

# Package ‘EGAD’

April 10, 2023

**Type** Package

**Title** Extending guilt by association by degree

**Version** 1.26.0

**Date** 2016-04-20

**Description** The package implements a series of highly efficient tools to calculate functional properties of networks based on guilt by association methods.

**License** GPL-2

**Depends** R(>= 3.5)

**Imports** gplots, Biobase, GEOquery, limma, impute, RColorBrewer, zoo, igraph, plyr, MASS, RCurl, methods

**Suggests** knitr, testthat, rmarkdown, markdown

**VignetteBuilder** rmarkdown

**RoxygenNote** 7.1.1

**LazyData** true

**LazyDataCompression** gzip

**Encoding** UTF-8

**biocViews** Software, FunctionalGenomics, SystemsBiology, GenePrediction, FunctionalPrediction, NetworkEnrichment, GraphAndNetwork, Network

**Author** Sara Ballouz [aut, cre], Melanie Weber [aut, ctb], Paul Pavlidis [aut], Jesse Gillis [aut, ctb]

**Maintainer** Sara Ballouz <sarahballouz@gmail.com>

**git\_url** <https://git.bioconductor.org/packages/EGAD>

**git\_branch** RELEASE\_3\_16

**git\_last\_commit** f4695cc

**git\_last\_commit\_date** 2022-11-01

**Date/Publication** 2023-04-10

**R topics documented:**

assortativity . . . . .	3
attr.human . . . . .	4
attr.mouse . . . . .	4
auc_multifunc . . . . .	5
auprc . . . . .	6
auroc_analytic . . . . .	6
biogrid . . . . .	7
build_binary_network . . . . .	7
build_coexp_expressionSet . . . . .	8
build_coexp_GEOID . . . . .	9
build_coexp_network . . . . .	9
build_semantic_similarity_network . . . . .	10
build_weighted_network . . . . .	11
calculate_multifunc . . . . .	11
conv_smoother . . . . .	12
example_annotations . . . . .	13
example_binary_network . . . . .	13
example_coexpression . . . . .	13
example_neighbor_voting . . . . .	13
extend_network . . . . .	14
filter_network . . . . .	14
filter_network_cols . . . . .	15
filter_network_rows . . . . .	16
filter_orthologs . . . . .	17
fmeasure . . . . .	17
genes . . . . .	18
get_auc . . . . .	18
get_biogrid . . . . .	19
get_counts . . . . .	19
get_density . . . . .	20
get_expression_data_gemma . . . . .	20
get_expression_matrix_from_GEO . . . . .	21
get_phenocarta . . . . .	21
get_prc . . . . .	22
get_roc . . . . .	22
GO.human . . . . .	23
GO.mouse . . . . .	23
GO.voc . . . . .	24
make_annotations . . . . .	24
make_genelist . . . . .	25
make_gene_network . . . . .	25
make_transparent . . . . .	26
neighbor_voting . . . . .	26
node_degree . . . . .	27
ortho . . . . .	28
pheno . . . . .	29

<i>assortativity</i>	3
plot_densities . . . . .	29
plot_density_compare . . . . .	30
plot_distribution . . . . .	31
plot_network_heatmap . . . . .	32
plot_prc . . . . .	33
plot_roc . . . . .	33
plot_roc_overlay . . . . .	34
plot_value_compare . . . . .	35
predictions . . . . .	35
repmat . . . . .	36
run_GBA . . . . .	37
<b>Index</b>	<b>38</b>

---

<i>assortativity</i>	<i>Calculating network assortativity</i>
----------------------	--

---

### **Description**

The function calculates the assortativity of a network, that measures the preference of interactions between similar nodes. As in most literature, 'similarity' is here defined in terms of node degrees.

### **Usage**

```
assortativity(network)
```

### **Arguments**

network	matrix indicating network structure (symmetric)
---------	---

### **Value**

Numeric value

### **Examples**

```
network <- matrix( sample(c(0,1),36, replace=TRUE), nrow=6,byrow=TRUE)
assort_value <- assortativity(network)
```

---

attr.human	<i>Human GENCODE annotations (v22)</i>
------------	--

---

**Description**

A dataset containing identifiers for gene transcripts

**Format**

A data frame with 60483 rows and 10 variables:

**chr** chromosome

**start** chromosomal start position, in base pairs

**end** chromosomal end position, in base pairs

**strand** chromosomal strand, + or -

**un** unknown

**ensemblID** ENSEMBL identifier

**type** type of transcript

**stat** status of transcript

**name** HUGO identifier

**entrezID** Entrez identifier

@source [ftp://ftp.sanger.ac.uk/pub/gencode/Gencode\\_human/release\\_22/](ftp://ftp.sanger.ac.uk/pub/gencode/Gencode_human/release_22/)

---

attr.mouse	<i>Mouse GENCODE annotations (M7)</i>
------------	---------------------------------------

---

**Description**

A dataset containing identifiers for gene transcripts

**Format**

A data frame with 46517 rows and 10 variables:

**chr** chromosome

**start** chromosomal start position, in base pairs

**end** chromosomal end position, in base pairs

**strand** chromosomal strand, + or -

**un** unknown

**ensemblID** ENSEMBL identifier

**type** type of transcript

**stat** status of transcript

**name** HUGO identifier

**entrezID** Entrez identifier

@source [ftp://ftp.sanger.ac.uk/pub/gencode/Gencode\\_mouse/release\\_M7/](ftp://ftp.sanger.ac.uk/pub/gencode/Gencode_mouse/release_M7/)

---

auc\_multifunc

*Calculating AUC for functional groups from ranked lists*

---

### Description

The function calculates the AUC for a functional group analytically using an optimal ranked list of genes that indicates association between genes and groups.

