MS Access

In Access, a database is the overall container for the data and associated objects. It's more than the collection of tables, however—a database includes many types of objects, including queries, forms, reports, macros, and code modules.

As you open an Access database, the objects (tables, queries, and so on) in the database are presented for you to work with. You may open several copies of Access at the same time and simultaneously work with more than one database, if needed.

The Access database contains six types of top-level objects, which consist of the data and tools that you need to use Access:

- Table: Holds the actual data
- Query: Searches for, sorts, and retrieves specific data
- Form: Lets you enter and display data in a customized format
- Report: Displays and prints formatted data
- Macro: Automates tasks without programming
- Module: Contains programming statements written in the VBA (Visual Basic for Applications) programming language

Tables

As you've discovered earlier in this chapter, tables serve as the primary data repository in an Access database. You interact with tables through a special kind of object called a datasheet. Although not a permanent database object, a datasheet displays a table's content in a row-and-column format, like an Excel worksheet. A datasheet displays a table's information in a raw form, without transformations or filtering. The Datasheet view is the default mode for displaying all fields for all records.

Queries

Queries extract information from a database. A query selects and defines a group of records that fulfil a certain condition. Most forms and reports are based on queries that combine, filter, or sort data before it's displayed. Queries are often called from macros or VBA procedures to change, add, or delete database records.

Forms

Data-entry forms help users get information into a database table quickly, easily, and accurately. Data-entry and display forms provide a more structured view of the data than what a datasheet provides. From this structured view, database records can be viewed, added, changed, or deleted. Entering data through the data-entry forms is the most common way to get the data into the database table.

Reports

Reports present your data in PDF-style formatting. Access allows for an extraordinary amount of flexibility when creating reports. For instance, you can configure a report to list all records in a given table (such as a Customers table), or you can have the report contain only the records meeting certain criteria (such as all customers living in Arizona). You do this by basing the report on a query that selects only the records needed by the report.

Designing tables

Designing a table is a multistep process. By following the steps in order, your table design can be created readily and with minimal effort:

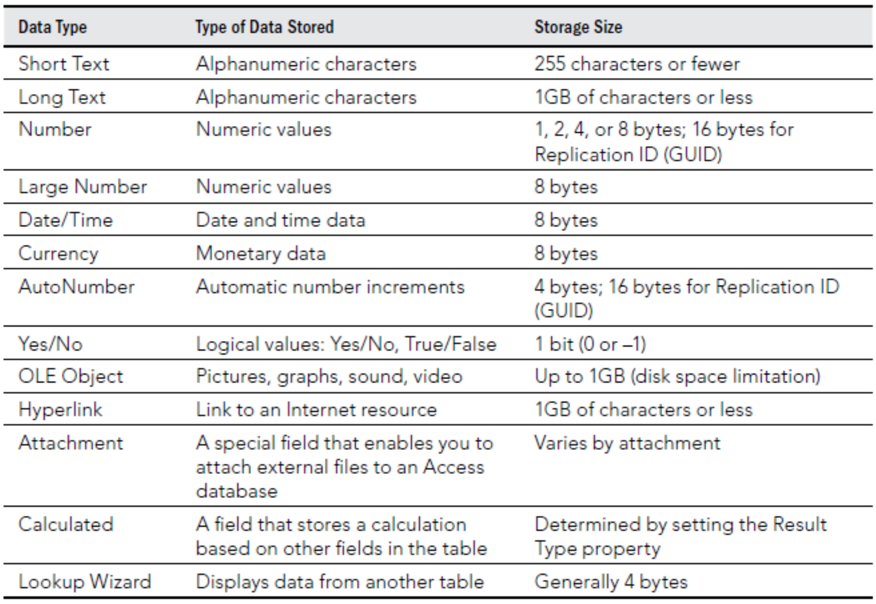
1. Create the new table.
2. Enter field names, data types, properties, and (optionally) descriptions.
3. Set the table's primary key.
4. Create indexes for appropriate fields.
5. Save the table's design.

There are two main ways to add new tables to an Access database, both of which are invoked from the Tables group on the Create tab:

- Clicking the Table button: Adds a table in Datasheet view to the database with one AutoNumber field named ID
- Clicking the Table Design button: Adds a table in Design view to the database

Specifying a data type

When you enter a field, you must also decide what type of data each of your fields will hold. In Access, you can choose any of several data types.



