Package 'PSGD'

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Type Package

Title Projected Subset Gradient Descent

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Description Functions to generate ensembles of generalized linear models using a greedy projected subset gradient descent algorithm. The sparsity and diversity tuning parameters are selected by cross-validation.

License GPL (>= 2)

Biarch true

LinkingTo Rcpp, RcppArmadillo

RoxygenNote 7.3.2

Imports Rcpp (>= 1.0.7)

Suggests testthat, mvnfast, vctrs

NeedsCompilation yes

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Repository CRAN

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Contents

coef.cv.PSGD *Coefficients for cv.PSGD Object*

Description

coef.cv.PSGD returns the coefficients for a cv.PSGD object.

Usage

```
## S3 method for class 'cv.PSGD'
coef(object, group_index = NULL, ...)
```

Arguments

object	An object of class cv.PSGD
group_index	Groups included in the ensemble. Default setting includes all the groups.
...	Additional arguments for compatibility.

Value

The coefficients for the cv.PSGD object.

Author(s)

Anthony-Alexander Christidis, <anthony.christidis@stat.ubc.ca>

See Also

cv.PSGD

Examples

```
# Required Libraries
library(mvnfast)

# Setting the parameters
p <- 100
n <- 40
n.test <- 1000
sparsity <- 0.2
rho <- 0.5
SNR <- 3

# Generating the coefficient
p.active <- floor(p*sparsity)
a <- 4*log(n)/sqrt(n)
neg.prob <- 0.2
nonzero.betas <- (-1)^(rbinom(p.active, 1, neg.prob))*(a + abs(rnorm(p.active)))
```

```
# Correlation structure
Sigma <- matrix(0, p, p)
Sigma[1:p.active, 1:p.active] <- rho
diag(Sigma) <- 1
true.beta <- c(nonzero.betas, rep(0 , p - p.active))

# Computing the noise parameter for target SNR
sigma.epsilon <- as.numeric(sqrt((t(true.beta) %*% Sigma %*% true.beta)/SNR))

# Simulate some data
set.seed(1)
x.train <- mvnfast::rmvn(n, mu=rep(0,p), sigma=Sigma)
y.train <- 1 + x.train %*% true.beta + rnorm(n=n, mean=0, sd=sigma.epsilon)
x.test <- mvnfast::rmvn(n.test, mu=rep(0,p), sigma=Sigma)
y.test <- 1 + x.test %*% true.beta + rnorm(n.test, sd=sigma.epsilon)

# CV PSGD Ensemble
output <- cv.PSGD(x = x.train, y = y.train, n_models = 5,
                  model_type = c("Linear", "Logistic")[1], include_intercept = TRUE,
                  split_grid = c(2, 3), size_grid = c(10, 15),
                  max_iter = 20,
                  cycling_iter = 0,
                  n_folds = 5,
                  n_threads = 1)
psgd.coef <- coef(output, group_index = 1:output$n_models)
psgd.predictions <- predict(output, newx = x.test, group_index = 1:output$n_models)
mean((y.test - psgd.predictions)^2)/sigma.epsilon^2
```

`coef.PSGD` *Coefficients for PSGD Object*

Description

`coef.PSGD` returns the coefficients for a PSGD object.

Usage

```
## S3 method for class 'PSGD'
coef(object, group_index = NULL, ...)
```

Arguments

`object`	An object of class PSGD.
`group_index`	Groups included in the ensemble. Default setting includes all the groups.
`...`	Additional arguments for compatibility.

Value

The coefficients for the PSGD object.

