

barry: Your go-to motif accountant

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Chapter 1

Main Page

Barry: your to-go motif accountant

This repository contains a C++ template library that essentially counts sufficient statistics on binary arrays. Its primary goal is to provide a general framework for building discrete exponential-family models. A particular example is Exponential Random Graph Models (ERGMs), but we can use `barry` to deal with non-square arrays.

Among the key features included in `barry`, we have:

- Sparse arrays.
- User-defined count statistics.
- User-defined constrain of the support set.
- Powerset generation of binary arrays.
- Discrete Exponential Family Models module (DEFMs).
- Pooled DEFMs.

To use `barry`, you can either download the entire repository or, since it is header-only, the single header version `barry.hpp`.

This library was created and maintained by Dr. George G. Vega Yon as part of his doctoral dissertation "Essays on Bioinformatics and Social Network Analysis: Statistical and Computational Methods for Complex Systems."

Examples

Counting statistics in a graph

In the following code we create an array of size 5x5 of class `Network` (available in the namespace `netcounters`), add/remove ties, print the graph, and count common statistics used in ERGMs:

```
#include <iostream>
#include <ostream>
#include "../include/barry.hpp"
typedef std::vector< unsigned int > vuint;
int main() {
    // Creating network of size six with five ties
    netcounters::Network net(
        6, 6,
        {0, 0, 4, 4, 2, 0, 1},
        {1, 2, 0, 2, 4, 0, 1}
    );

    // How does this looks like?
    net.print("Current view");

    // Adding extra ties
    net += {1, 0};
    net(2, 0) = true;

    // And removing a couple
    net(0, 0) = false;
    net -= {1, 1};
    net.print("New view");

    // Initializing the data. The program deals with freeing the memory
    net.set_data(new netcounters::NetworkData, true);
    // Creating counter object for the network and adding stats to count
    netcounters::NetStatsCounter counter(&net);
    netcounters::counter_edges(counter.counters);
    netcounters::counter_ttriads(counter.counters);
    netcounters::counter_isolates(counter.counters);
    netcounters::counter_ctriads(counter.counters);
    netcounters::counter_mutual(counter.counters);

    // Counting and printing the results
    std::vector< double > counts = counter.count_all();

    std::cout <<
        "Edges          : " << counts[0] << std::endl <<
        "Transitive triads : " << counts[1] << std::endl <<
        "Isolates         : " << counts[2] << std::endl <<
        "C triads         : " << counts[3] << std::endl <<
        "Mutuals         : " << counts[4] << std::endl;

    return 0;
}
```

Compiling this program using g++

```
g++ -std=c++11 -Wall -pedantic 08-counts.cpp -o counts && ./counts
```

Yields the following output:

```
Current view
[ 0,] 1 1 1 . . .
[ 1,] . 1 . . . .
[ 2,] . . . . 1 .
[ 3,] . . . . . .
[ 4,] 1 . 1 . . .
[ 5,] . . . . . .
New view
[ 0,] . 1 1 . . .
[ 1,] 1 . . . . .
[ 2,] 1 . . . 1 .
[ 3,] . . . . . .
[ 4,] 1 . 1 . . .
[ 5,] . . . . . .
Edges          : 7
Transitive triads : 3
Isolates       : 2
C triads       : 1
Mutuals        : 3
```


Features

Efficient memory usage

One of the key features of `barry` is that it will handle memory efficiently. In the case of pooled-data models, the module for statistical models avoids double-counting support when possible by keeping track of what datasets (networks, for instance) share the same.

Documentation

More information can be found in the Doxygen website [here](#) and in the PDF version of the documentation [here](#).

Code of Conduct

Please note that the `barry` project is released with a [Contributor Code of Conduct](#). By contributing to this project, you agree to abide by its terms.

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Chapter 5

Module Documentation

5.1 Counting

Classes

- class [NetworkData](#)
Data class for Networks.
- class [NodeData](#)
Data definition for the `PhyloArray` class.
- class [Counter](#)< [Array_Type](#), [Data_Type](#) >
A counter function based on change statistics.

5.1.1 Detailed Description

`barry` includes a flexible way to generate counters based on change statistics. Since most of the time we are counting many motifs in a graph, change statistics make a reasonable (and efficient) way to make such counts.

In particular, let the motif be defined as $s(y)$, with y as the binary array. The change statistic when adding cell y_{ij} , i.e. when the cell moves from being empty to have a one, is defined as

$$\delta(y_{ij}) = s_{ij}^+(y) - s_{ij}^-(y),$$

where $s_{ij}^+(y)$ and $s_{ij}^-(y)$ represent the motif statistic with and without the ij -cell. For example, in the case of networks, the change statistic for the number of edges is always 1.

To count statistics in an array, the [\[Counter\]](#) class will empty the array, initialize the counters, and then start counting while adding at each step a single cell, until matching the original array.

5.2 Statistical Models

Statistical models available in `barry`.

Classes

- class [Model](#)< [Array_Type](#), [Data_Counter_Type](#), [Data_Rule_Type](#), [Data_Rule_Dyn_Type](#) >
General framework for discrete exponential models. This class allows generating discrete exponential models in the form of a linear exponential model:
- class [Flock](#)
A [Flock](#) is a group of [Geese](#).
- class [Geese](#)
Annotated Phylo [Model](#).

5.2.1 Detailed Description

Statistical models available in `barry`.

5.3 DEFMArray counters

[Counters](#) for network models.

Functions

- void [counter_ones](#) ([DEFMCounters](#) *counters, int covar_index=-1, std::string vname="")
Prevalence of ones.
- void [counter_logit_intercept](#) ([DEFMCounters](#) *counters, size_t n_y, std::vector< size_t > which={}, int covar_index=-1, std::string vname="")
- void [counter_transition](#) ([DEFMCounters](#) *counters, std::vector< size_t > coords, std::vector< bool > signs, size_t m_order, size_t n_y, int covar_index=-1, std::string vname="")
Prevalence of ones.
- void [counter_transition_formula](#) ([DEFMCounters](#) *counters, std::string formula, size_t m_order, size_t n_y, int covar_index=-1, std::string vname="")
Prevalence of ones.
- void [counter_fixed_effect](#) ([DEFMCounters](#) *counters, int covar_index, double k, std::string vname="")
Prevalence of ones.
- template<typename Tnet = Network>
void [counter_edges](#) ([NetCounters](#)< Tnet > *counters)
Number of edges.
- template<typename Tnet = Network>
void [counter_isolates](#) ([NetCounters](#)< Tnet > *counters)
Number of isolated vertices.
- template<> void [counter_isolates](#) ([NetCounters](#)< [NetworkDense](#) > *counters)
- template<typename Tnet = Network>
void [counter_mutual](#) ([NetCounters](#)< Tnet > *counters)
Number of mutual ties.
- template<typename Tnet = Network>
void [counter_istar2](#) ([NetCounters](#)< Tnet > *counters)
- template<> void [counter_istar2](#) ([NetCounters](#)< [NetworkDense](#) > *counters)
- template<typename Tnet = Network>
void [counter_ostar2](#) ([NetCounters](#)< Tnet > *counters)
- template<> void [counter_ostar2](#) ([NetCounters](#)< [NetworkDense](#) > *counters)

- `template<typename Tnet = Network>`
`void counter_ttriads (NetCounters< Tnet > *counters)`
- `template<> void counter_ttriads (NetCounters< NetworkDense > *counters)`
- `template<typename Tnet = Network>`
`void counter_ctriads (NetCounters< Tnet > *counters)`
- `template<> void counter_ctriads (NetCounters< NetworkDense > *counters)`
- `template<typename Tnet = Network>`
`void counter_density (NetCounters< Tnet > *counters)`
- `template<typename Tnet = Network>`
`void counter_idegree15 (NetCounters< Tnet > *counters)`
- `template<> void counter_idegree15 (NetCounters< NetworkDense > *counters)`
- `template<typename Tnet = Network>`
`void counter_odegree15 (NetCounters< Tnet > *counters)`
- `template<> void counter_odegree15 (NetCounters< NetworkDense > *counters)`
- `template<typename Tnet = Network>`
`void counter_absdiff (NetCounters< Tnet > *counters, uint attr_id, double alpha=1.0)`
Sum of absolute attribute difference between ego and alter.
- `template<typename Tnet = Network>`
`void counter_diff (NetCounters< Tnet > *counters, uint attr_id, double alpha=1.0, double tail_head=true)`
Sum of attribute difference between ego and alter to pow(alpha)
- **NETWORK_COUNTER** (init_single_attr)
- `template<typename Tnet = Network>`
`void counter_nodeicov (NetCounters< Tnet > *counters, uint attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodeocov (NetCounters< Tnet > *counters, uint attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodcov (NetCounters< Tnet > *counters, uint attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodematch (NetCounters< Tnet > *counters, uint attr_id)`
- `template<typename Tnet = Network>`
`void counter_idegree (NetCounters< Tnet > *counters, std::vector< uint > d)`
Counts number of vertices with a given in-degree.
- `template<> void counter_idegree (NetCounters< NetworkDense > *counters, std::vector< uint > d)`
- `template<typename Tnet = Network>`
`void counter_odegree (NetCounters< Tnet > *counters, std::vector< uint > d)`
Counts number of vertices with a given out-degree.
- `template<> void counter_odegree (NetCounters< NetworkDense > *counters, std::vector< uint > d)`
- `template<typename Tnet = Network>`
`void counter_degree (NetCounters< Tnet > *counters, std::vector< uint > d)`
Counts number of vertices with a given out-degree.

Returns true if the cell is free

Parameters

<i>rules</i>	A pointer to a DEFMRules object (<code>Rules<DEFMArray, bool></code>).
--------------	--

- `void rules_markov_fixed (DEFMRules *rules, size_t markov_order)`
Number of edges.

5.3.1 Detailed Description

[Counters](#) for network models.

Parameters

<i>counters</i>	A pointer to a <code>DEFMCounters</code> object (Counters < <code>DEFMArray</code> , <code>DEFMCounterData</code> >).
<i>counters</i>	A pointer to a <code>NetCounters</code> object (Counters < <code>Network</code> , <code>NetCounterData</code> >).

5.3.2 Function Documentation

5.3.2.1 `counter_absdiff()`

```
template<typename Tnet = Network>
void counter_absdiff (
    NetCounters< Tnet > * counters,
    uint attr_id,
    double alpha = 1.0 ) [inline]
```

Sum of absolute attribute difference between ego and alter.

Definition at line 910 of file `network.hpp`.

5.3.2.2 `counter_ctriads()` [1/2]

```
template<>
void counter_ctriads (
    NetCounters< NetworkDense > * counters ) [inline]
```

Definition at line 665 of file `network.hpp`.

5.3.2.3 `counter_ctriads()` [2/2]

```
template<typename Tnet = Network>
void counter_ctriads (
    NetCounters< Tnet > * counters ) [inline]
```

Definition at line 610 of file `network.hpp`.

5.3.2.4 counter_degree()

```
template<typename Tnet = Network>
void counter_degree (
    NetCounters< Tnet > * counters,
    std::vector< uint > d ) [inline]
```

Counts number of vertices with a given out-degree.

Definition at line 1328 of file network.hpp.

5.3.2.5 counter_density()

```
template<typename Tnet = Network>
void counter_density (
    NetCounters< Tnet > * counters ) [inline]
```

Definition at line 731 of file network.hpp.

5.3.2.6 counter_diff()

```
template<typename Tnet = Network>
void counter_diff (
    NetCounters< Tnet > * counters,
    uint attr_id,
    double alpha = 1.0,
    double tail_head = true ) [inline]
```

Sum of attribute difference between ego and alter to pow(alpha)

Definition at line 955 of file network.hpp.

5.3.2.7 counter_edges()

```
template<typename Tnet = Network>
void counter_edges (
    NetCounters< Tnet > * counters ) [inline]
```

Number of edges.

Definition at line 152 of file network.hpp.

5.3.2.8 counter_fixed_effect()

```
void counter_fixed_effect (
    DEFMCounters * counters,
    int covar_index,
    double k,
    std::string vname = "" ) [inline]
```

Prevalence of ones.

Parameters

<i>counters</i>	Pointer of a vector of counters
<i>covar_index</i>	If \geq than 0, then the interaction

Definition at line 883 of file defm.hpp.

5.3.2.9 counter_iddegree() [1/2]

```
template<>
void counter_iddegree (
    NetCounters< NetworkDense > * counters,
    std::vector< uint > d ) [inline]
```

Definition at line 1172 of file network.hpp.

5.3.2.10 counter_iddegree() [2/2]

```
template<typename Tnet = Network>
void counter_iddegree (
    NetCounters< Tnet > * counters,
    std::vector< uint > d ) [inline]
```

Counts number of vertices with a given in-degree.

Definition at line 1125 of file network.hpp.

5.3.2.11 counter_iddegree15() [1/2]

```
template<>
void counter_iddegree15 (
    NetCounters< NetworkDense > * counters ) [inline]
```

Definition at line 787 of file network.hpp.

5.3.2.12 counter_iddegree15() [2/2]

```
template<typename Tnet = Network>
void counter_iddegree15 (
    NetCounters< Tnet > * counters ) [inline]
```

Definition at line 759 of file network.hpp.

5.3.2.13 counter_isolates() [1/2]

```
template<>
void counter_isolates (
    NetCounters< NetworkDense > * counters ) [inline]
```

Definition at line 215 of file network.hpp.

5.3.2.14 counter_isolates() [2/2]

```
template<typename Tnet = Network>
void counter_isolates (
    NetCounters< Tnet > * counters ) [inline]
```

Number of isolated vertices.

Definition at line 175 of file network.hpp.

5.3.2.15 counter_istar2() [1/2]

```
template<>
void counter_istar2 (
    NetCounters< NetworkDense > * counters ) [inline]
```

Definition at line 338 of file network.hpp.

5.3.2.16 counter_istar2() [2/2]

```
template<typename Tnet = Network>
void counter_istar2 (
    NetCounters< Tnet > * counters ) [inline]
```

Definition at line 312 of file network.hpp.

5.3.2.17 counter_logit_intercept()

```
void counter_logit_intercept (
    DEFMCounters * counters,
    size_t n_y,
    std::vector< size_t > which = {},
    int covar_index = -1,
    std::string vname = "" ) [inline]
```

Definition at line 466 of file defm.hpp.

5.3.2.18 counter_mutual()

```
template<typename Tnet = Network>
void counter_mutual (
    NetCounters< Tnet > * counters ) [inline]
```

Number of mutual ties.

Definition at line 256 of file network.hpp.

5.3.2.19 counter_nodecov()

```
template<typename Tnet = Network>
void counter_nodecov (
    NetCounters< Tnet > * counters,
    uint attr_id ) [inline]
```

Definition at line 1068 of file network.hpp.

5.3.2.20 counter_nodeicov()

```
template<typename Tnet = Network>
void counter_nodeicov (
    NetCounters< Tnet > * counters,
    uint attr_id ) [inline]
```

Definition at line 1018 of file network.hpp.

5.3.2.21 counter_nodematch()

```
template<typename Tnet = Network>
void counter_nodematch (
    NetCounters< Tnet > * counters,
    uint attr_id ) [inline]
```

Definition at line 1093 of file network.hpp.

5.3.2.22 counter_nodeocov()

```
template<typename Tnet = Network>
void counter_nodeocov (
    NetCounters< Tnet > * counters,
    uint attr_id ) [inline]
```

Definition at line 1043 of file network.hpp.

5.3.2.23 counter_odegree() [1/2]

```
template<>
void counter_odegree (
    NetCounters< NetworkDense > * counters,
    std::vector< uint > d ) [inline]
```

Definition at line 1273 of file network.hpp.

5.3.2.24 counter_odegree() [2/2]

```
template<typename Tnet = Network>
void counter_odegree (
    NetCounters< Tnet > * counters,
    std::vector< uint > d ) [inline]
```

Counts number of vertices with a given out-degree.

Definition at line 1225 of file network.hpp.

5.3.2.25 counter_odegree15() [1/2]

```
template<>
void counter_odegree15 (
    NetCounters< NetworkDense > * counters ) [inline]
```

Definition at line 864 of file network.hpp.

5.3.2.26 counter_odegree15() [2/2]

```
template<typename Tnet = Network>
void counter_odegree15 (
    NetCounters< Tnet > * counters ) [inline]
```

Definition at line 836 of file network.hpp.

5.3.2.27 counter_ones()

```
void counter_ones (
    DEFMCounters * counters,
    int covar_index = -1,
    std::string vname = "" ) [inline]
```

Prevalence of ones.

Parameters

<i>counters</i>	Pointer of a vector of counters
<i>covar_index</i>	If \geq than 0, then the interaction

Definition at line 413 of file defm.hpp.

5.3.2.28 counter_ostar2() [1/2]

```
template<>
void counter_ostar2 (
    NetCounters< NetworkDense > * counters ) [inline]
```

Definition at line 404 of file network.hpp.

5.3.2.29 counter_ostar2() [2/2]

```
template<typename Tnet = Network>
void counter_ostar2 (
    NetCounters< Tnet > * counters ) [inline]
```

Definition at line 376 of file network.hpp.

5.3.2.30 counter_transition()

```
void counter_transition (
    DEFMCounters * counters,
    std::vector< size_t > coords,
    std::vector< bool > signs,
    size_t m_order,
    size_t n_y,
    int covar_index = -1,
    std::string vname = "" ) [inline]
```

Prevalence of ones.

Parameters

<i>counters</i>	Pointer of a vector of counters
<i>covar_index</i>	If \geq than 0, then the interaction

Definition at line 547 of file defm.hpp.

5.3.2.31 counter_transition_formula()

```
void counter_transition_formula (
    DEFMCounters * counters,
    std::string formula,
    size_t m_order,
    size_t n_y,
    int covar_index = -1,
    std::string vname = "" ) [inline]
```

Prevalence of ones.

Parameters

<i>counters</i>	Pointer of a vector of counters
<i>covar_index</i>	If >= than 0, then the interaction

Definition at line 855 of file defm.hpp.

5.3.2.32 counter_ttriads() [1/2]

```
template<>
void counter_ttriads (
    NetCounters< NetworkDense > * counters ) [inline]
```

Definition at line 531 of file network.hpp.

5.3.2.33 counter_ttriads() [2/2]

```
template<typename Tnet = Network>
void counter_ttriads (
    NetCounters< Tnet > * counters ) [inline]
```

Definition at line 441 of file network.hpp.

5.3.2.34 NETWORK_COUNTER()

```
NETWORK_COUNTER (
    init_single_attr )
```

Definition at line 999 of file network.hpp.

5.3.2.35 rules_markov_fixed()

```
void rules_markov_fixed (
    DEFMRules * rules,
    size_t markov_order ) [inline]
```

Number of edges.

Definition at line 919 of file defm.hpp.

5.4 Phylo counters

[Counters](#) for phylogenetic modeling.

Functions

- void [counter_overall_gains](#) (PhyloCounters *counters, unsigned int duplication=DEFAULT_DUPPLICATION)
Overall functional gains.
- void [counter_gains](#) (PhyloCounters *counters, std::vector< uint > nfun, unsigned int duplication=DEFAULT_DUPPLICATION)
Functional gains for a specific function (nfun).
- void [counter_gains_k_offspring](#) (PhyloCounters *counters, std::vector< uint > nfun, uint k=1u, unsigned int duplication=DEFAULT_DUPPLICATION)
k genes gain function nfun
- void [counter_genes_changing](#) (PhyloCounters *counters, unsigned int duplication=DEFAULT_DUPPLICATION)
Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)
- void [counter_preserve_pseudogene](#) (PhyloCounters *counters, unsigned int nfunA, unsigned int nfunB, unsigned int duplication=DEFAULT_DUPPLICATION)
Keeps track of how many pairs of genes preserve pseudostate.
- void [counter_prop_genes_changing](#) (PhyloCounters *counters, unsigned int duplication=DEFAULT_DUPPLICATION)
Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)
- void [counter_overall_loss](#) (PhyloCounters *counters, unsigned int duplication=DEFAULT_DUPPLICATION)
Overall functional loss.
- void [counter_maxfuns](#) (PhyloCounters *counters, uint lb, uint ub, unsigned int duplication=DEFAULT_DUPPLICATION)
Cap the number of functions per gene.
- void [counter_loss](#) (PhyloCounters *counters, std::vector< uint > nfun, unsigned int duplication=DEFAULT_DUPPLICATION)
Total count of losses for an specific function.
- void [counter_overall_changes](#) (PhyloCounters *counters, unsigned int duplication=DEFAULT_DUPPLICATION)
Total number of changes. Use this statistic to account for "preservation".
- void [counter_subfun](#) (PhyloCounters *counters, uint nfunA, uint nfunB, unsigned int duplication=DEFAULT_DUPPLICATION)
Total count of Sub-functionalization events.
- void [counter_cogain](#) (PhyloCounters *counters, uint nfunA, uint nfunB, unsigned int duplication=DEFAULT_DUPPLICATION)
Co-evolution (joint gain or loss)
- void [counter_longest](#) (PhyloCounters *counters, unsigned int duplication=DEFAULT_DUPPLICATION)
Longest branch mutates (either by gain or by loss)
- void [counter_neofun](#) (PhyloCounters *counters, uint nfunA, uint nfunB, unsigned int duplication=DEFAULT_DUPPLICATION)
Total number of neofunctionalization events.
- void [counter_pairwise_neofun_singlefun](#) (PhyloCounters *counters, uint nfunA, unsigned int duplication=DEFAULT_DUPPLICATION)
*Total number of neofunctionalization events $\sum_u \sum_{\{w < u\}} [x(u,a) * (1 - x(w,a)) + (1 - x(u,a)) * x(w,a)]$ change stat: $\delta_{x(u,a): 0 \rightarrow 1} = 1 - 2 * x(w,a)$*

- void `counter_neofun_a2b` (`PhyloCounters *counters`, `uint nfunA`, `uint nfunB`, unsigned int duplication=`DEFAULT_DUPLICATION`)
Total number of neofunctionalization events.
- void `counter_co_opt` (`PhyloCounters *counters`, `uint nfunA`, `uint nfunB`, unsigned int duplication=`DEFAULT_DUPLICATION`)
Function co-opting.
- void `counter_k_genes_changing` (`PhyloCounters *counters`, unsigned int k, unsigned int duplication=`DEFAULT_DUPLICATION`)
Indicator function. Equals to one if k genes changed and zero otherwise.
- void `counter_less_than_p_prop_genes_changing` (`PhyloCounters *counters`, double p, unsigned int duplication=`DEFAULT_DUPLICATION`)
Indicator function. Equals to one if k genes changed and zero otherwise.
- void `counter_gains_from_0` (`PhyloCounters *counters`, `std::vector< uint > nfun`, unsigned int duplication=`DEFAULT_DUPLICATION`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_overall_gains_from_0` (`PhyloCounters *counters`, unsigned int duplication=`DEFAULT_DUPLICATION`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_pairwise_overall_change` (`PhyloCounters *counters`, unsigned int duplication=`DEFAULT_DUPLICATION`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_pairwise_preserving` (`PhyloCounters *counters`, `uint nfunA`, `uint nfunB`, unsigned int duplication=`DEFAULT_DUPLICATION`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_pairwise_first_gain` (`PhyloCounters *counters`, `uint nfunA`, `uint nfunB`, unsigned int duplication=`DEFAULT_DUPLICATION`)
Used when all the functions are in 0 (like the root node prob.)

5.4.1 Detailed Description

`Counters` for phylogenetic modeling.

Parameters

<code>counters</code>	A pointer to a <code>PhyloCounters</code> object (<code>Counters<PhyloArray, PhyloCounterData></code>).
-----------------------	---

5.4.2 Function Documentation

5.4.2.1 counter_co_opt()

```
void counter_co_opt (
    PhyloCounters * counters,
    uint nfunA,
    uint nfunB,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Function co-opting.

Function co-opting of functions A and B happens when, for example, function B is gained as a new featured leveraging what function A already does; without losing function A. The sufficient statistic is defined as follows:

$$x_{pa}(1 - x_{pb}) \sum_{i < j} \left[x_{ia}^p (1 - x_{ib}^p) x_{ja}^p x_{jb}^p + x_{ja}^p (1 - x_{jb}^p) x_{ia}^p x_{ib}^p \right]$$

This algorithm implements the change statistic.

Definition at line 1393 of file phylo.hpp.

5.4.2.2 counter_cogain()

```
void counter_cogain (
    PhyloCounters * counters,
    uint nfunA,
    uint nfunB,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Co-evolution (joint gain or loss)

Needs to specify pairs of functions (nfunA, nfunB).

Definition at line 888 of file phylo.hpp.

5.4.2.3 counter_gains()

```
void counter_gains (
    PhyloCounters * counters,
    std::vector< uint > nfun,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Functional gains for a specific function (nfun).

Definition at line 193 of file phylo.hpp.

5.4.2.4 counter_gains_from_0()

```
void counter_gains_from_0 (
    PhyloCounters * counters,
    std::vector< uint > nfun,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Used when all the functions are in 0 (like the root node prob.)

Needs to specify function a.

Definition at line 1727 of file phylo.hpp.

5.4.2.5 counter_gains_k_offspring()

```
void counter_gains_k_offspring (
    PhyloCounters * counters,
    std::vector< uint > nfun,
    uint k = 1u,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

k genes gain function nfun

Definition at line 253 of file phylo.hpp.

5.4.2.6 counter_genes_changing()

```
void counter_genes_changing (
    PhyloCounters * counters,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)

Definition at line 325 of file phylo.hpp.

5.4.2.7 counter_k_genes_changing()

```
void counter_k_genes_changing (
    PhyloCounters * counters,
    unsigned int k,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Indicator function. Equals to one if k genes changed and zero otherwise.

Definition at line 1491 of file phylo.hpp.

5.4.2.8 counter_less_than_p_prop_genes_changing()

```
void counter_less_than_p_prop_genes_changing (
    PhyloCounters * counters,
    double p,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Indicator function. Equals to one if k genes changed and zero otherwise.

< How many genes diverge the parent

Definition at line 1611 of file phylo.hpp.

5.4.2.9 counter_longest()

```
void counter_longest (
    PhyloCounters * counters,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Longest branch mutates (either by gain or by loss)

Definition at line 945 of file phylo.hpp.

5.4.2.10 counter_loss()

```
void counter_loss (
    PhyloCounters * counters,
    std::vector< uint > nfun,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Total count of losses for an specific function.

Definition at line 688 of file phylo.hpp.

5.4.2.11 counter_maxfuns()

```
void counter_maxfuns (
    PhyloCounters * counters,
    uint lb,
    uint ub,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Cap the number of functions per gene.

Definition at line 626 of file phylo.hpp.

5.4.2.12 counter_neofun()

```
void counter_neofun (
    PhyloCounters * counters,
    uint nfunA,
    uint nfunB,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Total number of neofunctionalization events.

Needs to specify pairs of function.

Definition at line 1115 of file phylo.hpp.

5.4.2.13 counter_neofun_a2b()

```
void counter_neofun_a2b (
    PhyloCounters * counters,
    uint nfunA,
    uint nfunB,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Total number of neofunctionalization events.

Needs to specify pairs of function.

Definition at line 1260 of file phylo.hpp.

5.4.2.14 counter_overall_changes()

```
void counter_overall_changes (
    PhyloCounters * counters,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Total number of changes. Use this statistic to account for "preservation".

Definition at line 740 of file phylo.hpp.

5.4.2.15 counter_overall_gains()

```
void counter_overall_gains (
    PhyloCounters * counters,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Overall functional gains.

Total number of gains (irrespective of the function).

Definition at line 155 of file phylo.hpp.

5.4.2.16 counter_overall_gains_from_0()

```
void counter_overall_gains_from_0 (
    PhyloCounters * counters,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Used when all the functions are in 0 (like the root node prob.)

Needs to specify function a.

Definition at line 1793 of file phylo.hpp.

5.4.2.17 counter_overall_loss()

```
void counter_overall_loss (
    PhyloCounters * counters,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Overall functional loss.

Definition at line 578 of file phylo.hpp.

5.4.2.18 counter_pairwise_first_gain()

```
void counter_pairwise_first_gain (
    PhyloCounters * counters,
    uint nfunA,
    uint nfunB,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Used when all the functions are in 0 (like the root node prob.)

Needs to specify function a. $\sum x(a)^3(1-x(b))^3 + x(b)^3(1-x(a))^3 + x(a)^3 * x(b)^3 + (1-x(a))^3 * (1-x(b))^3$

Definition at line 2045 of file phylo.hpp.

5.4.2.19 counter_pairwise_neofun_singlefun()

```
void counter_pairwise_neofun_singlefun (
    PhyloCounters * counters,
    uint nfunA,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Total number of neofunctionalization events $\sum_u \sum_{w < u} [x(u,a)*(1-x(w,a)) + (1-x(u,a)) * x(w,a)]$ change stat: $\Delta\{x(u,a): 0 \rightarrow 1\} = 1 - 2 * x(w,a)$

Definition at line 1196 of file phylo.hpp.

5.4.2.20 counter_pairwise_overall_change()

```
void counter_pairwise_overall_change (
    PhyloCounters * counters,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Used when all the functions are in 0 (like the root node prob.)

Needs to specify function a.

Definition at line 1841 of file phylo.hpp.

5.4.2.21 counter_pairwise_preserving()

```
void counter_pairwise_preserving (
    PhyloCounters * counters,
    uint nfunA,
    uint nfunB,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Used when all the functions are in 0 (like the root node prob.)

Needs to specify function a. $\sum x(a)^3(1-x(b))^3 + x(b)^3(1-x(a))^3 + x(a)^3 * x(b)^3 + (1-x(a))^3 * (1-x(b))^3$

Definition at line 1906 of file phylo.hpp.

5.4.2.22 counter_preserve_pseudogene()

```
void counter_preserve_pseudogene (
    PhyloCounters * counters,
    unsigned int nfunA,
    unsigned int nfunB,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Keeps track of how many pairs of genes preserve pseudostate.

Definition at line 394 of file phylo.hpp.

5.4.2.23 counter_prop_genes_changing()

```
void counter_prop_genes_changing (
    PhyloCounters * counters,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)

Definition at line 476 of file phylo.hpp.

5.4.2.24 counter_subfun()

```
void counter_subfun (
    PhyloCounters * counters,
    uint nfunA,
    uint nfunB,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Total count of Sub-functionalization events.

It requires to specify data = {funA, funB}

Definition at line 799 of file phylo.hpp.

5.5 Phylo rules

[Rules](#) for phylogenetic modeling.

Classes

- class [PhyloRuleDynData](#)

Functions

- void [rule_dyn_limit_changes](#) ([PhyloSupport](#) *support, [uint](#) pos, [uint](#) lb, [uint](#) ub, unsigned int duplication=[DEFAULT_DUPLICATION](#))
Overall functional gains.

5.5.1 Detailed Description

[Rules](#) for phylogenetic modeling.

Parameters

<i>rules</i>	A pointer to a <code>PhyloRules</code> object (<code>Rules<PhyloArray, PhyloRuleData></code>).
--------------	--

5.5.2 Function Documentation

5.5.2.1 `rule_dyn_limit_changes()`

```
void rule_dyn_limit_changes (
    PhyloSupport * support,
    uint pos,
    uint lb,
    uint ub,
    unsigned int duplication = DEFAULT_DUPLICATION ) [inline]
```

Overall functional gains.

Parameters

<i>support</i>	<code>Support</code> of a model.
<i>pos</i>	Position of the focal statistic.
<i>lb</i>	Lower bound
<i>ub</i>	Upper bound

Returns

(void) adds a rule limiting the support of the model.

Definition at line 2177 of file `phylo.hpp`.

Chapter 6

Namespace Documentation

6.1 `barry` Namespace Reference

`barry`: Your go-to motif accountant

Namespaces

- [counters](#)

Tree class and Treeliterator class.

6.1.1 Detailed Description

`barry`: Your go-to motif accountant

6.2 `barry::counters` Namespace Reference

Tree class and Treeliterator class.

Namespaces

- [defm](#)
- [network](#)
- [phylo](#)

6.2.1 Detailed Description

Tree class and Treeliterator class.

6.3 `barry::counters::defm` Namespace Reference

6.4 `barry::counters::network` Namespace Reference

6.5 `barry::counters::phylo` Namespace Reference

6.6 `CHECK` Namespace Reference

Integer constants used to specify which cell should be check.

Variables

- `const int BOTH` = -1
- `const int NONE` = 0
- `const int ONE` = 1
- `const int TWO` = 2

6.6.1 Detailed Description

Integer constants used to specify which cell should be check.

6.6.2 Variable Documentation

6.6.2.1 `BOTH`

```
const int CHECK::BOTH = -1
```

Definition at line 28 of file typedefs.hpp.

6.6.2.2 `NONE`

```
const int CHECK::NONE = 0
```

Definition at line 29 of file typedefs.hpp.

6.6.2.3 ONE

```
const int CHECK::ONE = 1
```

Definition at line 30 of file typedefs.hpp.

6.6.2.4 TWO

```
const int CHECK::TWO = 2
```

Definition at line 31 of file typedefs.hpp.

6.7 EXISTS Namespace Reference

Integer constants used to specify which cell should be check to exist or not.

Variables

- `const int BOTH = -1`
- `const int NONE = 0`
- `const int ONE = 1`
- `const int TWO = 1`
- `const int UNKNOWN = -1`
- `const int AS_ZERO = 0`
- `const int AS_ONE = 1`

6.7.1 Detailed Description

Integer constants used to specify which cell should be check to exist or not.

6.7.2 Variable Documentation

6.7.2.1 AS_ONE

```
const int EXISTS::AS_ONE = 1
```

Definition at line 46 of file typedefs.hpp.

6.7.2.2 AS_ZERO

```
const int EXISTS::AS_ZERO = 0
```

Definition at line 45 of file typedefs.hpp.

6.7.2.3 BOTH

```
const int EXISTS::BOTH = -1
```

Definition at line 39 of file typedefs.hpp.

6.7.2.4 NONE

```
const int EXISTS::NONE = 0
```

Definition at line 40 of file typedefs.hpp.

6.7.2.5 ONE

```
const int EXISTS::ONE = 1
```

Definition at line 41 of file typedefs.hpp.

6.7.2.6 TWO

```
const int EXISTS::TWO = 1
```

Definition at line 42 of file typedefs.hpp.

6.7.2.7 UNKNOWN

```
const int EXISTS::UNKNOWN = -1
```

Definition at line 44 of file typedefs.hpp.

Chapter 7

Class Documentation

7.1 BArray< Cell_Type, Data_Type > Class Template Reference

Baseline class for binary arrays.

```
#include <barray-bones.hpp>
```

Public Member Functions

- bool `operator==` (const BArray< Cell_Type, Data_Type > &Array_)
- `~BArray` ()
- void `out_of_range` (uint i, uint j) const
- Cell_Type `get_cell` (uint i, uint j, bool check_bounds=true) const
- std::vector< Cell_Type > `get_col_vec` (uint i, bool check_bounds=true) const
- std::vector< Cell_Type > `get_row_vec` (uint i, bool check_bounds=true) const
- void `get_col_vec` (std::vector< Cell_Type > *x, uint i, bool check_bounds=true) const
- void `get_row_vec` (std::vector< Cell_Type > *x, uint i, bool check_bounds=true) const
- const Row_type< Cell_Type > & `row` (uint i, bool check_bounds=true) const
- const Col_type< Cell_Type > & `col` (uint i, bool check_bounds=true) const
- Entries< Cell_Type > `get_entries` () const

Get the edgelist.

- void `transpose` ()
- void `clear` (bool hard=true)
- void `resize` (uint N_, uint M_)
- void `reserve` ()
- void `print` (const char *fmt=nullptr,...) const
- bool `is_dense` () const noexcept

Constructors

Parameters

N_	Number of rows
M_	Number of columns
source	An unsigned vector ranging from 0 to N_
target	An unsigned int vector ranging from 0 to M_
target	When <code>true</code> tries to add repeated observations.

- **BArray** ()
Zero-size array.
 - **BArray** (uint N_, uint M_)
Empty array.
 - **BArray** (uint N_, uint M_, const std::vector< uint > &source, const std::vector< uint > &target, const std::vector< Cell_Type > &value, bool add=true)
Edgelist with data.
 - **BArray** (uint N_, uint M_, const std::vector< uint > &source, const std::vector< uint > &target, bool add=true)
Edgelist with no data (simpler)
 - **BArray** (const BArray< Cell_Type, Data_Type > &Array_, bool copy_data=false)
Copy constructor.
 - **BArray**< Cell_Type, Data_Type > & operator= (const BArray< Cell_Type, Data_Type > &Array_)
Assignment constructor.
 - **BArray** (BArray< Cell_Type, Data_Type > &&x) noexcept
Move operator.
 - **BArray**< Cell_Type, Data_Type > & operator= (BArray< Cell_Type, Data_Type > &&x) noexcept
Move assignment.
-
- void **set_data** (Data_Type *data_, bool delete_data_=false)
Set the data object.
 - Data_Type * **D_ptr** ()
 - const Data_Type * **D_ptr** () const
 - Data_Type & **D** ()
 - const Data_Type & **D** () const
 - void **flush_data** ()

Queries

is_empty queries a single cell. *nrow*, *ncol*, and *nnozero* return the number of rows, columns, and non-zero cells respectively.

Parameters

i,j	<i>Coordinates</i>
check_bounds	<i>If false avoids checking bounds.</i>

- bool **is_empty** (uint i, uint j, bool check_bounds=true) const
- uint **nrow** () const noexcept
- uint **ncol** () const noexcept
- uint **nnozero** () const noexcept
- Cell< Cell_Type > **default_val** () const

Cell-wise insertion/deletion

Parameters

i,j	<i>Row,column</i>
check_bounds	<i>When true and out of range, the function throws an error.</i>
check_exists	<i>Wither check if the cell exists (before trying to delete/add), or, in the case of swap_cells, check if either of both cells exists/don't exist.</i>

- `BArray< Cell_Type, Data_Type > & operator+= (const std::pair< uint, uint > &coords)`
- `BArray< Cell_Type, Data_Type > & operator-= (const std::pair< uint, uint > &coords)`
- `BArrayCell< Cell_Type, Data_Type > operator() (uint i, uint j, bool check_bounds=true)`
- `const Cell_Type operator() (uint i, uint j, bool check_bounds=true) const`
- `void rm_cell (uint i, uint j, bool check_bounds=true, bool check_exists=true)`
- `void insert_cell (uint i, uint j, const Cell< Cell_Type > &v, bool check_bounds, bool check_exists)`
- `void insert_cell (uint i, uint j, Cell< Cell_Type > &&v, bool check_bounds, bool check_exists)`
- `void insert_cell (uint i, uint j, Cell_Type v, bool check_bounds, bool check_exists)`
- `void swap_cells (uint i0, uint j0, uint i1, uint j1, bool check_bounds=true, int check_exists=CHECK::BOTH, int *report=nullptr)`
- `void toggle_cell (uint i, uint j, bool check_bounds=true, int check_exists=EXISTS::UNKNOWN)`
- `void toggle_lock (uint i, uint j, bool check_bounds=true)`

Column/row wise interchange

- `void swap_rows (uint i0, uint i1, bool check_bounds=true)`
- `void swap_cols (uint j0, uint j1, bool check_bounds=true)`
- `void zero_row (uint i, bool check_bounds=true)`
- `void zero_col (uint j, bool check_bounds=true)`

Arithmetic operators

- `BArray< Cell_Type, Data_Type > & operator+= (const BArray< Cell_Type, Data_Type > &rhs)`
- `BArray< Cell_Type, Data_Type > & operator+= (const Cell_Type &rhs)`
- `BArray< Cell_Type, Data_Type > & operator-= (const BArray< Cell_Type, Data_Type > &rhs)`
- `BArray< Cell_Type, Data_Type > & operator-= (const Cell_Type &rhs)`
- `BArray< Cell_Type, Data_Type > & operator/= (const Cell_Type &rhs)`
- `BArray< Cell_Type, Data_Type > & operator*= (const Cell_Type &rhs)`

Public Attributes

- `bool visited = false`

Friends

- `class BArrayCell< Cell_Type, Data_Type >`
- `class BArrayCell_const< Cell_Type, Data_Type >`

7.1.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArray< Cell_Type, Data_Type >
```

Baseline class for binary arrays.

`BArray` class objects are arbitrary arrays in which non-empty cells hold data of type `Cell_Type`. The non-empty cells are stored by row and indexed using `unordered_maps`, i.e. `std::vector< std::unordered_map<unsigned int, Cell_Type> >`.

Template Parameters

<i>Cell_Type</i>	Type of cell (any type).
<i>Data_Type</i>	Data type of the array (bool default).

Definition at line 28 of file barray-bones.hpp.

7.1.2 Constructor & Destructor Documentation

7.1.2.1 BArray() [1/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray< Cell_Type, Data_Type >::BArray ( ) [inline]
```

Zero-size array.

Definition at line 69 of file barray-bones.hpp.

7.1.2.2 BArray() [2/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray< Cell_Type, Data_Type >::BArray (
    uint N_,
    uint M_ ) [inline]
```

Empty array.

Definition at line 72 of file barray-bones.hpp.

7.1.2.3 BArray() [3/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray< Cell_Type, Data_Type >::BArray (
    uint N_,
    uint M_,
    const std::vector< uint > & source,
    const std::vector< uint > & target,
    const std::vector< Cell_Type > & value,
    bool add = true )
```

Edgelist with data.

7.1.2.4 BArray() [4/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray< Cell_Type, Data_Type >::BArray (
    uint N_,
    uint M_,
    const std::vector< uint > & source,
    const std::vector< uint > & target,
    bool add = true )
```

Edgelist with no data (simpler)

7.1.2.5 BArray() [5/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray< Cell_Type, Data_Type >::BArray (
    const BArray< Cell_Type, Data_Type > & Array_,
    bool copy_data = false )
```

Copy constructor.

7.1.2.6 BArray() [6/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray< Cell_Type, Data_Type >::BArray (
    BArray< Cell_Type, Data_Type > && x ) [noexcept]
```

Move operator.

7.1.2.7 ~BArray()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray< Cell_Type, Data_Type >::~~BArray ( )
```

7.1.3 Member Function Documentation

7.1.3.1 clear()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::clear (
    bool hard = true )
```

7.1.3.2 col()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Col_type< Cell_Type >& BArray< Cell_Type, Data_Type >::col (
    uint i,
    bool check_bounds = true ) const
```

7.1.3.3 D() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Data_Type& BArray< Cell_Type, Data_Type >::D ( )
```

7.1.3.4 D() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Data_Type& BArray< Cell_Type, Data_Type >::D ( ) const
```

7.1.3.5 D_ptr() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Data_Type* BArray< Cell_Type, Data_Type >::D_ptr ( )
```

7.1.3.6 D_ptr() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Data_Type* BArray< Cell_Type, Data_Type >::D_ptr ( ) const
```

7.1.3.7 default_val()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Cell<Cell_Type> BArray< Cell_Type, Data_Type >::default_val ( ) const
```

7.1.3.8 flush_data()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::flush_data ( )
```

7.1.3.9 get_cell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Cell_Type BArray< Cell_Type, Data_Type >::get_cell (
    uint i,
    uint j,
    bool check_bounds = true ) const
```

7.1.3.10 get_col_vec() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::get_col_vec (
    std::vector< Cell_Type > * x,
    uint i,
    bool check_bounds = true ) const
```

7.1.3.11 get_col_vec() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
std::vector< Cell_Type > BArray< Cell_Type, Data_Type >::get_col_vec (
    uint i,
    bool check_bounds = true ) const
```

7.1.3.12 get_entries()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Entries<Cell_Type> BArray< Cell_Type, Data_Type >::get_entries ( ) const
```

Get the edgelist.

`Entries` is a class with three objects: Two `std::vector` with the row and column coordinates respectively, and one `std::vector` with the corresponding value of the cell.

Returns

`Entries<Cell_Type>`

7.1.3.13 get_row_vec() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::get_row_vec (
    std::vector< Cell_Type > * x,
    uint i,
    bool check_bounds = true ) const
```

7.1.3.14 get_row_vec() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
std::vector< Cell_Type > BArray< Cell_Type, Data_Type >::get_row_vec (
    uint i,
    bool check_bounds = true ) const
```

7.1.3.15 insert_cell() [1/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::insert_cell (
    uint i,
    uint j,
    Cell< Cell_Type > && v,
    bool check_bounds,
    bool check_exists )
```

7.1.3.16 insert_cell() [2/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::insert_cell (
    uint i,
    uint j,
    Cell_Type v,
    bool check_bounds,
    bool check_exists )
```

7.1.3.17 insert_cell() [3/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::insert_cell (
    uint i,
    uint j,
    const Cell< Cell_Type > & v,
    bool check_bounds,
    bool check_exists )
```

7.1.3.18 is_dense()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArray< Cell_Type, Data_Type >::is_dense ( ) const [inline], [noexcept]
```

Definition at line 240 of file `barray-bones.hpp`.

7.1.3.19 is_empty()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArray< Cell_Type, Data_Type >::is_empty (
    uint i,
    uint j,
    bool check_bounds = true ) const
```

7.1.3.20 ncol()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
uint BArray< Cell_Type, Data_Type >::ncol ( ) const [noexcept]
```

7.1.3.21 nnozero()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
uint BArray< Cell_Type, Data_Type >::nnozero ( ) const [noexcept]
```

7.1.3.22 nrow()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
uint BArray< Cell_Type, Data_Type >::nrow ( ) const [noexcept]
```

7.1.3.23 operator()() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayCell<Cell_Type,Data_Type> BArray< Cell_Type, Data_Type >::operator() (
    uint i,
    uint j,
    bool check_bounds = true )
```

7.1.3.24 operator()() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Cell_Type BArray< Cell_Type, Data_Type >::operator() (
    uint i,
    uint j,
    bool check_bounds = true ) const
```

7.1.3.25 operator*=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator*= (
    const Cell_Type & rhs )
```

7.1.3.26 operator+=() [1/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator+= (
    const BArray< Cell_Type, Data_Type > & rhs )
```

7.1.3.27 operator+=() [2/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator+= (
    const Cell_Type & rhs )
```

7.1.3.28 operator+=() [3/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator+= (
    const std::pair< uint, uint > & coords )
```

7.1.3.29 operator-=() [1/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator-= (
    const BArray< Cell_Type, Data_Type > & rhs )
```

7.1.3.30 operator-=() [2/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator-= (
    const Cell_Type & rhs )
```

7.1.3.31 operator-=() [3/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator-= (
    const std::pair< uint, uint > & coords )
```

7.1.3.32 operator/=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator/= (
    const Cell_Type & rhs )
```

7.1.3.33 operator=() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator= (
    BArray< Cell_Type, Data_Type > && x ) [noexcept]
```

Move assignment.

7.1.3.34 operator=() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArray<Cell_Type,Data_Type>& BArray< Cell_Type, Data_Type >::operator= (
    const BArray< Cell_Type, Data_Type > & Array_ )
```

Assignment constructor.

7.1.3.35 operator==()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArray< Cell_Type, Data_Type >::operator== (
    const BArray< Cell_Type, Data_Type > & Array_ )
```

7.1.3.36 out_of_range()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::out_of_range (
    uint i,
    uint j ) const
```

7.1.3.37 print()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::print (
    const char * fmt = nullptr,
    ... ) const
```

7.1.3.38 reserve()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::reserve ( )
```

7.1.3.39 resize()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::resize (
    uint N_,
    uint M_ )
```

7.1.3.40 rm_cell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::rm_cell (
    uint i,
    uint j,
    bool check_bounds = true,
    bool check_exists = true )
```

7.1.3.41 row()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Row_type< Cell_Type >& BArray< Cell_Type, Data_Type >::row (
    uint i,
    bool check_bounds = true ) const
```

7.1.3.42 set_data()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::set_data (
    Data_Type * data_,
    bool delete_data_ = false )
```

Set the data object.

Parameters

<i>data_</i>	
<i>delete_↔</i> <i>data_</i>	

7.1.3.43 swap_cells()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::swap_cells (
    uint i0,
    uint j0,
    uint i1,
    uint j1,
    bool check_bounds = true,
    int check_exists = CHECK::BOTH,
    int * report = nullptr )
```

7.1.3.44 swap_cols()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::swap_cols (
    uint j0,
    uint j1,
    bool check_bounds = true )
```

7.1.3.45 swap_rows()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::swap_rows (
    uint i0,
    uint i1,
    bool check_bounds = true )
```

7.1.3.46 toggle_cell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::toggle_cell (
    uint i,
    uint j,
    bool check_bounds = true,
    int check_exists = EXISTS::UNKNOWN )
```

7.1.3.47 toggle_lock()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::toggle_lock (
    uint i,
    uint j,
    bool check_bounds = true )
```

7.1.3.48 transpose()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::transpose ( )
```

7.1.3.49 zero_col()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::zero_col (
    uint j,
    bool check_bounds = true )
```

7.1.3.50 zero_row()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArray< Cell_Type, Data_Type >::zero_row (
    uint i,
    bool check_bounds = true )
```

7.1.4 Friends And Related Function Documentation

7.1.4.1 BArrayCell< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayCell< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file barray-bones.hpp.

