Movie Recommendation System Project in R(Using IMDB Data sets)

In [1]:
```
library(recommenderlab)
```

```
Loading required package: Matrix

Loading required package: arules


Attaching package: 'arules'


The following objects are masked from 'package:base':

    abbreviate, write


Loading required package: proxy


Attaching package: 'proxy'


The following object is masked from 'package:Matrix':

    as.matrix


The following objects are masked from 'package:stats':

    as.dist, dist


The following object is masked from 'package:base':

    as.matrix


Loading required package: registry

Registered S3 methods overwritten by 'registry':
  method               from
  print.registry_field proxy
  print.registry_entry proxy
```

In [2]:
```
install.packages("recommenderlab")
```

```
Warning message:
"package 'recommenderlab' is in use and will not be installed"
```

In [3]:
```
labrary(recommenderlab)
```

```
Error in labrary(recommenderlab): could not find function "labrary"
Traceback:
```

In [3]:
```
library(recommenderlab)
```

install.packages("ggplot2")

In [4]:
```
library(ggplot2)
```

In [5]:
```
install.packages("data.table")
```

```
Installing package into 'C:/Users/ACER/Documents/R/win-library/4.1'
(as 'lib' is unspecified)

package 'data.table' successfully unpacked and MD5 sums checked

The downloaded binary packages are in
        C:\Users\ACER\AppData\Local\Temp\RtmpSScmHm\downloaded_packages
```

In [6]:
```
library(data.table)
```

In [7]:
```
library(reshape2)
```

```
Attaching package: 'reshape2'


The following objects are masked from 'package:data.table':

    dcast, melt
```

In [14]:
```
setwd("C:/Users/ACER/Downloads/movie_data")
movie_data <-read.csv("movies.csv",stringsAsFactors=FALSE)
rating_data <-read.csv("ratings.csv")
str(movie_data)
```

```
'data.frame':   10329 obs. of  3 variables:
 $ movieId: int  1 2 3 4 5 6 7 8 9 10 ...
 $ title  : chr  "Toy Story (1995)" "Jumanji (1995)" "Grumpier Old Men (1995)" "Waiting to Exhale (1995)" ...
 $ genres : chr  "Adventure|Animation|Children|Comedy|Fantasy" "Adventure|Children|Fantasy" "Comedy|Romance" "Comedy|Drama|Romance" ...
```

In [15]:
```
summary(movie_data)
```

```
    movieId          title              genres
 Min.   :     1   Length:10329       Length:10329
 1st Qu.:  3240   Class :character   Class :character
 Median :  7088   Mode  :character   Mode  :character
 Mean   : 31924
 3rd Qu.: 59900
 Max.   :149532
```

In [16]:
```
head(movie_data)
```

A data.frame: 6 × 3

	movieId	title	genres
	<int>	<chr>	<chr>
1	1	Toy Story (1995)	Adventure|Animation|Children|Comedy|Fantasy
2	2	Jumanji (1995)	Adventure|Children|Fantasy
3	3	Grumpier Old Men (1995)	Comedy|Romance
4	4	Waiting to Exhale (1995)	Comedy|Drama|Romance
5	5	Father of the Bride Part II (1995)	Comedy
6	6	Heat (1995)	Action|Crime|Thriller

In [17]:
```
summary(rating_data)
```

```
     userId         movieId           rating        timestamp
 Min.   :  1.0   Min.   :     1   Min.   :0.500   Min.   :8.286e+08
 1st Qu.:192.0   1st Qu.:  1073   1st Qu.:3.000   1st Qu.:9.711e+08
 Median :383.0   Median :  2497   Median :3.500   Median :1.115e+09
 Mean   :364.9   Mean   : 13381   Mean   :3.517   Mean   :1.130e+09
 3rd Qu.:557.0   3rd Qu.:  5991   3rd Qu.:4.000   3rd Qu.:1.275e+09
 Max.   :668.0   Max.   :149532   Max.   :5.000   Max.   :1.452e+09
```

In [18]:
```
head(rating_data)
```

A data.frame: 6 × 4

	userId	movieId	rating	timestamp
	<int>	<int>	<dbl>	<int>
1	1	16	4.0	1217897793
2	1	24	1.5	1217895807
3	1	32	4.0	1217896246
4	1	47	4.0	1217896556
5	1	50	4.0	1217896523
6	1	110	4.0	1217896150

