



**IE220**

# Introduction to Database Systems

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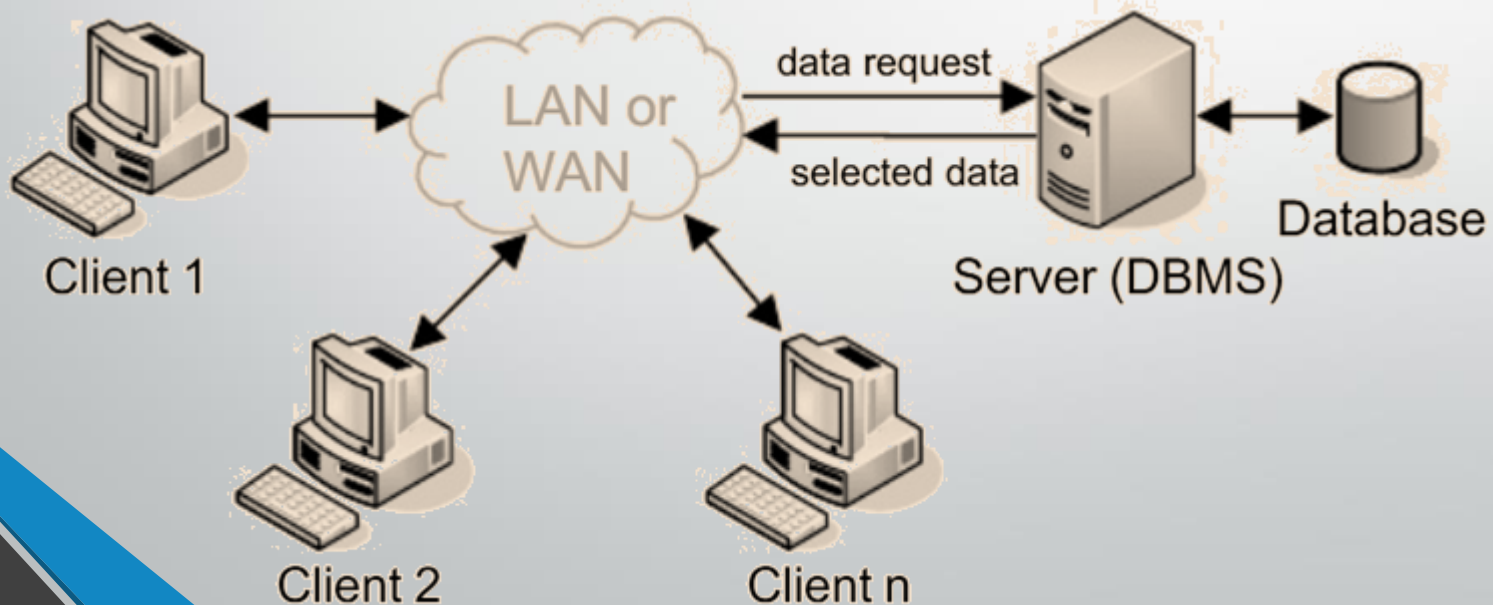
# Database Architecture

Data Model

Relational Database

# Database Architecture

- Old Database Architectures → *Mainframe*
- Today's Database Architectures → *Client-Server*



## Some Concepts

**Client:** Client is a computer that send a request to server to receive data or services.

**Server:** Server is a computer that responses to clients for wanted data or services by clients.

**LAN** Local Area Network

**WAN** Wide Area Network or Internet

# Why used databases?

- Easy to search data.
- Manage information in database.
- Save space.
- Easy to make maintenance.



# Entity-Relationship (E-R) Data Model

- **Entity-Relationship (E-R) data model** is the common technique used in database design. It captures the relationships between database tables and represent them in a graphical way. The relationships between two entities can be 1:1, 1:N, or M:N.
- **Entity:** Entity expresses a real-world thing or a concept. For example; an employee or a project which describes in mini-world, in a database.
- **Attribute:** Attribute is the property that defines an entity. For example; employee name or fee.
- **Relationship:** Relationship expresses the common point and unification between two entity. For example; relating an employee with a project.