Author(s)

Anthony-Alexander Christidis, <anthony.christidis@stat.ubc.ca>

See Also

PSGD

Examples

```
# Required Libraries
library(mvnfast)

# Setting the parameters
p <- 100
n <- 40
n.test <- 1000
sparsity <- 0.2
rho <- 0.5
SNR <- 3

# Generating the coefficient
p.active <- floor(p*sparsity)
a <- 4*log(n)/sqrt(n)
neg.prob <- 0.2
nonzero.betas <- (-1)^(rbinom(p.active, 1, neg.prob))*(a + abs(rnorm(p.active)))

# Correlation structure
Sigma <- matrix(0, p, p)
Sigma[1:p.active, 1:p.active] <- rho
diag(Sigma) <- 1
true.beta <- c(nonzero.betas, rep(0 , p - p.active))

# Computing the noise parameter for target SNR
sigma.epsilon <- as.numeric(sqrt((t(true.beta) %*% Sigma %*% true.beta)/SNR))

# Simulate some data
set.seed(1)
x.train <- mvnfast::rmvn(n, mu=rep(0,p), sigma=Sigma)
y.train <- 1 + x.train %*% true.beta + rnorm(n=n, mean=0, sd=sigma.epsilon)
x.test <- mvnfast::rmvn(n.test, mu=rep(0,p), sigma=Sigma)
y.test <- 1 + x.test %*% true.beta + rnorm(n.test, sd=sigma.epsilon)

# PSGD Ensemble
output <- PSGD(x = x.train, y = y.train, n_models = 5,
               model_type = c("Linear", "Logistic")[1], include_intercept = TRUE,
               split = 3, size = 10,
               max_iter = 20,
               cycling_iter = 0)
psgd.coef <- coef(output, group_index = 1:output$n_models)
psgd.predictions <- predict(output, newx = x.test, group_index = 1:output$n_models)
mean((y.test - psgd.predictions)^2)/sigma.epsilon^2
```

cv.PSGD *Cross-Validation - Projected Subset Gradient Descent*

Description

cv.PSGD performs the CV procedure for a projected subset gradient descent algorithm.

Usage

```
cv.PSGD(
  x,
  y,
  n_models,
  model_type = c("Linear", "Logistic")[1],
  include_intercept = TRUE,
  split_grid,
  size_grid,
  max_iter = 100,
  cycling_iter = 5,
  n_folds = 5,
  n_threads = 1
)
```

Arguments

x	Design matrix.
y	Response vector.
n_models	Number of models into which the variables are split.
model_type	Model type. Must be one of "Linear or Logistic". Default is "Linear".
include_intercept	TRUE or FALSE parameter for the inclusion of an intercept term. Default is TRUE.
split_grid	Grid for number of models that may share a variable.
size_grid	Grid for number of variables that a model may have.
max_iter	Maximum number of iterations in PSGD algorithm.
cycling_iter	Number of random cycling permutations.
n_folds	Number of cross-validation folds. Default is 5
n_threads	Number of threads. Default is 1.

Value

An object of class cv.PSGD

Author(s)

Anthony-Alexander Christidis, <anthony.christidis@stat.ubc.ca>

See Also

coef.cv.PSGD, predict.cv.PSGD

Examples

```
# Required Libraries
library(mvnfast)

# Setting the parameters
p <- 100
n <- 40
n.test <- 1000
sparsity <- 0.2
rho <- 0.5
SNR <- 3

# Generating the coefficient
p.active <- floor(p*sparsity)
a <- 4*log(n)/sqrt(n)
neg.prob <- 0.2
nonzero.betas <- (-1)^(rbinom(p.active, 1, neg.prob))*(a + abs(rnorm(p.active)))

# Correlation structure
Sigma <- matrix(0, p, p)
Sigma[1:p.active, 1:p.active] <- rho
diag(Sigma) <- 1
true.beta <- c(nonzero.betas, rep(0 , p - p.active))

# Computing the noise parameter for target SNR
sigma.epsilon <- as.numeric(sqrt((t(true.beta) %*% Sigma %*% true.beta)/SNR))

# Simulate some data
set.seed(1)
x.train <- mvnfast::rmvn(n, mu=rep(0,p), sigma=Sigma)
y.train <- 1 + x.train %*% true.beta + rnorm(n=n, mean=0, sd=sigma.epsilon)
x.test <- mvnfast::rmvn(n.test, mu=rep(0,p), sigma=Sigma)
y.test <- 1 + x.test %*% true.beta + rnorm(n.test, sd=sigma.epsilon)

# CV PSGD Ensemble
output <- cv.PSGD(x = x.train, y = y.train, n_models = 5,
                  model_type = c("Linear", "Logistic")[1], include_intercept = TRUE,
                  split_grid = c(2, 3), size_grid = c(10, 15),
                  max_iter = 20,
                  cycling_iter = 0,
                  n_folds = 5,
                  n_threads = 1)
psgd.coef <- coef(output, group_index = 1:output$n_models)
psgd.predictions <- predict(output, newx = x.test, group_index = 1:output$n_models)
```

```
mean((y.test - psgd.predictions)^2)/sigma.epsilon^2
```

---

predict.cv.PSGD *Predictions for cv.PSGD Object*

Description

predict.cv.PSGD returns the predictions for a cv.PSGD object.

