Package 'pda'

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Type Package

Title Privacy-Preserving Distributed Algorithms

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Description A collection of privacy-preserving distributed algorithms for conducting multi-site data analyses. The regression analyses can be linear regression for continuous outcome, logistic regression for binary outcome, Cox proportional hazard regression for time-to event outcome, or Poisson regression for count outcome. The PDA algorithm runs on a lead site and only requires summary statistics from collaborating sites, with one or few iterations. For more information, please visit our software websites: <https://github.com/Penncil/pda>, and <https://pdamethods.org/>.

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Suggests imager

Imports Rcpp (>= 0.12.19), stats, httr, rvest, jsonlite, data.table, survival

LinkingTo Rcpp, RcppArmadillo

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R topics documented:

`getCloudConfig` *gather cloud settings into a list*

Description

gather cloud settings into a list

Usage

```
getCloudConfig(site_id,dir,uri,secret)
```

Arguments

`site_id`	site identifier
`dir`	shared directory path if flat files
`uri`	web uri if web service
`secret`	web token if web service

Value

A list of cloud parameters: site_id, secret and uri

See Also

`pda`

pda *PDA: Privacy-preserving Distributed Algorithm*

Description

Fit Privacy-preserving Distributed Algorithms for linear, logistic, Poisson and Cox PH regression with possible heterogeneous data across sites.

Usage

```
pda(ipdata,site_id,control,dir,uri,secret)
```

Arguments

`ipdata`	Local IPD data in data frame, should include at least one column for the outcome and one column for the covariates
`site_id`	Character site name
`control`	pda control data
`dir`	directory for shared flat file cloud
`uri`	Universal Resource Identifier for this run
`secret`	password to authenticate as site_id on uri

Value

control

control

References

Michael I. Jordan, Jason D. Lee & Yun Yang (2019) Communication-Efficient Distributed Statistical Inference,
Journal of the American Statistical Association, 114:526, 668-681
https://doi.org/10.1080/01621459.2018.1429274.
(ODAL) Rui Duan, et al. (2020) Learning from electronic health records across multiple sites: A communication-efficient and privacy-preserving distributed algorithm.
Journal of the American Medical Informatics Association, 27.3:376–385,
https://doi.org/10.1093/jamia/ocz199.
(ODAC) Rui Duan, et al. (2020) Learning from local to global: An efficient distributed algorithm for modeling time-to-event data.
Journal of the American Medical Informatics Association, 27.7:1028–1036,
https://doi.org/10.1093/jamia/ocaa044.

See Also

`pdaPut`, `pdaList`, `pdaGet`, `getCloudConfig` and `pdaSync`.