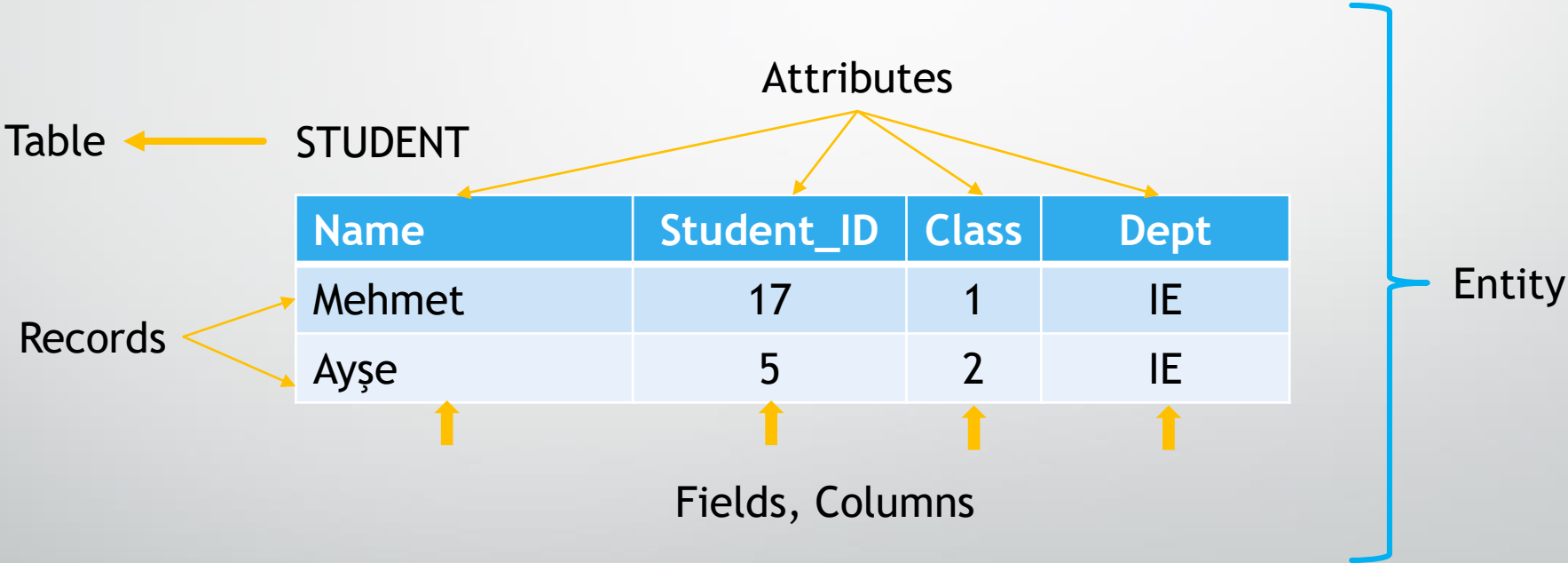


Entity

Attribute

Relationship

# Relational Data Model



# Relational Database Model

Relational model is a collection of relations on a database.

**SQL:** Structural Query Language

SQL-based DBMSs:

- MS SQL Server
- Oracle
- PostgreSQL
- MySQL
- Sybase SQL Server
- Informix
- ...

# Primary Key & Foreign Key

- **Primary Key:** Primary key is a unique field in a table for each record. It provides to separate the records from each other.



**Note:** The data defined in primary key field must not be same to each other!

- **Foreign Key, Secondary Key, Index:** Foreign key is a field to relate the records of other tables.





# Relational Database Design Rules (I)

- **We will create a miniworld virtually!**  
*Each of assets (persons, objects, processes) in the real world can be defined as an entity (table) in the database of virtual miniworld.*



# Relational Database Design Rules (II)

- Our aim is to create a database that is efficient and consumes minimal space of data area.
- So **any data should not repeat itself in the miniworld!** (exclude primary keys)
- In a table, the related fields with the other tables can be represented by selected from their primary key (index) fields.
- Representation by primary keys provide using dataspace efficiently.

