Introduction to Databases

How Do RDBMS Work? Managing DBs Using IDEs

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Data Management

When Do We Need a Database?

Storage vs. Management (1)

- Conventional Data Storage
  - Notes
 - Receipts

Storage vs. Management (2)

- We can group related pieces of data into separate columns

Order#	Date	Customer	Product	S/N	Unit Price	Qty	Total
315	07/16/2016	David Rivers	Oil Pump	OP147-0623	69.90	1	69.90

Storage vs. Management (3)

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- Storing data is **not** the primary reason to use a Database

- Flat storage **eventually** runs into **issues** with

  - Size

  - Ease of updating

  - Searching

  - Concurrency

  - Security

  - Consistency
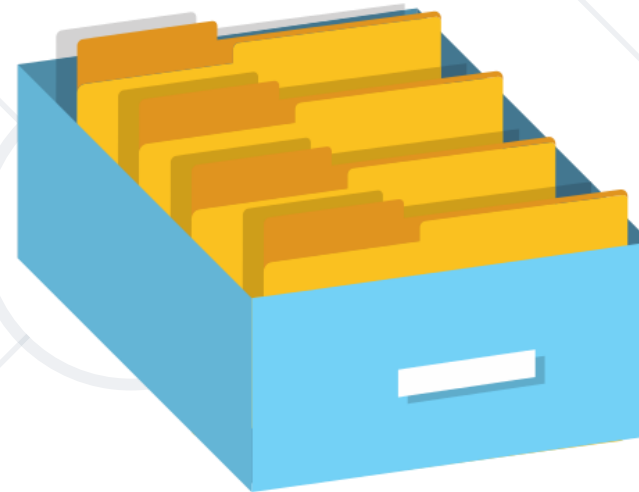
Databases and RDBMS

- A database is an **organized** collection of information
  - It imposes **rules** on the contained data
  - Relational storage first proposed by **Edgar Codd** in 1970

- A **R**elational **D**ata **B**ase **M**anagement **S**ystem provides tools to **manage** the database
  - It **parses requests** from the user and takes the **appropriate** action
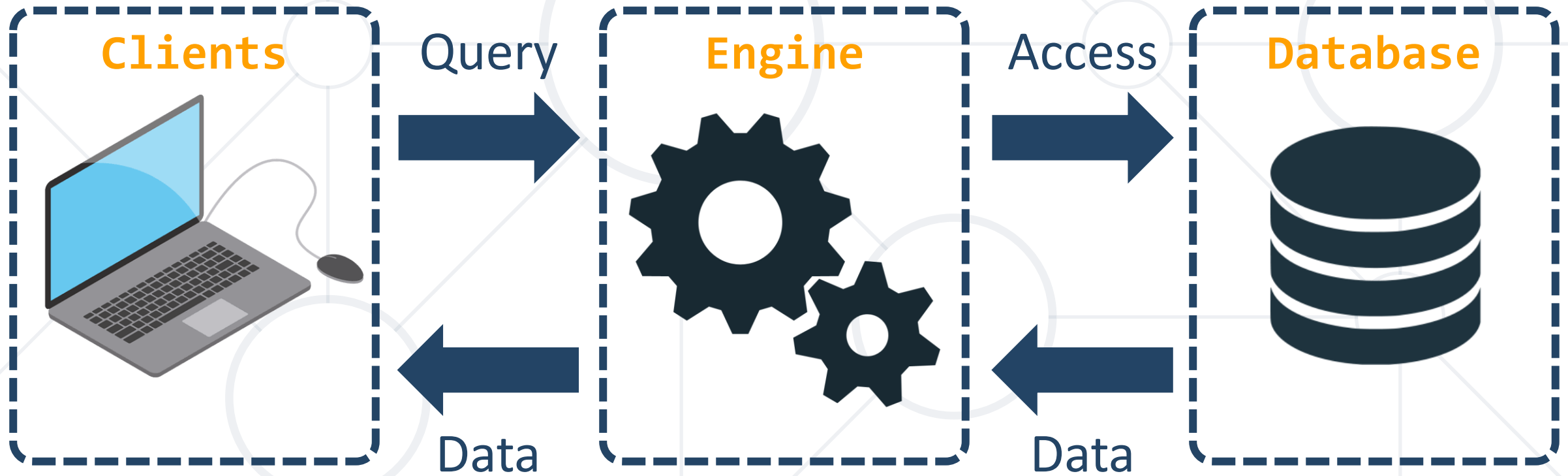 - The user doesn't have direct access to the stored data

