

# Naive Bayes - Spam Filtering

*V2 Maestros*

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## Problem Statement

The input data is a set of SMS messages that has been classified as either “ham” or “spam”. The goal of the exercise is to build a model to identify messages as either ham or spam.

## Techniques Used

1. Naive Bayes Classifier
2. Training and Testing
3. Confusion Matrix
4. Text Pre-Processing

## Data Engineering & Analysis

```
setwd("C:/Personal/V2Maestros/Modules/Machine Learning Algorithms/Naive Bayes")

sms_data <- read.csv("sms_spam_short.csv", stringsAsFactors=FALSE)

sms_data$type <- as.factor(sms_data$type)
str(sms_data)
```

## Loading and understanding the dataset

```
## 'data.frame':    500 obs. of  2 variables:
## $ type: Factor w/ 2 levels "ham","spam": 1 1 1 2 2 1 1 1 2 1 ...
## $ text: chr  "Hope you are having a good week. Just checking in" "K..give back my thanks." "Am also
```

```
summary(sms_data)
```

```
##      type      text
## ham :437  Length:500
## spam: 63   Class :character
##              Mode  :character
```

```
head(sms_data)
```

```
##      type
## 1  ham
## 2  ham
## 3  ham
## 4 spam
## 5 spam
## 6  ham
##
## 1
## 2
## 3
## 4      complimentary 4 STAR Ibiza Holiday or Â£10,000 cash needs your URGENT collection. 09066
## 5 okmail: Dear Dave this is your final notice to collect your 4* Tenerife Holiday or #5000 CASH awar
## 6
```

**Data Cleansing** The dataset contains raw text. The text need to be pre-processed and converted into a Document Term Matrix before it can be used for classification purposes. The steps required are documented as comments below

```
library(tm)
```

```
## Loading required package: NLP
```

```
## Warning: package 'NLP' was built under R version 3.1.1
```

```
#create a corpus for the message
mesg_corpus <- Corpus(VectorSource(sms_data$text))
#peek into the corpus
inspect(mesg_corpus[1:5])
```

```
## <<VCorpus (documents: 5, metadata (corpus/indexed): 0/0)>>
##
## [[1]]
## <<PlainTextDocument (metadata: 7)>>
## Hope you are having a good week. Just checking in
##
## [[2]]
```

```
## <<PlainTextDocument (metadata: 7)>>
## K..give back my thanks.
##
## [[3]]
## <<PlainTextDocument (metadata: 7)>>
## Am also doing in cbe only. But have to pay.
##
## [[4]]
## <<PlainTextDocument (metadata: 7)>>
## complimentary 4 STAR Ibiza Holiday or Â£10,000 cash needs your URGENT collection. 09066364349 NOW fr
##
## [[5]]
## <<PlainTextDocument (metadata: 7)>>
## okmail: Dear Dave this is your final notice to collect your 4* Tenerife Holiday or #5000 CASH award!
```

```
#cleanse the data
#remove punctuation marks
refined_corpus <- tm_map(mesg_corpus, removePunctuation)
#remove white space
refined_corpus <- tm_map(refined_corpus, stripWhitespace)
#convert to lower case
refined_corpus <- tm_map(refined_corpus, content_transformer(tolower))
#remove numbers in text
refined_corpus <- tm_map(refined_corpus, removeNumbers)
#remove stop words
refined_corpus <- tm_map(refined_corpus, removeWords, stopwords())
#remove specific words
refined_corpus <- tm_map(refined_corpus, removeWords, c("else","the","are","for",
                                                         "has","they","as","a","his","on","when","is","in","already"))
#look at the processed text
inspect(refined_corpus[1:5])
```

```
## <<VCorpus (documents: 5, metadata (corpus/indexed): 0/0)>>
##
## [[1]]
## <<PlainTextDocument (metadata: 7)>>
## hope      good week just checking
##
## [[2]]
## <<PlainTextDocument (metadata: 7)>>
## kgive back  thanks
##
## [[3]]
## <<PlainTextDocument (metadata: 7)>>
## also   cbe      pay
##
## [[4]]
## <<PlainTextDocument (metadata: 7)>>
## complimentary star ibiza holiday â cash needs urgent collection now landline lose boxskwpppm
##
## [[5]]
## <<PlainTextDocument (metadata: 7)>>
## okmail dear dave      final notice collect   tenerife holiday   cash award call   landline tcs sae bo
```

```
#create a document-term sparse matrix
dtm <- DocumentTermMatrix(refined_corpus)
dtm
```

```
## <<DocumentTermMatrix (documents: 500, terms: 1966)>>
## Non-/sparse entries: 4021/978979
## Sparsity          : 100%
## Maximal term length: 33
## Weighting         : term frequency (tf)
```

```
dim(dtm)
```

```
## [1] 500 1966
```

```
#Remove all words who has occurred less than 10 times to create a new DTM
```

```
filtered_dtm <- DocumentTermMatrix(refined_corpus, list(dictionary=findFreqTerms(dtm, 10)))
dim(filtered_dtm)
```

```
## [1] 500 59
```

```
#inspect the contents by converting it into a matrix and transposing it
t(inspect(filtered_dtm)[1:25,1:10])
```

```
## <<DocumentTermMatrix (documents: 500, terms: 59)>>
## Non-/sparse entries: 943/28557
## Sparsity          : 97%
## Maximal term length: 8
## Weighting         : term frequency (tf)
##
##      Terms
## Docs anything back box call can care claim come day didnt dont free get
## 1      0 0 0 0 0 0 0 0 0 0 0 0 0
## 2      0 1 0 0 0 0 0 0 0 0 0 0 0
## 3      0 0 0 0 0 0 0 0 0 0 0 0 0
## 4      0 0 0 0 0 0 0 0 0 0 0 0 0
## 5      0 0 1 1 0 0 0 0 0 0 0 0 0
## 6      0 0 0 0 0 0 0 0 0 0 0 0 0
## 7      0 0 0 0 0 0 0 0 0 0 0 0 0
## 8      0 0 0 1 0 0 0 0 0 0 0 0 0
## 9      0 0 0 0 0 0 0 0 0 0 0 1 0
## 10     0 0 0 0 0 0 0 0 0 0 0 0 0
## 11     0 0 0 0 0 0 0 0 0 0 0 0 0
## 12     1 0 0 0 0 0 0 0 0 0 0 0 0
## 13     0 0 0 1 0 0 0 0 0 0 0 0 0
## 14     0 0 0 0 0 0 0 0 0 0 0 0 0
## 15     0 0 0 0 0 0 0 0 0 0 0 0 1
## 16     0 0 0 0 0 0 0 0 0 0 0 0 0
## 17     0 0 0 0 0 0 0 0 0 0 0 0 0
## 18     1 0 0 0 0 0 0 0 0 0 0 0 0
## 19     0 0 0 0 0 0 0 0 2 0 0 0 0
```

