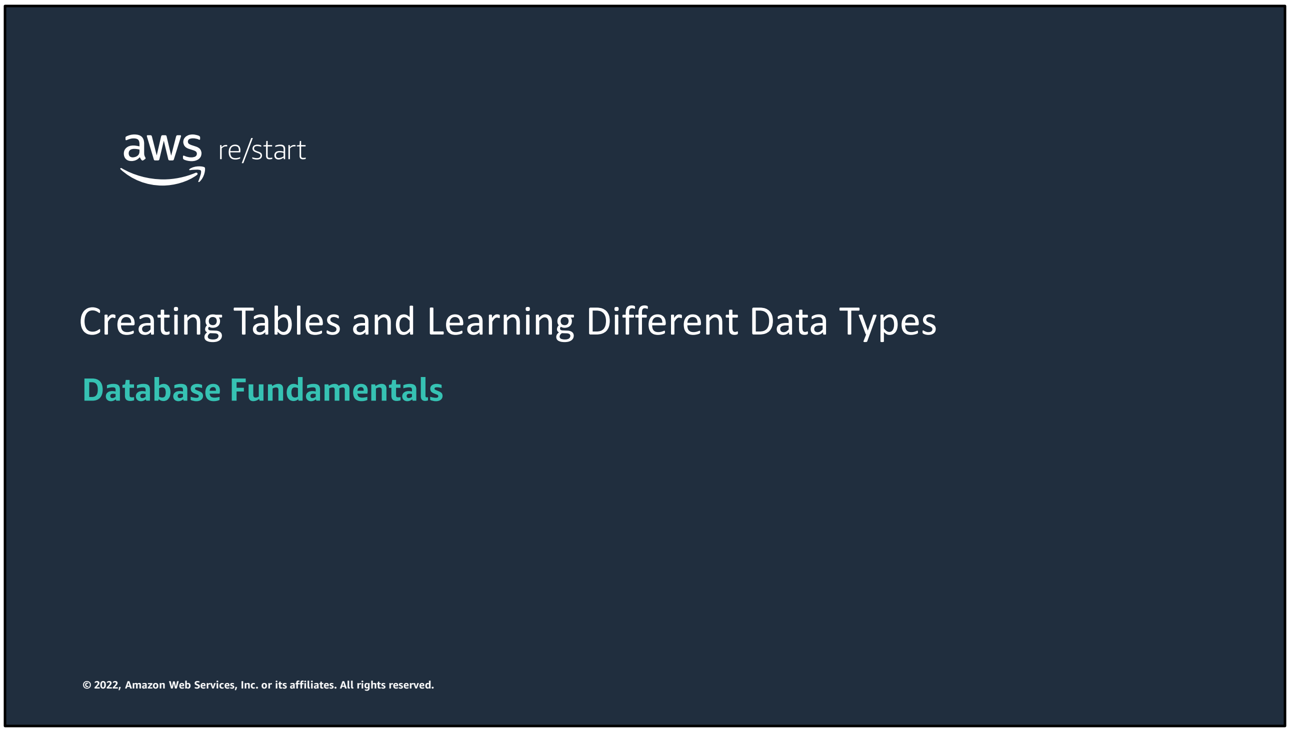

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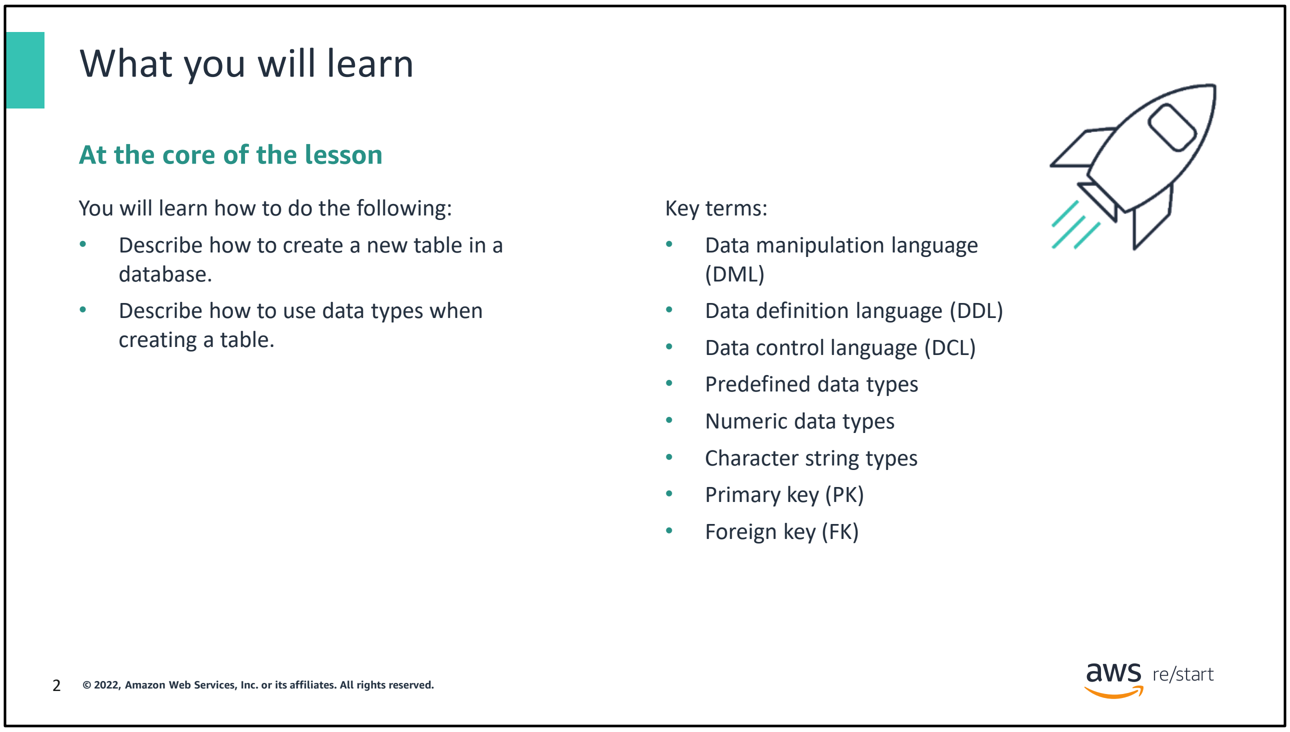
Creating Tables and Learning Different Data Types

Database Fundamentals

Welcome to Creating Tables and Learning Different Data Types.



What you will learn

At the core of the lesson

You will learn how to do the following:

- Describe how to create a new table in a database.
- Describe how to use data types when creating a table.

Key terms:

- Data manipulation language (DML)
- Data definition language (DDL)
- Data control language (DCL)
- Predefined data types
- Numeric data types
- Character string types
- Primary key (PK)
- Foreign key (FK)

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At this module, you will learn how to do the following:

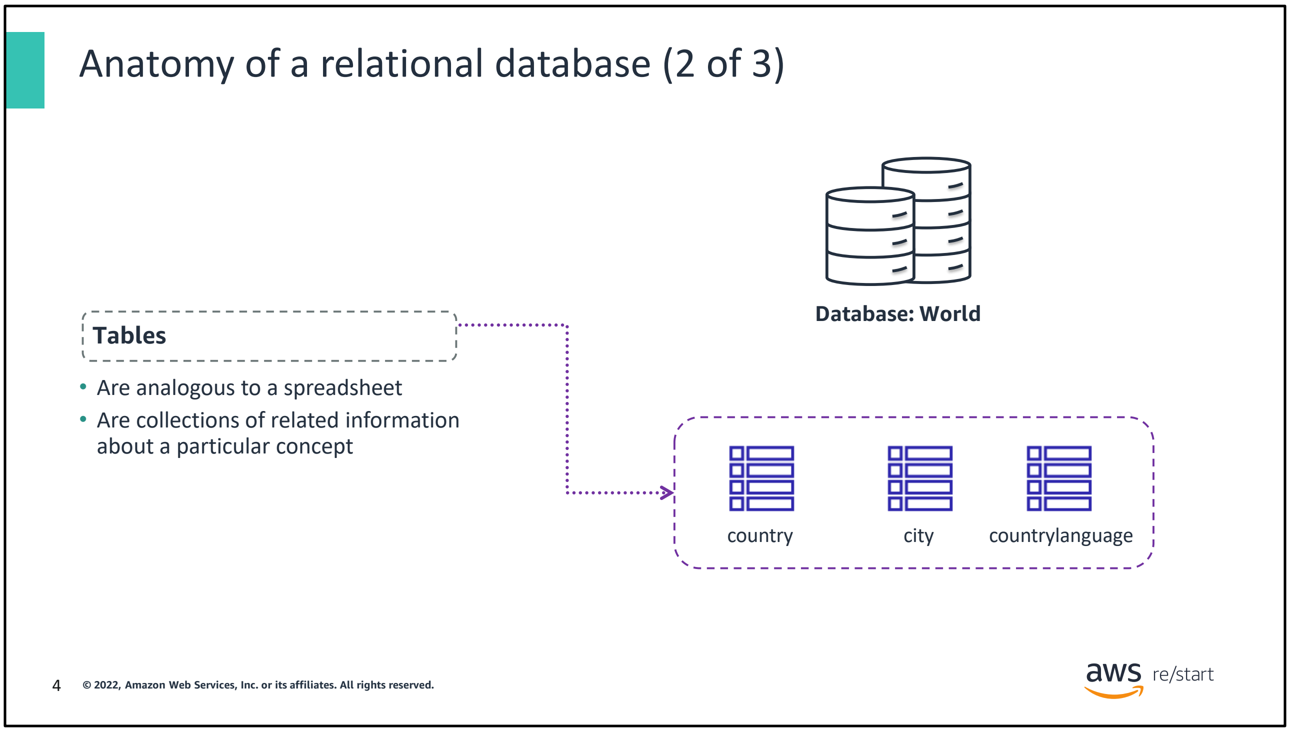
- Describe how to create a new table in a database.
- Describe how to use data types when creating a table.

Anatomy of a relational database (1 of 3)

Recall that a relational database is a collection of data items that have predefined relationships between them.

