T-SNE IP

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21/09/2020

Dimensionality Reduction with t-SNE

```
# loading the dataset
data<- read.csv(file.choose(), header = T, stringsAsFactors = T)
head(data)
```

```
##    Invoice.ID Branch Customer.type Gender           Product.line Unit.price
## 1 750-67-8428      A        Member Female      Health and beauty      74.69
## 2 226-31-3081      C        Normal Female Electronic accessories      15.28
## 3 631-41-3108      A        Normal   Male     Home and lifestyle      46.33
## 4 123-19-1176      A        Member   Male      Health and beauty      58.22
## 5 373-73-7910      A        Normal   Male      Sports and travel      86.31
## 6 699-14-3026      C        Normal   Male Electronic accessories      85.39
##   Quantity     Tax      Date  Time     Payment   cogs gross.margin.percentage
## 1        7 26.1415  1/5/2019 13:08     Ewallet 522.83                4.761905
## 2        5  3.8200  3/8/2019 10:29        Cash  76.40                4.761905
## 3        7 16.2155  3/3/2019 13:23 Credit card 324.31                4.761905
## 4        8 23.2880 1/27/2019 20:33     Ewallet 465.76                4.761905
## 5        7 30.2085  2/8/2019 10:37     Ewallet 604.17                4.761905
## 6        7 29.8865 3/25/2019 18:30     Ewallet 597.73                4.761905
##   gross.income Rating    Total
## 1      26.1415    9.1 548.9715
## 2       3.8200    9.6  80.2200
## 3      16.2155    7.4 340.5255
## 4      23.2880    8.4 489.0480
## 5      30.2085    5.3 634.3785
## 6      29.8865    4.1 627.6165
```

```
# checking the structure of the data
str(data)
```

```
## ’data.frame’:    1000 obs. of  16 variables:
##  $ Invoice.ID             : Factor w/ 1000 levels "101-17-6199",..: 815 143 654 19 340 734 316 265 7
##  $ Branch                 : Factor w/ 3 levels "A","B","C": 1 3 1 1 1 3 1 3 1 2 ...
##  $ Customer.type          : Factor w/ 2 levels "Member","Normal": 1 2 2 1 2 2 1 2 1 1 ...
##  $ Gender                 : Factor w/ 2 levels "Female","Male": 1 1 2 2 2 2 1 1 1 1 ...
##  $ Product.line           : Factor w/ 6 levels "Electronic accessories",..: 4 1 5 4 6 1 1 5 4 3 ...
##  $ Unit.price             : num  74.7 15.3 46.3 58.2 86.3 ...
##  $ Quantity               : int  7 5 7 8 7 7 6 10 2 3 ...
##  $ Tax                    : num  26.14 3.82 16.22 23.29 30.21 ...
##  $ Date                   : Factor w/ 89 levels "1/1/2019","1/10/2019",..: 27 88 82 20 58 77 49 48 2
##  $ Time                   : Factor w/ 506 levels "10:00","10:01",..: 147 24 156 486 30 394 215 78 342
##  $ Payment                : Factor w/ 3 levels "Cash","Credit card",..: 3 1 2 3 3 3 3 3 2 2 ...
##  $ cogs                   : num  522.8 76.4 324.3 465.8 604.2 ...
##  $ gross.margin.percentage: num  4.76 4.76 4.76 4.76 4.76 ...
##  $ gross.income           : num  26.14 3.82 16.22 23.29 30.21 ...
##  $ Rating                 : num  9.1 9.6 7.4 8.4 5.3 4.1 5.8 8 7.2 5.9 ...
##  $ Total                  : num  549 80.2 340.5 489 634.4 ...
```