In [22]:
```
movie_genre <- as.data.frame(movie_data$genres,stringsAsFactors=FALSE)
library(data.table)
movie_genre2 <- as.data.frame(tstrsplit(movie_genre[,1],'[ | ]',type.convert=TRUE),stringAsFactors= FALSE)
colnames(movie_genre2) <-c(1:10)
list_genre <- c("Action","Adventure","Animation","Children","Comedy","Crime","Documentary","Drama","Fantasy","Film-Noir","Horror","Musical","Mystery","Romance","Sci-Fi","Thriller","War","W
genre_mat1 <- matrix(0,10330,18)
genre_mat1[1,] <- list_genre

for(index in 1:nrow(movie_genre2))
    {
        for(col in 1:ncol(movie_genre2))
        {
            gen_col = which(genre_mat1[1,] == movie_genre2[index,col])
            genre_mat1[index+1,gen_col] <-1
         }
     }
     genre_mat2 <- as.data.frame(genre_mat1[-1,],stringsAsFactors=FALSE)
     for(col in 1:ncol(genre_mat2))
     {
         genre_mat2[,col]<-as.integer(genre_mat2[,col])
     }
     str(genre_mat2)
```

```
'data.frame':   10329 obs. of  18 variables:
 $ V1 : int  0 0 0 0 0 1 0 0 1 1 ...
 $ V2 : int  1 1 0 0 0 0 0 1 0 1 ...
 $ V3 : int  1 0 0 0 0 0 0 0 0 0 ...
 $ V4 : int  1 1 0 0 0 0 0 1 0 0 ...
 $ V5 : int  1 0 1 1 1 0 1 0 0 0 ...
 $ V6 : int  0 0 0 0 0 1 0 0 0 0 ...
 $ V7 : int  0 0 0 0 0 0 0 0 0 0 ...
 $ V8 : int  0 0 0 1 0 0 0 0 0 0 ...
 $ V9 : int  1 1 0 0 0 0 0 0 0 0 ...
 $ V10: int  0 0 0 0 0 0 0 0 0 0 ...
 $ V11: int  0 0 0 0 0 0 0 0 0 0 ...
 $ V12: int  0 0 0 0 0 0 0 0 0 0 ...
 $ V13: int  0 0 0 0 0 0 0 0 0 0 ...
 $ V14: int  0 0 1 1 0 0 1 0 0 0 ...
 $ V15: int  0 0 0 0 0 0 0 0 0 0 ...
 $ V16: int  0 0 0 0 0 1 0 0 0 1 ...
 $ V17: int  0 0 0 0 0 0 0 0 0 0 ...
 $ V18: int  0 0 0 0 0 0 0 0 0 0 ...
```

In [23]:
```
SearchMatrix <- cbind(movie_data[,1:2],genre_mat2[])
head(SearchMatrix)
```

A data.frame: 6 × 20

	movieId	title	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18
	<int>	<chr>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>
1	1	Toy Story (1995)	0	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0
2	2	Jumanji (1995)	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
3	3	Grumpier Old Men (1995)	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
4	4	Waiting to Exhale (1995)	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
5	5	Father of the Bride Part II (1995)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
6	6	Heat (1995)	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0

In [27]:
```
ratingMatrix <- dcast(rating_data,userId~movieId,value.var ="rating",na.rm=FALSE)
ratingMatrix<- as.matrix(ratingMatrix[,-1])
ratingMatrix<- as(ratingMatrix,"realRatingMatrix")
ratingMatrix
```

```
668 x 10325 rating matrix of class 'realRatingMatrix' with 105339 ratings.
```

In [29]:
```
recommendation_model <- recommenderRegistry$get_entries(dataType ="realRatingMatrix")
names(recommendation_model)
```

'HYBRID_realRatingMatrix' · 'ALS_realRatingMatrix' · 'ALS_implicit_realRatingMatrix' · 'IBCF_realRatingMatrix' · 'LIBMF_realRatingMatrix' · 'POPULAR_realRatingMatrix' · 'RANDOM_realRatingMatrix' · 'RERECOMMEND_realRatingMatrix' · 'SVD_realRatingMatrix' · 'SVDF_realRatingMatrix' · 'UBCF_realRatingMatrix'

In [30]:
```
lapply(recommendation_model, "[[","description")
```

$HYBRID_realRatingMatrix	'Hybrid recommender that aggegates several recommendation strategies using weighted averages.'
$ALS_realRatingMatrix	'Recommender for explicit ratings based on latent factors, calculated by alternating least squares algorithm.'
$ALS_implicit_realRatingMatrix	'Recommender for implicit data based on latent factors, calculated by alternating least squares algorithm.'
$IBCF_realRatingMatrix	'Recommender based on item-based collaborative filtering.'
$LIBMF_realRatingMatrix	'Matrix factorization with LIBMF via package recosystem (https://cran.r-project.org/web/packages/recosystem/vignettes/introduction.html).'
$POPULAR_realRatingMatrix	'Recommender based on item popularity.'
$RANDOM_realRatingMatrix	'Produce random recommendations (real ratings).'
$RERECOMMEND_realRatingMatrix	'Re-recommends highly rated items (real ratings).'
$SVD_realRatingMatrix	'Recommender based on SVD approximation with column-mean imputation.'
$SVDF_realRatingMatrix	'Recommender based on Funk SVD with gradient descend (https://sifter.org/~simon/journal/20061211.html).'
$UBCF_realRatingMatrix	'Recommender based on user-based collaborative filtering.'