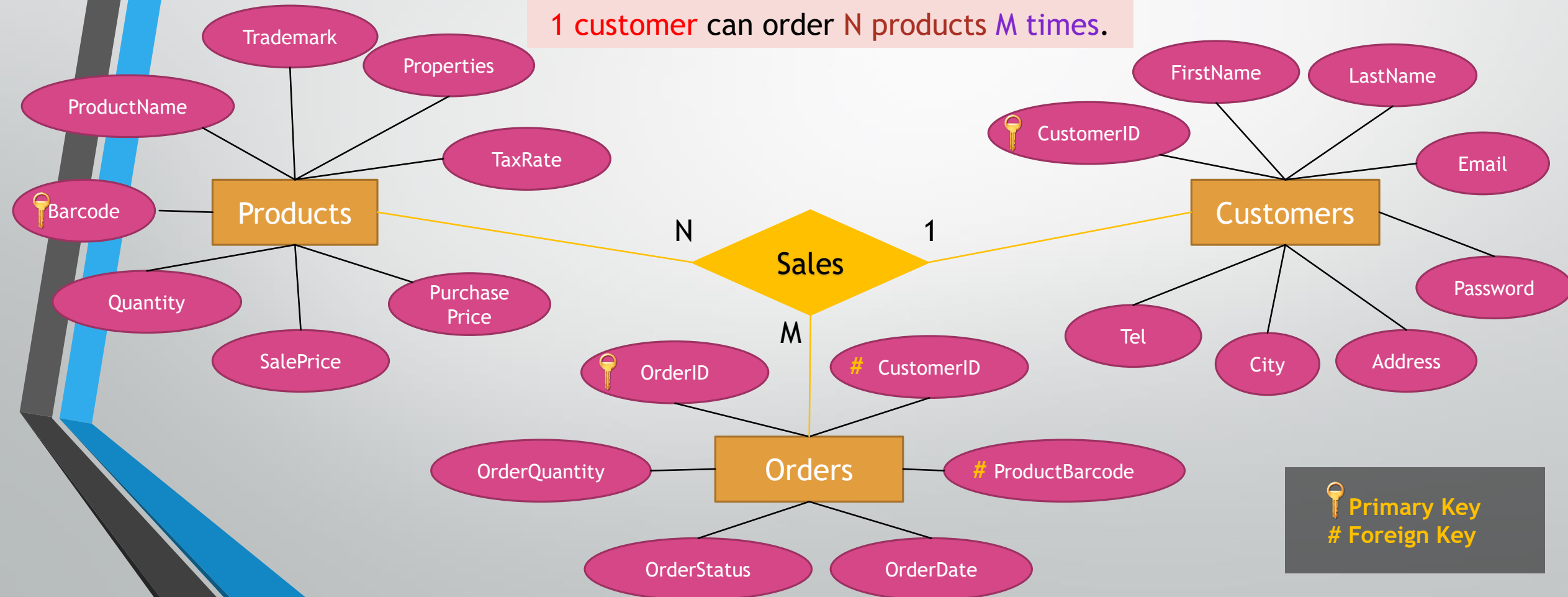


# A Relational Database Design Example: eMarketing Database

- **Problem:** A database design for a company that sells its products on Internet.
- First, we define entities in the database.
  - **Products;** Barcode, ProductName, TradeMark, Properties, TaxRate, PurchasePrice, SalePrice, Quantity
  - **Customers;** CustomerID, FirstName, LastName, eMail, Password, Adress, City, Tel
  - **Orders;** OrderID, CustomerID, ProductID, OrderDate, OrderStatus, OrderQuantity

# E-R Diagram of eMarketing Database

1 customer can order N products M times.



# Internal Structure of eMarketing Database

## Products

Barcode	ProductName	Trademark	Properties	TaxRate	PurchasePrice	SalePrice	Quantity
35126	Harddisk	Seagate	500 GB	%18	80,12	96,15	21
12525	Motherboard	Gigabyte	GA-Z170X-Gaming 3-EU	%18	201,15	250,83	12
18121	RAM	OEM	4 GB DDR	%18	50,22	75,91	30

