

Introduction to

Databases

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Introduction



- What is a Database?
- Standard Language for Accessing and Processing/Amending Data Entries
- ANSI Standard: ISO/IEC 9075
- SQL: Structured Query Language
- Structured? Query?

What Can We Do With SQL?




- Perform a Quick Search on a Database
- FETCH a record From the Database
- INSERT a record into the Database
- UPDATE a record in the Database
- DELETE a record from the Database
- CREATE a new Database
- Create Tables in a Database

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What Can We Do With SQL? (Cont.)



- Create and Store Functions/Procedures in a Database
- Authenticate and Certify the Functions and Tables Created in the Database
- And Many More ... (we will learn them all as we go through the course)

Database 101



➤ Different Placements:

- Web App
- Desktop APP (Datacenter is Required, Maybe Over TCP/IP)

➤ Database Engine:

- The Database Engine is the core service for storing, processing, and securing data. The Database Engine provides controlled access and rapid transaction processing to meet the requirements of the most demanding data consuming applications within your enterprise [1].

[1]: <https://docs.microsoft.com/en-us/sql/database-engine/sql-server-database-engine-overview?view=sql-server-2017>

Database 101 (Cont.)




- Flat File vs. Database File:
 - Flat file databases were a natural development early in computing history. The relational database model was developed and implemented in the early 1970's, primarily by IBM
 - Flat file databases are typically plain text files that store one record per line, with record fields delimited by whitespace or a delimiting character. Flat file databases can be read directly by a variety of software applications.
 - In addition to the data tables, relational databases use "indexes" to quickly find records based on search criteria. Relational databases generally require a relational database management system (RDBMS) to manage and access the data.

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Database 101 (Cont.)




➤ Flat File vs. Database File:

- Databases can handle querying tasks, so you do not have to walk over files manually.
- Databases can handle very complicated queries.
- Databases can quickly handle indexing tasks, such as get record with id = x
- Databases can handle multiprocess/multithreaded access.
- Databases can handle access from network.
- Databases can watch for data integrity.
- Databases can update data easily.
- Databases are reliable.
- Databases can handle transactions and concurrent access.
- Databases + ORMs let you manipulate data in very programmer friendly way.

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Database 101 (Cont.)



➤ Flat File vs. Database File:

➤ Flat files are adequate when:

- The amount of data is small
- One at a time write access is all that's needed
- The data structure is fairly simple, or (if complex) you can provide an API in library routines that each application must use in order to interpret the data contents and maintain their structural integrity

Database 101 (Cont.)



➤ Flat File vs. Database File:


➤ Databases are superior when:

- There is large data involved
- Multiuser concurrent reads and writes must be supported
- Complex structures are involved
- Complex queries and operations are needed
- Security is a significant factor
- Transactions, rollback, and consistency are necessary
- Things like Backup, Recovery, Reliability (Failover, Fault-Tolerance), Redundancy, Scalability etc. are requirements

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Database 101 (Cont.)



➤ Database Engines:

01

Oracle RDBMS

02

IBM DB2

03

Microsoft SQL Server

04

SAP Sybase ASE

05

Teradata

06

ADABAS

Database 101 (Cont.)



➤ Database Engines:

07

MySQL

08

FileMaker

09

Microsoft Access

10

Informix

11

SQLite

12

PostgreSQL

Database 101 (Cont.)



➤ Database Engines:

13

Amazon RDS

14

MongoDB

15

phpMyAdmin

16

Sequel PRO

17

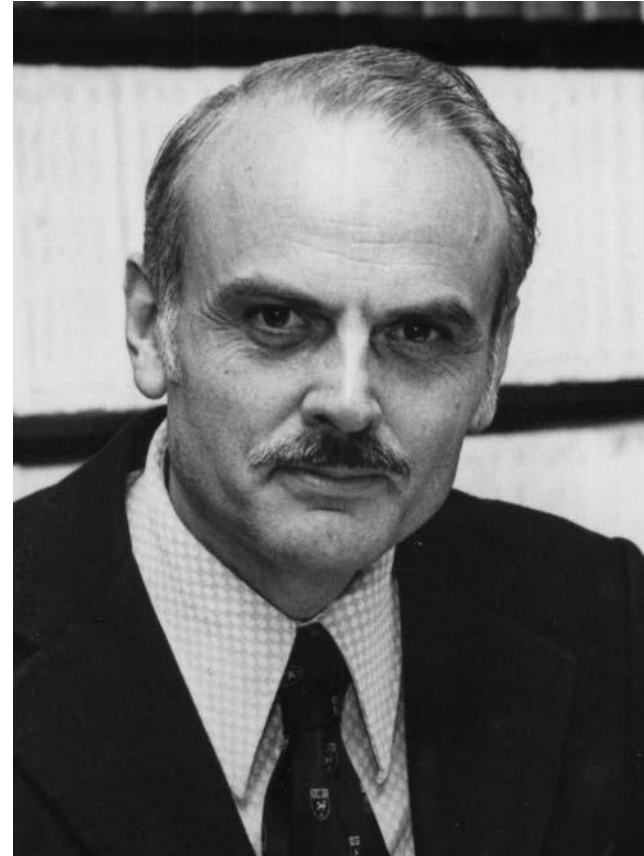
Hadoop HDFS

18

MariaDB

Database 101 (Cont.)


- RDBMS:
- Relational Database Management System
- First Introduced by Edward F. Codd
- Contains 12 Rules that Any RDBMS Must Adopt and Follow
- Relation?
 - (Customer Table and Purchase Table)



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Database 101 (Cont.)




- SQL and TCP/IP:
 - **TCP Port 1433:** The default port for SQL Server. This port is also the official Internet Assigned Number Authority (IANA) socket number for SQL Server.
 - **TCP Port 1434:** The default port for the Dedicated Admin Connection. You can start the Dedicated Admin Connection through sqlcmd or by typing ADMIN: followed by the server name in the SSMS Connect to Database Engine dialog box.
 - **UDP Port 1434:** Used for SQL Server named instances. The SQL Server Browser service listens on this port for incoming connections to a named instance.
 - **TCP port 2383:** The default port for SQL Server Analysis Services.
 - **TCP port 2382:** Used for connection requests to a named instance of Analysis Services. Much like the SQL Server Browser service does for the relational database engine on UDP 1434, the SQL Server Browser listens on TCP 2382 for requests for Analysis Services named instances.
 - **TCP Ports 135, 80, 443.**

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Relational Database Concepts



- A relational database management system (RDBMS) stores and retrieves data that is represented in tables.
- A relational database consists of a collection of tables that store interrelated data.
- You can use primary and foreign keys to describe relationships between the information in different tables.