7.1.4.2 BArrayCell_const< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayCell_const< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file `barray-bones.hpp`.

7.1.5 Member Data Documentation

7.1.5.1 visited

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArray< Cell_Type, Data_Type >::visited = false
```

This is as a reference, if we need to iterate through the cells and we need to keep track which were visited, we use this as a reference. So that if `cell.visited = true` and `visited = true`, it means that we haven't been here yet. Ideally, any routine using this->visited should switch it at the beginning of the routine.

Definition at line 54 of file `barray-bones.hpp`.

The documentation for this class was generated from the following file:

- `include/barry/barray-bones.hpp`

7.2 BArrayCell< Cell_Type, Data_Type > Class Template Reference

```
#include <barraycell-bones.hpp>
```

Public Member Functions

- `BArrayCell` (`BArray`< `Cell_Type`, `Data_Type` > *`Array_`, `uint` `i_`, `uint` `j_`, `bool` `check_bounds=true`)
- `~BArrayCell` ()
- `void operator=` (`const` `Cell_Type` &`val`)
- `void operator+=` (`const` `Cell_Type` &`val`)
- `void operator-=` (`const` `Cell_Type` &`val`)
- `void operator*=` (`const` `Cell_Type` &`val`)
- `void operator/=` (`const` `Cell_Type` &`val`)
- `operator Cell_Type` () `const`
- `bool operator==` (`const` `Cell_Type` &`val`) `const`

7.2.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayCell< Cell_Type, Data_Type >
```

Definition at line 7 of file `barraycell-bones.hpp`.

7.2.2 Constructor & Destructor Documentation

7.2.2.1 BArrayCell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayCell< Cell_Type, Data_Type >::BArrayCell (
    BArray< Cell_Type, Data_Type > * Array_,
    uint i_,
    uint j_,
    bool check_bounds = true ) [inline]
```

Definition at line 16 of file barraycell-bones.hpp.

7.2.2.2 ~BArrayCell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayCell< Cell_Type, Data_Type >::~~BArrayCell ( ) [inline]
```

Definition at line 31 of file barraycell-bones.hpp.

7.2.3 Member Function Documentation

7.2.3.1 operator Cell_Type()

```
template<typename Cell_Type , typename Data_Type >
BArrayCell< Cell_Type, Data_Type >::operator Cell_Type [inline]
```

Definition at line 58 of file barraycell-meat.hpp.

7.2.3.2 operator*=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayCell< Cell_Type, Data_Type >::operator*= (
    const Cell_Type & val ) [inline]
```

Definition at line 40 of file barraycell-meat.hpp.

7.2.3.3 operator+=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayCell< Cell_Type, Data_Type >::operator+= (
    const Cell_Type & val ) [inline]
```

Definition at line 18 of file barraycell-meat.hpp.

7.2.3.4 operator-=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayCell< Cell_Type, Data_Type >::operator-= (
    const Cell_Type & val ) [inline]
```

Definition at line 29 of file barraycell-meat.hpp.

7.2.3.5 operator/=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayCell< Cell_Type, Data_Type >::operator/= (
    const Cell_Type & val ) [inline]
```

Definition at line 49 of file barraycell-meat.hpp.

7.2.3.6 operator=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayCell< Cell_Type, Data_Type >::operator= (
    const Cell_Type & val ) [inline]
```

Definition at line 7 of file barraycell-meat.hpp.

7.2.3.7 operator==(())

```
template<typename Cell_Type , typename Data_Type >
bool BArrayCell< Cell_Type, Data_Type >::operator==(
    const Cell_Type & val ) const [inline]
```

Definition at line 63 of file barraycell-meat.hpp.

The documentation for this class was generated from the following files:

- [include/barry/barray-bones.hpp](#)
- [include/barry/barraycell-bones.hpp](#)
- [include/barry/barraycell-meat.hpp](#)
- [include/barry/barrayrow-meat.hpp](#)

7.3 BArrayCell_const< Cell_Type, Data_Type > Class Template Reference

```
#include <barraycell-bones.hpp>
```

Public Member Functions

- [BArrayCell_const](#) (const [BArray](#)< Cell_Type, Data_Type > *[Array_](#), [uint](#) [i_](#), [uint](#) [j_](#), bool [check_bounds](#)=true)
- [~BArrayCell_const](#) ()
- [operator Cell_Type](#) () const
- bool [operator==](#) (const [Cell_Type](#) &val) const
- bool [operator!=](#) (const [Cell_Type](#) &val) const
- bool [operator<](#) (const [Cell_Type](#) &val) const
- bool [operator>](#) (const [Cell_Type](#) &val) const
- bool [operator<=](#) (const [Cell_Type](#) &val) const
- bool [operator>=](#) (const [Cell_Type](#) &val) const

7.3.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayCell_const< Cell_Type, Data_Type >
```

Definition at line 46 of file `barraycell-bones.hpp`.

7.3.2 Constructor & Destructor Documentation

7.3.2.1 BArrayCell_const()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayCell_const< Cell_Type, Data_Type >::BArrayCell_const (
    const BArray< Cell_Type, Data_Type > * Array\_,
    uint i\_,
    uint j\_,
    bool check\_bounds = true ) [inline]
```

Definition at line 55 of file `barraycell-bones.hpp`.

7.3.2.2 ~BArrayCell_const()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayCell_const< Cell_Type, Data_Type >::~BArrayCell_const ( ) [inline]
```

Definition at line 67 of file `barraycell-bones.hpp`.

7.3.3 Member Function Documentation

7.3.3.1 operator Cell_Type()

```
template<typename Cell_Type , typename Data_Type >  
BArrayCell_const< Cell_Type, Data_Type >::operator Cell_Type [inline]
```

Definition at line 68 of file barraycell-meat.hpp.

7.3.3.2 operator"!=(())

```
template<typename Cell_Type , typename Data_Type >  
bool BArrayCell_const< Cell_Type, Data_Type >::operator!=( (   
    const Cell_Type & val ) const [inline]
```

Definition at line 78 of file barraycell-meat.hpp.

7.3.3.3 operator<()

```
template<typename Cell_Type , typename Data_Type >  
bool BArrayCell_const< Cell_Type, Data_Type >::operator< (   
    const Cell_Type & val ) const [inline]
```

Definition at line 83 of file barraycell-meat.hpp.

7.3.3.4 operator<=()

```
template<typename Cell_Type , typename Data_Type >  
bool BArrayCell_const< Cell_Type, Data_Type >::operator<= (   
    const Cell_Type & val ) const [inline]
```

Definition at line 93 of file barraycell-meat.hpp.

7.3.3.5 operator==(())

```
template<typename Cell_Type , typename Data_Type >  
bool BArrayCell_const< Cell_Type, Data_Type >::operator==( (   
    const Cell_Type & val ) const [inline]
```

Definition at line 73 of file barraycell-meat.hpp.

7.3.3.6 operator>()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayCell_const< Cell_Type, Data_Type >::operator> (
    const Cell_Type & val ) const [inline]
```

Definition at line 88 of file `barraycell-meat.hpp`.

7.3.3.7 operator>=()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayCell_const< Cell_Type, Data_Type >::operator>= (
    const Cell_Type & val ) const [inline]
```

Definition at line 98 of file `barraycell-meat.hpp`.

The documentation for this class was generated from the following files:

- `include/barry/barray-bones.hpp`
- `include/barry/barraycell-bones.hpp`
- `include/barry/barraycell-meat.hpp`
- `include/barry/barrayrow-meat.hpp`

7.4 BArrayDense< Cell_Type, Data_Type > Class Template Reference

Baseline class for binary arrays.

```
#include <barraydense-bones.hpp>
```

Public Member Functions

- `bool operator== (const BArrayDense< Cell_Type, Data_Type > &Array_)`
- `~BArrayDense ()`
- `void out_of_range (uint i, uint j) const`
- `Cell_Type get_cell (uint i, uint j, bool check_bounds=true) const`
- `std::vector< Cell_Type > get_col_vec (uint i, bool check_bounds=true) const`
- `std::vector< Cell_Type > get_row_vec (uint i, bool check_bounds=true) const`
- `void get_col_vec (std::vector< Cell_Type > *x, uint i, bool check_bounds=true) const`
- `void get_row_vec (std::vector< Cell_Type > *x, uint i, bool check_bounds=true) const`
- `BArrayDenseRow< Cell_Type, Data_Type > & row (uint i, bool check_bounds=true)`
- `const BArrayDenseRow_const< Cell_Type, Data_Type > row (uint i, bool check_bounds=true) const`
- `BArrayDenseCol< Cell_Type, Data_Type > & col (uint j, bool check_bounds=true)`
- `const BArrayDenseCol_const< Cell_Type, Data_Type > col (uint j, bool check_bounds=true) const`
- `Entries< Cell_Type > get_entries () const`

Get the edgelist.

- `void transpose ()`
- `void clear (bool hard=true)`
- `void resize (uint N_, uint M_)`
- `void reserve ()`
- `void print (const char *fmt=nullptr,...) const`
- `bool is_dense () const noexcept`
- `const std::vector< Cell_Type > & get_data () const`
- `const Cell_Type rowsum (unsigned int i) const`
- `const Cell_Type colsum (unsigned int i) const`

Constructors

Parameters

N_	Number of rows
M_	Number of columns
source	An unsigned vector ranging from 0 to N_
target	An unsigned int vector ranging from 0 to M_
target	When <code>true</code> tries to add repeated observations.
value	Cell_Type default fill-in value (zero, by default.)

- `BArrayDense ()`
Zero-size array.
 - `BArrayDense (uint N_, uint M_, Cell_Type value=static_cast< Cell_Type >(0))`
Empty array.
 - `BArrayDense (uint N_, uint M_, const std::vector< uint > &source, const std::vector< uint > &target, const std::vector< Cell_Type > &value, bool add=true)`
Edgelist with data.
 - `BArrayDense (uint N_, uint M_, const std::vector< uint > &source, const std::vector< uint > &target, bool add=true)`
Edgelist with no data (simpler)
 - `BArrayDense (const BArrayDense< Cell_Type, Data_Type > &Array_, bool copy_data=false)`
Copy constructor.
 - `BArrayDense< Cell_Type, Data_Type > & operator= (const BArrayDense< Cell_Type, Data_Type > &Array_)`
Assignment constructor.
 - `BArrayDense (BArrayDense< Cell_Type, Data_Type > &&x) noexcept`
Move operator.
 - `BArrayDense< Cell_Type, Data_Type > & operator= (BArrayDense< Cell_Type, Data_Type > &&x) noexcept`
Move assignment.
-
- `void set_data (Data_Type *data_, bool delete_data_=false)`
Set the data object.
 - `Data_Type * D_ptr ()`
 - `const Data_Type * D_ptr () const`
 - `Data_Type & D ()`
 - `const Data_Type & D () const`

Queries

is_empty queries a single cell. *nrow*, *ncol*, and *nnozero* return the number of rows, columns, and non-zero cells respectively.

Parameters

i,j	Coordinates
check_bounds	If <i>false</i> avoids checking bounds.

- `bool is_empty (uint i, uint j, bool check_bounds=true) const`
- `uint nrow () const noexcept`
- `uint ncol () const noexcept`
- `uint nnozero () const noexcept`

- [Cell](#)< Cell_Type > [default_val](#) () const

Cell-wise insertion/deletion

Parameters

i,j	<i>Row,column</i>
check_bounds	<i>When true and out of range, the function throws an error.</i>
check_exists	<i>Wither check if the cell exists (before trying to delete/add), or, in the case of swap_cells, check if either of both cells exists/don't exist.</i>

- [BArrayDense](#)< Cell_Type, Data_Type > & [operator+=](#) (const std::pair< uint, uint > &coords)
- [BArrayDense](#)< Cell_Type, Data_Type > & [operator-=](#) (const std::pair< uint, uint > &coords)
- [BArrayDenseCell](#)< Cell_Type, Data_Type > [operator\(\)](#) (uint i, uint j, bool check_bounds=true)
- const Cell_Type [operator\(\)](#) (uint i, uint j, bool check_bounds=true) const
- void [rm_cell](#) (uint i, uint j, bool check_bounds=true, bool check_exists=true)
- void [insert_cell](#) (uint i, uint j, const Cell< Cell_Type > &v, bool check_bounds, bool check_exists)
- void [insert_cell](#) (uint i, uint j, Cell_Type v, bool check_bounds, bool check_exists)
- void [swap_cells](#) (uint i0, uint j0, uint i1, uint j1, bool check_bounds=true, int check_exists=CHECK::BOTH, int *report=nullptr)
- void [toggle_cell](#) (uint i, uint j, bool check_bounds=true, int check_exists=EXISTS::UNKNOWN)
- void [toggle_lock](#) (uint i, uint j, bool check_bounds=true)

Column/row wise interchange

- void [swap_rows](#) (uint i0, uint i1, bool check_bounds=true)
- void [swap_cols](#) (uint j0, uint j1, bool check_bounds=true)
- void [zero_row](#) (uint i, bool check_bounds=true)
- void [zero_col](#) (uint j, bool check_bounds=true)

Arithmetic operators

- [BArrayDense](#)< Cell_Type, Data_Type > & [operator+=](#) (const [BArrayDense](#)< Cell_Type, Data_Type > &rhs)
- [BArrayDense](#)< Cell_Type, Data_Type > & [operator+=](#) (const Cell_Type &rhs)
- [BArrayDense](#)< Cell_Type, Data_Type > & [operator-=](#) (const [BArrayDense](#)< Cell_Type, Data_Type > &rhs)
- [BArrayDense](#)< Cell_Type, Data_Type > & [operator-=](#) (const Cell_Type &rhs)
- [BArrayDense](#)< Cell_Type, Data_Type > & [operator/=](#) (const Cell_Type &rhs)
- [BArrayDense](#)< Cell_Type, Data_Type > & [operator*=](#) (const Cell_Type &rhs)

Public Attributes

- bool [visited](#) = false

Friends

- class [BArrayDenseCell](#)< Cell_Type, Data_Type >
- class [BArrayDenseCol](#)< Cell_Type, Data_Type >
- class [BArrayDenseCol_const](#)< Cell_Type, Data_Type >
- class [BArrayDenseRow](#)< Cell_Type, Data_Type >
- class [BArrayDenseRow_const](#)< Cell_Type, Data_Type >

7.4.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayDense< Cell_Type, Data_Type >
```

Baseline class for binary arrays.

[BArrayDense](#) class objects are arbitrary dense-arrays. The data is stored internally in the `el` member, which can be accessed using the member function `get_data()`, by column.

Template Parameters

<i>Cell_Type</i>	Type of cell (any type).
<i>Data_Type</i>	Data type of the array (bool default).

Definition at line 33 of file `barraydense-bones.hpp`.

7.4.2 Constructor & Destructor Documentation

7.4.2.1 BArrayDense() [1/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense< Cell_Type, Data_Type >::BArrayDense ( ) [inline]
```

Zero-size array.

Definition at line 79 of file `barraydense-bones.hpp`.

7.4.2.2 BArrayDense() [2/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense< Cell_Type, Data_Type >::BArrayDense (
    uint N_,
    uint M_,
    Cell_Type value = static_cast<Cell_Type>(0) ) [inline]
```

Empty array.

Definition at line 82 of file `barraydense-bones.hpp`.

7.4.2.3 BArrayDense() [3/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense< Cell_Type, Data_Type >::BArrayDense (
    uint N_,
    uint M_,
    const std::vector< uint > & source,
    const std::vector< uint > & target,
    const std::vector< Cell_Type > & value,
    bool add = true )
```

Edgelist with data.

7.4.2.4 BArrayDense() [4/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense< Cell_Type, Data_Type >::BArrayDense (
    uint N_,
    uint M_,
    const std::vector< uint > & source,
    const std::vector< uint > & target,
    bool add = true )
```

Edgelist with no data (simpler)

7.4.2.5 BArrayDense() [5/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense< Cell_Type, Data_Type >::BArrayDense (
    const BArrayDense< Cell_Type, Data_Type > & Array_,
    bool copy_data = false )
```

Copy constructor.

7.4.2.6 BArrayDense() [6/6]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense< Cell_Type, Data_Type >::BArrayDense (
    BArrayDense< Cell_Type, Data_Type > && x ) [noexcept]
```

Move operator.

7.4.2.7 ~BArrayDense()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense< Cell_Type, Data_Type >::~~BArrayDense ( )
```

7.4.3 Member Function Documentation

7.4.3.1 clear()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::clear (
    bool hard = true )
```

7.4.3.2 col() [1/2]

```
template<typename Cell_Type , typename Data_Type >
BArrayDenseCol< Cell_Type, Data_Type > & BArrayDense< Cell_Type, Data_Type >::col (
    uint j,
    bool check_bounds = true ) [inline]
```

Definition at line 490 of file `barraydense-meat.hpp`.

7.4.3.3 col() [2/2]

```
template<typename Cell_Type , typename Data_Type >
const BArrayDenseCol_const< Cell_Type, Data_Type > BArrayDense< Cell_Type, Data_Type >::col (
    uint j,
    bool check_bounds = true ) const [inline]
```

Definition at line 476 of file `barraydense-meat.hpp`.

7.4.3.4 colsum()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Cell_Type BArrayDense< Cell_Type, Data_Type >::colsum (
    unsigned int i ) const
```

7.4.3.5 D() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Data_Type& BArrayDense< Cell_Type, Data_Type >::D ( )
```

7.4.3.6 D() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Data_Type& BArrayDense< Cell_Type, Data_Type >::D ( ) const
```

7.4.3.7 D_ptr() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Data_Type* BArrayDense< Cell_Type, Data_Type >::D_ptr ( )
```

7.4.3.8 D_ptr() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Data_Type* BArrayDense< Cell_Type, Data_Type >::D_ptr ( ) const
```

7.4.3.9 default_val()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Cell<Cell_Type> BArrayDense< Cell_Type, Data_Type >::default_val ( ) const
```

7.4.3.10 get_cell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Cell_Type BArrayDense< Cell_Type, Data_Type >::get_cell (
    uint i,
    uint j,
    bool check_bounds = true ) const
```

7.4.3.11 get_col_vec() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::get_col_vec (
    std::vector< Cell_Type > * x,
    uint i,
    bool check_bounds = true ) const
```

7.4.3.12 get_col_vec() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
std::vector< Cell_Type > BArrayDense< Cell_Type, Data_Type >::get_col_vec (
    uint i,
    bool check_bounds = true ) const
```

7.4.3.13 get_data()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const std::vector< Cell_Type >& BArrayDense< Cell_Type, Data_Type >::get_data ( ) const
```

7.4.3.14 get_entries()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Entries<Cell_Type> BArrayDense< Cell_Type, Data_Type >::get_entries ( ) const
```

Get the edgelist.

`Entries` is a class with three objects: Two `std::vector` with the row and column coordinates respectively, and one `std::vector` with the corresponding value of the cell.

Returns

`Entries<Cell_Type>`

7.4.3.15 get_row_vec() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::get_row_vec (
    std::vector< Cell_Type > * x,
    uint i,
    bool check_bounds = true ) const
```

7.4.3.16 get_row_vec() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
std::vector< Cell_Type > BArrayDense< Cell_Type, Data_Type >::get_row_vec (
    uint i,
    bool check_bounds = true ) const
```

7.4.3.17 insert_cell() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::insert_cell (
    uint i,
    uint j,
    Cell_Type v,
    bool check_bounds,
    bool check_exists )
```

7.4.3.18 insert_cell() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::insert_cell (
    uint i,
    uint j,
    const Cell< Cell_Type > & v,
    bool check_bounds,
    bool check_exists )
```

7.4.3.19 is_dense()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayDense< Cell_Type, Data_Type >::is_dense ( ) const [inline], [noexcept]
```

Definition at line 256 of file `barraydense-bones.hpp`.

7.4.3.20 is_empty()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayDense< Cell_Type, Data_Type >::is_empty (
    uint i,
    uint j,
    bool check_bounds = true ) const
```

7.4.3.21 ncol()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
uint BArrayDense< Cell_Type, Data_Type >::ncol ( ) const [noexcept]
```

7.4.3.22 nnozero()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
uint BArrayDense< Cell_Type, Data_Type >::nnozero ( ) const [noexcept]
```

7.4.3.23 nrow()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
uint BArrayDense< Cell_Type, Data_Type >::nrow ( ) const [noexcept]
```

7.4.3.24 operator>() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDenseCell<Cell_Type,Data_Type> BArrayDense< Cell_Type, Data_Type >::operator() (
    uint i,
    uint j,
    bool check_bounds = true )
```

7.4.3.25 operator>() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Cell_Type BArrayDense< Cell_Type, Data_Type >::operator() (
    uint i,
    uint j,
    bool check_bounds = true ) const
```

7.4.3.26 operator*=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator*= (
    const Cell_Type & rhs )
```

7.4.3.27 operator+=() [1/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator+=( (
    const BArrayDense< Cell_Type, Data_Type > & rhs )
```

7.4.3.28 operator+=() [2/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator+=( (
    const Cell_Type & rhs )
```

7.4.3.29 operator+=() [3/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator+=( (
    const std::pair< uint, uint > & coords )
```

7.4.3.30 operator-=() [1/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator-=( (
    const BArrayDense< Cell_Type, Data_Type > & rhs )
```

7.4.3.31 operator-=() [2/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator-=( (
    const Cell_Type & rhs )
```

7.4.3.32 operator-=() [3/3]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator-=( (
    const std::pair< uint, uint > & coords )
```

7.4.3.33 operator/=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator/= (
    const Cell_Type & rhs )
```

7.4.3.34 operator=() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator= (
    BArrayDense< Cell_Type, Data_Type > && x ) [noexcept]
```

Move assignment.

7.4.3.35 operator=() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDense<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::operator= (
    const BArrayDense< Cell_Type, Data_Type > & Array_ )
```

Assignment constructor.

7.4.3.36 operator==()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayDense< Cell_Type, Data_Type >::operator== (
    const BArrayDense< Cell_Type, Data_Type > & Array_ )
```

7.4.3.37 out_of_range()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::out_of_range (
    uint i,
    uint j ) const
```

7.4.3.38 print()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::print (
    const char * fmt = nullptr,
    ... ) const
```

7.4.3.39 reserve()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::reserve ( )
```

7.4.3.40 resize()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::resize (
    uint N_,
    uint M_ )
```

7.4.3.41 rm_cell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::rm_cell (
    uint i,
    uint j,
    bool check_bounds = true,
    bool check_exists = true )
```

7.4.3.42 row() [1/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDenseRow<Cell_Type,Data_Type>& BArrayDense< Cell_Type, Data_Type >::row (
    uint i,
    bool check_bounds = true )
```

7.4.3.43 row() [2/2]

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const BArrayDenseRow_const<Cell_Type,Data_Type> BArrayDense< Cell_Type, Data_Type >::row (
    uint i,
    bool check_bounds = true ) const
```

7.4.3.44 rowsum()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const Cell_Type BArrayDense< Cell_Type, Data_Type >::rowsum (
    unsigned int i ) const
```


7.4.3.45 set_data()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::set_data (
    Data_Type * data_,
    bool delete_data_ = false )
```

Set the data object.

Parameters

<i>data_</i>	
<i>delete_ ↔ data_</i>	

7.4.3.46 swap_cells()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::swap_cells (
    uint i0,
    uint j0,
    uint i1,
    uint j1,
    bool check_bounds = true,
    int check_exists = CHECK::BOTH,
    int * report = nullptr )
```

7.4.3.47 swap_cols()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::swap_cols (
    uint j0,
    uint j1,
    bool check_bounds = true )
```

7.4.3.48 swap_rows()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::swap_rows (
    uint i0,
    uint i1,
    bool check_bounds = true )
```

7.4.3.49 toggle_cell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::toggle_cell (
    uint i,
    uint j,
    bool check_bounds = true,
    int check_exists = EXISTS::UNKNOWN )
```

7.4.3.50 toggle_lock()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::toggle_lock (
    uint i,
    uint j,
    bool check_bounds = true )
```

7.4.3.51 transpose()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::transpose ( )
```

7.4.3.52 zero_col()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::zero_col (
    uint j,
    bool check_bounds = true )
```

7.4.3.53 zero_row()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayDense< Cell_Type, Data_Type >::zero_row (
    uint i,
    bool check_bounds = true )
```

7.4.4 Friends And Related Function Documentation

7.4.4.1 BArrayDenseCell< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCell< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file barraydense-bones.hpp.

7.4.4.2 BArrayDenseCol< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCol< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file barraydense-bones.hpp.

7.4.4.3 BArrayDenseCol_const< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCol_const< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file barraydense-bones.hpp.

7.4.4.4 BArrayDenseRow< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseRow< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file barraydense-bones.hpp.

7.4.4.5 BArrayDenseRow_const< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseRow_const< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file barraydense-bones.hpp.

7.4.5 Member Data Documentation

7.4.5.1 visited

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayDense< Cell_Type, Data_Type >::visited = false
```

This is as a reference, if we need to iterate through the cells and we need to keep track which were visited, we use this as a reference. So that if cell.visited = true and visited = true, it means that we haven't been here yet. Ideally, any routine using this->visited should switch it at the beginning of the routine.

Definition at line 63 of file `barraydense-bones.hpp`.

The documentation for this class was generated from the following files:

- `include/barry/barraydense-bones.hpp`
- `include/barry/barraydense-meat.hpp`

7.5 BArrayDenseCell< Cell_Type, Data_Type > Class Template Reference

```
#include <barraydensecell-bones.hpp>
```

Public Member Functions

- `BArrayDenseCell` (`BArrayDense`< `Cell_Type`, `Data_Type` > *`Array_`, `uint` `i_`, `uint` `j_`, `bool` `check_bounds`=true)
- `BArrayDenseCell`< `Cell_Type`, `Data_Type` > & `operator=` (`const` `BArrayDenseCell`< `Cell_Type`, `Data_Type` > &`other`)
- `~BArrayDenseCell` ()
- `void operator=` (`const` `Cell_Type` &`val`)
- `void operator+=` (`const` `Cell_Type` &`val`)
- `void operator-=` (`const` `Cell_Type` &`val`)
- `void operator*=` (`const` `Cell_Type` &`val`)
- `void operator/=` (`const` `Cell_Type` &`val`)
- `operator Cell_Type` () `const`
- `bool operator==` (`const` `Cell_Type` &`val`) `const`

Friends

- `class` `BArrayDense`< `Cell_Type`, `Data_Type` >
- `class` `BArrayDenseCol`< `Cell_Type`, `Data_Type` >
- `class` `BArrayDenseCol_const`< `Cell_Type`, `Data_Type` >

7.5.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayDenseCell< Cell_Type, Data_Type >
```

Definition at line 18 of file `barraydensecell-bones.hpp`.

7.5.2 Constructor & Destructor Documentation

7.5.2.1 BArrayDenseCell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDenseCell< Cell_Type, Data_Type >::BArrayDenseCell (
    BArrayDense< Cell_Type, Data_Type > * Array_,
    uint i_,
    uint j_,
    bool check_bounds = true ) [inline]
```

Definition at line 30 of file `barraydensecell-bones.hpp`.

7.5.2.2 ~BArrayDenseCell()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDenseCell< Cell_Type, Data_Type >::~~BArrayDenseCell ( ) [inline]
```

Definition at line 56 of file `barraydensecell-bones.hpp`.

7.5.3 Member Function Documentation

7.5.3.1 operator Cell_Type()

```
template<typename Cell_Type , typename Data_Type >
BArrayDenseCell< Cell_Type, Data_Type >::operator Cell_Type [inline]
```

Definition at line 72 of file `barraydensecell-meat.hpp`.

7.5.3.2 operator*=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayDenseCell< Cell_Type, Data_Type >::operator*= (
    const Cell_Type & val ) [inline]
```

Definition at line 52 of file `barraydensecell-meat.hpp`.

7.5.3.3 operator+=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayDenseCell< Cell_Type, Data_Type >::operator+= (
    const Cell_Type & val ) [inline]
```

Definition at line 34 of file `barraydensecell-meat.hpp`.

7.5.3.4 operator-=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayDenseCell< Cell_Type, Data_Type >::operator-= (
    const Cell_Type & val ) [inline]
```

Definition at line 43 of file `barraydensecell-meat.hpp`.

7.5.3.5 operator/=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayDenseCell< Cell_Type, Data_Type >::operator/= (
    const Cell_Type & val ) [inline]
```

Definition at line 62 of file `barraydensecell-meat.hpp`.

7.5.3.6 operator=() [1/2]

```
template<typename Cell_Type , typename Data_Type >
BArrayDenseCell< Cell_Type, Data_Type > & BArrayDenseCell< Cell_Type, Data_Type >::operator=
(
    const BArrayDenseCell< Cell_Type, Data_Type > & other ) [inline]
```

Definition at line 9 of file `barraydensecell-meat.hpp`.

7.5.3.7 operator=() [2/2]

```
template<typename Cell_Type , typename Data_Type >
void BArrayDenseCell< Cell_Type, Data_Type >::operator= (
    const Cell_Type & val ) [inline]
```

Definition at line 24 of file `barraydensecell-meat.hpp`.

7.5.3.8 operator==()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayDenseCell< Cell_Type, Data_Type >::operator==(
    const Cell_Type & val ) const [inline]
```

Definition at line 77 of file `barraydensecell-meat.hpp`.

7.5.4 Friends And Related Function Documentation

7.5.4.1 BArrayDense< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDense< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file `barraydensecell-bones.hpp`.

7.5.4.2 BArrayDenseCol< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCol< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file `barraydensecell-bones.hpp`.

7.5.4.3 BArrayDenseCol_const< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCol_const< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file `barraydensecell-bones.hpp`.

The documentation for this class was generated from the following files:

- `include/barry/barraydense-bones.hpp`
- `include/barry/barraydensecell-bones.hpp`
- `include/barry/barraydensecell-meat.hpp`

7.6 BArrayDenseCell_const< Cell_Type, Data_Type > Class Template Reference

7.6.1 Detailed Description

```
template<typename Cell_Type, typename Data_Type>
class BArrayDenseCell_const< Cell_Type, Data_Type >
```

Definition at line 20 of file `barraydense-bones.hpp`.

The documentation for this class was generated from the following file:

- [include/barry/barraydense-bones.hpp](#)

7.7 BArrayDenseCol< Cell_Type, Data_Type > Class Template Reference

```
#include <barraydensecol-bones.hpp>
```

Public Member Functions

- [BArrayDenseCol](#) ([BArrayDense](#)< Cell_Type, Data_Type > &array_, unsigned int j)
- [Col_type](#)< Cell_Type >::iterator & [begin](#) ()
- [Col_type](#)< Cell_Type >::iterator & [end](#) ()
- [size_t](#) [size](#) () [const](#) [noexcept](#)
- [std::pair](#)< unsigned int, Cell_Type * > & [operator\(\)](#) (unsigned int i)

Friends

- class [BArrayDense](#)< Cell_Type, Data_Type >
- class [BArrayDenseCell](#)< Cell_Type, Data_Type >
- class [BArrayDenseCell_const](#)< Cell_Type, Data_Type >

7.7.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayDenseCol< Cell_Type, Data_Type >
```

Definition at line 9 of file `barraydensecol-bones.hpp`.

7.7.2 Constructor & Destructor Documentation

7.7.2.1 BArrayDenseCol()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDenseCol< Cell_Type, Data_Type >::BArrayDenseCol (
    BArrayDense< Cell_Type, Data_Type > & array_,
    unsigned int j ) [inline]
```

Definition at line 38 of file barraydensecol-bones.hpp.

7.7.3 Member Function Documentation

7.7.3.1 begin()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Col_type<Cell_Type>::iterator& BArrayDenseCol< Cell_Type, Data_Type >::begin ( ) [inline]
```

Definition at line 44 of file barraydensecol-bones.hpp.

7.7.3.2 end()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Col_type<Cell_Type>::iterator& BArrayDenseCol< Cell_Type, Data_Type >::end ( ) [inline]
```

Definition at line 50 of file barraydensecol-bones.hpp.

7.7.3.3 operator()()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
std::pair<unsigned int,Cell_Type*>& BArrayDenseCol< Cell_Type, Data_Type >::operator() (
    unsigned int i ) [inline]
```

Definition at line 62 of file barraydensecol-bones.hpp.

7.7.3.4 size()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
size_t BArrayDenseCol< Cell_Type, Data_Type >::size ( ) const [inline], [noexcept]
```

Definition at line 56 of file barraydensecol-bones.hpp.

7.7.4 Friends And Related Function Documentation

7.7.4.1 BArrayDense< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDense< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file `barraydensecol-bones.hpp`.

7.7.4.2 BArrayDenseCell< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCell< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file `barraydensecol-bones.hpp`.

7.7.4.3 BArrayDenseCell_const< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCell_const< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file `barraydensecol-bones.hpp`.

The documentation for this class was generated from the following files:

- `include/barry/barraydense-bones.hpp`
- `include/barry/barraydensecol-bones.hpp`

7.8 BArrayDenseCol_const< Cell_Type, Data_Type > Class Template Reference

```
#include <barraydensecol-bones.hpp>
```

Public Member Functions

- `BArrayDenseCol_const` (`const BArrayDense` < `Cell_Type`, `Data_Type` > &`array_`, unsigned int `j`)
- `Col_type` < `Cell_Type` >::iterator `begin` ()
- `Col_type` < `Cell_Type` >::iterator `end` ()
- `size_t` `size` () `const noexcept`
- `const` std::pair< unsigned int, `Cell_Type` * > `operator()` (unsigned int `i`) `const`

Friends

- class [BArrayDenseCell< Cell_Type, Data_Type >](#)
- class [BArrayDenseCell_const< Cell_Type, Data_Type >](#)

7.8.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayDenseCol_const< Cell_Type, Data_Type >
```

Definition at line 71 of file `barraydensecol-bones.hpp`.

7.8.2 Constructor & Destructor Documentation

7.8.2.1 BArrayDenseCol_const()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDenseCol_const< Cell_Type, Data_Type >::BArrayDenseCol_const (
    const BArrayDense< Cell_Type, Data_Type > & array_,
    unsigned int j ) [inline]
```

Definition at line 80 of file `barraydensecol-bones.hpp`.

7.8.3 Member Function Documentation

7.8.3.1 begin()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Col_type<Cell_Type>::iterator BArrayDenseCol_const< Cell_Type, Data_Type >::begin ( ) [inline]
```

Definition at line 96 of file `barraydensecol-bones.hpp`.

7.8.3.2 end()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Col_type<Cell_Type>::iterator BArrayDenseCol_const< Cell_Type, Data_Type >::end ( ) [inline]
```

Definition at line 101 of file `barraydensecol-bones.hpp`.

7.8.3.3 operator()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const std::pair<unsigned int,Cell_Type*> BArrayDenseCol_const< Cell_Type, Data_Type >::operator()
(
    unsigned int i ) const [inline]
```

Definition at line 112 of file `barraydensecol-bones.hpp`.

7.8.3.4 size()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
size_t BArrayDenseCol_const< Cell_Type, Data_Type >::size ( ) const [inline], [noexcept]
```

Definition at line 107 of file `barraydensecol-bones.hpp`.

7.8.4 Friends And Related Function Documentation

7.8.4.1 BArrayDenseCell< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCell< Cell_Type, Data_Type > [friend]
```

Definition at line 62 of file `barraydensecol-bones.hpp`.

7.8.4.2 BArrayDenseCell_const< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCell_const< Cell_Type, Data_Type > [friend]
```

Definition at line 62 of file `barraydensecol-bones.hpp`.

The documentation for this class was generated from the following files:

- `include/barry/barraydense-bones.hpp`
- `include/barry/barraydensecol-bones.hpp`

7.9 BArrayDenseRow< Cell_Type, Data_Type > Class Template Reference

```
#include <barraydenserow-bones.hpp>
```

Public Member Functions

- [BArrayDenseRow](#) ([BArrayDense](#)< Cell_Type, Data_Type > &array_, unsigned int i)
- [Row_type](#)< Cell_Type >::iterator & [begin](#) ()
- [Row_type](#)< Cell_Type >::iterator & [end](#) ()
- [size_t](#) [size](#) () [const noexcept](#)
- [std::pair](#)< unsigned int, [Cell](#)< Cell_Type > > & [operator\(\)](#) (unsigned int i)

Friends

- class [BArrayDense](#)< Cell_Type, Data_Type >
- class [BArrayDenseCell](#)< Cell_Type, Data_Type >
- class [BArrayDenseCell_const](#)< Cell_Type, Data_Type >

7.9.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayDenseRow< Cell_Type, Data_Type >
```

Definition at line 9 of file `barraydenserow-bones.hpp`.

7.9.2 Constructor & Destructor Documentation

7.9.2.1 BArrayDenseRow()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDenseRow< Cell_Type, Data_Type >::BArrayDenseRow (
    BArrayDense< Cell_Type, Data_Type > & array_,
    unsigned int i ) [inline]
```

Definition at line 40 of file `barraydenserow-bones.hpp`.

7.9.3 Member Function Documentation

7.9.3.1 begin()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Row_type<Cell_Type>::iterator& BArrayDenseRow< Cell_Type, Data_Type >::begin ( ) [inline]
```

Definition at line 45 of file `barraydenserow-bones.hpp`.

7.9.3.2 end()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Row_type<Cell_Type>::iterator& BArrayDenseRow< Cell_Type, Data_Type >::end ( ) [inline]
```

Definition at line 53 of file bararraydenserow-bones.hpp.

7.9.3.3 operator()()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
std::pair<unsigned int,Cell<Cell_Type> >& BArrayDenseRow< Cell_Type, Data_Type >::operator()
(
    unsigned int i ) [inline]
```

Definition at line 69 of file bararraydenserow-bones.hpp.

7.9.3.4 size()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
size_t BArrayDenseRow< Cell_Type, Data_Type >::size ( ) const [inline], [noexcept]
```

Definition at line 61 of file bararraydenserow-bones.hpp.

7.9.4 Friends And Related Function Documentation

7.9.4.1 BArrayDense< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDense< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file bararraydenserow-bones.hpp.

7.9.4.2 BArrayDenseCell< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCell< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file bararraydenserow-bones.hpp.

7.9.4.3 BArrayDenseCell_const< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCell_const< Cell_Type, Data_Type > [friend]
```

Definition at line 1 of file `barraydenserow-bones.hpp`.

The documentation for this class was generated from the following files:

- `include/barry/barraydense-bones.hpp`
- `include/barry/barraydenserow-bones.hpp`

7.10 BArrayDenseRow_const< Cell_Type, Data_Type > Class Template Reference

```
#include <barraydenserow-bones.hpp>
```

Public Member Functions

- `BArrayDenseRow_const` (`const BArrayDense`< `Cell_Type`, `Data_Type` > &`array_`, unsigned int `i`)
- `Row_type`< `Cell_Type` >::const_iterator `begin` () `const`
- `Row_type`< `Cell_Type` >::const_iterator `end` () `const`
- `size_t` `size` () `const noexcept`
- `const` std::pair< unsigned int, `Cell`< `Cell_Type` > > `operator()` (unsigned int `i`) `const`

Friends

- class `BArrayDenseCell`< `Cell_Type`, `Data_Type` >
- class `BArrayDenseCell_const`< `Cell_Type`, `Data_Type` >

7.10.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayDenseRow_const< Cell_Type, Data_Type >
```

Definition at line 80 of file `barraydenserow-bones.hpp`.

7.10.2 Constructor & Destructor Documentation

7.10.2.1 BArrayDenseRow_const()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayDenseRow_const< Cell_Type, Data_Type >::BArrayDenseRow_const (
    const BArrayDense< Cell_Type, Data_Type > & array_,
    unsigned int i ) [inline]
```

Definition at line 89 of file barraydenserow-bones.hpp.

7.10.3 Member Function Documentation

7.10.3.1 begin()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Row_type< Cell_Type >::const_iterator BArrayDenseRow_const< Cell_Type, Data_Type >::begin ( )
const [inline]
```

Definition at line 108 of file barraydenserow-bones.hpp.

7.10.3.2 end()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
Row_type< Cell_Type >::const_iterator BArrayDenseRow_const< Cell_Type, Data_Type >::end ( )
const [inline]
```

Definition at line 113 of file barraydenserow-bones.hpp.

7.10.3.3 operator()()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
const std::pair<unsigned int, Cell<Cell_Type> > BArrayDenseRow_const< Cell_Type, Data_Type
>::operator() (
    unsigned int i ) const [inline]
```

Definition at line 123 of file barraydenserow-bones.hpp.

7.10.3.4 size()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
size_t BArrayDenseRow_const< Cell_Type, Data_Type >::size ( ) const [inline], [noexcept]
```

Definition at line 118 of file barraydenserow-bones.hpp.

7.10.4 Friends And Related Function Documentation

7.10.4.1 BArrayDenseCell< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCell< Cell_Type, Data_Type > [friend]
```

Definition at line 69 of file `barraydenserow-bones.hpp`.

7.10.4.2 BArrayDenseCell_const< Cell_Type, Data_Type >

```
template<typename Cell_Type = bool, typename Data_Type = bool>
friend class BArrayDenseCell_const< Cell_Type, Data_Type > [friend]
```

Definition at line 69 of file `barraydenserow-bones.hpp`.

The documentation for this class was generated from the following files:

- `include/barry/barraydense-bones.hpp`
- `include/barry/barraydenserow-bones.hpp`

7.11 BArrayRow< Cell_Type, Data_Type > Class Template Reference

```
#include <barrayrow-bones.hpp>
```

Public Member Functions

- [BArrayRow](#) ([BArray](#)< Cell_Type, Data_Type > *[Array_](#), [uint](#) i_, [bool](#) [check_bounds](#)=true)
- [~BArrayRow](#) ()
- [void operator=](#) ([const BArrayRow](#)< Cell_Type, Data_Type > &val)
- [void operator+=](#) ([const BArrayRow](#)< Cell_Type, Data_Type > &val)
- [void operator-=](#) ([const BArrayRow](#)< Cell_Type, Data_Type > &val)
- [void operator*=](#) ([const BArrayRow](#)< Cell_Type, Data_Type > &val)
- [void operator/=](#) ([const BArrayRow](#)< Cell_Type, Data_Type > &val)
- [operator BArrayRow](#)< Cell_Type, Data_Type > () [const](#)
- [bool operator==](#) ([const BArrayRow](#)< Cell_Type, Data_Type > &val) [const](#)

7.11.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayRow< Cell_Type, Data_Type >
```

Definition at line 5 of file `barrayrow-bones.hpp`.

7.11.2 Constructor & Destructor Documentation

7.11.2.1 BArrayRow()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayRow< Cell_Type, Data_Type >::BArrayRow (
    BArray< Cell_Type, Data_Type > * Array_,
    uint i_,
    bool check_bounds = true ) [inline]
```

Definition at line 13 of file barrayrow-bones.hpp.

7.11.2.2 ~BArrayRow()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayRow< Cell_Type, Data_Type >::~~BArrayRow ( ) [inline]
```

Definition at line 26 of file barrayrow-bones.hpp.

7.11.3 Member Function Documentation

7.11.3.1 operator BArrayRow< Cell_Type, Data_Type >()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayRow< Cell_Type, Data_Type >::operator BArrayRow< Cell_Type, Data_Type > ( ) const
```

7.11.3.2 operator*=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayRow< Cell_Type, Data_Type >::operator*= (
    const BArrayRow< Cell_Type, Data_Type > & val )
```

7.11.3.3 operator+=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayRow< Cell_Type, Data_Type >::operator+= (
    const BArrayRow< Cell_Type, Data_Type > & val )
```

7.11.3.4 operator-=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayRow< Cell_Type, Data_Type >::operator-= (
    const BArrayRow< Cell_Type, Data_Type > & val )
```

7.11.3.5 operator/=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayRow< Cell_Type, Data_Type >::operator/= (
    const BArrayRow< Cell_Type, Data_Type > & val )
```

7.11.3.6 operator=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
void BArrayRow< Cell_Type, Data_Type >::operator= (
    const BArrayRow< Cell_Type, Data_Type > & val )
```

7.11.3.7 operator==()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayRow< Cell_Type, Data_Type >::operator== (
    const BArrayRow< Cell_Type, Data_Type > & val ) const
```

The documentation for this class was generated from the following file:

- [include/barry/barrayrow-bones.hpp](#)

7.12 BArrayRow_const< Cell_Type, Data_Type > Class Template Reference

```
#include <barrayrow-bones.hpp>
```

Public Member Functions

- [BArrayRow_const](#) (const BArray< Cell_Type, Data_Type > *Array_, uint i_, bool check_bounds=true)
- [~BArrayRow_const](#) ()
- [operator BArrayRow_const< Cell_Type, Data_Type > \(\) const](#)
- [bool operator==](#) (const BArrayRow_const< Cell_Type, Data_Type > &val) const
- [bool operator!=](#) (const BArrayRow_const< Cell_Type, Data_Type > &val) const
- [bool operator<](#) (const BArrayRow_const< Cell_Type, Data_Type > &val) const
- [bool operator>](#) (const BArrayRow_const< Cell_Type, Data_Type > &val) const
- [bool operator<=](#) (const BArrayRow_const< Cell_Type, Data_Type > &val) const
- [bool operator>=](#) (const BArrayRow_const< Cell_Type, Data_Type > &val) const

7.12.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayRow_const< Cell_Type, Data_Type >
```

Definition at line 41 of file bararrayrow-bones.hpp.

7.12.2 Constructor & Destructor Documentation

7.12.2.1 BArrayRow_const()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayRow_const< Cell_Type, Data_Type >::BArrayRow_const (
    const BArray< Cell_Type, Data_Type > * Array_,
    uint i_,
    bool check_bounds = true ) [inline]
```

Definition at line 49 of file bararrayrow-bones.hpp.

7.12.2.2 ~BArrayRow_const()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayRow_const< Cell_Type, Data_Type >::~~BArrayRow_const ( ) [inline]
```

Definition at line 59 of file bararrayrow-bones.hpp.

7.12.3 Member Function Documentation

7.12.3.1 operator BArrayRow_const< Cell_Type, Data_Type >()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayRow_const< Cell_Type, Data_Type >::operator BArrayRow_const< Cell_Type, Data_Type > ( )
const
```

7.12.3.2 operator"!="()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayRow_const< Cell_Type, Data_Type >::operator!= (
    const BArrayRow_const< Cell_Type, Data_Type > & val ) const
```

7.12.3.3 operator<()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayRow_const< Cell_Type, Data_Type >::operator< (
    const BArrayRow_const< Cell_Type, Data_Type > & val ) const
```

7.12.3.4 operator<=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayRow_const< Cell_Type, Data_Type >::operator<= (
    const BArrayRow_const< Cell_Type, Data_Type > & val ) const
```

7.12.3.5 operator==()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayRow_const< Cell_Type, Data_Type >::operator== (
    const BArrayRow_const< Cell_Type, Data_Type > & val ) const
```

7.12.3.6 operator>()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayRow_const< Cell_Type, Data_Type >::operator> (
    const BArrayRow_const< Cell_Type, Data_Type > & val ) const
```

7.12.3.7 operator>=()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayRow_const< Cell_Type, Data_Type >::operator>= (
    const BArrayRow_const< Cell_Type, Data_Type > & val ) const
```

The documentation for this class was generated from the following file:

- [include/barry/barrayrow-bones.hpp](#)

7.13 BArrayVector< Cell_Type, Data_Type > Class Template Reference

Row or column of a [BArray](#)

```
#include <barrayvector-bones.hpp>
```

Public Member Functions

- [BArrayVector](#) ([BArray](#)< [Cell_Type](#), [Data_Type](#) > *[Array_](#), [uint](#) &[dim_ uint](#) &[i_](#), [bool](#) [check_bounds](#)=true)
Construct a new [BArrayVector](#) object.
- [~BArrayVector](#) ()
- [bool](#) [is_row](#) () [const](#) [noexcept](#)
- [bool](#) [is_col](#) () [const](#) [noexcept](#)
- [uint](#) [size](#) () [const](#) [noexcept](#)
- [std::vector](#)< [Cell_Type](#) >::[const_iterator](#) [begin](#) () [noexcept](#)
- [std::vector](#)< [Cell_Type](#) >::[const_iterator](#) [end](#) () [noexcept](#)
- [void](#) [operator=](#) ([const](#) [Cell_Type](#) &[val](#))
- [void](#) [operator+=](#) ([const](#) [Cell_Type](#) &[val](#))
- [void](#) [operator-=](#) ([const](#) [Cell_Type](#) &[val](#))
- [void](#) [operator*=](#) ([const](#) [Cell_Type](#) &[val](#))
- [void](#) [operator/=](#) ([const](#) [Cell_Type](#) &[val](#))
- [operator](#) [std::vector](#)< [Cell_Type](#) > () [const](#)
- [bool](#) [operator==](#) ([const](#) [Cell_Type](#) &[val](#)) [const](#)

7.13.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayVector< Cell_Type, Data_Type >
```

Row or column of a [BArray](#)

Template Parameters

<i>Cell_Type</i>	
<i>Data_Type</i>	

Definition at line 11 of file [barrayvector-bones.hpp](#).

7.13.2 Constructor & Destructor Documentation

7.13.2.1 BArrayVector()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayVector< Cell_Type, Data_Type >::BArrayVector (
    BArray< Cell_Type, Data_Type > * Array\_,
    uint &dim\_ uint & i\_,
    bool check\_bounds = true ) [inline]
```

Construct a new [BArrayVector](#) object.

