

Package ‘Fancy’

September 15, 2026

Type Package

Title Frequency and Nonlinear Correlation Hybrid Network Inference

Version 0.99.4

URL <https://github.com/wala-github/Fancy>

BugReports <https://github.com/wala-github/Fancy/issues>

Description Infers microbial co-abundance networks by combining mutual information (via MRNET) and distance correlation into a single hybrid edge score. Bootstrap resampling provides frequency-based confidence, and a weighted scoring function ranks edges for downstream module analysis. Designed for metagenome-assembled genome (MAG) count tables.

License GPL (>= 3)

Encoding UTF-8

LazyData true

Roxygen list(markdown = TRUE)

RoxygenNote 7.3.3

Depends R (>= 4.5.0)

Imports minet, compositions, energy, knnmi, snowfall, methods, dplyr, tidyrr, purrr, readr, rlang, tibble, stringr, graphics, stats, utils

Suggests BiocStyle, knitr, rmarkdown, testthat (>= 3.0.0), ggplot2, igraph, magick

biocViews NetworkInference, Network, Metagenomics, Microbiome, StatisticalMethod

VignetteBuilder knitr

Config/testthat/edition 3

git_url <https://git.bioconductor.org/packages/Fancy>

git_branch devel

git_last_commit 6820258

git_last_commit_date 2026-06-29

Repository Bioconductor 3.24

Date/Publication 2026-09-14

Author Wanxin Lai [aut, cre] (ORCID: <<https://orcid.org/0009-0000-1607-2453>>)

Maintainer Wanxin Lai <wanxin.graceca@gmail.com>

Contents

Fancy-package	2
.bootstrap_single	3
.extract_mi_edges	3
.init_snowfall	4
.read_column_from_tsvs	4
.remove_directionality	5
bootstrap_networks	5
clean_sample_names	6
clr_normalize	7
compute_dcor_matrix	7
compute_edge_frequencies	8
compute_hybrid_scores	8
compute_mi_matrix	9
compute_mrnet_network	9
export_cytoscape	10
fancy	11
FancyResult-class	12
fancy_tiny_clr	13
fancy_tiny_counts	14
fancy_tiny_coverage	14
fancy_tiny_metadata	15
fancy_tiny_taxonomy	15
filter_mags	16
find_optimal_k	17
hybrid_score	18
parse_count_tables	19
parse_gtdb_taxonomy	20
phyla_palette	21
plot,FancyResult,missing-method	22
plot_k_elbow	22
plot_network	23
show,FancyResult-method	24
threshold_edges	24
\$,FancyResult-method	25
Index	26

Fancy-package	<i>Fancy: Frequency and Nonlinear Correlation Hybrid Network Inference</i>
---------------	--

Description

Infers microbial co-abundance networks by combining mutual information (via MRNET) and distance correlation into a single hybrid edge score. Bootstrap resampling provides frequency-based confidence, and a weighted scoring function ranks edges for downstream module analysis. Designed for metagenome-assembled genome (MAG) count tables.

Author(s)

Maintainer: Wanxin Lai <wanxin.graceca@gmail.com> ([ORCID](#))

See Also

Useful links:

- <https://github.com/wala-github/Fancy>
- Report bugs at <https://github.com/wala-github/Fancy/issues>

<code>.bootstrap_single</code>	<i>Single bootstrap iteration</i>
--------------------------------	-----------------------------------

Description

Resamples rows of data with replacement, computes the MI matrix, optionally applies MRNET or extracts all MI edges, and computes dCor edges.

Usage

```
.bootstrap_single(iter, data, k, use_mrnet)
```

Arguments

<code>iter</code>	Integer; iteration number (unused but required by <code>sfClusterApplyLB</code>).
<code>data</code>	Numeric matrix (samples x MAGs).
<code>k</code>	Integer; kNN parameter for MI estimation.
<code>use_mrnet</code>	Logical; if TRUE, apply MRNET; if FALSE, extract all pairwise MI edges.

Value

A named list with MRNET (data.frame) and dCor (data.frame).

<code>.extract_mi_edges</code>	<i>Extract all pairwise MI edges from the upper triangle</i>
--------------------------------	--

Description

Returns every non-zero MI pair from the upper triangle of the MI matrix as an edge list. Used when `use_mrnet = FALSE` in `bootstrap_networks()` as a non-sparse alternative to MRNET.

Usage

```
.extract_mi_edges(mi_matrix)
```

Arguments

<code>mi_matrix</code>	A symmetric MI matrix (from <code>compute_mi_matrix()</code>).
------------------------	---

Value

A data.frame with columns source, target, weight.

<code>.init_snowfall</code>	<i>Initialise snowfall cluster</i>
-----------------------------	------------------------------------

Description

Sets up a **snowfall** parallel cluster and loads required packages on every worker.

