CH2: Database Systeme Concept and Architecture

→ Data Models

- Aset of concepts to describe the structure of a DB
- and operation for manipulation these structures
- and certains constraints that the DB should obey
- Hides details of data storage

مجموعة من المفاهيم تستخدم لوصف هيكل او DB بالإضافة إلى العمليات للتعديل على هذه الهياكل و بعض القيود التي يجب أن تطبق على او DB و هنا مع إخفاء تفاصيل تخزين البيانات.

DB structure: data type, relationships and constraint.

→ Categories of Data Models

↳ Conceptual (hight level, semantic) data models:

. Describe the structure and constraints for the whole database for a community of users
. Also called entity-based or object-based data models

↳ Physical (low-level; internal) data models:

. Provide concepts that describe details of how data is stored in the computer

↳ Implemtation (represential) data models

. Between hight-level and low level models
. Provide concepts that may be easily understood by end users but that are not too far removed from the way data is organized in computer storage
ex: relational data models used in many commerical systemes.

→ Schemas, Instances, and Database State.

- In any data model, it's important to distinguish between the description of DB and the DB itself
- The description of DB is called DB schema. (description of DB structure, data types, and the constrains)
- Data models represent database schema as diagrams, called Schema Diagram
- The diagram displays the structure of each record type but not the actual instances of records.
يحدد الـ diagram بناء الجداول لكن لا يذكر البيانات الفعلية.
- We call each object in the schema - such as STUDENT or COURSE - a schema construct

↳ Example of Database schema.

STUDENT

Name	Student_nb	Class	Major

COURSE

Course_name	Course_nb	credit_hour	Department

PREREQUISITE

Course_nb	Prerequisite_nb

SECTION

Section_id	Course_nb	Semester	Year	Instructor

GRADE REPORTS

Student_nb	Section_id	Grade

"Shema Diagram"

. The actual data in a database may change quite frequently (add new student, enter a new grade ...)
. The data in the data base at a particular moment in time is called a data base state (snapshot)
. It's also called the current set of occurence or instances in the database

→ Distinctions
. The database schema change very infrequently
. The database state change every time the DB is updated
. Shcema is also called intension
. State is also called extension

→ ER Model Concepts
. It's an conceptual data model
. ERmodel stands for an Entity - Relationship Model
. It also develops a very simple and easy design to view data
. It's a diagram that presente entities and the relations between these entities.
هو نموذج مفاهيمي مبسط يستخدم لتمثيل البيانات التي تحتفظ بيانات في قاعدة البيانات و العلاقة التي تربط بين هذه الكيانات المختلفة

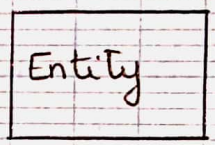
. The ER Model include:
↳ Entities: specific persons, places, event, objects
↳ Attributes: properties used to describe an entity
↳ Relationships: relate two or more entities with a specific meaning

- The questions to ask:
  - What are the entities (objects) in the organization?
  - Wich relationships exist among the entities?
  - What information (attributes) do we want to stored about these entities and relationships
  - What are business rules of the organization?
  - Wich integrity constraints do arise from them?

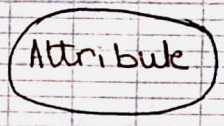
  => The answers are represented in an ER diagram

