

# PowerBI Course 2026

A comprehensive professional development programme designed to equip you with essential skills in data analysis, business intelligence, and artificial intelligence. This course combines technical expertise with practical applications, preparing you for the evolving demands of modern data-driven organisations.

## Fundamentals of IT & AI

Master application lifecycle management, Agile methodologies, cloud computing, and AI foundations.

## PowerBI for Data Analysis

Transform raw data into actionable insights with Microsoft's leading business intelligence platform.

## Excel & Advanced Excel

Develop advanced spreadsheet skills for sophisticated data analysis and visualization.

## Python for Data

Learn programming fundamentals and data manipulation with Python's powerful libraries.

## SQL for AI & Data

Query and manage databases efficiently with PostgreSQL and advanced SQL techniques.

## Generative AI & Agentic AI

Explore cutting-edge AI technologies including LLMs, RAG systems, and autonomous agents.

# Digital Edify

India's First AI-Native Training Institute

Learn AI. Build Agents. Lead Future.

# About Digital Edify

India's #1 Training Institute for the AI Era

**Established:** 2016

**Headquarters:** Hyderabad, Telangana

**Reach:** Global (Online + Offline)

## The Transformation Narrative

Digital Edify has evolved from a premium training institute in the Automation Era to an AI-first organisation leading the Agentic AI revolution. Since 2016, we've transformed over 100,000 professionals and built partnerships with more than 1,000 industry leaders. Our journey reflects the technological evolution of our time—from traditional job placement to career transformation, and now to building AI-native professionals who will shape the future of work.



### Automation Era (2016-2023)

Premium Training Institute focused on job placement with 100K+ students trained

### AI Revolution (2024-2025)

AI-Powered Training with industry-AI integration and career transformation focus

### Agentic AI Leadership (2026+)

AI First Institute building AI-Native Professionals with 1 Million AI-Native Vision

"We started in the Automation Era. We evolved through the AI Revolution. Now, we're leading the Agentic AI Future—with 100,000+ professionals already transformed and 1,000+ industry partners trusting our graduates."

## Vision & Mission

### Vision

"To Create 1 Million AI-Native Professionals Who Will Build the Agentic Future of Work"

### Mission

"We transform learners into AI-native professionals through industry-aligned programmes that integrate Agentic AI into every discipline—from development to data science to enterprise platforms."

# Course Highlights

## Section 1: Fundamentals of IT & AI

Understand application development, agile practices, computing basics, AI concepts, and real-world digital systems.

## Section 2: Power BI for Data Analysis

Build interactive dashboards and enterprise analytics using data modeling, DAX, and Power BI governance.

## Section 3: Excel & Advanced Excel for Data Analysis

Analyze, visualize, and automate data using Excel formulas, PivotTables, dashboards, and data models.

## Section 4: Python for AI & Data

Develop strong Python programming skills for data handling, automation, and AI-driven applications.

## Section 5: SQL for AI & Data

Design, query, optimize, and manage relational databases using advanced PostgreSQL concepts.

## Section 6: Generative AI & Agentic AI

Design, deploy, and manage generative and agentic AI systems using LLMs, RAG, and production workflows.

# Application Life Cycle Management

Understanding how applications are built, deployed, and maintained is fundamental to working in technology. This module explores the complete lifecycle of software applications, from initial concept through ongoing maintenance, providing essential context for data professionals working with enterprise systems.

## Application Fundamentals

- What is an Application
- Types of Applications
- Web Application Fundamentals

## Frontend Technologies

- HTML, CSS, JavaScript
- React framework

## Backend Technologies

- Python, Java, Node.js

## Database Systems

- SQL: MySQL, PostgreSQL
- NoSQL: MongoDB

## SDLC Phases

- Planning, Analysis, Design
- Implementation, Testing
- Deployment, Maintenance

# Agile & Scrum Framework

Modern software development relies on Agile methodologies to deliver value incrementally and respond to change effectively. This module introduces the Scrum framework, the most popular Agile approach, teaching you how teams collaborate, plan, and execute work in iterative cycles called sprints.

01

## Agile Foundations

Understand Waterfall vs. Agile methodologies, the Agile mindset, and popular frameworks.

02

## Scrum Framework

Learn Scrum pillars, roles (Product Owner, Scrum Master, Dev Team), and core principles.

03

## Scrum Events

Master Sprint Planning, Daily Scrum, Sprint Review, and Sprint Retrospective ceremonies.

04

## Artifacts & Stories

Work with Product Backlog, Sprint Backlog, and Increment whilst writing effective user stories.

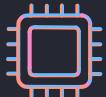
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## Backlog Management

Create epics and themes, define acceptance criteria, estimate stories, and manage backlogs using tools like Google Sheets and Azure Boards.

# Computing & Data

The foundation of modern data analysis rests on powerful computing infrastructure. This module explores the hardware and cloud technologies that enable processing vast amounts of data, from CPUs and GPUs to cloud service models that provide scalable, on-demand resources for analytics workloads.



## CPU Technology

Central Processing Units handle general-purpose computing tasks, executing instructions sequentially with high precision for diverse workloads.



## GPU Technology

Graphics Processing Units excel at parallel processing, making them essential for AI training, data analytics, and complex mathematical computations.



## Cloud Computing

Cloud platforms provide scalable infrastructure, enabling organisations to access computing power on-demand without maintaining physical hardware.

### IaaS

Infrastructure as a Service provides virtualised computing resources over the internet, offering maximum control and flexibility.

