DBSCAN

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Quick Start

All programs are tested on macOS 10.14 & Ubuntu 18.04

Requirements

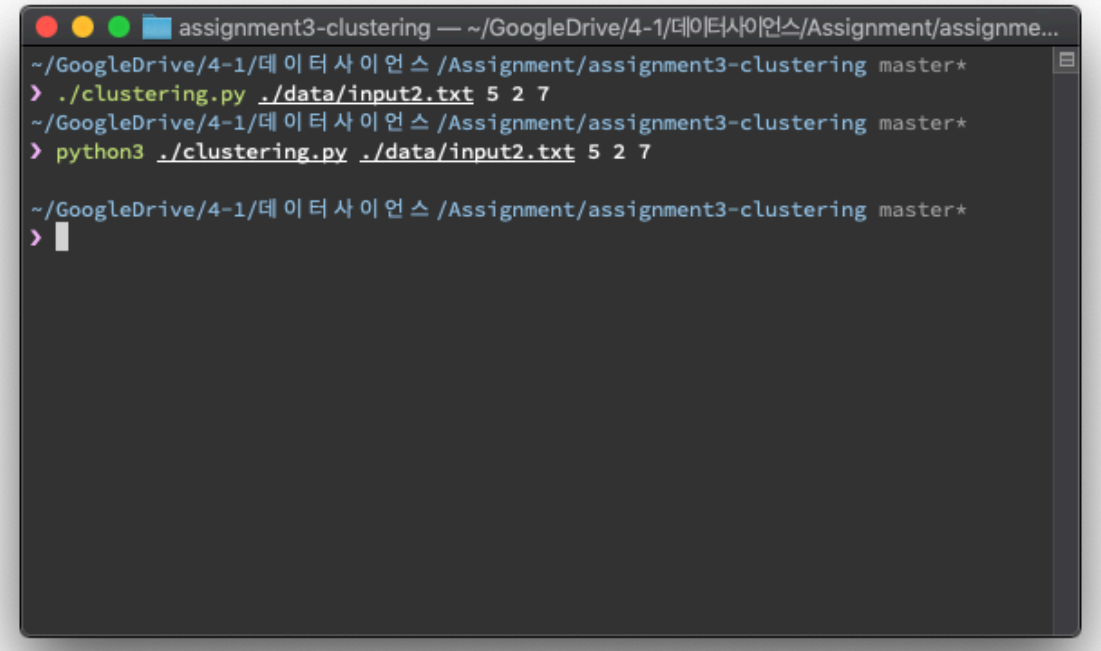
- Python3

How to Run

clustering.py

```
./clustering.py [input file] [number of clusters] [Eps] [MinPts]
python3 clustering.py [input file] [number of clusters] [Eps] [MinPts]
```

In order to execuate program using first command, you must have execution permission for `clustering.py`.
If it gives permission error, either give it an execution permission or use second command.



evaluation.py

```
./evaluation.py
python3 evaluation.py
```

Running above command will give you two options to run evaluation program.

1. Use existing outputfiles at test/ folder
2. Run DBSCAN to create new outputFiles

Either way program will use ideal & created output files to evaluate the accuracy.
Note that in order to run first command, you **MUST** have output files ready.

