Untitled3

July 16, 2021

[1]:
```
import numpy as np
import torch
from tqdm import tqdm
import os
import pandas as pd
from torch_geometric.data import Data
```

0.0.1 Explore Data

[2]:
```
df = pd.read_csv('AirPollutionSeoul/Measurement_summary.csv')
```

[3]:
```
df.head()
```

[3]:

	Measurement date	Station code	Address	Latitude	Longitude	SO2	NO2	O3	CO	PM10	PM2.5
0	2017-01-01 00:00	101	19, Jong-ro 35ga-gil, Jongno-gu, Seoul, Republ…	37.572016	127.005007	0.004	0.059	0.002	1.2	73.0	57.0
1	2017-01-01 01:00	101	19, Jong-ro 35ga-gil, Jongno-gu, Seoul, Republ…	37.572016	127.005007	0.004	0.058	0.002	1.2	71.0	59.0
2	2017-01-01 02:00	101	19, Jong-ro 35ga-gil, Jongno-gu, Seoul, Republ…	37.572016	127.005007	0.004	0.056	0.002	1.2	70.0	59.0
3	2017-01-01 03:00	101	19, Jong-ro 35ga-gil, Jongno-gu, Seoul, Republ…	37.572016	127.005007	0.004	0.056	0.002	1.2	70.0	58.0
4	2017-01-01 04:00	101	19, Jong-ro 35ga-gil, Jongno-gu, Seoul, Republ…	37.572016	127.005007	0.003	0.051	0.002	1.2	69.0	61.0

[4]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 647511 entries, 0 to 647510
```

```
Data columns (total 11 columns):
 #   Column            Non-Null Count   Dtype
---  ------            --------------   -----
 0   Measurement date  647511 non-null  object
 1   Station code      647511 non-null  int64
 2   Address           647511 non-null  object
 3   Latitude          647511 non-null  float64
 4   Longitude         647511 non-null  float64
 5   SO2               647511 non-null  float64
 6   NO2               647511 non-null  float64
 7   O3                647511 non-null  float64
 8   CO                647511 non-null  float64
 9   PM10              647511 non-null  float64
 10  PM2.5             647511 non-null  float64
dtypes: float64(8), int64(1), object(2)
memory usage: 54.3+ MB
```

[5]:
```
df_info = pd.read_csv('AirPollutionSeoul/Original Data/Measurement_info.csv')
```

- Measurement_info

[6]:
```
df_info.head()
```

[6]:

	Measurement date	Station code	Item code	Average value	Instrument status
0	2017-01-01 00:00	101	1	0.004	0
1	2017-01-01 00:00	101	3	0.059	0
2	2017-01-01 00:00	101	5	1.200	0
3	2017-01-01 00:00	101	6	0.002	0
4	2017-01-01 00:00	101	8	73.000	0

- Measurement_item_info

[7]:
```
df_item_info = pd.read_csv('AirPollutionSeoul/Original Data/
↪Measurement_item_info.csv')
```

[8]:
```
df_item_info.head()
```

[8]:

	Item code	Item name	Unit of measurement	Good(Blue)	Normal(Green)	Bad(Yellow)	Very bad(Red)
0	1	SO2	ppm	0.02	0.05	0.15	1.0
1	3	NO2	ppm	0.03	0.06	0.20	2.0
2	5	CO	ppm	2.00	9.00	15.00	50.0
3	6	O3	ppm	0.03	0.09		
4	8	PM10	Mircrogram/m3	30.00	80.00		

```
3         0.15            0.5
4       150.00          600.0
```

- Measurement_station_info

[9]:
```
station = pd.read_csv('AirPollutionSeoul/Original Data/Measurement_station_info.
↪csv')
```

[10]:
```
station.head()
```

[10]:
```
   Station code Station name(district)  \
0           101               Jongno-gu
1           102                  Jung-gu
2           103               Yongsan-gu
3           104             Eunpyeong-gu
4           105             Seodaemun-gu

