**Basic SQL Questions**

1. **What is SQL?**
   * **Answer**: SQL (Structured Query Language) is a standardized programming language used for managing and manipulating relational databases. It allows users to create, read, update, and delete data within a database.
2. **What are the different types of SQL commands?**
   * **Answer**: SQL commands are divided into five categories:
     + **DDL (Data Definition Language)**: CREATE, ALTER, DROP
     + **DML (Data Manipulation Language)**: SELECT, INSERT, UPDATE, DELETE
     + **DCL (Data Control Language)**: GRANT, REVOKE
     + **TCL (Transaction Control Language)**: COMMIT, ROLLBACK, SAVEPOINT
     + **DQL (Data Query Language)**: SELECT
3. **What is a primary key?**
   * **Answer**: A primary key is a column or a combination of columns that uniquely identifies each row in a table. It ensures that the values in the primary key column(s) are unique and not NULL.
   * **Example**:

sql

Copy code

CREATE TABLE Employees (

EmployeeID INT PRIMARY KEY,

FirstName VARCHAR(50),

LastName VARCHAR(50)

);

1. **What is a foreign key?**
   * **Answer**: A foreign key is a column or a combination of columns that establishes a link between the data in two tables. It refers to the primary key in another table, ensuring referential integrity.
   * **Example**:

sql

Copy code

CREATE TABLE Orders (

OrderID INT PRIMARY KEY,

OrderDate DATE,

CustomerID INT,

FOREIGN KEY (CustomerID) REFERENCES Customers(CustomerID)

);

1. **What is a join?**
   * **Answer**: A join is an SQL operation that combines rows from two or more tables based on a related column between them. Types of joins include INNER JOIN, LEFT JOIN, RIGHT JOIN, and FULL OUTER JOIN.
   * **Example**:

sql

Copy code

SELECT Employees.FirstName, Departments.DepartmentName

FROM Employees

INNER JOIN Departments ON Employees.DepartmentID = Departments.DepartmentID;

**Intermediate SQL Questions**

1. **What is an index?**
   * **Answer**: An index is a database object that improves the speed of data retrieval operations on a table at the cost of additional storage space. Indexes can be created on one or more columns of a table.
   * **Example**:

sql

Copy code

CREATE INDEX idx\_employee\_lastname ON Employees(LastName);

1. **What is a view in SQL?**
   * **Answer**: A view is a virtual table that is based on the result set of an SQL query. Views can simplify complex queries, provide security by restricting access to certain data, and present data in a specific format.
   * **Example**:

sql

Copy code

CREATE VIEW ActiveEmployees AS

SELECT FirstName, LastName, DepartmentID

FROM Employees

WHERE IsActive = 1;

1. **What is a subquery?**
   * **Answer**: A subquery is a query nested inside another query. It can be used in SELECT, INSERT, UPDATE, or DELETE statements and is often used to perform operations that are dependent on the result of another query.
   * **Example**:

sql

Copy code

SELECT FirstName, LastName

FROM Employees

WHERE DepartmentID = (SELECT DepartmentID FROM Departments WHERE DepartmentName = 'Sales');

1. **What is normalization?**
   * **Answer**: Normalization is the process of organizing the columns and tables of a relational database to minimize data redundancy. Normal forms (NF) are guidelines for achieving normalization, including 1NF, 2NF, 3NF, and BCNF.
   * **Example**: Ensuring that each table contains data related to only one topic and that each column holds atomic values.
2. **What is denormalization?**
   * **Answer**: Denormalization is the process of combining normalized tables to improve database read performance. It involves intentionally introducing redundancy into a table to reduce the complexity of queries.
   * **Example**: Combining customer and order details into a single table to reduce the number of joins required to retrieve customer order information.

**Advanced SQL Questions**

1. **What are transactions in SQL?**
   * **Answer**: Transactions are a sequence of SQL statements that are executed as a single unit of work. They ensure data integrity by following the ACID properties: Atomicity, Consistency, Isolation, and Durability.
   * **Example**:

sql

Copy code

BEGIN TRANSACTION;

UPDATE Accounts SET Balance = Balance - 100 WHERE AccountID = 1;

UPDATE Accounts SET Balance = Balance + 100 WHERE AccountID = 2;

COMMIT;

1. **What is a stored procedure?**
   * **Answer**: A stored procedure is a precompiled collection of SQL statements that can be executed as a single unit. Stored procedures can accept parameters, return results, and be called from other SQL statements or applications.
   * **Example**:

sql

Copy code

CREATE PROCEDURE GetEmployeeDetails (@EmployeeID INT)

AS

BEGIN

SELECT FirstName, LastName, DepartmentID

FROM Employees

WHERE EmployeeID = @EmployeeID;

