Package ‘traseR’

February 1, 2017

Type Package

Title GWAS trait-associated SNP enrichment analyses in genomic intervals

Version 1.5.0

Depends R (>= 3.2.0), GenomicRanges, IRanges, BSgenome.Hsapiens.UCSC.hg19

Suggests BiocStyle, RUnit, BiocGenerics

Date 2015-11-20

Author Li Chen, Zhaohui S. Qin

Maintainer li.chen@emory.edu

Description traseR performs GWAS trait-associated SNP enrichment analyses in genomic intervals using different hypothesis testing approaches, also provides various functionalities to explore and visualize the results.

License GPL

LazyLoad yes

biocViews Genetics, Sequencing, Coverage, Alignment, QualityControl, DataImport

NeedsCompilation no

R topics documented:

traseR-package .......................................................... 2
CEU ................................................................. 2
plots .............................................................. 3
print.traseR ........................................................ 4
queries .......................................................... 5
taSNP .......................................................... 6
taSNPLD ........................................................ 7
Tcell ........................................................... 7
traseR .......................................................... 8

Index 10
**traseR-package**  
*GWAS trait-associated SNP enrichment analyses in genomic intervals*

**Description**  
Perform GWAS trait-associated SNP enrichment analyses in genomic intervals. Explore and visualize the results.

**Details**

Package: traseR  
Type: Package  
Version: 1.0  
Date: 2015-11-18  
License: GPL

**Author(s)**  
Li Chen <li.chen@emory.edu>, Zhaohui S.Qin<zhaohui.qin@emory.edu>

---

**CEU**  
*Sampled SNPs from all SNPs of CEU population in 1000 genome project*

**Description**  
A GRang object CEU contains 5% of all SNPs from CEU by controlling genome-wide density is the same as all SNPs from CEU

**Usage**

data(CEU)

**Value**

The data frame CEU contains three columns,

<table>
<thead>
<tr>
<th>SNP_ID</th>
<th>SNP rs number</th>
</tr>
</thead>
<tbody>
<tr>
<td>seqnames</td>
<td>Chromosome number associated with rs number</td>
</tr>
<tr>
<td>ranges</td>
<td>Chromosomal position, in base pairs, associated with rs number</td>
</tr>
</tbody>
</table>

**Author(s)**  
Li Chen <li.chen@emory.edu>, Zhaohui S.Qin<zhaohui.qin@emory.edu>
Visualize of trait-associated SNPs

Description

These are a group of functions to generate plot to visualize the trait-associated SNPs.

Usage

plotContext(snpdb, region=NULL, keyword = NULL, pvalue = 1e-3)
plotPvalue(snpdb, region=NULL, keyword = NULL, plot.type = c("densityplot", "boxplot"), pvalue = 1e-3, xymax = 50)
plotSNP(snpdb, snpid, ext = 10000)
plotGene(snpdb, gene, ext = 10000)
plotInterval(snpdb, interval, ext = 10000)

Arguments

snpdb A GRange object or data frame, which is GWAS trait-associated SNPs downloaded from up-to-date dbGaP and NHGRI public database. It is maintained to be updated to the latest version. The data frame contains the following columns, Trait, SNP, p.value, Chr, Position, Context, GENE_NAME, GENE_START, GENE_END, GENE_STRAND. The data frame is in data subdirectory. Users are free to add more SNP records to the data frame for practical use.

region A data frame, which is genomic intervals with three columns, chromosome, genomic start position, genomic end position.

keyword The keyword is used when specific trait is of interest. If keyword is specified, only the SNPs associated to the trait are used for analyses. Otherwise, all traits will be analyzed.

snpid SNP rs number

gene Gene name

pvalue SNPs with p-value less than this threshold are used for analyses.

plot.type Either "densityplot" or "boxplot"

ext Bp extended upstream and downstream

xymax The maximum range on x-axis and y-axis

interval A data frame, genomic interval: chromosome, genomic start position, genomic end position

