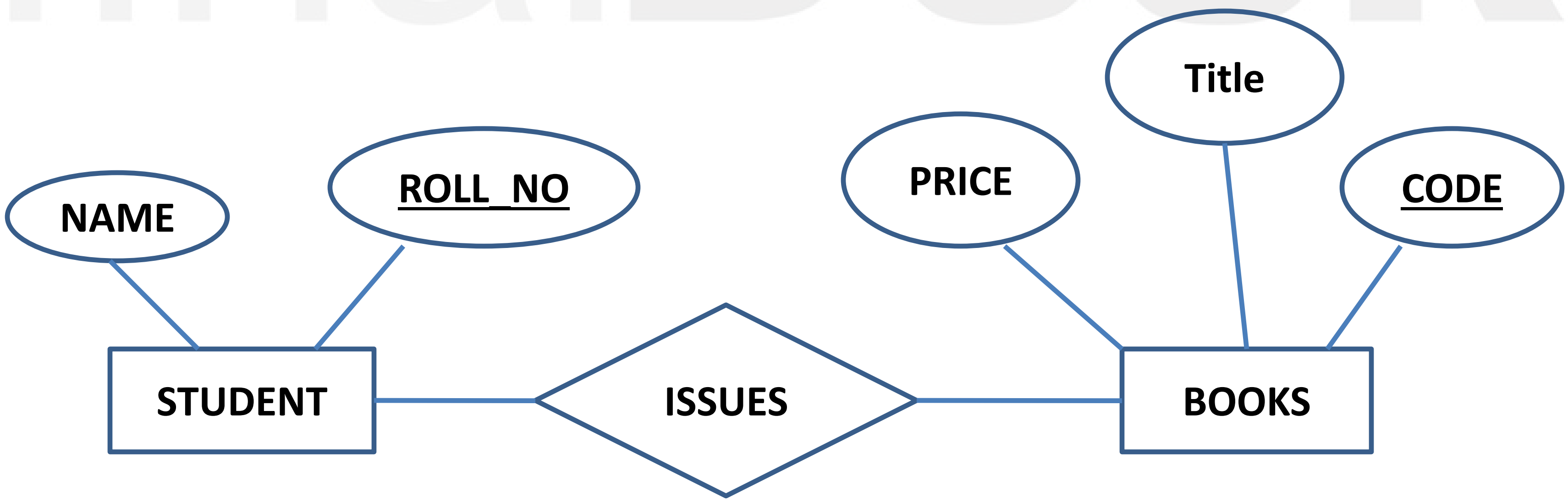
Database Design

- All the data in an organization is related to entities (Tables).

- Designing a database involves identifying the various entities and the relationships that bind the entities.

- After the entities and relationships are identified, an ER diagram is drawn to logically model the data.

Mapping ER Diagrams to Tables:



The given ER diagram maps to the following tables.

1) Student Table

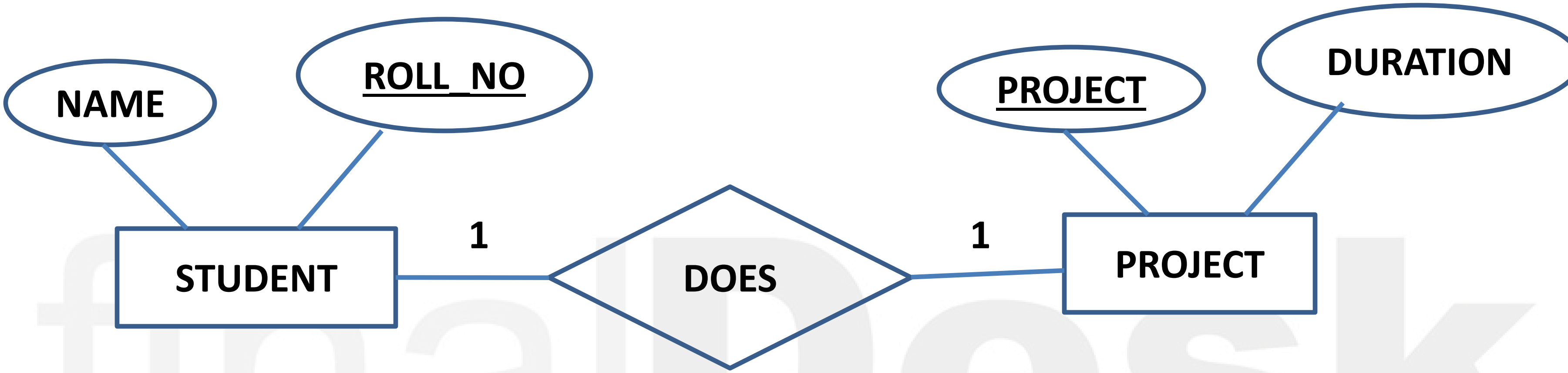
ROLL_NO	NAME

2) Books Table

CODE	TITLE	PRICE

How do we map the relationship into a table ?

