RawData.apply(lambda row:
            str(uuid.uuid4())
,axis=1)
Data=RawData.copy()
Data.drop('BirthDateUTC',
axis=1,inplace=True)
Data.drop('BirthDateISO',
axis=1,inplace=True) indexed_data =
Data.set_index(['PersonID'])
print('##############################
##')
print('#################')
sTable='Process_Person'print('Storing
:',sDatabaseName,' Table:',sTable)
indexed_data.to_sql(sTable, conn1,
if_exists="replace")
print('#################')
PersonHubRaw=Data[['PersonID','FirstName','SecondName','LastName','BirthDateKey']]
PersonHubRaw['PersonHubID']=RawData.apply(lambda row:
            str(uuid.uuid4())
            ,axis=1)
PersonHub=PersonHubRaw.drop_duplicates(subset=None, \
                                       keep='fi
                                       rst',\
                                       inplace
                                       =False)
indexed_PersonHub =
PersonHub.set_index(['PersonHubID'])sTable = 'Hub-
Person'
print('Storing :',sDatabaseName,' Table:',sTable)
indexed_PersonHub.to_sql(sTable, conn2, if_exists="replace")
PersonSatelliteGenderRaw=Data[['PersonID','FirstName','SecondName','LastName'\
                    ,'BirthDateKey','Gender']]
PersonSatelliteGenderRaw['PersonSatelliteID']=RawData.apply(lambd
a row:str(uuid.uuid4())
            ,axis=1)
PersonSatelliteGender=PersonSatelliteGenderRaw.drop_duplicates(subset=None, \
keep='first', \
                                          inplace=False)
indexed_PersonSatelliteGender =
PersonSatelliteGender.set_index(['PersonSatelliteID']) sTable = 'Satellite-Person-
Gender' print('Storing :',sDatabaseName,' Table:',sTable)
```

```
indexed_PersonSatelliteGender.to_sql(sTable, conn2, if_exists="replace")
################################################################
PersonSatelliteBirthdayRaw=Data[['PersonID','FirstName','SecondName','LastName',\
                    'BirthDateKey','TimeZone','BirthDate']]
PersonSatelliteBirthdayRaw['PersonSatelliteID']=RawData.apply(lambda row:
str(uuid.uuid4())
             ,axis=1)
PersonSatelliteBirthday=PersonSatelliteBirthdayRaw.drop_duplicates(subset=None,
\keep='first',\
                                        inplace=False)
indexed_PersonSatelliteBirt
             hday =
PersonSatelliteBirthday.set_index(['PersonSatelliteID']) sTable = 'Satellite-Person-
Names'print('Storing :',sDatabaseName,' Table:',sTable)
indexed_PersonSatelliteBirthday.to_sql(sTable, conn2,


EDS/02-Python' if not os.path.exists(sFileDir):
                                                    os.makedirs(sF
ileDir)sOutputFileName = sTable + '.csv' sFileName=sFileDir +
'/' + sOutputFileName
print('################################') print('Storing :',
sFileName) print('################################')
RawData.to_csv(sFileName, index =
False)
print('############################
#####')print('################')
print('Vacuum
Databases')
sSQL="VACUUM;
"
sql.execute(sSQL,conn1)
sql.execute(sSQL,conn2)
print('################')  print('### Done!!
######################################
#####')
```

Output :
It will apply golden nominal rules by assuming nobody born before January 1, 1900, droping to two ISO complex date time structures, as the code does not translate into SQLite's data types and saves your new golden nominalto a CSV file.

Load the person into the data vault

```
========== RESTART: C:\VKHCG\04-Clark\03-Process\Process-People.py
==========Working Base : C:/VKHCG using  win32
Loading : C:/VKHCG/04-Clark/02-Assess/01-EDS/02-
Python/Assess_People.csvC:/VKHCG/04-Clark/02-Assess/01-EDS/02-
Python/Assess_People.csv
Storing : C:/VKHCG/88-DV/datavault.db  Table: Process_Person
Storing : C:/VKHCG/88-DV/datavault.db Table: Satellite-Person-
GenderStoring : C:/VKHCG/88-DV/datavault.db  Table: Satellite-
Person-Names
Storing : C:/VKHCG/04-Clark/03-Process/01-EDS/02-Python/Satellite-Person-
Names.csvVacuum Databases
################
### Done!! ############################################
```

Vehicles

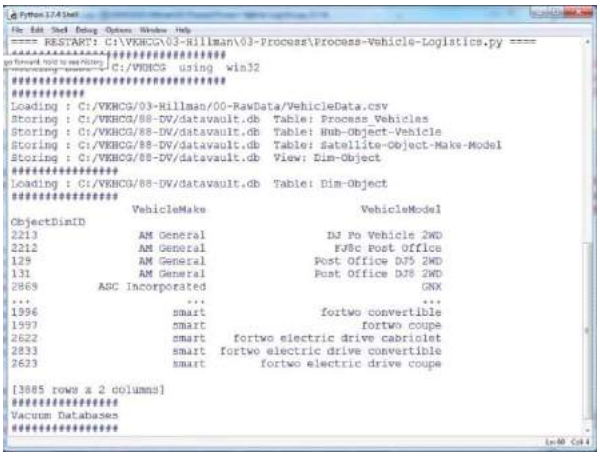
The international classification of vehicles is a complex process. There are standards, but these are not universally applied or similar between groups or countries.

Let's load the vehicle data for Hillman Ltd into the data vault, as we will need it later. Create a new file named Process-Vehicle-Logistics.py in the Python editor in directory ..\VKHCG\03-Hillman\03-Process.

```
# -*- coding: utf-8
-*- import sys
import os import
pandas as pd
import sqlite3 as
sq frompandas.io
import sql import
uuid

pd.options.mode.chained_assignment
= Noneif sys.platform == 'linux':
    Base=os.path.expanduser('~') +
'/VKHCG'else:
    Base='C:/VKHCG'
print('############################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
Company='03-Hillman'
InputDir='00-RawData'
InputFileName='VehicleData.csv'
sDataBaseDir=Base + '/' + Company + '/03-
Process/SQLite' if not
os.path.exists(sDataBaseDir):

    os.makedirs(sDataBaseDir)
sDatabaseName=sDataBaseDir
+ '/Hillman.db' conn1 =
sq.connect(sDatabaseName)
sDataVaultDir=Base + '/88-
DV' if not
os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir) sDatabaseName=sDataVaultDir +
'/datavault.db' conn2 = sq.connect(sDatabaseName)
sFileName=Base
+ '/' + Company + '/' + InputDir + '/' +
InputFileNameprint('###########')
print('Loading :',sFileName)
VehicleRaw=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1") sTable='Process_Vehicles' print('Storing :',sDatabaseName,'
Table:',sTable) VehicleRaw.to_sql(sTable, conn1, if_exists="replace")
VehicleRawKey=VehicleRaw[['Make','Model']].copy()
VehicleKey=VehicleRawKey.drop_duplicates()
VehicleKey['ObjectKey']=VehicleKey.apply(lambda row:
    str('('+ str(row['Make']).strip().replace(' ', '-').replace('/', '-').lower() +
     ')-(' + (str(row['Model']).strip().replace(' ', '-').replace(' ', '-').lower())
     +')')
       ,axis=1)
VehicleKey['ObjectType']=VehicleKey.apply(lambda
row:
    'vehicle'
```

```
      ,axis=1)
VehicleKey['ObjectUUID']=VehicleKey.apply(l
ambda row:                    str(uuid.uuid4())
          ,axis=1)
###
Vehicle
Hub#
VehicleHub=VehicleKey[['ObjectType','ObjectKey','ObjectUUID']].copy()
VehicleHub.index.name='ObjectHubID'
sTable = 'Hub-Object-Vehicle'
print('Storing :',sDatabaseName,'
Table:',sTable) VehicleHub.to_sql(sTable,
conn2, if_exists="replace")### Vehicle Satellite
#
VehicleSatellite=VehicleKey[['ObjectType','ObjectKey','ObjectUUID','Make','Model']].copy()
VehicleSatellite.index.name='ObjectSatelliteID'
sTable = 'Satellite-Object-Make-Model'
print('Storing :',sDatabaseName,' Table:',sTable)
VehicleSatellite.to_sql(sTable, conn2, if_exists="replace")


###      Vehicle      Dimension
sView='Dim-Object'
print('Storing          :',sDatabaseName,'
                         View:',sView)   sSQL="CREATE
VIEW IF NOT EXISTS [" + sView + "] AS"
sSQL=sSQL+       "       SELECT       DISTINCT"
sSQL=sSQL+  "
H.ObjectType,"   sSQL=sSQL+   "
                      H.ObjectKey   AS   VehicleKey,"
sSQL=sSQL+  "            TRIM(S.Make)          AS
VehicleMake," sSQL=sSQL+ " TRIM(S.Model) AS
VehicleModel" sSQL=sSQL+ " FROM" sSQL=sSQL+
" [Hub-Object-Vehicle] AS H" sSQL=sSQL+ " JOIN"
sSQL=sSQL+ " [Satellite-Object-Make-Model] AS S"
sSQL=sSQL+       "       ON"       sSQL=sSQL+       "
H.ObjectType=S.ObjectType"    sSQL=sSQL+    "    AND"sSQL=sSQL+ " H.ObjectUUID=S.ObjectUUID;" sql.execute(sSQL,conn2)


print('################')  print('Loading
:',sDatabaseName,' Table:',sView)
sSQL="SELECT DISTINCT"
sSQL=sSQL+ "
VehicleMake," sSQL=sSQL+ "
VehicleModel"sSQL=sSQL+ " FROM"
sSQL=sSQL+ " [" +
sView + "]"
sSQL=sSQL+ " ORDER BY"
sSQL=sSQL+ "
VehicleMake"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " VehicleMake;"
DimObjectData=pd.read_sql_query(sSQL,
conn2)

DimObjectData.index.name='ObjectDimID'
DimObjectData.sort_values(['VehicleMake','VehicleModel'],inplace=Tru
```

```
e, ascending=True) print('################') print(DimObjectData)
############################################################
######
# print('################')  print('Vacuum
Databases')sSQL="VACUUM;"
sql.execute(sSQL,co
nn1)
sql.execute(sSQL,co
nn2)
print('###########
#####')
#####################################################################
# conn1.close() conn2.close()
############################################################
#######print('### Done!!
##############################################')
############################################################
######
```



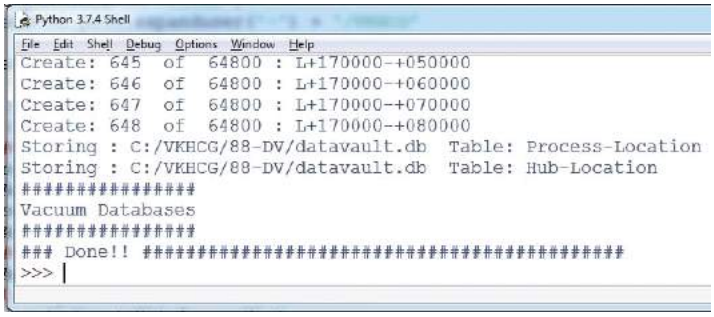
Human-Environment Interaction

In the Python editor, open a new file named Process_Location.py in directory ..\VKHCG\01Vermeulen\03-Process.

```
import sys import
os import pandas
as pd import
sqlite3 as sq from
pandas.io import
sql import uuid
Base='C:/VKHCG
'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)

Company='01-Vermeulen'
InputAssessGraphName='Assess_All_Animals.gml'
EDSAssessDir='02-Assess/01-EDS'
InputAssessDir=EDSAssessDir + '/02-Python'
sFileAssessDir=Base + '/' + Company + '/' +
InputAssessDir if notos.path.exists(sFileAssessDir):
```

```
    os.makedirs(sFileAssessDir) sDataBaseDir=Base
+ '/' +Company + '/03-Process/SQLite' if not
os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
sDatabaseName=sDataBaseDir
+ '/Vermeulen.db' conn1 =
sq.connect(sDatabaseName)
sDataVaultDir=Base + '/88-
DV' if not
os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
sDatabaseName=sDataVaultDir +
'/datavault.db'conn2 =
sq.connect(sDatabaseName)
t=0 tMax=360*180 for
Longitude inrange(-
180,180,10):              for
Latitude in range(-90,90,10):

                          t+=1
        IDNumber=str(uuid.uuid4())
        LocationName='L'+format(round(Longitude,3)*1000,
                    '+07d') +\'-
                    '+format(round(Latitude,3)*1000, '+07d')
        print('Create:',t,' of
',tMax,':',LocationName)
LocationLine=[('ObjectBaseKey',
['GPS']),
                    ('IDNumber', [IDNumber]),
                    ('LocationNumber', [str(t)]),
                    ('LocationName',
                    [LocationName]),
                    ('Longitude', [Longitude]),
            ('Latitude', [Latitude])]        if

t==1:

else:


LocationFrame = pd.DataFrame.from_items(LocationLine)

LocationRow = pd.DataFrame.from_items(LocationLine)
LocationFrame        =        LocationFrame.append(LocationRow)

    LocationHubIndex=LocationFrame.set_index(['IDNumber'],inplace=False
    ) sTable = 'Process-Location'
    print('Storing :',sDatabaseName,' Table:',sTable)
    LocationHubIndex.to_sql(sTable, conn1,
    if_exists="replace")sTable = 'Hub-Location'
    print('Storing :',sDatabaseName,'
    Table:',sTable)
    LocationHubIndex.to_sql(sTable, conn2,
    if_exists="replace")
    print('################')print('Vacuum
    Databases')
```

```
sSQL="VACUUM;"
sql.execute(sSQL,conn1)
sql.execute(sSQL,conn2)
print('################')  print('### Done!!
########################################
#####')
```



Forecasting

Forecasting is the ability to project a possible future, by looking at historical data. The datavault enables these types of investigations, owing to the complete history it collects as itprocesses the source's systems data. A data scientist supply answers to such questions as the following:

- What should we buy?
- What should we sell?
- Where will our next business come from?

People want to know what you calculate to determine what is about to happen. Open a new file in your Python editor and save it as Process-Shares-Data.py in directoryC: \VKHCG\04-Clark\03-Process. I will guide you through this process. You will require a library called quandl

type pipinstall quandl in cmd

```
################################################################
# import sys import os import sqlite3 as sq import quandl import pandas
as pd
################################################################
######Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
######
Company='04-Clark'
sInputFileName='00-RawData/VKHCG_Shares.csv'
sOutputFileName='Shares.csv'
################################################################
######
sDataBaseDir=Base + '/' + Company + '/03-
Process/SQLite'if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
################################################################
######
sFileDir1=Base + '/' + Company + '/01-Retrieve/01-EDS/02-
Python'if not os.path.exists(sFileDir1):
```

```
   os.makedirs(sFileDir1)
##############################################################
######
sFileDir2=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python'if not os.path.exists(sFileDir2):
   os.makedirs(sFileDir2)
##############################################################
######
sFileDir3=Base + '/' + Company + '/03-Process/01-EDS/02-
Python'if not os.path.exists(sFileDir3):
   os.makedirs(sFileDir3)
##############################################################
######
sDatabaseName=sDataBaseDir +
'/clark.db'conn =
sq.connect(sDatabaseName)

### Import Share Names Data
##############################################################
######
sFileName=Base + '/' + Company + '/' +
sInputFileName
print('################################')
print('Loading :',sFileName)
print('############################
#####')
RawData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1") RawData.drop_duplicates(subset=None,   keep='first',
inplace=True)       print('Rows                    :',RawData.shape[0])
print('Columns:',RawData.shape[1])
print('################')
#####################################################################


sFileName=sFileDir1 + '/Retrieve_' + sOutputFileName
print('################################')
print('Storing :', sFileName)
print('############################
#####')
RawData.to_csv(sFileName, index = False)
print('################################')
##############################################################
######
sFileName=sFileDir2 + '/Assess_' +
sOutputFileName
print('################################')
print('Storing :', sFileName)
print('############################
#####')
RawData.to_csv(sFileName, index = False)
print('################################')
##############################################################
######
sFileName=sFileDir3 + '/Process_' + sOutputFileName
print('################################')
```

```
print('Storing :', sFileName)
print('##########################
#####')
RawData.to_csv(sFileName, index = False)
print('################################')
############################################################
######
### Import Shares
Data Details
nShares=RawData.sh
ape[0]#nShares=6
for sShare in
range(nShares):
   sShareName=str(RawData['Shares'][sShar
   e])ShareData = quandl.get(sShareName)
   UnitsOwn=RawData['Units'][sShare]
   ShareData['UnitsOwn']=ShareData.apply(lambda
row:(UnitsOwn),axis=1)
ShareData['ShareCode']=ShareData.apply(lambda
row:(sShareName),axis=1)     print('################')      print('Share
:',sShareName) print('Rows
:',ShareData.shape[0])
   print('Columns:',ShareData.shape[1])
   print('################')

#####################################################################
print('################')
                              sTable=str(RawData['sTable'][sShare])
print('Storing :',sDatabaseName,' Table:',sTable)
                              ShareData.to_sql(sTable,conn,
if_exists="replace")          print('################')

#####################################################################
sOutputFileName = sTable.replace("/","-") + '.csv'
                                                    sFileName=sFile
Dir1 +'/Retrieve_' + sOutputFileName

print('################################')
                    ShareData.to_csv(sFileName,index = False)
                    print('################################')

#####################################################################
sOutputFileName = sTable.replace("/","-") + '.csv'
                              sFileName=sFileDir2 + '/Assess_' +
sOutputFileName
                              print('############################
###')print('Storing :', sFileName)
                              print('############################
###') ShareData.to_csv(sFileName, index = False)
print('################################')

#####################################################################
sOutputFileName = sTable.replace("/","-") + '.csv'
                              sFileName=sFileDir3 + '/Process_' +
sOutputFileName
                              print('############################
##')print('Storing :', sFileName)
```

```
                                    print('################################
##') ShareData.to_csv(sFileName, index = False)
print('################################') print('### Done!!
############################################')
#############################################################
#####
```

Output:

```
======== RESTART: C:\VKHCG\04-Clark\03-Process\Process-Shares-Data.py
========Working Base : C:/VKHCG using  win32
Loading : C:/VKHCG/04-Clark/00-
RawData/VKHCG_Shares.csvRows : 10
Columns: 3
Storing : C:/VKHCG/04-Clark/01-Retrieve/01-EDS/02-
Python/Retrieve_Shares.csvStoring : C:/VKHCG/04-Clark/02-Assess/01-
EDS/02-Python/Assess_Shares.csv Storing : C:/VKHCG/04-Clark/03-
Process/01-EDS/02-Python/Process_Shares.csv Share  : WIKI/GOOGL
Rows  : 3424
Columns: 14
Storing : C:/VKHCG/04-Clark/03-Process/SQLite/clark.db  Table: WIKI_Google
Storing :C:/VKHCG/04-Clark/01-Retrieve/01-EDS/02-
Python/Retrieve_WIKI_Google.csv  Storing
: C:/VKHCG/04-Clark/02-Assess/01-EDS/02-Python/Assess_WIKI_Google.
```

Transform Superstep

Practical 7:
Transforming Data

C: \VKHCG\01-Vermeulen\04-Transform.

