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MEASURING EFFECTIVENESS OF KNN CLASSIFICATION BASED ON PREPROCESSING PERFORMED ON DATASET

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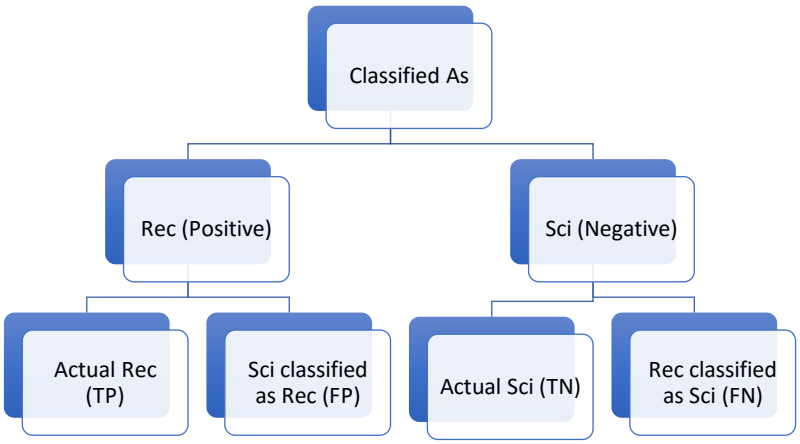
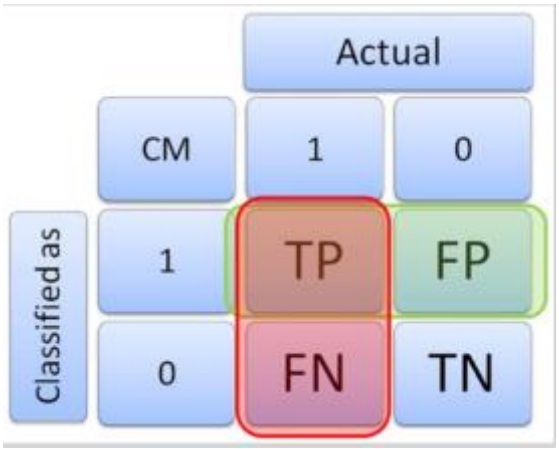
Objective: For the newsgroup classification dataset[1], estimate the effectiveness of classification for changes in the preprocessing steps and indicate how the effectiveness of classification changed.

Information:
"Rec" considered Positive and "Sci" as Negative
All calculations are tabulated at the end of Part A.



Confusion Matrix:



Source: 1 https://onlinecampus.bu.edu/bbcswebdav/pid-4757740-dt-content-rid-16646812_1/courses/17sprgmetcs688_o1/module4/allpages.htm

[1] Source: www.csail.mit.edu/~jrennie/20Newsgroups/

Experiment 1: No preprocessing

Steps:

1. The required libraries are loaded into the workspace
2. The corpus for 2 train document sets and 2 test document sets are created, and then merged
3. Preprocessing steps are skipped, and Document Term Matrix is generated and inspected.
4. Document term matrix is explored
5. Sparse terms are removed
6. Document term matrix is then saved as a simple matrix
7. Splitting Document Term Matrix into training and testing datasets
8. Tags are created
9. KNN classification is performed
10. Confusion matrix is generated using AutoCM for verification purpose
11. Confusion matrix is then manually generated
12. Precision, Recall and f-score values are calculated and the values are stored in exp1result object

Results:

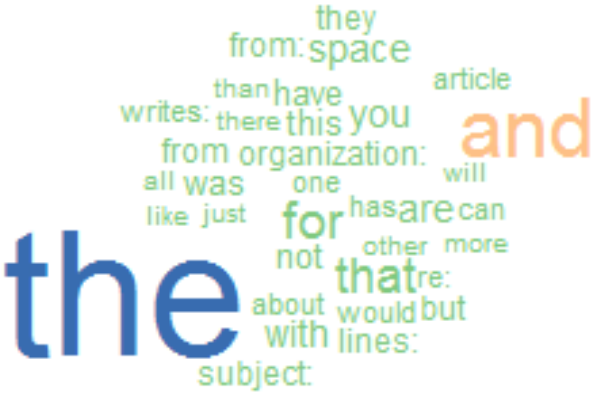


Figure 1 Word Cloud for Document Term Matrix

```
> sum(c)/length(Tags) # Overall probability
[1] 0.68625
> sum(prob.test==Tags)/length(Tags) # Percentage of TRUE/Correct classifications
[1] 0.575
> save(prob.test,dtm,file="ProbExp1")
> load(file="ProbExp1")
> table(prob.test, Tags) -> AutoCM
> AutoCM
         Tags
prob.test Rec Sci
      Rec  61  46
      Sci  39  54
```