Database Engines

Database Engine Flow

- SQL Server uses the Client-Server Model

Download Clients & Servers

- Download **SQL Server Express** Edition from Microsoft

  go.microsoft.com/fwlink/?linkid=866662

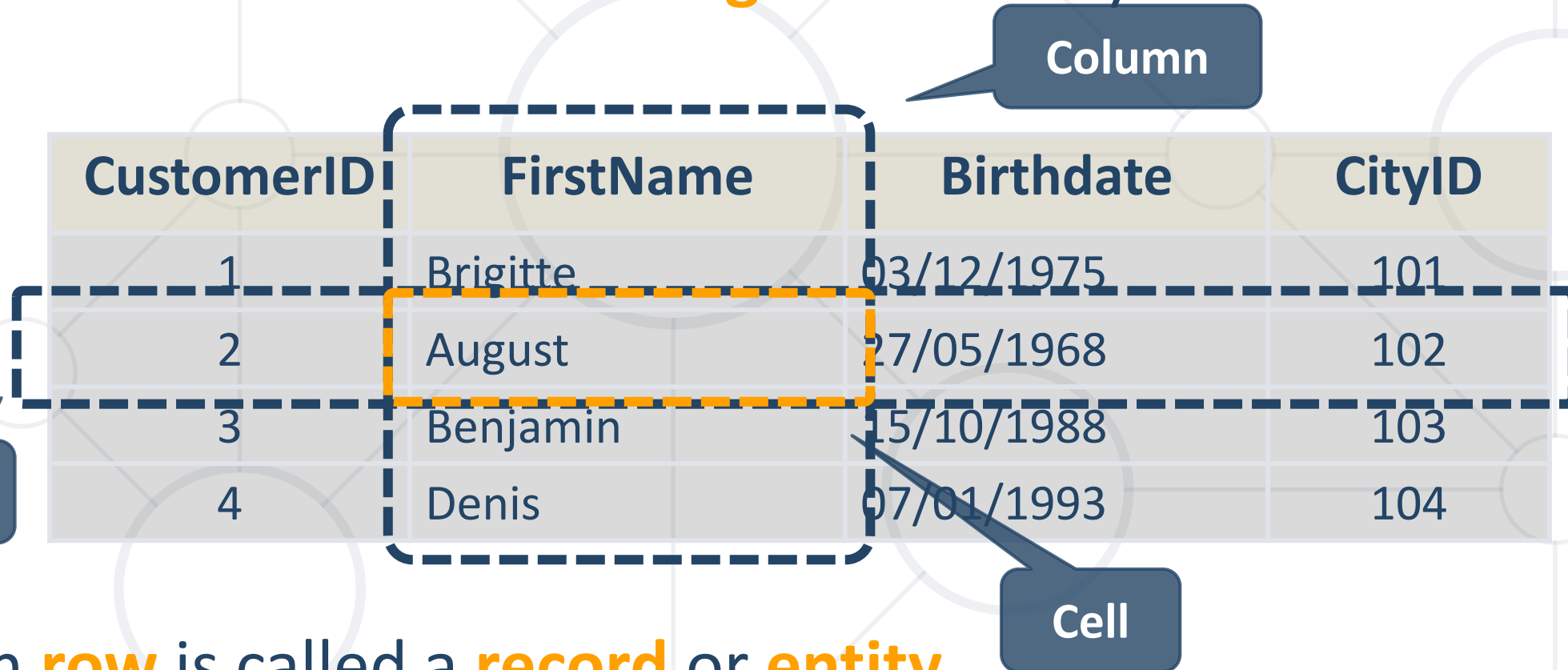- Download SQL Server **Management Studio** separately

