lec2_step1

August 15, 2022

[15]:
```
## Python basics for novice data scientists, supported by Wagatsuma Lab@Kyutech
#
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#
# # @Time    : 2022-8-10
# # @Author  : Hiroaki Wagatsuma
# # @Site    : https://github.com/hirowgit/2A1_python_intermediate_course
# # @IDE     : Python 3.9.13 (main, Aug  7 2022, 01:33:23)  [Clang 13.1.6␣
 ↪(clang-1316.0.21.2.5)] on darwin
# # @File    : lec2_step1.py
```

[512]:
```
import numpy as np
import matplotlib.pyplot as plt
```

[163]:
```
allData = np.loadtxt('allData200.csv', delimiter=',', dtype='int64')
allData
```

[163]:
```
array([[ 9,  7,  3, …,  4,  1, 10],
       [ 6,  4, 10, …,  5,  1,  2],
       [ 4,  3,  6, …, 10,  1,  8],
```

```
       …,
       [ 3,  4,  1, …,  2,  7,  8],
       [ 6,  7,  3, …,  8,  9,  4],
       [ 9,  8,  5, …, 10,  7,  6]])
```

[158]:
```
a = np.array([[1,2,4],[3,2,1]])
np.sort(a, axis=None)
```

[158]:
```
array([1, 1, 2, 2, 3, 4])
```

[160]:
```
np.sort(a, axis=0)
```

[160]:
```
array([[1, 2, 1],
       [3, 2, 4]])
```

[394]:
```
allData_sample=allData[0:20,:]
np.sort(allData_sample,axis=0)
```

[394]:
```
array([[ 1,  1,  2,  1,  1,  1,  1,  1,  1,  1],
       [ 2,  2,  2,  1,  1,  1,  1,  2,  1,  2],
       [ 2,  3,  3,  2,  1,  2,  1,  2,  1,  2],
       [ 2,  3,  3,  2,  1,  3,  1,  2,  1,  5],
       [ 3,  3,  3,  3,  2,  3,  2,  2,  2,  6],
       [ 3,  4,  3,  4,  3,  4,  2,  3,  2,  6],
       [ 4,  4,  4,  5,  3,  4,  3,  3,  3,  7],
       [ 4,  4,  4,  5,  5,  4,  3,  3,  4,  7],
       [ 5,  4,  4,  5,  5,  4,  4,  4,  5,  7],
       [ 6,  4,  5,  6,  6,  4,  5,  4,  5,  7],
       [ 6,  5,  5,  7,  6,  5,  5,  5,  5,  7],
       [ 7,  6,  6,  7,  6,  6,  5,  5,  6,  7],
       [ 8,  6,  6,  8,  7,  6,  6,  5,  7,  7],
       [ 8,  6,  6,  8,  7,  7,  7,  6,  7,  8],
       [ 8,  7,  7,  8,  9,  8,  8,  6,  8,  9],
       [ 9,  7,  7,  9,  9,  8,  8,  8,  9,  9],
       [ 9,  8,  8,  9, 10,  9,  8,  8,  9,  9],
       [ 9,  8,  9,  9, 10, 10,  8,  8, 10, 10],
       [ 9, 10,  9,  9, 10, 10,  9, 10, 10, 10],
       [10, 10, 10, 10, 10, 10,  9, 10, 10, 10]])
```

[170]:
```
data = np.array([[3, 0, 0, .24],
                 [4, 1, 1, .41],
                 [2, 1, 1, .63],
                 [1, 1, 3, .38]]) #imagine rows of a spreadsheet
#now do sortrows(data,[3,-4])
ix = np.lexsort((data[:, 3][::-1], data[:, 2]))
#this yields [0, 2, 1, 3]
```

```
#note that lexsort sorts first from the last row, so sort keys are in reverse␣
 ↪order

data[ix]
```