Usage

```
.init_snowfall(cpus, slave_outfile = NULL)
```

Arguments

<code>cpus</code>	Integer; number of workers.
<code>slave_outfile</code>	Character path for worker log output, or NULL for the platform null device.

Value

Called for its side-effect (cluster initialisation).

<code>.read_column_from_tsvs</code>	<i>Read a single column from each TSV and merge by MAG ID</i>
-------------------------------------	---

Description

Read a single column from each TSV and merge by MAG ID

Usage

```
.read_column_from_tsvs(file_paths, column, id_col = "mags_ids")
```

Arguments

<code>file_paths</code>	Character vector of file paths.
<code>column</code>	Integer; which data column to select (1-based, after the row-names column).
<code>id_col</code>	Character; name used for the MAG-ID join column.

Value

A data.frame with MAG IDs in the first column and one sample column per file.

`.remove_directionality`*Canonicalise edge direction*

Description

Swaps source and target so the lexicographically smaller node is always in the source column.

Usage

```
.remove_directionality(df)
```

Arguments

`df` A data.frame with at least source and target columns (character).

Value

The same data.frame with `source <= target` for every row.

`bootstrap_networks`*Bootstrap network inference*

Description

Runs `n_bootstrap` bootstrap iterations in parallel using **snowfall**. Each iteration resamples rows, computes MI and dCor networks, and returns edge lists. Results are collected into a single named list.

Usage

```
bootstrap_networks(  
  data,  
  n_bootstrap = 100L,  
  k = 5L,  
  cpus = 1L,  
  use_mrnet = TRUE,  
  save_path = NULL  
)
```

Arguments

`data` A numeric matrix or data.frame with observations (samples) as rows and variables (MAGs) as columns.

`n_bootstrap` Integer; number of bootstrap iterations.

`k` Integer; kNN parameter for `compute_mi_matrix()`.

`cpus` Integer; number of parallel workers. For large datasets (>1000 MAGs), consider using more CPUs (e.g. `cpus = 14L`).

use_mrnet	Logical; if TRUE (default), applies MRNET to the MI matrix for sparse edge selection. If FALSE, uses all pairwise MI edges directly.
save_path	Optional directory path. When non-NULL, each bootstrap result is saved as an RDS file for recovery.

Value

A named list with elements MRNET_1, dCor_1, MRNET_2, dCor_2, etc.

Examples

```
small_mat <- matrix(rnorm(50),
  nrow = 10, ncol = 5,
  dimnames = list(NULL, paste0("V", 1:5))
)
res <- bootstrap_networks(small_mat, n_bootstrap = 2, k = 2L, cpus = 1)
names(res)[1:4]
```

clean_sample_names	<i>Clean sample names from TSV column headers</i>
--------------------	---

Description

Removes the X prefix that `utils::read.csv()` adds to column names starting with a digit, replaces . with - to restore the original sample IDs, and strips format-specific suffixes such as .QUALITY_PASSED_R1.fastq.*.

Usage

```
clean_sample_names(
  x,
  remove_prefix = TRUE,
  dot_to_dash = TRUE,
  suffix_patterns = c("\\.QUALITY_PASSED_R1\\.fastq\\.Read\\.Count$",
    "\\.QUALITY_PASSED_R1\\.fastq\\.Covered\\.Fraction$",
    "\\.QUALITY_PASSED_R1\\.fastq\\.Relative\\.Abundance.*$")
)
```

Arguments

x	A character vector of sample names (typically <code>colnames(df)</code>).
remove_prefix	Logical; remove leading X added by R? Default TRUE.
dot_to_dash	Logical; replace . with -? Default TRUE.
suffix_patterns	Character vector of regex patterns to strip from the end of each name.

Value

A character vector of cleaned names.

Examples

```
clean_sample_names(c("X12.34.AB.QUALITY_PASSED_R1.fastq.Read.Count"))
```

clr_normalize	<i>CLR-normalise a count table</i>
---------------	------------------------------------

Description

Applies centred log-ratio (CLR) transformation via `compositions::clr()`, adding a pseudocount first to handle zeros. Equivalent to the original `clr(as.matrix(selected_count + 1))`.

Usage

```
clr_normalize(count_table, pseudocount = 1)
```

Arguments

count_table	A data.frame or matrix of counts (MAGs as rows, samples as columns).
pseudocount	Numeric value added to all counts before transformation. Default 1.

Value

A data.frame of CLR-transformed values preserving the original row and column names.

Note

In the original 02_Preprocessing.Rmd the CLR output was saved as `normalised_count`, but every downstream script (05_, 06_, 07_) references `clr_transform_df`. The saved RData was renamed at some point; this function's output corresponds to both names.