Value

plotContext A pie plot with the distribution of SNP function class

plotPvalue A density plot of -logPvalue of trait-associated SNPs

plotSNP A plot of trait-associated SNP on chromosome
print.traseR

plotGene  A plot with the gene and possible nearby trait-associated SNPs
plotInterval  A plot with chromosome interval with possible nearby genes and trait-associated SNPs

Author(s)

Li Chen <li.chen@emory.edu>, Zhaohui Qin <zhaohui.qin@emory.edu>

Examples

data(taSNP)
plotContext(snpdb= taSNP,keyword="Autoimmune")
plotGene(snpdb= taSNP,gene="ZFP92",ext=50000)
plotSNP(snpdb= taSNP,snpid="rs766420",ext=50000)
plotInterval(snpdb= taSNP,data.frame(chr="chrX",start=152633780,end=152737085))

print.traseR  Print the outcome of taSNP enrichment analyses

Description

Print the outcome of taSNP enrichment analyses. Print the overall taSNP enrichment, trait-specific taSNP enrichment, trait-class-specific taSNP enrichment.

Usage

## S3 method for class 'traseR'
print(x,isTopK1=FALSE,topK1=10,isTopK2=FALSE,topK2=10,trait.threshold=10,traitclass.threshold=10,...)

Arguments

x  Object returned from traseR
isTopK1  If isTopK1 is TRUE, topK1 traits are printed; otherwise, traits with p-value below Bonferroni correction threshold are printed. Default is FALSE.
topK1  Top K1 traits are printed. Default is 10.
isTopK2  If isTopK2 is TRUE, topK2 trait class are printed; otherwise, trait class with p-value below Bonferroni correction threshold are printed. Default is FALSE.
topK2  Top K2 trait class are printed. Default is 10.
trait.threshold  Traits above this threshold are reported. Default is 10.
traitclass.threshold  Trait class above this threshold are reported. Default is 10.
...  Other parameters to print

Value

Print a data frame of traits ranked by p-value
**Querys**

**Author(s)**

Li Chen <li.chen@emory.edu>, Zhaohui S. Qin <zhaohui.qin@emory.edu>

**Examples**

```r
data(taSNP)
data(Tcell)
x = traseR(snpdb = taSNP, region = Tcell)
print(x)
```

---

**Description**

These are a group of functions to retrieve the trait-associated SNPs based on input.

**Usage**

```r
queryKeyword(snpdb, region = NULL, keyword = NULL, returnby = c("SNP_ID", "trait"), pvalue = 1e-3)
queryGene(snpdb, genes = NULL)
querySNP(snpdb, snpid, region = NULL)
```

**Arguments**

- **snpdb**: A GRanges object or data frame, which is GWAS trait-associated SNPs downloaded from up-to-date dbGaP and NHGRI public database. It is maintained to be updated to the latest version. The data frame contains the following columns: Trait, SNP_ID, p.value, Chr, Position, Context, GENE_NAME, GENE_START, GENE_END, GENE_STRAND. The data frame is in data subdirectory. Users are free to add more SNP records to the data frame for practical use.
- **region**: A data frame, which is genomic intervals with three columns, chromosome, genomic start position, genomic end position.
- **keyword**: The keyword is used when specific trait is of interest. If keyword is specified, only the SNPs associated to the trait are used for analyses. Otherwise, all traits will be analyzed.
- **snpid**: SNP rs number.
- **genes**: Gene name.
- **pvalue**: SNPs with p-value less than this threshold are used for analyses.
- **returnby**: Either SNP or trait. If returnby is specified as ‘SNP_ID’, a data frame based on ’SNP_ID’ is returned. If returnby is specified as ‘trait’, a data frame based on ‘trait’ is returned.
Value

queryKeyword: Return a data frame of traits containing the keyword
queryGene: Return a data frame of traits associated with the gene
querySNP: Return a data frame of traits associated with the SNP