### Usage

```
auc_multifunc(annotations, optimallist)
```

### Arguments

**annotations** binary matrix indicating which list elements are in which functional groups.

**optimallist** Ranked list (multifunctionality analysis, see [calculate\\_multifunc](#)).

### Value

aucs array of aucs for each group in annotations

### Examples

```
annotations <- c(rep(0,10))
annotations[c(1,3,5)] <- 1
optimallist <- 10:1
aurocs_mf <- auc_multifunc(annotations, optimallist)
```

---

auprc	<i>Area under the precision recall curve</i>
-------	--

---

**Description**

The function calculates the area under the precision-recall curve

**Usage**

```
auprc(scores, labels)
```

**Arguments**

scores	numeric array
labels	binary array

**Value**

auprc Numeric value

**Examples**

```
labels <- c(rep(0,10))
labels[c(1,3,5)] <- 1
scores <- 10:1
auprc <- auprc(scores, labels)
```

---

auroc_analytic	<i>Area under the receiver operating characteristic curve</i>
----------------	---

---

**Description**

The function calculates the area under the receiver operating characteristic (ROC) curve analytically

**Usage**

```
auroc_analytic(ranks, labels)
```

**Arguments**

ranks	numeric array
labels	binary array

**Value**

auroc Numeric value

**Examples**

```
labels <- c(rep(0,10))
labels[c(1,3,5)] <- 1
scores <- 10:1
auroc <- auroc_analytic(scores, labels)
```

---

biogrid

*BIOGRID v3.4.126*

---

**Description**

A data frame containing protein-protein interactions

**Format**

A data frame with 211506 rows and 2 variables:

**entrezID\_A** List of Entrez identifiers, interactor A

**entrezID\_B** List of Entrez identifiers, interactor B

@source <http://thebiogrid.org/>

---

build\_binary\_network

*Builds a binary network*

---

**Description**

The function creates a gene-by-gene matrix with binary entries indicating interaction (1) or no interaction (0) between the genes.

**Usage**

```
build_binary_network(data, list)
```

**Arguments**

**data** 2-column matrix, each row a pair indicating a relationship or interaction

**list** string array of genes/labels/ids

**Value**

net matrix binary characterizing interactions

## Examples

```
data <- cbind(edgeA=c('gene1', 'gene2'), edgeB=c('gene3', 'gene3'))
list <- c('gene1', 'gene2', 'gene3')
network <- build_binary_network(data, list)
```

---

build\_coexp\_expressionSet

*Builds a coexpression network from an expressionSet*

---

## Description

The function generates a dense coexpression network from expression data stored in the `expressionSet` data type. Correlation coefficients are used as to weight the edges of the nodes (genes). Calls `build_coexp_network`.

## Usage

```
build_coexp_expressionSet(
  exprsSet,
  gene.list,
  method = "spearman",
  flag = "rank"
)
```

## Arguments

<code>exprsSet</code>	data class <code>ExpressionSet</code>
<code>gene.list</code>	array of gene labels
<code>method</code>	correlation method to use, default Spearman's rho
<code>flag</code>	string to indicate if the network should be ranked

## Value

net Matrix symmetric

## Examples

```
exprs <- matrix( rnorm(1000), ncol=10, byrow=TRUE)
gene.list <- paste('gene', 1:100, sep='')
sample.list <- paste('sample', 1:10, sep='')
rownames(exprs) <- gene.list
colnames(exprs) <- sample.list
network <- build_coexp_expressionSet(exprs, gene.list, method='pearson')
```



---

build_coexp_GEOID	<i>Builds a coexpression network given a GEO ID</i>
-------------------	---

---

### Description

The function generates a dense coexpression network from expression data stored in GEO. The expression data is downloaded from GEO. Correlation coefficients are used as to weight the edges of the nodes (genes). Calls [get\\_expression\\_matrix\\_from\\_GEO](#) and [build\\_coexp\\_network](#).

### Usage

```
build_coexp_GEOID(gseid, gene.list, method = "spearman", flag = "rank")
```

### Arguments

gseid	string GEO ID of expression experiment
gene.list	array of gene labels
method	correlation method to use, default Spearman's rho
flag	string to indicate if the network should be ranked

### Value

net Matrix symmetric

---

build_coexp_network	<i>Builds a coexpression network from an expressionSet</i>
---------------------	--

---

### Description

The function generates a dense coexpression network from expression data stored as a matrix, with the genes as row labels, and samples as column labels. Correlation coefficients are used as to weight the edges of the nodes (genes). Calls [cor](#).

### Usage

```
build_coexp_network(exprs, gene.list, method = "spearman", flag = "rank")
```

### Arguments

exprs	matrix of expression data
gene.list	array of gene labels
method	correlation method to use, default Spearman's rho
flag	string to indicate if the network should be ranked

**Value**

net Matrix symmetric

**Examples**

```
exprs <- matrix( rnorm(1000), ncol=10,byrow=TRUE)
gene.list <- paste('gene',1:100, sep='')
sample.list <- paste('sample',1:10, sep='')
rownames(exprs) <- gene.list
colnames(exprs) <- sample.list
network <- build_coexp_network(exprs, gene.list)
```

---

build\_semantic\_similarity\_network

*Builds a semantic similarity network*

---

**Description**

The function builds a semantic similarity network given a data and labels

**Usage**

```
build_semantic_similarity_network(genes.labels, genes)
```

**Arguments**

genes.labels	matrix with rows as genes and columns as a function/label
genes	array of gene IDs

**Value**

net Numeric value

**Examples**

```
genes.labels <- matrix( sample(c(0,1), 100, replace=TRUE),ncol=10,nrow=10)
rownames(genes.labels) <- 1:10
genes <- 1:10
net <- build_semantic_similarity_network(genes.labels, genes)
```

---

build\_weighted\_network  
*Builds a weighted network*

---

**Description**

The function creates a gene-by-gene matrix with binary entries indicating interaction (1) or no interaction (0) between the genes.