Examples

```
data(fancy_tiny_counts)
clr_df <- clr_normalize(fancy_tiny_counts[1:10, 1:10])
dim(clr_df)
```

compute_dcor_matrix	<i>Compute pairwise distance correlation matrix</i>
---------------------	---

Description

Computes the distance correlation for every pair of variables using `energy::dcor()`. The result is a symmetric matrix with zeros on the diagonal.

Usage

```
compute_dcor_matrix(data)
```

Arguments

`data` A numeric matrix or data.frame with observations (samples) as rows and variables (MAGs) as columns.

Value

A symmetric numeric matrix of dCor values. Diagonal is 0.

`compute_edge_frequencies`

Compute edge frequencies from bootstrap results

Description

Aggregates edge lists across bootstrap iterations for a given method. Canonicalises edge direction via `.remove_directionality()` and computes frequency, mean weight, and standard deviation per edge pair.

Usage

```
compute_edge_frequencies(bootstrap_results, method)
```

Arguments

`bootstrap_results` Named list as returned by `bootstrap_networks()`.

`method` Character; "MRNET" or "dCor".

Value

A data.frame with columns source, target, freq, mean, sd.

`compute_hybrid_scores` *Compute hybrid scores from MRNET/MI and dCor frequencies*

Description

Full-joins MRNET (or raw MI) and dCor edge frequency tables, computes dCor stability (mean / sd), robust-scales stability to [0, 1] using the 20th–99th percentile range, and filters edges based on frequency and stability thresholds.

Usage

```
compute_hybrid_scores(mrnet_freq, dcor_freq, return_unfiltered = FALSE)
```

Arguments

mrnet_freq data.frame from `compute_edge_frequencies()` with method "MRNET".
 dcor_freq data.frame from `compute_edge_frequencies()` with method "dCor".
 return_unfiltered Logical; if TRUE, the unfiltered edge table (before hard-filter) is attached as an "unfiltered" attribute on the returned data.frame (default FALSE).

Value

A data.frame with columns source, target, EdgeFrequency, mean.dcor, sd.dcor, Stability.dcor, Stability.dcor.scaled.

compute_mi_matrix	<i>Compute pairwise mutual information matrix</i>
-------------------	---

Description

Estimates pairwise mutual information for all variable pairs using the k-nearest-neighbour estimator from **knnmi**.

Usage

```
compute_mi_matrix(data, k = 5L)
```

Arguments

data A numeric matrix or data.frame with observations (samples) as rows and variables (MAGs) as columns.
 k Integer; number of neighbours for the kNN MI estimator.

Value

A symmetric numeric matrix of MI values with column names set.

compute_mrnet_network	<i>Apply MRNET to a mutual information matrix</i>
-----------------------	---

Description

Runs the MRNET algorithm via `minet::mrnet()` and extracts non-zero edges as a data.frame.

Usage

```
compute_mrnet_network(mi_matrix)
```

Arguments

mi_matrix A symmetric MI matrix (from `compute_mi_matrix()`).

Value

A data.frame with columns source, target, weight.

export_cytoscape

Export a fancy result for Cytoscape

Description

Writes node and edge tables as tab-separated files suitable for import into Cytoscape. The node table includes taxonomy columns and a hex colour derived from [phyla_palette\(\)](#).

Usage

```
export_cytoscape(
  fancy_result,
  taxonomy,
  file_prefix = "fancy_network",
  edges = "thresholded"
)
```

Arguments

fancy_result	A FancyResult object as returned by fancy() .
taxonomy	A data.frame with MAG IDs as row names and at least a Phyla column. Additional taxonomy ranks (Domain, Class, Order, Family, Genus, Species) are included when present.
file_prefix	Character; path prefix for the output files (default "fancy_network"). Two files are written: {prefix}_edges.tsv and {prefix}_nodes.tsv.
edges	Character; which edge set to export. "thresholded" (default) uses fancy_result\$edges; "all" uses fancy_result\$all_edges.

Value

Invisibly, a list with elements \$nodes and \$edges (data.frames matching the written files).

Examples

```
mock <- methods::new("FancyResult",
  edges = data.frame(
    source = c("MAG1", "MAG2"), target = c("MAG2", "MAG3"),
    HybridScore = c(0.9, 0.7)
  )
)
tax <- data.frame(
  Phyla = c("Bacillota", "Pseudomonadota", "Bacteroidota"),
  Genus = c("Genus_A", "Genus_B", "Genus_C"),
  row.names = c("MAG1", "MAG2", "MAG3")
)
out <- export_cytoscape(mock, tax,
  file_prefix = file.path(tempdir(), "ex")
)
head(out$edges)
```

fancy

*Run the full Fancy hybrid network inference pipeline***Description**

Convenience wrapper that chains preprocessing, bootstrap network inference, edge scoring, and thresholding into a single call. Uses MI (via MRNET) and distance correlation with bootstrap resampling to produce a ranked, thresholded edge list.