Figure 2 Automatically generated Confusion Matrix

```
> CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
> CM
    Rec Sci
Rec  61  46
Sci  39  54
```

Figure 3 Confusion matrix for data that is nor preprocessed

Experiment 2: Without Removing sparse terms from DTM

Steps:

1. The required libraries are loaded into the workspace
2. The corpus for 2 train document sets and 2 test document sets are created, and then merged
3. Preprocessing steps are skipped, and Document Term Matrix is generated and inspected.
4. Document term matrix is explored
5. Sparse terms are ignored
6. Document term matrix is then saved as a simple matrix
7. Splitting Document Term Matrix into training and testing datasets
8. Tags are created
9. KNN classification is performed
10. Results of classification are analyzed and saved as ProbExp2
11. Confusion matrix is generated using AutoCM for verification purpose
12. Confusion matrix is then manually generated
13. Precision, Recall and f-score values are calculated and the values are stored in exp2result object.

Results:

```
> CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
> CM
    Rec Sci
Rec  61  46
Sci  39  54
```

Figure 4 Confusion Matrix for classification Without Removing sparse terms from DTM

Experiment 3: Preprocessing, without removing stop words

Steps:

1. The required libraries are loaded into the workspace
2. The corpus for 2 train document sets and 2 test document sets are created, and then merged
3. Preprocessing steps are performed, skipping stop word removal
4. Document Term Matrix is generated and inspected.
5. Document term matrix is explored
6. Spare terms are removed
7. Document term matrix is then saved as a simple matrix
8. Splitting Document Term Matrix into training and testing datasets
9. Tags are created
10. KNN classification is performed
11. Results of classification are analyzed and saved as ProbExp2
12. Confusion matrix is generated using AutoCM for verification purpose
13. Confusion matrix is then manually generated
14. Precision, Recall and f-score values are calculated and the values are stored in exp2result object.

Results:

```
> TP <- sum(RecClassified=="TRUE") # Actual "Rec" classified as "Rec"
> FN<-sum(RecClassified=="FALSE")  # Actual "Rec" classified as "Sci"
> SciClassified <-(prob.test==Tags)[1:100] # Classified as "Sci" (Negative)
> TN <- sum(SciClassified=="TRUE") #Actual "sci"
> FP<-sum(SciClassified=="FALSE") # Actual "Sci" classified as "Rec"
> TP
[1] 78
> FP
[1] 50
> TN
[1] 50
> FN
[1] 22
> CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
> CM
    Rec Sci
Rec  78  50
Sci  22  50
```

Figure 5 Confusion Matrix for classification with preprocessing, without stop word removal

Experiment 4: Preprocessing, with stop words removal

Steps:

1. The required libraries are loaded into the workspace
2. The corpus for 2 train document sets and 2 test document sets are created, and then merged
3. Preprocessing steps are performed, including stop word removal
4. Document Term Matrix is generated and inspected.
5. Document term matrix is explored
6. Spare terms are removed
7. Document term matrix is then saved as a simple matrix
8. Splitting Document Term Matrix into training and testing datasets
9. Tags are created
10. KNN classification is performed
11. Results of classification are analyzed and saved as ProbExp2
12. Confusion matrix is generated using AutoCM for verification purpose
13. Confusion matrix is then manually generated
14. Precision, Recall and f-score values are calculated and the values are stored in exp2result object.