```
import sys import
os fromdatetime
import datetime

import pandas as pd
importsqlite3 as sq
import uuid
pd.options.mode.chained_assignment = None
################################################################
######Base='C:/VKHCG'
print('#################################')
print('Working Base :',Base, ' using ', sys.platform)
print('#################################')
################################################################
######
Company='01-Vermeulen'
InputDir='00-RawData'
InputFileName='VehicleD
ata.csv'
#####################################################################
sDataBaseDir=Base + '/' + Company + '/04-
Transform/SQLite'if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
################################################################
######
sDatabaseName=sDataBaseDir +
'/Vermeulen.db'conn1 =
sq.connect(sDatabaseName)
#####################################################################
```

```
# sDataVaultDir=Base + '/88-DV' if not
   os.path.exists(sDataVaultDir):os.makedirs(sDataVaultDir)
################################################################
sDatabaseName=sDataVaultDir +
'/datavault.db'conn2 =
sq.connect(sDatabaseName)
################################################################
sDataWarehouseDir=Base + '/99-
DW'                if                not
os.path.exists(sDataWarehouseDi
r):
os.makedirs(sDataWarehouseDir
)
################################################################
sDatabaseName=sDataWarehouseDir +
'/datawarehouse.db'conn3 =
sq.connect(sDatabaseName)
############################################################
######print('\n#################################')
print('Time
Category')
print('UTC
Time')
BirthDateUTC = datetime(1960,12,20,10,15,0)
BirthDateZoneUTC=BirthDateUTC.replace(tzinfo=timezone('UTC'))
BirthDateZoneStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S")
BirthDateZoneUTCStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S
(%Z) (%z)") print(BirthDateZoneUTCStr)
print('#################################') print('Birth Date in Reykjavik
:')
BirthZone = 'Atlantic/Reykjavik'
BirthDate = BirthDateZoneUTC.astimezone(timezone(BirthZone))
BirthDateStr=BirthDate.strftime("%Y-%m-%d %H:%M:%S (%Z)
(%z)")BirthDateLocal=BirthDate.strftime("%Y-%m-%d
%H:%M:%S") print(BirthDateStr)
print('#################################')
############################################################
######
IDZoneNumber=str(uuid.uuid4())
sDateTimeKey=BirthDateZoneStr.replace(' ','-').replace(':','-')
TimeLine=[('ZoneBaseKey', ['UTC']),
          ('IDNumber', [IDZoneNumber]),
          ('DateTimeKey', [sDateTimeKey]),
          ('UTCDateTimeValue',
          [BirthDateZoneUTC]),('Zone',
          [BirthZone]),

TimeFrame = pd.DataFrame.from_items(TimeLine)
############################################################
######
TimeHub=TimeFrame[['IDNumber','ZoneBaseKey','DateTimeKey','DateTimeValue']]
TimeHubIndex=TimeHub.set_index(['IDNumber'],inplace=False)
################################################################
sTable = 'Hub-Time-Gunnarsson'
print('\n############################
#####')
```

```
print('Storing :',sDatabaseName,'\n
Table:',sTable)
print('\n############################
#####')
TimeHubIndex.to_sql(sTable, conn2,
if_exists="replace")sTable = 'Dim-Time-
Gunnarsson' TimeHubIndex.to_sql(sTable, conn3,
if_exists="replace")
#################################################################
TimeSatellite=TimeFrame[['IDNumber','DateTimeKey','Zone','DateTimeValue']]
TimeSatelliteIndex=TimeSatellite.set_index(['IDNumber'],inplace=False)
#################################################################
BirthZoneFix=BirthZone.replace(' ','-').replace('/','-')
sTable ='Satellite-Time-' + BirthZoneFix + '-
Gunnarsson'
print('\n################################')
print('Storing :',sDatabaseName,'\n
Table:',sTable)
print('\n############################
#####')
TimeSatelliteIndex.to_sql(sTable, conn2,
if_exists="replace") sTable = 'Dim-Time-' +
BirthZoneFix +'-Gunnarsson'
TimeSatelliteIndex.to_sql(sTable, conn3, if_exists="replace")
#############################################################
######print('\n################################')
print('Person Category') FirstName =
'Guðmundur' LastName = 'Gunnarsson'
print('Name:',FirstName,LastName)
print('BirthDate:',BirthDateLocal)
print('Birth Zone:',BirthZone)
print('UTC Birth
Date:',BirthDateZoneStr)
print('############################
#####'
)
#############################################################
######
IDPersonNumber=str(uuid.uuid4())
PersonLine=[('IDNumber',
[IDPersonNumber]),
            ('FirstName', [FirstName]),
            ('LastName', [LastName]),
            ('Zone', ['UTC']),
            ('DateTimeValue', [BirthDateZoneStr])]
PersonFrame =
pd.DataFrame.from_items(PersonLine)
#################################################################
TimeHub=PersonFrame
TimeHubIndex=TimeHub.set_index(['IDNumber'],inplace=False)
#############################################################
######
sTable = 'Hub-Person-Gunnarsson'
print('\n############################
#####')
```

```
print('Storing :',sDatabaseName,'\n
Table:',sTable)
print('\n#############################
#####')
TimeHubIndex.to_sql(sTable, conn2,
if_exists="replace")sTable = 'Dim-Person-
Gunnarsson' TimeHubIndex.to_sql(sTable, conn3,
if_exists="replace")
#####################################################################
```

Output : Guðmundur Gunnarsson was born on December 20, 1960, at 9:15 in Landspítali,Hringbraut 101, 101Reykjavík, Iceland.

```
>>>
 RESTART: C:\VKHCG\01-Vermeulen\04-Transform\Transform-Gunnarsson_is_Born.py
Working Base : C:/VKHCG using win32
Time Category
UTC Time
1960-12-20 10:15:00 (UTC) (+0000)
####################################
Birth Date in Reykjavik :
1960-12-20 09:15:00 (-01) (-0100)
####################################
####################################
Storing : C:/VKHCG/99-DW/datawarehouse.db
 Table: Hub-Time-Gunnarsson
####################################
####################################
Storing : C:/VKHCG/99-DW/datawarehouse.db
 Table: Satellite-Time-Atlantic-Reykjavik-Gunnarsson
####################################
Person Category
Name: Guðmundur Gunnarsson
Birth Date: 1960-12-20 09:15:00
Birth Zone: Atlantic/Reykjavik
UTC Birth Date: 1960-12-20 10:15:00
####################################
Storing : C:/VKHCG/99-DW/datawarehouse.db
 Table: Hub-Person-Gunnarsson
####################################
```

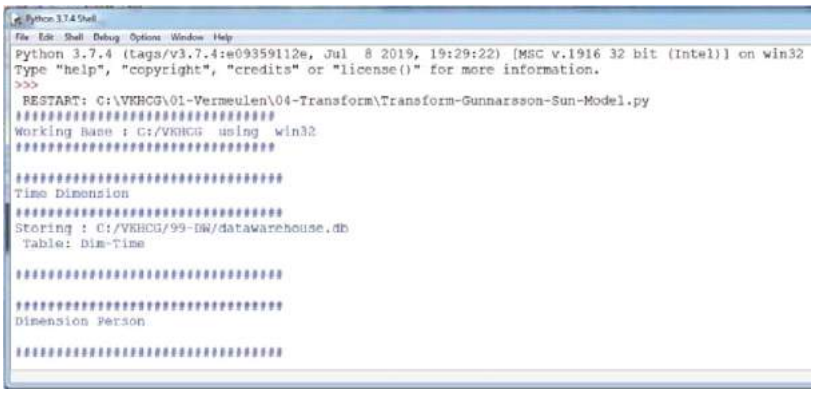
You must build three items: **dimension Person**, **dimension Time**, and **factPersonBornAtTime**. Open your Python editor and create a file named Transform-Gunnarsson-Sun-Model.py in directoryC:\VKHCG\01-Vermeulen\04-Transform.

```
#####################################################################
## import sys import os from datetime import datetime from pytz import timezone
importpandas as pd import sqlite3 as sq import uuid
pd.options.mode.chained_assignment = None
############################################################
######
if sys.platform == 'linux':
   Base=os.path.expanduser('~') + '/VKHCG'
else:
   Base='C:/VKHCG'
print('############################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
############################################################
######
Company='01-Vermeulen'
############################################################
######
sDataBaseDir=Base + '/' + Company + '/04-
Transform/SQLite'if not os.path.exists(sDataBaseDir):
```

```
   os.makedirs(sDataBaseDir)
############################################################
######
sDatabaseName=sDataBaseDir +
'/Vermeulen.db'conn1 =
sq.connect(sDatabaseName)
#################################################################
#          sDataWarehousetDir=Base          +          '/99-DW'          if          notos.path.exists(sDataWarehousetDir):
   os.makedirs(sDataWarehousetDir)
############################################################
######
sDatabaseName=sDataWarehousetDir +
'/datawarehouse.db'conn2 =
sq.connect(sDatabaseName)
############################################################
######print('\n#################################')
print('Time Dimension')
BirthZone =
'Atlantic/Reykjavik'

BirthDateZoneUTC=BirthDateUTC.replace(tzinfo=timezone('UTC'))
BirthDateZoneStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S")
BirthDateZoneUTCStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S (%Z)
(%z)") BirthDate = BirthDateZoneUTC.astimezone(timezone(BirthZone))
BirthDateStr=BirthDate.strftime("%Y-%m-%d %H:%M:%S (%Z) (%z)")
BirthDateLocal=BirthDate.strftime("%Y-%m-%d %H:%M:%S")
#################################################################
IDTimeNumber=str(uuid.uuid4())
TimeLine=[('TimeID',
[IDTimeNumber]),
        ('UTCDate',
        [BirthDateZoneStr]),
        ('LocalTime',
        [BirthDateLocal]),
        ('TimeZone', [BirthZone])]
TimeFrame = pd.DataFrame.from_items(TimeLine)
############################################################
######
DimTime=TimeFrame
DimTimeIndex=DimTime.set_index(['TimeID'],inplace=False)
############################################################
####### sTable = 'Dim-Time'
print('\n#################################')
print('Storing :',sDatabaseName,'\n
Table:',sTable)
print('\n############################
#####')
DimTimeIndex.to_sql(sTable, conn1, if_exists="replace")
DimTimeIndex.to_sql(sTable, conn2, if_exists="replace")
############################################################
######print('\n#################################')
print('Dimension Person')
print('\n############################
#####')
FirstName =
'Guðmundur'
```

```
LastName =
'Gunnarsson'
#################################################################
IDPersonNumber=str(uuid.uuid4())
PersonLine=[('PersonID',
[IDPersonNumber]),
            ('FirstName', [FirstName]),
            ('LastName', [LastName]),
            ('Zone', ['UTC']),
            ('DateTimeValue', [BirthDateZoneStr])]
PersonFrame =
pd.DataFrame.from_items(PersonLine)
#################################################################
DimPerson=PersonFrame
DimPersonIndex=DimPerson.set_index(['PersonID'],inplace=False)
#############################################################
####### sTable = 'Dim-Person'
print('\n#################################')
print('Storing :',sDatabaseName,'\n
Table:',sTable)
print('\n############################
#####')
DimPersonIndex.to_sql(sTable, conn1, if_exists="replace")
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
#############################################################
######print('\n#################################')
print('Fact - Person - time')
print('\n############################
#####')
IDFactNumber=str(uuid.uuid4())
PersonTimeLine=[('IDNumber',
[IDFactNumber]),
             ('IDPersonNumber',
             [IDPersonNumber]),
             ('IDTimeNumber',
             [IDTimeNumber])]
PersonTimeFrame = pd.DataFrame.from_items(PersonTimeLine)
#############################################################
######
FctPersonTime=PersonTimeFrame

FctPersonTimeIndex=FctPersonTime.set_index(['IDNumber'],inplace=
False)
#############################################################
######
# sTable = 'Fact-Person-Time'
print('\n#################################')
print('Storing
:',sDatabaseName,'\n Table:',sTable)
print('\n############################
#####')
FctPersonTimeIndex.to_sql(sTable, conn1, if_exists="replace")
FctPersonTimeIndex.to_sql(sTable, conn2, if_exists="replace")
#############################################################
######
```

Output:



Building a Data Warehouse

Open the Transform-Sun-Models.py file from directory C:\VKHCG\01-Vermeulen\04Transform.

