

# RDB&SQL Session 1 (RDB Concepts)

Pear Deck Session  
Training Clarusway  
Pear Deck - April 23, 2024 at 9:45AM

## Part 1 - Summary

Use this space to summarize your thoughts on the lesson

## Part 2 - Responses

Slide 1



Session 1

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## Slide 2



Fundamentals of RDBMS



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## Slide 3

### Your Response

I've completed the pre-class?

**True** **False**

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Students choose an option

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Do not remove this bar

You Chose

- True

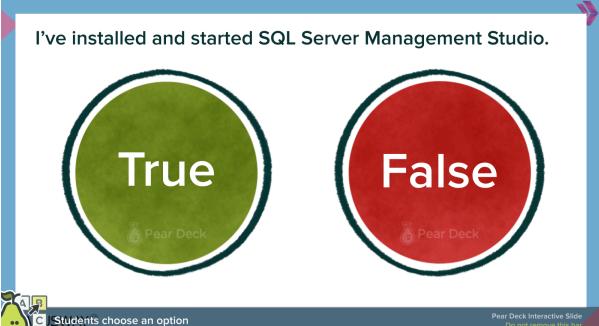
Other Choices

- False

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| Slide 4  | Your Response   |
|--|---|
|  <p>I've installed and started SQL Server Management Studio.</p> <p>True      False</p> <p>Students choose an option</p> <p>Pear Deck Interactive Slide<br/>Do not remove this bar</p> <p>Link(s) on this slide:</p> <ul style="list-style-type: none"><li>• </li></ul> | <p>You Chose</p> <ul style="list-style-type: none"><li>• <b>True</b></li></ul> <p>Other Choices</p> <ul style="list-style-type: none"><li>• False</li></ul> |

| Slide 5  | Your Response   |
|--|---|
|  <p>I've created SampleRetail database and executed a query.</p> <p>True      False</p> <p>Students choose an option</p> <p>Pear Deck Interactive Slide<br/>Do not remove this bar</p> <p>Link(s) on this slide:</p> <ul style="list-style-type: none"><li>• </li></ul> | <p>You Chose</p> <ul style="list-style-type: none"><li>• <b>True</b></li></ul> <p>Other Choices</p> <ul style="list-style-type: none"><li>• False</li></ul> |

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## Slide 6

### Table of Contents



- ▶ Relational Database Concepts
- ▶ ER-Diagram
- ▶ Data Types
- ▶ Constraints

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## Slide 7



Relational Database  
Concepts

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## Slide 8



- ★ Data
- ★ Table
- ★ Relations
- ★ Relationships
- ★ Domain
- ★ Column
- ★ Row
- ★ Normalization
- ★ ERD
- ★ Constraints
- ★ Data Types



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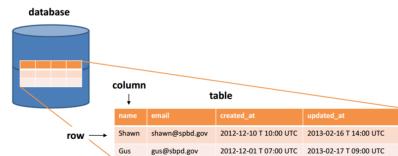
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## Slide 9

### ► Database Properties



A database has the following properties:



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## Slide 10

### ► Data (Structured)

| sale.orders |             |              |            |               |              |            |          |   |
|-------------|-------------|--------------|------------|---------------|--------------|------------|----------|---|
| order_id    | customer_id | order_status | order_date | required_date | shipped_date | store_id   | staff_id |   |
| 1           | 259         | 4            | 2018-01-01 | 2018-01-03    | 2018-01-03   | 1          | 2        |   |
| 2           | 1212        | 4            | 2018-01-01 | 2018-01-04    | 2018-01-03   | 2          | 6        |   |
| 3           | 523         | 4            | 2018-01-02 | 2018-01-05    | 2018-01-03   | 2          | 7        |   |
| 4           | 175         | 4            | 2018-01-03 | 2018-01-05    | 2018-01-05   | 1          | 3        |   |
| 5           | 1324        | 4            | 2018-01-03 | 2018-01-05    | 2018-01-05   | 2          | 6        |   |
| 6           | 69          | 4            | 2018-01-04 | 2018-01-07    | 2018-01-05   | 2          | 6        |   |
| 7           | 324         | 4            | 2018-01-04 | 2018-01-07    | 2018-01-05   | 2          | 6        |   |
| 8           | 1204        | 4            | 2018-01-04 | 2018-01-05    | 2018-01-05   | 2          | 7        |   |
| 9           | 9           | 60           | 4          | 2018-01-04    | 2018-01-08   | 2018-01-08 | 1        | 2 |
| 10          | 10          | 442          | 4          | 2018-01-04    | 2018-01-06   | 2018-01-06 | 2        | 6 |
| 11          | 1326        | 4            | 2018-01-05 | 2018-01-08    | 2018-01-07   | 2          | 7        |   |

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## Slide 11

### ► Metadata



A set of data that describes and gives information about data.