### PaaS

Platform as a Service delivers a complete development and deployment environment in the cloud for building applications.

### SaaS

Software as a Service provides ready-to-use applications over the internet, eliminating installation and maintenance requirements.

# Introduction to AI, Generative AI & Agentic AI

Artificial intelligence is transforming how we work with data and automate complex tasks. This module provides a comprehensive introduction to AI fundamentals, from traditional machine learning to cutting-edge generative models that can create text, images, and code, laying the groundwork for understanding modern AI applications.



## AI Fundamentals

Understand what Artificial Intelligence is and how AI systems work to solve complex problems.



## Machine Learning

Explore ML fundamentals and how systems learn patterns from data without explicit programming.



## Deep Learning

Discover deep neural networks that power modern AI applications and complex pattern recognition.

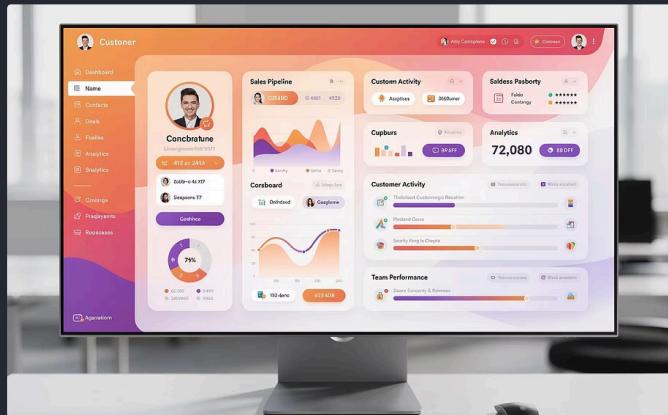


## Generative AI

Learn about Large Language Models, image generation, and AI applications in everyday learning and work.

# Real-World Applications

Understanding how technology is applied in real business contexts is essential for data professionals. This module examines enterprise systems across various industries, demonstrating how the concepts you've learnt are implemented in Customer Relationship Management, Human Resources, Retail, E-Commerce, and Healthcare sectors.



## Customer Relationship Management

CRM systems centralise customer data, track interactions, and automate sales processes to improve customer satisfaction and retention.



## Human Resource Management Systems

HRMS platforms streamline recruitment, payroll, performance management, and employee records for efficient workforce administration.



## Retail & E-Commerce

Digital commerce platforms manage inventory, process transactions, and provide personalised shopping experiences across multiple channels.



## Healthcare Applications

Healthcare systems manage patient records, appointments, and clinical workflows whilst ensuring compliance with medical data regulations.

# PowerBI for Data Analysis

Microsoft Power BI is the industry-leading business intelligence platform that transforms raw data into compelling visual insights. This comprehensive section takes you from fundamental concepts through to enterprise deployment, teaching you to connect to diverse data sources, model relationships, create interactive dashboards, and publish insights that drive business decisions.

## Module 1-2: Foundations

Business Intelligence fundamentals, Power BI architecture, interface navigation, and connecting to file, database, cloud, and web sources with Import, DirectQuery, and Live Connection modes.

## Module 3-4: Data Preparation

Power Query transformations, data profiling, quality assessment, reshaping operations, and data modelling with star schema design, relationships, and hierarchies.

## Module 5-6: Visualisation & DAX

Building interactive reports with core visualisations, slicers, bookmarks, and drill-through. Introduction to DAX syntax, calculated columns, measures, and essential functions.

## Module 7-10: Advanced Topics

Time intelligence, advanced DAX, custom visuals, AI features, publishing, sharing, collaboration, enterprise governance, Row-Level Security, and performance optimization.

# Data Transformation & Modeling

Effective data analysis begins with proper preparation and structure. Power Query provides a powerful interface for cleaning, transforming, and shaping data, whilst robust data modelling ensures relationships between tables are correctly defined. These foundational skills enable accurate analysis and efficient report performance.



## Power Query Essentials

- Interface and applied steps
- Data profiling and quality
- Filtering, splitting, merging
- Pivot, unpivot, grouping
- Append and merge queries



## Data Modeling

- Star schema vs. snowflake
- Creating relationships
- Primary and foreign keys
- Hierarchies and date tables
- Model optimization

# Visual Reports & DAX Fundamentals



Creating compelling visualisations requires understanding both design principles and the analytical language that powers calculations. This module combines the art of visual storytelling with the technical precision of DAX (Data Analysis Expressions), enabling you to build interactive dashboards that communicate insights effectively whilst performing sophisticated calculations.

## Visualisation Principles

- Chart selection and design
- Core visualisations: charts, tables, maps, KPIs
- Interactive elements: slicers, filters, bookmarks
- Drill-through navigation
- Dashboard layout and mobile optimization
- Data storytelling techniques

## DAX Essentials

- DAX syntax and structure
- Calculated columns vs. measures
- Aggregation, logical, text functions
- Date/time functions
- CALCULATE and FILTER functions
- Creating KPIs and business metrics

# Advanced Analytics & Time Intelligence

Sophisticated business analysis requires advanced DAX capabilities and temporal comparisons. This module explores time intelligence functions for year-to-date calculations, period-over-period comparisons, and growth rates. You'll also master custom visuals, AI-powered analytics, and integration with R and Python for statistical modeling.

## Time Intelligence

YTD, MTD, QTD functions, prior period comparisons, and growth rate calculations.

## Custom Visuals

AppSource visuals, waterfall charts, funnel diagrams, and decomposition trees.