```
# changing the date and time column into date and time
Dates <- format(as.POSIXct(strptime(data$Date, "%d/%m/%y"), format="%d/%m/%y"))
Times <- format(as.POSIXct(strptime(data$Time, "%H:%M"), format="%H:%M"))
head(Times)
```

```
## [1] "2020-09-22 13:08:00" "2020-09-22 10:29:00" "2020-09-22 13:23:00"
## [4] "2020-09-22 20:33:00" "2020-09-22 10:37:00" "2020-09-22 18:30:00"
```

```
class(data$Time)
```

```
## [1] "factor"
```

```
# separating the classes
library(tidyr)

data <- separate(data, "Date", c("Day","Month","Year"))

data <- separate(data, "Time", c("Hour","Minute"))
head(data)
```

```
##    Invoice.ID Branch Customer.type Gender           Product.line Unit.price
## 1 750-67-8428      A        Member Female      Health and beauty      74.69
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## 4 123-19-1176      A        Member   Male      Health and beauty      58.22
## 5 373-73-7910      A        Normal   Male      Sports and travel      86.31
## 6 699-14-3026      C        Normal   Male Electronic accessories      85.39
##   Quantity     Tax Day Month Year Hour Minute     Payment   cogs
## 1        7 26.1415   1     5 2019   13     08     Ewallet 522.83
## 2        5  3.8200   3     8 2019   10     29        Cash  76.40
## 3        7 16.2155   3     3 2019   13     23 Credit card 324.31
## 4        8 23.2880   1    27 2019   20     33     Ewallet 465.76
## 5        7 30.2085   2     8 2019   10     37     Ewallet 604.17
## 6        7 29.8865   3    25 2019   18     30     Ewallet 597.73
##   gross.margin.percentage gross.income Rating    Total
## 1                4.761905      26.1415    9.1 548.9715
## 2                4.761905       3.8200    9.6  80.2200
## 3                4.761905      16.2155    7.4 340.5255
## 4                4.761905      23.2880    8.4 489.0480
## 5                4.761905      30.2085    5.3 634.3785
## 6                4.761905      29.8865    4.1 627.6165
```

```r
# changing the new columns into factors
data$Day <- as.factor(data$Day)
data$Month <- as.factor(data$Month)
data$Year <- as.factor(data$Year)
data$Hour <- as.factor(data$Hour)
data$Minute <- as.factor(data$Minute)
```

```r
# removing columns that are not needed
data$Invoice.ID<-NULL
data$Year<-NULL
```