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## Slide 12

### ► Data vs Metadata



|   | Name          | Owner   | Type       | Created_datetime        |      |       |          |                    |                      |           |
|---|---------------|---------|------------|-------------------------|------|-------|----------|--------------------|----------------------|-----------|
| 1 | orders        | dbo     | user table | 2024-01-10 20:59:31.997 |      |       |          |                    |                      |           |
| 1 | Column_name   | Type    | Computed   | Length                  | Prec | Scale | Nullable | TrimTrailingBlanks | FixedLenNullInSource | Collation |
| 2 | order_id      | int     | no         | 4                       | 10   | 0     | yes      | (n/a)              | (n/a)                | NULL      |
| 3 | customer_id   | int     | no         | 4                       | 10   | 0     | yes      | (n/a)              | (n/a)                | NULL      |
| 4 | order_status  | tinyint | no         | 1                       | 3    | 0     | no       | (n/a)              | (n/a)                | NULL      |
| 4 | order_date    | date    | no         | 3                       | 10   | 0     | no       | (n/a)              | (n/a)                | NULL      |
| 5 | required_date | date    | no         | 3                       | 10   | 0     | no       | (n/a)              | (n/a)                | NULL      |
| 6 | shipped_date  | date    | no         | 3                       | 10   | 0     | yes      | (n/a)              | (n/a)                | NULL      |
| 7 | store_id      | int     | no         | 4                       | 10   | 0     | no       | (n/a)              | (n/a)                | NULL      |
| 8 | staff_id      | int     | no         | 4                       | 10   | 0     | no       | (n/a)              | (n/a)                | NULL      |

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## Slide 13

### ► Column



The principal storage units are called columns.

|    | column 1 | column 2    | column 3     |            |               |              |          |          |  |             |
|----|----------|-------------|--------------|------------|---------------|--------------|----------|----------|--|-------------|
| 1  | order_id | customer_id | order_status | order_date | required_date | shipped_date | store_id | staff_id |  | sale.orders |
| 2  | 1        | 259         | 4            | 2018-01-01 | 2018-01-03    | 2018-01-03   | 1        | 2        |  |             |
| 2  | 2        | 1212        | 4            | 2018-01-01 | 2018-01-04    | 2018-01-03   | 2        | 6        |  |             |
| 3  | 3        | 523         | 4            | 2018-01-02 | 2018-01-05    | 2018-01-03   | 2        | 7        |  |             |
| 4  | 4        | 175         | 4            | 2018-01-03 | 2018-01-04    | 2018-01-05   | 1        | 3        |  |             |
| 5  | 5        | 1324        | 4            | 2018-01-04 | 2018-01-07    | 2018-01-05   | 2        | 6        |  |             |
| 6  | 6        | 94          | 4            | 2018-01-04 | 2018-01-07    | 2018-01-05   | 2        | 6        |  |             |
| 7  | 7        | 324         | 4            | 2018-01-04 | 2018-01-07    | 2018-01-05   | 2        | 6        |  |             |
| 8  | 8        | 1204        | 4            | 2018-01-04 | 2018-01-05    | 2018-01-05   | 2        | 7        |  |             |
| 9  | 9        | 60          | 4            | 2018-01-05 | 2018-01-08    | 2018-01-08   | 1        | 2        |  |             |
| 10 | 10       | 442         | 4            | 2018-01-05 | 2018-01-06    | 2018-01-06   | 2        | 6        |  |             |
| 11 | 11       | 1326        | 4            | 2018-01-05 | 2018-01-08    | 2018-01-07   | 2        | 7        |  |             |

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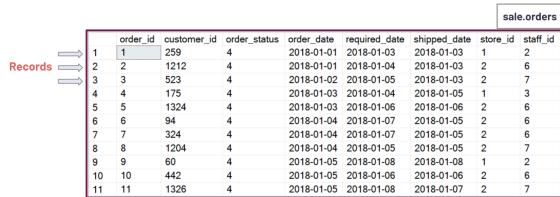