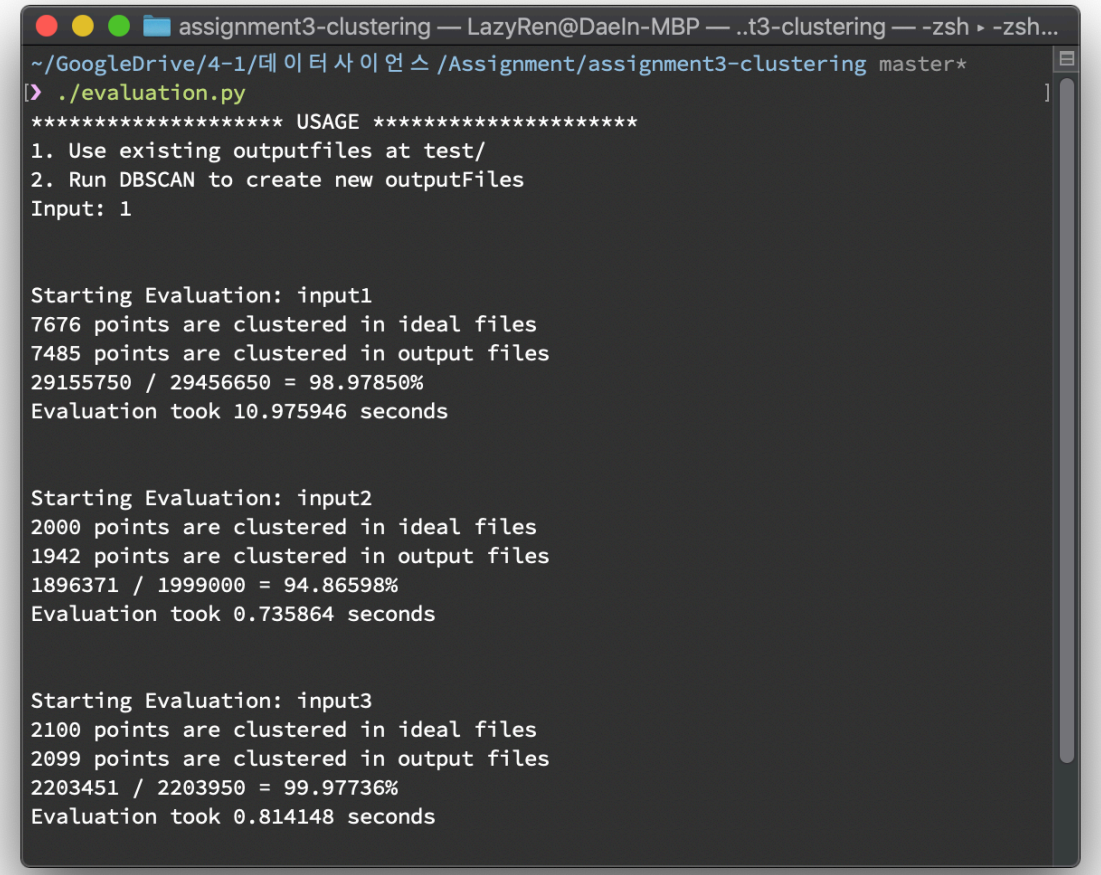
Directory of the files may be modified with below global variables.

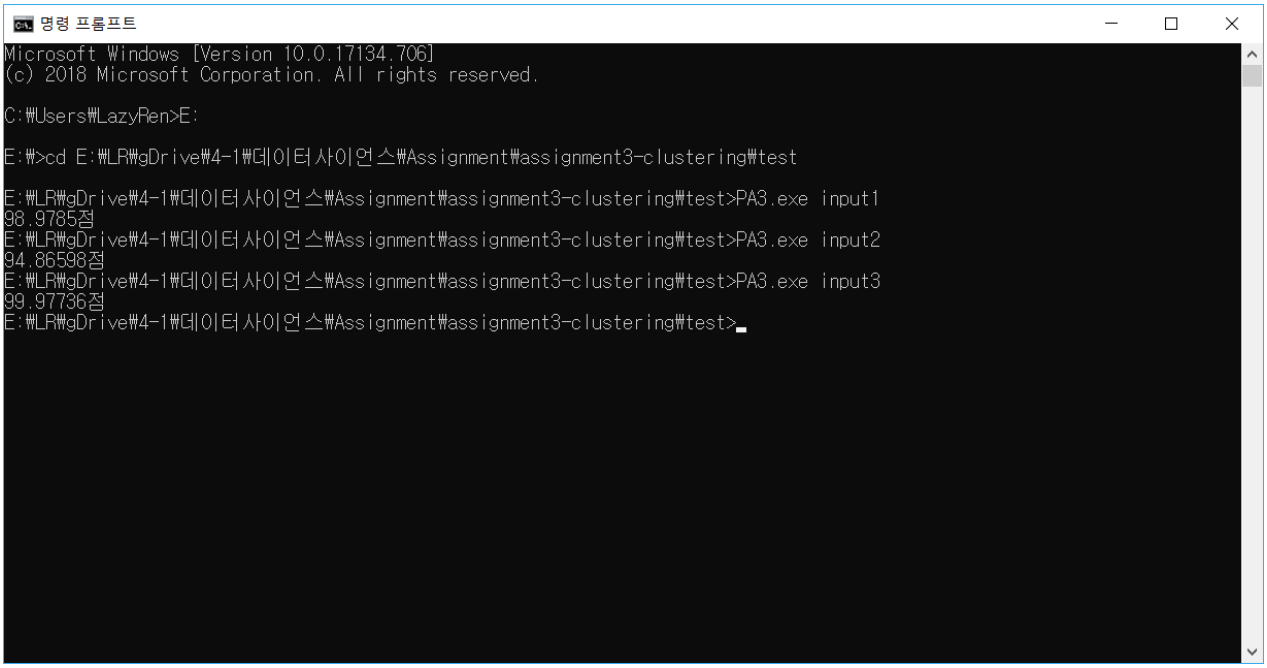
```
inputFileDir  = "data/"
idealFileDir  = "test/"
outputFileDir = "test/"
```