Parameters

<i>Array_</i>	Pointer to a BArray object
<i>dim_</i>	Dimension. 0 means row and 1 means column.
<i>i_</i>	Element to point.
<i>check_bounds</i>	When true , check boundaries.

Definition at line 32 of file barrayvector-bones.hpp.

7.13.2.2 ~BArrayVector()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayVector< Cell_Type, Data_Type >::~~BArrayVector ( ) [inline]
```

Definition at line 53 of file barrayvector-bones.hpp.

7.13.3 Member Function Documentation

7.13.3.1 begin()

```
template<typename Cell_Type , typename Data_Type >
std::vector< Cell_Type >::const_iterator BArrayVector< Cell_Type, Data_Type >::begin [inline],
[noexcept]
```

Definition at line 50 of file barrayvector-meat.hpp.

7.13.3.2 end()

```
template<typename Cell_Type , typename Data_Type >
std::vector< Cell_Type >::const_iterator BArrayVector< Cell_Type, Data_Type >::end [inline],
[noexcept]
```

Definition at line 64 of file barrayvector-meat.hpp.

7.13.3.3 is_col()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayVector< Cell_Type, Data_Type >::is_col [inline], [noexcept]
```

Definition at line 34 of file barrayvector-meat.hpp.

7.13.3.4 is_row()

```
template<typename Cell_Type , typename Data_Type >  
bool BArrayVector< Cell_Type, Data_Type >::is_row [inline], [noexcept]
```

Definition at line 29 of file barrayvector-meat.hpp.

7.13.3.5 operator std::vector< Cell_Type >()

```
template<typename Cell_Type , typename Data_Type >  
BArrayVector< Cell_Type, Data_Type >::operator std::vector< Cell_Type > [inline]
```

Definition at line 175 of file barrayvector-meat.hpp.

7.13.3.6 operator*=()

```
template<typename Cell_Type , typename Data_Type >  
void BArrayVector< Cell_Type, Data_Type >::operator*= (   
    const Cell_Type & val ) [inline]
```

Definition at line 133 of file barrayvector-meat.hpp.

7.13.3.7 operator+=()

```
template<typename Cell_Type , typename Data_Type >  
void BArrayVector< Cell_Type, Data_Type >::operator+= (   
    const Cell_Type & val ) [inline]
```

Definition at line 91 of file barrayvector-meat.hpp.

7.13.3.8 operator-=()

```
template<typename Cell_Type , typename Data_Type >  
void BArrayVector< Cell_Type, Data_Type >::operator-= (   
    const Cell_Type & val ) [inline]
```

Definition at line 112 of file barrayvector-meat.hpp.

7.13.3.9 operator/=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayVector< Cell_Type, Data_Type >::operator/= (
    const Cell_Type & val ) [inline]
```

Definition at line 154 of file `barrayvector-meat.hpp`.

7.13.3.10 operator=()

```
template<typename Cell_Type , typename Data_Type >
void BArrayVector< Cell_Type, Data_Type >::operator= (
    const Cell_Type & val ) [inline]
```

Definition at line 69 of file `barrayvector-meat.hpp`.

7.13.3.11 operator==()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayVector< Cell_Type, Data_Type >::operator== (
    const Cell_Type & val ) const [inline]
```

Definition at line 185 of file `barrayvector-meat.hpp`.

7.13.3.12 size()

```
template<typename Cell_Type , typename Data_Type >
uint BArrayVector< Cell_Type, Data_Type >::size [inline], [noexcept]
```

Definition at line 39 of file `barrayvector-meat.hpp`.

The documentation for this class was generated from the following files:

- `include/barry/barrayvector-bones.hpp`
- `include/barry/barrayvector-meat.hpp`

7.14 BArrayVector_const< Cell_Type, Data_Type > Class Template Reference

```
#include <barrayvector-bones.hpp>
```

Public Member Functions

- `BArrayVector_const` (`const BArray< Cell_Type, Data_Type > *Array_`, `uint &dim_` `uint &i_`, `bool check_bounds=true`)
- `~BArrayVector_const` ()
- `bool is_row` () `const noexcept`
- `bool is_col` () `const noexcept`
- `uint size` () `const noexcept`
- `std::vector< Cell_Type >::const_iterator begin` () `noexcept`
- `std::vector< Cell_Type >::const_iterator end` () `noexcept`
- `operator std::vector< Cell_Type >` () `const`
- `bool operator==` (`const Cell_Type &val`) `const`
- `bool operator!=` (`const Cell_Type &val`) `const`
- `bool operator<` (`const Cell_Type &val`) `const`
- `bool operator>` (`const Cell_Type &val`) `const`
- `bool operator<=` (`const Cell_Type &val`) `const`
- `bool operator>=` (`const Cell_Type &val`) `const`

7.14.1 Detailed Description

```
template<typename Cell_Type = bool, typename Data_Type = bool>
class BArrayVector_const< Cell_Type, Data_Type >
```

Definition at line 73 of file `barrayvector-bones.hpp`.

7.14.2 Constructor & Destructor Documentation

7.14.2.1 BArrayVector_const()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayVector_const< Cell_Type, Data_Type >::BArrayVector_const (
    const BArray< Cell_Type, Data_Type > * Array_,
    uint &dim_ uint & i_,
    bool check_bounds = true ) [inline]
```

Definition at line 86 of file `barrayvector-bones.hpp`.

7.14.2.2 ~BArrayVector_const()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
BArrayVector_const< Cell_Type, Data_Type >::~~BArrayVector_const ( ) [inline]
```

Definition at line 108 of file `barrayvector-bones.hpp`.

7.14.3 Member Function Documentation

7.14.3.1 begin()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
std::vector< Cell_Type >::const_iterator BArrayVector_const< Cell_Type, Data_Type >::begin (
) [noexcept]
```

7.14.3.2 end()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
std::vector< Cell_Type >::const_iterator BArrayVector_const< Cell_Type, Data_Type >::end ( )
[noexcept]
```

7.14.3.3 is_col()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayVector_const< Cell_Type, Data_Type >::is_col ( ) const [noexcept]
```

7.14.3.4 is_row()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
bool BArrayVector_const< Cell_Type, Data_Type >::is_row ( ) const [noexcept]
```

7.14.3.5 operator std::vector< Cell_Type >()

```
template<typename Cell_Type , typename Data_Type >
BArrayVector_const< Cell_Type, Data_Type >::operator std::vector< Cell_Type > [inline]
```

Definition at line 212 of file barrayvector-meat.hpp.

7.14.3.6 operator"!="()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayVector_const< Cell_Type, Data_Type >::operator!= (
    const Cell_Type & val ) const [inline]
```

Definition at line 249 of file barrayvector-meat.hpp.

7.14.3.7 operator<()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayVector_const< Cell_Type, Data_Type >::operator< (
    const Cell_Type & val ) const [inline]
```

Definition at line 254 of file barrayvector-meat.hpp.

7.14.3.8 operator<=()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayVector_const< Cell_Type, Data_Type >::operator<= (
    const Cell_Type & val ) const [inline]
```

Definition at line 281 of file barrayvector-meat.hpp.

7.14.3.9 operator==()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayVector_const< Cell_Type, Data_Type >::operator== (
    const Cell_Type & val ) const [inline]
```

Definition at line 222 of file barrayvector-meat.hpp.

7.14.3.10 operator>()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayVector_const< Cell_Type, Data_Type >::operator> (
    const Cell_Type & val ) const [inline]
```

Definition at line 308 of file barrayvector-meat.hpp.

7.14.3.11 operator>=()

```
template<typename Cell_Type , typename Data_Type >
bool BArrayVector_const< Cell_Type, Data_Type >::operator>= (
    const Cell_Type & val ) const [inline]
```

Definition at line 315 of file barrayvector-meat.hpp.

7.14.3.12 size()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
uint BArrayVector_const< Cell_Type, Data_Type >::size ( ) const [noexcept]
```

The documentation for this class was generated from the following files:

- include/barry/barrayvector-bones.hpp
- include/barry/barrayvector-meat.hpp

7.15 Cell< Cell_Type > Class Template Reference

Entries in [BArray](#). For now, it only has two members:

```
#include <cell-bones.hpp>
```

Public Member Functions

- [Cell](#) ()
- [Cell](#) (Cell_Type value_, bool visited_[_false](#), bool active_[_true](#))
- [~Cell](#) ()
- [Cell](#) (const [Cell](#)< Cell_Type > &arg)
- [Cell](#)< Cell_Type > & [operator=](#) (const [Cell](#)< Cell_Type > &other)
- [Cell](#) ([Cell](#)< Cell_Type > &&arg) [noexcept](#)
- [Cell](#)< Cell_Type > & [operator=](#) ([Cell](#)< Cell_Type > &&other) [noexcept](#)
- void [add](#) (Cell_Type x)
- [operator Cell_Type](#) () const
- bool [operator==](#) (const [Cell](#)< Cell_Type > &rhs) const
- bool [operator!=](#) (const [Cell](#)< Cell_Type > &rhs) const
- void [add](#) (double x)
- void [add](#) (unsigned int x)
- void [add](#) (int x)
- [Cell](#) ()
- [Cell](#) ()
- [Cell](#) ()

Public Attributes

- Cell_Type [value](#)
- bool [visited](#)
- bool [active](#)

7.15.1 Detailed Description

```
template<class Cell_Type>
class Cell< Cell_Type >
```

[Entries](#) in [BArray](#). For now, it only has two members:

- value: the content
- visited: boolean (just a convenient)

Definition at line 10 of file cell-bones.hpp.

7.15.2 Constructor & Destructor Documentation

7.15.2.1 Cell() [1/7]

```
template<class Cell_Type >
Cell< Cell_Type >::Cell ( )
```

7.15.2.2 Cell() [2/7]

```
template<class Cell_Type >
Cell< Cell_Type >::Cell (
    Cell_Type value_,
    bool visited_ = false,
    bool active_ = true ) [inline]
```

Definition at line 16 of file cell-bones.hpp.

7.15.2.3 ~Cell()

```
template<class Cell_Type >
Cell< Cell_Type >::~Cell ( ) [inline]
```

Definition at line 18 of file cell-bones.hpp.

7.15.2.4 Cell() [3/7]

```
template<class Cell_Type >
Cell< Cell_Type >::Cell (
    const Cell< Cell_Type > & arg ) [inline]
```

Definition at line 22 of file cell-bones.hpp.

7.15.2.5 Cell() [4/7]

```
template<class Cell_Type >
Cell< Cell_Type >::Cell (
    Cell< Cell_Type > && arg ) [inline], [noexcept]
```

Definition at line 29 of file cell-bones.hpp.

7.15.2.6 Cell() [5/7]

```
Cell< double >::Cell ( ) [inline]
```

Definition at line 62 of file cell-meat.hpp.

7.15.2.7 Cell() [6/7]

```
Cell< uint >::Cell ( ) [inline]
```

Definition at line 63 of file cell-meat.hpp.

7.15.2.8 Cell() [7/7]

```
Cell< int >::Cell ( ) [inline]
```

Definition at line 64 of file cell-meat.hpp.

7.15.3 Member Function Documentation

7.15.3.1 add() [1/4]

```
template<class Cell_Type >
void Cell< Cell_Type >::add (
    Cell_Type x )
```

7.15.3.2 add() [2/4]

```
void Cell< double >::add (
    double x ) [inline]
```

Definition at line 42 of file cell-meat.hpp.

7.15.3.3 add() [3/4]

```
void Cell< int >::add (
    int x ) [inline]
```

Definition at line 52 of file cell-meat.hpp.

7.15.3.4 add() [4/4]

```
void Cell< unsigned int >::add (
    unsigned int x ) [inline]
```

Definition at line 47 of file cell-meat.hpp.

7.15.3.5 operator Cell_Type()

```
template<class Cell_Type >
Cell< Cell_Type >::operator Cell_Type ( ) const [inline]
```

Definition at line 41 of file cell-bones.hpp.

7.15.3.6 operator"!="()

```
template<typename Cell_Type >
bool Cell< Cell_Type >::operator!= (
    const Cell< Cell_Type > & rhs ) const
```

Definition at line 31 of file cell-meat.hpp.

7.15.3.7 operator=() [1/2]

```
template<typename Cell_Type >
Cell< Cell_Type > & Cell< Cell_Type >::operator= (
    Cell< Cell_Type > && other ) [noexcept]
```

Definition at line 13 of file cell-meat.hpp.

7.15.3.8 operator=() [2/2]

```
template<typename Cell_Type >
Cell< Cell_Type > & Cell< Cell_Type >::operator= (
    const Cell< Cell_Type > & other )
```

Definition at line 5 of file cell-meat.hpp.

7.15.3.9 operator==()

```
template<typename Cell_Type >
bool Cell< Cell_Type >::operator== (
    const Cell< Cell_Type > & rhs ) const
```

Definition at line 21 of file cell-meat.hpp.

7.15.4 Member Data Documentation

7.15.4.1 active

```
template<class Cell_Type >
bool Cell< Cell_Type >::active
```

Definition at line 14 of file cell-bones.hpp.

7.15.4.2 value

```
template<class Cell_Type >
Cell_Type Cell< Cell_Type >::value
```

Definition at line 12 of file cell-bones.hpp.

7.15.4.3 visited

```
template<class Cell_Type >
bool Cell< Cell_Type >::visited
```

Definition at line 13 of file cell-bones.hpp.

The documentation for this class was generated from the following files:

- [include/barry/barray-meat.hpp](#)
- [include/barry/cell-bones.hpp](#)
- [include/barry/cell-meat.hpp](#)

7.16 Cell_const< Cell_Type > Class Template Reference

7.16.1 Detailed Description

```
template<typename Cell_Type>
class Cell_const< Cell_Type >
```

Definition at line 8 of file barray-meat.hpp.

The documentation for this class was generated from the following file:

- [include/barry/barray-meat.hpp](#)

7.17 ConstBArrayRowIter< Cell_Type, Data_Type > Class Template Reference

```
#include <barray-iterator.hpp>
```

Collaboration diagram for ConstBArrayRowIter< Cell_Type, Data_Type >:



Public Member Functions

- [ConstBArrayRowIter](#) ([const BArray](#)< Cell_Type, Data_Type > *[Array_](#))
- [~ConstBArrayRowIter](#) ()

Public Attributes

- [uint](#) [current_row](#)
- [uint](#) [current_col](#)
- [Row_type](#)< Cell_Type >::const_iterator [iter](#)
- [const BArray](#)< Cell_Type, Data_Type > * [Array](#)

7.17.1 Detailed Description

```
template<typename Cell_Type, typename Data_Type>
class ConstBArrayRowIter< Cell_Type, Data_Type >
```

Definition at line 10 of file `barray-iterator.hpp`.

7.17.2 Constructor & Destructor Documentation

7.17.2.1 ConstBArrayRowIter()

```
template<typename Cell_Type , typename Data_Type >
ConstBArrayRowIter< Cell_Type, Data_Type >::ConstBArrayRowIter (
    const BArray< Cell_Type, Data_Type > * Array_ ) [inline]
```

Definition at line 17 of file `barray-iterator.hpp`.

7.17.2.2 ~ConstBArrayRowIter()

```
template<typename Cell_Type , typename Data_Type >
ConstBArrayRowIter< Cell_Type, Data_Type >::~~ConstBArrayRowIter ( ) [inline]
```

Definition at line 29 of file `barray-iterator.hpp`.

7.17.3 Member Data Documentation

7.17.3.1 Array

```
template<typename Cell_Type , typename Data_Type >
const BArray<Cell_Type,Data_Type>* ConstBArrayRowIter< Cell_Type, Data_Type >::Array
```

Definition at line 15 of file `barray-iterator.hpp`.

7.17.3.2 current_col

```
template<typename Cell_Type , typename Data_Type >
uint ConstBArrayRowIter< Cell_Type, Data_Type >::current_col
```

Definition at line 13 of file `barray-iterator.hpp`.

7.17.3.3 current_row

```
template<typename Cell_Type , typename Data_Type >
uint ConstBArrayRowIter< Cell_Type, Data_Type >::current_row
```

Definition at line 13 of file `barray-iterator.hpp`.

7.17.3.4 iter

```
template<typename Cell_Type , typename Data_Type >
Row_type<Cell_Type>::const_iterator ConstBArrayRowIter< Cell_Type, Data_Type >::iter
```

Definition at line 14 of file `barray-iterator.hpp`.

The documentation for this class was generated from the following file:

- `include/barry/barray-iterator.hpp`

7.18 Counter< Array_Type, Data_Type > Class Template Reference

A counter function based on change statistics.

```
#include <counters-bones.hpp>
```

Public Member Functions

- `~Counter ()`
- `double count (Array_Type &Array, uint i, uint j)`
- `double init (Array_Type &Array, uint i, uint j)`
- `std::string get_name () const`
- `std::string get_description () const`

Creator passing a counter and an initializer

Parameters

count_fun↔ _	The main counter function.
init_fun_ _	The initializer function can also be used to check if the BArray as the needed variables (see BArray::data).
data_ _	Data to be used with the counter.
delete_↔ data_ _	When <code>true</code> , the destructor will delete the pointer in the main data.

- [Counter](#) ()
- [Counter](#) ([Counter_fun_type](#)< Array_Type, Data_Type > [count_fun](#)_, [Counter_fun_type](#)< Array_Type, Data_Type > [init_fun](#)_, Data_Type [data](#)_, std::string [name](#)_="", std::string [desc](#)_="")
- [Counter](#) (const [Counter](#)< Array_Type, Data_Type > &[counter](#)_)
Copy constructor.
- [Counter](#) ([Counter](#)< Array_Type, Data_Type > &&[counter](#)_) noexcept
Move constructor.
- [Counter](#)< Array_Type, Data_Type > [operator=](#) (const [Counter](#)< Array_Type, Data_Type > &[counter](#)_)
Copy assignment.
- [Counter](#)< Array_Type, Data_Type > & [operator=](#) ([Counter](#)< Array_Type, Data_Type > &&[counter](#)_)
noexcept
Move assignment.

Public Attributes

- [Counter_fun_type](#)< Array_Type, Data_Type > [count_fun](#)
- [Counter_fun_type](#)< Array_Type, Data_Type > [init_fun](#)
- Data_Type [data](#)
- std::string [name](#) = ""
- std::string [desc](#) = ""

7.18.1 Detailed Description

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
class Counter< Array_Type, Data_Type >
```

A counter function based on change statistics.

This class is used by `CountStats` and `StatsCounter` as a way to count statistics using change statistics.

Definition at line 35 of file `counters-bones.hpp`.

7.18.2 Constructor & Destructor Documentation

7.18.2.1 Counter() [1/4]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter< Array_Type, Data_Type >::Counter ( ) [inline]
```

Definition at line 55 of file counters-bones.hpp.

7.18.2.2 Counter() [2/4]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter< Array_Type, Data_Type >::Counter (
    Counter_fun_type< Array_Type, Data_Type > count_fun_,
    Counter_fun_type< Array_Type, Data_Type > init_fun_,
    Data_Type data_,
    std::string name_ = "",
    std::string desc_ = "" ) [inline]
```

Definition at line 57 of file counters-bones.hpp.

7.18.2.3 Counter() [3/4]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter< Array_Type, Data_Type >::Counter (
    const Counter< Array_Type, Data_Type > & counter_ )
```

Copy constructor.

7.18.2.4 Counter() [4/4]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter< Array_Type, Data_Type >::Counter (
    Counter< Array_Type, Data_Type > && counter_ ) [noexcept]
```

Move constructor.

7.18.2.5 ~Counter()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter< Array_Type, Data_Type >::~Counter ( ) [inline]
```

Definition at line 72 of file counters-bones.hpp.

7.18.3 Member Function Documentation

7.18.3.1 count()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
double Counter< Array_Type, Data_Type >::count (
    Array_Type & Array,
    uint i,
    uint j )
```

7.18.3.2 get_description()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
std::string Counter< Array_Type, Data_Type >::get_description ( ) const
```

7.18.3.3 get_name()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
std::string Counter< Array_Type, Data_Type >::get_name ( ) const
```

7.18.3.4 init()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
double Counter< Array_Type, Data_Type >::init (
    Array_Type & Array,
    uint i,
    uint j )
```

7.18.3.5 operator=() [1/2]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter<Array_Type,Data_Type> Counter< Array_Type, Data_Type >::operator= (
    const Counter< Array_Type, Data_Type > & counter_ )
```

Copy assignment.

7.18.3.6 operator=() [2/2]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter<Array_Type,Data_Type>& Counter< Array_Type, Data_Type >::operator= (
    Counter< Array_Type, Data_Type > && counter_ ) [noexcept]
```

Move assignment.

7.18.4 Member Data Documentation

7.18.4.1 count_fun

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter_fun_type<Array_Type,Data_Type> Counter< Array_Type, Data_Type >::count_fun
```

Definition at line 38 of file counters-bones.hpp.

7.18.4.2 data

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Data_Type Counter< Array_Type, Data_Type >::data
```

Definition at line 40 of file counters-bones.hpp.

7.18.4.3 desc

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
std::string Counter< Array_Type, Data_Type >::desc = ""
```

Definition at line 42 of file counters-bones.hpp.

7.18.4.4 init_fun

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter_fun_type<Array_Type,Data_Type> Counter< Array_Type, Data_Type >::init_fun
```

Definition at line 39 of file counters-bones.hpp.

7.18.4.5 name

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
std::string Counter< Array_Type, Data_Type >::name = ""
```

Definition at line 41 of file counters-bones.hpp.

The documentation for this class was generated from the following file:

- include/barry/counters-bones.hpp

7.19 Counters< Array_Type, Data_Type > Class Template Reference

Vector of counters.

```
#include <counters-bones.hpp>
```

Public Member Functions

- [Counters](#) ()
- [~Counters](#) ()
- [Counters](#) (const [Counters](#)< Array_Type, Data_Type > &[counter_](#))
Copy constructor.
- [Counters](#) ([Counters](#)< Array_Type, Data_Type > &&[counters_](#)) noexcept
Move constructor.
- [Counters](#)< Array_Type, Data_Type > [operator=](#) (const [Counters](#)< Array_Type, Data_Type > &[counter_](#))
Copy assignment constructor.
- [Counters](#)< Array_Type, Data_Type > & [operator=](#) ([Counters](#)< Array_Type, Data_Type > &&[counter_](#)) noexcept
Move assignment constructor.
- [Counter](#)< Array_Type, Data_Type > & [operator\[\]](#) (uint idx)
Returns a pointer to a particular counter.
- std::size_t [size](#) () const noexcept
Number of counters in the set.
- void [add_counter](#) ([Counter](#)< Array_Type, Data_Type > [counter](#))
- void [add_counter](#) ([Counter_fun_type](#)< Array_Type, Data_Type > [count_fun_](#), [Counter_fun_type](#)< Array_Type, Data_Type > [init_fun_](#), Data_Type [data_](#), std::string [name_](#)="", std::string [desc_](#)="")
- std::vector< std::string > [get_names](#) () const
- std::vector< std::string > [get_descriptions](#) () const

7.19.1 Detailed Description

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
class Counters< Array_Type, Data_Type >
```

Vector of counters.

Various functions hold more than one counter, so this class is a helper class that allows managing multiple counters efficiently. The main data is a vector to pointers of counters.

Definition at line 92 of file counters-bones.hpp.

7.19.2 Constructor & Destructor Documentation

7.19.2.1 Counters() [1/3]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counters< Array_Type, Data_Type >::Counters ( )
```

7.19.2.2 ~Counters()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counters< Array_Type, Data_Type >::~~Counters ( ) [inline]
```

Definition at line 103 of file counters-bones.hpp.

7.19.2.3 Counters() [2/3]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counters< Array_Type, Data_Type >::Counters (
    const Counters< Array_Type, Data_Type > & counter_ )
```

Copy constructor.

Parameters

<i>counter_↔</i>	
—	

7.19.2.4 Counters() [3/3]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counters< Array_Type, Data_Type >::Counters (
    Counters< Array_Type, Data_Type > && counters_ ) [noexcept]
```

Move constructor.

Parameters

<i>counters_↔</i>	
—	

7.19.3 Member Function Documentation

7.19.3.1 add_counter() [1/2]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
void Counters< Array_Type, Data_Type >::add_counter (
    Counter< Array_Type, Data_Type > counter )
```

7.19.3.2 add_counter() [2/2]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
void Counters< Array_Type, Data_Type >::add_counter (
    Counter_fun_type< Array_Type, Data_Type > count_fun_,
    Counter_fun_type< Array_Type, Data_Type > init_fun_,
    Data_Type data_,
    std::string name_ = "",
    std::string desc_ = "" )
```

7.19.3.3 get_descriptions()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
std::vector< std::string > Counters< Array_Type, Data_Type >::get_descriptions ( ) const
```

7.19.3.4 get_names()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
std::vector< std::string > Counters< Array_Type, Data_Type >::get_names ( ) const
```

7.19.3.5 operator=() [1/2]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counters<Array_Type,Data_Type> Counters< Array_Type, Data_Type >::operator= (
    const Counters< Array_Type, Data_Type > & counter_ )
```

Copy assignment constructor.

Parameters

<i>counter</i> ↔	
—	

Returns

[Counters<Array_Type,Data_Type>](#)

7.19.3.6 operator=() [2/2]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counters<Array_Type,Data_Type>& Counters< Array_Type, Data_Type >::operator= (
    Counters< Array_Type, Data_Type > && counter_ ) [noexcept]
```

Move assignment constructor.

Parameters

<i>counter</i> ↔	
—	

Returns

[Counters<Array_Type,Data_Type>&](#)

7.19.3.7 operator[]()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter<Array_Type,Data_Type>& Counters< Array_Type, Data_Type >::operator[] (
    uint idx )
```

Returns a pointer to a particular counter.

Parameters

<i>idx</i>	Id of the counter
------------	-------------------

Returns

[Counter<Array_Type,Data_Type>*](#)

7.19.3.8 size()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
std::size_t Counters< Array_Type, Data_Type >::size ( ) const [inline], [noexcept]
```

Number of counters in the set.

Returns

uint

Definition at line 147 of file counters-bones.hpp.

The documentation for this class was generated from the following file:

- include/barry/counters-bones.hpp

7.20 DEFM Class Reference

```
#include <defm-bones.hpp>
```

Public Member Functions

- **DEFM** (`const int *id`, `const int *y`, `const double *x`, `size_t id_length`, `size_t y_ncol`, `size_t x_ncol`, `size_t m_order`)
- `~DEFM` ()
- `defmcounters::DEFMModel & get_model` ()
- `void init` ()
- `double likelihood` (`std::vector< double > &par`, `bool as_log=false`)
- `void simulate` (`std::vector< double > par`, `int *y_out`)
- `size_t get_n_y` () `const`
- `size_t get_n_obs` () `const`
- `size_t get_n_covars` () `const`
- `size_t get_m_order` () `const`
- `size_t get_n_rows` () `const`
- `const int * get_Y` () `const`
- `const int * get_ID` () `const`
- `const double * get_X` () `const`
- `barry::FreqTable< int > motif_census` (`std::vector< size_t > idx`)
- `std::vector< double > logodds` (`const std::vector< double > &par`, `size_t i`, `size_t j`)

7.20.1 Detailed Description

Definition at line 4 of file defm-bones.hpp.

7.20.2 Constructor & Destructor Documentation

7.20.2.1 DEFM()

```
DEFM::DEFM (
    const int * id,
    const int * y,
    const double * x,
    size_t id_length,
    size_t y_ncol,
    size_t x_ncol,
    size_t m_order ) [inline]
```

Definition at line 110 of file defm-meat.hpp.

7.20.2.2 ~DEFM()

```
DEFM::~~DEFM ( ) [inline]
```

Definition at line 42 of file defm-bones.hpp.

7.20.3 Member Function Documentation

7.20.3.1 get_ID()

```
const int * DEFM::get_ID ( ) const [inline]
```

Definition at line 259 of file defm-meat.hpp.

7.20.3.2 get_m_order()

```
size_t DEFM::get_m_order ( ) const [inline]
```

Definition at line 244 of file defm-meat.hpp.

7.20.3.3 get_model()

```
defmcounters::DEFMModel& DEFM::get_model ( ) [inline]
```

Definition at line 44 of file defm-bones.hpp.

7.20.3.4 get_n_covars()

```
size_t DEFM::get_n_covars ( ) const [inline]
```

Definition at line 239 of file defm-meat.hpp.

7.20.3.5 get_n_obs()

```
size_t DEFM::get_n_obs ( ) const [inline]
```

Definition at line 234 of file defm-meat.hpp.

7.20.3.6 get_n_rows()

```
size_t DEFM::get_n_rows ( ) const [inline]
```

Definition at line 249 of file defm-meat.hpp.

7.20.3.7 get_n_y()

```
size_t DEFM::get_n_y ( ) const [inline]
```

Definition at line 229 of file defm-meat.hpp.

7.20.3.8 get_X()

```
const double * DEFM::get_X ( ) const [inline]
```

Definition at line 264 of file defm-meat.hpp.

7.20.3.9 get_Y()

```
const int * DEFM::get_Y ( ) const [inline]
```

Definition at line 254 of file defm-meat.hpp.

7.20.3.10 init()

```
void DEFM::init ( ) [inline]
```

Definition at line 188 of file defm-meat.hpp.

7.20.3.11 likelihood()

```
double DEFM::likelihood (
    std::vector< double > & par,
    bool as_log = false )
```

7.20.3.12 logodds()

```
std::vector< double > DEFM::logodds (
    const std::vector< double > & par,
    size_t i,
    size_t j ) [inline]
```

Definition at line 308 of file defm-meat.hpp.

7.20.3.13 motif_census()

```
barry::FreqTable< int > DEFM::motif_census (
    std::vector< size_t > idx ) [inline]
```

Definition at line 270 of file defm-meat.hpp.

7.20.3.14 simulate()

```
void DEFM::simulate (
    std::vector< double > par,
    int * y_out ) [inline]
```

Definition at line 44 of file defm-meat.hpp.

The documentation for this class was generated from the following files:

- include/barry/models/defm/[defm-bones.hpp](#)
- include/barry/models/defm/[defm-meat.hpp](#)

7.21 DEFMCOUNTERDATA Class Reference

Data class used to store arbitrary uint or double vectors.

```
#include <defm.hpp>
```

Public Member Functions

- [DEFMCOUNTERDATA](#) ()
- [DEFMCOUNTERDATA](#) ([const](#) std::vector< size_t > [indices_](#), [const](#) std::vector< double > [numbers_](#), [const](#) std::vector< bool > [logical_](#))
- size_t [idx](#) (size_t [i](#))
- double [num](#) (size_t [i](#))
- bool [is_true](#) (size_t [i](#))
- [~DEFMCOUNTERDATA](#) ()

Public Attributes

- std::vector< size_t > [indices](#)
- std::vector< double > [numbers](#)
- std::vector< bool > [logical](#)

7.21.1 Detailed Description

Data class used to store arbitrary uint or double vectors.

Definition at line 294 of file defm.hpp.

7.21.2 Constructor & Destructor Documentation

7.21.2.1 DEFMCOUNTERDATA() [1/2]

```
DEFMCOUNTERDATA::DEFMCOUNTERDATA ( ) [inline]
```

Definition at line 301 of file defm.hpp.

7.21.2.2 DEFMCOUNTERDATA() [2/2]

```
DEFMCOUNTERDATA::DEFMCOUNTERDATA (
    const std::vector< size_t > indices\_,
    const std::vector< double > numbers\_,
    const std::vector< bool > logical\_ ) [inline]
```

Definition at line 302 of file defm.hpp.

7.21.2.3 ~DEFMCounterData()

```
DEFMCounterData::~DEFMCounterData ( ) [inline]
```

Definition at line 313 of file defm.hpp.

7.21.3 Member Function Documentation

7.21.3.1 idx()

```
size_t DEFMCounterData::idx (
    size_t i ) [inline]
```

Definition at line 309 of file defm.hpp.

7.21.3.2 is_true()

```
bool DEFMCounterData::is_true (
    size_t i ) [inline]
```

Definition at line 311 of file defm.hpp.

7.21.3.3 num()

```
double DEFMCounterData::num (
    size_t i ) [inline]
```

Definition at line 310 of file defm.hpp.

7.21.4 Member Data Documentation

7.21.4.1 indices

```
std::vector< size_t > DEFMCounterData::indices
```

Definition at line 297 of file defm.hpp.

7.21.4.2 logical

```
std::vector< bool > DEFMCounterData::logical
```

Definition at line 299 of file defm.hpp.

7.21.4.3 numbers

```
std::vector< double > DEFMCounterData::numbers
```

Definition at line 298 of file defm.hpp.

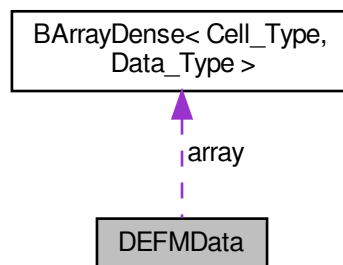
The documentation for this class was generated from the following file:

- include/barry/counters/[defm.hpp](#)

7.22 DEFMDData Class Reference

```
#include <defm.hpp>
```

Collaboration diagram for DEFMDData:



Public Member Functions

- [DEFMDData](#) ()
- [DEFMDData](#) ([DEFMArray](#) *array_, [const](#) double *covariates_, size_t obs_start_, size_t X_ncol_, size_t X_nrow_)
 - Constructor.*
- double [operator\(\)](#) (size_t i, size_t j) [const](#)
 - Access to the row (i) column (j) data.*
- double [at](#) (size_t i, size_t j) [const](#)
- size_t [ncol](#) () [const](#)
- void [print](#) () [const](#)
- [~DEFMDData](#) ()

Public Attributes

- [DEFMArray](#) * [array](#)
- [const](#) double * [covariates](#)
Vector of covariates (complete vector)
- [size_t](#) [obs_start](#)
Index of the observation in the data.
- [size_t](#) [X_ncol](#)
Number of covariates included in the model.
- [size_t](#) [X_nrow](#)
Number of covariates included in the model.

7.22.1 Detailed Description

Definition at line 249 of file defm.hpp.

7.22.2 Constructor & Destructor Documentation

7.22.2.1 DEFMDData() [1/2]

```
DEFMDData::DEFMDData ( ) [inline]
```

Definition at line 258 of file defm.hpp.

7.22.2.2 DEFMDData() [2/2]

```
DEFMDData::DEFMDData (
    DEFMArray * array_,
    const double * covariates_,
    size_t obs_start_,
    size_t X_ncol_,
    size_t X_nrow_ ) [inline]
```

Constructor.

Parameters

covariates_	Pointer to the attribute data.
obs_start_	Location of the current observation in the covariates vector
X_ncol_	Number of columns (covariates.)

Definition at line 267 of file defm.hpp.

7.22.2.3 ~DEFMDData()

```
DEFMDData::~DEFMDData ( ) [inline]
```

Definition at line 288 of file defm.hpp.

7.22.3 Member Function Documentation

7.22.3.1 at()

```
double DEFMDData::at (
    size_t i,
    size_t j ) const
```

7.22.3.2 ncol()

```
size_t DEFMDData::ncol ( ) const [inline]
```

Definition at line 354 of file defm.hpp.

7.22.3.3 operator()()

```
double DEFMDData::operator() (
    size_t i,
    size_t j ) const [inline]
```

Access to the row (i) column (j) data.

Parameters

<i>i</i>	
<i>j</i>	

Returns

double

Definition at line 349 of file defm.hpp.

7.22.3.4 print()

```
void DEFMDData::print ( ) const [inline]
```

Definition at line 358 of file defm.hpp.

7.22.4 Member Data Documentation

7.22.4.1 array

```
DEFMArray* DEFMDData::array
```

Definition at line 252 of file defm.hpp.

7.22.4.2 covariates

```
const double* DEFMDData::covariates
```

Vector of covariates (complete vector)

Definition at line 253 of file defm.hpp.

7.22.4.3 obs_start

```
size_t DEFMDData::obs_start
```

Index of the observation in the data.

Definition at line 254 of file defm.hpp.

7.22.4.4 X_ncol

```
size_t DEFMDData::X_ncol
```

Number of covariates included in the model.

Definition at line 255 of file defm.hpp.

7.22.4.5 X_nrow

```
size_t DEFMDData::X_nrow
```

Number of covariates included in the model.

Definition at line 256 of file defm.hpp.

The documentation for this class was generated from the following file:

- include/barry/counters/[defm.hpp](#)

7.23 DEFMRuleData Class Reference

```
#include <defm.hpp>
```

Public Member Functions

- double [num](#) (size_t [i](#))
- size_t [idx](#) (size_t [i](#))
- [DEFMRuleData](#) ()
- [DEFMRuleData](#) (std::vector< double > [numbers_](#), std::vector< size_t > [indices_](#))

7.23.1 Detailed Description

Definition at line 317 of file defm.hpp.

7.23.2 Constructor & Destructor Documentation

7.23.2.1 DEFMRuleData() [1/2]

```
DEFMRuleData::DEFMRuleData ( ) [inline]
```

Definition at line 327 of file defm.hpp.

7.23.2.2 DEFMRuleData() [2/2]

```
DEFMRuleData::DEFMRuleData (
    std::vector< double > numbers\_,
    std::vector< size_t > indices\_ ) [inline]
```

Definition at line 329 of file defm.hpp.

7.23.3 Member Function Documentation

7.23.3.1 idx()

```
size_t DEFMRuleData::idx (
    size_t i ) [inline]
```

Definition at line 325 of file defm.hpp.

7.23.3.2 num()

```
double DEFMRuleData::num (
    size_t i ) [inline]
```

Definition at line 324 of file defm.hpp.

The documentation for this class was generated from the following file:

- include/barry/counters/[defm.hpp](#)

7.24 Entries< Cell_Type > Class Template Reference

A wrapper class to store `source`, `target`, `val` from a [BArray](#) object.

```
#include <typedefs.hpp>
```

Public Member Functions

- [Entries](#) ()
- [Entries](#) (uint n)
- [~Entries](#) ()
- void [resize](#) (uint n)

Public Attributes

- std::vector< [uint](#) > [source](#)
- std::vector< [uint](#) > [target](#)
- std::vector< Cell_Type > [val](#)

7.24.1 Detailed Description

```
template<typename Cell_Type>
class Entries< Cell_Type >
```

A wrapper class to store `source`, `target`, `val` from a [BArray](#) object.

Template Parameters

<i>Cell_Type</i>	Any type
------------------	----------

Definition at line 79 of file typedefs.hpp.

7.24.2 Constructor & Destructor Documentation

7.24.2.1 Entries() [1/2]

```
template<typename Cell_Type >  
Entries< Cell_Type >::Entries ( ) [inline]
```

Definition at line 85 of file typedefs.hpp.

7.24.2.2 Entries() [2/2]

```
template<typename Cell_Type >  
Entries< Cell_Type >::Entries (   
    uint n ) [inline]
```

Definition at line 86 of file typedefs.hpp.

7.24.2.3 ~Entries()

```
template<typename Cell_Type >  
Entries< Cell_Type >::~~Entries ( ) [inline]
```

Definition at line 93 of file typedefs.hpp.

7.24.3 Member Function Documentation

7.24.3.1 resize()

```
template<typename Cell_Type >  
void Entries< Cell_Type >::resize (   
    uint n ) [inline]
```

Definition at line 95 of file typedefs.hpp.

7.24.4 Member Data Documentation

7.24.4.1 source

```
template<typename Cell_Type >  
std::vector< uint > Entries< Cell_Type >::source
```

Definition at line 81 of file typedefs.hpp.

7.24.4.2 target

```
template<typename Cell_Type >  
std::vector< uint > Entries< Cell_Type >::target
```

Definition at line 82 of file typedefs.hpp.

7.24.4.3 val

```
template<typename Cell_Type >  
std::vector< Cell_Type > Entries< Cell_Type >::val
```

Definition at line 83 of file typedefs.hpp.

The documentation for this class was generated from the following file:

- [include/barry/typedefs.hpp](#)

7.25 Flock Class Reference

A [Flock](#) is a group of [Geese](#).

```
#include <flock-bones.hpp>
```

Public Member Functions

- `Flock ()`
- `~Flock ()`
- `unsigned int add_data (std::vector< std::vector< unsigned int > > &annotations, std::vector< unsigned int > &geneid, std::vector< int > &parent, std::vector< bool > &duplication)`
Add a tree to the flock.
- `void set_seed (const unsigned int &s)`
Set the seed of the model.
- `void init (unsigned int bar_width=BARRY_PROGRESS_BAR_WIDTH)`
- `phylocounters::PhyloCounters * get_counters ()`
- `phylocounters::PhyloSupport * get_support_fun ()`
- `std::vector< std::vector< double > > * get_stats_support ()`
- `std::vector< std::vector< double > > * get_stats_target ()`
- `phylocounters::PhyloModel * get_model ()`
- `double likelihood_joint (const std::vector< double > &par, bool as_log=false, bool use_reduced_↔ sequence=true)`
Returns the joint likelihood of the model.
- `Geese * operator() (unsigned int i, bool check_bounds=true)`
Access the i-th geese element.

Information about the model

- `unsigned int nfuncs () const noexcept`
- `unsigned int ntrees () const noexcept`
- `std::vector< unsigned int > nnodes () const noexcept`
- `std::vector< unsigned int > nleafs () const noexcept`
- `unsigned int nterms () const`
- `unsigned int support_size () const noexcept`
- `std::vector< std::string > colnames () const`
- `unsigned int parse_polytomies (bool verb=true, std::vector< size_t > *dist=nullptr) const noexcept`
Check polytomies and return the largest.
- `void print () const`

Public Attributes

- `std::vector< Geese > dat`
- `unsigned int nfunctions = 0u`
- `bool initialized = false`
- `std::mt19937 engine`
- `phylocounters::PhyloModel model = phylocounters::PhyloModel()`

7.25.1 Detailed Description

A `Flock` is a group of `Geese`.

This object builds a model with multiple trees (`Geese` objects), with all of these using the same `PhyloModel` object. Available counters (terms) can be found in `counter-phylo`.

Definition at line 14 of file `flock-bones.hpp`.

7.25.2 Constructor & Destructor Documentation

7.25.2.1 Flock()

```
Flock::Flock ( ) [inline]
```

Definition at line 25 of file flock-bones.hpp.

7.25.2.2 ~Flock()

```
Flock::~~Flock ( ) [inline]
```

Definition at line 26 of file flock-bones.hpp.

7.25.3 Member Function Documentation

7.25.3.1 add_data()

```
unsigned int Flock::add_data (
    std::vector< std::vector< unsigned int > > & annotations,
    std::vector< unsigned int > & geneid,
    std::vector< int > & parent,
    std::vector< bool > & duplication ) [inline]
```

Add a tree to the flock.

Parameters

<i>annotations</i>	see Geese::Geese .
<i>geneid</i>	see Geese .
<i>parent</i>	see Geese .
<i>duplication</i>	see Geese .

Returns

unsigned int The number of tree in the model (starting from zero).

Definition at line 6 of file flock-meat.hpp.

7.25.3.2 colnames()

```
std::vector< std::string > Flock::colnames ( ) const [inline]
```

Definition at line 224 of file flock-meat.hpp.

7.25.3.3 get_counters()

```
phylocounters::PhyloCounters * Flock::get_counters ( ) [inline]
```

Definition at line 100 of file flock-meat.hpp.

7.25.3.4 get_model()

```
phylocounters::PhyloModel * Flock::get_model ( ) [inline]
```

Definition at line 131 of file flock-meat.hpp.

7.25.3.5 get_stats_support()

```
std::vector< std::vector< double > > * Flock::get_stats_support ( ) [inline]
```

Definition at line 117 of file flock-meat.hpp.

7.25.3.6 get_stats_target()

```
std::vector< std::vector< double > > * Flock::get_stats_target ( ) [inline]
```

Definition at line 124 of file flock-meat.hpp.

7.25.3.7 get_support_fun()

```
phylocounters::PhyloSupport * Flock::get_support_fun ( ) [inline]
```

Definition at line 110 of file flock-meat.hpp.

7.25.3.8 init()

```
void Flock::init (
    unsigned int bar_width = BARRY_PROGRESS_BAR_WIDTH ) [inline]
```

Definition at line 49 of file flock-meat.hpp.

7.25.3.9 likelihood_joint()

```
double Flock::likelihood_joint (
    const std::vector< double > & par,
    bool as_log = false,
    bool use_reduced_sequence = true ) [inline]
```

Returns the joint likelihood of the model.

Parameters

<i>par</i>	Vector of model parameters.
<i>as_log</i>	When <i>true</i> it will return the value as log.
<i>use_reduced_sequence</i>	When <i>true</i> (default) will compute the likelihood using the reduced sequence, which is faster.

Returns

double

Definition at line 138 of file flock-meat.hpp.

7.25.3.10 nfuncs()

```
unsigned int Flock::nfuncs ( ) const [inline], [noexcept]
```

Definition at line 167 of file flock-meat.hpp.

7.25.3.11 nleafs()

```
std::vector< unsigned int > Flock::nleafs ( ) const [inline], [noexcept]
```

Definition at line 195 of file flock-meat.hpp.

7.25.3.12 nnodes()

```
std::vector< unsigned int > Flock::nnodes ( ) const [inline], [noexcept]
```

Definition at line 181 of file flock-meat.hpp.

7.25.3.13 nterms()

```
unsigned int Flock::nterms ( ) const [inline]
```

Definition at line 209 of file flock-meat.hpp.

7.25.3.14 ntrees()

```
unsigned int Flock::ntrees ( ) const [inline], [noexcept]
```

Definition at line 174 of file flock-meat.hpp.

7.25.3.15 operator>()()

```
Geese * Flock::operator() (
    unsigned int i,
    bool check_bounds = true ) [inline]
```

Access the i-th geese element.

Parameters

<i>i</i>	Element to access
<i>check_bounds</i>	When true, it will check bounds.

Returns

Geese*

Definition at line 302 of file flock-meat.hpp.

7.25.3.16 parse_polytomies()

```
unsigned int Flock::parse_polytomies (
    bool verb = true,
    std::vector< size_t > * dist = nullptr ) const [inline], [noexcept]
```

Check polytomies and return the largest.

Definition at line 231 of file flock-meat.hpp.

7.25.3.17 print()

```
void Flock::print ( ) const [inline]
```

Definition at line 258 of file flock-meat.hpp.

7.25.3.18 set_seed()

```
void Flock::set_seed (
    const unsigned int & s ) [inline]
```

Set the seed of the model.

Parameters

s	Passed to the <code>rengine.seed()</code> member object.
---	--

Definition at line 42 of file flock-meat.hpp.

7.25.3.19 support_size()

```
unsigned int Flock::support_size ( ) const [inline], [noexcept]
```

Definition at line 217 of file flock-meat.hpp.

7.25.4 Member Data Documentation

7.25.4.1 dat

```
std::vector< Geese > Flock::dat
```

Definition at line 17 of file flock-bones.hpp.

7.25.4.2 initialized

```
bool Flock::initialized = false
```

Definition at line 19 of file flock-bones.hpp.

7.25.4.3 model

```
phylocounters::PhyloModel Flock::model = phylocounters::PhyloModel()
```

Definition at line 23 of file flock-bones.hpp.

7.25.4.4 nfunctions

```
unsigned int Flock::nfunctions = 0u
```

Definition at line 18 of file flock-bones.hpp.

7.25.4.5 engine

```
std::mt19937 Flock::engine
```

Definition at line 22 of file flock-bones.hpp.

