

barry: Your go-to motif accountant

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<b>1 Main Page</b>	<b>1</b>
<b>2 Module Index</b>	<b>5</b>
2.1 Modules	5
<b>3 Class Index</b>	<b>7</b>
3.1 Class List	7
<b>4 File Index</b>	<b>9</b>
4.1 File List	9
<b>5 Module Documentation</b>	<b>11</b>
5.1 Counting	11
5.1.1 Detailed Description	11
5.2 Statistical Models	11
5.2.1 Detailed Description	12
5.3 DEFMArray counters	12
5.3.1 Detailed Description	14
5.3.2 Function Documentation	14
5.3.2.1 counter_absdiff()	14
5.3.2.2 counter_ctriads() [1/2]	14
5.3.2.3 counter_ctriads() [2/2]	14
5.3.2.4 counter_degree()	15
5.3.2.5 counter_density()	15
5.3.2.6 counter_diff()	15
5.3.2.7 counter_edges()	15
5.3.2.8 counter_fixed_effect()	15
5.3.2.9 counter_iddegree() [1/2]	16
5.3.2.10 counter_iddegree() [2/2]	16
5.3.2.11 counter_iddegree15() [1/2]	16
5.3.2.12 counter_iddegree15() [2/2]	16
5.3.2.13 counter_isolates() [1/2]	17
5.3.2.14 counter_isolates() [2/2]	17
5.3.2.15 counter_istar2() [1/2]	17
5.3.2.16 counter_istar2() [2/2]	17
5.3.2.17 counter_logit_intercept()	17
5.3.2.18 counter_mutual()	18
5.3.2.19 counter_nodecov()	18
5.3.2.20 counter_nodeicov()	18
5.3.2.21 counter_nodematch()	18
5.3.2.22 counter_nodeocov()	18
5.3.2.23 counter_odegree() [1/2]	19
5.3.2.24 counter_odegree() [2/2]	19
5.3.2.25 counter_odegree15() [1/2]	19

5.3.2.26 counter_odegree15() [2/2]	19
5.3.2.27 counter_ones()	19
5.3.2.28 counter_ostar2() [1/2]	20
5.3.2.29 counter_ostar2() [2/2]	20
5.3.2.30 counter_transition()	20
5.3.2.31 counter_transition_formula()	21
5.3.2.32 counter_ttriads() [1/2]	21
5.3.2.33 counter_ttriads() [2/2]	21
5.3.2.34 NETWORK_COUNTER()	21
5.3.2.35 rules_markov_fixed()	22
5.4 Phylo counters	22
5.4.1 Detailed Description	23
5.4.2 Function Documentation	23
5.4.2.1 counter_co_opt()	23
5.4.2.2 counter_cogain()	24
5.4.2.3 counter_gains()	24
5.4.2.4 counter_gains_from_0()	24
5.4.2.5 counter_gains_k_offspring()	24
5.4.2.6 counter_genes_changing()	25
5.4.2.7 counter_k_genes_changing()	25
5.4.2.8 counter_less_than_p_prop_genes_changing()	25
5.4.2.9 counter_longest()	25
5.4.2.10 counter_loss()	26
5.4.2.11 counter_maxfuns()	26
5.4.2.12 counter_neofun()	26
5.4.2.13 counter_neofun_a2b()	26
5.4.2.14 counter_overall_changes()	27
5.4.2.15 counter_overall_gains()	27
5.4.2.16 counter_overall_gains_from_0()	27
5.4.2.17 counter_overall_loss()	27
5.4.2.18 counter_pairwise_first_gain()	28
5.4.2.19 counter_pairwise_neofun_singlefun()	28
5.4.2.20 counter_pairwise_overall_change()	28
5.4.2.21 counter_pairwise_preserving()	28
5.4.2.22 counter_preserve_pseudogene()	29
5.4.2.23 counter_prop_genes_changing()	29
5.4.2.24 counter_subfun()	29
5.5 Phylo rules	29
5.5.1 Detailed Description	29
5.5.2 Function Documentation	30
5.5.2.1 rule_dyn_limit_changes()	30

<b>6 Namespace Documentation</b>	<b>31</b>
6.1 barry Namespace Reference	31
6.1.1 Detailed Description	31
6.2 barry::counters Namespace Reference	31
6.2.1 Detailed Description	31
6.3 barry::counters::defm Namespace Reference	32
6.4 barry::counters::network Namespace Reference	32
6.5 barry::counters::phylo Namespace Reference	32
6.6 CHECK Namespace Reference	32
6.6.1 Detailed Description	32
6.6.2 Variable Documentation	32
6.6.2.1 BOTH	32
6.6.2.2 NONE	32
6.6.2.3 ONE	33
6.6.2.4 TWO	33
6.7 EXISTS Namespace Reference	33
6.7.1 Detailed Description	33
6.7.2 Variable Documentation	33
6.7.2.1 AS_ONE	33
6.7.2.2 AS_ZERO	34
6.7.2.3 BOTH	34
6.7.2.4 NONE	34
6.7.2.5 ONE	34
6.7.2.6 TWO	34
6.7.2.7 UNKNOWN	34
<b>7 Class Documentation</b>	<b>35</b>
7.1 BArray< Cell_Type, Data_Type > Class Template Reference	35
7.1.1 Detailed Description	37
7.1.2 Constructor & Destructor Documentation	38
7.1.2.1 BArray() [1/6]	38
7.1.2.2 BArray() [2/6]	38
7.1.2.3 BArray() [3/6]	38
7.1.2.4 BArray() [4/6]	39
7.1.2.5 BArray() [5/6]	39
7.1.2.6 BArray() [6/6]	39
7.1.2.7 ~BArray()	39
7.1.3 Member Function Documentation	39
7.1.3.1 clear()	39
7.1.3.2 col()	40
7.1.3.3 D() [1/2]	40
7.1.3.4 D() [2/2]	40

7.1.3.5 D_ptr() [1/2]	40
7.1.3.6 D_ptr() [2/2]	40
7.1.3.7 default_val()	40
7.1.3.8 flush_data()	40
7.1.3.9 get_cell()	41
7.1.3.10 get_col_vec() [1/2]	41
7.1.3.11 get_col_vec() [2/2]	41
7.1.3.12 get_entries()	41
7.1.3.13 get_row_vec() [1/2]	41
7.1.3.14 get_row_vec() [2/2]	42
7.1.3.15 insert_cell() [1/3]	42
7.1.3.16 insert_cell() [2/3]	42
7.1.3.17 insert_cell() [3/3]	42
7.1.3.18 is_dense()	42
7.1.3.19 is_empty()	43
7.1.3.20 ncol()	43
7.1.3.21 nnozero()	43
7.1.3.22 nrow()	43
7.1.3.23 operator>() [1/2]	43
7.1.3.24 operator>() [2/2]	43
7.1.3.25 operator*=( )	44
7.1.3.26 operator+=( ) [1/3]	44
7.1.3.27 operator+=( ) [2/3]	44
7.1.3.28 operator+=( ) [3/3]	44
7.1.3.29 operator-=( ) [1/3]	44
7.1.3.30 operator-=( ) [2/3]	44
7.1.3.31 operator-=( ) [3/3]	45
7.1.3.32 operator/=( )	45
7.1.3.33 operator=( ) [1/2]	45
7.1.3.34 operator=( ) [2/2]	45
7.1.3.35 operator==( )	45
7.1.3.36 out_of_range()	45
7.1.3.37 print()	46
7.1.3.38 reserve()	46
7.1.3.39 resize()	46
7.1.3.40 rm_cell()	46
7.1.3.41 row()	46
7.1.3.42 set_data()	46
7.1.3.43 swap_cells()	47
7.1.3.44 swap_cols()	47
7.1.3.45 swap_rows()	47
7.1.3.46 toggle_cell()	47

7.1.3.47 toggle_lock()	48
7.1.3.48 transpose()	48
7.1.3.49 zero_col()	48
7.1.3.50 zero_row()	48
7.1.4 Friends And Related Function Documentation	48
7.1.4.1 BArrayCell< Cell_Type, Data_Type >	48
7.1.4.2 BArrayCell_const< Cell_Type, Data_Type >	49
7.1.5 Member Data Documentation	49
7.1.5.1 visited	49
7.2 BArrayCell< Cell_Type, Data_Type > Class Template Reference	49
7.2.1 Detailed Description	49
7.2.2 Constructor & Destructor Documentation	50
7.2.2.1 BArrayCell()	50
7.2.2.2 ~BArrayCell()	50
7.2.3 Member Function Documentation	50
7.2.3.1 operator Cell_Type()	50
7.2.3.2 operator*=( )	50
7.2.3.3 operator+=( )	51
7.2.3.4 operator-=( )	51
7.2.3.5 operator/=( )	51
7.2.3.6 operator=( )	51
7.2.3.7 operator==( )	51
7.3 BArrayCell_const< Cell_Type, Data_Type > Class Template Reference	52
7.3.1 Detailed Description	52
7.3.2 Constructor & Destructor Documentation	52
7.3.2.1 BArrayCell_const()	52
7.3.2.2 ~BArrayCell_const()	52
7.3.3 Member Function Documentation	53
7.3.3.1 operator Cell_Type()	53
7.3.3.2 operator!=( )	53
7.3.3.3 operator<( )	53
7.3.3.4 operator<=( )	53
7.3.3.5 operator==( )	53
7.3.3.6 operator>( )	54
7.3.3.7 operator>=( )	54
7.4 BArrayDense< Cell_Type, Data_Type > Class Template Reference	54
7.4.1 Detailed Description	57
7.4.2 Constructor & Destructor Documentation	57
7.4.2.1 BArrayDense() [ 1 / 6 ]	57
7.4.2.2 BArrayDense() [ 2 / 6 ]	57
7.4.2.3 BArrayDense() [ 3 / 6 ]	58
7.4.2.4 BArrayDense() [ 4 / 6 ]	58

7.4.2.5 BArrayDense() [5/6] . . . . .	58
7.4.2.6 BArrayDense() [6/6] . . . . .	58
7.4.2.7 ~BArrayDense() . . . . .	59
7.4.3 Member Function Documentation . . . . .	59
7.4.3.1 clear() . . . . .	59
7.4.3.2 col() [1/2] . . . . .	59
7.4.3.3 col() [2/2] . . . . .	59
7.4.3.4 colsum() . . . . .	59
7.4.3.5 D() [1/2] . . . . .	60
7.4.3.6 D() [2/2] . . . . .	60
7.4.3.7 D_ptr() [1/2] . . . . .	60
7.4.3.8 D_ptr() [2/2] . . . . .	60
7.4.3.9 default_val() . . . . .	60
7.4.3.10 get_cell() . . . . .	60
7.4.3.11 get_col_vec() [1/2] . . . . .	61
7.4.3.12 get_col_vec() [2/2] . . . . .	61
7.4.3.13 get_data() . . . . .	61
7.4.3.14 get_entries() . . . . .	61
7.4.3.15 get_row_vec() [1/2] . . . . .	61
7.4.3.16 get_row_vec() [2/2] . . . . .	62
7.4.3.17 insert_cell() [1/2] . . . . .	62
7.4.3.18 insert_cell() [2/2] . . . . .	62
7.4.3.19 is_dense() . . . . .	62
7.4.3.20 is_empty() . . . . .	62
7.4.3.21 ncol() . . . . .	63
7.4.3.22 nnozero() . . . . .	63
7.4.3.23 nrow() . . . . .	63
7.4.3.24 operator>() [1/2] . . . . .	63
7.4.3.25 operator>() [2/2] . . . . .	63
7.4.3.26 operator*=( ) . . . . .	63
7.4.3.27 operator+=( ) [1/3] . . . . .	64
7.4.3.28 operator+=( ) [2/3] . . . . .	64
7.4.3.29 operator+=( ) [3/3] . . . . .	64
7.4.3.30 operator-=( ) [1/3] . . . . .	64
7.4.3.31 operator-=( ) [2/3] . . . . .	64
7.4.3.32 operator-=( ) [3/3] . . . . .	64
7.4.3.33 operator/=( ) . . . . .	65
7.4.3.34 operator=( ) [1/2] . . . . .	65
7.4.3.35 operator=( ) [2/2] . . . . .	65
7.4.3.36 operator==( ) . . . . .	65
7.4.3.37 out_of_range() . . . . .	65
7.4.3.38 print() . . . . .	65



7.4.3.39 reserve()	66
7.4.3.40 resize()	66
7.4.3.41 rm_cell()	66
7.4.3.42 row() [1/2]	66
7.4.3.43 row() [2/2]	66
7.4.3.44 rowsum()	66
7.4.3.45 set_data()	67
7.4.3.46 swap_cells()	67
7.4.3.47 swap_cols()	67
7.4.3.48 swap_rows()	67
7.4.3.49 toggle_cell()	68
7.4.3.50 toggle_lock()	68
7.4.3.51 transpose()	68
7.4.3.52 zero_col()	68
7.4.3.53 zero_row()	68
7.4.4 Friends And Related Function Documentation	68
7.4.4.1 BArrayDenseCell< Cell_Type, Data_Type >	69
7.4.4.2 BArrayDenseCol< Cell_Type, Data_Type >	69
7.4.4.3 BArrayDenseCol_const< Cell_Type, Data_Type >	69
7.4.4.4 BArrayDenseRow< Cell_Type, Data_Type >	69
7.4.4.5 BArrayDenseRow_const< Cell_Type, Data_Type >	69
7.4.5 Member Data Documentation	69
7.4.5.1 visited	70
7.5 BArrayDenseCell< Cell_Type, Data_Type > Class Template Reference	70
7.5.1 Detailed Description	70
7.5.2 Constructor & Destructor Documentation	71
7.5.2.1 BArrayDenseCell()	71
7.5.2.2 ~BArrayDenseCell()	71
7.5.3 Member Function Documentation	71
7.5.3.1 operator Cell_Type()	71
7.5.3.2 operator*=( )	71
7.5.3.3 operator+=( )	72
7.5.3.4 operator-=( )	72
7.5.3.5 operator/=( )	72
7.5.3.6 operator=( ) [1/2]	72
7.5.3.7 operator=( ) [2/2]	72
7.5.3.8 operator==( )	73
7.5.4 Friends And Related Function Documentation	73
7.5.4.1 BArrayDense< Cell_Type, Data_Type >	73
7.5.4.2 BArrayDenseCol< Cell_Type, Data_Type >	73
7.5.4.3 BArrayDenseCol_const< Cell_Type, Data_Type >	73
7.6 BArrayDenseCell_const< Cell_Type, Data_Type > Class Template Reference	74

7.6.1 Detailed Description	74
7.7 BArrayDenseCol< Cell_Type, Data_Type > Class Template Reference	74
7.7.1 Detailed Description	74
7.7.2 Constructor & Destructor Documentation	74
7.7.2.1 BArrayDenseCol()	75
7.7.3 Member Function Documentation	75
7.7.3.1 begin()	75
7.7.3.2 end()	75
7.7.3.3 operator()()	75
7.7.3.4 size()	75
7.7.4 Friends And Related Function Documentation	76
7.7.4.1 BArrayDense< Cell_Type, Data_Type >	76
7.7.4.2 BArrayDenseCell< Cell_Type, Data_Type >	76
7.7.4.3 BArrayDenseCell_const< Cell_Type, Data_Type >	76
7.8 BArrayDenseCol_const< Cell_Type, Data_Type > Class Template Reference	76
7.8.1 Detailed Description	77
7.8.2 Constructor & Destructor Documentation	77
7.8.2.1 BArrayDenseCol_const()	77
7.8.3 Member Function Documentation	77
7.8.3.1 begin()	77
7.8.3.2 end()	77
7.8.3.3 operator()()	78
7.8.3.4 size()	78
7.8.4 Friends And Related Function Documentation	78
7.8.4.1 BArrayDenseCell< Cell_Type, Data_Type >	78
7.8.4.2 BArrayDenseCell_const< Cell_Type, Data_Type >	78
7.9 BArrayDenseRow< Cell_Type, Data_Type > Class Template Reference	78
7.9.1 Detailed Description	79
7.9.2 Constructor & Destructor Documentation	79
7.9.2.1 BArrayDenseRow()	79
7.9.3 Member Function Documentation	79
7.9.3.1 begin()	79
7.9.3.2 end()	80
7.9.3.3 operator()()	80
7.9.3.4 size()	80
7.9.4 Friends And Related Function Documentation	80
7.9.4.1 BArrayDense< Cell_Type, Data_Type >	80
7.9.4.2 BArrayDenseCell< Cell_Type, Data_Type >	80
7.9.4.3 BArrayDenseCell_const< Cell_Type, Data_Type >	81
7.10 BArrayDenseRow_const< Cell_Type, Data_Type > Class Template Reference	81
7.10.1 Detailed Description	81
7.10.2 Constructor & Destructor Documentation	81

7.10.2.1 BArrayDenseRow_const()	82
7.10.3 Member Function Documentation	82
7.10.3.1 begin()	82
7.10.3.2 end()	82
7.10.3.3 operator>()	82
7.10.3.4 size()	82
7.10.4 Friends And Related Function Documentation	83
7.10.4.1 BArrayDenseCell< Cell_Type, Data_Type >	83
7.10.4.2 BArrayDenseCell_const< Cell_Type, Data_Type >	83
7.11 BArrayRow< Cell_Type, Data_Type > Class Template Reference	83
7.11.1 Detailed Description	83
7.11.2 Constructor & Destructor Documentation	84
7.11.2.1 BArrayRow()	84
7.11.2.2 ~BArrayRow()	84
7.11.3 Member Function Documentation	84
7.11.3.1 operator BArrayRow< Cell_Type, Data_Type >()	84
7.11.3.2 operator*=( )	84
7.11.3.3 operator+=( )	84
7.11.3.4 operator-=( )	85
7.11.3.5 operator/=( )	85
7.11.3.6 operator=( )	85
7.11.3.7 operator==( )	85
7.12 BArrayRow_const< Cell_Type, Data_Type > Class Template Reference	85
7.12.1 Detailed Description	86
7.12.2 Constructor & Destructor Documentation	86
7.12.2.1 BArrayRow_const()	86
7.12.2.2 ~BArrayRow_const()	86
7.12.3 Member Function Documentation	86
7.12.3.1 operator BArrayRow_const< Cell_Type, Data_Type >()	86
7.12.3.2 operator!=( )	86
7.12.3.3 operator<()	87
7.12.3.4 operator<=( )	87
7.12.3.5 operator==( )	87
7.12.3.6 operator>()	87
7.12.3.7 operator>=( )	87
7.13 BArrayVector< Cell_Type, Data_Type > Class Template Reference	87
7.13.1 Detailed Description	88
7.13.2 Constructor & Destructor Documentation	88
7.13.2.1 BArrayVector()	88
7.13.2.2 ~BArrayVector()	89
7.13.3 Member Function Documentation	89
7.13.3.1 begin()	89

7.13.3.2 end()	89
7.13.3.3 is_col()	89
7.13.3.4 is_row()	90
7.13.3.5 operator std::vector< Cell_Type >()	90
7.13.3.6 operator*=( )	90
7.13.3.7 operator+=( )	90
7.13.3.8 operator-=( )	90
7.13.3.9 operator/=( )	91
7.13.3.10 operator=()	91
7.13.3.11 operator==( )	91
7.13.3.12 size()	91
7.14 BArrayVector_const< Cell_Type, Data_Type > Class Template Reference	91
7.14.1 Detailed Description	92
7.14.2 Constructor & Destructor Documentation	92
7.14.2.1 BArrayVector_const()	92
7.14.2.2 ~BArrayVector_const()	92
7.14.3 Member Function Documentation	93
7.14.3.1 begin()	93
7.14.3.2 end()	93
7.14.3.3 is_col()	93
7.14.3.4 is_row()	93
7.14.3.5 operator std::vector< Cell_Type >()	93
7.14.3.6 operator!=( )	94
7.14.3.7 operator<()	94
7.14.3.8 operator<=()	94
7.14.3.9 operator==( )	94
7.14.3.10 operator>()	94
7.14.3.11 operator>=()	95
7.14.3.12 size()	95
7.15 Cell< Cell_Type > Class Template Reference	95
7.15.1 Detailed Description	96
7.15.2 Constructor & Destructor Documentation	96
7.15.2.1 Cell() [1/7]	96
7.15.2.2 Cell() [2/7]	96
7.15.2.3 ~Cell()	96
7.15.2.4 Cell() [3/7]	97
7.15.2.5 Cell() [4/7]	97
7.15.2.6 Cell() [5/7]	97
7.15.2.7 Cell() [6/7]	97
7.15.2.8 Cell() [7/7]	97
7.15.3 Member Function Documentation	97
7.15.3.1 add() [1/4]	98

7.15.3.2 add() [2/4]	98
7.15.3.3 add() [3/4]	98
7.15.3.4 add() [4/4]	98
7.15.3.5 operator Cell_Type()	98
7.15.3.6 operator"!=()	98
7.15.3.7 operator=() [1/2]	99
7.15.3.8 operator=() [2/2]	99
7.15.3.9 operator==()	99
7.15.4 Member Data Documentation	99
7.15.4.1 active	99
7.15.4.2 value	99
7.15.4.3 visited	100
7.16 Cell_const< Cell_Type > Class Template Reference	100
7.16.1 Detailed Description	100
7.17 ConstBArrayRowIter< Cell_Type, Data_Type > Class Template Reference	100
7.17.1 Detailed Description	101
7.17.2 Constructor & Destructor Documentation	101
7.17.2.1 ConstBArrayRowIter()	101
7.17.2.2 ~ConstBArrayRowIter()	101
7.17.3 Member Data Documentation	101
7.17.3.1 Array	102
7.17.3.2 current_col	102
7.17.3.3 current_row	102
7.17.3.4 iter	102
7.18 Counter< Array_Type, Data_Type > Class Template Reference	102
7.18.1 Detailed Description	103
7.18.2 Constructor & Destructor Documentation	104
7.18.2.1 Counter() [1/4]	104
7.18.2.2 Counter() [2/4]	104
7.18.2.3 Counter() [3/4]	104
7.18.2.4 Counter() [4/4]	104
7.18.2.5 ~Counter()	105
7.18.3 Member Function Documentation	105
7.18.3.1 count()	105
7.18.3.2 get_description()	105
7.18.3.3 get_hasher()	105
7.18.3.4 get_name()	105
7.18.3.5 init()	105
7.18.3.6 operator=() [1/2]	106
7.18.3.7 operator=() [2/2]	106
7.18.3.8 set_hasher()	106
7.18.4 Member Data Documentation	106

7.18.4.1 count_fun	106
7.18.4.2 data	107
7.18.4.3 desc	107
7.18.4.4 hasher_fun	107
7.18.4.5 init_fun	107
7.18.4.6 name	107
7.19 Counters< Array_Type, Data_Type > Class Template Reference	108
7.19.1 Detailed Description	108
7.19.2 Constructor & Destructor Documentation	108
7.19.2.1 Counters() [1/3]	109
7.19.2.2 ~Counters()	109
7.19.2.3 Counters() [2/3]	109
7.19.2.4 Counters() [3/3]	109
7.19.3 Member Function Documentation	109
7.19.3.1 add_counter() [1/2]	110
7.19.3.2 add_counter() [2/2]	110
7.19.3.3 add_hash()	110
7.19.3.4 gen_hash()	110
7.19.3.5 get_descriptions()	111
7.19.3.6 get_names()	111
7.19.3.7 operator=() [1/2]	111
7.19.3.8 operator=() [2/2]	111
7.19.3.9 operator[]()	112
7.19.3.10 size()	112
7.20 DEFM Class Reference	112
7.20.1 Detailed Description	113
7.20.2 Constructor & Destructor Documentation	113
7.20.2.1 DEFM()	113
7.20.2.2 ~DEFM()	113
7.20.3 Member Function Documentation	114
7.20.3.1 get_ID()	114
7.20.3.2 get_m_order()	114
7.20.3.3 get_model()	114
7.20.3.4 get_n_covars()	114
7.20.3.5 get_n_obs()	114
7.20.3.6 get_n_rows()	115
7.20.3.7 get_n_y()	115
7.20.3.8 get_X()	115
7.20.3.9 get_X_names()	115
7.20.3.10 get_Y()	115
7.20.3.11 get_Y_names()	115
7.20.3.12 init()	116

7.20.3.13 likelihood()	116
7.20.3.14 logodds()	116
7.20.3.15 motif_census()	116
7.20.3.16 set_names()	116
7.20.3.17 simulate()	117
7.21 DEFMCounterData Class Reference	117
7.21.1 Detailed Description	117
7.21.2 Constructor & Destructor Documentation	117
7.21.2.1 DEFMCounterData() [1/2]	118
7.21.2.2 DEFMCounterData() [2/2]	118
7.21.2.3 ~DEFMCounterData()	118
7.21.3 Member Function Documentation	118
7.21.3.1 idx()	118
7.21.3.2 is_true()	118
7.21.3.3 num()	119
7.21.4 Member Data Documentation	119
7.21.4.1 indices	119
7.21.4.2 logical	119
7.21.4.3 numbers	119
7.22 DEFMDData Class Reference	119
7.22.1 Detailed Description	120
7.22.2 Constructor & Destructor Documentation	120
7.22.2.1 DEFMDData() [1/2]	120
7.22.2.2 DEFMDData() [2/2]	121
7.22.2.3 ~DEFMDData()	122
7.22.3 Member Function Documentation	122
7.22.3.1 at()	122
7.22.3.2 ncol()	122
7.22.3.3 nrow()	122
7.22.3.4 operator>()	122
7.22.3.5 print()	123
7.22.4 Member Data Documentation	123
7.22.4.1 array	123
7.22.4.2 covar_sort	123
7.22.4.3 covar_used	123
7.22.4.4 covariates	124
7.22.4.5 obs_start	124
7.22.4.6 X_ncol	124
7.22.4.7 X_nrow	124
7.23 DEFMRuleData Class Reference	124
7.23.1 Detailed Description	125
7.23.2 Constructor & Destructor Documentation	125

7.23.2.1 DEFMRuleData() [1/2]	125
7.23.2.2 DEFMRuleData() [2/2]	125
7.23.3 Member Function Documentation	125
7.23.3.1 idx()	125
7.23.3.2 num()	126
7.24 Entries< Cell_Type > Class Template Reference	126
7.24.1 Detailed Description	126
7.24.2 Constructor & Destructor Documentation	126
7.24.2.1 Entries() [1/2]	127
7.24.2.2 Entries() [2/2]	127
7.24.2.3 ~Entries()	127
7.24.3 Member Function Documentation	127
7.24.3.1 resize()	127
7.24.4 Member Data Documentation	127
7.24.4.1 source	127
7.24.4.2 target	128
7.24.4.3 val	128
7.25 Flock Class Reference	128
7.25.1 Detailed Description	129
7.25.2 Constructor & Destructor Documentation	129
7.25.2.1 Flock()	129
7.25.2.2 ~Flock()	129
7.25.3 Member Function Documentation	129
7.25.3.1 add_data()	129
7.25.3.2 colnames()	130
7.25.3.3 get_counters()	130
7.25.3.4 get_model()	130
7.25.3.5 get_stats_support()	130
7.25.3.6 get_stats_target()	131
7.25.3.7 get_support_fun()	131
7.25.3.8 init()	131
7.25.3.9 likelihood_joint()	131
7.25.3.10 nfuncs()	132
7.25.3.11 nleaves()	132
7.25.3.12 nnodes()	132
7.25.3.13 nterms()	132
7.25.3.14 ntrees()	132
7.25.3.15 operator()()	132
7.25.3.16 parse_polytomies()	133
7.25.3.17 print()	133
7.25.3.18 set_seed()	133
7.25.3.19 support_size()	134



7.25.4 Member Data Documentation	134
7.25.4.1 dat	134
7.25.4.2 initialized	134
7.25.4.3 model	134
7.25.4.4 nfunctions	134
7.25.4.5 rengine	135
7.26 FreqTable< T > Class Template Reference	135
7.26.1 Detailed Description	135
7.26.2 Constructor & Destructor Documentation	136
7.26.2.1 FreqTable()	136
7.26.2.2 ~FreqTable()	136
7.26.3 Member Function Documentation	136
7.26.3.1 add()	136
7.26.3.2 as_vector()	136
7.26.3.3 clear()	137
7.26.3.4 get_data()	137
7.26.3.5 get_index()	137
7.26.3.6 make_hash()	137
7.26.3.7 print()	137
7.26.3.8 reserve()	138
7.26.3.9 size()	138
7.27 Geese Class Reference	138
7.27.1 Detailed Description	140
7.27.2 Constructor & Destructor Documentation	141
7.27.2.1 Geese() [1/4]	141
7.27.2.2 Geese() [2/4]	141
7.27.2.3 Geese() [3/4]	141
7.27.2.4 Geese() [4/4]	141
7.27.2.5 ~Geese()	141
7.27.3 Member Function Documentation	142
7.27.3.1 calc_reduced_sequence()	142
7.27.3.2 calc_sequence()	142
7.27.3.3 colnames()	142
7.27.3.4 get_annotated_nodes()	142
7.27.3.5 get_counters()	142
7.27.3.6 get_model()	143
7.27.3.7 get_probabilities()	143
7.27.3.8 get_rengine()	143
7.27.3.9 get_states()	143
7.27.3.10 get_support_fun()	143
7.27.3.11 inherit_support()	144
7.27.3.12 init()	144

7.27.3.13	<a href="#">init_node()</a>	144
7.27.3.14	<a href="#">likelihood()</a>	144
7.27.3.15	<a href="#">likelihood_exhaust()</a>	144
7.27.3.16	<a href="#">nannotations()</a>	145
7.27.3.17	<a href="#">nfuncs()</a>	145
7.27.3.18	<a href="#">nleaves()</a>	145
7.27.3.19	<a href="#">nnodes()</a>	145
7.27.3.20	<a href="#">nterms()</a>	145
7.27.3.21	<a href="#">observed_counts()</a>	146
7.27.3.22	<a href="#">operator=()</a> [1/2]	146
7.27.3.23	<a href="#">operator=()</a> [2/2]	146
7.27.3.24	<a href="#">parse_polytomies()</a>	146
7.27.3.25	<a href="#">predict()</a>	146
7.27.3.26	<a href="#">predict_backend()</a>	147
7.27.3.27	<a href="#">predict_exhaust()</a>	147
7.27.3.28	<a href="#">predict_exhaust_backend()</a>	147
7.27.3.29	<a href="#">predict_sim()</a>	147
7.27.3.30	<a href="#">print()</a>	147
7.27.3.31	<a href="#">print_observed_counts()</a>	148
7.27.3.32	<a href="#">set_seed()</a>	148
7.27.3.33	<a href="#">simulate()</a>	148
7.27.3.34	<a href="#">support_size()</a>	148
7.27.3.35	<a href="#">update_annotations()</a>	148
7.27.4	<a href="#">Member Data Documentation</a>	148
7.27.4.1	<a href="#">delete_engine</a>	149
7.27.4.2	<a href="#">delete_support</a>	149
7.27.4.3	<a href="#">initialized</a>	149
7.27.4.4	<a href="#">map_to_nodes</a>	149
7.27.4.5	<a href="#">nfunctions</a>	149
7.27.4.6	<a href="#">nodes</a>	149
7.27.4.7	<a href="#">pset_loc</a>	150
7.27.4.8	<a href="#">reduced_sequence</a>	150
7.27.4.9	<a href="#">sequence</a>	150
7.28	<a href="#">Model&lt; Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type &gt; Class Template Reference</a>	150
7.28.1	<a href="#">Detailed Description</a>	153
7.28.2	<a href="#">Constructor &amp; Destructor Documentation</a>	153
7.28.2.1	<a href="#">Model()</a> [1/3]	153
7.28.2.2	<a href="#">Model()</a> [2/3]	154
7.28.2.3	<a href="#">Model()</a> [3/3]	154
7.28.2.4	<a href="#">~Model()</a>	154
7.28.3	<a href="#">Member Function Documentation</a>	154

