LỘ TRÌNH SQL TỪ CƠ BẢN ĐẾN NÂNG CAO

SQL FROM BASIC TO ADVANCED

THÔNG TIN KHÓA HỌC

Thông tin	Chi tiết
Tên khóa học	SQL từ Cơ Bản đến Nâng Cao
Yêu cầu	Kiến thức cơ bản về máy tính, Logic tư duy
Tổng số buổi	30 buổi
Thời lượng	2.5 giờ/buổi
Tổng thời gian	75 giờ
Lộ trình	10 tuần (3 buổi/tuần)
Database	MySQL, PostgreSQL (có thể áp dụng cho SQL Server, Oracle)

MỤC TIÊU

- Nắm vững ngôn ngữ SQL từ cơ bản đến nâng cao
- Thiết kế database hiệu quả theo chuẩn normalization
- Viết queries phức tạp với Window Functions, CTEs, Subqueries
- Tối ưu performance với Indexes và Query Optimization
- Hiểu rõ Transactions, Concurrency, Locking
- Làm việc với Stored Procedures, Functions, Triggers
- Sẵn sàng làm việc với real-world database projects

CẤU TRÚC KHÓA HỌC - 30 BUỔI

Module	Tên Module	Buổi
1	SQL Cơ Bản - SQL Basics	6
2	SQL Trung Cấp - Intermediate SQL	6
3	SQL Nâng Cao - Advanced SQL	6
4	Thiết Kế Database - Database Design	4
5	Tối Ưu & Performance - Optimization	4
6	Stored Procedures & Functions	2

Module	Tên Module	Buổi
7	Transactions & Concurrency	2

MODULE 1: SQL CƠ BẢN (6 BUỔI)

Buổi 1: Database Basics & Setup

- Database là gì: RDBMS, Tables, Rows, Columns
- SQL vs NoSQL comparison
- RDBMS phổ biến: MySQL, PostgreSQL, SQL Server, Oracle
- Cài đặt MySQL/PostgreSQL
- Kết nối database: Command line, GUI tools (MySQL Workbench, pgAdmin, DBeaver)
- Database basics: CREATE DATABASE, DROP DATABASE, USE
- Basic data types: INT, VARCHAR, TEXT, DATE, DATETIME, BOOLEAN

Buổi 2: SELECT Fundamentals

- SELECT statement basics: SELECT * FROM table
- Selecting specific columns: SELECT col1, col2
- Column aliases: AS keyword
- DISTINCT: Remove duplicates
- ORDER BY: ASC, DESC, Multiple columns
- LIMIT/OFFSET: Pagination
- WHERE clause basics: =, !=, <, >, <=, >=
- Logical operators: AND, OR, NOT
- NULL handling: IS NULL, IS NOT NULL

Buổi 3: Filtering Data

- WHERE với nhiều điều kiện
- IN operator: WHERE column IN (value1, value2)
- BETWEEN operator: Range filtering
- LIKE operator: Pattern matching với %, _
- Wildcard patterns
- REGEXP/RLIKE: Regular expressions trong SQL
- CASE WHEN: Conditional logic
- Filtering best practices

Buổi 4: Aggregate Functions

- COUNT(): Đếm rows
- SUM(): Tổng giá trị
- AVG(): Trung bình
- MIN(), MAX(): Giá trị nhỏ nhất, lớn nhất
- GROUP BY: Nhóm dữ liệu
- HAVING clause: Filtering sau GROUP BY
- GROUP BY với nhiều columns

- Aggregate functions với DISTINCT

Buổi 5: JOINS - Part 1

- Relationship giữa tables: One-to-One, One-to-Many, Many-to-Many
- INNER JOIN: Matching rows from both tables
- LEFT JOIN (LEFT OUTER JOIN): All from left + matching right
- RIGHT JOIN (RIGHT OUTER JOIN): All from right + matching left
- FULL OUTER JOIN: All rows from both tables
- JOIN với nhiều tables
- Self JOIN: Join table với chính nó

Buổi 6: JOINS - Part 2 & Set Operations

- CROSS JOIN: Cartesian product
- Natural JOIN: JOIN based on same column names
- JOIN conditions: ON vs USING
- Multiple JOIN conditions
- Set Operations:
  - UNION: Combine results, remove duplicates
  - UNION ALL: Combine results, keep duplicates
  - INTERSECT: Common rows
  - EXCEPT/MINUS: Difference

