

# Package ‘affycoretools’

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**Title** Functions useful for those doing repetitive analyses with  
Affymetrix GeneChips

**Version** 1.42.0

**Author** James W. MacDonald

**Description** Various wrapper functions that have been written to  
streamline the more common analyses that a core Biostatistician  
might see.

**Maintainer** James W. MacDonald <jmacdon@u.washington.edu>

**License** Artistic-2.0

**Depends** Biobase

**Imports** affy, limma, GOstats, gcrma, splines, xtable, AnnotationDbi,  
ggplot2, gplots, oligoClasses, ReportingTools, hwriter, lattice

**Suggests** affydata, hgfocuscdf, BiocStyle, knitr, hgu95av2.db, rgl

**biocViews** ReportWriting, Microarray, OneChannel, GeneExpression

**VignetteBuilder** knitr

**NeedsCompilation** no

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affycoretools	<i>Make repetitive analyses of microarray and RNA-Seq data simpler with affycoretools.</i>
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## Description

The affycoretools package is primarily intended to make analyses of Affymetrix GeneChip data simpler and more straightforward. There are any number of packages designed for preprocessing or analyzing Affy data, but there are not so many that help streamline the analysis to help create useful output that can be given to collaborators.

## Details

The affycoretools package is primarily intended to be used as a way to do reproducible research, where the analysis and documentation are all held in a single file, that is then processed by R to create the output data, as well as a nicely formatted pdf that documents the analysis. The affycoretools package can be used with either Sweave or knitr documents, although these days knitr is really the way to go.

In addition, affycoretools can be used with either annaffy or ReportingTools to create useful output in HTML or text format to share with your collaborators. However, ReportingTools is being actively developed and maintained, whereas annaffy is not, so the intention is to slowly convert all the functions to primarily use ReportingTools.

## Author(s)

James W. MacDonald <jmacdon@u.washington.edu>

**Description**

This function is designed to automatically read in all cel files in a directory, make all pre-processing QC plots and compute expression measures.

**Usage**

```
affystart(..., filenames = NULL, groups = NULL, groupnames = NULL,
  plot = TRUE, pca = TRUE, squarepca = FALSE, plottype = "pdf",
  express = c("rma", "mas5", "gcrma"), addname = NULL, output = "txt",
  annotate = FALSE, ann.vec = c("SYMBOL", "GENENAME", "ENTREZID", "UNIGENE",
  "REFSEQ"))
```

**Arguments**

filenames	If not all cel files in a directory will be used, pass a vector of filenames.
groups	An integer vector indicating the group assignments for the PCA plot.
groupnames	A character vector with group names for PCA legend.
plot	Should density and degradation plots be made? Defaults to TRUE.
pca	Should a PCA plot be made? Defaults to TRUE.
squarepca	Should the y-axis of the PCA plot be made comparable to the x-axis? This may aid in interpretation of the PCA plot. Defaults to FALSE.
plottype	What type of plot to save. Can be "pdf", "postscript", "png", "jpeg", or "bmp". Defaults to "pdf". Note that "png" and "jpeg" may not be available on a given computer. See the help page for capabilities and png for more information.
express	One of either rma, mas5, gcrma. Defaults to rma. Partial matching OK.
addname	Used to append something to the name of the pca plot and the expression values output file (e.g., if function is run twice using different methods to compute expression values).
output	What format to use for the output of expression values. Currently only supports text format.
annotate	Boolean. Add annotation data to the output file?
ann.vec	A character vector of annotation data to add to the output file.
...	Requires that all variables be named.

**Value**

Returns an ExpressionSet.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

**See Also**

plotHist, plotDeg, plotPCA

---

dataAndHeatmapPage	<i>A function to create an annotated HTML table for all genes in a significant gene set as well as a heatmap of these data.</i>
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---

**Description**

This is intended to be an internal function to runRomer. It is documented here only because it may be necessary to pass alternative arguments to this function from runRomer.

**Usage**

```
dataAndHeatmapPage(eset, fit, ind, columns = NULL, fname, heatmap, title,
  key = TRUE, fitind = NULL, affy = TRUE, ...)
```

**Arguments**

eset	An <a href="#">ExpressionSet</a> containing normalized, summarized gene expression data.
fit	An MArrayLM object.
ind	Numeric vector indicating which rows of the <a href="#">ExpressionSet</a> to use.
columns	Numeric vector indicating which columns of the <a href="#">ExpressionSet</a> to use. If NULL, all columns will be used.
fname	The filename of the resulting output, without the 'html' file extension.
heatmap	Character. The filename of the heatmap to append to the bottom of the HTML page.
title	Title to be placed at the top of the resulting HTML page.
key	Character. The filename of the heatmap key to append to the bottom of the HTML page.
fitind	Numeric. Which column of the MArrayLM object to use for output in the HTML table.
affy	Boolean. Are these Affymetrix arrays? If TRUE, then links will be generated to netaffx for the probeset IDs.
...	Included to allow arbitrary commands to be passed to lower level functions.

**Details**

This function creates an annotation table using probes2table if an annotation file is used, otherwise data will be output in a simple HTML table. A heatmap showing the expression values for all the genes in the gene set is then placed below this table, along with a key that indicates the range of the expression values.

**Author(s)**

James W. MacDonald

---

entrezLinks

*Add links to data when using ReportingTools*

---

**Description**

These functions are intended to add links to the Affymetrix, Entrez Gene, and AmiGO databases when creating HTML tables using ReportingTools.

**Usage**

```
entrezLinks(df, ...)
```

**Arguments**

df	A data.frame, usually created using the select function of the AnnotationDbi package. For Entrez ID data, the column name must be ENTREZID. For Affy data, the column name must be PROBEID, and for GO data the column name must be Term. Any other names will fail.
...	Allows one to pass arbitrary arguments to lower level functions. Currently unsupported.

**Details**

These functions are not actually intended to be called directly. Instead, they are used as targets for the .modifyDF argument of the publish function of ReportingTools. See the example below for more detail.

