



Information System Management

Chapter Five – Part 2: Database Design

is the heart of any IS

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改善

Database Application Systems

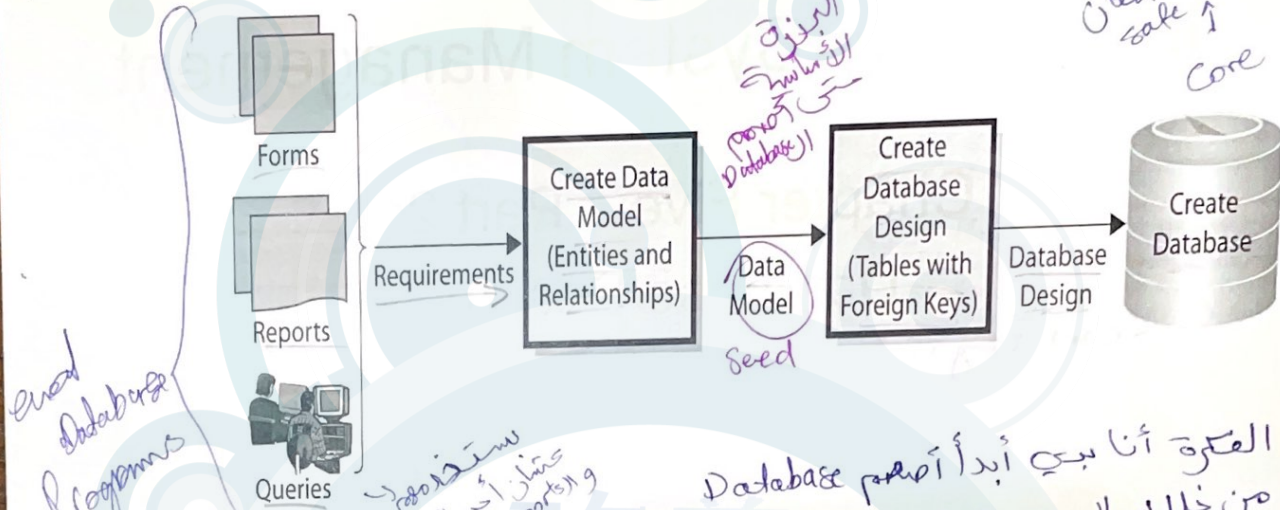
Access to data is the heart of any IS
Database Management System
Database
المستخدم
المستخدم يتعامل معها عن طريق
المستخدم يتعامل معها عن طريق

- Database application consists of:
 - Forms
 - Reports
 - Queries
 - Application programs

قدي الحارس
model

How Are Systems Developed?

موجودة مكان
scale ↑
Core



البنية الأساسية
Data Model
Seed

end Database
Programs
or
Applications

استخدموا
Forms أو Reports أو Queries
Node end
Administered
Info

الفكرة أنا بيبدأ أصمم Database
من خلال ال Forms أو Reports أو Queries

مبنياً ومستعمل أصمم Database
رأساً

Database Application System Development Process

Requirements → Datastructure → Data model → Database
منه
عن ال DP إلى أنشأنا بـ Ch. 2

- Developers interview users
- Develop requirements for new system
 - Analyze existing reports, forms, and user activities
- Requirements summarized in data model
 - Logical representation of structure of data
 - Contains description of data and relationships
- Users validate and approve model
- Design implemented in a database
 - Database filled with user data

على ال DP ما
عن ال DP إلى أنشأنا بـ Ch. 2

لاستعمل ال Database
doesn't only consist
metadata of data.

Also consists of relations
الأول Relational databases.

So I want to make a logical rep on the structure of data.

الخطوة
الأساسية
بدي
Req
إذا قريت
المفروقات
أنشأنا
بعين
I approve the
model & start
filling my data.

يجر ما أعين ال Data إلى عني
عملية ال Database يتكون عملية
متواصلة ويتكون Dynamic

Database

↓
of banks, libraries, etc.

- Must include all data necessary for users to perform jobs
- Contains only that amount of data, and no more
- Developers rely on users to:
 - ✱ Tell them what to include
 - ✱ Check data model
 - ✱ Verify correctness and completeness

Database Design

- Process of converting data model
- ▪ Transforms entities into tables
- ▪ Expresses relationships
- ✱ ▪ Defines foreign keys → *WB will know what are foreign keys*
- ▪ Shows data constraints → *When do I ~~decide~~ the constraints at apply. I should always have data constraints.*

الشيء الإجباري، إنما يكون موجودة والشيء optional رح نحدد عملية ال Relations
والشيء entities رح نحولها (Tables)

THE PROBLEM

How can we describe the structure of this database to others?