Usage

```
## S3 method for class 'cv.PSGD'
predict(object, newx, group_index = group_index, ...)
```

Arguments

object	An object of class cv.PSGD
newx	New data for predictions.
group_index	Groups included in the ensemble. Default setting includes all the groups.
...	Additional arguments for compatibility.

Value

The predictions for the cv.PSGD object.

Author(s)

Anthony-Alexander Christidis, <anthony.christidis@stat.ubc.ca>

See Also

cv.PSGD

Examples

```
# Required Libraries
library(mvnfast)

# Setting the parameters
p <- 100
n <- 40
n.test <- 1000
sparsity <- 0.2
rho <- 0.5
SNR <- 3

# Generating the coefficient
```

```
p.active <- floor(p*sparsity)
a <- 4*log(n)/sqrt(n)
neg.prob <- 0.2
nonzero.betas <- (-1)^(rbinom(p.active, 1, neg.prob))*(a + abs(rnorm(p.active)))

# Correlation structure
Sigma <- matrix(0, p, p)
Sigma[1:p.active, 1:p.active] <- rho
diag(Sigma) <- 1
true.beta <- c(nonzero.betas, rep(0 , p - p.active))

# Computing the noise parameter for target SNR
sigma.epsilon <- as.numeric(sqrt((t(true.beta) %*% Sigma %*% true.beta)/SNR))

# Simulate some data
set.seed(1)
x.train <- mvnfast::rmvn(n, mu=rep(0,p), sigma=Sigma)
y.train <- 1 + x.train %*% true.beta + rnorm(n=n, mean=0, sd=sigma.epsilon)
x.test <- mvnfast::rmvn(n.test, mu=rep(0,p), sigma=Sigma)
y.test <- 1 + x.test %*% true.beta + rnorm(n.test, sd=sigma.epsilon)

# CV PSGD Ensemble
output <- cv.PSGD(x = x.train, y = y.train, n_models = 5,
                  model_type = c("Linear", "Logistic")[1], include_intercept = TRUE,
                  split_grid = c(2, 3), size_grid = c(10, 15),
                  max_iter = 20,
                  cycling_iter = 0,
                  n_folds = 5,
                  n_threads = 1)
psgd.coef <- coef(output, group_index = 1:output$n_models)
psgd.predictions <- predict(output, newx = x.test, group_index = 1:output$n_models)
mean((y.test - psgd.predictions)^2)/sigma.epsilon^2
```

`predict.PSGD` *Predictions for PSGD Object*

Description

`predict.PSGD` returns the predictions for a PSGD object.

Usage

```
## S3 method for class 'PSGD'
predict(object, newx, group_index = NULL, ...)
```

Arguments

`object`	An object of class PSGD
`newx`	New data for predictions.

group_index	Groups included in the ensemble. Default setting includes all the groups.
...	Additional arguments for compatibility.

Value

The predictions for the PSGD object.

Author(s)