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## Slide 14

### ► Record / Row / Tuple

Records contain fields that are related, such as a customer or an employee. A tuple is another term used for record.



| sale.orders |             |              |            |               |              |            |          |   |
|-------------|-------------|--------------|------------|---------------|--------------|------------|----------|---|
| order_id    | customer_id | order_status | order_date | required_date | shipped_date | store_id   | staff_id |   |
| 1           | 259         | 4            | 2018-01-01 | 2018-01-03    | 2018-01-03   | 1          | 2        |   |
| 2           | 1212        | 4            | 2018-01-01 | 2018-01-04    | 2018-01-03   | 2          | 6        |   |
| 3           | 3           | 523          | 4          | 2018-01-02    | 2018-01-05   | 2018-01-03 | 2        | 7 |
| 4           | 4           | 175          | 4          | 2018-01-03    | 2018-01-04   | 2018-01-05 | 1        | 3 |
| 5           | 5           | 1324         | 4          | 2018-01-03    | 2018-01-06   | 2018-01-06 | 2        | 6 |
| 6           | 6           | 94           | 4          | 2018-01-04    | 2018-01-07   | 2018-01-05 | 2        | 6 |
| 7           | 7           | 324          | 4          | 2018-01-04    | 2018-01-07   | 2018-01-05 | 2        | 6 |
| 8           | 8           | 1204         | 4          | 2018-01-04    | 2018-01-05   | 2018-01-05 | 2        | 7 |
| 9           | 9           | 60           | 4          | 2018-01-05    | 2018-01-08   | 2018-01-08 | 1        | 2 |
| 10          | 10          | 442          | 4          | 2018-01-05    | 2018-01-06   | 2018-01-06 | 2        | 6 |
| 11          | 11          | 1326         | 4          | 2018-01-05    | 2018-01-08   | 2018-01-07 | 2        | 7 |

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## Slide 15

### ► Domain

A domain is the original sets of atomic values used to data modeling.

For example:

- The domain of Marital Status has a set of possibilities: Married, Single, Divorced.
- The domain of First Name is the set of character strings that represents names of people.

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## Slide 16

### ► Domain Example



| sale.orders |             |              |            |               |              |            |
|-------------|-------------|--------------|------------|---------------|--------------|------------|
| order_id    | customer_id | order_status | order_date | required_date | shipped_date | store_id   |
| 1           | 259         | 4            | 2018-01-01 | 2018-01-03    | 2018-01-03   | 1          |
| 2           | 1212        | 4            | 2018-01-01 | 2018-01-04    | 2018-01-03   | 2          |
| 3           | 3           | 523          | 4          | 2018-01-02    | 2018-01-06   | 2018-01-03 |
| 4           | 4           | 175          | 4          | 2018-01-03    | 2018-01-04   | 1          |
| 5           | 1324        | 4            | 2018-01-03 | 2018-01-06    | 2018-01-06   | 2          |
| 6           | 6           | 94           | 4          | 2018-01-04    | 2018-01-07   | 2018-01-05 |
| 7           | 7           | 324          | 4          | 2018-01-04    | 2018-01-07   | 2018-01-05 |
| 8           | 8           | 1204         | 4          | 2018-01-04    | 2018-01-05   | 2018-01-05 |
| 9           | 9           | 60           | 4          | 2018-01-05    | 2018-01-08   | 2018-01-08 |
| 10          | 10          | 442          | 4          | 2018-01-05    | 2018-01-06   | 2018-01-06 |
| 11          | 11          | 1326         | 4          | 2018-01-05    | 2018-01-08   | 2018-01-07 |

- **order\_status** provides information about the current status of an order.
- It takes values from 1 to 4 and is of the tinyint data type.

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## Slide 17

### ► Table



A database is composed of multiple tables and each table keep the data.



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## Slide 18

### ► Table Properties - 1



- A table has a **distinct name** from all other tables in the database.
- There are **no duplicate rows**; each row is distinct.
- Entries in **columns are atomic**. The table does not contain repeating groups or multivalued attributes.
- Entries are from **the same domain** based on their **data type** including:
  - number (numeric, integer, float, smallint,...)
  - character (string)
  - date
  - logical (true or false)

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## Slide 19

### ► Table Properties - 2



- Operations combining different data types are disallowed.
- Each attribute has a **distinct name**.
- The sequence of columns is insignificant.
- The sequence of rows is insignificant.