1

2

3

4

## Advanced DAX

Filter context vs. row context, variables, iterator functions, and performance optimization.

## AI Analytics

Key Influencers, Q&A natural language, Smart Narratives, and dynamic parameters with R/Python integration.

# Enterprise Deployment & Governance

Moving from development to production requires understanding publishing workflows, security models, and governance frameworks. This module covers workspace management, data refresh strategies, Row-Level Security implementation, and enterprise administration. You'll learn to deploy Power BI solutions that meet organisational standards for security, performance, and compliance.



## Publishing & Sharing

Workspace management, dashboards vs. reports, data refresh configuration, gateway setup, and sharing strategies with Power BI apps.



## Security & Governance

Admin portal configuration, tenant settings, Row-Level Security (RLS), Object-Level Security (OLS), and access control policies.



## Performance & Scale

Incremental refresh, aggregations, dataflows, deployment pipelines, capacity management, and performance optimization techniques.



## Integration & APIs

Teams, SharePoint, Excel, PowerPoint integration, enterprise licensing models, APIs, and embedded analytics for custom applications.

# Excel & Advanced Excel for Data Analysis

Microsoft Excel remains the world's most widely used data analysis tool, combining accessibility with powerful analytical capabilities. This comprehensive section progresses from fundamental spreadsheet skills through advanced formulas, PivotTables, and automation, equipping you with the expertise to handle complex data analysis tasks and create sophisticated analytical models.

## Module 1: Fundamentals

Interface mastery, cell references, basic formulas, formatting, data validation, named ranges, and file management.

## Module 2: Data & Visualization

Data organization, sorting, filtering, Excel Tables, text/date functions, logical functions, and chart creation.

## Module 3: Advanced Formulas

Nested functions, error handling, VLOOKUP, XLOOKUP, INDEX-MATCH, array formulas, and statistical functions.

## Module 4-5: Analytics

PivotTables, PivotCharts, Power Query, Data Model, DAX basics, What-If Analysis, and Solver optimization.

# Excel Fundamentals & Data Organization

Building a strong foundation in Excel is essential for all data work. This module covers interface navigation, cell referencing techniques, essential formulas, and formatting options. You'll learn data validation, conditional formatting, and best practices for organizing information effectively, ensuring your spreadsheets are both functional and professional.

## Core Skills

- Ribbon and interface
- Cell references (Relative, Absolute, Mixed)
- Basic formulas and operators
- Essential functions: SUM, AVERAGE, COUNT
- Named ranges

## Formatting

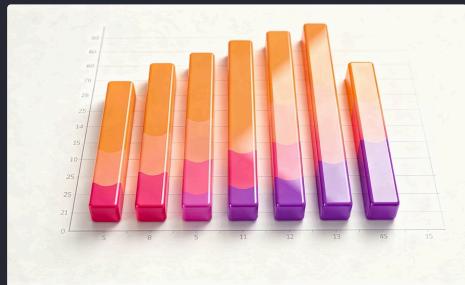
- Number, Currency, Date/Time formats
- Custom formats
- Conditional formatting
- Cell and sheet protection
- File formats (.xlsx, .xlsm, .csv)

## Data Management

- Data validation
- Sorting and filtering
- Excel Tables
- Removing duplicates
- Flash Fill

# Data Visualization & Analysis

Transforming data into visual insights is a critical skill for effective communication. This module teaches data visualization principles, chart selection, and formatting techniques. You'll master text and date functions, logical operations, and create dynamic dashboards that combine multiple chart types, sparklines, and interactive elements to tell compelling data stories.



## Chart Types

Column, Bar, Line, Pie, and Scatter charts with proper formatting, titles, axes, legends, and data labels.



## Advanced Charts

Combo charts with secondary axes and sparklines for inline visualizations within cells.



## Dynamic Dashboards

Combine multiple visualizations with text, date, and logical functions to create interactive analytical dashboards.

Master text functions (LEFT, RIGHT, MID, CONCATENATE, TEXTJOIN, TRIM), date/time functions (TODAY, NOW, DATE, DATEDIF, WORKDAY, NETWORKDAYS), and logical functions (IF, AND, OR, NOT, IFS, SWITCH) to manipulate and analyze data effectively.

# Advanced Formulas & Lookup Functions

Sophisticated data analysis requires mastery of Excel's most powerful functions. This module explores advanced logical operations, error handling, and the complete range of lookup functions from traditional VLOOKUP to modern XLOOKUP. You'll learn INDEX-MATCH combinations, dynamic arrays, and statistical functions that enable complex calculations and data retrieval across large datasets.

1

## Advanced Logic

Nested IF statements, IFS, SWITCH functions, and comprehensive error handling with IFERROR, IFNA, and ISERROR.

2

## Lookup Functions

VLOOKUP, HLOOKUP, modern XLOOKUP and XMATCH, plus powerful INDEX-MATCH combinations for flexible data retrieval.

3

## Dynamic Arrays

Excel 365 spill ranges, array formulas, and modern functions: FILTER, SORT, SORTBY, UNIQUE for dynamic data manipulation.

4

## Statistical Functions

SUMIF, SUMIFS, COUNTIF, COUNTIFS, AVERAGEIF, AVERAGEIFS for conditional aggregations and analysis.

5

## Specialized Functions

Mathematical (ROUND, MOD, ABS), Financial (PMT, FV, PV, NPV, IRR), and advanced date functions (EDATE, EOMONTH).

