

lec2_step1

November 30, 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]:

```

[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, 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, 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, 6, 7, 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, 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, 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, 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_id=list(bodyK)
      bodyK.tolist()
```

```
-----
AttributeError                                Traceback (most recent call last)
/var/folders/mg/w5t8lkhc8xj79f001s7kzpfh0000gp/T/ipykernel_46672/3209845136.py
↳ in <module>
      1 arr_id=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, 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, 1]),  
       array([2, 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, 4, 4]),  
       array([5, 5, 5, 5, 5, 5, 5, 5, 5]),  
       array([6, 6, 6, 6, 6, 6, 6, 6, 6]),  
       array([7, 7, 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, 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]),

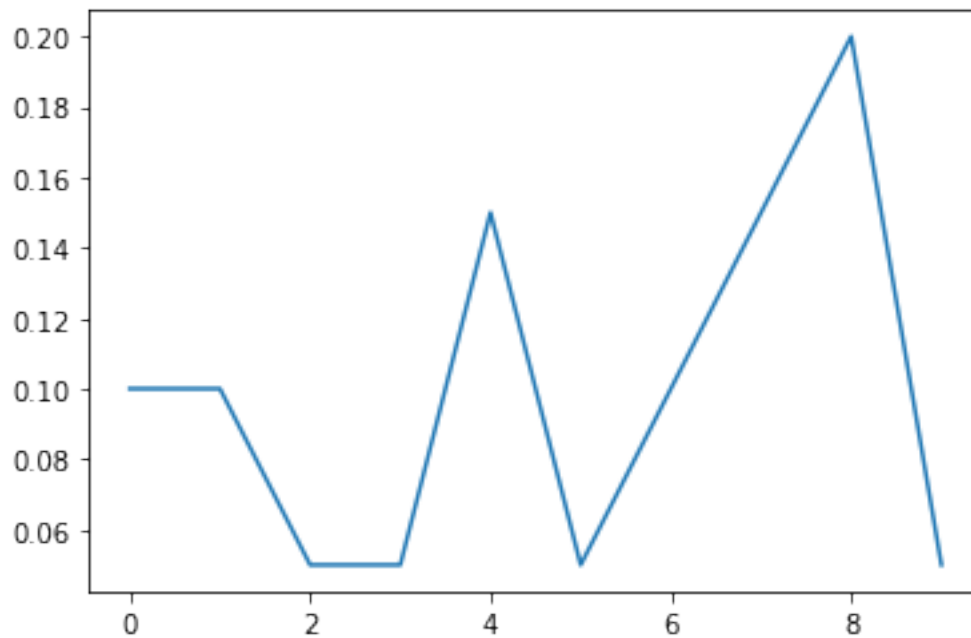
```

```
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
```

```
[ ]:
```