









# Database principles & DBMS

## Lecture 2

Dr Safaa Ghoneim



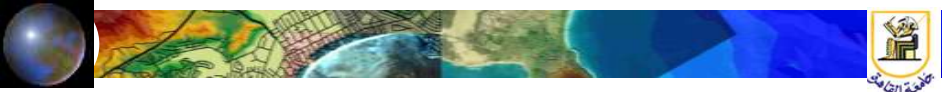


## Table

Column / Field

	Attribute	Attribute	Attribute
Row	Record	Value	Value
	Record	Value	Value
	Record	Value	Value

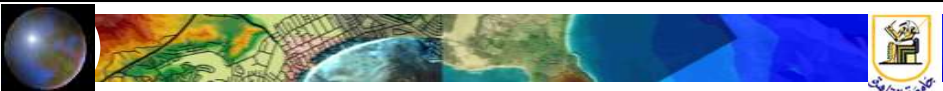
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## Definitions

- ✦ Database "DB":  
An integrated set of attributes on a particular subject

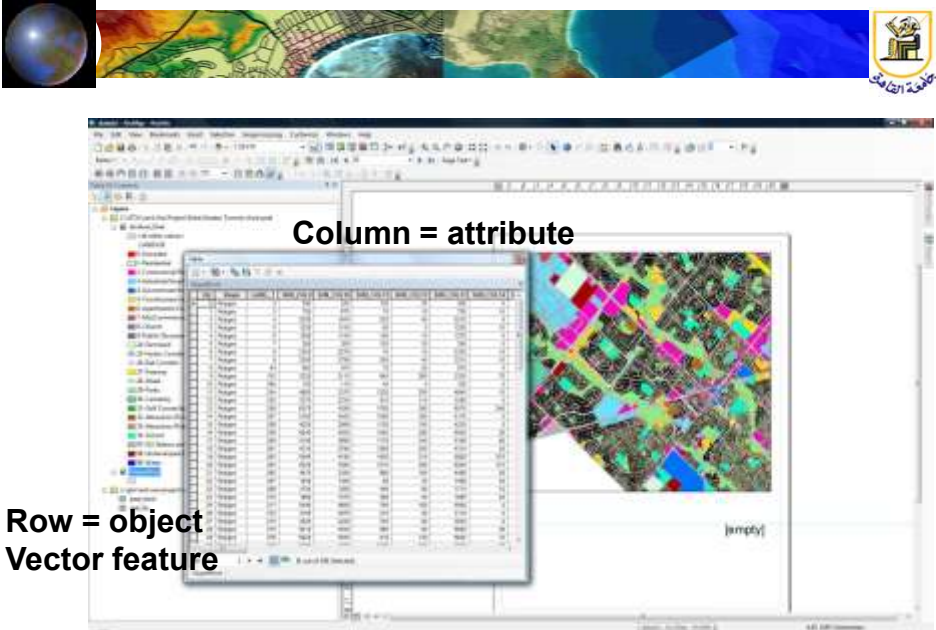
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## Definitions

- ✦ Geographic /spatial database:  
Set of attributes on a particular subject for a *particular geographic area*