- Basic forms in ER diagram

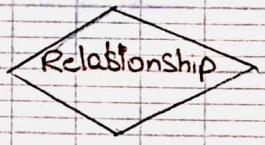
  ↳ Entity: rectangle



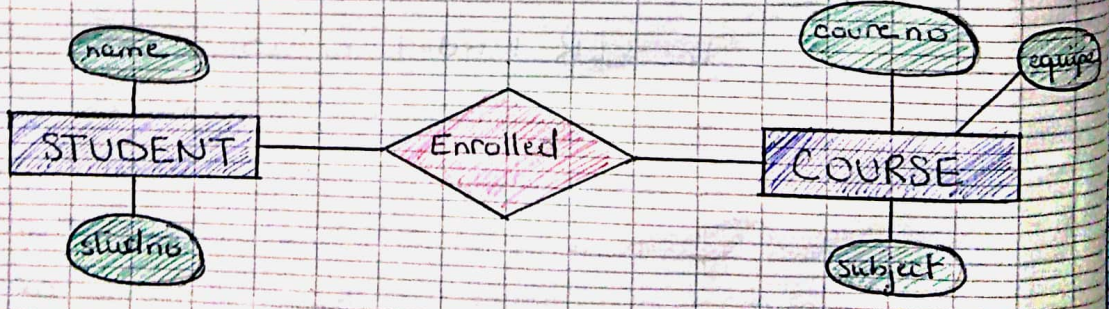
  ↳ Attribute: oval



  ↳ Relationship: Diamond



Exemple of a simple ER diagram.



→ Types of Attributes

1. Simple vs Composite Attribute

↳ Simple Attribute

Each entity has a single atomic value for the attribute.

ex: ID, Sexe, Color, Weight

هو Attribute له قيمة واحدة بدون تفاصيل.

Simple attribute

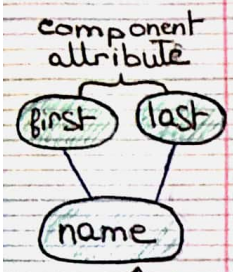
↳ Composite Attribute

The attribute may be composed of several components

ex: Address (Street, city, State, Zipcode, Contry)

Name (First Name, Midde Name, Last Name)

هو Attribute يتكون من Attributes أخرى ويمكن إستخراج عدة تفاصيل من قيمته



Composite attribute

2. Single valued vs Multivalued Attributes.

↳ Single valued Attribute

An attribute that have only one value for a given entity instance (or relationship)

لا يحمل سوى قيمة واحدة

Single valued attribute

↳ Multivalued Attribute

An attribute that may take on more than one value for a given entity instance (or relationship)

يمكن أن يحمل أكثر من قيمة.

multivalued attribute

3. Stored vs Derived Attributes

↳ Stored Attribute

يتم طلب قيمته من المستخدم لتخزينها في قاعدة البيانات

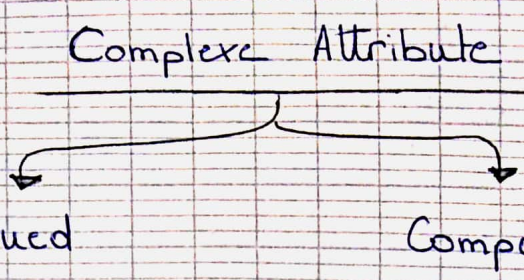
stored attribute

↳ Derived attribute

يمكن إستنتاجه من خلال قيم أخرى

Derived attribute

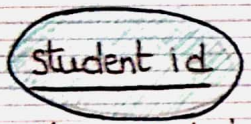
4. Complexe Attribute



ex: phone .

5. Primary Key / Identifier Attribute

. A Key is an attribute whose value distinguishes individual instances of an entity . That is, no two instance of the entity may have the same value of the Key / identifier attribute.



Key attribute

Attribute لـ قيمة مميزة لكل فرد لا تتكرر بين instance وأخرى

. An Entity may have more than Key or may not have any Key (weak Entity)

. A Composite Key is a Key that consists of a composite attribute

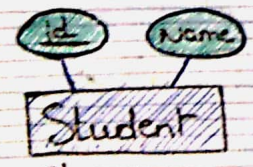
إذا كان هذا الـ attr ينتمي إلى weak entity يسمى discriminator

→ Type of Entities

↳ Strong or idenpendent entity :