Data Type	Type of Data Stored	Storage Size
Short Text	Alphanumeric characters	255 characters or fewer
Long Text	Alphanumeric characters	1GB of characters or less
Number	Numeric values	1, 2, 4, or 8 bytes; 16 bytes for Replication ID (GUID)
Large Number	Numeric values	8 bytes
Date/Time	Date and time data	8 bytes
Currency	Monetary data	8 bytes
AutoNumber	Automatic number increments	4 bytes; 16 bytes for Replication ID (GUID)
Yes/No	Logical values: Yes/No, True/False	1 bit (0 or –1)
OLE Object	Pictures, graphs, sound, video	Up to 1GB (disk space limitation)
Hyperlink	Link to an Internet resource	1GB of characters or less
Attachment	A special field that enables you to attach external files to an Access database	Varies by attachment
Calculated	A field that stores a calculation based on other fields in the table	Determined by setting the Result Type property
Lookup Wizard	Displays data from another table	Generally 4 bytes

Short text

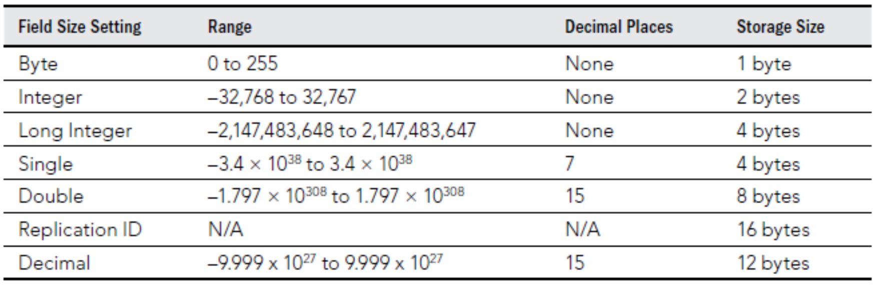
The Short Text data type holds information that is simply characters (letters, numbers, punctuation). Names, addresses, and descriptions are all text data, as are numeric data that are not used in a calculation (such as telephone numbers, Social Security numbers, and zip codes).

Long text

The Long Text data type holds a variable amount of data up to 1GB. Long Text fields use only as much memory as necessary for the data stored. So, if one record uses 100 characters, another requires only 10, and yet another needs 3,000, you use only as much space as each record requires.

Number

The Number data type enables you to enter numeric data—that is, numbers that will be used in mathematical calculations or represent scalar quantities such as inventory counts. (If you have data that will be used in monetary calculations, use the Currency data type, which performs calculations without rounding errors.)



Field Size Setting	Range	Decimal Places	Storage Size
Byte	0 to 255	None	1 byte
Integer	–32,768 to 32,767	None	2 bytes
Long Integer	–2,147,483,648 to 2,147,483,647	None	4 bytes
Single	-3.4×10^{38} to 3.4×10^{38}	7	4 bytes
Double	-1.797×10^{308} to 1.797×10^{308}	15	8 bytes
Replication ID	N/A	N/A	16 bytes
Decimal	-9.999×10^{27} to 9.999×10^{27}	15	12 bytes

Large number

The Large Number data type holds values from –263 to 263–1. Those are bigger numbers than most people need. It was added to Access mainly for compatibility with other databases that have this data type, specifically SQL Server.

Date/Time

The Date/Time data type is a specialized number field for holding dates or times (or dates and times). When dates are stored in a Date/Time field, it's easy to calculate days between dates and other calendar operations. Date data stored in Date/Time fields sort and filter properly as well. The Date/Time data type holds dates from January 1, 100, to December 31, 9999.

Currency

The Currency data type is another specialized number field. Currency numbers are not rounded during calculations and preserve 15 digits of precision to the left of the decimal point and 4 digits to the right. Because Currency fields use a fixed decimal point position, they're faster in numeric calculations than doubles.

AutoNumber

The AutoNumber field is another specialized Number data type. When an AutoNumber field is added to a table, Access automatically assigns a long integer (32-bit) value to the field (beginning at 1) and increments the value each time a record is added to the table. Alternatively (determined by the New Values property), the value of the AutoNumber field is a random integer that is automatically inserted into new records.

Yes/No

Yes/No fields accept only one of two possible values. Internally stored as –1 (Yes) or 0 (No), the Yes/No field is used to indicate yes/no, on/off, or true/false. A Yes/No field occupies a single bit of storage.

