

Untitled3

September 20, 2023

```
[1]: from google.colab import drive
drive.mount('/content/drive')
!unzip drive/MyDrive/assignment1.zip
```

Mounted at /content/drive

Archive: drive/MyDrive/assignment1.zip

```
  inflating: assignment_1/__init__.py
  inflating: assignment_1/notebooks/__init__.py
  inflating: assignment_1/notebooks/usairtraffic_analysis.ipynb
  inflating: assignment_1/utils/airtraffic_helpers.py
  inflating: assignment_1/utils/__init__.py
  inflating: assignment_1/figures/us_airports_network_withposition.pdf
  inflating: assignment_1/utils/__pycache__/airtraffic_helpers.cpython-36.pyc
  inflating: assignment_1/figures/pagerank.pdf
  inflating: assignment_1/figures/authorities.pdf
  inflating: assignment_1/figures/hubs.pdf
  inflating: assignment_1/utils/__pycache__/gspan.cpython-36.pyc
  inflating: assignment_1/utils/__pycache__/citibike_helpers.cpython-36.pyc
  inflating: assignment_1/utils/__pycache__/calroad_helpers.cpython-36.pyc
  inflating: assignment_1/utils/__pycache__/__init__.cpython-36.pyc
  inflating: assignment_1/utils/__pycache__/graph.cpython-36.pyc
  inflating: assignment_1/dataset/288798530_T_T100D_MARKET_ALL_CARRIER.csv
  inflating: assignment_1/dataset/Igismap/Alabama_AL4_US_Poly.shx
  inflating: assignment_1/dataset/288804893_T_MASTER_CORD.csv
  inflating: assignment_1/dataset/Igismap/Alabama_AL4_US_Poly.prj
  inflating: assignment_1/dataset/Igismap/Alabama_AL4_US_Poly.dbf
  inflating: assignment_1/figures/us_airports_nodes.pdf
  inflating: assignment_1/dataset/Igismap/Alabama_AL4_US_Poly.shp
```

```
[2]: import os
import sys
dir_path = '/content/assignment_1'
sys.path.append(dir_path)
```

```
[ ]: !pip install geopandas==0.8.1 matplotlib==3.2.2 networkx==2.3 numpy==1.18.5
↳ pandas==1.0.5 seaborn==0.10.1
```

Collecting geopandas==0.8.1

```

Downloading geopandas-0.8.1-py2.py3-none-any.whl (962 kB)
962.8/962.8
kB 6.9 MB/s eta 0:00:00
Collecting matplotlib==3.2.2
  Downloading matplotlib-3.2.2.tar.gz (40.3 MB)
40.3/40.3 MB
32.8 MB/s eta 0:00:00
  Preparing metadata (setup.py) ... done
Collecting networkx==2.3
  Downloading networkx-2.3.zip (1.7 MB)
1.7/1.7 MB
65.0 MB/s eta 0:00:00
  Preparing metadata (setup.py) ... done
Collecting numpy==1.18.5
  Downloading numpy-1.18.5.zip (5.4 MB)
5.4/5.4 MB
58.7 MB/s eta 0:00:00
  Installing build dependencies ... done
  Getting requirements to build wheel ... done
error: subprocess-exited-with-error

× Preparing metadata
(pyproject.toml) did not run successfully.
  exit code: 1
  > See above for output.

note: This error originates from a subprocess, and is likely not a
problem with pip.
  Preparing metadata (pyproject.toml) ... error
error: metadata-generation-failed

× Encountered error while generating package metadata.
  > See above for output.

note: This is an issue with the package mentioned above, not pip.
hint: See above for details.

```

```
[3]: !pip install geopandas matplotlib networkx numpy pandas seaborn
```

```

Requirement already satisfied: geopandas in /usr/local/lib/python3.10/dist-
packages (0.13.2)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.10/dist-
packages (3.7.1)
Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-
packages (3.1)
Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-packages
(1.23.5)

```

Requirement already satisfied: pandas in /usr/local/lib/python3.10/dist-packages (1.5.3)

Requirement already satisfied: seaborn in /usr/local/lib/python3.10/dist-packages (0.12.2)

Requirement already satisfied: fiona>=1.8.19 in /usr/local/lib/python3.10/dist-packages (from geopandas) (1.9.4.post1)

Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from geopandas) (23.1)

Requirement already satisfied: pyproj>=3.0.1 in /usr/local/lib/python3.10/dist-packages (from geopandas) (3.6.0)

Requirement already satisfied: shapely>=1.7.1 in /usr/local/lib/python3.10/dist-packages (from geopandas) (2.0.1)

Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (1.1.0)

Requirement already satisfied: cycycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (0.11.0)

Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (4.42.1)

Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (1.4.5)

Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (9.4.0)

Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (3.1.1)

Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.10/dist-packages (from matplotlib) (2.8.2)

Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas) (2023.3.post1)

Requirement already satisfied: attrs>=19.2.0 in /usr/local/lib/python3.10/dist-packages (from fiona>=1.8.19->geopandas) (23.1.0)

Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-packages (from fiona>=1.8.19->geopandas) (2023.7.22)

Requirement already satisfied: click~=8.0 in /usr/local/lib/python3.10/dist-packages (from fiona>=1.8.19->geopandas) (8.1.7)

Requirement already satisfied: click-plugins>=1.0 in /usr/local/lib/python3.10/dist-packages (from fiona>=1.8.19->geopandas) (1.1.1)

Requirement already satisfied: cligj>=0.5 in /usr/local/lib/python3.10/dist-packages (from fiona>=1.8.19->geopandas) (0.7.2)

Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages (from fiona>=1.8.19->geopandas) (1.16.0)

```
[4]: %matplotlib inline
import matplotlib.pyplot as plt
import pandas as pd
import datetime
import seaborn as sns
import operator
```

```

import numpy as np
import geopandas as gp
%load_ext autoreload
%autoreload 2
from utils import airtraffic_helpers
import networkx as nx
import community
import random
from shapely.geometry import Point

```

```

[5]: # Dometics airport details
airports_df = pd.read_csv("{}dataset/288804893_T_MASTER_CORD.csv".
    ↪format(dir_path))
print('Shape of the dataframe:',airports_df.shape,'\n')
print('Printing one record:',airports_df[:1].T)
print(airports_df.loc[airports_df['AIRPORT_ID']==11298].T)

```

Shape of the dataframe: (18101, 28)

Printing one record:

0

AIRPORT_ID	10001
AIRPORT	01A
DISPLAY_AIRPORT_NAME	Afognak Lake Airport
DISPLAY_AIRPORT_CITY_NAME_FULL	Afognak Lake, AK
AIRPORT_WAC	1
AIRPORT_COUNTRY_NAME	United States
AIRPORT_COUNTRY_CODE_ISO	US
AIRPORT_STATE_NAME	Alaska
AIRPORT_STATE_CODE	AK
AIRPORT_STATE_FIPS	2.0
CITY_MARKET_ID	30001
DISPLAY_CITY_MARKET_NAME_FULL	Afognak Lake, AK
CITY_MARKET_WAC	1
LAT_DEGREES	58.0
LAT_HEMISPHERE	N
LAT_MINUTES	6.0
LAT_SECONDS	34.0
LATITUDE	58.109444
LON_DEGREES	152.0
LON_HEMISPHERE	W
LON_MINUTES	54.0
LON_SECONDS	24.0
LONGITUDE	-152.906667
AIRPORT_START_DATE	2007-07-01
AIRPORT_THRU_DATE	NaN
AIRPORT_IS_CLOSED	0
AIRPORT_IS_LATEST	1

Unnamed: 27	NaN	3677 \
AIRPORT_ID		11298
AIRPORT		DFW
DISPLAY_AIRPORT_NAME	Dallas Fort Worth Regional	
DISPLAY_AIRPORT_CITY_NAME_FULL	Dallas/Fort Worth, TX	
AIRPORT_WAC		74
AIRPORT_COUNTRY_NAME	United States	
AIRPORT_COUNTRY_CODE_ISO		US
AIRPORT_STATE_NAME		Texas
AIRPORT_STATE_CODE		TX
AIRPORT_STATE_FIPS		48.0
CITY_MARKET_ID		30194
DISPLAY_CITY_MARKET_NAME_FULL	Dallas/Fort Worth, TX	
CITY_MARKET_WAC		74
LAT_DEGREES		32.0
LAT_HEMISPHERE		N
LAT_MINUTES		53.0
LAT_SECONDS		40.0
LATITUDE		32.894444
LON_DEGREES		97.0
LON_HEMISPHERE		W
LON_MINUTES		1.0
LON_SECONDS		47.0
LONGITUDE		-97.029722
AIRPORT_START_DATE		1950-01-01
AIRPORT_THRU_DATE		1989-12-31
AIRPORT_IS_CLOSED		0
AIRPORT_IS_LATEST		0
Unnamed: 27	NaN	

		3678 \
AIRPORT_ID		11298
AIRPORT		DFW
DISPLAY_AIRPORT_NAME	Dallas/Fort Worth International	
DISPLAY_AIRPORT_CITY_NAME_FULL	Dallas/Fort Worth, TX	
AIRPORT_WAC		74
AIRPORT_COUNTRY_NAME	United States	
AIRPORT_COUNTRY_CODE_ISO		US
AIRPORT_STATE_NAME		Texas
AIRPORT_STATE_CODE		TX
AIRPORT_STATE_FIPS		48.0
CITY_MARKET_ID		30194
DISPLAY_CITY_MARKET_NAME_FULL	Dallas/Fort Worth, TX	
CITY_MARKET_WAC		74
LAT_DEGREES		32.0
LAT_HEMISPHERE		N
LAT_MINUTES		53.0

LAT_SECONDS	47.0
LATITUDE	32.896389
LON_DEGREES	97.0
LON_HEMISPHERE	W
LON_MINUTES	2.0
LON_SECONDS	28.0
LONGITUDE	-97.041111
AIRPORT_START_DATE	1990-01-01
AIRPORT_THRU_DATE	2011-06-30
AIRPORT_IS_CLOSED	0
AIRPORT_IS_LATEST	0
Unnamed: 27	NaN
3679 \	
AIRPORT_ID	11298
AIRPORT	DFW
DISPLAY_AIRPORT_NAME	Dallas/Fort Worth International
DISPLAY_AIRPORT_CITY_NAME_FULL	Dallas/Fort Worth, TX
AIRPORT_WAC	74
AIRPORT_COUNTRY_NAME	United States
AIRPORT_COUNTRY_CODE_ISO	US
AIRPORT_STATE_NAME	Texas
AIRPORT_STATE_CODE	TX
AIRPORT_STATE_FIPS	48.0
CITY_MARKET_ID	30194
DISPLAY_CITY_MARKET_NAME_FULL	Dallas/Fort Worth, TX
CITY_MARKET_WAC	74
LAT_DEGREES	32.0
LAT_HEMISPHERE	N
LAT_MINUTES	53.0
LAT_SECONDS	49.0
LATITUDE	32.896944
LON_DEGREES	97.0
LON_HEMISPHERE	W
LON_MINUTES	2.0
LON_SECONDS	17.0
LONGITUDE	-97.038056
AIRPORT_START_DATE	2011-07-01
AIRPORT_THRU_DATE	2015-03-31
AIRPORT_IS_CLOSED	0
AIRPORT_IS_LATEST	0
Unnamed: 27	NaN
3680 \	
AIRPORT_ID	11298
AIRPORT	DFW
DISPLAY_AIRPORT_NAME	Dallas/Fort Worth International
DISPLAY_AIRPORT_CITY_NAME_FULL	Dallas/Fort Worth, TX

AIRPORT_WAC	74
AIRPORT_COUNTRY_NAME	United States
AIRPORT_COUNTRY_CODE_ISO	US
AIRPORT_STATE_NAME	Texas
AIRPORT_STATE_CODE	TX
AIRPORT_STATE_FIPS	48.0
CITY_MARKET_ID	30194
DISPLAY_CITY_MARKET_NAME_FULL	Dallas/Fort Worth, TX
CITY_MARKET_WAC	74
LAT_DEGREES	32.0
LAT_HEMISPHERE	N
LAT_MINUTES	53.0
LAT_SECONDS	50.0
LATITUDE	32.897222
LON_DEGREES	97.0
LON_HEMISPHERE	W
LON_MINUTES	2.0
LON_SECONDS	16.0
LONGITUDE	-97.037778
AIRPORT_START_DATE	2015-04-01
AIRPORT_THRU_DATE	2017-10-31
AIRPORT_IS_CLOSED	0
AIRPORT_IS_LATEST	0
Unnamed: 27	NaN

	3681 \
AIRPORT_ID	11298
AIRPORT	DFW
DISPLAY_AIRPORT_NAME	Dallas/Fort Worth International
DISPLAY_AIRPORT_CITY_NAME_FULL	Dallas/Fort Worth, TX
AIRPORT_WAC	74
AIRPORT_COUNTRY_NAME	United States
AIRPORT_COUNTRY_CODE_ISO	US
AIRPORT_STATE_NAME	Texas
AIRPORT_STATE_CODE	TX
AIRPORT_STATE_FIPS	48.0
CITY_MARKET_ID	30194
DISPLAY_CITY_MARKET_NAME_FULL	Dallas/Fort Worth, TX
CITY_MARKET_WAC	74
LAT_DEGREES	32.0
LAT_HEMISPHERE	N
LAT_MINUTES	53.0
LAT_SECONDS	49.0
LATITUDE	32.896944
LON_DEGREES	97.0
LON_HEMISPHERE	W
LON_MINUTES	2.0
LON_SECONDS	17.0