dfsd

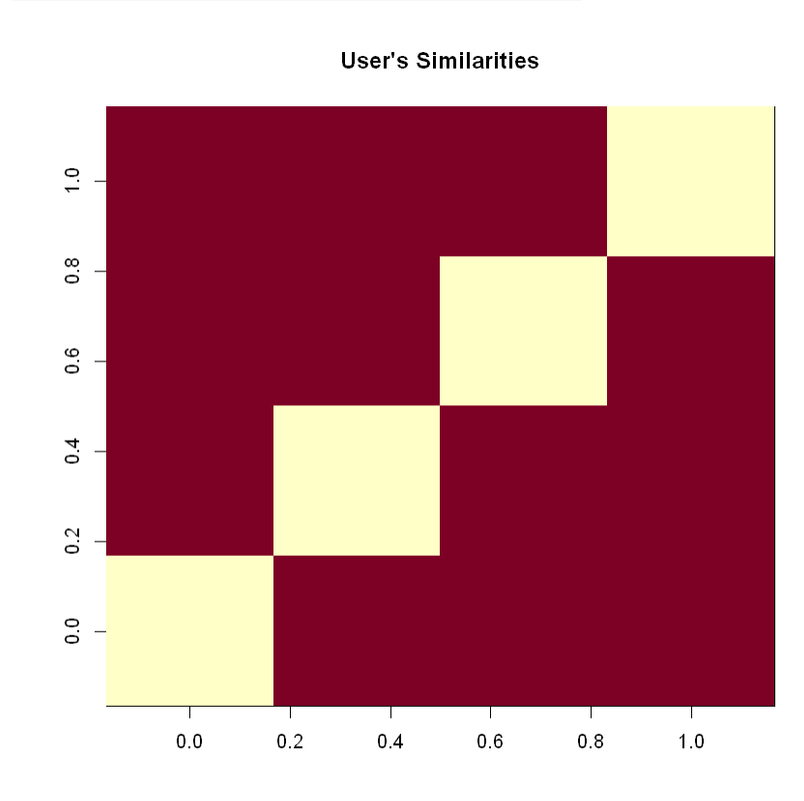
In [31]:
```
recommendation_model$IBCF_realRatingMatrix$parameters
```

$k	30
$method	'Cosine'
$normalize	'center'
$normalize_sim_matrix	FALSE
$alpha	0.5
$na_as_zero	FALSE

In [33]:
```
similarity_mat <- similarity(ratingMatrix[1:4, ],method ="cosine",which = "users")
as.matrix(similarity_mat)
image(as.matrix(similarity_mat),main ="User's Similarities")
```

A matrix: 4 × 4 of type dbl

	1	2	3	4
1	0.0000000	0.9760860	0.9641723	0.9914398
2	0.9760860	0.0000000	0.9925732	0.9374253
3	0.9641723	0.9925732	0.0000000	0.9888968
4	0.9914398	0.9374253	0.9888968	0.0000000



In [34]:
```
rating_values <-as.vector(ratingMatrix@data)
unique(rating_values)
```

0 · 5 · 4 · 3 · 4.5 · 1.5 · 2 · 3.5 · 1 · 2.5 · 0.5

In [38]:
```
Table_of_Ratings<-table(rating_values)
Table_of_Ratings
```

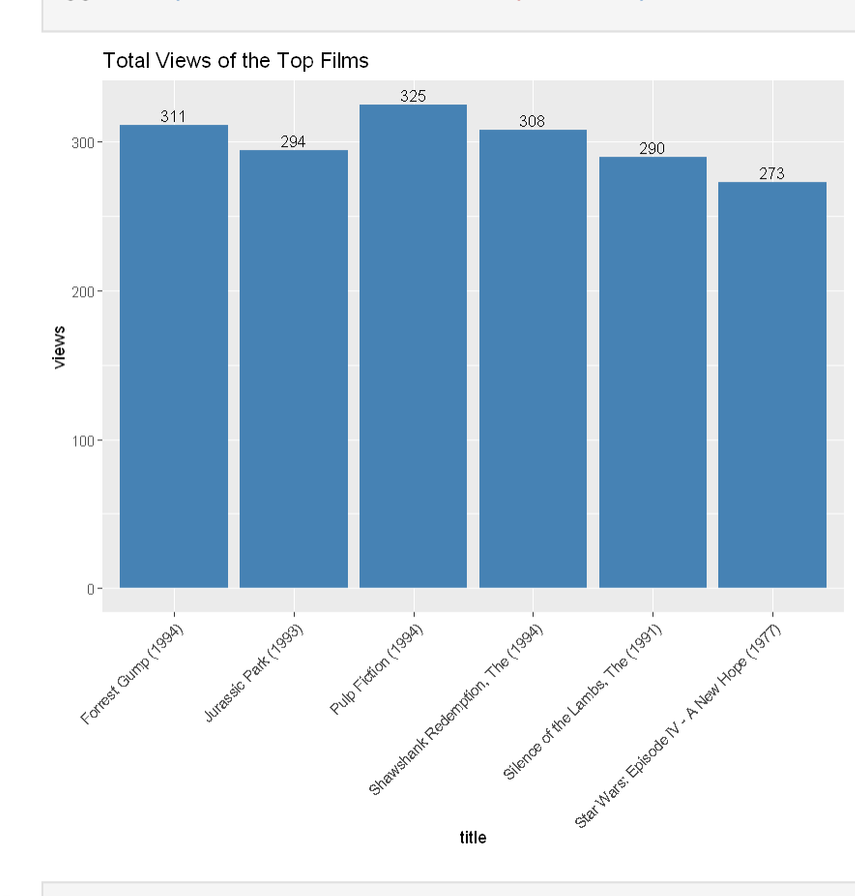
```
rating_values
      0     0.5       1     1.5       2     2.5       3     3.5       4     4.5
6791761    1198    3258    1567    7943    5484   21729   12237   28880    8187
      5
  14856
```