END;

1. **What is a trigger?**
   * **Answer**: A trigger is a special type of stored procedure that automatically executes in response to certain events on a table or view, such as INSERT, UPDATE, or DELETE operations.
   * **Example**:

sql

Copy code

CREATE TRIGGER trgAfterInsert ON Employees

AFTER INSERT

AS

BEGIN

INSERT INTO AuditLog (Action, ActionDate)

VALUES ('Insert', GETDATE());

END;

1. **What is a cursor?**
   * **Answer**: A cursor is a database object that allows row-by-row processing of the result set. Cursors are useful for operations that require iteration over each row in a query result.
   * **Example**:

sql

Copy code

DECLARE @EmployeeID INT;

DECLARE EmployeeCursor CURSOR FOR

SELECT EmployeeID FROM Employees;

OPEN EmployeeCursor;

FETCH NEXT FROM EmployeeCursor INTO @EmployeeID;

WHILE @@FETCH\_STATUS = 0

BEGIN

-- Perform operations using @EmployeeID

FETCH NEXT FROM EmployeeCursor INTO @EmployeeID;

END;

CLOSE EmployeeCursor;

DEALLOCATE EmployeeCursor;

1. **What is the difference between DELETE and TRUNCATE?**
   * **Answer**: DELETE removes rows from a table based on a condition and can be rolled back if used within a transaction. TRUNCATE removes all rows from a table, does not generate individual row delete operations, and cannot be rolled back if used within a transaction.
   * **Example**:

sql

Copy code

DELETE FROM Employees WHERE DepartmentID = 1;

TRUNCATE TABLE Employees;

**Performance and Optimization Questions**

1. **What are some common performance issues in SQL?**
   * **Answer**: Common performance issues include:
     + Lack of proper indexing
     + Inefficient query design
     + High table scan rates
     + Locking and blocking issues
     + Fragmented data
2. **How can you optimize SQL queries?**
   * **Answer**: Query optimization techniques include:
     + Creating appropriate indexes
     + Using proper JOIN operations
     + Avoiding SELECT \*
     + Writing efficient WHERE clauses
     + Analyzing and updating statistics
3. **What is an execution plan?**
   * **Answer**: An execution plan is a detailed description of how the SQL Server will execute a query, including the steps and order of operations. It helps in understanding and optimizing query performance.
   * **Example**:

sql

Copy code

EXPLAIN SELECT \* FROM Employees WHERE DepartmentID = 1;

1. **What are the differences between clustered and non-clustered indexes?**
   * **Answer**: A clustered index determines the physical order of data in a table and can only be one per table. A non-clustered index creates a separate structure to hold pointers to the data and can have multiple indexes per table.
   * **Example**:

sql

Copy code

CREATE CLUSTERED INDEX idx\_employee\_id ON Employees(EmployeeID);

CREATE NONCLUSTERED INDEX idx\_employee\_lastname ON Employees(LastName);

1. **What is a composite index?**
   * **Answer**: A composite index is an index on two or more columns of a table. It is useful for queries that filter based on multiple columns.
   * **Example**:

sql

Copy code

CREATE INDEX idx\_employee\_name\_department ON Employees(LastName, DepartmentID);

**Data Manipulation and Query Questions**

1. **What is the difference between UNION and UNION ALL?**
   * **Answer**: UNION combines the result sets of two queries and removes duplicate rows. UNION ALL combines the result sets and includes all duplicates.
   * **Example**:

sql

Copy code

SELECT FirstName FROM Employees

UNION

SELECT FirstName FROM Managers;

SELECT FirstName FROM Employees

UNION ALL

SELECT FirstName FROM Managers;

1. **How do you update data in SQL?**
   * **Answer**: The UPDATE statement is used to modify existing records in a table.
   * **Example**:

sql

Copy code

UPDATE Employees

SET LastName = 'Smith'

WHERE EmployeeID = 1;

1. **What is the difference between WHERE and HAVING?**
   * **Answer**: WHERE filters rows before grouping and is used with SELECT, UPDATE, and DELETE statements. HAVING filters groups after grouping and is used with GROUP BY.
   * **Example**:

sql

Copy code

SELECT DepartmentID, COUNT(\*)

FROM Employees

GROUP BY DepartmentID

HAVING COUNT(\*) > 5;

1. **How do you insert data into a table?**
   * **Answer**: The INSERT INTO statement is used to add new rows to a table.
   * **Example**:

sql

Copy code

INSERT INTO Employees (FirstName, LastName, DepartmentID)

VALUES ('John', 'Doe', 1);