Usage

```
fancy(
  data,
  n_bootstrap = 100L,
  k = 5L,
  find_k = FALSE,
  k_values = c(2L, 3L, 4L, 5L, 6L, 7L, 8L, 10L, 15L, 18L, 20L),
  cpus = 1L,
  use_mrnet = TRUE,
  w1 = 0.3,
  w2 = 0.7,
  score_type = "multiplicative",
  dcor_rescue_percentile = NULL,
  threshold_method = "quantile",
  threshold_value = 0.7,
  save_path = NULL,
  verbose = TRUE
)
```

Arguments

data	Numeric matrix or data.frame of CLR-transformed abundances with samples as rows and MAGs as columns . Pass <code>t(clr_normalize(counts))</code> or use the Samples x MAGs orientation directly.
n_bootstrap	Integer; number of bootstrap iterations (default 100).
k	Integer; kNN parameter for MI estimation (default 5).
find_k	Logical; if TRUE, run <code>find_optimal_k()</code> to choose k automatically via the elbow method (default FALSE).
k_values	Integer vector of k values to evaluate when <code>find_k = TRUE</code> .
cpus	Integer; number of parallel workers (default 1). Increase to parallelise bootstrap iterations across cores.
use_mrnet	Logical; if TRUE (default), apply MRNET to the MI matrix for sparse edge selection.
w1	Numeric weight for edge frequency in the hybrid score (default 0.3).
w2	Numeric weight for dCor stability in the hybrid score (default 0.7).
score_type	Character; "multiplicative" (default) or "additive". See <code>hybrid_score()</code> for details.

dcor_rescue_percentile	Numeric between 0 and 1, or NULL (default). When set, edges with dCor stability above this percentile receive a minimum EdgeFrequency floor in multiplicative mode. See hybrid_score() .
threshold_method	Character; one of "quantile", "score", or "top_n" (default "quantile").
threshold_value	Numeric; meaning depends on threshold_method (default 0.7, i.e. top 30 percent of edges for quantile method).
save_path	Optional directory path for saving bootstrap results.
verbose	Logical; if TRUE (default), emit progress messages.

Value

A [FancyResult](#) S4 object with slots:

`edges` The final thresholded edge data.frame.
`all_edges` All scored edges before thresholding (for re-thresholding).
`all_edges_unfiltered` All 4950 scored pairs before the hard frequency/stability filter. Useful for inspecting edges that were dropped by the pre-filter.
`k` The k value used.
`n_bootstrap` Number of bootstrap iterations run.
`params` List of all parameters for reproducibility.
Slots can be read with `$` (e.g. `result$edges`) or `@`.

See Also

[FancyResult](#)

Examples

```
data(fancy_tiny_clr)
result <- fancy(t(fancy_tiny_clr), n_bootstrap = 2, cpus = 1)
head(result$edges)
plot(result)
```

FancyResult-class

FancyResult: S4 container for Fancy pipeline output

Description

A formal S4 class holding the results of the [fancy\(\)](#) hybrid network inference pipeline. Use the [fancy\(\)](#) wrapper to construct objects of this class; slots can be read with the `$` operator (e.g. `result$edges`) or with standard slot access (`result@edges`).

Value

An object of class `FancyResult`.

Slots

edges A data.frame of thresholded edges (the final network).

all_edges A data.frame of all scored edges before thresholding (useful for re-thresholding).

all_edges_unfiltered A data.frame of all scored pairs before the hard frequency/stability pre-filter.

k Numeric; the kNN parameter used for MI estimation.

n_bootstrap Integer; number of bootstrap iterations run.

params A list of all pipeline parameters, for reproducibility.

See Also

[fancy\(\)](#)

fancy_tiny_clr

Tiny example CLR-transformed abundance table

Description

Pre-computed centred log-ratio (CLR) transformed abundance table for 100 MAGs across 321 rumen samples. The CLR was computed on the full 2178-MAG compositional reference before sub-setting, preserving the proper geometric mean. This is the primary input for network inference with [fancy\(\)](#).

Usage

```
fancy_tiny_clr
```

Format

A data.frame with 100 rows (MAGs) and 321 columns (samples). Values are CLR-transformed (continuous, centred around zero).

Details

MAGs 1–4 are known nonlinear interaction pairs: MAGs 1–2 (Bulleidia vs AC2028) show threshold competitive exclusion, and MAGs 3–4 (RUG023 vs Cryptobacteroides) show an L-shaped nonlinear relationship.

Source

Subset from a published rumen metagenome study via `data-raw/make_datasets.R` with `set.seed(42)`.

Examples

```
data(fancy_tiny_clr)
dim(fancy_tiny_clr)
```

fancy_tiny_counts	<i>Tiny example count table</i>
-------------------	---------------------------------

Description

Raw read-count table for the same 100 MAGs and 321 samples as [fancy_tiny_clr](#). Provided for coverage filtering and exploratory analysis; network inference should use the pre-CLR matrix.