Relational Database Concepts (Cont.)




➤ TABLE:

- In a relational database, all data is held in **tables**, which are made up of **rows** and **columns**.
- Each table has one or more columns, and each column is assigned a specific datatype, such as an integer number, a sequence of characters (for text), or a date. Each row in the table has a value for each column.
- The tables of a relational database have some important characteristics:
 - There is no significance to the order of the columns or rows.
 - Each row contains one and only one value for each column.
 - Each value for a given column has the same type.

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Relational Database Concepts (Cont.)



➤ TABLE:

- When you are designing your database, make sure that **each table in the database holds information about a specific thing**, such as employees, products, or customers.
- By designing a database this way, you can set up a structure that eliminates **redundancy and inconsistencies**.

Relational Database Concepts (Cont.)




➤ COLUMN AND ROW:

- In a relational database, a column is a set of data values of a particular simple type, one value for each row of the database.
- A column may contain text values, numbers, or even pointers to files in the operating system.
- Some relational database systems allow columns to contain more complex data types; whole documents, images or even video clips.
- A column can also be called an **attribute**.
- The word '**field**' is normally used interchangeably with 'column'. However, database perfectionists tend to favor using 'field' to signify a specific cell of a given row

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Relational Database Concepts (Cont.)




➤ COLUMN AND ROW:

- In the context of a relational database, a row, also called a **tuple**, represents a single, implicitly structured data item in a table.
- Each row in a table represents a set of related data, and every row in the table has the same structure.
- The implicit structure of a row, and the meaning of the data values in a row, requires that the row be understood as providing a **succession of data values**, one in each column of the table.
- The row is then interpreted as a **relvar (relation variable)** composed of a set of tuples, with each tuple consisting of the two items: **the name of the relevant column** and the **value this row provides for that column**.
- In the world of database, row is referred to as a **record**.

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Relational Database Concepts (Cont.)




➤ QUERY:

- In the form of **T-SQL** (PLSQL in Oracle).
- Retrieve data from a database using the **SELECT** statement.
- The basic query operations in a relational database system are **projection**, **restriction**, and **join**.
- The **SELECT** statement implements all of these operations.
- A **projection** is a subset of the columns in a table.
- A **restriction** (also called **selection**) is a subset of the rows in a table.
- A **join** links the rows in two or more tables by comparing the values in key columns and returning rows that have matching values.

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Relational Database Concepts (Cont.)



➤ QUERY:

- The following SELECT statement retrieves the names and prices of all products that cost more than \$15:


```
SELECT name, unit_price  
FROM product  
WHERE unit_price > 15
```

- This query uses both a restriction (WHERE unit_price > 15) and a projection (SELECT name, unit_price)

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Relational Database Concepts (Cont.)



➤ QUERY:

- You may want to select the item identification numbers and product names for all items for which more than a dozen has been shipped


```
SELECT sales_order_items.id, product.name  
FROM product KEY JOIN sales_order_items  
WHERE sales_order_items.quantity > 12
```

- The product table and the sales_order_items table are joined together based on the foreign key relationships between them.

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Relational Database Concepts (Cont.)




➤ SYSTEM TABLE:

- Every database contains a set of system tables, which are special tables that the system uses to manage data and the system.
- These tables are sometimes called the **data dictionary** or the **system catalog**.
- System tables contain information about the database. You never alter the system tables directly in the way that you can alter other tables.
- The system tables hold information about the tables in a database, the users of a database, the columns in each table, and so on.
- This information is data about data, or **metadata**.

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Relational Database Concepts (Cont.)




➤ INDEX:

- Indexes allow quick lookup of information.
- Conceptually, an index in a database is like an index in a book. In a book, the index relates each indexed term to the page or pages on which that word appears.
- In a database, the index relates each indexed column value to the physical location at which the row of data containing the indexed value is stored.
- Indexes are an important design element for high performance, however their use is **transparent** to the user.

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Relational Database Concepts (Cont.)




➤ VIEW:

- Views are computed tables, or virtual tables.
- They look like tables to client applications, but they do not hold data.
- Instead, whenever they are accessed, the information in them is computed from the underlying tables.
- The tables that actually hold the information are sometimes called **base tables** to distinguish them from views.

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Relational Database Concepts (Cont.)




➤ STORED PROCEDURES:

- These are routines held in the database itself that act on the information in the database.
- You can create and name your own stored procedures to execute specific database queries and to perform other database tasks.
- Stored procedures can take **parameters**.
- For example, you might create a stored procedure that returns the names of all customers who have spent more than the amount that you specify as a parameter in the call to the procedure.

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Relational Database Concepts (Cont.)



➤ TRIGGERS:

- A trigger is a special stored procedure that automatically fires whenever a user updates, deletes, or inserts data, depending on how you define the trigger.
- You associate a trigger with a table or columns within a table.
- Triggers are useful for automatically maintaining business rules in a database.

Relational Database Concepts (Cont.)



➤ USERS AND GROUPS:

- Each user of a database has a user ID and password.
- You can set permissions for each user, so that confidential information is kept private and users are prevented from making unauthorized changes.
- Users can be assigned to groups, in order to make the administration of permissions easier.

Relational Database Concepts (Cont.)




➤ JAVA OBJECTS:

- You can install Java classes into the database.
- Java classes provide a powerful way of building logic into your database, and a **special class of user-defined datatypes** for holding information.

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Relational Database Concepts (Cont.)




➤ KEYS:

- Keys are fields in a table which participate in below activities in RDBMS systems:
 - To create relationships between two tables.
 - To maintain uniqueness in a table.
 - To keep consistent and valid data in database.
 - Might help in fast data retrieval by facilitating indexes on column(s).

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Relational Database Concepts (Cont.)




➤ KEYS:

- **Super Key:** A set of one or more than one keys that can be used to identify a record uniquely in a table. **Example** : *Primary key, Unique key, Alternate key* are subset of Super Keys.
- **Candidate Key:** A set of one or more fields/columns that can identify a record uniquely in a table. There can be multiple candidate keys in one table. Each candidate key can work as primary key.
- **Primary Key:** A set of one or more fields/columns of a table that uniquely identify a record in database table. It can not accept null or duplicate values. Only one candidate key can be a primary key.

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Relational Database Concepts (Cont.)




