

barry: Your go-to motif accountant

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1 Main Page	1
2 Module Index	5
2.1 Modules	5
3 Hierarchical Index	7
3.1 Class Hierarchy	7
4 Class Index	9
4.1 Class List	9
5 File Index	11
5.1 File List	11
6 Module Documentation	13
6.1 Counting	13
6.1.1 Detailed Description	15
6.1.2 Macro Definition Documentation	15
6.1.2.1 IF_MATCHES	15
6.1.2.2 IF_NOTMATCHES	15
6.1.2.3 IS_DUPLICATION	15
6.1.2.4 IS_EITHER	16
6.1.2.5 IS_SPECIATION	16
6.1.2.6 MAKE_DEFM_HASHER	16
6.1.2.7 MAKE_DUPL_VARS	16
6.1.2.8 PHYLO_CHECK_MISSING	17
6.1.2.9 PHYLO_COUNTER_LAMBDA	17
6.1.2.10 PHYLO_RULE_DYN_LAMBDA	17
6.1.3 Function Documentation	17
6.1.3.1 counter_co_opt()	18
6.1.3.2 counter_cogain()	18
6.1.3.3 counter_gains()	18
6.1.3.4 counter_gains_from_0()	19
6.1.3.5 counter_gains_k_offspring()	19
6.1.3.6 counter_genes_changing()	19
6.1.3.7 counter_k_genes_changing()	19
6.1.3.8 counter_less_than_p_prop_genes_changing()	20
6.1.3.9 counter_longest()	20
6.1.3.10 counter_loss()	20
6.1.3.11 counter_maxfun()	20
6.1.3.12 counter_neofun()	21
6.1.3.13 counter_neofun_a2b()	21
6.1.3.14 counter_overall_changes()	21
6.1.3.15 counter_overall_gains()	21

6.1.3.16 counter_overall_gains_from_0()	22
6.1.3.17 counter_overall_loss()	22
6.1.3.18 counter_pairwise_first_gain()	22
6.1.3.19 counter_pairwise_neofun_singlefun()	22
6.1.3.20 counter_pairwise_overall_change()	23
6.1.3.21 counter_pairwise_preserving()	23
6.1.3.22 counter_preserve_pseudogene()	23
6.1.3.23 counter_prop_genes_changing()	23
6.1.3.24 counter_subfun()	24
6.1.3.25 get_last_name()	24
6.2 Statistical Models	24
6.2.1 Detailed Description	24
6.3 Network counters	24
6.3.1 Detailed Description	26
6.3.2 Function Documentation	26
6.3.2.1 counter_absdiff()	27
6.3.2.2 counter_ctriads() [1/2]	27
6.3.2.3 counter_ctriads() [2/2]	27
6.3.2.4 counter_degree()	27
6.3.2.5 counter_density()	28
6.3.2.6 counter_diff()	28
6.3.2.7 counter_edges()	28
6.3.2.8 counter_fixed_effect()	28
6.3.2.9 counter_iddegree() [1/2]	29
6.3.2.10 counter_iddegree() [2/2]	29
6.3.2.11 counter_iddegree15() [1/2]	29
6.3.2.12 counter_iddegree15() [2/2]	29
6.3.2.13 counter_isolates() [1/2]	30
6.3.2.14 counter_isolates() [2/2]	30
6.3.2.15 counter_istar2() [1/2]	30
6.3.2.16 counter_istar2() [2/2]	30
6.3.2.17 counter_logit_intercept()	30
6.3.2.18 counter_mutual()	31
6.3.2.19 counter_nodecov()	31
6.3.2.20 counter_nodeicov()	31
6.3.2.21 counter_nodematch()	31
6.3.2.22 counter_nodeocov()	31
6.3.2.23 counter_odegree() [1/2]	32
6.3.2.24 counter_odegree() [2/2]	32
6.3.2.25 counter_odegree15() [1/2]	32
6.3.2.26 counter_odegree15() [2/2]	32
6.3.2.27 counter_ones()	32

6.3.2.28 counter_ostar2() [1/2]	33
6.3.2.29 counter_ostar2() [2/2]	33
6.3.2.30 counter_transition()	33
6.3.2.31 counter_transition_formula()	34
6.3.2.32 counter_ttriads() [1/2]	34
6.3.2.33 counter_ttriads() [2/2]	34
6.3.2.34 NETWORK_COUNTER()	34
6.3.2.35 rules_dont_become_zero()	35
6.3.2.36 rules_markov_fixed()	35
6.4 Phylo rules	35
6.4.1 Detailed Description	37
6.4.2 Typedef Documentation	37
6.4.2.1 DEFMCounter	37
6.4.2.2 DEFMCounters	37
6.4.2.3 DEFMModel	38
6.4.2.4 DEFMRule	38
6.4.2.5 DEFMRuleDyn	38
6.4.2.6 DEFMRules	38
6.4.2.7 DEFMRulesDyn	38
6.4.2.8 DEFMStatsCounter	38
6.4.2.9 DEFMSupport	39
6.4.3 Function Documentation	39
6.4.3.1 at()	39
6.4.3.2 DEFMCounterData() [1/2]	39
6.4.3.3 DEFMCounterData() [2/2]	39
6.4.3.4 DEFMData() [1/2]	39
6.4.3.5 DEFMData() [2/2]	39
6.4.3.6 DEFMRuleData() [1/3]	40
6.4.3.7 DEFMRuleData() [2/3]	40
6.4.3.8 DEFMRuleData() [3/3]	40
6.4.3.9 DEFMRuleDynData()	40
6.4.3.10 idx() [1/2]	41
6.4.3.11 idx() [2/2]	41
6.4.3.12 is_true() [1/2]	41
6.4.3.13 is_true() [2/2]	41
6.4.3.14 ncol()	41
6.4.3.15 nrow()	41
6.4.3.16 num() [1/2]	42
6.4.3.17 num() [2/2]	42
6.4.3.18 operator()()	42
6.4.3.19 print()	42
6.4.3.20 rule_dyn_limit_changes()	43

6.4.3.21 <code>~DEFMCounterData()</code>	43
6.4.3.22 <code>~DEFMData()</code>	43
6.4.3.23 <code>~DEFMRuleDynData()</code>	43
6.4.4 Variable Documentation	44
6.4.4.1 <code>array</code>	44
6.4.4.2 <code>counts</code>	44
6.4.4.3 <code>covar_sort</code>	44
6.4.4.4 <code>covar_used</code>	44
6.4.4.5 <code>covariates</code>	44
6.4.4.6 <code>indices</code> [1/2]	45
6.4.4.7 <code>indices</code> [2/2]	45
6.4.4.8 <code>init</code>	45
6.4.4.9 <code>is_motif</code>	45
6.4.4.10 <code>logical</code> [1/2]	45
6.4.4.11 <code>logical</code> [2/2]	45
6.4.4.12 <code>numbers</code> [1/2]	46
6.4.4.13 <code>numbers</code> [2/2]	46
6.4.4.14 <code>obs_start</code>	46
6.4.4.15 <code>X_ncol</code>	46
6.4.4.16 <code>X_nrow</code>	46
6.5 Phylo counters	47
6.5.1 Detailed Description	48
6.5.2 Function Documentation	48
6.5.2.1 <code>counter_co_opt()</code>	48
6.5.2.2 <code>counter_cogain()</code>	49
6.5.2.3 <code>counter_gains()</code>	49
6.5.2.4 <code>counter_gains_from_0()</code>	49
6.5.2.5 <code>counter_gains_k_offspring()</code>	50
6.5.2.6 <code>counter_genes_changing()</code>	50
6.5.2.7 <code>counter_k_genes_changing()</code>	50
6.5.2.8 <code>counter_less_than_p_prop_genes_changing()</code>	50
6.5.2.9 <code>counter_longest()</code>	51
6.5.2.10 <code>counter_loss()</code>	51
6.5.2.11 <code>counter_maxfuns()</code>	51
6.5.2.12 <code>counter_neofun()</code>	51
6.5.2.13 <code>counter_neofun_a2b()</code>	52
6.5.2.14 <code>counter_overall_changes()</code>	52
6.5.2.15 <code>counter_overall_gains()</code>	52
6.5.2.16 <code>counter_overall_gains_from_0()</code>	52
6.5.2.17 <code>counter_overall_loss()</code>	53
6.5.2.18 <code>counter_pairwise_first_gain()</code>	53
6.5.2.19 <code>counter_pairwise_neofun_singlefun()</code>	53

6.5.2.20 counter_pairwise_overall_change()	53
6.5.2.21 counter_pairwise_preserving()	54
6.5.2.22 counter_preserve_pseudogene()	54
6.5.2.23 counter_prop_genes_changing()	54
6.5.2.24 counter_subfun()	54
7 Namespace Documentation	55
7.1 barry Namespace Reference	55
7.1.1 Detailed Description	55
7.2 barry::counters Namespace Reference	55
7.2.1 Detailed Description	55
7.3 barry::counters::network Namespace Reference	56
7.4 CHECK Namespace Reference	56
7.4.1 Detailed Description	56
7.4.2 Variable Documentation	56
7.4.2.1 BOTH	56
7.4.2.2 NONE	56
7.4.2.3 ONE	56
7.4.2.4 TWO	57
7.5 defm Namespace Reference	57
7.6 EXISTS Namespace Reference	57
7.6.1 Detailed Description	57
7.6.2 Variable Documentation	57
7.6.2.1 AS_ONE	57
7.6.2.2 AS_ZERO	57
7.6.2.3 BOTH	58
7.6.2.4 NONE	58
7.6.2.5 ONE	58
7.6.2.6 TWO	58
7.6.2.7 UNKNOWN	58
7.7 geese Namespace Reference	58
8 Class Documentation	59
8.1 BArray< Cell_Type, Data_Type > Class Template Reference	59
8.1.1 Detailed Description	61
8.1.2 Constructor & Destructor Documentation	62
8.1.2.1 BArray() [1/6]	62
8.1.2.2 BArray() [2/6]	62
8.1.2.3 BArray() [3/6]	62
8.1.2.4 BArray() [4/6]	63
8.1.2.5 BArray() [5/6]	63
8.1.2.6 BArray() [6/6]	63
8.1.2.7 ~BArray()	63

8.1.3 Member Function Documentation	63
8.1.3.1 clear()	63
8.1.3.2 col()	64
8.1.3.3 D() [1/2]	64
8.1.3.4 D() [2/2]	64
8.1.3.5 D_ptr() [1/2]	64
8.1.3.6 D_ptr() [2/2]	64
8.1.3.7 default_val()	64
8.1.3.8 flush_data()	64
8.1.3.9 get_cell()	65
8.1.3.10 get_col_vec() [1/2]	65
8.1.3.11 get_col_vec() [2/2]	65
8.1.3.12 get_entries()	65
8.1.3.13 get_row_vec() [1/2]	65
8.1.3.14 get_row_vec() [2/2]	66
8.1.3.15 insert_cell() [1/3]	66
8.1.3.16 insert_cell() [2/3]	66
8.1.3.17 insert_cell() [3/3]	66
8.1.3.18 is_dense()	66
8.1.3.19 is_empty()	67
8.1.3.20 ncol()	67
8.1.3.21 nnozero()	67
8.1.3.22 nrow()	67
8.1.3.23 operator>() [1/2]	67
8.1.3.24 operator>() [2/2]	67
8.1.3.25 operator*=()	68
8.1.3.26 operator+=() [1/3]	68
8.1.3.27 operator+=() [2/3]	68
8.1.3.28 operator+=() [3/3]	68
8.1.3.29 operator-=() [1/3]	68
8.1.3.30 operator-=() [2/3]	68
8.1.3.31 operator-=() [3/3]	69
8.1.3.32 operator/=()	69
8.1.3.33 operator=() [1/2]	69
8.1.3.34 operator=() [2/2]	69
8.1.3.35 operator==()	69
8.1.3.36 out_of_range()	69
8.1.3.37 print()	70
8.1.3.38 reserve()	70
8.1.3.39 resize()	70
8.1.3.40 rm_cell()	70
8.1.3.41 row()	70

8.1.3.42 set_data()	70
8.1.3.43 swap_cells()	71
8.1.3.44 swap_cols()	71
8.1.3.45 swap_rows()	71
8.1.3.46 toggle_cell()	71
8.1.3.47 toggle_lock()	72
8.1.3.48 transpose()	72
8.1.3.49 zero_col()	72
8.1.3.50 zero_row()	72
8.1.4 Friends And Related Function Documentation	72
8.1.4.1 BArrayCell< Cell_Type, Data_Type >	72
8.1.4.2 BArrayCell_const< Cell_Type, Data_Type >	73
8.1.5 Member Data Documentation	73
8.1.5.1 visited	73
8.2 BArrayCell< Cell_Type, Data_Type > Class Template Reference	73
8.2.1 Detailed Description	73
8.2.2 Constructor & Destructor Documentation	74
8.2.2.1 BArrayCell()	74
8.2.2.2 ~BArrayCell()	74
8.2.3 Member Function Documentation	74
8.2.3.1 operator Cell_Type()	74
8.2.3.2 operator*=()	74
8.2.3.3 operator+=()	75
8.2.3.4 operator-=()	75
8.2.3.5 operator/=()	75
8.2.3.6 operator=()	75
8.2.3.7 operator==()	75
8.3 BArrayCell_const< Cell_Type, Data_Type > Class Template Reference	76
8.3.1 Detailed Description	76
8.3.2 Constructor & Destructor Documentation	76
8.3.2.1 BArrayCell_const()	76
8.3.2.2 ~BArrayCell_const()	76
8.3.3 Member Function Documentation	77
8.3.3.1 operator Cell_Type()	77
8.3.3.2 operator!=()	77
8.3.3.3 operator<()	77
8.3.3.4 operator<=()	77
8.3.3.5 operator==()	77
8.3.3.6 operator>()	78
8.3.3.7 operator>=()	78
8.4 BArrayDense< Cell_Type, Data_Type > Class Template Reference	78
8.4.1 Detailed Description	81

8.4.2 Constructor & Destructor Documentation	81
8.4.2.1 BArrayDense() [1/6]	81
8.4.2.2 BArrayDense() [2/6]	81
8.4.2.3 BArrayDense() [3/6]	82
8.4.2.4 BArrayDense() [4/6]	82
8.4.2.5 BArrayDense() [5/6]	82
8.4.2.6 BArrayDense() [6/6]	82
8.4.2.7 ~BArrayDense()	83
8.4.3 Member Function Documentation	83
8.4.3.1 clear()	83
8.4.3.2 col() [1/2]	83
8.4.3.3 col() [2/2]	83
8.4.3.4 colsum()	83
8.4.3.5 D() [1/2]	84
8.4.3.6 D() [2/2]	84
8.4.3.7 D_ptr() [1/2]	84
8.4.3.8 D_ptr() [2/2]	84
8.4.3.9 default_val()	84
8.4.3.10 get_cell()	84
8.4.3.11 get_col_vec() [1/2]	85
8.4.3.12 get_col_vec() [2/2]	85
8.4.3.13 get_data()	85
8.4.3.14 get_entries()	85
8.4.3.15 get_row_vec() [1/2]	85
8.4.3.16 get_row_vec() [2/2]	86
8.4.3.17 insert_cell() [1/2]	86
8.4.3.18 insert_cell() [2/2]	86
8.4.3.19 is_dense()	86
8.4.3.20 is_empty()	86
8.4.3.21 ncol()	87
8.4.3.22 nnozero()	87
8.4.3.23 nrow()	87
8.4.3.24 operator()() [1/2]	87
8.4.3.25 operator()() [2/2]	87
8.4.3.26 operator*=()	87
8.4.3.27 operator+=() [1/3]	88
8.4.3.28 operator+=() [2/3]	88
8.4.3.29 operator+=() [3/3]	88
8.4.3.30 operator-=() [1/3]	88
8.4.3.31 operator-=() [2/3]	88
8.4.3.32 operator-=() [3/3]	88
8.4.3.33 operator/=()	89

8.4.3.34 operator=() [1/2]	89
8.4.3.35 operator=() [2/2]	89
8.4.3.36 operator==()	89
8.4.3.37 out_of_range()	89
8.4.3.38 print()	89
8.4.3.39 reserve()	90
8.4.3.40 resize()	90
8.4.3.41 rm_cell()	90
8.4.3.42 row() [1/2]	90
8.4.3.43 row() [2/2]	90
8.4.3.44 rowsum()	90
8.4.3.45 set_data()	91
8.4.3.46 swap_cells()	91
8.4.3.47 swap_cols()	91
8.4.3.48 swap_rows()	91
8.4.3.49 toggle_cell()	92
8.4.3.50 toggle_lock()	92
8.4.3.51 transpose()	92
8.4.3.52 zero_col()	92
8.4.3.53 zero_row()	92
8.4.4 Friends And Related Function Documentation	92
8.4.4.1 BArrayDenseCell< Cell_Type, Data_Type >	93
8.4.4.2 BArrayDenseCol< Cell_Type, Data_Type >	93
8.4.4.3 BArrayDenseCol_const< Cell_Type, Data_Type >	93
8.4.4.4 BArrayDenseRow< Cell_Type, Data_Type >	93
8.4.4.5 BArrayDenseRow_const< Cell_Type, Data_Type >	93
8.4.5 Member Data Documentation	93
8.4.5.1 visited	94
8.5 BArrayDenseCell< Cell_Type, Data_Type > Class Template Reference	94
8.5.1 Detailed Description	94
8.5.2 Constructor & Destructor Documentation	95
8.5.2.1 BArrayDenseCell()	95
8.5.2.2 ~BArrayDenseCell()	95
8.5.3 Member Function Documentation	95
8.5.3.1 operator Cell_Type()	95
8.5.3.2 operator*=()	95
8.5.3.3 operator+=()	96
8.5.3.4 operator-=()	96
8.5.3.5 operator/=()	96
8.5.3.6 operator=() [1/2]	96
8.5.3.7 operator=() [2/2]	96
8.5.3.8 operator==()	97

8.5.4 Friends And Related Function Documentation	97
8.5.4.1 BArrayDense< Cell_Type, Data_Type >	97
8.5.4.2 BArrayDenseCol< Cell_Type, Data_Type >	97
8.5.4.3 BArrayDenseCol_const< Cell_Type, Data_Type >	97
8.6 BArrayDenseCell_const< Cell_Type, Data_Type > Class Template Reference	98
8.6.1 Detailed Description	98
8.7 BArrayDenseCol< Cell_Type, Data_Type > Class Template Reference	98
8.7.1 Detailed Description	98
8.7.2 Constructor & Destructor Documentation	98
8.7.2.1 BArrayDenseCol()	99
8.7.3 Member Function Documentation	99
8.7.3.1 begin()	99
8.7.3.2 end()	99
8.7.3.3 operator()()	99
8.7.3.4 size()	99
8.7.4 Friends And Related Function Documentation	100
8.7.4.1 BArrayDense< Cell_Type, Data_Type >	100
8.7.4.2 BArrayDenseCell< Cell_Type, Data_Type >	100
8.7.4.3 BArrayDenseCell_const< Cell_Type, Data_Type >	100
8.8 BArrayDenseCol_const< Cell_Type, Data_Type > Class Template Reference	100
8.8.1 Detailed Description	101
8.8.2 Constructor & Destructor Documentation	101
8.8.2.1 BArrayDenseCol_const()	101
8.8.3 Member Function Documentation	101
8.8.3.1 begin()	101
8.8.3.2 end()	101
8.8.3.3 operator()()	102
8.8.3.4 size()	102
8.8.4 Friends And Related Function Documentation	102
8.8.4.1 BArrayDenseCell< Cell_Type, Data_Type >	102
8.8.4.2 BArrayDenseCell_const< Cell_Type, Data_Type >	102
8.9 BArrayDenseRow< Cell_Type, Data_Type > Class Template Reference	102
8.9.1 Detailed Description	103
8.9.2 Constructor & Destructor Documentation	103
8.9.2.1 BArrayDenseRow()	103
8.9.3 Member Function Documentation	103
8.9.3.1 begin()	103
8.9.3.2 end()	104
8.9.3.3 operator()()	104
8.9.3.4 size()	104
8.9.4 Friends And Related Function Documentation	104
8.9.4.1 BArrayDense< Cell_Type, Data_Type >	104

8.9.4.2 BArrayDenseCell< Cell_Type, Data_Type >	104
8.9.4.3 BArrayDenseCell_const< Cell_Type, Data_Type >	105
8.10 BArrayDenseRow_const< Cell_Type, Data_Type > Class Template Reference	105
8.10.1 Detailed Description	105
8.10.2 Constructor & Destructor Documentation	105
8.10.2.1 BArrayDenseRow_const()	106
8.10.3 Member Function Documentation	106
8.10.3.1 begin()	106
8.10.3.2 end()	106
8.10.3.3 operator>()	106
8.10.3.4 size()	106
8.10.4 Friends And Related Function Documentation	107
8.10.4.1 BArrayDenseCell< Cell_Type, Data_Type >	107
8.10.4.2 BArrayDenseCell_const< Cell_Type, Data_Type >	107
8.11 BArrayRow< Cell_Type, Data_Type > Class Template Reference	107
8.11.1 Detailed Description	107
8.11.2 Constructor & Destructor Documentation	108
8.11.2.1 BArrayRow()	108
8.11.2.2 ~BArrayRow()	108
8.11.3 Member Function Documentation	108
8.11.3.1 operator BArrayRow< Cell_Type, Data_Type >()	108
8.11.3.2 operator*=()	108
8.11.3.3 operator+=()	108
8.11.3.4 operator-=()	109
8.11.3.5 operator/=()	109
8.11.3.6 operator=()	109
8.11.3.7 operator==()	109
8.12 BArrayRow_const< Cell_Type, Data_Type > Class Template Reference	109
8.12.1 Detailed Description	110
8.12.2 Constructor & Destructor Documentation	110
8.12.2.1 BArrayRow_const()	110
8.12.2.2 ~BArrayRow_const()	110
8.12.3 Member Function Documentation	110
8.12.3.1 operator BArrayRow_const< Cell_Type, Data_Type >()	110
8.12.3.2 operator!=()	110
8.12.3.3 operator<()	111
8.12.3.4 operator<=()	111
8.12.3.5 operator==()	111
8.12.3.6 operator>()	111
8.12.3.7 operator>=()	111
8.13 BArrayVector< Cell_Type, Data_Type > Class Template Reference	111
8.13.1 Detailed Description	112

8.13.2 Constructor & Destructor Documentation	112
8.13.2.1 BArrayVector()	112
8.13.2.2 ~BArrayVector()	113
8.13.3 Member Function Documentation	113
8.13.3.1 begin()	113
8.13.3.2 end()	113
8.13.3.3 is_col()	113
8.13.3.4 is_row()	114
8.13.3.5 operator std::vector< Cell_Type >()	114
8.13.3.6 operator*=()	114
8.13.3.7 operator+=()	114
8.13.3.8 operator-=()	114
8.13.3.9 operator/=()	115
8.13.3.10 operator=()	115
8.13.3.11 operator==()	115
8.13.3.12 size()	115
8.14 BArrayVector_const< Cell_Type, Data_Type > Class Template Reference	115
8.14.1 Detailed Description	116
8.14.2 Constructor & Destructor Documentation	116
8.14.2.1 BArrayVector_const()	116
8.14.2.2 ~BArrayVector_const()	116
8.14.3 Member Function Documentation	117
8.14.3.1 begin()	117
8.14.3.2 end()	117
8.14.3.3 is_col()	117
8.14.3.4 is_row()	117
8.14.3.5 operator std::vector< Cell_Type >()	117
8.14.3.6 operator"!=()	118
8.14.3.7 operator<()	118
8.14.3.8 operator<=()	118
8.14.3.9 operator==()	118
8.14.3.10 operator>()	118
8.14.3.11 operator>=()	119
8.14.3.12 size()	119
8.15 Cell< Cell_Type > Class Template Reference	119
8.15.1 Detailed Description	120
8.15.2 Constructor & Destructor Documentation	120
8.15.2.1 Cell() [1/7]	120
8.15.2.2 Cell() [2/7]	120
8.15.2.3 ~Cell()	120
8.15.2.4 Cell() [3/7]	121
8.15.2.5 Cell() [4/7]	121

8.15.2.6 Cell() [5/7]	121
8.15.2.7 Cell() [6/7]	121
8.15.2.8 Cell() [7/7]	121
8.15.3 Member Function Documentation	121
8.15.3.1 add() [1/4]	122
8.15.3.2 add() [2/4]	122
8.15.3.3 add() [3/4]	122
8.15.3.4 add() [4/4]	122
8.15.3.5 operator Cell_Type()	122
8.15.3.6 operator"!=()	122
8.15.3.7 operator=() [1/2]	123
8.15.3.8 operator=() [2/2]	123
8.15.3.9 operator==(())	123
8.15.4 Member Data Documentation	123
8.15.4.1 active	123
8.15.4.2 value	123
8.15.4.3 visited	124
8.16 Cell_const< Cell_Type > Class Template Reference	124
8.16.1 Detailed Description	124
8.17 ConstBArrayRowIter< Cell_Type, Data_Type > Class Template Reference	124
8.17.1 Detailed Description	125
8.17.2 Constructor & Destructor Documentation	125
8.17.2.1 ConstBArrayRowIter()	125
8.17.2.2 ~ConstBArrayRowIter()	125
8.17.3 Member Data Documentation	125
8.17.3.1 Array	126
8.17.3.2 current_col	126
8.17.3.3 current_row	126
8.17.3.4 iter	126
8.18 Counter< Array_Type, Data_Type > Class Template Reference	126
8.18.1 Detailed Description	127
8.18.2 Constructor & Destructor Documentation	128
8.18.2.1 Counter() [1/4]	128
8.18.2.2 Counter() [2/4]	128
8.18.2.3 Counter() [3/4]	128
8.18.2.4 Counter() [4/4]	128
8.18.2.5 ~Counter()	129
8.18.3 Member Function Documentation	129
8.18.3.1 count()	129
8.18.3.2 get_description()	129
8.18.3.3 get_hasher()	129
8.18.3.4 get_name()	129

8.18.3.5 init()	129
8.18.3.6 operator=() [1/2]	130
8.18.3.7 operator=() [2/2]	130
8.18.3.8 set_hasher()	130
8.18.4 Member Data Documentation	130
8.18.4.1 count_fun	130
8.18.4.2 data	131
8.18.4.3 desc	131
8.18.4.4 hasher_fun	131
8.18.4.5 init_fun	131
8.18.4.6 name	131
8.19 Counters< Array_Type, Data_Type > Class Template Reference	132
8.19.1 Detailed Description	132
8.19.2 Constructor & Destructor Documentation	132
8.19.2.1 Counters() [1/3]	133
8.19.2.2 ~Counters()	133
8.19.2.3 Counters() [2/3]	133
8.19.2.4 Counters() [3/3]	133
8.19.3 Member Function Documentation	133
8.19.3.1 add_counter() [1/2]	134
8.19.3.2 add_counter() [2/2]	134
8.19.3.3 add_hash()	134
8.19.3.4 gen_hash()	134
8.19.3.5 get_descriptions()	135
8.19.3.6 get_names()	135
8.19.3.7 operator=() [1/2]	135
8.19.3.8 operator=() [2/2]	135
8.19.3.9 operator[]()	136
8.19.3.10 size()	136
8.20 DEFM Class Reference	137
8.20.1 Detailed Description	138
8.20.2 Constructor & Destructor Documentation	138
8.20.2.1 DEFM()	138
8.20.3 Member Function Documentation	138
8.20.3.1 get_ID()	138
8.20.3.2 get_m_order()	138
8.20.3.3 get_model()	139
8.20.3.4 get_n_covars()	139
8.20.3.5 get_n_obs()	139
8.20.3.6 get_n_rows()	139
8.20.3.7 get_n_y()	139
8.20.3.8 get_X()	139

8.20.3.9 <code>get_X_names()</code>	140
8.20.3.10 <code>get_Y()</code>	140
8.20.3.11 <code>get_Y_names()</code>	140
8.20.3.12 <code>init()</code>	140
8.20.3.13 <code>is_motif()</code>	140
8.20.3.14 <code>likelihood()</code>	140
8.20.3.15 <code>logodds()</code>	141
8.20.3.16 <code>motif_census()</code>	141
8.20.3.17 <code>print()</code>	141
8.20.3.18 <code>set_names()</code>	141
8.20.3.19 <code>simulate()</code>	141
8.21 DEFMCounterData Class Reference	142
8.21.1 Detailed Description	142
8.22 DEFMDData Class Reference	142
8.22.1 Detailed Description	143
8.23 DEFMRuleData Class Reference	144
8.23.1 Detailed Description	144
8.24 DEFMRuleDynData Class Reference	145
8.24.1 Detailed Description	145
8.25 Entries< Cell_Type > Class Template Reference	146
8.25.1 Detailed Description	146
8.25.2 Constructor & Destructor Documentation	146
8.25.2.1 <code>Entries()</code> [1/2]	146
8.25.2.2 <code>Entries()</code> [2/2]	147
8.25.2.3 <code>~Entries()</code>	147
8.25.3 Member Function Documentation	147
8.25.3.1 <code>resize()</code>	147
8.25.4 Member Data Documentation	147
8.25.4.1 <code>source</code>	147
8.25.4.2 <code>target</code>	147
8.25.4.3 <code>val</code>	148
8.26 Flock Class Reference	148
8.26.1 Detailed Description	149
8.26.2 Constructor & Destructor Documentation	149
8.26.2.1 <code>Flock()</code>	149
8.26.2.2 <code>~Flock()</code>	149
8.26.3 Member Function Documentation	149
8.26.3.1 <code>add_data()</code>	149
8.26.3.2 <code>colnames()</code>	150
8.26.3.3 <code>get_counters()</code>	150
8.26.3.4 <code>get_model()</code>	150
8.26.3.5 <code>get_stats_support()</code>	150

8.26.3.6 <code>get_stats_target()</code>	151
8.26.3.7 <code>get_support_fun()</code>	151
8.26.3.8 <code>init()</code>	151
8.26.3.9 <code>likelihood_joint()</code>	151
8.26.3.10 <code>nfun()</code>	152
8.26.3.11 <code>nleaves()</code>	152
8.26.3.12 <code>nnodes()</code>	152
8.26.3.13 <code>nterms()</code>	152
8.26.3.14 <code>ntrees()</code>	152
8.26.3.15 <code>operator()</code>	152
8.26.3.16 <code>parse_polytomies()</code>	153
8.26.3.17 <code>print()</code>	153
8.26.3.18 <code>set_seed()</code>	153
8.26.3.19 <code>support_size()</code>	154
8.26.4 Member Data Documentation	154
8.26.4.1 <code>dat</code>	154
8.26.4.2 <code>initialized</code>	154
8.26.4.3 <code>model</code>	154
8.26.4.4 <code>nfunctions</code>	154
8.26.4.5 <code>engine</code>	155
8.27 <code>FreqTable< T ></code> Class Template Reference	155
8.27.1 Detailed Description	155
8.27.2 Constructor & Destructor Documentation	156
8.27.2.1 <code>FreqTable()</code>	156
8.27.2.2 <code>~FreqTable()</code>	156
8.27.3 Member Function Documentation	156
8.27.3.1 <code>add()</code>	156
8.27.3.2 <code>as_vector()</code>	156
8.27.3.3 <code>clear()</code>	157
8.27.3.4 <code>get_data()</code>	157
8.27.3.5 <code>get_index()</code>	157
8.27.3.6 <code>make_hash()</code>	157
8.27.3.7 <code>print()</code>	157
8.27.3.8 <code>reserve()</code>	158
8.27.3.9 <code>size()</code>	158
8.28 Geese Class Reference	158
8.28.1 Detailed Description	161
8.28.2 Constructor & Destructor Documentation	161
8.28.2.1 <code>Geese()</code> [1/4]	161
8.28.2.2 <code>Geese()</code> [2/4]	161
8.28.2.3 <code>Geese()</code> [3/4]	162
8.28.2.4 <code>Geese()</code> [4/4]	162

8.28.2.5 <code>~Geese()</code>	162
8.28.3 Member Function Documentation	162
8.28.3.1 <code>calc_reduced_sequence()</code>	162
8.28.3.2 <code>calc_sequence()</code>	162
8.28.3.3 <code>colnames()</code>	163
8.28.3.4 <code>get_annotated_nodes()</code>	163
8.28.3.5 <code>get_counters()</code>	163
8.28.3.6 <code>get_model()</code>	163
8.28.3.7 <code>get_probabilities()</code>	163
8.28.3.8 <code>get_rengine()</code>	163
8.28.3.9 <code>get_states()</code>	164
8.28.3.10 <code>get_support_fun()</code>	164
8.28.3.11 <code>inherit_support()</code>	164
8.28.3.12 <code>init()</code>	164
8.28.3.13 <code>init_node()</code>	164
8.28.3.14 <code>likelihood()</code>	165
8.28.3.15 <code>likelihood_exhaust()</code>	165
8.28.3.16 <code>nannotations()</code>	165
8.28.3.17 <code>nfuns()</code>	165
8.28.3.18 <code>nleaves()</code>	165
8.28.3.19 <code>nnodes()</code>	166
8.28.3.20 <code>nterms()</code>	166
8.28.3.21 <code>observed_counts()</code>	166
8.28.3.22 <code>operator=()</code> [1/2]	166
8.28.3.23 <code>operator=()</code> [2/2]	166
8.28.3.24 <code>parse_polytomies()</code>	166
8.28.3.25 <code>predict()</code>	167
8.28.3.26 <code>predict_backend()</code>	167
8.28.3.27 <code>predict_exhaust()</code>	167
8.28.3.28 <code>predict_exhaust_backend()</code>	167
8.28.3.29 <code>predict_sim()</code>	167
8.28.3.30 <code>print()</code>	168
8.28.3.31 <code>print_nodes()</code>	168
8.28.3.32 <code>print_observed_counts()</code>	168
8.28.3.33 <code>set_seed()</code>	168
8.28.3.34 <code>simulate()</code>	168
8.28.3.35 <code>support_size()</code>	168
8.28.3.36 <code>update_annotations()</code>	169
8.28.4 Member Data Documentation	169
8.28.4.1 <code>delete_rengine</code>	169
8.28.4.2 <code>delete_support</code>	169
8.28.4.3 <code>etype_default</code>	169

8.28.4.4 etype_duplication	169
8.28.4.5 etype_either	170
8.28.4.6 etype_speciation	170
8.28.4.7 initialized	170
8.28.4.8 map_to_state_id	170
8.28.4.9 nfunctions	170
8.28.4.10 nodes	170
8.28.4.11 pset_loc	171
8.28.4.12 reduced_sequence	171
8.28.4.13 sequence	171
8.29 Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > Class Template Reference	172
8.29.1 Detailed Description	176
8.29.2 Constructor & Destructor Documentation	176
8.29.2.1 Model() [1/3]	176
8.29.2.2 Model() [2/3]	176
8.29.2.3 Model() [3/3]	177
8.29.2.4 ~Model()	177
8.29.3 Member Function Documentation	177
8.29.3.1 add_array()	177
8.29.3.2 add_counter() [1/2]	178
8.29.3.3 add_counter() [2/2]	178
8.29.3.4 add_hasher()	178
8.29.3.5 add_rule() [1/2]	178
8.29.3.6 add_rule() [2/2]	178
8.29.3.7 add_rule_dyn() [1/2]	179
8.29.3.8 add_rule_dyn() [2/2]	179
8.29.3.9 colnames()	179
8.29.3.10 conditional_prob()	179
8.29.3.11 gen_key()	180
8.29.3.12 get_arrays2support()	180
8.29.3.13 get_counters()	180
8.29.3.14 get_norm_const()	180
8.29.3.15 get_pset()	181
8.29.3.16 get_pset_arrays()	181
8.29.3.17 get_pset_probs()	181
8.29.3.18 get_pset_stats() [1/2]	181
8.29.3.19 get_pset_stats() [2/2]	181
8.29.3.20 get_rengine()	182
8.29.3.21 get_rules()	182
8.29.3.22 get_rules_dyn()	182
8.29.3.23 get_stats_support()	182

8.29.3.24	get_stats_target()	182
8.29.3.25	get_support_fun()	183
8.29.3.26	likelihood() [1/4]	183
8.29.3.27	likelihood() [2/4]	183
8.29.3.28	likelihood() [3/4]	183
8.29.3.29	likelihood() [4/4]	184
8.29.3.30	likelihood_total()	184
8.29.3.31	nrules()	184
8.29.3.32	nrules_dyn()	184
8.29.3.33	nterms()	184
8.29.3.34	operator=()	185
8.29.3.35	print()	185
8.29.3.36	print_stats()	185
8.29.3.37	sample() [1/2]	185
8.29.3.38	sample() [2/2]	186
8.29.3.39	set_counters()	186
8.29.3.40	set_engine()	186
8.29.3.41	set_rules()	186
8.29.3.42	set_rules_dyn()	186
8.29.3.43	set_seed()	187
8.29.3.44	set_transform_model()	187
8.29.3.45	size()	187
8.29.3.46	size_unique()	187
8.29.3.47	store_psets()	188
8.29.3.48	support_size()	188
8.29.3.49	transform_model()	188
8.29.4	Member Data Documentation	188
8.29.4.1	arrays2support	188
8.29.4.2	counter_fun	188
8.29.4.3	counters	189
8.29.4.4	delete_counters	189
8.29.4.5	delete_engine	189
8.29.4.6	delete_rules	189
8.29.4.7	delete_rules_dyn	189
8.29.4.8	first_calc_done	190
8.29.4.9	keys2support	190
8.29.4.10	normalizing_constants	190
8.29.4.11	params_last	190
8.29.4.12	pset_arrays	191
8.29.4.13	pset_probs	191
8.29.4.14	pset_stats	191
8.29.4.15	engine	191

8.29.4.16 rules	192
8.29.4.17 rules_dyn	192
8.29.4.18 stats_support	192
8.29.4.19 stats_support_n_arrays	192
8.29.4.20 stats_target	193
8.29.4.21 support_fun	193
8.29.4.22 transform_model_fun	193
8.29.4.23 transform_model_term_names	194
8.29.4.24 with_pset	194
8.30 NetCounterData Class Reference	194
8.30.1 Detailed Description	194
8.30.2 Constructor & Destructor Documentation	195
8.30.2.1 NetCounterData() [1/2]	195
8.30.2.2 NetCounterData() [2/2]	195
8.30.2.3 ~NetCounterData()	195
8.30.3 Member Data Documentation	195
8.30.3.1 indices	195
8.30.3.2 numbers	195
8.31 NetworkData Class Reference	196
8.31.1 Detailed Description	196
8.31.2 Constructor & Destructor Documentation	196
8.31.2.1 NetworkData() [1/3]	196
8.31.2.2 NetworkData() [2/3]	196
8.31.2.3 NetworkData() [3/3]	197
8.31.2.4 ~NetworkData()	197
8.31.3 Member Data Documentation	197
8.31.3.1 directed	197
8.31.3.2 vertex_attr	198
8.32 Node Class Reference	198
8.32.1 Detailed Description	199
8.32.2 Constructor & Destructor Documentation	199
8.32.2.1 Node() [1/5]	199
8.32.2.2 Node() [2/5]	200
8.32.2.3 Node() [3/5]	200
8.32.2.4 Node() [4/5]	200
8.32.2.5 Node() [5/5]	200
8.32.2.6 ~Node()	200
8.32.3 Member Function Documentation	200
8.32.3.1 get_parent()	201
8.32.3.2 is_leaf()	201
8.32.3.3 noffspring()	201
8.32.4 Member Data Documentation	201

8.32.4.1 annotations	201
8.32.4.2 array	201
8.32.4.3 arrays	202
8.32.4.4 duplication	202
8.32.4.5 id	202
8.32.4.6 narray	202
8.32.4.7 offspring	202
8.32.4.8 ord	203
8.32.4.9 parent	203
8.32.4.10 probability	203
8.32.4.11 subtree_prob	203
8.32.4.12 visited	203
8.33 NodeData Class Reference	204
8.33.1 Detailed Description	204
8.33.2 Constructor & Destructor Documentation	204
8.33.2.1 NodeData()	204
8.33.3 Member Data Documentation	204
8.33.3.1 blengths	205
8.33.3.2 duplication	205
8.33.3.3 states	205
8.34 PhyloCounterData Class Reference	205
8.34.1 Detailed Description	206
8.34.2 Constructor & Destructor Documentation	206
8.34.2.1 PhyloCounterData() [1/2]	206
8.34.2.2 PhyloCounterData() [2/2]	206
8.34.3 Member Function Documentation	206
8.34.3.1 at()	206
8.34.3.2 begin()	206
8.34.3.3 empty()	207
8.34.3.4 end()	207
8.34.3.5 get_counters()	207
8.34.3.6 operator()()	207
8.34.3.7 operator[]()	207
8.34.3.8 push_back()	207
8.34.3.9 reserve()	208
8.34.3.10 shrink_to_fit()	208
8.34.3.11 size()	208
8.35 PhyloRuleDynData Class Reference	208
8.35.1 Detailed Description	209
8.35.2 Constructor & Destructor Documentation	209
8.35.2.1 PhyloRuleDynData()	209
8.35.2.2 ~PhyloRuleDynData()	209

8.35.3 Member Function Documentation	209
8.35.3.1 operator>()	209
8.35.4 Member Data Documentation	209
8.35.4.1 counts	209
8.35.4.2 duplication	210
8.35.4.3 lb	210
8.35.4.4 pos	210
8.35.4.5 ub	210
8.36 PowerSet< Array_Type, Data_Rule_Type > Class Template Reference	210
8.36.1 Detailed Description	211
8.36.2 Constructor & Destructor Documentation	212
8.36.2.1 PowerSet() [1/3]	212
8.36.2.2 PowerSet() [2/3]	212
8.36.2.3 PowerSet() [3/3]	212
8.36.2.4 ~PowerSet()	212
8.36.3 Member Function Documentation	212
8.36.3.1 add_rule() [1/2]	213
8.36.3.2 add_rule() [2/2]	213
8.36.3.3 begin()	213
8.36.3.4 calc()	213
8.36.3.5 end()	213
8.36.3.6 get_data()	214
8.36.3.7 get_data_ptr()	214
8.36.3.8 init_support()	214
8.36.3.9 operator[]()	214
8.36.3.10 reset()	214
8.36.3.11 size()	215
8.36.4 Member Data Documentation	215
8.36.4.1 coordinates_free	215
8.36.4.2 coordinates_locked	215
8.36.4.3 data	215
8.36.4.4 EmptyArray	215
8.36.4.5 M	216
8.36.4.6 N	216
8.36.4.7 n_free	216
8.36.4.8 n_locked	216
8.36.4.9 rules	216
8.36.4.10 rules_deleted	217
8.37 Progress Class Reference	217
8.37.1 Detailed Description	217
8.37.2 Constructor & Destructor Documentation	217
8.37.2.1 Progress()	217

8.37.2.2 <code>~Progress()</code>	218
8.37.3 Member Function Documentation	218
8.37.3.1 <code>end()</code>	218
8.37.3.2 <code>next()</code>	218
8.38 Rule< Array_Type, Data_Type > Class Template Reference	218
8.38.1 Detailed Description	219
8.38.2 Constructor & Destructor Documentation	219
8.38.2.1 <code>Rule()</code> [1/2]	219
8.38.2.2 <code>Rule()</code> [2/2]	219
8.38.2.3 <code>~Rule()</code>	220
8.38.3 Member Function Documentation	220
8.38.3.1 <code>D()</code>	220
8.38.3.2 <code>get_description()</code> [1/2]	220
8.38.3.3 <code>get_description()</code> [2/2]	220
8.38.3.4 <code>get_name()</code> [1/2]	220
8.38.3.5 <code>get_name()</code> [2/2]	221
8.38.3.6 <code>operator>()</code>	221
8.39 Rules< Array_Type, Data_Type > Class Template Reference	221
8.39.1 Detailed Description	222
8.39.2 Constructor & Destructor Documentation	222
8.39.2.1 <code>Rules()</code> [1/2]	222
8.39.2.2 <code>Rules()</code> [2/2]	222
8.39.2.3 <code>~Rules()</code>	223
8.39.3 Member Function Documentation	223
8.39.3.1 <code>add_rule()</code> [1/2]	223
8.39.3.2 <code>add_rule()</code> [2/2]	223
8.39.3.3 <code>begin()</code>	223
8.39.3.4 <code>end()</code>	223
8.39.3.5 <code>get_descriptions()</code>	224
8.39.3.6 <code>get_names()</code>	224
8.39.3.7 <code>get_seq()</code>	224
8.39.3.8 <code>operator>()</code>	224
8.39.3.9 <code>operator=()</code>	225
8.39.3.10 <code>size()</code>	225
8.40 StatsCounter< Array_Type, Data_Type > Class Template Reference	225
8.40.1 Detailed Description	226
8.40.2 Constructor & Destructor Documentation	226
8.40.2.1 <code>StatsCounter()</code> [1/3]	226
8.40.2.2 <code>StatsCounter()</code> [2/3]	227
8.40.2.3 <code>StatsCounter()</code> [3/3]	227
8.40.2.4 <code>~StatsCounter()</code>	227
8.40.3 Member Function Documentation	227

8.40.3.1 add_counter()	227
8.40.3.2 count_all()	228
8.40.3.3 count_current()	228
8.40.3.4 count_init()	228
8.40.3.5 get_counters()	228
8.40.3.6 get_descriptions()	228
8.40.3.7 get_names()	228
8.40.3.8 reset_array()	228
8.40.3.9 set_counters()	229
8.40.3.10 size()	229
8.41 Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > Class Template Reference	229
8.41.1 Detailed Description	231
8.41.2 Constructor & Destructor Documentation	231
8.41.2.1 Support() [1/3]	231
8.41.2.2 Support() [2/3]	232
8.41.2.3 Support() [3/3]	232
8.41.2.4 ~Support()	232
8.41.3 Member Function Documentation	232
8.41.3.1 add_counter()	232
8.41.3.2 add_rule() [1/2]	233
8.41.3.3 add_rule() [2/2]	233
8.41.3.4 add_rule_dyn() [1/2]	233
8.41.3.5 add_rule_dyn() [2/2]	233
8.41.3.6 calc()	233
8.41.3.7 eval_rules_dyn()	234
8.41.3.8 get_counters()	234
8.41.3.9 get_counts()	234
8.41.3.10 get_current_stats()	234
8.41.3.11 get_data()	235
8.41.3.12 get_rules()	235
8.41.3.13 get_rules_dyn()	235
8.41.3.14 init_support()	235
8.41.3.15 print()	235
8.41.3.16 reset_array() [1/2]	236
8.41.3.17 reset_array() [2/2]	236
8.41.3.18 set_counters()	236
8.41.3.19 set_rules()	236
8.41.3.20 set_rules_dyn()	236
8.41.4 Member Data Documentation	236
8.41.4.1 change_stats	237
8.41.4.2 coordiantes_n_free	237

8.41.4.3 coordiantes_n_locked	237
8.41.4.4 coordinates_free	237
8.41.4.5 coordinates_locked	237
8.41.4.6 current_stats	238
8.41.4.7 delete_counters	238
8.41.4.8 delete_rules	238
8.41.4.9 delete_rules_dyn	238
8.41.4.10 hashes	238
8.41.4.11 hashes_initialized	239
8.41.4.12 M	239
8.41.4.13 max_num_elements	239
8.41.4.14 N	239
8.41.4.15 n_counters	239
8.42 vecHasher< T > Struct Template Reference	240
8.42.1 Detailed Description	240
8.42.2 Member Function Documentation	240
8.42.2.1 operator>()	240
9 File Documentation	241
9.1 include/barry/barray-bones.hpp File Reference	241
9.2 include/barry/barray-iterator.hpp File Reference	241
9.3 include/barry/barray-meat-operators.hpp File Reference	242
9.3.1 Macro Definition Documentation	242
9.3.1.1 BARRAY_TEMPLATE	243
9.3.1.2 BARRAY_TEMPLATE_ARGS	243
9.3.1.3 BARRAY_TYPE	243
9.3.1.4 COL	243
9.3.1.5 ROW	243
9.3.2 Function Documentation	243
9.3.2.1 BARRAY_TEMPLATE() [1/6]	244
9.3.2.2 BARRAY_TEMPLATE() [2/6]	244
9.3.2.3 BARRAY_TEMPLATE() [3/6]	244
9.3.2.4 BARRAY_TEMPLATE() [4/6]	244
9.3.2.5 BARRAY_TEMPLATE() [5/6]	244
9.3.2.6 BARRAY_TEMPLATE() [6/6]	245
9.3.2.7 BARRAY_TEMPLATE_ARGS()	245
9.3.2.8 BARRAY_TYPE()	245
9.3.2.9 for()	245
9.3.2.10 operator>()	245
9.3.3 Variable Documentation	245
9.3.3.1 rhs	246
9.3.3.2 this	246

9.4 include/barry/barray-meat.hpp File Reference	246
9.4.1 Macro Definition Documentation	248
9.4.1.1 BARRAY_TEMPLATE	248
9.4.1.2 BARRAY_TEMPLATE_ARGS	248
9.4.1.3 BARRAY_TYPE	249
9.4.1.4 COL	249
9.4.1.5 ROW	249
9.4.2 Function Documentation	249
9.4.2.1 ans()	249
9.4.2.2 BARRAY_TEMPLATE() [1/24]	249
9.4.2.3 BARRAY_TEMPLATE() [2/24]	250
9.4.2.4 BARRAY_TEMPLATE() [3/24]	250
9.4.2.5 BARRAY_TEMPLATE() [4/24]	250
9.4.2.6 BARRAY_TEMPLATE() [5/24]	250
9.4.2.7 BARRAY_TEMPLATE() [6/24]	250
9.4.2.8 BARRAY_TEMPLATE() [7/24]	250
9.4.2.9 BARRAY_TEMPLATE() [8/24]	251
9.4.2.10 BARRAY_TEMPLATE() [9/24]	251
9.4.2.11 BARRAY_TEMPLATE() [10/24]	251
9.4.2.12 BARRAY_TEMPLATE() [11/24]	251
9.4.2.13 BARRAY_TEMPLATE() [12/24]	251
9.4.2.14 BARRAY_TEMPLATE() [13/24]	252
9.4.2.15 BARRAY_TEMPLATE() [14/24]	252
9.4.2.16 BARRAY_TEMPLATE() [15/24]	252
9.4.2.17 BARRAY_TEMPLATE() [16/24]	252
9.4.2.18 BARRAY_TEMPLATE() [17/24]	252
9.4.2.19 BARRAY_TEMPLATE() [18/24]	252
9.4.2.20 BARRAY_TEMPLATE() [19/24]	253
9.4.2.21 BARRAY_TEMPLATE() [20/24]	253
9.4.2.22 BARRAY_TEMPLATE() [21/24]	253
9.4.2.23 BARRAY_TEMPLATE() [22/24]	253
9.4.2.24 BARRAY_TEMPLATE() [23/24]	253
9.4.2.25 BARRAY_TEMPLATE() [24/24]	253
9.4.2.26 COL()	254
9.4.2.27 for() [1/3]	254
9.4.2.28 for() [2/3]	254
9.4.2.29 for() [3/3]	254
9.4.2.30 if() [1/17]	254
9.4.2.31 if() [2/17]	254
9.4.2.32 if() [3/17]	255
9.4.2.33 if() [4/17]	255
9.4.2.34 if() [5/17]	255

9.4.2.35 if() [6/17]	255
9.4.2.36 if() [7/17]	255
9.4.2.37 if() [8/17]	255
9.4.2.38 if() [9/17]	256
9.4.2.39 if() [10/17]	256
9.4.2.40 if() [11/17]	256
9.4.2.41 if() [12/17]	256
9.4.2.42 if() [13/17]	256
9.4.2.43 if() [14/17]	256
9.4.2.44 if() [15/17]	256
9.4.2.45 if() [16/17]	257
9.4.2.46 if() [17/17]	257
9.4.2.47 M()	257
9.4.2.48 resize() [1/2]	257
9.4.2.49 resize() [2/2]	257
9.4.2.50 return()	257
9.4.2.51 ROW() [1/2]	258
9.4.2.52 ROW() [2/2]	258
9.4.3 Variable Documentation	258
9.4.3.1 add	258
9.4.3.2 ans	258
9.4.3.3 Array_	258
9.4.3.4 check_bounds	259
9.4.3.5 check_exists	259
9.4.3.6 col0	259
9.4.3.7 const	259
9.4.3.8 copy_data	260
9.4.3.9 data	260
9.4.3.10 delete_data	260
9.4.3.11 delete_data_	260
9.4.3.12 else	260
9.4.3.13 false	261
9.4.3.14 first	261
9.4.3.15 i1	261
9.4.3.16 j	261
9.4.3.17 j0	261
9.4.3.18 j1	261
9.4.3.19 M	262
9.4.3.20 M_	262
9.4.3.21 N	262
9.4.3.22 NCells	262
9.4.3.23 report	262

