

CONTENTS

	Acknowledgements	xi
	Introduction	xii
1	The Five Minute DBA	1
	Identifying Performance Problems	2
	Finding a Slow SQL Statement	2
	Confirming the Slow Query	2
	Optimizing Your Query	4
	What You Should Not Do	5
	Confirm Your Optimization	5
	The Correct Approach	6
	An Alternative Solution	7
	Conclusion	7
2	The Essential Analysis Commands	9
	EXPLAIN	10
	EXPLAIN PARTITIONS	11
	EXPLAIN EXTENDED	12
	SHOW CREATE TABLE	13
	SHOW INDEXES	14
	SHOW TABLE STATUS	15
	SHOW STATUS	17
	SHOW VARIABLES	19
	INFORMATION_SCHEMA	20
	Conclusion	20
3	Understanding MySQL Indexes	23
	Example Tables	24
	MySQL Index Usages	25
	Data Integrity	25
	Optimizing Data Access	26
	Table Joins	28
	Sorting Results	28
	Aggregation	28

	About Storage Engines	28
	Index Terminology	30
	MySQL Index Types	30
	Index Data Structure Theory	31
	MySQL Implementation	35
	MySQL Partitioning	43
	Conclusion	43
4	Creating MySQL Indexes	45
	Example Tables	46
	Existing Indexes	47
	Single Column Indexes	48
	Syntax	48
	Restricting Rows with an Index	48
	Joining Tables with an Index	50
	Understanding Index Cardinality	51
	Using Indexes for Pattern Matching	54
	Selecting a Unique Row	55
	Ordering Results	57
	Multi Column Indexes	58
	Determining Which Index to Use	58
	Multi Column Index Syntax	61
	Providing a Better Index	61
	Many Column Indexes	63
	Combining WHERE and ORDER BY	64
	MySQL Optimizer Features	66
	Query Hints	67
	Complicated Queries	71
	The Impact of Adding Indexes	71
	DML Impact	71
	DDL Impact	73
	Disk Space Impact	74
	MySQL Limitations	76
	Cost Based Optimizer	76
	QEP Pinning	77
	Index Statistics	77
	Function Based Indexes	77
	Multiple Indexes per Table	77
	Conclusion	78

5	Creating Better MySQL Indexes	79
	Better Indexes	80
	Covering Index	80
	Storage Engine Implications	84
	Partial Index	85
	Conclusion	88
6	MySQL Configuration Options	89
	Memory Related Variables	90
	key_buffer_size	92
	Named Key Buffers	93
	innodb_buffer_pool_size	93
	innodb_additional_mem_pool_size	95
	query_cache_size	95
	max_heap_table_size	97
	tmp_table_size	97
	join_buffer_size	99
	sort_buffer_size	99
	read_buffer_size	99
	read_rnd_buffer_size	99
	Instrumentation Related Variables	100
	slow_query_log	100
	slow_query_log_file	100
	general_log	101
	general_log_file	101
	long_query_time	101
	log_output	101
	Profiling	101
	Other Optimization Variables	102
	optimizer_switch	102
	default_storage_engine	102
	max_allowed_packet	103
	sql_mode	103
	innodb_strict_mode	103
	Other Variables	103
	Conclusion	104

7	The SQL Lifecycle	105
	Capture Statements	106
	General Query Log	107
	Slow Query Log	108
	Binary Log	109
	Processlist	110
	Engine Status	110
	MySQL Connectors	111
	Application Code	112
	INFORMATION_SCHEMA	113
	PERFORMANCE_SCHEMA	114
	SQL Statement Statistics Plugin	114
	MySQL Proxy	114
	TCP/IP	114
	Identify Problematic Statements	115
	Slow Query Log Analysis	117
	TCP/IP Analysis	118
	Confirm Statement Operation	119
	Environment	119
	Timing	120
	Analyze Statements	121
	Optimize Statements	121
	Verify the Results	121
	Conclusion	122
8	Hidden Performance Tips	123
	Index Management Optimizations	124
	Combining Your DDL	124
	Removing Duplicate Indexes	125
	Removing Unused Indexes	126
	Monitoring Ineffective Indexes	126
	Index Column Improvements	126
	Data Types	127
	Column Types	129
	Other SQL Optimizations	130
	Eliminating SQL Statements	131
	Simplifying SQL Statements	137
	Using MySQL Replication	139
	Conclusion	139

9	Explaining the MySQL EXPLAIN.....	141
	Syntax.....	142
	Explain Columns	142
	key.....	144
	rows.....	144
	possible_keys.....	147
	key_len	147
	table.....	149
	select_type	149
	partitions	150
	Extra	150
	id	152
	ref.....	152
	filtered.....	153
	type	153
	Interpreting EXPLAIN Output.....	153
	Conclusion.....	155