LONGITUDE	-97.038056
AIRPORT_START_DATE	2017-11-01
AIRPORT_THRU_DATE	2017-11-30
AIRPORT_IS_CLOSED	0
AIRPORT_IS_LATEST	0
Unnamed: 27	NaN

	3682
AIRPORT_ID	11298
AIRPORT	DFW
DISPLAY_AIRPORT_NAME	Dallas/Fort Worth International
DISPLAY_AIRPORT_CITY_NAME_FULL	Dallas/Fort Worth, TX
AIRPORT_WAC	74
AIRPORT_COUNTRY_NAME	United States
AIRPORT_COUNTRY_CODE_ISO	US
AIRPORT_STATE_NAME	Texas
AIRPORT_STATE_CODE	TX
AIRPORT_STATE_FIPS	48.0
CITY_MARKET_ID	30194
DISPLAY_CITY_MARKET_NAME_FULL	Dallas/Fort Worth, TX
CITY_MARKET_WAC	74
LAT_DEGREES	32.0
LAT_HEMISPHERE	N
LAT_MINUTES	53.0
LAT_SECONDS	50.0
LATITUDE	32.897222
LON_DEGREES	97.0
LON_HEMISPHERE	W
LON_MINUTES	2.0
LON_SECONDS	16.0
LONGITUDE	-97.037778
AIRPORT_START_DATE	2017-12-01
AIRPORT_THRU_DATE	NaN
AIRPORT_IS_CLOSED	0
AIRPORT_IS_LATEST	1
Unnamed: 27	NaN

```
[6]: print(airports_df.loc[airports_df['AIRPORT_ID']==13487].T)
```

	9694 \
AIRPORT_ID	13487
AIRPORT	MSP
DISPLAY_AIRPORT_NAME	Minneapolis-St Paul International
DISPLAY_AIRPORT_CITY_NAME_FULL	Minneapolis, MN
AIRPORT_WAC	63
AIRPORT_COUNTRY_NAME	United States
AIRPORT_COUNTRY_CODE_ISO	US
AIRPORT_STATE_NAME	Minnesota

AIRPORT_STATE_CODE	MN
AIRPORT_STATE_FIPS	27.0
CITY_MARKET_ID	31650
DISPLAY_CITY_MARKET_NAME_FULL	Minneapolis/St. Paul, MN
CITY_MARKET_WAC	63
LAT_DEGREES	44.0
LAT_HEMISPHERE	N
LAT_MINUTES	53.0
LAT_SECONDS	10.0
LATITUDE	44.886111
LON_DEGREES	93.0
LON_HEMISPHERE	W
LON_MINUTES	13.0
LON_SECONDS	4.0
LONGITUDE	-93.217778
AIRPORT_START_DATE	1950-01-01
AIRPORT_THRU_DATE	2011-06-30
AIRPORT_IS_CLOSED	0
AIRPORT_IS_LATEST	0
Unnamed: 27	NaN

	9695
AIRPORT_ID	13487
AIRPORT	MSP
DISPLAY_AIRPORT_NAME	Minneapolis-St Paul International
DISPLAY_AIRPORT_CITY_NAME_FULL	Minneapolis, MN
AIRPORT_WAC	63
AIRPORT_COUNTRY_NAME	United States
AIRPORT_COUNTRY_CODE_ISO	US
AIRPORT_STATE_NAME	Minnesota
AIRPORT_STATE_CODE	MN
AIRPORT_STATE_FIPS	27.0
CITY_MARKET_ID	31650
DISPLAY_CITY_MARKET_NAME_FULL	Minneapolis/St. Paul, MN
CITY_MARKET_WAC	63
LAT_DEGREES	44.0
LAT_HEMISPHERE	N
LAT_MINUTES	52.0
LAT_SECONDS	55.0
LATITUDE	44.881944
LON_DEGREES	93.0
LON_HEMISPHERE	W
LON_MINUTES	13.0
LON_SECONDS	18.0
LONGITUDE	-93.221667
AIRPORT_START_DATE	2011-07-01
AIRPORT_THRU_DATE	NaN
AIRPORT_IS_CLOSED	0

AIRPORT_IS_LATEST

1

Unnamed: 27

NaN

```
[7]: # Dometics airlines connections
trips_df = pd.read_csv("{}/dataset/288798530_T_T100D_MARKET_ALL_CARRIER.csv".
    ↪format(dir_path))
print('Shape of the dataframe:',trips_df.shape,'\n')
print('Printing one record:',trips_df[:1].T)
```

Shape of the dataframe: (41930, 8)

Printing one record:

0

UNIQUE_CARRIER	04Q
UNIQUE_CARRIER_NAME	Tradewind Aviation
ORIGIN_AIRPORT_ID	13535
ORIGIN	MVL
DEST_AIRPORT_ID	12197
DEST	HPN
MONTH	1
Unnamed: 7	NaN

```
[8]: # Extracting edges - we consider a connection from one airport to another as an
    ↪edge.
# Note: these edges will be directed.
edges = list(zip(trips_df['ORIGIN_AIRPORT_ID'],trips_df['DEST_AIRPORT_ID']))
```

```
[9]: # creating directed and undirected graphs based on airports and their
    ↪connections
G = nx.DiGraph()
G.add_edges_from(edges)
G_undirected = nx.Graph()
G_undirected.add_edges_from(edges)
```

```
[10]: # printing the total number of nodes and edges of directed graph
print('Total number of airports:',len(list(G.nodes)))
print('Total number of connections:',len(list(G.edges)))
```

Total number of airports: 894

Total number of connections: 13760

```
[11]: airport_ids = list(G.nodes)
edgelist = list(G.edges)
geo_stations = airtraffic_helpers.
    ↪get_geodataframe_airports(airports_df,airport_ids)
```

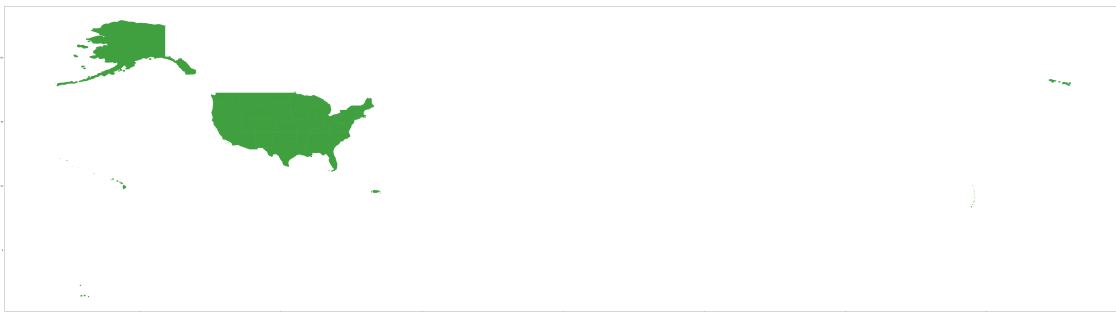
```
[12]: # reading the shape file of US
```

```
shp_us = gp.GeoDataFrame.from_file("{}dataset/Igismap/Alabama_AL4_US_Poly.shp".
    ↪format(dir_path))
shp_us=shp_us.to_crs({'init':'epsg:4326'})
shp_us.plot(figsize=(100,100),color='g',alpha=0.75)
```

/usr/local/lib/python3.10/dist-packages/pyproj/crs/crs.py:141: FutureWarning: '+init=<authority>:<code>' syntax is deprecated. '<authority>:<code>' is the preferred initialization method. When making the change, be mindful of axis order changes: <https://pyproj4.github.io/pyproj/stable/gotchas.html#axis-order-changes-in-proj-6>

```
in_crs_string = _prepare_from_proj_string(in_crs_string)
```

[12]: <Axes: >



```
[13]: plt.style.use("default")
%matplotlib inline
fig, ax = plt.subplots(1,1,figsize=(50,50))
base = shp_us.plot(ax=ax, color='gray', alpha=0.2)
geo_stations.plot(ax=base, marker="o", color="r", markersize=10,alpha=0.8,
    ↪zorder=0)
_ = ax.axis('off')
ax.set_title("Plot of airports in United States",fontsize=20)
fig.tight_layout()
fig.savefig("{}figures/us_airports_nodes.pdf".format(dir_path))
```



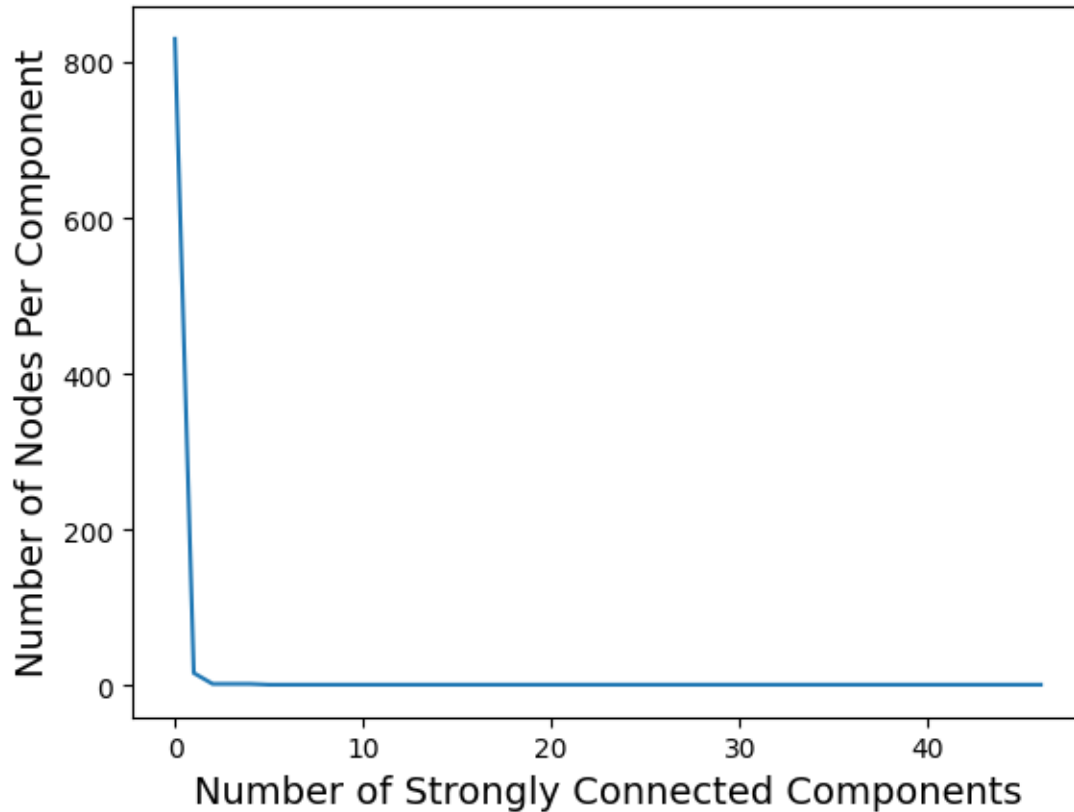
```
[14]: # displaying the network based on actual geographical placement of nodes
position_dict = {} # will contain the node coordinates
for item in list(geo_stations.station_ids):
    position_dict[item] = geo_stations[geo_stations.station_ids==item].geometry.
    ↪values[0].x,geo_stations[geo_stations.station_ids==item].geometry.values[0].y
fig, ax = plt.subplots(1,1,figsize=(100,40))
nx.draw(G,pos=position_dict)
fig.tight_layout()
fig.savefig("{}figures/us_airports_network_withposition.pdf".format(dir_path))
```

Output hidden; open in <https://colab.research.google.com> to view.

```
[15]: # displaying the network with optimal placement of nodes
airtraffic_helpers.plot_network(G,title="",edgealpha=0.
    ↪08,node_dist=1,nodesize=20,savefig=False,figsize=(15,15))
```

1

1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 16, 830]



```
[17]: # Weakly Connected Components
wcc=[list(l) for l in nx.weakly_connected_components(G)] #Strongly Connected
↳Components
print("Number of Weakly Connected Components",len(wcc),"\\nSample Weakly
↳Connected Components",wcc[:3])
plt.plot(list(sorted(map(lambda x: len(x),wcc),reverse=True)))
plt.xlabel("Number of Weakly Connected Components",fontsize=18)
plt.ylabel("Number of Nodes Per Component",fontsize=18)
```