The documentation for this class was generated from the following files:

- [include/barry/models/geese/flock-bones.hpp](#)
- [include/barry/models/geese/flock-meat.hpp](#)

7.26 FreqTable< T > Class Template Reference

Frequency table of vectors.

```
#include <freqtable.hpp>
```

Public Member Functions

- [FreqTable](#) ()
 - [~FreqTable](#) ()
 - [size_t add](#) ([const](#) std::vector< T > &x, [size_t](#) *h_precomp)
 - [Counts_type as_vector](#) () [const](#)
 - [const](#) std::vector< double > & [get_data](#) () [const](#)
 - [const](#) std::unordered_map< [size_t](#), [size_t](#) > & [get_index](#) () [const](#)
 - void [clear](#) ()
 - void [reserve](#) ([size_t](#) n, [size_t](#) k)
 - void [print](#) () [const](#)
 - [size_t size](#) () [const](#) [noexcept](#)
 - [size_t make_hash](#) ([const](#) std::vector< T > &x) [const](#)
- Number of unique elements in the table. (.*

7.26.1 Detailed Description

```
template<typename T = double>
class FreqTable< T >
```

Frequency table of vectors.

This is mostly used in [Support](#). The main data is contained in the `data` double vector. The matrix is stored in a row-wise fashion, where the first element is the frequency with which the vector is observed.

For example, in a model with `k` terms the first `k + 1` elements of `data` would be:

- weights
- term 1
- term 2
- ...
- term k

Definition at line 22 of file `freqtable.hpp`.

7.26.2 Constructor & Destructor Documentation

7.26.2.1 FreqTable()

```
template<typename T = double>
FreqTable< T >::FreqTable ( ) [inline]
```

Definition at line 34 of file `freqtable.hpp`.

7.26.2.2 ~FreqTable()

```
template<typename T = double>
FreqTable< T >::~~FreqTable ( ) [inline]
```

Definition at line 35 of file freqtable.hpp.

7.26.3 Member Function Documentation

7.26.3.1 add()

```
template<typename T >
size_t FreqTable< T >::add (
    const std::vector< T > & x,
    size_t * h_precomp ) [inline]
```

Definition at line 59 of file freqtable.hpp.

7.26.3.2 as_vector()

```
template<typename T >
Counts_type FreqTable< T >::as_vector [inline]
```

Definition at line 139 of file freqtable.hpp.

7.26.3.3 clear()

```
template<typename T >
void FreqTable< T >::clear [inline]
```

Definition at line 168 of file freqtable.hpp.

7.26.3.4 get_data()

```
template<typename T = double>
const std::vector< double > FreqTable< T >::get_data ( ) const [inline]
```

Definition at line 40 of file freqtable.hpp.

7.26.3.5 get_index()

```
template<typename T = double>
const std::unordered_map<size_t, size_t>& FreqTable< T >::get_index ( ) const [inline]
```

Definition at line 41 of file freqtable.hpp.

7.26.3.6 make_hash()

```
template<typename T >
size_t FreqTable< T >::make_hash (
    const std::vector< T > & x ) const [inline]
```

Definition at line 239 of file freqtable.hpp.

7.26.3.7 print()

```
template<typename T >
void FreqTable< T >::print [inline]
```

Definition at line 204 of file freqtable.hpp.

7.26.3.8 reserve()

```
template<typename T >
void FreqTable< T >::reserve (
    size_t n,
    size_t k ) [inline]
```

Definition at line 182 of file freqtable.hpp.

7.26.3.9 size()

```
template<typename T >
size_t FreqTable< T >::size [inline], [noexcept]
```

Number of unique elements in the table. (.

Returns

size_t

Definition at line 231 of file freqtable.hpp.

The documentation for this class was generated from the following file:

- [include/barry/freqtable.hpp](#)

7.27 Geese Class Reference

Annotated Phylo [Model](#).

```
#include <geese-bones.hpp>
```

Public Member Functions

- [~Geese](#) ()
- void [init](#) (unsigned int bar_width=[BARRY_PROGRESS_BAR_WIDTH](#))
- void [inherit_support](#) (const [Geese](#) &model_, bool delete_support_[=false](#))
- void [calc_sequence](#) ([Node](#) *n=nullptr)
- void [calc_reduced_sequence](#) ()
- double [likelihood](#) (const std::vector< double > &par, bool as_log=[false](#), bool use_reduced_sequence=true)
- double [likelihood_exhaust](#) (const std::vector< double > &par)
- std::vector< double > [get_probabilities](#) () const
- void [set_seed](#) (const unsigned int &s)
- std::vector< std::vector< unsigned int > > & [simulate](#) (const std::vector< double > &par)
- std::vector< std::vector< double > > & [observed_counts](#) ()
- void [print_observed_counts](#) ()
- void [print](#) () const

Prints information about the GEESE.
- void [init_node](#) ([Node](#) &n)
- void [update_annotations](#) (unsigned int nodeid, std::vector< unsigned int > newann)
- std::vector< std::vector< bool > > & [get_states](#) () const

Powerset of a gene's possible states.
- std::vector< unsigned int > & [get_annotated_nodes](#) () const

Returns the ids of the nodes with at least one annotation.

Construct a new Geese object

The model includes a total of $N + 1$ nodes, the $+ 1$ beign the root node.

Parameters

annotations	A vector of vectors with annotations. It should be of length k (number of functions). Each vector should be of length N (equal to the number of nodes, including interior). Possible values are 0, 1, and 9.
geneid	Id of the gene. It should be of length N .
parent	Id of the parent gene. Also of length N
duplication	Logical scalar indicating the type of event (true: duplication, false: speciation.)

The ordering of the entries does not matter. Passing the nodes in post order or not makes no difference to the constructor.

- [Geese](#) ()
- [Geese](#) (std::vector< std::vector< unsigned int > > &annotations, std::vector< unsigned int > &geneid, std::vector< int > &parent, std::vector< bool > &duplication)
- [Geese](#) (const [Geese](#) &model_, bool copy_data=true)
- [Geese](#) ([Geese](#) &&x) noexcept
- [Geese](#) & operator= (const [Geese](#) &model_)=delete
- [Geese](#) & operator= ([Geese](#) &&model_) noexcept=delete

Information about the model

Parameters

verb	When <code>true</code> it will print out information about the encountered polytomies.
------	--

- unsigned int `nfuncs` () `const noexcept`
Number of functions analyzed.
- unsigned int `nnodes` () `const noexcept`
Number of nodes (interior + leaf)
- unsigned int `nleafs` () `const noexcept`
Number of leaf.
- unsigned int `nterms` () `const`
Number of terms included.
- unsigned int `support_size` () `const noexcept`
Number of unique sets of sufficient stats.
- `std::vector< unsigned int >` `nannotations` () `const noexcept`
Number of annotations.
- `std::vector< std::string >` `colnames` () `const`
Names of the terms in the model.
- unsigned int `parse_polytomies` (bool verb=true, `std::vector< size_t > *dist=nullptr`) `const noexcept`
Check polytomies and return the largest.

Geese prediction

Calculate the conditional probability

Parameters

par	Vector of parameters (terms + root).
res_prob	Vector indicating each nodes' state probability.
leave_one_out	When <code>true</code> , it will compute the predictions using leave-one-out, thus the prediction will be repeated <code>nleaf</code> times.
only_annotated	When <code>true</code> , it will make the predictions only on the induced sub-tree with annotated leafs.
use_reduced_sequence	Passed to the <code>likelihood</code> method.
preorder	For the tree traversal.

When `res_prob` is specified, the function will attach the member vector probabilities from the `Nodes` objects. This contains the probability that the `ith` node has either of the possible states.

Returns

`std::vector< double >` Returns the posterior probability

- `std::vector< std::vector< double > >` `predict` (`const std::vector< double > &par`, `std::vector< std::vector< double > > *res_prob=nullptr`, bool leave_one_out=false, bool only_annotated=false, bool use_reduced_sequence=true)
- `std::vector< std::vector< double > >` `predict_backend` (`const std::vector< double > &par`, bool use_reduced_sequence, `const std::vector< uint > &preorder`)
- `std::vector< std::vector< double > >` `predict_exhaust_backend` (`const std::vector< double > &par`, `const std::vector< uint > &preorder`)
- `std::vector< std::vector< double > >` `predict_exhaust` (`const std::vector< double > &par`)
- `std::vector< std::vector< double > >` `predict_sim` (`const std::vector< double > &par`, bool only_annotated=false, unsigned int nsims=10000u)

Non-const pointers to shared objects in `<tt>Geese</tt>`

These functions provide direct access to some member objects that are shared by the nodes within `Geese`.

Returns

`get_engine()` returns the Pseudo-RNG engine used.
`get_counters()` returns the vector of counters used.
`get_model()` returns the [Model](#) object used.
`get_support_fun()` returns the computed support of the model.

- `std::mt19937 * get_engine ()`
- `phylocounters::PhyloCounters * get_counters ()`
- `phylocounters::PhyloModel * get_model ()`
- `phylocounters::PhyloSupport * get_support_fun ()`

Public Attributes

- unsigned int [nfunctions](#)
- `std::map< unsigned int, Node > nodes`
- `barry::MapVec_type< unsigned int > map_to_nodes`
- `std::vector< std::vector< std::vector< size_t > > > pset_loc`
Locations of columns.
- `std::vector< unsigned int > sequence`
- `std::vector< unsigned int > reduced_sequence`
- bool [initialized](#) = `false`
- bool [delete_engine](#) = `false`
- bool [delete_support](#) = `false`

7.27.1 Detailed Description

Annotated Phylo [Model](#).

A list of available terms for this model can be found in the [Phylo counters](#) section.

Definition at line 80 of file `geese-bones.hpp`.

7.27.2 Constructor & Destructor Documentation**7.27.2.1 Geese() [1/4]**

```
Geese::Geese ( ) [inline]
```

Definition at line 6 of file `geese-meat-constructors.hpp`.

7.27.2.2 Geese() [2/4]

```
Geese::Geese (
    std::vector< std::vector< unsigned int > > & annotations,
    std::vector< unsigned int > & geneid,
    std::vector< int > & parent,
    std::vector< bool > & duplication ) [inline]
```

Definition at line 20 of file geese-meat-constructors.hpp.

7.27.2.3 Geese() [3/4]

```
Geese::Geese (
    const Geese & model_,
    bool copy_data = true ) [inline]
```

Definition at line 214 of file geese-meat-constructors.hpp.

7.27.2.4 Geese() [4/4]

```
Geese::Geese (
    Geese && x ) [inline], [noexcept]
```

Definition at line 293 of file geese-meat-constructors.hpp.

7.27.2.5 ~Geese()

```
Geese::~Geese ( ) [inline]
```

Definition at line 91 of file geese-meat.hpp.

7.27.3 Member Function Documentation

7.27.3.1 calc_reduced_sequence()

```
void Geese::calc_reduced_sequence ( ) [inline]
```

Definition at line 331 of file geese-meat.hpp.

7.27.3.2 calc_sequence()

```
void Geese::calc_sequence (
    Node * n = nullptr ) [inline]
```

Definition at line 287 of file geese-meat.hpp.

7.27.3.3 colnames()

```
std::vector< std::string > Geese::colnames ( ) const [inline]
```

Names of the terms in the model.

Definition at line 453 of file geese-meat.hpp.

7.27.3.4 get_annotated_nodes()

```
std::vector< unsigned int > Geese::get_annotated_nodes ( ) const [inline]
```

Returns the ids of the nodes with at least one annotation.

Definition at line 669 of file geese-meat.hpp.

7.27.3.5 get_counters()

```
phylocounters::PhyloCounters * Geese::get_counters ( ) [inline]
```

Definition at line 652 of file geese-meat.hpp.

7.27.3.6 get_model()

```
phylocounters::PhyloModel * Geese::get_model ( ) [inline]
```

Definition at line 657 of file geese-meat.hpp.

7.27.3.7 get_probabilities()

```
std::vector< double > Geese::get_probabilities ( ) const [inline]
```

Definition at line 379 of file geese-meat.hpp.

7.27.3.8 get_engine()

```
std::mt19937 * Geese::get_engine ( ) [inline]
```

Definition at line 647 of file geese-meat.hpp.

7.27.3.9 get_states()

```
std::vector< std::vector< bool > > Geese::get_states ( ) const [inline]
```

Powerset of a gene's possible states.

This list of vectors is used throughout [Geese](#). It lists all possible combinations of functional states for any gene. Thus, for P functions, there will be 2^P possible combinations.

Returns

`std::vector< std::vector< bool > >` of length 2^P .

Definition at line 665 of file geese-meat.hpp.

7.27.3.10 get_support_fun()

```
phylocounters::PhyloSupport * Geese::get_support_fun ( ) [inline]
```

Definition at line 661 of file geese-meat.hpp.

7.27.3.11 inherit_support()

```
void Geese::inherit_support (
    const Geese & model_,
    bool delete_support_ = false ) [inline]
```

Definition at line 230 of file geese-meat.hpp.

7.27.3.12 init()

```
void Geese::init (
    unsigned int bar_width = BARRY_PROGRESS_BAR_WIDTH ) [inline]
```

Definition at line 103 of file geese-meat.hpp.

7.27.3.13 init_node()

```
void Geese::init_node (
    Node & n ) [inline]
```

Definition at line 6 of file geese-meat.hpp.

7.27.3.14 likelihood()

```
double Geese::likelihood (
    const std::vector< double > & par,
    bool as_log = false,
    bool use_reduced_sequence = true ) [inline]
```

Definition at line 6 of file geese-meat-likelihood.hpp.

7.27.3.15 likelihood_exhaust()

```
double Geese::likelihood_exhaust (
    const std::vector< double > & par ) [inline]
```

Definition at line 7 of file geese-meat-likelihood_exhaust.hpp.

7.27.3.16 nannotations()

```
std::vector< unsigned int > Geese::nannotations ( ) const [inline], [noexcept]
```

Number of annotations.

Definition at line 444 of file geese-meat.hpp.

7.27.3.17 nfuncs()

```
unsigned int Geese::nfuncs ( ) const [inline], [noexcept]
```

Number of functions analyzed.

Definition at line 400 of file geese-meat.hpp.

7.27.3.18 nleafs()

```
unsigned int Geese::nleafs ( ) const [inline], [noexcept]
```

Number of leaf.

Definition at line 414 of file geese-meat.hpp.

7.27.3.19 nnodes()

```
unsigned int Geese::nnodes ( ) const [inline], [noexcept]
```

Number of nodes (interior + leaf)

Definition at line 407 of file geese-meat.hpp.

7.27.3.20 nterms()

```
unsigned int Geese::nterms ( ) const [inline]
```

Number of terms included.

Definition at line 426 of file geese-meat.hpp.

7.27.3.21 observed_counts()

```
std::vector< std::vector< double > > Geese::observed_counts ( ) [inline]
```

Definition at line 495 of file geese-meat.hpp.

7.27.3.22 operator=() [1/2]

```
Geese& Geese::operator= (
    const Geese & model_ ) [delete]
```

7.27.3.23 operator=() [2/2]

```
Geese& Geese::operator= (
    Geese && model_ ) [delete], [noexcept]
```

7.27.3.24 parse_polytomies()

```
unsigned int Geese::parse_polytomies (
    bool verb = true,
    std::vector< size_t > * dist = nullptr ) const [inline], [noexcept]
```

Check polytomies and return the largest.

Definition at line 460 of file geese-meat.hpp.

7.27.3.25 predict()

```
std::vector< std::vector< double > > Geese::predict (
    const std::vector< double > & par,
    std::vector< std::vector< double > > * res_prob = nullptr,
    bool leave_one_out = false,
    bool only_annotated = false,
    bool use_reduced_sequence = true ) [inline]
```

Definition at line 243 of file geese-meat-predict.hpp.

7.27.3.26 predict_backend()

```
std::vector< std::vector< double > > Geese::predict_backend (
    const std::vector< double > & par,
    bool use_reduced_sequence,
    const std::vector< uint > & preorder ) [inline]
```

< True if the array belongs to the set

Definition at line 6 of file geese-meat-predict.hpp.

7.27.3.27 predict_exhaust()

```
std::vector< std::vector< double > > Geese::predict_exhaust (
    const std::vector< double > & par ) [inline]
```

Definition at line 5 of file geese-meat-predict_exhaust.hpp.

7.27.3.28 predict_exhaust_backend()

```
std::vector< std::vector< double > > Geese::predict_exhaust_backend (
    const std::vector< double > & par,
    const std::vector< uint > & preorder ) [inline]
```

Definition at line 47 of file geese-meat-predict_exhaust.hpp.

7.27.3.29 predict_sim()

```
std::vector< std::vector< double > > Geese::predict_sim (
    const std::vector< double > & par,
    bool only_annotated = false,
    unsigned int nsims = 10000u ) [inline]
```

Definition at line 6 of file geese-meat-predict_sim.hpp.

7.27.3.30 print()

```
void Geese::print ( ) const [inline]
```

Prints information about the GEESE.

Definition at line 629 of file geese-meat.hpp.

7.27.3.31 print_observed_counts()

```
void Geese::print_observed_counts ( ) [inline]
```

Definition at line 566 of file geese-meat.hpp.

7.27.3.32 set_seed()

```
void Geese::set_seed (
    const unsigned int & s ) [inline]
```

Definition at line 4 of file geese-meat-simulate.hpp.

7.27.3.33 simulate()

```
std::vector< std::vector< unsigned int > > Geese::simulate (
    const std::vector< double > & par ) [inline]
```

Definition at line 8 of file geese-meat-simulate.hpp.

7.27.3.34 support_size()

```
unsigned int Geese::support_size ( ) const [inline], [noexcept]
```

Number of unique sets of sufficient stats.

Definition at line 434 of file geese-meat.hpp.

7.27.3.35 update_annotations()

```
void Geese::update_annotations (
    unsigned int nodeid,
    std::vector< unsigned int > newann ) [inline]
```

Definition at line 258 of file geese-meat.hpp.

7.27.4 Member Data Documentation

7.27.4.1 delete_engine

```
bool Geese::delete_engine = false
```

Definition at line 118 of file geese-bones.hpp.

7.27.4.2 delete_support

```
bool Geese::delete_support = false
```

Definition at line 119 of file geese-bones.hpp.

7.27.4.3 initialized

```
bool Geese::initialized = false
```

Definition at line 117 of file geese-bones.hpp.

7.27.4.4 map_to_nodes

```
barry::MapVec_type< unsigned int > Geese::map_to_nodes
```

Definition at line 109 of file geese-bones.hpp.

7.27.4.5 nfunctions

```
unsigned int Geese::nfunctions
```

Definition at line 107 of file geese-bones.hpp.

7.27.4.6 nodes

```
std::map< unsigned int, Node > Geese::nodes
```

Definition at line 108 of file geese-bones.hpp.

7.27.4.7 pset_loc

```
std::vector< std::vector< std::vector< size_t > > > Geese::pset_loc
```

Locations of columns.

Definition at line 110 of file geese-bones.hpp.

7.27.4.8 reduced_sequence

```
std::vector< unsigned int > Geese::reduced_sequence
```

Definition at line 114 of file geese-bones.hpp.

7.27.4.9 sequence

```
std::vector< unsigned int > Geese::sequence
```

Definition at line 113 of file geese-bones.hpp.

The documentation for this class was generated from the following files:

- include/barry/models/geese/geese-bones.hpp
- include/barry/models/geese/geese-meat-constructors.hpp
- include/barry/models/geese/geese-meat-likelihood.hpp
- include/barry/models/geese/geese-meat-likelihood_exhaust.hpp
- include/barry/models/geese/geese-meat-predict.hpp
- include/barry/models/geese/geese-meat-predict_exhaust.hpp
- include/barry/models/geese/geese-meat-predict_sim.hpp
- include/barry/models/geese/geese-meat-simulate.hpp
- include/barry/models/geese/geese-meat.hpp

7.28 Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > Class Template Reference

General framework for discrete exponential models. This class allows generating discrete exponential models in the form of a linear exponential model:

```
#include <model-bones.hpp>
```

Public Member Functions

- void [set_engine](#) (std::mt19937 *engine_, bool delete_=false)
- void [set_seed](#) (unsigned int s)
- [Model](#) ()
- [Model](#) (uint size_)
- [Model](#) (const [Model](#)< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > &Model_)
- [Model](#)< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > & [operator=](#) (const [Model](#)< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > &Model_)
- [~Model](#) ()
- void [store_psets](#) () [noexcept](#)
- void [set_keygen](#) (std::function< std::vector< double > (const Array_Type &)> keygen_)
- std::vector< double > [gen_key](#) (const Array_Type &Array_)
- uint [add_array](#) (const Array_Type &Array_, bool force_new=false)
Adds an array to the support of not already included.
- void [print_stats](#) (uint i) [const](#)
- void [print](#) () [const](#)
Prints information about the model.
- Array_Type [sample](#) (const Array_Type &Array_, const std::vector< double > ¶ms={})
- Array_Type [sample](#) (const uint &i, const std::vector< double > ¶ms)
- double [conditional_prob](#) (const Array_Type &Array_, const std::vector< double > ¶ms, unsigned int i, unsigned int j)
Conditional probability ("Gibbs sampler")

- `const std::mt19937 * get_engine () const`
- `Counters< Array_Type, Data_Counter_Type > * get_counters ()`
- `Rules< Array_Type, Data_Rule_Type > * get_rules ()`
- `Rules< Array_Type, Data_Rule_Dyn_Type > * get_rules_dyn ()`
- `Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > * get_support_fun ()`

Wrappers for the `<tt>Counters</tt>` member.

These will add counters to the model, which are shared by the support and the actual counter function.

- `void add_counter (Counter< Array_Type, Data_Counter_Type > &counter)`
- `void add_counter (Counter_fun_type< Array_Type, Data_Counter_Type > count_fun_, Counter_fun_type< Array_Type, Data_Counter_Type > init_fun_=nullptr, Data_Counter_Type data_=nullptr)`
- `void set_counters (Counters< Array_Type, Data_Counter_Type > *counters_)`

Wrappers for the `<tt>Rules</tt>` member.

These will add rules to the model, which are shared by the support and the actual counter function.

- `void add_rule (Rule< Array_Type, Data_Rule_Type > &rule)`
- `void add_rule (Rule_fun_type< Array_Type, Data_Rule_Type > count_fun_, Data_Rule_Type data_)`
- `void set_rules (Rules< Array_Type, Data_Rule_Type > *rules_)`
- `void add_rule_dyn (Rule< Array_Type, Data_Rule_Dyn_Type > &rule)`
- `void add_rule_dyn (Rule_fun_type< Array_Type, Data_Rule_Dyn_Type > count_fun_, Data_Rule_Dyn_Type data_)`
- `void set_rules_dyn (Rules< Array_Type, Data_Rule_Dyn_Type > *rules_)`

Likelihood functions.

Calculation of likelihood functions is done reusing normalizing constants. Before recalculating the normalizing constant, the function checks whether *params* matches the last set vector of parameters used to compute it.

Parameters

<code>params</code>	Vector of parameters
<code>as_log</code>	When <code>true</code> , the function returns the log-likelihood.

- `double likelihood (const std::vector< double > ¶ms, const uint &i, bool as_log=false)`
- `double likelihood (const std::vector< double > ¶ms, const Array_Type &Array_, int i=-1, bool as_log=false)`
- `double likelihood (const std::vector< double > ¶ms, const std::vector< double > &target_, const uint &i, bool as_log=false)`
- `double likelihood (const std::vector< double > ¶ms, const double *target_, const uint &i, bool as_log=false)`
- `double likelihood_total (const std::vector< double > ¶ms, bool as_log=false)`

Extract elements by index

Parameters

<code>i</code>	Index relative to the array in the model.
<code>params</code>	A new vector of model parameters to compute the normalizing constant.
<code>as_log</code>	When <code>true</code> returns the logged version of the normalizing constant.

- `double get_norm_const (const std::vector< double > ¶ms, const uint &i, bool as_log=false)`

- `const std::vector< Array_Type > * get_pset (const uint &i)`
- `const std::vector< double > * get_pset_stats (const uint &i)`

Size of the model

Number of different supports included in the model

This will return the size of `stats_target`.

Returns

`size ()` returns the number of arrays in the model.
`size_unique ()` returns the number of unique arrays (according to the hasher) in the model.
`nterms ()` returns the number of terms in the model.

- unsigned int `size ()` `const noexcept`
- unsigned int `size_unique ()` `const noexcept`
- unsigned int `nterms ()` `const noexcept`
- unsigned int `support_size ()` `const noexcept`
- `std::vector< std::string > colnames ()` `const`

- `std::vector< std::vector< double > > * get_stats_target ()`

Raw pointers to the support and target statistics.

- `std::vector< std::vector< double > > * get_stats_support ()`
- `std::vector< unsigned int > * get_arrays2support ()`
- `std::vector< std::vector< Array_Type > > * get_pset_arrays ()`
- `std::vector< std::vector< double > > * get_pset_stats ()`

Statistics of the support(s)

- `std::vector< std::vector< double > > * get_pset_probs ()`

- void `set_transform_model (std::function< std::vector< double >(double *, unsigned int)> fun, std::vector< std::string > names)`

Set the transform_model_fun object.

- `std::vector< double > transform_model (double *data, unsigned int k)`

7.28.1 Detailed Description

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename
Data_Rule_Dyn_Type = bool>
class Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >
```

General framework for discrete exponential models. This class allows generating discrete exponential models in the form of a linear exponential model:

$$\frac{\exp\left(\theta^t c(A)\right)}{\sum_{A' \in \mathcal{A}} \exp\left(\theta^t c(A')\right)}$$

This implementation aims to reduce the number of times that the support needs to be computed. Models included here use more than a single array, and thus allow the function to recycle support sets as needed. For example, if we are looking at directed graphs all of the same size and without vertex level features, i.e. a model that only counts edges, triangles, etc. then the support needs to be fully computed only once.

Template Parameters

<i>Array_Type</i>	Class of BArray object.
<i>Data_Counter_Type</i>	Any type.
<i>Data_Rule_Type</i>	Any type.

Definition at line 44 of file model-bones.hpp.

7.28.2 Constructor & Destructor Documentation

7.28.2.1 Model() [1/3]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::Model ( )
```

7.28.2.2 Model() [2/3]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::Model (
    uint size_ )
```

7.28.2.3 Model() [3/3]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::Model (
    const Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >
    & Model_ )
```

7.28.2.4 ~Model()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::~Model ( ) [inline]
```

Definition at line 173 of file model-bones.hpp.

7.28.3 Member Function Documentation

7.28.3.1 add_array()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
uint Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_array (
    const Array_Type & Array_,
    bool force_new = false )
```

Adds an array to the support of not already included.

Parameters

<i>Array_</i>	array to be added
<i>force_new</i>	If false, it will use <code>keygen</code> to obtain a double vector and create a hash of it. If the hash has been computed earlier, the support is recycled.

Returns

The number of the array.

7.28.3.2 add_counter() [1/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_counter (
    Counter< Array_Type, Data_Counter_Type > & counter )
```

7.28.3.3 add_counter() [2/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_counter (
    Counter_fun_type< Array_Type, Data_Counter_Type > count_fun_,
    Counter_fun_type< Array_Type, Data_Counter_Type > init_fun_ = nullptr,
    Data_Counter_Type data_ = nullptr )
```

7.28.3.4 add_rule() [1/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_rule (
    Rule< Array_Type, Data_Rule_Type > & rule )
```

7.28.3.5 add_rule() [2/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_rule (
    Rule_fun_type< Array_Type, Data_Rule_Type > count_fun_,
    Data_Rule_Type data_ )
```

7.28.3.6 add_rule_dyn() [1/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_rule_dyn
(
    Rule< Array_Type, Data_Rule_Dyn_Type > & rule )
```

7.28.3.7 add_rule_dyn() [2/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_rule_dyn
(
    Rule_fun_type< Array_Type, Data_Rule_Dyn_Type > count_fun_,
    Data_Rule_Dyn_Type data_ )
```

7.28.3.8 colnames()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< std::string > Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::colnames ( ) const
```

7.28.3.9 conditional_prob()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
double Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::conditional↵
_prob (
    const Array_Type & Array_,
    const std::vector< double > & params,
    unsigned int i,
    unsigned int j )
```

Conditional probability ("Gibbs sampler")

Computes the conditional probability of observing $P\{Y(i,j) = \mid Y^{\wedge}C, \text{theta}\}$, i.e., the probability of observing the entry $Y(i,j)$ equal to one given the rest of the array.

Parameters

<i>Array_↵</i>	Array to check
<i>params</i>	Vector of parameters
<i>i</i>	Row entry
<i>j</i>	Column entry

Returns

double The conditional probability

7.28.3.10 gen_key()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< double > Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_↵
Type >::gen_key (
    const Array_Type & Array_ )
```

7.28.3.11 get_arrays2support()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< unsigned int >* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_↵
Rule_Dyn_Type >::get_arrays2support ( )
```


7.28.3.12 get_counters()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Model<Array_Type, Data_Counter_Type>* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::get_counters ( )
```

7.28.3.13 get_norm_const()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
double Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::get_norm_const (
    const std::vector< double > & params,
    const uint & i,
    bool as_log = false )
```

7.28.3.14 get_pset()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
const std::vector< Array_Type >* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::get_pset (
    const uint & i )
```

7.28.3.15 get_pset_arrays()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< std::vector< Array_Type > >* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::get_pset_arrays ( )
```

7.28.3.16 get_pset_probs()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< std::vector<double> >* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::get_pset_probs ( )
```

7.28.3.17 get_pset_stats() [1/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< std::vector<double> >* Model< Array_Type, Data_Counter_Type, Data_Rule_Type,
Data_Rule_Dyn_Type >::get_pset_stats ( )
```

Statistics of the support(s)

7.28.3.18 get_pset_stats() [2/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
const std::vector< double >* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_↵
Rule_Dyn_Type >::get_pset_stats (
    const uint & i )
```

7.28.3.19 get_engine()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
const std::mt19937* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type
>::get_engine ( ) const
```

7.28.3.20 get_rules()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Rules<Array_Type,Data_Rule_Type>* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_↵
_Rule_Dyn_Type >::get_rules ( )
```

7.28.3.21 get_rules_dyn()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Rules<Array_Type,Data_Rule_Dyn_Type>* Model< Array_Type, Data_Counter_Type, Data_Rule_Type,
Data_Rule_Dyn_Type >::get_rules_dyn ( )
```

7.28.3.22 get_stats_support()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< std::vector< double > >* Model< Array_Type, Data_Counter_Type, Data_Rule_Type,
Data_Rule_Dyn_Type >::get_stats_support ( )
```

7.28.3.23 get_stats_target()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< std::vector< double > >* Model< Array_Type, Data_Counter_Type, Data_Rule_Type,
Data_Rule_Dyn_Type >::get_stats_target ( )
```

Raw pointers to the support and target statistics.

The support of the model is stored as a vector of vector<double>. Each element of it contains the support for an specific type of array included. It represents an array of size $(k + 1) \times n$ unique elements, with the data stored by-row. The last element of each entry corresponds to the weights, i.e., the frequency with which such sufficient statistics are observed in the support.

7.28.3.24 get_support_fun()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Support<Array_Type,Data_Counter_Type,Data_Rule_Type,Data_Rule_Dyn_Type>* Model< Array_Type,
Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::get_support_fun ( )
```

7.28.3.25 likelihood() [1/4]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
double Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::likelihood
(
    const std::vector< double > & params,
    const Array_Type & Array_,
    int i = -1,
    bool as_log = false )
```

7.28.3.26 likelihood() [2/4]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
double Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::likelihood
(
    const std::vector< double > & params,
    const double * target_,
    const uint & i,
    bool as_log = false )
```

7.28.3.27 likelihood() [3/4]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
double Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::likelihood
(
    const std::vector< double > & params,
    const std::vector< double > & target_,
    const uint & i,
    bool as_log = false )
```

7.28.3.28 likelihood() [4/4]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
double Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::likelihood
(
    const std::vector< double > & params,
    const uint & i,
    bool as_log = false )
```

7.28.3.29 likelihood_total()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
double Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::likelihood_total
(
    const std::vector< double > & params,
    bool as_log = false )
```

7.28.3.30 nterms()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
unsigned int Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::nterms
( ) const [noexcept]
```

7.28.3.31 operator=()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Model<Array_Type,Data_Counter_Type,Data_Rule_Type,Data_Rule_Dyn_Type>& Model< Array_Type,
Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::operator= (
    const Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >
    & Model_ )
```

7.28.3.32 print()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::print ( )
const
```

Prints information about the model.

7.28.3.33 print_stats()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::print_stats (
    uint i ) const
```

7.28.3.34 sample() [1/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Array_Type Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::sample
(
    const Array_Type & Array_,
    const std::vector< double > & params = {} )
```

7.28.3.35 sample() [2/2]

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Array_Type Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::sample
(
    const uint & i,
    const std::vector< double > & params )
```

7.28.3.36 set_counters()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_counters
(
    Counters< Array_Type, Data_Counter_Type > * counters_ )
```

7.28.3.37 set_keygen()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_keygen (
    std::function< std::vector< double >(const Array_Type &)> keygen_ )
```

7.28.3.38 set_engine()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_engine (
    std::mt19937 * rengine_,
    bool delete_ = false ) [inline]
```

Definition at line 143 of file model-bones.hpp.

7.28.3.39 set_rules()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_rules (
    Rules< Array_Type, Data_Rule_Type > * rules_ )
```

7.28.3.40 set_rules_dyn()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_rules_dyn
(
    Rules< Array_Type, Data_Rule_Dyn_Type > * rules_ )
```

7.28.3.41 set_seed()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_seed (
    unsigned int s ) [inline]
```

Definition at line 153 of file model-bones.hpp.

7.28.3.42 set_transform_model()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_transform↵
_model (
    std::function< std::vector< double >(double *, unsigned int)> fun,
    std::vector< std::string > names )
```

Set the transform_model_fun object.

The transform_model function is used to transform the data

Parameters

<i>data</i>	
<i>target</i>	
<i>n_arrays</i>	
<i>arrays2support</i>	

7.28.3.43 size()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
unsigned int Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::size
( ) const [noexcept]
```

7.28.3.44 size_unique()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
unsigned int Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >↵
::size_unique ( ) const [noexcept]
```

7.28.3.45 store_psets()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::store_psets (
) [noexcept]
```

7.28.3.46 support_size()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
unsigned int Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::support_size ( ) const [noexcept]
```

7.28.3.47 transform_model()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector<double> Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::transform_model (
    double * data,
    unsigned int k )
```

The documentation for this class was generated from the following file:

- [include/barry/model-bones.hpp](#)

7.29 NetCounterData Class Reference

Data class used to store arbitrary uint or double vectors.

```
#include <network.hpp>
```

Public Member Functions

- [NetCounterData](#) ()
- [NetCounterData](#) (const std::vector< uint > indices_, const std::vector< double > numbers_)
- [~NetCounterData](#) ()

Public Attributes

- std::vector< uint > [indices](#)
- std::vector< double > [numbers](#)

7.29.1 Detailed Description

Data class used to store arbitrary uint or double vectors.

Definition at line 56 of file network.hpp.

7.29.2 Constructor & Destructor Documentation

7.29.2.1 NetCounterData() [1/2]

```
NetCounterData::NetCounterData ( ) [inline]
```

Definition at line 62 of file network.hpp.

7.29.2.2 NetCounterData() [2/2]

```
NetCounterData::NetCounterData (
    const std::vector< uint > indices_,
    const std::vector< double > numbers_ ) [inline]
```

Definition at line 63 of file network.hpp.

7.29.2.3 ~NetCounterData()

```
NetCounterData::~~NetCounterData ( ) [inline]
```

Definition at line 68 of file network.hpp.

7.29.3 Member Data Documentation

7.29.3.1 indices

```
std::vector< uint > NetCounterData::indices
```

Definition at line 59 of file network.hpp.

7.29.3.2 numbers

```
std::vector< double > NetCounterData::numbers
```

Definition at line 60 of file network.hpp.

The documentation for this class was generated from the following file:

- include/barry/counters/[network.hpp](#)

7.30 NetworkData Class Reference

Data class for Networks.

```
#include <network.hpp>
```

Public Member Functions

- [NetworkData](#) ()
- [NetworkData](#) (std::vector< double > vertex_attr_, bool directed_=true)
Constructor using a single attribute.
- [NetworkData](#) (std::vector< std::vector< double > > vertex_attr_, bool directed_=true)
Constructor using multiple attributes.
- [~NetworkData](#) ()

Public Attributes

- bool [directed](#) = true
- std::vector< std::vector< double > > [vertex_attr](#)

7.30.1 Detailed Description

Data class for Networks.

Details on the available counters for [NetworkData](#) can be found in the [DEFMArray counters](#) section.

This holds information about whether the graph is directed or not, and, if defined, vectors of node (vertex) attributes ([vertex_attr](#)).

Definition at line 19 of file [network.hpp](#).

7.30.2 Constructor & Destructor Documentation

7.30.2.1 NetworkData() [1/3]

```
NetworkData::NetworkData ( ) [inline]
```

Definition at line 25 of file [network.hpp](#).

7.30.2.2 NetworkData() [2/3]

```
NetworkData::NetworkData (
    std::vector< double > vertex_attr_,
    bool directed_ = true ) [inline]
```

Constructor using a single attribute.

Parameters

<i>vertex_↔ attr_</i>	Double vector of length equal to the number of vertices in the data.
<i>directed_</i>	When <code>true</code> the graph as treated as directed.

Definition at line 33 of file network.hpp.

7.30.2.3 NetworkData() [3/3]

```
NetworkData::NetworkData (
    std::vector< std::vector< double > > vertex_attr_,
    bool directed_ = true ) [inline]
```

Constructor using multiple attributes.

Parameters

<i>vertex_↔ attr_</i>	Vector of double vectors. The size equals to the number of attributes to be created. Each individual vector should be of length equal to the number of vertices.
<i>directed_</i>	When <code>true</code> the graph as treated as directed.

Definition at line 45 of file network.hpp.

7.30.2.4 ~NetworkData()

```
NetworkData::~NetworkData ( ) [inline]
```

Definition at line 51 of file network.hpp.

7.30.3 Member Data Documentation**7.30.3.1 directed**

```
bool NetworkData::directed = true
```

Definition at line 22 of file network.hpp.

7.30.3.2 vertex_attr

```
std::vector< std::vector< double > > NetworkData::vertex_attr
```

Definition at line 23 of file network.hpp.

The documentation for this class was generated from the following file:

- include/barry/counters/[network.hpp](#)

7.31 Node Class Reference

A single node for the model.

```
#include <geese-node-bones.hpp>
```

Collaboration diagram for Node:



Public Member Functions

- [~Node](#) ()
- int [get_parent](#) () const
- unsigned int [noffspring](#) () const noexcept
- bool [is_leaf](#) () const noexcept

Construct a new Node object

- [Node](#) ()
- [Node](#) (unsigned int id_, unsigned int ord_, bool duplication_)
- [Node](#) (unsigned int id_, unsigned int ord_, std::vector< unsigned int > annotations_, bool duplication_)
- [Node](#) ([Node](#) &&x) noexcept
- [Node](#) (const [Node](#) &x)

Public Attributes

- unsigned int [id](#)
Id of the node (as specified in the input)
- unsigned int [ord](#)
Order in which the node was created.
- [phylocounters::PhyloArray](#) array
- std::vector< unsigned int > [annotations](#)
Observed annotations (only defined for [Geese](#))
- bool [duplication](#)
- std::vector< [phylocounters::PhyloArray](#) > [arrays](#) = {}
Arrays given all possible states.
- [Node](#) * [parent](#) = nullptr
Parent node.
- std::vector< [Node](#) * > [offspring](#) = {}
Offspring nodes.
- std::vector< unsigned int > [narray](#) = {}
ID of the array in the model.
- bool [visited](#) = false
- std::vector< double > [subtree_prob](#)
Induced subtree probabilities.
- std::vector< double > [probability](#)
The probability of observing each state.

7.31.1 Detailed Description

A single node for the model.

Each node contains all the information to compute the conditional probability of the pruning algorithm at that node.

Definition at line 11 of file `geese-node-bones.hpp`.

7.31.2 Constructor & Destructor Documentation

7.31.2.1 Node() [1/5]

```
Node::Node ( ) [inline]
```

Definition at line 36 of file `geese-node-bones.hpp`.

7.31.2.2 Node() [2/5]

```
Node::Node (
    unsigned int id_,
    unsigned int ord_,
    bool duplication_ ) [inline]
```

Definition at line 56 of file geese-node-bones.hpp.

7.31.2.3 Node() [3/5]

```
Node::Node (
    unsigned int id_,
    unsigned int ord_,
    std::vector< unsigned int > annotations_,
    bool duplication_ ) [inline]
```

Definition at line 62 of file geese-node-bones.hpp.

7.31.2.4 Node() [4/5]

```
Node::Node (
    Node && x ) [inline], [noexcept]
```

Definition at line 69 of file geese-node-bones.hpp.

7.31.2.5 Node() [5/5]

```
Node::Node (
    const Node & x ) [inline]
```

Definition at line 83 of file geese-node-bones.hpp.

7.31.2.6 ~Node()

```
Node::~Node ( ) [inline]
```

Definition at line 47 of file geese-node-bones.hpp.

7.31.3 Member Function Documentation

7.31.3.1 get_parent()

```
int Node::get_parent ( ) const [inline]
```

Definition at line 97 of file geese-node-bones.hpp.

7.31.3.2 is_leaf()

```
bool Node::is_leaf ( ) const [inline], [noexcept]
```

Definition at line 109 of file geese-node-bones.hpp.

7.31.3.3 noffspring()

```
unsigned int Node::noffspring ( ) const [inline], [noexcept]
```

Definition at line 103 of file geese-node-bones.hpp.

7.31.4 Member Data Documentation

7.31.4.1 annotations

```
std::vector< unsigned int > Node::annotations
```

Observed annotations (only defined for [Geese](#))

Definition at line 18 of file geese-node-bones.hpp.

7.31.4.2 array

```
phylocounters::PhyloArray Node::array
```

Definition at line 17 of file geese-node-bones.hpp.

7.31.4.3 arrays

```
std::vector< phylocounters::PhyloArray > Node::arrays = {}
```

Arrays given all possible states.

Definition at line 21 of file geese-node-bones.hpp.

7.31.4.4 duplication

```
bool Node::duplication
```

Definition at line 19 of file geese-node-bones.hpp.

7.31.4.5 id

```
unsigned int Node::id
```

Id of the node (as specified in the input)

Definition at line 14 of file geese-node-bones.hpp.

7.31.4.6 narray

```
std::vector< unsigned int > Node::narray = {}
```

ID of the array in the model.

Definition at line 24 of file geese-node-bones.hpp.

7.31.4.7 offspring

```
std::vector< Node\* > Node::offspring = {}
```

Offspring nodes.

Definition at line 23 of file geese-node-bones.hpp.

7.31.4.8 ord

```
unsigned int Node::ord
```

Order in which the node was created.

Definition at line 15 of file geese-node-bones.hpp.

7.31.4.9 parent

```
Node* Node::parent = nullptr
```

Parent node.

Definition at line 22 of file geese-node-bones.hpp.

7.31.4.10 probability

```
std::vector< double > Node::probability
```

The probability of observing each state.

Definition at line 28 of file geese-node-bones.hpp.

7.31.4.11 subtree_prob

```
std::vector< double > Node::subtree_prob
```

Induced subtree probabilities.

Definition at line 27 of file geese-node-bones.hpp.

7.31.4.12 visited

```
bool Node::visited = false
```

Definition at line 25 of file geese-node-bones.hpp.

The documentation for this class was generated from the following file:

- [include/barry/models/geese/geese-node-bones.hpp](#)

7.32 NodeData Class Reference

Data definition for the `PhyloArray` class.

```
#include <phylo.hpp>
```

Public Member Functions

- `NodeData` (`const` `std::vector< double >` &`blengths_`, `const` `std::vector< bool >` &`states_`, `bool` `duplication_` ← `_`=`true`)

Public Attributes

- `std::vector< double >` `blengths` = {}
- `std::vector< bool >` `states` = {}
- `bool` `duplication` = `true`

7.32.1 Detailed Description

Data definition for the `PhyloArray` class.

Details about the available counters for `PhyloArray` objects can be found in the [Phylo counters](#) section.

This holds basic information about a given node.

Definition at line 38 of file `phylo.hpp`.

7.32.2 Constructor & Destructor Documentation

7.32.2.1 NodeData()

```
NodeData::NodeData (
    const std::vector< double > & blengths_,
    const std::vector< bool > & states_,
    bool duplication_ = true ) [inline]
```

Definition at line 58 of file `phylo.hpp`.

7.32.3 Member Data Documentation

7.32.3.1 blengths

```
std::vector< double > NodeData::blengths = {}
```

Branch length.

Definition at line 44 of file phylo.hpp.

7.32.3.2 duplication

```
bool NodeData::duplication = true
```

Definition at line 54 of file phylo.hpp.

7.32.3.3 states

```
std::vector< bool > NodeData::states = {}
```

State of the parent node.

Definition at line 49 of file phylo.hpp.

The documentation for this class was generated from the following file:

- include/barry/counters/[phylo.hpp](#)

7.33 PhyloCounterData Class Reference

```
#include <phylo.hpp>
```

Public Member Functions

- [PhyloCounterData](#) (std::vector< [uint](#) > [data_](#), std::vector< double > *[counters_](#)=nullptr)
- [PhyloCounterData](#) ()
- [uint at](#) ([uint d](#))
- [uint operator\(\)](#) ([uint d](#))
- [uint operator\[\]](#) ([uint d](#))
- void [reserve](#) ([uint x](#))
- void [push_back](#) ([uint x](#))
- void [shrink_to_fit](#) ()
- [uint size](#) ()
- std::vector< [uint](#) >::iterator [begin](#) ()
- std::vector< [uint](#) >::iterator [end](#) ()
- bool [empty](#) ()
- std::vector< double > * [get_counters](#) ()

7.33.1 Detailed Description

Definition at line 69 of file phylo.hpp.

7.33.2 Constructor & Destructor Documentation

7.33.2.1 PhyloCounterData() [1/2]

```
PhyloCounterData::PhyloCounterData (
    std::vector< uint > data_,
    std::vector< double > * counters_ = nullptr ) [inline]
```

Definition at line 75 of file phylo.hpp.

7.33.2.2 PhyloCounterData() [2/2]

```
PhyloCounterData::PhyloCounterData ( ) [inline]
```

Definition at line 80 of file phylo.hpp.

7.33.3 Member Function Documentation

7.33.3.1 at()

```
uint PhyloCounterData::at (
    uint d ) [inline]
```

Definition at line 82 of file phylo.hpp.

7.33.3.2 begin()

```
std::vector< uint >::iterator PhyloCounterData::begin ( ) [inline]
```

Definition at line 90 of file phylo.hpp.

7.33.3.3 empty()

```
bool PhyloCounterData::empty ( ) [inline]
```

Definition at line 93 of file phylo.hpp.

7.33.3.4 end()

```
std::vector< uint >::iterator PhyloCounterData::end ( ) [inline]
```

Definition at line 91 of file phylo.hpp.

7.33.3.5 get_counters()

```
std::vector< double >* PhyloCounterData::get_counters ( ) [inline]
```

Definition at line 94 of file phylo.hpp.

7.33.3.6 operator()()

```
uint PhyloCounterData::operator() (
    uint d ) [inline]
```

Definition at line 83 of file phylo.hpp.

7.33.3.7 operator[]()

```
uint PhyloCounterData::operator[] (
    uint d ) [inline]
```

Definition at line 84 of file phylo.hpp.

7.33.3.8 push_back()

```
void PhyloCounterData::push_back (
    uint x ) [inline]
```

Definition at line 86 of file phylo.hpp.

7.33.3.9 reserve()

```
void PhyloCounterData::reserve (
    uint x ) [inline]
```

Definition at line 85 of file phylo.hpp.

7.33.3.10 shrink_to_fit()

```
void PhyloCounterData::shrink_to_fit ( ) [inline]
```

Definition at line 87 of file phylo.hpp.

7.33.3.11 size()

```
uint PhyloCounterData::size ( ) [inline]
```

Definition at line 88 of file phylo.hpp.

The documentation for this class was generated from the following file:

- include/barry/counters/[phylo.hpp](#)

7.34 PhyloRuleDynData Class Reference

```
#include <phylo.hpp>
```

Public Member Functions

- [PhyloRuleDynData](#) ([const](#) std::vector< double > *counts_, [uint](#) pos_, [uint](#) lb_, [uint](#) ub_, [uint](#) duplication_)
- [~PhyloRuleDynData](#) ()

Public Attributes

- [const](#) std::vector< double > * [counts](#)
- [uint](#) [pos](#)
- [uint](#) [lb](#)
- [uint](#) [ub](#)
- [uint](#) [duplication](#)

7.34.1 Detailed Description

Definition at line 2147 of file phylo.hpp.