Results:

```
> TP <- sum(RecClassified=="TRUE") # Actual "Rec" classified as "Rec"
> FN<-sum(RecClassified=="FALSE")  # Actual "Rec" classified as "Sci"
> SciClassified <-(prob.test==Tags)[1:100] # Classified as "Sci" (Negative)
> TN <- sum(SciClassified=="TRUE") #Actual "sci"
> FP<-sum(SciClassified=="FALSE") # Actual "Sci" classified as "Rec"
> TP
[1] 69
> FP
[1] 56
> TN
[1] 44
> FN
[1] 31
> CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
> CM
    Rec Sci
Rec  69  56
Sci  31  44
```

Figure 6 Confusion Matrix for classification with preprocessing, with stop word removal

Experiment 5: Changing term frequency from 5 to 10

Steps:

1. The required libraries are loaded into the workspace
2. The corpus for 2 train document sets and 2 test document sets are created, and then merged
3. Preprocessing steps are performed, including stop word removal
4. Document Term Matrix is generated with term frequency set to 10
5. Document term matrix is explored
6. Spare terms are removed
7. Document term matrix is then saved as a simple matrix
8. Splitting Document Term Matrix into training and testing datasets
9. Tags are created
10. KNN classification is performed
11. Results of classification are analyzed and saved as ProbExp2
12. Confusion matrix is generated using AutoCM for verification purpose
13. Confusion matrix is then manually generated
14. Precision, Recall and f-score values are calculated and the values are stored in exp2result object.

Results:

Figure 7 Word cloud for experiment 5

```
> TP
[1] 69
> FP
[1] 56
> TN
[1] 44
> FN
[1] 31
> CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
> CM
    Rec Sci
Rec  69  56
Sci  31  44
```

Figure 8 Confusion Matrix for classification with document frequency =10

Experiment 6: Changing word length from 2 to 4

Steps:

1. The required libraries are loaded into the workspace
2. The corpus for 2 train document sets and 2 test document sets are created, and then merged
3. Preprocessing steps are performed, including stop word removal
4. Document Term Matrix is generated with word length set to 4
5. Document term matrix is explored

6. Spare terms are removed
7. Document term matrix is then saved as a simple matrix
8. Splitting Document Term Matrix into training and testing datasets
9. Tags are created
10. KNN classification is performed
11. Results of classification are analyzed and saved as ProbExp2
12. Confusion matrix is generated using AutoCM for verification purpose
13. Confusion matrix is then manually generated
14. Precision, Recall and f-score values are calculated and the values are stored in exp2result object.

Results:

Figure 9 Word Cloud for Experiment 6

```
> TP <- sum(RecClassified=="TRUE") # Actual "Rec" classified as "Rec"
> FN<-sum(RecClassified=="FALSE")  # Actual "Rec" classified as "Sci"
> SciClassified <-(prob.test==Tags)[1:100] # Classified as "Sci" (Negative)
> TN <- sum(SciClassified=="TRUE") #Actual "sci"
> FP<-sum(SciClassified=="FALSE") # Actual "Sci" classified as "Rec"
> TP
[1] 70
> FP
[1] 46
> TN
[1] 54
> FN
[1] 30
> CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
> CM
    Rec Sci
Rec  70  46
Sci  30  54
```

Figure 10 Confusion matrix for classification with wordLength=4

Experiment 7: Wordlength=4, Document frequency=10

Steps:

1. The required libraries are loaded into the workspace
2. The corpus for 2 train document sets and 2 test document sets are created, and then merged
3. Preprocessing steps are performed, including stop word removal
4. Document Term Matrix is generated with word length set to 4 and document frequency as 10
5. Document term matrix is explored
6. Spare terms are removed
7. Document term matrix is then saved as a simple matrix
8. Splitting Document Term Matrix into training and testing datasets
9. Tags are created
10. KNN classification is performed
11. Results of classification are analyzed and saved as ProbExp2
12. Confusion matrix is generated using AutoCM for verification purpose
13. Confusion matrix is then manually generated
14. Precision, Recall and f-score values are calculated and the values are stored in exp2result object.

Results:

Figure 11 Word cloud for Experiment 7

```
> TP <- sum(RecClassified=="TRUE") # Actual "Rec" classified as "Rec"
> FN<-sum(RecClassified=="FALSE")  # Actual "Rec" classified as "Sci"
> SciClassified <-(prob.test==Tags)[1:100] # Classified as "Sci" (Negative)
> TN <- sum(SciClassified=="TRUE") #Actual "sci"
> FP<-sum(SciClassified=="FALSE") # Actual "Sci" classified as "Rec"
> TP
[1] 84
> FP
[1] 56
> TN
[1] 44
> FN
[1] 16
> CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
> CM
    Rec Sci
Rec  84  56
Sci  16  44
```

Figure 12 Confusion matrix for wordLength=4, DocFreq=10

Experiment 8: Wordlength=4, Document frequency=20

Steps:

1. The required libraries are loaded into the workspace
2. The corpus for 2 train document sets and 2 test document sets are created, and then merged
3. Preprocessing steps are performed, including stop word removal
4. Document Term Matrix is generated with word length set to 4 and document frequency as 20
5. Document term matrix is explored
6. Spare terms are removed
7. Document term matrix is then saved as a simple matrix
8. Splitting Document Term Matrix into training and testing datasets
9. Tags are created
10. KNN classification is performed
11. Results of classification are analyzed and saved as ProbExp2
12. Confusion matrix is generated using AutoCM for verification purpose
13. Confusion matrix is then manually generated
14. Precision, Recall and f-score values are calculated and the values are stored in exp2result object.

Results:

Figure 13 Word cloud for Experiment 8

```
> TP <- sum(RecClassified=="TRUE") # Actual "Rec" classified as "Rec"
> FN<-sum(RecClassified=="FALSE")  # Actual "Rec" classified as "Sci"
> SciClassified <-(prob.test==Tags)[1:100] # Classified as "Sci" (Negative)
> TN <- sum(SciClassified=="TRUE") #Actual "sci"
> FP<-sum(SciClassified=="FALSE") # Actual "Sci" classified as "Rec"
> FP
[1] 56
> TP
[1] 90
> TN
[1] 44
> FN
[1] 10
> CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
> CM
    Rec Sci
Rec  90  56
Sci  10  44
```

Figure 14 Confusion matrix for Experiment 8

Experiment 9: Selecting different dataset range (59 to 199)

1. **Steps:**

2. The required libraries are loaded into the workspace
3. The corpus for 2 train document sets and 2 test document sets are created, and then merged
4. Preprocessing steps are performed, including stop word removal
5. Document Term Matrix is generated with word length set to 4 and document frequency as 20
6. Document term matrix is explored
7. Spare terms are removed

8. Document term matrix is then saved as a simple matrix
9. Splitting Document Term Matrix into training and testing datasets
10. Tags are created
11. KNN classification is performed
12. Results of classification are analyzed and saved as ProbExp2
13. Confusion matrix is generated using AutoCM for verification purpose
14. Confusion matrix is then manually generated
15. Precision, Recall and f-score values are calculated and the values are stored in exp2result object.

Results:

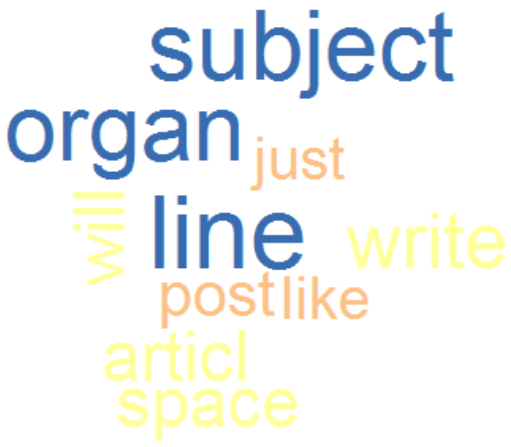


Figure 15 Word Cloud for Experiment 9

```
> TP <- sum(RecClassified=="TRUE") # Actual "Rec" classified as "Rec"
> FN<-sum(RecClassified=="FALSE")  # Actual "Rec" classified as "Sci"
> SciClassified <-(prob.test==Tags)[1:100] # Classified as "Sci" (Negative)
> TN <- sum(SciClassified=="TRUE") #Actual "sci"
> FP<-sum(SciClassified=="FALSE") # Actual "Sci" classified as "Rec"
> TP
[1] 91
> FP
[1] 45
> TN
[1] 55
> FN
[1] 9
> CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
> CM
    Rec Sci
Rec  91  45
Sci   9  55
```

Figure 16 Confusion matrix for Experiment 9

Observations:

Result Dataframe:

```
> total.result
      overall.Probability Precision Recall Accuracy F.Score
Exp 1              68.620    57.009     61     57.5   58.93
Exp 2              68.620    57.009     61     57.5   58.93
Exp 3              75.125    60.937     78     64.0   68.42
Exp 4              65.500    55.200     69     56.5   61.33
Exp 5              84.000    54.838     85     57.5   66.66
Exp 6              69.210    60.340     70     62.0   64.81
Exp 7              78.350    60.000     84     64.0   70.00
Exp 8              79.940    61.640     90     67.0   73.17
Exp 9              87.760    66.910     91     73.0   77.11
>
```