  https://aka.ms/ssmsfullsetup

SQL Server Architecture

- Logical Storage

  - Instance

  - Database

  - Schema

  - Table

- Physical Storage

  - Data Files and Log files

  - Data Pages

Instance

Database

Schema

| Table | Table | Table |

Schema

Database

Database

Data

Logs
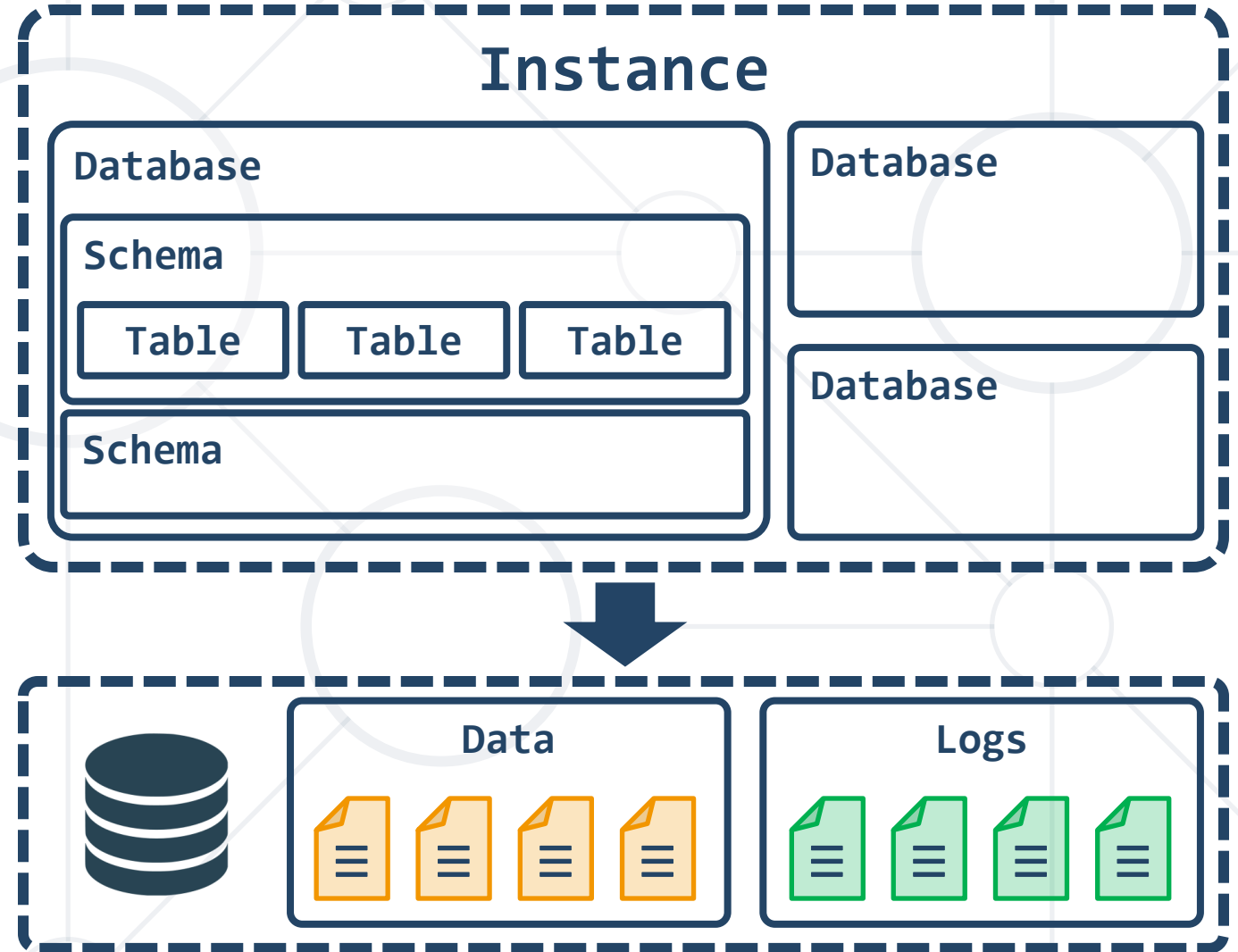
Database Table Elements

- The table is the main **building block** of any database

CustomerID	FirstName	Birthdate	CityID
1	Brigitte	03/12/1975	101
2	August	27/05/1968	102
3	Benjamin	15/10/1988	103
4	Denis	07/01/1993	104