[170]:
```
array([[3.  , 0.  , 0.  , 0.24],
       [2.  , 1.  , 1.  , 0.63],
       [4.  , 1.  , 1.  , 0.41],
       [1.  , 1.  , 3.  , 0.38]])
```

[177]:
```
sample_2d = np.array([[50,4, 89], [5, 150, 20], [110, 8, 1]])
print(sample_2d)
print(' ')

col_id = 1
print(sample_2d[:, col_id])
print(' ')
print(np.argsort(a_2d[:, col_id]))
```

```
[[ 50   4  89]
 [  5 150  20]
 [110   8   1]]

[  4 150   8]

[0 2 1]
```

[178]:
```
sorted_by_col = sample_2d[np.argsort(sample_2d[:, col_id])]
print(sorted_by_col)
```

```
[[ 50   4  89]
 [110   8   1]
 [  5 150  20]]
```

[460]:
```
allData_sample
```

[460]:
```
array([[ 9,  7,  3,  5,  6,  2,  8,  4,  1, 10],
       [ 6,  4, 10,  7,  9,  3,  8,  5,  1,  2],
       [ 4,  3,  6,  2,  7,  5,  9, 10,  1,  8],
       [ 3,  6,  7,  4,  1,  8,  2,  5,  9, 10],
       [ 1, 10,  4,  8,  7,  6,  3,  5,  2,  9],
       [ 7,  8,  9,  2,  3,  4,  5, 10,  1,  6],
       [ 9,  4,  2,  5, 10,  3,  1,  8,  6,  7],
       [ 5,  8,  4,  9,  3,  1,  7,  6,  2, 10],
       [ 9, 10,  3,  6,  1,  4,  8,  2,  5,  7],
       [ 3,  6,  2, 10,  1,  9,  4,  8,  5,  7],
       [ 2,  4,  3,  9,  6, 10,  1,  8,  5,  7],
```

```
       [ 8,  5,  4,  9,  2,  1,  6,  3, 10,  7],
       [ 8,  4,  7,  9,  5, 10,  2,  1,  3,  6],
       [ 4,  3,  8,  1, 10,  6,  5,  2,  7,  9],
       [10,  2,  5,  1,  6,  4,  8,  3,  9,  7],
       [ 6,  4,  9,  8,  1, 10,  5,  3,  7,  2],
       [ 9,  6,  3,  5, 10,  4,  1,  2,  8,  7],
       [ 2,  1,  5,  8, 10,  7,  3,  6,  4,  9],
       [ 2,  7,  6,  3,  5,  8,  9,  4, 10,  1],
       [ 8,  3,  6,  7,  9,  4,  1,  2, 10,  5]])
```

[461]:
```
sorted_data=np.sort(allData_sample, axis=0)
sorted_data
```

[461]:
```
array([[ 1,  1,  2,  1,  1,  1,  1,  1,  1,  1],
       [ 2,  2,  2,  1,  1,  1,  1,  2,  1,  2],
       [ 2,  3,  3,  2,  1,  2,  1,  2,  1,  2],
       [ 2,  3,  3,  2,  1,  3,  1,  2,  1,  5],
       [ 3,  3,  3,  3,  2,  3,  2,  2,  2,  6],
       [ 3,  4,  3,  4,  3,  4,  2,  3,  2,  6],
       [ 4,  4,  4,  5,  3,  4,  3,  3,  3,  7],
       [ 4,  4,  4,  5,  5,  4,  3,  3,  4,  7],
       [ 5,  4,  4,  5,  5,  4,  4,  4,  5,  7],
       [ 6,  4,  5,  6,  6,  4,  5,  4,  5,  7],
       [ 6,  5,  5,  7,  6,  5,  5,  5,  5,  7],
       [ 7,  6,  6,  7,  6,  6,  5,  5,  6,  7],
       [ 8,  6,  6,  8,  7,  6,  6,  5,  7,  7],
       [ 8,  6,  6,  8,  7,  7,  7,  6,  7,  8],
       [ 8,  7,  7,  8,  9,  8,  8,  6,  8,  9],
       [ 9,  7,  7,  9,  9,  8,  8,  8,  9,  9],
       [ 9,  8,  8,  9, 10,  9,  8,  8,  9,  9],
       [ 9,  8,  9,  9, 10, 10,  8,  8, 10, 10],
       [ 9, 10,  9,  9, 10, 10,  9, 10, 10, 10],
       [10, 10, 10, 10, 10, 10,  9, 10, 10, 10]])
```