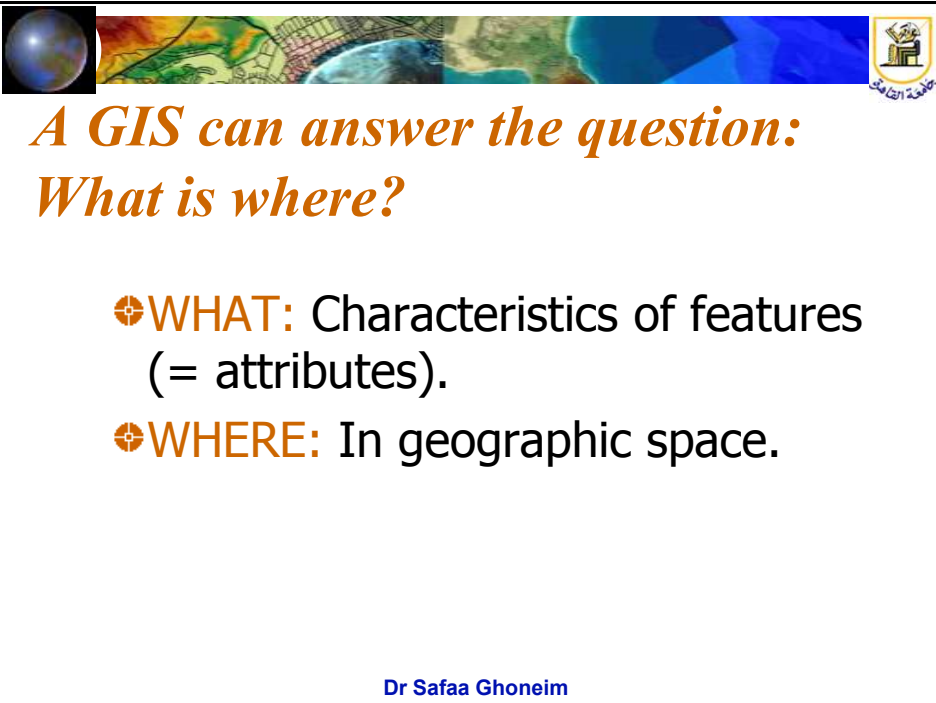
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**Column = attribute**

**Row = object  
Vector feature**

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*A GIS can answer the question:  
What is where?*

- ⊕ **WHAT:** Characteristics of features (= attributes).
- ⊕ **WHERE:** In geographic space.

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data types, structures and  
constraints, data capture -  
entry/validation



## Spatial Data Types

- ✦ *continuous*: elevation, rainfall, ocean salinity
- ✦ *areas*:
  - ❑ *unbounded*: landuse, market areas, soils, rock type
  - ❑ *bounded*: city/county/state boundaries, ownership parcels, zoning
  - ❑ *moving*: air masses, animal herds, schools of fish
- ✦ *networks*: roads, transmission lines, streams
- ✦ *points*:
  - ❑ *fixed*: wells, street lamps, addresses
  - ❑ *moving*: cars, fish, deer

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## Attribute data types

<h3>Categorical (name):</h3> <ul style="list-style-type: none"> <li>❖ nominal           <ul style="list-style-type: none"> <li>• no inherent ordering</li> <li>• land use types, county names</li> </ul> </li> <li>❖ ordinal           <ul style="list-style-type: none"> <li>• inherent order</li> <li>• road class; stream class</li> </ul> </li> <li>⊕ often coded to numbers eg SSN but can't do arithmetic</li> </ul>	<h3>Numerical</h3> <p style="text-align: center;">Known difference between values</p> <ul style="list-style-type: none"> <li>❖ interval           <ul style="list-style-type: none"> <li>• No natural zero</li> <li>• can't say 'twice as much'</li> <li>• temperature (Celsius or Fahrenheit)</li> </ul> </li> <li>❖ ratio           <ul style="list-style-type: none"> <li>• natural zero</li> <li>• ratios make sense (e.g. twice as much)</li> <li>• income, age, rainfall</li> </ul> </li> <li>⊕ may be expressed as <i>integer</i> [whole number] or <i>floating point</i> [decimal fraction]</li> </ul>
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Attribute data tables can contain locational information, such as addresses or a list of X,Y coordinates. ArcView refers to these as *event tables*. However, these must be converted to true spatial data (shape file), for example by geocoding, before they can be displayed as a map.