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## Slide 20

### ► Relation

A relation, also known as a table or file, is a **subset of the Cartesian product** of a list of domains characterized by a name.

| product.stock |            |          |
|---------------|------------|----------|
| store_id      | product_id | quantity |
| 1             | 1          | 27       |
| 2             | 1          | 5        |
| 3             | 1          | 6        |
| 4             | 1          | 23       |
| 5             | 1          | 22       |
| 6             | 1          | 0        |
| 7             | 1          | 8        |
| 8             | 1          | 0        |
| 9             | 1          | 11       |
| 10            | 1          | 15       |
| 11            | 1          | 8        |

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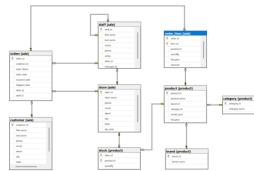
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## Slide 21

### ► What is Relational Data Model?



The relational data model describes the world as "a collection of **interrelated relations** (or tables)."



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## Slide 22



Let's look up Sample Retail DB

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## Slide 23



Entity Relationship  
Diagram



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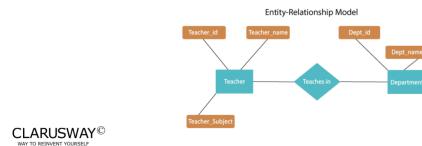
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## Slide 24

### ► Entity-Relationship Model

- ❖ An entity-relationship model (or ER model) describes interrelated things of interest in a specific domain of knowledge.
- ❖ A basic ER model is composed of **entity types** (which classify the things of interest) and specifies **relationships** that can exist between entities (instances of those entity types).



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## Slide 25

### ► Entity

An entity is **an object** in the real world with an independent existence that can be differentiated from other objects.

An entity might be:

- **physical existence** (e.g., a lecturer, a student, a car)
- **conceptual existence** (e.g., a course, a job, a position)



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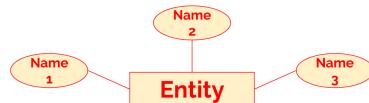
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## Slide 26

### ► Attributes



- Each entity is described by a set of attributes.
- Each attribute has a **name** and is associated with an entity and a **domain of legal values**.
- However, the information about attribute domain is not presented on the ERD.



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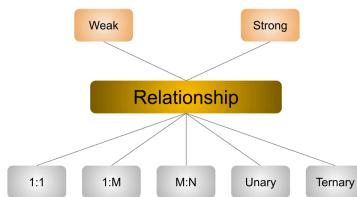
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## Slide 27

### ► Relationships



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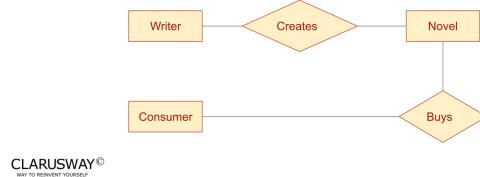
## Slide 28

### ►What is ER diagram?



An Entity Relationship Diagram (ERD) is a **visual representation of different entities** within a system and how they **relate to each other**.

For example, the elements **writer**, **novel**, and a **consumer** may be described using ER diagrams the following way:



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## Slide 29

### ►ERD Notations



The two of notations most widely used for creating Entity Relationship Diagrams are:

- ▶ Chen's notation
- ▶ Crow's foot notation

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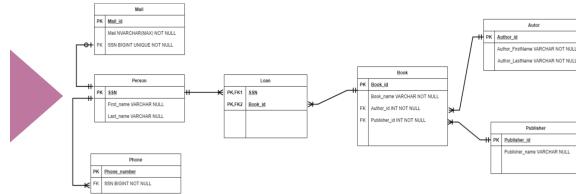


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## Slide 30



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## Slide 31

### ▶ How to Draw ER Diagrams

draw.io



- ◆ **Identify all the entities** in the system. An entity should appear only once in a particular diagram.
- ◆ **Identify relationships** between entities. Connect them using a line and add a diamond in the middle describing the relationship.
- ◆ **Add attributes** for entities. Give meaningful attribute names so they can be understood easily.