##	20	0	0	0	0	1	0	0	0	0	0	0	0
##	21	0	0	0	0	0	0	0	0	0	0	0	0
##	22	0	0	0	0	0	0	0	0	0	0	0	1
##	23	0	0	0	0	0	0	0	0	0	0	0	0
##	24	0	0	0	0	0	0	0	0	0	0	0	0
##	25	0	0	0	0	0	0	0	0	0	0	0	0
##	26	0	0	0	0	0	0	0	0	0	0	0	0
##	27	0	0	0	1	0	0	0	0	0	0	0	0
##	28	0	0	0	0	0	0	0	0	0	0	0	0
##	29	0	0	0	0	0	0	0	0	0	0	0	0
##	30	0	0	0	0	0	0	0	0	0	0	0	0
##	31	0	0	0	0	0	0	0	0	0	0	0	0
##	32	0	0	0	0	0	1	0	0	0	0	0	0
##	33	0	0	0	1	0	0	0	0	0	0	0	0
##	34	0	0	0	0	0	0	0	0	0	0	0	0
##	35	0	0	0	0	0	0	0	0	0	0	2	1
##	36	0	0	0	0	0	0	0	0	0	0	0	0
##	37	0	0	0	1	0	0	0	0	0	0	0	0
##	38	0	0	0	0	0	0	0	0	0	0	0	0
##	39	0	0	0	2	0	0	0	0	0	0	0	0
##	40	0	0	0	0	2	0	0	0	0	0	0	0
##	41	0	0	0	0	0	0	0	0	0	0	0	0
##	42	0	0	0	1	0	0	0	0	0	0	0	0
##	43	0	0	0	0	0	0	0	0	0	0	0	0
##	44	0	0	0	1	0	0	1	0	0	0	0	0
##	45	0	0	0	0	0	0	0	0	0	0	0	0
##	46	0	0	0	0	0	0	0	0	0	0	0	0
##	47	0	0	0	0	0	0	0	0	0	0	0	0
##	48	0	0	0	0	0	0	0	0	0	0	0	0
##	49	0	0	0	0	1	0	0	1	0	0	0	0
##	50	0	0	0	0	0	0	0	0	0	0	0	0
##	51	0	0	0	0	0	0	0	1	0	0	0	0
##	52	0	0	0	0	0	0	0	0	0	0	0	0
##	53	0	0	0	0	0	0	0	0	0	0	0	0
##	54	0	0	0	0	0	0	0	0	0	0	0	0
##	55	0	0	0	0	0	0	0	0	0	0	0	0
##	56	0	0	0	0	0	0	0	0	0	0	1	0
##	57	0	0	0	0	0	0	0	0	0	0	0	0
##	58	0	0	0	0	0	0	0	0	0	0	0	0
##	59	0	0	0	0	0	0	0	0	0	0	0	0
##	60	0	0	0	0	0	0	0	0	0	0	0	0
##	61	0	0	0	0	0	0	0	0	0	0	0	1
##	62	0	0	0	0	0	0	0	0	0	0	0	0
##	63	0	0	0	0	1	0	0	0	0	0	0	0
##	64	0	0	0	0	0	0	0	0	2	0	0	0
##	65	0	0	0	0	0	0	0	0	0	0	0	0
##	66	0	0	0	0	1	0	0	0	0	1	1	0
##	67	0	0	0	0	0	0	0	0	0	0	0	0
##	68	0	0	0	0	0	0	0	0	0	0	0	0
##	69	0	0	0	0	0	0	0	0	0	0	0	0
##	70	0	0	0	0	0	0	0	1	0	0	0	0
##	71	0	0	0	0	1	0	0	0	0	0	0	0
##	72	0	0	0	0	0	0	0	0	0	0	0	0
##	73	0	0	0	0	0	0	0	0	0	0	0	0

##	74	0	0	0	0	0	0	0	0	0	0	0	0
##	75	0	0	0	0	0	0	0	0	0	0	0	0
##	76	0	0	0	0	0	0	0	0	0	0	0	0
##	77	0	0	0	0	1	0	0	0	0	0	0	0
##	78	0	0	0	0	0	0	0	0	0	0	0	0
##	79	0	0	0	0	0	0	0	0	0	0	0	0
##	80	0	0	0	0	0	0	0	0	0	0	0	0
##	81	0	0	0	0	0	0	1	0	0	0	0	0
##	82	0	0	0	1	0	0	1	0	0	0	0	0
##	83	0	0	0	0	1	0	0	0	0	0	0	0
##	84	0	0	0	0	0	0	0	0	0	0	0	0
##	85	0	0	0	0	1	0	0	0	0	0	0	0
##	86	0	0	0	0	0	0	0	0	0	0	0	0
##	87	0	0	0	0	0	0	0	0	0	0	0	0
##	88	0	0	0	0	0	0	0	0	0	0	0	0
##	89	0	0	0	0	0	0	0	0	0	1	0	1
##	90	0	0	0	0	0	0	0	0	0	0	0	0
##	91	0	0	0	0	0	1	0	0	0	0	1	1
##	92	0	0	0	0	0	0	0	0	0	0	0	0
##	93	0	0	0	0	0	0	0	0	0	0	0	0
##	94	0	0	0	0	0	0	0	0	0	0	0	0
##	95	0	0	0	0	0	0	0	0	0	0	0	0
##	96	0	0	0	0	0	0	0	0	0	0	0	0
##	97	0	0	0	0	0	0	0	0	0	0	0	0
##	98	0	0	0	0	0	0	0	0	0	0	0	0
##	99	0	0	0	0	0	0	0	0	0	0	0	0
##	100	0	0	0	2	0	0	1	0	0	0	0	2
##	101	0	0	0	0	0	0	0	0	0	0	0	0
##	102	0	0	0	0	0	0	0	0	0	0	0	0
##	103	0	0	0	0	0	0	0	0	0	0	0	0
##	104	0	0	0	0	0	0	0	0	0	0	0	0
##	105	0	0	0	0	0	0	0	0	0	0	0	0
##	106	1	0	0	0	0	0	0	0	0	0	0	0
##	107	0	0	0	0	0	0	0	0	0	0	0	0
##	108	0	0	0	0	0	0	0	0	0	0	0	0
##	109	0	0	0	0	0	0	0	0	0	0	0	0
##	110	0	0	0	0	0	0	0	0	0	0	0	0
##	111	1	0	0	0	0	0	0	0	0	0	0	0
##	112	0	0	0	1	0	0	1	0	0	0	0	0
##	113	0	0	0	0	0	0	0	0	0	0	0	0
##	114	0	0	0	0	0	0	0	0	0	0	0	0
##	115	0	0	0	0	0	0	0	0	0	0	0	0
##	116	0	0	0	0	0	0	0	0	0	0	0	0
##	117	0	0	0	0	0	0	0	0	0	0	0	0
##	118	0	0	0	0	0	0	0	0	0	0	0	0
##	119	0	0	0	0	0	0	0	0	0	0	0	0
##	120	0	0	0	0	0	0	0	0	0	0	0	0
##	121	0	0	0	0	0	0	0	0	0	1	0	0
##	122	0	0	0	0	0	0	0	0	0	0	0	0
##	123	0	0	0	0	0	0	0	0	0	1	0	0
##	124	0	0	0	0	0	0	0	0	0	0	0	0
##	125	0	0	0	0	0	0	0	0	0	0	0	0
##	126	0	0	0	0	0	0	0	0	0	0	0	0
##	127	0	1	0	1	0	0	1	0	0	0	0	1