# PivotTables & Power Query

PivotTables are Excel's most powerful analytical tool, enabling rapid summarization and exploration of large datasets. This module teaches you to create sophisticated PivotTables with calculated fields, grouping, and interactive filtering using slicers and timelines. You'll also discover Power Query (Get & Transform) for connecting to diverse data sources and automating data preparation workflows.

## PivotTable Mastery

- Creating PivotTables from various sources
- Fields: Rows, Columns, Values, Filters
- Value settings: Sum, Count, Average, % of Total
- Grouping: Dates, Numbers, Custom groups
- Calculated fields and items
- Styles and formatting
- Slicers and Timelines
- PivotCharts for visual analysis

## Power Query Introduction

- Get & Transform data interface
- Connecting to Excel, CSV, Folders
- Database connections
- Data transformation steps
- Query editing and refresh
- Combining multiple sources
- Automated data preparation

# Advanced Analytics & Data Modeling

Excel's Data Model and Power Pivot capabilities bring database-like functionality to spreadsheets, enabling analysis of millions of rows across related tables. This module introduces DAX (Data Analysis Expressions) for creating calculated columns and measures, What-If Analysis tools for scenario planning, and Solver for optimization problems, transforming Excel into a comprehensive analytical platform.

## Excel Data Model

Import multiple tables into the Data Model, create relationships between tables, and analyze data across millions of rows with Power Pivot.

## DAX Fundamentals

Learn Data Analysis Expressions basics for Power Pivot, including calculated columns and measures for advanced analytics.

## What-If Analysis

Use Goal Seek to find input values, Scenario Manager for comparing alternatives, and Data Tables for sensitivity analysis with one or two variables.

## Solver Optimization

Apply Solver add-in to find optimal solutions for complex problems with constraints, maximizing or minimizing objective functions.

## SECTION 4

# Python for AI & Data

Python has become the dominant programming language for data science and artificial intelligence, valued for its readability, extensive libraries, and versatility. This comprehensive section takes you from basic syntax through object-oriented programming, teaching you to manipulate data structures, work with files, handle exceptions, and write efficient, maintainable code for data analysis and AI applications.

01

## Python Fundamentals

Environment setup, syntax, variables, data types, operators, conditionals, loops, and user input.

02

## String Manipulation

String operations, indexing, slicing, formatting, methods for case conversion, searching, and text processing.

03

## Data Structures

Lists, tuples, dictionaries, sets, comprehensions, and operations for organizing and manipulating data.

04

## Advanced Collections

Collections module, iterators, generators, lambda functions, and functional programming with map, filter, reduce.

05

## Functions & Modules

Function definition, parameters, scope, modules, packages, pip, and working with CSV/JSON files.

# Python Fundamentals & String Manipulation

Learning Python begins with understanding its clean syntax and fundamental concepts. This module covers environment setup with Visual Studio Code, Python's 35 keywords, variables, data types, and operators. You'll master conditional statements, loops, and control flow, then progress to sophisticated string manipulation techniques including indexing, slicing, formatting, and the extensive range of string methods.

## Core Concepts

- Python installation (Windows/Mac)
- Visual Studio Code setup
- Syntax and 35 keywords
- Variables and memory management
- Data types (Simple & Complex)
- Type conversion and casting
- Operators (Arithmetic, Comparison, Logical)
- Conditional statements (if, elif, else, match-case)
- Loops (while, for) and range()
- Control flow (break, continue, pass)

## String Operations

- String definition and rules
- Positive and negative indexing
- Slicing (start:end:step)
- Concatenation and repetition
- f-strings and format() method
- Immutability concept
- Case conversion methods
- Search methods (find, index, count)
- Checking methods (isalpha, isdigit)
- Trimming, replacement, split/join

# Data Structures: Lists, Tuples, Dictionaries & Sets

Python's built-in data structures provide powerful ways to organize and manipulate information. Lists offer flexible, ordered collections with extensive methods for adding, removing, and sorting elements. Tuples provide immutable sequences for data integrity. Dictionaries enable key-value storage for fast lookups, whilst sets handle unique elements with mathematical operations. Mastering these structures is fundamental to effective Python programming.

## Lists



Creation, indexing, slicing, operations, methods (append, insert, extend, remove, pop, clear), searching (index, count), sorting (sort, reverse), and list comprehensions.

## Tuples



Creation, operations, immutability concept, tuple packing and unpacking, and comparison with lists for choosing appropriate data structures.

## Dictionaries



Creation, access, operations, methods (keys, values, items), dictionary comprehensions, nested dictionaries, and fast key-based lookups.

## Sets



Creation, UUU properties (Unique, Unordered, Unindexed), mathematical operations (union, intersection, difference), subset/superset checks, and frozen sets.

# Advanced Collections & Functional Programming

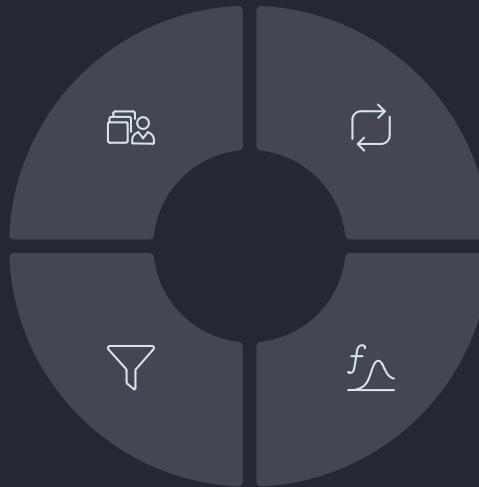
Python's collections module extends built-in data structures with specialized containers like namedtuple, Counter, defaultdict, and deque. Understanding iterators and generators enables memory-efficient data processing, whilst lambda functions and higher-order functions (map, filter, reduce) introduce functional programming paradigms. These advanced concepts are essential for writing elegant, efficient Python code.