I decided to remove the columns that were not necessary. I removed the Year column because it had only one year. The ID was not useful therefore I decided to remove it.

```r
# Label encoding the categorical column Gender
data$Gender <- ifelse(data$Gender == "Male",1,2)
table(data$Gender)
```

```
##
##   1   2
## 499 501
```

```r
# label encoding the customer type column
data$Customer.type <- ifelse(data$Customer.type == "Member",1,2)
table(data$Customer.type)
```

```
##
##   1   2
## 501 499
```

```r
# label encoding the payment column
data$Payment <- as.numeric(data$Payment)
table(data$Payment)
```

```
##
##   1   2   3
## 344 311 345
```

```r
# label encoding the product line column
data$Product.line <- as.numeric(data$Product.line)
table(data$Product.line)
```

```
##
##   1   2   3   4   5   6
## 170 178 174 152 160 166
```

```r
# label encoding the branch column
data$Branch <- as.numeric(data$Branch)
table(data$Branch)
```

```
##
##   1   2   3
## 340 332 328
```

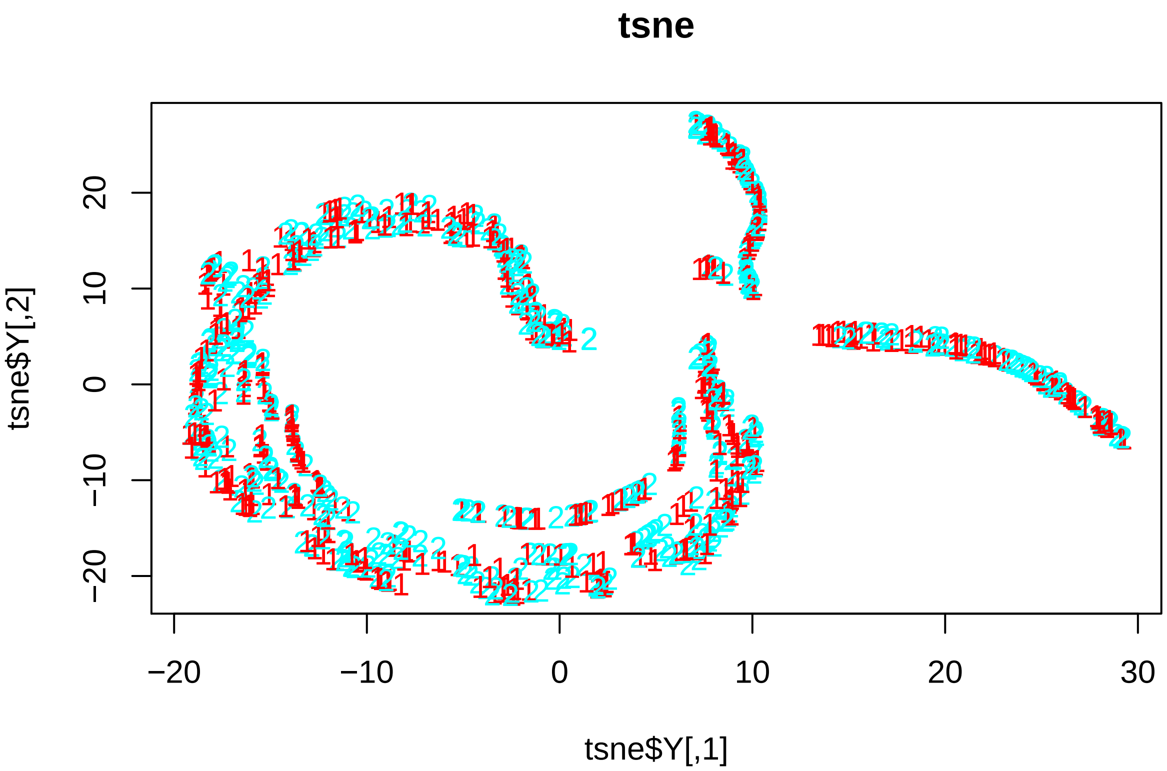
```
# creating a label column in this case we will use the column product line
Labels<-data$Customer.type
data$Product.line<-as.factor(data$Customer.type)

# obtaining unique colors for the different classes in the column
colors = rainbow(length(unique(data$Customer.type)))
names(colors) = unique(data$Customer.type)
```

```
# loading the rtsne library
library(Rtsne)
```

```
# perfoming the rtsne
tsne <- Rtsne(data, dims = 2, perplexity=30, verbose=TRUE, max_iter = 500)
```

```
## Performing PCA
## Read the 1000 x 50 data matrix successfully!
## OpenMP is working. 1 threads.
## Using no_dims = 2, perplexity = 30.000000, and theta = 0.500000
## Computing input similarities...
## Building tree...
## Done in 0.31 seconds (sparsity = 0.101256)!
## Learning embedding...
## Iteration 50: error is 58.174684 (50 iterations in 0.27 seconds)
## Iteration 100: error is 51.957333 (50 iterations in 0.28 seconds)
## Iteration 150: error is 51.027442 (50 iterations in 0.24 seconds)
## Iteration 200: error is 50.751173 (50 iterations in 0.23 seconds)
## Iteration 250: error is 50.639810 (50 iterations in 0.37 seconds)
## Iteration 300: error is 0.560585 (50 iterations in 0.30 seconds)
## Iteration 350: error is 0.403747 (50 iterations in 0.22 seconds)
## Iteration 400: error is 0.369864 (50 iterations in 0.33 seconds)
## Iteration 450: error is 0.354234 (50 iterations in 0.22 seconds)
## Iteration 500: error is 0.343741 (50 iterations in 0.22 seconds)
## Fitting performed in 2.67 seconds.
```

```
# plotting the tsne graph
plot(tsne$Y, t=’n’, main="tsne")
text(tsne$Y, labels=data$Customer.type, col=colors[data$Customer.type])
```


tsne
tsne$Y[,2]
20
10
0
−10
−20
tsne$Y[,1]
−20
−10
0
10
20
30
1
2