EmailNum	Date	Message	Student Number
1	2/1/2007	For homework 1, do you want us to provide notes on our references?	1325
2	3/15/2007	My group consists of Swee Lau and Stuart Nelson.	1325
3	3/15/2007	Could you please assign me to a group?	1644

Student Number	Student Name	HW1	HW2	MidTerm
1325	BAKER, ANDREA	88	100	78
1644	LAU, SWEET	75	90	90
2881	NELSON, STUART	100	90	98
3007	FISCHER, MAYAN	95	100	74
3559	TAM, JEFFREY		100	88
4867	VERBERRA, ADAM	70	90	92
5265	VALDEZ, MARIE	80	90	85
8009	ROGERS, SHELLEY	95	100	98

VisitID	Date	Notes	Student Number
2	2/13/2007	Andrea had questions about using IS for raising barriers to entry.	1325
3	2/17/2007	Jeffrey is considering an IS major. Wanted to talk about career opportunities.	3559
4	2/17/2007	Will miss class Friday due to job conflict.	4867

لو بدي أبدأ أصمم Tables من خلال شكل ال Database إلى هندي رح يكون شكلها كالتالي ←

لحسب بدأ نشخ Structure لل Database من خلال Tables

أي Database بتفهم عدد لا يمكن

حقن من ال Tables فصيح جداً

تحول model عليه . أنا بحاجة لنشخ مريح بصرياً يختصر كل ال Data حاي

ويحدد طبيعة ال Data إلى تكون موجودة

1. Nature of the data
2. Types of data
3. Constraints of the data.
4. Relations

The metadata!

How can we describe the structure of this database to others?

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Structure ⇒ Metadata.

المعلومات هي ال Database

هي ال headers of the tables كبرق من Metadata.

THE PROBLEM

Using Text?

حل ممكن نستخرج
Text
to describe or model the database?

EMAIL (EmailNum, Date, Message, Student Number)

STUDENT (Student Number, Student Name, HW1, HW2, MidTerm)

OFFICE_VISIT (VisitID, Date, Notes, Student Number)

Has limitations:

- » Lacks relationships.
- » Lacks properties of attributes.
- » Hard to visualize.

Limitations

lack of

Using texts. lacks visualization
ERD will perform visualization

ERD → more than onetype
→ visualization
وبالتالي رح يكون شكل models

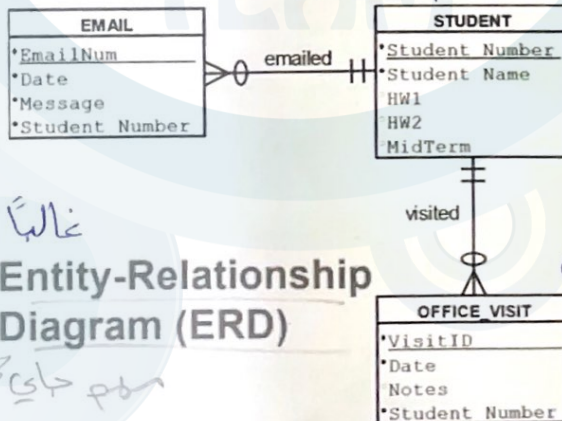
رح يشرح لي ال Entity
ايك مطلوبة مني
رح اعدد منه خلال
ال constraints
Data

visual
Representation
Database
Relations
والى عندي

THE PROBLEM

وكان رح يعطيني
ال data
ال neta
رح يشرح لي ال Entity
ايك مطلوبة مني
رح اعدد منه خلال
ال constraints
Data

Using a Diagram?



غالباً مستخدم

Entity-Relationship Diagram (ERD)

مهم حاي تحسّر على التفاصيل

في أكثر من Version

لل ERD إلى رح نستعمل
فون حي إلى
بطريقة التمثيل
عنا يراها لل Relations

طريقة التمثيل أو Diagram
أحياناً تسمى بـ جريد البنية
أو الشجرة

E-R DIAGRAM (ERD)

↓
Flow Chart
illustrates database's → Data model.

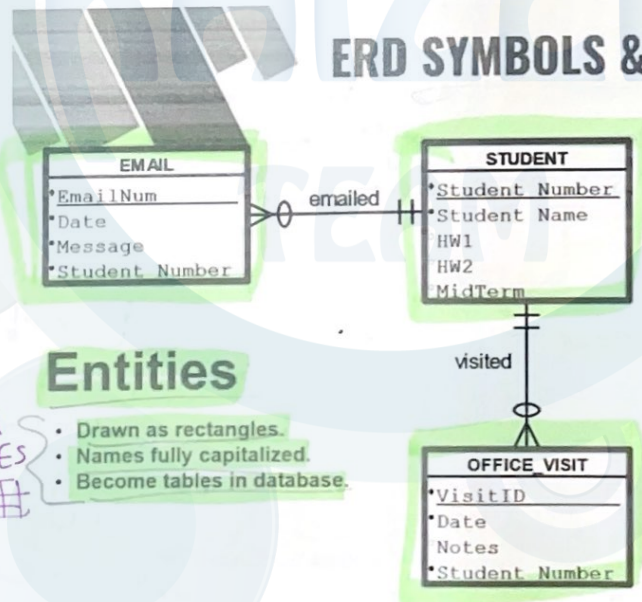
What is an E-R Diagram (ERD)?