[462]:
```
diffData=np.diff(sorted_data,axis=0)
diffData
```

[462]:
```
array([[1, 1, 0, 0, 0, 0, 0, 1, 0, 1],
       [0, 1, 1, 1, 0, 1, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 1, 0, 0, 0, 3],
       [1, 0, 0, 1, 1, 0, 1, 0, 1, 1],
       [0, 1, 0, 1, 1, 1, 0, 1, 0, 0],
       [1, 0, 1, 1, 0, 0, 1, 0, 1, 1],
       [0, 0, 0, 0, 2, 0, 0, 0, 1, 0],
       [1, 0, 0, 0, 0, 0, 1, 1, 1, 0],
       [1, 0, 1, 1, 1, 0, 1, 0, 0, 0],
       [0, 1, 0, 1, 0, 1, 0, 1, 0, 0],
```

```
       [1, 1, 1, 0, 0, 1, 0, 0, 1, 0],
       [1, 0, 0, 1, 1, 0, 1, 0, 1, 0],
       [0, 0, 0, 0, 0, 1, 1, 1, 0, 1],
       [0, 1, 1, 0, 2, 1, 1, 0, 1, 1],
       [1, 0, 0, 1, 0, 0, 0, 2, 1, 0],
       [0, 1, 1, 0, 1, 1, 0, 0, 0, 0],
       [0, 0, 1, 0, 0, 1, 0, 0, 1, 1],
       [0, 2, 0, 0, 0, 0, 1, 2, 0, 0],
       [1, 0, 1, 1, 0, 0, 0, 0, 0, 0]])
```

[464]:

```
array([[1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 0, 1, 0, 0, 0, 1],
       [1, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 2, 0],
       [0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1],
       [0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1],
       [0, 0, 0, 1, 1, 0, 2, 0, 1, 0, 0, 1, 0, 2, 0, 1, 0, 0, 0],
       [0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0],
       [0, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 0],
       [1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 2, 0, 0, 2, 0],
       [0, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 0, 0],
       [1, 0, 3, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0]])
```

[465]:

```
key=np.where(np.transpose(diffData)>0)
key
```

[465]:

```
(array([0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2,
        2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 5, 5, 5,
        5, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6, 6, 6, 6, 7, 7, 7, 7, 7, 7, 7, 8,
        8, 8, 8, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 9, 9]),
 array([ 0,  3,  5,  7,  8, 10, 11, 14, 18,  0,  1,  4,  9, 10, 13, 15, 17,
         1,  5,  8, 10, 13, 15, 16, 18,  1,  3,  4,  5,  8,  9, 11, 14, 18,
         3,  4,  6,  8, 11, 13, 15,  1,  2,  4,  9, 10, 12, 13, 15, 16,  3,
         5,  7,  8, 11, 12, 13, 17,  0,  4,  7,  9, 12, 14, 17,  3,  5,  6,
         7, 10, 11, 13, 14, 16,  0,  2,  3,  5, 12, 13, 16]))
```

[466]:

```
kj=key[0]
kj
```

[466]:

```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2,
       2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6, 6, 6, 6, 7, 7, 7, 7, 7, 7, 7, 8,
       8, 8, 8, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 9, 9])
```