## Collections Module

Specialized containers:  
namedtuple for readable tuples, Counter for counting, defaultdict for default values, and deque for efficient queues.

## Higher-Order Functions

Functional programming with map, filter, and reduce functions, generator pipelines, and composing operations for data transformation.



## Iterators & Generators

Iteration protocol, custom iterators, generators with yield statement, generator expressions, and memory-efficient data processing.

## Lambda Functions

Anonymous functions, lambda syntax, Immediately Invoked Function Expressions (IIFE), and use cases for concise operations.

# Functions & Scope Management

Functions are the building blocks of modular, reusable code. This module covers function definition, various parameter types (positional, keyword, default, \*args, \*\*kwargs), return values, and scope rules. You'll learn to write clear documentation with docstrings, implement recursive algorithms, and use lambda functions effectively, creating well-structured programs that are easy to maintain and extend.

## Function Basics

- Definition and calling
- Parameters and arguments
- Positional arguments
- Keyword arguments
- Default arguments

## Advanced Parameters

- Arbitrary positional (\*args)
- Arbitrary keyword (\*\*kwargs)
- Return statements
- Multiple return values
- Tuple unpacking

## Scope & Documentation

- Local and global scope
- Global keyword usage
- Built-in functions
- Docstrings
- Function documentation

## Special Functions

- Lambda functions
- IIFE pattern
- Recursive functions
- Base cases
- Recursion limits

# Modules, Packages & External Libraries

Python's module system enables code organization and reuse across projects. This module explores built-in modules (math, random, datetime, os, sys), creating custom modules, and package structure with `__init__.py` files. You'll master pip for installing external packages, managing dependencies with `requirements.txt`, and leveraging popular libraries like requests, pandas, and numpy for extended functionality.

## Module Types

Built-in modules, user-defined modules, and external packages with various importing techniques.

## Built-in Modules

Common modules: math for calculations, random for generation, datetime for time, os for system, sys for interpreter.

## Package Structure

Creating packages, `__init__.py` purpose, nested packages, and organizing code hierarchically.

## External Packages

pip package manager, installing packages, `requirements.txt` for dependencies, and popular libraries (requests, pandas, numpy).

# Working with Data Formats

Data professionals frequently work with various file formats for storing and exchanging information. This module teaches file operations (CRUD), reading and writing text files, managing directories with `os` and `shutil` modules, and working with structured data formats. You'll master CSV file handling with `csv.reader`, `csv.writer`, and `DictReader/DictWriter`, plus JSON operations for data serialization and API integration.

## File Operations

- CRUD operations basics
- `open()` function and modes
- Reading: `read`, `readline`, `readlines`
- Writing: `write`, `writelines`
- Append mode operations
- File path operations
- Directory management (`os`, `shutil`)
- File handling best practices

## Structured Data

- Working with CSV files
- `csv.reader` and `csv.writer`
- `csv.DictReader` and `csv.DictWriter`
- Working with JSON files
- JSON operations: `dump`, `dumps`
- JSON operations: `load`, `loads`
- Data serialization
- Data deserialization

# Advanced Python Concepts

Professional Python development requires mastery of exception handling, decorators, generators, and context managers. This module teaches you to handle errors gracefully with try-except-else-finally blocks, create custom exceptions, and use decorators to modify function behaviour. You'll explore generator deep dives, infinite generators, and context managers for resource management, writing robust, production-ready code.



## Exception Handling

try-except-else-finally blocks, catching specific exceptions, raising and re-raising exceptions, custom exception classes, and built-in exception types.



## Decorators

Function decorators, decorators with arguments, multiple decorators, class decorators, and practical applications for modifying function behaviour.



## Generators Deep Dive

Generator expressions, infinite generators, memory efficiency, and advanced iteration patterns for processing large datasets.



## Context Managers

with statement, custom context managers, resource management, automatic cleanup, and ensuring proper file/connection handling.

# Object-Oriented Programming

Object-Oriented Programming (OOP) is a fundamental paradigm for organizing complex code into reusable, maintainable structures. This comprehensive module covers OOP fundamentals, classes and objects, instance and class methods, and the four pillars: Encapsulation (access control), Inheritance (code reuse), Abstraction (hiding complexity), and Polymorphism (flexible interfaces). You'll learn to design elegant, scalable applications using OOP principles.

## OOP Foundations



Philosophy, classes, objects, attributes (instance & class variables), `__init__` constructor, and understanding self.

## Methods



Instance methods, class methods (@classmethod), static methods (@staticmethod), and method types comparison.

## Encapsulation



Access modifiers: public, protected (\_), private (\_), data hiding, and controlled access to attributes.

## Inheritance



Single, multi-level, multiple inheritance, method overriding, `super()` function, and code reuse patterns.

## Abstraction



Abstract Base Classes (ABC module), abstract methods, interface design, and hiding implementation details.

## Polymorphism



Method overriding, duck typing, special methods (`__str__`, `__repr__`, `__len__`), and flexible interfaces.