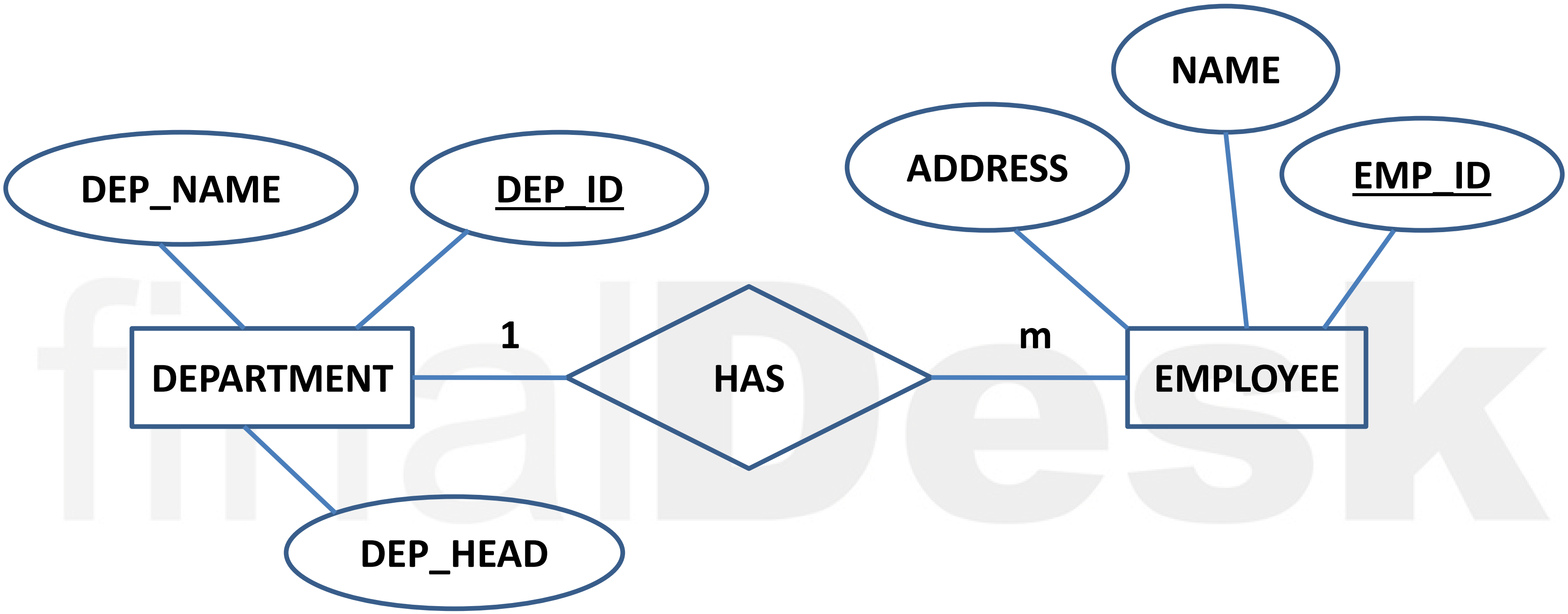
Mapping One-to-One Relationships



- In the above diagram, the DOES relationship associates STUDENT to PROJECT.
- This type of relationship can be handled in several ways.
- One way is to handle it is by storing a foreign key in either table.
- Another way is to merge the two tables into one for faster access.

ROLL_NO	NAME	PROJECT	DURATION

Mapping One-to-Many Relationships



DEPARTMENT:

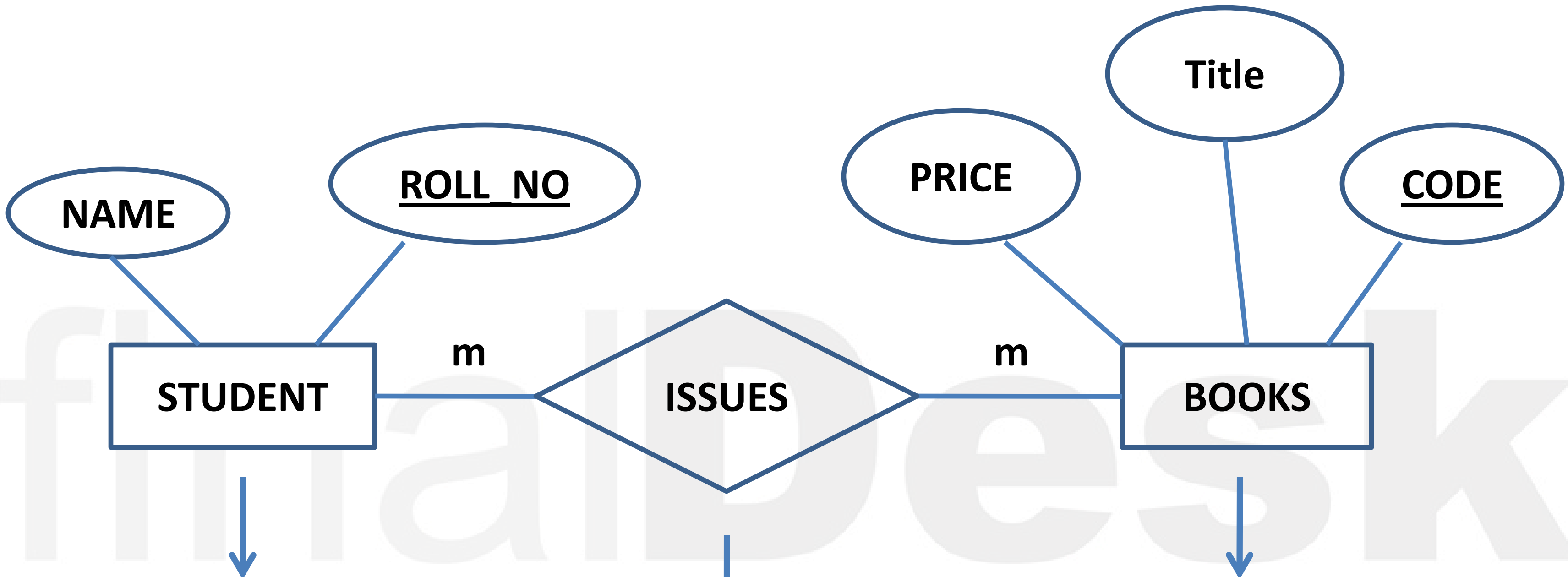
DEP_ID	DEP_NAME	DEP_HEAD
D001	Marketing	John S.
D002	Accounts	Tony D.

EMPOLYEE:

EMP_ID	NAME	ADDRESS	DEPT_ID
E001	Robert	Shanghai	D001
E002	Polly W.	Beijing	D001
E003	David J.	Nanjing	D002
E004	Nelson G.	Shanghai	D002

- DEPT_ID is a foreign key in the EMPLOYEE table.

Mapping Many-to-Many Relationships



ROLL_NO	NAME

CODE	TITLE	PRICE

ROLL_NO	CODE	ISSUE_DATE	RETURN_DATE

Keys

The various types of keys in an RDBMS are:

- Primary
- Foreign
- Candidate
- Alternate
- Composite

NAME	SURNAME	AGE	ROLL NO
Anand	Joshi	22	101
Yash	Gupta	21	105
Anand	Gandhi	43	109
Jignesh	Darji	23	125

Normalization

- After designing the database, it is important to ensure that the data in the tables is consistent and relevant.

- Normalization is a method of breaking down complex table structures into simple table structures by using certain rules , called the Normal forms.

- This helps in removing redundancies from the database.

- It helps in simplifying the structure of tables, therefore, making a database more compact and reliable.

- It simplifies the database operations like insert, update, delete etc.

- Normalization makes your database AWESOME !!

First Normal Form (1NF)

- A table is said to be in 1NF when each cell of the table contains precisely one value.

- Consider a PROJECT table as shown below.

ECODE	DEPT	DEPTHEAD	PROJECT CODE	HOURS
E101	Systems	E901	P27 P51 P20	90 101 60
E305	Sales	E906	P27 P22	109 98
E508	Admin	E908	P51 P27	NULL 72

- By applying the 1NF definition to the PROJECT table we get ,

ECODE	DEPT	DEPTHEAD	PROJECT CODE	HOURS
E101	Systems	E901	P27	90
E101	Systems	E901	P51	101
E101	Systems	E901	P20	60
E305	Sales	E906	P27	109
E305	Sales	E906	P22	98
E508	Admin	E908	P51	NULL

- Consider a STUDENT table as shown below.

ROLL NO	FIRST NAME	LAST NAME	PH NO1	PH NO2
R01	Luke	Thomas	234456	
R02	Rita	Wilson	245688	276453
R03	Tom	Gellar	256487	
R04	Jack	Miles	234789	2341543

- Although the table is in 1NF form it is not a good design because
  - The table creates wastage of space.
  - The database is not scalable.

- The solution is to break the table down into smaller tables and join them with one-to-many relationship.

FOREIGN KEY

TABLE 1

ROLL NO	FIRST NAME	LAST NAME
R01	Luke	Thomas
R02	Rita	Wilson
R03	Tom	Gellar
R04	Jack	Miles

TABLE 2

ROLL NO	PHONE NO
R01	234456
R02	245688
R02	276453
R03	256487
R04	234789
R04	2341543

- Table 1 and Table 2 are joined by the primary key ROLL NO.

Second Normal Form (2NF)

- A table is said to be in 2NF if all the non-key fields are dependent on the **entire** key (i.e. Primary key or Composite key).

- Consider an EVENTS table as shown below.

COURSE	DATE	TITLE	ROOM	CAPACITY	AVAILABLE
SQL101	3/1/2014	SQL	4A	12	4
DB202	3/1/2014	DATABASE DESIGN	7B	14	7
SQL101	10/2/2014	SQL	7B	14	10
SQL101	12/3/2014	SQL	12A	8	8
CS200	6/3/2014	JAVA	4A	12	11

Composite key

- COURSE and DATE form a composite key.

- ROOM completely depends on the composite key.

- So does the other attributes except TITLE, which only depends on the attribute COURSE.

- According to the definition of 2NF , all non-key attributes should depend on the **ENTIRE** key. Hence the above table is not in 2NF.

- To convert it into 2NF , break the table down into smaller tables as shown below.

TABLE 1

COURSE ID	TITLE
SQL101	SQL
DB202	DATABASE DESIGN
CS200	JAVA

TABLE 2

COURSE	DATE	ROOM	CAPACITY	AVAILABLE
SQL101	3/1/2014	4A	12	4
DB202	3/1/2014	7B	14	7
SQL101	10/2/2014	7B	14	10
SQL101	12/3/2014	12A	8	8
CS200	6/3/2014	4A	12	11

- Table 1 and Table 2 have one-to-many relationship.

Third Normal Form (3NF)

- A table is said to be in 3NF if **no** non-key field is dependent on any other non-key field.

- Consider an EVENTS table as shown below.

COURSE	DATE	ROOM	CAPACITY	AVAILABLE
SQL101	3/1/2014	4A	12	4
DB202	3/1/2014	7B	14	7
SQL101	10/2/2014	7B	14	10
SQL101	12/3/2014	12A	8	8
CS200	6/3/2014	4A	12	11

• The above table is in 2NF form.

• A close observation will show that ROOM and CAPACITY are dependent.

• By the definition of 3NF , no non-key attribute should be dependent on any other non-key attribute. Hence the above table is not in 3NF.

•To convert it into 3NF , break the table down into smaller tables as shown below.

ROOM	CAPACITY
4A	12
7B	14
12A	8

• Therefore the complete solution would be :

Events

Course	Date	Room	Available	...
SQL101	3/1/2013	4A	4	
DB202	3/1/2013	7B	7	
SQL101	4/14/2013	7B	10	
SQL101	5/28/2013	12A	8	
CS200	4/15/2012	4A	11	

Course

CourseID	Title	...
SQL101	SQL Fundamentals	...
DB202	Database Design	...
CS200	C Programming	...

Room

Room	Capacity
4A	12
7B	14
12A	8

Denormalisation

- The intentional introduction of redundancy in a table in order to improve performance is called **Denormalisation**.

- Denormalisation increases disk space but it improves query execution.

- The decision to denormalise results in a compromise between performace and data integrity.

- More about it will be covered while studying SQL queries.

Summary

- Normalization is used to simplify table structures.
- 1NF - One cell in the table should contain only one value.
- 2NF - all non-key attributes should depend on the **ENTIRE** key.
- 3NF - No non-key attribute should be dependent on any other non-key attribute.
- The intentional introduction of redundancy in a table in order to improve performance is called **Denormalisation**.

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