**Value**

A data.frame is returned, with links included.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

**Examples**

```
## Not run:
## say we have an ExpressionSet from HuGene 1.0 ST array
## and fit a model using limma
fit <- lmFit(eset, design)
fit2 <- eBayes(fit)
## now annotate the genes using select()
fit2$genes <- select(hugene10sttranscriptcluster.db, featureNames(eset),
c("ENTREZID", "SYMBOL"))
```

```
## and create an HTML page with links to Affy and Entrez
out <- topTable(fit2, coef=2)
htab <- HTMLReport("The title", "a_short_name")
publish(out, htab, .modifyDF = list(affylinks, entrezlinks))
finish(htab)
## End(Not run)
```

---

fixHeaderAndGo

*Fix data.frame header for use with ReportingTools*

---

## Description

Internal function used to automatically test for columns that can be converted to links

## Usage

```
fixHeaderAndGo(df, affy = TRUE, probecol = "PROBEID")
```

## Arguments

df	A data.frame
affy	Boolean; does the data.frame contain Affymetrix probeset IDs?
probecol	Character. The column header containing Affymetrix probeset IDs. Defaults to "PROBEID".

## Details

This is an internal function designed to test for the presence of Affymetrix Probeset IDs or Entrez Gene IDs, and if found, generate a list that can be passed to the ReportingTools publish function in order to generate hyperlinks. The underlying assumption is that the data will have been annotated using a Bioconductor annotation package, and thus Affy probeset IDs will have a column header "PROBEID", and Entrez Gene IDs will have a header "ENTREZID" (or any combination of upper and lowercase letters).

## Value

Returns a list of length two (with names mdf and df). The mdf object can be passed to the [publish](#) using the .modifyDF argument, and the df object is input data.frame with column names corrected to conform to affylinks and entrezlinks, so links will be generated correctly.

## Author(s)

Jim MacDonald

---

geneSetPage                      *A function to create an HTML page for each gene set, as well as the HTML pages for each significant gene set.*

---

## Description

This is intended to be an internal function to runRomer, and is not intended to be called by end users. However, the ... argument to runRomer allows one to pass arguments to lower level functions, so the arguments are described here.

## Usage

```
geneSetPage(rsalts, genesets, eset, fit, file, cutoff = 0.05, dir = ".",
  subdir = ".", columns = NULL, colnames = NULL, col = NULL,
  caption = NULL, fitind = NULL, bline = NULL, affy = TRUE, ...)
```

## Arguments

rsalts	The results from running <a href="#">romer</a> on one gene set.
genesets	Character. A vector of gene symbols for one gene set.
eset	An <a href="#">ExpressionSet</a> containing normalized, summarized gene expression data.
fit	An MArrayLM object, containing the fitted data.
file	Filename for the resulting HTML page.
cutoff	Numeric. The cutoff for significance for a given gene set. Defaults to 0.05.
dir	The directory to write the results. Defaults to the working directory.
subdir	The subdirectory to write the individual gene set results. Defaults to the working directory.
columns	Numeric. The columns of the ExpressionSet to use for the individual gene set output pages. See <a href="#">dataAndHeatmapPage</a> for more information.
colnames	Character. Alternative column names for the resulting heatmap. See <a href="#">dataAndHeatmapPage</a> for more information.
col	A vector of colors for the heatmap. Defaults to <a href="#">bluered</a> .
caption	Caption to put at the top of the HTML page.
fitind	Numeric. The columns of the MArrayLM object to use for the individual HTML tables.
bline	Defaults to NULL. Otherwise, a numeric vector indicating which columns of the data are the baseline samples. The data used for the heatmap will be centered by subtracting the mean of these columns from all data.
affy	Boolean; are these Affymetrix arrays? If TRUE, the Affymetrix probeset IDs will contain links to the <a href="#">netaffx</a> site.
...	Allows arguments to be passed to lower-level functions. See <a href="#">dataAndHeatmapPage</a> and <a href="#">gsHeatmap</a> for available arguments.

**Details**

This function creates a 'midlevel' HTML table that contains each gene set that was significant, with a link to an HTML table that shows data for each gene in that gene set (with annotation), as well as a heatmap showing the expression levels. Normally this is not run by end users, but is called as part of the runRomer function.

**Value**

Nothing is returned. Called only for the side effect of creating HTML tables.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

---

getMainProbes

*Remove control probesets from ST arrays*

---

**Description**

This function is designed to remove all but the 'main' type of probesets from the Gene ST array types.

**Usage**

```
getMainProbes(input)
```

**Arguments**

input            Either a character string (e.g., "pd.hugene.1.0.st.v1") or a FeatureSet object.

**Value**

If the argument is a character string, returns a data.frame containing probeset IDs along with the probeset type, that can be used to subset e.g., an ExpressionSet of Gene ST data, or an MArrayLM object created from Gene ST data. Note that the order of the probesets is not guaranteed to match the order in your ExpressionSet or MArrayLM object, so that should be checked first. If the argument is a FeatureSet object, it returns a FeatureSet object with only main probes remaining.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>



---

 gsHeatmap

*A function to create a simple heatmap and key.*


---

### Description

This is an internal function called by runRomer and is not intended to be used directly. It is documented here only because arguments may be passed down via the dots argument.

### Usage

```
gsHeatmap(eset, ind, filename, columns = NULL, colnames = NULL,
  col = NULL, annot = NULL, scale.row = FALSE, key = TRUE,
  bline = NULL)
```

### Arguments

eset	An <a href="#">ExpressionSet</a> containing normalized, summarized gene expression data.
ind	Numeric vector indicating which rows of the <a href="#">ExpressionSet</a> to use.
filename	The filename for the heatmap and associated key.
columns	Numeric vector indicating which columns of the <a href="#">ExpressionSet</a> to use. If NULL, all columns will be used.
colnames	Character. Substitute column names for the heatmap. If NULL, the sampleNames will be used.
col	A vector of colors to use for the heatmap. If NULL, the <a href="#">bluered</a> function will be used.
annot	A matrix or data.frame containing gene symbols to annotate the heatmap. This will normally be extracted automatically from the 'fit' object passed to geneSetPage. If there is no annotation in the fit object, then the probe IDs will be used instead.
scale.row	Boolean. Should the data be scaled by row? Defaults to FALSE.
key	Boolean. Should a key be produced that shows the numeric range for the colors of the heatmap? Defaults to TRUE.
bline	A numeric vector, usually extracted from a contrast matrix, used to 'sweep' the mean baseline sample means from the heatmap data. The end result will be a heatmap in which the colors correspond to log fold changes from the baseline samples.

