# segmenting images to data

*Julia Sheriff*

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## flower image

### How images are described in R

- Grayscale
- matrix of pixel intensities from 0 (black) to 1 (white) “Intensity matrices”
- 8bits/pixel (bpp) means 256 color levels
- decimals between 0 and 1 as matrix values indicate darkness
- number of columns indicates width (in pixels), number of rows indicates length
- clusters choose ranges of decimals to group matrix
- input to clustering algorithm is the matrix described above, but reorganized
- each column will represent a decimal value/shade (ex. .2 or .1)
    - done with as.vector() function
- Distance matrix:
- Distance between elements of intensity vector.
- Calculate “pairwise distance”" between each elements and the other elements
- Do this for each element in the cluster
- (will be done n*(n-1)/2 times) because of a to b is b to a

Inputting data to matrix/vector/distance:

```r
flower <- read.csv("flower.csv", header = FALSE)
#remember, default is header = TRUE

str(flower)
```

```
## 'data.frame':    50 obs. of  50 variables:
##  $ V1 : num  0.0991 0.0991 0.1034 0.1034 0.1034 ...
##  $ V2 : num  0.112 0.108 0.112 0.116 0.108 ...
##  $ V3 : num  0.134 0.116 0.121 0.116 0.112 ...
##  $ V4 : num  0.138 0.138 0.121 0.121 0.112 ...
##  $ V5 : num  0.138 0.134 0.125 0.116 0.112 ...
##  $ V6 : num  0.138 0.129 0.121 0.108 0.112 ...
##  $ V7 : num  0.129 0.116 0.103 0.108 0.112 ...
##  $ V8 : num  0.116 0.103 0.103 0.103 0.116 ...
##  $ V9 : num  0.1121 0.0991 0.1078 0.1121 0.1164 ...
##  $ V10: num  0.121 0.108 0.112 0.116 0.125 ...
##  $ V11: num  0.134 0.125 0.129 0.134 0.129 ...
##  $ V12: num  0.147 0.134 0.138 0.129 0.138 ...
##  $ V13: num  0.000862 0.146552 0.142241 0.142241 0.133621 ...
##  $ V14: num  0.000862 0.000862 0.142241 0.133621 0.12931 ...
##  $ V15: num  0.142 0.142 0.134 0.121 0.116 ...
##  $ V16: num  0.125 0.125 0.116 0.108 0.108 ...
##  $ V17: num  0.1121 0.1164 0.1078 0.0991 0.0991 ...
##  $ V18: num  0.108 0.112 0.108 0.108 0.108 ...
##  $ V19: num  0.121 0.129 0.125 0.116 0.116 ...
##  $ V20: num  0.138 0.129 0.125 0.116 0.116 ...
##  $ V21: num  0.138 0.134 0.121 0.125 0.125 ...
##  $ V22: num  0.134 0.129 0.125 0.121 0.103 ...
##  $ V23: num  0.125 0.1207 0.1164 0.1164 0.0819 ...
##  $ V24: num  0.1034 0.1034 0.0991 0.0991 0.1034 ...
##  $ V25: num  0.0948 0.0905 0.0905 0.1034 0.125 ...
##  $ V26: num  0.0862 0.0862 0.0991 0.125 0.1422 ...
##  $ V27: num  0.086207 0.086207 0.103448 0.12931 0.000862 ...
##  $ V28: num  0.0991 0.1078 0.1164 0.1293 0.1466 ...
##  $ V29: num  0.116 0.134 0.134 0.121 0.142 ...
##  $ V30: num  0.121 0.138 0.142 0.129 0.138 ...
##  $ V31: num  0.121 0.134 0.142 0.134 0.129 ...
##  $ V32: num  0.116 0.134 0.129 0.116 0.112 ...
##  $ V33: num  0.108 0.112 0.116 0.108 0.108 ...
##  $ V34: num  0.1078 0.1078 0.1034 0.0991 0.1034 ...
##  $ V35: num  0.1078 0.1034 0.0991 0.0991 0.0991 ...
##  $ V36: num  0.1078 0.1034 0.1034 0.0905 0.0862 ...
##  $ V37: num  0.1078 0.1078 0.1034 0.0819 0.0733 ...
##  $ V38: num  0.0948 0.0991 0.0776 0.069 0.0733 ...
##  $ V39: num  0.0733 0.056 0.0474 0.0474 0.056 ...
##  $ V40: num  0.0474 0.0388 0.0431 0.0474 0.0603 ...
##  $ V41: num  0.0345 0.0345 0.0388 0.0474 0.0647 ...
##  $ V42: num  0.0259 0.0259 0.0345 0.0431 0.056 ...
##  $ V43: num  0.0259 0.0259 0.0388 0.0517 0.0603 ...
##  $ V44: num  0.0302 0.0302 0.0345 0.0517 0.0603 ...
##  $ V45: num  0.0259 0.0259 0.0259 0.0388 0.0474 ...
##  $ V46: num  0.0259 0.0172 0.0172 0.0259 0.0345 ...
##  $ V47: num  0.01724 0.01724 0.00862 0.02155 0.02586 ...
##  $ V48: num  0.0216 0.0129 0.0129 0.0172 0.0302 ...
##  $ V49: num  0.0216 0.0216 0.0216 0.0345 0.0603 ...
##  $ V50: num  0.0302 0.0345 0.0388 0.0603 0.0776 ...
```

```r
#r doesn't read this like it represents a distance matrix. just reg vars and obs

flowermatrix <- as.matrix(flower)
#turned into matrix

flowervector = as.vector(flowermatrix)
str(flowervector)
```

```
##  num [1:2500] 0.0991 0.0991 0.1034 0.1034 0.1034 ...
```

```r
#turned into vector, dataframe with as.vector() command will return dataframe, not individual vectors

#distance matrix:
distance = dist(flowervector, method = "euclidean")
str(distance)
```

```
##  'dist' num [1:3123750] 0 0.00431 0.00431 0.00431 0.01293 ...
##  - attr(*, "Size")= int 2500
##  - attr(*, "Diag")= logi FALSE
##  - attr(*, "Upper")= logi FALSE
##  - attr(*, "method")= chr "euclidean"
##  - attr(*, "call")= language dist(x = flowervector, method = "euclidean")
```