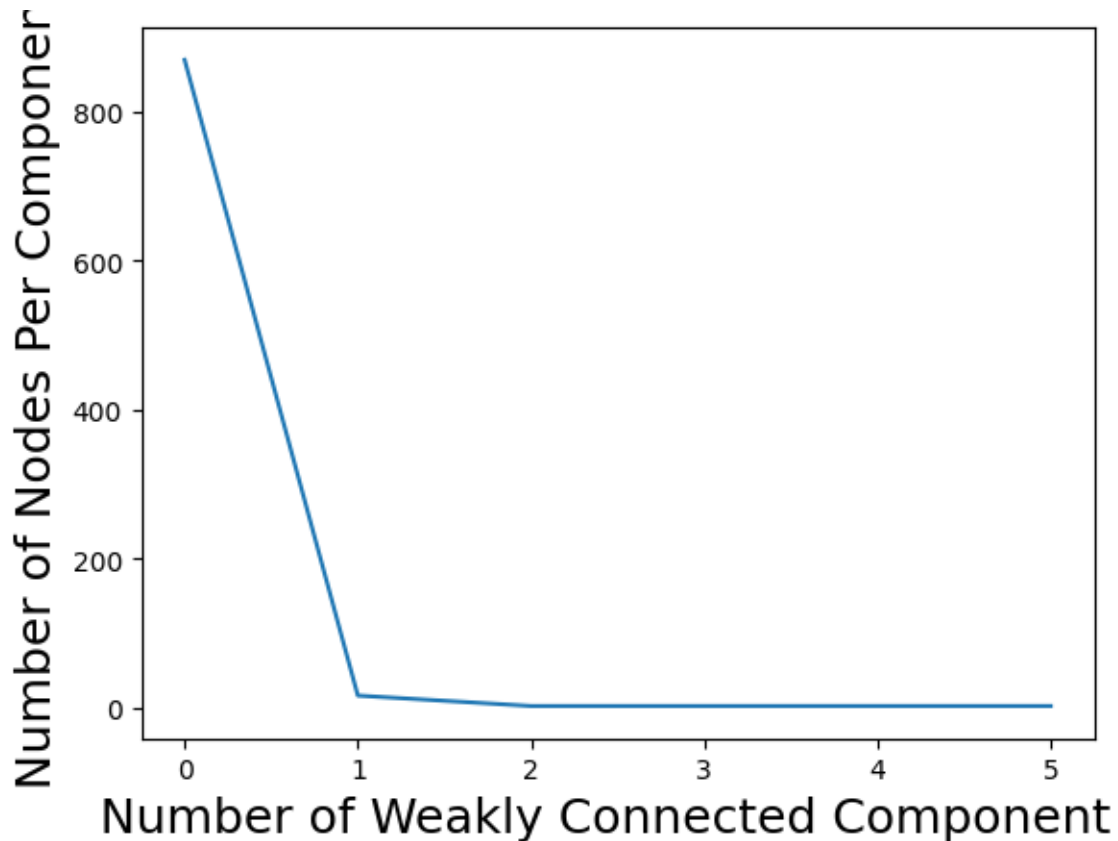
Number of Weakly Connected Components 6

Sample Weakly Connected Components [[10241, 10243, 10245, 16390, 10247, 12294,
10257, 12315, 10268, 10272, 12321, 12323, 12324, 10275, 10278, 10279, 12335,
12339, 12343, 10298, 10299, 12348, 10304, 10313, 12363, 12365, 10322, 12370,
10325, 10327, 12375, 10329, 14424, 10333, 12391, 10347, 10348, 12397, 10349,
12402, 14457, 10361, 12412, 14467, 10372, 10374, 14470, 14474, 14477, 12436,
14485, 14487, 14488, 12441, 14489, 14492, 10397, 10396, 14493, 12448, 12451,
10405, 12455, 10408, 10409, 10414, 14512, 10416, 10419, 16566, 10423, 14520,
16567, 14524, 12478, 10431, 14530, 10434, 14533, 14534, 14539, 12492, 14543,
14551, 16603, 12511, 14559, 10466, 10469, 12519, 10472, 14570, 12523, 14572,

14574, 10478, 14576, 14582, 14588, 12544, 12545, 16647, 12553, 12559, 10511,
10519, 16668, 12574, 12576, 10529, 14627, 12583, 10535, 14633, 14635, 10540,
12587, 12598, 10551, 14648, 10556, 10557, 10558, 10559, 10561, 10562, 12610,
12615, 10572, 12621, 14672, 10577, 14673, 14674, 10581, 14679, 10583, 14683,
12635, 14685, 10590, 10589, 12638, 14689, 12641, 14691, 10599, 14696, 16745,
14698, 12649, 12652, 12653, 14704, 14709, 14711, 14712, 10615, 10617, 12663,
10620, 14716, 14718, 12671, 10627, 12676, 10630, 10631, 14730, 14736, 10640,
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12709, 14761, 10666, 10670, 12719, 12720, 12721, 14771, 10676, 12728, 10683,
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12769, 14819, 12772, 16869, 12771, 10728, 10731, 10732, 14828, 12779, 14831,
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10781, 14877, 10783, 14880, 10785, 12831, 10792, 12841, 12844, 14893, 14895,
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12892, 14942, 14943, 12896, 10849, 12898, 12899, 12902, 14952, 10857, 14955,
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10926, 15023, 15024, 10927, 10930, 15027, 10933, 15030, 12982, 10938, 12992,
10945, 15041, 15043, 15045, 10950, 15048, 15049, 13002, 15051, 10958, 13008,
15057, 10965, 15061, 10967, 13016, 15070, 13024, 15074, 10980, 13029, 13032,
13034, 15085, 10990, 10994, 15091, 10996, 15096, 11002, 11003, 13055, 11007,
13061, 11013, 13072, 11027, 13076, 15124, 11028, 11036, 11041, 11042, 15138,
11049, 11050, 11053, 11057, 15153, 13105, 11058, 15154, 13111, 15160, 11066,
11067, 13117, 15167, 13121, 15171, 11076, 13125, 13127, 15177, 11085, 11086,
13139, 11092, 11097, 11109, 13158, 11111, 13157, 15215, 11122, 11123, 11126,
13176, 15231, 13184, 15232, 11140, 15236, 13192, 11146, 13194, 13196, 15245,
13198, 11150, 13200, 15249, 15250, 13203, 13204, 15257, 13211, 15260, 13217,
13230, 15278, 13232, 15282, 11193, 13241, 15289, 13244, 15293, 11198, 15295,
11197, 13246, 11203, 15304, 13256, 11214, 13264, 11218, 15323, 11227, 13277,
15325, 11233, 13282, 11241, 13290, 11245, 15342, 13295, 13296, 13297, 15346,
15344, 11252, 13303, 11259, 15356, 11267, 15370, 11274, 11278, 15374, 15376,
11283, 15380, 15381, 15382, 15383, 11288, 15385, 11292, 15389, 13342, 13341,
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15412, 15411, 13367, 13369, 13377, 15427, 13381, 11336, 11337, 15434, 13388,
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13424, 11381, 15478, 13433, 13434, 11387, 13439, 11391, 11392, 11399, 15497,
15498, 13459, 11411, 13461, 11413, 11415, 15511, 13467, 11421, 11423, 13476,
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11517, 15618, 11525, 13574, 15624, 13577, 15626, 13579, 15628, 11531, 11535,
11537, 13587, 11540, 11545, 11550, 11555, 11563, 13619, 11577, 13629, 11587,
11588, 11603, 13656, 11612, 15709, 11615, 11617, 11618, 13667, 11619, 11624,
15721, 13676, 15725, 11630, 13682, 13685, 11637, 11638, 11641, 11646, 11648,

11650, 13700, 13704, 13710, 13714, 13715, 15769, 13731, 15785, 11695, 11697,
 15794, 11699, 15798, 11711, 13767, 11719, 11721, 13770, 13771, 13768, 11725,
 11726, 11728, 13785, 13788, 13791, 15841, 15842, 13795, 13796, 15850, 15853,
 13806, 11762, 11764, 15861, 11766, 15862, 11775, 11778, 13826, 13829, 13830,
 13832, 11789, 11790, 15887, 13851, 11813, 13862, 13863, 15919, 13871, 11823,
 11826, 11827, 13873, 11833, 11834, 13888, 13890, 13891, 11844, 11845, 13894,
 13898, 11859, 11865, 11867, 11869, 11870, 11871, 15973, 11879, 13927, 13930,
 13931, 11884, 13933, 15982, 13934, 13936, 13942, 15991, 11898, 13947, 11904,
 11905, 11908, 13964, 11921, 13970, 11924, 11931, 13983, 13984, 13987, 13988,
 11941, 11952, 11953, 14004, 14006, 14013, 11973, 11977, 14025, 14027, 11980,
 11982, 11986, 11995, 11996, 16091, 14046, 14044, 11997, 14050, 12003, 16101,
 14054, 12007, 14057, 12012, 14062, 12016, 12018, 14081, 14082, 14088, 14092,
 14098, 14100, 14102, 12055, 10006, 14107, 14108, 14109, 10011, 14112, 14113,
 14119, 14120, 14122, 14125, 10033, 14130, 14131, 12087, 10042, 12094, 10139,
 14150, 10056, 12119, 14167, 16218, 12124, 12127, 12129, 12132, 14182, 12136,
 12141, 14193, 14197, 12153, 12156, 14218, 12171, 12173, 14222, 12175, 12177,
 14231, 10135, 10136, 12184, 14234, 10140, 14237, 10141, 12191, 14236, 12187,
 10146, 12190, 12195, 12197, 10154, 10155, 14252, 10157, 12206, 10158, 14254,
 14256, 14255, 14259, 12211, 12207, 14262, 10165, 12214, 12217, 10170, 10171,
 14268, 10172, 12222, 12223, 14273, 14275, 10184, 10185, 14282, 12235, 14288,
 10194, 12244, 12245, 10198, 12247, 12250, 10204, 12255, 10208, 14303, 14306,
 14307, 12263, 12264, 10216, 14314, 12266, 12265, 10221, 12268, 14320, 14321,
 10225, 14323, 12278, 12280, 10237, 10238], [13504, 12773, 11367, 15754, 12252,
 15885, 12815, 12857, 15793, 10961, 12253, 14229, 12633, 11484, 15741, 13693],
 [14475, 13087]]

[17]: Text(0, 0.5, 'Number of Nodes Per Component')



```
[ ]: from google.colab import drive
drive.mount('/content/drive')
```

```
[18]: # node degree calculation
node_indegrees=[item for item in dict(G.in_degree()).items()]
node_outdegrees=[item for item in dict(G.out_degree()).items()]
sorted_indegrees=sorted(node_indegrees,key=operator.itemgetter(1),reverse=True)
sorted_outdegrees=sorted(node_outdegrees,key=operator.
    ↪itemgetter(1),reverse=True)
```

```
[19]: print("Sample Indegree List",node_indegrees[:5],"\n")
print("Sorted In Decreasing Order of Indegrees",sorted_indegrees[:5],"\n")
print("Sample Outdegree List",node_outdegrees[:5],"\n")
print("Sorted In Decreasing Order of Outdegree",sorted_outdegrees[:5],"\n")
```

Sample Indegree List [(13535, 5), (12197, 58), (10792, 65), (10540, 39), (13303, 101)]

Sorted In Decreasing Order of Indegrees [(11292, 192), (11298, 192), (13930, 183), (10397, 174), (13244, 154)]

Sample Outdegree List [(13535, 2), (12197, 60), (10792, 61), (10540, 39), (13303, 103)]

Sorted In Decreasing Order of Outdegree [(11292, 191), (11298, 191), (13930, 188), (10397, 177), (13244, 148)]

```
[20]: node_degrees=airtraffic_helpers.getdegree(G)
      print("Sample degree list",node_degrees[:5],"\n")
      sorted_degrees=sorted(node_degrees,key=operator.itemgetter(1),reverse=True)
      print("Sorted in decreasing order of degrees",sorted_degrees[:5],"\n")
```

Sample degree list [(13535, 7), (12197, 118), (10792, 126), (10540, 78), (13303, 204)]

Sorted in decreasing order of degrees [(11292, 383), (11298, 383), (13930, 371), (10397, 351), (13244, 302)]

```
[21]: # plotting the degree distribution
      sns.distplot(pd.Series(np.array(node_degrees).T[1], name="Degree distribution"))
```

<ipython-input-21-44cc6e898ae4>:2: UserWarning:

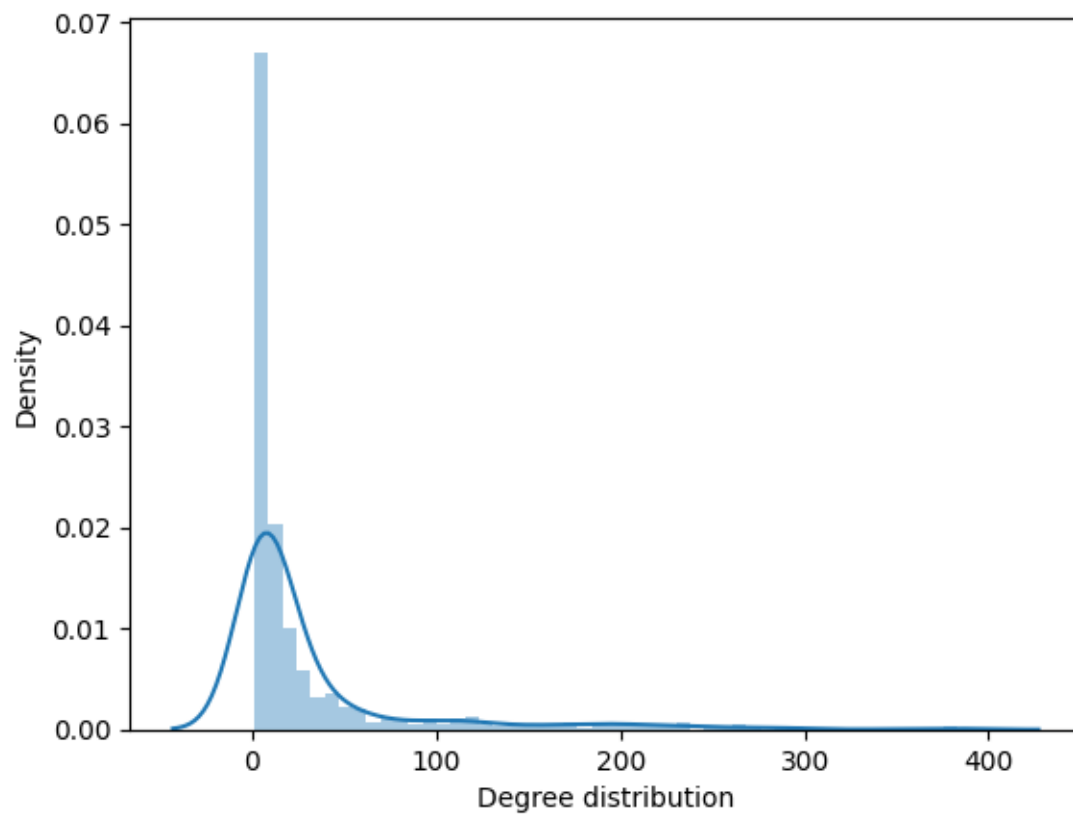
`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).