**Usage**

```
build_weighted_network(data, list)
```

**Arguments**

data	3-column matrix, each row a pair indicating a relationship or interaction, and the last column the weight
list	string array of genes/labels/ids

**Value**

net matrix characterizing interactions

**Examples**

```
data <- cbind(edgeA=c('gene1','gene2'),edgeB=c('gene3','gene3'), weight=c(0.5, 0.9))
list <- c('gene1','gene2','gene3')
network <- build_weighted_network(data,list)
```

---

calculate\_multifunc *Performing multifunctionality analysis*

---

**Description**

The function performs multifunctionality analysis ([1]) for a set of annotated genes and creates a rank based optimallist. For annotations use an ontology that is large enough to serve as a prior (e.g. GO, Phenocarta).

**Usage**

```
calculate_multifunc(genes.labels)
```

**Arguments**

genes.labels	Annotation matrix
--------------	-------------------

**Value**

gene.mfs Returns matrix with evaluation of gene function prediction by given labels:

**Examples**

```
genes.labels <- matrix( sample(c(0,1), 100, replace=TRUE),ncol=10,nrow=10)
rownames(genes.labels) = paste('gene', 1:10, sep='')
colnames(genes.labels) = paste('label', 1:10, sep='')
mf <- calculate_multifunc(genes.labels)
```

---

conv\_smoother

*Plot smoothed curve*

---

**Description**

The function plots a smoothed curve using the [convolve](#) function.

**Usage**

```
conv_smoother(X, Y, window, raw = FALSE, output = FALSE, ...)
```

**Arguments**

X	numeric array
Y	numeric array
window	numeric value indicating size of window to use
raw	boolean
output	boolean
...	other input into the plot function

**Value**

smoothed X,Y and std Y matrix

**Examples**

```
x <- 1:1000
y <- rnorm(1000)
conv <- conv_smoother(x,y,10)
```

---

example\_annotations    *Example of annotations*

---

**Description**

This dataset includes

---

example\_binary\_network  
*Example of binary network*

---

**Description**

This dataset includes

**Format**

Matrices and vectors

---

example\_coexpression    *Example of binary network*

---

**Description**

This dataset includes

**Format**

Matrices and vectors

---

example\_neighbor\_voting  
*Example of binary network*

---

**Description**

This dataset includes

**Format**

**entrezID** chromosomal start position, in base pairs  
**name** HUGO gene identifier  
**species** species  
**disease** disease

---

extend_network	<i>Builds an extended network from a binary network</i>
----------------	---

---

**Description**

The function extends a binary network by using the inverse of the path length between nodes as a weighted edge

**Usage**

```
extend_network(net, max = 6)
```

**Arguments**

net	matrix binary and symmetric
max	numeric maximum number of jumps

**Value**

ext\_net matrix dense and symmetric

**Examples**

```
net <- matrix( sample(c(0,1),36, replace=TRUE), nrow=6,byrow=TRUE)
ext_net <- extend_network(net)
```

---

filter_network	<i>Filter on matrix</i>
----------------	-------------------------

---

**Description**

The function filters out the rows or columns of a matrix such that the size of the group is exclusively between given min and max values

**Usage**

```
filter_network(network, flag = 1, min = 0, max = 1, ids = NA)
```

**Arguments**

network	numeric matrix
flag	numeric 1 for row filtering, 2 for column filtering
min	numeric value
max	numeric value
ids	array to filter on

**Value**

network numeric matrix

**Examples**

```
net <- matrix( rnorm(10000), nrow=100)
filt_net <- filter_network(net,1,10,100)
```

---

filter\_network\_cols     *Filter on columns*

---

**Description**

The function filters out the columns of a matrix such that the size of the group is exclusively between given min and max values

**Usage**

```
filter_network_cols(network, min = 0, max = 1, ids = NA)
```

**Arguments**

network	numeric matrix
min	numeric value
max	numeric value
ids	array

**Value**

network numeric matrix

**Examples**

```
genes.labels <- matrix( sample( c(0,1), 10000, replace=TRUE), nrow=100)
rownames(genes.labels) = paste('gene', 1:100, sep='')
colnames(genes.labels) = paste('function', 1:100, sep='')
genes.labels <- filter_network_cols(genes.labels,50,200)

genes.labels <- matrix( sample( c(0,1), 10000, replace=TRUE), nrow=100)
rownames(genes.labels) = paste('gene', 1:100, sep='')
colnames(genes.labels) = paste('function', 1:100, sep='')
genes.labels <- filter_network_cols(genes.labels,ids = paste('function', 1:20, sep=''))
```

---

filter\_network\_rows    *Filter on rows*

---

## Description

The function filters out the rows of a matrix such that the size of the group is exclusively between given min and max values

## Usage

```
filter_network_rows(network, min = 0, max = 1, ids = NA)
```

## Arguments

network	numeric matrix
min	numeric value
max	numeric value
ids	array to filter on

## Value

network numeric matrix

## Examples

```
genes.labels <- matrix( sample( c(0,1), 10000, replace=TRUE), nrow=100)  
rownames(genes.labels) = paste('gene', 1:100, sep='')  
colnames(genes.labels) = paste('function', 1:100, sep='')  
genes.labels <- filter_network_rows(genes.labels,50,200)
```

```
genes.labels <- matrix( sample( c(0,1), 10000, replace=TRUE), nrow=100)  
rownames(genes.labels) = paste('gene', 1:100, sep='')  
colnames(genes.labels) = paste('function', 1:100, sep='')  
genes.labels <- filter_network_rows(genes.labels,ids = paste('gene', 1:20, sep=''))
```



---

filter_orthologs	<i>Filter on orthologs</i>
------------------	----------------------------