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- <http://draw.io/>
- 

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## Slide 32

### ► ER Diagram Best Practices



- ❖ Provide a **precise and appropriate name** for each entity, attribute, and relationship in the diagram. In naming entities, remember to use singular nouns.
- ❖ **Remove** vague, redundant or unnecessary relationships between entities.
- ❖ **Never connect** a relationship to another relationship.
- ❖ Make effective use of colors. You can use colors to classify similar entities or to highlight key areas in your diagrams.

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## Slide 33



Let's Explore  
The Diagram of the Sample Retail DB

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## Slide 34



### ▶ Data Types

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## Slide 35

### ▶ Data Types



- ▶ String
- ▶ Date and Time
- ▶ Numeric

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## Slide 36

### ► String Data Types



| Data Type             | Lower Limit | Upper Limit         | Memory                    |
|-----------------------|-------------|---------------------|---------------------------|
| <code>char</code>     | 0 chars     | 8000 chars          | n bytes                   |
| <code>varchar</code>  | 0 chars     | 8000 chars          | n bytes + 2 bytes         |
| <code>text</code>     | 0 chars     | 2,147,483,647 chars | n bytes + 4 bytes         |
| <code>nchar</code>    | 0 chars     | 4000 chars          | 2 times n bytes           |
| <code>nvarchar</code> | 0 chars     | 4000 chars          | 2 times n bytes + 2 bytes |
| <code>ntext</code>    | 0 chars     | 1,073,741,823 chars | 2 times the string length |

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## Slide 37

### ► Date and Time Data Types



| Data Type                   | Format  |
|-----------------------------|---|
| <code>time</code>           | <code>hh:mm:ss[.nnnnnnn]</code>                       |
| <code>date</code>           | <code>YYYY-MM-DD</code>                               |
| <code>smalldatetime</code>  | <code>YYYY-MM-DD hh:mm:ss[.nnnnnnn]</code>            |
| <code>datetime</code>       | <code>YYYY-MM-DD hh:mm:ss[.nnnnnnn]</code>            |
| <code>datetime2</code>      | <code>YYYY-MM-DD hh:mm:ss[.nnnnnnn]</code>            |
| <code>datetimeoffset</code> | <code>YYYY-MM-DD hh:mm:ss[.nnnnnnn] [+ -]hh:mm</code> |

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## Slide 38

### ► Numeric Data Types



| Data Type                         | Lower Limit                | Upper Limit               | Memory        |
|-----------------------------------|----------------------------|---------------------------|---------------|
| <b>Tinyint</b>                    | 0                          | 255                       | 1 bytes       |
| <b>Smallint</b>                   | -32,000                    | 32,000                    | 2 bytes       |
| <b>Int</b>                        | -2,000,000,000             | 2,000,000,000             | 4 bytes       |
| <b>BIGINT</b>                     | -9,223,372,036,854,775,808 | 9,223,372,036,854,775,808 | 8 bytes       |
| <b>Decimal (precision, scale)</b> | $-10^{38+1}$               | $10^{38+1}$               | 5 to 17 bytes |
| <b>Numeric (precision, scale)</b> | $-10^{38+1}$               | $10^{38+1}$               | 5 to 17 bytes |
| <b>Money</b>                      | -9,223,372,036,854,775,808 | 9,223,372,036,854,775,808 | 8 bytes       |
| <b>Smallmoney</b>                 | -214,478,3648              | 214,478,3648              | 4 bytes       |
| <b>Float</b>                      | 1 digit                    | 38 digits                 | 4 bytes       |

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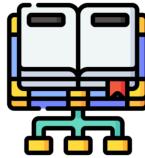
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## Slide 39



### ► Constraints



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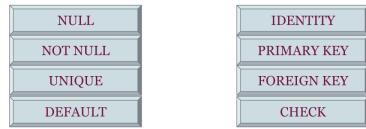
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## Slide 40

### ► Constraints



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## Slide 41

### ► Example



```
1 USE SW;
2 CREATE TABLE EMPLOYEES(
3     EmployeeNo CHAR(5) NOT NULL UNIQUE,
4     DepartmentName CHAR(30) NOT NULL DEFAULT "Human Resources",
5     FirstName CHAR(25) NOT NULL,
6     LastName CHAR(25) NOT NULL,
7     Category CHAR(25) NOT NULL,
8     HourlySalaried LOGICAL NOT NULL,
9     TimeCard LOGICAL NOT NULL,
10    HourlySalaried CHAR(1) NOT NULL,
11    EmpType CHAR(1) NOT NULL,
12    EmpGrade LOGICAL NOT NULL,
13    ExemptCode CHAR(2) NOT NULL,
14    Supervisor LOGICAL NOT NULL,
15    SupervisorName CHAR(50) NOT NULL,
16    BirthDate DATE NOT NULL,
17    CollegeDegree CHAR(5) NOT NULL,
18    CONSTRAINT Employee_PK PRIMARY KEY(EmployeeNo)
19 );
```