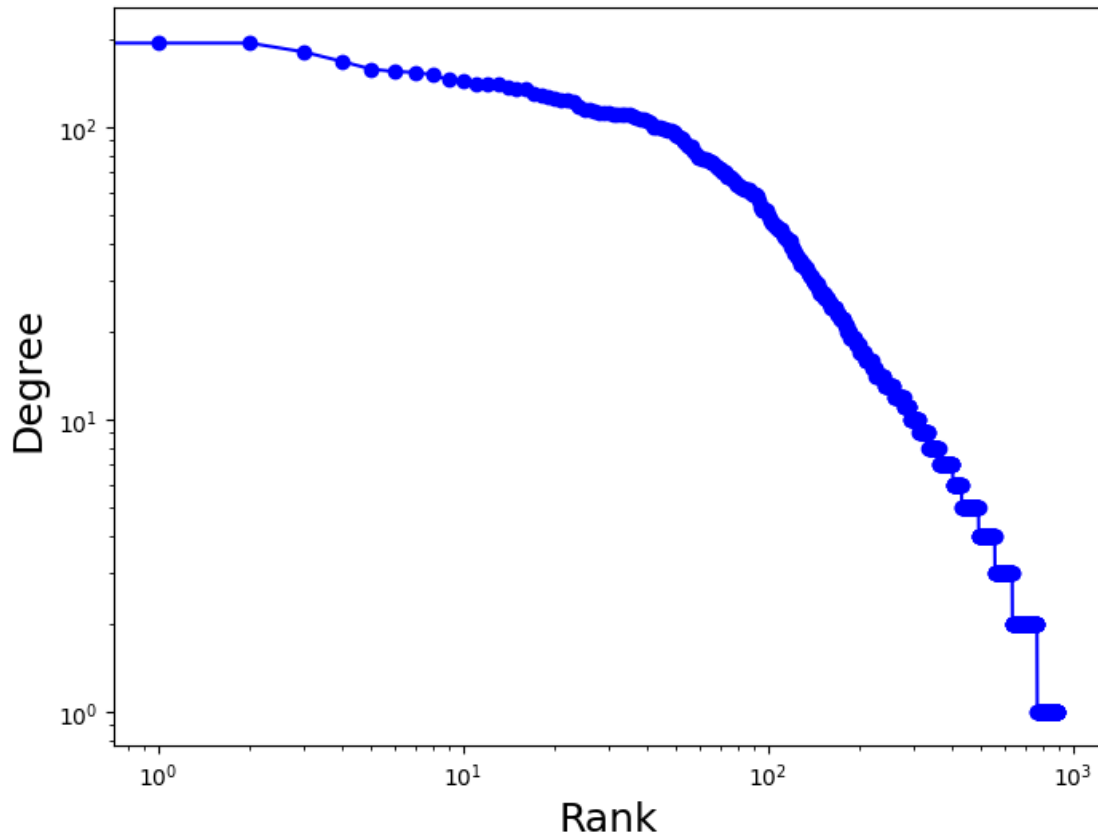
For a guide to updating your code to use the new functions, please see <https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751>

```
sns.distplot(pd.Series(np.array(node_degrees).T[1], name="Degree
distribution"))
```

```
[21]: <Axes: xlabel='Degree distribution', ylabel='Density'>
```



```
[22]: # plotting the degree-rank plot  
airtraffic_helpers.generate_degree_rank_plot(edgelist)
```



```
[23]: # find network density
print('Network density:', nx.density(G))
```

Network density: 0.017235721031838486

```
[24]: sub_graphs = [G_undirected.subgraph(c).copy() for c in nx.
    ↪connected_components(G_undirected)]
print('Number of connected components: ', len([k for k in sub_graphs]))
```

Number of connected components: 6

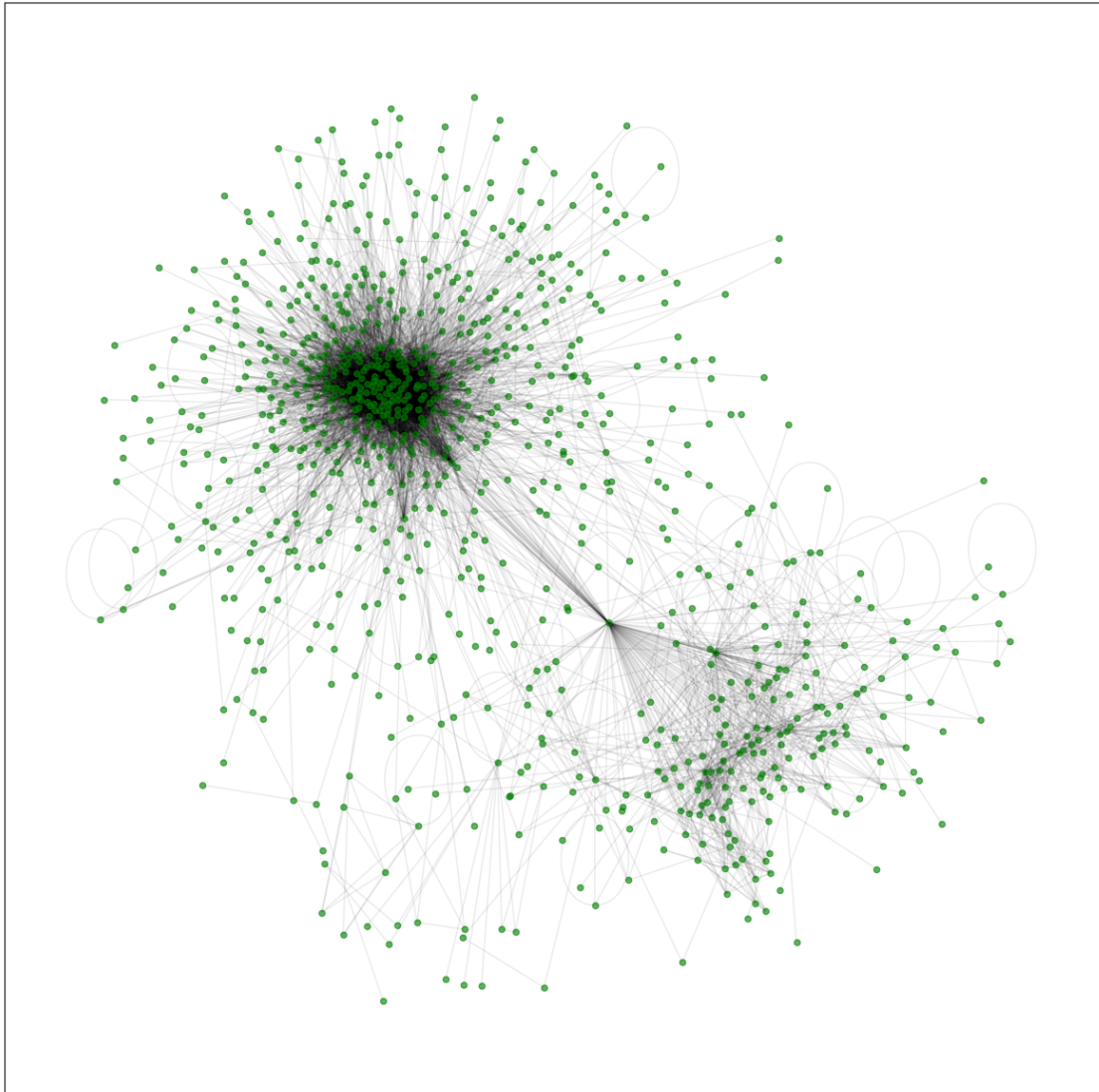
```
[25]: # finding and plotting the giant connected component
Gc = max(sub_graphs, key=len)
Gc=nx.convert_node_labels_to_integers(Gc)
Gc.name='GCC'
print(Gc)
print('Diameter of the Giant connected component:', nx.diameter(Gc))
print('Average shortest path:', nx.average_shortest_path_length(Gc))
```

Graph named 'GCC' with 870 nodes and 8097 edges
Diameter of the Giant connected component: 10

Average shortest path: 3.1862068965517243

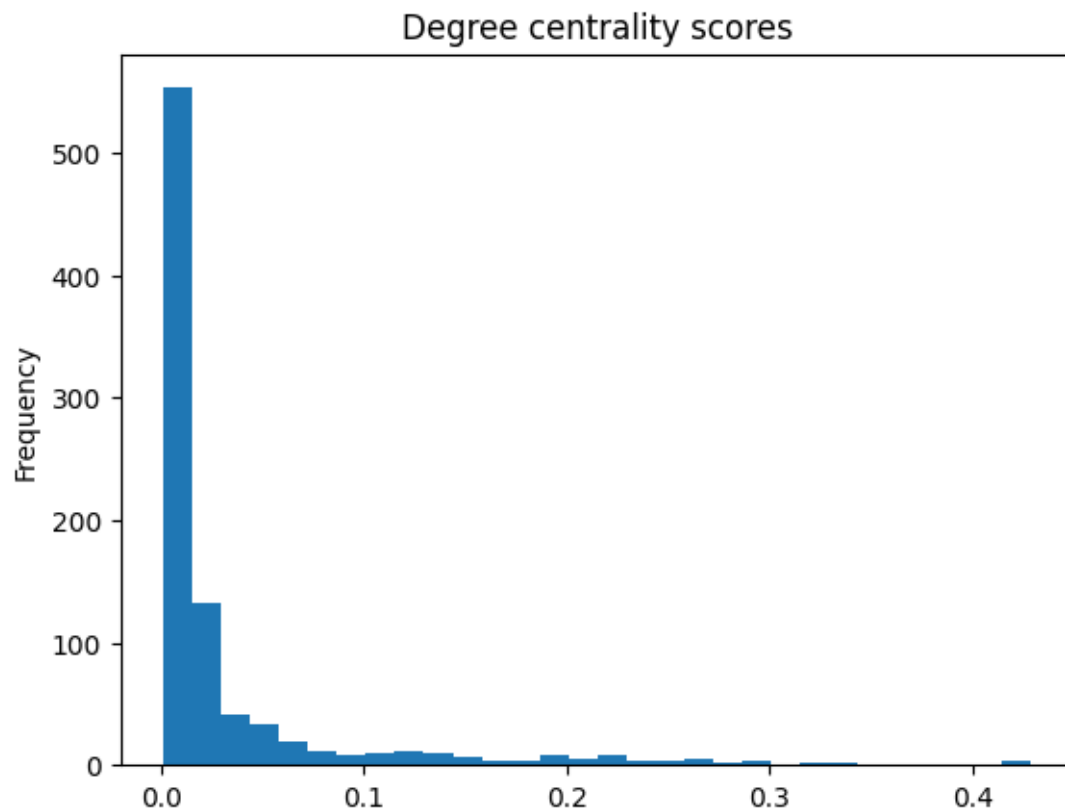
```
[26]: # plotting the GCC
airtraffic_helpers.plot_network(Gc,title="",edgealpha=0.
↪08,node_dist=1,nodesize=20,savefig=False,figsize=(15,15))
```

