

Package ‘GGBase’

October 12, 2016

Title GGBase infrastructure for genetics of gene expression package
GGtools

Version 3.34.0

Author VJ Carey <stvjc@channing.harvard.edu>

Description infrastructure

Suggests GGtools, illuminaHumanv1.db

Depends R (>= 2.14), methods, snpStats

Imports limma, genefilter, Biobase, BiocGenerics, S4Vectors, IRanges,
Matrix, AnnotationDbi, digest, GenomicRanges,
SummarizedExperiment

Maintainer VJ Carey <stvjc@channing.harvard.edu>

License Artistic-2.0

LazyLoad yes

biocViews Genetics, Infrastructure

Collate casting.R smlSet.R filters.R plot_EvG.R externalize.R getSS.R
make_smlSet.R permEx.R

NeedsCompilation no

R topics documented:

| | |
|------------------------|---|
| clipPCs | 2 |
| externalize | 3 |
| MAFilter | 4 |
| make_smlSet | 5 |
| plot_EvG | 7 |
| rsid-class | 8 |
| smlSet-class | 9 |

| | |
|--------------|-----------|
| Index | 11 |
|--------------|-----------|

clipPCs

transformations of expression data in smlSet instances

Description

transformations of expression data in `smlSet` instances or assay data in `SummarizedExperiment`

Usage

```
clipPCs(x, inds2drop, center = TRUE)
```

```
regressOut(sms, rhs, ...)
```

Arguments

| | |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>x</code> | instance of <code>smlSet</code> or <code>RangedSummarizedExperiment</code> |
| <code>sms</code> | instance of <code>smlSet</code> or <code>RangedSummarizedExperiment</code> |
| <code>inds2drop</code> | Vector of PCs to be eliminated by setting the associated diagonal elements in the SVD to zero before recomposing the matrix of expression values. If the value 0 is present in <code>inds2drop</code> , the <code>smlSet</code> is returned unchanged, with a message. |
| <code>center</code> | logical, passed to <code>prcomp</code> |
| <code>rhs</code> | formula fragment (no dependent variable) used to form residuals in a reexpression of the expression matrix; variable bindings found in <code>pData</code> of an <code>ExpressionSet</code> or <code>colData</code> of a <code>SummarizedExperiment</code> |
| <code>...</code> | arguments passed to <code>lmFit</code> |

Details

`clipPCs` is an operation on the $n \times p$ transposed matrix X of expression data. The singular value decomposition $X = UDV^t$ is formed, the diagonal elements of D corresponding to `inds2drop` are set to zero yielding the diagonal matrix E , and then $Y = UEV^t$ is computed and transposed to replace the expression data.

`regressOut` obtains residuals after genewise regression of expression on the design matrix specified by the `rhs`; `lmFit` is used to compute coefficients, linear predictions and residuals.

Value

an instance of `smlSet`

Author(s)

VJ Carey <stvjc@channing.harvard.edu>

References

The use of PCA-based adjustments to remove mass extraneous effects from expression matrices has been criticized in work of Oliver Stegle and Jeffrey Leek, who offer Bayesian PEER and SVA respectively as alternative solutions. The PCA-based method seems to have reasonable effectiveness in examples worked with GGdata.

Examples

```
## Not run: # this would induce cyclic dependency, but should
# run manually
if ("GGtools" %in% installed.packages()[,1]) {
  require("GGtools")
  c20 = getSS("GGtools", "20")
  t1 = gwSnpTests(genesym("CPNE1")~male, c20, chrnum("20"))
  topSnps(t1)
  c20c = clipPCs(c20, 1:10)
  t2 = gwSnpTests(genesym("CPNE1")~male, c20c, chrnum("20"))
  topSnps(t2)
}

## End(Not run)
```

| | |
|-------------|-----------------------------------------------------------------------------------------------------------------------|
| externalize | <i>create a package with a decomposed smlSet instance from a unified smlSet instance, to reduce memory footprints</i> |
|-------------|-----------------------------------------------------------------------------------------------------------------------|