7.34.2 Constructor & Destructor Documentation

7.34.2.1 PhyloRuleDynData()

```
PhyloRuleDynData::PhyloRuleDynData (
    const std::vector< double > * counts_,
    uint pos_,
    uint lb_,
    uint ub_,
    uint duplication_ ) [inline]
```

Definition at line 2155 of file phylo.hpp.

7.34.2.2 ~PhyloRuleDynData()

```
PhyloRuleDynData::~PhyloRuleDynData ( ) [inline]
```

Definition at line 2164 of file phylo.hpp.

7.34.3 Member Data Documentation

7.34.3.1 counts

```
const std::vector< double >* PhyloRuleDynData::counts
```

Definition at line 2149 of file phylo.hpp.

7.34.3.2 duplication

```
uint PhyloRuleDynData::duplication
```

Definition at line 2153 of file phylo.hpp.

7.34.3.3 lb

```
uint PhyloRuleDynData::lb
```

Definition at line 2151 of file phylo.hpp.

7.34.3.4 pos

```
uint PhyloRuleDynData::pos
```

Definition at line 2150 of file phylo.hpp.

7.34.3.5 ub

```
uint PhyloRuleDynData::ub
```

Definition at line 2152 of file phylo.hpp.

The documentation for this class was generated from the following file:

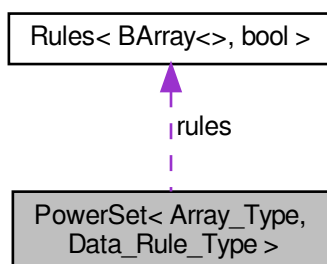
- include/barry/counters/[phylo.hpp](#)

7.35 PowerSet< Array_Type, Data_Rule_Type > Class Template Reference

Powerset of a binary array.

```
#include <powerset-bones.hpp>
```

Collaboration diagram for PowerSet< Array_Type, Data_Rule_Type >:



Public Member Functions

- void [init_support](#) ()
- void [calc](#) ()
- void [reset](#) (uint N_, uint M_)

Construct and destroy a PowerSet object

- [PowerSet](#) ()
- [PowerSet](#) (uint N_, uint M_)
- [PowerSet](#) (const Array_Type &array)
- [~PowerSet](#) ()

Wrappers for the `<tt>Rules</tt>` member.

These will add rules to the model, which are shared by the support and the actual counter function.

- void [add_rule](#) (Rule< Array_Type, Data_Rule_Type > rule)
- void [add_rule](#) (Rule_fun_type< Array_Type, Data_Rule_Type > count_fun_, Data_Rule_Type data_)

Getter functions

- const std::vector< Array_Type > * [get_data_ptr](#) () const
- std::vector< Array_Type > [get_data](#) () const
- std::vector< Array_Type >::iterator [begin](#) ()
- std::vector< Array_Type >::iterator [end](#) ()
- std::size_t [size](#) () const noexcept
- const Array_Type & [operator\[\]](#) (const unsigned int &i) const

Public Attributes

- Array_Type [EmptyArray](#)
- std::vector< Array_Type > [data](#)
- Rules< Array_Type, Data_Rule_Type > * [rules](#)
- uint [N](#)
- uint [M](#)
- bool [rules_deleted](#) = false
- std::vector< size_t > [coordinates_free](#)
- std::vector< size_t > [coordinates_locked](#)
- size_t [n_free](#)
- size_t [n_locked](#)

7.35.1 Detailed Description

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
class PowerSet< Array_Type, Data_Rule_Type >
```

Powerset of a binary array.

Template Parameters

<i>Array_Type</i>	
<i>Data_Rule_Type</i>	

Definition at line 11 of file powerset-bones.hpp.

7.35.2 Constructor & Destructor Documentation

7.35.2.1 PowerSet() [1/3]

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
PowerSet< Array_Type, Data_Rule_Type >::PowerSet ( ) [inline]
```

Definition at line 36 of file powerset-bones.hpp.

7.35.2.2 PowerSet() [2/3]

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
PowerSet< Array_Type, Data_Rule_Type >::PowerSet (
    uint N_,
    uint M_ ) [inline]
```

Definition at line 38 of file powerset-bones.hpp.

7.35.2.3 PowerSet() [3/3]

```
template<typename Array_Type , typename Data_Rule_Type >
PowerSet< Array_Type, Data_Rule_Type >::PowerSet (
    const Array_Type & array ) [inline]
```

Definition at line 5 of file powerset-meat.hpp.

7.35.2.4 ~PowerSet()

```
template<typename Array_Type , typename Data_Rule_Type >
PowerSet< Array_Type, Data_Rule_Type >::~~PowerSet [inline]
```

Definition at line 13 of file powerset-meat.hpp.

7.35.3 Member Function Documentation

7.35.3.1 add_rule() [1/2]

```
template<typename Array_Type , typename Data_Rule_Type >
void PowerSet< Array_Type, Data_Rule_Type >::add_rule (
    Rule< Array_Type, Data_Rule_Type > rule ) [inline]
```

Definition at line 173 of file powerset-meat.hpp.

7.35.3.2 add_rule() [2/2]

```
template<typename Array_Type , typename Data_Rule_Type >
void PowerSet< Array_Type, Data_Rule_Type >::add_rule (
    Rule_fun_type< Array_Type, Data_Rule_Type > count_fun_,
    Data_Rule_Type data_ ) [inline]
```

Definition at line 182 of file powerset-meat.hpp.

7.35.3.3 begin()

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
std::vector< Array_Type >::iterator PowerSet< Array_Type, Data_Rule_Type >::begin ( ) [inline]
```

Definition at line 68 of file powerset-bones.hpp.

7.35.3.4 calc()

```
template<typename Array_Type , typename Data_Rule_Type >
void PowerSet< Array_Type, Data_Rule_Type >::calc [inline]
```

Definition at line 144 of file powerset-meat.hpp.

7.35.3.5 end()

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
std::vector< Array_Type >::iterator PowerSet< Array_Type, Data_Rule_Type >::end ( ) [inline]
```

Definition at line 69 of file powerset-bones.hpp.

7.35.3.6 get_data()

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
std::vector< Array_Type > PowerSet< Array_Type, Data_Rule_Type >::get_data ( ) const [inline]
```

Definition at line 67 of file powerset-bones.hpp.

7.35.3.7 get_data_ptr()

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
const std::vector< Array_Type >* PowerSet< Array_Type, Data_Rule_Type >::get_data_ptr ( )
const [inline]
```

Definition at line 66 of file powerset-bones.hpp.

7.35.3.8 init_support()

```
template<typename Array_Type , typename Data_Rule_Type >
void PowerSet< Array_Type, Data_Rule_Type >::init_support [inline]
```

Definition at line 19 of file powerset-meat.hpp.

7.35.3.9 operator[]()

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
const Array_Type& PowerSet< Array_Type, Data_Rule_Type >::operator[] (
    const unsigned int & i ) const [inline]
```

Definition at line 71 of file powerset-bones.hpp.

7.35.3.10 reset()

```
template<typename Array_Type , typename Data_Rule_Type >
void PowerSet< Array_Type, Data_Rule_Type >::reset (
    uint N_,
    uint M_ ) [inline]
```

Definition at line 160 of file powerset-meat.hpp.

7.35.3.11 size()

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
std::size_t PowerSet< Array_Type, Data_Rule_Type >::size ( ) const [inline], [noexcept]
```

Definition at line 70 of file powerset-bones.hpp.

7.35.4 Member Data Documentation

7.35.4.1 coordinates_free

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
std::vector< size_t > PowerSet< Array_Type, Data_Rule_Type >::coordinates_free
```

Definition at line 26 of file powerset-bones.hpp.

7.35.4.2 coordinates_locked

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
std::vector< size_t > PowerSet< Array_Type, Data_Rule_Type >::coordinates_locked
```

Definition at line 27 of file powerset-bones.hpp.

7.35.4.3 data

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
std::vector< Array_Type > PowerSet< Array_Type, Data_Rule_Type >::data
```

Definition at line 19 of file powerset-bones.hpp.

7.35.4.4 EmptyArray

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
Array_Type PowerSet< Array_Type, Data_Rule_Type >::EmptyArray
```

Definition at line 18 of file powerset-bones.hpp.

7.35.4.5 M

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
uint PowerSet< Array_Type, Data_Rule_Type >::M
```

Definition at line 22 of file powerset-bones.hpp.

7.35.4.6 N

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
uint PowerSet< Array_Type, Data_Rule_Type >::N
```

Definition at line 22 of file powerset-bones.hpp.

7.35.4.7 n_free

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
size_t PowerSet< Array_Type, Data_Rule_Type >::n_free
```

Definition at line 28 of file powerset-bones.hpp.

7.35.4.8 n_locked

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
size_t PowerSet< Array_Type, Data_Rule_Type >::n_locked
```

Definition at line 29 of file powerset-bones.hpp.

7.35.4.9 rules

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
Rules<Array_Type,Data_Rule_Type>* PowerSet< Array_Type, Data_Rule_Type >::rules
```

Definition at line 20 of file powerset-bones.hpp.

7.35.4.10 rules_deleted

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
bool PowerSet< Array_Type, Data_Rule_Type >::rules_deleted = false
```

Definition at line 23 of file powerset-bones.hpp.

The documentation for this class was generated from the following files:

- include/barry/powerset-bones.hpp
- include/barry/powerset-meat.hpp

7.36 Progress Class Reference

A simple progress bar.

```
#include <progress.hpp>
```

Public Member Functions

- [Progress](#) (int n_, int width_)
- [~Progress](#) ()
- void [next](#) ()
- void [end](#) ()

7.36.1 Detailed Description

A simple progress bar.

Definition at line 11 of file progress.hpp.

7.36.2 Constructor & Destructor Documentation

7.36.2.1 Progress()

```
Progress::Progress (
    int n_,
    int width_ ) [inline]
```

Definition at line 30 of file progress.hpp.

7.36.2.2 ~Progress()

```
Progress::~~Progress ( ) [inline]
```

Definition at line 23 of file progress.hpp.

7.36.3 Member Function Documentation

7.36.3.1 end()

```
void Progress::end ( ) [inline]
```

Definition at line 52 of file progress.hpp.

7.36.3.2 next()

```
void Progress::next ( ) [inline]
```

Definition at line 41 of file progress.hpp.

The documentation for this class was generated from the following file:

- [include/barry/progress.hpp](#)

7.37 Rule< Array_Type, Data_Type > Class Template Reference

[Rule](#) for determining if a cell should be included in a sequence.

```
#include <rules-bones.hpp>
```

Public Member Functions

- [~Rule](#) ()
- Data_Type & [D](#) ()
Read/Write access to the data.
- bool [operator\(\)](#) (const Array_Type &a, [uint](#) i, [uint](#) j)

Construct a new Rule object

Construct a new [Rule](#) object

Parameters

<code>fun_</code>	<i>A function of type <code>Rule_fun_type</code>.</i>
<code>dat_</code>	<i>Data pointer to be passed to <code>fun_</code></i>
<code>delete_↔ dat_</code>	<i>When <code>true</code>, the Rule destructor will delete the pointer, if defined.</i>

- [Rule](#) ()
- [Rule](#) ([Rule_fun_type](#)< Array_Type, Data_Type > fun_, Data_Type dat_)

7.37.1 Detailed Description

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
class Rule< Array_Type, Data_Type >
```

[Rule](#) for determining if a cell should be included in a sequence.

[Rules](#) can be used together with [Support](#) and [PowerSet](#) to determine which cells should be included when enumerating all possible realizations of a binary array.

Template Parameters

<i>Array_Type</i>	An object of class BArray .
<i>Data_Type</i>	Any type.

Definition at line 20 of file `rules-bones.hpp`.

7.37.2 Constructor & Destructor Documentation**7.37.2.1 Rule() [1/2]**

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Rule< Array_Type, Data_Type >::Rule ( ) [inline]
```

Definition at line 38 of file `rules-bones.hpp`.

7.37.2.2 Rule() [2/2]

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Rule< Array_Type, Data_Type >::Rule (
    Rule\_fun\_type< Array_Type, Data_Type > fun_,
    Data_Type dat_ ) [inline]
```

Definition at line 39 of file `rules-bones.hpp`.

7.37.2.3 ~Rule()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Rule< Array_Type, Data_Type >::~~Rule ( ) [inline]
```

Definition at line 45 of file rules-bones.hpp.

7.37.3 Member Function Documentation

7.37.3.1 D()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Data_Type& Rule< Array_Type, Data_Type >::D ( )
```

Read/Write access to the data.

7.37.3.2 operator()()

```
template<typename Array_Type , typename Data_Type >
bool Rule< Array_Type, Data_Type >::operator() (
    const Array_Type & a,
    uint i,
    uint j ) [inline]
```

Definition at line 37 of file rules-meat.hpp.

The documentation for this class was generated from the following files:

- include/barry/rules-bones.hpp
- include/barry/rules-meat.hpp

7.38 Rules< Array_Type, Data_Type > Class Template Reference

Vector of objects of class [Rule](#).

```
#include <rules-bones.hpp>
```

Public Member Functions

- [Rules](#) ()
- [Rules](#) (const [Rules](#)< Array_Type, Data_Type > &rules_)
- [Rules](#)< Array_Type, Data_Type > [operator=](#) (const [Rules](#)< Array_Type, Data_Type > &rules_)
- [~Rules](#) ()
- [uint size](#) () const noexcept
- bool [operator\(\)](#) (const Array_Type &a, uint i, uint j)
Check whether a given cell is free or locked.
- void [get_seq](#) (const Array_Type &a, std::vector< size_t > *free, std::vector< size_t > *locked=nullptr)
Computes the sequence of free and locked cells in an [BArray](#).

Rule adding

Parameters

rule	
------	--

- void [add_rule](#) ([Rule](#)< Array_Type, Data_Type > rule)
- void [add_rule](#) ([Rule_fun_type](#)< Array_Type, Data_Type > rule_, Data_Type [data_](#))

7.38.1 Detailed Description

```
template<typename Array_Type, typename Data_Type>
class Rules< Array_Type, Data_Type >
```

Vector of objects of class [Rule](#).

Template Parameters

<i>Array_Type</i>	An object of class BArray
<i>Data_Type</i>	Any type.

Definition at line 60 of file rules-bones.hpp.

7.38.2 Constructor & Destructor Documentation

7.38.2.1 Rules() [1/2]

```
template<typename Array_Type , typename Data_Type >
Rules< Array_Type, Data_Type >::Rules ( ) [inline]
```

Definition at line 66 of file rules-bones.hpp.

7.38.2.2 Rules() [2/2]

```
template<typename Array_Type , typename Data_Type >
Rules< Array_Type, Data_Type >::Rules (
    const Rules< Array_Type, Data_Type > & rules_ ) [inline]
```

Definition at line 5 of file rules-meat.hpp.

7.38.2.3 ~Rules()

```
template<typename Array_Type , typename Data_Type >
Rules< Array_Type, Data_Type >::~~Rules ( ) [inline]
```

Definition at line 71 of file rules-bones.hpp.

7.38.3 Member Function Documentation

7.38.3.1 add_rule() [1/2]

```
template<typename Array_Type , typename Data_Type >
void Rules< Array_Type, Data_Type >::add_rule (
    Rule< Array_Type, Data_Type > rule ) [inline]
```

Definition at line 42 of file rules-meat.hpp.

7.38.3.2 add_rule() [2/2]

```
template<typename Array_Type , typename Data_Type >
void Rules< Array_Type, Data_Type >::add_rule (
    Rule_fun_type< Array_Type, Data_Type > rule_,
    Data_Type data_ ) [inline]
```

Definition at line 52 of file rules-meat.hpp.

7.38.3.3 get_seq()

```
template<typename Array_Type , typename Data_Type >
void Rules< Array_Type, Data_Type >::get_seq (
    const Array_Type & a,
    std::vector< size_t > * free,
    std::vector< size_t > * locked = nullptr ) [inline]
```

Computes the sequence of free and locked cells in an [BArray](#).

Parameters

<i>a</i>	An object of class BArray .
<i>free</i>	Pointer to a vector of pairs (i, j) listing the free cells.
<i>locked</i>	(optional) Pointer to a vector of pairs (i, j) listing the locked cells.

Returns

Nothing.

Definition at line 83 of file rules-meat.hpp.

7.38.3.4 operator()

```
template<typename Array_Type , typename Data_Type >
bool Rules< Array_Type, Data_Type >::operator() (
    const Array_Type & a,
    uint i,
    uint j ) [inline]
```

Check whether a given cell is free or locked.

Parameters

<i>a</i>	A BArray object
<i>i</i>	row position
<i>j</i>	col position

Returns

true If the cell is locked
false If the cell is free

Definition at line 67 of file rules-meat.hpp.

7.38.3.5 operator=()

```
template<typename Array_Type , typename Data_Type >
Rules< Array_Type, Data_Type > Rules< Array_Type, Data_Type >::operator= (
    const Rules< Array_Type, Data_Type > & rules_ )
```

Definition at line 19 of file rules-meat.hpp.

7.38.3.6 size()

```
template<typename Array_Type , typename Data_Type >
uint Rules< Array_Type, Data_Type >::size ( ) const [inline], [noexcept]
```

Definition at line 73 of file rules-bones.hpp.

The documentation for this class was generated from the following files:

- include/barry/[rules-bones.hpp](#)
- include/barry/[rules-meat.hpp](#)

7.39 StatsCounter< Array_Type, Data_Type > Class Template Reference

Count stats for a single Array.

```
#include <statscounter-bones.hpp>
```

Public Member Functions

- [StatsCounter](#) ([const](#) Array_Type *[Array_](#))
Creator of a [StatsCounter](#)
- [StatsCounter](#) ([const](#) [StatsCounter](#)< Array_Type, Data_Type > &[counter](#))
Copy constructor.
- [StatsCounter](#) ()
Can be created without setting the array.
- [~StatsCounter](#) ()
- void [reset_array](#) ([const](#) Array_Type *[Array_](#))
Changes the reference array for the counting.
- void [add_counter](#) ([Counter](#)< Array_Type, Data_Type > [f_](#))
- void [set_counters](#) ([Counters](#)< Array_Type, Data_Type > *[counters_](#))
- void [count_init](#) (uint i, uint j)
*[Counter](#) functions This function recurses through the entries of *Array* and at each step of adding a new cell it uses the functions to list the statistics.*
- void [count_current](#) (uint i, uint j)
- std::vector< double > [count_all](#) ()
- [Counters](#)< Array_Type, Data_Type > * [get_counters](#) ()
- std::vector< std::string > [get_names](#) () [const](#)
- std::vector< std::string > [get_descriptions](#) () [const](#)
- size_t [size](#) () [const](#)

7.39.1 Detailed Description

```
template<typename Array_Type, typename Data_Type>
class StatsCounter< Array_Type, Data_Type >
```

Count stats for a single Array.

Users can a list of functions that can be used with this. The baseline set of arguments is a pointer to a binary array and a dataset to add the counts to.

Definition at line 14 of file statscounter-bones.hpp.

7.39.2 Constructor & Destructor Documentation

7.39.2.1 StatsCounter() [1/3]

```
template<typename Array_Type , typename Data_Type >
StatsCounter< Array_Type, Data_Type >::StatsCounter (
    const Array_Type * Array\_ ) [inline]
```

Creator of a [StatsCounter](#)

Parameters

<i>Array</i> ↔	A const pointer to a BArray .
—	

Definition at line 37 of file statscounter-bones.hpp.

7.39.2.2 StatsCounter() [2/3]

```
template<typename Array_Type , typename Data_Type >
StatsCounter< Array_Type, Data_Type >::StatsCounter (
    const StatsCounter< Array_Type, Data_Type > & counter )
```

Copy constructor.

Parameters

<i>counter</i>	
----------------	--

7.39.2.3 StatsCounter() [3/3]

```
template<typename Array_Type , typename Data_Type >
StatsCounter< Array_Type, Data_Type >::StatsCounter ( ) [inline]
```

Can be created without setting the array.

Definition at line 59 of file statscounter-bones.hpp.

7.39.2.4 ~StatsCounter()

```
template<typename Array_Type , typename Data_Type >
StatsCounter< Array_Type, Data_Type >::~StatsCounter ( )
```

7.39.3 Member Function Documentation

7.39.3.1 add_counter()

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::add_counter (
    Counter< Array_Type, Data_Type > f_ )
```

7.39.3.2 count_all()

```
template<typename Array_Type , typename Data_Type >
std::vector< double > StatsCounter< Array_Type, Data_Type >::count_all [inline]
```

Definition at line 99 of file statscounter-meat.hpp.

7.39.3.3 count_current()

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::count_current (
    uint i,
    uint j )
```

7.39.3.4 count_init()

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::count_init (
    uint i,
    uint j )
```

Counter functions This function recurses through the entries of `Array` and at each step of adding a new cell it uses the functions to list the statistics.

7.39.3.5 get_counters()

```
template<typename Array_Type , typename Data_Type >
Counters<Array_Type,Data_Type>* StatsCounter< Array_Type, Data_Type >::get_counters ( )
```

7.39.3.6 get_descriptions()

```
template<typename Array_Type , typename Data_Type >
std::vector< std::string > StatsCounter< Array_Type, Data_Type >::get_descriptions ( ) const
```

7.39.3.7 get_names()

```
template<typename Array_Type , typename Data_Type >
std::vector< std::string > StatsCounter< Array_Type, Data_Type >::get_names ( ) const
```

7.39.3.8 reset_array()

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::reset_array (
    const Array_Type * Array_ )
```

Changes the reference array for the counting.

Parameters

<i>Array_</i> _	A pointer to an array of class <code>Array_Type</code> .
--------------------	--

7.39.3.9 set_counters()

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::set_counters (
    Counters< Array_Type, Data_Type > * counters_ )
```

7.39.3.10 size()

```
template<typename Array_Type , typename Data_Type >
size_t StatsCounter< Array_Type, Data_Type >::size ( ) const [inline]
```

Definition at line 86 of file statscounter-bones.hpp.

The documentation for this class was generated from the following files:

- include/barry/statscounter-bones.hpp
- include/barry/statscounter-meat.hpp

7.40 Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > Class Template Reference

Compute the support of sufficient statistics.

```
#include <support-bones.hpp>
```

Public Member Functions

- [Support](#) (const Array_Type &Array_)
Constructor passing a reference Array.
- [Support](#) (uint N_, uint M_)
Constructor specifying the dimensions of the array (empty).
- [Support](#) ()
- [~Support](#) ()
- void [init_support](#) (std::vector< Array_Type > *array_bank=nullptr, std::vector< double > *stats_bank=nullptr)
- void [calc](#) (std::vector< Array_Type > *array_bank=nullptr, std::vector< double > *stats_bank=nullptr, unsigned int max_num_elements_=0u)
Computes the entire support.
- std::vector< double > [get_counts](#) () const

- `std::vector< double > * get_current_stats ()`
List current statistics.
- `void print () const`
- `const FreqTable< double > & get_data () const`
- `Counters< Array_Type, Data_Counter_Type > * get_counters ()`
Vector of counter functions.
- `Rules< Array_Type, Data_Rule_Type > * get_rules ()`
Vector of static rules (cells to iterate).
- `Rules< Array_Type, Data_Rule_Dyn_Type > * get_rules_dyn ()`
Vector of dynamic rules (to include/exclude a realization).

Resets the support calculator

If needed, the counters of a support object can be reused.

Parameters

<code>Array↔</code>	<i>New array over which the support will be computed.</i>
<code>—</code>	

- `void reset_array ()`
- `void reset_array (const Array_Type &Array_)`

Manage counters

Parameters

<code>f_</code>	<i>A counter to be added.</i>
<code>counters↔</code>	<i>A vector of counters to be added.</i>
<code>—</code>	

- `void add_counter (Counter< Array_Type, Data_Counter_Type > f_)`
- `void set_counters (Counters< Array_Type, Data_Counter_Type > *counters_)`

Manage rules

Parameters

<code>f_</code>	<i>A rule to be added.</i>
<code>counters↔</code>	<i>A vector of rules to be added.</i>
<code>—</code>	

- `void add_rule (Rule< Array_Type, Data_Rule_Type > *f_)`
- `void add_rule (Rule< Array_Type, Data_Rule_Type > f_)`
- `void set_rules (Rules< Array_Type, Data_Rule_Type > *rules_)`
- `void add_rule_dyn (Rule< Array_Type, Data_Rule_Dyn_Type > *f_)`
- `void add_rule_dyn (Rule< Array_Type, Data_Rule_Dyn_Type > f_)`
- `void set_rules_dyn (Rules< Array_Type, Data_Rule_Dyn_Type > *rules_)`
- `bool eval_rules_dyn (const std::vector< double > &counts, const uint &i, const uint &j)`

Public Attributes

- `uint N`

- `uint M`
- `bool delete_counters = true`
- `bool delete_rules = true`
- `bool delete_rules_dyn = true`
- `uint max_num_elements = BARRY_MAX_NUM_ELEMENTS`
- `std::vector< double > current_stats`
- `std::vector< size_t > coordinates_free`
- `std::vector< size_t > coordinates_locked`
- `size_t coordiantes_n_free`
- `size_t coordiantes_n_locked`
- `std::vector< double > change_stats`
- `std::vector< size_t > hashes`
- `std::vector< bool > hashes_initialized`
- `size_t n_counters`

7.40.1 Detailed Description

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool,
typename Data_Rule_Dyn_Type = bool>
class Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >
```

Compute the support of sufficient statistics.

Given an array and a set of counters, this object iterates throughout the support set of the Array while at the same time computing the support of the sufficient statitics.

The members `rule` and `rule_dyn` allow constraining the support. The first will establish which cells of the array will be used to iterate, for example, in the case of social networks, self-loops are not allowed, so the entire diagonal would be fixed to zero, reducing the size of the support.

In the case of `rule_dyn`, the function will stablish dynamically whether the current state will be included in the counts or not. For example, this set of rules can be used to constrain the support to networks that have a prescribed degree sequence.

Definition at line 42 of file support-bones.hpp.

7.40.2 Constructor & Destructor Documentation

7.40.2.1 Support() [1/3]

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::Support (
    const Array_Type & Array_ ) [inline]
```

Constructor passing a reference Array.

Definition at line 87 of file support-bones.hpp.

7.40.2.2 Support() [2/3]

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::Support (
    uint N_,
    uint M_ ) [inline]
```

Constructor specifying the dimensions of the array (empty).

Definition at line 96 of file support-bones.hpp.

7.40.2.3 Support() [3/3]

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::Support ( )
[inline]
```

Definition at line 103 of file support-bones.hpp.

7.40.2.4 ~Support()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::~Support ( )
[inline]
```

Definition at line 110 of file support-bones.hpp.

7.40.3 Member Function Documentation

7.40.3.1 add_counter()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_counter
(
    Counter< Array_Type, Data_Counter_Type > f_ )
```

7.40.3.2 add_rule() [1/2]

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_rule (
    Rule< Array_Type, Data_Rule_Type > * f_ )
```

7.40.3.3 add_rule() [2/2]

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_rule (
    Rule< Array_Type, Data_Rule_Type > f_ )
```

7.40.3.4 add_rule_dyn() [1/2]

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_rule_↵
dyn (
    Rule< Array_Type, Data_Rule_Dyn_Type > * f_ )
```

7.40.3.5 add_rule_dyn() [2/2]

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::add_rule_↵
dyn (
    Rule< Array_Type, Data_Rule_Dyn_Type > f_ )
```

7.40.3.6 calc()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::calc (
    std::vector< Array_Type > * array_bank = nullptr,
    std::vector< double > * stats_bank = nullptr,
    unsigned int max_num_elements_ = 0u )
```

Computes the entire support.

Not to be used by the user. Sets the starting point in the array (column-major).

Parameters

<i>array_bank</i>	If specified, the counter will add to the vector each possible state of the array, as it counts.
<i>stats_bank</i>	If specified, the counter will add to the vector each possible set of statistics, as it counts.

7.40.3.7 eval_rules_dyn()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
bool Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::eval_↵
rules_dyn (
    const std::vector< double > & counts,
    const uint & i,
    const uint & j )
```

7.40.3.8 get_counters()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Counters<Array_Type,Data_Counter_Type>* Support< Array_Type, Data_Counter_Type, Data_Rule_↵
Type, Data_Rule_Dyn_Type >::get_counters ( )
```

Vector of counter functions.

7.40.3.9 get_counts()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< double > Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_↵
_Type >::get_counts ( ) const
```

7.40.3.10 get_current_stats()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< double >* Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_↵
Dyn_Type >::get_current_stats ( )
```

List current statistics.

7.40.3.11 get_data()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
const FreqTable< double >& Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_↵
Rule_Dyn_Type >::get_data ( ) const
```

7.40.3.12 get_rules()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Rules<Array_Type,Data_Rule_Type>* Support< Array_Type, Data_Counter_Type, Data_Rule_Type,
Data_Rule_Dyn_Type >::get_rules ( )
```

Vector of static rules (cells to iterate).

7.40.3.13 get_rules_dyn()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Rules<Array_Type,Data_Rule_Dyn_Type>* Support< Array_Type, Data_Counter_Type, Data_Rule_Type,
Data_Rule_Dyn_Type >::get_rules_dyn ( )
```

Vector of dynamic rules (to include/exclude a realization).

7.40.3.14 init_support()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::init_↵
support (
    std::vector< Array_Type > * array_bank = nullptr,
    std::vector< double > * stats_bank = nullptr )
```

7.40.3.15 print()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::print ( )
const
```

7.40.3.16 reset_array() [1/2]

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::reset_array
( )
```

7.40.3.17 reset_array() [2/2]

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::reset_array
(
    const Array_Type & Array_ )
```

7.40.3.18 set_counters()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_↵
counters (
    Counters< Array_Type, Data_Counter_Type > * counters_ )
```

7.40.3.19 set_rules()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_rules (
    Rules< Array_Type, Data_Rule_Type > * rules_ )
```

7.40.3.20 set_rules_dyn()

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_rules↵
_dyn (
    Rules< Array_Type, Data_Rule_Dyn_Type > * rules_ )
```

7.40.4 Member Data Documentation

7.40.4.1 change_stats

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< double > Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_↵
_Type >::change_stats
```

Definition at line 80 of file support-bones.hpp.

7.40.4.2 coordiantes_n_free

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::coordiantes↵
_n_free
```

Definition at line 78 of file support-bones.hpp.

7.40.4.3 coordiantes_n_locked

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::coordiantes↵
_n_locked
```

Definition at line 79 of file support-bones.hpp.

7.40.4.4 coordinates_free

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< size_t > Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_↵
_Type >::coordinates_free
```

Definition at line 76 of file support-bones.hpp.

7.40.4.5 coordinates_locked

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< size_t > Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_↵
_Type >::coordinates_locked
```

Definition at line 77 of file support-bones.hpp.

7.40.4.6 current_stats

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< double > Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_↵
_Type >::current_stats
```

Definition at line 75 of file support-bones.hpp.

7.40.4.7 delete_counters

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
bool Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::delete_↵
counters = true
```

Definition at line 69 of file support-bones.hpp.

7.40.4.8 delete_rules

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
bool Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::delete_↵
rules = true
```

Definition at line 70 of file support-bones.hpp.

7.40.4.9 delete_rules_dyn

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
bool Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::delete_↵
rules_dyn = true
```

Definition at line 71 of file support-bones.hpp.

7.40.4.10 hashes

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< size_t > Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_↵
_Type >::hashes
```

Definition at line 81 of file support-bones.hpp.

7.40.4.11 hashes_initialized

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< bool > Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::hashes_initialized
```

Definition at line 82 of file support-bones.hpp.

7.40.4.12 M

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
uint Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::M
```

Definition at line 68 of file support-bones.hpp.

7.40.4.13 max_num_elements

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
uint Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::max_num_elements = BARRY_MAX_NUM_ELEMENTS
```

Definition at line 72 of file support-bones.hpp.

7.40.4.14 N

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
uint Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::N
```

Definition at line 68 of file support-bones.hpp.

7.40.4.15 n_counters

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::n_counters
```

Definition at line 83 of file support-bones.hpp.

The documentation for this class was generated from the following file:

- [include/barry/support-bones.hpp](#)

7.41 vecHasher< T > Struct Template Reference

```
#include <typedefs.hpp>
```

Public Member Functions

- `std::size_t operator()` (`std::vector< T > const &dat`) `const noexcept`

7.41.1 Detailed Description

```
template<typename T>  
struct vecHasher< T >
```

Definition at line 106 of file typedefs.hpp.

7.41.2 Member Function Documentation

7.41.2.1 operator()

```
template<typename T >  
std::size_t vecHasher< T >::operator() (  
    std::vector< T > const & dat ) const [inline], [noexcept]
```

Definition at line 109 of file typedefs.hpp.

The documentation for this struct was generated from the following file:

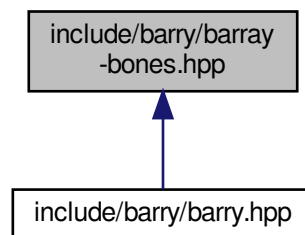
- `include/barry/typedefs.hpp`

Chapter 8

File Documentation

8.1 `include/barry/barray-bones.hpp` File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class `BArray< Cell_Type, Data_Type >`
Baseline class for binary arrays.

8.2 `include/barry/barray-iterator.hpp` File Reference

Classes

- class `ConstBArrayRowIter< Cell_Type, Data_Type >`

8.3 include/barry/barray-meat-operators.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- `#define BARRAY_TYPE() BArray<Cell_Type, Data_Type>`
- `#define BARRAY_TEMPLATE_ARGS() <typename Cell_Type, typename Data_Type>`
- `#define BARRAY_TEMPLATE(a, b) template BARRAY_TEMPLATE_ARGS() inline a BARRAY_TYPE()::b`
- `#define ROW(a) this->el_ij[a]`
- `#define COL(a) this->el_ji[a]`

Functions

- `template BARRAY_TEMPLATE_ARGS () inline void checkdim_(const BARRAY_TYPE() &lhs`
- `template const BARRAY_TYPE () &rhs)`
- `BARRAY_TEMPLATE (BARRAY_TYPE()&, operator+=)(const BArray< Cell_Type`
- `for (uint i=0u;i< nrow();++i) for(uint j=0u = el[POS(i, j)]`
- `j< ncol();++j) this-> operator() (i, j)+`
- `BARRAY_TEMPLATE (BARRAY_TYPE()&, operator+=)(const Cell_Type &rhs)`
- `BARRAY_TEMPLATE (BARRAY_TYPE()&, operator-=(const BArray< Cell_Type`
- `BARRAY_TEMPLATE (BARRAY_TYPE()&, operator-=(const Cell_Type &rhs)`
- `BARRAY_TEMPLATE (BARRAY_TYPE()&, operator*=(const Cell_Type &rhs)`
- `BARRAY_TEMPLATE (BARRAY_TYPE()&, operator/=(const Cell_Type &rhs)`

Variables

- `Data_Type & rhs`
- `return * this`

8.3.1 Macro Definition Documentation

8.3.1.1 BARRAY_TEMPLATE

```
#define BARRAY_TEMPLATE(  
    a,  
    b )  template BARRAY_TEMPLATE_ARGS() inline a BARRAY_TYPE()::b
```

Definition at line 11 of file barray-meat-operators.hpp.

8.3.1.2 BARRAY_TEMPLATE_ARGS

```
template BARRAY_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

Definition at line 9 of file barray-meat-operators.hpp.

8.3.1.3 BARRAY_TYPE

```
template Data_Type BARRAY_TYPE( ) BArray<Cell_Type, Data_Type>
```

Definition at line 7 of file barray-meat-operators.hpp.

8.3.1.4 COL

```
#define COL(  
    a )  this->el_ji[a]
```

Definition at line 15 of file barray-meat-operators.hpp.

8.3.1.5 ROW

```
#define ROW(  
    a )  this->el_ij[a]
```

Definition at line 14 of file barray-meat-operators.hpp.

8.3.2 Function Documentation

8.3.2.1 BARRAY_TEMPLATE() [1/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator* ) const &
```

Definition at line 88 of file barray-meat-operators.hpp.

8.3.2.2 BARRAY_TEMPLATE() [2/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator+ ) const
```

8.3.2.3 BARRAY_TEMPLATE() [3/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator+ ) const &
```

Definition at line 46 of file barray-meat-operators.hpp.

8.3.2.4 BARRAY_TEMPLATE() [4/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator- ) const
```

8.3.2.5 BARRAY_TEMPLATE() [5/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator- ) const &
```

Definition at line 75 of file barray-meat-operators.hpp.

8.3.2.6 BARRAY_TEMPLATE() [6/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator/ ) const &
```

Definition at line 105 of file barray-meat-operators.hpp.

8.3.2.7 BARRAY_TEMPLATE_ARGS()

```
template BARRAY_TEMPLATE_ARGS ( ) const &
```

8.3.2.8 BARRAY_TYPE()

```
template const BARRAY_TYPE ( ) &
```

Definition at line 20 of file barray-meat-operators.hpp.

8.3.2.9 for()

```
for ( ) = el[POS(i, j)] [pure virtual]
```

Definition at line 66 of file barray-meat-operators.hpp.

8.3.2.10 operator>()

```
j< ncol(); ++j) this-> operator() (
    i ,
    j )
```

8.3.3 Variable Documentation

8.3.3.1 rhs

Data_Type & rhs

Initial value:

```
{  
    checkdim_(*this, rhs)
```

Definition at line 33 of file `barray-meat-operators.hpp`.

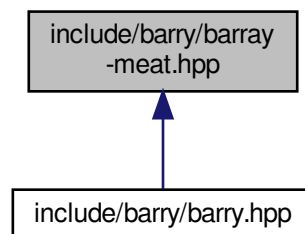
8.3.3.2 this

```
return * this
```

Definition at line 43 of file `barray-meat-operators.hpp`.

8.4 include/barry/barray-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- #define `BARRAY_TYPE()` `BArray<Cell_Type, Data_Type>`
- #define `BARRAY_TEMPLATE_ARGS()` `<typename Cell_Type, typename Data_Type>`
- #define `BARRAY_TEMPLATE(a, b)` `template BARRAY_TEMPLATE_ARGS() inline a BARRAY_TYPE()::b`
- #define `ROW(a) this->el_ij[a]`
- #define `COL(a) this->el_ji[a]`

Functions

- [BARRAY_TEMPLATE](#) (, [BArray](#))([uint](#) N_
- [el_ij](#) [resize](#) (N)
- [el_ji](#) [resize](#) (M)
- [for](#) ([uint](#) i=0u;i< source.size();++i)
- [Data_Type](#) [bool](#) [M](#) ([Array_](#).M)
- [BARRAY_TEMPLATE](#) ([BARRAY_TYPE](#)() &, operator=)([const](#) [BArray](#)< [Cell_Type](#)
- [BARRAY_TEMPLATE](#) (, [BArray](#))([BARRAY_TYPE](#)() &&x) [noexcept](#)
- [BARRAY_TEMPLATE](#) ([BARRAY_TYPE](#)() &, operator=)([BARRAY_TYPE](#)() &&x) [noexcept](#)
- [BARRAY_TEMPLATE](#) ([bool](#), operator=)([const](#) [BARRAY_TYPE](#)() &[Array_](#))
- [BARRAY_TEMPLATE](#) (,~[BArray](#)())()
- [BARRAY_TEMPLATE](#) ([void](#), set_data)([Data_Type](#) *[data_](#)
- [BARRAY_TEMPLATE](#) ([Data_Type](#) *, [D_ptr](#)())()
- [BARRAY_TEMPLATE](#) ([Data_Type](#) &, [D](#)())()
- [BARRAY_TEMPLATE](#) ([void](#), out_of_range)([uint](#) i
- [BARRAY_TEMPLATE](#) ([Cell_Type](#), get_cell)([uint](#) i
- [if](#) ([ROW](#)(i).size()==0u) [return](#)([Cell_Type](#)) 0.0
- [if](#) ([search](#) !=[ROW](#)(i).end()) [return](#) [search](#) -> [second.value](#)
- [return](#) ([Cell_Type](#)) 0.0
- [BARRAY_TEMPLATE](#) ([std::vector](#)< [Cell_Type](#) >, get_row_vec)([uint](#) i
- [std::vector](#)< [Cell_Type](#) > [ans](#) ([ncol](#)(),([Cell_Type](#)) [false](#))
- [for](#) ([const](#) [auto](#) &iter :[row](#)(i, [false](#))) [ans](#)[iter.first]
- [BARRAY_TEMPLATE](#) ([void](#), get_row_vec)([std](#)
- [BARRAY_TEMPLATE](#) ([BARRAY_TYPE](#)() &, operator-)([const](#) [std](#)
- [BARRAY_TEMPLATE](#) ([void](#), [insert_cell](#))([uint](#) i
- [if](#) ([check_exists](#))
- [COL](#) (j).emplace(i
- & [ROW](#) (i)[j])
- [BARRAY_TEMPLATE](#) ([void](#), swap_cells)([uint](#) i0
- [if](#) ([report](#) !=[nullptr](#))(*[report](#))
- [if](#) ([check0](#) &[check1](#))
- [else if](#) (![check0](#) &[check1](#))
- [else if](#) ([check0](#) &![check1](#))
- [BARRAY_TEMPLATE](#) ([void](#), toggle_cell)([uint](#) i
- [BARRAY_TEMPLATE](#) ([void](#), swap_rows)([uint](#) i0
- [if](#) ([ROW](#)(i0).size()==0u) [move0](#)
- [if](#) ([ROW](#)(i1).size()==0u) [move1](#)
- [if](#) (![move0](#) &&![move1](#)) [return](#)
- [ROW](#) (i0).swap([ROW](#)(i1))
- [BARRAY_TEMPLATE](#) ([void](#), swap_cols)([uint](#) j0
- [if](#) ([COL](#)(j0).size()==0u) [check0](#)
- [if](#) ([COL](#)(j1).size()==0u) [check1](#)
- [if](#) ([check0](#) &&[check1](#))
- [else if](#) ([check0](#) &&![check1](#))
- [else if](#) (![check0](#) &&[check1](#))
- [BARRAY_TEMPLATE](#) ([void](#), zero_row)([uint](#) i
- [for](#) ([auto](#) [row](#)=[row0](#).begin();[row](#) !=[row0](#).end();++[row](#)) [rm_cell](#)(i
- [BARRAY_TEMPLATE](#) ([void](#), zero_col)([uint](#) j
- [if](#) ([COL](#)(j).size()==0u) [return](#)
- [BARRAY_TEMPLATE](#) ([void](#), transpose)()
- [BARRAY_TEMPLATE](#) ([void](#), [clear](#))([bool](#) [hard](#))
- [BARRAY_TEMPLATE](#) ([void](#), [resize](#))([uint](#) N_
- [if](#) ([M](#)< [M](#)) [for](#)([uint](#) j = N_

Variables

- `uint M_`
- `uint const std::vector< uint > & source`
- `uint const std::vector< uint > const std::vector< uint > & target`
- `uint const std::vector< uint > const std::vector< uint > const std::vector< Cell_Type > & value`
- `uint const std::vector< uint > const std::vector< uint > const std::vector< Cell_Type > bool add`
- `if(source.size() !=value.size()) throw std N = N_`
- `M = M_`
- `return`
- `Data_Type & Array_`
- `Data_Type bool copy_data`
- `bool delete_data_`
- `data = data_`
- `delete_data = delete_data_`
- `uint j const`
- `uint j`
- `auto search = ROW(i).find(j)`
- `return ans`
- `uint const Cell< Cell_Type > & v`
- `uint const Cell< Cell_Type > bool check_bounds`
- `uint const Cell< Cell_Type > bool bool check_exists`
- `else`
- `NCells`
- `uint j0`
- `uint uint i1`
- `uint uint uint j1`
- `uint uint uint bool int int * report`
- `auto row0 = ROW(i)`
- `row first`
- `row false`
- `auto col0 = COL(j)`

8.4.1 Macro Definition Documentation

8.4.1.1 BARRAY_TEMPLATE

```
#define BARRAY_TEMPLATE(
    a,
    b )  template BARRAY_TEMPLATE_ARGS() inline a BARRAY_TYPE()::b
```

Definition at line 17 of file `barray-meat.hpp`.

8.4.1.2 BARRAY_TEMPLATE_ARGS

```
#define BARRAY_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

Definition at line 15 of file `barray-meat.hpp`.

8.4.1.3 BARRAY_TYPE

```
#define BARRAY_TYPE( ) BArray<Cell_Type, Data_Type>
```

Definition at line 13 of file barray-meat.hpp.

8.4.1.4 COL

```
#define COL(  
    a ) this->el_ji[a]
```

Definition at line 21 of file barray-meat.hpp.

8.4.1.5 ROW

```
#define ROW(  
    a ) this->el_ij[a]
```

Definition at line 20 of file barray-meat.hpp.

8.4.2 Function Documentation

8.4.2.1 ans()

```
std::vector< Cell_Type > ans (  
    ncol() ,  
    (Cell_Type) false )
```

8.4.2.2 BARRAY_TEMPLATE() [1/24]

```
BARRAY_TEMPLATE (  
    BArray ) && [noexcept]
```

Definition at line 230 of file barray-meat.hpp.

8.4.2.3 BARRAY_TEMPLATE() [2/24]

```
BARRAY_TEMPLATE (
    BArray )
```

8.4.2.4 BARRAY_TEMPLATE() [3/24]

```
BARRAY_TEMPLATE (
    ~ BArray )
```

Definition at line 339 of file barray-meat.hpp.

8.4.2.5 BARRAY_TEMPLATE() [4/24]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator- ) const
```

Definition at line 597 of file barray-meat.hpp.

8.4.2.6 BARRAY_TEMPLATE() [5/24]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator ) && [noexcept]
```

Definition at line 272 of file barray-meat.hpp.

8.4.2.7 BARRAY_TEMPLATE() [6/24]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator ) const
```

8.4.2.8 BARRAY_TEMPLATE() [7/24]

```
BARRAY_TEMPLATE (
    bool ,
    operator == ) const &
```

Definition at line 321 of file barray-meat.hpp.

8.4.2.9 BARRAY_TEMPLATE() [8/24]

```
BARRAY_TEMPLATE (
    Cell_Type ,
    get_cell )
```

8.4.2.10 BARRAY_TEMPLATE() [9/24]

```
BARRAY_TEMPLATE (
    Data_Type & ,
    D )
```

Definition at line 372 of file barray-meat.hpp.

8.4.2.11 BARRAY_TEMPLATE() [10/24]

```
BARRAY_TEMPLATE (
    Data_Type * ,
    D_ptr )
```

Definition at line 361 of file barray-meat.hpp.

8.4.2.12 BARRAY_TEMPLATE() [11/24]

```
BARRAY_TEMPLATE (
    std::vector< Cell_Type > ,
    get_row_vec )
```

8.4.2.13 BARRAY_TEMPLATE() [12/24]

```
BARRAY_TEMPLATE (
    void ,
    clear )
```

Definition at line 1130 of file barray-meat.hpp.

8.4.2.14 BARRAY_TEMPLATE() [13/24]

```
BARRAY_TEMPLATE (
    void ,
    get_row_vec )
```

Definition at line 452 of file barray-meat.hpp.

8.4.2.15 BARRAY_TEMPLATE() [14/24]

```
BARRAY_TEMPLATE (
    void ,
    insert_cell )
```

8.4.2.16 BARRAY_TEMPLATE() [15/24]

```
BARRAY_TEMPLATE (
    void ,
    out_of_range )
```

8.4.2.17 BARRAY_TEMPLATE() [16/24]

```
BARRAY_TEMPLATE (
    void ,
    resize )
```

8.4.2.18 BARRAY_TEMPLATE() [17/24]

```
BARRAY_TEMPLATE (
    void ,
    set_data )
```

8.4.2.19 BARRAY_TEMPLATE() [18/24]

```
BARRAY_TEMPLATE (
    void ,
    swap_cells )
```


8.4.2.20 BARRAY_TEMPLATE() [19/24]

```
BARRAY_TEMPLATE (
    void ,
    swap_cols )
```

8.4.2.21 BARRAY_TEMPLATE() [20/24]

```
BARRAY_TEMPLATE (
    void ,
    swap_rows )
```

8.4.2.22 BARRAY_TEMPLATE() [21/24]

```
BARRAY_TEMPLATE (
    void ,
    toggle_cell )
```

8.4.2.23 BARRAY_TEMPLATE() [22/24]

```
BARRAY_TEMPLATE (
    void ,
    transpose )
```

Definition at line 1069 of file barray-meat.hpp.