1



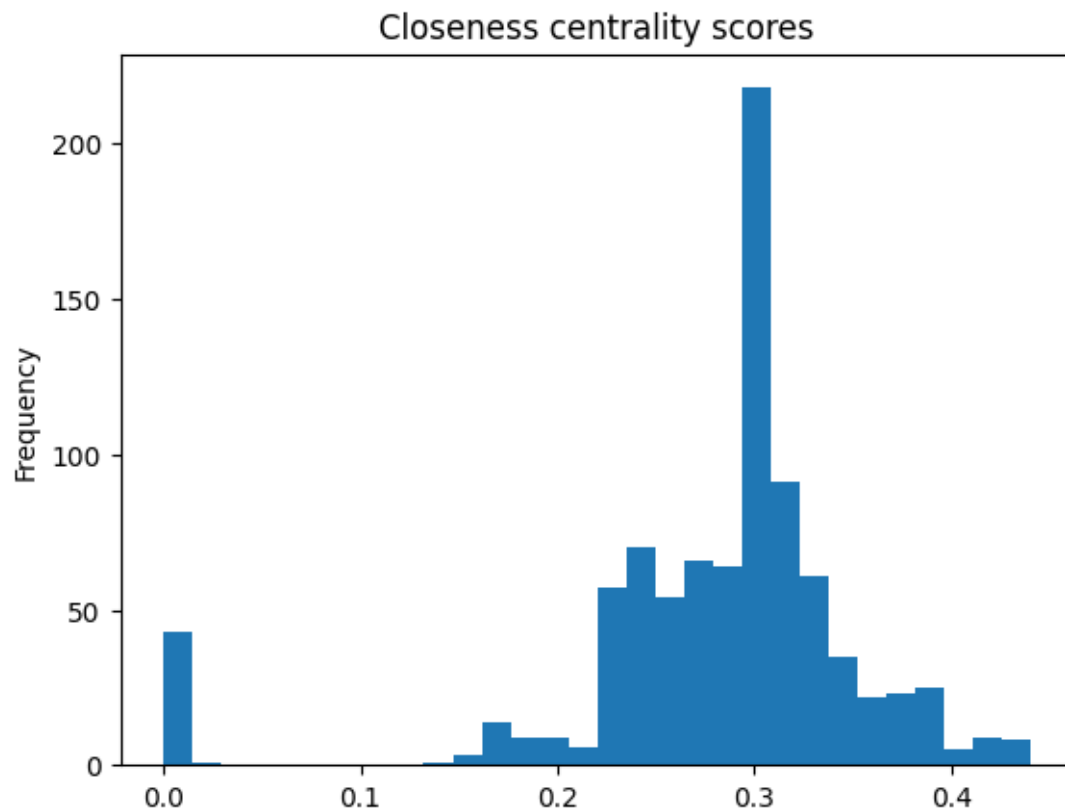
```
[27]: pd.Series(nx.degree_centrality(G)).sort_values().
↪plot(kind='hist',bins=30,title="Degree centrality scores")
```

```
[27]: <Axes: title={'center': 'Degree centrality scores'}, ylabel='Frequency'>
```



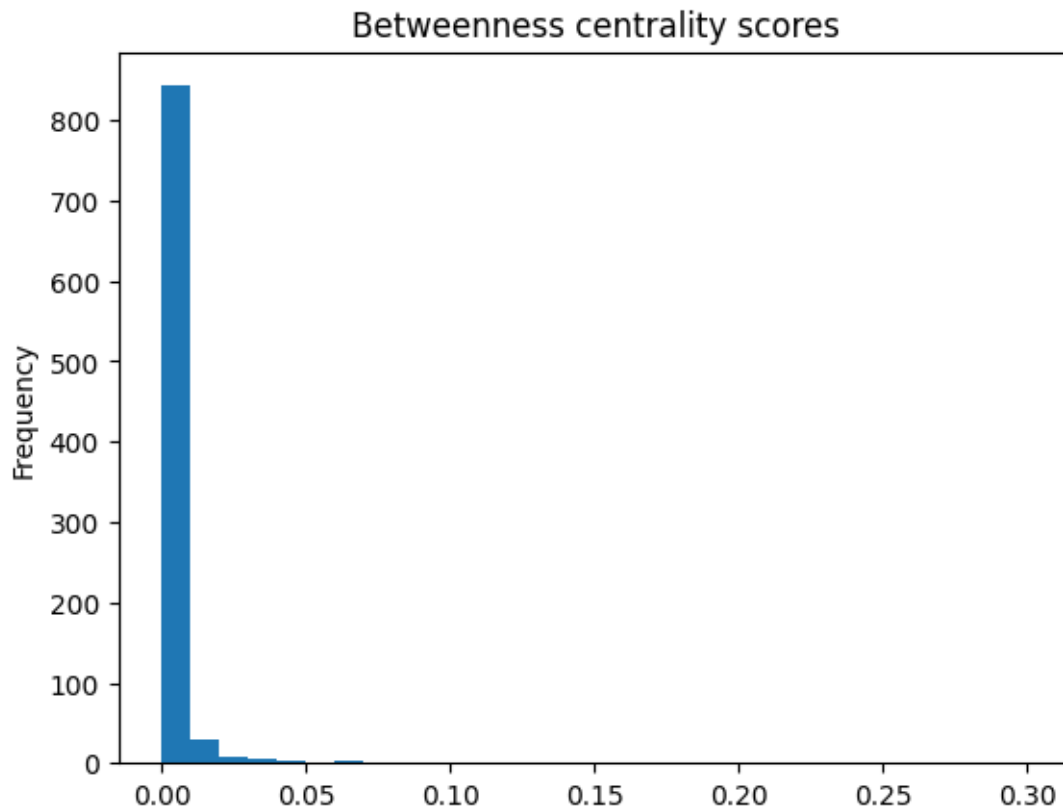
```
[28]: pd.Series(nx.closeness centrality(G)).sort_values().  
      ↪plot(kind='hist',bins=30,title="Closeness centrality scores")
```

```
[28]: <Axes: title={'center': 'Closeness centrality scores'}, ylabel='Frequency'>
```



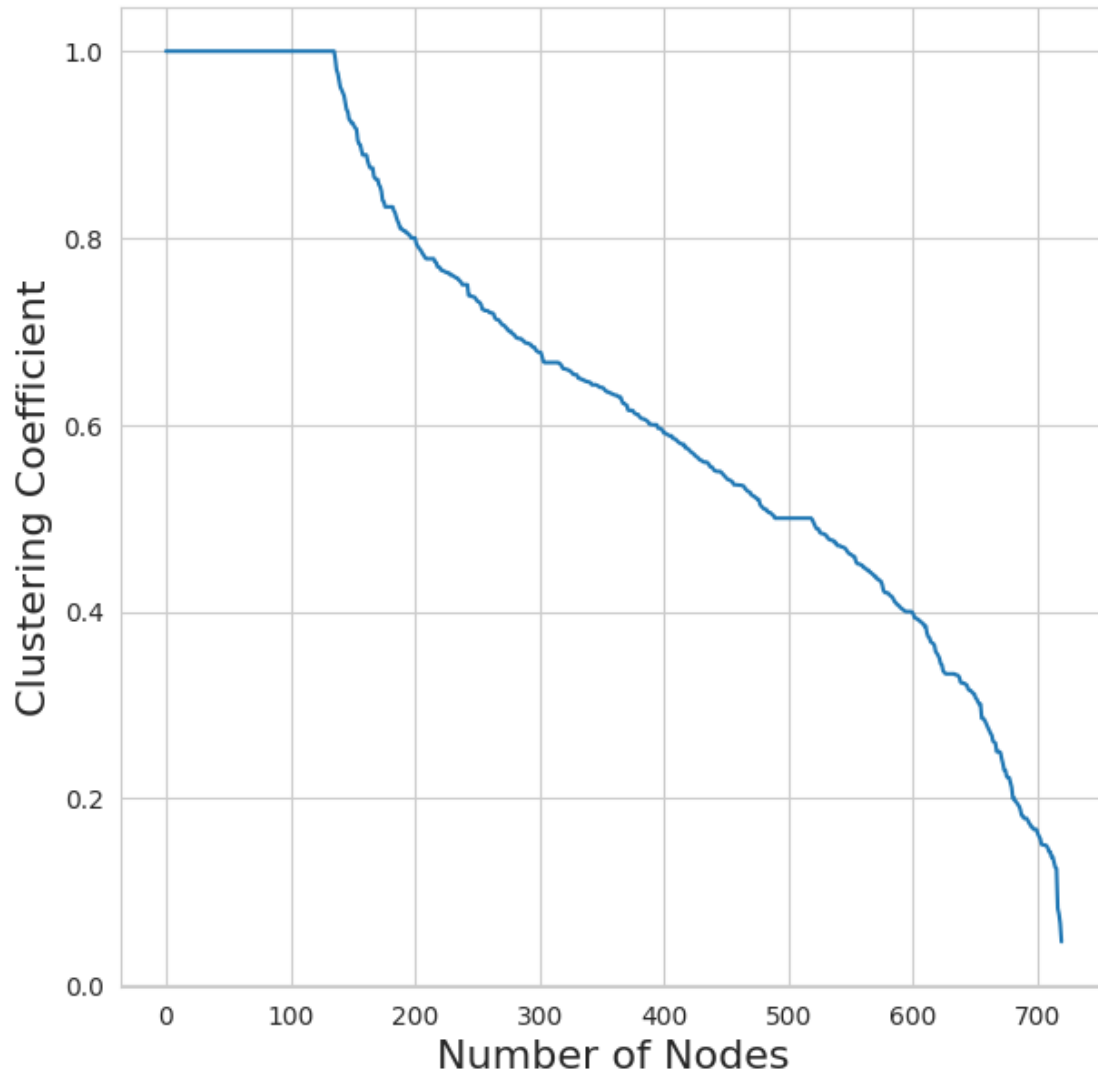
```
[29]: pd.Series(nx.betweenness centrality(G)).sort_values().  
      ↪ plot(kind='hist', bins=30, title="Betweenness centrality scores")
```

```
[29]: <Axes: title={'center': 'Betweenness centrality scores'}, ylabel='Frequency'>
```



```
[30]: # plotting average clustering coefficient
airtraffic_helpers.generate_clustering_coefficient_plot(G)
clust_coeff=nx.average_clustering(G)
print("Average Clustering Coefficient",round(clust_coeff,4))
```

Average Clustering Coefficient 0.5151



```
[31]: # As the network is large, we will randomly select 400 nodes for node centric_
      ↪ community detection analysis
airportids_subset = random.sample(airport_ids,k=300)
```

```
[32]: # filter edges to contain nodes only from the above generated airports subset
edgelist_subset = []
for item in edgelist:
    if item[0] in airportids_subset and item[1] in airportids_subset:
        edgelist_subset.append(item)
```

```
[33]: G_subset_undirected = nx.Graph()
G_subset_undirected.add_edges_from(edgelist_subset)
```

```
[34]: # identifying the cliques in the network
      cl=nx.enumerate_all_cliques(G_subset_undirected)
      #print last 10 cliques
      print([l for l in cl][-10:])
```

```
[[13930, 11292, 14100, 13342, 11066, 12478, 13244, 12889, 12892, 12266, 14683,
14893, 14679, 10821, 14570, 10140], [13930, 11292, 14100, 13342, 11066, 12478,
13244, 12889, 12892, 12266, 14683, 14679, 10821, 14570, 10140, 14831], [13930,
11292, 14100, 13342, 12478, 13244, 12889, 12892, 14635, 12266, 14893, 14679,
10821, 14570, 10140, 15376], [13930, 11292, 14100, 13342, 12478, 13244, 12889,
12892, 14635, 12266, 14679, 10821, 14570, 10140, 14831, 15376], [13930, 11292,
14100, 13342, 12478, 13244, 12889, 12892, 12266, 14683, 14893, 14679, 10821,
14570, 10140, 15376], [13930, 11292, 14100, 13342, 12478, 13244, 12889, 12892,
12266, 14683, 14679, 10821, 14570, 10140, 14831, 15376], [14122, 13930, 11292,
14100, 13342, 11066, 12478, 13244, 12889, 12892, 14635, 12266, 14893, 14679,
10821, 14570, 10140], [14122, 13930, 11292, 14100, 13342, 11066, 12478, 13244,
12889, 12892, 14635, 12266, 14679, 10821, 14570, 10140, 14831], [14122, 13930,
11292, 14100, 13342, 11066, 12478, 13244, 12889, 12892, 12266, 14683, 14893,
14679, 10821, 14570, 10140], [14122, 13930, 11292, 14100, 13342, 11066, 12478,
13244, 12889, 12892, 12266, 14683, 14679, 10821, 14570, 10140, 14831]]
```

```
[35]: # printing the 5 largest cliques
      print("5 Largest Cliques",sorted([l for l in nx.
      ↪find_cliques(G_subset_undirected)],key=lambda x: len(x),reverse=True)[:5])
```

```
5 Largest Cliques [[11292, 12892, 12889, 12266, 13244, 13930, 10821, 14100,
12478, 13342, 14122, 14679, 11066, 14570, 10140, 14635, 14893], [11292, 12892,
12889, 12266, 13244, 13930, 10821, 14100, 12478, 13342, 14122, 14679, 11066,
14570, 10140, 14635, 14831], [11292, 12892, 12889, 12266, 13244, 13930, 10821,
14100, 12478, 13342, 14122, 14679, 11066, 14570, 10140, 14683, 14893], [11292,
12892, 12889, 12266, 13244, 13930, 10821, 14100, 12478, 13342, 14122, 14679,
11066, 14570, 10140, 14683, 14831], [11292, 12892, 12889, 12266, 13244, 13930,
10821, 14100, 12478, 13342, 15376, 14679, 14570, 10140, 14635, 14893]]
```

```
[36]: # printing cliques containing Node ID 14107
      print(nx.cliques_containing_node(G_subset_undirected,14107))
```

```
[]
```

<ipython-input-36-9426a9e4197a>:2: DeprecationWarning:

cliques_containing_node is deprecated and will be removed.