9.4.3.24 return	263
9.4.3.25 row0	263
9.4.3.26 search	263
9.4.3.27 source	263
9.4.3.28 target	263
9.4.3.29 v	263
9.4.3.30 value	264
9.5 include/barry/barraycell-bones.hpp File Reference	264
9.6 include/barry/barraycell-meat.hpp File Reference	264
9.7 include/barry/barraydense-bones.hpp File Reference	265
9.8 include/barry/barraydense-meat-operators.hpp File Reference	265
9.8.1 Macro Definition Documentation	266
9.8.1.1 BDENSE_TEMPLATE	266
9.8.1.2 BDENSE_TEMPLATE_ARGS	266
9.8.1.3 BDENSE_TYPE	266
9.8.1.4 COL	266
9.8.1.5 POS	267
9.8.1.6 POS_N	267
9.8.1.7 ROW	267
9.8.2 Function Documentation	267
9.8.2.1 BDENSE_TEMPLATE() [1/4]	267
9.8.2.2 BDENSE_TEMPLATE() [2/4]	267
9.8.2.3 BDENSE_TEMPLATE() [3/4]	268
9.8.2.4 BDENSE_TEMPLATE() [4/4]	268
9.8.2.5 BDENSE_TEMPLATE_ARGS()	268
9.8.2.6 BDENSE_TYPE()	268
9.9 include/barry/barraydense-meat.hpp File Reference	268
9.9.1 Macro Definition Documentation	271
9.9.1.1 BDENSE_TEMPLATE	271
9.9.1.2 BDENSE_TEMPLATE_ARGS	271
9.9.1.3 BDENSE_TYPE	271
9.9.1.4 COL	271
9.9.1.5 POS	271
9.9.1.6 POS_N	272
9.9.1.7 ROW	272
9.9.1.8 ZERO_CELL	272
9.9.2 Function Documentation	272
9.9.2.1 ans()	272
9.9.2.2 BDENSE_TEMPLATE() [1/39]	272
9.9.2.3 BDENSE_TEMPLATE() [2/39]	273
9.9.2.4 BDENSE_TEMPLATE() [3/39]	273
9.9.2.5 BDENSE_TEMPLATE() [4/39]	273

9.9.2.6 BDENSE_TEMPLATE() [5/39]	273
9.9.2.7 BDENSE_TEMPLATE() [6/39]	273
9.9.2.8 BDENSE_TEMPLATE() [7/39]	273
9.9.2.9 BDENSE_TEMPLATE() [8/39]	274
9.9.2.10 BDENSE_TEMPLATE() [9/39]	274
9.9.2.11 BDENSE_TEMPLATE() [10/39]	274
9.9.2.12 BDENSE_TEMPLATE() [11/39]	274
9.9.2.13 BDENSE_TEMPLATE() [12/39]	274
9.9.2.14 BDENSE_TEMPLATE() [13/39]	275
9.9.2.15 BDENSE_TEMPLATE() [14/39]	275
9.9.2.16 BDENSE_TEMPLATE() [15/39]	275
9.9.2.17 BDENSE_TEMPLATE() [16/39]	275
9.9.2.18 BDENSE_TEMPLATE() [17/39]	275
9.9.2.19 BDENSE_TEMPLATE() [18/39]	276
9.9.2.20 BDENSE_TEMPLATE() [19/39]	276
9.9.2.21 BDENSE_TEMPLATE() [20/39]	276
9.9.2.22 BDENSE_TEMPLATE() [21/39]	276
9.9.2.23 BDENSE_TEMPLATE() [22/39]	276
9.9.2.24 BDENSE_TEMPLATE() [23/39]	277
9.9.2.25 BDENSE_TEMPLATE() [24/39]	277
9.9.2.26 BDENSE_TEMPLATE() [25/39]	277
9.9.2.27 BDENSE_TEMPLATE() [26/39]	277
9.9.2.28 BDENSE_TEMPLATE() [27/39]	277
9.9.2.29 BDENSE_TEMPLATE() [28/39]	278
9.9.2.30 BDENSE_TEMPLATE() [29/39]	278
9.9.2.31 BDENSE_TEMPLATE() [30/39]	278
9.9.2.32 BDENSE_TEMPLATE() [31/39]	278
9.9.2.33 BDENSE_TEMPLATE() [32/39]	278
9.9.2.34 BDENSE_TEMPLATE() [33/39]	278
9.9.2.35 BDENSE_TEMPLATE() [34/39]	279
9.9.2.36 BDENSE_TEMPLATE() [35/39]	279
9.9.2.37 BDENSE_TEMPLATE() [36/39]	279
9.9.2.38 BDENSE_TEMPLATE() [37/39]	279
9.9.2.39 BDENSE_TEMPLATE() [38/39]	279
9.9.2.40 BDENSE_TEMPLATE() [39/39]	279
9.9.2.41 for()	280
9.9.2.42 if() [1/4]	280
9.9.2.43 if() [2/4]	280
9.9.2.44 if() [3/4]	280
9.9.2.45 if() [4/4]	280
9.9.2.46 insert_cell() [1/2]	280
9.9.2.47 insert_cell() [2/2]	281

9.9.2.48 M()	281
9.9.2.49 printf_barry()	281
9.9.2.50 resize() [1/6]	281
9.9.2.51 resize() [2/6]	281
9.9.2.52 resize() [3/6]	281
9.9.2.53 resize() [4/6]	282
9.9.2.54 resize() [5/6]	282
9.9.2.55 resize() [6/6]	282
9.9.2.56 rm_cell() [1/3]	282
9.9.2.57 rm_cell() [2/3]	282
9.9.2.58 rm_cell() [3/3]	282
9.9.2.59 va_end()	283
9.9.2.60 va_start()	283
9.9.3 Variable Documentation	283
9.9.3.1 add	283
9.9.3.2 ans	283
9.9.3.3 check_bounds	283
9.9.3.4 check_exists	284
9.9.3.5 col	284
9.9.3.6 const	284
9.9.3.7 copy_data	284
9.9.3.8 data	284
9.9.3.9 delete_data	285
9.9.3.10 delete_data_	285
9.9.3.11 el	285
9.9.3.12 el_colsums	285
9.9.3.13 el_rowsums	285
9.9.3.14 else	286
9.9.3.15 false	286
9.9.3.16 i1	286
9.9.3.17 j	286
9.9.3.18 j0	286
9.9.3.19 j1	286
9.9.3.20 M	287
9.9.3.21 M_	287
9.9.3.22 N	287
9.9.3.23 report	287
9.9.3.24 return	287
9.9.3.25 source	288
9.9.3.26 target	288
9.9.3.27 v	288
9.9.3.28 val0	288

9.9.3.29 val1	288
9.9.3.30 value	288
9.10 include/barry/barraydensecell-bones.hpp File Reference	289
9.10.1 Macro Definition Documentation	289
9.10.1.1 POS	289
9.11 include/barry/barraydensecell-meat.hpp File Reference	290
9.11.1 Macro Definition Documentation	290
9.11.1.1 POS	290
9.12 include/barry/barraydensecol-bones.hpp File Reference	290
9.12.1 Macro Definition Documentation	291
9.12.1.1 POS	291
9.12.1.2 POS_N	291
9.12.1.3 ZERO_CELL	291
9.13 include/barry/barraydenserow-bones.hpp File Reference	292
9.13.1 Macro Definition Documentation	292
9.13.1.1 POS	292
9.13.1.2 POS_N	293
9.13.1.3 ZERO_CELL	293
9.14 include/barry/barrayrow-bones.hpp File Reference	293
9.15 include/barry/barrayrow-meat.hpp File Reference	293
9.15.1 Macro Definition Documentation	293
9.15.1.1 BROW_TEMPLATE	294
9.15.1.2 BROW_TEMPLATE_ARGS	294
9.15.1.3 BROW_TYPE	294
9.15.2 Function Documentation	294
9.15.2.1 BROW_TEMPLATE() [1/5]	294
9.15.2.2 BROW_TEMPLATE() [2/5]	294
9.15.2.3 BROW_TEMPLATE() [3/5]	295
9.15.2.4 BROW_TEMPLATE() [4/5]	295
9.15.2.5 BROW_TEMPLATE() [5/5]	295
9.16 include/barry/barrayvector-bones.hpp File Reference	295
9.17 include/barry/barrayvector-meat.hpp File Reference	296
9.18 include/barry/barry-configuration.hpp File Reference	296
9.18.1 Macro Definition Documentation	297
9.18.1.1 BARRY_CHECK_SUPPORT	297
9.18.1.2 BARRY_ISFINITE	297
9.18.1.3 BARRY_MAX_NUM_ELEMENTS	297
9.18.1.4 BARRY_SAFE_EXP	297
9.18.1.5 printf_barry	297
9.18.2 Typedef Documentation	298
9.18.2.1 Map	298
9.19 include/barry/barry-debug.hpp File Reference	298

9.19.1 Macro Definition Documentation	298
9.19.1.1 BARRY_DEBUG_LEVEL	298
9.20 include/barry/barry-macros.hpp File Reference	299
9.20.1 Macro Definition Documentation	299
9.20.1.1 BARRY_ONE	299
9.20.1.2 BARRY_ONE_DENSE	299
9.20.1.3 BARRY_UNUSED	300
9.20.1.4 BARRY_ZERO	300
9.20.1.5 BARRY_ZERO_DENSE	300
9.21 include/barry/barry.hpp File Reference	300
9.21.1 Macro Definition Documentation	301
9.21.1.1 BARRY_HPP	302
9.21.1.2 BARRY_VERSION	302
9.21.1.3 BARRY_VERSION_MAYOR	302
9.21.1.4 BARRY_VERSION_MINOR	302
9.21.1.5 COUNTER_FUNCTION	302
9.21.1.6 COUNTER_LAMBDA	303
9.21.1.7 RULE_FUNCTION	303
9.21.1.8 RULE_LAMBDA	303
9.22 include/barry/cell-bones.hpp File Reference	303
9.23 include/barry/cell-meat.hpp File Reference	304
9.24 include/barry/col-bones.hpp File Reference	304
9.25 include/barry/counters-bones.hpp File Reference	304
9.26 include/barry/counters-meat.hpp File Reference	305
9.26.1 Macro Definition Documentation	306
9.26.1.1 COUNTER_TEMPLATE	306
9.26.1.2 COUNTER_TEMPLATE_ARGS	307
9.26.1.3 COUNTER_TYPE	307
9.26.1.4 COUNTERS_TEMPLATE	307
9.26.1.5 COUNTERS_TEMPLATE_ARGS	307
9.26.1.6 COUNTERS_TYPE	307
9.26.1.7 TMP_HASHER_CALL	307
9.26.2 Function Documentation	308
9.26.2.1 count_fun()	308
9.26.2.2 COUNTER_TEMPLATE() [1/9]	308
9.26.2.3 COUNTER_TEMPLATE() [2/9]	308
9.26.2.4 COUNTER_TEMPLATE() [3/9]	308
9.26.2.5 COUNTER_TEMPLATE() [4/9]	308
9.26.2.6 COUNTER_TEMPLATE() [5/9]	309
9.26.2.7 COUNTER_TEMPLATE() [6/9]	309
9.26.2.8 COUNTER_TEMPLATE() [7/9]	309
9.26.2.9 COUNTER_TEMPLATE() [8/9]	309

9.26.2.10 COUNTER_TEMPLATE() [9/9]	309
9.26.2.11 COUNTERS_TEMPLATE() [1/9]	310
9.26.2.12 COUNTERS_TEMPLATE() [2/9]	310
9.26.2.13 COUNTERS_TEMPLATE() [3/9]	310
9.26.2.14 COUNTERS_TEMPLATE() [4/9]	310
9.26.2.15 COUNTERS_TEMPLATE() [5/9]	310
9.26.2.16 COUNTERS_TEMPLATE() [6/9]	310
9.26.2.17 COUNTERS_TEMPLATE() [7/9]	311
9.26.2.18 COUNTERS_TEMPLATE() [8/9]	311
9.26.2.19 COUNTERS_TEMPLATE() [9/9]	311
9.26.2.20 data()	311
9.26.2.21 desc()	311
9.26.2.22 for()	311
9.26.2.23 hasher() [1/2]	312
9.26.2.24 hasher() [2/2]	312
9.26.2.25 hasher_fun() [1/2]	312
9.26.2.26 hasher_fun() [2/2]	312
9.26.2.27 if() [1/3]	312
9.26.2.28 if() [2/3]	312
9.26.2.29 if() [3/3]	313
9.26.2.30 init_fun() [1/3]	313
9.26.2.31 init_fun() [2/3]	313
9.26.2.32 init_fun() [3/3]	313
9.26.2.33 name()	313
9.26.3 Variable Documentation	313
9.26.3.1 add_dims	313
9.26.3.2 count_fun_	314
9.26.3.3 counter	314
9.26.3.4 counter_	314
9.26.3.5 data_	314
9.26.3.6 desc_	315
9.26.3.7 fun	315
9.26.3.8 fun_	315
9.26.3.9 hasher_fun_	315
9.26.3.10 i	316
9.26.3.11 init_fun_	316
9.26.3.12 j	316
9.26.3.13 name_	316
9.26.3.14 noexcept	316
9.26.3.15 res	317
9.26.3.16 return	317
9.27 include/barry/counters/network-css.hpp File Reference	317

9.27.1 Macro Definition Documentation	318
9.27.1.1 CSS_APPEND	319
9.27.1.2 CSS_CASE_ELSE	319
9.27.1.3 CSS_CASE_PERCEIVED	319
9.27.1.4 CSS_CASE_TRUTH	319
9.27.1.5 CSS_CHECK_SIZE	319
9.27.1.6 CSS_CHECK_SIZE_INIT	320
9.27.1.7 CSS_NET_COUNTER_LAMBDA_INIT	320
9.27.1.8 CSS_PERCEIVED_CELLS	320
9.27.1.9 CSS_SIZE	320
9.27.1.10 CSS_TRUE_CELLS	321
9.27.2 Function Documentation	321
9.27.2.1 counter_css_census01()	321
9.27.2.2 counter_css_census02()	321
9.27.2.3 counter_css_census03()	321
9.27.2.4 counter_css_census04()	322
9.27.2.5 counter_css_census05()	322
9.27.2.6 counter_css_census06()	322
9.27.2.7 counter_css_census07()	322
9.27.2.8 counter_css_census08()	323
9.27.2.9 counter_css_census09()	323
9.27.2.10 counter_css_census10()	323
9.27.2.11 counter_css_completely_false_recip_comiss()	323
9.27.2.12 counter_css_completely_false_recip_omiss()	324
9.27.2.13 counter_css_mixed_recip()	324
9.27.2.14 counter_css_partially_false_recip_commi()	324
9.27.2.15 counter_css_partially_false_recip_omiss()	325
9.28 include/barry/counters/network.hpp File Reference	325
9.28.1 Macro Definition Documentation	328
9.28.1.1 BARRY_ZERO_NETWORK	328
9.28.1.2 BARRY_ZERO_NETWORK_DENSE	328
9.28.1.3 NET_C_DATA_IDX	328
9.28.1.4 NET_C_DATA_NUM	328
9.28.1.5 NETWORK_COUNTER	329
9.28.1.6 NETWORK_COUNTER_LAMBDA	329
9.28.1.7 NETWORK_RULE	329
9.28.1.8 NETWORK_RULE_LAMBDA	329
9.28.1.9 NETWORKDENSE_COUNTER_LAMBDA	330
9.28.2 Typedef Documentation	330
9.28.2.1 NetCounter	330
9.28.2.2 NetCounters	330
9.28.2.3 NetModel	330

9.28.2.4 NetRule	330
9.28.2.5 NetRules	331
9.28.2.6 NetStatsCounter	331
9.28.2.7 NetSupport	331
9.28.2.8 Network	331
9.28.2.9 NetworkDense	331
9.28.3 Function Documentation	331
9.28.3.1 rules_zerodiag()	332
9.29 include/barry/freqtable.hpp File Reference	332
9.30 include/barry/model-bones.hpp File Reference	332
9.31 include/barry/model-meat.hpp File Reference	333
9.31.1 Macro Definition Documentation	335
9.31.1.1 MODEL_TEMPLATE	335
9.31.1.2 MODEL_TEMPLATE_ARGS	335
9.31.1.3 MODEL_TYPE	335
9.31.2 Function Documentation	336
9.31.2.1 for()	336
9.31.2.2 if() [1/4]	336
9.31.2.3 if() [2/4]	336
9.31.2.4 if() [3/4]	336
9.31.2.5 if() [4/4]	336
9.31.2.6 insert_cell()	337
9.31.2.7 likelihood_()	337
9.31.2.8 MODEL_TEMPLATE() [1/33]	337
9.31.2.9 MODEL_TEMPLATE() [2/33]	337
9.31.2.10 MODEL_TEMPLATE() [3/33]	337
9.31.2.11 MODEL_TEMPLATE() [4/33]	338
9.31.2.12 MODEL_TEMPLATE() [5/33]	338
9.31.2.13 MODEL_TEMPLATE() [6/33]	338
9.31.2.14 MODEL_TEMPLATE() [7/33]	338
9.31.2.15 MODEL_TEMPLATE() [8/33]	338
9.31.2.16 MODEL_TEMPLATE() [9/33]	339
9.31.2.17 MODEL_TEMPLATE() [10/33]	339
9.31.2.18 MODEL_TEMPLATE() [11/33]	339
9.31.2.19 MODEL_TEMPLATE() [12/33]	339
9.31.2.20 MODEL_TEMPLATE() [13/33]	339
9.31.2.21 MODEL_TEMPLATE() [14/33]	340
9.31.2.22 MODEL_TEMPLATE() [15/33]	340
9.31.2.23 MODEL_TEMPLATE() [16/33]	340
9.31.2.24 MODEL_TEMPLATE() [17/33]	340
9.31.2.25 MODEL_TEMPLATE() [18/33]	340
9.31.2.26 MODEL_TEMPLATE() [19/33]	341

9.31.2.27 MODEL_TEMPLATE() [20/33]	341
9.31.2.28 MODEL_TEMPLATE() [21/33]	341
9.31.2.29 MODEL_TEMPLATE() [22/33]	341
9.31.2.30 MODEL_TEMPLATE() [23/33]	341
9.31.2.31 MODEL_TEMPLATE() [24/33]	342
9.31.2.32 MODEL_TEMPLATE() [25/33]	342
9.31.2.33 MODEL_TEMPLATE() [26/33]	342
9.31.2.34 MODEL_TEMPLATE() [27/33]	342
9.31.2.35 MODEL_TEMPLATE() [28/33]	342
9.31.2.36 MODEL_TEMPLATE() [29/33]	342
9.31.2.37 MODEL_TEMPLATE() [30/33]	343
9.31.2.38 MODEL_TEMPLATE() [31/33]	343
9.31.2.39 MODEL_TEMPLATE() [32/33]	343
9.31.2.40 MODEL_TEMPLATE() [33/33]	343
9.31.2.41 push_back() [1/2]	343
9.31.2.42 push_back() [2/2]	343
9.31.2.43 return()	344
9.31.2.44 set_counters()	344
9.31.2.45 set_rules()	344
9.31.2.46 set_rules_dyn()	344
9.31.2.47 size()	344
9.31.2.48 temp_stats()	344
9.31.2.49 tmp_counts()	344
9.31.2.50 update_normalizing_constant()	345
9.31.2.51 urand()	345
9.31.3 Variable Documentation	345
9.31.3.1 a	345
9.31.3.2 count_fun_	345
9.31.3.3 counter	345
9.31.3.4 counters_	346
9.31.3.5 cumprob	346
9.31.3.6 data_	346
9.31.3.7 Data_Counter_Type	346
9.31.3.8 Data_Rule_Type	346
9.31.3.9 delete_rules	347
9.31.3.10 delete_rules_dyn	347
9.31.3.11 else	347
9.31.3.12 force_new	347
9.31.3.13 fun_	347
9.31.3.14 i	348
9.31.3.15 i_matches	348
9.31.3.16 init_fun_	348

9.31.3.17 j	348
9.31.3.18 k	348
9.31.3.19 key	348
9.31.3.20 locator	349
9.31.3.21 params	349
9.31.3.22 probs	349
9.31.3.23 pset_arrays	349
9.31.3.24 r	349
9.31.3.25 return	349
9.31.3.26 rule_fun_	350
9.31.3.27 rules	350
9.31.3.28 rules_	350
9.31.3.29 rules_dyn	350
9.31.3.30 stats	350
9.31.3.31 stats_support_n_arrays	351
9.32 include/barry/models/defm.hpp File Reference	351
9.33 include/barry/models/defm/counters.hpp File Reference	351
9.33.1 Macro Definition Documentation	353
9.33.1.1 DEFM_COUNTER	353
9.33.1.2 DEFM_COUNTER_LAMBDA	353
9.33.1.3 DEFM_RULE	353
9.33.1.4 DEFM_RULE_LAMBDA	354
9.33.1.5 DEFM RULEDYN_LAMBDA	354
9.33.1.6 UNI_SUB	354
9.34 include/barry/models/geese/counters.hpp File Reference	355
9.35 include/barry/models/defm/defm-bones.hpp File Reference	357
9.36 include/barry/models/defm/defm-meat.hpp File Reference	357
9.36.1 Macro Definition Documentation	358
9.36.1.1 DEFM_LOOP_ARRAYS	358
9.36.1.2 DEFM_RANGES	358
9.36.2 Function Documentation	358
9.36.2.1 keygen_defm()	358
9.37 include/barry/models/defm/defm-types.hpp File Reference	359
9.37.1 Typedef Documentation	359
9.37.1.1 DEFMArray	360
9.38 include/barry/models/defm/formula.hpp File Reference	360
9.38.1 Function Documentation	360
9.38.1.1 defm_motif_parser()	361
9.39 include/barry/models/geese.hpp File Reference	362
9.40 include/barry/models/geese/flock-bones.hpp File Reference	362
9.41 include/barry/models/geese/flock-meat.hpp File Reference	363
9.42 include/barry/models/geese/geese-bones.hpp File Reference	363

9.42.1 Macro Definition Documentation	364
9.42.1.1 INITIALIZED	364
9.42.2 Function Documentation	364
9.42.2.1 keygen_full()	364
9.42.2.2 RULE_FUNCTION()	364
9.42.2.3 vec_diff()	365
9.42.2.4 vector_caster()	365
9.43 include/barry/models/geese/geese-meat-constructors.hpp File Reference	365
9.44 include/barry/models/geese/geese-meat-likelihood.hpp File Reference	366
9.45 include/barry/models/geese/geese-meat-likelihood_exhaust.hpp File Reference	367
9.46 include/barry/models/geese/geese-meat-predict.hpp File Reference	367
9.47 include/barry/models/geese/geese-meat-predict_exhaust.hpp File Reference	368
9.48 include/barry/models/geese/geese-meat-predict_sim.hpp File Reference	368
9.49 include/barry/models/geese/geese-meat-simulate.hpp File Reference	369
9.50 include/barry/models/geese/geese-meat.hpp File Reference	369
9.51 include/barry/models/geese/geese-node-bones.hpp File Reference	370
9.52 include/barry/models/geese/geese-types.hpp File Reference	370
9.52.1 Typedef Documentation	371
9.52.1.1 PhyloArray	371
9.52.1.2 PhyloCounter	371
9.52.1.3 PhyloCounters	371
9.52.1.4 PhyloModel	371
9.52.1.5 PhyloPowerSet	372
9.52.1.6 PhyloRule	372
9.52.1.7 PhyloRuleData	372
9.52.1.8 PhyloRuleDyn	372
9.52.1.9 PhyloRules	372
9.52.1.10 PhyloRulesDyn	372
9.52.1.11 PhyloStatsCounter	373
9.52.1.12 PhyloSupport	373
9.53 include/barry/powerset-bones.hpp File Reference	373
9.54 include/barry/powerset-meat.hpp File Reference	374
9.55 include/barry/progress.hpp File Reference	374
9.55.1 Macro Definition Documentation	375
9.55.1.1 BARRY_PROGRESS_BAR_WIDTH	375
9.56 include/barry/rules-bones.hpp File Reference	375
9.56.1 Function Documentation	375
9.56.1.1 rule_fun_default()	376
9.57 include/barry/rules-meat.hpp File Reference	376
9.58 include/barry/statscounter-bones.hpp File Reference	376
9.59 include/barry/statscounter-meat.hpp File Reference	377
9.59.1 Macro Definition Documentation	378

9.59.1.1 STATSCOUNTER_TEMPLATE	378
9.59.1.2 STATSCOUNTER_TEMPLATE_ARGS	378
9.59.1.3 STATSCOUNTER_TYPE	378
9.59.2 Function Documentation	378
9.59.2.1 clear()	378
9.59.2.2 for()	379
9.59.2.3 resize()	379
9.59.2.4 STATSCOUNTER_TEMPLATE() [1/9]	379
9.59.2.5 STATSCOUNTER_TEMPLATE() [2/9]	379
9.59.2.6 STATSCOUNTER_TEMPLATE() [3/9]	379
9.59.2.7 STATSCOUNTER_TEMPLATE() [4/9]	379
9.59.2.8 STATSCOUNTER_TEMPLATE() [5/9]	380
9.59.2.9 STATSCOUNTER_TEMPLATE() [6/9]	380
9.59.2.10 STATSCOUNTER_TEMPLATE() [7/9]	380
9.59.2.11 STATSCOUNTER_TEMPLATE() [8/9]	380
9.59.2.12 STATSCOUNTER_TEMPLATE() [9/9]	380
9.59.3 Variable Documentation	380
9.59.3.1 counter	381
9.59.3.2 counter_deleted	381
9.59.3.3 counters	381
9.59.3.4 counters_	381
9.59.3.5 current_stats	381
9.59.3.6 EmptyArray	382
9.59.3.7 f_	382
9.59.3.8 j	382
9.59.3.9 return	382
9.60 include/barry/support-bones.hpp File Reference	382
9.61 include/barry/support-meat.hpp File Reference	383
9.61.1 Macro Definition Documentation	384
9.61.1.1 BARRY_SUPPORT_MEAT_HPP	384
9.61.1.2 SUPPORT_TEMPLATE	384
9.61.1.3 SUPPORT_TEMPLATE_ARGS	385
9.61.1.4 SUPPORT_TYPE	385
9.61.2 Function Documentation	385
9.61.2.1 calc_backend_dense()	385
9.61.2.2 calc_backend_sparse()	385
9.61.2.3 for()	385
9.61.2.4 if() [1/3]	386
9.61.2.5 if() [2/3]	386
9.61.2.6 if() [3/3]	386
9.61.2.7 insert_cell() [1/2]	386
9.61.2.8 insert_cell() [2/2]	386

9.61.2.9 rm_cell()	387
9.61.2.10 SUPPORT_TEMPLATE() [1/17]	387
9.61.2.11 SUPPORT_TEMPLATE() [2/17]	387
9.61.2.12 SUPPORT_TEMPLATE() [3/17]	387
9.61.2.13 SUPPORT_TEMPLATE() [4/17]	387
9.61.2.14 SUPPORT_TEMPLATE() [5/17]	388
9.61.2.15 SUPPORT_TEMPLATE() [6/17]	388
9.61.2.16 SUPPORT_TEMPLATE() [7/17]	388
9.61.2.17 SUPPORT_TEMPLATE() [8/17]	388
9.61.2.18 SUPPORT_TEMPLATE() [9/17]	388
9.61.2.19 SUPPORT_TEMPLATE() [10/17]	388
9.61.2.20 SUPPORT_TEMPLATE() [11/17]	389
9.61.2.21 SUPPORT_TEMPLATE() [12/17]	389
9.61.2.22 SUPPORT_TEMPLATE() [13/17]	389
9.61.2.23 SUPPORT_TEMPLATE() [14/17]	389
9.61.2.24 SUPPORT_TEMPLATE() [15/17]	389
9.61.2.25 SUPPORT_TEMPLATE() [16/17]	390
9.61.2.26 SUPPORT_TEMPLATE() [17/17]	390
9.61.3 Variable Documentation	390
9.61.3.1 array_bank	390
9.61.3.2 change_stats_different	390
9.61.3.3 coord_i	390
9.61.3.4 coord_j	390
9.61.3.5 counters	391
9.61.3.6 counters_	391
9.61.3.7 delete_counters	391
9.61.3.8 delete_rules	391
9.61.3.9 delete_rules_dyn	391
9.61.3.10 else	392
9.61.3.11 f_	392
9.61.3.12 hashes	392
9.61.3.13 return	392
9.61.3.14 rules	392
9.61.3.15 rules_	393
9.61.3.16 rules_dyn	393
9.61.3.17 stats_bank	393
9.61.3.18 tmp_chng	393
9.62 include/barry/typedefs.hpp File Reference	394
9.62.1 Typedef Documentation	396
9.62.1.1 Col_type	396
9.62.1.2 Counter_fun_type	396
9.62.1.3 Counts_type	396

9.62.1.4 Hasher_fun_type	396
9.62.1.5 MapVec_type	397
9.62.1.6 Row_type	397
9.62.1.7 Rule_fun_type	397
9.62.2 Function Documentation	397
9.62.2.1 sort_array()	397
9.62.2.2 vec_equal()	398
9.62.2.3 vec_equal_approx()	398
9.62.2.4 vec_inner_prod() [1/2]	399
9.62.2.5 vec_inner_prod() [2/2]	399
9.63 README.md File Reference	399
Index	401

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	13
Statistical Models	24
Network counters	24
Phylo counters	47
Phylo rules	35

Chapter 3

Hierarchical Index

3.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

BArray< Cell_Type, Data_Type >	59
BArray< bool, bool >	59
BArray< Cell_Type, Data_Type >	59
BArrayCell< Cell_Type, Data_Type >	73
BArrayCell_const< Cell_Type, Data_Type >	76
BArrayDense< Cell_Type, Data_Type >	78
BArrayDense< bool, bool >	78
BArrayDenseCell< Cell_Type, Data_Type >	94
BArrayDenseCell_const< Cell_Type, Data_Type >	98
BArrayDenseCol< Cell_Type, Data_Type >	98
BArrayDenseCol_const< Cell_Type, Data_Type >	100
BArrayDenseRow< Cell_Type, Data_Type >	102
BArrayDenseRow_const< Cell_Type, Data_Type >	105
BArrayRow< Cell_Type, Data_Type >	107
BArrayRow_const< Cell_Type, Data_Type >	109
BArrayVector< Cell_Type, Data_Type >	111
BArrayVector_const< Cell_Type, Data_Type >	115
Cell< Cell_Type >	119
Cell< bool >	119
Cell_const< Cell_Type >	124
ConstBArrayRowIter< Cell_Type, Data_Type >	124
Counter< Array_Type, Data_Type >	126
Counters< Array_Type, Data_Type >	132
Counters< Array_Type, Data_Type >	132
Counters< BArray< bool, bool >, bool >	132
Counters< BArray<>, bool >	132
DEFMCounterData	142
DEFMData	142
DEFMModel	
DEFM	137
DEFMRuleData	144
DEFMRuleDynData	145
Entries< Cell_Type >	146
Flock	148
FreqTable< T >	155

Geese	158
Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >	172
NetCounterData	194
NetworkData	196
Node	198
NodeData	204
PhyloCounterData	205
PhyloRuleDynData	208
PowerSet< Array_Type, Data_Rule_Type >	210
Progress	217
Rule< Array_Type, Data_Type >	218
Rules< Array_Type, Data_Type >	221
Rules< BArray< bool, bool >, bool >	221
Rules< BArray<>, bool >	221
StatsCounter< Array_Type, Data_Type >	225
StatsCounter< BArray<>, bool >	225
Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >	229
Support< BArray<>, bool, bool, bool >	229
vecHasher< T >	240

Chapter 4

Class Index

4.1 Class List

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

BArray< Cell_Type, Data_Type >	
Baseline class for binary arrays	59
BArrayCell< Cell_Type, Data_Type >	73
BArrayCell_const< Cell_Type, Data_Type >	76
BArrayDense< Cell_Type, Data_Type >	
Baseline class for binary arrays	78
BArrayDenseCell< Cell_Type, Data_Type >	94
BArrayDenseCell_const< Cell_Type, Data_Type >	98
BArrayDenseCol< Cell_Type, Data_Type >	98
BArrayDenseCol_const< Cell_Type, Data_Type >	100
BArrayDenseRow< Cell_Type, Data_Type >	102
BArrayDenseRow_const< Cell_Type, Data_Type >	105
BArrayRow< Cell_Type, Data_Type >	107
BArrayRow_const< Cell_Type, Data_Type >	109
BArrayVector< Cell_Type, Data_Type >	
Row or column of a BArray	111
BArrayVector_const< Cell_Type, Data_Type >	115
Cell< Cell_Type >	
Entries in BArray . For now, it only has two members:	119
Cell_const< Cell_Type >	124
ConstBArrayRowIter< Cell_Type, Data_Type >	124
Counter< Array_Type, Data_Type >	
A counter function based on change statistics	126
Counters< Array_Type, Data_Type >	
Vector of counters	132
DEFM	137
DEFMCounterData	
Data class used to store arbitrary size_t or double vectors	142
DEFMData	
Data class for DEFM arrays	142
DEFMRuleData	144
DEFMRuleDynData	145
Entries< Cell_Type >	
A wrapper class to store source, target, val from a BArray object	146
Flock	
A Flock is a group of Geese	148

FreqTable< T >	
Frequency table of vectors	155
Geese	
Annotated Phylo Model	158
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:	172
NetCounterData	
Data class used to store arbitrary size_t or double vectors	194
NetworkData	
Data class for Networks	196
Node	
A single node for the model	198
NodeData	
Data definition for the PhyloArray class	204
PhyloCounterData	205
PhyloRuleDynData	208
PowerSet< Array_Type, Data_Rule_Type >	
Powerset of a binary array	210
Progress	
A simple progress bar	217
Rule< Array_Type, Data_Type >	
Rule for determining if a cell should be included in a sequence	218
Rules< Array_Type, Data_Type >	
Vector of objects of class Rule	221
StatsCounter< Array_Type, Data_Type >	
Count stats for a single Array	225
Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >	
Compute the support of sufficient statistics	229
vecHasher< T >	240

Chapter 5

File Index

5.1 File List

Here is a list of all files with brief descriptions:

include/barry/barray-bones.hpp	241
include/barry/barray-iterator.hpp	241
include/barry/barray-meat-operators.hpp	242
include/barry/barray-meat.hpp	246
include/barry/barraycell-bones.hpp	264
include/barry/barraycell-meat.hpp	264
include/barry/barraydense-bones.hpp	265
include/barry/barraydense-meat-operators.hpp	265
include/barry/barraydense-meat.hpp	268
include/barry/barraydensecell-bones.hpp	289
include/barry/barraydensecell-meat.hpp	290
include/barry/barraydensecol-bones.hpp	290
include/barry/barraydenserow-bones.hpp	292
include/barry/barrayrow-bones.hpp	293
include/barry/barrayrow-meat.hpp	293
include/barry/barrayvector-bones.hpp	295
include/barry/barrayvector-meat.hpp	296
include/barry/barray-configuration.hpp	296
include/barry/barray-debug.hpp	298
include/barry/barray-macros.hpp	299
include/barry/barray.hpp	300
include/barry/cell-bones.hpp	303
include/barry/cell-meat.hpp	304
include/barry/col-bones.hpp	304
include/barry/counters-bones.hpp	304
include/barry/counters-meat.hpp	305
include/barry/freqtable.hpp	332
include/barry/model-bones.hpp	332
include/barry/model-meat.hpp	333
include/barry/powerset-bones.hpp	373
include/barry/powerset-meat.hpp	374
include/barry/progress.hpp	374
include/barry/rules-bones.hpp	375
include/barry/rules-meat.hpp	376
include/barry/statscounter-bones.hpp	376

include/barry/statscounter-meat.hpp	377
include/barry/support-bones.hpp	382
include/barry/support-meat.hpp	383
include/barry/typedefs.hpp	394
include/barry/counters/network-css.hpp	317
include/barry/counters/network.hpp	325
include/barry/models/defm.hpp	351
include/barry/models/geese.hpp	362
include/barry/models/defm/counters.hpp	351
include/barry/models/defm/defm-bones.hpp	357
include/barry/models/defm/defm-meat.hpp	357
include/barry/models/defm/defm-types.hpp	359
include/barry/models/defm/formula.hpp	360
include/barry/models/geese/counters.hpp	355
include/barry/models/geese/flock-bones.hpp	362
include/barry/models/geese/flock-meat.hpp	363
include/barry/models/geese/geese-bones.hpp	363
include/barry/models/geese/geese-meat-constructors.hpp	365
include/barry/models/geese/geese-meat-likelihood.hpp	366
include/barry/models/geese/geese-meat-likelihood_exhaust.hpp	367
include/barry/models/geese/geese-meat-predict.hpp	367
include/barry/models/geese/geese-meat-predict_exhaust.hpp	368
include/barry/models/geese/geese-meat-predict_sim.hpp	368
include/barry/models/geese/geese-meat-simulate.hpp	369
include/barry/models/geese/geese-meat.hpp	369
include/barry/models/geese/geese-node-bones.hpp	370
include/barry/models/geese/geese-types.hpp	370

Chapter 6

Module Documentation

6.1 Counting

Classes

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

Macros

- `#define MAKE_DEFM_HASHER(hasher, a, cov)`
- `#define MAKE_DUPL_VARS()`
- `#define IS_EITHER() (DATA_AT == Geese::etype_either)`
- `#define IS_DUPLICATION() ((DATA_AT == Geese::etype_duplication) & (DPL))`
- `#define IS_SPECIATION() ((DATA_AT == Geese::etype_speciation) & (!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()`
- `std::string get_last_name (size_t d)`
- `void counter_overall_gains (PhyloCounters *counters, size_t duplication=Geese::etype_default)`
Overall functional gains.
- `void counter_gains (PhyloCounters *counters, std::vector< size_t > nfun, size_t duplication=Geese::etype_default)`
Functional gains for a specific function (nfun).
- `void counter_gains_k_offspring (PhyloCounters *counters, std::vector< size_t > nfun, size_t k=1u, size_t duplication=Geese::etype_default)`
k genes gain function nfun
- `void counter_genes_changing (PhyloCounters *counters, size_t duplication=Geese::etype_default)`
Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)

- void `counter_preserve_pseudogene` (`PhyloCounters *counters`, `size_t nfunA`, `size_t nfunB`, `size_t duplication=Geese::etype_default`)
Keeps track of how many pairs of genes preserve pseudostate.
- void `counter_prop_genes_changing` (`PhyloCounters *counters`, `size_t duplication=Geese::etype_default`)
Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)
- void `counter_overall_loss` (`PhyloCounters *counters`, `size_t duplication=Geese::etype_default`)
Overall functional loss.
- void `counter_maxfuns` (`PhyloCounters *counters`, `size_t lb`, `size_t ub`, `size_t duplication=Geese::etype_default`)
Cap the number of functions per gene.
- void `counter_loss` (`PhyloCounters *counters`, `std::vector< size_t > nfun`, `size_t duplication=Geese::etype_default`)
Total count of losses for an specific function.
- void `counter_overall_changes` (`PhyloCounters *counters`, `size_t duplication=Geese::etype_default`)
Total number of changes. Use this statistic to account for "preservation".
- void `counter_subfun` (`PhyloCounters *counters`, `size_t nfunA`, `size_t nfunB`, `size_t duplication=Geese::etype_default`)
Total count of Sub-functionalization events.
- void `counter_cogain` (`PhyloCounters *counters`, `size_t nfunA`, `size_t nfunB`, `size_t duplication=Geese::etype_default`)
Co-evolution (joint gain or loss)
- void `counter_longest` (`PhyloCounters *counters`, `size_t duplication=Geese::etype_default`)
Longest branch mutates (either by gain or by loss)
- void `counter_neofun` (`PhyloCounters *counters`, `size_t nfunA`, `size_t nfunB`, `size_t duplication=Geese::etype_default`)
Total number of neofunctionalization events.
- void `counter_pairwise_neofun_singlefun` (`PhyloCounters *counters`, `size_t nfunA`, `size_t duplication=Geese::etype_default`)
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`, `size_t nfunA`, `size_t nfunB`, `size_t duplication=Geese::etype_default`)
Total number of neofunctionalization events.
- void `counter_co_opt` (`PhyloCounters *counters`, `size_t nfunA`, `size_t nfunB`, `size_t duplication=Geese::etype_default`)
Function co-opting.
- void `counter_k_genes_changing` (`PhyloCounters *counters`, `size_t k`, `size_t duplication=Geese::etype_default`)
Indicator function. Equals to one if k genes changed and zero otherwise.
- void `counter_less_than_p_prop_genes_changing` (`PhyloCounters *counters`, `double p`, `size_t duplication=Geese::etype_default`)
Indicator function. Equals to one if k genes changed and zero otherwise.
- void `counter_gains_from_0` (`PhyloCounters *counters`, `std::vector< size_t > nfun`, `size_t duplication=Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_overall_gains_from_0` (`PhyloCounters *counters`, `size_t duplication=Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_pairwise_overall_change` (`PhyloCounters *counters`, `size_t duplication=Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_pairwise_preserving` (`PhyloCounters *counters`, `size_t nfunA`, `size_t nfunB`, `size_t duplication=Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_pairwise_first_gain` (`PhyloCounters *counters`, `size_t nfunA`, `size_t nfunB`, `size_t duplication=Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)

6.1.1 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.

6.1.2 Macro Definition Documentation

6.1.2.1 IF_MATCHES

```
#define IF_MATCHES( )
```

Value:

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

Definition at line 20 of file `counters.hpp`.

6.1.2.2 IF_NOTMATCHES

```
#define IF_NOTMATCHES( )
```

Value:

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

Definition at line 22 of file `counters.hpp`.

6.1.2.3 IS_DUPLICATION

```
#define IS_DUPLICATION( ) ((DATA_AT == Geese::etype_duplication) & (DPL))
```

Definition at line 17 of file `counters.hpp`.

6.1.2.4 IS_EITHER

```
#define IS_EITHER( ) (DATA_AT == Geese::etype_either)
```

Definition at line 16 of file counters.hpp.

6.1.2.5 IS_SPECIATION

```
#define IS_SPECIATION( ) ((DATA_AT == Geese::etype_speciation) & (!DPL))
```

Definition at line 18 of file counters.hpp.

6.1.2.6 MAKE_DEFM_HASHER

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

Value:

```
barry::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;\  
};
```

Details on the available counters for DEFMworkData can be found in the [Network counters](#) section.

Definition at line 21 of file counters.hpp.

6.1.2.7 MAKE_DUPL_VARS

```
#define MAKE_DUPL_VARS( )
```

Value:

```
bool DPL = Array.D_ptr()->duplication; \  
size_t DATA_AT = data[0u];
```

Details about the available counters for PhyloArray objects can be found in the [Phylo counters](#) section.

Definition at line 12 of file counters.hpp.

6.1.2.8 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 42 of file counters.hpp.

6.1.2.9 PHYLO_COUNTER_LAMBDA

```
#define PHYLO_COUNTER_LAMBDA(  
    a )
```

Value:

```
barry::Counter_fun_type<PhyloArray, PhyloCounterData> a = \
[] (const PhyloArray & Array, size_t i, size_t 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 36 of file counters.hpp.

6.1.2.10 PHYLO_RULE_DYN_LAMBDA

```
#define PHYLO_RULE_DYN_LAMBDA(  
    a )
```

Value:

```
barry::Rule_fun_type<PhyloArray, PhyloRuleDynData> a = \
[] (const PhyloArray & Array, size_t i, size_t j, PhyloRuleDynData & data)
```

Definition at line 39 of file counters.hpp.

6.1.3 Function Documentation

6.1.3.1 counter_co_opt()

```
void counter_co_opt (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [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 1296 of file counters.hpp.

6.1.3.2 counter_cogain()

```
void counter_cogain (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Co-evolution (joint gain or loss)

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

Definition at line 791 of file counters.hpp.

6.1.3.3 counter_gains()

```
void counter_gains (
    PhyloCounters * counters,
    std::vector< size_t > nfun,
    size_t duplication = Geese::etype_default ) [inline]
```

Functional gains for a specific function (nfun).

Definition at line 96 of file counters.hpp.

6.1.3.4 counter_gains_from_0()

```
void counter_gains_from_0 (
    PhyloCounters * counters,
    std::vector< size_t > nfun,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Needs to specify function a.

Definition at line 1630 of file counters.hpp.

6.1.3.5 counter_gains_k_offspring()

```
void counter_gains_k_offspring (
    PhyloCounters * counters,
    std::vector< size_t > nfun,
    size_t k = 1u,
    size_t duplication = Geese::etype_default ) [inline]
```

k genes gain function nfun

Definition at line 156 of file counters.hpp.

6.1.3.6 counter_genes_changing()

```
void counter_genes_changing (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Definition at line 228 of file counters.hpp.

6.1.3.7 counter_k_genes_changing()

```
void counter_k_genes_changing (
    PhyloCounters * counters,
    size_t k,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Definition at line 1394 of file counters.hpp.

6.1.3.8 counter_less_than_p_prop_genes_changing()

```
void counter_less_than_p_prop_genes_changing (
    PhyloCounters * counters,
    double p,
    size_t duplication = Geese::etype_default ) [inline]
```

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

< How many genes diverge the parent

Definition at line 1514 of file counters.hpp.

6.1.3.9 counter_longest()

```
void counter_longest (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

Longest branch mutates (either by gain or by loss)

Definition at line 848 of file counters.hpp.

6.1.3.10 counter_loss()

```
void counter_loss (
    PhyloCounters * counters,
    std::vector< size_t > nfun,
    size_t duplication = Geese::etype_default ) [inline]
```

Total count of losses for an specific function.

Definition at line 591 of file counters.hpp.

6.1.3.11 counter_maxfuns()

```
void counter_maxfuns (
    PhyloCounters * counters,
    size_t lb,
    size_t ub,
    size_t duplication = Geese::etype_default ) [inline]
```

Cap the number of functions per gene.

Definition at line 529 of file counters.hpp.

6.1.3.12 counter_neofun()

```
void counter_neofun (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Total number of neofunctionalization events.

Needs to specify pairs of function.

Definition at line 1018 of file counters.hpp.

6.1.3.13 counter_neofun_a2b()

```
void counter_neofun_a2b (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Total number of neofunctionalization events.

Needs to specify pairs of function.

Definition at line 1163 of file counters.hpp.

6.1.3.14 counter_overall_changes()

```
void counter_overall_changes (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Definition at line 643 of file counters.hpp.

6.1.3.15 counter_overall_gains()

```
void counter_overall_gains (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

Overall functional gains.

Total number of gains (irrespective of the function).

Definition at line 58 of file counters.hpp.

6.1.3.16 counter_overall_gains_from_0()

```
void counter_overall_gains_from_0 (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Needs to specify function a.

Definition at line 1696 of file counters.hpp.

6.1.3.17 counter_overall_loss()

```
void counter_overall_loss (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

Overall functional loss.

Definition at line 481 of file counters.hpp.

6.1.3.18 counter_pairwise_first_gain()

```
void counter_pairwise_first_gain (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [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 1948 of file counters.hpp.

6.1.3.19 counter_pairwise_neofun_singlefun()

```
void counter_pairwise_neofun_singlefun (
    PhyloCounters * counters,
    size_t nfunA,
    size_t duplication = Geese::etype_default ) [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 1099 of file counters.hpp.

6.1.3.20 counter_pairwise_overall_change()

```
void counter_pairwise_overall_change (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Needs to specify function a.

Definition at line 1744 of file counters.hpp.

6.1.3.21 counter_pairwise_preserving()

```
void counter_pairwise_preserving (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [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 1809 of file counters.hpp.

6.1.3.22 counter_preserve_pseudogene()

```
void counter_preserve_pseudogene (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Keeps track of how many pairs of genes preserve pseudostate.

Definition at line 297 of file counters.hpp.

6.1.3.23 counter_prop_genes_changing()

```
void counter_prop_genes_changing (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Definition at line 379 of file counters.hpp.

6.1.3.24 counter_subfun()

```
void counter_subfun (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Total count of Sub-functionalization events.

It requires to specify data = {funA, funB}

Definition at line 702 of file counters.hpp.

6.1.3.25 get_last_name()

```
std::string get_last_name (
    size_t d ) [inline]
```

Definition at line 45 of file counters.hpp.

6.2 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](#).

6.2.1 Detailed Description

Statistical models available in `barry`.

6.3 Network counters

[Counters](#) for network models.

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, size_t 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, size_t 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, size_t attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodeocov (NetCounters< Tnet > *counters, size_t attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodcov (NetCounters< Tnet > *counters, size_t attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodematch (NetCounters< Tnet > *counters, size_t attr_id)`
- `template<typename Tnet = Network>`
`void counter_idegree (NetCounters< Tnet > *counters, std::vector< size_t > d)`
Counts number of vertices with a given in-degree.
- `template<> void counter_idegree (NetCounters< NetworkDense > *counters, std::vector< size_t > d)`
- `template<typename Tnet = Network>`
`void counter_odegree (NetCounters< Tnet > *counters, std::vector< size_t > d)`
Counts number of vertices with a given out-degree.
- `template<> void counter_odegree (NetCounters< NetworkDense > *counters, std::vector< size_t > d)`

- `template<typename Tnet = Network>`
`void counter_degree (NetCounters< Tnet > *counters, std::vector< size_t > d)`
Counts number of vertices with a given out-degree.
- `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

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

- `void rules_markov_fixed (DEFMRules *rules, size_t markov_order)`
Number of edges.
- `void rules_dont_become_zero (DEFMSupport *support, std::vector< size_t > ids)`
Blocks switching a one to zero.

6.3.1 Detailed Description

`Counters` for network models.

Parameters

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

6.3.2 Function Documentation

6.3.2.1 counter_absdiff()

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

Sum of absolute attribute difference between ego and alter.

Definition at line 908 of file network.hpp.

6.3.2.2 counter_ctriads() [1/2]

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

Definition at line 665 of file network.hpp.

6.3.2.3 counter_ctriads() [2/2]

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

Definition at line 610 of file network.hpp.

6.3.2.4 counter_degree()

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

Counts number of vertices with a given out-degree.

Definition at line 1326 of file network.hpp.

6.3.2.5 counter_density()

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

Definition at line 729 of file network.hpp.

6.3.2.6 counter_diff()

```
template<typename Tnet = Network>
void counter_diff (
    NetCounters< Tnet > * counters,
    size_t 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 953 of file network.hpp.

6.3.2.7 counter_edges()

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

Number of edges.

Definition at line 152 of file network.hpp.

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

Definition at line 610 of file counters.hpp.

6.3.2.9 counter_iddegree() [1/2]

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

Definition at line 1170 of file network.hpp.

6.3.2.10 counter_iddegree() [2/2]

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

Counts number of vertices with a given in-degree.

Definition at line 1123 of file network.hpp.

6.3.2.11 counter_iddegree15() [1/2]

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

Definition at line 785 of file network.hpp.

6.3.2.12 counter_iddegree15() [2/2]

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

Definition at line 757 of file network.hpp.

6.3.2.13 counter_isolates() [1/2]

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

Definition at line 215 of file network.hpp.

6.3.2.14 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.

6.3.2.15 counter_istar2() [1/2]

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

Definition at line 338 of file network.hpp.

6.3.2.16 counter_istar2() [2/2]

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

Definition at line 312 of file network.hpp.

6.3.2.17 counter_logit_intercept()

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

Definition at line 151 of file counters.hpp.

6.3.2.18 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.

6.3.2.19 counter_nodecov()

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

Definition at line 1066 of file network.hpp.

6.3.2.20 counter_nodeicov()

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

Definition at line 1016 of file network.hpp.

6.3.2.21 counter_nodematch()

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

Definition at line 1091 of file network.hpp.

6.3.2.22 counter_nodeocov()

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

Definition at line 1041 of file network.hpp.

6.3.2.23 counter_odegree() [1/2]

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

Definition at line 1271 of file network.hpp.

6.3.2.24 counter_odegree() [2/2]

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

Counts number of vertices with a given out-degree.

Definition at line 1223 of file network.hpp.

6.3.2.25 counter_odegree15() [1/2]

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

Definition at line 862 of file network.hpp.

6.3.2.26 counter_odegree15() [2/2]

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

Definition at line 834 of file network.hpp.

6.3.2.27 counter_ones()

```
void counter_ones (
    DEFMCounters * 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 of a vector of counters
<i>covar_index</i>	If \geq than 0, then the interaction

Definition at line 81 of file counters.hpp.

6.3.2.28 counter_ostar2() [1/2]

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

Definition at line 404 of file network.hpp.

6.3.2.29 counter_ostar2() [2/2]

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

Definition at line 376 of file network.hpp.

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

Definition at line 270 of file counters.hpp.

6.3.2.31 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 579 of file counters.hpp.

6.3.2.32 counter_ttriads() [1/2]

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

Definition at line 531 of file network.hpp.

6.3.2.33 counter_ttriads() [2/2]

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

Definition at line 441 of file network.hpp.

6.3.2.34 NETWORK_COUNTER()

```
NETWORK_COUNTER (
    init_single_attr )
```

Definition at line 997 of file network.hpp.

6.3.2.35 rules_dont_become_zero()

```
void rules_dont_become_zero (
    DEFMSupport * support,
    std::vector< size_t > ids ) [inline]
```

Blocks switching a one to zero.

Parameters

<i>rules</i>	
<i>ids</i>	Ids of the variables that will follow this rule.

Definition at line 678 of file counters.hpp.

6.3.2.36 rules_markov_fixed()

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

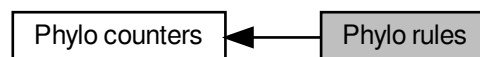
Number of edges.

Definition at line 653 of file counters.hpp.

6.4 Phylo rules

[Rules](#) for phylogenetic modeling.