MODULE 2: SQL TRUNG CẤP (6 BUỔI)

Buổi 7: Subqueries - Part 1

- Subquery là gì
- Subquery trong WHERE clause
- Subquery với IN, NOT IN
- Subquery với comparison operators: =, >, <
- Subquery trả về single value
- Subquery trả về multiple values
- EXISTS và NOT EXISTS
- Correlated subqueries

Buổi 8: Subqueries - Part 2

- Subquery trong FROM clause (Derived tables)
- Subquery trong SELECT clause
- Nested subqueries
- Subquery performance considerations
- Replacing subqueries với JOINs
- When to use subqueries vs JOINs

Buổi 9: String Functions

- CONCAT(), CONCAT_WS(): Nối chuỗi
- SUBSTRING()/SUBSTR(): Cắt chuỗi
- LENGTH()/CHAR_LENGTH(): Độ dài chuỗi
- UPPER(), LOWER(): Chuyển đổi case
- TRIM(), LTRIM(), RTRIM(): Xóa khoảng trắng
- REPLACE(): Thay thế chuỗi
- LEFT(), RIGHT(): Lấy ký tự từ trái/phải
- INSTR(), LOCATE(): Tìm vị trí
- String comparison và sorting

Buổi 10: Numeric & Date Functions

- Numeric Functions:
  - ROUND(), CEIL(), FLOOR()
  - ABS(), POWER(), SQRT()
  - MOD(): Modulo
  - RAND(): Random number
- Date/Time Functions:
  - NOW(), CURDATE(), CURTIME()
  - DATE(), TIME()
  - YEAR(), MONTH(), DAY()
  - HOUR(), MINUTE(), SECOND()
  - DATE_ADD(), DATE_SUB()
  - DATEDIFF(), TIMESTAMPDIFF()
  - DATE_FORMAT(): Format dates
  - Working with timezones

Buổi 11: Data Manipulation Language (DML)

- INSERT INTO: Thêm dữ liệu
  - Single row insert
  - Multiple rows insert
  - INSERT INTO SELECT
- UPDATE: Cập nhật dữ liệu
  - UPDATE với WHERE
  - UPDATE với JOIN
  - UPDATE multiple columns
- DELETE: Xóa dữ liệu
  - DELETE với WHERE
  - DELETE với JOIN
  - TRUNCATE vs DELETE
- REPLACE: Insert or Update
- INSERT ... ON DUPLICATE KEY UPDATE

Buổi 12: Data Definition Language (DDL)

- CREATE TABLE: Tạo bảng
  - Column definitions

    - Data types selection
    - NOT NULL, DEFAULT values
- PRIMARY KEY: Khóa chính
- FOREIGN KEY: Khóa ngoại, References
- UNIQUE constraint: Duy nhất
- CHECK constraint: Điều kiện validation
- AUTO_INCREMENT: Tự động tăng
- ALTER TABLE:
    - ADD column
    - MODIFY column
    - DROP column
    - RENAME column
    - ADD/DROP constraints
- DROP TABLE, TRUNCATE TABLE
- CREATE TABLE AS SELECT
- Temporary tables

MODULE 3: SQL NÂNG CAO (6 BUỔI)

Buổi 13: Common Table Expressions (CTEs)

- CTE là gì: WITH clause
- Simple CTE syntax
- Multiple CTEs trong một query
- CTE với complex queries
- Recursive CTEs:
    - Base query
    - Recursive query
    - Termination condition
- Recursive CTE applications:
    - Hierarchical data (org charts, categories)
    - Graph traversal
    - Number series generation
- CTE vs Subqueries vs Temporary Tables

Buổi 14: Window Functions - Part 1

- Window Functions là gì
- OVER() clause
- PARTITION BY: Chia nhóm
- ORDER BY trong window functions
- ROW_NUMBER(): Đánh số thứ tự
- RANK(): Xếp hạng với gaps
- DENSE_RANK(): Xếp hạng không gaps
- NTILE(n): Chia thành n groups
- Ranking functions applications

Buổi 15: Window Functions - Part 2

- Aggregate window functions:
  - SUM() OVER()
  - AVG() OVER()
  - COUNT() OVER()
  - MIN(), MAX() OVER()
- Running totals (Cumulative sum)
- Moving averages
- ROWS vs RANGE frame specification:
  - ROWS BETWEEN
  - RANGE BETWEEN
  - UNBOUNDED PRECEDING
  - CURRENT ROW
  - UNBOUNDED FOLLOWING
- Frame clause applications