Use the result of find_cliques directly to compute maximal cliques containing each node:

```
{n: [c for c in nx.find_cliques(G) if n in c] for n in G}
```

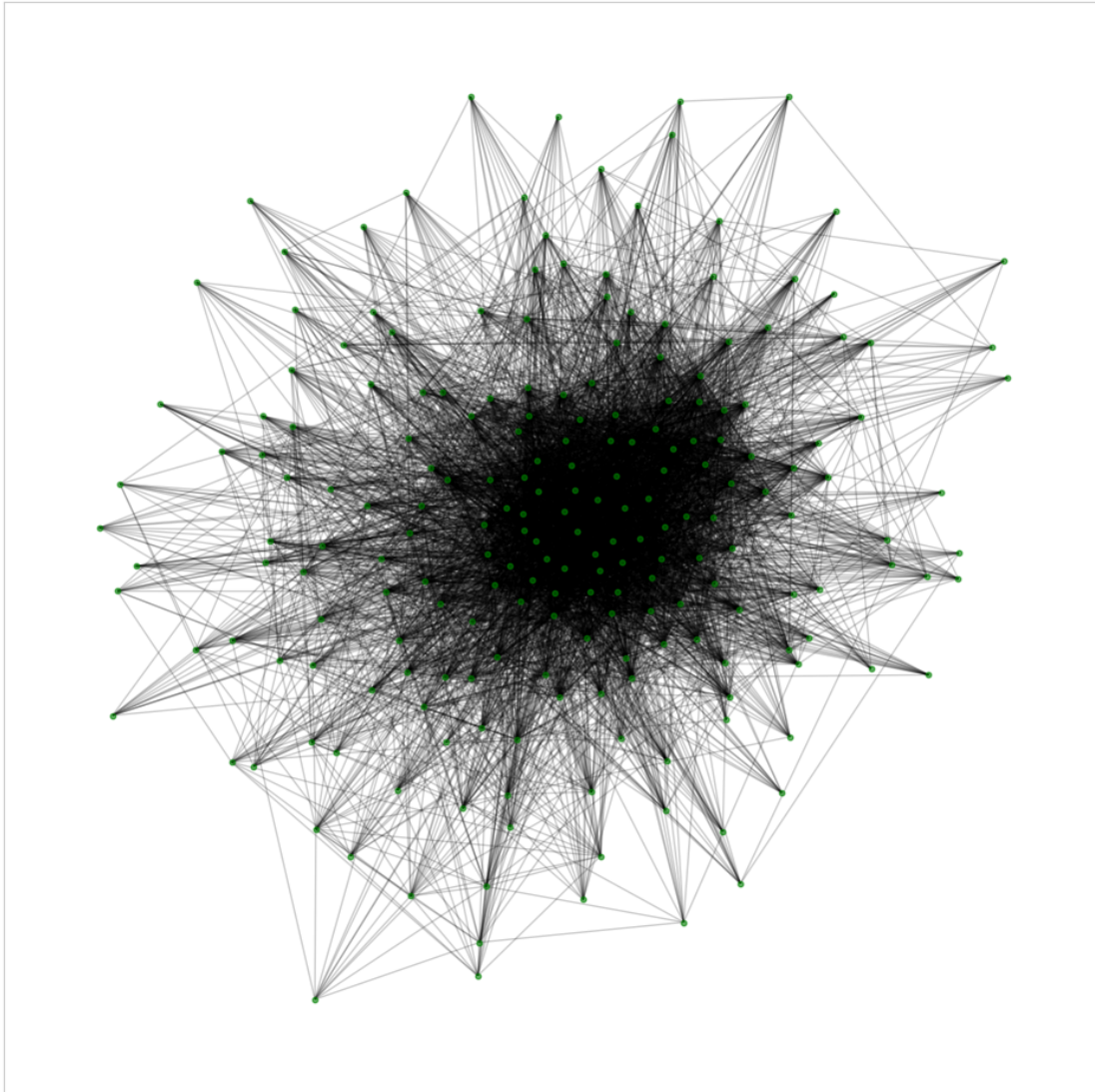
```
print(nx.cliques_containing_node(G_subset_undirected,14107))
```

```
[37]: # Find K cliques using percolation method. K=10
print([l for l in nx.algorithms.community.
      ↪k_clique_communities(G_subset_undirected,10)])
```

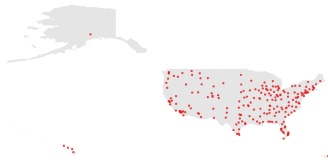
```
[frozenset({12173, 15376, 11540, 14100, 12954, 10140, 11292, 13342, 14122,
14635, 14893, 12206, 13485, 13232, 14512, 11066, 13244, 14524, 12478, 10821,
14027, 14679, 12889, 14683, 12892, 14685, 12896, 11618, 13158, 14570, 12266,
13930, 14831, 10994})]
```

```
[38]: # finding k-core, in this case k=12
G_noselfloop = G_undirected
G_noselfloop.remove_edges_from(nx.selfloop_edges(G_noselfloop))
g_k=nx.k_core(G_noselfloop,k=12)
airtraffic_helpers.plot_network(g_k,node_dist=4,figsize=(12,12),nodesize=10)
```

1



```
[39]: #Code to generate the shape file and station k_core visualization.
labels=g_k.nodes()
fig, ax = plt.subplots(1,1,figsize=(100,40))
base = shp_us.plot(ax=ax, color='gray', alpha=0.2)
geo_stations[geo_stations.station_ids.isin(labels)].plot(ax=base, marker="o",
    ↪color="r", markersize=100,alpha=0.8, zorder=0)
_ = ax.axis('off')
```



```
[40]: pg_rank=sorted([l for l in nx.pagerank(G).items()],key=lambda x:
    ↪x[1],reverse=True)
print("Top 10 Stations By Pagerank",pg_rank[:10])
```

```
Top 10 Stations By Pagerank [(11292, 0.01221494725476268), (11298,
0.011381590445025938), (13930, 0.00997962312402018), (10299,
0.00939511707467981), (10397, 0.009064999187123815), (11630,
0.009051601926279329), (11057, 0.0076106941137978265), (14107,
0.007596691365580076), (13244, 0.007578474594985932), (13487,
0.007464106315286927)]
```

```
[41]: hubs,authorities=nx.hits(G)
hubs=sorted([l for l in hubs.items()],key=lambda x: x[1],reverse=True)
authorities=sorted([l for l in authorities.items()],key=lambda x:
    ↪x[1],reverse=True)
print("Top 10 Biggest Hubs",hubs[:10])
print("\nTop 10 Biggest Authorities",authorities[:10])
```

```
Top 10 Biggest Hubs [(10397, 0.011091413715196823), (11292,
0.01086711243082248), (13930, 0.010807784511584909), (11298,
0.01072620103658908), (13244, 0.01052437141472659), (14100,
0.009893463383107247), (12889, 0.00986617712981815), (11057,
0.009857304537613588), (13487, 0.009770138089794309), (12892,
0.009718608757415011)]
```

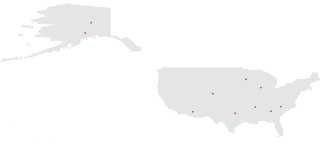
```
Top 10 Biggest Authorities [(11292, 0.010985791978555697), (10397,
0.010864123359412343), (11298, 0.010761317526652953), (13930,
0.010613211902404619), (13244, 0.010582992351075342), (12889,
0.010082646481226256), (14100, 0.010008257719157799), (10693,
0.009961046586770972), (13487, 0.009821757310018176), (14107,
0.009756191224934407)]
```

```
[42]: # Top 10 pagerank nodes visualization
labels=list(map(lambda x: x[0],pg_rank[:10]))
fig, ax = plt.subplots(1,1,figsize=(100,40))
base = shp_us.plot(ax=ax, color='gray', alpha=0.2)
```

```

geo_stations[geo_stations.station_ids.isin(labels)].plot(ax=base, marker="o",
↳color="r", markersize=100,alpha=0.8, zorder=0)
_ = ax.axis('off')
fig.tight_layout()
fig.savefig("{}figures/pagerank.pdf".format(dir_path))

```



```

[43]: # Top 10 hubs nodes visualization
labels=list(map(lambda x: x[0],hubs[:10]))
fig, ax = plt.subplots(1,1,figsize=(100,40))
base = shp_us.plot(ax=ax, color='gray', alpha=0.2)
geo_stations[geo_stations.station_ids.isin(labels)].plot(ax=base, marker="o",
↳color="r", markersize=100,alpha=0.8, zorder=0)
_ = ax.axis('off')
fig.tight_layout()
fig.savefig("{}figures/hubs.pdf".format(dir_path))

```



```

[44]: # Top 10 authorities nodes visualization
labels=list(map(lambda x: x[0],authorities[:10]))
fig, ax = plt.subplots(1,1,figsize=(100,40))
base = shp_us.plot(ax=ax, color='gray', alpha=0.2)
geo_stations[geo_stations.station_ids.isin(labels)].plot(ax=base, marker="o",
↳color="r", markersize=100,alpha=0.8, zorder=0)
_ = ax.axis('off')
fig.tight_layout()
fig.savefig("{}figures/authorities.pdf".format(dir_path))

```



[49]: `!pip install nbconvert`

```
Requirement already satisfied: nbconvert in /usr/local/lib/python3.10/dist-packages (6.5.4)
Requirement already satisfied: lxml in /usr/local/lib/python3.10/dist-packages (from nbconvert) (4.9.3)
Requirement already satisfied: beautifulsoup4 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (4.11.2)
Requirement already satisfied: bleach in /usr/local/lib/python3.10/dist-packages (from nbconvert) (6.0.0)
Requirement already satisfied: defusedxml in /usr/local/lib/python3.10/dist-packages (from nbconvert) (0.7.1)
Requirement already satisfied: entrypoints>=0.2.2 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (0.4)
Requirement already satisfied: Jinja2>=3.0 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (3.1.2)
Requirement already satisfied: jupyter-core>=4.7 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (5.3.1)
Requirement already satisfied: jupyterlab-pygments in /usr/local/lib/python3.10/dist-packages (from nbconvert) (0.2.2)
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (2.1.3)
Requirement already satisfied: mistune<2,>=0.8.1 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (0.8.4)
Requirement already satisfied: nbclient>=0.5.0 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (0.8.0)
Requirement already satisfied: nbformat>=5.1 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (5.9.2)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from nbconvert) (23.1)
Requirement already satisfied: pandocfilters>=1.4.1 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (1.5.0)
Requirement already satisfied: pygments>=2.4.1 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (2.16.1)
Requirement already satisfied: tinycss2 in /usr/local/lib/python3.10/dist-packages (from nbconvert) (1.2.1)
Requirement already satisfied: traitlets>=5.0 in /usr/local/lib/python3.10/dist-
```

packages (from nbconvert) (5.7.1)
 Requirement already satisfied: platformdirs>=2.5 in
 /usr/local/lib/python3.10/dist-packages (from jupyter-core>=4.7->nbconvert)
 (3.10.0)
 Requirement already satisfied: jupyter-client>=6.1.12 in
 /usr/local/lib/python3.10/dist-packages (from nbclient>=0.5.0->nbconvert)
 (6.1.12)
 Requirement already satisfied: fastjsonschema in /usr/local/lib/python3.10/dist-
 packages (from nbformat>=5.1->nbconvert) (2.18.0)
 Requirement already satisfied: jsonschema>=2.6 in
 /usr/local/lib/python3.10/dist-packages (from nbformat>=5.1->nbconvert) (4.19.0)
 Requirement already satisfied: soupsieve>1.2 in /usr/local/lib/python3.10/dist-
 packages (from beautifulsoup4->nbconvert) (2.5)
 Requirement already satisfied: six>=1.9.0 in /usr/local/lib/python3.10/dist-
 packages (from bleach->nbconvert) (1.16.0)
 Requirement already satisfied: webencodings in /usr/local/lib/python3.10/dist-
 packages (from bleach->nbconvert) (0.5.1)
 Requirement already satisfied: attrs>=22.2.0 in /usr/local/lib/python3.10/dist-
 packages (from jsonschema>=2.6->nbformat>=5.1->nbconvert) (23.1.0)
 Requirement already satisfied: jsonschema-specifications>=2023.03.6 in
 /usr/local/lib/python3.10/dist-packages (from
 jsonschema>=2.6->nbformat>=5.1->nbconvert) (2023.7.1)
 Requirement already satisfied: referencing>=0.28.4 in
 /usr/local/lib/python3.10/dist-packages (from
 jsonschema>=2.6->nbformat>=5.1->nbconvert) (0.30.2)
 Requirement already satisfied: rpds-py>=0.7.1 in /usr/local/lib/python3.10/dist-
 packages (from jsonschema>=2.6->nbformat>=5.1->nbconvert) (0.10.2)
 Requirement already satisfied: pyzmq>=13 in /usr/local/lib/python3.10/dist-
 packages (from jupyter-client>=6.1.12->nbclient>=0.5.0->nbconvert) (23.2.1)
 Requirement already satisfied: python-dateutil>=2.1 in
 /usr/local/lib/python3.10/dist-packages (from jupyter-
 client>=6.1.12->nbclient>=0.5.0->nbconvert) (2.8.2)
 Requirement already satisfied: tornado>=4.1 in /usr/local/lib/python3.10/dist-
 packages (from jupyter-client>=6.1.12->nbclient>=0.5.0->nbconvert) (6.3.2)

```
[50]: !sudo apt-get install texlive-xetex texlive-fonts-recommended
      ↪ texlive-plain-generic
```