---

**Description**

The function filters away the labels for the genes that are not in the orthologs list

**Usage**

```
filter_orthologs(annotations, genelist, orthologs)
```

**Arguments**

annotations	binary matrix
genelist	array of gene ids
orthologs	array to filter on

**Value**

annotations\_filtered binary matrix

**Examples**

```
genes.labels <- matrix( sample( c(0,1), 1000, replace=TRUE), nrow=100)
rownames(genes.labels) = paste('gene', 1:100, sep='')
colnames(genes.labels) = paste('function', 1:10, sep='')
gene.list <- paste('gene', 1:100, sep='')
orthologs <- paste('gene', (1:50)*2, sep='')
genes.labels.filt <- filter_orthologs(genes.labels, gene.list, orthologs)
```

---

fmeasure	<i>Fmeasure of precision-recall</i>
----------	-------------------------------------

---

**Description**

The function calculates fmeasure for a given beta of a precision-recall curve

**Usage**

```
fmeasure(recall, precis, beta = 1)
```

**Arguments**

recall	numeric array
precis	numeric array
beta	numeric value, default is 1

**Value**

fmeasure Numeric value

**Examples**

```
labels <- c(rep(0,10))
labels[c(1,3,5)] <- 1
scores <- 10:1
prc <- get_prc(scores, labels)
fm <- fmeasure(prc[,1], prc[,2])
```

---

genes

*Genes from BIOGRID v3.4.126*

---

**Description**

An array containing identifiers for genes in biogrid

**Format**

Array

**genes** List of Entrez identifiers

@source <http://thebiogrid.org/>

---

get\_auc

*Calculates the area under a curve*

---

**Description**

The function calculates the area under the curve defined by x and y

**Usage**

```
get_auc(x, y)
```

**Arguments**

x numeric array

y numeric array

**Value**

auc numeric value

**Examples**

```
x <- 1:100
y <- 1:100
auc <- get_auc(x,y)
```

---

`get_biogrid`*Downloading and filtering BIOGRID*

---

**Description**

The function downloads the specified version of biogrid for a particular taxon

**Usage**

```
get_biogrid(species = "9606", version = "3.5.181", interactions = "physical")
```

**Arguments**

species	numeric taxon of species
version	string of biogrid version
interactions	string stating either physical or genetic interactions

**Value**

biogrid data.frame with interactions

---

`get_counts`*Get counts*

---

**Description**

The function formats the count distribution from the histogram function

**Usage**

```
get_counts(hist)
```

**Arguments**

hist	histogram
------	-----------

**Value**

x,y

**Examples**

```
x <- runif(1000)
counts <- get_counts( hist(x, plot=FALSE))
```

---

get_density	<i>Get density</i>
-------------	--------------------

---

**Description**

The function formats the density distribution from the histogram function

**Usage**

```
get_density(hist)
```

**Arguments**

hist	histogram
------	-----------

**Value**

array

**Examples**

```
x <- runif(1000)
density <- get_density( hist(x, plot=FALSE))
```

---

get_expression_data_gemma	<i>Obtain expression matrix from the GEMMA database</i>
---------------------------	---

---

**Description**

The function downloads and parses the expression matrix from the GEMMA database, specified by the GEO ID

**Usage**

```
get_expression_data_gemma(gseid, filtered = "true")
```

**Arguments**

gseid	GEO ID of the expression experiment
filtered	flag to indicate whether or not the data is QC

**Value**

list of genes and the expression matrix

---

*get\_expression\_matrix\_from\_GEO*  
*Obtain expression matrix from GEO database*

---

**Description**

The function downloads and parses the expression matrix from the GEO file specified by the GEO ID

**Usage**

```
get_expression_matrix_from_GEO(gseid)
```

**Arguments**

`gseid`                   GEO ID of the expression experiment

**Value**

list of genes and the expression matrix

---

*get\_phenocarta*           *Downloading and filtering Phenocarta*

---

**Description**

The function downloads the latest version of phenocarta

**Usage**

```
get_phenocarta(species = "human", type = "all")
```

**Arguments**

`species`           string  
`type`               string

**Value**

data data.frame with phenocarta data

---

`get_prc`*Build precision-recall curve*

---

**Description**

The function calculates the recall and precision

**Usage**

```
get_prc(ranks, labels)
```

**Arguments**

ranks	numeric array
labels	binary array

**Value**

recall,precision numeric arrays

**Examples**

```
labels <- c(rep(0,10))
labels[c(1,3,5)] <- 1
scores <- 10:1
ranks <- rank(scores)
prc <- get_prc(ranks, labels)
```

---

`get_roc`*Build receiver operating characteristic curve*

---

**Description**

The function calculates the FPR and TRPR for the receiver operating characteristic (ROC)

**Usage**

```
get_roc(ranks, labels)
```

**Arguments**

ranks	numeric array
labels	binary array

**Value**

FPR,TPR numeric arrays

**Examples**

```
labels <- c(rep(0,10))
labels[c(1,3,5)] <- 1
scores <- 10:1
ranks <- rank(scores)
roc <- get_roc(ranks, labels)
```

---

GO.human

*GO - human*

---

**Description**

A dataset of the gene GO associations

**Format**

A data frame with 2511938 rows and 4 variables:

**name** gene symbol

**entrezID** entrez identifier

**GO** gene ontology term ID

**evidence** evidence code

@source <http://geneontology.org/>

---

GO.mouse

*GO - mouse*

---

**Description**

A dataset of the gene GO associations

**Format**

A data frame with 2086086 rows and 4 variables:

**name** gene symbol

**entrezID** entrez identifier

**GO** gene ontology term ID

**evidence** evidence code

@source <http://geneontology.org/>

---

GO.voc	<i>Gene ontology vocabulary</i>
--------	---------------------------------

---

**Description**

A dataset of the gene ontology vocabulary

**Format**

A data frame with 42266 rows and 3 variables:

**GOID** GO identifier

**term** GO description

**domain** GO domain

@source <http://geneontology.org/>

---

make_annotations	<i>Creating gene annotations</i>
------------------	----------------------------------

---

**Description**

The function annotates a list of genes according to a given ontology. It creates a binary matrix associating genes (rows) with labels (columns).

