

# EM Algorithm and VB Algorithm

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## EM Algorithm

### Requirements:

python 3.10.4  
numpy 1.22.3  
matplotlib 3.5.1

### Command:

```
$python EM.py [path/to/x.csv] [path/to/z.csv] [path/to/params.dat]
```

## VB Algorithm

### Requirements:

python 3.10.4  
numpy 1.22.3  
matplotlib 3.5.1  
scipy 1.8.1

### Command:

```
$python VB.py [path/to/x.csv] [path/to/z.csv] [path/to/params.dat]
```

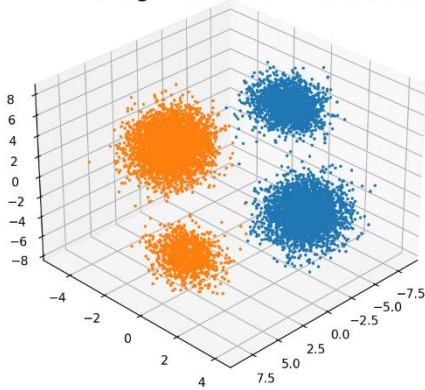
## Test with several K and discussion about an appropriate K

The classification results with EM and VB algorithm are displayed below. The input data are apparently separated into four classes. When K is set to four, both algorithms separate them into 4 subsets reasonably. When K is set to the larger value than four, both algorithms fail to classify. The data having the same label assigned by EM algorithms are widely scattered, though those ones labelled with VB algorithm seem to gather around.

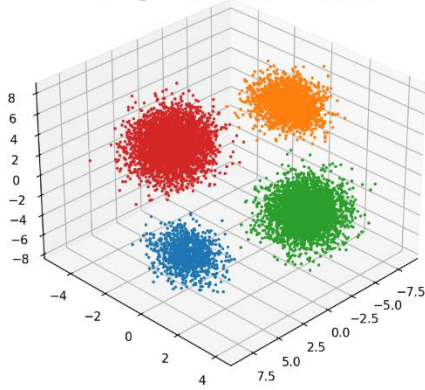
In the light of the likelihood, the larger the value of K is, smaller it is. This is common to both algorithms.

## EM algorithm

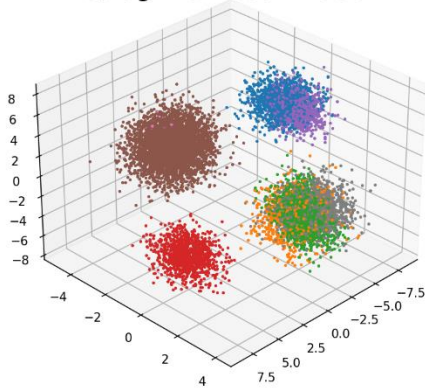
$K = 2$ , log likelihood = -62993.0



$K = 4$ , log likelihood = -56631.7

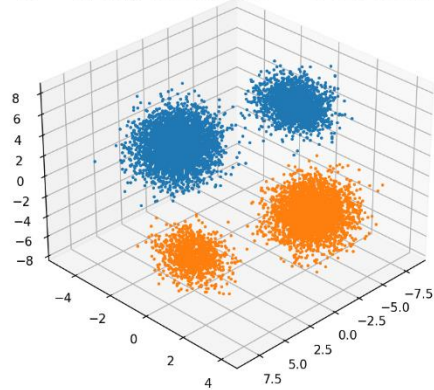


$K = 8$ , log likelihood = -56621.2

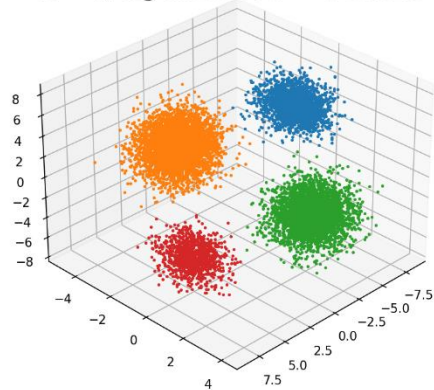


## VB algorithm

$K = 2$ , log likelihood = -1425890.7



$K = 4$ , log likelihood = -70301.3



$K = 8$ , log likelihood = -67342.5