Database: World

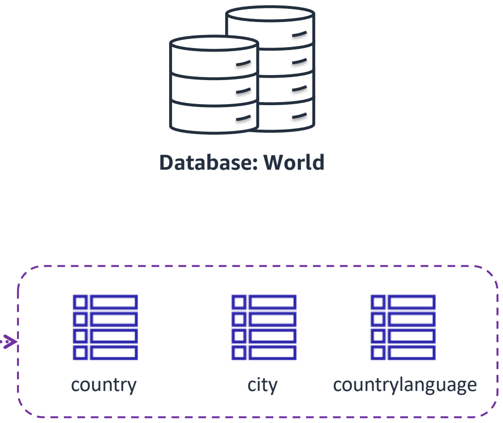
The example database used in this course is the World database.



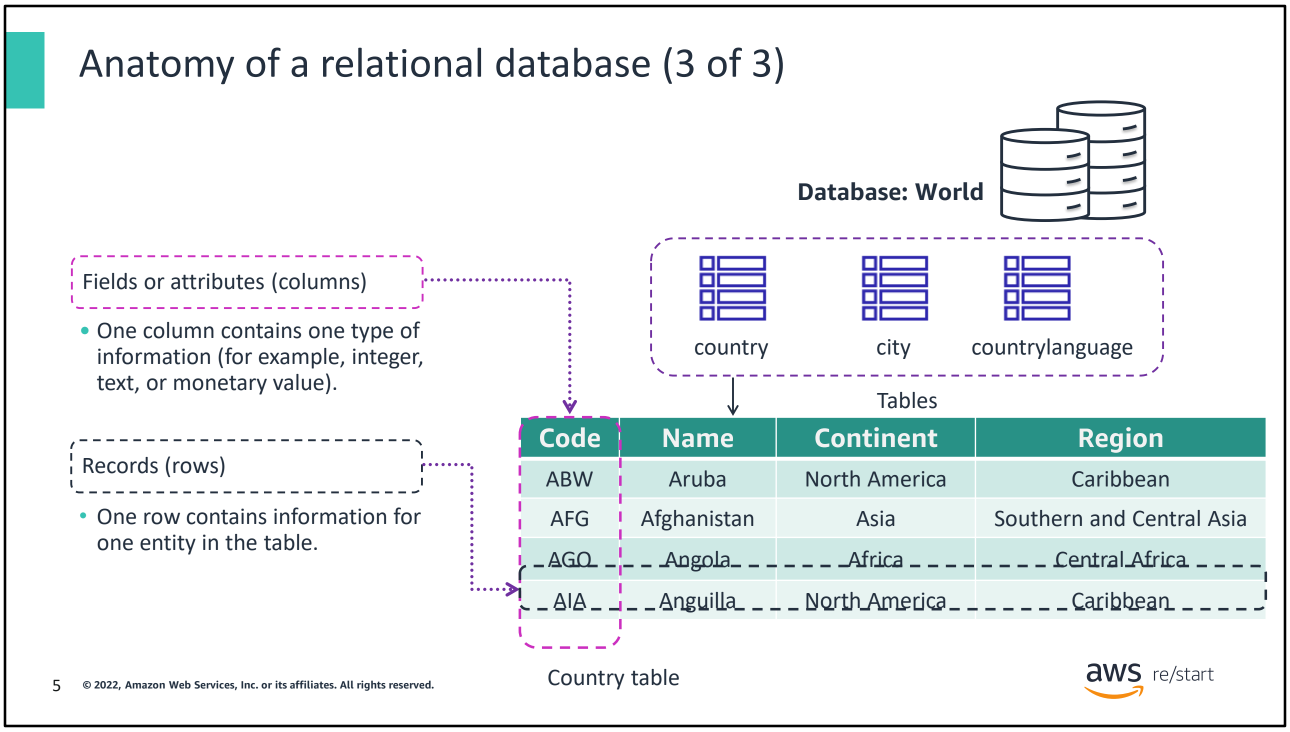
Anatomy of a relational database (2 of 3)

Tables

- Are analogous to a spreadsheet
- Are collections of related information about a particular concept



Items in a database are organized as a set of tables with columns and rows. Tables are used to hold information about the objects that will be represented in the database.



Anatomy of a relational database (3 of 3)

Fields or attributes (columns)

- One column contains one type of information (for example, integer, text, or monetary value).

Records (rows)

- One row contains information for one entity in the table.

Code	Name	Continent	Region
ABW	Aruba	North America	Caribbean
AFG	Afghanistan	Asia	Southern and Central Asia
AGO	Angola	Africa	Central Africa
AIA	Anguilla	North America	Caribbean

Country table

Each column in a table holds data that represents the value of an attribute. The rows in the table represent a collection of related values of one object or entity. Each row in a table could be marked with a unique identifier, which is called a primary key (PK). You can use foreign keys (FKs) to relate rows among multiple tables.

Over the next few slides, you will discuss the structured query language (SQL) language elements that are used to build a database.

SQL

Recall that **SQL** (pronounced *SEE-kwell*) is the language that is used for querying and manipulating data. SQL is also used for defining structures in databases. SQL is a standard programming language for relational databases.

SQL is a powerful yet simple language

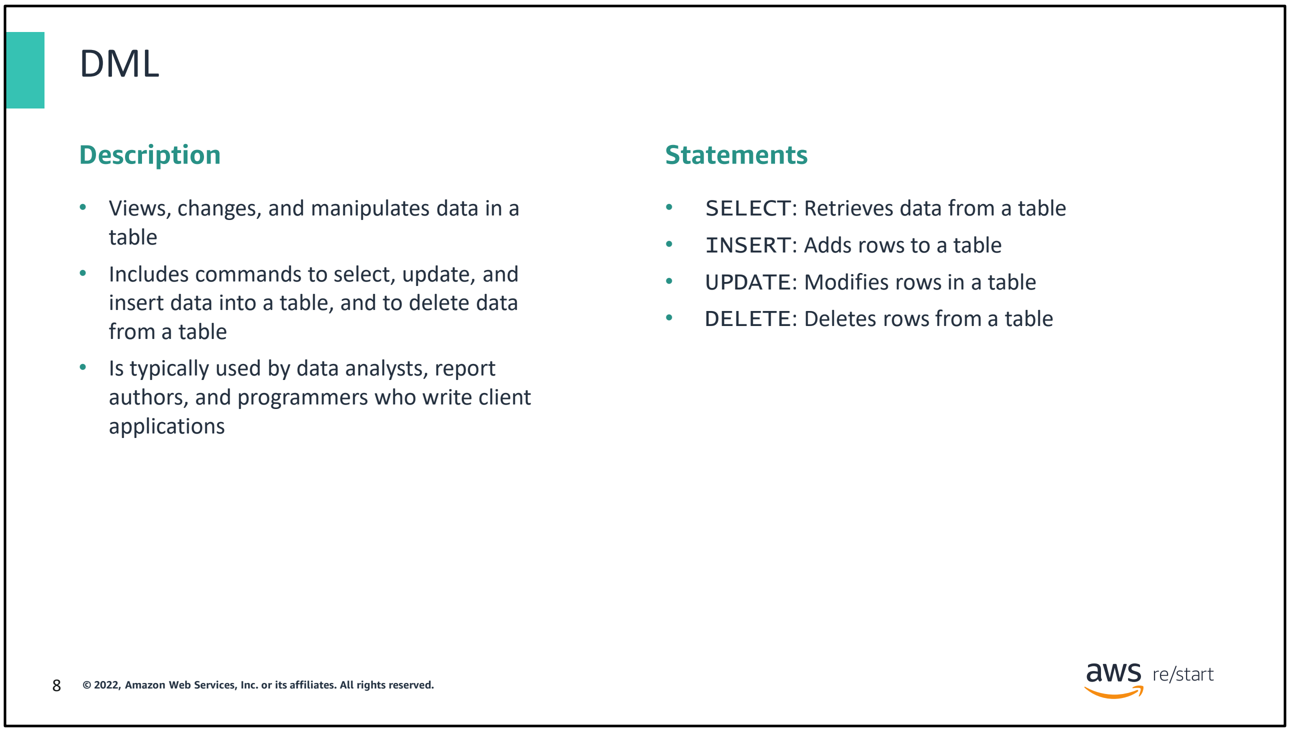
What can SQL do?

- SQL can perform many of the necessary actions on a database.

What are SQL sublanguage groups?

- **Data manipulation language** (DML)
  - You can use DML to view, add, change, or delete data in a table.
- **Data definition language** (DDL)
  - You can use DDL to define and maintain the objects in your database (its schema). The schema includes the tables, columns, and data types of your database.
- **Data control language** (DCL)
  - DCL statements control access to the data in a database.

SQL is the language that is used to create, query, modify, secure, and configure a relational database. SQL statements can be grouped into the major groups on the slide.



DML

Description

- Views, changes, and manipulates data in a table
- Includes commands to select, update, and insert data into a table, and to delete data from a table
- Is typically used by data analysts, report authors, and programmers who write client applications

Statements

- `SELECT`: Retrieves data from a table
- `INSERT`: Adds rows to a table
- `UPDATE`: Modifies rows in a table
- `DELETE`: Deletes rows from a table

Note that the **SELECT** statement is a limited form of a DML statement. Technically, it is used only to read data, but in doing so, you can operate on the accessed data before returning the query results.