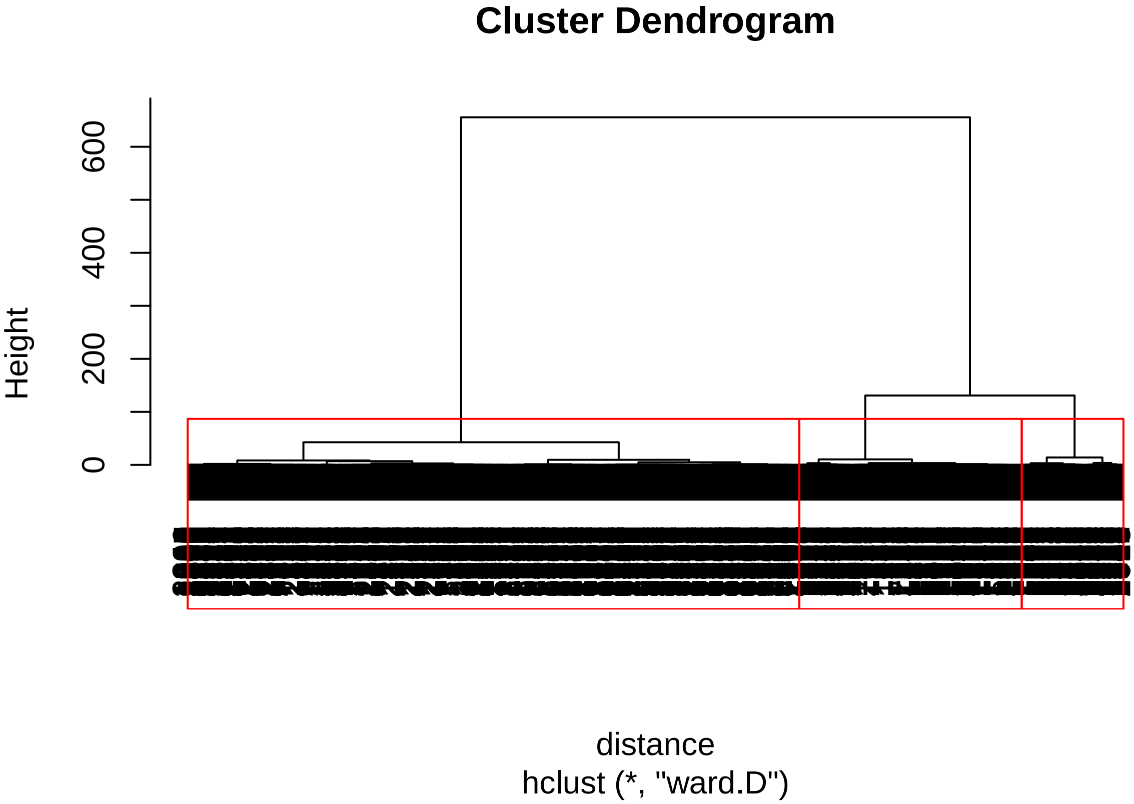
Heigharachial clustering:

```
clusterintensity = hclust(distance, method = "ward")
```

```
## The "ward" method has been renamed to "ward.D"; note new "ward.D2"
```

```
#"ward" method minimizes variance within and distance between each clusterplot

#make dendrogram
plot(clusterintensity)
#3clusters on dentrogram represented with rectangular area
rect.hclust(clusterintensity, k = 3, border = "red")
```



```
#reminders: all observations are on the bottom row; vertical lengths represent distances between each c
#suggestion: make cutoff/choose number of clusters where the distance between different numbers of clus

#creates clusters via segmentation
#see new matrix with same dimensions but with new values determined by cluster number:
flowerclusters = cutree(clusterintensity, k = 3)
flowerclusters
```

```
##    [1] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [35] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [69] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [103] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [137] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [171] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [205] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [239] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [273] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [307] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [341] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 3
##  [375] 2 2 3 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [409] 1 1 1 1 1 1 1 1 1 2 2 1 1 1 3 3 3 3 3 2 1 2 3 2 1 1 1 1 1 1 1 1 1 1
##  [443] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 3 1 1 1 3 3 3 3
##  [477] 3 2 2 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [511] 1 1 1 1 1 1 2 3 3 2 1 1 3 3 3 3 3 2 3 3 3 1 2 3 3 1 1 1 1 1 1 1 1 1
##  [545] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 3 2 1 2 3 3 3 1 1 3 3 3 3 3 2
##  [579] 3 3 2 2 3 3 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [613] 2 3 3 2 1 3 3 3 2 1 2 3 3 3 3 3 3 3 2 3 3 3 3 3 3 3 1 1 1 1 1 1 1 1
##  [647] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 