Column

Row

Cell

- Each **row** is called a **record** or **entity**

- Columns (**fields**) define the **type** of data they contain

Structured Query Language

- To communicate with the Engine we use **SQL**

  - **Declarative** language

- Logically divided in four sections

  - **Data Definition** – describe the structure of our data

  - **Data Manipulation** – store and retrieve data

  - **Data Control** – define who can access the data

  - **Transaction Control** – bundle operations and allow rollback

Data Types in SQL Server

Data Types in SQL Server (1)

- Numeric
  - **BIT** (1-bit), **TINYINT** (8-bit), **SMALLINT** (16-bit)
  - **INT** (32-bit), **BIGINT** (64-bit)
  - **FLOAT**, **REAL**, **DECIMAL**(**precision, scale**)
- Textual
  - **CHAR**(**size**) – fixed size string
  - **VARCHAR**(**size**) – variable size string
  - **NCHAR**(**size**) – Unicode fixed size string
  - **NVARCHAR**(**size**) – Unicode variable size string

Size of Textual Characters

```
DECLARE @VarcharVar VARCHAR(5) = 'Test';
DECLARE @NVarcharVar NVARCHAR(5) = 'Test';
DECLARE @CharVar CHAR(5) = 'Test';
DECLARE @NCharVar NCHAR(5) = 'Test';

SELECT DATALENGTH(@VarcharVar),
       DATALENGTH(@NVarcharVar),
       DATALENGTH(@CharVar),
       DATALENGTH(@NCharVar)
```

Data Types in SQL Server (2)

- Binary data
  - **BINARY(size)** – fixed length sequence of bits
  - **VARBINARY(size)** – a sequence of bits, 1-8000 bytes or **MAX** (2GB)
- Date and time
  - **DATE** – date in range 0001-01-01 through 9999-12-31
  - **DATETIME** – date and time with precision of 1/300 sec
  - **DATETIME2** – type that has a larger date range
  - **SMALLDATETIME** – date and time (1 minute precision)
  - **TIME** – defines a time of a day (no time zone)
  - **DATETIMEOFFSET** – date and time that has time zone

Date and Time in SQL Server

DATA TYPE	❶ RANGE OF VALUES	❷ ACCURACY	❸ STORAGE SPACE
SMALLDATETIME	01/01/1900 to 06/06/2079	1 minute	4 bytes
DATETIME	01/01/1753 to 12/31/9999	0.00333 seconds	8 bytes
DATETIME2	01/01/0001 to 12/31/9999	100 nanoseconds	6 to 8 bytes
DATETIMEOFFSET	01/01/0001 to 12/31/9999	100 nanoseconds	8 to 10 bytes
DATE	01/01/0001 to 12/31/9999	1 day	3 bytes
TIME	00:00:00.0000000 to 23:59:59.9999999	100 nanoseconds	3 to 5 bytes

Database Modelling

Data Definition Using SSMS

Creating a New Database

- Select **New Database** from the **context menu** under "Databases"
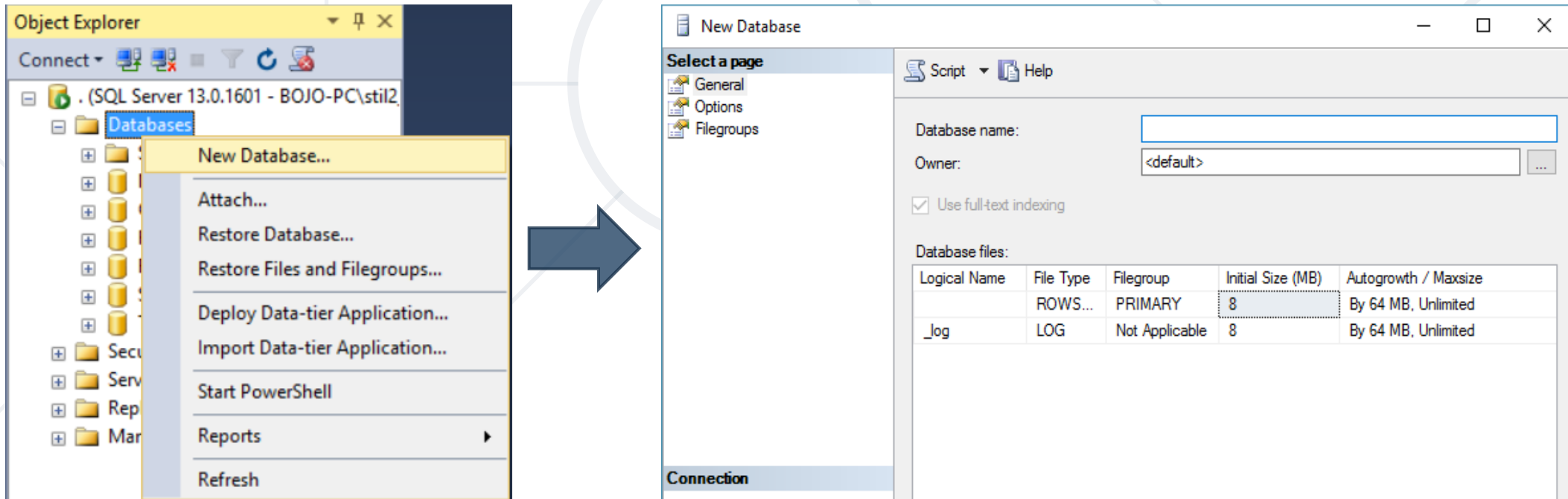
- You may need to **Refresh [F5]** to see the results