Usage

```
fancy_tiny_counts
```

Format

A data.frame with 100 rows (MAGs) and 321 columns (samples). Values are non-negative integers.

Source

Subset from a published rumen metagenome study via `data-raw/make_datasets.R` with `set.seed(42)`.

Examples

```
data(fancy_tiny_counts)
dim(fancy_tiny_counts)
```

fancy_tiny_coverage	<i>Tiny example covered-fraction table</i>
---------------------	--

Description

Genome covered-fraction table matching [fancy_tiny_clr](#). Values represent the fraction of each MAG's reference genome covered by mapped reads in each sample.

Usage

```
fancy_tiny_coverage
```

Format

A data.frame with 100 rows (MAGs) and 321 columns (samples). Values are numeric fractions in [0, 1].

Source

Subset from a published rumen metagenome study via `data-raw/make_datasets.R` with `set.seed(42)`.

Examples

```
data(fancy_tiny_coverage)
summary(unlist(fancy_tiny_coverage))
```

fancy_tiny_metadata	<i>Tiny example sample metadata</i>
---------------------	-------------------------------------

Description

Per-sample metadata for the 321 samples in [fancy_tiny_clr](#).

Usage

```
fancy_tiny_metadata
```

Format

A data.frame with 321 rows and 3 columns:

Sample Sample identifier (anonymised).

Breed Cattle breed (Aberdeen_Angus_X, Charolais_X, Limousin_X, or Luing).

CH4 Methane emissions in grams per day (continuous, range approximately 8–36).

Source

Subset from a published rumen metagenome study via `data-raw/make_datasets.R` with `set.seed(42)`.

Examples

```
data(fancy_tiny_metadata)
hist(fancy_tiny_metadata$CH4)
```

fancy_tiny_taxonomy	<i>Tiny example GTDB taxonomy table</i>
---------------------	---

Description

GTDB taxonomy for the 100 MAGs in [fancy_tiny_clr](#). MAGs 1–2 are a nonlinear threshold-exclusion pair (Bulleidia vs AC2028, both Bacillota), and MAGs 3–4 are a nonlinear L-shaped pair (RUG023 / Spirochaetota vs Cryptobacteroides / Bacteroidota). The 100 MAGs span 9 phyla.

Usage

```
fancy_tiny_taxonomy
```

Format

A data.frame with 100 rows (MAGs as row names) and 7 columns: Domain, Phyla, Class, Order, Family, Genus, Species.

Source

Subset from a published rumen metagenome study via `data-raw/make_datasets.R` with `set.seed(42)`.

Examples

```
data(fancy_tiny_taxonomy)
table(fancy_tiny_taxonomy$Phyla)
```

filter_mags

Filter MAGs by coverage and prevalence

Description

Applies two filtering steps from the preprocessing pipeline:

1. **Coverage masking:** Binarises the coverage table at min_coverage and multiplies element-wise with the count table, zeroing out counts for MAG-sample pairs with insufficient genome coverage.
2. **Prevalence filter:** Retains only MAGs present (non-zero after masking) in at least min_samples samples.

Usage

```
filter_mags(count_table, coverage_table, min_coverage = 0.3, min_samples = 50L)
```

Arguments

count_table	A data.frame of read counts with MAGs as rows and samples as columns.
coverage_table	A data.frame of covered-fraction values with the same dimensions and names as count_table.
min_coverage	Numeric; minimum covered fraction to retain a count.
min_samples	Integer; minimum number of samples in which a MAG must be present after coverage masking.

Value

A data.frame of filtered counts (MAGs as rows, samples as columns).

Note

The original 02_Preprocessing.Rmd referenced count_table_cov on line 111, but the variable was actually count_table_cov_stats (line 105). This function eliminates that confusion.

Examples

```
data(fancy_tiny_counts)
data(fancy_tiny_coverage)
filt <- filter_mags(fancy_tiny_counts, fancy_tiny_coverage)
dim(filt)
```

find_optimal_k

*Find optimal k for the kNN MI estimator***Description**

Tests multiple k values by computing the full MI matrix for each k and recording the average MI across all variable pairs. The resulting elbow curve helps choose k: the point where MI stops improving steeply (largest negative second derivative) is selected automatically when `auto_select = TRUE`.

Usage

```
find_optimal_k(
  data,
  k_values = c(2L, 3L, 4L, 5L, 6L, 7L, 8L, 10L, 15L, 18L, 20L),
  cpus = 1L,
  auto_select = TRUE
)
```

Arguments

<code>data</code>	A numeric matrix or data.frame with observations (samples) as rows and variables (MAGs) as columns.
<code>k_values</code>	Integer vector of k values to evaluate.
<code>cpus</code>	Integer; number of parallel workers.
<code>auto_select</code>	Logical; if TRUE (default), returns the elbow point as <code>\$best_k</code> .

