Package 'tensorsign'

February 2, 2021

Type Package

Title Nonparametric Tensor Completion Via Sign Series

Version 0.1.0

Author Chanwoo Lee <chanwoo.lee@wisc.edu>, Miaoyan Wang <miaoyan.wang@wisc.edu>

Maintainer Chanwoo Lee <chanwoo.lee@wisc.edu>

Imports rTensor,
Matrix,
pracma

Description Efficient algorithm for nonparametric tensor completion ~~method~~ via sign series. The algorithm employs the alternating optimization approach to solve the weighted classification problem. The detailed algorithm description can be found in Lee and Wang (2021) <arXiv:2102.00384>.

URL https://arxiv.org/abs/2102.00384

License GPL(>=2)

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

R topics documented:

Alt *Alternating optimization of the weighted classification loss*

Description

Optimize the weighted classification loss given a weight tensor, an observed data tensor, and a large margin loss.

Usage

```
Alt(Ybar,W,r,type = c("logistic","hinge"),start = "random")
```

pay attention to the order. If parentheses are *part of* the sentence, the sentence should read well even without the parentheses.

Arguments

Ybar	A given ~~data tensor~~ (possibly noisy and incomplete~~)~~. data tensor
W	A weight tensor ~~of~~ the weighted classification loss. used in
r	~~A~~ rank to be fitted. tensor rank to be fitted
type	A large margin loss to be used. Logistic or hinge loss is available.
start	Choice of initialization method. Use random initialization if `start = "random"`~~;~~. Use the initialization based on low rank approximation if `start = "linear"`. Linear initialization is default.

Value

of

The returned value is a list ~~with~~ components. trajectories of binary loss values over iterations.

binary_obj	~~A series of~~ binary loss values ~~at each iteration.~~
obj	A series of the weighted classification loss values at each iteration.
iter	The number of iterations.
error	A series of errors at each iteration.
fitted	A tensor that optimizes the weighted classification loss.

References

Lee, C., & Wang, M. (2021). Beyond the Signs: Nonparametric Tensor Completion via Sign Series. *arXiv preprint arXiv:2102.00384.*

``a series of '' allows non-ordered list.

Examples

I've thought quite a bit when I decide between ``a series of sign tensors'' vs. ``a sequence of sign tensors.'' in our paper — think about why

```
library(rTensor)
indices = c(2,3,4)
noise = rand_tensor(indices)@data
Theta = array(runif(prod(indices),min=-3,max = 3),indices)

# The signal plus noise model
Y = Theta + noise

# Optimize the weighted classification for a given sign tensor sign(Y) and a weight tensor abs(Y)
given a sign tensor
result = Alt(sign(Y),abs(Y),r = 2,type = "logistic",start = "random")
signTheta = sign(result$fitted)
```

Revise the code to allow r >= d_min.
Current random initialization seems require r <= min d.
in the final documentation, use r=3 and start = "linear".

~~Signal tensor estimation~~

fit_continuous	*~~Estimating a signal tensor~~ from a noisy and incomplete data tensor based on CP low rank tensor method.*

Description

Estimate a signal tensor from a noisy and incomplete data tensor using CP low rank tensor method.

Usage

```
fit_continuous(data,r)
```

Arguments

data	A given <mark>data tensor (possibly noisy and incomplete).</mark>
r	~~A~~ rank of the signal tensor.

Value

object

The returned ~~value~~ is a list <mark>with</mark> components.

est   An estimated signal tensor based on CP low rank tensor method.

U   A list of factor matrices.

lambda A vector of tensor singular values.

Examples

```
library(rTensor)
indices = c(2,3,4)
noise = rand_tensor(indices)@data
Theta = array(runif(prod(indices),min=-3,max = 3),indices)

# The signal plus noise model
Y = Theta + noise

# Estimate Theta from CP low rank tensor method
hatTheta = fit_continuous(Y,3)
print(hatTheta$est)
```

	Signal tensor estimation
<mark>SignT</mark>	*~~Estimation of a signal tensor~~ from a noisy and incomplete data tensor based on nonparametric tensor method via sign series.*

Description

Estimate a signal tensor from a noisy and incomplete data tensor using nonparametric tensor method via sign series.

Usage

```
SignT(Y,truer,H,Lmin,Lmax,option = 1)
```

Arguments

Y	<mark>A given data tensor (possibly noisy and incomplete).</mark>
truer	~~A~~ sign rank of the signal tensor.
H	~~A~~ resolution parameter.
Lmin	~~A~~ minimum value of the signal tensor (or a minimum value of the tensor Y).
Lmax	~~A m~~aximum value of the signal tensor (or a maximum value of the tensor Y).
option	A large margin loss to be used. Use logistic loss if option = 1, hinge loss if option = 2.

Value

The returned ~~value~~ object is a list with components.

fitted   A series of optimizers that minimize the weighted classification loss at ~~a given level~~ each pi.

est   An estimated signal tensor based on nonparametric tensor method via sign series.

References

Lee, C., & Wang, M. (2021). Beyond the Signs: Nonparametric Tensor Completion via Sign Series. *arXiv preprint arXiv:2102.00384.*

Examples

```
library(rTensor)
indices = c(2,3,4)
noise = rand_tensor(indices)@data
Theta = array(runif(prod(indices),min=-3,max = 3),indices)

# The signal plus noise model
Y = Theta + noise

# Estimate Theta from nonparametic completion method via sign series
hatTheta = SignT(Y,truer = 3,H = 5,Lmin = -3,Lmax = 3, option =1)
print(hatTheta$est)
```

Index