Author(s)

Li Chen <li.chen@emory.edu>, Zhaohui Qin<zhaohui.qin@emory.edu>

Examples

data(taSNP)
data(Tcell)
x=queryKeyword(snpdb=taSNP,region=Tcell,keyword="Autoimmune",returnby="SNP_ID")
x=queryGene(snpdb=taSNP,genes=c("AGRN","UBE2J2","SSU72"))
x=querySNP(snpdb=taSNP,snpid=c("rs3766178","rs880051"))

Description

A GRange object taSNP contains trait-associated SNPs from dbGaP and NHGRI downloaded from Association Results Browser.

Usage

data(taSNP)

Value

The data frame taSNP contains the following columns

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait</td>
<td>Trait</td>
</tr>
<tr>
<td>Trait Class</td>
<td>Trait class which is formed based on the phenotype tree. Close traits are grouped together to form one class</td>
</tr>
<tr>
<td>SNP_ID</td>
<td>SNP rs number</td>
</tr>
<tr>
<td>p.value</td>
<td>GWAS SNP p-value</td>
</tr>
<tr>
<td>seqnames</td>
<td>Chromosome</td>
</tr>
<tr>
<td>ranges</td>
<td>Chromosome position</td>
</tr>
<tr>
<td>Context</td>
<td>SNP functional class</td>
</tr>
<tr>
<td>GENE_NAME</td>
<td>Nearest gene name</td>
</tr>
<tr>
<td>GENE_START</td>
<td>Gene start genomic position</td>
</tr>
<tr>
<td>GENE_END</td>
<td>Gene end genomic position</td>
</tr>
<tr>
<td>GENE_STRAND</td>
<td>Gene strand</td>
</tr>
</tbody>
</table>

Author(s)

Li Chen <li.chen@emory.edu>, Zhaohui Qin<zhaohui.qin@emory.edu>
**taSNPLD**

linkage disequilibrium (>0.8) within 100kb SNPs of all trait-associated SNPs from dbGaP and NHGRI

**Description**

A GRRange object taSNPLD contains linkage disequilibrium (>0.8) SNPs of all trait-associated SNPs from dbGaP and NHGRI.

**Usage**

data(taSNPLD)

**Value**

The data frame taSNPLD contains four columns,

- **SNP_ID**: SNP rs number
- **seqnames**: Chromosome number associated with rs number
- **ranges**: Chromosomal position, in base pairs, associated with rs number
- **Trait**: Trait the SNP is associated with
- **Trait Class**: Trait class which is formed based on the phenotype tree. Close traits are grouped together to form one class

**Author(s)**

Li Chen <li.chen@emory.edu>, Zhaohui S. Qin <zhaohui.qin@emory.edu>

---

**Tcell**

Peak regions of H3K4me1 in Peripheral blood T cell

**Description**

A GRRange object Tcell contains three columns: chromosome, genomic start position and genomic end position.

**Usage**

data(Tcell)

**Value**

The data frame Tcell contains three columns,

- **seqnames**: Chromosome id
- **ranges**: Chromosome position

**Author(s)**

Li Chen <li.chen@emory.edu>, Zhaohui S. Qin <zhaohui.qin@emory.edu>
**traseR**  
*TRait-Associated SNP EnRichment analyses*

**Description**

Perform GWAS trait-associated SNP enrichment analyses in genomic intervals using different approaches.

**Usage**

```r
traseR(snpdb, region, snpdb.bg=NULL, keyword = NULL, rankby = c("pvalue", "odds.ratio"), test.method = c("binomial", "fisher", "chisq", "nonparametric"), alternative = c("greater", "less", "two.sided"), ntimes=100, nbatch=1, trait.threshold = 0, traitclass.threshold=0, pvalue = 1e-3)
```

**Arguments**

- `snpdb`: A GRRange object. It could be GWAS trait-associated SNPs downloaded from up-to-date dbGaP and NHGRI public database. It is maintained to be updated to the latest version. The data frame contains the following columns: `Source`, `Trait`, `SNP`, `p.value`, `Chr`, `Position`, `Context`, `GENE_NAME`, `GENE_START`, `GENE_END`, `GENE_STRAND`. The data frame is in data subdirectory. Users are free to add more SNP records to the data frame for practical use. It could also be a data frame with columns as `SNP`, `Chr`, `Position`.