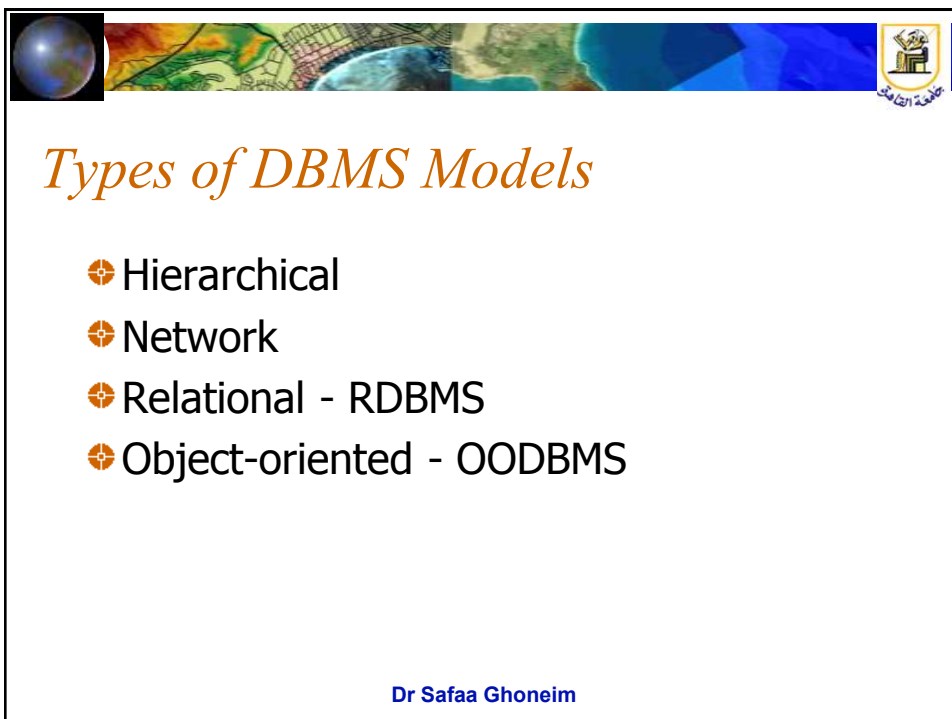
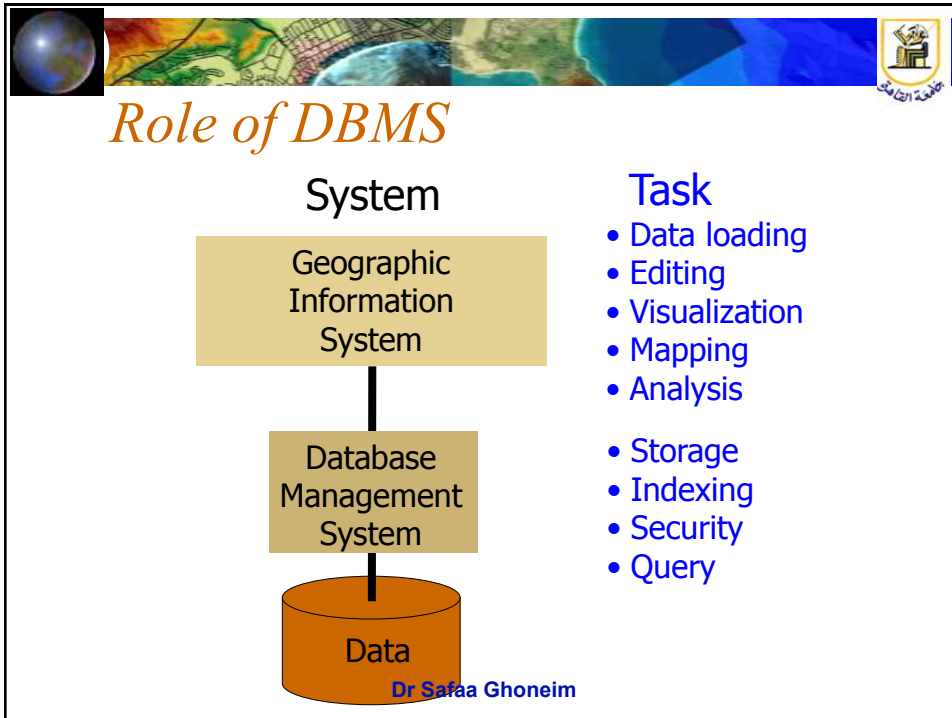
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## Definitions