➤ KEYS:

- **Alternate Key:** A key that can work as a primary key. Basically it is a candidate key that currently is not primary key.
- **Composite Key:** A combination of more than one fields/columns of a table. It can be a candidate key or a primary key.
- **Unique Key:** A set of one or more fields/columns of a table that uniquely identify a record in database table. It is like primary key but it can accept **only one null value** and it can not have duplicate values.
- **Foreign Key:** A field in database table that is a primary key in another table. It can accept multiple null and duplicate values.

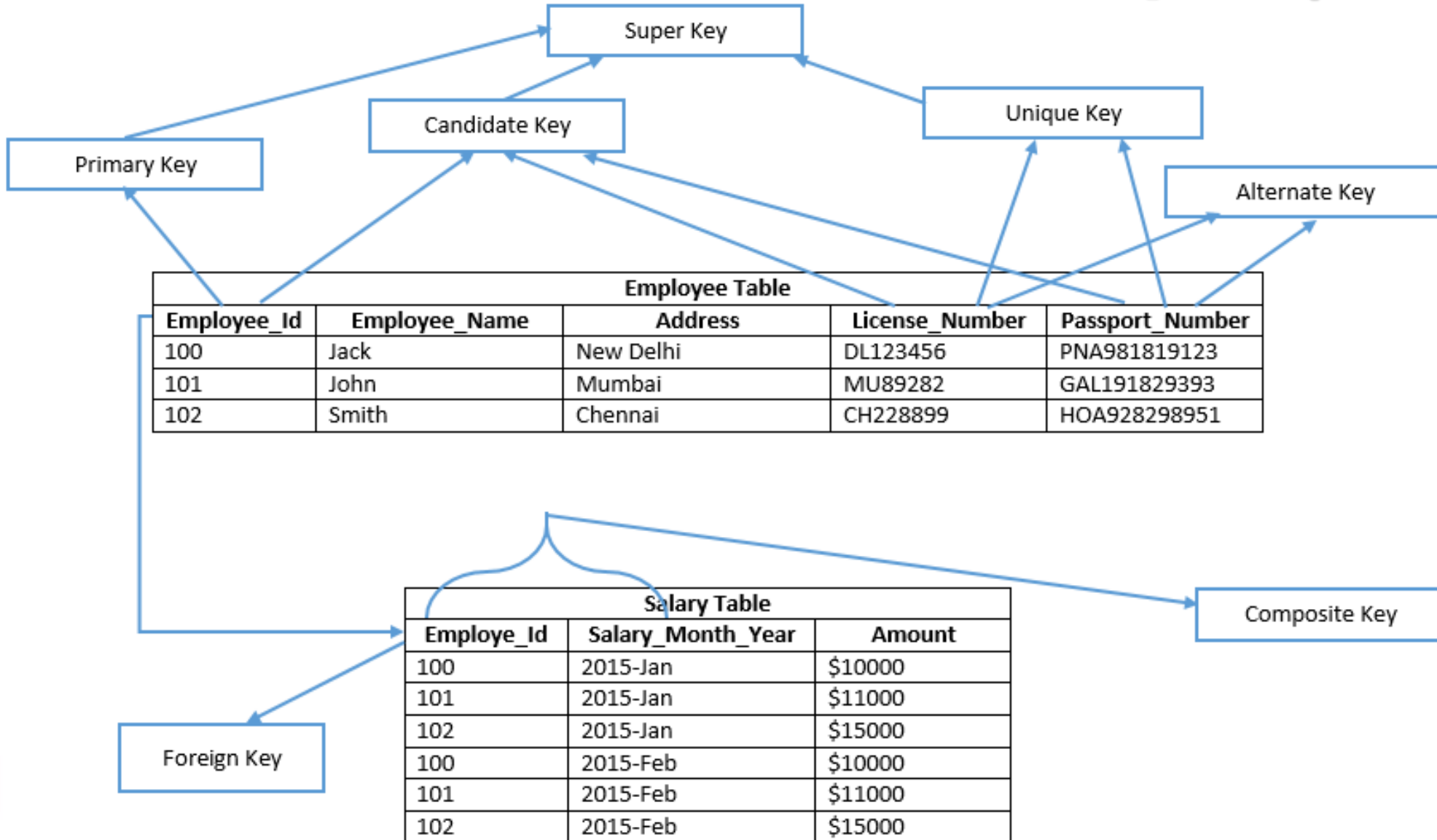
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Relational Database Concepts (Cont.)



Relational Database Concepts (Cont.)



➤ KEYS:

➤ Question:

- What are **Artificial**, **Surrogate** and **Natural** Keys?


➤ More information on:

- <https://begriffs.com/posts/2018-01-01-sql-keys-in-depth.html>
- <https://docs.microsoft.com/en-us/sql/relational-databases/tables/primary-and-foreign-key-constraints?view=sql-server-2017>
- <https://www.mssqltips.com/sqlservertip/5431/surrogate-key-vs-natural-key-differences-and-when-to-use-in-sql-server/>

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SQL Server Components



- 1 SQL Server Database Engine
- 2 Analysis Service (SSAS)
- 3 Reporting Service (SSRS)
- 4 Integration Service (SSIS)
- 5 Master Data Service (MDS)
- 6 SQL Server ML Service

SQL Server Components (Cont.)




- DATABASE ENGINE:
- The Database Engine component of SQL Server is the core service for storing, processing, and securing data.
- The Database Engine provides controlled access and rapid transaction processing to meet the requirements of the most demanding data consuming applications in your enterprise.
- SQL Server supports up to 50 instances of the Database Engine on a single computer.

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SQL Server Components (Cont.)




- ANALYSIS SERVICE:
- Analysis Services is an analytical data engine used in decision support and business analytics.
- It provides enterprise-grade semantic data models for business reports and client applications such as **Power BI**, Excel, Reporting Services reports, and other data visualization tools.
- Analysis Services is available in two different platforms:
 - **Azure Analysis Services:** Supports tabular models at the **120 and higher compatibility levels**. DirectQuery, partitions, row-level security, bi-directional relationships, and translations are all supported. To learn more, see Azure Analysis Services.
 - **SQL Server Analysis Services:** Supports tabular models at all compatibility levels, multidimensional models, data mining, and Power Pivot for SharePoint.

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SQL Server Components (Cont.)