Details

Computation is parallelised across k values using **snowfall**.

Value

A list with:

`results` A data.frame(k, avg_mi) for plotting.

`best_k` (when `auto_select = TRUE`) the k at the elbow point, determined by the most negative second derivative.

Examples

```
small_mat <- matrix(rnorm(50), nrow = 10, ncol = 5)
res <- find_optimal_k(small_mat, k_values = c(2L, 3L), cpus = 1)
res$best_k
```

hybrid_score	<i>Compute hybrid edge score</i>
--------------	----------------------------------

Description

Scores edges by combining MRNET edge frequency with dCor stability. Two scoring modes are available:

"multiplicative" (**default**)

$$\text{HybridScore} = \text{EdgeFrequency}^{w1} \times \text{Stability.dcor.scaled}^{w2}$$

Edges need support from both components; a near-zero value in either component pulls the score toward zero.

"additive"

$$\text{HybridScore} = w1 \times \text{EdgeFrequency} + w2 \times \text{Stability.dcor.scaled}$$

Allows edges with strong dCor but weak MRNET frequency (or vice versa) to retain a meaningful score.

Usage

```
hybrid_score(
  edge_metrics,
  w1 = 0.3,
  w2 = 0.7,
  score_type = "multiplicative",
  dcor_rescue_percentile = NULL
)
```

Arguments

edge_metrics	A data.frame containing at least EdgeFrequency and Stability.dcor.scaled columns (as returned by compute_hybrid_scores()).
w1	Numeric weight for edge frequency (default 0.3).
w2	Numeric weight for dCor stability (default 0.7).
score_type	Character; "multiplicative" (default) or "additive".
dcor_rescue_percentile	Numeric between 0 and 1, or NULL (default). When set, edges with Stability.dcor.scaled above this percentile receive a minimum EdgeFrequency floor. Only applies to multiplicative scoring.

Details

When dcor_rescue_percentile is set (multiplicative mode only), edges whose Stability.dcor.scaled exceeds the given percentile have their EdgeFrequency raised to a minimum floor (the 30th percentile of non-zero EdgeFrequency values). This prevents near-zero MRNET frequency from suppressing edges that dCor finds reliably.

Value

The input data.frame with an added HybridScore column.

Examples

```
edges <- data.frame(
  source = c("MAG1", "MAG2", "MAG3"),
  target = c("MAG2", "MAG3", "MAG4"),
  EdgeFrequency = c(0.8, 0.5, 0.9),
  Stability.dcor.scaled = c(0.7, 0.3, 0.85)
)
scored <- hybrid_score(edges, w1 = 0.3, w2 = 0.7)
scored$HybridScore
```

parse_count_tables	<i>Parse per-sample TSV files into combined MAG-by-sample matrices</i>
--------------------	--

Description

Reads a directory of per-sample TSV files (as produced by read-mapping pipelines) and merges them into MAG-by-sample matrices for read counts, relative abundance, and covered fraction.

Usage

```
parse_count_tables(
  path,
  pattern = "*.tsv",
  columns = c(count = 1L, relative_abundance = 2L, covered_fraction = 3L),
  clean_names = TRUE,
  drop_first_row = TRUE
)
```

Arguments

path	Directory containing the TSV files.
pattern	Glob pattern passed to <code>base::list.files()</code> .
columns	Named integer vector mapping result names to column indices. Defaults to <code>c(count = 1L, relative_abundance = 2L, covered_fraction = 3L)</code> . Set to NULL or a subset to read only the matrices you need.
clean_names	Logical; apply <code>clean_sample_names()</code> to column names?
drop_first_row	Logical; drop the first data row (header duplication artifact in raw TSVs)?

Details

Each TSV is expected to have MAG identifiers as row names and at least three data columns (count, relative abundance, covered fraction). The first row in the raw files is often a duplicated header and is dropped by default (`drop_first_row = TRUE`).

Value

A named list of data.frames, one per entry in columns. Each data.frame has MAG IDs as row names and samples as columns.

Examples

```
d <- tempfile("tsvdir")
dir.create(d)
writelines(
  c(
    "MAG\tcount\trel_abund\tcov_frac",
    "MAG1\t100\t0.5\t0.8", "MAG2\t200\t0.3\t0.6"
  ),
  file.path(d, "sample1.tsv")
)
tables <- parse_count_tables(d, drop_first_row = FALSE)
tables$count
```

parse_gtdb_taxonomy	<i>Parse a GTDB-format taxonomy file</i>
---------------------	--

Description

Reads a GTDB taxonomy TSV and cleans every rank by stripping rank prefixes (d_, p_, etc.) and removing sub-designation suffixes on Phyla and Genus (e.g. Bacillota_C becomes Bacillota). Species are simplified by removing the genus portion before the space and stripping trailing digits after "sp".