Collaboration diagram for Phylo rules:

**Classes**

- class [DEFMRuleDynData](#)

Functions

- [DEFMData::DEFMData](#) ()
Vector indicating which covariates are included in the model.
- [DEFMData::DEFMData](#) ([DEFMArray](#) *array_, [const](#) double *covariates_, [size_t](#) obs_start_, [size_t](#) X_ncol_, [size_t](#) X_nrow_)
Constructor.
- [double DEFMData::operator\(\)](#) ([size_t](#) i, [size_t](#) j) [const](#)
Access to the row (i) column (j) data.
- [double DEFMData::at](#) ([size_t](#) i, [size_t](#) j) [const](#)
- [size_t DEFMData::ncol](#) () [const](#)
- [size_t DEFMData::nrow](#) () [const](#)
- [void DEFMData::print](#) () [const](#)
- [DEFMData::~~DEFMData](#) ()
- [DEFMCounterData::DEFMCounterData](#) ()
- [DEFMCounterData::DEFMCounterData](#) ([const](#) [std::vector](#)< [size_t](#) > indices_, [const](#) [std::vector](#)< double > numbers_, [const](#) [std::vector](#)< bool > logical_, bool is_motif_=true)
- [size_t DEFMCounterData::idx](#) ([size_t](#) i) [const](#)
- [double DEFMCounterData::num](#) ([size_t](#) i) [const](#)
- [bool DEFMCounterData::is_true](#) ([size_t](#) i) [const](#)
- [DEFMCounterData::~~DEFMCounterData](#) ()
- [double DEFMRuleData::num](#) ([size_t](#) i) [const](#)
- [size_t DEFMRuleData::idx](#) ([size_t](#) i) [const](#)
- [bool DEFMRuleData::is_true](#) ([size_t](#) i) [const](#)
- [DEFMRuleData::DEFMRuleData](#) ()
- [DEFMRuleData::DEFMRuleData](#) ([std::vector](#)< double > numbers_, [std::vector](#)< [size_t](#) > indices_, [std::vector](#)< bool > logical_)
- [DEFMRuleData::DEFMRuleData](#) ([std::vector](#)< double > numbers_, [std::vector](#)< [size_t](#) > indices_)
- [DEFMRuleDynData::DEFMRuleDynData](#) ([const](#) [std::vector](#)< double > *counts_, [std::vector](#)< double > numbers_={}, [std::vector](#)< [size_t](#) > indices_={}, [std::vector](#)< bool > logical_={})
- [DEFMRuleDynData::~~DEFMRuleDynData](#) ()
- [void rule_dyn_limit_changes](#) ([PhyloSupport](#) *support, [size_t](#) pos, [size_t](#) lb, [size_t](#) ub, [size_t](#) duplication=[Geese::etype_default](#))
Overall functional gains.

Variables

- [DEFMArray](#) * [DEFMData::array](#)
- [const](#) double * [DEFMData::covariates](#)
Vector of covariates (complete vector)
- [size_t DEFMData::obs_start](#)
Index of the observation in the data.
- [size_t DEFMData::X_ncol](#)
Number of columns in the array of covariates.
- [size_t DEFMData::X_nrow](#)
Number of rows in the array of covariates.
- [std::vector](#)< [size_t](#) > [DEFMData::covar_sort](#)
- [std::vector](#)< [size_t](#) > [DEFMData::covar_used](#)
Value where the sorting of the covariates is stored.
- [std::vector](#)< [size_t](#) > [DEFMCounterData::indices](#)
- [std::vector](#)< double > [DEFMCounterData::numbers](#)
- [std::vector](#)< bool > [DEFMCounterData::logical](#)
- [bool DEFMCounterData::is_motif](#)

If false, then is a logit intercept.

- `std::vector< double > DEFMRuleData::numbers`
- `std::vector< size_t > DEFMRuleData::indices`
- `std::vector< bool > DEFMRuleData::logical`
- `bool DEFMRuleData::init = false`
- `const std::vector< double > * DEFMRuleDynData::counts`

Convenient typedefs for network objects.

- `typedef barry::Counter< DEFMArray, DEFMCounterData > DEFMCounter`
- `typedef barry::Counters< DEFMArray, DEFMCounterData > DEFMCounters`
- `typedef barry::Support< DEFMArray, DEFMCounterData, DEFMRuleData, DEFMRuleDynData > DEFMSupport`
- `typedef barry::StatsCounter< DEFMArray, DEFMCounterData > DEFMStatsCounter`
- `typedef barry::Model< DEFMArray, DEFMCounterData, DEFMRuleData, DEFMRuleDynData > DEFMModel`
- `typedef barry::Rule< DEFMArray, DEFMRuleData > DEFMRule`
- `typedef barry::Rules< DEFMArray, DEFMRuleData > DEFMRules`
- `typedef barry::Rule< DEFMArray, DEFMRuleDynData > DEFMRuleDyn`
- `typedef barry::Rules< DEFMArray, DEFMRuleDynData > DEFMRulesDyn`

6.4.1 Detailed Description

[Rules](#) for phylogenetic modeling.

Parameters

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

6.4.2 Typedef Documentation

6.4.2.1 DEFMCounter

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

Definition at line 171 of file `defm-types.hpp`.

6.4.2.2 DEFMCounters

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

Definition at line 172 of file `defm-types.hpp`.

6.4.2.3 DEFMMModel

```
typedef barry::Model<DEFMArray, DEFMCounterData, DEFMRuleData, DEFMRuleDynData> DEFMMModel
```

Definition at line 175 of file defm-types.hpp.

6.4.2.4 DEFMRule

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

Definition at line 178 of file defm-types.hpp.

6.4.2.5 DEFMRuleDyn

```
typedef barry::Rule<DEFMArray, DEFMRuleDynData> DEFMRuleDyn
```

Definition at line 180 of file defm-types.hpp.

6.4.2.6 DEFMRules

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

Definition at line 179 of file defm-types.hpp.

6.4.2.7 DEFMRulesDyn

```
typedef barry::Rules<DEFMArray, DEFMRuleDynData> DEFMRulesDyn
```

Definition at line 181 of file defm-types.hpp.

6.4.2.8 DEFMStatsCounter

```
typedef barry::StatsCounter<DEFMArray, DEFMCounterData> DEFMStatsCounter
```

Definition at line 174 of file defm-types.hpp.

6.4.2.9 DEFMSupport

```
typedef barry::Support<DEFMArray, DEFMCounterData, DEFMRuleData,DEFMRuleDynData> DEFMSupport
```

Definition at line 173 of file defm-types.hpp.

6.4.3 Function Documentation

6.4.3.1 at()

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

6.4.3.2 DEFMCounterData() [1/2]

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

Definition at line 72 of file defm-types.hpp.

6.4.3.3 DEFMCounterData() [2/2]

```
DEFMCounterData::DEFMCounterData (
    const std::vector< size_t > indices_,
    const std::vector< double > numbers_,
    const std::vector< bool > logical_,
    bool is_motif_ = true ) [inline]
```

Definition at line 73 of file defm-types.hpp.

6.4.3.4 DEFMDData() [1/2]

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

Vector indicating which covariates are included in the model.

Definition at line 27 of file defm-types.hpp.

6.4.3.5 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 36 of file defm-types.hpp.

6.4.3.6 DEFMRuleData() [1/3]

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

Definition at line 102 of file defm-types.hpp.

6.4.3.7 DEFMRuleData() [2/3]

```
DEFMRuleData::DEFMRuleData (
    std::vector< double > numbers_,
    std::vector< size_t > indices_ ) [inline]
```

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

6.4.3.8 DEFMRuleData() [3/3]

```
DEFMRuleData::DEFMRuleData (
    std::vector< double > numbers_,
    std::vector< size_t > indices_,
    std::vector< bool > logical_ ) [inline]
```

Definition at line 104 of file defm-types.hpp.

6.4.3.9 DEFMRuleDynData()

```
DEFMRuleDynData::DEFMRuleDynData (
    const std::vector< double > * counts_,
    std::vector< double > numbers_ = {},
    std::vector< size_t > indices_ = {},
    std::vector< bool > logical_ = {} ) [inline]
```

Definition at line 156 of file defm-types.hpp.

6.4.3.10 idx() [1/2]

```
size_t DEFMCOUNTERData::idx (
    size_t i ) const [inline]
```

Definition at line 81 of file defm-types.hpp.

6.4.3.11 idx() [2/2]

```
size_t DEFMRULEData::idx (
    size_t i ) const [inline]
```

Definition at line 99 of file defm-types.hpp.

6.4.3.12 is_true() [1/2]

```
bool DEFMCOUNTERData::is_true (
    size_t i ) const [inline]
```

Definition at line 83 of file defm-types.hpp.

6.4.3.13 is_true() [2/2]

```
bool DEFMRULEData::is_true (
    size_t i ) const [inline]
```

Definition at line 100 of file defm-types.hpp.

6.4.3.14 ncol()

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

Definition at line 123 of file defm-types.hpp.

6.4.3.15 nrow()

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

Definition at line 127 of file defm-types.hpp.

6.4.3.16 num() [1/2]

```
double DEFMCOUNTERData::num (
    size_t i ) const [inline]
```

Definition at line 82 of file defm-types.hpp.

6.4.3.17 num() [2/2]

```
double DEFMRULEData::num (
    size_t i ) const [inline]
```

Definition at line 98 of file defm-types.hpp.

6.4.3.18 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 118 of file defm-types.hpp.

6.4.3.19 print()

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

Definition at line 131 of file defm-types.hpp.

6.4.3.20 rule_dyn_limit_changes()

```
void rule_dyn_limit_changes (
    PhyloSupport * support,
    size_t pos,
    size_t lb,
    size_t ub,
    size_t duplication = Geese::etype_default ) [inline]
```

Overall functional gains.

Parameters

<i>support</i>	Support 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 2058 of file counters.hpp.

6.4.3.21 ~DEFMCounterData()

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

Definition at line 85 of file defm-types.hpp.

6.4.3.22 ~DEFMData()

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

Definition at line 58 of file defm-types.hpp.

6.4.3.23 ~DEFMRuleDynData()

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

Definition at line 163 of file defm-types.hpp.

6.4.4 Variable Documentation

6.4.4.1 array

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

Definition at line 19 of file defm-types.hpp.

6.4.4.2 counts

```
const std::vector< double >* DEFMRuleDynData::counts
```

Definition at line 154 of file defm-types.hpp.

6.4.4.3 covar_sort

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

Definition at line 24 of file defm-types.hpp.

6.4.4.4 covar_used

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

Value where the sorting of the covariates is stored.

Definition at line 25 of file defm-types.hpp.

6.4.4.5 covariates

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

Vector of covariates (complete vector)

Definition at line 20 of file defm-types.hpp.

6.4.4.6 indices [1/2]

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

Definition at line 67 of file defm-types.hpp.

6.4.4.7 indices [2/2]

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

Definition at line 93 of file defm-types.hpp.

6.4.4.8 init

```
bool DEFMRULEData::init = false
```

Definition at line 96 of file defm-types.hpp.

6.4.4.9 is_motif

```
bool DEFMCOUNTERData::is_motif
```

If false, then is a logit intercept.

Definition at line 70 of file defm-types.hpp.

6.4.4.10 logical [1/2]

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

Definition at line 69 of file defm-types.hpp.

6.4.4.11 logical [2/2]

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

Definition at line 94 of file defm-types.hpp.

6.4.4.12 numbers [1/2]

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

Definition at line 68 of file defm-types.hpp.

6.4.4.13 numbers [2/2]

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

Definition at line 92 of file defm-types.hpp.

6.4.4.14 obs_start

```
size_t DEFMDData::obs_start
```

Index of the observation in the data.

Definition at line 21 of file defm-types.hpp.

6.4.4.15 X_ncol

```
size_t DEFMDData::X_ncol
```

Number of columns in the array of covariates.

Definition at line 22 of file defm-types.hpp.

6.4.4.16 X_nrow

```
size_t DEFMDData::X_nrow
```

Number of rows in the array of covariates.

Definition at line 23 of file defm-types.hpp.

6.5 Phylo counters

[Counters](#) for phylogenetic modeling.

Collaboration diagram for Phylo counters:



Modules

- [Phylo rules](#)

Rules for phylogenetic modeling.

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

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

6.5.1 Detailed Description

`Counters` for phylogenetic modeling.

Parameters

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

6.5.2 Function Documentation

6.5.2.1 counter_co_opt()

```
void counter_co_opt (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [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 1296 of file counters.hpp.

6.5.2.2 counter_cogain()

```
void counter_cogain (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Co-evolution (joint gain or loss)

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

Definition at line 791 of file counters.hpp.

6.5.2.3 counter_gains()

```
void counter_gains (
    PhyloCounters * counters,
    std::vector< size_t > nfun,
    size_t duplication = Geese::etype_default ) [inline]
```

Functional gains for a specific function (nfun).

Definition at line 96 of file counters.hpp.

6.5.2.4 counter_gains_from_0()

```
void counter_gains_from_0 (
    PhyloCounters * counters,
    std::vector< size_t > nfun,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Needs to specify function a.

Definition at line 1630 of file counters.hpp.

6.5.2.5 counter_gains_k_offspring()

```
void counter_gains_k_offspring (
    PhyloCounters * counters,
    std::vector< size_t > nfun,
    size_t k = 1u,
    size_t duplication = Geese::etype_default ) [inline]
```

k genes gain function nfun

Definition at line 156 of file counters.hpp.

6.5.2.6 counter_genes_changing()

```
void counter_genes_changing (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Definition at line 228 of file counters.hpp.

6.5.2.7 counter_k_genes_changing()

```
void counter_k_genes_changing (
    PhyloCounters * counters,
    size_t k,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Definition at line 1394 of file counters.hpp.

6.5.2.8 counter_less_than_p_prop_genes_changing()

```
void counter_less_than_p_prop_genes_changing (
    PhyloCounters * counters,
    double p,
    size_t duplication = Geese::etype_default ) [inline]
```

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

< How many genes diverge the parent

Definition at line 1514 of file counters.hpp.

6.5.2.9 counter_longest()

```
void counter_longest (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

Longest branch mutates (either by gain or by loss)

Definition at line 848 of file counters.hpp.

6.5.2.10 counter_loss()

```
void counter_loss (
    PhyloCounters * counters,
    std::vector< size_t > nfun,
    size_t duplication = Geese::etype_default ) [inline]
```

Total count of losses for an specific function.

Definition at line 591 of file counters.hpp.

6.5.2.11 counter_maxfuns()

```
void counter_maxfuns (
    PhyloCounters * counters,
    size_t lb,
    size_t ub,
    size_t duplication = Geese::etype_default ) [inline]
```

Cap the number of functions per gene.

Definition at line 529 of file counters.hpp.

6.5.2.12 counter_neofun()

```
void counter_neofun (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Total number of neofunctionalization events.

Needs to specify pairs of function.

Definition at line 1018 of file counters.hpp.

6.5.2.13 counter_neofun_a2b()

```
void counter_neofun_a2b (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Total number of neofunctionalization events.

Needs to specify pairs of function.

Definition at line 1163 of file counters.hpp.

6.5.2.14 counter_overall_changes()

```
void counter_overall_changes (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Definition at line 643 of file counters.hpp.

6.5.2.15 counter_overall_gains()

```
void counter_overall_gains (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

Overall functional gains.

Total number of gains (irrespective of the function).

Definition at line 58 of file counters.hpp.

6.5.2.16 counter_overall_gains_from_0()

```
void counter_overall_gains_from_0 (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Needs to specify function a.

Definition at line 1696 of file counters.hpp.

6.5.2.17 counter_overall_loss()

```
void counter_overall_loss (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

Overall functional loss.

Definition at line 481 of file counters.hpp.

6.5.2.18 counter_pairwise_first_gain()

```
void counter_pairwise_first_gain (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [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 1948 of file counters.hpp.

6.5.2.19 counter_pairwise_neofun_singlefun()

```
void counter_pairwise_neofun_singlefun (
    PhyloCounters * counters,
    size_t nfunA,
    size_t duplication = Geese::etype_default ) [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 1099 of file counters.hpp.

6.5.2.20 counter_pairwise_overall_change()

```
void counter_pairwise_overall_change (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Needs to specify function a.

Definition at line 1744 of file counters.hpp.

6.5.2.21 counter_pairwise_preserving()

```
void counter_pairwise_preserving (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [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 1809 of file counters.hpp.

6.5.2.22 counter_preserve_pseudogene()

```
void counter_preserve_pseudogene (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Keeps track of how many pairs of genes preserve pseudostate.

Definition at line 297 of file counters.hpp.

6.5.2.23 counter_prop_genes_changing()

```
void counter_prop_genes_changing (
    PhyloCounters * counters,
    size_t duplication = Geese::etype_default ) [inline]
```

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

Definition at line 379 of file counters.hpp.

6.5.2.24 counter_subfun()

```
void counter_subfun (
    PhyloCounters * counters,
    size_t nfunA,
    size_t nfunB,
    size_t duplication = Geese::etype_default ) [inline]
```

Total count of Sub-functionalization events.

It requires to specify data = {funA, funB}

Definition at line 702 of file counters.hpp.

Chapter 7

Namespace Documentation

7.1 `barry` Namespace Reference

`barry`: Your go-to motif accountant

Namespaces

- [counters](#)

Tree class and Treeliterator class.

7.1.1 Detailed Description

`barry`: Your go-to motif accountant

7.2 `barry::counters` Namespace Reference

Tree class and Treeliterator class.

Namespaces

- [network](#)

7.2.1 Detailed Description

Tree class and Treeliterator class.

7.3 barry::counters::network Namespace Reference

7.4 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`

7.4.1 Detailed Description

Integer constants used to specify which cell should be check.

7.4.2 Variable Documentation

7.4.2.1 BOTH

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

Definition at line 27 of file typedefs.hpp.

7.4.2.2 NONE

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

Definition at line 28 of file typedefs.hpp.

7.4.2.3 ONE

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

Definition at line 29 of file typedefs.hpp.

7.4.2.4 TWO

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

Definition at line 30 of file typedefs.hpp.

7.5 defm Namespace Reference

7.6 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`

7.6.1 Detailed Description

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

7.6.2 Variable Documentation

7.6.2.1 AS_ONE

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

Definition at line 45 of file typedefs.hpp.

7.6.2.2 AS_ZERO

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

Definition at line 44 of file typedefs.hpp.

7.6.2.3 BOTH

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

Definition at line 38 of file typedefs.hpp.

7.6.2.4 NONE

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

Definition at line 39 of file typedefs.hpp.

7.6.2.5 ONE

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

Definition at line 40 of file typedefs.hpp.

7.6.2.6 TWO

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

Definition at line 41 of file typedefs.hpp.

7.6.2.7 UNKNOWN

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

Definition at line 43 of file typedefs.hpp.

7.7 geese Namespace Reference

Chapter 8

Class Documentation

8.1 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` (size_t i, size_t j) const
- Cell_Type `get_cell` (size_t i, size_t j, bool check_bounds=true) const
- std::vector< Cell_Type > `get_col_vec` (size_t i, bool check_bounds=true) const
- std::vector< Cell_Type > `get_row_vec` (size_t i, bool check_bounds=true) const
- void `get_col_vec` (std::vector< Cell_Type > *x, size_t i, bool check_bounds=true) const
- void `get_row_vec` (std::vector< Cell_Type > *x, size_t i, bool check_bounds=true) const
- const Row_type< Cell_Type > & `row` (size_t i, bool check_bounds=true) const
- const Col_type< Cell_Type > & `col` (size_t i, bool check_bounds=true) const
- Entries< Cell_Type > `get_entries` () const

Get the edgelist.

- void `transpose` ()
- void `clear` (bool hard=true)
- void `resize` (size_t N_, size_t 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 size_t vector ranging from 0 to M_
target	When true tries to add repeated observations.

- **BArray** ()
Zero-size array.
 - **BArray** (size_t N_, size_t M_)
Empty array.
 - **BArray** (size_t N_, size_t M_, const std::vector< size_t > &source, const std::vector< size_t > &target, const std::vector< Cell_Type > &value, bool add=true)
Edgelist with data.
 - **BArray** (size_t N_, size_t M_, const std::vector< size_t > &source, const std::vector< size_t > &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** (size_t i, size_t j, bool check_bounds=true) const
- size_t **nrow** () const noexcept
- size_t **ncol** () const noexcept
- size_t **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< size_t, size_t > &coords)`
- `BArray< Cell_Type, Data_Type > & operator-= (const std::pair< size_t, size_t > &coords)`
- `BArrayCell< Cell_Type, Data_Type > operator() (size_t i, size_t j, bool check_bounds=true)`
- `const Cell_Type operator() (size_t i, size_t j, bool check_bounds=true) const`
- `void rm_cell (size_t i, size_t j, bool check_bounds=true, bool check_exists=true)`
- `void insert_cell (size_t i, size_t j, const Cell< Cell_Type > &v, bool check_bounds, bool check_exists)`
- `void insert_cell (size_t i, size_t j, Cell< Cell_Type > &&v, bool check_bounds, bool check_exists)`
- `void insert_cell (size_t i, size_t j, Cell_Type v, bool check_bounds, bool check_exists)`
- `void swap_cells (size_t i0, size_t j0, size_t i1, size_t j1, bool check_bounds=true, int check_exists=CHECK::BOTH, int *report=nullptr)`
- `void toggle_cell (size_t i, size_t j, bool check_bounds=true, int check_exists=EXISTS::UNKNOWN)`
- `void toggle_lock (size_t i, size_t j, bool check_bounds=true)`

Column/row wise interchange

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

8.1.1 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<size_t, 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.

8.1.2 Constructor & Destructor Documentation

8.1.2.1 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.

8.1.2.2 BArray() [2/6]

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

Empty array.

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

8.1.2.3 BArray() [3/6]

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

Edgelist with data.

8.1.2.4 BArray() [4/6]

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

Edgelist with no data (simpler)

8.1.2.5 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.

8.1.2.6 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.

8.1.2.7 ~BArray()

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

8.1.3 Member Function Documentation

8.1.3.1 clear()

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

8.1.3.2 col()

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

8.1.3.3 D() [1/2]

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

8.1.3.4 D() [2/2]

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

8.1.3.5 D_ptr() [1/2]

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

8.1.3.6 D_ptr() [2/2]

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

8.1.3.7 default_val()

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

8.1.3.8 flush_data()

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

8.1.3.9 get_cell()

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

8.1.3.10 get_col_vec() [1/2]

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

8.1.3.11 get_col_vec() [2/2]

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

8.1.3.12 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>`

8.1.3.13 get_row_vec() [1/2]

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

8.1.3.14 get_row_vec() [2/2]

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

8.1.3.15 insert_cell() [1/3]

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

8.1.3.16 insert_cell() [2/3]

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

8.1.3.17 insert_cell() [3/3]

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

8.1.3.18 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`.

8.1.3.19 is_empty()

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

8.1.3.20 ncol()

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

8.1.3.21 nnozero()

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

8.1.3.22 nrow()

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

8.1.3.23 operator>() [1/2]

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

8.1.3.24 operator>() [2/2]

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

8.1.3.25 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 )
```

8.1.3.26 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 )
```

8.1.3.27 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 )
```

8.1.3.28 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< size_t, size_t > & coords )
```

8.1.3.29 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 )
```

8.1.3.30 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 )
```


8.1.3.31 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< size_t, size_t > & coords )
```

8.1.3.32 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 )
```

8.1.3.33 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.

8.1.3.34 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.

8.1.3.35 operator==()

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

8.1.3.36 out_of_range()

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

8.1.3.37 print()

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

8.1.3.38 reserve()

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

8.1.3.39 resize()

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

8.1.3.40 rm_cell()

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

8.1.3.41 row()

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

8.1.3.42 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>	

8.1.3.43 swap_cells()

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

8.1.3.44 swap_cols()

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

8.1.3.45 swap_rows()

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

8.1.3.46 toggle_cell()

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

8.1.3.47 toggle_lock()

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

8.1.3.48 transpose()

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

8.1.3.49 zero_col()

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

8.1.3.50 zero_row()

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

8.1.4 Friends And Related Function Documentation

8.1.4.1 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`.

8.1.4.2 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.

8.1.5 Member Data Documentation

8.1.5.1 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

8.2 BArrayCell< Cell_Type, Data_Type > Class Template Reference

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

Public Member Functions

- BArrayCell (BArray< Cell_Type, Data_Type > *Array_, size_t i_, size_t 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

8.2.1 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.

8.2.2 Constructor & Destructor Documentation

8.2.2.1 BArrayCell()

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

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

8.2.2.2 ~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.

8.2.3 Member Function Documentation

8.2.3.1 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.

8.2.3.2 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.

8.2.3.3 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.

8.2.3.4 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.

8.2.3.5 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.

8.2.3.6 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.

8.2.3.7 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](#)

8.3 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_](#), size_t [i_](#), size_t [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

8.3.1 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`.

8.3.2 Constructor & Destructor Documentation

8.3.2.1 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\_,
    size_t i\_,
    size_t j\_,
    bool check\_bounds = true ) [inline]
```

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

8.3.2.2 ~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`.

8.3.3 Member Function Documentation

8.3.3.1 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.

8.3.3.2 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.

8.3.3.3 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.

8.3.3.4 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.

8.3.3.5 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.

8.3.3.6 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`.

8.3.3.7 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`

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

Get the edgelist.

- `void transpose ()`
- `void clear (bool hard=true)`
- `void resize (size_t N_, size_t 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 (size_t i) const`
- `const Cell_Type colsum (size_t i) const`

Constructors

Parameters

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

- **BArrayDense** ()
Zero-size array.
- **BArrayDense** (size_t N_, size_t M_, Cell_Type value=static_cast< Cell_Type >(0))
Empty array.
- **BArrayDense** (size_t N_, size_t M_, const std::vector< size_t > &source, const std::vector< size_t > &target, const std::vector< Cell_Type > &value, bool add=true)
Edgelist with data.
- **BArrayDense** (size_t N_, size_t M_, const std::vector< size_t > &source, const std::vector< size_t > &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 false avoids checking bounds.

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

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

Cell-wise insertion/deletion

Parameters

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

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

Column/row wise interchange

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

8.4.1 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`.

8.4.2 Constructor & Destructor Documentation

8.4.2.1 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`.

8.4.2.2 BArrayDense() [2/6]

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

Empty array.

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

8.4.2.3 BArrayDense() [3/6]

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

Edgelist with data.

8.4.2.4 BArrayDense() [4/6]

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

Edgelist with no data (simpler)

8.4.2.5 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.

8.4.2.6 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.

8.4.2.7 ~BArrayDense()

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

8.4.3 Member Function Documentation

8.4.3.1 clear()

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

8.4.3.2 col() [1/2]

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

Definition at line 496 of file `barraydense-meat.hpp`.

8.4.3.3 col() [2/2]

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

Definition at line 482 of file `barraydense-meat.hpp`.

8.4.3.4 colsum()

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

8.4.3.5 D() [1/2]

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

8.4.3.6 D() [2/2]

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

8.4.3.7 D_ptr() [1/2]

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

8.4.3.8 D_ptr() [2/2]

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

8.4.3.9 default_val()

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

8.4.3.10 get_cell()

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


8.4.3.11 get_col_vec() [1/2]

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

8.4.3.12 get_col_vec() [2/2]

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

8.4.3.13 get_data()

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

8.4.3.14 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>`

8.4.3.15 get_row_vec() [1/2]

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

8.4.3.16 get_row_vec() [2/2]

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

8.4.3.17 insert_cell() [1/2]

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

8.4.3.18 insert_cell() [2/2]

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

8.4.3.19 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`.

8.4.3.20 is_empty()

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

8.4.3.21 ncol()

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

8.4.3.22 nnozero()

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

8.4.3.23 nrow()

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

8.4.3.24 operator>() [1/2]

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

8.4.3.25 operator>() [2/2]

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

8.4.3.26 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 )
```

8.4.3.27 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 )
```

8.4.3.28 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 )
```

8.4.3.29 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< size_t, size_t > & coords )
```

8.4.3.30 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 )
```

8.4.3.31 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 )
```

8.4.3.32 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< size_t, size_t > & coords )
```

8.4.3.33 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 )
```

8.4.3.34 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.

8.4.3.35 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.

8.4.3.36 operator==()

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

8.4.3.37 out_of_range()

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

8.4.3.38 print()

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

8.4.3.39 reserve()

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

8.4.3.40 resize()

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

8.4.3.41 rm_cell()

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

8.4.3.42 row() [1/2]

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

8.4.3.43 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 (
    size_t i,
    bool check_bounds = true ) const
```

8.4.3.44 rowsum()

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

8.4.3.45 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>	

8.4.3.46 swap_cells()

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

8.4.3.47 swap_cols()

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

8.4.3.48 swap_rows()

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

8.4.3.49 toggle_cell()

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

8.4.3.50 toggle_lock()

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

8.4.3.51 transpose()

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

8.4.3.52 zero_col()

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

8.4.3.53 zero_row()

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

8.4.4 Friends And Related Function Documentation

8.4.4.1 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.

8.4.4.2 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.

8.4.4.3 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.

8.4.4.4 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.

8.4.4.5 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.

8.4.5 Member Data Documentation

8.4.5.1 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 bararraydense-bones.hpp.

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

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

8.5 BArrayDenseCell< Cell_Type, Data_Type > Class Template Reference

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

Public Member Functions

- [BArrayDenseCell](#) ([BArrayDense](#)< Cell_Type, Data_Type > *[Array_](#), size_t i_, size_t 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 >

8.5.1 Detailed Description

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

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

8.5.2 Constructor & Destructor Documentation

8.5.2.1 BArrayDenseCell()

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

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

8.5.2.2 ~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`.

8.5.3 Member Function Documentation

8.5.3.1 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`.

8.5.3.2 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`.

8.5.3.3 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`.

8.5.3.4 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`.

8.5.3.5 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`.

8.5.3.6 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`.

8.5.3.7 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`.

8.5.3.8 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`.

8.5.4 Friends And Related Function Documentation

8.5.4.1 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`.

8.5.4.2 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`.

8.5.4.3 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`

8.6 BArrayDenseCell_const< Cell_Type, Data_Type > Class Template Reference

8.6.1 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](#)

8.7 BArrayDenseCol< Cell_Type, Data_Type > Class Template Reference

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

Public Member Functions

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

Friends

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

8.7.1 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`.

8.7.2 Constructor & Destructor Documentation

8.7.2.1 BArrayDenseCol()

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

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

8.7.3 Member Function Documentation

8.7.3.1 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.

8.7.3.2 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.

8.7.3.3 operator()()

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

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

8.7.3.4 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.

8.7.4 Friends And Related Function Documentation

8.7.4.1 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`.

8.7.4.2 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`.

8.7.4.3 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`

8.8 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_, size_t j)`
- `Col_type< Cell_Type >::iterator begin ()`
- `Col_type< Cell_Type >::iterator end ()`
- `size_t size () const noexcept`
- `const std::pair< size_t, Cell_Type * > operator() (size_t i) const`

Friends

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

8.8.1 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`.

8.8.2 Constructor & Destructor Documentation

8.8.2.1 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_,
    size_t j ) [inline]
```

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

8.8.3 Member Function Documentation

8.8.3.1 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`.

8.8.3.2 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`.

8.8.3.3 operator()()

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

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

8.8.3.4 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`.

8.8.4 Friends And Related Function Documentation

8.8.4.1 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`.

8.8.4.2 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`

8.9 BArrayDenseRow< Cell_Type, Data_Type > Class Template Reference

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

Public Member Functions

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

Friends

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

8.9.1 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`.

8.9.2 Constructor & Destructor Documentation

8.9.2.1 BArrayDenseRow()

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

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

8.9.3 Member Function Documentation

8.9.3.1 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`.

8.9.3.2 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.

8.9.3.3 operator()()

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

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

8.9.3.4 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.

8.9.4 Friends And Related Function Documentation

8.9.4.1 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.

8.9.4.2 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.

8.9.4.3 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`

8.10 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_, size_t 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< size_t, Cell< Cell_Type > >` `operator() (size_t i) const`

Friends

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

8.10.1 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`.

8.10.2 Constructor & Destructor Documentation

8.10.2.1 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_,
    size_t i ) [inline]
```

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

8.10.3 Member Function Documentation

8.10.3.1 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.

8.10.3.2 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.

8.10.3.3 operator()()

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

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

8.10.3.4 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.

8.10.4 Friends And Related Function Documentation

8.10.4.1 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`.

8.10.4.2 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`

8.11 BArrayRow< Cell_Type, Data_Type > Class Template Reference

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

Public Member Functions

- [BArrayRow](#) ([BArray](#)< Cell_Type, Data_Type > *[Array_](#), size_t [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](#)

8.11.1 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`.

8.11.2 Constructor & Destructor Documentation

8.11.2.1 BArrayRow()

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

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

8.11.2.2 ~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.

8.11.3 Member Function Documentation

8.11.3.1 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
```

8.11.3.2 operator*=()

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

8.11.3.3 operator+=()

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


8.11.3.4 operator-=()

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

8.11.3.5 operator/=()

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

8.11.3.6 operator=()

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

8.11.3.7 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](#)

8.12 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_, size_t 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

8.12.1 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`.

8.12.2 Constructor & Destructor Documentation

8.12.2.1 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_,
    size_t i_,
    bool check_bounds = true ) [inline]
```

Definition at line 49 of file `barrayrow-bones.hpp`.

8.12.2.2 ~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`.

8.12.3 Member Function Documentation

8.12.3.1 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
```

8.12.3.2 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
```

8.12.3.3 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
```

8.12.3.4 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
```

8.12.3.5 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
```

8.12.3.6 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
```

8.12.3.7 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](#)

8.13 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_](#), size_t &dim_size_t &i_, bool [check_bounds](#)=true)
Construct a new [BArrayVector](#) object.
- [~BArrayVector](#) ()
- bool [is_row](#) () const noexcept
- bool [is_col](#) () const noexcept
- size_t [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

8.13.1 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](#).

8.13.2 Constructor & Destructor Documentation

8.13.2.1 BArrayVector()

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

Construct a new [BArrayVector](#) object.

Parameters

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

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

8.13.2.2 ~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.

8.13.3 Member Function Documentation

8.13.3.1 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.

8.13.3.2 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.

8.13.3.3 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.

8.13.3.4 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.

8.13.3.5 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.

8.13.3.6 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.

8.13.3.7 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.

8.13.3.8 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.

8.13.3.9 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`.

8.13.3.10 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`.

8.13.3.11 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`.

8.13.3.12 size()

```
template<typename Cell_Type , typename Data_Type >
size_t 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`

8.14 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_](#), [size_t](#) &[dim_](#) [size_t](#) &[i_](#), [bool](#) [check_bounds](#)=true)
- [~BArrayVector_const](#) ()
- [bool](#) [is_row](#) () [const](#) [noexcept](#)
- [bool](#) [is_col](#) () [const](#) [noexcept](#)
- [size_t](#) [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](#)

8.14.1 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`.

8.14.2 Constructor & Destructor Documentation

8.14.2.1 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\_,
    size_t &dim\_ size\_t & i\_,
    bool check\_bounds = true ) [inline]
```

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

8.14.2.2 ~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`.

8.14.3 Member Function Documentation

8.14.3.1 begin()

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

8.14.3.2 end()

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

8.14.3.3 is_col()

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

8.14.3.4 is_row()

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

8.14.3.5 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.

8.14.3.6 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.

8.14.3.7 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.

8.14.3.8 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.

8.14.3.9 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.

8.14.3.10 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.

8.14.3.11 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.

8.14.3.12 size()

```
template<typename Cell_Type = bool, typename Data_Type = bool>
size_t 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

8.15 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](#) (size_t x)
- void [add](#) (int x)
- [Cell](#) ()
- [Cell](#) ()
- [Cell](#) ()

Public Attributes

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

8.15.1 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.

8.15.2 Constructor & Destructor Documentation

8.15.2.1 Cell() [1/7]

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

8.15.2.2 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.

8.15.2.3 ~Cell()

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

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

8.15.2.4 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.

8.15.2.5 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.

8.15.2.6 Cell() [5/7]

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

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

8.15.2.7 Cell() [6/7]

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

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

8.15.2.8 Cell() [7/7]

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

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

8.15.3 Member Function Documentation

8.15.3.1 add() [1/4]

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

8.15.3.2 add() [2/4]

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

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

8.15.3.3 add() [3/4]

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

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

8.15.3.4 add() [4/4]

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

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

8.15.3.5 operator Cell_Type()

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

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

8.15.3.6 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.

8.15.3.7 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.

8.15.3.8 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.

8.15.3.9 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.

8.15.4 Member Data Documentation

8.15.4.1 active

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

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

8.15.4.2 value

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

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

8.15.4.3 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

8.16 Cell_const< Cell_Type > Class Template Reference

8.16.1 Detailed Description

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

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

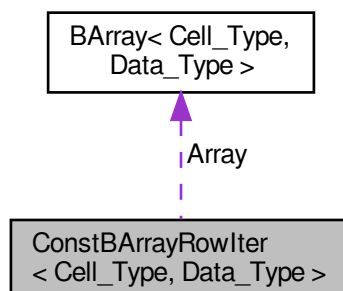
The documentation for this class was generated from the following file:

- include/barry/barray-meat.hpp

8.17 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

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

8.17.1 Detailed Description

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

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

8.17.2 Constructor & Destructor Documentation

8.17.2.1 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`.

8.17.2.2 ~ConstBArrayRowIter()

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

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

8.17.3 Member Data Documentation

8.17.3.1 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`.

8.17.3.2 current_col

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

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

8.17.3.3 current_row

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

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

8.17.3.4 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`

8.18 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, size_t i, size_t j)`
- `double init (Array_Type &Array, size_t i, size_t j)`
- `std::string get_name () const`
- `std::string get_description () const`

Creator passing a counter and an initializer

Parameters

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

- [Counter](#) ()
- [Counter](#) ([Counter_fun_type](#)< Array_Type, Data_Type > [count_fun](#), [Counter_fun_type](#)< Array_Type, Data_Type > [init_fun](#), [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](#)_) noexcept
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](#) = ""

8.18.1 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`.

8.18.2 Constructor & Destructor Documentation

8.18.2.1 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.

8.18.2.2 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.

8.18.2.3 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.

8.18.2.4 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.

8.18.2.5 ~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.

8.18.3 Member Function Documentation

8.18.3.1 count()

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

8.18.3.2 get_description()

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

8.18.3.3 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 ( )
```

8.18.3.4 get_name()

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

8.18.3.5 init()

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

8.18.3.6 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.

8.18.3.7 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.

8.18.3.8 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>	
------------	--

8.18.4 Member Data Documentation**8.18.4.1 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.

8.18.4.2 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.

8.18.4.3 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.

8.18.4.4 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.

8.18.4.5 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.

8.18.4.6 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](#)

8.19 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[] (size_t 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_)

8.19.1 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.

8.19.2 Constructor & Destructor Documentation

8.19.2.1 Counters() [1/3]

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

8.19.2.2 ~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.

8.19.2.3 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>	
—	

8.19.2.4 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>	
—	

8.19.3 Member Function Documentation

8.19.3.1 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 )
```

8.19.3.2 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_ = "" )
```

8.19.3.3 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_ )
```

8.19.3.4 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.

8.19.3.5 get_descriptions()

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

8.19.3.6 get_names()

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

8.19.3.7 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>](#)

8.19.3.8 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](#)>&

8.19.3.9 operator[]()

```
template<typename Array_Type = BArray<>, typename Data_Type = bool>
Counter<Array\_Type,Data\_Type>& Counters< Array\_Type, Data\_Type >::operator[] (
    size_t idx )
```

Returns a pointer to a particular counter.

Parameters

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

Returns

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

8.19.3.10 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

size_t

Definition at line 164 of file counters-bones.hpp.

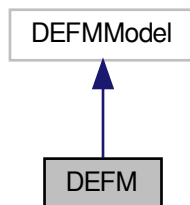
The documentation for this class was generated from the following file:

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

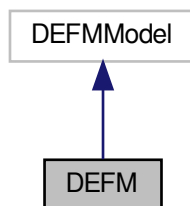
8.20 DEFM Class Reference

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

Inheritance diagram for DEFM:



Collaboration diagram for DEFM:



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`)
- **DEFModel** & `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`
- `const std::vector< std::string > & get_X_names () const`
- `void print () const`
- `std::vector< bool > is_motif ()`

8.20.1 Detailed Description

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

8.20.2 Constructor & Destructor Documentation

8.20.2.1 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 104 of file `defm-meat.hpp`.

8.20.3 Member Function Documentation

8.20.3.1 get_ID()

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

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

8.20.3.2 get_m_order()

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

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

8.20.3.3 get_model()

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

Definition at line 48 of file defm-bones.hpp.

8.20.3.4 get_n_covars()

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

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

8.20.3.5 get_n_obs()

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

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

8.20.3.6 get_n_rows()

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

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

8.20.3.7 get_n_y()

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

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

8.20.3.8 get_X()

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

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

8.20.3.9 get_X_names()

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

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

8.20.3.10 get_Y()

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

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

8.20.3.11 get_Y_names()

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

Definition at line 367 of file defm-meat.hpp.

8.20.3.12 init()

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

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

8.20.3.13 is_motif()

```
std::vector< bool > DEFM::is_motif ( ) [inline]
```

Definition at line 388 of file defm-meat.hpp.

8.20.3.14 likelihood()

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


8.20.3.15 logodds()

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

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

8.20.3.16 motif_census()

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

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

8.20.3.17 print()

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

Definition at line 375 of file defm-meat.hpp.

8.20.3.18 set_names()

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

Definition at line 350 of file defm-meat.hpp.

8.20.3.19 simulate()

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

Definition at line 38 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](#)

8.21 DEFMCOUNTERDATA Class Reference

Data class used to store arbitrary size_t or double vectors.

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

Public Member Functions

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

Public Attributes

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

If false, then is a logit intercept.

8.21.1 Detailed Description

Data class used to store arbitrary size_t or double vectors.

Definition at line 64 of file defm-types.hpp.

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

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

8.22 DEFMDATA Class Reference

Data class for [DEFM](#) arrays.

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

Public Member Functions

- [DEFMDData](#) ()
Vector indicating which covariates are included in the model.
- [DEFMDData](#) ([DEFMArray](#) *array_, [const](#) double *covariates_, [size_t](#) obs_start_, [size_t](#) X_ncol_, [size_t](#) X_nrow_)
Constructor.
- [double operator\(\)](#) ([size_t](#) i, [size_t](#) j) [const](#)
Access to the row (i) column (j) data.
- [double at](#) ([size_t](#) i, [size_t](#) j) [const](#)
- [size_t ncol](#) () [const](#)
- [size_t nrow](#) () [const](#)
- [void print](#) () [const](#)
- [~DEFMDData](#) ()

Public Attributes

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

8.22.1 Detailed Description

Data class for [DEFM](#) arrays.

This holds information pointing to the data array, including information regarding the number of observations, the time slices of the observation, and the number of covariates in the data.

Definition at line 16 of file [defm-types.hpp](#).

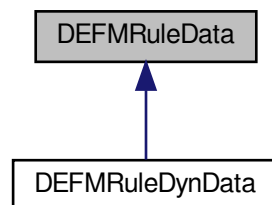
The documentation for this class was generated from the following file:

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

8.23 DEFMRuleData Class Reference

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

Inheritance diagram for DEFMRuleData:



Public Member Functions

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

Public Attributes

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

8.23.1 Detailed Description

Definition at line 89 of file defm-types.hpp.

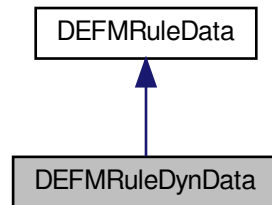
The documentation for this class was generated from the following file:

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

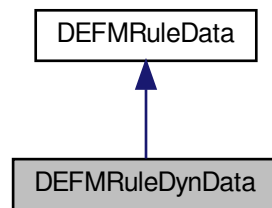
8.24 DEFMRuleDynData Class Reference

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

Inheritance diagram for DEFMRuleDynData:



Collaboration diagram for DEFMRuleDynData:



Public Member Functions

- [DEFMRuleDynData](#) (`const` `std::vector< double > *counts_`, `std::vector< double > numbers_={}`, `std::vector< size_t > indices_={}`, `std::vector< bool > logical_={}`)
- [~DEFMRuleDynData](#) ()

Public Attributes

- `const` `std::vector< double > * counts`

8.24.1 Detailed Description

Definition at line 152 of file `defm-types.hpp`.

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

- `include/barry/models/defm/defm-types.hpp`

8.25 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](#) (size_t n)
- [~Entries](#) ()
- void [resize](#) (size_t n)

Public Attributes

- std::vector< size_t > [source](#)
- std::vector< size_t > [target](#)
- std::vector< Cell_Type > [val](#)

8.25.1 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 78 of file `typedefs.hpp`.

8.25.2 Constructor & Destructor Documentation

8.25.2.1 Entries() [1/2]

```
template<typename Cell_Type >
Entries< Cell_Type >::Entries ( ) [inline]
```

Definition at line 84 of file `typedefs.hpp`.

8.25.2.2 Entries() [2/2]

```
template<typename Cell_Type >
Entries< Cell_Type >::Entries (
    size_t n ) [inline]
```

Definition at line 85 of file typedefs.hpp.

8.25.2.3 ~Entries()

```
template<typename Cell_Type >
Entries< Cell_Type >::~~Entries ( ) [inline]
```

Definition at line 92 of file typedefs.hpp.

8.25.3 Member Function Documentation

8.25.3.1 resize()

```
template<typename Cell_Type >
void Entries< Cell_Type >::resize (
    size_t n ) [inline]
```

Definition at line 94 of file typedefs.hpp.

8.25.4 Member Data Documentation

8.25.4.1 source

```
template<typename Cell_Type >
std::vector< size_t > Entries< Cell_Type >::source
```

Definition at line 80 of file typedefs.hpp.

8.25.4.2 target

```
template<typename Cell_Type >
std::vector< size_t > Entries< Cell_Type >::target
```

Definition at line 81 of file typedefs.hpp.

8.25.4.3 val

```
template<typename Cell_Type >
std::vector< Cell_Type > Entries< Cell_Type >::val
```

Definition at line 82 of file typedefs.hpp.

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

- include/barry/typedefs.hpp

8.26 Flock Class Reference

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

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

Public Member Functions

- [Flock](#) ()
- [~Flock](#) ()
- [size_t add_data](#) (std::vector< std::vector< [size_t](#) > > &annotations, std::vector< [size_t](#) > &geneid, std::vector< [int](#) > &parent, std::vector< [bool](#) > &duplication)
Add a tree to the flock.
- void [set_seed](#) (const [size_t](#) &s)
Set the seed of the model.
- void [init](#) ([size_t](#) bar_width=[BARRY_PROGRESS_BAR_WIDTH](#))
- [PhyloCounters](#) * [get_counters](#) ()
- [PhyloSupport](#) * [get_support_fun](#) ()
- std::vector< std::vector< [double](#) > > * [get_stats_support](#) ()
- std::vector< std::vector< [double](#) > > * [get_stats_target](#) ()
- [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\(\)](#) ([size_t](#) i, [bool](#) check_bounds=[true](#))
Access the i-th geese element.

Information about the model

- [size_t nfuncs](#) () const noexcept
- [size_t ntrees](#) () const noexcept
- std::vector< [size_t](#) > [nnodes](#) () const noexcept
- std::vector< [size_t](#) > [nleafs](#) () const noexcept
- [size_t nterms](#) () const
- [size_t support_size](#) () const noexcept
- std::vector< std::string > [colnames](#) () const
- [size_t 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`
- `size_t nfunctions = 0u`
- `bool initialized = false`
- `std::mt19937 engine`
- `PhyloModel model = PhyloModel()`

8.26.1 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.

8.26.2 Constructor & Destructor Documentation

8.26.2.1 Flock()

```
Flock::Flock ( ) [inline]
```

Definition at line 25 of file flock-bones.hpp.

8.26.2.2 ~Flock()

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

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

8.26.3 Member Function Documentation

8.26.3.1 add_data()

```
size_t Flock::add_data (
    std::vector< std::vector< size_t > > & annotations,
    std::vector< size_t > & geneid,
    std::vector< int > & parent,
    std::vector< bool > & duplication ) [inline]
```

Add a tree to the flock.

Parameters

<i>annotations</i>	see Geese::Geese .
<i>geneid</i>	see Geese .
<i>parent</i>	see Geese .
<i>duplication</i>	see Geese .

Returns

size_t The number of tree in the model (starting from zero).

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

8.26.3.2 colnames()

```
std::vector< std::string > Flock::colnames ( ) const [inline]
```

Definition at line 224 of file flock-meat.hpp.

8.26.3.3 get_counters()

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

Definition at line 100 of file flock-meat.hpp.

8.26.3.4 get_model()

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

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

8.26.3.5 get_stats_support()

```
std::vector< std::vector< double > > * Flock::get_stats_support ( ) [inline]
```

Definition at line 117 of file flock-meat.hpp.

8.26.3.6 get_stats_target()

```
std::vector< std::vector< double > > * Flock::get_stats_target ( ) [inline]
```

Definition at line 124 of file flock-meat.hpp.

8.26.3.7 get_support_fun()

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

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

8.26.3.8 init()

```
void Flock::init (
    size_t bar_width = BARRY_PROGRESS_BAR_WIDTH ) [inline]
```

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

8.26.3.9 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 138 of file flock-meat.hpp.

8.26.3.10 nfuncs()

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

Definition at line 167 of file flock-meat.hpp.

8.26.3.11 nleafs()

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

Definition at line 195 of file flock-meat.hpp.

8.26.3.12 nnodes()

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

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

8.26.3.13 nterms()

```
size_t Flock::nterms ( ) const [inline]
```

Definition at line 209 of file flock-meat.hpp.

8.26.3.14 ntrees()

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

Definition at line 174 of file flock-meat.hpp.

8.26.3.15 operator>()()

```
Geese * Flock::operator() (
    size_t i,
    bool check_bounds = true ) [inline]
```

Access the i-th geese element.

Parameters

<i>i</i>	Element to access
<i>check_bounds</i>	When true, it will check bounds.

Returns

Geese*

Definition at line 302 of file flock-meat.hpp.

8.26.3.16 parse_polytomies()

```
size_t Flock::parse_polytomies (
    bool verb = true,
    std::vector< size_t > * dist = nullptr ) const [inline], [noexcept]
```

Check polytomies and return the largest.

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

8.26.3.17 print()

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

Definition at line 258 of file flock-meat.hpp.

8.26.3.18 set_seed()

```
void Flock::set_seed (
    const size_t & s ) [inline]
```

Set the seed of the model.

Parameters

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

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

8.26.3.19 support_size()

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

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

8.26.4 Member Data Documentation

8.26.4.1 dat

```
std::vector< Geese > Flock::dat
```

Definition at line 17 of file flock-bones.hpp.

8.26.4.2 initialized

```
bool Flock::initialized = false
```

Definition at line 19 of file flock-bones.hpp.

8.26.4.3 model

```
PhyloModel Flock::model = PhyloModel()
```

Definition at line 23 of file flock-bones.hpp.

8.26.4.4 nfunctions

```
size_t Flock::nfunctions = 0u
```

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

8.26.4.5 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

8.27 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

8.27.1 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.

8.27.2 Constructor & Destructor Documentation

8.27.2.1 FreqTable()

```
template<typename T = double>
FreqTable< T >::FreqTable ( ) [inline]
```

Definition at line 34 of file freqtable.hpp.

8.27.2.2 ~FreqTable()

```
template<typename T = double>
FreqTable< T >::~~FreqTable ( ) [inline]
```

Definition at line 35 of file freqtable.hpp.

8.27.3 Member Function Documentation

8.27.3.1 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.

8.27.3.2 as_vector()

```
template<typename T >
Counts_type FreqTable< T >::as_vector [inline]
```

Definition at line 139 of file freqtable.hpp.

8.27.3.3 clear()

```
template<typename T >
void FreqTable< T >::clear [inline]
```

Definition at line 168 of file freqtable.hpp.

8.27.3.4 get_data()

```
template<typename T = double>
const std::vector< double >& FreqTable< T >::get_data ( ) const [inline]
```

Definition at line 40 of file freqtable.hpp.

8.27.3.5 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.

8.27.3.6 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.

8.27.3.7 print()

```
template<typename T >
void FreqTable< T >::print [inline]
```

Definition at line 204 of file freqtable.hpp.

8.27.3.8 reserve()

```
template<typename T >
void FreqTable< T >::reserve (
    size_t n,
    size_t k ) [inline]
```

Definition at line 182 of file freqtable.hpp.

8.27.3.9 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

8.28 Geese Class Reference

Annotated Phylo [Model](#).