- REPORTING SERVICE:
- SQL Server Reporting Services is a solution that customers deploy on their *own premises* for **creating**, **publishing**, and **managing** reports, then delivering them to the right users in different ways, whether that's viewing them in web browser, on their mobile device, or as an email in their in-box.
- SQL Server Reporting Services offers an updated suite of products:
 - **"Traditional" paginated reports** brought up to date, so you can create modern-looking reports, with updated tools and new features for creating them.
 - **New mobile reports** with a responsive layout that adapts to different devices and the different ways you hold them.
 - **A modern web portal** you can view in any modern browser. In the new portal, you can organize and display mobile and paginated Reporting Services reports and KPIs. You can also store Excel workbooks on the portal.

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SQL Server Components (Cont.)




- INTEGRATION SERVICE:
- Microsoft Integration Services is a platform for **building enterprise-level data integration and data transformations solutions**. Use Integration Services to solve complex business problems by copying or downloading files, loading data warehouses, cleansing and mining data, and managing SQL Server objects and data.
- Integration Services can **extract and transform data from a wide variety of sources** such as XML data files, flat files, and relational data sources, and then load the data into one or more destinations.
- Integration Services includes a rich set of **built-in** tasks and transformations, graphical tools for building packages, and the Integration Services Catalog database, where you store, run, and manage packages.
- You can use the **graphical** Integration Services tools to create solutions **without writing a single line of code**. You can also **program** the extensive Integration Services object model to create packages programmatically and code **custom tasks** and other package objects.

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SQL Server Components (Cont.)




- MASTER DATA SERVICE:
- Master Data Services (MDS) is the SQL Server solution for master data management. Master data management (MDM) describes the efforts made by an organization to discover and define non-transactional lists of data, with the goal of compiling maintainable master lists.
- Other Master Data Services features include **hierarchies**, granular **security**, **transactions**, data **versioning**, and **business rules**.
- Master Data Services includes the following components and tools:
 - **Master Data Services Configuration Manager**, a tool you use to create and configure Master Data Services databases and web applications.
 - **Master Data Manager**, a **web application** you use to perform administrative tasks (like creating a model or business rule), and that users access to update data.
 - **MDSModelDeploy.exe**, a tool you use to create packages of your model objects and data so you can **deploy them to other environments**.
 - **Master Data Services web service**, which developers can use to extend or **develop custom solutions** for Master Data Services.
 - **Master Data Services Add-in for Excel**, which you use to manage data and create new entities and attributes.

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SQL Server Components (Cont.)




- MACHINE LEARNING SERVICE:
- SQL Server 2017 Machine Learning Services is an **add-on to a database engine** instance, used for **executing R and Python** code on SQL Server. The feature includes Microsoft R and Python **packages** for **high-performance** predictive analytics and machine learning. Code runs in an extensibility framework, isolated from core engine processes, but fully available to relational data as stored procedures, as T-SQL script containing R or Python statements, or as R or Python code containing T-SQL.
- If you previously used SQL Server 2016 R Services, Machine Learning Services in SQL Server 2017 is the next generation of R support, with updated versions of base R, RevoScaleR, MicrosoftML, and other libraries introduced in 2016.
- The key value proposition of Machine Learning Services is the power of its enterprise R and Python packages to deliver advanced analytics at scale, and the ability to **bring calculations and processing to where the data resides, eliminating the need to pull data across the network.**

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SQL Server Tools



- 1 SQL Server management Studio
- 2 Configuration Manager
- 3 SQL Server Profiler
- 4 Database Engine Tuning Advisor
- 5 Data Quality Client (DQC)
- 6 SQL Server Data Tools (SSDT)

SQL Server Tools (Cont.)




- MANAGEMENT STUDIO (SSMS):
- Microsoft SQL Server Management Studio (SSMS) which was first introduced in the 2005 version, is an integrated environment used for configuring, managing, and administering all components within SQL Server. It provides a **user interface and a group of tools** with rich script **editors** that interact with SQL Server.
- The tool includes both **script editors** and **graphical tools** which work with objects and features of the server.

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SQL Server Tools (Cont.)




- CONFIGURATION MANAGER (SSMS):
- SQL Server Configuration Manager is a tool to **manage the services** associated with SQL Server, to **configure the network protocols** used by SQL Server, and to **manage the network connectivity** configuration from SQL Server client computers.
- SQL Server Configuration Manager is a Microsoft Management Console **snap-in** that is **available from the Start menu**, or can be added to any other Microsoft Management Console display.
- Microsoft Management Console (**mmc.exe**) uses the `SQLServerManager<version>.msc` file (such as **SQLServerManager14.msc** for SQL Server 2017 to open Configuration Manager.

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SQL Server Tools (Cont.)




- PROFILER:
- SQL Server Profiler is an **interface to create and manage traces** and analyze and replay trace results. Events are saved in a trace file that can later be analyzed or used to replay a specific series of steps when trying to diagnose a problem.
- Profiler is a **graphical user interface to SQL Trace** for monitoring an instance of the Database Engine or Analysis Services. You can capture and save data about each event to a file or table to analyze later. For example, you can monitor a production environment to see which stored procedures are affecting performance by executing too slowly.
- **SQL Trace and SQL Server Profiler are deprecated.** The `Microsoft.SqlServer.Management.Trace` namespace that contains the Microsoft SQL Server Trace and Replay objects are also deprecated.

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SQL Server Tools (Cont.)




- TUNING ADVISOR:
- Database Engine Tuning Advisor examines how queries are processed in the databases you specify, and then **recommends how you can improve query processing** performance by modifying database structures such as indexes, indexed views, and partitioning.
- Database Engine Tuning Advisor provides two user interfaces: a **graphical user interface** (GUI) and the **dta** command prompt utility.
- The **GUI** makes it easy to quickly **view** the results of tuning sessions, and the **dta** utility makes it easy to incorporate Database Engine Tuning Advisor functionality into **scripts** for **automated tuning**. In addition, Database Engine Tuning Advisor can take **XML input**, which offers more control over the tuning process.

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SQL Server Tools (Cont.)




- DATA QUALITY CLIENT:
- The Data Quality Client **application** enables you to perform **data quality operations** using a standalone tool.
- This application enables you to create knowledge bases, create and run data quality projects, and perform administrative tasks.
- Data experts or IT professionals who are responsible for managing data assets and maintaining high standards of data quality can use the client application in any **of three roles**:
 - A DQS KB **Operator** who can **edit and execute a data quality project**
 - A DQS KB **Editor** who can **perform project functions**, and create and edit a knowledge base
 - A DQS **Administrator** who can perform project and knowledge base functions and administer the system.