##	128	0	0	0	0	0	0	0	0	0	0	0	0
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##	130	0	0	0	0	0	0	0	0	0	0	0	0
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##	133	0	0	0	0	0	0	0	0	0	0	0	0
##	134	0	0	0	0	0	0	0	0	0	0	0	0
##	135	0	0	0	1	1	0	0	0	0	0	0	0
##	136	0	0	0	0	0	0	0	0	0	0	0	0
##	137	0	0	0	0	0	0	0	0	0	0	0	0
##	138	0	0	0	0	0	0	0	0	0	0	0	0
##	139	0	0	0	0	0	0	0	0	0	0	0	0
##	140	0	0	0	0	0	0	0	0	0	0	0	0
##	141	0	0	0	0	0	0	0	0	0	0	1	0
##	142	0	0	0	0	0	0	0	0	0	0	0	0
##	143	0	1	1	0	0	0	0	0	0	0	0	0
##	144	0	0	0	0	0	0	0	0	0	0	0	0
##	145	0	0	0	0	0	0	0	0	0	0	0	0
##	146	0	0	0	0	0	1	0	0	0	0	0	0
##	147	0	0	0	0	1	0	0	0	0	0	0	0
##	148	0	0	0	0	0	0	0	0	0	0	0	0
##	149	0	0	0	0	0	0	1	0	0	0	0	1
##	150	0	0	1	1	0	0	0	0	0	0	0	0
##	151	0	0	0	0	0	0	0	0	0	0	0	0
##	152	0	0	0	0	0	0	0	0	0	0	0	0
##	153	0	0	0	0	0	0	0	0	0	0	0	0
##	154	0	0	0	0	0	0	0	0	0	0	0	0
##	155	0	0	0	0	0	0	0	0	0	0	0	0
##	156	0	0	0	0	0	0	0	0	0	0	0	0
##	157	1	0	0	0	0	0	0	0	1	1	0	0
##	158	0	0	0	0	0	0	0	0	0	2	0	0
##	159	0	0	0	0	0	0	0	0	0	0	0	0
##	160	0	0	0	0	0	0	0	0	0	0	0	0
##	161	0	0	0	0	0	0	0	0	0	0	0	0
##	162	0	0	0	0	0	0	0	0	0	0	0	0
##	163	0	0	0	0	0	0	0	0	0	0	0	0
##	164	0	0	0	1	0	0	1	0	0	0	0	0
##	165	0	0	0	0	0	0	0	0	0	0	0	0
##	166	0	0	0	0	0	0	0	0	0	0	0	1
##	167	0	0	0	0	0	0	0	0	0	0	0	0
##	168	0	0	0	0	0	0	0	0	0	0	0	0
##	169	0	0	0	0	0	0	0	0	0	0	0	0
##	170	0	0	0	0	0	0	0	0	0	0	0	0
##	171	0	0	0	1	0	0	0	0	0	0	0	0
##	172	0	0	0	0	0	0	0	0	0	0	0	0
##	173	0	0	0	0	0	0	0	0	0	0	0	0
##	174	1	0	0	0	0	0	0	0	0	1	0	0
##	175	1	0	0	0	0	0	0	0	0	1	0	0
##	176	0	0	0	0	0	0	0	0	0	0	0	0
##	177	1	0	0	0	0	0	0	0	0	0	0	0
##	178	0	0	0	0	0	0	0	0	0	0	0	0
##	179	0	0	0	0	0	0	0	0	0	0	0	0
##	180	0	0	0	0	0	0	0	0	0	0	0	0
##	181	0	0	0	0	0	0	0	0	0	0	0	0

##	182	0	0	0	0	0	0	0	0	0	0	0	0
##	183	0	0	0	0	0	0	0	0	0	0	0	0
##	184	0	0	0	0	0	0	0	0	0	0	0	0
##	185	0	0	0	0	0	1	0	0	0	0	0	0
##	186	0	0	0	0	0	0	0	0	0	0	0	0
##	187	0	0	0	0	0	0	0	0	0	0	0	0
##	188	0	0	0	0	0	0	0	0	0	0	0	0
##	189	0	0	0	0	0	0	0	1	0	0	0	0
##	190	0	0	0	0	0	0	0	0	0	0	0	0
##	191	0	0	0	0	0	0	0	0	0	0	0	0
##	192	0	0	0	0	0	0	0	0	0	0	0	0
##	193	0	0	0	0	1	0	0	0	0	0	0	0
##	194	0	0	0	0	0	0	0	0	0	1	0	1
##	195	0	0	0	0	0	0	0	0	0	0	0	0
##	196	0	0	1	1	0	0	0	0	0	0	0	0
##	197	0	0	0	0	0	0	0	0	0	0	0	0
##	198	0	0	0	0	0	0	0	0	0	0	0	0
##	199	0	1	0	0	0	0	0	0	0	0	0	0
##	200	0	0	0	1	0	0	0	0	0	0	0	0
##	201	0	0	0	2	0	0	0	0	0	0	2	0
##	202	0	0	0	0	0	0	0	0	0	0	0	0
##	203	0	0	0	0	0	0	1	0	0	0	0	0
##	204	0	0	0	0	0	0	0	0	0	0	0	1
##	205	0	0	0	0	0	0	0	0	0	0	0	0
##	206	0	0	0	0	0	0	0	0	0	0	0	0
##	207	0	0	0	0	1	0	0	0	0	0	0	0
##	208	0	0	0	0	0	0	0	0	0	0	0	0
##	209	0	0	0	0	0	0	0	0	0	0	0	0
##	210	0	0	0	0	0	0	0	0	0	0	0	0
##	211	0	0	0	0	0	0	0	0	0	0	0	0
##	212	0	0	0	0	0	0	0	0	0	0	0	0
##	213	0	0	0	0	0	0	0	0	0	1	0	0
##	214	0	1	0	0	0	0	0	0	0	0	0	0
##	215	0	0	0	0	0	0	0	0	0	0	0	0
##	216	0	0	0	0	1	0	0	0	0	0	0	0
##	217	0	0	0	0	0	0	0	0	0	1	0	0
##	218	0	0	0	0	0	0	0	0	0	0	0	0
##	219	0	0	0	0	0	0	0	0	0	0	0	0
##	220	0	0	0	0	0	1	0	0	0	0	0	0
##	221	0	0	0	0	0	0	0	0	0	0	0	0
##	222	0	0	0	0	0	0	0	0	0	0	0	0
##	223	0	0	0	0	0	0	0	0	0	0	0	0
##	224	0	0	0	0	0	0	0	0	0	0	0	0
##	225	0	1	0	0	0	0	0	0	0	0	0	0
##	226	0	0	0	0	0	0	0	0	0	0	0	0
##	227	0	0	0	0	0	0	0	0	0	0	0	0
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##	231	0	0	0	0	0	0	0	0	0	0	0	0
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##	233	0	0	0	0	0	0	0	0	0	0	0	0
##	234	0	0	0	0	0	0	0	0	0	0	0	0
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##	236	0	0	0	0	0	0	0	0	0	0	0	0
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##	500	0	0	0	0	0	0	0	0	0	0	0	0	
##	Terms													
##	Docs	going	good	got	great	hey	home	ill	ive	just	know	landline	last	later
##	1	0	1	0		0	0	0	0	1	0		0	0
##	2	0	0	0		0	0	0	0	0	0		0	0
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##	266	0	0	0	0	0	0	0	0	0	0	0	0	0
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##	270	0	0	0	0	0	0	0	0	0	0	0	0	0
##	271	0	0	1	0	0	0	0	1	0	0	0	0	0
##	272	0	0	0	0	0	0	0	0	0	0	0	0	0
##	273	0	0	0	0	0	0	0	0	0	0	0	0	0