Creating Tables (1)

- From the **context menu** under "**Tables**" inside the desired database

- Table name can be set from its **Properties [F4]** or when it is **saved**

Creating Tables (2)

- A **Primary Key** is used to uniquely identify and index records

- Setting **primary key** on a column:

Creating Tables (3)
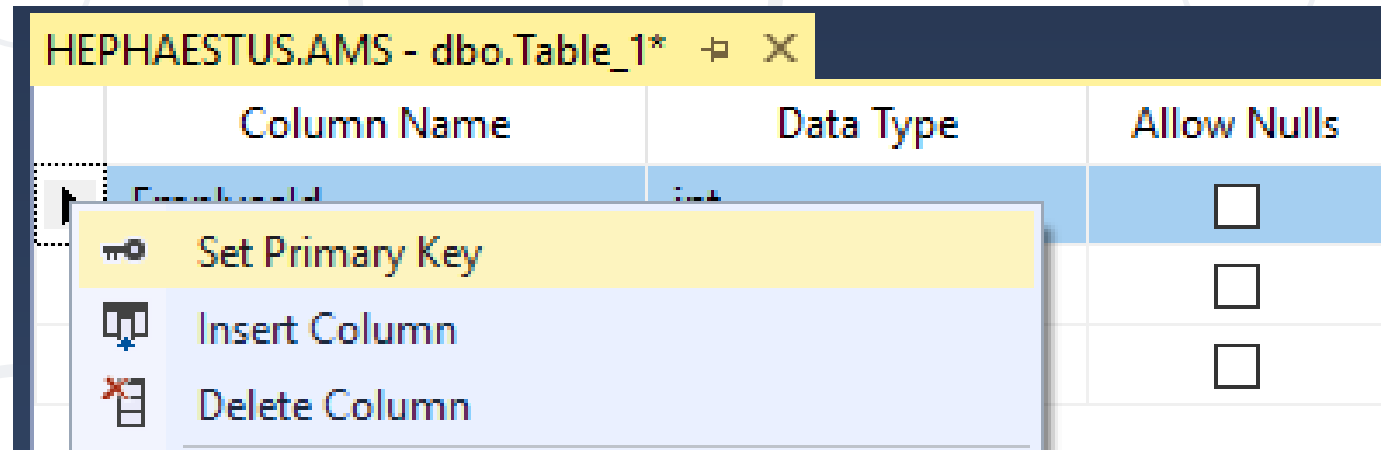
- **Identity** – The value in the column is automatically incremented when a new record is added

  - These values cannot be assigned manually

  - **Identity Seed** – the initial number (1 by default)

  - **Identity Increment** – how much each consecutive value is incremented

Creating Tables (4)