DDL

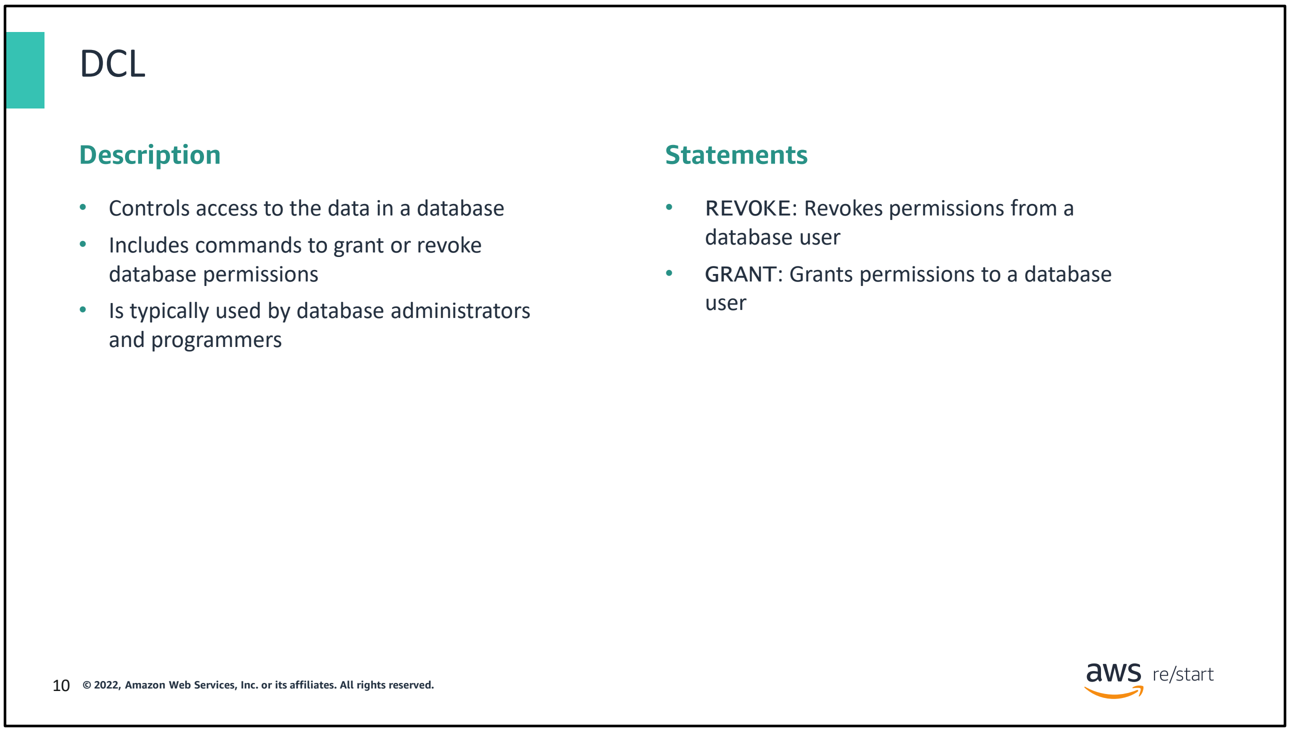
Description

- Creates and defines the database and the objects in it
- Includes commands to create and delete tables
- Is typically used by database administrators and programmers

Statements

- `CREATE`: Creates a database or a table
- `ALTER TABLE`: Adds, deletes, or modifies columns in a table; also adds or deletes constraints
- `DROP`: Deletes a database object, such as a table or a constraint

In addition to creating a database or table, the CREATE statement can also be used to create other database objects, such as a view or an index.



DCL

Description

- Controls access to the data in a database
- Includes commands to grant or revoke database permissions
- Is typically used by database administrators and programmers

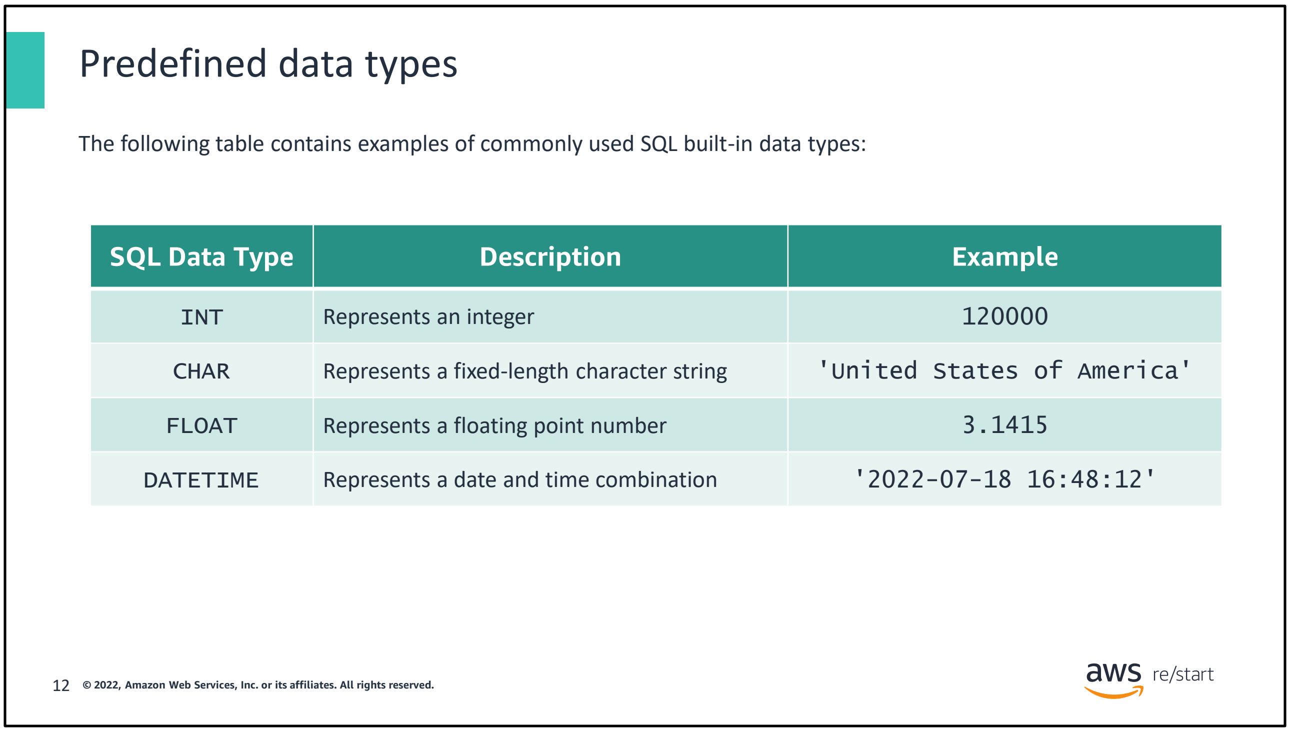
Statements

- `REVOKE`: Revokes permissions from a database user
- `GRANT`: Grants permissions to a database user

You can use DCL statements to grant and revoke permissions to objects and enforce security in a database.

Basic SQL elements

In this section, you'll look at several basic elements of the SQL language.

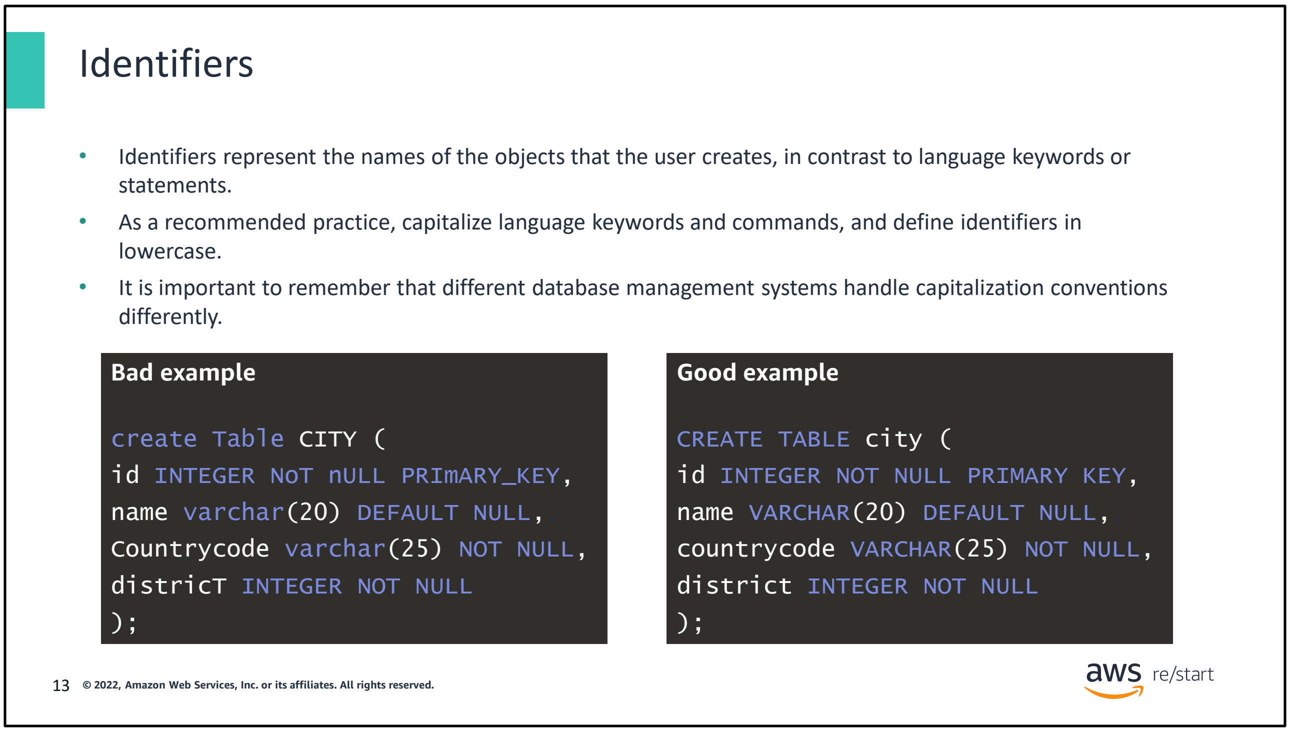


Predefined data types

The following table contains examples of commonly used SQL built-in data types:

SQL Data Type	Description	Example
`INT`	Represents an integer	`120000`
`CHAR`	Represents a fixed-length character string	`'United States of America'`
`FLOAT`	Represents a floating point number	`3.1415`
`DATETIME`	Represents a date and time combination	`'2022-07-18 16:48:12'`

Predefined data types are also known as *built-in* data types. This slide shows some of the commonly used built-in SQL data types and provides example values for each. For numeric data types, the range of permissible values depends on the database management systems (DBMS).



Identifiers

- Identifiers represent the names of the objects that the user creates, in contrast to language keywords or statements.
- As a recommended practice, capitalize language keywords and commands, and define identifiers in lowercase.
- It is important to remember that different database management systems handle capitalization conventions differently.