**Usage**

```
make_annotations(data, listA, listB)
```

**Arguments**

data	2-column matrix, each row a pair indicating a relationship or interaction
listA	string array of genes
listB	string array of labels/functions

**Value**

net matrix binary

**Examples**

```
gene.list <- paste('gene', 1:100, sep='')
labels.list <- paste('labels', 1:10, sep='')
data <- matrix(0, nrow=100, ncol=2)
data[,1] <- sample(gene.list, 100, replace=TRUE)
data[,2] <- sample(labels.list, 100, replace=TRUE)
net <- make_annotations(data, gene.list, labels.list)
```



---

make_genelist	<i>Creating list of all genes in the data set.</i>
---------------	--

---

**Description**

The function extracts the list of all genes in the data set

**Usage**

```
make_genelist(gene_data_interacting)
```

**Arguments**

gene\_data\_interacting  
2-column matrix, each row a pair indicating a relationship or interaction

**Value**

list array of data labels

**Examples**

```
gene.list <- paste('gene', 1:100, sep='')  
data <- matrix(0,nrow=100, ncol=2)  
data[,1] <- sample(gene.list, 50, replace=TRUE)  
data[,2] <- sample(gene.list, 50, replace=TRUE)  
genes <- make_genelist(data)
```

---

make_gene_network	<i>Creating gene-by-gene network</i>
-------------------	--------------------------------------

---

**Description**

The function creates a gene-by-gene matrix with binary entries indicating interaction (1) or no interaction (0) between the genes.

**Usage**

```
make_gene_network(data, list)
```

**Arguments**

data            2-column matrix, each row a pair indicating a relationship or interaction  
list            string array of genes

**Value**

net matrix binary characterizing interactions

**Examples**

```
gene.list <- paste('gene', 1:100, sep='')
data <- matrix(0,nrow=100, ncol=2)
data[,1] <- sample(gene.list, 100)
data[,2] <- sample(gene.list, 100)
net <- make_gene_network(data, gene.list)
```

---

make_transparent	<i>Make a color transparent (Taken from an answer on StackOverflow by Nick Sabbe)</i>
------------------	---

---

**Description**

Make a color transparent (Taken from an answer on StackOverflow by Nick Sabbe)

**Usage**

```
make_transparent(color, alpha = 100)
```

**Arguments**

color	color number, string or hexadecimal code
alpha	numeric transparency

**Value**

someColor rgb

---

neighbor_voting	<i>Evaluating Gene Function Prediction</i>
-----------------	--

---

**Description**

The function performs gene function prediction based on 'guilt by association' using cross validation ([1]). Performance and significance are evaluated by calculating the AUROC or AUPRC of each functional group.

**Usage**

```
neighbor_voting(
  genes.labels,
  network,
  nFold = 3,
  output = "AUROC",
  FLAG_DRAW = FALSE
)
```

**Arguments**

genes.labels	numeric array
network	numeric array symmetric, gene-by-gene matrix
nFold	numeric value, default is 3
output	string, default is AUROC
FLAG_DRAW	binary flag to draw roc plot

**Value**

scores numeric matrix with a row for each gene label and columns auc: the average area under the ROC or PR curve for the neighbor voting predictor across cross validation replicates avg\_node\_degree: the average node degree degree\_null\_auc: the area the ROC or PR curve for the node degree predictor

**Examples**

```
genes.labels <- matrix( sample( c(0,1), 1000, replace=TRUE), nrow=100)
rownames(genes.labels) = paste('gene', 1:100, sep='')
colnames(genes.labels) = paste('function', 1:10, sep='')
net <- cor( matrix( rnorm(10000), ncol=100), method='spearman')
rownames(net) <- paste('gene', 1:100, sep='')
colnames(net) <- paste('gene', 1:100, sep='')

aurocs <- neighbor_voting(genes.labels, net, output = 'AUROC')

avgprcs <- neighbor_voting(genes.labels, net, output = 'PR')
```

---

node\_degree

*Calculate node degree*


---

**Description**

The function calculates the node degree of a network

**Usage**

```
node_degree(net)
```

**Arguments**

`net` numeric matrix

**Value**

`node_degree` numeric array

**Examples**

```
net <- cor( matrix(rnorm(1000), ncol=10))
n <- 10
net <- matrix(rank(net, na.last = 'keep', ties.method = 'average'), nrow = n, ncol = n)
net <- net/max(net, na.rm=TRUE)
nd <- node_degree(net)
```

---

ortho

*Gene orthologs*

---

**Description**

A list containing identifiers for the subsets of gene orthologs

**Format**

List orthologs for 5 species

**dros** List of Entrez identifiers, Drosophila

**celeg** List of Entrez identifiers, C. elegans

**yeast** List of Entrez identifiers, Yeast

**mouse** List of Entrez identifiers, Mouse

**zf** List of Entrez identifiers, Zebrafish

@source <http://useast.ensembl.org/index.html/>

---

pheno	<i>Phenocarta</i>
-------	-------------------

---

**Description**

A dataset of gene disease associations

**Format**

A data frame with 142272 rows and 4 variables:

**entrezID** chromosomal start position, in base pairs

**name** HUGO gene identifier

**species** species

**disease** disease

@source <http://www.chibi.ubc.ca/Gemma/phenotypes.html>

---

plot_densities	<i>Plot densities</i>
----------------	-----------------------

---

**Description**

The function plots multiple density curves and compares their modes

**Usage**

```
plot_densities(
  hists,
  id,
  col = c("lightgrey"),
  xlab = "",
  ylab = "Density",
  mode = "hist"
)
```