- Setting an identity through the "**Column Properties**" window:
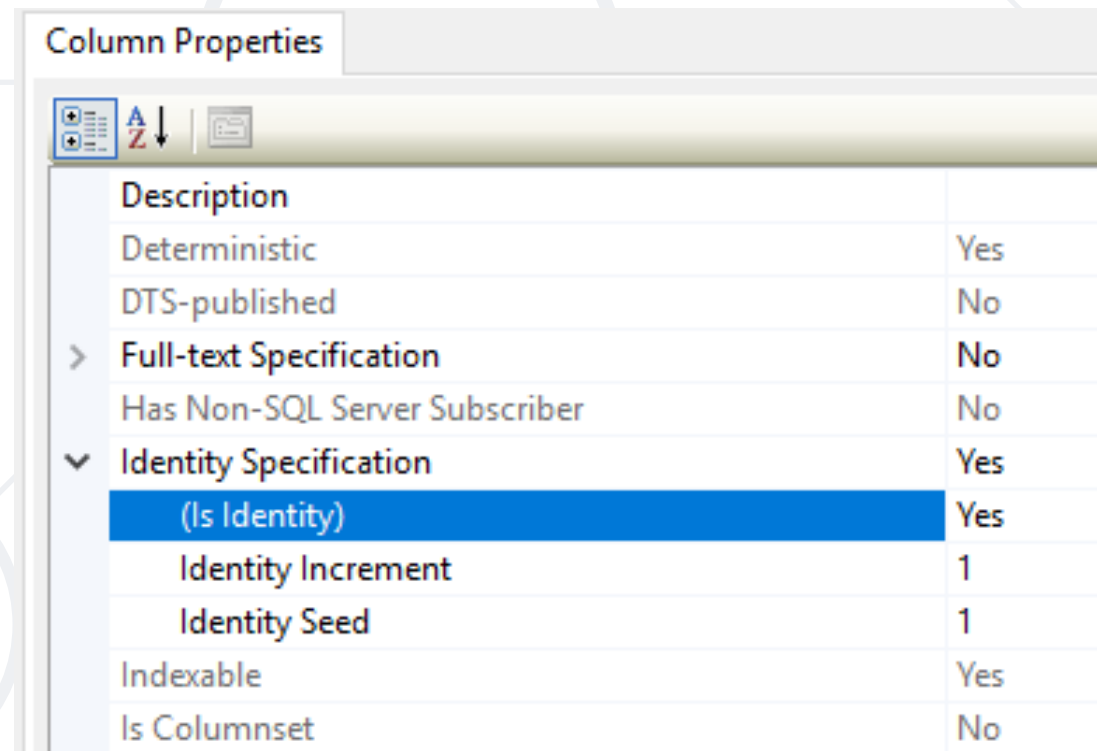
Storing and Retrieving Data (1)