##	274	0	0	0	0	0	0	0	0	0	0	0	0	0
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##	276	0	0	1	0	0	0	0	0	0	0	0	0	0
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##	433	0	2	0	0	0	0	0	0	0	0	0	0	0
##	434	0	0	0	0	0	0	1	0	0	0	0	0	0
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##	436	0	0	0	0	0	0	0	0	0	0	0	1	0
##	437	0	0	0	0	0	0	0	0	0	0	0	0	0
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##	500	0	0	1	0	0	0	0	0	0	0	1	0	0

##	Terms													
##	Docs	like	lor	love	make	meet	mobile	much	need	new	night	now	one	phone
##	1	0	0	0	0	0	0	0	0	0	0	0	0	0
##	2	0	0	0	0	0	0	0	0	0	0	0	0	0
##	3	0	0	0	0	0	0	0	0	0	0	0	0	0
##	4	0	0	0	0	0	0	0	0	0	0	1	0	0
##	5	0	0	0	0	0	0	0	0	0	0	0	0	0
##	6	0	0	0	0	0	0	0	0	0	0	0	0	0
##	7	0	0	0	0	0	0	1	0	0	0	0	0	0
##	8	0	0	0	0	0	0	0	0	0	0	0	0	0
##	9	0	0	0	0	0	2	0	0	0	0	1	0	0
##	10	0	0	0	0	0	0	0	0	0	0	1	0	0
##	11	0	0	0	0	0	0	0	0	0	0	0	0	0
##	12	0	1	0	0	0	0	0	0	0	0	0	0	0
##	13	0	0	0	0	0	0	0	0	0	0	0	0	0
##	14	0	0	0	0	0	0	0	0	0	2	0	0	0
##	15	0	0	0	0	0	0	0	0	0	0	0	0	0
##	16	0	0	0	0	0	0	0	0	0	0	0	0	0
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##	18	0	0	0	0	0	0	0	0	0	0	0	0	0
##	19	0	1	0	0	0	0	0	0	0	0	0	0	0
##	20	0	0	0	0	0	0	0	0	0	0	1	0	0
##	21	0	0	0	0	0	0	0	0	0	0	0	0	0
##	22	0	0	0	0	0	0	0	0	0	0	0	0	0
##	23	0	0	0	0	0	0	0	0	0	0	0	0	0
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##	305	0	0	0	0	0	0	0	0	0	0	0	0
##	306	0	0	0	0	0	0	0	0	0	1	0	0
##	307	0	0	0	0	0	0	0	0	0	0	0	0
##	308	0	0	0	0	0	0	0	0	0	0	0	0
##	309	0	0	0	0	0	0	0	0	0	0	0	0
##	310	0	0	0	0	0	0	0	0	0	0	0	0
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##	312	0	0	0	0	0	0	0	0	0	0	0	0
##	313	1	0	2	0	0	0	0	1	0	0	0	0
##	314	0	0	2	2	0	0	0	0	0	1	0	2
##	315	0	0	0	0	0	0	0	0	0	0	0	0
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##	317	0	0	0	0	0	0	0	0	0	0	0	0
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##	370	0	0	0	0	0	1	0	0	0	0	0	0
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##	372	1	0	0	0	0	0	0	0	0	0	0	0
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##	376	0	0	0	0	0	0	1	0	0	0	0	0
##	377	0	0	0	0	0	0	0	0	0	0	0	0
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##	380	0	0	0	0	0	0	0	0	1	0	0	0
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##	382	0	0	0	0	0	0	0	0	0	0	1	0
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##	388	0	0	0	0	0	1	0	0	0	0	0	0
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##	391	0	0	0	0	0	0	0	0	0	1	0	0
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##	420	0	0	0	0	0	0	0	0	0	0	0	0
##	421	0	0	0	0	0	0	0	0	0	0	0	0
##	422	0	0	0	0	0	0	0	0	0	0	0	0
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##	424	0	0	0	0	0	1	0	0	0	1	0	0
##	425	0	0	0	0	0	0	0	0	0	0	0	0
##	426	1	0	0	0	0	0	0	0	0	0	0	0
##	427	0	0	0	0	0	0	0	0	0	0	0	0
##	428	0	0	0	0	0	0	0	1	0	0	0	0
##	429	0	0	0	0	0	0	0	0	0	0	0	0
##	430	0	0	0	0	0	0	0	0	0	0	0	0
##	431	0	0	0	0	0	0	0	0	0	0	0	0
##	432	0	0	0	0	0	0	0	0	0	0	0	0
##	433	0	0	0	2	0	0	0	1	0	0	0	0
##	434	0	0	0	0	0	0	0	0	0	0	0	0
##	435	1	0	0	0	0	0	0	0	0	0	1	1
##	436	0	0	0	0	0	0	0	0	0	0	0	0
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##	440	0	0	0	0	0	0	0	0	0	0	0	0
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##	444	0	0	0	1	0	0	0	0	0	0	0	0
##	445	0	0	0	0	0	0	0	0	0	0	0	0
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##	452	0	0	0	0	0	0	0	0	0	0	0	0
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##	455	0	0	0	0	0	0	0	0	0	0	0	0
##	456	0	0	0	0	0	0	0	0	0	0	0	0
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##	463	0	0	0	1	0	0	0	0	0	0	0	0
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##	469	0	0	0	0	0	1	0	0	0	0	0	0
##	470	1	0	0	0	0	0	0	0	0	0	0	0
##	471	0	0	0	0	0	0	0	0	0	0	0	0
##	472	0	0	0	0	0	0	0	0	0	0	0	0
##	473	0	0	0	0	0	0	0	0	0	0	0	0

##	474	0	0	0	0	0	0	0	0	0	0	0	0
##	475	0	0	0	0	0	0	0	0	0	0	0	0
##	476	0	0	0	0	0	0	0	0	0	0	0	0
##	477	0	0	0	0	0	0	0	0	0	0	0	0
##	478	0	0	0	0	0	0	0	0	0	0	0	0
##	479	0	0	0	0	0	0	0	0	0	1	0	0
##	480	1	0	0	0	0	0	0	0	0	0	0	0
##	481	0	0	0	0	0	0	0	0	0	0	0	0
##	482	0	0	0	0	0	0	0	0	0	0	1	0
##	483	0	0	0	0	0	0	0	0	0	0	0	0
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##	485	0	0	0	0	0	0	0	0	0	0	0	0
##	486	0	0	0	0	0	0	0	0	0	0	0	0
##	487	0	0	0	0	0	0	0	0	0	0	0	0
##	488	0	0	0	0	0	0	0	0	0	0	0	0
##	489	0	0	0	0	0	0	0	0	0	0	0	0
##	490	0	0	0	0	0	0	0	0	0	0	0	0
##	491	0	0	0	0	0	0	0	0	0	0	0	0
##	492	0	0	0	0	0	0	0	0	0	0	0	0
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##	496	0	0	0	0	0	0	0	0	0	0	0	0
##	497	0	0	0	0	0	0	0	0	0	0	0	0
##	498	0	0	0	0	0	0	0	0	0	0	0	0
##	499	0	0	0	0	0	0	0	0	0	0	0	2
##	500	0	0	0	0	0	0	0	0	0	0	0	0

