

Contents

Foreword	v
Preface	vii
Part I Introduction	1
1 The concept of the C++ Standard Template Library	3
1.1 Genericity of components	4
1.2 Abstract and implicit data types	4
1.3 The fundamental concept	5
1.3.1 Containers	5
1.3.2 Iterators	5
1.3.3 Algorithms	6
1.3.4 Interplay	6
1.4 Internal functioning	9
1.5 Complexity	14
1.5.1 O notation	15
1.5.2 Ω notation	18
1.6 Auxiliary classes and functions	19
1.6.1 Pairs	19
1.6.2 Comparison operators	20
1.6.3 Function objects	21
1.6.4 Function adapters	24
1.7 Some conventions	27
1.7.1 Namespaces	27
1.7.2 Header files	28
1.7.3 Allocators	28
2 Iterators	29
2.1 Iterator properties	30
2.1.1 States	30
2.1.2 Standard iterator and traits classes	30
2.1.3 Distances	32
2.1.4 Categories	33

2.1.5	Reverse iterators	35
2.1.6	Const iterators	36
2.1.7	Tag classes	36
2.2	Stream iterators	37
2.2.1	Istream iterator	37
2.2.2	Ostream iterator	40
3	Containers	45
3.1	Data type interface	45
3.2	Container methods	46
3.2.1	Reversible containers	46
3.3	Sequences	47
3.3.1	Vector	49
3.3.2	List	52
3.3.3	Deque	56
3.3.4	showSequence	56
3.4	Iterator categories and containers	58
3.4.1	Derivation of value and distance types	61
3.4.2	Inheriting iterator properties	63
3.5	Iterators for insertion into containers	63
4	Abstract data types	69
4.1	Stack	69
4.2	Queue	70
4.3	Priority queue	72
4.4	Sorted associative containers	73
4.4.1	Set	74
4.4.2	Multiset	78
4.4.3	Map	78
4.4.4	Multimap	81
Part II	Algorithms	83
5	Standard algorithms	85
5.1	Copying algorithms	85
5.2	Algorithms with predicates	86
5.2.1	Algorithms with binary predicates	87
5.3	Nonmutating sequence operations	87
5.3.1	for_each	87
5.3.2	find and find_if	89
5.3.3	find_end	90
5.3.4	find_first_of	92
5.3.5	adjacent_find	93
5.3.6	count and count_if	94
5.3.7	mismatch	95

5.3.8	equal	98
5.3.9	search	99
5.3.10	search_n	101
5.4	Mutating sequence operations	101
5.4.1	iota	101
5.4.2	copy and copy_backward	102
5.4.3	copy_if	104
5.4.4	swap, iter_swap, and swap_ranges	105
5.4.5	transform	107
5.4.6	replace and variants	109
5.4.7	fill and fill_n	111
5.4.8	generate and generate_n	112
5.4.9	remove and variants	113
5.4.10	unique	115
5.4.11	reverse	116
5.4.12	rotate	117
5.4.13	random_shuffle	119
5.4.14	partition	121
5.5	Sorting, merging, and related operations	122
5.5.1	sort	122
5.5.2	nth_element	126
5.5.3	Binary search	127
5.5.4	Merging	130
5.6	Set operations on sorted structures	134
5.6.1	includes	134
5.6.2	set_union	135
5.6.3	set_intersection	136
5.6.4	set_difference	137
5.6.5	set_symmetric_difference	138
5.6.6	Conditions and limitations	139
5.7	Heap algorithms	141
5.7.1	pop_heap	143
5.7.2	push_heap	145
5.7.3	make_heap	147
5.7.4	sort_heap	148
5.8	Minimum and maximum	150
5.9	Lexicographical comparison	151
5.10	Permutations	152
5.11	Numeric algorithms	153
5.11.1	accumulate	153
5.11.2	inner_product	154
5.11.3	partial_sum	156
5.11.4	adjacent_difference	157

Part III	Beyond the STL: components and applications	159
6	Set operations on associative containers	161
6.1	Subset relation	162
6.2	Union	162
6.3	Intersection	163
6.4	Difference	163
6.5	Symmetric difference	164
6.6	Example	165
7	Fast associative containers	169
7.1	Fundamentals	169
7.1.1	Collision handling	170
7.2	Map	171
7.2.1	Example	180
7.3	Set	181
7.4	Overloaded operators for sets	182
7.4.1	Union	182
7.4.2	Intersection	183
7.4.3	Difference	183
7.4.4	Symmetric difference	183
7.4.5	Example	184
8	Various applications	185
8.1	Cross-reference	185
8.2	Permuted index	187
8.3	Thesaurus	190
9	Vectors and matrices	195
9.1	Checked vectors	195
9.2	Matrices as nested containers	197
9.2.1	Two-dimensional matrices	198
9.2.2	Three-dimensional matrix	201
9.2.3	Generalization	204
9.3	Matrices for different memory models	204
9.3.1	C memory layout	207
9.3.2	FORTRAN memory layout	208
9.3.3	Memory layout for symmetric matrices	209
9.4	Sparse matrices	210
9.4.1	Index operator and assignment	213
9.4.2	Hash function for index pairs	214
9.4.3	Class MatrixElement	215
9.4.4	Class sparseMatrix	217
9.4.5	Run time measurements	220

10 External sorting	221
10.1 External sorting by merging	221
10.2 External sorting with accelerator	228
11 Graphs	233
11.1 Class Graph	236
11.1.1 Insertion of vertices and edges	238
11.1.2 Analysis of a graph	239
11.1.3 Input and output tools	243
11.2 Dynamic priority queue	245
11.2.1 Data structure	246
11.2.2 Class <code>dynamic_priority_queue</code>	246
11.3 Graph algorithms	252
11.3.1 Shortest paths	254
11.3.2 Topological sorting of a graph	258
A Appendix	265
A.1 Auxiliary programs	265
A.1.1 Reading the thesaurus file <code>roget.dat</code>	265
A.1.2 Reading a graph file	266
A.1.3 Creation of vertices with random coordinates	267
A.1.4 Connecting neighboring vertices	268
A.1.5 Creating a \LaTeX file	269
A.2 Sources and comments	271
A.3 Solutions to selected exercises	271
A.4 Overview of the sample files	279
A.4.1 Files in the include directory	279
A.4.2 Files for the introductory examples	279
A.4.3 Files for the standard algorithms	279
A.4.4 Files for applications and extensions	280
References	283
Index	285