

Package ‘CFF’

October 12, 2022

Title Simple Similarity for User-Based Collaborative Filtering Systems

Version 1.0

Date 2020-02-25

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Description A simple, fast algorithm to find the neighbors and similarities of users in user-based filtering systems, to break free from the complex computation of existing similarity formulas and the ability to solve big data.

License GPL (>= 2)

Encoding UTF-8

RoxygenNote 7.0.2

NeedsCompilation no

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Repository CRAN

Date/Publication 2020-03-04 10:00:05 UTC

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CFF-package

*Simple Similarity for User-Based Collaborative Filtering Systems***Description**

A simple, fast algorithm to find the neighbors and similarities of users in user-based filtering systems, to break free from the complex computation of existing similarity formulas and the ability to solve big data.

Details

The DESCRIPTION file:

```
Package:      CFF
Title:       Simple Similarity for User-Based Collaborative Filtering Systems
Version:     1.0
Date:       2020-02-25
Authors@R:  c(person(given="Farimah", family="Houshmand Nanehkaran", role = c("aut", "cre"), email="hoshmandcomp
Maintainer:  Farimah Houshmand Nanehkaran <hoshmandcomputer@gmail.com>
Description: A simple, fast algorithm to find the neighbors and similarities of users in user-based filtering systems, to bre
License:     GPL (>= 2)
Encoding:   UTF-8
RoxygenNote: 7.0.2
Author:     Farimah Houshmand Nanehkaran [aut, cre] (<https://orcid.org/0000-0003-1687-1719>, University=Islamic A
```

Index of help topics:

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                  Filtering Systems
Score_replace    Replacing of Neighbor Users' Ratings on
                  Non-Rated Items By The Active User
simple_predict    Prediction Unseen Items For The Active User
simple_similarity Finding Neighbor Users And Their Similarity
                  Values
```

User-Based Collaborative Filtering Systems

Author(s)

NA

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References

Kumar, P., Kumar, V., & Thakur, R. S. (2019). *A new approach for rating prediction system using collaborative filtering*. *Iran Journal of Computer Science*, vol.2, no. 2, pp. 81-87.

Zhang, P., Zhang, Z., Tian, T., & Wang, Y. (2019). *Collaborative filtering recommendation algorithm integrating time windows and rating predictions*. *Applied Intelligence*, vol. 49, no. 8, pp. 3146-3157.

Gadekula, S. K., Rao, U. P., Vyas, R. K., Dontula, A. L., & Gaikwad, S. V. (2019). *Improved Pearson Similarity for Collaborative Filtering Recommendation System*. In 2019 6th International Conference on Computing for Sustainable Global Development (INDIACom), pp. 1047-1054, IEEE.

Examples

```

ratings <- matrix(c( 2, 5, NaN, NaN, NaN, 4,
                  NaN, NaN, NaN, 1, NaN, 5,
                  NaN, 4, 5, NaN, 4, NaN,
                  4, NaN, NaN, 5, NaN, NaN,
                  5, NaN, 2, NaN, NaN, NaN,
                  NaN, 1, NaN, 4, 2, NaN),nrow=6,byrow=TRUE)
active_users <- c(1:dim(ratings)[2])

time_all <- c(rep(NaN, length(active_users)))

ratings3 <- ratings

for (ac in 1:length(active_users))
{
  cat("==== user",active_users[ac], "====", "\n","\n")
  ##1
  T1_start <- Sys.time()
  sim <- simple_similarity(ratings, max_score=5, min_score=1, ac)
  T1_end <- Sys.time()

  cat("    Similar Users =", sim$sim_index,          "\n","\n")
  cat("Similarity Values =", sim$sim_x,             "\n","\n")

  ##2
  T2_start <- Sys.time()
  ratings2 <- Score_replace(ratings, sim_index= sim$sim_index, ac)
  T2_end <- Sys.time()

  cat(" Predicted Scores =", ratings2[,ac],         "\n","\n")

  ##3
  T3_start <- Sys.time()
  predictedItems <- simple_predict(ratings, ratings2, ac)
  T3_end <- Sys.time()

  cat(" Predicted Items =", predictedItems,         "\n","\n")

  ##4
  time_all[ac] <- (T1_end - T1_start) + (T2_end - T2_start) + (T3_end - T3_start)

  cat("          Time =", time_all[ac],             "\n","\n")

  ##5

```

```

  ratings3[,ac] <- ratings2[,ac]
}

Mean_Time <- mean(time_all)

cat("==== Mean Time =====", "\n", "\n")
cat("      Mean Time =", Mean_Time, "\n", "\n")
cat("      Full Matrix =", "\n", "\n")

print(ratings3)

```

Score_replace	<i>Replacing of Neighbor Users' Ratings on Non-Rated Items By The Active User</i>
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Description

The ratings of each user that has more similar to the active user are directly replaced in his unseen items.

Usage

```
Score_replace(ratings, sim_index, ac)
```

Arguments

ratings	A rating matrix whose rows are items and columns are users.
sim_index	Descending sorted indexes based on similarity to the active user who is a vector of integers.
ac	The id of an active user as an integer ($1 \leq ac \leq \text{lengthofusers}$).

Details

The unseen items of the active user are filled by the ratings of the similar users, respectively. Each element remains unchanged after one placement.

Value

ratings2	A matrix the size of the original user-item matrix in which the active user's empty elements are filled.
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Author(s)

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References

Gadekula, S. K., Rao, U. P., Vyas, R. K., Dontula, A. L., & Gaikwad, S. V. (2019). *Improved Pearson Similarity for Collaborative Filtering Recommendation System*. In 2019 6th International Conference on Computing for Sustainable Global Development (INDIACom), pp. 1047-1054, IEEE.

Examples