Bad example

```
create Table CITY (
id INTEGER NoT nULL PRImARY_KEY,
name varchar(20) DEFAULT NULL,
Countrycode varchar(25) NOT NULL,
districT INTEGER NOT NULL
);
```

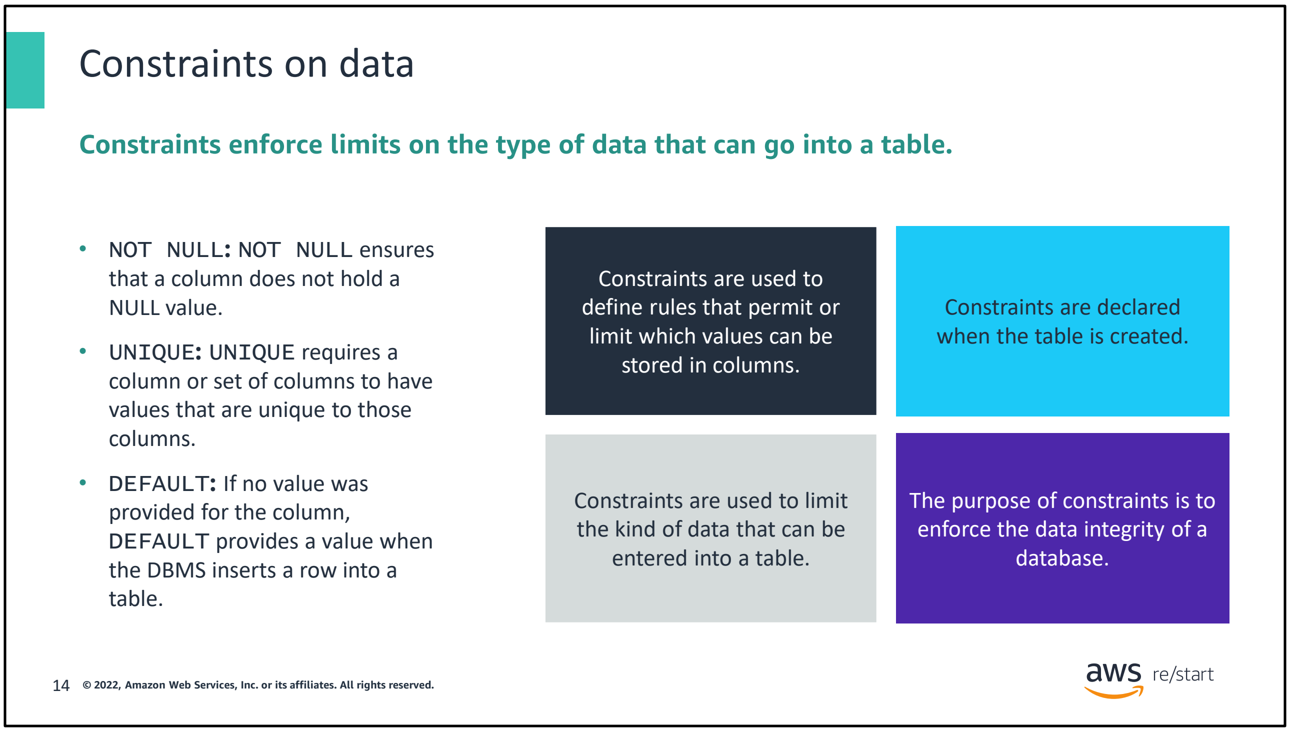
Good example

```
CREATE TABLE city (
id INTEGER NOT NULL PRIMARY KEY,
name VARCHAR(20) DEFAULT NULL,
countrycode VARCHAR(25) NOT NULL,
district INTEGER NOT NULL
);
```

aws re/start

In the example shown in the slide, `city`, `id`, `name`, `countrycode`, and `district` are all identifiers.

Different database management systems handle capitalization conventions differently. The following are some examples:
- IBM and Oracle: When you are processing code that you write, IBM and Oracle database management systems automatically convert identifiers to uppercase. (That is, they will ignore the case that you used.) To retain the case that you used for your identifiers, you must enclose them in double quotation marks (" ").
- Microsoft SQL Server: Microsoft SQL Server can be configured to be case sensitive or not case sensitive, but it is case sensitive by default. Case sensitivity is associated with the collation properties of SQL Server, which determine the sorting rules, case, and accent sensitivity properties for your data.
- MySQL Server: MySQL Server is case sensitive by default except in Microsoft Windows.



Constraints on data

Constraints enforce limits on the type of data that can go into a table.

- NOT NULL**:** NOT NULL ensures that a column does not hold a NULL value.
- UNIQUE**:** UNIQUE requires a column or set of columns to have values that are unique to those columns.
- DEFAULT**:** If no value was provided for the column, DEFAULT provides a value when the DBMS inserts a row into a table.

Constraints are used to define rules that permit or limit which values can be stored in columns.

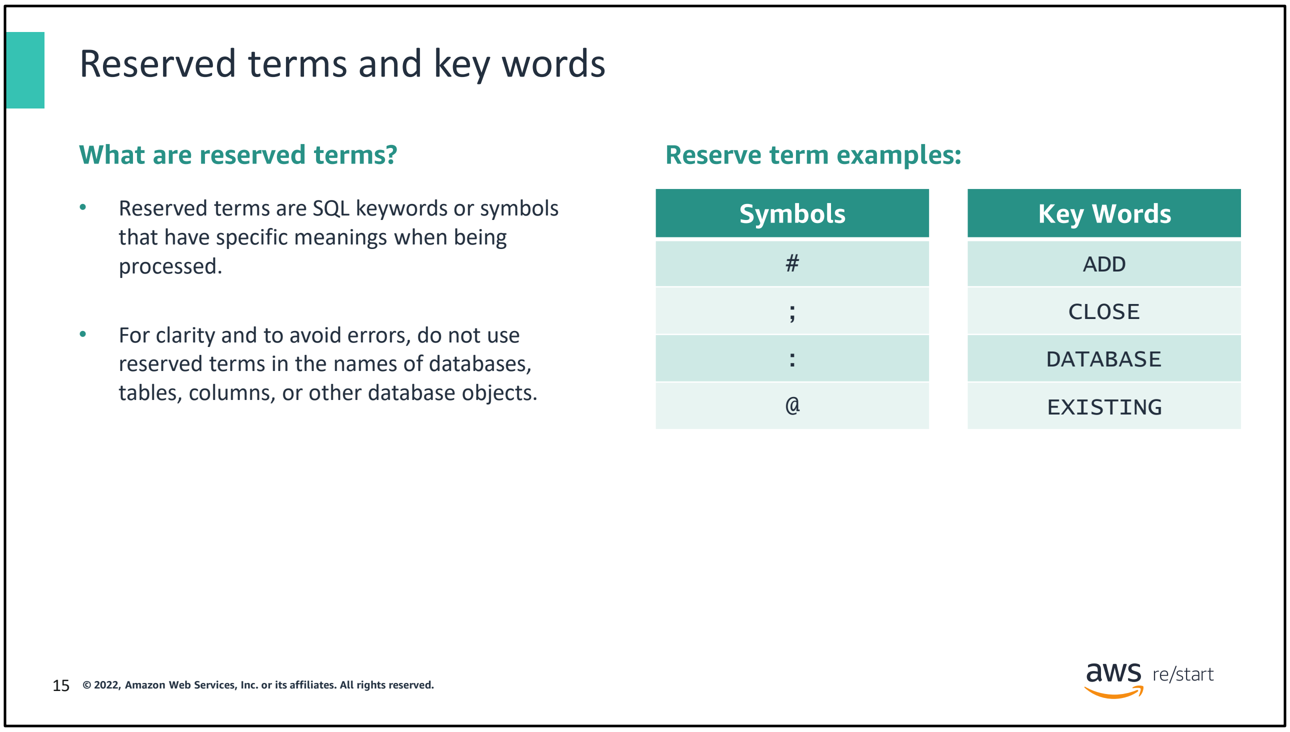
Constraints are declared when the table is created.

Constraints are used to limit the kind of data that can be entered into a table.

The purpose of constraints is to enforce the data integrity of a database.

You can use the NOT NULL constraint to define a column as requiring a value. In addition, you can use the UNIQUE constraint to make sure that each row in the table has a unique value for the column.

Another SQL constraint that is commonly used is the PRIMARY KEY constraint. It identifies the associated column as the table's primary key and, therefore, enforces that the column's values are unique.



Reserved terms and key words

What are reserved terms?

- Reserved terms are SQL keywords or symbols that have specific meanings when being processed.
- For clarity and to avoid errors, do not use reserved terms in the names of databases, tables, columns, or other database objects.

Reserve term examples:

Symbols
#
;
:
@

Key Words
ADD
CLOSE
DATABASE
EXISTING

Even though some database management systems provide a way to use reserved keywords as object names, it is not a recommended practice.

Tables

In this section, you learn about tables.