In [39]:
```
library(ggplot2)
movie_views <-colCounts(ratingMatrix)
table_views <- data.frame(movie = names(movie_views),views = movie_views)
table_views <- table_views[order(table_views$views,decreasing=TRUE),]
table_views$title <-NA
for (index in 1:10325)
    {
    table_views[index,3]<-as.character(subset(movie_data,movie_data$movieId == table_views[index,1])$title)
    }
table_views[1:6,]
```

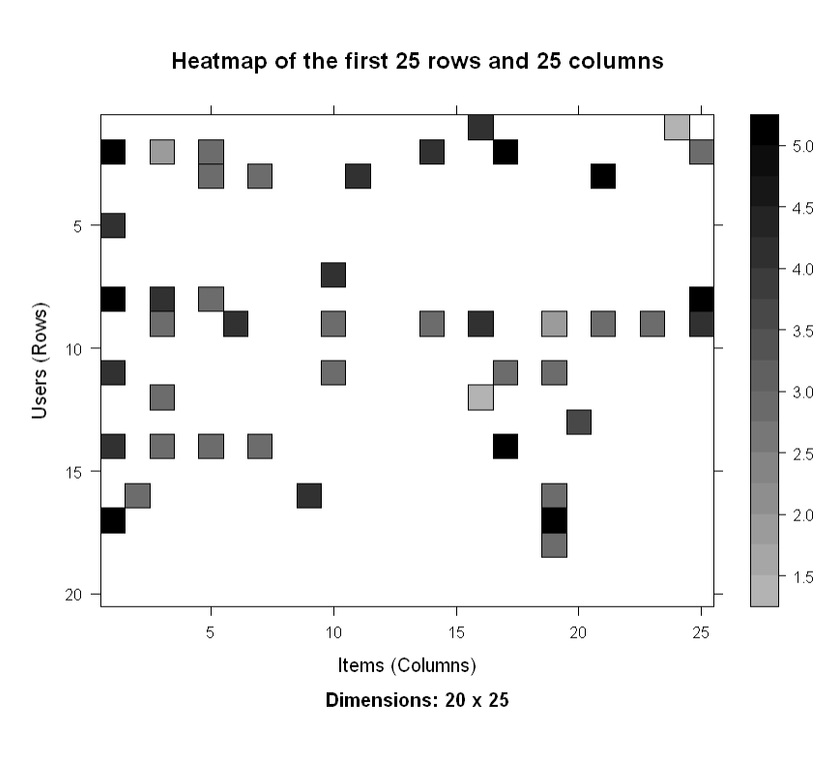
A data.frame: 6 × 3

	movie	views	title
	<chr>	<int>	<chr>
296	296	325	Pulp Fiction (1994)
356	356	311	Forrest Gump (1994)
318	318	308	Shawshank Redemption, The (1994)
480	480	294	Jurassic Park (1993)
593	593	290	Silence of the Lambs, The (1991)
260	260	273	Star Wars: Episode IV - A New Hope (1977)

In [50]:
```
ggplot(table_views[1:6, ], aes(x=title,y=views))+
geom_bar(stat="identity",fill = 'steelblue')+
geom_text(aes(label=views),vjust=-0.3,size=3.5)+
theme(axis.text.x=element_text(angle=45,hjust=1))+
ggtitle("Total Views of the Top Films")
```



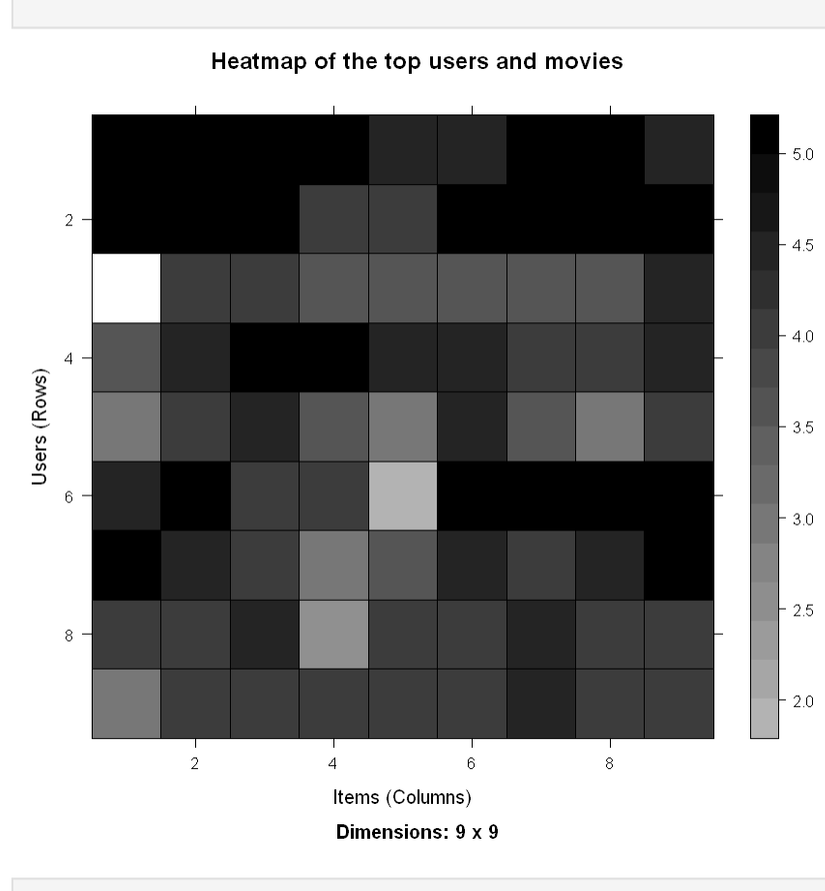
In [51]:
```
image(ratingMatrix[1:20,1:25],axes=FALSE,main= "Heatmap of the first 25 rows and 25 columns")
```