Reading package lists... Done
 Building dependency tree... Done
 Reading state information... Done
 The following additional packages will be installed:
 dvisvgm fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono
 fonts-texgyre fonts-urw-base35 libapache-pom-java libcommons-logging-java
 libcommons-parent-java libfontbox-java libfontenc1 libgs9 libgs9-common
 libidn12 libijs-0.35 libjbig2dec0 libkpathsea6 libpdfbox-java libptexenc1
 libruby3.0 libsynchronet2 libteckit0 libtexlua53 libtexluajit2 libwoff1
 libzzip-0-13 lmodern poppler-data preview-latex-style rake ruby

ruby-net-telnet ruby-rubygems ruby-webrick ruby-xmlrpc ruby3.0
rubygems-integration tlutils teckit tex-common tex-gyre texlive-base
texlive-binaries texlive-latex-base texlive-latex-extra
texlive-latex-recommended texlive-pictures tipa xfonts-encodings
xfonts-utils

Suggested packages:

fonts-noto fonts-freefont-otf | fonts-freefont-ttf libavalon-framework-java
libcommons-logging-java-doc libexcalibur-logkit-java liblog4j1.2-java
poppler-utils ghostscript fonts-japanese-mincho | fonts-ipafont-mincho
fonts-japanese-gothic | fonts-ipafont-gothic fonts-arphic-ukai
fonts-arphic-uming fonts-nanum ri ruby-dev bundler debhelper gv
| postscript-viewer perl-tk xpdf | pdf-viewer xzdec
texlive-fonts-recommended-doc texlive-latex-base-doc python3-pygments
icc-profiles libfile-which-perl libspreadsheet-parseexcel-perl
texlive-latex-extra-doc texlive-latex-recommended-doc texlive-luatex
texlive-pstricks dot2tex prerex texlive-pictures-doc vprerex
default-jre-headless tipa-doc

The following NEW packages will be installed:

dvisvgm fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono
fonts-texgyre fonts-urw-base35 libapache-pom-java libcommons-logging-java
libcommons-parent-java libfontbox-java libfontenc1 libgs9 libgs9-common
libidn12 libijs-0.35 libjbig2dec0 libkpathsea6 libpdfbox-java libptexenc1
libruby3.0 libsynchronet2 libteckit0 libtexlua53 libtexlua53-2 libwoff1
libzip-0-13 lmodern poppler-data preview-latex-style rake ruby
ruby-net-telnet ruby-rubygems ruby-webrick ruby-xmlrpc ruby3.0
rubygems-integration tlutils teckit tex-common tex-gyre texlive-base
texlive-binaries texlive-fonts-recommended texlive-latex-base
texlive-latex-extra texlive-latex-recommended texlive-pictures
texlive-plain-generic texlive-xetex tipa xfonts-encodings xfonts-utils

0 upgraded, 54 newly installed, 0 to remove and 18 not upgraded.

Need to get 182 MB of archives.

After this operation, 571 MB of additional disk space will be used.

Get:1 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 fonts-droid-fallback all 1:6.0.1r16-1.1build1 [1,805 kB]

Get:2 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 fonts-lato all 2.0-2.1 [2,696 kB]

Get:3 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 poppler-data all 0.4.11-1 [2,171 kB]

Get:4 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 tex-common all 6.17 [33.7 kB]

Get:5 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 fonts-urw-base35 all 20200910-1 [6,367 kB]

Get:6 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libgs9-common all 9.55.0-0ubuntu5.4 [752 kB]

Get:7 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libidn12 amd64 1.38-4ubuntu1 [60.0 kB]

Get:8 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 libijs-0.35 amd64 0.35-15build2 [16.5 kB]

Get:9 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 libjbig2dec0 amd64
0.19-3build2 [64.7 kB]
Get:10 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libgs9 amd64
9.55.0~dfsg1-0ubuntu5.4 [5,032 kB]
Get:11 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libkpathsea6
amd64 2021.20210626.59705-1ubuntu0.1 [60.3 kB]
Get:12 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 libwoff1 amd64
1.0.2-1build4 [45.2 kB]
Get:13 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 dvisvgm amd64
2.13.1-1 [1,221 kB]
Get:14 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 fonts-lmodern all
2.004.5-6.1 [4,532 kB]
Get:15 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 fonts-noto-mono all
20201225-1build1 [397 kB]
Get:16 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 fonts-texgyre all
20180621-3.1 [10.2 MB]
Get:17 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libapache-pom-java
all 18-1 [4,720 B]
Get:18 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libcommons-parent-
java all 43-1 [10.8 kB]
Get:19 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libcommons-logging-
java all 1.2-2 [60.3 kB]
Get:20 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 libfontenc1 amd64
1:1.1.4-1build3 [14.7 kB]
Get:21 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libptexenc1
amd64 2021.20210626.59705-1ubuntu0.1 [39.1 kB]
Get:22 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 rubygems-integration
all 1.18 [5,336 B]
Get:23 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 ruby3.0 amd64
3.0.2-7ubuntu2.4 [50.1 kB]
Get:24 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 ruby-rubygems all
3.3.5-2 [228 kB]
Get:25 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 ruby amd64 1:3.0~exp1
[5,100 B]
Get:26 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 rake all 13.0.6-2 [61.7
kB]
Get:27 <http://archive.ubuntu.com/ubuntu> jammy/main amd64 ruby-net-telnet all
0.1.1-2 [12.6 kB]
Get:28 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 ruby-webrick all
1.7.0-3 [51.8 kB]
Get:29 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 ruby-xmlrpc all
0.3.2-1ubuntu0.1 [24.9 kB]
Get:30 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libruby3.0
amd64 3.0.2-7ubuntu2.4 [5,113 kB]
Get:31 <http://archive.ubuntu.com/ubuntu> jammy-updates/main amd64 libsynchronet2
amd64 2021.20210626.59705-1ubuntu0.1 [55.5 kB]
Get:32 <http://archive.ubuntu.com/ubuntu> jammy/universe amd64 libteckit0 amd64
2.5.11+ds1-1 [421 kB]

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Get:33 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libtexlua53
amd64 2021.20210626.59705-1ubuntu0.1 [120 kB]
Get:34 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 libtexluajit2
amd64 2021.20210626.59705-1ubuntu0.1 [267 kB]
Get:35 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libzzip-0-13 amd64
0.13.72+dfsg.1-1.1 [27.0 kB]
Get:36 http://archive.ubuntu.com/ubuntu jammy/main amd64 xfonts-encodings all
1:1.0.5-0ubuntu2 [578 kB]
Get:37 http://archive.ubuntu.com/ubuntu jammy/main amd64 xfonts-utils amd64
1:7.7+6build2 [94.6 kB]
Get:38 http://archive.ubuntu.com/ubuntu jammy/universe amd64 lmodern all
2.004.5-6.1 [9,471 kB]
Get:39 http://archive.ubuntu.com/ubuntu jammy/universe amd64 preview-latex-style
all 12.2-1ubuntu1 [185 kB]
Get:40 http://archive.ubuntu.com/ubuntu jammy/main amd64 t1utils amd64
1.41-4build2 [61.3 kB]
Get:41 http://archive.ubuntu.com/ubuntu jammy/universe amd64 teckit amd64
2.5.11+ds1-1 [699 kB]
Get:42 http://archive.ubuntu.com/ubuntu jammy/universe amd64 tex-gyre all
20180621-3.1 [6,209 kB]
Get:43 http://archive.ubuntu.com/ubuntu jammy-updates/universe amd64 texlive-
binaries amd64 2021.20210626.59705-1ubuntu0.1 [9,848 kB]
Get:44 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-base all
2021.20220204-1 [21.0 MB]
Get:45 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-fonts-
recommended all 2021.20220204-1 [4,972 kB]
Get:46 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-latex-base
all 2021.20220204-1 [1,128 kB]
Get:47 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libfontbox-java all
1:1.8.16-2 [207 kB]
Get:48 http://archive.ubuntu.com/ubuntu jammy/universe amd64 libpdfbox-java all
1:1.8.16-2 [5,199 kB]
Get:49 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-latex-
recommended all 2021.20220204-1 [14.4 MB]
Get:50 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-pictures
all 2021.20220204-1 [8,720 kB]
Get:51 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-latex-extra
all 2021.20220204-1 [13.9 MB]
Get:52 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-plain-
generic all 2021.20220204-1 [27.5 MB]
Get:53 http://archive.ubuntu.com/ubuntu jammy/universe amd64 tipa all 2:1.3-21
[2,967 kB]
Get:54 http://archive.ubuntu.com/ubuntu jammy/universe amd64 texlive-xetex all
2021.20220204-1 [12.4 MB]
Fetched 182 MB in 3s (58.9 MB/s)
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based
frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line 78,

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<> line 54.)
debconf: falling back to frontend: Readline
debconf: unable to initialize frontend: Readline
debconf: (This frontend requires a controlling tty.)
debconf: falling back to frontend: Teletype
dpkg-preconfigure: unable to re-open stdin:
Selecting previously unselected package fonts-droid-fallback.
(Reading database ... 120895 files and directories currently installed.)
Preparing to unpack .../00-fonts-droid-fallback_1%3a6.0.1r16-1.1build1_all.deb
...
Unpacking fonts-droid-fallback (1:6.0.1r16-1.1build1) ...
Selecting previously unselected package fonts-lato.
Preparing to unpack .../01-fonts-lato_2.0-2.1_all.deb ...
Unpacking fonts-lato (2.0-2.1) ...
Selecting previously unselected package poppler-data.
Preparing to unpack .../02-poppler-data_0.4.11-1_all.deb ...
Unpacking poppler-data (0.4.11-1) ...
Selecting previously unselected package tex-common.
Preparing to unpack .../03-tex-common_6.17_all.deb ...
Unpacking tex-common (6.17) ...
Selecting previously unselected package fonts-urw-base35.
Preparing to unpack .../04-fonts-urw-base35_20200910-1_all.deb ...
Unpacking fonts-urw-base35 (20200910-1) ...
Selecting previously unselected package libgs9-common.
Preparing to unpack .../05-libgs9-common_9.55.0~dfsg1-0ubuntu5.4_all.deb ...
Unpacking libgs9-common (9.55.0~dfsg1-0ubuntu5.4) ...
Selecting previously unselected package libidn12:amd64.
Preparing to unpack .../06-libidn12_1.38-4ubuntu1_amd64.deb ...
Unpacking libidn12:amd64 (1.38-4ubuntu1) ...
Selecting previously unselected package libijs-0.35:amd64.
Preparing to unpack .../07-libijs-0.35_0.35-15build2_amd64.deb ...
Unpacking libijs-0.35:amd64 (0.35-15build2) ...
Selecting previously unselected package libjbig2dec0:amd64.
Preparing to unpack .../08-libjbig2dec0_0.19-3build2_amd64.deb ...
Unpacking libjbig2dec0:amd64 (0.19-3build2) ...
Selecting previously unselected package libgs9:amd64.
Preparing to unpack .../09-libgs9_9.55.0~dfsg1-0ubuntu5.4_amd64.deb ...
Unpacking libgs9:amd64 (9.55.0~dfsg1-0ubuntu5.4) ...
Selecting previously unselected package libkpathsea6:amd64.
Preparing to unpack .../10-libkpathsea6_2021.20210626.59705-1ubuntu0.1_amd64.deb
...
Unpacking libkpathsea6:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Selecting previously unselected package libwoff1:amd64.
Preparing to unpack .../11-libwoff1_1.0.2-1build4_amd64.deb ...
Unpacking libwoff1:amd64 (1.0.2-1build4) ...
Selecting previously unselected package dvisvgm.
Preparing to unpack .../12-dvisvgm_2.13.1-1_amd64.deb ...
Unpacking dvisvgm (2.13.1-1) ...