```
################################################################
#####
## import sys import os from datetime import datetime from pytz import timezone
importpandas as pd import sqlite3 as sq import uuid
pd.options.mode.chained_assignment = None
################################################################
######
if sys.platform == 'linux':
    Base=os.path.expanduser('~') +
'/VKHCG'else:
    Base='C:/VKHCG'
print('############################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
######
Company='01-Vermeulen'
################################################################
######
sDataBaseDir=Base + '/' + Company + '/04-
Transform/SQLite'if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
################################################################
######
sDatabaseName=sDataBaseDir + '/Vermeulen.db' conn1 = sq.connect(sDatabaseName)
################################################################
# sDataVaultDir=Base + '/88-DV' if not
    os.path.exists(sDataVaultDir):os.makedirs(sDataVaultDir)
################################################################
sDatabaseName=sDataVaultDir +
'/datavault.db'conn2 =
sq.connect(sDatabaseName)
################################################################

sDataWarehouseDir=Base + '/99-
DW' ifnot
```

```
os.path.exists(sDataWarehouseDi
r):
   os.makedirs(sDataWarehouseDir)
############################################################
######
sDatabaseName=sDataWarehouseDir +
'/datawarehouse.db'conn3 =
sq.connect(sDatabaseName)
#####################################################################
sSQL=" SELECT DateTimeValue FROM [Hub-
Time];"DateDataRaw=pd.read_sql_query(sSQL,
conn2) DateData=DateDataRaw.head(1000)
print(DateData)
############################################################
######print('\n#################################'
) print('Time Dimension')
print('\n############################
#####'
) t=0 mt=DateData.shape[0] for i in range(mt):
   BirthZone =
('Atlantic/Reykjavik','Europe/London','UCT')for j in
range(len(BirthZone)):
      t+=1
print(t,mt*3)
      BirthDateUTC = datetime.strptime(DateData['DateTimeValue'][i],"%Y-%m-%d
      %H:%M:%S")BirthDateZoneUTC=BirthDateUTC.replace(tzinfo=timezone('UTC'))
      BirthDateZoneStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S")
      BirthDateZoneUTCStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S (%Z)
      (%z)") BirthDate = BirthDateZoneUTC.astimezone(timezone(BirthZone[j]))
      BirthDateStr=BirthDate.strftime("%Y-%m-%d %H:%M:%S (%Z) (%z)")
      BirthDateLocal=BirthDate.strftime("%Y-%m-%d %H:%M:%S")
      ######################################################################
      IDTimeNumber=str(uuid.uuid4())
      TimeLine=[('TimeID', [str(IDTimeNumber)]),
            ('UTCDate',
            [str(BirthDateZoneStr)]),
            ('LocalTime',
[str(BirthDateLocal)]),
                        ('TimeZone',
[str(BirthZone)])]      if t==1:
         TimeFrame = pd.DataFrame.from_items(TimeLine)
else:
         TimeRow =
         pd.DataFrame.from_items(TimeLine)
         TimeFrame=TimeFrame.append(TimeRow
         )
#####################################################################
DimTime=TimeFrame
DimTimeIndex=DimTime.set_index(['TimeID'],inplace=False)
############################################################
######
sTable = 'Dim-Time'
print('\n############################
#####')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
```

```
DimTimeIndex.to_sql(sTable, conn1, if_exists="replace")
DimTimeIndex.to_sql(sTable, conn3, if_exists="replace")
################################################################## sSQL=" SELECT "
+ \
    " FirstName," + \
    "
    SecondName
    ," + \"
    LastName,"
    + \
    " BirthDateKey " + \
    " FROM [Hub-Person];"
PersonDataRaw=pd.read_sql_query(sSQL,
conn2)

#############################################################
######print('\n###################################'
) print('Dimension Person')
print('\n############################
#####'
) t=0 mt=DateData.shape[0] for i in range(mt):
   t+=1
   print(t,mt)
   FirstName =
str(PersonData["FirstName"])
SecondName =
str(PersonData["SecondName"])if
len(SecondName) > 0:
      SecondName=""
   LastName = str(PersonData["LastName"])
   BirthDateKey =
   str(PersonData["BirthDateKey"])
   ################################################################
   IDPersonNumber=str(uuid.uuid4())
   PersonLine=[('PersonID',
   [str(IDPersonNumber)]),
            ('FirstName',
            [FirstName]),
            ('SecondName',
            [SecondName]),
            ('LastName',
            [LastName]), ('Zone',
            [str('UTC')]),
('BirthDate', [BirthDateKey])]      if t==1:
      PersonFrame = pd.DataFrame.from_items(PersonLine)
else:
      PersonRow =
      pd.DataFrame.from_items(PersonLine)
      PersonFrame =
      PersonFrame.append(PersonRow)
#################################################################
DimPerson=Person
Frame
print(DimPerson)
```

```
DimPersonIndex=DimPerson.set_index(['PersonID'],inplace=False)
############################################################
######
sTable = 'Dim-Person'
print('\n############################
#####')
print('Storing :',sDatabaseName,'\n
Table:',sTable)
print('\n############################
#####')
DimPersonIndex.to_sql(sTable, conn1, if_exists="replace")
DimPersonIndex.to_sql(sTable, conn3, if_exists="replace")
############################################################
######
```

Output:

You have successfully performed data vault to data warehouse transformation.

Simple Linear Regression

Linear regression is used if there is a relationship or significant association between the variables. This can be checked by scatterplots. If no linear association appears between the variables, fitting a linear regression model to the data will not provide a useful model.A linear regression line has equations in the following form:

Y = a + bX,

Where, X = explanatory variable andY = dependent variable

b = slope of the line

a = intercept (the value of y when x = 0)

```
#####################################################################
# -*- coding: utf-8 -*-
############################################################
######
# import sys import os import pandas as pd import sqlite3 as sq import

import numpy as np

from sklearn import datasets, linear_model from
sklearn.metrics import mean_squared_error,
r2_score
############################################################
######Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
############################################################
######
############################################################
######
Company='01-Vermeulen'
############################################################
######
```

```
    sDataBaseDir=Base + '/' + Company + '/04-
    Transform/SQLite'if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
    ########################################################################
    sDatabaseName=sDataBaseDir +
    '/Vermeulen.db'conn1 =
    sq.connect(sDatabaseName)
    ########################################################################
    sDataVaultDir=Base  +  '/88-
    DV'             if             not
    os.path.exists(sDataVaultDir
    ):
    os.makedirs(sDataVaultDir)
    ########################################################################
    sDatabaseName=sDataVaultDir +
    '/datavault.db'conn2 =
    sq.connect(sDatabaseName)
    ########################################################################
    sDataWarehouseDir=Base + '/99-
    DW'             if             not
    os.path.exists(sDataWarehouseDi
    r):
    os.makedirs(sDataWarehouseDir
    )
    ########################################################################
    sDatabaseName=sDataWarehouseDir +
    '/datawarehouse.db'conn3 =
    sq.connect(sDatabaseName)
    ########################################################################
    t=0
    tMax=((300-100)/10)*((300-30)/5) for
    heightSelect  in
    range(100,300,10): for
    weightSelect in
    range(30,300,5): height =
    round(heightSelect/100,3)
    weight = int(weightSelect)        bmi =weight/(height*height)  if bmi <=18.5:      BMI_Result=1                          elif bmi > 18.5 and
    elif bmi > 30:



    else:


  BMI_Result=4

  BMI_Result=0 PersonLine=[('PersonID',
[str(t)]),
        ('Height', [height]),
        ('Weight', [weight]),
        ('bmi', [bmi]),

                ('Indicator',
    [BMI_Result])]       t+=1
    print('Row:',t,'of',tMax)
                            if t==1:
```

```
        PersonFrame = pd.DataFrame.from_items(PersonLine)
else:
        PersonRow =
        pd.DataFrame.from_items(PersonLine)
        PersonFrame =
        PersonFrame.append(PersonRow)
#################################################################
DimPerson=PersonFrame
DimPersonIndex=DimPerson.set_index(['PersonID'],inplace=False)
#############################################################
######
# sTable = 'Transform-BMI'
print('\n#################################')
print('Storing
:',sDatabaseName,'\n Table:',sTable)
print('\n############################
#####')
DimPersonIndex.to_sql(sTable, conn1, if_exists="replace")
#############################################################
######
#############################################################
#####
# sTable = 'Person-Satellite-BMI'
print('\n#################################')
print('Storing
:',sDatabaseName,'\n Table:',sTable)
print('\n############################
#####')
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
#############################################################
#######
#############################################################
####### sTable = 'Dim-BMI'
print('\n#################################')
print('Storing :',sDatabaseName,'\n
Table:',sTable)
print('\n############################
#####')
DimPersonIndex.to_sql(sTable, conn3, if_exists="replace")
#############################################################
######
fig = plt.figure()
PlotPerson=DimPerson[DimPerson['Indicator']==1]
x=PlotPerson['Height']
y=PlotPerson['Weight']
plt.plot(x, y, ".")
PlotPerson=DimPerson[DimPerson['Indicator']==2]
x=PlotPerson['Height']
y=PlotPerson['Weight']
plt.plot(x, y, "o")
PlotPerson=DimPerson[DimPerson['Indicator']==3]
x=PlotPerson['Height']
y=PlotPerson['Weight']
plt.plot(x, y, "+")
PlotPerson=DimPerson[DimPerson['Indicator']==4]
x=PlotPerson['Height']
```

```
y=PlotPerson['Weigh
t'] plt.plot(x, y, "^")
plt.axis('tight')
plt.title("BMI
Curve")
plt.xlabel("Height(m
eters)")
plt.ylabel("Weight(k
g)") plt.plot()


# Load the diabetes dataset


# Use only one feature diabetes_X =
diabetes.data[:, np.newaxis, 2]
diabetes_X_train = diabetes_X[:-30]
diabetes_X_test = diabetes_X[-50:]
diabetes_y_train = diabetes.target[:-
30] diabetes_y_test = diabetes.target[-
50:] regr =
linear_model.LinearRegression()
regr.fit(diabetes_X_train,
diabetes_y_train) diabetes_y_pred =
regr.predict(diabetes_X_test)
print('Coefficients: \n', regr.coef_)
print("Mean squared error: %.2f"
    % mean_squared_error(diabetes_y_test, diabetes_y_pred))
print('Variance score: %.2f' % r2_score(diabetes_y_test,
diabetes_y_pred)) plt.scatter(diabetes_X_test, diabetes_y_test,
color='black') plt.plot(diabetes_X_test, diabetes_y_pred,
color='blue',linewidth=3) plt.xticks(()) plt.yticks(())
plt.axis('tight') plt.title("Diabetes") plt.xlabel("BMI")
plt.ylabel("Age") plt.show()
```

Output:

Practical 8:

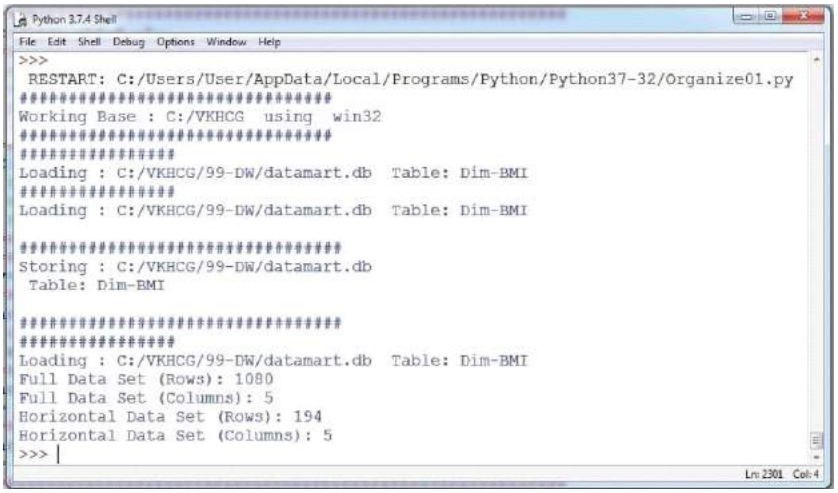
Organizing Data

C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Horizontal.py

```
################################################################
######
# import sys import os import pandas as pd
import sqlite3 as sq
```

```
#############################################################
######Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#####################################################################
#####################################################################
Company='01-
Vermeulen'
#############################################################
######
sDataWarehouseDir=Base + '/99-
DW'                 if                 not
os.path.exists(sDataWarehouseDi
r):
os.makedirs(sDataWarehouseDir
)
#####################################################################
sDatabaseName=sDataWarehouseDir +
'/datawarehouse.db'conn1 =
sq.connect(sDatabaseName)
#####################################################################
sDatabaseName=sDataWarehouseDir +
'/datamart.db'conn2 =
sq.connect(sDatabaseName)
#####################################################################
# print('################') sTable = 'Dim-BMI' print('Loading
:',sDatabaseName,' Table:',sTable) sSQL="SELECT * FROM [Dim-
BMI];"PersonFrame0=pd.read_sql_query(sSQL, conn1)
print('################') sTable = 'Dim-BMI'
print('Loading
:',sDatabaseName,'
Table:',sTable)
sSQL="SELECT
   PersonID,\Height,\
W
ei
g
ht
,\
b
m
i,\
   Indicator\
   FROM
   [Dim-BMI]\
   WHERE \
Height >
1.5 \ and
Indicator =
1\
   ORDER BY \
      H
      ei
      gh
      t,\
```

W
ei
gh
t;"
PersonFrame1=pd.read_sql_query(sSQL, conn1)
##
######
DimPerson=PersonFrame1
DimPersonIndex=DimPerson.set_index(['PersonID'],inplace=False)
##
######
sTable = 'Dim-BMI'
print('\n#############################
#####')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
#DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
##
######print('#################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,'
Table:',sTable)sSQL="SELECT * FROM
[Dim-BMI];"
PersonFrame2=pd.read_sql_query(sSQL, conn2) print('Full Data Set (Rows):', PersonFrame0.shape[0]) print('Full Data Set (Columns):', PersonFrame0.shape[1]) print('Horizontal Data Set (Rows):', PersonFrame2.shape[0]) print('Horizontal Data Set (Columns):',



Vertical Style

C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Vertical.py import sys import os import pandas as pd importsqlite3 as sq

##
######Base='C:/VKHCG'
print('################################')

```
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
############################################################
######
############################################################
######
Company='01-Vermeulen'
############################################################
######
sDataWarehouseDir=Base + '/99-
DW' ifnot
os.path.exists(sDataWarehouseDi
r):
    os.makedirs(sDataWarehouseDir)
############################################################
######
sDatabaseName=sDataWarehouseDir +
'/datawarehouse.db'conn1 =
sq.connect(sDatabaseName)
#####################################################################
sDatabaseName=sDataWarehouseDir +
'/datamart.db'conn2 = sq.connect(sDatabaseName)
############################################################
######print('##################################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,'
Table:',sTable)sSQL="SELECT * FROM
[Dim-BMI];"
PersonFrame0=pd.read_sql_query(sSQL, conn1)
############################################################
######
print('##################################') sTable = 'Dim-BMI' print('Loading
:',sDatabaseName,' Table:',sTable) print('##################################')
sSQL="SELECT \
      He
      igh
      t,\
      W
      eig
      ht,
      \
      In
      dic
      ato
      r\
  FROM [Dim-BMI];"
PersonFrame1=pd.read_sql_query(sSQL, conn1)

DimPerson=PersonFrame1
DimPersonIndex=DimPerson.set_index(['Indicator'],inplace=False)
############################################################
######
# sTable = 'Dim-BMI-Vertical'
print('\n##################################')
print('Storing
```

:',sDatabaseName,'\n Table:',sTable)
print('\n############################
#####')
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
##
######
print('################') sTable = 'Dim-BMI-Vertical' print('Loading
:',sDatabaseName,' Table:',sTable) sSQL="SELECT * FROM
[Dim-BMI-Vertical];"
PersonFrame2=pd.read_sql_query(sSQL, conn2)
##
######print('################################') print('Full Data
Set (Rows):', PersonFrame0.shape[0]) print('Full
Data Set(Columns):', PersonFrame0.shape[1])
print('################################')
print('Horizontal Data Set (Rows):',
PersonFrame2.shape[0])print('Horizontal Data Set
(Columns):', PersonFrame2.shape[1])
print('################################')
###

Output:

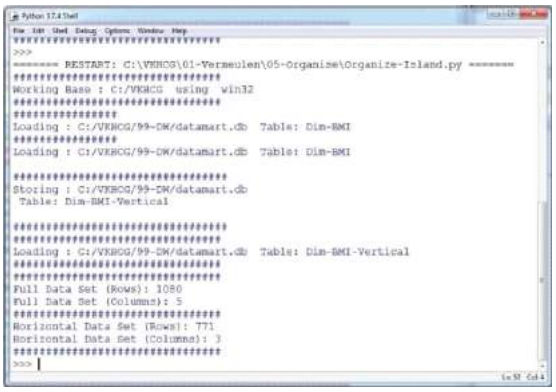
```
====== RESTART: C:\VKHCG\01-Vermeulen\05-Organise\Organize-Vertical.py ======
################################
Working Base : C:/VKHCG  using  win32
################################
################################
Loading : C:/VKHCG/99-DW/datamart.db  Table: Dim-BMI
################################
Loading : C:/VKHCG/99-DW/datamart.db  Table: Dim-BMI
################################

################################
Storing : C:/VKHCG/99-DW/datamart.db
 Table: Dim-BMI-Vertical

################################
################
Loading : C:/VKHCG/99-DW/datamart.db  Table: Dim-BMI-Vertical
################################
Full Data Set (Rows): 1080
Full Data Set (Columns): 5
################################
Horizontal Data Set (Rows): 1080
Horizontal Data Set (Columns): 3
################################
```

Island Style

C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Island.py import sys import os import
pandas as pdimport sqlite3 as sq
##
######Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
###
###
Company='01-
Vermeulen'
##
######
sDataWarehouseDir=Base + '/99-
DW' if not
os.path.exists(sDataWarehouseDi
r):
os.makedirs(sDataWarehouseDir
)
###
sDatabaseName=sDataWarehouseDir +
'/datawarehouse.db'conn1 =
sq.connect(sDatabaseName)