Tabular form:

Exp	Description	Overall Probability	Precision	Recall	Accuracy	F-Score
1	No preprocessing	68.62	57.009	61	57.5	58.93
2	No preprocessing, without removing sparse words	68.62	57.009	61	57.5	58.93
3	Preprocessing, without stop words removal	75.125	60.937	78	64	68.42
4	Preprocessing, with stop words removal	65.5	55.2	69	56.5	61.33
5	Term frequency changed from 5 to 10, minWordLength=2	84	54.838	85	57.5	66.66
6	minWordLength=4, DocFreq=5	69.21	60.34	70	62	64.81
7	minWordLength=4, DocFreq=10	78.35	60	84	64	70
8	minWordLength=4, DocFreq=20	79.94	61.64	90	67	73.17
9	Change in dataset: 201:300 range, DocFreq=20, minWordLength=4	87.76	66.91	91	73	77.11

Observation:

- Based on the f-score values, Experiment 9 (f-score =77.11)is the most effective method with highest accuracy. This could also indicate that the newly selected dataset is more relevant for classification.

- Experiment 8 is closely following (with an f-score value on 73.17) with second best accuracy. It could be related to the word length selection and term frequency values because in both experiments 8 and 9, only those terms which are at least 4 characters in length and occurring in at least 20 documents are selected for creating the document term matrix.

- From Experiments 6,7 and 8, where the minimum word length is set as 4, but the term frequency is varied, we can observe that with increasing term frequency, the f-score values makes a steady increase.

- As shown in the table, Experiments 1 and 2 are least effective and there may be a correlation with the fact that the data is not preprocessed.