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Selecting previously unselected package fonts-lmodern.
Preparing to unpack .../13-fonts-lmodern_2.004.5-6.1_all.deb ...
Unpacking fonts-lmodern (2.004.5-6.1) ...
Selecting previously unselected package fonts-noto-mono.
Preparing to unpack .../14-fonts-noto-mono_20201225-1build1_all.deb ...
Unpacking fonts-noto-mono (20201225-1build1) ...
Selecting previously unselected package fonts-texgyre.
Preparing to unpack .../15-fonts-texgyre_20180621-3.1_all.deb ...
Unpacking fonts-texgyre (20180621-3.1) ...
Selecting previously unselected package libapache-pom-java.
Preparing to unpack .../16-libapache-pom-java_18-1_all.deb ...
Unpacking libapache-pom-java (18-1) ...
Selecting previously unselected package libcommons-parent-java.
Preparing to unpack .../17-libcommons-parent-java_43-1_all.deb ...
Unpacking libcommons-parent-java (43-1) ...
Selecting previously unselected package libcommons-logging-java.
Preparing to unpack .../18-libcommons-logging-java_1.2-2_all.deb ...
Unpacking libcommons-logging-java (1.2-2) ...
Selecting previously unselected package libfontenc1:amd64.
Preparing to unpack .../19-libfontenc1_1%3a1.1.4-1build3_amd64.deb ...
Unpacking libfontenc1:amd64 (1:1.1.4-1build3) ...
Selecting previously unselected package libptexenc1:amd64.
Preparing to unpack .../20-libptexenc1_2021.20210626.59705-1ubuntu0.1_amd64.deb
...
Unpacking libptexenc1:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Selecting previously unselected package rubygems-integration.
Preparing to unpack .../21-rubygems-integration_1.18_all.deb ...
Unpacking rubygems-integration (1.18) ...
Selecting previously unselected package ruby3.0.
Preparing to unpack .../22-ruby3.0_3.0.2-7ubuntu2.4_amd64.deb ...
Unpacking ruby3.0 (3.0.2-7ubuntu2.4) ...
Selecting previously unselected package ruby-rubygems.
Preparing to unpack .../23-ruby-rubygems_3.3.5-2_all.deb ...
Unpacking ruby-rubygems (3.3.5-2) ...
Selecting previously unselected package ruby.
Preparing to unpack .../24-ruby_1%3a3.0~exp1_amd64.deb ...
Unpacking ruby (1:3.0~exp1) ...
Selecting previously unselected package rake.
Preparing to unpack .../25-rake_13.0.6-2_all.deb ...
Unpacking rake (13.0.6-2) ...
Selecting previously unselected package ruby-net-telnet.
Preparing to unpack .../26-ruby-net-telnet_0.1.1-2_all.deb ...
Unpacking ruby-net-telnet (0.1.1-2) ...
Selecting previously unselected package ruby-webrick.
Preparing to unpack .../27-ruby-webrick_1.7.0-3_all.deb ...
Unpacking ruby-webrick (1.7.0-3) ...
Selecting previously unselected package ruby-xmlrpc.
Preparing to unpack .../28-ruby-xmlrpc_0.3.2-1ubuntu0.1_all.deb ...

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Unpacking ruby-xmlrpc (0.3.2-1ubuntu0.1) ...
Selecting previously unselected package libruby3.0:amd64.
Preparing to unpack .../29-libruby3.0_3.0.2-7ubuntu2.4_amd64.deb ...
Unpacking libruby3.0:amd64 (3.0.2-7ubuntu2.4) ...
Selecting previously unselected package libsyntax2:amd64.
Preparing to unpack .../30-libsyntax2_2021.20210626.59705-1ubuntu0.1_amd64.deb
...
Unpacking libsyntax2:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Selecting previously unselected package libteckit0:amd64.
Preparing to unpack .../31-libteckit0_2.5.11+ds1-1_amd64.deb ...
Unpacking libteckit0:amd64 (2.5.11+ds1-1) ...
Selecting previously unselected package libtexlua53:amd64.
Preparing to unpack .../32-libtexlua53_2021.20210626.59705-1ubuntu0.1_amd64.deb
...
Unpacking libtexlua53:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Selecting previously unselected package libtexluajit2:amd64.
Preparing to unpack
.../33-libtexluajit2_2021.20210626.59705-1ubuntu0.1_amd64.deb ...
Unpacking libtexluajit2:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Selecting previously unselected package libzip-0-13:amd64.
Preparing to unpack .../34-libzip-0-13_0.13.72+dfsg.1-1.1_amd64.deb ...
Unpacking libzip-0-13:amd64 (0.13.72+dfsg.1-1.1) ...
Selecting previously unselected package xfonts-encodings.
Preparing to unpack .../35-xfonts-encodings_1%3a1.0.5-0ubuntu2_all.deb ...
Unpacking xfonts-encodings (1:1.0.5-0ubuntu2) ...
Selecting previously unselected package xfonts-utils.
Preparing to unpack .../36-xfonts-utils_1%3a7.7+6build2_amd64.deb ...
Unpacking xfonts-utils (1:7.7+6build2) ...
Selecting previously unselected package lmodern.
Preparing to unpack .../37-lmodern_2.004.5-6.1_all.deb ...
Unpacking lmodern (2.004.5-6.1) ...
Selecting previously unselected package preview-latex-style.
Preparing to unpack .../38-preview-latex-style_12.2-1ubuntu1_all.deb ...
Unpacking preview-latex-style (12.2-1ubuntu1) ...
Selecting previously unselected package t1utils.
Preparing to unpack .../39-t1utils_1.41-4build2_amd64.deb ...
Unpacking t1utils (1.41-4build2) ...
Selecting previously unselected package teckit.
Preparing to unpack .../40-teckit_2.5.11+ds1-1_amd64.deb ...
Unpacking teckit (2.5.11+ds1-1) ...
Selecting previously unselected package tex-gyre.
Preparing to unpack .../41-tex-gyre_20180621-3.1_all.deb ...
Unpacking tex-gyre (20180621-3.1) ...
Selecting previously unselected package texlive-binaries.
Preparing to unpack .../42-texlive-
binaries_2021.20210626.59705-1ubuntu0.1_amd64.deb ...
Unpacking texlive-binaries (2021.20210626.59705-1ubuntu0.1) ...
Selecting previously unselected package texlive-base.

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Preparing to unpack .../43-texlive-base_2021.20220204-1_all.deb ...
Unpacking texlive-base (2021.20220204-1) ...
Selecting previously unselected package texlive-fonts-recommended.
Preparing to unpack .../44-texlive-fonts-recommended_2021.20220204-1_all.deb ...
Unpacking texlive-fonts-recommended (2021.20220204-1) ...
Selecting previously unselected package texlive-latex-base.
Preparing to unpack .../45-texlive-latex-base_2021.20220204-1_all.deb ...
Unpacking texlive-latex-base (2021.20220204-1) ...
Selecting previously unselected package libfontbox-java.
Preparing to unpack .../46-libfontbox-java_1%3a1.8.16-2_all.deb ...
Unpacking libfontbox-java (1:1.8.16-2) ...
Selecting previously unselected package libpdfbox-java.
Preparing to unpack .../47-libpdfbox-java_1%3a1.8.16-2_all.deb ...
Unpacking libpdfbox-java (1:1.8.16-2) ...
Selecting previously unselected package texlive-latex-recommended.
Preparing to unpack .../48-texlive-latex-recommended_2021.20220204-1_all.deb ...
Unpacking texlive-latex-recommended (2021.20220204-1) ...
Selecting previously unselected package texlive-pictures.
Preparing to unpack .../49-texlive-pictures_2021.20220204-1_all.deb ...
Unpacking texlive-pictures (2021.20220204-1) ...
Selecting previously unselected package texlive-latex-extra.
Preparing to unpack .../50-texlive-latex-extra_2021.20220204-1_all.deb ...
Unpacking texlive-latex-extra (2021.20220204-1) ...
Selecting previously unselected package texlive-plain-generic.
Preparing to unpack .../51-texlive-plain-generic_2021.20220204-1_all.deb ...
Unpacking texlive-plain-generic (2021.20220204-1) ...
Selecting previously unselected package tipa.
Preparing to unpack .../52-tipa_2%3a1.3-21_all.deb ...
Unpacking tipa (2:1.3-21) ...
Selecting previously unselected package texlive-xetex.
Preparing to unpack .../53-texlive-xetex_2021.20220204-1_all.deb ...
Unpacking texlive-xetex (2021.20220204-1) ...
Setting up fonts-lato (2.0-2.1) ...
Setting up fonts-noto-mono (20201225-1build1) ...
Setting up libwoff1:amd64 (1.0.2-1build4) ...
Setting up libtexlua53:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Setting up libijs-0.35:amd64 (0.35-15build2) ...
Setting up libtexluajit2:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Setting up libfontbox-java (1:1.8.16-2) ...
Setting up rubygems-integration (1.18) ...
Setting up libzip-0-13:amd64 (0.13.72+dfsg.1-1.1) ...
Setting up fonts-urw-base35 (20200910-1) ...
Setting up poppler-data (0.4.11-1) ...
Setting up tex-common (6.17) ...
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based
frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line
78.)

```

```

debconf: falling back to frontend: Readline
update-language: texlive-base not installed and configured, doing nothing!
Setting up libfontenc1:amd64 (1:1.1.4-1build3) ...
Setting up libjbig2dec0:amd64 (0.19-3build2) ...
Setting up libteckit0:amd64 (2.5.11+ds1-1) ...
Setting up libapache-pom-java (18-1) ...
Setting up ruby-net-telnet (0.1.1-2) ...
Setting up xfonts-encodings (1:1.0.5-0ubuntu2) ...
Setting up t1utils (1.41-4build2) ...
Setting up libidn12:amd64 (1.38-4ubuntu1) ...
Setting up fonts-texgyre (20180621-3.1) ...
Setting up libkpathsea6:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Setting up ruby-webrick (1.7.0-3) ...
Setting up fonts-lmodern (2.004.5-6.1) ...
Setting up fonts-droid-fallback (1:6.0.1r16-1.1build1) ...
Setting up ruby-xmlrpc (0.3.2-1ubuntu0.1) ...
Setting up libsynchronet2:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Setting up libgs9-common (9.55.0~dfsg1-0ubuntu5.4) ...
Setting up teckit (2.5.11+ds1-1) ...
Setting up libpdfbox-java (1:1.8.16-2) ...
Setting up libgs9:amd64 (9.55.0~dfsg1-0ubuntu5.4) ...
Setting up preview-latex-style (12.2-1ubuntu1) ...
Setting up libcommons-parent-java (43-1) ...
Setting up dvisvgm (2.13.1-1) ...
Setting up libcommons-logging-java (1.2-2) ...
Setting up xfonts-utils (1:7.7+6build2) ...
Setting up libptexenc1:amd64 (2021.20210626.59705-1ubuntu0.1) ...
Setting up texlive-binaries (2021.20210626.59705-1ubuntu0.1) ...
update-alternatives: using /usr/bin/xdvi-xaw to provide /usr/bin/xdvi.bin
(xdvi.bin) in auto mode
update-alternatives: using /usr/bin/bibtex.original to provide /usr/bin/bibtex
(bibtex) in auto mode
Setting up lmodern (2.004.5-6.1) ...
Setting up texlive-base (2021.20220204-1) ...
/usr/bin/ucfr
/usr/bin/ucfr
/usr/bin/ucfr
/usr/bin/ucfr
mktexlsr: Updating /var/lib/texmf/ls-R-TEXLIVEDIST...
mktexlsr: Updating /var/lib/texmf/ls-R-TEXMFMAIN...
mktexlsr: Updating /var/lib/texmf/ls-R...
mktexlsr: Done.
tl-paper: setting paper size for dvips to a4:
/var/lib/texmf/dvips/config/config-paper.ps
tl-paper: setting paper size for dvipdfmx to a4:
/var/lib/texmf/dvipdfmx/dvipdfmx-paper.cfg
tl-paper: setting paper size for xdvi to a4: /var/lib/texmf/xdvi/XDvi-paper
tl-paper: setting paper size for pdftex to a4: /var/lib/texmf/tex/generic/tex-

```



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ini-files/pdftexconfig.tex
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based
frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line
78.)
debconf: falling back to frontend: Readline
Setting up tex-gyre (20180621-3.1) ...
Setting up texlive-plain-generic (2021.20220204-1) ...
Setting up texlive-latex-base (2021.20220204-1) ...
Setting up texlive-latex-recommended (2021.20220204-1) ...
Setting up texlive-pictures (2021.20220204-1) ...
Setting up texlive-fonts-recommended (2021.20220204-1) ...
Setting up tipa (2:1.3-21) ...
Setting up texlive-latex-extra (2021.20220204-1) ...
Setting up texlive-xetex (2021.20220204-1) ...
Setting up rake (13.0.6-2) ...
Setting up libruby3.0:amd64 (3.0.2-7ubuntu2.4) ...
Setting up ruby3.0 (3.0.2-7ubuntu2.4) ...
Setting up ruby (1:3.0~exp1) ...
Setting up ruby-rubygems (3.3.5-2) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for fontconfig (2.13.1-4.2ubuntu5) ...
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...
/sbin/ldconfig.real: /usr/local/lib/libtbbmalloc.so.2 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbmalloc_proxy.so.2 is not a symbolic
link

/sbin/ldconfig.real: /usr/local/lib/libtbbbind.so.3 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbbind_2_5.so.3 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbbbind_2_0.so.3 is not a symbolic link

/sbin/ldconfig.real: /usr/local/lib/libtbb.so.12 is not a symbolic link

Processing triggers for tex-common (6.17) ...
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based
frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line
78.)
debconf: falling back to frontend: Readline
Running updmap-sys. This may take some time... done.
Running mktexlsr /var/lib/texmf ... done.
Building format(s) --all.
    This may take some time... done.

```

```
[51]: !jupyter nbconvert --to pdf "/content/assignment_1/notebooks/  
↪usairtraffic_analysis.ipynb"
```

```
[NbConvertApp] Converting notebook  
/content/assignment_1/notebooks/usairtraffic_analysis.ipynb to pdf  
[NbConvertApp] Writing 62366 bytes to notebook.tex  
[NbConvertApp] Building PDF  
[NbConvertApp] Running xelatex 3 times: ['xelatex', 'notebook.tex', '-quiet']  
[NbConvertApp] Running bibtex 1 time: ['bibtex', 'notebook']  
[NbConvertApp] WARNING | bibtex had problems, most likely because there were no  
citations  
[NbConvertApp] PDF successfully created  
[NbConvertApp] Writing 58114 bytes to  
/content/assignment_1/notebooks/usairtraffic_analysis.pdf
```