In [59]:
```
movie_rating <- ratingMatrix[rowCounts(ratingMatrix) >50,colCounts(ratingMatrix)>50]
movie_rating
```

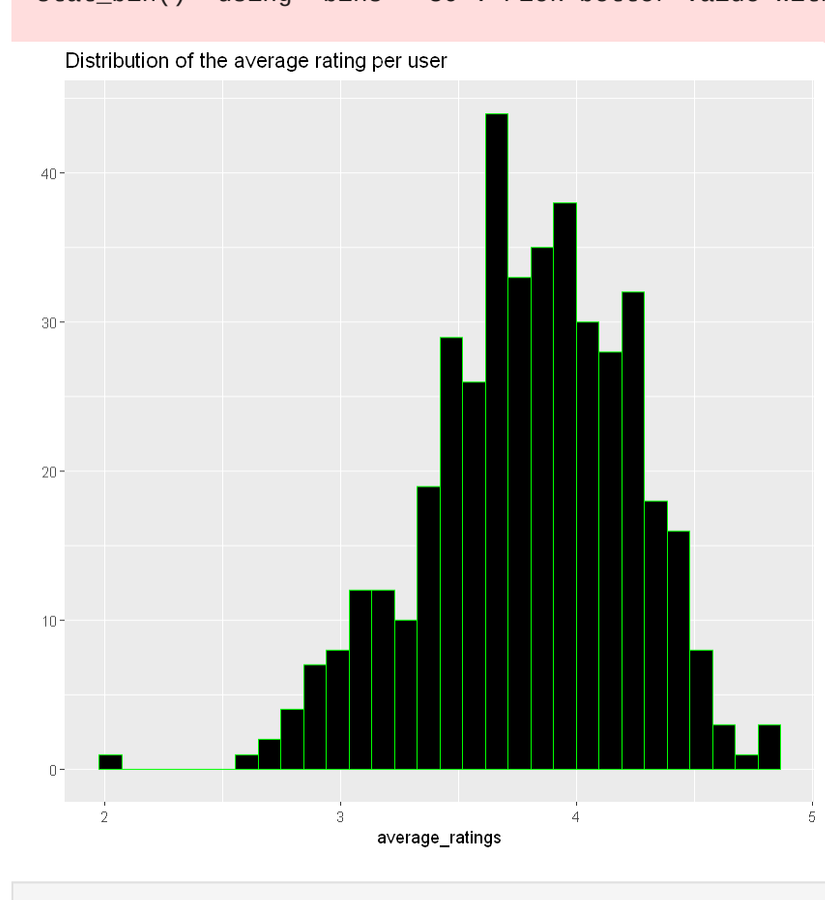
```
420 x 447 rating matrix of class 'realRatingMatrix' with 38341 ratings.
```

In [60]:
```
minimum_movies<- quantile(rowCounts(movie_rating),0.98)
minimum_users<- quantile(colCounts(movie_rating),0.98)
image(movie_rating[rowCounts(movie_rating) > minimum_movies,colCounts(movie_rating) > minimum_users],
     main="Heatmap of the top users and movies")
```



