SQL Server DB Architecture-Components

Component	Description	Details
Databases	A logical container for data storage within SQL Server.	- **Primary Database File (.mdf):** Contains the primary data file. - **Secondary Data Files (.ndf):** Optional, for distributing data across multiple files. - **Log File (.ldf):** Stores transaction logs.
Data Storage Structures	The physical storage units within a database.	- **Pages:** 8 KB units, the basic storage unit. - **Extents:** Groups of eight pages (64 KB) used to manage space. - **Heaps:** Tables without a clustered index, storing data unordered.
Tables	Structures that store data in rows and columns.	- **Clustered Index:** Physically sorts data based on the indexed column. - **Non-Clustered Index:** Provides a logical order, separate from physical data order. - **Partitions:** Splits large tables for better management.
Indexes	Structures that improve data retrieval speeds.	- **Clustered Index:** Alters the physical order of data to match the index. - **Non-Clustered Index:** Does not alter physical order, providing an alternative way to access data. - **Full-Text Index:** Allows fast searches on large text fields.
Transaction Log	A sequential record of all transactions and database modifications.	- **Write-Ahead Logging:** Ensures that log records are written before the actual data is modified. - **Rollback:** Allows the database to return to a previous state if a transaction fails.
Memory Structures	Memory components used by SQL Server to store and manage data.	- **Buffer Cache:** Stores frequently accessed data pages in memory. - **Plan Cache:** Stores execution plans for reuse. - **Log Buffer:** Temporarily holds transaction log records before writing to disk.

Transaction Management	Manages the execution of transactions in SQL Server, ensuring ACID properties.	- **ACID Compliance:** Ensures Atomicity, Consistency, Isolation, and Durability. - **Isolation Levels:** Controls transaction isolation (e.g., Read Committed, Serializable).
Filegroups	Logical storage units that group database files together for easier management.	- **Primary Filegroup:** Contains the primary data file and other objects not assigned to other filegroups. - **Secondary Filegroups:** Used for partitioning or managing large data sets.
Data Integrity	Ensures the accuracy and consistency of data within the database.	- **Constraints:** Enforces rules on data (e.g., PRIMARY KEY, FOREIGN KEY, CHECK). - **Triggers:** Automatically executes code in response to certain events in the database.
Backup and Restore	Mechanisms for protecting and recovering data.	- **Full Backup:** Backs up the entire database. - **Differential Backup:** Backs up only the data that has changed since the last full backup. - **Transaction Log Backup:** Backs up the transaction log.
Security	Mechanisms for controlling access to the database and its data.	- **Authentication:** Methods of verifying user identity (Windows Authentication, SQL Server Authentication). - **Authorization:** Assigning permissions to users and roles. - **Encryption:** Protects sensitive data (TDE, Always Encrypted).
Query Processing	The steps SQL Server takes to parse, optimize, and execute queries.	- **Query Parser:** Parses the query into a logical tree. - **Optimizer:** Creates an efficient execution plan. - **Execution Engine:** Executes the query using the generated plan.

Concurrency Control	Methods for managing simultaneous access to the database by multiple users.	- **Locks:** Mechanisms to prevent conflicts (e.g., row locks, page locks). - **Latches:** Lightweight mechanisms to ensure data consistency during in-memory operations.
Data Replication	The process of copying and distributing data across different databases or servers.	- **Snapshot Replication:** Copies and applies the entire data set at once. - **Transactional Replication:** Continuously replicates data changes. - **Merge Replication:** Allows multiple databases to synchronize and merge changes.
High Availability	Techniques to ensure that the database remains available in case of failure.	- **Always On Availability Groups:** Provides failover capability for a set of databases. - **Log Shipping:** Automates log backup and restore operations to a standby server. - **Database Mirroring:** Maintains a hot standby copy of the database.
Full-Text Search	A specialized feature that allows fast text searches on large amounts of unstructured text data.	- **Full-Text Index:** Indexes large text fields. - **Full-Text Query:** Enables searching within text data using specific predicates (e.g., CONTAINS, FREETEXT).
Service Broker	A framework for building asynchronous, distributed, and reliable messaging and queue-based applications.	- **Queues:** Store messages for asynchronous processing. - **Activation:** Automatically starts a stored procedure when new messages arrive in a queue.

This table provides a comprehensive overview of SQL Server Database Architecture, covering all critical components, their roles, and their details.