**Arguments**

hists	list of histogram objects or density objects
id	string
col	color for shading
xlab	string x-axis label
ylab	string y-axis label
mode	flag indicating histogram or density

**Value**

null

**Examples**

```
aurocsA <- density((runif(1000)+runif(1000)+runif(1000)+runif(1000))/4)
aurocsB <- density((runif(1000)+runif(1000)+runif(1000))/3)
aurocsC <- density(runif(1000))
hists <- list(aurocsA, aurocsB, aurocsC)
temp <- plot_densities(hists, '', mode='density')
```

---

plot\_density\_compare *Plot density comparisons*

---

**Description**

The function plots two density curves and compares their modes

**Usage**

```
plot_density_compare(
  aucA,
  aucB,
  col = "lightgrey",
  xlab = "AUROC (neighbor voting)",
  ylab = "Density",
  mode = TRUE
)
```

**Arguments**

aucA	numeric array of aurocs
aucB	numeric array of aurocs
col	color of lines
xlab	string label
ylab	string label
mode	boolean to plot mode or mean

**Value**

null

**Examples**

```
aurocsA <- (runif(1000)+runif(1000)+runif(1000)+runif(1000))/4
aurocsB <- runif(1000)
plot_density_compare(aurocsA, aurocsB)
```

---

plot\_distribution      *Plot distribution histogram*

---

**Description**

The function plots a the distribution of AUROCs

**Usage**

```
plot_distribution(  
  auc,  
  b = 20,  
  col = "lightgrey",  
  xlab = "",  
  ylab = "Density",  
  xlim = c(0.4, 1),  
  ylim = c(0, 5),  
  med = TRUE,  
  avg = TRUE,  
  density = TRUE,  
  bars = FALSE  
)
```

**Arguments**

auc	numeric aucs
b	array of breaks
col	color of line
xlab	string label
ylab	string label
xlim	range of values for xaxis
ylim	range of values for yaxis
med	boolean to plot median auc
avg	boolean to plot average auc
density	boolean
bars	boolean for barplot

**Value**

auc list and quartiles

**Examples**

```
aurops <- (runif(1000)+runif(1000)+runif(1000)+runif(1000))/4  
d <- plot_distribution(aurops)
```

---

plot\_network\_heatmap *Plot network heatmap*

---

**Description**

The function draws a heatmap to visualize a network

**Usage**

```
plot_network_heatmap(net, colrs)
```

**Arguments**

net	a numeric matrix of edge weights
colrs	a range of colors to plot the network

**Value**

null

**Examples**

```
network <- cor(matrix( rnorm(10000), nrow=100))  
plot_network_heatmap(network)
```



---

plot_prc	<i>Plot precision recall curve</i>
----------	------------------------------------

---

**Description**

The function calculates the precision and recall and plots the curve

**Usage**

```
plot_prc(scores, labels)
```

**Arguments**

scores	numeric array
labels	binary array

**Value**

prc numeric arrays

**Examples**

```
labels <- c(rep(0,10))
labels[c(1,3,5)] <- 1
scores <- 10:1
roc <- plot_prc(scores, labels)
```

---

plot_roc	<i>Plot receiver operating characteristic curve</i>
----------	---

---

**Description**

The function calculates the FPR and TRPR for the receiver operating characteristic (ROC) and plots the curve

**Usage**

```
plot_roc(scores, labels)
```

**Arguments**

scores	numeric array
labels	binary array

**Value**

FPR,TPR numeric arrays

**Examples**

```
labels <- c(rep(0,10))
labels[c(1,3,5)] <- 1
scores <- 10:1
roc <- plot_roc(scores, labels)
```

---

plot\_roc\_overlay      *Plot ROC overlay*

---

**Description**

The function plots a density overlay of ROCs given the scores and labels

**Usage**

```
plot_roc_overlay(scores.mat, labels.mat, nbins = 100)
```

**Arguments**

scores.mat	numeric array
labels.mat	numeric array
nbins	numeric value

**Value**

list of Z(matrix) and roc\_sum (average ROC curve)

**Examples**

```
genes.labels <- matrix( c(rep(1, 1000), rep(0,9000)), nrow=1000, byrow=TRUE)
rownames(genes.labels) = paste('gene', 1:1000, sep='')
colnames(genes.labels) = paste('function', 1:10, sep='')

scores <- matrix( rnorm(10000), nrow=1000)
scores <- apply(scores, 2, rank)
rownames(scores) = paste('gene', 1:1000, sep='')
colnames(scores) = paste('function', 1:10, sep='')

z <- plot_roc_overlay(scores, genes.labels)
```

---

plot\_value\_compare      *Plot value comparisons*

---

### Description

The function plots a scatter

### Usage

```
plot_value_compare(
  aucA,
  aucB,
  xlab = "AUROC",
  ylab = "AUROC",
  xlim = c(0, 1),
  ylim = c(0, 1)
)
```

### Arguments

aucA	numeric array of aucs
aucB	numeric array of aucs
xlab	string label
ylab	string label
xlim	range of values for xaxis
ylim	range of values for yaxis

### Value

null

---

predictions      *Performing Gene Function Prediction*

---

### Description

The function performs gene function prediction on the whole data set using the 'guilt by association'-principle ([1]).