### Details

As noted above, this is only intended to be called indirectly by runRomer. However, certain arguments such as scale.row, or col, etc, can be passed down to this function via the dots argument, allowing the end user to have more control over the finished product.

**Value**

Nothing is returned. Called only for the side effect of creating heatmaps in 'png' format.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

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makeGoGeneTable	<i>Make Gene table from GO analysis results</i>
-----------------	---

---

**Description**

A function to create an HTML table showing genes that gave rise to a significant GO term

**Usage**

```
makeGoGeneTable(fit.table, probe.sum.table, go.id, cont.name, base.dir = NULL,
  extraname = NULL, probecol = "PROBEID", affy = TRUE)
```

**Arguments**

fit.table	The output from <a href="#">topTable</a>
probe.sum.table	The output from running <a href="#">probeSetSummary</a> on a <a href="#">GOHyperGResults</a> object.
go.id	The GO ID of interest
cont.name	The contrast name.
base.dir	Character. Where should the HTML tables be generated? Defaults to NULL.
extraname	Character. An extra name that can be used if the contrast name isn't descriptive enough.
probecol	The column name in the topTable object that contains probe IDs. Defaults to PROBEID.
affy	Boolean. Are the arrays from Affymetrix?

**Details**

This is an internal function, not intended to be called by the end user. Documentation here for clarity. After running a GO analysis, it is advantageous to output a table listing those genes that gave rise to a significant GO term. This function creates the table, along with links to Netaffx (if the data are Affymetrix) and to the NCBI Gene database (if there are Entrez Gene IDs).

**Value**

Returns an [HTMLReportRef](#) object.

**Author(s)**

Jim MacDonald

---

makeGoTable	<i>Create HTML tables for Gene Ontology (GO) analyses</i>
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---

### Description

This function is used to create HTML tables to present the results from a Gene Ontology (GO) analysis.

### Usage

```
makeGoTable(fit.table, go.summary, probe.summary, cont.name,  
            base.dir = "GO_results", extraname = NULL, probecol = "PROBEID",  
            affy = TRUE)
```

### Arguments

<code>fit.table</code>	The output from <a href="#">topTable</a>
<code>go.summary</code>	The output from running <a href="#">summary</a> on a <a href="#">GOHyperGResults</a> object.
<code>probe.summary</code>	The output from running <a href="#">probeSetSummary</a> on a <a href="#">GOHyperGResults</a> object.
<code>cont.name</code>	The contrast name.
<code>base.dir</code>	Character. Where should the HTML tables be generated? Defaults to <code>GO_results</code> .
<code>extraname</code>	Character. An extra name that can be used if the contrast name isn't descriptive enough.
<code>probecol</code>	The column name in the <code>topTable</code> object that contains probe IDs. Defaults to <code>PROBEID</code> .
<code>affy</code>	Boolean. Are the arrays from Affymetrix?

### Details

After running a GO analysis, it is often useful to first present a table showing the set of significant GO terms for a given comparison, and then have links to a sub-table for each GO term that shows the genes that were responsible for the significance of that term. The first table can be generated using the [summary](#) function, but it will not contain the links to the sub-table. The `ReportingTools` package has functionality to make these tables and sub-tables automatically, but the default is to include extra glyphs in the main table that are not that useful.

This function is intended to generate a more useful version of the table that one normally gets from `ReportingTools`.

### Value

Returns an [HTMLReportRef](#) object, which can be used when creating an index page to link to the results.

### Author(s)

Jim MacDonald

---

makeHmap	<i>A function to create a heatmap-like object or matrix of correlations between miRNA and mRNA data.</i>
----------	--

---

### Description

This function is intended for use when both miRNA and mRNA data are available for the same samples. In this situation it may be advantageous to compute correlations between the two RNA types, in order to detect mRNA transcripts that are targeted by miRNA.

### Usage

```
makeHmap(mRNAdat, miRNAdat, mRNA1st, mRNAvec = NULL, miRNAvec = NULL,
         chipPkg, header, plot = TRUE, out = TRUE)
```

### Arguments

mRNAdat	An ExpressionSet, data.frame or matrix of mRNA expression values. The row.names for these data should correspond to the manufacturer's probe ID. Currently, the only manufacturer supported is Affymetrix.
miRNAdat	An ExpressionSet, data.frame or matrix of mRNA expression values. The row.names for these data should correspond to the manufacturer's probe ID. Currently, the only manufacturer supported is Affymetrix.
mRNA1st	A list of mRNA probe IDs where the names of each list item are mirBase miRNA IDs. Usually this will be the output from <a href="#">mirna2mrna</a> .
mRNAvec	A numeric vector used to subset or reorder the mRNA data, by column. If NULL, this will simply be 1:ncol(mRNAdat).
miRNAvec	A numeric vector used to subset or reorder the miRNA data, by column. If NULL, this will simply be 1:ncol(miRNAdat).
chipPkg	Character. The name of the chip-specific annotation package (e.g., "hgu133plus2.db").
header	Character. The plot title if a heatmap is output.
plot	Boolean. Should a heatmap be generated?
out	Boolean. Should the matrix of correlation coefficients be output?

### Details

As noted above, this function is intended to generate output from simultaneous analyses of miRNA and mRNA data for the same samples, the goal being either a heatmap like plot of correlations, or the data (or both).

If creating a plot, note that if the number of significant mRNA probes is large, the resulting heatmap will have many rows and will not plot correctly on the usual graphics device within R. In order to visualize, it is almost always better to output as a pdf. In addition, the dimensions of this pdf will have to be adjusted so the row names for the heatmap will be legible. As an example, a heatmap with 10 miRNA transcripts and 100 mRNA transcripts will likely need a pdf with a width argument

of 6 and a height argument of 25 or 30. It may require some experimentation to get the correct arguments to the pdf function.

Also please note that this function by necessity outputs rectangular data. However, there will be many instances in which a given miRNA isn't thought to target a particular mRNA. Whenever this occurs, the heatmap will have a white cell, and the output data for that combination will be NA.