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SQL Server Tools (Cont.)




- DATA TOOLS:
- SQL Server Data Tools is a **modern development tool** for building SQL Server relational databases, Azure SQL databases, Analysis Services (AS) data models, Integration Services (IS) packages, and Reporting Services (RS) reports.
- With SSDT, you can design and deploy any SQL Server content type with **the same ease as you would develop an application in Visual Studio**.
- For most users, SQL Server Data Tools (SSDT) is installed during **Visual Studio installation**. Installing SSDT using the Visual Studio installer **adds the base SSDT functionality**, so you still need to run the **SSDT standalone installer** to get AS, IS, and RS tools.

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Legends

- **CTP:** Community Technology Preview (beta release)
- **RC:** Release Candidate
- **RTM:** Released To Manufacturing; It is the original, released build version of the product, i.e. what you get on the DVD or when you download the ISO file from MSDN.
- **GDR:** General Distribution Release; GDR fixes should not contain any of the CU updates.
- **QFE:** Quick Fix Engineering; QFE updates include CU fixes.

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Database Models




- Logical and Physical
- Models are required in order to **visually present** the database that has been proposed for a certain business requirement.
- The models help in **showing the association** of business requirements and the database objects.
- This is necessary in order to gather all requirements of the database **accurately and completely**.
- More information:
 - <https://www.developer.com/tech/article.php/641521/Logical-Versus-Physical-Database-Modeling.htm>

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Database Models (Cont.)




- Logical Database Model
 - Logical database modeling is required for **compiling business requirements** and **representing** the requirements as a model.
 - It is mainly associated with the **gathering of business needs** rather than the database design.
 - The information that needs to be gathered is about **organizational units, business entities, and business processes.**

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Database Models (Cont.)




➤ Physical Database Model

- Deals with **designing the actual database** based on the requirements gathered during logical database modeling.
- All the information gathered is converted into relational models and business models.
- During physical modeling, **objects** are defined at a level called a **schema level**.
- A **schema** is considered a group of objects which are related to each other in a database.
- **Tables** and **columns** are made according to the information provided during logical modeling. **Primary keys**, **unique keys**, and **foreign keys** are defined in order to provide constraints. **Indexes** and **snapshots** are defined. Data can be summarized, and users are provided with an alternative perspective once the tables have been created.

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Database File Types




- Every SQL Server database has two operating system files (at minimum):
 - **Data file** and a **Log file**.
- Data files contain data and objects such as tables, indexes, stored procedures, and views.
- Log files contain the information that is required to recover all transactions in the database.
- SQL Server databases have three types of files: **MDF, NDF, LDF**.

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Database File Types (Cont.)




- PRIMARY DATA FILE:
- The primary data file contains the **startup information** for the database and **points to the other files** in the database.
- User data and objects can be stored in this file or in secondary data files.
- Every database has **one primary** data file. The recommended file name extension for primary data files is **.mdf ***.
- * mdf: Master Data File

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Database File Types (Cont.)




- SECONDARY DATA FILE:
- Secondary data files are **optional**, are user-defined, and store user data.
- Secondary files can be used to **spread data across multiple disks** by putting each file on a different disk drive.
- Additionally, if a database exceeds the maximum size for a single Windows file, you can use secondary data files so the database can continue to grow.
- The recommended file name extension for secondary data files is **.ndf** *.
- * ndf: Named Data File

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Database File Types (Cont.)




- LOG DATA FILE:
- The transaction log files hold the log information that is used to **recover the database**.
- There must be at least **one log file for each database**.
- The recommended file name extension for transaction logs is **.ldf ***.
- * ldf: Log Data File

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Transact-SQL or T-SQL




- Transact-SQL (T-SQL) is **Microsoft's** and **Sybase's** proprietary extension to the SQL (Structured Query Language) used to interact with relational databases.
- T-SQL **expands on the SQL** standard to include:
 - Procedural programming
 - Local variables
 - Various support functions for string processing
 - Date processing
 - Mathematics
 - Changes to the DELETE and UPDATE statements.
 - etc.

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Transact-SQL or T-SQL (Cont.)




- Transact-SQL is central to using Microsoft SQL Server.
- All applications that communicate with an instance of SQL Server do so by sending Transact-SQL statements to the server, regardless of the user interface of the application.
- **Stored procedures** in SQL Server are executable **server-side** routines.
- The advantage of stored procedures is the ability to **pass parameters**.

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Transact-SQL or T-SQL (Cont.)



➤ Other SQL Extensions:

- Oracle: PL/SQL
- PostgreSQL: PL/pgSQL
- ISO Standard: SQL/PSM


➤ More information:

- <https://docs.microsoft.com/en-us/sql/t-sql/language-reference?view=sql-server-2017>
- <https://docs.microsoft.com/en-us/sql/t-sql/tutorial-writing-transact-sql-statements?view=sql-server-2017>

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SQL Server Relationships




- One-to-One
- One-to-Many
- Many-to-Many
- Self-Referencing
- **Query** is most of the time done by **JOIN** command. If the relationship is too complicated or a NULL is present, you may have to use complicated JOIN such as Outer JOIN.

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SQL Server Relationships (Cont.)



➤ One-to-One

➤ Let's say you have a table for customers:

CUSTOMERS		
customer_id	customer_name	customer_address
101	John Doe	12 Main St., Houston TX 77001
102	Bruce Wayne	1007 Mountain Dr., Gotham NY 10286

➤ We can put the customer address information on a separate table:

CUSTOMERS		
customer_id	customer_name	address_id
101	John Doe	301
102	Bruce Wayne	302

ADDRESSES	
address_id	address
301	12 Main St., Houston TX 77001
302	1007 Mountain Dr., Gotham NY 10286

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SQL Server Relationships (Cont.)




- One-to-One
 - We have a relationship between the Customers table and the Addresses table.
 - If each address can belong to only one customer, this relationship is "**One to One**".
 - Keep in mind that this kind of relationship is **not very common**.
 - Initial table that included the address along with the customer could have worked fine in most cases.
 - Notice that now there is a field named "address_id" in the Customers table, that refers to the matching record in the Address table (*Foreign Key*).