- We can **add**, **modify** and **read** records with Management Studio

- To insert or edit a record, click **Edit** from the context menu
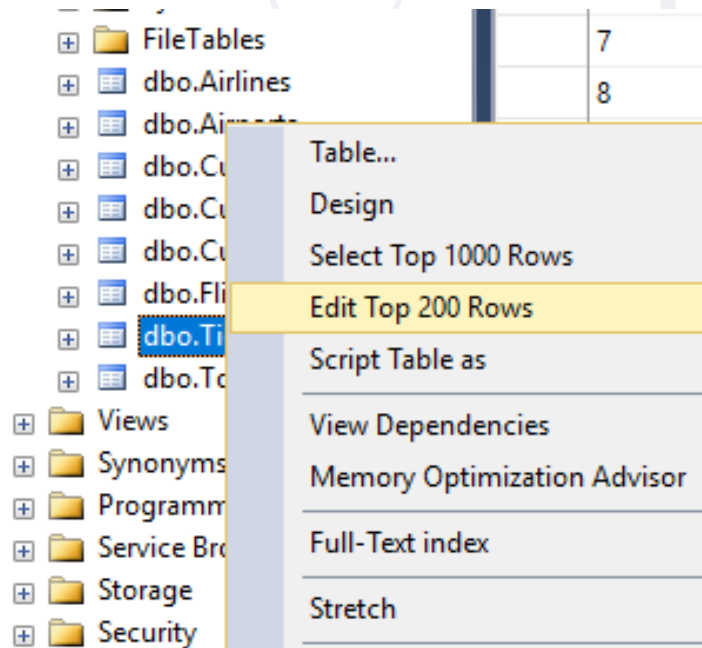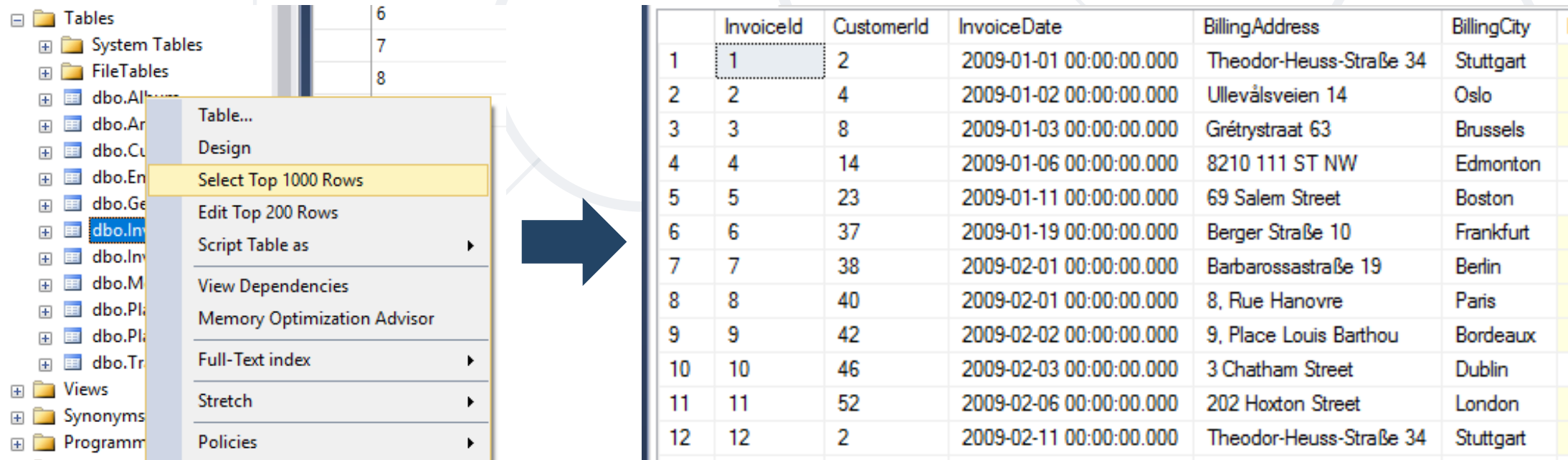
Enter data at the end to add a new row

Storing and Retrieving Data (2)