```
#################################################################

sDatabaseName=sDataWarehouseDir +
'/datamart.db'conn2 = sq.connect(sDatabaseName)
#################################################################
# print('################')  sTable = 'Dim-BMI' print('Loading
:',sDatabaseName,' Table:',sTable) sSQL="SELECT * FROM [Dim-
BMI];" PersonFrame0=pd.read_sql_query(sSQL, conn1)
#########################################################
######
# print('################')  sTable = 'Dim-BMI' print('Loading
:',sDatabaseName,' Table:',sTable)

sSQL="SELECT \
      He
      igh
      t,\
      W
      eig
      ht,
      \
      In
      dic
      ato
      r\
  FROM [Dim-BMI]\
  WHERE
  Indicator > 2\
  ORDER BY \
      H
      ei
      gh
      t,\
      W
      ei
      gh
      t;"
PersonFrame1=pd.read_sql_query(sSQL, conn1)
#########################################################
######
DimPerson=PersonFrame1
DimPersonIndex=DimPerson.set_index(['Indicator'],inplace=False)
#########################################################
######
# sTable = 'Dim-BMI-Vertical'
print('\n#################################')
print('Storing
:',sDatabaseName,'\n Table:',sTable)
print('\n############################
#####')
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
#################################################################
######print('#################################')
sTable = 'Dim-BMI-Vertical' print('Loading
:',sDatabaseName,' Table:',sTable)
print('############################
```

#####')sSQL="SELECT * FROM
[Dim-BMI-
Vertical];"
PersonFrame2=pd.read_sql_query(sSQL,
conn2)
##
######print('################################') print('Full Data
Set (Rows):', PersonFrame0.shape[0]) print('Full
Data Set(Columns):', PersonFrame0.shape[1])
print('################################')
print('Horizontal Data Set (Rows):',
PersonFrame2.shape[0])print('Horizontal Data Set
(Columns):', PersonFrame2.shape[1])
print('################################')
Output:

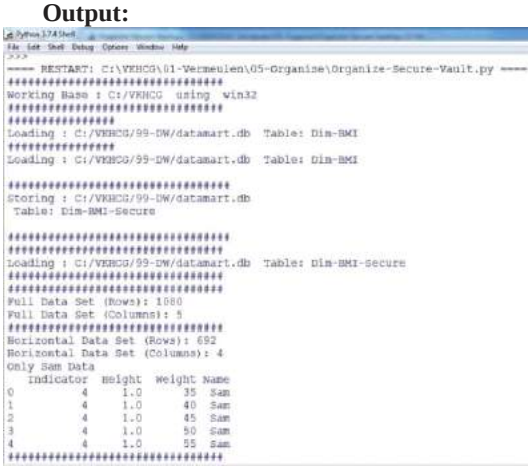


Secure Vault Style
C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Secure-Vault.py import sys import os import
pandas as pdimport sqlite3 as sq
##
######Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
##
##
Company='01-
Vermeulen'
##
######
sDataWarehouseDir=Base + '/99-
DW' if not
os.path.exists(sDataWarehouseDi
r):
os.makedirs(sDataWarehouseDir
)
##
sDatabaseName=sDataWarehouseDir +
'/datawarehouse.db'conn1 =
sq.connect(sDatabaseName)
##

```
sDatabaseName=sDataWarehouseDir +
'/datamart.db'conn2 = sq.connect(sDatabaseName)
#################################################################
# print('################')  sTable = 'Dim-BMI' print('Loading
:',sDatabaseName,' Table:',sTable) sSQL="SELECT * FROM [Dim-
BMI];" PersonFrame0=pd.read_sql_query(sSQL, conn1)
#################################################################
######
# print('################')  sTable = 'Dim-BMI' print('Loading
:',sDatabaseName,' Table:',sTable)

sSQL="SELECT \
      Height,\
      Weight,\
      Indicator,
      \ CASE
      Indicator\
      WHEN 1 THEN 'Pip'\
      WHEN 2 THEN
      'Norman'\WHEN 3
      THEN 'Grant'\
ELSE 'Sam'\


      END AS Name\

  WHERE
  Indicator > 2\
  ORDER BY \
      H
      ei
      gh
      t,\
      W
      ei
      gh
      t;"
PersonFrame1=pd.read_sql_query(sSQL, conn1)
#################################################################
######
DimPerson=PersonFrame1
DimPersonIndex=DimPerson.set_index(['Indicator'],inplace=False)
#################################################################
######
# sTable = 'Dim-BMI-Secure'
print('\n#################################')
print('Storing
:',sDatabaseName,'\n Table:',sTable)
print('\n############################
#####')
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
#################################################################
######print('#################################')
sTable = 'Dim-BMI-Secure' print('Loading
:',sDatabaseName,' Table:',sTable)
print('##########################
#####')
```

```
sSQL="SELECT * FROM [Dim-BMI-Secure] WHERE Name = 'Sam';"
PersonFrame2=pd.read_sql_query(sSQL, conn2)
#################################################################
######print('################################') print('Full Data
Set (Rows):', PersonFrame0.shape[0]) print('Full
Data Set(Columns):', PersonFrame0.shape[1])
print('################################')
print('Horizontal Data Set (Rows):',
PersonFrame2.shape[0])print('Horizontal Data Set
(Columns):', PersonFrame2.shape[1]) print('Only Sam
Data') print(PersonFrame2.head())
print('################################')
#####################################################################
```

Output:



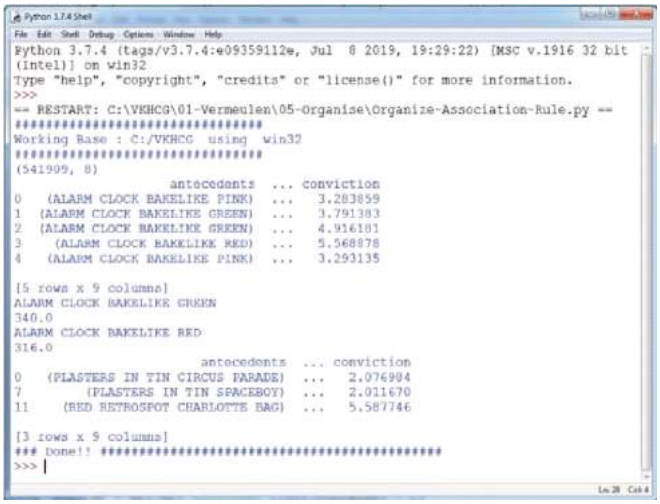
Association Rule Mining

C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Association- Rule.py import sys import os import pandas as pd from mlxtend.frequent_patterns import apriori from mlxtend.frequent_patternsimport association_rules

```
#########################################################
##########
Base='C:/VKHCG'
print('############################
#####')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#############################################################
######
Company='01-Vermeulen'
InputFileName='Online-Retail-
Billboard.xlsx'EDSAssessDir='02-
Assess/01-EDS'
InputAssessDir=EDSAssessDir + '/02-
Python'
#####################################################################
sFileAssessDir=Base + '/' + Company + '/' +
InputAssessDirif not os.path.exists(sFileAssessDir):
os.makedirs(sFileAssessDir)
#####################################################################
```

```
sFileName=Base+'/'+ Company + '/00-RawData/' + InputFileName
#############################################################
######
df =
pd.read_excel(sFileNam
e)print(df.shape)
#####################################################################
df['Description'] = df['Description'].str.strip()
df.dropna(axis=0, subset=['InvoiceNo'],
inplace=True)df['InvoiceNo'] =
df['InvoiceNo'].astype('str')
df = df[~df['InvoiceNo'].str.contains('C')]

basket = (df[df['Country'] =="France"]
          .groupby(['InvoiceNo', 'Description'])['Quantity']
          .sum().unstack().reset_index().fillna(0)
          .set_index('InvoiceNo'))
############################################################
######
# def encode_units(x):     if x <= 0:          return 0     if x >= 1:          return
1
############################################################
######
basket_sets = basket.applymap(encode_units)
basket_sets.drop('POSTAGE',inplace=True, axis=1)
frequent_itemsets = apriori(basket_sets, min_support=0.07,
use_colnames=True) rules = association_rules(frequent_itemsets,
metric="lift", min_threshold=1) print(rules.head()) rules[ (rules['lift']
>= 6) &
       (rules['confidence'] >= 0.8) ]
############################################################
######sProduct1='ALARM CLOCK BAKELIKE GREEN'
print(sProduct1)
print(basket[sProduct1].
sum())
sProduct2='ALARM CLOCK BAKELIKE RED'
print(sProduct2)
print(basket[sProduct2].
sum())
#####################################################################
basket2 = (df[df['Country'] =="Germany"]
.groupby(['InvoiceNo', 'Description'])['Quantity']
          .sum().unstack().reset_index().fillna(0)
          .set_index('InvoiceNo'))

basket_sets2 = basket2.applymap(encode_units)
basket_sets2.drop('POSTAGE', inplace=True, axis=1)
frequent_itemsets2 = apriori(basket_sets2, min_support=0.05,
use_colnames=True)rules2 = association_rules(frequent_itemsets2,
metric="lift", min_threshold=1)

############################################################
#####print('### Done!!
###############################################')
############################################################
######
```

Output:



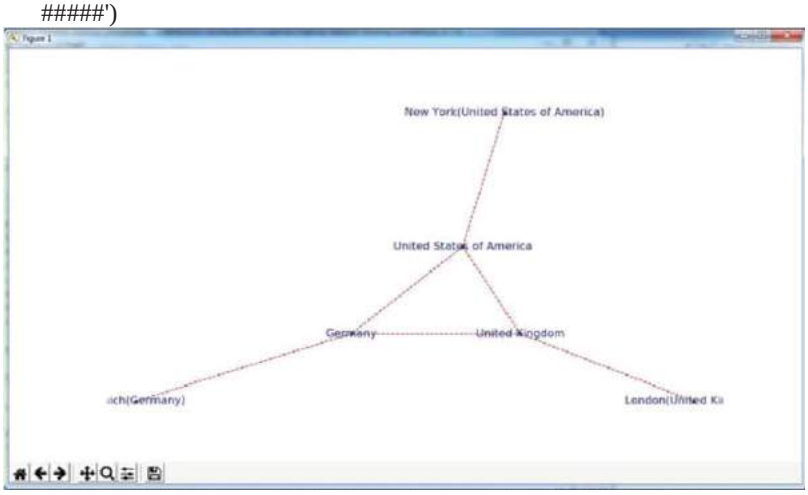
Create a Network Routing Diagram

I will guide you through a possible solution for the requirement, by constructing an island- style Organize superstep that uses a graph data model to reduce the records and the columnson the data set.

C:\VKHCG\01-Vermeulen\05-Organise\ Organise-Network-Routing-Company.py import sys import os import pandas as pd import networkx as nx importmatplotlib.pyplot as plt

```
##################################################################
#
pd.options.mode.chained_assignment = None
################################################################
######Base='C:/VKHCG'
################################################################
######print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################## sInputFileName='02-
Assess/01-EDS/02-Python/Assess-Network-Routing-Company.csv'
################################################################
######
sOutputFileName1='05-Organise/01-EDS/02-Python/Organise-Network-Routing-
Company.gml' sOutputFileName2='05-Organise/01-EDS/02-Python/Organise-Network-
Routing-Company.png'Company='01-Vermeulen'
################################################################
################################################################
### Import Country Data
################################################################
######
sFileName=Base + '/' + Company + '/' +
sInputFileName
print('##################################')
print('Loading :',sFileName)

CompanyData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin- 1") print('##################################')
```

```
print(CompanyData.head()) print(CompanyData.shape) G=nx.Graph() for i in
range(CompanyData.shape[0]):                                                    for jin range(CompanyData.shape[0]):
      Node0=CompanyData['Company_Country_Name'][i]
Node1=CompanyData['Company_Country_Name'][j]
if Node0 != Node1:
         G.add_edge(Node0,Node1)

for i in range(CompanyData.shape[0]):
   Node0=CompanyData['Company_Country_Name'][i]
   Node1=CompanyData['Company_Place_Name'][i] + '('+
CompanyData['Company_Country_Name'][i] + ')'if Node0 != Node1:
      G.add_edge(Node0,Node1)

print('Nodes:', G.number_of_nodes())
print('Edges:',G.number_of_edges())
                                  sFileName=Base +
'/' + Company + '/' + sOutputFileName1
print('################################'
)
print('Storing :',sFileName)
print('############################
#####')
nx.write_gml(G, sFileName)
                                       sFileName=Bas
e + '/' +Company + '/' + sOutputFileName2
print('################################')
print('Storing Graph Image:',sFileName)
print('############################
#####')
plt.figure(figsize=(15, 15)) pos=nx.spectral_layout(G,dim=2)
nx.draw_networkx_nodes(G,pos, node_color='k', node_size=10,
alpha=0.8) nx.draw_networkx_edges(G, pos,edge_color='r',
arrows=False, style='dashed')
nx.draw_networkx_labels(G,pos,font_size=12,font_family='sans-
serif',font_color='b') plt.axis('off') plt.savefig(sFileName,dpi=600)
plt.show()
print('############################
#####')print('### Done!!
####################')
print('############################
#####')
```



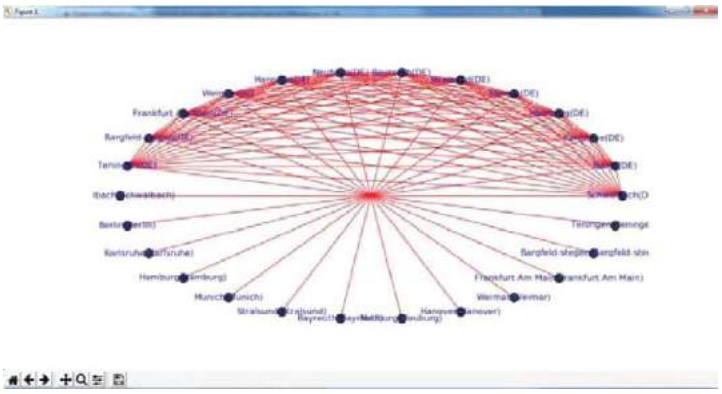
Picking Content for Billboards

C:\VKHCG\02-Krennwallner\05-Organise\ Organise-billboards.py

```
print('################################')
############################################################
######
# import sys import os import pandas as pd import networkx as nx import
matplotlib.pyplot as plt import numpy as np
############################################################
######
pd.options.mode.chained_assignment = None
############################################################
######Base='C:/VKHCG'
############################################################
######print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
############################################################
######
sInputFileName='02-Assess/01-EDS/02-Python/Assess-DE-Billboard-Visitor.csv'
#################################################################
sOutputFileName1='05-Organise/01-EDS/02-Python/Organise-
Billboards.gml' sOutputFileName2='05-Organise/01-EDS/02-
Python/Organise-Billboards.png' Company='02-Krennwallner'
############################################################
######
############################################################
######
### Import Company Data
############################################################
######
sFileName=Base + '/' + Company + '/' +
sInputFileName
print('################################')
print('Loading :',sFileName)
print('#########################
#####')
BillboardDataRaw=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1")print('################################')
#################################################################
# print(BillboardDataRaw.head()) print(BillboardDataRaw.shape)
BillboardData=BillboardDataRaw
sSample=list(np.random.choice(BillboardData.shape[0],20))
############################################################
######
G=nx.Grap
h() fori in
sSample:
for j in sSample:
      Node0=BillboardData['BillboardPlaceName'][i] + '('+ BillboardData['BillboardCountry'][i] + ')'
Node1=BillboardData['BillboardPlaceName'][j] + '('+ BillboardData['BillboardCountry'][i] + ')'
if Node0 != Node1:
         G.add_edge(Node0,Node1)
```

```
for i in sSample:
   Node0=BillboardData['BillboardPlaceName'][i]                    +                    '('+
BillboardData['VisitorPlaceName'][i]                              +                     ')'
Node1=BillboardData['BillboardPlaceName'][i] + '('+ BillboardData['VisitorCountry'][i]
+ ')'  if Node0 != Node1:
       G.add_edge(Node0,Node1)

print('Nodes:',
G.number_of_nodes())
print('Edges:',
G.number_of_edges())
#####################################################################
sFileName=Base + '/02-Krennwallner/' +
sOutputFileName1
print('################################')
print('Storing

:',sFileName)

nx.write_gml(G,

sFileName)




#####################################################################
sFileName=Base + '/02-Krennwallner/' +
sOutputFileName2
print('################################')
print('Storing Graph Image:',sFileName)
print('############################
#####')
plt.figure(figsize=(15, 15)) pos=nx.circular_layout(G,dim=2)
nx.draw_networkx_nodes(G,pos, node_color='k', node_size=150,
alpha=0.8) nx.draw_networkx_edges(G, pos,edge_color='r',
arrows=False,style='solid')
nx.draw_networkx_labels(G,pos,font_size=12,font_family='sans-
serif',font_color='b') plt.axis('off') plt.savefig(sFileName,dpi=600)
plt.show()
#############################################################
######print('################################')
print('### Done!! ####################')
print('################################')
#############################################################
######
```

Output :



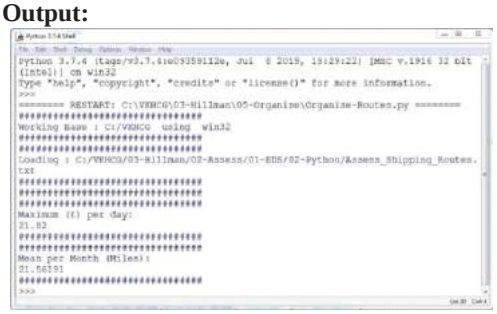
Create a Delivery Route

C:\VKHCG\03-Hillman\05-Organise\Organise-Routes.py import sys import os import pandas as pd