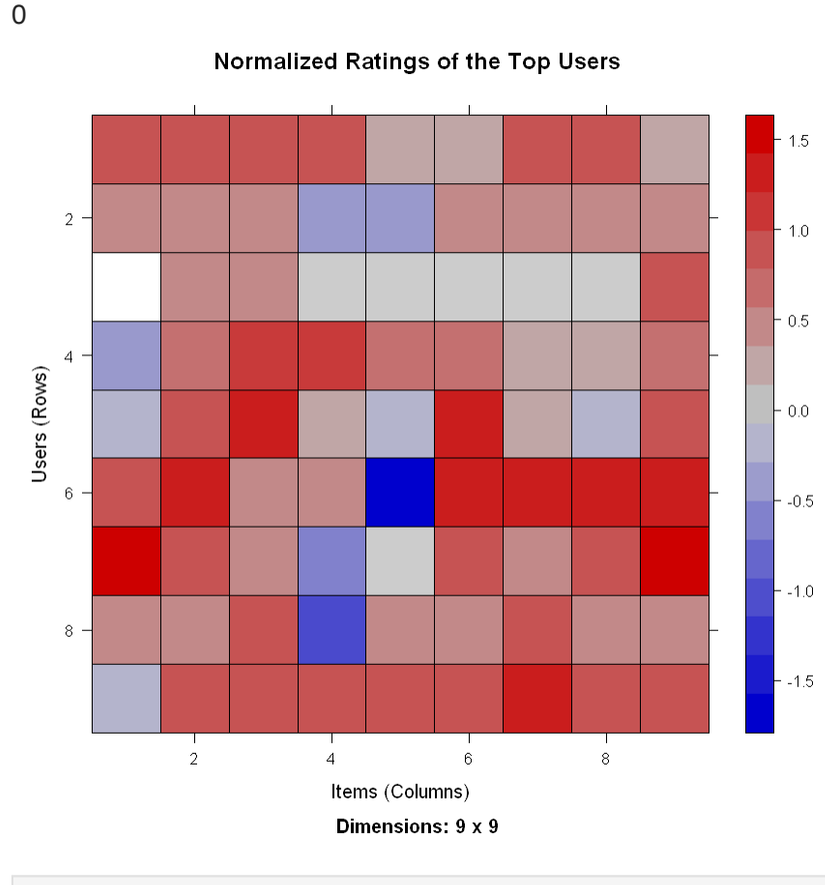
In [66]:
```
average_ratings <- rowMeans(movie_rating)
qplot(average_ratings, fill = I("black"),col=I("green"))+
ggtitle("Distribution of the average rating per user")
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



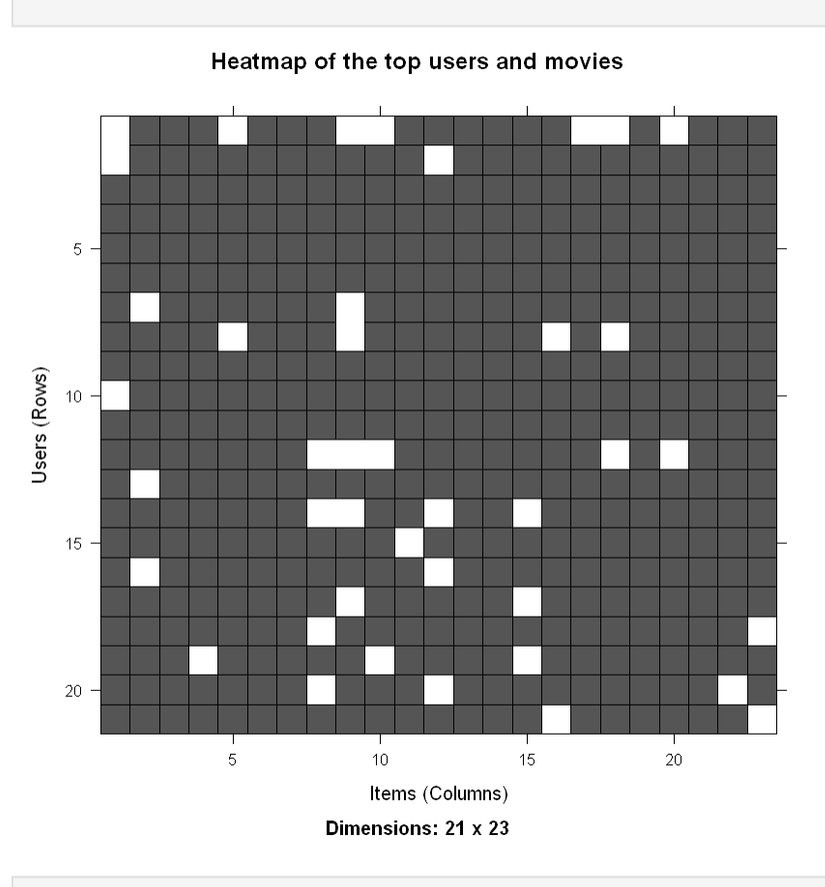
In [67]:
```
normalized_ratings <- normalize(movie_rating)
sum(rowMeans(normalized_ratings)>0.00001)
image(normalized_ratings[rowCounts(normalized_ratings)>minimum_movies,colCounts(normalized_ratings)>minimum_users],
     main = "Normalized Ratings of the Top Users")
```

0



In [73]:
```
binary_minimum_movies <- quantile(rowCounts(movie_rating),0.95)
binary_minimum_users<- quantile(colCounts(movie_rating),0.95)
movies_watched <-binarize(movie_rating,minRating =1)

good_rated_films <- binarize(movie_rating,minRating=3)
image(good_rated_films[rowCounts(movie_rating)> binary_minimum_movies,colCounts(movie_rating)>binary_minimum_users],
     main="Heatmap of the top users and movies")
```



In [75]:
```
sampled_data<-sample(x= c(TRUE,FALSE),size = nrow(movie_rating),replace =TRUE,prob= c(0.8,0.2))
training_data <- movie_rating[sampled_data, ]
testing_data <-movie_rating[!sampled_data, ]
```

In [76]:
```
recommendation_system<- recommenderRegistry$get_entries(dataType ="realRatingMatrix")
recommendation_system$IBCF_realRatingMatrix$parameters
```

$k	30
$method	'Cosine'
$normalize	'center'
$normalize_sim_matrix	FALSE
$alpha	0.5
$na_as_zero	FALSE

In [79]:
```
recommen_model <-Recommender(data = training_data,method="IBCF",parameter = list(k=30))
recommen_model
class (recommen_model)
```