- To retrieve records, click **Select** from the context menu

- The received information can be customized with **SQL queries**

Altering Tables

- You can change the properties of a table after its creation

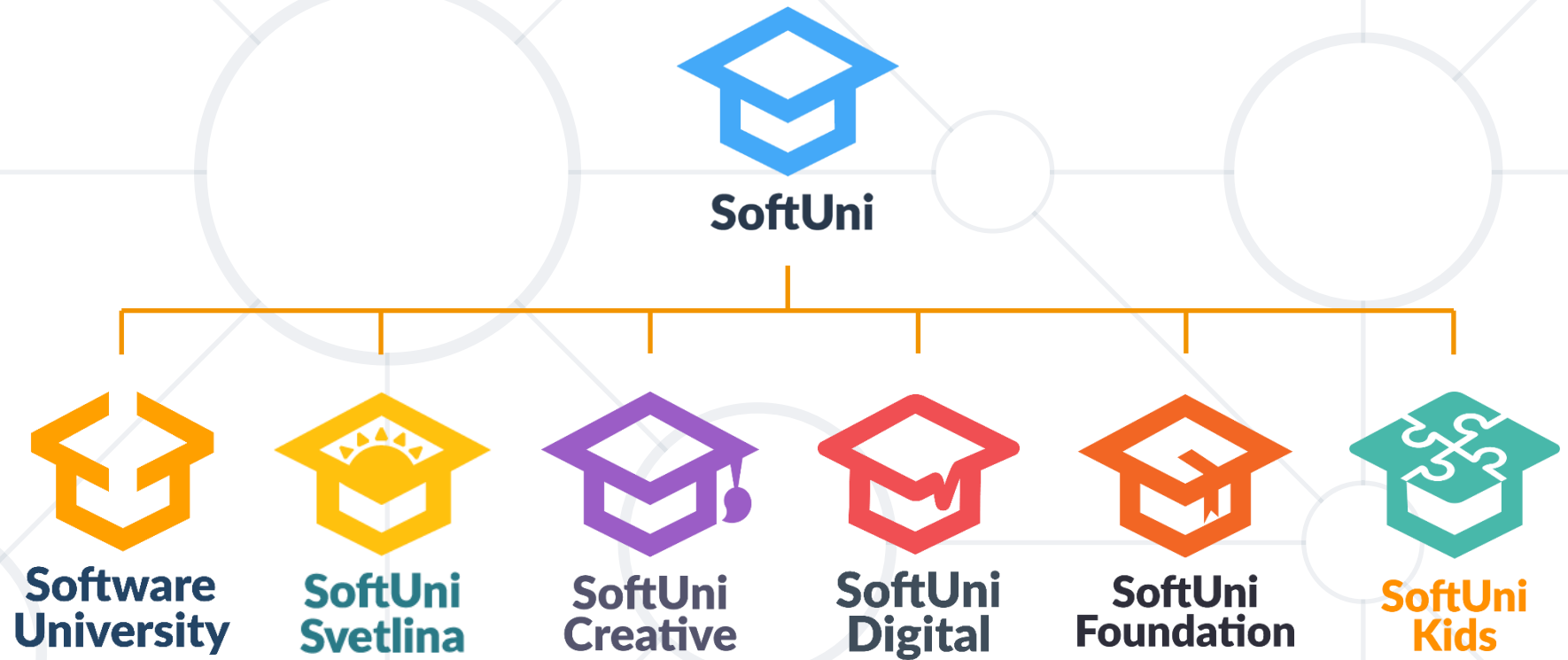- Select **Design** from the table's context menu
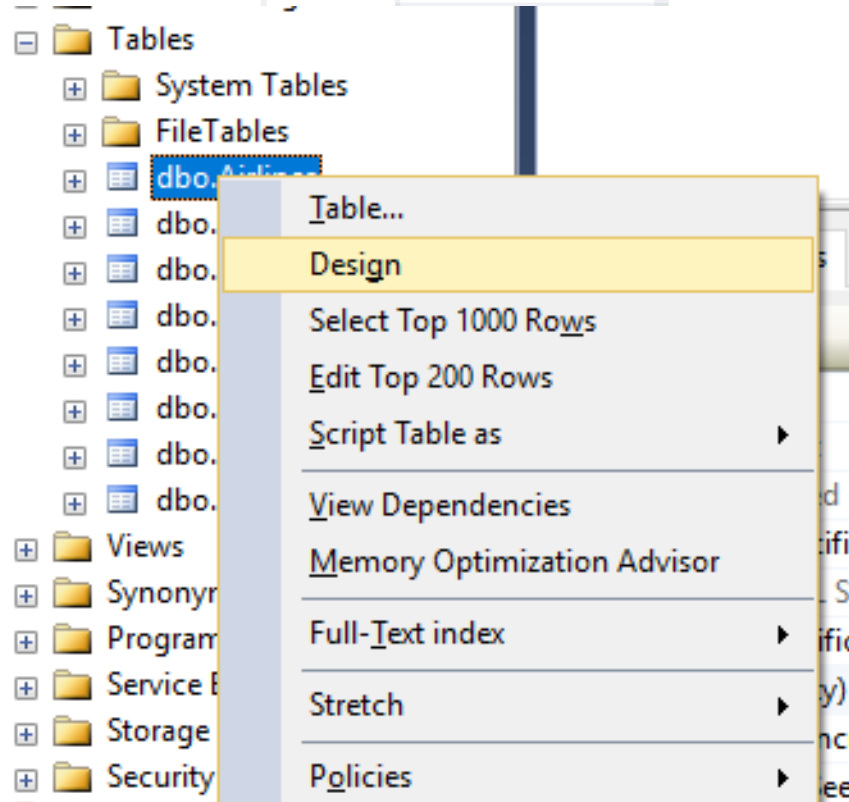
Changes cannot conflict with existing rules!

Summary

- RDBMS store and manage data
- Table relations reduce repetition and complexity
- Table columns have **fixed types**
- We can use Management Studio to **create** and **customize** tables

Questions?

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