7.28.3.1 add_array()	154
7.28.3.2 add_counter() [1/2]	155
7.28.3.3 add_counter() [2/2]	155
7.28.3.4 add_hasher()	155
7.28.3.5 add_rule() [1/2]	155
7.28.3.6 add_rule() [2/2]	155
7.28.3.7 add_rule_dyn() [1/2]	156
7.28.3.8 add_rule_dyn() [2/2]	156
7.28.3.9 colnames()	156
7.28.3.10 conditional_prob()	156
7.28.3.11 gen_key()	157
7.28.3.12 get_arrays2support()	157
7.28.3.13 get_counters()	157
7.28.3.14 get_norm_const()	157
7.28.3.15 get_pset()	158
7.28.3.16 get_pset_arrays()	158
7.28.3.17 get_pset_probs()	158
7.28.3.18 get_pset_stats() [1/2]	158
7.28.3.19 get_pset_stats() [2/2]	158
7.28.3.20 get_rengine()	159
7.28.3.21 get_rules()	159
7.28.3.22 get_rules_dyn()	159
7.28.3.23 get_stats_support()	159
7.28.3.24 get_stats_target()	159
7.28.3.25 get_support_fun()	160
7.28.3.26 likelihood() [1/4]	160
7.28.3.27 likelihood() [2/4]	160
7.28.3.28 likelihood() [3/4]	160
7.28.3.29 likelihood() [4/4]	161
7.28.3.30 likelihood_total()	161
7.28.3.31 nterms()	161
7.28.3.32 operator=()	161
7.28.3.33 print()	161
7.28.3.34 print_stats()	162
7.28.3.35 sample() [1/2]	162
7.28.3.36 sample() [2/2]	162
7.28.3.37 set_counters()	162
7.28.3.38 set_rengine()	162
7.28.3.39 set_rules()	163
7.28.3.40 set_rules_dyn()	163
7.28.3.41 set_seed()	163
7.28.3.42 set_transform_model()	163

7.28.3.43 size()	164
7.28.3.44 size_unique()	164
7.28.3.45 store_psets()	164
7.28.3.46 support_size()	164
7.28.3.47 transform_model()	164
7.29 NetCounterData Class Reference	165
7.29.1 Detailed Description	165
7.29.2 Constructor & Destructor Documentation	165
7.29.2.1 NetCounterData() [1/2]	165
7.29.2.2 NetCounterData() [2/2]	165
7.29.2.3 ~NetCounterData()	166
7.29.3 Member Data Documentation	166
7.29.3.1 indices	166
7.29.3.2 numbers	166
7.30 NetworkData Class Reference	166
7.30.1 Detailed Description	167
7.30.2 Constructor & Destructor Documentation	167
7.30.2.1 NetworkData() [1/3]	167
7.30.2.2 NetworkData() [2/3]	167
7.30.2.3 NetworkData() [3/3]	167
7.30.2.4 ~NetworkData()	168
7.30.3 Member Data Documentation	168
7.30.3.1 directed	168
7.30.3.2 vertex_attr	168
7.31 Node Class Reference	168
7.31.1 Detailed Description	169
7.31.2 Constructor & Destructor Documentation	169
7.31.2.1 Node() [1/5]	170
7.31.2.2 Node() [2/5]	170
7.31.2.3 Node() [3/5]	170
7.31.2.4 Node() [4/5]	170
7.31.2.5 Node() [5/5]	170
7.31.2.6 ~Node()	171
7.31.3 Member Function Documentation	171
7.31.3.1 get_parent()	171
7.31.3.2 is_leaf()	171
7.31.3.3 noffspring()	171
7.31.4 Member Data Documentation	171
7.31.4.1 annotations	171
7.31.4.2 array	172
7.31.4.3 arrays	172
7.31.4.4 duplication	172

7.31.4.5 id	172
7.31.4.6 narray	172
7.31.4.7 offspring	173
7.31.4.8 ord	173
7.31.4.9 parent	173
7.31.4.10 probability	173
7.31.4.11 subtree_prob	173
7.31.4.12 visited	174
7.32 NodeData Class Reference	174
7.32.1 Detailed Description	174
7.32.2 Constructor & Destructor Documentation	174
7.32.2.1 NodeData()	174
7.32.3 Member Data Documentation	175
7.32.3.1 blengths	175
7.32.3.2 duplication	175
7.32.3.3 states	175
7.33 PhyloCounterData Class Reference	175
7.33.1 Detailed Description	176
7.33.2 Constructor & Destructor Documentation	176
7.33.2.1 PhyloCounterData() [1/2]	176
7.33.2.2 PhyloCounterData() [2/2]	176
7.33.3 Member Function Documentation	176
7.33.3.1 at()	176
7.33.3.2 begin()	176
7.33.3.3 empty()	177
7.33.3.4 end()	177
7.33.3.5 get_counters()	177
7.33.3.6 operator()()	177
7.33.3.7 operator[]()	177
7.33.3.8 push_back()	177
7.33.3.9 reserve()	178
7.33.3.10 shrink_to_fit()	178
7.33.3.11 size()	178
7.34 PhyloRuleDynData Class Reference	178
7.34.1 Detailed Description	178
7.34.2 Constructor & Destructor Documentation	179
7.34.2.1 PhyloRuleDynData()	179
7.34.2.2 ~PhyloRuleDynData()	179
7.34.3 Member Data Documentation	179
7.34.3.1 counts	179
7.34.3.2 duplication	179
7.34.3.3 lb	179

7.34.3.4 pos	180
7.34.3.5 ub	180
7.35 PowerSet< Array_Type, Data_Rule_Type > Class Template Reference	180
7.35.1 Detailed Description	181
7.35.2 Constructor & Destructor Documentation	182
7.35.2.1 PowerSet() [1/3]	182
7.35.2.2 PowerSet() [2/3]	182
7.35.2.3 PowerSet() [3/3]	182
7.35.2.4 ~PowerSet()	182
7.35.3 Member Function Documentation	182
7.35.3.1 add_rule() [1/2]	183
7.35.3.2 add_rule() [2/2]	183
7.35.3.3 begin()	183
7.35.3.4 calc()	183
7.35.3.5 end()	183
7.35.3.6 get_data()	184
7.35.3.7 get_data_ptr()	184
7.35.3.8 init_support()	184
7.35.3.9 operator[]()	184
7.35.3.10 reset()	184
7.35.3.11 size()	185
7.35.4 Member Data Documentation	185
7.35.4.1 coordinates_free	185
7.35.4.2 coordinates_locked	185
7.35.4.3 data	185
7.35.4.4 EmptyArray	185
7.35.4.5 M	186
7.35.4.6 N	186
7.35.4.7 n_free	186
7.35.4.8 n_locked	186
7.35.4.9 rules	186
7.35.4.10 rules_deleted	187
7.36 Progress Class Reference	187
7.36.1 Detailed Description	187
7.36.2 Constructor & Destructor Documentation	187
7.36.2.1 Progress()	187
7.36.2.2 ~Progress()	188
7.36.3 Member Function Documentation	188
7.36.3.1 end()	188
7.36.3.2 next()	188
7.37 Rule< Array_Type, Data_Type > Class Template Reference	188
7.37.1 Detailed Description	189

7.37.2 Constructor & Destructor Documentation	189
7.37.2.1 Rule() [1/2]	189
7.37.2.2 Rule() [2/2]	189
7.37.2.3 ~Rule()	190
7.37.3 Member Function Documentation	190
7.37.3.1 D()	190
7.37.3.2 operator()()	190
7.38 Rules< Array_Type, Data_Type > Class Template Reference	190
7.38.1 Detailed Description	191
7.38.2 Constructor & Destructor Documentation	191
7.38.2.1 Rules() [1/2]	191
7.38.2.2 Rules() [2/2]	191
7.38.2.3 ~Rules()	192
7.38.3 Member Function Documentation	192
7.38.3.1 add_rule() [1/2]	192
7.38.3.2 add_rule() [2/2]	192
7.38.3.3 get_seq()	192
7.38.3.4 operator()()	193
7.38.3.5 operator=()	193
7.38.3.6 size()	193
7.39 StatsCounter< Array_Type, Data_Type > Class Template Reference	194
7.39.1 Detailed Description	194
7.39.2 Constructor & Destructor Documentation	194
7.39.2.1 StatsCounter() [1/3]	194
7.39.2.2 StatsCounter() [2/3]	195
7.39.2.3 StatsCounter() [3/3]	195
7.39.2.4 ~StatsCounter()	195
7.39.3 Member Function Documentation	195
7.39.3.1 add_counter()	195
7.39.3.2 count_all()	196
7.39.3.3 count_current()	196
7.39.3.4 count_init()	196
7.39.3.5 get_counters()	196
7.39.3.6 get_descriptions()	196
7.39.3.7 get_names()	196
7.39.3.8 reset_array()	196
7.39.3.9 set_counters()	197
7.39.3.10 size()	197
7.40 Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > Class Template Reference	197
7.40.1 Detailed Description	199
7.40.2 Constructor & Destructor Documentation	199

7.40.2.1 Support() [1/3]	199
7.40.2.2 Support() [2/3]	200
7.40.2.3 Support() [3/3]	200
7.40.2.4 ~Support()	200
7.40.3 Member Function Documentation	200
7.40.3.1 add_counter()	200
7.40.3.2 add_rule() [1/2]	201
7.40.3.3 add_rule() [2/2]	201
7.40.3.4 add_rule_dyn() [1/2]	201
7.40.3.5 add_rule_dyn() [2/2]	201
7.40.3.6 calc()	201
7.40.3.7 eval_rules_dyn()	202
7.40.3.8 get_counters()	202
7.40.3.9 get_counts()	202
7.40.3.10 get_current_stats()	202
7.40.3.11 get_data()	203
7.40.3.12 get_rules()	203
7.40.3.13 get_rules_dyn()	203
7.40.3.14 init_support()	203
7.40.3.15 print()	203
7.40.3.16 reset_array() [1/2]	204
7.40.3.17 reset_array() [2/2]	204
7.40.3.18 set_counters()	204
7.40.3.19 set_rules()	204
7.40.3.20 set_rules_dyn()	204
7.40.4 Member Data Documentation	204
7.40.4.1 change_stats	205
7.40.4.2 coordiantes_n_free	205
7.40.4.3 coordiantes_n_locked	205
7.40.4.4 coordinates_free	205
7.40.4.5 coordinates_locked	205
7.40.4.6 current_stats	206
7.40.4.7 delete_counters	206
7.40.4.8 delete_rules	206
7.40.4.9 delete_rules_dyn	206
7.40.4.10 hashes	206
7.40.4.11 hashes_initialized	207
7.40.4.12 M	207
7.40.4.13 max_num_elements	207
7.40.4.14 N	207
7.40.4.15 n_counters	207
7.41 vecHasher< T > Struct Template Reference	208



7.41.1 Detailed Description	208
7.41.2 Member Function Documentation	208
7.41.2.1 operator()()	208
<b>8 File Documentation</b>	<b>209</b>
8.1 include/barry/barray-bones.hpp File Reference	209
8.2 include/barry/barray-iterator.hpp File Reference	209
8.3 include/barry/barray-meat-operators.hpp File Reference	210
8.3.1 Macro Definition Documentation	210
8.3.1.1 BARRAY_TEMPLATE	211
8.3.1.2 BARRAY_TEMPLATE_ARGS	211
8.3.1.3 BARRAY_TYPE	211
8.3.1.4 COL	211
8.3.1.5 ROW	211
8.3.2 Function Documentation	211
8.3.2.1 BARRAY_TEMPLATE() [1/6]	212
8.3.2.2 BARRAY_TEMPLATE() [2/6]	212
8.3.2.3 BARRAY_TEMPLATE() [3/6]	212
8.3.2.4 BARRAY_TEMPLATE() [4/6]	212
8.3.2.5 BARRAY_TEMPLATE() [5/6]	212
8.3.2.6 BARRAY_TEMPLATE() [6/6]	213
8.3.2.7 BARRAY_TEMPLATE_ARGS()	213
8.3.2.8 BARRAY_TYPE()	213
8.3.2.9 for()	213
8.3.2.10 operator()()	213
8.3.3 Variable Documentation	213
8.3.3.1 rhs	214
8.3.3.2 this	214
8.4 include/barry/barray-meat.hpp File Reference	214
8.4.1 Macro Definition Documentation	216
8.4.1.1 BARRAY_TEMPLATE	216
8.4.1.2 BARRAY_TEMPLATE_ARGS	216
8.4.1.3 BARRAY_TYPE	217
8.4.1.4 COL	217
8.4.1.5 ROW	217
8.4.2 Function Documentation	217
8.4.2.1 ans()	217
8.4.2.2 BARRAY_TEMPLATE() [1/24]	217
8.4.2.3 BARRAY_TEMPLATE() [2/24]	218
8.4.2.4 BARRAY_TEMPLATE() [3/24]	218
8.4.2.5 BARRAY_TEMPLATE() [4/24]	218
8.4.2.6 BARRAY_TEMPLATE() [5/24]	218

8.4.2.7 BARRAY_TEMPLATE() [6/24]	218
8.4.2.8 BARRAY_TEMPLATE() [7/24]	218
8.4.2.9 BARRAY_TEMPLATE() [8/24]	219
8.4.2.10 BARRAY_TEMPLATE() [9/24]	219
8.4.2.11 BARRAY_TEMPLATE() [10/24]	219
8.4.2.12 BARRAY_TEMPLATE() [11/24]	219
8.4.2.13 BARRAY_TEMPLATE() [12/24]	219
8.4.2.14 BARRAY_TEMPLATE() [13/24]	220
8.4.2.15 BARRAY_TEMPLATE() [14/24]	220
8.4.2.16 BARRAY_TEMPLATE() [15/24]	220
8.4.2.17 BARRAY_TEMPLATE() [16/24]	220
8.4.2.18 BARRAY_TEMPLATE() [17/24]	220
8.4.2.19 BARRAY_TEMPLATE() [18/24]	220
8.4.2.20 BARRAY_TEMPLATE() [19/24]	221
8.4.2.21 BARRAY_TEMPLATE() [20/24]	221
8.4.2.22 BARRAY_TEMPLATE() [21/24]	221
8.4.2.23 BARRAY_TEMPLATE() [22/24]	221
8.4.2.24 BARRAY_TEMPLATE() [23/24]	221
8.4.2.25 BARRAY_TEMPLATE() [24/24]	221
8.4.2.26 COL()	222
8.4.2.27 for() [1/3]	222
8.4.2.28 for() [2/3]	222
8.4.2.29 for() [3/3]	222
8.4.2.30 if() [1/17]	222
8.4.2.31 if() [2/17]	222
8.4.2.32 if() [3/17]	223
8.4.2.33 if() [4/17]	223
8.4.2.34 if() [5/17]	223
8.4.2.35 if() [6/17]	223
8.4.2.36 if() [7/17]	223
8.4.2.37 if() [8/17]	223
8.4.2.38 if() [9/17]	224
8.4.2.39 if() [10/17]	224
8.4.2.40 if() [11/17]	224
8.4.2.41 if() [12/17]	224
8.4.2.42 if() [13/17]	224
8.4.2.43 if() [14/17]	224
8.4.2.44 if() [15/17]	224
8.4.2.45 if() [16/17]	225
8.4.2.46 if() [17/17]	225
8.4.2.47 M()	225
8.4.2.48 resize() [1/2]	225

8.4.2.49 <a href="#">resize()</a> [2/2]	225
8.4.2.50 <a href="#">return()</a>	225
8.4.2.51 <a href="#">ROW()</a> [1/2]	226
8.4.2.52 <a href="#">ROW()</a> [2/2]	226
8.4.3 <a href="#">Variable Documentation</a>	226
8.4.3.1 <a href="#">add</a>	226
8.4.3.2 <a href="#">ans</a>	226
8.4.3.3 <a href="#">Array_</a>	226
8.4.3.4 <a href="#">check_bounds</a>	227
8.4.3.5 <a href="#">check_exists</a>	227
8.4.3.6 <a href="#">col0</a>	227
8.4.3.7 <a href="#">const</a>	227
8.4.3.8 <a href="#">copy_data</a>	228
8.4.3.9 <a href="#">data</a>	228
8.4.3.10 <a href="#">delete_data</a>	228
8.4.3.11 <a href="#">delete_data_</a>	228
8.4.3.12 <a href="#">else</a>	228
8.4.3.13 <a href="#">false</a>	229
8.4.3.14 <a href="#">first</a>	229
8.4.3.15 <a href="#">i1</a>	229
8.4.3.16 <a href="#">j</a>	229
8.4.3.17 <a href="#">j0</a>	229
8.4.3.18 <a href="#">j1</a>	229
8.4.3.19 <a href="#">M</a>	230
8.4.3.20 <a href="#">M_</a>	230
8.4.3.21 <a href="#">N</a>	230
8.4.3.22 <a href="#">NCells</a>	230
8.4.3.23 <a href="#">report</a>	230
8.4.3.24 <a href="#">return</a>	231
8.4.3.25 <a href="#">row0</a>	231
8.4.3.26 <a href="#">search</a>	231
8.4.3.27 <a href="#">source</a>	231
8.4.3.28 <a href="#">target</a>	231
8.4.3.29 <a href="#">v</a>	231
8.4.3.30 <a href="#">value</a>	232
8.5 <a href="#">include/barry/barraycell-bones.hpp File Reference</a>	232
8.6 <a href="#">include/barry/barraycell-meat.hpp File Reference</a>	232
8.7 <a href="#">include/barry/barraydense-bones.hpp File Reference</a>	233
8.8 <a href="#">include/barry/barraydense-meat-operators.hpp File Reference</a>	233
8.8.1 <a href="#">Macro Definition Documentation</a>	234
8.8.1.1 <a href="#">BDENSE_TEMPLATE</a>	234
8.8.1.2 <a href="#">BDENSE_TEMPLATE_ARGS</a>	234

8.8.1.3 BDENSE_TYPE	234
8.8.1.4 COL	234
8.8.1.5 POS	235
8.8.1.6 POS_N	235
8.8.1.7 ROW	235
8.8.2 Function Documentation	235
8.8.2.1 BDENSE_TEMPLATE() [1/4]	235
8.8.2.2 BDENSE_TEMPLATE() [2/4]	235
8.8.2.3 BDENSE_TEMPLATE() [3/4]	236
8.8.2.4 BDENSE_TEMPLATE() [4/4]	236
8.8.2.5 BDENSE_TEMPLATE_ARGS()	236
8.8.2.6 BDENSE_TYPE()	236
8.9 include/barry/barraydense-meat.hpp File Reference	236
8.9.1 Macro Definition Documentation	239
8.9.1.1 BDENSE_TEMPLATE	239
8.9.1.2 BDENSE_TEMPLATE_ARGS	239
8.9.1.3 BDENSE_TYPE	239
8.9.1.4 COL	239
8.9.1.5 POS	239
8.9.1.6 POS_N	240
8.9.1.7 ROW	240
8.9.1.8 ZERO_CELL	240
8.9.2 Function Documentation	240
8.9.2.1 ans()	240
8.9.2.2 BDENSE_TEMPLATE() [1/39]	240
8.9.2.3 BDENSE_TEMPLATE() [2/39]	241
8.9.2.4 BDENSE_TEMPLATE() [3/39]	241
8.9.2.5 BDENSE_TEMPLATE() [4/39]	241
8.9.2.6 BDENSE_TEMPLATE() [5/39]	241
8.9.2.7 BDENSE_TEMPLATE() [6/39]	241
8.9.2.8 BDENSE_TEMPLATE() [7/39]	241
8.9.2.9 BDENSE_TEMPLATE() [8/39]	242
8.9.2.10 BDENSE_TEMPLATE() [9/39]	242
8.9.2.11 BDENSE_TEMPLATE() [10/39]	242
8.9.2.12 BDENSE_TEMPLATE() [11/39]	242
8.9.2.13 BDENSE_TEMPLATE() [12/39]	242
8.9.2.14 BDENSE_TEMPLATE() [13/39]	243
8.9.2.15 BDENSE_TEMPLATE() [14/39]	243
8.9.2.16 BDENSE_TEMPLATE() [15/39]	243
8.9.2.17 BDENSE_TEMPLATE() [16/39]	243
8.9.2.18 BDENSE_TEMPLATE() [17/39]	243
8.9.2.19 BDENSE_TEMPLATE() [18/39]	244

8.9.2.20	BDENSE_TEMPLATE()	[19/39]	244
8.9.2.21	BDENSE_TEMPLATE()	[20/39]	244
8.9.2.22	BDENSE_TEMPLATE()	[21/39]	244
8.9.2.23	BDENSE_TEMPLATE()	[22/39]	244
8.9.2.24	BDENSE_TEMPLATE()	[23/39]	245
8.9.2.25	BDENSE_TEMPLATE()	[24/39]	245
8.9.2.26	BDENSE_TEMPLATE()	[25/39]	245
8.9.2.27	BDENSE_TEMPLATE()	[26/39]	245
8.9.2.28	BDENSE_TEMPLATE()	[27/39]	245
8.9.2.29	BDENSE_TEMPLATE()	[28/39]	246
8.9.2.30	BDENSE_TEMPLATE()	[29/39]	246
8.9.2.31	BDENSE_TEMPLATE()	[30/39]	246
8.9.2.32	BDENSE_TEMPLATE()	[31/39]	246
8.9.2.33	BDENSE_TEMPLATE()	[32/39]	246
8.9.2.34	BDENSE_TEMPLATE()	[33/39]	246
8.9.2.35	BDENSE_TEMPLATE()	[34/39]	247
8.9.2.36	BDENSE_TEMPLATE()	[35/39]	247
8.9.2.37	BDENSE_TEMPLATE()	[36/39]	247
8.9.2.38	BDENSE_TEMPLATE()	[37/39]	247
8.9.2.39	BDENSE_TEMPLATE()	[38/39]	247
8.9.2.40	BDENSE_TEMPLATE()	[39/39]	247
8.9.2.41	for()		248
8.9.2.42	if()	[1/4]	248
8.9.2.43	if()	[2/4]	248
8.9.2.44	if()	[3/4]	248
8.9.2.45	if()	[4/4]	248
8.9.2.46	insert_cell()	[1/2]	248
8.9.2.47	insert_cell()	[2/2]	249
8.9.2.48	M()		249
8.9.2.49	resize()	[1/6]	249
8.9.2.50	resize()	[2/6]	249
8.9.2.51	resize()	[3/6]	249
8.9.2.52	resize()	[4/6]	249
8.9.2.53	resize()	[5/6]	250
8.9.2.54	resize()	[6/6]	250
8.9.2.55	rm_cell()	[1/3]	250
8.9.2.56	rm_cell()	[2/3]	250
8.9.2.57	rm_cell()	[3/3]	250
8.9.2.58	va_end()		250
8.9.2.59	va_start()		251
8.9.2.60	vprintf()		251
8.9.3	Variable Documentation		251

8.9.3.1 add	251
8.9.3.2 ans	251
8.9.3.3 check_bounds	251
8.9.3.4 check_exists	252
8.9.3.5 col	252
8.9.3.6 const	252
8.9.3.7 copy_data	252
8.9.3.8 data	252
8.9.3.9 delete_data	253
8.9.3.10 delete_data_	253
8.9.3.11 el	253
8.9.3.12 el_colsums	253
8.9.3.13 el_rowsums	253
8.9.3.14 else	254
8.9.3.15 false	254
8.9.3.16 i1	254
8.9.3.17 j	254
8.9.3.18 j0	254
8.9.3.19 j1	254
8.9.3.20 M	255
8.9.3.21 M_	255
8.9.3.22 N	255
8.9.3.23 report	255
8.9.3.24 return	255
8.9.3.25 source	256
8.9.3.26 target	256
8.9.3.27 v	256
8.9.3.28 val0	256
8.9.3.29 val1	256
8.9.3.30 value	256
8.10 include/barry/barraydensecell-bones.hpp File Reference	257
8.10.1 Macro Definition Documentation	257
8.10.1.1 POS	257
8.11 include/barry/barraydensecell-meat.hpp File Reference	258
8.11.1 Macro Definition Documentation	258
8.11.1.1 POS	258
8.12 include/barry/barraydensecol-bones.hpp File Reference	258
8.12.1 Macro Definition Documentation	259
8.12.1.1 POS	259
8.12.1.2 POS_N	259
8.12.1.3 ZERO_CELL	259
8.13 include/barry/barraydenserow-bones.hpp File Reference	260

8.13.1 Macro Definition Documentation	260
8.13.1.1 POS	260
8.13.1.2 POS_N	261
8.13.1.3 ZERO_CELL	261
8.14 include/barry/barrayrow-bones.hpp File Reference	261
8.15 include/barry/barrayrow-meat.hpp File Reference	261
8.15.1 Macro Definition Documentation	261
8.15.1.1 BROW_TEMPLATE	262
8.15.1.2 BROW_TEMPLATE_ARGS	262
8.15.1.3 BROW_TYPE	262
8.15.2 Function Documentation	262
8.15.2.1 BROW_TEMPLATE() [1/5]	262
8.15.2.2 BROW_TEMPLATE() [2/5]	262
8.15.2.3 BROW_TEMPLATE() [3/5]	263
8.15.2.4 BROW_TEMPLATE() [4/5]	263
8.15.2.5 BROW_TEMPLATE() [5/5]	263
8.16 include/barry/barrayvector-bones.hpp File Reference	263
8.17 include/barry/barrayvector-meat.hpp File Reference	264
8.18 include/barry/barry-configuration.hpp File Reference	264
8.18.1 Macro Definition Documentation	265
8.18.1.1 BARRY_CHECK_SUPPORT	265
8.18.1.2 BARRY_ISFINITE	265
8.18.1.3 BARRY_MAX_NUM_ELEMENTS	265
8.18.1.4 BARRY_SAFE_EXP	265
8.18.1.5 printf_barry	265
8.18.2 Typedef Documentation	265
8.18.2.1 Map	266
8.19 include/barry/barry-debug.hpp File Reference	266
8.19.1 Macro Definition Documentation	266
8.19.1.1 BARRY_DEBUG_LEVEL	266
8.20 include/barry/barry-macros.hpp File Reference	267
8.20.1 Macro Definition Documentation	267
8.20.1.1 BARRY_ONE	267
8.20.1.2 BARRY_ONE_DENSE	267
8.20.1.3 BARRY_UNUSED	268
8.20.1.4 BARRY_ZERO	268
8.20.1.5 BARRY_ZERO_DENSE	268
8.21 include/barry/barry.hpp File Reference	268
8.21.1 Macro Definition Documentation	269
8.21.1.1 BARRY_HPP	270
8.21.1.2 BARRY_VERSION	270
8.21.1.3 BARRY_VERSION_MAYOR	270

8.21.1.4 BARRY_VERSION_MINOR . . . . .	270
8.21.1.5 COUNTER_FUNCTION . . . . .	270
8.21.1.6 COUNTER_LAMBDA . . . . .	271
8.21.1.7 RULE_FUNCTION . . . . .	271
8.21.1.8 RULE_LAMBDA . . . . .	271
8.22 include/barry/cell-bones.hpp File Reference . . . . .	271
8.23 include/barry/cell-meat.hpp File Reference . . . . .	272
8.24 include/barry/col-bones.hpp File Reference . . . . .	272
8.25 include/barry/counters-bones.hpp File Reference . . . . .	272
8.26 include/barry/counters-meat.hpp File Reference . . . . .	273
8.26.1 Macro Definition Documentation . . . . .	274
8.26.1.1 COUNTER_TEMPLATE . . . . .	274
8.26.1.2 COUNTER_TEMPLATE_ARGS . . . . .	275
8.26.1.3 COUNTER_TYPE . . . . .	275
8.26.1.4 COUNTERS_TEMPLATE . . . . .	275
8.26.1.5 COUNTERS_TEMPLATE_ARGS . . . . .	275
8.26.1.6 COUNTERS_TYPE . . . . .	275
8.26.1.7 TMP_HASHER_CALL . . . . .	275
8.26.2 Function Documentation . . . . .	276
8.26.2.1 count_fun() . . . . .	276
8.26.2.2 COUNTER_TEMPLATE() [1/9] . . . . .	276
8.26.2.3 COUNTER_TEMPLATE() [2/9] . . . . .	276
8.26.2.4 COUNTER_TEMPLATE() [3/9] . . . . .	276
8.26.2.5 COUNTER_TEMPLATE() [4/9] . . . . .	276
8.26.2.6 COUNTER_TEMPLATE() [5/9] . . . . .	277
8.26.2.7 COUNTER_TEMPLATE() [6/9] . . . . .	277
8.26.2.8 COUNTER_TEMPLATE() [7/9] . . . . .	277
8.26.2.9 COUNTER_TEMPLATE() [8/9] . . . . .	277
8.26.2.10 COUNTER_TEMPLATE() [9/9] . . . . .	277
8.26.2.11 COUNTERS_TEMPLATE() [1/9] . . . . .	278
8.26.2.12 COUNTERS_TEMPLATE() [2/9] . . . . .	278
8.26.2.13 COUNTERS_TEMPLATE() [3/9] . . . . .	278
8.26.2.14 COUNTERS_TEMPLATE() [4/9] . . . . .	278
8.26.2.15 COUNTERS_TEMPLATE() [5/9] . . . . .	278
8.26.2.16 COUNTERS_TEMPLATE() [6/9] . . . . .	278
8.26.2.17 COUNTERS_TEMPLATE() [7/9] . . . . .	279
8.26.2.18 COUNTERS_TEMPLATE() [8/9] . . . . .	279
8.26.2.19 COUNTERS_TEMPLATE() [9/9] . . . . .	279
8.26.2.20 data() . . . . .	279
8.26.2.21 desc() . . . . .	279
8.26.2.22 for() . . . . .	279
8.26.2.23 hasher() [1/2] . . . . .	280



8.26.2.24 hasher() [2/2]	280
8.26.2.25 hasher_fun() [1/2]	280
8.26.2.26 hasher_fun() [2/2]	280
8.26.2.27 if() [1/3]	280
8.26.2.28 if() [2/3]	280
8.26.2.29 if() [3/3]	281
8.26.2.30 init_fun() [1/3]	281
8.26.2.31 init_fun() [2/3]	281
8.26.2.32 init_fun() [3/3]	281
8.26.2.33 name()	281
8.26.3 Variable Documentation	281
8.26.3.1 add_dims	281
8.26.3.2 count_fun_	282
8.26.3.3 counter	282
8.26.3.4 counter_	282
8.26.3.5 data_	282
8.26.3.6 desc_	283
8.26.3.7 fun	283
8.26.3.8 fun_	283
8.26.3.9 hasher_fun_	283
8.26.3.10 i	284
8.26.3.11 init_fun_	284
8.26.3.12 j	284
8.26.3.13 name_	284
8.26.3.14 noexcept	284
8.26.3.15 res	285
8.26.3.16 return	285
8.27 include/barry/counters/defm-formula.hpp File Reference	285
8.27.1 Function Documentation	285
8.27.1.1 defm_motif_parser()	286
8.28 include/barry/counters/defm.hpp File Reference	287
8.28.1 Macro Definition Documentation	289
8.28.1.1 DEFM_COUNTER	289
8.28.1.2 DEFM_COUNTER_LAMBDA	289
8.28.1.3 DEFM_RULE	289
8.28.1.4 DEFM_RULE_LAMBDA	290
8.28.1.5 MAKE_DEFM_HASHER	290
8.28.1.6 UNI_SUB	290
8.28.2 Typedef Documentation	290
8.28.2.1 DEFMArray	291
8.28.2.2 DEFMCounter	291
8.28.2.3 DEFMCounters	291

8.28.2.4 DEFModel	291
8.28.2.5 DEFMRule	291
8.28.2.6 DEFMRules	291
8.28.2.7 DEFStatsCounter	292
8.28.2.8 DEFMSupport	292
8.29 include/barry/models/defm.hpp File Reference	292
8.30 include/barry/counters/network-css.hpp File Reference	293
8.30.1 Macro Definition Documentation	294
8.30.1.1 CSS_APPEND	294
8.30.1.2 CSS_CASE_ELSE	295
8.30.1.3 CSS_CASE_PERCEIVED	295
8.30.1.4 CSS_CASE_TRUTH	295
8.30.1.5 CSS_CHECK_SIZE	295
8.30.1.6 CSS_CHECK_SIZE_INIT	295
8.30.1.7 CSS_NET_COUNTER_LAMBDA_INIT	296
8.30.1.8 CSS_PERCEIVED_CELLS	296
8.30.1.9 CSS_SIZE	296
8.30.1.10 CSS_TRUE_CELLS	296
8.30.2 Function Documentation	296
8.30.2.1 counter_css_census01()	297
8.30.2.2 counter_css_census02()	297
8.30.2.3 counter_css_census03()	297
8.30.2.4 counter_css_census04()	297
8.30.2.5 counter_css_census05()	298
8.30.2.6 counter_css_census06()	298
8.30.2.7 counter_css_census07()	298
8.30.2.8 counter_css_census08()	298
8.30.2.9 counter_css_census09()	299
8.30.2.10 counter_css_census10()	299
8.30.2.11 counter_css_completely_false_recip_comiss()	299
8.30.2.12 counter_css_completely_false_recip_omiss()	299
8.30.2.13 counter_css_mixed_recip()	300
8.30.2.14 counter_css_partially_false_recip_commi()	300
8.30.2.15 counter_css_partially_false_recip_omiss()	300
8.31 include/barry/counters/network.hpp File Reference	301
8.31.1 Macro Definition Documentation	303
8.31.1.1 BARRY_ZERO_NETWORK	304
8.31.1.2 BARRY_ZERO_NETWORK_DENSE	304
8.31.1.3 NET_C_DATA_IDX	304
8.31.1.4 NET_C_DATA_NUM	304
8.31.1.5 NETWORK_COUNTER	304
8.31.1.6 NETWORK_COUNTER_LAMBDA	305