3 3 2 2 3 3 3 1 2 3 3 3 3 3 3 3
##  [681] 3 3 3 3 3 3 3 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
##  [715] 3 3 3 3 3 3 3 2 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 2 1 1 1 1 1 1 1 1 1 1
##  [749] 1 1 1 1 1 1 1 1 1 1 1 2 3 2 1 1 2 3 3 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3
##  [783] 3 3 3 3 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 3 3 3 2 1 1
##  [817] 3 3 3 3 3 3 2 2 3 3 3 3 3 3 3 3 3 3 3 2 1 1 2 2 3 3 1 1 1 1 1 1 1 1
##  [851] 1 1 1 1 1 1 1 1 1 1 2 3 3 3 2 1 2 3 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3 3
##  [885] 2 1 2 3 3 3 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 3 3 3 3 2 2
##  [919] 3 3 3 3 3 2 2 3 3 3 3 3 3 3 3 2 1 3 3 3 3 3 3 2 1 1 1 1 1 1 1 1 1 1
##  [953] 1 1 1 1 1 1 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 2 2 2 2 2 3 3 3 3 2 2 3 3
##  [987] 3 3 3 3 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 3 3 3 3 3 3 3 3 3
## [1021] 3 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [1055] 1 1 2 2 2 3 3 3 3 3 3 3 3 3 3 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 2 2
## [1089] 2 2 3 3 3 2 1 1 1 1 1 1 1 1 1 1 1 2 3 3 3 3 3 3 3 3 3 3 3 3 3 2 2 2
## [1123] 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 2 1 1 1 1 1 1 1 1 1 1 1 1
## [1157] 2 3 3 3 3 3 3 3 3 3 3 3 3 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 2
## [1191] 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 3 3 3 3 3 2 2 2 2 2 2
## [1225] 2 2 2 2 2 2 2 3 3 3 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [1259] 3 3 3 3 3 3 3 3 3 3 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1
## [1293] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 3 3 3 3 3 3 3 3 3 3 3 2 2 2 2 2 2 2
## [1327] 2 2 2 2 3 3 3 3 3 3 3 3 3 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 3 3
## [1361] 3 3 3 3 3 3 3 3 3 3 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 1
## [1395] 1 1 1 1 1 1 1 1 1 1 1 1 1 2 3 3 3 3 3 3 3 3 3 3 3 3 2 2 2 2 2 2 2 2
## [1429] 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 3 3 3
## [1463] 3 3 3 3 3 3 3 3 3 3 3 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 3 3 2 1 1 1 1 1
## [1497] 1 1 1 1 1 1 1 