Package ‘gcTensor’

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Type Package

Title Generalized Coupled Tensor Factorization

Version 0.99.0

Date 2021-08-24

Suggests testthat

Depends R (>= 4.1.0)

Imports rTensor, einsum

Description Multiple matrices/tensors can be specified and decomposed simultaneously by Probabilistic Latent Tensor Factorisation (PLTF). See the reference section of GitHub README.md <https://github.com/rikenbit/gcTensor>, for details of the method.

License Artistic-2.0

URL https://github.com/rikenbit/gcTensor

NeedsCompilation no

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Description

Multiple matrices/tensors can be specified and decomposed simultaneously by Probabilistic Latent Tensor Factorisation (PLTF). See the reference section of GitHub README.md <https://github.com/rikenbit/gcTensor>, for details of the method.

Details

The DESCRIPTION file:

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Title: Generalized Coupled Tensor Factorization
Version: 0.99.0
Date: 2021-08-24
Authors@R: c(person("Koki", "Tsuyuzaki", role = c("aut", "cre"), email = "k.t.the-answer@hotmail.co.jp"))
Suggests: testthat
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License: Artistic-2.0
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Author: Koki Tsuyuzaki [aut, cre]
Maintainer: Koki Tsuyuzaki <k.t.the-answer@hotmail.co.jp>

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GCTF Generalised Coupled Tensor Factorisation (GCTF)

Author(s)

NA

Maintainer: NA

References


Beyza Ermis, et. al., (2015). Link prediction in heterogeneous data via generalized coupled tensor factorization, Data Mining and Knowledge Discovery
Examples

```r
ls("package:gcTensor")
```

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**GCTF**  
*Generalised Coupled Tensor Factorisation (GCTF)*

**Description**

The input data is assumed to be a list containing multiple matrices. GCTF decomposes N matrices (\(X_i\)) to M low-dimensional factor matrices (\(Z_j\)).

**Usage**

```r
GCTF(X, R, M=NULL, initZ=NULL, fix=NULL, Ranks, Beta=1,  
    num.iter=30, thr=1E-10, verbose=FALSE)
```

**Arguments**

- **X**
  A list containing N data matrices.

- **R**
  Coupling matrix which has N-rows and M-columns. N is the number of data matrices and M is the number of factor matrices decomposed by GCTF algorithm. If i-th data \((X_i)\) has j-th factor matrix \((Z_j)\), 1 is filled in \(R[i,j]\), otherwise 0.

- **M**
  A list containing N mask matrices. If in n-th data matrix, i-th row/j-th column is missing value, 0 is filled, otherwise 0. Default value is NULL, which means all the values are filled with 1 (No missing value).

- **initZ**
  A M-length list, which is the initial values of factor matrix \(Z\). If not specified, random matrices are generated and used (Default: NULL).

- **fix**
  Whether each factor matrix \(Z\) is updated in each iteration step (Default: NULL, which means all \(Z\)s are updated).

- **Ranks**
  A M-length list, which is the correspondence between the dimension of data matrices and the lower dimension of factor matrices.

- **Beta**
  The parameter of Beta-divergence. Beta=0, 1, and 2 each mean Euclid Distance, KL-divergence, and Itakura-Saito divergence between the data matrices and reconstructed matrices by factor matrices (Default: 1).

- **num.iter**
  The number of iteration step (Default: 30).

- **thr**
  When error change rate is lower than thr, the iteration is terminated (Default: 1E-10).

- **verbose**
  If verbose == TRUE, Error change rate is generated in console window (Default: FALSE).
Value

U : A matrix which has N-rows and J-columns (J < N, M). V : A matrix which has M-rows and J-columns (J < N, M). J : The number of dimension (J < N, M). RecError : The reconstruction error between data tensor and reconstructed tensor from U and V. TrainRecError : The reconstruction error calculated by training set (observed values specified by M). TestRecError : The reconstruction error calculated by test set (missing values specified by M). RelChange : The relative change of the error. Trial : All the results of the trials to estimate the rank. Runtime : The number of the trials to estimate the rank. RankMethod : The rank estimation method.

Author(s)

Koki Tsuyuzaki

References

Beyza Ermis, et. al., (2015). Link prediction in heterogeneous data via generalized coupled tensor factorization, Data Mining and Knowledge Discovery

Examples

```r
if(interactive()){
  # Simulation Datasets
  set.seed(123)

  # I times J times K
  X1 <- rand_tensor(modes = c(4, 5, 6))
  X1 <- X1@data^2
  names(dim(X1)) <- c("I", "J", "K")

  # I times P
  X2 <- matrix(runif(4 * 7), nrow=4, ncol=7)
  names(dim(X2)) <- c("I", "M")

  # J times Q
  X3 <- matrix(runif(5 * 8), nrow=5, ncol=8)
  names(dim(X3)) <- c("J", "N")

  # Coupled Tensor/Matrix
  X <- list(X1 = X1, X2 = X2, X3 = X3)

  # Coupling matrix R (CP)
  R_CP <- rbind(
    c(1,1,1,0,0),
    c(1,0,0,1,0),
    c(0,1,0,0,1)
  )
  rownames(R_CP) <- paste0("X", seq(3))
  colnames(R_CP) <- LETTERS[seq(5)]

  # Size of Factor matrices (CP)
```
Ranks_CP <- list(
  A=list(I=4, r=3),
  B=list(J=5, r=3),
  C=list(K=6, r=3),
  D=list(M=7, r=3),
  E=list(N=8, r=3))

# Coupling matrix R (Tucker)
R_Tucker <- rbind(
  c(1,1,1,0,0),
  c(1,0,0,1,0),
  c(0,1,0,0,1)
)
rownames(R_Tucker) <- paste0("X", seq(3))
colnames(R_Tucker) <- LETTERS[seq(6)]

# Size of Factor matrices (Tucker)
Ranks_Tucker <- list(
  A=list(I=4, p=3),
  B=list(J=5, q=4),
  C=list(K=6, r=3),
  D=list(p=3, q=4, r=3),
  E=list(M=7, p=3),
  F=list(N=8, q=4))

# CP
out.CP_EUC <- GCTF(X, R_CP, Ranks=Ranks_CP, Beta=0, verbose=TRUE)
out.CP_KL <- GCTF(X, R_CP, Ranks=Ranks_CP, Beta=1, verbose=TRUE)
out.CP_IS <- GCTF(X, R_CP, Ranks=Ranks_CP, Beta=2, verbose=TRUE)

# Tucker
out.Tucker_EUC <- GCTF(X, R_Tucker, Ranks=Ranks_Tucker, Beta=0, verbose=TRUE)
out.Tucker_KL <- GCTF(X, R_Tucker, Ranks=Ranks_Tucker, Beta=1, verbose=TRUE)
out.Tucker_IS <- GCTF(X, R_Tucker, Ranks=Ranks_Tucker, Beta=2, verbose=TRUE)
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