### Value

This function will output a numeric matrix if the 'out' argument is TRUE.

### Author(s)

James W. MacDonald

### See Also

mirna2mrna

---

makeImages

*Add dotplot images*

---

### Description

A function to add dotplot glyphs and links to HTML tables

### Usage

```
makeImages(df, eset, grp.factor, design, contrast, colind, boxplot = FALSE,
  repdir = "./reports", extraname = NULL, weights = NULL,
  insert.after = 3, ...)
```

### Arguments

df	A data.frame from calling topTable. Note that the row.names for this data.frame must be consistent with the "eset" object. In other words, if "eset" is an ExpressionSet, then the row.names of the data.frame must consistent with the featureNames of the ExpressionSet.
eset	A matrix, data.frame, or ExpressionSet. If using RNA-Seq data, use voom from edgeR to create an EList object, and then pass in the "E" list item.
grp.factor	A factor that indicates which group ALL of the samples belong to. This will be subsetted internally, so do not subset yourself.
design	The design matrix used by limma or edgeR to fit the model.
contrast	The contrast matrix used by limma or edgeR to make comparisons.
colind	Which column of the contrast matrix are we using? In other words, for which comparison are we creating a table?

boxplot	Boolean. If TRUE, the output HTML table will have a boxplot showing differences between groups. If FALSE (default), the table will have dotplots.
repdir	A directory in which to put the HTML tables. Defaults to a "reports" directory in the working directory.
extraname	By default, the tables will go in a "reports" subdirectory, and will be named based on the column name of the contrast that is specified by the colind argument (after replacing any spaces with an underscore). If this will result in name collisions (e.g., a previous file will be over-written because the resulting names are the same), then an extraname can be appended to ensure uniqueness.
weights	Array weights, generally from arrayWeights in the limma package. These will affect the size of the plotting symbols, to reflect the relative importance of each sample.
insert.after	Which column should the image be inserted after? Defaults to 3.
...	Allows arbitrary arguments to be passed down to lower level functions.

### Details

This function is intended to create little dotplot glyphs that can be added to an HTML table of results from e.g., a microarray or RNA-Seq experiment, showing graphically how much the different groups are changing. The glyphs have unlabeled axes to make them small enough to fit in an HTML table, and clicking on a glyph will result in a new page loading with a full sized dotplot, complete with axis labels.

This function is very similar to the stock functions in the ReportingTools package, but the standard glyphs for that package consist of a dotplot on top of a boxplot, which seems too busy to me. In addition, for most microarray analyses there are not enough replicates to make a boxplot useful.

### Value

A list, two items. The first item is the input data.frame with the glyphs included, ready to be used with ReportingTools to create an HTML table. The second item is a pdf of the most differentially expressed comparison. This is useful for those who are using e.g., knitr or Sweave and want to be able to automatically insert an example dotplot in the document to show clients what to expect.

### Author(s)

James W. MacDonald <jmacdon@u.washington.edu>

---

makeVenn

*High-level function for making Venn diagrams and outputting the results from the diagrams in HTML and CSV files.*

---

### Description

This function is designed to output CSV and HTML tables based on an analysis using the limma package, with output generated using the ReportingTools package.

**Usage**

```
makeVenn(fit, contrast, design, groups = NULL, collist = NULL,
         p.value = 0.05, lfc = 0, method = "both", adj.meth = "BH",
         titleadd = NULL, fileadd = NULL, baseUrl = ".",
         reportDirectory = "./venns", affy = TRUE, probecol = "PROBEID", ...)
```

**Arguments**

fit	An <a href="#">MArrayLM</a> object, from a call to <a href="#">eBayes</a> .
contrast	A contrasts matrix, produced either by hand, or by a call to <a href="#">makeContrasts</a>
design	A design matrix.
groups	This argument is used when creating a legend for the resulting HTML pages. If NULL, the groups will be generated using the column names of the design matrix. In general it is best to leave this NULL.
collist	A list containing numeric vectors indicating which columns of the fit, contrast and design matrix to use. If NULL, all columns will be used.
p.value	A p-value to filter the results by.
lfc	A log fold change to filter the results by.
method	One of "same", "both", "up", "down", "sameup", or "samedown". See details for more information.
adj.meth	Method to use for adjusting p-values. Default is 'BH', which corresponds to 'fdr'. Ideally one would set this value to be the same as was used for <a href="#">decideTests</a> .
titleadd	Additional text to add to the title of the HTML tables. Default is NULL, in which case the title of the table will be the same as the filename.
fileadd	Additional text to add to the name of the HTML and CSV tables. Default is NULL.
baseUrl	A character string giving the location of the page in terms of HTML locations. Defaults to "."
reportDirectory	A character string giving the location that the results will be written. Defaults to "./venns"
affy	Boolean. Are these Affymetrix data, and should hyperlinks to the affy website be generated in the HTML tables?
probecol	This argument is used in concert with the preceding argument. If these are Affymetrix data, then specify the column header in the <a href="#">MArrayLM</a> object that contains the Affymetrix IDs. Defaults to "PROBEID", which is the expected result if the data are annotated using a BioC annotation package.
...	Used to pass other arguments to lower level functions.

**Details**

The purpose of this function is to output HTML and text tables with lists of genes that fulfill the criteria of a call to [decideTests](#) as well as the direction of differential expression. This is a high-level function that calls `vennSelect2` internally, and is intended to be used with `vennPage` to create

a set of Venn diagrams (on an HTML page) that have clickable links in each cell of the diagram. The links will then pass the end user to individual HTML pages that contain the genes that are represented by the counts in a given cell of the Venn diagram.

In general, the only thing that is needed to create a set of Venn diagrams is a list of numeric vectors that indicate the columns of the contrast matrix that are to be used for a given diagram. See the example below for a better explanation.

Some important things to note: First, the names of the HTML and text tables are extracted from the `colnames` of the `TestResults` object, which come from the contrasts matrix, so it is important to use something descriptive. Second, the method argument is analogous to the `include` argument from `vennCounts` or `vennDiagram`. Choosing "both" will select genes that are differentially expressed in one or more comparisons, regardless of direction. Choosing "up" or "down" will select genes that are only differentially expressed in one direction. Choosing "same" will select genes that are differentially expressed in the same direction. Choosing "sameup" or "samedown" will select genes that are differentially expressed in the same direction as well as 'up' or 'down'.