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

Public Member Functions

- [~Geese](#) ()
- void [init](#) (size_t 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 size_t &s)
- std::vector< std::vector< size_t > > [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 [print_nodes](#) () const
- void [init_node](#) ([Node](#) &n)
- void [update_annotations](#) (size_t nodeid, std::vector< size_t > newann)
- std::vector< std::vector< bool > > [get_states](#) () const

Powerset of a gene's possible states.
- std::vector< size_t > [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 k (number of functions). Each vector should be of length N (equal to the number of nodes, including interior). Possible values are 0, 1, and 9.</i>
geneid	<i>Id of the gene. It should be of length N.</i>
parent	<i>Id of the parent gene. Also of length N</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< size_t > > &annotations, std::vector< size_t > &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>
------	---

- size_t nfuncs () const noexcept
Number of functions analyzed.
- size_t nnodes () const noexcept
Number of nodes (interior + leaf)
- size_t nleafs () const noexcept
Number of leaf.
- size_t nterms () const
Number of terms included.
- size_t support_size () const noexcept
Number of unique sets of sufficient stats.
- std::vector< size_t > nannotations () const noexcept
Number of annotations.
- std::vector< std::string > colnames () const
Names of the terms in the model.
- size_t 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 leafs.</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< size_t >* &preorder)
- *std::vector< std::vector< double > >* [predict_exhaust_backend](#) (*const* *std::vector< double >* &par, *const* *std::vector< size_t >* &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](#), *size_t* 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](#) * [get_counters\(\)](#)
- [PhyloModel](#) * [get_model\(\)](#)
- [PhyloSupport](#) * [get_support_fun\(\)](#)

Public Attributes

- *size_t* [nfunctions](#)
- *std::map< size_t, Node >* [nodes](#)
- *barry::MapVec_type< size_t >* [map_to_state_id](#)
- *std::vector< std::vector< std::vector< size_t > > >* [pset_loc](#)
Locations of columns.
- *std::vector< size_t >* [sequence](#)
- *std::vector< size_t >* [reduced_sequence](#)
- bool [initialized](#) = [false](#)
- bool [delete_engine](#) = [false](#)
- bool [delete_support](#) = [false](#)

Static Public Attributes

- static *const* *size_t* [etype_default](#) = 1ul
- static *const* *size_t* [etype_speciation](#) = 0ul
- static *const* *size_t* [etype_duplication](#) = 1ul
- static *const* *size_t* [etype_either](#) = 2ul

8.28.1 Detailed Description

Annotated Phylo [Model](#).

A list of available terms for this model can be found in the [Phylo counters](#) section.

Class representing a phylogenetic tree model with annotations.

The [Geese](#) class represents a phylogenetic tree model with annotations. It includes a total of $N + 1$ nodes, the $+ 1$ being the root node. The class provides methods for initializing the model, calculating the likelihood, simulating trees, and making predictions.

The class includes shared objects within a [Geese](#) object, such as `rengine`, `model`, `states`, `n_zeros`, `n_ones`, `n_dupl_events`, and `n_spec_events`. It also includes information about the type of event, such as `etype_default`, `etype_speciation`, `etype_duplication`, and `etype_either`.

The class provides constructors, a destructor, and methods for initializing the model, inheriting support, calculating the sequence, calculating the reduced sequence, calculating the likelihood, calculating the likelihood exhaustively, getting probabilities, setting the seed, simulating trees, parsing polytomies, getting observed counts, printing observed counts, printing information about the GEESE, and making predictions.

See also

[Flock](#)

Definition at line 104 of file `geese-bones.hpp`.

8.28.2 Constructor & Destructor Documentation

8.28.2.1 Geese() [1/4]

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

Definition at line 6 of file `geese-meat-constructors.hpp`.

8.28.2.2 Geese() [2/4]

```
Geese::Geese (
    std::vector< std::vector< size_t > > & annotations,
    std::vector< size_t > & geneid,
    std::vector< int > & parent,
    std::vector< bool > & duplication ) [inline]
```

Definition at line 20 of file `geese-meat-constructors.hpp`.

8.28.2.3 Geese() [3/4]

```
Geese::Geese (
    const Geese & model_,
    bool copy_data = true ) [inline]
```

Definition at line 218 of file geese-meat-constructors.hpp.

8.28.2.4 Geese() [4/4]

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

Definition at line 297 of file geese-meat-constructors.hpp.

8.28.2.5 ~Geese()

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

Definition at line 119 of file geese-meat.hpp.

8.28.3 Member Function Documentation

8.28.3.1 calc_reduced_sequence()

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

Definition at line 358 of file geese-meat.hpp.

8.28.3.2 calc_sequence()

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

Definition at line 314 of file geese-meat.hpp.

8.28.3.3 colnames()

```
std::vector< std::string > Geese::colnames ( ) const [inline]
```

Names of the terms in the model.

Definition at line 480 of file geese-meat.hpp.

8.28.3.4 get_annotated_nodes()

```
std::vector< size_t > Geese::get_annotated_nodes ( ) const [inline]
```

Returns the ids of the nodes with at least one annotation.

Definition at line 769 of file geese-meat.hpp.

8.28.3.5 get_counters()

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

Definition at line 752 of file geese-meat.hpp.

8.28.3.6 get_model()

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

Definition at line 757 of file geese-meat.hpp.

8.28.3.7 get_probabilities()

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

Definition at line 406 of file geese-meat.hpp.

8.28.3.8 get_rengine()

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

Definition at line 747 of file geese-meat.hpp.

8.28.3.9 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 765 of file `geese-meat.hpp`.

8.28.3.10 get_support_fun()

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

Definition at line 761 of file `geese-meat.hpp`.

8.28.3.11 inherit_support()

```
void Geese::inherit_support (
    const Geese & model_,
    bool delete_support_ = false ) [inline]
```

Definition at line 257 of file `geese-meat.hpp`.

8.28.3.12 init()

```
void Geese::init (
    size_t bar_width = BARRY_PROGRESS_BAR_WIDTH ) [inline]
```

Definition at line 131 of file `geese-meat.hpp`.

8.28.3.13 init_node()

```
void Geese::init_node (
    Node & n ) [inline]
```

Definition at line 6 of file `geese-meat.hpp`.

8.28.3.14 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.

8.28.3.15 likelihood_exhaust()

```
double Geese::likelihood_exhaust (
    const std::vector< double > & par ) [inline]
```

Definition at line 7 of file geese-meat-likelihood_exhaust.hpp.

8.28.3.16 nannotations()

```
std::vector< size_t > Geese::nannotations ( ) const [inline], [noexcept]
```

Number of annotations.

Definition at line 471 of file geese-meat.hpp.

8.28.3.17 nfuncs()

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

Number of functions analyzed.

Definition at line 427 of file geese-meat.hpp.

8.28.3.18 nleafs()

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

Number of leaf.

Definition at line 441 of file geese-meat.hpp.

8.28.3.19 nnodes()

```
size_t Geese::nnodes ( ) const [inline], [noexcept]
```

Number of nodes (interior + leaf)

Definition at line 434 of file geese-meat.hpp.

8.28.3.20 nterms()

```
size_t Geese::nterms ( ) const [inline]
```

Number of terms included.

Definition at line 453 of file geese-meat.hpp.

8.28.3.21 observed_counts()

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

Definition at line 522 of file geese-meat.hpp.

8.28.3.22 operator=() [1/2]

```
Geese& Geese::operator= (
    const Geese & model_ ) [delete]
```

8.28.3.23 operator=() [2/2]

```
Geese& Geese::operator= (
    Geese && model_ ) [delete], [noexcept]
```

8.28.3.24 parse_polytomies()

```
size_t Geese::parse_polytomies (
    bool verb = true,
    std::vector< size_t > * dist = nullptr ) const [inline], [noexcept]
```

Check polytomies and return the largest.

Definition at line 487 of file geese-meat.hpp.

8.28.3.25 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 262 of file geese-meat-predict.hpp.

8.28.3.26 predict_backend()

```
std::vector< std::vector< double > > Geese::predict_backend (
    const std::vector< double > & par,
    bool use_reduced_sequence,
    const std::vector< size_t > & preorder ) [inline]
```

< True if the array belongs to the set

Definition at line 6 of file geese-meat-predict.hpp.

8.28.3.27 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.

8.28.3.28 predict_exhaust_backend()

```
std::vector< std::vector< double > > Geese::predict_exhaust_backend (
    const std::vector< double > & par,
    const std::vector< size_t > & preorder ) [inline]
```

Definition at line 47 of file geese-meat-predict_exhaust.hpp.

8.28.3.29 predict_sim()

```
std::vector< std::vector< double > > Geese::predict_sim (
    const std::vector< double > & par,
    bool only_annotated = false,
    size_t nsims = 10000u ) [inline]
```

Definition at line 6 of file geese-meat-predict_sim.hpp.

8.28.3.30 print()

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

Prints information about the GEESE.

Definition at line 656 of file geese-meat.hpp.

8.28.3.31 print_nodes()

```
void Geese::print_nodes ( ) const [inline]
```

Definition at line 674 of file geese-meat.hpp.

8.28.3.32 print_observed_counts()

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

Definition at line 593 of file geese-meat.hpp.

8.28.3.33 set_seed()

```
void Geese::set_seed (
    const size_t & s ) [inline]
```

Definition at line 4 of file geese-meat-simulate.hpp.

8.28.3.34 simulate()

```
std::vector< std::vector< size_t > > Geese::simulate (
    const std::vector< double > & par ) [inline]
```

Definition at line 8 of file geese-meat-simulate.hpp.

8.28.3.35 support_size()

```
size_t Geese::support_size ( ) const [inline], [noexcept]
```

Number of unique sets of sufficient stats.

Definition at line 461 of file geese-meat.hpp.

8.28.3.36 update_annotations()

```
void Geese::update_annotations (
    size_t nodeid,
    std::vector< size_t > newann ) [inline]
```

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

8.28.4 Member Data Documentation

8.28.4.1 delete_engine

```
bool Geese::delete_engine = false
```

Definition at line 143 of file geese-bones.hpp.

8.28.4.2 delete_support

```
bool Geese::delete_support = false
```

Definition at line 144 of file geese-bones.hpp.

8.28.4.3 etype_default

```
const size_t Geese::etype_default = 1ul [static]
```

Definition at line 157 of file geese-bones.hpp.

8.28.4.4 etype_duplication

```
const size_t Geese::etype_duplication = 1ul [static]
```

Definition at line 159 of file geese-bones.hpp.

8.28.4.5 etype_either

```
const size_t Geese::etype_either = 2ul [static]
```

Definition at line 160 of file geese-bones.hpp.

8.28.4.6 etype_speciation

```
const size_t Geese::etype_speciation = 0ul [static]
```

Definition at line 158 of file geese-bones.hpp.

8.28.4.7 initialized

```
bool Geese::initialized = false
```

Definition at line 142 of file geese-bones.hpp.

8.28.4.8 map_to_state_id

```
barry::MapVec_type< size_t > Geese::map_to_state_id
```

Definition at line 134 of file geese-bones.hpp.

8.28.4.9 nfunctions

```
size_t Geese::nfunctions
```

Definition at line 131 of file geese-bones.hpp.

8.28.4.10 nodes

```
std::map< size_t, Node > Geese::nodes
```

Definition at line 132 of file geese-bones.hpp.

8.28.4.11 pset_loc

```
std::vector< std::vector< std::vector< size_t > > > Geese::pset_loc
```

Locations of columns.

Definition at line 135 of file geese-bones.hpp.

8.28.4.12 reduced_sequence

```
std::vector< size_t > Geese::reduced_sequence
```

Definition at line 139 of file geese-bones.hpp.

8.28.4.13 sequence

```
std::vector< size_t > Geese::sequence
```

Definition at line 138 of file geese-bones.hpp.

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

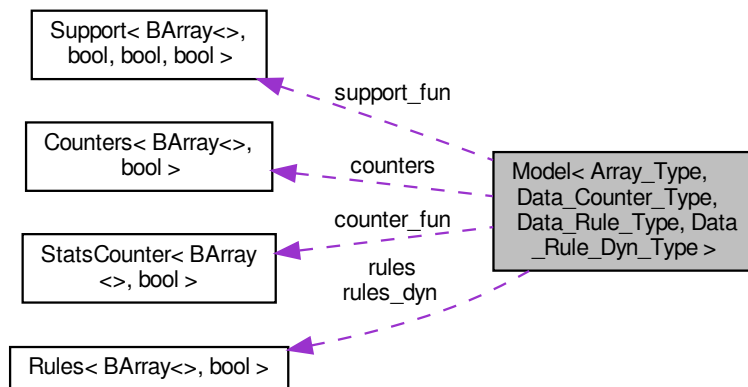
- [include/barry/models/geese/geese-bones.hpp](#)
- [include/barry/models/geese/geese-meat-constructors.hpp](#)
- [include/barry/models/geese/geese-meat-likelihood.hpp](#)
- [include/barry/models/geese/geese-meat-likelihood_exhaust.hpp](#)
- [include/barry/models/geese/geese-meat-predict.hpp](#)
- [include/barry/models/geese/geese-meat-predict_exhaust.hpp](#)
- [include/barry/models/geese/geese-meat-predict_sim.hpp](#)
- [include/barry/models/geese/geese-meat-simulate.hpp](#)
- [include/barry/models/geese/geese-meat.hpp](#)

8.29 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>
```

Collaboration diagram for Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >:



Public Member Functions

- void `set_engine` (std::mt19937 *engine_, bool delete_=false)
- void `set_seed` (size_t s)
- `Model` ()
- `Model` (size_t 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_)
- virtual `~Model` ()
- void `store_psets` () noexcept
- std::vector< double > `gen_key` (const Array_Type &Array_)
- size_t `add_array` (const Array_Type &Array_, bool force_new=false)
Adds an array to the support of not already included.
- void `print_stats` (size_t i) const
- virtual void `print` () const
Prints information about the model.
- Array_Type `sample` (const Array_Type &Array_, const std::vector< double > ¶ms={})
- Array_Type `sample` (const size_t &i, const std::vector< double > ¶ms)
- double `conditional_prob` (const Array_Type &Array_, const std::vector< double > ¶ms, size_t i, size_t 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 `Counters` 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 `Rules` member.

These will add rules to the model, which are shared by the support and the actual counter function.

- void [add_rule](#) ([Rule](#)< Array_Type, [Data_Rule_Type](#) > &rule)
- void [add_rule](#) ([Rule_fun_type](#)< Array_Type, [Data_Rule_Type](#) > count_fun_, [Data_Rule_Type](#) data_)
- void [set_rules](#) ([Rules](#)< Array_Type, [Data_Rule_Type](#) > *rules_)
- void [add_rule_dyn](#) ([Rule](#)< Array_Type, [Data_Rule_Dyn_Type](#) > &rule)
- void [add_rule_dyn](#) ([Rule_fun_type](#)< Array_Type, [Data_Rule_Dyn_Type](#) > count_fun_, [Data_Rule_Dyn_Type](#) data_)
- void [set_rules_dyn](#) ([Rules](#)< Array_Type, [Data_Rule_Dyn_Type](#) > *rules_)

Likelihood functions.

Calculation of likelihood functions is done reusing normalizing constants. Before recalculating the normalizing constant, the function checks whether `params` matches the last set vector of parameters used to compute it.

Parameters

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

- double [likelihood](#) (const std::vector< double > ¶ms, const size_t &i, bool as_log=false)
- double [likelihood](#) (const std::vector< double > ¶ms, const [Array_Type](#) &Array_, int i=-1, bool as_log=false)
- double [likelihood](#) (const std::vector< double > ¶ms, const std::vector< double > &target_, const size_t &i, bool as_log=false)
- double [likelihood](#) (const std::vector< double > ¶ms, const double *target_, const size_t &i, bool as_log=false)
- double [likelihood_total](#) (const std::vector< double > ¶ms, 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 <code>true</code> returns the logged version of the normalizing constant.

- double [get_norm_const](#) (const std::vector< double > ¶ms, const size_t &i, bool as_log=false)
- const std::vector< [Array_Type](#) > * [get_pset](#) (const size_t &i)
- const std::vector< double > * [get_pset_stats](#) (const size_t &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.

- `size_t size()` `const noexcept`
 - `size_t size_unique()` `const noexcept`
 - `size_t nterms()` `const noexcept`
 - `size_t nrules()` `const noexcept`
 - `size_t nrules_dyn()` `const noexcept`
 - `size_t 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< size_t > * 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 *, size_t)> fun, std::vector< std::string > names)`
Set the transform_model_fun object.
 - `std::vector< double > transform_model(double *data, size_t k)`

Protected Attributes

- `MapVec_type< double, size_t > keys2support`
Map of types of arrays to support sets.
- `std::vector< std::vector< double > > params_last`
Vector of the previously used parameters.
- `std::vector< double > normalizing_constants`
- `std::vector< bool > first_calc_done`
- `bool delete_counters = false`
- `bool delete_rules = false`
- `bool delete_rules_dyn = false`
- `std::function< std::vector< double >(double *, size_t k)> transform_model_fun = nullptr`
Transformation of the model.
- `std::vector< std::string > transform_model_term_names`

Random number generation*Random number generation*

- `std::mt19937 * rengine = nullptr`
- `bool delete_rengine = false`

Information about the arrays used in the model

stats_target holds the observed sufficient statistics for each array in the dataset. *array_↔ frequency* contains the frequency with which each of the target *stats_target* (arrays) shows in the support. *array2support* maps array indices (0, 1, ...) to the corresponding support.

Each vector of *stats_support* has the data stored in a row-wise order, with each row starting with the weights, e.g., in a model with k terms the first $k + 1$ elements of *stats_support* would be:

- *weights*
- *term 1*
- *term 2*
- ...
- *term k*
- `std::vector< std::vector< double > > stats_support`
Sufficient statistics of the model (support)
- `std::vector< size_t > stats_support_n_arrays`
Number of arrays included per support.
- `std::vector< std::vector< double > > stats_target`
Target statistics of the model.
- `std::vector< size_t > arrays2support`

Container space for the powerset (and its sufficient stats_target)

This is useful in the case of using simulations or evaluating functions that need to account for the full set of states.

- `bool with_pset = false`
- `std::vector< std::vector< Array_Type > > pset_arrays`
Arrays of the support(s)
- `std::vector< std::vector< double > > pset_stats`
Statistics of the support(s)
- `std::vector< std::vector< double > > pset_probs`
Probabilities of the support(s)

Functions to compute statistics

Arguments are recycled to save memory and computation.

- `Counters< Array_Type, Data_Counter_Type > * counters`
- `Rules< Array_Type, Data_Rule_Type > * rules`
- `Rules< Array_Type, Data_Rule_Dyn_Type > * rules_dyn`
- `Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type > support_fun`
- `StatsCounter< Array_Type, Data_Counter_Type > counter_fun`

8.29.1 Detailed Description

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename
Data_Rule_Dyn_Type = bool>
class Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >
```

General framework for discrete exponential models. This class allows generating discrete exponential models in the form of a linear exponential model:

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

This implementation aims to reduce the number of times that the support needs to be computed. Models included here use more than a single array, and thus allow the function to recycle support sets as needed. For example, if we are looking at directed graphs all of the same size and without vertex level features, i.e. a model that only counts edges, triangles, etc. then the support needs to be fully computed only once.

Template Parameters

<i>Array_Type</i>	Class of BArray object.
<i>Data_Counter_Type</i>	Any type.
<i>Data_Rule_Type</i>	Any type.

Definition at line 34 of file model-bones.hpp.

8.29.2 Constructor & Destructor Documentation

8.29.2.1 Model() [1/3]

```
template<typename Array_Type , typename Data_Counter_Type , typename Data_Rule_Type , typename
Data_Rule_Dyn_Type >
Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::Model [inline]
```

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

8.29.2.2 Model() [2/3]

```
template<typename Array_Type , typename Data_Counter_Type , typename Data_Rule_Type , typename
Data_Rule_Dyn_Type >
Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::Model (
    size_t size_ ) [inline]
```

Definition at line 166 of file model-meat.hpp.

8.29.2.3 Model() [3/3]

```
template<typename Array_Type , typename Data_Counter_Type , typename Data_Rule_Type , typename
Data_Rule_Dyn_Type >
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_ ) [inline]
```

Definition at line 204 of file model-meat.hpp.

8.29.2.4 ~Model()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
virtual Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::~~Model (
) [inline], [virtual]
```

Definition at line 159 of file model-bones.hpp.

8.29.3 Member Function Documentation

8.29.3.1 add_array()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t 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.

8.29.3.2 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 )
```

8.29.3.3 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 )
```

8.29.3.4 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_ )
```

8.29.3.5 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 )
```

8.29.3.6 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_ )
```

8.29.3.7 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 )
```

8.29.3.8 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_ )
```

8.29.3.9 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
```

8.29.3.10 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,
    size_t i,
    size_t 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

8.29.3.11 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_ )
```

8.29.3.12 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< size_t >* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::get_arrays2support ( )
```

8.29.3.13 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 ( )
```

8.29.3.14 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 size_t & i,
    bool as_log = false )
```


8.29.3.15 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 size_t & i )
```

8.29.3.16 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 ( )
```

8.29.3.17 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 ( )
```

8.29.3.18 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)

8.29.3.19 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 size_t & i )
```

8.29.3.20 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
```

8.29.3.21 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 ( )
```

8.29.3.22 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 ( )
```

8.29.3.23 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 ( )
```

8.29.3.24 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.

8.29.3.25 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 ( )
```

8.29.3.26 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 )
```

8.29.3.27 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 size_t & i,
    bool as_log = false )
```

8.29.3.28 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 size_t & i,
    bool as_log = false )
```

8.29.3.29 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 std::vector< double > & target_,
    const size_t & i,
    bool as_log = false )
```

8.29.3.30 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 )
```

8.29.3.31 nrules()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::nrules ( )
const [noexcept]
```

8.29.3.32 nrules_dyn()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::nrules_dyn
( ) const [noexcept]
```

8.29.3.33 nterms()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::nterms ( )
const [noexcept]
```

8.29.3.34 operator=()

```
template<typename Array_Type , typename Data_Counter_Type , typename Data_Rule_Type , typename
Data_Rule_Dyn_Type >
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_ ) [inline]
```

Definition at line 248 of file model-meat.hpp.

8.29.3.35 print()

```
template<typename Array_Type , typename Data_Counter_Type , typename Data_Rule_Type , typename
Data_Rule_Dyn_Type >
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::print [inline],
[virtual]
```

Prints information about the model.

Definition at line 971 of file model-meat.hpp.

8.29.3.36 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 (
    size_t i ) const
```

8.29.3.37 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 = {} )
```

8.29.3.38 sample() [2/2]

```
template<typename Array_Type , typename Data_Counter_Type , typename Data_Rule_Type , typename
Data_Rule_Dyn_Type >
Array_Type Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::sample
(
    const size_t & i,
    const std::vector< double > & params ) [inline]
```

Definition at line 1098 of file model-meat.hpp.

8.29.3.39 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_ )
```

8.29.3.40 set_engine()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
void Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::set_engine (
    std::mt19937 * rengine_,
    bool delete_ = false ) [inline]
```

Definition at line 129 of file model-bones.hpp.

8.29.3.41 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_ )
```

8.29.3.42 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_ )
```

8.29.3.43 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 (
    size_t s ) [inline]
```

Definition at line 139 of file model-bones.hpp.

8.29.3.44 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 *, size_t)> 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>	

8.29.3.45 size()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::size ( )
const [noexcept]
```

8.29.3.46 size_unique()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::size_unique
( ) const [noexcept]
```

8.29.3.47 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]
```

8.29.3.48 support_size()

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::support_↵
size ( ) const [noexcept]
```

8.29.3.49 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,
    size_t k )
```

8.29.4 Member Data Documentation

8.29.4.1 arrays2support

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< size_t > Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_↵
Type >::arrays2support [protected]
```

Definition at line 65 of file model-bones.hpp.

8.29.4.2 counter_fun

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
StatsCounter<Array_Type,Data_Counter_Type> Model< Array_Type, Data_Counter_Type, Data_Rule_Type,
Data_Rule_Dyn_Type >::counter_fun [protected]
```

Definition at line 95 of file model-bones.hpp.

8.29.4.3 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 >::counters [protected]
```

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

8.29.4.4 delete_counters

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵  
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>  
bool Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::delete_↵  
counters = false [protected]
```

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

8.29.4.5 delete_rengine

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵  
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>  
bool Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::delete_↵  
rengine = false [protected]
```

Definition at line 43 of file model-bones.hpp.

8.29.4.6 delete_rules

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵  
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>  
bool Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::delete_rules  
= false [protected]
```

Definition at line 104 of file model-bones.hpp.

8.29.4.7 delete_rules_dyn

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵  
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>  
bool Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::delete_↵  
rules_dyn = false [protected]
```

Definition at line 105 of file model-bones.hpp.

8.29.4.8 first_calc_done

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< bool > Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type
>::first_calc_done [protected]
```

Definition at line 101 of file model-bones.hpp.

8.29.4.9 keys2support

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_↵
Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
MapVec_type< double, size_t > Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_↵
Rule_Dyn_Type >::keys2support [protected]
```

Map of types of arrays to support sets.

This is of the same length as the vector stats_target.

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

8.29.4.10 normalizing_constants

```
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 >::normalizing_constants [protected]
```

Definition at line 100 of file model-bones.hpp.

8.29.4.11 params_last

```
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 >::params_last [protected]
```

Vector of the previously used parameters.

Definition at line 99 of file model-bones.hpp.

8.29.4.12 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 >::pset_arrays [protected]
```

Arrays of the support(s)

Definition at line 81 of file model-bones.hpp.

8.29.4.13 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 >::pset_probs [protected]
```

Probabilities of the support(s)

Definition at line 83 of file model-bones.hpp.

8.29.4.14 pset_stats

```
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 >::pset_stats [protected]
```

Statistics of the support(s)

Definition at line 82 of file model-bones.hpp.

8.29.4.15 rengine

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::mt19937* Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::rengine = nullptr [protected]
```

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

8.29.4.16 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 >::rules [protected]
```

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

8.29.4.17 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 >::rules_dyn [protected]
```

Definition at line 93 of file model-bones.hpp.

8.29.4.18 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 >::stats_support [protected]
```

Sufficient statistics of the model (support)

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

8.29.4.19 stats_support_n_arrays

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::vector< size_t > Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::stats_support_n_arrays [protected]
```

Number of arrays included per support.

Definition at line 63 of file model-bones.hpp.

8.29.4.20 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 >::stats_target [protected]
```

Target statistics of the model.

Definition at line 64 of file model-bones.hpp.

8.29.4.21 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 >::support_fun [protected]
```

Definition at line 94 of file model-bones.hpp.

8.29.4.22 transform_model_fun

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
std::function<std::vector<double>double *, size_t k>> Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::transform_model_fun = nullptr [protected]
```

Transformation of the model.

When specified, this function will update the model by modifying the linear equation. For example, if the user wanted to add interaction terms, rescale, or apply other operations of the sorts, the user can do such through this function.

The function should return `void` and receive the following arguments:

- `data` Pointer to the first element of the set of sufficient statistics
- `k` `size_t` indicating the number of sufficient statistics

Returns

Nothing, but it will modify the model data.

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

8.29.4.23 transform_model_term_names

```
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 >::transform_model_term_names [protected]
```

Definition at line 125 of file model-bones.hpp.

8.29.4.24 with_pset

```
template<typename Array_Type = BArray<>, typename Data_Counter_Type = bool, typename Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
bool Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::with_pset = false [protected]
```

Definition at line 80 of file model-bones.hpp.

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

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

8.30 NetCounterData Class Reference

Data class used to store arbitrary size_t or double vectors.

```
#include <network.hpp>
```

Public Member Functions

- [NetCounterData](#) ()
- [NetCounterData](#) (const std::vector< size_t > indices_, const std::vector< double > numbers_)
- [~NetCounterData](#) ()

Public Attributes

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

8.30.1 Detailed Description

Data class used to store arbitrary size_t or double vectors.

Definition at line 56 of file network.hpp.

8.30.2 Constructor & Destructor Documentation

8.30.2.1 NetCounterData() [1/2]

```
NetCounterData::NetCounterData ( ) [inline]
```

Definition at line 62 of file network.hpp.

8.30.2.2 NetCounterData() [2/2]

```
NetCounterData::NetCounterData (
    const std::vector< size_t > indices_,
    const std::vector< double > numbers_ ) [inline]
```

Definition at line 63 of file network.hpp.

8.30.2.3 ~NetCounterData()

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

Definition at line 68 of file network.hpp.

8.30.3 Member Data Documentation

8.30.3.1 indices

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

Definition at line 59 of file network.hpp.

8.30.3.2 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](#)

8.31 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](#)

8.31.1 Detailed Description

Data class for Networks.

Details on the available counters for [NetworkData](#) can be found in the [Network 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](#).

8.31.2 Constructor & Destructor Documentation

8.31.2.1 NetworkData() [1/3]

```
NetworkData::NetworkData ( ) [inline]
```

Definition at line 25 of file [network.hpp](#).

8.31.2.2 NetworkData() [2/3]

```
NetworkData::NetworkData (
    std::vector< double > vertex_attr_,
    bool directed_ = true ) [inline]
```

Constructor using a single attribute.

Parameters

<i>vertex_↔ attr_</i>	Double vector of length equal to the number of vertices in the data.
<i>directed_</i>	When <code>true</code> the graph as treated as directed.

Definition at line 33 of file network.hpp.

8.31.2.3 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.

8.31.2.4 ~NetworkData()

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

Definition at line 51 of file network.hpp.

8.31.3 Member Data Documentation

8.31.3.1 directed

```
bool NetworkData::directed = true
```

Definition at line 22 of file network.hpp.

8.31.3.2 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](#)

8.32 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
- size_t [noffspring](#) () const noexcept
- bool [is_leaf](#) () const noexcept

Construct a new Node object

- [Node](#) ()
- [Node](#) (size_t id_, size_t ord_, bool duplication_)
- [Node](#) (size_t id_, size_t ord_, std::vector< size_t > annotations_, bool duplication_)
- [Node](#) (Node &&x) noexcept
- [Node](#) (const Node &x)

Public Attributes

- `size_t` `id`
Id of the node (as specified in the input)
- `size_t` `ord`
Order in which the node was created.
- `PhyloArray` `array`
Array of the node.
- `std::vector< size_t >` `annotations`
Observed annotations (only defined for [Geese](#))
- `bool` `duplication`
- `std::vector< PhyloArray >` `arrays` = {}
Arrays given all possible states.
- `Node *` `parent` = nullptr
Parent node.
- `std::vector< Node * >` `offspring` = {}
Offspring nodes.
- `std::vector< size_t >` `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.

8.32.1 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`.

8.32.2 Constructor & Destructor Documentation

8.32.2.1 `Node()` [1/5]

```
Node::Node ( ) [inline]
```

Definition at line 37 of file `geese-node-bones.hpp`.

8.32.2.2 Node() [2/5]

```
Node::Node (
    size_t id_,
    size_t ord_,
    bool duplication_ ) [inline]
```

Definition at line 57 of file geese-node-bones.hpp.

8.32.2.3 Node() [3/5]

```
Node::Node (
    size_t id_,
    size_t ord_,
    std::vector< size_t > annotations_,
    bool duplication_ ) [inline]
```

Definition at line 63 of file geese-node-bones.hpp.

8.32.2.4 Node() [4/5]

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

Definition at line 70 of file geese-node-bones.hpp.

8.32.2.5 Node() [5/5]

```
Node::Node (
    const Node & x ) [inline]
```

Definition at line 85 of file geese-node-bones.hpp.

8.32.2.6 ~Node()

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

Definition at line 48 of file geese-node-bones.hpp.

8.32.3 Member Function Documentation

8.32.3.1 get_parent()

```
int Node::get_parent ( ) const [inline]
```

Definition at line 100 of file geese-node-bones.hpp.

8.32.3.2 is_leaf()

```
bool Node::is_leaf ( ) const [inline], [noexcept]
```

Definition at line 112 of file geese-node-bones.hpp.

8.32.3.3 noffspring()

```
size_t Node::noffspring ( ) const [inline], [noexcept]
```

Definition at line 106 of file geese-node-bones.hpp.

8.32.4 Member Data Documentation

8.32.4.1 annotations

```
std::vector< size_t > Node::annotations
```

Observed annotations (only defined for [Geese](#))

Definition at line 18 of file geese-node-bones.hpp.

8.32.4.2 array

```
PhyloArray Node::array
```

Array of the node.

Definition at line 17 of file geese-node-bones.hpp.

8.32.4.3 arrays

```
std::vector< PhyloArray > Node::arrays = {}
```

Arrays given all possible states.

Definition at line 21 of file geese-node-bones.hpp.

8.32.4.4 duplication

```
bool Node::duplication
```

Definition at line 19 of file geese-node-bones.hpp.

8.32.4.5 id

```
size_t Node::id
```

Id of the node (as specified in the input)

Definition at line 14 of file geese-node-bones.hpp.

8.32.4.6 narray

```
std::vector< size_t > Node::narray = {}
```

ID of the array in the model.

Definition at line 25 of file geese-node-bones.hpp.

8.32.4.7 offspring

```
std::vector< Node\* > Node::offspring = {}
```

Offspring nodes.

Definition at line 24 of file geese-node-bones.hpp.

8.32.4.8 ord

```
size_t Node::ord
```

Order in which the node was created.

Definition at line 15 of file geese-node-bones.hpp.

8.32.4.9 parent

```
Node* Node::parent = nullptr
```

Parent node.

Definition at line 23 of file geese-node-bones.hpp.

8.32.4.10 probability

```
std::vector< double > Node::probability
```

The probability of observing each state.

Definition at line 29 of file geese-node-bones.hpp.

8.32.4.11 subtree_prob

```
std::vector< double > Node::subtree_prob
```

Induced subtree probabilities.

Definition at line 28 of file geese-node-bones.hpp.

8.32.4.12 visited

```
bool Node::visited = false
```

Definition at line 26 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](#)

8.33 NodeData Class Reference

Data definition for the `PhyloArray` class.

```
#include <geese-types.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

8.33.1 Detailed Description

Data definition for the `PhyloArray` class.

This holds basic information about a given node.

Definition at line 12 of file `geese-types.hpp`.

8.33.2 Constructor & Destructor Documentation

8.33.2.1 NodeData()

```
NodeData::NodeData (
    const std::vector< double > & blengths_,
    const std::vector< bool > & states_,
    bool duplication_ = true ) [inline]
```

Definition at line 32 of file `geese-types.hpp`.

8.33.3 Member Data Documentation

8.33.3.1 blengths

```
std::vector< double > NodeData::blengths = {}
```

Branch length.

Definition at line 18 of file geese-types.hpp.

8.33.3.2 duplication

```
bool NodeData::duplication = true
```

Definition at line 28 of file geese-types.hpp.

8.33.3.3 states

```
std::vector< bool > NodeData::states = {}
```

State of the parent node.

Definition at line 23 of file geese-types.hpp.

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

- [include/barry/models/geese/geese-types.hpp](#)

8.34 PhyloCounterData Class Reference

```
#include <geese-types.hpp>
```

Public Member Functions

- [PhyloCounterData](#) (std::vector< size_t > [data_](#), std::vector< double > *[counters_](#)=nullptr)
- [PhyloCounterData](#) ()
- size_t [at](#) (size_t d)
- size_t [operator\(\)](#) (size_t d)
- size_t [operator\[\]](#) (size_t d)
- void [reserve](#) (size_t x)
- void [push_back](#) (size_t x)
- void [shrink_to_fit](#) ()
- size_t [size](#) ()
- std::vector< size_t >::iterator [begin](#) ()
- std::vector< size_t >::iterator [end](#) ()
- bool [empty](#) ()
- std::vector< double > * [get_counters](#) ()

8.34.1 Detailed Description

Definition at line 42 of file geese-types.hpp.

8.34.2 Constructor & Destructor Documentation

8.34.2.1 PhyloCounterData() [1/2]

```
PhyloCounterData::PhyloCounterData (
    std::vector< size_t > data_,
    std::vector< double > * counters_ = nullptr ) [inline]
```

Definition at line 48 of file geese-types.hpp.

8.34.2.2 PhyloCounterData() [2/2]

```
PhyloCounterData::PhyloCounterData ( ) [inline]
```

Definition at line 53 of file geese-types.hpp.

8.34.3 Member Function Documentation

8.34.3.1 at()

```
size_t PhyloCounterData::at (
    size_t d ) [inline]
```

Definition at line 55 of file geese-types.hpp.

8.34.3.2 begin()

```
std::vector< size_t >::iterator PhyloCounterData::begin ( ) [inline]
```

Definition at line 63 of file geese-types.hpp.

8.34.3.3 empty()

```
bool PhyloCounterData::empty ( ) [inline]
```

Definition at line 66 of file geese-types.hpp.

8.34.3.4 end()

```
std::vector< size_t >::iterator PhyloCounterData::end ( ) [inline]
```

Definition at line 64 of file geese-types.hpp.

8.34.3.5 get_counters()

```
std::vector< double >* PhyloCounterData::get_counters ( ) [inline]
```

Definition at line 67 of file geese-types.hpp.

8.34.3.6 operator()()

```
size_t PhyloCounterData::operator() (
    size_t d ) [inline]
```

Definition at line 56 of file geese-types.hpp.

8.34.3.7 operator[]()

```
size_t PhyloCounterData::operator[] (
    size_t d ) [inline]
```

Definition at line 57 of file geese-types.hpp.

8.34.3.8 push_back()

```
void PhyloCounterData::push_back (
    size_t x ) [inline]
```

Definition at line 59 of file geese-types.hpp.

8.34.3.9 reserve()

```
void PhyloCounterData::reserve (
    size_t x ) [inline]
```

Definition at line 58 of file geese-types.hpp.

8.34.3.10 shrink_to_fit()

```
void PhyloCounterData::shrink_to_fit ( ) [inline]
```

Definition at line 60 of file geese-types.hpp.

8.34.3.11 size()

```
size_t PhyloCounterData::size ( ) [inline]
```

Definition at line 61 of file geese-types.hpp.

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

- [include/barry/models/geese/geese-types.hpp](#)

8.35 PhyloRuleDynData Class Reference

```
#include <geese-types.hpp>
```

Public Member Functions

- [PhyloRuleDynData](#) ([const](#) std::vector< double > *counts_, size_t pos_, size_t lb_, size_t ub_, size_t duplication_)
- [const](#) double [operator\(\)](#) () [const](#)
- [~PhyloRuleDynData](#) ()

Public Attributes

- [const](#) std::vector< double > * [counts](#)
- size_t [pos](#)
- size_t [lb](#)
- size_t [ub](#)
- size_t [duplication](#)

8.35.1 Detailed Description

Definition at line 71 of file geese-types.hpp.

8.35.2 Constructor & Destructor Documentation

8.35.2.1 PhyloRuleDynData()

```
PhyloRuleDynData::PhyloRuleDynData (
    const std::vector< double > * counts_,
    size_t pos_,
    size_t lb_,
    size_t ub_,
    size_t duplication_ ) [inline]
```

Definition at line 79 of file geese-types.hpp.

8.35.2.2 ~PhyloRuleDynData()

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

Definition at line 93 of file geese-types.hpp.

8.35.3 Member Function Documentation

8.35.3.1 operator()()

```
const double PhyloRuleDynData::operator() ( ) const [inline]
```

Definition at line 88 of file geese-types.hpp.

8.35.4 Member Data Documentation

8.35.4.1 counts

```
const std::vector< double >* PhyloRuleDynData::counts
```

Definition at line 73 of file geese-types.hpp.

8.35.4.2 duplication

```
size_t PhyloRuleDynData::duplication
```

Definition at line 77 of file geese-types.hpp.

8.35.4.3 lb

```
size_t PhyloRuleDynData::lb
```

Definition at line 75 of file geese-types.hpp.

8.35.4.4 pos

```
size_t PhyloRuleDynData::pos
```

Definition at line 74 of file geese-types.hpp.

8.35.4.5 ub

```
size_t PhyloRuleDynData::ub
```

Definition at line 76 of file geese-types.hpp.

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

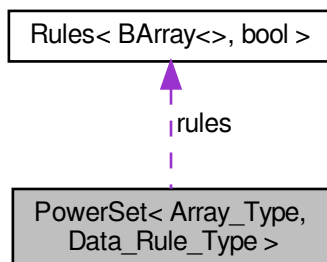
- include/barry/models/geese/[geese-types.hpp](#)

8.36 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](#) (size_t N_, size_t M_)

Construct and destroy a PowerSet object

- [PowerSet](#) ()
- [PowerSet](#) (size_t N_, size_t 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 size_t &i) const

Public Attributes

- Array_Type [EmptyArray](#)
- std::vector< Array_Type > [data](#)
- Rules< Array_Type, Data_Rule_Type > * [rules](#)
- size_t [N](#)
- size_t [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](#)

8.36.1 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.

8.36.2 Constructor & Destructor Documentation

8.36.2.1 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.

8.36.2.2 PowerSet() [2/3]

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
PowerSet< Array_Type, Data_Rule_Type >::PowerSet (
    size_t N_,
    size_t M_ ) [inline]
```

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

8.36.2.3 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.

8.36.2.4 ~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.

8.36.3 Member Function Documentation

8.36.3.1 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.

8.36.3.2 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.

8.36.3.3 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.

8.36.3.4 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.

8.36.3.5 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.

8.36.3.6 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.

8.36.3.7 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.

8.36.3.8 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.

8.36.3.9 operator[]()

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
const Array_Type& PowerSet< Array_Type, Data_Rule_Type >::operator[] (
    const size_t & i ) const [inline]
```

Definition at line 71 of file powerset-bones.hpp.

8.36.3.10 reset()

```
template<typename Array_Type , typename Data_Rule_Type >
void PowerSet< Array_Type, Data_Rule_Type >::reset (
    size_t N_,
    size_t M_ ) [inline]
```

Definition at line 160 of file powerset-meat.hpp.

8.36.3.11 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.

8.36.4 Member Data Documentation

8.36.4.1 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.

8.36.4.2 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.

8.36.4.3 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.

8.36.4.4 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.

8.36.4.5 M

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
size_t PowerSet< Array_Type, Data_Rule_Type >::M
```

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

8.36.4.6 N

```
template<typename Array_Type = BArray<>, typename Data_Rule_Type = bool>
size_t PowerSet< Array_Type, Data_Rule_Type >::N
```

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

8.36.4.7 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.

8.36.4.8 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.

8.36.4.9 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.

8.36.4.10 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

8.37 Progress Class Reference

A simple progress bar.

```
#include <progress.hpp>
```

Public Member Functions

- [Progress](#) (int n_, int width_)
- [~Progress](#) ()
- void [next](#) ()
- void [end](#) ()

8.37.1 Detailed Description

A simple progress bar.

Definition at line 11 of file progress.hpp.

8.37.2 Constructor & Destructor Documentation

8.37.2.1 Progress()

```
Progress::Progress (
    int n_,
    int width_ ) [inline]
```

Definition at line 30 of file progress.hpp.

8.37.2.2 ~Progress()

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

Definition at line 23 of file progress.hpp.

8.37.3 Member Function Documentation

8.37.3.1 end()

```
void Progress::end ( ) [inline]
```

Definition at line 52 of file progress.hpp.

8.37.3.2 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](#)

8.38 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, size_t i, size_t j)
- std::string & [get_name](#) ()
- std::string & [get_description](#) ()
- std::string [get_name](#) () const
- std::string [get_description](#) () const

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_, std::string name_="", std::string desc_="")`

8.38.1 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`.

8.38.2 Constructor & Destructor Documentation**8.38.2.1 Rule() [1/2]**

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

Definition at line 41 of file `rules-bones.hpp`.

8.38.2.2 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_,
    std::string name_ = "",
    std::string desc_ = "" ) [inline]
```

Definition at line 42 of file `rules-bones.hpp`.

8.38.2.3 ~Rule()

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

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

8.38.3 Member Function Documentation

8.38.3.1 D()

```
template<typename Array_Type , typename Data_Type >
Data_Type & Rule< Array_Type, Data_Type >::D [inline]
```

Read/Write access to the data.

Definition at line 37 of file rules-meat.hpp.

8.38.3.2 get_description() [1/2]

```
template<typename Array_Type , typename Data_Type >
std::string & Rule< Array_Type, Data_Type >::get_description [inline]
```

Definition at line 54 of file rules-meat.hpp.

8.38.3.3 get_description() [2/2]

```
template<typename Array_Type , typename Data_Type >
std::string Rule< Array_Type, Data_Type >::get_description [inline]
```

Definition at line 66 of file rules-meat.hpp.

8.38.3.4 get_name() [1/2]

```
template<typename Array_Type , typename Data_Type >
std::string & Rule< Array_Type, Data_Type >::get_name [inline]
```

Definition at line 48 of file rules-meat.hpp.

8.38.3.5 `get_name()` [2/2]

```
template<typename Array_Type , typename Data_Type >
std::string Rule< Array_Type, Data_Type >::get_name [inline]
```

Definition at line 60 of file rules-meat.hpp.

8.38.3.6 `operator()`

```
template<typename Array_Type , typename Data_Type >
bool Rule< Array_Type, Data_Type >::operator() (
    const Array_Type & a,
    size_t i,
    size_t j ) [inline]
```

Definition at line 43 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

8.39 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](#) ()
- size_t [size](#) () const noexcept
- bool [operator\(\)](#) (const Array_Type &a, size_t i, size_t 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.
- std::vector< std::string > [get_names](#) () const
- std::vector< std::string > [get_descriptions](#) () const
- std::vector< [Rule](#)< Array_Type, Data_Type > >::iterator [begin](#) ()
- std::vector< [Rule](#)< Array_Type, Data_Type > >::iterator [end](#) ()

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_](#), std::string [name_](#)="", std::string [description_](#)="")

8.39.1 Detailed Description

```
template<typename Array_Type, typename Data_Type>
class Rules< Array_Type, Data_Type >
```

Vector of objects of class [Rule](#).

Template Parameters

<i>Array_Type</i>	An object of class BArray
<i>Data_Type</i>	Any type.

Definition at line 71 of file rules-bones.hpp.

8.39.2 Constructor & Destructor Documentation**8.39.2.1 Rules() [1/2]**

```
template<typename Array_Type , typename Data_Type >
Rules< Array_Type, Data_Type >::Rules ( ) [inline]
```

Definition at line 77 of file rules-bones.hpp.

8.39.2.2 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.

8.39.2.3 ~Rules()

```
template<typename Array_Type , typename Data_Type >
Rules< Array_Type, Data_Type >::~~Rules ( ) [inline]
```

Definition at line 82 of file rules-bones.hpp.

8.39.3 Member Function Documentation

8.39.3.1 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 72 of file rules-meat.hpp.

8.39.3.2 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_,
    std::string name_ = "",
    std::string description_ = "" ) [inline]
```

Definition at line 82 of file rules-meat.hpp.

8.39.3.3 begin()

```
template<typename Array_Type , typename Data_Type >
std::vector< Rule<Array_Type,Data_Type> >::iterator Rules< Array_Type, Data_Type >::begin (
) [inline]
```

Definition at line 134 of file rules-bones.hpp.

8.39.3.4 end()

```
template<typename Array_Type , typename Data_Type >
std::vector< Rule<Array_Type,Data_Type> >::iterator Rules< Array_Type, Data_Type >::end ( )
[inline]
```

Definition at line 137 of file rules-bones.hpp.

8.39.3.5 `get_descriptions()`

```
template<typename Array_Type , typename Data_Type >
std::vector< std::string > Rules< Array_Type, Data_Type >::get_descriptions  [inline]
```

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

8.39.3.6 `get_names()`

```
template<typename Array_Type , typename Data_Type >
std::vector< std::string > Rules< Array_Type, Data_Type >::get_names  [inline]
```

Definition at line 167 of file rules-meat.hpp.

8.39.3.7 `get_seq()`

```
template<typename Array_Type , typename Data_Type >
void Rules< Array_Type, Data_Type >::get_seq (
    const Array_Type & a,
    std::vector< size_t > * free,
    std::vector< size_t > * locked = nullptr )  [inline]
```

Computes the sequence of free and locked cells in an [BArray](#).

Parameters

<i>a</i>	An object of class BArray .
<i>free</i>	Pointer to a vector of pairs (i, j) listing the free cells.
<i>locked</i>	(optional) Pointer to a vector of pairs (i, j) listing the locked cells.

Returns

Nothing.

Definition at line 117 of file rules-meat.hpp.

8.39.3.8 `operator()()`

```
template<typename Array_Type , typename Data_Type >
bool Rules< Array_Type, Data_Type >::operator() (
    const Array_Type & a,
    size_t i,
    size_t j )  [inline]
```

Check whether a given cell is free or locked.

Parameters

<i>a</i>	A BArray object
<i>i</i>	row position
<i>j</i>	col position

Returns

true If the cell is locked
false If the cell is free

Definition at line 101 of file rules-meat.hpp.

8.39.3.9 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.

8.39.3.10 size()

```
template<typename Array_Type , typename Data_Type >
size_t Rules< Array_Type, Data_Type >::size ( ) const [inline], [noexcept]
```

Definition at line 84 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](#)

8.40 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](#) (size_t [i](#), size_t [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](#) (size_t [i](#), size_t [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](#)

8.40.1 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.

8.40.2 Constructor & Destructor Documentation

8.40.2.1 StatsCounter() [1/3]

```
template<typename Array_Type , typename Data_Type >
StatsCounter< Array_Type, Data_Type >::StatsCounter (
    const Array_Type * Array\_ ) [inline]
```

Creator of a [StatsCounter](#)

Parameters

<i>Array</i> ↔	A const pointer to a BArray .
—	

Definition at line 37 of file statscounter-bones.hpp.

8.40.2.2 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>	
----------------	--

8.40.2.3 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.

8.40.2.4 ~StatsCounter()

```
template<typename Array_Type , typename Data_Type >
StatsCounter< Array_Type, Data_Type >::~StatsCounter ( )
```

8.40.3 Member Function Documentation**8.40.3.1 add_counter()**

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::add_counter (
    Counter< Array_Type, Data_Type > f_ )
```

8.40.3.2 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.

8.40.3.3 count_current()

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::count_current (
    size_t i,
    size_t j )
```

8.40.3.4 count_init()

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::count_init (
    size_t i,
    size_t 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.

8.40.3.5 get_counters()

```
template<typename Array_Type , typename Data_Type >
Counters<Array_Type,Data_Type>* StatsCounter< Array_Type, Data_Type >::get_counters ( )
```

8.40.3.6 get_descriptions()

```
template<typename Array_Type , typename Data_Type >
std::vector< std::string > StatsCounter< Array_Type, Data_Type >::get_descriptions ( ) const
```

8.40.3.7 get_names()

```
template<typename Array_Type , typename Data_Type >
std::vector< std::string > StatsCounter< Array_Type, Data_Type >::get_names ( ) const
```

8.40.3.8 reset_array()

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::reset_array (
    const Array_Type * Array_ )
```

Changes the reference array for the counting.

Parameters

<i>Array_</i> _	A pointer to an array of class <code>Array_Type</code> .
--------------------	--

8.40.3.9 set_counters()

```
template<typename Array_Type , typename Data_Type >
void StatsCounter< Array_Type, Data_Type >::set_counters (
    Counters< Array_Type, Data_Type > * counters_ )
```

8.40.3.10 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

8.41 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](#) (size_t N_, size_t 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, size_t 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 size_t &i, const size_t &j)`

Public Attributes

- `size_t N`

- size_t `M`
- bool `delete_counters` = true
- bool `delete_rules` = true
- bool `delete_rules_dyn` = true
- size_t `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 `cooriantes_n_free`
- size_t `cooriantes_n_locked`
- std::vector< double > `change_stats`
- std::vector< size_t > `hashes`
- std::vector< bool > `hashes_initialized`
- size_t `n_counters`

8.41.1 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.

8.41.2 Constructor & Destructor Documentation

8.41.2.1 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.

8.41.2.2 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 (
    size_t N_,
    size_t M_ ) [inline]
```

Constructor specifying the dimensions of the array (empty).

Definition at line 96 of file support-bones.hpp.

8.41.2.3 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.

8.41.2.4 ~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.

8.41.3 Member Function Documentation

8.41.3.1 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_ )
```

8.41.3.2 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_ )
```

8.41.3.3 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_ )
```

8.41.3.4 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_ )
```

8.41.3.5 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_ )
```

8.41.3.6 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,
    size_t 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.

8.41.3.7 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 size_t & i,
    const size_t & j )
```

8.41.3.8 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.

8.41.3.9 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
```

8.41.3.10 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.

8.41.3.11 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
```

8.41.3.12 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).

8.41.3.13 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).

8.41.3.14 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 )
```

8.41.3.15 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
```

8.41.3.16 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
( )
```

8.41.3.17 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_ )
```

8.41.3.18 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_ )
```

8.41.3.19 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_ )
```

8.41.3.20 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_ )
```

8.41.4 Member Data Documentation

8.41.4.1 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.

8.41.4.2 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.

8.41.4.3 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.

8.41.4.4 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.

8.41.4.5 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.

8.41.4.6 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.

8.41.4.7 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.

8.41.4.8 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.

8.41.4.9 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.

8.41.4.10 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.

8.41.4.11 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.

8.41.4.12 M

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::M
```

Definition at line 68 of file support-bones.hpp.

8.41.4.13 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>
size_t 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.

8.41.4.14 N

```
template<typename Array_Type = BArray<bool, bool>, typename Data_Counter_Type = bool, typename
Data_Rule_Type = bool, typename Data_Rule_Dyn_Type = bool>
size_t Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >::N
```

Definition at line 68 of file support-bones.hpp.

8.41.4.15 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](#)

8.42 vecHasher< T > Struct Template Reference

```
#include <typedefs.hpp>
```

Public Member Functions

- `std::size_t operator()` (`std::vector< T > const &dat`) `const noexcept`

8.42.1 Detailed Description

```
template<typename T>  
struct vecHasher< T >
```

Definition at line 105 of file typedefs.hpp.

8.42.2 Member Function Documentation

8.42.2.1 operator()

```
template<typename T >  
std::size_t vecHasher< T >::operator() (   
    std::vector< T > const & dat ) const [inline], [noexcept]
```

Definition at line 108 of file typedefs.hpp.

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

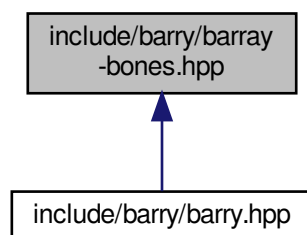
- `include/barry/typedefs.hpp`

Chapter 9

File Documentation

9.1 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.

9.2 include/barry/barray-iterator.hpp File Reference

Classes

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

9.3 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 (size_t i=0u;i< nrow();++i) for(size_t 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`

9.3.1 Macro Definition Documentation

9.3.1.1 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.

9.3.1.2 BARRAY_TEMPLATE_ARGS

```
template BARRAY_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

Definition at line 9 of file barray-meat-operators.hpp.