[467]:

```
ki=key[1]
ki
```

[467]:
```
array([ 0,  3,  5,  7,  8, 10, 11, 14, 18,  0,  1,  4,  9, 10, 13, 15, 17,
        1,  5,  8, 10, 13, 15, 16, 18,  1,  3,  4,  5,  8,  9, 11, 14, 18,
        3,  4,  6,  8, 11, 13, 15,  1,  2,  4,  9, 10, 12, 13, 15, 16,  3,
        5,  7,  8, 11, 12, 13, 17,  0,  4,  7,  9, 12, 14, 17,  3,  5,  6,
        7, 10, 11, 13, 14, 16,  0,  2,  3,  5, 12, 13, 16])
```

[468]:
```
bodyK=np.where(np.diff(kj)>0)
bodyK
```

[468]:
```
(array([ 8, 16, 24, 33, 40, 49, 57, 64, 73]),)
```

[403]:
```
sizeD=np.shape(allData_sample)
sizeD
```

[403]:
```
(20, 10)
```

[469]:
```
# n0=np.array([0],dtype=int)
np.concatenate([bodyK, bodyK],axis=1)
```

[469]:
```
array([[ 8, 16, 24, 33, 40, 49, 57, 64, 73,  8, 16, 24, 33, 40, 49, 57,
        64, 73]])
```

[234]:
```
np.array([0])
```

[234]:
```
array([0])
```

[237]:
```
bodyK
```

[237]:
```
(array([ 5, 11, 16, 21, 28, 38, 43, 50]),)
```

[247]:
```
bodyK
```

[247]:
```
(array([ 5, 11, 16, 21, 28, 38, 43, 50]),)
```

[277]:
```
a1 = np.ones((1,3), int)
a2 = np.ones((1,3), int)
np.concatenate([a1, a2],axis=1)
```

[277]:
```
array([[1, 1, 1, 1, 1, 1]])
```

[270]:
```
a1 = np.ones((1,3), int)
```

[299]:
```
[0,list(bodyK), len(kj)]
```

[299]:
```
[0, [array([ 5, 11, 16, 21, 28, 38, 43, 50])], 57]
```

[266]:
```
np.shape(bodyK)
```

[266]:
```
(1, 8)
```

[281]:
```
len(kj)
```

[281]:
```
57
```

[284]:
```
 len(kj)*np.ones((1,1), int)
```

[284]:
```
array([[57]])
```

[285]:
```
[[ len(kj)]]
```

[285]:
```
[[57]]
```

[294]:
```
bodyK
```

[294]:
```
(array([ 5, 11, 16, 21, 28, 38, 43, 50]),)
```

[296]:
```
list(bodyK)
```

[296]:
```
[array([ 5, 11, 16, 21, 28, 38, 43, 50])]
```

[302]:
```
arr_1d=list(bodyK)
bodyK.tolist()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
/var/folders/mg/w5t8lkhc8xj79f001s7kzpfh0000gp/T/ipykernel_46672/3209845136.py␣
 ↪in <module>
      1 arr_1d=list(bodyK)
----> 2 bodyK.tolist()

AttributeError: 'tuple' object has no attribute 'tolist'
```

[303]:
```
bodyK
```

[303]:
```
(array([ 5, 11, 16, 21, 28, 38, 43, 50]),)
```

[307]:
```
bodyK
```

[307]:
```
(array([ 5, 11, 16, 21, 28, 38, 43, 50]),)
```

[308]:
```
kj
```

[308]:
```
array([0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3,
       4, 4, 4, 4, 4, 4, 4, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6,
```

```
       7, 7, 7, 7, 7, 7, 7, 8, 8, 8, 8, 8, 8])
```

[313]:
```
kj[bodyK]
```

[313]:
```
array([0, 1, 2, 3, 4, 5, 6, 7])
```

[314]:
```
ab=np.concatenate([[[0]], bodyK],axis=1)
```

[314]:
```
array([[ 0,  5, 11, 16, 21, 28, 38, 43, 50]])
```

[315]:
```
kj[ab]
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
/var/folders/mg/w5t8lkhc8xj79f001s7kzpfh0000gp/T/ipykernel_46672/942133995.py i
 ↪<module>
----> 1 kj[ab]

NameError: name 'ab' is not defined
```