# SQL for AI & Data

Structured Query Language (SQL) is the universal language for working with relational databases, essential for data analysis and AI applications. This comprehensive section teaches PostgreSQL from foundations through advanced programming, covering database design, complex queries, joins, transactions, stored procedures, triggers, and optimization. You'll gain the skills to design, query, and manage enterprise databases effectively.



# Database Foundations & Querying

Understanding relational databases begins with core concepts: DBMS systems, ACID properties ensuring data integrity, and PostgreSQL's architecture. This module covers installation, data types, constraints (PRIMARY KEY, FOREIGN KEY, UNIQUE, NOT NULL, CHECK), and fundamental querying with SELECT statements. You'll master filtering, sorting, string/numeric/date functions, and aggregations for extracting meaningful insights from data.

## Database Fundamentals

- DBMS and RDBMS concepts
- ACID properties
- PostgreSQL installation
- psql and pgAdmin 4 tools
- Database objects
- Data types: Numeric, Character, Date/Time, Boolean
- Constraints: PRIMARY KEY, FOREIGN KEY, UNIQUE, NOT NULL, CHECK, DEFAULT
- Creating databases and tables
- INSERT operations

## Querying Basics

- SELECT statement
- Column aliases and expressions
- WHERE clause filtering
- Comparison and logical operators
- BETWEEN, IN, LIKE operators
- NULL handling
- ORDER BY sorting
- DISTINCT and LIMIT/OFFSET
- String, numeric, date functions
- Aggregate functions
- GROUP BY and HAVING

# Advanced Queries & Joins

Sophisticated data analysis requires combining data from multiple tables and using advanced query techniques. This module teaches window functions (ROW\_NUMBER, RANK, DENSE\_RANK, LAG, LEAD) for analytical operations, all JOIN types (INNER, LEFT, RIGHT, FULL OUTER, CROSS, SELF) for relating tables, subqueries in various clauses, Common Table Expressions (CTEs) for readable queries, and set operators (UNION, INTERSECT, EXCEPT) for combining results.



## Window Functions

ROW\_NUMBER, RANK, DENSE\_RANK, LAG, LEAD, and other analytical functions for advanced calculations over partitions.



## JOIN Operations

INNER JOIN, LEFT/RIGHT JOIN, FULL OUTER JOIN, CROSS JOIN, SELF JOIN, multi-table joins, and optimization.



## Subqueries & CTEs

Subqueries in WHERE, SELECT, FROM clauses, correlated subqueries, EXISTS, Common Table Expressions, and recursive CTEs.



## Set Operators

UNION and UNION ALL for combining results, INTERSECT for common rows, EXCEPT for differences between queries.

# Data Manipulation & Transactions

Beyond querying, databases require operations to modify data and ensure consistency. This module covers UPDATE statements with expressions and joins, DELETE operations with subqueries, TRUNCATE vs DELETE differences, and comprehensive transaction management. You'll learn BEGIN, COMMIT, ROLLBACK commands, savepoints for partial rollbacks, transaction isolation levels, and concurrency control mechanisms for multi-user environments.



## UPDATE Operations



UPDATE statements, expressions, UPDATE with JOIN, modifying data based on conditions and related table values.

## DELETE Operations



DELETE statements, DELETE with subqueries, TRUNCATE vs DELETE comparison, and data removal strategies.

## Transaction Management



BEGIN, COMMIT, ROLLBACK commands, savepoints for partial rollbacks, ensuring data consistency across operations.