```
Recommender of type 'IBCF' for 'realRatingMatrix'
learned using 348 users.
```

'Recommender'

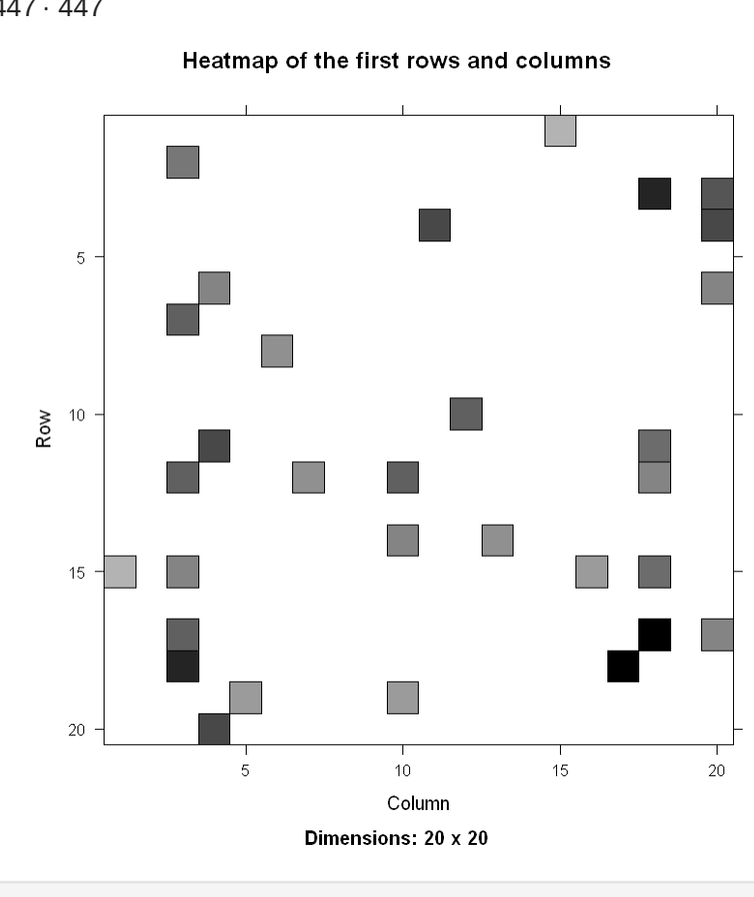
In [80]:
```
class (recommen_model)
```

'Recommender'

In [81]:
```
model_info <- getModel(recommen_model)
class(model_info$sim)
dim(model_info$sim)
top_items<-20
image(model_info$sim[1:top_items, 1:top_items],
      main="Heatmap of the first rows and columns")
```

'dgCMatrix'

447 · 447

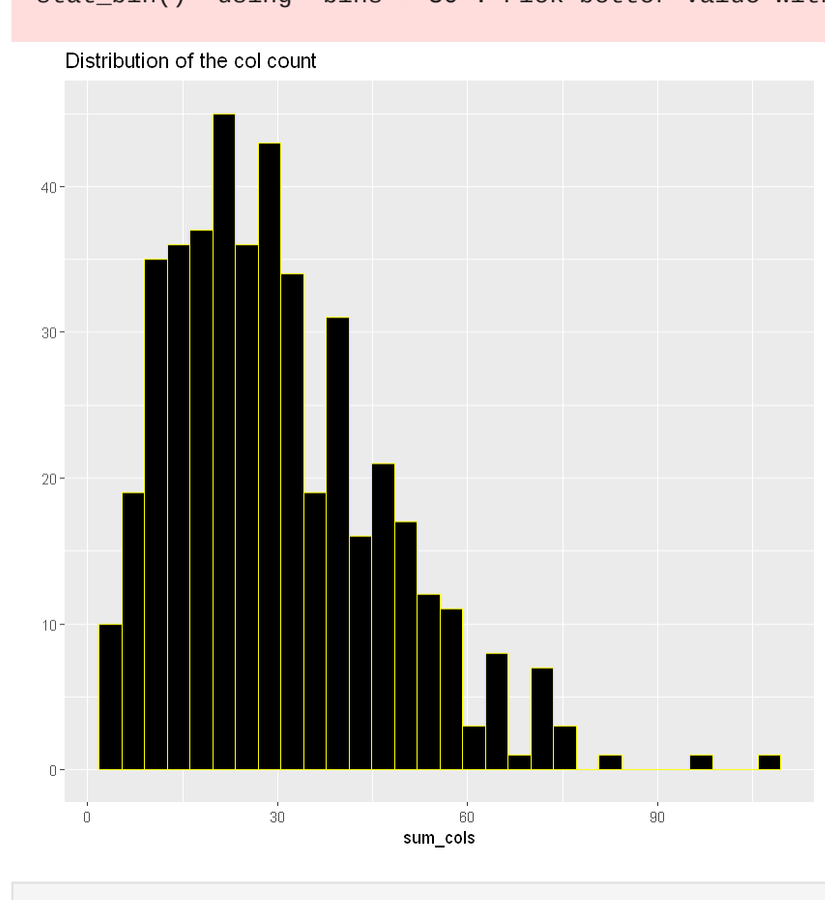


In [83]:
```
sum_rows <-rowSums(model_info$sim >0)
table(sum_rows)
```