[496]:
```
bodyK2=bodyK+np.array([[1]])
sect_id=np.insert(bodyK2, 0,0)
sect_id=np.append(sect_id, len(kj))
sect_id
```

[496]:
```
array([ 0,  9, 17, 25, 34, 41, 50, 58, 65, 74, 81])
```

[497]:
```
kj
```

[497]:
```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2,
       2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6, 6, 6, 6, 7, 7, 7, 7, 7, 7, 7, 8,
       8, 8, 8, 8, 8, 8, 8, 8, 9, 9, 9, 9, 9, 9, 9])
```

[498]:
```
ki
```

[498]:
```
array([ 0,  3,  5,  7,  8, 10, 11, 14, 18,  0,  1,  4,  9, 10, 13, 15, 17,
        1,  5,  8, 10, 13, 15, 16, 18,  1,  3,  4,  5,  8,  9, 11, 14, 18,
        3,  4,  6,  8, 11, 13, 15,  1,  2,  4,  9, 10, 12, 13, 15, 16,  3,
        5,  7,  8, 11, 12, 13, 17,  0,  4,  7,  9, 12, 14, 17,  3,  5,  6,
        7, 10, 11, 13, 14, 16,  0,  2,  3,  5, 12, 13, 16])
```

[339]:
```
kj[sect_id]
```

[339]:
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 8])
```

[363]:
```
kj[sect_id[0]:sect_id[1]]
```

[363]:
```
array([0, 0, 0, 0, 0, 0, 1])
```

[368]:
```
sect_id[1]
```

[368]:
```
6
```

[499]:
```
g2=np.arange(sect_id[0],sect_id[1])
g2
```

[499]:
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8])
```

[347]:
```
kj[sect_id[1]:sect_id[2]]
```

[347]:
```
array([1, 1, 1, 1, 1, 1])
```

[367]:
```
kj[g2]
```

[367]:
```
array([0, 0, 0, 0, 0, 0])
```

[350]:
```
sect_id
```

[350]:
```
array([ 0,  6, 12, 17, 22, 29, 39, 44, 51, 56])
```

[501]:
```
setN=sizeD[0]
NofD=sizeD[1]
```

[500]:
```
sect_eg=np.vstack([sect_id[0:-1],sect_id[1:]])
sect_eg
```

[500]:
```
array([[ 0,  9, 17, 25, 34, 41, 50, 58, 65, 74],
       [ 9, 17, 25, 34, 41, 50, 58, 65, 74, 81]])
```

[502]:
```
sect_egT=np.transpose(sect_eg)
sect_egT
```

[502]:
```
array([[ 0,  9],
       [ 9, 17],
       [17, 25],
       [25, 34],
       [34, 41],
       [41, 50],
       [50, 58],
       [58, 65],
       [65, 74],
       [74, 81]])
```

[492]:
```
[sect_egT[i]  for i in range(0,5)]
```

[492]:
```
[array([0, 9]),
 array([ 9, 17]),
 array([17, 25]),
 array([25, 34]),
 array([34, 41])]
```

[439]:
```
sect_egT[0][1]
```

[439]:
```
4
```

[440]:
```
len(sect_egT)
```

[440]:
```
19
```

[503]:
```
[kj[sect_egT[i][0]:sect_egT[i][1]]  for i in range(0,len(sect_egT))]
```

[503]:
```
[array([0, 0, 0, 0, 0, 0, 0, 0, 0]),
 array([1, 1, 1, 1, 1, 1, 1, 1]),
 array([2, 2, 2, 2, 2, 2, 2, 2]),
 array([3, 3, 3, 3, 3, 3, 3, 3, 3]),
 array([4, 4, 4, 4, 4, 4, 4]),
 array([5, 5, 5, 5, 5, 5, 5, 5, 5]),
 array([6, 6, 6, 6, 6, 6, 6, 6]),
 array([7, 7, 7, 7, 7, 7, 7]),
 array([8, 8, 8, 8, 8, 8, 8, 8, 8]),
 array([9, 9, 9, 9, 9, 9, 9])]
```