1 1 1 1 1 3 3 3 3 3 3 3 2 3 3 3 3 3 3 3 2 2 3 3 3 2 3
## [1531] 3 3 3 3 3 2 3 3 3 3 3 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 3 3 2 2 1
## [1565] 2 3 3 3 3 3 3 3 3 2 2 3 3 3 3 2 3 3 3 3 3 2 1 2 2 2 2 2 1 1 1 1 1 1
## [1599] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 3 3 3 3 3 3 3 3 3 2 3 3 3 3 3 2 3 3
## [1633] 3 3 3 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 3 3 3
## [1667] 2 3 3 3 3 3 2 2 3 3 3 3 3 2 1 3 3 3 3 3 3 3 2 1 1 1 1 1 1 1 1 1 1 1
## [1701] 1 1 1 1 1 1 1 1 1 1 1 2 3 3 2 2 3 3 3 3 3 3 1 3 3 3 3 3 3 2 1 2 3 3
## [1735] 3 3 3 3 3 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 3 2 1 3 3 3
## [1769] 3 3 3 1 1 3 3 3 3 3 3 2 1 1 2 3 3 3 3 2 3 2 1 1 1 1 1 1 1 1 1 1 1 1
## [1803] 1 1 1 1 1 1 1 1 1 2 2 1 2 3 3 3 3 3 2 1 2 3 3 2 3 3 3 2 1 1 1 1 3 3
## [1837] 3 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 3 3 3 3 3 3
## [1871] 1 1 2 3 3 2 3 3 3 3 1 1 1 1 1 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [1905] 1 1 1 1 1 1 1 1 1 1 2 3 3 3 3 3 1 1 2 3 3 1 3 3 3 3 1 1 1 1 1 1 1 1
## [1939] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 3 3 2 1 1
## [1973] 2 3 3 1 2 3 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2007] 1 1 1 1 1 1 1 1 1 1 1 2 3 1 1 1 1 3 3 1 1 3 3 3 1 1 1 1 1 1 1 1 1 1
## [2041] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2
## [2075] 3 1 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2109] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2143] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2177] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2211] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2245] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2279] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2313] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2347] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2381] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2415] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2449] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [2483] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

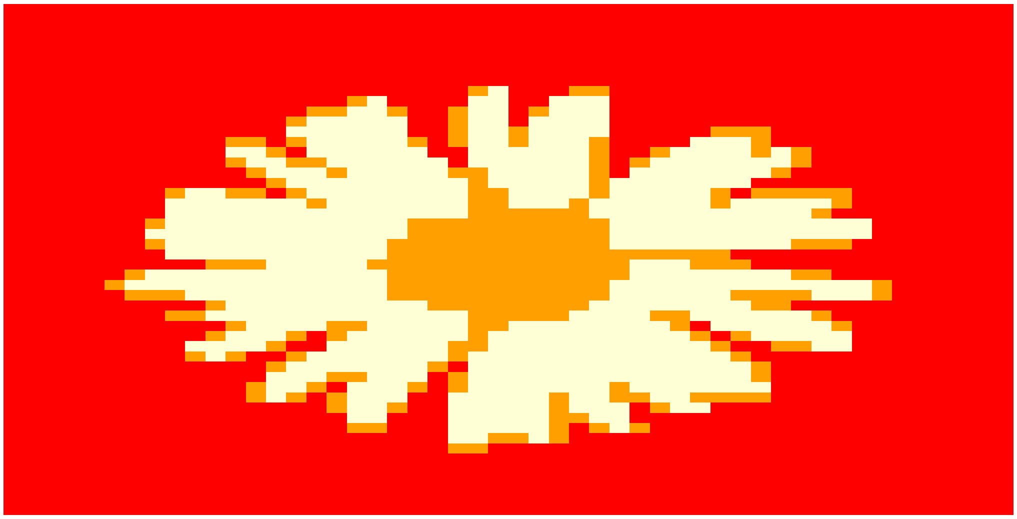
```
str(flowerclusters)
```