8.31.1.7 NETWORK_RULE . . . . .	305
8.31.1.8 NETWORK_RULE_LAMBDA . . . . .	305
8.31.1.9 NETWORKDENSE_COUNTER_LAMBDA . . . . .	305
8.31.2 Typedef Documentation . . . . .	306
8.31.2.1 NetCounter . . . . .	306
8.31.2.2 NetCounters . . . . .	306
8.31.2.3 NetModel . . . . .	306
8.31.2.4 NetRule . . . . .	306
8.31.2.5 NetRules . . . . .	306
8.31.2.6 NetStatsCounter . . . . .	307
8.31.2.7 NetSupport . . . . .	307
8.31.2.8 Network . . . . .	307
8.31.2.9 NetworkDense . . . . .	307
8.31.3 Function Documentation . . . . .	307
8.31.3.1 rules_zerodiag() . . . . .	307
8.32 include/barry/counters/phylo.hpp File Reference . . . . .	308
8.32.1 Macro Definition Documentation . . . . .	310
8.32.1.1 DEFAULT_DUPLICATION . . . . .	310
8.32.1.2 DUPL_DUPL . . . . .	310
8.32.1.3 DUPL_EITH . . . . .	310
8.32.1.4 DUPL_SPEC . . . . .	311
8.32.1.5 IF_MATCHES . . . . .	311
8.32.1.6 IF_NOTMATCHES . . . . .	311
8.32.1.7 IS_DUPLICATION . . . . .	311
8.32.1.8 IS_EITHER . . . . .	311
8.32.1.9 IS_SPECIATION . . . . .	312
8.32.1.10 MAKE_DUPL_VARS . . . . .	312
8.32.1.11 PHYLO_CHECK_MISSING . . . . .	312
8.32.1.12 PHYLO_COUNTER_LAMBDA . . . . .	312
8.32.1.13 PHYLO_RULE_DYN_LAMBDA . . . . .	313
8.32.2 Typedef Documentation . . . . .	313
8.32.2.1 PhyloArray . . . . .	313
8.32.2.2 PhyloCounter . . . . .	313
8.32.2.3 PhyloCounters . . . . .	313
8.32.2.4 PhyloModel . . . . .	313
8.32.2.5 PhyloPowerSet . . . . .	314
8.32.2.6 PhyloRule . . . . .	314
8.32.2.7 PhyloRuleData . . . . .	314
8.32.2.8 PhyloRuleDyn . . . . .	314
8.32.2.9 PhyloRules . . . . .	314
8.32.2.10 PhyloRulesDyn . . . . .	314
8.32.2.11 PhyloStatsCounter . . . . .	315

8.32.2.12 PhyloSupport . . . . .	315
8.32.3 Function Documentation . . . . .	315
8.32.3.1 get_last_name() . . . . .	315
8.33 include/barry/freqtable.hpp File Reference . . . . .	315
8.34 include/barry/model-bones.hpp File Reference . . . . .	316
8.35 include/barry/model-meat.hpp File Reference . . . . .	316
8.35.1 Macro Definition Documentation . . . . .	317
8.35.1.1 MODEL_TEMPLATE . . . . .	317
8.35.1.2 MODEL_TEMPLATE_ARGS . . . . .	317
8.35.1.3 MODEL_TYPE . . . . .	317
8.35.2 Function Documentation . . . . .	317
8.35.2.1 likelihood_() . . . . .	318
8.35.2.2 MODEL_TEMPLATE() [1/2] . . . . .	318
8.35.2.3 MODEL_TEMPLATE() [2/2] . . . . .	318
8.35.2.4 update_normalizing_constant() . . . . .	318
8.36 include/barry/models/defm/defm-bones.hpp File Reference . . . . .	319
8.37 include/barry/models/defm/defm-meat.hpp File Reference . . . . .	319
8.37.1 Macro Definition Documentation . . . . .	320
8.37.1.1 DEFM_LOOP_ARRAYS . . . . .	320
8.37.1.2 DEFM_RANGES . . . . .	320
8.38 include/barry/models/geese.hpp File Reference . . . . .	320
8.39 include/barry/models/geese/flock-bones.hpp File Reference . . . . .	321
8.40 include/barry/models/geese/flock-meat.hpp File Reference . . . . .	321
8.41 include/barry/models/geese/geese-bones.hpp File Reference . . . . .	322
8.41.1 Macro Definition Documentation . . . . .	322
8.41.1.1 INITIALIZED . . . . .	323
8.41.2 Function Documentation . . . . .	323
8.41.2.1 keygen_full() . . . . .	323
8.41.2.2 RULE_FUNCTION() . . . . .	323
8.41.2.3 vec_diff() . . . . .	323
8.41.2.4 vector_caster() . . . . .	323
8.42 include/barry/models/geese/geese-meat-constructors.hpp File Reference . . . . .	324
8.43 include/barry/models/geese/geese-meat-likelihood.hpp File Reference . . . . .	324
8.44 include/barry/models/geese/geese-meat-likelihood_exhaust.hpp File Reference . . . . .	325
8.45 include/barry/models/geese/geese-meat-predict.hpp File Reference . . . . .	326
8.46 include/barry/models/geese/geese-meat-predict_exhaust.hpp File Reference . . . . .	326
8.47 include/barry/models/geese/geese-meat-predict_sim.hpp File Reference . . . . .	327
8.48 include/barry/models/geese/geese-meat-simulate.hpp File Reference . . . . .	327
8.49 include/barry/models/geese/geese-meat.hpp File Reference . . . . .	328
8.50 include/barry/models/geese/geese-node-bones.hpp File Reference . . . . .	328
8.51 include/barry/powerset-bones.hpp File Reference . . . . .	329
8.52 include/barry/powerset-meat.hpp File Reference . . . . .	329

8.53 include/barry/progress.hpp File Reference . . . . .	330
8.53.1 Macro Definition Documentation . . . . .	330
8.53.1.1 BARRY_PROGRESS_BAR_WIDTH . . . . .	330
8.54 include/barry/rules-bones.hpp File Reference . . . . .	331
8.54.1 Function Documentation . . . . .	331
8.54.1.1 rule_fun_default() . . . . .	331
8.55 include/barry/rules-meat.hpp File Reference . . . . .	332
8.56 include/barry/statscounter-bones.hpp File Reference . . . . .	332
8.57 include/barry/statscounter-meat.hpp File Reference . . . . .	333
8.57.1 Macro Definition Documentation . . . . .	334
8.57.1.1 STATSCOUNTER_TEMPLATE . . . . .	334
8.57.1.2 STATSCOUNTER_TEMPLATE_ARGS . . . . .	334
8.57.1.3 STATSCOUNTER_TYPE . . . . .	334
8.57.2 Function Documentation . . . . .	334
8.57.2.1 clear() . . . . .	334
8.57.2.2 for() . . . . .	334
8.57.2.3 resize() . . . . .	335
8.57.2.4 STATSCOUNTER_TEMPLATE() [1/9] . . . . .	335
8.57.2.5 STATSCOUNTER_TEMPLATE() [2/9] . . . . .	335
8.57.2.6 STATSCOUNTER_TEMPLATE() [3/9] . . . . .	335
8.57.2.7 STATSCOUNTER_TEMPLATE() [4/9] . . . . .	335
8.57.2.8 STATSCOUNTER_TEMPLATE() [5/9] . . . . .	335
8.57.2.9 STATSCOUNTER_TEMPLATE() [6/9] . . . . .	336
8.57.2.10 STATSCOUNTER_TEMPLATE() [7/9] . . . . .	336
8.57.2.11 STATSCOUNTER_TEMPLATE() [8/9] . . . . .	336
8.57.2.12 STATSCOUNTER_TEMPLATE() [9/9] . . . . .	336
8.57.3 Variable Documentation . . . . .	336
8.57.3.1 counter . . . . .	336
8.57.3.2 counter_deleted . . . . .	337
8.57.3.3 counters . . . . .	337
8.57.3.4 counters_ . . . . .	337
8.57.3.5 current_stats . . . . .	337
8.57.3.6 EmptyArray . . . . .	337
8.57.3.7 f_ . . . . .	338
8.57.3.8 j . . . . .	338
8.57.3.9 return . . . . .	338
8.58 include/barry/support-bones.hpp File Reference . . . . .	338
8.59 include/barry/support-meat.hpp File Reference . . . . .	339
8.59.1 Macro Definition Documentation . . . . .	340
8.59.1.1 BARRY_SUPPORT_MEAT_HPP . . . . .	340
8.59.1.2 SUPPORT_TEMPLATE . . . . .	340
8.59.1.3 SUPPORT_TEMPLATE_ARGS . . . . .	341

8.59.1.4 SUPPORT_TYPE	341
8.59.2 Function Documentation	341
8.59.2.1 calc_backend_dense()	341
8.59.2.2 calc_backend_sparse()	341
8.59.2.3 for()	341
8.59.2.4 if() [1/3]	342
8.59.2.5 if() [2/3]	342
8.59.2.6 if() [3/3]	342
8.59.2.7 insert_cell() [1/2]	342
8.59.2.8 insert_cell() [2/2]	342
8.59.2.9 rm_cell()	343
8.59.2.10 SUPPORT_TEMPLATE() [1/17]	343
8.59.2.11 SUPPORT_TEMPLATE() [2/17]	343
8.59.2.12 SUPPORT_TEMPLATE() [3/17]	343
8.59.2.13 SUPPORT_TEMPLATE() [4/17]	343
8.59.2.14 SUPPORT_TEMPLATE() [5/17]	344
8.59.2.15 SUPPORT_TEMPLATE() [6/17]	344
8.59.2.16 SUPPORT_TEMPLATE() [7/17]	344
8.59.2.17 SUPPORT_TEMPLATE() [8/17]	344
8.59.2.18 SUPPORT_TEMPLATE() [9/17]	344
8.59.2.19 SUPPORT_TEMPLATE() [10/17]	344
8.59.2.20 SUPPORT_TEMPLATE() [11/17]	345
8.59.2.21 SUPPORT_TEMPLATE() [12/17]	345
8.59.2.22 SUPPORT_TEMPLATE() [13/17]	345
8.59.2.23 SUPPORT_TEMPLATE() [14/17]	345
8.59.2.24 SUPPORT_TEMPLATE() [15/17]	345
8.59.2.25 SUPPORT_TEMPLATE() [16/17]	346
8.59.2.26 SUPPORT_TEMPLATE() [17/17]	346
8.59.3 Variable Documentation	346
8.59.3.1 array_bank	346
8.59.3.2 change_stats_different	346
8.59.3.3 coord_i	346
8.59.3.4 coord_j	346
8.59.3.5 counters	347
8.59.3.6 counters_	347
8.59.3.7 delete_counters	347
8.59.3.8 delete_rules	347
8.59.3.9 delete_rules_dyn	347
8.59.3.10 else	348
8.59.3.11 f_	348
8.59.3.12 hashes	348
8.59.3.13 return	348

8.59.3.14 rules	348
8.59.3.15 rules_	349
8.59.3.16 rules_dyn	349
8.59.3.17 stats_bank	349
8.59.3.18 tmp_chng	349
8.60 include/barry/typedefs.hpp File Reference	350
8.60.1 Typedef Documentation	352
8.60.1.1 Col_type	352
8.60.1.2 Counter_fun_type	352
8.60.1.3 Counts_type	352
8.60.1.4 Hasher_fun_type	352
8.60.1.5 MapVec_type	353
8.60.1.6 Row_type	353
8.60.1.7 Rule_fun_type	353
8.60.1.8 uint	353
8.60.2 Function Documentation	353
8.60.2.1 sort_array()	353
8.60.2.2 vec_equal()	354
8.60.2.3 vec_equal_approx()	354
8.60.2.4 vec_inner_prod() [1/2]	355
8.60.2.5 vec_inner_prod() [2/2]	355
8.61 README.md File Reference	355
<b>Index</b>	<b>357</b>





# 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.



## Chapter 2

# Module Index

### 2.1 Modules

Here is a list of all modules:

Counting . . . . .	<a href="#">11</a>
Statistical Models . . . . .	<a href="#">11</a>
DEFMArray counters . . . . .	<a href="#">12</a>
Phylo counters . . . . .	<a href="#">22</a>
Phylo rules . . . . .	<a href="#">29</a>



## Chapter 3

# Class Index

### 3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

<a href="#">BArray&lt; Cell_Type, Data_Type &gt;</a>	
Baseline class for binary arrays	35
<a href="#">BArrayCell&lt; Cell_Type, Data_Type &gt;</a>	49
<a href="#">BArrayCell_const&lt; Cell_Type, Data_Type &gt;</a>	52
<a href="#">BArrayDense&lt; Cell_Type, Data_Type &gt;</a>	
Baseline class for binary arrays	54
<a href="#">BArrayDenseCell&lt; Cell_Type, Data_Type &gt;</a>	70
<a href="#">BArrayDenseCell_const&lt; Cell_Type, Data_Type &gt;</a>	74
<a href="#">BArrayDenseCol&lt; Cell_Type, Data_Type &gt;</a>	74
<a href="#">BArrayDenseCol_const&lt; Cell_Type, Data_Type &gt;</a>	76
<a href="#">BArrayDenseRow&lt; Cell_Type, Data_Type &gt;</a>	78
<a href="#">BArrayDenseRow_const&lt; Cell_Type, Data_Type &gt;</a>	81
<a href="#">BArrayRow&lt; Cell_Type, Data_Type &gt;</a>	83
<a href="#">BArrayRow_const&lt; Cell_Type, Data_Type &gt;</a>	85
<a href="#">BArrayVector&lt; Cell_Type, Data_Type &gt;</a>	
Row or column of a <a href="#">BArray</a>	87
<a href="#">BArrayVector_const&lt; Cell_Type, Data_Type &gt;</a>	91
<a href="#">Cell&lt; Cell_Type &gt;</a>	
Entries in <a href="#">BArray</a> . For now, it only has two members:	95
<a href="#">Cell_const&lt; Cell_Type &gt;</a>	100
<a href="#">ConstBArrayRowIter&lt; Cell_Type, Data_Type &gt;</a>	100
<a href="#">Counter&lt; Array_Type, Data_Type &gt;</a>	
A counter function based on change statistics	102
<a href="#">Counters&lt; Array_Type, Data_Type &gt;</a>	
Vector of counters	108
<a href="#">DEFM</a>	112
<a href="#">DEFMCounterData</a>	
Data class used to store arbitrary uint or double vectors	117
<a href="#">DEFMData</a>	119
<a href="#">DEFMRuleData</a>	124
<a href="#">Entries&lt; Cell_Type &gt;</a>	
A wrapper class to store source, target, val from a <a href="#">BArray</a> object	126
<a href="#">Flock</a>	
A <a href="#">Flock</a> is a group of <a href="#">Geese</a>	128
<a href="#">FreqTable&lt; T &gt;</a>	
Frequency table of vectors	135

<a href="#">Geese</a>	
Annotated Phylo <a href="#">Model</a>	138
<a href="#">Model&lt; Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type &gt;</a>	
General framework for discrete exponential models. This class allows generating discrete exponential models in the form of a linear exponential model:	150
<a href="#">NetCounterData</a>	
Data class used to store arbitrary uint or double vectors	165
<a href="#">NetworkData</a>	
Data class for Networks	166
<a href="#">Node</a>	
A single node for the model	168
<a href="#">NodeData</a>	
Data definition for the <code>PhyloArray</code> class	174
<a href="#">PhyloCounterData</a>	175
<a href="#">PhyloRuleDynData</a>	178
<a href="#">PowerSet&lt; Array_Type, Data_Rule_Type &gt;</a>	
Powerset of a binary array	180
<a href="#">Progress</a>	
A simple progress bar	187
<a href="#">Rule&lt; Array_Type, Data_Type &gt;</a>	
Rule for determining if a cell should be included in a sequence	188
<a href="#">Rules&lt; Array_Type, Data_Type &gt;</a>	
Vector of objects of class <code>Rule</code>	190
<a href="#">StatsCounter&lt; Array_Type, Data_Type &gt;</a>	
Count stats for a single Array	194
<a href="#">Support&lt; Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type &gt;</a>	
Compute the support of sufficient statistics	197
<a href="#">vecHasher&lt; T &gt;</a>	208



## Chapter 4

# File Index

### 4.1 File List

Here is a list of all files with brief descriptions:

include/barry/barray-bones.hpp . . . . .	209
include/barry/barray-iterator.hpp . . . . .	209
include/barry/barray-meat-operators.hpp . . . . .	210
include/barry/barray-meat.hpp . . . . .	214
include/barry/barraycell-bones.hpp . . . . .	232
include/barry/barraycell-meat.hpp . . . . .	232
include/barry/barraydense-bones.hpp . . . . .	233
include/barry/barraydense-meat-operators.hpp . . . . .	233
include/barry/barraydense-meat.hpp . . . . .	236
include/barry/barraydensecell-bones.hpp . . . . .	257
include/barry/barraydensecell-meat.hpp . . . . .	258
include/barry/barraydensecol-bones.hpp . . . . .	258
include/barry/barraydenserow-bones.hpp . . . . .	260
include/barry/barrayrow-bones.hpp . . . . .	261
include/barry/barrayrow-meat.hpp . . . . .	261
include/barry/barrayvector-bones.hpp . . . . .	263
include/barry/barrayvector-meat.hpp . . . . .	264
include/barry/barray-configuration.hpp . . . . .	264
include/barry/barray-debug.hpp . . . . .	266
include/barry/barray-macros.hpp . . . . .	267
include/barry/barray.hpp . . . . .	268
include/barry/cell-bones.hpp . . . . .	271
include/barry/cell-meat.hpp . . . . .	272
include/barry/col-bones.hpp . . . . .	272
include/barry/counters-bones.hpp . . . . .	272
include/barry/counters-meat.hpp . . . . .	273
include/barry/freqtable.hpp . . . . .	315
include/barry/model-bones.hpp . . . . .	316
include/barry/model-meat.hpp . . . . .	316
include/barry/powerset-bones.hpp . . . . .	329
include/barry/powerset-meat.hpp . . . . .	329
include/barry/progress.hpp . . . . .	330
include/barry/rules-bones.hpp . . . . .	331
include/barry/rules-meat.hpp . . . . .	332
include/barry/statscounter-bones.hpp . . . . .	332

<a href="#">include/barry/statscounter-meat.hpp</a>	333
<a href="#">include/barry/support-bones.hpp</a>	338
<a href="#">include/barry/support-meat.hpp</a>	339
<a href="#">include/barry/typedefs.hpp</a>	350
<a href="#">include/barry/counters/defm-formula.hpp</a>	285
<a href="#">include/barry/counters/defm.hpp</a>	287
<a href="#">include/barry/counters/network-css.hpp</a>	293
<a href="#">include/barry/counters/network.hpp</a>	301
<a href="#">include/barry/counters/phylo.hpp</a>	308
<a href="#">include/barry/models/defm.hpp</a>	292
<a href="#">include/barry/models/geese.hpp</a>	320
<a href="#">include/barry/models/defm/defm-bones.hpp</a>	319
<a href="#">include/barry/models/defm/defm-meat.hpp</a>	319
<a href="#">include/barry/models/geese/flock-bones.hpp</a>	321
<a href="#">include/barry/models/geese/flock-meat.hpp</a>	321
<a href="#">include/barry/models/geese/geese-bones.hpp</a>	322
<a href="#">include/barry/models/geese/geese-meat-constructors.hpp</a>	324
<a href="#">include/barry/models/geese/geese-meat-likelihood.hpp</a>	324
<a href="#">include/barry/models/geese/geese-meat-likelihood_exhaust.hpp</a>	325
<a href="#">include/barry/models/geese/geese-meat-predict.hpp</a>	326
<a href="#">include/barry/models/geese/geese-meat-predict_exhaust.hpp</a>	326
<a href="#">include/barry/models/geese/geese-meat-predict_sim.hpp</a>	327
<a href="#">include/barry/models/geese/geese-meat-simulate.hpp</a>	327
<a href="#">include/barry/models/geese/geese-meat.hpp</a>	328
<a href="#">include/barry/models/geese/geese-node-bones.hpp</a>	328

## 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="", const std::vector< std::string > \*x\_names=nullptr)  
*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="", const std::vector< std::string > \*x\_names=nullptr, const std::vector< std::string > \*y\_names=nullptr)
- 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="", const std::vector< std::string > \*x\_names=nullptr, const std::vector< std::string > \*y\_names=nullptr)  
*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="", const std::vector< std::string > \*x\_names=nullptr, const std::vector< std::string > \*y\_names=nullptr)  
*Prevalence of ones.*
- void [counter\\_fixed\\_effect](#) ([DEFMCounters](#) \*counters, int covar\_index, double k, std::string vname="", const std::vector< std::string > \*x\_names=nullptr)  
*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&lt;DEFMArray, bool&gt;</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 ( <a href="#">Counters</a> < <code>DEFMArray</code> , <code>DEFMCounterData</code> >).
<i>counters</i>	A pointer to a <code>NetCounters</code> object ( <a href="#">Counters</a> < <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 = "",
    const std::vector< std::string > * x_names = nullptr ) [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 736 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 (
    DEFMArrays * counters,
    size_t n_y,
    std::vector< size_t > which = {},
    int covar_index = -1,
    std::string vname = "",
    const std::vector< std::string > * x_names = nullptr,
    const std::vector< std::string > * y_names = nullptr ) [inline]
```

Definition at line 277 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 (
    DEFMArrays * counters,
    int covar_index = -1,
    std::string vname = "",
    const std::vector< std::string > * x_names = nullptr ) [inline]
```

Prevalence of ones.

**Parameters**

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

Definition at line 210 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 = "",
    const std::vector< std::string > * x_names = nullptr,
    const std::vector< std::string > * y_names = nullptr ) [inline]
```

Prevalence of ones.

**Parameters**

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

Definition at line 396 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 = "",
    const std::vector< std::string > * x_names = nullptr,
    const std::vector< std::string > * y_names = nullptr ) [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 705 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 779 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&lt;PhyloArray, PhyloCounterData&gt;</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&lt;PhyloArray, PhyloRuleData&gt;</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>	<a href="#">Support</a> 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

<code>i,j</code>	<i>Row,column</i>
<code>check_bounds</code>	<i>When <code>true</code> and out of range, the function throws an error.</i>
<code>check_exists</code>	<i>Wither check if the cell exists (before trying to delete/add), or, in the case of <code>swap_cells</code>, 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 bararrayrow-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 bararrayrow-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 `barrayrow-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 `barrayrow-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 `barrayrow-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 <a href="#">BArray</a> object
<i>dim_</i>	Dimension. 0 means row and 1 means column.
<i>i_</i>	Element to point.
<i>check_bounds</i>	When <a href="#">true</a> , 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.

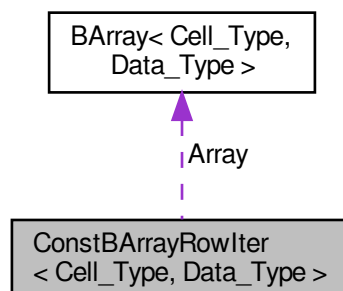
The documentation for this class was generated from the following file:

- [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 <a href="#">BArray</a> as the needed variables (see <a href="#">BArray::data</a> ).
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](#), [Hasher\\_fun\\_type](#)< Array\_Type, Data\_Type > [hasher\\_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](#)\_)  
Move assignment.

- void [set\\_hasher](#) ([Hasher\\_fun\\_type](#)< Array\_Type, Data\_Type > [fun](#))  
Get and set the hasher function.
- [Hasher\\_fun\\_type](#)< Array\_Type, Data\_Type > [get\\_hasher](#) ()

**Public Attributes**

- [Counter\\_fun\\_type](#)< Array\_Type, Data\_Type > [count\\_fun](#)
- [Counter\\_fun\\_type](#)< Array\_Type, Data\_Type > [init\\_fun](#)
- [Hasher\\_fun\\_type](#)< Array\_Type, Data\_Type > [hasher\\_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 57 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_,
    Hasher_fun_type< Array_Type, Data_Type > hasher_fun_,
    Data_Type data_,
    std::string name_ = "",
    std::string desc_ = "" ) [inline]
```

Definition at line 59 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 75 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\_hasher()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Hasher_fun_type<Array_Type,Data_Type> Counter< Array_Type, Data_Type >::get_hasher ( )
```

### 7.18.3.4 get\_name()

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

### 7.18.3.5 init()

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

**7.18.3.6 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.

**7.18.3.7 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.

**7.18.3.8 set\_hasher()**

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
void Counter< Array_Type, Data_Type >::set_hasher (
    Hasher_fun_type< Array_Type, Data_Type > fun )
```

Get and set the hasher function.

The hasher function is used to characterize the support of the array. This way, if possible, the support enumeration is recycled.

**Parameters**

<i>fun</i>	
------------	--

**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 42 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 44 of file counters-bones.hpp.

#### 7.18.4.4 hasher\_fun

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

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

#### 7.18.4.5 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.

#### 7.18.4.6 name

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

Definition at line 43 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\\_](#), [Hasher\\_fun\\_type](#)< Array\_Type, Data\_Type > [hasher\\_fun\\_](#), Data\_Type [data\\_](#), std::string [name\\_](#)="", std::string [desc\\_](#)="")
- std::vector< std::string > [get\\_names](#) () const
- std::vector< std::string > [get\\_descriptions](#) () const
- std::vector< double > [gen\\_hash](#) (const Array\_Type &array, bool [add\\_dims](#)=true)  
*Generates a hash for the given array according to the counters.*
- void [add\\_hash](#) ([Hasher\\_fun\\_type](#)< Array\_Type, Data\_Type > [fun\\_](#))

### 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 108 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 120 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_,
    Hasher_fun_type< Array_Type, Data_Type > hasher_fun_,
    Data_Type data_,
    std::string name_ = "",
    std::string desc_ = "" )
```

**7.19.3.3 add\_hash()**

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
void Counters< Array_Type, Data_Type >::add_hash (
    Hasher_fun_type< Array_Type, Data_Type > fun_ )
```

**7.19.3.4 gen\_hash()**

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
std::vector< double > Counters< Array_Type, Data_Type >::gen_hash (
    const Array_Type & array,
    bool add_dims = true )
```

Generates a hash for the given array according to the counters.

**Parameters**

<i>array</i>	
<i>add_dims</i>	When <code>true</code> (default) the dimension of the array will be added to the hash.

**Returns**

`std::vector< double >` That can be hashed later.

**7.19.3.5 get\_descriptions()**

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

**7.19.3.6 get\_names()**

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

**7.19.3.7 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>](#)

**7.19.3.8 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](#)>&

**7.19.3.9 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](#)>\*

**7.19.3.10 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 164 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`)
- `void set_names` (`std::vector< std::string > Y_names_`, `std::vector< std::string > X_names_`)
- `const std::vector< std::string > & get_Y_names` ()
- `const std::vector< std::string > & get_X_names` ()

### 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 44 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 264 of file defm-meat.hpp.

#### 7.20.3.2 `get_m_order()`

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

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

#### 7.20.3.3 `get_model()`

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

Definition at line 46 of file defm-bones.hpp.

#### 7.20.3.4 `get_n_covars()`

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

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

#### 7.20.3.5 `get_n_obs()`

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

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

### 7.20.3.6 get\_n\_rows()

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

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

### 7.20.3.7 get\_n\_y()

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

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

### 7.20.3.8 get\_X()

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

Definition at line 269 of file defm-meat.hpp.

### 7.20.3.9 get\_X\_names()

```
const std::vector< std::string > & DEFM::get_X_names ( ) [inline]
```

Definition at line 376 of file defm-meat.hpp.

### 7.20.3.10 get\_Y()

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

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

### 7.20.3.11 get\_Y\_names()

```
const std::vector< std::string > & DEFM::get_Y_names ( ) [inline]
```

Definition at line 372 of file defm-meat.hpp.

#### 7.20.3.12 init()

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

Definition at line 193 of file defm-meat.hpp.

#### 7.20.3.13 likelihood()

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

#### 7.20.3.14 logodds()

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

Definition at line 313 of file defm-meat.hpp.

#### 7.20.3.15 motif\_census()

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

Definition at line 275 of file defm-meat.hpp.

#### 7.20.3.16 set\_names()

```
void DEFM::set_names (
    std::vector< std::string > Y_names_,
    std::vector< std::string > X_names_ ) [inline]
```

Definition at line 355 of file defm-meat.hpp.

### 7.20.3.17 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 75 of file defm.hpp.

### 7.21.2 Constructor & Destructor Documentation

### 7.21.2.1 DEFMCOUNTERDATA() [1/2]

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

Definition at line 82 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 83 of file defm.hpp.

### 7.21.2.3 ~DEFMCOUNTERDATA()

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

Definition at line 94 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 90 of file defm.hpp.

### 7.21.3.2 is\_true()

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

Definition at line 92 of file defm.hpp.

### 7.21.3.3 num()

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

Definition at line 91 of file defm.hpp.

## 7.21.4 Member Data Documentation

### 7.21.4.1 indices

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

Definition at line 78 of file defm.hpp.

### 7.21.4.2 logical

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

Definition at line 80 of file defm.hpp.

### 7.21.4.3 numbers

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

Definition at line 79 of file defm.hpp.

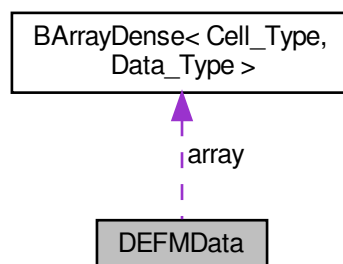
The documentation for this class was generated from the following file:

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

## 7.22 DEFMDData Class Reference

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

Collaboration diagram for DEFMDData:



## Public Member Functions

- [DEFMData](#) ()  
*Vector indicating which covariates are included in the model.*
- [DEFMData](#) ([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](#)
- [size\\_t nrow](#) () [const](#)
- [void print](#) () [const](#)
- [~DEFMData](#) ()

## 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 columns in the array of covariates.*
- [size\\_t X\\_nrow](#)  
*Number of rows in the array of covariates.*
- [std::vector< size\\_t >](#) covar\_sort
- [std::vector< size\\_t >](#) covar\_used  
*Value where the sorting of the covariates is stored.*

### 7.22.1 Detailed Description

Definition at line 27 of file defm.hpp.

### 7.22.2 Constructor & Destructor Documentation

#### 7.22.2.1 DEFMData() [1/2]

```
DEFMData::DEFMData ( ) [inline]
```

Vector indicating which covariates are included in the model.

Definition at line 38 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**

<i>covariates</i> ↔ —	Pointer to the attribute data.
<i>obs_</i> ↔ <i>start_</i>	Location of the current observation in the covariates vector
<i>X_ncol_</i>	Number of columns (covariates.)

Definition at line 47 of file defm.hpp.

**7.22.2.3 ~DEFMData()**

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

Definition at line 69 of file defm.hpp.

**7.22.3 Member Function Documentation****7.22.3.1 at()**

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

**7.22.3.2 ncol()**

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

Definition at line 135 of file defm.hpp.

**7.22.3.3 nrow()**

```
size_t DEFMData::nrow ( ) const [inline]
```

Definition at line 139 of file defm.hpp.

**7.22.3.4 operator()()**

```
double DEFMData::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 130 of file defm.hpp.

**7.22.3.5 print()**

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

Definition at line 143 of file defm.hpp.

**7.22.4 Member Data Documentation****7.22.4.1 array**

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

Definition at line 30 of file defm.hpp.

**7.22.4.2 covar\_sort**

```
std::vector< size_t > DEFMDData::covar_sort
```

Definition at line 35 of file defm.hpp.

**7.22.4.3 covar\_used**

```
std::vector< size_t > DEFMDData::covar_used
```

Value where the sorting of the covariates is stored.

Definition at line 36 of file defm.hpp.

#### 7.22.4.4 covariates

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

Vector of covariates (complete vector)

Definition at line 31 of file defm.hpp.

#### 7.22.4.5 obs\_start

```
size_t DEFMDData::obs_start
```

Index of the observation in the data.

Definition at line 32 of file defm.hpp.