🔑 Primary Key  
# Foreign Key

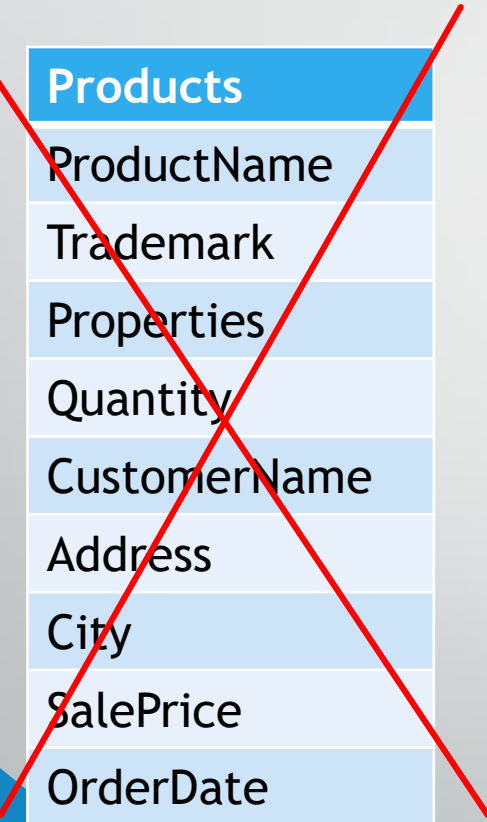
## Customers

CustomerID	FirstName	LastName	EMail	Password	Address	City	Tel
1	Ahmet	Akcan	akcan@abc.com	*****	Ak. Ün. Kampus	Antalya	02423212212
2	Hatice	Özay	hozay@xyz.com	*****	KYK Yurdu Kampus	Antalya	05333333333
3	Salih	Zafer	zafer@hotmail.com	****	Dumlupınar Bulvarı	Antalya	02423221112

## Orders

OrderID	#CustomerID	#ProductBarcode	OrderDate	OrderStatus	OrderQuantity
121	2	35126	22/09/2017	Teslim edildi	3
122	1	12525	30/09/2017	Kargoda	1

# Design of a Database - Mistakes



Products
ProductName
Trademark
Properties
Quantity
CustomerName
Address
City
SalePrice
OrderDate

**WRONG!**



Products
Barcode
ProductName
Properties
Quantity

Customers
CustomerID
CustomerName
Address
City

Orders
OrderID
ProductBarcode
CustomerID
SalePrice
OrderDate

**RIGHT!**

# Design of a Database - Mistakes

Products
Barcode
ProductName
Properties
Quantity
<del>OrderID</del>

**WRONG!**

If designed as above,  
a product can be sell  
only one time!!!

Orders
OrderID
ProductBarcode
CustomerID
SalePrice
OrderDate

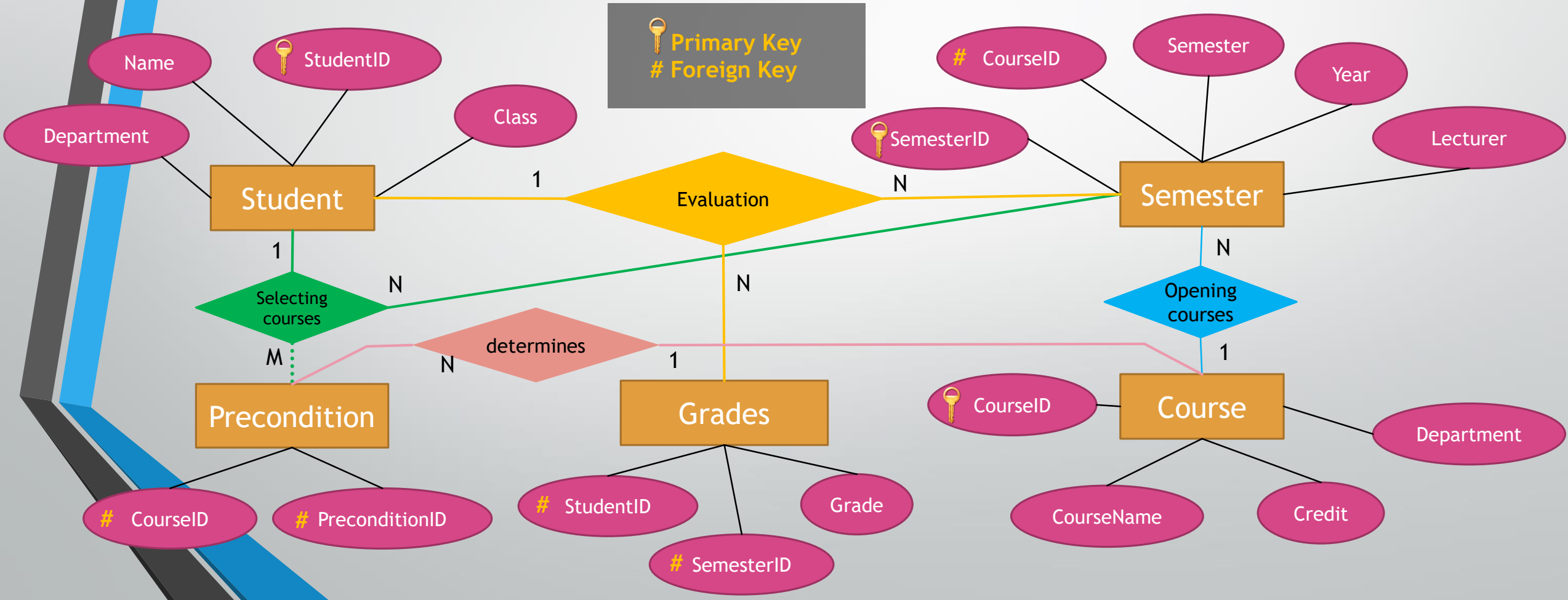
Customers
CustomerID
CustomerName
Address
City
<del>ProductID</del>