Examples

```
require(survival)
require(data.table)
require(pda)
data(lung)

## In the toy example below we aim to analyze the association of lung status with
## age and sex using logistic regression, data(lung) from 'survival', we randomly
## assign to 3 sites: 'site1', 'site2', 'site3'. we demonstrate using PDA ODAL can
## obtain a surrogate estimator that is close to the pooled estimate. We run the
## example in local directory. In actual collaboration, account/password for pda server
## will be assigned to the sites at the server https://pda.one.
## Each site can access via web browser to check the communication of the summary stats.

## for more examples, see demo(ODAC) and demo(ODAP)

# Create 3 sites, split the lung data amongst them
sites = c('site1', 'site2', 'site3')
set.seed(42)
lung2 <- lung[,c('status', 'age', 'sex')]
lung2$sex <- lung2$sex - 1
lung2$status <- ifelse(lung2$status == 2, 1, 0)
lung_split <- split(lung2, sample(1:length(sites), nrow(lung), replace=TRUE))
## fit logistic reg using pooled data
fit.pool <- glm(status ~ age + sex, family = 'binomial', data = lung2)


# ############################  STEP 1: initialize  ################################
control <- list(project_name = 'Lung cancer study',
                step = 'initialize',
                sites = sites,
                heterogeneity = FALSE,
                model = 'ODAL',
                family = 'binomial',
                outcome = "status",
                variables = c('age', 'sex'),
                optim_maxit = 100,
                lead_site = 'site1',
                upload_date = as.character(Sys.time()) )


## run the example in local directory:
## specify your working directory, default is the tempdir
mydir <- tempdir()
## assume lead site1: enter "1" to allow transferring the control file
pda(site_id = 'site1', control = control, dir = mydir)
## in actual collaboration, account/password for pda server will be assigned, thus:
## Not run: pda(site_id = 'site1', control = control, uri = 'https://pda.one', secret='abc123')
## you can also set your environment variables, and no need to specify them in pda:
## Not run: Sys.setenv(PDA_USER = 'site1', PDA_SECRET = 'abc123', PDA_URI = 'https://pda.one')
## Not run: pda(site_id = 'site1', control = control)
```

```
##' assume remote site3: enter "1" to allow tranferring your local estimate
pda(site_id = 'site3', ipdata = lung_split[[3]], dir=mydir)

##' assume remote site2: enter "1" to allow tranferring your local estimate
pda(site_id = 'site2', ipdata = lung_split[[2]], dir=mydir)

##' assume lead site1: enter "1" to allow tranferring your local estimate
##' control.json is also automatically updated
pda(site_id = 'site1', ipdata = lung_split[[1]], dir=mydir)

##' if lead site1 initialized before other sites,
##' lead site1: uncomment to sync the control before STEP 2
## Not run: pda(site_id = 'site1', control = control)
## Not run: config <- getCloudConfig(site_id = 'site1')
## Not run: pdaSync(config)

#' ############################'  STEP 2: derivative  ############################
##' assume remote site3: enter "1" to allow tranferring your derivatives
pda(site_id = 'site3', ipdata = lung_split[[3]], dir=mydir)

##' assume remote site2: enter "1" to allow tranferring your derivatives
pda(site_id = 'site2', ipdata = lung_split[[2]], dir=mydir)

##' assume lead site1: enter "1" to allow tranferring your derivatives
pda(site_id = 'site1', ipdata = lung_split[[1]], dir=mydir)


#' ############################'  STEP 3: estimate  ############################
##' assume lead site1: enter "1" to allow tranferring the surrogate estimate
pda(site_id = 'site1', ipdata = lung_split[[1]], dir=mydir)

##' the PDA ODAL is now completed!
##' All the sites can still run their own surrogate estimates and broadcast them.

##' compare the surrogate estimate with the pooled estimate
config <- getCloudConfig(site_id = 'site1', dir=mydir)
fit.odal <- pdaGet(name = 'site1_estimate', config = config)
cbind(b.pool=fit.pool$coef,
      b.odal=fit.odal$btilde,
      sd.pool=summary(fit.pool)$coef[,2],
      sd.odal=sqrt(diag(solve(fit.odal$Htilde)/nrow(lung2))))

## see demo(ODAL) for more optional steps
```

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pdaGet *Function to download json and return as object*

Description

Function to download json and return as object

Usage

```
pdaGet(name,config)
```

Arguments

name	of file
config	cloud configuration

Value

A list of data objects from the json file on the cloud

See Also

pda

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pdaList *Function to list available objects*

Description

Function to list available objects

Usage

```
pdaList(config)
```

Arguments

config	a list of variables for cloud configuration

Value

A list of (json) files on the cloud

See Also

pda

pdaPut *Function to upload object to cloud as json*

Description

Function to upload object to cloud as json

Usage

```
pdaPut(obj,name,config)
```

Arguments

obj	R object to encode as json and uploaded to cloud
name	of file
config	a list of variables for cloud configuration

Value

NONE

See Also

pda

pdaSync *pda control synchronize*

Description

update pda control if ready (run by lead)

Usage

```
pdaSync(config)
```

Arguments

config	cloud configuration

Value

control

See Also

pda

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