#### 7.22.4.6 X\_ncol

```
size_t DEFMDData::X_ncol
```

Number of columns in the array of covariates.

Definition at line 33 of file defm.hpp.

#### 7.22.4.7 X\_nrow

```
size_t DEFMDData::X_nrow
```

Number of rows in the array of covariates.

Definition at line 34 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 98 of file `defm.hpp`.

### 7.23.2 Constructor & Destructor Documentation

#### 7.23.2.1 DEFMRuleData() [1/2]

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

Definition at line 108 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 110 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 106 of file `defm.hpp`.

### 7.23.3.2 num()

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

Definition at line 105 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 <a href="#">Geese::Geese</a> .
<i>geneid</i>	see <a href="#">Geese</a> .
<i>parent</i>	see <a href="#">Geese</a> .
<i>duplication</i>	see <a href="#">Geese</a> .

**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 222 of file flock-meat.hpp.

**7.25.3.3 get\_counters()**

```
phylocounters::PhyloCounters * Flock::get_counters ( ) [inline]
```

Definition at line 98 of file flock-meat.hpp.

**7.25.3.4 get\_model()**

```
phylocounters::PhyloModel * Flock::get_model ( ) [inline]
```

Definition at line 129 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 115 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 122 of file flock-meat.hpp.

### 7.25.3.7 get\_support\_fun()

```
phylocounters::PhyloSupport * Flock::get_support_fun ( ) [inline]
```

Definition at line 108 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 47 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 <code>true</code> it will return the value as log.
<i>use_reduced_sequence</i>	When <code>true</code> (default) will compute the likelihood using the reduced sequence, which is faster.

#### Returns

double

Definition at line 136 of file flock-meat.hpp.

#### 7.25.3.10 nfuncs()

```
unsigned int Flock::nfuncs ( ) const [inline], [noexcept]
```

Definition at line 165 of file flock-meat.hpp.

#### 7.25.3.11 nleafs()

```
std::vector< unsigned int > Flock::nleafs ( ) const [inline], [noexcept]
```

Definition at line 193 of file flock-meat.hpp.

#### 7.25.3.12 nnodes()

```
std::vector< unsigned int > Flock::nnodes ( ) const [inline], [noexcept]
```

Definition at line 179 of file flock-meat.hpp.

#### 7.25.3.13 nterms()

```
unsigned int Flock::nterms ( ) const [inline]
```

Definition at line 207 of file flock-meat.hpp.

#### 7.25.3.14 ntrees()

```
unsigned int Flock::ntrees ( ) const [inline], [noexcept]
```

Definition at line 172 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 300 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 229 of file flock-meat.hpp.

### 7.25.3.17 print()

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

Definition at line 256 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

<i>s</i>	Passed to the <code>rengine.seed()</code> member object.
----------	--

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

### 7.25.3.19 support\_size()

```
unsigned int Flock::support_size ( ) const [inline], [noexcept]
```

Definition at line 215 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](#)
- Number of unique elements in the table. (.*
- [size\\_t](#) [make\\_hash](#) ([const](#) std::vector< T > &x) [const](#)

### 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	<i>A vector of vectors with annotations. It should be of length <math>k</math> (number of functions). Each vector should be of length <math>N</math> (equal to the number of nodes, including interior). Possible values are 0, 1, and 9.</i>
geneid	<i>Id of the gene. It should be of length <math>N</math>.</i>
parent	<i>Id of the parent gene. Also of length <math>N</math></i>
duplication	<i>Logical scalar indicating the type of event (true: duplication, false: speciation.)</i>

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	<i>When <code>true</code> it will print out information about the encountered polytomies.</i>
------	---

- 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	<i>Vector of parameters (terms + root).</i>
res_prob	<i>Vector indicating each nodes' state probability.</i>
leave_one_out	<i>When <code>true</code>, it will compute the predictions using leave-one-out, thus the prediction will be repeated nleaf times.</i>
only_annotated	<i>When <code>true</code>, it will make the predictions only on the induced sub-tree with annotated leaves.</i>
use_reduced_sequence	<i>Passed to the <code>likelihood</code> method.</i>
preorder	<i>For the tree traversal.</i>

When *res\_prob* is specified, the function will attach the member vector probabilities from the [Nodes](#) objects. This contains the probability that the *i*th 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 19 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 212 of file geese-meat-constructors.hpp.

### 7.27.2.4 Geese() [4/4]

```
Geese::Geese (
    Geese && x ) [inline], [noexcept]
```

Definition at line 287 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 329 of file geese-meat.hpp.

#### 7.27.3.2 `calc_sequence()`

```
void Geese::calc_sequence (
    Node * n = nullptr ) [inline]
```

Definition at line 285 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 451 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 667 of file geese-meat.hpp.

#### 7.27.3.5 `get_counters()`

```
phylocounters::PhyloCounters * Geese::get_counters ( ) [inline]
```

Definition at line 650 of file geese-meat.hpp.

### 7.27.3.6 get\_model()

```
phylocounters::PhyloModel * Geese::get_model ( ) [inline]
```

Definition at line 655 of file geese-meat.hpp.

### 7.27.3.7 get\_probabilities()

```
std::vector< double > Geese::get_probabilities ( ) const [inline]
```

Definition at line 377 of file geese-meat.hpp.

### 7.27.3.8 get\_rengine()

```
std::mt19937 * Geese::get_rengine ( ) [inline]
```

Definition at line 645 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 663 of file geese-meat.hpp.

### 7.27.3.10 get\_support\_fun()

```
phylocounters::PhyloSupport * Geese::get_support_fun ( ) [inline]
```

Definition at line 659 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 228 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 442 of file geese-meat.hpp.

### 7.27.3.17 nfuncs()

```
unsigned int Geese::nfuncs ( ) const [inline], [noexcept]
```

Number of functions analyzed.

Definition at line 398 of file geese-meat.hpp.

### 7.27.3.18 nleafs()

```
unsigned int Geese::nleafs ( ) const [inline], [noexcept]
```

Number of leaf.

Definition at line 412 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 405 of file geese-meat.hpp.

### 7.27.3.20 nterms()

```
unsigned int Geese::nterms ( ) const [inline]
```

Number of terms included.

Definition at line 424 of file geese-meat.hpp.

### 7.27.3.21 observed\_counts()

```
std::vector< std::vector< double > > Geese::observed_counts ( ) [inline]
```

Definition at line 493 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 458 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 627 of file geese-meat.hpp.

#### 7.27.3.31 print\_observed\_counts()

```
void Geese::print_observed_counts ( ) [inline]
```

Definition at line 564 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 432 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 256 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
- 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 > &params={})
- Array\_Type [sample](#) (const uint &i, const std::vector< double > &params)
- double [conditional\\_prob](#) (const Array\_Type &Array\_[\\_](#), const std::vector< double > &params, 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\_[\\_](#))
- void [add\\_hasher](#) ([Hasher\\_fun\\_type](#)< Array\_Type, Data\_Counter\_Type > fun\_[\\_](#))

### 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\_[\\_](#) 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**

params	Vector of parameters
as_log	When <i>true</i> , the function returns the log-likelihood.

- double [likelihood](#) ([const](#) std::vector< double > &params, [const](#) uint &i, bool as\_log=[false](#))
- double [likelihood](#) ([const](#) std::vector< double > &params, [const](#) Array\_Type &Array\_, int i=-1, bool as\_log=[false](#))
- double [likelihood](#) ([const](#) std::vector< double > &params, [const](#) std::vector< double > &target\_, [const](#) uint &i, bool as\_log=[false](#))
- double [likelihood](#) ([const](#) std::vector< double > &params, [const](#) double \*target\_, [const](#) uint &i, bool as\_log=[false](#))
- double [likelihood\\_total](#) ([const](#) std::vector< double > &params, bool as\_log=[false](#))

**Extract elements by index****Parameters**

i	Index relative to the array in the model.
params	A new vector of model parameters to compute the normalizing constant.
as_log	When <i>true</i> returns the logged version of the normalizing constant.

- double [get\\_norm\\_const](#) ([const](#) std::vector< double > &params, [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:

$$\frac{\exp(\theta^t c(A))}{\sum_{A' \in \mathcal{A}} \exp(\theta^t c(A'))}$$

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 <a href="#">BArray</a> object.
<i>Data_Counter_Type</i>	Any type.
<i>Data_Rule_Type</i>	Any type.

Definition at line 34 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 159 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 keygen 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\_hasher()**

```
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_hasher (
    Hasher_fun_type< Array_Type, Data_Counter_Type > fun_ )
```

**7.28.3.5 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 )
```

**7.28.3.6 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_ )
```

**7.28.3.7 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 )
```

**7.28.3.8 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_ )
```

**7.28.3.9 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
```

**7.28.3.10 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  $P\{Y(i,j) = Y^C, \theta\}$ , 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

## 7.28.3.11 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_ )
```

## 7.28.3.12 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 ( )
```

## 7.28.3.13 get\_counters()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
Counters<Array_Type,Data_Counter_Type>* Model< Array_Type, Data_Counter_Type, Data_Rule_Type,
Data_Rule_Dyn_Type >::get_counters ( )
```

## 7.28.3.14 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 )
```

**7.28.3.15 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 )
```

**7.28.3.16 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 ( )
```

**7.28.3.17 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 ( )
```

**7.28.3.18 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)

**7.28.3.19 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 )
```

**7.28.3.20 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
```

**7.28.3.21 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 ( )
```

**7.28.3.22 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 ( )
```

**7.28.3.23 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 ( )
```

**7.28.3.24 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.

**7.28.3.25 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 ( )
```

**7.28.3.26 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 )
```

**7.28.3.27 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 )
```

**7.28.3.28 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 )
```



**7.28.3.29 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 )
```

**7.28.3.30 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 )
```

**7.28.3.31 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]
```

**7.28.3.32 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_ )
```

**7.28.3.33 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.

**7.28.3.34 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
```

**7.28.3.35 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 = {} )
```

**7.28.3.36 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 )
```

**7.28.3.37 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_ )
```

**7.28.3.38 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 * engine_,
    bool delete_ = false ) [inline]
```

Definition at line 129 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 139 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

<code>vertex_attr_</code>	Double vector of length equal to the number of vertices in the data.
<code>directed_</code>	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:

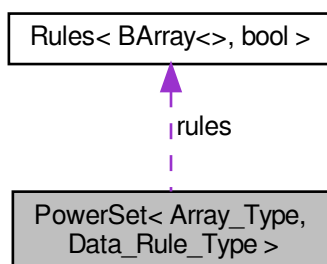
- include/barry/counters/[phylo.hpp](#)

### 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 <code>Rule</code> 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 <code>BArray</code> .
<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 <a href="#">BArray</a>
<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 <a href="#">BArray</a> .
<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 <a href="#">BArray</a> 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 <a href="#">BArray</a> .
—	

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

<code>Array_↵</code> —	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`

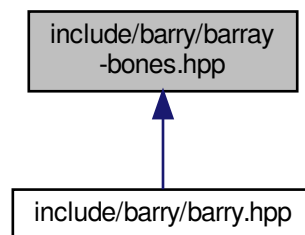


## Chapter 8

# 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.*

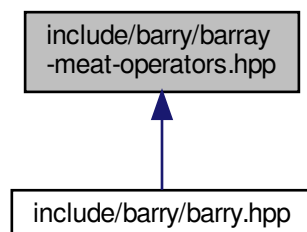
### 8.2 `include/barry/barray-iterator.hpp` File Reference

#### 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`.

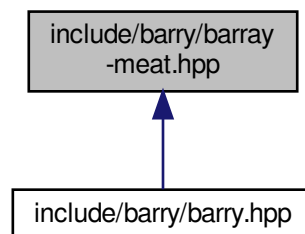
### 8.3.3.2 this

```
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.

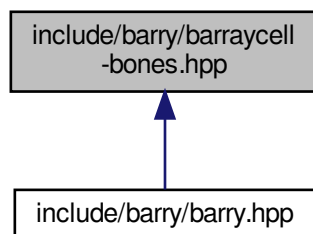
#### 8.4.3.30 value

```
uint const std::vector< uint > const std::vector< uint > const std::vector< Cell_Type >&  
value
```

Definition at line 33 of file bararray-meat.hpp.

## 8.5 include/barry/barraycell-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

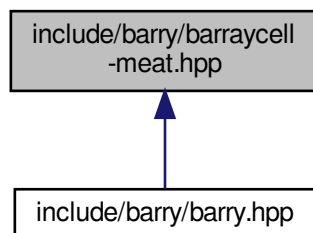


### Classes

- class [BArrayCell< Cell\\_Type, Data\\_Type >](#)
- class [BArrayCell\\_const< Cell\\_Type, Data\\_Type >](#)

## 8.6 include/barry/barraycell-meat.hpp File Reference

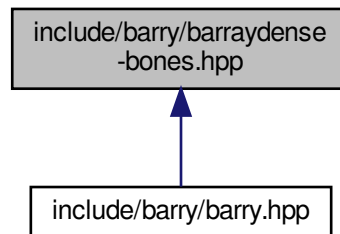
This graph shows which files directly or indirectly include this file:





## 8.7 include/barry/barraydense-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

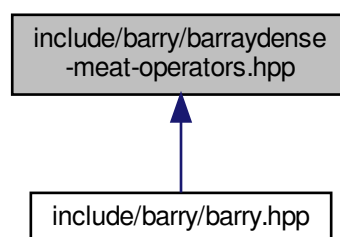


### Classes

- 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 &
```

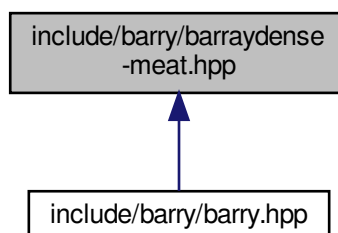
### 8.8.2.6 BDENSE\_TYPE()

```
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 bararraydense-meat.hpp.

### 8.9.1.7 ROW

```
#define ROW(  
    a ) this->el_ij[a]
```

Definition at line 30 of file bararraydense-meat.hpp.

### 8.9.1.8 ZERO\_CELL

```
#define ZERO_CELL static_cast<Cell_Type>(0.0)
```

Definition at line 38 of file bararraydense-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 bararraydense-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 baraydense-meat.hpp.

**8.9.2.20 BDENSE\_TEMPLATE() [19/39]**

```
BDENSE_TEMPLATE (
    Data_Type * ,
    D_ptr )
```

Definition at line 341 of file baraydense-meat.hpp.

**8.9.2.21 BDENSE\_TEMPLATE() [20/39]**

```
BDENSE_TEMPLATE (
    Entries< Cell_Type > ,
    get_entries ) const
```

Definition at line 502 of file baraydense-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 baraydense-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 baraydense-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(el[POS(i0, j)], el[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(el)
```

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

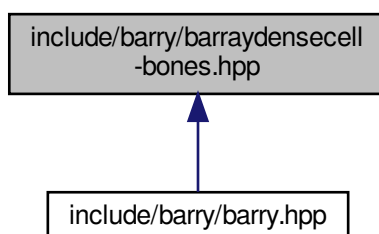
```
uint const std::vector< uint > const std::vector< uint > const std::vector< Cell_Type >&  
value
```

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

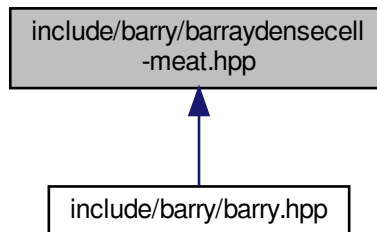
#### 8.10.1.1 POS

```
#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

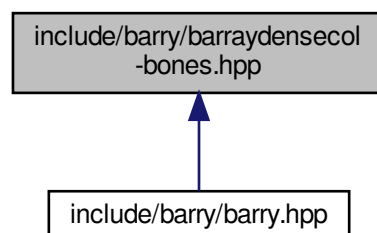
##### 8.11.1.1 POS

```
#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`.

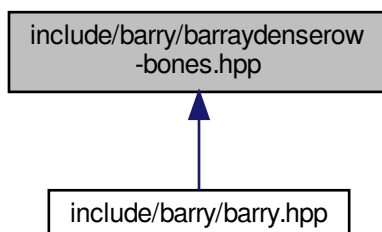
#### 8.12.1.3 ZERO\_CELL

```
#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

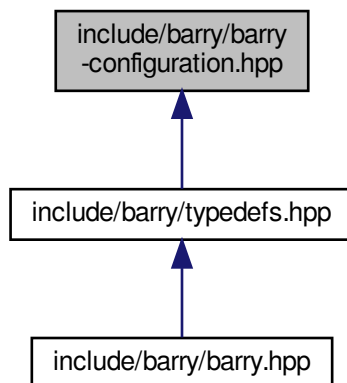
### Classes

- 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

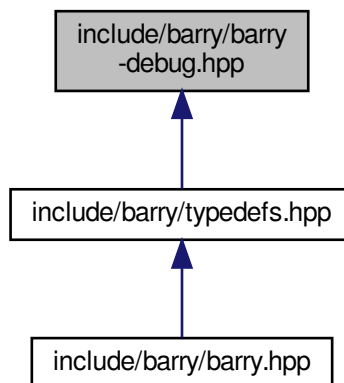
### 8.18.2.1 Map

```
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 )
```

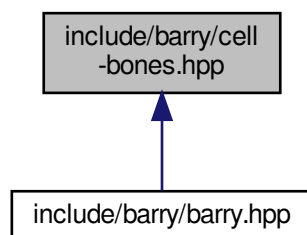
**Value:**

```
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:

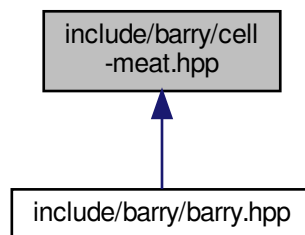


## Classes

- class [Cell< Cell\\_Type >](#)  
*Entries in [BArray](#). For now, it only has two members:*

## 8.23 include/barry/cell-meat.hpp File Reference

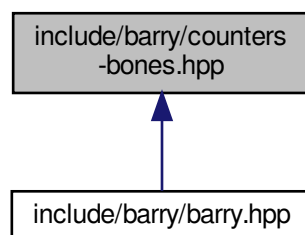
This graph shows which files directly or indirectly include this file:



## 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 TMP_HASHER_CALL Hasher_fun_type<Array_Type,Data_Type>`
- `#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 hasher_fun (counter_.hasher_fun)`
- `Data_Type &&counter_.init_fun (std::move(counter_.init_fun))`
- `Data_Type &&counter_.hasher_fun (std::move(counter_.hasher_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`
- `COUNTER_TEMPLATE (void, set_hasher)(Hasher_fun_type< Array_Type`

- [COUNTER\\_TEMPLATE](#) ([TMP\\_HASHER\\_CALL](#), [get\\_hasher](#)())
- [COUNTERS\\_TEMPLATE](#) (, [Counters](#)())
- [COUNTERS\\_TEMPLATE](#) ([COUNTER\\_TYPE](#)() &, [operator\[\]](#))([uint](#) idx)
- [Data\\_Type](#) [hasher](#) ([counter\\_.hasher](#))
- [Data\\_Type](#) &&[counters\\_ hasher](#) ([std::move](#)([counter\\_.hasher](#)))
- [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](#)
- [COUNTERS\\_TEMPLATE](#) ([std::vector](#)< [double](#) >, [gen\\_hash](#))([const](#) [Array\\_Type](#) &[array](#)
- [for](#) ([auto](#) &[c:data](#))
- [if](#) ([add\\_dims](#))
- [if](#) ([hasher](#))
- [if](#) ([res.size\(\)](#)==0u) [res.push\\_back](#)(0.0)
- [COUNTERS\\_TEMPLATE](#) ([void](#), [add\\_hash](#))([Hasher\\_fun\\_type](#)< [Array\\_Type](#)

## Variables

- [Data\\_Type](#) & [counter\\_](#)
- [Data\\_Type](#) &&[counter\\_ noexcept](#)
- [uint](#) [i](#)
- [uint](#) [uint j](#)
- [Data\\_Type](#) [fun](#)
- [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](#) > [Hasher\\_fun\\_type](#)< [Array\\_Type](#), [Data\\_Type](#) > [hasher\\_fun\\_](#)
- [Data\\_Type](#) [Counter\\_fun\\_type](#)< [Array\\_Type](#), [Data\\_Type](#) > [Hasher\\_fun\\_type](#)< [Array\\_Type](#), [Data\\_Type](#) > [Data\\_Type](#) [data\\_](#)
- [Data\\_Type](#) [Counter\\_fun\\_type](#)< [Array\\_Type](#), [Data\\_Type](#) > [Hasher\\_fun\\_type](#)< [Array\\_Type](#), [Data\\_Type](#) > [Data\\_Type](#) [std::string](#) [name\\_](#)
- [Data\\_Type](#) [Counter\\_fun\\_type](#)< [Array\\_Type](#), [Data\\_Type](#) > [Hasher\\_fun\\_type](#)< [Array\\_Type](#), [Data\\_Type](#) > [Data\\_Type](#) [std::string](#) [std::string](#) [desc\\_](#)
- [bool](#) [add\\_dims](#)
- [return](#) [res](#)
- [Data\\_Type](#) [fun\\_](#)

## 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 129 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 127 of file counters-meat.hpp.

### 8.26.1.6 COUNTERS\_TYPE

```
#define COUNTERS_TYPE( ) Counters<Array_Type,Data_Type>
```

Definition at line 125 of file counters-meat.hpp.

### 8.26.1.7 TMP\_HASHER\_CALL

```
#define TMP_HASHER_CALL Hasher_fun_type<Array_Type,Data_Type>
```

Definition at line 115 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() [1/9]

```
COUNTER_TEMPLATE (
    Counter ) const
```

### 8.26.2.3 COUNTER\_TEMPLATE() [2/9]

```
COUNTER_TEMPLATE (
    COUNTER_TYPE() & ,
    operator )
```

### 8.26.2.4 COUNTER\_TEMPLATE() [3/9]

```
COUNTER_TEMPLATE (
    COUNTER_TYPE() ,
    operator ) const
```

### 8.26.2.5 COUNTER\_TEMPLATE() [4/9]

```
COUNTER_TEMPLATE (
    double ,
    count ) &
```

[< Move assignment](#)

**8.26.2.6 COUNTER\_TEMPLATE()** [5/9]

```
COUNTER_TEMPLATE (
    double ,
    init ) &
```

**8.26.2.7 COUNTER\_TEMPLATE()** [6/9]

```
COUNTER_TEMPLATE (
    std::string ,
    get_description ) const
```

Definition at line 107 of file counters-meat.hpp.

**8.26.2.8 COUNTER\_TEMPLATE()** [7/9]

```
COUNTER_TEMPLATE (
    std::string ,
    get_name ) const
```

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

**8.26.2.9 COUNTER\_TEMPLATE()** [8/9]

```
COUNTER_TEMPLATE (
    TMP_HASHER_CALL ,
    get_hasher )
```

Definition at line 116 of file counters-meat.hpp.

**8.26.2.10 COUNTER\_TEMPLATE()** [9/9]

```
COUNTER_TEMPLATE (
    void ,
    set_hasher )
```

**8.26.2.11 COUNTERS\_TEMPLATE()** [1/9]

```
COUNTERS_TEMPLATE (
    Counters )
```

Definition at line 132 of file counters-meat.hpp.

**8.26.2.12 COUNTERS\_TEMPLATE()** [2/9]

```
COUNTERS_TEMPLATE (
    COUNTER_TYPE() & ,
    operator [ ] )
```

Definition at line 134 of file counters-meat.hpp.

**8.26.2.13 COUNTERS\_TEMPLATE()** [3/9]

```
COUNTERS_TEMPLATE (
    COUNTERS_TYPE() & ,
    operator )
```

**8.26.2.14 COUNTERS\_TEMPLATE()** [4/9]

```
COUNTERS_TEMPLATE (
    COUNTERS_TYPE() ,
    operator ) const
```

**8.26.2.15 COUNTERS\_TEMPLATE()** [5/9]

```
COUNTERS_TEMPLATE (
    std::vector< double > ,
    gen_hash ) const &
```

**8.26.2.16 COUNTERS\_TEMPLATE()** [6/9]

```
COUNTERS_TEMPLATE (
    std::vector< std::string > ,
    get_descriptions ) const
```

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

**8.26.2.17 COUNTERS\_TEMPLATE() [7/9]**

```
COUNTERS_TEMPLATE (
    std::vector< std::string > ,
    get_names ) const
```

Definition at line 201 of file counters-meat.hpp.

**8.26.2.18 COUNTERS\_TEMPLATE() [8/9]**

```
COUNTERS_TEMPLATE (
    void ,
    add_counter )
```

**8.26.2.19 COUNTERS\_TEMPLATE() [9/9]**

```
COUNTERS_TEMPLATE (
    void ,
    add_hash )
```

**8.26.2.20 data()**

```
Data_Type&& counter_ data (
    std::move(counter_.data) )
```

**8.26.2.21 desc()**

```
Data_Type&& counter_ desc (
    std::move(counter_.desc) )
```

Move constructor.

Definition at line 32 of file counters-meat.hpp.

**8.26.2.22 for()**

```
for (
    auto &c:data )
```

Definition at line 231 of file counters-meat.hpp.

**8.26.2.23 hasher()** [1/2]

```
Data_Type hasher (  
    counter_.  hasher )
```

Definition at line 141 of file counters-meat.hpp.

**8.26.2.24 hasher()** [2/2]

```
Data_Type&& counters_ hasher (  
    std::move(counter_.hasher) )
```

Definition at line 144 of file counters-meat.hpp.

**8.26.2.25 hasher\_fun()** [1/2]

```
Data_Type hasher_fun (  
    counter_.  hasher_fun )
```

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

**8.26.2.26 hasher\_fun()** [2/2]

```
Data_Type&& counter_ hasher_fun (  
    std::move(counter_.hasher_fun) )
```

**8.26.2.27 if()** [1/3]

```
if (  
    add_dims )
```

Definition at line 246 of file counters-meat.hpp.

**8.26.2.28 if()** [2/3]

```
if (  
    hasher )
```

Definition at line 253 of file counters-meat.hpp.



### 8.26.2.29 if() [3/3]

```
if (
    res.  size() == 0u )
```

### 8.26.2.30 init\_fun() [1/3]

```
return init_fun (
    Array ,
    i ,
    j ,
    data )
```

### 8.26.2.31 init\_fun() [2/3]

```
Data_Type init_fun (
    counter_.  init_fun )
```

### 8.26.2.32 init\_fun() [3/3]

```
Data_Type&& counter_ init_fun (
    std::move(counter_.init_fun) )
```

### 8.26.2.33 name()

```
Data_Type&& counter_ name (
    std::move(counter_.name) )
```

## 8.26.3 Variable Documentation

### 8.26.3.1 add\_dims

```
bool add_dims
```

#### Initial value:

```
{
    std::vector<double> res
```

Definition at line 225 of file counters-meat.hpp.

### 8.26.3.2 count\_fun\_

Data\_Type count\_fun\_

Definition at line 179 of file counters-meat.hpp.

### 8.26.3.3 counter

Data\_Type counter

#### Initial value:

```
{
    data.push_back(counter)
```

Definition at line 170 of file counters-meat.hpp.

### 8.26.3.4 counter\_

Data\_Type & counter\_

#### Initial value:

```
{
    if (this != &counter_) {
        this->count_fun = counter_.count_fun;
        this->init_fun = counter_.init_fun;
        this->hasher_fun = counter_.hasher_fun;

        this->data = counter_.data;
        this->name = counter_.name;
        this->desc = counter_.desc;
    }
    return *this
```

Definition at line 12 of file counters-meat.hpp.

### 8.26.3.5 data\_

Data\_Type Counter\_fun\_type<Array\_Type,Data\_Type> Hasher\_fun\_type<Array\_Type,Data\_Type> Data↔  
\_Type data\_

Definition at line 182 of file counters-meat.hpp.

### 8.26.3.6 desc\_

```
Data_Type Counter_fun_type<Array_Type,Data_Type> Hasher_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_,  
        hasher_fun_,  
        data_,  
        name_,  
        desc_  
    ))  
}
```

Definition at line 184 of file counters-meat.hpp.

### 8.26.3.7 fun

```
Data_Type fun
```

**Initial value:**

```
{  
    hasher_fun = fun
```

Definition at line 111 of file counters-meat.hpp.

### 8.26.3.8 fun\_

```
Data_Type fun_
```

**Initial value:**

```
{  
    hasher = fun_
```

Definition at line 268 of file counters-meat.hpp.

### 8.26.3.9 hasher\_fun\_

```
Data_Type Counter_fun_type<Array_Type,Data_Type> Hasher_fun_type<Array_Type,Data_Type> hasher←  
_fun_
```

Definition at line 181 of file counters-meat.hpp.

**8.26.3.10 i**

```
uint i
```

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

**8.26.3.11 init\_fun\_**

```
Data_Type Counter_fun_type<Array_Type,Data_Type> init_fun_
```

Definition at line 180 of file counters-meat.hpp.

**8.26.3.12 j**

```
uint uint j
```

**Initial value:**

```
{
    if (count_fun == nullptr)
        return 0.0
```

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

**8.26.3.13 name\_**

```
Data_Type Counter_fun_type<Array_Type,Data_Type> Hasher_fun_type<Array_Type,Data_Type> Data↔
_Type std::string name_
```

Definition at line 183 of file counters-meat.hpp.

**8.26.3.14 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->hasher_fun = std::move(counter_.hasher_fun);

        this->name = std::move(counter_.name);
        this->desc = std::move(counter_.desc);
    }
    return *this
```

Definition at line 26 of file counters-meat.hpp.

### 8.26.3.15 res

```
return res
```

Definition at line 263 of file counters-meat.hpp.

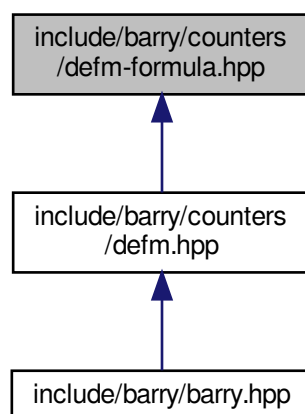
### 8.26.3.16 return

```
return
```

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

## 8.27 include/barry/counters/defm-formula.hpp File Reference

This graph shows which files directly or indirectly include this file:



## 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.*

### 8.27.1 Function Documentation

### 8.27.1.1 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

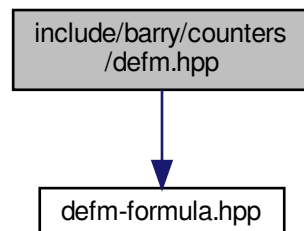
<i>formula</i>	
<i>locations</i>	
<i>signs</i>	
<i>m_order</i>	
<i>y_ncol</i>	

Definition at line 46 of file `defm-formula.hpp`.

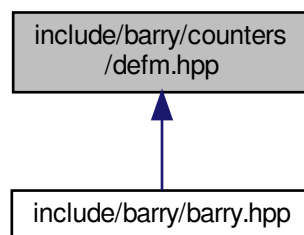
## 8.28 include/barry/counters/defm.hpp File Reference

```
#include "defm-formula.hpp"
```

Include dependency graph for defm.hpp:



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 [MAKE\\_DEFM\\_HASHER](#)(hasher, a, cov)
- #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, DEFMDData > 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 `counter_ones (DEFMCounters *counters, int covar_index=-1, std::string vname="", const std::vector< std::string > *x_names=nullptr)`

*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="", const std::vector< std::string > *x_names=nullptr, const std::vector< std::string > *y_names=nullptr)`
- 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="", const std::vector< std::string > *x_names=nullptr, const std::vector< std::string > *y_names=nullptr)`

*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="", const std::vector< std::string > *x_names=nullptr, const std::vector< std::string > *y_names=nullptr)`

*Prevalence of ones.*

- void `counter_fixed_effect (DEFMCounters *counters, int covar_index, double k, std::string vname="", const std::vector< std::string > *x_names=nullptr)`

*Prevalence of ones.*

### Returns true if the cell is free

#### Parameters

rules	A pointer to a <code>DEFMRules</code> object ( <code>Rules&lt;DEFMArray, bool&gt;</code> ).
-------	---



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

## 8.28.1 Macro Definition Documentation

### 8.28.1.1 DEFM\_COUNTER

```
#define DEFM_COUNTER(  
    a ) inline double (a) (const DEFMArrary & Array, uint i, uint j, DEFMCOUNTERData  
& data)
```

Function for definition of a network counter function

Definition at line 174 of file defm.hpp.

### 8.28.1.2 DEFM\_COUNTER\_LAMBDA

```
#define DEFM_COUNTER_LAMBDA(  
    a )
```

#### Value:

```
Counter_fun_type<DEFMArrary, DEFMCOUNTERData> a = \  
[] (const DEFMArrary & Array, uint i, uint j, DEFMCOUNTERData & data)
```

Lambda function for definition of a network counter function

Definition at line 178 of file defm.hpp.

### 8.28.1.3 DEFM\_RULE

```
#define DEFM_RULE(  
    a ) inline bool (a) (const DEFMArrary & Array, uint i, uint j, bool & data)
```

Function for definition of a network counter function

Definition at line 188 of file defm.hpp.

### 8.28.1.4 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 192 of file defm.hpp.

### 8.28.1.5 MAKE\_DEFM\_HASHER

```
#define MAKE_DEFM_HASHER(
    hasher,
    a,
    cov )
```

#### Value:

```
Hasher_fun_type<DEFMArray,DEFMCounterData> hasher = [cov](const DEFMArray & array,
DEFMCounterData * d) { \
    std::vector< double > res; \
    /* Adding the column feature */ \
    for (size_t i = 0u; i < array.nrow(); ++i) \
        res.push_back(array.D()(i, cov)); \
    /* Adding the fixed dims */ \
    for (size_t i = 0u; i < (array.nrow() - 1); ++i) \
        for (size_t j = 0u; j < array.ncol(); ++j) \
            res.push_back(array(i, j)); \
    return res;\
};
```

Definition at line 157 of file defm.hpp.

### 8.28.1.6 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")))))))\
)
```

## 8.28.2 Typedef Documentation

### 8.28.2.1 DEFMArray

```
typedef BArrayDense<int, DEFMDData> DEFMArray
```

Definition at line 25 of file defm.hpp.