- ⊕ Database Management System "DBMS"  
Software to create, maintain and access databases

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*Historically, databases were structured hierarchically in flat files*

```

graph TD
    University[University] --> Arts[Arts Division]
    University --> Science[Science Division]
    University --> Humanities[Humanities Division]
    Science --> Physics[Physics]
    Science --> Engineering[Engineering Department]
    Science --> Geography[Geography]
    Geography --> Names["John Smith  
Jane Doe  
Henry Jones  
Janet Roberts"]
    
```

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*Database types - hierarchical (ii)*

**COUNTRY (USA)**

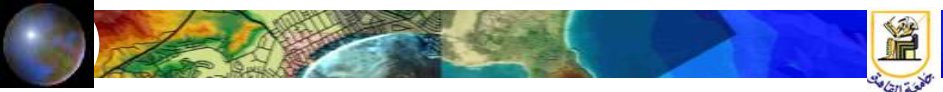
States

Counties

Boundaries

Nodes


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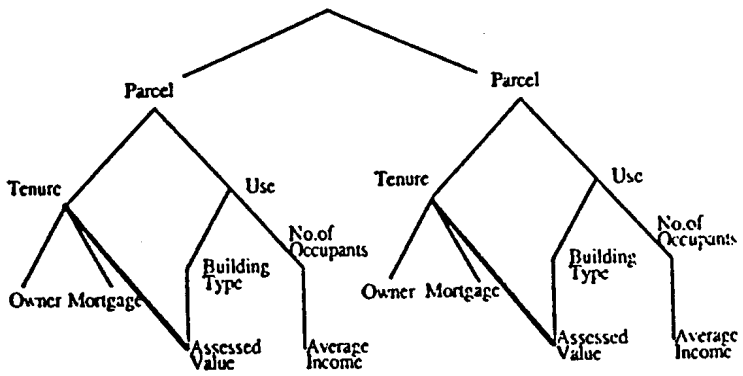
## Database types - network

- ❑ similar to hierarchical but have multiple connections between files to accommodate many to many (M:M) relationships
- ❑ access to a particular file without searching the entire hierarchy above that file
- ❑ linked records ... quick preset searches ... large overhead in pointer management
- ❑ modification after creation difficult

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## Database types - network (ii)



**NETWORK STRUCTURE**

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*Database types - relational*

SOIL-ID	AREA	TYPE	SYM
1	45.6	23	12
2	139.5	20	4
3	50.8	14	19
4	104.3	12	21
5	92.6	21	7

TYPE	SUIT-ABILITY	STA-BILITY
12	Hi	10
13	Med	7
14	Med	6
15	Med	7
20	Low	3
21	Low	1
22	Med	5
23	Low	2
24	Hi	9

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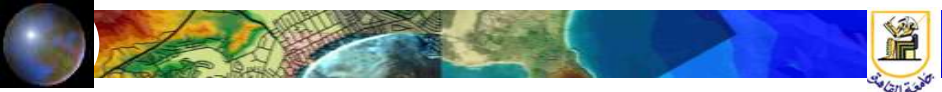
*Relational Databases rule now*

Patient Record			
Key	Check-in	Check Out	Room No.
42	2/1/98	2/4/98	N763
78			N712

Purchase Record				
Item	Date	Price	Customer	Key
Skate Board	2/1/98	49.95	John Smith	42
Baseball Bat	2/1/98	17.99	James Brown	78

Accident Report				
Date	Injury	Name	Key	Location
2/1/98	Broken Leg	John Smith	42	75 Elm Street
2/2/98	Concussion	Sylvia Jones	654	12 State Street
2/2/98	Cut on Ear	Robert Doe	123	2323 Broad Street

