WAYPOINT REPLY

PostgreSQL

Design & Development

Course Editorial Plan

17	79	~35h	3
MODULES	TOTAL LESSONS	TOTAL DURATION	LEVELS

Course Description

Learn the skills required to design, implement, and develop applications with PostgreSQL. This course prepares you to install, configure, and use PostgreSQL effectively — covering database design, advanced SQL, server-side programming, query optimization, and the extension ecosystem. Oriented toward developers and junior DBAs who want to master PostgreSQL in real-world development contexts.

Target Audience

The course is aimed at developers with basic SQL and relational database knowledge, junior DBAs who want to deepen their PostgreSQL skills, and IT professionals who need practical PostgreSQL competencies in development and production contexts.

Prerequisites

Basic knowledge of relational database concepts (tables, keys, elementary SQL queries). Familiarity with a Linux or macOS terminal. No prior PostgreSQL experience required.

Learning Outcomes

By the end of the course, students will be able to: install and configure PostgreSQL on multiple platforms; design relational databases using native and advanced data types; manage roles, privileges and security; write advanced SQL with CTEs and window functions; implement server-side logic with PL/pgSQL functions, procedures and triggers; optimize queries using EXPLAIN and index strategies; leverage key PostgreSQL extensions (pgcrypto, pg_trgm, postgres_fdw).

Module Index

#	MODULE	LEVEL	LESSONS	DURATION
01	Introduction & Architectural Overview	Foundation	4	1h 30min
02	PostgreSQL Installation	Foundation	4	1h 30min
03	User Tools — Command Line Interfaces	Foundation	5	2h
04	Database Clusters	Intermediate	4	1h 30min
05	Configuration	Intermediate	5	2h
06	Data Dictionary	Intermediate	4	1h 30min
07	Creating & Managing Databases	Intermediate	6	2h 30min
08	Database Security	Intermediate	5	2h
09	Monitoring & Admin Tools	Intermediate	4	1h 30min
10	SQL Core	Intermediate	6	2h 30min
11	PostgreSQL-Specific SQL	Intermediate	5	2h 30min
12	Transactions & Isolation Levels	Intermediate	4	1h 30min
13	Procedures & Functions (PL/pgSQL)	Advanced	5	2h 30min
14	Triggers	Advanced	5	1h 30min
15	Query Optimization	Advanced	5	2h
16	Extensions Ecosystem	Advanced	4	1h 30min
17	Moving Data	Advanced	4	1h 30min

Module Details

01 Introduction & Architectural Overview

FOUNDATION 1h 30min

Overview of PostgreSQL: history, positioning in the open source DBMS market, use cases and high-level architecture.

LESSONS

1. What is PostgreSQL: history and open source philosophy — 20min
2. Comparison with other RDBMS (MySQL, Oracle, SQL Server) — 20min
3. Use cases: OLTP, analytics, GIS, JSON/document store — 20min
4. Client-server architecture overview — 30min

Objectives: Market positioning • Open source ecosystem • Key use cases • Base architecture

02 PostgreSQL Installation

FOUNDATION 1h 30min

Installing PostgreSQL on different platforms. Directory structure, main configuration files and service verification.

LESSONS

1. Installation on Linux (Debian/Ubuntu, RHEL/Rocky) — 25min
2. Installation on Windows — 20min
3. Directory structure and configuration files — 20min
4. Starting, stopping and verifying the service — 25min

Objectives: Linux installation • Windows installation • Directory layout • Service management

03 User Tools — Command Line Interfaces

FOUNDATION 2h

Essential command-line tools: psql, pg_dump, pg_restore, createdb, createuser and related meta-commands.

LESSONS

1. psql: connection, options, environment variables — 25min
2. psql meta-commands: \d, \l, \dt, \copy and others — 25min
3. SQL scripts from file and formatted output — 20min
4. Client utilities: createdb, createuser, dropdb — 20min
5. pg_dump and pg_restore: basic usage — 30min

Objectives: Advanced psql • Meta-commands • CLI utilities • Dump/restore basics

04 Database Clusters

INTERMEDIATE
1h 30min

The PostgreSQL cluster concept (initdb), management of multiple instances and physical data organization on disk.