9.3.1.3 BARRAY_TYPE

```
template Data_Type BARRAY_TYPE( ) BArray<Cell_Type, Data_Type>
```

Definition at line 7 of file barray-meat-operators.hpp.

9.3.1.4 COL

```
#define COL(  
    a )  this->el_ji[a]
```

Definition at line 15 of file barray-meat-operators.hpp.

9.3.1.5 ROW

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

Definition at line 14 of file barray-meat-operators.hpp.

9.3.2 Function Documentation

9.3.2.1 BARRAY_TEMPLATE() [1/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator* ) const &
```

Definition at line 88 of file barray-meat-operators.hpp.

9.3.2.2 BARRAY_TEMPLATE() [2/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator+ ) const
```

9.3.2.3 BARRAY_TEMPLATE() [3/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator+ ) const &
```

Definition at line 46 of file barray-meat-operators.hpp.

9.3.2.4 BARRAY_TEMPLATE() [4/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator- ) const
```

9.3.2.5 BARRAY_TEMPLATE() [5/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator- ) const &
```

Definition at line 75 of file barray-meat-operators.hpp.

9.3.2.6 BARRAY_TEMPLATE() [6/6]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator/ ) const &
```

Definition at line 105 of file barray-meat-operators.hpp.

9.3.2.7 BARRAY_TEMPLATE_ARGS()

```
template BARRAY_TEMPLATE_ARGS ( ) const &
```

9.3.2.8 BARRAY_TYPE()

```
template const BARRAY_TYPE ( ) &
```

Definition at line 20 of file barray-meat-operators.hpp.

9.3.2.9 for()

```
for ( ) = el[POS(i, j)] [pure virtual]
```

Definition at line 66 of file barray-meat-operators.hpp.

9.3.2.10 operator()()

```
j< ncol(); ++j) this-> operator() (
    i ,
    j )
```

9.3.3 Variable Documentation

9.3.3.1 rhs

Data_Type & rhs

Initial value:

```
{  
    checkdim_(*this, rhs)
```

Definition at line 33 of file `barray-meat-operators.hpp`.

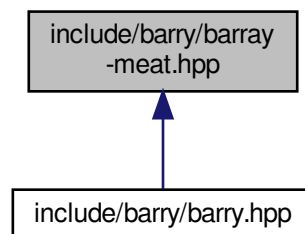
9.3.3.2 this

```
return * this
```

Definition at line 43 of file `barray-meat-operators.hpp`.

9.4 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](#))(size_t N_
- [el_ij](#) [resize](#) (N)
- [el_ji](#) [resize](#) (M)
- [for](#) (size_t 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)(size_t [i](#)
- [BARRAY_TEMPLATE](#) (Cell_Type, get_cell)(size_t [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)(size_t [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](#))(size_t [i](#)
- [if](#) ([check_exists](#))
- [COL](#) ([j](#)).emplace([i](#)
- & [ROW](#) ([i](#))[[j](#)])
- [BARRAY_TEMPLATE](#) (void, swap_cells)(size_t [i0](#)
- [if](#) ([report](#) !=nullptr)(*[report](#))
- [if](#) ([check0](#) &[check1](#))
- [else if](#) (![check0](#) &[check1](#))
- [else if](#) ([check0](#) &![check1](#))
- [BARRAY_TEMPLATE](#) (void, toggle_cell)(size_t [i](#)
- [BARRAY_TEMPLATE](#) (void, swap_rows)(size_t [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)(size_t [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)(size_t [i](#)
- [for](#) (auto [row](#)=[row0.begin](#)();[row](#) !=[row0.end](#)();++[row](#)) [rm_cell](#)([i](#)
- [BARRAY_TEMPLATE](#) (void, zero_col)(size_t [j](#)
- [if](#) ([COL](#)([j](#)).size()==0u) [return](#)
- [BARRAY_TEMPLATE](#) (void, transpose)()
- [BARRAY_TEMPLATE](#) (void, [clear](#))(bool [hard](#))
- [BARRAY_TEMPLATE](#) (void, [resize](#))(size_t N_
- [if](#) ([M](#)< [M](#)) [for](#)(size_t [j](#) = N_

Variables

- size_t `M_`
- size_t `const` std::vector< size_t > & `source`
- size_t `const` std::vector< size_t > `const` std::vector< size_t > & `target`
- size_t `const` std::vector< size_t > `const` std::vector< size_t > `const` std::vector< Cell_Type > & `value`
- size_t `const` std::vector< size_t > `const` std::vector< size_t > `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_`
- size_t `j` `const`
- size_t `j`
- auto `search` = `ROW(i).find(j)`
- `return ans`
- size_t `const` Cell< Cell_Type > & `v`
- size_t `const` Cell< Cell_Type > bool `check_bounds`
- size_t `const` Cell< Cell_Type > bool bool `check_exists`
- `else`
- `NCells`
- size_t `j0`
- size_t size_t `i1`
- size_t size_t size_t `j1`
- size_t size_t size_t bool int int * `report`
- auto `row0` = `ROW(i)`
- row `first`
- row `false`
- auto `col0` = `COL(j)`

9.4.1 Macro Definition Documentation

9.4.1.1 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`.

9.4.1.2 BARRAY_TEMPLATE_ARGS

```
#define BARRAY_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

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

9.4.1.3 BARRAY_TYPE

```
#define BARRAY_TYPE( ) BArray<Cell_Type, Data_Type>
```

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

9.4.1.4 COL

```
#define COL(  
    a ) this->el_ji[a]
```

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

9.4.1.5 ROW

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

Definition at line 20 of file barray-meat.hpp.

9.4.2 Function Documentation

9.4.2.1 ans()

```
std::vector< Cell_Type > ans (  
    ncol() ,  
    (Cell_Type) false )
```

9.4.2.2 BARRAY_TEMPLATE() [1/24]

```
BARRAY_TEMPLATE (  
    BArray ) && [noexcept]
```

Definition at line 230 of file barray-meat.hpp.

9.4.2.3 BARRAY_TEMPLATE() [2/24]

```
BARRAY_TEMPLATE (
    BArray )
```

9.4.2.4 BARRAY_TEMPLATE() [3/24]

```
BARRAY_TEMPLATE (
    ~ BArray )
```

Definition at line 339 of file barray-meat.hpp.

9.4.2.5 BARRAY_TEMPLATE() [4/24]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator- ) const
```

Definition at line 597 of file barray-meat.hpp.

9.4.2.6 BARRAY_TEMPLATE() [5/24]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator ) && [noexcept]
```

Definition at line 272 of file barray-meat.hpp.

9.4.2.7 BARRAY_TEMPLATE() [6/24]

```
BARRAY_TEMPLATE (
    BARRAY_TYPE() & ,
    operator ) const
```

9.4.2.8 BARRAY_TEMPLATE() [7/24]

```
BARRAY_TEMPLATE (
    bool ,
    operator == ) const &
```

Definition at line 321 of file barray-meat.hpp.

9.4.2.9 BARRAY_TEMPLATE() [8/24]

```
BARRAY_TEMPLATE (
    Cell_Type ,
    get_cell )
```

9.4.2.10 BARRAY_TEMPLATE() [9/24]

```
BARRAY_TEMPLATE (
    Data_Type & ,
    D )
```

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

9.4.2.11 BARRAY_TEMPLATE() [10/24]

```
BARRAY_TEMPLATE (
    Data_Type * ,
    D_ptr )
```

Definition at line 361 of file barray-meat.hpp.

9.4.2.12 BARRAY_TEMPLATE() [11/24]

```
BARRAY_TEMPLATE (
    std::vector< Cell_Type > ,
    get_row_vec )
```

9.4.2.13 BARRAY_TEMPLATE() [12/24]

```
BARRAY_TEMPLATE (
    void ,
    clear )
```

Definition at line 1130 of file barray-meat.hpp.

9.4.2.14 BARRAY_TEMPLATE() [13/24]

```
BARRAY_TEMPLATE (
    void ,
    get_row_vec )
```

Definition at line 452 of file barray-meat.hpp.

9.4.2.15 BARRAY_TEMPLATE() [14/24]

```
BARRAY_TEMPLATE (
    void ,
    insert_cell )
```

9.4.2.16 BARRAY_TEMPLATE() [15/24]

```
BARRAY_TEMPLATE (
    void ,
    out_of_range )
```

9.4.2.17 BARRAY_TEMPLATE() [16/24]

```
BARRAY_TEMPLATE (
    void ,
    resize )
```

9.4.2.18 BARRAY_TEMPLATE() [17/24]

```
BARRAY_TEMPLATE (
    void ,
    set_data )
```

9.4.2.19 BARRAY_TEMPLATE() [18/24]

```
BARRAY_TEMPLATE (
    void ,
    swap_cells )
```


9.4.2.20 BARRAY_TEMPLATE() [19/24]

```
BARRAY_TEMPLATE (
    void ,
    swap_cols )
```

9.4.2.21 BARRAY_TEMPLATE() [20/24]

```
BARRAY_TEMPLATE (
    void ,
    swap_rows )
```

9.4.2.22 BARRAY_TEMPLATE() [21/24]

```
BARRAY_TEMPLATE (
    void ,
    toggle_cell )
```

9.4.2.23 BARRAY_TEMPLATE() [22/24]

```
BARRAY_TEMPLATE (
    void ,
    transpose )
```

Definition at line 1069 of file barray-meat.hpp.

9.4.2.24 BARRAY_TEMPLATE() [23/24]

```
BARRAY_TEMPLATE (
    void ,
    zero_col )
```

9.4.2.25 BARRAY_TEMPLATE() [24/24]

```
BARRAY_TEMPLATE (
    void ,
    zero_row )
```

9.4.2.26 COL()

```
COL (
    j )
```

9.4.2.27 for() [1/3]

```
for (
    auto row = row0.begin(); row != row0.end(); ++row )
```

9.4.2.28 for() [2/3]

```
for (
    const auto &iter : rowi, false )
```

9.4.2.29 for() [3/3]

```
for ( )
```

Definition at line 51 of file barray-meat.hpp.

9.4.2.30 if() [1/17]

```
else if (
    !check0 && check1 )
```

Definition at line 1008 of file barray-meat.hpp.

9.4.2.31 if() [2/17]

```
else if (
    !check0 & check1 )
```

Definition at line 856 of file barray-meat.hpp.

9.4.2.32 if() [3/17]

```
if (
    !move0 &&!  move1 )
```

9.4.2.33 if() [4/17]

```
else if (
    check0 &!  check1 )
```

Definition at line 864 of file barray-meat.hpp.

9.4.2.34 if() [5/17]

```
else if (
    check0 &&!  check1 )
```

Definition at line 999 of file barray-meat.hpp.

9.4.2.35 if() [6/17]

```
if (
    check0 &&  check1 )
```

Definition at line 972 of file barray-meat.hpp.

9.4.2.36 if() [7/17]

```
if (
    check0 &  check1 )
```

Definition at line 838 of file barray-meat.hpp.

9.4.2.37 if() [8/17]

```
else if (
    check_exists  ==  CHECK::BOTH )
```

Definition at line 679 of file barray-meat.hpp.

9.4.2.38 if() [9/17]

```
if (
    COL(j).size() == 0u )
```

9.4.2.39 if() [10/17]

```
if (
    COL(j0).size() == 0u )
```

9.4.2.40 if() [11/17]

```
if (
    COL(j1).size() == 0u )
```

9.4.2.41 if() [12/17]

```
if ( ) = N_
```

Definition at line 86 of file barray-meat.hpp.

9.4.2.42 if() [13/17]

```
if (
    report ! == nullptr )
```

9.4.2.43 if() [14/17]

```
if (
    ROW(i).size() == 0u )
```

9.4.2.44 if() [15/17]

```
if (
    ROW(i0).size() == 0u )
```

9.4.2.45 if() [16/17]

```
if (
    ROW(i1).size() == 0u )
```

9.4.2.46 if() [17/17]

```
if (
    search ! = ROW(i).end() ) -> second.value
```

9.4.2.47 M()

```
Data_Type bool M (
    Array_ M )
```

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

9.4.2.48 resize() [1/2]

```
el_ji resize (
    M )
```

9.4.2.49 resize() [2/2]

```
el_ij resize (
    N )
```

9.4.2.50 return()

```
return (
    Cell_Type )
```

9.4.2.51 ROW() [1/2]

```
& ROW (
    i )
```

9.4.2.52 ROW() [2/2]

```
ROW (
    i0 )
```

9.4.3 Variable Documentation**9.4.3.1 add**

```
size_t const std::vector< size_t > const std::vector< size_t > 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.

9.4.3.2 ans

```
return ans
```

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

9.4.3.3 Array_

```
Data_Type & Array_
```

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

9.4.3.4 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.

9.4.3.5 check_exists

size_t bool int check_exists

Initial value:

```
{  
    if (check_bounds)  
        out_of_range(i,j)
```

Definition at line 673 of file barray-meat.hpp.

9.4.3.6 col0

auto col0 = COL(j)

Definition at line 1061 of file barray-meat.hpp.

9.4.3.7 const

size_t 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.

9.4.3.8 copy_data

```
Data_Type bool copy_data
```

Definition at line 135 of file barray-meat.hpp.

9.4.3.9 data

```
data = data_
```

Definition at line 354 of file barray-meat.hpp.

9.4.3.10 delete_data

```
delete_data = delete_data_
```

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

9.4.3.11 delete_data_

```
bool delete_data_
```

Initial value:

```
{  
    if ((data != nullptr) && delete_data)  
        delete data
```

Definition at line 348 of file barray-meat.hpp.

9.4.3.12 else

```
else (  
    void )
```

Initial value:

```
{  
    ROW(i).insert(std::pair< size_t, Cell<Cell_Type>>(j, v))
```

Definition at line 703 of file barray-meat.hpp.

9.4.3.13 false

`row false`

Definition at line 1042 of file barray-meat.hpp.

9.4.3.14 first

`row first`

Definition at line 1042 of file barray-meat.hpp.

9.4.3.15 i1

`size_t i1`

Definition at line 776 of file barray-meat.hpp.

9.4.3.16 j

`size_t j`

Initial value:

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

Definition at line 414 of file barray-meat.hpp.

9.4.3.17 j0

`size_t j0`

Definition at line 775 of file barray-meat.hpp.

9.4.3.18 j1

`size_t j1`

Definition at line 776 of file barray-meat.hpp.

9.4.3.19 M

M = `M_`

Definition at line 44 of file `barray-meat.hpp`.

9.4.3.20 M_

`size_t M_`

Initial value:

```
{
    if (N_ < N)
        for (size_t i = N_; i < N; ++i)
            zero_row(i, false)
```

Definition at line 30 of file `barray-meat.hpp`.

9.4.3.21 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`.

9.4.3.22 NCells

`NCells`

Definition at line 707 of file `barray-meat.hpp`.

9.4.3.23 report

`size_t size_t size_t bool int int* report`

Definition at line 779 of file `barray-meat.hpp`.

9.4.3.24 return

```
return
```

Definition at line 66 of file barray-meat.hpp.

9.4.3.25 row0

```
auto row0 = ROW(i)
```

Definition at line 1040 of file barray-meat.hpp.

9.4.3.26 search

```
auto search = ROW(i).find(j)
```

Definition at line 426 of file barray-meat.hpp.

9.4.3.27 source

```
size_t const std::vector< size_t > & source
```

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

9.4.3.28 target

```
size_t const std::vector< size_t > const std::vector< size_t > & target
```

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

9.4.3.29 v

```
size_t Cell_Type v
```

Definition at line 671 of file barray-meat.hpp.

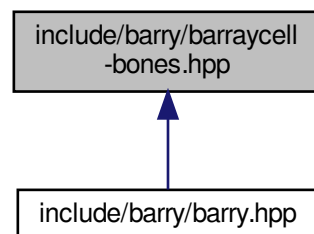
9.4.3.30 value

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

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

9.5 include/barry/barraycell-bones.hpp File Reference

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

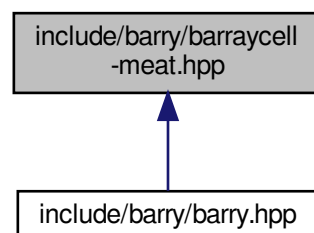


Classes

- class [BArrayCell< Cell_Type, Data_Type >](#)
- class [BArrayCell_const< Cell_Type, Data_Type >](#)

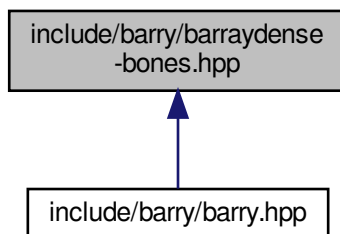
9.6 include/barry/barraycell-meat.hpp File Reference

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



9.7 include/barry/barraydense-bones.hpp File Reference

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

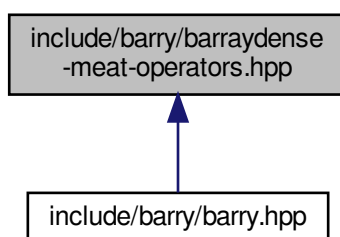


Classes

- class [BArrayDense< Cell_Type, Data_Type >](#)
Baseline class for binary arrays.

9.8 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)

9.8.1 Macro Definition Documentation

9.8.1.1 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`.

9.8.1.2 BDENSE_TEMPLATE_ARGS

```
template BDENSE_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

Definition at line 9 of file `barraydense-meat-operators.hpp`.

9.8.1.3 BDENSE_TYPE

```
template Data_Type BDENSE_TYPE( ) BArrayDense<Cell_Type, Data_Type>
```

Definition at line 7 of file `barraydense-meat-operators.hpp`.

9.8.1.4 COL

```
#define COL(  
    a )  this->el_ji[a]
```

Definition at line 15 of file `barraydense-meat-operators.hpp`.

9.8.1.5 POS

```
#define POS(  
    a,  
    b ) (b)*N + (a)
```

Definition at line 16 of file barraydense-meat-operators.hpp.

9.8.1.6 POS_N

```
#define POS_N(  
    a,  
    b,  
    c ) (b)*(c) + (a)
```

Definition at line 17 of file barraydense-meat-operators.hpp.

9.8.1.7 ROW

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

Definition at line 14 of file barraydense-meat-operators.hpp.

9.8.2 Function Documentation

9.8.2.1 BDENSE_TEMPLATE() [1/4]

```
BDENSE_TEMPLATE (  
    BDENSE_TYPE() & ,  
    operator* ) const &
```

Definition at line 90 of file barraydense-meat-operators.hpp.

9.8.2.2 BDENSE_TEMPLATE() [2/4]

```
BDENSE_TEMPLATE (  
    BDENSE_TYPE() & ,  
    operator+ ) const &
```

Definition at line 34 of file barraydense-meat-operators.hpp.

9.8.2.3 BDENSE_TEMPLATE() [3/4]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator- ) const &
```

Definition at line 61 of file barrydense-meat-operators.hpp.

9.8.2.4 BDENSE_TEMPLATE() [4/4]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator/ ) const &
```

Definition at line 101 of file barrydense-meat-operators.hpp.

9.8.2.5 BDENSE_TEMPLATE_ARGS()

```
template BDENSE_TEMPLATE_ARGS ( ) const &
```

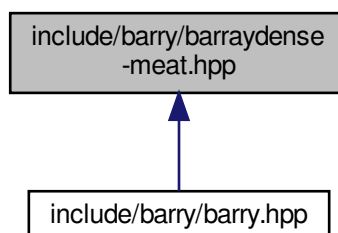
9.8.2.6 BDENSE_TYPE()

```
template const BDENSE_TYPE ( ) &
```

Definition at line 22 of file barrydense-meat-operators.hpp.

9.9 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)(size_t N_`
- `el resize (N *M, ZERO_CELL)`
- `el_rowsums resize (N, ZERO_CELL)`
- `el_colsums resize (M, ZERO_CELL)`
- `for (size_t 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)(size_t i`
- `BDENSE_TEMPLATE (Cell_Type, get_cell)(size_t i`
- `BDENSE_TEMPLATE (std::vector< Cell_Type >, get_row_vec)(size_t 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)(size_t i`
- `BDENSE_TEMPLATE (size_t, nrow)() const noexcept`
- `BDENSE_TEMPLATE (size_t, ncol)() const noexcept`
- `BDENSE_TEMPLATE (size_t, 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)(size_t i`
- `if (el[POS(i, j)]==BARRY_ZERO_DENSE)`
- `BDENSE_TEMPLATE (void, swap_cells)(size_t 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)(size_t i`
- `else rm_cell (i, j, false, false)`
- `BDENSE_TEMPLATE (void, swap_rows)(size_t i0`

- `BDENSE_TEMPLATE` (void, swap_cols)(size_t j0
- `BDENSE_TEMPLATE` (void, zero_row)(size_t i
- `if (el_rowsums[i]==ZERO_CELL) return`
- `BDENSE_TEMPLATE` (void, zero_col)(size_t j
- `if (el_colsums[j]==ZERO_CELL) return`
- `BDENSE_TEMPLATE` (void, transpose)()
- `BDENSE_TEMPLATE` (void, clear)(bool hard)
- `BDENSE_TEMPLATE` (void, resize)(size_t 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)
- `printf_barry` (fmt, args)
- `va_end` (args)
- `BDENSE_TEMPLATE` (const std::vector< Cell_Type > &, get_data)() const
- `BDENSE_TEMPLATE` (const Cell_Type, rowsum)(size_t i) const
- `BDENSE_TEMPLATE` (const Cell_Type, colsum)(size_t j) const

Variables

- size_t M_
- size_t const std::vector< size_t > & source
- size_t const std::vector< size_t > const std::vector< size_t > & target
- size_t const std::vector< size_t > const std::vector< size_t > const std::vector< Cell_Type > & value
- size_t const std::vector< size_t > const std::vector< size_t > 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_
- size_t j const
- size_t j
- `return el [POS(i, j)] == ZERO_CELL`
- return ans
- size_t const Cell< Cell_Type > & v
- size_t const Cell< Cell_Type > bool check_bounds
- size_t const Cell< Cell_Type > bool bool check_exists
- else
- `el_rowsums [i] = (v.value - old)`
- `el_colsums [j] = (v.value - old)`
- size_t j0
- size_t size_t i1
- size_t size_t size_t j1
- size_t size_t size_t bool int int * report
- Cell_Type val0 = el[POS(i0,j0)]
- Cell_Type val1 = el[POS(i1,j1)]
- false
- col

9.9.1 Macro Definition Documentation

9.9.1.1 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.

9.9.1.2 BDENSE_TEMPLATE_ARGS

```
#define BDENSE_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

Definition at line 25 of file barraydense-meat.hpp.

9.9.1.3 BDENSE_TYPE

```
#define BDENSE_TYPE( ) BArrayDense<Cell_Type, Data_Type>
```

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

9.9.1.4 COL

```
#define COL(  
    a )  this->el_ji[a]
```

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

9.9.1.5 POS

```
#define POS(  
    a,  
    b )  (b)*N + (a)
```

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

9.9.1.6 POS_N

```
#define POS_N(  
    a,  
    b,  
    c ) (b)*(c) + (a)
```

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

9.9.1.7 ROW

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

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

9.9.1.8 ZERO_CELL

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

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

9.9.2 Function Documentation

9.9.2.1 ans()

```
std::vector< Cell_Type > ans (  
    ncol() ,  
    static_cast< Cell_Type > false )
```

9.9.2.2 BDENSE_TEMPLATE() [1/39]

```
BDENSE_TEMPLATE (  
    BArrayDense ) && [noexcept]
```

Definition at line 240 of file bararraydense-meat.hpp.

9.9.2.3 BDENSE_TEMPLATE() [2/39]

```
BDENSE_TEMPLATE (
    BArrayDense ) const &
```

9.9.2.4 BDENSE_TEMPLATE() [3/39]

```
BDENSE_TEMPLATE (
    BArrayDense )
```

9.9.2.5 BDENSE_TEMPLATE() [4/39]

```
BDENSE_TEMPLATE (
    ~ BArrayDense )
```

Definition at line 318 of file barraydense-meat.hpp.

9.9.2.6 BDENSE_TEMPLATE() [5/39]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator+ ) const
```

Definition at line 572 of file barraydense-meat.hpp.

9.9.2.7 BDENSE_TEMPLATE() [6/39]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator- ) const
```

Definition at line 590 of file barraydense-meat.hpp.

9.9.2.8 BDENSE_TEMPLATE() [7/39]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator ) && [noexcept]
```

Definition at line 257 of file barraydense-meat.hpp.

9.9.2.9 BDENSE_TEMPLATE() [8/39]

```
BDENSE_TEMPLATE (
    BDENSE_TYPE() & ,
    operator ) const &
```

Definition at line 194 of file bararraydense-meat.hpp.

9.9.2.10 BDENSE_TEMPLATE() [9/39]

```
BDENSE_TEMPLATE (
    bool ,
    is_empty )
```

9.9.2.11 BDENSE_TEMPLATE() [10/39]

```
BDENSE_TEMPLATE (
    bool ,
    operator == ) const &
```

Definition at line 300 of file bararraydense-meat.hpp.

9.9.2.12 BDENSE_TEMPLATE() [11/39]

```
BDENSE_TEMPLATE (
    Cell< Cell_Type > ,
    default_val ) const
```

Definition at line 568 of file bararraydense-meat.hpp.

9.9.2.13 BDENSE_TEMPLATE() [12/39]

```
BDENSE_TEMPLATE (
    Cell_Type ,
    get_cell )
```

9.9.2.14 BDENSE_TEMPLATE() [13/39]

```
BDENSE_TEMPLATE (
    const Cell_Type,
    colsum ) const
```

Definition at line 1005 of file barraydense-meat.hpp.

9.9.2.15 BDENSE_TEMPLATE() [14/39]

```
BDENSE_TEMPLATE (
    const Cell_Type,
    rowsum ) const
```

Definition at line 1000 of file barraydense-meat.hpp.

9.9.2.16 BDENSE_TEMPLATE() [15/39]

```
BDENSE_TEMPLATE (
    const Data_Type & ,
    D ) const
```

Definition at line 353 of file barraydense-meat.hpp.

9.9.2.17 BDENSE_TEMPLATE() [16/39]

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

Definition at line 345 of file barraydense-meat.hpp.

9.9.2.18 BDENSE_TEMPLATE() [17/39]

```
BDENSE_TEMPLATE (
    const std::vector< Cell_Type > & ,
    get_data ) const
```

Definition at line 995 of file barraydense-meat.hpp.

9.9.2.19 BDENSE_TEMPLATE() [18/39]

```
BDENSE_TEMPLATE (
    Data_Type & ,
    D )
```

Definition at line 349 of file bararraydense-meat.hpp.

9.9.2.20 BDENSE_TEMPLATE() [19/39]

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

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

9.9.2.21 BDENSE_TEMPLATE() [20/39]

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

Definition at line 508 of file bararraydense-meat.hpp.

9.9.2.22 BDENSE_TEMPLATE() [21/39]

```
BDENSE_TEMPLATE (
    size_t ,
    ncol ) const [noexcept]
```

Definition at line 554 of file bararraydense-meat.hpp.

9.9.2.23 BDENSE_TEMPLATE() [22/39]

```
BDENSE_TEMPLATE (
    size_t ,
    nnozero ) const [noexcept]
```

Definition at line 558 of file bararraydense-meat.hpp.

9.9.2.24 BDENSE_TEMPLATE() [23/39]

```
BDENSE_TEMPLATE (
    size_t ,
    nrow ) const [noexcept]
```

Definition at line 550 of file barraydense-meat.hpp.

9.9.2.25 BDENSE_TEMPLATE() [24/39]

```
BDENSE_TEMPLATE (
    std::vector< Cell_Type > ,
    get_row_vec )
```

9.9.2.26 BDENSE_TEMPLATE() [25/39]

```
BDENSE_TEMPLATE (
    void ,
    clear )
```

Definition at line 902 of file barraydense-meat.hpp.

9.9.2.27 BDENSE_TEMPLATE() [26/39]

```
BDENSE_TEMPLATE (
    void ,
    get_row_vec )
```

Definition at line 408 of file barraydense-meat.hpp.

9.9.2.28 BDENSE_TEMPLATE() [27/39]

```
BDENSE_TEMPLATE (
    void ,
    insert_cell )
```

9.9.2.29 BDENSE_TEMPLATE() [28/39]

```
BDENSE_TEMPLATE (
    void ,
    out_of_range )
```

9.9.2.30 BDENSE_TEMPLATE() [29/39]

```
BDENSE_TEMPLATE (
    void ,
    print ) const
```

9.9.2.31 BDENSE_TEMPLATE() [30/39]

```
BDENSE_TEMPLATE (
    void ,
    reserve )
```

Definition at line 952 of file `barraydense-meat.hpp`.

9.9.2.32 BDENSE_TEMPLATE() [31/39]

```
BDENSE_TEMPLATE (
    void ,
    resize )
```

9.9.2.33 BDENSE_TEMPLATE() [32/39]

```
BDENSE_TEMPLATE (
    void ,
    set_data )
```

9.9.2.34 BDENSE_TEMPLATE() [33/39]

```
BDENSE_TEMPLATE (
    void ,
    swap_cells )
```

9.9.2.35 BDENSE_TEMPLATE() [34/39]

```
BDENSE_TEMPLATE (
    void ,
    swap_cols )
```

9.9.2.36 BDENSE_TEMPLATE() [35/39]

```
BDENSE_TEMPLATE (
    void ,
    swap_rows )
```

9.9.2.37 BDENSE_TEMPLATE() [36/39]

```
BDENSE_TEMPLATE (
    void ,
    toggle_cell )
```

9.9.2.38 BDENSE_TEMPLATE() [37/39]

```
BDENSE_TEMPLATE (
    void ,
    transpose )
```

Definition at line 874 of file barraydense-meat.hpp.

9.9.2.39 BDENSE_TEMPLATE() [38/39]

```
BDENSE_TEMPLATE (
    void ,
    zero_col )
```

9.9.2.40 BDENSE_TEMPLATE() [39/39]

```
BDENSE_TEMPLATE (
    void ,
    zero_row )
```

9.9.2.41 for()

```
for ( )
```

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

9.9.2.42 if() [1/4]

```
if (
    (i0==i1) && (j0==j1) )
```

9.9.2.43 if() [2/4]

```
if (
    el [POS(i, j)] == BARRY_ZERO_DENSE )
```

Definition at line 669 of file bararraydense-meat.hpp.

9.9.2.44 if() [3/4]

```
if (
    el_colsums [j] == ZERO_CELL )
```

9.9.2.45 if() [4/4]

```
if (
    el_rowsums [i] == ZERO_CELL )
```

9.9.2.46 insert_cell() [1/2]

```
insert_cell (
    i0 ,
    j0 ,
    val ,
    false ,
    false )
```

9.9.2.47 insert_cell() [2/2]

```
insert_cell (
    i1 ,
    j1 ,
    val0 ,
    false ,
    false )
```

9.9.2.48 M()

```
bool M (
    Array_. M )
```

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

9.9.2.49 printf_barry()

```
printf_barry (
    fmt ,
    args )
```

9.9.2.50 resize() [1/6]

```
el_colsums resize (
    M ,
    ZERO_CELL )
```

9.9.2.51 resize() [2/6]

```
el_colsums resize (
    M_ ,
    ZERO_CELL )
```

9.9.2.52 resize() [3/6]

```
el resize (
    N * M,
    ZERO_CELL )
```

9.9.2.53 `resize()` [4/6]

```
el_rowsums resize (
    N ,
    ZERO_CELL )
```

9.9.2.54 `resize()` [5/6]

```
el resize (
    N_ * M_,
    ZERO_CELL )
```

9.9.2.55 `resize()` [6/6]

```
el_rowsums resize (
    N_ ,
    ZERO_CELL )
```

9.9.2.56 `rm_cell()` [1/3]

```
else rm_cell (
    i ,
    j ,
    false ,
    false )
```

9.9.2.57 `rm_cell()` [2/3]

```
rm_cell (
    i0 ,
    j0 ,
    false ,
    false )
```

9.9.2.58 `rm_cell()` [3/3]

```
rm_cell (
    i1 ,
    j1 ,
    false ,
    false )
```

9.9.2.59 va_end()

```
va_end (
    args )
```

9.9.2.60 va_start()

```
va_start (
    args ,
    fmt )
```

9.9.3 Variable Documentation

9.9.3.1 add

```
size_t const std::vector< size_t > const std::vector< size_t > 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.

9.9.3.2 ans

```
return ans
```

Definition at line 404 of file barraydense-meat.hpp.

9.9.3.3 check_bounds

```
bool check_bounds
```

Initial value:

```
{
    if (check_bounds)
    {
        out_of_range(i0,0u);
        out_of_range(i1,0u);
    }

    for (size_t j = 0u; j < M; ++j)
        std::swap(el[POS(i0, j)], el[POS(i1, j)])
```

Definition at line 660 of file barraydense-meat.hpp.

9.9.3.4 check_exists

```
size_t bool int check_exists
```

Initial value:

```
{  
    if (check_bounds)  
        out_of_range(i, j)
```

Definition at line 661 of file `barraydense-meat.hpp`.

9.9.3.5 col

```
col
```

Definition at line 849 of file `barraydense-meat.hpp`.

9.9.3.6 const

```
const
```

Initial value:

```
{  
    if (i >= N)  
    {  
        std::string err_msg = "The row is out of range: " + std::to_string(i) + " >= " + std::to_string(N);  
        throw std::range_error(err_msg);  
    } else if (j >= M)  
    {  
        std::string err_msg = "The column is out of range: " + std::to_string(j) + " >= " +  
            std::to_string(M);  
        throw std::range_error(err_msg);  
    }  
    return
```

Definition at line 360 of file `barraydense-meat.hpp`.

9.9.3.7 copy_data

```
bool copy_data
```

Definition at line 156 of file `barraydense-meat.hpp`.

9.9.3.8 data

```
data = data_
```

Definition at line 334 of file `barraydense-meat.hpp`.

9.9.3.9 delete_data

```
delete_data = delete_data_
```

Definition at line 335 of file barraydense-meat.hpp.

9.9.3.10 delete_data_

```
bool delete_data_
```

Initial value:

```
{  
    if ((data != nullptr) && delete_data)  
        delete data
```

Definition at line 328 of file barraydense-meat.hpp.

9.9.3.11 el

```
return el == ZERO_CELL
```

Definition at line 387 of file barraydense-meat.hpp.

9.9.3.12 el_colsums

```
el_colsums[j] = (v.value - old)
```

Definition at line 681 of file barraydense-meat.hpp.

9.9.3.13 el_rowsums

```
el_rowsums[i] = (v.value - old)
```

Definition at line 680 of file barraydense-meat.hpp.

9.9.3.14 else

```
else (
    void )
```

Initial value:

```
{
    Cell_Type old = el[POS(i,j)]
```

Definition at line 676 of file bararraydense-meat.hpp.

9.9.3.15 false

```
false
```

Definition at line 773 of file bararraydense-meat.hpp.

9.9.3.16 i1

```
size_t i1
```

Definition at line 727 of file bararraydense-meat.hpp.

9.9.3.17 j

```
j
```

Definition at line 379 of file bararraydense-meat.hpp.

9.9.3.18 j0

```
size_t j0
```

Definition at line 726 of file bararraydense-meat.hpp.

9.9.3.19 j1

```
size_t j1
```

Definition at line 727 of file bararraydense-meat.hpp.

9.9.3.20 M

M = [M_](#)

Definition at line 57 of file barraydense-meat.hpp.

9.9.3.21 M_

size_t M_

Initial value:

```
{
    std::vector< Cell_Type > el_tmp(el)
```

Definition at line 43 of file barraydense-meat.hpp.

9.9.3.22 N

N = [N_](#)

Definition at line 56 of file barraydense-meat.hpp.

9.9.3.23 report

size_t size_t size_t 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 730 of file barraydense-meat.hpp.

9.9.3.24 return

return

Definition at line 94 of file barraydense-meat.hpp.

9.9.3.25 source

```
size_t const std::vector< size_t >& source
```

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

9.9.3.26 target

```
size_t const std::vector< size_t > const std::vector< size_t >& target
```

Definition at line 45 of file bararraydense-meat.hpp.

9.9.3.27 v

```
size_t Cell_Type v
```

Definition at line 659 of file bararraydense-meat.hpp.

9.9.3.28 val0

```
Cell_Type val0 = el[POS(i0,j0)]
```

Definition at line 748 of file bararraydense-meat.hpp.

9.9.3.29 val1

```
Cell_Type val1 = el[POS(i1,j1)]
```

Definition at line 749 of file bararraydense-meat.hpp.

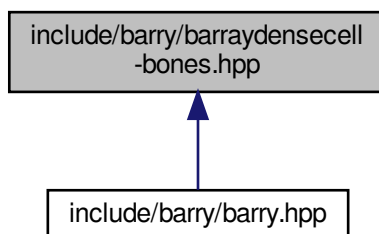
9.9.3.30 value

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

Definition at line 46 of file bararraydense-meat.hpp.

9.10 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](#)

9.10.1 Macro Definition Documentation

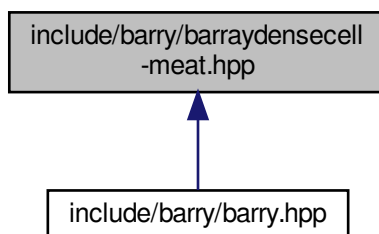
9.10.1.1 POS

```
#define POS(  
    a,  
    b ) (a) + (b) * N
```

Definition at line 6 of file barraydensecell-bones.hpp.

9.11 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

9.11.1 Macro Definition Documentation

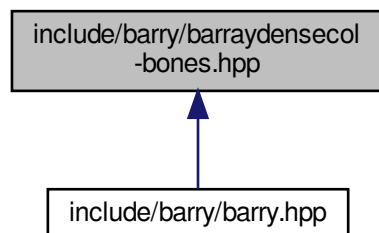
9.11.1.1 POS

```
#define POS(  
    a,  
    b ) (a) + (b) * dat->N
```

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

9.12 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)

9.12.1 Macro Definition Documentation

9.12.1.1 POS

```
#define POS(  
    a,  
    b ) (b)*N + (a)
```

Definition at line 4 of file `barraydensecol-bones.hpp`.

9.12.1.2 POS_N

```
#define POS_N(  
    a,  
    b,  
    c ) (b)*(c) + (a)
```

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

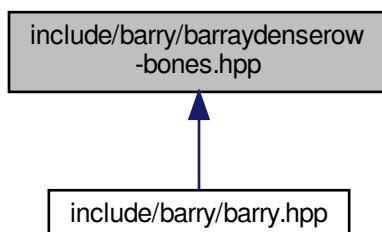
9.12.1.3 ZERO_CELL

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

Definition at line 6 of file `barraydensecol-bones.hpp`.

9.13 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)

9.13.1 Macro Definition Documentation

9.13.1.1 POS

```
#define POS(  
    a,  
    b ) (b) * N + (a)
```

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

9.13.1.2 POS_N

```
#define POS_N(  
    a,  
    b,  
    c ) (b)*(c) + (a)
```

Definition at line 5 of file barraydenserow-bones.hpp.

9.13.1.3 ZERO_CELL

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

Definition at line 6 of file barraydenserow-bones.hpp.

9.14 include/barry/barrayrow-bones.hpp File Reference

Classes

- class [BArrayRow< Cell_Type, Data_Type >](#)
- class [BArrayRow_const< Cell_Type, Data_Type >](#)

9.15 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)

9.15.1 Macro Definition Documentation

9.15.1.1 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.

9.15.1.2 BROW_TEMPLATE_ARGS

```
#define BROW_TEMPLATE_ARGS( ) <typename Cell_Type, typename Data_Type>
```

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

9.15.1.3 BROW_TYPE

```
#define BROW_TYPE( ) BArrayRow<Cell_Type, Data_Type>
```

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

9.15.2 Function Documentation

9.15.2.1 BROW_TEMPLATE() [1/5]

```
BROW_TEMPLATE (  
    void ,  
    operator* ) const &
```

Definition at line 45 of file bararrayrow-meat.hpp.

9.15.2.2 BROW_TEMPLATE() [2/5]

```
BROW_TEMPLATE (  
    void ,  
    operator+ ) const &
```

Definition at line 25 of file bararrayrow-meat.hpp.

9.15.2.3 BROW_TEMPLATE() [3/5]

```
BROW_TEMPLATE (
    void ,
    operator- ) const &
```

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

9.15.2.4 BROW_TEMPLATE() [4/5]

```
BROW_TEMPLATE (
    void ,
    operator/ ) const &
```

Definition at line 55 of file barrayrow-meat.hpp.

9.15.2.5 BROW_TEMPLATE() [5/5]

```
BROW_TEMPLATE (
    void ,
    operator ) const &
```

Definition at line 11 of file barrayrow-meat.hpp.

9.16 include/barry/barrayvector-bones.hpp File Reference

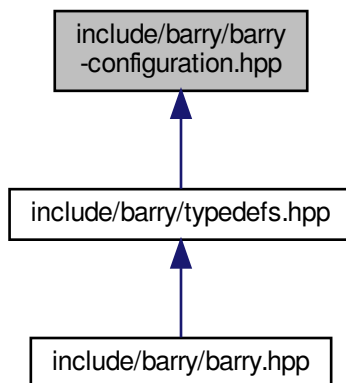
Classes

- class [BArrayVector< Cell_Type, Data_Type >](#)
Row or column of a [BArray](#)
- class [BArrayVector_const< Cell_Type, Data_Type >](#)

9.17 include/barry/barrayvector-meat.hpp File Reference

9.18 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 >(std::numeric_limits< size_t >::max() / 2u)`
 - `template<typename Ta, typename Tb >`
`using Map = std::map< Ta, Tb >`

9.18.1 Macro Definition Documentation

9.18.1.1 BARRY_CHECK_SUPPORT

```
#define BARRY_CHECK_SUPPORT(  
    x,  
    maxs )
```

Definition at line 47 of file barry-configuration.hpp.

9.18.1.2 BARRY_ISFINITE

```
#define BARRY_ISFINITE(  
    a )
```

Definition at line 40 of file barry-configuration.hpp.

9.18.1.3 BARRY_MAX_NUM_ELEMENTS

```
#define BARRY_MAX_NUM_ELEMENTS static_cast< size_t >(std::numeric_limits< size_t >::max()  
/2u)
```

Definition at line 55 of file barry-configuration.hpp.

9.18.1.4 BARRY_SAFE_EXP

```
#define BARRY_SAFE_EXP -100.0
```

Definition at line 33 of file barry-configuration.hpp.

9.18.1.5 printf_barry

```
#define printf_barry printf
```

Definition at line 51 of file barry-configuration.hpp.

9.18.2 Typedef Documentation

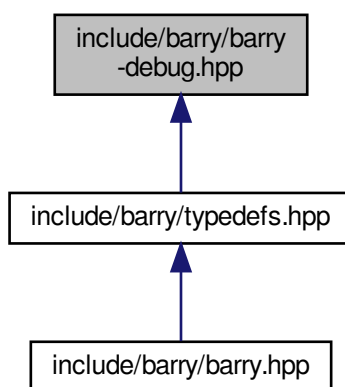
9.18.2.1 Map

```
template<typename Ta , typename Tb >  
using Map = std::map<Ta,Tb>
```

Definition at line 27 of file barry-configuration.hpp.

9.19 include/barry/barry-debug.hpp File Reference

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



Macros

- #define BARRY_DEBUG_LEVEL 0

9.19.1 Macro Definition Documentation

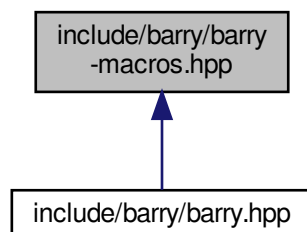
9.19.1.1 BARRY_DEBUG_LEVEL

```
#define BARRY_DEBUG_LEVEL 0
```

Definition at line 5 of file barry-debug.hpp.

9.20 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);`

9.20.1 Macro Definition Documentation

9.20.1.1 BARRY_ONE

```
#define BARRY_ONE Cell<Cell_Type>(1.0)
```

Definition at line 7 of file barry-macros.hpp.

9.20.1.2 BARRY_ONE_DENSE

```
#define BARRY_ONE_DENSE static_cast<Cell_Type>(1.0)
```

Definition at line 8 of file barry-macros.hpp.

9.20.1.3 BARRY_UNUSED

```
#define BARRY_UNUSED(  
    expr ) do { (void)(expr); } while (0);
```

Definition at line 10 of file barry-macros.hpp.

9.20.1.4 BARRY_ZERO

```
#define BARRY_ZERO Cell<Cell_Type>(0.0)
```

Definition at line 4 of file barry-macros.hpp.

9.20.1.5 BARRY_ZERO_DENSE

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

Definition at line 5 of file barry-macros.hpp.

9.21 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 dependency graph for barry.hpp:



Namespaces

- [barry](#)
barry: Your go-to motif accountant
- [barry::counters](#)
Tree class and TreeIterator class.
- [barry::counters::network](#)

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)`

9.21.1 Macro Definition Documentation

9.21.1.1 BARRY_HPP

```
#define BARRY_HPP
```

Definition at line 25 of file barry.hpp.

9.21.1.2 BARRY_VERSION

```
#define BARRY_VERSION BARRY_VERSION_MAYOR ## . ## BARRY_VERSION_MINOR
```

Definition at line 29 of file barry.hpp.

9.21.1.3 BARRY_VERSION_MAYOR

```
#define BARRY_VERSION_MAYOR 0
```

Definition at line 27 of file barry.hpp.

9.21.1.4 BARRY_VERSION_MINOR

```
#define BARRY_VERSION_MINOR 1
```

Definition at line 28 of file barry.hpp.

9.21.1.5 COUNTER_FUNCTION

```
#define COUNTER_FUNCTION(  
    a )
```

Value:

```
template <typename Array_Type = barry::BArray<>, typename Data_Type = bool> \  
inline double (a) (const Array_Type & Array, size_t i, size_t j, Data_Type & data) \  
{
```

Definition at line 88 of file barry.hpp.

9.21.1.6 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, size_t i, size_t j, Data_Type & data)
```

Definition at line 91 of file barry.hpp.

9.21.1.7 RULE_FUNCTION

```
#define RULE_FUNCTION(  
    a )
```

Value:

```
template <typename Array_Type = barry::BArray<>, typename Data_Type = bool> \  
inline bool (a) (const Array_Type & Array, size_t i, size_t j, Data_Type & data) \  
{
```

Definition at line 95 of file barry.hpp.

9.21.1.8 RULE_LAMBDA

```
#define RULE_LAMBDA(  
    a )
```

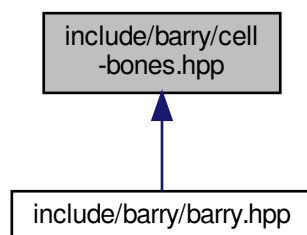
Value:

```
template <typename Array_Type = barry::BArray<>, typename Data_Type = bool> \  
Rule_fun_type<Array_Type, Data_Type> a = \  
[] (const Array_Type & Array, size_t i, size_t j, Data_Type & data)
```

Definition at line 98 of file barry.hpp.

9.22 include/barry/cell-bones.hpp File Reference

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

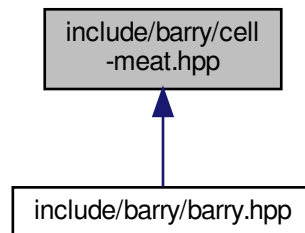


Classes

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

9.23 include/barry/cell-meat.hpp File Reference

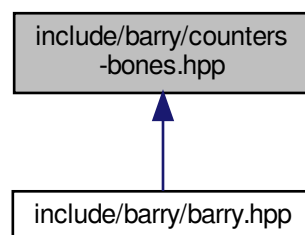
This graph shows which files directly or indirectly include this file:



9.24 include/barry/col-bones.hpp File Reference

9.25 include/barry/counters-bones.hpp File Reference

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

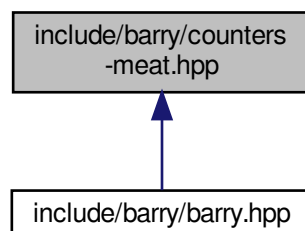


Classes

- class [Counter< Array_Type, Data_Type >](#)
A counter function based on change statistics.
- class [Counters< Array_Type, Data_Type >](#)
Vector of counters.

9.26 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[]`)(`size_t` `idx`)
- `Data_Type` `hasher` (`counter_.hasher`)
- `Data_Type` `&&counters_.hasher` (`std::move(counters_.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`
- `size_t` `i = locator->second`
- `size_t` `size_t 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_`

9.26.1 Macro Definition Documentation

9.26.1.1 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.

9.26.1.2 COUNTER_TEMPLATE_ARGS

```
#define COUNTER_TEMPLATE_ARGS( ) <typename Array_Type, typename Data_Type>
```

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

9.26.1.3 COUNTER_TYPE

```
#define COUNTER_TYPE( ) Counter<Array_Type,Data_Type>
```

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

9.26.1.4 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.

9.26.1.5 COUNTERS_TEMPLATE_ARGS

```
#define COUNTERS_TEMPLATE_ARGS( ) <typename Array_Type, typename Data_Type>
```

Definition at line 127 of file counters-meat.hpp.

9.26.1.6 COUNTERS_TYPE

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

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

9.26.1.7 TMP_HASHER_CALL

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

Definition at line 115 of file counters-meat.hpp.

9.26.2 Function Documentation

9.26.2.1 count_fun()

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

9.26.2.2 COUNTER_TEMPLATE() [1/9]

```
COUNTER_TEMPLATE (
    Counter ) const
```

9.26.2.3 COUNTER_TEMPLATE() [2/9]

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

9.26.2.4 COUNTER_TEMPLATE() [3/9]

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

9.26.2.5 COUNTER_TEMPLATE() [4/9]

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

[< Move assignment](#)

9.26.2.6 COUNTER_TEMPLATE() [5/9]

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

9.26.2.7 COUNTER_TEMPLATE() [6/9]

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

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

9.26.2.8 COUNTER_TEMPLATE() [7/9]

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

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

9.26.2.9 COUNTER_TEMPLATE() [8/9]

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

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

9.26.2.10 COUNTER_TEMPLATE() [9/9]

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

9.26.2.11 COUNTERS_TEMPLATE() [1/9]

```
COUNTERS_TEMPLATE (
    Counters )
```

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

9.26.2.12 COUNTERS_TEMPLATE() [2/9]

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

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

9.26.2.13 COUNTERS_TEMPLATE() [3/9]

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

9.26.2.14 COUNTERS_TEMPLATE() [4/9]

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

9.26.2.15 COUNTERS_TEMPLATE() [5/9]

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

9.26.2.16 COUNTERS_TEMPLATE() [6/9]

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

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

9.26.2.17 COUNTERS_TEMPLATE() [7/9]

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

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

9.26.2.18 COUNTERS_TEMPLATE() [8/9]

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

9.26.2.19 COUNTERS_TEMPLATE() [9/9]

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

9.26.2.20 data()

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

9.26.2.21 desc()

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

Move constructor.

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

9.26.2.22 for()

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

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

9.26.2.23 hasher() [1/2]

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

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

9.26.2.24 hasher() [2/2]

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

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

9.26.2.25 hasher_fun() [1/2]

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

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

9.26.2.26 hasher_fun() [2/2]

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

9.26.2.27 if() [1/3]

```
if (  
    add_dims )
```

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

9.26.2.28 if() [2/3]

```
if (  
    hasher )
```

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

9.26.2.29 if() [3/3]

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

9.26.2.30 init_fun() [1/3]

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

9.26.2.31 init_fun() [2/3]

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

9.26.2.32 init_fun() [3/3]

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

9.26.2.33 name()

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

9.26.3 Variable Documentation**9.26.3.1 add_dims**

```
bool add_dims
```

Initial value:

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

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

9.26.3.2 count_fun_

Data_Type count_fun_

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

9.26.3.3 counter

Data_Type counter

Initial value:

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

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

9.26.3.4 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.

9.26.3.5 data_

Data_Rule_Dyn_Type Data_Rule_Dyn_Type data_

Initial value:

```
{  
    rules_dyn->add_rule(  
        rule_fun_,  
        data_  
    )
```

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

9.26.3.6 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.

9.26.3.7 fun

```
Data_Type fun
```

Initial value:

```
{  
    hasher_fun = fun
```

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

9.26.3.8 fun_

```
Data_Type fun_
```

Initial value:

```
{  
    hasher = fun_
```

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

9.26.3.9 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.

9.26.3.10 i

```
const std::vector< double > size_t i = locator->second
```

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

9.26.3.11 init_fun_

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

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

9.26.3.12 j

```
size_t size_t j
```

Initial value:

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

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

9.26.3.13 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.

9.26.3.14 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.

9.26.3.15 res

```
return res
```

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

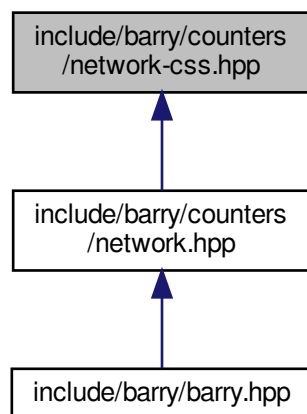
9.26.3.16 return

```
return
```

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

9.27 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, size_t netsize, const std::vector< size_t > &end_)`
Counts errors of commission.
- `template<typename Tnet = Network>`
`void counter_css_partially_false_recip_omiss (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
Counts errors of omission.
- `template<typename Tnet = Network>`
`void counter_css_completely_false_recip_comiss (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
Counts completely false reciprocity (comission)
- `template<typename Tnet = Network>`
`void counter_css_completely_false_recip_omiss (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
Counts completely false reciprocity (omission)
- `template<typename Tnet = Network>`
`void counter_css_mixed_recip (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
Counts mixed reciprocity errors.
- `template<typename Tnet = Network>`
`void counter_css_census01 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census02 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census03 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census04 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census05 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census06 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census07 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census08 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census09 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`
- `template<typename Tnet = Network>`
`void counter_css_census10 (NetCounters< Tnet > *counters, size_t netsize, const std::vector< size_t > &end_)`

9.27.1 Macro Definition Documentation

9.27.1.1 CSS_APPEND

```
#define CSS_APPEND(
    name )
```

Value:

```
std::string name_ = (name);\
for (size_t i = 0u; i < end_.size(); ++i) { \
std::string tmpname = name_ + " (" + std::to_string(i) + ")";\
counters->add_counter(tmp_count, tmp_init, nullptr, \
    NetCounterData({netsize, i == 0u ? netsize : end_[i-1], end_[i]}, {}),\
    tmpname);}
```

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

9.27.1.2 CSS_CASE_ELSE

```
#define CSS_CASE_ELSE( )
```

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

9.27.1.3 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.

9.27.1.4 CSS_CASE_TRUTH

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

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

9.27.1.5 CSS_CHECK_SIZE

```
#define CSS_CHECK_SIZE( )
```

Value:

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

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

9.27.1.6 CSS_CHECK_SIZE_INIT

```
#define CSS_CHECK_SIZE_INIT( )
```

Value:

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

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

9.27.1.7 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.

9.27.1.8 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.

9.27.1.9 CSS_SIZE

```
#define CSS_SIZE( )
```

Value:

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

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

9.27.1.10 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.

9.27.2 Function Documentation

9.27.2.1 counter_css_census01()

```
template<typename Tnet = Network>
void counter_css_census01 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 275 of file network-css.hpp.

