

圖17-2 安裝相關地圖套件

```
!pip install geos
!pip install pyshp
#!pip install pyproj
!pip install pyproj==1.9.6
!apt-get install libgeos-clv5 libgeos-dev
!pip install https://github.com/matplotlib/basemap/archive/master.zip

#!wget https://github.com/matplotlib/basemap/archive/v1.1.0.tar.gz
#!tar -xf v1.1.0.tar.gz; cd ./basemap-1.1.0; python setup.py install
#!rm -rf temp.zip; rm -rf basemap-1.1.0
#!rm -rf v1.1.0.tar.gz*
```



Collecting geos

Downloading <https://files.pythonhosted.org/packages/49/5b/b8acf74c01187a36aa41b6523>

| 409kB 26.0MB/s

Requirement already satisfied: lxml in /usr/local/lib/python3.7/dist-packages (from geos)

Requirement already satisfied: flask in /usr/local/lib/python3.7/dist-packages (from geos)

Requirement already satisfied: pillow in /usr/local/lib/python3.7/dist-packages (from geos)

Requirement already satisfied: Jinja2<3.0,>=2.10.1 in /usr/local/lib/python3.7/dist-packages (from geos)

Requirement already satisfied: click<8.0,>=5.1 in /usr/local/lib/python3.7/dist-packages (from geos)

Requirement already satisfied: Werkzeug<2.0,>=0.15 in /usr/local/lib/python3.7/dist-packages (from geos)

Requirement already satisfied: itsdangerous<2.0,>=0.24 in /usr/local/lib/python3.7/dist-packages (from geos)

Requirement already satisfied: MarkupSafe<2.0,>=0.23 in /usr/local/lib/python3.7/dist-packages (from geos)

Installing collected packages: geos

Successfully installed geos-0.2.3

Collecting pyshp

Downloading <https://files.pythonhosted.org/packages/38/85/fbf87e7aa55103e0d06af7561>

| 225kB 23.2MB/s

Building wheels for collected packages: pyshp

圖17-3 上傳字體

Stored in directory: /root/.cache/pip/wheels/76/2b/d4/53e6b9a0+b0a9+9+29664c+82605a

```
from google.colab import files
```

```
uploaded = files.upload()
```

選擇檔案 未選擇任何檔案

Upload widget is only available when the cell has been

executed in the current browser session. Please rerun this cell to enable.

Saving kaiu.ttf to kaiu.ttf

Building wheel for pyshp (setup.py) ... done

圖17-4 世界地圖

Successfully built pyshp

```
import matplotlib.pyplot as plt
from mpl_toolkits.basemap import Basemap
# 1. 設定basemap
map = Basemap()#首先要有basemap地圖底圖
# 2. 畫海岸線圖
map.drawcoastlines()
# 3. 顯示圖片
plt.show()
plt.savefig('result.png', dpi=300)
```



<Figure size 432x288 with 0 Axes>

Created wheel for basemap: filename=basemap-1.2.2.dev-cp37-cp37m-linux_x86_64.whl

圖17-6 繪出台灣地圖

Installing collected packages: basemap

```
import matplotlib.pyplot as plt
from mpl_toolkits.basemap import Basemap
```

```

from mpl_toolkits.basemap import Basemap
import warnings
warnings.filterwarnings("ignore")#忽略警告訊息輸出
# 1. 設定basemap
map = Basemap(projection='merc', resolution='h', #projection表投影類型merc麥卡托 #resolution表
              llcrnrlon=119.0, llcrnrlat=21.8, urcrnrlon=122.05, urcrnrlat=25.4) #llcrnrlon最低經度值 llcrnr
# 2. 畫海岸線圖
map.drawcoastlines(linewidth=1)
map.drawmapboundary(fill_color='cyan')#地圖著色
# 3. 顯示圖片
plt.show()