### Usage

```
predictions(genes.labels, network)
```

**Arguments**

genes.labels    numeric array  
network        numeric array symmetric, gene-by-gene matrix

**Value**

scores numeric matrix

**Examples**

```
genes.labels <- matrix( sample( c(0,1), 1000, replace=TRUE), nrow=100)
rownames(genes.labels) = paste('gene', 1:100, sep='')
colnames(genes.labels) = paste('function', 1:10, sep='')
net <- cor( matrix( rnorm(10000), ncol=100), method='spearman')
rownames(net) <- paste('gene', 1:100, sep='')
colnames(net) <- paste('gene', 1:100, sep='')

preds <- predictions(genes.labels, net)
```

---

repmat

*Rep function for matrices*


---

**Description**

The function generates a matrix by binding the columns and rows

**Usage**

```
repmat(X, m, n)
```

**Arguments**

X                numeric matrix  
m                numeric value, repeat rows m times  
n                numeric value, repeat columns n times

**Value**

list of genes and the expression matrix

**Examples**

```
genes.labels <- matrix( sample( c(0,1), 1000, replace=TRUE), nrow=100)
expand <- repmat( genes.labels, 1,2)
```

---

`run_GBA`*Performing 'Guilt by Association' Analysis*

---

### Description

The function runs and evaluates gene function prediction based on the 'guilt by association'-principle using neighbor voting ([neighbor\\_voting](#)) [1]. As a measure of performance and significance of results, AUCs of all evaluated functional groups are calculated.

### Usage

```
run_GBA(network, labels, min = 20, max = 1000, nfold = 3)
```

### Arguments

<code>network</code>	numeric array symmetric, gene-by-gene matrix
<code>labels</code>	numeric array
<code>min</code>	numeric value to limit gene function size
<code>max</code>	numeric value to limit gene function size
<code>nfold</code>	numeric value, default is 3

### Value

list roc.sub, genes, auroc

### Examples

```
genes.labels <- matrix( sample( c(0,1), 1000, replace=TRUE), nrow=100)
rownames(genes.labels) = paste('gene', 1:100, sep='')
colnames(genes.labels) = paste('function', 1:10, sep='')
net <- cor( matrix( rnorm(10000), ncol=100), method='spearman')
rownames(net) <- paste('gene', 1:100, sep='')
colnames(net) <- paste('gene', 1:100, sep='')

gba <- run_GBA(net, genes.labels, min=10)
```

# Index

- \* **AUC**
  - auc\_multifunc, 5
- \* **AUROC**
  - plot\_distribution, 31
- \* **ExpressionSet**
  - build\_coexp\_expressionSet, 8
  - build\_coexp\_network, 9
- \* **FPR**
  - get\_roc, 22
  - plot\_roc, 33
- \* **GEMMA**
  - get\_expression\_data\_gemma, 20
- \* **GEO**
  - build\_coexp\_GEOID, 9
  - get\_expression\_data\_gemma, 20
  - get\_expression\_matrix\_from\_GEO, 21
- \* **GSE**
  - build\_coexp\_GEOID, 9
  - get\_expression\_data\_gemma, 20
  - get\_expression\_matrix\_from\_GEO, 21
- \* **PRC**
  - plot\_prc, 33
- \* **ROC**
  - auroc\_analytic, 6
  - get\_roc, 22
  - plot\_distribution, 31
  - plot\_roc, 33
  - plot\_roc\_overlay, 34
- \* **TPR**
  - get\_roc, 22
  - plot\_roc, 33
- \* **analytic**
  - auroc\_analytic, 6
- \* **annotations**
  - filter\_orthologs, 17
  - make\_annotations, 24
- \* **area**
  - auprc, 6
  - auroc\_analytic, 6
  - get\_auc, 18
- \* **association**
  - neighbor\_voting, 26
  - predictions, 35
  - run\_GBA, 37
- \* **assortativity**
  - assortativity, 3
- \* **a**
  - get\_auc, 18
- \* **biogrid**
  - get\_biogrid, 19
- \* **by**
  - neighbor\_voting, 26
  - predictions, 35
  - run\_GBA, 37
- \* **characteristic**
  - auroc\_analytic, 6
  - get\_roc, 22
  - plot\_roc, 33
- \* **coexpression**
  - build\_coexp\_expressionSet, 8
  - build\_coexp\_GEOID, 9
  - build\_coexp\_network, 9
- \* **cross**
  - neighbor\_voting, 26
  - run\_GBA, 37
- \* **curve**
  - get\_auc, 18
- \* **degree**
  - node\_degree, 27
- \* **dense**
  - build\_coexp\_expressionSet, 8
  - build\_coexp\_GEOID, 9
  - build\_coexp\_network, 9
- \* **density**
  - plot\_densities, 29
- \* **distribution**
  - plot\_distribution, 31
- \* **download**

