Package 'gcTensor'

October 13, 2022

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

Author Koki Tsuyuzaki [aut, cre]

Maintainer Koki Tsuyuzaki <k.t.the-answer@hotmail.co.jp>

Repository CRAN

Date/Publication 2021-09-13 11:30:02 UTC

R topics documented:

gcTensor-package *Generalized Coupled Tensor Factorization*

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:

Package:	gcTensor
Type:	Package
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
Depends:	R (>= 4.1.0)
Imports:	rTensor, einsum
Description:	Multiple matrices/tensors can be specified and decomposed simultaneously by Probabilistic Latent Tensor Fact
License:	Artistic-2.0
URL:	https://github.com/rikenbit/gcTensor
Author:	Koki Tsuyuzaki [aut, cre]
Maintainer:	Koki Tsuyuzaki <k.t.the-answer@hotmail.co.jp>

Index of help topics:

Author(s)

NA

Maintainer: NA

References

Y. Kenan Yilmaz, et. al., (2011). Generalised Coupled Tensor Factorisation, NIPS

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

Examples

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

GCTF *Generalised Coupled Tensor Factorisation (GCTF)*

Description

The input data is assumed to be a list containing multiple matrices. GCTF decomposes N matrices (Xs) to M low-dimensional factor matices (Zs).

Usage

```
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 Zs 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 interation 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

Y. Kenan Yilmaz, et. al., (2011). Generalised Coupled Tensor Factorisation, NIPS

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

Examples

```
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(1,1,1,1,0,0),
    c(1,0,0,0,1,0),
    c(0,1,0,0,0,1)
)
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)
}
```

Index