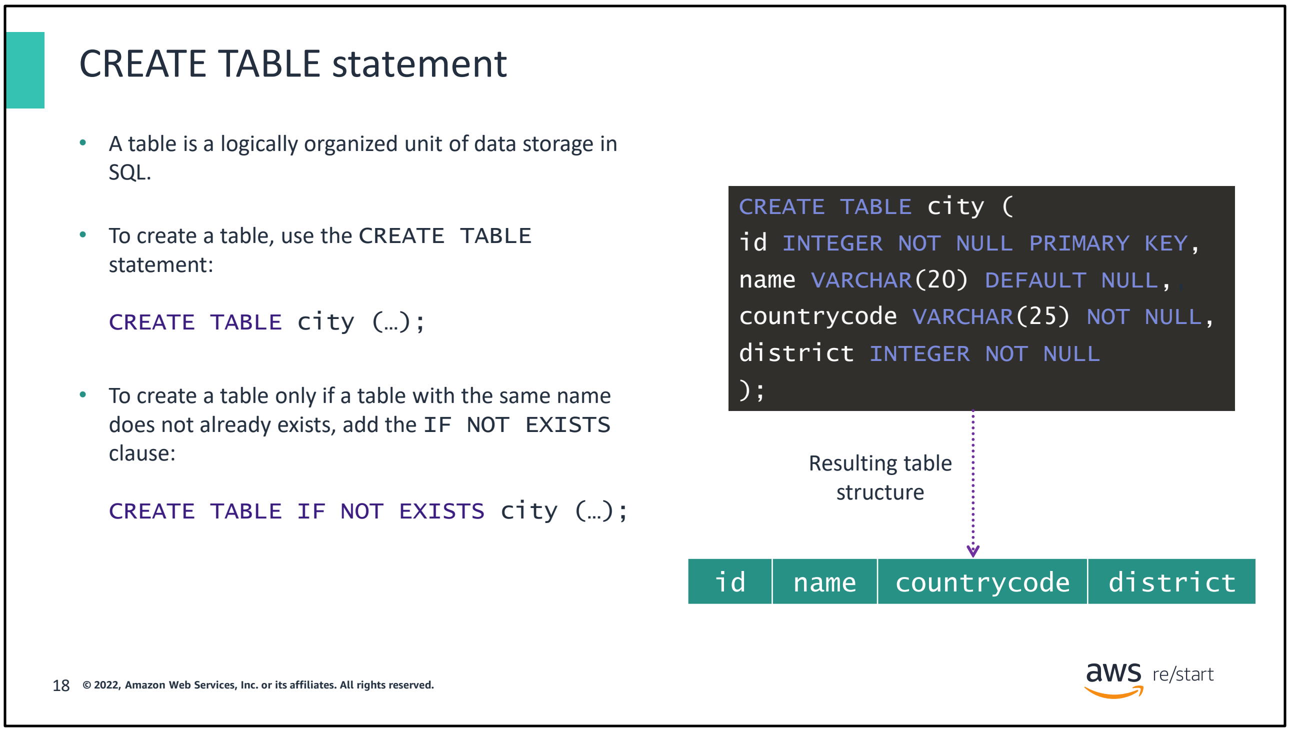
Naming tables

Purposeful naming conventions

- Carefully select purposeful names (identifiers).
- Certain factors should drive your naming conventions. For example, for the database, tables, and columns, consider the following factors:
  - Rules and limitations that the DBMS imposes
  - Naming conventions that the organization adopts
  - Clarity

Some additional recommended practices when naming tables and table elements include the following:

- Use descriptive names. The name should be meaningful and should describe the entity that is being modeled.
- Be consistent when choosing to use singular or plural table names.
- Use a consistent format in table names. For example, if you create a table to store order details, you can use camel case (orderDetails) or underscore (order_details) for the compound table name. Whichever convention you select, use it consistently.



CREATE TABLE statement

- A table is a logically organized unit of data storage in SQL.
- To create a table, use the `CREATE TABLE` statement:

```
CREATE TABLE city (…);
```

- To create a table only if a table with the same name does not already exists, add the `IF NOT EXISTS` clause:

```
CREATE TABLE IF NOT EXISTS city (…);
```

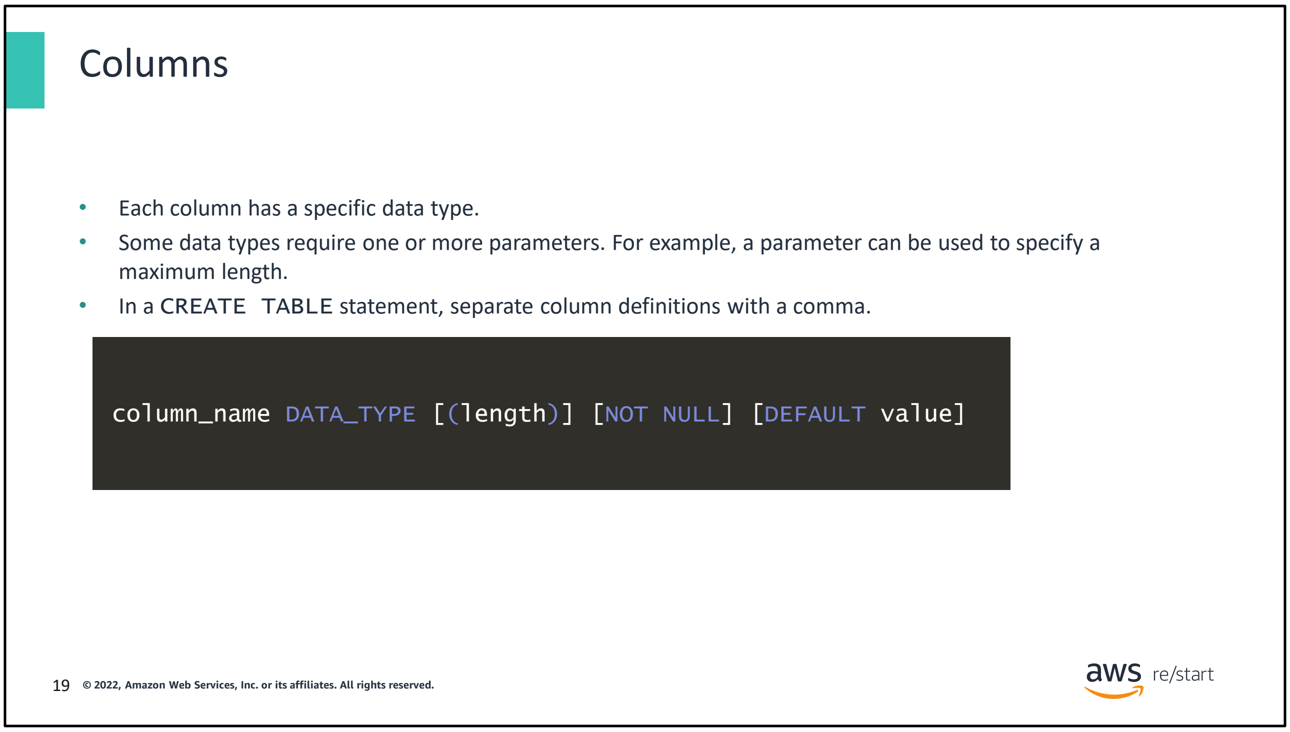
```
CREATE TABLE city (
id INTEGER NOT NULL PRIMARY KEY,
name VARCHAR(20) DEFAULT NULL,
countrycode VARCHAR(25) NOT NULL,
district INTEGER NOT NULL
);
```

Resulting table structure

id	name	countrycode	district

Use the `IF NOT EXISTS` clause to ensure that the table name does not duplicate the name of an already existing table.

In the example, the SQL statement creates a table that is named city. The table includes four columns: `id`, `name`, `countrycode`, and `district`. The `id` column is the table's primary key, has a data type of `INTEGER`, and cannot have a `NULL` value. The `name` and `countrycode` columns are of type `VARCHAR` (a variable length set of character data). The `name` field has a default value of `NULL`.

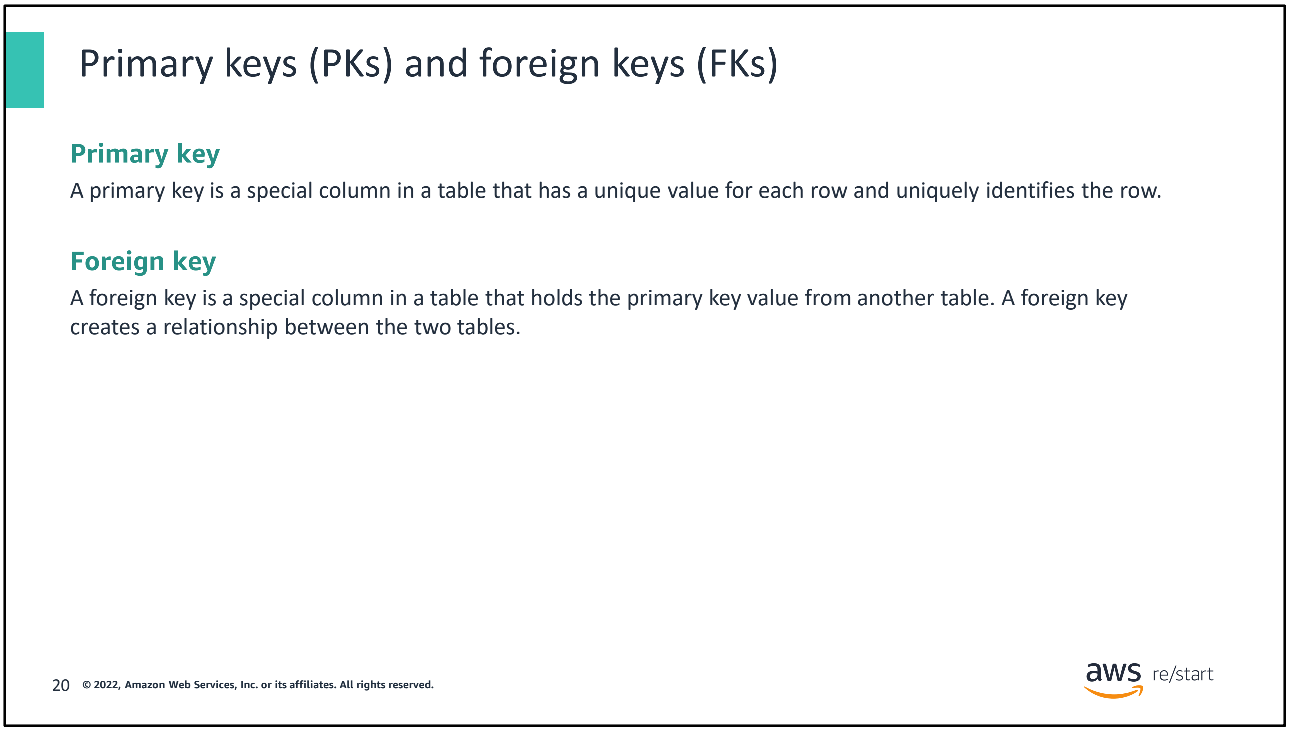


Columns

- Each column has a specific data type.
- Some data types require one or more parameters. For example, a parameter can be used to specify a maximum length.
- In a CREATE TABLE statement, separate column definitions with a comma.

```
column_name DATA_TYPE [(length)] [NOT NULL] [DEFAULT value]
```

The SQL example in the slide shows a typical format for a column definition. The column name is followed by the data type name and optional length, NOT NULL, and DEFAULT value clauses.



Primary keys (PKs) and foreign keys (FKs)

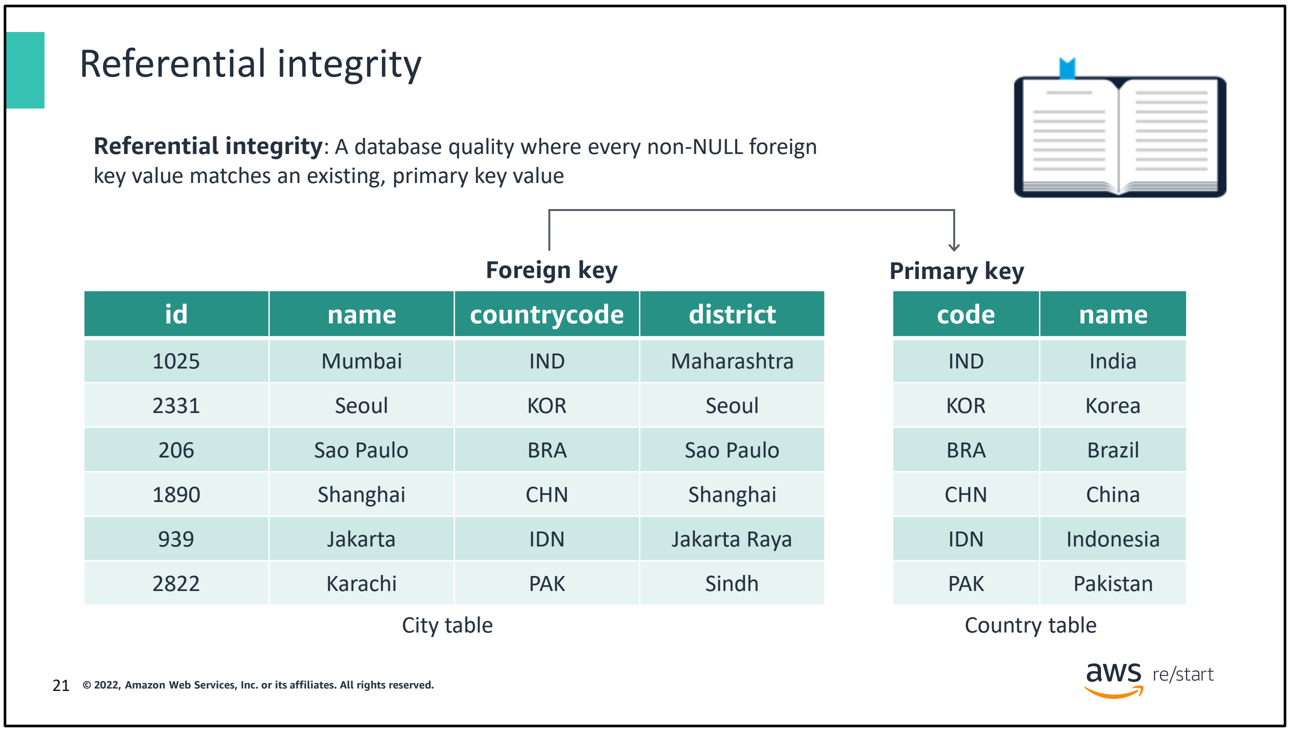
Primary key

A primary key is a special column in a table that has a unique value for each row and uniquely identifies the row.

Foreign key

A foreign key is a special column in a table that holds the primary key value from another table. A foreign key creates a relationship between the two tables.

A table can have zero or one primary key (PK). The PK can consist of one column or multiple columns (compound PK). The PK of one table can be defined as a foreign key (FK) of another table to establish a relationship between the two tables.



Referential integrity

Referential integrity: A database quality where every non-NULL foreign key value matches an existing, primary key value

Foreign key

id	name	countrycode	district
1025	Mumbai	IND	Maharashtra
2331	Seoul	KOR	Seoul
206	Sao Paulo	BRA	Sao Paulo
1890	Shanghai	CHN	Shanghai
939	Jakarta	IDN	Jakarta Raya
2822	Karachi	PAK	Sindh

City table

Primary key

code	name
IND	India
KOR	Korea
BRA	Brazil
CHN	China
IDN	Indonesia
PAK	Pakistan

Country table

Referential integrity is a database quality where every non-NULL foreign key value matches an existing, PK value.

For example, examine the city table and the country table that are shown in the slide. The country code column in the city table is an FK that matches the PK from the country table.

DROP TABLE statement

To remove a table, use the DROP TABLE statement.

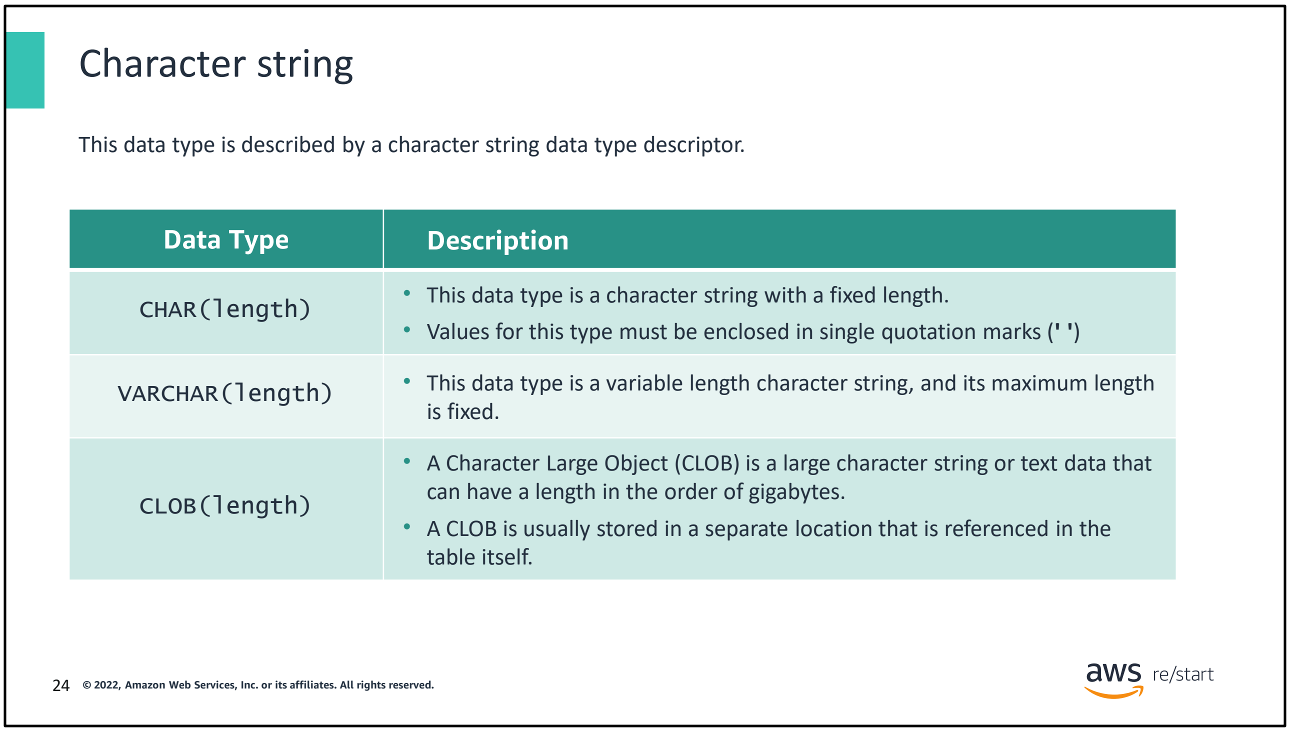
```
DROP TABLE table_name1 [, table_name2] … [, table_nameN]
```

This statement permanently removes the table and its data from the database.

To delete multiple tables, separate each table by a comma in the DROP TABLE statement.

Character string data types

In this section, you will learn about character string data types.



Character string

This data type is described by a character string data type descriptor.

Data Type	Description
`CHAR(length)`	• This data type is a character string with a fixed length. • Values for this type must be enclosed in single quotation marks (' ')
`VARCHAR(length)`	• This data type is a variable length character string, and its maximum length is fixed.
`CLOB(length)`	• A Character Large Object (CLOB) is a large character string or text data that can have a length in the order of gigabytes. • A CLOB is usually stored in a separate location that is referenced in the table itself.

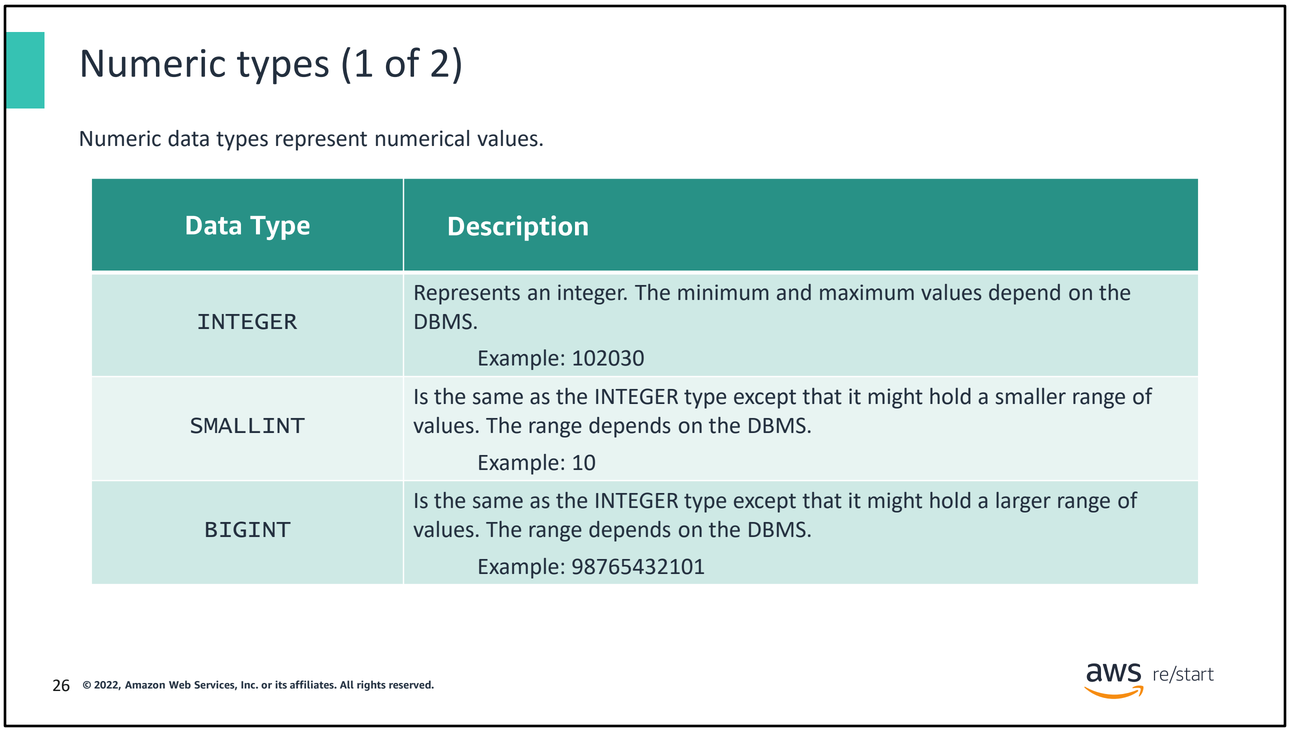
This table lists some commonly used SQL data types to represent character strings.

The following is some general guideline:

- Use fixed-length character data types for consistent-length data, such as a postal code, product code, or telephone number.
- Use variable-length data types when the length of data is widely variable. Make sure that variable-length columns are not wider than they need to be.
- Make sure that you understand how CLOB storage is allocated in the system that you use.

Numeric and date data types

In this section, you will learn about numeric and date data types.



Numeric types (1 of 2)

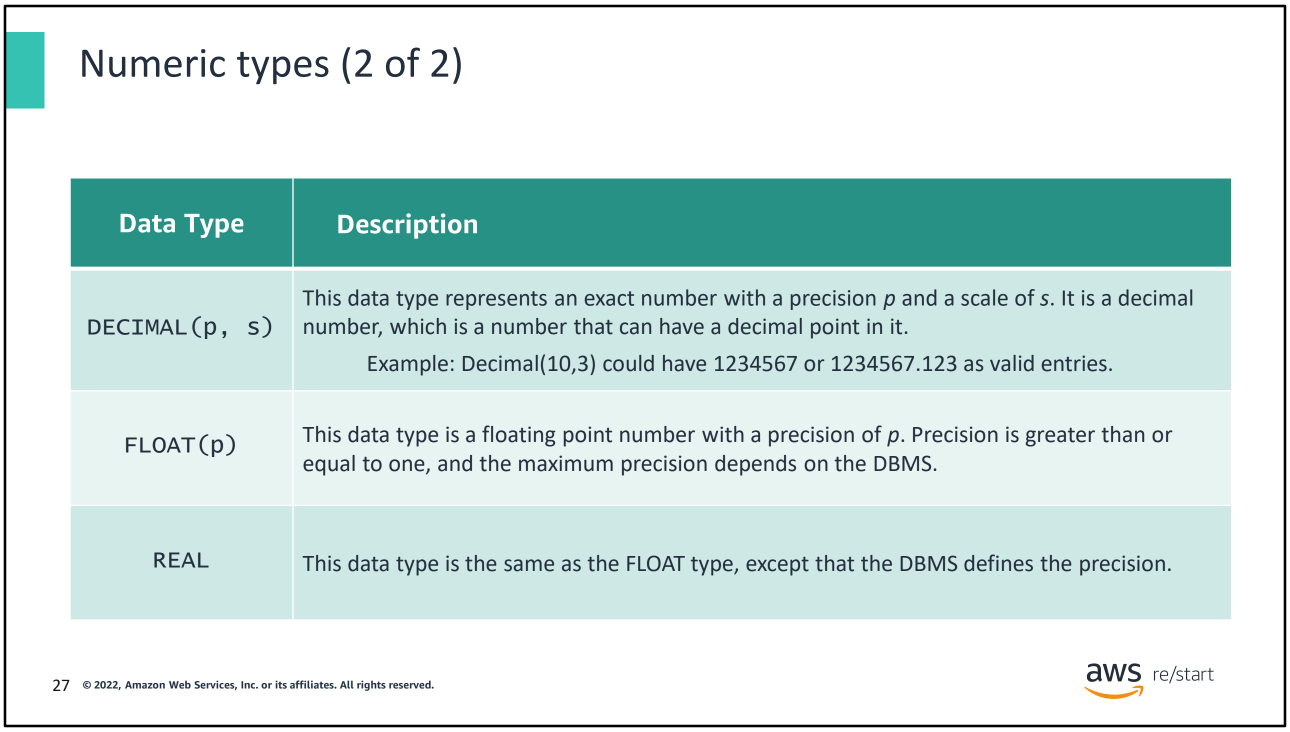
Numeric data types represent numerical values.

Data Type	Description
`INTEGER`	Represents an integer. The minimum and maximum values depend on the DBMS. Example: 102030
`SMALLINT`	Is the same as the INTEGER type except that it might hold a smaller range of values. The range depends on the DBMS. Example: 10
`BIGINT`	Is the same as the INTEGER type except that it might hold a larger range of values. The range depends on the DBMS. Example: 98765432101

The `INTEGER`, `SMALLINT`, and `BIGINT` data types represent whole numbers that can be positive, negative, or zero. They are exact numeric data types.

When choosing which integer data type to use for a numeric column, select the type with the smallest range that is enough to accommodate the values that will be stored. In other words, do not over-allocate and waste storage.

Note that the `INTEGER` data type can also be abbreviated as `INT`.

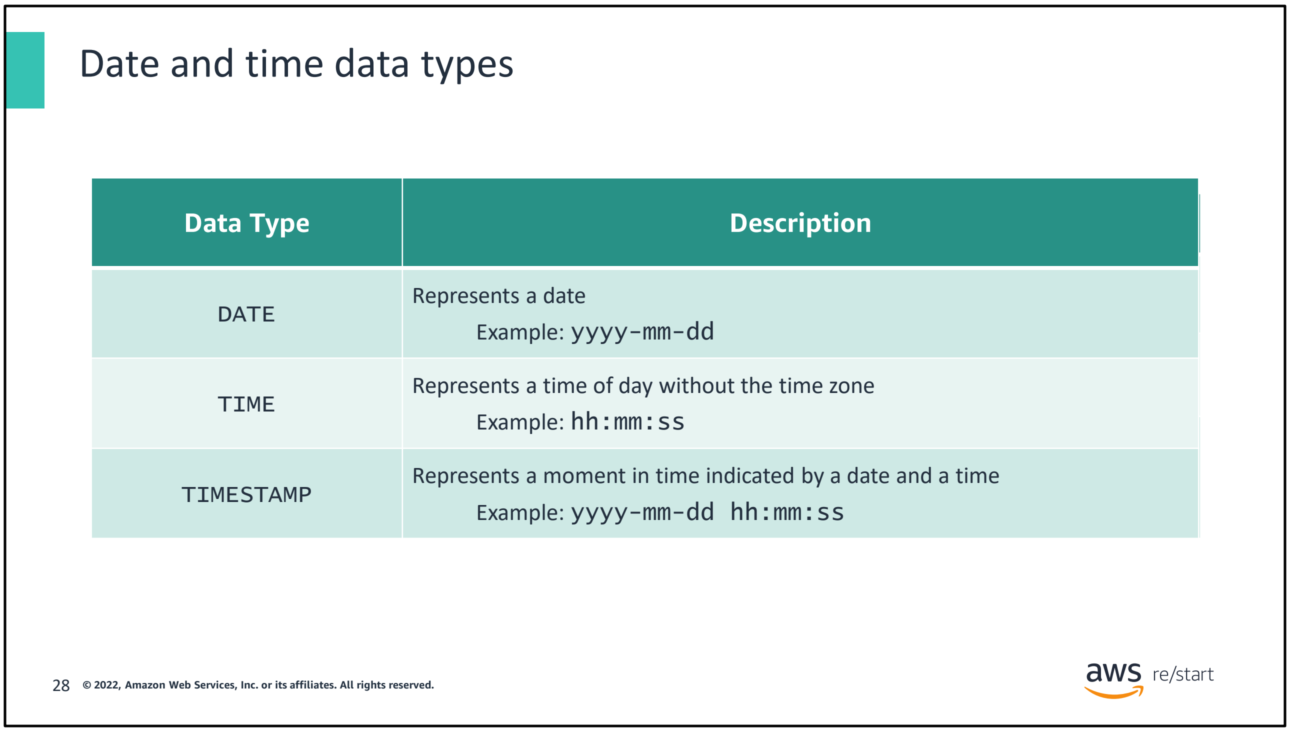


Numeric types (2 of 2)

Data Type	Description
`DECIMAL(p, s)`	This data type represents an exact number with a precision *p* and a scale of *s*. It is a decimal number, which is a number that can have a decimal point in it. Example: Decimal(10,3) could have 1234567 or 1234567.123 as valid entries.
`FLOAT(p)`	This data type is a floating point number with a precision of *p*. Precision is greater than or equal to one, and the maximum precision depends on the DBMS.
`REAL`	This data type is the same as the FLOAT type, except that the DBMS defines the precision.

A `DECIMAL` data type represents an exact fixed-point number. It has two arguments: precision and scale. Precision defines the total number of digits in the number. Scale defines the number of digits after the decimal point. The scale cannot exceed the precision. An example use case for a DECIMAL is to store monetary values.

The `FLOAT` and `REAL` data types represent approximate numbers. They are stored more efficiently and can generally be processed faster than `DECIMAL` values. They work well for scientific calculations that must be fast but not necessarily exact to a digit.