↳ Shows:-
how entities are related to each other & what attributes they contain!

- ★ Type of flowchart that illustrates a database's data model.
- ★ Shows how entities are related to each other and the attributes they contain.
- ★ Used in database design as an initial step to represent the database in a system independent way.

الهيكلية
↳ Structure of data = entities + metadata

ERD SYMBOLS & NOTATIONS



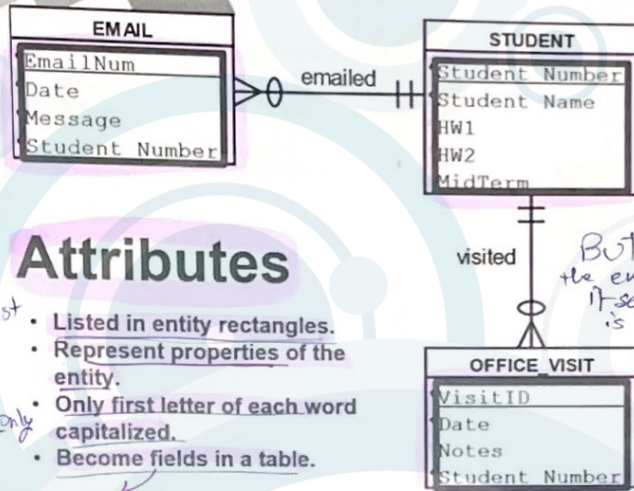
مثلاً بار EMAIL
ار entities رح تتحول في
ال header (EMAIL) عبارتي
metadata

Entities

NAMES

- Drawn as rectangles.
- Names fully capitalized.
- Become tables in database.

ERD SYMBOLS & NOTATIONS



Attributes

- Listed in entity rectangles.
- Represent properties of the entity.
- Only first letter of each word capitalized.
- Become fields in a table.

OR
Constraints

First letter on

fields
or
columns.

المواصفات
عائني عني داخل
Data Structure

Attributes = صفات
entity = كيان
meta-data = بيانات

الأسماء
أو الرموز ← Attributes

~~or constraints~~

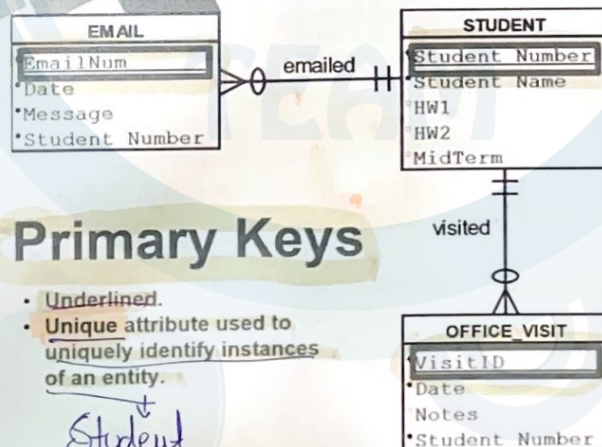
يعني مواصفات

entities $\cup$ Properties of
Standard Number entities.
Student Email.

ال Email
معتبره Metadate.

اَول حروف بكل
Attribute → Capitalized

ERD SYMBOLS & NOTATIONS



Primary Keys

- Underlined.
- Unique attribute used to uniquely identify instances of an entity.

تَعْلَمُ خُط

Instance
بالقوله
بسم الله
الحمد لله

Student
entity هو ال
لها اذ هو كلاس
Student Num.
Instances هي

Primary keys

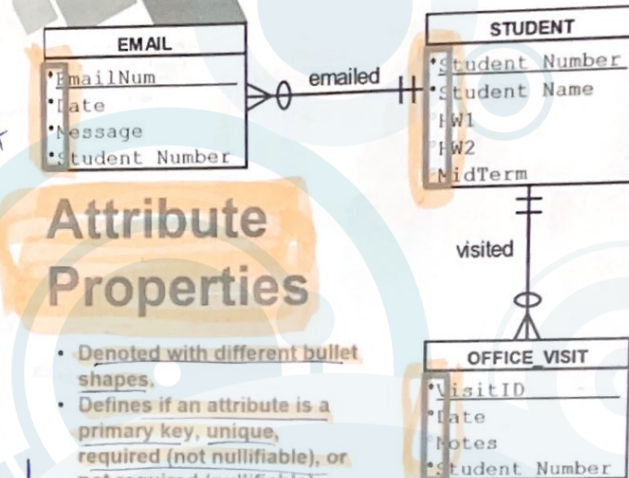
التي تحتها
خط

Student Number

الحرف الأساسي
إلى نهائي

STUDENT entity
المعرف الأساسي هو
Student Number.

ERD SYMBOLS & NOTATIONS



Attribute Properties

- Denoted with different bullet shapes.
- Defines if an attribute is a primary key, unique, required (not nullifiable), or not required (nullifiable).