9.27.2.2 counter_css_census02()

```
template<typename Tnet = Network>
void counter_css_census02 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 325 of file network-css.hpp.

9.27.2.3 counter_css_census03()

```
template<typename Tnet = Network>
void counter_css_census03 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 364 of file network-css.hpp.

9.27.2.4 counter_css_census04()

```
template<typename Tnet = Network>
void counter_css_census04 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 403 of file network-css.hpp.

9.27.2.5 counter_css_census05()

```
template<typename Tnet = Network>
void counter_css_census05 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 442 of file network-css.hpp.

9.27.2.6 counter_css_census06()

```
template<typename Tnet = Network>
void counter_css_census06 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 481 of file network-css.hpp.

9.27.2.7 counter_css_census07()

```
template<typename Tnet = Network>
void counter_css_census07 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 520 of file network-css.hpp.

9.27.2.8 counter_css_census08()

```
template<typename Tnet = Network>
void counter_css_census08 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 559 of file network-css.hpp.

9.27.2.9 counter_css_census09()

```
template<typename Tnet = Network>
void counter_css_census09 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 598 of file network-css.hpp.

9.27.2.10 counter_css_census10()

```
template<typename Tnet = Network>
void counter_css_census10 (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Definition at line 637 of file network-css.hpp.

9.27.2.11 counter_css_completely_false_recip_comiss()

```
template<typename Tnet = Network>
void counter_css_completely_false_recip_comiss (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Counts completely false reciprocity (comission)

Definition at line 154 of file network-css.hpp.

9.27.2.12 counter_css_completely_false_recip_omiss()

```
template<typename Tnet = Network>
void counter_css_completely_false_recip_omiss (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Counts completely false reciprocity (omission)

Definition at line 194 of file network-css.hpp.

9.27.2.13 counter_css_mixed_recip()

```
template<typename Tnet = Network>
void counter_css_mixed_recip (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

Counts mixed reciprocity errors.

Definition at line 234 of file network-css.hpp.

9.27.2.14 counter_css_partially_false_recip_commi()

```
template<typename Tnet = Network>
void counter_css_partially_false_recip_commi (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & 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.

9.27.2.15 counter_css_partially_false_recip_omiss()

```
template<typename Tnet = Network>
void counter_css_partially_false_recip_omiss (
    NetCounters< Tnet > * counters,
    size_t netsize,
    const std::vector< size_t > & end_ ) [inline]
```

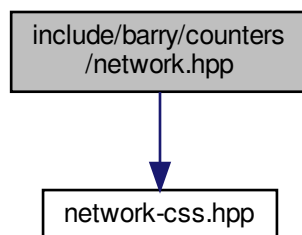
Counts errors of omission.

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

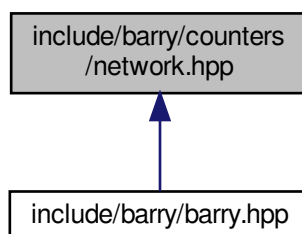
9.28 include/barry/counters/network.hpp File Reference

```
#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 size_t 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_iddegree15 (NetCounters< Tnet > *counters)`
- `template<> void counter_iddegree15 (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, size_t 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, size_t 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, size_t attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodeocov (NetCounters< Tnet > *counters, size_t attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodecov (NetCounters< Tnet > *counters, size_t attr_id)`
- `template<typename Tnet = Network>`
`void counter_nodematch (NetCounters< Tnet > *counters, size_t attr_id)`
- `template<typename Tnet = Network>`
`void counter_iddegree (NetCounters< Tnet > *counters, std::vector< size_t > d)`
Counts number of vertices with a given in-degree.
- `template<> void counter_iddegree (NetCounters< NetworkDense > *counters, std::vector< size_t > d)`
- `template<typename Tnet = Network>`
`void counter_odegree (NetCounters< Tnet > *counters, std::vector< size_t > d)`
Counts number of vertices with a given out-degree.
- `template<> void counter_odegree (NetCounters< NetworkDense > *counters, std::vector< size_t > d)`
- `template<typename Tnet = Network>`
`void counter_degree (NetCounters< Tnet > *counters, std::vector< size_t > d)`
Counts number of vertices with a given out-degree.

Rules for network models

Parameters

rules	A pointer to a <code>NetRules</code> object (<code>Rules<Network, bool></code>).
-------	--

- `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 >`

9.28.1 Macro Definition Documentation

9.28.1.1 BARRY_ZERO_NETWORK

```
#define BARRY_ZERO_NETWORK 0.0
```

Definition at line 85 of file network.hpp.

9.28.1.2 BARRY_ZERO_NETWORK_DENSE

```
#define BARRY_ZERO_NETWORK_DENSE 0
```

Definition at line 86 of file network.hpp.

9.28.1.3 NET_C_DATA_IDX

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

Definition at line 74 of file network.hpp.

9.28.1.4 NET_C_DATA_NUM

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

Definition at line 75 of file network.hpp.

9.28.1.5 NETWORK_COUNTER

```
#define NETWORK_COUNTER(  
    a )
```

Value:

```
template<typename Tnet = Network>\  
inline double (a) (const Tnet & Array, size_t i, size_t j, NetCounterData & data)
```

Function for definition of a network counter function

Definition at line 114 of file network.hpp.

9.28.1.6 NETWORK_COUNTER_LAMBDA

```
#define NETWORK_COUNTER_LAMBDA(  
    a )
```

Value:

```
Counter_fun_type<Tnet, NetCounterData> a = \  
    [] (const Tnet & Array, size_t i, size_t j, NetCounterData & data)
```

Lambda function for definition of a network counter function

Definition at line 119 of file network.hpp.

9.28.1.7 NETWORK_RULE

```
#define NETWORK_RULE(  
    a )
```

Value:

```
template<typename Tnet = Network>\  
inline bool (a) (const Tnet & Array, size_t i, size_t j, bool & data)
```

Function for definition of a network counter function

Definition at line 133 of file network.hpp.

9.28.1.8 NETWORK_RULE_LAMBDA

```
#define NETWORK_RULE_LAMBDA(  
    a )
```

Value:

```
Rule_fun_type<Tnet, bool> a = \  
    [] (const Tnet & Array, size_t i, size_t j, bool & data)
```

Lambda function for definition of a network counter function

Definition at line 138 of file network.hpp.

9.28.1.9 NETWORKDENSE_COUNTER_LAMBDA

```
#define NETWORKDENSE_COUNTER_LAMBDA(  
    a )
```

Value:

```
Counter_fun_type<NetworkDense, NetCounterData> a = \  
    [](const NetworkDense & Array, size_t i, size_t j, NetCounterData & data)
```

Definition at line 123 of file network.hpp.

9.28.2 Typedef Documentation

9.28.2.1 NetCounter

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

Definition at line 89 of file network.hpp.

9.28.2.2 NetCounters

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

Definition at line 92 of file network.hpp.

9.28.2.3 NetModel

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

Definition at line 101 of file network.hpp.

9.28.2.4 NetRule

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

Definition at line 104 of file network.hpp.

9.28.2.5 NetRules

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

Definition at line 107 of file network.hpp.

9.28.2.6 NetStatsCounter

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

Definition at line 98 of file network.hpp.

9.28.2.7 NetSupport

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

Definition at line 95 of file network.hpp.

9.28.2.8 Network

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

Definition at line 82 of file network.hpp.

9.28.2.9 NetworkDense

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

Definition at line 83 of file network.hpp.

9.28.3 Function Documentation

9.28.3.1 rules_zerodiag()

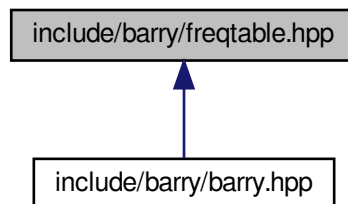
```
template<typename Tnet = Network>
void rules_zerodiag (
    NetRules< Tnet > * rules ) [inline]
```

Number of edges.

Definition at line 1381 of file network.hpp.

9.29 include/barry/freqtable.hpp File Reference

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

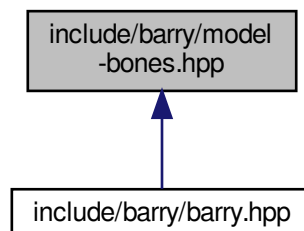


Classes

- class [FreqTable< T >](#)
Frequency table of vectors.

9.30 include/barry/model-bones.hpp File Reference

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



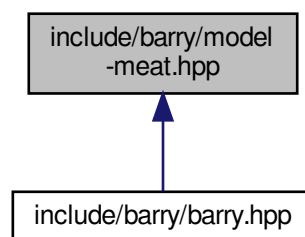
Classes

- 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:

9.31 include/barry/model-meat.hpp File Reference

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



Macros

- `#define MODEL_TYPE()`
- `#define MODEL_TEMPLATE_ARGS()`
- `#define MODEL_TEMPLATE(a, b) template MODEL_TEMPLATE_ARGS() inline a MODEL_TYPE()::b`

Functions

- `double update_normalizing_constant (const double *params, const double *support, size_t k, size_t n)`
- `double likelihood (const double *stats_target, const std::vector< double > ¶ms, const double normalizing_constant, size_t n_params, bool log_ = false)`
- `MODEL_TEMPLATE (void, store_psets)() noexcept`
- `MODEL_TEMPLATE (std::vector< double >, gen_key)(const Array_Type &Array_)`
- `MODEL_TEMPLATE (void, add_counter)(Counter< Array_Type`
- `MODEL_TEMPLATE (void, set_counters)(Counters< Array_Type`
- `support_fun set_counters (counters)`
- `MODEL_TEMPLATE (void, add_hasher)(Hasher_fun_type< Array_Type`
- `MODEL_TEMPLATE (void, add_rule)(Rule< Array_Type`
- `MODEL_TEMPLATE (void, set_rules)(Rules< Array_Type`
- `support_fun set_rules (rules)`
- `MODEL_TEMPLATE (void, add_rule_dyn)(Rule< Array_Type`
- `MODEL_TEMPLATE (void, set_rules_dyn)(Rules< Array_Type`
- `support_fun set_rules_dyn (rules_dyn)`
- `MODEL_TEMPLATE (size_t, add_array)(const Array_Type &Array_`
- `if (transform_model_fun) = transform_model_fun(&tmp_counts[0u], tmp_counts.size())`
- `else stats_target push_back (counter_fun.count_all())`

- `if (force_new || (locator==keys2support.end()))`
- `arrays2support push_back (locator->second)`
- `return arrays2support size () - 1u`
- `MODEL_TEMPLATE (double, likelihood)(const std`
- `MODEL_TEMPLATE (double, likelihood_total)(const std`
- `MODEL_TEMPLATE (double, get_norm_const)(const std`
- `MODEL_TEMPLATE (const std::vector< Array_Type > *, get_pset)(const size_t &i)`
- `MODEL_TEMPLATE (const std::vector< double > *, get_pset_stats)(const size_t &i)`
- `MODEL_TEMPLATE (void, print_stats)(size_t i) const`
- `MODEL_TEMPLATE (size_t, size)() const noexcept`
- `MODEL_TEMPLATE (size_t, size_unique)() const noexcept`
- `MODEL_TEMPLATE (size_t, nterms)() const noexcept`
- `MODEL_TEMPLATE (size_t, nrules)() const noexcept`
- `MODEL_TEMPLATE (size_t, nrules_dyn)() const noexcept`
- `MODEL_TEMPLATE (size_t, support_size)() const noexcept`
- `MODEL_TEMPLATE (std::vector< std::string >, colnames)() const`
- `MODEL_TEMPLATE (Array_Type, sample)(const Array_Type &Array_`
- `if (locator==keys2support.end())`
- `std::uniform_real_distribution urand (0, 1)`
- `if ((probs.size() > 0u) && (vec_equal_approx(params, params_last[a])))`
- `std::vector< double > temp_stats (params.size())`
- `for (size_t array=0u; array< probs.size(); ++array)`
- `MODEL_TEMPLATE (double, conditional_prob)(const Array_Type &Array_`
- `A insert_cell (i, j, A.default_val(), true, false)`
- `std::vector< double > tmp_counts (counters->size())`
- `return (1.0+std::exp(-vec_inner_prod< double > (¶ms[0u], &tmp_counts[0u], params.size())))`
- `MODEL_TEMPLATE (const std::mt19937 *, get_engine)() const`
- `MODEL_TEMPLATE (std::vector< std::vector< double > > *, get_stats_target)()`
- `MODEL_TEMPLATE (std::vector< std::vector< double > > *, get_stats_support)()`
- `MODEL_TEMPLATE (std::vector< size_t > *, get_arrays2support)()`
- `MODEL_TEMPLATE (std::vector< std::vector< Array_Type > > *, get_pset_arrays)()`
- `MODEL_TEMPLATE (std::vector< std::vector< double > > *, get_pset_stats)()`
- `MODEL_TEMPLATE (std::vector< std::vector< double > > *, get_pset_probs)()`
- `MODEL_TEMPLATE (void, set_transform_model)(std`

Variables

- `Data_Counter_Type & counter`
- `return`
- `Data_Counter_Type count_fun_`
- `Data_Counter_Type Counter_fun_type< Array_Type, Data_Counter_Type > init_fun_`
- `Data_Counter_Type Counter_fun_type< Array_Type, Data_Counter_Type > Data_Counter_Type data_`
- `Data_Counter_Type * counters_`
- `Data_Counter_Type fun_`
- `Data_Rule_Type & rules`
- `Data_Rule_Type * rules_`
- `this delete_rules = false`
- `Data_Rule_Dyn_Type rule_fun_`
- `this rules_dyn = rules_`
- `this delete_rules_dyn = false`
- `bool force_new`
- `std::vector< double > key = counters->gen_hash(Array_)`
- `MapVec_type< double, size_t >::const_iterator locator = keys2support.find(key)`
- `stats_support_n_arrays [locator->second]`

- `const std::vector< double > & params`
- `size_t i = locator->second`
- `size_t a = arrays2support[i]`
- `double r = urand(*rengine)`
- `double cumprob = 0.0`
- `size_t k = params.size()`
- `size_t j = 0u`
- `std::vector< double > & probs = pset_probs[a]`
- `else`
- `const std::vector< double > & stats = pset_stats[a]`
- `int i_matches = -1`
- `return this pset_arrays [a][i]`
- `template Data_Counter_Type`
- `template Data_Rule_Type`

9.31.1 Macro Definition Documentation

9.31.1.1 MODEL_TEMPLATE

```
#define MODEL_TEMPLATE(
    a,
    b )  template MODEL_TEMPLATE_ARGS() inline a MODEL_TYPE()::b
```

Definition at line 123 of file model-meat.hpp.

9.31.1.2 MODEL_TEMPLATE_ARGS

```
template MODEL_TEMPLATE_ARGS( )
```

Value:

```
<typename Array_Type, typename Data_Counter_Type,\
typename Data_Rule_Type, typename Data_Rule_Dyn_Type>
```

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

9.31.1.3 MODEL_TYPE

```
template Data_Rule_Dyn_Type * MODEL_TYPE( )
```

Value:

```
Model<Array_Type, Data_Counter_Type, Data_Rule_Type,\
Data_Rule_Dyn_Type>
```

Definition at line 117 of file model-meat.hpp.

9.31.2 Function Documentation

9.31.2.1 for()

```
for ( )
```

Definition at line 1307 of file model-meat.hpp.

9.31.2.2 if() [1/4]

```
if (
    (probs.size() > 0u) &&(vec_equal_approx(params, params_last[a])) )
```

Definition at line 1290 of file model-meat.hpp.

9.31.2.3 if() [2/4]

```
if (
    force_new| locator==keys2support.end() )
```

When computing with the powerset, we need to grow the corresponding vectors on the fly

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

9.31.2.4 if() [3/4]

```
if (
    locator == keys2support.end() )
```

When computing with the powerset, we need to grow the corresponding vectors on the fly

Definition at line 1192 of file model-meat.hpp.

9.31.2.5 if() [4/4]

```
if (
    transform_model_fun ) = transform_model_fun(&tmp_counts[0u], tmp_counts.size())
```

Definition at line 434 of file model-meat.hpp.

9.31.2.6 insert_cell()

```
A insert_cell (
    i ,
    j ,
    A. default_val(),
    true ,
    false )
```

9.31.2.7 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 59 of file model-meat.hpp.

9.31.2.8 MODEL_TEMPLATE() [1/33]

```
MODEL_TEMPLATE (
    Array_Type ,
    sample ) const &
```

9.31.2.9 MODEL_TEMPLATE() [2/33]

```
MODEL_TEMPLATE (
    const std::mt19937 * ,
    get_rengine ) const
```

Definition at line 1376 of file model-meat.hpp.

9.31.2.10 MODEL_TEMPLATE() [3/33]

```
MODEL_TEMPLATE (
    const std::vector< Array_Type > * ,
    get_pset ) const &
```

Definition at line 918 of file model-meat.hpp.

9.31.2.11 MODEL_TEMPLATE() [4/33]

```
MODEL_TEMPLATE (
    const std::vector< double > * ,
    get_pset_stats ) const &
```

Definition at line 930 of file model-meat.hpp.

9.31.2.12 MODEL_TEMPLATE() [5/33]

```
MODEL_TEMPLATE (
    double ,
    conditional_prob ) const &
```

9.31.2.13 MODEL_TEMPLATE() [6/33]

```
MODEL_TEMPLATE (
    double ,
    get_norm_const ) const
```

Definition at line 882 of file model-meat.hpp.

9.31.2.14 MODEL_TEMPLATE() [7/33]

```
MODEL_TEMPLATE (
    double ,
    likelihood ) const
```

Definition at line 561 of file model-meat.hpp.

9.31.2.15 MODEL_TEMPLATE() [8/33]

```
MODEL_TEMPLATE (
    double ,
    likelihood_total ) const
```

Definition at line 816 of file model-meat.hpp.

9.31.2.16 MODEL_TEMPLATE() [9/33]

```
MODEL_TEMPLATE (
    size_t ,
    add_array ) const &
```

9.31.2.17 MODEL_TEMPLATE() [10/33]

```
MODEL_TEMPLATE (
    size_t ,
    nrules ) const [noexcept]
```

Definition at line 1056 of file model-meat.hpp.

9.31.2.18 MODEL_TEMPLATE() [11/33]

```
MODEL_TEMPLATE (
    size_t ,
    nrules_dyn ) const [noexcept]
```

Definition at line 1063 of file model-meat.hpp.

9.31.2.19 MODEL_TEMPLATE() [12/33]

```
MODEL_TEMPLATE (
    size_t ,
    nterms ) const [noexcept]
```

Definition at line 1046 of file model-meat.hpp.

9.31.2.20 MODEL_TEMPLATE() [13/33]

```
MODEL_TEMPLATE (
    size_t ,
    size ) const [noexcept]
```

Definition at line 1031 of file model-meat.hpp.

9.31.2.21 MODEL_TEMPLATE() [14/33]

```
MODEL_TEMPLATE (
    size_t ,
    size_unique ) const [noexcept]
```

Definition at line 1038 of file model-meat.hpp.

9.31.2.22 MODEL_TEMPLATE() [15/33]

```
MODEL_TEMPLATE (
    size_t ,
    support_size ) const [noexcept]
```

Definition at line 1070 of file model-meat.hpp.

9.31.2.23 MODEL_TEMPLATE() [16/33]

```
MODEL_TEMPLATE (
    std::vector< double > ,
    gen_key ) const &
```

Definition at line 304 of file model-meat.hpp.

9.31.2.24 MODEL_TEMPLATE() [17/33]

```
MODEL_TEMPLATE (
    std::vector< size_t > * ,
    get_arrays2support )
```

Definition at line 1411 of file model-meat.hpp.

9.31.2.25 MODEL_TEMPLATE() [18/33]

```
MODEL_TEMPLATE (
    std::vector< std::string > ,
    colnames ) const
```

Definition at line 1082 of file model-meat.hpp.

9.31.2.26 MODEL_TEMPLATE() [19/33]

```
MODEL_TEMPLATE (
    std::vector< std::vector< Array_Type > > * ,
    get_pset_arrays )
```

Definition at line 1416 of file model-meat.hpp.

9.31.2.27 MODEL_TEMPLATE() [20/33]

```
MODEL_TEMPLATE (
    std::vector< std::vector< double > > * ,
    get_pset_probs )
```

Definition at line 1424 of file model-meat.hpp.

9.31.2.28 MODEL_TEMPLATE() [21/33]

```
MODEL_TEMPLATE (
    std::vector< std::vector< double > > * ,
    get_pset_stats )
```

Definition at line 1420 of file model-meat.hpp.

9.31.2.29 MODEL_TEMPLATE() [22/33]

```
MODEL_TEMPLATE (
    std::vector< std::vector< double > > * ,
    get_stats_support )
```

Definition at line 1406 of file model-meat.hpp.

9.31.2.30 MODEL_TEMPLATE() [23/33]

```
MODEL_TEMPLATE (
    std::vector< std::vector< double > > * ,
    get_stats_target )
```

Definition at line 1401 of file model-meat.hpp.

9.31.2.31 MODEL_TEMPLATE() [24/33]

```
MODEL_TEMPLATE (
    void ,
    add_counter )
```

9.31.2.32 MODEL_TEMPLATE() [25/33]

```
MODEL_TEMPLATE (
    void ,
    add_hasher )
```

9.31.2.33 MODEL_TEMPLATE() [26/33]

```
MODEL_TEMPLATE (
    void ,
    add_rule )
```

9.31.2.34 MODEL_TEMPLATE() [27/33]

```
MODEL_TEMPLATE (
    void ,
    add_rule_dyn )
```

9.31.2.35 MODEL_TEMPLATE() [28/33]

```
MODEL_TEMPLATE (
    void ,
    print_stats ) const
```

Definition at line 941 of file model-meat.hpp.

9.31.2.36 MODEL_TEMPLATE() [29/33]

```
MODEL_TEMPLATE (
    void ,
    set_counters )
```

9.31.2.37 MODEL_TEMPLATE() [30/33]

```
MODEL_TEMPLATE (
    void ,
    set_rules )
```

9.31.2.38 MODEL_TEMPLATE() [31/33]

```
MODEL_TEMPLATE (
    void ,
    set_rules_dyn )
```

9.31.2.39 MODEL_TEMPLATE() [32/33]

```
MODEL_TEMPLATE (
    void ,
    set_transform_model )
```

Definition at line 1428 of file model-meat.hpp.

9.31.2.40 MODEL_TEMPLATE() [33/33]

```
MODEL_TEMPLATE (
    void ,
    store_psets ) [noexcept]
```

Definition at line 297 of file model-meat.hpp.

9.31.2.41 push_back() [1/2]

```
else stats_target push_back (
    counter_fun. count_all() )
```

9.31.2.42 push_back() [2/2]

```
arrays2support push_back (
    locator-> second )
```

9.31.2.43 return()

```
return (
    1.0+ std::exp-vec_inner_prod< double >(&params[0u], &tmp_counts[0u], params.↵
size()) )
```

9.31.2.44 set_counters()

```
counter_fun set_counters (
    counters )
```

9.31.2.45 set_rules()

```
support_fun set_rules (
    rules )
```

9.31.2.46 set_rules_dyn()

```
support_fun set_rules_dyn (
    rules_dyn )
```

9.31.2.47 size()

```
return arrays2support size ( )
```

9.31.2.48 temp_stats()

```
std::vector< double > temp_stats (
    params. size() )
```

9.31.2.49 tmp_counts()

```
std::vector< double > tmp_counts (
    counters-> size() )
```

9.31.2.50 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.

9.31.2.51 urand()

```
std::uniform_real_distribution urand (
    0 ,
    1 )
```

9.31.3 Variable Documentation

9.31.3.1 a

```
size_t a = arrays2support[i]
```

Definition at line 1278 of file model-meat.hpp.

9.31.3.2 count_fun_

```
Data_Counter_Type count_fun_
```

Definition at line 319 of file model-meat.hpp.

9.31.3.3 counter

```
Data_Counter_Type& counter
```

Initial value:

```
{
    counters->add_counter(counter, Data_Counter_Type())
```

Definition at line 311 of file model-meat.hpp.

9.31.3.4 counters_

```
Data_Counter_Type* counters_
```

Initial value:

```
{  
    if (delete_counters) {  
        delete counters;  
        delete_counters = false;  
    }  
  
    this->counters = counters_  
}
```

Definition at line 335 of file model-meat.hpp.

9.31.3.5 cumprob

```
double cumprob = 0.0
```

Definition at line 1283 of file model-meat.hpp.

9.31.3.6 data_

```
Data_Rule_Dyn_Type Data_Rule_Dyn_Type data_
```

Initial value:

```
{  
  
    counters->add_counter(  
        count_fun_,  
        init_fun_,  
        data_  
    )  
}
```

Definition at line 321 of file model-meat.hpp.

9.31.3.7 Data_Counter_Type

```
template Data_Counter_Type
```

Definition at line 1396 of file model-meat.hpp.

9.31.3.8 Data_Rule_Type

```
template Data_Rule_Type
```

Definition at line 1396 of file model-meat.hpp.

9.31.3.9 delete_rules

```
this delete_rules = false
```

Definition at line 378 of file model-meat.hpp.

9.31.3.10 delete_rules_dyn

```
this delete_rules_dyn = false
```

Definition at line 417 of file model-meat.hpp.

9.31.3.11 else

```
else (  
    void )
```

Initial value:

```
{  
    probs.resize(pset_arrays[a].size())
```

Definition at line 1300 of file model-meat.hpp.

9.31.3.12 force_new

```
bool force_new
```

Initial value:

```
{  
    counter_fun.reset_array(&Array_)
```

Definition at line 428 of file model-meat.hpp.

9.31.3.13 fun_

```
Data_Counter_Type fun_
```

Initial value:

```
{  
    counters->add_hash(fun_)
```

Definition at line 352 of file model-meat.hpp.

9.31.3.14 i

```
const std::vector< double > size_t i = locator->second
```

Definition at line 1186 of file model-meat.hpp.

9.31.3.15 i_matches

```
int i_matches = -1
```

Definition at line 1306 of file model-meat.hpp.

9.31.3.16 init_fun_

```
Data_Counter_Type Counter_fun_type<Array_Type,Data_Counter_Type> init_fun_
```

Definition at line 320 of file model-meat.hpp.

9.31.3.17 j

```
const std::vector< double > size_t size_t j = 0u
```

Definition at line 1288 of file model-meat.hpp.

9.31.3.18 k

```
size_t k = params.size()
```

Definition at line 1285 of file model-meat.hpp.

9.31.3.19 key

```
std::vector< double > key = counters->gen_hash(Array_)
```

Definition at line 447 of file model-meat.hpp.

9.31.3.20 locator

```
MapVec_type< double, size_t >::const_iterator locator = keys2support.find(key)
```

Definition at line 448 of file model-meat.hpp.

9.31.3.21 params

```
const std::vector< double > & params
```

Initial value:

```
{  
    if (!this->with_pset)  
        throw std::logic_error("Sampling is only available when store_pset() is active.")  
}
```

Definition at line 1179 of file model-meat.hpp.

9.31.3.22 probs

```
std::vector< double > & probs = pset_probs[a]
```

Definition at line 1289 of file model-meat.hpp.

9.31.3.23 pset_arrays

```
return this pset_arrays[a][j]
```

Definition at line 1340 of file model-meat.hpp.

9.31.3.24 r

```
double r = urand(*rengine)
```

Definition at line 1282 of file model-meat.hpp.

9.31.3.25 return

```
return
```

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

9.31.3.26 rule_fun_

```
Data_Rule_Dyn_Type rule_fun_
```

Definition at line 396 of file model-meat.hpp.

9.31.3.27 rules

```
this rules
```

Initial value:

```
{  
    rules->add_rule(rules, Data_Rule_Type())
```

Definition at line 362 of file model-meat.hpp.

9.31.3.28 rules_

```
Data_Rule_Dyn_Type * rules_
```

Initial value:

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

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

9.31.3.29 rules_dyn

```
this rules_dyn = rules_
```

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

9.31.3.30 stats

```
const std::vector< double >& stats = pset_stats[a]
```

Definition at line 1304 of file model-meat.hpp.

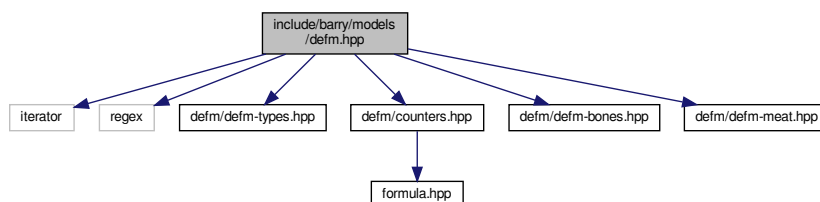
9.31.3.31 stats_support_n_arrays

```
stats_support_n_arrays[locator->second]
```

Definition at line 552 of file model-meat.hpp.

9.32 include/barry/models/defm.hpp File Reference

```
#include <iterator>
#include <regex>
#include "defm/defm-types.hpp"
#include "defm/counters.hpp"
#include "defm/defm-bones.hpp"
#include "defm/defm-meat.hpp"
Include dependency graph for defm.hpp:
```



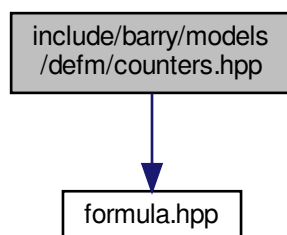
Namespaces

- [defm](#)

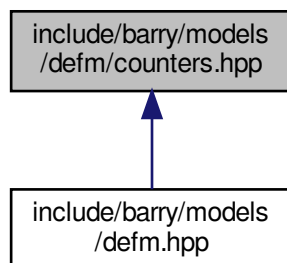
9.33 include/barry/models/defm/counters.hpp File Reference

```
#include "formula.hpp"
```

Include dependency graph for counters.hpp:



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



Macros

- #define `MAKE_DEFM_HASHER(hasher, a, cov)`
- #define `DEFM_RULEDYN_LAMBDA(a)`
- #define `UNI_SUB(a)`

Macros for defining counters

- #define `DEFM_COUNTER(a)` inline double (a) (const `DEFMArray` & Array, size_t i, size_t j, `DEFMCounterData` & data)
- #define `DEFM_COUNTER_LAMBDA(a)`

Macros for defining rules

- #define `DEFM_RULE(a)` inline bool (a) (const `DEFMArray` & Array, size_t i, size_t j, bool & data)
- #define `DEFM_RULE_LAMBDA(a)`

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 <i>DEFMRules</i> object (<i>Rules</i> < <i>DEFMArray</i> , <i>bool</i> >).
-------	--

- void *rules_markov_fixed* (*DEFMRules* **rules*, size_t *markov_order*)
Number of edges.
- void *rules_dont_become_zero* (*DEFMSupport* **support*, std::vector< size_t > *ids*)
Blocks switching a one to zero.

9.33.1 Macro Definition Documentation**9.33.1.1 DEFM_COUNTER**

```
#define DEFM_COUNTER(  
    a ) inline double (a) (const DEFMArray & Array, size_t i, size_t j, DEFMCounterData  
    & data)
```

Function for definition of a network counter function

Definition at line 39 of file counters.hpp.

9.33.1.2 DEFM_COUNTER_LAMBDA

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

Value:

```
barry::Counter_fun_type<DEFMArray, DEFMCounterData> a = \  
    [](const DEFMArray & Array, size_t i, size_t j, DEFMCounterData & data) -> double
```

Lambda function for definition of a network counter function

Definition at line 43 of file counters.hpp.

9.33.1.3 DEFM_RULE

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

Function for definition of a network counter function

Definition at line 53 of file counters.hpp.

9.33.1.4 DEFM_RULE_LAMBDA

```
#define DEFM_RULE_LAMBDA(  
    a )
```

Value:

```
barry::Rule_fun_type<DEFMArray, DEFMRuleData> a = \  
[] (const DEFMArray & Array, size_t i, size_t j, DEFMRuleData & data) -> bool
```

Lambda function for definition of a network counter function

Definition at line 57 of file counters.hpp.

9.33.1.5 DEFM_RULEDYN_LAMBDA

```
#define DEFM_RULEDYN_LAMBDA(  
    a )
```

Value:

```
barry::Rule_fun_type<DEFMArray, DEFMRuleDynData> a = \  
[] (const DEFMArray & Array, size_t i, size_t j, DEFMRuleDynData & data) -> bool
```

Lambda function for definition of a network counter function

Definition at line 63 of file counters.hpp.

9.33.1.6 UNI_SUB

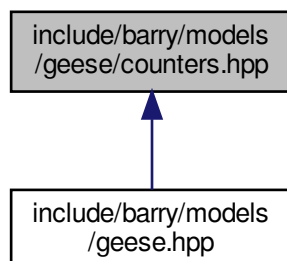
```
#define UNI_SUB(  
    a )
```

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")))))))\  
)
```

9.34 include/barry/models/geese/counters.hpp File Reference

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



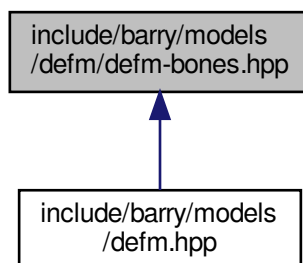
Functions

- void [rule_dyn_limit_changes](#) ([PhyloSupport](#) *support, size_t pos, size_t lb, size_t ub, size_t duplication=[Geese::etype_default](#))
Overall functional gains.
- #define [MAKE_DUPL_VARS](#)()
- #define [IS_EITHER](#)() ((DATA_AT == [Geese::etype_either](#))
- #define [IS_DUPLICATION](#)() ((DATA_AT == [Geese::etype_duplication](#)) & (DPL))
- #define [IS_SPECIATION](#)() ((DATA_AT == [Geese::etype_speciation](#)) & (!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](#)()
- std::string [get_last_name](#) (size_t d)
- void [counter_overall_gains](#) ([PhyloCounters](#) *counters, size_t duplication=[Geese::etype_default](#))
Overall functional gains.
- void [counter_gains](#) ([PhyloCounters](#) *counters, std::vector< size_t > nfun, size_t duplication=[Geese::etype_default](#))
Functional gains for a specific function (nfun).
- void [counter_gains_k_offspring](#) ([PhyloCounters](#) *counters, std::vector< size_t > nfun, size_t k=1u, size_t duplication=[Geese::etype_default](#))
k genes gain function nfun
- void [counter_genes_changing](#) ([PhyloCounters](#) *counters, size_t duplication=[Geese::etype_default](#))
Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)
- void [counter_preserve_pseudogene](#) ([PhyloCounters](#) *counters, size_t nfunA, size_t nfunB, size_t duplication=[Geese::etype_default](#))
Keeps track of how many pairs of genes preserve pseudostate.
- void [counter_prop_genes_changing](#) ([PhyloCounters](#) *counters, size_t duplication=[Geese::etype_default](#))
Keeps track of how many genes are changing (either 0, 1, or 2 if dealing with regular trees.)

- void `counter_overall_loss` (`PhyloCounters *counters`, `size_t` duplication=`Geese::etype_default`)
Overall functional loss.
- void `counter_maxfun` (`PhyloCounters *counters`, `size_t` lb, `size_t` ub, `size_t` duplication=`Geese::etype_default`)
Cap the number of functions per gene.
- void `counter_loss` (`PhyloCounters *counters`, `std::vector< size_t >` nfun, `size_t` duplication=`Geese::etype_default`)
Total count of losses for an specific function.
- void `counter_overall_changes` (`PhyloCounters *counters`, `size_t` duplication=`Geese::etype_default`)
Total number of changes. Use this statistic to account for "preservation".
- void `counter_subfun` (`PhyloCounters *counters`, `size_t` nfunA, `size_t` nfunB, `size_t` duplication=`Geese::etype_default`)
Total count of Sub-functionalization events.
- void `counter_cogain` (`PhyloCounters *counters`, `size_t` nfunA, `size_t` nfunB, `size_t` duplication=`Geese::etype_default`)
Co-evolution (joint gain or loss)
- void `counter_longest` (`PhyloCounters *counters`, `size_t` duplication=`Geese::etype_default`)
Longest branch mutates (either by gain or by loss)
- void `counter_neofun` (`PhyloCounters *counters`, `size_t` nfunA, `size_t` nfunB, `size_t` duplication=`Geese::etype_default`)
Total number of neofunctionalization events.
- void `counter_pairwise_neofun_singlefun` (`PhyloCounters *counters`, `size_t` nfunA, `size_t` duplication=`Geese::etype_default`)
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`, `size_t` nfunA, `size_t` nfunB, `size_t` duplication=`Geese::etype_default`)
Total number of neofunctionalization events.
- void `counter_co_opt` (`PhyloCounters *counters`, `size_t` nfunA, `size_t` nfunB, `size_t` duplication=`Geese::etype_default`)
Function co-opting.
- void `counter_k_genes_changing` (`PhyloCounters *counters`, `size_t` k, `size_t` duplication=`Geese::etype_default`)
Indicator function. Equals to one if k genes changed and zero otherwise.
- void `counter_less_than_p_prop_genes_changing` (`PhyloCounters *counters`, `double` p, `size_t` duplication=`Geese::etype_default`)
Indicator function. Equals to one if k genes changed and zero otherwise.
- void `counter_gains_from_0` (`PhyloCounters *counters`, `std::vector< size_t >` nfun, `size_t` duplication=`Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_overall_gains_from_0` (`PhyloCounters *counters`, `size_t` duplication=`Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_pairwise_overall_change` (`PhyloCounters *counters`, `size_t` duplication=`Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_pairwise_preserving` (`PhyloCounters *counters`, `size_t` nfunA, `size_t` nfunB, `size_t` duplication=`Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)
- void `counter_pairwise_first_gain` (`PhyloCounters *counters`, `size_t` nfunA, `size_t` nfunB, `size_t` duplication=`Geese::etype_default`)
Used when all the functions are in 0 (like the root node prob.)

9.35 include/barry/models/defm/defm-bones.hpp File Reference

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

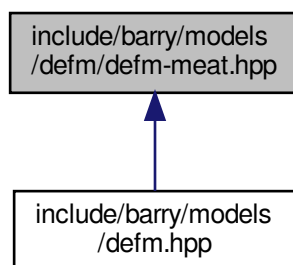


Classes

- class [DEFM](#)

9.36 include/barry/models/defm/defm-meat.hpp File Reference

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



Macros

- #define [DEFM_RANGES\(a\)](#)
- #define [DEFM_LOOP_ARRAYS\(a\)](#) `for (size_t a = 0u; a < (nobs_i - M_order); ++a)`

Functions

- `std::vector< double > keygen_defm (const DEFMArray &Array_, DEFMCounterData *data)`

9.36.1 Macro Definition Documentation

9.36.1.1 DEFM_LOOP_ARRAYS

```
#define DEFM_LOOP_ARRAYS(  
    a )    for (size_t a = 0u; a < (nobs_i - M_order); ++a)
```

Definition at line 35 of file defm-meat.hpp.

9.36.1.2 DEFM_RANGES

```
#define DEFM_RANGES(  
    a )
```

Value:

```
size_t start_i = start_end[a * 2u];\  
size_t end_i   = start_end[a * 2u + 1u];\  
size_t nobs_i  = end_i - start_i + 1u;
```

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

9.36.2 Function Documentation

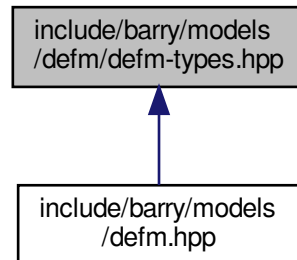
9.36.2.1 keygen_defm()

```
std::vector< double > keygen_defm (  
    const DEFMArray & Array_,  
    DEFMCounterData * data ) [inline]
```

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

9.37 include/barry/models/defm/defm-types.hpp File Reference

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



Classes

- class [DEFMData](#)
Data class for [DEFM](#) arrays.
- class [DEFMCounterData](#)
Data class used to store arbitrary `size_t` or double vectors.
- class [DEFMRuleData](#)
- class [DEFMRuleDynData](#)

Typedefs

- typedef `barry::BArrayDense< int, DEFMData >` [DEFMArray](#)

Convenient typedefs for network objects.

- typedef `barry::Counter< DEFMArray, DEFMCounterData >` [DEFMCounter](#)
- typedef `barry::Counters< DEFMArray, DEFMCounterData >` [DEFMCounters](#)
- typedef `barry::Support< DEFMArray, DEFMCounterData, DEFMRuleData, DEFMRuleDynData >` [DEFMSupport](#)
- typedef `barry::StatsCounter< DEFMArray, DEFMCounterData >` [DEFMStatsCounter](#)
- typedef `barry::Model< DEFMArray, DEFMCounterData, DEFMRuleData, DEFMRuleDynData >` [DEFMModel](#)
- typedef `barry::Rule< DEFMArray, DEFMRuleData >` [DEFMRule](#)
- typedef `barry::Rules< DEFMArray, DEFMRuleData >` [DEFMRules](#)
- typedef `barry::Rule< DEFMArray, DEFMRuleDynData >` [DEFMRuleDyn](#)
- typedef `barry::Rules< DEFMArray, DEFMRuleDynData >` [DEFMRulesDyn](#)

9.37.1 Typedef Documentation

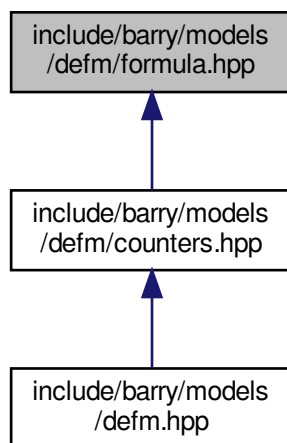
9.37.1.1 DEFMArrray

```
typedef barry::BArrayDense<int, DEFMData> DEFMArrray
```

Definition at line 5 of file defm-types.hpp.

9.38 include/barry/models/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.

9.38.1 Function Documentation

9.38.1.1 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 `formula.hpp`.

9.39 include/barry/models/geese.hpp File Reference

```
#include "geese/geese-types.hpp"
#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 "geese/counters.hpp"
```

Include dependency graph for geese.hpp:

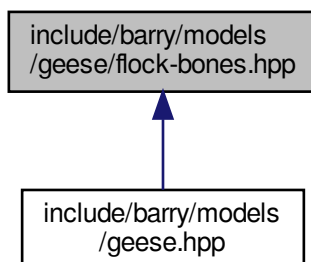


Namespaces

- [geese](#)

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

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

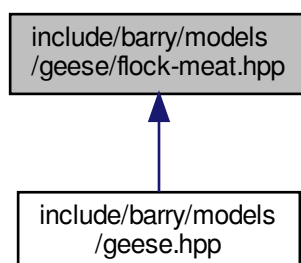


Classes

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

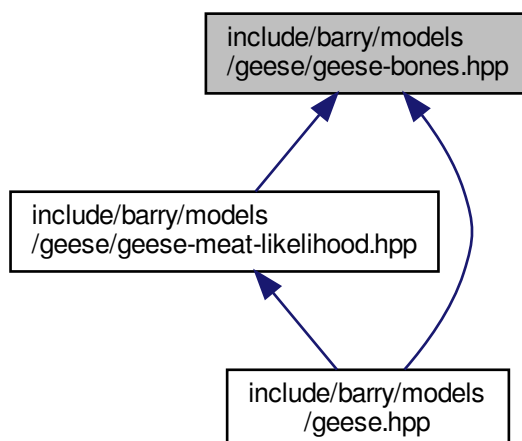
9.41 include/barry/models/geese/flock-meat.hpp File Reference

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



9.42 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 PhyloArray &array, const PhyloCounterData *d)`
- `bool vec_diff (const std::vector< size_t > &s, const std::vector< size_t > &a)`

9.42.1 Macro Definition Documentation

9.42.1.1 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.

9.42.2 Function Documentation

9.42.2.1 keygen_full()

```
std::vector< double > keygen_full (
    const PhyloArray & array,
    const PhyloCounterData * d ) [inline]
```

Definition at line 36 of file geese-bones.hpp.

9.42.2.2 RULE_FUNCTION()

```
RULE_FUNCTION (
    rule_empty_free )
```

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

9.42.2.3 vec_diff()

```
bool vec_diff (
    const std::vector< size_t > & s,
    const std::vector< size_t > & a ) [inline]
```

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

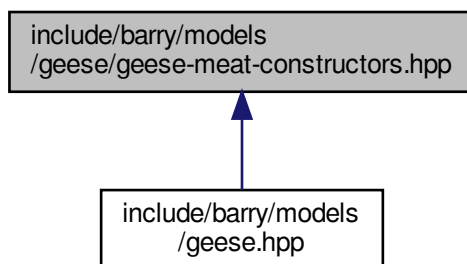
9.42.2.4 vector_caster()

```
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.

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

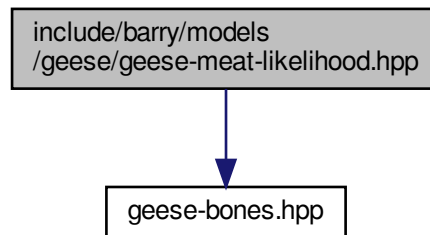
This graph shows which files directly or indirectly include this file:



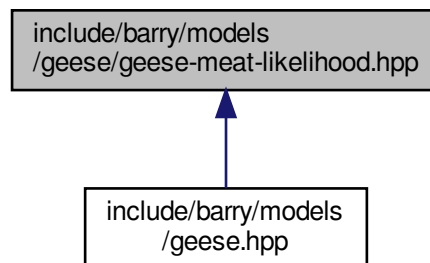
9.44 include/barry/models/geese/geese-meat-likelihood.hpp File Reference

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

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

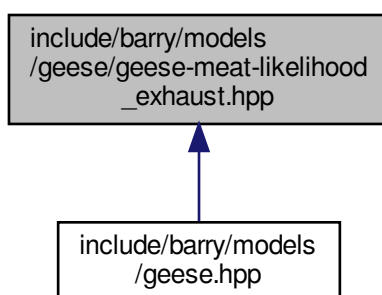


This graph shows which files directly or indirectly include this file:



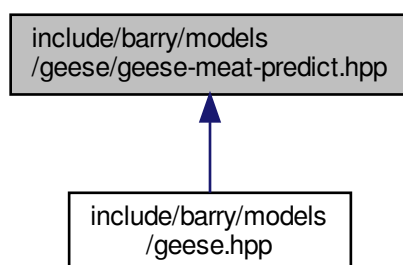
9.45 include/barry/models/geese/geese-meat-likelihood_exhaust.hpp File Reference

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



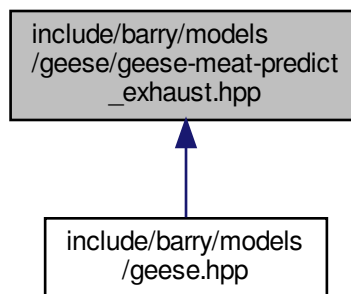
9.46 include/barry/models/geese/geese-meat-predict.hpp File Reference

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



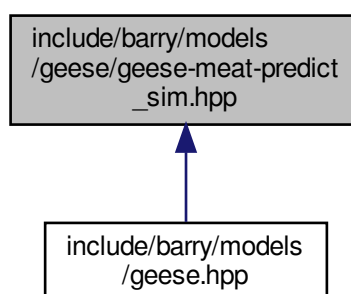
9.47 include/barry/models/geese/geese-meat-predict_exhaust.hpp File Reference

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



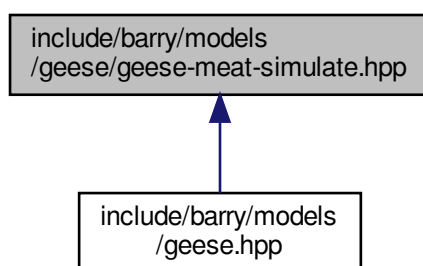
9.48 include/barry/models/geese/geese-meat-predict_sim.hpp File Reference

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



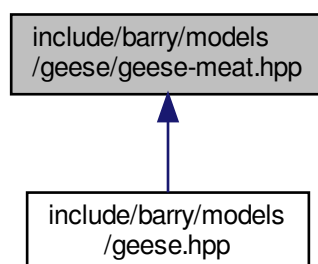
9.49 include/barry/models/geese/geese-meat-simulate.hpp File Reference

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



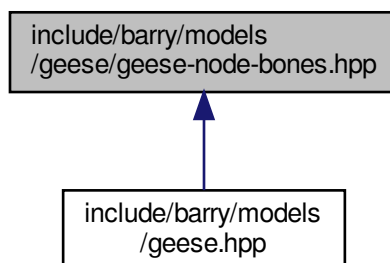
9.50 include/barry/models/geese/geese-meat.hpp File Reference

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



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

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

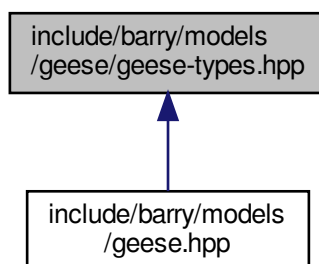


Classes

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

9.52 include/barry/models/geese/geese-types.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](#)

Typedefs

Convenient typedefs for Node objects.

- typedef std::vector< std::pair< size_t, size_t > > [PhyloRuleData](#)
- typedef barry::BArrayDense< size_t, [NodeData](#) > [PhyloArray](#)
- typedef barry::Counter< [PhyloArray](#), [PhyloCounterData](#) > [PhyloCounter](#)
- typedef barry::Counters< [PhyloArray](#), [PhyloCounterData](#) > [PhyloCounters](#)
- typedef barry::Rule< [PhyloArray](#), [PhyloRuleData](#) > [PhyloRule](#)
- typedef barry::Rules< [PhyloArray](#), [PhyloRuleData](#) > [PhyloRules](#)
- typedef barry::Rule< [PhyloArray](#), [PhyloRuleDynData](#) > [PhyloRuleDyn](#)
- typedef barry::Rules< [PhyloArray](#), [PhyloRuleDynData](#) > [PhyloRulesDyn](#)
- typedef barry::Support< [PhyloArray](#), [PhyloCounterData](#), [PhyloRuleData](#), [PhyloRuleDynData](#) > [PhyloSupport](#)
- typedef barry::StatsCounter< [PhyloArray](#), [PhyloCounterData](#) > [PhyloStatsCounter](#)
- typedef barry::Model< [PhyloArray](#), [PhyloCounterData](#), [PhyloRuleData](#), [PhyloRuleDynData](#) > [PhyloModel](#)
- typedef barry::PowerSet< [PhyloArray](#), [PhyloRuleData](#) > [PhyloPowerSet](#)

9.52.1 Typedef Documentation

9.52.1.1 [PhyloArray](#)

```
typedef barry::BArrayDense<size_t, NodeData> PhyloArray
```

Definition at line 101 of file geese-types.hpp.

9.52.1.2 [PhyloCounter](#)

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

Definition at line 102 of file geese-types.hpp.

9.52.1.3 [PhyloCounters](#)

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

Definition at line 103 of file geese-types.hpp.

9.52.1.4 [PhyloModel](#)

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

Definition at line 113 of file geese-types.hpp.

9.52.1.5 PhyloPowerSet

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

Definition at line 114 of file geese-types.hpp.

9.52.1.6 PhyloRule

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

Definition at line 105 of file geese-types.hpp.

9.52.1.7 PhyloRuleData

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

Definition at line 98 of file geese-types.hpp.

9.52.1.8 PhyloRuleDyn

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

Definition at line 108 of file geese-types.hpp.

9.52.1.9 PhyloRules

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

Definition at line 106 of file geese-types.hpp.

9.52.1.10 PhyloRulesDyn

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

Definition at line 109 of file geese-types.hpp.

9.52.1.11 PhyloStatsCounter

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

Definition at line 112 of file geese-types.hpp.

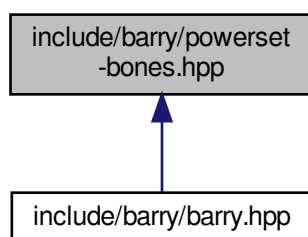
9.52.1.12 PhyloSupport

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

Definition at line 111 of file geese-types.hpp.

9.53 include/barry/powerset-bones.hpp File Reference

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

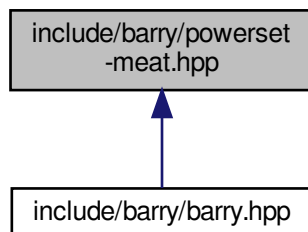


Classes

- class `PowerSet< Array_Type, Data_Rule_Type >`
Powerset of a binary array.

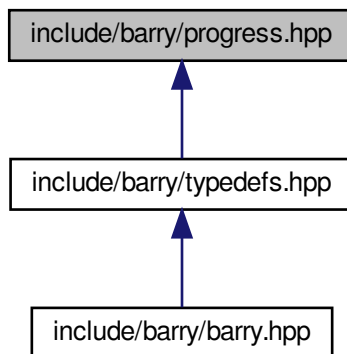
9.54 include/barry/powerset-meat.hpp File Reference

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



9.55 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

9.55.1 Macro Definition Documentation

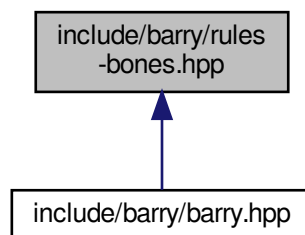
9.55.1.1 BARRY_PROGRESS_BAR_WIDTH

```
#define BARRY_PROGRESS_BAR_WIDTH 80
```

Definition at line 5 of file progress.hpp.

9.56 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, size_t [i](#), size_t [j](#), [Data_Type](#) *dat)

9.56.1 Function Documentation

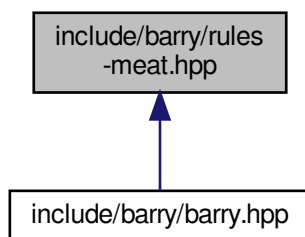
9.56.1.1 rule_fun_default()

```
template<typename Array_Type , typename Data_Type >  
bool rule_fun_default (   
    const Array_Type * array,  
    size_t i,  
    size_t j,  
    Data_Type * dat )
```

Definition at line 5 of file rules-bones.hpp.

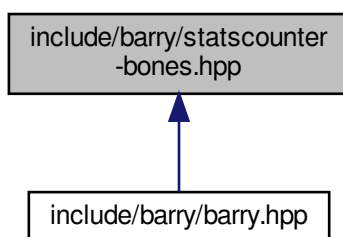
9.57 include/barry/rules-meat.hpp File Reference

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



9.58 include/barry/statscounter-bones.hpp File Reference

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

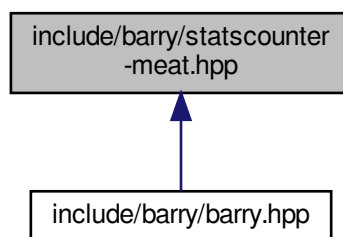


Classes

- class [StatsCounter< Array_Type, Data_Type >](#)
Count stats for a single Array.

9.59 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)(size_t i
- [current_stats](#) resize (counters->size(), 0.0)
- for (size_t n=0u;n< counters->size();++n) [current_stats](#)[n]
- [STATSCOUNTER_TEMPLATE](#) (void, count_current)(size_t 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_
- size_t j

9.59.1 Macro Definition Documentation

9.59.1.1 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.

9.59.1.2 STATSCOUNTER_TEMPLATE_ARGS

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

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

9.59.1.3 STATSCOUNTER_TYPE

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

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

9.59.2 Function Documentation

9.59.2.1 clear()

```
EmptyArray clear ( )
```

9.59.2.2 for()

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

9.59.2.3 resize()

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

9.59.2.4 STATSCOUNTER_TEMPLATE() [1/9]

```
STATSCOUNTER_TEMPLATE (
    StatsCounter ) const
```

9.59.2.5 STATSCOUNTER_TEMPLATE() [2/9]

```
STATSCOUNTER_TEMPLATE (
    ~ StatsCounter )
```

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

9.59.2.6 STATSCOUNTER_TEMPLATE() [3/9]

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

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

9.59.2.7 STATSCOUNTER_TEMPLATE() [4/9]

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

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

9.59.2.8 STATSCOUNTER_TEMPLATE() [5/9]

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

9.59.2.9 STATSCOUNTER_TEMPLATE() [6/9]

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

9.59.2.10 STATSCOUNTER_TEMPLATE() [7/9]

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

9.59.2.11 STATSCOUNTER_TEMPLATE() [8/9]

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

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

9.59.2.12 STATSCOUNTER_TEMPLATE() [9/9]

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

9.59.3 Variable Documentation

9.59.3.1 counter

```
Data_Type& counter
```

Initial value:

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

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

9.59.3.2 counter_deleted

```
counter_deleted = false
```

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

9.59.3.3 counters

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

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

9.59.3.4 counters_

```
Data_Type* counters_
```

Initial value:

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

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

9.59.3.5 current_stats

```
current_stats = counter.current_stats
```

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

9.59.3.6 EmptyArray

```
EmptyArray = *Array
```

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

9.59.3.7 f_

```
Data_Rule_Dyn_Type f_
```

Initial value:

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

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

9.59.3.8 j

```
size_t 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.

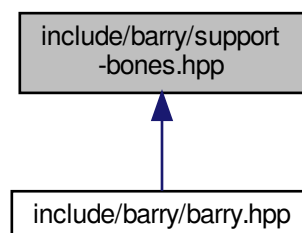
9.59.3.9 return

```
return
```

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

9.60 include/barry/support-bones.hpp File Reference

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

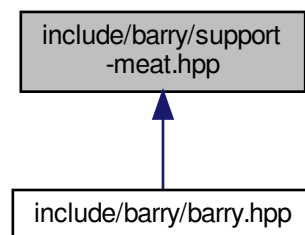


Classes

- class [Support](#)< [Array_Type](#), [Data_Counter_Type](#), [Data_Rule_Type](#), [Data_Rule_Dyn_Type](#) >
Compute the support of sufficient statistics.

9.61 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](#))(size_t pos
- [calc_backend_sparse](#) (pos+1u, [array_bank](#), [stats_bank](#))
- [EmptyArray](#) insert_cell ([coord_i](#), [coord_j](#), [EmptyArray.default_val\(\).value](#), false, false)
- for (size_t 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](#))(size_t 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`
- size_t `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_

9.61.1 Macro Definition Documentation

9.61.1.1 BARRY_SUPPORT_MEAT_HPP

```
#define BARRY_SUPPORT_MEAT_HPP 1
```

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

9.61.1.2 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.

9.61.1.3 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.

9.61.1.4 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.

9.61.2 Function Documentation

9.61.2.1 calc_backend_dense()

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

9.61.2.2 calc_backend_sparse()

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

9.61.2.3 for()

```
for ( )
```

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

9.61.2.4 if() [1/3]

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

9.61.2.5 if() [2/3]

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

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

9.61.2.6 if() [3/3]

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

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

9.61.2.7 insert_cell() [1/2]

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

9.61.2.8 insert_cell() [2/2]

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

9.61.2.9 rm_cell()

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

9.61.2.10 SUPPORT_TEMPLATE() [1/17]

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

Definition at line 489 of file support-meat.hpp.

9.61.2.11 SUPPORT_TEMPLATE() [2/17]

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

Definition at line 558 of file support-meat.hpp.

9.61.2.12 SUPPORT_TEMPLATE() [3/17]

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

Definition at line 543 of file support-meat.hpp.

9.61.2.13 SUPPORT_TEMPLATE() [4/17]

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

Definition at line 531 of file support-meat.hpp.

9.61.2.14 SUPPORT_TEMPLATE() [5/17]

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

9.61.2.15 SUPPORT_TEMPLATE() [6/17]

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

9.61.2.16 SUPPORT_TEMPLATE() [7/17]

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

9.61.2.17 SUPPORT_TEMPLATE() [8/17]

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

Definition at line 367 of file support-meat.hpp.

9.61.2.18 SUPPORT_TEMPLATE() [9/17]

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

9.61.2.19 SUPPORT_TEMPLATE() [10/17]

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


9.61.2.20 SUPPORT_TEMPLATE() [11/17]

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

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

9.61.2.21 SUPPORT_TEMPLATE() [12/17]

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

Definition at line 547 of file support-meat.hpp.

9.61.2.22 SUPPORT_TEMPLATE() [13/17]

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

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

9.61.2.23 SUPPORT_TEMPLATE() [14/17]

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

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

9.61.2.24 SUPPORT_TEMPLATE() [15/17]

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

9.61.2.25 SUPPORT_TEMPLATE() [16/17]

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

9.61.2.26 SUPPORT_TEMPLATE() [17/17]

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

9.61.3 Variable Documentation

9.61.3.1 array_bank

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

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

9.61.3.2 change_stats_different

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

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

9.61.3.3 coord_i

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

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

9.61.3.4 coord_j

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

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

9.61.3.5 counters

```
counters = counters_
```

Definition at line 417 of file support-meat.hpp.

9.61.3.6 counters_

```
Data_Counter_Type* counters_
```

Initial value:

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

Definition at line 410 of file support-meat.hpp.

9.61.3.7 delete_counters

```
delete_counters = false
```

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

9.61.3.8 delete_rules

```
delete_rules = false
```

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

9.61.3.9 delete_rules_dyn

```
delete_rules_dyn = false
```

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

9.61.3.10 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.

9.61.3.11 f_

```
Data_Rule_Dyn_Type f_
```

Initial value:

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

Definition at line 401 of file support-meat.hpp.

9.61.3.12 hashes

```
& hashes
```

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

9.61.3.13 return

```
return
```

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

9.61.3.14 rules

```
rules = rules_
```

Definition at line 451 of file support-meat.hpp.

9.61.3.15 rules_

Data_Rule_Dyn_Type* rules_

Initial value:

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

Definition at line 444 of file support-meat.hpp.

9.61.3.16 rules_dyn

rules_dyn = rules_

Definition at line 483 of file support-meat.hpp.

9.61.3.17 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.

9.61.3.18 tmp_chng

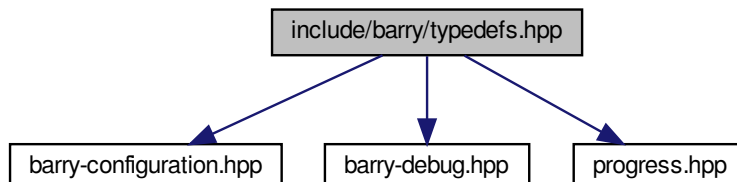
double tmp_chng

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

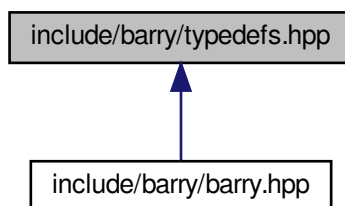
9.62 include/barry/typedefs.hpp File Reference

```
#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 std::vector< std::pair< std::vector< double >, size_t > > [Counts_type](#)
- template<typename Cell_Type >
using [Row_type](#) = [Map](#)< size_t, [Cell](#)< Cell_Type > >
- template<typename Cell_Type >
using [Col_type](#) = [Map](#)< size_t, [Cell](#)< Cell_Type > * >
- template<typename Ta = double, typename Tb = size_t>
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 &, size_t, size_t, Data_Type &)>
Counter and rule functions.
- template<typename Array_Type , typename Data_Type >
using [Rule_fun_type](#) = std::function< bool([const](#) Array_Type &, size_t, size_t, 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

9.62.1 Typedef Documentation

9.62.1.1 Col_type

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

Definition at line 70 of file typedefs.hpp.

9.62.1.2 Counter_fun_type

```
template<typename Array_Type , typename Data_Type >
using Counter_fun_type = std::function<double(const Array_Type &, size_t, size_t, Data_Type
&)>
```

[Counter](#) and rule functions.

Parameters

<i>Array_Type</i>	a BArray
<i>unit, size_t</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 187 of file typedefs.hpp.

9.62.1.3 Counts_type

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

Definition at line 51 of file typedefs.hpp.

9.62.1.4 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 200 of file typedefs.hpp.

9.62.1.5 MapVec_type

```
template<typename Ta = double, typename Tb = size_t>
using MapVec_type = std::unordered_map< std::vector< Ta >, Tb, vecHasher<Ta> >
```

Definition at line 128 of file typedefs.hpp.

9.62.1.6 Row_type

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

Definition at line 67 of file typedefs.hpp.

9.62.1.7 Rule_fun_type

```
template<typename Array_Type , typename Data_Type >
using Rule_fun_type = std::function<bool(const Array_Type &, size_t, size_t, Data_Type &)>
```

Definition at line 190 of file typedefs.hpp.

9.62.2 Function Documentation

9.62.2.1 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 141 of file `typedefs.hpp`.

9.62.2.2 `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 210 of file `typedefs.hpp`.

9.62.2.3 `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 235 of file `typedefs.hpp`.

9.62.2.4 `vec_inner_prod()` [1/2]

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

Definition at line 286 of file typedefs.hpp.

9.62.2.5 `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 263 of file typedefs.hpp.

9.63 README.md File Reference

Index

- ~BArray
 - BArray< Cell_Type, Data_Type >, [63](#)
- ~BArrayCell
 - BArrayCell< Cell_Type, Data_Type >, [74](#)
- ~BArrayCell_const
 - BArrayCell_const< Cell_Type, Data_Type >, [76](#)
- ~BArrayDense
 - BArrayDense< Cell_Type, Data_Type >, [82](#)
- ~BArrayDenseCell
 - BArrayDenseCell< Cell_Type, Data_Type >, [95](#)
- ~BArrayRow
 - BArrayRow< Cell_Type, Data_Type >, [108](#)
- ~BArrayRow_const
 - BArrayRow_const< Cell_Type, Data_Type >, [110](#)
- ~BArrayVector
 - BArrayVector< Cell_Type, Data_Type >, [113](#)
- ~BArrayVector_const
 - BArrayVector_const< Cell_Type, Data_Type >, [116](#)
- ~Cell
 - Cell< Cell_Type >, [120](#)
- ~ConstBArrayRowIter
 - ConstBArrayRowIter< Cell_Type, Data_Type >, [125](#)
- ~Counter
 - Counter< Array_Type, Data_Type >, [128](#)
- ~Counters
 - Counters< Array_Type, Data_Type >, [133](#)
- ~DEFMCounterData
 - Phylo rules, [43](#)
- ~DEFMData
 - Phylo rules, [43](#)
- ~DEFMRuleDynData
 - Phylo rules, [43](#)
- ~Entries
 - Entries< Cell_Type >, [147](#)
- ~Flock
 - Flock, [149](#)
- ~FreqTable
 - FreqTable< T >, [156](#)
- ~Geese
 - Geese, [162](#)
- ~Model
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [177](#)
- ~NetCounterData
 - NetCounterData, [195](#)
- ~NetworkData
 - NetworkData, [197](#)
- ~Node
 - Node, [200](#)
- ~PhyloRuleDynData
 - PhyloRuleDynData, [209](#)
- ~PowerSet
 - PowerSet< Array_Type, Data_Rule_Type >, [212](#)
- ~Progress
 - Progress, [217](#)
- ~Rule
 - Rule< Array_Type, Data_Type >, [219](#)
- ~Rules
 - Rules< Array_Type, Data_Type >, [222](#)
- ~StatsCounter
 - StatsCounter< Array_Type, Data_Type >, [227](#)
- ~Support
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [232](#)
- a
 - model-meat.hpp, [345](#)
- active
 - Cell< Cell_Type >, [123](#)
- add
 - barray-meat.hpp, [258](#)
 - barraydense-meat.hpp, [283](#)
 - Cell< Cell_Type >, [121](#), [122](#)
 - FreqTable< T >, [156](#)
- add_array
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [177](#)
- add_counter
 - Counters< Array_Type, Data_Type >, [133](#), [134](#)
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [177](#), [178](#)
 - StatsCounter< Array_Type, Data_Type >, [227](#)
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [232](#)
- add_data
 - Flock, [149](#)
- add_dims
 - counters-meat.hpp, [313](#)
- add_hash
 - Counters< Array_Type, Data_Type >, [134](#)
- add_hasher

- Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
178
- add_rule
 - Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
178
 - PowerSet< Array_Type, Data_Rule_Type >,
212, 213
 - Rules< Array_Type, Data_Type >,
223
 - Support< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
232, 233
- add_rule_dyn
 - Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
178, 179
 - Support< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
233
- annotations
 - Node, 201
- ans
 - barray-meat.hpp, 249, 258
 - barraydense-meat.hpp, 272, 283
- Array
 - ConstBArrayRowIter< Cell_Type, Data_Type >,
125
- array
 - Node, 201
 - Phylo rules, 44
- Array_
 - barray-meat.hpp, 258
- array_bank
 - support-meat.hpp, 390
- arrays
 - Node, 201
- arrays2support
 - Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
188
- AS_ONE
 - EXISTS, 57
- as_vector
 - FreqTable< T >,
156
- AS_ZERO
 - EXISTS, 57
- at
 - Phylo rules, 39
 - PhyloCounterData, 206
- BArray
 - BArray< Cell_Type, Data_Type >,
62, 63
- BArray< Cell_Type, Data_Type >,
59
 - ~BArray, 63
 - BArray, 62, 63
 - BArrayCell< Cell_Type, Data_Type >,
72
 - BArrayCell_const< Cell_Type, Data_Type >,
72
 - clear, 63
 - col, 63
 - D, 64
 - D_ptr, 64
 - default_val, 64
 - flush_data, 64
 - get_cell, 64
 - get_col_vec, 65
 - get_entries, 65
 - get_row_vec, 65
 - insert_cell, 66
 - is_dense, 66
 - is_empty, 66
 - ncol, 67
 - nnozero, 67
 - nrow, 67
 - operator*=
operator(),
operator+=,
operator-=
operator/=,
operator=,
operator==,
out_of_range,
print,
reserve,
resize,
rm_cell,
row,
set_data,
swap_cells,
swap_cols,
swap_rows,
toggle_cell,
toggle_lock,
transpose,
visited,
zero_col,
zero_row,
- barray-meat-operators.hpp
 - BARRAY_TEMPLATE, 242–244
 - BARRAY_TEMPLATE_ARGS, 243, 245
 - BARRAY_TYPE, 243, 245
 - COL, 243
 - for, 245
 - operator(), 245
 - rhs, 245
 - ROW, 243
 - this, 246
- barray-meat.hpp
 - add, 258
 - ans, 249, 258
 - Array_, 258
 - BARRAY_TEMPLATE, 248–253
 - BARRAY_TEMPLATE_ARGS, 248
 - BARRAY_TYPE, 248
 - check_bounds, 258
 - check_exists, 259
 - COL, 249, 253

- col0, [259](#)
- const, [259](#)
- copy_data, [259](#)
- data, [260](#)
- delete_data, [260](#)
- delete_data_, [260](#)
- else, [260](#)
- false, [260](#)
- first, [261](#)
- for, [254](#)
- i1, [261](#)
- if, [254–257](#)
- j, [261](#)
- j0, [261](#)
- j1, [261](#)
- M, [257](#), [261](#)
- M_, [262](#)
- N, [262](#)
- NCells, [262](#)
- report, [262](#)
- resize, [257](#)
- return, [257](#), [262](#)
- ROW, [249](#), [257](#), [258](#)
- row0, [263](#)
- search, [263](#)
- source, [263](#)
- target, [263](#)
- v, [263](#)
- value, [263](#)
- BARRAY_TEMPLATE
 - barray-meat-operators.hpp, [242–244](#)
 - barray-meat.hpp, [248–253](#)
- BARRAY_TEMPLATE_ARGS
 - barray-meat-operators.hpp, [243](#), [245](#)
 - barray-meat.hpp, [248](#)
- BARRAY_TYPE
 - barray-meat-operators.hpp, [243](#), [245](#)
 - barray-meat.hpp, [248](#)
- BArrayCell
 - BArrayCell< Cell_Type, Data_Type >, [74](#)
- BArrayCell< Cell_Type, Data_Type >, [73](#)
 - ~BArrayCell, [74](#)
 - BArray< Cell_Type, Data_Type >, [72](#)
 - BArrayCell, [74](#)
 - operator Cell_Type, [74](#)
 - operator*=[, 74](#)
 - operator+=[, 74](#)
 - operator-=[, 75](#)
 - operator/=[, 75](#)
 - operator=[, 75](#)
 - operator==[, 75](#)
- BArrayCell_const
 - BArrayCell_const< Cell_Type, Data_Type >, [76](#)
- BArrayCell_const< Cell_Type, Data_Type >, [76](#)
 - ~BArrayCell_const, [76](#)
 - BArray< Cell_Type, Data_Type >, [72](#)
 - BArrayCell_const, [76](#)
 - operator Cell_Type, [77](#)
- operator!=, [77](#)
- operator<, [77](#)
- operator<=[, 77](#)
- operator>, [77](#)
- operator>=[, 78](#)
- operator==[, 77](#)
- BArrayDense
 - BArrayDense< Cell_Type, Data_Type >, [81](#), [82](#)
- BArrayDense< Cell_Type, Data_Type >, [78](#)
 - ~BArrayDense, [82](#)
 - BArrayDense, [81](#), [82](#)
 - BArrayDenseCell< Cell_Type, Data_Type >, [92](#), [97](#)
 - BArrayDenseCol< Cell_Type, Data_Type >, [93](#), [100](#)
 - BArrayDenseCol_const< Cell_Type, Data_Type >, [93](#)
 - BArrayDenseRow< Cell_Type, Data_Type >, [93](#), [104](#)
 - BArrayDenseRow_const< Cell_Type, Data_Type >, [93](#)
 - clear, [83](#)
 - col, [83](#)
 - colsum, [83](#)
 - D, [83](#), [84](#)
 - D_ptr, [84](#)
 - default_val, [84](#)
 - get_cell, [84](#)
 - get_col_vec, [84](#), [85](#)
 - get_data, [85](#)
 - get_entries, [85](#)
 - get_row_vec, [85](#)
 - insert_cell, [86](#)
 - is_dense, [86](#)
 - is_empty, [86](#)
 - ncol, [86](#)
 - nnozero, [87](#)
 - nrow, [87](#)
 - operator*=[, 87](#)
 - operator(), [87](#)
 - operator+=[, 87](#), [88](#)
 - operator-=[, 88](#)
 - operator/=[, 88](#)
 - operator=[, 89](#)
 - operator==[, 89](#)
 - out_of_range, [89](#)
 - print, [89](#)
 - reserve, [89](#)
 - resize, [90](#)
 - rm_cell, [90](#)
 - row, [90](#)
 - rowsum, [90](#)
 - set_data, [90](#)
 - swap_cells, [91](#)
 - swap_cols, [91](#)
 - swap_rows, [91](#)
 - toggle_cell, [91](#)
 - toggle_lock, [92](#)

- transpose, [92](#)
- visited, [93](#)
- zero_col, [92](#)
- zero_row, [92](#)
- barrydense-meat-operators.hpp
 - BDENSE_TEMPLATE, [266–268](#)
 - BDENSE_TEMPLATE_ARGS, [266](#), [268](#)
 - BDENSE_TYPE, [266](#), [268](#)
 - COL, [266](#)
 - POS, [266](#)
 - POS_N, [267](#)
 - ROW, [267](#)
- barrydense-meat.hpp
 - add, [283](#)
 - ans, [272](#), [283](#)
 - BDENSE_TEMPLATE, [271–279](#)
 - BDENSE_TEMPLATE_ARGS, [271](#)
 - BDENSE_TYPE, [271](#)
 - check_bounds, [283](#)
 - check_exists, [283](#)
 - COL, [271](#)
 - col, [284](#)
 - const, [284](#)
 - copy_data, [284](#)
 - data, [284](#)
 - delete_data, [284](#)
 - delete_data_, [285](#)
 - el, [285](#)
 - el_colsums, [285](#)
 - el_rowsums, [285](#)
 - else, [285](#)
 - false, [286](#)
 - for, [279](#)
 - i1, [286](#)
 - if, [280](#)
 - insert_cell, [280](#)
 - j, [286](#)
 - j0, [286](#)
 - j1, [286](#)
 - M, [281](#), [286](#)
 - M_, [287](#)
 - N, [287](#)
 - POS, [271](#)
 - POS_N, [271](#)
 - printf_barry, [281](#)
 - report, [287](#)
 - resize, [281](#), [282](#)
 - return, [287](#)
 - rm_cell, [282](#)
 - ROW, [272](#)
 - source, [287](#)
 - target, [288](#)
 - v, [288](#)
 - va_end, [282](#)
 - va_start, [283](#)
 - val0, [288](#)
 - val1, [288](#)
 - value, [288](#)
 - ZERO_CELL, [272](#)
- BArrayDenseCell
 - BArrayDenseCell< Cell_Type, Data_Type >, [95](#)
- BArrayDenseCell< Cell_Type, Data_Type >, [94](#)
 - ~BArrayDenseCell, [95](#)
 - BArrayDense< Cell_Type, Data_Type >, [92](#), [97](#)
 - BArrayDenseCell, [95](#)
 - BArrayDenseCol< Cell_Type, Data_Type >, [97](#), [100](#)
 - BArrayDenseCol_const< Cell_Type, Data_Type >, [97](#), [102](#)
 - BArrayDenseRow< Cell_Type, Data_Type >, [104](#)
 - BArrayDenseRow_const< Cell_Type, Data_Type >, [107](#)
 - operator Cell_Type, [95](#)
 - operator*=: [95](#)
 - operator+=, [95](#)
 - operator-=, [96](#)
 - operator/=: [96](#)
 - operator=, [96](#)
 - operator==, [96](#)
- barrydensecell-bones.hpp
 - POS, [289](#)
- barrydensecell-meat.hpp
 - POS, [290](#)
- BArrayDenseCell_const< Cell_Type, Data_Type >, [98](#)
 - BArrayDenseCol< Cell_Type, Data_Type >, [100](#)
 - BArrayDenseCol_const< Cell_Type, Data_Type >, [102](#)
 - BArrayDenseRow< Cell_Type, Data_Type >, [104](#)
 - BArrayDenseRow_const< Cell_Type, Data_Type >, [107](#)
- BArrayDenseCol
 - BArrayDenseCol< Cell_Type, Data_Type >, [98](#)
- BArrayDenseCol< Cell_Type, Data_Type >, [98](#)
 - BArrayDense< Cell_Type, Data_Type >, [93](#), [100](#)
 - BArrayDenseCell< Cell_Type, Data_Type >, [97](#), [100](#)
 - BArrayDenseCell_const< Cell_Type, Data_Type >, [100](#)
 - BArrayDenseCol, [98](#)
 - begin, [99](#)
 - end, [99](#)
 - operator(), [99](#)
 - size, [99](#)
- barrydensecol-bones.hpp
 - POS, [291](#)
 - POS_N, [291](#)
 - ZERO_CELL, [291](#)
- BArrayDenseCol_const
 - BArrayDenseCol_const< Cell_Type, Data_Type >, [101](#)
- BArrayDenseCol_const< Cell_Type, Data_Type >, [100](#)
 - BArrayDense< Cell_Type, Data_Type >, [93](#)
 - BArrayDenseCell< Cell_Type, Data_Type >, [97](#), [102](#)
 - BArrayDenseCell_const< Cell_Type, Data_Type >, [102](#)

- BArrayDenseCol_const, 101
- begin, 101
- end, 101
- operator(), 101
- size, 102
- BArrayDenseRow
 - BArrayDenseRow< Cell_Type, Data_Type >, 103
- BArrayDenseRow< Cell_Type, Data_Type >, 102
 - BArrayDense< Cell_Type, Data_Type >, 93, 104
 - BArrayDenseCell< Cell_Type, Data_Type >, 104
 - BArrayDenseCell_const< Cell_Type, Data_Type >, 104
 - BArrayDenseRow, 103
 - begin, 103
 - end, 103
 - operator(), 104
 - size, 104
- barraydenserow-bones.hpp
 - POS, 292
 - POS_N, 292
 - ZERO_CELL, 293
- BArrayDenseRow_const
 - BArrayDenseRow_const< Cell_Type, Data_Type >, 105
- BArrayDenseRow_const< Cell_Type, Data_Type >, 105
 - BArrayDense< Cell_Type, Data_Type >, 93
 - BArrayDenseCell< Cell_Type, Data_Type >, 107
 - BArrayDenseCell_const< Cell_Type, Data_Type >, 107
 - BArrayDenseRow_const, 105
 - begin, 106
 - end, 106
 - operator(), 106
 - size, 106
- BArrayRow
 - BArrayRow< Cell_Type, Data_Type >, 108
- BArrayRow< Cell_Type, Data_Type >, 107
 - ~BArrayRow, 108
 - BArrayRow, 108
 - operator BArrayRow< Cell_Type, Data_Type >, 108
 - operator*=, 108
 - operator+=, 108
 - operator-=, 108
 - operator/=: 109
 - operator=, 109
 - operator==, 109
- barrayrow-meat.hpp
 - BROW_TEMPLATE, 293–295
 - BROW_TEMPLATE_ARGS, 294
 - BROW_TYPE, 294
- BArrayRow_const
 - BArrayRow_const< Cell_Type, Data_Type >, 110
- BArrayRow_const< Cell_Type, Data_Type >, 109
 - ~BArrayRow_const, 110
 - BArrayRow_const, 110
- operator BArrayRow_const< Cell_Type, Data_Type >, 110
- operator!=, 110
- operator<, 110
- operator<=, 111
- operator>, 111
- operator>=, 111
- operator==, 111
- BArrayVector
 - BArrayVector< Cell_Type, Data_Type >, 112
- BArrayVector< Cell_Type, Data_Type >, 111
 - ~BArrayVector, 113
 - BArrayVector, 112
 - begin, 113
 - end, 113
 - is_col, 113
 - is_row, 113
 - operator std::vector< Cell_Type >, 114
 - operator*=, 114
 - operator+=, 114
 - operator-=, 114
 - operator/=: 114
 - operator=, 115
 - operator==, 115
 - size, 115
- BArrayVector_const
 - BArrayVector_const< Cell_Type, Data_Type >, 116
- BArrayVector_const< Cell_Type, Data_Type >, 115
 - ~BArrayVector_const, 116
 - BArrayVector_const, 116
 - begin, 117
 - end, 117
 - is_col, 117
 - is_row, 117
 - operator std::vector< Cell_Type >, 117
 - operator!=, 117
 - operator<, 118
 - operator<=, 118
 - operator>, 118
 - operator>=, 118
 - operator==, 118
 - size, 119
- barry, 55
- barry-configuration.hpp
 - BARRY_CHECK_SUPPORT, 297
 - BARRY_ISFINITE, 297
 - BARRY_MAX_NUM_ELEMENTS, 297
 - BARRY_SAFE_EXP, 297
 - Map, 298
 - printf_barry, 297
- barry-debug.hpp
 - BARRY_DEBUG_LEVEL, 298
- barry-macros.hpp
 - BARRY_ONE, 299
 - BARRY_ONE_DENSE, 299
 - BARRY_UNUSED, 299
 - BARRY_ZERO, 300

- BARRY_ZERO_DENSE, 300
- barry.hpp
 - BARRY_HPP, 301
 - BARRY_VERSION, 302
 - BARRY_VERSION_MAYOR, 302
 - BARRY_VERSION_MINOR, 302
 - COUNTER_FUNCTION, 302
 - COUNTER_LAMBDA, 302
 - RULE_FUNCTION, 303
 - RULE_LAMBDA, 303
- barry::counters, 55
- barry::counters::network, 56
- BARRY_CHECK_SUPPORT
 - barry-configuration.hpp, 297
- BARRY_DEBUG_LEVEL
 - barry-debug.hpp, 298
- BARRY_HPP
 - barry.hpp, 301
- BARRY_ISFINITE
 - barry-configuration.hpp, 297
- BARRY_MAX_NUM_ELEMENTS
 - barry-configuration.hpp, 297
- BARRY_ONE
 - barry-macros.hpp, 299
- BARRY_ONE_DENSE
 - barry-macros.hpp, 299
- BARRY_PROGRESS_BAR_WIDTH
 - progress.hpp, 375
- BARRY_SAFE_EXP
 - barry-configuration.hpp, 297
- BARRY_SUPPORT_MEAT_HPP
 - support-meat.hpp, 384
- BARRY_UNUSED
 - barry-macros.hpp, 299
- BARRY_VERSION
 - barry.hpp, 302
- BARRY_VERSION_MAYOR
 - barry.hpp, 302
- BARRY_VERSION_MINOR
 - barry.hpp, 302
- BARRY_ZERO
 - barry-macros.hpp, 300
- BARRY_ZERO_DENSE
 - barry-macros.hpp, 300
- BARRY_ZERO_NETWORK
 - network.hpp, 328
- BARRY_ZERO_NETWORK_DENSE
 - network.hpp, 328
- BDENSE_TEMPLATE
 - barraydense-meat-operators.hpp, 266–268
 - barraydense-meat.hpp, 271–279
- BDENSE_TEMPLATE_ARGS
 - barraydense-meat-operators.hpp, 266, 268
 - barraydense-meat.hpp, 271
- BDENSE_TYPE
 - barraydense-meat-operators.hpp, 266, 268
 - barraydense-meat.hpp, 271
- begin
 - BArrayDenseCol< Cell_Type, Data_Type >, 99
 - BArrayDenseCol_const< Cell_Type, Data_Type >, 101
 - BArrayDenseRow< Cell_Type, Data_Type >, 103
 - BArrayDenseRow_const< Cell_Type, Data_Type >, 106
 - BArrayVector< Cell_Type, Data_Type >, 113
 - BArrayVector_const< Cell_Type, Data_Type >, 117
 - PhyloCounterData, 206
 - PowerSet< Array_Type, Data_Rule_Type >, 213
 - Rules< Array_Type, Data_Type >, 223
- blengths
 - NodeData, 204
- BOTH
 - CHECK, 56
 - EXISTS, 57
- BROW_TEMPLATE
 - barrayrow-meat.hpp, 293–295
- BROW_TEMPLATE_ARGS
 - barrayrow-meat.hpp, 294
- BROW_TYPE
 - barrayrow-meat.hpp, 294
- calc
 - PowerSet< Array_Type, Data_Rule_Type >, 213
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 233
- calc_backend_dense
 - support-meat.hpp, 385
- calc_backend_sparse
 - support-meat.hpp, 385
- calc_reduced_sequence
 - Geese, 162
- calc_sequence
 - Geese, 162
- Cell
 - Cell< Cell_Type >, 120, 121
- Cell< Cell_Type >, 119
 - ~Cell, 120
 - active, 123
 - add, 121, 122
 - Cell, 120, 121
 - operator Cell_Type, 122
 - operator!=, 122
 - operator=, 122, 123
 - operator==, 123
 - value, 123
 - visited, 123
- Cell_const< Cell_Type >, 124
- change_stats
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 236
- change_stats_different
 - support-meat.hpp, 390
- CHECK, 56
 - BOTH, 56

- NONE, [56](#)
- ONE, [56](#)
- TWO, [56](#)
- check_bounds
 - barray-meat.hpp, [258](#)
 - barraydense-meat.hpp, [283](#)
- check_exists
 - barray-meat.hpp, [259](#)
 - barraydense-meat.hpp, [283](#)
- clear
 - BArray< Cell_Type, Data_Type >, [63](#)
 - BArrayDense< Cell_Type, Data_Type >, [83](#)
 - FreqTable< T >, [156](#)
 - statscounter-meat.hpp, [378](#)
- COL
 - barray-meat-operators.hpp, [243](#)
 - barray-meat.hpp, [249](#), [253](#)
 - barraydense-meat-operators.hpp, [266](#)
 - barraydense-meat.hpp, [271](#)
- col
 - BArray< Cell_Type, Data_Type >, [63](#)
 - BArrayDense< Cell_Type, Data_Type >, [83](#)
 - barraydense-meat.hpp, [284](#)
- col0
 - barray-meat.hpp, [259](#)
- Col_type
 - typedefs.hpp, [396](#)
- colnames
 - Flock, [150](#)
 - Geese, [162](#)
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [179](#)
- colsum
 - BArrayDense< Cell_Type, Data_Type >, [83](#)
- conditional_prob
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [179](#)
- const
 - barray-meat.hpp, [259](#)
 - barraydense-meat.hpp, [284](#)
- ConstBArrayRowIter
 - ConstBArrayRowIter< Cell_Type, Data_Type >, [125](#)
- ConstBArrayRowIter< Cell_Type, Data_Type >, [124](#)
 - ~ConstBArrayRowIter, [125](#)
 - Array, [125](#)
 - ConstBArrayRowIter, [125](#)
 - current_col, [126](#)
 - current_row, [126](#)
 - iter, [126](#)
- coord_i
 - support-meat.hpp, [390](#)
- coord_j
 - support-meat.hpp, [390](#)
- cooriantes_n_free
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [237](#)
- cooriantes_n_locked
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [237](#)
- coordinates_free
 - PowerSet< Array_Type, Data_Rule_Type >, [215](#)
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [237](#)
- coordinates_locked
 - PowerSet< Array_Type, Data_Rule_Type >, [215](#)
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [237](#)
- copy_data
 - barray-meat.hpp, [259](#)
 - barraydense-meat.hpp, [284](#)
- count
 - Counter< Array_Type, Data_Type >, [129](#)
- count_all
 - StatsCounter< Array_Type, Data_Type >, [227](#)
- count_current
 - StatsCounter< Array_Type, Data_Type >, [228](#)
- count_fun
 - Counter< Array_Type, Data_Type >, [130](#)
 - counters-meat.hpp, [308](#)
- count_fun_
 - counters-meat.hpp, [313](#)
 - model-meat.hpp, [345](#)
- count_init
 - StatsCounter< Array_Type, Data_Type >, [228](#)
- Counter
 - Counter< Array_Type, Data_Type >, [128](#)
- counter
 - counters-meat.hpp, [314](#)
 - model-meat.hpp, [345](#)
 - statscounter-meat.hpp, [380](#)
- Counter< Array_Type, Data_Type >, [126](#)
 - ~Counter, [128](#)
 - count, [129](#)
 - count_fun, [130](#)
 - Counter, [128](#)
 - data, [130](#)
 - desc, [131](#)
 - get_description, [129](#)
 - get_hasher, [129](#)
 - get_name, [129](#)
 - hasher_fun, [131](#)
 - init, [129](#)
 - init_fun, [131](#)
 - name, [131](#)
 - operator=, [129](#), [130](#)
 - set_hasher, [130](#)
- counter_
 - counters-meat.hpp, [314](#)
- counter_absdiff

- Network counters, 26
- counter_co_opt
 - Counting, 17
 - Phylo counters, 48
- counter_cogain
 - Counting, 18
 - Phylo counters, 49
- counter_css_census01
 - network-css.hpp, 321
- counter_css_census02
 - network-css.hpp, 321
- counter_css_census03
 - network-css.hpp, 321
- counter_css_census04
 - network-css.hpp, 321
- counter_css_census05
 - network-css.hpp, 322
- counter_css_census06
 - network-css.hpp, 322
- counter_css_census07
 - network-css.hpp, 322
- counter_css_census08
 - network-css.hpp, 322
- counter_css_census09
 - network-css.hpp, 323
- counter_css_census10
 - network-css.hpp, 323
- counter_css_completely_false_recip_comiss
 - network-css.hpp, 323
- counter_css_completely_false_recip_omiss
 - network-css.hpp, 323
- counter_css_mixed_recip
 - network-css.hpp, 324
- counter_css_partially_false_recip_commi
 - network-css.hpp, 324
- counter_css_partially_false_recip_omiss
 - network-css.hpp, 324
- counter_ctriads
 - Network counters, 27
- counter_degree
 - Network counters, 27
- counter_deleted
 - statscounter-meat.hpp, 381
- counter_density
 - Network counters, 27
- counter_diff
 - Network counters, 28
- counter_edges
 - Network counters, 28
- counter_fixed_effect
 - Network counters, 28
- counter_fun
 - Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
188
- Counter_fun_type
 - typedefs.hpp, 396
- COUNTER_FUNCTION
 - barry.hpp, 302
- counter_gains
 - Counting, 18
 - Phylo counters, 49
- counter_gains_from_0
 - Counting, 18
 - Phylo counters, 49
- counter_gains_k_offspring
 - Counting, 19
 - Phylo counters, 49
- counter_genes_changing
 - Counting, 19
 - Phylo counters, 50
- counter_iddegree
 - Network counters, 29
- counter_iddegree15
 - Network counters, 29
- counter_isolates
 - Network counters, 29, 30
- counter_istar2
 - Network counters, 30
- counter_k_genes_changing
 - Counting, 19
 - Phylo counters, 50
- COUNTER_LAMBDA
 - barry.hpp, 302
- counter_less_than_p_prop_genes_changing
 - Counting, 19
 - Phylo counters, 50
- counter_logit_intercept
 - Network counters, 30
- counter_longest
 - Counting, 20
 - Phylo counters, 50
- counter_loss
 - Counting, 20
 - Phylo counters, 51
- counter_maxfun
 - Counting, 20
 - Phylo counters, 51
- counter_mutual
 - Network counters, 30
- counter_neofun
 - Counting, 20
 - Phylo counters, 51
- counter_neofun_a2b
 - Counting, 21
 - Phylo counters, 51
- counter_nodecov
 - Network counters, 31
- counter_nodeicov
 - Network counters, 31
- counter_nodematch
 - Network counters, 31
- counter_nodecov
 - Network counters, 31
- counter_odegree
 - Network counters, 31, 32

- counter_odegree15
 - Network counters, [32](#)
- counter_ones
 - Network counters, [32](#)
- counter_ostar2
 - Network counters, [33](#)
- counter_overall_changes
 - Counting, [21](#)
 - Phylo counters, [52](#)
- counter_overall_gains
 - Counting, [21](#)
 - Phylo counters, [52](#)
- counter_overall_gains_from_0
 - Counting, [21](#)
 - Phylo counters, [52](#)
- counter_overall_loss
 - Counting, [22](#)
 - Phylo counters, [52](#)
- counter_pairwise_first_gain
 - Counting, [22](#)
 - Phylo counters, [53](#)
- counter_pairwise_neofun_singlefun
 - Counting, [22](#)
 - Phylo counters, [53](#)
- counter_pairwise_overall_change
 - Counting, [22](#)
 - Phylo counters, [53](#)
- counter_pairwise_preserving
 - Counting, [23](#)
 - Phylo counters, [53](#)
- counter_preserve_pseudogene
 - Counting, [23](#)
 - Phylo counters, [54](#)
- counter_prop_genes_changing
 - Counting, [23](#)
 - Phylo counters, [54](#)
- counter_subfun
 - Counting, [23](#)
 - Phylo counters, [54](#)
- COUNTER_TEMPLATE
 - counters-meat.hpp, [306, 308, 309](#)
- COUNTER_TEMPLATE_ARGS
 - counters-meat.hpp, [306](#)
- counter_transition
 - Network counters, [33](#)
- counter_transition_formula
 - Network counters, [34](#)
- counter_ttriads
 - Network counters, [34](#)
- COUNTER_TYPE
 - counters-meat.hpp, [307](#)
- Counters
 - Counters< Array_Type, Data_Type >, [132, 133](#)
- counters
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [188](#)
 - statscounter-meat.hpp, [381](#)
 - support-meat.hpp, [390](#)
- Counters< Array_Type, Data_Type >, [132](#)
 - ~Counters, [133](#)
 - add_counter, [133, 134](#)
 - add_hash, [134](#)
 - Counters, [132, 133](#)
 - gen_hash, [134](#)
 - get_descriptions, [134](#)
 - get_names, [135](#)
 - operator=, [135](#)
 - operator[], [136](#)
 - size, [136](#)
- counters-meat.hpp
 - add_dims, [313](#)
 - count_fun, [308](#)
 - count_fun_, [313](#)
 - counter, [314](#)
 - counter_, [314](#)
 - COUNTER_TEMPLATE, [306, 308, 309](#)
 - COUNTER_TEMPLATE_ARGS, [306](#)
 - COUNTER_TYPE, [307](#)
 - COUNTERS_TEMPLATE, [307, 309–311](#)
 - COUNTERS_TEMPLATE_ARGS, [307](#)
 - COUNTERS_TYPE, [307](#)
 - data, [311](#)
 - data_, [314](#)
 - desc, [311](#)
 - desc_, [314](#)
 - for, [311](#)
 - fun, [315](#)
 - fun_, [315](#)
 - hasher, [311, 312](#)
 - hasher_fun, [312](#)
 - hasher_fun_, [315](#)
 - i, [315](#)
 - if, [312](#)
 - init_fun, [313](#)
 - init_fun_, [316](#)
 - j, [316](#)
 - name, [313](#)
 - name_, [316](#)
 - noexcept, [316](#)
 - res, [316](#)
 - return, [317](#)
 - TMP_HASHER_CALL, [307](#)
- counters.hpp
 - DEFM_COUNTER, [353](#)
 - DEFM_COUNTER_LAMBDA, [353](#)
 - DEFM_RULE, [353](#)
 - DEFM_RULE_LAMBDA, [353](#)
 - DEFM_RULEDYN_LAMBDA, [354](#)
 - UNI_SUB, [354](#)
- counters_
 - model-meat.hpp, [345](#)
 - statscounter-meat.hpp, [381](#)
 - support-meat.hpp, [391](#)
- COUNTERS_TEMPLATE
 - counters-meat.hpp, [307, 309–311](#)

- COUNTERS_TEMPLATE_ARGS
 - counters-meat.hpp, 307
- COUNTERS_TYPE
 - counters-meat.hpp, 307
- Counting, 13
 - counter_co_opt, 17
 - counter_cogain, 18
 - counter_gains, 18
 - counter_gains_from_0, 18
 - counter_gains_k_offspring, 19
 - counter_genes_changing, 19
 - counter_k_genes_changing, 19
 - counter_less_than_p_prop_genes_changing, 19
 - counter_longest, 20
 - counter_loss, 20
 - counter_maxfun, 20
 - counter_neofun, 20
 - counter_neofun_a2b, 21
 - counter_overall_changes, 21
 - counter_overall_gains, 21
 - counter_overall_gains_from_0, 21
 - counter_overall_loss, 22
 - counter_pairwise_first_gain, 22
 - counter_pairwise_neofun_singlefun, 22
 - counter_pairwise_overall_change, 22
 - counter_pairwise_preserving, 23
 - counter_preserve_pseudogene, 23
 - counter_prop_genes_changing, 23
 - counter_subfun, 23
 - get_last_name, 24
 - IF_MATCHES, 15
 - IF_NOTMATCHES, 15
 - IS_DUPLICATION, 15
 - IS_EITHER, 15
 - IS_SPECIATION, 16
 - MAKE_DEFM_HASHER, 16
 - MAKE_DUPL_VARS, 16
 - PHYLO_CHECK_MISSING, 16
 - PHYLO_COUNTER_LAMBDA, 17
 - PHYLO_RULE_DYN_LAMBDA, 17
- counts
 - Phylo rules, 44
 - PhyloRuleDynData, 209
- Counts_type
 - typedefs.hpp, 396
- covar_sort
 - Phylo rules, 44
- covar_used
 - Phylo rules, 44
- covariates
 - Phylo rules, 44
- CSS_APPEND
 - network-css.hpp, 318
- CSS_CASE_ELSE
 - network-css.hpp, 319
- CSS_CASE_PERCEIVED
 - network-css.hpp, 319
- CSS_CASE_TRUTH
 - network-css.hpp, 319
- CSS_CHECK_SIZE
 - network-css.hpp, 319
- CSS_CHECK_SIZE_INIT
 - network-css.hpp, 319
- CSS_NET_COUNTER_LAMBDA_INIT
 - network-css.hpp, 320
- CSS_PERCEIVED_CELLS
 - network-css.hpp, 320
- CSS_SIZE
 - network-css.hpp, 320
- CSS_TRUE_CELLS
 - network-css.hpp, 320
- cumprob
 - model-meat.hpp, 346
- current_col
 - ConstBArrayRowIter< Cell_Type, Data_Type >, 126
- current_row
 - ConstBArrayRowIter< Cell_Type, Data_Type >, 126
- current_stats
 - statscounter-meat.hpp, 381
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 237
- D
 - BArray< Cell_Type, Data_Type >, 64
 - BArrayDense< Cell_Type, Data_Type >, 83, 84
 - Rule< Array_Type, Data_Type >, 220
- D_ptr
 - BArray< Cell_Type, Data_Type >, 64
 - BArrayDense< Cell_Type, Data_Type >, 84
- dat
 - Flock, 154
- data
 - barray-meat.hpp, 260
 - barraydense-meat.hpp, 284
 - Counter< Array_Type, Data_Type >, 130
 - counters-meat.hpp, 311
 - PowerSet< Array_Type, Data_Rule_Type >, 215
- data_
 - counters-meat.hpp, 314
 - model-meat.hpp, 346
- Data_Counter_Type
 - model-meat.hpp, 346
- Data_Rule_Type
 - model-meat.hpp, 346
- default_val
 - BArray< Cell_Type, Data_Type >, 64
 - BArrayDense< Cell_Type, Data_Type >, 84
- DEFM, 137
 - DEFM, 138
 - get_ID, 138
 - get_m_order, 138
 - get_model, 138
 - get_n_covars, 139
 - get_n_obs, 139

- get_n_rows, 139
- get_n_y, 139
- get_X, 139
- get_X_names, 139
- get_Y, 140
- get_Y_names, 140
- init, 140
- is_motif, 140
- likelihood, 140
- logodds, 140
- motif_census, 141
- print, 141
- set_names, 141
- simulate, 141
- defm, 57
- defm-meat.hpp
 - DEFM_LOOP_ARRAYS, 358
 - DEFM_RANGES, 358
 - keygen_defm, 358
- defm-types.hpp
 - DEFMArray, 359
- DEFM_COUNTER
 - counters.hpp, 353
- DEFM_COUNTER_LAMBDA
 - counters.hpp, 353
- DEFM_LOOP_ARRAYS
 - defm-meat.hpp, 358
- defm_motif_parser
 - formula.hpp, 360
- DEFM_RANGES
 - defm-meat.hpp, 358
- DEFM_RULE
 - counters.hpp, 353
- DEFM_RULE_LAMBDA
 - counters.hpp, 353
- DEFM_RULEDYN_LAMBDA
 - counters.hpp, 354
- DEFMArray
 - defm-types.hpp, 359
- DEFMCounter
 - Phylo rules, 37
- DEFMCounterData, 142
 - Phylo rules, 39
- DEFMCounters
 - Phylo rules, 37
- DEFMData, 142
 - Phylo rules, 39
- DEFMModel
 - Phylo rules, 37
- DEFMRule
 - Phylo rules, 38
- DEFMRuleData, 144
 - Phylo rules, 40
- DEFMRuleDyn
 - Phylo rules, 38
- DEFMRuleDynData, 145
 - Phylo rules, 40
- DEFMRules
 - Phylo rules, 38
- DEFMRulesDyn
 - Phylo rules, 38
- DEFMStatsCounter
 - Phylo rules, 38
- DEFMSupport
 - Phylo rules, 38
- delete_counters
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 189
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 238
 - support-meat.hpp, 391
- delete_data
 - barray-meat.hpp, 260
 - barraydense-meat.hpp, 284
- delete_data_
 - barray-meat.hpp, 260
 - barraydense-meat.hpp, 285
- delete_rengine
 - Geese, 169
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 189
- delete_rules
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 189
 - model-meat.hpp, 346
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 238
 - support-meat.hpp, 391
- delete_rules_dyn
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 189
 - model-meat.hpp, 347
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 238
 - support-meat.hpp, 391
- delete_support
 - Geese, 169
- desc
 - Counter< Array_Type, Data_Type >, 131
 - counters-meat.hpp, 311
- desc_
 - counters-meat.hpp, 314
- directed
 - NetworkData, 197
- duplication
 - Node, 202
 - NodeData, 205
 - PhyloRuleDynData, 209
- el