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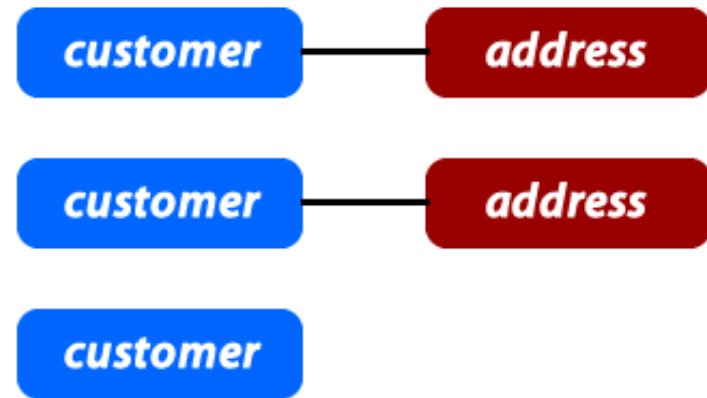
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SQL Server Relationships (Cont.)



➤ One-to-One


- We can visualize the relationship between the customer and address records.
- Note that the existence of a relationship can be **optional**, like having a customer record that has no related address record.



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SQL Server Relationships (Cont.)




- One-to-Many
 - This is the most commonly used type of relationship.
 - Consider an e-commerce website, with the following:
 - Customers can make many orders.
 - Orders can contain many items.
 - Items can have descriptions in many languages.

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SQL Server Relationships (Cont.)



➤ One-to-Many

➤ In these cases we would need to create "One to Many" relationships:


CUSTOMERS	
customer_id	customer_name
101	John Doe
102	Bruce Wayne

ORDERS			
order_id	customer_id	order_date	amount
555	101	12/24/09	\$156.78
556	102	12/25/09	\$99.99
557	101	12/26/09	\$75.00

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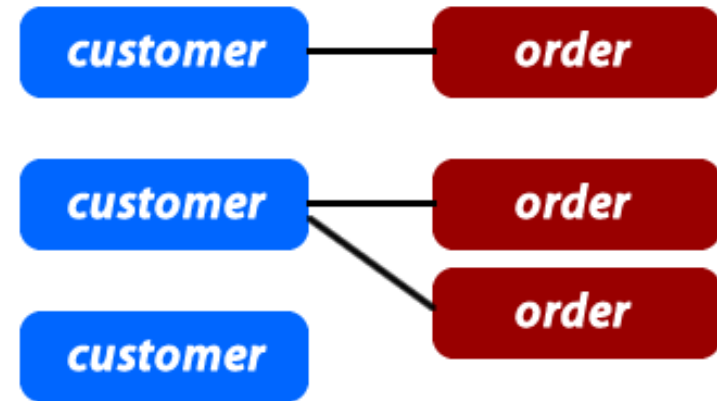
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SQL Server Relationships (Cont.)



➤ One-to-Many


- We can visualize the relationship between the customer and address records.
- Each **customer** may have **zero, one** or **multiple** orders. But an **order** can belong to **only one customer**.



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SQL Server Relationships (Cont.)



➤ Many-to-Many


- In some cases, you may need multiple instances on both sides of the relationship.
- For example, each order can contain multiple items. And each item can also be in multiple orders.
- For these relationships, we need to create an extra table.

<u>ORDERS</u>			
order_id	customer_id	order_date	amount
555	101	12/24/09	\$156.78
556	102	12/25/09	\$99.99
<u>ITEMS</u>			
item_id	item_name	item_description	
201	Tickle Me Elmo	It wants to be tickled	
202	District 9 DVD	Awesome sci-fi movie	
203	Batarang	It is very sharp	
<u>ITEMS_ORDERS</u>			
order_id	item_id		
555	201		
555	202		
556	202		
556	203		

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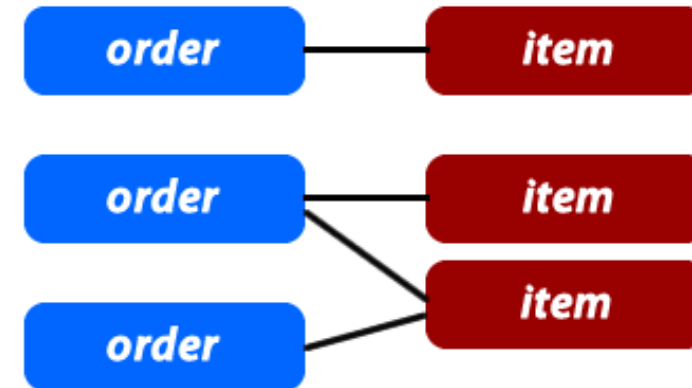
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SQL Server Relationships (Cont.)




- Many-to-Many
 - The **Items_Orders** table has only **one purpose**, and that is to create a "Many to Many" relationship between the items and the orders.
 - Here is a how we can visualize this kind of relationship.



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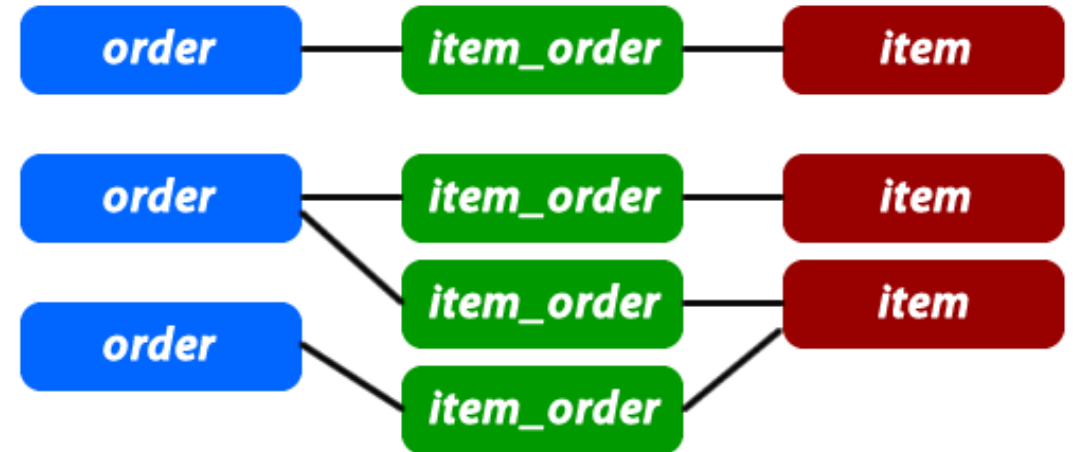
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SQL Server Relationships (Cont.)

➤ Many-to-Many


- If you want to include the items_orders records in the graph, it may look like this:



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SQL Server Relationships (Cont.)