Must be put
 Required
 Student Name
 لا بد يكون عندي

Notes
 من بالضرورة
 تكون موجودة

- ✓ Filled dark circles/Bullets (Required).
- ✓ Empty white Bullets → (Not Required).

ERD SYMBOLS & NOTATIONS

Attribute Properties



Primary Key Attribute
 Also denotes a primary key.



Required Attribute
 Each instances of an entity must have a value of this attribute (e.g. all students must have a name).

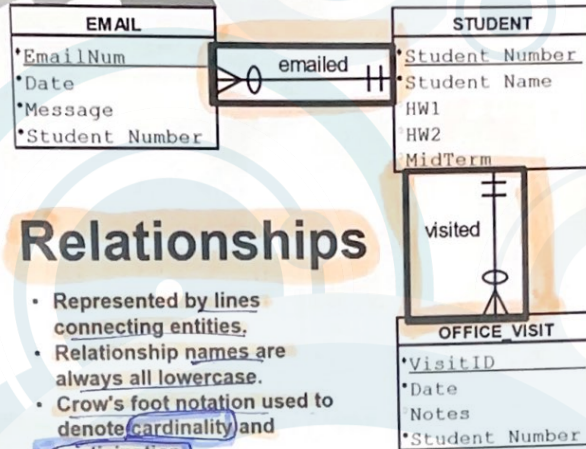


Nullifiable Attribute
 An instances of an entity may have no value for this attribute (e.g. students are NOT required to have a date of birth).

ممكن أستغنى
 عن هاته المعلومة

Databases are more ~~than~~ Records

ERD SYMBOLS & NOTATIONS



Relationships

- Represented by lines connecting entities.
- Relationship names are always all lowercase.
- Crow's foot notation used to denote cardinality and participation.

In Relationships

Names are always Lowercase.

Lines connecting entities.

Crow's foot → جد البقاء

ERD here is crow's foot ERD.

CARDINALITY

↳ # of instances of entities involved in the Relationship.

» Indicates the number of instances of the entities that are involved in the relationship.

NOTE: **Not** the total number of instances in the entity.

This regards how many instances in one Entity are related to how many instances in the other Entity in the relationship

الهدف اني

أعرف كل شيء

one to one.

يعني كل

entity

Relation

مع Instance

مع entity

ولا one to many

يعني كل instance

داخل مع many

instances

مع entity

or many to many

many من entity

Cardinality

CARDINALITY

Email Table			Student Number
EmailNum	Date	Message	
1	2/1/2007	For homework 1, do you want us to provide notes on our references?	1325
2	3/15/2007	My group consists of Swee Lau and Stuart Nelson.	1325
3	3/15/2007	Could you please assign me to a group?	1644

Student Table

Student Number	Student Name	HW1	HW2	MidTerm
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8009	ROGERS, SHELLEY	95	100	98

1:N

1:N

Office_Visit Table

VisitID	Date	Notes	Student Number
2	2/13/2007	Andrea had questions about using IS for raising barriers to entry.	1325
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Student Number

مرتبط بـ

Student Name

واحد

كل طالب

يمكن

يصل

Email. أكثر من

One to Many.

CARDINALITY

بإحدى طرفي العلاقة
إلى جميع الأطراف

- » 1:1 relationships
 - ◊ Single entity instance to single entity instance
- » 1:N (N:1) relationships
 - ◊ One to many
 - ◊ Single entity instance to many entity instances
- » N:M relationships
 - ◊ Many to many
 - ◊ Many entity instances to many entity instances

PARTICIPATION

(a.k.a. Modality -or- Multiplicity)

- » The participation of an entity in a relationship indicates whether all or only some of the instances of the entity are involved in the relationship

Participation of entity in Relationship -

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عدد على الأكثر
أو الأقل

بحد عدد
المشاركين بالحلقة نفسها

PARTICIPATION

(a.k.a. Modality -or- Multiplicity)

2 types
of participation

» "Mandatory" participation:

- All of the instances are involved in the relationship

» "Optional" participation:

- If NOT all of the instances are involved in the relationship

In Other Words: every time an instance is added to an entity, must an associated instance be added to the related entity?

PARTICIPATION

Email Table		Message	Student Number
EmailNum	Date		
1	2/1/2007	For homework 1, do you want us to provide notes on our references?	1325
2	3/15/2007	My group consists of Swee Lau and Stuart Nelson.	1325
3	3/15/2007	Could you please assign me to a group?	1644

All e-mails must have a student (mandatory).

All emails must have a student (Mandatory)

Student Table					
Student Number	Student Name	HW1	HW2	MidTerm	
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Not all students will have sent an e-mail (optional).