1. **How do you delete data from a table?**
   * **Answer**: The DELETE statement is used to remove rows from a table based on a condition.
   * **Example**:

sql

Copy code

DELETE FROM Employees

WHERE EmployeeID = 1;

**Functions and Procedures Questions**

1. **What are aggregate functions?**
   * **Answer**: Aggregate functions perform calculations on a set of values and return a single value. Examples include COUNT, SUM, AVG, MIN, and MAX.
   * **Example**:

sql

Copy code

SELECT AVG(Salary) FROM Employees;

1. **What is a scalar function?**
   * **Answer**: A scalar function returns a single value based on the input values. Examples include UPPER, LOWER, LEN, and ROUND.
   * **Example**:

sql

Copy code

SELECT UPPER(FirstName) FROM Employees;

1. **How do you create a user-defined function in SQL?**
   * **Answer**: User-defined functions (UDFs) are created using the CREATE FUNCTION statement. They can return a single value (scalar) or a table (table-valued).
   * **Example**:

sql

Copy code

CREATE FUNCTION GetFullName (@FirstName VARCHAR(50), @LastName VARCHAR(50))

RETURNS VARCHAR(100)

AS

BEGIN

RETURN @FirstName + ' ' + @LastName;

END;

1. **What is a table-valued function?**
   * **Answer**: A table-valued function returns a table data type and can be used in place of a table in SQL queries.
   * **Example**:

sql

Copy code

CREATE FUNCTION GetEmployeesByDepartment (@DepartmentID INT)

RETURNS TABLE

AS

RETURN (SELECT \* FROM Employees WHERE DepartmentID = @DepartmentID);

1. **What is a common table expression (CTE)?**
   * **Answer**: A CTE is a temporary result set that is defined within the execution scope of a single SELECT, INSERT, UPDATE, or DELETE statement.
   * **Example**:

sql

Copy code

WITH EmployeeCTE AS (

SELECT EmployeeID, FirstName, LastName, DepartmentID

FROM Employees

WHERE DepartmentID = 1

)

SELECT \* FROM EmployeeCTE;

**Data Integrity and Constraints Questions**

1. **What are constraints in SQL?**
   * **Answer**: Constraints are rules enforced on columns in a table to ensure data integrity. Types of constraints include PRIMARY KEY, FOREIGN KEY, UNIQUE, NOT NULL, and CHECK.
   * **Example**:

sql

Copy code

CREATE TABLE Employees (

EmployeeID INT PRIMARY KEY,

Email VARCHAR(100) UNIQUE,

Salary DECIMAL CHECK (Salary > 0)

);

1. **What is a unique constraint?**
   * **Answer**: A unique constraint ensures that all values in a column or a group of columns are distinct.
   * **Example**:

sql

Copy code

ALTER TABLE Employees

ADD CONSTRAINT UQ\_Email UNIQUE (Email);

1. **What is a check constraint?**
   * **Answer**: A check constraint ensures that all values in a column satisfy a specific condition.
   * **Example**:

sql

Copy code

ALTER TABLE Employees

ADD CONSTRAINT CK\_Salary CHECK (Salary > 0);

1. **What is a default constraint?**
   * **Answer**: A default constraint provides a default value for a column when no value is specified during an insert operation.
   * **Example**:

sql

Copy code

CREATE TABLE Employees (

EmployeeID INT PRIMARY KEY,

HireDate DATE DEFAULT GETDATE()

);

1. **How do you add a constraint to an existing table?**
   * **Answer**: Constraints can be added to an existing table using the ALTER TABLE statement.
   * **Example**:

sql

Copy code

ALTER TABLE Employees

ADD CONSTRAINT FK\_Department FOREIGN KEY (DepartmentID) REFERENCES Departments(DepartmentID);

**Advanced Querying and Data Management Questions**

1. **What is a self-join?**
   * **Answer**: A self-join is a join in which a table is joined with itself. It is useful for hierarchical or adjacency list data structures.
   * **Example**:

sql

Copy code

SELECT A.EmployeeID, A.FirstName, B.FirstName AS ManagerName

FROM Employees A

INNER JOIN Employees B ON A.ManagerID = B.EmployeeID;

1. **What is a correlated subquery?**
   * **Answer**: A correlated subquery is a subquery that refers to columns from the outer query. It is evaluated once for each row processed by the outer query.
   * **Example**:

sql

Copy code

SELECT EmployeeID, FirstName

FROM Employees E

WHERE Salary > (SELECT AVG(Salary) FROM Employees WHERE DepartmentID = E.DepartmentID);

1. **What is a temporary table?**
   * **Answer**: A temporary table is a special type of table that is created and stored in the tempdb database. It is used to store intermediate results and is automatically dropped when the session ends.
   * **Example**:

sql

Copy code

CREATE TABLE #TempEmployees (

EmployeeID INT,

FirstName VARCHAR(50)