Description

create a package with a decomposed smlSet instance from a unified smlSet instance, to reduce memory footprints

Usage

```
externalize(smlSet, packname,
  author = "Replace Me <auth@a.b.com>",
  maintainer = "Replace Me <repl@a.b.com>")
```

```
allsnps(packname)
```

Arguments

| | |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| smlSet | an smlSet instance to be regarded as a source or template for a package that can be used with greater efficiency of access to genotype contents |
| packname | name of the package to be generated |
| author | string to be used in DESCRIPTION file of generated package |
| maintainer | string to be used in DESCRIPTION file of generated package |

Details

The genotype content of the input `smlSet` is separated into separate RDA files in the `inst/parts` folder of the package to be generated. The `ExpressionSet` element of the input `smlSet` is stored as object `ex` in file `eset.rda` in the `data` folder of the package to be generated.

Value

creates folder structure and metadata for an installable R package

Note

`allsnps()` gives the list of vectors of `snpnames` in use in the package

Author(s)

VJ Carey <stvjc@channing.harvard.edu>

Examples

```
## Not run:
setwd(tempdir())
sms = getSS("GGtools", c("20", "21"))
externalize(sms, "demopack")
dir()
dir("demopack")

## End(Not run)
```

MAFilter

Filter genotype contents of an smlSet according to certain SNP allele frequency features.

Description

Filter genotype contents of an `smlSet` according to certain SNP allele frequency features.

Usage

```
MAFilter(x, lower = 0, upper = 1)
```

```
GTFilter(x, lower = 0)
```

```
dropMonomorphies(sms)
```

Arguments

| | |
|-------|------------------------------------------------------------------|
| x | smlSet-class instance |
| sms | smlSet-class instance |
| lower | lower bound on MAF or GTF to allow retention of associated locus |
| upper | upper bound on MAF or GTF to allow retention of associated locus |

Details

uses [col.summary](#) to compute MAF or GTF. `dropMonomorphies` also uses `col.summary`.

Value

[smlSet-class](#) instance

Author(s)

VJ Carey <stvjc@channing.harvard.edu>

Examples

```
if (file.exists(system.file("parts/20.rda", package="GGtools"))) {  
  c20 = getSS("GGtools", "20")  
  c20  
  c20f = MAFFilter(c20, lower=.05)  
  c20f  
}
```

make_smlSet

construct an smlSet instance from existing resources

Description

construct an `smlSet` instance from existing resources, either using `ExpressionSet` and `SnpMatrix` instances, or a suitably structured package

Usage

```
make_smlSet(es, sml, organism = "Homo sapiens", harmonizeSamples = FALSE)
```

```
getSS(packname, chrs, renameChrs, probesToKeep=NULL, exFilter=function(x)x,  
      wrapperEndo=NULL, checkValid=TRUE)
```

Arguments

| | |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| es | instance of ExpressionSet-class |
| sml | named list of SnpMatrix-class instances |
| organism | conventional token for species |
| harmonizeSamples | logical indicating whether steps should be taken to be sure that the components represent identical sets of samples. can be time consuming so defaults to FALSE, in which case the user must be sure that the genotype and expression components are compatible in terms of sample content |
| packname | string naming the installed package from which expression and genotype data will be acquired |
| chrs | character vector naming the prefixes of genotype files to be used in the resulting smlSet instance; see notes below |
| renameChrs | character vector of same length as chrs specifying one-to-one renaming operation for genotype components in smlSet |
| probesToKeep | character vector identifying probes to be retained in the constructed smlSet – to be deprecated in favor of exFilter |
| exFilter | function that should accept and return ExpressionSet, will be executed just after probesToKeep filter if present |
| wrapperEndo | function that accepts and returns an smlSet instance, allowing any sort of transformation of contents acquired with getSS, executed after all assembly and filtering completed. |
| checkValid | logical, if TRUE, function will fail if created smlSet instance does not pass validObject() |

Details

Packages that work with getSS can be created out of existing smlSet instances using [externalize](#).