Note that this is different than sequentially choosing "up" and then "down". For instance, a gene that is upregulated in one comparison and downregulated in another comparison will be listed in the intersection of those two comparisons if "both" is chosen, it will be listed in only one comparison for both the "up" and "down" methods, and it will be listed in the union (e.g., not selected) if "same" is chosen.

Unlike `vennSelect`, this function automatically creates both HTML and CSV output files.

Also please note that this function relies on annotation information contained in the "genes" slot of the "fit" object. If there are no annotation data, then just statistics will be output in the resulting HTML tables.

## Value

A list containing the output from calling `vennSelect2` on the columns specified by the `collist` argument. This is intended as input to `vennPage`, which will use those data to create the HTML page with Venn diagrams with clickable links.

## Author(s)

James W. MacDonald <jmacdon@u.washington.edu>

## Examples

```
## Not run:
mat <- matrix(rnorm(1e6), ncol = 20)
design <- model.matrix(~factor(1:4, each=5))
colnames(design) <- LETTERS[1:4]
contrast <- matrix(c(1,-1,0,0,1,0,-1,0,1,0,0,-1,0,1,-1,0,0,1,0,-1),
ncol = 5)
colnames(contrast) <- paste(LETTERS[c(1,1,1,2,2)],
LETTERS[c(2,3,4,3,4)], sep = " vs ")
fit <- lmFit(mat, design)
fit2 <- contrasts.fit(fit, contrast)
fit2 <- eBayes(fit2)
## two Venn diagrams - a 3-way Venn with the first three contrasts
## and a 2-way Venn with the last two contrasts
```



```
collist <- list(1:3,4:5)
venn <- makeVenn(fit2, contrast, design, collist = collist)
vennPage(venn, "index.html", "Venn diagrams")

## End(Not run)
```

---

maplot

*A Function to make MA plots from all arrays.*

---

### Description

This function creates an MA plot for all arrays in either an ExpressionSet or a matrix. A 'baseline' array is created using the median expression for each gene, and each array is then compared to the baseline array.

### Usage

```
maplot(object)
```

### Arguments

object            An ExpressionSet or matrix containing log-transformed array data.

### Value

No output. Used only for the side effect of creating MA plots.

### Author(s)

James W. MacDonald <jmacdon@u.washington.edu>

---

mirna2mrna

*A function to map miRNA to mRNA.*

---

### Description

This function is intended use when there are miRNA and mRNA data for the same subjects, and the goal is to detect mRNAs that appear to be targeted by the miRNA.

### Usage

```
mirna2mrna(miRNAids, miRNAannot, mRNAids, orgPkg, chipPkg, sanger = TRUE,
           miRNAcol = NULL, mRNAcol = NULL, transType = "ensembl")
```

**Arguments**

miRNAids	A character vector of miRNA IDs. Currently only supports Affymetrix platform.
miRNAannot	Character. The filename (including path if not in working directory) for the file containing miRNA to mRNA mappings.
mRNAids	A character vector of mRNA IDs. Currently only supports Affymetrix platform.
orgPkg	Character. The Bioconductor organism package (e.g., org.Hs.eg.db) to be used for mapping.
chipPkg	Character. The Bioconductor chip-specific package (e.g., hgu133plus2.db) to be used for mapping.
sanger	Boolean. Is the miRNAannot file a Sanger miRBase targets file? These can be downloaded from <a href="http://www.ebi.ac.uk/enright-srv/microcosm/cgi-bin/targets/v5/download.pl">http://www.ebi.ac.uk/enright-srv/microcosm/cgi-bin/targets/v5/download.pl</a>
miRNAcol	Numeric. If using a Sanger miRBase targets file, leave NULL. Otherwise, use this to indicate which column of the miRNAannot file contains miRNA IDs.
mRNAcol	Numeric. If using Sanger miRBase targets file, leave NULL. Otherwise, use this to indicate which column of the miRNAannot file contains mRNA IDs.
transType	Character. Designates the type of transcript ID for mRNA supplied by the miRNAannot file. If using the Sanger miRBase files, this is ensembl. Other choices include refseq and accnum.

**Details**

This function is intended to take a vector of miRNA IDs that are significantly differentially expressed in a given experiment and then map those IDs to putative mRNA transcripts that the miRNAs are supposed to target. The mRNA transcript IDs are then mapped to chip-specific probeset IDs, which are then subsetted to only include those probesets that were also significantly differentially expressed.

The output from this function is intended as input for [makeHmap](#).

**Value**

A list with names that correspond to each significant miRNA, and the mRNA probeset IDs that are targeted by that miRNA.

**Author(s)**

James W. MacDonald

**See Also**

[makeHmap](#)

---

outputRomer	<i>A function to create HTML output from the results of running romer on a set of contrasts.</i>
-------------	--

---

### Description

This function is actually intended to be a sub-function of runRomer, but can hypothetically run by itself if the `romer` step has already been done.

### Usage

```
outputRomer(rs1st, geneset1st, eset, fit, design = NULL, contrast = NULL,
  changenames = TRUE, dir = "genesets", explanation = NULL,
  baseline.hmap = TRUE, file = "indexRomer.html", affy = TRUE, ...)
```