```

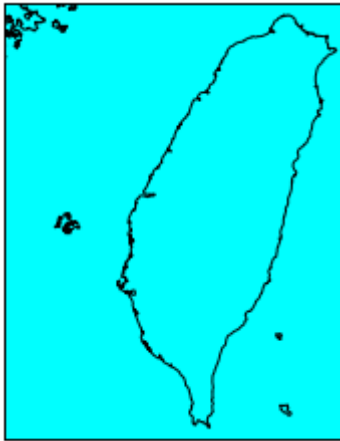


圖17-8 台灣著色

```

import matplotlib.pyplot as plt
from mpl_toolkits.basemap import Basemap
import numpy as np
# 1. 設定basemap
lllon, lllat, urlon, urlat=119.0, 21.8, 122.05, 25.4
map = Basemap(projection='cyl', resolution='h', #cyl等距圓柱投影
              llcrnrlon=lllon, llcrnrlat=lllat, urcrnrlon=urlon, urcrnrlat=urlat)
# 2. 畫海岸線圖
map.drawcoastlines(linewidth=1)
map.drawmapboundary(fill_color='cyan') #整體著色
map.fillcontinents(color='yellow') #國土著色
# 3. 經緯度
#畫緯度線21.5(<21.8)和26(>25.4) #畫經度線119(<120)和123(>112.05)
map.drawparallels(np.arange(21.5, 26), labels=[1, 1, 0, 0], fontsize=10) #drawparallels畫緯度格線 ;la
map.drawmeridians(np.arange(119, 123), labels=[0, 0, 0, 1], fontsize=10) #drawmeridians畫經度格線
# 4. 儲存顯示圖片
plt.show()

```

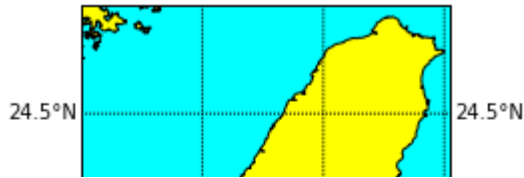


圖17-10 安裝縣市界線所需套件 <https://data.gov.tw/dataset/7442>



圖17-11 <https://data.moi.gov.tw/MoiOD/System/DownloadFile.aspx?DATA=72874C55-884D-4CEA-B7D6-F60B0BE85AB0>

```
# 7442: 直轄市、縣市界線
!rm -rf mapshape/*; rmdir mapshape 2> /dev/null #清空原本mapshape
!wget --no-check-certificate 'https://data.moi.gov.tw/MoiOD/System/DownloadFile.aspx?DATA=72874C55-884D-4CEA-B7D6-F60B0BE85AB0' -O temp.zip
!unzip temp.zip -d mapshape; rm temp.zip # unzip解壓縮-d mapshape在colab上 產生資料夾

Archive: temp.zip
  inflating: mapshape/COUNTY_MOI_1090820.CPG
  inflating: mapshape/COUNTY_MOI_1090820.dbf
  inflating: mapshape/COUNTY_MOI_1090820.prj
  inflating: mapshape/COUNTY_MOI_1090820.shp
  inflating: mapshape/COUNTY_MOI_1090820.shx
  inflating: mapshape/TW-01-301000100G-000017.xml
  inflating: mapshape/Φ Γ ο ϰ Η Γ ϰ Γ Ε x Ι ο _1081113&21.xlsx
  inflating: mapshape/Metadata.xml
```

圖17-12 台灣地圖新增縣市界線

```
import matplotlib.pyplot as plt
from mpl_toolkits.basemap import Basemap
import warnings
warnings.filterwarnings("ignore")
import numpy as np

# 1. 設定basemap
l1lon, l1lat, urlon, urlat=119.0, 21.8, 122.05, 25.4
map = Basemap(projection='cyl', resolution='h',
              llcrnrlon=l1lon, llcrnrlat=l1lat, urcrnrlon=urlon, urcrnrlat=urlat)

# 2. 畫海岸線圖
map.drawcoastlines(linewidth=0.5)
map.drawmapboundary(fill_color='cyan')

# 3. 畫緯度線21.5(<21.8)和26(>25.4) #畫經度線119(<120)和123(>112.05)
map.drawparallels(np.arange(21.5, 26), labels=[1, 0, 0, 0], fontsize=10)
map.drawmeridians(np.arange(119, 123), labels=[0, 0, 0, 1], fontsize=10)

# 4. 讀入shape file/依需要修改MOI名稱
#SHP, MOI = "mapshape/COUNTY_MOI_1070516", "COUNTY_MOI_1070516"
SHP, MOI = "mapshape/COUNTY_MOI_1090820", "COUNTY_MOI_1090820" #此處看上面的解壓縮檔案的日期
map.readshapefile(SHP, MOI, linewidth=0.25, drawbounds=True) #readshapefile(檔案路徑+檔名, 檔名)

# 5. 儲存顯示圖片
plt.show()
```

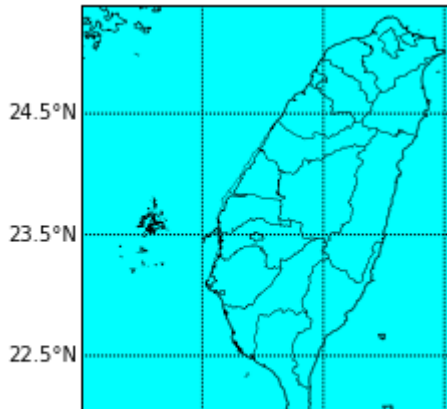
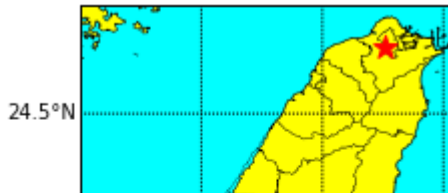


圖17-14 標台北高雄位置

zorder: <https://www.delftstack.com/zh-tw/howto/matplotlib/how-to-connect-scatterplot-points-with-line-in-matplotlib/>

```
import matplotlib.pyplot as plt
from mpl_toolkits.basemap import Basemap
import warnings
warnings.filterwarnings("ignore")
import numpy as np
from matplotlib.font_manager import FontProperties
font = FontProperties(fname=r"kaiu.ttf", size=16)
# 1. 設定basemap
l1lon, l1lat, urlon, urlat = 119.0, 21.8, 122.05, 25.4
map = Basemap(projection='cyl', resolution='h',
               llcrnrlon=l1lon, llcrnrlat=l1lat, urcrnrlon=urlon, urcrnrlat=urlat)
# 2. 畫海岸線圖
map.drawcoastlines(linewidth=0.5)
map.drawmapboundary(fill_color='cyan')
map.fillcontinents(color='yellow')
# 3. 畫緯度線21.5(<21.8)和26(>25.4) #畫經度線119(<120)和123(>112.05)
map.drawparallels(np.arange(21.5, 26), labels=[1, 0, 0, 0], fontsize=10)
map.drawmeridians(np.arange(119, 123), labels=[0, 0, 0, 1], fontsize=10)
# 4. 讀入shape file/依需要修改MOI名稱
SHP, MOI = "mapshape/COUNTY_MOI_1090820", "COUNTY_MOI_1090820"
map.readshapefile(SHP, MOI, linewidth=0.25, drawbounds=True)
# 5. Taipei 121.597366, 25.105497; Kaohsiung 120.31333, 22.61626
x, y, c_name = [121.521792, 120.31333], [25.048650, 22.61626], ['台北', '高雄']
map.scatter(x, y, latlon=True, marker='*', color='red', zorder=10, s=150) #zorder調整繪圖順序 #
for i in range(len(c_name)):
    plt.text(x[i]+0.08, y[i], c_name[i], fontsize=14, fontproperties=font) #plt.text新增文字(x軸位
# 6. 顯示圖片
plt.show()
```



上傳csv檔



```
from google.colab import files
uploaded = files.upload()
```

選擇檔案 未選擇任何檔案

Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving chap17a.csv to chap17a.csv
Saving chap17b.csv to chap17b.csv
Saving chap17c.csv to chap17c.csv
Saving chap17d.csv to chap17d.csv
Saving chap17e.csv to chap17e.csv
Saving chap17g.csv to chap17g.csv
Saving chap17h.csv to chap17h.csv
Saving chap17i.csv to chap17i.csv
```

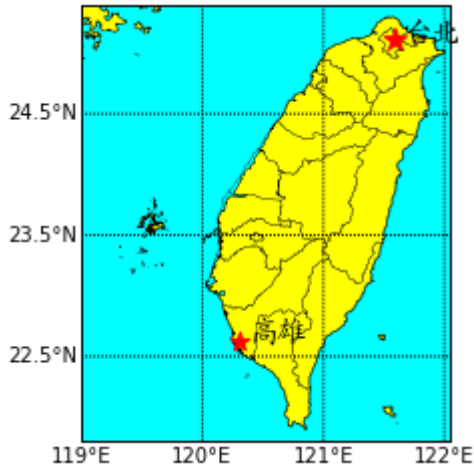
p346上 讀出台北高雄經緯度並標記

```
import matplotlib.pyplot as plt
from mpl_toolkits.basemap import Basemap
import warnings
warnings.filterwarnings("ignore")
import numpy as np
from matplotlib.font_manager import FontProperties
font = FontProperties(fname=r"kaiu.ttf", size=16)
# 1. 設定basemap
lllon, lllat, urlon, urlat = 119.0, 21.8, 122.05, 25.4
map = Basemap(projection='cyl', resolution='h',
              llcrnrlon=lllon, llcrnrlat=lllat, urcrnrlon=urlon, urcrnrlat=urlat)
# 2. 畫海岸線圖
map.drawcoastlines(linewidth=0.5)
map.drawmapboundary(fill_color='cyan')
map.fillcontinents(color='yellow')
# 3. 畫緯度線21.5(<21.8)和26(>25.4) #畫經度線119(<120)和123(>112.05)
map.drawparallels(np.arange(21.5, 26), labels=[1, 0, 0, 0], fontsize=10)
map.drawmeridians(np.arange(119, 123), labels=[0, 0, 0, 1], fontsize=10)
# 4. 讀入shape file/依需要修改MOI名稱
SHP, MOI = "mapshape/COUNTY_MOI_1090820", "COUNTY_MOI_1090820"
map.readshapefile(SHP, MOI, linewidth=0.25, drawbounds=True)
# 5. Read from data
import pandas as pd
```

```

df = pd.read_csv("chap17a.csv", encoding='utf-8')
x,y,c_name, c_size=df.Longitude, df.Latitude,df.Name, df.Size
map.scatter(x,y, latlon=True, marker='*',color='red', zorder=10, s=c_size)
for i in range(len(c_name)):
    plt.text(x[i]+0.08, y[i], c_name[i], fontsize=14, fontproperties=font)
# 6. 顯示圖片
plt.show()

```



p347上 引入縣市著色相關套件

```

import matplotlib.pyplot as plt
from mpl_toolkits.basemap import Basemap
import warnings
warnings.filterwarnings("ignore")
import numpy as np
from matplotlib.font_manager import FontProperties
font = FontProperties(fname=r"kaiu.ttf", size=16)
import pandas as pd
from matplotlib.patches import Polygon #可連成多邊形的套件
from matplotlib.collections import PatchCollection #集結多邊形的套件
from statistics import mean

```

p347下 縣市著色副程式

extend:<https://www.runoob.com/python/att-list-extend.html>

```

def set_colorCity(patches, citylst, data, c_map='Purples'):
    ##### Taipei and Chiayi are inside other cities! #####
    uc, up = [], []
    for i in range(len(citylst)):
        if citylst[i] == 'Taipei City' or citylst[i] == 'Chiayi City':
            uc.append(citylst[i])
            up.append(patches[i])
    clst = [x for x in citylst if x not in uc]
    plst = [x for x in patches if x not in up]
    clst.extend(uc) #數列A.extend(數列B) 延展list
    plst.extend(up)
    patches, citylst = plst, clst
    #####

```

```
#####
clr = np.zeros((len(citylst)))
for i in range(len(citylst)):
    clr[i]=data[citylst[i]]
return PatchCollection(patches, cmap=c_map, linewidths=0.2, zorder=2), clr
```

圖17-19 顯示map.COUNTY_MOI_1090820_info資料

```
import matplotlib.pyplot as plt
from mpl_toolkits.basemap import Basemap
import numpy as np
# 1. 設定basemap
map = Basemap(projection='cyl', resolution='h',
              llcrnrlon=119.0, llcrnrlat=21.8, urcrnrlon=122.05, urcrnrlat=25.4)
# 2. 畫海岸線圖
map.drawcoastlines(linewidth=1)
map.drawmapboundary(fill_color='cyan')
#3. 讀入shape file
SHP, MOI = "mapshape/COUNTY_MOI_1090820", "COUNTY_MOI_1090820"
map.readshapefile(SHP, MOI, linewidth=0.25, drawbounds=True)
for i in map.COUNTY_MOI_1090820_info:
    print(i)
# 4. 儲存顯示圖片
plt.show()
```


圖19-20 台灣人口漸層圖 .set_array(colors):<http://hk.uwenku.com/question/p-mrowvoju-bq.html>

<https://colab.research.google.com/drive/12ckVm8bZOcLABVaX7R9ULbmRrNz2DUHC#printMode=true>

```
#print(p, colors)
```

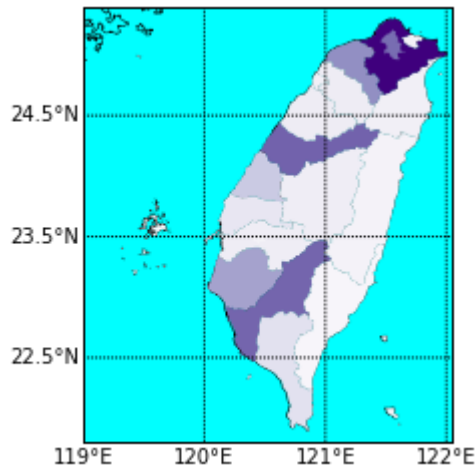


圖19-22 台灣人口密度