R Code:

```
# Author: Archana Balachandran
# --------- Installing and loading required packages----------


install.packages("tm")
install.packages("SnowballC")
install.packages("wordcloud")
install.packages("class")


library(tm) # for using tm_map functions
library(SnowballC)
library(wordcloud) # for generating wordcloud
library(class) # for using KNN function

# --------- OBTAINING FILE DIRECTORIES ----------

# Saving the directory source for sci.space.test folder to Temp1 - 394 files
Temp1 <- DirSource("//Mac/Home/Documents/R/win-library/3.3/tm/texts/sci.space.test")
Temp1$filelist[1:100] #verifying that the correct file path is displayed

# Saving the directory source for rec.autos test folder to Temp2 -396 files
Temp2 <- DirSource("//Mac/Home/Documents/R/win-library/3.3/tm/texts/rec.autos.test")

# Saving the directory source for sci.space.train folder to Temp3 - 593 files
Temp3 <- DirSource("//Mac/Home/Documents/R/win-library/3.3/tm/texts/sci.space.train")

# Saving the directory source for rec.autos.train folder to Temp4 - 594 files
Temp4 <- DirSource("//Mac/Home/Documents/R/win-library/3.3/tm/texts/rec.autos.train")

# ------------CORPUS GENERATION -----------------

# Creating the corpus for sci.space.train with 100 elements/files
Doc1.Train <- Corpus(URISource(Temp3$filelist[201:300]),readerControl=list(reader=readPlain))

# Creating the corpus for sci.space.test with 100 elements/files
Doc1.Test <- Corpus(URISource(Temp1$filelist[201:300]),readerControl=list(reader=readPlain))

# Creating the corpus for rec.autos.train with 100 elements/files
```

```
Doc2.Train <- Corpus(URISource(Temp4$filelist[201:300]),readerControl=list(reader=readPlain))

# Creating the corpus for rec.autos.test with 100 elements/files
Doc2.Test <- Corpus(URISource(Temp2$filelist[201:300]),readerControl=list(reader=readPlain))

# Merging all of 4 Corpora into 1 Corpus so all pre processing steps can be implemented at once and create one DTM.

# Obtaining merged corpus


Doc.Corpus<-c(Doc1.Train,Doc1.Test,Doc2.Train,Doc2.Test)

# ------------------ PREPROCESSING ----------------

# Objective: To apply transformations across all documents within a corpus, using tm_map()
# NOTE:  original Doc.Corpus is preserved for backtracking purposes, doc.tranf will undergo transformations



# Two functions used in this section: getTransformations() and content_transformer()
#    Steps performed:
# 1. converting the text to lowercase
# 2. Removing \t
# 3. Convert to plaintext
# 4. Transform @,-,: to white space
# 5. Stripping whitespace
# 6. Removing stop words
# 7. Removing punctuation - removes , and .
# 8. Removing numbers
# 9. Performing STEMMING


# 1 Transforming to lower case
doc.tranf <-tm_map(Doc.Corpus,content_transformer(tolower))
doc.tranf[[1]]$content[1:10]

#Studying a sample document to understand what patterns to eliminate
doc.tranf[[1]]$content[1:10]

# REMOVE <.+?> - Omitted since it gives negative result -displays unnecessary spaces between every letter
# transform.char1<-content_transformer(function(x,pattern) gsub(pattern," ",x))
```

```
# doc.tranf <-tm_map(doc.tranf, transform.char1,"<|?|>")
# doc.tranf[[1]]$content[1:10]

# 2. REMOVE \t
transform.tab<-content_transformer(function(x,pattern) gsub(pattern," ",x))
doc.tranf <-tm_map(doc.tranf, transform.tab,"\t")

doc.tranf[[1]]$content[1:10]

# 3. TO PLAINTEXT
doc.tranf <- tm_map(doc.tranf, PlainTextDocument)
doc.tranf[[1]]$content[1:10]


# 4. Transforming @,-,: to white space
transform.char2<-content_transformer(function(x,pattern) gsub(pattern," ",x))
doc.tranf <-tm_map(doc.tranf, transform.char2,"@|:|-")
doc.tranf[[1]]$content[1:10]

# 5. Stripping whitespace
doc.tranf <-tm_map(doc.tranf, stripWhitespace)
doc.tranf[[1]]$content[1:10]


# 6. Removing stop words

doc.tranf <- tm_map(doc.tranf,removeWords,stopwords("english"))
doc.tranf[[1]]$content[1:10]

# 7. Removing punctuation - removes , and .
doc.tranf <- tm_map(doc.tranf,removePunctuation)
doc.tranf[[1]]$content[1:10]


# 8. Removing numbers
doc.tranf <- tm_map(doc.tranf,removeNumbers)
doc.tranf[[1]]$content[1:10]

# 9. Performing STEMMING
doc.tranf <-tm_map(doc.tranf,stemDocument)
doc.tranf[[1]]$content[1:10]
```

```
#------------CREATING DOCUMENT TERM MATRIX----------

# A document-term matrix is a matrix with documents as the rows,
# terms as the columns, and a count of the frequency of words as the cells.
# In the tm package, DocumentTermMatrix() is used to create this matrix.
# To inspect the document-term matrix, inspect() is used.
# SOURCE: onlinecampus.bu.edu/CS688/module3

?DocumentTermMatrix