### 8.28.2.2 DEFMCounter

```
typedef Counter<DEFMArray, DEFMCounterData > DEFMCounter
```

Definition at line 121 of file defm.hpp.

### 8.28.2.3 DEFMCounters

```
typedef Counters<DEFMArray, DEFMCounterData> DEFMCounters
```

Definition at line 122 of file defm.hpp.

### 8.28.2.4 DEFMModel

```
typedef Model<DEFMArray, DEFMCounterData, DEFMRuleData, DEFMRuleData> DEFMModel
```

Definition at line 125 of file defm.hpp.

### 8.28.2.5 DEFMRule

```
typedef Rule<DEFMArray, DEFMRuleData> DEFMRule
```

Definition at line 126 of file defm.hpp.

### 8.28.2.6 DEFMRules

```
typedef Rules<DEFMArray, DEFMRuleData> DEFMRules
```

Definition at line 127 of file defm.hpp.

### 8.28.2.7 DEFStatsCounter

```
typedef StatsCounter<DEFMArray, DEFMCounterData> DEFStatsCounter
```

Definition at line 124 of file defm.hpp.

### 8.28.2.8 DEFMSupport

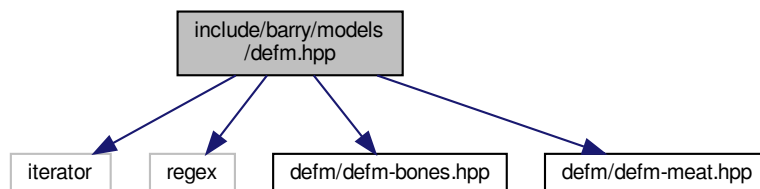
```
typedef Support<DEFMArray, DEFMCounterData, DEFMRuleData> DEFMSupport
```

Definition at line 123 of file defm.hpp.

## 8.29 include/barry/models/defm.hpp File Reference

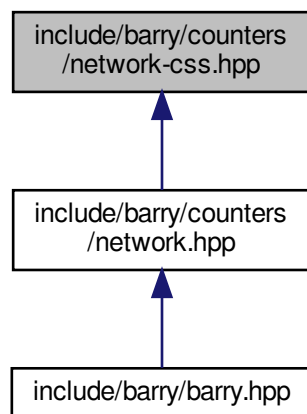
```
#include <iterator>
#include <regex>
#include "defm/defm-bones.hpp"
#include "defm/defm-meat.hpp"
```

Include dependency graph for defm.hpp:



## 8.30 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_)`

## 8.30.1 Macro Definition Documentation

### 8.30.1.1 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, nullptr, \n        NetCounterData({netsize, i == 0u ? netsize : end_[i-1], end_[i]}, {}),\n        tmpname); }
```

Definition at line 42 of file network-css.hpp.

### 8.30.1.2 CSS\_CASE\_ELSE

```
#define CSS_CASE_ELSE( )
```

Definition at line 27 of file network-css.hpp.

### 8.30.1.3 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.

### 8.30.1.4 CSS\_CASE\_TRUTH

```
#define CSS_CASE_TRUTH( ) if ((i < n) && (j < n))
```

Definition at line 13 of file network-css.hpp.

### 8.30.1.5 CSS\_CHECK\_SIZE

```
#define CSS_CHECK_SIZE( )
```

#### Value:

```
for (uint i = 0u; i < end_.size(); ++i) {\n    if (i == 0u) continue; \n    else if (end_[i] < end_[i-1u]) \n        throw std::logic_error("Endpoints should be specified in order.");}
```

Definition at line 37 of file network-css.hpp.

### 8.30.1.6 CSS\_CHECK\_SIZE\_INIT

```
#define CSS_CHECK_SIZE_INIT( )
```

#### Value:

```
/* The indices fall within the network */ \nif ((data.indices.at(0) > Array.ncol()) \n    | (data.indices.at(2) > Array.ncol())) \n    throw std::range_error("The network does not match the prescribed size.");
```

Definition at line 31 of file network-css.hpp.

### 8.30.1.7 CSS\_NET\_COUNTER\_LAMBDA\_INIT

```
#define CSS_NET_COUNTER_LAMBDA_INIT( )
```

**Value:**

```
NETWORK_COUNTER_LAMBDA(tmp_init) {\
    CSS_CHECK_SIZE_INIT() \
    return 0.0; \
};
```

Definition at line 49 of file network-css.hpp.

### 8.30.1.8 CSS\_PERCEIVED\_CELLS

```
#define CSS_PERCEIVED_CELLS( )
```

**Value:**

```
double tji = static_cast<double>(Array(j - s, i - s, false)); \
double pji = static_cast<double>(Array(j, i, false)); \
double tij = static_cast<double>(Array(i - s, j - s, false));
```

Definition at line 21 of file network-css.hpp.

### 8.30.1.9 CSS\_SIZE

```
#define CSS_SIZE( )
```

**Value:**

```
uint n = data.indices[0u]; \
uint s = data.indices[1u]; \
uint e = data.indices[2u];
```

Definition at line 7 of file network-css.hpp.

### 8.30.1.10 CSS\_TRUE\_CELLS

```
#define CSS_TRUE_CELLS( )
```

**Value:**

```
double tji = static_cast<double>(Array(j, i, false)); \
double pij = static_cast<double>(Array(i + s, j + s, false)); \
double pji = static_cast<double>(Array(j + s, i + s, false));
```

Definition at line 14 of file network-css.hpp.

## 8.30.2 Function Documentation



### 8.30.2.1 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.

### 8.30.2.2 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.

### 8.30.2.3 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.

### 8.30.2.4 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.

### 8.30.2.5 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.

### 8.30.2.6 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.

### 8.30.2.7 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.

### 8.30.2.8 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.

### 8.30.2.9 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.

### 8.30.2.10 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.

### 8.30.2.11 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.

### 8.30.2.12 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.

### 8.30.2.13 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.

### 8.30.2.14 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.

### 8.30.2.15 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]
```

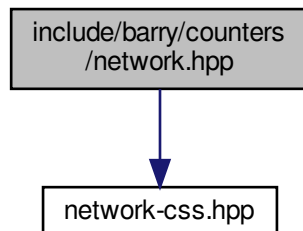
Counts errors of omission.

Definition at line 110 of file network-css.hpp.

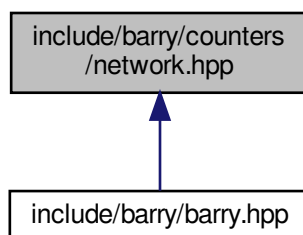
## 8.31 include/barry/counters/network.hpp File Reference

```
#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&lt;Network, bool&gt;</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 >`

#### 8.31.1 Macro Definition Documentation

#### 8.31.1.1 BARRY\_ZERO\_NETWORK

```
#define BARRY_ZERO_NETWORK 0.0
```

Definition at line 85 of file network.hpp.

#### 8.31.1.2 BARRY\_ZERO\_NETWORK\_DENSE

```
#define BARRY_ZERO_NETWORK_DENSE 0
```

Definition at line 86 of file network.hpp.

#### 8.31.1.3 NET\_C\_DATA\_IDX

```
#define NET_C_DATA_IDX(  
    i ) (data.indices[i])
```

Definition at line 74 of file network.hpp.

#### 8.31.1.4 NET\_C\_DATA\_NUM

```
#define NET_C_DATA_NUM(  
    i ) (data.numbers[i])
```

Definition at line 75 of file network.hpp.

#### 8.31.1.5 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.



### 8.31.1.6 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.

### 8.31.1.7 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.

### 8.31.1.8 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.

### 8.31.1.9 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.

## 8.31.2 Typedef Documentation

### 8.31.2.1 NetCounter

```
template<typename Tnet = Network>  
using NetCounter = Counter<Tnet, NetCounterData >
```

Definition at line 89 of file network.hpp.

### 8.31.2.2 NetCounters

```
template<typename Tnet = Network>  
using NetCounters = Counters<Tnet, NetCounterData>
```

Definition at line 92 of file network.hpp.

### 8.31.2.3 NetModel

```
template<typename Tnet >  
using NetModel = Model<Tnet, NetCounterData>
```

Definition at line 101 of file network.hpp.

### 8.31.2.4 NetRule

```
template<typename Tnet = Network>  
using NetRule = Rule<Tnet, bool>
```

Definition at line 104 of file network.hpp.

### 8.31.2.5 NetRules

```
template<typename Tnet = Network>  
using NetRules = Rules<Tnet, bool>
```

Definition at line 107 of file network.hpp.

### 8.31.2.6 NetStatsCounter

```
template<typename Tnet = Network>
using NetStatsCounter = StatsCounter<Tnet, NetCounterData>
```

Definition at line 98 of file network.hpp.

### 8.31.2.7 NetSupport

```
template<typename Tnet = Network>
using NetSupport = Support<Tnet, NetCounterData >
```

Definition at line 95 of file network.hpp.

### 8.31.2.8 Network

```
typedef BArray<double, NetworkData> Network
```

Definition at line 82 of file network.hpp.

### 8.31.2.9 NetworkDense

```
typedef BArrayDense<int, NetworkData> NetworkDense
```

Definition at line 83 of file network.hpp.

## 8.31.3 Function Documentation

### 8.31.3.1 rules\_zerodiag()

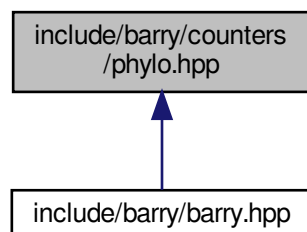
```
template<typename Tnet = Network>
void rules_zerodiag (
    NetRules< Tnet > * rules ) [inline]
```

Number of edges.

Definition at line 1383 of file network.hpp.

## 8.32 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:  $\delta\{x(u,a): 0 \rightarrow 1\} = 1 - 2 * x(w,a)$*
- 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.*

## 8.32.1 Macro Definition Documentation

### 8.32.1.1 DEFAULT\_DUPLICATION

```
#define DEFAULT_DUPLICATION 1u
```

Definition at line 5 of file phylo.hpp.

### 8.32.1.2 DUPL\_DUPL

```
#define DUPL_DUPL 1u
```

Definition at line 7 of file phylo.hpp.

### 8.32.1.3 DUPL\_EITH

```
#define DUPL_EITH 2u
```

Definition at line 8 of file phylo.hpp.

#### 8.32.1.4 DUPL\_SPEC

```
#define DUPL_SPEC 0u
```

Definition at line 6 of file phylo.hpp.

#### 8.32.1.5 IF\_MATCHES

```
#define IF_MATCHES( )
```

**Value:**

```
MAKE_DUPL_VARS() \
if (IS_EITHER() | IS_DUPLICATION() | IS_SPECIATION())
```

Definition at line 19 of file phylo.hpp.

#### 8.32.1.6 IF\_NOTMATCHES

```
#define IF_NOTMATCHES( )
```

**Value:**

```
MAKE_DUPL_VARS() \
if (!IS_EITHER() & !IS_DUPLICATION() & !IS_SPECIATION())
```

Definition at line 21 of file phylo.hpp.

#### 8.32.1.7 IS\_DUPLICATION

```
#define IS_DUPLICATION( ) ((DATA_AT == DUPL_DUPL) & (DPL))
```

Definition at line 16 of file phylo.hpp.

#### 8.32.1.8 IS\_EITHER

```
#define IS_EITHER( ) (DATA_AT == DUPL_EITH)
```

Definition at line 15 of file phylo.hpp.

### 8.32.1.9 IS\_SPECIATION

```
#define IS_SPECIATION( ) ((DATA_AT == DUPL_SPEC) & (!DPL))
```

Definition at line 17 of file phylo.hpp.

### 8.32.1.10 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.

### 8.32.1.11 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.

### 8.32.1.12 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.



### 8.32.1.13 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.

## 8.32.2 Typedef Documentation

### 8.32.2.1 PhyloArray

```
typedef BArrayDense<uint, NodeData> PhyloArray
```

Definition at line 106 of file phylo.hpp.

### 8.32.2.2 PhyloCounter

```
typedef Counter<PhyloArray, PhyloCounterData > PhyloCounter
```

Definition at line 107 of file phylo.hpp.

### 8.32.2.3 PhyloCounters

```
typedef Counters< PhyloArray, PhyloCounterData> PhyloCounters
```

Definition at line 108 of file phylo.hpp.

### 8.32.2.4 PhyloModel

```
typedef Model<PhyloArray, PhyloCounterData, PhyloRuleData, PhyloRuleDynData > PhyloModel
```

Definition at line 118 of file phylo.hpp.

### 8.32.2.5 PhyloPowerSet

```
typedef PowerSet<PhyloArray, PhyloRuleData> PhyloPowerSet
```

Definition at line 119 of file phylo.hpp.

### 8.32.2.6 PhyloRule

```
typedef Rule<PhyloArray,PhyloRuleData> PhyloRule
```

Definition at line 110 of file phylo.hpp.

### 8.32.2.7 PhyloRuleData

```
typedef std::vector< std::pair< uint, uint > > PhyloRuleData
```

Definition at line 99 of file phylo.hpp.

### 8.32.2.8 PhyloRuleDyn

```
typedef Rule<PhyloArray,PhyloRuleDynData> PhyloRuleDyn
```

Definition at line 113 of file phylo.hpp.

### 8.32.2.9 PhyloRules

```
typedef Rules<PhyloArray,PhyloRuleData> PhyloRules
```

Definition at line 111 of file phylo.hpp.

### 8.32.2.10 PhyloRulesDyn

```
typedef Rules<PhyloArray,PhyloRuleDynData> PhyloRulesDyn
```

Definition at line 114 of file phylo.hpp.

### 8.32.2.11 PhyloStatsCounter

```
typedef StatsCounter<PhyloArray, PhyloCounterData> PhyloStatsCounter
```

Definition at line 117 of file phylo.hpp.

### 8.32.2.12 PhyloSupport

```
typedef Support<PhyloArray, PhyloCounterData, PhyloRuleData, PhyloRuleDynData > PhyloSupport
```

Definition at line 116 of file phylo.hpp.

## 8.32.3 Function Documentation

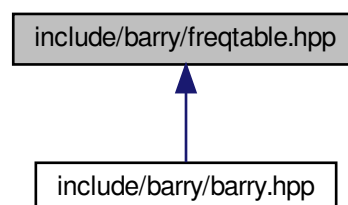
### 8.32.3.1 get\_last\_name()

```
std::string get_last_name (
    unsigned int d ) [inline]
```

Definition at line 142 of file phylo.hpp.

## 8.33 include/barry/freqtable.hpp File Reference

This graph shows which files directly or indirectly include this file:

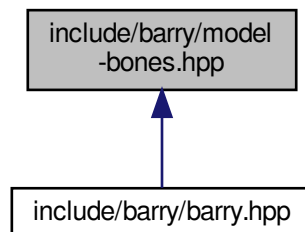


## Classes

- class `FreqTable< T >`  
*Frequency table of vectors.*

## 8.34 include/barry/model-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:



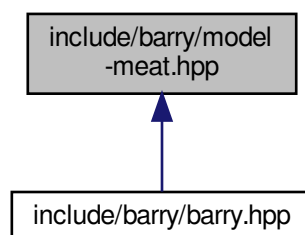
### Classes

- 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:*

## 8.35 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 > &params, const double normalizing\_constant, size\_t n\_params, bool log\_=false)
- [MODEL\\_TEMPLATE](#) (, [Model](#)())()
- [MODEL\\_TEMPLATE](#) (, [Model](#))(const [MODEL\\_TYPE](#)() &Model\_)

### 8.35.1 Macro Definition Documentation

#### 8.35.1.1 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.

#### 8.35.1.2 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.

#### 8.35.1.3 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.

### 8.35.2 Function Documentation

### 8.35.2.1 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.

### 8.35.2.2 MODEL\_TEMPLATE() [1/2]

```
MODEL_TEMPLATE (
    Model )
```

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

### 8.35.2.3 MODEL\_TEMPLATE() [2/2]

```
MODEL_TEMPLATE (
    Model ) const &
```

Definition at line 149 of file model-meat.hpp.

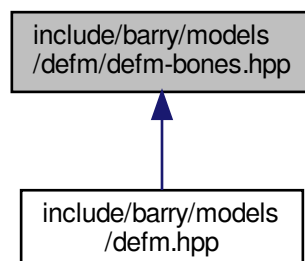
### 8.35.2.4 update\_normalizing\_constant()

```
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.

## 8.36 include/barry/models/defm/defm-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

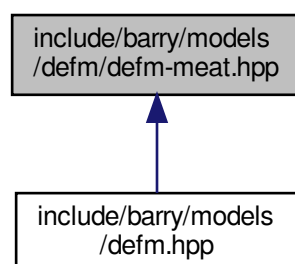


### Classes

- class [DEFM](#)

## 8.37 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)`

## 8.37.1 Macro Definition Documentation

### 8.37.1.1 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.

### 8.37.1.2 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.

## 8.38 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"
```

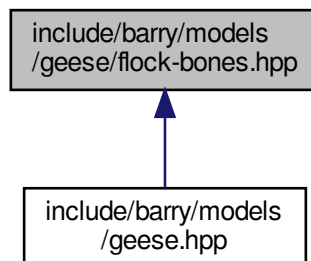
Include dependency graph for geese.hpp:





## 8.39 include/barry/models/geese/flock-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

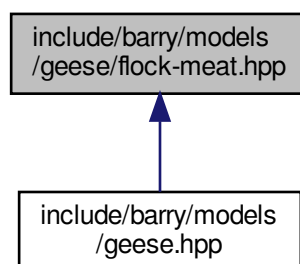


### Classes

- class [Flock](#)  
*A [Flock](#) is a group of [Geese](#).*

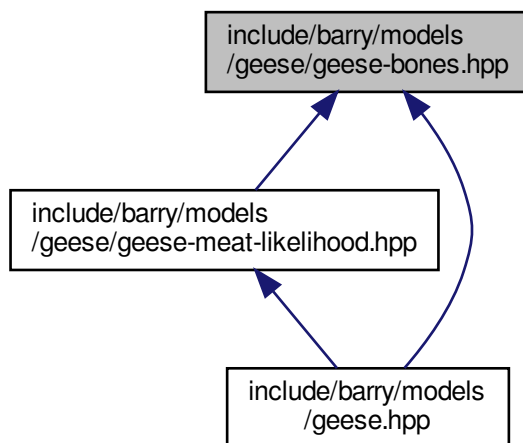
## 8.40 include/barry/models/geese/flock-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



## 8.41 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)`

#### 8.41.1 Macro Definition Documentation

### 8.41.1.1 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.

## 8.41.2 Function Documentation

### 8.41.2.1 keygen\_full()

```
std::vector< double > keygen_full (   
    const phylocounters::PhyloArray & array ) [inline]
```

Definition at line 35 of file geese-bones.hpp.

### 8.41.2.2 RULE\_FUNCTION()

```
RULE_FUNCTION (   
    rule_empty_free )
```

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

### 8.41.2.3 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.

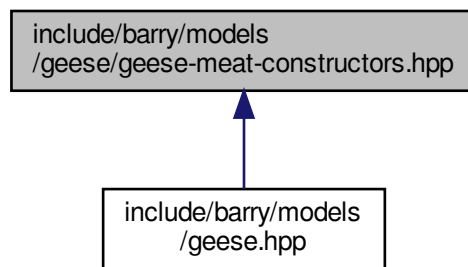
### 8.41.2.4 vector\_caster()

```
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.

## 8.42 include/barry/models/geese/geese-meat-constructors.hpp File Reference

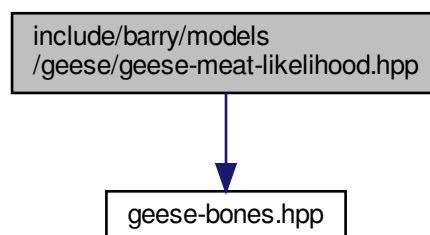
This graph shows which files directly or indirectly include this file:



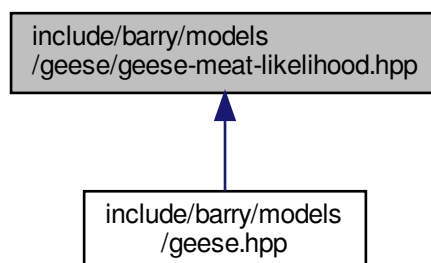
## 8.43 include/barry/models/geese/geese-meat-likelihood.hpp File Reference

```
#include "geese-bones.hpp"
```

Include dependency graph for geese-meat-likelihood.hpp:

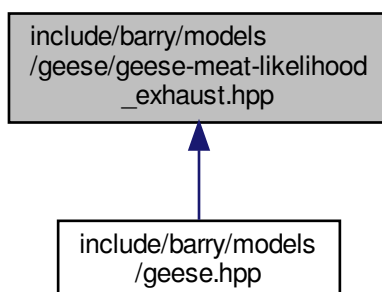


This graph shows which files directly or indirectly include this file:



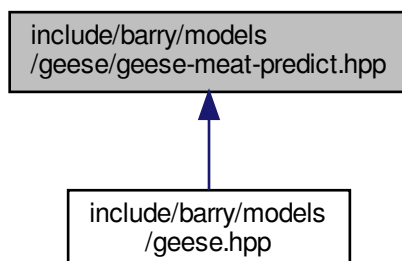
## 8.44 include/barry/models/geese/geese-meat-likelihood\_exhaust.hpp File Reference

This graph shows which files directly or indirectly include this file:



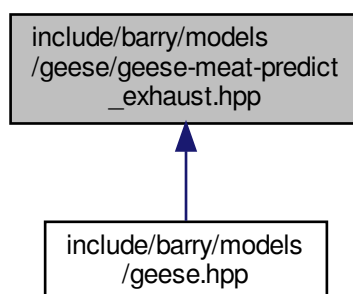
## 8.45 include/barry/models/geese/geese-meat-predict.hpp File Reference

This graph shows which files directly or indirectly include this file:



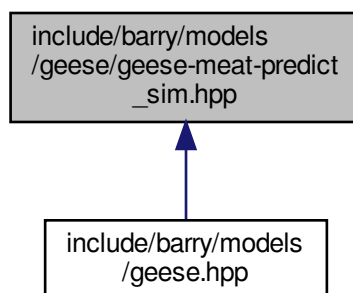
## 8.46 include/barry/models/geese/geese-meat-predict\_exhaust.hpp File Reference

This graph shows which files directly or indirectly include this file:



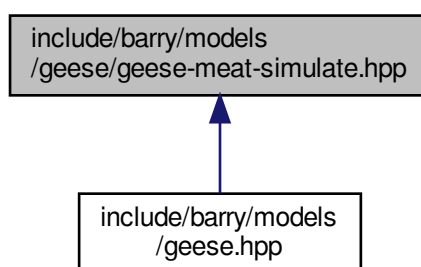
## 8.47 include/barry/models/geese/geese-meat-predict\_sim.hpp File Reference

This graph shows which files directly or indirectly include this file:



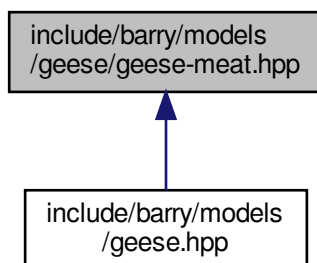
## 8.48 include/barry/models/geese/geese-meat-simulate.hpp File Reference

This graph shows which files directly or indirectly include this file:



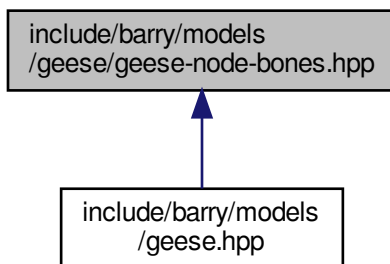
## 8.49 include/barry/models/geese/geese-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



## 8.50 include/barry/models/geese/geese-node-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:



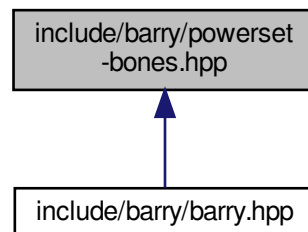
## Classes

- class [Node](#)  
*A single node for the model.*



## 8.51 include/barry/powerset-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

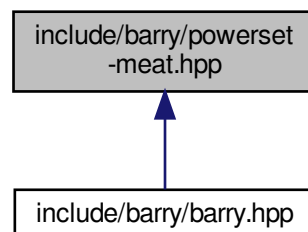


### Classes

- class [PowerSet< Array\\_Type, Data\\_Rule\\_Type >](#)  
*Powerset of a binary array.*

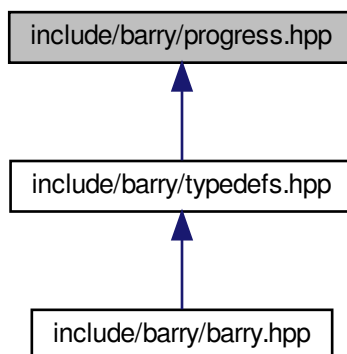
## 8.52 include/barry/powerset-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



## 8.53 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`

### 8.53.1 Macro Definition Documentation

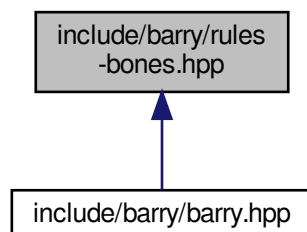
#### 8.53.1.1 BARRY\_PROGRESS\_BAR\_WIDTH

```
#define BARRY_PROGRESS_BAR_WIDTH 80
```

Definition at line 5 of file progress.hpp.

## 8.54 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)`

#### 8.54.1 Function Documentation

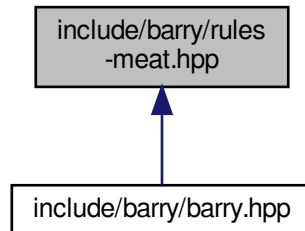
##### 8.54.1.1 `rule_fun_default()`

```
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.

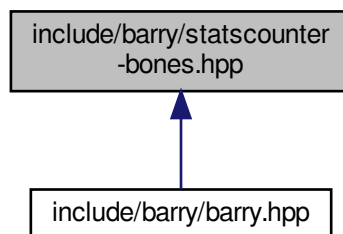
## 8.55 include/barry/rules-meat.hpp File Reference

This graph shows which files directly or indirectly include this file:



## 8.56 include/barry/statscounter-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

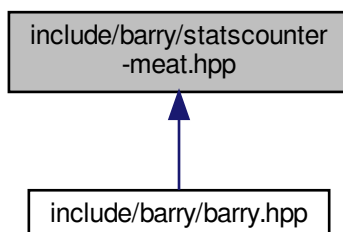


## Classes

- class [StatsCounter< Array\\_Type, Data\\_Type >](#)  
*Count stats for a single Array.*

## 8.57 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`

## 8.57.1 Macro Definition Documentation

### 8.57.1.1 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.

### 8.57.1.2 STATSCOUNTER\_TEMPLATE\_ARGS

```
template STATSCOUNTER_TEMPLATE_ARGS( ) <typename Array_Type, typename Data_Type>
```

Definition at line 6 of file statscounter-meat.hpp.

### 8.57.1.3 STATSCOUNTER\_TYPE

```
template Data_Type * STATSCOUNTER_TYPE( ) StatsCounter<Array_Type, Data_Type>
```

Definition at line 4 of file statscounter-meat.hpp.

## 8.57.2 Function Documentation

### 8.57.2.1 clear()

```
EmptyArray clear ( )
```

### 8.57.2.2 for()

```
for (  
    uint n = 0u; n< counters->size(); ++n )
```

### 8.57.2.3 `resize()`

```
current_stats resize (
    counters-> size(),
    0. 0 )
```

### 8.57.2.4 `STATSCOUNTER_TEMPLATE()` [1/9]

```
STATSCOUNTER_TEMPLATE (
    StatsCounter ) const
```

### 8.57.2.5 `STATSCOUNTER_TEMPLATE()` [2/9]

```
STATSCOUNTER_TEMPLATE (
    ~ StatsCounter )
```

Definition at line 27 of file statscounter-meat.hpp.

### 8.57.2.6 `STATSCOUNTER_TEMPLATE()` [3/9]

```
STATSCOUNTER_TEMPLATE (
    std::vector< std::string > ,
    get_descriptions ) const
```

Definition at line 256 of file statscounter-meat.hpp.

### 8.57.2.7 `STATSCOUNTER_TEMPLATE()` [4/9]

```
STATSCOUNTER_TEMPLATE (
    std::vector< std::string > ,
    get_names ) const
```

Definition at line 251 of file statscounter-meat.hpp.

### 8.57.2.8 `STATSCOUNTER_TEMPLATE()` [5/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    add_counter )
```

#### 8.57.2.9 STATSCOUNTER\_TEMPLATE() [6/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    count_current )
```

#### 8.57.2.10 STATSCOUNTER\_TEMPLATE() [7/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    count_init )
```

#### 8.57.2.11 STATSCOUNTER\_TEMPLATE() [8/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    reset_array ) const
```

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

#### 8.57.2.12 STATSCOUNTER\_TEMPLATE() [9/9]

```
STATSCOUNTER_TEMPLATE (
    void ,
    set_counters )
```

### 8.57.3 Variable Documentation

#### 8.57.3.1 counter

Data\_Type& counter

##### Initial value:

```
{
    Array      = counter.Array
```

Definition at line 12 of file statscounter-meat.hpp.



### 8.57.3.2 counter\_deleted

```
counter_deleted = false
```

Definition at line 23 of file statscounter-meat.hpp.

### 8.57.3.3 counters

```
counters = new Counters<Array_Type,Data_Type> ((*counter.counters))
```

Definition at line 22 of file statscounter-meat.hpp.

### 8.57.3.4 counters\_

```
Data_Type* counters_
```

#### Initial value:

```
{  
  
    if (!counter_deleted)  
        delete counters
```

Definition at line 53 of file statscounter-meat.hpp.

### 8.57.3.5 current\_stats

```
current_stats = counter.current_stats
```

Definition at line 19 of file statscounter-meat.hpp.

### 8.57.3.6 EmptyArray

```
EmptyArray = *Array
```

Definition at line 17 of file statscounter-meat.hpp.

### 8.57.3.7 f\_

Data\_Rule\_Dyn\_Type f\_

#### Initial value:

```
{  
    counters->add_counter(f_)
```

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

### 8.57.3.8 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.

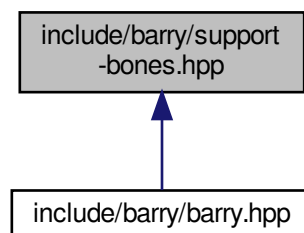
### 8.57.3.9 return

return

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

## 8.58 include/barry/support-bones.hpp File Reference

This graph shows which files directly or indirectly include this file:

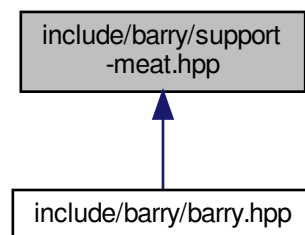


## Classes

- class [Support](#)< [Array\\_Type](#), [Data\\_Counter\\_Type](#), [Data\\_Rule\\_Type](#), [Data\\_Rule\\_Dyn\\_Type](#) >  
*Compute the support of sufficient statistics.*

## 8.59 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_`

## 8.59.1 Macro Definition Documentation

### 8.59.1.1 BARRY\_SUPPORT\_MEAT\_HPP