##	Terms													
##	Docs	please	ppm	prize	said	see	send	sorry	still	stop	sure	take	tell	text
##	1	0	0	0	0	0	0	0	0	0	0	0	0	0
##	2	0	0	0	0	0	0	0	0	0	0	0	0	0
##	3	0	0	0	0	0	0	0	0	0	0	0	0	0
##	4	0	0	0	0	0	0	0	0	0	0	0	0	0
##	5	0	1	0	0	0	0	0	0	0	0	0	0	0
##	6	0	0	0	0	0	0	0	0	0	0	0	0	0
##	7	0	0	0	0	0	0	0	0	0	0	0	0	0
##	8	1	0	0	0	0	0	0	0	0	0	0	0	0
##	9	0	0	0	0	0	1	0	0	0	0	0	0	1
##	10	0	0	0	0	0	0	0	0	0	0	0	0	0
##	11	0	0	0	0	0	0	0	0	0	1	0	0	0
##	12	0	0	0	0	0	0	0	0	0	0	0	0	0
##	13	0	0	0	0	0	0	0	0	0	1	0	0	0
##	14	0	0	0	0	0	0	0	0	0	0	0	0	0
##	15	0	0	0	0	1	0	0	0	0	1	0	0	0
##	16	0	0	0	0	0	0	0	0	0	0	0	0	0
##	17	0	0	0	0	0	0	0	0	0	0	0	0	0
##	18	0	0	0	0	0	0	0	0	0	0	0	1	0
##	19	0	0	0	0	0	0	0	0	0	0	0	0	0
##	20	0	0	0	0	0	0	0	0	0	0	0	0	0
##	21	0	0	0	0	0	0	0	0	0	0	0	0	0
##	22	0	0	0	0	0	0	0	0	0	0	0	0	0
##	23	0	0	0	0	0	0	0	0	0	0	0	0	0
##	24	0	0	0	0	0	0	0	0	0	0	0	0	0
##	25	0	0	0	0	0	0	0	0	0	0	0	0	0



##	26	0	0	0	0	0	0	0	0	0	0	0	0
##	27	0	0	0	0	0	0	0	0	0	0	0	0
##	28	0	0	0	0	0	0	0	0	1	0	0	0
##	29	0	0	0	0	0	0	0	0	0	0	0	0
##	30	0	0	0	0	0	0	0	0	0	0	0	0
##	31	0	0	0	0	0	0	0	0	0	0	0	0
##	32	0	0	0	0	0	0	0	0	0	0	0	0
##	33	0	0	0	0	0	0	1	0	0	0	0	0
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##	35	0	0	0	0	0	1	0	0	0	0	1	0
##	36	0	0	0	2	0	0	0	0	0	0	0	0
##	37	0	0	0	0	0	0	0	0	0	0	0	0
##	38	0	0	0	0	0	0	0	0	0	0	0	0
##	39	0	0	0	0	0	0	0	0	1	0	0	0
##	40	0	0	0	0	0	0	0	0	0	2	0	0
##	41	0	0	0	0	0	0	0	0	0	0	0	0
##	42	0	0	0	0	0	0	0	0	0	0	0	0
##	43	0	0	0	0	0	0	0	0	0	1	0	0
##	44	0	1	1	0	0	0	0	0	0	0	0	0
##	45	0	0	0	0	0	0	0	0	0	0	0	0
##	46	0	0	0	0	0	0	0	0	0	0	0	0
##	47	0	0	0	0	0	0	0	0	0	0	0	0
##	48	0	0	0	0	0	0	0	0	0	0	0	0
##	49	0	0	0	0	1	0	0	0	0	0	0	0
##	50	0	0	0	0	0	0	0	1	0	0	0	0
##	51	0	0	0	0	0	0	0	0	0	0	0	0
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##	54	0	0	0	0	0	0	0	0	0	0	0	0
##	55	1	0	0	0	0	0	0	0	0	0	0	0
##	56	0	0	0	0	0	0	0	0	0	0	0	0
##	57	0	0	0	0	0	0	0	0	0	0	0	0
##	58	0	0	0	0	0	0	0	0	0	0	0	0
##	59	0	0	0	0	0	0	0	0	0	0	0	0
##	60	0	0	0	0	0	0	0	0	0	0	0	0
##	61	0	0	0	0	0	0	0	0	0	0	0	0
##	62	0	0	0	0	0	0	0	0	0	0	0	0
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##	66	0	0	0	0	0	0	0	0	0	0	1	0
##	67	0	0	0	0	0	0	0	0	0	0	0	0
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##	70	0	0	0	0	0	0	0	0	0	0	0	0
##	71	0	0	0	1	0	0	0	0	0	0	0	0
##	72	0	0	0	0	0	0	0	0	0	0	0	0
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##	76	0	0	0	0	0	0	0	0	0	0	0	0
##	77	0	0	0	0	0	0	0	0	0	0	0	0
##	78	0	0	0	0	0	0	0	0	0	0	0	0
##	79	0	0	0	0	0	0	0	0	0	0	0	0

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##	458	0	0	0	0	0	0	0	0	0	0	0	0	0
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##	500	0	0	0	0	0	0	0	0	0	0	0	0	0

##	Terms							
##	Docs	think	time	txt	urgent	want	well	will
##	1	0	0	0	0	0	0	0
##	2	0	0	0	0	0	0	0
##	3	0	0	0	0	0	0	0
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##	7	0	0	0	0	0	0	0
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##	10	0	0	0	0	0	0
##	11	0	0	0	0	0	0
##	12	0	0	0	0	0	0
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##	188	0	0	1	0	0	0
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##	219	0	0	0	0	0	0
##	220	0	0	0	0	0	0
##	221	0	0	0	0	0	0
##	222	0	0	0	0	0	0
##	223	0	0	0	0	0	0
##	224	0	0	0	0	0	1
##	225	0	0	0	0	0	0

##	226	0	0	0	0	0	0	0
##	227	0	0	0	0	0	0	0
##	228	0	0	0	0	0	0	0
##	229	0	0	0	0	0	0	0
##	230	0	0	0	0	0	0	0
##	231	0	0	0	0	0	0	0
##	232	0	0	0	1	0	0	0
##	233	0	0	0	0	0	0	0
##	234	0	1	0	0	0	1	0
##	235	0	0	1	0	0	0	0
##	236	0	0	0	0	0	0	0
##	237	0	0	0	0	0	0	0
##	238	0	0	0	0	0	0	0
##	239	0	0	0	0	0	0	0
##	240	0	0	0	0	0	1	0
##	241	0	0	0	0	0	0	0
##	242	0	0	0	0	1	0	0
##	243	0	0	0	0	0	0	0
##	244	0	0	0	0	0	0	0
##	245	0	0	0	0	0	0	0
##	246	0	0	0	0	0	0	0
##	247	0	0	0	0	0	0	0
##	248	0	1	0	0	0	0	0
##	249	0	0	0	0	0	0	0
##	250	0	0	0	0	0	0	0
##	251	0	0	0	0	0	0	0
##	252	0	0	0	0	0	0	0
##	253	0	0	0	0	0	0	0
##	254	0	0	0	0	0	0	0
##	255	0	0	0	0	0	0	0
##	256	0	0	0	0	0	0	0
##	257	0	0	0	0	0	0	0
##	258	1	0	0	0	0	0	0
##	259	0	0	0	0	0	0	0
##	260	0	0	0	0	0	0	0
##	261	0	0	0	0	0	0	0
##	262	0	0	0	0	0	1	0
##	263	0	0	0	0	0	0	0
##	264	0	0	0	0	0	0	0
##	265	0	0	0	0	0	0	0
##	266	0	0	0	0	0	0	0
##	267	0	0	0	0	0	0	0
##	268	0	0	0	0	1	0	0
##	269	0	0	0	0	0	0	0
##	270	0	0	0	0	0	0	0
##	271	0	0	0	0	0	0	1
##	272	0	1	0	0	0	0	0
##	273	0	0	0	0	0	0	0
##	274	0	0	0	0	0	0	0
##	275	0	0	0	0	0	0	0
##	276	0	0	0	0	0	0	0
##	277	0	0	0	0	0	0	0
##	278	0	0	0	0	0	0	0
##	279	0	0	0	0	0	0	0