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## Slide 42

### ► NULL - NOT NULL



The column constraint **NULL** indicates that null values are allowed, which means that a row can be created without a value for this column.



The column constraint **NOT NULL** indicates that a value must be supplied when a new row is created.

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## Slide 43

### ► Example of NULL

Student

| Std_ID | First Name | Last Name | Email        |
|--------|------------|-----------|--------------|
| 1109   | John       | Price     | jp@gmail.com |
| 1401   | Bran       | NULL      | bw@gmail.com |
| 1756   |            | Natan     | cn@gmail.com |
| 1945   | Tom        | Black     | tb@gmail.com |
| 1987   | Nick       | Norris    | nn@gmail.com |

This is NOT NULL

This is NULL

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## Slide 44

### ► UNIQUE



The **UNIQUE** constraint prevents duplicate values from being entered into a column.



- ❖ Both **PK** and **UNIQUE** constraints are used to enforce entity integrity.
- ❖ Multiple **UNIQUE** constraints can be defined for a table.
- ❖ A **UNIQUE** constraint can be placed on columns that accept nulls. Only one row can be **NULL**.
- ❖ A **UNIQUE** constraint automatically creates a unique index on the selected column.



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## Slide 45

### ► DEFAULT



The **DEFAULT** constraint is used to supply a value that is automatically added for a column if the user does not supply one.



- ❖ A column can have only one **DEFAULT**.
- ❖ The **DEFAULT** constraint cannot be used on columns with a timestamp data type or identity property.
- ❖ **DEFAULT** constraints are automatically bound to a column when they are created.



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## Slide 46

### ► IDENTITY

IDENTITY [(seed, increment)]

CREATE TABLE tbl\_hotel (

hotel\_id INT IDENTITY (1,1),

... );

We can use the optional column constraint IDENTITY to provide a unique, incremental value for that column.

Often used with the IDENTITY constraints to serve as the unique row identifier for the table.

- ❖ Generates sequential numbers.
- ❖ Does not enforce entity integrity.
- ❖ Only one column can have the IDENTITY property.
- ❖ Must be defined as an integer, numeric or decimal data type.
- ❖ Cannot update a column with the IDENTITY property.
- ❖ Cannot contain NULL values.
- ❖ Cannot bind defaults and default constraints to the column.

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## Slide 47

### ► CHECK

The CHECK constraint restricts values that can be entered into a table.

- ❖ It can contain search conditions similar to a WHERE clause.
- ❖ It can reference columns in the same table.
- ❖ The data validation rule for a CHECK constraint must evaluate to a boolean expression.

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## Slide 48

### ► CHECK Constraints Example

```
1  GO
2  CREATE TABLE SALESREPS
3  (
4      Empl_num Int Not Null,
5      CHECK (Empl_num BETWEEN 101 and 199),
6      Name Varchar(15),
7      Age Int CHECK (Age >= 21),
8      Quota Money CHECK (Quota >= 0.0),
9      HireDate DateTime,
10     CONSTRAINT QuotaCap CHECK ((HireDate < "01-01-2004") OR (Quota <=300000))
11 );
```

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## Slide 49

### Keys Constraints



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## Slide 50

### ► Keys



- Keys are very important part of Relational data model. They are used to establish and identify relationships between tables and also to uniquely identify any record or row of data inside a table.
- A Key can be a single attribute or a group of attributes, where the combination may act as a key.
- There are several types of keys, such as **Candidate key**, **Super key**, **Composite key**, **Primary key (PK)**, **Secondary key**, **Alternate key** and **Foreign key (FK)**.



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## Slide 51

### ► Types of Keys - 1



- ❑ **Candidate key:** A candidate key is a simple or composite key that is unique and minimal. It is unique because no two rows in a table may have the same value at any time. It is minimal because every column is necessary in order to attain uniqueness.
- ❑ **Composite key:** A composite key is composed of two or more attributes.