. An entity that exists independently of other entity types

. A strong entity always have a Key attribute



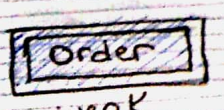
Strong entity

primary Key لا يعتمد وجودها على وجود Entity أخرى، عندها

↳ Weak or dependent entity

. An entity whose exists depend on other entity

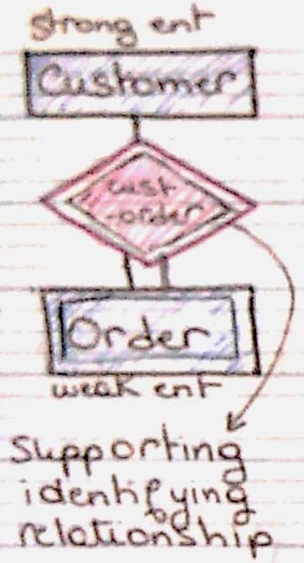
. Don't have a Key attribute (Partial Key)



weak entity

هو Entity ليس له Key و يكون وجوده مرتبط بوجود Entity أخرى

يسمى بالـ identifying entity بحيث إذا غابت الـ id entity تلغى الـ weak entity.



* العلاقة بين الـ identifying entity و الـ weakEntity
تسمى بالـ Supporting identifying relation

↳ Association Entity

. An associative entity is an entity that represents a relationship type .

هي RIt تحولت إلى Entity عندها Attributes تخص العلاقة
بين Entities

→ Relationships and Relationship Types

. A relationship is an association between two or more entities

العلاقة بين إثنان أو أكثر Entities.

. Relationships can have attributes

. A relationship is an association representing an interaction among the instances of one or more entity .

العلاقة تمثل التفاعل بين instances الذين ينتمون إلى entity واحد أو أكثر

↳ Degree of relationship

. The degree of relationship is the number of entity that participate in that relationship.

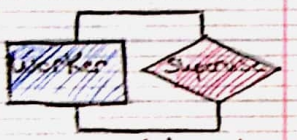
هو عدد الـ entities المشتركين في هذه العلاقة.

. There are 3 commons relationship degrees in E/R model

1. Unary relationship (Recursive)

A relation between instances of a single entity

مثل: موظف معين يشرف على باقي الموظفين.

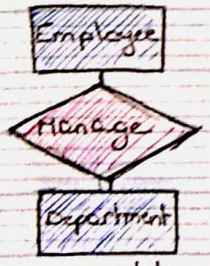


Unary relationship

2. Binary relationship (ثنائية)

A relationship between instances of two entities

مثل: "موظف" يدير "قسم".

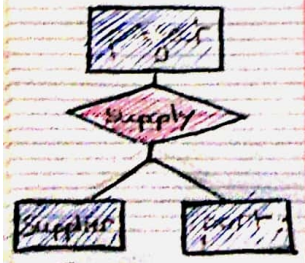


Binary relationship

3. Ternary relationship (ثلاثية)

A relationship between instances of three entities

مثل: المورد يورد قطعة الغيار للمشروع



Ternary relationship

Cardinality of Relationships

في العلاقة بين 2 entities أو أكثر الطرف الذي يمكنه التفاعل مع كم واحد من الطرف الثاني؟

1. One-to-one

Each entity in the relationship will have exactly one related entity

- القسم يديره موظف واحد
- الموظف لا يدير إلا قسم واحد

2. One-to-many (1:N / 1:m)

An entity on one side of the relationship can have many related entities, but on the other side the entity will have a maximum of one related entity

- القسم يدير عدة مشاريع
- المشروع يديره قسم واحد

3. Many-to-many

Entities on both sides of the relationship can have many related entities on the other side

- الموظف يعمل في عدة مشاريع
- المشروع يعمل فيه عدة موظفين

Participation Constraints

1. Total participation (min = 1)

Every instance of an entity must participate in a relationship with another entity. (double line)

ليس بالضرورة أن كل الموظفين يريدون القيام بأي قسم. كل قسم يجب أن يكون له موظف يديره

2. Partial participation (min = 0)

An Entity may or may not have a relationship (single line)

Alternative (min, max) notation

1. Minimum Cardinality

   The minimum number of instances of one entity that may be associated with each instance of another entity

2. Maximum Cardinality

   The maximum number of instances of one entity that may be associated with each instance of another entity

- لكل موظف الحق في تسجيل أربعة تابعين له في خدمة التأمين الصحي في الشركة