Value

Instance of [smlSet-class](#).

Author(s)

VJ Carey <stvjc@channing.harvard.edu>

Examples

```
if ("GGtools" %in% installed.packages()[,1]) {
  s20 = getSS("GGtools", "20", renameChrs="chr20")
  s20
  make_smlSet( as(s20, "ExpressionSet"), smList(s20) )
}
```

| | |
|----------|----------------------------------------------------------------------------------------------|
| plot_EvG | <i>display the association between expression values and genotypes in an smlSet instance</i> |
|----------|----------------------------------------------------------------------------------------------|

Description

display the association between expression values and genotypes in an smlSet instance

Usage

```
plot_EvG(gsym, rsid, sms, ...)
```

Arguments

| | |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| gsym | instance of class genesym or probeId , casting a string that names a gene (which will be looked up using the annotation slot of sms) or a probe which must be resident on the array underlying the expression content of sms |
| rsid | instance of class rsid naming a SNP with genotype values given among the columns of the smList components of sms |
| sms | an instance of smlSet |
| ... | additional parameter to plot |

Details

When the genotype is categorical, will use boxplots; when genotype has been imputed and includes expected allele counts, will use a scatterplot.

Value

a plot is rendered on the current display

Author(s)

VJ Carey <stvjc@channing.harvard.edu>

Examples

```
if ("GGtools" %in% installed.packages()[,1]) {  
  s20 = getSS("GGtools", "20")  
  plot_EvG(genesym("CPNE1"), rsid("rs6060535"), s20)  
}
```

| | |
|------------|--------------|
| rsid-class | Class "rsid" |
|------------|--------------|

Description

rsid(), probeId(), and genesym() are basic casting methods that assign a type to a token.

Objects from the Class

Objects can be created by calls of the form `new("rsid", ...)`.

Slots

`.Data`: Object of class "character" that holds the content to which a type is associated by the method.

Extends

Class "character", from data part. Class "vector", by class "character", distance 2. Class "data.frameRowLabels", by class "character", distance 2. Class "SuperClassMethod", by class "character", distance 2. Class "characterORconnection", by class "character", distance 2. Class "characterORMIAME", by class "character", distance 2. Class "atomicVector", by class "character", distance 2. Class "index", by class "character", distance 2.

Methods

No methods defined with class "probeId" or "genesym" in the signature. However [with a `smlSet-class` argument will dispatch differently if instances of these classes are supplied. Various GGtools reporting functions will use "rsid" for dispatch.

Author(s)

VJ Carey <stvjc@channing.harvard.edu>

Examples

```
showClass("rsid")
```

| | |
|--------------|----------------|
| smlSet-class | Class "smlSet" |
|--------------|----------------|

Description

Integrative container for expression plus genotype data. Genotypes are stored in an efficient format defined in the `snpStats` package.

Objects from the Class

Objects can be created by calls of the form `new("smlSet", assayData, phenoData, featureData, experimentData, ...)`. The `make_smlSet` function can also be used to build `smlSet` instances.

Slots

smlEnv: Object of class "environment" that has a key `smlList` element, to which a list of [SnpMatrix-class](#) instances is bound.

annotation: Object of class "character", describes `featureNames` component in terms of the name of the annotation package that can be used to decode expression probe names.

organism: Object of class "character", a conventional string.

assayData: Object of class "AssayData", manages the expression data. See [AssayData-class](#).

phenoData: Object of class "AnnotatedDataFrame", manages sample level data. See [AnnotatedDataFrame-class](#).

featureData: Object of class "AnnotatedDataFrame", manages metadata on expression probes.

experimentData: Object of class "MIAXE", manages metadata on experiment as a whole. See [MIAXE-class](#).

protocolData: Object of class "AnnotatedDataFrame", additional storage for experimental protocol description. See [eSet-class](#).

.__classVersion__: Object of class "Versions"; internal management of class version.