[518]:
```
sect_range=[ki[sect_egT[i][0]:sect_egT[i][1]]  for i in range(0,len(sect_egT))]
sect_range
```

[518]:
```
[array([ 0,  3,  5,  7,  8, 10, 11, 14, 18]),
 array([ 0,  1,  4,  9, 10, 13, 15, 17]),
 array([ 1,  5,  8, 10, 13, 15, 16, 18]),
 array([ 1,  3,  4,  5,  8,  9, 11, 14, 18]),
 array([ 3,  4,  6,  8, 11, 13, 15]),
 array([ 1,  2,  4,  9, 10, 12, 13, 15, 16]),
 array([ 3,  5,  7,  8, 11, 12, 13, 17]),
 array([ 0,  4,  7,  9, 12, 14, 17]),
 array([ 3,  5,  6,  7, 10, 11, 13, 14, 16]),
 array([ 0,  2,  3,  5, 12, 13, 16])]
```

[505]:
```
[np.diff(np.hstack([-1,d,setN-1])) for d in sect_range]
```

[505]:
```
[array([1, 3, 2, 2, 1, 2, 1, 3, 4, 1]),
 array([1, 1, 3, 5, 1, 3, 2, 2, 2]),
```

```
 array([2, 4, 3, 2, 3, 2, 1, 2, 1]),
 array([2, 2, 1, 1, 3, 1, 2, 3, 4, 1]),
 array([4, 1, 2, 2, 3, 2, 2, 4]),
 array([2, 1, 2, 5, 1, 2, 1, 2, 1, 3]),
 array([4, 2, 2, 1, 3, 1, 1, 4, 2]),
 array([1, 4, 3, 2, 3, 2, 3, 2]),
 array([4, 2, 1, 1, 3, 1, 2, 1, 2, 3]),
 array([1, 2, 1, 2, 7, 1, 3, 3])]
```

[508]:
```
[np.diff(np.hstack([-1,d,setN-1]))/setN for d in sect_range]
```

[508]:
```
[array([0.05, 0.15, 0.1 , 0.1 , 0.05, 0.1 , 0.05, 0.15, 0.2 , 0.05]),
 array([0.05, 0.05, 0.15, 0.25, 0.05, 0.15, 0.1 , 0.1 , 0.1 ]),
 array([0.1 , 0.2 , 0.15, 0.1 , 0.15, 0.1 , 0.05, 0.1 , 0.05]),
 array([0.1 , 0.1 , 0.05, 0.05, 0.15, 0.05, 0.1 , 0.15, 0.2 , 0.05]),
 array([0.2 , 0.05, 0.1 , 0.1 , 0.15, 0.1 , 0.1 , 0.2 ]),
 array([0.1 , 0.05, 0.1 , 0.25, 0.05, 0.1 , 0.05, 0.1 , 0.05, 0.15]),
 array([0.2 , 0.1 , 0.1 , 0.05, 0.15, 0.05, 0.05, 0.2 , 0.1 ]),
 array([0.05, 0.2 , 0.15, 0.1 , 0.15, 0.1 , 0.15, 0.1 ]),
 array([0.2 , 0.1 , 0.05, 0.05, 0.15, 0.05, 0.1 , 0.05, 0.1 , 0.15]),
 array([0.05, 0.1 , 0.05, 0.1 , 0.35, 0.05, 0.15, 0.15])]
```

[519]:
```
NofE_data=[np.diff(np.hstack([-1,ki[sect_egT[i][0]:sect_egT[i][1]],setN-1]))␣
↪for i in range(0,len(sect_egT))]
NofE_data
```