In order to create new tests, you must append appropriate values to below list, and place ideal cluster files ready at `idealFileDir`.

```
testNameList   = ["input1", "input2", "input3" ]
clusterNumList = [8,        5,        4        ]
epsList        = [15,       2,        5        ]
minPtsList     = [22,       7,        5        ]
```

Score of `evaluation.py` is equal to that of `PA3.exe`. But it gives extra information about clustered data.

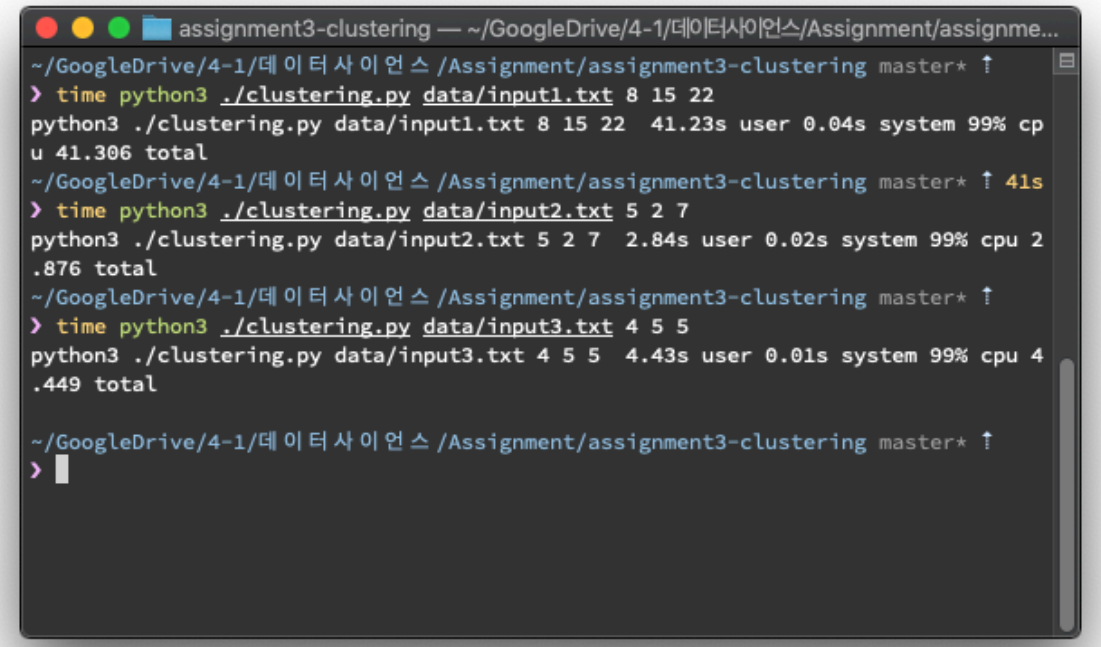

assignment3-clustering — LazyRen@Daeln-MBP — ..t3-clustering — -zsh ▸ -zsh...
~/GoogleDrive/4-1/데이터사이언스/Assignment/assignment3-clustering master*
❯ ./evaluation.py
******************** USAGE ********************
1. Use existing outputfiles at test/
2. Run DBSCAN to create new outputFiles
Input: 1
Starting Evaluation: input1
7676 points are clustered in ideal files
7485 points are clustered in output files
29155750 / 29456650 = 98.97850%
Evaluation took 10.975946 seconds
Starting Evaluation: input2
2000 points are clustered in ideal files
1942 points are clustered in output files
1896371 / 1999000 = 94.86598%
Evaluation took 0.735864 seconds
Starting Evaluation: input3
2100 points are clustered in ideal files
2099 points are clustered in output files
2203451 / 2203950 = 99.97736%
Evaluation took 0.814148 seconds