);

1. **What is a pivot table in SQL?**
   * **Answer**: A pivot table is a data summarization tool that is used to rotate rows into columns to create a cross-tabulated view of data.
   * **Example**:

sql

Copy code

SELECT DepartmentID, [2022] AS Sales2022, [2023] AS Sales2023

FROM (

SELECT DepartmentID, Year, Sales

FROM SalesData

) AS SourceTable

PIVOT (

SUM(Sales)

FOR Year IN ([2022], [2023])

) AS PivotTable;

1. **What is a ranking function?**
   * **Answer**: Ranking functions provide a rank for each row within a partition of a result set. Common ranking functions include ROW\_NUMBER(), RANK(), DENSE\_RANK(), and NTILE().
   * **Example**:

sql

Copy code

SELECT EmployeeID, FirstName, Salary,

RANK() OVER (ORDER BY Salary DESC) AS SalaryRank

FROM Employees;

**Data Security and Access Questions**

1. **What are roles in SQL?**
   * **Answer**: Roles are database security principals that group together multiple users to simplify the management of permissions.
   * **Example**:

sql

Copy code

CREATE ROLE SalesRole;

GRANT SELECT ON Sales TO SalesRole;

1. **How do you grant permissions in SQL?**
   * **Answer**: Permissions can be granted to users or roles using the GRANT statement.
   * **Example**:

sql

Copy code

GRANT SELECT, INSERT ON Employees TO SalesRole;

1. **What is the difference between GRANT and REVOKE?**
   * **Answer**: GRANT is used to provide permissions to users or roles, while REVOKE is used to remove previously granted permissions.
   * **Example**:

sql

Copy code

REVOKE INSERT ON Employees FROM SalesRole;

1. **How do you implement row-level security in SQL?**
   * **Answer**: Row-level security can be implemented using security policies and predicates to filter rows based on the user's role or context.
   * **Example**:

sql

Copy code

CREATE SECURITY POLICY RowLevelSecurityPolicy

ADD FILTER PREDICATE dbo.RowFilterPredicate(EmployeeID) ON dbo.Employees;

1. **What are database roles and schemas?**
   * **Answer**: Database roles are security entities that group users for permission management. Schemas are containers for database objects, providing a way to group objects and manage permissions.
   * **Example**:

sql

Copy code

CREATE SCHEMA Sales AUTHORIZATION SalesRole;

**Miscellaneous Questions**

1. **What is a sequence in SQL?**
   * **Answer**: A sequence is a database object that generates a sequence of unique numbers. It is often used to generate unique identifiers.
   * **Example**:

sql

Copy code

CREATE SEQUENCE EmployeeSeq

START WITH 1

INCREMENT BY 1;

1. **How do you handle NULL values in SQL?**
   * **Answer**: NULL values represent missing or unknown data. Functions like ISNULL() or COALESCE() can be used to handle NULL values.
   * **Example**:

sql

Copy code

SELECT FirstName, ISNULL(MiddleName, 'N/A') AS MiddleName

FROM Employees;

1. **What is a partitioned table?**
   * **Answer**: A partitioned table divides data into smaller, more manageable pieces called partitions, which can improve performance and manageability.
   * **Example**:

sql

Copy code

CREATE PARTITION FUNCTION myPartitionFunction (INT)

AS RANGE LEFT FOR VALUES (1000, 2000, 3000);

CREATE PARTITION SCHEME myPartitionScheme

AS PARTITION myPartitionFunction

TO (filegroup1, filegroup2, filegroup3, filegroup4);

CREATE TABLE myPartitionedTable (

ID INT,

Data VARCHAR(50)

) ON myPartitionScheme(ID);

1. **What are window functions in SQL?**
   * **Answer**: Window functions perform calculations across a set of table rows related to the current row. Examples include ROW\_NUMBER(), RANK(), DENSE\_RANK(), and NTILE().
   * **Example**:

sql

Copy code

SELECT EmployeeID, FirstName, Salary,

ROW\_NUMBER() OVER (PARTITION BY DepartmentID ORDER BY Salary DESC) AS RowNum

FROM Employees;

1. **What is the difference between a temporary table and a table variable?**
   * **Answer**: Temporary tables are created in the tempdb database and can be indexed and have constraints. Table variables are stored in memory, have a more limited scope, and typically perform better for small datasets.
   * **Example**:

sql

Copy code

CREATE TABLE #TempTable (

ID INT,

Data VARCHAR(50)

);

DECLARE @TableVar TABLE (

ID INT,

Data VARCHAR(50)

);