**WRONG!**

If designed as above,  
a customer can order  
only one time!!!

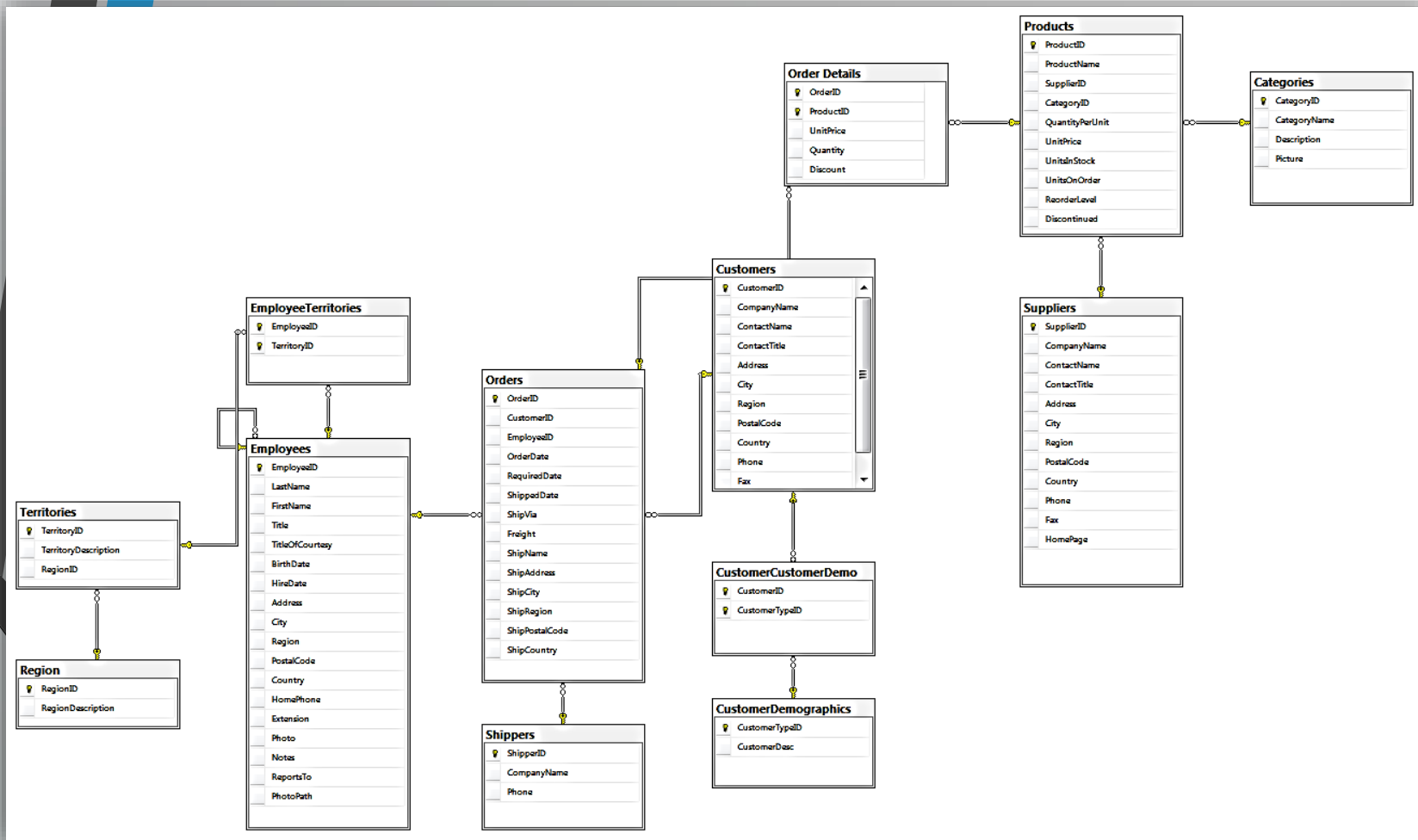


# E-R Diagram for the UNIVERSITY Database





# Database Schema Diagram



- Schema diagrams are the shapes that show entities, attributes and relationships in a database.

# Three-Layer Architecture

## Internal Layer

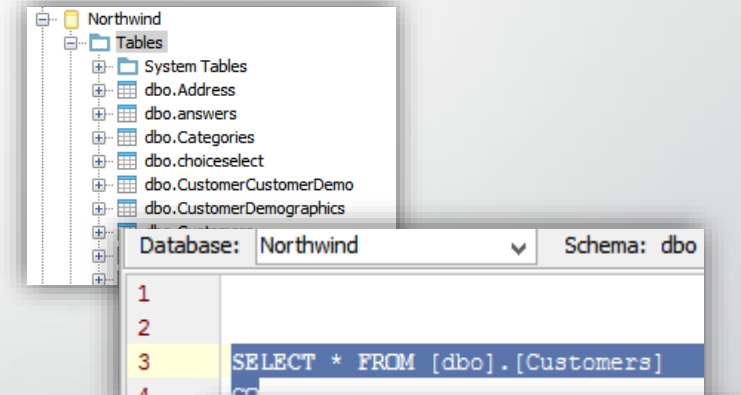
- It defines internal structure of a database.

## Conceptual Layer

- It is defines the data model of database. It also provide the with connection user and internal layer.

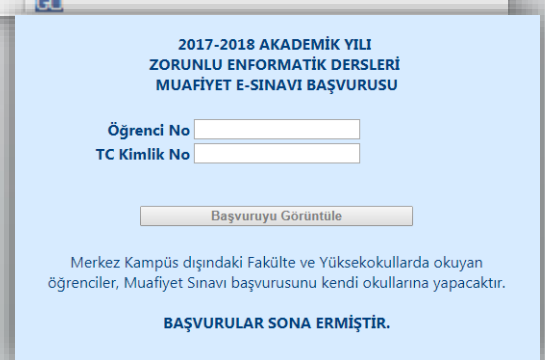
## External Layer

- It is a user-friendly interface of database.



The screenshot shows a SQL Server Enterprise Manager interface. On the left, a tree view displays the 'Northwind' database structure, including 'System Tables' and various tables like 'dbo.Address', 'dbo.answers', 'dbo.Categories', 'dbo.choiceselect', 'dbo.CustomerCustomerDemo', and 'dbo.CustomerDemographics'. On the right, a query window is open with the following text:

```
Database: Northwind Schema: dbo  
1  
2  
3 SELECT * FROM [dbo].[Customers]  
4 GO
```



The screenshot shows a web application interface for a university exam registration. The page title is '2017-2018 AKADEMİK YILI ZORUNLU ENFORMATİK DERSLERİ MUAFİYET E-SINAVI BAŞVURUSU'. It features two input fields for 'Öğrenci No' and 'TC Kimlik No', followed by a 'Başvuruyu Görüntüle' button. Below the button, there is a message: 'Merkez Kampüs dışındaki Fakülte ve Yüksekokullarda okuyan öğrenciler, Muafiyet Sınavı başvurusunu kendi okullarına yapacaktır.' and a bold statement: 'BAŞVURULAR SONA ERMİŞTİR.'

# Database Design Problems

- A database for a library to perform borrowing/lending of books process.
- A database for a pharmacy to sell medicines.
- A database for a bus company to sell ticket.