명령 프롬프트
Microsoft Windows [Version 10.0.17134.706]
(c) 2018 Microsoft Corporation. All rights reserved.
C:₩Users₩LazyRen>E:
E:₩>cd E:₩LR₩gDrive₩4-1₩데이터사이언스₩Assignment₩assignment3-clustering₩test
E:₩LR₩gDrive₩4-1₩데이터사이언스₩Assignment₩assignment3-clustering₩test>PA3.exe input1
98.9785점
E:₩LR₩gDrive₩4-1₩데이터사이언스₩Assignment₩assignment3-clustering₩test>PA3.exe input2
94.86598점
E:₩LR₩gDrive₩4-1₩데이터사이언스₩Assignment₩assignment3-clustering₩test>PA3.exe input3
99.97736점
E:₩LR₩gDrive₩4-1₩데이터사이언스₩Assignment₩assignment3-clustering₩test>

Results

Note that output files will be located on the same folder as input file. (in data folder in example)
< If `evaluation.py` is used to create output files(by choosing option *2*), it will generate output files at test folder. >

Result score may differ from each excution because DBSCAN algorithm choose *random point* to generate *density-based clustering*.




```
E:₩LR₩gDrive₩4-1₩데이터사이언스₩Assignment₩assignment3-clustering₩test>pa3.exe input1
98.9785점
E:₩LR₩gDrive₩4-1₩데이터사이언스₩Assignment₩assignment3-clustering₩test>pa3.exe input2
94.86598점
E:₩LR₩gDrive₩4-1₩데이터사이언스₩Assignment₩assignment3-clustering₩test>pa3.exe input3
99.97736점
```

Implementation

class Point

```python
class Point:
    def __init__(self, id, x, y):
        self.id = int(id)
        self.x = float(x)
        self.y = float(y)
        self.isVisited = False
        self.label = -1

    def __repr__(self):
        return self.__str__()
```

```
    def __str__(self):
        ret = "("
        ret += str(self.id) + ": "
        ret += str(self.x) + ", "
        ret += str(self.y) + ")"
        return ret
```

Each line from input file will be converted to a `Point` object.

`id`: unique number that represents Point object.
`x`: x-coordinate in 2D
`y`: y-coordinate in 2D
`isVisited`: boolean value that is used while DBSCAN algorithm.
label: id of cluster that it belongs to.

{isVisited, label} == {False, -1} --> not yet identified.
{isVisited, label} == {True, -1} --> outlier
Point may become {True, -1} after labelConverter is used to reduce # of clusters.

loadData()

Simply read line to line from *input file* and generate `Point` object.
Return value is list of all `Point` objects that will be used to clustering.

findNeighbor()

Find all neighbor Points from `cur` point. Neighbor must be positioned within radius of `eps`.
Time Complexity = O(n)

dbscan()

Algorithm: DBSCAN: a density-based clustering algorithm.

Input:

- D: a data set containing n objects,
- ϵ: the radius parameter, and
- *MinPts*: the neighborhood density threshold.

Output: A set of density-based clusters.

Method:

```
(1)  mark all objects as unvisited;
(2)  do
(3)      randomly select an unvisited object p;
(4)      mark p as visited;
(5)      if the ε-neighborhood of p has at least MinPts objects
(6)          create a new cluster C, and add p to C;
(7)          let N be the set of objects in the ε-neighborhood of p;
(8)          for each point p' in N
(9)              if p' is unvisited
(10)                 mark p' as visited;
(11)                 if the ε-neighborhood of p' has at least MinPts points,
                     add those points to N;
(12)             if p' is not yet a member of any cluster, add p' to C;
(13)         end for
(14)         output C;
(15)     else mark p as noise;
(16) until no object is unvisited;
```

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pseudo code of DBSCAN [1]

Implementation of DBSCAN algorithm. *Time Complexity* = $O(n^2)$

After creating *density-based clusters*, function also generates `labelconverter` dictionary. Which is used to remove any extra clusters exceeding `N` (user given argument of max cluser #).

createOutputFile()

Generates `N` output files. Each file represents one *density-based cluster*.
`labelConverter` is used at this point to eliminate extra clusters(labels). Any *Point* with -1 as a label is either outlier or belongs to extra cluster.
Note that if number of created clusters is smaller than `N`, some output files are created as a blank file.

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1. Data Mining Concepts and Techniques Chapter 10.4↩