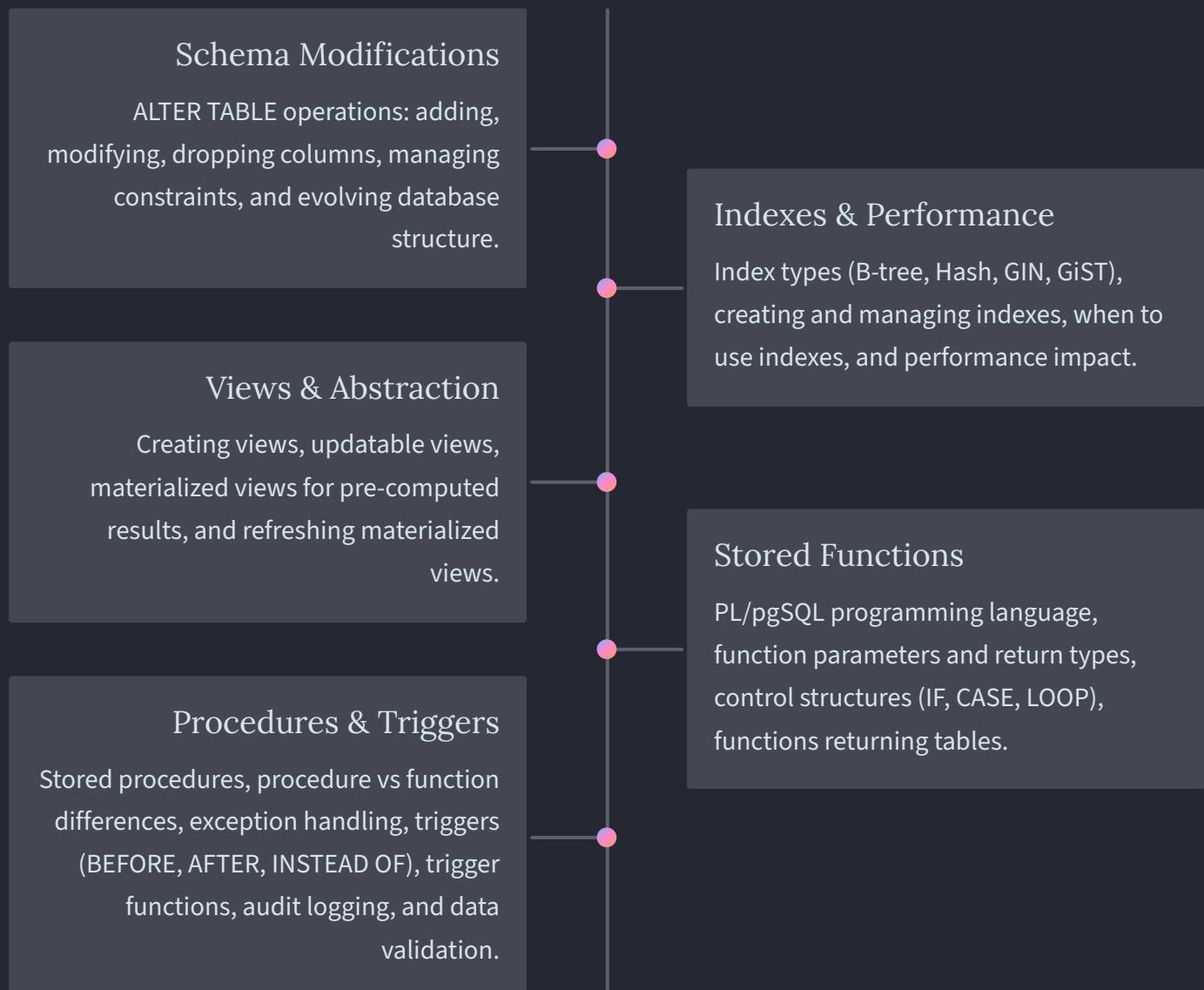
## Concurrency Control



Transaction isolation levels (Read Uncommitted, Read Committed, Repeatable Read, Serializable), and managing concurrent access.

# Database Programming & Automation

Advanced database management requires programming capabilities within the database itself. This module teaches ALTER TABLE operations for schema modifications, index creation and management for performance, views for data abstraction, materialized views for pre-computed results, stored functions in PL/pgSQL, stored procedures, and triggers for automated responses to data changes, enabling sophisticated database automation and business logic implementation.



# Database Design & Optimization

Professional database development requires strong design principles and optimization skills. This module covers Entity-Relationship modeling for conceptual design, normalization (1NF, 2NF, 3NF) for eliminating redundancy, database design best practices including naming conventions and key strategies, query optimization with EXPLAIN ANALYZE, reading execution plans, index strategies, query rewriting, and performance tuning with statistics, VACUUM, connection pooling, and table partitioning.

## Database Design

- Entity-Relationship (ER) modeling
- Entities, attributes, relationships
- Relationship types (1:1, 1:M, M:N)
- ER diagrams
- Normalization principles
- First Normal Form (1NF)
- Second Normal Form (2NF)
- Third Normal Form (3NF)
- Benefits and trade-offs
- When to denormalize