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## Slide 52

### ► Types of Keys - 2

- **Primary key:** The primary key (PK) is a candidate key that is selected by the database designer to be used as an identifying mechanism for the whole entity set. It must **uniquely identify tuples in a table and not be null**. The primary key is indicated in the ER model by **underlining the attribute**.
- **Foreign key:** A foreign key (FK) is an attribute in a table that references the **primary key in another table**. Both foreign and primary keys must be of the same data type.

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## Slide 53

### ► PRIMARY KEY



A primary key is a column or a group of columns that uniquely identifies each row in a table. You create a primary key for a table by using the **PRIMARY KEY constraint**.



- ❖ In case the primary key has two or more columns, you must use the **PRIMARY KEY constraint** as a table constraint.
- ❖ Each table can contain only one primary key.
- ❖ SQL Server automatically sets the **NOT NULL constraint** for all the primary key columns.
- ❖ SQL Server also automatically creates a unique clustered index (or a non-clustered index if specified as such) when you create a primary key.

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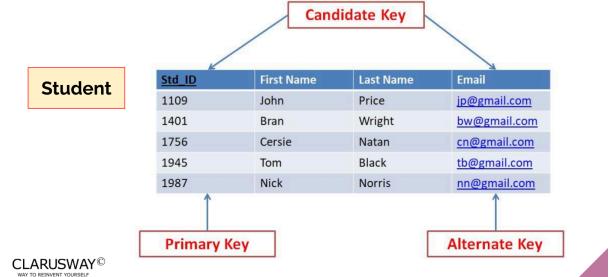
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## Slide 54

### ► Example of Keys - 1



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## Slide 55

### ► FOREIGN KEY

- The FOREIGN KEY (FK) constraint defines a column, or combination of columns, whose values match the PRIMARY KEY (PK) of another table.
- - ❖ Values in an FK are automatically updated when the PK values in the associated table are updated/changed.
  - ❖ FK constraints must reference PK or the UNIQUE constraint of another table.

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```
...  
CONSTRAINT constraint_name FOREIGN KEY (column_names)  
REFERENCES Parent_table name (column_name)  
ON UPDATE CASCADE  
ON DELETE CASCADE  
GO
```

55

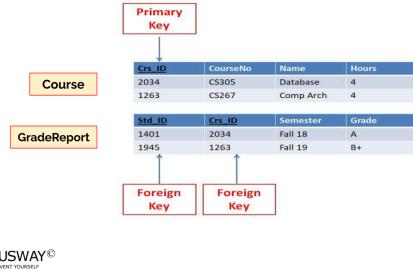
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## Slide 56

### ► Example of Keys - 2



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## Slide 57

### ► Foreign Key Rules



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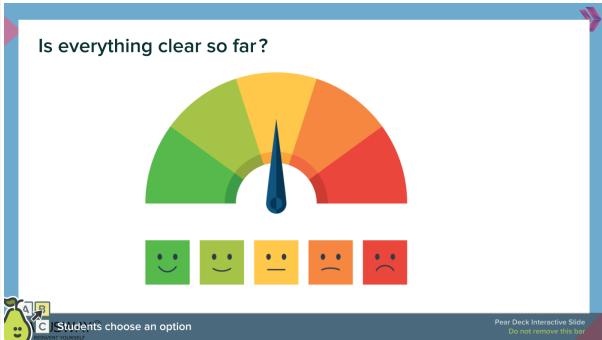
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## Slide 58

## Your Response



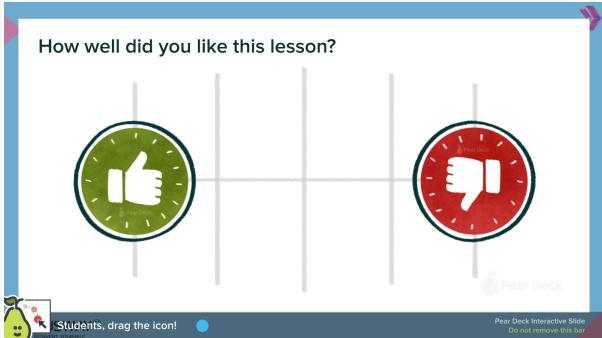
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## Slide 59

## Your Response



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# THANKS!

**Any questions?**

You can reach us at:

- ▶ @Owen



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