##	280	0	0	0	0	0	1	0
##	281	0	0	0	1	0	0	0
##	282	0	0	0	0	0	0	0
##	283	0	0	0	0	0	0	0
##	284	0	0	0	0	0	0	0
##	285	0	0	0	0	0	0	0
##	286	0	0	0	0	0	0	1
##	287	0	0	0	0	0	0	0
##	288	0	0	0	0	0	0	0
##	289	0	0	0	0	0	0	0
##	290	0	0	0	0	0	0	0
##	291	0	0	0	0	0	0	0
##	292	0	1	0	0	0	0	0
##	293	0	0	0	0	0	0	0
##	294	0	0	0	0	0	0	0
##	295	0	1	0	0	0	0	0
##	296	0	0	0	0	0	0	0
##	297	0	0	0	0	0	0	0
##	298	0	0	0	0	0	0	0
##	299	0	0	0	0	0	0	0
##	300	0	0	0	0	0	0	0
##	301	0	0	0	0	0	0	0
##	302	0	0	0	0	0	0	0
##	303	0	0	0	0	0	0	0
##	304	0	0	0	0	0	0	0
##	305	0	0	0	0	0	0	0
##	306	0	0	0	0	0	0	0
##	307	0	0	0	0	0	0	0
##	308	0	0	0	0	0	0	0
##	309	0	0	0	0	0	0	0
##	310	0	0	0	0	0	0	0
##	311	0	0	0	0	0	0	0
##	312	0	0	0	0	0	0	0
##	313	0	2	0	0	0	0	9
##	314	0	0	0	0	0	0	0
##	315	0	0	0	0	0	1	0
##	316	0	0	0	0	0	0	0
##	317	0	0	0	0	0	0	0
##	318	0	0	0	0	0	0	0
##	319	0	1	0	0	0	0	0
##	320	0	0	0	0	0	0	0
##	321	0	0	0	0	0	0	0
##	322	0	0	0	0	0	0	0
##	323	0	0	0	0	0	0	0
##	324	0	0	0	0	1	0	0
##	325	0	0	0	0	0	0	0
##	326	1	0	0	0	0	0	0
##	327	0	0	0	0	0	0	0
##	328	0	0	0	0	0	0	0
##	329	0	0	0	0	0	0	1
##	330	0	0	0	0	0	0	0
##	331	1	0	0	0	0	0	0
##	332	0	0	0	0	0	0	0
##	333	0	0	0	0	0	0	0

##	334	0	0	1	0	0	0	0
##	335	0	0	0	0	0	0	0
##	336	0	0	0	0	0	0	0
##	337	0	0	0	0	0	0	0
##	338	0	0	0	0	0	0	0
##	339	0	0	0	0	0	0	0
##	340	0	0	0	0	0	0	0
##	341	0	0	0	0	0	0	0
##	342	0	0	0	0	0	0	0
##	343	0	0	0	0	0	0	0
##	344	0	0	0	0	0	0	0
##	345	0	0	0	0	0	0	0
##	346	0	0	0	0	0	0	0
##	347	0	0	0	0	0	0	0
##	348	0	0	0	0	0	0	0
##	349	0	0	0	0	0	0	0
##	350	0	0	0	0	0	0	1
##	351	0	0	0	0	0	0	0
##	352	0	0	0	0	0	0	0
##	353	0	0	0	0	0	0	0
##	354	0	0	0	0	1	0	0
##	355	0	0	0	0	0	0	0
##	356	0	0	0	0	0	0	0
##	357	0	0	1	0	0	0	1
##	358	0	0	0	0	0	0	0
##	359	0	0	0	0	0	0	0
##	360	0	0	0	1	0	0	0
##	361	0	0	0	0	0	0	0
##	362	0	0	0	0	0	0	0
##	363	0	0	0	0	0	0	0
##	364	0	0	0	0	0	0	0
##	365	0	0	1	0	0	0	0
##	366	0	0	0	0	0	0	1
##	367	0	0	0	0	0	0	0
##	368	0	0	0	0	0	0	0
##	369	0	1	0	0	0	0	0
##	370	0	0	0	0	0	0	1
##	371	0	0	0	0	0	0	0
##	372	0	0	0	0	0	0	0
##	373	0	0	0	0	0	0	0
##	374	0	0	0	0	0	0	0
##	375	0	0	0	0	0	0	0
##	376	0	0	0	0	0	0	0
##	377	0	0	0	0	0	0	0
##	378	0	0	0	0	0	0	0
##	379	0	0	0	0	0	0	0
##	380	0	0	0	0	0	0	0
##	381	0	0	0	0	0	0	0
##	382	0	0	0	0	0	0	0
##	383	0	0	0	0	0	0	0
##	384	0	0	0	0	0	0	0
##	385	0	0	0	1	0	0	0
##	386	0	0	0	0	0	1	0
##	387	1	0	0	0	0	0	0



##	388	0	0	0	0	0	0
##	389	0	0	0	0	0	1
##	390	0	0	0	0	0	0
##	391	0	0	0	0	0	0
##	392	0	0	0	0	0	0
##	393	0	0	0	0	0	0
##	394	0	0	0	0	0	0
##	395	0	0	0	0	0	0
##	396	0	0	0	0	0	0
##	397	0	0	0	0	0	0
##	398	0	0	0	0	0	0
##	399	0	0	0	0	0	0
##	400	0	0	1	1	0	0
##	401	0	0	0	0	0	0
##	402	0	0	1	0	0	0
##	403	0	0	0	0	0	0
##	404	0	0	0	0	0	0
##	405	0	0	0	0	0	0
##	406	0	0	0	0	0	0
##	407	0	0	0	0	0	0
##	408	0	0	0	0	0	0
##	409	0	0	0	0	0	0
##	410	1	0	0	0	0	0
##	411	0	0	0	0	0	0
##	412	0	0	0	0	0	0
##	413	0	0	0	0	1	0
##	414	1	0	0	0	0	0
##	415	0	0	0	0	0	0
##	416	0	0	0	0	0	0
##	417	0	0	0	0	0	0
##	418	0	0	0	0	0	0
##	419	1	0	0	0	0	0
##	420	0	0	0	0	0	0
##	421	0	0	0	0	0	0
##	422	0	0	0	0	1	0
##	423	0	0	0	0	0	0
##	424	0	0	0	0	0	0
##	425	0	0	0	0	0	1
##	426	0	0	0	0	0	0
##	427	0	0	0	0	0	0
##	428	0	0	0	0	0	0
##	429	0	0	0	0	0	0
##	430	0	0	0	0	0	0
##	431	0	0	0	0	0	0
##	432	0	0	0	0	0	0
##	433	0	0	0	0	0	0
##	434	0	0	0	0	0	0
##	435	0	0	0	0	1	0
##	436	0	0	0	0	0	0
##	437	0	0	0	0	0	0
##	438	0	0	0	0	0	0
##	439	0	0	0	0	0	0
##	440	0	0	0	0	0	0
##	441	0	0	0	0	1	0