```
#define BARRY_SUPPORT_MEAT_HPP 1
```

Definition at line 2 of file support-meat.hpp.

### 8.59.1.2 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.

### 8.59.1.3 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.

### 8.59.1.4 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.

## 8.59.2 Function Documentation

### 8.59.2.1 calc\_backend\_dense()

```
calc_backend_dense (   
    pos+ 1u,   
    array_bank ,   
    stats_bank )
```

### 8.59.2.2 calc\_backend\_sparse()

```
calc_backend_sparse (   
    pos+ 1u,   
    array_bank ,   
    stats_bank )
```

### 8.59.2.3 for()

```
for ( )
```

Definition at line 159 of file support-meat.hpp.

**8.59.2.4 if() [1/3]**

```
if (
    array_bank !    = nullptr ) -> push_back(EmptyArray)
```

**8.59.2.5 if() [2/3]**

```
if (
    change_stats_different ,
    Ou )
```

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

**8.59.2.6 if() [3/3]**

```
if (
    rules_dyn-> size(),
    Ou )
```

Definition at line 187 of file support-meat.hpp.

**8.59.2.7 insert\_cell() [1/2]**

```
EmptyArray insert_cell (
    coord_i ,
    coord_j ,
    1 ,
    false ,
    false )
```

**8.59.2.8 insert\_cell() [2/2]**

```
EmptyArray insert_cell (
    coord_i ,
    coord_j ,
    EmptyArray.default_val(). value,
    false ,
    false )
```

### 8.59.2.9 rm\_cell()

```
EmptyArray rm_cell (
    coord_i ,
    coord_j ,
    false ,
    false )
```

### 8.59.2.10 SUPPORT\_TEMPLATE() [1/17]

```
SUPPORT_TEMPLATE (
    bool ,
    eval_rules_dyn ) const
```

Definition at line 488 of file support-meat.hpp.

### 8.59.2.11 SUPPORT\_TEMPLATE() [2/17]

```
SUPPORT_TEMPLATE (
    const FreqTable< double > & ,
    get_data ) const
```

Definition at line 557 of file support-meat.hpp.

### 8.59.2.12 SUPPORT\_TEMPLATE() [3/17]

```
SUPPORT_TEMPLATE (
    std::vector< double > * ,
    get_current_stats )
```

Definition at line 542 of file support-meat.hpp.

### 8.59.2.13 SUPPORT\_TEMPLATE() [4/17]

```
SUPPORT_TEMPLATE (
    std::vector< double > ,
    get_counts ) const
```

Definition at line 530 of file support-meat.hpp.

**8.59.2.14 SUPPORT\_TEMPLATE()** [5/17]

```
SUPPORT_TEMPLATE (
    void ,
    add_counter )
```

**8.59.2.15 SUPPORT\_TEMPLATE()** [6/17]

```
SUPPORT_TEMPLATE (
    void ,
    add_rule )
```

**8.59.2.16 SUPPORT\_TEMPLATE()** [7/17]

```
SUPPORT_TEMPLATE (
    void ,
    add_rule_dyn )
```

**8.59.2.17 SUPPORT\_TEMPLATE()** [8/17]

```
SUPPORT_TEMPLATE (
    void ,
    calc )
```

Definition at line 371 of file support-meat.hpp.

**8.59.2.18 SUPPORT\_TEMPLATE()** [9/17]

```
SUPPORT_TEMPLATE (
    void ,
    calc_backend_dense )
```

**8.59.2.19 SUPPORT\_TEMPLATE()** [10/17]

```
SUPPORT_TEMPLATE (
    void ,
    calc_backend_sparse )
```



**8.59.2.20 SUPPORT\_TEMPLATE()** [11/17]

```
SUPPORT_TEMPLATE (
    void ,
    init_support )
```

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

**8.59.2.21 SUPPORT\_TEMPLATE()** [12/17]

```
SUPPORT_TEMPLATE (
    void ,
    print ) const
```

Definition at line 546 of file support-meat.hpp.

**8.59.2.22 SUPPORT\_TEMPLATE()** [13/17]

```
SUPPORT_TEMPLATE (
    void ,
    reset_array )
```

Definition at line 114 of file support-meat.hpp.

**8.59.2.23 SUPPORT\_TEMPLATE()** [14/17]

```
SUPPORT_TEMPLATE (
    void ,
    reset_array ) const &
```

Definition at line 120 of file support-meat.hpp.

**8.59.2.24 SUPPORT\_TEMPLATE()** [15/17]

```
SUPPORT_TEMPLATE (
    void ,
    set_counters )
```

**8.59.2.25 SUPPORT\_TEMPLATE() [16/17]**

```
SUPPORT_TEMPLATE (
    void ,
    set_rules )
```

**8.59.2.26 SUPPORT\_TEMPLATE() [17/17]**

```
SUPPORT_TEMPLATE (
    void ,
    set_rules_dyn )
```

**8.59.3 Variable Documentation****8.59.3.1 array\_bank**

```
std::vector< Array_Type > * array_bank
```

Definition at line 131 of file support-meat.hpp.

**8.59.3.2 change\_stats\_different**

```
unsigned int change_stats_different = hashes_initialized[pos] ? 0u : 1u
```

Definition at line 158 of file support-meat.hpp.

**8.59.3.3 coord\_i**

```
const size_t & coord_i = coordinates_free[pos * 2u]
```

Definition at line 144 of file support-meat.hpp.

**8.59.3.4 coord\_j**

```
const size_t & coord_j = coordinates_free[pos * 2u + 1u]
```

Definition at line 145 of file support-meat.hpp.

### 8.59.3.5 counters

```
counters = counters_
```

Definition at line 416 of file support-meat.hpp.

### 8.59.3.6 counters\_

```
Data_Counter_Type* counters_
```

**Initial value:**

```
{  
  
    if (delete_counters)  
        delete counters
```

Definition at line 409 of file support-meat.hpp.

### 8.59.3.7 delete\_counters

```
delete_counters = false
```

Definition at line 415 of file support-meat.hpp.

### 8.59.3.8 delete\_rules

```
delete_rules = false
```

Definition at line 449 of file support-meat.hpp.

### 8.59.3.9 delete\_rules\_dyn

```
delete_rules_dyn = false
```

Definition at line 481 of file support-meat.hpp.

#### 8.59.3.10 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.

#### 8.59.3.11 f\_

```
Data_Rule_Dyn_Type f_
```

##### Initial value:

```
{  
    counters->add_counter(f_)
```

Definition at line 400 of file support-meat.hpp.

#### 8.59.3.12 hashes

```
& hashes
```

Definition at line 217 of file support-meat.hpp.

#### 8.59.3.13 return

```
return
```

Definition at line 251 of file support-meat.hpp.

#### 8.59.3.14 rules

```
rules = rules_
```

Definition at line 450 of file support-meat.hpp.

### 8.59.3.15 rules\_

Data\_Rule\_Dyn\_Type \* rules\_

#### Initial value:

```
{  
  
    if (delete_rules)  
        delete rules
```

Definition at line 443 of file support-meat.hpp.

### 8.59.3.16 rules\_dyn

rules\_dyn = rules\_

Definition at line 482 of file support-meat.hpp.

### 8.59.3.17 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.

### 8.59.3.18 tmp\_chng

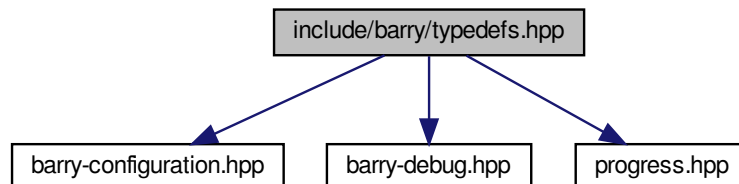
double tmp\_chng

Definition at line 157 of file support-meat.hpp.

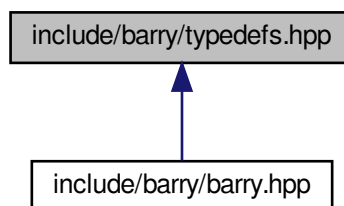
## 8.60 include/barry/typedefs.hpp File Reference

```
#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 [Hasher\\_fun\\_type](#) = std::function< std::vector< double >([const](#) Array\_Type &, Data\_Type \*)>  
*Hasher function used by the counter.*
- 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

- std::vector< size\_t > [sort\\_array](#) ([const](#) double \*v, size\_t start, size\_t ncols, size\_t nrows)  
*Ascending sorting an array.*
- 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

## 8.60.1 Typedef Documentation

### 8.60.1.1 Col\_type

```
template<typename Cell_Type >
using Col_type = Map< uint, Cell<Cell_Type>*>
```

Definition at line 71 of file typedefs.hpp.

### 8.60.1.2 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 <a href="#">BArray</a>
<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 188 of file typedefs.hpp.

### 8.60.1.3 Counts\_type

```
typedef std::vector< std::pair< std::vector<double>, uint > > Counts_type
```

Definition at line 52 of file typedefs.hpp.

### 8.60.1.4 Hasher\_fun\_type

```
template<typename Array_Type , typename Data_Type >
using Hasher_fun_type = std::function<std::vector<double>(const Array_Type &, Data_Type *)>
```

Hasher function used by the counter.

Used to characterize the support of the array.



## Template Parameters

<i>Array_Type</i>	
-------------------	--

Definition at line 201 of file typedefs.hpp.

**8.60.1.5 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.

**8.60.1.6 Row\_type**

```
template<typename Cell_Type >
using Row_type = Map< uint, Cell<Cell_Type> >
```

Definition at line 68 of file typedefs.hpp.

**8.60.1.7 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 191 of file typedefs.hpp.

**8.60.1.8 uint**

```
typedef unsigned int uint
```

Definition at line 18 of file typedefs.hpp.

**8.60.2 Function Documentation****8.60.2.1 sort\_array()**

```
std::vector< size_t > sort_array (
    const double * v,
    size_t start,
    size_t ncols,
    size_t nrows ) [inline]
```

Ascending sorting an array.

It will sort an array solving ties using the next column. Data is stored column-wise.

## Template Parameters

<i>T</i>	
----------	--

## Parameters

<i>v</i>	
<i>nrows</i>	

## Returns

`std::vector<size_t>` The sorting index.

Definition at line 142 of file `typedefs.hpp`.

8.60.2.2 `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 211 of file `typedefs.hpp`.

8.60.2.3 `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 229 of file `typedefs.hpp`.

**8.60.2.4 vec\_inner\_prod() [1/2]**

```
template<>
double vec_inner_prod (
    const double * a,
    const double * b,
    size_t n ) [inline]
```

Definition at line 275 of file typedefs.hpp.

**8.60.2.5 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 252 of file typedefs.hpp.

**8.61 README.md File Reference**



# Index

- ~BArray
  - BArray< Cell\_Type, Data\_Type >, [39](#)
- ~BArrayCell
  - BArrayCell< Cell\_Type, Data\_Type >, [50](#)
- ~BArrayCell\_const
  - BArrayCell\_const< Cell\_Type, Data\_Type >, [52](#)
- ~BArrayDense
  - BArrayDense< Cell\_Type, Data\_Type >, [58](#)
- ~BArrayDenseCell
  - BArrayDenseCell< Cell\_Type, Data\_Type >, [71](#)
- ~BArrayRow
  - BArrayRow< Cell\_Type, Data\_Type >, [84](#)
- ~BArrayRow\_const
  - BArrayRow\_const< Cell\_Type, Data\_Type >, [86](#)
- ~BArrayVector
  - BArrayVector< Cell\_Type, Data\_Type >, [89](#)
- ~BArrayVector\_const
  - BArrayVector\_const< Cell\_Type, Data\_Type >, [92](#)
- ~Cell
  - Cell< Cell\_Type >, [96](#)
- ~ConstBArrayRowIter
  - ConstBArrayRowIter< Cell\_Type, Data\_Type >, [101](#)
- ~Counter
  - Counter< Array\_Type, Data\_Type >, [104](#)
- ~Counters
  - Counters< Array\_Type, Data\_Type >, [109](#)
- ~DEFM
  - DEFM, [113](#)
- ~DEFMCounterData
  - DEFMCounterData, [118](#)
- ~DEFMData
  - DEFMData, [122](#)
- ~Entries
  - Entries< Cell\_Type >, [127](#)
- ~Flock
  - Flock, [129](#)
- ~FreqTable
  - FreqTable< T >, [136](#)
- ~Geese
  - Geese, [141](#)
- ~Model
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [154](#)
- ~NetCounterData
  - NetCounterData, [165](#)
- ~NetworkData
  - NetworkData, [168](#)
- ~Node
  - Node, [170](#)
- ~PhyloRuleDynData
  - PhyloRuleDynData, [179](#)
- ~PowerSet
  - PowerSet< Array\_Type, Data\_Rule\_Type >, [182](#)
- ~Progress
  - Progress, [187](#)
- ~Rule
  - Rule< Array\_Type, Data\_Type >, [189](#)
- ~Rules
  - Rules< Array\_Type, Data\_Type >, [191](#)
- ~StatsCounter
  - StatsCounter< Array\_Type, Data\_Type >, [195](#)
- ~Support
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [200](#)
- active
  - Cell< Cell\_Type >, [99](#)
- add
  - barray-meat.hpp, [226](#)
  - barraydense-meat.hpp, [251](#)
  - Cell< Cell\_Type >, [97](#), [98](#)
  - FreqTable< T >, [136](#)
- add\_array
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [154](#)
- add\_counter
  - Counters< Array\_Type, Data\_Type >, [109](#), [110](#)
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [155](#)
  - StatsCounter< Array\_Type, Data\_Type >, [195](#)
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [200](#)
- add\_data
  - Flock, [129](#)
- add\_dims
  - counters-meat.hpp, [281](#)
- add\_hash
  - Counters< Array\_Type, Data\_Type >, [110](#)
- add\_hasher
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [155](#)
- add\_rule

- Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
155
- PowerSet< Array\_Type, Data\_Rule\_Type >, 182,  
183
- Rules< Array\_Type, Data\_Type >, 192
- Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
200, 201
- add\_rule\_dyn
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
155, 156
  - Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
201
- annotations
  - Node, 171
- ans
  - barray-meat.hpp, 217, 226
  - barraydense-meat.hpp, 240, 251
- Array
  - ConstBArrayRowIter< Cell\_Type, Data\_Type >,  
101
- array
  - DEFMData, 123
  - Node, 171
- Array\_
  - barray-meat.hpp, 226
- array\_bank
  - support-meat.hpp, 346
- arrays
  - Node, 172
- AS\_ONE
  - EXISTS, 33
- as\_vector
  - FreqTable< T >, 136
- AS\_ZERO
  - EXISTS, 33
- at
  - DEFMData, 122
  - PhyloCounterData, 176
- BArray
  - BArray< Cell\_Type, Data\_Type >, 38, 39
- BArray< Cell\_Type, Data\_Type >, 35
  - ~BArray, 39
  - BArray, 38, 39
  - BArrayCell< Cell\_Type, Data\_Type >, 48
  - BArrayCell\_const< Cell\_Type, Data\_Type >, 48
  - clear, 39
  - col, 39
  - D, 40
  - D\_ptr, 40
  - default\_val, 40
  - flush\_data, 40
  - get\_cell, 40
  - get\_col\_vec, 41
  - get\_entries, 41
  - get\_row\_vec, 41
  - insert\_cell, 42
  - is\_dense, 42
  - is\_empty, 42
  - ncol, 43
  - nnozero, 43
  - nrow, 43
  - operator\*=: 43
  - operator(), 43
  - operator+=, 44
  - operator-=, 44
  - operator/=: 45
  - operator=, 45
  - operator==, 45
  - out\_of\_range, 45
  - print, 45
  - reserve, 46
  - resize, 46
  - rm\_cell, 46
  - row, 46
  - set\_data, 46
  - swap\_cells, 47
  - swap\_cols, 47
  - swap\_rows, 47
  - toggle\_cell, 47
  - toggle\_lock, 47
  - transpose, 48
  - visited, 49
  - zero\_col, 48
  - zero\_row, 48
- barray-meat-operators.hpp
  - BARRAY\_TEMPLATE, 210–212
  - BARRAY\_TEMPLATE\_ARGS, 211, 213
  - BARRAY\_TYPE, 211, 213
  - COL, 211
  - for, 213
  - operator(), 213
  - rhs, 213
  - ROW, 211
  - this, 214
- barray-meat.hpp
  - add, 226
  - ans, 217, 226
  - Array\_, 226
  - BARRAY\_TEMPLATE, 216–221
  - BARRAY\_TEMPLATE\_ARGS, 216
  - BARRAY\_TYPE, 216
  - check\_bounds, 226
  - check\_exists, 227
  - COL, 217, 221
  - col0, 227
  - const, 227
  - copy\_data, 227
  - data, 228
  - delete\_data, 228
  - delete\_data\_, 228
  - else, 228
  - false, 228

- first, 229
- for, 222
- i1, 229
- if, 222–225
- j, 229
- j0, 229
- j1, 229
- M, 225, 229
- M\_, 230
- N, 230
- NCells, 230
- report, 230
- resize, 225
- return, 225, 230
- ROW, 217, 225, 226
- row0, 231
- search, 231
- source, 231
- target, 231
- v, 231
- value, 231
- BARRAY\_TEMPLATE
  - barray-meat-operators.hpp, 210–212
  - barray-meat.hpp, 216–221
- BARRAY\_TEMPLATE\_ARGS
  - barray-meat-operators.hpp, 211, 213
  - barray-meat.hpp, 216
- BARRAY\_TYPE
  - barray-meat-operators.hpp, 211, 213
  - barray-meat.hpp, 216
- BArrayCell
  - BArrayCell< Cell\_Type, Data\_Type >, 50
- BArrayCell< Cell\_Type, Data\_Type >, 49
  - ~BArrayCell, 50
  - BArray< Cell\_Type, Data\_Type >, 48
  - BArrayCell, 50
  - operator Cell\_Type, 50
  - operator\*=, 50
  - operator+=, 50
  - operator-=, 51
  - operator/=: 51
  - operator=, 51
  - operator==, 51
- BArrayCell\_const
  - BArrayCell\_const< Cell\_Type, Data\_Type >, 52
- BArrayCell\_const< Cell\_Type, Data\_Type >, 52
  - ~BArrayCell\_const, 52
  - BArray< Cell\_Type, Data\_Type >, 48
  - BArrayCell\_const, 52
  - operator Cell\_Type, 53
  - operator!=, 53
  - operator<, 53
  - operator<=, 53
  - operator>, 53
  - operator>=, 54
  - operator==, 53
- BArrayDense
  - BArrayDense< Cell\_Type, Data\_Type >, 57, 58
- BArrayDense< Cell\_Type, Data\_Type >, 54
  - ~BArrayDense, 58
  - BArrayDense, 57, 58
  - BArrayDenseCell< Cell\_Type, Data\_Type >, 68, 73
  - BArrayDenseCol< Cell\_Type, Data\_Type >, 69, 76
  - BArrayDenseCol\_const< Cell\_Type, Data\_Type >, 69
  - BArrayDenseRow< Cell\_Type, Data\_Type >, 69, 80
  - BArrayDenseRow\_const< Cell\_Type, Data\_Type >, 69
  - clear, 59
  - col, 59
  - colsum, 59
  - D, 59, 60
  - D\_ptr, 60
  - default\_val, 60
  - get\_cell, 60
  - get\_col\_vec, 60, 61
  - get\_data, 61
  - get\_entries, 61
  - get\_row\_vec, 61
  - insert\_cell, 62
  - is\_dense, 62
  - is\_empty, 62
  - ncol, 62
  - nnozero, 63
  - nrow, 63
  - operator\*=, 63
  - operator(), 63
  - operator+=, 63, 64
  - operator-=, 64
  - operator/=: 64
  - operator=, 65
  - operator==, 65
  - out\_of\_range, 65
  - print, 65
  - reserve, 65
  - resize, 66
  - rm\_cell, 66
  - row, 66
  - rowsum, 66
  - set\_data, 66
  - swap\_cells, 67
  - swap\_cols, 67
  - swap\_rows, 67
  - toggle\_cell, 67
  - toggle\_lock, 68
  - transpose, 68
  - visited, 69
  - zero\_col, 68
  - zero\_row, 68
- barraydense-meat-operators.hpp
  - BDENSE\_TEMPLATE, 234–236
  - BDENSE\_TEMPLATE\_ARGS, 234, 236
  - BDENSE\_TYPE, 234, 236
  - COL, 234

- POS, [234](#)
- POS\_N, [235](#)
- ROW, [235](#)
- barraydense-meat.hpp
  - add, [251](#)
  - ans, [240](#), [251](#)
  - BDENSE\_TEMPLATE, [239–247](#)
  - BDENSE\_TEMPLATE\_ARGS, [239](#)
  - BDENSE\_TYPE, [239](#)
  - check\_bounds, [251](#)
  - check\_exists, [251](#)
  - COL, [239](#)
  - col, [252](#)
  - const, [252](#)
  - copy\_data, [252](#)
  - data, [252](#)
  - delete\_data, [252](#)
  - delete\_data\_, [253](#)
  - el, [253](#)
  - el\_colsums, [253](#)
  - el\_rowsums, [253](#)
  - else, [253](#)
  - false, [254](#)
  - for, [247](#)
  - i1, [254](#)
  - if, [248](#)
  - insert\_cell, [248](#)
  - j, [254](#)
  - j0, [254](#)
  - j1, [254](#)
  - M, [249](#), [254](#)
  - M\_, [255](#)
  - N, [255](#)
  - POS, [239](#)
  - POS\_N, [239](#)
  - report, [255](#)
  - resize, [249](#), [250](#)
  - return, [255](#)
  - rm\_cell, [250](#)
  - ROW, [240](#)
  - source, [255](#)
  - target, [256](#)
  - v, [256](#)
  - va\_end, [250](#)
  - va\_start, [250](#)
  - val0, [256](#)
  - val1, [256](#)
  - value, [256](#)
  - vprintf, [251](#)
  - ZERO\_CELL, [240](#)
- BArrayDenseCell
  - BArrayDenseCell< Cell\_Type, Data\_Type >, [71](#)
- BArrayDenseCell< Cell\_Type, Data\_Type >, [70](#)
  - ~BArrayDenseCell, [71](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [68](#), [73](#)
  - BArrayDenseCell, [71](#)
  - BArrayDenseCol< Cell\_Type, Data\_Type >, [73](#), [76](#)
- BArrayDenseCol\_const< Cell\_Type, Data\_Type >, [73](#), [78](#)
- BArrayDenseRow< Cell\_Type, Data\_Type >, [80](#)
- BArrayDenseRow\_const< Cell\_Type, Data\_Type >, [83](#)
- operator Cell\_Type, [71](#)
- operator\*=: [71](#)
- operator+=, [71](#)
- operator-=, [72](#)
- operator/=: [72](#)
- operator=: [72](#)
- operator==, [72](#)
- barraydensecell-bones.hpp
  - POS, [257](#)
- barraydensecell-meat.hpp
  - POS, [258](#)
- BArrayDenseCell\_const< Cell\_Type, Data\_Type >, [74](#)
  - BArrayDenseCol< Cell\_Type, Data\_Type >, [76](#)
  - BArrayDenseCol\_const< Cell\_Type, Data\_Type >, [78](#)
  - BArrayDenseRow< Cell\_Type, Data\_Type >, [80](#)
  - BArrayDenseRow\_const< Cell\_Type, Data\_Type >, [83](#)
- BArrayDenseCol
  - BArrayDenseCol< Cell\_Type, Data\_Type >, [74](#)
- BArrayDenseCol< Cell\_Type, Data\_Type >, [74](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [69](#), [76](#)
  - BArrayDenseCell< Cell\_Type, Data\_Type >, [73](#), [76](#)
  - BArrayDenseCell\_const< Cell\_Type, Data\_Type >, [76](#)
  - BArrayDenseCol, [74](#)
  - begin, [75](#)
  - end, [75](#)
  - operator(), [75](#)
  - size, [75](#)
- barraydensecol-bones.hpp
  - POS, [259](#)
  - POS\_N, [259](#)
  - ZERO\_CELL, [259](#)
- BArrayDenseCol\_const
  - BArrayDenseCol\_const< Cell\_Type, Data\_Type >, [77](#)
- BArrayDenseCol\_const< Cell\_Type, Data\_Type >, [76](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [69](#)
  - BArrayDenseCell< Cell\_Type, Data\_Type >, [73](#), [78](#)
  - BArrayDenseCell\_const< Cell\_Type, Data\_Type >, [78](#)
  - BArrayDenseCol\_const, [77](#)
  - begin, [77](#)
  - end, [77](#)
  - operator(), [77](#)
  - size, [78](#)
- BArrayDenseRow
  - BArrayDenseRow< Cell\_Type, Data\_Type >, [79](#)
- BArrayDenseRow< Cell\_Type, Data\_Type >, [78](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [69](#), [80](#)



- BArrayDenseCell< Cell\_Type, Data\_Type >, 80
- BArrayDenseCell\_const< Cell\_Type, Data\_Type >, 80
- BArrayDenseRow, 79
- begin, 79
- end, 79
- operator(), 80
- size, 80
- barraydenserow-bones.hpp
  - POS, 260
  - POS\_N, 260
  - ZERO\_CELL, 261
- BArrayDenseRow\_const
  - BArrayDenseRow\_const< Cell\_Type, Data\_Type >, 81
- BArrayDenseRow\_const< Cell\_Type, Data\_Type >, 81
  - BArrayDense< Cell\_Type, Data\_Type >, 69
  - BArrayDenseCell< Cell\_Type, Data\_Type >, 83
  - BArrayDenseCell\_const< Cell\_Type, Data\_Type >, 83
  - BArrayDenseRow\_const, 81
  - begin, 82
  - end, 82
  - operator(), 82
  - size, 82
- BArrayRow
  - BArrayRow< Cell\_Type, Data\_Type >, 84
- BArrayRow< Cell\_Type, Data\_Type >, 83
  - ~BArrayRow, 84
  - BArrayRow, 84
  - operator BArrayRow< Cell\_Type, Data\_Type >, 84
  - operator\*=: 84
  - operator+=, 84
  - operator-=, 84
  - operator/=: 85
  - operator=, 85
  - operator==, 85
- barrayrow-meat.hpp
  - BROW\_TEMPLATE, 261–263
  - BROW\_TEMPLATE\_ARGS, 262
  - BROW\_TYPE, 262
- BArrayRow\_const
  - BArrayRow\_const< Cell\_Type, Data\_Type >, 86
- BArrayRow\_const< Cell\_Type, Data\_Type >, 85
  - ~BArrayRow\_const, 86
  - BArrayRow\_const, 86
  - operator BArrayRow\_const< Cell\_Type, Data\_Type >, 86
  - operator!=, 86
  - operator<, 86
  - operator<=, 87
  - operator>, 87
  - operator>=, 87
  - operator==, 87
- BArrayVector
  - BArrayVector< Cell\_Type, Data\_Type >, 88
- BArrayVector< Cell\_Type, Data\_Type >, 87
  - ~BArrayVector, 89
- BArrayVector, 88
  - begin, 89
  - end, 89
  - is\_col, 89
  - is\_row, 89
  - operator std::vector< Cell\_Type >, 90
  - operator\*=: 90
  - operator+=, 90
  - operator-=, 90
  - operator/=: 90
  - operator=, 91
  - operator==, 91
  - size, 91
- BArrayVector\_const
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 92
- BArrayVector\_const< Cell\_Type, Data\_Type >, 91
  - ~BArrayVector\_const, 92
  - BArrayVector\_const, 92
  - begin, 93
  - end, 93
  - is\_col, 93
  - is\_row, 93
  - operator std::vector< Cell\_Type >, 93
  - operator!=, 93
  - operator<, 94
  - operator<=, 94
  - operator>, 94
  - operator>=, 94
  - operator==, 94
  - size, 95
- barry, 31
- barry-configuration.hpp
  - BARRY\_CHECK\_SUPPORT, 265
  - BARRY\_ISFINITE, 265
  - BARRY\_MAX\_NUM\_ELEMENTS, 265
  - BARRY\_SAFE\_EXP, 265
  - Map, 265
  - printf\_barry, 265
- barry-debug.hpp
  - BARRY\_DEBUG\_LEVEL, 266
- barry-macros.hpp
  - BARRY\_ONE, 267
  - BARRY\_ONE\_DENSE, 267
  - BARRY\_UNUSED, 267
  - BARRY\_ZERO, 268
  - BARRY\_ZERO\_DENSE, 268
- barry.hpp
  - BARRY\_HPP, 269
  - BARRY\_VERSION, 270
  - BARRY\_VERSION\_MAYOR, 270
  - BARRY\_VERSION\_MINOR, 270
  - COUNTER\_FUNCTION, 270
  - COUNTER\_LAMBDA, 270
  - RULE\_FUNCTION, 271
  - RULE\_LAMBDA, 271
- barry::counters, 31
- barry::counters::defm, 32
- barry::counters::network, 32

- barry::counters::phylo, 32
- BARRY\_CHECK\_SUPPORT
  - barry-configuration.hpp, 265
- BARRY\_DEBUG\_LEVEL
  - barry-debug.hpp, 266
- BARRY\_HPP
  - barry.hpp, 269
- BARRY\_ISFINITE
  - barry-configuration.hpp, 265
- BARRY\_MAX\_NUM\_ELEMENTS
  - barry-configuration.hpp, 265
- BARRY\_ONE
  - barry-macros.hpp, 267
- BARRY\_ONE\_DENSE
  - barry-macros.hpp, 267
- BARRY\_PROGRESS\_BAR\_WIDTH
  - progress.hpp, 330
- BARRY\_SAFE\_EXP
  - barry-configuration.hpp, 265
- BARRY\_SUPPORT\_MEAT\_HPP
  - support-meat.hpp, 340
- BARRY\_UNUSED
  - barry-macros.hpp, 267
- BARRY\_VERSION
  - barry.hpp, 270
- BARRY\_VERSION\_MAYOR
  - barry.hpp, 270
- BARRY\_VERSION\_MINOR
  - barry.hpp, 270
- BARRY\_ZERO
  - barry-macros.hpp, 268
- BARRY\_ZERO\_DENSE
  - barry-macros.hpp, 268
- BARRY\_ZERO\_NETWORK
  - network.hpp, 303
- BARRY\_ZERO\_NETWORK\_DENSE
  - network.hpp, 304
- BDENSE\_TEMPLATE
  - barraydense-meat-operators.hpp, 234–236
  - barraydense-meat.hpp, 239–247
- BDENSE\_TEMPLATE\_ARGS
  - barraydense-meat-operators.hpp, 234, 236
  - barraydense-meat.hpp, 239
- BDENSE\_TYPE
  - barraydense-meat-operators.hpp, 234, 236
  - barraydense-meat.hpp, 239
- begin
  - BArrayDenseCol< Cell\_Type, Data\_Type >, 75
  - BArrayDenseCol\_const< Cell\_Type, Data\_Type >, 77
  - BArrayDenseRow< Cell\_Type, Data\_Type >, 79
  - BArrayDenseRow\_const< Cell\_Type, Data\_Type >, 82
  - BArrayVector< Cell\_Type, Data\_Type >, 89
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 93
  - PhyloCounterData, 176
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 183
- blengths
  - NodeData, 175
- BOTH
  - CHECK, 32
  - EXISTS, 34
- BROW\_TEMPLATE
  - barrayrow-meat.hpp, 261–263
- BROW\_TEMPLATE\_ARGS
  - barrayrow-meat.hpp, 262
- BROW\_TYPE
  - barrayrow-meat.hpp, 262
- calc
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 183
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 201
- calc\_backend\_dense
  - support-meat.hpp, 341
- calc\_backend\_sparse
  - support-meat.hpp, 341
- calc\_reduced\_sequence
  - Geese, 142
- calc\_sequence
  - Geese, 142
- Cell
  - Cell< Cell\_Type >, 96, 97
- Cell< Cell\_Type >, 95
  - ~Cell, 96
  - active, 99
  - add, 97, 98
  - Cell, 96, 97
  - operator Cell\_Type, 98
  - operator!=, 98
  - operator=, 98, 99
  - operator==, 99
  - value, 99
  - visited, 99
- Cell\_const< Cell\_Type >, 100
- change\_stats
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 204
- change\_stats\_different
  - support-meat.hpp, 346
- CHECK, 32
  - BOTH, 32
  - NONE, 32
  - ONE, 32
  - TWO, 33
- check\_bounds
  - barray-meat.hpp, 226
  - barraydense-meat.hpp, 251
- check\_exists
  - barray-meat.hpp, 227
  - barraydense-meat.hpp, 251
- clear
  - BArray< Cell\_Type, Data\_Type >, 39
  - BArrayDense< Cell\_Type, Data\_Type >, 59
  - FreqTable< T >, 136