Date and time data types

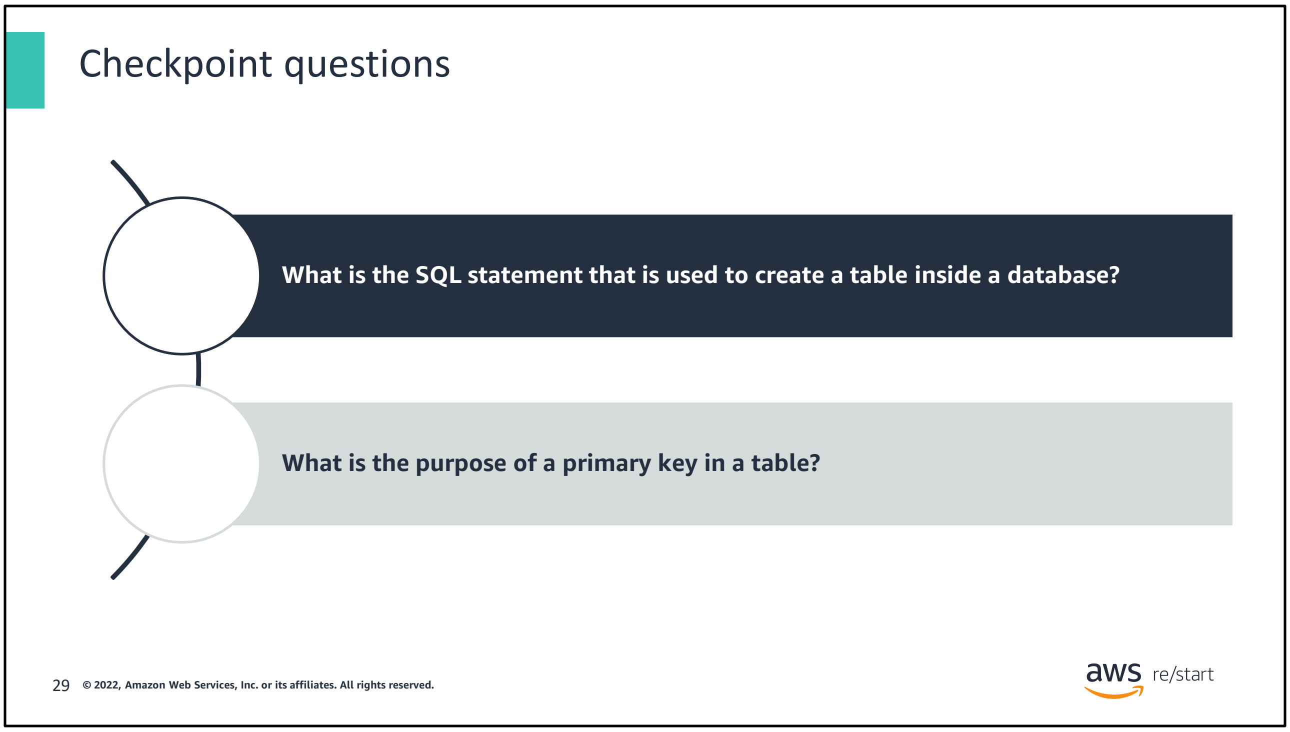
Data Type	Description
`DATE`	Represents a date Example: `yyyy-mm-dd`
`TIME`	Represents a time of day without the time zone Example: `hh:mm:ss`
`TIMESTAMP`	Represents a moment in time indicated by a date and a time Example: `yyyy-mm-dd hh:mm:ss`

In a DATE value, `yyyy` represents the four-digit year, `mm` the two-digit month, and `dd` the two-digit day.

In a `TIME` value, `hh` represents the two-digit hour, `mm` the two-digit minute, and `ss` the two-digit second.

A `TIMESTAMP` combines the values of a `DATE` and a `TIME`.

Notice that different database management systems might store date-related and time-related data types differently.



Checkpoint questions

What is the SQL statement that is used to create a table inside a database?

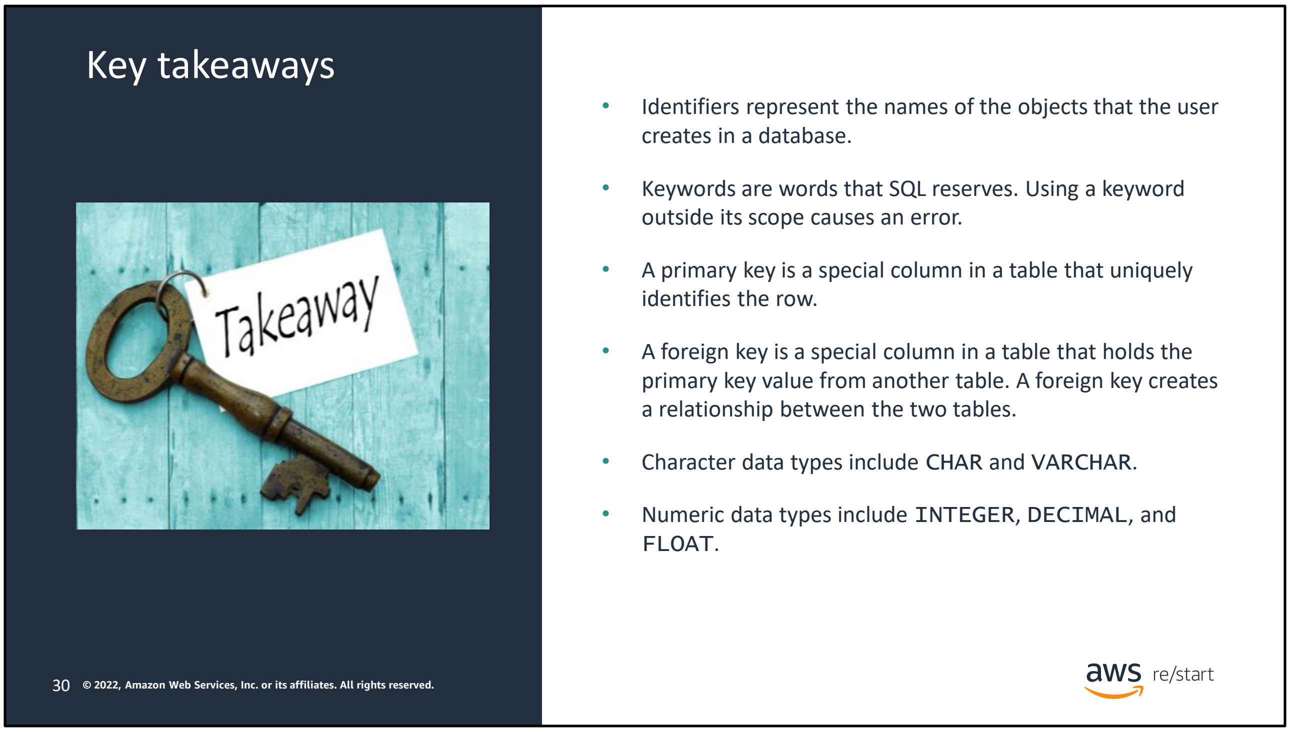
What is the purpose of a primary key in a table?

1. What is the SQL statement that is used to create a table inside a database?

   The statement CREATE TABLE is used to create a table in a database.

2. What is the purpose of a primary key in a table?

   A primary key is used to create a unique identifier for each row in a table.



Key takeaways

- Identifiers represent the names of the objects that the user creates in a database.
- Keywords are words that SQL reserves. Using a keyword outside its scope causes an error.
- A primary key is a special column in a table that uniquely identifies the row.
- A foreign key is a special column in a table that holds the primary key value from another table. A foreign key creates a relationship between the two tables.
- Character data types include CHAR and VARCHAR.
- Numeric data types include `INTEGER`, `DECIMAL`, and `FLOAT`.

aws re/start

This module includes the following key takeaways:
- Identifiers represent the names of the objects that the user creates in a database.
- Keywords are words that SQL reserves. Using a keyword outside its scope causes an error.
- A primary key is a special column in a table that uniquely identifies the row.
- A foreign key is a special column in a table that holds the primary key value from another table. A foreign key creates a relationship between the two tables.
- Character data types include CHAR and VARCHAR.
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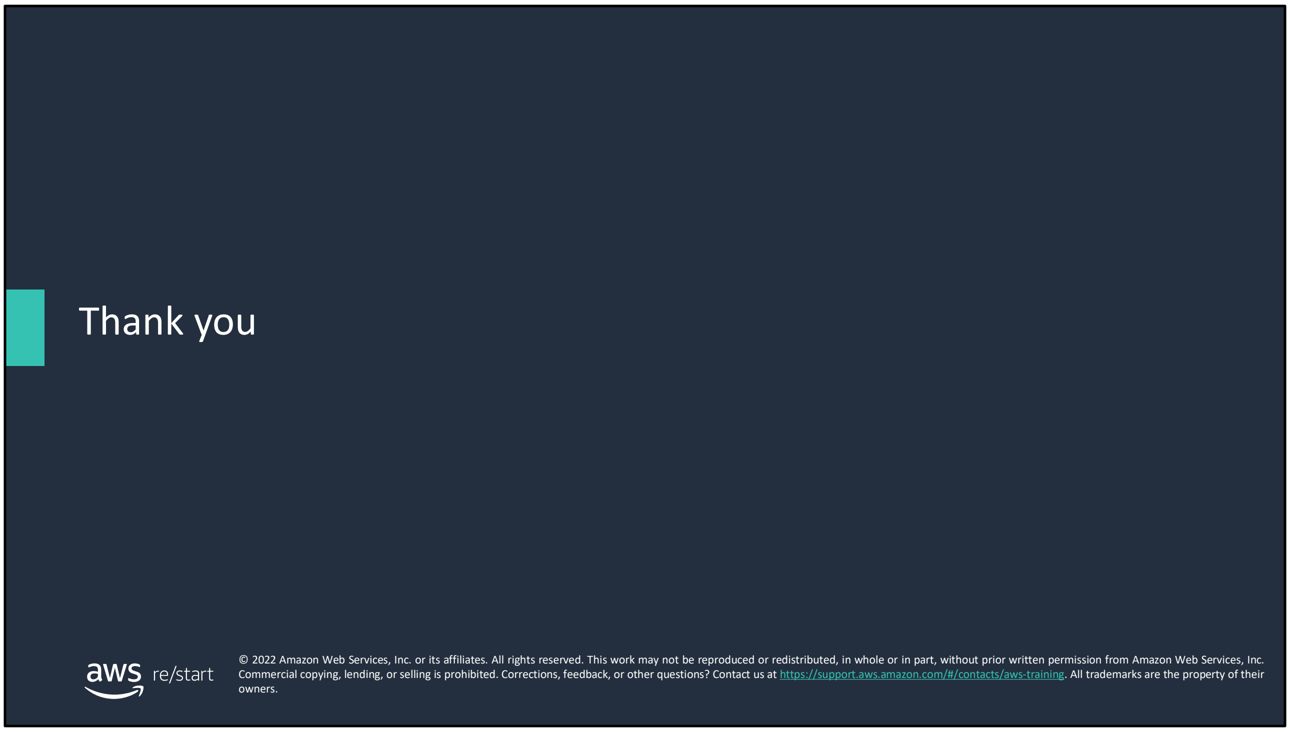

Thank you

Thank you for completing this module.