```
sum_rows
 30
447
```

In [89]:
```
sum_cols <-colSums(model_info$sim >0)
qplot(sum_cols,fill=I("black"),col=I(" yellow "))+ggtitle("Distribution of the col count")
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



In [90]:
```
top_recommendations <-10
predicted_recommendations<-predict(object = recommen_model,newdata=testing_data,n=top_recommendations)
predicted_recommendations
```

```
Recommendations as 'topNList' with n = 10 for 72 users.
```

In [94]:
```
user1 <-predicted_recommendations@items[[1]]
movies_user1 <- predicted_recommendations@itemLabels[user1]
movies_user2 <-movies_user1
for ( index in 1:10)
    {
        movies_user2[index] <- as.character(subset(movie_data,movie_data$movieId ==movies_user1[index])$title)
    }
movies_user2
```

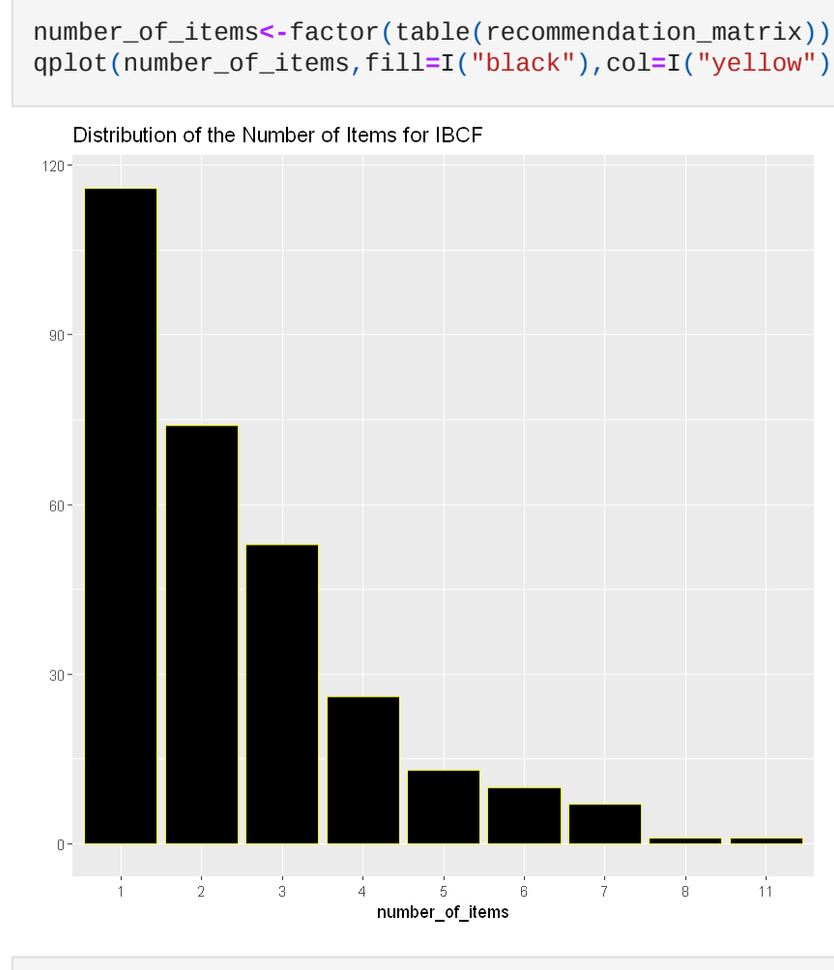
'Toy Story (1995)' · 'Casino (1995)' · 'Sense and Sensibility (1995)' · 'Get Shorty (1995)' · 'Leaving Las Vegas (1995)' · 'Babe (1995)' · 'Dead Man Walking (1995)' · 'Mr. Holland\'s Opus (1995)' · 'Braveheart (1995)' · 'Taxi Driver (1976)'

In [106…
```
recommendation_matrix <- sapply(predicted_recommendations@items,function(x)
                                {as.integer(colnames(movie_rating)[x])})
recommendation_matrix[,1:4]
```

A matrix: 10 × 4 of type int

1	32	785	1961
16	145	1275	2571
17	168	3481	1625
21	260	1035	8665
25	261	4720	4993
34	293	1641	1682
36	520	1527	1234
62	852	3418	17
110	858	4963	25
111	1047	3175	265

In [108…
```
number_of_items<-factor(table(recommendation_matrix))
qplot(number_of_items,fill=I("black"),col=I("yellow"))+ggtitle("Distribution of the Number of Items for IBCF")
```



In [109…
```
number_of_items_sorted <-sort(number_of_items,decreasing =TRUE)
number_of_items_top <-head(number_of_items_sorted,n=4)
table_top<-data.frame(as.integer(names(number_of_items_top)),number_of_items_top)
for(i in 1:4)
    {
        table_top[i,1]<-as.character(subset(movie_data,movie_data$movieId==table_top[i,1])$title)
    }
colnames(table_top)<-c("Movie Title","No.of Items")
head(table_top)
```

A data.frame: 4 × 2

	Movie Title	No.of Items
	<chr>	<fct>
25	Leaving Las Vegas (1995)	11
745	Wallace & Gromit: A Close Shave (1995)	8
1	Toy Story (1995)	7
6	Heat (1995)	7

In [ ]: