

Databases

Relation - A table (with rows and columns)

Attribute - A named column of a relation

Domain - The set of allowable values for an attribute

Tuple - A row of a relation

Cell - The intersection of a row and column

Degree - The number of attributes of a relation

Cardinality - The number of tuples of a relation

1 Keys

Candidate Key - A minimal (not minimum) set of attributes whose values uniquely identify the tuples

Primary Key - The candidate key selected to identify rows uniquely within the table

Alternate Key - Those candidate key(s) not selected as a primary key

Simple Key - The key consists of only one attribute

Composite Key - The key consists of only one several attributes

Foreign Key - An attribute in a table whose values must:

- Either match the primary key in another table
- Be NULL

2 Integrity Constraints

Entity integrity - Every attribute of a primary key can not be null

Purpose of entity integrity:

- Guarantees each entity has a unique identifier
- Ensures that foreign key values can reference primary key values

Referential integrity

- A foreign key either matches the primary key in the table it refers to
- or it is null

Referential integrity exists so that a reference between tables is value and prevents deleting a primary key that has a matching foreign key

3 Entity Relation Model

Objective of the ER model:

- Helps understanding of the nature and relationships among the data
- Helps derive tables in the Relational Data Model

Basic concepts:

- Important data objects (entities)
- Important properties of the entities (attributes)
- Associations between entities (relationships)

There is also the constraints of entities, relationships and attributes

3.1 Main concepts

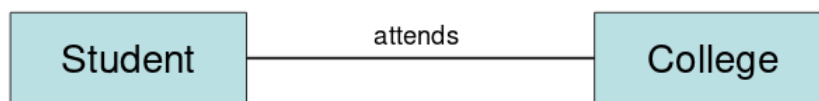
Entity

- Any real thing that we recognise as a separate concern within the database
- Represented by rectangles



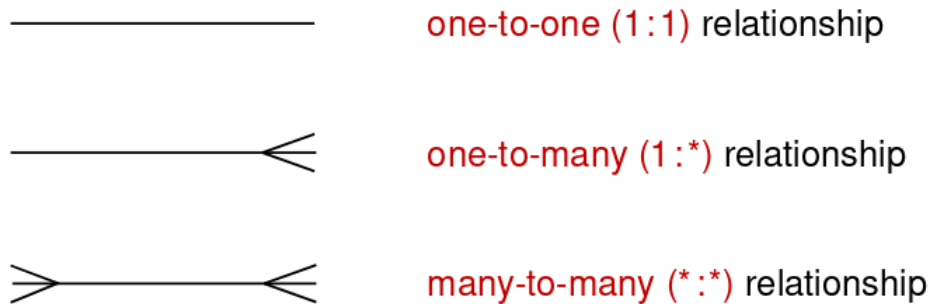
Relationship

- A names association between two entity types
- Represented by a labelled line connecting two entities



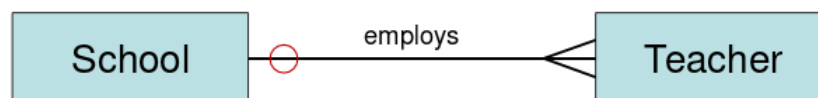
4 Cardinality

Cardinality - The number of entity occurrences that are related to a single occurrence of an associated entity type through this relationship



5 Optionality and Participation

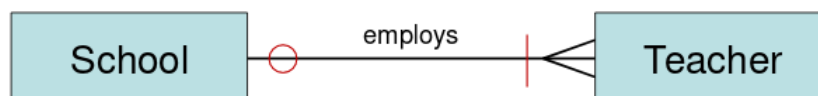
If a teacher is employed by one or zero schools, it is denoted like so:



If an entity participates optionally in a relationship:

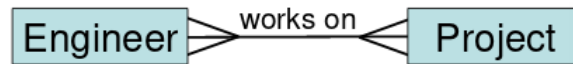
- It has partial participation
- Otherwise it has total participation

To say one school employs at least one Teacher, you would do it like so



6 Many to many relationships

Many to many relationships are not allowed in the ER model, so we introduce a new entity, for example if you have the relationship



Introducing a new entity will resolve this



7 Functional data dependencies

Functional data dependency - Describes the relationship among attributes in the same relation

For example "B is functionally dependent on A" if each value of A is associated with exactly one value of B

Informally if we know the attribute values of the set A then we know the unique values for the set B

In a functional data dependency ($A \rightarrow B$)

- Determinant - The set of all attributes on the left hand side (A)
- Dependent - The set of all attributes on the right hand side (B)

Full functional dependency - B is functionally dependent on A and B is not functionally dependent on any proper subset of A

Partial functional dependency - B is functionally dependent on A and B remains functionally dependent on at least one proper subset of A

Transitive functional dependency - If there exists functional dependencies $A \rightarrow B$ and $B \rightarrow C$ then the functional dependency $A \rightarrow C$ also exists

8 First Normal Form

A table is in First normal form if it has:

- No repeating groups (every cell has one value)
- No identical rows

9 Second Normal Form

A table is in Second Normal Form if:

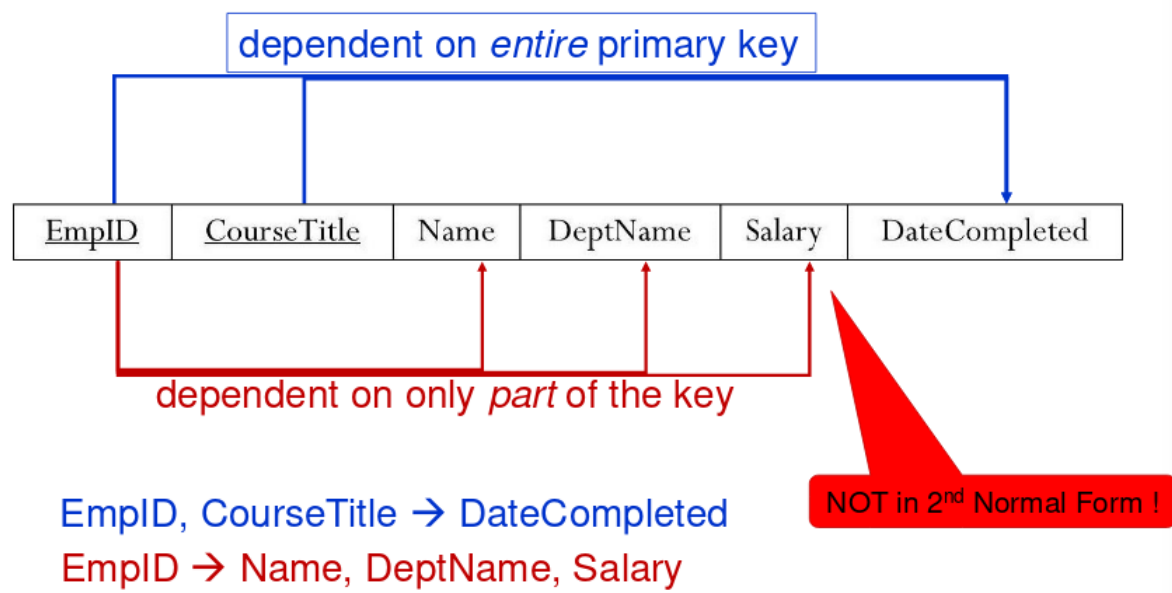
- It is in 1NF and
- There is no partial functional dependencies - every non-key attribute is dependent on the whole primary key

When the primary key has only one attribute, if the table is in 1NF, it is also in 2NF

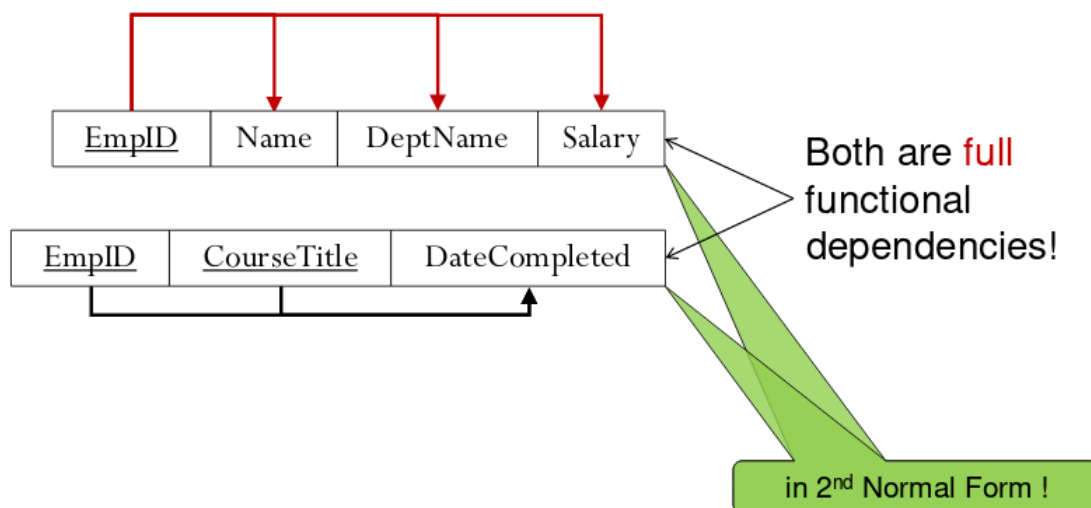
To bring a table into 2NF:

- Remove any partially dependent attributes
- Place them in a new relation, along with the copy of their determinant

This is not in 2NF:



Example (converted in 2NF) has it decomposed into two separate relations



10 Third Normal Form

A table is in Third Normal Form if:

- It is in 2NF
- There are no transitive functional dependencies e.e. no non-key attribute is transitively dependent on the primary key

In other words, in 3NF all attributes (which are not part of the primary key) are functionally dependent on the key, the whole key, and nothing but the key

How to bring a table into 3NF:

- Remove the transitively dependent attributes
- Place them in a new relation
- Take the attributes of their determinant as the primary key in the new table

11 SQL Queries

An example of nested queries

```
SELECT staffNo, fName, IName, position
FROM Staff
WHERE branchNo=
      (SELECT branchNo
       FROM Branch
       WHERE street='163 Main St')
```