8.4.2.24 BARRAY_TEMPLATE() [23/24]

```
BARRAY_TEMPLATE (
    void ,
    zero_col )
```

8.4.2.25 BARRAY_TEMPLATE() [24/24]

```
BARRAY_TEMPLATE (
    void ,
    zero_row )
```

8.4.2.26 COL()

```
COL (
    j )
```

8.4.2.27 for() [1/3]

```
for (
    auto row = row0.begin(); row != row0.end(); ++row )
```

8.4.2.28 for() [2/3]

```
for (
    const auto &iter : rowi, false )
```

8.4.2.29 for() [3/3]

```
for ( )
```

Definition at line 51 of file barray-meat.hpp.

8.4.2.30 if() [1/17]

```
else if (
    !check0 && check1 )
```

Definition at line 1008 of file barray-meat.hpp.

8.4.2.31 if() [2/17]

```
else if (
    !check0 & check1 )
```

Definition at line 856 of file barray-meat.hpp.

8.4.2.32 if() [3/17]

```
if (
    !move0 &&!  move1 )
```

8.4.2.33 if() [4/17]

```
else if (
    check0 &!  check1 )
```

Definition at line 864 of file barray-meat.hpp.

8.4.2.34 if() [5/17]

```
else if (
    check0 &&!  check1 )
```

Definition at line 999 of file barray-meat.hpp.

8.4.2.35 if() [6/17]

```
if (
    check0 &&  check1 )
```

Definition at line 972 of file barray-meat.hpp.

8.4.2.36 if() [7/17]

```
if (
    check0 &  check1 )
```

Definition at line 838 of file barray-meat.hpp.

8.4.2.37 if() [8/17]

```
else if (
    check_exists  == CHECK::BOTH )
```

Definition at line 679 of file barray-meat.hpp.

8.4.2.38 if() [9/17]

```
if (
    COL(j).size() == 0u )
```

8.4.2.39 if() [10/17]

```
if (
    COL(j0).size() == 0u )
```

8.4.2.40 if() [11/17]

```
if (
    COL(j1).size() == 0u )
```

8.4.2.41 if() [12/17]

```
else if ( ) = N_
```

Definition at line 86 of file barray-meat.hpp.

8.4.2.42 if() [13/17]

```
if (
    report ! == nullptr )
```

8.4.2.43 if() [14/17]

```
if (
    ROW(i).size() == 0u )
```

8.4.2.44 if() [15/17]

```
if (
    ROW(i0).size() == 0u )
```

8.4.2.45 if() [16/17]

```
if (
    ROW(i1).size() == 0u )
```

8.4.2.46 if() [17/17]

```
if (
    search ! = ROW(i).end() ) -> second.value
```

8.4.2.47 M()

```
Data_Type bool M (
    Array_ M )
```

Definition at line 136 of file barray-meat.hpp.

8.4.2.48 resize() [1/2]

```
el_ji resize (
    M )
```

8.4.2.49 resize() [2/2]

```
el_ij resize (
    N )
```

8.4.2.50 return()

```
return (
    Cell_Type )
```

8.4.2.51 ROW() [1/2]

```
& ROW (
    i )
```

8.4.2.52 ROW() [2/2]

```
ROW (
    i0 )
```

8.4.3 Variable Documentation**8.4.3.1 add**

```
uint const std::vector< uint > const std::vector< uint > bool add
```

Initial value:

```
{
    if (source.size() != target.size())
        throw std::length_error("-source- and -target- don't match on length.")
```

Definition at line 34 of file barray-meat.hpp.

8.4.3.2 ans

```
return ans
```

Definition at line 449 of file barray-meat.hpp.

8.4.3.3 Array_

```
Data_Type & Array_
```

Definition at line 134 of file barray-meat.hpp.

8.4.3.4 check_bounds

bool check_bounds

Initial value:

```
{  
    if (check_bounds) {  
        out_of_range(i0,0u);  
        out_of_range(i1,0u);  
    }  
  
    bool move0=true, move1=true
```

Definition at line 672 of file barray-meat.hpp.

8.4.3.5 check_exists

uint bool int check_exists

Initial value:

```
{  
    if (check_bounds)  
        out_of_range(i,j)
```

Definition at line 673 of file barray-meat.hpp.

8.4.3.6 col0

auto col0 = COL(j)

Definition at line 1061 of file barray-meat.hpp.

8.4.3.7 const

uint bool check_bounds const

Initial value:

```
{  
    if (i >= N)  
        throw std::range_error("The row is out of range.")
```

Definition at line 402 of file barray-meat.hpp.

8.4.3.8 copy_data

```
Data_Type bool copy_data
```

Definition at line 135 of file barray-meat.hpp.

8.4.3.9 data

```
data = data_
```

Definition at line 354 of file barray-meat.hpp.

8.4.3.10 delete_data

```
delete_data = delete_data_
```

Definition at line 355 of file barray-meat.hpp.

8.4.3.11 delete_data_

```
bool delete_data_
```

Initial value:

```
{  
    if ((data != nullptr) && delete_data)  
        delete data
```

Definition at line 348 of file barray-meat.hpp.

8.4.3.12 else

```
else (  
    void )
```

Initial value:

```
{  
    ROW(i).insert(std::pair< uint, Cell<Cell_Type>>(j, v))
```

Definition at line 703 of file barray-meat.hpp.

8.4.3.13 false

```
row false
```

Definition at line 1042 of file barray-meat.hpp.

8.4.3.14 first

```
row first
```

Definition at line 1042 of file barray-meat.hpp.

8.4.3.15 i1

```
uint i1
```

Definition at line 776 of file barray-meat.hpp.

8.4.3.16 j

```
uint j
```

Initial value:

```
{  
    if (init_fun == nullptr)  
        return 0.0
```

Definition at line 414 of file barray-meat.hpp.

8.4.3.17 j0

```
uint j0
```

Definition at line 775 of file barray-meat.hpp.

8.4.3.18 j1

```
uint j1
```

Definition at line 776 of file barray-meat.hpp.

8.4.3.19 M

M = M_

Definition at line 44 of file barray-meat.hpp.

8.4.3.20 M_

uint M_

Initial value:

```
{
    if (N_ < N)
        for (uint i = N_; i < N; ++i)
            zero_row(i, false)
```

Definition at line 30 of file barray-meat.hpp.

8.4.3.21 N

```
if (source.size() != target.size()) throw std::if (source.size() != value.size()) throw std::N =
N_
```

Definition at line 43 of file barray-meat.hpp.

8.4.3.22 NCells

NCells

Definition at line 707 of file barray-meat.hpp.

8.4.3.23 report

uint uint uint bool int int* report

Definition at line 779 of file barray-meat.hpp.

8.4.3.24 return

```
return
```

Definition at line 66 of file barray-meat.hpp.

8.4.3.25 row0

```
auto row0 = ROW(i)
```

Definition at line 1040 of file barray-meat.hpp.

8.4.3.26 search

```
auto search = ROW(i).find(j)
```

Definition at line 426 of file barray-meat.hpp.

8.4.3.27 source

```
uint const std::vector< uint > & source
```

Definition at line 31 of file barray-meat.hpp.

8.4.3.28 target

```
uint const std::vector< uint > const std::vector< uint > & target
```

Definition at line 32 of file barray-meat.hpp.

8.4.3.29 v

```
uint Cell_Type v
```

Definition at line 671 of file barray-meat.hpp.

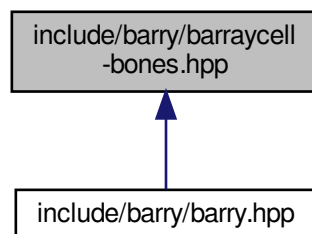
8.4.3.30 value

```
uint const std::vector< uint > const std::vector< uint > const std::vector< Cell_Type >&  
value
```

Definition at line 33 of file barray-meat.hpp.

8.5 include/barry/barraycell-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

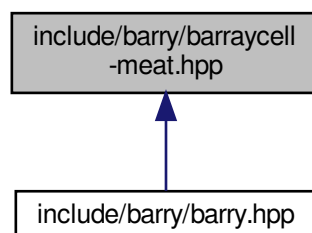


Classes

- class [BArrayCell< Cell_Type, Data_Type >](#)
- class [BArrayCell_const< Cell_Type, Data_Type >](#)

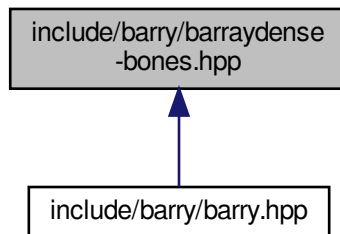
8.6 include/barry/barraycell-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



8.7 include/barry/barraydense-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

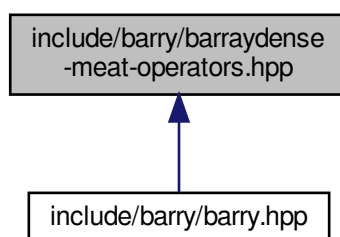


Classes

- class [BArrayDense< Cell_Type, Data_Type >](#)
Baseline class for binary arrays.

8.8 include/barry/barraydense-meat-operators.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- #define [BDENSE_TYPE\(\)](#) [BArrayDense<Cell_Type, Data_Type>](#)
- #define [BDENSE_TEMPLATE_ARGS\(\)](#) [<typename Cell_Type, typename Data_Type>](#)
- #define [BDENSE_TEMPLATE\(a, b\)](#) [template BDENSE_TEMPLATE_ARGS\(\)](#) inline a [BDENSE_TYPE\(\)](#)::b
- #define [ROW\(a\)](#) [this->el_ij\[a\]](#)
- #define [COL\(a\)](#) [this->el_ji\[a\]](#)
- #define [POS\(a, b\)](#) (b)*N + (a)
- #define [POS_N\(a, b, c\)](#) (b)*(c) + (a)

Functions

- template `BDENSE_TEMPLATE_ARGS` () inline void `checkdim_(const BDENSE_TYPE() &lhs`
- template `const BDENSE_TYPE` () &rhs)
- `BDENSE_TEMPLATE` (`BDENSE_TYPE`()&, operator+=)(`const BDENSE_TYPE`() &rhs)
- `BDENSE_TEMPLATE` (`BDENSE_TYPE`()&, operator-=)(`const BDENSE_TYPE`() &rhs)
- `BDENSE_TEMPLATE` (`BDENSE_TYPE`()&, operator*=)(`const Cell_Type` &rhs)
- `BDENSE_TEMPLATE` (`BDENSE_TYPE`()&, operator/=(`const Cell_Type` &rhs)

8.8.1 Macro Definition Documentation

8.8.1.1 BDENSE_TEMPLATE

```
#define BDENSE_TEMPLATE(  
    a,  
    b )  template BDENSE_TEMPLATE_ARGS() inline a BDENSE_TYPE()::b
```

Definition at line 11 of file `barraydense-meat-operators.hpp`.

8.8.1.2 BDENSE_TEMPLATE_ARGS

```
template BDENSE_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

Definition at line 9 of file `barraydense-meat-operators.hpp`.

8.8.1.3 BDENSE_TYPE

```
template Data_Type BDENSE_TYPE( ) BArrayDense<Cell_Type, Data_Type>
```

Definition at line 7 of file `barraydense-meat-operators.hpp`.

8.8.1.4 COL

```
#define COL(  
    a )  this->el_ji[a]
```

Definition at line 15 of file `barraydense-meat-operators.hpp`.

8.8.1.5 POS

```
#define POS(  
    a,  
    b ) (b)*N + (a)
```

Definition at line 16 of file barraydense-meat-operators.hpp.

8.8.1.6 POS_N

```
#define POS_N(  
    a,  
    b,  
    c ) (b)*(c) + (a)
```

Definition at line 17 of file barraydense-meat-operators.hpp.

8.8.1.7 ROW

```
#define ROW(  
    a ) this->el_ij[a]
```

Definition at line 14 of file barraydense-meat-operators.hpp.

8.8.2 Function Documentation

8.8.2.1 BDENSE_TEMPLATE() [1/4]

```
BDENSE_TEMPLATE (  
    BDENSE_TYPE() & ,  
    operator* ) const &
```

Definition at line 90 of file barraydense-meat-operators.hpp.

8.8.2.2 BDENSE_TEMPLATE() [2/4]

```
BDENSE_TEMPLATE (  
    BDENSE_TYPE() & ,  
    operator+ ) const &
```

Definition at line 34 of file barraydense-meat-operators.hpp.

8.8.2.3 BDENSE_TEMPLATE() [3/4]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator- ) const &
```

Definition at line 61 of file barrydense-meat-operators.hpp.

8.8.2.4 BDENSE_TEMPLATE() [4/4]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator/ ) const &
```

Definition at line 101 of file barrydense-meat-operators.hpp.

8.8.2.5 BDENSE_TEMPLATE_ARGS()

```
template BDENSE_TEMPLATE_ARGS ( ) const &
```

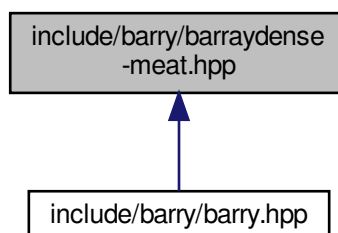
8.8.2.6 BDENSE_TYPE()

```
template const BDENSE_TYPE ( ) &
```

Definition at line 22 of file barrydense-meat-operators.hpp.

8.9 include/barry/barrydense-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- `#define BDENSE_TYPE() BArrayDense<Cell_Type, Data_Type>`
- `#define BDENSE_TEMPLATE_ARGS() <typename Cell_Type, typename Data_Type>`
- `#define BDENSE_TEMPLATE(a, b) template BDENSE_TEMPLATE_ARGS() inline a BDENSE_TYPE():b`
- `#define ROW(a) this->el_ij[a]`
- `#define COL(a) this->el_ji[a]`
- `#define POS(a, b) (b)*N + (a)`
- `#define POS_N(a, b, c) (b)*(c) + (a)`
- `#define ZERO_CELL static_cast<Cell_Type>(0.0)`

Functions

- `BDENSE_TEMPLATE (, BArrayDense)(uint N_`
- `el resize (N *M, ZERO_CELL)`
- `el_rowsums resize (N, ZERO_CELL)`
- `el_colsums resize (M, ZERO_CELL)`
- `for (uint i=0u;i< source.size();++i)`
- `BDENSE_TEMPLATE (, BArrayDense)(const BDENSE_TYPE() &Array_`
- `bool M (Array_.M)`
- `BDENSE_TEMPLATE (BDENSE_TYPE() &, operator=)(const BDENSE_TYPE() &Array_)`
- `BDENSE_TEMPLATE (, BArrayDense)(BDENSE_TYPE() &&x) noexcept`
- `BDENSE_TEMPLATE (BDENSE_TYPE() &, operator=)(BDENSE_TYPE() &&x) noexcept`
- `BDENSE_TEMPLATE (bool, operator==)(const BDENSE_TYPE() &Array_)`
- `BDENSE_TEMPLATE (, ~BArrayDense)()`
- `BDENSE_TEMPLATE (void, set_data)(Data_Type *data_`
- `BDENSE_TEMPLATE (Data_Type *, D_ptr)()`
- `BDENSE_TEMPLATE (const Data_Type *, D_ptr)() const`
- `BDENSE_TEMPLATE (Data_Type &, D)()`
- `BDENSE_TEMPLATE (const Data_Type &, D)() const`
- `BDENSE_TEMPLATE (void, out_of_range)(uint i`
- `BDENSE_TEMPLATE (Cell_Type, get_cell)(uint i`
- `BDENSE_TEMPLATE (std::vector< Cell_Type >, get_row_vec)(uint i`
- `std::vector< Cell_Type > ans (ncol(), static_cast< Cell_Type >(false))`
- `BDENSE_TEMPLATE (void, get_row_vec)(std`
- `BDENSE_TEMPLATE (Entries< Cell_Type >, get_entries)() const`
- `BDENSE_TEMPLATE (bool, is_empty)(uint i`
- `BDENSE_TEMPLATE (unsigned int, nrow)() const noexcept`
- `BDENSE_TEMPLATE (unsigned int, ncol)() const noexcept`
- `BDENSE_TEMPLATE (unsigned int, nnonzero)() const noexcept`
- `BDENSE_TEMPLATE (Cell< Cell_Type >, default_val)() const`
- `BDENSE_TEMPLATE (BDENSE_TYPE() &, operator+=)(const std`
- `BDENSE_TEMPLATE (BDENSE_TYPE() &, operator-=)(const std`
- `BDENSE_TEMPLATE (void, insert_cell)(uint i`
- `if (el[POS(i, j)]==BARRY_ZERO_DENSE)`
- `BDENSE_TEMPLATE (void, swap_cells)(uint i0`
- `if ((i0==i1) &&(j0==j1)) return`
- `rm_cell (i0, j0, false, false)`
- `rm_cell (i1, j1, false, false)`
- `insert_cell (i0, j0, val1, false, false)`
- `insert_cell (i1, j1, val0, false, false)`
- `BDENSE_TEMPLATE (void, toggle_cell)(uint i`
- `else rm_cell (i, j, false, false)`
- `BDENSE_TEMPLATE (void, swap_rows)(uint i0`

- `BDENSE_TEMPLATE` (void, swap_cols)(uint j0
- `BDENSE_TEMPLATE` (void, zero_row)(uint i
- `if` (el_rowsums[i]==ZERO_CELL) `return`
- `BDENSE_TEMPLATE` (void, zero_col)(uint j
- `if` (el_colsums[j]==ZERO_CELL) `return`
- `BDENSE_TEMPLATE` (void, transpose)()
- `BDENSE_TEMPLATE` (void, clear)(bool hard)
- `BDENSE_TEMPLATE` (void, resize)(uint N_
- `el` `resize` (N_*M_, ZERO_CELL)
- `el_rowsums` `resize` (N_, ZERO_CELL)
- `el_colsums` `resize` (M_, ZERO_CELL)
- `BDENSE_TEMPLATE` (void, reserve)()
- `BDENSE_TEMPLATE` (void, print)(const char *fmt
- `va_start` (args, fmt)
- `vprintf` (fmt, args)
- `va_end` (args)
- `BDENSE_TEMPLATE` (const std::vector< Cell_Type > &, get_data)() `const`
- `BDENSE_TEMPLATE` (const Cell_Type, rowsum)(unsigned int i) `const`
- `BDENSE_TEMPLATE` (const Cell_Type, colsum)(unsigned int j) `const`

Variables

- `uint` `M_`
- `uint` `const` `std::vector< uint > & source`
- `uint` `const` `std::vector< uint > const` `std::vector< uint > & target`
- `uint` `const` `std::vector< uint > const` `std::vector< uint > const` `std::vector< Cell_Type > & value`
- `uint` `const` `std::vector< uint > const` `std::vector< uint > const` `std::vector< Cell_Type > bool add`
- `if`(source.size() !=value.size()) `throw` `std` `N` = `N_`
- `M` = `M_`
- `return`
- `bool` `copy_data`
- `bool` `delete_data_`
- `data` = `data_`
- `delete_data` = `delete_data_`
- `uint` `j` `const`
- `uint` `j`
- `return` `el` [`POS`(i, j)] == `ZERO_CELL`
- `return` `ans`
- `uint` `const` `Cell`< `Cell_Type` > & `v`
- `uint` `const` `Cell`< `Cell_Type` > `bool` `check_bounds`
- `uint` `const` `Cell`< `Cell_Type` > `bool` `bool` `check_exists`
- `else`
- `el_rowsums` [`i`] = (`v.value` - `old`)
- `el_colsums` [`j`] = (`v.value` - `old`)
- `uint` `j0`
- `uint` `uint` `i1`
- `uint` `uint` `uint` `j1`
- `uint` `uint` `uint` `bool` `int` `int` * `report`
- `Cell_Type` `val0` = `el`[`POS`(i0,j0)]
- `Cell_Type` `val1` = `el`[`POS`(i1,j1)]
- `false`
- `col`

8.9.1 Macro Definition Documentation

8.9.1.1 BDENSE_TEMPLATE

```
#define BDENSE_TEMPLATE(  
    a,  
    b )  template BDENSE_TEMPLATE_ARGS() inline a BDENSE_TYPE()::b
```

Definition at line 27 of file barraydense-meat.hpp.

8.9.1.2 BDENSE_TEMPLATE_ARGS

```
#define BDENSE_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

Definition at line 25 of file barraydense-meat.hpp.

8.9.1.3 BDENSE_TYPE

```
#define BDENSE_TYPE( ) BArrayDense<Cell_Type, Data_Type>
```

Definition at line 23 of file barraydense-meat.hpp.

8.9.1.4 COL

```
#define COL(  
    a )  this->el_ji[a]
```

Definition at line 31 of file barraydense-meat.hpp.

8.9.1.5 POS

```
#define POS(  
    a,  
    b )  (b)*N + (a)
```

Definition at line 32 of file barraydense-meat.hpp.

8.9.1.6 POS_N

```
#define POS_N(  
    a,  
    b,  
    c ) (b)*(c) + (a)
```

Definition at line 33 of file `barraydense-meat.hpp`.

8.9.1.7 ROW

```
#define ROW(  
    a ) this->el_ij[a]
```

Definition at line 30 of file `barraydense-meat.hpp`.

8.9.1.8 ZERO_CELL

```
#define ZERO_CELL static_cast<Cell_Type>(0.0)
```

Definition at line 38 of file `barraydense-meat.hpp`.

8.9.2 Function Documentation

8.9.2.1 ans()

```
std::vector< Cell_Type > ans (  
    ncol() ,  
    static_cast< Cell_Type > false )
```

8.9.2.2 BDENSE_TEMPLATE() [1/39]

```
BDENSE_TEMPLATE (  
    BArrayDense ) && [noexcept]
```

Definition at line 240 of file `barraydense-meat.hpp`.

8.9.2.3 BDENSE_TEMPLATE() [2/39]

```
BDENSE_TEMPLATE (
    BArrayDense ) const &
```

8.9.2.4 BDENSE_TEMPLATE() [3/39]

```
BDENSE_TEMPLATE (
    BArrayDense )
```

8.9.2.5 BDENSE_TEMPLATE() [4/39]

```
BDENSE_TEMPLATE (
    ~ BArrayDense )
```

Definition at line 318 of file barraydense-meat.hpp.

8.9.2.6 BDENSE_TEMPLATE() [5/39]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator+ ) const
```

Definition at line 566 of file barraydense-meat.hpp.

8.9.2.7 BDENSE_TEMPLATE() [6/39]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator- ) const
```

Definition at line 584 of file barraydense-meat.hpp.

8.9.2.8 BDENSE_TEMPLATE() [7/39]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator ) && [noexcept]
```

Definition at line 257 of file barraydense-meat.hpp.

8.9.2.9 BDENSE_TEMPLATE() [8/39]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator ) const &
```

Definition at line 194 of file bararraydense-meat.hpp.

8.9.2.10 BDENSE_TEMPLATE() [9/39]

```
BDENSE_TEMPLATE (
    bool ,
    is_empty )
```

8.9.2.11 BDENSE_TEMPLATE() [10/39]

```
BDENSE_TEMPLATE (
    bool ,
    operator == ) const &
```

Definition at line 300 of file bararraydense-meat.hpp.

8.9.2.12 BDENSE_TEMPLATE() [11/39]

```
BDENSE_TEMPLATE (
    Cell< Cell_Type > ,
    default_val ) const
```

Definition at line 562 of file bararraydense-meat.hpp.

8.9.2.13 BDENSE_TEMPLATE() [12/39]

```
BDENSE_TEMPLATE (
    Cell_Type ,
    get_cell )
```

8.9.2.14 BDENSE_TEMPLATE() [13/39]

```
BDENSE_TEMPLATE (
    const Cell_Type,
    colsum ) const
```

Definition at line 999 of file barraydense-meat.hpp.

8.9.2.15 BDENSE_TEMPLATE() [14/39]

```
BDENSE_TEMPLATE (
    const Cell_Type,
    rowsum ) const
```

Definition at line 994 of file barraydense-meat.hpp.

8.9.2.16 BDENSE_TEMPLATE() [15/39]

```
BDENSE_TEMPLATE (
    const Data_Type & ,
    D ) const
```

Definition at line 353 of file barraydense-meat.hpp.

8.9.2.17 BDENSE_TEMPLATE() [16/39]

```
BDENSE_TEMPLATE (
    const Data_Type * ,
    D_ptr ) const
```

Definition at line 345 of file barraydense-meat.hpp.

8.9.2.18 BDENSE_TEMPLATE() [17/39]

```
BDENSE_TEMPLATE (
    const std::vector< Cell_Type > & ,
    get_data ) const
```

Definition at line 989 of file barraydense-meat.hpp.

8.9.2.19 BDENSE_TEMPLATE() [18/39]

```
BDENSE_TEMPLATE (
    Data_Type & ,
    D )
```

Definition at line 349 of file bararraydense-meat.hpp.

8.9.2.20 BDENSE_TEMPLATE() [19/39]

```
BDENSE_TEMPLATE (
    Data_Type * ,
    D_ptr )
```

Definition at line 341 of file bararraydense-meat.hpp.

8.9.2.21 BDENSE_TEMPLATE() [20/39]

```
BDENSE_TEMPLATE (
    Entries< Cell_Type > ,
    get_entries ) const
```

Definition at line 502 of file bararraydense-meat.hpp.

8.9.2.22 BDENSE_TEMPLATE() [21/39]

```
BDENSE_TEMPLATE (
    std::vector< Cell_Type > ,
    get_row_vec )
```

8.9.2.23 BDENSE_TEMPLATE() [22/39]

```
BDENSE_TEMPLATE (
    unsigned int ,
    ncol ) const [noexcept]
```

Definition at line 548 of file bararraydense-meat.hpp.

8.9.2.24 BDENSE_TEMPLATE() [23/39]

```
BDENSE_TEMPLATE (
    unsigned int ,
    nnozero ) const [noexcept]
```

Definition at line 552 of file barraydense-meat.hpp.

8.9.2.25 BDENSE_TEMPLATE() [24/39]

```
BDENSE_TEMPLATE (
    unsigned int ,
    nrow ) const [noexcept]
```

Definition at line 544 of file barraydense-meat.hpp.

8.9.2.26 BDENSE_TEMPLATE() [25/39]

```
BDENSE_TEMPLATE (
    void ,
    clear )
```

Definition at line 896 of file barraydense-meat.hpp.

8.9.2.27 BDENSE_TEMPLATE() [26/39]

```
BDENSE_TEMPLATE (
    void ,
    get_row_vec )
```

Definition at line 402 of file barraydense-meat.hpp.

8.9.2.28 BDENSE_TEMPLATE() [27/39]

```
BDENSE_TEMPLATE (
    void ,
    insert_cell )
```

8.9.2.29 BDENSE_TEMPLATE() [28/39]

```
BDENSE_TEMPLATE (
    void ,
    out_of_range )
```

8.9.2.30 BDENSE_TEMPLATE() [29/39]

```
BDENSE_TEMPLATE (
    void ,
    print ) const
```

8.9.2.31 BDENSE_TEMPLATE() [30/39]

```
BDENSE_TEMPLATE (
    void ,
    reserve )
```

Definition at line 946 of file `barraydense-meat.hpp`.

8.9.2.32 BDENSE_TEMPLATE() [31/39]

```
BDENSE_TEMPLATE (
    void ,
    resize )
```

8.9.2.33 BDENSE_TEMPLATE() [32/39]

```
BDENSE_TEMPLATE (
    void ,
    set_data )
```

8.9.2.34 BDENSE_TEMPLATE() [33/39]

```
BDENSE_TEMPLATE (
    void ,
    swap_cells )
```

8.9.2.35 BDENSE_TEMPLATE() [34/39]

```
BDENSE_TEMPLATE (
    void ,
    swap_cols )
```

8.9.2.36 BDENSE_TEMPLATE() [35/39]

```
BDENSE_TEMPLATE (
    void ,
    swap_rows )
```

8.9.2.37 BDENSE_TEMPLATE() [36/39]

```
BDENSE_TEMPLATE (
    void ,
    toggle_cell )
```

8.9.2.38 BDENSE_TEMPLATE() [37/39]

```
BDENSE_TEMPLATE (
    void ,
    transpose )
```

Definition at line 868 of file barraydense-meat.hpp.

8.9.2.39 BDENSE_TEMPLATE() [38/39]

```
BDENSE_TEMPLATE (
    void ,
    zero_col )
```

8.9.2.40 BDENSE_TEMPLATE() [39/39]

```
BDENSE_TEMPLATE (
    void ,
    zero_row )
```

8.9.2.41 for()

```
for ( )
```

Definition at line 64 of file bararraydense-meat.hpp.

8.9.2.42 if() [1/4]

```
if (
    (i0==i1) && (j0==j1) )
```

8.9.2.43 if() [2/4]

```
if (
    el [POS(i, j)] == BARRY_ZERO_DENSE )
```

Definition at line 663 of file bararraydense-meat.hpp.

8.9.2.44 if() [3/4]

```
if (
    el_colsums [j] == ZERO_CELL )
```

8.9.2.45 if() [4/4]

```
if (
    el_rowsums [i] == ZERO_CELL )
```

8.9.2.46 insert_cell() [1/2]

```
insert_cell (
    i0 ,
    j0 ,
    val ,
    false ,
    false )
```

8.9.2.47 insert_cell() [2/2]

```
insert_cell (
    i1 ,
    j1 ,
    val0 ,
    false ,
    false )
```

8.9.2.48 M()

```
bool M (
    Array_. M )
```

Definition at line 157 of file barraydense-meat.hpp.

8.9.2.49 resize() [1/6]

```
el_colsums resize (
    M ,
    ZERO_CELL )
```

8.9.2.50 resize() [2/6]

```
el_colsums resize (
    M_ ,
    ZERO_CELL )
```

8.9.2.51 resize() [3/6]

```
el resize (
    N * M,
    ZERO_CELL )
```

8.9.2.52 resize() [4/6]

```
el_rowsums resize (
    N ,
    ZERO_CELL )
```

8.9.2.53 `resize()` [5/6]

```
el_resize (
    N_ * M_,
    ZERO_CELL )
```

8.9.2.54 `resize()` [6/6]

```
el_rowsums_resize (
    N_ ,
    ZERO_CELL )
```

8.9.2.55 `rm_cell()` [1/3]

```
else rm_cell (
    i ,
    j ,
    false ,
    false )
```

8.9.2.56 `rm_cell()` [2/3]

```
rm_cell (
    i0 ,
    j0 ,
    false ,
    false )
```

8.9.2.57 `rm_cell()` [3/3]

```
rm_cell (
    i1 ,
    j1 ,
    false ,
    false )
```

8.9.2.58 `va_end()`

```
va_end (
    args )
```

8.9.2.59 va_start()

```
va_start (
    args ,
    fmt )
```

8.9.2.60 vprintf()

```
vprintf (
    fmt ,
    args )
```

8.9.3 Variable Documentation

8.9.3.1 add

```
uint const std::vector< uint > const std::vector< uint > bool add
```

Initial value:

```
{
    if (source.size() != target.size())
        throw std::length_error("-source- and -target- don't match on length.")
```

Definition at line 47 of file barraydense-meat.hpp.

8.9.3.2 ans

```
return ans
```

Definition at line 398 of file barraydense-meat.hpp.

8.9.3.3 check_bounds

```
bool check_bounds
```

Initial value:

```
{
    if (check_bounds)
    {
        out_of_range(i0,0u);
        out_of_range(i1,0u);
    }

    for (uint j = 0u; j < M; ++j)
        std::swap(e1[POS(i0, j)], e1[POS(i1, j)])
```

Definition at line 654 of file barraydense-meat.hpp.

8.9.3.4 check_exists

```
uint bool int check_exists
```

Initial value:

```
{  
    if (check_bounds)  
        out_of_range(i, j)
```

Definition at line 655 of file baraydense-meat.hpp.

8.9.3.5 col

```
col
```

Definition at line 843 of file baraydense-meat.hpp.

8.9.3.6 const

```
const
```

Initial value:

```
{  
    if (i >= N)  
        throw std::range_error("The row is out of range.")
```

Definition at line 360 of file baraydense-meat.hpp.

8.9.3.7 copy_data

```
bool copy_data
```

Definition at line 156 of file baraydense-meat.hpp.

8.9.3.8 data

```
data = data_
```

Definition at line 334 of file baraydense-meat.hpp.

8.9.3.9 delete_data

```
delete_data = delete_data_
```

Definition at line 335 of file barraydense-meat.hpp.

8.9.3.10 delete_data_

```
bool delete_data_
```

Initial value:

```
{  
    if ((data != nullptr) && delete_data)  
        delete data
```

Definition at line 328 of file barraydense-meat.hpp.

8.9.3.11 el

```
return el == ZERO_CELL
```

Definition at line 381 of file barraydense-meat.hpp.

8.9.3.12 el_colsums

```
el_colsums[j] = (v.value - old)
```

Definition at line 675 of file barraydense-meat.hpp.

8.9.3.13 el_rowsums

```
el_rowsums[i] = (v.value - old)
```

Definition at line 674 of file barraydense-meat.hpp.

8.9.3.14 else

```
else (
    void )
```

Initial value:

```
{
    Cell_Type old = el[POS(i,j)]
```

Definition at line 670 of file baraydense-meat.hpp.

8.9.3.15 false

```
false
```

Definition at line 767 of file baraydense-meat.hpp.

8.9.3.16 i1

```
uint i1
```

Definition at line 721 of file baraydense-meat.hpp.

8.9.3.17 j

```
j
```

Definition at line 373 of file baraydense-meat.hpp.

8.9.3.18 j0

```
uint j0
```

Definition at line 720 of file baraydense-meat.hpp.

8.9.3.19 j1

```
uint j1
```

Definition at line 721 of file baraydense-meat.hpp.

8.9.3.20 M

M = M_

Definition at line 57 of file barraydense-meat.hpp.

8.9.3.21 M_

uint M_

Initial value:

```
{  
    std::vector< Cell_Type > el_tmp(e1)
```

Definition at line 43 of file barraydense-meat.hpp.

8.9.3.22 N

N = N_

Definition at line 56 of file barraydense-meat.hpp.

8.9.3.23 report

uint uint uint bool int int* report

Initial value:

```
{  
    if (check_bounds) {  
        out_of_range(i0,j0);  
        out_of_range(i1,j1);  
    }  
  
    if (report != nullptr)  
        (*report) = EXISTS::BOTH
```

Definition at line 724 of file barraydense-meat.hpp.

8.9.3.24 return

return

Definition at line 94 of file barraydense-meat.hpp.

8.9.3.25 source

```
uint const std::vector< uint >& source
```

Definition at line 44 of file bararraydense-meat.hpp.

8.9.3.26 target

```
uint const std::vector< uint > const std::vector< uint >& target
```

Definition at line 45 of file bararraydense-meat.hpp.

8.9.3.27 v

```
uint Cell_Type v
```

Definition at line 653 of file bararraydense-meat.hpp.

8.9.3.28 val0

```
Cell_Type val0 = el[POS(i0,j0)]
```

Definition at line 742 of file bararraydense-meat.hpp.

8.9.3.29 val1

```
Cell_Type val1 = el[POS(i1,j1)]
```

Definition at line 743 of file bararraydense-meat.hpp.

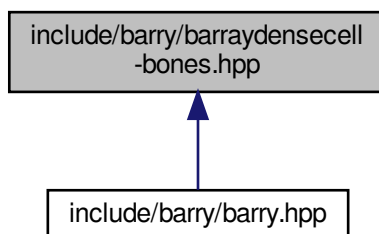
8.9.3.30 value

```
uint const std::vector< uint > const std::vector< uint > const std::vector< Cell_Type >&  
value
```

Definition at line 46 of file bararraydense-meat.hpp.

8.10 include/barry/barraydensecell-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class [BArrayDenseCell< Cell_Type, Data_Type >](#)

Macros

- `#define POS(a, b) (a) + (b) * N`

8.10.1 Macro Definition Documentation

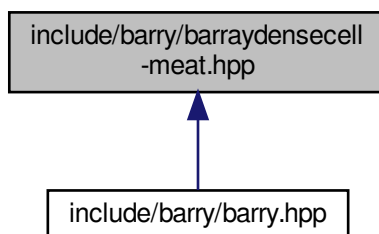
8.10.1.1 POS

```
#define POS(  
    a,  
    b ) (a) + (b) * N
```

Definition at line 6 of file barraydensecell-bones.hpp.

8.11 include/barry/barraydensecell-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- #define POS(a, b) (a) + (b) * dat->N

8.11.1 Macro Definition Documentation

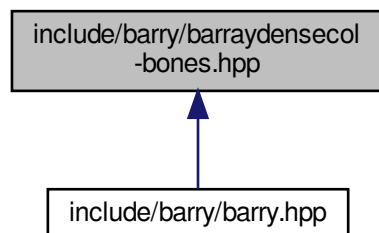
8.11.1.1 POS

```
#define POS(  
    a,  
    b ) (a) + (b) * dat->N
```

Definition at line 6 of file barraydensecell-meat.hpp.

8.12 include/barry/barraydensecol-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class [BArrayDenseCol< Cell_Type, Data_Type >](#)
- class [BArrayDenseCol_const< Cell_Type, Data_Type >](#)

Macros

- `#define POS(a, b) (b)*N + (a)`
- `#define POS_N(a, b, c) (b)*(c) + (a)`
- `#define ZERO_CELL static_cast<Cell_Type>(0.0)`

8.12.1 Macro Definition Documentation

8.12.1.1 POS

```
#define POS(  
    a,  
    b ) (b)*N + (a)
```

Definition at line 4 of file `barraydensecol-bones.hpp`.

8.12.1.2 POS_N

```
#define POS_N(  
    a,  
    b,  
    c ) (b)*(c) + (a)
```

Definition at line 5 of file `barraydensecol-bones.hpp`.

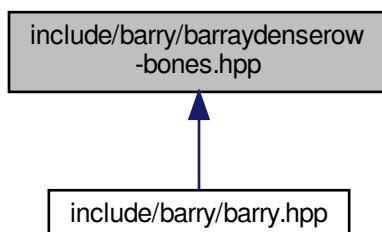
8.12.1.3 ZERO_CELL

```
#define ZERO_CELL static_cast<Cell_Type>(0.0)
```

Definition at line 6 of file `barraydensecol-bones.hpp`.

8.13 include/barry/barraydenserow-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class [BArrayDenseRow< Cell_Type, Data_Type >](#)
- class [BArrayDenseRow_const< Cell_Type, Data_Type >](#)

Macros

- `#define POS(a, b) (b) * N + (a)`
- `#define POS_N(a, b, c) (b)*(c) + (a)`
- `#define ZERO_CELL static_cast< Cell_Type >(0.0)`

8.13.1 Macro Definition Documentation

8.13.1.1 POS

```
#define POS(  
    a,  
    b ) (b) * N + (a)
```

Definition at line 4 of file barraydenserow-bones.hpp.

8.13.1.2 POS_N

```
#define POS_N(
    a,
    b,
    c ) (b)*(c) + (a)
```

Definition at line 5 of file barraydenserow-bones.hpp.

8.13.1.3 ZERO_CELL

```
#define ZERO_CELL static_cast< Cell_Type >(0.0)
```

Definition at line 6 of file barraydenserow-bones.hpp.

8.14 include/barry/barrayrow-bones.hpp File Reference

Classes

- class [BArrayRow< Cell_Type, Data_Type >](#)
- class [BArrayRow_const< Cell_Type, Data_Type >](#)

8.15 include/barry/barrayrow-meat.hpp File Reference

Macros

- #define [BROW_TYPE\(\)](#) [BArrayRow<Cell_Type, Data_Type>](#)
- #define [BROW_TEMPLATE_ARGS\(\)](#) <typename Cell_Type, typename Data_Type>
- #define [BROW_TEMPLATE\(a, b\)](#) template [BROW_TEMPLATE_ARGS\(\)](#) inline a [BROW_TYPE\(\)](#)::b

Functions

- [BROW_TEMPLATE](#) (void, operator=)(const [BROW_TYPE\(\)](#) &val)
- [BROW_TEMPLATE](#) (void, operator+=)(const [BROW_TYPE\(\)](#) &val)
- [BROW_TEMPLATE](#) (void, operator-=)(const [BROW_TYPE\(\)](#) &val)
- [BROW_TEMPLATE](#) (void, operator*=)(const [BROW_TYPE\(\)](#) &val)
- [BROW_TEMPLATE](#) (void, operator/=)(const [BROW_TYPE\(\)](#) &val)

8.15.1 Macro Definition Documentation

8.15.1.1 BROW_TEMPLATE

```
#define BROW_TEMPLATE(  
    a,  
    b )  template BROW_TEMPLATE_ARGS() inline a BROW_TYPE():b
```

Definition at line 8 of file bararrayrow-meat.hpp.

8.15.1.2 BROW_TEMPLATE_ARGS

```
#define BROW_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

Definition at line 6 of file bararrayrow-meat.hpp.

8.15.1.3 BROW_TYPE

```
#define BROW_TYPE( ) BArrayRow<Cell_Type, Data_Type>
```

Definition at line 4 of file bararrayrow-meat.hpp.

8.15.2 Function Documentation

8.15.2.1 BROW_TEMPLATE() [1/5]

```
BROW_TEMPLATE (  
    void ,  
    operator* ) const &
```

Definition at line 45 of file bararrayrow-meat.hpp.

8.15.2.2 BROW_TEMPLATE() [2/5]

```
BROW_TEMPLATE (  
    void ,  
    operator+ ) const &
```

Definition at line 25 of file bararrayrow-meat.hpp.

8.15.2.3 BROW_TEMPLATE() [3/5]

```
BROW_TEMPLATE (
    void ,
    operator- ) const &
```

Definition at line 34 of file barrayrow-meat.hpp.

8.15.2.4 BROW_TEMPLATE() [4/5]

```
BROW_TEMPLATE (
    void ,
    operator/ ) const &
```

Definition at line 55 of file barrayrow-meat.hpp.

8.15.2.5 BROW_TEMPLATE() [5/5]

```
BROW_TEMPLATE (
    void ,
    operator ) const &
```

Definition at line 11 of file barrayrow-meat.hpp.

8.16 include/barry/barrayvector-bones.hpp File Reference

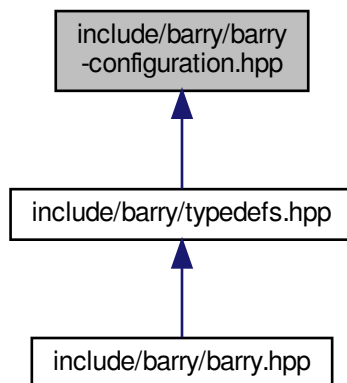
Classes

- class [BArrayVector< Cell_Type, Data_Type >](#)
Row or column of a [BArray](#)
- class [BArrayVector_const< Cell_Type, Data_Type >](#)

8.17 include/barry/barrayvector-meat.hpp File Reference

8.18 include/barry/barry-configuration.hpp File Reference

This graph shows which files directly or indirectly include this file:



Configuration MACROS

These are mostly related to performance. The definitions follow:

- `BARRY_USE_UNORDERED_MAP` If specified, then barry is compiled using `std::unordered_map`. Otherwise it will use `std::map` for the arrays.
 - `BARRY_USE_SAFE_EXP` When specified, it will multiply all likelihoods in [Model](#) by $(1/100)/(1/100)$ so that numerical overflows are avoided.
 - `BARRY_USE_ISFINITE` When specified, it will introduce a macro that checks whether the likelihood is finite or not.
 - `printf_barry` If not specified, will be defined as `printf`.
 - `BARRY_DEBUG_LEVEL`, when defined, will make things verbose.
-
- `#define BARRY_SAFE_EXP -100.0`
 - `#define BARRY_ISFINITE(a)`
 - `#define BARRY_CHECK_SUPPORT(x, maxs)`
 - `#define printf_barry printf`
 - `#define BARRY_MAX_NUM_ELEMENTS static_cast< size_t >(UINT_MAX/2u)`
 - `template<typename Ta, typename Tb >`
`using Map = std::map< Ta, Tb >`

8.18.1 Macro Definition Documentation

8.18.1.1 BARRY_CHECK_SUPPORT

```
#define BARRY_CHECK_SUPPORT(  
    x,  
    maxs )
```

Definition at line 47 of file barry-configuration.hpp.

8.18.1.2 BARRY_ISFINITE

```
#define BARRY_ISFINITE(  
    a )
```

Definition at line 40 of file barry-configuration.hpp.

8.18.1.3 BARRY_MAX_NUM_ELEMENTS

```
#define BARRY_MAX_NUM_ELEMENTS static_cast< size_t > (UINT_MAX/2u)
```

Definition at line 55 of file barry-configuration.hpp.

8.18.1.4 BARRY_SAFE_EXP

```
#define BARRY_SAFE_EXP -100.0
```

Definition at line 33 of file barry-configuration.hpp.

8.18.1.5 printf_barry

```
#define printf_barry printf
```

Definition at line 51 of file barry-configuration.hpp.

8.18.2 Typedef Documentation

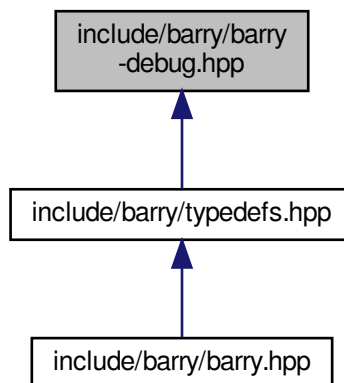
8.18.2.1 Map

```
template<typename Ta , typename Tb >  
using Map = std::map<Ta,Tb>
```

Definition at line 27 of file barry-configuration.hpp.

8.19 include/barry/barry-debug.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- #define `BARRY_DEBUG_LEVEL` 0

8.19.1 Macro Definition Documentation

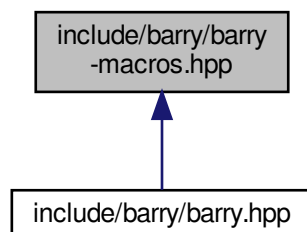
8.19.1.1 BARRY_DEBUG_LEVEL

```
#define BARRY_DEBUG_LEVEL 0
```

Definition at line 5 of file barry-debug.hpp.

8.20 include/barry/barry-macros.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- `#define BARRY_ZERO Cell<Cell_Type>(0.0)`
- `#define BARRY_ZERO_DENSE static_cast<Cell_Type>(0.0)`
- `#define BARRY_ONE Cell<Cell_Type>(1.0)`
- `#define BARRY_ONE_DENSE static_cast<Cell_Type>(1.0)`
- `#define BARRY_UNUSED(expr) do { (void)(expr); } while (0);`

8.20.1 Macro Definition Documentation

8.20.1.1 BARRY_ONE

```
#define BARRY_ONE Cell<Cell_Type>(1.0)
```

Definition at line 7 of file barry-macros.hpp.

8.20.1.2 BARRY_ONE_DENSE

```
#define BARRY_ONE_DENSE static_cast<Cell_Type>(1.0)
```

Definition at line 8 of file barry-macros.hpp.

8.20.1.3 BARRY_UNUSED

```
#define BARRY_UNUSED(  
    expr ) do { (void)(expr); } while (0);
```

Definition at line 10 of file barry-macros.hpp.

8.20.1.4 BARRY_ZERO

```
#define BARRY_ZERO Cell<Cell_Type>(0.0)
```

Definition at line 4 of file barry-macros.hpp.

8.20.1.5 BARRY_ZERO_DENSE

```
#define BARRY_ZERO_DENSE static_cast<Cell_Type>(0.0)
```

Definition at line 5 of file barry-macros.hpp.

8.21 include/barry/barry.hpp File Reference

```
#include <iostream>  
#include <cstdint>  
#include <vector>  
#include <unordered_map>  
#include <functional>  
#include <stdexcept>  
#include <cmath>  
#include <map>  
#include <algorithm>  
#include <utility>  
#include <random>  
#include <climits>  
#include <cfloat>  
#include <string>  
#include <cstdint>  
#include <memory>  
#include <regex>  
#include <iterator>  
#include "typedefs.hpp"  
#include "barry-macros.hpp"  
#include "freqtable.hpp"  
#include "cell-bones.hpp"  
#include "cell-meat.hpp"  
#include "barray-bones.hpp"  
#include "barraycell-bones.hpp"  
#include "barray-meat.hpp"  
#include "barraycell-meat.hpp"
```