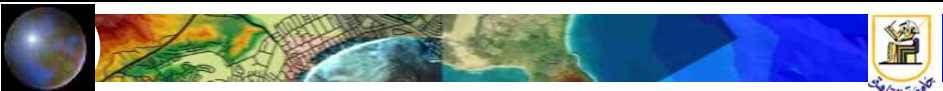
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## *Relational DBMS*

- ✦ Most popular type of DBMS
  - ▣ Over 95% of data in DBMS is in RDBMS
- ✦ Commercial systems
  - ▣ Microsoft Access
  - ▣ Microsoft SQL Server
  - ▣ Oracle
  - ▣ IBM DB2
  - ▣ Informix
  - ▣ Sybase

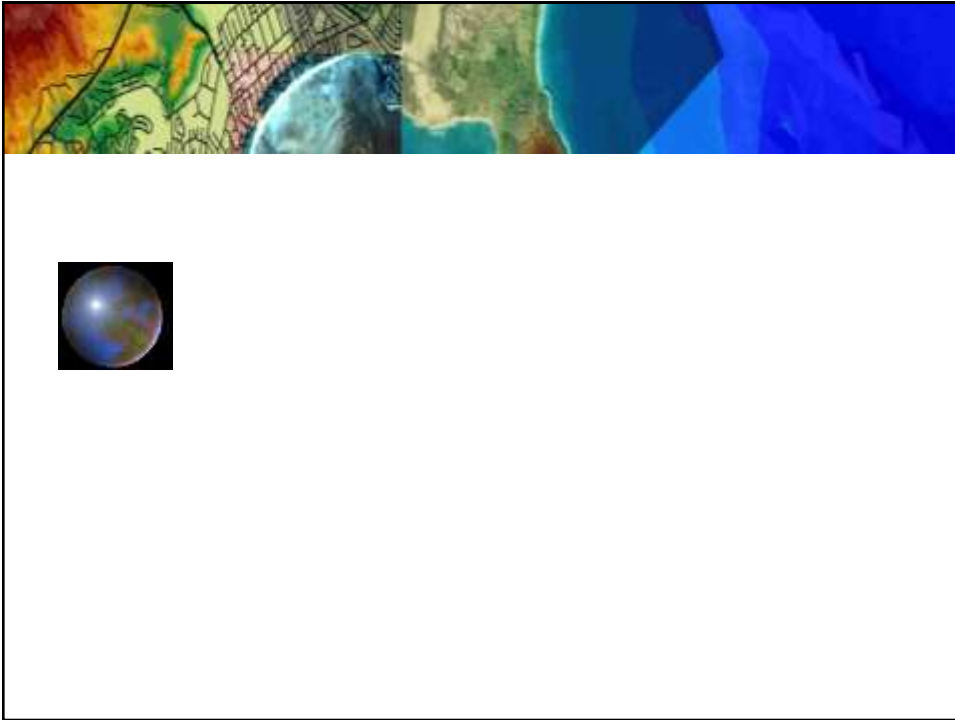
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## *Types of DBMS Models*

- ✦ Hierarchical
- ✦ Network
- ✦ Relational - RDBMS
- ✦ Object-oriented - OODBMS

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### *Centralised vs distributed*

- ❖ a database does not necessarily mean a centralised arrangement i.e. all data in one physical place

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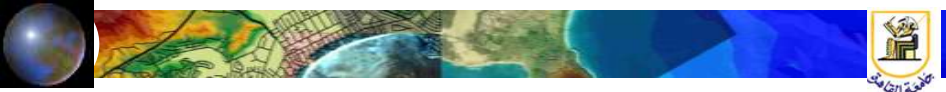
## *Design and develop DB*



### *Databases ... objectives/advantages*

1. Standardisation of data aspects
2. Reduced duplication
3. Multiple access / retrieval flexibility
4. validation enforced
5. Security ..