                                              Address   Latitude   Longitude
0  19, Jong-ro 35ga-gil, Jongno-gu, Seoul, Republ…  37.572016  127.005008
1  15, Deoksugung-gil, Jung-gu, Seoul, Republic o…  37.564263  126.974676
2  136, Hannam-daero, Yongsan-gu, Seoul, Republic…  37.540033  127.004850
3  215, Jinheung-ro, Eunpyeong-gu, Seoul, Republi…  37.609823  126.934848
4  32, Segeomjeong-ro 4-gil, Seodaemun-gu, Seoul,…  37.593742  126.949679
```

- Visualization

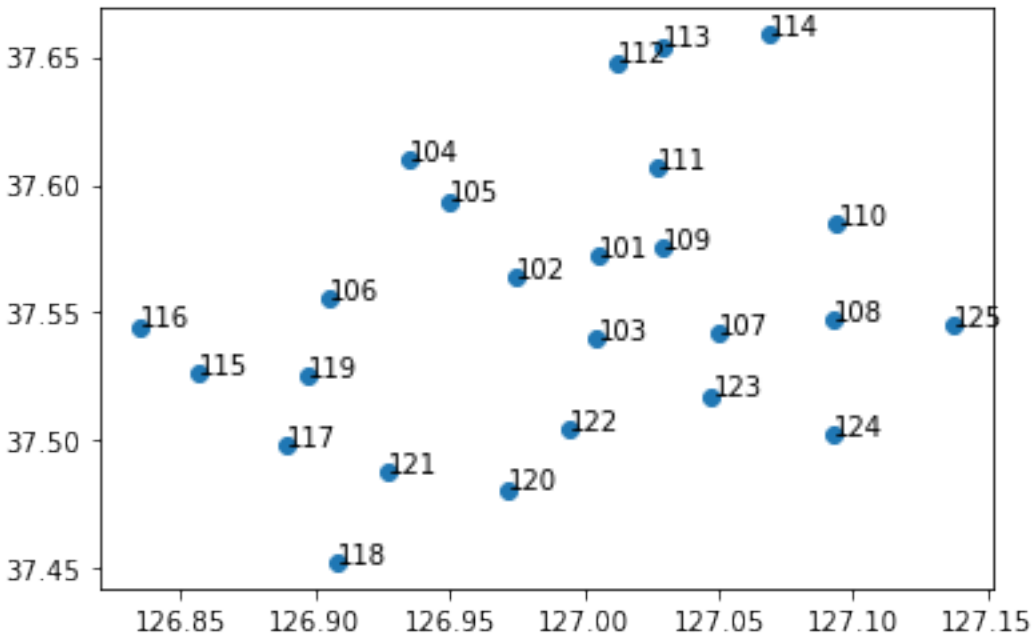
[11]:
```
import matplotlib.pyplot as plt
```

[12]:
```
y = station.loc[:, 'Latitude']
x = station.loc[:, 'Longitude']
n = station.loc[:, 'Station code']

fig, ax = plt.subplots()
ax.scatter(x, y)

for i, txt in enumerate(n):
    ax.annotate(txt, (x[i], y[i]))

plt.savefig('station_code.png')
```



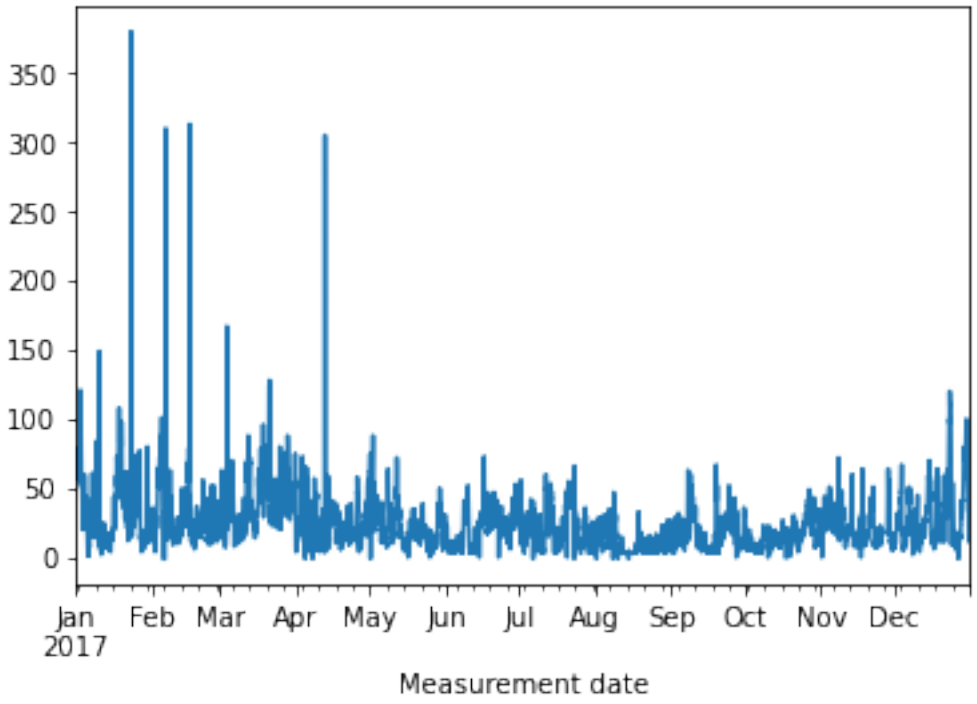
[13]:
```
station101 = df[df['Station code'] == 101]
station101['Measurement date'] = pd.to_datetime(station101['Measurement date'],␣
 ↪format='%Y-%m-%d %H:%M')
```