```
ratings <- matrix(c( 2, 5, NaN, NaN, NaN, 4,
                  NaN, NaN, NaN, 1, NaN, 5,
                  NaN, 4, 5, NaN, 4, NaN,
                  4, NaN, NaN, 5, NaN, NaN,
                  5, NaN, 2, NaN, NaN, NaN,
                  NaN, 1, NaN, 4, 2, NaN),nrow=6,byrow=TRUE)

sim <- simple_similarity(ratings, max_score=5, min_score=1, ac=1)

ratings2 <- Score_replace(ratings, sim_index= sim$sim_index, ac=1)
```

simple_predict

Prediction Unseen Items For The Active User

Description

In the predicted items list, items with more scores replace in top of the list.

Usage

```
simple_predict(ratings, ratings2, ac)
```

Arguments

ratings	A rating matrix whose rows are items and columns are users.
ratings2	A matrix the size of the original user-item matrix in which the active user's empty elements are filled.
ac	The id of an active user as an integer ($1 \leq ac \leq \text{lengthofusers}$).

Details

Collaborative filtering is a recommender system for predicting the missing ratings that an active user might have given to an item. These ratings have been calculated and accumulate in a vector by this function.

Value

predictedItems A sorted vector of predicted items based on the scores.

Author(s)

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References

Song, B., Gao, Y., & Li, X. M. (2020, January). *Research on Collaborative Filtering Recommendation Algorithm Based on Mahout and User Model*. In *Journal of Physics: Conference Series*, Vol. 1437, no. 1, p. 012095, IOP Publishing.

Ramakrishnan, G., Saicharan, V., Chandrasekaran, K., Rathnamma, M. V., & Ramana, V. V. (2020). *Collaborative Filtering for Book Recommendation System*. In *Soft Computing for Problem Solving*, pp. 325-338, Springer, Singapore.

Examples

```
ratings <- matrix(c( 2, 5, NaN, NaN, NaN, 4,
                  NaN, NaN, NaN, 1, NaN, 5,
                  NaN, 4, 5, NaN, 4, NaN,
                  4, NaN, NaN, 5, NaN, NaN,
                  5, NaN, 2, NaN, NaN, NaN,
                  NaN, 1, NaN, 4, 2, NaN), nrow=6, byrow=TRUE)

sim <- simple_similarity(ratings, max_score=5, min_score=1, ac=1)

ratings2 <- Score_replace(ratings, sim_index= sim$sim_index, ac=1)

predictedItems <- simple_predict(ratings, ratings2, ac=1)
```

simple_similarity *Finding Neighbor Users And Their Similarity Values*

Description

Steps of calculating the similarity of one user to an active user :

- 1- Calculating the difference between the desired user ratings with the active user in common items.
- 2- Calculating the similarity value for each common item.
- 3- Calculating the mean value of similarities.

Usage

```
simple_similarity(ratings, max_score=5, min_score=1, ac)
```

Arguments

ratings	A rating matrix whose rows are items and columns are users.
max_score	The maximum range of ratings.
min_score	The minimum range of ratings.
ac	The id of an active user as an integer ($1 \leq ac \leq \text{lengthofusers}$).

Details

The similarity of the active user with other users is obtained by the following formulas :

$$dif_{(u_i,j)} = |r_{(u_a,j)} - r_{(u_i,j)}|$$

$$sim_{dif_{(u_i,j)}} = \frac{-dif_{(u_i,j)}}{max_{score} - min_{score}} + 1$$

$$sim_{(u_a,u_j)} = \frac{\sum_{j=1}^{N_j} sim_{(dif_{(u_i,j)})}}{N_j}$$

j is the row number for the items and i is the column number for the users in the ratings matrix.

u_i is a i th column user and u_a is an active user.

$r_{(u_a,j)}$ is the rating of active user in the j th row and $r_{(u_i,j)}$ is the rating of the i th user in the j th row.

$dif_{(u_i,j)}$ is the difference of the rating for the i th user with the active user in the j th row.

$sim_{dif_{(u_i,j)}}$ is the similarity of the i th user with the active user in the j th row.

$sim_{(u_a,u_i)}$ is the similarity of the user i , with the active user.

N_j is the number of common items.

For example, suppose active user ratings are: {2, nan, 3, nan, 5} and one user ratings are: {3, 4, nan, nan, 1} then for ratings between 1 and 5:

dif={1, nan, nan, nan, 4} and

sim(dif)={ $\frac{-1}{5-1} + 1$, nan, nan, nan, $\frac{-4}{5-1} + 1$ }={0.75, nan, nan, nan, 0}

and mean of sim(dif) is sim=0.375.

Value

An object of class "simple_similarity", a list with components:

call	The call used.
sim_x	Neighboring user similarity values in descending order.
sim_index	Number of columns for neighboring users in descending order of similarity.

Author(s)

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References

- Mongia, A., & Majumdar, A. (2019). *Matrix completion on multiple graphs: Application in collaborative filtering*. Signal Processing, vol. 165, pp. 144-148.
- Hong, B., & Yu, M. (2019). *A collaborative filtering algorithm based on correlation coefficient*. Neural Computing and Applications, vol. 31, no. 12, pp. 8317-8326.

Examples

```
ratings <- matrix(c( 2, 5, NaN, NaN, NaN, 4,  
                  NaN, NaN, NaN, 1, NaN, 5,  
                  NaN, 4, 5, NaN, 4, NaN,  
                  4, NaN, NaN, 5, NaN, NaN,  
                  5, NaN, 2, NaN, NaN, NaN,  
                  NaN, 1, NaN, 4, 2, NaN),nrow=6,byrow=TRUE)#items*users  
  
sim <- simple_similarity(ratings, max_score=5, min_score=1, ac=1)
```


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