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### *Data function matrix ...an example*

DATA	FUNCTION						
	Land Use Planning	Land Devel. Mgmt.	Building Permit Mgmt.	Address Management	Assessment	Roadway Mgmt.	Transportation Planning
Master plan	C	U					U
Land use zone	C	U					
Land development		C					
Subdivision	U	C					
Building permit	U		C				
Address			C*	C*	C*		
Assessor parcel	U	U	U		C		U
Parcel ownership	U	U	U		C		
Street	U	U		U		C	U
Traffic survey						U	C
Transportation plan	U	U				U	C

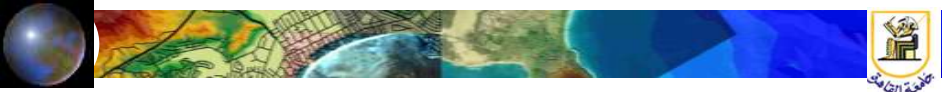
Dr Safaa Ghoneim      C = create      U = use



### *Database... stages of development*

1. Plan For Project
2. Needs Analysis...System Specification
3. Database Design... Physical Design
4. Implementation
5. Monitoring/Audit

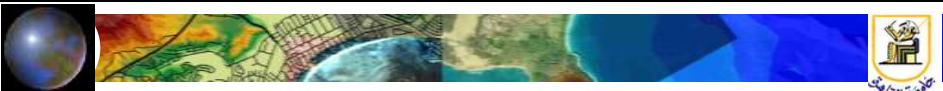
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## 2. Define entities and their relationships

- ❏ entities: distinguishable objects which have a common set of properties
  - identify and describe entities
  - identify and describe the relationship among these entities
  - document the process
    - diagrams
    - data dictionary
  - Normalise the data

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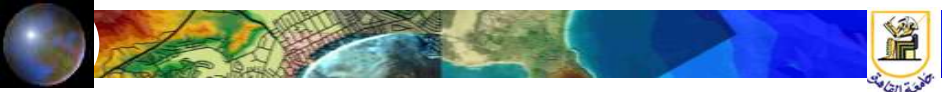


## Entity/relationship definition

**Entity Definition**

<b>Entity name:</b>	Building
<b>Definition:</b>	A structure with roof and walls having a designated use.
<b>Unique identifier:</b>	BldgId
<b>Attributes:</b>	BldgId BldgType Area YearConstr

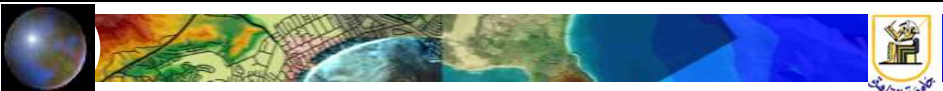
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### 3. Identify representation of entities

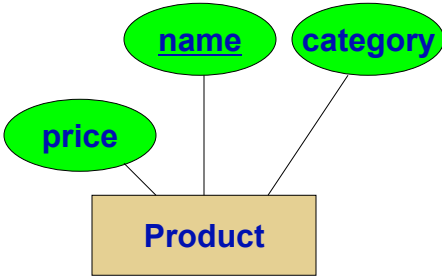
- ❏ determine the most effective spatial representation for geographic features
- ❏ consider whether:
  - a feature might be represented on a map
  - the shape of a feature might be significant in performing geographic analysis
  - the feature will have different representations and different map scales
  - textual attributes of the feature will be displayed on map products
  - ...