OLE Object

The OLE Object field stores OLE data, highly specialized binary objects such as Word documents, Excel spreadsheets, sound or video clips, and images. The OLE object is created by an application that Windows recognizes as an OLE server and can be linked to the parent application or embedded in the Access table. OLE objects can be displayed only in bound object frames in Access forms and reports. OLE fields can't be indexed.

Hyperlink

The Hyperlink data type field holds combinations of text and numbers stored as text and used as a hyperlink address.

Attachment

The Attachment data type was introduced in Access 2007. In fact, the Attachment data type is one of the reasons Microsoft changed the format of the Access data file. The older MDB format is unable to accommodate attachments.

Calculated

A Calculated field holds an expression that can include numbers, text, fields from within the same table, and Access functions. It cannot reference fields from other tables. "Calculated" isn't a data type although Access includes it in the data type list. It has a ResultType property that determines what kind of data the field holds.

Lookup Wizard

The Lookup Wizard data type inserts a field that enables the end user to choose a value from another table or from the results of a SQL statement. The values may also be presented as a combo box or list box. At design time, the Lookup Wizard leads the developer through the process of defining the lookup characteristics when this data is assigned to a field.

Assigning field properties

The field properties built into Access tables are powerful allies that can help you manage the data in your tables. In most cases, the field property is enforced by the database engine, which means the property is consistently applied wherever the field's value is used. For example, if you've set the Default Value property in the table design, the default value is available in the table's Datasheet view, on forms, and in queries.

Each field data type has its own set of properties. For example, Number fields have a Decimal Places property, and Short Text fields have a Text Align property. Although many data types share several properties (such as Caption) in common, there are enough different field properties to make it easy to become confused or to incorrectly use the properties. The following sections discuss some of the more important and frequently used field properties. Here's a list of all the general properties (note that they may not all be displayed, depending on which data type you chose):

- Field Size: When applied to Short Text fields, limits the size of the field to the specified number of characters (1–255). The default is 255.

- New Values: Applies to AutoNumber fields. Allows specification of Increment or Random type.
- Format: Changes the way data appears after you enter it (uppercase, dates, and so on). There are many different types of formats that may be applied to Access data.
- Input Mask: Used for data entry into a predefined format (phone numbers, zip codes, Social Security numbers, dates, customer IDs). Applicable to both numeric and text data types.
- Decimal Places: Specifies the number of decimal places for the Currency, Number, and Large Number data types.
- Caption: Optional label that's used in place of the field's name. Access uses the Caption property when displaying a control in a datasheet or on a form or report.
- Default Value: The value automatically provided for new data entry into the field. This value can be any value appropriate for the field's data type. A default is no more than an initial value; you can change it during data entry. To specify a default value, simply enter the desired value into the Default Value property setting. A default value can be an expression, as well as a number or a text string.
- Validation Rule: Ensures that data entered into the field conforms to some business rule, such as "greater than zero," "date must occur after January 1, 2000," and so on.
- Validation Text: The message displayed when data fails validation.
- Required: Specifies whether you must enter a value into a field.
- Allow Zero Length: Determines whether you may enter an empty string ("") into a Short Text or Long Text field to distinguish it from a null value.
- Indexed: Speeds up data access and (if desired) limits data to unique values.
- Unicode Compression: Used for multilanguage applications. Requires about twice the data storage but enables Office documents, including Access reports, to be displayed correctly no matter what language or symbols are used. Generally speaking, Unicode is of no value unless the application is likely to be used in Asian environments.
- IME Mode: Also known as the Kanji conversion mode property, this is used to show whether the Kanji mode is maintained when the control is lost. The setting has no relevance in English or European-language applications.
- IME Sentence Mode: Used to determine the Sequence mode of fields of a table or controls of a form that switch when the focus moves in or out of the field. The setting has no relevance in English or European-language applications.

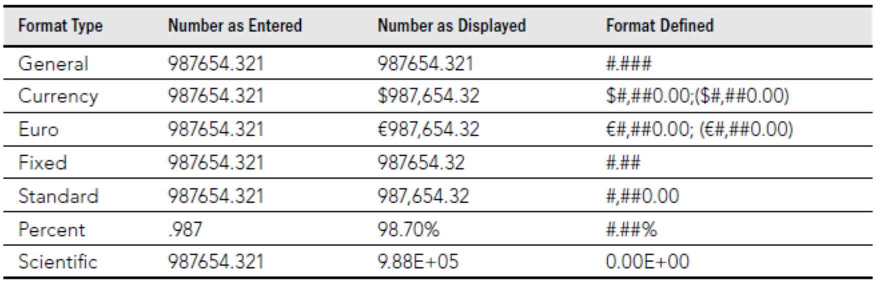
Format

The Format property specifies how the data contained in table fields appears whenever the data is displayed or printed. When set at the table level, the format is in effect throughout the application. There are different format options for each data type:

- (space): Displays spaces as characters.
- "SomeText": Displays the text between the quotes as literal text.
- ! (exclamation point): Left-aligns the display.
- (asterisk): Fills empty space with the next character.