[519]:
```
[array([1, 3, 2, 2, 1, 2, 1, 3, 4, 1]),
 array([1, 1, 3, 5, 1, 3, 2, 2, 2]),
 array([2, 4, 3, 2, 3, 2, 1, 2, 1]),
 array([2, 2, 1, 1, 3, 1, 2, 3, 4, 1]),
 array([4, 1, 2, 2, 3, 2, 2, 4]),
 array([2, 1, 2, 5, 1, 2, 1, 2, 1, 3]),
 array([4, 2, 2, 1, 3, 1, 1, 4, 2]),
 array([1, 4, 3, 2, 3, 2, 3, 2]),
 array([4, 2, 1, 1, 3, 1, 2, 1, 2, 3]),
 array([1, 2, 1, 2, 7, 1, 3, 3])]
```

[520]:
```
NofE_data_p=[np.diff(np.hstack([-1,ki[sect_egT[i][0]:sect_egT[i][1]],setN-1]))/
↪setN   for i in range(0,len(sect_egT))]
NofE_data_p
```

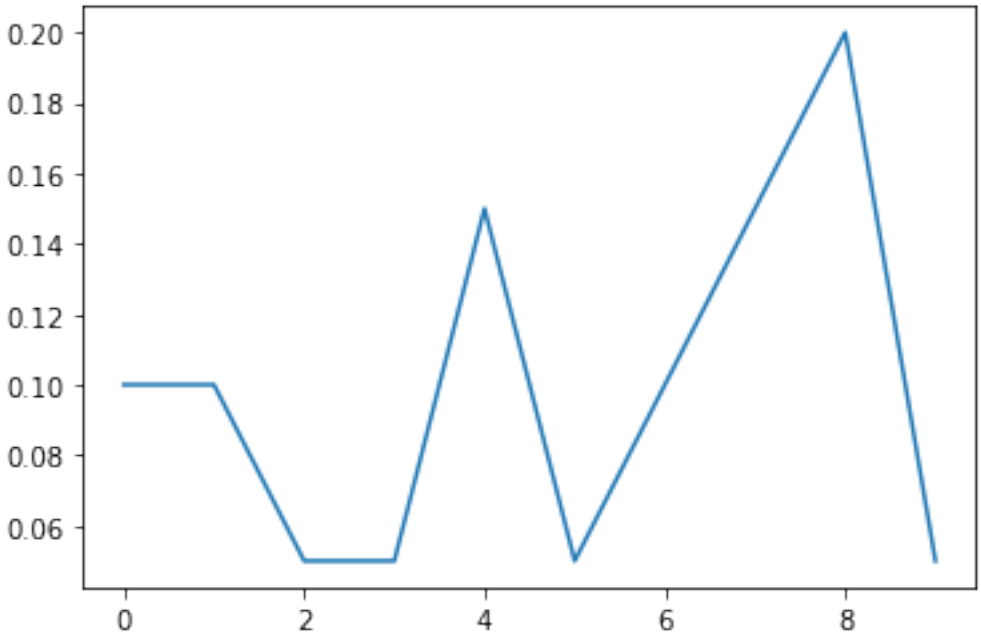
[520]:
```
[array([0.05, 0.15, 0.1 , 0.1 , 0.05, 0.1 , 0.05, 0.15, 0.2 , 0.05]),
 array([0.05, 0.05, 0.15, 0.25, 0.05, 0.15, 0.1 , 0.1 , 0.1 ]),
 array([0.1 , 0.2 , 0.15, 0.1 , 0.15, 0.1 , 0.05, 0.1 , 0.05]),
 array([0.1 , 0.1 , 0.05, 0.05, 0.15, 0.05, 0.1 , 0.15, 0.2 , 0.05]),
 array([0.2 , 0.05, 0.1 , 0.1 , 0.15, 0.1 , 0.1 , 0.2 ]),
 array([0.1 , 0.05, 0.1 , 0.25, 0.05, 0.1 , 0.05, 0.1 , 0.05, 0.15]),
```

```
array([0.2 , 0.1 , 0.1 , 0.05, 0.15, 0.05, 0.05, 0.2 , 0.1 ]),
array([0.05, 0.2 , 0.15, 0.1 , 0.15, 0.1 , 0.15, 0.1 ]),
array([0.2 , 0.1 , 0.05, 0.05, 0.15, 0.05, 0.1 , 0.05, 0.1 , 0.15]),
array([0.05, 0.1 , 0.05, 0.1 , 0.35, 0.05, 0.15, 0.15])]
```