```
#include "barray-meat-operators.hpp"
#include "barraydense-bones.hpp"
#include "barraydensecell-bones.hpp"
#include "barraydenserow-bones.hpp"
#include "barraydensecol-bones.hpp"
#include "barraydense-meat.hpp"
#include "barraydensecell-meat.hpp"
#include "barraydense-meat-operators.hpp"
#include "counters-bones.hpp"
#include "counters-meat.hpp"
#include "statscounter-bones.hpp"
#include "statscounter-meat.hpp"
#include "support-bones.hpp"
#include "support-meat.hpp"
#include "powerset-bones.hpp"
#include "powerset-meat.hpp"
#include "model-bones.hpp"
#include "model-meat.hpp"
#include "rules-bones.hpp"
#include "rules-meat.hpp"
#include "counters/network.hpp"
#include "counters/phylo.hpp"
#include "counters/defm.hpp"
```

Namespaces

- [barry](#)
barry: Your go-to motif accountant
- [barry::counters](#)
Tree class and Treeliterator class.
- [barry::counters::network](#)
- [barry::counters::phylo](#)
- [barry::counters::defm](#)

Macros

- `#define BARRY_HPP`
- `#define BARRY_VERSION_MAYOR 0`
- `#define BARRY_VERSION_MINOR 1`
- `#define BARRY_VERSION BARRY_VERSION_MAYOR ## . ## BARRY_VERSION_MINOR`
- `#define COUNTER_FUNCTION(a)`
- `#define COUNTER_LAMBDA(a)`
- `#define RULE_FUNCTION(a)`
- `#define RULE_LAMBDA(a)`

8.21.1 Macro Definition Documentation

8.21.1.1 BARRY_HPP

```
#define BARRY_HPP
```

Definition at line 25 of file barry.hpp.

8.21.1.2 BARRY_VERSION

```
#define BARRY_VERSION BARRY_VERSION_MAYOR ## . ## BARRY_VERSION_MINOR
```

Definition at line 29 of file barry.hpp.

8.21.1.3 BARRY_VERSION_MAYOR

```
#define BARRY_VERSION_MAYOR 0
```

Definition at line 27 of file barry.hpp.

8.21.1.4 BARRY_VERSION_MINOR

```
#define BARRY_VERSION_MINOR 1
```

Definition at line 28 of file barry.hpp.

8.21.1.5 COUNTER_FUNCTION

```
#define COUNTER_FUNCTION(  
    a )
```

Value:

```
template <typename Array_Type = barry::BArray<>, typename Data_Type = bool> \  
inline double (a) (const Array_Type & Array, uint i, uint j, Data_Type & data) \  
{
```

Definition at line 96 of file barry.hpp.

8.21.1.6 COUNTER_LAMBDA

```
#define COUNTER_LAMBDA(  
    a )
```

Value:

```
template <typename Array_Type = barry::BArray<>, typename Data_Type = bool> \  
Counter_fun_type<Array_Type, Data_Type> a = \  
[] (const Array_Type & Array, uint i, uint j, Data_Type & data)
```

Definition at line 99 of file barry.hpp.

8.21.1.7 RULE_FUNCTION

```
#define RULE_FUNCTION(  
    a )
```

Value:

```
template <typename Array_Type = barry::BArray<>, typename Data_Type = bool> \  
inline bool (a) (const Array_Type & Array, uint i, uint j, Data_Type & data) \  
{
```

Definition at line 103 of file barry.hpp.

8.21.1.8 RULE_LAMBDA

```
#define RULE_LAMBDA(  
    a )
```

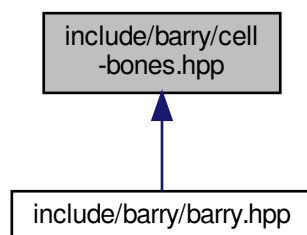
Value:

```
template <typename Array_Type = barry::BArray<>, typename Data_Type = bool> \  
Rule_fun_type<Array_Type, Data_Type> a = \  
[] (const Array_Type & Array, uint i, uint j, Data_Type & data)
```

Definition at line 106 of file barry.hpp.

8.22 include/barry/cell-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

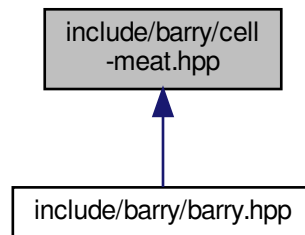


Classes

- class [Cell< Cell_Type >](#)
Entries in [BArray](#). For now, it only has two members:

8.23 include/barry/cell-meat.hpp File Reference

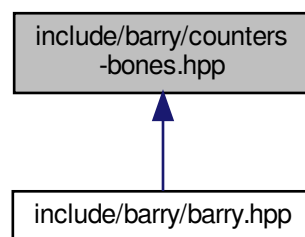
This graph shows which files directly or indirectly include this file:



8.24 include/barry/col-bones.hpp File Reference

8.25 include/barry/counters-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

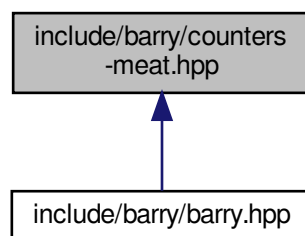


Classes

- class [Counter< Array_Type, Data_Type >](#)
A counter function based on change statistics.
- class [Counters< Array_Type, Data_Type >](#)
Vector of counters.

8.26 include/barry/counters-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- #define [COUNTER_TYPE\(\)](#) [Counter](#)<Array_Type,Data_Type>
- #define [COUNTER_TEMPLATE_ARGS\(\)](#) <typename Array_Type, typename Data_Type>
- #define [COUNTER_TEMPLATE](#)(a, b) template [COUNTER_TEMPLATE_ARGS\(\)](#) inline a [COUNTER_TYPE\(\)](#)↔
::b
- #define [COUNTERS_TYPE\(\)](#) [Counters](#)<Array_Type,Data_Type>
- #define [COUNTERS_TEMPLATE_ARGS\(\)](#) <typename Array_Type, typename Data_Type>
- #define [COUNTERS_TEMPLATE](#)(a, b) template [COUNTERS_TEMPLATE_ARGS\(\)](#) inline a [COUNTERS_TYPE\(\)](#)↔
::b

Functions

- [COUNTER_TEMPLATE](#) (, [Counter](#))(const [Counter](#)< Array_Type
- Data_Type [init_fun](#) (counter_.init_fun)
- Data_Type &&[counter_init_fun](#) (std::move(counter_.init_fun))
- Data_Type &&[counter_data](#) (std::move(counter_.data))
- Data_Type &&[counter_name](#) (std::move(counter_.name))
- Data_Type &&[counter_desc](#) (std::move(counter_.desc))
- *Move constructor.*
- [COUNTER_TEMPLATE](#) ([COUNTER_TYPE\(\)](#), operator=)(const [Counter](#)< Array_Type
- [COUNTER_TEMPLATE](#) ([COUNTER_TYPE\(\)](#) &, operator=)([Counter](#)< Array_Type
- [COUNTER_TEMPLATE](#) (double, count)(Array_Type &Array
- *< Move assignment*
- [return count_fun](#) (Array, i, j, [data](#))
- [COUNTER_TEMPLATE](#) (double, init)(Array_Type &Array
- [return init_fun](#) (Array, i, j, [data](#))
- [COUNTER_TEMPLATE](#) (std::string, get_name)() const
- [COUNTER_TEMPLATE](#) (std::string, get_description)() const
- [COUNTERS_TEMPLATE](#) (, [Counters](#))()
- [COUNTERS_TEMPLATE](#) ([COUNTER_TYPE\(\)](#) &, operator[])(uint idx)
- Data_Type [Counters](#) ([Counters](#)< Array_Type, Data_Type > &&[counters_](#)) noexcept
- [COUNTERS_TEMPLATE](#) ([COUNTERS_TYPE\(\)](#), operator=)(const [Counters](#)< Array_Type
- [COUNTERS_TEMPLATE](#) ([COUNTERS_TYPE\(\)](#) &, operator=)([Counters](#)< Array_Type
- [COUNTERS_TEMPLATE](#) (void, add_counter)([Counter](#)< Array_Type
- [COUNTERS_TEMPLATE](#) (std::vector< std::string >, get_names)() const
- [COUNTERS_TEMPLATE](#) (std::vector< std::string >, get_descriptions)() const

Variables

- Data_Type & [counter_](#)
- Data_Type &&[counter_ noexcept](#)
- [uint i](#)
- [uint uint j](#)
- [return * this](#)
- Data_Type [counter](#)
- [return](#)
- Data_Type [count_fun_](#)
- Data_Type [Counter_fun_type](#)< Array_Type, Data_Type > [init_fun_](#)
- Data_Type [Counter_fun_type](#)< Array_Type, Data_Type > Data_Type [data_](#)
- Data_Type [Counter_fun_type](#)< Array_Type, Data_Type > Data_Type std::string [name_](#)
- Data_Type [Counter_fun_type](#)< Array_Type, Data_Type > Data_Type std::string std::string [desc_](#)

8.26.1 Macro Definition Documentation

8.26.1.1 COUNTER_TEMPLATE

```
#define COUNTER_TEMPLATE(
    a,
    b )  template COUNTER\_TEMPLATE\_ARGS() inline a COUNTER\_TYPE()::b
```

Definition at line 8 of file counters-meat.hpp.

8.26.1.2 COUNTER_TEMPLATE_ARGS

```
#define COUNTER_TEMPLATE_ARGS( ) <typename Array_Type, typename Data_Type>
```

Definition at line 6 of file counters-meat.hpp.

8.26.1.3 COUNTER_TYPE

```
#define COUNTER_TYPE( ) Counter<Array_Type,Data_Type>
```

Definition at line 4 of file counters-meat.hpp.

8.26.1.4 COUNTERS_TEMPLATE

```
#define COUNTERS_TEMPLATE(  
    a,  
    b )  template COUNTERS_TEMPLATE_ARGS() inline a COUNTERS_TYPE()::b
```

Definition at line 116 of file counters-meat.hpp.

8.26.1.5 COUNTERS_TEMPLATE_ARGS

```
#define COUNTERS_TEMPLATE_ARGS( ) <typename Array_Type, typename Data_Type>
```

Definition at line 114 of file counters-meat.hpp.

8.26.1.6 COUNTERS_TYPE

```
#define COUNTERS_TYPE( ) Counters<Array_Type,Data_Type>
```

Definition at line 112 of file counters-meat.hpp.

8.26.2 Function Documentation

8.26.2.1 count_fun()

```
return count_fun (  
    Array ,  
    i ,  
    j ,  
    data )
```

8.26.2.2 COUNTER_TEMPLATE() [1/7]

```
COUNTER_TEMPLATE (  
    Counter ) const
```

8.26.2.3 COUNTER_TEMPLATE() [2/7]

```
COUNTER_TEMPLATE (
    COUNTER_TYPE() & ,
    operator )
```

8.26.2.4 COUNTER_TEMPLATE() [3/7]

```
COUNTER_TEMPLATE (
    COUNTER_TYPE() ,
    operator ) const
```

8.26.2.5 COUNTER_TEMPLATE() [4/7]

```
COUNTER_TEMPLATE (
    double ,
    count ) &
```

< Move assignment

8.26.2.6 COUNTER_TEMPLATE() [5/7]

```
COUNTER_TEMPLATE (
    double ,
    init ) &
```

8.26.2.7 COUNTER_TEMPLATE() [6/7]

```
COUNTER_TEMPLATE (
    std::string ,
    get_description ) const
```

Definition at line 104 of file counters-meat.hpp.

8.26.2.8 COUNTER_TEMPLATE() [7/7]

```
COUNTER_TEMPLATE (
    std::string ,
    get_name ) const
```

Definition at line 100 of file counters-meat.hpp.

8.26.2.9 Counters()

```
Data_Type Counters (
    Counters< Array_Type, Data_Type > && counters_ ) [noexcept]
```

Definition at line 130 of file counters-meat.hpp.

8.26.2.10 COUNTERS_TEMPLATE() [1/7]

```
COUNTERS_TEMPLATE (
    Counters )
```

Definition at line 119 of file counters-meat.hpp.

8.26.2.11 COUNTERS_TEMPLATE() [2/7]

```
COUNTERS_TEMPLATE (
    COUNTER_TYPE() & ,
    operator [] )
```

Definition at line 121 of file counters-meat.hpp.

8.26.2.12 COUNTERS_TEMPLATE() [3/7]

```
COUNTERS_TEMPLATE (
    COUNTERS_TYPE() & ,
    operator )
```

8.26.2.13 COUNTERS_TEMPLATE() [4/7]

```
COUNTERS_TEMPLATE (
    COUNTERS_TYPE() ,
    operator ) const
```

8.26.2.14 COUNTERS_TEMPLATE() [5/7]

```
COUNTERS_TEMPLATE (
    std::vector< std::string > ,
    get_descriptions ) const
```

Definition at line 192 of file counters-meat.hpp.

8.26.2.15 COUNTERS_TEMPLATE() [6/7]

```
COUNTERS_TEMPLATE (
    std::vector< std::string > ,
    get_names  ) const
```

Definition at line 181 of file counters-meat.hpp.

8.26.2.16 COUNTERS_TEMPLATE() [7/7]

```
COUNTERS_TEMPLATE (
    void ,
    add_counter  )
```

8.26.2.17 data()

```
Data_Type&& counter_ data (
    std::move(counter_.data)  )
```

8.26.2.18 desc()

```
Data_Type&& counter_ desc (
    std::move(counter_.desc)  )
```

Move constructor.

Definition at line 31 of file counters-meat.hpp.

8.26.2.19 init_fun() [1/3]

```
return init_fun (
    Array ,
    i ,
    j ,
    data  )
```

8.26.2.20 init_fun() [2/3]

```
Data_Type init_fun (  
    counter_.  init_fun )
```

Definition at line 13 of file counters-meat.hpp.

8.26.2.21 init_fun() [3/3]

```
Data_Type&& counter_ init_fun (  
    std::move(counter_.init_fun) )
```

8.26.2.22 name()

```
Data_Type&& counter_ name (  
    std::move(counter_.name) )
```

8.26.3 Variable Documentation

8.26.3.1 count_fun_

```
Data_Type count_fun_
```

Definition at line 161 of file counters-meat.hpp.

8.26.3.2 counter

```
Data_Type counter
```

Initial value:

```
{  
    data.push_back(counter)
```

Definition at line 152 of file counters-meat.hpp.

8.26.3.3 counter_

Data_Type & counter_

Initial value:

```
{
    if (this != &counter_) {
        this->count_fun = counter_.count_fun;
        this->init_fun = counter_.init_fun;

        this->data = counter_.data;
        this->name = counter_.name;
        this->desc = counter_.desc;
    }
    return *this
}
```

Definition at line 12 of file counters-meat.hpp.

8.26.3.4 data_

Data_Type Counter_fun_type<Array_Type,Data_Type> Data_Type data_

Definition at line 163 of file counters-meat.hpp.

8.26.3.5 desc_

Data_Type Counter_fun_type<Array_Type,Data_Type> Data_Type std::string std::string desc_

Initial value:

```
{
    data.push_back(Counter<Array_Type,Data_Type>(
        count_fun_,
        init_fun_,
        data_,
        name_,
        desc_
    ))
}
```

Definition at line 165 of file counters-meat.hpp.

8.26.3.6 i

uint i

Definition at line 80 of file counters-meat.hpp.

8.26.3.7 init_fun_

Data_Type Counter_fun_type<Array_Type,Data_Type> init_fun_

Definition at line 162 of file counters-meat.hpp.

8.26.3.8 j

uint uint j

Initial value:

```
{  
    if (count_fun == nullptr)  
        return 0.0
```

Definition at line 80 of file counters-meat.hpp.

8.26.3.9 name_

Data_Type Counter_fun_type<Array_Type,Data_Type> Data_Type std::string name_

Definition at line 164 of file counters-meat.hpp.

8.26.3.10 noexcept

Data_Type &&counters_ noexcept

Initial value:

```
{  
    if (this != &counter_)  
    {  
        this->data = std::move(counter_.data);  
  
        this->count_fun = std::move(counter_.count_fun);  
        this->init_fun = std::move(counter_.init_fun);  
  
        this->name = std::move(counter_.name);  
        this->desc = std::move(counter_.desc);  
    }  
    return *this
```

Definition at line 26 of file counters-meat.hpp.

8.26.3.11 return

return

Definition at line 157 of file counters-meat.hpp.

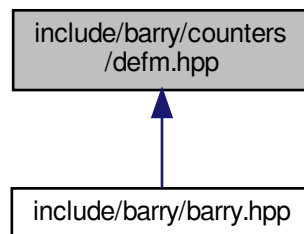
8.26.3.12 this

```
return* this
```

Definition at line 138 of file counters-meat.hpp.

8.27 include/barry/counters/defm.hpp File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class [DEFMData](#)
- class [DEFMCounterData](#)
Data class used to store arbitrary uint or double vectors.
- class [DEFMRuleData](#)

Macros

- #define [UNI_SUB\(a\)](#)

Macros for defining counters

- #define [DEFM_COUNTER\(a\)](#) inline double (a) ([const DEFMArray](#) & Array, [uint i](#), [uint j](#), [DEFMCounterData](#) & [data](#))
- #define [DEFM_COUNTER_LAMBDA\(a\)](#)

Macros for defining rules

- #define [DEFM_RULE\(a\)](#) inline bool (a) ([const DEFMArray](#) & Array, [uint i](#), [uint j](#), bool & [data](#))
- #define [DEFM_RULE_LAMBDA\(a\)](#)

Typedefs

- typedef [BArrayDense](#)< int, [DEFMData](#) > [DEFMArray](#)

Convenient typedefs for network objects.

- typedef [Counter](#)< [DEFMArray](#), [DEFMCounterData](#) > [DEFMCounter](#)
- typedef [Counters](#)< [DEFMArray](#), [DEFMCounterData](#) > [DEFMCounters](#)
- typedef [Support](#)< [DEFMArray](#), [DEFMCounterData](#), [DEFMRuleData](#) > [DEFMSupport](#)
- typedef [StatsCounter](#)< [DEFMArray](#), [DEFMCounterData](#) > [DEFMStatsCounter](#)
- typedef [Model](#)< [DEFMArray](#), [DEFMCounterData](#), [DEFMRuleData](#), [DEFMRuleData](#) > [DEFMModel](#)
- typedef [Rule](#)< [DEFMArray](#), [DEFMRuleData](#) > [DEFMRule](#)
- typedef [Rules](#)< [DEFMArray](#), [DEFMRuleData](#) > [DEFMRules](#)

Functions

- void [defm_motif_parser](#) (std::string formula, std::vector< size_t > &locations, std::vector< bool > &signs, size_t m_order, size_t y_ncol)
Parses a motif formula.
- void [counter_ones](#) ([DEFMCounters](#) *counters, int covar_index=-1, std::string vname="")
Prevalence of ones.
- void [counter_logit_intercept](#) ([DEFMCounters](#) *counters, size_t n_y, std::vector< size_t > which={}, int covar_index=-1, std::string vname="")
- void [counter_transition](#) ([DEFMCounters](#) *counters, std::vector< size_t > coords, std::vector< bool > signs, size_t m_order, size_t n_y, int covar_index=-1, std::string vname="")
Prevalence of ones.
- void [counter_transition_formula](#) ([DEFMCounters](#) *counters, std::string formula, size_t m_order, size_t n_y, int covar_index=-1, std::string vname="")
Prevalence of ones.
- void [counter_fixed_effect](#) ([DEFMCounters](#) *counters, int covar_index, double k, std::string vname="")
Prevalence of ones.

Returns true if the cell is free

Parameters

rules	A pointer to a DEFMRules object (Rules < DEFMArray , bool>).
-------	---

- void [rules_markov_fixed](#) ([DEFMRules](#) *rules, size_t markov_order)
Number of edges.

8.27.1 Macro Definition Documentation

8.27.1.1 DEFM_COUNTER

```
#define DEFM_COUNTER(  
    a ) inline double (a) (const DEFMArray & Array, uint i, uint j, DEFMCOUNTERData  
    & data)
```

Function for definition of a network counter function

Definition at line 376 of file defm.hpp.

8.27.1.2 DEFM_COUNTER_LAMBDA

```
#define DEFM_COUNTER_LAMBDA(  
    a )
```

Value:

```
Counter_fun_type<DEFMArray, DEFMCOUNTERData> a = \  
[] (const DEFMArray & Array, uint i, uint j, DEFMCOUNTERData & data)
```

Lambda function for definition of a network counter function

Definition at line 380 of file defm.hpp.

8.27.1.3 DEFM_RULE

```
#define DEFM_RULE(  
    a ) inline bool (a) (const DEFMArray & Array, uint i, uint j, bool & data)
```

Function for definition of a network counter function

Definition at line 391 of file defm.hpp.

8.27.1.4 DEFM_RULE_LAMBDA

```
#define DEFM_RULE_LAMBDA(  
    a )
```

Value:

```
Rule_fun_type<DEFMArray, DEFMRULEData> a = \  
[] (const DEFMArray & Array, uint i, uint j, DEFMRULEData & data)
```

Lambda function for definition of a network counter function

Definition at line 395 of file defm.hpp.

8.27.1.5 UNI_SUB

```
#define UNI_SUB(  
    a )
```

Value:

```
(\
  ((a) == 0) ? "\u2080" : (\
  ((a) == 1) ? "\u2081" : (\
  ((a) == 2) ? "\u2082" : (\
  ((a) == 3) ? "\u2083" : (\
  ((a) == 4) ? "\u2084" : (\
  ((a) == 5) ? "\u2085" : (\
  ((a) == 6) ? "\u2086" : (\
  ((a) == 7) ? "\u2087" : (\
  ((a) == 8) ? "\u2088" : (\
  "\u2089")))))))\
)
```

8.27.2 Typedef Documentation

8.27.2.1 DEFMArray

```
typedef BArrayDense<int, DEFMDData> DEFMArray
```

Definition at line 247 of file defm.hpp.

8.27.2.2 DEFMCounter

```
typedef Counter<DEFMArray, DEFMCounterData > DEFMCounter
```

Definition at line 340 of file defm.hpp.

8.27.2.3 DEFMCounters

```
typedef Counters<DEFMArray, DEFMCounterData> DEFMCounters
```

Definition at line 341 of file defm.hpp.

8.27.2.4 DEFMModel

```
typedef Model<DEFMArray, DEFMCounterData, DEFMRuleData, DEFMRuleData> DEFMModel
```

Definition at line 344 of file defm.hpp.

8.27.2.5 DEFMRule

```
typedef Rule<DEFMArray, DEFMRuleData> DEFMRule
```

Definition at line 345 of file defm.hpp.

8.27.2.6 DEFMRules

```
typedef Rules<DEFMArray, DEFMRuleData> DEFMRules
```

Definition at line 346 of file defm.hpp.

8.27.2.7 DEFMStatsCounter

```
typedef StatsCounter<DEFMArray, DEFMCounterData> DEFMStatsCounter
```

Definition at line 343 of file defm.hpp.

8.27.2.8 DEFMSupport

```
typedef Support<DEFMArray, DEFMCounterData, DEFMRuleData> DEFMSupport
```

Definition at line 342 of file defm.hpp.

8.27.3 Function Documentation

8.27.3.1 defm_motif_parser()

```
void defm_motif_parser (
    std::string formula,
    std::vector< size_t > & locations,
    std::vector< bool > & signs,
    size_t m_order,
    size_t y_ncol ) [inline]
```

Parses a motif formula.

This function will take the formula and generate the corresponding input for `defm::counter_transition()`. Formulas can be specified in the following ways:

- Intercept effect: {...} No transition, only including the current state.
- Transition effect: {...} > {...} Includes current and previous states.

The general notation is `[0]y[column id]_[row id]`. A preceeding zero means that the value of the cell is considered to be zero. The column id goes between 0 and the number of columns in the array - 1 (so it is indexed from 0,) and the row id goes from 0 to `m_order`.

Intercept effects

Intercept effects only involve a single set of curly brackets. Using the 'greater-than' symbol (i.e., '>') is only for transition effects. When specifying intercept effects, users can skip the `row_id`, e.g., `y0_0` is equivalent to `y0`. If the passed `row_id` is different from the Markov order, i.e., `row_id != m_order`, then the function returns with an error.

Examples:

- "`{y0, 0y1}`" is equivalent to set a motif with the first element equal to one and the second to zero.

Transition effects

Transition effects can be specified using two sets of curly brackets and an greater-than symbol, i.e., `{...} > {...}`. The first set of brackets, which we call LHS, can only hold `row_id` that are less than `m_order`.

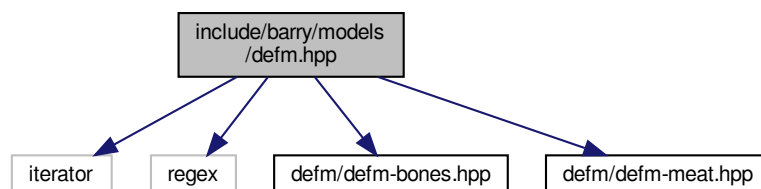
Parameters

<i>formula</i>	
<i>locations</i>	
<i>signs</i>	
<i>m_order</i>	
<i>y_ncol</i>	

Definition at line 47 of file `defm.hpp`.

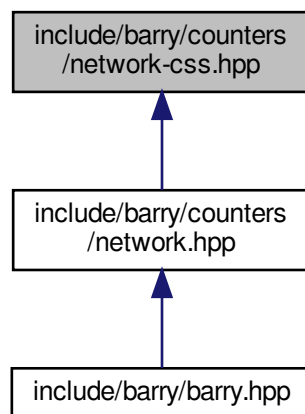
8.28 include/barry/models/defm.hpp File Reference

```
#include <iterator>
#include <regex>
#include "defm/defm-bones.hpp"
#include "defm/defm-meat.hpp"
Include dependency graph for defm.hpp:
```



8.29 include/barry/counters/network-css.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- `#define CSS_SIZE()`
- `#define CSS_CASE_TRUTH() if ((i < n) && (j < n))`
- `#define CSS_TRUE_CELLS()`
- `#define CSS_CASE_PERCEIVED() else if (((i >= s) && (i < e)) & ((j >= s) && (j < e)))`
- `#define CSS_PERCEIVED_CELLS()`
- `#define CSS_CASE_ELSE()`
- `#define CSS_CHECK_SIZE_INIT()`
- `#define CSS_CHECK_SIZE()`
- `#define CSS_APPEND(name)`
- `#define CSS_NET_COUNTER_LAMBDA_INIT()`

Functions

- `template<typename Tnet = Network>`
`void counter_css_partially_false_recip_commi (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
Counts errors of commission.
- `template<typename Tnet = Network>`
`void counter_css_partially_false_recip_omiss (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
Counts errors of omission.
- `template<typename Tnet = Network>`
`void counter_css_completely_false_recip_comiss (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
Counts completely false reciprocity (comission)

- `template<typename Tnet = Network>`
`void counter_css_completely_false_recip_omiss (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
Counts completely false reciprocity (omission)
- `template<typename Tnet = Network>`
`void counter_css_mixed_recip (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
Counts mixed reciprocity errors.
- `template<typename Tnet = Network>`
`void counter_css_census01 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census02 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census03 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census04 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census05 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census06 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census07 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census08 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census09 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census10 (NetCounters< Tnet > *counters, uint netsize, const std::vector< uint > &end_)`

8.29.1 Macro Definition Documentation

8.29.1.1 CSS_APPEND

```
#define CSS_APPEND(  
    name )
```

Value:

```
std::string name_ = (name);\nfor (uint i = 0u; i < end_.size(); ++i) { \n\n    std::string tmpname = name_ + " (" + std::to_string(i) + ")";\n    counters->add_counter(tmp_count, tmp_init,\n        NetCounterData({netsize, i == 0u ? netsize : end_[i-1], end_[i]}, {}),\n        tmpname); }
```

Definition at line 42 of file network-css.hpp.

8.29.1.2 CSS_CASE_ELSE

```
#define CSS_CASE_ELSE( )
```

Definition at line 27 of file network-css.hpp.

8.29.1.3 CSS_CASE_PERCEIVED

```
#define CSS_CASE_PERCEIVED( ) else if (((i >= s) && (i < e)) & ((j >= s) && (j < e)))
```

Definition at line 20 of file network-css.hpp.

8.29.1.4 CSS_CASE_TRUTH

```
#define CSS_CASE_TRUTH( ) if ((i < n) && (j < n))
```

Definition at line 13 of file network-css.hpp.

8.29.1.5 CSS_CHECK_SIZE

```
#define CSS_CHECK_SIZE( )
```

Value:

```
for (uint i = 0u; i < end_.size(); ++i) {\
  if (i == 0u) continue; \
  else if (end_[i] < end_[i-1u]) \
    throw std::logic_error("Endpoints should be specified in order.");}
```

Definition at line 37 of file network-css.hpp.

8.29.1.6 CSS_CHECK_SIZE_INIT

```
#define CSS_CHECK_SIZE_INIT( )
```

Value:

```
/* The indices fall within the network */ \
if ((data.indices.at(0) > Array.ncol()) \
| (data.indices.at(2) > Array.ncol())) \
  throw std::range_error("The network does not match the prescribed size.");
```

Definition at line 31 of file network-css.hpp.

8.29.1.7 CSS_NET_COUNTER_LAMBDA_INIT

```
#define CSS_NET_COUNTER_LAMBDA_INIT( )
```

Value:

```
NETWORK_COUNTER_LAMBDA(tmp_init) {\n    CSS_CHECK_SIZE_INIT() \n    return 0.0; \n};
```

Definition at line 49 of file network-css.hpp.

8.29.1.8 CSS_PERCEIVED_CELLS

```
#define CSS_PERCEIVED_CELLS( )
```

Value:

```
double tji = static_cast<double>(Array(j - s, i - s, false)); \ndouble pji = static_cast<double>(Array(j, i, false)); \ndouble tij = static_cast<double>(Array(i - s, j - s, false));
```

Definition at line 21 of file network-css.hpp.

8.29.1.9 CSS_SIZE

```
#define CSS_SIZE( )
```

Value:

```
uint n = data.indices[0u]; \nuint s = data.indices[1u]; \nuint e = data.indices[2u];
```

Definition at line 7 of file network-css.hpp.

8.29.1.10 CSS_TRUE_CELLS

```
#define CSS_TRUE_CELLS( )
```

Value:

```
double tji = static_cast<double>(Array(j, i, false)); \ndouble pij = static_cast<double>(Array(i + s, j + s, false)); \ndouble pji = static_cast<double>(Array(j + s, i + s, false));
```

Definition at line 14 of file network-css.hpp.

8.29.2 Function Documentation

8.29.2.1 counter_css_census01()

```
template<typename Tnet = Network>
void counter_css_census01 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 275 of file network-css.hpp.

8.29.2.2 counter_css_census02()

```
template<typename Tnet = Network>
void counter_css_census02 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 325 of file network-css.hpp.

8.29.2.3 counter_css_census03()

```
template<typename Tnet = Network>
void counter_css_census03 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 364 of file network-css.hpp.

8.29.2.4 counter_css_census04()

```
template<typename Tnet = Network>
void counter_css_census04 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 403 of file network-css.hpp.

8.29.2.5 counter_css_census05()

```
template<typename Tnet = Network>
void counter_css_census05 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 442 of file network-css.hpp.

8.29.2.6 counter_css_census06()

```
template<typename Tnet = Network>
void counter_css_census06 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 481 of file network-css.hpp.

8.29.2.7 counter_css_census07()

```
template<typename Tnet = Network>
void counter_css_census07 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 520 of file network-css.hpp.

8.29.2.8 counter_css_census08()

```
template<typename Tnet = Network>
void counter_css_census08 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 559 of file network-css.hpp.

8.29.2.9 counter_css_census09()

```
template<typename Tnet = Network>
void counter_css_census09 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 598 of file network-css.hpp.

8.29.2.10 counter_css_census10()

```
template<typename Tnet = Network>
void counter_css_census10 (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Definition at line 637 of file network-css.hpp.

8.29.2.11 counter_css_completely_false_recip_comiss()

```
template<typename Tnet = Network>
void counter_css_completely_false_recip_comiss (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Counts completely false reciprocity (comission)

Definition at line 154 of file network-css.hpp.

8.29.2.12 counter_css_completely_false_recip_omiss()

```
template<typename Tnet = Network>
void counter_css_completely_false_recip_omiss (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Counts completely false reciprocity (omission)

Definition at line 194 of file network-css.hpp.

8.29.2.13 counter_css_mixed_recip()

```
template<typename Tnet = Network>
void counter_css_mixed_recip (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Counts mixed reciprocity errors.

Definition at line 234 of file network-css.hpp.

8.29.2.14 counter_css_partially_false_recip_commi()

```
template<typename Tnet = Network>
void counter_css_partially_false_recip_commi (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

Counts errors of commission.

Parameters

<i>netsize</i>	Size of the reference (true) network
<i>end_</i> —	Vector indicating one past the ending index of each network. (see details)

The *end_* parameter should be of length *N* of *networks* - 1. It is assumed that the first network ends at *netsize*.

Definition at line 63 of file network-css.hpp.

8.29.2.15 counter_css_partially_false_recip_omiss()

```
template<typename Tnet = Network>
void counter_css_partially_false_recip_omiss (
    NetCounters< Tnet > * counters,
    uint netsize,
    const std::vector< uint > & end_ ) [inline]
```

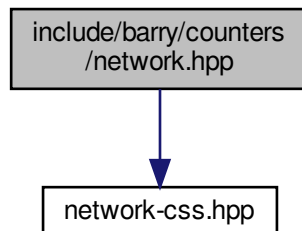
Counts errors of omission.

Definition at line 110 of file network-css.hpp.

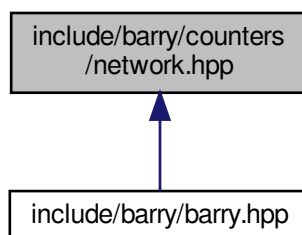
8.30 include/barry/counters/network.hpp File Reference

```
#include "network-css.hpp"
```

Include dependency graph for network.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class [NetworkData](#)
Data class for Networks.
- class [NetCounterData](#)
Data class used to store arbitrary uint or double vectors.

Macros

- #define [NET_C_DATA_IDX\(i\)](#) (data.indices[i])
- #define [NET_C_DATA_NUM\(i\)](#) (data.numbers[i])

Macros for defining counters

- #define `NETWORK_COUNTER(a)`
- #define `NETWORK_COUNTER_LAMBDA(a)`
- #define `NETWORKDENSE_COUNTER_LAMBDA(a)`

Macros for defining rules

- #define `NETWORK_RULE(a)`
- #define `NETWORK_RULE_LAMBDA(a)`

Functions

- template<typename Tnet = Network>
void `counter_edges` (NetCounters< Tnet > *counters)
Number of edges.
- template<typename Tnet = Network>
void `counter_isolates` (NetCounters< Tnet > *counters)
Number of isolated vertices.
- template<> void `counter_isolates` (NetCounters< NetworkDense > *counters)
- template<typename Tnet = Network>
void `counter_mutual` (NetCounters< Tnet > *counters)
Number of mutual ties.
- template<typename Tnet = Network>
void `counter_istar2` (NetCounters< Tnet > *counters)
- template<> void `counter_istar2` (NetCounters< NetworkDense > *counters)
- template<typename Tnet = Network>
void `counter_ostar2` (NetCounters< Tnet > *counters)
- template<> void `counter_ostar2` (NetCounters< NetworkDense > *counters)
- template<typename Tnet = Network>
void `counter_ttriads` (NetCounters< Tnet > *counters)
- template<> void `counter_ttriads` (NetCounters< NetworkDense > *counters)
- template<typename Tnet = Network>
void `counter_ctriads` (NetCounters< Tnet > *counters)
- template<> void `counter_ctriads` (NetCounters< NetworkDense > *counters)
- template<typename Tnet = Network>
void `counter_density` (NetCounters< Tnet > *counters)
- template<typename Tnet = Network>
void `counter_idegree15` (NetCounters< Tnet > *counters)
- template<> void `counter_idegree15` (NetCounters< NetworkDense > *counters)
- template<typename Tnet = Network>
void `counter_odegree15` (NetCounters< Tnet > *counters)
- template<> void `counter_odegree15` (NetCounters< NetworkDense > *counters)
- template<typename Tnet = Network>
void `counter_absdiff` (NetCounters< Tnet > *counters, uint attr_id, double alpha=1.0)
Sum of absolute attribute difference between ego and alter.
- template<typename Tnet = Network>
void `counter_diff` (NetCounters< Tnet > *counters, uint attr_id, double alpha=1.0, double tail_head=true)
Sum of attribute difference between ego and alter to pow(alpha)
- `NETWORK_COUNTER` (init_single_attr)
- template<typename Tnet = Network>
void `counter_nodeicov` (NetCounters< Tnet > *counters, uint attr_id)
- template<typename Tnet = Network>
void `counter_nodeocov` (NetCounters< Tnet > *counters, uint attr_id)

- `template<typename Tnet = Network>`
`void counter_nodecov (NetCounters< Tnet > *counters, uint attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodematch (NetCounters< Tnet > *counters, uint attr_id)`
- `template<typename Tnet = Network>`
`void counter_idgree (NetCounters< Tnet > *counters, std::vector< uint > d)`
Counts number of vertices with a given in-degree.
- `template<> void counter_idgree (NetCounters< NetworkDense > *counters, std::vector< uint > d)`
- `template<typename Tnet = Network>`
`void counter_odegree (NetCounters< Tnet > *counters, std::vector< uint > d)`
Counts number of vertices with a given out-degree.
- `template<> void counter_odegree (NetCounters< NetworkDense > *counters, std::vector< uint > d)`
- `template<typename Tnet = Network>`
`void counter_degree (NetCounters< Tnet > *counters, std::vector< uint > d)`
Counts number of vertices with a given out-degree.

Rules for network models

Parameters

rules	A pointer to a <i>NetRules</i> object (<i>Rules<Network, bool></i>).
-------	--

- `template<typename Tnet = Network>`
`void rules_zerodiag (NetRules< Tnet > *rules)`
Number of edges.

Convenient typedefs for network objects.

- `#define BARRY_ZERO_NETWORK 0.0`
- `#define BARRY_ZERO_NETWORK_DENSE 0`
- `typedef BArray< double, NetworkData > Network`
- `typedef BArrayDense< int, NetworkData > NetworkDense`
- `template<typename Tnet = Network>`
`using NetCounter = Counter< Tnet, NetCounterData >`
- `template<typename Tnet = Network>`
`using NetCounters = Counters< Tnet, NetCounterData >`
- `template<typename Tnet = Network>`
`using NetSupport = Support< Tnet, NetCounterData >`
- `template<typename Tnet = Network>`
`using NetStatsCounter = StatsCounter< Tnet, NetCounterData >`
- `template<typename Tnet >`
`using NetModel = Model< Tnet, NetCounterData >`
- `template<typename Tnet = Network>`
`using NetRule = Rule< Tnet, bool >`
- `template<typename Tnet = Network>`
`using NetRules = Rules< Tnet, bool >`

8.30.1 Macro Definition Documentation

8.30.1.1 BARRY_ZERO_NETWORK

```
#define BARRY_ZERO_NETWORK 0.0
```

Definition at line 85 of file network.hpp.

8.30.1.2 BARRY_ZERO_NETWORK_DENSE

```
#define BARRY_ZERO_NETWORK_DENSE 0
```

Definition at line 86 of file network.hpp.

8.30.1.3 NET_C_DATA_IDX

```
#define NET_C_DATA_IDX(  
    i ) (data.indices[i])
```

Definition at line 74 of file network.hpp.

8.30.1.4 NET_C_DATA_NUM

```
#define NET_C_DATA_NUM(  
    i ) (data.numbers[i])
```

Definition at line 75 of file network.hpp.

8.30.1.5 NETWORK_COUNTER

```
#define NETWORK_COUNTER(  
    a )
```

Value:

```
template<typename Tnet = Network>\ninline double (a) (const Tnet & Array, uint i, uint j, NetCounterData & data)
```

Function for definition of a network counter function

Definition at line 114 of file network.hpp.

8.30.1.6 NETWORK_COUNTER_LAMBDA

```
#define NETWORK_COUNTER_LAMBDA(  
    a )
```

Value:

```
Counter_fun_type<Tnet, NetCounterData> a = \  
    [] (const Tnet & Array, uint i, uint j, NetCounterData & data)
```

Lambda function for definition of a network counter function

Definition at line 119 of file network.hpp.

8.30.1.7 NETWORK_RULE

```
#define NETWORK_RULE(  
    a )
```

Value:

```
template<typename Tnet = Network>\  
inline bool (a) (const Tnet & Array, uint i, uint j, bool & data)
```

Function for definition of a network counter function

Definition at line 133 of file network.hpp.

8.30.1.8 NETWORK_RULE_LAMBDA

```
#define NETWORK_RULE_LAMBDA(  
    a )
```

Value:

```
Rule_fun_type<Tnet, bool> a = \  
    [] (const Tnet & Array, uint i, uint j, bool & data)
```

Lambda function for definition of a network counter function

Definition at line 138 of file network.hpp.

8.30.1.9 NETWORKDENSE_COUNTER_LAMBDA

```
#define NETWORKDENSE_COUNTER_LAMBDA(  
    a )
```

Value:

```
Counter_fun_type<NetworkDense, NetCounterData> a = \  
    [] (const NetworkDense & Array, uint i, uint j, NetCounterData & data)
```

Definition at line 123 of file network.hpp.

8.30.2 Typedef Documentation

8.30.2.1 NetCounter

```
template<typename Tnet = Network>  
using NetCounter = Counter<Tnet, NetCounterData >
```

Definition at line 89 of file network.hpp.

8.30.2.2 NetCounters

```
template<typename Tnet = Network>  
using NetCounters = Counters<Tnet, NetCounterData>
```

Definition at line 92 of file network.hpp.

8.30.2.3 NetModel

```
template<typename Tnet >  
using NetModel = Model<Tnet, NetCounterData>
```

Definition at line 101 of file network.hpp.

8.30.2.4 NetRule

```
template<typename Tnet = Network>  
using NetRule = Rule<Tnet, bool>
```

Definition at line 104 of file network.hpp.

8.30.2.5 NetRules

```
template<typename Tnet = Network>  
using NetRules = Rules<Tnet, bool>
```

Definition at line 107 of file network.hpp.

8.30.2.6 NetStatsCounter

```
template<typename Tnet = Network>
using NetStatsCounter = StatsCounter<Tnet, NetCounterData>
```

Definition at line 98 of file network.hpp.

8.30.2.7 NetSupport

```
template<typename Tnet = Network>
using NetSupport = Support<Tnet, NetCounterData >
```

Definition at line 95 of file network.hpp.

8.30.2.8 Network

```
typedef BArray<double, NetworkData> Network
```

Definition at line 82 of file network.hpp.

8.30.2.9 NetworkDense

```
typedef BArrayDense<int, NetworkData> NetworkDense
```

Definition at line 83 of file network.hpp.

8.30.3 Function Documentation

8.30.3.1 rules_zerodiag()

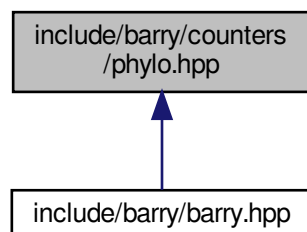
```
template<typename Tnet = Network>
void rules_zerodiag (
    NetRules< Tnet > * rules ) [inline]
```

Number of edges.

Definition at line 1383 of file network.hpp.

8.31 include/barry/counters/phylo.hpp File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class [NodeData](#)
Data definition for the `PhyloArray` class.
- class [PhyloCounterData](#)
- class [PhyloRuleDynData](#)

Macros

- `#define` [DEFAULT_DUPLICATION](#) 1u
- `#define` [DUPL_SPEC](#) 0u
- `#define` [DUPL_DUPL](#) 1u
- `#define` [DUPL_EITH](#) 2u
- `#define` [MAKE_DUPL_VARS](#)()
- `#define` [IS_EITHER](#)() (DATA_AT == [DUPL_EITH](#))
- `#define` [IS_DUPLICATION](#)() ((DATA_AT == [DUPL_DUPL](#)) & (DPL))
- `#define` [IS_SPECIATION](#)() ((DATA_AT == [DUPL_SPEC](#)) & (!DPL))
- `#define` [IF_MATCHES](#)()
- `#define` [IF_NOTMATCHES](#)()
- `#define` [PHYLO_COUNTER_LAMBDA](#)(a)
Extension of a simple counter.
- `#define` [PHYLO_RULE_DYN_LAMBDA](#)(a)
- `#define` [PHYLO_CHECK_MISSING](#)()

Typedefs

- `typedef std::vector< std::pair< uint, uint > > PhyloRuleData`

Convenient typedefs for Node objects.

- typedef `BArrayDense< uint, NodeData >` `PhyloArray`
- typedef `Counter< PhyloArray, PhyloCounterData >` `PhyloCounter`
- typedef `Counters< PhyloArray, PhyloCounterData >` `PhyloCounters`
- typedef `Rule< PhyloArray, PhyloRuleData >` `PhyloRule`
- typedef `Rules< PhyloArray, PhyloRuleData >` `PhyloRules`
- typedef `Rule< PhyloArray, PhyloRuleDynData >` `PhyloRuleDyn`
- typedef `Rules< PhyloArray, PhyloRuleDynData >` `PhyloRulesDyn`
- typedef `Support< PhyloArray, PhyloCounterData, PhyloRuleData, PhyloRuleDynData >` `PhyloSupport`
- typedef `StatsCounter< PhyloArray, PhyloCounterData >` `PhyloStatsCounter`
- typedef `Model< PhyloArray, PhyloCounterData, PhyloRuleData, PhyloRuleDynData >` `PhyloModel`
- typedef `PowerSet< PhyloArray, PhyloRuleData >` `PhyloPowerSet`

Functions

- std::string `get_last_name` (unsigned int d)
- void `counter_overall_gains` (`PhyloCounters *counters`, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Overall functional gains.
- void `counter_gains` (`PhyloCounters *counters`, std::vector< `uint` > nfun, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Functional gains for a specific function (nfun).
- void `counter_gains_k_offspring` (`PhyloCounters *counters`, std::vector< `uint` > nfun, `uint` k=1u, unsigned int duplication=`DEFAULT_DUPPLICATION`)
k genes gain function nfun
- void `counter_genes_changing` (`PhyloCounters *counters`, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)
- void `counter_preserve_pseudogene` (`PhyloCounters *counters`, unsigned int nfunA, unsigned int nfunB, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Keeps track of how many pairs of genes preserve pseudostate.
- void `counter_prop_genes_changing` (`PhyloCounters *counters`, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)
- void `counter_overall_loss` (`PhyloCounters *counters`, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Overall functional loss.
- void `counter_maxfuns` (`PhyloCounters *counters`, `uint` lb, `uint` ub, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Cap the number of functions per gene.
- void `counter_loss` (`PhyloCounters *counters`, std::vector< `uint` > nfun, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Total count of losses for an specific function.
- void `counter_overall_changes` (`PhyloCounters *counters`, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Total number of changes. Use this statistic to account for "preservation".
- void `counter_subfun` (`PhyloCounters *counters`, `uint` nfunA, `uint` nfunB, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Total count of Sub-functionalization events.
- void `counter_cogain` (`PhyloCounters *counters`, `uint` nfunA, `uint` nfunB, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Co-evolution (joint gain or loss)
- void `counter_longest` (`PhyloCounters *counters`, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Longest branch mutates (either by gain or by loss)
- void `counter_neofun` (`PhyloCounters *counters`, `uint` nfunA, `uint` nfunB, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Total number of neofunctionalization events.
- void `counter_pairwise_neofun_singlefun` (`PhyloCounters *counters`, `uint` nfunA, unsigned int duplication=`DEFAULT_DUPPLICATION`)
*Total number of neofunctionalization events $\sum_u \sum_{\{w < u\}} [x(u,a) * (1 - x(w,a)) + (1 - x(u,a)) * x(w,a)]$ change
stat: $\text{delta}\{x(u,a): 0 \rightarrow 1\} = 1 - 2 * x(w,a)$*
- void `counter_neofun_a2b` (`PhyloCounters *counters`, `uint` nfunA, `uint` nfunB, unsigned int duplication=`DEFAULT_DUPPLICATION`)
Total number of neofunctionalization events.
- void `counter_co_opt` (`PhyloCounters *counters`, `uint` nfunA, `uint` nfunB, unsigned int duplication=`DEFAULT_DUPPLICATION`)

Function co-opting.

- void `counter_k_genes_changing` (PhyloCounters *counters, unsigned int k, unsigned int duplication=DEFAULT_DUPLICATION)

Indicator function. Equals to one if k genes changed and zero otherwise.

- void `counter_less_than_p_prop_genes_changing` (PhyloCounters *counters, double p, unsigned int duplication=DEFAULT_DUPLICATION)

Indicator function. Equals to one if k genes changed and zero otherwise.

- void `counter_gains_from_0` (PhyloCounters *counters, std::vector< uint > nfun, unsigned int duplication=DEFAULT_DUPLICATION)

Used when all the functions are in 0 (like the root node prob.)

- void `counter_overall_gains_from_0` (PhyloCounters *counters, unsigned int duplication=DEFAULT_DUPLICATION)

Used when all the functions are in 0 (like the root node prob.)

- void `counter_pairwise_overall_change` (PhyloCounters *counters, unsigned int duplication=DEFAULT_DUPLICATION)

Used when all the functions are in 0 (like the root node prob.)

- void `counter_pairwise_preserving` (PhyloCounters *counters, uint nfunA, uint nfunB, unsigned int duplication=DEFAULT_DUPLICATION)

Used when all the functions are in 0 (like the root node prob.)

- void `counter_pairwise_first_gain` (PhyloCounters *counters, uint nfunA, uint nfunB, unsigned int duplication=DEFAULT_DUPLICATION)

Used when all the functions are in 0 (like the root node prob.)

- void `rule_dyn_limit_changes` (PhyloSupport *support, uint pos, uint lb, uint ub, unsigned int duplication=DEFAULT_DUPLICATION)

Overall functional gains.

8.31.1 Macro Definition Documentation

8.31.1.1 DEFAULT_DUPLICATION