- \ (backslash): Displays the next character as literal text. Use the backslash to display characters that otherwise have special meaning to Access.
- [color]: Displays the output in the color (black, blue, green, cyan, red, magenta, yellow, or white) indicated between the brackets.

Number and Currency field formats



Format Type	Number as Entered	Number as Displayed	Format Defined
General	987654.321	987654.321	#.###
Currency	987654.321	$987,654.32	$#,##0.00;($#,##0.00)
Euro	987654.321	€987,654.32	€#,##0.00; (€#,##0.00)
Fixed	987654.321	987654.32	#.##
Standard	987654.321	987,654.32	#,##0.00
Percent	.987	98.70%	#.##%
Scientific	987654.321	9.88E+05	0.00E+00

Custom formats are created by combining several symbols to create a format. The symbols used with Number and Currency fields are listed here:

- . (period): Specifies where the decimal point should appear.
- , (comma): The thousands separator.
- 0 (zero): A placeholder for 0 or a digit.
- # (pound sign): A placeholder for nothing or a digit.
- $ (dollar sign): Displays the dollar sign character.
- % (percent sign): Multiplies the value by 100 and adds a percent sign.
- E– or e–: Uses scientific notation to display the number. Uses a minus sign to indicate a negative exponent and no sign for positive exponents.
- E+ or e+: Uses scientific notation to display the number. Uses a plus sign to indicate a positive exponent.

Date/Time formats

The following are the built-in Date/Time formats. Note that these examples are based on the "English (United States)" Region and Language settings in Windows Settings:

- General Date: If the value contains a date only, don't display a time value, and vice versa. Dates are displayed in the built-in Short Date format (m/d/yyyy), while time data is displayed in the Long Time format.
- Long Date: Thursday, November 12, 2015
- Medium Date: 12-Nov-15
- Short Date: 11/12/2015
- Long Time: 5:34:23 PM
- Medium Time: 5:34 PM
- Short Time: 17:34

Custom formats are created by constructing a specification string containing the following symbols:

- : (colon): Separates time elements (hours, minutes, seconds)

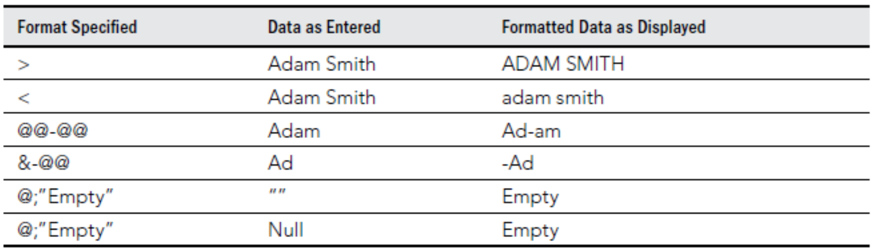
- / (forward slash): Separates date elements (days, months, years)
- c: Instructs Access to use the built-in General Date format
- d: Displays the day of the month as one or two digits (1–31)
- dd: Displays the day of the month using two digits (01–31)
- ddd: Displays the day of the week as a three-character abbreviation (Sun, Mon, Tue, Wed, Thu, Fri, Sat)
- dddd: Uses the full name of the day of the week (Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday)
- ddddd: Uses the built-in Short Date format
- dddddd: Uses the built-in Long Date format
- w: Uses a number to indicate the day of the week
- ww: Shows the week of the year
- m: Displays the month of the year using one or two digits
- mm: Displays the month of the year using two digits (with a leading zero if necessary)
- mmm: Displays the month as a three-character abbreviation (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec)
- mmmm: Displays the full name of the month (for example, January)
- q: Displays the date as the quarter of the year
- y: Displays the day of the year (1 through 366)
- yy: Displays the year as two digits (for example, 15)
- yyyy: Displays the year as four digits (2015)
- h: Displays the hour using one or two digits (0–23)
- hh: Displays the hour using two digits (00–23)
- n: Displays the minutes using one or two digits (0–59)
- nn: Displays the minutes using two digits (00–59)
- s: Displays the seconds using one or two digits (0–59)
- ss: Displays the seconds using two digits (00–59)
- ttttt: Uses the built-in Long Time format
- AM/PM: Uses a 12-hour format with uppercase AM or PM
- am/pm: Uses a 12-hour format with lowercase am or pm
- A/P: Uses a 12-hour format with uppercase A or P
- a/p: Uses a 12-hour format with lowercase a or p