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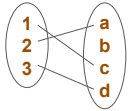
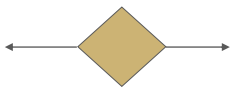
### Keys in E/R Diagrams

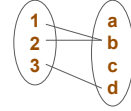
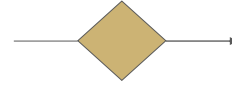
✦ Every entity set must have a key

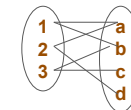
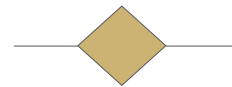


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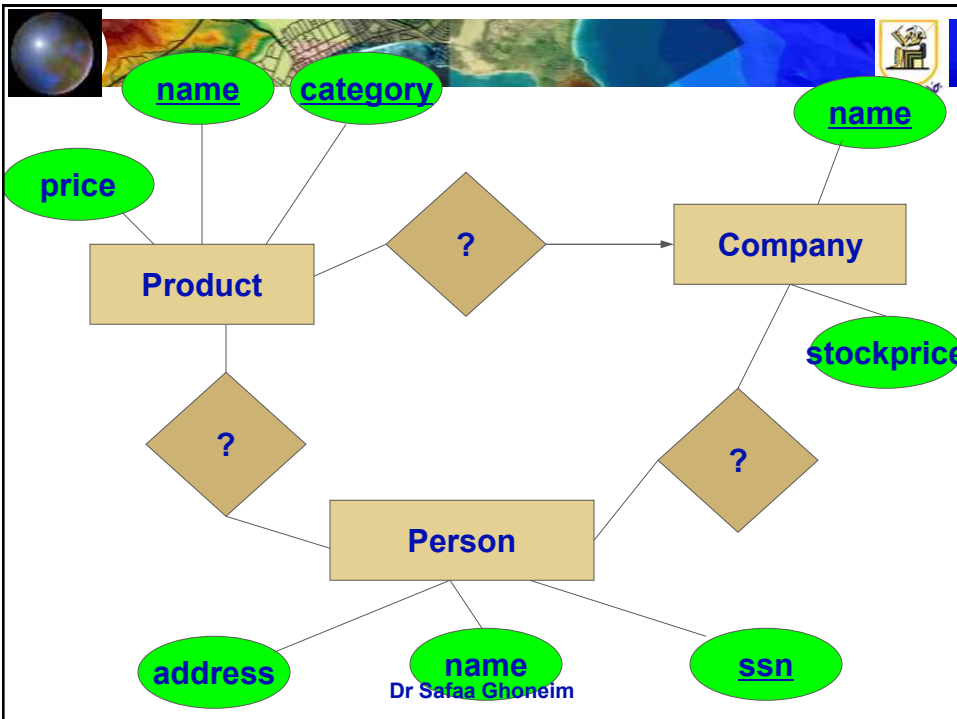
Relations

one-one: 


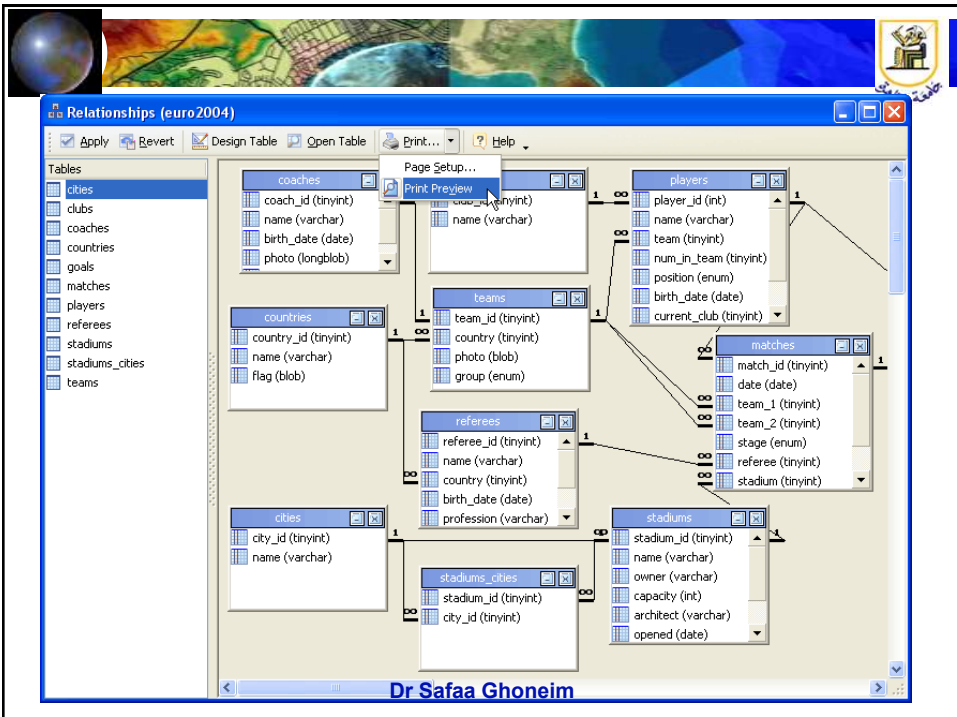
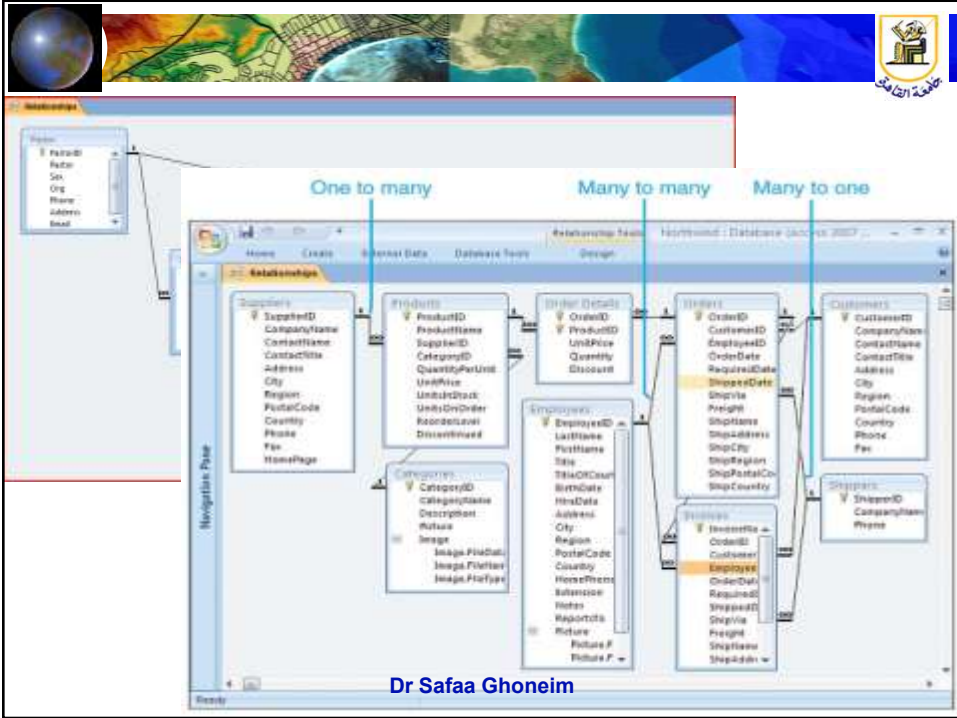
many-one: 


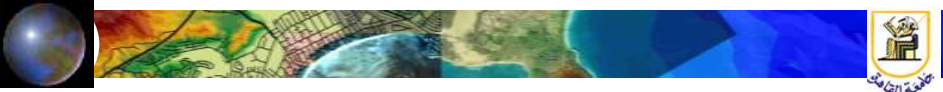
many-many: 


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**Project work**

- ✦ Aim & outputs of the project
- ✦ Flowchart of the project stages
- ✦ Database needs analysis (users & needs)
- ✦ Spatial data layers
- ✦ Data function (data / use)
- ✦ Entity definitions
- ✦ E/R diagram
- ✦ Data types (attributes)
- ✦ Data constraints & validation