Extends

Class "eSet", directly. Class "VersionedBiobase", by class "eSet", distance 2. Class "Versioned", by class "eSet", distance 3.

Methods

[`signature(x = "smlSet", i = "ANY", j = "ANY", drop = "ANY")`]: will restrict the content of the `smlSet` instance according to features of the arguments supplied. If `x` is numeric or a [probeId-class](#), the expression content will be restricted. If `y` is numeric or character, samples will be restricted accordingly.

combine `signature(x = "smlSet", y = "smlSet")`: This method attempts to amalgamate two `smlSet` instances in the appropriate way – assuming that samples are disjoint.

nsFilter `signature(eset = "smlSet")`: executes `genefilter`'s method (see [nsFilter, ExpressionSet-method](#)) on the expression content, and then propagates the additional genotype and sample level content unchanged.

smList signature(x = "smlSet"): retrieves the list of SnpMatrix instances defining the genotype content.

exprs signature(x = "smlSet"): retrieves the matrix of expression values

permEx signature(sms = "smlSet"): uses sample() to generate a permutation of sample indices so that expression data are permuted against genotype data, but original unpermuted sample identifiers are preserved; this is necessitated by the rematching behavior of [snp.rhs.tests](#).

Author(s)

VJ Carey <stvjc@channing.harvard.edu>

Examples

```
showClass("smlSet")
```

Index

- *Topic **classes**
 - rsid-class, 8
 - smlSet-class, 9
- *Topic **models**
 - clipPCs, 2
 - externalize, 3
 - MAFilter, 4
 - make_smlSet, 5
 - plot_EvG, 7
- [, smlSet, ANY, ANY, ANY-method (smlSet-class), 9

- allsnps (externalize), 3
- atomicVector, 8

- casting (rsid-class), 8
- character, 8
- characterORconnection, 8
- characterORMIAME, 8
- clipPCs, 2
- clipPCs, RangedSummarizedExperiment, numeric, logical-method (clipPCs), 2
- clipPCs, RangedSummarizedExperiment, numeric, missing-method (clipPCs), 2
- clipPCs, smlSet, numeric, logical-method (clipPCs), 2
- clipPCs, smlSet, numeric, missing-method (clipPCs), 2
- clipPCs, SummarizedExperiment, numeric, logical-method (clipPCs), 2
- clipPCs, SummarizedExperiment, numeric, missing-method (clipPCs), 2
- col.summary, 5
- combine, smlSet, smlSet-method (smlSet-class), 9

- data.frameRowLabels, 8
- dropMonomorphies (MAFilter), 4

- eSet, 9

- exprs, smlSet-method (smlSet-class), 9
- externalize, 3, 6

- genesym, 7
- genesym (rsid-class), 8
- genesym, character-method (rsid-class), 8
- genesym-class (rsid-class), 8
- getSS (make_smlSet), 5
- GTFFilter (MAFilter), 4

- index, 8

- lmFit, 2

- MAFilter, 4
- make_smlSet, 5

- nsFilter, smlSet-method (smlSet-class), 9

- permEx (smlSet-class), 9
- permEx, smlSet-method (smlSet-class), 9
- plot_EvG, 7
- plot_EvG, genesym, rsid, smlSet-method (plot_EvG), 7
- plot_EvG, probeId, rsid, smlSet-method (plot_EvG), 7
- prcomp, 2
- probeId, 7
- probeId (rsid-class), 8
- probeId, character-method (rsid-class), 8
- probeId-class (rsid-class), 8
- RangedSummarizedExperiment, 2
- regressOut (clipPCs), 2
- rsid, 7
- rsid (rsid-class), 8
- rsid, character-method (rsid-class), 8
- rsid, numeric-method (rsid-class), 8
- rsid-class, 8

- smlList (smlSet-class), 9

smList, smSet-method (smSet-class), 9
smSet, 2, 7
smSet-class, 9
snp.rhs.tests, 10
SuperClassMethod, 8

vector, 8
Versioned, 9
VersionedBiobase, 9