Buổi 16: Window Functions - Part 3

- Analytic functions:
  - LAG(): Previous row value
  - LEAD(): Next row value
  - FIRST_VALUE(): First in partition
  - LAST_VALUE(): Last in partition
  - NTH_VALUE(): Nth value
- LAG/LEAD applications:
  - Year-over-year comparison
  - Calculating differences
  - Finding gaps
- Complex window function queries
- Combining multiple window functions

Buổi 17: Advanced Query Techniques

- PIVOT operations: Rows to Columns
- UNPIVOT operations: Columns to Rows
- Dynamic SQL: Building queries programmatically
- JSON functions:
  - JSON_EXTRACT()
  - JSON_OBJECT()
  - JSON_ARRAY()
  - Working with JSON columns
- Full-text search:
  - MATCH() AGAINST()
  - Boolean mode
  - Natural language mode
- Advanced CASE expressions
- Complex conditional logic

Buổi 18: Query Optimization Basics

- Execution plans: EXPLAIN, EXPLAIN ANALYZE
- Reading execution plans
- Query optimization principles
- Avoiding common pitfalls:
  - SELECT *
  - N+1 queries
  - Unnecessary JOINs
  - Function calls in WHERE
- Query refactoring techniques
- Using covering indexes
- Index hints

MODULE 4: THIẾT KẾ DATABASE (4 BUỔI)

Buổi 19: Database Design Fundamentals

- Database design process
- Requirements gathering
- Conceptual design
- Entity-Relationship (ER) Diagrams:
  - Entities
  - Attributes
  - Relationships
  - Cardinality: 1:1, 1:N, M:N
- ER diagram tools
- Converting ER to tables
- Primary keys selection strategies
- Foreign keys and referential integrity

Buổi 20: Normalization

- Normalization là gì: Mục đích, Benefits
- Functional dependencies
- Normal Forms:
  - 1NF (First Normal Form): Atomic values
  - 2NF (Second Normal Form): No partial dependencies
  - 3NF (Third Normal Form): No transitive dependencies
  - BCNF (Boyce-Codd Normal Form)
  - 4NF, 5NF (overview)
- Normalization process step-by-step
- Denormalization: When and why
- Trade-offs: Normalization vs Performance

Buổi 21: Advanced Database Design

- Designing for scalability
- Partitioning strategies:
    - Horizontal partitioning (Sharding)
    - Vertical partitioning
    - Range partitioning
    - Hash partitioning
    - List partitioning
- Surrogate keys vs Natural keys
- Composite keys
- Database design patterns:
    - Star schema (Data warehousing)
    - Snowflake schema
    - Slowly Changing Dimensions (SCD)
- Handling many-to-many relationships
- Audit tables and history tracking
- Soft delete vs Hard delete

Buổi 22: Data Integrity & Constraints

- Data integrity types:
    - Entity integrity
    - Referential integrity
    - Domain integrity
- Constraint enforcement
- CASCADE options:
    - ON DELETE CASCADE
    - ON UPDATE CASCADE
    - ON DELETE SET NULL
    - ON DELETE RESTRICT
- CHECK constraints best practices
- Triggers for complex integrity rules
- Validation at database level vs application level
- Database documentation

MODULE 5: TỐI ƯU & PERFORMANCE (4 BUỔI)

Buổi 23: Indexes - Part 1

- Index là gì: Purpose, How they work
- Index types:
    - B-Tree indexes (default)
    - Hash indexes
    - Full-text indexes
    - Spatial indexes
- Creating indexes:
    - Single-column index
    - Composite index (Multi-column)

    - UNIQUE index
    - Partial indexes (WHERE clause)
- Index selection guidelines
- Column order trong composite indexes

Buổi 24: Indexes - Part 2

- Index benefits và costs
- When to use indexes
- When NOT to use indexes
- Covering indexes
- Index maintenance
- Analyzing index usage
- Identifying missing indexes
- Removing unused indexes
- Clustered vs Non-clustered indexes
- Index fragmentation

Buổi 25: Query Performance Tuning

- Performance monitoring tools
- Slow query log
- Query profiling
- Common performance issues:
    - Missing indexes
    - Inefficient JOINs
    - Large table scans
    - Suboptimal WHERE clauses
- Optimization techniques:
    - Query rewriting
    - Index optimization
    - JOIN order optimization
    - Avoiding implicit conversions
- Batch operations vs Single operations
- LIMIT optimization
- COUNT(*) optimization