- barraydense-meat.hpp, 285
- el_colsums
 - barraydense-meat.hpp, 285
- el_rowsums
 - barraydense-meat.hpp, 285
- else
 - barray-meat.hpp, 260
 - barraydense-meat.hpp, 285
 - model-meat.hpp, 347
 - support-meat.hpp, 391
- empty
 - PhyloCounterData, 206
- EmptyArray
 - PowerSet< Array_Type, Data_Rule_Type >, 215
 - statscounter-meat.hpp, 381
- end
 - BArrayDenseCol< Cell_Type, Data_Type >, 99
 - BArrayDenseCol_const< Cell_Type, Data_Type >, 101
 - BArrayDenseRow< Cell_Type, Data_Type >, 103
 - BArrayDenseRow_const< Cell_Type, Data_Type >, 106
 - BArrayVector< Cell_Type, Data_Type >, 113
 - BArrayVector_const< Cell_Type, Data_Type >, 117
 - PhyloCounterData, 207
 - PowerSet< Array_Type, Data_Rule_Type >, 213
 - Progress, 218
 - Rules< Array_Type, Data_Type >, 223
- Entries
 - Entries< Cell_Type >, 146
- Entries< Cell_Type >, 146
 - ~Entries, 147
 - Entries, 146
 - resize, 147
 - source, 147
 - target, 147
 - val, 147
- etype_default
 - Geese, 169
- etype_duplication
 - Geese, 169
- etype_either
 - Geese, 169
- etype_speciation
 - Geese, 170
- eval_rules_dyn
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 234
- EXISTS, 57
 - AS_ONE, 57
 - AS_ZERO, 57
 - BOTH, 57
 - NONE, 58
 - ONE, 58
 - TWO, 58
 - UNKNOWN, 58
- f_
 - statscounter-meat.hpp, 382
 - support-meat.hpp, 392
- false
 - barray-meat.hpp, 260
 - barraydense-meat.hpp, 286
- first
 - barray-meat.hpp, 261
- first_calc_done
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 189
- Flock, 148
 - ~Flock, 149
 - add_data, 149
 - colnames, 150
 - dat, 154
 - Flock, 149
 - get_counters, 150
 - get_model, 150
 - get_stats_support, 150
 - get_stats_target, 150
 - get_support_fun, 151
 - init, 151
 - initialized, 154
 - likelihood_joint, 151
 - model, 154
 - nfunctions, 154
 - nfuncs, 151
 - nleaves, 152
 - nnodes, 152
 - nterms, 152
 - ntrees, 152
 - operator(), 152
 - parse_polytomies, 153
 - print, 153
 - rengine, 154
 - set_seed, 153
 - support_size, 153
- flush_data
 - BArray< Cell_Type, Data_Type >, 64
- for
 - barray-meat-operators.hpp, 245
 - barray-meat.hpp, 254
 - barraydense-meat.hpp, 279
 - counters-meat.hpp, 311
 - model-meat.hpp, 336
 - statscounter-meat.hpp, 378
 - support-meat.hpp, 385
- force_new
 - model-meat.hpp, 347
- formula.hpp
 - defm_motif_parser, 360
- FreqTable
 - FreqTable< T >, 156
- FreqTable< T >, 155
 - ~FreqTable, 156
 - add, 156

- as_vector, 156
- clear, 156
- FreqTable, 156
- get_data, 157
- get_index, 157
- make_hash, 157
- print, 157
- reserve, 157
- size, 158
- fun
 - counters-meat.hpp, 315
- fun_
 - counters-meat.hpp, 315
 - model-meat.hpp, 347
- Geese, 158
 - ~Geese, 162
 - calc_reduced_sequence, 162
 - calc_sequence, 162
 - colnames, 162
 - delete_engine, 169
 - delete_support, 169
 - etype_default, 169
 - etype_duplication, 169
 - etype_either, 169
 - etype_speciation, 170
 - Geese, 161, 162
 - get_annotated_nodes, 163
 - get_counters, 163
 - get_model, 163
 - get_probabilities, 163
 - get_engine, 163
 - get_states, 163
 - get_support_fun, 164
 - inherit_support, 164
 - init, 164
 - init_node, 164
 - initialized, 170
 - likelihood, 164
 - likelihood_exhaust, 165
 - map_to_state_id, 170
 - nannotations, 165
 - nfunctions, 170
 - nfuncs, 165
 - nleaves, 165
 - nnodes, 165
 - nodes, 170
 - nterms, 166
 - observed_counts, 166
 - operator=, 166
 - parse_polytomies, 166
 - predict, 166
 - predict_backend, 167
 - predict_exhaust, 167
 - predict_exhaust_backend, 167
 - predict_sim, 167
 - print, 167
 - print_nodes, 168
 - print_observed_counts, 168
 - pset_loc, 170
 - reduced_sequence, 171
 - sequence, 171
 - set_seed, 168
 - simulate, 168
 - support_size, 168
 - update_annotations, 168
- geese, 58
- geese-bones.hpp
 - INITIALIZED, 364
 - keygen_full, 364
 - RULE_FUNCTION, 364
 - vec_diff, 364
 - vector_caster, 365
- geese-types.hpp
 - PhyloArray, 371
 - PhyloCounter, 371
 - PhyloCounters, 371
 - PhyloModel, 371
 - PhyloPowerSet, 371
 - PhyloRule, 372
 - PhyloRuleData, 372
 - PhyloRuleDyn, 372
 - PhyloRules, 372
 - PhyloRulesDyn, 372
 - PhyloStatsCounter, 372
 - PhyloSupport, 373
- gen_hash
 - Counters< Array_Type, Data_Type >, 134
- gen_key
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 180
- get_annotated_nodes
 - Geese, 163
- get_arrays2support
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 180
- get_cell
 - BArray< Cell_Type, Data_Type >, 64
 - BArrayDense< Cell_Type, Data_Type >, 84
- get_col_vec
 - BArray< Cell_Type, Data_Type >, 65
 - BArrayDense< Cell_Type, Data_Type >, 84, 85
- get_counters
 - Flock, 150
 - Geese, 163
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 180
 - PhyloCounterData, 207
 - StatsCounter< Array_Type, Data_Type >, 228
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 234
- get_counts
 - Support< Array_Type, Data_Counter_Type,

- Data_Rule_Type, Data_Rule_Dyn_Type >, [234](#)
- get_current_stats
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [234](#)
- get_data
 - BArrayDense< Cell_Type, Data_Type >, [85](#)
 - FreqTable< T >, [157](#)
 - PowerSet< Array_Type, Data_Rule_Type >, [213](#)
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [234](#)
- get_data_ptr
 - PowerSet< Array_Type, Data_Rule_Type >, [214](#)
- get_description
 - Counter< Array_Type, Data_Type >, [129](#)
 - Rule< Array_Type, Data_Type >, [220](#)
- get_descriptions
 - Counters< Array_Type, Data_Type >, [134](#)
 - Rules< Array_Type, Data_Type >, [223](#)
 - StatsCounter< Array_Type, Data_Type >, [228](#)
- get_entries
 - BArray< Cell_Type, Data_Type >, [65](#)
 - BArrayDense< Cell_Type, Data_Type >, [85](#)
- get_hasher
 - Counter< Array_Type, Data_Type >, [129](#)
- get_ID
 - DEFM, [138](#)
- get_index
 - FreqTable< T >, [157](#)
- get_last_name
 - Counting, [24](#)
- get_m_order
 - DEFM, [138](#)
- get_model
 - DEFM, [138](#)
 - Flock, [150](#)
 - Geese, [163](#)
- get_n_covars
 - DEFM, [139](#)
- get_n_obs
 - DEFM, [139](#)
- get_n_rows
 - DEFM, [139](#)
- get_n_y
 - DEFM, [139](#)
- get_name
 - Counter< Array_Type, Data_Type >, [129](#)
 - Rule< Array_Type, Data_Type >, [220](#)
- get_names
 - Counters< Array_Type, Data_Type >, [135](#)
 - Rules< Array_Type, Data_Type >, [224](#)
 - StatsCounter< Array_Type, Data_Type >, [228](#)
- get_norm_const
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [180](#)
- get_parent
 - Node, [200](#)
- get_probabilities
 - Geese, [163](#)
- get_pset
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [180](#)
- get_pset_arrays
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [181](#)
- get_pset_probs
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [181](#)
- get_pset_stats
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [181](#)
- get_rengine
 - Geese, [163](#)
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [181](#)
- get_row_vec
 - BArray< Cell_Type, Data_Type >, [65](#)
 - BArrayDense< Cell_Type, Data_Type >, [85](#)
- get_rules
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [182](#)
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [235](#)
- get_rules_dyn
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [182](#)
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [235](#)
- get_seq
 - Rules< Array_Type, Data_Type >, [224](#)
- get_states
 - Geese, [163](#)
- get_stats_support
 - Flock, [150](#)
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [182](#)
- get_stats_target
 - Flock, [150](#)
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [182](#)
- get_support_fun
 - Flock, [151](#)

- Geese, [164](#)
- Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [182](#)
- get_X
 - DEFM, [139](#)
- get_X_names
 - DEFM, [139](#)
- get_Y
 - DEFM, [140](#)
- get_Y_names
 - DEFM, [140](#)
- hasher
 - counters-meat.hpp, [311](#), [312](#)
- hasher_fun
 - Counter< Array_Type, Data_Type >, [131](#)
 - counters-meat.hpp, [312](#)
- hasher_fun_
 - counters-meat.hpp, [315](#)
- Hasher_fun_type
 - typedefs.hpp, [396](#)
- hashes
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [238](#)
 - support-meat.hpp, [392](#)
- hashes_initialized
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [238](#)
- i
 - counters-meat.hpp, [315](#)
 - model-meat.hpp, [347](#)
- i1
 - barray-meat.hpp, [261](#)
 - barraydense-meat.hpp, [286](#)
- i_matches
 - model-meat.hpp, [348](#)
- id
 - Node, [202](#)
- idx
 - Phylo rules, [40](#), [41](#)
- if
 - barray-meat.hpp, [254–257](#)
 - barraydense-meat.hpp, [280](#)
 - counters-meat.hpp, [312](#)
 - model-meat.hpp, [336](#)
 - support-meat.hpp, [385](#), [386](#)
- IF_MATCHES
 - Counting, [15](#)
- IF_NOTMATCHES
 - Counting, [15](#)
- include/barry/barray-bones.hpp, [241](#)
- include/barry/barray-iterator.hpp, [241](#)
- include/barry/barray-meat-operators.hpp, [242](#)
- include/barry/barray-meat.hpp, [246](#)
- include/barry/barraycell-bones.hpp, [264](#)
- include/barry/barraycell-meat.hpp, [264](#)
- include/barry/barraydense-bones.hpp, [265](#)
- include/barry/barraydense-meat-operators.hpp, [265](#)
- include/barry/barraydense-meat.hpp, [268](#)
- include/barry/barraydensecell-bones.hpp, [289](#)
- include/barry/barraydensecell-meat.hpp, [290](#)
- include/barry/barraydensecol-bones.hpp, [290](#)
- include/barry/barraydenserow-bones.hpp, [292](#)
- include/barry/barrayrow-bones.hpp, [293](#)
- include/barry/barrayrow-meat.hpp, [293](#)
- include/barry/barrayvector-bones.hpp, [295](#)
- include/barry/barrayvector-meat.hpp, [296](#)
- include/barry/barry-configuration.hpp, [296](#)
- include/barry/barry-debug.hpp, [298](#)
- include/barry/barry-macros.hpp, [299](#)
- include/barry/barry.hpp, [300](#)
- include/barry/cell-bones.hpp, [303](#)
- include/barry/cell-meat.hpp, [304](#)
- include/barry/col-bones.hpp, [304](#)
- include/barry/counters-bones.hpp, [304](#)
- include/barry/counters-meat.hpp, [305](#)
- include/barry/counters/network-css.hpp, [317](#)
- include/barry/counters/network.hpp, [325](#)
- include/barry/freqtable.hpp, [332](#)
- include/barry/model-bones.hpp, [332](#)
- include/barry/model-meat.hpp, [333](#)
- include/barry/models/defm.hpp, [351](#)
- include/barry/models/defm/counters.hpp, [351](#)
- include/barry/models/defm/defm-bones.hpp, [357](#)
- include/barry/models/defm/defm-meat.hpp, [357](#)
- include/barry/models/defm/defm-types.hpp, [359](#)
- include/barry/models/defm/formula.hpp, [360](#)
- include/barry/models/geese.hpp, [362](#)
- include/barry/models/geese/counters.hpp, [355](#)
- include/barry/models/geese/flock-bones.hpp, [362](#)
- include/barry/models/geese/flock-meat.hpp, [363](#)
- include/barry/models/geese/geese-bones.hpp, [363](#)
- include/barry/models/geese/geese-meat-constructors.hpp, [365](#)
- include/barry/models/geese/geese-meat-likelihood.hpp, [366](#)
- include/barry/models/geese/geese-meat-likelihood_exhaust.hpp, [367](#)
- include/barry/models/geese/geese-meat-predict.hpp, [367](#)
- include/barry/models/geese/geese-meat-predict_exhaust.hpp, [368](#)
- include/barry/models/geese/geese-meat-predict_sim.hpp, [368](#)
- include/barry/models/geese/geese-meat-simulate.hpp, [369](#)
- include/barry/models/geese/geese-meat.hpp, [369](#)
- include/barry/models/geese/geese-node-bones.hpp, [370](#)
- include/barry/models/geese/geese-types.hpp, [370](#)
- include/barry/powerset-bones.hpp, [373](#)
- include/barry/powerset-meat.hpp, [374](#)
- include/barry/progress.hpp, [374](#)

- include/barry/rules-bones.hpp, 375
- include/barry/rules-meat.hpp, 376
- include/barry/statscounter-bones.hpp, 376
- include/barry/statscounter-meat.hpp, 377
- include/barry/support-bones.hpp, 382
- include/barry/support-meat.hpp, 383
- include/barry/typedefs.hpp, 394
- indices
 - NetCounterData, 195
 - Phylo rules, 44, 45
- inherit_support
 - Geese, 164
- init
 - Counter< Array_Type, Data_Type >, 129
 - DEFM, 140
 - Flock, 151
 - Geese, 164
 - Phylo rules, 45
- init_fun
 - Counter< Array_Type, Data_Type >, 131
 - counters-meat.hpp, 313
- init_fun_
 - counters-meat.hpp, 316
 - model-meat.hpp, 348
- init_node
 - Geese, 164
- init_support
 - PowerSet< Array_Type, Data_Rule_Type >, 214
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 235
- INITIALIZED
 - geese-bones.hpp, 364
- initialized
 - Flock, 154
 - Geese, 170
- insert_cell
 - BArray< Cell_Type, Data_Type >, 66
 - BArrayDense< Cell_Type, Data_Type >, 86
 - barraydense-meat.hpp, 280
 - model-meat.hpp, 336
 - support-meat.hpp, 386
- is_col
 - BArrayVector< Cell_Type, Data_Type >, 113
 - BArrayVector_const< Cell_Type, Data_Type >, 117
- is_dense
 - BArray< Cell_Type, Data_Type >, 66
 - BArrayDense< Cell_Type, Data_Type >, 86
- IS_DUPLICATION
 - Counting, 15
- IS_EITHER
 - Counting, 15
- is_empty
 - BArray< Cell_Type, Data_Type >, 66
 - BArrayDense< Cell_Type, Data_Type >, 86
- is_leaf
 - Node, 201
- is_motif
 - DEFM, 140
 - Phylo rules, 45
- is_row
 - BArrayVector< Cell_Type, Data_Type >, 113
 - BArrayVector_const< Cell_Type, Data_Type >, 117
- IS_SPECIATION
 - Counting, 16
- is_true
 - Phylo rules, 41
- iter
 - ConstBArrayRowIter< Cell_Type, Data_Type >, 126
- j
 - barray-meat.hpp, 261
 - barraydense-meat.hpp, 286
 - counters-meat.hpp, 316
 - model-meat.hpp, 348
 - statscounter-meat.hpp, 382
- j0
 - barray-meat.hpp, 261
 - barraydense-meat.hpp, 286
- j1
 - barray-meat.hpp, 261
 - barraydense-meat.hpp, 286
- k
 - model-meat.hpp, 348
- key
 - model-meat.hpp, 348
- keygen_defm
 - defm-meat.hpp, 358
- keygen_full
 - geese-bones.hpp, 364
- keys2support
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 190
- lb
 - PhyloRuleDynData, 210
- likelihood
 - DEFM, 140
 - Geese, 164
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 183
- likelihood_
 - model-meat.hpp, 337
- likelihood_exhaust
 - Geese, 165
- likelihood_joint
 - Flock, 151
- likelihood_total
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 184

- locator
 - model-meat.hpp, 348
- logical
 - Phylo rules, 45
- logodds
 - DEFM, 140
- M
 - barray-meat.hpp, 257, 261
 - barraydense-meat.hpp, 281, 286
 - PowerSet< Array_Type, Data_Rule_Type >, 215
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 239
- M_
 - barray-meat.hpp, 262
 - barraydense-meat.hpp, 287
- MAKE_DEFM_HASHER
 - Counting, 16
- MAKE_DUPL_VARS
 - Counting, 16
- make_hash
 - FreqTable< T >, 157
- Map
 - barry-configuration.hpp, 298
- map_to_state_id
 - Geese, 170
- MapVec_type
 - typedefs.hpp, 397
- max_num_elements
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 239
- Model
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 176
- model
 - Flock, 154
- Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 172
 - ~Model, 177
 - add_array, 177
 - add_counter, 177, 178
 - add_hasher, 178
 - add_rule, 178
 - add_rule_dyn, 178, 179
 - arrays2support, 188
 - colnames, 179
 - conditional_prob, 179
 - counter_fun, 188
 - counters, 188
 - delete_counters, 189
 - delete_engine, 189
 - delete_rules, 189
 - delete_rules_dyn, 189
 - first_calc_done, 189
 - gen_key, 180
 - get_arrays2support, 180
 - get_counters, 180
 - get_norm_const, 180
 - get_pset, 180
 - get_pset_arrays, 181
 - get_pset_probs, 181
 - get_pset_stats, 181
 - get_engine, 181
 - get_rules, 182
 - get_rules_dyn, 182
 - get_stats_support, 182
 - get_stats_target, 182
 - get_support_fun, 182
 - keys2support, 190
 - likelihood, 183
 - likelihood_total, 184
 - Model, 176
 - normalizing_constants, 190
 - nrules, 184
 - nrules_dyn, 184
 - nterms, 184
 - operator=, 184
 - params_last, 190
 - print, 185
 - print_stats, 185
 - pset_arrays, 190
 - pset_probs, 191
 - pset_stats, 191
 - engine, 191
 - rules, 191
 - rules_dyn, 192
 - sample, 185
 - set_counters, 186
 - set_engine, 186
 - set_rules, 186
 - set_rules_dyn, 186
 - set_seed, 186
 - set_transform_model, 187
 - size, 187
 - size_unique, 187
 - stats_support, 192
 - stats_support_n_arrays, 192
 - stats_target, 192
 - store_psets, 187
 - support_fun, 193
 - support_size, 188
 - transform_model, 188
 - transform_model_fun, 193
 - transform_model_term_names, 193
 - with_pset, 194
- model-meat.hpp
 - a, 345
 - count_fun_, 345
 - counter, 345
 - counters_, 345
 - cumprob, 346
 - data_, 346
 - Data_Counter_Type, 346
 - Data_Rule_Type, 346

- delete_rules, 346
- delete_rules_dyn, 347
- else, 347
- for, 336
- force_new, 347
- fun_, 347
- i, 347
- i_matches, 348
- if, 336
- init_fun_, 348
- insert_cell, 336
- j, 348
- k, 348
- key, 348
- likelihood_, 337
- locator, 348
- MODEL_TEMPLATE, 335, 337–343
- MODEL_TEMPLATE_ARGS, 335
- MODEL_TYPE, 335
- params, 349
- probs, 349
- pset_arrays, 349
- push_back, 343
- r, 349
- return, 343, 349
- rule_fun_, 349
- rules, 350
- rules_, 350
- rules_dyn, 350
- set_counters, 344
- set_rules, 344
- set_rules_dyn, 344
- size, 344
- stats, 350
- stats_support_n_arrays, 350
- temp_stats, 344
- tmp_counts, 344
- update_normalizing_constant, 344
- urand, 345
- MODEL_TEMPLATE
 - model-meat.hpp, 335, 337–343
- MODEL_TEMPLATE_ARGS
 - model-meat.hpp, 335
- MODEL_TYPE
 - model-meat.hpp, 335
- motif_census
 - DEFM, 141
- N
 - barray-meat.hpp, 262
 - barraydense-meat.hpp, 287
 - PowerSet< Array_Type, Data_Rule_Type >, 216
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 239
- n_counters
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 239
- n_free
 - PowerSet< Array_Type, Data_Rule_Type >, 216
- n_locked
 - PowerSet< Array_Type, Data_Rule_Type >, 216
- name
 - Counter< Array_Type, Data_Type >, 131
 - counters-meat.hpp, 313
- name_
 - counters-meat.hpp, 316
- nannotations
 - Geese, 165
- narray
 - Node, 202
- NCells
 - barray-meat.hpp, 262
- ncol
 - BArray< Cell_Type, Data_Type >, 67
 - BArrayDense< Cell_Type, Data_Type >, 86
 - Phylo rules, 41
- NET_C_DATA_IDX
 - network.hpp, 328
- NET_C_DATA_NUM
 - network.hpp, 328
- NetCounter
 - network.hpp, 330
- NetCounterData, 194
 - ~NetCounterData, 195
 - indices, 195
 - NetCounterData, 195
 - numbers, 195
- NetCounters
 - network.hpp, 330
- NetModel
 - network.hpp, 330
- NetRule
 - network.hpp, 330
- NetRules
 - network.hpp, 330
- NetStatsCounter
 - network.hpp, 331
- NetSupport
 - network.hpp, 331
- Network
 - network.hpp, 331
- Network counters, 24
 - counter_absdiff, 26
 - counter_ctriads, 27
 - counter_degree, 27
 - counter_density, 27
 - counter_diff, 28
 - counter_edges, 28
 - counter_fixed_effect, 28
 - counter_iddegree, 29
 - counter_iddegree15, 29
 - counter_isolates, 29, 30
 - counter_istar2, 30
 - counter_logit_intercept, 30
 - counter_mutual, 30

- counter_nodecov, [31](#)
- counter_nodeicov, [31](#)
- counter_nodematch, [31](#)
- counter_nodeecov, [31](#)
- counter_odegree, [31](#), [32](#)
- counter_odegree15, [32](#)
- counter_ones, [32](#)
- counter_ostar2, [33](#)
- counter_transition, [33](#)
- counter_transition_formula, [34](#)
- counter_ttriads, [34](#)
- NETWORK_COUNTER, [34](#)
- rules_dont_become_zero, [34](#)
- rules_markov_fixed, [35](#)
- network-css.hpp
 - counter_css_census01, [321](#)
 - counter_css_census02, [321](#)
 - counter_css_census03, [321](#)
 - counter_css_census04, [321](#)
 - counter_css_census05, [322](#)
 - counter_css_census06, [322](#)
 - counter_css_census07, [322](#)
 - counter_css_census08, [322](#)
 - counter_css_census09, [323](#)
 - counter_css_census10, [323](#)
 - counter_css_completely_false_recip_comiss, [323](#)
 - counter_css_completely_false_recip_omiss, [323](#)
 - counter_css_mixed_recip, [324](#)
 - counter_css_partially_false_recip_commi, [324](#)
 - counter_css_partially_false_recip_omiss, [324](#)
 - CSS_APPEND, [318](#)
 - CSS_CASE_ELSE, [319](#)
 - CSS_CASE_PERCEIVED, [319](#)
 - CSS_CASE_TRUTH, [319](#)
 - CSS_CHECK_SIZE, [319](#)
 - CSS_CHECK_SIZE_INIT, [319](#)
 - CSS_NET_COUNTER_LAMBDA_INIT, [320](#)
 - CSS_PERCEIVED_CELLS, [320](#)
 - CSS_SIZE, [320](#)
 - CSS_TRUE_CELLS, [320](#)
- network.hpp
 - BARRY_ZERO_NETWORK, [328](#)
 - BARRY_ZERO_NETWORK_DENSE, [328](#)
 - NET_C_DATA_IDX, [328](#)
 - NET_C_DATA_NUM, [328](#)
 - NetCounter, [330](#)
 - NetCounters, [330](#)
 - NetModel, [330](#)
 - NetRule, [330](#)
 - NetRules, [330](#)
 - NetStatsCounter, [331](#)
 - NetSupport, [331](#)
 - Network, [331](#)
 - NETWORK_COUNTER, [328](#)
 - NETWORK_COUNTER_LAMBDA, [329](#)
 - NETWORK_RULE, [329](#)
 - NETWORK_RULE_LAMBDA, [329](#)
 - NetworkDense, [331](#)
 - NETWORKDENSE_COUNTER_LAMBDA, [329](#)
 - rules_zerodiag, [331](#)
- NETWORK_COUNTER
 - Network counters, [34](#)
 - network.hpp, [328](#)
- NETWORK_COUNTER_LAMBDA
 - network.hpp, [329](#)
- NETWORK_RULE
 - network.hpp, [329](#)
- NETWORK_RULE_LAMBDA
 - network.hpp, [329](#)
- NetworkData, [196](#)
 - ~NetworkData, [197](#)
 - directed, [197](#)
 - NetworkData, [196](#), [197](#)
 - vertex_attr, [197](#)
- NetworkDense
 - network.hpp, [331](#)
- NETWORKDENSE_COUNTER_LAMBDA
 - network.hpp, [329](#)
- next
 - Progress, [218](#)
- nfunctions
 - Flock, [154](#)
 - Geese, [170](#)
- nfuncs
 - Flock, [151](#)
 - Geese, [165](#)
- nleaves
 - Flock, [152](#)
 - Geese, [165](#)
- nnodes
 - Flock, [152](#)
 - Geese, [165](#)
- nnozero
 - BArray< Cell_Type, Data_Type >, [67](#)
 - BArrayDense< Cell_Type, Data_Type >, [87](#)
- Node, [198](#)
 - ~Node, [200](#)
 - annotations, [201](#)
 - array, [201](#)
 - arrays, [201](#)
 - duplication, [202](#)
 - get_parent, [200](#)
 - id, [202](#)
 - is_leaf, [201](#)
 - narray, [202](#)
 - Node, [199](#), [200](#)
 - noffspring, [201](#)
 - offspring, [202](#)
 - ord, [202](#)
 - parent, [203](#)
 - probability, [203](#)
 - subtree_prob, [203](#)
 - visited, [203](#)
- NodeData, [204](#)
 - blengths, [204](#)
 - duplication, [205](#)

- NodeData, 204
- states, 205
- nodes
 - Geese, 170
- noexcept
 - counters-meat.hpp, 316
- noffspring
 - Node, 201
- NONE
 - CHECK, 56
 - EXISTS, 58
- normalizing_constants
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 190
- nrow
 - BArray< Cell_Type, Data_Type >, 67
 - BArrayDense< Cell_Type, Data_Type >, 87
 - Phylo rules, 41
- nrules
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 184
- nrules_dyn
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 184
- nterms
 - Flock, 152
 - Geese, 166
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 184
- ntrees
 - Flock, 152
- num
 - Phylo rules, 41, 42
- numbers
 - NetCounterData, 195
 - Phylo rules, 45, 46
- obs_start
 - Phylo rules, 46
- observed_counts
 - Geese, 166
- offspring
 - Node, 202
- ONE
 - CHECK, 56
 - EXISTS, 58
- operator BArrayRow< Cell_Type, Data_Type >
 - BArrayRow< Cell_Type, Data_Type >, 108
- operator BArrayRow_const< Cell_Type, Data_Type >
 - BArrayRow_const< Cell_Type, Data_Type >, 110
- operator Cell_Type
 - BArrayCell< Cell_Type, Data_Type >, 74
 - BArrayCell_const< Cell_Type, Data_Type >, 77
 - BArrayDenseCell< Cell_Type, Data_Type >, 95
 - Cell< Cell_Type >, 122
- operator std::vector< Cell_Type >
 - BArrayVector< Cell_Type, Data_Type >, 114
 - BArrayVector_const< Cell_Type, Data_Type >, 117
- operator!=
 - BArrayCell_const< Cell_Type, Data_Type >, 77
 - BArrayRow_const< Cell_Type, Data_Type >, 110
 - BArrayVector_const< Cell_Type, Data_Type >, 117
 - Cell< Cell_Type >, 122
- operator<
 - BArrayCell_const< Cell_Type, Data_Type >, 77
 - BArrayRow_const< Cell_Type, Data_Type >, 110
 - BArrayVector_const< Cell_Type, Data_Type >, 118
- operator<=
 - BArrayCell_const< Cell_Type, Data_Type >, 77
 - BArrayRow_const< Cell_Type, Data_Type >, 111
 - BArrayVector_const< Cell_Type, Data_Type >, 118
- operator>
 - BArrayCell_const< Cell_Type, Data_Type >, 77
 - BArrayRow_const< Cell_Type, Data_Type >, 111
 - BArrayVector_const< Cell_Type, Data_Type >, 118
- operator>=
 - BArrayCell_const< Cell_Type, Data_Type >, 78
 - BArrayRow_const< Cell_Type, Data_Type >, 111
 - BArrayVector_const< Cell_Type, Data_Type >, 118
- operator*=
 - BArray< Cell_Type, Data_Type >, 67
 - BArrayCell< Cell_Type, Data_Type >, 74
 - BArrayDense< Cell_Type, Data_Type >, 87
 - BArrayDenseCell< Cell_Type, Data_Type >, 95
 - BArrayRow< Cell_Type, Data_Type >, 108
 - BArrayVector< Cell_Type, Data_Type >, 114
- operator()
 - BArray< Cell_Type, Data_Type >, 67
 - barray-meat-operators.hpp, 245
 - BArrayDense< Cell_Type, Data_Type >, 87
 - BArrayDenseCol< Cell_Type, Data_Type >, 99
 - BArrayDenseCol_const< Cell_Type, Data_Type >, 101
 - BArrayDenseRow< Cell_Type, Data_Type >, 104
 - BArrayDenseRow_const< Cell_Type, Data_Type >, 106
 - Flock, 152
 - Phylo rules, 42
 - PhyloCounterData, 207
 - PhyloRuleDynData, 209
 - Rule< Array_Type, Data_Type >, 221
 - Rules< Array_Type, Data_Type >, 224
 - vecHasher< T >, 240
- operator+=
 - BArray< Cell_Type, Data_Type >, 68
 - BArrayCell< Cell_Type, Data_Type >, 74
 - BArrayDense< Cell_Type, Data_Type >, 87, 88

- BArrayDenseCell< Cell_Type, Data_Type >, 95
- BArrayRow< Cell_Type, Data_Type >, 108
- BArrayVector< Cell_Type, Data_Type >, 114
- operator-=
 - BArray< Cell_Type, Data_Type >, 68
 - BArrayCell< Cell_Type, Data_Type >, 75
 - BArrayDense< Cell_Type, Data_Type >, 88
 - BArrayDenseCell< Cell_Type, Data_Type >, 96
 - BArrayRow< Cell_Type, Data_Type >, 108
 - BArrayVector< Cell_Type, Data_Type >, 114
- operator/=
 - BArray< Cell_Type, Data_Type >, 69
 - BArrayCell< Cell_Type, Data_Type >, 75
 - BArrayDense< Cell_Type, Data_Type >, 88
 - BArrayDenseCell< Cell_Type, Data_Type >, 96
 - BArrayRow< Cell_Type, Data_Type >, 109
 - BArrayVector< Cell_Type, Data_Type >, 114
- operator=
 - BArray< Cell_Type, Data_Type >, 69
 - BArrayCell< Cell_Type, Data_Type >, 75
 - BArrayDense< Cell_Type, Data_Type >, 89
 - BArrayDenseCell< Cell_Type, Data_Type >, 96
 - BArrayRow< Cell_Type, Data_Type >, 109
 - BArrayVector< Cell_Type, Data_Type >, 115
 - Cell< Cell_Type >, 122, 123
 - Counter< Array_Type, Data_Type >, 129, 130
 - Counters< Array_Type, Data_Type >, 135
 - Geese, 166
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 184
 - Rules< Array_Type, Data_Type >, 225
- operator==
 - BArray< Cell_Type, Data_Type >, 69
 - BArrayCell< Cell_Type, Data_Type >, 75
 - BArrayCell_const< Cell_Type, Data_Type >, 77
 - BArrayDense< Cell_Type, Data_Type >, 89
 - BArrayDenseCell< Cell_Type, Data_Type >, 96
 - BArrayRow< Cell_Type, Data_Type >, 109
 - BArrayRow_const< Cell_Type, Data_Type >, 111
 - BArrayVector< Cell_Type, Data_Type >, 115
 - BArrayVector_const< Cell_Type, Data_Type >, 118
 - Cell< Cell_Type >, 123
- operator[]
 - Counters< Array_Type, Data_Type >, 136
 - PhyloCounterData, 207
 - PowerSet< Array_Type, Data_Rule_Type >, 214
- ord
 - Node, 202
- out_of_range
 - BArray< Cell_Type, Data_Type >, 69
 - BArrayDense< Cell_Type, Data_Type >, 89
- params
 - model-meat.hpp, 349
- params_last
- Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 190
- parent
 - Node, 203
- parse_polytomies
 - Flock, 153
 - Geese, 166
- Phylo counters, 47
 - counter_co_opt, 48
 - counter_cogain, 49
 - counter_gains, 49
 - counter_gains_from_0, 49
 - counter_gains_k_offspring, 49
 - counter_genes_changing, 50
 - counter_k_genes_changing, 50
 - counter_less_than_p_prop_genes_changing, 50
 - counter_longest, 50
 - counter_loss, 51
 - counter_maxfun, 51
 - counter_neofun, 51
 - counter_neofun_a2b, 51
 - counter_overall_changes, 52
 - counter_overall_gains, 52
 - counter_overall_gains_from_0, 52
 - counter_overall_loss, 52
 - counter_pairwise_first_gain, 53
 - counter_pairwise_neofun_singlefun, 53
 - counter_pairwise_overall_change, 53
 - counter_pairwise_preserving, 53
 - counter_preserve_pseudogene, 54
 - counter_prop_genes_changing, 54
 - counter_subfun, 54
- Phylo rules, 35
 - ~DEFMCounterData, 43
 - ~DEFMData, 43
 - ~DEFMRuleDynData, 43
 - array, 44
 - at, 39
 - counts, 44
 - covar_sort, 44
 - covar_used, 44
 - covariates, 44
 - DEFMCounter, 37
 - DEFMCounterData, 39
 - DEFMCounters, 37
 - DEFMData, 39
 - DEFMModel, 37
 - DEFMRule, 38
 - DEFMRuleData, 40
 - DEFMRuleDyn, 38
 - DEFMRuleDynData, 40
 - DEFMRules, 38
 - DEFMRulesDyn, 38
 - DEFMStatsCounter, 38
 - DEFMSupport, 38
 - idx, 40, 41
 - indices, 44, 45

- init, [45](#)
- is_motif, [45](#)
- is_true, [41](#)
- logical, [45](#)
- ncol, [41](#)
- nrow, [41](#)
- num, [41](#), [42](#)
- numbers, [45](#), [46](#)
- obs_start, [46](#)
- operator(), [42](#)
- print, [42](#)
- rule_dyn_limit_changes, [42](#)
- X_ncol, [46](#)
- X_nrow, [46](#)
- PHYLO_CHECK_MISSING
 - Counting, [16](#)
- PHYLO_COUNTER_LAMBDA
 - Counting, [17](#)
- PHYLO_RULE_DYN_LAMBDA
 - Counting, [17](#)
- PhyloArray
 - geese-types.hpp, [371](#)
- PhyloCounter
 - geese-types.hpp, [371](#)
- PhyloCounterData, [205](#)
 - at, [206](#)
 - begin, [206](#)
 - empty, [206](#)
 - end, [207](#)
 - get_counters, [207](#)
 - operator(), [207](#)
 - operator[], [207](#)
 - PhyloCounterData, [206](#)
 - push_back, [207](#)
 - reserve, [207](#)
 - shrink_to_fit, [208](#)
 - size, [208](#)
- PhyloCounters
 - geese-types.hpp, [371](#)
- PhyloModel
 - geese-types.hpp, [371](#)
- PhyloPowerSet
 - geese-types.hpp, [371](#)
- PhyloRule
 - geese-types.hpp, [372](#)
- PhyloRuleData
 - geese-types.hpp, [372](#)
- PhyloRuleDyn
 - geese-types.hpp, [372](#)
- PhyloRuleDynData, [208](#)
 - ~PhyloRuleDynData, [209](#)
 - counts, [209](#)
 - duplication, [209](#)
 - lb, [210](#)
 - operator(), [209](#)
 - PhyloRuleDynData, [209](#)
 - pos, [210](#)
 - ub, [210](#)
- PhyloRules
 - geese-types.hpp, [372](#)
- PhyloRulesDyn
 - geese-types.hpp, [372](#)
- PhyloStatsCounter
 - geese-types.hpp, [372](#)
- PhyloSupport
 - geese-types.hpp, [373](#)
- POS
 - barraydense-meat-operators.hpp, [266](#)
 - barraydense-meat.hpp, [271](#)
 - barraydensecell-bones.hpp, [289](#)
 - barraydensecell-meat.hpp, [290](#)
 - barraydensecol-bones.hpp, [291](#)
 - barraydenserow-bones.hpp, [292](#)
- pos
 - PhyloRuleDynData, [210](#)
- POS_N
 - barraydense-meat-operators.hpp, [267](#)
 - barraydense-meat.hpp, [271](#)
 - barraydensecol-bones.hpp, [291](#)
 - barraydenserow-bones.hpp, [292](#)
- PowerSet
 - PowerSet< Array_Type, Data_Rule_Type >, [212](#)
- PowerSet< Array_Type, Data_Rule_Type >, [210](#)
 - ~PowerSet, [212](#)
 - add_rule, [212](#), [213](#)
 - begin, [213](#)
 - calc, [213](#)
 - coordinates_free, [215](#)
 - coordinates_locked, [215](#)
 - data, [215](#)
 - EmptyArray, [215](#)
 - end, [213](#)
 - get_data, [213](#)
 - get_data_ptr, [214](#)
 - init_support, [214](#)
 - M, [215](#)
 - N, [216](#)
 - n_free, [216](#)
 - n_locked, [216](#)
 - operator[], [214](#)
 - PowerSet, [212](#)
 - reset, [214](#)
 - rules, [216](#)
 - rules_deleted, [216](#)
 - size, [214](#)
- predict
 - Geese, [166](#)
- predict_backend
 - Geese, [167](#)
- predict_exhaust
 - Geese, [167](#)
- predict_exhaust_backend
 - Geese, [167](#)
- predict_sim
 - Geese, [167](#)
- print

- BArray< Cell_Type, Data_Type >, [69](#)
- BArrayDense< Cell_Type, Data_Type >, [89](#)
- DEFM, [141](#)
- Flock, [153](#)
- FreqTable< T >, [157](#)
- Geese, [167](#)
- Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [185](#)
- Phylo rules, [42](#)
- Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [235](#)
- print_nodes
 - Geese, [168](#)
- print_observed_counts
 - Geese, [168](#)
- print_stats
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [185](#)
- printf_barry
 - barraydense-meat.hpp, [281](#)
 - barry-configuration.hpp, [297](#)
- probability
 - Node, [203](#)
- probs
 - model-meat.hpp, [349](#)
- Progress, [217](#)
 - ~Progress, [217](#)
 - end, [218](#)
 - next, [218](#)
 - Progress, [217](#)
- progress.hpp
 - BARRY_PROGRESS_BAR_WIDTH, [375](#)
- pset_arrays
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [190](#)
 - model-meat.hpp, [349](#)
- pset_loc
 - Geese, [170](#)
- pset_probs
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [191](#)
- pset_stats
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [191](#)
- push_back
 - model-meat.hpp, [343](#)
 - PhyloCounterData, [207](#)
- r
 - model-meat.hpp, [349](#)
- README.md, [399](#)
- reduced_sequence
 - Geese, [171](#)
- rengine
 - Flock, [154](#)
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [191](#)
- report
 - barray-meat.hpp, [262](#)
 - barraydense-meat.hpp, [287](#)
- res
 - counters-meat.hpp, [316](#)
- reserve
 - BArray< Cell_Type, Data_Type >, [70](#)
 - BArrayDense< Cell_Type, Data_Type >, [89](#)
 - FreqTable< T >, [157](#)
 - PhyloCounterData, [207](#)
- reset
 - PowerSet< Array_Type, Data_Rule_Type >, [214](#)
- reset_array
 - StatsCounter< Array_Type, Data_Type >, [228](#)
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [235](#), [236](#)
- resize
 - BArray< Cell_Type, Data_Type >, [70](#)
 - barray-meat.hpp, [257](#)
 - BArrayDense< Cell_Type, Data_Type >, [90](#)
 - barraydense-meat.hpp, [281](#), [282](#)
 - Entries< Cell_Type >, [147](#)
 - statscounter-meat.hpp, [379](#)
- return
 - barray-meat.hpp, [257](#), [262](#)
 - barraydense-meat.hpp, [287](#)
 - counters-meat.hpp, [317](#)
 - model-meat.hpp, [343](#), [349](#)
 - statscounter-meat.hpp, [382](#)
 - support-meat.hpp, [392](#)
- rhs
 - barray-meat-operators.hpp, [245](#)
- rm_cell
 - BArray< Cell_Type, Data_Type >, [70](#)
 - BArrayDense< Cell_Type, Data_Type >, [90](#)
 - barraydense-meat.hpp, [282](#)
 - support-meat.hpp, [386](#)
- ROW
 - barray-meat-operators.hpp, [243](#)
 - barray-meat.hpp, [249](#), [257](#), [258](#)
 - barraydense-meat-operators.hpp, [267](#)
 - barraydense-meat.hpp, [272](#)
- row
 - BArray< Cell_Type, Data_Type >, [70](#)
 - BArrayDense< Cell_Type, Data_Type >, [90](#)
- row0
 - barray-meat.hpp, [263](#)
- Row_type
 - typedefs.hpp, [397](#)
- rowsum
 - BArrayDense< Cell_Type, Data_Type >, [90](#)
- Rule

- Rule< Array_Type, Data_Type >, 219
- Rule< Array_Type, Data_Type >, 218
 - ~Rule, 219
 - D, 220
 - get_description, 220
 - get_name, 220
 - operator(), 221
 - Rule, 219
- rule_dyn_limit_changes
 - Phylo rules, 42
- rule_fun_
 - model-meat.hpp, 349
- rule_fun_default
 - rules-bones.hpp, 375
- Rule_fun_type
 - typedefs.hpp, 397
- RULE_FUNCTION
 - barry.hpp, 303
 - geese-bones.hpp, 364
- RULE_LAMBDA
 - barry.hpp, 303
- Rules
 - Rules< Array_Type, Data_Type >, 222
- rules
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 191
 - model-meat.hpp, 350
 - PowerSet< Array_Type, Data_Rule_Type >, 216
 - support-meat.hpp, 392
- Rules< Array_Type, Data_Type >, 221
 - ~Rules, 222
 - add_rule, 223
 - begin, 223
 - end, 223
 - get_descriptions, 223
 - get_names, 224
 - get_seq, 224
 - operator(), 224
 - operator=, 225
 - Rules, 222
 - size, 225
- rules-bones.hpp
 - rule_fun_default, 375
- rules_
 - model-meat.hpp, 350
 - support-meat.hpp, 392
- rules_deleted
 - PowerSet< Array_Type, Data_Rule_Type >, 216
- rules_dont_become_zero
 - Network counters, 34
- rules_dyn
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 192
 - model-meat.hpp, 350
 - support-meat.hpp, 393
- rules_markov_fixed
 - Network counters, 35
- rules_zerodiag
 - network.hpp, 331
- sample
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 185
- search
 - barray-meat.hpp, 263
- sequence
 - Geese, 171
- set_counters
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 186
 - model-meat.hpp, 344
 - StatsCounter< Array_Type, Data_Type >, 229
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 236
- set_data
 - BArray< Cell_Type, Data_Type >, 70
 - BArrayDense< Cell_Type, Data_Type >, 90
- set_hasher
 - Counter< Array_Type, Data_Type >, 130
- set_names
 - DEFM, 141
- set_engine
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 186
- set_rules
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 186
 - model-meat.hpp, 344
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 236
- set_rules_dyn
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 186
 - model-meat.hpp, 344
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 236
- set_seed
 - Flock, 153
 - Geese, 168
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 186
- set_transform_model
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 187
- shrink_to_fit

- PhyloCounterData, 208
- simulate
 - DEFM, 141
 - Geese, 168
- size
 - BArrayDenseCol< Cell_Type, Data_Type >, 99
 - BArrayDenseCol_const< Cell_Type, Data_Type >, 102
 - BArrayDenseRow< Cell_Type, Data_Type >, 104
 - BArrayDenseRow_const< Cell_Type, Data_Type >, 106
 - BArrayVector< Cell_Type, Data_Type >, 115
 - BArrayVector_const< Cell_Type, Data_Type >, 119
 - Counters< Array_Type, Data_Type >, 136
 - FreqTable< T >, 158
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 187
 - model-meat.hpp, 344
 - PhyloCounterData, 208
 - PowerSet< Array_Type, Data_Rule_Type >, 214
 - Rules< Array_Type, Data_Type >, 225
 - StatsCounter< Array_Type, Data_Type >, 229
- size_unique
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 187
- sort_array
 - typedefs.hpp, 397
- source
 - barray-meat.hpp, 263
 - barraydense-meat.hpp, 287
 - Entries< Cell_Type >, 147
- states
 - NodeData, 205
- Statistical Models, 24
- stats
 - model-meat.hpp, 350
- stats_bank
 - support-meat.hpp, 393
- stats_support
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 192
- stats_support_n_arrays
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 192
 - model-meat.hpp, 350
- stats_target
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 192
- StatsCounter
 - StatsCounter< Array_Type, Data_Type >, 226, 227
- StatsCounter< Array_Type, Data_Type >, 225
- ~StatsCounter, 227
 - add_counter, 227
 - count_all, 227
 - count_current, 228
 - count_init, 228
 - get_counters, 228
 - get_descriptions, 228
 - get_names, 228
 - reset_array, 228
 - set_counters, 229
 - size, 229
 - StatsCounter, 226, 227
- statscounter-meat.hpp
 - clear, 378
 - counter, 380
 - counter_deleted, 381
 - counters, 381
 - counters_, 381
 - current_stats, 381
 - EmptyArray, 381
 - f_, 382
 - for, 378
 - j, 382
 - resize, 379
 - return, 382
 - STATSCOUNTER_TEMPLATE, 378–380
 - STATSCOUNTER_TEMPLATE_ARGS, 378
 - STATSCOUNTER_TYPE, 378
- STATSCOUNTER_TEMPLATE
 - statscounter-meat.hpp, 378–380
- STATSCOUNTER_TEMPLATE_ARGS
 - statscounter-meat.hpp, 378
- STATSCOUNTER_TYPE
 - statscounter-meat.hpp, 378
- store_psets
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 187
- subtree_prob
 - Node, 203
- Support
 - Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 231, 232
- Support< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, 229
 - ~Support, 232
 - add_counter, 232
 - add_rule, 232, 233
 - add_rule_dyn, 233
 - calc, 233
 - change_stats, 236
 - coordiantes_n_free, 237
 - coordiantes_n_locked, 237
 - coordinates_free, 237
 - coordinates_locked, 237
 - current_stats, 237
 - delete_counters, 238

- delete_rules, 238
- delete_rules_dyn, 238
- eval_rules_dyn, 234
- get_counters, 234
- get_counts, 234
- get_current_stats, 234
- get_data, 234
- get_rules, 235
- get_rules_dyn, 235
- hashes, 238
- hashes_initialized, 238
- init_support, 235
- M, 239
- max_num_elements, 239
- N, 239
- n_counters, 239
- print, 235
- reset_array, 235, 236
- set_counters, 236
- set_rules, 236
- set_rules_dyn, 236
- Support, 231, 232
- support-meat.hpp
 - array_bank, 390
 - BARRY_SUPPORT_MEAT_HPP, 384
 - calc_backend_dense, 385
 - calc_backend_sparse, 385
 - change_stats_different, 390
 - coord_i, 390
 - coord_j, 390
 - counters, 390
 - counters_, 391
 - delete_counters, 391
 - delete_rules, 391
 - delete_rules_dyn, 391
 - else, 391
 - f_, 392
 - for, 385
 - hashes, 392
 - if, 385, 386
 - insert_cell, 386
 - return, 392
 - rm_cell, 386
 - rules, 392
 - rules_, 392
 - rules_dyn, 393
 - stats_bank, 393
 - SUPPORT_TEMPLATE, 384, 387–390
 - SUPPORT_TEMPLATE_ARGS, 384
 - SUPPORT_TYPE, 385
 - tmp_chng, 393
- support_fun
 - Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
193
- support_size
 - Flock, 153
 - Geese, 168
- Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
188
- SUPPORT_TEMPLATE
 - support-meat.hpp, 384, 387–390
- SUPPORT_TEMPLATE_ARGS
 - support-meat.hpp, 384
- SUPPORT_TYPE
 - support-meat.hpp, 385
- swap_cells
 - BArray< Cell_Type, Data_Type >, 71
 - BArrayDense< Cell_Type, Data_Type >, 91
- swap_cols
 - BArray< Cell_Type, Data_Type >, 71
 - BArrayDense< Cell_Type, Data_Type >, 91
- swap_rows
 - BArray< Cell_Type, Data_Type >, 71
 - BArrayDense< Cell_Type, Data_Type >, 91
- target
 - barray-meat.hpp, 263
 - barraydense-meat.hpp, 288
 - Entries< Cell_Type >, 147
- temp_stats
 - model-meat.hpp, 344
- this
 - barray-meat-operators.hpp, 246
- tmp_chng
 - support-meat.hpp, 393
- tmp_counts
 - model-meat.hpp, 344
- TMP_HASHER_CALL
 - counters-meat.hpp, 307
- toggle_cell
 - BArray< Cell_Type, Data_Type >, 71
 - BArrayDense< Cell_Type, Data_Type >, 91
- toggle_lock
 - BArray< Cell_Type, Data_Type >, 71
 - BArrayDense< Cell_Type, Data_Type >, 92
- transform_model
 - Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
188
- transform_model_fun
 - Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
193
- transform_model_term_names
 - Model< Array_Type, Data_Counter_Type,
Data_Rule_Type, Data_Rule_Dyn_Type >,
193
- transpose
 - BArray< Cell_Type, Data_Type >, 72
 - BArrayDense< Cell_Type, Data_Type >, 92
- TWO
 - CHECK, 56
 - EXISTS, 58
- typedefs.hpp
 - Col_type, 396

- Counter_fun_type, [396](#)
- Counts_type, [396](#)
- Hasher_fun_type, [396](#)
- MapVec_type, [397](#)
- Row_type, [397](#)
- Rule_fun_type, [397](#)
- sort_array, [397](#)
- vec_equal, [398](#)
- vec_equal_approx, [398](#)
- vec_inner_prod, [398](#), [399](#)
- ub
 - PhyloRuleDynData, [210](#)
- UNKNOWN
 - EXISTS, [58](#)
- UNI_SUB
 - counters.hpp, [354](#)
- update_annotations
 - Geese, [168](#)
- update_normalizing_constant
 - model-meat.hpp, [344](#)
- urand
 - model-meat.hpp, [345](#)
- v
 - barray-meat.hpp, [263](#)
 - barraydense-meat.hpp, [288](#)
- va_end
 - barraydense-meat.hpp, [282](#)
- va_start
 - barraydense-meat.hpp, [283](#)
- val
 - Entries< Cell_Type >, [147](#)
- val0
 - barraydense-meat.hpp, [288](#)
- val1
 - barraydense-meat.hpp, [288](#)
- value
 - barray-meat.hpp, [263](#)
 - barraydense-meat.hpp, [288](#)
 - Cell< Cell_Type >, [123](#)
- vec_diff
 - geese-bones.hpp, [364](#)
- vec_equal
 - typedefs.hpp, [398](#)
- vec_equal_approx
 - typedefs.hpp, [398](#)
- vec_inner_prod
 - typedefs.hpp, [398](#), [399](#)
- vecHasher< T >, [240](#)
 - operator(), [240](#)
- vector_caster
 - geese-bones.hpp, [365](#)
- vertex_attr
 - NetworkData, [197](#)
- visited
 - BArray< Cell_Type, Data_Type >, [73](#)
 - BArrayDense< Cell_Type, Data_Type >, [93](#)
 - Cell< Cell_Type >, [123](#)
 - Node, [203](#)
- with_pset
 - Model< Array_Type, Data_Counter_Type, Data_Rule_Type, Data_Rule_Dyn_Type >, [194](#)
- X_ncol
 - Phylo rules, [46](#)
- X_nrow
 - Phylo rules, [46](#)
- ZERO_CELL
 - barraydense-meat.hpp, [272](#)
 - barraydensecol-bones.hpp, [291](#)
 - barraydenserow-bones.hpp, [293](#)
- zero_col
 - BArray< Cell_Type, Data_Type >, [72](#)
 - BArrayDense< Cell_Type, Data_Type >, [92](#)
- zero_row
 - BArray< Cell_Type, Data_Type >, [72](#)
 - BArrayDense< Cell_Type, Data_Type >, [92](#)