```
##############################################################
######Base='C:/VKHCG'
##############################################################
######print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
##############################################################
######
sInputFileName='02-Assess/01-EDS/02-
Python/Assess_Shipping_Routes.txt'
##############################################################
######
sOutputFileName='05-Organise/01-EDS/02-Python/Organise-
Routes.csv' Company='03-Hillman'
##############################################################
######
##############################################################
######
### Import Routes Data
##############################################################
######
sFileName=Base + '/' + Company + '/' + sInputFileName
print('################################') print('Loading
:',sFileName)print('################################')


print('################################')
RouteDataRaw=pd.read_csv(sFileName,header=0,low_memory=False, sep='|', encoding="latin-1")
print('################################')
#################################################################
RouteStart=RouteDataRaw[RouteDataRaw['StartAt']=='WH-KA13']
##############################################################
######
RouteDistance=RouteStart[RouteStart['Cost']=='DistanceMiles']
RouteDistance=RouteDistance.sort_values(by=['Measure'],
ascending=False)
##############################################################
######
```

```
RouteMax=RouteStart["Measure"].max()
RouteMaxCost=round((((RouteMax/1000)*1.5*2)),2)
print('################################')
print('Maximum (£) per day:')
print(RouteMaxCost)
print('############################
#####')
#####################################################################
RouteMean=RouteStart["Measure"].mean()
RouteMeanMonth=round((((RouteMean/1000)*2*30)),6)
print('################################')
print('Mean per Month (Miles):')
print(RouteMeanMonth)
print('############################
#####')
```

Output:



Clark Ltd

Our financial services company has been tasked to investigate the options to convert1 million pounds sterling into extra income. Mr. Clark Junior suggests using the simplevariance in the daily rate between the British pound sterling and the US dollar, togenerate extra income from trading. Your chief financial officer wants to know if thisisfeasible?

Simple Forex Trading Planner

Your challenge is to take 1 million US dollars or just over six hunderd thou sand pounds sterling and, by simply converting it between pounds sterling and US dollars,achieve a profit. Are you up to this challenge?

The Program will help you how to model this problem and achieve a positive outcome. Theforex data has been collected on a daily basis by Clark's accounting department, from previous overseas transactions.

C:\VKHCG\04-Clark\05-Organise\Organise-Forex.py import sys import os import pandas as pd import sqlite3as sq import re

```
############################################################
######Base='C:/VKHCG'
############################################################
######
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
############################################################
######
```

```
sInputFileName='03-Process/01-EDS/02-
Python/Process_ExchangeRates.csv'
##############################################################
######
sOutputFileName='05-Organise/01-EDS/02-Python/Organise-
Forex.csv' Company='04-Clark'
##############################################################
######
# sDatabaseName=Base + '/' + Company + '/05-
Organise/SQLite/clark.db'conn = sq.connect(sDatabaseName)
#conn = sq.connect(':memory:')
##############################################################
######
##############################################################
######
### Import Forex Data
##############################################################
######
sFileName=Base + '/' + Company + '/' +
sInputFileName
print('#################################')
print('Loading :',sFileName)
print('############################
#####')
ForexDataRaw=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
print('#################################')
#####################################################################
ForexDataRaw.index.names      =
                              ['RowID'
]sTable='Forex_All'
                              print('St
oring
:',sDatabaseName,' Table:',sTable)
ForexDataRaw.to_sql(sTable, conn,
if_exists="replace")
#####################################################################
sSQL="SELECT 1 as Bag\
      , CAST(min(Date) AS VARCHAR(10)) as Date \
      ,CAST(1000000.0000000 as NUMERIC(12,4)) as Money \
      ,'USD' as
      Currency \
      FROM
      Forex_All \
      ;"
sSQL=re.sub("\s\s+", " ", sSQL)
nMoney=pd.read_sql_query(sSQL
, conn)

#####################################################################
nMoney.index.names =
['RowID']
sTable='MoneyData'
print('Storing :',sDatabaseName,'
Table:',sTable) nMoney.to_sql(sTable,
conn, if_exists="replace")
#####################################################################
```

```
# sTable='TransactionData' print('Storing :',sDatabaseName,'
Table:',sTable) nMoney.to_sql(sTable, conn, if_exists='replace')
############################################################
######
ForexDay=pd.read_sql_query("SELECT Date FROM Forex_All GROUP BY
Date;", conn)
####################################################################
t=0
for i in range(ForexDay.shape[0]):     sDay1=ForexDay['Date'][i]
                                       sDay=str(sDay1)sSQL='\
   SELECT M.Bag as Bag, \
        F.Date as Date, \           round(M.Money
* F.Rate,6) AS Money, \
        F.CodeIn AS
        PCurrency, \
        F.CodeOut AS
        Currency \



print('################################')
   FROM MoneyData
   AS M \JOIN \
   ( \
      SELECT  CodeIn, CodeOut, Date, Rate  FROM  Forex_All
     WHERECodeIn = "USD" AND CodeOut = "GBP" \
      UNION \
      SELECT CodeOut AS CodeIn, CodeIn AS CodeOut, Date, (1/Rate) AS Rate FROM \
      Forex_All WHERE  CodeIn = "USD" AND CodeOut = "GBP" \
   ) AS F \
   ON \
   M.Currency=F.C
   odeIn \AND \
   F.Date ='" +sDay + "';'
   sSQL=re.sub("\s\s+", " ", sSQL)

   ForexDayRate=pd.read_sql_query(sSQL,
conn)for j in
range(ForexDayRate.shape[0]):
sBag=str(ForexDayRate['Bag'][j])
nMoney=str(round(ForexDayRate['Money']
[j],2))
sCodeIn=ForexDayRate['PCurrency'][j]
      sCodeOut=ForexDayRate['Currency'][j]

   sSQL='UPDATE MoneyData SET Date= '" + sDay + "', '     sSQL=
sSQL + 'Money = ' + nMoney + ', Currency='" + sCodeOut + ""
                                                    sSQL= sSQL
+ ' WHERE Bag=' + sBag + ' AND Currency='" + sCodeIn + "';'

   sSQL=re.sub("\s\s+", " ", sSQL)     cur =conn.cursor()        cur.execute(sSQL) conn.commit()                t+=1       print('Trade :', t, sD

   sSQL=' \
   INSERT INTO TransactionData ( \
                        Ro
                        wI
                        D, \
```

```
                    Bag
                    , \
                    Dat
                    e, \
                    Mo
                    ney
                    , \
                    Cur
                    ren
                    cy \
                ) \
  SELECT ' + str(t) + ' AS RowID, \
    Bag
    , \
    Dat
    e, \
    Mo
    ney
    , \
    Cur
    ren
    cy \
  FROM    MoneyData          ;'sSQL=re.sub("\s\s+", " ", sSQL)cur  =          conn.cursor()cur.execute(sSQL)
conn.commit()
############################################################
######
sSQL="SELECT RowID, Bag, Date, Money, Currency FROM TransactionData ORDER BY
RowID;"sSQL=re.sub("\s\s+", " ", sSQL)
TransactionData=pd.read_sql_query(sSQL, conn)
OutputFile=Base + '/' + Company + '/' +
sOutputFileName
TransactionData.to_csv(OutputFile, index = False)

#####################################################################
```

Output:

Save the Assess-Forex.py file, then compile and execute with your Python compiler.This will produce a set of demonstrated values onscreen.

Report Superstep

Practical 9

Generating Data

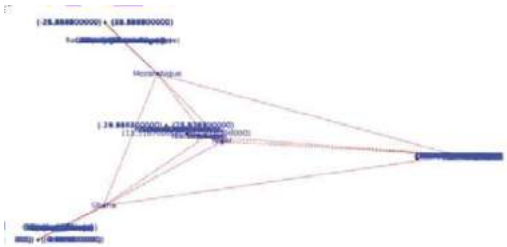
The Report superstep is the step in the ecosystem that enhances the data science findings with the art of storytelling and data visualization. You can perform the best data science, but if you cannot execute a respectable and trustworthy Report step by turning your data science into actionable business insights, you have achieved no advantage for your business.

Vermeulen PLC

Vermeulen requires a map of all their customers' data links. Can you provide a report todeliver this? I will guide you through an example that delivers this requirement.**C:\VKHCG\01-Vermeulen\06-Report\Raport-Network-Routing-Customer.py**

```
################################################################
## import sys import os import pandas as pd import networkx as nx import
matplotlib.pyplotas plt
################################################################
pd.options.mode.chained_assignment = None
################################################################
######
if sys.platform == 'linux':
   Base=os.path.expanduser('~') +
'VKHCG'else:
   Base='C:/VKHCG'
################################################################
######print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
######
sInputFileName='02-Assess/01-EDS/02-Python/Assess-Network-Routing-Customer.csv'
################################################################
sOutputFileName1='06-Report/01-EDS/02-Python/Report-Network-Routing-
Customer.gml' sOutputFileName2='06-Report/01-EDS/02-Python/Report-Network-
Routing-Customer.png'Company='01-Vermeulen'
################################################################
################################################################
### Import Country Data
################################################################
######
sFileName=Base + '/' + Company + '/' +
sInputFileName
print('################################')
print('Loading :',sFileName)
print('############################
#####')
CustomerDataRaw=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1")
CustomerData=CustomerDataRaw.head(100)
print('Loaded
Country:',CustomerData.columns.values)
print('################################')
################################################################
# print(CustomerData.head()) print(CustomerData.shape)
################################################################
######
G=nx.Graph() for i in
range(CustomerData.shape[0]):     for jin range(CustomerData.shape[0]):
      Node0=CustomerData['Customer_Country_Name'][i]
Node1=CustomerData['Customer_Country_Name'][j]
if Node0 != Node1:

         G.add_edge(Node0,Node1)
```

```
for i in range(CustomerData.shape[0]):
   Node0=CustomerData['Customer_Country_Name'][i]
   Node1=CustomerData['Customer_Place_Name'][i] + '('+
   CustomerData['Customer_Country_Name'][i] + ')'Node2='('+
   "{:.9f}".format(CustomerData['Customer_Latitude'][i]) +
')\    ('+
"{:.9f}".format(CustomerData['Customer_Longitude'][i]) + ')'if
Node0 != Node1:
      G.add_edge(Node0,
Node1)    if Node1 !=
Node2:
      G.add_edge(Node1,Node2)

print('Nodes:',
G.number_of_nodes())
print('Edges:',
G.number_of_edges())
#####################################################################
sFileName=Base + '/' + Company + '/' + sOutputFileName1
print('################################')
print('Storing :',sFileName)
print('############################
#####')
nx.write_gml(G, sFileName)
############################################################
######
sFileName=Base + '/' + Company + '/' + sOutputFileName2
print('################################')
print('Storing Graph Image:',sFileName)
print('############################
#####')

plt.figure(figsize=(25, 25))
pos=nx.spectral_layout(G,dim=2)
nx.draw_networkx_nodes(G,pos, node_color='k', node_size=10, alpha=0.8)
nx.draw_networkx_edges(G, pos,edge_color='r', arrows=False, style='dashed')
nx.draw_networkx_labels(G,pos,font_size=12,font_family='sans-
serif',font_color='b') plt.axis('off')
plt.savefig(sFileName,dpi=600)
plt.show()
print('############################
####')print('### Done!!
####################')
print('############################
#####')
```



Krennwallner AG

The Krennwallner marketing department wants to deploy the locations of the billboardsonto the company web server. Can you prepare three versions of the locations' web pages?

- Locations clustered into bubbles when you zoom out
- Locations as pins
- Locations as heat map

Picking Content for

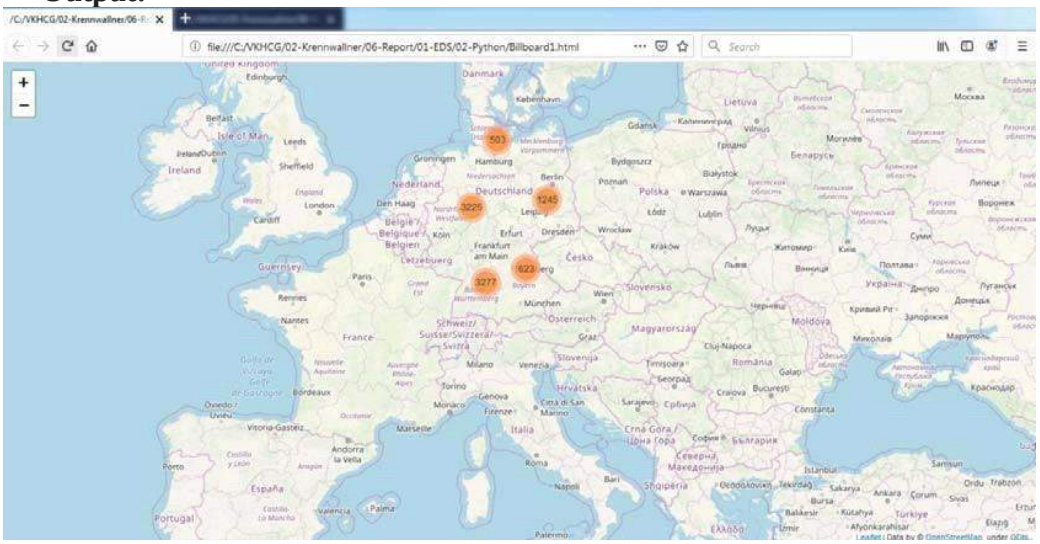
Billboards

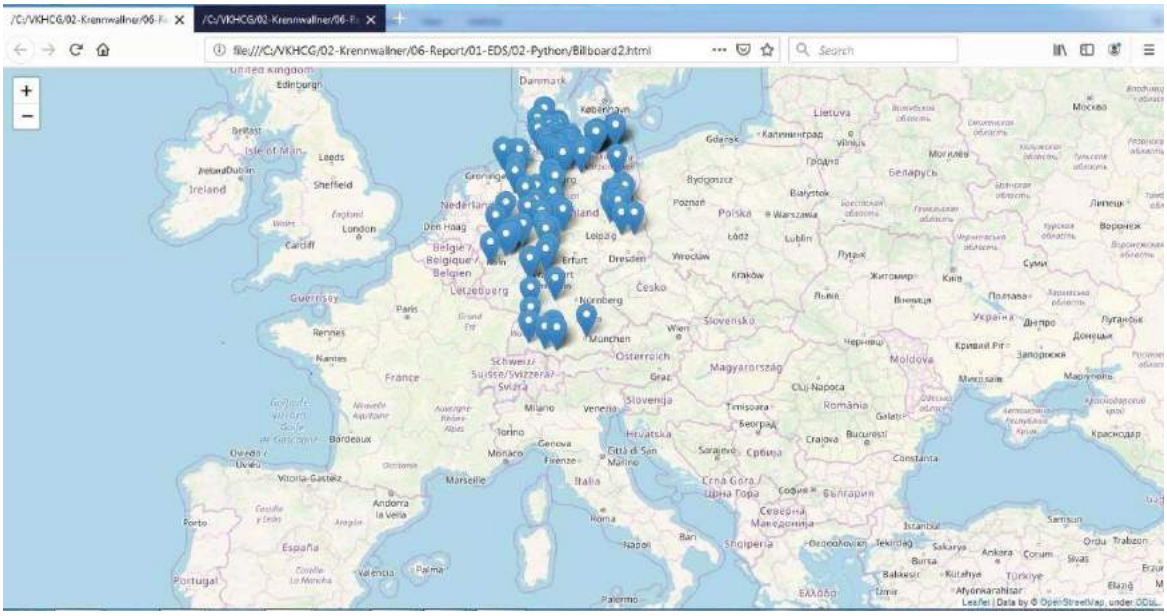
C:\VKHCG\02-Krennwallner\06-Report\Report_Billboard.py

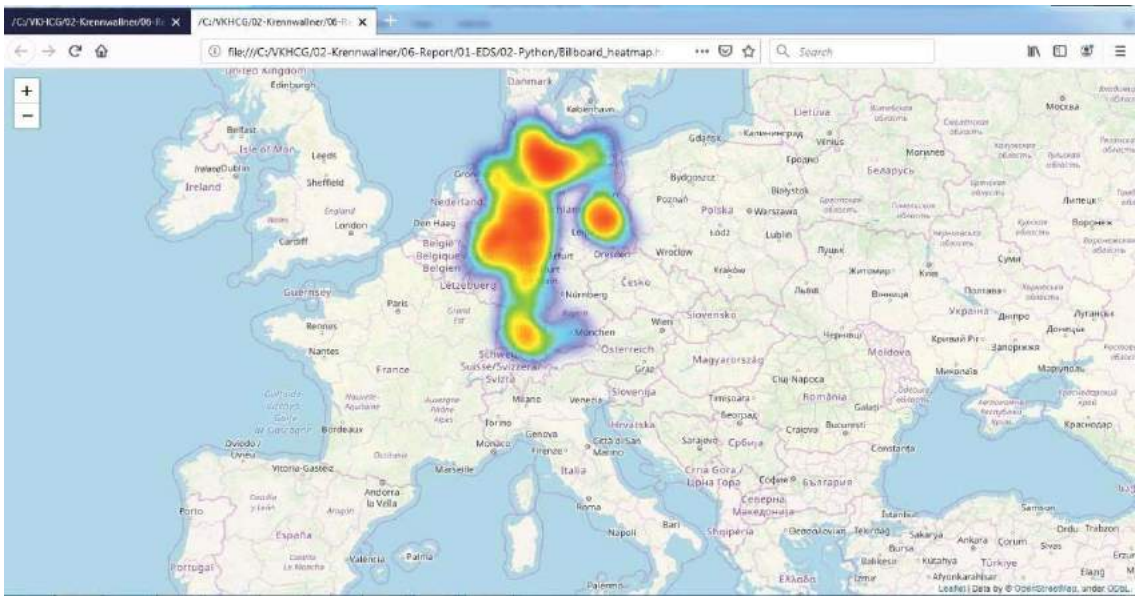
```
import sys import os import pandas aspd
from folium.plugins import FastMarkerCluster, HeatMap from folium import Marker, Map importwebbrowser
################################################################
######Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
######
sFileName=Base+'/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_DE_Billboard_Locations.csv' df = pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1") df.fillna(value=0, inplace=True) print(df.shape)
################################################################
# t=0 for i in range(df.shape[0]):     try:sLongitude=df["Longitude"][i] sLongitude=float(sLongitude)     exceptException:
        sLongitude=float(0.0)
try:
        sLatitude=df["Latitude"][i] sLatitude=float(sLatitude)     exceptException:
        sLatitude=float(0.0)
try:
        sDescription=df["Place_Name"][i] + ' (' + df["Country"][i]+')'
except Exception:
        sDescription='VKHC
        G'                                  if sLongitude != 0.0 and sLatitude != 0.0:
        DataClusterList=list([sLatitude, sLongitude])
        DataPointList=list([sLatitude, sLongitude, sDescription])        t+=1
                            if t==1:
            DataCluster=[DataClust
            erList] DataPoint=[DataPointList]        else:
            DataCluster.append(DataClust
            erList)
```