Buổi 26: Advanced Performance Topics

- Database caching:
    - Query cache
    - Result caching
- Connection pooling
- Prepared statements và parameter binding
- Analyzing query patterns
- Database statistics và maintenance
- VACUUM, ANALYZE (PostgreSQL)
- OPTIMIZE TABLE (MySQL)

- Table statistics update
- Database monitoring và alerting
- Performance testing strategies

MODULE 6: STORED PROCEDURES & FUNCTIONS (2 BUỔI)

Buổi 27: Stored Procedures

- Stored Procedures là gì: Benefits, Use cases
- Creating stored procedures
- Parameters: IN, OUT, INOUT
- Variable declaration và assignment
- Control flow:
  - IF-THEN-ELSE
  - CASE
  - WHILE loops
  - REPEAT-UNTIL
  - LOOP, LEAVE
- Cursors: Iterating through result sets
- Error handling: DECLARE HANDLER
- Calling stored procedures
- Stored procedures best practices
- When to use stored procedures vs application logic

Buổi 28: Functions & Triggers

- User-Defined Functions (UDFs):
  - Scalar functions (return single value)
  - Table-valued functions
  - Creating functions
  - DETERMINISTIC vs NOT DETERMINISTIC
  - Function parameters
- Triggers:
  - BEFORE vs AFTER triggers
  - INSERT, UPDATE, DELETE triggers
  - Row-level triggers
  - OLD và NEW keywords
  - Trigger use cases
  - Multiple triggers order
  - Trigger performance considerations
- Views:
  - Creating views
  - Updatable views
  - Materialized views
  - Views vs CTEs vs Subqueries

MODULE 7: TRANSACTIONS & CONCURRENCY (2 BUỔI)

Buổi 29: Transactions & ACID

- Transaction là gì
- ACID properties:
  - Atomicity: All or nothing
  - Consistency: Valid state
  - Isolation: Concurrent transactions
  - Durability: Permanent changes
- Transaction commands:
  - BEGIN/START TRANSACTION
  - COMMIT
  - ROLLBACK
  - SAVEPOINT
- Transaction best practices
- Transaction scope management
- Nested transactions
- Long-running transactions

Buổi 30: Concurrency & Locking

- Concurrency issues:
  - Lost updates
  - Dirty reads
  - Non-repeatable reads
  - Phantom reads
- Isolation levels:
  - READ UNCOMMITTED
  - READ COMMITTED
  - REPEATABLE READ
  - SERIALIZABLE
- Locking mechanisms:
  - Shared locks (S)
  - Exclusive locks (X)
  - Intention locks
  - Row-level locking
  - Table-level locking
- Deadlocks:
  - Detection
  - Prevention
  - Resolution
- Optimistic vs Pessimistic locking
- Multi-Version Concurrency Control (MVCC)
- Concurrency best practices

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10 SQL PATTERNS QUAN TRỌNG

Pattern	Mô Tả	Use Case
Aggregation với GROUP BY	Tính toán theo nhóm	Reports, Statistics
Self JOIN	Join table với chính nó	Hierarchies, Comparisons
Subquery trong WHERE	Filtering với subquery	Complex conditions
Window Functions	Calculations across rows	Rankings, Running totals
CTEs	Temporary named result sets	Complex queries readability
PIVOT/UNPIVOT	Transform data layout	Reporting, Data transformation
Running Totals	Cumulative calculations	Financial reports
Top-N per Group	Best/Worst in each category	Leaderboards
Gap & Islands	Find continuous sequences	Time series analysis
Slowly Changing Dimensions	Track historical changes	Data warehousing

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LỘ TRÌNH HỌC TẬP 10 TUẦN

Tuần 1: SQL Basics (3)
Tuần 2: SQL Basics (3)
Tuần 3: Intermediate SQL (3)
Tuần 4: Intermediate SQL (3)
Tuần 5: Advanced SQL (3)
Tuần 6: Advanced SQL (3)
Tuần 7: Database Design (3), Optimization (1)
Tuần 8: Optimization (3)
Tuần 9: Stored Procedures & Functions (2), Transactions (1)
Tuần 10: Transactions & Concurrency (1), Review (2)