[521]:
```
NofE_data_p[1]
```

[521]:
```
array([0.05, 0.05, 0.15, 0.25, 0.05, 0.15, 0.1 , 0.1 , 0.1 ])
```

[524]:
```
x=np.arange(0,NofD)
y=NofE_data_p[3]
plt.plot(x,y)
plt.show()
```



[ ]:
```

```

[517]:
```
np.arange(0,NofD)
```

[517]:
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

[454]:
```
sorted_data
```

[454]:
```
array([[ 1,  1,  2,  1,  1,  1,  1,  1,  1,  1],
       [ 2,  2,  2,  1,  1,  1,  1,  2,  1,  2],
       [ 2,  3,  3,  2,  1,  2,  1,  2,  1,  2],
       [ 2,  3,  3,  2,  1,  3,  1,  2,  1,  5],
```

```
[ 3,  3,  3,  3,  2,  3,  2,  2,  2,  6],
[ 3,  4,  3,  4,  3,  4,  2,  3,  2,  6],
[ 4,  4,  4,  5,  3,  4,  3,  3,  3,  7],
[ 4,  4,  4,  5,  5,  4,  3,  3,  4,  7],
[ 5,  4,  4,  5,  5,  4,  4,  4,  5,  7],
[ 6,  4,  5,  6,  6,  4,  5,  4,  5,  7],
[ 6,  5,  5,  7,  6,  5,  5,  5,  5,  7],
[ 7,  6,  6,  7,  6,  6,  5,  5,  6,  7],
[ 8,  6,  6,  8,  7,  6,  6,  5,  7,  7],
[ 8,  6,  6,  8,  7,  7,  7,  6,  7,  8],
[ 8,  7,  7,  8,  9,  8,  8,  6,  8,  9],
[ 9,  7,  7,  9,  9,  8,  8,  8,  9,  9],
[ 9,  8,  8,  9, 10,  9,  8,  8,  9,  9],
[ 9,  8,  9,  9, 10, 10,  8,  8, 10, 10],
[ 9, 10,  9,  9, 10, 10,  9, 10, 10, 10],
[10, 10, 10, 10, 10, 10,  9, 10, 10, 10]])
```

[ ]:
```
sect_range=[ki[sect_egT[i][0]:sect_egT[i][1]]  for i in range(0,len(sect_egT))]
sect_range
```

[373]:
```
g3[0]
```

[373]:
```
array([0, 6])
```

[325]:
```
sect_id[0:-1]
```

[325]:
```
array([ 0,  5, 11, 16, 21, 28, 38, 43, 50])
```

[333]:
```
kj[sect_id[0:-1]]
```

[333]:
```
array([0, 0, 1, 2, 3, 4, 5, 6, 7])
```

[327]:
```
bodyK
```

[327]:
```
(array([ 5, 11, 16, 21, 28, 38, 43, 50]),)
```

[331]:
```
bodyK-np.array([[1]])
```

[331]:
```
array([[ 4, 10, 15, 20, 27, 37, 42, 49]])
```

[388]:
```
setN
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
/var/folders/mg/w5t8lkhc8xj79f001s7kzpfh0000gp/T/ipykernel_46672/466309160.py i
 ↪<module>
----> 1 setN
```

```
NameError: name 'setN' is not defined
```

[ ]: