隨機過程Diffusion maps程式

I18071015 王崇亘

環境: Google Colab
程式: Python
資料: 手的照片

Code (Python)

```python
import numpy as np
import math
from numpy import linalg as LA
from numpy.linalg import inv
import statistics
import cv2
from PIL import Image

from matplotlib.pyplot import plot, gca, show
from matplotlib.pyplot import figure
from matplotlib.image import imread
from matplotlib.cbook import get_sample_data
from matplotlib.offsetbox import OffsetImage, AnnotationBbox
#number of data
n=20
#dimension of data
d=256
#some constant to be determined
c=3
t=3
norm=[]
data=np.zeros((n,d,d))
# 載入n張圖片並轉成灰階
for i in range(n):
    im=Image.open("00"+str(i+1)+".jpg").convert('L')
    data[i]=im.resize((d, d), Image.BILINEAR)
for i in range(n):
    for j in range(n):
        norm.append(np.power(LA.norm(data[i]-data[j]),2))
epsilon=c*statistics.median(norm)
W=np.zeros((n,n))
for i in range(n):
    for j in range(n):
        W[i][j]=math.exp(-np.power(LA.norm(data[i]-data[j]),2)/epsilon)
```

```python
deg=[]
for i in range(n):
    deg.append(np.sum(W[i]))
D=np.diag(deg)
```

[15]
```python
#P=D^(-1)*W
P=np.dot(inv(D),W)
```

[16]
```python
Q=np.dot(np.dot(np.sqrt(D),P),inv(np.sqrt(D)))
Lam, V = LA.eigh(Q) #return eigenvalues(ascending order) and eigenvectors of matrix Q
Lam[::-1].sort() # from eigenvalues(ascending order) to eigenvalues(descending order)
Lam=np.diag(Lam)
#將eigenvectors順序根據eigenvalues調換
V_new=np.zeros((n,n))
for i in range(n):
    V_new[:,i]=V[:,n-1-i]
print(V_new)
print(np.dot(V_new,np.transpose(V_new)))
#將eigenvalue的matrix次方
Lam_t=LA.matrix_power(Lam, t)
Lam_t=np.diag(Lam_t)
print(Lam_t)
Phi=np.dot(inv(np.sqrt(D)),V_new)
Psi=np.dot(np.sqrt(D),V_new)

print(Phi)
print(Psi)
#Construct Diffusion map and project to 2D
coordinate=np.zeros((n,2))

for i in range(n):
    for j in range(2):
        #print(Lam_t[j+1]*Phi[i][j+1])
        coordinate[i][j]=100000*Lam_t[j+1]*Phi[i][j+1]
```

```python
x_min=min(coordinate[:,0])
x_max=max(coordinate[:,0])
y_min=min(coordinate[:,1])
y_max=max(coordinate[:,1])
print(x_min, x_max, y_min, y_max)
```

-13.013952376818725 9.101827155125337 -1.2624912709770197 2.182371719379745

```python
#調整圖片大小 figsize= inch by inch
figure(figsize=(10, 10), dpi=1000)
plot([x_min-2,x_max+2],[y_min-2,y_max+2])
for i in range(n):
    im=imread("00"+str(i+1)+".jpg")
    #要貼的圖片大小
    res=cv2.resize(im,(40, 40), interpolation=cv2.INTER_CUBIC)
    #im=imread(get_sample_data("grace_hopper.png", asfileobj=False))
    oi=OffsetImage(res, zoom=0.5)
    ab=AnnotationBbox(oi, (coordinate[i][0], coordinate[i][1]), xycoords='data', frameon=False)
    gca().add_artist(ab)
show()
```