##	442	0	0	0	0	0	0
##	443	0	0	0	0	0	0
##	444	1	0	0	0	0	0
##	445	0	0	0	0	0	0
##	446	0	0	0	0	0	0
##	447	0	0	0	0	0	0
##	448	0	0	0	0	0	0
##	449	0	0	0	0	0	0
##	450	0	0	0	0	0	0
##	451	0	0	0	0	0	0
##	452	0	0	0	0	0	0
##	453	0	0	0	0	0	0
##	454	0	0	0	0	0	0
##	455	0	0	0	0	0	0
##	456	0	0	0	0	0	0
##	457	1	0	0	0	0	1
##	458	0	0	0	0	0	0
##	459	0	0	0	0	0	0
##	460	0	0	0	0	0	0
##	461	0	0	1	0	0	1
##	462	0	0	0	0	0	1
##	463	0	0	0	0	0	0
##	464	0	0	0	0	0	0
##	465	0	0	0	0	0	0
##	466	0	0	0	0	0	0
##	467	0	0	0	0	0	0
##	468	0	0	0	0	0	0
##	469	0	0	0	0	0	0
##	470	0	0	0	0	0	0
##	471	0	0	0	0	0	0
##	472	0	0	0	0	0	0
##	473	1	0	0	0	0	0
##	474	0	0	0	0	0	1
##	475	0	0	0	0	0	0
##	476	0	0	0	0	0	0
##	477	0	0	0	0	0	0
##	478	0	0	0	0	0	0
##	479	0	0	0	0	0	1
##	480	0	0	0	0	0	1
##	481	0	0	0	0	0	0
##	482	0	0	0	0	0	0
##	483	0	0	0	0	0	0
##	484	0	0	0	0	0	1
##	485	0	0	0	0	0	0
##	486	0	0	0	0	0	0
##	487	0	0	0	0	0	1
##	488	0	0	0	0	0	0
##	489	0	0	0	0	0	0
##	490	0	0	1	1	0	0
##	491	0	0	0	0	0	0
##	492	0	0	0	0	0	0
##	493	0	0	0	0	0	0
##	494	0	0	0	0	0	0
##	495	0	0	0	0	0	0

```
## 496      0      0      0      0      0      0      0
## 497      0      0      0      0      0      1      0
## 498      0      1      0      0      0      0      0
## 499      0      0      0      0      0      0      0
## 500      0      0      0      0      0      0      0

##          Docs
## Terms      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
## anything  0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0
## back       0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## box        0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## call       0 0 0 0 1 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
## can        0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
## care       0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## claim      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## come       0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 0 0 0 0
## day        0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## didnt      0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

##          Docs
## Terms      25
## anything   0
## back       0
## box        0
## call       0
## can        0
## care       0
## claim      0
## come       0
## day        0
## didnt      0
```

**Exploratory Data Analysis** The following example shows a word cloud for both ham and spam message. The size of words shown in the word cloud is based on the frequency of occurrence. It will clearly show that there is a difference in the most common occurring words between these types

```
library(wordcloud)
```

```
## Warning: package 'wordcloud' was built under R version 3.1.1
```

```
## Loading required package: RColorBrewer
```

```
## Warning: package 'RColorBrewer' was built under R version 3.1.1
```

```
pal <- brewer.pal(9,"Dark2")
```

```
## Warning: n too large, allowed maximum for palette Dark2 is 8
```

```
## Returning the palette you asked for with that many colors
```

```
wordcloud(refined_corpus[sms_data$type=="ham"], min.freq=5,
          random.order=FALSE, colors=pal)
```





## Modeling & Prediction

**Split Training and Testing** Split training and testing datasets in the ratio of 70-30

```
library(caret)
```

```
## Warning: package 'caret' was built under R version 3.1.1
```

```
## Loading required package: lattice
```

```
## Loading required package: ggplot2
```

```
## Warning: package 'ggplot2' was built under R version 3.1.1
```

##

```
## Attaching package: 'ggplot2'
```

##

```
## The following object is masked from 'package:NLP':
```

##

```
##      annotate
```

```
inTrain <- createDataPartition(y=sms_data$type ,p=0.7,list=FALSE)
```

### #Splitting the raw data

```

train_raw <- sms_data[inTrain,]
test_raw <- sms_data[-inTrain,]

#splitting the corpus
train_corpus <- refined_corpus[inTrain]
test_corpus <- refined_corpus[-inTrain]

#splitting the dtm
train_dtm <- filtered_dtm[inTrain,]
test_dtm <- filtered_dtm[-inTrain,]

# Instead of using the counts of words within document, we will replace them with indicators "Yes" or "No".
# Yes indicates if the word occurred in the document and No indicate it does not. This procedure converts
# Numeric data into factor data

conv_counts <- function(x) {
  x <- ifelse(x > 0, 1, 0)
  x <- factor(x, levels = c(0, 1), labels = c("No", "Yes"))
}

train <- apply(train_dtm, MARGIN = 2, conv_counts)
test <- apply(test_dtm, MARGIN = 2, conv_counts)

#convert to a data frame and add the target variable
df_train <- as.data.frame(train)
df_test <- as.data.frame(test)

df_train$type <- train_raw$type
df_test$type <- test_raw$type

df_train[1:10,1:10]

```

```

##      anything back box call can care claim come day didnt
## 1      No   No No   No No   No   No No No   No
## 10     No   No No   No No   No   No No No   No
## 11     No   No No   No No   No   No No No   No
## 12     Yes  No No   No No   No   No No No   No
## 13     No   No No   Yes No   No   No No No   No
## 14     No   No No   No No   No   No No No   No
## 18     Yes  No No   No No   No   No No No   No
## 21     No   No No   No No   No   No No No   No
## 22     No   No No   No No   No   No No No   No
## 23     No   No No   No No   No   No No No   No

```

**Model Building** Build model based on the training data

```
library(e1071)
```

```
## Warning: package 'e1071' was built under R version 3.1.1
```

```

#Leave out the last column (target)
modFit <- naiveBayes(df_train[,-60], df_train$type)
modFit

```

```

##
## Naive Bayes Classifier for Discrete Predictors
##
## Call:
## naiveBayes.default(x = df_train[, -60], y = df_train$type)
##
## A-priori probabilities:
## df_train$type
##   ham   spam
## 0.8718 0.1282
##
## Conditional probabilities:
##           anything
## df_train$type    No    Yes
##       ham 0.98039 0.01961
##       spam 1.00000 0.00000
##
##           back
## df_train$type    No    Yes
##       ham 0.98693 0.01307
##       spam 0.95556 0.04444
##
##           box
## df_train$type    No    Yes
##       ham 1.0000 0.0000
##       spam 0.8222 0.1778
##
##           call
## df_train$type    No    Yes
##       ham 0.95752 0.04248
##       spam 0.53333 0.46667
##
##           can
## df_train$type    No    Yes
##       ham 0.92484 0.07516
##       spam 0.93333 0.06667
##
##           care
## df_train$type    No    Yes
##       ham 0.98366 0.01634
##       spam 0.97778 0.02222
##
##           claim
## df_train$type    No    Yes
##       ham 1.0000 0.0000
##       spam 0.8222 0.1778
##
##           come
## df_train$type    No    Yes