➤ Self-Referencing


- This is used when a table needs to **have a relationship with itself**.
- For example, let's say you have a referral program. Customers can refer other customers to your shopping website. The table may look like this:

<u>CUSTOMERS</u>		
customer_id	customer_name	referrer_customer_id
101	John Doe	0
102	Bruce Wayne	101
103	James Smith	101

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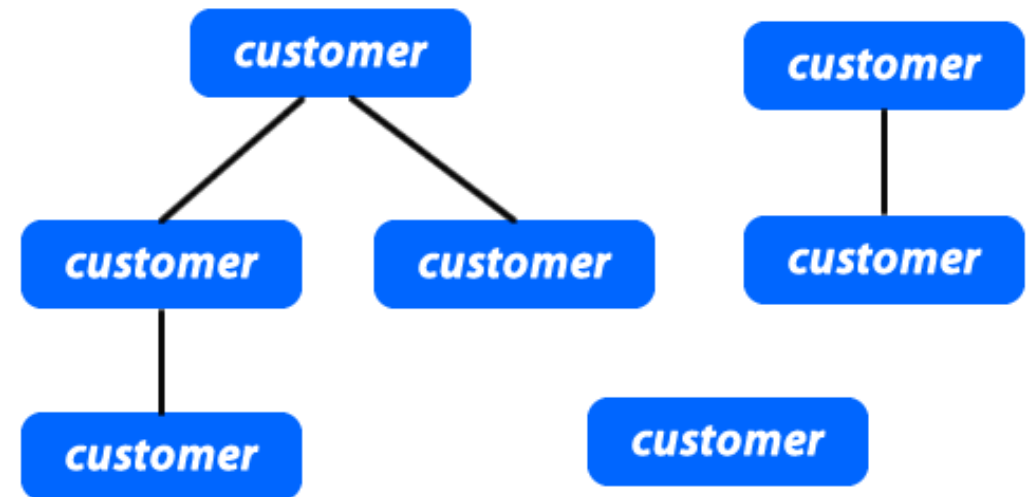
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SQL Server Relationships (Cont.)

➤ Many-to-Many


- Similar to "one to many" relationship since one customer can refer multiple customers.
- It can be visualized like a tree structure.



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Example



شماره فاکتور: ۱۰۱۸۷۷۸	آفتاب صورت حساب فروش	
تاریخ: ۱۳۹۱/۰۷/۱۰		

فروشنده	نام شرکت: آفتاب	شماره ثبت: ۰۱	کد اقتصادی:	نام ویزیتور: مجتبی طبیب چی
خریدار	نام: آقای جوزی	کد: ۱۲۳۰۳۸۷۷	تلفن: ۰۹۱۲۵۱۷۳۳۹۸	موبایل:
	آدرس: فردیس چهارراه قریشی نبش دو راهی بنفشه			
	توضیحات:			

Example:

Design a database to represent this factor of sale

مبلغ نهایی	تخفیف		جمع قیمت	کالا						ردیف
	مبلغ	درصد		قیمت	مقدار	واحد	تعداد	نام	کد	
۶۰,۰۰۰	۰	۰	۶۰,۰۰۰	۶۰,۰۰۰	۱	باکس	۱	مینی شکلات مغزدار ۲ تپه	۵۰۰۰۱۰۰۰	۱
۸۲,۸۰۰	۰	۰	۸۲,۸۰۰	۸۲,۸۰۰	۱	بسته	۱	پاستیل میوه ای ۴۰ گرم	۵۰۰۰۱۴۰۰	۲
۴۴,۰۰۰	۰	۰	۴۴,۰۰۰	۴۴,۰۰۰	۴۰	کارتن	۱	آبمیوه آلبالو ۱۶۰ گرم یکدانه	۵۰۰۱۳۱۰۰	۳
۴۴,۰۰۰	۰	۰	۴۴,۰۰۰	۴۴,۰۰۰	۴۰	کارتن	۱	آبمیوه پرتقال ۱۶۰ گرم یکدانه	۵۰۰۱۳۳۰۰	۴
۸۸,۰۰۰	۰	۰	۸۸,۰۰۰	۴۴,۰۰۰	۸۰	کارتن	۲	آبمیوه مخلوط ۱۶۰ گرم یکدانه	۵۰۰۱۳۴۰۰	۵
۳۱۸,۸۰۰	۰		۳۱۸,۸۰۰		۱۶۲		۶			جمع:
۰	تخفیف فاکتور (./):									
۰	جایزه نقدی:									
۳۱۸,۸۰۰	مبلغ نهایی فاکتور: مبلغ فاکتور به حروف: سیصد و هجده هزار و هشتصد ریال									
بدهی پیشین به حروف: صفرریال به عدد: ۰ ریال										