```
DataPoint.append(DataPointList)
data=DataCluster
pins=pd.DataFrame(DataPoint)
pins.columns = [ 'Latitude','Longitude','Description']
############################################################
######
stops_map1 = Map(location=[48.1459806, 11.4985484], zoom_start=5) marker_cluster
= FastMarkerCluster(data).add_to(stops_map1)
sFileNameHtml=Base+'/02-Krennwallner/06-Report/01-EDS/02-
Python/Billboard1.html' stops_map1.save(sFileNameHtml)
webbrowser.open('file://' + os.path.realpath(sFileNameHtml))
############################################################
######
# stops_map2 = Map(location=[48.1459806, 11.4985484],
zoom_start=5) forname, row in pins.iloc[:100].iterrows():
    Marker([row["Latitude"],row["Longitude"]],
popup=row["Description"]).add_to(stops_map2)
sFileNameHtml=Base+'/02-Krennwallner/06-Report/01-EDS/02-
Python/Billboard2.html' stops_map2.save(sFileNameHtml)
webbrowser.open('file://' + os.path.realpath(sFileNameHtml))

#####################################################################
stops_heatmap = Map(location=[48.1459806, 11.4985484], zoom_start=5)
stops_heatmap.add_child(HeatMap([[row["Latitude"], row["Longitude"]] for name,
row in pins.iloc[:100].iterrows()])) sFileNameHtml=Base+'/02-Krennwallner/06-
Report/01-EDS/02-Python/Billboard_heatmap.html'
stops_heatmap.save(sFileNameHtml) webbrowser.open('file://' +
os.path.realpath(sFileNameHtml))
#####################################################################
print('### Done!!
##############################################')
############################################################
######
```

Output:







Hillman Ltd

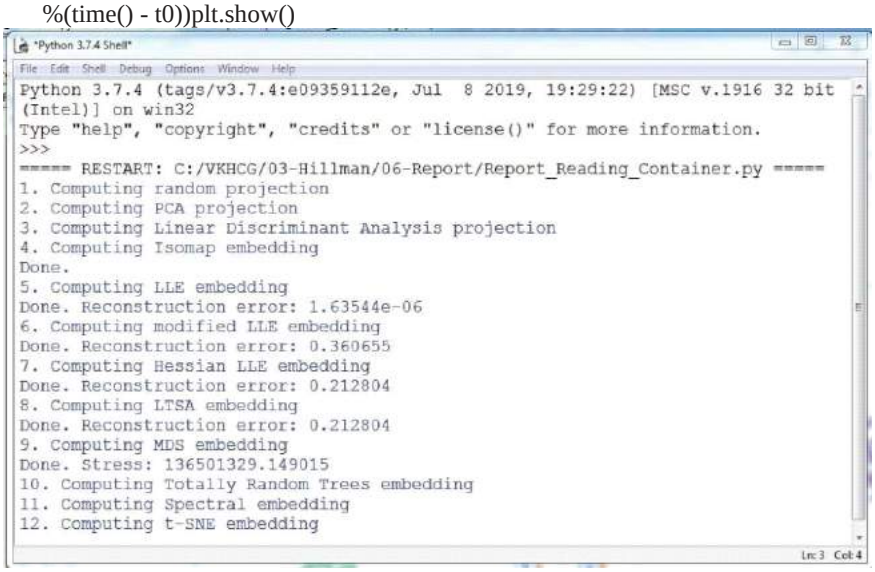
Dr. Hillman Sr. has just installed a camera system that enables the company to capture video and, therefore, indirectly, images of all containers that enter or leave the warehouse. Can youconvert the number on the side of the containers into digits?

Reading the Containers

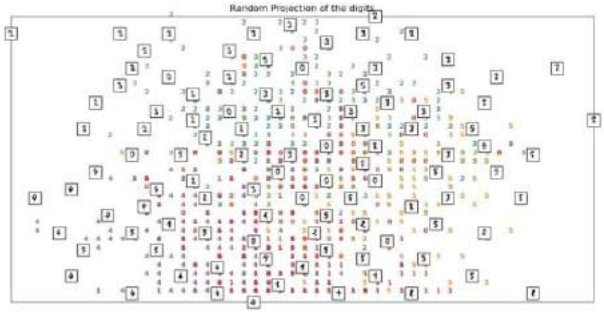
C:\VKHCG\03-Hillman\06-Report\ Report_Reading_Container.py from time import time import numpy as np import matplotlib.pyplot as plt from matplotlib import offsetbox from sklearn import (manifold, datasets, decomposition, ensemble, discriminant_analysis, random_projection) digits = datasets.load_digits(n_class=6) X = digits.data y = digits.target n_samples, n_features = X.shape n_neighbors
= 30 def plot_embedding(X, title=None): x_min, x_max = np.min(X, 0), np.max(X, 0) X = (X - x_min)

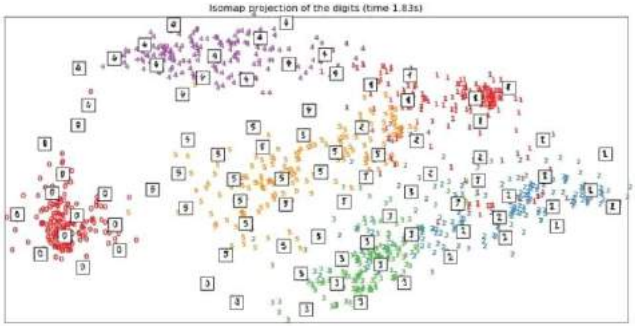
```
/ (x_max - x_min) plt.figure(figsize=(10, 10)) ax = plt.subplot(111) for i in range(X.shape[0]):
        plt.text(X[i, 0], X[i, 1], str(digits.target[i]),
color=plt.cm.Set1(y[i] / 10.),
                 fontdict={'weight':'bold', 'size':
9})                  if hasattr(offsetbox,
'AnnotationBbox'):# only print thumbnails with
matplotlib > 1.0 shown_images = np.array([[1.,
1.]]) # just something big for i in
range(digits.data.shape[0]):
        dist = np.sum((X[i] - shown_images)
** 2, 1)if np.min(dist) < 4e-3:
            # don't show points that are too close
continue
        shown_images = np.r_[shown_images,
        [X[i]]]imagebox =
offsetbox.AnnotationBbox(offsetbox.OffsetImage(digits.images[i],
cmap=plt.cm.gray_r),X[i])            ax.add_artist(imagebox)
                    plt.xticks([]),plt.yticks([])  if title is not None:
                    plt.title(title)
n_img_per_row = 20 img = np.zeros((10 * n_img_per_row, 10 *
n_img_per_row)) for i in range(n_img_per_row):     ix = 10 * i + 1     for jin range(n_img_per_row):              iy = 10 * j + 1

plt.xticks([]) plt.yticks([]) plt.title('A selection from the 64-
dimensionaldigits dataset')
print("Computing random projection") rp =
random_projection.SparseRandomProjection(n_components=2, random_state=42)
X_projected = rp.fit_transform(X)
plot_embedding(X_projected, "Random Projection of the digits")
print("Computing PCA projection")
t0 = time()
X_pca = decomposition.TruncatedSVD(n_components=2).fit_transform(X)
plot_embedding(X_pca,"Principal Components projection of the digits (time %.2fs)"
%(time() - t0))print("Computing Linear Discriminant Analysis projection")
X2 = X.copy()
X2.flat[::X.shape[1] + 1] += 0.01 # Make X
invertiblet0 = time()
X_lda =
discriminant_analysis.LinearDiscriminantAnalysis(n_components=2).fit_transform(X2, y)
plot_embedding(X_lda,"Linear Discriminant projection of the digits (time %.2fs)" %(time()
- t0)) print("Computing Isomap embedding")
t0 = time()
X_iso = manifold.Isomap(n_neighbors, n_components=2).fit_transform(X)
print("Done.")plot_embedding(X_iso,"Isomap projection of the digits (time %.2fs)"
%(time() - t0)) print("Computing LLE embedding") clf =
manifold.LocallyLinearEmbedding(n_neighbors,
n_components=2,method='standard') t0
= time()
X_lle = clf.fit_transform(X)
print("Done. Reconstruction error: %g" % clf.reconstruction_error_)
plot_embedding(X_lle,"Locally Linear Embedding of the digits (time %.2fs)"
%(time() - t0)) print("Computing modified LLE embedding") clf =
manifold.LocallyLinearEmbedding(n_neighbors, n_components=2,
method='modified') t0
= time()
X_mlle = clf.fit_transform(X)
```

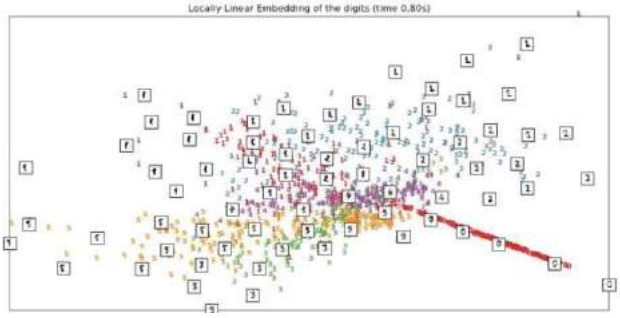
```
print("Done. Reconstruction error: %g" % clf.reconstruction_error_)
plot_embedding(X_mlle,"Modified Locally Linear Embedding of the digits (time %.2fs)"
%(time() -t0)) print("Computing Hessian LLE embedding") clf =
manifold.LocallyLinearEmbedding(n_neighbors, n_components=2,method='hessian') t0 =
time() X_hlle = clf.fit_transform(X)
print("Done. Reconstruction error: %g" % clf.reconstruction_error_)
plot_embedding(X_hlle,"Hessian Locally Linear Embedding of the digits (time %.2fs)"
%(time() -t0)) print("Computing LTSA embedding") clf =
manifold.LocallyLinearEmbedding(n_neighbors, n_components=2,method='ltsa') t0 =
time()
X_ltsa = clf.fit_transform(X)
print("Done. Reconstruction error: %g" % clf.reconstruction_error_)
plot_embedding(X_ltsa,"Local Tangent Space Alignment of the digits (time %.2fs)"
%(time() -t0)) print("Computing MDS embedding") clf =
manifold.MDS(n_components=2, n_init=1, max_iter=100) t0 = time()
X_mds = clf.fit_transform(X) print("Done. Stress: %f" % clf.stress_)
plot_embedding(X_mds,"MDS embedding of the digits (time %.2fs)"
%(time() -t0)) print("Computing Totally Random Trees embedding")
hasher = ensemble.RandomTreesEmbedding(n_estimators=200,
random_state=0, max_depth=5) t0 = time()
X_transformed = hasher.fit_transform(X)
pca =
decomposition.TruncatedSVD(n_component
s=2) X_reduced =
pca.fit_transform(X_transformed)
plot_embedding(X_reduced,"Random forest embedding of the digits (time %.2fs)"
%(time() -t0)) print("Computing Spectral embedding") embedder =
manifold.SpectralEmbedding(n_components=2, random_state=0,
eigen_solver="arpack")
t0 = time()
X_se = embedder.fit_transform(X)

plot_embedding(X_se,"Spectral embedding of the digits (time %.2fs)"
%(time() - t0)) print("Computing t-SNE embedding") tsne =
manifold.TSNE(n_components=2,init='pca', random_state=0) t0 = time()
X_tsne = tsne.fit_transform(X)
plot_embedding(X_tsne,"t-SNE embedding of the digits (time %.2fs)"
%(time() - t0))plt.show()
```

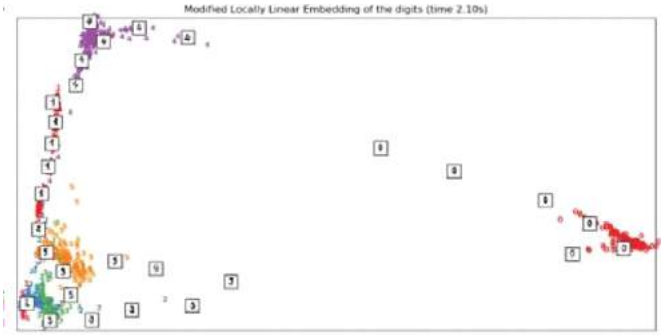


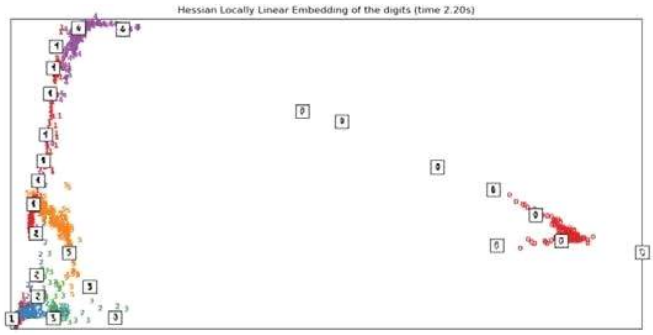
A selection from the 64-dimensional digits dataset

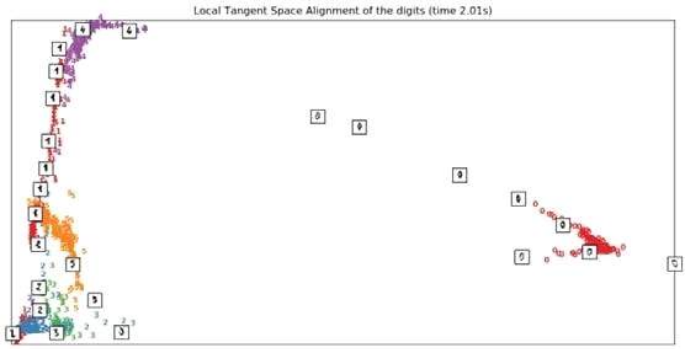












Clark Ltd

The financial company in VKHCG is the Clark accounting firm that VKHCG owns with a 60% stake. Theaccountants are the financial advisers to the group and handle everything to do with the complex work of international accounting.

Financials

The VKHCG companies did well last year, and the teams at Clark must prepare a balance sheet for each company in the group. The companies require a balance sheet for each company, to be produced using thetemplate (Balance-Sheet-Template.xlsx) that can be found in the example directory (..\VKHCG\04- Clark\00RawData).

The Program will guide you through a process that will enable you to merge the data science with preformattedMicrosoft Excel template, to produce a balance sheet for each of the VKHCG companies.

C:\VKHCG\04-Clark\06-Report\Report-Balance-Sheet.py import sys import os import pandas as pd import sqlite3 as sqimport re