ہو سکتا ہے کہ
بعض طلبہ
ای میل نہیں بھیجے

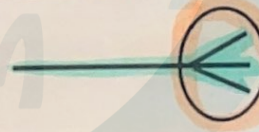
بعض
طلبہ کی
ای میل
ہو سکتی ہے

Office_Visit Table			Student Number
VisitID	Date		
2	2/13/2007	Andrea had questions about using IS for raising barriers to entry.	1325
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CROW'S FOOT NOTATION

Cardinality (Multiplicity - [one] -or- [many]):



many
crow's foot

Participation Level ([optional] -or- [mandatory]):



CROW'S FOOT NOTATION

One and ONLY One



(Only One Instance BUT Mandatory)

على الأكثر عندي واحد
One or Many



(One or More Instance BUT Mandatory)

على الأقل عندي واحد

Zero or One



(Only One Instance BUT Optional)

ممكن
1
و ممكن
0

Zero or Many



(One or More Instance BUT Optional)

ممكن
zero
ممكن
many.

CROW'S FOOT NOTATION

EMAIL
*EmailNum
*Date
*Message
*Student Number

emailed

STUDENT
*Student Number
*Student Name
HW1
HW2
MidTerm

visited

OFFICE_VISIT
*VisitID
*Date
Notes
*Student Number

العملية
Lerning

Normalization

Process

- Converts table into two or more tables
- Changes from poorly structured to well-structured

Data integrity problems

- Different names for the same entity
- Produces incorrect and inconsistent information
- Resolve by eliminating duplicated data

Normalized tables

- Eliminate data duplication
- Slower to process
- Every table has single topic

Relational Database Design

- Designer creates table for every entity
- Entity identifier becomes primary key of table
- Attributes of entity become columns
- Tables normalized to single theme
- Represent relationships between tables
- Add foreign key to one or more tables

Database
model
في
ال
نموذج

دع تكون
واحد
Table

What Is the Users' Role?

users' role → users interview
users judgement

- Final judges as to what data should be contained
- Determine how records are related to each other
- Need to review data model
- Must insure that model reflects an accurate view of business

interview in the first
& Review in the last.

Review مع users نفسهم بس أخلاص Database عثمان أثوف
هل ال model يعكس Requirements ادي عندي ولا لا

Who Will Volunteer?

- Consultant creates data model
 - Based on interviews with users
- Data model reviewed and approved
- Database tables constructed
 - Primary and foreign keys selected → عثمان نفس ال relationship between the tables.
 - Based on interviews
- Microsoft Access database created
 - Relationships indicated → نوع من أنواع
 - Forms and reports constructed

Obj. of this
Ch. Create
Database using
Microsoft Access.

كل حد
بي اطلب
منظلة
Programmer
خااص

Personal database Management
systems.

The 7 Steps

Step 2: Identify **entities & attributes** draw them on your ER diagram

Step 3: Identify the **key attribute(s)** and underline them on your diagram

Step 4: Decide on the **relationships** and **draw lines** between the entities, including any **attributes** of the relationships.

Step 5: Decide on the **cardinality** of each relationship and add it to the diagram

Step 6: Decide on the **participation** of each entity in each relationship and **add** if required.

Step 7: Add the **foreign keys** of each relationship for each entity pairs and **add relationship attributes** if present.

Where it's advantage to the new table is more than its own table.

↑
Isas poro line
Tables in
cities
"foreign keys"

Primary key
unique identifiers

اجدہم بنا علی
Basic Requirements

The Doctor's Office

Requirements/Use Cases

1. Nurses **work for** the Doctor in the office.
2. Each Nurse **works for** (assigned to) a **single** Doctor.
3. Every Doctor has **one or more** Nurses **working for** (assigned) them.
4. Each Nurse has a **first name**, **last name** and a **unique** Nurse's ID.
5. Each Doctor has a **first name**, **last name** and a **unique** Doctor's ID.
6. Only a Doctor can **order** a type of **Test**, but not all Doctors order Tests.
7. Each type of Test has a **unique** Test ID number and the **name of Test**.
8. If known, keep track of the **hours per week** worked by the Nurse.
9. We need to keep track of the **date** that any Test order was placed.

STEP 1 & 2

Step 1: Collect & review ALL the data.

Step 2: Identity entities & attributes draw them on your ER diagram

NURSE

DOCTOR

TEST

بشيء واحد ال entities
ماشي عندي

1. Nurses work for the Doctor in the office
2. Each Nurse works for (assigned to) a single Doctor.
6. Only a Doctor can order a type of Test, but not all Doctors order Tests.

STEP 1 & 2

Step 1: Collect & review ALL the data.

Step 2: Identity entities & attributes draw them on your ER diagram

NURSE

nurse ID
lastName
firstName

DOCTOR

doctor ID
lastName
firstName

TEST

test ID
type

Attributes
التخصص
نوعه

4. Each Nurse has a first name, last name and a unique Nurse's ID.
5. Each Doctor has a first name, last name and a unique Doctor's ID.
7. Each type of Test has a unique Test ID number and the name of Test.

Step 1: Collect & review ALL the data.