### Arguments

rs1st	A list of results, generated by the <code>romer</code> function. See discussion for more information.
geneset1st	A list of genesets, usually created by loading in the RData files that can be downloaded from <a href="http://bioinf.wehi.edu.au/software/MSigDB/">http://bioinf.wehi.edu.au/software/MSigDB/</a> . See details for more information.
eset	An <a href="#">ExpressionSet</a> containing normalized, summarized gene expression data.
fit	An MArrayLM object, containing the fitted data.
design	A design matrix describing the model.
contrast	A contrast matrix describing the contrasts that were fit. This matrix should have colnames, which will be used to name subdirectories containing results.
changenames	Boolean. When creating heatmaps of the gene sets, should the columns be appended with the colnames from the design matrix? If FALSE, the sampleNames will be used.
dir	Character. The subdirectory to use for the output data. Defaults to 'genesets'.
explanation	If NULL, a generic paragraph will be placed at the top of the indexRomer.html page, giving a brief explanation of the analysis. Alternatively, this can be replaced with other text. Please note that this text should conform to HTML standards (e.g., will be pasted into the HTML document as-is, so should contain any required HTML markup).
baseline.hmap	Boolean. If TRUE, then the resulting heatmaps will be centered by subtracting the mean of the baseline sample. As an example, in a contrast of treatment A - treatment B, the mean of the treatment B samples will be subtracted. The heatmap colors then represent the fold change between the A and B samples.
file	Character. The filename to output. Defaults to 'indexRomer.html'.
affy	Boolean. Are these Affymetrix arrays? if TRUE, then there will be links generated in the HTML table to the netaffx site.
...	Arguments to be passed to lower-level functions. See <code>geneSetPage</code> , <code>dataAndHeatmapPage</code> and <code>gsHeatmap</code> for available arguments.

**Details**

This function is intended to be an internal function for runRomer. However, it is possible that runRomer errored out after saving the results from running `romer` on a set of contrasts, and all that remains is to create the output HTML.

Please note that the first two arguments to this function have certain expectations. The `rsltlst` should be the output from running `romer`. If using the saved output from runRomer, one should first load the 'romer.Rdata' file, which will introduce a list object with the name 'romerlst' into the working directory, so the first argument should be `rsltlst = romerlst`.

Second, see the code for runRomer, specifically the line that creates the 'sets' object, which will show how to create the correct `genesetlst` object.

**Value**

Nothing is returned. The function is run only for the side effect of creating HTML tables with output for each significant gene set.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

---

plotDeg

*Functions to Plot Density and RNA Degradation Plots*

---

**Description**

These functions make density and RNA degradation plots with automatic placement of legends.

**Usage**

```
plotDeg(dat, filenames = NULL)
```

**Arguments**

dat	An AffyBatch object, or in the case of plotHist, a matrix (e.g., from a call to <code>read.probematrix</code> ). Note that plotDeg requires an AffyBatch object to work correctly.
filenames	Filenames that will be used in the legend of the resulting plot. If NULL (the default), these names will be extracted from the <code>sampleNames</code> slot of the AffyBatch object.

**Value**

These functions are called only for the side effect of making the plots. Nothing else is returned.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

**Examples**

```
library("affydata")
data(Dilution)
plotDeg(Dilution)
plotHist(Dilution)
```

plotPCA

*A Function to Make a PCA Plot from an ExpressionSet***Description**

This function makes a PCA plot from an ExpressionSet or matrix

**Usage**

```
plotPCA(object, groups = NULL, groupnames = NULL, addtext = NULL,
  x.coord = NULL, y.coord = NULL, screeplot = FALSE, squarepca = FALSE,
  pch = NULL, col = NULL, pcs = c(1, 2), legend = TRUE,
  main = "Principal Components Plot", plot3d = FALSE, outside = FALSE,
  ...)
```

**Arguments**

object	An ExpressionSet, matrix or prcomp object.
groups	A numeric vector delineating group membership for samples. Default is NULL, in which case default plotting symbols and colors will be used.
groupnames	A character vector describing the different groups. Default is NULL, in which case the sample names will be used.
addtext	A character vector of additional text to be placed just above the plotting symbol for each sample. This is helpful if there are a lot of samples for identifying e.g., outliers.
x.coord	Pass an x-coordinate if automatic legend placement fails
y.coord	Pass a y-coordinate if automatic legend placement fails.
screeplot	Boolean: Plot a <a href="#">screeplot</a> instead of a PCA plot? Defaults to FALSE.
squarepca	Should the y-axis of the PCA plot be made comparable to the x-axis? This may aid in interpretation of the PCA plot. Defaults to FALSE.
pch	A numeric vector indicating what plotting symbols to use. Default is NULL, in which case default plotting symbols will be used. Note that this argument will override the 'groups' argument.
col	A numeric or character vector indicating what color(s) to use for the plotting symbols. Default is NULL in which case default colors will be used. Note that this argument will override the 'groups' argument.
pcs	A character vector of length two (or three if plot3d is TRUE), indicating which principal components to plot. Defaults to the first two principal components.

legend	Boolean. Should a legend be added to the plot? Defaults to TRUE.
main	A character vector for the plot title.
plot3d	Boolean. If TRUE, then the PCA plot will be rendered in 3D using the rgl package. Defaults to FALSE. Note that the pcs argument should have a length of three in this case.
outside	Boolean. If TRUE the legend will be placed outside the plotting region, at the top right of the plot.
...	Further arguments to be passed to plot. See the help page for plot for further information.

**Value**

This function returns nothing. It is called only for the side effect of producing a PCA plot or screeplot.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

**Examples**

```
library("affy")
data(sample.ExpressionSet)
plotPCA(sample.ExpressionSet, groups =
  as.numeric(pData(sample.ExpressionSet)[,2]), groupnames =
  levels(pData(sample.ExpressionSet)[,2]))
```

---

runRomer

*A function to run the romer function on a set of contrasts.*

---

**Description**

This function automates both running [romer](#) on a set of contrasts as well as the creation of output HTML tables that can be used to explore the results. The basic idea here is that one might have used limma to fit a model and compute some contrasts, and then want to do a GSEA using [romer](#).

**Usage**

```
runRomer(setloc, annot = NULL, eset, design = NULL, contrast = NULL, fit,
  wts = NULL, save = TRUE, baseline.hmap = TRUE, affy = TRUE, ...)
```

**Arguments**

setloc	A character vector giving the path for gene set RData files (see description for more information).
annot	Character. The name of the array annotation package.
eset	An <a href="#">ExpressionSet</a> containing normalized expression data.
design	A design matrix describing the model fit to the data.
contrast	A contrast matrix describing the contrasts that were computed from the data. This contrast should have colnames, which will be used to create parts of the resulting directory structure.
fit	An MArrayLM object, containing the fitted model data.
wts	Optional weights vector - if array weights were used to fit the model, they should be supplied here as well.
save	Boolean. If true, after running the <a href="#">romer</a> step, the results will be saved in a file 'romer.Rdata', which can be used as input for <a href="#">outputRomer</a> to create HTML tables. Since <a href="#">romer</a> can take a long time to run, it is advantageous to keep the default.
baseline.hmap	Boolean. If TRUE, then the resulting heatmaps will be centered by subtracting the mean of the baseline sample. As an example, in a contrast of treatment A - treatment B, the mean of the treatment B samples will be subtracted. The heatmap colors then represent the fold change between the A and B samples.
affy	Boolean; are these Affymetrix arrays? If TRUE, the output tables will contain links to the netaffx site.
...	Used to pass arguments to lower-level functions. See <a href="#">outputRomer geneSetPage</a> , <a href="#">dataAndHeatmapPage</a> and <a href="#">gsHeatmap</a> for available arguments.