```
##  int [1:2500] 1 1 1 1 1 1 1 1 1 1 ...
```

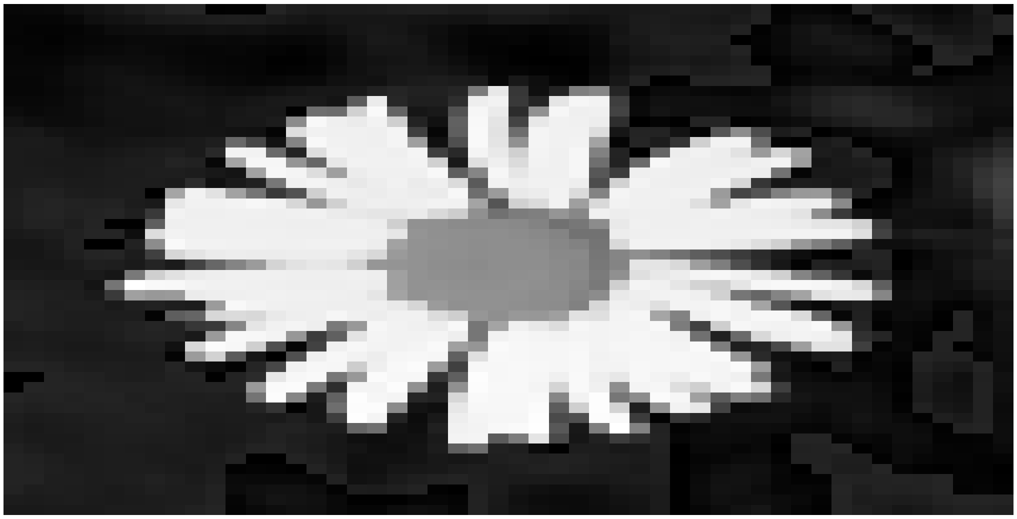
```
#means of clusters. higher number = lighter shade
tapply(flowervector, flowerclusters, mean)
```

```
##          1          2          3
## 0.08574315 0.50826255 0.93147713
```

```
#creates image as input by rewriting dimensions of vector into a matrix with original dimensions (50 x
dim(flowerclusters) = c(50, 50)
image(flowerclusters, axes = FALSE)
```



```
#review what initial greyscale image looks like
image(flowermatrix, axes = FALSE, col = grey(seq(0, 1, length = 256)))
```



## BrainScans