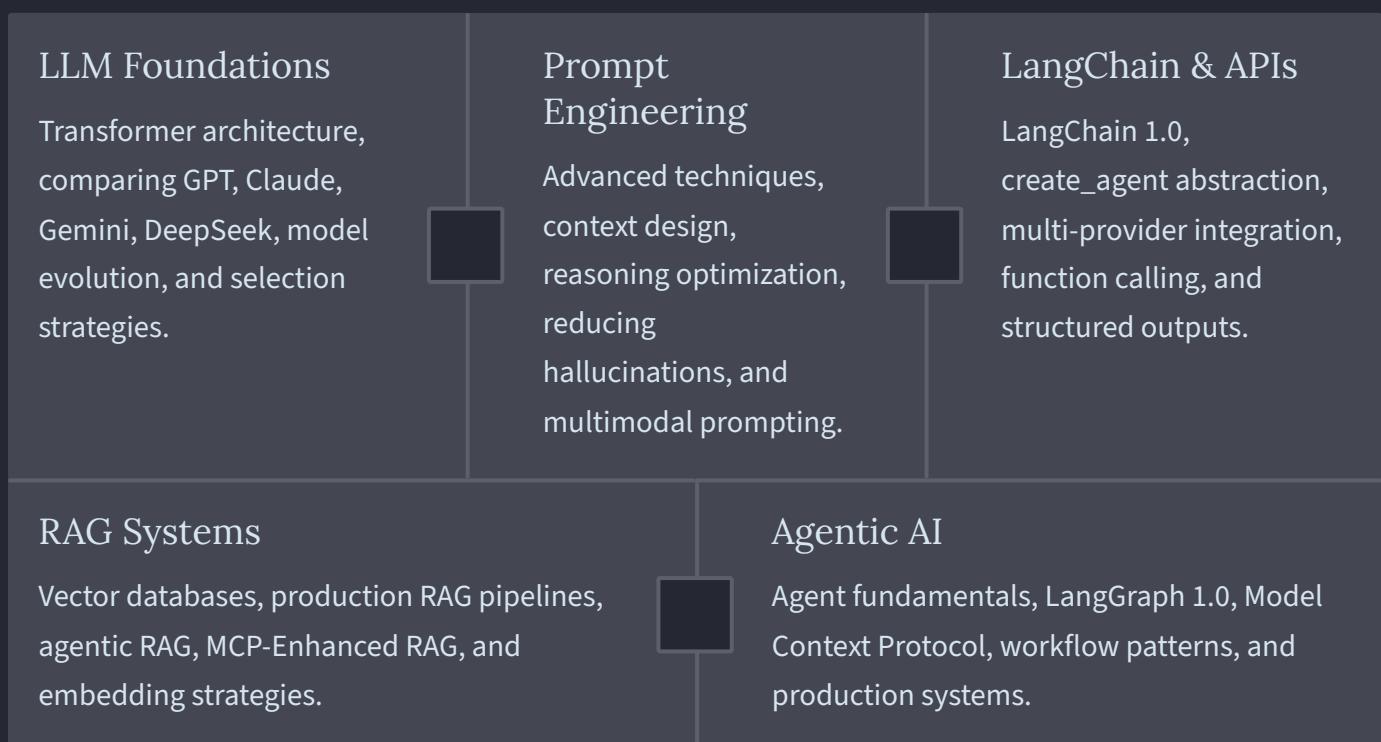
## Optimization

- EXPLAIN and EXPLAIN ANALYZE
- Reading execution plans
- Index strategies
- Query rewriting techniques
- Database statistics (ANALYZE)
- VACUUM and maintenance
- Connection pooling
- Table partitioning
- Primary key strategies
- Foreign key design

## SECTION 6

# Generative AI & Agentic AI

Generative AI represents the cutting edge of artificial intelligence, with Large Language Models transforming how we interact with technology. This comprehensive section explores LLM fundamentals, prompt engineering, API integration with LangChain 1.0, Retrieval-Augmented Generation (RAG) systems, production deployment strategies, and agentic AI systems that can plan, reason, and act autonomously using LangGraph 1.0 and the Model Context Protocol.



# LLM Foundations & Prompt Engineering

Understanding Large Language Models begins with their architecture and capabilities. This module explores transformer architecture, compares major LLMs (GPT, Claude, Gemini, DeepSeek), traces evolution from GPT-1 to 2026 frontier models, and covers tokenization and model selection. You'll master advanced prompt engineering techniques, context design, reasoning mode optimization, hallucination reduction, zero-shot and few-shot prompting, chain-of-thought reasoning, and multimodal prompting across text, image, and audio.

## LLM Architecture

Transformer fundamentals, attention mechanisms, tokenization, model parameters, and architectural innovations.

## Prompting Strategies

Zero-shot, few-shot, chain-of-thought prompting, multimodal prompting (text, image, audio), and optimization.

## Model Comparison

GPT, Claude, Gemini, DeepSeek capabilities, strengths, weaknesses, cost considerations, and use case matching.

## Model Evolution

GPT-1 through 2026 frontier models, capability improvements, scaling laws, and emerging architectures.

## Prompt Engineering

Advanced techniques, context engineering, reasoning optimization, reducing hallucinations, and domain-specific design.



# LangChain, APIs & RAG Systems

Building production AI applications requires robust frameworks and architectures. This module teaches LangChain 1.0 fundamentals with `create_agent` abstraction and middleware systems, integration with OpenAI, Anthropic, Google, and DeepSeek APIs, streaming and batching, function calling, and structured outputs. You'll build production RAG pipelines using vector databases (ChromaDB, Pinecone, Qdrant), implement agentic RAG, MCP-Enhanced RAG, embedding strategies, hybrid search, and hallucination reduction techniques.

## LangChain 1.0 & APIs

- LangChain fundamentals
- `create_agent` abstraction
- Middleware systems
- Multi-provider integration
- OpenAI, Anthropic, Google, DeepSeek APIs
- Streaming and batching
- Function calling
- Structured outputs
- Cost-optimized pipelines

## RAG Systems

- Vector databases: ChromaDB, Pinecone, Qdrant
- Production RAG pipelines
- Agentic RAG
- MCP-Enhanced RAG
- Embedding strategies
- Hybrid search (semantic + keyword)
- Document processing at scale
- Hallucination reduction

# Production Deployment & Agentic Systems

Deploying AI systems to production requires understanding interfaces, governance, security, and advanced agent architectures. This module covers Streamlit and Gradio interfaces, LangGraph Platform deployment, cost optimization, EU AI Act compliance, API security, monitoring, and scaling. You'll explore agentic AI fundamentals (plan, reason, act), LangGraph 1.0 architecture with state management, advanced workflow patterns, persistence, human-in-the-loop implementations, multi-agent systems, Google A2A Protocol, LangSmith observability, and production guardrails.

## Production Deployment

Streamlit and Gradio interfaces, LangGraph Platform, cost optimization, AI governance, EU AI Act compliance, API security, rate limiting, monitoring, observability, and scaling strategies.

## Agentic AI Fundamentals

Plan, reason, act paradigm, LangChain 1.0 Agents with middleware, Model Context Protocol (MCP), tool integration patterns, and enterprise adoption.

## LangGraph 1.0

Architecture, state management, graph-based logic, node caching, pre/post hooks for guardrails, building AI workflows, and production use cases.

## Advanced Workflows

Parallel execution with deferred nodes, conditional routing, iterative refinement loops, type-safe streaming, essay evaluation, customer feedback routing, and quality-gated generation.

## Enterprise Systems

Durable state management, persistence (PostgreSQL, Redis), human-in-the-loop (HITL), multi-day workflows, multi-agent design, Google A2A Protocol, LangSmith observability, MCP security, prompt injection prevention, compliance, audit trails, and agent guardrails.