- statscounter-meat.hpp, 334
- COL
  - barray-meat-operators.hpp, 211
  - barray-meat.hpp, 217, 221
  - barraydense-meat-operators.hpp, 234
  - barraydense-meat.hpp, 239
- col
  - BArray< Cell\_Type, Data\_Type >, 39
  - BArrayDense< Cell\_Type, Data\_Type >, 59
  - barraydense-meat.hpp, 252
- col0
  - barray-meat.hpp, 227
- Col\_type
  - typedefs.hpp, 352
- colnames
  - Flock, 130
  - Geese, 142
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 156
- colsum
  - BArrayDense< Cell\_Type, Data\_Type >, 59
- conditional\_prob
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 156
- const
  - barray-meat.hpp, 227
  - barraydense-meat.hpp, 252
- ConstBArrayRowIter
  - ConstBArrayRowIter< Cell\_Type, Data\_Type >, 101
- ConstBArrayRowIter< Cell\_Type, Data\_Type >, 100
  - ~ConstBArrayRowIter, 101
  - Array, 101
  - ConstBArrayRowIter, 101
  - current\_col, 102
  - current\_row, 102
  - iter, 102
- coord\_i
  - support-meat.hpp, 346
- coord\_j
  - support-meat.hpp, 346
- cooriantes\_n\_free
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 205
- cooriantes\_n\_locked
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 205
- coordinates\_free
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 185
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 205
- coordinates\_locked
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 185
- Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 205
- copy\_data
  - barray-meat.hpp, 227
  - barraydense-meat.hpp, 252
- count
  - Counter< Array\_Type, Data\_Type >, 105
- count\_all
  - StatsCounter< Array\_Type, Data\_Type >, 195
- count\_current
  - StatsCounter< Array\_Type, Data\_Type >, 196
- count\_fun
  - Counter< Array\_Type, Data\_Type >, 106
  - counters-meat.hpp, 276
- count\_fun\_
  - counters-meat.hpp, 281
- count\_init
  - StatsCounter< Array\_Type, Data\_Type >, 196
- Counter
  - Counter< Array\_Type, Data\_Type >, 104
- counter
  - counters-meat.hpp, 282
  - statscounter-meat.hpp, 336
- Counter< Array\_Type, Data\_Type >, 102
  - ~Counter, 104
  - count, 105
  - count\_fun, 106
  - Counter, 104
  - data, 106
  - desc, 107
  - get\_description, 105
  - get\_hasher, 105
  - get\_name, 105
  - hasher\_fun, 107
  - init, 105
  - init\_fun, 107
  - name, 107
  - operator=, 105, 106
  - set\_hasher, 106
- counter\_
  - counters-meat.hpp, 282
- counter\_absdiff
  - DEFMArray counters, 14
- counter\_co\_opt
  - Phylo counters, 23
- counter\_cogain
  - Phylo counters, 23
- counter\_css\_census01
  - network-css.hpp, 296
- counter\_css\_census02
  - network-css.hpp, 297
- counter\_css\_census03
  - network-css.hpp, 297
- counter\_css\_census04
  - network-css.hpp, 297
- counter\_css\_census05
  - network-css.hpp, 297

- counter\_css\_census06
  - network-css.hpp, [298](#)
- counter\_css\_census07
  - network-css.hpp, [298](#)
- counter\_css\_census08
  - network-css.hpp, [298](#)
- counter\_css\_census09
  - network-css.hpp, [298](#)
- counter\_css\_census10
  - network-css.hpp, [299](#)
- counter\_css\_completely\_false\_recip\_comiss
  - network-css.hpp, [299](#)
- counter\_css\_completely\_false\_recip\_omiss
  - network-css.hpp, [299](#)
- counter\_css\_mixed\_recip
  - network-css.hpp, [299](#)
- counter\_css\_partially\_false\_recip\_commi
  - network-css.hpp, [300](#)
- counter\_css\_partially\_false\_recip\_omiss
  - network-css.hpp, [300](#)
- counter\_ctriads
  - DEFMArray counters, [14](#)
- counter\_degree
  - DEFMArray counters, [14](#)
- counter\_deleted
  - statscounter-meat.hpp, [336](#)
- counter\_density
  - DEFMArray counters, [15](#)
- counter\_diff
  - DEFMArray counters, [15](#)
- counter\_edges
  - DEFMArray counters, [15](#)
- counter\_fixed\_effect
  - DEFMArray counters, [15](#)
- Counter\_fun\_type
  - typedefs.hpp, [352](#)
- COUNTER\_FUNCTION
  - barry.hpp, [270](#)
- counter\_gains
  - Phylo counters, [24](#)
- counter\_gains\_from\_0
  - Phylo counters, [24](#)
- counter\_gains\_k\_offspring
  - Phylo counters, [24](#)
- counter\_genes\_changing
  - Phylo counters, [24](#)
- counter\_idegree
  - DEFMArray counters, [16](#)
- counter\_idegree15
  - DEFMArray counters, [16](#)
- counter\_isolates
  - DEFMArray counters, [16](#), [17](#)
- counter\_istar2
  - DEFMArray counters, [17](#)
- counter\_k\_genes\_changing
  - Phylo counters, [25](#)
- COUNTER\_LAMBDA
  - barry.hpp, [270](#)
- counter\_less\_than\_p\_prop\_genes\_changing
  - Phylo counters, [25](#)
- counter\_logit\_intercept
  - DEFMArray counters, [17](#)
- counter\_longest
  - Phylo counters, [25](#)
- counter\_loss
  - Phylo counters, [25](#)
- counter\_maxfuns
  - Phylo counters, [26](#)
- counter\_mutual
  - DEFMArray counters, [17](#)
- counter\_neofun
  - Phylo counters, [26](#)
- counter\_neofun\_a2b
  - Phylo counters, [26](#)
- counter\_nodecov
  - DEFMArray counters, [18](#)
- counter\_nodeicov
  - DEFMArray counters, [18](#)
- counter\_nodematch
  - DEFMArray counters, [18](#)
- counter\_nodeocov
  - DEFMArray counters, [18](#)
- counter\_odegree
  - DEFMArray counters, [18](#), [19](#)
- counter\_odegree15
  - DEFMArray counters, [19](#)
- counter\_ones
  - DEFMArray counters, [19](#)
- counter\_ostar2
  - DEFMArray counters, [20](#)
- counter\_overall\_changes
  - Phylo counters, [26](#)
- counter\_overall\_gains
  - Phylo counters, [27](#)
- counter\_overall\_gains\_from\_0
  - Phylo counters, [27](#)
- counter\_overall\_loss
  - Phylo counters, [27](#)
- counter\_pairwise\_first\_gain
  - Phylo counters, [27](#)
- counter\_pairwise\_neofun\_singlefun
  - Phylo counters, [28](#)
- counter\_pairwise\_overall\_change
  - Phylo counters, [28](#)
- counter\_pairwise\_preserving
  - Phylo counters, [28](#)
- counter\_preserve\_pseudogene
  - Phylo counters, [28](#)
- counter\_prop\_genes\_changing
  - Phylo counters, [29](#)
- counter\_subfun
  - Phylo counters, [29](#)
- COUNTER\_TEMPLATE
  - counters-meat.hpp, [274](#), [276](#), [277](#)
- COUNTER\_TEMPLATE\_ARGS
  - counters-meat.hpp, [274](#)

- counter\_transition
  - DEFMArray counters, 20
- counter\_transition\_formula
  - DEFMArray counters, 21
- counter\_ttriads
  - DEFMArray counters, 21
- COUNTER\_TYPE
  - counters-meat.hpp, 275
- Counters
  - Counters< Array\_Type, Data\_Type >, 108, 109
- counters
  - statscounter-meat.hpp, 337
  - support-meat.hpp, 346
- Counters< Array\_Type, Data\_Type >, 108
  - ~Counters, 109
  - add\_counter, 109, 110
  - add\_hash, 110
  - Counters, 108, 109
  - gen\_hash, 110
  - get\_descriptions, 110
  - get\_names, 111
  - operator=, 111
  - operator[], 112
  - size, 112
- counters-meat.hpp
  - add\_dims, 281
  - count\_fun, 276
  - count\_fun\_, 281
  - counter, 282
  - counter\_, 282
  - COUNTER\_TEMPLATE, 274, 276, 277
  - COUNTER\_TEMPLATE\_ARGS, 274
  - COUNTER\_TYPE, 275
  - COUNTERS\_TEMPLATE, 275, 277–279
  - COUNTERS\_TEMPLATE\_ARGS, 275
  - COUNTERS\_TYPE, 275
  - data, 279
  - data\_, 282
  - desc, 279
  - desc\_, 282
  - for, 279
  - fun, 283
  - fun\_, 283
  - hasher, 279, 280
  - hasher\_fun, 280
  - hasher\_fun\_, 283
  - i, 283
  - if, 280
  - init\_fun, 281
  - init\_fun\_, 284
  - j, 284
  - name, 281
  - name\_, 284
  - noexcept, 284
  - res, 284
  - return, 285
  - TMP\_HASHER\_CALL, 275
- counters\_
  - statscounter-meat.hpp, 337
  - support-meat.hpp, 347
- COUNTERS\_TEMPLATE
  - counters-meat.hpp, 275, 277–279
- COUNTERS\_TEMPLATE\_ARGS
  - counters-meat.hpp, 275
- COUNTERS\_TYPE
  - counters-meat.hpp, 275
- Counting, 11
- counts
  - PhyloRuleDynData, 179
- Counts\_type
  - typedefs.hpp, 352
- covar\_sort
  - DEFMData, 123
- covar\_used
  - DEFMData, 123
- covariates
  - DEFMData, 123
- CSS\_APPEND
  - network-css.hpp, 294
- CSS\_CASE\_ELSE
  - network-css.hpp, 294
- CSS\_CASE\_PERCEIVED
  - network-css.hpp, 295
- CSS\_CASE\_TRUTH
  - network-css.hpp, 295
- CSS\_CHECK\_SIZE
  - network-css.hpp, 295
- CSS\_CHECK\_SIZE\_INIT
  - network-css.hpp, 295
- CSS\_NET\_COUNTER\_LAMBDA\_INIT
  - network-css.hpp, 295
- CSS\_PERCEIVED\_CELLS
  - network-css.hpp, 296
- CSS\_SIZE
  - network-css.hpp, 296
- CSS\_TRUE\_CELLS
  - network-css.hpp, 296
- current\_col
  - ConstBArrayRowIter< Cell\_Type, Data\_Type >, 102
- current\_row
  - ConstBArrayRowIter< Cell\_Type, Data\_Type >, 102
- current\_stats
  - statscounter-meat.hpp, 337
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 205
- D
  - BArray< Cell\_Type, Data\_Type >, 40
  - BArrayDense< Cell\_Type, Data\_Type >, 59, 60
  - Rule< Array\_Type, Data\_Type >, 190
- D\_ptr
  - BArray< Cell\_Type, Data\_Type >, 40
  - BArrayDense< Cell\_Type, Data\_Type >, 60
- dat

- Flock, 134
- data
  - barray-meat.hpp, 228
  - barraydense-meat.hpp, 252
  - Counter< Array\_Type, Data\_Type >, 106
  - counters-meat.hpp, 279
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 185
- data\_
  - counters-meat.hpp, 282
- DEFAULT\_DUPLICATION
  - phylo.hpp, 310
- default\_val
  - BArray< Cell\_Type, Data\_Type >, 40
  - BArrayDense< Cell\_Type, Data\_Type >, 60
- DEFM, 112
  - ~DEFM, 113
  - DEFM, 113
  - get\_ID, 114
  - get\_m\_order, 114
  - get\_model, 114
  - get\_n\_covars, 114
  - get\_n\_obs, 114
  - get\_n\_rows, 114
  - get\_n\_y, 115
  - get\_X, 115
  - get\_X\_names, 115
  - get\_Y, 115
  - get\_Y\_names, 115
  - init, 115
  - likelihood, 116
  - logodds, 116
  - motif\_census, 116
  - set\_names, 116
  - simulate, 116
- defm-formula.hpp
  - defm\_motif\_parser, 285
- defm-meat.hpp
  - DEFM\_LOOP\_ARRAYS, 320
  - DEFM\_RANGES, 320
- defm.hpp
  - DEFM\_COUNTER, 289
  - DEFM\_COUNTER\_LAMBDA, 289
  - DEFM\_RULE, 289
  - DEFM\_RULE\_LAMBDA, 289
  - DEFMArray, 290
  - DEFMCounter, 291
  - DEFMCounters, 291
  - DEFMModel, 291
  - DEFMRule, 291
  - DEFMRules, 291
  - DEFMStatsCounter, 291
  - DEFMSupport, 292
  - MAKE\_DEFM\_HASHER, 290
  - UNI\_SUB, 290
- DEFM\_COUNTER
  - defm.hpp, 289
- DEFM\_COUNTER\_LAMBDA
  - defm.hpp, 289
- DEFM\_LOOP\_ARRAYS
  - defm-meat.hpp, 320
- defm\_motif\_parser
  - defm-formula.hpp, 285
- DEFM\_RANGES
  - defm-meat.hpp, 320
- DEFM\_RULE
  - defm.hpp, 289
- DEFM\_RULE\_LAMBDA
  - defm.hpp, 289
- DEFMArray
  - defm.hpp, 290
- DEFMArray counters, 12
  - counter\_absdiff, 14
  - counter\_ctriads, 14
  - counter\_degree, 14
  - counter\_density, 15
  - counter\_diff, 15
  - counter\_edges, 15
  - counter\_fixed\_effect, 15
  - counter\_iddegree, 16
  - counter\_iddegree15, 16
  - counter\_isolates, 16, 17
  - counter\_istar2, 17
  - counter\_logit\_intercept, 17
  - counter\_mutual, 17
  - counter\_nodecov, 18
  - counter\_nodeicov, 18
  - counter\_nodematch, 18
  - counter\_nodeocov, 18
  - counter\_odegree, 18, 19
  - counter\_odegree15, 19
  - counter\_ones, 19
  - counter\_ostar2, 20
  - counter\_transition, 20
  - counter\_transition\_formula, 21
  - counter\_ttriads, 21
  - NETWORK\_COUNTER, 21
  - rules\_markov\_fixed, 21
- DEFMCounter
  - defm.hpp, 291
- DEFMCounterData, 117
  - ~DEFMCounterData, 118
  - DEFMCounterData, 117, 118
  - idx, 118
  - indices, 119
  - is\_true, 118
  - logical, 119
  - num, 118
  - numbers, 119
- DEFMCounters
  - defm.hpp, 291
- DEFMData, 119
  - ~DEFMData, 122
  - array, 123
  - at, 122
  - covar\_sort, 123
  - covar\_used, 123

- covariates, 123
- DEFMData, 120
- ncol, 122
- nrow, 122
- obs\_start, 124
- operator(), 122
- print, 123
- X\_ncol, 124
- X\_nrow, 124
- DEFMModel
  - defm.hpp, 291
- DEFMRule
  - defm.hpp, 291
- DEFMRuleData, 124
  - DEFMRuleData, 125
  - idx, 125
  - num, 125
- DEFMRules
  - defm.hpp, 291
- DEFMStatsCounter
  - defm.hpp, 291
- DEFMSupport
  - defm.hpp, 292
- delete\_counters
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 206
  - support-meat.hpp, 347
- delete\_data
  - barray-meat.hpp, 228
  - barraydense-meat.hpp, 252
- delete\_data\_
  - barray-meat.hpp, 228
  - barraydense-meat.hpp, 253
- delete\_engine
  - Geese, 148
- delete\_rules
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 206
  - support-meat.hpp, 347
- delete\_rules\_dyn
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 206
  - support-meat.hpp, 347
- delete\_support
  - Geese, 149
- desc
  - Counter< Array\_Type, Data\_Type >, 107
  - counters-meat.hpp, 279
- desc\_
  - counters-meat.hpp, 282
- directed
  - NetworkData, 168
- DUPL\_DUPL
  - phylo.hpp, 310
- DUPL\_EITH
  - phylo.hpp, 310
- DUPL\_SPEC
  - phylo.hpp, 310
- duplication
  - Node, 172
  - NodeData, 175
  - PhyloRuleDynData, 179
- el
  - barraydense-meat.hpp, 253
- el\_colsums
  - barraydense-meat.hpp, 253
- el\_rowsums
  - barraydense-meat.hpp, 253
- else
  - barray-meat.hpp, 228
  - barraydense-meat.hpp, 253
  - support-meat.hpp, 347
- empty
  - PhyloCounterData, 176
- EmptyArray
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 185
  - statscounter-meat.hpp, 337
- end
  - BArrayDenseCol< Cell\_Type, Data\_Type >, 75
  - BArrayDenseCol\_const< Cell\_Type, Data\_Type >, 77
  - BArrayDenseRow< Cell\_Type, Data\_Type >, 79
  - BArrayDenseRow\_const< Cell\_Type, Data\_Type >, 82
  - BArrayVector< Cell\_Type, Data\_Type >, 89
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 93
  - PhyloCounterData, 177
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 183
  - Progress, 188
- Entries
  - Entries< Cell\_Type >, 126, 127
- Entries< Cell\_Type >, 126
  - ~Entries, 127
  - Entries, 126, 127
  - resize, 127
  - source, 127
  - target, 127
  - val, 128
- eval\_rules\_dyn
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 202
- EXISTS, 33
  - AS\_ONE, 33
  - AS\_ZERO, 33
  - BOTH, 34
  - NONE, 34
  - ONE, 34
  - TWO, 34
  - UNKNOWN, 34
- f\_
  - statscounter-meat.hpp, 337

- support-meat.hpp, 348
- false
  - barray-meat.hpp, 228
  - barraydense-meat.hpp, 254
- first
  - barray-meat.hpp, 229
- Flock, 128
  - ~Flock, 129
  - add\_data, 129
  - colnames, 130
  - dat, 134
  - Flock, 129
  - get\_counters, 130
  - get\_model, 130
  - get\_stats\_support, 130
  - get\_stats\_target, 130
  - get\_support\_fun, 131
  - init, 131
  - initialized, 134
  - likelihood\_joint, 131
  - model, 134
  - nfunctions, 134
  - nfuncs, 131
  - nleafs, 132
  - nnodes, 132
  - nterms, 132
  - ntrees, 132
  - operator(), 132
  - parse\_polytomies, 133
  - print, 133
  - rengine, 134
  - set\_seed, 133
  - support\_size, 133
- flush\_data
  - BArray< Cell\_Type, Data\_Type >, 40
- for
  - barray-meat-operators.hpp, 213
  - barray-meat.hpp, 222
  - barraydense-meat.hpp, 247
  - counters-meat.hpp, 279
  - statscounter-meat.hpp, 334
  - support-meat.hpp, 341
- FreqTable
  - FreqTable< T >, 136
- FreqTable< T >, 135
  - ~FreqTable, 136
  - add, 136
  - as\_vector, 136
  - clear, 136
  - FreqTable, 136
  - get\_data, 137
  - get\_index, 137
  - make\_hash, 137
  - print, 137
  - reserve, 137
  - size, 138
- fun
  - counters-meat.hpp, 283
- fun\_
  - counters-meat.hpp, 283
- Geese, 138
  - ~Geese, 141
  - calc\_reduced\_sequence, 142
  - calc\_sequence, 142
  - colnames, 142
  - delete\_rengine, 148
  - delete\_support, 149
  - Geese, 141
  - get\_annotated\_nodes, 142
  - get\_counters, 142
  - get\_model, 142
  - get\_probabilities, 143
  - get\_rengine, 143
  - get\_states, 143
  - get\_support\_fun, 143
  - inherit\_support, 143
  - init, 144
  - init\_node, 144
  - initialized, 149
  - likelihood, 144
  - likelihood\_exhaust, 144
  - map\_to\_nodes, 149
  - nannotations, 144
  - nfunctions, 149
  - nfuncs, 145
  - nleafs, 145
  - nnodes, 145
  - nodes, 149
  - nterms, 145
  - observed\_counts, 145
  - operator=, 146
  - parse\_polytomies, 146
  - predict, 146
  - predict\_backend, 146
  - predict\_exhaust, 147
  - predict\_exhaust\_backend, 147
  - predict\_sim, 147
  - print, 147
  - print\_observed\_counts, 147
  - pset\_loc, 149
  - reduced\_sequence, 150
  - sequence, 150
  - set\_seed, 148
  - simulate, 148
  - support\_size, 148
  - update\_annotations, 148
- geese-bones.hpp
  - INITIALIZED, 322
  - keygen\_full, 323
  - RULE\_FUNCTION, 323
  - vec\_diff, 323
  - vector\_caster, 323
- gen\_hash
  - Counters< Array\_Type, Data\_Type >, 110
- gen\_key



- Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
157
- get\_annotated\_nodes  
Geese, 142
- get\_arrays2support  
Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
157
- get\_cell  
BArray< Cell\_Type, Data\_Type >, 40  
BArrayDense< Cell\_Type, Data\_Type >, 60
- get\_col\_vec  
BArray< Cell\_Type, Data\_Type >, 41  
BArrayDense< Cell\_Type, Data\_Type >, 60, 61
- get\_counters  
Flock, 130  
Geese, 142  
Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
157  
PhyloCounterData, 177  
StatsCounter< Array\_Type, Data\_Type >, 196  
Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
202
- get\_counts  
Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
202
- get\_current\_stats  
Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
202
- get\_data  
BArrayDense< Cell\_Type, Data\_Type >, 61  
FreqTable< T >, 137  
PowerSet< Array\_Type, Data\_Rule\_Type >, 183  
Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
202
- get\_data\_ptr  
PowerSet< Array\_Type, Data\_Rule\_Type >, 184
- get\_description  
Counter< Array\_Type, Data\_Type >, 105
- get\_descriptions  
Counters< Array\_Type, Data\_Type >, 110  
StatsCounter< Array\_Type, Data\_Type >, 196
- get\_entries  
BArray< Cell\_Type, Data\_Type >, 41  
BArrayDense< Cell\_Type, Data\_Type >, 61
- get\_hasher  
Counter< Array\_Type, Data\_Type >, 105
- get\_ID  
DEFM, 114
- get\_index  
FreqTable< T >, 137
- get\_last\_name  
phylo.hpp, 315
- get\_m\_order  
DEFM, 114
- get\_model  
DEFM, 114  
Flock, 130  
Geese, 142
- get\_n\_covars  
DEFM, 114
- get\_n\_obs  
DEFM, 114
- get\_n\_rows  
DEFM, 114
- get\_n\_y  
DEFM, 115
- get\_name  
Counter< Array\_Type, Data\_Type >, 105
- get\_names  
Counters< Array\_Type, Data\_Type >, 111  
StatsCounter< Array\_Type, Data\_Type >, 196
- get\_norm\_const  
Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
157
- get\_parent  
Node, 171
- get\_probabilities  
Geese, 143
- get\_pset  
Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
157
- get\_pset\_arrays  
Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
158
- get\_pset\_probs  
Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
158
- get\_pset\_stats  
Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
158
- get\_rengine  
Geese, 143  
Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
158
- get\_row\_vec  
BArray< Cell\_Type, Data\_Type >, 41  
BArrayDense< Cell\_Type, Data\_Type >, 61
- get\_rules  
Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
159  
Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,

- 203
- get\_rules\_dyn
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 159
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 203
- get\_seq
  - Rules< Array\_Type, Data\_Type >, 192
- get\_states
  - Geese, 143
- get\_stats\_support
  - Flock, 130
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 159
- get\_stats\_target
  - Flock, 130
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 159
- get\_support\_fun
  - Flock, 131
  - Geese, 143
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 159
- get\_X
  - DEFM, 115
- get\_X\_names
  - DEFM, 115
- get\_Y
  - DEFM, 115
- get\_Y\_names
  - DEFM, 115
- hasher
  - counters-meat.hpp, 279, 280
- hasher\_fun
  - Counter< Array\_Type, Data\_Type >, 107
  - counters-meat.hpp, 280
- hasher\_fun\_
  - counters-meat.hpp, 283
- Hasher\_fun\_type
  - typedefs.hpp, 352
- hashes
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 206
  - support-meat.hpp, 348
- hashes\_initialized
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 206
- i
  - counters-meat.hpp, 283
- i1
  - barray-meat.hpp, 229
  - barraydense-meat.hpp, 254
- id
  - Node, 172
- idx
  - DEFMCounterData, 118
  - DEFMRuleData, 125
- if
  - barray-meat.hpp, 222–225
  - barraydense-meat.hpp, 248
  - counters-meat.hpp, 280
  - support-meat.hpp, 341, 342
- IF\_MATCHES
  - phylo.hpp, 311
- IF\_NOTMATCHES
  - phylo.hpp, 311
- include/barry/barray-bones.hpp, 209
- include/barry/barray-iterator.hpp, 209
- include/barry/barray-meat-operators.hpp, 210
- include/barry/barray-meat.hpp, 214
- include/barry/barraycell-bones.hpp, 232
- include/barry/barraycell-meat.hpp, 232
- include/barry/barraydense-bones.hpp, 233
- include/barry/barraydense-meat-operators.hpp, 233
- include/barry/barraydense-meat.hpp, 236
- include/barry/barraydensecell-bones.hpp, 257
- include/barry/barraydensecell-meat.hpp, 258
- include/barry/barraydensecol-bones.hpp, 258
- include/barry/barraydenserow-bones.hpp, 260
- include/barry/barrayrow-bones.hpp, 261
- include/barry/barrayrow-meat.hpp, 261
- include/barry/barrayvector-bones.hpp, 263
- include/barry/barrayvector-meat.hpp, 264
- include/barry/barry-configuration.hpp, 264
- include/barry/barry-debug.hpp, 266
- include/barry/barry-macros.hpp, 267
- include/barry/barry.hpp, 268
- include/barry/cell-bones.hpp, 271
- include/barry/cell-meat.hpp, 272
- include/barry/col-bones.hpp, 272
- include/barry/counters-bones.hpp, 272
- include/barry/counters-meat.hpp, 273
- include/barry/counters/defm-formula.hpp, 285
- include/barry/counters/defm.hpp, 287
- include/barry/counters/network-css.hpp, 293
- include/barry/counters/network.hpp, 301
- include/barry/counters/phylo.hpp, 308
- include/barry/freqtable.hpp, 315
- include/barry/model-bones.hpp, 316
- include/barry/model-meat.hpp, 316
- include/barry/models/defm.hpp, 292
- include/barry/models/defm/defm-bones.hpp, 319
- include/barry/models/defm/defm-meat.hpp, 319
- include/barry/models/geese.hpp, 320
- include/barry/models/geese/flock-bones.hpp, 321
- include/barry/models/geese/flock-meat.hpp, 321
- include/barry/models/geese/geese-bones.hpp, 322

- include/barry/models/geese/geese-meat-constructors.hpp, 324
- include/barry/models/geese/geese-meat-likelihood.hpp, 324
- include/barry/models/geese/geese-meat-likelihood\_exhaust.hpp, 325
- include/barry/models/geese/geese-meat-predict.hpp, 326
- include/barry/models/geese/geese-meat-predict\_exhaust.hpp, 326
- include/barry/models/geese/geese-meat-predict\_sim.hpp, 327
- include/barry/models/geese/geese-meat-simulate.hpp, 327
- include/barry/models/geese/geese-meat.hpp, 328
- include/barry/models/geese/geese-node-bones.hpp, 328
- include/barry/powerset-bones.hpp, 329
- include/barry/powerset-meat.hpp, 329
- include/barry/progress.hpp, 330
- include/barry/rules-bones.hpp, 331
- include/barry/rules-meat.hpp, 332
- include/barry/statscounter-bones.hpp, 332
- include/barry/statscounter-meat.hpp, 333
- include/barry/support-bones.hpp, 338
- include/barry/support-meat.hpp, 339
- include/barry/typedefs.hpp, 350
- indices
  - DEFMCounterData, 119
  - NetCounterData, 166
- inherit\_support
  - Geese, 143
- init
  - Counter< Array\_Type, Data\_Type >, 105
  - DEFM, 115
  - Flock, 131
  - Geese, 144
- init\_fun
  - Counter< Array\_Type, Data\_Type >, 107
  - counters-meat.hpp, 281
- init\_fun\_
  - counters-meat.hpp, 284
- init\_node
  - Geese, 144
- init\_support
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 184
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 203
- INITIALIZED
  - geese-bones.hpp, 322
- initialized
  - Flock, 134
  - Geese, 149
- insert\_cell
  - BArray< Cell\_Type, Data\_Type >, 42
  - BArrayDense< Cell\_Type, Data\_Type >, 62
  - barraydense-meat.hpp, 248
  - support-meat.hpp, 342
- is\_col
  - BArrayVector< Cell\_Type, Data\_Type >, 89
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 93
- is\_dense
  - BArray< Cell\_Type, Data\_Type >, 42
  - BArrayDense< Cell\_Type, Data\_Type >, 62
- IS\_DUPLICATION
  - phylo.hpp, 311
- IS\_EITHER
  - phylo.hpp, 311
- is\_empty
  - BArray< Cell\_Type, Data\_Type >, 42
  - BArrayDense< Cell\_Type, Data\_Type >, 62
- is\_leaf
  - Node, 171
- is\_row
  - BArrayVector< Cell\_Type, Data\_Type >, 89
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 93
- IS\_SPECIATION
  - phylo.hpp, 311
- is\_true
  - DEFMCounterData, 118
- iter
  - ConstBArrayRowIter< Cell\_Type, Data\_Type >, 102
- j
  - barray-meat.hpp, 229
  - barraydense-meat.hpp, 254
  - counters-meat.hpp, 284
  - statscounter-meat.hpp, 338
- j0
  - barray-meat.hpp, 229
  - barraydense-meat.hpp, 254
- j1
  - barray-meat.hpp, 229
  - barraydense-meat.hpp, 254
- keygen\_full
  - geese-bones.hpp, 323
- lb
  - PhyloRuleDynData, 179
- likelihood
  - DEFM, 116
  - Geese, 144
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 160
- likelihood\_
  - model-meat.hpp, 317
- likelihood\_exhaust
  - Geese, 144
- likelihood\_joint
  - Flock, 131
- likelihood\_total

- Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
161
- logical
  - DEFMCounterData, 119
- logodds
  - DEFM, 116
- M
  - barray-meat.hpp, 225, 229
  - barraydense-meat.hpp, 249, 254
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 185
  - Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
207
- M\_
  - barray-meat.hpp, 230
  - barraydense-meat.hpp, 255
- MAKE\_DEFM\_HASHER
  - defm.hpp, 290
- MAKE\_DUPL\_VARS
  - phylo.hpp, 312
- make\_hash
  - FreqTable< T >, 137
- Map
  - barry-configuration.hpp, 265
- map\_to\_nodes
  - Geese, 149
- MapVec\_type
  - typedefs.hpp, 353
- max\_num\_elements
  - Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
207
- Model
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
153, 154
- model
  - Flock, 134
- Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type,  
Data\_Rule\_Dyn\_Type >, 150
  - ~Model, 154
  - add\_array, 154
  - add\_counter, 155
  - add\_hasher, 155
  - add\_rule, 155
  - add\_rule\_dyn, 155, 156
  - colnames, 156
  - conditional\_prob, 156
  - gen\_key, 157
  - get\_arrays2support, 157
  - get\_counters, 157
  - get\_norm\_const, 157
  - get\_pset, 157
  - get\_pset\_arrays, 158
  - get\_pset\_probs, 158
  - get\_pset\_stats, 158
  - get\_engine, 158
  - get\_rules, 159
  - get\_rules\_dyn, 159
  - get\_stats\_support, 159
  - get\_stats\_target, 159
  - get\_support\_fun, 159
  - likelihood, 160
  - likelihood\_total, 161
  - Model, 153, 154
  - nterms, 161
  - operator=, 161
  - print, 161
  - print\_stats, 161
  - sample, 162
  - set\_counters, 162
  - set\_engine, 162
  - set\_rules, 162
  - set\_rules\_dyn, 163
  - set\_seed, 163
  - set\_transform\_model, 163
  - size, 164
  - size\_unique, 164
  - store\_psets, 164
  - support\_size, 164
  - transform\_model, 164
- model-meat.hpp
  - likelihood\_, 317
  - MODEL\_TEMPLATE, 317, 318
  - MODEL\_TEMPLATE\_ARGS, 317
  - MODEL\_TYPE, 317
  - update\_normalizing\_constant, 318
- MODEL\_TEMPLATE
  - model-meat.hpp, 317, 318
- MODEL\_TEMPLATE\_ARGS
  - model-meat.hpp, 317
- MODEL\_TYPE
  - model-meat.hpp, 317
- motif\_census
  - DEFM, 116
- N
  - barray-meat.hpp, 230
  - barraydense-meat.hpp, 255
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 186
  - Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
207
- n\_counters
  - Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
207
- n\_free
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 186
- n\_locked
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 186
- name
  - Counter< Array\_Type, Data\_Type >, 107
  - counters-meat.hpp, 281
- name\_
  - counters-meat.hpp, 284