Step 2: Identity entities & attributes draw them on your ER diagram

NURSE
• NurseID
• FirstName
• LastName

DOCTOR
• DoctorID
• LastName
• FirstName

TEST
• TestID
• TypeName

Step 3: Identify the key attribute(s) and underline them on your diagram

Key attributes
Primary keys

NURSE
•NurseID
•FirstName
•LastName

DOCTOR
• DoctorID
• LastName
• FirstName

TEST
• TestID
• TypeName

روح ياخذوا
السَّحْلَ الْعَاصِينَ

diagonal.

- Each Nurse has a first name, last name and a unique Nurse's ID.
- Each Doctor has a first name, last name and a unique Doctor's ID.
- Each type of Test has a unique Test ID number and the name of Test.

Required
S-terkell

STEP 3

Step 3: Identify the **key attribute(s)** and underline them on your diagram

NURSE
• <u>NurseID</u>
• FirstName
• LastName

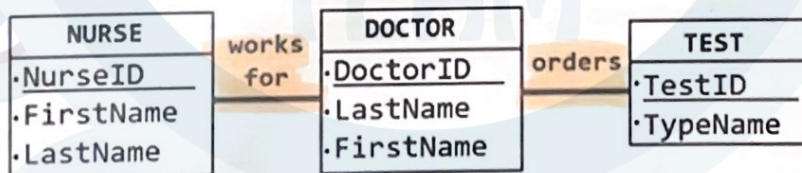
DOCTOR
• <u>DoctorID</u>
• LastName
• FirstName

TEST
• <u>TestID</u>
• TypeName

↓
Relationships

STEP 4

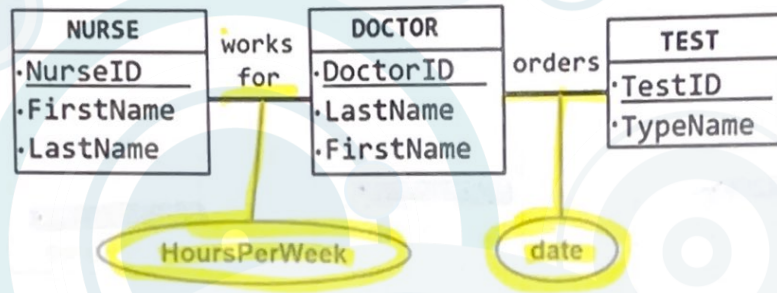
Step 4: Decide on the **relationships** and draw lines between the entities, including any **attributes** of the relationships.



1. **Nurses work for** the **Doctor** in the office.
6. Only a **Doctor** can **order** a type of **Test**, but not all **Doctors order Tests**.

STEP 4

Step 4: Decide on the **relationships** and draw lines between the entities, including any **attributes** of the relationships.

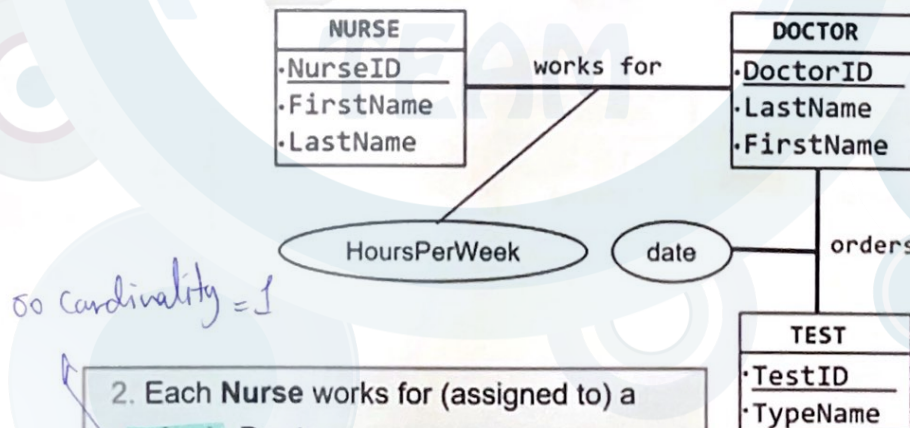


8. If known, keep track of the **hours per week** worked by the Nurse.

9. We need to keep track of the **date** that any Test order was placed.

STEP 5

Step 5: Decide on the **cardinality** of each relationship and add it to the diagram.

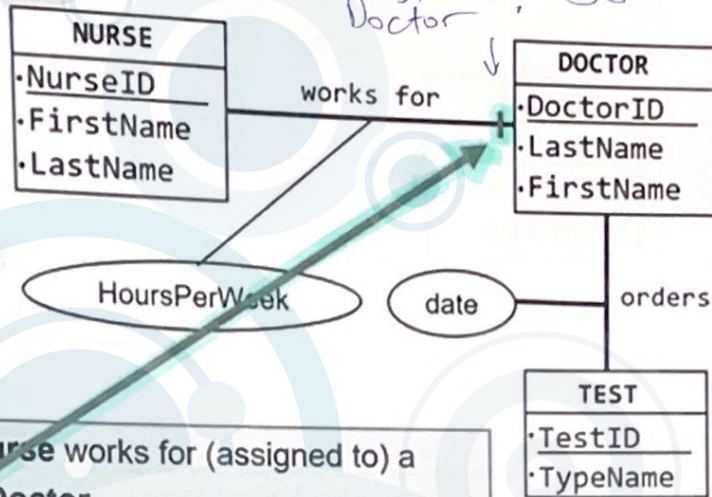


2. Each Nurse works for (assigned to) a **single** Doctor.

3. Every Doctor has **one or more** Nurses working for (assigned) them.

1 +.