```
from openpyxl import load_workbook
##############################################################
######Base='C:/VKHCG'
##############################################################
######print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
##############################################################
######
sInputTemplateName='00-RawData/Balance-Sheet-Template.xlsx'
##############################################################
######
sOutputFileName='06-Report/01-EDS/02-Python/Report-Balance-Sheet' Company='04-Clark'
#####################################################################
# sDatabaseName=Base + '/' + Company + '/06-Report/SQLite/clark.db' conn
=
sq.connect(sDatabaseNa
me) #conn =
sq.connect(':memory:')
#####################################################################
### Import Balance Sheet Data
##############################################################
######
for y in range(1,13):
   sInputFileName='00-RawData/BalanceSheets' +
str(y).zfill(2) +'.csv'
         sFileName=Base + '/' + Company + '/' +
sInputFileName
print('################################')
         print('Loading
:',sFileName)
   print('############################
   ###')
   ForexDataRaw=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
print('################################')
   ######################################################################
   ForexDataRaw.index.names =
   ['RowID']sTable='BalanceSheets'
                                 print('S
   toring
:',sDatabaseName,' Table:',sTable)     if
      y == 1:print('Load Data')
      ForexDataRaw.to_sql(sTable, conn, if_exists="replace")
else:
      print('Append Data')
      ForexDataRaw.to_sql(sTable, conn, if_exists="append")
##############################################################
######sSQL="SELECT \
         Year, \
```

```
        Quar
        ter, \
        Cou
        ntry,
        \
        Com
        pany
        , \
        CAST(Year AS INT) || 'Q' || CAST(Quarter AS INT) AS
        sDate, \Company || ' (' || Country || ')' AS sCompanyName ,
        \
        CAST(Year AS INT) || 'Q' || CAST(Quarter AS INT) || '-' ||\
        Company || '-' || Country AS sCompanyFile \
    FROM
    BalanceSheets \
    GROUP BY \
        Year,
        \
        Quart
        er, \
        Count
        ry, \
        Comp
        any \
    HAVING Year is not null \
    ;"
sSQL=re.sub("\s\s+", " ", sSQL)
sDatesRaw=pd.read_sql_query(sSQL,
conn)print(sDatesRaw.shape)
sDates=sDatesRaw.head(5)
#####################################################################
## Loop Dates
#############################################################
######
# for i in range(sDates.shape[0]):     sFileName=Base + '/' +
Company + '/' +sInputTemplateName                wb =
load_workbook(sFileName) ws=wb.get_sheet_by_name("Balance-
Sheet")                        sYear=sDates['sDate'][i]
sCompany=sDates['sCompanyName'][i]
sCompanyFile=sDates['sCompanyFile'][i]
  sCompanyFile=re.sub("\s+", "", sCompanyFile)



  ws['D3'] =
  sYear ws['D5']
  = sCompany

  sFields =
        pd.DataFram
        e([
      ['Cash','D16', 1],
      ['Accounts_Receivable','D17', 1],
      ['Doubtful_Accounts','D18', 1],
      ['Inventory','D19', 1],
```

```
            ['Temporary_Investment','D20', 1],
            ['Prepaid_Expenses','D21', 1],
            ['Long_Term_Investments','D24', 1],
            ['Land','D25', 1],
            ['Buildings','D26', 1],
            ['Depreciation_Buildings','D27', -1],
            ['Plant_Equipment','D28', 1],
            ['Depreciation_Plant_Equipment','D29', -1],
            ['Furniture_Fixtures','D30', 1],
            ['Depreciation_Furniture_Fixtures','D31', -1],
            ['Accounts_Payable','H16', 1],
            ['Short_Term_Notes','H17', 1],
            ['Current_Long_Term_Notes','H18', 1],
            ['Interest_Payable','H19', 1],
            ['Taxes_Payable','H20', 1],
            ['Accrued_Payroll','H21', 1],
            ['Mortgage','H24', 1],

            ['Other_Long_Term_Liabilities','H25', 1],
            ['Capital_Stock','H30', 1]
            ]
             )

    nYear=str(int(sDates['Year'][i]))
nQuarter=str(int(sDates['Quarter'][i]
))
sCountry=str(sDates['Country'][i])
    sCompany=str(sDates['Company'][i])

    sFileName=Base + '/' + Company + '/' +
    sOutputFileName + \'-' + sCompanyFile + '.xlsx'

    print(sFileName)
    for j in

        range(sFields.shape[0

        ]):

        sSumField=sFields[0]

        [j]

sCellField=sFields[1][j]
nSumSign=sFields[2][j]

        sSQL="SELECT  \
              Year
              , \
              Quar
              ter, \
              Cou
              ntry,
              \
              Com
```

```
            pany
            , \
            SUM(" + sSumField + ") AS
          nSumTotal \FROM BalanceSheets \
          GROUP BY \
            Yea
            r, \
            Qua
            rter,
            \
            Cou
            ntry
            , \
            Co
            mpa
            ny \
          HAVING \