```
fig = plt.figure()
ax = fig.add_subplot(111)
# 1. 設定basemap
l1lon, l1lat, urlon, urlat=119.0, 21.8, 122.05, 25.4
map = Basemap(projection='cyl', resolution='h',
               llcrnrlon=l1lon, llcrnrlat=l1lat, urcrnrlon=urlon, urcrnrlat=urlat)
# 2. 畫海岸線圖
map.drawcoastlines(linewidth=0.5)
map.drawmapboundary(fill_color='cyan')
# 3. 畫緯度線21.5(<21.8)和26(>25.4) 畫經度線119(<120)和123(>112.05)
map.drawparallels(np.arange(21.5, 26), labels=[1, 0, 0, 0], fontsize=10)
map.drawmeridians(np.arange(119, 123), labels=[0, 0, 0, 1], fontsize=10)
# 4. 讀入shape file
SHP, MOI = "mapshape/COUNTY_MOI_1090820", "COUNTY_MOI_1090820"
map.readshapefile(SHP, MOI, linewidth=0.25, drawbounds=True)
# 5. 縣市資料"
citylst, patches = [], []
df = pd.read_csv("chap17c.csv") # data file with population
data=dict(zip(df.Name, df.Population/df.Area)) # associate name/(density)
for info, shape in zip(map.COUNTY_MOI_1090820_info, map.COUNTY_MOI_1090820):
    citylst.append(info['COUNTYENG'])
    patches.append(Polygon(np.array(shape), True))
p, colors = set_colorCity(patches, citylst, data, 'OrRd')
p.set_array(colors)
ax.add_collection(p)
plt.show()
```

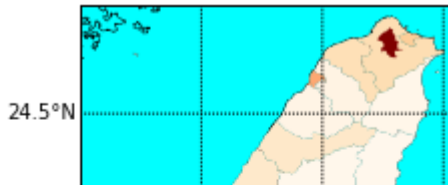


圖17-24 安裝鄉鎮市區界線套件



```
# 7441: 鄉鎮市區界線
!rm -rf mapshape/*; rmdir mapshape 2> /dev/null
!wget --no-check-certificate 'https://data.moi.gov.tw/MoiOD/System/DownloadFile.aspx?DATA=CD02C82'
!unzip temp.zip -d mapshape; rm temp.zip
```

```
Archive: temp.zip
  inflating: mapshape/Town_Majia_Sanhe.dbf
  inflating: mapshape/Town_Majia_Sanhe.prj
  inflating: mapshape/Town_Majia_Sanhe.shp
  inflating: mapshape/Town_Majia_Sanhe.shx
  inflating: mapshape/TOWN_MOI_1100415.dbf
  inflating: mapshape/TOWN_MOI_1100415.prj
  inflating: mapshape/TOWN_MOI_1100415.shp
  inflating: mapshape/TOWN_MOI_1100415.shx
  inflating: mapshape/TW-07-301000100G-614001.xml
  inflating: mapshape/Φ Γ ο υ η ρ ι ς Ε x Ι ο _1081113&21.xlsx
  inflating: mapshape/Φ Γ ο υ η ρ ι ς Ε x Ι ο _1100415.xlsx
  inflating: mapshape/Metadata.xml
```

圖17-25 繪出鄉鎮市區界線

```
# 1. 設定basemap
l1lon, l1lat, urlon, urlat=119.0, 21.8, 122.05, 25.4
map = Basemap(projection='cyl', resolution='h',
               llcrnrlon=l1lon, llcrnrlat=l1lat, urcrnrlon=urlon, urcrnrlat=urlat)
# 2. 畫海岸線圖
map.drawmapboundary(fill_color='cyan')
# 3. 經緯度 -- label [West, East, North, South]
map.drawparallels(np.arange(l1lat, urlat), labels=[1, 0, 0, 0], fontsize=10)
map.drawmeridians(np.arange(l1lon, urlon), labels=[0, 0, 1, 0], fontsize=10)
# 4. 讀入shape file
SHP, MOI = "mapshape/TOWN_MOI_1100415", "TOWN_MOI_1100415"
map.readshapefile(SHP, MOI, linewidth=0.1, drawbounds=True)
# 5. 儲存顯示圖片
plt.show()
```

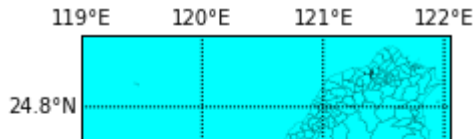
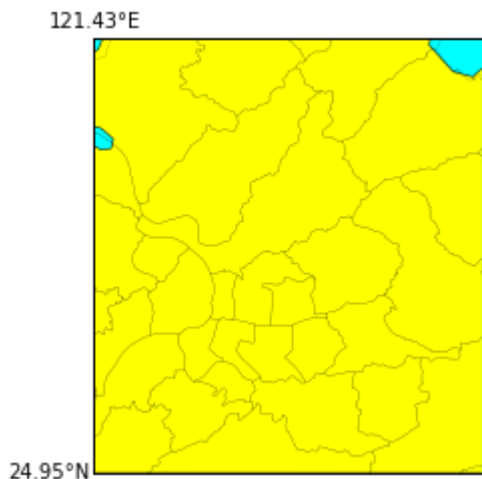


圖17-27 只顯示北部部分區域