```
#define DEFAULT_DUPLICATION 1u
```

Definition at line 5 of file phylo.hpp.

8.31.1.2 DUPL_DUPL

```
#define DUPL_DUPL 1u
```

Definition at line 7 of file phylo.hpp.

8.31.1.3 DUPL_EITH

```
#define DUPL_EITH 2u
```

Definition at line 8 of file phylo.hpp.

8.31.1.4 DUPL_SPEC

```
#define DUPL_SPEC 0u
```

Definition at line 6 of file phylo.hpp.

8.31.1.5 IF_MATCHES

```
#define IF_MATCHES( )
```

Value:

```
MAKE_DUPL_VARS() \
if (IS_EITHER() | IS_DUPLICATION() | IS_SPECIATION())
```

Definition at line 19 of file phylo.hpp.

8.31.1.6 IF_NOTMATCHES

```
#define IF_NOTMATCHES( )
```

Value:

```
MAKE_DUPL_VARS() \
if (!IS_EITHER() & !IS_DUPLICATION() & !IS_SPECIATION())
```

Definition at line 21 of file phylo.hpp.

8.31.1.7 IS_DUPLICATION

```
#define IS_DUPLICATION( ) ((DATA_AT == DUPL_DUPL) & (DPL))
```

Definition at line 16 of file phylo.hpp.

8.31.1.8 IS_EITHER

```
#define IS_EITHER( ) (DATA_AT == DUPL_EITH)
```

Definition at line 15 of file phylo.hpp.

8.31.1.9 IS_SPECIATION

```
#define IS_SPECIATION( ) ((DATA_AT == DUPL_SPEC) & (!DPL))
```

Definition at line 17 of file phylo.hpp.

8.31.1.10 MAKE_DUPL_VARS

```
#define MAKE_DUPL_VARS( )
```

Value:

```
bool DPL = Array.D_ptr()->duplication; \
unsigned int DATA_AT = data[0u];
```

Definition at line 11 of file phylo.hpp.

8.31.1.11 PHYLO_CHECK_MISSING

```
#define PHYLO_CHECK_MISSING( )
```

Value:

```
if (Array.D_ptr() == nullptr) \
throw std::logic_error("The array data is nullptr."); \
```

Definition at line 139 of file phylo.hpp.

8.31.1.12 PHYLO_COUNTER_LAMBDA

```
#define PHYLO_COUNTER_LAMBDA(
    a )
```

Value:

```
Counter_fun_type<PhyloArray, PhyloCounterData> a = \
[] (const PhyloArray & Array, uint i, uint j, PhyloCounterData & data)
```

Extension of a simple counter.

It allows specifying extra arguments, in particular, the corresponding sets of rows to which this statistic may be relevant. This could be important in the case of, for example, counting correlation type statistics between function 1 and 2, and between function 1 and 3.

Definition at line 133 of file phylo.hpp.

8.31.1.13 PHYLO_RULE_DYN_LAMBDA

```
#define PHYLO_RULE_DYN_LAMBDA(  
    a )
```

Value:

```
Rule_fun_type<PhyloArray, PhyloRuleDynData> a = \  
[] (const PhyloArray & Array, uint i, uint j, PhyloRuleDynData & data)
```

Definition at line 136 of file phylo.hpp.

8.31.2 Typedef Documentation

8.31.2.1 PhyloArray

```
typedef BArrayDense<uint, NodeData> PhyloArray
```

Definition at line 106 of file phylo.hpp.

8.31.2.2 PhyloCounter

```
typedef Counter<PhyloArray, PhyloCounterData > PhyloCounter
```

Definition at line 107 of file phylo.hpp.

8.31.2.3 PhyloCounters

```
typedef Counters< PhyloArray, PhyloCounterData> PhyloCounters
```

Definition at line 108 of file phylo.hpp.

8.31.2.4 PhyloModel

```
typedef Model<PhyloArray, PhyloCounterData, PhyloRuleData, PhyloRuleDynData > PhyloModel
```

Definition at line 118 of file phylo.hpp.

8.31.2.5 PhyloPowerSet

```
typedef PowerSet<PhyloArray, PhyloRuleData> PhyloPowerSet
```

Definition at line 119 of file phylo.hpp.

8.31.2.6 PhyloRule

```
typedef Rule<PhyloArray,PhyloRuleData> PhyloRule
```

Definition at line 110 of file phylo.hpp.

8.31.2.7 PhyloRuleData

```
typedef std::vector< std::pair< uint, uint > > PhyloRuleData
```

Definition at line 99 of file phylo.hpp.

8.31.2.8 PhyloRuleDyn

```
typedef Rule<PhyloArray,PhyloRuleDynData> PhyloRuleDyn
```

Definition at line 113 of file phylo.hpp.

8.31.2.9 PhyloRules

```
typedef Rules<PhyloArray,PhyloRuleData> PhyloRules
```

Definition at line 111 of file phylo.hpp.

8.31.2.10 PhyloRulesDyn

```
typedef Rules<PhyloArray,PhyloRuleDynData> PhyloRulesDyn
```

Definition at line 114 of file phylo.hpp.

8.31.2.11 PhyloStatsCounter

```
typedef StatsCounter<PhyloArray, PhyloCounterData> PhyloStatsCounter
```

Definition at line 117 of file phylo.hpp.

8.31.2.12 PhyloSupport

```
typedef Support<PhyloArray, PhyloCounterData, PhyloRuleData, PhyloRuleDynData > PhyloSupport
```

Definition at line 116 of file phylo.hpp.

8.31.3 Function Documentation

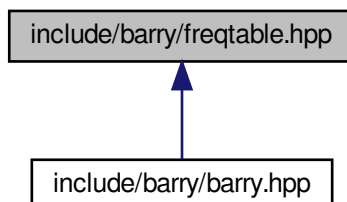
8.31.3.1 get_last_name()

```
std::string get_last_name (
    unsigned int d ) [inline]
```

Definition at line 142 of file phylo.hpp.

8.32 include/barry/freqtable.hpp File Reference

This graph shows which files directly or indirectly include this file:

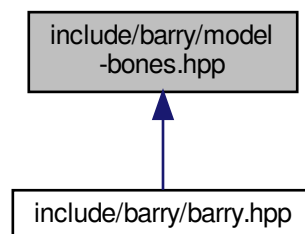


Classes

- class `FreqTable< T >`
Frequency table of vectors.

8.33 include/barry/model-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class [Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >](#)

General framework for discrete exponential models. This class allows generating discrete exponential models in the form of a linear exponential model:

Functions

- `template<typename Array_Type >`
`std::vector< double > keygen_default (const Array_Type &Array_)`

Array Hasher class (used for computing support)

8.33.1 Function Documentation

8.33.1.1 [keygen_default\(\)](#)

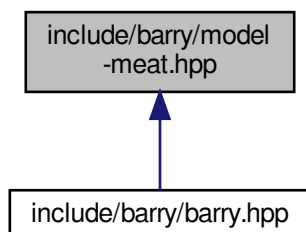
```
template<typename Array_Type >  
std::vector< double > keygen_default (  
    const Array_Type & Array_ ) [inline]
```

Array Hasher class (used for computing support)

Definition at line 9 of file model-bones.hpp.

8.34 include/barry/model-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- `#define MODEL_TYPE()`
- `#define MODEL_TEMPLATE_ARGS()`
- `#define MODEL_TEMPLATE(a, b) template MODEL_TEMPLATE_ARGS() inline a MODEL_TYPE()::b`

Functions

- `double update_normalizing_constant(const double *params, const double *support, size_t k, size_t n)`
- `double likelihood_(const double *stats_target, const std::vector< double > ¶ms, const double normalizing_constant, size_t n_params, bool log_=false)`
- `MODEL_TEMPLATE(, Model)()`
- `MODEL_TEMPLATE(, Model)(const MODEL_TYPE() &Model_)`

8.34.1 Macro Definition Documentation

8.34.1.1 MODEL_TEMPLATE

```

#define MODEL_TEMPLATE(
    a,
    b )  template MODEL_TEMPLATE_ARGS() inline a MODEL_TYPE()::b
  
```

Definition at line 87 of file model-meat.hpp.

8.34.1.2 MODEL_TEMPLATE_ARGS

```
#define MODEL_TEMPLATE_ARGS( )
```

Value:

```
<typename Array_Type, typename Data_Counter_Type,\  
    typename Data_Rule_Type, typename Data_Rule_Dyn_Type>
```

Definition at line 84 of file model-meat.hpp.

8.34.1.3 MODEL_TYPE

```
#define MODEL_TYPE( )
```

Value:

```
Model<Array_Type, Data_Counter_Type, Data_Rule_Type,\  
    Data_Rule_Dyn_Type>
```

Definition at line 81 of file model-meat.hpp.

8.34.2 Function Documentation

8.34.2.1 likelihood_()

```
double likelihood_ (  
    const double * stats_target,  
    const std::vector< double > & params,  
    const double normalizing_constant,  
    size_t n_params,  
    bool log_ = false ) [inline]
```

Definition at line 45 of file model-meat.hpp.

8.34.2.2 MODEL_TEMPLATE() [1/2]

```
MODEL_TEMPLATE (  
    Model )
```

Definition at line 91 of file model-meat.hpp.

8.34.2.3 MODEL_TEMPLATE() [2/2]

```
MODEL_TEMPLATE (
    Model ) const &
```

Definition at line 155 of file model-meat.hpp.

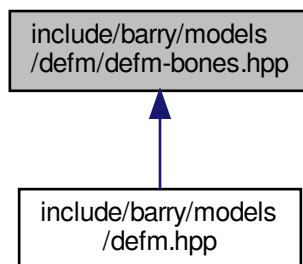
8.34.2.4 update_normalizing_constant()

```
double update_normalizing_constant (
    const double * params,
    const double * support,
    size_t k,
    size_t n ) [inline]
```

Definition at line 9 of file model-meat.hpp.

8.35 include/barry/models/defm/defm-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

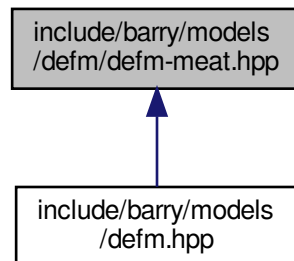


Classes

- class [DEFM](#)

8.36 include/barry/models/defm/defm-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- `#define` [DEFM_RANGES](#)(a)
- `#define` [DEFM_LOOP_ARRAYS](#)(a) `for` (size_t a = 0u; a < (nobs_i - M_order); ++a)

Functions

- `std::vector< double >` [keygen_defm](#) (const defmcounters::DEFMArray &Array_)

8.36.1 Macro Definition Documentation

8.36.1.1 DEFM_LOOP_ARRAYS

```
#define DEFM_LOOP_ARRAYS(
    a )    for (size_t a = 0u; a < (nobs_i - M_order); ++a)
```

Definition at line 41 of file defm-meat.hpp.

8.36.1.2 DEFM_RANGES

```
#define DEFM_RANGES(
    a )
```

Value:

```
size_t __CONCAT(start_,a) = start_end[a * 2u];\
size_t __CONCAT(end_,a)   = start_end[a * 2u + 1u];\
size_t __CONCAT(nobs_,a)  = __CONCAT(end_,i) - __CONCAT(start_,i) + 1u;
```

Definition at line 36 of file defm-meat.hpp.

8.36.2 Function Documentation

8.36.2.1 keygen_defm()

```
std::vector< double > keygen_defm (
    const defmcounters::DEFMArray & Array_ ) [inline]
```

Definition at line 4 of file defm-meat.hpp.

8.37 include/barry/models/geese.hpp File Reference

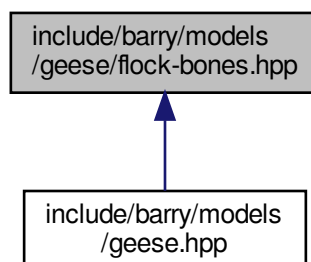
```
#include "geese/geese-node-bones.hpp"
#include "geese/geese-bones.hpp"
#include "geese/geese-meat.hpp"
#include "geese/geese-meat-constructors.hpp"
#include "geese/geese-meat-likelihood.hpp"
#include "geese/geese-meat-likelihood_exhaust.hpp"
#include "geese/geese-meat-simulate.hpp"
#include "geese/geese-meat-predict.hpp"
#include "geese/geese-meat-predict_exhaust.hpp"
#include "geese/geese-meat-predict_sim.hpp"
#include "geese/flock-bones.hpp"
#include "geese/flock-meat.hpp"
```

Include dependency graph for geese.hpp:



8.38 include/barry/models/geese/flock-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:



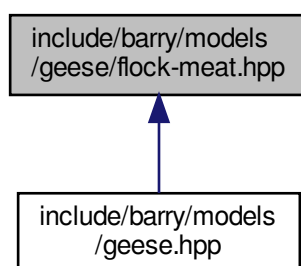
Classes

- class [Flock](#)

A [Flock](#) is a group of [Geese](#).

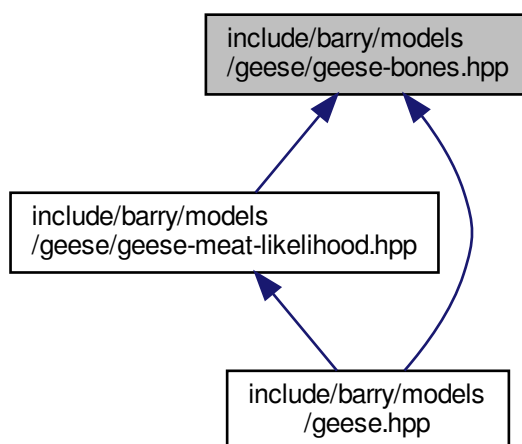
8.39 include/barry/models/geese/flock-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



8.40 include/barry/models/geese/geese-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class [Geese](#)
Annotated Phylo [Model](#).

Macros

- `#define` [INITIALIZED\(\)](#)

Functions

- `template<typename Ta , typename Tb >`
 `std::vector< Ta > vector_caster (const std::vector< Tb > &x)`
- [RULE_FUNCTION](#) (rule_empty_free)
- `std::vector< double > keygen_full (const phylocounters::PhyloArray &array)`
- `bool vec_diff (const std::vector< unsigned int > &s, const std::vector< unsigned int > &a)`

8.40.1 Macro Definition Documentation

8.40.1.1 INITIALIZED

```
#define INITIALIZED( )
```

Value:

```
if (!this->initialized) \
    throw std::logic_error("The model has not been initialized yet.");
```

Definition at line 22 of file `geese-bones.hpp`.

8.40.2 Function Documentation

8.40.2.1 keygen_full()

```
std::vector< double > keygen_full (
    const phylocounters::PhyloArray & array )    [inline]
```

Definition at line 35 of file `geese-bones.hpp`.

8.40.2.2 RULE_FUNCTION()

```
RULE_FUNCTION (
    rule_empty_free )
```

Definition at line 26 of file geese-bones.hpp.

8.40.2.3 vec_diff()

```
bool vec_diff (
    const std::vector< unsigned int > & s,
    const std::vector< unsigned int > & a ) [inline]
```

Definition at line 59 of file geese-bones.hpp.

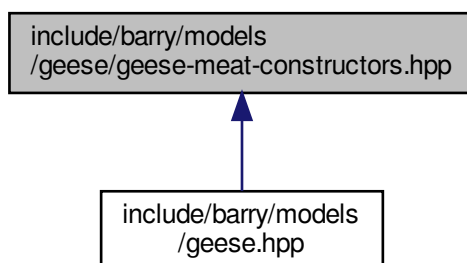
8.40.2.4 vector_caster()

```
template<typename Ta , typename Tb >
std::vector< Ta > vector_caster (
    const std::vector< Tb > & x ) [inline]
```

Definition at line 10 of file geese-bones.hpp.

8.41 include/barry/models/geese/geese-meat-constructors.hpp File Reference

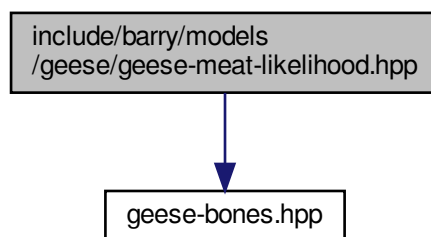
This graph shows which files directly or indirectly include this file:



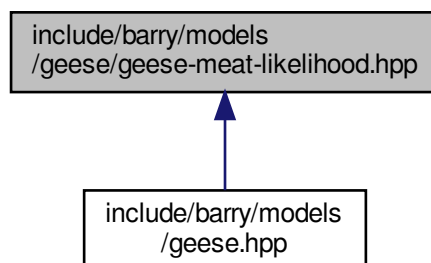
8.42 include/barry/models/geese/geese-meat-likelihood.hpp File Reference

```
#include "geese-bones.hpp"
```

Include dependency graph for geese-meat-likelihood.hpp:

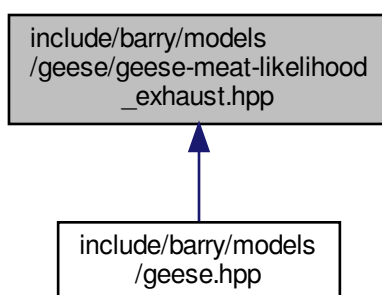


This graph shows which files directly or indirectly include this file:



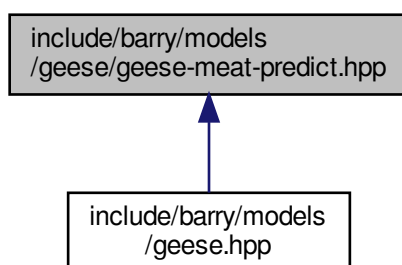
8.43 include/barry/models/geese/geese-meat-likelihood_exhaust.hpp File Reference

This graph shows which files directly or indirectly include this file:



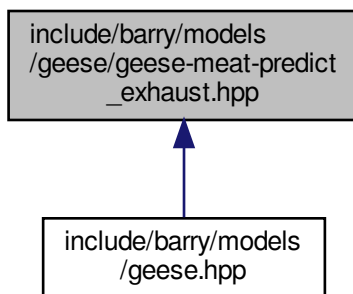
8.44 include/barry/models/geese/geese-meat-predict.hpp File Reference

This graph shows which files directly or indirectly include this file:



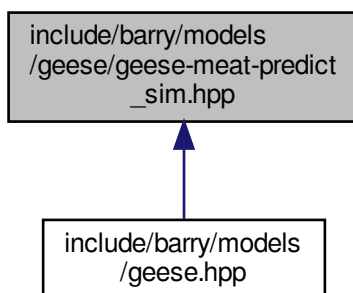
8.45 include/barry/models/geese/geese-meat-predict_exhaust.hpp File Reference

This graph shows which files directly or indirectly include this file:



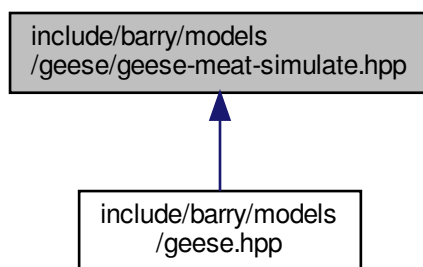
8.46 include/barry/models/geese/geese-meat-predict_sim.hpp File Reference

This graph shows which files directly or indirectly include this file:



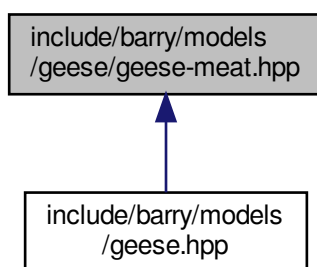
8.47 include/barry/models/geese/geese-meat-simulate.hpp File Reference

This graph shows which files directly or indirectly include this file:



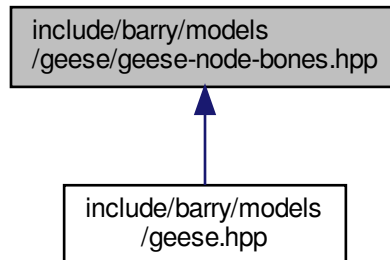
8.48 include/barry/models/geese/geese-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



8.49 include/barry/models/geese/geese-node-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

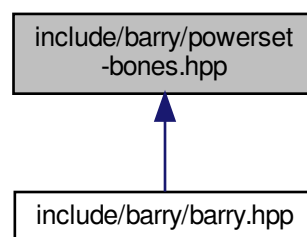


Classes

- class [Node](#)
A single node for the model.

8.50 include/barry/powerset-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

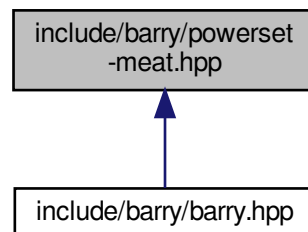


Classes

- class [PowerSet< Array_Type, Data_Rule_Type >](#)
Powerset of a binary array.

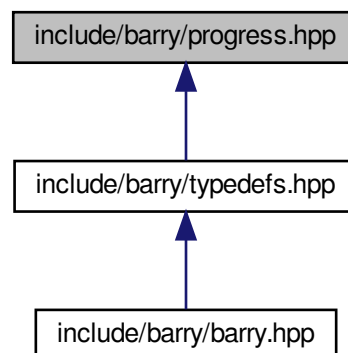
8.51 include/barry/powerset-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



8.52 include/barry/progress.hpp File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class [Progress](#)
A simple progress bar.

Macros

- #define [BARRY_PROGRESS_BAR_WIDTH](#) 80

8.52.1 Macro Definition Documentation

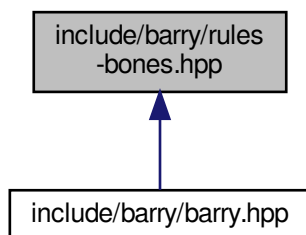
8.52.1.1 BARRY_PROGRESS_BAR_WIDTH

```
#define BARRY_PROGRESS_BAR_WIDTH 80
```

Definition at line 5 of file progress.hpp.

8.53 include/barry/rules-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:



Classes

- class [Rule< Array_Type, Data_Type >](#)
Rule for determining if a cell should be included in a sequence.
- class [Rules< Array_Type, Data_Type >](#)
Vector of objects of class Rule.

Functions

- template<typename Array_Type , typename Data_Type >
bool [rule_fun_default](#) (const Array_Type *array, uint i, uint j, Data_Type *dat)

8.53.1 Function Documentation

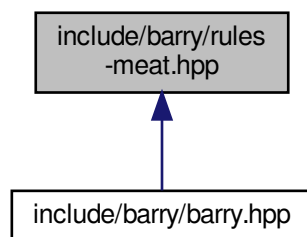
8.53.1.1 rule_fun_default()

```
template<typename Array_Type , typename Data_Type >
bool rule_fun_default (
    const Array_Type * array,
    uint i,
    uint j,
    Data_Type * dat )
```

Definition at line 5 of file rules-bones.hpp.

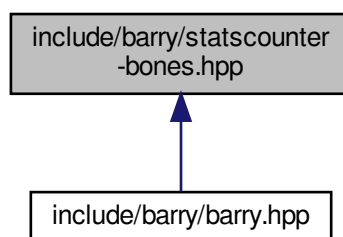
8.54 include/barry/rules-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



8.55 include/barry/statscounter-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

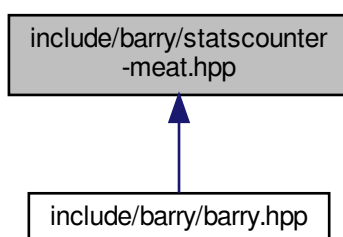


Classes

- class [StatsCounter< Array_Type, Data_Type >](#)
Count stats for a single Array.

8.56 include/barry/statscounter-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- #define [STATSCOUNTER_TYPE\(\)](#) [StatsCounter<Array_Type,Data_Type>](#)
- #define [STATSCOUNTER_TEMPLATE_ARGS\(\)](#) <typename Array_Type, typename Data_Type>
- #define [STATSCOUNTER_TEMPLATE\(a, b\)](#) template [STATSCOUNTER_TEMPLATE_ARGS\(\)](#) inline a [STATSCOUNTER_TYPE\(\)](#)::b

Functions

- [STATSCOUNTER_TEMPLATE](#) (, [StatsCounter](#))(const [StatsCounter](#)< Array_Type
- [EmptyArray](#) clear ()
- [STATSCOUNTER_TEMPLATE](#) (,~[StatsCounter](#)())()
- [STATSCOUNTER_TEMPLATE](#) (void, reset_array)(const Array_Type *[Array_](#))
- [STATSCOUNTER_TEMPLATE](#) (void, add_counter)([Counter](#)< Array_Type
- [STATSCOUNTER_TEMPLATE](#) (void, set_counters)([Counters](#)< Array_Type
- [STATSCOUNTER_TEMPLATE](#) (void, count_init)(uint i
- [current_stats](#) resize (counters->size(), 0.0)
- for (uint n=0u;n< counters->size();++n) [current_stats](#)[n]
- [STATSCOUNTER_TEMPLATE](#) (void, count_current)(uint i
- [STATSCOUNTER_TEMPLATE](#) (std::vector< std::string >, get_names)() const
- [STATSCOUNTER_TEMPLATE](#) (std::vector< std::string >, get_descriptions)() const

Variables

- Data_Type & [counter](#)
- [EmptyArray](#) = *Array
- [current_stats](#) = counter.current_stats
- [counters](#) = new [Counters](#)<Array_Type,Data_Type>((*counter.counters))
- [counter_deleted](#) = false
- Data_Type [f_](#)
- [return](#)
- Data_Type * [counters_](#)
- [uint](#) j

8.56.1 Macro Definition Documentation

8.56.1.1 STATSCOUNTER_TEMPLATE

```
#define STATSCOUNTER_TEMPLATE(
    a,
    b )  template STATSCOUNTER\_TEMPLATE\_ARGS() inline a STATSCOUNTER\_TYPE()::b
```

Definition at line 8 of file statscounter-meat.hpp.

8.56.1.2 STATSCOUNTER_TEMPLATE_ARGS

```
template STATSCOUNTER\_TEMPLATE\_ARGS( ) <typename Array_Type, typename Data_Type>
```

Definition at line 6 of file statscounter-meat.hpp.

8.56.1.3 STATSCOUNTER_TYPE

```
template Data_Type * STATSCOUNTER\_TYPE( ) StatsCounter<Array_Type,Data_Type>
```

Definition at line 4 of file statscounter-meat.hpp.

8.56.2 Function Documentation

8.56.2.1 clear()

```
EmptyArray clear ( )
```

8.56.2.2 for()

```
for (
    uint n = 0; n < counters->size(); ++n )
```

8.56.2.3 resize()

```
current_stats resize (
    counters-> size(),
    0. 0 )
```

8.56.2.4 STATSCOUNTER_TEMPLATE() [1/9]

```
STATSCOUNTER_TEMPLATE (
    StatsCounter ) const
```

8.56.2.5 STATSCOUNTER_TEMPLATE() [2/9]

```
STATSCOUNTER_TEMPLATE (
    ~ StatsCounter )
```

Definition at line 27 of file statscounter-meat.hpp.

8.56.2.6 STATSCOUNTER_TEMPLATE() [3/9]

```
STATSCOUNTER_TEMPLATE (
    std::vector< std::string > ,
    get_descriptions ) const
```

Definition at line 256 of file statscounter-meat.hpp.

8.56.2.7 STATSCOUNTER_TEMPLATE() [4/9]

```
STATSCOUNTER_TEMPLATE (
    std::vector< std::string > ,
    get_names ) const
```

Definition at line 251 of file statscounter-meat.hpp.

8.56.2.8 STATSCOUNTER_TEMPLATE() [5/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    add_counter )
```

8.56.2.9 STATSCOUNTER_TEMPLATE() [6/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    count_current )
```

8.56.2.10 STATSCOUNTER_TEMPLATE() [7/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    count_init )
```

8.56.2.11 STATSCOUNTER_TEMPLATE() [8/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    reset_array ) const
```

Definition at line 34 of file statscounter-meat.hpp.

8.56.2.12 STATSCOUNTER_TEMPLATE() [9/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    set_counters )
```

8.56.3 Variable Documentation

8.56.3.1 counter

```
Data_Type& counter
```

Initial value:

```
{  
    Array      = counter.Array
```

Definition at line 12 of file statscounter-meat.hpp.

8.56.3.2 counter_deleted

```
counter_deleted = false
```

Definition at line 23 of file statscounter-meat.hpp.

8.56.3.3 counters

```
counters = new Counters<Array_Type,Data_Type>((*counter.counters))
```

Definition at line 22 of file statscounter-meat.hpp.

8.56.3.4 counters_

```
Data_Type* counters_
```

Initial value:

```
{  
  
    if (!counter_deleted)  
        delete counters
```

Definition at line 53 of file statscounter-meat.hpp.

8.56.3.5 current_stats

```
current_stats = counter.current_stats
```

Definition at line 19 of file statscounter-meat.hpp.

8.56.3.6 EmptyArray

```
EmptyArray = *Array
```

Definition at line 17 of file statscounter-meat.hpp.

8.56.3.7 f_

```
Data_Rule_Dyn_Type f_
```

Initial value:

```
{  
    counters->add_counter(f_)
```

Definition at line 44 of file statscounter-meat.hpp.

8.56.3.8 j

```
uint j
```

Initial value:

```
{  
  
    if (counters->size() == 0u)  
        throw std::logic_error("No counters added: Cannot count without knowing what to count!")
```

Definition at line 66 of file statscounter-meat.hpp.

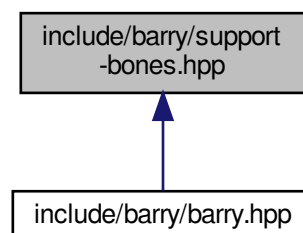
8.56.3.9 return

```
return
```

Definition at line 49 of file statscounter-meat.hpp.

8.57 include/barry/support-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

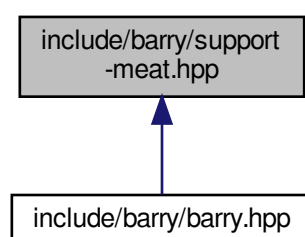


Classes

- class [Support](#)< [Array_Type](#), [Data_Counter_Type](#), [Data_Rule_Type](#), [Data_Rule_Dyn_Type](#) >
Compute the support of sufficient statistics.

8.58 include/barry/support-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



Macros

- `#define BARRY_SUPPORT_MEAT_HPP 1`
- `#define SUPPORT_TEMPLATE_ARGS()`
- `#define SUPPORT_TYPE()`
- `#define SUPPORT_TEMPLATE(a, b)`

Functions

- [SUPPORT_TEMPLATE](#) (void, init_support)(std
- [SUPPORT_TEMPLATE](#) (void, reset_array)()
- [SUPPORT_TEMPLATE](#) (void, reset_array)(const [Array_Type](#) &[Array_](#))
- [SUPPORT_TEMPLATE](#) (void, [calc_backend_sparse](#))(uint pos
- [calc_backend_sparse](#) (pos+1u, [array_bank](#), [stats_bank](#))
- [EmptyArray](#) insert_cell ([coord_i](#), [coord_j](#), [EmptyArray.default_val\(\).value](#), false, false)
- for (uint n=0u;n< n_counters;++n)
- if ([rules_dyn->size\(\)](#) > 0u)
- if ([array_bank](#) !=nullptr) [array_bank](#) -> push_back([EmptyArray](#))
- [EmptyArray](#) rm_cell ([coord_i](#), [coord_j](#), false, false)
- if ([change_stats_different](#) > 0u)
- [SUPPORT_TEMPLATE](#) (void, [calc_backend_dense](#))(uint pos
- [calc_backend_dense](#) (pos+1u, [array_bank](#), [stats_bank](#))
- [EmptyArray](#) insert_cell ([coord_i](#), [coord_j](#), 1, false, false)
- [SUPPORT_TEMPLATE](#) (void, calc)(std
- [SUPPORT_TEMPLATE](#) (void, add_counter)([Counter](#)< [Array_Type](#)
- [SUPPORT_TEMPLATE](#) (void, set_counters)([Counters](#)< [Array_Type](#)

- [SUPPORT_TEMPLATE](#) (void, add_rule)(Rule< Array_Type
- [SUPPORT_TEMPLATE](#) (void, set_rules)(Rules< Array_Type
- [SUPPORT_TEMPLATE](#) (void, add_rule_dyn)(Rule< Array_Type
- [SUPPORT_TEMPLATE](#) (void, set_rules_dyn)(Rules< Array_Type
- [SUPPORT_TEMPLATE](#) (bool, eval_rules_dyn)(const std
- [SUPPORT_TEMPLATE](#) (std::vector< double >, get_counts)() const
- [SUPPORT_TEMPLATE](#) (std::vector< double > *, get_current_stats)()
- [SUPPORT_TEMPLATE](#) (void, print)() const
- [SUPPORT_TEMPLATE](#) (const FreqTable< double > &, get_data)() const

Variables

- std::vector< Array_Type > * [array_bank](#)
- std::vector< Array_Type > std::vector< double > * [stats_bank](#)
- const size_t & [coord_i](#) = coordinates_free[pos * 2u]
- const size_t & [coord_j](#) = coordinates_free[pos * 2u + 1u]
- double [tmp_chng](#)
- unsigned int [change_stats_different](#) = hashes_initialized[pos] ? 0u : 1u
- [else](#)
- & [hashes](#) [pos]
- [return](#)
- Data_Counter_Type [f_](#)
- Data_Counter_Type * [counters_](#)
- [delete_counters](#) = false
- [counters](#) = [counters_](#)
- Data_Rule_Type * [rules_](#)
- [delete_rules](#) = false
- [rules](#) = [rules_](#)
- [delete_rules_dyn](#) = false
- [rules_dyn](#) = [rules_](#)

8.58.1 Macro Definition Documentation

8.58.1.1 BARRY_SUPPORT_MEAT_HPP

```
#define BARRY_SUPPORT_MEAT_HPP 1
```

Definition at line 2 of file support-meat.hpp.

8.58.1.2 SUPPORT_TEMPLATE

```
#define SUPPORT_TEMPLATE(  
    a,  
    b )
```

Value:

```
template SUPPORT_TEMPLATE_ARGS() \  
inline a SUPPORT_TYPE()::b
```

Definition at line 10 of file support-meat.hpp.

8.58.1.3 SUPPORT_TEMPLATE_ARGS

```
template SUPPORT_TEMPLATE_ARGS( )
```

Value:

```
<typename Array_Type, typename \
Data_Counter_Type, typename Data_Rule_Type, typename Data_Rule_Dyn_Type>
```

Definition at line 4 of file support-meat.hpp.

8.58.1.4 SUPPORT_TYPE

```
template Data_Rule_Dyn_Type * SUPPORT_TYPE( )
```

Value:

```
Support<Array_Type, Data_Counter_Type, Data_Rule_Type, \
Data_Rule_Dyn_Type>
```

Definition at line 7 of file support-meat.hpp.

8.58.2 Function Documentation

8.58.2.1 calc_backend_dense()

```
calc_backend_dense (
    pos+ 1u,
    array_bank ,
    stats_bank )
```

8.58.2.2 calc_backend_sparse()

```
calc_backend_sparse (
    pos+ 1u,
    array_bank ,
    stats_bank )
```

8.58.2.3 for()

```
for ( )
```

Definition at line 159 of file support-meat.hpp.

8.58.2.4 if() [1/3]

```
if (
    array_bank !    = nullptr ) -> push_back(EmptyArray)
```

8.58.2.5 if() [2/3]

```
if (
    change_stats_different ,
    Ou )
```

Definition at line 239 of file support-meat.hpp.

8.58.2.6 if() [3/3]

```
if (
    rules_dyn-> size(),
    Ou )
```

Definition at line 187 of file support-meat.hpp.

8.58.2.7 insert_cell() [1/2]

```
EmptyArray insert_cell (
    coord_i ,
    coord_j ,
    1 ,
    false ,
    false )
```

8.58.2.8 insert_cell() [2/2]

```
EmptyArray insert_cell (
    coord_i ,
    coord_j ,
    EmptyArray.default_val(). value,
    false ,
    false )
```

8.58.2.9 rm_cell()

```
EmptyArray rm_cell (
    coord_i ,
    coord_j ,
    false ,
    false )
```

8.58.2.10 SUPPORT_TEMPLATE() [1/17]

```
SUPPORT_TEMPLATE (
    bool ,
    eval_rules_dyn ) const
```

Definition at line 488 of file support-meat.hpp.

8.58.2.11 SUPPORT_TEMPLATE() [2/17]

```
SUPPORT_TEMPLATE (
    const FreqTable< double > & ,
    get_data ) const
```

Definition at line 557 of file support-meat.hpp.

8.58.2.12 SUPPORT_TEMPLATE() [3/17]

```
SUPPORT_TEMPLATE (
    std::vector< double > * ,
    get_current_stats )
```

Definition at line 542 of file support-meat.hpp.

8.58.2.13 SUPPORT_TEMPLATE() [4/17]

```
SUPPORT_TEMPLATE (
    std::vector< double > ,
    get_counts ) const
```

Definition at line 530 of file support-meat.hpp.

8.58.2.14 SUPPORT_TEMPLATE() [5/17]

```
SUPPORT_TEMPLATE (
    void ,
    add_counter )
```

8.58.2.15 SUPPORT_TEMPLATE() [6/17]

```
SUPPORT_TEMPLATE (
    void ,
    add_rule )
```

8.58.2.16 SUPPORT_TEMPLATE() [7/17]

```
SUPPORT_TEMPLATE (
    void ,
    add_rule_dyn )
```

8.58.2.17 SUPPORT_TEMPLATE() [8/17]

```
SUPPORT_TEMPLATE (
    void ,
    calc )
```

Definition at line 371 of file support-meat.hpp.

8.58.2.18 SUPPORT_TEMPLATE() [9/17]

```
SUPPORT_TEMPLATE (
    void ,
    calc_backend_dense )
```

8.58.2.19 SUPPORT_TEMPLATE() [10/17]

```
SUPPORT_TEMPLATE (
    void ,
    calc_backend_sparse )
```

8.58.2.20 SUPPORT_TEMPLATE() [11/17]

```
SUPPORT_TEMPLATE (
    void ,
    init_support )
```

Definition at line 13 of file support-meat.hpp.

8.58.2.21 SUPPORT_TEMPLATE() [12/17]

```
SUPPORT_TEMPLATE (
    void ,
    print ) const
```

Definition at line 546 of file support-meat.hpp.

8.58.2.22 SUPPORT_TEMPLATE() [13/17]

```
SUPPORT_TEMPLATE (
    void ,
    reset_array )
```

Definition at line 114 of file support-meat.hpp.

8.58.2.23 SUPPORT_TEMPLATE() [14/17]

```
SUPPORT_TEMPLATE (
    void ,
    reset_array ) const &
```

Definition at line 120 of file support-meat.hpp.

8.58.2.24 SUPPORT_TEMPLATE() [15/17]

```
SUPPORT_TEMPLATE (
    void ,
    set_counters )
```


8.58.2.25 SUPPORT_TEMPLATE() [16/17]

```
SUPPORT_TEMPLATE (
    void ,
    set_rules )
```

8.58.2.26 SUPPORT_TEMPLATE() [17/17]

```
SUPPORT_TEMPLATE (
    void ,
    set_rules_dyn )
```

8.58.3 Variable Documentation

8.58.3.1 array_bank

```
std::vector< Array_Type > * array_bank
```

Definition at line 131 of file support-meat.hpp.

8.58.3.2 change_stats_different

```
unsigned int change_stats_different = hashes_initialized[pos] ? 0u : 1u
```

Definition at line 158 of file support-meat.hpp.

8.58.3.3 coord_i

```
const size_t & coord_i = coordinates_free[pos * 2u]
```

Definition at line 144 of file support-meat.hpp.

8.58.3.4 coord_j

```
const size_t & coord_j = coordinates_free[pos * 2u + 1u]
```

Definition at line 145 of file support-meat.hpp.

8.58.3.5 counters

```
counters = counters_
```

Definition at line 416 of file support-meat.hpp.

8.58.3.6 counters_

```
Data_Counter_Type* counters_
```

Initial value:

```
{  
  
    if (delete_counters)  
        delete counters
```

Definition at line 409 of file support-meat.hpp.

8.58.3.7 delete_counters

```
delete_counters = false
```

Definition at line 415 of file support-meat.hpp.

8.58.3.8 delete_rules

```
delete_rules = false
```

Definition at line 449 of file support-meat.hpp.

8.58.3.9 delete_rules_dyn

```
delete_rules_dyn = false
```

Definition at line 481 of file support-meat.hpp.

8.58.3.10 else

```
else (
    void )
```

Initial value:

```
{
    if (change_stats_different > 0u)
        hashes[pos] = data.add(current_stats, nullptr)
```

Definition at line 212 of file support-meat.hpp.

8.58.3.11 f_

```
Data_Rule_Dyn_Type f_
```

Initial value:

```
{
    counters->add_counter(f_)
```

Definition at line 400 of file support-meat.hpp.

8.58.3.12 hashes

```
& hashes
```

Definition at line 217 of file support-meat.hpp.

8.58.3.13 return

```
return
```

Definition at line 251 of file support-meat.hpp.

8.58.3.14 rules

```
rules = rules_
```

Definition at line 450 of file support-meat.hpp.

8.58.3.15 rules_

Data_Rule_Dyn_Type * rules_

Initial value:

```
{  
  
    if (delete_rules)  
        delete rules
```

Definition at line 443 of file support-meat.hpp.

8.58.3.16 rules_dyn

rules_dyn = rules_

Definition at line 482 of file support-meat.hpp.

8.58.3.17 stats_bank

std::vector< Array_Type > std::vector< double > * stats_bank

Initial value:

```
{  
  
    if (pos >= coordiantes_n_free)  
        return
```

Definition at line 132 of file support-meat.hpp.

8.58.3.18 tmp_chng

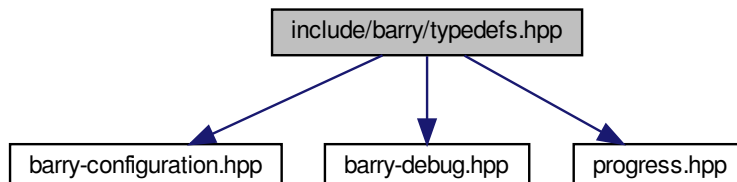
double tmp_chng

Definition at line 157 of file support-meat.hpp.

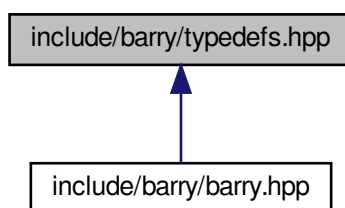
8.59 include/barry/typedefs.hpp File Reference

```
#include "barry-configuration.hpp"  
#include "barry-debug.hpp"  
#include "progress.hpp"
```

Include dependency graph for typedefs.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class [Entries< Cell_Type >](#)
A wrapper class to store source, target, val from a [BArray](#) object.
- struct [vecHasher< T >](#)

Namespaces

- [CHECK](#)
Integer constants used to specify which cell should be check.
- [EXISTS](#)
Integer constants used to specify which cell should be check to exist or not.

Typedefs

- typedef unsigned int [uint](#)
- typedef std::vector< std::pair< std::vector< double >, [uint](#) > > [Counts_type](#)
- template<typename Cell_Type >
using [Row_type](#) = [Map](#)< [uint](#), [Cell](#)< Cell_Type > >
- template<typename Cell_Type >
using [Col_type](#) = [Map](#)< [uint](#), [Cell](#)< Cell_Type > * >
- template<typename Ta = double, typename Tb = uint>
using [MapVec_type](#) = std::unordered_map< std::vector< Ta >, Tb, [vecHasher](#)< Ta > >

- template<typename Array_Type , typename Data_Type >
using [Counter_fun_type](#) = std::function< double([const](#) Array_Type &, [uint](#), [uint](#), Data_Type &)>
[Counter](#) and rule functions.
- template<typename Array_Type , typename Data_Type >
using [Rule_fun_type](#) = std::function< bool([const](#) Array_Type &, [uint](#), [uint](#), Data_Type &)>

Functions

- template<typename T >
T [vec_inner_prod](#) ([const](#) T *a, [const](#) T *b, size_t n)
- template<> double [vec_inner_prod](#) ([const](#) double *a, [const](#) double *b, size_t n)

- template<typename T >
bool [vec_equal](#) ([const](#) std::vector< T > &a, [const](#) std::vector< T > &b)
Compares if -a- and -b- are equal.
- template<typename T >
bool [vec_equal_approx](#) ([const](#) std::vector< T > &a, [const](#) std::vector< T > &b, double eps=1e-100)

Variables

- [const](#) int [CHECK::BOTH](#) = -1
- [const](#) int [CHECK::NONE](#) = 0
- [const](#) int [CHECK::ONE](#) = 1
- [const](#) int [CHECK::TWO](#) = 2
- [const](#) int [EXISTS::BOTH](#) = -1
- [const](#) int [EXISTS::NONE](#) = 0
- [const](#) int [EXISTS::ONE](#) = 1
- [const](#) int [EXISTS::TWO](#) = 1
- [const](#) int [EXISTS::UNKNOWN](#) = -1
- [const](#) int [EXISTS::AS_ZERO](#) = 0
- [const](#) int [EXISTS::AS_ONE](#) = 1

8.59.1 Typedef Documentation

8.59.1.1 Col_type

```
template<typename Cell_Type >
using Col_type = Map< uint, Cell<Cell_Type>* >
```

Definition at line 71 of file typedefs.hpp.

8.59.1.2 Counter_fun_type

```
template<typename Array_Type , typename Data_Type >
using Counter_fun_type = std::function<double(const Array_Type &, uint, uint, Data_Type &)>
```

[Counter](#) and rule functions.

Parameters

<i>Array_Type</i>	a BArray
<i>unit,uint</i>	Focal cell
<i>Data_Type</i>	Data associated with the function, for example, id of the attribute in the Array.

Returns

[Counter_fun_type](#) a double (the change statistic)

[Rule_fun_type](#) a bool. True if the cell is blocked.

Definition at line 148 of file typedefs.hpp.

8.59.1.3 Counts_type

```
typedef std::vector< std::pair< std::vector<double>, uint > > Counts_type
```

Definition at line 52 of file typedefs.hpp.

8.59.1.4 MapVec_type

```
template<typename Ta = double, typename Tb = uint>
using MapVec_type = std::unordered_map< std::vector< Ta >, Tb, vecHasher<Ta> >
```

Definition at line 129 of file typedefs.hpp.

8.59.1.5 Row_type

```
template<typename Cell_Type >
using Row_type = Map< uint, Cell<Cell_Type> >
```

Definition at line 68 of file typedefs.hpp.

8.59.1.6 Rule_fun_type

```
template<typename Array_Type , typename Data_Type >
using Rule_fun_type = std::function<bool(const Array_Type &, uint, uint, Data_Type &)>
```

Definition at line 151 of file typedefs.hpp.

8.59.1.7 uint

```
typedef unsigned int uint
```

Definition at line 18 of file typedefs.hpp.

8.59.2 Function Documentation

8.59.2.1 vec_equal()

```
template<typename T >
bool vec_equal (
    const std::vector< T > & a,
    const std::vector< T > & b ) [inline]
```

Compares if -a- and -b- are equal.

Parameters

<i>a,b</i>	Two vectors of the same length
------------	--------------------------------

Returns

`true` if all elements are equal.

Definition at line 162 of file typedefs.hpp.

8.59.2.2 `vec_equal_approx()`

```
template<typename T >
bool vec_equal_approx (
    const std::vector< T > & a,
    const std::vector< T > & b,
    double eps = 1e-100 ) [inline]
```

Definition at line 180 of file typedefs.hpp.

8.59.2.3 `vec_inner_prod()` [1/2]

```
template<>
double vec_inner_prod (
    const double * a,
    const double * b,
    size_t n ) [inline]
```

Definition at line 226 of file typedefs.hpp.

8.59.2.4 `vec_inner_prod()` [2/2]

```
template<typename T >
T vec_inner_prod (
    const T * a,
    const T * b,
    size_t n ) [inline]
```

Definition at line 203 of file typedefs.hpp.

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