- `region`: A GRRange object or data frame, which is genomic intervals with three columns, chromosome, genomic start position, genomic end position.

- `snpdb.bg`: A GRRange object contains non-trait-associated SNPs. They are treated as background for statistical testing instead of whole genome as background if specified.

- `keyword`: The keyword is used when specific trait is of interest. If `keyword` is specified, only the SNPs associated to the trait are used for analyses. Otherwise, all traits will be analyzed.

- `rankby`: Traits could be ranked by either `p-value` or `odds.ratio` based on the enrichment level of trait-associated SNPs in genomic intervals.

- `test.method`: Several hypothesis testing options are provided: `binomial` (binomial test), `fisher` (Fisher’s exact test), `chisq` (Chi-squared test), `chisq` (nonparametric test). Default is `binomial` (binomial test).

- `alternative`: Indicate the alternative hypothesis. If `greater`, test if the genomic intervals are enriched in trait-associated SNPs than background. If `less`, test if the genomic intervals are depleted in trait-associated SNPs than background. If `two.sided`, test if there is difference between the enrichment of trait-associated SNPs in genomic intervals and in background.

- `ntimes`: The number of shuffling time for one batch. See `nbatch`.

- `nbatch`: The number of batches. The product of `ntimes` and `nbatch` is the total number of shuffling time.

- `trait.threshold`: Test traits with number of SNPs more than the threshold.

- `traitclass.threshold`: Test trait class with number of SNPs more than the threshold.

- `pvalue`: SNPs with `p-value` less than this threshold are used for analyses.
Details

Return a list that contains three data frames. One data frame tb.all contains the results of enrichment analyses for all trait-associated SNPs in genomic intervals. Another data frame tb1 contains the results of enrichment analyses for each trait-associated SNPs in genomic intervals separately. Another data frame tb2 contains the results of enrichment analyses for each trait-class-associated SNPs in genomic intervals separately.

Value

The data frame tb1 has columns,

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait</td>
<td>Name of trait</td>
</tr>
<tr>
<td>p.value</td>
<td>P-value calculated from hypothesis testing</td>
</tr>
<tr>
<td>q.value</td>
<td>Adjusted p-value from multiple testing using FDR correction</td>
</tr>
<tr>
<td>odds.ratio</td>
<td>Odds ratio calculated based on number of trait-associated SNPs in genomic intervals, number of trait-associated SNPs across whole genome, genomic intervals size (bps) and genome size (bps)</td>
</tr>
<tr>
<td>taSNP.hits</td>
<td>Number of trait-associated SNPs in genomic intervals</td>
</tr>
<tr>
<td>taSNP.num</td>
<td>Number of SNPs for specific trait</td>
</tr>
</tbody>
</table>

Author(s)

Li Chen <li.chen@emory.edu>, Zhaohui S. Qin <zhaohui.qin@emory.edu>

See Also

print.traseR

Examples

data(taSNP)
data(Tcell)
x=traseR(snpdb=taSNP,region=Tcell)
print(x)
Index

*Topic package
  traseR-package, 2

CEU, 2
plotContext (plots), 3
plotGene (plots), 3
plotInterval (plots), 3
plotPvalue (plots), 3
plots, 3
plotSNP (plots), 3
print.traseR, 4
queryGene (queries), 5
queryKeyword (queries), 5
queries, 5
querySNP (queries), 5

taSNP, 6
taSNPLD, 7
Tcell, 7
traseR, 8
traseR-package, 2