تبعاً (cardinality) 1 Nurse
 1 Doctor

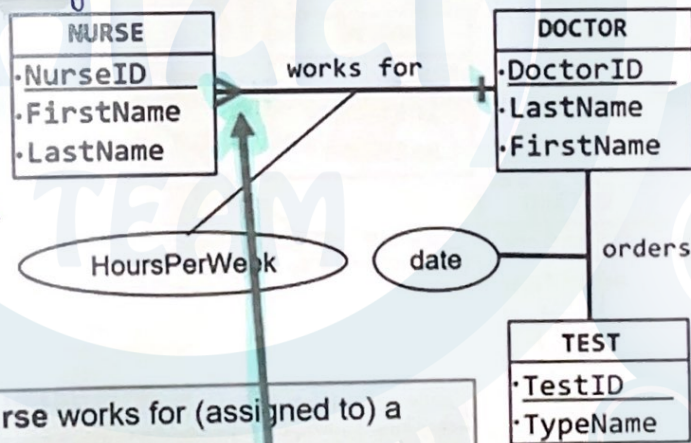


2. Each **Nurse** works for (assigned to) a **single Doctor**.
3. Every **Doctor** has one or **more Nurses** working for (assigned) them.

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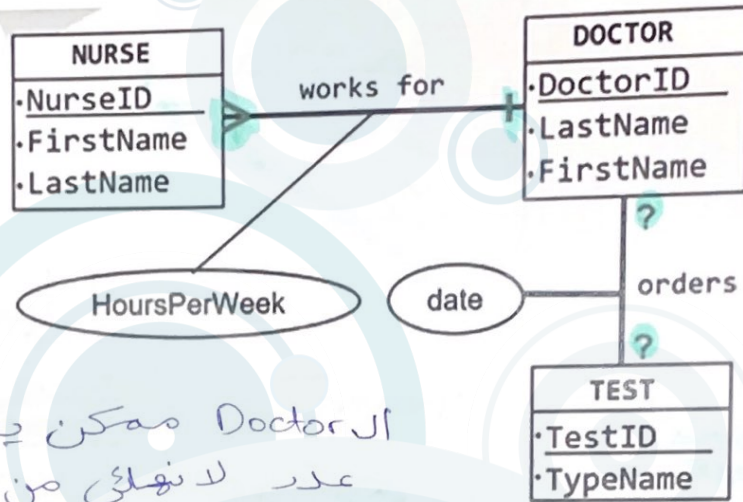
*
 The cardinality of the entity would be on the opposite side of it Not its own adjacent side.

Nurse 1 to Doctor 1 cardinality edge.

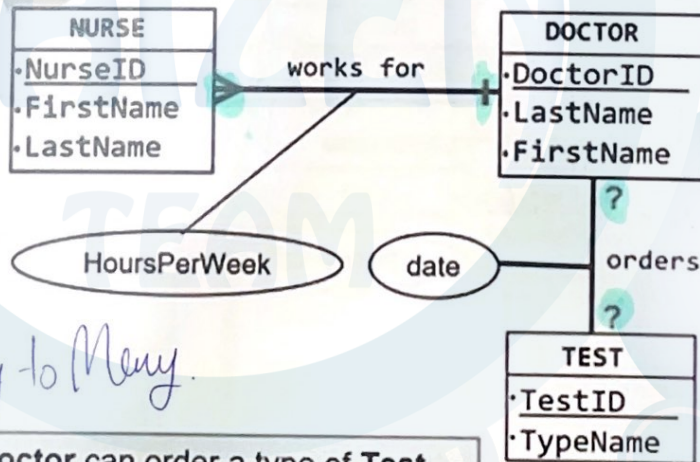


2. Each **Nurse** works for (assigned to) a **single Doctor**.
3. Every **Doctor** has one or **more Nurses** working for (assigned) them.