```
C:\Users\ideapad 330\.conda\envs\AIML\lib\site-packages\ipykernel_launcher.py:2:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

[14]:
```
station101.set_index(['Measurement date'], inplace=True)
station101.iloc[0 : 24 * 365]['PM2.5'].plot()
```

[14]: <AxesSubplot:xlabel='Measurement date'>



- Prepare Data

[15]:
```
station = dict()
for i in [101, 116, 118, 125, 114]:
    station[f'{i}'] = df[df['Station code'] == i].iloc[0 : 24 * 365]
```

[16]:
```
df.iloc[0, 10]
```

[16]: 57.0

[17]:
```
L = []
for i in range(365*24 ):
    A = []
    for code in [101, 116, 118, 125, 114]:
        data = station[f'{code}']
        A.append(data.iloc[i, 10].tolist())
    L.append(A)
```

[18]:
```
stacked_target = np.array(L)
```

[19]:
```
stacked_target.shape
```

[19]: (8760, 5)

[20]:
```
lags = 4
features = [stacked_target[i:i+lags,:].T for i in range(stacked_target.
 ↪shape[0]-lags)]
targets  = [stacked_target[i+lags,:].T for i in range(stacked_target.
 ↪shape[0]-lags)]
```

[21]:
```
_edges = torch.tensor([[1, 2, 3, 4, 0],
                                    [0, 0, 0, 0, 1]], dtype=torch.long)

_edge_weights = np.ones(_edges.shape[1])
```

[22]:
```
_edge_weights.shape
```

[22]:
```
(5,)
```

0.0.2 Model

[23]:
```
from torch_geometric_temporal.signal import StaticGraphTemporalSignal
from torch_geometric_temporal.signal import temporal_signal_split
```

- create datasets

[24]:
```
dataset = StaticGraphTemporalSignal(_edges, _edge_weights, features, targets)
```

[25]:
```
train_dataset, test_dataset = temporal_signal_split(dataset, train_ratio=0.2)
```

- Initial Model

[26]:
```
import torch
import torch.nn.functional as F
from torch_geometric_temporal.nn.recurrent import DCRNN

class RecurrentGCN(torch.nn.Module):
    def __init__(self, node_features):
        super(RecurrentGCN, self).__init__()
        self.recurrent = DCRNN(node_features, 32, 1)
        self.linear = torch.nn.Linear(32, 1)

    def forward(self, x, edge_index, edge_weight):
        h = self.recurrent(x, edge_index, edge_weight)
        h = F.relu(h)
        h = self.linear(h)
        return h
```

- Train

[27]:
```
from tqdm import tqdm
```

```
model = RecurrentGCN(node_features = 4)

optimizer = torch.optim.Adam(model.parameters(), lr=0.01)

model.train()

for epoch in tqdm(range(50)):
    cost = 0
    for time, snapshot in enumerate(train_dataset):
        y_hat = model(snapshot.x, snapshot.edge_index, snapshot.edge_attr)
        cost = cost + torch.mean((y_hat-snapshot.y)**2)
    cost = cost / (time+1)
    cost.backward()
    optimizer.step()
    optimizer.zero_grad()
```

```
100%|
    | 50/50 [05:00<00:00,  6.00s/it]
```

- Measure MSE

[28]:
```
model.eval()
cost = 0
for time, snapshot in enumerate(test_dataset):
    y_hat = model(snapshot.x, snapshot.edge_index, snapshot.edge_attr)
    cost = cost + torch.mean((y_hat-snapshot.y)**2)
cost = cost / (time+1)
cost = cost.item()
print("MSE: {:.4f}".format(cost))
```

```
MSE: 468.3608
```

- Check Model

[29]:
```
k = list(test_dataset)[50]
```

[30]:
```
model(k.x, k.edge_index, k.edge_attr)
```

[30]:
```
tensor([[9.0237],
        [9.0237],
        [9.0237],
        [9.0237],
        [9.0237]], grad_fn=<AddmmBackward>)
```

[31]:
```
k.y
```

[31]:
```
tensor([48., 46., 59., 53., 48.])
```

[ ]:
```

```