             Year=" +
          nYear + " \AND
          \
             Quarter=" +
          nQuarter + " \AND \
             Country='" +
          sCountry + "' \AND \
             Company='" + sCompany + "' \
         ;"
       sSQL=re.sub("\s\s+", " ", sSQL)
sSumRaw=pd.read_sql_query(sSQL, conn)
ws[sCellField] = sSumRaw["nSumTotal"][0] *
nSumSignprint('Set cell',sCellField,' to ',
sSumField,'Total')
   wb.save(sFileName)
```

Output:

Graphics

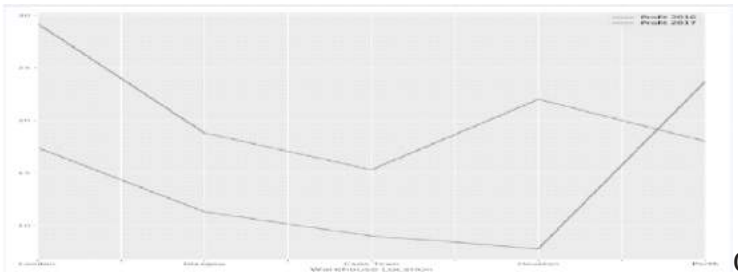
This section will now guide you through a number of visualizations that particularly useful in presenting data tomy customers.

Pie Graph

Double Pie

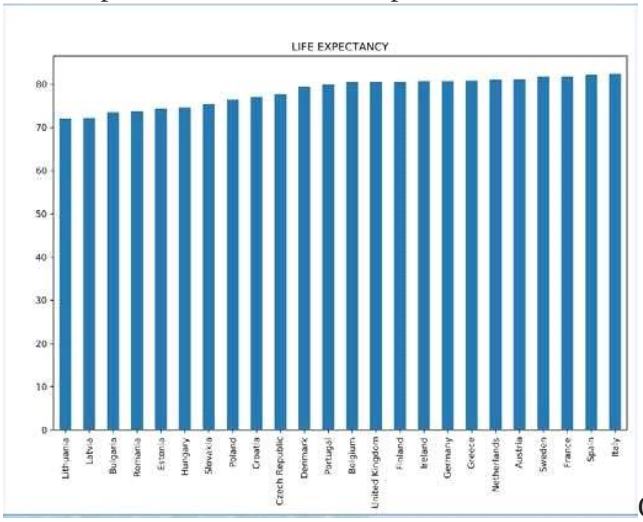
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_A.py

Line Graph



C:/VKHCG/01-Vermeulen/06-Report/Report_Graph_A.py

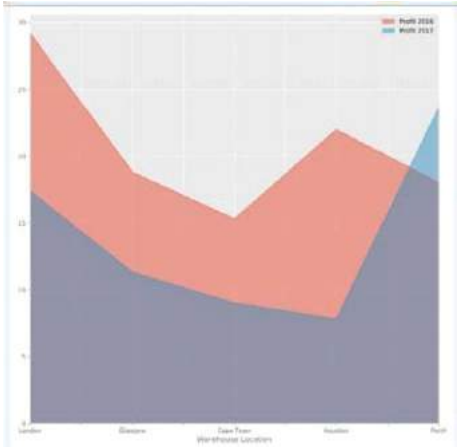
Bar Graph / Horizontal Bar Graph



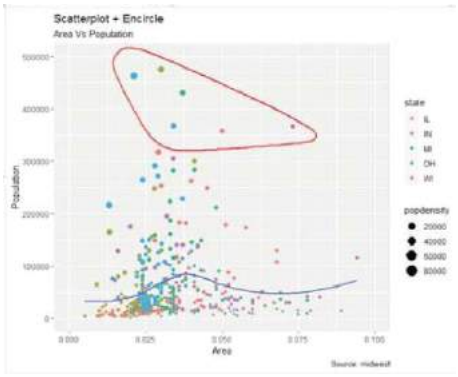
C:/VKHCG/01-Vermeulen/06-Report/Report_Graph_A.py

Area Graph

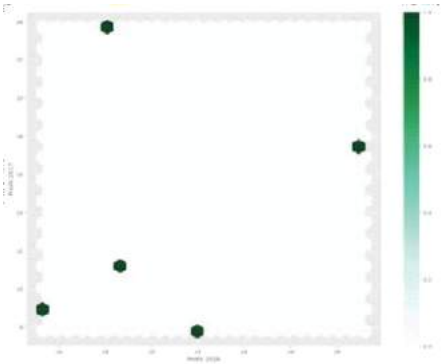
C:/VKHCG/01-Vermeulen/06-Report/Report_Graph_A.py



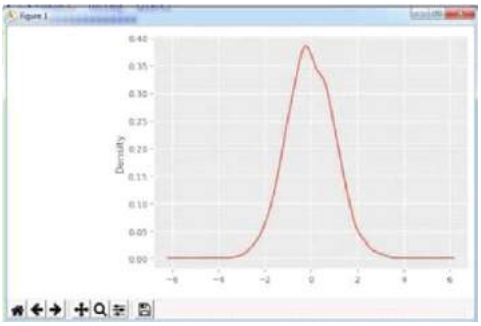
SCATTER GRAPH : VKHCG/03-HILLMAN/06-REPORT/REPORT-SCATTERPLOT-WITH-ENCIRCLING.R



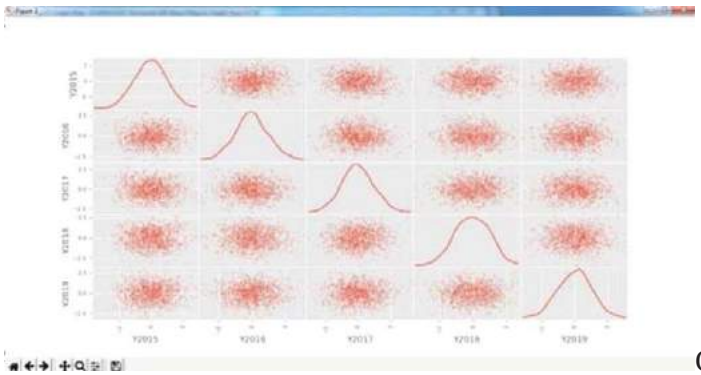
Hexbin:
Program : C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_A.py



Kernel Density Estimation (KDE) Graph
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_B.py

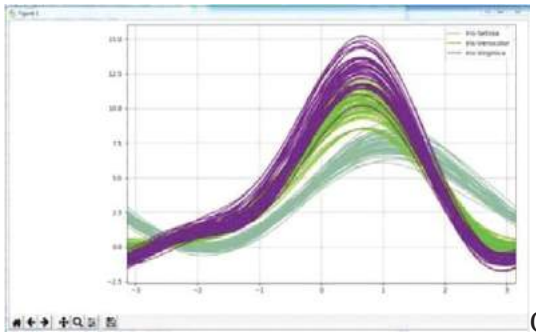


Scatter Matrix Graph



C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_B.py

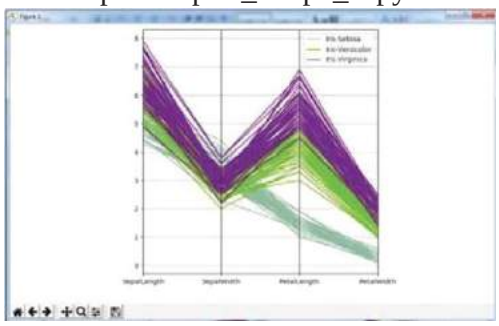
Andrews' Curves



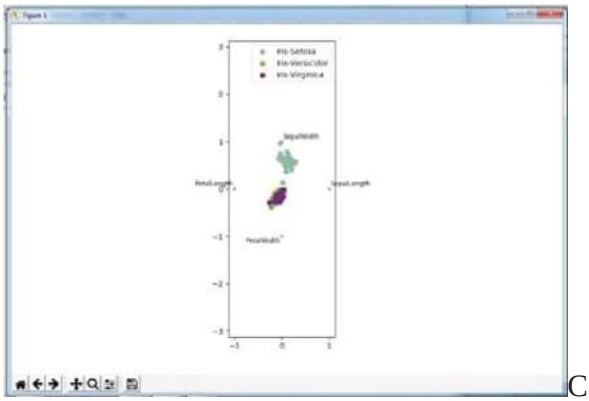
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_C.py

Parallel Coordinates

C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_C.py

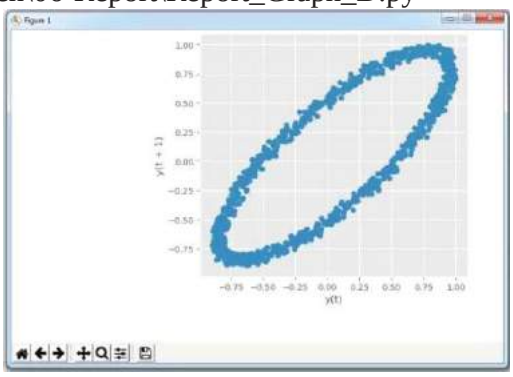


RADVIZ Method


C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_C.py

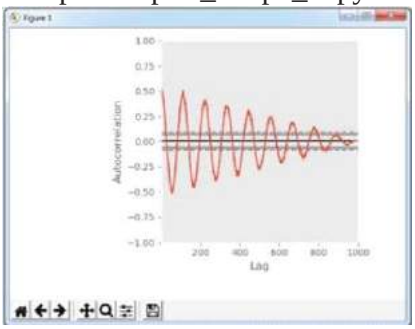
Lag Plot

C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_D.py



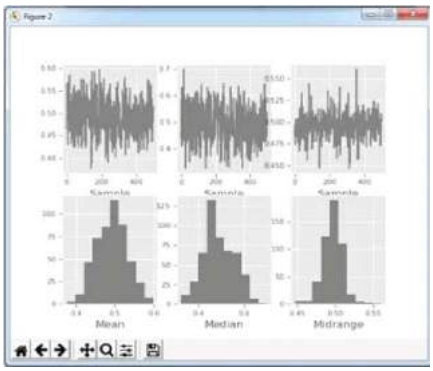
Autocorrelation Plot

C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_D.py

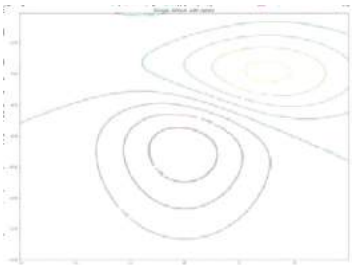


Bootstrap Plot

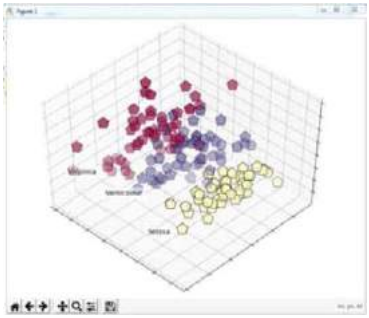
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_D.py



Contour Graphs
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_G.py



3D Graphs
C:\VKHCG\01-Vermeulen\06-Report\Report_PCA_IRIS.py



Case Study : Sales Data

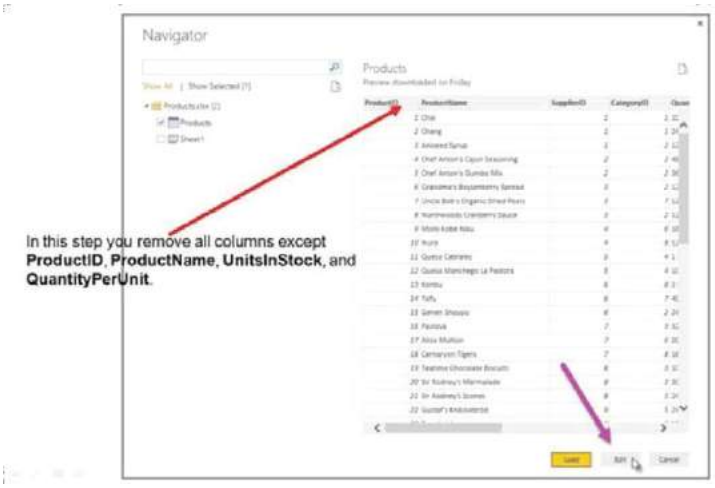
Practical 10

Data Visualization with Power BI

Step 1: Connect to an Excel workbook

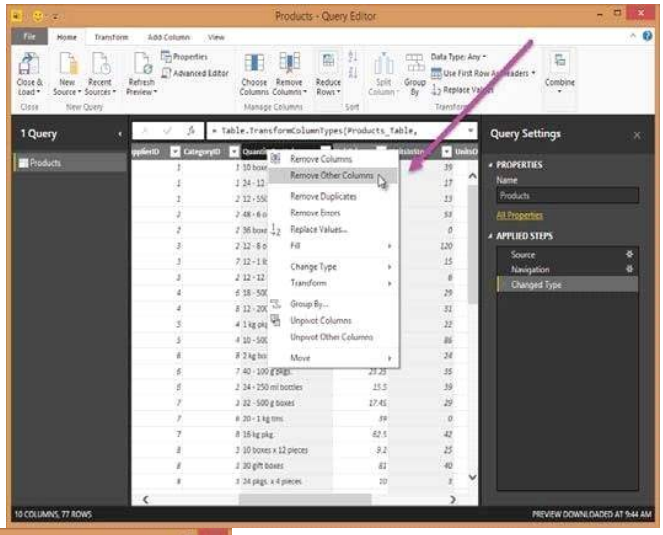
1. Launch Power BI Desktop.
2. From the Home ribbon, select **Get Data**. Excel is one of the **Most Common** data connections, so you can select it directly from the **Get Data** menu.

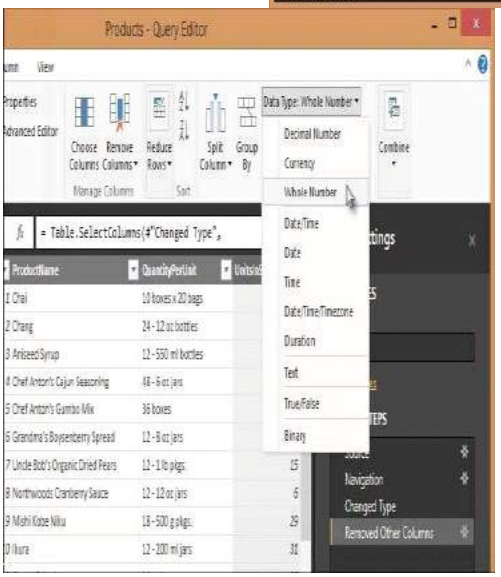
3. If you select the Get Data button directly, you can also select **File > Excel** and select **Connect**.
4. In the **Open File** dialog box, select the **Products.xlsx** file.



You can also open the Query Editor by selecting Edit Queries from the Home ribbon inPower BI Desktop. The following steps are performed in Query Editor.

- In Query Editor, select the ProductID, ProductName, QuantityPerUnit, andUnitsInStock columns
  (use Ctrl+Click to select more than one column, or Shift+Click to select columns thatare beside each other)
- Select Remove ColumnsRemove Other Columns from the ribbon, or right-click on acolumn header and click Remove Other Columns.





Step 3: Change the data type of the UnitsInStock column

For the Excel workbook, products in stock will always be a whole number, so in this step youconfirm the UnitsInStock column's datatype is Whole Number.

- Select the UnitsInStock column.
- 2. Select the Data Type drop-down button in the Home ribbon.
- If not already a Whole Number, select Whole Number for data type from the dropdown *(the Data Type: button also displays the data type for the current selection).*

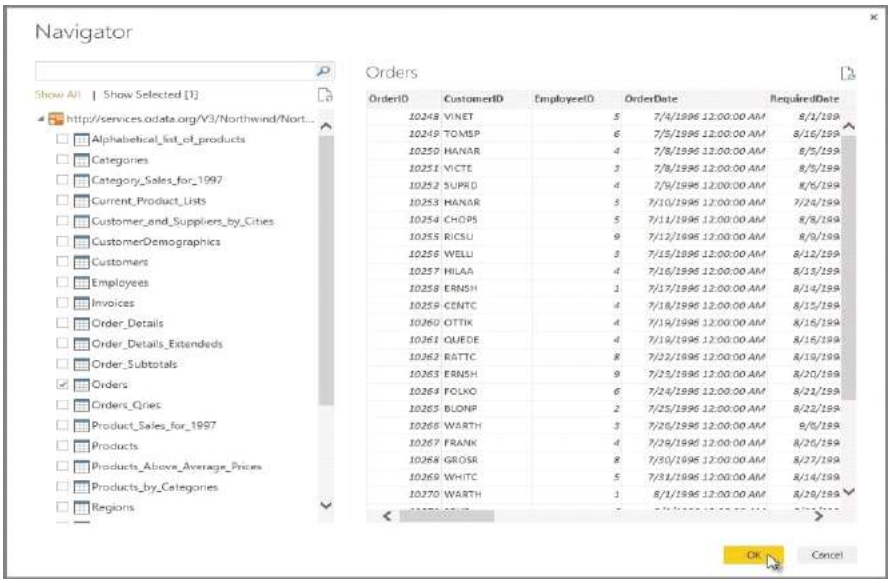
Task 2: Import order data from an OData feed

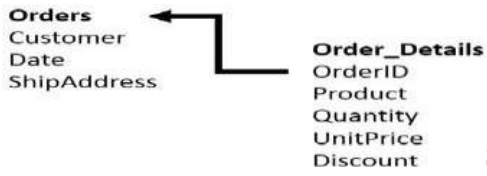
You import data into Power BI Desktop from the sample Northwind OData feed at thefollowing URL, which you can copy (and then paste) in the steps below: http://services.odata.org/V3/Northwind/Northwind.svc/

Step 1: Connect to an OData feed

- From the **Home** ribbon tab in Query Editor, select **Get Data.**
- Browse to the **OData Feed** data source.

- In the **OData Feed** dialog box, paste the **URL** for the Northwind OData feed.
- Select **OK**.





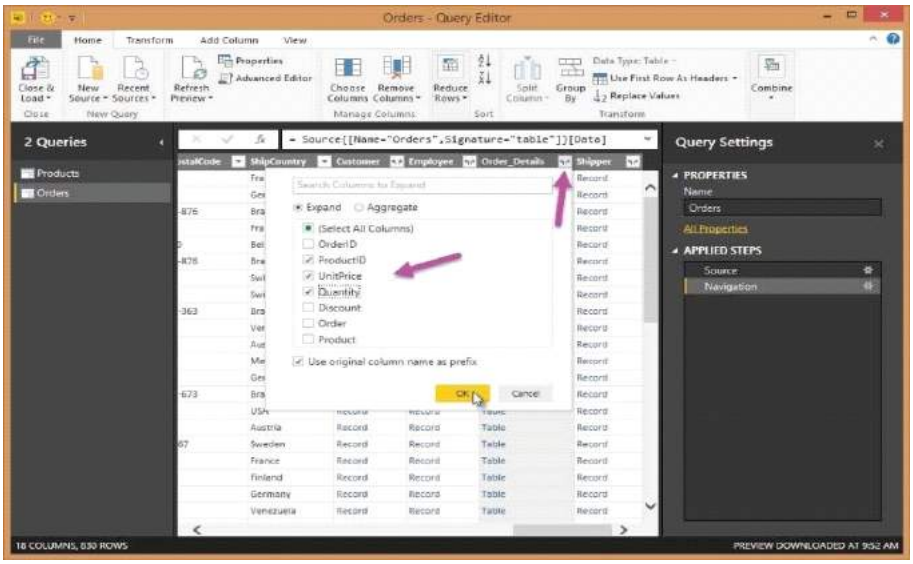
Step 2: Expand the Order_Details table

Expand the **Order_Details** table that is related to the **Orders** table, to combine the **ProductID**, **UnitPrice**, and **Quantity** columns from **Order_Details** into the **Orders** table. The **Expand** operation combines columns from a related table into a subject table. When thequery runs, rows from the related table (**Order_Details**) are combined into rows from the subject table (**Orders**).

After you expand the **Order_Details** table, three new columns and additional rows are addedto the **Orders** table, one for each row in the nested or related table.

- In the **Query View**, scroll to the **Order_Details** column.
- In the **Order_Details** column, select the expand icon ().
- In the **Expand** drop-down: a. Select **(Select All Columns)** to clear all columns.Select **ProductID**, **UnitPrice**, and **Quantity**.

click **OK**.



Step 3: Remove other columns to only display columns of interest
In this step you remove all columns except **OrderDate, ShipCity**, **ShipCountry**, **Order_Details.ProductID**, **Order_Details.UnitPrice**, and **Order_Details.Quantity** columns. In the previous task, you used **Remove Other Columns**. For this task, you removeselected columns.
In the **Query View**, select all columns by completing a.

- Click the first column (**OrderID**).
- Shift+Click the last column (**Shipper**).
- Now that all columns are selected, use Ctrl+Click to unselect the following columns: OrderDate, ShipCity, ShipCountry, Order_Details.ProductID, Order_Details.UnitPrice,and Order_Details.Quantity.

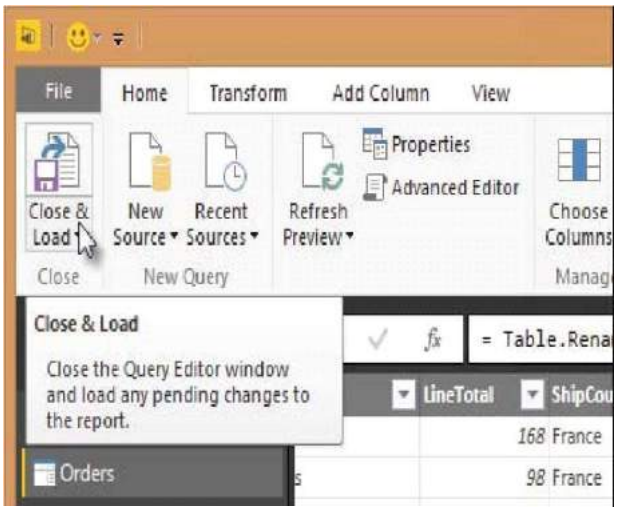
Now that only the columns we want to remove are selected, right-click on any selectedcolumn header and click Remove Columns.

Step 4: Calculate the line total for each Order_Details row
Power BI Desktop lets you to create calculations based on the columns you are importing, soyou can enrich the data that you connect to. In this step, you create a **Custom Column** to calculate the line total for each **Order_Details** row.
Calculate the line total for each **Order_Details** row:

- In the **Add Column** ribbon tab, click **Add Custom Column**.
- In the Add Custom Column dialog box, in the Custom Column Formula textbox,enter

[Order_Details.UnitPrice] * [Order_Details.Quantity].

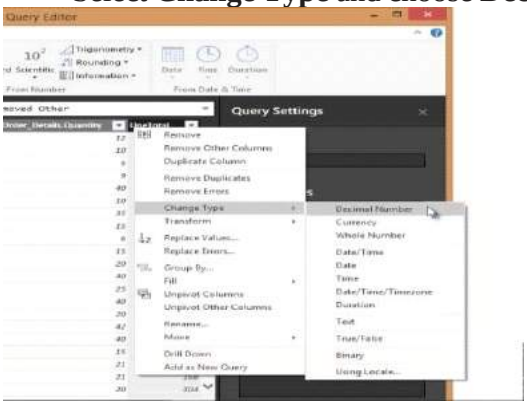
- In the New column name textbox, enter LineTotal.



Click **OK**.

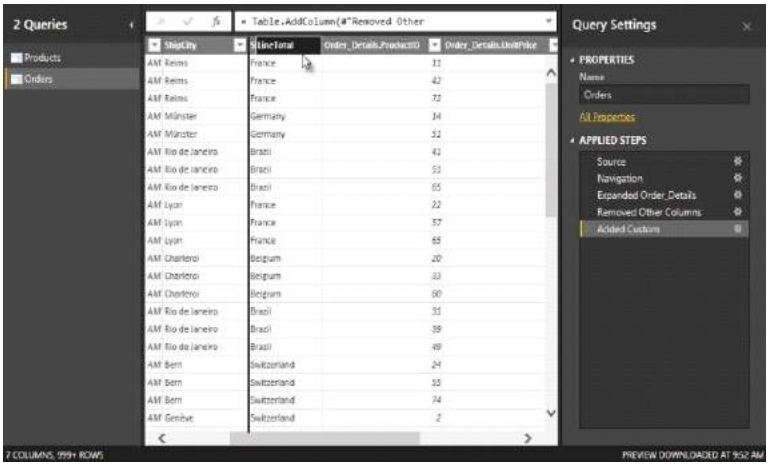
Step 5: Set the datatype of the LineTotal field

- Right click the **LineTotal** column.
- Select **Change Type** and choose **Decimal Number.**

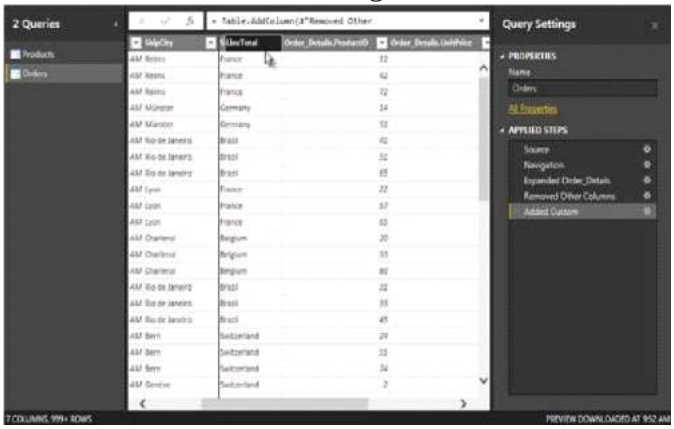


Step 6: Rename and reorder columns in the query

- In **Query Editor**, drag the **LineTotal** column to the left, after **ShipCountry**. 2. Remove



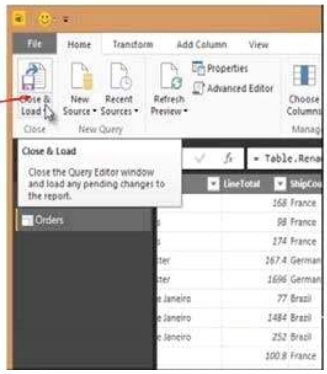
- Remove the *Order_Details.* prefix from the **Order_Details.ProductID**, **Order_Details.UnitPrice** and **Order_Details.Quantity** columns, by double-clicking oneach column header, and then deleting that text from the column name.



Task 3: Combine the Products and Total Sales queries

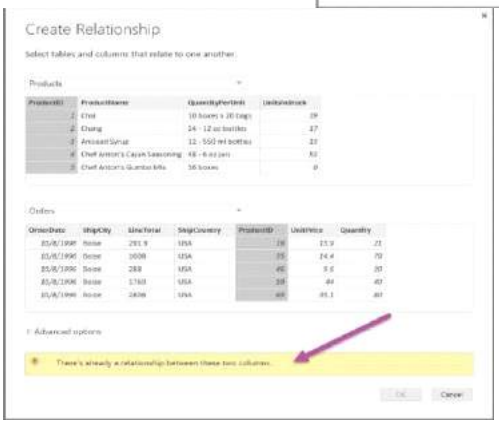
Step 1: Confirm the relationship between Products and Total Sales

1. First, we need to load the model that we created in Query Editor into Power BI Desktop. From the **Home** ribbon of Query Editor, select **Close & Load**.

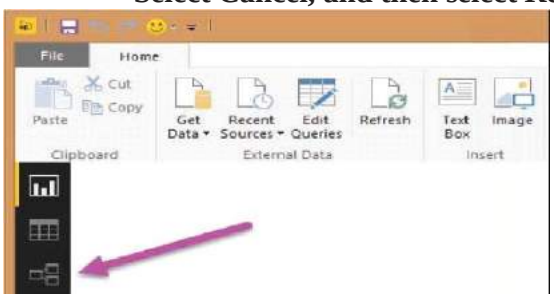


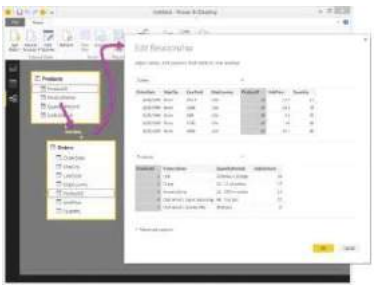
- Power BI Desktop loads the data from the two queries
- Once the data is loaded, select the Manage Relationships button Home ribbon 4.Select the New… button

- When we attempt to create the relationship, we see that one already exists! As shown in the Create Relationship dialog (by the shaded columns), the ProductsIDfields in each query already have an established relationship.



- **Select Cancel, and then select Relationship view in Power BI Desktop.**





Task 4: Build visuals using your data

Step 1: Create charts showing Units in Stock by Product and Total Sales by Year

- **Next, drag ShipCountry to a space on the canvas in the top right. Because you selected a geographic field, a map was created automatically. Now drag LineTotalto the Values field; the circles on the map for each country are now relative in sizeto the LineTotal for orders shipped to that country.**

Step 2: Interact with your report visuals to analyze further