**Details**

The [romer](#) expects as input a list or lists of gene symbols that represent individual gene sets. One example is the various gene sets from the Broad Institute that are available at <http://bioinf.wehi.edu.au/software/MSigDB/>, which are distributed as RData files. The default assumption for this function is that the end user will have downloaded these files, and the setloc argument simply tells runRomer where to find them.

Alternatively, user-based gene sets could be created (these should consist of lists of character vectors of gene symbols - see one of the Broad gene sets for an example).

This function will run [romer](#) using all the gene sets in the referenced directory, on all the contrasts supplied, and then output the results in a (default) 'genesets' subdirectory. There will be an HTML file in the working directory with a (default) filename of 'indexRomer.html' that will point to individual HTML files in the genesets subdirectory, which will point to individual files in subdirectories within the genesets subdirectory (named after the colnames of the contrast matrix).

**Value**

Nothing is returned. This function is called only for the side-effects of creating output HTML files in the working and sub-directories.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

---

venn4Way

*4-way Venn Diagrams*

---

**Description**

A function to create a 4-way Venn diagram

**Usage**

```
venn4Way(fit, contrast, p.value, lfc, adj.meth, baseUrl = ".",
         reportDirectory = "./venns", ...)
```

**Arguments**

<code>fit</code>	An MArrayLM object, created by the limma package.
<code>contrast</code>	A contrasts matrix, used by limma to generate the comparisons made.
<code>p.value</code>	A p-value cutoff for significance
<code>lfc</code>	A log fold change cutoff
<code>adj.meth</code>	The method used to adjust for multiple comparisons.
<code>baseUrl</code>	The base directory for the tables generated. Defaults to ".", meaning the current directory.
<code>reportDirectory</code>	The directory in which to put the results. Defaults to a "venns" subdirectory.
<code>...</code>	Allows arbitrary arguments to be passed to lower level functions

**Details**

This function is an internal function and not really intended to be called by the end user. It is generally called by the `vennPage` function. The goal is to create a 4-way Venn diagram in an HTML page with clickable links to tables of the genes found in a given cell. In addition, the numbers in each cell are underlined with colored bars that help end users tell what contrasts are captured by that cell.

**Value**

Returns a list. The first item is a (list of) `HTMLReportRef` objects that can be used by Reporting-Tools to create HTML links. The second item is the output from the `venn` function in `gtools`, and the third item is the name of the contrasts used to generate the Venn diagram.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>



**Description**

This function is designed to compute counts for a Venn diagram. It is slightly different from [vennCounts](#) in the additional ability to compute counts for genes that are differentially expressed in the same direction.

**Usage**

```
vennCounts2(x, method = "same", fit = NULL, foldFilt = NULL)
```

**Arguments**

<code>x</code>	A <a href="#">TestResults</a> object, produced by a call to <a href="#">decideTests</a> or <a href="#">foldFilt</a> .
<code>method</code>	One of "same", "both", "up", "down". See details for more information.
<code>fit</code>	An <a href="#">MArrayLM</a> object, produced by a call to <a href="#">lmFit</a> and <a href="#">eBayes</a> . Only necessary if 'foldFilt' = TRUE.
<code>foldFilt</code>	A fold change to filter samples. This is primarily here for consistency with the corresponding argument in <a href="#">vennSelect</a> .

**Details**

The function [vennCounts](#) will return identical results except for the "same" method. This will only select those genes that both pass the criteria of [decideTests](#) as well as being differentially expressed in the same direction. Note that this is different from the "both" method, which simply requires that a given gene be differentially expressed in e.g., two different comparisons without any requirement that the direction be the same.

**Value**

A [VennCounts](#) object.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

**Examples**

```
library("limma")
tstat <- matrix(rt(300,df=10),100,3)
tstat[1:33,] <- tstat[1:33,]+2
clas <- classifyTestsF(tstat,df=10,p.value=0.05)
a <- vennCounts2(clas)
print(a)
vennDiagram(a)
```

---

vennPage	<i>High-level function for making Venn diagrams with clickable links to HTML pages with the underlying genes.</i>
----------	---

---

### Description

This function is designed to be used in conjunction with the `makeVenn` function, to first create a set of HTML pages containing the genes that are represented by the cells of a Venn diagram, and then create an HTML page with the same Venn diagrams, with clickable links that will point the end user to the HTML pages.

### Usage

```
vennPage(vennlst, pagename, pagetitle, cex.venn = 1, shift.title = FALSE,
         baseUrl = ".", reportDirectory = NULL, ...)
```

### Arguments

<code>vennlst</code>	The output from <code>makeVenn</code> .
<code>pagename</code>	Character. The file name for the resulting HTML page. Something like 'venns' is reasonable. Note that the .html will automatically be appended.
<code>pagetitle</code>	Character. The heading for the HTML page.
<code>cex.venn</code>	Numeric. Adjusts the size of the font in the Venn diagram. Usually the default is OK.
<code>shift.title</code>	Boolean. Should the right contrast name of the Venn diagram be shifted down? Useful for long contrast names. If a two-way Venn diagram, this will shift the right name down so they don't overlap. If a three-way Venn diagram, this will shift the top right name down.
<code>baseUrl</code>	Character. The base URL for the resulting HTML page. The default of "." is usually optimal.
<code>reportDirectory</code>	If NULL, the <code>reportDirectory</code> will be extracted from the <code>vennlst</code> . This is usually what one should do.
<code>...</code>	To allow passing other arguments to lower level functions. Currently not used.