```

```

##          ham  0.97059 0.02941
##          spam 1.00000 0.00000
##
##          day
## df_train$type      No      Yes
##          ham  0.98039 0.01961
##          spam 1.00000 0.00000
##
##          didnt
## df_train$type      No      Yes
##          ham  0.97059 0.02941
##          spam 1.00000 0.00000
##
##          dont
## df_train$type      No      Yes
##          ham  0.95098 0.04902
##          spam 0.95556 0.04444
##
##          free
## df_train$type      No      Yes
##          ham  0.98366 0.01634
##          spam 0.86667 0.13333
##
##          get
## df_train$type      No      Yes
##          ham  0.95425 0.04575
##          spam 0.93333 0.06667
##
##          going
## df_train$type      No      Yes
##          ham  0.96405 0.03595
##          spam 1.00000 0.00000
##
##          good
## df_train$type      No      Yes
##          ham  0.97712 0.02288
##          spam 0.97778 0.02222
##
##          got
## df_train$type      No      Yes
##          ham  0.93791 0.06209
##          spam 0.97778 0.02222
##
##          great
## df_train$type      No      Yes
##          ham  0.98039 0.01961
##          spam 1.00000 0.00000
##
##          hey
## df_train$type      No      Yes
##          ham  0.97059 0.02941
##          spam 1.00000 0.00000
##
##          home

```



```

## df_train$type      No      Yes
##      ham 0.96078 0.03922
##      spam 1.00000 0.00000
##
##      ill
## df_train$type      No      Yes
##      ham 0.95752 0.04248
##      spam 1.00000 0.00000
##
##      ive
## df_train$type      No      Yes
##      ham 0.97712 0.02288
##      spam 1.00000 0.00000
##
##      just
## df_train$type      No      Yes
##      ham 0.93791 0.06209
##      spam 0.93333 0.06667
##
##      know
## df_train$type      No      Yes
##      ham 0.97059 0.02941
##      spam 0.88889 0.11111
##
##      landline
## df_train$type      No      Yes
##      ham 1.0000 0.0000
##      spam 0.8444 0.1556
##
##      last
## df_train$type      No      Yes
##      ham 0.96732 0.03268
##      spam 0.97778 0.02222
##
##      later
## df_train$type      No      Yes
##      ham 0.98039 0.01961
##      spam 1.00000 0.00000
##
##      like
## df_train$type      No      Yes
##      ham 0.95752 0.04248
##      spam 0.97778 0.02222
##
##      lor
## df_train$type      No      Yes
##      ham 0.97712 0.02288
##      spam 1.00000 0.00000
##
##      love
## df_train$type      No      Yes
##      ham 0.97059 0.02941
##      spam 0.97778 0.02222
##

```

```

##           make
## df_train$type      No      Yes
##           ham  0.97712 0.02288
##           spam 1.00000 0.00000
##
##           meet
## df_train$type      No      Yes
##           ham  0.98039 0.01961
##           spam 1.00000 0.00000
##
##           mobile
## df_train$type      No      Yes
##           ham  1.0000 0.0000
##           spam 0.8222 0.1778
##
##           much
## df_train$type      No      Yes
##           ham  0.97386 0.02614
##           spam 1.00000 0.00000
##
##           need
## df_train$type      No      Yes
##           ham  0.97712 0.02288
##           spam 0.95556 0.04444
##
##           new
## df_train$type      No      Yes
##           ham  0.98366 0.01634
##           spam 0.93333 0.06667
##
##           night
## df_train$type      No      Yes
##           ham  0.96405 0.03595
##           spam 1.00000 0.00000
##
##           now
## df_train$type      No      Yes
##           ham  0.93791 0.06209
##           spam 0.82222 0.17778
##
##           one
## df_train$type      No      Yes
##           ham  0.98039 0.01961
##           spam 1.00000 0.00000
##
##           phone
## df_train$type      No      Yes
##           ham  0.990196 0.009804
##           spam 0.955556 0.044444
##
##           please
## df_train$type      No      Yes
##           ham  0.98366 0.01634
##           spam 0.91111 0.08889

```

```

##
##           ppm
## df_train$type      No      Yes
##           ham  1.0000 0.0000
##           spam 0.7556 0.2444
##
##           prize
## df_train$type      No      Yes
##           ham   1.0 0.0
##           spam 0.8 0.2
##
##           said
## df_train$type      No      Yes
##           ham  0.97059 0.02941
##           spam 1.00000 0.00000
##
##           see
## df_train$type      No      Yes
##           ham  0.98039 0.01961
##           spam 0.97778 0.02222
##
##           send
## df_train$type      No      Yes
##           ham  0.98366 0.01634
##           spam 0.95556 0.04444
##
##           sorry
## df_train$type      No      Yes
##           ham  0.97059 0.02941
##           spam 1.00000 0.00000
##
##           still
## df_train$type      No      Yes
##           ham  0.96405 0.03595
##           spam 0.97778 0.02222
##
##           stop
## df_train$type      No      Yes
##           ham  0.990196 0.009804
##           spam 0.866667 0.133333
##
##           sure
## df_train$type      No      Yes
##           ham  0.98366 0.01634
##           spam 1.00000 0.00000
##
##           take
## df_train$type      No      Yes
##           ham  0.98693 0.01307
##           spam 0.97778 0.02222
##
##           tell
## df_train$type      No      Yes
##           ham  0.97712 0.02288

```

```

##          spam 0.95556 0.04444
##
##          text
## df_train$type      No      Yes
##          ham  0.98366 0.01634
##          spam 0.88889 0.11111
##
##          think
## df_train$type      No      Yes
##          ham  0.94444 0.05556
##          spam 1.00000 0.00000
##
##          time
## df_train$type      No      Yes
##          ham  0.95752 0.04248
##          spam 0.97778 0.02222
##
##          txt
## df_train$type      No      Yes
##          ham  0.993464 0.006536
##          spam 0.755556 0.244444
##
##          urgent
## df_train$type      No Yes
##          ham  1.0 0.0
##          spam 0.8 0.2
##
##          want
## df_train$type      No      Yes
##          ham  0.97386 0.02614
##          spam 0.97778 0.02222
##
##          well
## df_train$type      No      Yes
##          ham  0.96078 0.03922
##          spam 0.95556 0.04444
##
##          will
## df_train$type      No      Yes
##          ham  0.94444 0.05556
##          spam 0.95556 0.04444

```

## Testing

Now let us predict the class for each sample in the test data. Then compare the prediction with the actual value of the class.

```

predictions <- predict(modFit, df_test)
confusionMatrix(predictions, df_test$type)

```

```

## Confusion Matrix and Statistics
##
##          Reference

```

```

## Prediction ham spam
##      ham 126   3
##      spam  5  15
##
##              Accuracy : 0.946
##              95% CI : (0.897, 0.977)
##      No Information Rate : 0.879
##      P-Value [Acc > NIR] : 0.00476
##
##              Kappa : 0.759
##      McNemar's Test P-Value : 0.72367
##
##      Sensitivity : 0.962
##      Specificity : 0.833
##      Pos Pred Value : 0.977
##      Neg Pred Value : 0.750
##      Prevalence : 0.879
##      Detection Rate : 0.846
##      Detection Prevalence : 0.866
##      Balanced Accuracy : 0.898
##
##      'Positive' Class : ham
##

```

## Conclusions

Text data need to be converted to its numeric counter-parts in order to use machine learning algorithms

---