# Only for experiment 1 and 2
# dtm = DocumentTermMatrix(Doc.Corpus,  control = list(minWordLength = 2,minDocFreq = 5))
# Only for Experiment 5
# dtm = DocumentTermMatrix(doc.tranf,  control=list(wordLengths=c(2, 15), bounds =
list(global = c(10,Inf))))
# Only for Experiment 6
# dtm = DocumentTermMatrix(doc.tranf,  control=list(wordLengths=c(4, 15), bounds =
list(global = c(5,Inf))))
# Only for Experiment 7
# dtm = DocumentTermMatrix(doc.tranf,  control=list(wordLengths=c(4, 15), bounds =
list(global = c(10,Inf))))
# Only for Experiment 8 and 9
# dtm = DocumentTermMatrix(doc.tranf,  control=list(wordLengths=c(4, 15), bounds =
list(global = c(20,Inf))))

dtm = DocumentTermMatrix(doc.tranf,
control = list(minWordLength = 2,
minDocFreq = 5))
# exploring the documentterm matrix

inspect(dtm)
freq<-colSums(as.matrix(dtm)) # Term frequencies
ord<-order(freq) # Ordering frequencies
freq[tail(ord)] # most frequent terms
findFreqTerms(dtm,lowfreq = 400) # finding frequent terms having at least 200  occurrences
set.seed(123)
wordcloud(names(freq),freq,min.freq = 200, colors = brewer.pal(5,"Accent"))

# Removing Sparse terms from DocumentTermMatrix with sparse=0.60
?removeSparseTerms
removeSparseTerms(dtm, 0.60)
```

```
#saving dtm as simple matrix
matdtm <- as.matrix(dtm)
write.csv(matdtm,file="dtm.csv")
ncol(matdtm)

#------------- GENERATING TRAINING AND TESTING DATASETS FROM  Document Term Matrix-----
---------

# Splitting DocumentTermMatrix into train dataset and verifying
matdtm[c(1:100),]
train.dataset<-rbind(matdtm[c(1:100),],matdtm[c(201:300),])
#View(train.dataset[c(1:200),c(1:4)])

# Splitting DocumentTermMatrix into test dataset and verifying

test.dataset <-rbind(matdtm[c(101:200),],matdtm[c(301:400),])
#View(test.dataset[c(1:200),c(1:4)])

#    ------- CLASSIFICATION PROCESS ----------

# CREATING tags using rep()

nrow(test.dataset)
nrow(train.dataset)
ncol(test.dataset)
ncol(train.dataset)
Tags <- factor(c(rep("Sci",100),rep("Rec",100)))

# Classifying text using KNN from package class

prob.test <- knn(train.dataset, test.dataset, Tags, k = 2, prob=TRUE)

# Analyzing the output of knn()


a<-1:length(prob.test)
a
b<-levels(prob.test)[prob.test]
b
c<-attributes(prob.test)$prob
c
result<-data.frame(Doc=a, Predict=b, Prob=c, Correct=(prob.test==Tags))
result
```

```
overall.prob<-(sum(c)/length(Tags))*100 # Overall probability
overall.prob

sum(prob.test==Tags)/length(Tags) # Percentage of TRUE/Correct classifications, i.e., the
accuracy of classifiication


# Saving the required objects into a file for ease of experimenting

save(prob.test,dtm,file="ProbExp1")
load(file="ProbExp1")

table(prob.test, Tags) -> AutoCM # Automatically Generating CM, only for verification purpose

# --------EVALUATING EFFECTIVENESS OF CLASSIFICATION----------


# Creating TP, FP, FN, TN

# "Rec" considered Positive and "Sci" as Negative

RecClassified <- (prob.test==Tags)[101:200] # Classified as "Rec" (Positive)
TP <- sum(RecClassified=="TRUE") # Actual "Rec" classified as "Rec"
FN<-sum(RecClassified=="FALSE")  # Actual "Rec" classified as "Sci"



SciClassified <-(prob.test==Tags)[1:100] # Classified as "Sci" (Negative)
TN <- sum(SciClassified=="TRUE") #Actual "sci"
FP<-sum(SciClassified=="FALSE") # Actual "Sci" classified as "Rec"

TP
FP
TN
FN

# Creating the Confusion Matrix


CM <- data.frame(Rec=c(TP,FN),Sci=c(FP,TN),row.names=c("Rec","Sci"))
CM
```

```
# Computing the evaluation metrics.

n = sum(CM) # number of instances
diag = TP+TN # number of correctly classified instances per class


# Calculating Accuracy - the fraction of instances that are correctly classified.

accuracy = (sum(diag) / n )*100
accuracy


# Calculating Precision and Recall
# Precision – The fraction of the returned results that are relevant to the information need
# Recall – The fraction of the relevant documents in the collection that were returned by the
system

precision<-(TP/(TP+FP))*100
precision
recall<-(TP/(TP+FN))*100
recall

#Calculating f score

fscore<- (2*precision*recall)/(precision+recall)
fscore

# Results


overall.Probability<-c(68.62,68.62,75.125,65.5,84.00,69.21,78.35,79.94,87.76)
Precision<-c(57.009,57.009,60.937,55.20,54.838,60.34,60.00,61.64,66.91)
Recall<-c(61.00,61.00,78.00,69.00,85.00,70.00,84.00,90.00,91.00)
Accuracy<-c(57.50,57.50,64.00,56.50,57.50,62.00,64.00,67.00,73.00)
F.Score <- c(58.93,58.93,68.42,61.33,66.66,64.81,70.00,73.17,77.11)
# Creating a data frame with all the results:

total.result<-data.frame(overall.Probability, Precision,Recall,Accuracy,F.Score, row.names
=c("Exp 1","Exp 2","Exp 3","Exp 4","Exp 5","Exp 6","Exp 7","Exp 8","Exp 9") )
```