LESSONS

1. What is a PostgreSQL cluster and PGDATA — 20min
2. initdb: initialization and options — 20min
3. Tablespace: creation and management — 25min
4. Managing multiple instances on the same machine — 25min

Objectives: initdb • PGDATA layout • Tablespace • Multi-instance

05 Configuration

INTERMEDIATE
2h

Key configuration parameters in postgresql.conf and pg_hba.conf. Basic resource tuning and authentication strategies.

LESSONS

1. postgresql.conf: structure and main parameters — 30min
2. Memory tuning: shared_buffers, effective_cache_size — 25min
3. Connections and authentication: max_connections, pg_hba.conf — 25min
4. Logging: log_destination, log_min_duration_statement — 20min
5. ALTER SYSTEM and SHOW: runtime configuration — 20min

Objectives: postgresql.conf • pg_hba.conf • Memory tuning • Logging config

06 Data Dictionary

INTERMEDIATE
1h 30min

The PostgreSQL system catalog: information_schema and pg_catalog views for inspecting structures, objects and metadata.

LESSONS

1. information_schema: tables, columns, constraints — 25min
2. pg_catalog: pg_class, pg_attribute, pg_type — 25min
3. Statistics views: pg_stat_user_tables, pg_stat_activity — 25min
4. Practical catalog queries for the DBA developer — 25min

Objectives: information_schema • pg_catalog • Statistics views • Practical queries

07 Creating & Managing Databases

INTERMEDIATE
2h 30min

Designing and creating databases, schemas, tables and data types. Advanced DDL, constraints and dependency management.

LESSONS

1. CREATE DATABASE: encoding, locale, template — 20min
2. Schemas: organization, search_path, pg_catalog — 25min
3. Native data types: numeric, text, datetime, boolean — 25min
4. Advanced types: JSON/JSONB, arrays, hstore, UUID — 25min
5. DDL: CREATE TABLE, ALTER TABLE, constraints — 30min
6. Indexes: B-tree, Hash, GiST, GIN — when to use them — 25min

Objectives: Full DDL • Schemas and search_path • Native and advanced types • Indexes

08 Database Security

INTERMEDIATE
2h

PostgreSQL security model: roles, privileges, Row Level Security, encryption and best practices for production environments.

LESSONS

1. Roles and users: CREATE ROLE, GRANT, REVOKE — 25min
2. Object privileges: tables, schemas, functions — 25min
3. Row Level Security (RLS): policies and use cases — 30min
4. SSL/TLS: configuration and certificates — 20min
5. Advanced pg_hba.conf: authentication methods — 20min

Objectives: Roles and privileges • RLS • SSL/TLS • Auth methods

09 Monitoring & Admin Tools

INTERMEDIATE
1h 30min

Tools for monitoring performance, connections, locks and slow queries. Introduction to pgAdmin and third-party tools.

LESSONS

1. pg_stat_activity: active queries and sessions — 20min
2. pg_stat_statements: query analysis — 25min
3. Lock monitoring: pg_locks, pg_blocking_pids() — 20min
4. pgAdmin 4: overview and main features — 25min

Objectives: pg_stat_activity • pg_stat_statements • Lock monitoring • pgAdmin 4

10 SQL Core

INTERMEDIATE
2h 30min

Foundational and intermediate SQL with PostgreSQL: DML, all JOIN types, subqueries and set operations.

LESSONS

1. DML: SELECT, INSERT, UPDATE, DELETE, MERGE — 30min
2. JOINs: INNER, LEFT, RIGHT, FULL, CROSS — 25min
3. Correlated subqueries and scalar subqueries — 20min
4. Set operations: UNION, INTERSECT, EXCEPT — 15min
5. Aggregation: GROUP BY, HAVING, FILTER — 20min
6. NULL handling and conditional expressions (CASE, COALESCE) — 20min

Objectives: Full DML • All JOIN types • Subqueries • Aggregation • Set operations

11 PostgreSQL-Specific SQL

INTERMEDIATE
2h 30min

Advanced SQL features that make PostgreSQL stand out: CTEs, window functions, LATERAL joins and full-text search.