```
# 1. 設定basemap
l1lon, l1lat, urlon, urlat=121.43, 24.95, 121.68, 25.23
map = Basemap(projection='cyl', resolution='h',
               llcrnrlon=l1lon, llcrnrlat=l1lat, urcrnrlon=urlon, urcrnrlat=urlat)
# 2. 畫海岸線圖
map.drawcoastlines(linewidth=0.5)
map.drawmapboundary(fill_color='cyan')
map.fillcontinents(color='yellow')
# 3. 經緯度 -- label [West, East, North, South]
map.drawparallels(np.arange(l1lat, urlat), labels=[1, 0, 0, 0], fontsize=10)
map.drawmeridians(np.arange(l1lon, urlon), labels=[0, 0, 1, 0], fontsize=10)
# 4. 讀入shape file
SHP, MOI = "mapshape/TOWN_MOI_1100415", "TOWN_MOI_1100415"
map.readshapefile(SHP, MOI, linewidth=0.1, drawbounds=True)
# 5. 儲存顯示圖片
plt.show()
```



p355 行政區著色副程式

```
def set_colorTown(patches, citylst, data, c_map='Purples'):
    allTown, allValues = data.keys(), data.values()
    basedValue = min(allValues)-mean(allValues)/4 #台北市以外的顏色值
    clr = np.zeros((len(citylst)))
    for i in range(len(citylst)):
        # clr[i]=data[citylst[i]] ## 顏色會太深， 用下面的方式正規化
        clr[i]=data[citylst[i]] if (citylst[i] in allTown) else basedValue #如果是台北市以內
    return PatchCollection(patches, cmap=c_map, linewidths=0.2, zorder=2), clr
```

圖17-30 行政區著色

```

fig = plt.figure()
ax = fig.add_subplot(111)
# 1. 設定basemap
l1lon, l1lat, urlon, urlat=121.43, 24.95, 121.68, 25.23
map = Basemap(projection='cyl', resolution='h',
               llcrnrlon=l1lon, llcrnrlat=l1lat, urcrnrlon=urlon, urcrnrlat=urlat)
# 2. 畫海岸線圖
map.drawmapboundary(fill_color='cyan')
# 3. 經緯度 -- label [West, East, North, South]
map.drawparallels(np.arange(l1lat, urlat), labels=[1, 0, 0, 0], fontsize=10)
map.drawmeridians(np.arange(l1lon, urlon), labels=[0, 0, 1, 0], fontsize=10)
# 4. 讀入shape file
SHP, MOI = "mapshape/TOWN_MOI_1100415", "TOWN_MOI_1100415"
map.readshapefile(SHP, MOI, linewidth=0.1, drawbounds=True)
# 5. 縣市資料--小心有很多 "中正區"
citylst, patches = [], []
df = pd.read_csv("chap17d.csv")
data=dict(zip('臺北市'+':'+df.Name, df.Population))
for info, shape in zip(map.TOWN_MOI_1100415_info, map.TOWN_MOI_1100415):
    citylst.append(info['COUNTYNAME']+' ':'TOWNENG'])
    patches.append(Polygon(np.array(shape), True))
p, colors = set_colorTown(patches, citylst, data, 'BuGn')
p.set_array(colors) #PatchCollection().set_array(顏色值, 表深淺度, 會一併套用cmap值)
ax.add_collection(p)
# 6. 儲存顯示圖片
plt.show()
#for i in colors:
#    print(i)
#print(min(data.values())-mean(data.values())/4)

```