Usage

```
parse_gtdb_taxonomy(file, strain_col = "Strain", fill_missing = TRUE)
```

Arguments

file	Path to a GTDB taxonomy TSV file.
strain_col	Character; name of the column containing MAG / strain identifiers (used as row names). Default "Strain".
fill_missing	Logical; fill missing taxonomy levels as described above? Default TRUE.

Details

When fill_missing = TRUE (the default):

- Family "NA" is replaced with the Order value.
- Genus "NA" or "" is replaced with the Family value.
- Species "" is replaced with "sp".

Value

A data.frame with strain_col values as row names and columns: Domain, Phyla, Class, Order, Family, Genus, Species.

Examples

```
tsv <- tempfile(fileext = ".tsv")
header <- paste(
  "Strain", "Domain", "Phyla", "Class", "Order",
  "Family", "Genus", "Species",
  sep = "\t"
)
row1 <- paste(
  "MAG1", "d__Bacteria", "p__Bacillota_C", "c__Clostridia",
  "o__Lachnospirales", "f__Lachnospiraceae", "g__Butyrivibrio",
  "s__Butyrivibrio sp1",
  sep = "\t"
)
writelines(c(header, row1), tsv)
tax <- parse_gtdb_taxonomy(tsv)
tax$Phyla
```

phyla_palette	<i>Assign colours to phyla</i>
---------------	--------------------------------

Description

Returns a named character vector mapping each unique phylum to a colourblind-friendly hex colour. Colours are assigned in alphabetical order of phylum names so the mapping is deterministic.

Usage

```
phyla_palette(phyla)
```

Arguments

phyla Character vector of phylum names (duplicates are OK).

Value

A named character vector of hex colours, one per unique phylum (sorted alphabetically).

Examples

```
phyla_palette(c("Bacillota", "Pseudomonadota", "Bacillota"))
```

```
plot,FancyResult,missing-method
```

Plot the hybrid score distribution of a FancyResult

Description

Plot method for [FancyResult](#) objects returned by [fancy\(\)](#). Draws a histogram of HybridScore across all scored edges with a vertical line at the threshold cutoff. The number of retained edges is annotated.

Usage

```
## S4 method for signature 'FancyResult,missing'
plot(x, y, ...)
```

Arguments

x	A FancyResult object as returned by fancy() .
y	Ignored; present for compatibility with the plot() generic.
...	Additional arguments passed to graphics::hist() .

Value

Invisibly returns x.

Examples

```
mock <- methods::new("FancyResult",
  edges = data.frame(source = "A", target = "B", HybridScore = 0.9),
  all_edges = data.frame(
    source = paste0("M", seq_len(20)),
    target = paste0("M", 21:40),
    HybridScore = runif(20)
  ),
  params = list(threshold_method = "quantile", threshold_value = 0.7)
)
plot(mock)
```

```
plot_k_elbow
```

Plot elbow curve for k selection

Description

Takes the list returned by [find_optimal_k\(\)](#) and plots the elbow curve (k vs average MI). When `$best_k` is present, marks the elbow point with a distinct symbol and label.

Usage

```
plot_k_elbow(k_results)
```

Arguments

k_results A list as returned by `find_optimal_k()`, containing `$results` (data.frame with `k` and `avg_mi` columns) and optionally `$best_k`.

Value

Invisibly returns `k_results`.

Examples

```
k_res <- list(
  results = data.frame(k = c(3, 5, 7, 10), avg_mi = c(0.5, 0.45, 0.42, 0.41)),
  best_k = 5
)
plot_k_elbow(k_res)
```

plot_network

Plot the co-abundance network

Description

Draws a network graph from a "fancy" result using igraph. Nodes are coloured by phylum (via `phyla_palette()`) and labelled with genus names. Edge width is proportional to HybridScore. When `community = TRUE`, modularity-based community detection is applied and clusters are shown as shaded convex hulls around groups of co-abundant MAGs.

Usage

```
plot_network(
  fancy_result,
  taxonomy,
  top_n = NULL,
  layout = "fruchterman.reingold",
  community = FALSE
)
```

Arguments

fancy_result A `FancyResult` object as returned by `fancy()`.

taxonomy A data.frame with MAG IDs as row names and at least Phyla and Genus columns.

top_n Integer or NULL; if set, only the top N edges by HybridScore are plotted (default NULL = all thresholded edges).

layout Character; igraph layout algorithm name (default "fruchterman.reingold").

community Logical; if TRUE, run modularity-based community detection and draw shaded convex hulls around clusters (default FALSE).

Value

Invisibly returns the igraph graph object.