### Details

This function is intended to be used as part of a pipeline, by first calling `makeVenn` and then using the output from that function as input to this function to create the HTML page with clickable links.

### Value

An `HTMLReport` object. If used as input to the `ReportingTools` `publish` function, this will create a link on an index page to the Venn diagram HTML page. See e.g., the microarray analysis vignette for `ReportingTools` for more information.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

**Examples**

```
## Not run:
mat <- matrix(rnorm(1e6), ncol = 20)
design <- model.matrix(~factor(1:4, each=5))
colnames(design) <- LETTERS[1:4]
contrast <- matrix(c(1,-1,0,0,1,0,-1,0,1,0,0,-1,0,1,-1,0,0,1,0,-1),
  ncol = 5)
colnames(contrast) <- paste(LETTERS[c(1,1,1,2,2)],
  LETTERS[c(2,3,4,3,4)], sep = " vs ")
fit <- lmFit(mat, design)
fit2 <- contrasts.fit(fit, contrast)
fit2 <- eBayes(fit2)
## two Venn diagrams - a 3-way Venn with the first three contrasts
## and a 2-way Venn with the last two contrasts
collist <- list(1:3,4:5)
venn <- makeVenn(fit2, contrast, design, eset, collist = collist)
vennreport <- vennPage(venn, "index.html", "Venn diagrams")
indexPage <- HTMLReport("index", "My results", reportDirectory =
  ".", baseUrl = ".")
publish(vennreport)
finish(indexPage)

## End(Not run)
```

---

 vennSelect2

*Select and Output Genelists Based on Venn Diagrams*


---

**Description**

This function is designed to output text and/or HTML tables based on the results of a call to [decideTests](#), using the ReportingTools package.

**Usage**

```
vennSelect2(fit, contrast, design, groups = NULL, cols = NULL,
  p.value = 0.05, lfc = 0, method = "same", adj.meth = "BH",
  titleadd = NULL, fileadd = NULL, baseUrl = ".",
  reportDirectory = "./venns", affy = TRUE, probecol = "PROBEID", ...)
```

**Arguments**

fit	An <a href="#">MArrayLM</a> object, from a call to <a href="#">eBayes</a> .
contrast	A contrasts matrix, produced either by hand, or by a call to <a href="#">makeContrasts</a>
design	A design matrix.

groups	This argument is used when creating a legend for the resulting HTML pages. If NULL, the groups will be generated using the column names of the design matrix.
cols	A numeric vector indicating which columns of the fit, contrast and design matrix to use. If NULL, all columns will be used.
p.value	A p-value to filter the results by.
lfc	A log fold change to filter the results by.
method	One of "same", "both", "up", "down", "sameup", or "samedown". See details for more information.
adj.meth	Method to use for adjusting p-values. Default is 'BH', which corresponds to 'fdr'. Ideally one would set this value to be the same as was used for <a href="#">decideTests</a> .
titleadd	Additional text to add to the title of the HTML tables. Default is NULL, in which case the title of the table will be the same as the filename.
fileadd	Additional text to add to the name of the HTML and CSV tables. Default is NULL.
baseUrl	A character string giving the location of the page in terms of HTML locations. Defaults to "."
reportDirectory	A character string giving the location that the results will be written. Defaults to "./venns"
affy	Boolean; are these Affymetrix arrays, and do you want hyperlinks for each probeset to the Affy website to be generated for the resulting HTML tables?
probecol	If the "affy" argument is TRUE, what is the column header for the Affymetrix probeset IDs? Defaults to "PROBEID", which is the default if the data are annotated using a Bioconductor annotation package.
...	Used to pass arguments to lower level functions.

## Details

The purpose of this function is to output HTML and text tables with lists of genes that fulfill the criteria of a call to [decideTests](#) as well as the direction of differential expression.

Some important things to note: First, the names of the HTML and text tables are extracted from the `colnames` of the `TestResults` object, which come from the contrasts matrix, so it is important to use something descriptive. Second, the `method` argument is analogous to the `include` argument from [vennCounts](#) or [vennDiagram](#). Choosing "both" will select genes that are differentially expressed in one or more comparisons, regardless of direction. Choosing "up" or "down" will select genes that are only differentially expressed in one direction. Choosing "same" will select genes that are differentially expressed in the same direction. Choosing "sameup" or "samedown" will select genes that are differentially expressed in the same direction as well as 'up' or 'down'.

Note that this is different than sequentially choosing "up" and then "down". For instance, a gene that is upregulated in one comparison and downregulated in another comparison will be listed in the intersection of those two comparisons if "both" is chosen, it will be listed in only one comparison for both the "up" and "down" methods, and it will be listed in the union (e.g., not selected) if "same" is chosen.

Unlike `vennSelect`, this function automatically creates both HTML and CSV output files.

**Value**

A list with two items. First, a list of HTMLReport objects from the ReportingTools package, which can be used to create an index page with links to the HTML pages created by this function. See the help page for HTMLReport in ReportingTools as well as the vignettes for more information. The second item is a vennCounts object from limma, which can be used to create a Venn diagram, e.g., in a report if this function is called within a Sweave or knitR pipeline.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

---

writeFit

*Function to output annotated fit data from limma*

---

**Description**

This function is designed to take an ExpressionSet an annotation package and an lmFit object, and output an annotated text file containing t-statistics, p-values, and fold change data for all contrasts.

**Usage**

```
writeFit(fit, annotation = NULL, eset, touse = c("symbol", "genename",  
        "accnum", "entrezid", "unigene"))
```

**Arguments**

fit	A lmFit object, created by the limma package.
annotation	An annotation package, specific for the chip used in the analysis.
eset	An ExpressionSet object containing expression values.
touse	Character vector of BiMaps from annotation package. As an example, if the annotation package is the hgu133plus2.db package, then 'symbol' refers to the hgu133plus2SYMBOL BiMap.

**Details**

This function is designed to output annotation data as well as statistics (p-values, fold change, t-statistics) for all probes on a chip.

**Value**

A data.frame is returned.

**Author(s)**

James W. MacDonald <jmacdon@u.washington.edu>

**See Also**[write.fit](#)

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