- get\_biogrid, 19
  - get\_phenocarta, 21
- \* **evaluation**
  - calculate\_multifunc, 11
  - neighbor\_voting, 26
  - run\_GBA, 37
- \* **evaluation**
  - auc\_multifunc, 5
- \* **experiment**
  - get\_expression\_data\_gemma, 20
  - get\_expression\_matrix\_from\_GEO, 21
- \* **expressionSet**
  - build\_coexp\_expressionSet, 8
  - build\_coexp\_network, 9
- \* **expression**
  - get\_expression\_data\_gemma, 20
  - get\_expression\_matrix\_from\_GEO, 21
- \* **extended**
  - extend\_network, 14
- \* **extract**
  - make\_genelist, 25
- \* **filter**
  - filter\_network, 14
  - filter\_network\_cols, 15
  - filter\_network\_rows, 16
  - filter\_orthologs, 17
- \* **fmeasure**
  - fmeasure, 17
- \* **function**
  - calculate\_multifunc, 11
  - make\_annotations, 24
  - neighbor\_voting, 26
  - predictions, 35
  - run\_GBA, 37
- \* **gene-by-gene**
  - build\_binary\_network, 7
  - build\_weighted\_network, 11
  - make\_gene\_network, 25
- \* **gene**
  - calculate\_multifunc, 11
  - make\_annotations, 24
  - make\_genelist, 25
  - neighbor\_voting, 26
  - predictions, 35
  - run\_GBA, 37
- \* **guilt**
  - neighbor\_voting, 26
  - predictions, 35
- run\_GBA, 37
- \* **heatmap**
  - plot\_network\_heatmap, 32
- \* **histogram**
  - get\_counts, 19
  - get\_density, 20
- \* **igraph**
  - extend\_network, 14
- \* **image**
  - plot\_network\_heatmap, 32
- \* **interaction**
  - build\_binary\_network, 7
  - build\_weighted\_network, 11
  - make\_gene\_network, 25
- \* **jaccard**
  - build\_semantic\_similarity\_network, 10
- \* **labels**
  - make\_annotations, 24
- \* **length**
  - extend\_network, 14
- \* **list**
  - make\_genelist, 25
- \* **matrix**
  - repmat, 36
- \* **mean**
  - get\_auc, 18
- \* **metric**
  - auprc, 6
  - auroc\_analytic, 6
  - get\_roc, 22
  - node\_degree, 27
  - plot\_prc, 33
  - plot\_roc, 33
- \* **multifunctionality**
  - auc\_multifunc, 5
- \* **neighbor**
  - neighbor\_voting, 26
  - predictions, 35
  - run\_GBA, 37
- \* **network**
  - assortativity, 3
  - build\_binary\_network, 7
  - build\_coexp\_expressionSet, 8
  - build\_coexp\_GEOID, 9
  - build\_coexp\_network, 9
  - build\_semantic\_similarity\_network, 10

- build\_weighted\_network, 11
- extend\_network, 14
- filter\_network, 14
- filter\_network\_cols, 15
- filter\_network\_rows, 16
- make\_gene\_network, 25
- node\_degree, 27
- plot\_network\_heatmap, 32
- \* **node**
  - node\_degree, 27
- \* **ontology**
  - calculate\_multifunc, 11
  - make\_annotations, 24
- \* **operating**
  - auroc\_analytic, 6
  - get\_roc, 22
  - plot\_roc, 33
- \* **orthologs**
  - filter\_orthologs, 17
- \* **overlay**
  - plot\_roc\_overlay, 34
- \* **path**
  - extend\_network, 14
- \* **phenocarta**
  - get\_phenocarta, 21
- \* **plot**
  - conv\_smoother, 12
  - get\_density, 20
  - plot\_densities, 29
  - plot\_density\_compare, 30
  - plot\_distribution, 31
  - plot\_network\_heatmap, 32
  - plot\_prc, 33
  - plot\_roc\_overlay, 34
  - plot\_value\_compare, 35
- \* **precision-recall**
  - auprc, 6
  - fmeasure, 17
- \* **precision**
  - get\_prc, 22
  - plot\_prc, 33
- \* **precision-recall**
  - get\_prc, 22
- \* **prediction**
  - calculate\_multifunc, 11
  - neighbor\_voting, 26
  - predictions, 35
  - run\_GBA, 37
- \* **properties**
  - assortativity, 3
- \* **recall**
  - get\_prc, 22
  - plot\_prc, 33
- \* **receiver**
  - auroc\_analytic, 6
  - get\_roc, 22
  - plot\_roc, 33
- \* **repeat**
  - repmat, 36
- \* **repmat**
  - repmat, 36
- \* **rolling**
  - get\_auc, 18
- \* **rows**
  - filter\_network, 14
  - filter\_network\_cols, 15
  - filter\_network\_rows, 16
- \* **semantic**
  - build\_semantic\_similarity\_network, 10
- \* **shortest**
  - extend\_network, 14
- \* **similarity**
  - build\_semantic\_similarity\_network, 10
- \* **smooth**
  - conv\_smoother, 12
- \* **topology**
  - assortativity, 3
  - node\_degree, 27
- \* **to**
  - make\_annotations, 24
- \* **under**
  - get\_auc, 18
- \* **validation**
  - neighbor\_voting, 26
  - run\_GBA, 37
- \* **voting**
  - neighbor\_voting, 26
  - predictions, 35
  - run\_GBA, 37
- assortativity, 3
- attr.human, 4
- attr.mouse, 4
- auc\_multifunc, 5
- auprc, 6



auroc\_analytic, 6

biogrid, 7

build\_binary\_network, 7

build\_coexp\_expressionSet, 8

build\_coexp\_GEOID, 9

build\_coexp\_network, 8, 9, 9

build\_semantic\_similarity\_network, 10

build\_weighted\_network, 11

calculate\_multifunc, 5, 11

conv\_smoother, 12

convolve, 12

cor, 9

example\_annotations, 13

example\_binary\_network, 13

example\_coexpression, 13

example\_neighbor\_voting, 13

extend\_network, 14

filter\_network, 14

filter\_network\_cols, 15

filter\_network\_rows, 16

filter\_orthologs, 17

fmeasure, 17

genes, 18

get\_auc, 18

get\_biogrid, 19

get\_counts, 19

get\_density, 20

get\_expression\_data\_gemma, 20

get\_expression\_matrix\_from\_GEO, 9, 21

get\_phenocarta, 21

get\_prc, 22

get\_roc, 22

GO.human, 23

GO.mouse, 23

GO.voc, 24

make\_annotations, 24

make\_gene\_network, 25

make\_genelist, 25

make\_transparent, 26

neighbor\_voting, 26, 37

node\_degree, 27

ortho, 28

pheno, 29

plot\_densities, 29

plot\_density\_compare, 30

plot\_distribution, 31

plot\_network\_heatmap, 32

plot\_prc, 33

plot\_roc, 33

plot\_roc\_overlay, 34

plot\_value\_compare, 35

predictions, 35

repmat, 36

run\_GBA, 37