Examples

```
data(fancy_tiny_clr)
data(fancy_tiny_taxonomy)
result <- fancy(t(fancy_tiny_clr), n_bootstrap = 2, cpus = 1)
plot_network(result, fancy_tiny_taxonomy)
```

show,FancyResult-method
Display a FancyResult

Description

Compact summary method for [FancyResult](#) objects.

Usage

```
## S4 method for signature 'FancyResult'
show(object)
```

Arguments

object A [FancyResult](#) object.

Value

object, invisibly.

threshold_edges *Threshold scored edges*

Description

Filters a scored edge list using one of three methods:

"quantile" Retain edges above the given quantile of HybridScore. Default value = 0.7 retains the top 30 percent.

"score" Retain edges with HybridScore >= value.

"top_n" Retain the top value edges by HybridScore.

Usage

```
threshold_edges(scored_edges, method = "quantile", value = 0.7)
```

Arguments

scored_edges A data.frame with a HybridScore column.

method Character; one of "quantile", "score", "top_n".

value Numeric; meaning depends on method.

Value

A data.frame of retained edges, sorted by descending HybridScore.

Examples

```
scored <- data.frame(
  source = paste0("MAG", 1:10),
  target = paste0("MAG", 11:20),
  HybridScore = seq(0.1, 1.0, by = 0.1)
)
top5 <- threshold_edges(scored, method = "top_n", value = 5)
nrow(top5)
```

\$.FancyResult-method *Access FancyResult slots with \$*

Description

Convenience accessor so that `result$edges`, `result$all_edges`, `result$params`, etc. retrieve the corresponding slot of a [FancyResult](#) object.

Usage

```
## S4 method for signature 'FancyResult'
x$name
```

Arguments

<code>x</code>	A FancyResult object.
<code>name</code>	Slot name to extract.

Value

The contents of the named slot.

Index

* datasets

- fancy_tiny_clr, [13](#)
- fancy_tiny_counts, [14](#)
- fancy_tiny_coverage, [14](#)
- fancy_tiny_metadata, [15](#)
- fancy_tiny_taxonomy, [15](#)

* internal

- .bootstrap_single, [3](#)
- .extract_mi_edges, [3](#)
- .init_snowfall, [4](#)
- .read_column_from_tsvs, [4](#)
- .remove_directionality, [5](#)
- compute_dcor_matrix, [7](#)
- compute_edge_frequencies, [8](#)
- compute_hybrid_scores, [8](#)
- compute_mi_matrix, [9](#)
- compute_mrnet_network, [9](#)
- Fancy-package, [2](#)
- .bootstrap_single, [3](#)
- .extract_mi_edges, [3](#)
- .init_snowfall, [4](#)
- .read_column_from_tsvs, [4](#)
- .remove_directionality, [5](#)
- .remove_directionality(), [8](#)
- \$, FancyResult-method, [25](#)

- base::list.files(), [19](#)
- bootstrap_networks, [5](#)
- bootstrap_networks(), [3](#), [8](#)

- clean_sample_names, [6](#)
- clean_sample_names(), [19](#)
- clr_normalize, [7](#)
- compositions::clr(), [7](#)
- compute_dcor_matrix, [7](#)
- compute_edge_frequencies, [8](#)
- compute_edge_frequencies(), [9](#)
- compute_hybrid_scores, [8](#)
- compute_hybrid_scores(), [18](#)
- compute_mi_matrix, [9](#)
- compute_mi_matrix(), [3](#), [5](#), [9](#)
- compute_mrnet_network, [9](#)

- energy::dcor(), [7](#)

- export_cytoscape, [10](#)

- Fancy (Fancy-package), [2](#)
- fancy, [11](#)
- fancy(), [10](#), [12](#), [13](#), [22](#), [23](#)
- Fancy-package, [2](#)
- fancy_tiny_clr, [13](#), [14](#), [15](#)
- fancy_tiny_counts, [14](#)
- fancy_tiny_coverage, [14](#)
- fancy_tiny_metadata, [15](#)
- fancy_tiny_taxonomy, [15](#)
- FancyResult, [10](#), [12](#), [22–25](#)
- FancyResult-class, [12](#)
- filter_mags, [16](#)
- find_optimal_k, [17](#)
- find_optimal_k(), [11](#), [22](#), [23](#)

- graphics::hist(), [22](#)

- hybrid_score, [18](#)
- hybrid_score(), [11](#), [12](#)

- minet::mrnet(), [9](#)

- parse_count_tables, [19](#)
- parse_gtdb_taxonomy, [20](#)
- phyla_palette, [21](#)
- phyla_palette(), [10](#), [23](#)
- plot(), [22](#)
- plot, FancyResult, missing-method, [22](#)
- plot_k_elbow, [22](#)
- plot_network, [23](#)

- show, FancyResult-method, [24](#)

- threshold_edges, [24](#)

- utils::read.csv(), [6](#)