- nannotations
  - Geese, [144](#)
- narray
  - Node, [172](#)
- NCells
  - barray-meat.hpp, [230](#)
- ncol
  - BArray< Cell\_Type, Data\_Type >, [43](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [62](#)
  - DEFMData, [122](#)
- NET\_C\_DATA\_IDX
  - network.hpp, [304](#)
- NET\_C\_DATA\_NUM
  - network.hpp, [304](#)
- NetCounter
  - network.hpp, [306](#)
- NetCounterData, [165](#)
  - ~NetCounterData, [165](#)
  - indices, [166](#)
  - NetCounterData, [165](#)
  - numbers, [166](#)
- NetCounters
  - network.hpp, [306](#)
- NetModel
  - network.hpp, [306](#)
- NetRule
  - network.hpp, [306](#)
- NetRules
  - network.hpp, [306](#)
- NetStatsCounter
  - network.hpp, [306](#)
- NetSupport
  - network.hpp, [307](#)
- Network
  - network.hpp, [307](#)
- network-css.hpp
  - counter\_css\_census01, [296](#)
  - counter\_css\_census02, [297](#)
  - counter\_css\_census03, [297](#)
  - counter\_css\_census04, [297](#)
  - counter\_css\_census05, [297](#)
  - counter\_css\_census06, [298](#)
  - counter\_css\_census07, [298](#)
  - counter\_css\_census08, [298](#)
  - counter\_css\_census09, [298](#)
  - counter\_css\_census10, [299](#)
  - counter\_css\_completely\_false\_recip\_comiss, [299](#)
  - counter\_css\_completely\_false\_recip\_omiss, [299](#)
  - counter\_css\_mixed\_recip, [299](#)
  - counter\_css\_partially\_false\_recip\_commi, [300](#)
  - counter\_css\_partially\_false\_recip\_omiss, [300](#)
  - CSS\_APPEND, [294](#)
  - CSS\_CASE\_ELSE, [294](#)
  - CSS\_CASE\_PERCEIVED, [295](#)
  - CSS\_CASE\_TRUTH, [295](#)
  - CSS\_CHECK\_SIZE, [295](#)
  - CSS\_CHECK\_SIZE\_INIT, [295](#)
  - CSS\_NET\_COUNTER\_LAMBDA\_INIT, [295](#)
  - CSS\_PERCEIVED\_CELLS, [296](#)
  - CSS\_SIZE, [296](#)
  - CSS\_TRUE\_CELLS, [296](#)
- network.hpp
  - BARRY\_ZERO\_NETWORK, [303](#)
  - BARRY\_ZERO\_NETWORK\_DENSE, [304](#)
  - NET\_C\_DATA\_IDX, [304](#)
  - NET\_C\_DATA\_NUM, [304](#)
  - NetCounter, [306](#)
  - NetCounters, [306](#)
  - NetModel, [306](#)
  - NetRule, [306](#)
  - NetRules, [306](#)
  - NetStatsCounter, [306](#)
  - NetSupport, [307](#)
  - Network, [307](#)
  - NETWORK\_COUNTER, [304](#)
  - NETWORK\_COUNTER\_LAMBDA, [304](#)
  - NETWORK\_RULE, [305](#)
  - NETWORK\_RULE\_LAMBDA, [305](#)
  - NetworkDense, [307](#)
  - NETWORKDENSE\_COUNTER\_LAMBDA, [305](#)
  - rules\_zerodiag, [307](#)
- NETWORK\_COUNTER
  - DEFMArray counters, [21](#)
  - network.hpp, [304](#)
- NETWORK\_COUNTER\_LAMBDA
  - network.hpp, [304](#)
- NETWORK\_RULE
  - network.hpp, [305](#)
- NETWORK\_RULE\_LAMBDA
  - network.hpp, [305](#)
- NetworkData, [166](#)
  - ~NetworkData, [168](#)
  - directed, [168](#)
  - NetworkData, [167](#)
  - vertex\_attr, [168](#)
- NetworkDense
  - network.hpp, [307](#)
- NETWORKDENSE\_COUNTER\_LAMBDA
  - network.hpp, [305](#)
- next
  - Progress, [188](#)
- nfunctions
  - Flock, [134](#)
  - Geese, [149](#)
- nfunfs
  - Flock, [131](#)
  - Geese, [145](#)
- nleafs
  - Flock, [132](#)
  - Geese, [145](#)
- nnodes
  - Flock, [132](#)
  - Geese, [145](#)
- nnozero
  - BArray< Cell\_Type, Data\_Type >, [43](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [63](#)

- Node, 168
  - ~Node, 170
  - annotations, 171
  - array, 171
  - arrays, 172
  - duplication, 172
  - get\_parent, 171
  - id, 172
  - is\_leaf, 171
  - narray, 172
  - Node, 169, 170
  - noffspring, 171
  - offspring, 172
  - ord, 173
  - parent, 173
  - probability, 173
  - subtree\_prob, 173
  - visited, 173
- NodeData, 174
  - blengths, 175
  - duplication, 175
  - NodeData, 174
  - states, 175
- nodes
  - Geese, 149
- noexcept
  - counters-meat.hpp, 284
- noffspring
  - Node, 171
- NONE
  - CHECK, 32
  - EXISTS, 34
- nrow
  - BArray< Cell\_Type, Data\_Type >, 43
  - BArrayDense< Cell\_Type, Data\_Type >, 63
  - DEFMData, 122
- nterms
  - Flock, 132
  - Geese, 145
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 161
- ntrees
  - Flock, 132
- num
  - DEFMCounterData, 118
  - DEFMRuleData, 125
- numbers
  - DEFMCounterData, 119
  - NetCounterData, 166
- obs\_start
  - DEFMData, 124
- observed\_counts
  - Geese, 145
- offspring
  - Node, 172
- ONE
  - CHECK, 32
- EXISTS, 34
- operator BArrayRow< Cell\_Type, Data\_Type >
  - BArrayRow< Cell\_Type, Data\_Type >, 84
- operator BArrayRow\_const< Cell\_Type, Data\_Type >
  - BArrayRow\_const< Cell\_Type, Data\_Type >, 86
- operator Cell\_Type
  - BArrayCell< Cell\_Type, Data\_Type >, 50
  - BArrayCell\_const< Cell\_Type, Data\_Type >, 53
  - BArrayDenseCell< Cell\_Type, Data\_Type >, 71
  - Cell< Cell\_Type >, 98
- operator std::vector< Cell\_Type >
  - BArrayVector< Cell\_Type, Data\_Type >, 90
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 93
- operator!=
  - BArrayCell\_const< Cell\_Type, Data\_Type >, 53
  - BArrayRow\_const< Cell\_Type, Data\_Type >, 86
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 93
  - Cell< Cell\_Type >, 98
- operator<
  - BArrayCell\_const< Cell\_Type, Data\_Type >, 53
  - BArrayRow\_const< Cell\_Type, Data\_Type >, 86
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 94
- operator<=
  - BArrayCell\_const< Cell\_Type, Data\_Type >, 53
  - BArrayRow\_const< Cell\_Type, Data\_Type >, 87
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 94
- operator>
  - BArrayCell\_const< Cell\_Type, Data\_Type >, 53
  - BArrayRow\_const< Cell\_Type, Data\_Type >, 87
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 94
- operator>=
  - BArrayCell\_const< Cell\_Type, Data\_Type >, 54
  - BArrayRow\_const< Cell\_Type, Data\_Type >, 87
  - BArrayVector\_const< Cell\_Type, Data\_Type >, 94
- operator\*=
  - BArray< Cell\_Type, Data\_Type >, 43
  - BArrayCell< Cell\_Type, Data\_Type >, 50
  - BArrayDense< Cell\_Type, Data\_Type >, 63
  - BArrayDenseCell< Cell\_Type, Data\_Type >, 71
  - BArrayRow< Cell\_Type, Data\_Type >, 84
  - BArrayVector< Cell\_Type, Data\_Type >, 90
- operator()
  - BArray< Cell\_Type, Data\_Type >, 43
  - barray-meat-operators.hpp, 213
  - BArrayDense< Cell\_Type, Data\_Type >, 63
  - BArrayDenseCol< Cell\_Type, Data\_Type >, 75
  - BArrayDenseCol\_const< Cell\_Type, Data\_Type >, 77
  - BArrayDenseRow< Cell\_Type, Data\_Type >, 80
  - BArrayDenseRow\_const< Cell\_Type, Data\_Type >, 82
  - DEFMData, 122
  - Flock, 132
  - PhyloCounterData, 177
  - Rule< Array\_Type, Data\_Type >, 190
  - Rules< Array\_Type, Data\_Type >, 193
  - vecHasher< T >, 208
- operator+=

- BArray< Cell\_Type, Data\_Type >, [44](#)
- BArrayCell< Cell\_Type, Data\_Type >, [50](#)
- BArrayDense< Cell\_Type, Data\_Type >, [63](#), [64](#)
- BArrayDenseCell< Cell\_Type, Data\_Type >, [71](#)
- BArrayRow< Cell\_Type, Data\_Type >, [84](#)
- BArrayVector< Cell\_Type, Data\_Type >, [90](#)
- operator-=
  - BArray< Cell\_Type, Data\_Type >, [44](#)
  - BArrayCell< Cell\_Type, Data\_Type >, [51](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [64](#)
  - BArrayDenseCell< Cell\_Type, Data\_Type >, [72](#)
  - BArrayRow< Cell\_Type, Data\_Type >, [84](#)
  - BArrayVector< Cell\_Type, Data\_Type >, [90](#)
- operator/=
  - BArray< Cell\_Type, Data\_Type >, [45](#)
  - BArrayCell< Cell\_Type, Data\_Type >, [51](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [64](#)
  - BArrayDenseCell< Cell\_Type, Data\_Type >, [72](#)
  - BArrayRow< Cell\_Type, Data\_Type >, [85](#)
  - BArrayVector< Cell\_Type, Data\_Type >, [90](#)
- operator=
  - BArray< Cell\_Type, Data\_Type >, [45](#)
  - BArrayCell< Cell\_Type, Data\_Type >, [51](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [65](#)
  - BArrayDenseCell< Cell\_Type, Data\_Type >, [72](#)
  - BArrayRow< Cell\_Type, Data\_Type >, [85](#)
  - BArrayVector< Cell\_Type, Data\_Type >, [91](#)
  - Cell< Cell\_Type >, [98](#), [99](#)
  - Counter< Array\_Type, Data\_Type >, [105](#), [106](#)
  - Counters< Array\_Type, Data\_Type >, [111](#)
  - Geese, [146](#)
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [161](#)
  - Rules< Array\_Type, Data\_Type >, [193](#)
- operator==
  - BArray< Cell\_Type, Data\_Type >, [45](#)
  - BArrayCell< Cell\_Type, Data\_Type >, [51](#)
  - BArrayCell\_const< Cell\_Type, Data\_Type >, [53](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [65](#)
  - BArrayDenseCell< Cell\_Type, Data\_Type >, [72](#)
  - BArrayRow< Cell\_Type, Data\_Type >, [85](#)
  - BArrayRow\_const< Cell\_Type, Data\_Type >, [87](#)
  - BArrayVector< Cell\_Type, Data\_Type >, [91](#)
  - BArrayVector\_const< Cell\_Type, Data\_Type >, [94](#)
  - Cell< Cell\_Type >, [99](#)
- operator[]
  - Counters< Array\_Type, Data\_Type >, [112](#)
  - PhyloCounterData, [177](#)
  - PowerSet< Array\_Type, Data\_Rule\_Type >, [184](#)
- ord
  - Node, [173](#)
- out\_of\_range
  - BArray< Cell\_Type, Data\_Type >, [45](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [65](#)
- parent
  - Node, [173](#)
- parse\_polytomies
  - Flock, [133](#)
  - Geese, [146](#)
- Phylo counters, [22](#)
  - counter\_co\_opt, [23](#)
  - counter\_cogain, [23](#)
  - counter\_gains, [24](#)
  - counter\_gains\_from\_0, [24](#)
  - counter\_gains\_k\_offspring, [24](#)
  - counter\_genes\_changing, [24](#)
  - counter\_k\_genes\_changing, [25](#)
  - counter\_less\_than\_p\_prop\_genes\_changing, [25](#)
  - counter\_longest, [25](#)
  - counter\_loss, [25](#)
  - counter\_maxfun, [26](#)
  - counter\_neofun, [26](#)
  - counter\_neofun\_a2b, [26](#)
  - counter\_overall\_changes, [26](#)
  - counter\_overall\_gains, [27](#)
  - counter\_overall\_gains\_from\_0, [27](#)
  - counter\_overall\_loss, [27](#)
  - counter\_pairwise\_first\_gain, [27](#)
  - counter\_pairwise\_neofun\_singlefun, [28](#)
  - counter\_pairwise\_overall\_change, [28](#)
  - counter\_pairwise\_preserving, [28](#)
  - counter\_preserve\_pseudogene, [28](#)
  - counter\_prop\_genes\_changing, [29](#)
  - counter\_subfun, [29](#)
- Phylo rules, [29](#)
  - rule\_dyn\_limit\_changes, [30](#)
- phylo.hpp
  - DEFAULT\_DUPLICATION, [310](#)
  - DUPL\_DUPL, [310](#)
  - DUPL\_EITH, [310](#)
  - DUPL\_SPEC, [310](#)
  - get\_last\_name, [315](#)
  - IF\_MATCHES, [311](#)
  - IF\_NOTMATCHES, [311](#)
  - IS\_DUPLICATION, [311](#)
  - IS\_EITHER, [311](#)
  - IS\_SPECIATION, [311](#)
  - MAKE\_DUPL\_VARS, [312](#)
  - PHYLO\_CHECK\_MISSING, [312](#)
  - PHYLO\_COUNTER\_LAMBDA, [312](#)
  - PHYLO\_RULE\_DYN\_LAMBDA, [312](#)
  - PhyloArray, [313](#)
  - PhyloCounter, [313](#)
  - PhyloCounters, [313](#)
  - PhyloModel, [313](#)
  - PhyloPowerSet, [313](#)
  - PhyloRule, [314](#)
  - PhyloRuleData, [314](#)
  - PhyloRuleDyn, [314](#)
  - PhyloRules, [314](#)
  - PhyloRulesDyn, [314](#)
  - PhyloStatsCounter, [314](#)
  - PhyloSupport, [315](#)
  - PHYLO\_CHECK\_MISSING
  - phylo.hpp, [312](#)



- PHYLO\_COUNTER\_LAMBDA
  - phylo.hpp, [312](#)
- PHYLO\_RULE\_DYN\_LAMBDA
  - phylo.hpp, [312](#)
- PhyloArray
  - phylo.hpp, [313](#)
- PhyloCounter
  - phylo.hpp, [313](#)
- PhyloCounterData, [175](#)
  - at, [176](#)
  - begin, [176](#)
  - empty, [176](#)
  - end, [177](#)
  - get\_counters, [177](#)
  - operator(), [177](#)
  - operator[], [177](#)
  - PhyloCounterData, [176](#)
  - push\_back, [177](#)
  - reserve, [177](#)
  - shrink\_to\_fit, [178](#)
  - size, [178](#)
- PhyloCounters
  - phylo.hpp, [313](#)
- PhyloModel
  - phylo.hpp, [313](#)
- PhyloPowerSet
  - phylo.hpp, [313](#)
- PhyloRule
  - phylo.hpp, [314](#)
- PhyloRuleData
  - phylo.hpp, [314](#)
- PhyloRuleDyn
  - phylo.hpp, [314](#)
- PhyloRuleDynData, [178](#)
  - ~PhyloRuleDynData, [179](#)
  - counts, [179](#)
  - duplication, [179](#)
  - lb, [179](#)
  - PhyloRuleDynData, [179](#)
  - pos, [179](#)
  - ub, [180](#)
- PhyloRules
  - phylo.hpp, [314](#)
- PhyloRulesDyn
  - phylo.hpp, [314](#)
- PhyloStatsCounter
  - phylo.hpp, [314](#)
- PhyloSupport
  - phylo.hpp, [315](#)
- POS
  - barraydense-meat-operators.hpp, [234](#)
  - barraydense-meat.hpp, [239](#)
  - barraydensecell-bones.hpp, [257](#)
  - barraydensecell-meat.hpp, [258](#)
  - barraydensecol-bones.hpp, [259](#)
  - barraydenserow-bones.hpp, [260](#)
- pos
  - PhyloRuleDynData, [179](#)
- POS\_N
  - barraydense-meat-operators.hpp, [235](#)
  - barraydense-meat.hpp, [239](#)
  - barraydensecol-bones.hpp, [259](#)
  - barraydenserow-bones.hpp, [260](#)
- PowerSet
  - PowerSet< Array\_Type, Data\_Rule\_Type >, [182](#)
- PowerSet< Array\_Type, Data\_Rule\_Type >, [180](#)
  - ~PowerSet, [182](#)
  - add\_rule, [182](#), [183](#)
  - begin, [183](#)
  - calc, [183](#)
  - coordinates\_free, [185](#)
  - coordinates\_locked, [185](#)
  - data, [185](#)
  - EmptyArray, [185](#)
  - end, [183](#)
  - get\_data, [183](#)
  - get\_data\_ptr, [184](#)
  - init\_support, [184](#)
  - M, [185](#)
  - N, [186](#)
  - n\_free, [186](#)
  - n\_locked, [186](#)
  - operator[], [184](#)
  - PowerSet, [182](#)
  - reset, [184](#)
  - rules, [186](#)
  - rules\_deleted, [186](#)
  - size, [184](#)
- predict
  - Geese, [146](#)
- predict\_backend
  - Geese, [146](#)
- predict\_exhaust
  - Geese, [147](#)
- predict\_exhaust\_backend
  - Geese, [147](#)
- predict\_sim
  - Geese, [147](#)
- print
  - BArray< Cell\_Type, Data\_Type >, [45](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [65](#)
  - DEFMData, [123](#)
  - Flock, [133](#)
  - FreqTable< T >, [137](#)
  - Geese, [147](#)
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [161](#)
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [203](#)
- print\_observed\_counts
  - Geese, [147](#)
- print\_stats
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, [161](#)



- 161
- printf\_barry
  - barry-configuration.hpp, 265
- probability
  - Node, 173
- Progress, 187
  - ~Progress, 187
  - end, 188
  - next, 188
  - Progress, 187
- progress.hpp
  - BARRY\_PROGRESS\_BAR\_WIDTH, 330
- pset\_loc
  - Geese, 149
- push\_back
  - PhyloCounterData, 177
- README.md, 355
- reduced\_sequence
  - Geese, 150
- rengine
  - Flock, 134
- report
  - barray-meat.hpp, 230
  - barraydense-meat.hpp, 255
- res
  - counters-meat.hpp, 284
- reserve
  - BArray< Cell\_Type, Data\_Type >, 46
  - BArrayDense< Cell\_Type, Data\_Type >, 65
  - FreqTable< T >, 137
  - PhyloCounterData, 177
- reset
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 184
- reset\_array
  - StatsCounter< Array\_Type, Data\_Type >, 196
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 203, 204
- resize
  - BArray< Cell\_Type, Data\_Type >, 46
  - barray-meat.hpp, 225
  - BArrayDense< Cell\_Type, Data\_Type >, 66
  - barraydense-meat.hpp, 249, 250
  - Entries< Cell\_Type >, 127
  - statscounter-meat.hpp, 334
- return
  - barray-meat.hpp, 225, 230
  - barraydense-meat.hpp, 255
  - counters-meat.hpp, 285
  - statscounter-meat.hpp, 338
  - support-meat.hpp, 348
- rhs
  - barray-meat-operators.hpp, 213
- rm\_cell
  - BArray< Cell\_Type, Data\_Type >, 46
  - BArrayDense< Cell\_Type, Data\_Type >, 66
  - barraydense-meat.hpp, 250
  - support-meat.hpp, 342
- ROW
  - barray-meat-operators.hpp, 211
  - barray-meat.hpp, 217, 225, 226
  - barraydense-meat-operators.hpp, 235
  - barraydense-meat.hpp, 240
- row
  - BArray< Cell\_Type, Data\_Type >, 46
  - BArrayDense< Cell\_Type, Data\_Type >, 66
- row0
  - barray-meat.hpp, 231
- Row\_type
  - typedefs.hpp, 353
- rowsum
  - BArrayDense< Cell\_Type, Data\_Type >, 66
- Rule
  - Rule< Array\_Type, Data\_Type >, 189
- Rule< Array\_Type, Data\_Type >, 188
  - ~Rule, 189
  - D, 190
  - operator(), 190
  - Rule, 189
- rule\_dyn\_limit\_changes
  - Phylo rules, 30
- rule\_fun\_default
  - rules-bones.hpp, 331
- Rule\_fun\_type
  - typedefs.hpp, 353
- RULE\_FUNCTION
  - barry.hpp, 271
  - geese-bones.hpp, 323
- RULE\_LAMBDA
  - barry.hpp, 271
- Rules
  - Rules< Array\_Type, Data\_Type >, 191
- rules
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 186
  - support-meat.hpp, 348
- Rules< Array\_Type, Data\_Type >, 190
  - ~Rules, 191
  - add\_rule, 192
  - get\_seq, 192
  - operator(), 193
  - operator=, 193
  - Rules, 191
  - size, 193
- rules-bones.hpp
  - rule\_fun\_default, 331
- rules\_
  - support-meat.hpp, 348
- rules\_deleted
  - PowerSet< Array\_Type, Data\_Rule\_Type >, 186
- rules\_dyn
  - support-meat.hpp, 349
- rules\_markov\_fixed
  - DEFMArray counters, 21
- rules\_zerodiag
  - network.hpp, 307
- sample

- Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[162](#)
- search
  - barray-meat.hpp, [231](#)
- sequence
  - Geese, [150](#)
- set\_counters
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[162](#)
  - StatsCounter< Array\_Type, Data\_Type >, [197](#)
  - Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[204](#)
- set\_data
  - BArray< Cell\_Type, Data\_Type >, [46](#)
  - BArrayDense< Cell\_Type, Data\_Type >, [66](#)
- set\_hasher
  - Counter< Array\_Type, Data\_Type >, [106](#)
- set\_names
  - DEFM, [116](#)
- set\_engine
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[162](#)
- set\_rules
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[162](#)
  - Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[204](#)
- set\_rules\_dyn
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[163](#)
  - Support< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[204](#)
- set\_seed
  - Flock, [133](#)
  - Geese, [148](#)
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[163](#)
- set\_transform\_model
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[163](#)
- shrink\_to\_fit
  - PhyloCounterData, [178](#)
- simulate
  - DEFM, [116](#)
  - Geese, [148](#)
- size
  - BArrayDenseCol< Cell\_Type, Data\_Type >, [75](#)
  - BArrayDenseCol\_const< Cell\_Type, Data\_Type >,  
[78](#)
  - BArrayDenseRow< Cell\_Type, Data\_Type >, [80](#)
  - BArrayDenseRow\_const< Cell\_Type, Data\_Type  
>, [82](#)
  - BArrayVector< Cell\_Type, Data\_Type >, [91](#)
  - BArrayVector\_const< Cell\_Type, Data\_Type >, [95](#)
  - Counters< Array\_Type, Data\_Type >, [112](#)
  - FreqTable< T >, [138](#)
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[164](#)
  - PhyloCounterData, [178](#)
  - PowerSet< Array\_Type, Data\_Rule\_Type >, [184](#)
  - Rules< Array\_Type, Data\_Type >, [193](#)
  - StatsCounter< Array\_Type, Data\_Type >, [197](#)
- size\_unique
  - Model< Array\_Type, Data\_Counter\_Type,  
Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
[164](#)
- sort\_array
  - typedefs.hpp, [353](#)
- source
  - barray-meat.hpp, [231](#)
  - barraydense-meat.hpp, [255](#)
  - Entries< Cell\_Type >, [127](#)
- states
  - NodeData, [175](#)
- Statistical Models, [11](#)
- stats\_bank
  - support-meat.hpp, [349](#)
- StatsCounter
  - StatsCounter< Array\_Type, Data\_Type >, [194](#),  
[195](#)
- StatsCounter< Array\_Type, Data\_Type >, [194](#)
- ~StatsCounter, [195](#)
- add\_counter, [195](#)
- count\_all, [195](#)
- count\_current, [196](#)
- count\_init, [196](#)
- get\_counters, [196](#)
- get\_descriptions, [196](#)
- get\_names, [196](#)
- reset\_array, [196](#)
- set\_counters, [197](#)
- size, [197](#)
- StatsCounter, [194](#), [195](#)
- statscounter-meat.hpp
  - clear, [334](#)
  - counter, [336](#)
  - counter\_deleted, [336](#)
  - counters, [337](#)
  - counters\_, [337](#)
  - current\_stats, [337](#)
  - EmptyArray, [337](#)
  - f\_, [337](#)
  - for, [334](#)
  - j, [338](#)
  - resize, [334](#)

- return, 338
- STATSCOUNTER\_TEMPLATE, 334–336
- STATSCOUNTER\_TEMPLATE\_ARGS, 334
- STATSCOUNTER\_TYPE, 334
- STATSCOUNTER\_TEMPLATE
  - statscounter-meat.hpp, 334–336
- STATSCOUNTER\_TEMPLATE\_ARGS
  - statscounter-meat.hpp, 334
- STATSCOUNTER\_TYPE
  - statscounter-meat.hpp, 334
- store\_psets
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 164
- subtree\_prob
  - Node, 173
- Support
  - Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 199, 200
- Support< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 197
  - ~Support, 200
  - add\_counter, 200
  - add\_rule, 200, 201
  - add\_rule\_dyn, 201
  - calc, 201
  - change\_stats, 204
  - cooriantes\_n\_free, 205
  - cooriantes\_n\_locked, 205
  - coordinates\_free, 205
  - coordinates\_locked, 205
  - current\_stats, 205
  - delete\_counters, 206
  - delete\_rules, 206
  - delete\_rules\_dyn, 206
  - eval\_rules\_dyn, 202
  - get\_counters, 202
  - get\_counts, 202
  - get\_current\_stats, 202
  - get\_data, 202
  - get\_rules, 203
  - get\_rules\_dyn, 203
  - hashes, 206
  - hashes\_initialized, 206
  - init\_support, 203
  - M, 207
  - max\_num\_elements, 207
  - N, 207
  - n\_counters, 207
  - print, 203
  - reset\_array, 203, 204
  - set\_counters, 204
  - set\_rules, 204
  - set\_rules\_dyn, 204
  - Support, 199, 200
- support-meat.hpp
  - array\_bank, 346
  - BARRY\_SUPPORT\_MEAT\_HPP, 340
  - calc\_backend\_dense, 341
  - calc\_backend\_sparse, 341
  - change\_stats\_different, 346
  - coord\_i, 346
  - coord\_j, 346
  - counters, 346
  - counters\_, 347
  - delete\_counters, 347
  - delete\_rules, 347
  - delete\_rules\_dyn, 347
  - else, 347
  - f\_, 348
  - for, 341
  - hashes, 348
  - if, 341, 342
  - insert\_cell, 342
  - return, 348
  - rm\_cell, 342
  - rules, 348
  - rules\_, 348
  - rules\_dyn, 349
  - stats\_bank, 349
  - SUPPORT\_TEMPLATE, 340, 343–346
  - SUPPORT\_TEMPLATE\_ARGS, 340
  - SUPPORT\_TYPE, 341
  - tmp\_chng, 349
- support\_size
  - Flock, 133
  - Geese, 148
  - Model< Array\_Type, Data\_Counter\_Type, Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >, 164
- SUPPORT\_TEMPLATE
  - support-meat.hpp, 340, 343–346
- SUPPORT\_TEMPLATE\_ARGS
  - support-meat.hpp, 340
- SUPPORT\_TYPE
  - support-meat.hpp, 341
- swap\_cells
  - BArray< Cell\_Type, Data\_Type >, 47
  - BArrayDense< Cell\_Type, Data\_Type >, 67
- swap\_cols
  - BArray< Cell\_Type, Data\_Type >, 47
  - BArrayDense< Cell\_Type, Data\_Type >, 67
- swap\_rows
  - BArray< Cell\_Type, Data\_Type >, 47
  - BArrayDense< Cell\_Type, Data\_Type >, 67
- target
  - barray-meat.hpp, 231
  - barraydense-meat.hpp, 256
  - Entries< Cell\_Type >, 127
- this
  - barray-meat-operators.hpp, 214
- tmp\_chng
  - support-meat.hpp, 349
- TMP\_HASHER\_CALL
  - counters-meat.hpp, 275

toggle\_cell  
     BArray< Cell\_Type, Data\_Type >, [47](#)  
     BArrayDense< Cell\_Type, Data\_Type >, [67](#)  
 toggle\_lock  
     BArray< Cell\_Type, Data\_Type >, [47](#)  
     BArrayDense< Cell\_Type, Data\_Type >, [68](#)  
 transform\_model  
     Model< Array\_Type, Data\_Counter\_Type,  
         Data\_Rule\_Type, Data\_Rule\_Dyn\_Type >,  
         [164](#)  
 transpose  
     BArray< Cell\_Type, Data\_Type >, [48](#)  
     BArrayDense< Cell\_Type, Data\_Type >, [68](#)  
 TWO  
     CHECK, [33](#)  
     EXISTS, [34](#)  
 typedefs.hpp  
     Col\_type, [352](#)  
     Counter\_fun\_type, [352](#)  
     Counts\_type, [352](#)  
     Hasher\_fun\_type, [352](#)  
     MapVec\_type, [353](#)  
     Row\_type, [353](#)  
     Rule\_fun\_type, [353](#)  
     sort\_array, [353](#)  
     uint, [353](#)  
     vec\_equal, [354](#)  
     vec\_equal\_approx, [354](#)  
     vec\_inner\_prod, [354](#), [355](#)  
 ub  
     PhyloRuleDynData, [180](#)  
 uint  
     typedefs.hpp, [353](#)  
 UNKNOWN  
     EXISTS, [34](#)  
 UNI\_SUB  
     defm.hpp, [290](#)  
 update\_annotations  
     Geese, [148](#)  
 update\_normalizing\_constant  
     model-meat.hpp, [318](#)  
 v  
     barray-meat.hpp, [231](#)  
     barraydense-meat.hpp, [256](#)  
 va\_end  
     barraydense-meat.hpp, [250](#)  
 va\_start  
     barraydense-meat.hpp, [250](#)  
 val  
     Entries< Cell\_Type >, [128](#)  
 val0  
     barraydense-meat.hpp, [256](#)  
 val1  
     barraydense-meat.hpp, [256](#)  
 value  
     barray-meat.hpp, [231](#)  
     barraydense-meat.hpp, [256](#)  
     Cell< Cell\_Type >, [99](#)  
 vec\_diff  
     geese-bones.hpp, [323](#)  
 vec\_equal  
     typedefs.hpp, [354](#)  
 vec\_equal\_approx  
     typedefs.hpp, [354](#)  
 vec\_inner\_prod  
     typedefs.hpp, [354](#), [355](#)  
 vecHasher< T >, [208](#)  
     operator(), [208](#)  
 vector\_caster  
     geese-bones.hpp, [323](#)  
 vertex\_attr  
     NetworkData, [168](#)  
 visited  
     BArray< Cell\_Type, Data\_Type >, [49](#)  
     BArrayDense< Cell\_Type, Data\_Type >, [69](#)  
     Cell< Cell\_Type >, [99](#)  
     Node, [173](#)  
 vprintf  
     barraydense-meat.hpp, [251](#)  
 X\_ncol  
     DEFMData, [124](#)  
 X\_nrow  
     DEFMData, [124](#)  
 ZERO\_CELL  
     barraydense-meat.hpp, [240](#)  
     barraydensecol-bones.hpp, [259](#)  
     barraydenserow-bones.hpp, [261](#)  
 zero\_col  
     BArray< Cell\_Type, Data\_Type >, [48](#)  
     BArrayDense< Cell\_Type, Data\_Type >, [68](#)  
 zero\_row  
     BArray< Cell\_Type, Data\_Type >, [48](#)  
     BArrayDense< Cell\_Type, Data\_Type >, [68](#)