1 Nurse
 Cardinality
 One to Many.

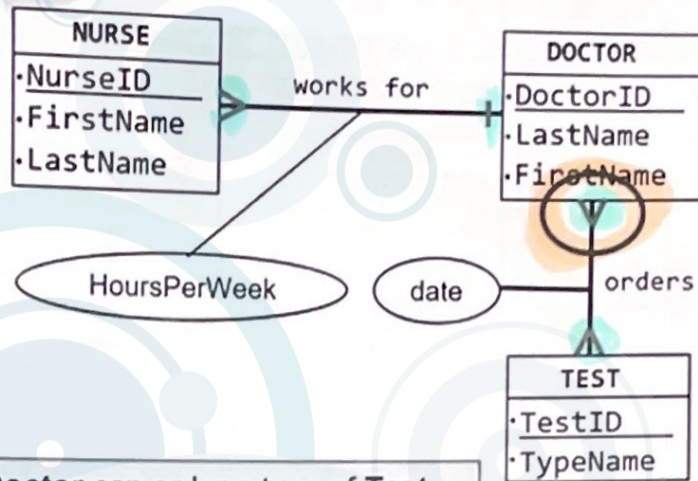


ال Doctor ممكن يطلب
عدد لا نهائي من ال Tests
وكمان نفس ال Test ممكن
يطلب من أكثر من
Doctor.



6. Only a Doctor can order a type of Test,
but not all Doctors order Tests.

(notice the ambiguity – now common sense comes in to play ...)

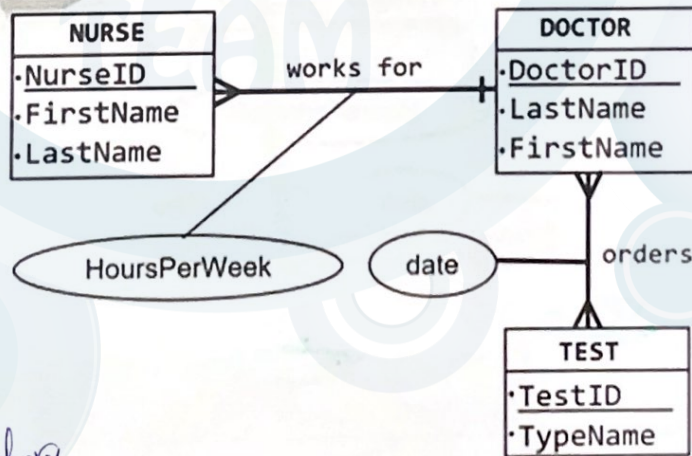


6. Only a **Doctor** can order a type of **Test**, but not all Doctors order Tests.

Test can be ordered by different Doctors (e.g. both Dr. A and Dr. B can order a MRI).

STEP 6

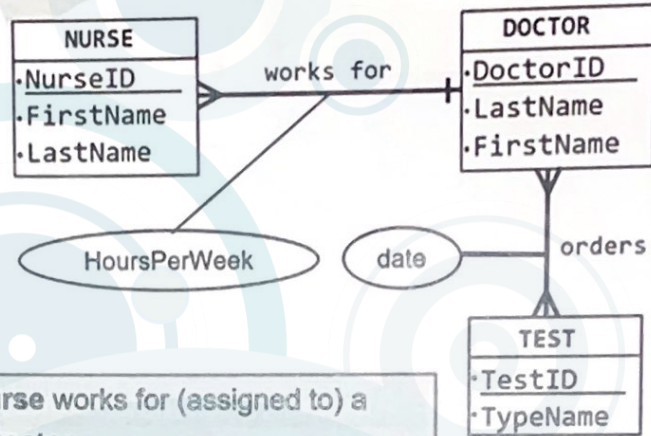
Step 6: Decide on the **participation** of each entity in each relationship and **add** if required.



لازم كل Nurse
يكون على الأقل
Doctor
وكل Doctor لازم يكون
له على الأقل Nurse
وحد
وبالتالي
Participation
→ Mandatory.

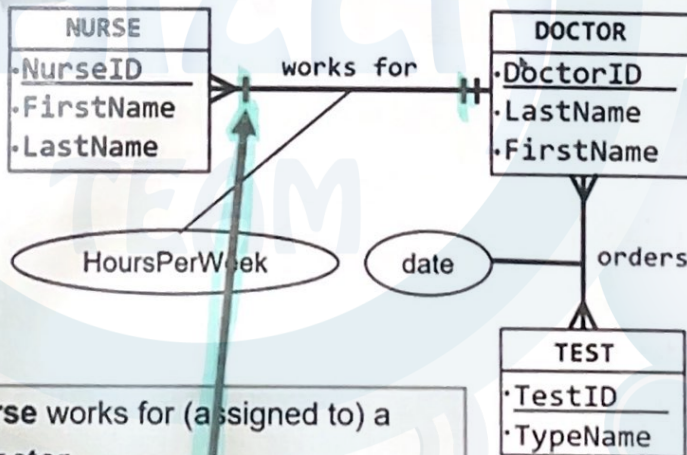
STEP 6

Step 6: Decide on the **participation** of each entity in each relationship and **add** if required.



2. Each Nurse works for (assigned to) a **single** Doctor.
3. Every Doctor has **one or more** Nurses working for (assigned) them.

Mandatory participation.



*Cardinality many
& Participation
mandatory.*

2. Each Nurse works for (assigned to) a **single** Doctor.
3. Every Doctor has **one or more** Nurses working for (assigned) them.

1

1+