Anthony-Alexander Christidis, <anthony.christidis@stat.ubc.ca>

See Also

PSGD

Examples

```
# Required Libraries
library(mvnfast)

# Setting the parameters
p <- 100
n <- 40
n.test <- 1000
sparsity <- 0.2
rho <- 0.5
SNR <- 3

# Generating the coefficient
p.active <- floor(p*sparsity)
a <- 4*log(n)/sqrt(n)
neg.prob <- 0.2
nonzero.betas <- (-1)^(rbinom(p.active, 1, neg.prob))*(a + abs(rnorm(p.active)))

# Correlation structure
Sigma <- matrix(0, p, p)
Sigma[1:p.active, 1:p.active] <- rho
diag(Sigma) <- 1
true.beta <- c(nonzero.betas, rep(0 , p - p.active))

# Computing the noise parameter for target SNR
sigma.epsilon <- as.numeric(sqrt((t(true.beta) %*% Sigma %*% true.beta)/SNR))

# Simulate some data
set.seed(1)
x.train <- mvnfast::rmvn(n, mu=rep(0,p), sigma=Sigma)
y.train <- 1 + x.train %*% true.beta + rnorm(n=n, mean=0, sd=sigma.epsilon)
x.test <- mvnfast::rmvn(n.test, mu=rep(0,p), sigma=Sigma)
y.test <- 1 + x.test %*% true.beta + rnorm(n.test, sd=sigma.epsilon)

# PSGD Ensemble
output <- PSGD(x = x.train, y = y.train, n_models = 5,
```

```
                model_type = c("Linear", "Logistic")[1], include_intercept = TRUE,
                split = 3, size = 10,
                max_iter = 20,
                cycling_iter = 0)
psgd.coef <- coef(output, group_index = 1:output$n_models)
psgd.predictions <- predict(output, newx = x.test, group_index = 1:output$n_models)
mean((y.test - psgd.predictions)^2)/sigma.epsilon^2
```

PSGD *Projected Subset Gradient Descent*

Description

PSGD performs a projected subset gradient descent algorithm.

Usage

```
PSGD(
  x,
  y,
  n_models,
  model_type = c("Linear", "Logistic")[1],
  include_intercept = TRUE,
  split,
  size,
  max_iter = 100,
  cycling_iter = 5
)
```

Arguments

x	Design matrix.
y	Response vector.
n_models	Number of models into which the variables are split.
model_type	Model type. Must be one of "Linear or Logistic". Default is "Linear".
include_intercept	TRUE or FALSE parameter for the inclusion of an intercept term. Default is TRUE.
split	Number of models that may share a variable.
size	Number of variables that a model may have.
max_iter	Maximum number of iterations in PSGD algorithm.
cycling_iter	Number of random cycling permutations.

Value

An object of class PSGD

Author(s)

Anthony-Alexander Christidis, <anthony.christidis@stat.ubc.ca>

See Also

coef.PSGD, predict.PSGD

Examples

```
# Required Libraries
library(mvnfast)

# Setting the parameters
p <- 100
n <- 40
n.test <- 1000
sparsity <- 0.2
rho <- 0.5
SNR <- 3

# Generating the coefficient
p.active <- floor(p*sparsity)
a <- 4*log(n)/sqrt(n)
neg.prob <- 0.2
nonzero.betas <- (-1)^(rbinom(p.active, 1, neg.prob))*(a + abs(rnorm(p.active)))

# Correlation structure
Sigma <- matrix(0, p, p)
Sigma[1:p.active, 1:p.active] <- rho
diag(Sigma) <- 1
true.beta <- c(nonzero.betas, rep(0 , p - p.active))

# Computing the noise parameter for target SNR
sigma.epsilon <- as.numeric(sqrt((t(true.beta) %*% Sigma %*% true.beta)/SNR))

# Simulate some data
set.seed(1)
x.train <- mvnfast::rmvn(n, mu=rep(0,p), sigma=Sigma)
y.train <- 1 + x.train %*% true.beta + rnorm(n=n, mean=0, sd=sigma.epsilon)
x.test <- mvnfast::rmvn(n.test, mu=rep(0,p), sigma=Sigma)
y.test <- 1 + x.test %*% true.beta + rnorm(n.test, sd=sigma.epsilon)

# PSGD Ensemble
output <- PSGD(x = x.train, y = y.train, n_models = 5,
               model_type = c("Linear", "Logistic")[1], include_intercept = TRUE,
               split = 3, size = 10,
               max_iter = 20,
               cycling_iter = 0)
psgd.coef <- coef(output, group_index = 1:output$n_models)
psgd.predictions <- predict(output, newx = x.test, group_index = 1:output$n_models)
mean((y.test - psgd.predictions)^2)/sigma.epsilon^2
```

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