Short Text and Long Text field formats

When applied to Short Text fields, formats help clarify the data contained within the fields. tblCustomers uses several formats. The State text field has a > in the Format property to display the data entry in uppercase. The Active field has a Yes/No format with lookup Display Control property set to Text Box. Short Text and Long Text fields are displayed as plain text by default. If a particular format is to be applied to Short Text or Long Text field data, use the following symbols to construct the format:

- @: A character or space is required.
- &: A character is optional (not required).

- <: Force all characters to their lowercase equivalents.
- >: Force all characters to their uppercase equivalents.



Format Specified	Data as Entered	Formatted Data as Displayed
>	Adam Smith	ADAM SMITH
<	Adam Smith	adam smith
@@-@@	Adam	Ad-am
&-@@	Ad	-Ad
@;"Empty"	""	Empty
@;"Empty"	Null	Empty

Input mask

The Input Mask property makes it easier for users to enter the data in the correct format. An input mask limits the way the user inputs data into the application. For example, you can restrict entry to only digits for phone numbers, Social Security numbers, and employee IDs. An input mask for a Social Security number might look like "000-00-0000." This mask requires input into every space, restricts entry to digits only, and does not permit characters or spaces. The following characters are used to compose the input mask string:

0: A digit is required, and plus (+) and minus (–) signs are not permitted.

9: A digit is optional, and plus (+) and minus (–) signs are not permitted.

#: Optional digit or space. Spaces are removed when the data is saved in the table. Plus and minus signs are allowed.

- L: A letter from A to Z is required.
- ?: A letter from A to Z is optional.
- A: A character or digit is required.
- a: A character or digit is optional.
- &: Permits any character or space (required).
- C: Permits any character or space (optional).
- . (period): Decimal placeholder.
- , (comma): Thousands separator.
- : (colon): Date and time separator.
- ; (semicolon): Separator character.
  - (dash): Separator character.
- / (forward slash): Separator character.
- < (less-than sign): Converts all characters to lowercase.
    - (greater-than sign): Converts all characters to uppercase.
- ! (exclamation point): Displays the input mask from right to left. Characters fill the mask from right to left.
- \ (backslash): Displays the next character as a literal.

Setting the Primary Key

Every table should have a primary key—one field or a combination of fields with a unique value for each record. (This principle is called entity integrity in the world of database management.) If you don't designate a field as a primary key, Access can add an AutoNumber field and designate it as the table's primary key. AutoNumber fields make very good primary keys because Access creates the value for you, the number is never reused within a table, and you can’t change the value of an AutoNumber field. The ideal primary key is, then, a single field that is immutable and guaranteed to be unique within the table.

Understanding Table Relationships

We have three basic types of relationships between tables:

- One-to-one
- One-to-many
- Many-to-many

One-to-one

A one-to-one relationship between tables means that for every record in the first table, one and only one record exists in the second table. Pure one-to-one relationships are not common in relational databases. In most cases, the data contained in the second table is included in the first table.

One-to-many

A far more common relationship between tables in a relational database is the one-to-many. In one-to-many relationships, each record in the first table (the parent) is related to one or more records in the second table (the child). Each record in the second table is related to one and only one record in the first table.

Many-to-many

You’ll come across many-to-many situations from time to time. In a many-to-many arrangement, each record in both tables can be related to zero, one, or many records in the other table. Because of the additional complication of the join table, many-to-many relationships are often considered more difficult to establish and maintain.

Query

Queries answer a question by selecting and sorting and filtering data based on search criteria. Queries show a selection of data based on criteria (limitations) you provide. Queries can pull from one or more related Tables and other Queries. Types of Query can be SELECT, INSERT, UPDATE, DELETE.

Form

A form is a database object that you can use to create a user interface for a database application. Forms help you to display live data from the table. It mainly used to ease the process of data entry or editing.

Report

A report is an object in desktop databases primarily used for formatting, calculating, printing, and summarizing selected data. You can even customize the report's look and feel.