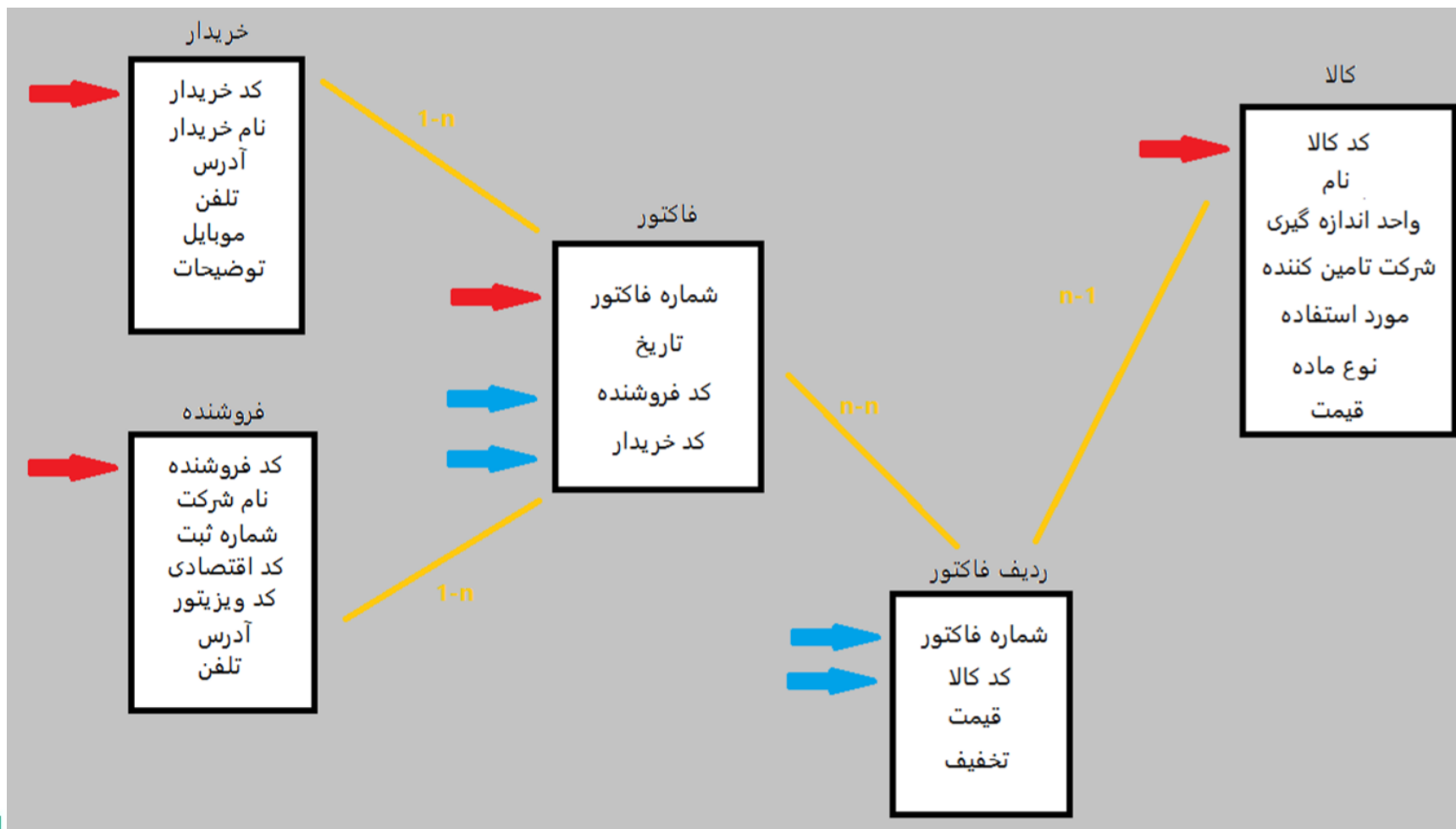
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Example





Question:

Change this solution so the database can hold and represent the history of each item's price.

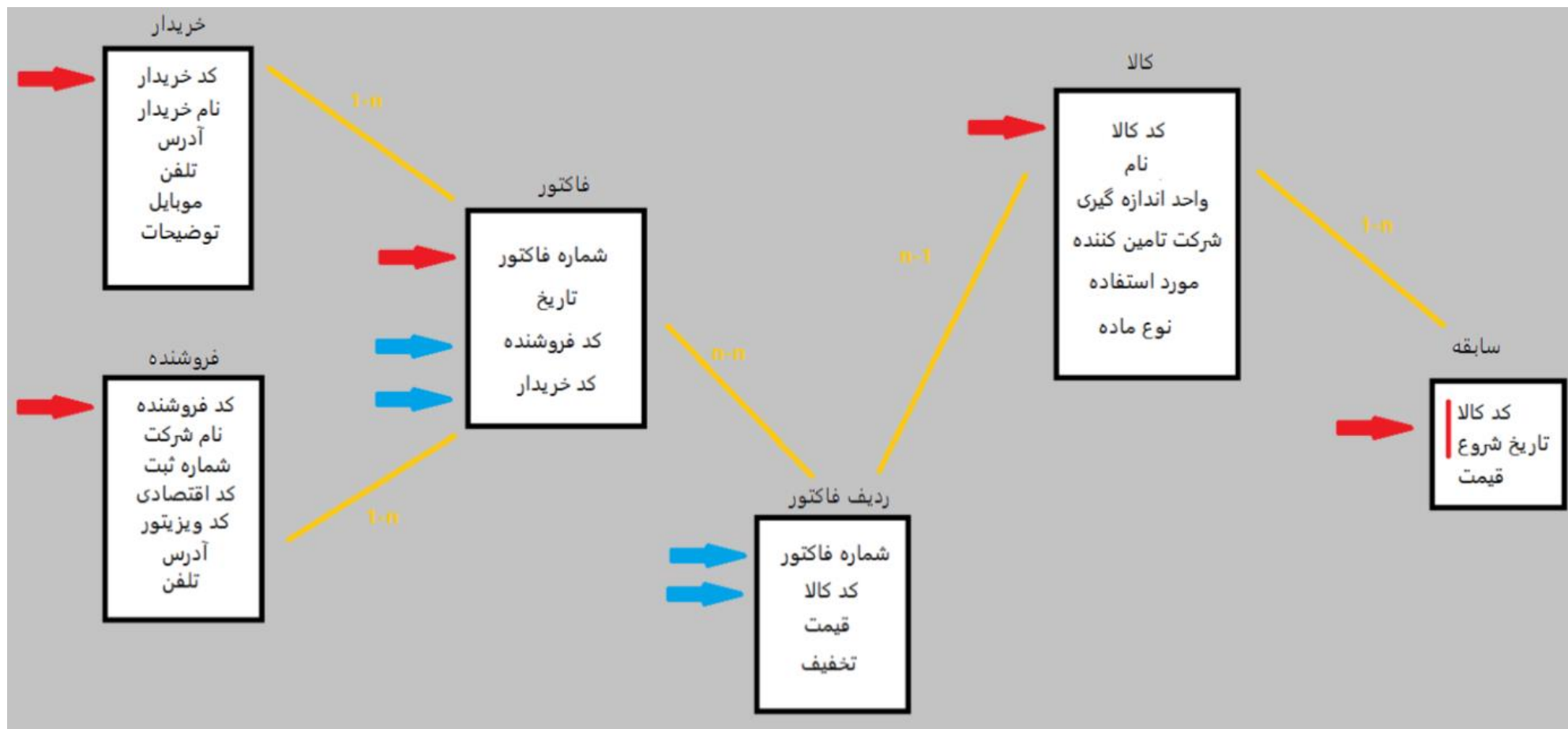
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Example



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Few Important Notes



- DO NOT use a field more than once in a table !
- Everything has to be related to the Primary Key. If you see a programmer for instance working on the database using any other column rather than the PK, then the choice of the PK was inadequate from the beginning.
- Sometimes, when you have a logging system for instance, you have to use a composite key to uniquely address the issue.
- Try not to have a Null value if that is possible (one-to-one relations)

Few Important Notes (Cont.)



- You Need to have RAID-1 (Mirror) for both **operating system** and **database engine** and the **database itself** (mdf, ldf, ...) on RAID-5



➔ Thanks

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