LESSONS

1. CTE (WITH) and recursive CTEs — 30min
2. Window functions: OVER, PARTITION BY, ROW_NUMBER, RANK — 35min
3. LATERAL joins: use cases and patterns — 25min
4. Full-text search: tsvector, tsquery, GIN index — 30min
5. JSONB operators and path queries — 30min

Objectives: CTEs and recursive CTEs • Window functions • LATERAL joins • Full-text search • JSONB queries

12 Transactions & Isolation Levels

INTERMEDIATE
1h 30min

Transaction management in PostgreSQL: concurrency control, isolation levels, MVCC and practical patterns for developers.

LESSONS

1. BEGIN, COMMIT, ROLLBACK, SAVEPOINT — 20min
2. MVCC: how PostgreSQL handles concurrency — 25min
3. Isolation levels: READ COMMITTED, REPEATABLE READ, SERIALIZABLE — 30min
4. Locking strategies: FOR UPDATE, SKIP LOCKED, advisory locks — 25min

Objectives: Transaction control • MVCC internals • Isolation levels • Locking patterns

13 Procedures & Functions (PL/pgSQL)

ADVANCED
2h 30min

Server-side programmability with PL/pgSQL: writing functions, stored procedures, control structures and error handling.

LESSONS

1. PL/pgSQL fundamentals: block structure, variables, types — 25min
2. Writing functions: scalar, set-returning, polymorphic — 35min
3. Stored procedures: CREATE PROCEDURE, CALL, transaction control — 25min
4. Control structures: IF, LOOP, FOREACH, RETURN NEXT — 25min
5. Exception handling and RAISE — 20min

Objectives: PL/pgSQL syntax • Functions • Stored procedures • Control flow • Error handling

14 Triggers

ADVANCED 1h 30min

Trigger design and implementation: row-level and statement-level triggers, event triggers and common patterns.

LESSONS

1. Trigger concepts: BEFORE, AFTER, INSTEAD OF — 20min
2. Row-level vs statement-level triggers — 20min
3. Trigger functions: OLD, NEW, TG_ variables — 25min
4. Event triggers: DDL-level automation — 20min
5. Common trigger patterns and anti-patterns — 25min

Objectives: Trigger types • Trigger functions • Row vs statement level • Event triggers • Design patterns

15 Query Optimization

ADVANCED 2h

Understanding and improving query performance: reading query plans, statistics, index strategies and optimization techniques.

LESSONS

1. EXPLAIN and EXPLAIN ANALYZE: reading query plans — 30min
2. Planner statistics: pg_statistic, analyze frequency — 20min
3. Index strategies: covering indexes, partial indexes, expression indexes — 30min
4. Common performance pitfalls and how to fix them — 25min
5. Query rewriting techniques for better plans — 15min

Objectives: EXPLAIN/ANALYZE • Planner statistics • Index strategies • Performance patterns

16 Extensions Ecosystem

ADVANCED 1h 30min

The PostgreSQL extension model: how extensions work, the CREATE EXTENSION lifecycle, and hands-on with three essential extensions.

LESSONS

1. Extension architecture: CREATE EXTENSION, pg_extension catalog — 20min
2. pgcrypto: hashing, encryption and password management in SQL — 25min
3. pg_trgm: fuzzy string matching and similarity search — 25min
4. postgres_fdw: querying remote PostgreSQL instances — 30min

Objectives: Extension model • pgcrypto • pg_trgm • postgres_fdw

17 Moving Data

ADVANCED
1h 30min

Techniques for importing and exporting data: COPY, foreign data wrappers and strategies for bulk loading.

LESSONS

1. COPY and \copy: CSV, binary, stdout/stdin — 25min
2. Bulk load strategies: unlogged tables, index deferral — 25min
3. Logical replication for live migrations — 25min
4. pg_bulkload and mass loading best practices — 25min

Objectives: COPY command • Bulk load patterns • Logical replication • Migration strategies